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ECOLINGUISTIC CHANGES IN CLIMATE EMERGENCY:

AN INVESTIGATION INTO CLIMATE-RELATED TWEETS IN EUROPE AND THE UNITED STATES

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To my family

Table of contents

List of Figures

List of Tables

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Abstract

Climate change is an environmental, social, cultural, and political phenomenon and has become one of the most important challenges in the twenty-first century (Hulme, 2009). The greatest divergence about climate change lies in the multitude and contrasting messages we receive and the different ways we interpret them (Hulme, 2009).

Previous research focused primarily on the discourse of environmental politics in general and climate change in particular, in order to identify underlying ideologies (Halliday, 1990; Hajer, 2002; Hajer & Versteeg, 2005). However, to the best of my knowledge, these studies have not investigated into linguistic variations in environmental discourses or their influence on the emergence of new words. Recently, a growing number of researchers has analyzed climate change in social-networking-based communications, focusing on linguistic variations and lexical creativity in environmental discourses (Jang & Hart, 2015; Kirilenko & Stepchenkova, 2014; Kirilenko et al., 2015; Koteyko & Atanasova, 2016; Veltri & Atanasova, 2015). Nevertheless, most studies are synchronic or have a local focus. Therefore, since climate change is a global discussion that evolves through time, a comparative, long-term study, involving different types of stakeholders from the U.S.A. and Europe, would be of great interest for the field.

In light of this, the objective of this research is to examine how stakeholders directly act through their language using the social network Twitter, from 2015 to 2020. The main focus is on language variation and lexical innovations which reflect environmental, cultural, and political changes in English usage considered as a universal language for a global problem.

In the present work, three research questions are addressed and five hypotheses are tested to analyze to what extent language varies among the different users, i.e., social movements, activists, politicians, NGOs, news sites and institutional organizations. Particularly, tweets and specific metadata are compiled into a corpus of Twitter data used for comparative analysis. Indeed, this research follows a corpus-based approach with mixed methods. A quantitative approach to corpus linguistics is used to determine the frequency of terms, identify new lexical items and collocates, and to find differences between time, place, and people. A qualitative approach is adopted for the manual annotation of polarity of new items, and to carry out discourse analysis and a framing approach.

The study highlights the pivotal role played by climate change communication, framing, discourse, and language in conveying messages and constructing meanings, just as much as the use of the social media Twitter can contribute to the strengthening of voices, actions, and scope. Specifically, the results show how climate change is depicted and discussed by the different stakeholders over time in the European Union and the United States. Social movements are the leading authors, along with climate activists. Through the analysis of their discourse and lexical innovations, their communicative function is mainly aimed to inform, educate, and mobilize their audience. In addition, climate strikes, protests, and participation in summits and conferences during this time period reflect the primary frames these authors used, such as call to action, civil society protest, and attribution of blame. The news sites analyzed in this study emphasize facts, scientific evidence, and disaster and catastrophe issue-specific frames to shed light on risks, encourage action, and address responsibility. Furthermore, NGOs also deal with the same issue from a variety of perspectives, promoting healthier, environmentally friendly behaviors and providing unbiased information about disasters and risks. While promoting

a dominant economic discourse, European politicians engage continuously with environmental issues. On the contrary, political campaigns and periodic disagreements tend to polarize and politicize U.S. climate discourse over the years. Finally, organizations confirm a close connection with political orientations, especially in the United States.

Lastly, this work includes pedagogical implications for English for Specific Purposes courses. The section highlights how the use of authentic material, such as messages retrieved from social media platforms, may further motivate learners with different levels of language proficiency to deal with specific topics using concrete language samples. Hence, analyzing linguistic and discursive aspects of climate-related matters, through interdisciplinary approaches, could contribute to increasing learners' awareness regarding crucial topics such as climate change, climate justice, and sustainable development.

Chapter One

Introduction

1.1 Motivational background to the study

The motivation underlying the present research is twofold: (1) it emerges from an ongoing interest in the climate change issue due to its paramount importance in all domains, and, most particularly, (2) it arises from the increasing ability of digital natives to come together and fight against a global threat through technology, and thanks to a common language, English. As a matter of fact, climate change has become one of the most important challenges in the twenty-first century; it is an environmental, social, cultural, and political phenomenon which has caused a bitter controversy among political leaders, scientists, media, and general public (Hulme, 2009). Additionally, along with the digital transformation, the current platform society we live in allows citizens all over the world to access information directly from the source, making it a widespread topic. Indeed, through time, particularly since the 1980s, this issue has become present in several contexts and one of the most covered topics by mass media, thus influencing personal, local, and global action to address climate change.

To date, in literature the focus has been to establish to what extent science and policy affect media reporting and, subsequently public understanding, and also how journalism and public opinion shape climate science and policy decisions and activities. A number of research primarily focused on the discourse of environmental politics in general and climate change in particular (Hajer, 2002; Hajer & Versteeg, 2005). Ecolinguists have used critical discourse analysis, framing theories, and cognitive linguistics to identify

underlying ideologies (Adamson, 2016; Ereaut & Segnit, 2006; Halliday, 1990; Hajer et al., 2015; Schäfer, 2012; Schlosberg & Collins 2014). However, linguistic variations in environmental discourses or their influence on the emergence of new words have not been investigated in-depth. Moreover, a great deal of research has focused on media coverage (Bevitori, 2012; Bevitori & Johnson, 2022; Boykoff & Boykoff, 2004; Carvalho & Burgess, 2005; Carvalho, 2010; Kirilenko & Stepchenkova, 2012; Hase et al., 2021; Painter et al., 2018). Nevertheless, media coverage reports messages which might be affected by authors' interpretation and ideological orientations, while nowadays everyone has the tools to directly participate in the climate change debate. In fact, social media platforms have promoted political engagement, especially of younger generations, offering the opportunity to act and voice political views. Also, global environmental movements have developed a unique sense of connectedness especially through social media, while raising awareness and increasing active participation and involvement (Geiger & Swim, 2016). Consequently, global climate strikes and protests are a result of the interaction and strength achievable through social networks on a global scale (Boulianne et al., 2020).

Currently, some studies have analyzed climate change in social-networking-based communications, investigating into language variations and environmental discourses. However, most scholarship on these topics deal with relatively short timeframes, based on random messages and from anonymous users, and, mostly linked to results from two keywords, "climate change" and "global warming" (Jang & Hart, 2015; Veltri & Atanasova, 2015) or to specific hashtags (Kirilenko & Stepchenkova, 2014), with reference to main events (Abbar et al., 2016; Bruns & Burgess, 2011; Kirilenko et al., 2015; Pearce et al., 2014; Bennett & Segerberg, 2012), mostly based on framing theories and sentiment analysis.

Therefore, since climate change is a global discussion which evolves through time, a comparative, long-term study, involving as many specific users as meaning-makers from the U.S. and Europe in a wide timespan, would be of great interest for the field, with the attempt to fill the gap in the literature. As a matter of fact, this contribution is instrumental in the examination of how stakeholders directly act through their language, using a social networking service (Twitter) in a six-year time, from 2015 to 2020.

1.2 Personal motivation behind the study

As mentioned above, climate change has become a shared problem which affects people's everyday life. It cannot be merely confined to academic research fields as it involves every human being on the planet. As such, I strongly believe this issue must be explored and discussed to the greatest extent starting from education. My experience as an English language teacher and instructor has offered me the opportunity to integrate and deal with this topic in higher education. In fact, during the years I have taught *English for Specific Purposes* (ESP) courses at the University of Calabria, and regardless of students' degree course, the environment and climate change have always been important topics covered in various syllabi. These were particularly covered during the Business English, Statistics, and Cooperation and Development courses that I held. Students have always shown strong empathy towards this issue, questioning themselves on how to build their career and become professionals seeking for climate-friendly solutions and an environmentally friendly lifestyle, without harming the environment. In the last few years, students have also become more engaged in tackling climate change following the rise of youth environmental movements, such as Fridays for Future.

Initially, the intent of this research was to examine the messages posted by young environmental activists and politicians on the social networking service Twitter by means of discourse analysis. The objective was to identify the main differences and similarities in language use through the analysis of word frequency and main collocates in the coverage of climate change among users, and how language itself has developed over time.

Gradually, as the research developed, I became increasingly more interested in how specific stakeholders have come to shape and affect the way scientific facts are reported, and how policy discourse related to climate change is presented. In light of the fact that technology, cultural perceptions, and political settings, including knowledge frames, reflect the human capacity to perceive, construct, and reconstruct reality, the main objective of this research broadly endorsed the search for new lexical items and linguistic variation among activists, social movements, politicians, NGOs, news sites and organizations. As a matter of fact, the need to give birth to or renew linguistic forms calls for the existence of a mutual understanding among language participants in relation to time, place, and socio-cultural contexts (Mühlhäusler, 2003). As this study places emphasis on the content being communicated and the contexts that shape the language, the creation of a corpus, i.e., a collection of texts, is necessary and crucial to conduct a complex analysis focusing on word frequency and collocations. Therefore, the corpus is compiled from Twitter data, which are particularly useful for the information related to the geographical location and time of publication of a tweet. The investigation of the content of tweets, along with additional metadata of their spatial and temporal distribution (Kirilenko & Stepchenkova, 2014), through corpus tools and statistical analyses, provide the possibility to monitor language evolution throughout time and space within the field of climate change, and analyze how language varies among the different users. In

addition, by virtue of discourse analysis and framing theory, this study will highlight differences and similarities among the U.S. and EU considering political and social factors.

1.3 Research focus and outline of the study

To achieve the aims discussed above, and to explore the central research issue of how language has evolved with reference to climate change, this research will investigate the following questions which are primarily oriented to language variation related to climate change on Twitter:

RQ1. To what extent does language change according to the different users?

H1. Collocations related to climate change are more typical in NGOs, social movements, and activists.

H2. Lexical creativity related to climate change is more frequent among social movements, NGOs, and activists.

RQ2. To what extent does language vary from 2015 to 2020?

H3. The number of messages about climate increases throughout time among all author types.

H4. New lexical items have a stronger negative meaning throughout time.

RQ3. Are there any differences in terms of language use between the United States and the European Union?

H5. The European Union has had a more stable and coherent concern about climate change throughout time, compared to the United States.

This dissertation provides insight into a long-term study based on the investigation into language variation and lexical innovations which reflect environmental, cultural, and political changes in English usage considered as a global language for a shared problem.

The study here presented includes the following chapters. Chapter 2, Review of the Literature, outlines core issues such as the development of the ecological perspective added along with the study of language, a brief history of climate change coverage in the media and in the social networking service Twitter, Corpus Linguistics studies, the theoretical background of Discourse Analysis and Framing Theory, Language Variation and Neology, and Social Network Analysis.

Chapter 3, Methodology and Data Description, presents the collected data, outlines the creation of the corpus and explains the methodology used in order to analyze the data.

Chapter 4, Results and Discussion, provides a detailed analysis of the corpus data and metadata. In particular, three functions from Corpus Linguistics are employed to analyze data: collocations, word-sketches and keywords using the online Sketch Engine software. Discourse Analysis and Framing Theory are used to determine how climate issues are represented with reference to differences and similarities among the U.S. and the EU taking into account political and social factors, as well. Further to this, findings and conclusions are extensively discussed in this chapter.

The final chapter provides a summary of this work and entails limitations to the study and directions for future research. Lastly, the chapter also includes a section on potential pedagogical implications proposing teaching approaches and learning strategies. These latter may provide different insights into the process of examining climate-related topics and raising students' awareness of crucial topics such as climate change, climate justice, and sustainable development in the classroom.

Chapter Two

Review of the Literature

2.1 Introduction

The way we communicate, harness the Earth's energy, move around, shelter ourselves, and eat are so basic to the organization of economic and social life that we often take them for granted until a fundamental disruption in the way we think of them and use them forces a revolution in our social orientation and the way we perceive the world around us. The transformation in the way we live our lives in a digitally enhanced ecological society is already proving to be very different than our forebears' way of life in a mechanized fossil fuel civilization.

(Jeremy Rifkin, The Green New Deal, 2019, p. 99)

The issue of global climate change, as influenced by anthropogenic processes, has become an increasingly prominent social problem. As a common global emergency, since the 1990s a lot of attention has been paid to language use related to ecology. Hence, a new research field was born with the name of *ecolinguistics* which focuses on language use in relation to social and environmental contexts (Halliday, 1990; Haugen, 1972; Jung, 2001; Mühlhäusler, 2003).

According to the International Ecolinguistics Association:

> ecolinguistics explores the role of language in the life-sustaining interactions of humans, other species, and the physical environment. The first aim is to develop linguistic theories which see humans not only as part of society, but also as part of the larger ecosystems that life depends on. The second aim is to show how linguistics can be used to address key ecological issues, from climate change and biodiversity loss to environmental justice[1].

[1] https://www.ecolinguistics-association.org/

Historically, an ecological perspective added to the study of language is associated with the work of Einar Haugen, which first appeared in 1972, who defined language ecology as "the study of interactions between any given language and its environment" (Haugen, 2001, p. 57). Haugen highlighted the existence of language in relation to its users taking distance from his contemporary linguists whom he described as "too eager to get on with the phonology, grammar, and lexicon". He argued that:

> the true environment of a language is the society that uses it as one of its codes. Language exists only in the minds of its users, and it only functions in relating these users to one another and to nature, i.e., their social and natural environment [...] The ecology of a language is determined primarily by those who learn it, use it, and transmit it to others (Haugen, 2001, p. 57).

In particular, the ten 'ecological' questions referred to "any given language" he posed at the end of his article provide fruitful insights from a linguistic and sociolinguistic point of view for studying ecolinguistics. Accordingly, some of his questions can be considered as the backbone of the research questions of this study, such as (2) *Who are its users?*, in terms of location and grouping; (3) *What are its domains of use?*; (7) *To what degree has its written form been standardized, i.e., unified and codified?*, specifically, I am interested in investigating whether there are linguistic variations and lexical innovations; (8) *What kind of institutional support has it won, either in government, education or private organizations, either to regulate its form or propagate it?*, for instance, as regards the topic of climate change, I will analyze how often the selected users deal with it and how they talk about it; (9) *What are the attitudes of its users towards the language, in terms of intimacy and status, leading to personal identification?*, in particular, I will attempt to study the attitudes and the discourse behind words of the users involved.

Further to this, along with Einar Haugen, it is believed that ecolinguistics as an emerging discipline started with a speech, "New ways of meaning", delivered by Michael Halliday at the 1990 World Conference of Applied Linguistics in Greece, where he shed light on the relation between language and environment (Fill & Mühlhäusler, 2001; LeVasseur, 2015). According to Halliday, there is a strong connection between language use and environmental crisis, and ecolinguistics can raise ecological awareness. In his speech, he argues that language, including semantics, evolves within its environment, thus "language does not passively reflect reality; language actively creates reality" (Halliday, 2001, p. 179). Thanks to language we are able to "transform our perceptions into meanings" and language is also "a principle of social action" (Halliday, p. 179). As a result, through language it is possible to mold our consciousness, create social relationships and construe reality. Therefore, he argues how the use of language makes humans responsible for ecological degradation providing examples such as economic growth, which has *per se* a positive meaning considering how we have been used to conceptualizing this term, albeit it has a strongly negative effect on the ecosystem. For these reasons, Halliday is considered the pioneer of eco-critical discourse analysis, the one who emphasized that the role of linguists is to unveil the ideologies behind the semantic construction of meanings.

As summarized by LeVasseur (2015), the "Haugenian tradition" of ecolinguistics includes language as part of a bigger environment, where language mutually interacts and shapes ecological systems, society, and the mind of the speaker. On the other hand, the "Hallidayan tradition" is based on a functional approach to language founded upon linguistic anthropocentrism where human beings are considered responsible for ecological devastation. I will attempt to carry out a study which considers both approaches in order to identify a broader picture of the relationship between the social

actors and language variation across space and time. The intersection of these two variables will enable me to analyze the stakeholders' language use, lexical creativity, and discourses behind the messages posted on Twitter in relation to their social and political context. In fact, the social media platform Twitter is the data provider for this research. Indeed, sociolinguistic studies related to climate change based on data retrieved on social media platforms have increased over the past two decades, and Twitter is the most harnessed one, followed by Facebook and Instagram (Sun et al., 2021). Nevertheless, research on climate change effects from a sociolinguistic perspective has already a long history, and legacy media have started contributing to climate change coverage since the first half of the 20th century. In the next section I will provide a brief recapitulation of media coverage and the shift of the most salient features emerged over the years.

2.2 Contextual Background

2.2.1 Overview of climate change main events

The climate change debate started gaining attention through time and specific events. In particular, in 1985, the first major international conference on the greenhouse effect at Villach, Austria[2], took place shedding light on the negative effects of greenhouse gases and the rise of global temperatures in the current century. The Villach conference helped to raise awareness about the issue of climate change and paved the way for future international efforts to address the problem, including the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988 to assess and report on scientific findings of climate change and its potential impacts.

[2] https://library.wmo.int/index.php?lvl=notice_display&id=6321#.ZFFFG3ZBw2w

Another important fact that raised attention refers to the testimony to the U.S. Congress in 1988 of scientists, including NASA scientist James Hansen, who underlined the contribution of human activities to higher temperatures because of the burning of fossil fuels. Moreover, in 1992, the Rio de Janeiro Earth Summit, also known as the United Nations Conference on Environment and Development (UNCED), was held in Rio de Janeiro, Brazil[3]. The conference was attended by representatives from 178 countries and was the largest gathering of world leaders until then. The Earth Summit aimed to address global environmental issues, such as climate change, biodiversity loss, deforestation, and pollution. The conference led to the adoption of (1) the United Nations Framework Convention on Climate Change (UNFCCC), which provided a framework for international cooperation on climate change, (2) the Convention on Biological Diversity (CBD), and (3) Agenda 21, a plan for sustainable development as a key goal for global environmental policy. The Earth Summit also highlighted the importance of involving civil society and stakeholders in environmental decision-making processes.

Further to this, the Kyoto Protocol was an international treaty adopted in 1997 under the United Nations Framework Convention on Climate Change (UNFCCC)[4]. The treaty aimed to address global warming by setting binding targets for the reduction of greenhouse gas emissions with more significant reductions required from developed countries, such as the United States and Europe. However, some developed countries, such as the United States, did not ratify the treaty.

Thenceforth, the above-mentioned events laid the groundwork for future international climate agreements. Overall, 2015 was a critical year for climate change and the adoption of the Paris Agreement in 2015 was a significant milestone in global efforts to address

[3] https://www.un.org/en/conferences/environment/rio1992
[4] https://unfccc.int/kyoto_protocol

climate change. Indeed, the UNFCCC Conference of the Parties (COP21) took place in Paris from November 30 to December 12, 2015[5]. The conference was attended by representatives from 195 countries, and it was the first universal agreement to address the issue and set out a framework for countries to work together to reduce greenhouse gas emissions and adapt to the impacts of climate change. Countries are required to submit updated emissions reduction targets every five years, starting in 2020, and to report on their progress in implementing their targets and adapting to the impacts of climate change. The agreement entered into force on November 4, 2016, after it was ratified by 55 countries that together accounted for at least 55% of global greenhouse gas emissions.

Since the adoption of the Paris Agreement, there has been progress in terms of setting emissions reduction targets, implementing the agreement, and raising awareness of the urgent need to address climate change. For instance, the European Union has committed to reducing its greenhouse gas emissions by at least 55% by 2030. The United States has had a complex relationship with the Paris Agreement on climate change. In 2015, the U.S. played a key role in negotiating the agreement, and President Obama signed it on behalf of his nation. However, in 2017, President Trump announced that the U.S. would withdraw from the agreement, explaining that it was unfair to American workers and businesses. In 2020, during the presidential election, Joe Biden campaigned on a platform that included rejoining the Paris Agreement. Nevertheless, Wendler (2022, p. 9) defines European policy development as "stable and progressive" compared to the "fragmented and contested" one in the U.S. Indeed, since all Parties are subject to the Paris Agreement in the same manner, and they establish their contribution or target, it can be stated the EU is moving forward to pursue its goals. Delbeke et al. (2019) suggest the EU is prepared to leverage its extensive efforts in international cooperation and financial support for the

[5] https://unfccc.int/process-and-meetings/the-paris-agreement

implementation of the Paris Agreement both with emerging economies and developing countries. Moreover, according to a predictive model of greenhouse gas emission based on economic and energy sector development at the national level, Liu et al. (2017), argue the U.S. would need a major acceleration of the clean energy process to achieve its goals, while the EU is more likely to reach its targets.

In light of the above, social movements and climate activists have emerged in response to the growing scientific consensus on the risks posed by climate change, as well as the perceived lack of action by governments and corporations to address the issue. Many climate activist movements are led by young people who are concerned about the impact of climate change on their future. The youth-led movement gained significant attention in 2019, when millions of young people around the world participated in the Global Climate Strike, calling for urgent action on climate change (Boulianne et al., 2020). Although social movements are often organized at the local level, social media platforms and other online tools have been critical in connecting and mobilizing these movements that are working towards a common goal (Anderson & Huntington, 2017).

Despite these efforts, the COVID-19 pandemic has also had a significant impact on efforts to address climate change, such as economic slowdown, which led to a significant reduction in greenhouse gas emissions in 2020, but also to a reduction in investments in renewable energy, which could have long-term implications for the transition to a low-carbon economy (Maniatis et al., 2021). Moreover, climate action was postponed, as many countries shifted their focus to addressing the immediate health and economic impacts of the crisis. On the other hand, the pandemic also provided opportunities for a green recovery and for countries to invest in renewable energy and other low-carbon technologies that could help them to meet their COP21 targets. Similarly, while COVID-19 posed significant challenges for climate change activism (Loureiro & Alló, 2021), it

also presented opportunities for innovation and creativity in mobilizing and engaging people in the fight against climate change. The pandemic highlighted the interconnectedness of global challenges and the need for collective action to address them, especially thanks to social media platforms. Indeed, climate activists found new ways to mobilize and raise awareness of the issue during the pandemic through virtual protests and online events, including digital strikes, social media campaigns, and webinars. In these circumstances, some activists highlighted the relationship between climate change and other social issues, such as climate justice, economic inequality, and public health, and advocated for solutions that address these issues holistically (Pleyers, 2020). Thus, the time frame 2015 – 2020 may be considered as a representative timespan to better understand social and political dynamics which depict the current picture of the climate crisis.

2.2.2 Climate change coverage

Climate science and mass media first started climate change coverage in the 1930s, while media coverage involving human contribution appeared more directly in the 1950s. Since the 1980s, climate change has become a noteworthy topic of the news media, which reflects the agenda setting-theory. Indeed, as first stated in 1972, the agenda setting theory refers to the ability of the news media to select specific topics and act upon their salience by frequently reporting them (McCombs & Shaw, 1972). Moreover, the media are considered to have the ability to influence how specific topics may be perceived (McCombs & Shaw). Nowadays, modern media communication has begun to take its current globalized form, sharply marked by emerging corporate concentration (McChesney, 1999), and the three media-science-policy spheres started to impact each other when media coverage of climate change, science, and policy rose drastically.

For instance, Boykoff and Boykoff (2004) carried out a study showing how the U.S. prestige press, i.e., the *New York Times*, the *Washington Post*, the *Los Angeles Times*, and the *Wall Street Journal*, biased coverage of global warming from 1988 to 2002, promoting deviation between scientific community discourse and the U.S. prestige-press discourse in terms of actual anthropogenic contributions to global warming, and decisions regarding action on global warming. Similarly, Carvalho and Burgess (2005) demonstrated in their paper *Cultural Circuits of Climate Change in U.K. Broadsheet Newspapers*, from 1985 to 2003, the strong tie between climate change coverage and the political agenda, and how the media construct

> particular images of scientific knowledge and uncertainty on climate change, and emphasize or de-emphasize forecasts of impacts, in order to sustain their political preferences regarding the regulatory role of the state, individual freedom, and the general economic and social status quo (p. 1467).

Moreover, as pointed out by Carvalho (2010), media coverage related to climate issues has helped to raise awareness among the public considering it as a means to access scientific information and political debates, being also able to affect people's understanding of risks and responsibilities. In a similar vein, Kirilenko and Stepchenkova (2012) carried out a study on climate change discourse in articles published in the New York Times from 1995 to 2010. They highlighted a shift in the topics associated with climate change and a particular decrease in the issue related to science and an increase related to politics. Moreover, in a recent study, Hase *et al.* (2021) focused on the main differences in terms of issue attention and themes between the Global South and the Global North when reporting on climate change from 2006 to 2018 across 10 countries. They argue that key factors which determine climate coverage are political, economic, scientific, and societal events. In their findings, not only do countries from the Global

North cover climate change more frequently, but also the focus is different. Countries from the Global South focus more on the societal dimension of climate change, in particular its impacts on humans and how to foster a social change, whereas the Global North refers more often to climate science.

Considering the growing pervasive nature of the internet, differences between legacy and digital media have started being investigated, as well. Indeed, Painter et al. (2018) carried out a study including media coverage from traditional news media in comparison with three online media, Huffington Post, Vice, and BuzzFeed. They analyzed how the news related to the COP21 summit in Paris in 2015 was reported across France, Germany, Spain, the UK, and the USA and identified 12 main topics. Although the topics were mostly consistent over all countries, they highlighted how the news media prioritize different aspects of the issue, such as civil society protests, and emphasize the importance of multimedia and visual content, such as the imagery of protestors and politicians at work.

Nowadays, climate change can be considered a common and popular issue that is no longer only discussed by scientists and politicians and disseminated by the media. Everyone contributes to it; anyone can act on it. As argued by Mühlhäusler (2003, p. 201):

> the environmental ideology existing in most Western societies is that it is responsible individual choices that will save the Earth. While local improvements can indeed result from individual choices, it remains unclear what global impact those choices have given power politics, large-scale environmental crime, and continued widespread ignorance and indifference. […] I am concerned about the trend to blame individual consumers' moral responsibility for policies and social processes which are beyond the control of individuals.

In line with this statement, I will analyze to what extent individual choices of politicians, activists, and wider groups represented by NGOs, social movements, and organizations can shape climate change discourse in their messages.

As reported above, most scholarship on climate change communication has focused on media coverage. On the other hand, the growth of the internet and social media has provided grassroots and youths with the tools to directly engage in the climate change debate. Indeed, the strong sense of connectedness, particularly fostered by social media, encourages more people to talk about their worries about climate change, and potentially raise awareness and instill concern through people's social networks while increasing active participation and involvement (Geiger & Swim, 2016). In fact, social media platforms promote active engagement while offering people the opportunity to voice their political views also by spurring them into concrete action. Indeed, anyone can question, contest, and/or support decisions bridging the gap between the unheard and those who are designed to participate in global policy decision-making. For instance, global climate strikes and protests are a result of the strong involvement and connectedness through social networks on a global scale (Boulianne et al., 2020; Bruns et al., 2014; Freelon et al., 2016; Hodges & Stocking, 2016; Pickard, 2021). As emphasized by some scholars (Chen et al., 2022; Chinn et al., 2020), news media tend to highlight the relationship between politics and climate change and the effects on the economy and businesses. On the contrary, climate movements aim at mobilizing citizens and advocating for political action. The most popular social media platforms can increase the level of connectedness among users while communicating actions, feelings, and perceptions about climate change. In the case of Twitter, the use of specific features, such as hashtags and mentions, strengthens an ideal characteristic of social glue, in the metaphorical sense as highlighted by Klein (2000), that indicates a mutual bond of recognition, connectedness, the feeling

of responsibility for, and concern for others because they occupy the same community (Bennett, 2003; Bennett & Segerberg, 2012; Gaard, 2018; Kirk, 1997; Livingston & Asmolov, 2010; Ray & Tarafdar, 2017; Rosenbaum & Bouvier, 2020). Moreover, it is believed that the *Twittersphere* allows people to retrieve and discuss scientific topics and it is where climate change is debated online (Anderson & Huntington, 2017).

The following section illustrates Twitter's main features and provides a review of the main studies which have examined the climate change issue through Twitter data.

2.2.3 Twitter

2.2.3.1 Twitter and climate change

Currently, social networking-based communications generate a vast amount of data on a daily basis and cover a great number of topics. As a result, social network mining represents a valuable source of information and an important opportunity for the study of 21st-century society (see Carveth, 2019; Davis & Sinnreich, 2019; Dahal et al., 2019; Golbeck et al., 2010; Kirilenko & Stepchenkova, 2014; Lutz, 2019; Resce & Maynard, 2018; Veltri & Atanasova, 2015).

Generally, one of the most popular platforms of academic research is Twitter due to the number of Application Programming Interfaces (API) that enable researchers to retrieve data. Indeed, the growing number of advanced data analyses and statistical applications related to this social network facilitates the investigation of social media data. In particular, Twitter is an American microblogging and social networking service where users post and interact with messages known as "tweets". It was created and launched in 2006 and originally a tweet was restricted to 140 characters, but it was doubled to 280 in November 2017.

Twitter, Inc. described its social media platform in the general overview of the annual report related to 2019[6] as follows:

> Twitter is what's happening in the world and what people are talking about right now. From breaking news and entertainment to sports, politics, and everyday interests. Twitter shows every side of the story. On Twitter, you can join the open conversation and watch highlights, clips, or live-streaming events. Twitter is available in more than 40 languages around the world…. Our primary product, Twitter, is a global platform for self-expression and conversation in real-time. Twitter allows people to consume, create, distribute, and discover content and has democratized content creation and distribution.

In addition to the message, Twitter data offer the opportunity to study several aspects related to the reception and use of any kind of information. Moreover, they provide information about the content generated by users, news and information from other sources, conversations held on specific topics, and network relationships. Although Twitter messages might be brief, they undergo the process of length standardization of the messages and provide extra information in-built into the structure of tweets. Thus, instant retrievable data refer to the users, such as geographical location, time zone, when the account was created, number of followers and followed, and number of tweets posted. Other data refer to the tweets, including the content, hashtags, mentions, and URL references to external sources.

Since Twitter consists of concise content such as phrases, quick comments, images, or links to videos, I believe that, as a mode of communication, it can be defined as public, simple, quick, interactive, networked, and invoking, in all positive and negative

[6] https://s22.q4cdn.com/826641620/files/doc_financials/2019/FiscalYR2019_Twitter_Annual_-Report-(3).pdf)

connotations of the term. All author types involved in this research have different messages to convey, but the ultimate goal is to reach out to the Twitter community, starting with world leaders and politicians who have been increasingly using this social media channel to engage with their citizens. In fact, a 2018 BCW (Burson Cohn and Wolfe, a multinational public relations and communications firm) Twiplomacy study found that 951 Twitter accounts were of heads of state and government and foreign ministers of 187 countries, 372 personal and 579 institutional accounts, representing 97 percent of all UN member states, with a combined audience of 485 million followers.

Specifically, focusing on the communicative function of a tweet, in line with Harré et al. (1999), I believe attention should be drawn to the way common people use the English language on a daily basis to talk about "ecological and environmental matters and the role of speaking and writing in the active engagement of people in conversations about such matters" (1999, p. 3). As pointed out by Veltri and Atanasova (2015), taking into account the number of users involved in the climate change arena, providing different perceptions and perspectives worth studying, Twitter has become too decisive to be excluded in linguistic analyses. As a matter of fact, social network mining will become a major source of data in the public discourse on climate change for several reasons. Firstly, collecting data from Twitter is a non-intrusive research mode. Secondly, data retrieval and collection are relatively simple and fast. Finally, Twitter's default settings enable researchers to collect most tweets (Kirilenko & Stepchenkova, 2014), compared to other social networks such as Facebook and Instagram. These are some of the reasons why academic research has been collecting data from Twitter over the last decade (Lazer & Redford, 2017). Moreover, Pearce et al. (2019) argue there is a considerable bias toward Twitter, and this is attributable to the accessibility and availability of data. In fact, in their findings from the literature, they discovered that out of 35 articles about climate change, 26 retrieved

data from Twitter, although this social media platform ranks sixth[7] by number of active users in the U.S. and fifteenth worldwide[8]. For instance, Bennett and Segerberg (2012) studied climate change protests related to the 2009 15th United Nations Conference of the Parties on Climate Change (COP-15) in Copenhagen by analyzing random samples of tweets related to the event. Furthermore, Bruns and Burgess (2011) analyzed the public discourse, including climate change, during the 2010 Australian elections. Similarly, Kirilenko and Stepchenkova (2014) investigated the global public discourse related to climate change on Twitter in five main languages from 2012 to 2013, based on the collection of 1.8 million tweets that included the words "climate change" and/or "global warming". Similarly, Veltri and Atanasova (2015) carried out a study exploiting different aspects deriving from Twitter data. They collected a random weekly sample of tweets in March 2013 containing the keywords "climate change" and "global warming" and carried out text mining and semantic networks, and a psychological process-based classification of tweets, as well. In 2015 Jang and Hart published a study on frames and terms employed by users about "climate change" and "global warming" in four English-speaking countries retrieving tweets over two years. Lastly, Loureiro and Alló (2021) carried out a study based on tweets and other information, such as socioeconomic variables, social norms, and cultural dimensions, in 20 countries from 2018 to 2020. They demonstrated how natural catastrophes impact the number of tweets commenting on the event. For instance, they proved how wildfires boost the number of climate-related tweets, whereas droughts and volcanic eruptions do not have any impact on the trend of tweets posted. In the same research, they also analyzed the relationship between the climate change debate and the COVID-19 pandemic on Twitter. Despite the fact that the number of climate-

[7] Surveys of U.S. adults conducted 2012-2021. PEW RESEARCH CENTER.
[8] Source: We Are Social; Hootsuite; DataReportal; Kepios.

related tweets decreased during 2020, after the pandemic a positive trend was recorded in most developed countries, whereas it decreased in most developing countries.

To the best of my knowledge, very few research studies involve as many specific social actors considered meaning-makers in such a wide timespan. Thus, this present work aims at overcoming the limitations of the current state of knowledge which are mostly related to short timespans, tweets from random and anonymous users, and, above all, linked to two keywords, "climate change" and "global warming" (Jang & Hart, 2015; Veltri & Atanasova, 2015) or to specific hashtags (Kirilenko & Stepchenkova, 2014), with reference to specific main events (Segerberg & Bennett, 2012; Bruns & Burgess, 2011; Pearce et al., 2014, Kirilenko et al., 2015; Abbar et al., 2016). Moreover, as Twitter enables the creation of social relations and communities, it is worth investigating how a social network analysis may be applied to the *Twittersphere*.

2.2.3.2 Twitter and Social network analysis

A social network is made of a set of nodes that are socially relevant and are connected by one or more types of relations (Wasserman & Faust, 1994). The nodes represent units, which are usually identified with people or organizations, and are connected by types of relations from which may arise specific patterns that can be further investigated (Marin & Wellman, 2009).

The importance of social relations was widely dealt with by Georg Simmel, whose theory is the basis of most empirical findings in network analysis. According to Simmel, things can be better understood not as isolated units, but as part of relations whose characteristics come from the intersection of these relations. He defined society as a web of relations, thus, to understand society, attention must be drawn to the consequences of the interaction of individual actions, and not to the analysis of a mass of individuals who each react

independently to circumstances based on individual values. As reported by Marin and Wellman (2009, p. 15):

> A collection of human beings does not become a society because each of them has an objectively determined or subjectively impelling life content. It becomes a society only when the vitality of these contents attains the form of reciprocal influence; only when one individual has an effect, immediate or mediate, upon another, is mere spatial aggregation or temporal succession transformed into society (Simmel, 1908).

Hence, a society is the product of the interactions among individuals, and not of the sense of aggregation they may create, i.e., the community.

In recent years, the study of social network analysis (SNA) has become strongly interdisciplinary, due to the possibility to explore interconnections in large-scale social media datasets. Thanks to the development of a number of sophisticated tools, it is now possible to calculate network metrics such as detecting the importance of people in a specific network and identifying social structures (Hansen, 2011). Nodes in an interconnected network tend to share similar characteristics leading to the so-called homophily phenomenon which is "a basic organizing principle" that "a contact between similar people occurs at a higher rate than among dissimilar people" (McPherson et al. 2001, p. 416). As noted by Himelboim et al. (2017), homophily captures a key characteristic that indicates that "individuals are more likely to form social network connections with others who are often very similar to them" (Himelboim et al., 2017, p. 3).

In social media network research, the study of network clusters has become of great importance as some scholars show. Indeed, social media platforms allow users to create connections with each other while sharing texts, videos, images, and URLs. In particular,

Twitter fosters personal expression in the so-called *Twittersphere* which is suitable for the analysis of this social network from different perspectives. Indeed, it allows for uncovering relational ties and connections among users applying different Twitter-specific metrics, e.g., who is following whom, and who mentions who, as well (Bruns & Stieglitz, 2013).

According to Conover et al. (2011) when people retweet, they tend to create communities of politically like-minded users. Indeed, communities on Twitter are created as users decide whom to reply to, mention, or retweet. Social media networks may differ according to "the density of connections within them, and dense groups of people who mostly share a belief or orientation are key social features governing the rate and type of information that is distributed through social media" (Himelboim et al., 2017, p. 3).

In particular, Twitter presents the function of mentioning people through the @ sign followed by the username and including it in the tweet. Honeycutt and Herring (2009) carried out a study focusing on the role of the @ sign highlighting its importance in Twitter communications. They concluded that @ followed by a username, which has the function of addressing people, increases the interactive function of Twitter making it "a tool for interpersonal interaction" (Honeycutt & Herring, p. 8). In line with this conversational aspect of Twitter, Small (2011) argues that "a tweet is a public message sent from one person to another, distinguished from normal updates by the @username prefix" (p. 80). Pearce et al. (2014) investigated how Twitter users were connected with each other forming communities based on a dataset of English language tweets containing the keyword "IPCC". The resulting network was visualized and studied in Gephi which highlighted the high level of conversational connections in the shared community, namely the "likeminded people" (Pearce et al., 2014, p. 8), thus promoting a polarized debate of climate change between supportive and unsupportive communities.

By its nature, this corpus cannot aim to be comprehensive of an in-depth SNA. However, the objective is to include a segment of the population present in the corpus and analyze the connectedness of the main users. This preliminary investigation might anticipate the existence of specific patterns which will be better examined in a more qualitative study through discourse analysis and corpus linguistic techniques.

2.3 Theoretical Background of the Methodological Approach

2.3.1 Corpus Linguistics

The fundamentals of corpus linguistics (CL) have existed for almost a century. In fact, the collections of examples of language in use by lexicographers and dictionary makers in order to accurately define words started in the 19th century. Thanks to the advent of computers, it is now possible to create what we currently call corpora, i.e., collections of authentic texts that have been compiled in electronic form for the purpose of linguistic research (Hunston, 2002; Baker, 2006). The Brown Corpus was the first computer-based corpus created in 1961 and comprised about 1 million words. Nowadays, a corpus is defined as a "collection of recorded utterances used as a basis for the descriptive analysis of a language"[9]. As defined by McEnery et al. (2006, p. 5), a corpus is "a collection of (1) *machine-readable* (2) *authentic* texts […] which is (3) *sampled* to be (4) *representative* of a particular language or language variety".

Although many theories of language have been proposed so far, the main objective when using corpora is to analyze and demonstrate how speakers and writers use language to achieve their communicative goals (Meyer, 2002). Indeed, CL provides an empirical approach to analyzing and describing several aspects of language, such as vocabulary,

[9] "Corpus." Merriam-Webster.com Dictionary, Merriam-Webster, https://www.merriamwebster.com/dictionary/corpus. Accessed 29 Nov. 2021

grammar, discourse patterns, and usage frequencies, based on patterns and evidence from corpora. In other words, it is "a methodological basis for pursuing linguistic research" (Leech, 1992, p. 105). Moreover, in order to study language use "A corpus is best used to answer a research question which it is well composed to address" (McEnery & Hardie, 2012, p. 2). As pointed out by Teubert (2001, p. 128), CL "deals with the patterns and structures of semantic cohesion between text elements that are interpreted as compounds, multi-word units, collocations, and set phrases". When using CL, the analysis carried out is not a mere textual analysis, but the context becomes of paramount importance and therefore "CL assumes that language is a social phenomenon, to be observed and described above all inaccessible empirical data—as it were, communication acts" (Teubert, 2001, p. 129). Indeed, CL techniques are widely used for automated text analysis, suitable for the investigation of language patterns (Baker, 2006), and the semantic interaction between a text and a given community concerning their context. As a matter of fact, by the use of CL within the analysis of an item and its function in the co-text, "semantic prosody has a leading role to play in the integration of an item with its surroundings" (Sinclair, 1996, p. 87). As McEnery and Hardie (2012) suggest, semantic prosody is associated with the concept of connotation referred to the negative or positive meaning conveyed by words that co-occur. As highlighted by Louw (1993, p. 159), semantic prosody can only be identified through the analysis of concordances. Moreover:

> A semantic prosody refers to a form of meaning which is established through the proximity of a consistent series of collocates, often characterizable as positive or negative, and whose primary function is the expression of the attitude of its speaker or writer towards some pragmatic situation (Louw, 2000, p. 9).

According to Louw's view, semantic prosody is the result of its context in terms of causation; when a word occurs in a context that has a negative meaning, this word can

pass on the negative meaning in other contexts in which it may occur. This process is what Louw defines as “imbuing” which might bring a change in the meaning of a word over time. Simultaneously, in a more pragmatic dimension, Stubbs (2001, pp. 65-66) suggests the notion of discourse prosody relies on the meaning conveyed by the speaker and not on the meaning of words.

Nevertheless, the construction of representative, comprehensive, and balanced corpora may be challenging and time-consuming. Further to this, when building a corpus, certain decisions about text selection, transcription, and annotation may be biased or subjective, resulting in potentially invalid and unreliable analysis. In some instances, corpus samples may reflect a particular genre or specific written text, thus limiting generalizability (Mautner, 2019). On the other hand, corpora allow objective observations about language usage and draw conclusions supported by data providing a comprehensive view of how language is actually used in different contexts. The examination of real language data with computer software and computational tools offers insight into language patterns, trends, and variations across different genres, registers, or time periods in an accelerated research process. Despite the lack of new information in corpora, the software gives a new perspective on what is already known about a language (Hunston, 2002). For instance, the most common tools are frequency lists (the frequency of each word), keywords (the most frequent words in a specific corpus), concordances (a set of text fragments that co-occur with a particular search word), n-grams (frequent set of words), and collocations (words that occur frequently together).

As for its methodological applications, Corpus Linguistic tools have been widely used to study the climate change debate. For instance, they have been put into practice to investigate different spheres that are closely linked to this topic, such as newspaper coverage, scientific reports, policy documents, blogs, and social media. All these sources

represent large collections of texts of different genres, continuously increasing and easy to retrieve, but might be difficult to analyze only with the human eye. Indeed, Grundmann and Krishnamurthy (2010), using a corpus-based approach, conducted discourse analysis involving framing theory, while identifying the main differences of climate change policies among the US, the UK, France, and Germany. Specifically, they retrieved online articles applying search words such as climate change, global warming, and the greenhouse effect. Through the analysis of collocates, they identified the main frames and drew discursive conclusions. Furthermore, Koteyko et al. (2012) analyzed online reader comments of the *Daily Mail* which included "climate change", based on a corpus-assisted approach for the quantitative analysis using keywords and collocations. Moreover, Wild et al. (2013), investigated three specialized web corpora and a web reference corpus to study environmental lexis focusing on collocates and connotations. Collins and Nerlich (2014) used CL showing the usefulness of frequency analysis and the extraction sample of comments to analyze the online climate debate and assess whether it encourages public engagement and understanding in a deliberative and democratic way. Simultaneously, Fløttum et al. (2014) studied language use and linguistic representation of notions of the future based on a large corpus created with climate-related blog posts in English. Through the analysis of frequencies and co-occurrences of words repeated in sentences containing the phrases "climate change" and "global warming", they identified nine meaning categories under two main frames: a "bright" future (positive), and a "gloom-and-doom" future (negative) (Fløttum et al., 2014, p. 220). Willis (2017), through corpus linguistics techniques, studied how British Members of Parliament dealt with climate change as a political issue in their discussion.

In view of the above considerations, it is possible to create corpora that represent the language of a particular subject area, such as climate change, or to analyze a particular

text type, such as social media messages. Following Leech's (1992, p. 116) description of corpora as a purposeful collection of textual material with the aim of being "representative of some language or text type", this research is corpus-based as it uses corpus data and tools to validate or reject the hypotheses. In this work, representativeness is considered as the involvement of extra-linguistic criteria which contribute to the definition of the corpus and are not only based on the distribution of linguistic features (Biber, 1993). In addition, the specialized corpus of this research can be defined as a sample corpus, or snapshot corpus, since this study attempts to analyze a specific type of language in a particular time span, and the sampling frame is identified with tweets, thus short written texts, retrieved from a balanced population. I will particularly focus on collocates, analyzing the patterns that co-occur in the corpus based on the assumption that the meaning of words put together may be different from their independent ones (Sinclair, 2004). Additionally, language analysis through corpus techniques can show how attitudes are formed and how language is used regarding climate change (Fløttum, 2017), allowing to unveil meanings and trace back the change of meanings as well as discover lexical creativity, and explore discourse analysis.

2.3.2 Definition of discourse

Discourse is a term that encompasses several definitions in social and linguistic research. Stubbs (1983, p. 1) defined it as "language above the sentence or above the clause", while Stibbe (2015, p. 22) described it as a "standardized way that particular groups in society use language, images and other forms of representation". According to Hajer and Versteeg (2005, p. 175), in line with the Foucauldian sense, discourse is considered "an ensemble of ideas, concepts, and categories through which meaning is given to social and physical phenomena, and which is produced and reproduced through an identifiable set

of practices". Indeed, the connection of discourse to reality, such as social and natural phenomena, is widely shared (Halliday, 1990; Harré et al., 1999). Fairclough (2003, p. 3) identifies discourse "as an element of social life which is closely interconnected with other elements". As a result of multiple interpretations of discourse, in the analysis of several papers Jaworski and Coupland (1999) classified its definition into three groups: (1) anything beyond the sentence, (2) language use, and (3) a broader range of social practice that includes non-linguistic and non-specific instances of language (Tannen et al. 2015, p. 2).

As a matter of fact, when studying a language, it is fundamental to take into account its relationship with the natural and cultural environment (Haugen, 2001), but also the connectedness of language to the variables of time and place. Specifically, in environmental discourse, through language we express worries and concerns about climate change, build solutions and negotiations, and through discourse we can raise social and environmental awareness. In the narrower definition of environmental discourse, I agree with Jung's view (2001): "the entirety of texts […] in which the relation between humans and natural environment is defined publicly, i.e., in the media, or in which the effects of human activity on the environment and its repercussions on humans are discussed" (2001, p. 271). Consequently, in this research, I will analyze what kind of discourse lies behind the messages posted directly by the stakeholders and how is it influenced by social and political events in the climate change arena.

2.3.3 Discourse Analysis

According to Fairclough (2003, p. 2), "discourse analysis is based upon the assumption that language is an irreducible part of social life, dialectically interconnected with other

elements of social life so that social analysis and research always has to take account of language".

As pointed out by Koteyko and Atanasova (2016), Discourse Analysis as an academic field, has developed on two main strands, i.e., "Foucauldian" discourse analysis which primarily focuses on social issues reflected on language use, and "Critical Discourse Analysis" (CDA) which is based on the linguistic characteristics of texts (Fairclough, 2003).

DA is a useful technique to unveil what kind of climate change representations are emphasized, which social actors have more authority, and what type of reality they promote by looking at their particular linguistic choice of words. In fact, DA is an important tool that helps understand how climate-related tweets are created within particular social and cultural contexts. Indeed:

> The basic assumption of discourse analysis is that language profoundly shapes one's view of the world and reality, instead of being only a neutral medium mirroring it. Environmental arguments might seem factual and scientific, but they are also meaningful, suggestive, and atmospheric (Hajer & Versteeg, 2005, p. 176).

Already in 1912, Sapir stated "the simplest environmental influence is either supported or transformed by social factors" (1912, p. 226). The environment itself presents physical and social features; the former includes geographical characteristics, and climate included. The latter refers to ethics, politics, art, and religion. The most affected component of a language by these two features is the vocabulary of speakers intertwined with cultural symbols and background. Cultural change is followed by language change. Accordingly, the vocabulary becomes "constantly enriched and ramified with the increase within a group of cultural complexity" (Sapir, 1912, p. 233).

Through Discourse Analysis it is possible to identify regular linguistic patterns in discussions and debates. As highlighted by Hajer and Versteeg (2005), the discussion is "the object of analysis". DA is founded on the idea of the existence of multiple realities that are socially constructed. Thus, the objective is to unveil the meaning social actors give to phenomena and this can be done by taking into consideration the socio-cultural and political events and contexts in which phenomena take place.

Fløttum et al. (2014) investigated how discourse enables decisions and actions to be shaped by the construction, reproduction, challenge, and exclusion of representations of the world; hence, following their viewpoint, climate change communication allows to gain insight into some of the basic assumptions of climate and environmental policy and priorities. For instance, Pickard (2021) focused on linguistic features of discourse based on the words of Greta Thunberg, Fridays for Future and Extinction Rebellion, and interviews with climate activists. In her research, she underpinned how the portrayal of climate change as an emergency and a crisis by the aforementioned actors, along with a strong emphasis on generational responsibility, have played a crucial role in mobilizing young people worldwide, partly as a result of emotional responses generated by this representation. Cunningham et al. (2022) carried out an investigation into climate change discourses of climate activists and politicians demonstrating a strong connection between climate change and discourses of ecological and social justice for the former group, while politicians' discourse is driven by economic dominance. In a similar vein, in this work, I will attempt to analyze how the different users involved influence the definition of climate change, and how they address this problem.

2.3.4 Integrating Corpus Linguistics and Discourse Analysis

Although CL and DA started developing as fields of research almost simultaneously in the 1980s and 1990s, their use as integrated tools and techniques took place in the last two decades (Bevitori, 2012; Mautner, 2016; Thornbury, 2010). Indeed, as argued by Partington (2004)

> for some considerable time, then, the dichotomy was virtually complete: corpus linguists were generally unaware that their quantitative techniques could have much to say about discourse, while discourse analysts rarely saw reason to venture forth very far from their qualitative ivory tower". (p. 11)

The combination of Corpus Linguistics and Discourse Analysis may present benefits and drawbacks. Interpretation bias may be one of the main issues when dealing with Corpus Linguistics and Discourse Analysis. However, using a corpus helps to limit researchers' subjectivity by having recourse to empirical evidence based on a scientific methodology and statistical measures, thus limiting cognitive bias (Baker, 2006). In fact, the synergic use of both approaches allows quantitative and qualitative analyses proving an in-depth understanding of language phenomena. For instance, statistical methods for the identification of language patterns and frequencies can be combined with qualitative analysis and interpretation of language use.

Furthermore, as emphasized by some experts (Hunston, 2002; McEnery et al., 2006), CL may present some difficulty in capturing the context of the society in which the text was produced. Indeed, the lack of information about the context is of the biggest disadvantages identified within the combined use of CL and DA is (Thornbury, 2010). As noted by Baker:

> questions involving production such as who authored a text, under what circumstances, for what motives, and for whom, in addition to questions surrounding the interpretation of a text: who bought, read, accessed, and used the text, what were their responses, etc. cannot be simply answered by traditional corpus-based techniques. (Baker, 2006, 18)

The lack of knowledge in which the language is used can challenge the interpretation of the meanings of the language. However, as pointed out by Mahlberg (2007, p. 196), in her research on the study of textual functions of the collocation sustainable development, "The way in which an analysis of corpus data can be related to social situations depends on the information that is available on the origins and contexts of the texts." Thus, encoded corpora with information related to the context "can provide useful insights into meanings that are relevant to a society and indicative of the ways in which society creates itself." (Mahlberg, 2007). Through DA social, cultural, and historical factors are of paramount importance in analyzing language use as they provide insights into the functions of language beyond the text *per se*.

Using a corpus enables us to verify hypotheses providing findings grounded in solid interpretations and explanations, which allows us to deal with unexpected challenges more effectively (Baker, 2006). Moreover, Discourse Analysis can greatly benefit from smaller and specialized corpora (Baker, 2006; Mautner, 1995; McEnery et al., 2006; Partington, 2003 Stubbs, 1997, 2001). In order to conduct corpus-based studies on discourse as language in use, contextual information is essential, and "small corpora, gathered in restricted contexts, allow closer tracking of contextual factors" (Thornbury 2010, p. 274). Representative corpora provide a more comprehensive view of language use, along with encoded variables within the corpus. A specifically designed corpus enables us to identify how discourse communities use language and determine their lexical choices. In addition, CL enables both diachronic and synchronic analysis of

language use providing a valuable source for the investigation of language variation and evolution from a temporal perspective.

The advantages of DA and CL outweigh the drawbacks as the present dissertation shows how this integration can actually work. Indeed, in order to answer my research questions, it is necessary to combine quantitative and qualitative approaches. In the adoption of a bottom-up approach, corpus linguistics techniques are used to understand the most meaningful and salient features in climate change discourse; while Discourse Analysis provides the opportunity to uncover the communicative and social functions encoded in the tweets, thus how climate change is socially represented and what is the role of the involved stakeholders (Koteyko, 2015; Koteyko et al., 2015; Koteyko & Atanasova, 2016). As highlighted by Mautner (2019), this combination of CL and DA needs a "constant oscillation between quantitative and qualitative viewpoints, moving back and forth between computer-based discovery procedures and traditional, human hermeneutics". Moreover, several studies related to climate change investigation (Nerlich & Koteyko, 2009a; Nerlich & Koteyko, 2009b; Koteyko, 2010) focused on the integration of corpus linguistics techniques, i.e., collocations and concordances, and discourse analysis to define the lexical creativity and use of carbon compounds in several domains.

As part of the investigation, the lexicon is considered "the most accessible layer of language" (Mühlhäusler, 2003, p. 63). Therefore, considering language as a continuous creative process of words, meanings, and discourses, it is crucial to devote attention to the new lexical items that arise in the corpus and construct the connotation they convey to the whole message. Thus, following the assumptions hereinabove, with the help of the annotated metadata, which refers to the stakeholders involved in the analysis, within the specialized corpus designed for this study, the aim is to discover how the English language use and the social community are related with particular focus on lexical

innovation (Baker, 2010) based on a sociolinguistic viewpoint. As pointed out by McEnery et al. (2006), a corpus-based approach may provide a great contribution to sociolinguistic studies when using corpora with encoded sociolinguistic metadata. In fact, having an understanding of how language reflects and shapes social structures, identities, and interactions is a key aspect of sociolinguistics. Moreover, sociolinguistics contributes to the construction of world representations through discourse analysis also based on the analysis of digital content (Baker, 2010). Herring & Androutsopoulos (2015) point out how at the sentence level, the analysis of computer-mediated language highlights "creative and non-standard typography, spelling, word-formation processes, and syntax" (p.131). They argue that "choice, frequency, and distribution of *words* can indicate what a segment of discourse is about (topicality), as well as communicators' attitudes and affective states" (p. 134).

2.3.5 Sociolinguistics and Language Change

From a sociolinguistic perspective, language change is a primal aspect to be taken into consideration in the analysis of textual data in combination with social variables (Coupland, 2007). As highlighted by de Beaugrande (1998, p. 135), sociolinguistics is facilitated by the use of a corpus to intertwine changes in language use with issues owing to the fact that data in a corpus "can help us monitor the ongoing collocational approximation and contestation of terms that refer to the social conditions themselves and discursively position these in respect to the interests of various social groups." (McEnery et al., 2006). Indeed, sociolinguistics investigates how language and society are interrelated within social groups, communities, and different contexts, and analyzes the way social factors shape language use in terms of language choices and patterns of communication (Baker, 2010). In other words, sociolinguistics studies "the social use of

language" (Chambers, 2018, p. 1) and analyzes how language is affected by social variables such as sex, age, social class, geographic region, etc. (see Wagner, 2012; Sankoff, 2019). These variables are advantageous in the detection of linguistic patterns, and specific lexis concerning particular social groups with similar backgrounds. Further variables contribute to the constant evolution of languages and change over time, such as social factors, language contact, and lexical innovations among communities.

Broadly speaking, language change focuses on historical shifts and transformations that occur in a language over time and can manifest at various levels, including phonetic, phonological, morphological, syntactic, and semantic. Several external factors can lead to language change, namely social norms, technological advancements, globalization, and cultural shifts, along with other sociocultural factors. These may be considered extra-linguistic motivation (Dorian 1993). Additionally, social changes affecting power dynamics, attitudes, and fashion, can have a profound impact on language use and lead to linguistic innovation or alteration.

It can be inferred that language change happens for a reason, and the use of corpora enables the exploration of the changes through time and to find a possible match to real events (Baker, 2010). A growing body of research has been studying the outcomes of media communication concerning language change and the formation of new lexical items and neologisms (Androutsopoulos, 2011; Crystal, 2011; Eisenstein et al. 2014). As pointed out by Baker (2010, p. 2), a sociolinguistic approach may be based on a "'micro' study of a small group or community, looking at social networks and focusing on the role of 'language inventors', or by examining a much larger population, relating aspects of language uptake (or decline) to various social contexts".

This research analyzes language change to identify how the different stakeholders – politicians, social movements, politicians, NGOs, news sites, and organizations – communicate about climate change, focusing on who says what, in which context, and with which final achievement (Nerlich et al., 2010).

2.3.6 New lexical items

The idea of retrieving linguistic data from specific stakeholders provides the opportunity (1) to analyze language variation in terms of discourse use and (2) to detect the emergence of new lexical items to monitor changes throughout time. According to Webster's New World Dictionary, a neologism is a new word or a new meaning for an established word, the use of, or the practice of creating, new words or new meanings for established words. In addition, neologisms are frequently generated in the media as pointed out by Crystal (2001) who defines them as the foundation of new lexical items that are accepted into the language of a certain speech community during a particular period of time[10].

> Neology is an activity, that is, a process, a dynamic field, producing new lexical units in a language system, in a cultural body, or in a social group. This may be due to the desire to control an evolving world, where new objects or kinds of objects appear; or due to the desire to rename things that had already been given a name for reasons that are difficult to analyze, and which can account for totally subjective and collective phenomena such as snobbism, as well as the internal need to renew the lexical stock. (Rey,1988, cited in Cabré, 1999, p. 205)

[10] Based on Crystal's (2001) definition, I will identify novel lexical units detected in the corpus as *new lexical items*. Nevertheless, in the study of the literature, I have considered the general terms *new lexical item*, *new lexical unit*, *lexical innovation*, and *neologism*, as semantically interchangeable here.

Niska (1998, p. 89) stated that “neologisms are tokens of a creative process, a novel relational product growing out of the uniqueness of the individual on the one hand, and the materials, events, people, or circumstances of his life on the other”. He also argued that lexical neology may arise either in single words or compound words and phrases, although these neologisms might be very short-lived and never get lexicalized. According to Fischer (1998, p. 45), a neologism is “a word which has lost its status of a nonce-formation but is still one which is considered new by the majority of members of a speech community”. Moreover, Leibold (1989, p. 110) defined neologisms as the “combination or modification of existing words or the addition of modifying prefixes and suffixes to words to condense or simplify the message and accelerate delivery”.

The analysis of new lexical items is linked to a diachronic viewpoint since new words arise in a specific timespan related to a particular context. The temporal features for the creation of new items must consider: “1. The existing linguistic knowledge of speakers, 2. The cognitive processing involved in their perceptions and responses to given external and internal circumstances, 3. The online creation of new forms and meanings by speakers, and 4. The linguistic choices made by speakers” (Zawada, 2006, 242).

Furthermore, as highlighted by Newmark, new objects and processes are related to technology, and in the same way, new ideas and variations on feelings come from the media. He defined neologisms as “newly coined lexical units or existing lexical units that acquire a new sense” (Newmark, 1988, 140), and he suggested twelve types of neologisms divided into two groups. Existing lexical items with new senses in the form of words and collocations belong to the first group. Whereas, the second group includes new forms, such as new coinages; derived words (including blends) from pre-existing other words; abbreviations; new collocations (noun compounds or adjective plus nouns) which are particularly common in the social sciences and computer language; eponyms

that are any word derived from a proper name; phrasal words; transferred words (new and old referents), acronyms (new and old referents); pseudo-neologism defined as "a generic word that stands in for a specific word"; internationalisms.

Furthermore, Cabré (1999, p. 205) identified different criteria to assess whether a unit is a neologism or not. Therefore, she remarked that "a unit is a neologism if it has arisen recently, if it is not in dictionaries if it exhibits signs of formal instability (i.e., morphological, graphic, phonetic) or semantic instability, and if speakers perceive it as a new unit". According to the function of a neologism, she also classified them into referential or expressive, "referential neologisms develop because they are required, i.e., there is a gap in a specific special field that must be filled; expressive neologisms develop simply to introduce new forms of expression into the discourse" (Cabré, p. 206).

Janssen (2005)[11] defined neologisms following five criteria. The first criterion is the psychological one, "a neologism is a word that is perceived as new by the language community"; the second one is the lexicographic neologisms, i.e., "any word that does not appear in the dictionary is considered a neologism". The third criterion is based on the exclusive definition, "a word not appearing in a pre-determined exclusion lexicon is a neologism"; the fourth has a diachronic definition, "any word-form that appears in a recent general language text and was not previously part of that language is a neologism". The last criterion is related to reference corpora definition, which considers a neologism any word in a text that "does not appear in an established reference corpus" (Janssen 2005), thus the new word becomes part of the language system although it was not before.

According to Gerrig and Gibbs (1988), language users may employ lexical creativity for two main reasons. A first motivation could be the need to "express ideas that are

[11] http://maarten.janssenweb.net/Papers/neologisms.pdf

unavailable in the standardized repertory of meanings" (Gerrig & Gibbs, p. 3), intended as a pragmatic reason. A second type of motivation lies in social factors. Thus, since users face new kinds of situations, innovations may occur to achieve new communicative purposes. Also, Gupta (1992, p. 15) denoted creativity as a need to express either an "inner state" or an external goal or problem. This type of lexical creativity may be used to strengthen the sense of connectedness within a community.

Overall, neologisms related to ecology, which mostly appear in social networks, might have a significant impact on how people perceive climate change in particular, and the environment in general. The creation of new lexical items has an important role since it introduces new words and collocations that shed light on the general picture of current human life (Guslyakova et al., 2020). Therefore, the study of neologisms, and more broadly lexical creativity, depicts the current environmental situation, and might also unveil the reasons that lie behind this climate crisis. Consequently, new lexical items can provide solutions or suggest how to live and behave in a more climate-friendly way (Guslyakova et al., 2020). In addition, creativity is extremely relevant in persuasive discourse where the objective is not only to inform but also to change opinions (Gerrig & Gibbs, 1988). Thus, starting from the assumption that language is a human characteristic, and can be part of the solution to a problem, it is important to analyze how a general sentiment about climate change evolves through time, and whether it brings positive or negative ways of expressing actions, feelings or depicting behaviors.

By the end of the 20th century the sharp technological and scientific revolution, particularly in the Western world, raised the problem of environmental pollution and the negative human impact on natural resources on the planet. To different extents, all parts of the environment have experienced a change, and therefore new words and concepts inspired by this new context of climate change have appeared in languages to meet the

changing communicative needs of the speakers, particularly among those who started to protest against the destruction of Nature. For instance, words such as "ecology" and "environment" concerning anti-pollution activities and an ecological sense started being used at the end of the 1950s[12]. Today these words and many others are being used by climate activists, scientists, politicians, journalists, and economists and are actively introduced in social media discourse in several countries. Currently, social media have become very present in human life, and the discourse that arises from them reflects to some extent the state of society with its main problems, latest trends, new values, and climate change issues among others.

Despite not being climate-related studies, some scholars have analyzed Twitter data to investigate lexical creativity. For instance, a recent study carried out by Grieve et al. (2018), based on a multi-billion-word corpus of Tweets collected between 2013 and 2014, focused on mapping lexical innovations, and defining their origin and spread on American Twitter. Although the language used on Twitter is not representative of all lexical innovations in English, Twitter is still a vast and freely accessible source of geo-tagged and time-stamped language. Thus, they were able to identify five main regional patterns of lexical innovation, by means of corpus linguistics and manual filtration for the identification of new words using the *Merriam-Webster Dictionary* for reference.

More recently, Würschinger (2021) published a study based on a large Twitter dataset to investigate the sociolinguistic dynamics of the spread of neologisms on Twitter. The objective was to focus on three main aspects of the "temporal dynamics of diffusion: trends in usage intensity, age, and volatility". As a result, neologisms are likely to be created in specific communities, in this case, they are mostly associated with youth

[12] https://www.etymonline.com/

language and political discourse; hence, a neologism might not be used by speakers outside a given community. Furthermore, Al-Azzawi and Ali Haleem (2021) focused on neologisms on Twitter, in particular the forms of borrowing, word formation, and deviation, by analyzing hashtags related to COVID-19, highlighting the increased opportunity for tweeters to communicate and share neologisms within their community and also beyond.

Within the climate change domain, as a result of the analysis of these studies, little knowledge exists on language variation related to climate change, with a particular focus on language creativity. As language reflects actuality, but has also the power to shape, change and create new realities, this research focuses on the expressiveness of the language of tweets and on how language use differs according to different social groups.

Indeed, Twitter is a real-time conversation tool that allows tweeters to read, inform and comment on posts immediately, and share succinct texts, videos, photos, and links. Tweets can be quoted, in other words, a post can be retweeted, and a different user can add further information to it. In addition, hashtags enable to contextualize tweets allowing people and communities to follow topics they are interested in. Compared to messages on other social media platforms, tweets have specific features that make them unique. Firstly, the nature of Twitter is to build topic-based networks allowing users to discover new content, while Facebook is oriented toward the construction of networks among people. Secondly, another widely used social media is Instagram which primarily focuses on media content, while Twitter enables text posts, polls, and multilevel reply chains compared to the single-level reply chain of the former. As a result, emotions, reactions, and events expressed by users having recourse to new lexical items or semantic changes, play an important role in people's ecological literacy and environmental perception. Therefore, the informative content of tweets is presented in written texts that include key

concepts related to the environment, which translated into words, often become new lexical items. In relation to the field of climate change, the awareness of the lack of words to express new climate-related perceptions, feelings, and scenarios, and thus the need to create new ones, derives from what Mühlhäusler (2003) defines as a source of environmental awareness of lexical gaps.

In light of the above, I will attempt to detect and analyze lexical creativity within the corpus in order to study the period in which they arose, in what context they were created and who is the meaning maker. With this purpose, I decided to adopt the lexicographic definition of a neologism, i.e., "any word that does not appear in the dictionary is considered a neologism" (Janssen, 2005). Although dictionaries are stable and updated, they might be incomplete and not objective as expected. In fact, as emphasized by Curzan (2000, p. 96), "The apparent objectivity of dictionaries rests on an extensive series of subjective editorial decisions" which can be linked to the criteria set for the suitability of the acceptance of a new word or meaning, for example, the length of time that a word must have been in circulation.

Therefore, it is not my intention to provide definitions of new lexical units since, as emphasized by Stubbs (2001, p. 44), "meanings are essentially mental or psychological events, they take place inside people's brains or minds, and we have no idea how this works". Nevertheless, I will attempt to define the connotation of the new items in relation to the other words in the co-text, referring to three categories, i.e., positive, negative, and neutral. The meaning of a word is not determined by its literal meaning or word fort, but rather by the "quality of the contexts produced in the course of its use" (Jung, 2001, p. 280).

Lastly, I will endeavor to reconstruct the frames that might arise in the tweets which contain a new lexical item through the analysis of the discourse. Indeed, "with a microfocus on discourse", together with "a microanalysis of frames, namely of the mental schemata by which experience is interpreted", it is possible to recreate "the mental structures" of the analyzed stakeholders "from the bottom up, from the text to the frame" (Johnston, 1995, p. 219).

2.3.7 Framing new lexical items

Studies undertaken on climate change have seen the application of framing processes as a fundamental approach to understanding the conceptual dimensions of different types of stakeholders (Benford & Snow, 2000; Matthes & Kohring, 2008; Schäfer, 2012; Schäfer & O'Neill, 2017). Moreover, several framing theories in climate change communication have been elaborated with different approaches and backgrounds (Benford & Snow, 2000; Hulme, 2009; Jang & Hart, 2015; Nisbet, 2008; Painter et al., 2018; Schäfer & O'Neill, 2017; Taylor, 2000; Touri & Koteyko, 2015).

To frame means "to select some aspects of a perceived reality and make them more salient in a communicating text" (Entman, 1993, p. 52). Additionally, Entman suggested that framing facilitates "a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation" (Entman, p. 52). According to several scholars, framing analysis originates from the idea that phenomena are not perceived objectively and in the same way by all types of audiences. Correspondingly, Goffman (1974, p. 21) defined frames as "schemata of interpretation" which allow people "to locate, perceive, identify, and label" events about their lives. Additionally, framing is meant as the "communicative processes of sense-making" (Schäfer & O'Neill, 2017, p.

2) with the attempt to say the truth about a topic, while highlighting some features of reality and weakening some others; thus, it helps to define an issue and provide an interpretation of the message that is being conveyed (see also Benford & Snow, 2000; Entman, 1993; Gamson & Modigliani, 1989; Nisbet, 2009). Furthermore, framing has also been defined as "an unavoidable reality of the communication process, especially as applied to public affairs and policy" (Nisbet, 2009, p. 15). Consequently, understanding how frames are used is of paramount importance to assess how a part of reality is presented and prioritized according to the interpretation of the author. In fact, as pinpointed by Entman et al. (2009, p. 177):

> A frame *repeatedly invokes the same objects and traits, using identical or synonymous words and symbols in a series of similar communications that are concentrated in time. These frames function to promote an interpretation of a problematic situation or actor and (implicit or explicit) support of a desirable response, often along with a moral judgment that provides an emotional charge*.

A growing body of research has demonstrated how framing analysis in climate change communication can be carried out through different methods, such as discourse analysis (Boykoff, 2008; Fløttum et al., 2014; Plastina, 2020), by means of topic modeling (Chen et al., 2022) as well as corpus linguistic methods (Grundmann & Krishnamurthy, 2010; Koteyko et al., 2013; Touri & Koteyko, 2015; Willis, 2017). For instance, with a corpus linguistics-based approach, Grundmann and Krishnamurthy (2010) identified how climate change was framed in four different countries drawing on frequency lists. As a result, they distinguished three main frames, namely *science, political,* and *action* frames. Moreover, Willis (2017) aimed at framing how climate change is presented, and what is omitted from the discussions by UK politicians by means of collocations and keyword analyses. As a result of her finding, *economic and technical frames* prevailed, whereas

little discussion was dedicated to the *environment and non-human species*, *people* and *social groupings*, and *catastrophic climate events*. Additionally, Touri and Koteyko (2015) analyzed the most dominant frames in the press coverage of the Greek financial crisis through corpus linguistic techniques, with the analysis of keywords. Despite using a different methodology, i.e., an unsupervised topic model algorithm Latent Dirichlet Allocation, it is worth mentioning the contribution of Chen et al. (2022) to the field of the climate strike discourse framing on Twitter from 2018 to 2020. They identified two major frames and eight dominant themes, namely *Awareness* (Responsibility Attribution, Climate Consequences, Urgency) and *Action* (Policy Discussion, Youth Driven Climate Action, Political Action, Climate Justice, and Climate Solutions). On the other hand, Fløttum et al. (2014) investigated the main frames linked to the representations of the future employed in the blogosphere about climate change. By means of discourse analysis, they reconstructed the presence of two main frames, *bright future,* and g*loom and doom future*. Similarly, Plastina (2020) studied how climate change is framed from a social-ecological resilience discourse, highlighting positive opportunities from climate emergency. In her research, she shed light on the construction of different action frames that provide new meanings of resilience, which widely differ from other climate discourses, such as *biodiversity alternative*.

Therefore, these studies highlight the importance of frames which can help to define an issue, identify who or what might be responsible, and what can or should be done (Nisbet, 2008). The frames analyzed in the present work are based on a deductive approach for the identification of mental structures that may help to interpret whether the authors try to shape beliefs and behaviors or mobilize action.

The following chapter illustrates the methodology adopted in this research study and the data selected for the analysis.

Chapter three

Methodology and Data Description

3.1 Research Aims

As described in chapter two, a growing body of research has focused on climate change communication. However, relatively little research has investigated linguistic variation in environmental discourses and its influence on the emergence of new words. This dissertation is an attempt to carry out a comparative, long-term study, involving different types of stakeholders from the U.S. and Europe. Specifically, it aims at the analysis of language variation in discourse use in relation to climate change in social-networking - based communication on Twitter. In particular, the research questions which prompted this study are:

RQ1. To what extent does language change according to the different users?

> **H1.** Collocations related to climate change are more typical in NGOs, social movements, news sites, and activists.
>
> **H2.** Lexical creativity related to climate change is more frequent among social movements, NGOs, news sites, and activists.

RQ2. To what extent does language vary from 2015 to 2020?

> **H3.** The number of messages about climate increases throughout time among all author types.
>
> **H4.** New lexical items have a stronger negative meaning throughout time.

RQ3. Are there any differences in terms of language use between the United States and the European Union?

H5. The European Union has had a more stable and coherent concern about climate change throughout time, compared to the United States.

The following sections will provide a detailed explanation of the research methodology adopted in this study.

3.2 Building a climate-related corpus

This research is based on the analysis of a specialized corpus created with climate-related texts in English retrieved from the social media platform Twitter. Therefore, a series of filtration steps were performed on the original dataset in order to obtain the final corpus, as described hereunder.

The first procedure implied the criteria of data collection based on specific Twitter users and the time of publication. Tweets were automatically collected following the Cougnon et al. (2022) methodology, using Twint, an advanced Twitter scraping tool written in Python that allows for scraping tweets from Twitter profiles without using Twitter's API, and consequently with no restrictions[13]. In fact, this scraping tool provides open access for the collection of Tweets from specific users, with no time limit, and the searched data represent active accounts run by real people. For this study, all tweets were retrieved with metadata related to authors' screen name, time of publication, hashtags, mentions, URLs, and the different languages the tweets are written in. However, all tweets related to former president Trump were downloaded from www.thetrumparchive.com since the @realDonaldTrump account was permanently suspended on 8th January 2021. Moreover, retweets were excluded since they were not relevant to the research aims.

[13] https://github.com/twintproject/twint

For the purpose of investigating the development and change of language use, a diachronic corpus was created. This is a corpus built with the aim of being representative of a language over a particular period of time in order to track linguistic changes within it (Baker, 2006). In addition, not only the meaning of words may change over time, but they might also present different connotations for different people. For this research, the selected time frame goes from 2015 to 2020. To the best of my knowledge, no other research encompasses such length of time, in terms of duration and recentness.

A further specialized criterion for this corpus creation refers to place. Indeed, Twitter enables users to indicate their location for each tweet, specifying longitude and latitude. However, since it is an optional feature, as pointed out by Gaffney and Puschmann (2013), approximately 1% of tweets are "geo-tagged". For the purposes of this study, geolocation metadata retrievable directly when scraping tweets were ignored. Notably, this source of data is particularly useful when investigating and comparing public perception (Abbar et al., 2016; Jang & Hart, 2015), or when relating climate change discourse to spatial patterns of climate change messaging, i.e., in relation to climate disasters (Kirilenko et al., 2015; Kryvasheyeu et al., 2015). In the case of this study, all tweets were manually annotated considering the origin of each actor, based on the "home" location specified in their public profile. This geographical label, i.e., EU, U.S., or International for the accounts which specified their location as "global" or "Earth", provides a clear distinction of their provenance and helps to better understand whether they mostly act in Europe, in the United States or on an international level. Most importantly, it allows to compare language use among these stakeholders and define whether social and cultural factors affect discourse.

The tweets were collected from sixty-three users, divided into specific groups, labeled as "author type", such as climate activists, news companies, NGOs, institutional

organizations, politicians, and social movements. Specifically, the corpus consists of eight climate activists, four from the USA and four from Europe; two news companies, a European and an international one; four NGOs, a European one and three international ones; nine governmental organizations, five from Europe and three from the U.S.; eighteen European politicians and eighteen from the U.S.; and five social movements, one from Europe, two international ones and two from the U.S.

Moreover, this research follows the nonrandom sampling schemes (Patton, 1990; Miles & Huberman, 1994; Onwuegbuzie & Leech, 2007). Sampling is defined as "a finite part of a statistical population whose properties are studied to gain information about the whole" (Merriam-Webster dictionary). Indeed, this stage is "an important step in the research process because it helps to inform the quality of inferences made by the researcher that stem from the underlying findings" (Onwuegbuzie & Collins, 2007, p. 281). Specifically, I used purposive sampling, thus, the primary criteria in the selection of the population are of paramount importance in relation to the goals of this research (Andrade, 2021). As pointed out by Onwuegbuzie and Collins (2007, p. 287), "if the goal is not to generalize to a population but to obtain insights into a phenomenon, individuals, or events [….], then the researcher purposefully selects individuals, groups, and settings for this phase that maximize understanding of the underlying phenomenon.". The sample was stratified with different attributes, i.e., author type and origin. The division of the population in groups, taking into consideration the context which may affect the meaning of discourse, is important to understand in depth the studied phenomenon (Onwuegbuzie & Leech, 2007). My research fits in what Stake (2000) defined as collective case studies. Indeed, case studies enable to investigate a phenomenon within set boundaries of time and space based on some cases with the intent to analyze a phenomenon, population or general condition, and when multiple cases are involved, "nothing is more important than

making a proper selection of cases" (Stake, 2000, p. 446). Therefore, the population was defined and divided in groups *a priori*; as underlined by Biber (1993, p. 244) "stratified samples are almost always more representative than non-stratified samples". The preestablished groups include activists, social movements, NGOs, news sites, politicians and organizations, and the main goal is to discover discourse use related to climate change among these groups identified as leading spokespeople about climate or acknowledged as those who have the power and duty to act. All accounts were selected according to their popularity within the European and U.S. contexts. Information related to the single stakeholders can be found in Appendix 1.

Overall, 372,719 tweets were collected in the time frame from 2015 to 2020. Specifically, table 3.1 shows the number of tweets collected from each user:

Authors sorted by type and origin	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Activists	**29**	**92**	**122**	**998**	**4278**	**2565**	**8084**
EU		45	33	486	2055	1755	4374
Adélaïde Charlier					12	92	104
Anuna De Wever					61	51	112
Greta Thunberg				358	863	524	1745
Luisa Neubauer		45	33	128	1119	1088	2413
US	29	47	89	512	2223	810	3710
Jerome Foster II			70	476	1893	589	3028
Varshini Prakash						27	27
Vic J. Barrett	29	47	19	36	65	47	243
Xiye Bastida					265	147	412
NEWS	**13428**	**11489**	**9597**	**7322**	**6205**	**6536**	**54577**
EU	7618	6027	4827	3866	3386	3163	28887
Guardian Environment	7618	6027	4827	3866	3386	3163	28887
INT	5810	5462	4770	3456	2819	3373	25690
EcoWatch	5810	5462	4770	3456	2819	3373	25690
NGOS	**7275**	**6338**	**5549**	**5459**	**5338**	**4856**	**34815**
EU	1018	1292	1133	1196	992	908	6539
EEB	1018	1292	1133	1196	992	908	6539
INT	6257	5046	4416	4263	4346	3948	28276
Climate Action Network Int (CAN)	751	374	369	526	823	679	3522
Greenpeace	5506	4672	4047	3737	3523	3269	24754
Organizations	**7055**	**7388**	**7504**	**7443**	**7576**	**7024**	**43990**
EU	2272	2152	2908	3022	2737	2491	15582

ENVI Committee Press	223	223	212	202	144	246	1250
EU Climate Action	425	335	345	469	407	345	2326
EU Environment	421	609	812	938	708	598	4086
Greens/EFA	486	510	806	653	667	722	3844
IPCC	717	475	733	760	811	580	4076
US	4783	5236	4596	4421	4839	4533	28408
NOAA	618	477	520	438	331	244	2628
The Nature Conservancy	1145	2032	1960	1870	2041	1881	10929
U.S. Department of Energy	1517	1877	1435	1620	1873	1352	9674
U.S. EPA	1503	850	681	493	594	1056	5177
Politicians	**24016**	**25469**	**20700**	**22284**	**25594**	**33775**	**151838**
EU	4994	4134	5033	5405	5488	8094	33148
Adina Valean	58	60	35	7	39	210	409
Andreea Strachinescu	319	316	594	610	507	275	2621
Antonio Guterres			222	559	525	881	2187
Catharina Sikow Magny	130	428	522	379	333	65	1857
Charles Michel	821	717	474	345	360	561	3278
David Sassoli			9	1	274	499	783
Ditte Juul Jorgensen						41	41
Frans Timmermans	912	450	443	273	500	240	2818
Jean Lambert	291	165	244	194	307	282	1483
Kadri Simson	57	40	22	10	54	492	675
Mairead McGuinness	386	475	536	578	514	320	2809
Margaritis Schinas	210	285	334	308	242	341	1720
Mariya Gabriel	450	396	527	935	545	1229	4082
Miguel Arias Cañete	568	158	147	228	108		1209
Stella Kyriakides	102	100	37	93	171	578	1081
Ursula von der Leyen					165	960	1125
Valdis Dombrovskis	631	478	751	782	714	698	4054
Virginijus Sinkevičius	59	66	136	103	130	422	916
US	19022	21335	15667	16879	20106	25681	118690
Al Gore	246	233	303	202	152	110	1246
Alexandria Ocasio-Cortez	2	3	1365	2810	1812	1442	7434
Barack Obama	1273	865	59	78	136	322	2733
Bernie Sanders	2555	3444	426	745	3041	2391	12602
Deb Haaland	141	601	1617	1648	642	1961	6610
Donald Trump	7536	4037	2292	3104	4805	6121	27895
Ed Markey	1369	1248	2093	1545	1333	1165	8753
Andrew Wheeler				65	130	365	560
Gina McCarthy	554	430	11				995
Hillary Clinton	2168	5101	204	501	540	771	9285
Jennifer Granholm	510	2083	2297	1802	1652	1587	9931
Joe Biden	11	109	147	125	1775	3183	5350
John Kerry	576	547	116	119	92	140	1590
Michael S. Regan	6	104	247	477	568	332	1734
Mike Pence	622	1058	122	251	256	2013	4322

Nancy Pelosi	540	481	1602	1076	1215	1067	5981
Rep. Frank Pallone	913	991	2115	2033	1862	2711	10625
Scott Pruitt			651	298	95		1044
Social movements	**14276**	**13091**	**13813**	**11872**	**16425**	**9938**	**79415**
EU	904	645	1580	464	1403	968	5964
350.org Europe	904	645	1580	464	1403	968	5964
INT				1816	6582	2876	11274
Extinction Rebellion				1721	6180	2400	10301
Fridays For Future				95	402	476	973
US	13372	12446	12233	9592	8440	6094	62177
Climate Reality	12036	10036	10069	8169	7835	5710	53855
Earth Guardians	1336	2410	2164	1423	605	384	8322
Total	**66079**	**63867**	**57285**	**55378**	**65416**	**64694**	**372719**

Table 3. 1: Number of tweets per authors (in raw numbers)

In particular, 94,495 tweets come from European users, 213,144 from Americans, and 65,241 from international ones as illustrated in Figure 3.1 below.

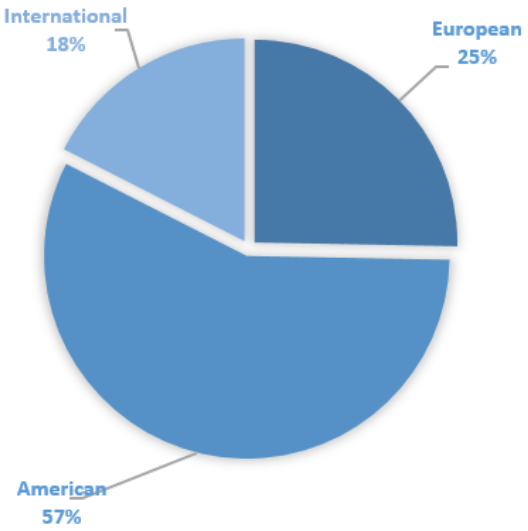


Figure 3.1: Distribution of tweets by origin in percentages

Since this study investigates English language variation, the tweets were filtered by language. As a result, the corpus includes 86,472 tweets in English from the EU, 208,998 from the U.S. and 64,484 from international authors, for a total of 359,954 tweets. Moreover, the following section outlines a further step to the corpus filtration through keyword lists.

3.3 Corpus filtration with climate-related words

The aim of this research is to approach the study of the language within a determined context and, in line with the scientific method. Thus, the filtration of tweets was instrumental in creating a more climate-related corpus, representing the relevant set of data to possibly validate or reject the hypotheses and answer the research questions. Indeed, as pointed out by McEnery (2006), the creation of a "problem-oriented corpus" might involve the extraction of data from a larger corpus. Therefore, the final specialized corpus is the result of a text collection gathered according to specific criteria. Baker (2006, p. 29) suggests that "when building a specialized corpus for the purposes of investigating a particular subject, a selective choice of texts might take place, resulting in giving equal or more precedence to quality or content of data over issues of quantity".

Specifically, the study carries out a keyword analysis as it is believed that a keyword list provides a measure of saliency (Baker, 2006). This process was implemented through the analysis of keywords of four specific authors within the corpus, i.e., Eco Watch, Greenpeace, Guardian Environment, Extinction Rebellion, therefore, two environmental news companies, an NGO, and an international social movement. These author types were chosen since their tweets deal particularly with climate-related content only, attention is paid to main events around the world and therefore have been considered representative to the study with no need to apply further filtration.

The keyword list was obtained through Sketch Engine. Sketch Engine is a leading online corpus analysis service with a range of highly flexible functions to build and analyze corpora. It is a set of software tools for corpus analysis developed by Lexical Computing Ltd. The system was created by a British lexicographer and corpus linguist, Adam

Kilgarriff, and a Czech programmer, Pavel Rychlý. It provides common statistical methods to produce frequency statistics, calculate co-occurrence patterns, visualize contrasts and to explore user and multilingual corpora (Kilgarriff et al., 2014).

Keywords were extracted using the Keywords & Terms tool in Sketch Engine. These are words (single-token items) that appear more frequently in the focus corpus than in the reference corpus and can be used to identify what is specific to one corpus (focus corpus) in comparison with another one (reference corpus), which represents the general language. Hence, they are useful to define and understand the main topic of the corpus acting as a benchmark of what is "normal" language (Baker, 2006, p. 43). Sketch Engine combines statistics with linguistic criteria to extract keywords and terms. Typically, the largest corpus in the language used is preselected as the reference corpus. Although it is possible to set a different corpus as the reference corpus, I decided to carry out the analysis with the one selected by the software, that is English Web 2020 (enTenTen20), due to its characteristics. Indeed, the enTenTen corpus version used is an English corpus made up of texts collected from the Internet and consists of 38 billion words extracted from texts downloaded between 2019 and 2021. It belongs to the TenTen corpus family, i.e., a set of text corpora generated from the Web detected through a technology able to collect linguistically valuable web content. The name TenTen refers to the target corpus size 10+ billion words per language (Jakubíček et al., 2013).

As a result, 1,000 words were extracted and ranked based on the document frequency, i.e., the number of documents in which the word or phrase appears in the focus corpus. Subsequently, the items were manually cleaned. Firstly, proper names, group names, animals and words in other languages were discarded. Secondly, the main corpus was filtered, i.e., one tweet at a time in *Excel*, by using climate-related words with absolute frequencies of at least 50, based on the number of occurrences in the subcorpus and a

minimum keyness score of 5 calculated using the simple math method in Sketch Engine – a high score expresses the domain of the focus corpus. This choice was based on the aim of creating a balanced list taking into consideration both document frequency and score. As highlighted by Baker (2006), the choice of cut-off points in the analysis of corpora may represent a major issue in CL. Currently, no formulae are available to establish the most suitable balance between "saliency and quantity in terms of cut-off points" (Baker, 2006, p. 179). Subsequently, as illustrated in table 3.2, a total of 93 keywords were employed, resulting in 163,753 tweets.

	Item	**Frequency**	**Score**
1	climate	11075	72,4
2	oil	2836	10,939
3	planet	2497	26,457
4	crisis	2245	20,377
5	fuel	2190	16,087
6	plastic	2017	22,731
7	fossil	1910	66,568
8	ecological	1761	76,746
9	ocean	1722	18,977
10	coal	1652	35,003
11	forest	1632	11,935
12	pollution	1584	43,286
13	green	1510	5,894
14	extinction	1414	110,149

15	emergency	1388	11,978
16	emission	1359	20,983
17	earth	1261	6,251
18	renewable	1257	34,468
19	environmental	1176	6,991
20	solar	1147	13,091
21	clean	1142	5,641
22	waste	1043	8,216
23	wildlife	1003	17,551
24	carbon	1003	12,474
25	pipeline	937	25,724
26	inaction	858	182,638
27	reef	762	31,446
28	fracking	752	118,535
29	indigenous	716	15,923
30	nuclear	688	6,829
31	flood	668	10,818
32	warming	630	22,909
33	toxic	628	22,311
34	specie	563	5,28
35	meat	521	8,064
36	drilling	514	28,634
37	sustainable	449	5,814
38	drought	424	20,761

39	endangered	414	33,382
40	species	410	5,748
41	marine	398	5,195
42	coral	394	17,344
43	melt	380	12,855
44	deforestation	373	65,644
45	mining	360	7,319
46	biodiversity	337	20,385
47	pesticide	314	17,844
48	rainforest	304	31,002
49	wildfire	288	29,866
50	denier	274	70,981
51	pollute	264	37,361
52	hurricane	262	7,601
53	ecosystem	261	6,955
54	greenhouse	258	10,712
55	denial	254	12,607
56	drill	238	5,879
57	glacier	233	14,597
58	co2	225	9,243
59	polluter	224	71,004
60	dump	220	6,745
61	flooding	215	14,478
62	bushfire	194	49,032

63	renewables	193	69,9
64	heatwave	193	66,503
65	single-use	188	53,605
66	recycle	181	9,545
67	bleach	160	17,479
68	recycling	152	7,035
69	extinct	150	15,931
70	methane	149	15,375
71	plant-based	138	28,622
72	poison	132	5,356
73	polluted	131	27,083
74	coalmine	126	65,776
75	smog	126	33,383
76	glyphosate	116	31,767
77	vegan	116	7,745
78	ecocidal	114	66,031
79	conservationist	113	28,546
80	footprint	106	5,635
81	environmentalist	104	14,792
82	endanger	98	9,151
83	solar-powered	92	34,682
84	microplastic	91	37,563
85	ecocide	81	43,772
86	radioactive	79	6,961

87	eco-friendly	70	11,117
88	reusable	68	9,715
89	landfill	63	6,004
90	plastic-free	61	32,692
91	permafrost	61	15,727
92	microbead	55	28,375
93	low-carbon	51	14,43

Table 3. 2: Keywords ranked by frequency

Overall, as can be seen in table 3.2, non-renewable resources show high frequency and saliency in the focus corpus - *oil, fuel, fossil, coal, carbon, nuclear*. These items suggest major attention on climate change causes. Accordingly, most keywords refer to disasters and human impact thus highlighting the negative consequences of climate change, such as *extinction, waste, deforestation, pesticide, wildfire, greenhouse, flooding, heatwave, footprint, microplastic, pollution, inaction, fracking, drilling, CO2, bleach, recycling, landfill*. In addition, part of the items refers to people, such as *indigenous, denier, polluter, environmentalist,* and presumably allude to the main actors, who, according to the specific context, might be interpreted as "victims" or "perpetrators". By analogy, other keywords relate to natural elements and the environment, e.g., *planet, ocean, forest, earth, wildlife, reef, species, ecosystem,* which may be considered as the vulnerable target of climate change. However, other items, specifically adjectives, seem to put forward possible solutions – *ecological, green, renewable, solar, clean, sustainable, reusable, plastic-free, low-carbon.*

Considering the variables of origin and time, figure 3.2 and table 3.3 show a general picture of the results obtained through a pivot table in *Excel*:

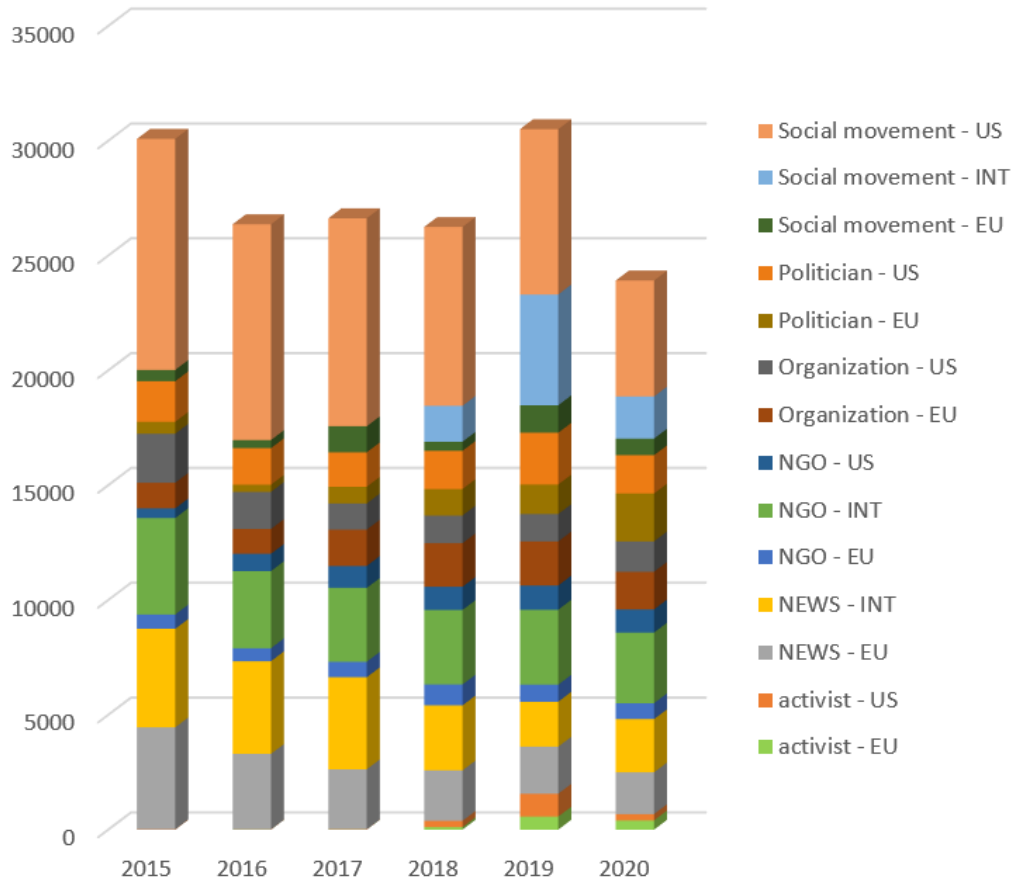


Figure 3.2: Number of tweets per author type through years

Indeed, table 3.3 displays detailed information of the number of tweets per author type from 2015 to 2020.

Years	Social movements	Politicians	Organizations	NGOs	NEWS	Activists	Total
2015	10559	2282	3256	5243	8731	16	**30087**
2016	9749	1909	2696	4679	7324	11	**26368**
2017	10191	2228	2724	4849	6618	17	**26627**
2018	9747	2820	3103	5166	5024	388	**26248**
2019	13218	3541	3113	5063	4004	1567	**30506**
2020	7609	3752	2962	4779	4135	680	**23917**
Total	**61073**	**16532**	**17854**	**29779**	**35836**	**2679**	**163753**

Table 3. 3: Number of tweets per author type through years

As illustrated in table 3.3, overall, the year which counts the greatest number of tweets related to climate is 2019, probably due to a global climate strike across 4,500 locations in 150 countries in September which received a great deal of media attention, followed by the 2019 Climate Summit in New York and the unprecedented wildfires across the Amazon rainforest. Whereas the least tweeted year is 2020. As pointed out by Loureiro and Alló (2021), COVID-19 pandemic sharply decreased the number of climate related tweets.

Social movements are the most active users with 61,073 tweets in the considered time frame. The most tweeted year is 2019, while the least tweeted one is 2020. News companies followed with 35,836 tweets, the most tweets in 2015 and the least in 2020. With 29,779 tweets total, NGOs represent the third most prolific group of users. The most effective year was 2015, while the least was 2016. Overall, 23,050 tweets were posted by organizations, primarily in 2019, but a smaller number in 2016. Among politicians, 16,532 tweets were posted, ranking them as the second least active tweeters. Accordingly, 2020 was the most prolific year, while 2017 was the most ineffective one. The least productive group is the activist community. Because of the more active status in 2018, and the most prolific year in 2019; 2015, 2016, and 2017 may not be relevant.

In addition, from figure 3.3 and table 3.4, it is easily understandable how U.S. stakeholders are leading the trend, followed by international users. Occurrences may vary under the impact of political leaders who presumably dictate the trend. Indeed, in 2015 there was a strong involvement with the Paris agreement. However, from the following year, during the Trump era, in the U.S. the issue was possibly silenced, as climate change denialism ruled. Thus, a rising urge to take action to fight the climate crisis stands out.

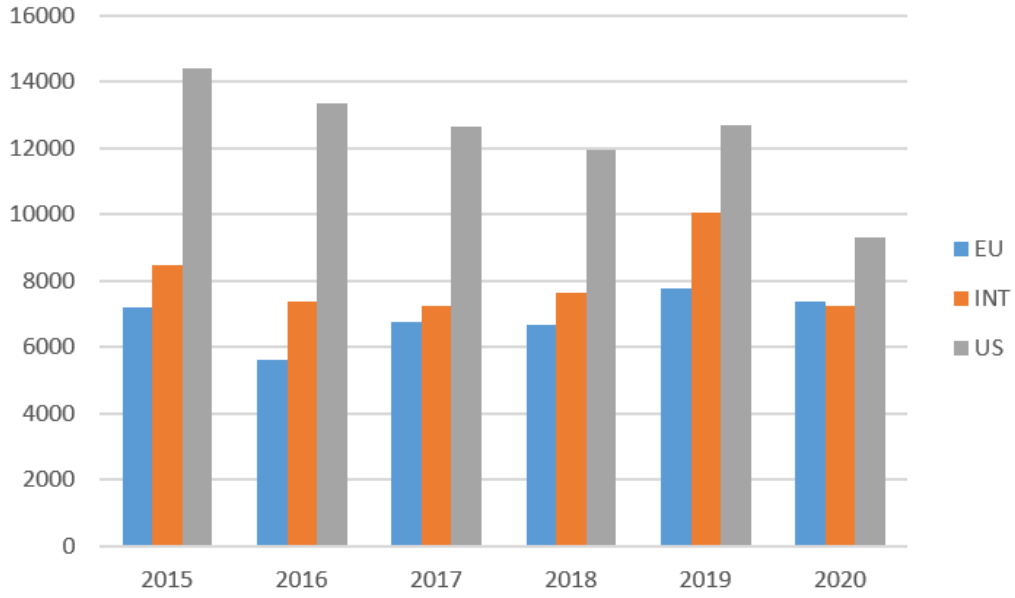


Figure 3.3: Tweets related to climate from 2015 to 2020 distributed according to the origin (in raw numbers)

Indeed, table 3.4 provides clear numbers of tweets according to the origin. Tweets from the United States are the most numerous with a total of 74,392, in particular in 2015.

Years	**EU**	**INT**	**US**	**Total**
2015	7188	8495	14404	**30087**
2016	5612	7393	13363	**26368**
2017	6746	7222	12659	**26627**
2018	6670	7640	11938	**26248**
2019	7764	10044	12698	**30506**
2020	7358	7229	9330	**23917**
Total	**41338**	**48023**	**74392**	**163753**

Table 3. 4: Number of tweets per year by origin (in raw numbers)

A detailed analysis of the number of tweets per each author is illustrated in the following section.

3.4 Tweets per stakeholder

Overall, as shown in table 3.3 (tweets per year per group), the six author types can be ranked from the most to the least active ones as follows: social movements, news, NGOs, organizations, politicians, and activists.

As reported in figure 3.4, among the social movements, the European 350.org Europe and the two Americans Climate Reality and Earth Guardians have been active since 2015. The two international ones, Extinction Rebellion and Fridays for Future, were established in 2018 and thus stared tweeting that year. The American Climate Reality is the one with the highest number of tweets, 44,633. The most tweeted year was 2015 and the trend steadily decreased until 2020. The second most active account is the international one of Extinction Rebellion which posted 7,725 tweets in only three years, with a peak in 2019. The third most active social movement is 350.org Europe with 4,296 tweets, only 1,196 in 2019. The American Earth Guardians posted 3,921 tweets in total with the highest peak in 2017 with 1,082 tweets. The international Fridays for Future posted 498 tweets in three years, 2020 was the most active year. As shown in figure 3.4, the year with the highest number of tweets is 2019 which "was the year of climate action!" (Climate Reality 30.12.2019). In addition, most tweets denounce extreme weather events and call to action.

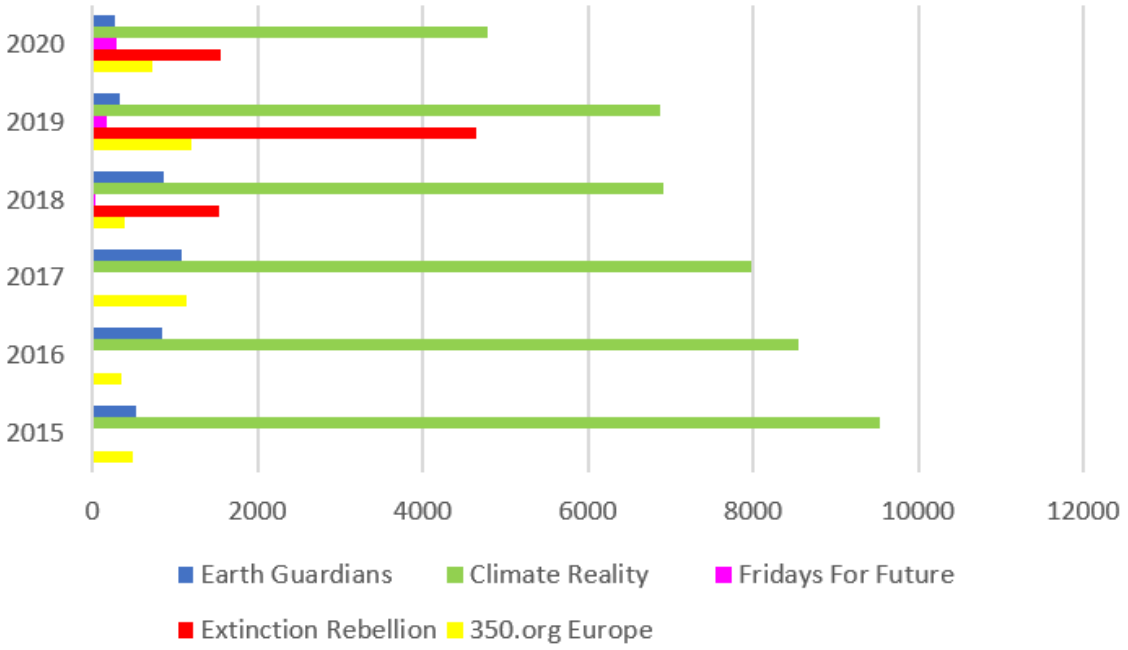
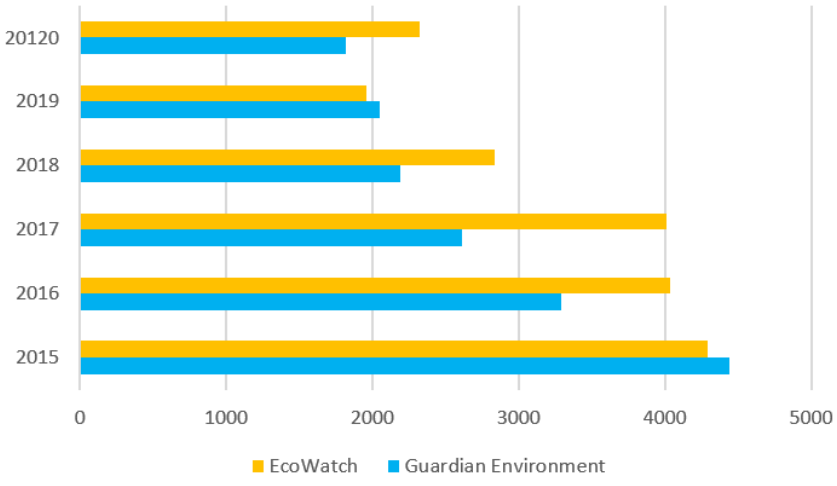


Figure 3.4: Number of tweets by Social Movements per year[14]

As for news companies, with only two accounts as illustrated in figure 3.5, this group is the second most productive one. It includes two accounts: the European Guardian Environment and the international EcoWatch. Both posted in the considered time frame, EcoWatch has a total of 19,438 posts, whereas Guardian Environment has 16,398. In both cases 2015 is the most tweeted year and the most frequent topics were the Paris agreement, fracking bans, and investments in renewable energy.



[14] Detailed figures are reported in Appendix 2.

Figure 3.5: Number of tweets by news companies per year[15]

Moreover, the four selected NGOs are one from Europe, the European Environmental Bureau (EEB), one from the U.S., The Nature Conservancy, and two international, Climate Action Network International and Greenpeace. As reported in figure 3.6, the latter is the one with the highest number of tweets, 17,625, with a hit in 2015, followed by The Nature Conservancy with 5196 tweets, then EEB and Climate Action Network International with 4,221 and 2,737 tweets, respectively. Overall, there is a constant number of tweets over the years, however the one with the highest number is 2015. The most covered topics are related to pollution and deforestation and COP25, as well.

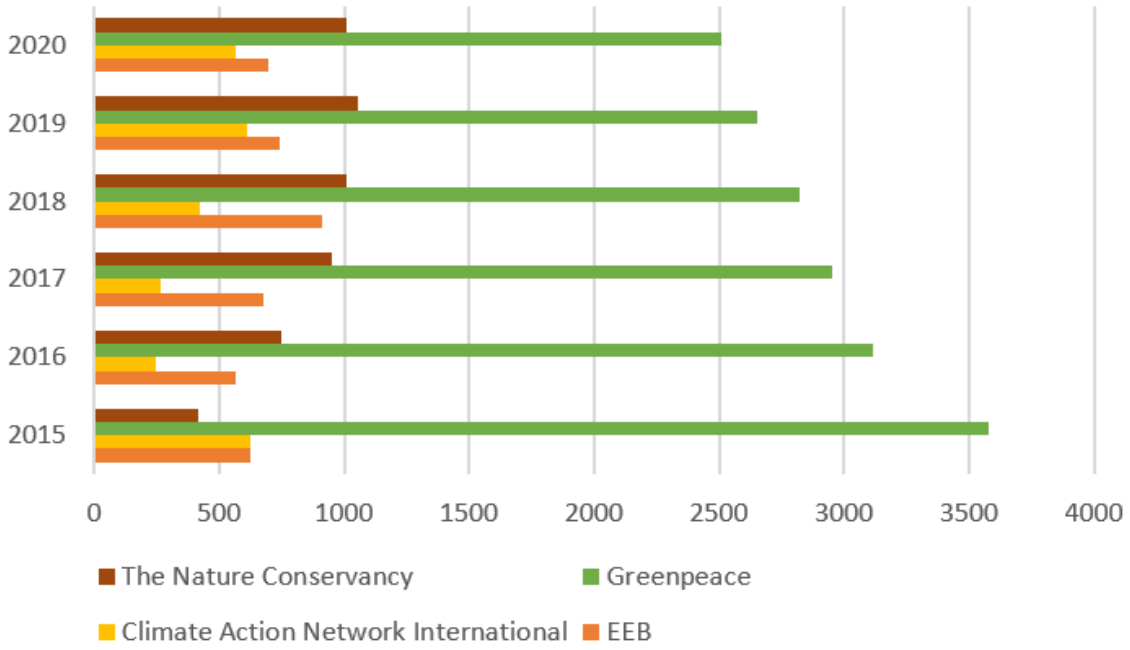


Figure 3.6: Number of tweets by NGOs per year[16]

Organizations are either European or American and the former have the highest number of posts also due to the fact that there are two more organizations in the European group.

[15] Detailed figures are reported in Appendix 2.
[16] Detailed figures are reported in Appendix 2.

In general, as shown in figure 3.7, the number of tweets is well balanced over the years. Among the American accounts, the U.S. Department of Energy is the most active one with 5,196 tweets, then the U.S. Environmental Protection Agency with 3,740 tweets, and the National Oceanic and Atmospheric Administration (NOAA) with 1,949. Whereas, for the European organizations, EU Environment leads the trend with 2,901 tweets, the IPCC with 2,672, EU Climate Action with 1,798, Greens/ European Free Alliance (Greens/EFA) with 1,275, and finally ENVI Committee Press with 5,94 tweets.

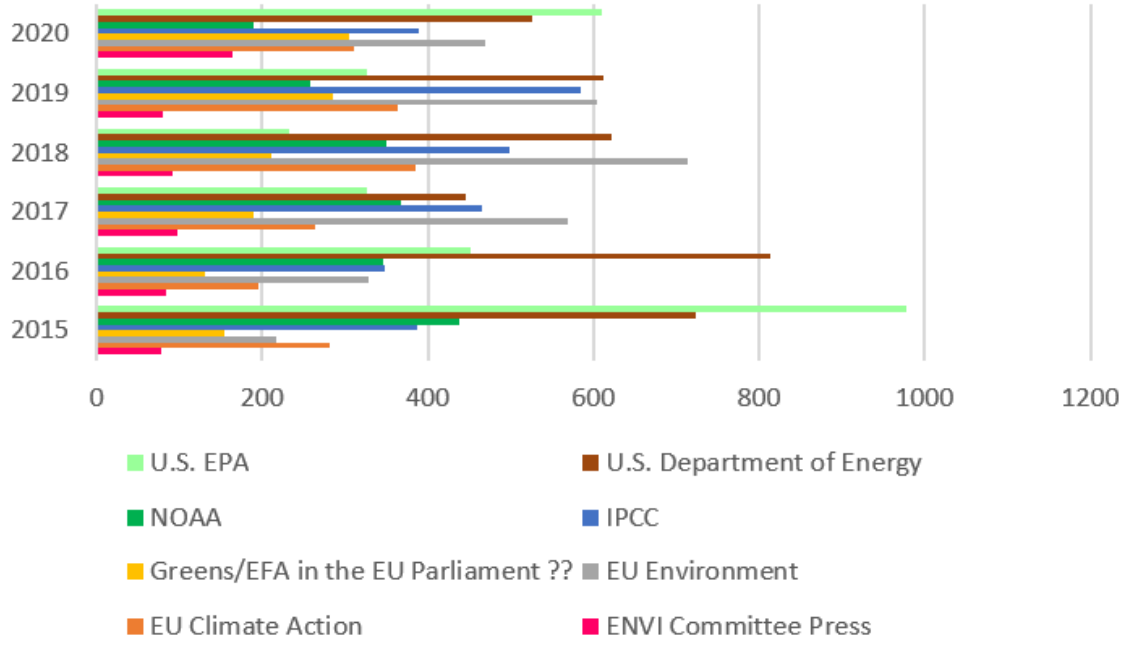


Figure 3.7: Number of tweets by organizations per year[17]

Starting with the European Politicians, they all became more active users in 2020 posting a total of 6,086 tweets, as shown in figure 3.8. Andreea Strachinescu, Head of Unit New Energy Technologies and Innovation in the Directorate General for Energy, is the user with the highest number of climate-related tweets, active since 2015 with a peak in 2018 with 342 tweets. She is followed by Miguel Arias Cañete, former European Commissioner for Energy and Climate Action until 2019, with 644 tweets. In fact, he was

[17] Detailed figures are reported in Appendix 2.

an active user from 2015 to 2019. Antonio Guterres, former president of the European Council and current Secretary General of the United Nations, follows with one tweet less, 643, from 2017 to 2020. Catharina Sikow Magny, Valdis Dombrovskis, Frans Timmermans posted 488, 477, 430 tweets, respectively, from 2015 to 2020. Virginijus Sinkevicius posted 416 tweets, only one in 2015 and none in 2016. Kadri Simson was an active user in the last two years with 343 tweets in total. Mariya Gabriel, Jean Lambert and Mairead McGuinness posted 321, 299 and 278 tweets, respectively. All the others tweeted less than two hundred times, including Charles Michel, current President of the European Council, and Ursula von der Leyen, current President of the European Commission.

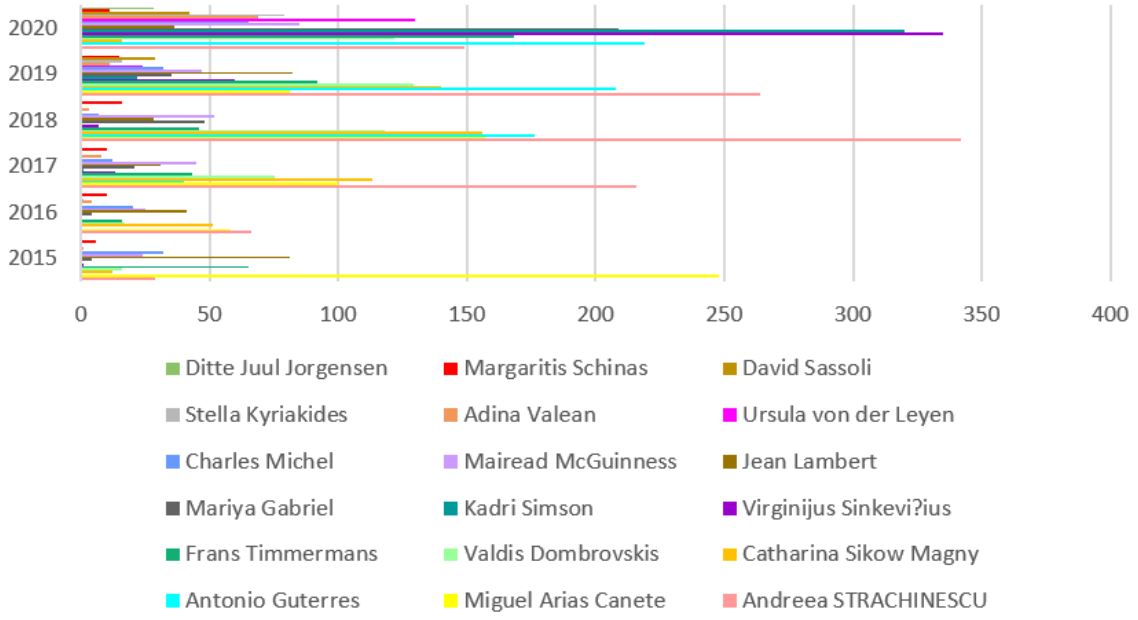


Figure 3.8: Number of tweets by European politicians per year[18]

As for the U.S. politicians, the number of tweets is higher compared to the Europeans as shown in figure 3.9. Ed Markey is US Senator for Massachusetts and chair of Subcommittees on Clean Air, Climate & Nuclear Safety, is the most active user among

[18] Detailed figures are reported in Appendix 2.

American politicians in this domain with 2,154 tweets. He is followed by Frank Pallone, chair of the House Energy and Commerce Committee, with 1459 posts. American politician and activist Bernie Sanders follows with 925 tweets, and then politician and environmentalist Al Gore with 819. Michael S. Regan, current administrator of the Environmental Protection Agency, posted 796 tweets, while Gina McCarthy, former administrator of the EPA, posted 659 tweets from 2015 to 2017. Alexandria Ocasio-Cortez and Deb Haaland tweeted 464 and 455 times, respectively. Donald Trump posted 408 tweets related to climate change, whereas Barack Obama 380. Jennifer Granholm, U.S. secretary of energy, is author of 318 posts, and Andrew Wheeler, former EPA administrator, 311 from 2018 to 2020. President Joe Biden started posting in 2016, but actively in 2019 with a total of 290 tweets. In the six-year time, Hilary Clinton tweeted 270 times, followed by John Kerry, current United States special presidential envoy for climate, with 256 tweets. Nancy Pelosi, Speaker of the United States House of Representatives, has 200 tweets, and Scott Pruitt, also former EPA administrator, tweeted 197 times from 2017 to 2019. Mike Pence, former vice president of the U.S., tweeted only 85 times with reference to climate change.

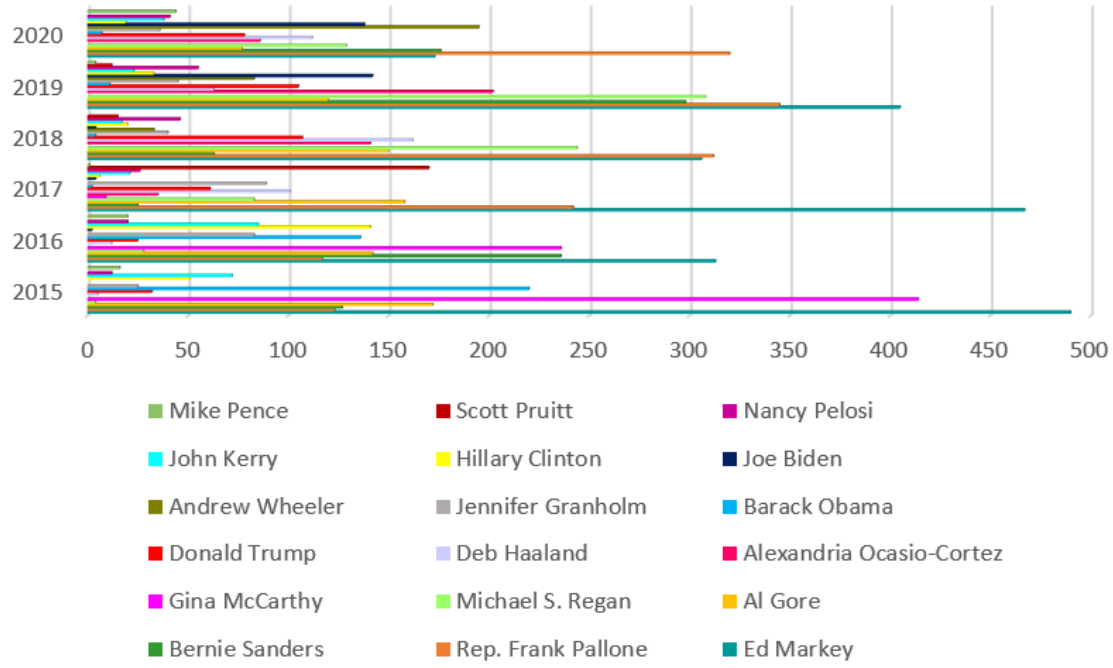


Figure 3.9: Number of tweets by American politicians per year[19]

Eight activists' tweets were analyzed, four from Europe and four from the United States. American activists posted 1582 tweets in total, while the European ones 1097, as illustrated in figure 3.10. In Europe Greta Thunberg, the Swedish climate activist, tweeted 897 times from 2018 to 2020, followed by German Luisa Neubauer with 141 tweets, although the latter started being active in 2016. Belgian Anuna De Wever Van der Heyden and Adélaïde Charlier posted 33 and 26 tweets respectively, from 2019 to 2020.

As for the U.S. activists, Jerome Foster II, who currently is serving on the White House Environmental Justice Advisory Council, is the most active user with 1,292 tweets since 2017. Xiye Bastida, a Mexican-Chilean climate activist, posted 221 tweets between 2019 and 2020. Honduran American Vic J. Barrett tweeted 55 times and American Varshini Prakash only 14 times in 2020.

[19] Detailed figures are reported in Appendix 2.

Generally, most tweeters started being active in 2018 mostly due to their age. The highest number of tweets occurred in 2019, that is when school strikes for climate began to take place all over the world. In addition, the UN Climate Summit in New York was held in September 2019 with Greta Thunberg's participation.

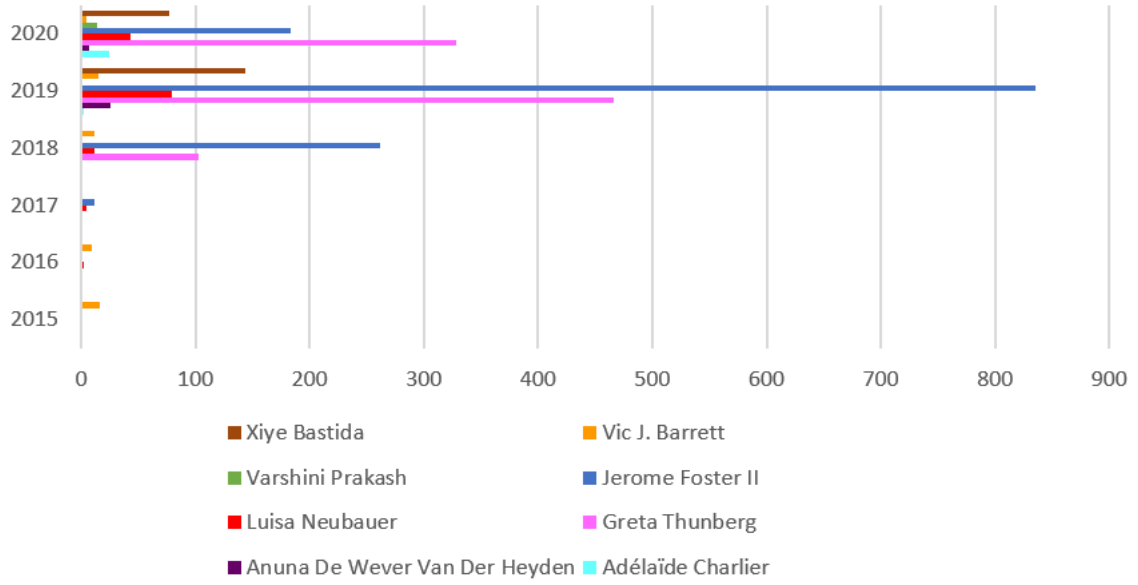


Figure 3.10: Number of tweets by activists per year[20]

3.5 Hashtags

Most social media platforms, especially Twitter, include the use of hashtags within the message being posted. The symbol "#" followed by any word or phrase forms a hashtag, which can contextualize the tweet and boost the reach and engagement of a topic. In particular, hashtags were taken into account in this study due to their multi-functional linguistic features in online discourse over time. They can be considered as keywords which allow users to follow a specific topic or might be used as search terms contributing to the creation of a virtual community which shares a particular interest. Zappavigna (2011) defines hashtags as a typographic convention used to mark the topic of a tweet,

[20] Detailed figures are reported in Appendix 2.

they are a kind of “inline” metadata integrated into the linguistic structure of the tweets which usually explicitly refer to the topic of the tweet (Zappavigna, 2012, 2015). In fact, the hashtag in particular enables people to connect online, and thanks to the easiness of its use, anyone can create a new one, and therefore, create new words. In turn, anyone may adopt and modify a hashtag increasing the spread of its usage and can see whether a hashtag is shared by other users or not (De Cock & Pizarro Pedraza, 2018). The main characteristic of a hashtag is the ability to increase the “loudness” of a discourse related to a specific topic, making it viral and searchable, and also creating a more solid bond within the virtual community (Zappavigna, 2011; Roginsky & De Cock, 2015; Schwell, 2015). When this type of bond is established among a large number of Twitter users, the so called “ambient affiliation” is formed (Bruns & Burgess, 2011; Zappavigna, 2011). The process of affiliation is based on a system of shared values where the participants identify themselves as members of a community, in this case expressed through hashtags (Knight, 2010). As from a linguistic point of view, hashtags might appear as neologisms in relation to what Crystal (2001) describes as the creation of new lexical items that become part of the language of a determined speech community during a particular period of time.

As reported in table 3.12 and figure 3.11, out of 163,753 tweets, 93,502 contain at least one hashtag. Tweets from the U.S. are most likely to include a hashtag, especially the ones posted by social movements. This might be related to the fact that social movements are the main tweeters and might aim at creating a strong bond among the community emphasizing the characteristic of hashtags of acting as a social glue, in the metaphorical sense as highlighted by Klein (2000), fostering recognition, connectedness, feeling of responsibility for, and concern for others because they occupy the same community. A great contribution is also given by international users (29,371 tweets) made of news

companies, NGOs, and social movements. And lastly by European tweets, 21,833 tweets, mostly by organizations and politicians.

Author type	**EU**	**INT**	**US**	**Total**
Activists	793		529	1322
NEWS	531	9337		9868
NGOs	3733	13397	2186	19316
Organizations	8452		6607	15059
Politicians	5163		5609	10772
Social movements	3161	6637	27367	37165
Total	**21833**	**29371**	**42298**	**93502**

Table

Table 3. 5: Number of tweets which contain hashtags per author type

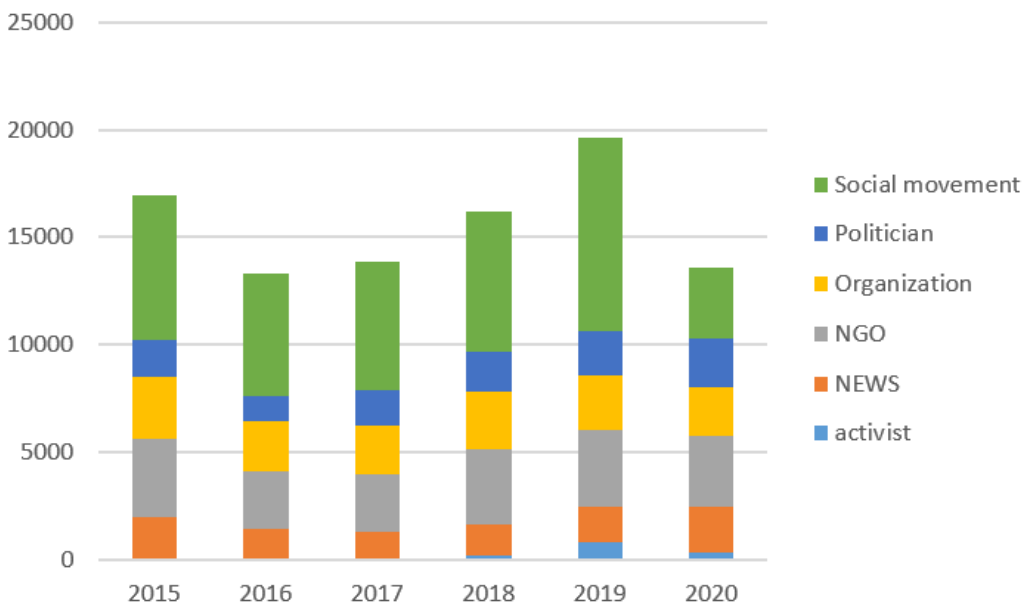


Figure 3.11: Number of tweets with hashtags per author type over time

The following section illustrates how the corpus was compiled on the software Sketch Engine and describes the annotation of metadata.

3.6 Corpus compilation on Sketch Engine

As mentioned above, it is of paramount importance to maintain extra-textual information about the tweets. As stated by Anthony (2013), using a corpus tool means understanding and accepting a certain number of linguistic assumptions incorporated into it by the designers. Therefore, several data were encoded in the corpus, although separately from the corpus data *per se*, in order to address the research questions (McEnery et al., 2006). Accordingly, each tweet was manually annotated with a timestamp attribute, i.e., the publication date, the author type (activist, NEWS, NGO, organization, politician, social movement), author name and origin, to make it readable to Sketch Engine, which is the software used to carry out linguistic analyses. Indeed, among the core system functions provided by the software Sketch Engine (Kilgarriff et al., 2014), I used the following tools to conduct this research: 1. *Concordance* to search for a word form, a lemma, a phrase, 2. *Keywords and Terms* to extract core lexis in the corpus using "keyness score". 3. *Collocations* to calculate words that are statistically associated with the query term. Collocation is a key concept of corpus linguistics, and it is defined as "the relation between two or more words which tend to co-occur in a text" (Stubbs, 2001, p. 24). Indeed, collocations may provide the semantic fields in which a word is used and a representation of the social actors (Koteyko et al., 2013). Specifically, I decided to use *Word Sketch* which displays the searched words and the surrounding terms and divides them into grammatical categories. The collocations are ranked using the logDice score which determines the strength of the collocation without being affected by the size of the corpus as it measures both the frequency of the node and of its collocate, and the frequency of the whole collocation (co-occurrence of the node and collocate). Indeed, the logDice score is preferred to identify how strong the collocation is; thus, the list

includes collocations that are not entirely predictable. 4. *Trends* to conduct a diachronic analysis of word usage.

Firstly, the corpus was annotated manually, as shown in the following example:

<doc pub="2020-12" authortype="activist" author="GretaThunberg" origin="EU"> <s> *tweet content* </s> </doc>

Then, the corpus compilation was followed by a manual setting of the compilation parameters. Specifically, the configuration file was edited with the definition of the timestamp attribute, namely DIACHRONIC "doc.pub", and the attribute *wordcount* was added in the document structure, as well. As a result, the final corpus consists of 163,753 documents, i.e., tweets, with a total of 3,050,469-word tokens and 272,651-word types, from 63 authors of three different origins, over 72 months.

Bearing in mind that the main goal of this study is to analyze how language changes in a specific time frame, the detection of new lexical items in the corpus was an essential process in order to provide a thorough investigation into language variation.

3.7 New lexical items in the corpus

From the original corpus, the CSV file was encoded into UTF-8. A text file based on the "text" column of the CSV was generated, and all hashtags, mentions and URLs from the original file were removed. This file was uploaded in Unitex/GramLab[21], which is an "open source, cross-platform, multilingual, lexicon and grammar-based corpus processing suite" and allows users to apply electronic dictionaries and perform automatic textual analyses.

[21] https://unitexgramlab.org/

A dictionary per every language present in the corpus was generated using the Spacy[22] package in Python (Honnibal & Montani, 2017), i.e., Catalan, Chinese, Danish, Dutch, German, English, French, Greek, Italian, Russian, Spanish, international. The generated dictionaries were included in the Unitex/GramLab directory, and the GramLab preprocessing of tokenization and application of dictionaries were performed. With the option "Apply All default Dictionaries", dictionaries in the DELA[23] format (Dictionnaires Electroniques du LADL) were applied. This procedure generated a file containing all known words and a second file with unknown words which could be possible neologisms (Cougnon and Viron 2020). The ERR file, i.e., the file with words without any correspondence in the dictionary, was crossed with the tok_by_freq file (number of occurrences per each token). Conclusively, an XLS file was created with the non-present words sorted by frequency and included 13253 words. The list provided in the file was manually checked and the words with only one frequency rate were excluded. Remaining foreign or misspelt words were detected and deleted. All other 451 words were looked up in the Oxford English dictionary (OED) and in the Merriam-Webster dictionary, both online versions, in order to identify whether any of them had already been added as new entries on online dictionaries. Therefore, already lexicalized words in both dictionaries were not considered novel, thus not part of the category. Whereas the ones which appeared in only one of the two dictionaries were regarded as candidate items in a final 202 wordlist, saved in lowercase for further analysis. Previous studies already referred to these dictionaries as language references in establishing the entry of new words (Bevitori, 2012; Grieve et al., 2018; Nerlich & Koteyko, 2009a; Würschinger, 2021), however, the

[22] SpaCy is an open-source software library for advanced natural language processing, written in the programming languages Python and Cython.
[23] The electronic dictionaries within Unitex use the DELA syntax (Dictionnaires Electroniques du LADL, LADL electronic dictionaries). This syntax describes the simple and compound lexical entries of a language with their grammatical, semantic and inflectional information.

authors opted for the use of only one dictionary. I decided to use both simultaneously on account of the presumable linguistic difference and variety of the represented population in the corpus due to cultural and historical differences between the U.S. and the EU, and of the different approaches adopted by the dictionaries themselves (Creese, 2018). The dictionaries were consulted in the timeframe from the 1st to the 5th of October 2021.

The Merriam-Webster Dictionary is a unique, regularly updated, online-only reference. It is America's foremost publisher of language-related reference works. The first Merriam-Webster dictionary was issued on September 24, 1847. "Dictionaries have always been data-driven. A dictionary isn't an idea museum, it's a user's manual for communication" (Merriam-Webster)[24].

The Oxford English Dictionary is considered as an accepted authority on the English language, and a guide to the meaning, history, and pronunciation of words. Its creation started more than 150 years ago. It is regularly revised and extended. It provides an important record of the evolution of the English language and culture.

For a better understanding of what is meant for lexicalized words, the OED takes into consideration a word to be included if it first appears in the dictionary's "watch list" database. The entries included in this watch list come from different sources, such as the "OED's own reading programs to crowdsourcing appeals with the general public, and from automated monitoring and analysis of massive databases of language in use" (https://public.oed.com/how-words-enter-the-oed/). Thousands of word suggestions from these sources are taken into consideration every year by OED's editors who review the information collected and star to trace the word's development. Such research involves newspaper archives, online forums, academic studies, magazines, law tracts, recipe

[24] www.merriam-webster.com/words-at-play/how-does-a-word-get-into-the-dictionary

books, or social media for published evidence of the word. Once all details are put together and analyzed, the dictionary entry is drafted. Completed entries take place in quarterly updates on OED Online[25].

Similarly, Merriam-Webster dictionary editors look for changes in the language by reading sites and publications with wide national readership in order to find vocabulary that has entered mainstream life. The first step of research is to collect every new word encountered and identified as a citation and save it with its context and source into a searchable database. The collection includes new words and also new ways of using old words. The research is based on how frequent, widespread, and meaningful the use of a word is. New entries taken into account follow an editorial process to assess whether there is enough evidence to record a new word in the dictionary. Words that are not included into the dictionary are still words, but might not be either very frequent, widespread or meaningful[26].

As pointed out by Creese (2018), these two dictionaries present different criteria to detect and include new words in their dictionary. In this case, for example, terms such as *artivism*, *bioeconomy*, *climatarian*, *doomism*, *fuelish*, are some of the encountered new lexical items closely related to the climate change issue which have not been lexicalized. Whereas words such as *craftivism* and *rewild* are an example of the ones that have been entered in the Oxford English Dictionary, but not in the Webster-Merriam. Below the definitions provided by the OED:

[25] https://public.oed.com/how-words-enter-the-oed/
[26] https://www.merriam-webster.com/words-at-play/how-does-a-word-get-into-the-dictionar

Craftivism: the practice of creating and displaying handmade objects, esp. items incorporating knitted or sewn text or imagery, to promote a political message or raise awareness of a social issue.

Rewild: to return (land) to a wilder and more natural state.

On the contrary, words such as *BIPOC* and *e-cycling* have been added in the Webster-Merriam and not in the OED, with the following definitions:

BIPOC: Black, Indigenous, People of Color. People are using the term to acknowledge that not all people of color face equal levels of injustice. They say BIPOC is significant in recognizing that Black and Indigenous people are severely impacted by systemic racial injustices.

E-cycle: to reuse or recycle (electronic equipment or components) especially for the purpose of reducing waste and pollution.

To summarize, novel items present in both dictionaries, but not related to the climate issue, were classified as unsuitable candidate items. Moreover, other particular units, such as specialized vocabulary (e.g., microgrid, nanoplastics and pfas), and new items mostly related to politics (e.g., Bidencare, Obamagate, Trumpism), or to the social media platform (e.g., twitterverse, twitterstorm) were removed from the list. As a result of a cross-checked analysis, the final list included 50 new lexical items.

Moreover, the intent was to define the polarity of these new items., which means that the general purpose was not to provide definitions of the new lexical units, but to define their connotation – also referred to as affective, associative, attitudinal and emotive meaning (Stubbs, 2001) – in relation to the other words in the co-text, using three categories, positive, negative and neutral.

Finally, following a personal manual annotation, it was necessary to calculate the level of agreement with another annotator as explained in the next section.

3.8 Inter-annotator agreement

Interesting results rose from the linguistic analysis of the corpus and the presence of lexical innovations. Overall, 50 new climate-related words were considered, and, in order to monitor language variation across time, it is of paramount importance to assess what kind of meaning they have within the co-text, i.e., a positive, negative or neutral connotation. Further investigation is also needed to identify who introduced these lexical items, where and when they first appeared. While these last questions can be answered through statistical analyses, the former issue has to be manually assessed, annotating each lexical innovation with reference to one of the three categories (positive, negative, neutral).

On account of this, the corpus was opened in *Excel* and set with different columns, i.e., Tweet_id, author type, name, screen name, date, text, and three new columns were added; lexical innovation, presence of lexical innovation (yes/no), and lexical innovation annotation in order to assess whether the word is positive, negative or neutral within the co-text. All lexical innovations were searched and filtered with reference to the text column, and then the relevant fields related to the annotation was completed. A sample (30 percent) of these words encountered in the corpus was extracted and provided with the related tweets. The general purpose was to evaluate the meaning of the whole message specifying it in the *annotation* column of the given table, as specified in Appendix 3. Therefore, the attribution is not associated with the item itself, but to the entire message.

For further consistency, in terms of reliability, meant as "the extent to which different methods, research results, or people arrive at the same interpretations or facts" (Krippendorff, 2011, p. 2), of the annotated data, inter-annotator agreement was calculated based on the results provided by two human annotators experts in the field and familiar with the research questions.

> The main reason for the analysis of annotation quality is to obtain a measure of the 'trustworthiness' of annotations. […] Only if we can trust that annotations are provided in a consistent and reproducible manner, can we be sure that conclusions drawn from such data are likewise reliable and that the subsequent usage of annotations is not negatively influenced by inconsistencies and errors in the data. Inter-annotator (or inter-coder) agreement has become the quasi-standard procedure for testing the accuracy of manual annotations. (Bayerl & Paul, 2011, p. 700)

As stated by Rau and Shih (2021), the main rater of the data is the author, while the second rater could be a specialist of the field or a linguist. For this study I decided to adopt Cohen's kappa. Moreno and Swales (2018, p. 55) consider it "more useful than the agreement percentage because it is a chance-corrected measure, which takes into account the likelihood that the agreement between coders has occurred by chance". On the contrary, as highlighted by Biber (2007, p. 35) with reference to the percentage agreement "it does not account for chance agreement among raters". Cohen's kappa (κ) was introduced by Jacob Cohen in 1960 as a measure of inter-rater reliability for psychological assessment and nominal categorical data (Cohen, 1960).

This data analysis was carried out using *RStudio* and the psych package. At first the two datasets were merged and then the contingency table was created as shown in table 3.6.

	Rater 2			
Rater 1	Negative	Neutral	Positive	Sum
Negative	**144**	6	6	156
Neutral	0	**13**	9	22
Positive	2	2	**116**	120
Sum	146	21	131	**298**

Table 3. 6: Contingency table of the two raters

The Unweighted Kappa was used since I was dealing with a nominal scale. Firstly, a manual calculation was performed as illustrated below, including the P0, i.e., the proportion of observed agreement, and Pe, the proportion of chance agreement:

Cohen's Kappa - Manual Calculation:

```
diag_cohen_final <- sum(diag(cohen_final)) # Diagonal Sum N <- sum(cohen_final) # Total sum
```

P0 - Proportion of observed agreement, which is the sum of the diagonal entries:

```
P0 <- diag_cohen_final/N P0
```

Pe - Proportion of chance agreement, which is the sum of the products of the rows and columns marginal proportions.

Then, the expected frequency (Diagonal) was performed:

```
cohen_final_marginal <- addmargins(cohen_final) # added the marginal frequency cohen_final_marginal

exp_frequency1 <- (cohen_final_marginal[4:4, 1:1] * cohen_final_marginal[1:1, 4:4]) / N exp_frequency2 <- (cohen_final_marginal[4:4, 2:2] * cohen_final_marginal[2:2, 4:4]) / N exp_frequency3 <- (cohen_final_marginal[4:4, 3:3] * cohen_final_marginal[3:3, 4:4]) / N

Pe <- sum(exp_frequency1, exp_frequency2, exp_frequency3) / N Pe
```

The result of both manual calculation and the one through psych package gave the same result, 85% of agreement. According to McHugh' kappa interpretation (2012), the range between 82 and 100% is considered almost perfect, thus an excellent agreement.

Cohen's Kappa - Manual Calculation:

k <- (P0 - Pe)/(1 - Pe) k #0.8505397 -> 0.80 - 0.90 Strong 64 - 81%

Cohen's Kappa - cohen.kappa (psych):

cohen.kappa(cohen_final) #0.8505 -> Unweighted "Almost perfect agreement"

Following the attempt to define the connotation of a lexical item, a further step was carried out aiming at the definition of manifested frames within the tweets. In fact, taking into account how messages may be built with the objective to negotiate the understanding of an issue – i.e., highlighting dangers, making attributions of responsibility or calling to action – frames can define a problem, determine causes, express moral judgements and suggest solutions.

3.9 Framing Identification

As mentioned above, this section focuses on the identification of the main frames within the tweets which contain a new lexical item. As pointed out by many scholars, framing analysis can be approached with different methods, i.e., discourse analysis (Boykoff, 2008; Fløttum et al., 2014; Plastina, 2020), and corpus linguistic methods (Chen et al., 2022; Grundmann & Krishnamurthy, 2010; Koteyko et al., 2013; Touri & Koteyko, 2015; Willis, 2017). Accordingly, in this present study, I decided to adopt a method of research framing combined with discourse analysis in order to seize the main themes that accompany new lexical items. Indeed, as pinpointed by Plastina (2020), frames can be retrieved in smaller elements detected in a discourse, namely keywords, key expressions, identical words, which contribute to the construction of framing categories. Although Johnston (1995) highlighted how traditional frame methodology has been criticized as being based on inferential suppositions, he also suggested a *micro-discourse analysis*

defined as “a more intensive approach that takes a specific example of written text or bounded speech and seeks to explain why the words, sentences, and concepts are put together the way they are.” (Johnston, 1995, p. 219). Hence, this approach to framing analysis is based on the connection of frame structures to lexical items which allow to uncover possible frames.

Additionally, this research draws on the use of issue-specific frames which are considered as the ones related to a specific topic or event – climate change – (Entman et al., 2009). As a matter of fact, the present study provides an extension of the research carried out by O’Neill et al. (2015) and Painter et al. (2018), by investigating the occurrence of the frames identified in their studies then integrated based on the themes that emerged within the use of new lexical items. In the first study, the investigation focused on the identification of climate change frames in elite discourses, mass media research, and peoples’ everyday perceptions through the analysis of legacy and social media coverage (Twitter) of the IPCC Fifth Assessment Report. The second research provided a set of frames built upon the analysis of climate change coverage in both digital and legacy media following the COP 21 summit.

Moreover, following the methodological approach adopted by Plastina (2020) to identify frames within the social-ecological resilience to climate change, the “core framing tasks” refer to the ones identified by Benford and Snow (2000), i.e., (1) “diagnostic framing” for the problem identification and attributional component of who or what to blame, (2) “prognostic framing” for the eventual solutions proposed to tackle climate issues, (3) “motivational framing” related to a call to action. Further to this, the linguistic devices used to identify the salience of the frames were the neologisms detected in the corpus analyzed in this research, which were mapped onto the three core framing tasks. Subsequently, the most issue-specific frames were identified using pre-existing frame sets

in line with a manual-holistic approach (Matthes & Kohring, 2008). However, taking into account the weaknesses of this approach defined as "quite inflexible when it comes to the identification of newly emerging frames" (Matthes & Kohring, p. 263), and the actual necessity to define new frames, a hermeneutic-qualitative method was also employed. This method implies a qualitative interpretive approach to the identified tweets, and it is carried out through an inductive reconstruction of the meaning. Nevertheless, as pointed out by Semetko and Valkenburg (2000, p. 94), "This approach can detect the many possible ways in which an issue can be framed, but this method is labor intensive, often based on small samples, and can be difficult to replicate."

As a result, the first eight frames listed below were adapted from the abovementioned studies (O'Neill et al., 2015; Painter et al., 2018), i.e., *disasters or catastrophes*, *opportunities*, *economics and business*, *renewable energy*, *climate justice*, *civil society protests*, *health impacts*, *scientific background*. Moreover, the five frames that follow were inductively defined based on a bottom-up analysis of tweets which did not fit the predetermined ones described above, namely *call to action*, *stereotyping people*, *attribution of responsibility or blame*, *restoration of nature*, *connectedness in pandemic*. As illustrated below, each frame attempts to group tweets with similar semantic meaning:

- *Disasters or catastrophes* linked to climate change and extreme weather events impacts on nature and people, also highlighting the anthropogenic causes.

- *Opportunities* related to action on climate change and fight against it through culture and sport, and through the promotion of solutions, e.g., investment in clean energy, green jobs healthier and environmentally friendly behaviors, extended to the involvement of tweeters and "followers".

- *Economics and business* meant as the "relationship between economies and climate change, […] disinvestment from fossil fuels initiatives, and the possibility of delinking growth and carbon emissions" (Painter et al., 2018, p. 4).

- *Climate justice* highlights the negative consequences and the inequities derived from climate change at the expense of the most vulnerable people and communities, e.g., indigenous people.

- *Civil society protests* are polite forms of contrast, and demonstrations and protests to defend the planet, also through art.

- *Health impact* relates to climate change effects on people's health.

- *Information of facts* or *Scientific background* indicate the provision of information with the intent to inform the general audience, these messages may include scientific evidence of causes and effects of climate change.

- *Call to action* arises as a sense of protest through a gentle and polite discourse to mobilize people as a call to arm, e.g., signing petitions and taking part in meeting. This urge to act on climate can be also addressed to politicians and governments.

- *Stereotyping people* refers to the labelling of individuals who share beliefs and/or behaviors towards the environment.

- *Nature restoration* is meant as the reactivation of a pre-existing condition before anthropogenic actions and to the rediscovery of nature.

- *Attribution of responsibility and blame* points out the contribution of different stakeholders to climate worsening.

- *Connectedness in pandemic* resides in the production of positive messages, while referring to new forms of communication such as webinars and highlighting the positive effects of less CO2 emissions due to the lockdown.

Specifically, the examples reported in table 3.7 highlight the core framing tasks – i.e., diagnostic, prognostic, and motivational – and the issue-specific frames related to some examples.

Core framing tasks *Issue-specific frames*	**Examples**
Diagnostic	
Attribution of responsibility and blame	#NeverForget that the **patriarchy**, **colonialism**, **capitalism**, **extractivism**, **racism**, **sexism**, **classism**, **ableism**, **ageism** and other **forms of oppression** are at the root of the **complicity of our governments** in the climate and ecological catastrophe. (11/09/2019 Extinction Rebellion)
	As long as **we don't treat the climate crisis** like a crisis, we can have as many climate conferences and summits as we want, but as it is now it will just be negotiations, **empty words**, **loopholes** and **greenwash**. (10/11/2020 Greta Thunberg)
Climate justice	The expansion of fossil fuels is a direct **threat to the lives** of Indigenous Peoples. It is time to stop this extractivist relationship with nature: decimating forests, **displacing communities** of the land, increasing pollution, and locking in deadly emissions for decades. (20/06/2020 Climate Action Network International)
	A5: The environment has always been used to **oppress BIPOC**. It is high time to shift to a more **humane**

	approach. #EarthDay50 #BM4F #YoungGiftedGreen #LeadFreeUSA (23/04/2020 Climate Reality)
Disasters or catastrophes	We're **facing** the possibility of **megadroughts** much like with the 1930s Dust Bowl, except these could last 30-35 years (18/02/2015 Climate Reality)
	Weatherwatch: **Extreme flooding** on rise in Europe over past 20 years (12/02/2018 Guardian Environment)
Health impacts	'Solastalgia': Arctic **inhabitants** overwhelmed by new form of **climate grief** (15/10/2020 Guardian Environment)
	Climate doomism is a common **psychological response** to the urgency of climate change. But it shouldn't mean the end of your activism! (27/10/2020 ClimateReality)
Information of facts or Scientific background	Pollutionwatch: log fires are cosy, but their days **may be** numbered (08/10/2017 Guardian Environment)
	.@**NASA**: #Megadrought Lasting Decades Is 99% Certain in American Southwest @Waterkeeper @SaveTheColorado @acousteau (06/10/2016 EcoWatch)
Prognostic	
Economics and business	EU #**Bioeconomy** represents 2 trillion euros **turnover** & **employs** & than 17 million people #Food #Agriculture #Forestry #Energy - @ScalingUp2016 (16/11/2016 Andreea Strachinescu)
	New @EUEnvironment report "The #**CircularEconomy** and the Bioeconomy Partners in **sustainability**": analysis, challenges and promising **innovations** on #FoodWaste, biomass and bio-based **products** #WasteToResource (11/09/2018 EU Environment)
Nature restoration	Healthy living systems can soak up millions of tonnes of CO2. **Rewilding** involves the large-scale **restoration** of

	natural habitats and systems to help **wildlife thrive**, with species **naturally** managing the landscape. #BiodiversityCrisis rewilding. (07/11/2020 Greenpeace) In this left-brain paradigm we are living in, it's about scarcity, separation and powerlessness. The solution to this crisis is **RE-loving nature**: **rewilding**, **regenerating**, **reducing**... (27/01/2020 Extinction Rebellion)
Opportunity	We are ignoring natural climate solutions. Here is a short film with @GeorgeMonbiot and me, by Tom Mustill, about **restoring** and **rewilding** nature to help repair the broken climate. (10/11/2019 Greta Thunberg) Companies in our Electronics Challenge **encourage ecycling**. Recycle your electronics w/@BBYNews, @Dell4Good, @LGUS (14/01/2015 U.S. EPA)
Connectedness in pandemic	#WorldHealthDay highlights the need for international cooperation in achieving #HealthforAll and building a safer, **healthier** and more **resilient planet**. Let's also take this time to express our gratitude to & appreciation for our **healthcare** workers #ThankYouFrontliners #COVID19 (07/04/2020 Climate Action Network International) Even **from our balcony or garden**, **we** can still enjoy #**biodiversity** This is a Great Spotted Woodpecker, observed in Brussels Learn more tks to @Natures_Voice Do you run a birdwatch programme? Contact us! #Biodiversity2020 #EUBiodiversity (12/04/2020 EU Environment)
Motivational	
Civil society protests	The latest **poetic artivist performance** by @FFcultureNL leaves its mark. Making visible the **fossil fueled relationship** between the @vangoghmuseum and #Shell. #FossilFreeCulture #FossilFree (03/05/2018 350Europe) #ExtinctionRebellion **activists block** part of the road in front of BEIS **demanding** #zerocarbon. (12/11/2018 Extinction Rebellion)

Call to action	Demand 02 - #ActNow **Governments** around the world **must act now** to **halt** biodiversity loss and **go** net #ZeroCarbon2025. **We need #Everybody**Now #InternationalRebellion (19/10/2019 Extinction Rebellion)
	Are we living in a corporatocracy or something? Our **governments must put us first and ecocidal corporations last**. We must all #RebelForLife for **action** on the climate and ecological emergency. Join our non-violent Rebellion (08/07/2019 Extinction Rebellion)
Stereotyping people	**We are** the **frontliners** fighting against #climatechange and we have our own voices (25/06/2017 Greenpeace)
	Some great advice about intersectional climate justice **from #climatestriker** @israhirsi (30/03/2019 Fridays4future)

Table 3. 7: Core framing tasks and issue-specific frames

As can be seen in the examples illustrated in table 3.7, tweets may include mentions (@) which generally identify to whom the content of the message is addressed to. The investigation of these relationships may be carried out through a social network analysis, which, in a sociolinguistic perspective, aims at discovering eventual correspondence between the language use and the social ties (Würschinger, 2021).

The following section describes the methodological approach adopted in the attempt to identify the connectedness among the authors involved in this research.

3.10 Social network analysis

Social network analysis (SNA) allows to investigate social structures present in a network through the use of networks and graph theory. As stated by Wasserman and Faust (1994), social network analysis first emerged in sociology and social psychology and

anthropology. SNA of language variation and change have mainly focused on vernacular linguistic variables based on networks of friendship and kinship (Milroy & Milroy, 1992). The importance of the analysis of the social network created by the users involved in this research is due to the type of relationship which may occur between this social world and the language use. Thus, this analysis may help understand whether the ties among social entities, i.e., the connectedness created through the mentions "@" on Twitter, reflects the usage among the members of a given community of the same discourse, and who might share the same ideology of climate change (Milroy, 2002, 2004; Silverstein, 1992).

Specifically, the networked structures include nodes (individual actors, people, or things within the network) and edges, the relationships or interactions that connect them (Wasserman & Faust, 1994; Marin & Wellman, 2009). As a matter of fact, social media networks are common social structures analyzed and visualized through social network analysis. For instance, force-directed graph drawing algorithms are used to attribute forces among the set of nodes and the edges of a graph drawing. Forces are used to attract the nodes and the simultaneous repulsive force is used to separate the nodes. As a result, the nodes that are less connected tend to be visualized further apart (Jacomy et al., 2014).

3.10.1 Network visualization

Gephi is the open-source software for graph and network analysis that has been chosen to carry out this analysis. In particular, *Gephi* version 0.9.2 was employed to examine the stakeholders' network, since it is able to provide an interactive visualization and supports Blondel's algorithm as the modularity function, as well.

Moreover, Force Atlas layout was applied to visualize the network, which is a spatial layout algorithm for real-world networks, from 10 to 10,000 nodes. The Force Atlas layout algorithm comes under a category of algorithms called force-directed algorithms

and it focused on quality. Therefore, it is suitable for analyzing real data allowing a rigorous interpretation of the graph, such as in the case of a Social Network Analysis with the fewest biases and clear readability (gephi.org).

In this particular graphic layout, each stakeholder is represented as a node, while the edge connecting a pair of nodes means that the stakeholder has been mentioned. Overall, the network is made of 63 nodes and 800 edges. To provide a more readable network, the repulsion strength, used to assess how strongly each node rejects others, has been fixed at 10000, and adjusted by size.

3.10.2 Evaluation Measures

3.10.2.1 Network Diameter and Closeness Centrality

In order to obtain a mathematical representation of the connectedness of stakeholders in the Force Atlas layout and then analyze the clustering topologically, network diameter and closeness centrality were run as the evaluation measures. In connected graphs, there is a natural distance metric between all pairs of nodes, defined by the length of their shortest paths. The average graph-distance between all connected nodes have a graph distance equal to 1. Network diameter is the longest distance between any two nodes in the network and it considers three parameters: *Betweenness Centrality*, which measures how often a node appears on the shortest paths between nodes in the network; *Closeness Centrality*, which calculates the average distance from a given starting point to all other nodes in the network; *Eccentricity*, which measures the farness from one node to all the other nodes. The more central a node is, the lower its total distance to all other nodes appears. The distribution of closeness centrality was used as a measure to evaluate the network centralization, therefore attributing a size to the nodes in a range from 10 to 35.

3.10.2.2 Modularity

Modularity was applied to examine the resulting communities (also called module classes) in mentions networks. Modularity measures the quality of clustering and helps to identify different types of highly dense networks. In this research, the implemented community detection algorithm was a modularity optimization based heuristic method. In fact, Blondel's algorithm, also called Louvain method, has several advantages, such as easy implementation, fast computation speed, and the capability to handle large and weighted networks. As a result, it is demonstrated to provide higher quality results for community detection. Blondel's algorithm has also been applied to some popular social networks with millions of nodes like LinkedIn and Twitter (Haynes & Perisic, 2009; Pujol et al., 2012). Therefore, I implemented the Blondel's algorithm, available in Gephi, to examine the networks among the tweeters involved in this research.

The results of the social network of the stakeholders based on mentions are discussed in chapter 4, section 4.4.6. Accordingly, the visual output following the Force Atlas layout in Gephi, based on Blondel's algorithm, is displayed in figure 4.44.

3.11 Concluding remarks

This chapter has offered a description of the methodologies and approaches adopted for the investigation into the climate-related tweets in order to assess language variation and to corroborate the goals listed above. Nevertheless, it becomes apparent that all the definitions and approaches adopted are disputable. What I claim in this study is what makes language, the ecological system, society, and the mind of the speaker mutually interact and shape one another. Are all stakeholders equally concerned for the environment? Are political assets determining factors?

The purpose of this research is to identify a broader picture of the relationship between the stakeholders and language variation across space and time, and analyze their language use, lexical creativity, and discourse behind the messages in relation to their social and political context.

The findings will be discussed in the following chapter with evidence taken from the corpus.

Chapter Four

Results and Discussion

4.1 Introductory remarks

This chapter illustrates the statistical analyses and the qualitative approaches employed in order to address the postulated research questions and the findings obtained. The main objective is to examine how stakeholders directly act through their language, and how they interact with each other. Moreover, the investigation into language variation and into lexical innovations, which reflect environmental, cultural, and political changes, mainly focus on the keyword *climate*.

The chapter is divided into different sections which describe the quantitative and qualitative analyses carried out for each research question and hypothesis. Specifically, the first section focuses on how language varies among the different users through the study of collocations and lexical creativity. The second section draws attention to how climate-related messages evolve through time. Finally, the third section presents the differences and similarities between the U.S. and the EU, considering political and social factors, by means of discourse analysis and framing approach.

4.2 Language change among the different users (RQ1)

4.2.1 First hypothesis

As mentioned above, the first research question – *To what extent does language change according to the different users (young environmentalists, politicians, NGOs, and organizations)?* – attempts to analyze the differences and similarities of language use among the identified stakeholders, specifically drawing attention to the environmental lexicon. Following the first hypothesis based on the assumption that collocations related

to climate change are more typical in NGOs, social movements and activists, this part of the study investigates the most frequent collocates of climate detected in the corpus.

As explained in the methodology section, the corpus includes tweets collected in a specific timeframe, from 2015 to 2020, on Twitter and from preidentified users, namely politicians, climate activists, organizations, social movements, news sites, and NGOs. As a result of the preliminary corpus filtration described in the methodology section, *climate* became the most frequent word in the corpus with an absolute frequency of 39,702. The collocates of climate were identified through *Word Sketch*; specifically, the collocations analyzed presented a logDice score equal or higher than 8.7 in two specific categories: modifiers of *climate* and nouns modified by *climate*, as can be seen in table 4.1 and figure 4.2. The complete list of collocations can be found in Appendix 4.

Modifiers of climate	**Frequency**	**logDice Score**
stable	50	10.81
safe	60	10.54
livable	37	10.28
warming	29	9.39
healthy	26	8.78

Table 4.1: Modifiers of climate ranked by logDice score

As an introduction to the analysis, figure 4.1 illustrates an overview of the findings:

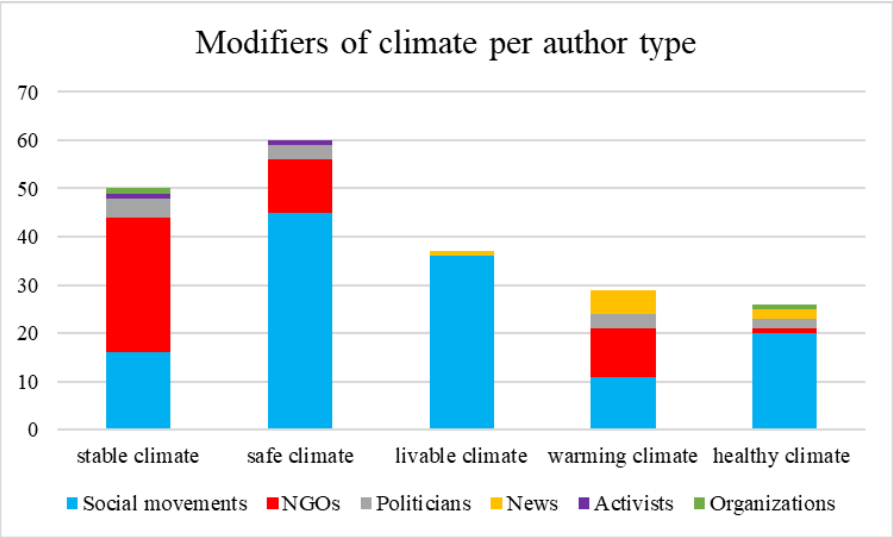


Figure 4.1: Selected collocations per author type

The collocation *stable climate* appears 50 times, it was used 28 times by NGOs, 16 by social movements, 4 times by politicians, and once by Organizations and Activists. In total, the collocation was used 34 times in the U.S., 14 internationally, and twice in Europe. As can be seen in the examples below, NGOs, social movements, and activists, describe *stable climate* either as a matter to preserve and protect, especially from policy makers, or as something that has already been taken away from future generations:

1. Bolsonaro's anti-environmental agenda is a threat to the forest, to wildlife and to a **stable climate**. Indigenous Peoples have been fighting to protect the Amazon and their rights for centuries. Join them #savetheamazon #forestsarelife (06/09/2019 Greenpeace)

2. The latest climate report from the UN says we have only 12 years to transform our economy to preserve the **stable climate** human civilization has depended on for millennia. @sunrisemvmt @AOC @EdMarkey (11/02/2019 Jerome Foster II)

3. Currently, there is minimal to no regulation in place holding US banks accountable for their impact on our climate. This needs to change if we

are to secure a **stable climate** for generations to come. (02/08/2020 Climate Reality)

4. 'We are the generation that has never known a **stable climate**'. -Blue Sandford, 17yo climate activist (04/09/2020 Extinction Rebellion)

On the other hand, politicians and the organization EU Environment address *stable climate* in a different way; in the case of politicians, it is related to an economic discourse depicting it as an important component of economic growth. As for the organization, it explicitly affirms that the climate is stable and it could be even more stable, thus without questioning its status quo:

5. We #ActOnClimate to protect & strengthen the economy. A **stable climate** is critical to growth & to companies' bottom lines. (13/03/2015 Gina McCarthy)

6. Happy #IntlForestDay! Forests cover more than 42% of EU land area while 37.5 million hectares are part of #Natura2000! Our forests are necessary for our #EUBiodiversity and a more **stable climate**! (21/03/2019 EU Environment)

Safe climate was written in 60 tweets, 45 by Social Movements, 11 by NGOs, 3 by politicians and once by activists: 44 times in the U.S., 10 internationally and 6 times in Europe. In most tweets, *safe climate* concerns the climate justice domain posing it as a human right while bringing up legal actions. Moreover, some of these posts are aimed at mobilizing people, especially the youth; others express blame and denounce politicians' inaction:

7. A **safe climate** is a human right. Stand with the #PeoplevsBigPolluters now! (24/09/2016 Greenpeace)

8. We can all agree our families should have clean air to breathe and a **safe climate** to live in. Stand up for the #CleanPowerPlan now (22/12/2017 ClimateReality)

9. We're counting down to the #TrialOfTheCentury. On October 29, the US government will have to answer for violating kids' right to a **safe climate** #YouthGov (25/10/2018 Climate Reality)

10. Join the youth legal action for a **safe climate**. #JoinJuliana #ReportOnClimate #ThisIsZeroHour (17/02/2019 Jerome Foster II)

11. We have a right to clean water and a **safe climate**. Join us in demanding that the Trump Administration's EPA leave the Clean Water Act alone. (08/09/2019 ClimateReality)

12. A coronavirus recovery plan that: Protects our public services -Bails out communities instead of corporations -Delivers a **safe climate** and thousands of good jobs with a Green New Deal. Sound good? Tell Boris Johnson: #BuildBackBetter! (25/05/2020 350Europe)

As for *livable climate*, it appears 37 times in posts from two author types: social movements for 36 times and once from news; 32 times from the U.S. and 5 internationally. This collocation is used with reference to the preservation of nature and of the essential elements to life, i.e., air, water, soil.

13. Our children deserve clean air and a **livable climate**. Agree? Take the #RealityPledge (18/10/2016 ClimateReality)

14. #ExtinctionRebellion are #rebelling against the ecocidal government so we can: - Have a **livable climate** - Breathe clean air - Drink clean water - Eat food from clean soil. If you are able to make a donation it would us help us help you (23/11/2018 Extinction Rebellion)

15. Happy #ArborDay! "It can be easy to take trees for granted, but they are absolutely critical to maintaining balance on our planet supporting clean air and water, healthy food and a **livable climate**." @arborday (26/04/2019 EcoWatch)

Warming climate is 29 times frequent. It was adopted 11 times by Social Movements, 10 times by NGOs, 5 times by news and 3 by politicians; 10 times in the U.S., 6 in Europe, and 4 from international actors. This expression is mainly contextualized in a frame that outlines the impacts of the rise of temperatures on the whole ecosystem, such as wildfires and the proliferation of viruses, thus emphasizing the natural consequences of anthropogenic effects, as illustrated in the examples below:

16. Dangerous wildfires once again threaten the US, particularly the West. These wildfires are tragic & made worse by the **warming climate**. Yet, Trump & Congressional Republican STILL refuse to address climate change and instead are push policies that only serve to escalate the issue (14/09/2018 Frank Pallone)

17. The land we use for food and water, the people who help harvest these resources, are experiencing the impacts of a **warming climate**

firsthand with deadly megafires and hazardous wildfire smoke. #EarthGuardians #ActionSprout (21/12/2018 Earth Guardians)

18. Melting Arctic Sea ice brought on by the Earth's **warming climate** created a way for the virus to move into a new region and infect a new population of sea life. #ActOnClimate (13/11/2019 Greenpeace)

19. Our **warming climate** is causing more wildfires. Which creates even more emissions. Which causes further warming and even more wildfires. The time for real action is now. (18/06/2020 Climate Reality)

Healthy climate was tweeted 20 times by Social Movements, twice by news and politicians, once by NGOs and Organizations; 20 times in the U.S., and three times in Europe and globally. Similar to safe climate, this collocation also draws attention to climate justice, while the only politician, president of the EU Council, addresses the economic discourse:

20. To truly tackle the issues that face us hunger, poverty, inequality, conflict, we need a **healthy climate**. #HappyPlanet #HappyDay (20/03/2015 Climate Reality)

21. A **healthy climate** and environment is a constitutional right for us and for future generations. Oil drilling in the Arctic is violating that right. #ClimateEmergency #PeopleVSArcticOil Read more in the @nytimes (05/11/2020 Greenpeace)

22. People's Right to a **Healthy Climate** Takes Center Stage in Federal Court (08/07/2017 EcoWatch)

23. Healthy climate, healthy development we can do both. #Cop25Madrid 02/12/2019 Charles Michel)

The following analysis focuses on the selection of the most frequent collocations based on nouns modified by climate considering the wordform, as illustrated in table 4.2.

Nouns modified by climate	***Frequency***	***logDice Score***
change	9191	12,83
crisis	4971	12,07
action	1446	10,41
Change	715	9,55
solution	562	9,16
justice	455	8,88
emergency	450	8,86
denier	428	8,82
activist	435	8,79

Table 4.2: Nouns modified by climate ranked by logDice score

As an introductory overview of the results, figure 4.2 shows the distribution of the collocates among the different author types:

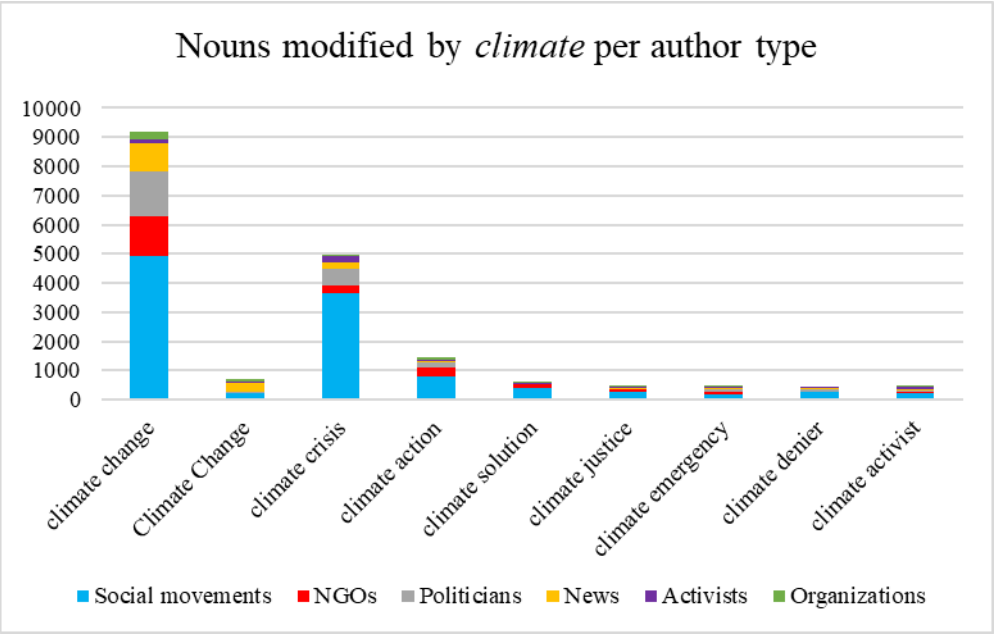


Figure 4.2: Distribution of selected collocations per author type

Not surprisingly, the collocate *climate change* is the most frequent one. It appears 9191 times in lower case, and 715 times in upper case. As for the lower case, it was used 4,943 times by social movements, 1,536 by politicians, 1,363 by NGOs, 958 by news companies, 279 times by organizations and 100 times by activists. In total it appears 6,552 times in U.S. posts, 1,536 in European ones and 1,093 in international posts. As for Climate Change, with the initials in capital letters, it was used 715 times. News companies employed it 311 times, followed by social movements with 225 times, organizations 126 times, politicians 25, NGOs 21, and activists 17. Overall, 357 posts were from international accounts, while 219 and 149 tweets were from European and American users, respectively.

In order to understand what the general discourse around *climate change* is, I decided to look into the most frequent collocates. As a result, *fight climate change* occurred 316 times in the corpus. It was mainly used by social movements and politicians, 155 and 87 times each, respectively. Indeed, as illustrated in figure 4.3, this expression is highly typical among politicians based on the result of the relative density. In fact, the relative

density compares the frequency of a word or expression in a specific text type to the frequency in the whole corpus, when the percentage is more than 100 %, it is more frequent in this text type than in the whole corpus. In this case the text type refers to the authortype.

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	155	106.56	131.57 %
Politician	87	158.47	195.67 %
Organization	34	53.17	65.65 %
NGO	21	34.08	42.08 %
NEWS	17	30.36	37.49 %
activist	2	24.22	29.90 %

Figure 4.3: Frequency of *fight climate change*

On the one hand, social movements, NGOs and activists use the expression "fight climate change" linking it to a broader discourse of justice and highlighting the possible solutions that must be adopted. On the other hand, U.S. and European politicians address the issue emphasizing the economic discourse.

24. To **fight climate change**, we have to defend Indigenous rights (09/10/2017 Greenpeace)

25. Trump's failure to **fight climate change** is a crime against humanity (25/11/2018 Earth Guardians)

26. Fossil gas lobbyists want more public money for gas, to **fight climate change**. Wait. WHAT? Seriously, @Total and @Eurogas_Eu? Repeat after us: gas is a fossil fuel. It causes climate breakdown. IT NEEDS TO STAY IN THE GROUND. #FossilFreeEIB (09/09/2019 350Europe)

27. ‘Saving millions of lives’ sounds like a great reason to start **fighting climate change** with everything we’ve got. (09/12/2018 Climate Reality)

28. We need to keep up efforts to **fight climate change** at every level, locally, nationally, globally. #ActOnClimate (09/09/2016 Barack Obama)

29. Climate change is happening now. We need to get serious about it. Aspiring to achieve a green economy with good union jobs that leave no one behind is exactly the solution we need to **fight climate change** and provide opportunity for all Americans. (17/04/2019 Edward Markey)

30. Today we present an #EUGreenDeal which will **fight climate change**, protect nature, make our economy sustainable and leave nobody behind. Because if this is not a social Green Deal, it will not be a successful Green Deal. (11/12/2019 Frans Timmermans)

31. To **fight climate change**, we need business onboard. #NextGenerationEU will create opportunities for sustainable companies worldwide. Thank you @EuroChamSG for the Sustainability Awards & congratulations to the winners! Glad to see companies in Europe & Asia exploring new solutions (17/11/2020 Ursula von der Leyen)

Concurrently, another collocate of *climate change* is *tackle*, which was mainly used by politicians, as shown by the relative frequency in figure 4.4. However, as can be seen in

the examples below, the emerging discourse is similar to the previous one as it is still economic in nature and expresses blame from the U.S. politicians:

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
Politician	59	107.47	188.04 %
SocialMovement	50	34.37	60.14 %
NEWS	40	71.43	124.98 %
Organization	39	60.99	106.71 %
NGO	33	53.55	93.71 %
activist	2	24.22	42.37 %

Figure 4.4: Frequency of *tackle climate change*

32. Add your name if you support global efforts to **tackle climate change** (28/04/2016 Barack Obama)

33. $1.7T is not enough to **tackle climate change**. Inadequate climate plans are a form of denialism over how bad this problem really is. My generation & future ones will have to contend with the horrifying mess that the cowardly leadership of previous ones left us. It's a betrayal. (16/03/2020 Alexandria Ocasio-Cortez)

34. '#Renewables, including solar, have a key role to play in cost-effectively **tackling climate change**, while enhancing energy security, creating growth & jobs.' My speech from the 1st World Solar Technology Summit (08/09/2020 Kadri Simson)

35. Just after the hottest November on record, it's clear the need to **tackle climate change** remains as high as ever. Transport is one of the three sectors where more efforts are necessary. Emissions must get on a clear downward trend if we are to achieve #ClimateNeutralEU. (09/12/2020 Frans Timmermans)

Moreover, *tackle climate change* is also used by organizations, such as the IPCC, and the issue is presented in a confident manner with due acknowledgment. Despite the policy neutral discourse, there is a subtle call to action:

36. We know how to **tackle climate change** and we have the means: economic, technological and institutional... - #IPCC 's Hoesung Lee #COP21 (01/12/2015 IPCC)

37. What is the #IPCC? The IPCC is a panel of 195 member states. The IPCC provides scientific assessments to help understand #climatechange, its impacts and future risks, and options for #adaptation and #mitigation. IPCC reports inform negotiations to **tackle climate change**. (19/08/2020 IPCC)

A more typical expression among social movements, NGOs and activists is *stop climate change*, as reported in figure 4.5. Moreover, an interesting element is provided by two politicians, namely Hilary Clinton and Valdis Dombrovskis, who use this expression to refer to "teen girls", presumably climate activists, and #Strike4climate and #Friday4Future.

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	87	59.81	185.21 %
NGO	12	19.47	60.31 %
activist	10	121.08	374.95 %
Politician	7	12.75	39.48 %
NEWS	6	10.71	33.18 %
Organization	4	6.25	19.37 %

Figure 4.5: Frequency of *stop climate change*

38. What does #FightFor1Point5 mean? It means pressuring world leaders to limit their country's CO2 emissions to below 1.5° Celsius because not doing so has been proven to cause even more catastrophic changes

to our environment that will limit our ability to **stop climate change**. (12/12/2020 Jerome Foster II)

39. Something extraordinary is happening in Europe and perhaps soon in America. Teen girls are leading a movement to **stop climate change**. (12/02/2019 Hillary Clinton)

40. The biggest ever global #Strike4climate: We need massive investments to **stop climate change**. Public money is not enough, we need private capital. EU has tabled a #SustainableFinanceEU strategy to get it done #Friday4Future (15/03/2019 Valdis Dombrovskis)

Climate crisis was tweeted 4971 times, among which 3,659 posts were from social movements, 551 from politicians, 270 from NGOs, 255 from activists, 222 from news, and 14 from organizations. Overall, 4,054 posts were from the U.S., 490 from Europe and 427 internationals. As shown in figure 4.6, *solve climate crisis* was more typical among social movements and politicians. Nevertheless, a different meaning is attributed to "solve". For instance, activists and social movements highlight the urgency to find a solution whether it is still possible. Conversely, U.S. politicians boast a possible panacea.

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	365	250.92	192.35 %
Politician	113	205.83	157.78 %
activist	10	121.08	92.82 %
NGO	9	14.61	11.20 %
NEWS	7	12.50	9.58 %
Organization	5	7.82	5.99 %

Figure 4.6: Frequency *solve climate crisis*

41. “It’s time to stop pretending that we can **solve the climate crisis** without treating it as a crisis" Tonight @adelaidecharli2 @Luisamneubauer @fffitalia @MartiComparelli @Laura42739528 & I, are meeting with Italian PM Giuseppe Conte #FaceTheClimateEmergency (19/10/2020 GretaThunberg)

42. “The youth climate revolution to **solve the climate crisis** is not fueled by the silence of inaction but by the sounds of impassioned assertiveness” (02/12/2019 Jerome Foster II)

43. The **Climate Crisis** is an ecological issue... The Climate Crisis is a discrimination issue... The Climate Crisis is a generational issue... ...and we need intergenerational and intersectional cooperation to **solve** it #StrikeWithUs (02/09/2019 Xiye Bastida)

44. We are running out of time to **solve the climate crisis**. Every day it seems more people are calling out for... https://t.co/j9JY35lRSi (05/06/2017 Earth Guardians)

45. What's “unrealistic” is thinking we will let fossil fuel companies continue to destroy the planet. The outrageous greed of companies like BP got us into this crisis. We are going to **solve the climate crisis**, end their greed and hold them accountable for the damage they caused. (22/01/2020 Bernie Sanders)

46. This heat wave is a reminder that we’re already feeling the impacts of climate change. It’s clear we need to take drastic action now to **solve our climate crisis** and protect the planet for future generations. Stay safe this weekend. (20/07/2019 Joe Biden)

Climate action appeared 1,446 times and it was posted 808 times by Social Movements, 309 by NGOs, 165 by politicians, 71 by Organizations, 57 by news, and 36 by activists. Overall, 951 tweets were from the U.S., 260 from international accounts, and 235 from European ones. As reported in figure 4.7, *take climate action* is the most frequent collocate and it encompasses a call to action and blame discourses:

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	194	133.37	242.04 %
NGO	9	14.61	26.51 %
Politician	5	9.11	16.53 %
Organization	4	6.25	11.35 %
NEWS	2	3.57	6.48 %
activist	1	12.11	21.97 %

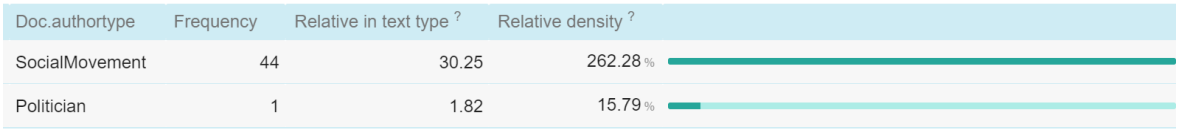
Figure 4.7: Frequency of *take climate action*

47. Now more than ever, we need to **take #climate action**. The good news is, there's a lot we can do for the climate, even while social distancing. Learn how to use your voice and choices to take climate action in 2020 and beyond with our new e-book! (22/05/2020 Climate Reality)

48. "It's not enough what we are doing individually. We need... to get our governments to act to protect us... They are saying... that we are going to **take climate action** & doing... the opposite subsidising fossil flues", Kara Flannigan, #ExtinctionRebellion. (22/01/2019 Extinction Rebellion)

49. **Taking climate action** makes good business sense, with or without the Trump Administration (18/09/2017 Climate Reality)

Climate solution was used 562 times. Social movements tweeted it 419 times, NGOs 108 times, politicians 16, activists 8 and news and Organizations 6 and 5, respectively. Most tweets came from the U.S., 531, while 18 and 13 were from international and European accounts. This expression mostly occurs with the adjective *natural*, as can be seen in figure 4.8. For instance, *natural climate solution* is perceived as a favorable option to fight climate change and has a more realistic and optimistic impact as it is contextualized compared to *solve climate crisis*.



Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	44	30.25	262.28 %
Politician	1	1.82	15.79 %

Figure 4.8: Frequency of *natural climate solution*

50. **Natural climate solutions** are not only cost-effective, they also improve water, biodiversity & livelihoods. @MarkTercek #ECOSFallMtg16 (26/09/2016 The Nature Conservancy)

51. Land use & **natural climate solutions** need to be taken much more seriously because both rapid decarbonisation & nature-based land-use solutions will be needed to limit warming to 1.5C. Our forests are our future. Without them we face the prospect of runaway climate change. (30/07/2019 Climate Action Network International)

Climate justice occurred 455 times. It was used 279 times by social movements, 76 by NGOs, 58 times by activists, 22 by news, 16 by politicians and 3 times by organizations. It was retrieved 180 times in American tweets, 153 in international ones and 121 in Europeans. The most frequent collocate is *demand* and its relative density is highest

among activists (figure 4.9). It is strongly related to youth movements and events as a form of collective action.

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	17	11.69	168.89 %
NGO	6	9.74	140.72 %
activist	3	36.32	524.93 %
NEWS	1	1.79	25.81 %

Figure 4.9: Frequency of *demand climate justice*

52. The rectors have given the right example to their students by coming to the strikes to join us in the fight for our future. They know what education means. Now follow them and go in the streets to **demand climate justice**! The fight is not over yet. #YouthForClimate (14/04/2019 Anuna De Wever Van Der Heyden)

53. My friends from @DivestHarvard joined by @FossilFreeYale have staged a magnificent sit-in during a football game to **demand climate justice**. There are no winners on a dead planet (23/11/2019 Xiye Bastida)

54. We **demand climate justice** and a safer climate with under 1.5C of warming! #COP24 #peoplesdemands @naomiaklein @georgemonbiot @harjeet11 (14/12/2018 Climate Action Network International)

55. Listen to local groups from all around the world as they talk about their demands and how you can help combat #ClimateChange, along with music, art builds, and zoom strikes. Reply if you're ready to #DigitalStrike to **demand climate justice**! #FridaysForFuture (22/09/2020 Fridays For Future)

Climate emergency was tweeted 450 times. Social movements used it 191 times, politicians 107 times, NGOs 80, news 37, activists 28, and organizations 7, as illustrated in figure 4.10. This collocate was found 217 times in international posts, 126 in European ones and 107 in Americans. The first tweet containing this expression was posted in 2016 by the NGO Green Europe, followed then by the social movement Earth Guardians:

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	191	131.30	113.85 %
Politician	107	194.90	168.99 %
NGO	80	129.83	112.57 %
NEWS	37	66.07	57.29 %
activist	28	339.02	293.96 %
Organization	7	10.95	9.49 %

Figure 4.10: Frequency of *climate emergency*

56. When will @EU_Commission stand up & respond to #**climate emergency** with action & increase #EU2030 #GHG target? (14/03/2016 Green_Europe)

57. Getting off of fossil fuels is key to moving away from the **Climate emergency** we are in. But everybody has to also… (18/06/2016 Earth Guardians)

This collocation became particularly viral in 2019. It was not only used to urge political action, but also to compliment the governments that acknowledged climate emergency:

58. This is an ecological and **climate emergency**. Government around the world must #ActNow to halt biodiversity loss and reduce greenhouse gas emissions to net zero by 2025 @IPBES #GlobalAssessment

#IPBES7 @IPCC_CH #SR15 report (07/05/2019 Extinction Rebellion)

59. "Analysis of language data collected in the Oxford Corpus shows the rapid rise of **climate emergency** from relative obscurity to becoming one of the most prominent and prominently debated terms of 2019" @OxfordWords #WordoftheYear "21/11/2019 350Europe"

60. What great news! The UK has passed the motion to declare environment and climate change emergency. Congratulations to school strikers, XR, UK politicians, and **climate emergency** declarations campaigners everywhere. Which country will be next? (01/05/2019 Fridays for Future)

Among the politicians, in Europe it is possible to seize a sense of unity for the achievement of a common goal, also including the economic discourse. Whereas in the States climate emergency is subject to politization and blame of the counterpart, as well.

61. Climate change does not respect national borders, the whole world needs to work together to fight it. It was a pleasure to meet @SpeakerPelosi and the US Congressional Delegation at #COP25 to discuss what we can all do to respond to the **climate emergency**. (02/12/2019 David Sassoli)

62. The global **climate emergency** is becoming more obvious. Our response has to be global too. In presence of @KGeorgieva, Argentina, Canada, Chile, China, India, Kenya, Marocco and the EU launched the International Platform for Sustainable Finance to scale up the green investment. (18/10/2019 Valdis Dombrovskis)

63. Because the odds of President Trump mentioning the words “climate change” at tonight’s #SOTU are slim, we need to remind him that the science is undeniable. We’re in a **climate emergency**. These pins represent the urgent need to #ActOnClimate. (05/02/2020 Edward Markey)

64. We are in a **climate emergency** and we must take drastic action now to address it. So today, I’m announcing my plan for a Clean Energy Revolution and Environmental Justice. (04/06/2019 Joe Biden)

Climate denier was tweeted 428 times, 257 times by social movements, 84 by news, 50 by politicians, 30 by NGOs and 7 times by activists (figure 4.11). Not surprisingly, it was mostly used in the U.S. with 290 posts, then 99 times by international accounts and 39 times by Europeans. Moreover, independently of the geographical provenience, most tweets are addressed to Donald Trump and his administration.

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	257	176.68	161.07 %
NEWS	84	150.00	136.75 %
Politician	50	91.07	83.03 %
NGO	30	48.69	44.39 %
activist	7	84.76	77.27 %

Figure 4.11: Frequency of *climate denier*

65. Our next President is a **climate denier**. There's no time to wait. @POTUS needs to end this case now. #YouthvGov (17/11/2016 Vic J. Barrett)

66. $82,882,725: That’s how much dark money 180 **climate deniers** in Congress have taken from Big Polluters (18/05/2017 Climate Reality)

67. #Trump's EPA transition chief Myron Ebell visiting UK to meet **climate deniers** #SpecialRelationship #draintheswamp (30/01/2017 350Europe)

68. From Brazil to Australia, leaders are using Trump's dangerous approach as an excuse to limit their commitment to the fight against #climatechange. We need climate leaders, not **climate deniers**. (04/12/2018 Greenpeace)

69. US **climate deniers** call Paris summit 'a threat' to the world (26/06/2015 Guardian Environment)

70. The EPA needs a leader who will actually protect the environment, not a **climate denier** like Trump's choice Scott Pruitt. (29/12/2016 Bernie Sanders)

Climate activist appeared 435 times. It was used 235 times by social movements, 81 by activists, 50 by news, 45 by NGOs, 17 by politicians and 7 times by organizations, as shown in figure 4.12. It was used 237 times by U.S. accounts, 102 by Europeans and 96 internationally. As can be seen in the examples below, in this corpus, the collocation *climate activist* specifically refers to the current young generation in general, and to the most popular representatives who are struggling to fight climate issues, such as Xiuhtezcatl Martinez and Greta Thunberg. Indeed, it can be considered as an appellation employed by all user types and by themselves, as well.

Doc.authortype	Frequency	Relative in text type ?	Relative density ?
SocialMovement	235	161.55	144.91 %
activist	81	980.75	879.72 %
NEWS	50	89.29	80.09 %
NGO	44	71.41	64.05 %
Politician	17	30.97	27.78 %
Organization	8	12.51	11.22 %

Figure 4.12: Frequency of *climate activist*

71. Indigenous **climate activist** Xiuhtezcatl Martinez is one of 21 young plaintiffs suing the federal government to... (01/01/2017 Earth Guardians)

72. Breaking: Port of Amsterdam coal stations being occupied by c. 350 **climate activists**. #KeepItInTheGround #CodeRood (24/06/2017 350Europe)

73. **Climate activist** @GretaThunberg in a sea of cameras and microphones @Europarl_EN calmly and with determination talking about her campaign #ClimateChange #climatestrike #ClimateDebate (16/04/2019 Mairead McGuinness)

74. This generation of **climate activists** is tired of inaction, and they've caught the attention of leaders all over the world. So while this challenge is only getting more urgent, they show us the kind of action it'll take to meet this moment. (22/04/2019 Barack Obama)

75. There are countless of school strikers and young **climate activists** around the world. Not just me. They all have names and stories waiting to be told. (28/01/2020 Greta Thunberg)

As a result, figure 4.13 illustrates the number of collocates per author type, specifically the abovementioned collocates identified with *Word Sketch* with the highest logDice score – i.e., *stable climate*, *safe climate*, *livable climate*, *warming climate*, *healthy climate*, *climate change*, *climate crisis*, *climate action*, climate solution, climate justice, *climate emergency*, *climate denier*, *climate activist*. Social movements used these collocates 11,141 times, thus this is the group with the highest number of collocates in their tweets. Politicians and NGOs almost reached the same number of tweets containing the collocations, 2,495 and 2,352, respectively. News companies ranked slightly below with 1,755 posts. Activists tweeted 562 times and organizations 514.

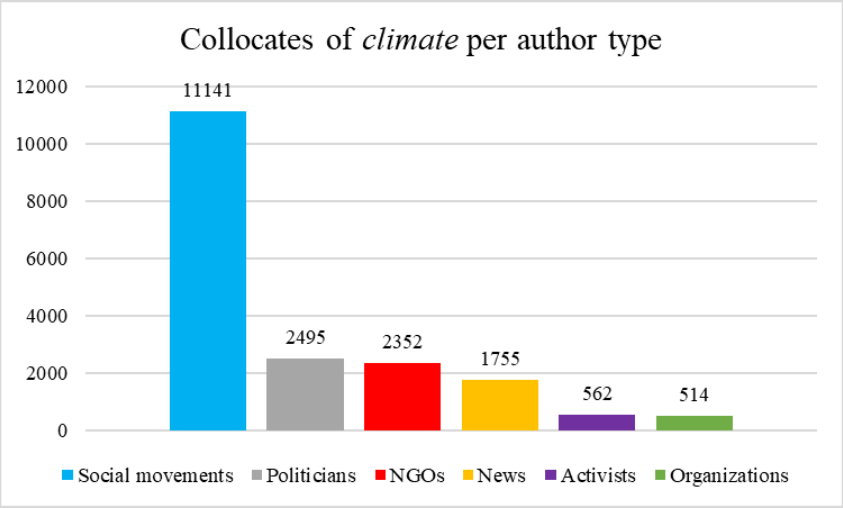


Figure 4.13: Collocates of climate per author type (in raw numbers)

However, owing to the fact that each author type does not include the same number of stakeholders, it arose the necessity to calculate the frequency of the tweets containing the analyzed collocations in relation to the total number of tweets posted by each author type.

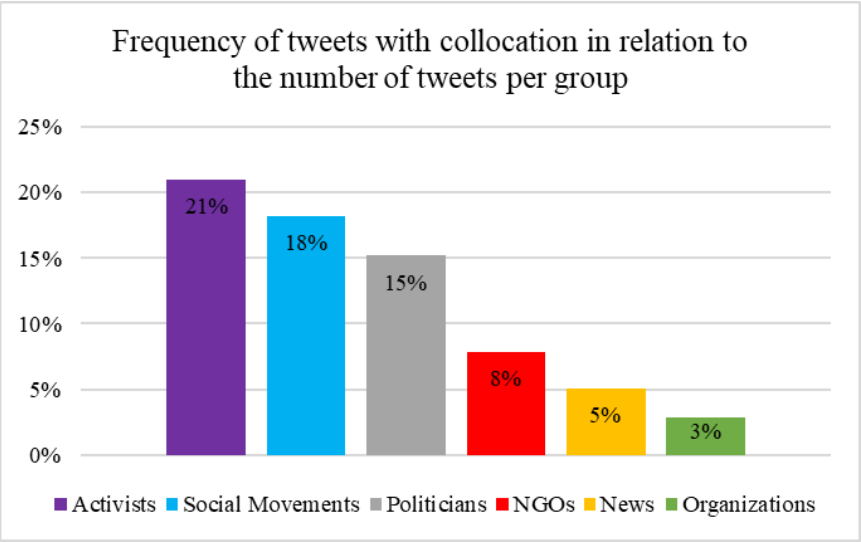


Figure 4.14: Frequency of tweets containing collocates of climate per author type (in percentages)

Author types	Tweets with collocate	Tweets posted	Ratio
Activists	562	2679	**21%**
Social Movements	11441	61073	**18%**
Politicians	2495	16532	**15%**
NGOs	2352	29779	**8%**
News	1755	35836	**5%**
Organizations	514	17854	**3%**

Table 4.3: Frequency of tweets containing collocates of climate per author type (in raw numbers)

As illustrated in figure 4.14 and described in table 4.3, the calculation of the ratio between the number of tweets with a collocate and the total number of tweets posted by each author type provides different results. Indeed, activists are the major users of collocates (21%) despite the smallest number of posts. These are followed by social movements (18%). Surprisingly, the third group which used most collocates compared to the total number of their tweets is represented by politicians (15%). Only 8% of tweets posted by NGOs included one of the most frequent collocates, and 5% of the news sites did as well. Organizations still come last with a 3% of tweets employing a climate collocate.

As can be seen in figure 4.15, a further analysis was carried out to calculate the relative density in the interface of collocations to determine how typical the listed collocations are through the comparison of its frequency in a specific author type with the frequency in the whole corpus. More specifically, this calculation is based on the ratio of the number of tweets by each author type including a collocate, the total number of tweets containing a collocate of climate in the corpus, and the proportion of tweets in the whole corpus per author type. As an example, activists posted 562 tweets with a collocate, in total the corpus counts of 19,320 tweets with a listed collocate, and 2% is the percentage of tweets belonging to activists in the corpus, i.e., 2679 divided by 163,753. As a result, the percentage is 178 of relative density.

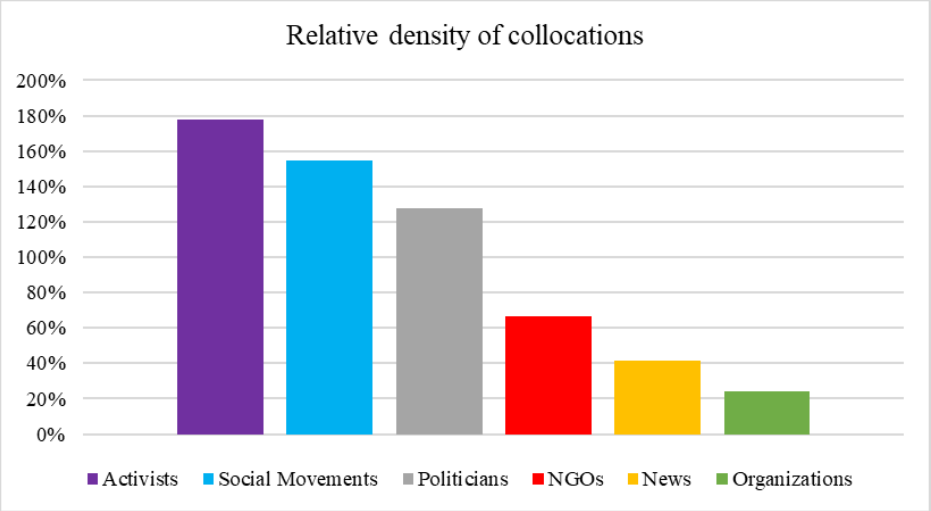


Figure 4. 15: Relative density in the interface of collocations (in percentages)

In addition, when the percentage is higher than 100, it means that the use of collocations is more frequent among that type of authors compared to the whole corpus, whereas less than 100 represents a low frequency. Consequently, the use of collocations is very typical among activists (178%), social movements (155%), and politicians (128%). On the other hand, the typicality decreases among NGOs (67%), News (42%) and organizations (24%).

Based on the outcomes of the quantitative analysis, the wider use of collocations among specific users may be explained by the purpose *per se* of these stakeholders which dictates the number of tweets posted, and by the extension of the community structures (Würschinger, 2021).

The following sections show the results of the other hypothesis offering a different perspective of language variation in terms of lexical creativity.

4.2.2 Second hypothesis

As mentioned above, along with the first research question – *To what extent does language vary according to the different users, i.e., young environmentalists, politicians, NGOs and organizations?* – the second hypothesis poses the assumption that lexical creativity related to climate change is more frequent among social movements, NGOs, and activists. Indeed, social media platforms, such as Twitter, provide the opportunity to communicate worldwide and foster the creation of virtual communities which share a common interaction interest. Additionally, environmental problems do not belong any longer to specialists, but to a wider public, and the need to communicate new concepts and the awareness of the lack of words to express new perceptions and scenarios, bring to the creation of new terms (Mühlhäusler, 2003). Consequently, I embraced the idea that new lexical items can be considered as such when a specific speech community uses it in a given time frame (Crystal, 2001).

For an in-depth study and detection of new lexical items in my corpus, the investigation was carried out through statistical analyses using metadata referred to groups, time, and location. Indeed, as mentioned in the previous chapter, the new items were obtained through a first automated analysis carried out with Unitex/GramLab with the application of electronic dictionaries generated with a spaCy package. The resultant XLS file created

with the non-present words sorted by frequency were manually verified in order to exclude words with only one frequency rate and foreign or misspelt units. All the other items were looked up in the Oxford English dictionary (OED) and in the Merriam-Webster dictionary, both online versions, to verify the inclusion of these items as existing entries in online dictionaries. Therefore, already lexicalized units identified in both dictionaries were not considered. As a result, table 4.4 illustrates the new lexical items detected in the corpus which do not appear in neither of the two dictionaries.

	Lexical unit	Frequency		Lexical unit	Frequency
1	airpocalypse	44	20	fuelish	2
2	artivism	20	21	gigafactory	17
3	artivist	17	22	gigaplant	2
4	bioeconomy	31	23	greenprint	3
5	brandalism	6	24	hyperconsumption	2
6	butterflywatch	3	25	megabank	3
7	climatarian	2	26	megadam	3
8	climatestriker	3	27	megadrought	22
9	corporatocracy	49	28	megafire	20
10	doomism	4	29	megamine	3
11	dumpsite	5	30	megapipeline	4
12	ecoambassador	1	31	megastorms	2
13	ecocapsule	2	32	pollutionwatch	73
14	ecopoetry	2	33	postgrowth	34
15	ecowatcher	21	34	reducetarian	2
16	extractivism	8	35	solastalgia	5
17	extractivist	6	36	solutionary	2
18	foodprint	4	37	weatherwatch	33
19	fracker	7		**Total**	**467**

Table 4.4: New lexical items in alphabetical order

Moreover, table 4.5 provides the list of items which were not detected either in the Merriam-Webster or in the Oxford English dictionary. In addition, as both dictionaries

include “major parts of speech as separate entries[27]” and the headword “is followed by the part of speech[28]”, items, such as *fracker*, *frontliner* and *birdwatch*, were considered as new lexical items.

	Lexical units not entered in M-W	Frequency		Lexical units not entered in OED	Frequency
1	bioproduct	3	1	bipoc	9
2	craftivism	1	2	birdwatch	6
3	craftivist	3	3	ecycling	4
4	earthship	6			
5	frontliner	2			
6	rewild (rewilded, rewilding)	68			
7	specieswatch	35			
8	zerocarbon	329			

Table 4.5: New lexical items in Merriam-Webster or in OED

The items displayed in table 4.5 show how the OED has a faster approach in including new lexical units, while the Merriam-Webster may be considered as a more “‘historical’ dictionary, and not the more ‘current’ one” (Creese, 2018, p. 556). However, among the new lexical items which did not appear in the Merriam-Webster, only one was effectively used by a U.S. stakeholder, namely *bioproduct* by the U.S. Department of Energy for 3 times. Besides, the listed items were mostly used by international accounts for 379 times, specifically Climate Action Network International, EcoWatch, Extinction Rebellion, and Greenpeace. On the other hand, European stakeholders, such as Green_Europe, Greta Thunberg, and the Guardian Environment, used them 52 times totally. On the contrary, in some cases the items which are not entries in the OED present different results. *Bipoc* was mainly used by U.S. stakeholders, namely Jerome Foster II, Climate Reality and

[27] https://public.oed.com/how-to-use-the-oed/glossary/
[28] https://www.merriam-webster.com/words-at-play/how-to-use-the-dictionary

Earth Guardians. This item was also posted by the international accounts Fridays for Future and Climate Action Network International. Despite appearing in the tweets of the European social movement 350Europe, the lexical unit referred to a specific Twitter community (@BipocN), which is considered as a proper name, and thus not instrumental in this analysis. Nonetheless, the item *birdwatch* was mainly tweeted by the European Guardian Environment and only once by the American NGO The Nature Conservancy. Lastly, *ecycling* only appeared in the tweets of the U.S. EPA. These differences in the two dictionaries may reflect cultural and political distinctiveness between the geographical areas. For instance, items as *birdwatch* and *specieswatch* were mainly employed to provide information about nature and the natural world, nevertheless they were used by European accounts.

Overall, as shown in table 4.6, social movements are the ones who mostly used lexical innovations, 547 times in total. International social movements only used lexical innovations 456 times, U.S. ones 66 times and the European 272 times. This means that international tweeters are more active in this case, and cover a wider action range, as well. These are followed by news sites, 225, and then by NGOs with a frequency of 107 times. Among the other three groups, European politicians used lexical innovations 24 times, 8 times more compared to the U.S. European and American organizations has recourse to these lexical units in a similar way, 18 times in total. Activists have the lowest frequency, 6 times. This is due to the fact that the selected activists started posting on Twitter from 2018 onward.

Presence of new lexical items	EU	INT	US	Total
Activists	5		1	6
NEWS	172	53		225
NGOs	38	58	11	107
Organization	8		10	18
Politicians	24		2	26
Social movements	272	456	66	547
Total	**519**	**586**	**95**	**929**

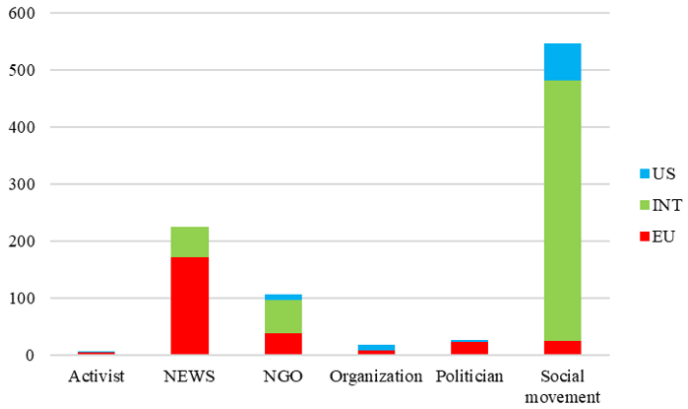


Table 4.6: Presence of lexical innovations by groups (in raw numbers)

There is clear evidence that the second hypothesis of the first research question is confirmed. Indeed, social movements, news sites and NGOs, used new lexical items more than the other author types. Additionally, these results are confirmed by further analyses, i.e., relative density in the interface and frequency. Indeed, figure 16 shows that new lexical items are highly typical among social movements (159%), and news (110%). NGOs do not have a high level of typicality (64%), yet it ranks third. Moreover, there is a difference regarding activists as it is demonstrated that new items are more typical in this type of author (34%) compared to politicians (28%) and organizations (18%). However, it cannot be said that new lexical items are typical among these three author types.

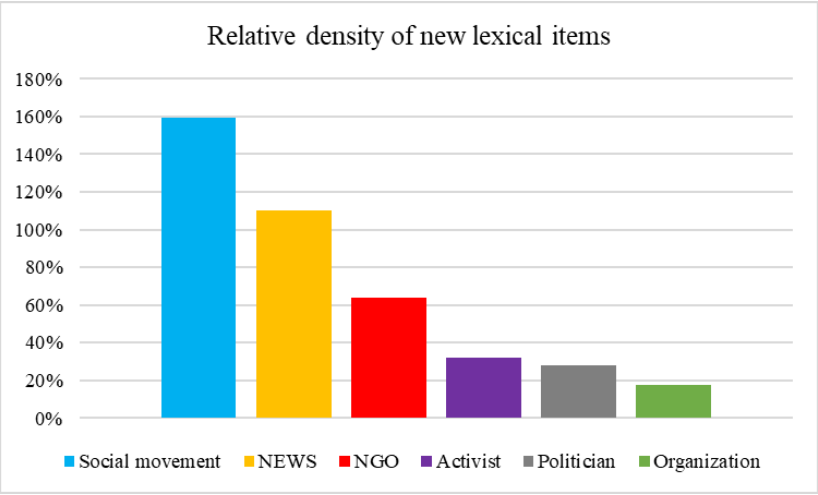


Figure 4.16: Relative density on new lexical items (in percentages)

A further confirmation of these results is given by the calculation of the frequency of tweets with new lexical items in relation to the number of tweets per author type as illustrated in figure 4.17.

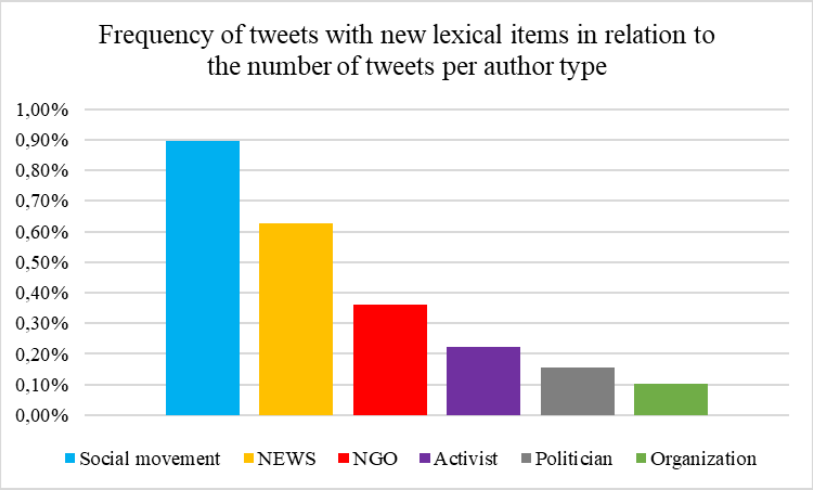


Figure 4.17: Frequency of tweets with new lexical items in relation to the number of tweets per author type (in percentages)

Furthermore, as represented in figure 4.18, the trend referred to the use of new lexical items was erratic over time. In fact, in 2015 lexical innovations were used 80 times, the year after their usage dropped to 41 times. However, in 2017 their frequency started to increase, 65 times, and the peak was reached in 2018, when new items were used 312 times. Almost the same frequency was achieved in 2019, i.e., 306 times. Nevertheless, in 2020, the use of lexical innovations plummeted to 125 times.

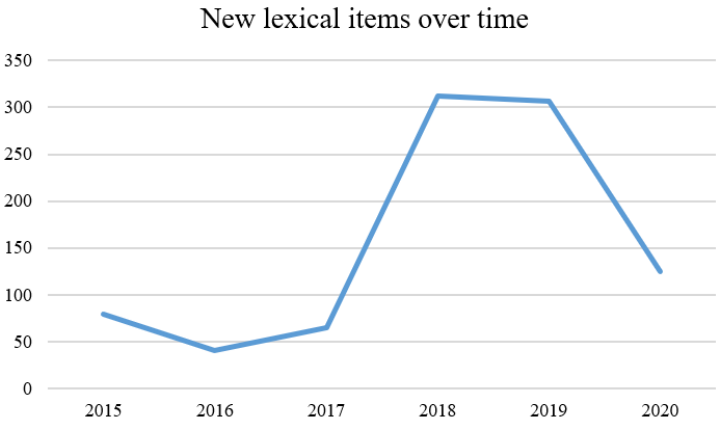


Figure 4.18: Lexical innovations over time (in raw numbers)

For the purpose of this investigation, I will confine the attention here to a more descriptive statistical analysis, however highlighting the most salient features for a comprehensive understanding of the aforementioned trends. For instance, as reported in table 4.7, in 2015 lexical innovations were detected 80 times and were mostly used by news sites, 38 times in total, 25 in European posts and 13 in international ones. NGOs used them in 19 tweets, all from international accounts. Social movements used new lexical items 17 times, 14 come from American tweets and 3 from European ones. Whereas American organizations used them 3 times, European politicians twice and U.S. politicians only once.

Presence of lexical innovation	**EU**	**INT**	**US**	**Total**
2015				**80**
Activist				0
NEWS	25	13		38
NGO		19		19
Organization			3	3
Politician	2		1	3
Social movement	3		14	17

Table 4.7: Lexical innovations in 2015 per group and place

Moreover, the most tweeted items were *airpocalypse*, *megadrought* and *pollutionwatch*, as illustrated in figure 4.19. Most of the tweets were annotated with a negative meaning; while *airpocalypse* and *megadrought* refer to particular conditions resulting from manmade induced climate change, the word *pollutionwatch* mainly serves as a label to categorize the content conveyed in the tweets.

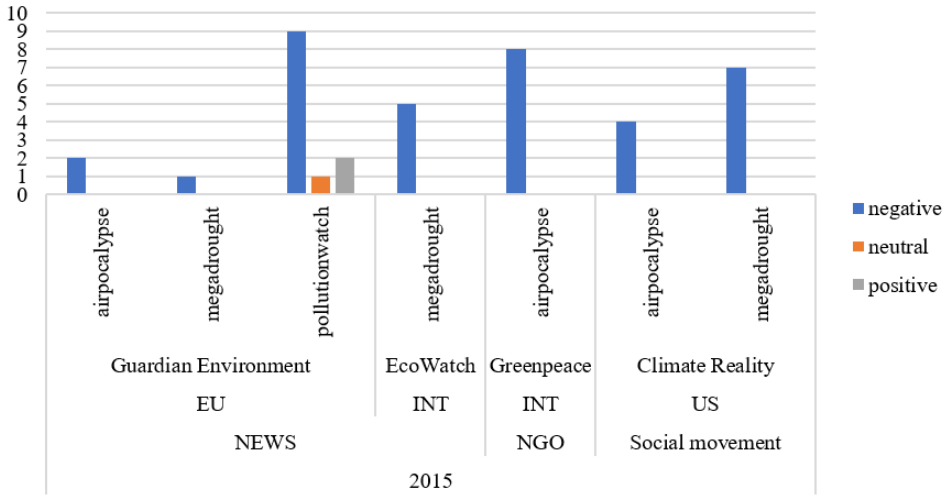


Figure 4.19: Most frequent lexical creations in 2015 per authortype (in raw numbers)

In 2016, as shown in table 4.8, NGOs were the most active users with the same frequency compared to the previous year, 16 from international posts and 3 from the U.S. News sites came second with 14 posts, 9 international and 3 European ones. Social movements used them 4 times, 3 from Europe and 1 from the US, followed by politicians with 4 European posts. Notwithstanding, activists and organizations did not use any new lexical items.

Presence of lexical innovation	**EU**	**INT**	**US**	**Total**
2016				**41**
Activist				0
NEWS	5	9		14
NGO		16	3	19
Organization				0
Politician	4			4
Social movement	3		1	4

Table 4.8: Lexical innovations in 2016 per group and place

Further to this, the most frequent items were *airpocalypse*, *artivism*, *bioeconomy* and *megadrought*, as can be seen in figure 4.20. *Airpocalypse* and *megadrought* maintained a negative meaning, whereas *artivism* and *bioeconomy* were introduced with a positive

connotation. Indeed, the first one derives from the combination of the words *artist* and *activism* and its meaning becomes clear in a tweet posted by Greenpeace *"#Artivism! 12 ways the arts can encourage action on #climatechange"* (02/05/2016). While *bioeconomy* was first employed in this corpus by a European politician referring to sustainable development.

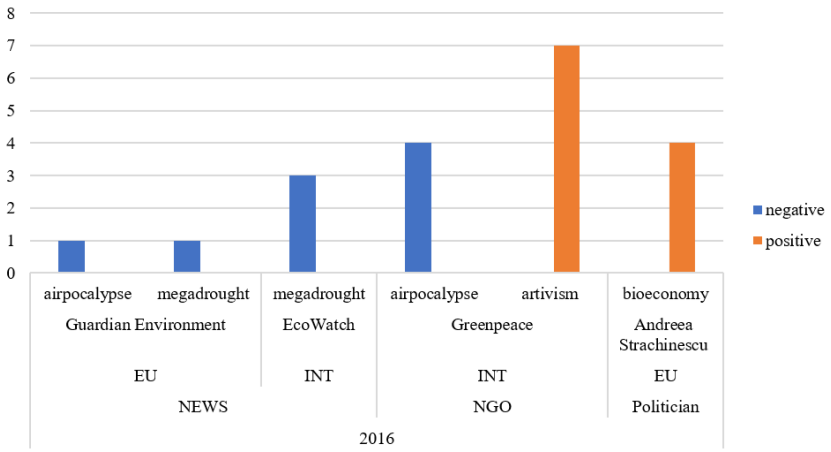


Figure 4.20: Most frequent lexical creations in 2016 per authortype (in raw numbers)

As mentioned above, the use of lexical innovations increased the following year. In fact, as shown in table 4.9, in 2017, social movements posted 35 tweets with a new item, thus recording the highest frequency, with 28 posts from the U.S. and 7 from Europe. News sites used them 15 times, 10 from Europe and 5 from international accounts. These are followed by NGOs which used new items 11 times, 1 from a European account, 6 international and 4 from the U.S. In the same year, one tweet from a European organization included a new lexical item, and three were used from U.S. organizations. However, politicians and activists did not use any lexical innovations.

Presence of lexical innovation	EU	INT	US	Total posts
2017				**65**
Activist				0
NEWS	10	5		15
NGO	1	6	4	11
Organization	1		3	4
Politician				0
Social movement	7		28	35

Table 4.9: Lexical innovations in 2017 per group and place

For a more detailed examination, figure 4.21 shows the 3 new items which occurred the most; besides *airpocalypse* and *artivism*, the word *gigafactory* was identified as positive since it represents a key to renewable energy future as announced by EcoWatch *"3 More Gigafactories Coming Soon to 'Change the Way the World Uses Energy'"* (24/02/2017).

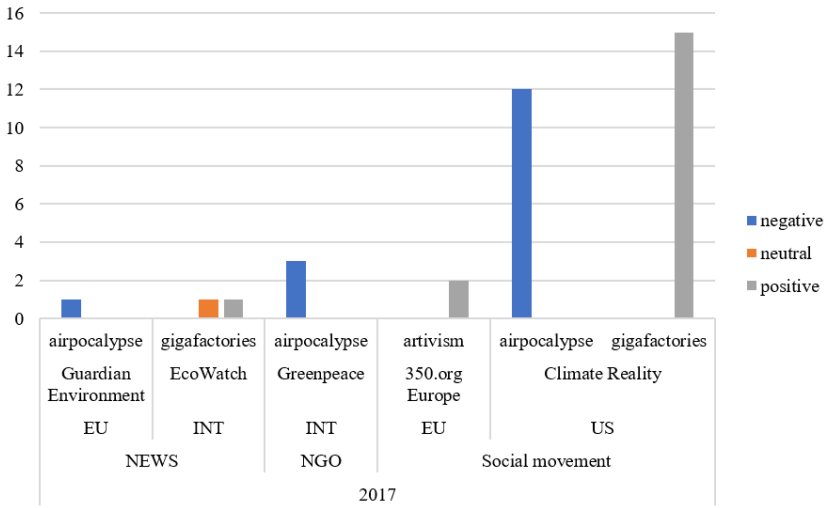


Figure 4.21: Most frequent lexical creations in 2017 per authortype (in raw numbers)

The tweets posted in 2018, as displayed in table 4.10, are the ones with the highest usage of new lexical items and again social movements with a frequency of 206 tweets lead the trend, 5 were detected in European tweets, 190 in international ones, and 11 in American posts. News sites came second with a total of 66 posts containing a new item, 61 from

Europe and 5 from international accounts. NGOs employed new items 25 times, 21 in European posts, 2 from international accounts and 2 from the U.S. Other 11 tweets containing new items were posted by European politicians, and 1 post by a U.S. politician. Organizations used them only 3 times, 1 from Europe and 2 from the U.S.

Presence of lexical innovation	**EU**	**INT**	**US**	**Total posts**
2018				**312**
Activist				0
NEWS	61	5		66
NGO	21	2	2	25
Organization	1		2	3
Politician	11		1	12
Social movement	5	190	11	206

Table 4.10: Lexical innovations in 2018 per group and place

In addition, figure 4.22 highlights the high usage of the item *zerocarbon*, followed by *corporatocracy* and *pollutionwatch*. The latter confirms its use as a label to the type of information provided. Although *corporatocracy* is a known word, it was not found as an entry on the dictionaries consulted, and in all cases, it was addressed for a blameworthy conduct, e.g., *"@BBCNews - "[M]eet the militant #ClimateChange activists.", @lhknightbbc. The #ExtinctionRebellion are using non-violent direct action & civil disobedience against the militant ecocidal UK government & corporatocracy because this is a #ClimateEmergency."* (15/11/2018). On the other hand, *zerocarbon* was mainly used as a hashtag and this contributed to making it viral. As a target to achieve, the tweets appear with different connotations based on the nature of the content. For instance, if the aim is to highlight the goal, it is positive: *"It's happening. 300+ sitting on #BlackfriarsBridge protesting the government to act on #climatebreakdown and get us to #zerocarbon2025 #RebellionDay #ExtinctionRebellion #XR"* (17/11/2018).

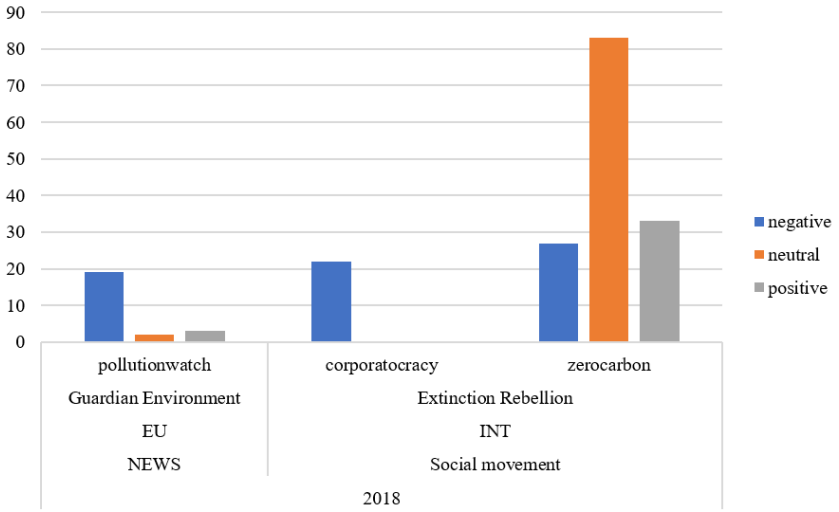


Figure 4.22: Most frequent lexical creations in 2018 per authortype (in raw numbers)

Moreover, in 2019 the use of lexical innovations slightly decreases compared to the previous year as it can be seen in table 4.11. However, social movements lead the tendency of using new items in 243 posts, 240 come from international accounts, while only 1 from Europe and 2 from the U.S. A downward trend is represented by news sites which only used them 39 times, 35 from Europe and 4 from international accounts. These are followed by NGOs with a use of 13 times, 8 from Europe, 1 from the U.S. and 4 from international accounts. For the first time activists used lexical innovations in 4 posts, 3 from Europe and 1 from the U.S.; European politicians used them 4 times. In addition, only one post comes from a European organization, while 2 from the U.S.

Presence of lexical innovation	**EU**	**INT**	**US**	**Total**
2019				**306**
Activist	3		1	4
NEWS	35	4		39
NGO	8	4	1	13
Organization	1		2	3
Politician	4			4
Social movement	1	240	2	243

Table 4.11: Lexical innovations in 2019 per group and place

Indeed, the two most frequent lexical items are again *corporatocracy* and *zerocarbon*, and the third is *rewilding* also used by Greta Thunberg (figure 4.23). The usage of this word may be interpreted as the will to propose positive and doable measures with the intent to call to action, e.g., *"Plant, plant & plant by all means but let's not forget that this is no substitute for the diversity & resilience of #rewilding. We can create the political will for rewilding: #NaturalClimateSolutions #NaturalEcologicalSolutions"* (04/09/2019 Extinction Rebellion).

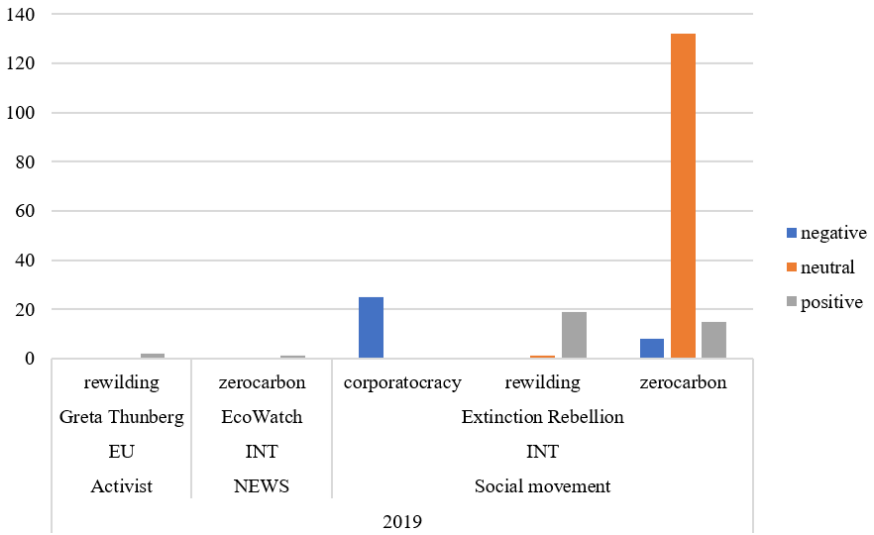


Figure 4.23: Most frequent lexical creations in 2019 per authortype (in raw numbers)

Finally, in 2020 the number of tweets containing a new lexical item dropped to 125 as shown in table 4.12. This figure is related to the general trend of the total number of tweets collected in the corpus, where 2020 is the year with the lowest number of tweets. However, news sites used these items the most, 53 times, 36 from Europe and 17 from international accounts. They are followed by social movements with 42 posts with a new item, 6 from Europe, 26 international and 10 from the U.S. NGOs come third with 20 posts, 8 European, 11 international and 1 from the U.S. This year also includes 2 posts from European activists. As for organizations and politicians, only European ones tweeted new lexical items, 5 and 3, respectively.

Presence of lexical innovation	EU	INT	US	Total posts
2020				**125**
Activist	2			2
NEWS	36	17		53
NGO	8	11	1	20
Organization	5			5
Politician	3			3
Social movement	6	26	10	42

Table 4.12: Lexical innovations in 2020 per group and place

The most tweeted new lexical units were *pollutionwatch*, *ecowatcher*, and *specieswatch* as displayed in figure 4.24. The communicative function of *pollutionwatch* is also confirmed this year, and provided links with the effects of the pandemic, e.g., *"Pollutionwatch: air quality benefits of lockdown continue"* (18/06/2020 Guardian Environment). Moreover, *ecowatcher* was mainly used to foster the sense of connectedness among the followers of the news site account EcoWatch. Lastly, *specieswatch* served to provide mostly neutral information about species.

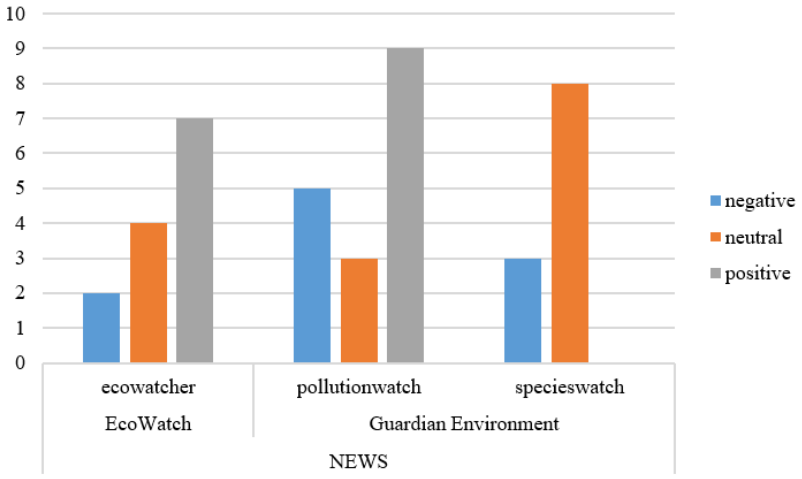


Figure 4.24: Most frequent lexical creations in 2020 per authortype (in raw numbers)

Overall, among the social movements, the international group Extinction Rebellion gave the greatest contribution with 454 posts that included a new lexical item, starting from

2018 to 2020, as shown in figure 4.25. In addition, another group, the American Climate Reality, tweeted 59 times with a new item in the text. Moreover, 350.org Europe tweeted 25 times, while Earth Guardians and Fridays for Future used a new lexical innovation 7 and 2 times, respectively.

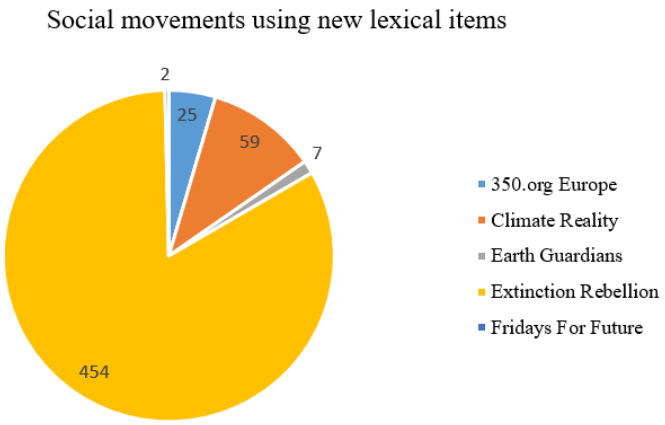


Figure 4.25: New lexical items per social movement (in raw numbers)

Despite the fact that news sites rank second in the employment of lexical innovations, this group includes only two accounts, as can be seen in figure 4.26. The greatest contribution is given by the European Guardian Environment with 172 posts. The other 53 posts come from the international account EcoWatch.

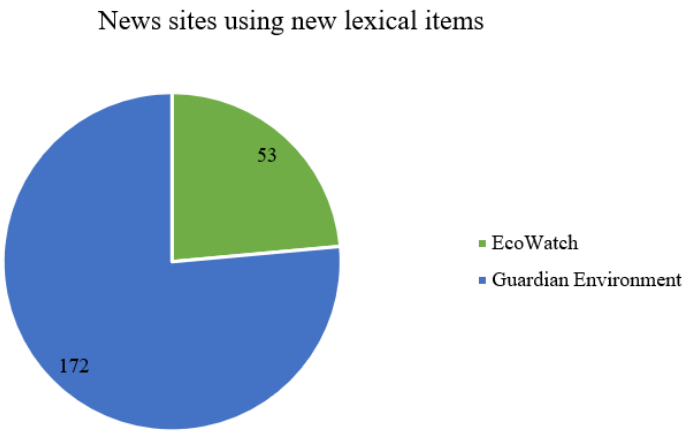


Figure 4.26: New lexical items per news site (in raw numbers)

In addition, among the NGOs, figure 4.27 shows that the international Greenpeace posted 55 tweets using a new lexical unit, followed by the European Environmental Bureau (EEB) with 38 tweets. The American Nature Conservancy and the international Climate Action Network used new items 11 and 3 times, respectively.

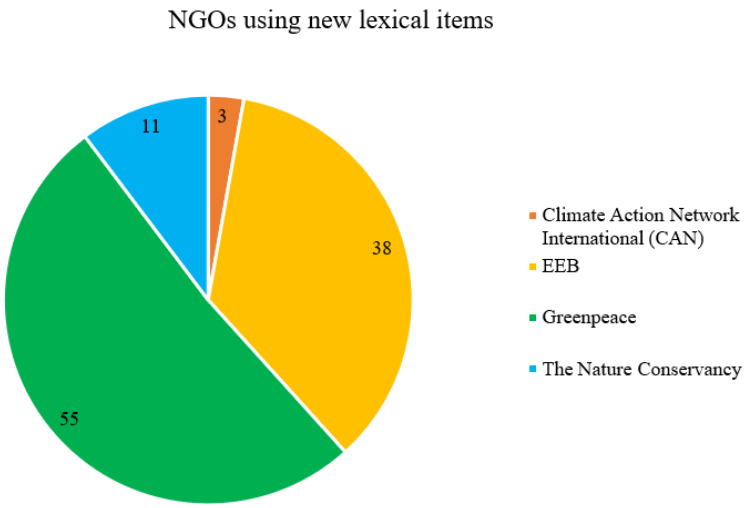
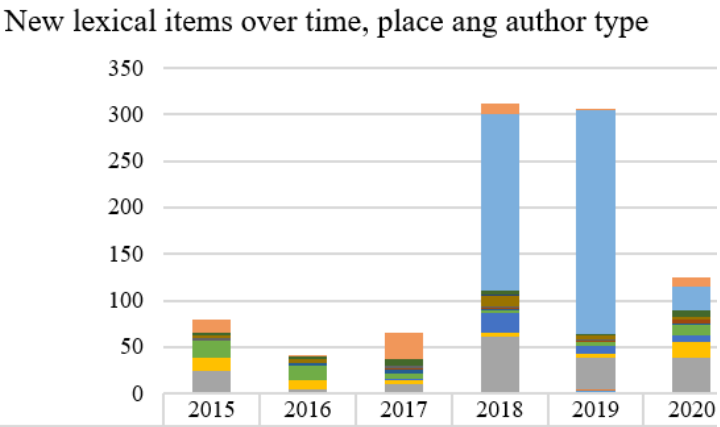


Figure 4.27: Lexical items per NGO (in raw numbers)

As can be seen in figure 4.28, despite a general low usage of lexical innovations among politicians, Andreea Strachinescu, Head of Unit New Energy Technologies and Innovation in the Directorate General for Energy of the European Commission, used new items 20 times. Other European commissioners, namely Frans Timmermans and Mariya Gabriel, used them twice each. On the other hand, in the American scenario, Gina McCarthy, Den Haaland and Ed Markey used new units once each. As for the organizations, there are 18 posts in total which include a new item, 10 from the U.S. and 8 from Europe. Specifically, U.S. EPA 4, U.S. Department of Energy 6, EU Environment 3, and EU Climate Action 5. As mentioned above, the tweeters with the lowest number of new lexical items encountered are activist. However, the European Greta Thunberg used them 7 times, and the Americans Jerome Foster II and Xiye Bastida included them 3 and 2 times, respectively.



	2015	2016	2017	2018	2019	2020
Social movement - US	14	1	28	11	2	10
Social movement - INT				190	240	26
Social movement - EU	3	3	7	5	1	6
Politician - US	1			1		
Politician - EU	2	4		11	4	3
Organization - US	3		3	2	2	
Organization - EU			1	1	1	5
NGO - US		3	4	2	1	1
NGO - INT	19	16	6	2	4	11
NGO - EU			1	21	8	8
NEWS - INT	13	9	5	5	4	17
NEWS - EU	25	5	10	61	35	36
Activist - US					1	
Activist - EU					3	2

Figure 4.28: New lexical items over time, place, and author type

To summarize, the group which mostly used new lexical items is social movements with 547 posts in total, specifically the international ones, then followed by news sites and NGOs. In this case, most tweets containing new lexical items come from international groups, i.e., news sites, NGOs and social movements. It is worth highlighting that European tweets with new items are three times as much compared to the American ones, 272 and 90, respectively. This difference is also due to the fact that European tweets include a news site account, hence an extra group. Indeed, with the subtraction of the 172 tweets posted by the news site Guardian Environment, European tweets would count of 100 posts with new lexical units, versus the 90 from the U.S.

To conclude, the analyzed data present a similar interpretation of the results of the previous hypothesis: (1) the three specific stakeholders pursue precise goals, such as

awareness raising, call to action, and attribution of responsibility; (2) the size of their community structure fosters a wider action range. Indeed, the facts reported are not circumscribed to particular geographical areas, but to the whole world, thus the need to express new phenomena becomes greater and also more urgent if taken into account the commonality of the issue.

4.2.3 Discussion

As emphasized by Mühlhäusler (2003, p. 33), "the misfit between the contours of language and the contours of nature perceived by many environmentalists today, has been the concern of language planners, scientists and the popular mind in a different form for a very considerable time". The results show how the ongoing environmental issues have been reconceptualized and have found a new way of being expressed with new words and collocations. However, the first hypothesis may not be validated. In fact, the statistical analyses showed how the employment of collocations is highly typical among activists, politicians and social movements. On the other hand, the second hypothesis can be validated. In fact, from the results activists, social movements, news sites and NGOs use the highest number of new lexical items.

Overall, all groups show a digital engagement in relation to the climate change context taking advantage of the possibility to communicate directly their social or political view to the world thanks to the development of social networking platforms, which enable either personal or collective actions (Livingston & Asmolov, 2010). In addition, the advent of the digital provides the opportunity to reach out without extra costs (Bennett & Segerberg 2012) and with no geographical border constraint (Bennett, 2003). In fact, the use of social networks, such as Twitter, has generally promoted the possibility to interact

with individuals, other groups and/or politicians, offering the chance to commit to their cause fostering a collective identity (Ray & Tarafdar, 2017). Furthermore, the use of specific collocations and new lexical items may also aim at influencing and convincing followers to consider climate change issues as a community problem (Nerlich & Koteyko, 2009b). As a matter of fact, in the so-called *twittersphere* analyzed in this study, some collocations and new lexical items were also used as hashtags, e.g., *climate change* and *zerocarbon*; and as pointed out by De Cock and Pizarro Pedraza (2018), hashtags have the capacity to increase the spread of a lexical expression and expand the "loudness" of a discourse, thus making it viral and searchable, and fostering a more solid tie within the virtual community (Zappavigna, 2011; Roginsky & De Cock, 2015; Schwell, 2015). Indeed, assuming that specific language use and lexical innovations do have precise communicative functions, some attention must be given to the spread of these features among the different users. With regard to this, as emphasized by Granovetter (1973), in social networks, as can be in online social media, general diffusion, e.g., the use of specific language patterns such as collocations and lexical innovations, follows universal trajectories and the chances of making something viral depends on the social structure of the community and on its ties. In the case of Twitter, the ties created within a community have been defined as an "ambient affiliation" (Bruns & Burgess, 2011; Zappavigna, 2011), i.e., the affiliation process based on shared values where the participants identify themselves as members of a community. For instance, some author types, i.e., social networks and NGOs, operate on a global scale, gaining popularity measured by the number of followers, who in turn use and disseminate new words and contents. In fact, the findings confirm how in the climate debate social movements cover an important role in spreading and sharing information to political and public stakeholders and thus serve as unbiased watchdogs (see Hodges & Stocking, 2016). This can also be related to forms

of action such as spreading information, signing petitions, mobilizing protests, and expressing one's opinion. As a result, in their discourse, social movements tend to shed light on climate events all over the world contributing to the creation of a widespread community tackling the same issue.

Additionally, young activists are enabled to take part in the discussion of important topics on Twitter. The findings show how activists contributed to emphasize the urgency of the situation through their discourses which are mainly built around (1) political inaction as politicians are not doing enough to stop the climate emergency; (2) the lack of fairness related to a call on climate justice, since a safe climate is a human right and younger generations will experience the worst effects of climate change (Pickard, 2021).

As for the two news companies, they show an intense involvement in the climate crisis and make a great use of social media platforms to disseminate information. The two chosen ones give considerable editorial importance to environmental coverage and are particularly interested in youth involvement in the topic (Painter et al., 2018).

On the other hand, the involved organizations did not provide a great deal of evidence of online climate engagement; consequently, a further investigation was carried out to highlight the nature of their discourse through the analysis of the collocation *climate change* among these authors. As can be seen in the examples (77), (78), (79) below, the common feature is the acknowledgement of climate change and most of them are policy-oriented tweets. Nevertheless, in the European scenario, Greens/EFA in the EU Parliament do question political action, see example (80), while in the American context the trend of posts containing the expression "climate change" undergoes a period of reticence during the Trump administration, thus signaling the influence of political polarization (Fløttum, 2010).

76. This report gives policymakers & practitioners the information they need to make decisions that tackle climate change while considering local context & people's needs. The next few years are probably the most important in our history, Debra Robers, Co-Chair WGII #sr15 #ipcc (08/10/2018 IPCC)

77. Opinion by @pcanfin on a new partnership with UK calls for including protection of biodiversity and environment and fight against climate change including full alignment of UK to EU 2030 & 2050 climate targets. Approved with 64 votes to 15 Read it here (04/05/2020 ENVI Committee Press)

78. Air pollution is the 2nd biggest environmental concern for Europeans after climate change & they are making their own contributions to reduce it. Learn more about #airquality in Europe #CleanAirEU (17/11/2017 EU Environment)

79. Wondering what the ???? does on #Adaptation to climate change? Here is the new outline of the #EUAdaptationStrategy #AF2018 #ClimaDiplo (19/06/2018 EUClimateAction)

80. #ClimateChange is one of the biggest challenges threatening the future and security of the EU. The good news is that we know what to do about climate change. The bad news is that we don't do it. The @EU_Commission has been too shy on this issue!? @SkaKeller #SOTEU (12/09/2018 Greens/EFA in the EU Parliament)

81. Scientists: Climate change posing bleaching risk to Australia's #GreatBarrierReef (14/04/2016 NOAA)

82. Everyone has places important to them. Climate change affects us all. #ActOnClimate #COP21 (07/12/2015 EPA)

83. Combat climate change in your community! Learn about @POTUS' new initiative & join us TODAY @ 2pm EDT. #ActOnClimate (15/07/2015 U.S. Department of Energy)

As for politicians, already Carvalho and Burgess (2005) showed how politicians highlight the urgency to mitigate climate change, while other studies on Twitter emphasized the use of tweets by politicians as short press releases and personal ones to engage with the public (Golbeck et al., 2010). In addition, Resce and Maynard (2018) showed how climate change engagement on Twitter is very high in comparison to other salient topics of different nature. Nonetheless, the number of tweets by this authortype is relatively low. Additionally, as pointed out by Cunningham et al. (2022), the main discourses held by politicians are mainly related to the economy, industry, and politics. Both in Europe and in the United States, politicians do not question the existence of a climate issue and refer to it as a solvable problem, apart from some the so-called *climate deniers* such as Donald Trump. The solutions seem to be provided by sustainable economic plans and by ideal world agreements, nevertheless there is no reference to anthropogenic causes. However, an internal dispute manifested through a discourse of blame, rises among U.S. politicians and evidence was provided to show how this topic was politicized and served as an offence towards the counterparts.

The following section outlines the results of the other research questions offering a different perspective of language variation through a diachronic analysis.

4.3 Language variation from 2015 to 2020 (RQ2)

4.3.1 First hypothesis

As for the second Research Question – *To what extent does language vary from 2015 to 2020?* – the first hypothesis predicts that the number of tweets increases over time. Thus, this part of the study focuses on the analysis of the trend of the number of tweets through the established time frame. However, the results of a statistical analysis, as illustrated in figure 4.29, provides a general picture of an unsteady trend. Hence, further investigation is needed in order to identify what might affect the up and downturns of tweets, such as extreme weather events or global mobilization.

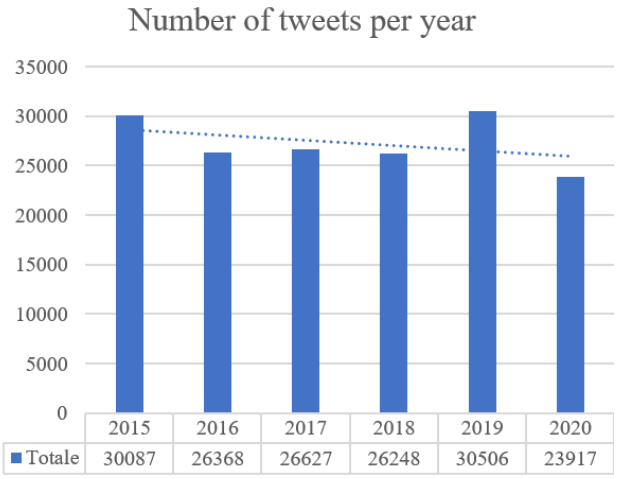


Figure 4.29: Total number of tweets per year (in raw numbers)

In fact, many scholars have investigated how the number of climate-related tweets rises in connection to particular events (Segerberg & Bennett, 2012; Pearce et al., 2014; Kirilenko & Stepchenkova, 2014; Kirilenko et al., 2015), and how hashtags increase the "loudness" of a discourse related to a specific topic, thus making it viral (Zappavigna, 2011; Segerberg & Bennett, 2012; Pearce et al., 2014). Specifically, hashtags were also used by Pearce et al. (2019) to identify the main topics of the hashtags when tweeting about the IPCC report of 2013. In light of this, I analyzed the most frequent hashtags to trace back the main events that occurred over this time span in relation to the posted

messages per author types as shown in table 4.13. Specifically, the ranking list of the most frequent hashtags was obtained in Excel and each event, especially extreme weather events, to which the hashtag referred to was confirmed with the WMO (World Meteorological Organization) bulletins.

Years	Social movements	Politicians	Organizations	NGOs	NEWS	Activists	Total
2015	10559	2282	3256	5243	8731	16	**30087**
2016	9749	1909	2696	4679	7324	11	**26368**
2017	10191	2228	2724	4849	6618	17	**26627**
2018	9747	2820	3103	5166	5024	388	**26248**
2019	13218	3541	3113	5063	4004	1567	**30506**
2020	7609	3752	2962	4779	4135	680	**23917**
Total	**61073**	**16532**	**17854**	**29779**	**35836**	**2679**	**163753**

Table 4.13: Number of tweets per author type through years

As a result, in 2015 there was a total of 30087 tweets and 13161 contained at least one hashtag. The most active users were social movements, news sites and NGOs. The most frequent hashtag was #COP21 in 1429 tweets together with 650 posts containing #Paris2015. In addition, another important event was the implementation of the Clean Power Plant, introduced by President Barack Obama and the rejection of the KeystoneXL pipeline in the U.S. with 65 tweets. The #IPCC was also present 344 times.

Thereafter, 2016, which reported 26,368 climate-related tweets in total, presented 13,292 hashtags, and 494 of these referred to #ParisAgreement, still discussing perspectives and effects of the agreement and already expressing concern about the new elections is the U.S. as tweeted by Climate Reality *"@JohnKerry: We will fight to keep the US in the Paris climate deal #ParisAgreement #ClimateHope"* (27/11/2016). Moreover, 166 hashtags contained #drought as an extreme weather event, especially in the U.S. Another issue was the #DAPL, in protest to the Dakota Access Pipeline. Also, in this year the most active users were social movements, news sites and NGOs.

In 2017, there were 13,852 tweets with a hashtag. The trend of the users is the same as the previous years and through #ActOnClimate, in all over the geographical areas considered, the discourse is politically oriented against President Trump and climate denialism as shown in the examples below:

84. Now more than ever, we need people like you to stand up to climate denial. Don’t just #ActOnClimate #LeadOnClimate (10/01/2017 ClimateReality)

85. Trump is taking the US out of the Paris Deal. But it's not the end for climate action. Join us #actonclimate (02/06/2017 350Europe)

This hashtag also referred climate events such as droughts and megafires.

Subsequently, in 2018, out of 26,242 tweets, 16204 had a hashtag. A new popular hashtag was #ExtinctionRebellion, which signals the start of the youth climate movement which took off the next year voicing their political protest (Boulianne et al., 2020):

86. Still think plastic straws are the world's worst enemy? Sorry, but that's not going to cut it. Let's tackle this problem at the root, not the output. #Rebelforlife #ExtinctionRebellion (27/12/2018 Extinction Rebellion)

Indeed, there is a significant increase in the number of posts by activists, 388 tweets. No particular extreme events were highlighted in the hashtags and the main topics were #breakfreefromplastic and #RenewableEnergy. Thus, most of the attention was drawn to the fight against plastic pollution and fossil fuels and the shift to renewable sources.

The following year, 2019, is unsurprisingly the most tweeted one with 30,506 posts and 19,648 hashtags. The most frequent hashtag is #climatecrisis along with #ExtinctionRebellion and #ClimateStrike. This was the year of youth protests led by

Swedish climate activist Greta Thunberg who started protesting in front of Swedish Parliament with a sign: “School Strike for Climate”. The biggest climate protest took place on March 15, 2019, involving more than 1 million protesters around the world. This can be considered as the year with the biggest number of tweets by social movements and activists, 13,218 and 1,567, respectively. Young environmentalists’ action was extremely supportive of a particular political aspect, the Green New Deal. In fact, #GreenNewDeal was a hashtag adopted by most author types, from social movements to U.S. and European politicians.

Finally, in 2020, there were 13,573 hashtags, 854 included the word “Covid-19”, and the most frequent hashtag was #climatecrisis. It can be said this is the year with the smallest number of tweets, 23,917. However, it is also the year with the biggest number of posts by politicians, 3,752. The main topics dealt by European politicians are related to #EUGreenDeal, #ClimateAction and #COVID19. For instance, climate change and the coronavirus seem to be associated as two enemies to fight against:

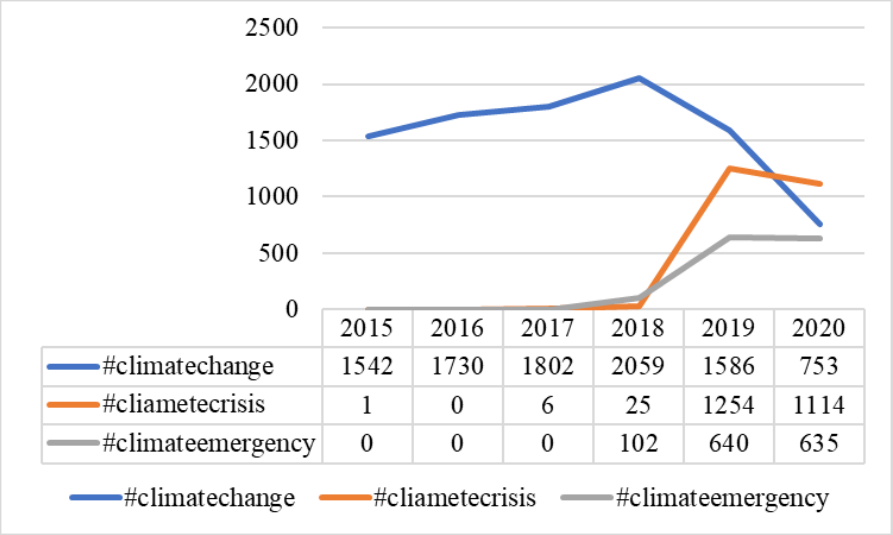
> 87. Fighting climate change, #COVID19 & protecting our economies: global challenges require global solutions. This #G20Summit marks a new beginning for global cooperation. With its partners, Europe is ready to be a driver of this new beginning (20/11/2020 Ursula von der Leyen

In the U.S., politicians mainly used the hashtag #GreenNewDeal, #ClimateChange and #COVID19, and the discourse is also related to the accusation of President Trump’s administration:

> 88. The Trump Administration is cooking the books, prioritizing polluters’ interests over Americans’ health. Much like #COVID19, ignoring the

costs of #ClimateChange won't make it disappear. (15/07/2020 Frank Pallone)

Overall, from 2015 to 2017, #ActOnClimate, #ClimateHope and #ClimateChange were the leading hashtags. In 2018 #ClimateChange was the most tweeted hashtag followed by #ExtinctionRebellion and #ClimateHope. Thereafter, in 2019, the most frequent ones were #climatecrisis, #climate, #ExtinctionRebellion, #ClimateStrike and finally #ClimateChange. As in 2020, #climatecrisis confirmed to be the trendiest, followed by #ActOnClimate, #ClimateAction, #COVID19 and #ClimateEmergency. This can be related to the change of the perception of climate change also confirmed by the Oxford University Press identifying "climate emergency" Word of the Year 2019[29]. As can be seen in figure 4.30, *climate* starts being associated to other nouns to describe its urge, which independently from the number of tweets, it becomes more compelling.



	2015	2016	2017	2018	2019	2020
#climatechange	1542	1730	1802	2059	1586	753
#cliametecrisis	1	0	6	25	1254	1114
#climateemergency	0	0	0	102	640	635

Figure 4.30: Frequency of *#climatechange*, *#climatecris#*, *#climateemergency* over time

[29] https://global.oup.com/news-items/archive/woty19?cc=it

4.3.2 Second hypothesis

The second Research Question also included a second hypothesis affirming that new lexical items have a stronger negative meaning throughout time due to the fact people are more aware of the negative consequences of climate change. As already reported in the previous section, in the corpus there is evidence of new lexical items, and the occurrence of these words varies across the years. Overall, 2018 was the year with the highest usage of new items (312), followed by 2019 (306). On the other hand, 2016 was the weakest year (41), after a good start in 2015 (80), and followed by a slight rise in 2017 (65). Nevertheless, in 2020 the use of these words decreased again. Moreover, it has already been analyzed that social movements employed lexical innovations more than the other groups, with 547 tweets, followed by news sites and then NGOs.

Specifically, in the attempt to validate or reject the second hypothesis, it was necessary to annotate manually the connotation of the new lexical items with reference to the whole co-text. As a result, table 4.14 illustrates the general picture of the polarity of words per year. I must remind that the objective was to identify the connotation of the new words considering the general meaning conveyed in each tweet. Thus, the same lexical unit may present a different label (positive, negative, neutral) according to the tweets.

Year	Negative	Neutral	Positive	Total
2015	45	6	29	80
2016	19	1	21	41
2017	31	4	30	65
2018	120	105	87	312
2019	66	156	84	306
2020	43	26	56	125
Total	324	298	307	929

Table 4.14 Connotation of new lexical items per year (in raw numbers)

Additionally, to gain a better understanding of the polarity of these words, I adopted the framing process which allows “to select some aspects of a perceived reality and make

them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation" (Entman, 1993, p. 52).

On the whole, the usage of new lexical items with a negative meaning is greater compared to the neutral and positive ones. This particularly occurred in 2015 and 2018. Starting an in-depth analysis for each year, in 2015 the lexical innovations were used 80 times, 45 times they were attributed a negative meaning, 6 a neutral one and 29 positive. Specifically, *airpocalypse* was the most used word, 2 times by the news site Guardian Environment, 8 times by Greenpeace and 4 times by Climate reality.

89. Media outlets are calling China's record air pollution an "Airpocalypse". (Climate Reality) – negative

90. Beijing's "airpocalypse". Just one reason why we're doing the #COP21 (Greenpeace) – negative

91. Airpocalypse now: China pollution reaching record levels (Guardian Environment) – negative

As reported in the examples above, the three tweets declare an alert referred to a high and dangerous air pollution level in China describing it as an apocalypse, with a clear mention to the movie *Apocalypse now*, creating a blend from the two existing words air + apocalypse, such as ecotage (eco + sabotage), smog (smoke + fog) (Mühlhäusler, 2003, p. 79). The frame is related to *disasters or catastrophes*, connected to climate change and its impacts on nature and people, also highlighting the anthropogenic cause.

The word *artivism* was present 4 times and posted by Greenpeace. It was annotated 1 time negative and 3 times positive. In addition, *artivist* was used twice with a positive meaning by the social movement 350Europe. The creation of these items comes from the

derivation of the free-standing lexical form art with a non-free form (Mühlhäusler, 2003, p. 78). The coinage of these words may be explained by the need to identify a specific community with shared actions towards the climate, i.e., people who take advantage of their art to protest against climate change.

92. These sculptures of beach trash will make you reconsider #plastic #artivism (25/10/2015 Greenpeace) – positive

93. This artist brought ice from Greenland to Paris as a reminder of #climatechange. #artivism (03/12/2015 Greenpeace) – positive

94. Greenland icebergs are melting this week. In Paris. #climatechange #COP21 #Artivism (05/12/2015 Greenpeace) – negative

95. Live Q&A including @350's own Artivist Coordinator: How can culture and sport inspire #climate action? (22/01/2015 350Europe) – positive

96. Art, oil & arrests in Paris as artivists lay down #redlines & call on Louvre Museum to drop @total & @eni sponsors (09/12/2015 350Europe) – positive

These tweets draw on the c*ivil society protests* issue-specific frame, i.e., polite forms of contrast, and demonstrations and protests to defend the planet, also through art.

Birdwatch is a lexical item that occurred in the corpus such as *pollutionwatch, specieswatch* and *weatherwatch* as compounds in a single-stress word. As described in figure 4.31, the meaning provided tends to be negative, in 4 tweets it is neutral, and in 3 positive.

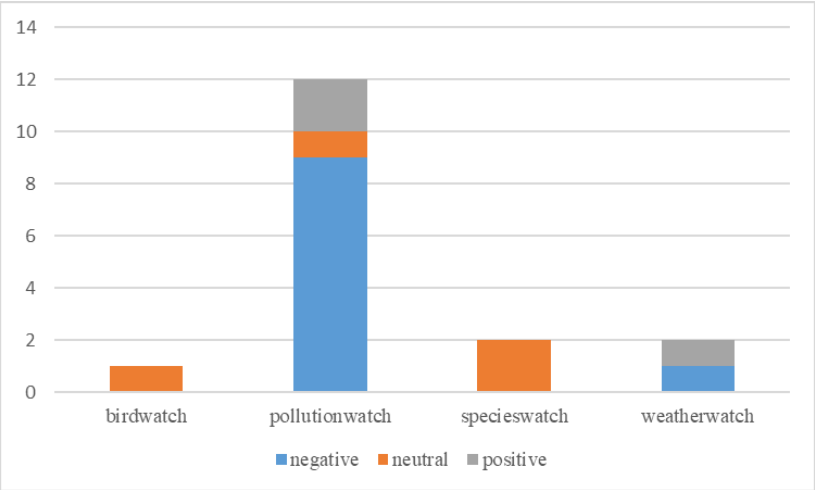


Figure 4.31: Frequency and polarity of *birdwatch*, *pollutionwatch*, *specieswatch* and *weatherwatch*

The main aim of these tweets is to provide *information of facts or scientific background*, providing information with the intent to inform the general audience of causes and effects of climate change, including on wildlife. Specifically, they can be interpreted either as warns or advice, and were all posted by the Guardian Environment. Presumably, these words are meant to specify the focus on what is meant to be kept under control, namely wildlife, pollution, and weather.

97. Birdwatch: Green sandpiper (16/08/2015 Guardian Environment) – neutral

98. Pollutionwatch: A deadline missed, with deadly consequences (10/05/2015 Guardian Environment) – negative

99. Pollutionwatch: How to make our cities safer (07/06/2015 Guardian Environment) – positive

100. Specieswatch: Wild boar (23/08/2015 Guardian Environment) – neutral

101. Weatherwatch: Melting polar ice brings promise of prosperity (03/08/2015 Guardian Environment) – positive

Brandalism is a derivation and was reported three times, by Greenpeace, 350Europe and by EcoWatch. It was annotated with a positive meaning:

102. Fantastic Brandalism art placed on advertising boards across Paris, mocking fossil fuel corporate sponsors of COP21 (29/11/2015 350 Europe). – positive

As shown in the tweet sample above (102), the posts refer to the frame of *civil society protests* through art which report vandal actions of fossil fuel companies. Moreover, this word may have been created to signal a connection between brands seen as vandals, and activism against it.

Climatarian occurred only once, posted by Ecowatch. It is a case of a derivation from the word climate referring to people. This word can be framed within the *opportunity* frame linked to possible ways of fighting climate change with a wise selection of food, and it was annotated as positive:

103. 'Climatarian' Makes @NYTimes List of Top New Food Words for 2015 (22/12/2015 EcoWacth) – positive

Earthship was tweeted 3 times by EcoWatch with a positive meaning. This lexical item is a compound and fits the *opportunity* frame as it promotes an environmentally friendly solution to inhabit the planet:

104. Incredible Photos Show Why Earthships Make the Perfect Home (01/06/2015 EcoWacth) – positive

Ecoambassador occurred once by Gina McCarthy, American politician. It is a compound, and it is identified as a name for environmentalists with a positive connotation. As suggested by Mühlhäusler (2003, p. 80), "this is a field of worthwhile enquiry" as it is common to stereotype individuals who share "attitudes and actions towards the environment". As a personal integration of the issue-specific frames, this item reflects the *stereotyping people* one.

105. Great to see 1,000+ #NativeYouth from #WHTYG. I encouraged them join our tribal ecoAmbassadors prog & #ActonClimate. (10/07/2015 Gina McCarthy) – positive

Ecocapsule, again a compound, was tweeted twice by EcoWatch. It refers to the *renewable energy* frame as it promotes new ways of living thanks to natural energy sources.

106. World's First Off-Grid EcoCapsule Runs Entirely on Renewable Energy (24/12/2015 EcoWacth) – positive

The American Environmental Protection Agency (EPA) tweeted three times the item *ecycling* with a positive meaning. It refers to electronic recycling and it fits within the *opportunity* frame as the message aims at offering the possibility to readdress personal actions in an eco-friendly way while safeguarding the environment:

107. Companies in our Electronics Challenge help us promote ecycling. Recycle your electronics (13/01/2015 EPA) – positive

Foodprint was posted twice by Frans Timmermans, European politician. This compound was annotated as neutral, and it refers to the *opportunity* frame. In particular, it may refer to the mark human beings leave on the planet based on one's choice:

108. @eufoodprint tackling food waste is important - we need to look at the whole value chain and get all relevant actors to cooperate on this (15/07/2015 Frans Timmermans) – neutral

Fracker occurred only once in a Guardian Environment tweet. It is a derivation and conveys a negative meaning to the message since it refers to the action of drilling which is considered harmful for the environment, and it belongs to the *Attribution of responsibility or Blame* frame. Among the tweets over the years, the noun *fracker* specifically refers to INEOS, a British multinational chemicals company, which also acquired British Petroleum.

109. Denton, Texas, banned fracking last year then the frackers fought back (22/05/2015 Guardian Environment) – negative

Climate Reality tweeted *fuelish* twice. This derivation is an adjective to describe people, and it is in line with the *attribution of responsibility or blame* specific-issue frame as it points out the contribution to climate worsening.

110. MT @IEA: Don't be fuelish! Can you guess what year or decade this vintage energy conservation campaign is from? (15/03/2015 Climate Reality) – negative

The following four lexical items are forms of derivation characterized by the same prefix *mega-*: *megadam*, *megadrought*, *megafire*, *megamine*. The use of the prefix mega- may aim at magnifying the risks and dangers of manmade constructions, as dams and mines, and anthropogenic causes, as droughts and fires. All four were annotated as negative and were used by the Climate Reality, Greenpeace, Guardian Environment and EcoWatch.

Megadam was tweeted twice and refers to *disasters or catastrophes*, but in this case with a direct accusation of manmade disasters, it recalls *climate justice* specific- issue frame as it involves Indigenous People:

111. Megadams threaten the Amazon and the Indigenous Peoples who live there (11/10/2015 Greenpeace) – negative

Megadrought occurred 13 times. These tweets are linked to the *disasters or catastrophes* frames; however, the example below was framed as *information of facts or scientific evidence*:

112. @NASA: Future #Megadroughts Could Last 30 Years 'Thanks to Human-Induced #ClimateChange' (13/02/2015 EcoWatch)

Megafire occurred only once. Also, this word refers to *disasters or catastrophes* connected to climate change:

113. 'Megafires' are already transforming the US landscape - and climate change is making it worse (12/08/2015 Greenpeace) – negative

Megamine was tweeted once and is also linked to *attribution of responsibility or blame*:

114. There's no good place for a megamine - Especially not the Great Barrier Reef doorstep (22/05/2015 Greenpeace) – negative

The words *rewild, rewilded* and *rewilding* occurred 6 times in total with a positive meaning and were used by Greenpeace and Guardian Environment. For the message conveyed in these tweets I added an additional frame compared to the ones of reference, i.e., *nature restoration* as they recall a pre-existing condition before anthropogenic actions. In some tweets, these three words also relate to *information of facts or scientific*

evidence, specific-issue frame. but not as a variant of something existing such as green jobs.

115. Rewilding Britain launches with the aim of restoring UK's lost wildlife and habitats (15/07/2015 Guardian Environment) – positive

Solutionary appeared only once with a positive meaning. It is a derivation and belongs to the *stereotyping people* frame as it refers to someone who looks for solutions against climate change, as specified in the example below, naming *solutionary* a member of the social movement Earth Guardians:

116. Aidan Ferris (a badass Earth Guardian solutionary and RYSE Youth Council member) and Earth Guardians New York met... (21/05/2015 Earth Guardians)

Zerocarbon, a compound with a positive meaning, occurred only once in 2015. It will then reappear in 2018 in 143 tweets as one of the most viral hashtags. This word relates to products and services that do not emit carbon dioxide and to countries to hit net zero. The concept rose after the Paris Agreement and spread a few years later with countries and companies setting new targets. It's meaning refers to the *opportunity* frame.

117. 3 Steps to a #ZeroCarbonFuture (13/05/2015 EcoWatch) – positive

The year 2016 reports the lowest usage of lexical innovations, 41. Most of them were already used in the previous year such as *airpocalypse*. However, this year it is not only employed to talk about China's air pollution, but it also involves India and Nairobi:

118. An 'airpocalypse' is threatening Nairobi. (11/07/2016 Greenpeace) – negative

119. India's #airpocalypse isn't just a Delhi problem. It's a national problem #DelhiSmog (02/12/2016 Greenpeace) – negative

120. Smog refugees flee Chinese cities as 'airpocalypse' blights half a billion (21/12/2016 Guardian Environment) – negative

Artivist and *artivism* appear again, 9 times in total by Greenpeace and EcoWatch, always with a positive meaning. The main frame is the *civil society protests*.

121. This artist is making a statement on our #oceans trash issue through photography (30/01/2016 Greenpeace) – positive

122. SUPER COOL! Ocean 'Artivist' Creates Breathtaking Coral Reef Sculptures (07/03/2016 EcoWatch) – positive

The item *bioeconomy* appears for the first time this year in politician Andreea Strachinescu's tweets. It was annotated as positive and refers to the e*conomics and business* issue-specific frame. In fact, this item denotes the use of renewable resources to produce materials and energy. It then became part of the 2018 EU Bioeconomy Strategy in order to enhance a circular and low-carbon economy.

123. Looking forward to present European #Bioeconomy at @ScalingUp2016 Nov. 16 in #Ottawa (15/11/2016 Andreea Strachinescu) – positive

Climatarian appears in the same tweet with the new word *reducetarian*. The meaning is positive and the tweet sounds like a joke. This is another case of the *opportunity* frame for fostering healthier and environmentally friendly behaviors.

124. A climatarian, a reducetarian and a sustainatarian walk into a bar. (23/05/2016 Greenpeace) – positive

A new word of this year was *dumpsite*. The general meaning of the sentence is positive, and this compound refers to the *opportunity* frame of taking action to promote cleaner cities:

125. New York comes clean: the story of the notorious Fresh Kills dumpsite (28/10/2016 Guardian Environment) – positive

Earthship reoccurs in 3 tweets posted by EcoWatch. In these tweets it is more referred to the frame of *opportunity* related to mankind to rediscover nature and environmentally friendly behaviors.

126. Want to Get Off the Grid and Live in Harmony With Nature? Build an #Earthship (01/02/2016 EcoWatch) – positive

Fracker is repeated 3 times by Greenpeace and Guardian Environment. It refers to the *stereotype people* frame but also to *attribution of responsibility or blame* linked to the activity of drilling.

127. In Ohio, frackers are drilling. Soon Ineos will be doing the same in Britain (17/09/2016 Guardian Environment) – negative

The previous derivation forms *megadam*, *megadrought*, *megafire* and *megamine* are present again together with two new forms: *megapipline* and *megastorms*. In total they occurred 13 times and were used by Greenpeace, The nature Conservancy, 350Europe, Guardian Environment and EcoWatch. For 12 times they were annotated negatively, while one tweet containing *megapipeline* was associated with a positive meaning as referring to victory over the construction of a pipeline:

128. Inspiring words from @janekleeb @BoldNebraska about KXL fight victory & lessons to apply to Euro-Caspian Gas megapipeline in Europe (26/09/2016 350Europe) – positive

The tweets below (129 – 132) refer to four different frames, such as *attribution of responsibility or blame*, *information of facts or scientific evidence*, *disasters or catastrophes*, and *call to action*.

129. A megadam could threaten the #wildlife in the? of the #Amazon. Take action to stop it (29/06/2016 Greenpeace) – negative - *disasters or catastrophes*

130. Collapsing ice sheets, violent megastorms. New scientific study on planet's future is dire (27/03/2016 Greenpeace) - *information of facts or scientific evidence*

131. We have a lot of work to do to restore our forests from megafires, beetles (16/07/2016 The Nature Conservancy) – negative - *call to action*

132. Optimism for the megamine project at the Great Barrier Reef is a mask over its ongoing failure, says @NikolaCasule (15/02/2016 Greenpeace) – negative - *attribution of responsibility or blame*

Rewilding was used again only once by EcoWatch. It was annotated with a positive meaning and refers to the *nature restoration* frame:

133. Rewilding Our National Parks (07/06/2016 EcoWatch) – positive

Solutionary was tweeted again once by Earth Guardians and the frame is *stereotyping people*.

134. Mensa Tsedze, an incredible environmental solutionary and leader of Earth Guardians TOGO has proposed a project... (16/03/2016 Earth Guardians) – positive

In 2017 new lexical items occurred 65 times, 31 were negative messages, 4 neutral and 30 positive. The total number of new lexical words was 19 and 7 appeared for the first time that year. *Airpocalypse* is part of this list, and it is the most frequent one, 16 tweets, all with a negative meaning. It was used by Climate Reality, Greenpeace, and Guardian Environment. The issue is still related to China and Hong Kong this time. In one tweet the Guardian Environment also relates the problem to climate change. It still refers to the *disasters or catastrophes* frame, and to *climate justice*.

135. An import nobody wants. How China's #airpocalypse becomes Hong Kong's problem (21/02/2017 Greenpeace) – negative

136. People are fleeing a dangerous #Airpocalypse in Chinese cities. They're called 'smog refugees' (06/01/2017 Climate Reality) – negative

Artivism and *artivist* are present also in that year seven times, particularly in a European social movement's post, 350Europe, and one in Greenpeace's. These two words are annotated as positive except for one tweet, and the frames are *civil society protest* and a*ttribution of responsibility or blame*.

137. Hundreds watch as police arrive to arrest the 8 #FossilFreeCulture artivist performers at @vangoghmuse (12/05/2017 350Europe) – negative

In this case the negative polarity refers to how this form protest ended with the arrest of 8 artivists. The other tweets are linked to specific European places:

138. A call on @vangoghmuseum to cut ties with oil giant #Shell - 8 @FFcultureNL artivists arrested. #fossilfree (13/05/2017 350Europe) – positive

139. Artivists calling for a #FossilFree @MuseeLouvre stage powerful @total-sponsored oil spill performance inside museum. #zerofossile (05/03/2017 350Europe) – positive

Bioeconomy is tweeted three times, and once with another new word: *bioproduct*. Both are derivations of *bio-* and have a positive meaning, they are part of the *economics and business* frame as they relate to new energy sectors. The three tweets came from the American Department of Energy, in this corpus it is the first time an organization uses a new lexical item.

140. 3 new R&D projects aim to slash costs of producing algal biofuels and bioproducts. #Bioeconomy2017 (11/07/2017 U.S. Department of Energy) – positive

Corporatocracy is used for the first time and only once by EcoWatch. The tweet with this compound was annotated as negative as it refers to the domination of corporates, and it is part of the frame *attribution of responsibility or blame*.

141. Sci-Fi Novel Envisions Corporatocracy in a Climate-Changed Future (21/09/2017 EcoWatch) – negative

Two new words appear in the same tweet: *craftivism* and *craftivist*. Similar to *artivism* and *artivist*, these derivations are part of the *civil society protests* as they perform demonstrations to defend the planet:

142. These craftivists are crocheting coral to protect the Amazon Reef #Craftivism (05/02/2017 Greenpeace) – positive

Dumpsite is tweeted three times in 2016 with a negative meaning by Green Europe and EcoWatch. The frame is *disasters or catastrophes* but linked to anthropogenic causes.

143. As the world's environment ministers gather in Nairobi, one of the planet's largest dumpsites on the outskirts of the city shows just how bad the waste problem can get #BeatPollution #UNEA3 READ more in METAmag (06/12/2017 Green_Europe) – negative

144. A Tiny Island Used as a Nuclear Dumpsite Is About to Be Submerged by Water (28/11/2017 EcoWatch) – negative

Frontliner occurs for the first time in a tweet by Greenpeace with a positive meaning. The frame is *stereotyping people*:

145. We are the frontliners fighting against #climatechange and we have our own voices (25/06/2017 Greenpeace) – positive

Gigafactory is tweeted for the first time in 17 posts by Climate Reality and Eco Watch with a positive meaning in all, expect for one neutral one. This new word is part of the *opportunity* frame.

146. Move Over Tesla, Europe's Building Its Own Battery Gigafactories #ClimateHope (24/05/2017 ClimateReality)

147. 3 More Gigafactories Coming Soon to 'Change the Way the World Uses Energy' (24/02/2017 EcoWatch) – positive

That year the derivation of lexical forms with *mega-* include *megapipeline*, *megafire* and *megabank*. The 6 tweets express a negative meaning and they either refer to *attribution*

of responsibility or blame, *call to action*, or to *information of facts or scientific evidence*, mainly highlighting the harm to nature or to people.

148. Fossil fuel projects already exceed the carbon budget. @EBRD we can't afford a gas megapipeline #NoTANAP (18/10/2017 350Europe) – negative - *attribution of responsibility or blame*

149. Japanese indigenous groups and others just did a petition delivery in Tokyo calling on the 3 megabanks to stop... (17/02/2017 Earth Guardians) – negative - *call to action*

150. An unusual partnership aims to prove that loggers and conservationists can work together to make forests healthier and less prone to megafires while creating jobs (30/12/2017 The Nature Conservancy) – negative - *information of facts or scientific evidence*

The compound of -*watch* involves *pollutionwatch*, *weatherwatch*, and *specieswatch*. The eight tweets which contain these words are mainly informative of facts and were posted by the Guardian Environment. As such, the annotation may vary from positive to negative and the frames may be either *disasters or catastrophes* or *information of facts or scientific evidence*:

151. Weatherwatch: real-time maps of air pollution will soon make it easy to see where danger lies (05/12/2017 Guardian Environment) – positive - *information of facts or scientific evidence*

152. Weatherwatch: climate change and overfishing bring explosion of jellyfish (07/11/2017 Guardian Environment) – negative - *disasters or catastrophes*

153. Pollutionwatch: sepia skies point to smoke and smog in our atmosphere (12/11/2017 Guardian Environment) – negative - *information of facts or scientific evidence*

154. Specieswatch: efforts are being made to preserve the Arctic char in Britain (22/10/2017 Guardian Environment) – positive - *information of facts or scientific evidence*

The last lexical item is *rewilding* which occurred two times by the Guardian Environment and the organization EU Environment. In the first tweet the message was annotated as neutral, the second one has a positive meaning, both related to *information of facts or scientific evidence*:

155. Rewilding, climate scepticism and G20 green news roundup (07/07/2017 Guardian Environment) – neutral

156. Natural Capital Financing Facility 6 mln loan to @RewildingEurope to support wildlife & #Natura2000 (11/04/2017 EU Environment) – positive

As for 2018, it is the year with the highest frequency of new lexical items usage. Overall, there were 312 tweets which contained a new word, 120 were negative, 105 neutral and 87 positive. The new words detected were 27, however only 5 appeared for the first time that year. *Airpocalypse* and *artivist* occurred 8 and 4 times with negative and positive meaning, respectively. *Bioeconomy* appeared 8 times in the tweets of politician Andreea Strachinescu and the organizations EU Environment and U.S. Department of Energy, with a positive meaning trying to highlight climate solutions and political engagement and relates to the *economics and business* issue-specific frame:

157. A new #Bioeconomy Strategy to change the way we produce, consume & discard goods. In 2019, @EU_Commission will launch 14 concrete measures to preserve our #ecosystem #CircularEconomy #BlueEconomy #SmartCities #OurOcean #H2020 #LowCarbonEU2050 (22/10/2018 Andreea Strachinescu) – positive

Bioproduct occurred once in a post by the U.S. Department of Energy with a positive meaning, maintaining the frame of *economics and business* as bioeconomy:

158. FROM MOO TO GOO: @PNNLab researchers developed a system that converts methane from cows and other livestock into a deep green, energy-rich, gelatin-like substance that can be used to make biofuels and bioproducts. #CowAppreciationDay (10/07/2018 U.S. Department of Energy) – positive

Among the compounds of -*watch*, a new word was detected: *butterflywatch*. Also in this case, the tweeter is the Guardian Environment, it was annotated as neutral, and the frame is *information of facts*:

159. Butterflywatch: chilling impact of heatwaves on caterpillars (30/07/2018 Guardian Environment) – neutral

Corporatocracy was tweeted 22 times alone and 11 times with *zerocarbon* always by the international social movement Extinction Rebellion.

160. The @IPCC_CH report would have been even more terrifying / truthful if they had not 'self-censored' for the corporatocracy? There should be a Hippocratic Oath for scientists? Join the #ExtinctionRebellion now for people & planet (04/11/2018 Extinction Rebellion) – negative

161. We r almost #OutOfTime? The #ClimateEmergency is an #ExistentialThreat. But we r #RisingFromTheWreckage 4 an #EcologicalRevolution #Rebel against the ecocidal corporatocracy 31 Oct - 17 Nov (14/10/2018 Extinction Rebellion) – negative

162. #Rebel against the criminal climate wrecking UK government this Nov w/ us so that the end game is not the #extinction of people & planet but is the extinction of #corporatocracy. Declare the #rebellion w/ us 31 Oct (28/09/2018 Extinction Rebellion) – negative

Corporatocracy is framed within the strong *attribution of responsibility* and *call to action* and *civil society protests*, as well. Specifically, the tweets are addressed to the IPCC, and the UK government as supporters of oil and gas companies. The same frames occur in the tweets containing *corporatocracy* and *zerocarbon*:

163. Rebel w/ us against the corporatocracy for #ZeroCarbon2025: #LocalFood #OrganicFood #HealthyFood #HealthySoil #Permaculture Declare the #rebellion w/ us 31 Oct #Rebel on #RebellionDay w/ us 17 Nov (12/10/2018 Extinction Rebellion) – negative

A new word of that year is the derivation *ecopoetry*, tweeted twice by Extinction Rebellion with a positive meaning. The main frame is the *call to action*:

164. Climate Action Fundraiser: #ExtinctionRebellion Xmas Party Today, 7 PM 10.30 PM Star and Shadow Cinema, 210 Warwick Street, Newcastle upon Tyne, NE2 1BB Bring your voice, instruments, and ecopoetry. (17/12/2018 Extinction Rebellion) – positive

Another new word is the derivation *ecowatcher*. It was used 5 times by EcoWatch. The peculiarity of this term resides in the *stereotyping people* frame identifying the followers of this news site. This contributes to the creation of the sense of connectedness (Gupta, 1992) typical of SN and acting as a social glue (Klein, 2000), while expressing appraisal and infirming. Additionally, some tweets were framed within the *attribution of responsibility or blame*, *call to action*, and *information of facts or scientific evidence*.

165. We appreciate your hard work to generate awareness on plastic pollution and to stop single use plastic use at the source! #PlasticPollutes #EcoWatchers (27/08/2018 EcoWatch) – positive

166. ANNOUNCEMENT #ECOWATCHERS: You probably saw gmail has a new design, make sure your @EcoWatch newsletter is being sent to your primary inbox so you continue to receive EcoWatch's top news of the day. Not signed up yet? Here you go! (17/10/2018 EcoWatch) – positive

167. Adidas Will Use Only Recycled Plastics by 2024 @plasticpollutes @socialplastic #plasticpollutes #plastics #plasticpollution #adidassustainability #environmentalnews #ecowatchers (17/07/2018 EcoWatch) – positive - *information of facts or scientific evidence*

An additional new word is the derivation of *extractivism*. It was tweeted once by Extinction Rebellion with a negative meaning. The main frame is the *attribution of responsibility*.

168. The inaction on & complicity in of our governments in (mis)development predicated on extractivism & capitalism is not only a #GlobalHealth crisis but it is an existential threat to life itself. Please

donate to the #ExtinctionRebellion for life itself. (08/11/2018 Extinction Rebellion) – negative

Foodprint is used by Greenpeace with a neutral meaning providing the *opportunity* to start healthier and environmentally friendly behaviors:

169. Here are 6 tips to reduce your foodprint while dining out #environment (03/11/2018 Greenpeace) – neutral

Frackers recurs twice also in that year with Extinction Rebellion, conveying a negative meaning. This word not only refers to the *call to action*, but also to *civil society protest*:

170. @friends_earth are doing a great job helping @frackfreelancs & so many others on the front line in the struggle against @cuadrillauk & the other frackers who are polluting our water, land & air & wrecking our climate. #FossilFree #FrackFree #PNR (11/11/2018 Extinction Rebellion) – negative - *call to action*

Megadrought, *megafire* and *megapipeline* occurred also that year, 9 times in total, with a negative message and much more related to *climate justice* and not only to *disasters and catastrophes*.

171. From Italy to Greece & across Europe people are protesting the fossil gas megapipeline #TAP. @SocieteGenerale @FredericOudea climate science #IPCC #1o5C says gas must stay in the ground. Pledge not to fund TAP now! #ReclaimPower #GasdownFrackdown (16/10/2018 350Europe) – negative

172. The land we use for food and water, the people who help harvest these resources, are experiencing the impacts of a warming climate

firsthand with deadly megafires and hazardous wildfire smoke. #EarthGuardians #ActionSprout (21/12/2018 Earth Guardians) – negative

Pollutionwatch, *specieswatch* and *weatherwatch* occurred again in the Guardian Environments' posts. The main frames are *information of facts or scientific evidence* and *disasters or catastrophes*, although they might have a positive, negative or neutral meaning.

Postgrowth appeared for the first time as derivation lexical form. It was tweeted 20 times by the NGO Green Europe and once by Extinction Rebellion. The messages conveyed are positive and refer to the *opportunity* frame and *call to action*:

173. In a Post-Growth world, trade protects the interests of people and planet. #sustainabledevelopment #PostGrowth2018 sign the petition (18/09/2018 Green_Europe) – positive

Greenpeace posted once the item *reducetarian* in a positive message referred to *stereotyping people*:

174. Reducetarian includes all people striving to reduce consumption of animal products. Are you a reducetarian? #MeatFreeMonday (05/11/2018 Greenpeace) – positive

Rewild and *rewilding* were detected 10 times with Extinction Rebellion, Green Europe and the Guardian Environment, with a positive meaning related to *opportunity*, as reported in the example. However, other tweets containing this item were mapped onto other frames, such as *call to action*, *civil society protests*, *attribution of responsibility or blame*, and *nature restoration*.

175. #Rewilding is about keeping #nature connected to ensure vital ecosystems remain rich in species! At #UNBiodiversityConvention on Sunday, find out about benefits of restoring large & interconnected natural areas incl. flood prevention & well-being (21/11/2018 Green_Europe) – positive

Zerocarbon is the most used lexical innovation compound, 183 times, mostly in neutral messages and as a hashtag by Extinction Rebellion. The main frames of opportunity related to the *attribution of responsibility or blame* and *call to action*:

176. DECLARE: A non-violent rebellion against governments for their criminal inaction on the climate & ecological crisis DEMAND: - Governments #TellTheTruth - WWII-Scale mobilization for #ZeroCarbon2025 - #ParticipatoryDemocracy JOIN: #ExtinctionRebellion (29/12/2018 Extinction Rebellion) – neutral

In 2019, totally 28 new words were used in 306 tweets, 66 negative, 156 neutral and 84 positive. *Zerocarbon* was the most tweeted one, especially as a hashtag, like in the previous year, followed by corporatocracy, 27 times. They mostly maintained the same frame, however much more attention was drawn on *call to action* and *attribution of responsibility or blame*. This may be due to the global climate strikes.

The frequency of *airpocalypse* decreased to one post by Greenpeace. The meaning is negative, and it refers to *disasters or catastrophes*, however it now considers a wider geographical area:

177. NOT a single city among the 313 cities with data met the WHO guideline. #airpocalypse (30/01/2019 Greenpeace) – negative

Artivism and *artivist* appear 7 times in total, the messages are positive, although they highlight the current condition of the climate. More than *civil society protest*, the frame is *climate justice*:

> 178. Tipping Point - Anonymous artivist "Gray" placed ice sculpture lifejackets in front of the Tate Modern (& in Parliament Square) this morning to highlights how the climate & ecological crisis will continue to lead to mass migration. (04/02/2019 Extinction Rebellion) – positive

Bioeconomy and *bioproducts* are still tweeted with a positive sense by Andreea Strachinescu and U.S. Department of Energy, and always related to the *economics and business* frame.

In 2019, the acronym *BIPOC* is posted for the first time in the U.S. It is linked to the *climate justice* frame, and it stands for black indigenous people of color.

> 179. @MaryHeglar @nadiabaltimore @imkevinjpatel @sohayeldeeb @Elsamengistu @nainagradin @kaylahkirnon Thank you so much for continually working to uplift the voices of BIPOC environmental activists as we fight for climate justice! (27/10/2019 Jerome Foster II) – positive.

Birdwatch and *butterflywatch* were posted 5 times in total by the Guardian Environment and the Nature Conservancy, with either a neutral or negative meaning with the intent to provide *information of facts or scientific evidence*.

Climatestriker appeared for the first time in 2019, as well. It is also the first new word adopted by the new social movement Fridays4future. It refers to the *stereotyping people* frame identifying this new type of climate activists who strike school to protest against climate change and government inaction.

180. Some great advice about intersectional climate justice from #climatestriker @israhirsi (30/03/2019 Fridays4future) – positive

181. Remember to vote #icanvote #voteclimate my grandpa voted for me, all you climatestrikers in the eu ask your grandparents to vote for you -let your vote be your voice #EuElection2019 (24/05/2019 Greenpeace) – positive

182. Grootouders voor het Klimaat supporting as always the climatestrikers in Holland (24/05/2019 Greenpeace) – positive

Corporatocracy is also present, always tweeted by Extinction Rebellion with a negative meaning. It is framed within the *attribution of responsibility or blame* and the involvement of followers to take part in the protest as a *call to action*.

183. Our rebels will continue to be arrested by the ecocidal corporatocracy until we, @Fridays4future & all of the other people & groups on the right side of history transform the system for climate & environmental justice... So join us this Monday & shut the corporatocracy down. (06/10/2019 Extinction Rebellion) – negative

Craftivist was posted twice by Extinction Rebellion; in this case the frame is *civil society protest*:

184. Banner Making Workshop Today, 10:00 AM - 2:00 PM Brighton Peace and Environment Centre, 39-41 Surrey Street, Brighton, BN1 3PB Calling all local rebels and craftivists to join us at this #ExtinctionRebellion Banner Making Workshop. (03/02/2019 Extinction Rebellion) – neutral

Ecowatcher occurs again by Ecowatch, with the intent to involve followers within the frame of *stereotype people*.

Ecycling appears again in one tweet by the EPA referring to the *opportunity* frame:

> 185. @EPAAWheeler The participants in the #ElectronicsChallenge saved roughly 276,000 tons of electronics from going to landfills and instead diverted it to certified recyclers. #eCycling (11/03/2019 EPA) – positive

Extractivist and *extractivist* occurred 9 times with Extinction Rebellion. This item relates to the *attribution of responsibility*, and to *climate justice*, as well:

> 186. People in the global south are being murdered by the state on the frontline by the extractivist industries that feed our own economies, meat and minerals., @times_ofthesign. #ActForAmazonia (25/08/2019 Extinction rebellion) - negative

Foodprint appeared only once with the organization EU Climate Action with the aim to provide the *opportunity* to start healthier and environmentally friendly behaviors:

> 187. #FoodForThought on #WorldFoodDay Everything we eat affects us & the environment. When we make food choices we need to think about #OurPlanet too! Let's try to reduce our foodprint eat smart go for seasonal & local products avoid #food (16/10/2019 EU Climate Action) – neutral

Megadrought and *megafire* occurred 3 time relating them to *disasters and catastrophes* also for wildlife:

188. Megadroughts could hit parts of the US again soon but it's not too late to turn this around (28/07/2019 Climate Reality) – negative

189. Even the animals that can generally thrive in wildfires are now unable to take the heat of megafires (10/08/2019 Greenpeace) – negative

Pollutionwatch, specieswatch and *weatherwatch* were posted again by the Guardian Environment with the aim of providing *information of facts or scientific evidence*.

Postgrowth was posted 11 times by Extinction Rebellion and the NGO Green Europe with a positive meaning of *attribution of responsibility or blame*. It was very often used as a hashtag.

190. "The polluter pays principle is already in practice: the polluters are paying the most for hard lobbying," said the EEB's @NickMeynen. He spoke about #postgrowth in a panel also featuring MEP @ph_lamberts. Read our blueprint for a post-growth future. (10/12/2019 Green_Europe) – positive

Rewild and *rewilding* occurred 39 times in total with Extinction Rebellion with the frame of *opportunity* as a solution to the climate crisis:

191. There are solutions to both the #EcologicalEmergency & the #ClimateEmergency. Working with & like nature & letting life #rewild as opposed to working against nature & killing life would be a good place to start. #RebelForLife (06/05/2019 Extinction rebellion) – positive

Zerocarbon is the most frequent item with Extinction rebellion. It occurs 156 times, especially as a hashtag and the main frames covered are: *attribution of responsibility* and *call to action*:

> 192. Our demands to the "crazy" governments of the world: 1. #TellTheTruth - Declare a climate and ecological emergency 2. #ActNow - Halt biodiversity loss and go net #ZeroCarbon2025 3. #BeyondPolitics - A #CitizensAssembly for climate and ecological justice (09/08/2019 Extinction Rebellion) – neutral

In 2020, 29 new lexical items were employed. Among these, 4 were used for the first time: *doomisms*, *greenprint*, *hyperconsumption*, *solastalgia*. The frequency, 125 hits, decreased compared to the two previous years. There were 43 tweets with a negative meaning, 26 neutral and 56 positive.

Aritist and *artivism* occur 4 times in total with a positive meaning, either within the *opportunity* frame or *call to action*:

> 193. What is artivism? Artists using their creativity to inspire action? Check out these stunning 6 works of climate artivism (22/11/2020 Greenpeace) – positive
>
> 194. #XRYouth declares #ArtRebellion! Over the next month, join us in a campaign to create art centered around your feelings about the climate and ecological crisis. #XRtivism #Artivism #LoveAndRageInTimesOfCorona (03/05/2020 Extinction Rebellion) – positive

In addition to the main frames, what is interesting in one of the hashtags is the mention to Covid-19 (see example 194). Further to this, the smaller number of tweets recorded that year can be explained by the spread of the Coronavirus.

As for *bioeconomy*, it appears 7 times in European politicians' and organization's tweets. The message is positive and within the *economics and business* frame. Moreover, a form of youth involvement arises on behalf of politicians, and also new methods of communication and gathering, fostered during and after the COVID-19 pandemic through the use of webinars:

195. The land use sector is key for a #ClimateNeutralEU. We're organising a series of webinars to showcase how @LIFEprogramme & @EU_H2020 projects boost #ClimateAction in agriculture, food systems, forestry & bioeconomy. 6-9 Oct Registration & more (14/09/2020 EU Climate Action) – positive

196. Delighted to speak at the youth engagement session @OfficeBECouncil @EU2020DE. #Bioeconomy Youth Champions - you represent the present & the future. Working together we can manage the deeply transformative changes ahead of us & achieve our ambitious #climate goals. #EUGreenDeal (19/11/2020 Mariya Gabriel) – positive

BIPOC appeared in American, European and international tweets within the *climate justice* or *call to action* frames:

197. Dear Press, The climate movement is a leaderful movement, there's enough space to center BIPOC voices, not just white ones Because our stories can't be manufactured, we've lived through the consequences of

the crisis & it's unjust to erase us. This is our fight @AyishaSiddiqa12 (22/07/2020 Fridays4future) – positive

198. The environment has always been used to oppress BIPOC. It is high time to shift to a more humane approach. #EarthDay50 #BM4F #YoungGiftedGreen #LeadFreeUSA (23/04/2020 ClimateReality) – positive

199. Those who are most vulnerable to the COVID crisis are frontline workers, those living in poverty, BIPOC communities, said @TasneemEssop, executive director @CANIntl. Those communities are the same ones that are most vulnerable to the climate crisis. (14/12/2020 Climate Action Network International) – negative

In the last tweet (199), there is a clear connection between the climate crisis and the pandemic impact on the most vulnerable parts of society, thus shedding light on climate and social justice.

Birdwatch was tweeted once by EU Environment. In the previous year it was framed of *information of facts*, whereas this year a new frame arises as a *sense of connectedness in pandemic*.

200. Even from our balcony or garden, we can still enjoy #biodiversity. This is a Great Spotted Woodpecker, observed in Brussels. Learn more tks to @Natures_Voice: https://t.co/8brXW8iC3k Do you run a birdwatch programme? Contact us! #Biodiversity2020 #EUBiodiversity (12/04/2020 EU Environment) – neutral

Brandalism appeared three times within the frame of *civil society protest*.

Butterflywatch, pollutionwatch, specieswatch and *weatherwatch* were tweeted in total 31 times by the Guardian Environment. They all refer to the *information of facts or scientific evidence* frame.

Doomism is a new derivation appeared in 2020 in a same post retweeted 4 times by Climate Reality. This item refers to the *health impact* frame:

> 201. Climate doomism is a common psychological response to the urgency of climate change. But it shouldn't mean the end of your activism! (10/11/2020 ClimateReality) – negative

Dumpsite appeared only once within the frame of *opportunity* issue-specific frame, and *ecowatcher* 13 times framed as *attribution of responsibility or blame*, *opportunity* or *information of facts or scientific evidence*.

Extractivism and *extractivist* were posted 3 times. Also in 2020, the main frame they refer to is *climate justice*:

> 202. The expansion of fossil fuels is a direct threat to the lives of Indigenous Peoples. It is time to stop this extractivist relationship with nature: decimating forests, displacing communities of the land, increasing pollution, and locking in deadly emissions for decades. (20/06/2020 Climate Action Network International) – negative

Frontliner was tweeted once in relation to *connectedness in pandemic* combining both the planet and people's safety with reference to COVID-19:

> 203. #WorldHealthDay highlights the need for international cooperation in achieving #HealthforAll and building a safer, healthier and more resilient planet. Let's also take this time to express our gratitude to &

appreciation for our healthcare workers #ThankYouFrontliners #COVID19 (07/04/2020 Climate Action Network International) – positive

Ecowatch tweets *gigaplant* twice with a positive meaning within the *economics and business* frame:

204. #EVs over #trees? German court rules in favor of #Tesla EV gigaplant tree-clearing. @ElonMusk: project "#sustainability and the environment in mind," and company will plant three for each one cut down. (21/02/2020 EcoWatch) – positive

The NGO Green Europe used for the first time the compound *greenprint* with a positive meaning within the *call to action* frame. It also mentions COVID-19 and the need of recovery:

205. A growing chorus of voices calls for the #EUGreenDeal to become a 'greenprint' for the post-#COVID19 economy. #CoronaCrisis #CoronavirusPandemic @GreenpeaceEU @StayGroundedNet @TimmermansEU (26/03/2020 Green Europe) – positive

The derivation item *hyperconsumption* was tweeted twice for the first time by Extinction Rebellion with a negative sense and within the *attribution of responsibility* frame:

206. It's said that Nero fiddled while Rome burned. What are we doing while the planet is burning? So blinded by our success as a species, we're preoccupied by our own amusement, comfort, hyperconsumption, businesses and politics. (02/02/2020 Extinction Rebellion) – negative

Megabanks, *megadrought*, *megafire*, and *megastorm* were tweeted 9 times. They mainly refer to the *disasters or catastrophes* and *attribution of responsibility or blame* issue-specific frames. *Postgrowth* was posted twice by Green Europe within the *climate justice* and *economics and business* frames. *Rewild* and *rewilding* were tweeted 16 times mostly referring to *attribution of responsibility or blame* frame.

Solastalgia appeared for the first time in 5 tweets by Climate Reality and the Guardian Environment with a negative meaning. Indeed, similar to doomism, this item refers to psychological *health impacts*:

> 207. Solastalgia' is the fear and grief associated with a rapidly changing environment but if we take action, we can protect our home. (19/10/2020 Climate Reality)
>
> 208. 'Solastalgia': Arctic inhabitants overwhelmed by new form of climate grief (15/10/2020 Guardian Environment) – negative

In the previous two years, *zerocarbon* was the most tweeted new lexical item. In 2020 it appeared only 10 times. The frames include *opportunity* and *call to action*.

To summarize, table 4.15 shows the distribution of issue-specific frames throughout time. Overall, it can be said that the total number of tweets and the occurrence of new lexical items are not strongly related. However, as shown in the previous section, social, political, and extreme weather events influence the number of messages posted. On the other hand, the number of tweets posted is related to the new author types who enter the social arena. In fact, the social movement Extinction Rebellion was the greatest contributor in terms of lexical creativity and in the definition of specific frames, namely *call to action* and *attribution of responsibility or blame*.

Issue-specific frames	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Call to action		3	2	83	139	14	241
Civil society protests	8	9	6	55	20	5	103
Climate justice	2	1	12	2	10	10	37
Connectedness in pandemic						3	3
Disasters or catastrophes	25	7	8	30	9	8	87
Economics and business	1	4	3	16	6	10	40
Health impacts						11	11
Nature restoration	3	1		1	2	5	12
Opportunity	15	5	16	19	20	17	92
Stereotyping people	2	1	1	3	4	1	12
Attribution of responsibility or Blame	5	5	4	58	64	14	150
Information of facts or Scientific evidence	19	5	13	45	32	27	141
Total	**80**	**41**	**65**	**312**	**306**	**125**	**929**

Table 4.15: Frequency of issue-specific frames per year

4.3.3 Discussion

As shown in the analysis of the trend of tweets in the given time frame, the activity of the different users fluctuated over time. The number of messages increased around two main events which were able to draw particular attention to the topic and mobilize crowds: the Paris agreement in 2015 and the climate strikes in 2019. In all the years, social movements led the trend and in 2019 they were supported by young activists. As emphasized by many scholars (see Boulianne et al., 2020; Bruns et al., 2014; Freelon et al., 2016), protest activities are able to sprout and engage a wider public thanks to social media and Twitter in particular, which offers the possibility to take part in a collective action to express opinions and enter the world of politics and decision making. Indeed, through the analysis of hashtags, data show how #climatechange is a trendy hashtag over the years and further interesting fact lies on the shift of the use of words to describe climate change. In fact,

considering the three hashtags #climatechange, #climatecrisis and #climateemergency, in my view, these collocations represent three different levels of an increasing danger, where climatechange seems to be a more neutral and overused expression as to refer to *a fait accompli*. The investigation carried out in the first hypothesis of the second research question, highlighted that international posts mainly address the topic as an emergency. Whereas, in the European scenario, it is reassuring the fact that "ClimateChange" occurs frequently, and it is quite typical according to the given percentage. This means there is an explicit and formal acknowledgment of the problem from politicians, as well. In addition, climate emergency is still rare, although it can be said it is an emerging expression.

As for the United States, the data suggest a more complex and discouraging situation. Indeed, none of the hashtags – #climatechange, #climatecrisis and #climateemergency – can be considered as typical expression among these users. However, the highest percentage is related to climate crisis, which was posted mostly by environmental movements and activists, and thankfully by a few politicians from 2019 to 2020, such as Frank Pallone. Thus, it is easily understood that occurrences may vary under the impact of political leaders who presumably dictate the trend.

Moreover, climate change appears as a hegemonic discourse as it has been consistently tackled in Europe, both socially and politically, but the same cannot be said about the U.S. where it seems to face a counter hegemonic discourse of what is not written. For instance, #Climatechange was tweeted by governmental institutions, such as the EPA, only between 2015 and 2016. Right after, during the Trump era, the issue was possibly silenced, as climate change denialism ruled. In fact, the #climatechange only occurred to dismantle the problem as Scott Pruitt, former EPA administrator did. Indeed, the rising urge to declare a climate crisis going beyond the simple admission of climate change,

from current politicians and young activists stands out in 2020 against the last presidential administration.

There is not a strict connection between the total number of tweets per year and the frequency of new items. The most meaningful relation is recorded in 2019 which is the most tweeted year with the highest usage of new words. As stated above, this is particularly due to the activity of young activists who majorly started tweeting in 2018 and reached a significant number in 2019. However, the use of new lexical items and the general number of tweets decreased in 2020 and this may be related to the Covid-19 pandemic which stopped the possibility to organize protests and global strikes.

As shown in table 4.14, the figures suggest that negative messages recurred more often compared to the neutral and positive ones. Through the analysis of the polarity of new items associated to frames, it emerges how most tweets annotated as positive do express a sense of protest and call to action through a gentle and polite discourse. In 2015, most of the negative new lexical items report climate disasters or catastrophes (*airpocalypse, megadrought, megafire*) and act in favor of climate justice highlighting the negative consequences at the expense of Indigenous People. Moreover, civil society protests are already present as a polite form of contrast specifically against corporations which occurred around the COP21 held in 2015. These words, *artivism, artivist* and *brandalism,* do convey a positive message while promoting a way of fighting climate change and, most of all, raising awareness pacifically. Thus, also within the positivity there is a message of accusation especially of corporations. These neologisms also promote and advertise new ways of acting individually (*erecycling, ecocapsule, rewilding, foodprint*).

In 2016 most of the new words were repeated from the previous year. However, the five new words mainly have a positive meaning such as *bioeconomy, reducetarian* and

dumpsite. While the items *megapipeline* and *megastorms* contribute to highlight manmade dangers and extreme weather events.

Furthermore, the main frame built around the new lexical items detected in 2017 is mainly related to manmade climate disasters and their consequences. However, there is a positive attitude in fighting climate change, both from individual actions and from political and economic solutions. On behalf of social movements, news sites and NGOs, the main aim is to raise awareness through the provision of information about what was happening around the world and not only in a specific country, and this form of protest was also carried out with a positive message, such as in the case of *craftivism*.

Thereafter, in 2018 the users' discourse starts taking a new direction. There is a more personal involvement, a clear accusation and attribution of responsibilities and a higher involvement of the community, especially from social movements and news sites. The content becomes freer and more personal following the shift from "collective action" to a more "connective action" as described by Bennett and Segerberg (2012). This refers to the fact activism started moving from a collective action, which included the sharing of the same ideal and values while mobilizing users from far and beyond (Rosenbaum & Bouvier, 2020), to a more personal expression, in line with the main intent of social networks.

The "collective action" became more evident in 2019 with the tweets of single climate activists. In addition, as pointed out by Pickard (2021), youth activism and mobilization were decisively emphasized in 2019 with the foundation of new social movements, Fridays for Future and Extinction Rebellion which also influenced lexicon and frames, and their intensive communication was also accompanied by worldwide protests (Boulianne et al., 2020; Hodges & Stocking, 2016; Pickard, 2021). In fact, the most

recurring frame is call to action. Moreover, as already mentioned above, this year was particularly meaningful for civil society protests, stereotyping the young participants as *climatestikers*. The messages started to be more inclusive of the *climate justice* frame referring to the indigenous people and creating the acronym *BIPOC*.

Finally, in 2020, as highlighted by Loureiro and Alló (2021), the number of climate-related tweets dropped since the beginning of COVID-19. Within my analysis, the number of positive and negative messages is the same (56 per category), as if there were an attempt to look at the bright side while experiencing two negative events, such as the climate crisis and the pandemic. The pandemic contributed to the production of positive messages, creating a sense of connectedness while considering to new forms of communication such as webinars, and highlighting the positive effects of less CO2 emissions due to the lockdown. However, *doomism* and *solastalgia* are connected to the need to express negative effects that young people experience psychologically. I argue that the year 2020 may have brought to a sense of frustration caused by the impossibility to actively take part in the climate change fight and this can be seen in the shift of the main frames used. In fact, in 2019 the most frequent issue-specific frame was *call to action*, justified by protests and strikes worldwide which fostered mobilization and sense of belonging; conversely the year after was mainly characterized by a strong attribution of responsibility and blame of the others highlighting the fact that there was no chance of action mobilization. Moreover, the *climate justice* frame, which refers to the people and communities who are most vulnerable to climate impacts, is strongly related to social justice, highlighting the inequities derived from the climate and the pandemic. On the other hand, social movements attempted to promote gatherings to share their feelings about the climate crisis.

The following section sets out the main differences and similarities between European and U.S. activists and politicians drawing attention to the most relevant discourses over time, through the analysis of lexical phrases.

4.4 Language variation across space (RQ3)

The analysis of the most salient lexical phrases aims at revealing the meanings conveyed to a complex issue such as climate change and define how it is represented. Indeed, by means of discourse analysis, the objective is to investigate the social construction of this issue and how specific stakeholders make sense of it (Hajer & Versteeg, 2005), in different places and at different times.

4.4.1 Hypothesis

The third research question – *Are there any differences in terms of language use between the United Sates and the European Union?* – seeks to determine whether there is a relationship between language use and geographical location. Indeed, the present study was designed to test the hypothesis that the European Union has had a more stable and coherent concern about climate change throughout time, compared to the United States. A likely method to verify this assumption is based on the analysis of typical words extracted from the corpus, which identify the lexical saliency (Baker, 2006). Specifically, the multi-word terms in the corpus were identified through the *keywords* tool in Sketch Engine, which enables the comparison of corpora and the determination of typical terminology in one's corpus. This software identifies keywords and multi-word terms and calculates them through a simple math method, based on a parameter which allows to focus either on higher, or lower frequency words (Kilgarriff, 2009).

Although in this part of the work the focus is on the U.S and the EU, the multi-word terms were extracted from the whole corpus, including tweets from American, European, and international stakeholders. Through this approach, the attempt is to account for a cross section of the salient expressions of the entire corpus, and then compare their usage to specific tweeters to analyze how they shape them in their discourse. The reference corpus adopted was the English Web 2020 (enTenTen20) and the first five multi-word were considered, i.e., the most typical and salient expressions in the studied corpus, as can be seen in table 4.16. In addition, repeated expressions related to the same word-form were eliminated while maintaining only one form, e.g., fossil fuel, fossil fuel industry, fuel industry.

	Item	**Frequency (focus corpus)**	**Frequency (reference-enTenTen20)**	**Keyness Score**
1	climate crisis	5669	37513	777,54
2	climate action	1687	36066	235,99
3	big polluter	818	1899	201,76
4	clean energy	2800	115638	195,2
5	fossil fuel	4986	290405	165,35
6	ecological emergency	636	773	161,11
7	climate solution	622	7212	137,43
8	climate activist	565	8818	121,05
9	ecological crisis	481	8367	104,08
10	government inaction	417	1730	103,71
11	climate denial	421	3017	101,78
12	climate justice	528	15111	100,95
13	climate change	11380	1232153	98,66
14	climate emergency	525	16207	98,524

Table 4.16: Most salient lexical phrases

The following sections will investigate the meanings of the messages of these stakeholders in order to provide a thorough answer to the research question. In addition, the analysis will focus on the first five lexical phrases distinctively, and on the explanation of their main features.

4.4.2 Climate crisis

Climate crisis is the most typical expression with a score of 777,54 and it appears 5669 times in the whole corpus. However, among the two categories of users there is a great difference as it occurs 4943 times in the American posts and 602 times in the European ones.

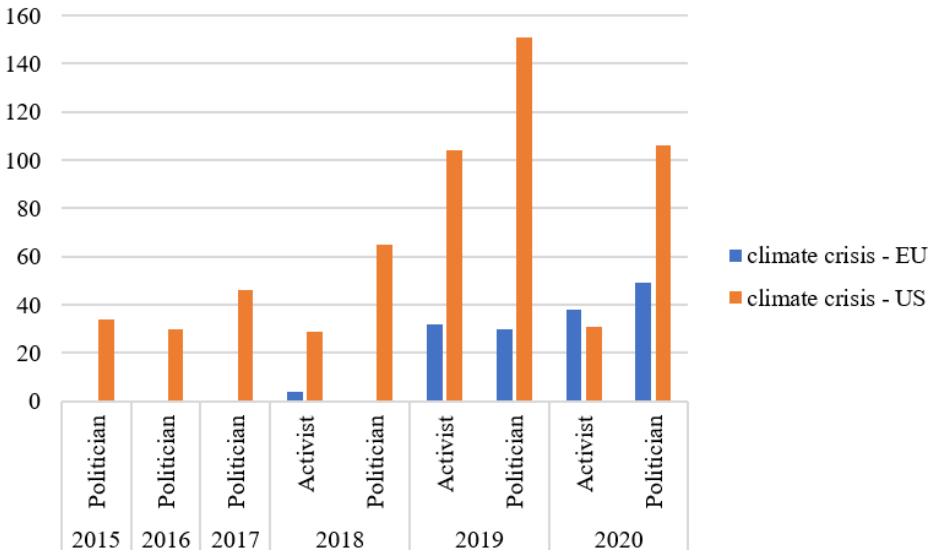


Figure 4.32: *Climate crisis* through place, time, and author types

Based on the data in figure 4.32, there is a clear difference in the usage of this expression between the U.S. and the EU, in particular among politicians. Indeed, as illustrated in figure 4.33, most of the Democratic politicians included in the study used this collocation. Not surprisingly, Al Gore tweeted messages referring to climate crisis 249 times since 2015. His engagement was also highlighted in the movies *An inconvenient truth* and its

sequel launched in 2006 and 2017, respectively, following his efforts to address climate change issues.

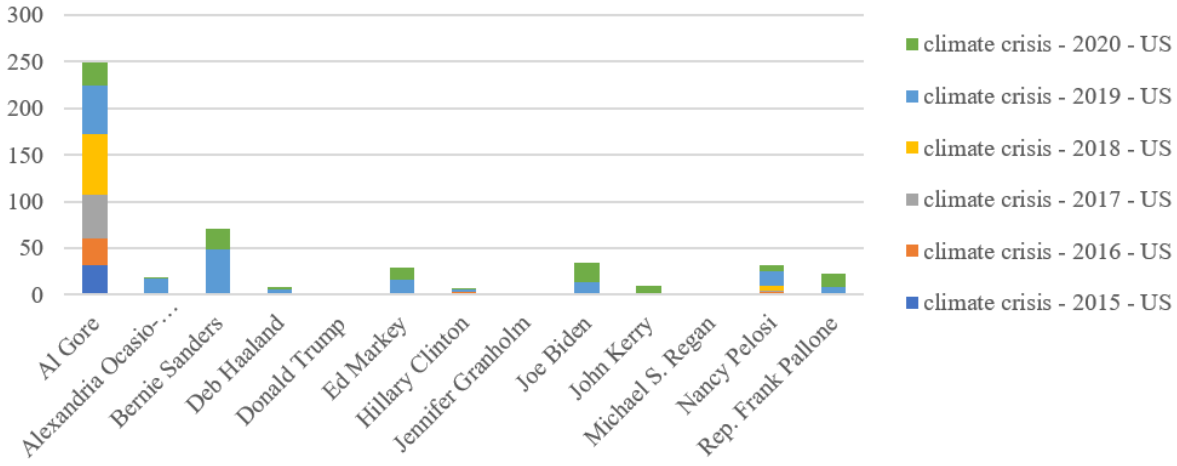


Figure 4.33: *Climate crisis* among American politicians

As an example, the first tweet in 2015 relates to scientific facts of global warming and the necessity to take action:

> 209. Confirmed: 2014 was the hottest year EVER recorded. The reality of the **climate crisis** is undeniable. We must act now. (16/01/2015 Al Gore)

Yet, in the following years, the discourse of climate crisis becomes highly related to political choices and discontentment:

> 210. The choice in this election is whether we will solve the **climate crisis** in time or whether the United States will move backwards. (04/11/2016 Al Gore)
>
> 211. The Trump administration justifies its rollback of methane standards by saying it will be a cost-saver for industry. But what about the costs to our health, and the costs of the **climate crisis**? We need to put people and our planet over polluters' profits. (19/09/2018 Al Gore)

The feeling of political dissent is accentuated in 2019 by other politicians along with Al Gore, namely Alexandra Ocasio-Cortez, Bernie Sanders and Joe Biden:

212. This is what the **climate crisis** is doing, and will do, to American infrastructure. This is why we need a #GreenNewDeal that invests in a solution on the scale of the problem - and can help our nation transition, adjust, and prevent further damage in the **climate crisis**. (20/07/2019 Alexandria Ocasio-Cortez)

213. When we take back the White House, we will not only rejoin the Paris Agreement. We will launch the decade of the Green New Deal to lead the world in averting the **climate crisis** and create 20 million new jobs. Read our plan (04/11/2019 Bernie Sanders)

214. President Trump's failure to lead on the **climate crisis** is inexcusable - it endangers the future of our country and planet. As president, I'll rejoin the #ParisAgreement and rally the world to push our progress further and faster. (01/07/2019 Joe Biden)

Surprisingly, Donald Trump posted a tweet referring to *climate crisis*. However, this post, which is addressed to an environmentalist, sheds light on Trump's point of view of climate change as a hoax:

215. Patrick Moore, co-founder of Greenpeace: The whole **climate crisis** is not only Fake News, it's Fake Science. There is no **climate crisis**, there's weather and climate all around the world, and in fact carbon dioxide is the main building block of all life. Wow! (12/03/2019 Donald Trump)

Simultaneously, these political users show an extended network of relationships, including young activists, which can be interpreted as a collective action. Research in this area has mainly focused on the concept of collective action among activists, social movements, and NGOs (Bennett & Segerberg, 2012; Boulianne et al., 2020; Bruns et al., 2014; Freelon et al., 2016; Pickard, 2021). For instance, on most occasions these stakeholders take advantage of the digital connectivity provided by social media to express opinions, share values, and mobilize a wider public through prolific environmental activism and political engagement. In this case, the examples listed below show the connectedness created by politicians towards activists:

216. @**GretaThunberg**'s passion and courage have inspired millions and sparked a youth-led movement for change in every corner of the globe. This honor is well-deserved and serves as a reminder of the urgent, drastic action we must take to address the **climate crisis**. (11/12/2019 JoeBiden)

217. I know so many people who feel hopeless, and they ask me, "What should I do?" And I say: "Act." It was such an honor to share this conversation with you, @**GretaThunberg**. Thank you for being one of the leading voices on climate action today. (29/06/2019 Alexandria Ocasio-Cortez)

218. The **climate crisis** isn't 30 or 40 or 50 years in the future. It is right now. We need a president in office who understands the immediate threat of that crisis, and Bernie Sanders is that guy. @**VarshPrakash** of @sunrisemvmt (09/01/2020 Bernie Sanders)

On the other hand, significant differences appear in the European context. Firstly, *climate crisis* was detected in politicians' tweets only in 2019 and 2020. Secondly, the number of

users is less than half of the Americans, as shown in figure 4.34. Lastly, the discourse is markedly different, presumably due to the general political asset.

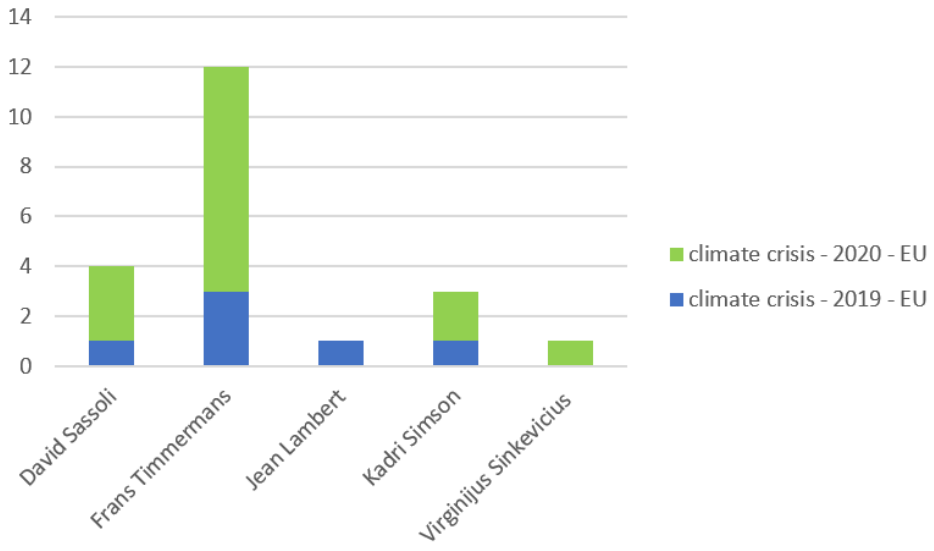


Figure 4.34: *Climate crisis* among European politicians

In this instance, climate issues are not used as part of political campaigns and disputes. On the contrary, these politicians seem to aim at a wider involvement of political collaboration and define the issue in terms of its economic relevance, as well.

219. Over the last 10-15 years we have had many discussions about what the EU is good for. I believe if there is one area where we can convince citizens of our value it is in tackling the **climate crisis**. More than 90% of our citizens want us to act on this! (08/10/2019 Frans Timmermans)

220. We can tackle the **climate crisis** if we step up our ambition. Raising our 2030 target to -55% is realistic. It improves our health and wellbeing, and grows our economy in a sustainable way. Tomorrow, @kadrisimson and I will detail how we will get there. (16/09/2020 Frans Timmermans)

221. The **climate crisis** and rising inequality can only be tackled together. Today in Rome I called on national governments to be

ambitious on the next long term EU budget. The @Europarl_EN will not approve if it doesn't address these challenges and boost growth and cohesion. (07/02/2020 David Sassoli)

222. Talking #climatechange, #recovery, #EUGreenDeal & the future of #energy @liberalismi akadeemia event. The economic crisis & the **climate crisis** are two sides of the same coin. The actions to decarbonise economy can create new opportunities for lasting growth. (07/11/2020 Kadri Simson)

However, in one tweet by Jean Lambert, EU MP, the climate activist Greta Thunberg is mentioned:

223. #EP hears from @GretaThunberg in packed meeting. Urges us "unite behind the science" & go for radical change to combat **climate crisis** created by ' buying & selling'. #ExtinctionRebellion (16/04/2019 Jean Lambert)

As previously mentioned, most of the environmental activists involved in this work started being active on Twitter in 2018. Consequently, their contribution covers a shorter time frame. Moreover, consistent with the outcomes of the politicians, American activists used this expression more frequently compared to the European ones, excluding 2020 when *climate crisis* was used 39 times by the Europeans and 37 by the Americans as shown in figure 4.35.

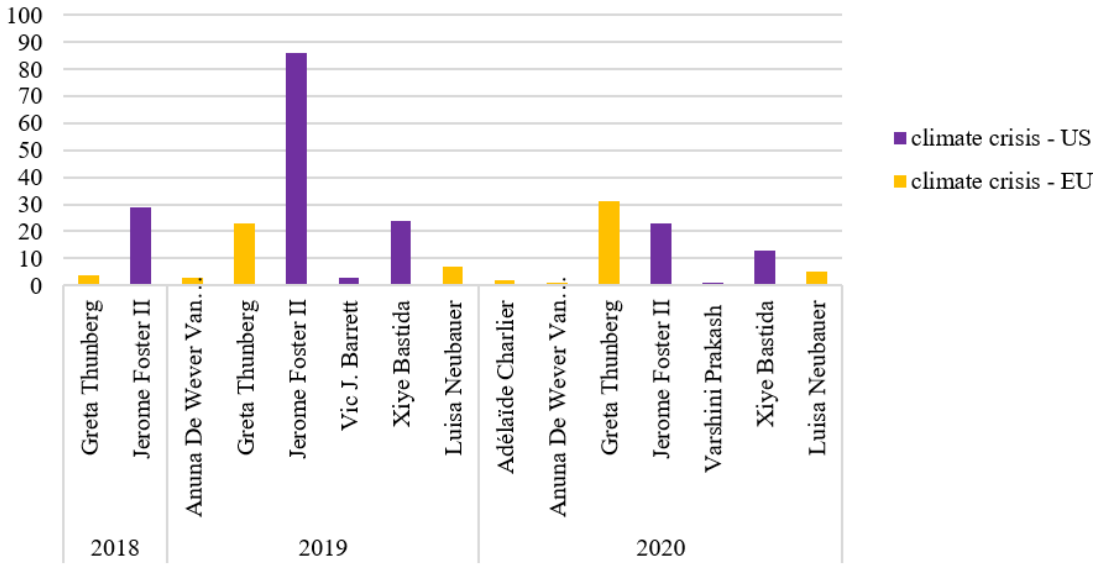


Figure 4.35: *Climate crisis* among American and European activists

As 2018 may be considered the debut of Greta Thunberg and Jerome Foster, it is interesting to compare the features of their tweets. Indeed, some similarities in the way they present themselves, try to involve a wider public, and engage with politics, can be detected in the examples below:

224. "A Swedish pupil, Greta Thunberg, 15, is protesting outside parliament in Stockholm to draw attention to the **climate crisis** in her country. Shouldn't we be doing the same?" #klimatstrejk #climatestrike (11/09/2018 Greta Thunberg)

225. I want everyone who's sees this tweet to comment #ReportOnClimate!!! To show you support the people on the planet suffering from the **climate crisis**, who's stories are not being told in the media. I am 16 years and trying to stop climate change, please join me!!! (22/11/2018 Jerome Foster II)

In these two tweets (224 - 225), they both present themselves highlighting the age as a meaningful element addressed to a younger audience and showing confidence in what

they can do despite the young age. They both seek attention while expressing the need to uncover climate issues, one from the government, the other from the media.

226. The **climate crisis** doesn't go on holiday. Nor do we! Climate strike tomorrow as usual. #climatestrike #fridaysforfuture #schoolstrike4climate (27/12/2018 Greta Thunberg)

227. We the youth, have come to together to tell the stories of humanity and how the **climate crisis** has devastated entire ecosystems. (20/11/2018 Jerome Foster II)

Moreover, the examples in 226 and 227 also show to some extent the common will to involve people, one exhorting them to take part in the climate strike, the other seeking for a digital community to share stories. Similarly, the following posts (228 – 229) are addressed to politicians in terms of accusation and blame focusing on their inaction.

228. As soon as our politicians, the media and our society start treating the **climate crisis** as the crisis it is, we will no longer need climate conferences like the #cop24. Because then all our time will be spent on cutting emissions and changing our society into a sustainable one. (16/12/2018 Greta Thunberg)

229. Just had to say some words about climate justice in front of the Supreme Court and raise awareness of @youthvgov, a lawsuit by 21 youth against the US Government for their failure for decades to protect our life, liberty, and future in the face of **climate crisis**, happening now. (19/12/2018 Jerome Foster II)

Conversely, Jerome Foster also refers to a politician in terms of appreciation and approval that can be linked to the concept of collective action. In addition, these posts referred to

politicians with different tones and meanings highlight the split over climate change as part of political polarization (Antonio & Brulle, 2011; Zhou, 2016).

> 230. It was great meeting you @SenSanders, at the #SolvingOurClimateCrisis Summit. Your energy and determination continue to inspire me to act and take real steps to help solve the **climate crisis** for the sake of our future. #ReportOnClimate (05/12/2018 Jerome Foster II)

Overall, U.S. and European activists advocate a collective climate action with the attempt to create a massive mobilization. However, in Europe the main discussion is based on climate school strikes while calling on politicians to act:

> 231. Not even catastrophes like these seem to bring any political action. How is this possible? Because we still fail to make the connection between the **climate crisis** and increased extreme weather events and nature disasters like the #AustraliaFires That's what has to change. Now. (22/12/2019 Greta Thunberg)
>
> 232. On our way to the #SibiuSummit in Romania! Tomorrow, when EU state leaders will discuss the "future of Europe" youth from Romania, Belgium (@AnunaDe), Austria and Germany will strike outside to remind them that there will be no future if they don't prioritize the **climate crisis**. (08/05/2019 Luisa Neubauer)

On the other hand, in the U.S., climate issues are related to further causes and effects, i.e., climate justice:

> 233. As we move forward in our fight for climate justice, an essential factor is to be mindful about the wrongful celebration of colonialism.

Native knowledge is the core of tackling the **climate crisis**, so let's educate ourselves and be allies rather than be complacent and complicit (29/11/2019 Xiye Bastida)

234. Give this a read. Get the full story of what this **climate crisis** is, an issue of justice. This movement is so much a movement of black and brown youth not just fighting for our future but trying to reclaim some of the past that's been taken from our people. (27/09/2019 Vic J. Barrett)

Moreover, in 2020 there is a strong parallelism between *climate crisis* and the pandemic; in Europe there is an urge to consider the climate issue as important as COVID-19:

235. #ClimateStrikeOnline. Of course we keep striking, until our government decides to also listen to science, takes necessary measures and act on the **climate crisis** as they do on the #CoronaCrisis (20/03/2020 Anuna De Wever Van Der Heyden)

236. The EU cannot derail from the Green deal because of the Corona. The green deal is part of the answer. Rather than backing off we should take this opportunity to take a leap forward towards a carbon free society we need to prevent the **climate crisis**. (14/05/2020 Adélaïde Charlier)

4.4.3 Climate action

Climate action is defined by the Oxford Learner's Dictionaries as "the act of doing something to reduce or stop climate change and prevent serious permanent damage to the environment". Broadly speaking, the idea of climate action must be implemented from

the local to the global levels, from the households to governments. Although a high keyness score of 235,99, based on a frequency of 1687 hits in the whole corpus, it was used 114 times by European politicians and activists and 309 by the Americans (see figure 4.36), confirming a similar trend compared to the employment of *climate crisis*.

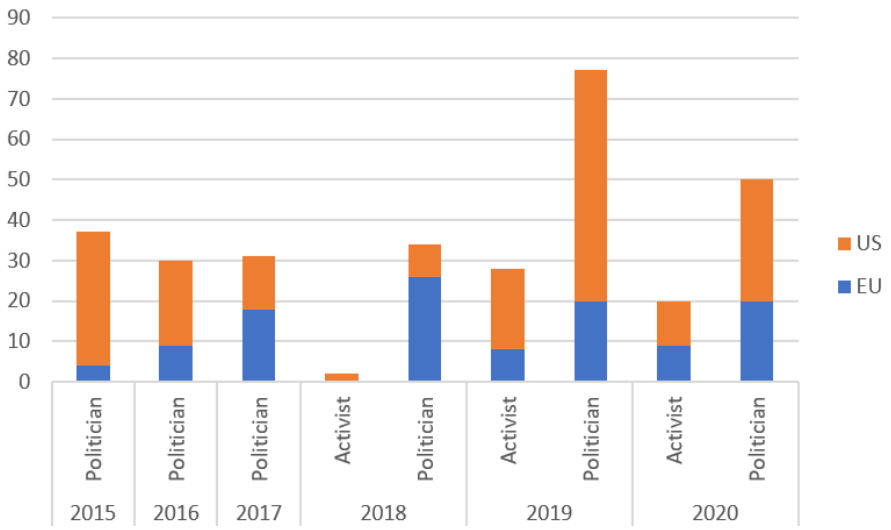


Figure 4.36: *Climate action* through place, time, and author types

As illustrated in figure 4.37, in the U.S. *climate action* is used over the years with a peak in 2019, especially by Senator Markey, author of the Green New Deal.

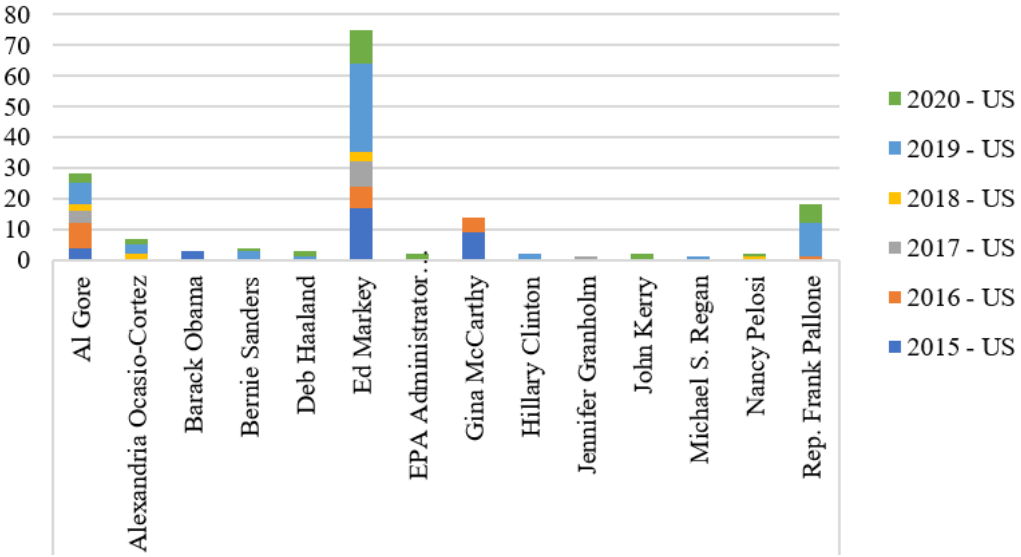


Figure 4.37: *Climate action* among American politicians

In large part, the tones of the general discourse of *climate action* appear closely associated with the presidential rotation. De facto, the efforts to act on climate are welcomed and fostered in 2015 and 2016 with clear trust and approval of the political policies as in (237), (238) and (239):

237. @POTUS @EPA CleanPowerPlan is a signal to the world that America will lead the global effort for **climate action**. #roadtoparis (21/09/2015 Edward Markey)

238. Powerful words from President Obama at a critical time for **climate action**. Together, we can solve this crisis. #ActOnClimate (21/01/2015 Al Gore)

239. Today, the EU voted to ratify the #ParisAgreement turning our climate hope into **climate action**. Now, together, we must get to work! (04/10/2016 Al Gore)

However, from 2017 a feeling of accusation and discontent arises among politicians towards Donald Trump, who was by then the new president of the United States. In fact, during the Trump administration (2017 – 2021), approximately 100 environmental rules were either rolled back or relaxed, as in the case of the withdrawal from the Paris Agreement, the weakening of the Clean Water Rule, the reduction of the borders to the Bear Ears National Monument, and the approval of the construction of the Keystone XL pipeline[30]. This type of resentment, and yet the strong will to fight, are perceivable in some tweets as reported below:

[30] https://eelp.law.harvard.edu/portfolios/environmental-governance/regulatory-tracker/

240. @realDonaldTrump & #RexTillerson must give Americans assurances that the US & @StateDept will continue to lead world on #**climate action**. (11/01/2017 Edward Markey)

241. Democrats are challenging Republicans to abandon their usual 3 climate principles of Deny, Debase, and Defund. It's time they embrace science, listen to the American people, and support **climate action**. They ignore this existential threat at political and planetary peril. (21/02/2019 Edward Markey)

242. We need a president who will face down the greed of fossil fuel executives and the billionaire class who stand in the way of **climate action**. I welcome their hatred. We will enact the #GreenNewDeal and bring the world together to defeat the existential threat of climate change. (22/08/2019 Bernie Sanders)

243. Trump's #ClimateDenial and rollback of Obama emissions standards is now hurting the auto industry and putting jobs at risk. Now is not the time to turn back the clock on **climate action**. (07/06/2019 Frank Pallone)

Again, the feeling of connectedness on behalf of politicians towards young activists and voters is manifested while soliciting environmental and political shifts:

244. Young people around the world achieved something extraordinary on Friday: A strike to demand **climate action** that touched all corners of the globe. Countries around the world should listen and act. "There is no Planet B." (18/03/2019 Hillary Clinton)

245. Young voters sent a clear message on Election Day for urgent and aggressive **climate action**. They know there is no time for half

measures - the era of the Green New Deal is here. Proud to stand alongside @IENearth @ggjalliance @CJAOurPower @greenpeaceusa (20/11/2020 Edward Markey)

Analogously to the American scenario, as summarized in figure 4.38, this expression had a widespread occurrence also in Europe in 2019 and 2020. Furthermore, Miguel Arias Cañete, who served as European Commissioner for Energy and Climate Action from 2014 to 2019, provided the greatest number of tweets containing *climate action*.

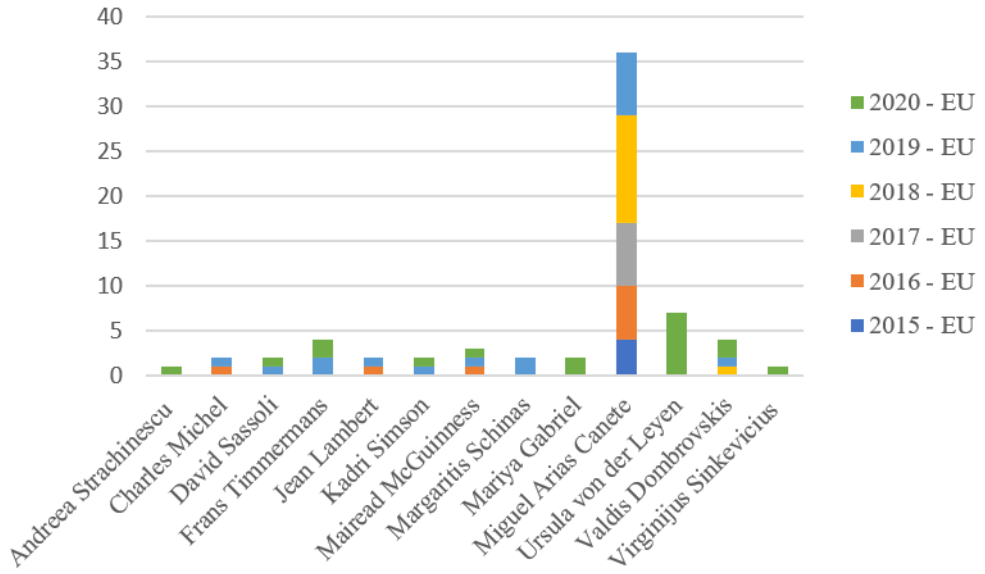


Figure 4.38: *Climate action* among European politicians

However, in contrast to the American discourse, the European one is driven by a sense of unity which seeks for support and offers help to other countries in order to trigger climate action as a common target from an economic perspective:

246. Developed and developing countries at Major Economies Forum: we are #CommittedtoParis and determined to push global **climate action**. #COP22 (Miguel Arias Cañete 16/11/2016)

247. We have proposed that 25% of the #EU budget should contribute to **climate action** as of 2021. It is EUR 320bn over 7 years. But public

funds won't be enough, so private finance needs to play its full part too. #OnePlanetSummit #SustainableFinanceEU (26/09/2018 Valdis Dombrovskis)

248. Looking forward to enhancing EU's cooperation with India at today's summit. Coronavirus response, **climate action**, digital agenda, economic relations, strengthening rules-based multilateralism, foreign & security challenges - we have a lot to discuss @narendramodi, @eucopresident! (15/07/2020 Ursula von der Leyen)

249. Tomorrow, @Europarl_EN will vote on the #ClimateLaw, a historic piece of legislation. We need ambitious **climate action** in the EU and the world. I thank Parliament and @JytteGuteland for the work already done. My remarks at today's #EPlenary (06/10/2020 Frans Timmermans)

With regard to the European and American activists, they used the expression *climate action* 18 and 32 times, respectively (see figure 4.39). In 2019, American activists adopted this phrase twice as much as the Europeans, however in 2020, the frequency was similar in both cases.

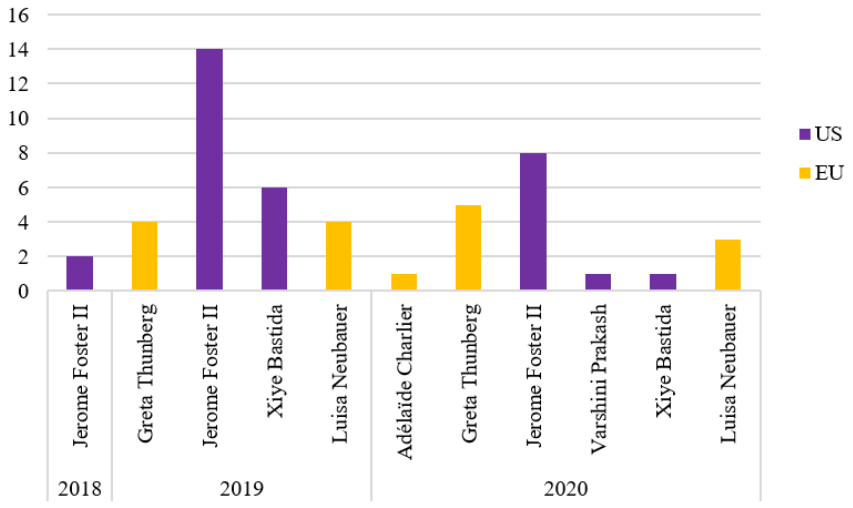


Figure 4.39: *Climate action* among American and European activists

To start with, some tweets draw attention to the climate justice discourse, which may be defined as a common thread among American activists, as highlighted in the cited examples (250) and (251) below:

250. Door of COP closes to lock protestors out. They are demanding that human and indigenous rights be recognized in **climate action** (11/12/2019 Xiye Bastida)

251. If we try to address the climate crisis without factoring in the aspects of equity and justice then we have not addressed the climate crisis at all. **Climate Action** = Climate Justice (25/02/2020 Jerome Foster II)

Conversely, as emphasized by Greta Thunberg, the theme of justice sheds light on a different concept, namely ecofeminism:

252. "Fearless women will lead on **climate action**." #InternationalWomansDay (08/03/2019 Greta Thunberg)

Moreover, the sense of connectedness among activists from the two geographical spheres, including massive mobilization, is clearly defined from both sides:

253. We must act like we are in a crisis, we must act with urgency, we must act as a united people, united planet, and a united movement to demand international **climate action** from world leaders. So join myself and @GretaThunberg at the White House this Friday from 11am - 2pm (11/09/2019 Jerome Foster II)

254. Over 1,4mn on #SchoolStrike4Climate yesterday according to latest update. 2083 places in 125 countries on all continents. "Biggest day of global **climate action** ever" says @350 And this isn't even the

beginning. Because we have done our homework. #FridayForFuture (16/03/2019 GretaThunberg)

Additionally, the youth discourse addressed to the powerful adults is prevailing:

255. I'm happy that "Climate Strike" is 2019 word of the year BUT Let's make 2020's word of the year be "**Climate Action"**. For the massive amounts of actions world leaders will take to stop this ecological crisis. (10/11/2019 Jerome Foster II)

256. @TimmermansEU is willing to align the CAP to the urgent **climate action** needed. What about you @alexanderdecroo @DavidClarinval @EUCouncil (11/11/2020 Adélaïde Charlier)

4.4.4 Big polluter

The expression *big polluter* has a keyness score of 201,76, despite occurring 818 times in the corpus. Nevertheless, the data reported in figure 4.40 show how it was mainly used by American politicians and by one activist. Thus, the high score is related to the use by social movements and news sites.

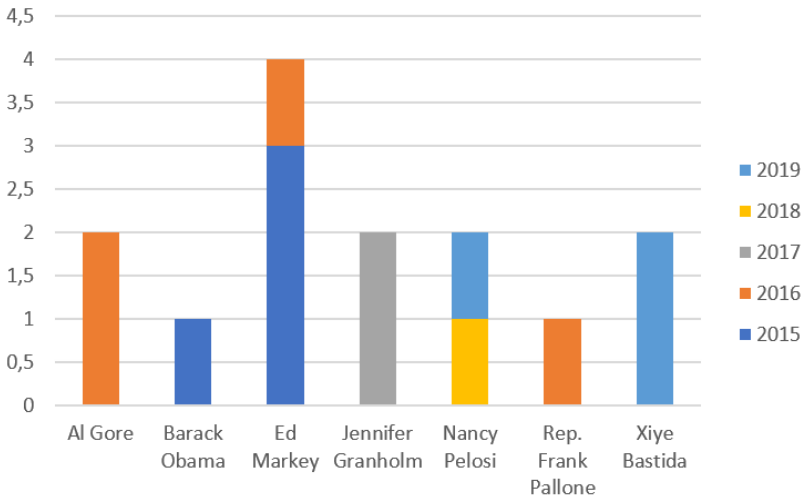


Figure 4.40: *Big polluter* among American politicians and activist

From the perspective of the American politicians, the big polluters are likely to be identified as corporations (e.g., ExxonMobil) and countries (e.g., China) and, in these cases, they are brought into play based on the relationship between them and former President Trump:

257. @POTUS, @SenateDems block #GOP & **big polluter** push to roll back #CleanWaterRule that will protect drinking water of 117M Americans (21/01/2016 Edward Markey)

258. From Day One, the Trump Admin has sold out our children's health to enrich special interests & **big polluters** pushing their toxic agenda. (30/08/2019 Nancy Pelosi)

259. @realDonaldTrump cares more about **big polluters** than the well-being of our communities" -- @LCVoters #climatechange (28/03/2017 Jennifer Granholm)

Although it may well be true that European politicians and activists do not refer to this lexical phase, to this end it is important not to overlook the content of tweets posted by the European social movement to determine whether it is a non-existing expression in that area, or intentionally not used. For instance, already the American activist Xiye Bastida tweets about big polluters while expressing indignation against a country at that time still part of the EU, i.e., the United Kingdom:

260. So let me break it down for you: 1) Only *one* **big polluter**, the **UK**, released a plan to cut carbon emissions by 2050. 2) Article 6, which decides whether or not "human rights" are to be included in carbon markets, was inconclusive. Hint: human rights are a *must* (15/12/2019Xiye Bastida)

Similarly, the social movement 350Europe denounces possible relations between the EU and the "big polluters". However, the main intent in the U.S. is to blame the President's administration who is believed to promote financial and legislative maneuvers at the expenses of the people. Whereas, in Europe the focus is mainly on offering wider visibility to disagreeable companies:

261. BREAKING It's just been revealed that **big polluters** like BP & Shell are being seriously considered as key sponsors for the UN climate talks. Take action now & sign to #KickPollutersOut of @COP26 @Cult_Unstained (01/10/2020 350Europe)

262. Will Merkel cave in to **big polluters**? (07/05/2015 350Europe)

4.4.5 Clean energy

The lexical phrase, *clean energy*, with a 195,2 score, was found 2800 times in the corpus. As can be seen in figure 4.41, like the other expressions, it is predominant in the American geographical area with 314 tweets versus the 94 in the EU.

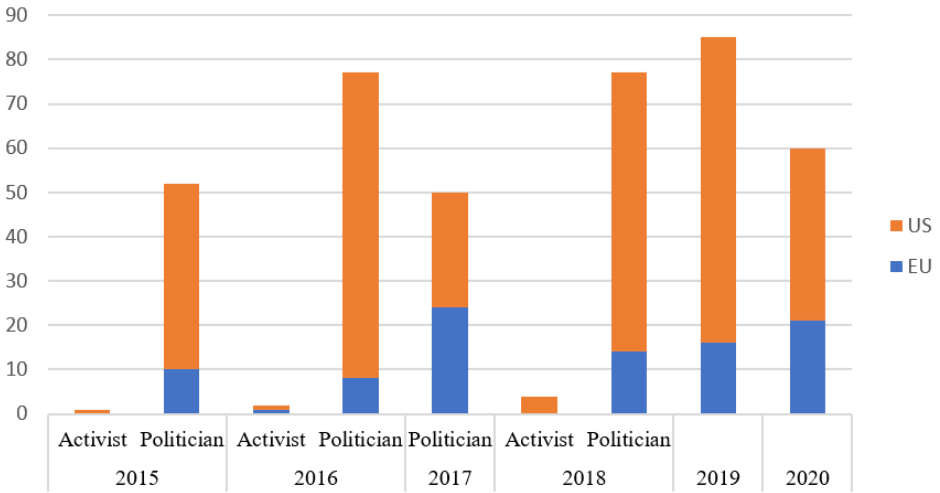


Figure 4.41: *Clean energy* through place, time, and author types

Based on the analysis of both American and European politicians, the topic of *clean energy* is highly related to the economy and business themes, highlighting the relationship between climate change and economies in both geographical areas. In this regard, financial stability, disinvestment from fossil fuel, and reduction of carbon emissions are also included. Additionally, this lexical phrase also comprises green job opportunities, better health conditions and less pollution. As a result, most tweets convey positive meanings as addressing climate change solutions. A number of examples are provided below ranked by year.

In 2015:

263. Acting on climate isn't only about risk. **Clean energy** & innovation mean better jobs, stronger economies & better health. #AMS2015 (07/01/2015 Gina McCarthy)

264. Investing in the **clean energy** industry is an important way to #ActOnClimate. (16/06/2015 Barack Obama)

265. EU diplomacy mobilised to support our #EnergyUnion goals: diversification, safety, security, climate and **clean energy** (20/07/2015 Miguel Arias Cañete)

In 2016:

266. Offshore wind power will create **clean energy** jobs & help combat #ClimateChange NJ needs to embrace this opportunity (11/01/2016 Frank Pallone)

267. EU-China climate and **clean energy** leadership now more important than ever. We agreed to boost our cooperation, announcements soon. #COP22 (14/11/2016 Miguel Arias Cañete)

In 2017:

268. We're already feeling impacts of climate change. Exiting #ParisAgreement imperils US security and our ability to own the **clean energy** future (01/06/2017 Joe Biden)

269. We need to create a solid #industrial basis in support to #CleanEnergy transition. Launch next year of "**clean energy** industrial competitiveness forum" @ristori20 #CEDEnergy #EnergyUnion #CleanEnergyEU #IndustryEU #CEERegion (11/12/2017 Andreea Strachinescu)

In 2018:

270. A year ago today, Trump announced America would leave the #ParisAgreement. Despite his best efforts, many of our states, cities & citizens are continuing to look to the future, invest in **clean energy** & fight #climatechange. Let's keep it up. We'll always have Paris... #StillIn (01/06/2018 Edward Markey)

271. Politics can show the direction but industry will deliver the innovation needed for the **clean energy** transition #energyforeurope (27/09/2018 Miguel Arias Cañete)

In 2019, although the Europeans keep focusing on the same theme, *clean energy* related to the climate issues becomes an instrument of political dissent in the U.S. This may be due to the scheduled presidential elections:

272. To Donald Trump, the #GreenNewDeal is a just political football. To the people who have had homes destroyed by flooding, hurricanes,

and wildfires, for kids with asthma, for workers in **clean energy**, it's about their futures. (22/03/2019 Edward Markey)

273. President Trump continues to deny the scientific evidence in front of his own eyes and attack the progress we've made on climate change. It's unacceptable. In a Biden Administration, we'll turbocharge our efforts to achieve a 100% **clean energy** economy. (21/06/2019 Joe Biden)

274. Europe has pioneered many innovative clean energy solutions available today. As a result, Europe is now home to some of the world's largest clean tech companies. But we have to keep it up to win the global **clean energy** race. My speech at #CEICIF (18/03/2019 Miguel Arias Cañete)

In 2020, *clean energy* strongly resonates with the political propaganda in the U.S.; for instance, this signals a shift from the economic to a more political-oriented discourse (Chen et al., 2022):

275. This pandemic has put our country in an economic hole. We need real leadership - we need @JoeBiden. His #BuildBackBetter plan creates jobs, raises wages, invests in **clean energy**, and helps build a better America for all. Vote blue -vote #JoeBiden2020. #TeamJoe (09/07/2020 Deb Haaland)

276. The climate emergency requires our urgent action. As president, I will: - Ensure we achieve a 100% **clean energy** economy and net-zero emissions by 2050 - Rejoin the #ParisAgreement and rally the world to go further - Make the largest-ever investment in clean energy (22/04/2020 Joe Biden)

277. Offshore renewable energy is a true European success story. Over the next years, we will aim to turn it into an even greater opportunity for c**lean energy**, high quality jobs, international competitiveness, and sustainable growth. #EUGreenDeal #OffshoreRenewableEnergy (19/11/2020 Frans Timmermans)

Among the activists, there is no significant use of *clean energy*; it was tweeted once in Europe and 13 times in the U.S. This may be due to the fact that activists do not consider the economic aspect as a possible solution. Indeed, their discourse mainly focuses on attribution of responsibility, blame and political inaction (Boulianne et al., 2020), as well as raising awareness of the topic and taking action with strikes. Nevertheless, the connectedness among American activists and politicians emerges with the use of *clean energy*, yet linked to the elections:

278. Today makes the beginning of a new era of economic operation which allows my generation to have green jobs, clean energy, and a green new world. #GreenNewDeal #GreenNewDealResolution #GreenNewWorld (07/02/2019 Jerome Foster II)

279. Basically, this office should report directly and have direct access to the President, have the power to shape the federal budget, and be fully empowered to convene and lead all agencies and departments in the all-government, all-society mobilization towards 100% clean energy. (16/12/2020 Varshini Prakash)

4.4.5 Fossil fuel

As a common lexical phrase in everyday language, *fossil fuel* has a keyness score of 165,35 compared to the reference corpus, which makes it a very common expression the analyzed corpus. However, it appears 594 times among American and European politicians and activists, and it is mostly used in the U.S., as shown in figure 4.42.

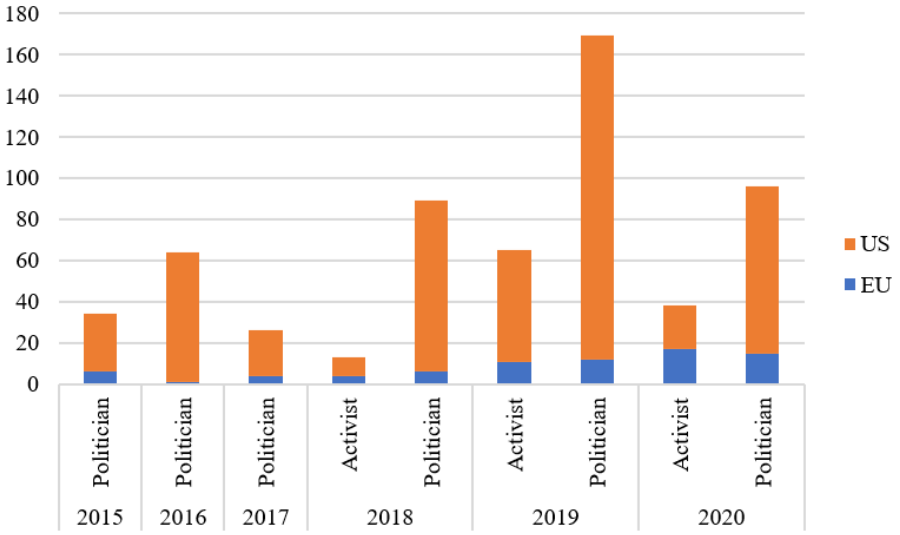


Figure 4.42: *Fossil fuel* among American and European politicians and activists

Although the relatively small number of tweets about *fossil fuels* in 2015, on the one hand, in both geographical areas, fossil fuel is fitted in positive tweets considering it as an opportunity to shift to sustainable energy (280) and (281). On the other hand, resentment against the big polluters in terms of accusation arises (282). However, as shown below, the discourse is strongly economic in nature:

280. We must move away from **fossil fuels** and into energy efficiency and sustainable energy (05/07/2015 Bernie Sanders)

281. European unity can create sustainable society, make us less dependent on **fossil fuels** and external energy providers, and benefit citizens (11/03/2015 Frans Timmermans)

282. #ExxonKnew the truth about **fossil fuels** and climate change and lied to protect their business model at the expense of the planet. (16/10/2015 Bernie Sanders)

The same discourses on economy and resentment emerge in the following years in both countries. Although in the U.S. the discourse is markedly politically oriented and refers to the U.S. 2017 elections first, to Trump's administration then, and finally to the 2021 elections:

283. THIS: @realDonaldTrump handing energy policy over to climate deniers & **fossil fuel** energy lobbyists @BernieSanders (26/09/2016 Jennifer Granholm)

284. Trump: Want to know what fake news is? Your denial of climate change and the lies spread by **fossil fuel** companies to protect their profits. (19/02/2017 Bernie Sanders)

285. These policies continue to allow **fossil fuel** companies to pollute our clean air, water, and soil with impunity. Our environment may never recover from the damage he has caused. (05/07/2018 Deb Haaland)

286. Today we are putting an end to coal in Europe. As we go #BeyondCoal towards clean energy, capacity mechanisms will not be used as a backdoor subsidy of high-polluting **fossil fuels** - this would go against the #ParisAgreement. Press release (19/12/2018 Miguel Arias Cañete)

287. Donald Trump thinks climate change is a hoax. Donald Trump is bought and paid for by the **fossil fuel** industry. Their time is up. We

are going to end the greed of the fossil fuel industry and pass a #GreenNewDeal. (22/08/2019 Bernie Sanders)

288. Joe Biden & Kamala Harris have repeatedly said they're going to abolish fossil fuels & ban fracking. President @realDonaldTrump & I are not going to let that happen & we're going to build on the record that for the first time in over 70 years, the US is a net exporter of energy! (24/10/2020 Mike Pence)

With reference to climate activists, it can be said this expression was mainly adopted in 2019 in the U.S. and in 2020 in the EU, as illustrated in figure 4.43.

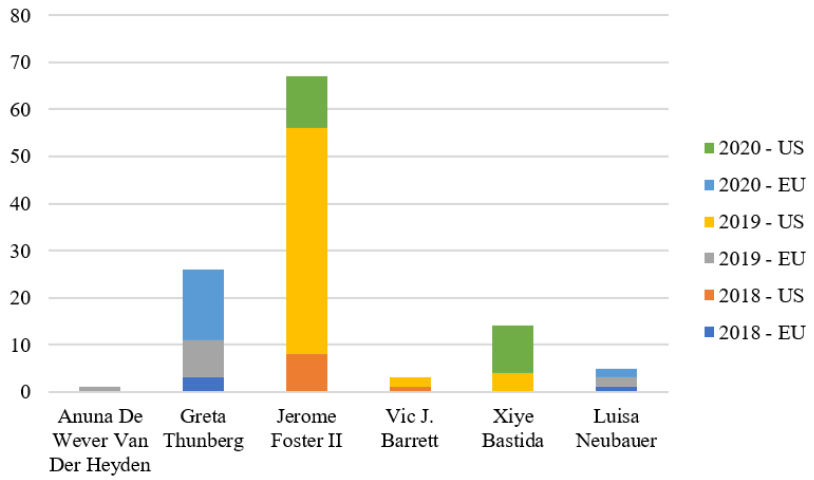


Figure 4.43: *Fossil fuel* among activists

As shown in the examples below, the language used by these stakeholders focuses on the climate strike and the attribution of responsibility discourses:

289. "**Fossil fuel** emissions rose by 1.7% in 2017 and are set to rise 2.7% this year." Whatever our world leaders are "doing" to reduce emissions, they are doing it wrong. (05/12/2018 GretaThunberg)

290. The youth environmental movement has begun around the world. Today, we are seeing youth take against **fossil fuel** interests through

science, media, politics, corporate relations… (23/07/2018 Jerome Foster II)

291. Since the world agreed on 1.5° in 2015, global installed coal-fired capacity grew by 92 GW. That's twice the coal capacity of Germany. The fossil fuel industry won't pack up just because their business is wrecking our #future. We have to make them stop. #rise (15/01/2019 Luisa Neubauer)

292. If you weren't able to join us this Friday at the #HarvardClimateRally then you can still support us by signing this petition to urge Harvard University to divest from **Fossil fuels**! (21/07/2019 Jerome Foster II)

293. Too much for some indeed, like **fossil fuel** companies & lobbyists. And not enough for others, like the science - or those who think we should fulfill what we promised in the Paris Agreement. Our economy might manage this but the ecosystems won't. And we can't bargain with nature. (16/09/2020 GretaThunberg)

294. We protest pipelines not only because they perpetuate the use of **fossil fuels**, but also because they leak and contaminate communities and waterways Accurate headline: Alberta minister in favor of furthering health hazard in frontline communities during global Covid-19 pandemic (26/05/2020 Xiye Bastida)

4.4.6 Discussion

The five lexical phrases – *climate crisis, climate action, big polluter, clean energy, fossil fuel* – were used to answer the last research question: "*Are there any differences in terms*

of language use between the United States and the European Union?". As this part of the study analyzed the tweets produced by youth activists and politicians, the findings suggest a general politization of the climate change issue in both areas, and a highly polarized discourse in the U.S. (Chen et al., 2022; Chinn et al., 2020). Indeed, the results show particular reference to two specific policies: namely the Green New Deal and the Paris Agreement. Moreover, climate change is dealt with economic language, especially in Europe, whereas in the U.S. most tweets reveal a more polarized discourse based on blame and dissent, following specific events, such as the U.S. elections. By contrast, youth activists' discourse is built upon three main themes: climate justice, call to action, mainly by school striking, and attribution of responsibility.

As pointed out by Jang and Hart (2015, p. 16), the Twittersphere may be regarded as a "natural field where interpersonal conversations are unobtrusively measured and analyzed". However, in a broader sense, it is also considered that politicians adopt a vague style since they are "aware that they are playing a language game" (Baker, 2006, p. 122). Additionally, within the political discourse, Hajer and Versteeg (2005, p. 179) outlined that "language has the capacity to make politics, to create signs and symbols that shift power balances, to render events harmless or, on the contrary, to create political conflict".

Further to this, among many studies which analyzed the meanings in newspaper coverage, Carvalho and Burgess (2005) pointed out that messages are socially constructed, and, to a certain extent, messages conveyed by newspaper include and may be influenced by, political agendas and contexts. In their study, the authors highlighted how journalists from different newspapers (i.e., the Guardian, the Independent, the Times), can present in very much different ways the same scientific issues to their audience. Moreover, they (2005, p. 1467) concluded that the media "emphasize or de-emphasize forecasts of impacts, in order to sustain their political preferences regarding the regulatory role of the state,

individual freedom, and the general economic and social status quo". In addition, Jang and Hart (2015), noted how tweets from the general public reflect the same dispute of traditional media, and as a matter of fact, media polarization is mirrored in the public opinion.

In a similar vein, the results of my research confirm how the construction of the climate change issue is politically and ideologically constrained by the users themselves, connected to the political context of the moment, and to the discontent or contentedness related to the governmental organization. De facto, this is confirmed in the American context as the messages show a shift from an *emotional* perspective. The messages posted in the first years of the analysis, 2015 – 2016, could be interpreted with a positive and supportive feeling, expressing political consent. Conversely, in the following years, a change of direction occurred following the presidential elections in 2017, and a discourse of tension emerges. The stakeholders who provide an opinion on their accounts are mostly of the Democratic party who manifest approval and alliance with American and European activists, as well. Notwithstanding that tweets from members of the Republican party were also included during the data collection, the results show little participation in these salient topics. In this scenario, this may be interpreted as a hegemonic discourse which "can be at its most powerful when it does not even have to invoked, because it is taken for granted (Baker, 2006, p. 19). What is not being said and discussed is not only interpreted as a puzzling denialism. Many scholars have investigated Trump's political discourse and the concept of *fake news* classifying it as a "rhetorical device for discrediting unfavorable coverage of his presidency" (Davis & Sinnreich, 2019, p. 149) and have also analyze the use of the same strategy by other Republicans (see also Carveth, 2019; Lutz, 2019). Specifically, as highlighted by many scholars (Bomberg, 2017; Sarathchandra & Haltinner, 2021; Zhang et al., 2017), climate change as a hoax used by

Republicans in the U.S. context is also confirmed in this corpus. Indeed, a similarity with the above reported example (133), i.e., the only tweet where Donald Trump mentioned *climate crisis* and defined it as fake news, is demonstrated in a tweet by another Republican:

> 295. #ClimateChange is a **hoax**. Can't respond now though because I have sunscreen all over hands, at the beach in Rehoboth today. #february (24/02/2017 Scott Pruitt)

On the other hand, there is evidence that European politicians do adopt a vague style with no accusation of responsibility; their main intent is to provide solutions approaching the *techno-optimism* repertoire, as identified by Ereaut and Segnit (2006). In fact, the discourse around this theme focuses on the promotion of technology or business which are believed to be able to address climate changes issue while aiming at green and clean energy. Moreover, especially in the European scenario, the discourse used matches Hajer's et al. (2015) coinage and definition of "cockpit-ism", that is the tendency to create the illusion that governments have the magic recipe to address climate change in the best interests of the planet.

In relation to activists, many scholars have investigated the dynamics of collective action and their use of social media, as Twitter, to encourage massive mobilization both online, with the provision of information before and after strikes, and offline, fostering the rise of a digital community especially during the pandemic (Boulianne et al., 2020). Additionally, the discourse addressed to the powerful adults in terms of blame of governments' failure and the attribution of responsibility for political inaction is vivid and strong as in much other research. Based on the findings of this research, the discourse that sparks interest is climate-justice, especially among American activists. Indeed, their

language use highlights their preoccupation of climate change on vulnerable communities. This type of environmental discourse prioritizes "local impacts and experience, inequitable vulnerabilities, the importance of community voice, and demands for community sovereignty and functioning" (Schlosberg & Collins, 2014, p. 359). As emphasized by environmental justice research, the main focus is on climate change impacts on poor communities and communities of color (Ikeme, 2003; Mohai & Saha, 2006). In fact, the concept of climate justice dates to the 1960s, when in the U.S. African Americans, together with environmentalists, started campaigning for their environmental and civil rights because of the disposal of toxic waste near their community. Furthermore, to date, these elements are foregrounded by accentuating the condition of indigenous people. As a result, this aspect is strongly related to the coinage of the new acronym *BIPOC* (Black, Indigenous and People of Color), as analyzed in the second research question.

Differently, another perspective of climate justice is provided by the European activist Greta Thunberg, i.e., the ecofeminism. Akin to the climate justice movement, ecofeminism comes from the 19th and 20th century feminisms, however it was much related to the concept of social environment affected sexism, racism, classism, and other oppressions (Adamson, 2016). Further on, at the end of the 1990s, in the plurality of its meaning, the current idea of ecofeminism aroused with the alliances between ecofeminists and environmental justice activists (Gaard, 2018; Kirk, 1997). Thus, the young Swedish girl emphasizes the importance of the ecofeminist perspective which addresses the preservation of the environment, as also embraced by the objectives of the Sustainable Development Goals (SDGs). To date, on behalf of a young girl, ecofeminism may be interpreted as women's commitment to the environment and the bond between women and nature.

Although this part of the study focused on the U.S. and Europe as two distinct geographical areas, the most salient lexical expressions were extracted from the whole corpus and some of the examples above provided clear evidence of the connectedness among the users through mentions "@username" (Chen et al., 2022; Pearce et al., 2014). Hence, based on the data provided in figure 4.44, additional investigation into the connections among all the stakeholders could provide further confirmation.

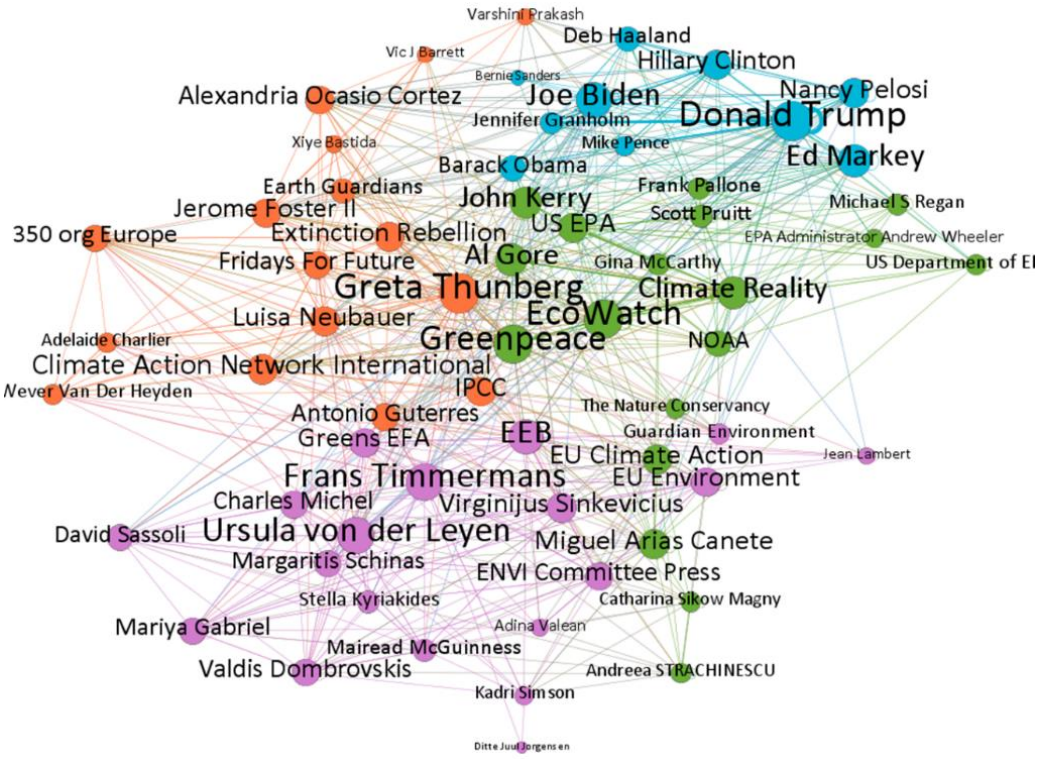


Figure 4.44: The social network of the stakeholders based on mentions (visualized using Force Atlas layout in Gephi and based on Blondel's algorithm)

Specifically, the network represents the 63 stakeholders and how they mentioned each other through the collected tweets. According to the coloring scheme, four main communities were detected. In particular, 30% of the users (19/63) tended to aggregate forming the biggest community, colored in violet, which includes most European politicians and organizations.

The green community is the second biggest with 29% of users (18/63), and encompasses the most climate- related American politicians, i.e., Al Gore, John Kerry, Frank Pallone, Scott Pruitt, Michael S. Regan, Andrew Wheeler, and Gina McCarthy. Also, three European politicians, – Andreea Strachinescu, Catharina Sikow Magny, and Miguel Aries Cañete – and Greenpeace, EcoWatch and Climate Reality are part of this cluster.

The orange community, 25% of the users (16/63), mainly includes activists and social movements, American politician Alexandria Ocasio Cortez, and the IPCC, as well. Whereas the blue community represents some of the American politicians, 16% of users (10/63).

These results confirm a demographic relation among most politicians, whereas social movements and activist, although in different parts of the world, create a unified community (Pearce et al., 2014). Greta Thunberg, as the leading climate activist, together with Donald Trump, may appear as those who attract the attention of the climate discourse, although for different reasons.

Concluding this section after answering my last research question, the evidence leads to the confirmation of socially constructed discourses mainly related to political events. Following the hypothesis, I assumed that climate change in Europe was addressed in a more coherent and stable way compared to the U.S. The exploration of the data and the findings provide evidence to validate the hypothesis. As a matter of fact, European politicians' discourse remained scientific and economic in nature throughout the years. In fact, with their language use, they also safeguarded their elitist political position favoring communicative actions with their counterparts. Simultaneously, U.S. politicians took advantage of the climate issue for a more exploitative use, in terms of blame and attack of their political counterpart, confirming strong polarization and politization of the

topic. Vice versa, call to action and blame discourses, especially in the tweets addressed to the political representatives, are dominant among the environmental activists from both countries. However, the substantial difference among the two groups is dictated by the social factor that is typical of the American continent. Indeed, as described above, the issue becomes more personalized among the American youths who strongly urge the importance of climate justice supporting the communities of native Americans and people of color, thus confirming how social variables impact the climate change discourse.

4.4 Concluding remarks

The analysis of this corpus provides an overview of how climate change has been depicted and discussed by different stakeholders over time in the European Union and in the United States. Overall, the leading authors are social movements who gradually gained the first place during the years, also based on social and cultural changes and dynamics. Indeed, although they have long existed, together with climate activists, the use of the social media Twitter by a young digital generation contributed to the strengthening of their voices, namely Extinction rebellion, Fridays for Future, Greta Thunberg, Jerome Foster among the others. Their strategic communication mainly aimed to inform, educate, and mobilize their audience. In fact, the analysis of their discourse, lexical innovations and frames emphasizes their need to highlight who or what is good or bad (Gamson, 1995) in the climate change fight and what are the possible solutions. In addition, the ultimate goal is to raise awareness and encourage wide participation, especially of youths. In fact, the main frames adopted by these author types are *call to action*, *civil society protests* and *attribution of responsibility or blame*. Their actions and credibility, and consequently their resonance, materialized with global climate strikes, protests, participation in summits and conferences (Boulianne et al., 2020; Hodges & Stocking, 2016; Pickard,

2021). Also, the creation of new words highlights the need to foster awareness, cause greater concern, and reinforce collective identity (Nerlich & Koteyko, 2009a). The same can be said about the frames used (Benford & Snow, 2000). For instance, I argue that words as *climatestriker*, *artivist*, *craftivist*, *BIPOC* fortify their identity and denote a sense of belonging to a group which contribute to nurture further motivation. Similarly, the creation of lexical items as *solastalgia* and *doomism*, strengthens the sense of connectedness and community in a time of ecoanxiety.

As discussed by Hulme (2009), climate change information with scientific evidence cannot completely engage a wider audience; to change people's behaviors it is necessary to change "the status of climate change in the minds of citizens – psychological, emotional and behavioural berries" (Hulme, p. 215) and in this sense, climate change communication, framing, discourse and language play a crucial role in conveying messages and constructing their perception. Hulme (2009) also points out that the media build their type of communication mainly on "scientifically sound information" (p. 217). As a matter of fact, the news sites analyzed in this research, mostly utilize the *information of facts or scientific evidence* and *disasters or catastrophes* issue-specific frames. Nevertheless, I believe the main goal of this author type's discourse is not merely related to awareness raising, it actually focuses on shedding light on risks, urging action and implicating responsibility.

As outlined by Schäfer (2012, p. 530), NGOs can be defined as "the champions of online climate communication". Indeed, their contribution of tweets in the corpus is substantial and this may be due to the fact that this author type, like social movements, do not have other resources to reach their audience. Their discourse covers different facets for the same issue highlighting the need for unbiased information about disasters and risks on wildlife and human beings. Nevertheless, in contrast with the sense of alarmism and fear,

I argue that they attempt to foster an ecological consciousness by proposing and promoting healthier and environmentally friendly behaviors (Schäfer, 2012), particularly specified through the *opportunity* frame. In addition, they attempt to encourage support and action through *civil society protests* and *call to action* issue-specific frames.

With reference to politicians, in contradiction with the aforementioned stakeholders, their discourse is closely associated with time and place. On the one hand, European politicians showed constant engagement with broad environmental issues. Nevertheless, the dominant economic discourse, prompting what is considered to be sustainable technology or business, may deceive into complete acknowledgment and action. Moreover, there is little reference and interaction with other stakeholders. On the other hand, in the U.S., climate change seems to be a highly polarized topic (Chen et al., 2022; Chinn et al., 2020), and its discourse is intermittently politicized over the years following political campaigns and periodic dissent. However, for better or for worse, a decent level of interaction among politicians and other users was proven.

Finally, organizations did not manifest great involvement. Indeed, a small number of tweets was recorded within these accounts which mainly seem to be policy neutral. Yet, the most recurring frame was the *economics and business* one, confirming a connection with political orientations, especially in the U.S (Fløttum, 2010).

Chapter Five

Conclusion

5.1 Summary of the study

The main objective of this research was to gain new insights into the relation between the evolution of English as a global language and climate change as a common and earthly issue. In particular, the study investigated into new lexical items and language variation among activists, social movements, politicians, NGOs, news sites and organizations in relation to time, place, as well as social and political contexts.

In the last three decades, a great deal of research has focused on environmental discourses, specifically highlighting environmental politics and their underlying ideologies. In addition, a large number of studies has focused on media coverage carrying out discourse analyses and framing approaches also to determine how media reporting affects and shapes public opinion. More recently, many scholars have analyzed climate change communication from several social networking platforms, examining environmental discourses and active participation of new kinds of stakeholders, as well.

Although the issue has been much discussed in recent literature, the aim of this study was to sketch a broader picture of the relationship between the social actors and language variation across space and time. Indeed, it provides a number of contributions in the examination of how many specific users as meaning-makers from the U.S. and Europe directly acted through their language, by means of a social networking service (Twitter) in a six-year time, from 2015 to 2020.

The present work was designed to address three research questions and test five hypotheses. Specifically, this comparative study was conducted through the compilation

of a corpus with Twitter data consisting of tweets and specific metadata related to the geographical location and time of publication of a tweet. The intersection of these two variables addressed the analysis of language use and lexical creativity among users of the social media platform. In addition, by virtue of discourse analysis and framing theory, differences and similarities between the U.S. and the EU in terms of political and social factors were identified. Indeed, this research followed a corpus-based approach with mixed methods; a quantitative approach to corpus linguistics was used to determine the frequency of terms, identify new lexical items and collocates, and find differences over time, places and people through statistical analyses. A qualitative approach was adopted for the manual annotation of the polarity of new items, and to carry out discourse analysis and a framing approach.

The analysis was conducted on a specialized corpus created with climate-related texts in English taken from the social media platform Twitter dating from January 2015 to December 2020. All tweets were retrieved with metadata related to authors' screen name, time of publication, hashtags, mentions, URLs, and the different languages the tweets were written in. Furthermore, tweets were manually annotated considering the origin of each author based on the "home" location indicated in their public profile. Thus, specific geographical labels were added, i.e., EU, U.S., or International for the accounts which specified their location as "global" or "Earth". Although the initial corpus included 372,882 tweets, a series of filtration steps were taken in order to obtain a climate-related final corpus, which then included 163,753 tweets of 63 authors, from 3 locations, over 72 months. In particular, the tweets were collected from specific groups, labeled as "author type", such as climate activists, news companies, NGOs, institutional organizations, politicians, and social movements. Particularly, the corpus included eight climate activists, four from the USA and four from Europe; two news companies, a European and

an international one; four NGOs, a European one and three international ones; nine governmental organizations, five from Europe and three from the U.S.; eighteen European politicians and eighteen from the U.S.; five social movements, one from Europe, two international ones and two from the U.S. The main goal was to define discourse use related to climate change among these groups identified as leading spokespeople about climate or acknowledged as those who have the power and duty to act. Moreover, as this study focused on English language variation, the first filtration step was to sort tweets by language. Subsequently, the corpus was compiled following a manual data annotation with timestamp on the corpus tool Sketch Engine. Through this software, another filtration step was performed using the keyword analysis function. This process was implemented through the analysis of keywords of four specific authors within the corpus, i.e., Eco Watch, Greenpeace, Guardian Environment, Extinction Rebellion, because of their highly climate-related content. The climate-related words with at least an absolute frequency of 50 were employed to filter the main corpus in Excel.

Within the first research question, the objective was to study the collocates of climate through corpus linguistic techniques, and lexical creativity in order to test the hypothesis that collocations related to climate change were more typical among NGOs, social movements and activists. The first step of the quantitative approach was to identify the main collocates of the word climate with the Word Sketch tool. The collocations used for the analysis presented a logDice score equal or higher than 8.7 in two specific categories: modifiers of climate and nouns modified by climate. The logDice score is a statistical measure which determines the strength of the collocation without being affected by the size of the corpus as it measures both the frequency of the noun and of the collocate, and the frequency of the whole collocation. Moreover, the obtained collocates were manually analyzed together with the co-text, while identifying differences among the author types.

Nevertheless, due to the various number of stakeholders in each author type, it was necessary to calculate the frequency of the tweets containing the analyzed collocations in relation to the total number of tweets posted by each author type. Therefore, a further analysis was carried out to calculate the relative density in the interface of collocations to determine the typicality of the listed collocations through the comparison of their frequency in a specific author type with the frequency in the whole corpus. As a result, activists were the most prolific users of collocates (21%), followed by social movements (18%), politicians (15%), NGOs (8%), news sites (5%), and organizations (3%). Based on the outcomes of the quantitative analysis, the extensive use of collocations among specific author types may be explained by the purpose *per se* of these stakeholders which dictated the number of tweets posted, and by the extension of the community structures (Würschinger, 2021). On the other hand, from a qualitative approach, the several facets to the climate discourse made it a more challenging and articulated issue, thus highlighting the different perceptions of its complexity and the ways of addressing it. Nevertheless, the hypothesis may not be validated as the statistical analyses showed how the use of collocations was highly typical among activists, politicians, and social movements.

Moreover, since environmental issues can be considered a shared and ongoing problem, the need to communicate new concepts and the awareness of the lack of words to express new perceptions and scenarios, bring to the creation of new terms (Mühlhäusler, 2003). Additionally, social media platforms, such as Twitter, provide the opportunity to communicate worldwide and foster the creation of virtual communities which share a common interaction interest. I embraced the idea that new lexical items can be considered as such when a specific speech community uses it in a given time frame (Crystal, 2001). As a result, the second hypothesis that lexical creativity related to climate change was

more frequent among social movements, NGOs, and activists was evaluated. For an in-depth study and detection of new lexical items in the corpus, the investigation was carried out through statistical analyses using metadata referred to groups, time, and location. The new lexical items were firstly obtained with an automated analysis carried out with Unitex/GramLab with the application of electronic dictionaries generated with a spaCy package. Then, the file created with the non-present words were manually verified with the Oxford English dictionary (OED) and the Merriam-Webster dictionary, both online versions, in order to assess the inclusion of these items as existing entries in online dictionaries. Thus, already lexicalized units identified in both dictionaries were not considered, and 50 units were regarded as new lexical items. As a result, the groups which mostly used new lexical items were social movements with 547 posts in total, specifically the international ones, followed by news sites and NGOs. Overall, the analyzed data showed how specific stakeholders, such as social movements, NGOs, and news sites, pursued precise goals, such as awareness raising, call to action, and attribution of responsibility. In addition, the content of their tweets highlighted the wide action range. Indeed, the facts reported in tweets were not circumscribed to particular geographical areas, but to the whole world. Therefore, the need to express new phenomena seemed to become greater and also more urgent if taken into account the commonality of the issue.

As for the second research question, language variation was investigated under a temporal perspective. Following the first hypothesis, the initial step attempted to evaluate whether the number of tweets increased over time. Through statistical analyses, an unsteady trend emerged over the years. For this reason, further investigation was carried out focusing on the most frequent hashtags to trace back the main events that occurred over the time span in relation to the posted messages per author types. Evidence showed how social, political, and extreme weather events influenced the number of tweets posted. Indeed, the

two main events which succeeded in drawing particular attention to the topic and mobilize crowds were the Paris agreement, in 2015, and the 2019 climate strikes.

The second hypothesis comprised in this research question stated that new lexical items had a stronger negative meaning throughout time due to the fact people were more aware of the negative consequences of climate change. In the attempt to validate or reject this hypothesis, it was necessary to annotate manually the connotation of the new lexical items with reference to the whole co-text. Further to this, 30% of the items were annotated by a second annotator and the reliability between the annotators was calculated with Cohen's Kappa metric through R with a reliability output of 85%. Additionally, for a better understanding of the polarity of these words, a framing process was implemented to determine the saliency of the communicated messages. Generally speaking, the usage of new lexical items with a negative meaning was greater compared to the neutral and positive ones. Most of the negative new lexical items reported climate disasters or catastrophes. On the other hand, the analysis pointed out how most tweets annotated as positive expressed a sense of protest and call to action through a gentle and polite discourse; rather than calling for offensive language or violent protests, this type of call to arms aimed at mobilizing people to sign petitions and join meetings.

The last stage of the study explored the main differences and similarities between European and U.S. activists and politicians drawing attention to the most relevant discourses over time, through the analysis of lexical phrases. In fact, by means of discourse analysis, the objective was to investigate the social construction of the issue and how specific stakeholders made sense of it (Hajer & Versteeg, 2005), in different places and at different times. The hypothesis that the European Union had a more stable and coherent concern about climate change throughout time compared to the United States was tested. In this part of research, the keywords tool in Sketch Engine was

employed to detect the multi-word terms in the corpus which identify the lexical saliency. Indeed, through this approach, the attempt was to account for a cross section of the salient expressions of the entire corpus, and then compare their usage to specific tweeters to analyze how they shaped them in their discourse. Specifically, the analysis focused on the first five lexical phrases – climate crisis, climate action, big polluter, clean energy, and fossil fuel. Overall, the results confirmed how the construction of the climate change issue was politically and ideologically constrained by the users themselves, connected to the political context of the moment, and to the discontent or contentedness related to the governmental organization. In fact, the findings suggest a general politization of the climate change issue in both political areas, and a highly polarized discourse in the U.S. Conversely, youth activists' discourse is built upon three main themes: climate justice, call to action, mainly by school striking, and attribution of responsibility.

As this final part of the study mainly focused on the U.S. and Europe as two distinct geographical areas, the analyzed data provided clear evidence of the connectedness among the users through mentions "@username". Indeed, a further investigation by means of social network analysis implemented with Gephi, confirmed a demographic relation among most politicians, whereas social movements and activist created a unified community despite being in different parts of the world.

The present work offered an overview of how climate change was depicted and discussed by different stakeholders over time in the European Union and in the United States. Globally speaking, social movements were the leading authors, along with climate activists. Their communicative function was mainly aimed to inform, educate, and mobilize their audience. In fact, the analysis of their discourse, lexical innovations and frames emphasizes their need to highlight which stakeholders or which actions are good or bad (Gamson, 1995) in the climate change fight and what the possible solutions are. In

addition, the main frames these author types had recourse to were call to action, civil society protests and attribution of responsibility or blame, which concretely materialized in global climate strikes, protests, participation in summits and conferences (Boulianne et al., 2020; Hodges & Stocking, 2016; Pickard, 2021). Also, the creation of new words highlights the need to foster awareness, cause greater concern, and reinforce collective identity (Nerlich & Koteyko, 2009a). Moreover, although with a different purpose, the news sites analyzed in this research, mostly referred to the information of facts or scientific evidence and disasters or catastrophes issue-specific frames to shed light on risks, urge action and implicate responsibility. Similarly, NGOs covered different facets for the same issue highlighting the need for unbiased information about disasters and risks on wildlife and human beings and proposing and promoting healthier and environmentally friendly behaviors.

With reference to politicians, European politicians showed constant engagement with broad environmental issues, although promoting a dominant economic discourse. On the contrary, U.S. politicians made use of a highly polarized and intermittently politicized discourse over the years following political campaigns and periodic dissent. Lastly, organizations confirmed a strong tie with political orientations, especially in the U.S.

To conclude, I argued that climate change communication, framing, discourse, and language play a crucial role in conveying messages and constructing their perception just as much as the use of the social media Twitter can contribute to the strengthening of voices, actions, and scope.

5.2 Pedagogical Implications

Climate change is a current and much debated issue (Hulme, 2009), thus, the introduction of this topic in university curricula is of paramount importance. Based on the assumption that language plays a crucial role, universities may encourage the establishment of climate related issues through interdisciplinary approaches for the analysis of linguistic and discursive features (Fløttum et al., 2014). Considering the growing eco-anxiety among young people, the introduction of this topic in higher education in a positive way, whether focusing on what can be done on a daily basis, or on future involvement with an eco-friendly working-environment, may enable students to learn how to become more active and proactive for a sustainable future.

Since the 1960s, the goal of environmental education was outlined as the education of "a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (Stapp et al., 1969, p. 34). Currently, European higher institutions have started moving forward including environmental education, sustainable development, and climate change literacies as essential goals (Molthan-Hill et al., 2019). The United Nations Framework Convention on Climate Change (UNFCCC) introduced seventeen sustainable development goals (SDG) (IPCC 2018). For instance, Target 13.3 of the SDGs aims at improving education while making students aware of climate change mitigation, adaptation, impact reduction and early warning (UNESCO, 2021, p. 8).

Students' involvement, while attending an *English for Specific Purposes* (ESP) course, might provide different insights in the process of examining climate-related topics and thus raise awareness of crucial topics such as climate change, climate justice, and sustainable development. Indeed, corpus linguistics techniques, discourse analysis, and framing theory, and students' educational background, as well as English language

learning objectives, may all be intertwined with the aim of training “ecologically minded students” (Kopnina, 2012, p. 1).

The combination of data-driven learning approach and corpus linguistics, based on authentic material, can be compatible with English for Specific Purposes (ESP) courses based on content and language learning. According to Gavioli and Aston (2001), corpora can be considered as resources from which learners can learn directly. Indeed, as emphasized by Biber et al. (1998), corpus linguistics has four main characteristics, namely:

1. it is an empirical (experiment -based) approach that allows for the observation and analysis of patterns of language in real language texts,

2. it is based on a representative sample of the target language stored electronically (a corpus),

3. it uses a computer software to carry out the analysis,

4. the interpretation of findings is both quantitative and qualitative.

Accordingly, the data-driven learning (DDL) approach is a language teaching strategy, which uses corpus data that cannot be retrieved in a dictionary, grammar, or course book as language-learning material (Chambers, 2010). As highlighted by Johns (1997, p. 101), through the DDL approach, students are directly challenged with the data which make “the learner a linguistic researcher” and “every student is Sherlock Holmes”. Being an inductive approach, it fosters the “ability to see patterning in the target language and to form generalizations” about how the language is used (Johns, 1991, p. 2).

Moreover, Aston (1997) argued that the use of small and specialized corpora is more suitable and useful in a DDL approach. Indeed, small corpora are easier to analyze and to

become familiar with. In addition, the interpretation of results, such as the identification of collocations, is facilitated thanks to the contextualization of fewer texts. In light of this, the inductive and explanatory approach may be employed based on what Johns (1991) defined as the principles of DDL: observation (concordance lines), classification (of main features) and generalization (of rules). These phases were also elaborated by Carter and McCarthy (1995), who defined them as the "three Is" (Illustration, Interaction and Induction). Illustration refers to the observation of real data, interaction to the discussion of observations made, and induction to the formulation of one's own rule. In addition, DDL, as any other approach, is inevitably "dependent not only on the social, cultural and political setting of a particular society at a particular point in time and the development of education within that setting but also on the technology available in the classroom" (Johns, 1988, p. 13).

Additionally, learning how to deal with data and with corpus linguistics techniques fosters a student-based learning process. Indeed, as argued by Boulton (2011), the hands-on use of authentic corpus data promotes self-directed language learning of advanced usage and students take on more responsibility for their learning, which allows them to become autonomous learners (see also Holec, 1981; Little, 1991). An autonomous learning process "gives the student the realistic expectation of breaking new ground as a 'researcher', doing something which is a unique and individual contribution" (Leech, 1997, p. 10).

Furthermore, the use of authentic material, such as messages retrieved from social media platforms as Twitter or Instagram, may further motivate learners with different levels of language proficiency to deal with specific topics using concrete language samples with the help of visual data (Marcella & Samofalova, 2022). In fact, in addition to textual contents, social media offer other types of communication, such as videos and images,

which provide further knowledge. Further to this, digital media give movements, opinion leaders and politicians as well, the opportunity to share information, discuss strategies and goals, and build discourses around current issues (Lee et al., 2021). In actual fact, as pointed out by Halliday (2001, p. 199), "We cannot transform language; it is people's acts of meaning that do that. But we can observe these acts of meaning as they happen around us, and try to chart the currents and patterns of change". Thus, the "acts of meaning" can be traced in posts which uncover the communicative functions of the messages, thus the meanings and strategies of the communicators. In relation to this, carrying out discourse analysis in class, combined with corpus linguistic techniques may contribute to train students to grasp eventual mismatches between saying and meaning, and foster further reflection on how language is used.

Furthermore, corpus linguistics tools provide useful insight into the detection of frames, as highlighted by Touri and Koteyko (2015). In fact, framing helps to define an issue and provide an interpretation of the message that is being conveyed. For instance, starting from a set of defined frames used as guidance, through the analysis of the concordances of the most frequent words in a specialized corpus, students can inductively identify more specific frames.

To conclude, encouraging a positive change while adopting a more climate-friendly and sustainable lifestyle has become essential and it is doable by educating ecologically minded future generations in order to foster environmental behaviors and enable them to find solutions (Kopnina, 2012, 2014).

5.3 Limitations of the study

There are certain limitations to this study. Firstly, I acknowledge that the investigation into climate-related issues, given their urgency and importance, fall under a wide range of disciplines (e.g., Science, Economics, Sociology, Linguistics and so forth). Although the results were primarily discussed from a linguistic perspective, the study endeavored to reconstruct the sociological, cultural, and political milieu to which the messages were related to.

Further to this, this research was conducted with the combination of a corpus-based approach to discourse analysis with the aim of reducing researcher bias. As for the framing theory, both hermeneutic- qualitative and manual holistic methods present some drawbacks. For instance, the former can be considered "quite inflexible when it comes to the identification of newly emerging frames" (Matthes & Kohring, 2008, p. 263). While the latter can be "labor intensive, often based on small samples, and difficult to replicate" (Semetko & Valkenburg, 2000, p. 94). Nevertheless, the investigation of the message attempted to draw on a completer analysis of the metadata included in the corpus, as for example the stakeholders' role. However, an inter-annotator reliability test was not carried out, consequently the interpretation of the frames may be debatable due to the subjective evaluation of the analysis.

Moreover, as for the detection and diffusion of lexical creativity, this study analyzes messages posted by 63 users and does not take into consideration retweets. Hence, this limits an in-depth investigation into the diffusion of new lexical items in the wider community, i.e., the further use and trajectory of these items.

5.4 Implications for further research

This study presented theoretical perspectives and methodological approaches for the analysis of a paramount issue: climate change communication on Twitter. The large amount of information provided by Twitter, together with the results of this present study suggest a number of new avenues that require a great deal of further research. For instance, this work focused on the analysis of climate change communication through a text-based analysis; thus, a different direction for future work is to investigate into the role of emotions by means of Sentiment Analysis with the aim to identify possible nuances and cultural features such as humor, sarcasm, and anxiety within the tweets.

Moreover, the analysis of visual representation of climate-related issues, and more precisely the combination of verbal and visual material, merits additional study as it could reveal more complex concepts and attitudes and lead to cogent discourses and frames.

In addition, future research is also needed into tweets which include URLs; they could provide further context for the results of this work by analyzing what type of information users believe it is important to include in their short messages, namely news articles and scientific evidence.

Finally, the methodology used, and the results of this research will be integrated and applied in *ESP* classes to expand teaching approaches and techniques which can promote sustainable literacy and environmental education and foster students' understanding of language use.

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Appendices

Appendix 1: Information of Stakeholders

Among the European activists there are: Adélaïde Charlier, Anuna De Wever Van der Heyden, Greta Thunberg and Luisa Neubauer. Adélaïde Charlier and Anuna De Wever Van der Heyden are two Belgian climate activists, leaders of the School Strike for Climate, and both named Ambassador of Conscience by Amnesty International. Greta Thunberg is a Swedish climate activist, co-founder of the movement Fridays for Future. Luisa Neubauer is a German climate activist and one of the organizers of School Strike for Climate in Germany. The group of American activists includes Varshini Prakash, co-founder, and executive director of the Sunrise Movement; Xiye Bastida, a Mexican-Chilean climate activist in New York; Vic J. Barrett, a Honduran American student and plaintiff, who is also a fellow with the Alliance for Climate Education. Finally, Jerome Foster II, an American climate justice activist and the youngest-ever White House Advisor in United States history, serving on the White House Environmental Justice Advisory Council within the Biden administration.

All social movements, NGOs and news sites were selected according to their popularity, as well. Specifically, the social movement group includes both social movements and non-profit organizations. The American Climate Reality is a non-profit organization founded by Al Gore; Extinction rebellion is a global non-violent direct-action movement; 350.org Europe is a European social movement; Earth Guardians is an American social movement; Fridays for Future is now an international youth-led movement founded by Greta Thunberg.

The NGOs include the European Environmental Bureau (Green_Europe), Climate Action Network International, the American nongovernmental conservation organization Nature

Conservancy, and Greenpeace. Whereas the news accounts include EcoWatch, a community of experts who publish international environmental news, and the Guardian Environment, a European account which posts news and comments on the world's most important environmental stories.

As for the politicians, they were all selected either for their duties related to climate change or for their governmental role in order to detect how relevant this issue is in politics and how they discuss it. In the European scenario, the politicians are members of either the EU Parliament or the EU Commission. This group comprises, in alphabetical order: Miguel Arias Cañete, European Commissioner for Energy and Climate Action from 2014 and 2019; Valdis Dombrovskis, executive vice president of the European Commission for An Economy that Works for People; Mariya Gabriel, European Commissioner for Innovation, Research, Culture, Education and Youth; António Guterres, Secretary-general of the United Nations; Ditte Juul Jorgensen, Director General for Energy of the European Commission; Stella Kyriakides, European Commissioner for Health and Food Safety; Jean Lambert, member of the European Parliament; Mairead McGuinness, European Commissioner for Financial Stability, Financial Services and the Capital Markets Union; Charles Michel, President of the European Council; David Sassoli, former president of the European Parliament; Margaritis Schinas, vice-president of the European Commission and European Commissioner for Promoting the European Way of Life; Catharina Sikow Magny, director of Green Transition & Energy System Integration at EU Commission; Kadri Simson, European Commissioner for Energy; Virginijus Sinkevicius, European Commissioner for the Environment & Oceans and Fisheries; Andreea Strachinescu, member of the European Commission in the Directorate General for Energy as Head of Unit for new energy technologies; Frans Timmermans, executive vice president of the European Commission for the European Green Deal and

European Commissioner for Climate Action since 2019; Adina Valean, European Commissioner for Transport; Ursula von der Leyen, President of the European Commission since 2019.

The group of U.S. politicians, instead, includes, in alphabetical order: Joe Biden, the 46th and current president of the United States and member of the Democratic Party; Hillary Clinton a politician who also served as the 67th United States secretary of state from 2009 to 2013; Al Gore, a politician and environmentalist who served as the 45th vice president of the United States from 1993 to 2001 under president Bill Clinton; Jennifer Granholm, currently the 16th United States secretary of energy; Deb Haaland, a Democrat who supports the Green New Deal and currently serves as 54th United States Secretary of the Interior; John Kerry, currently the first United States special presidential envoy for climate and formerly served as the 68th United States secretary of state from 2013 to 2017 under Barack Obama; Ed Markey, member of the Democratic Party who has focused on climate change and energy policy and is also the Senate author of the Green New Deal; Regina McCarthy, an environmental health and air quality expert serving as the first White House National Climate Advisor under U.S. President Joe Biden. She was the 13th Administrator of the Environmental Protection Agency from 2013 to 2017 under Obama's administration. Barack Obama, president of the United States from 2009 to 2017; Alexandria Ocasio-Cortez, a politician and activist of the Democratic Party, promoter of the Green New Deal; Frank Pallone, currently chair of the House Energy and Commerce Committee; Nancy Pelosi, member of the democratic Party who serves as Speaker of the United States House of Representatives since 2019; Mike Pence, served as the 48th vice president of the United States from 2017 to 2021 under president Donald Trump; Scott Pruitt, a Republican politician who served as the 14th Administrator of the Environmental Protection Agency from 2017 to 2018 under Trump's administration;

Michael Regan, a Democrat who addresses environmental racism and supports policy to address climate change. Currently he is the 16th administrator of the Environmental Protection Agency, and formerly served as the secretary of North Carolina's Department of Environmental Quality and air quality specialist in the United States Environmental Protection Agency. Bernie Sanders, a politician and activist very conscious about climate change; Donald Trump, a Republican who served as the 45th president of the United States from 2017 to 2021; Andrew Wheeler, a Republican who served as the 15th Administrator of the Environmental Protection Agency from 2019 to 2021 under Trump's administration.

As for the European organizations, the Intergovernmental Panel on Climate Change (IPCC) is an intergovernmental body of the United Nations; the ENVI Committee Press is the European Parliament Committee on Environment, Public Health and Food Safety; EU Environment is the official account for the European Commission's Directorate-General for Environment; EU Climate Action is the European Commission's Directorate-General for Climate Action; the Greens/European Free Alliance (Greens/EFA) is a political group of the European Parliament that includes green political parties. In the American organizations group, there are the National Oceanic and Atmospheric Administration (NOAA), an American scientific and regulatory agency within the United States Department of Commerce; the Environmental Protection Agency (EPA) which is an independent executive agency of the United States federal government; the U.S. Department of Energy, dedicated to the United States' policies regarding energy and safety.

Appendix 2: Tweets per stakeholder over time (Section 3.4)

Table 1: Number of tweets by Social Movements per year

	2015	2016	2017	2018	2019	2020	Total
Social movements	**10559**	**9749**	**10191**	**9747**	**13218**	**7609**	**61073**
EU	**492**	**353**	**1136**	**394**	**1196**	**725**	**4296**
350.org Europe	492	353	1136	394	1196	725	4296
INT				**1566**	**4823**	**1834**	**8223**
Extinction Rebellion				1533	4644	1548	7725
Fridays For Future				33	179	286	498
US	**10067**	**9396**	**9055**	**7787**	**7199**	**5050**	**48554**
Climate Reality	9538	8548	7973	6918	6872	4784	44633
Earth Guardians	529	848	1082	869	327	266	3921

Table 2: Number of tweets by news companies per year

	2015	2016	2017	2018	2019	2020	Total
NEWS	**8731**	**7324**	**6618**	**5024**	**4004**	**4135**	**35836**
EU	**4439**	**3292**	**2612**	**2193**	**2046**	**1816**	**16398**
Guardian Environment	4439	3292	2612	2193	2046	1816	16398
INT	**4292**	**4032**	**4006**	**2831**	**1958**	**2319**	**19438**
EcoWatch	4292	4032	4006	2831	1958	2319	19438

Table 3: Number of tweets by NGOs per year

	2015	2016	2017	2018	2019	2020	Total
NGOs	**5243**	**4679**	**4849**	**5166**	**5063**	**4779**	**29779**
EU	**622**	**567**	**680**	**913**	**745**	**694**	**4221**
EEB	622	567	680	913	745	694	4221
INT	**4203**	**3361**	**3216**	**3243**	**3263**	**3076**	**20362**
Climate Action Network International	626	248	264	423	609	567	2737
Greenpeace	3577	3113	2952	2820	2654	2509	17625

US	**418**	**751**	**953**	**1010**	**1055**	**1009**	**5196**
The Nature Conservancy	418	751	953	1010	1055	1009	5196

Table 4: Number of tweets by organizations per year

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Organizations	**3256**	**2696**	**2724**	**3103**	**3113**	**2962**	**17854**
EU	**1116**	**1085**	**1585**	**1899**	**1917**	**1638**	**9240**
ENVI Committee Press	77	84	97	92	80	164	594
EU Climate Action	281	195	264	384	363	311	1798
EU Environment	217	329	569	713	603	470	2901
Greens/EFA	154	130	189	211	286	305	1275
IPCC	387	347	466	499	585	388	2672
US	**2140**	**1611**	**1139**	**1204**	**1196**	**1324**	**8614**
NOAA	438	346	367	350	258	190	1949
U.S. Department of Energy	724	813	445	621	612	525	3740
U.S. EPA	978	452	327	233	326	609	2925

Table 5: Number of tweets by European politicians per year

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
EU	**519**	**313**	**728**	**1156**	**1287**	**2083**	**6086**
Andreea Strachinescu	29	66	216	342	264	149	1066
Miguel Arias Cañete	248	58	100	157	81		644
Antonio Guterres			40	176	208	219	643
Catharina Sikow Magny	12	51	113	156	140	16	488
Valdis Dombrovskis	16	17	75	118	129	122	477
Frans Timmermans	65	16	43	46	92	168	430
Virginijus Sinkevicius	1		13	7	60	335	416
Kadri Simson			1		22	320	343
Mariya Gabriel	4	4	21	48	35	209	321
Jean Lambert	81	41	31	28	82	36	299
Mairead McGuinness	24	25	45	52	47	85	278

Charles Michel	32	20	12	7	32	65	168
Ursula von der Leyen					24	130	154
Adina Valean	1	4	8	3	11	69	96
Stella Kyriakides		1			16	79	96
David Sassoli					29	42	71
Margaritis Schinas	6	10	10	16	15	11	68
Ditte Juul Jorgensen						28	28

Table 6: Number of tweets by American politicians per year

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
US	**1763**	**1596**	**1500**	**1664**	**2254**	**1669**	**10446**
Ed Markey	490	313	467	306	405	173	2154
Frank Pallone	123	117	242	312	345	320	1459
Bernie Sanders	127	236	25	63	298	176	925
Al Gore	172	142	158	150	120	77	819
Michael S. Regan	4	28	83	244	308	129	796
Gina McCarthy	414	236	9				659
Alexandria Ocasio-Cortez			35	141	202	86	464
Deb Haaland	5	12	101	162	63	112	455
Donald Trump	32	25	61	107	105	78	408
Barack Obama	220	136	2	4	11	7	380
Jennifer Granholm	25	83	89	40	45	36	318
Andrew Wheeler				33	83	195	311
Joe Biden		2	4	4	142	138	290
Hillary Clinton	51	141	6	20	33	19	270
John Kerry	72	85	21	17	23	38	256
Nancy Pelosi	12	20	26	46	55	41	200
Scott Pruitt			170	15	12		197
Mike Pence	16	20	1		4	44	85

Table 7: Number of tweets by activists per year

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Activists	**16**	**11**	**17**	**388**	**1567**	**680**	**2679**
EU		**2**	**5**	**115**	**573**	**402**	**1097**
Adélaïde Charlier					2	24	26
Anuna De Wever Van der Heyden					26	7	33
Greta Thunberg				103	466	328	897
Luisa Neubauer		2	5	12	79	43	141
US	**16**	**9**	**12**	**273**	**994**	**278**	**1582**
Jerome Foster II			12	262	835	183	1292
Varshini Prakash						14	14
Vic J. Barrett	16	9		11	15	4	55
Xiye Bastida					144	77	221

Appendix 3: Inter-annotator agreement protocol for polarity attribution task

In total, 50 new climate-related words in the Twitter corpus were considered as new lexical items. This choice of these new items has been made according to the lexicographic definition of a neologism: "any word that does not appear in the dictionary is considered a neologism" (Janssen 2005). Some particular units were excluded from the list (e.g., specialized vocabulary such as *microgrid*, *nanoplastics* and *pfas,* or neologisms not related to climate change but rather to politics, i.e., *Bidencare*, *Obamagate*, *Trumpism*, or to social media, i.e., *twitterverse*, *twitterstorm*).

The aim of this task is to define the polarity of these new items in the co-text, referring to three categories: positive, negative, and neutral.

The annotators are asked to analyze a sample of 15 words that will be given in their context in Twitter publications.

15 Lexical Units to be analyzed:

1 airpocalypse
2 bipoc
3 brandalism
4 climatarian
5 corporatocracy
6 ecocapsule
7 extractivist
8 frontliners
9 gigafactories
10 megamine
11 megapipeline

12 pollutionwatch
13 postgrowth
14 rewilding
15 weatherwatch

These units are provided to the annotators with several contextual tweets in an Excel file with three columns, i.e., lexical unit, text column, and the annotation column. This last column must be completed according to three annotating tags, i.e. **– 1** = negative, **0** = neutral, **+1** = positive, as shown in table 1.

Lexical unit	**Text**	**Annotation**
megamine	Drone footage: The Russian megamines where the UK gets its coal https://t.co/phr3HzvRMr via @energydesk	
megamine	Optimism for the megamine project at the Great Barrier Reef is a mask over its ongoing failure, says @NikolaCasule https://t.co/n4mJpG1xUo	
megamine	There's no good place for a megamine - Especially not the Great Barrier Reef doorstep: http://t.co/zwwwV8g1uC http://t.co/ngizdAliKG	

Table 1. Sample of lexical units to be analyzed in the given format.

The evaluation has to be based essentially on **the meaning of the whole message**. This means that the attribution of the polarity value is not associated with the item itself, but with the entire message. Below some examples are provided for each type of possible annotation.

Example1

Lexical unit: *birdwatch*

Text: *Birdwatch: I spot 55 species on 1 Jan, but it's not about numbers*

Annotation: *neutral*. This tweet does not provide any information to establish a positive or negative meaning, it reports a fact without any comparable measures.

Example 2

Lexical unit: *extractivism*

Text: *The root causes of The Climate And Ecological Emergency include colonialism, capitalism, extractivism, racism, sexism, classism and ableism. Our Rebellion must have diversity and inclusivity at its centre. @ExtinctionRebe8*

Annotation: *negative*. The analyzed item is part of a list of causes that lead to an emergency.

Example 3

Lexical unit: *greenprint*

Text: *We don't just need to restart the economy, we need to rebuild it. The #EUGreenDeal can provide a 'greenprint', helping to create millions of safe, green jobs and providing opportunities for people and nature to thrive. https://t.co/3D8ZBMrIiB #BuildBackBetter #COVID19*

Annotation: *positive*. The polarity of this item is associated with other words in the text, such as "*helping to create", "providing opportunities"* and *"thrive"* which assume a positive meaning.

Appendix 4: Collocates of *climate* – all words

Keyword	Grammatical relation	Collocate	Frequency	lodDice Score
climate	*modifiers of X*		831	2,09
		stable	50	10,81
		safe	60	10,54
		livable	37	10,28
		warming	29	9,39
		healthy	26	8,78
		free	17	8,49
		different	9	8,05
		important	14	7,94
		mind-boggling	6	7,87
		first	17	7,77
		Paris	12	7,72
		business	7	7,45
		current	6	7,41
		political	7	7,38
		UN	7	7,36
		most	6	7,29
		future	7	7,06
		Arctic	6	7,04
		good	15	6,97
		national	6	6,96
		global	21	6,93
		US	6	6,41
		S	24	6,4
		EU	7	6,23
		new	16	6,16
		more	9	5,97
climate	*nouns modified by X*		30287	76,2
		change	9191	12,83
		crisis	4971	12,07
		action	1446	10,41
		Change	715	9,55
		solution	562	9,16
		justice	455	8,88
		emergency	450	8,86
		denier	428	8,82
		activist	435	8,79
		denial	407	8,75
		scientist	355	8,53
		movement	338	8,46
		fight	310	8,35
		science	289	8,25
		talk	268	8,13

		impact	263	8,07
		reality	236	7,97
		leader	223	7,78
		breakdown	196	7,71
		agreement	189	7,63
		policy	188	7,6
		isn	157	7,35
		strike	154	7,35
		target	145	7,24
		[url]	155	7,14
		deal	126	7,04
		Action	121	7,01
		Summit	117	6,96
		Strike	112	6,9
		disaster	109	6,85
		plan	109	6,8
		goal	100	6,71
		Leader	99	6,71
		champion	94	6,66
		catastrophe	94	6,66
		conversation	87	6,54
		leadership	83	6,46
		lawsuit	82	6,46
		ambition	82	6,45
		activism	80	6,42
		today	87	6,4
		summit	73	6,28
		shouldn	71	6,25
		negotiation	71	6,25
		commitment	65	6,11
		training	64	6,04
		story	62	6,03
		reporter	57	5,94
		inaction	56	5,89
		risk	55	5,86
		pledge	53	5,82
		chaos	52	5,81
		report	52	5,69
		refugee	48	5,69
		neutrality	47	5,66
		March	47	5,65
		expert	47	5,64
		conference	47	5,62
		record	44	5,55
		warrior	43	5,53
		hope	43	5,53
		Plan	44	5,52
		event	45	5,49

		striker	41	5,46
		protest	41	5,45
		system	42	5,42
		law	41	5,42
		#crisis	39	5,4
		#SROCC	39	5,39
		march	39	5,39
		anxiety	37	5,31
		chapter	37	5,31
		challenge	37	5,28
		legislation	36	5,26
		model	36	5,26
		issue	32	5,05
		collapse	31	5,05
		campaign	31	5,04
		threat	31	5,02
		criminal	30	5,01
		Justice	30	5,01
		knowledge	29	4,96
		finance	29	4,96
		protection	29	4,93
		Act	29	4,93
		hero	28	4,91
		protester	28	4,9
		progress	28	4,9
		week	28	4,86
		adaptation	27	4,86
		debate	27	4,85
		group	27	4,82
		resolution	26	4,8
		tonight	26	4,8
		education	25	4,74
		case	25	4,74
		share	25	4,74
		work	25	4,71
		research	24	4,67
		mitigation	23	4,63
		page	23	4,63
		datum	23	4,61
		health	23	4,58
		Assessment	22	4,57
		question	22	4,55
		agenda	22	4,55
		extreme	21	4,5
		Force	21	4,49
		concern	20	4,42
		project	21	4,4
		Conference	19	4,35

		advocate	19	4,35
		doesn	19	4,34
		right	19	4,32
		strategy	19	4,31
		continent	18	4,27
		myth	18	4,27
		fact	18	4,27
		poem	17	4,19
		resilience	17	4,19
		history	17	4,18
		problem	17	4,17
		pollution	18	4,17
		fund	17	4,17
		Corps	16	4,11
		migration	16	4,11
		future	17	4,09
		matter	16	4,09
		rule	16	4,08
		w	16	4,04
		Infographics	15	4,02
		grief	15	4,02
		disruption	15	4,01
		campaigner	15	4,01
		objective	14	3,92
		Accord	14	3,92
		Network	14	3,91
		dialogue	14	3,91
		@MichaelEMann	14	3,91
		presentation	14	3,91
		speech	14	3,91
		kit	14	3,9
		finding	13	3,81
		accord	13	3,81
		head	13	3,81
		Study	13	3,8
		benefit	13	3,8
		chat	13	3,8
		moment	13	3,8
		destruction	13	3,8
		damage	13	3,8
		bill	13	3,79
		decision	13	3,79
		revolution	13	3,78
		tomorrow	13	3,78
		Guy	12	3,7
		on-air	12	3,7
		apartheid	12	3,7
		misinformation	12	3,7

		cool	12	3,69
		biodiversity	12	3,69
		Training	12	3,68
		Week	12	3,68
		news	12	3,62
		skeptic	11	3,57
		playbook	11	3,56
		Movement	11	3,56
		injustice	11	3,56
		everything	11	3,56
		emission	12	3,56
		Council	11	3,56
		panel	11	3,53
		Knowledge	10	3,43
		stance	10	3,43
		#COP24	10	3,43
		Martinez	10	3,43
		quiz	10	3,43
		win	10	3,43
		war	10	3,43
		@BusinessGreen	10	3,42
		study	10	3,39
		camp	9	3,28
		#California	9	3,28
		legacy	9	3,28
		Coalition	9	3,28
		advocacy	9	3,28
		migrant	9	3,28
		chief	9	3,27
		pollutant	9	3,27
		kid	9	3,27
		Report	9	3,26
		discussion	9	3,26
		coverage	9	3,26
		Agreement	9	3,26
		condition	9	3,26
		cost	9	3,26
		meeting	9	3,24
		Pact	8	3,11
		Index	8	3,11
		chump	8	3,11
		champ	8	3,11
		litigation	8	3,11
		rally	8	3,11
		Declaration	8	3,11
		promise	8	3,11
		denialism	8	3,11
		@GretaThunberg	8	3,1

		Thunberg	8	3,1
		cooperation	8	3,1
		crime	8	3,1
		declaration	8	3,1
		effect	8	3,1
		demand	8	3,1
		information	8	3,1
		award	8	3,08
		job	8	3,04
		community	8	3,03
		potato	7	2,92
		puzzle	7	2,92
		Envoy	7	2,91
		Brought	7	2,91
		Amendment	7	2,91
		Fund	7	2,91
		@ReportOnClimate	7	2,91
		diplomacy	7	2,91
		blog	7	2,91
		mobilization	7	2,91
		pattern	7	2,91
		Land	7	2,91
		Prize	7	2,91
		scenario	7	2,91
		reporting	7	2,91
		rainfall	7	2,91
		politics	7	2,91
		nature	7	2,91
		election	7	2,91
		winner	7	2,91
		president	7	2,91
		funding	7	2,91
		bank	7	2,91
		regulation	7	2,91
		proposal	7	2,9
		message	7	2,9
		effort	7	2,88
		adviser	6	2,69
		#adaptation	6	2,69
		sceptic	6	2,69
		negotiator	6	2,69
		pact	6	2,69
		#IPCC	6	2,69
		Alliance	6	2,69
		bomb	6	2,69
		haven	6	2,69
		Will	6	2,69
		Meet	6	2,69

		headline	6	2,69
		Youth	6	2,69
		safety	6	2,69
		prediction	6	2,69
		connection	6	2,69
		link	6	2,69
		term	6	2,69
		Initiative	6	2,69
		Hall	6	2,69
		truth	6	2,69
		President	6	2,69
		cut	6	2,69
		defender	6	2,69
		force	6	2,69
		aren	6	2,68
		footprint	6	2,68
		development	6	2,67
		weather	6	2,67
		home	6	2,67
		transition	6	2,66
		investment	6	2,66
		step	6	2,66
		world	6	2,65
		day	6	2,64
		country	6	2,63
climate	*verbs with X as object*		1397	3,52
		change	161	10,87
		declare	89	10,51
		ruin	26	9,17
		know	34	8,89
		address	33	8,85
		stabilize	18	8,69
		protect	57	8,38
		save	29	8,22
		call	18	8,19
		destroy	15	7,96
		talk	13	7,96
		become	20	7,94
		fight	21	7,81
		treat	11	7,81
		cause	17	7,8
		be	182	7,79
		face	16	7,79
		tackle	17	7,78
		achieve	11	7,64
		secure	9	7,58
		wreck	9	7,58
		make	42	7,56

		pollute	10	7,5
		put	16	7,34
		discuss	11	7,32
		offset	7	7,32
		regulate	7	7,3
		solve	11	7,29
		say	14	7,28
		fuel	8	7,26
		affect	10	7,19
		threaten	10	7,15
		stop	12	7,14
		ignore	7	7,07
		combat	7	7,03
		mitigate	6	7,02
		harm	6	6,95
		defend	6	6,85
		demand	8	6,77
		build	6	6,25
		need	9	6,08
		see	7	6,05
		create	6	6,01
		take	11	5,66
		do	6	5,6
		have	9	5,37
climate	*verbs with X as subject*		1304	3,28
		change	545	12,87
		wreck	96	11,11
		warm	30	9,24
		impact	20	8,51
		strike	15	8,39
		read	13	8,13
		plan	14	7,99
		talk	11	7,84
		get	21	7,83
		be	309	7,62
		risk	8	7,58
		target	7	7,34
		report	6	7,07
		affect	9	7,06
		cause	7	6,73
		have	28	6,3
		make	9	6,25
climate	*X and/or ...*		1899	4,78
		emergency	400	12,4
		justice	204	11,44
		crisis	172	11,05
		economy	91	10,19

		weather	58	9,78
		catastrophe	43	9,49
		health	55	9,3
		future	29	8,74
		biodiversity	27	8,7
		air	30	8,69
		nature	25	8,49
		water	29	8,45
		land	23	8,4
		environment	28	8,38
		country	22	8,35
		effect	15	7,97
		community	19	7,89
		forest	13	7,58
		breakdown	11	7,5
		Energy	9	7,23
		job	10	7,21
		energy	11	7,15
		#ecologicalemergency	8	7,09
		food	9	7,05
		people	12	6,94
		right	8	6,9
		temperature	7	6,82
		report	7	6,77
		policy	7	6,77
		security	7	6,74
		fuel	7	6,72
		#StopPipeline	6	6,68
		tonight	6	6,68
		goal	6	6,63
		story	6	6,63
		protection	6	6,57
		planet	8	6,53
		today	7	6,52
		activist	6	6,44
climate	*prepositional phrases*		2920	0
		... on "%w"	1093	2,75
		... for "%w"	643	1,62
		... of "%w"	216	0,54
		... about "%w"	198	0,5
		... to "%w"	154	0,39
		... in "%w"	121	0,3
		... against "%w"	78	0,2
		"%w" in ...	58	0,15
		"%w" for ...	42	0,11
		"%w" at ...	33	0,08
		... with "%w"	30	0,08
		... between "%w"	28	0,07

		... from "%w"	25	0,06
		"%w" than ...	20	0,05
		... by "%w"	19	0,05
		"%w" with ...	14	0,04
		"%w" of ...	13	0,03
		... as "%w"	13	0,03
		... at "%w"	11	0,03
		"%w" from ...	9	0,02
		... than "%w"	8	0,02
		... out "%w"	8	0,02
		"%w" to ...	7	0,02
climate	*adjective predicates of X*		116	0,29
		neutral	24	11,83
		skeptic	9	11,2
		friendly	9	11,08
		change-driven	6	10,65
		Skeptic	6	10,51
		crucial	6	9,51
		important	7	8,87
climate	*possessors of X*		63	0,16
		earth	12	11,52
		Earth	8	10,35
		world	12	9,03
climate	*pronominal possessors of X*		631	1,59
		our	584	9,71
		your	25	6,56
		their	15	6,36
		its	6	5,7
climate	*... on X*		1093	2,75
		act	171	11,8
		inaction	148	11,67
		government	104	11,39
		#ActNow	86	11,18
		action	90	10,85
		#CitizensAssembly	57	10,66
		#ActNow	39	10,12
		act	29	9,68
		impact	32	9,51
		leader	13	8,52
		lead	12	8,4
		silence	10	8,21
		message	9	8,03
		leadership	9	7,97
		perception	8	7,89
		Action	8	7,85
		do	8	7,82

		roof	6	7,48
		assembly	6	7,48
		ball	6	7,48
		alarm	6	7,47
		news	6	7,45
		progress	6	7,36
climate	*... for X*		643	1,62
		strike	36	10,72
		rebellion	36	10,71
		vital	31	10,47
		fight	45	10,39
		bad	33	10,3
		#CitizensAssembly	20	9,94
		fight	34	9,72
		action	16	9,36
		year	16	9,34
		difference	14	9,31
		news	15	9,23
		march	13	9,13
		Strike	10	8,96
		rise	10	8,95
		sense	8	8,64
		strike	8	8,52
		rise	7	8,43
		win	7	8,26
		good	10	8,22
		dangerous	6	8,19
		rebel	6	8,16
		stand	6	8,13
		do	6	7,98
climate	*... of X*		216	0,54
		aspect	16	10,76
		declaration	13	10,38
		neighborhood	8	10,19
		state	15	9,86
		midst	8	9,71
		scale	6	9,48
		impact	10	8,46
climate	*... about X*		198	0,5
		#TellTheTruth	40	12,29
		#TellTheTruth	32	12,08
		truth	17	10,88
		care	14	10,49
		talk	6	9,23
		talk	14	9,21
		learn	7	8,49
climate	*... to X*		154	0,39
		right	13	10,65

		come	24	10,21
		adapt	6	9,56
		due	12	9,52
climate	*... in X*		121	0,3
		complicity	22	11,93
		government	17	11,74
		shift	15	11,55
		change	9	9,35
		be	13	8,03
climate	*... against X*		78	0,2
		#rebellion	13	11,63
		#ExtinctionRebellion	8	11,3
		rebellion	15	11,02
climate	*X in ...*		58	0,15
		way	9	9,53
climate	*X for ...*		42	0,11
		sake	9	11,47
		generation	12	10,33
		decade	7	10,14
climate	*X at ...*		33	0,08
		@EPA	10	12,65
climate	*... between X*		28	0,07
		choice	15	13,2
		difference	7	10,91
climate	*... from X*		25	0,06
		go	7	12,25
climate	*X than ...*		20	0,05
		oil	13	13,2
climate	*... is a X*		12	0,03
		This	6	12,62
climate	*... out X*		8	0,02
		check	7	8,33