

13 Years of Change?
Exploring the Climate Change Debate on Reddit
Through Topic Modeling

by
Laura Funke

A Thesis Submitted to the School of Graduate Studies in Partial Fulfillment
of the Requirements for the Degree of

Master of Arts in Sociology

Memorial University of Newfoundland and Labrador

© Laura Funke

February 2026

St. John's, Newfoundland and Labrador

Abstract

A growing body of academic literature analyses the public climate change debate carried out on social media platforms. As most studies focused on Twitter/X, little is known about long-term developments on other platforms, despite their popularity. The present study addresses this by analyzing a 13-year timespan during which five million posts and comments discussing climate change were published on Reddit, one of the most popular social media platforms in anglophone countries. Through topic modeling (LDA) and subsequent analyses, the main themes of discussion, the most popular communities, and changes over time are examined to describe the climate change debate on Reddit as well as how it relates to the general public debate and that on other platforms. The debate populates thousands of subreddit communities, and several recurring themes were found, discussing climate change in relation to environmental impact, scientific evidence, politics, and the economy, as well as extreme weather events. Similar to evidence from news media and other social media, the results attest to growing attention to the debate, while also noting how it becomes increasingly intertwined with political day-to-day business and popular discourse. This politicization is also evident in the dependence on mostly political events to generate and sustain significant levels of attention. Meanwhile, discussions pertaining to climate justice appear only marginally in the dominant themes.

General Summary

Despite growing interest in the climate change debate on social media, only a few studies have examined this debate on the popular platform Reddit. Since previous studies have not analyzed long-term changes in the content of the Reddit debate, this study uses computational analysis to examine five million posts and comments published over the course of 13 years, from 2010 to 2022. The analysis provides an overview of the main themes of discussion, the main communities it takes place in, and compares the Reddit debate to that in news media and on other social media platforms. The results show that on Reddit, climate change is discussed in many different communities and in relation to environmental impacts, extreme weather, science, and politics. As the debate grew more popular, it also became more connected to the general political debate, with political events like elections or conferences having noticeable effects on publication volumes. However, discussions of climate justice are noticeably absent in the mainstream debates.

Acknowledgements

I acknowledge that the lands on which Memorial University's campuses are situated are in the traditional territories of diverse Indigenous groups, and I acknowledge with respect the diverse histories and cultures of the Beothuk, Mi'kmaq, Innu, and Inuit of this province.

I acknowledge the great privilege it is to receive education and pursue an academic degree at a University, especially within a community that is continuously created, upheld, and enriched by people from various social as well as geographical backgrounds.

For their continuous support throughout this program, I want to particularly acknowledge my supervisors, Mark and Allyson. Thank you for your interest and curiosity, the thoughtfully curated syllabi that structured the coursework part of this program for me, and, of course, your guidance and comments that helped me craft this thesis.

Last but not least, I also want to thank the other members of our department, including my fellow graduate students and friends, as well as my partner, for their invaluable support and literally open doors, making possible countless personal and professional conversations over hot and cold beverages, pastries, and meals.

Table of Contents

Abstract	ii
General Summary.....	iii
Acknowledgements.....	iv
Table of Contents	v
List of Tables.....	vii
List of Figures.....	viii
1 Introduction.....	1
2 Literature Review	7
2.1 The Public Debate on Climate Change	7
2.2 The Media Debate on Climate Change	11
2.3 The Social Media Debate on Climate Change	13
3 Methodology	21
3.1 Platform: Reddit	21
3.2 Dataset	24
3.3 Preprocessing	25
3.4 Topic Modeling: Latent Dirichlet Allocation.....	27
3.4.1 Model Evaluation and Theme Labeling.....	29
4 Results	31
4.1 Themes	33
4.1.1 Changes in Themes Over Time	40

4.2	Popular Subreddits	41
4.3	Most Popular Subreddits by Theme.....	44
4.4	Historic Subreddits	45
5	Discussion	48
6	References.....	59

List of Tables

Table 3.1 Results of a Scopus database search conducted on March 10, 2025, using the search query: ("climate change" OR "global warming") AND "platform name" in title, abstract, keywords.....	23
Table 4.1 Subreddit groups by minimal publication volume: counts, total publications, and each group's share of total publications included in the dataset.....	33
Table 4.2 Overview of the ten most popular subreddits, including a description text, the number of members, the rank by size, and the proportion of the Reddit climate change dataset they account for.....	42

List of Figures

Figure 3.1 Illustration of the data preprocessing steps through the components of the spaCy pipeline.	26
Figure 3.2 Illustration of the Latent Dirichlet Allocation process used for topic modeling.....	28
Figure 4.1 Monthly publication volumes in the Reddit climate change dataset over time. Labels mark events relevant to the dataset: red – UN Climate Change Conferences, blue – political events, green – extreme weather events, grey – other events.	32
Figure 4.2 Force-directed network of topic similarity, visualizing semantic relationships between topics based on clustering with the Louvain algorithm. Colors correspond to manually assigned group labels, numeric labels correspond to the year the topic belongs to (YY-format).	34
Figure 4.3 Word clouds for the nine main themes in the Reddit climate change dataset.	35
Figure 4.4 Stacked bar chart showing the annual proportions of the nine main themes in the Reddit climate change dataset.	40
Figure 4.5 Stacked bar chart showing the proportion of publications the ten most popular subreddits account for yearly from 2010-2022.....	44
Figure 4.6 Stacked bar chart showing the ten most popular subreddits for every main theme...	45
Figure 4.7 Nested pie chart showing the proportions of the 35 historic subreddits as individuals on the outside, and grouped into thematic categories on the inside.....	47

1 Introduction

Climate science dates back to at least the 19th century, when scientists developed hypotheses about gases in the Earth's atmosphere trapping heat, a natural phenomenon henceforth known as the *greenhouse effect* (Fourier, 1837; Foote, 1856; Tyndall, 1861). At the beginning of the 20th century, significant global warming was predicted (Arrhenius, 1908) and later linked to the burning of fossil fuels (Callendar, 1938; US National Academy of Sciences, 1977). Shortly after the founding of the Intergovernmental Panel on Climate Change (IPCC) in 1988, its first report, published in 1990, also linked global warming to human activity (Houghton et al., 1990).

Since then, peer-reviewed, scientific publications evaluating this link state a nearly full consensus regarding the hypothesis that climate change is anthropogenic (Cook et al., 2013, 2016; Howe, 2014). Relatedly, the latest IPCC report states that anthropogenic climate change led to and is continuously causing substantial, rapid, and increasingly irreversible changes like sea level rise, extreme weather and climate, and permafrost thawing. At the same time, both adaptation and mitigation efforts are projected to be too slow, while risks and effects are, with high confidence, expected to intensify with rising levels of global warming (IPCC, 2023). Despite the scientific consensus and continuously updated evidence highlighting the ongoing manifestation of climate change related risks and losses, public opinion is far from unanimous. For instance, while US studies show that about half of Americans think human activity causes global warming, about a quarter thinks it is just a natural development, and 14% reject the idea of global warming altogether (Pasquini et al., 2023). While the US might be the most evident case of a polarized climate change discourse that manifests particularly in a lack of public consensus, this has also

been noted for other Anglophone, and to some extent Western European countries, where not only the popularity of the discourse, but also its polarization appear to be on the rise (Egan & Mullin, 2017; United Nations Development Programme (UNDP) & University of Oxford, 2024). This is largely caused by the level of political polarization that has emerged over the last few decades and ultimately leads to the slowing or even halting of climate change action by political and economic actors and organizations (Caldwell et al., 2025; Egan & Mullin, 2024).

A lack of public consensus in particular is a problem because, although climate change can be seen as a scientific issue, it is largely a social problem that requires societies' trust in the well-established scientific findings to enable coordinated, intentional and international action on (Broadbent et al., 2016; Fownes et al., 2018). With climate change likely being the biggest threat to Earth in modern history (United Nations, 2021), Broadbent et al. (2016) have fittingly described the "situation of global noncooperation" as "the largest dilemma of collective action in world history" (Broadbent et al., 2016, p. 2).

Since timely action seems dependent on the development of a unified understanding and mobilization, research analyzing public climate change discourse, in particular on social media, is needed to develop effective strategies and aid these processes (Fownes et al., 2018; Chang et al., 2022; Fariello & Jemielniak, 2025).

This thesis will contribute to this undertaking by examining part of the online discourse on climate change, namely that emerging on the social media platform Reddit over more than a decade from 2010 to 2022, generating a dataset of five million posts and comments. Reddit was chosen as it is one of the most popular social media platforms, which evidently hosts lots of conversations regarding climate change, yet previous studies leave a gap in knowledge around

long-term developments that needs to be filled to develop a nuanced understanding of what influences the public climate change debate.

Therefore, this study contributes to this slowly but surely emerging inquiry through an analysis that employs topic modeling techniques as well as quantitative analysis of publication volumes and popular communities. The analysis is guided by the following research questions:

- 1) What links to other debates emerge from the main themes of discussion when climate change is mentioned on Reddit?
- 2) What are the primary community types users populate with this discussion, and how do they reflect the thematic foci?
- 3) How do changes in dominant themes and communities relate to the development of the public climate change debate outside of Reddit?

Through this analysis, more knowledge is created around a platform increasingly frequented by social-scientific inquiry. Despite the popularity of social media, relatively few publications center the climate change debate on these platforms, and the vast majority of existing ones focus on Twitter/X (Pearce et al., 2019; Treen et al., 2022). This is important to note, as findings for one platform might not be generalizable, since platforms can largely vary in terms of their user group, main purpose, and other characteristics (Fownes et al., 2018; Stoddart et al., 2025). Compared to Twitter/X, Reddit has been studied far less: Only about a dozen publications, all from more recent years, are focusing on the climate change debate on Reddit in particular. While Reddit is not as big as Twitter/X, it is one of the most popular platforms among young US-Americans and, in terms of research data, has some comparable but also advantageous characteristics: Analyses can be done on posts and comments, and Reddit allows for short and

long texts to be published, while Twitter/X is known for its very limited character count. Furthermore, Reddit allows users to create communities (“subreddits”) with thematic foci, which theoretically allows for prolonged, deeper conversations and potentially community building.

Nowadays, social media provide important platforms for information and communication across societal groups and levels, and therefore hold significant research potential for studies seeking to examine the public’s development of knowledge, beliefs, and attitudes regarding issues like climate change (Yang et al., 2021; B. C. Sultana et al., 2024; Stoddart et al., 2025). Relatedly, Harvey et al. (2018) highlighted that popular social media platforms are important tools when it comes to shaping public opinion, and Snelson (2016), based on multiple literature reviews, pointed out that studies of social media platforms “have entered the mainstream of academic literature” (Snelson, 2016, p. 11). Pearce et al. (2019) provide three main reasons for social media being a particularly interesting sphere for social scientific research: Besides relatively easily available, enormous datasets, along with public interest because of the rapid growth of social media platforms, their emergence also means a shift in communication hierarchies, as even individual people may be able to create large audiences.

The existing publications focusing on the climate change debate on Reddit offer some valuable insights that will be presented in the next chapter. However, there are only a few studies, and none focused on a longer period of time, which leaves a gap in knowledge surrounding the development of the climate change debate online, specifically on Reddit. As will be shown in more detail, the case of the United States has so far received particular attention, because the level of polarization and politicization of the climate change debate is uniquely high (Chinn et al., 2020), while the country plays an important role in the global context of climate action (Bang et al.,

2016). However, in recent years, it has also been responsible for much controversy, with the government relapsing from major developments and withdrawing from international accords such as the Paris Agreement.

As Reddit users are primarily based in the US, it might enable the platform to provide unique insights into processes shaping public opinion on climate change. Therefore, addressing the gap in knowledge by crafting an overview of major developments in the climate change debate on Reddit will not only contribute to the general understanding of the debate, but also offer an important basis for further research. More detailed inquiries can then guide those working on climate communication – whether from the point of view of general public communication, climate action mobilization, policy work, or even the scientific community that wants to enhance the reach and thereby accessibility of currently available knowledge. To develop the context necessary to locate the findings on a more global scale, the literature review will introduce relevant background information regarding the public climate change discourse, as well as findings of previous social media and Reddit studies.

The main findings of this study include the observation of continuous growth of the climate change debate on Reddit that populates an increasing number of communities, while a smaller group, particularly representative of the main themes, remains important. A shift in both themes and communities is noted, in which an increasing part of the discussion is directly linked to political themes and political events, while controversies establish themselves as the drivers of the main peaks in publication volume. More generally, the findings add to the existing literature on social media and climate change, showing that the debate on Reddit is lively and multifaceted. In line with evidence from other platforms and spheres of public debate, a mainstreaming of the

debate is noticed to some degree, while it also becomes increasingly visible as part of popular political discourse, day-to-day politics, and electoral debates. As some evidence suggests that this connection causes a level of polarization higher than that in the general public's stance on the matter, this trend has to be closely monitored to highlight how political elites, business actors, and media outlets foster and reproduce the false perception of the climate crisis as a scientifically disputed or non-immediate issue.

The next chapter will provide an overview of existing research on the public climate change debate, including that on social media and Reddit in particular. In the methodology chapter, the platform and the used dataset will be presented in more detail before the topic modeling process is introduced. Then, the modeling results and additional analysis are presented, providing a high-level overview of some answers to the research questions. Finally, the discussion will provide a deeper analysis of the results, which are embedded in the context of other studies and interpreted in the context of the general public climate change debate.

2 Literature Review

The climate change debate is multifaceted and spans many different societal spheres as well as, by now, decades full of conversations, research, and publications. Since the climate crisis is not and perhaps might not be resolved, the debate is naturally not over either. To draw a more nuanced picture of what this long debate entails, this chapter will gradually zoom in on this study's topic – the climate change debate on Reddit. Starting with an overview of research on the general public debate, this section will focus on some historical data, outlining the trends and thematic foci within the debate. The following section will focus on findings regarding social media in general, before moving on to the last section, which will summarize the existing research focusing on the debate on Reddit in particular.

2.1 The Public Debate on Climate Change

One reason the debate is so multifaceted is that climate change is an issue deeply intertwined with other processes that are just as complex. For example, (Malone, 2009) examined many publications from the 1990s and 2000s to find common “families”, as she called them, of arguments regarding climate change. As part of this analysis, some parallels between globalization and climate change are drawn. While the latter is naturally associated with questions of the environment and scientific inquiry, it can also be analyzed in dimensions capturing globalization, namely economics, politics, and culture (Malone, 2009). Malone fittingly summarized the link, stating “[c]limate change globalizes the environment by specifying the connections among what happens in specific places and the whole climate system” (Malone, 2009, p. 47). While climate change would need even more dimensions to be described, through

this lens it can be elaborated on nonetheless: Since the different dimensions of globalization are so intertwined with the causes of climate change, they are also sites of the debate, of the search for solutions, and of new issues arising in the process.

Broadbent et al. (2016) call this close link between globalization and climate change “a world-historical opportunity for the emergence of a common global society” (Broadbent et al., 2016, p. 1). This suggestion is based on the principles of (sociological) cosmopolitanism, a theory introduced by Beck (2004), which defines the seemingly opposing qualities found in the context of globalization (i.e., contextual/universal, same/different, global/local) as intertwined, emphasizing a view of the world as an interdependent system, rather than a cluster of nations (and their own goals) (Beck, 2004). Given this view, it is clear that a productive climate change debate, i.e., one that unites knowledge and produces practical propositions, would center this cosmopolitan thought of global interdependence that creates the necessity to unite interests and efforts. And while climate change seems to trigger a growth in cosmopolitan thought, this is countered by global inequalities, as well as states prioritizing their own (economic) interests and, in part, undermining progress by promoting ideas contrary to the scientific consensus around anthropogenic climate change (Broadbent et al., 2016). Overall, research examining the public discourse shows that it has been evolving around some key topics for many years now: Broadbent et al. (2016) examined data from newspaper articles published in more than a dozen countries from 1997-2010 and found that the topics can be categorized into four categories, namely the

- 1) debate around the validity of climate science,
- 2) ecological risks (domestic ↔ global),
- 3) climate politics (domestic ↔ global),

4) debate around mitigation policy.

As will be shown in the following sections, these findings hold up in the context of social media discourse as well. And while there is such a strong, longstanding scientific consensus around the hypothesis of anthropogenic climate change, the validity of climate science has been and is still actively being discussed from various points of view. Upon examination of various publications, Malone (2009) found 6 major clusters of arguments ranging from rejection to acceptance of the hypothesis, with different practical implications, such as need for more research, modernization (e.g., innovation in politics, energy, mitigation, and adaptation), or focusing efforts on reducing inequality (Malone, 2009). On the side of climate delay discourses, Lamb et al. (2020) defined four major categories, namely arguments that:

- 1) *Redirect responsibility*,
- 2) *Push non-transformative solutions* (e.g., focusing on (potential) technological advancements),
- 3) *Emphasize downsides* (e.g., economic implications of policies),
- 4) *Call for surrender* (focusing on adaptation instead of mitigation).

Commenting these findings, Stern (2020) added that even on the side of those promoting climate action, some discourses still cause delay, e.g., when emission targets are downplayed, adaptation is focused, or gradual transformation is rejected as an alternative to fully transformational propositions.

Delay mechanisms are a profound issue, engrained even in seemingly progressive, popular frames such as clean growth which slow down climate action by design, while appearing to promote it: For instance, in the case of Canada, Carroll et al. (2020) mapped how clean growth

initiatives are funded and governed through an interplay of corporate, state, and civil society elites in a way that creates the impression of increased environmental concern, while actually ensuring that policy “action” is aligned with business and fossil fuel sector interests. These types of elite network structures that enable centrality and influence of carbon-capital and other private sector actors are at the core of obstruction to effective climate action, while also enabling the production and dissemination of climate change denial and contrarian information (Carroll et al., 2018; Farrell, 2016). Relatedly, climate action is further obstructed by the way the public’s stance is strongly influenced by these elites: Numerous studies show that belief in anthropogenic climate change and related support for mitigation efforts are tied to general political stance and partisan alignment (McCright & Dunlap, 2011b; Jang & Hart, 2015; Zhou, 2016; Chen et al., 2021). Particular attention is given to the case of the United States, where the historic divide between Democrat and Republican positions grew stronger in the 2000s, with the former being more aligned with the scientific consensus (McCright & Dunlap, 2011b). The resulting polarization is so strong that attempts at communication through frames highlighting the importance of climate action have been shown to further manifest Republicans’ skeptic stance – an effect that is doubled when individuals reported strong political interest (Zhou, 2016).

Park et al. (2010) found that congressional hearings on climate change are not only more likely to take place in a Democratic Congress, but are also more likely to include pro-environmental and scientific positions, whereas under a Republican majority, testimonies are more likely to challenge scientific findings and stress potential economic drawbacks of climate change policy. Fisher et al. (2013) contrast this finding with the notion that the American public increasingly accepts the reality of anthropogenic climate change, highlighting that there might be

an important, progressive development in the general public that is not evident amongst political elites. This is alarming, given their position of power and obligation to represent the will of their voters.

2.2 The Media Debate on Climate Change

Understanding how the public's view on climate change is shaped is crucial but complex, as it depends on a multitude of factors. Following (scientific) news on climate change can, for instance, educate about it, which can increase risk perception and support for policy action, while following political news can reduce it (X. Zhao et al., 2011). But, as shown above, the political debate is polarized, and individuals (and their response to information) are often biased based on their political stance. Selective interpretation of information is likely to strengthen previously held positions (Hart et al., 2015). This makes it important to pay attention to how media coverage portrays the issue of and debate around climate change. Meanwhile, it is important to note that media coverage is highly intertwined with the political sphere, as it provides space for political and economic elite cues to the public (Carmichael & Brulle, 2017).

An analysis of news coverage from 1987-2017 found increasing levels of polarization and especially politicization, in that reports on climate change, since the 2000s, typically feature mentions of politicians, and since 2006, their number of appearances surpassed that of scientists (Chinn et al., 2020). Relatedly, a number of other studies attests to mass media, in anglophone countries and particularly the US, creating the false impression of a balance between scientific consensus and dispute around the hypothesis of anthropogenic climate change, where, in fact, the consensus outweighs skeptic positions by far (Antilla, 2005; Brüggemann & Engesser, 2017;

Stoddart et al., 2023). Fittingly, it was shown that press releases of scientific organizations receive less news coverage than large businesses, while press releases rejecting climate action are cited twice as much in national news media compared to those favoring climate action (Wetts, 2020).

Often, this false balance is justified as an attempt to inform the public with “both” sides of the story and thereby offer a complete and nuanced picture. In this, however, denialist and unscientific claims are presented with such frequency that the opposite becomes true, and the general public receives an impression of division within or even fearmongering attempts by the scientific community and peer-reviewed publications. Meanwhile, it becomes increasingly evident that, if the positions in the scientific consensus were wrong, the so-called other side would be that research findings were underestimated, and reports and news coverage should be more pessimistic (Freudenburg & Muselli, 2010; Boykoff, 2011; Freudenburg & Muselli, 2013; Fisher et al., 2013).

While this portrayal leads to more polarization, specific media framings that are more dominant in other countries, e.g., centering climate action leadership questions, might also lead to more specific, practical debates like those negotiating priorities amongst economic, social, and environmental matters (Stoddart et al., 2023). Whether or not people consider an issue as serious and (actively) support its resolution depends on more than just knowledge of and belief in the existence of the issue; they need to develop an active attitude based on the understanding of possible consequences and the related need to take responsibility (Krosnick et al., 2006). Still, the certainty that the problem exists is fundamental for this process and frames promoting the idea of substantial disagreement amongst climate scientists actively people’s certainty and, in turn, decreases the level of support for policy action (Ding et al., 2011).

On the other hand, the increase in coverage on climate change since the 1990s suggests an increased global awareness (Broadbent et al., 2016). Analyzing newspaper articles published in the US, Finland, France, Russia, and India from 1997-2013, Ylä-Anttila et al. (2018) found that ecological arguments (and representation of actors such as NGOs) are on the rise while economic ones (and respective portrayal of business actors) decline, making room for the notion that climate change mitigation may foster, not threaten, economic growth.

Noticeable peaks in coverage, particularly in countries with widespread acceptance of climate science, often relate to events such as political meetings (e.g., COP) or publication of major reports (e.g., IPCC). In 2019, a major peak in coverage was observed was related to climate activism such as the Fridays for Future movement, followed by a decline in coverage levels that can be explained, only in part, by extensive media attention given to the COVID-19 pandemic (Stoddart et al., 2023). The maintenance of attention to climate change issues in light of other globally relevant debates is a continuous task, especially in its links to the mobilization of public participation in the discourse and actions (Fariello & Jemielniak, 2025).

2.3 The Social Media Debate on Climate Change

Many research publications focus on traditional media, such as newspapers. Meanwhile, their reach is declining, while social media platforms are becoming increasingly popular. While they are often used as a gateway to traditional outlets or to share news, they are also populated by a variety of topics that are otherwise less reported on and, given their different nature, allow for user-generated content, more interaction as well as the unfolding and monitoring of discourses in real time (Castells, 2009; W. X. Zhao et al., 2011; Stoddart et al., 2017; Yang et al., 2021). Social

media are an established yet still increasingly important tool, used by individuals and organizations, to gather information, communicate, network, and mobilize – in all kinds of contexts, including that of climate change and its counter movement (Castells, 2009; Segerberg & Bennett, 2011; Jang & Hart, 2015; Farrell, 2016; Falkenberg et al., 2022; Fage-Butler, 2022; B. C. Sultana et al., 2024).

Publications analyzing the climate change debate on social media mostly focus on polarization and peaks in publication volume, particularly in relation to partisan alignment (Chen et al., 2021), weather events and conditions (Baylis, 2020; Roxburgh et al., 2019; Berglez & Al-Saqaf, 2021; Moernaut et al., 2022), or events such as the Conference of the Parties (COP) (Falkenberg et al., 2022; Stoddart et al., 2025; Wang et al., 2025). Contrary to platforms such as Twitter and Instagram, Reddit centers individual users and their following much less, and is much more focused, as it is primarily structured through thematically oriented communities (i.e., subreddits) (Sylla et al., 2022). The publications presented in the following mostly focus on climate change skepticism, denial, or delay discourse, or analyze interactions between skeptics and advocates. Many findings indicate that there are differences beyond the baseline belief when it comes to discussions of climate change among believers and skeptics: Each side frames and approaches the discussion differently – rhetorically, emotionally, in terms of goals.

On the side of publications that worked on a general exploration or comparison between the two sides, Treen et al. (2022) analyzed climate change related posts and comments published across all subreddits in April-June 2017, which resulted in a dataset of over 18,000 posts and more than 267,000 comments. They found that climate change is continuously discussed across subreddits, while there are noticeable peaks in the discussion that can be linked to events like

Trump's decision to leave the Paris Agreement. Interestingly, a general finding was that even though Reddit allows for long posts and comments, most of them were very short, even though a noticeable portion still makes use of the high character limit. Furthermore, they conducted a topic analysis resulting in 22 topics that they clustered into six groups:

- 1) Various types of debate (e.g., identity-driven, evidence-based, media);
- 2) global warming causes/impacts;
- 3) US-politics (mainly related to Trump and domestic matters), (scientific) consensus, and (Reddit) moderation;
- 4) Policy (UK-politics);
- 5) Paris agreement, regulation, denial;
- 6) Globalization and economics (Treen et al., 2022, p. 688).

They also conducted a topic analysis that revealed the variety of contexts in which climate change is discussed on Reddit, including but not limited to policy discussions, comparisons of governments, and scientific discourse. Furthermore, the topic analysis highlighted links between politics and climate change, which the present study will explore further. By tracking replies of users, they were able to create a reply network and detect very connected communities that exist beyond the limits of single subreddits. While polarization was present, no strong evidence of echo chambers was found, which might be the result of the thematic (subreddit) structure of Reddit, as opposed to a user-centered structure on Twitter, which might facilitate more interactions between polarized users.

Gadanidis (2020) conducted a mixed-method study on five major climate-subreddits to analyze how climate change is constructed and framed, how the communities differ in this regard,

and ultimately investigated to what extent the findings align with mass media coverage of climate change. Much alignment was found between the Reddit discussions and media discourse, even though some frames, like those linking the debate to that on social justice, were rather exclusive to the online discussion.

While many publications presented in this section point out activity spikes linked to “real-world” events like political meetings or natural disasters, Shah et al. (2021) examined these spikes more closely: For their analysis, they focused on discussions that were triggered by natural disasters or political or policy events. They sampled subreddits of six major US cities that faced a natural disaster in 2014-2019 and collected four million posts covering 13 months of discussion, with the month of the trigger event being in the middle of this period. Finally, they found that all types of events triggered significant discussion levels. However, their results also suggest that political controversies might have a stronger effect on activity levels than natural disasters (despite immediate local consequences).

After the US presidential elections in 2016, for instance, the biggest spike occurred, and activity remained heightened for four months, while activity after other events mostly returned to usual levels after just two months (Shah et al., 2021). Using a longer time period but focusing on fewer subreddits, a recent study by Parsa et al. (2022) analyzed the climate change debate on Reddit in 2016-2019, through detecting communities that (most frequently) discuss climate change, as well as the topics that are discussed within them. They found that their top communities (r/climate, r/environment, r/climatechange, r/climateskeptics, and r/climateOffensive) show heightened activity around events like new political agreements concerning climate action or natural disasters like the California wildfires in 2018. For their

analysis of discussion topics, Parsa et al. ran a non-negative matrix factorization (NMF) topic modeling algorithm on each of the five subreddits to analyze the posts based on their (lexical) similarity. They found that climate-related terminology is used more and more, while general terms like “climate change” are more common than “technical terms such as carbon tax”. Based on the results, they suggest four fields of discussion: expression of skepticism (towards climate change) (1) or concerns about skeptics and politics (2), and discussions around the effects of climate change (3), along with solutions and (individuals’) climate action (4). They noted that the last field shows a more positive sentiment compared to the others.

Fittingly, Sylla et al. (2022) compared differences in climate delay discourses as discussed by Republicans and Democrats, and a deductive qualitative content analysis showed that while the latter emphasize non-transformative solutions, the former focus on downsides and hinder progress through redirection of responsibilities. A linguistic study carried out by Biri (2022) analyzed the epistemic stance in the climate change debate and found that there are differences when comparing users on Reddit and Twitter, as well as advocates and skeptics: While the users’ epistemic stance is more clearly stressed on Reddit, it was generally concluded that skeptics’ arguments are more often based on judging the factuality (of advocates’ statements).

Yueh (2021) used logistic regression to compare the subreddits r/climate and r/climateskeptics to assess how the discussions differ in the two opposing communities, and their results showed that the skeptics’ community made more use of vocabulary that indicates certainty, as well as second and third person pronouns. Meanwhile, the believers’ community was characterized by vocabulary linked to gratitude, along with first-person (plural) pronouns. Another analysis with yet another framework was conducted by Villanueva (2021) and focused

on Reddit discussions surrounding the 2019 UN Climate Action summit and analyzed posts from six climate-subreddits. It was found that political/ideological struggle was the most common frame across the subreddits, while anger (by far) and hope were the most dominant emotions. However, differences in emotional expressions were observed when examined posts belonged to different frames: Anxiety, for instance, was much more present in health-related posts than those related to economy or political struggles, whereas anger was more dominant in the latter than in others. Overall, it was also found that subreddits as a whole differ in their levels of anxiety, when comparing neutral to climate change believer or skeptic communities, and anger was more common within the skeptic community than in the believer one, which displayed hope, closely followed by anger, as dominant emotions.

Two more publications that focused on climate skepticism also revealed that the two sides draw on different sources with likewise differing levels of reliability: In an analysis of Reddit comments, Areni (2022) showed that motivated reasoning led climate change deniers to access information sources that support their political views, but are unreliable, while their opponents were more likely to access reliable sources, regardless of whether those aligned with their political views. Directly adding on to these findings, Oswald and Bright (2022) analyzed a major climate skeptic subreddit (*r/climateskeptics*) to see whether or not science skepticism would be reduced when faced with opposing arguments. They found that opposing statements triggered comment activity, but that this rather reinforced the community, while the confrontation did not seem to alter the skepticism. They concluded that their findings oppose traditional theories and strategies that would emphasize confrontation as an effective method to conquer skepticism. Adding on to this, they point out the potential of rather defensive strategies, like limiting the

reach of those spreading misinformation or providing more education on accessing reliable information.

Only in 2025, a most recent study on Reddit analyzing common terminology and sentiment in the climate change debate, constructed a long-term dataset – consisting of more than 11 billion documents covering climate-related publications from 2005 to 2021 (Fariello & Jemielniak, 2025). After extensive filtering and validation processes to ensure only relevant documents in English were included, just 1.5 million documents remained in the dataset. It was found that while the climate change debate was growing, its proportion of all publications was getting smaller. Furthermore, while “global warming” was a common term in the beginning, since 2013, “climate change” has become much more common. Interestingly, in comparison, “climate change” seems to be associated with less positive sentiment. This language shift was compared to that within Google search terms, and the authors concluded that it can be detected earlier within online discussions, indicating that analyses of them can “serve as early indicators of changing public attention and discourse” (Fariello & Jemielniak, 2025, p. 6).

The currently published research on the climate change debate on Reddit offers some valuable insights, as it reveals, amongst other things, characteristics of the two “contesting” sides within this debate. More generally, the presented literature shows that social media platforms are increasingly important spaces for public debate and, consequently, crucial to research seeking to explore them. While numerous platforms have been popular for many years, only some have received significant attention in academic studies. Despite being a popular platform, Reddit has not been the focus of many publications. Only the most recent study examines a significant, multi-year period, but none have analyzed long-term changes in the thematic foci and popular

communities. Given the importance of effective communication and action regarding climate change, the amount of evidence pointing out systemic obstruction, delay, and continued polarization is concerning. It makes it all the more important to research how this complex debate evolves in public, which is increasingly dominated by social media platforms. While research on other platforms undoubtedly produced valuable insights, different platforms need to be examined, as they can largely differ in terms of user demographics, content creation and moderation, and beyond.

Therefore, the analysis described in the following chapters seeks to address this gap in knowledge by examining the debate over a 13-year period in which it populated thousands of communities. The analysis is guided by three research questions asking 1) which links to other debates emerge when climate change is discussed on Reddit, 2) which communities (i.e., subreddits) are most popular for the debate, and 3) how changes in thematic foci and community selection relate to the climate change debate outside of Reddit. Based on the insights from the literature presented above, the debate on Reddit might show an increase in popularity over the years, which would be noticeable in growing, stable publication numbers. At the same time, it might also become more aligned with general politics, as the debate is often tied to policy debates, and significant political events are known to drive debate activity. Furthermore, based on previous Reddit studies, it can be expected that much of the discussion happens in communities that are particularly focused on environmental themes or politics.

3 Methodology

In this chapter, the platform Reddit and the dataset containing five million publications discussing climate change will be introduced in more detail, before the data processing and analysis steps are laid out. The chosen dataset captures all publications mentioning climate change from the first time this happened in 2010 until September 2022, when the dataset was created. The main analysis uses topic modeling techniques to find dominant topics in every year, which were then semantically compared to obtain nine themes that are tracked throughout the years and the many communities they populate.

3.1 Platform: Reddit

Reddit was founded in 2005 and is a website where users can create communities (subreddits) and publish posts as well as comments about all kinds of topics, ranging from entertainment, subcultures, news, to political debates and movements. Except for subreddits that set their community to “private”, a user account is not required to view anything on the website. However, to interact or publish something, a user account needs to be created. The platform allows for anonymity as users can register with just an email address and password, becoming an active user under a self-chosen, normally anonymous username. Since Reddit’s founding in 2005, the number of daily publications, is growing steadily, especially driven by comment activity: In 2013, about 1 million comments were published daily, in 2016 this number doubled, and by 2019, it doubled again to more than 4 million daily comments (Baumgartner et al., 2020). In 2022, over 492 million posts and 2.8 billion comments were published by users (Reddit Inc., 2023a), more than 57 million of which are active daily (Reddit Inc., 2023b).

Most of the users are from English-speaking countries: Users from the United States account for roughly half of the traffic to reddit.com, while the United Kingdom (7.5%), Canada (7.4%), and Australia (4.2%) account for another big part of the website's audience (Bianchi, 2023).

Reddit differs from other social media platforms in various ways, but perhaps most importantly, through the way its built on a forum-like community structure where each subreddit can be governed by select volunteers/community moderators that enforce a likewise community-specific code of conduct including that regulating user behavior and content (Baumgartner et al., 2020). While some subreddits focus on pictures and videos or external content, such as news articles, much of Reddit activity still centers textual content and interaction. Furthermore, the way the subreddit structure organizes the platform, users naturally curate their own experience for the most part, meaning they consume the content and contribute to those communities they chose , whereas other popular platforms increasingly rely on an algorithmically curated content feed at the heart of users' experiences.

When reviewing research on the climate change debate on social media, it is quickly revealed that the popularity of a platform does not correlate with the attention it gets in research studies: YouTube, Facebook, Instagram, X (formerly Twitter), and Reddit are some of the biggest social media platforms (excluding those that are messenger apps) (Kepios, 2025). Even though all of them have been established for more than a decade, they have received varying levels of attention in research studies. In terms of publications related to climate change, a simple query using the Scopus Database, for example, shows huge differences in publication volumes (Table 3.1). While the search yielded almost 600 publications focusing on Twitter/X since 2010, Facebook

and YouTube are associated with far fewer studies, despite having a similar year range beginning in 2009 and 2007, respectively. On the other hand, Instagram (87 publications) and Reddit (37 publications) only account for a fraction of studies compared to Twitter, and seem to have only gained attention since 2018-2019, about a decade after the aforementioned platforms.

Table 3.1 Results of a Scopus database search conducted on March 10, 2025, using the search query: “(“climate change” OR “global warming”) AND “platform name”” in title, abstract, keywords.

Platform name	No. of documents found	Year range
Twitter	587	2010-2025
Facebook	223	2009-2025
YouTube	141	2007-2025
Instagram	87	2018-2025
Reddit	37	2019-2025

While a simple database query like this can certainly not account for all publications and potential nuances, it still provides a useful indication of how strongly current social media research on climate change is biased towards certain platforms. A disproportionate number of publications focusing on Twitter in particular has also been noted by other studies (Pearce et al., 2019; Stoddart et al., 2025). It might, in part, be explained by (previously) publicly (i.e., without an account) accessible data as well as through APIs, being more text-based and therefore easier to analyze using established methods, and last but not least, its popularity beyond use in private life – practically being a meeting platform for individuals, politicians, journalists, and organizations alike. Pearce et al. (2019) found that studies of Twitter are mostly associated with three general points of view, examining the platform as either a

- place for knowledge and opinion exchange on scientific issues and climate change in general;
- database that can be thematically filtered and analyzed, e.g., through use of hashtags and keywords;
- an opportunity for professionals to gain insights (through research) that could help adapt communication strategies.

Apart from the bias towards Twitter, many general findings exhibit parallels with those in studies regarding traditional media.

3.2 Dataset

The publicly available dataset was retrieved online (SocialGrep, 2022). The dataset is available in two parts, one with the 4.6 million comments, and the other one with about 620 thousand posts. These include all the publications on Reddit mentioning the terms “climate” and “change” before September 2022, thereby containing data for almost 13 years. Because the dataset was created based on publications including key words, no entries are fully empty. However, among the posts, there were 71,799 entries marked as *[removed]* and 52,800 as *[deleted]*, meaning the text is not available because it was deleted, e.g., by the platform or moderators because of a violation of the code of conduct, or by the author themselves, respectively. These entries were marked as missing values and removed from the dataset. As posts can have a title and a main body (called *selftext*), these two texts are stored in separate columns. To be able to analyze the dataset as a whole, it was adjusted to match the format of comments, which only have one text field. As a rule, the *title* was added to the beginning of the *selftext*. Where the *selftext* was empty, the *title* filled it. When

the *title* was partially (4345 times) or fully (44 times) contained in the *selftext*, it was removed to avoid duplicate text. Additionally, the datasets originally come with two columns listing a unique identifier for each entry, as well as a code for the type of publication (i.e., post or comment). These columns were combined into a unique ID that ensures this differentiation remains possible, after which the datasets were combined and unnecessary columns were removed. As a result, the dataset contains columns with the text, a timestamp indicating when it was published, and the name of the subreddit it was published in. In this state, the dataset was used for some exploratory analysis, determining publication volumes, as well as the number of subreddits and changes in popularity over time.

3.3 Preprocessing

After these initial data cleaning and overview steps, the data were prepared for topic modeling. Before the main preprocessing, URLs were removed from the data to reduce noise and all mentions (or tags) of subreddits (e.g. r/climate) and users were replaced with the codes “SUBREDDIT_[name]” and “USER_[name]” respectively, to ensure they stay identifiable and are not processed as regular words (e.g. “climate”). Finally, the data were fully preprocessed through the spaCy (Honnibal & Montani, 2017) pipeline, in which the process depicted in Figure 3.1 was repeated for each entry (i.e., post or comment) in the dataset.



Figure 3.1 Illustration of the data preprocessing steps through the components of the spaCy pipeline.

First, the pipeline took the raw text as input and handed it to the *tokenizer* component, which broke the text down into *tokens* (i.e., the words it is made up of). Using a pretrained statistical language model for the English language (“en_core_web_sm”) and language-specific rules, the tokenizer identified the boundaries of words and sentences and was able to, e.g., differentiate between a full stop that ends a sentence, and one that marks an abbreviation. Next, the *tagger* assigned tags to all the *tokens*, making sure only the wanted types of words are included. In this case, all words except nouns, proper nouns, and adjectives were removed. This was done to remove noise in the data by eliminating insignificant words. As the preprocessing was done primarily to enable topic modeling, words such as prepositions and verbs hold little informational value and would not facilitate the interpretation of model outputs. Additionally, spaCy’s default stop word list is used to remove some of the most common words that usually do not add any value to the data, either. Finally, the *lemmatizer* takes the filtered data, puts it into lowercase as a final step of text normalization, and then returns the (dictionary) base form of all *tokens*. This reduced duplicates of words and made it easier to group and interpret them according to their meaning, as, e.g. the singular and plural forms of a word would otherwise be seen as two different words, despite generally having the same meaning. As a result of this

process, the raw text input was transformed into *docs*, i.e., groups of preprocessed tokens for which the original post or comment still determines the boundaries.

3.4 Topic Modeling: Latent Dirichlet Allocation

In the main analysis, these data were used for topic modeling through *Latent Dirichlet Allocation* (LDA), which was first introduced by Blei et al. (2003). It is a generative probabilistic topic model that can be used to analyze corpora of discrete data, like text data. Generative modeling is particularly useful in cases such as the present study, where a large number of documents makes up the dataset and it is known that these documents contain a variety of thematic foci, each to varying extents (McLevey, 2022).

Applied to the given study and based on the definitions of Blei et al. (2012; 2003), the process of LDA can be described as depicted in Figure 3.2: The used dataset is the *corpus* that consists of M comments and posts, each of which is a *document* w . Each document is made up of N words, and all the words in the corpus form the *vocabulary* (Blei et al., 2003). This vocabulary is the basis for the topics found by the model, where each *topic* is defined as a distribution over the (fixed) vocabulary (Blei, 2012). LDA assumes the topics to be a given, based on which the documents are generated.

First, a distribution over topics is chosen randomly. Then, for each word in a document, a random topic is chosen from that distribution, after which a random word is chosen from the distribution over the vocabulary. The underlying idea here is that each topic is present to a varying proportion in each document (Blei, 2012). To reduce computation times and facilitate tracking of thematic foci and changes over time, the dataset was divided into 13 parts, one for each calendar

year from 2010-2022, and then modeled separately. The *vocabulary* was created using Gensim (Rehurek & Sojka, 2011) and then filtered to further improve model clarity by removing extreme outliers, namely terms that occur in more than 95% or in fewer than 10 documents. These values were chosen after trying out different values and finding an effective threshold that, upon increase, does not significantly alter the number of excluded terms anymore. Notably, there were close to no dominant terms (i.e., those appearing in more than 95% of the documents), while removing extremely rare ones (i.e., those appearing in a total of less than 10 documents) reduced the number of terms used for the model by half or more.

With the finalized vocabulary, a sample model was run multiple times to determine the best number of topics for the data, which was evaluated by plotting the coherence values (c_v) of the model against the number of topics. The number of topics after which the coherence values dropped or plateaued was chosen for further analysis. The optimal values for the final models ranged from 6 to 12 topics, which yielded model coherence values of about 0.6.

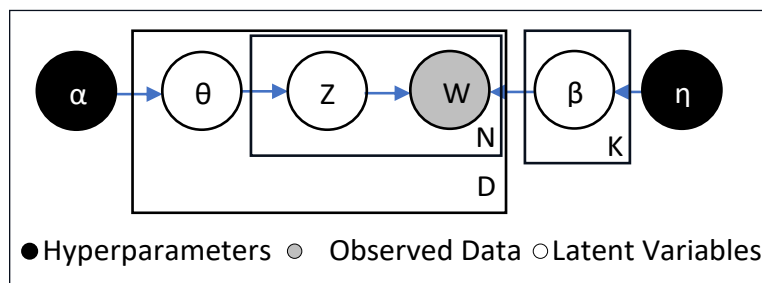


Figure 3.2 Illustration of the Latent Dirichlet Allocation process used for topic modeling.

After the number of topics was determined, the models were further refined through grid searches, testing different combinations of model parameters (*iterations*, *passes*) and the

hyperparameters. Generally, it was observed that increasing the number of passes or iterations did not improve model coherence, so the models were fitted after 3-5 passes and 50-200 iterations.

3.4.1 Model Evaluation and Theme Labeling

The final models were initially evaluated based on their coherence values, but then examined more extensively through visual representation of their outputs in LDAvis (Sievert & Shirley, 2014), and an analysis of the most frequent and most important terms for the individual topics.

The topics were analyzed to determine their (semantic) similarity through topic embeddings and clustering using a Louvain algorithm. To further verify the similarity, and thereby recurrence, of certain topics across years, the topics were analyzed semantically, based on a GloVe vector representation. The GloVe model is based on the assumption that words have a similar representation if they appear in a similar context. For each word in the vocabulary, the 100-dimensional vector of GloVe embeddings is looked up. Thereby, the semantics of each topic can be captured, and topics can be connected even when their top words are not identical. A weighted average (based on a word's probability in a topic) of word embeddings was computed for every topic, making it possible to represent each topic as a vector in a semantic space.

Then, cosine similarity was computed for all topic embeddings, measuring the angle between every pair of vectors. Based on their similarity and their nearest neighbors ($knn = 3$), a graph was drawn. Using this graph, the Louvain algorithm for community detection was employed to detect clusters of similar topics, which, in turn, can be interpreted as recurring themes. Then, the network graph was plotted, and clusters were compared to manual labels, after which the

theme labels were finalized in preparation for subsequent analysis of temporal changes in theme proportions, as well as associations with communities they are discussed in.

4 Results

This chapter presents the results of both an explorative analysis, as well as the outlined topic modeling and subsequent thematic analysis. It provides an overview of trends in the publication volume, including significant peaks and coinciding events that received international attention. It then introduces nine main themes of discussion found across the five million publications, which is followed by an overview of the most popular subreddits overall, for each of the main themes, and those that have “historically” been integral communities for the debate. While the presentation of the results includes necessary contextualization, the deeper analysis and interpretation, particularly regarding how they relate to the general climate change debate, will be developed in the last chapter.

First, the distribution of publications over time was analyzed (Figure 4.1). The years 2010-2015, nearly half the analyzed timespan, show a slow but steady growth, yet only account for about 10% of the volume in the entire dataset. A first growth spurt occurred around the US presidential elections in 2016, followed by a second peak on the day of Trump’s announcement regarding the withdrawal from the Paris agreement. After publication volumes plateaued in 2018, the largest spike in activity occurred in 2019, reaching over 140 thousand publications in September alone. This coincides with the Global Climate Strike, as well as the Conference of the Parties (COP25), which received significant media attention following a speech by climate activist Greta Thunberg. This enormous activity is again followed by lower publication volumes, this time coinciding with the COVID-19-related lockdowns. After this, less significant peaks coincide mainly with extreme weather events, particularly when multiple of them occur in a short period of time.

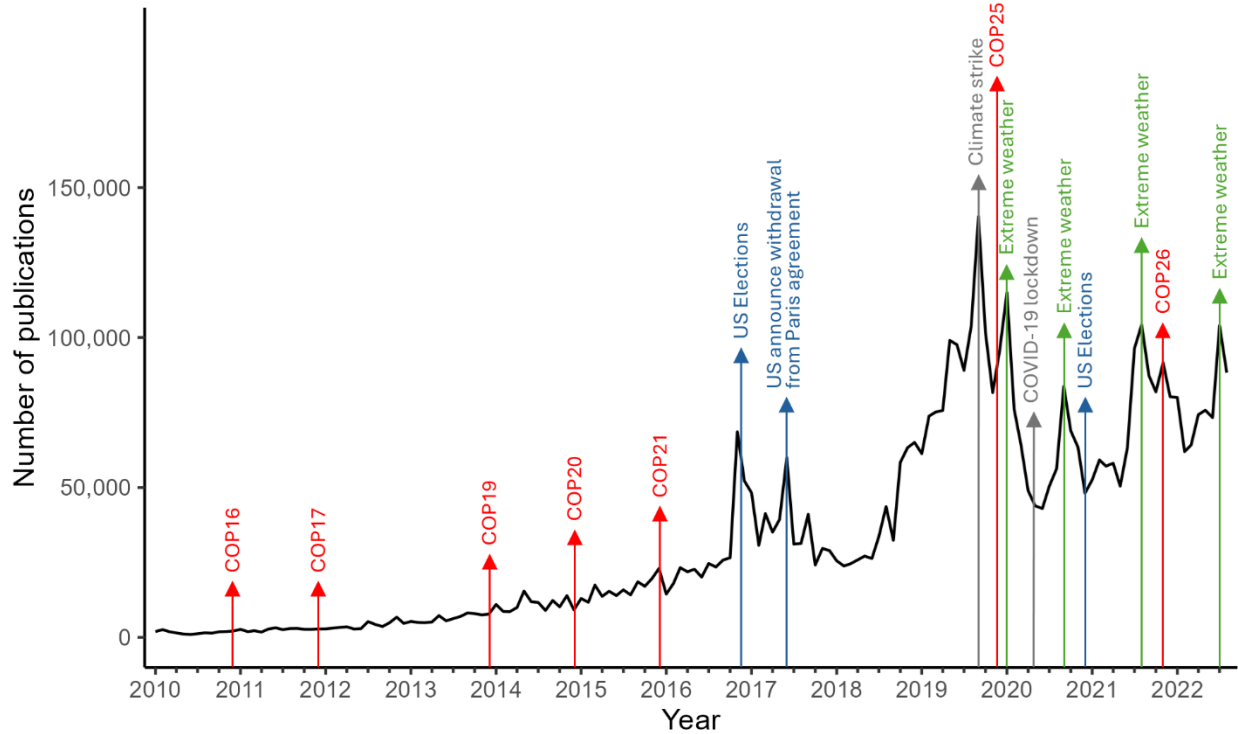


Figure 4.1 Monthly publication volumes in the Reddit climate change dataset over time. Labels mark events relevant to the dataset: red – UN Climate Change Conferences, blue – political events, green – extreme weather events, grey – other events.

The five million publications in the dataset were made across more than 42,000 different subreddits. However, the majority of publications were made in just 76 (0,2%) subreddits that account for about 60% of all publications, with another 435 subreddits accounting for an additional 22% (Table 4.1).

Table 4.1 Subreddit groups by minimal publication volume: counts, total publications, and each group’s share of total publications included in the dataset.

Publications per subreddit	Number of subreddits	Total publications	Proportion of total publications (%)
< 10	32,972	71,358	1.4
10-99	6,746	208,977	4.1
100-999	2,017	621,835	12.2
1000-9999	435	1,136,633	22.3
> 10000	76	3,058,204	60.0
Any (total dataset)	42,246	5,097,007	100

4.1 Themes

Initially, 120 topics were found through topic modeling. They were then interpreted and labeled based on their top words and sample documents. Six topics, containing only small amounts of data, were found to contain auto-generated content, e.g., informing a user of the removal of their comment based on a violation of community guidelines, or a majority of non-English text. They were therefore excluded from further interpretation. The remaining topics were grouped based on similar labels and sample texts. To further confirm the grouping, the semantic similarity was analyzed and a Louvain algorithm was employed to cluster the closest topics.

By plotting a forced-graph network (Figure 4.2), the algorithmically found groups were compared to the group labels that were manually assigned. Overall, the results are very similar, as the algorithm found eight clusters, whereas nine were manually assigned. The discrepancy is explained by the economy theme, which is semantically closely related to the US-Politics theme and was therefore clustered as part of it. However, as manual verification confirms some overlap

but more importantly reveals a coherent theme with topics discussing economic matters, the subsequent analysis includes this theme on its own.

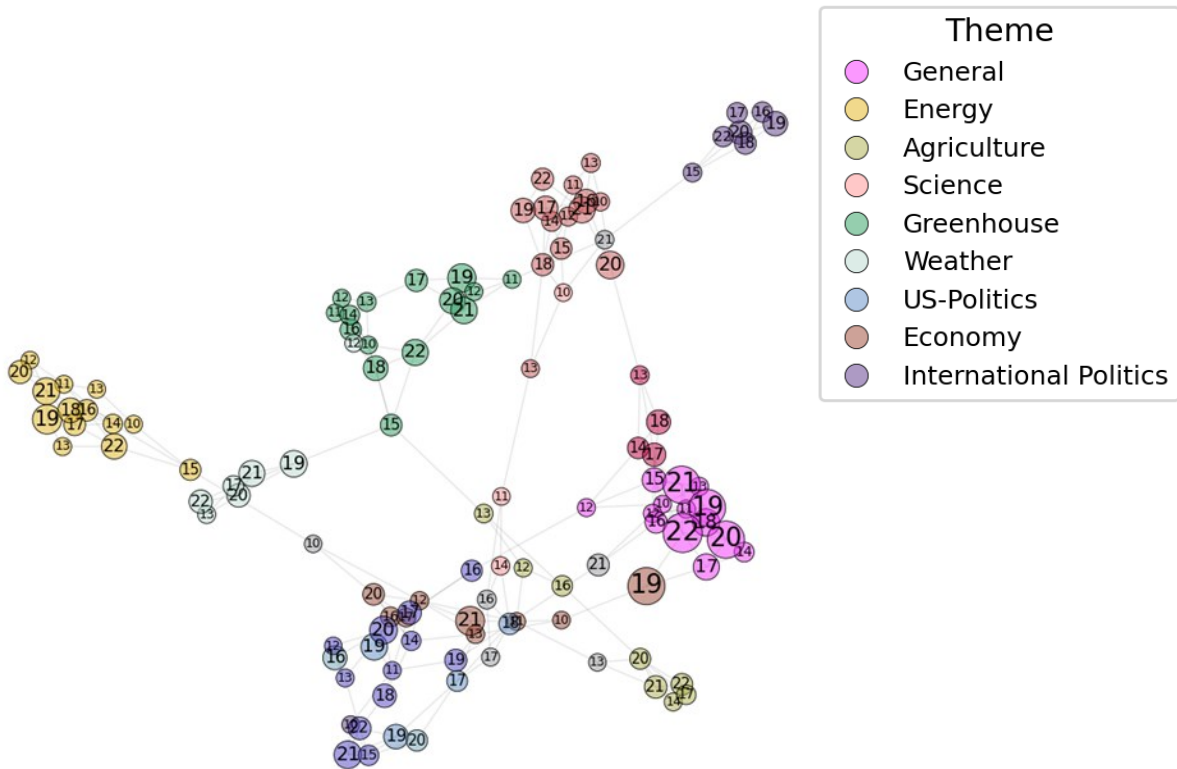


Figure 4.2 Force-directed network of topic similarity, visualizing semantic relationships between topics based on clustering with the Louvain algorithm. Colors correspond to manually assigned group labels, numeric labels correspond to the year the topic belongs to (YY-format).

General Debate and Belief

This theme is the biggest one, accounting for a large share of the entire dataset. While an initial screening of the top words in the model outputs did not immediately lead to a specific label, it demonstrated that this theme is present every year. The terminology was very similar every year, including words like “people, world, life, thing, problem”. Sample documents revealed a much more coherent theme than these top-words and showed that this theme in fact harbors the more general debate, making reference to various socio-political themes and, in some cases, e.g., just mentioning climate change as an example of current global issues. While some individual topics in this theme focus on media content and events such as the release of books or the discussion of popular shows, that is not the case for the majority of topics. Most samples show the discussion of belief in climate change, with users arguing why they do (not) believe in it or why they think others do (not). Many documents show users relating religious belief to that in climate change, by either stating their own relationship with the two, or more generally arguing that, e.g., people with strong religious beliefs would tend not to believe in climate change. A smaller set of samples shows how the perception of climate change related risks influences their personal life, including interpersonal relationships (e.g., with those of opposing beliefs) and family planning.

Energy

This theme is made up of all topics focusing on energy. It is present with high coherence values and very similar top words across all years. Only in 2013, it was split into two topics, where one is more focused on various sources and technology, whereas the other one focuses more on fossil fuels, while mentioning some economic keywords.

Agriculture and Natural Resources

This theme is present in most years, but its coherence values are more mixed and, compared to other topic groups, the top words are slightly less clear. However, when compared across years and manually validated with sample documents, it still describes a coherent topic that is mainly focused on the environmental impacts of agriculture. It includes discussion of land use, the meat industry, population growth, and related agricultural problems. While in the first years, the topics are more general and perhaps more similar to the *Global warming* theme, over the years, the top words become increasingly related to agriculture and (threats to) biodiversity.

The following three themes, labeled Greenhouse effect, Scientific Evidence, and Weather, form a group of themes that is, broadly, concerned with debating evidence for and noticeable effects of climate change, such as scientific publications or the observation of extreme weather events.

Greenhouse Effect and Global Warming

In this topic group, documents discuss causes and impacts of the greenhouse effect, like the thawing of glacial masses and the rise of sea levels. Sample documents for this group include many that also discuss how terms, particularly “climate change” and “global warming”, are (not) the same, and whether or not climate change is “natural” or anthropogenic.

Scientific Evidence and Publications

This theme is also present every year and discusses *Evidence* for climate change, but has a particular focus on scientific evidence. While there is some discussion about whether or not climate change is real, most sample documents argue that the consensus in the scientific community is that climate change is anthropogenic. To support their statements, many include

lists of academic publications, names of scientists, or long lists of scientific organizations and associations. Notably, samples across years mention and criticize a publication by Cook et al. (2013) that famously concluded a near-full consensus among peer-reviewed publications regarding anthropogenic climate change. While some users cite this finding to illustrate the strong scientific evidence, others argue it shows the opposite, claiming the paper is methodically unsound.

Weather

While this theme's top words seemed less clear and had a comparatively low coherence score, it appeared in many years and sample documents still appear to show a coherent topic: They relate to weather in general, but include many documents discussing catastrophic weather events, like hurricanes, floods, and wildfires. Finally, the remaining three themes pertain to political matters. Labeled *US-Politics*, *International Politics*, and *Economy*, they all debate political events and measures, such as taxes, policy changes, protests, elections, and political news concerning various countries.

US-Politics

The first topic group, *US-Politics*, is focused on domestic politics in the United States and, to a smaller extent, its international relations. While most years' top words are very general, some give insights into what in particular is being discussed, with, e.g., 2016's and 2019's top words including "abortion", "gay", "gun", "woman", "health", or 2022 showing a focus on the Dakota Pipeline project. The mixed top-words hint at what can be confirmed in sample documents: While some discussion is focused on climate change related matters, many publications discuss it as one of multiple topics. A small number of topics in this theme attest to significant political events that

extend the discussion beyond the usual topics: For instance, a topic from 2017 is related to Trump's announcement to withdraw from the Paris Agreement, while in 2019, a smaller topic focuses on the protests related to the Global Climate Strike. Furthermore, in 2016 and 2020, an additional topic was modeled that included discussions of the presidential elections.

International Politics

This theme is present in most years, albeit being smaller, and includes documents that discuss international politics, relations, and conflicts. Some significant global events are visible in the top words: For instance, in 2016, with increasing numbers of war refugees, the top words include "refugee", and in 2020, "COVID-19" and "coronavirus" are mentioned. In 2021, the relevance-based top words reveal a focus on G7 and COP26.

Economy

This last theme represents all topics whose top words focus on economic themes, such as government policies and taxes, businesses, and global markets. Sample documents reveal some overlap with the other political themes, as the economy is often discussed in direct relation with government actions of particular countries. The samples also show that a portion of the discussion focuses on capitalism and wealth distribution, with some explicitly pointing out capitalism as a main driver of climate change.

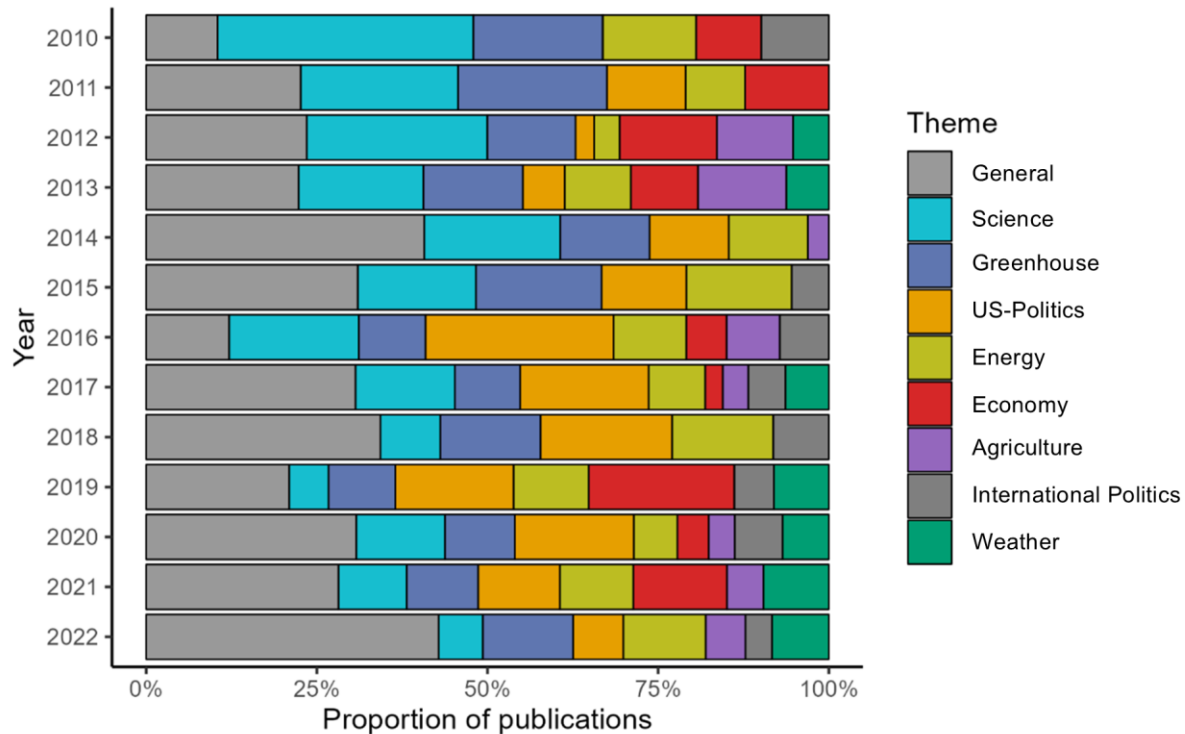


Figure 4.4 Stacked bar chart showing the annual proportions of the nine main themes in the Reddit climate change dataset.

4.1.1 Changes in Themes Over Time

Regarding the temporal development of theme proportions, a few things are notable in Figure 4.4. As the general debate theme becomes established as the most prominent theme, the science theme shrinks from top to bottom ranks. The greenhouse and energy themes see few changes in proportions and are the more stable themes that are likewise present in all years.

While most themes are relatively stable and grow proportionately with the overall volume, the political themes, particularly regarding US-Politics and economy, stand out, appearing to be the drivers of the main peaks: In 2016-2017, the growth in the US theme coincides with the presidential elections in the US, as well as the following rollback from Obama-era climate

policies: The newly elected Trump administration targeted, e.g., the Clean Power Plan, and announced plans to withdraw from the Paris Agreement in June 2017, which is followed by a spike in publication volume as well. In 2019, the peak was largely driven by the US-Politics and economy theme and coincided with numerous protest movements, associated with Extinction Rebellion, Fridays For Future, and the Global Climate Strike. The top words in the economy theme for that year also include words like “problem, capitalism, people, issue”, while the politics theme, e.g., includes “protester”.

While the economy theme grows most disproportionately, sample documents indicate that while some economic debate, such as capitalism critique, is triggered in light of global protests, a large portion of this theme is likely equally related to the political themes. Therefore, the economic debate is likely less dominant than it appears when looking at the yearly theme proportions, particularly in 2019. Finally, the weather theme is becoming bigger, establishing a stable presence in recent years. By contrast, the agriculture theme seems to be reestablishing itself after losing its presence in some years.

4.2 Popular Subreddits

The ten most frequented subreddits are focused on general politics and news (r/politics, r/worldnews, news), general debate (r/askreddit), specific countries (r/Canada, r/Australia), and topics more closely related to climate change (r/collapse, r/environment, r/futurology, r/science). As shown in Table 4.2, these communities are amongst the largest on Reddit, with r/askreddit even ranking second and r/worldnews ranking fourth with 57 and 47 million members respectively.

Table 4.2 Overview of the ten most popular subreddits, including a description text, the number of members, the rank by size, and the proportion of the Reddit climate change dataset they account for.

Subreddit	Description*	Members (million)*	Rank by size*	Proportion of dataset (%)
Politics	r/Politics is for news and discussion about U.S. politics.	8.9	Top 1%	7.51
Worldnews	A place for major news from around the world, excluding US-internal news.	47	4	7.08
Askreddit	r/AskReddit is the place to ask and answer thought-provoking questions.	57	2	5.23
Collapse	Discussion regarding the potential collapse of global civilization, defined as a significant decrease in human population and/or political/economic/social complexity over a considerable area, for an extended time. We seek to deepen our understanding of collapse while providing mutual support, not to document every detail of our demise.	0.6	Top 1%	1.96
News	The place for news articles about current events in the United States and the rest of the world. Discuss it all here.	31	13	1.96
Environment	Current news, information and issues related to the environment.	1.5	Top 1%	1.86
Futurology	A subreddit devoted to the field of Future(s) Studies and evidence-based speculation about the development of humanity, technology, and civilization. [...]	22	32	1.81
Science	This community is a place to share and discuss new scientific research. Read about the latest advances in astronomy, biology, medicine, physics, social science, and more. Find and submit new publications and popular science coverage of current research.	34	10	1.50
Canada	[...]This is the place to engage on all things Canada. Nous parlons en anglais et en français. Please be respectful of each other when posting, and note that users new to the subreddit might experience posting limitations until they become more active and longer members of the community. Do not hesitate to message the mods if you experience any issues!	4.3	Top 1%	1.34
Australia	A dusty corner on the internet where you can chew the fat about Australia and Australians.	2.7	Top 1%	1.22

* Manually retrieved from reddit.com on July 18, 2025.

Despite staying important throughout the years, the data portion they account for is shrinking as the growing debate becomes more scattered across subreddits: While they account for 60% of the data in 2010, it is less than 40% in 2017, and just over 20% in 2022 (Figure 4.5).

The subreddit focused specifically on US politics (r/politics) is accounting for the largest share of publications in most years, until its proportion significantly shrinks in the most recent years (Figure 4.5). Still, a shift is apparent from more thematically focused subreddits (e.g., r/environment, r/science) to more general (r/askreddit) and politics-oriented subreddits (r/worldnews, r/askreddit). On the other hand, r/collapse accounts for a steadily increasing share of publications.

Some spikes in subreddit proportions coincide with thematically related events: In 2011 and 2013, r/australia shows a larger-than-usual proportion, which coincides with the contentious passing of the Clean Energy Act (incl. the implementation of a carbon tax) in 2011, and record-breaking heatwaves in Australia's 2012-2013 summer. In 2016, the growth in r/politics coincided with the presidential elections in the United States.

Overall, these largest subreddits and the proportions of data they account for mostly align with the thematic foci in the debate, as well as the user demographics on Reddit. However, the selection becomes more nuanced when considering which subreddits are most relevant to the discussion of each theme, and when not only the size is considered, but long-term contribution to the debate is emphasized.

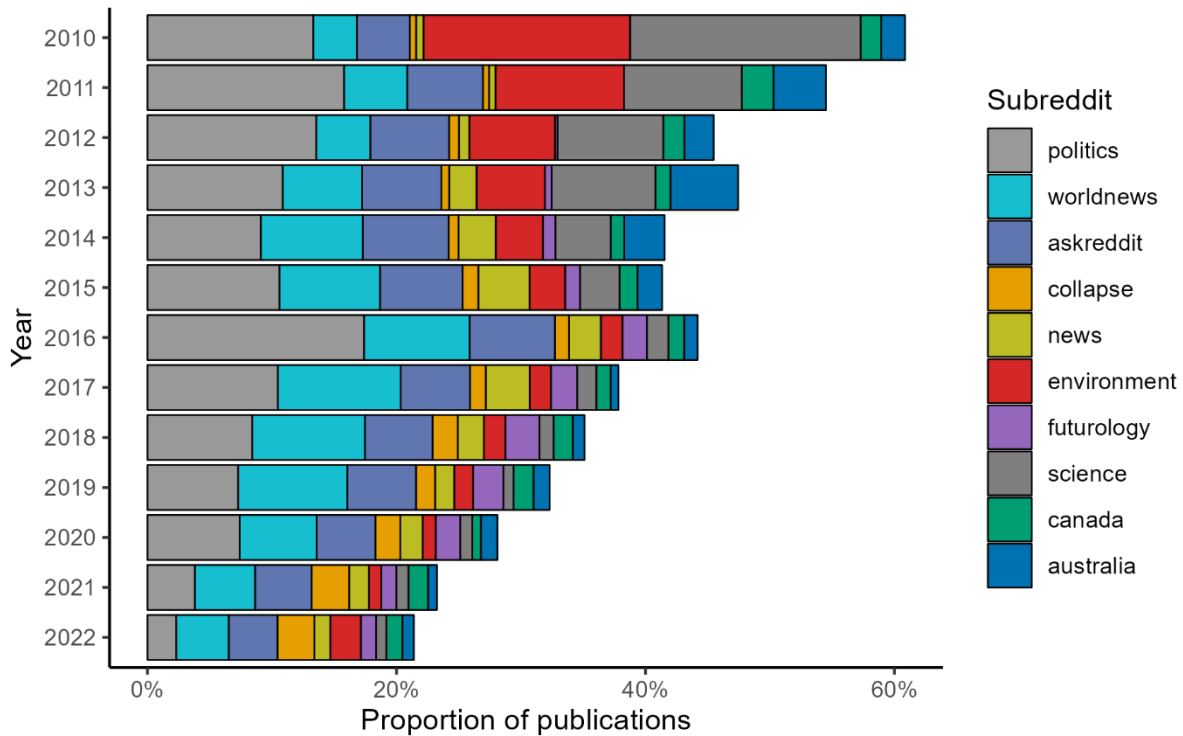


Figure 4.5 Stacked bar chart showing the proportion of publications the ten most popular subreddits account for yearly from 2010-2022.

4.3 Most Popular Subreddits by Theme

First, looking at the ten most significant contributors for each of the presented themes (Figure 4.6), a few things stand out: Naturally, the just introduced top-subreddits make a significant appearance across themes. However, a part of the thematic discussion also occurs in theme-specific communities. For instance, *r/energy* is uniquely present in the energy theme, *r/veganism* in the agriculture theme, and *r/science* in the science theme. Furthermore, this part of the analysis revealed that about 3.5% of the data in the US-Politics theme is non-user generated, as it was created in *r/bottown2*, a subreddit exclusively featuring content created by bots that students are testing in a computer science class.

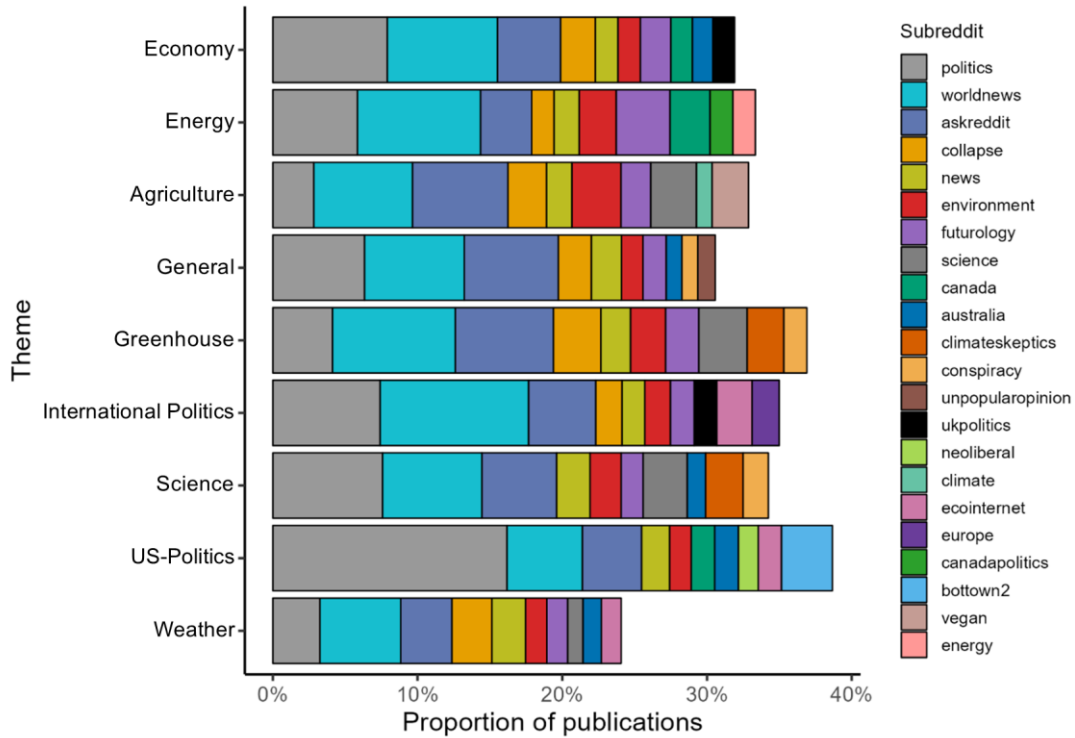


Figure 4.6 Stacked bar chart showing the ten most popular subreddits for every main theme.

4.4 Historic Subreddits

As established earlier, just a few subreddits contribute to higher numbers of publications. Only 76 subreddits have a total of ten thousand or more publications across the entire dataset. Focusing on those present in all years, this number is cut in half: Just 35 communities are present reliably, yet they still account for 43% of all publications in the dataset. Especially given that there are more and more publications across a similarly rising number of subreddits every year, these “historic” subreddits are interesting to note for their ability to maintain a significant role amongst sites used for the climate change debate on Reddit.

As depicted in Figure 4.7, about half of them can be roughly grouped into communities that have a local focus (anglophone countries, or Europe), debate politics and (political) news, the

environment and climate change, or multimedia content (pictures and videos). The other half comprises thematic subreddits, many of which were seen among the top-subreddits for individual themes, and those explicitly discussion-based and conversational subreddits. The latter type is, e.g., represented by r/askreddit. These subreddits invite users to ask questions to be discussed in the community, or in the case of r/iama, by one person or group (e.g., experts, artists, celebrities) that starts a discussion thread introducing themselves and then answering questions by users.

Overall, the most important sites of the climate change debate are communities that reflect the thematic foci, meaning more general or political subreddits for a large part of the debate. However, analyzing theme-subreddit relationships individually or highlighting subreddits that are important to the debate as “historic” communities reveals some more nuance, showing that smaller subreddits might be consistent contributors with a thematic focus related to the community’s purpose.

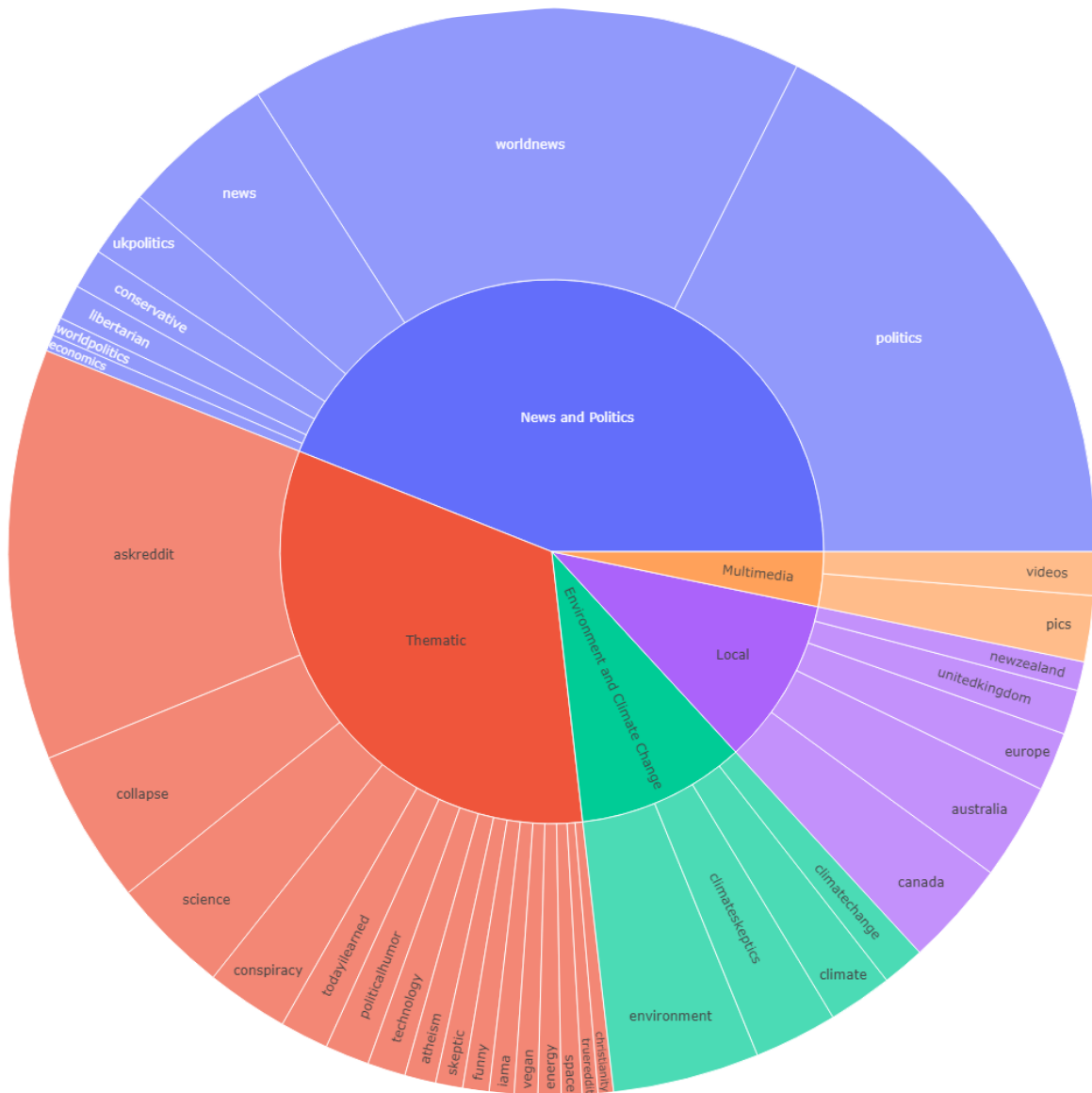


Figure 4.7 Nested pie chart showing the proportions of the 35 historic subreddits as individuals on the outside, and grouped into thematic categories on the inside.

5 Discussion

Based on the overview of publication trends, thematic foci, and popular communities in the previous chapter, this last chapter will dive deeper into the interpretation and analysis. Therein, the most important findings and implications will be highlighted and linked to previous research by relating the trends on Reddit to those in the general public debate, including other social media platforms.

The primary motivation for this study was the lack of research focusing on the climate change debate on Reddit, which is especially apparent when it comes to long-term studies. As social media platforms function differently and attract varying user demographics, scientific investigation into the dynamics of public debate needs to include different types of platforms to develop a nuanced understanding. Therefore, this study examined the popular platform Reddit to find the main themes of discussion, the main communities it takes place in, and to analyze how both content and location change over time.

The climate change debate on Reddit has started as what seemed like a rather niche topic, discussed primarily in specific communities and likely by those with immediate interest in it and particularly the science behind it. Steadily, it grew into a larger topic before it multiplied in size in 2016, as it was included in much discussion related to the presidential debates in the US. Exploratory analysis showed that despite the accelerated growth since 2016, a massive spike in 2019 seems to be followed by somewhat of a plateau, which may in part be explained by global (media) attention shifting to the COVID-19 pandemic, which has also been noted by other studies (Stoddart et al., 2023).

The main analysis was opened by investigating the first research question: *What links to other debates emerge from the main themes of discussion when climate change is mentioned on Reddit?* Through topic modeling, semantic comparison of initial topics, and reading of sample documents, nine coherent and recurring themes were found that contain exchanges regarding general and personal belief around climate change, as well as discussion of scientific evidence and publications, news reports, politics and economy, energy, natural resources, and extreme weather events. The found thematic foci are in line with findings from long-term studies of traditional media (Malone, 2009; Broadbent et al., 2016), Twitter/X (Wang et al., 2025), and short-term studies on Reddit (Parsa et al., 2022; Treen et al., 2022).

Next, the subreddit proportions were analyzed to answer the second research question: *What are the primary community types users populate with this discussion, and how do they reflect the thematic foci?* Accompanying the general growth of the debate, it increasingly spread across more and more communities, where just ten subreddits accounted for the majority of content in early years, it is only about a quarter in more recent years. Still, the 35 communities that actively contribute throughout the dataset account for almost half of the data and show that, despite being scattered across thousands of communities on Reddit, a group of them continues to exist as an established contributor. Relatedly, the main themes are well represented by the most frequented communities, particularly those that are “historic” hosts of the debate. After the thematic analysis showed a clear US-bias, the analysis of subreddits further confirmed the dominance of anglophone countries, including the United States, as the main sites of the debate. As this reflects the user demographics on Reddit and the analysis focused on publications in English, this is an expected result.

Finally, the two dimensions of the analysis are collapsed to answer the last question: *How do changes in dominant themes and communities relate to the development of the public climate change debate outside of Reddit?* While the general debate established itself as the most prominent theme in most years and overall, the initially dominant science theme becomes much smaller, though the related greenhouse theme remains a stable top-theme. The weather theme is slowly becoming more important, as extreme weather events, record temperatures, and wildfires occur increasingly often and trigger subsequent online debate. This has also been noted by other studies, some of which attest to the fact that, especially on a local level, extreme weather events can trigger significant activity, albeit usually only for a limited amount of time (Baylis, 2020; Moernaut et al., 2022; Roxburgh et al., 2019; Shah et al., 2021).

Although unsteady in their individual proportions and appearance, the themes regarding international politics, US politics, and the economy account for an increasingly large number of publications, especially since the 2016 US presidential elections. This group of themes is semantically closely related, which makes it a good example to point out that changes in proportions and the absence of a topic in a certain period do not necessarily mean it truly disappeared. As the analysis forces a single (most dominant) topic on each document to allow analysis of such proportions, documents that might relatively equally discuss two related themes can only be assigned with one. Still, the proportions, especially analyzed over time, indicate some shifts, like that to more general and political themes.

Relatedly, large spikes in publication volume appear driven mainly by significant political events such as (US) presidential elections, controversial statements and decisions (such as the withdrawal from the Paris Agreement), as was likewise observed in other studies (Treen et al.,

2022). Smaller spikes, specifically within the weather theme, coincide with extreme weather events. Shah et al. (2021) found that on a local level, these events can be drivers of heightened activity for a limited time. On a more global level, this study found evidence of larger numbers of publications related to these events, which are noticeable only in sum. Therefore, only political events were able to cause significant spikes in publication volumes, sometimes just through a single event like a speech.

Similar to findings from studies on traditional media attesting to increasing attention to the topic (Broadbent et al., 2016; Chinn et al., 2020), this study found continuous growth in publications mentioning climate change. The growth in volume is paired with the spread across more communities. At the same time, in earlier years, the climate change debate appeared to be more of a niche theme, discussed in thematically focused communities such as r/science, it is increasingly discussed in relation to other topics as well as on its own. Thereby, something of a mainstreaming effect is implicated by the findings. However, proportionately to the overall publication volumes on Reddit, the climate change debate remains a smaller topic outside of significant public events.

The analysis also found that while economic discussion appeared unsteady in yearly themes, the theme is still recurring regularly and relatively large. Part of the instability as well as fluctuation in proportion might be explained by an overlap between the political and economic topics: In years of absence, it might be implicit but subordinate in documents from political themes, whereas in 2019, where it is disproportionately large, samples indicate it also included general political discussion and that related to the climate strikes. Still, the economic theme

suggests a notable portion of the climate change debate on Reddit is concerned with the economic impact of related policies, but also explicitly includes capitalism critique.

In their analysis of international news articles, Ylä-Antilla (2018) found a decrease in solely economic arguments and strengthened union with environmental arguments through green growth frames. This analysis of the Reddit debate cannot clearly confirm or reject these findings, as more qualitative analysis is necessary to determine proportions and concrete argumentations. However, the findings do indicate that economic frames remain a relatively stable part of the discussion, and that Reddit might be a site for debates beyond those frames usually found in traditional media.

Another interesting nuance found through the thematic analysis is that, based on the reviewed samples, the general debate theme seems to contain a large share of discussion around the link between (dis-)belief in climate change and religious beliefs, either through first-hand accounts or observations shared by users. Particularly, samples show user statements indicating the assumption that strong religious belief correlates with holding a skeptic or denialist stance regarding climate change. Studies testing various socio-demographic variables found religiosity to be a predictor of (negative) climate change stance only in relation to particular beliefs (Grindal et al., 2023). Regardless, this discussion illustrates how the individual's stance on climate change can be significantly influenced by various factors.

In moving forward, it is necessary to understand climate change as socially constructed insofar as its perception depends on socio-demographic factors and related risk perception. Particularly, albeit not exclusively, for the case of the United States, where political polarization remains a major concern, studies have found some important evidence in this regard: The political

polarization in the United States is historically rooted in the transition to neoliberalism starting in the 1970s, prioritizing economic growth and corporate interests while rejecting regulation and redistribution, and decisively obstructing environmental policy efforts. Thereby, the idea of liberty is directly tied to ownership rights and consumer choice, which conservatives see under threat when “regulating fuel efficiency, and thereby vehicle size and weight, increases energy prices and taxes, “kills jobs”” (Antonio & Brulle, 2011, p. 197). When political policies seem to directly affect life quality, it is no surprise that political ideology is found to be the most important predictor of environmental stance, with studies linking liberal identity to a pro-environmental stance, while finding conservatives to be more likely to reject the idea of anthropogenic climate change (McCright & Dunlap, 2011b; Zhou, 2016).

For the United States, Dunlap and McCright (2011a) found that conservative white males are significantly more likely to deny climate change than other groups, and even more so when they claim a high level of understanding of global warming. Their findings point to denialism being an identity-protective cognition that is increased through the justification of the status quo, such as the socio-economic regime. Grindal et al. (2023) agree with this notion and make the connection to a social dominance orientation more explicit: Development of a strong white identity can be linked to the feeling of superiority and thereby (social) dominance, resulting in views such as human rulership over the environment. Furthermore, this motivates alignment against people and positions questioning this hierarchy by pointing out the need for climate change mitigation, as it is associated with actions or policies weakening the privileged status of the dominant group. Their analysis of survey data confirmed the link between white identity and social dominance orientation, as well as the latter enhancing climate change skepticism.

This is important to note, especially as politics at the federal and state levels are often dominated by white males – in the US, for instance, they make up about a third of the population, but hold just over half of all elected offices (Reflective Democracy Campaign, 2024). On the other hand, various socio-demographic groups such as Indigenous peoples, youth, or women, are significantly less central, or not even represented, in political and economic elites, whereas research shows they are already or will be experiencing the negative consequences of climate change disproportionately (IPCC, 2023).

In the present analysis, some sample documents point to the presence of discussion among the lines of climate change and social inequality, such as the gap between populations of different geographical locations in which some face less immediate risks compared to others despite their disproportionately high contribution to accelerated climate change. Meanwhile, among the more general topics found across years, this discussion was not distinctive enough to create its own theme, meaning it could easily be missed altogether.

The limited visibility of these discourses constitutes a systemically induced silence, a phenomenon that has been documented and studied for a long time, including in foundational work for contemporary social sciences (Beauvoir, 1953; Foucault, 1978). Due to the power structures in dominant discourse, marginalized voices are excluded altogether, or, when included at all, are moderated by the dominant group's lens. In this practice, the influence of marginalized groups is limited to symbolic inclusion or actions that do not threaten the status quo: Instead of ensuring real agency, the collaboration with them often reproduces power dynamics, reducing their role to victims of the ongoing crises, to be saved by the charitable actions of the dominant group. These dynamics have been analyzed for various groups, for instance, the case of gender

and climate change (MacGregor, 2010), which emphasizes the need for gendered policy action (MacGregor, 2009). Or the case of Indigenous peoples, which highlights how collaboration with Indigenous groups without decolonial efforts only leads to a reproduction of colonial trauma and disempowerment (Whyte, 2018).

The inclusion of marginalized groups in policy debates and climate action is a mere first step, that achieves significant meaning only when it is followed by steps to acknowledge and address the power dynamics under which the climate crisis was caused and exacerbated in the first place, and which caused the exclusion and oppression of these same groups, that are now “invited back to the table”. This perspective emphasizes the need to address the climate crisis not only as a scientific or economic issue, but fundamentally as a justice issue, which calls for intersectional interventions to create effective and just solutions (F. Sultana, 2022).

These are critical points for understanding what fundamentally obstructs the way to a more united understanding of the imminent risks associated with climate change and the understanding that immediate action is crucial. Furthermore, since partisan sorting is such an important factor in determining climate change stances, attention needs to be paid to how political elites influence the public’s understanding, as evidence suggests they may be manifesting a level of polarization that is no longer apparent in the general public (Fisher et al., 2013).

This is especially true, given the increased politicization of the debate in the last decades, as is evident not only in traditional media (Chinn et al., 2020) but also in the online debate. Chen et al. (2021) highlighted how social media platforms provide space for polarization, even in the context of a country that overall shows high agreement with the scientific consensus regarding climate change. In their study of Finnish Twitter posts, they compare the discussion of climate

politics to that of other political topics and note that while the climate debate is not more polarized than others, it is aligned with partisan stance and the debate around immigration politics. Overall, debate alignment intensifies with higher polarization levels.

While the present study cannot comment on the level of polarization, politicization is apparent both in the increased proportions of themes related to the economy, US-domestic and international politics, as well as the shift from thematic and science themed communities, to those focused on news and politics. Both the sample documents and key terms identified in the modeled topics further underscore this trend, revealing a notable increase in the mention of politicians across various themes. Furthermore, a portion of the discussion remains actively concerned with the question of whether climate change is real or not. Given that the sample is US-biased, this tendency mirrors patterns seen in Twitter/X discussions within the same region (Jang & Hart, 2015).

While this study successfully contributed to the ongoing academic inquiry into the climate change debate on Reddit, some limitations have to be noted. While the US focus found in the data is to be expected on Reddit as it is reflective of the general user demographics, it still means that some of the findings are particularly applicable to this demographic, and comparisons with other demographics, such as users on other social media platforms, need to be drawn with caution. Furthermore, topic modeling is a useful technique to gain an overview of a large dataset such as the one examined in this study, as it allowed for aggregated analysis of five million documents that were finally reviewed mostly in relation to just nine themes they belong to. However, this level of aggregation means that some nuances are missed, and more qualitative inquiry is required to confirm patterns seen in sample documents, as well as to describe prevalent

argumentations more closely. Additionally, smaller, more focused topics might not be revealed if they do not make a strong appearance, for example, related to heightened activity after a significant event.

Particular attention needs to be paid to the processes pertaining to data selection and filtering. As was noted only after modeling topics, a smaller portion of the data were not user-generated, but instead bot-generated. Reddit is built on a unique community structure that usually includes concrete, community-specific rules and is characterized by a high level of moderation. Consequently, user-generated content is more valued by default, and automated content (particularly if it is not labeled as such) is likely to be of significantly lesser concern than on other platforms. Nonetheless, it is evident in the data and might be an increasing concern that has to be handled consciously before or during data analysis.

All of these points should inform future research seeking to examine the climate change debate on Reddit in more detail. While valuable insights were gained in this analysis that compiled an overview of a significant time span of the ongoing social media debate, several questions remain unanswered and require further investigation. For instance, the analysis noted several nuances evident in the data that attest to the existence of discussions outside of those commonly found in traditional and social media alike. To understand these nuances and reveal more about non-mainstream themes, further analysis should consciously separate these discussions from the dominant discourse that more closely aligns with the general public and media debate. Qualitative inquiry into these threads could explain heightened activity more accurately and show how those moments might have (temporarily) diversified or focused the debate, e.g., in terms of rhetoric, arguments, or emotionality and polarity. Furthermore, it might reveal more about how

Reddit differs from other major platforms, particularly with regards to how users make use of the unique community structure, including the community-led user and content moderation, and how that might mitigate the influence of mis- or disinformation campaigns on online discourse. And while US-based users form a majority on Reddit, the community structure alongside the thematically diverse textual data offer ample opportunity for an exploration of the discourses in other countries and the differences between them. Overall, more research is needed to find ways of increasing and maintaining the general public's attention to the issue of climate change outside of cycles of political controversy, along with the creation of a strong consensus around the notion that climate action needs to be prioritized.

Finally, the case of the climate change debate on Reddit is yet another piece of the puzzle that is being assembled as a result of numerous analyses of media content and other parts of the public debate. The developments over the course of more than a decade attest to the ongoing struggle of mobilizing sustained, massive public attention to the unfolding climate crisis. While it is discussed more than in the past, it is by far not discussed enough to bring about the pressure on political elites that is needed to cause significant changes. As evidence points to increased understanding and acceptance of the scientific consensus on climate change, it is time for political actors to align policy debate and action with this reality, and for media to create coverage in ways that informs the public of it, instead of misleading it.

6 References

- Antilla, L. (2005). Climate of scepticism: US newspaper coverage of the science of climate change. *Global Environmental Change*, 15(4), 338–352. <https://doi.org/10.1016/j.gloenvcha.2005.08.003>
- Antonio, R. J., & Brulle, R. J. (2011). The unbearable lightness of politics: Climate change denial and political polarization. *The Sociological Quarterly*, 52(2), 195–202. <https://doi.org/10.1111/j.1533-8525.2011.01199.x>
- Areni, C. (2022). *Motivated reasoning leads climate change deniers to access unreliable online sources of information: Automated text analyses of multiple reddit communities* [Preprint]. <https://doi.org/10.32388/67ECXV>
- Arrhenius, S. (1908). *Worlds in the making; the evolution of the universe* (H. Borns, Trans.). Harper and Brothers.
- Bang, G., Hovi, J., & Skodvin, T. (2016). The Paris agreement: Short-term and long-term effectiveness. *Politics and Governance*, 4(3), 209–218. <https://doi.org/10.17645/pag.v4i3.640>
- Baumgartner, J., Zannettou, S., Keegan, B., Squire, M., & Blackburn, J. (2020). The Pushshift Reddit dataset. *Proceedings of the International AAAI Conference on Web and Social Media*, 14, 830–839. <https://doi.org/10.1609/icwsm.v14i1.7347>
- Baylis, P. (2020). Temperature and temperament: Evidence from Twitter. *Journal of Public Economics*, 184, 104161. <https://doi.org/10.1016/j.jpubeco.2020.104161>
- Beauvoir, S. de. (1953). *The second sex* (H. M. Parshley, Trans.). Alfred A. Knopf.
- Beck, U. (2004). *Der kosmopolitische Blick, oder, Krieg ist Frieden* (1. Aufl., Originalausg.). Suhrkamp.
- Berglez, P., & Al-Saqaf, W. (2021). Extreme weather and climate change: Social media results, 2008–2017. *Environmental Hazards*, 20(4), 382–399. <https://doi.org/10.1080/17477891.2020.1829532>

- Bianchi, T. B. (2023, January 13). *Regional distribution of desktop traffic to Reddit.com as of May 2022 by country*. Statista. <https://www.statista.com/statistics/325144/reddit-global-active-user-distribution/>
- Biri, Y. (2022). Epistemic stance in the climate change debate: A comparison of proponents and sceptics on Twitter and Reddit. *Register Studies*, 4(2), 232–262. <https://doi.org/10.1075/rs.22005.bir>
- Blei, D. M. (2012). Probabilistic topic models. *Communications of the ACM*, 55(4), 77–84. <https://doi.org/10.1145/2133806.2133826>
- Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent Dirichlet Allocation. *Journal of Machine Learning Research*, 3, 993–1022.
- Boykoff, M. T. (2011). *Who speaks for the climate? Making sense of media reporting on climate change* (1st ed.). Cambridge University Press. <https://doi.org/10.1017/cbo9780511978586>
- Broadbent, J., Sonnett, J., Botetzagias, I., Carson, M., Carvalho, A., Chien, Y.-J., Edling, C., Fisher, D., Giouzevas, G., Haluza-DeLay, R., Hasegawa, K., Hirschi, C., Horta, A., Ikeda, K., Jin, J., Ku, D., Lahsen, M., Lee, H.-C., Lin, T.-L. A., ... Zhengyi, S. (2016). Conflicting climate change frames in a global field of media discourse. *Socius: Sociological Research for a Dynamic World*, 2, 2378023116670660. <https://doi.org/10.1177/2378023116670660>
- Brüggemann, M., & Engesser, S. (2017). Beyond false balance: How interpretive journalism shapes media coverage of climate change. *Global Environmental Change*, 42, 58–67. <https://doi.org/10.1016/j.gloenvcha.2016.11.004>
- Caldwell, D., Cohen, G., & Vivyan, N. (2025). Long-run trends in partisan polarization of climate policy-relevant attitudes across countries. *Environmental Politics*, 34(5), 767–792. <https://doi.org/10.1080/09644016.2024.2403957>

Callendar, G. S. (1938). The artificial production of carbon dioxide and its influence on temperature.

Quarterly Journal of the Royal Meteorological Society, 64(275), 223–240.

<https://doi.org/10.1002/qj.49706427503>

Carmichael, J. T., & Brulle, R. J. (2017). Elite cues, media coverage, and public concern: An integrated path analysis of public opinion on climate change, 2001–2013. *Environmental Politics*, 26(2), 232–252.

<https://doi.org/10.1080/09644016.2016.1263433>

Carroll, W., Graham, N., Lang, M. K., Yunker, Z., & McCartney, K. D. (2018). The corporate elite and the architecture of climate change denial: A network analysis of carbon capital's reach into civil society. *Canadian Review of Sociology/Revue Canadienne de Sociologie*, 55(3), 425–450.

<https://doi.org/10.1111/cars.12211>

Carroll, W., Graham, N., & Shakespear, M. (2020). Foundations, ENGOs, clean-growth networks and the integral state. *Canadian Journal of Sociology*, 45(2), 109–142. <https://doi.org/10.29173/cjs29638>

Castells, M. (2009). *Communication power*. Oxford University Press.

Chang, C. H., Armsworth, P. R., & Masuda, Y. J. (2022). Environmental discourse exhibits consistency and variation across spatial scales on Twitter. *BioScience*, 72(8), 789–797.

<https://doi.org/10.1093/biosci/biac051>

Chen, T. H. Y., Salloum, A., Gronow, A., Ylä-Anttila, T., & Kivelä, M. (2021). Polarization of climate politics results from partisan sorting: Evidence from Finnish Twittersphere. *Global Environmental Change*, 71, 102348. <https://doi.org/10.1016/j.gloenvcha.2021.102348>

Chinn, S., Hart, P. S., & Soroka, S. (2020). Politicization and polarization in climate change news content, 1985–2017. *Science Communication*, 42(1), 112–129.

<https://doi.org/10.1177/1075547019900290>

- Cook, J., Nuccitelli, D., Green, S. A., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P., & Skuce, A. (2013). Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters*, *8*(2), 024024. <https://doi.org/10.1088/1748-9326/8/2/024024>
- Cook, J., Oreskes, N., Doran, P. T., Anderegg, W. R. L., Verheggen, B., Maibach, E. W., Carlton, J. S., Lewandowsky, S., Skuce, A. G., Green, S. A., Nuccitelli, D., Jacobs, P., Richardson, M., Winkler, B., Painting, R., & Rice, K. (2016). Consensus on consensus: A synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*, *11*(4), 048002. <https://doi.org/10.1088/1748-9326/11/4/048002>
- Ding, D., Maibach, E. W., Zhao, X., Roser-Renouf, C., & Leiserowitz, A. (2011). Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nature Climate Change*, *1*(9), 462–466. <https://doi.org/10.1038/nclimate1295>
- Egan, P. J., & Mullin, M. (2017). Climate change: US public opinion. *Annual Review of Political Science*, *20*(1), 209–227. <https://doi.org/10.1146/annurev-polisci-051215-022857>
- Egan, P. J., & Mullin, M. (2024). US partisan polarization on climate change: Can stalemate give way to opportunity? *PS: Political Science & Politics*, *57*(1), 30–35. <https://doi.org/10.1017/S1049096523000495>
- Fage-Butler, A. (2022). A values-based approach to knowledge in the public's representations of climate change on social media. *Frontiers in Communication*, *7*, 978670. <https://doi.org/10.3389/fcomm.2022.978670>
- Falkenberg, M., Galeazzi, A., Torricelli, M., Di Marco, N., Larosa, F., Sas, M., Mekacher, A., Pearce, W., Zollo, F., Quattrocioni, W., & Baronchelli, A. (2022). Growing polarization around climate change on social media. *Nature Climate Change*, *12*(12), 1114–1121. <https://doi.org/10.1038/s41558-022-01527-x>

- Fariello, G., & Jemielniak, D. (2025). The changing language and sentiment of conversations about climate change in Reddit posts over sixteen years. *Communications Earth & Environment*, 6(1), 3. <https://doi.org/10.1038/s43247-024-01974-8>
- Farrell, J. (2016). Network structure and influence of the climate change counter-movement. *Nature Climate Change*, 6(4), 370–374. <https://doi.org/10.1038/nclimate2875>
- Fisher, D. R., Waggle, J., & Leifeld, P. (2013). Where does political polarization come from? Locating polarization within the U.S. climate change debate. *American Behavioral Scientist*, 57(1), 70–92. <https://doi.org/10.1177/0002764212463360>
- Foote, E. (1856). Circumstances affecting the heat of the sun's rays. *American Journal of Science and Arts*, 22(66), 382–383.
- Foucault, M. (1978). *The history of sexuality* (1st American edition). Pantheon Books.
- Fourier, J. B. J. (1837). General remarks on the temperature of the terrestrial globe and the planetary spaces. *American Journal of Science and Arts*, 32, 1–20.
- Fownes, J. R., Yu, C., & Margolin, D. B. (2018). Twitter and climate change. *Sociology Compass*, 12(6), e12587. <https://doi.org/10.1111/soc4.12587>
- Freudenburg, W. R., & Muselli, V. (2010). Global warming estimates, media expectations, and the asymmetry of scientific challenge. *Global Environmental Change*, 20(3), 483–491. <https://doi.org/10.1016/j.gloenvcha.2010.04.003>
- Freudenburg, W. R., & Muselli, V. (2013). Reexamining climate change debates: Scientific disagreement or scientific certainty argumentation methods (SCAMs)? *American Behavioral Scientist*, 57(6), 777–795. <https://doi.org/10.1177/0002764212458274>
- Gadanidis, T. (2020). The discourse of climate change on Reddit. *Toronto Working Papers in Linguistics*. <https://twpl.library.utoronto.ca/index.php/twpl/article/view/41010>

- Grindal, M., Sarathchandra, D., & Haltinner, K. (2023). White identity and climate change skepticism: Assessing the mediating roles of social dominance orientation and conspiratorial ideation. *Climate*, 11(2), 26. <https://doi.org/10.3390/cli11020026>
- Hart, P. S., Nisbet, E. C., & Myers, T. A. (2015). Public attention to science and political news and support for climate change mitigation. *Nature Climate Change*, 5(6), 541–545. <https://doi.org/10.1038/nclimate2577>
- Harvey, J. A., Van Den Berg, D., Eilers, J., Kampen, R., Crowther, T. W., Roessingh, P., Verheggen, B., Nuijten, R. J. M., Post, E., Lewandowsky, S., Stirling, I., Balgopal, M., Amstrup, S. C., & Mann, M. E. (2018). Internet blogs, polar bears, and climate-change denial by proxy. *BioScience*, 68(4), 281–287. <https://doi.org/10.1093/biosci/bix133>
- Honnibal, M., & Montani, I. (2017). *spaCy 2: Natural language understanding with Bloom embeddings, convolutional neural networks and incremental parsing*. [Computer software].
- Houghton, J. T., Jenkins, G. J., & Ephraums, J. J. (1990). Climate change: The IPCC scientific assessment. *American Scientist; (United States)*, 80:6. <https://www.osti.gov/biblio/6819363>
- Howe, J. P. (2014). *Behind the curve: Science and the politics of global warming*. University of Washington Press.
- IPCC. (2023). *Climate change 2023: Synthesis report. Contribution of working groups I, II and III to the sixth assessment report of the intergovernmental panel on climate change [Core writing team, H. Lee and J. Romero (eds.)]*. IPCC.
- Jang, S. M., & Hart, P. S. (2015). Polarized frames on “climate change” and “global warming” across countries and states: Evidence from Twitter big data. *Global Environmental Change*, 32, 11–17. <https://doi.org/10.1016/j.gloenvcha.2015.02.010>
- Kepios. (2025). *Global social media statistics*. Datareportal. <https://datareportal.com/social-media-users>

- Krosnick, J. A., Holbrook, A. L., Lowe, L., & Visser, P. S. (2006). The origins and consequences of democratic citizens' policy agendas: A study of popular concern about global warming. *Climatic Change*, 77(1–2), 7–43. <https://doi.org/10.1007/s10584-006-9068-8>
- Lamb, W. F., Mattioli, G., Levi, S., Roberts, J. T., Capstick, S., Creutzig, F., Minx, J. C., Müller-Hansen, F., Culhane, T., & Steinberger, J. K. (2020). Discourses of climate delay. *Global Sustainability*, 3, e17. <https://doi.org/10.1017/sus.2020.13>
- MacGregor, S. (2009). A stranger silence still: The need for feminist social research on climate change. *The Sociological Review*, 57(2_suppl), 124–140. <https://doi.org/10.1111/j.1467-954X.2010.01889.x>
- MacGregor, S. (2010). 'Gender and climate change': From impacts to discourses. *Journal of the Indian Ocean Region*, 6(2), 223–238. <https://doi.org/10.1080/19480881.2010.536669>
- Malone, E. L. (2009). *Debating climate change: Pathways through argument to agreement*. Earthscan. <https://doi.org/10.4324/9781849774420>
- McCright, A. M., & Dunlap, R. E. (2011a). Cool dudes: The denial of climate change among conservative white males in the United States. *Global Environmental Change*, 21(4), 1163–1172. <https://doi.org/10.1016/j.gloenvcha.2011.06.003>
- McCright, A. M., & Dunlap, R. E. (2011b). The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *The Sociological Quarterly*, 52(2), 155–194. <https://doi.org/10.1111/j.1533-8525.2011.01198.x>
- McLevey, J. (2022). *Doing computational social science*. Sage.
- Moernaut, R., Mast, J., Temmerman, M., & Broersma, M. (2022). Hot weather, hot topic. Polarization and sceptical framing in the climate debate on Twitter. *Information, Communication & Society*, 25(8), 1047–1066. <https://doi.org/10.1080/1369118X.2020.1834600>

- Oswald, L., & Bright, J. (2022). How do climate change skeptics engage with opposing views online? Evidence from a major climate change skeptic forum on Reddit. *Environmental Communication*, 16(6), 805–821. <https://doi.org/10.1080/17524032.2022.2071314>
- Park, H. S., Liu, X., & Vedlitz, A. (2010). *Framing climate policy debates: Science, network, and U.S. congress, 1976-2007*. <http://opensiuc.lib.siu.edu/pnconfs2010/41>
- Parsa, M. S., Shi, H., Xu, Y., Yim, A., Yin, Y., & Golab, L. (2022). *Analyzing climate change discussions on Reddit*. International Conference on Computational Science and Computational Intelligence (CSCI). <https://doi.org/10.1109/CSCI58124.2022.00093>
- Pasquini, G., Spencer, A., Tyson, A., & Funk, C. (2023). *Why some Americans do not see urgency on climate change*. Pew Research Centre. https://www.pewresearch.org/wp-content/uploads/sites/20/2023/08/PS_2023.09.08_climate-change-interviews_REPORT.pdf
- Pearce, W., Niederer, S., Özkula, S. M., & Sánchez Querubín, N. (2019). The social media life of climate change: Platforms, publics, and future imaginaries. *WIREs Climate Change*, 10(2). <https://doi.org/10.1002/wcc.569>
- Reddit Inc. (2023a). *2022 transparency report*. <https://www.redditinc.com/policies/2022-transparency-report>
- Reddit Inc. (2023b). *Press*. <https://www.redditinc.com/press>
- Reflective Democracy Campaign. (2024, July 31). *Breaking data on the demographics of political power and “electability”*. <https://wholeads.us/updated-data-demographic-changes/>
- Rehurek, R., & Sojka, P. (2011). *Gensim—python framework for vector space modelling* (Version 3) [Computer software].
- Roxburgh, N., Guan, D., Shin, K. J., Rand, W., Managi, S., Lovelace, R., & Meng, J. (2019). Characterising climate change discourse on social media during extreme weather events. *Global Environmental Change*, 54, 50–60. <https://doi.org/10.1016/j.gloenvcha.2018.11.004>

- Segeberg, A., & Bennett, W. L. (2011). Social media and the organization of collective action: Using Twitter to explore the ecologies of two climate change protests. *The Communication Review*, *14*(3), 197–215. <https://doi.org/10.1080/10714421.2011.597250>
- Shah, M., Seraj, S., & Pennebaker, J. W. (2021). Climate Denial Fuels Climate Change Discussions More Than Local Climate-Related Disasters. *Frontiers in Psychology*, *12*.
<https://doi.org/10.3389/fpsyg.2021.682057>
- Sievert, C., & Shirley, K. (2014). LDAvis: A method for visualizing and interpreting topics. *Proceedings of the Workshop on Interactive Language Learning, Visualization, and Interfaces*, 63–70.
<https://doi.org/10.3115/v1/W14-3110>
- Snelson, C. L. (2016). Qualitative and mixed methods social media research: A review of the literature. *International Journal of Qualitative Methods*, *15*(1), 160940691562457.
<https://doi.org/10.1177/1609406915624574>
- SocialGrep. (2022). *The-reddit-climate-change-dataset* [Dataset]. Hugging Face.
<https://huggingface.co/datasets/SocialGrep/the-reddit-climate-change-dataset>
- Stern, P. C. (2020). Well-meaning discourses of climate delay. *Global Sustainability*, *3*, e35.
<https://doi.org/10.1017/sus.2020.31>
- Stoddart, M. C. J., Koop-Monteiro, Y., & Tindall, D. B. (2025). Instagram as an Arena of Climate Change Communication and Mobilization: A Discourse Network Analysis of COP26. *Environmental Communication*, *19*(2), 218–237. <https://doi.org/10.1080/17524032.2024.2377719>
- Stoddart, M. C. J., Ramos, H., Foster, K., & Ylä-Anttila, T. (2023). Competing crises? Media coverage and framing of climate change during the covid-19 pandemic. *Environmental Communication*, *17*(3), 276–292. <https://doi.org/10.1080/17524032.2021.1969978>

- Stoddart, M. C. J., Ylä-Anttila, T., & Tindall, D. B. (2017). Media, politics, and climate change: The ASA task force report and beyond. *Environmental Sociology*, 3(4), 309–320.
<https://doi.org/10.1080/23251042.2017.1329613>
- Sultana, B. C., Prodhan, Md. T. R., Alam, E., Sohel, Md. S., Bari, A. B. M. M., Pal, S. C., Islam, Md. K., & Islam, A. R. Md. T. (2024). A systematic review of the nexus between climate change and social media: Present status, trends, and future challenges. *Frontiers in Communication*, 9, 1301400.
<https://doi.org/10.3389/fcomm.2024.1301400>
- Sultana, F. (2022). Critical climate justice. *The Geographical Journal*, 188(1), 118–124.
<https://doi.org/10.1111/geoj.12417>
- Sylla, A., Glawe, F., Braun, D., Padev, M., Schäfer, S., Ahmetaj, A., Kojan, L., & Calero Valdez, A. (2022). Discourses of Climate Delay in American Reddit Discussions. In F. Spezzano, A. Amaral, D. Ceolin, L. Fazio, & E. Serra (Eds.), *Disinformation in Open Online Media* (Vol. 13545, pp. 123–137). Springer International Publishing. https://doi.org/10.1007/978-3-031-18253-2_9
- Treen, K., Williams, H., O’Neill, S., & Coan, T. G. (2022). Discussion of Climate Change on Reddit: Polarized Discourse or Deliberative Debate? *Environmental Communication*, 16(5), 680–698.
<https://doi.org/10.1080/17524032.2022.2050776>
- Tyndall, J. (1861). On the absorption and radiation of heat by gases and vapours, and on the physical connexion of radiation, absorption, and conduction. *Philosophical Transactions of the Royal Society of London*, 151, 1–36. <https://doi.org/10.1098/rstl.1861.0001>
- United Nations. (2021). *Climate change ‘biggest threat modern humans have ever faced’, world-renowned naturalist tells security council, calls for greater global cooperation* [Press Release SC/14445]. <https://press.un.org/en/2021/sc14445.doc.htm>
- United Nations Development Programme (UNDP) & University of Oxford. (2024). *People’s climate vote 2024*. <https://www.undp.org/publications/peoples-climate-vote-2024>

- US National Academy of Sciences. (1977). *Energy and climate: Studies in geophysics*. National Academies Press. <https://doi.org/10.17226/12024>
- Villanueva, I. I. (2021). *Climate change frames and emotional responses on Reddit* [Master Thesis, University of Arkansas]. <https://scholarworks.uark.edu/etd/4076>
- Wang, X., Judge, M., & Steg, L. (2025). Climate action on Twitter: Perceived barriers for actions and actors, and sentiments during COP26. *Environmental Research Communications*, 7(1), 015032. <https://doi.org/10.1088/2515-7620/ad7fbc>
- Wetts, R. (2020). In climate news, statements from large businesses and opponents of climate action receive heightened visibility. *Proceedings of the National Academy of Sciences*, 117(32), 19054–19060. <https://doi.org/10.1073/pnas.1921526117>
- Whyte, K. P. (2018). Indigenous science (fiction) for the Anthropocene: Ancestral dystopias and fantasies of climate change crises. *Environment and Planning E: Nature and Space*, 1(1–2), 224–242. <https://doi.org/10.1177/2514848618777621>
- Yang, C.-L., Huang, C.-Y., & Hsiao, Y.-H. (2021). Using social media mining and PLS-SEM to examine the causal relationship between public environmental concerns and adaptation strategies. *International Journal of Environmental Research and Public Health*, 18(10), 5270. <https://doi.org/10.3390/ijerph18105270>
- Ylä-Anttila, T., Vesa, J., Eranti, V., Kukkonen, A., Lehtimäki, T., Lonkila, M., & Luhtakallio, E. (2018). Up with ecology, down with economy? The consolidation of the idea of climate change mitigation in the global public sphere. *European Journal of Communication*, 33(6), 587–603. <https://doi.org/10.1177/0267323118790155>
- Yueh, C. (2021). *Classification of conversations: Distinguishing between opposing climate change communities on Reddit* [Bachelor Thesis, Utrecht University].

https://studenttheses.uu.nl/bitstream/handle/20.500.12932/40698/yueh_656255.pdf?sequence=1

Zhao, W. X., Jiang, J., Weng, J., He, J., Lim, E.-P., Yan, H., & Li, X. (2011). Comparing Twitter and traditional media using topic models. In P. Clough, C. Foley, C. Gurrin, G. J. F. Jones, W. Kraaij, H. Lee, & V. Mudoch (Eds.), *Advances in Information Retrieval* (Vol. 6611, pp. 338–349). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-20161-5_34

Zhao, X., Leiserowitz, A. A., Maibach, E. W., & Roser-Renouf, C. (2011). Attention to science/environment news positively predicts and attention to political news negatively predicts global warming risk perceptions and policy support. *Journal of Communication*, *61*(4), 713–731.
<https://doi.org/10.1111/j.1460-2466.2011.01563.x>

Zhou, J. (2016). Boomerangs versus javelins: How polarization constrains communication on climate change. *Environmental Politics*, *25*(5), 788–811.
<https://doi.org/10.1080/09644016.2016.1166602>