# 5. Mapping the Resonance of Climate Change Discourses in Twitter

In the previous chapters, I have proposed networked content analysis as an approach to the study of online networked content shaped by the technicity of its platforms and engines. The first case study traced climate change skeptics in science (through scientific publications) and on the web (looking at hyperlinking networks and their resonance in search engine results for the query of climate change). What I found was that networked content analysis presented the skeptics as *professional skeptics* engaged in skepticism of a variety of topics, rather than presenting them as scientists dedicated to the topic of climate change alone. The second case study discussed in detail the technicity of Wikipedia, as a socio-technical site especially suited for controversy mapping. The study of the climate debate in Wikipedia further established the profile of skeptics as dedicated to debate, as in the controversy management by Wikipedia editors, creating an article dedicated to the scientific debate, the actors most active in questioning and editing the article on climate change migrated along to the new article. They even never returned to the main article on the issue of climate change.

In this chapter, I will apply networked content analysis to the climate change debate in Twitter in the period of 2012-2014. More than in the previous case studies of the web and Wikipedia, I will discuss in detail the issue of climate change, its sub-issues, and the recent literature connecting it to conflict. This study entails working with the built-in logic of the platform and begins with recognizing the very particular (socio-technical) ways in which content is networked there. Therefore, I will first briefly discuss how content circulates on the micro-blogging platform.[[1]](#footnote-1) This discussion is not designed to be a full glossary of Twitter features (which can be found on Twitter) but rather a brief introduction to the many ways in which content and its users are networked on Twitter.[[2]](#footnote-2)

Twitter is a global messaging social network that allows its users to publish short messages (and links) up to 140 characters in length. These so-called ‘tweets’ can be posted by registered users that have a username that starts with an @. Twitter prioritizes ‘fresh’ data and presents tweets in reverse chronological order (with the latest post on top) and does so in real-time.[[3]](#footnote-3) For each tweet, Twitter displays some numeric data, such as the number of retweets and favorites, and a timestamp indicating how much time has passed since the tweet was posted. For each user, Twitter lists the number of followers, and the number of users this user is following, as well as the date of registration. Furthermore, users can add a short description, a URL, and a location (even geo-location) to each of their tweets. All tweets are publicly accessible, except for direct messages between users and tweets from protected accounts.

Hashtags (keywords marked with a hash or #) are included in tweets to tag content and to participate in a public conversation, by connecting to public channels of content that carries the same hashtag (a convention to group content known from Internet Relay Chat [IRC]). Hashtags thus ‘facilitate[s] a global discussion on a topic beyond a user’s follower network’, as they can be clicked to present a stream of all messages containing that hashtag (again, with the most recent tweet presented on top).[[4]](#footnote-4)[[5]](#footnote-5)[[6]](#footnote-6) The use of hashtags can therefore also be interpreted as a willful means to connect to a broader conversation, trending beyond one’s personal network. The use of hashtags for analysis has some limitations, as hashtags occur in less than 20% of all tweets and are used by specific users for specific practices.[[7]](#footnote-7) However, as I will discuss later in this chapter, tweets containing multiple hashtags offer possibilities for co-hashtag analysis, where the co-occurring hashtags are regarded as topical clusters.[[8]](#footnote-8) Users following other users (to ‘listen’ to their stream of messages), is one of the prominent activities on Twitter.[[9]](#footnote-9) This activity adds followed users’ posts to one’s own ‘Timeline.’ Other user interactions include @mentions (tweets that address a user by mentioning their @username), @replies (tweets sent in response to other tweets), and retweets.[[10]](#footnote-10)[[11]](#footnote-11)

Retweeting, or the resending or quoting of another user’s tweet, is done to amplify a message, sharing information with a user’s followers, or commenting on a quoted message. Other motivations for retweeting are discussed extensively in boyd et al., based on interviews.[[12]](#footnote-12) Retweeting has been built into the Twitter interface (alongside favorites and replies). Different third-party apps have different formats of retweeting, just as different users may style their retweets differently (for instance, by adding ‘via @username’ rather than RT, short for ReTweet), which should be taken into account when studying Twitter data.[[13]](#footnote-13) Tweets may include URLs, where reported percentages of tweets with URLs vary from 22% to 11.7%.[[14]](#footnote-14) Here, networked content analysts have to keep in mind that URLs may be shortened (for example, with bit.ly) in order to save space, i.e., a URL mentioned in a tweet can't always be recognized by a common web address including www.[[15]](#footnote-15)

As tweets can cover all sorts of mundane topics, but also carry more substantive missives of public political and informational value, the use of Twitter data for scholarly research is becoming widespread.[[16]](#footnote-16) According to Tumasjan et al., tweets can function as indicators of political opinion, while Twitter offers a platform for political deliberation, which also makes it a highly suitable site for controversy analysis around a social issue.[[17]](#footnote-17)[[18]](#footnote-18) The choice of including Twitter as a platform for the study of the form and substance of the issue of climate change and vulnerability concepts therein is not arbitrary. Twitter relates knowledge perception, reception, and conversation. Furthermore, Twitter has an interesting relationship with mass media content, as it is not just a media platform, but a platform that transpires within multiple media networks. Twitter could be approached through more conventional news cycle analyses but also through ‘meme-tracking’.[[19]](#footnote-19) In the latter mode, Twitter as a micro-blog could then be seen as highly responsive to or even parasitical or imploding of conventional news ‘sites’, echoing and amplifying news snippets by tweeting and retweeting. Further, as Twitter is often moving information faster than the news, Twitter content, in some cases, *is* news. Of course, for these reasons, Twitter is a popular medium for professional journalists. They bind tweets to their stories, and when their work has been published, they may tweet a link to that article, using it as a channel for the distribution of their own work. As news and mass media sources strive to make their content ‘platform-ready’, a term by Helmond, the entanglement of news, other mass media content, and new platforms has entered the next level.[[20]](#footnote-20) Networked content analysis proposes to take this entanglement as a given and to demarcate content through the logic of the platform (as developed in digital methods) and thus follow the actors across sources (as is key to controversy analysis). The rise of digital media does not mean the end of traditional mass media, but its reconfiguration as part of online networked content. This is important to bear in mind analytically, and a key to its utility for research practices such as networked content analysis.

Just as in Wikipedia and the web (accessed through Google Web Search), it is no longer possible to separate content from its carrier. Looking at the entanglement of content with Twitter's technicities of distributing, networking, and amplification its content, it also highly unadvisable to even attempt to ignore these mechanisms.[[21]](#footnote-21)[[22]](#footnote-22) Taking that as a starting point of networked content analysis, where any evaluation of online content should acknowledge the significance of its socio-technological structure, I operationalize the previously introduced socio-technics of Twitter (in shared links, retweets, etc.) in the following analyses of the climate change debate. Firstly, I will compare the resonance of terms associated with climate change, including skepticism, mitigation, adaptation, and conflict through a climate change content collection in Twitter. This is to propose that the changing prominence of each concept in time indicates a ‘phase' in the issue evolution of climate change as a controversy object.[[23]](#footnote-23)

For the first part of the case study, I worked with a data set containing 8.3 million climate change tweets (from the period of 23 November 2012 until 30 May 2013), which I queried for the keywords [skeptic], [mitigation], [adaptation] and [conflict OR violence], using the online Digital Method Initiative’s Twitter Capture and Analysis Tool (DMI-TCAT).[[24]](#footnote-24) Each of these queries refer to one of four related climate change discourses: skepticism (towards the man-made origins and unprecedentedness of climate change), mitigation (the prevention of further climate change by minimizing its causes), adaptation (to climate change), and conflict (here taken to mean political unrest relatable to climate change vulnerability).[[25]](#footnote-25) Given ‘vulnerability’ has become a prominent and focalizing, contested discourse within climate change debates, both in the scientific literature (as mapped out by the IPCC in 2014) and in news coverage around climate change, I will discuss this more elaborately.[[26]](#footnote-26)[[27]](#footnote-27) Here, I will build on the influential work of sociologist Ulrich Beck, who has described climate change as one of the main problems of our *World at Risk*.[[28]](#footnote-28) In his framing, multiple anticipated crises (climate change, terrorism, financial disaster, and so on) lead to a situation in which:

The decoupling of the social location and the social decision-making responsibility from the places and times in which other “foreign” populations become (or are made) the object of possible physical and social injuries.[[29]](#footnote-29)

This decoupling between the decision-making and the sites of such possible ‘injuries’, or *casualties*, can be clearly demonstrated when looking at the assessment of climate change adaptation and climate change vulnerability, and the way discussions about the distribution of resources to those places most vulnerable to the adverse effects of climate change play out at the UN Framework Convention on Climate Change’s Conference of the Parties (UNFCC COP).[[30]](#footnote-30) Climate change vulnerability, according to the IPCC, is the ‘degree to which a system is susceptible to and is unable to cope with adverse effects (of climate change)’.[[31]](#footnote-31) Vulnerability research is, therefore, interested in ‘the shocks and stresses experienced by the social-ecological system, the response of the system, and the capacity for adaptive action’.[[32]](#footnote-32)

The Kyoto protocol’s Adaptation Fund and the UNFCC have described their commitment to and funding of adaptation as designed ‘to assist developing countries that are particularly vulnerable to the adverse effects of climate change’.[[33]](#footnote-33) Importantly, the assessment of such *particularly vulnerable* countries has been critically described as a ‘political challenge’, rather than a scientific effort, as the socio-economic variables addressed when determining vulnerability blur the line between adaptation actions and development aid.[[34]](#footnote-34) The prominence that is now given to ‘adaptation' and ‘vulnerability' discourses and models within the discussion of climate change, both in the UNFCC and scientific literature and on an operational level, as in the field of urban planning, has led to the declaration of an ‘adaptation turn’.[[35]](#footnote-35)[[36]](#footnote-36)

The following case study addresses the further development of Networked Content Analysis by attending to technicities of the widely used and globally accessed Twitter platform. The case study foregrounds not just the utility of Twitter for such analyses but also, in the other direction, considers which of the aforementioned networked content analysis methods and techniques developed in the previous case studies (in chapters 3 and 4) might also be applied to the platform of Twitter, and which others are so productively platform-specific to be non-transferable.

## Using Twitter Data for Research

Twitter has often been described as an important channel during political events and social unrest.[[37]](#footnote-37)[[38]](#footnote-38) At the same time, popular and scholarly assessments of the role played by Twitter in social uprisings come with some caveats. For example, news coverage of the uprisings in Iran has been (productively) criticized as ‘heavily skewed’ towards being presented as a technology-driven social movement.[[39]](#footnote-39) Gladwell has pointed out that such skewing is due partly to Western scholars’ and media pundits’ own ‘outsized enthusiasm(s) for social media’.[[40]](#footnote-40) Other scholars have looked closer at the composition of the actors in the various uprisings, painting a more fine-grained picture of the role and relevance of the platform in these uprisings.[[41]](#footnote-41)

According to Hermida, Twitter is a site for ‘the immediate dissemination of digital fragments of news and information from official and unofficial sources over a variety of systems and devices’, and might, therefore, be better understood as an ‘awareness system’, rather than merely a micro-blogging platform.[[42]](#footnote-42) This awareness system functions as an always-on communication channel, ready to move ‘from the background to the foreground’ when necessary.[[43]](#footnote-43) Twitter, Hermida argues, creates the means for ‘ambient journalism’, where value does not lie in any single tweet but rather in the ‘awareness system that offers diverse means to collect, communicate, share and display news and information, serving diverse purposes’.[[44]](#footnote-44) And it is this function of Twitter as an awareness system that I will assess in the case study of Twitter hashtag clusters.

Twitter has been analyzed as a source of *happening* *content* and *fresh data*, as a site for *real-time research*, as a platform with a ‘dual nature of information source and conversation enabler’[[45]](#footnote-45), and as an ‘(archived) data set and anticipatory medium’.[[46]](#footnote-46)[[47]](#footnote-47)[[48]](#footnote-48) Methods and tools for capturing and analyzing this real-time data have been developed for instance by Bruns and Liang, who study Twitter as an important channel for crisis communication during and after natural disasters, and by scholars who have looked at the predictive quality of tweets in relation to the stock market, such as Sprenger et al., or political sentiment around elections, such as Tumasjan et al.[[49]](#footnote-49)[[50]](#footnote-50)[[51]](#footnote-51)[[52]](#footnote-52)[[53]](#footnote-53)

In what follows, I will look at the content that Twitter serves around the issue of climate change, and conduct a Networked Content Analysis of a year’s worth of English-language climate-related tweets, exploring the ‘Twitter ecology’ of climate change content.[[54]](#footnote-54) Twitter evidently does not produce ‘climate science’ but instead, puts scientific research into circulation while enabling up close, located and platform-literate engagements able to assess the resonance of climate change adaptation and indicators of vulnerability within the broader online discussion of climate change. Before exploring the resonance of the adaptation turn on Twitter, I will discuss the critical need to attend to vulnerability and adaptation concepts through a review of recent literature (news media, NGO reports, and scientific literature) that is connecting the risk of climate change to injuries and to conflict.[[55]](#footnote-55) Combining a description of vulnerability assessments from published reports and media content with a methodological application of digital methods to Twitter, this chapter shows networked content analysis working to unpack and give analytic complexity to important discourses *within* the issue of climate change. This chapter focuses on the period of 2012-2014, a timeframe during which conflict was increasingly attributed to climate change, as I will discuss in the next section.

## **Climate Change Vulnerability and Its Relation to Conflict**

Climate scholar Richard Klein has recently paid due critical attention to this rise of vulnerability research in scientific work. Klein describes how ‘vulnerability has become a popular concept in a very diverse set of research fields’ in projects ranging from ‘studies of vulnerability to terrorism, to poverty, to computer viruses, to oil spills, to globalisation, to radiation, to SARS, to earthquakes, to financial collapse, to political change, and so on’.[[56]](#footnote-56) Importantly for this thesis, the particular connection I want to make between climate vulnerability and conflict has been steadily gaining attention in both scholarly research and popular media outlets. Following the publication of a research article on climate and conflict by Hsiang, Burke and Miguel, media outlets themselves began to pose speculative research questions,[[57]](#footnote-57) for example: ‘Could hotter temperatures from climate change boost violence?’ and, ‘How could a drought spark a civil war?’[[58]](#footnote-58) The link between the Arab Spring and climate change was quickly made during this time, as headlines reported ‘Drought helped cause Syria’s war. Will climate change bring more like it?’ and ‘Climate change and rising food prices heightened Arab Spring’.[[59]](#footnote-59) The climate-conflict nexus, however, comprises many complicated facets of indexing and data triangulation, spurring further debates among scientists within and across disciplines.[[60]](#footnote-60)[[61]](#footnote-61)[[62]](#footnote-62)[[63]](#footnote-63)[[64]](#footnote-64)[[65]](#footnote-65)

The emerging literature on climate change and conflict further appears to focus on two broader questions: ‘how’ climate change leads to conflict and ‘where’ climate change-induced conflicts will most likely take place.[[66]](#footnote-66) As bleak headlines already indicate, a variety of climatic variables are considered to be of influence on human conflict. According to Barnett and Adger, there are two ways in which conflict might be stimulated by climate change.[[67]](#footnote-67) First, in line with research by Rifkin, changes in the political economy of energy resources (due to mitigative action to reduce emissions from fossil fuels) could result in conflict.[[68]](#footnote-68) Second, conflict could be stimulated by the effects of actual or perceived long-term or short-term climate impacts in causing changes to social systems.[[69]](#footnote-69) Short-term impacts include a change in the intensity and frequency of floods, droughts, storms and cyclones, fires, heatwaves, and epidemics. In the long term, changes in average conditions such as temperature, sea level, and annual precipitation will impact social-ecological systems. Also mediating the relationship between these climatic changes and human conflict are the interrelated issues of resource scarcity (cropland, freshwater, fisheries or forests) and migration.[[70]](#footnote-70) Environmentally induced migration could lead to increased pressures on resources in areas or countries of destination and inter-communal tensions in source areas.[[71]](#footnote-71)[[72]](#footnote-72) These trends may also complicate future food security as the competition around increasingly scarce resources proliferates.

The question then of where climate change-induced conflicts (and other casualties and damages) will most likely take place, makes the question of how the concept of climate vulnerability can be studied even more urgent. A number of studies on the connection between climate change and conflict note that the vulnerability of people to climate change depends on the extent to which they are dependent on natural resources and ecosystem services, the extent to which the resources and services they rely on are sensitive to climate change, and their capacity to adapt to changes in these resources and services.[[73]](#footnote-73)[[74]](#footnote-74) Furthermore, those countries that do not have the ability to adapt to environmental change — often poor and underdeveloped states — are, in turn, more vulnerable to environmentally-related violence.[[75]](#footnote-75) This vulnerability to climate change impacts and related effects such as violence is described in terms of a lack of ‘adaptive capacity’, or ‘the ability or potential of a system to respond successfully to climate variability and change. [...] Common traits include human and social capital, wealth, technology, and the quantity and quality of infrastructure.’[[76]](#footnote-76) These traits are among the variables used in so-called climate vulnerability indices, published as annual research reports that rank countries according to their adaptive capacity to climate change.

## **Vulnerability Indices and the Assessment of Adaptive Capacity**

Since the 1990s, there have been many projects that attempted to develop indices that claim to measure vulnerability to social and environmental change.[[77]](#footnote-77) These vulnerability indices typically combine multiple indicators of a variable into a single measure, thus ordering a set of entities into quantitative attributes or traits. As such, they are integral to many contexts that require systematic approaches to decision-making, especially those that concern the management or governance of risk.[[78]](#footnote-78)[[79]](#footnote-79) At the same time, however, according to Barnett, Lambert and Fry, there have been so many attempts to create such indices that it has ‘[lead] the National Research Council (2000) to conclude that there is no consensus on their appropriateness, theoretical and scientific basis, and appropriate level of specificity or aggregation’.[[80]](#footnote-80) Furthermore, measuring vulnerability has been described as ‘impossible’, as well as problematic in ‘rais[ing] false expectations’, around socio-ecological systems, given that ‘there is ambiguity on what exactly the problem to be solved is and no canonical solution exists’.[[81]](#footnote-81)[[82]](#footnote-82)[[83]](#footnote-83) Nevertheless, vulnerability research aims to inform decision-making around funding opportunities to mitigate the worst possible impacts of climate change for particularly vulnerable target nations.[[84]](#footnote-84)

In a comparative analysis of three vulnerability indices, their ranked lists of most and least vulnerable countries and their usage, we have found that countries calculated to be most vulnerable and at-risk according to one Index may be among those with the greatest adaptive capacity according to the other Indices that take into account other variables.[[85]](#footnote-85) Figure 15 shows a world map that compares the output of this triangulation, which illustrates some comparative appreciation of vulnerability, but also the lack of consensus on methodologies and, therefore, rankings of vulnerability. It is not surprising that the assessment of climate change vulnerability using indicators continues to divide both policy and academic communities alike. EMAPS, 'Who is Vulnerable According to Whom?'.[[86]](#footnote-86)

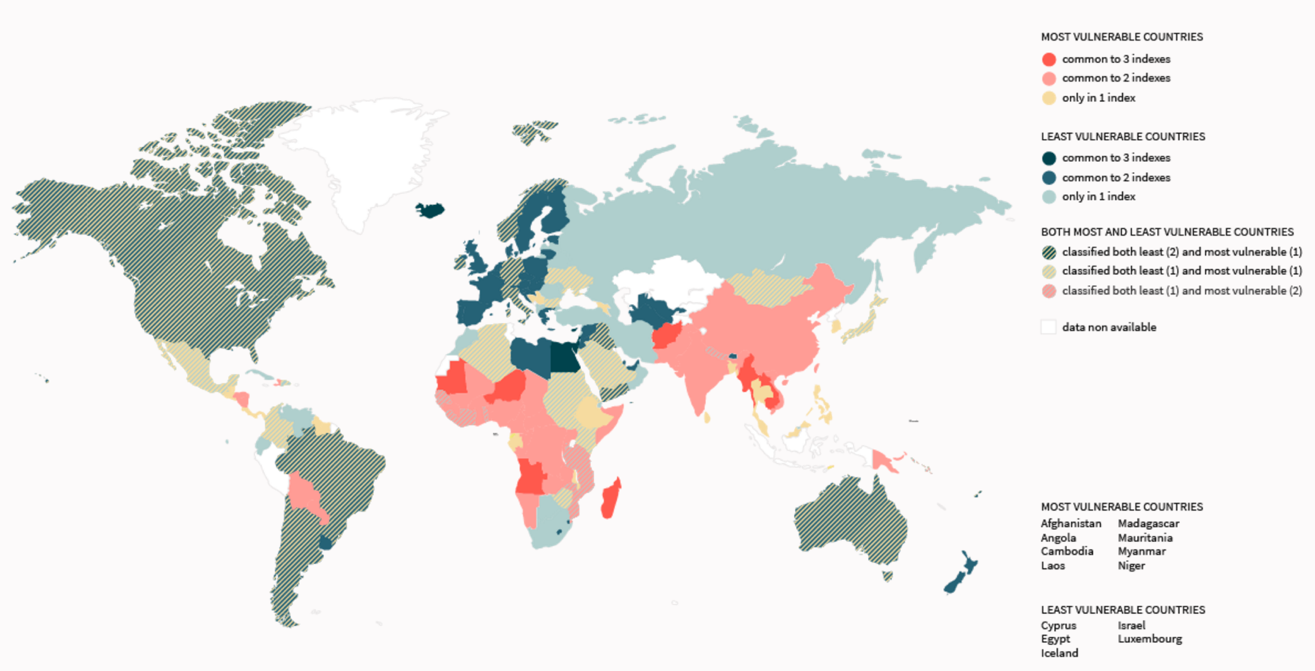


Figure 15: Who is vulnerable according to whom? This world map visualizes an exploratory comparative analysis of Germanwatch’s Climate Risk Index (CRI), DARA’s Climate Vulnerability Monitor (CVM), and the Global Adaptation Initiative’s Global Adaptation Index (GAIN) in their assessment of vulnerability.[[87]](#footnote-87)[[88]](#footnote-88)

## **Twitter, Climate Vulnerability and the Adaptation Turn**

However significant the differences between the three discussed indices may be, the lack of consensus does not seem to have hindered the coverage and talk of adaptation in official negotiations and gatherings as well as scientific literature, where a turn of attention to climate adaptation has been recognized. In the remainder of this chapter dedicated to Twitter, I will ask what kind of view on the climate change debate Twitter enables. Does a climate change *awareness system* indeed play out through the platform? And secondly, does an adaptation turn resonate here too? Taking as a starting point of Networked Content Analysis, the notion that any evaluation of online content should acknowledge the significance of its socio-technological structure, I operationalize the previously introduced socio-technics of Twitter—in shared links, retweets, etc.—in the following analyses of this case study. Firstly, I will compare the resonance of terms associated with climate change, including skepticism, mitigation, adaptation, and conflict through a climate change content collection in Twitter. This is to propose that the changing prominence of each concept in time indicates a ‘phase' in the issue evolution of climate change as a controversy object.[[89]](#footnote-89)

As mentioned earlier in this chapter, for this analysis a data set containing 8.3 million climate change tweets (from the period of 23 November 2012 until 30 May 2013) is queried for the keywords ‘skeptic,’ ‘mitigation,’ ‘adaptation’ and ‘conflict OR violence,’ using the online Twitter Capture and Analysis Tool (TCAT).[[90]](#footnote-90)[[91]](#footnote-91) Following the logic of the Twitter platform, I have created profiles for each keyword indicating their various socio-technical formats of resonance, listing their URLs, top 10 hashtags, top 10 mentioned users, top 10 active users, and top 10 hosts (of the URLs mentioned in the tweets). The profiles include the most linked URL and the most retweeted tweet for each of the keywords. Focusing on the top does not merely attune to the logic of the platform and its ranking; from a user perspective, it means the selection of content with the most exposure, those tweets most viewed by users.[[92]](#footnote-92)

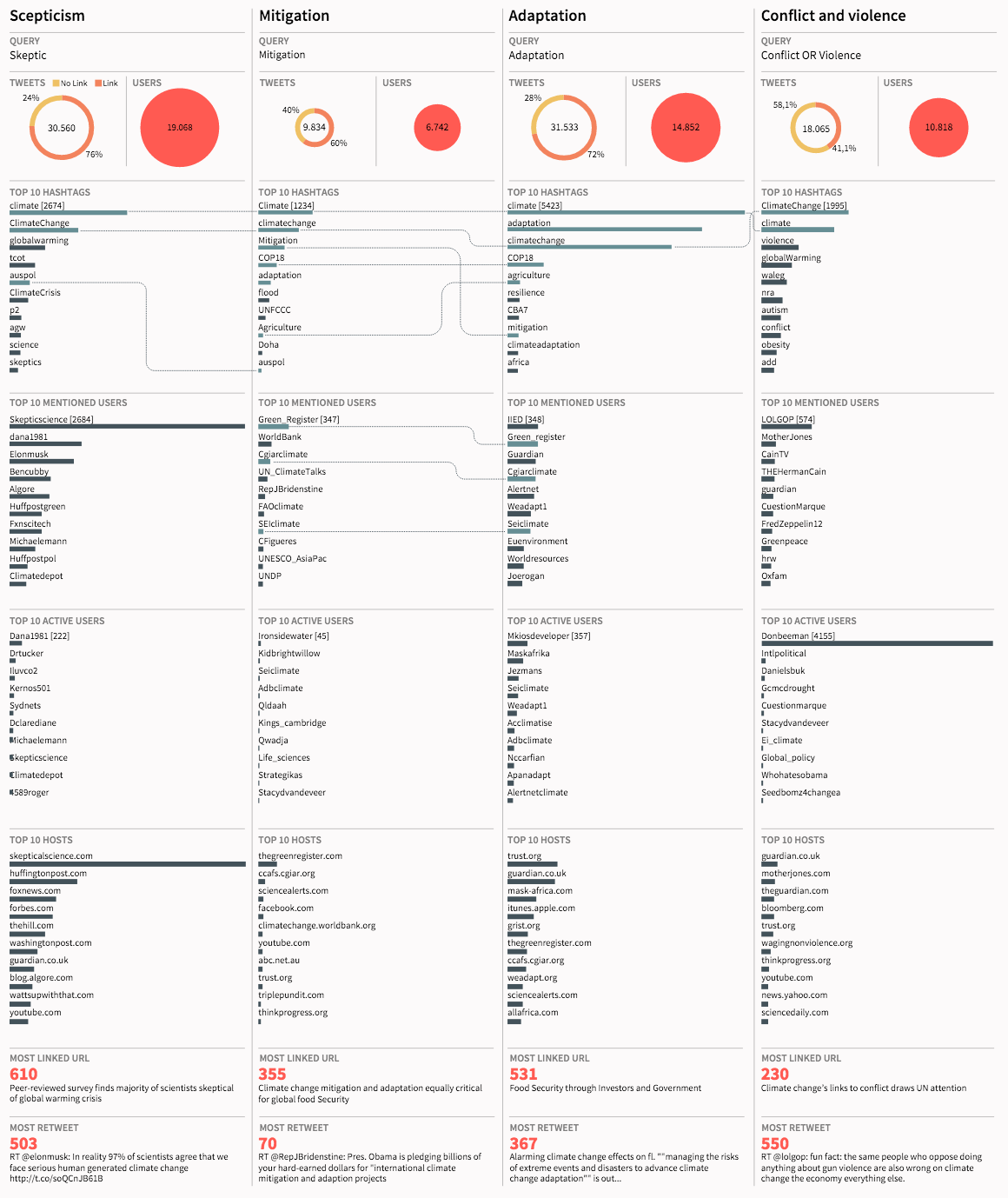


Figure 16: Profiling adaptation and its place in climate change debates with Twitter. This map shows profiles of four discursive areas within the climate debate: skepticism (with the query ‘skeptic’), mitigation, adaptation, and conflict (with the query ‘conflict’ OR ‘violence’). EMAPS, 'Profiling Adaptation and Its Place in Climate Change Debates With Twitter', 2014, http://climaps.eu/#!/map/profiling-adaptation-and-its-place-in-climate-change-debates-with-twitter-I.

Figure 16 offers a visual rendition of these discourse profiles. The term of ‘adaptation’ resonates most in the climate change tweets, with 30,560 results, indicating that indeed also in Twitter the ‘adaptation turn’ has occurred.[[93]](#footnote-93) Overall, ‘adaptation' and ‘mitigation' have similarities in terms of most-used hashtags (where five hashtags from the top 10 are shared). The occurrence of ‘adaptation' in the ‘mitigation' set and vice versa further confirms the overlap between the two terms. The UN and its events dominate both ‘mitigation' and ‘adaptation' (e.g., the users UN climate talks, UNDP), where ‘adaptation' receives the most attention. For example, #COP18 is the hashtag for the 18th Conference of the Parties, which took place in Doha and is present in both ‘adaptation' and ‘mitigation' tweets. #UNFCCC is present in relation to ‘mitigation.' A noteworthy top hashtag is #agriculture, a food-related issue, also present in both ‘mitigation' and ‘adaptation' tweets, but (again) with a larger occurrence in the ‘adaptation' collection.[[94]](#footnote-94)

The ‘skepticism’ and ‘conflict’ profiles both offer up distinct discursive spaces. The resonance of skepticism is dominated by actors that are, in fact, critical of climate change skepticism, rather than being skeptical themselves of human-induced change. Furthermore, it is striking how the top users are recognized throughout this space, as will become clear from the following example of the Twitter user named Skepticscience. @Skepticscience is the most-mentioned user for ‘skepticism,’ and with 2684 mentions is even the most-mentioned user across the board, outnumbering those for ‘mitigation’, ‘adaptation’ and ‘conflict’.[[95]](#footnote-95) The user is connected to skepticalscience.com, a website with the slogan ‘getting skeptical about global warming skepticism’, which is the top host in the ‘skepticism’ collection.[[96]](#footnote-96) This underlines the importance of combining computational analysis with a qualitative close reading of the data, with attention to the actors and their content. A solely quantitative analysis, in this case, would have lead to misinterpretation of the results, concluding a strong presence of skepticism, where, in fact, criticism of skepticism resonates strongly here.

*SkepticalScience*’s survey report *The Consensus Project*, which assessed over 12,000 peer-reviewed climate science papers for consensus on human-induced climate change, is the object that resonates most in this space, receiving 660 links and listings in the most retweeted message by the third most mentioned user, the entrepreneur @elonmusk: ‘In reality 97% of scientists agree that we face serious human generated climate change http://t.co/soQCnJB61B’, which was retweeted 503 times.[[97]](#footnote-97)[[98]](#footnote-98)

In conclusion, the profiles offer a view beyond the substance of the issue, to capture the actors present in this space as most active or most mentioned users, be they individuals or organizations. This way, the Twitter networked content analysis offers insights into the types of actors present in the debate and the intensity (and perhaps even interrelatedness) of their arguments and references. Again, we may productively ask: Whatkind of climate change debate does Twitter present? In the climate change adaptation and mitigation profiles, the most resonating users (mentioned) are international organizations working on the issue of food security. For example, the CGIAR (Research Program on Climate Change Agriculture and Food Security) ranks highly in both. Similarly, top users and hostnames are organizations, such as the Mask-Africa Food Security Program, in the case of adaptation. In the case of ‘mitigation’, when looking at the type of content that circulates best through the most shared URLs, the organization Green Register, a blog dedicated to environmental sustainability news and eco-friendly living tips, ranks highly. The top users actively engaging with the mitigation discourse are more diverse, and include companies, academics, and international organizations.

For the climate change skepticism profile, the top users are those skeptical of climate change skepticism, and the most-shared content acknowledges the human-made origins of climate change. News media rank highly, and famous protagonists of human-made global warming appear here, including Al Gore. The cluster also gives voice to journalists and entrepreneurs infamous for their skepticism. The interrelation between the scientific and the public debate is perhaps best captured by the Consensus Project.[[99]](#footnote-99) The Consensus Project takes an academically published scientometric analysis of climate consensus in climate science publications and publishes it in media campaigns stressing consensus on climate change, in collaboration with *SkepticalScience*. As the website theconsensusproject.org reads: ‘Using peer-reviewed science, it plays an active role in debunking climate misinformation published across the spectrum of media, including TV, online, and print.’ Its resonance is easily retrievable in Twitter, where it has performed as the most shared URL in the skepticism set. Relatedly, the study in the previous chapter showed the strong connections between skepticism and mass media, indicating the shift from a scientific to a public (and heavily mediated) debate. Similarly, conflict is associated with news media and public figures, for instance, radio show hosts (@hermancain), but also organizations with a humanitarian focus, such as Oxfam and Greenpeace, that address the humanitarian aspects of the environmental crisis.[[100]](#footnote-100)

Having zoomed in on the most prominent issues and actors in climate change-related tweets, where adaptation and food security are leading issues, my analysis now takes a more exploratory approach (in the vein of Tukey’s approach).[[101]](#footnote-101) Hashtags included in the same tweets, for example, can form thematic clusters with a myriad of sub-issues illustrating the current state of climate action and adaptation. Co-hashtag analysis allows for the characterization of hashtags in terms of how they are networked associatively with other hashtags.[[102]](#footnote-102) As discussed in the introduction, there are limitations to samples demarcated by hashtags. However, given the large dataset that I am attending to here — 4,771,135 tweets from 1,780,225 distinct users — this filtering by hashtag usage provides a sizeable yet manageable subset of sample data.[[103]](#footnote-103)

## Exploratory View: Co-hashtag Analysis of Climate Change Tweets

For the exploration of co-hashtags within the data set, we first visualized the thematic clusters that could be identified within the Twitter space, based on the ‘modularity class’ algorithm in Gephi, an algorithm that detects communities of densely connected nodes where the nodes belong to different communities more sparsely connected.[[104]](#footnote-104) Considering the (still) large amount of data in the data set, we made use of the OpenOrd layout, a force-directed layout algorithm specifically designed to encourage clustering in densely connected, large-scale, undirected graphs.[[105]](#footnote-105) As the nodes ‘climate change’ and ‘global warming’ generated the strongest results (as expected), we excluded them from the graph to render legible their sub-clusters. The resulting clusters were manually categorized into themes that captured the essence of the connected hashtags. We followed this with a close reading of the actual tweets involved to verify the themes.[[106]](#footnote-106)

An exploratory reading of the network graph in Figure 17 shows some aspects that have long been a subject of discussion where climate change emerges as a controversy object, both among scientists and the public. The network displays clusters focused on the two main approaches to dealing with the impacts of climate change: adaptation and mitigation. This is reflected in hashtags such as #adaptation, #preparedness, #mitigation, #resilience, #impacts and #naturaldisasters. More specific discussions of adaptation revolve around energy, solar power, and fossil fuels, explicated in hashtags revealing the need to take action to counteract the impact of environmental change, such as #gofossilfree, #fossilfools, #carbonfootprint, #cleantech, and #renewables.

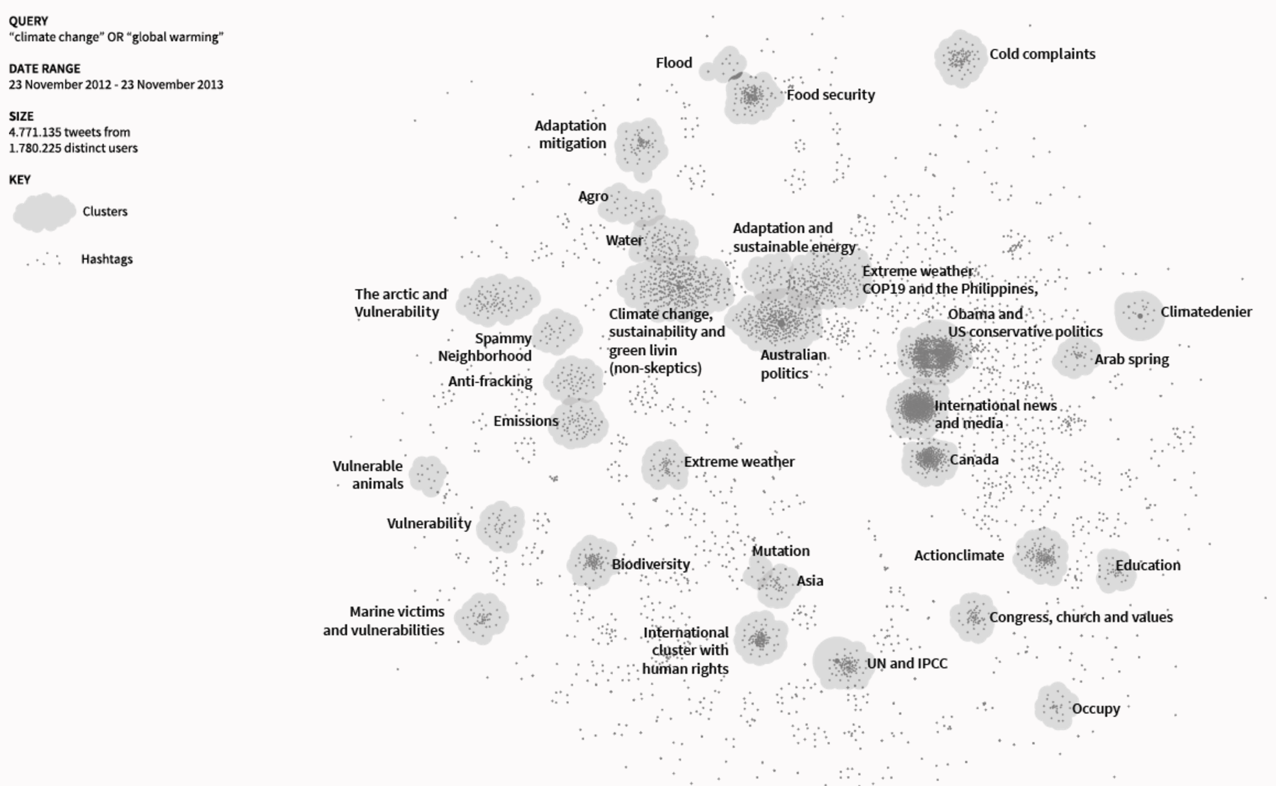


Figure 17: Climate change tweets co-hashtag cluster map. This network visualization shows thematic clusters in hashtag clusters within a set of climate change tweets.[[107]](#footnote-107)

Skeptical views on climate change are also addressed in the Twitter space. In this case, however, as seen in the profiles, the skepticism-related tweets mainly oppose climate skepticism. These users organize their content through hashtags such as #sciencesaysso (the prominent user in the skepticism profile in figure 3-2), #actionaugust, #climatedenier, and #climatedenieraward. The hashtag #actionaugust refers to the August of 2013 when the Organizing for Action movement delivered unicorn-shaped ‘climate denier awards’ to congressional members skeptical of climate change, ‘ignoring the overwhelming judgment of science’.[[108]](#footnote-108) The prominence of actions against known climate change skeptics and their institutional networks shows that views acknowledging climate change still take a more central position in the Twitter co-hashtag network than those skeptical of its man-made production and mitigation.

Of specific interest, is the number and variation of thematic clusters of climate vulnerabilities and casualties that can be identified specifically through the networked content analysis of climate change in Twitter. Here, tweets clustered by hashtags range to include everything from vulnerable animals and habitats to victims of extreme weather events. The majority of vulnerability-related clusters is concerned with marine habitats and the vulnerability of the Arctic, as hashtags like ‘northpole’, ‘antarctic’, ‘melting’, ‘overfishing’, ‘oceans’ prevail. In particular, ‘reefs’ and ‘antarctic’ are named in this context as vulnerable spots, where ‘polar bears’, ‘penguins’, ‘whales’, ‘trout’ and ‘sharks’ seem to be the most prominent *issue animals* threatened with injury, death, and, ultimately, extinction.[[109]](#footnote-109) The biodiversity cluster reflects the need for resilience towards climate change for ‘birds’, ‘turtles’, ‘koalas’, ‘tigers’, and ‘butterflies’, again pointing towards the vulnerability of habitats and species.[[110]](#footnote-110)

Other clusters tend to focus on geographical regions such as Australia, Canada, and the US, albeit mainly in terms of climate change or global warming as an important topic in the national political agenda. Particularly dense clusters reflect specific, localized takes on the issue of climate change, centered on political events. One of these clusters focuses on Obama and conservative U.S. politics, with hashtags such as #obamacare, #obamaisnotsatan #inauguration2013 mentioned alongside #climategate #badscience and #globalwarminghoax. In his inaugural speech in 2013, Obama emphasized the need to respond to climate change as a threat to future generations. He further stressed the urgency of action when he argued: ‘some may still deny the overwhelming judgment of science, but none can avoid the devastating impact of raging fires and crippling drought, and more powerful storms’.[[111]](#footnote-111) A Canada-themed cluster reflects both the political events in Vancouver and the climate hearings in Saskatoon. The events in Vancouver revolved around the British Columbian Green Party in the weeks leading up to the elections, addressing the need to reduce greenhouse gas emissions and opposing oil pipeline expansions.[[112]](#footnote-112) Canada conservatives, on the other hand, supported the expansion of oil pipelines, spurring a debate on Twitter regarding the facts of climate change.[[113]](#footnote-113)

In November 2013, the Saskatchewan citizens’ hearings on climate change also gained prominence on Twitter through the hashtag ‘climatesk’. The hearings included a two-day event with presentations on the realities of climate change from scientists, teachers, newcomers to Canada, and affected groups, allowing the voiceless victims of climate change to be heard.[[114]](#footnote-114) A third political cluster includes hashtags on Australian politics, reflected in hashtags such as #melbourne, #auspol, #ausvotes, and #carbontax. The debate there revolved around Tony Abbott, prime minister of Australia since 2013, and his statements of September 2013 announcing that he would not increase funding for further carbon tax reductions if Australia missed its emission reductions target.[[115]](#footnote-115) These clusters thus seem to detail the discussions on statements made about climate change following specific political events, as well as the political views of those involved in elections around the world. Each identifies clear opportunities for scholarly research that uses Twitter as a ‘source of current and topical news’ as proposed by Phelan, McCarthy, and Smyth.[[116]](#footnote-116)

Clusters that are formed by hashtags related to official sources (UN and IPCC), climate activism and everyday weather remarks additionally express that many, if not most, conversations on Twitter emerge around particular (current) events and other real-time experiences.[[117]](#footnote-117) This endorses the aforementioned scientific literature on Twitter as a medium for real-time and happening content. Lastly, the network further displays resonance of the previously profiled climate change discourse of conflict. These very small clusters of hashtags focus on the Arab Spring in particular, and hashtags such as #arabspring, #libya, #syria, #egypt, #morsi, #iran, and #drones appear here. A close reading of these tweets reveals that in part, the relation between climate change and conflict is popularly recognized on Twitter, with re-tweets from news articles on the issue, but these being also skeptically assessed, in tweets similar to the following: ‘Syria conflict is not caused by drought. Its more to do with a bad mix of Religion and politics just like everywhere else.’[[118]](#footnote-118)

Taken as a group then, these Twitter clusters provide a rich snapshot of the state of the climate debate, indeed work as a kind of ‘awareness system,’ to speak with Hermida, that gives voice to the different voices and actors active in this realm, and reveals the intertwinement of the news and other mass media content with the platform’s content.[[119]](#footnote-119) Twitter does not produce ‘climate science’ but instead puts scientific research into circulation, while also enabling up close, located and platform-literate engagements that assess the resonance of climate change adaptation and indicators of vulnerability within the broader online discussion of climate change. It should be noted, however, that this awareness system is only accessible by combining computational analysis with a qualitative close reading of the data, with attention to the actors and their content. As mentioned, Twitter’s entanglement with news journalism and mass media should be kept in mind here, as Twitter *is* news, amplifies news, and is a channel for news distribution.

## Conclusions

On a methodological level, we may conclude that networked content analysis applied to Twitter content entails working with the logic of the platform and recognizing the socio-technical structures of its content. By attending to the natively digital elements of this platform, it becomes possible to assess how content is networked and circulated. In the case study presented here, I compare the resonance of three different climate change discourses. After demarcating a specific set of issue-related tweets, I query the set for the resonance of recognized keywords to create ‘keyword profiles’. Important to note is that, against the rise of ‘big data’ pattern recognition, a close reading of the data proved necessary to correctly interpret the found data and further filter the data to improve its relevance.

The keyword profiles offer zoom-in views on particular discourses within the broader issue of climate change. Here, looking at skepticism, mitigation, adaptation, and violence, the profiles enable a comparative view, and it becomes clear that mitigation and adaptation are very proximate issues, in terms of argumentation and actors, with most actors involved in the Twitter space being organizations in the field of food security. The UN and its initiatives dominate both discourses. Adaptation has now surpassed mitigation in terms of resonance; thus, here also in Twitter, the so-called adaptation turn discussed in the introduction of this chapter has taken place. Skepticism and conflict have distinct profiles, where a focus on ‘skepticism' as a keyword brings up (perhaps counter to expectations) much criticism of climate change skepticism. This is mainly organized around the actor Skepticalscience (both as a user named @Skepticalscience and as a website host) and major news sources, and makes an important point for the close reading of data rather than favoring coarser pattern recognition. In the profile of conflict, news media, and media personalities resonate strongly, as do humanitarian NGOs.[[120]](#footnote-120)

The exploratory analysis of the climate change Twitter hashtag network shows us that climate change as a controversy object appears through, or is a sum of, a multiplicity of sub-issues including skepticism, mitigation, adaptation, vulnerability, and conflict. Just as the comparison of different Indices’ rankings revealed conflicting vulnerabilities, the Twitter hashtag network also points to different metrics of vulnerability.[[121]](#footnote-121)[[122]](#footnote-122) In contrast to how vulnerability indices organize and rank vulnerability by country listings, it appears that the ‘nation’ is not the key entity we are tracking in relation to vulnerabilities registering on Twitter. Rather, the objects of vulnerability and injury that are put forward on Twitter are mostly animal species and habitats (which, needless to say, are categories of ‘actors’ entirely oblivious to legally drawn borders). As discussed in the Introduction, animals are mediagenic issue actors, and some are more mediagenic than others. Nevertheless, it is important not to overstate mediagenic power and take the prominence of animal species and habitats seriously as they appear. I would like to argue that such a framing of risk in terms of present and future risked species, ecologies, and systems provides a possible Beckian extension to the study of Bruns and Liang, who described Twitter as a powerful channel for crisis management after the fact of a natural disaster.

The networked content analysis of hashtag clusters that are dedicated to sub-issues, casualties and events can be read as a time slice presenting the status quo of climate change, one that is not merely stating ‘what’s happening’ but rather serves as a progress report on an issue, in this case both addressing where we are with climate change adaptation and what is at stake.

1. For historical accounts of the development of the micro-blogging platform Twitter, see, for instance: Rogers, *Digital Methods*;Van Dijck, ‘Tracing Twitter’; Van Dijck, ‘The Culture of Connectivity’. [↑](#footnote-ref-1)
2. See, for instance, Twitter, 'Getting started with Twitter', https://support.twitter.com/articles/215585. [↑](#footnote-ref-2)
3. For a critical analysis of the freshness of data and the ‘real-time-ness’ of Twitter and other social media, see: Helmond, ‘The Perceived Freshness Fetish’ and Weltevrede, Helmond, and Gerlitz, 'The Politics of Real-time’. [↑](#footnote-ref-3)
4. Lotan et al. ‘The Revolutions Were Tweeted’. [↑](#footnote-ref-4)
5. See later in this chapter for a brief discussion of the role of the hashtag on Twitter. [↑](#footnote-ref-5)
6. See also C. Gerlitz and B. Rieder, 'Mining One Percent of Twitter: Collections, Baselines, Sampling', *M/C Journal*, 16.2 (2013) for a discussion of the affordances of hashtags for research. They find, on the basis of their 1% sample analyzing 1 day of tweets, that 13,1% of the tweets include hashtags. [↑](#footnote-ref-6)
7. Gerlitz and Rieder, 'Mining One Percent of Twitter’. [↑](#footnote-ref-7)
8. See also: Gerlitz and Rieder, 'Mining One Percent of Twitter’. [↑](#footnote-ref-8)
9. Van Dijck, ‘Tracing Twitter’. [↑](#footnote-ref-9)
10. danah boyd, S. Golder, and G. Lotan, 'Tweet, Tweet, Retweet: Conversational Aspects of Retweeting on Twitter', in *43rd Hawaii International Conference on System Sciences (HICSS),* 2010, 2. [↑](#footnote-ref-10)
11. See also Honeycutt and Herring, *Beyond Microblogging: Conversation and Collaboration via Twitter*, 2009, https://www.researchgate.net/publication/224373137\_Beyond\_Microblogging\_Conversation\_and\_Collaboration\_via\_Twitter, for discussions of the various motivations users may have to include an @mention, such as attention-seeking, addressing users, etc. [↑](#footnote-ref-11)
12. boyd et al. ‘Tweet, Tweet, Retweet’, 6. [↑](#footnote-ref-12)
13. Gerlitzand and Rieder, 'Mining One Percent of Twitter’, discuss demarcation of data in Twitter, as many case studies use specific hashtags or user practices (such as retweeting or favoriting) as a means to demarcate a sample, which is a question of recall (how many data points did I get?) and precision (how many of these data points are relevant?). [↑](#footnote-ref-13)
14. (boyd et al., 2010; Gerlitz & Rieder, 2013; Smyrnaios & Rieder, 2013)# boyd et al. ‘Tweet, Tweet, Retweet’. Gerlitzand and Rieder, 'Mining One Percent of Twitter’. Smyrnaion and Rieder, 'Social Infomediation of News on Twitter’. [↑](#footnote-ref-14)
15. boyd et al. ‘Tweet, Tweet, Retweet’, 2. [↑](#footnote-ref-15)
16. The use of Twitter data for cultural and social analysis has been described as the third phase in Twitter's popular cultural uptake, which had as its first phase the function of being an ‘ambient friend-following tool’, where user content answers the question ‘What are you doing?’ The second phase of Twitter usage encouraged by Twitter’s new tagline ‘What’s happening?’ both recognized and further fostered its use as a ‘news medium for event-following’. Rogers, R. 'Debanalising Twitter’, xii-xiv. [↑](#footnote-ref-16)
17. A. Tumasjan, T.O. Sprenger, P.G. Sandner, and I.M. Welpe, 'Predicting Elections with Twitter: What 140 Characters Reveal About Political Sentiment', in *Fourth International AAAI Conference on Weblogs and Social Media*, 2010, https://www.aaai.org/ocs/index.php/ICWSM/ICWSM10/paper/view/1441. In their 2010 study, Tumasjan et al. studied deliberation by looking at the exchange of substantive issues and equality of participation (as put forward by Koop and Jansen in their study of blogs as sites of deliberation). Through a content analysis of 100,000 tweets about German political parties around the federal elections of 2009, they found that Twitter was used extensively for political deliberation, with a massive number of tweets mentioning one or more of the political parties, and one-third of these messages partaking in platform-based conversations. [↑](#footnote-ref-17)
18. The predictive affordances of Twitter have been criticized by scholars such as Daniel Gayo-Avello, whose paper from 2012 offers an interesting ‘annotated biography’ with a discussion of Twitter prediction literature. D. Gayo-Avello, 'I Wanted to Predict Elections with Twitter and All I Got Was This Lousy Paper: A Balanced Survey on Election Prediction Using Twitter Data', *Arxiv Preprint arXiv12046441*, 2012, http://arxiv.org/pdf/1204.6441.pdf. [↑](#footnote-ref-18)
19. J. Leskovec, L. Backstrom, and J. Kleinberg, 'Meme-tracking and the Dynamics of the News Cycle', In *Proceedings of the 15th ACM SIGKDD international conference on Knowledge discovery and data mining*, ACM, 2009, pp. 497-506, http://dl.acm.org/citation.cfm?id=1557077. [↑](#footnote-ref-19)
20. Helmond, *The Web as Platform.* [↑](#footnote-ref-20)
21. DMI-TCAT, as a tool, does separate Twitter content from the platform Twitter. However, it retains information about how Twitter structures its information. [↑](#footnote-ref-21)
22. See also E. Borra and B. Rieder, 'Programmed Method: Developing a Toolset for Capturing and Analyzing Tweets', *Aslib Journal of Information Management*, 66.3 (2014): 262–278. [↑](#footnote-ref-22)
23. EMAPS, 'Vulnerability, Resilience and Conflict’. Needless to say, these phases are not cleanly separated chronologically but rather overlap. [↑](#footnote-ref-23)
24. Borra and Rieder, 'Programmed Method’. [↑](#footnote-ref-24)
25. In the EMAPS Digital Methods Fall Data Sprint, we also asked whether conflict could be seen as a fourth phase in the evolution of the issue of climate change, after skepticism, mitigation, and adaptation. EMAPS, 'Vulnerability, Resilience and Conflict’. [↑](#footnote-ref-25)
26. IPCC, 'Climate Change 2014: Synthesis Report: Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change', Geneva: IPCC, 2014, http://ar5-syr.ipcc.ch/, 3. [↑](#footnote-ref-26)
27. The IPCC's Working Group II has mapped adaptation within scientific literature on climate change and concludes that there is an overall doubling of the volume of publication in this field in less than five years, and secondly, that adaptation has become a central area of research within the scientific literature on climate change. EMAPS, 'Reading the State of Climate Change From Digital Media', 2014, http://climaps.eu/#!/narrative/reading-the-state-of-climate-change-from-digital-media. [↑](#footnote-ref-27)
28. Beck, *World at Risk.* [↑](#footnote-ref-28)
29. Beck, *World at Risk,* 161. [↑](#footnote-ref-29)
30. Beck, *World at Risk,* 161. [↑](#footnote-ref-30)
31. IPCC, 'Working Group II: Impacts, Adaptation and Vulnerability: Summary for Policymakers', 2001, http://www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=8. [↑](#footnote-ref-31)
32. Adger, 'Vulnerability', 269. [↑](#footnote-ref-32)
33. R.J.T. Klein, 'Identifying Countries That Are Particularly Vulnerable to the Adverse Effects of Climate Change: An Academic or a Political Challenge?' *Carbon and Climate Law Review* 3 (2009): 284–289. [↑](#footnote-ref-33)
34. Klein, ‘Identifying Countries That Are Particularly Vulnerable to the Adverse Effects of Climate Change’, 289. This is discussed in detail in EMAPS, 'Who Deserved to Be Funded? A Closer Look at the Practices of Vulnerability Assessment and the Priorities of Adaptation Funding', 2014, http://climaps.eu/#!/narrative/who-deserves-to-be-funded. [↑](#footnote-ref-34)
35. J. Howard, 'Climate Change Mitigation and Adaptation in Developed Nations: A Critical Perspective on the Adaptation Turn in Urban Climate Planning', in S. Davoudi, J. Crawford and A. Mehmood (eds) *Planning for Climate Change: Strategies for Mitigation and Adaptation for Spatial Planning*, London: Earthscan, 2009, pp. 19-32. [↑](#footnote-ref-35)
36. Venturini et al. ‘Climaps by EMAPS in 2 Pages'. [↑](#footnote-ref-36)
37. Shirky, *Here Comes Everybody.* Sullivan, ‘The Revolution Will Be Twittered’. [↑](#footnote-ref-37)
38. Z. Tufekci and C. Wilson, 'Social Media and the Decision to Participate in Political Protest: Observations from Tahrir Square', *Journal of Communication* 62.2 (2012): 363–379. [↑](#footnote-ref-38)
39. E. Morozov, 'Iran: Downside to the “Twitter Revolution”’, *Dissent* 56.4 (2009): 10–14. [↑](#footnote-ref-39)
40. Gladwell, 'Small Change’. [↑](#footnote-ref-40)
41. T. Poell and K. Darmoni, 'Twitter as a Multilingual Space: The Articulation of the Tunisian Revolution Through #sidibouzid', *NECSUS European Journal of Media Studies* 1.1 (2012): 14–34. [↑](#footnote-ref-41)
42. The term ‘awareness systems’ here refers to systems that support remote co-working. A. Hermida, 'Twittering the News', *Journalism Practice* 4.3 (2010): 298-301. [↑](#footnote-ref-42)
43. Hermida, ‘Twittering the News’, 298. [↑](#footnote-ref-43)
44. Hermida, ‘Twittering the News’, 301. [↑](#footnote-ref-44)
45. G. Veltri, 'Microblogging and Nanotweets: Nanotechnology on Twitter', *Public Understanding of Science* 22.7 (2013): 832–849. [↑](#footnote-ref-45)
46. Rogers, 'Debanalising Twitter', xiv. [↑](#footnote-ref-46)
47. Back et al. ‘Doing Real Time Research’. [↑](#footnote-ref-47)
48. Marres and Weltevrede, ‘Scraping the Social?’ [↑](#footnote-ref-48)
49. T.O. Sprenger, A. Tumasjan, P.G. Sandner, and I.M. Welpe, 'Tweets and Trades: The Information Content of Stock Microblogs', *European Financial Management* 20 (2014): 926-957, 10.1111/j.1468-036X.2013.12007.x. [↑](#footnote-ref-49)
50. Tumasjan, Sprenger, Sandner, and Welpe, 'Predicting Elections with Twitter’. [↑](#footnote-ref-50)
51. A. Bruns and Y.E. Liang, 'Tools and Methods for Capturing Twitter Data During Natural Disasters', *First Monday* 17.4 (2012): http://firstmonday.org/ojs/index.php/fm/article/view/3937/3193. [↑](#footnote-ref-51)
52. In the vein of big data research, researchers such as M. de Rijke repurpose the *real-timeness* of Twitter data to reveal current cultural preferences in real-time; for example, in their work, to overview what music the world is listening to right now. Their project *Streamwatchr* collects about 500,000 music tweets per day. For each of the tweets that mention what someone is listening to, Streamwatchr outputs a tile on its front-page interface ‘with a photo of the artist and a play button (via mouse scroll over) that does, indeed, play the song (from Youtube)’. De Rijke, ‘Going out with Streamwatchr’, 2014, http://staff.science.uva.nl/~mdr/. [↑](#footnote-ref-52)
53. MIT MediaLab project *Whose Voices?* tracks which Twitter users are cited in the media, and through case studies zooms in on the diversity of sources quoted on the international citizen media platform Global Voices. J.N. Matias, 'Whose voices? Twitter citation in Global Voices', 2012, http://natematias.com/medialab/gv-viewer/. [↑](#footnote-ref-53)
54. boyd et al. ‘Tweet, Tweet, Retweet’. [↑](#footnote-ref-54)
55. In this chapter, more than in the previous case studies on the web and Wikipedia, I will discuss in detail the issue of climate change, its sub-issues, and the recent literature connecting it to conflict. [↑](#footnote-ref-55)
56. Klein, 'Identifying Countries That Are Particularly Vulnerable to the Adverse Effects of Climate Change’, 285. [↑](#footnote-ref-56)
57. S.M. Hsiang, M. Burke, E. Miguel, 'Quantifying the Influence of Climate on Human Conflict', *Science*, 341.6151 (2013): http://doi.org/10.1126/science.1235367. [↑](#footnote-ref-57)
58. Doucleff, 'Could Hotter Temperatures from Climate Change Boost Violence?’. NPR, 'How Could a Drought Spark a Civil War?' [↑](#footnote-ref-58)
59. Perez, 'Climate Change and Rising Food Prices Heightened Arab Spring'. Plumer, ‘Drought Helped Cause Syria’s War’. [↑](#footnote-ref-59)
60. It is important to clarify how ‘solid' this relationship between climate change and conflict is conceived to be at the time of writing. In a meta-analysis conducted by Hsiang, Burke, and Miguel 'Quantifying the Influence of Climate on Human Conflict', who evaluated 60 primary studies on the topic, particular trends are observed. For one, deviations from average rainfall and temperatures, whether up or down, are likely to result in human conflict on three levels, from the more local level of interpersonal violence and crime, moving to intergroup violence and political instability, and then measuring conflict at the global level, in terms of institutional breakdown and the collapse of civilizations. 'Quantifying the Influence of Climate on Human Conflict', 1. [↑](#footnote-ref-60)
61. On a local level, several studies in psychology and economics have found that individuals are more likely to act aggressively or show violent behavior if ambient temperatures at the time of observation are higher. C.A. Anderson, 'Heat and violence', *Current Directions in Psychological Science*, 10.1 (2001): 33–38. A. Auliciems and L. DiBartolo, 'Domestic Violence in a Subtropical Environment: Police Calls and Weather in Brisbane', *International Journal of Biometeorology*, 39.1 (1995): 34–39. D.T. Kenrick and S.W. MacFarlane, 'Ambient Temperature and Horn Honking: A Field Study of the Heat/Aggression Relationship', *Environment and Behavior* 18 (1986): 179–197. [↑](#footnote-ref-61)
62. Other recent literature indicates that in low-income settings, extreme rainfall events that adversely affect agricultural income are similarly associated with higher rates of personal violence and property crime. D. Blakeslee and R. Fishman, 'Rainfall shocks and property crimes in agrarian societies: Evidence from India', 2013, http://papers.ssrn.com/sol3/papers.cfm?abstract\_id=2208292. H. Mehlum, E. Miguel, and R. Torvik, 'Poverty and Crime in 19th Century Germany', *Journal of Urban Economics* 59.3 (2006): 370–388. [↑](#footnote-ref-62)
63. Some longitudinal studies of intergroup violence point out that such social conflicts tend to be more likely after extreme rainfall conditions. Such research tends to confirm rather than challenge the aforementioned findings on the a priori relationship between social unrest and rainfall in low-income settings. In other words, reduced agricultural production may be an important mediating mechanism of conflict, although alternative explanations such as political instability cannot be excluded. [↑](#footnote-ref-63)
64. C.S. Hendrix and I. Salehyan, 'Climate Change, Rainfall, and Social Conflict in Africa', *Journal of Peace Research* 49.1 (2012): 35–50. [↑](#footnote-ref-64)
65. A.T. Bohlken and E.J. Sergenti, 'Economic Growth and Ethnic Violence: An Empirical Investigation of Hindu-Muslim Riots in India', *Journal of Peace Research*, 47 (2010): 589–600. [↑](#footnote-ref-65)
66. T.F. Homer-Dixon, 'On the Threshold: Environmental Changes as Causes of Acute Conflict', *International Security* 16 (1991): 76–116. [↑](#footnote-ref-66)
67. J. Barnett and W.N. Adger, 'Climate Change, Human Security and Violent Conflict', *Political Geography*, 26.6 (2008): 639–655. [↑](#footnote-ref-67)
68. Jeremy Rifkin, *The Hydrogen Economy: The Creation of the Worldwide Energy Web and the Redistribution of Power on Earth Tarcher* (New York: Putnam, 2002). [↑](#footnote-ref-68)
69. Barnett and Adger, 'Climate Change, Human Security and Violent Conflict'. [↑](#footnote-ref-69)
70. C. Raleigh and H. Urdal, 'Climate Change, Environmental Degradation and Armed Conflict', *Political Geography* 26.6 (2007): 674–694. [↑](#footnote-ref-70)
71. J. Barnett, 'Security and Climate Change', *Global Environmental Change*, 13.1 (2003): 7–17. [↑](#footnote-ref-71)
72. R. Reuveny, 'Climate Change-induced Migration and Violent Conflict', *Political Geography* 26.6 (2007): 656–673. [↑](#footnote-ref-72)
73. Adger, 'Climate Change, Human Security and Violent Conflict'. [↑](#footnote-ref-73)
74. Homer-Dixon, 'On the Threshold’. Reuveny, 'Climate Change-induced Migration and Violent Conflict'. [↑](#footnote-ref-74)
75. Homer-Dixon, 'On the Threshold’. [↑](#footnote-ref-75)
76. E.A. Stanton, J. Cegan, R. Bueno, and F. Ackerman, *Estimating Regions’ Relative Vulnerability to Climate Damages in the CRED Model*, Somerville, MA: Stockholm Environment Institute, 2011, 4. [↑](#footnote-ref-76)
77. J. Barnett, S. Lambert, and I. Fry, 'The Hazards of Indicators: Insights from the Environmental Vulnerability Index', *Annals of the Association of American Geographers*, 98.1 (2008): 102–119. [↑](#footnote-ref-77)
78. Beck, *World at Risk.* [↑](#footnote-ref-78)
79. O. Renn and P. Graham, *White Paper on Risk Governance: Towards an Integrative Approach*, International risk governance council, 2015. [↑](#footnote-ref-79)
80. Barnett, Lambert, and Fry, 'The Hazards of Indicators: Insights from the Environmental Vulnerability Index', 106. [↑](#footnote-ref-80)
81. J. Hinkel presents an analysis of six diverse types of problems that vulnerability indicators are meant to address according to his review of the literature: ‘(i) identification of mitigation targets; (ii) identification of vulnerable people, communities, regions, etc.; (iii) raising awareness; (iv) allocation of adaptation funds; (v) monitoring of adaptation policy; and (vi) conducting scientific research’. Based on this, he finds that only the second type of problem can be addressed by vulnerability indicators, but only at small and local scales, causing him to question the concept of vulnerability itself and the applied methodologies. J. Hinkel, 'Indicators of Vulnerability and Adaptive Capacity: Towards a Clarification of the Science–policy Interface', *Global Environmental Change* 21.1 (2011): 198-206. [↑](#footnote-ref-81)
82. In his review of vulnerability research traditions, climate change scholar W. Neil Adger distinguishes between two scholarly ‘antecedents’ that have ‘acted as seedbeds for ideas that eventually translated into current research on the vulnerability of social and physical systems in an integrated manner’. These are ‘the analysis of vulnerability as lack of entitlements and the analysis of vulnerability to natural hazard’. This double-ness in the history of the research concept has lead to distinct parallelism in research practices where some researchers focus solely on ecological systems and ‘largely ignore physical and biological systems (entitlements and livelihoods, while others ‘try to integrate social and ecological systems’. A serious challenge following from the rise of adaptation and its inherent complexity is the question of how to develop robust and credible indicators and criteria for measuring vulnerability. Adger, 'Vulnerability', 270. [↑](#footnote-ref-82)
83. S.H. Eriksen and P.M. Kelly, 'Developing Credible Vulnerability Indicators for Climate Adaptation Policy Assessment', *Mitigation and Adaptation Strategies for Global Change* 12.4 (2007): 495–524. [↑](#footnote-ref-83)
84. Naomi Klein, in her book *This Changes Everything* (2014), discusses this as a justice issue. Many developing countries, due to both their specific local environments and limited infrastructures, will be worse hit by the impacts of climate change while having contributed least (e.g., in the sense of carbon emission levels) to creating the problem in the first place. [↑](#footnote-ref-84)
85. EMAPS, 'Who is Vulnerable According to Whom?', 2014, http://climaps.eu/#!/map/who-is-vulnerable-according-to-whom. [↑](#footnote-ref-85)
86. Hinkel, 'Indicators of Vulnerability and Adaptive Capacity’, 198. [↑](#footnote-ref-86)
87. EMAPS, 'Who is Vulnerable According to Whom?'. [↑](#footnote-ref-87)
88. See also: http://climaps.org/?utm\_content=buffer51f08&utm\_medium=social&utm\_source=twitter.com&utm\_campaign=buffer#!/map/who-is-vulnerable-according-to-whom. [↑](#footnote-ref-88)
89. EMAPS, 'Vulnerability, Resilience and Conflict: Mapping Climate Change, Reading Cli-fi', *Electronic Maps to Assist Public Science Blog*, 2013, http://www.emapsproject.com/blog/archives/2293. [↑](#footnote-ref-89)
90. Borra and Rieder, 'Programmed Method’. [↑](#footnote-ref-90)
91. The climate change collection was made with TCAT by collecting tweets that mention climate change (also spelled as climatechange), global warming (and globalwarming), climate, drought, or flood. This is a very wide data set, opting for high recall and low precision, which we then filtered, retaining only tweets mentioning ‘climate change’ or ‘global warming.’ The data set is available from the tool at: http://tcat.digitalmethods.net/analysis/index.php?dataset=globalwarming&query=&url\_query=&exclude=&from\_user\_name=&from\_source=&startdate=2012-11-23&enddate=2013-05-30&whattodo=&graph\_resolution=day. [↑](#footnote-ref-91)
92. This is similar to working with top results in the Google Web Search engine; it follows the logic of the medium and the logic of working with the results most viewed (and clicked) by its users. [↑](#footnote-ref-92)
93. The tweets were checked for false positives by close reading the top tweets to see whether these indeed refer to climate change. The reason to focus on top tweets is that these are not only the most prominent according to the logic of the platform itself but (similar to search engine results that are high in the ranking) they are also the tweets with the most exposure and therefore are most viewed by users. [↑](#footnote-ref-93)
94. EMAPS, 'Profiling Adaptation and Its Place in Climate Change Debates With Twitter'. [↑](#footnote-ref-94)
95. As the data set contains retweets too, it could occur that a single message that is often retweeted skews the data heavily. Therefore, it is important to read the data closely to interpret the results. [↑](#footnote-ref-95)
96. SkepticalScience, ‘http://www.skepticalscience.com/’, also prominent in the search engine case study in chapter 5. [↑](#footnote-ref-96)
97. Cook et al., 'Quantifying the Consensus on Anthropogenic Global Warming in the Scientific Literature'. [↑](#footnote-ref-97)
98. Skeptical Science. 'The Consensus Project'. [↑](#footnote-ref-98)
99. Skeptical Science, 'The Consensus Project'. [↑](#footnote-ref-99)
100. EMAPS, 'Profiling Adaptation and Its Place in Climate Change Debates with Twitter'. [↑](#footnote-ref-100)
101. J.W. Tukey, 'Exploratory Data Analysis', 1977, http://xa.yimg.com/kq/groups/16412409/1159714453/name/exploratorydataanalysis.pdf [↑](#footnote-ref-101)
102. Gerlitz and Rieder, 'Mining One Percent of Twitter’. [↑](#footnote-ref-102)
103. For this case study, we took a dataset of tweets posted between 23 November 2012 and 23 November 2013 containing the query [climate change OR global warming], consisting of 4,771,136 tweets from 1,785,296 distinct users, using the tool TCAT. Borra and Rieder, 'Programmed Method’. [↑](#footnote-ref-103)
104. V.D. Blondel, J.-L. Guillaume, R. Lambiotte, and E. Lefebvre, 'Fast Unfolding of Communities in Large Networks', *Journal of Statistical Mechanics: Theory and Experiment* (2008): 2. [↑](#footnote-ref-104)
105. Shawn W. Martin, Michael Brown, Richard Klavans, and Kevin Boyak, 'OpenOrd: An Open-source Toolbox for Large Graph Layout', *Proceedings of the SPIE Visualisation and Data Analysis*, 2011, https://doi.org/10.1117/12.871402. The algorithm uses a so-called ‘simulated annealing' schedule, with five different iterations in which several parameters are changed. In the first two stages, a strong edge-cutting strategy is employed: long connections between nodes are ignored, promoting clusters segregation and increasing at the same time the amount of white space in the layout. [↑](#footnote-ref-105)
106. This proved necessary to eliminate the noise of tweets unrelated to climate change, for instance, one discussing a positively changing *investment climate* in the Chinese real estate market. [↑](#footnote-ref-106)
107. EMAPS, 'Climate Change Tweets Co-Hashtag Cluster Map', 2014, http://climaps.eu/#!/map/profiling-adaptation-and-its-place-in-climate-change-debates-with-twitter-ii. [↑](#footnote-ref-107)
108. K. Burkhart, 'Organizing for Action Delivers Unicorn Trophies to 135 Climate Deniers in Congress', *The Huffington Post*, 13 August 2013, http://www.huffingtonpost.com/2013/08/13/organizing-for-action-climate-deniers\_n\_3750126.html. [↑](#footnote-ref-108)
109. These clusters reflect indicators of habitat change as included in the DARA index, and ecosystem services as defined in the ND-Gain index, albeit mostly focused on animals rather than indicators of effects on human habitats. A number of countries are however, mentioned in the context of #drought and #rainfall, such as Haiti, Namibia, Malawi, Jemen, and Liberia. [↑](#footnote-ref-109)
110. See also the *Issue Animals* study by Niederer and Weltevrede. Digital Methods Initiative, 'Networked Content', 2008, https://digitalmethods.net/Digitalmethods/TheNetworkedContent. Rogers, *Digital Methods.* [↑](#footnote-ref-110)
111. Stevenson and Broder, ‘Climate Change Prominent in Obama’s Inaugural Address’. [↑](#footnote-ref-111)
112. J. MacNab, 'Will Climate Be a Winner in British Columbia’s Election?' *Pembina Institute*, 2013, http://www.pembina.org/blog/724. [↑](#footnote-ref-112)
113. C. Cattaneo, 'As B.C. Election Looms, Both NDP and Liberals Take Hard Line on Oil Pipelines', *Financial Post*, 2013, http://business.financialpost.com/2013/05/06/bc-election-oil-sands/?\_\_lsa=d52e-3289. [↑](#footnote-ref-113)
114. 'Saskatchewan Citizens’ Hearings on Climate Change', 2014, http://skclimatehearings.org/. [↑](#footnote-ref-114)
115. L. Taylor, 'Rudd Accuses Abbott of Abandoning Australia’s Alimate Commitments, *The Guardian*, 13 September 2013, http://www.theguardian.com/world/2013/sep/03/rudd-abbott-abandoning-climate-commitments. [↑](#footnote-ref-115)
116. O. Phelan, K. McCarthy, and B. Smyth, 'Using Twitter to Recommend Real-time Topical News', in *Proceedings of the Third ACM Conference on Recommender Systems*, 2009, pp. 385-388, http://dl.acm.org/citation.cfm?doid=1639714.1639794. [↑](#footnote-ref-116)
117. As expected, mundaneclimate change ‘updates’ also find their way into the climate change Twitter network, with complaining tweets about the cold weather that include such hashtags as #cold and #freezing. [↑](#footnote-ref-117)
118. The small clusters include tweets recognizing the connection, such as ‘#arabspring caused by #history’s most underrated force: #climate change’. The discussion also includes skepticism towards this connection between climate change and conflict, as with the example given in the text and with this tweet: ‘seriously global warming err climate change caused Syria? Unreal’. [↑](#footnote-ref-118)
119. Hermida, ‘Twittering News’. [↑](#footnote-ref-119)
120. The profile, however, also shows that this specific discourse also seems to have been hijacked by a single user trying to widen the issue by connecting it to medical conditions such as obesity. [↑](#footnote-ref-120)
121. While I focus on Twitter analysis here, the EMAPS study also analyzed the prominence of adaptation and the other discourses on the web as accessed through Google. Querying the keywords ‘skepticism,' ‘mitigation,' ‘adaptation’ and ‘conflict’ in the top Google results for the query ‘climate change OR global warming,’ we also found ‘adaptation’ to be the most widely present keyword in Google top results about climate change. [↑](#footnote-ref-121)
122. See also: EMAPS, 'Reading the State of Climate Change From the Web: Top Google Results', 2014, http://climaps.eu/#!/map/profiling-adaptation-and-its-place-in-climate-change-debates-with-twitter-ii. [↑](#footnote-ref-122)