

The discourse of climate change on Reddit

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1 Introduction

Over the last several decades, as climate change has become a more and more salient issue, it has drawn increased attention from discourse analysts as well as climate scientists. A 2018 report by the Intergovernmental Panel on Climate Change (IPCC) (Masson-Delmotte et al., 2018) projected that there were 12 years remaining to avert an increase in global temperature greater than 1.5C, and recent environmental disasters such as fires in the Amazon and Australia have further increased public consciousness about climate change.

Discourse analyses of climate change in the news media have identified a host of different frames used by journalists when writing about climate change, including “(false) balance/objectivity” (Boykoff & Boykoff, 2004), “IPCC view” and “contrarian view” (Brüggemann & Engesser, 2017), “urgent/moral/responsibility-attributing” (Grundmann & Krishnamurthy, 2010), and “fear/misery/doom” (Boykoff, 2008), among others. However, comparatively few studies have investigated how such discourses are (re)produced and (re)constructed by members of the general public (but see Koteyko et al., 2013; Walter et al., 2018, who examined reader comments on news sites). The goal of the present study is to (further) address this question by investigating stances and ideologies expressed, upheld, and/or contested by pseudonymous online commenters on Reddit (a collection of online discussion forums), rather than by powerful institutions, such as news media or governments. Large discussion forums, such as Reddit, provide a public, easily accessible repository of discussion about climate change. However, the traditional tools of (critical) discourse analysis are focused on individual texts (such as newspaper articles or policy documents) and not on large corpora. This study uses established computational tools (latent Dirichlet allocation and machine classification) to identify patterns in the data and guide the qualitative methodology.

Past research has indicated a tendency for communities to develop into “echo chambers” in which one view predominates (Farrell, 2015; Sunstein, 2002; Walter et al., 2018). Given this tendency, we have grounds to expect that while different climate-change discussion forums may focus on a single, broad topic, the frames that they tend to use, and the subtopics that they discuss, will differ, because each group may have different shared views and values—for instance, commenters on */r/climatescience*, a Reddit subforum dedicated to “the rational discussion of the **science** of climate change” (emphasis in original) are likely to behave differently compared to commenters on */r/collapse*, a subforum dedicated to the putatively impending collapse of civilization, or commenters on */r/climateskeptics*, a subforum dedicated to “seeing past hyperbole, alarmism, and environmentalism driven politics.”

The goal of this study is to map the discursive landscape of climate change online, addressing the following questions: How is climate change constructed and framed by commenters on public forums? Which frames are dominant in each community, and how can we explain differences in which frames are most commonly used in different communities? Are these findings consistent with mass media discourse on climate change, and if not, how do they differ, and how can these differences be explained? A secondary goal of the study is to integrate existing computational tools into critical discourse analysis (CDA), allowing for analysis of large, publicly-available text corpora from a CDA perspective. I frame this analysis as

“critical” discourse analysis because it seeks to go beyond cataloguing discursive differences between communities, and understand how ideologies of climate change, including climate change denial/‘skepticism’ and climate-change-related nihilism, are reproduced in online discourse. With respect to climate skepticism specifically, I discuss discourses of climate skeptics on Reddit in the context of the powerful think tanks whose discourse strategies they emulate. I also aim to highlight differences and similarities based on power differentials between anonymous online commenters (who can be assumed to possess little institutional power) and hegemonic mass-media institutions that have previously been studied.

The remainder of this paper is organized as follows. §2 reviews the literature on climate change discourse and provides some examples of previous work using computational discourse analysis which influenced the present study. §3 describes how the data were collected, and the quantitative and qualitative methods used to analyze the data. §4 summarizes the data by providing an overview of each subreddit to be analyzed. §5 reports the results of topic modelling using latent Dirichlet allocation, including subsequent qualitative follow-ups. §6 reports the results of pairwise classification models, including subsequent qualitative follow-ups. §7 discusses and integrates the key findings of the previous sections. §8 concludes the paper.

2 Literature review

2.1 Climate change discourse

Climate change in the news media

Many articles have examined the mass print media’s framing and coverage of climate change.

An influential study by Boykoff and Boykoff (2004) analyzed the US prestige press (the *New York Times*, the *Los Angeles Times*, the *Washington Post* and the *Wall Street Journal*) and compared their coverage of anthropogenic climate change to the relevant scientific discourse. Their primary finding was that the journalistic norm of ‘balance’ led to distortions in coverage, by giving roughly equal attention to the scientific consensus (that humans are contributing to global warming) and a countervailing denialist discourse.

In a follow-up study, Boykoff (2007: 6) found that this frame had begun to shift, with reporting “more closely reflect[ing] the scientific consensus on attribution for climate change.” Similarly, in a more recent study of climate change journalism, Brüggemann and Engesser (2017) combined an analysis of the content of journalistic articles with a survey of the authors who wrote them. They found that while contrarian voices were still quoted, the quotes were contextualized with dismissals of climate change denial. Outright denialism still existed in pockets, such as conservative opinion columns, however.

Moving beyond the US, Grundmann and Krishnamurthy (2010) constructed a corpus containing US, UK, German and French articles on climate change and found that French and German sources represented climate change with a “heightened sense of urgency” and a “moral frame which attributes responsibility” (132), neither of which were dominant frames in US and UK sources.

Boykoff (2008) conducted a critical discourse analysis of climate change-related articles in four UK tabloids: the *Sun*, the *Daily Mail*, the *Daily Express*, and the *Mirror*. Rather than the prestige sources analyzed in the studies described above, tabloids were selected because prior analyses of climate change in the print news media focused on broadsheet newspapers, but tabloid papers have a much higher circulation and the majority of their readership is working-class. Analysis of tabloids was thus seen as a way to centre a working-class-directed perspective which had been lacking from previous research. The analysis found that climate change was predominantly represented through extreme weather events and politics, as opposed to justice and risk or scientific findings. The overall tenor of the coverage involved fear, misery, and doom, illustrated with the following set of headlines:

- (1)
 - a. IT'S THE END OF THE WORLD. MAINLY FOR CHILDREN — *The Express*, 17 January 2000
 - b. HOW THE WORLD WILL END — *The Daily Mail*, 28 December 2002
 - c. WAVE IT GOODBYE: RAGING FLOODS COULD SWAMP OUR CITIES WITHIN A LIFETIME — *The Mirror*, 16 September 2002
 - d. POLLUTION IS TURNING THE SEAS INTO ACID — *The Daily Mail*, 11 November 2006

Climate change in reader comments

To the best of my knowledge, no research has focused on discussion forums dedicated to climate change (such as the subreddits analyzed in the present study). However, multiple studies have examined user comments on climate-change articles on news sites. These analyses are useful because they provide information about how individual members of the newspaper's readership take up (or not) stances and frames that the newspaper does.

Koteyko et al. (2013) analyzed online reader comments from the *Daily Mail*, investigating the discursive construction of climate science by tabloid readers after a 2009 controversy in which the University of East Anglia's Climatic Research Unit was hacked shortly before the UN Copenhagen summit, and emails were leaked purportedly showing that the scientists had been manipulating data and attempting to silence their critics ("climategate"). The authors employ a corpus-assisted approach (Baker et al., 2008), including the use of *keyword* (frequency of words in a given corpus relative to another corpus) and *collocation* analysis (sets of words that tend to co-occur), to analyze a large volume of reader comments. For example, in comments shortly after the release of the emails, the word *science* collocated with *not*, *so-called*, *pseudo*, and *junk*, indicating that readers were "dissociating climate scientists from the ideal norm of science" (79).

Walter et al. (2018) examined reader comments on online news stories from Germany, India, Switzerland, the UK, and the US, seeking to identify factors that lead to comments that are either skeptical or supportive of the scientific consensus on anthropogenic climate change. The authors found that reader comments were fragmented into "ideologically like-minded echo chambers" (215), such that commenters on publications with a conservative editorial line, such as the *Daily Telegraph*, were more likely to express denial of anthropogenic climate change than commenters on centre-left publications like the *Huffington Post*.

2.2 Computational critical discourse analysis

Critical discourse analysis (CDA) is a approach to analysis of discourse that seeks to uncover how ideological processes, especially those related to power, control, hegemony, and injustice are (re)constructed in language and society (Strauss & Feiz, 2014: 312–3). Work from a CDA perspective employs "micro-level" discourse analysis (i.e., analysis of words, phrases, metaphors, and others) to uncover, explain, and denaturalize such ideologies.

In this paper, I use the term *computational critical discourse analysis* (CCDA) in the same sense as Hogan and Lavolette (2019: 324–5), who describe it as "a nascent field that is focused on understanding and articulating ideologies latent within large-scale text corpora" by means of "the scaling-up and refining of the traditional quantitative elements of discourse analysis, suitable for discourses in large digital corpora." In this sense, the integration of computational and CDA methods entailed by CCDA is similar to the integration of corpus-linguistic and CDA methods proposed (and popularized) by Baker et al. (2008).

CCDA-based analyses are particularly useful for identifying differences between different sets of documents, using methods such as classification and/or latent topic identification. Below I discuss several case

studies in which computational models are used to scale up discourse-analytical techniques in order to identify differences in discourses and, consequently, ideologies, within the same broad topic area.

Hogan and Laviolette (2019) employ a CCDA methodology to analyze the language and ideology characterizing two Reddit subforums nominally focusing on men's issues: /r/MensRights, an anti-feminist group, and /r/MensLib, a pro-feminist group. They make use of machine-learning text classification methods, first converting each document into a *tf-idf* (term frequency – inverse document frequency) vector and then using supervised machine learning classification models from the scikit-learn Python module (Pedregosa et al., 2011a) to predict whether a given document is from the /r/MensRights or /r/MensLib community. This classification methodology is supplemented by analysis of the list of unique words in each subforum. Overall, they find that /r/MensRights discourse portrays men as non-agentive victims of a “feminized society,” whereas /r/MensLib focuses on “actions men can take to liberate themselves from the expectations of traditional masculine roles” (332). This finding is reflected in their finding that the term *masculinity* itself strongly predicts that a comment is from /r/MensLib, whereas terms used to refer to women, including *she* and *her*, predict that a comment is from /r/MensRights.

A similar methodology was employed by Chancellor et al. (2018), who contrasted the social support language used on two Reddit weight loss communities: /r/proED, a subreddit for users with disordered eating habits who are not seeking recovery, and /r/loseit, a community that promotes more sustainable weight loss methods. The authors developed three classification models to predict whether posts were taken from /r/proED or /r/loseit: a Content model, a Context model, and a Content+Context model. The Content model included the 1000 linguistic tokens with the highest *tf-idf* weights (i.e., the words most characteristic of each corpus). The Context model made use of word2vec word embedding analysis (Mikolov et al., 2013), and included the 50 most similar words to the embeddings corresponding to each of the 600 tokens with the largest *tf-idf* weights (duplicates excluded). The Content+Context model contained both independent variables. Each model performed well above baseline, with the Content+Context model having an accuracy of 78%, the Context model 75%, and the Content model 69%. Features predictive of whether a post was from /r/loseit mainly related to healthy lifestyle changes, such as *moderation*, *5k*, and *cardio*, whereas features predicting a post was from /r/proED included words related to thinness, such as *underweight*, *bmi*, *thinspo*, as well as words related to bingeing and purging cycles, such as *purge* and *laxatives*. Similar to Hogan and Laviolette (2019), the results demonstrate the value of computational modelling for characterizing the differences between topically similar communities: both /r/loseit and /r/proED are about social support for weight loss, but the top features used by the classifier reveal discursive and ideological differences.

Ammari et al. (2018) employed a computational but non-classificational approach to contrasting parenting communities on Reddit: /r/parenting, /r/mommit (a subreddit specifically for mothers) and /r/daddit (a subreddit specifically for fathers). The authors used latent Dirichlet allocation (LDA) models (Blei et al., 2003) to extract latent topics from text data, and where the same topics appeared across multiple subreddits, used word2vec (Mikolov et al., 2013) models to investigate how each topic is discussed differently in each. For example, both /r/daddit and /r/mommit users discussed circumcision, but /r/daddit users focused on male circumcision (e.g., *phimosis*, *uncut*, *intact*) whereas /r/mommit users discussed both male and female genital mutilation and circumcision (e.g., *male*, *female*, *mutilation*, *FGM*). Some topics also differed across subreddits—for example, only on /r/daddit was “legal custody questions and experiences” identified as a topic, and only on /r/mommit was “maintaining the home” identified as a topic. This work highlights the utility of topic modelling for comparing and contrasting discourses on similar communities—while both /r/mommit and /r/daddit discuss parenting, the specific topics discussed, and how shared topics are discussed, differ, and these differences are detectable using computational models.

3 Methodology

3.1 Integrating computational methods with critical discourse analysis

This study aims to integrate computational-linguistic methods into a qualitative (critical) discourse analysis framework for the study of discourse on Internet climate change discussion forums. Computational models, which convert language data into a numerical format for processing by a computer, may seem at odds with CDA approaches, which are typically qualitative. But as argued by Nishizaka (2015), resources from these two worldviews are not incompatible, though ‘facts’ and figures associated with a computational worldview are transformed through their integration into a CDA worldview. For instance, finding via a computational model that the term *she* is distinctive of a mens’ rights community, as Hogan and Laviolette (2019) did, tells us only that *she* occurs frequently in that community and less frequently in the rest of the corpus. What indexical associations does *she* has in the community? Does it have an additional meaning or function? In what contexts is it used? These questions are difficult or impossible to fully address using quantitative methods, because identifying that a word or feature is distinctive of a community, or that it frequently collocates with certain other words or features, is only the starting point: we don’t yet know the word’s place in the indexical space of the community (Eckert, 2008; Silverstein, 2003). Answering these questions is therefore a matter of critical qualitative analysis, such as sampling full comments using *she* and identifying its referents and which contexts it is used in. In this sense we can view computational models as feeding the qualitative analysis by providing a means of automatic, large-scale pattern detection; once a putative pattern is identified by the computer, it can be critically analyzed by the human researcher. The quantitative findings thus reinforce and support qualitative findings, helping to ensure that they are not due to cherry-picking, as well as providing new avenues to explore qualitatively that may be missed through manual inspection (especially when a large amount of data is to be analyzed).

3.2 Data collection and processing

The data for this study were collected from Reddit. Comments from each subreddit that were posted in the year 2019 were extracted until either all posts were collected, or the total word count for that subreddit reached 6 million. This was done by, for each subreddit, picking a random date in 2019, collecting all comments from that date, then checking the total word count and stopping if it exceeded 6 million. This algorithm was implemented in Python using the Python Pushshift.io API Wrapper (PSAW) (Marx, 2020) and the Python Reddit API Wrapper (PRAW) (Boe, 2020). PSAW provides simple access to the pushshift.io (Baumgartner et al., 2020) searchable database of public Reddit comments, and was used to collect IDs for comments. These IDs were fed to PRAW to collect the live version of each comment (with up-to-date upvote/downvote scores and other data).

The data resulting from the procedure above was used as-is for the qualitative analysis. However, prior to fitting the computational models described in the next section, stopwords (e.g., “the”, “a”, “to”) and punctuation were removed and the remaining words were tokenized and lemmatized. This was done using SpaCy (Honnibal & Montani, 2017).

3.3 Computational models

This study makes use of two computational models: latent Dirichlet allocation and text classification. I will describe each of these models in turn.

Latent Dirichlet allocation. Latent Dirichlet allocation (LDA) (Blei et al., 2003) is a Bayesian model for representing text corpora. In an LDA model, each document in a corpus is modelled as a mixture of underlying *topics*, themselves represented as a mixture of word probabilities.¹ The term *topic* is not meant to be taken literally, to imply that a topic always represents an actual topic of discussion. An LDA topic may represent an actual topic, or it could represent a mode of discourse (e.g., if a topic’s word distribution includes words like *thanks*, *great*, *interesting*, it is not clear what discrete “topic” it might represent, but it does appear to represent a unified type of discourse act, i.e., positive evaluation of or gratitude for another user’s contribution).

Concretely, the utility of LDA modelling for discourse analysis is similar to the utility of collocation analysis (e.g., Baker et al., 2008), in that it shows how words pattern together in discourse. However, the underlying principles are different. Unlike LDA, a set of common collocations is not taken to be a representation of the corpus as a whole; it is only a list of words that commonly appear together. As a statistical model, LDA is a dimensionality reduction technique: it aims to represent the entire corpus as a set of underlying topics, such that the differences in which words are used between individual documents can be explained based on these underlying topics. While this entails some loss of granularity (as with all dimensionality reduction techniques), it serves as a useful way to get a sense of what is being discussed, and how, in a large set of data. For instance, in LDA results for a dataset containing discussion about pets, we might find a topic containing important words *brush*, *groom*, *trim*, and *fur*, potentially representing discussion of pet hair/fur grooming, and another topic containing important words *fish*, *tank*, *water*, *chlorine*, potentially representing discussion of aquarium maintenance.

To conduct the LDA analysis for the present study, I used the implementation available in the Python machine learning library *scikit-learn* (Pedregosa et al., 2011a). LDA models were fit both to the aggregate corpus (containing all 5 subreddits) as well as to each subreddit individually. Because the LDA algorithm requires the user to specify the number of topics to be used, I began with a model containing 10 topics, then ran additional models iteratively, with larger and larger numbers of components, until most topics appeared to represent a coherent and distinct set of words. For example, for the aggregate model, the final model consisted of 50 topics. The lists of topics were then pruned using the method described by Ammari et al. (2018): I took a random sample of comments that scored highly on each topic, and manually judged whether all or most of the comments in the sample represented a coherent discourse topic or style. These topics, termed “verified topics” after Ammari et al. (2018), were the ones interpreted and used in later analysis stages; topics that were not verified were excluded.

Text classification. Text classification is a machine-learning model which assigns the computer the task of classifying documents into categories (in this case, the subreddit in which the comment was posted). This is done by splitting the data into *training* and *test* sets. The training set is pre-labelled, and the features of the documents in each category in the training set are used to predict the category of the documents in the test set, whose labels are not used by the model. In the present study, I used binomial classification, comparing one subreddit to one other subreddit at a time. What features are used by the model varies; in the present study, individual words are used as features (so the model tries to predict which subreddit the comment was posted in based on the individual words in the comment), but other features, such as total word count of each comment, could also be used, in principle.

After running the classifier, it is then possible to extract the most important features of the model: the features (words, in this case) which the model identified as best distinguishing the two datasets from one

¹I use the term “word” here for the purposes of this explanation, but the model can also operate using bigrams, trigrams, sentences, paragraphs, or other higher-order features (or, in theory, lower-order features like phonemes or letters, though this would not provide any insight for our current discourse-analytic purposes).

another. These words can be used for further analysis, such as extracting comments from the subreddit that use its most distinctive words, to see in what context they are being used.

As an example, if we were to run a classification analysis on two datasets, one containing discussion about cats and one containing discussion about fish, we would likely find words like *cat*, *purr*, and *litter* in the important feature set for the cat discussion, and words like *fish*, *water*, and *filter* for the fish discussion.

To conduct the classifier analysis for the present study, I used the implementation of the logistic regression classifier available in the Python machine learning library scikit-learn (Pedregosa et al., 2011a), with a ‘liblinear’ solver. Because some subreddit corpora have many more comments than other corpora, such that the classifier could achieve a good performance by simply predicting that all the unknown documents belong to the larger corpus, I used class weighting. This weights each category inversely to its proportion in the data, correcting for the imbalance in the dataset. This classifier model was run for all possible pairs of subreddits, for 10 models in total (*/r/climate* vs. */r/climate_science*, */r/climate* vs. */r/collapse*, and so on).

3.4 Qualitative methods

Subreddit overviews. After the data was collected, the initial qualitative analysis began on an exploratory subreddit-by-subreddit basis, with the goal of constructing an overview of each subreddit to guide the later stages of the computational and qualitative analysis (presented in §4). This involved examining each subreddit’s sidebar (which contains a summary of the purpose of the community and/or a set of rules or guidelines that participants are expected to follow), as well as browsing the data and taking note of frequently discussed topics, notable aspects of the discourse, and other impressions and patterns.

Verified topic analysis. After the LDA analysis described in §3.3, qualitative methods were used to investigate selected verified topics in detail. Not all verified topics were analyzed qualitatively because analyzing every topic would constitute an infeasible expansion of the scope of the paper. For topics selected for analysis, 50 comments which scored highly for that topic were sampled from the dataset (50 from each subreddit, for topics from the aggregate model). I read these closely, taking note of aspects of discourse such as which entities are presented as agents, metaphors used, explicit and implicit stancetaking, and so on, as well as how the words associated with the topic in question are used in context.

Classifier result analysis. After running the classifiers described in §3.3, qualitative methods were used to investigate selected important features (words) in detail. As with the verified topics, when interpreting a feature of interest, I sampled 50 comments containing that word and read these closely, taking note of how each word was used in context. Along with and in light of these individual feature analyses, I also interpret the overall set of important features for each given subreddit in order to characterize differences between two communities. For example, as discussed in more detail in §7.4, I interpret the presence of *Greta* (Greta Thunberg) and *Gore* (Al Gore) in the important-feature list for */r/climateskeptics* as evidence that the discourse associated with that subreddit foregrounds its antagonists.

4 Subreddit overviews

4.1 */r/climate*

In the sidebar on its main page, where subreddits typically list an overview of their topic and their rules, the */r/climate* subreddit bills itself as a forum for “real and accurate data about the Earth’s climate.” It

goes on to explicitly represent itself as subscribing to mainstream consensus about climate change: it links to two articles from skepticalscience.com, a website devoted to countering claims from climate skeptics. The articles are entitled “Evidence that warming is still happening” and “The human fingerprint in global warming”.

As of May 2020, the subreddit also flags an explicit political stance using two “announcements” or “stickied posts”: posts that moderators have set to remain at the top of the list of topics indefinitely. The first stickied post is entitled “How to get involved with a local group to create the political will for climate action”, which lists and describes some climate activism groups and provides links to join them. The second stickied post is entitled “Without a Democrat as next President of the United States, our ability to limit greenhouse gas emissions will be nonexistent”, which exhorts readers to support Democratic politicians, including presidential candidate Joe Biden.

Typical content on /r/climate consists of links to articles related to climate change, including popular articles about newly released studies and essays about individual or collective actions that should be taken. It is difficult to generalize about the broad ideological stance taken by /r/climate, other than that they are not climate-change skeptics/deniers.

4.2 /r/climateskeptics

In its sidebar, /r/climateskeptics describes itself as “Seeing past hyperbole, alarmist, and environmentalism driven politics” and states “this subreddit is about climate related environmentalism and alarmism.” One rule is listed: “Don’t disparage the sub as a whole. It is our experience that those who do generally don’t contribute anything of substance to the discussion.” The sidebar concludes with a statement that “Around 97% of the people on here agree that CO2 causes warming, that there has been warming, and that humans have contributed to increased CO2 in the atmosphere.” This appears to be an attempt to preemptively disarm criticism of skeptics as not believing in the greenhouse effect, global warming, or the anthropogenic nature of climate change. (The use of “97%” is an ironic reference to the commonly-cited figure from Cook et al. 2016 that 97% of scientific papers that expressed a viewpoint on climate change endorsed the scientific consensus.)

Typical content on /r/climateskeptics consists of links to news articles (from mainstream and non-mainstream sources) that either suggest that climate change is less severe than has been claimed, or *do* suggest that climate change is severe, but are posted with mocking titles. For instance, a link to an article from the *Harvard Business Review* entitled “The Story of Sustainability in 2018: ‘We Have About 12 Years Left’” was posted to /r/climateskeptics with the sarcastic comment “Oh Snap! look everybody we have another point of no return” as the post title.

While most posts are created by skeptics, some posts to /r/climateskeptics are created by non-skeptics seeking to convince, argue, or make fun of skeptics. These posts tend to be high-engagement; for example, the post in the /r/climateskeptics corpus with the most comments is a post from an M.S. student in climate science asking for skeptic arguments to respond to in their thesis.

Despite their opposition to the mainstream scientific consensus on anthropogenic climate change, /r/climateskeptics users frequently align with ideals of science, and they dissociate their opponents from ideals of science by labeling them as unscientific or pseudoscientific:

- (2) /r/climateskeptics:
 - a. Face it bruh, but climate science is pseudoscience at worst and at best is flawed and has proven nothing.
 - b. Is Greta a scientist? Because a lot of people seem to think she’s the expert. Is Al Gore a scientist?

Is Leo Dicaprio a scientist? Are the idiots blocking bridges and subways scientists? Nobody in the alarmist group seems to be a scientist. You will find plenty of data and evidence here from real scientists in fields that actually pertain to the topic telling you that the Co2 theory does not compute.

- c. Wiki is WORTHLESS & totally biased. JUNK SCIENCE is BIG BUSINESS & very profitable. Scientists are just as vulnerable to GREED as any other industry so JUNK SCIENCE is being pushed by the United Nations which is the New World Order & they are mandating Western Societies bow to their wishes as they attempt to eliminate ALL of Western Culture & replace with Muslim illiterate 3rd world migrants who are unable to take care of themselves. Its a planned invasion. Wiki is filled with liberal left wingnuts who LIE to push their agenda. They attack everything DJT including media who supports the Prez.

This resonates with the findings of Koteyko et al. (2013), who found that *scien-* frequently collocated with *not, so-called, pseudo, and junk* in anti-climate scientist news article comments.

Rather than being explicitly anti-science, as they're often portrayed in other communities, the "skeptics" assert that climate change is happening, but that there is not enough evidence that it is anthropogenic, or that it will not be as bad as mainstream scientists say.

/r/climateskeptics users also make explicit use of scientific terminology and jargon, such as *hypothesis, theory, evidence*, and so on. This is illustrated in the two lengthy comments in (3), which are responses from two different skeptics to a user who is an M.S. student in climate science who solicited skeptics' arguments. Both users make extensive use of scientific language, including words like *epistemic, observations, model estimates, deviations* (in the technical/statistical sense), and *bell curve*.

(3) */r/climateskeptics*:

- a. Just to clarify something about my epistemic position as a scientifically literate skeptic, I'm not asserting any claims thus there's nothing for you to address directly. My position is only that claims of impending climate doom have not been sufficiently justified by the published science.
This paper² shows that the best and most recent actual observations indicate ECS and TCS at the extreme lower end of the IPCC's very wide range of model estimates. Justifying dramatic and immediate "climate policy action" and its associated economic hardships, especially on the impoverished countries generating most of the anthropogenic CO₂, requires accepting model-only estimates in the extreme upper end of the IPCC range. Anywhere on the lower end of the range, less disruptive mitigation strategies combined with funding better real-world observations (vs yet more models) is the optimal near-term action plan under any reasonable 'balance of harms' assessment.
- b. I would love you to start at the idea that climate change is based on science, not blog-posts and tweets. That the probabilities that science uses include more than just the "beyond three deviations away from center," and that the central 68% of a standard bell curve is what is most likely to happen. When the media gives all of the press to people who look at outside the most likely, when they look at the most extreme, most unlikely possibility and say, "well, we can't rule extinction out" just because it's only a 99.95% possibility that something else will happen, we skeptics have to spend our time arguing against fringe crap.
If you did a bunch of studies and said, "there's a 68% probability that we might see a few tenths of a degree of warming in the next three decades," I'd probably come back with, "okay, that

²The user includes a hyperlink here to a manuscript version of Lewis and Curry (2018).

seems reasonable.” I mean, given the data, sure. We’ve seen warming, and I don’t see anything that has changed that would indicate a sudden reversal of that warming, so, yeah.

But, if you say, ”we can’t rule out the possibility that humans will be extinct by 2030,” I’m going to call BS. Much like all the calls for the Arctic to be ”Ice free in the summer” by 2013 or 2018, these are fringe possibilities, not mainstream probabilities. We’re not going to be extinct by 2030 due to climate change. We’re not going to see civilization collapse by 2050 because of climate change. The Statue of Liberty isn’t going to be 50% underwater by 2040, no matter what they put on the front of a magazine.

How about we dial back the hyperbole and talk about the actual science, and good, non-bullshit, possible issues.

Both users also present their views as moderate, in contrast to the extreme views of alarmists. (3a) claims that dramatic, immediate action requires accepting “model-only estimates in the extreme upper end of the IPCC range,” and (3b) juxtaposes the “reasonable” claim that “we might see a few tenths of a degree of warming in the next three decades” with “fringe possibilities” like human extinction by 2030 or collapse of civilization by 2050. This rhetorical move constructs the skeptic position as middle-ground or centrist, an idea made explicit by another user in (4).

- (4) The way I see it on one extreme you’ve got alarmist. On the other extreme you’ve got deniers. What’s right in the middle? The skeptic.
Wanting proof of something shouldn’t be considered an extreme stance.

The effect of these discourse strategies is to position skeptics as non-ideological, interested in facts, and not in politics, in contrast with politically-motivated climate scientists and activists:

- (5) There’s been tons of posts on here today clarifying the stances of skeptics. Please take a look at those. By-and-large, we don’t think climate change is fake. We are skeptical of what is being reported and the motives behind the movement (example: those in the climate movement are almost exclusively left-wing and use fear of climate change to generate support for their policies.)

Many comments on /r/climateskeptics invoke right-wing Given the skeptic movement’s close association with right-wing politics (Jacques, 2012; Lockwood, 2018). This includes comments expressing Islamophobia (6a–c), xenophobia (6c), anti-Semitism (6d, e), and conspiracy theories about billionaire investor George Soros (6d, e). Note the use of the triple parentheses around the name ‘Soros’ in (6e), a notational practice used by the alt-right to ‘out’ Jewish people or highlight the fact that they are Jewish (Pollard, 2018: 77–78).

- (6) a. This pope is an openly muslim communist. Is there a way to get a Catholic in there?
b. Rhodesia used to be the breadbasket of Africa. Muslims took over, expelled and murdered the white farmers, now it’s Zimbabwe and people are starving and holding up their hands for food aid.
c. Your daily reminder that the west IQ is falling, mostly due to immigration.
d. You will see Greta is accompanied by far left activist Luisa-Marie Neubauer, member of the ONE Foundation, funded by Bill Gates and Soros. What do they have to gain? Soros is a known hedger, debilitated entire economies for his own gain.
e. “You ruined my childhood!” - Greta (((Soros)))

The frequency of these alt-right stances and notational practices is unsurprising, given the well-documented

connections between the climate ‘skeptic’ movement and the conservative and right-wing-populist movements in North America and Europe (Jacques, 2012; Lockwood, 2018).

4.3 /r/collapse

In its sidebar, /r/collapse describes itself as a forum for “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.” The sidebar notes that browsing the subreddit may result in detrimental effects on users’ mental health and goes on to provide a list of mental health resources, including /r/suicidewatch and /r/collapsesupport.

The sidebar also contains a list of 11 rules, most of which concern the types of content that are allowed to be posted (for example, “low effort content” is only allowed on Fridays, duplicate posts are not allowed, and so on). Notably, climate science denial is explicitly forbidden: “No provably false material (e.g. climate science denial).” While /r/collapse is not explicitly about climate-change related collapse, climate change is a very popular topic (particularly in 2019, the year of study, before the widespread outbreak of the COVID-19 pandemic).

As with other subreddits, a large portion of content on /r/collapse consists of links to news articles which relate to impending societal collapse. A sizable number of posts also consist of questions to the community, such as asking for advice on preparing for collapse, or making personal predictions about how or when collapse will occur.

Commenters on /r/collapse near-universally express stances of fatalism about collapse, arguing that it is inevitable and individual actions are useless. In a metaphor for drug addiction, non-fatalistic viewpoints or arguments are described as “hopium” (a portmanteau of “hope” and “opium”). Users that express non-fatalistic stances are typically downvoted, such as (7):

- (7) Meditating on death sounds like a death cult. The most dignified you can be is to make an effort to fight back, so people at least have a chance to be angry at the right parties when their daily life finally gets upheaved. It’s decades too late, but fatalism was never useful.

4.4 /r/climate_science

Unlike other subreddits, in its sidebar, /r/climate_science does not explicitly describe its purpose as a community, other than the title “Climate Change and Climatology.” Instead, it lists five rules for participants to follow when posting or commenting:

1. Linked submissions must be directly to or reference a peer-reviewed publication. If possible, link to articles that are not behind a paywall. *Note: Official lectures that refer to peer-reviewed research are allowed.
2. Text posts and comments should be made in good faith with ample clarification. If it’s obvious you’re not asking a question in good faith, your comment/submission will be removed and only re-approved in rare circumstances.
3. This is a science-based subreddit. All politically charged submissions will be removed. Discussion of the political implications of science will be allowed as long as it doesn’t become disruptive.
4. Be polite and check your ego at the door. This subreddit is actively moderated, and belligerence will not be tolerated.

5. No pseudoscience. Your claims should be supported by peer-reviewed research. Be prepared to provide citations when challenged.

Cumulatively, these rules establish /r/climate_science as a community with strict moderation, a high standard for politeness/civility, and firm rules over what is considered acceptable content, i.e., peer-reviewed climate science. While text posts (i.e., posts that consist of a block of user-written text rather than a link to another website) are allowed, they are required to be in “good faith”, which is at the discretion of the moderators to determine.

Typical content on /r/climate_science consists of links to peer-reviewed studies in scientific journals such as *Nature*, or journalistic articles that cite such studies, as specified by Rule 1. Also frequent are “self” or “text” posts, which typically consist of questions from users about climate science. For instance, one such post from July 2019 was made by a user identifying themselves as a member of the climate activist group Extinction Rebellion (XR), asking for assistance with communicating climate science through their organization:

- (8) I’m not a climate scientist nor do I have any formal education in climate science. I would like to put out a call for help from individuals who do have such training or are active in climate science who are willing to assist in clarifying questions around climate change from within XR. I would also like to invite and welcome criticism of the scientific basis of XR’s communication, as well as my own communication. I think that greater engagement from the scientific community with public communication and social movements acting on climate change has the potential to amplify our effectiveness.

4.5 /r/ClimateOffensive

/r/ClimateOffensive’s sidebar opens with the text “WHO ARE WE?” and goes on to explain:

We’re here to do something about climate change. We’re not here to talk about why it’s happening, how bad it is, or who to blame. We’re here to brainstorm, organize, and act. Use this space to find resources, connect with others, and learn more about you can make a difference. Join us for our sub-wide campaigns as we leverage the platform of Reddit to do some good for the climate.

As is evident from this excerpt, the focus of the subreddit is on action, specifically direct action taken by organizations or individuals to combat climate change. In fact, this is mandated in the subreddit rules (“posting guidelines”):

- Posts must relate to direct climate action
- Respect other people and ideas
- No doom-and-gloom
- Do not advocate violence or death
- No propaganda or science denial
- No memes or low-effort posts
- No spam or self-promotion

In framing itself around action, the community deliberately deemphasizes questions about “who to blame [for climate change]”, “how bad [climate change] is”, or “why [climate change is] happening”, which differentiates /r/ClimateOffensive from communities like /r/collapse (“how bad it is”) and /r/climate_science (“why it’s happening”).

Typical content on /r/ClimateOffensive consists of links to journalistic articles about recent positive developments in climate change (e.g., a municipality adopting stricter regulations), links to resources and petitions, and questions/discussion about climate activist strategies and tactics.

5 Latent topic analysis

In this section, I discuss the results of latent Dirichlet allocation (LDA) (Blei et al., 2003), in which each document in a corpus (in this case, each collected Reddit comment) is modelled as a mixture of a set of underlying “topics”. The model was fit to the corpus as a whole.³

After fitting the LDA model, the transformed data was added to the corpus, creating a dataframe containing each comment as well as each comment’s estimated probability for each topic. These probability scores were used to sample the comments that best represented each topic from each subreddit. This sampling procedure was used to manually inspect each topic to determine whether it actually represented a distinct, coherent topic (“verified topics”). This procedure was adapted from Ammari et al. (2018). Topics that were not evaluated as “verified” were excluded from the remainder of the qualitative analyses presented here. One example of a topic that was not verified contained the terms *let*, *lol*, *capitalism*, *news*, *stop*, *free*, *green*, and *new*. While some comments associated with this topic had commonalities, like being related to the Green New Deal (*green*, *new*), or including the discourse marker *lol*, they could not be reasonably characterized as a single topic or discourse style. Some examples of topics that were verified follow.

5.1 Examples of verified topics

5.1.1 Facts, evidence and arguments

The top eight keywords for the “facts, evidence, and arguments” topic are *fact*, *true*, *argument*, *evidence*, *claim*, *lie*, *age*, and *theory*. Comments associated with this topic discuss or invoke scientific evidence, and evaluate each other’s arguments. /r/climateskeptics has the highest mean comment probability for this topic, reflecting that a goal of the subreddit is to refute claims made by mainstream climate scientists and activists, followed by /r/climate_science, which requires all posts to be related to scientific articles.

Comments associated with this topic on /r/climateskeptics frequently assert that mainstream/‘alarmist’ climate science is untrue and/or based on little or no evidence. For instance, (9a) states that ‘alarmists’ make claims that cannot be observed or reproduced; (9b) accuses ‘alarmists’ of using the well-known ‘correlation does not equal causation’ logical fallacy; and (9c) distinguishes between “buying into” scientific evidence (a behaviour attributed to ‘alarmists’) and “accepting [evidence] because it explains a phenomenon with data” (a behaviour attributed to skeptics). What these comments (and many others associated with the topic in this community) have in common is that they accuse climate scientists and/or activists of poor scientific practice, in contrast to themselves. These comments also employ terminology associated with scientific discourse, such as *rebut*, *substantiated* (9a), *correlation*, *causation*, *theory* (9b), *phenomenon*, and *data* (9c).

³Subreddit-specific models were fit on an exploratory basis, but did not yield additional insight as they largely resembled the aggregate model.

- (9) a. I don't need to rebut alarmist science, it has to prove itself to me. You make the claims, yet we cannot observe the claims, let alone see those claims substantiated by reproduction. Zero evidence my ass. (/r/climateskeptics)
- b. All a skeptic needs to do is prove that correlation does not equal causation and the theory is void. (/r/climateskeptics)
- c. That's bad logic. You don't buy in to scientific evidence, you accept it because it explains a phenomenon with data. (/r/climateskeptics)

A great deal of comments associated with this topic from other communities also relate to debate over the reality of anthropogenic climate change. For instance, (10a) is drawn from a back-and-forth between two users on /r/climate and suggests that it is unlikely that scientific evidence is fabricated. In non-skeptic communities, comments associated with this topic often highlight the unreliability of particular skeptic sources, as in (10b, c), which criticize Peter Temple and World Cycles Institute and the AEI and Heartland Institute, respectively. On /r/collapse, where discourse about evidence typically relates to evidence for impending collapse (10d).

- (10) a. Are you really that gullible to think that scientific evidence is fabricated to support socialists? (/r/climate)
- b. Temple is a "market analyst" who bases everything on assertions of rigidly cyclical models of economics - and also climate, for when he's producing press for Shell, Petro-Canada, Imperial Oil and other fossil fuel merchants. The World Cycles Institute (WCI) is literally just him. It's easy to search for information contradicting the conclusions he draws from the Greenland ice core project in the video. (/r/ClimateOffensive)
- c. What a load of horseshit. As already said, it's conjecture not facts if you do something in a lab with a tank and ten termites then extrapolate that over a global termite population, a number that is pure guesswork. That's c-o-n-j-e-c-t-u-r-e and the "fact" that this has been repeated in Heartland Inst and AEI publications still don't make 'em facts (/r/climate_science)
- d. The evidence leans more and more that we are. Its only our own ego that refuses to believe the evidence. (/r/collapse)

climateskeptics	climate_science	climate	collapse	ClimateOffensive
0.0379	0.0212	0.0191	0.0165	0.0145

Table 1: Mean comment probabilities for *Facts, evidence, and arguments*

5.1.2 Global warming

The keywords for the "global warming" topic are *global, warming, heat, temperature, surface, energy, absorb, and warm*.

This topic involves discussion around the heating of the earth as a result of climate change. Examples from each subreddit are given in (11). As shown in Table 2, /r/climateskeptics and /r/climate_science have the highest mean probabilities for this topic. However, the way the topic is discussed varies greatly: on /r/climate_science, posts associated with this topic mostly have to do with discussion of temperature data, projections for future warming, and so on, as in (11c). However, on /r/climateskeptics, global warming is mainly invoked disparagingly or dismissively, as in (11d), which uses the analogy of a candle in an auditorium to downplay the extent of anthropogenic warming. A common theme is to portray "alarmists" as

taking any weather event or abnormal temperature as evidence of global warming, as in (11e). Discussion of global warming is less frequent in the other three communities, likely because the basic facts around anthropogenic global warming are largely taken for granted in these communities.

- (11)
- a. I have friends in the Phillipines complaining about the heat and how they have never had it this bad. (/r/climate)
 - b. You have to hit them where it hurts. Maybe allude to the fact that there will be no Wi-Fi in the global warming wasteland. (/r/ClimateOffensive)
 - c. Also what does the probability distribution for the expected warming look like? Is it a normal distribution? Is it really widely spread out or is it really tightly centered around 0.5°C? What are the main sources of uncertainty and how do we estimate them? (/r/climate_science)
 - d. Lighting a candle in an auditorium will raise the room temperature in there, too, and to about the same degree as humans contribute to “global warming”. (/r/climateskeptics)
 - e. Too hot? Global warming. Too cold? Global warming. Too dry? Global warming. Too wet? Global warming. Just right? Global warming is on the way! (/r/climateskeptics)
 - f. This idea that we have just a little more than 300 billion tons of carbon in our “budget” is absurd. Look at global temperatures. Look at an actual globe and all the hot spots. I recommend the app Living Earth for that as you can see global temperatures. The oven is on, and it’s heating up. And next year is going to be a doozy. (/r/collapse)

climateskeptics	climate_science	climate	collapse	ClimateOffensive
0.0232	0.0226	0.0122	0.0096	0.0086

Table 2: Mean comment probabilities for *Global warming*

5.1.3 Economics and markets

The top eight keywords for the “economics and markets” topic are *money*, *government*, *company*, *system*, *market*, *economy*, *business*, and *people*.

This topic involves discussion around economics, money, markets, and regulations (hence *government*). As shown in Table 3, /r/ClimateOffensive, /r/climate, and /r/collapse, in that order, have the highest mean comment probabilities for this topic. Many comments in these communities point a finger at capitalist and neoliberal economics for causing and exacerbating the climate crisis, as in (12a) from /r/climate, (12b) from /r/ClimateOffensive, and (12d) from /r/collapse. There is also discussion of potential economic solutions to the crisis, particularly on /r/ClimateOffensive, as in (12c), which criticizes carbon taxes/fees as a “corporate cost externalization” and invokes the rhetorical construct of “the 1%”, a reference to wealth inequality and the disproportionate share of wealth and power held by the richest 1% of people (Alvaredo et al., 2013). This frame is remarkable in the sense that it was not identified as a major frame in previous analyses of climate change discourse in newspapers. For example, Grundmann and Krishnamurthy (2010) found that newspapers in the US and UK did not employ moral frames or attribute responsibility for climate change, and while French and German papers do attribute responsibility (e.g., directing expectations to the US to take action), the authors do not mention discussion of economics, capitalism, or wealth inequality. The same is true of Boykoff’s (2008) analysis of UK tabloids. Fundamental economic issues such as the ownership of the means of production and the distribution of wealth are largely taken for granted in mainstream publications (Fisher, 2009). Online discussion forums such as those analyzed here reside

outside the mainstream and serve as hosts for debate and discussion about issues that are not found in mass media discourses.

- (12)
- a. What a bunch of bullcrap. The capitalism market economic train of thought is what has caused the problems to begin with, because it fundamentally has so many externalities that hurts the Earth's life systems. Capitalism will always do its darnest to avoid government regulation, because according to the market logic, monetary profit always trumps ecological sustainability if there's a conflict of interests. (/r/climate)
 - b. There are a few people who make a ton of money off the coal industry. Unfortunately, due to several decades of deregulation coupled with corruption throughout our government, those few are subverting market forces and have a stronger say in legislation than the rest of the population. That's why it's so essential for Americans to get out and protest, contact their reps, petition, and most importantly: vote these corrupt, self-serving assholes out.
 - c. This is being pushed by the coal industry/"Republicans". Don't be a fool and fall for carbon fees. It's a corporate cost externalization. THE 1% NEED TO PAY FOR IT not the poor. As the rich are the ones that profited from the destruction of the planet's biosphere. (/r/ClimateOffensive)
 - d. Capitalism does not work because it completely ignores the damage to the environment and that cost is never added to the product or service. If it did, products and services would be extremely expensive. Hence, the system would not work. Welcome to the fairytale that is capitalism. (/r/collapse)

In contrast to the non-skeptic forums, /r/climateskeptics posts that are associated with this topic focus on alleged corruption on the part of governments and climate scientists, as in (13a–c). A common idea is that members of the government, the media, and/or the scientific community are engaged in efforts to promote climate action in order to replace the current world order and replace it with socialism, as expressed in (13d).

- (13) /r/climateskeptics:
- a. Maybe you're the one not listening. The government has the greatest incentive to pay for the crony-science that gives them more money, power, and control.
 - b. Publish or perish. They need that grant money and governments are all too willing to throw money at anything that nets them more power and control.
 - c. The public is being scammed by politicians who pay for the pseudoscience they peddle. Anyone who "believes" that the government can control the weather through higher taxes is a fool.
 - d. The media have been engaged in a coordinated campaign to increase racial grievances, to demonize the upper classes and wealth, and to chip away at our trusted institutions including local police, government, and religion. Under the exaggerated threat of climate change we see an effort to unite these grievances under one goal: the destruction of our current order and to replace it with world socialism.

I have not included examples from /r/climate_science here because this topic is largely absent, given that community's focus on climate science research, and the rule against "politically-charged submissions".

ClimateOffensive	climate	collapse	climateskeptics	climate_science
0.0357	0.0313	0.0276	0.0185	0.0107

Table 3: Mean comment probabilities for *Economics and markets*

5.1.4 CO₂ emissions and reduction policies

The top eight keywords for the “carbon reduction policies” are *carbon, emission, tax, green, reduce, policy, new, and cut*.

This topic involves discussion around CO₂ emissions and policies intended to reduce them. As shown in Table 4, */r/climate* and */r/ClimateOffensive* have the highest mean comment probabilities for this topic. On both of these subreddits, there is a great deal of discussion about whether or not carbon taxes are effective or not, and whether or not more drastic action is possible or needs to be taken. These discussions frequently center around pragmatic considerations, such as whether voters will approve a given policy or whether a given policy is more drastic than necessary, as well as frequent invocations of science and scientists. For instance, (14a), invoking ‘science’, argues that carbon taxes are insufficient because the price for carbon would need to be much higher than voters have been willing to accept. (14b) also invokes science when arguing in favour of carbon taxation.

- (14)
- a. All we need is a carbon tax? That would mean the carbon tax in the hundreds of dollars per ton that science says we need, then. How can that happen when voters have firmly slapped down even \$15 per ton carbon taxes? Carbon taxes are good, but I’m afraid we need much, much more. */r/climate*
 - b. Well, like a lot of scientists, I’ve looked at the numbers. We can’t afford not to tax carbon. *(/r/climate)*

Comments about carbon reduction policies are also often framed in terms of their relationship to capitalism and alternative economic systems, such as socialism. For instance, (15a) uses a capitalism vs. socialism frame, arguing the Green New Deal is popular among DSA (Democratic Socialists of America) members, but that climate change can be addressed within capitalism; and (15b) argues that capitalism and sustainability are incompatible.

- (15)
- a. The green new deal is great at getting DSA people excited, but it’s bad at fighting climate change. We don’t need to tear down capitalism, we need to tax and eliminate carbon emissions. *(/r/climate)*
 - b. But they don’t really care about avoiding the pollution. They care about avoiding the tax. These companies have been avoiding taxes for decades, and this is nothing new. Some might play fair and take carbon reducing steps - and, again, I must state that I *do* support carbon pricing, for that aspect - but the majority will find other ways around it. More to the point, they will find ways of repealing it before too long. Carbon pricing is a good first step, but without direct democratic involvement in the economic processes which impact our environment, it’s just a bandaid, a stop-gap measure which doesn’t actually change anything meaningfully. Capitalism is not compatible with a sustainable future. *(/r/ClimateOffensive)*

On */r/collapse*, carbon emissions and reduction are frequently discussed in the context of having children and overpopulation (16a–b), though this is sometimes challenged (16c). Where policies like carbon

taxation and the Green New Deal are discussed, they are frequently dismissed out of hand (16d–e).

- (16) a. ABORTION IS GREEN. <https://youtu.be/YkgDhDa4HHo?t=27> (/r/collapse)
- b. Going vegan in a developed country would have a minimal impact on limiting your carbon footprint. By far the greatest choice you can make as a human in order to reduce emissions is to not have children, then reducing or entirely eliminating flying and driving, the rest of the things you can do are relatively minor in comparison. (/r/collapse)
- c. It’s scientifically poor to blame the world’s problems on overpopulation alone, without calling out certain countries for massively disproportionate per-capita consumption. ”Racist” is not the best term IMHO, but there is a problem here. But, as usual, these threads devolve into name-calling and finger-pointing - which is the exact behaviour that got us here. To actually solve our problems, many countries need to control birth rates, most countries need to reduce pollution, and most developed countries need to reduce per-capita consumption (a few developed nations require very significant reductions). (/r/collapse)
- d. I think an effective tax on carbon emissions or enviromental damage in general would make most businesses unprofitable, so it would never be approved. (/r/collapse)
- e. What has the green new deal actually accomplished? (/r/collapse)

Unsurprisingly, /r/climateskeptics users generally take a dim view of carbon reduction strategies. However, they respond to these proposals in a variety of ways. For instance, (17a) uses mockery, responding to a since-removed submission from a non-skeptic entitled “You assholes are preventing us from saving the planet” by telling them to kill themselves in order to reduce their carbon footprint. In response to a user asking what climate scientists would gain from hiding data, (17b) attaches carbon mitigation policies to a conspiracy to implement “radical ideas”. Some comments, such as (17c), dispute that CO₂ is a problem in the first place, arguing that it is good for plants, for example. (This narrative can be traced to think tanks espousing climate change denial, such as the UK’s Global Warming Policy Foundation, e.g., Goklany 2015.)

- (17) a. Kill yourself so your future carbon footprint will be around net zero. If you refuse to kill yourself now you’re not saving the planet. Hypocrit commie. (/r/climateskeptics)
- b. Using the big scare and pushing people to adopt more radical ideas (socialism for example, or the green new deal, so on) (/r/climateskeptics)
- c. carbon dioxide desperatly needed. to double carbon dioxide in the atmosphere would be best for plants. (/r/climateskeptics)

climate	ClimateOffensive	climate_science	climateskeptics	collapse
0.031	0.0303	0.0207	0.0149	0.0123

Table 4: Mean comment probabilities for CO₂ emissions and reduction policies

5.1.5 Food and agriculture

The top eight keywords for the “food and agriculture” topic are *food*, *grow*, *population*, *eat*, *meat*, *animal*, *feed*, and *plant*. This topic involves discussion around growing food, meat consumption, and veganism.

Comments highly associated with this topic can be largely grouped into two categories: growing one’s own food, and the environmental impacts of eating meat. The former is very commonly found on /r/col-

lapse: users discuss sustainable food-growing practices, intended to help them survive after the collapse of society (18a–c).

- (18) a. One should not confuse growing tomatoes with growing calories. Tomatoes are an addition of flavor with a number of different glutamates. One will need to be growing/acquiring sufficient calories every day. (/r/collapse)
- b. I can only grow food on my balcony. ;((/r/collapse)
- c. I suggest substituting pork for beef as much as you can, and incorporate some legumes and tofu into your diet. Pork is cheaper, less taxing on your system, and requires less land to grow. Pigs are omnivorous, meaning their feed is generally less expensive, whereas cows need to graze on grass, which requires lots of land. (/r/collapse)

Discussion of meat-eating and veganism is found across subreddits. For example, users on /r/climate and /r/ClimateOffensive advocate reduction in meat consumption as a means of reducing carbon emissions (19a, b). These discourses are also present on /r/collapse, but the tenor of these comments is often more critical. For example, (19c) dismisses potential positive impacts of veganism unless the food is grown independently. Users on /r/climateskeptics often oppose veganism explicitly, as in (19d), which claims that plant-based diets lead to nutrient deficiencies and cannot be digested properly, and (19e), which mocks the animal-welfare basis of veganism by extending consciousness to vegetables. Note that (19d) also associates vegans with antifa (anti-fascists); this serves to conflate the two categories into one group of left-of-centre enemies.

- (19) a. More taxes on meat/dairy products should be implemented too. Animal agriculture/factory farming is a bigger threat to our environment than burning fossil fuels. (/r/climate)
- b. Today there are so many meat alternatives, it's easier than ever to not eat meat. It's arguably the easiest thing you can do to make the most dramatic impact towards lowering your carbon footprint. (/r/ClimateOffensive)
- c. Vegans? Unless you're growing your own food, you're contributing just as much as everyone else. (/r/collapse)
- d. Not to mention eating a plant based diet heavily degenerates human cells. That's partly why antifa vegans are so stupid and aggressive: B12, A and trace mineral deficiency. We have evolved eating meat. Animal fat is life. (Plus we can't even digest plant foods, the fiber is just there to make us shit. And our intestines cannot extract nutrients from plants either, facts) (/r/climateskeptics)
- e. I don't think vegetables want to be eaten either. This food chain idea is awful. We should just stop eating and be done with it. (/r/climateskeptics)

ClimateOffensive	collapse	climate	climate_science	climateskeptics
0.036	0.029	0.021	0.015	0.013

Table 5: Mean comment probabilities for *Food and agriculture*

5.1.6 Collapse of society

The top eight keywords for the “collapse of society” topic are *collapse*, *society*, *species*, *rate*, *population*, *civilization*, *decline*, and *bear*. Unsurprisingly, comments associated with this topic are most prevalent on /r/collapse (Table 6), although collapse-related discussion occurs to some degree in all five communities.

Discourse about collapse is largely fatalistic, with a number of comments framing it as an inevitability (20a–c). In fact, in (20b, c), collapse of the environment is presupposed (embedded in a structure such that it’s not cancellable by negating the matrix sentence).

- (20)
- a. In my view I don’t think there’s any ”stopping” a collapse of our current population/resource consumption – we’re already in overshoot, and the carrying capacity of the planet will decline along with runaway carbon feedback loops and the continuation of the sixth mass extinction. However, I don’t think we’ll go totally extinct either – we’ll probably adapt, albeit in much smaller numbers, with greater difficulty, and with a much lower standard of living. (/r/collapse)
 - b. This is precisely my line of thinking on why collapse will happen ”sooner than expected”. Once everyone realizes environmental collapse is inevitable within their lifetime, societal collapse will occur - at least a decade prior to environmental. And if a critical mass of people understand that, then it’ll come sooner. (/r/collapse)
 - c. It’s only avoidable under a social philosophy where growth/improvement is not a goal. Only when there is no push to increase population, increase resources, increase *safety and security*, and improve the ”future” for ones ”progeny”. If humanity could come to a philosophy that avoids all of that, then I believe collapse *would* have been avoidable. (/r/collapse)

Discourse about the /r/collapse community itself appears in the other four subreddits, as well. The opinions expressed in these comments is largely polarized. Some comments, as in (21a), invite other potentially receptive users to visit and engage with /r/collapse. A large number of comments, especially on /r/climate_science, denounce /r/collapse and its users for being unscientific and/or expressing more certainty about impending collapse than is warranted (21b–d). /r/ClimateOffensive comments typically criticize /r/collapse from the perspective that its “ideology of inaction” (21e) is counterproductive. Comments on /r/climateskeptics cite /r/collapse as an example of the consequences of climate change alarmism.

- (21)
- a. Welcome to the dark side, friend! /r/collapse awaits (/r/climate)
 - b. What is up with you /r/collapse posters and your absolute certainty of the future? You seem far more certain than 99% of the scientists who actually study all of these things. I’ve learned to spot people like you with about 80% accuracy just from the wording you use. (/r/climate)
 - c. /r/collapse is a cesspool or non-scientific hyperbole that verges more on climate fan fiction than climate science. Most of the commenters take all of the worst case scenarios, inflate them, and combine them, without any consideration of the assumptions, probability, or uncertainty associated with the projections. What bothers me most about that subreddit is that they all think they know *better* than scientists and that a person who reads internet blogs in their free time has a more comprehensive understanding of the climate change problem than someone who’s worked on it. We might all have specialties within science but we still have to write textbooks and review papers, teach introductory classes, give public lectures, collaborate with people outside our field of expertise, listen to other scientists at conferences, etc. (/r/climate_science)
 - d. Don’t read either /r/collapse or skeptic blogs. There’s nothing of substance in either. Just read the excellent material at places like NASA, Carbonbrief, and RealClimate.org. These

- e. are written / vetted by actual scientists and have high production value. (/r/climate_science)
I spent a good amount of time on r/collapse before making this sub, so I'm really glad that we're having this discussion to counter them. In everything we do we need to be the anti-r/collapse, because an ideology of inaction is dangerous both to our climate and to the mental health of those subscribing to it. The only way to know if our fight is futile is to throw everything at it. (/r/ClimateOffensive)
- f. Seeing the den of despair and madness that is r/collapse, I would think that true warmist believers wallowing in depression and suicidal thoughts are the ones needing psychiatric studies and, most urgently, help. (/r/climate_skeptics)

collapse	climate_science	climate	ClimateOffensive	climateskeptics
0.026	0.017	0.014	0.01	0.009

Table 6: Mean comment probabilities for *Collapse of society*

5.1.7 Nation states and geopolitics

The top eight keywords for the “nation states and geopolitics” topic are *country, china, america, weather, day, europe, australia, and india*. Comments associated with this topic are found across all five subreddits. A common theme in these comments is discussion of the Global South vs. the Global North, as well as related equity and justice issues. For example, (22a) argues that China and India have no reason to stop using fossil fuels unless compensated by countries that have been emitting fossil fuels since the industrial revolution. Along the same lines, (22b) points out that imperialist states had previously exploited African nations, arguing they should be compensated for not extracting resources. In contrast, (22c) states that Asian countries are *more* responsible than ‘Western’ nations for pollution, and thus should not be “let off the hook” for it.

- (22) a. The huge developing countries like China and India would love to stop building new fossil fuel power plants. As long as the developed countries directly pay them for the cost of building renewables. Since they've been emitting their share since the industrial evolution. No pay. No play. Let's not pretend the world works in an utopian way. (/r/climate)
- b. Here's how the west can help, give money to those African nations you had previously exploited for not extracting resources. (/r/ClimateOffensive)
- c. Western nations are all contributing to a less polluted world. Asian economies don't give 2 fucks. The idiots at Davos wants to keep penalizing the West and let Asia of the hook. (/r/climateskeptics)

Another common topic area where nation states are commonly invoked is overpopulation. There is ongoing debate over whether states in the Global South with growing populations are a cause of the climate crisis, or whether increased global populations are sustainable. For example, (23a) states that improvements in the quality of life of people in the Global South and are not sustainable given their population levels, whereas (23b) argues that it is racist to focus on countries in (e.g.) sub-Saharan Africa when people living in the US consume far more per capita. (23c) makes a similar point by ironically voicing a “rich kid” who blames China and Africa for climate change while enjoying luxury entertainment products and fast

food. Note the use of overt *tb*-stopping (“dem”) when taking on the voice of the “rich kid”, which helps distinguish the comment-writer’s voice from the voice they are satirizing.

- (23) a. So sure if you want the majority of African/Indian/Chinese etc people to live a life of abject poverty forever. Then yes, those countries aren’t overpopulated. But if they want/desire to improve their circumstances without doing untold damage to the environment then they are very overpopulated.
- b. This is a racist talking point. A person living in the United States is going to consume 53 times more in their lifetime as someone in sub Saharan Africa. Your focusing your anger on there being, to put it lightly, too many brown people, when in reality that’s not the cause of the problem at all, and hardly a contributor to the problem. This is eco-fascism, and it’s wrong (/r/ClimateOffensive)
- c. Rich kids dont wanna hear the truth. It is the fault of china and dem blacks in Africa as long as i have my ps4 and kfc (/r/collapse)

collapse	climate	climateskeptics	ClimateOffensive	climate_science
0.023	0.019	0.017	0.016	0.011

Table 7: Mean comment probabilities for *Nation states and geopolitics*

5.1.8 Greenhouse effect

The top eight keywords for the “greenhouse effect” topic are *co2, effect, atmosphere, increase, gas, greenhouse, temperature, and water*. This topic is associated with discussion about the mechanics of the greenhouse effect—that is, how CO₂ in the atmosphere contributes to warming of the Earth. As is clear from Table 8, comments associated with this topic are most prevalent in /r/climate_science and /r/climateskeptics.

Unsurprisingly, while both of these subreddits discuss the greenhouse effect and how it works, the goals of doing so are different. Comments in /r/climateskeptics about the greenhouse effect frequently dispute it, as in (24), which draws an analogy between the Earth and Mars, whose atmosphere is almost entirely CO₂ but is much colder than the Earth. This is actually because Mars is farther from the Sun. Other comments endorse some aspects of the greenhouse effect, but dispute others, such as (24b), which claims that the warming effect of CO₂ diminishes as it becomes more concentrated in the atmosphere. Note that while the comment overall disputes the IPCC view on climate change, it deploys scientific terminology/jargon to do so (*logarithmic, ppm, GHG*). Comments from /r/climate_science (24c, d) are written in a similar style, but generally endorse the IPCC view.

- (24) a. You know what other planet has a high atmospheric co2 concentration? Mars. About 96%. And guess what, it’s not hot there. (/r/climateskeptics)
- b. But CO2s ”warming abilities” if you want to call it that, diminish in a logarithmic fashion, so that most of it’s warming abilities occur far below 100ppm, which we surpassed millions if not billions of years ago. As CO2 continues to increase, we can expect a very quickly diminishing impact to the planet from it’s warming abilities. The more CO2 levels increase, the less impact it has, until it has none whatsoever. If CO2 could somehow overpower water vapor as a GHG, deserts wouldn’t get as cold at night like they do. The reason they do is a lack of water vapor, not CO2. (/r/climateskeptics)

- c. One of the fingerprints of climate change is that all of the increases in atmospheric CO₂ are increases in C12 as oppose to C13. The 12 and 13 refer to atomic weight and are called isotopes - C13 is what plants use; therefore, what animals eat, therefore all the carbon we eat, therefore all the CO₂ we exhale. C12 is the type of carbon found in fossil fuels. The observed increase in atmospheric CO₂ is from 280 ppm to 415 ppm all of that C12. (/r/climate_science)
- d. Don't forget that carbon dioxide is only one of the factors that determines the global temperature average, so we can't extrapolate that easily. You also need to account for the velocity of change: even if we do trigger a feedback loop, it's not a huge deal if only produces say 1% of its effect over the century. (/r/climate_science)

climate_science	climateskeptics	climate	ClimateOffensive	collapse
0.041	0.035	0.017	0.012	0.011

Table 8: Mean comment probabilities for *Greenhouse effect*

5.1.9 Increasing and rising

The top eight keywords for the “increasing/rising” topic are *level, rise, sea, expect, increase, faster, rate, and high*. This topic is interesting because rather than being focused around a set of concrete concepts, like *food* or *carbon*, it is focused around the abstract concept of *increasing*. There are a number of aspects of climate change that are increasing and thus collected under this topic: atmospheric CO₂ levels, CO₂ emission rates, global temperatures, sea levels, and so on. This topic is unsurprisingly associated with comments discussing increasing phenomena:

- (25) a. I just had a quick look at the link you posted. And clicked on the time series plots. These plots are of ice extent in End of December and beginning of January. This is the lead up to the maximum ice extent. I would expect The Ice to increase as the plots show. But as the years advance from 2015 to 2019, the yearly lines travel down the plot showing that there is less ice every year. Is this plot what you got? (/r/climate_science)
- b. If it is expanding at a rate of x4 every 6 years, then it will be melting 16x's faster by 2031? How bad will that be? (/r/climate)
- c. I disagree with the study that "The restoration of trees remains among the most effective strategies for climate change mitigation." We *have* restored our forests, and yet atmospheric CO₂ and CH₄ levels are increasing at accelerating rates. (/r/ClimateOffensive)
- d. Yes, sea levels are rising, but that's not really new or extraordinary. When humans first arrived in North America about 15k years ago, sea levels were 450 feet lower and Boston was under a mile of ice. None of that warming was the result of humans. (/r/climateskeptics)

On /r/collapse, the phrase “faster than expected” has become a meme, apparently playing on the frequency with which negative climate-change news articles contain it. The term is “memeified” to the extent that users overtly comment on it (26a, b), make plays of words using it (26c, d), post comments with it as the only content (26e, f), suffix it with the trademark symbol (26g), and abbreviate it to FTE (26h). This appears to be a tool for the construction of ironic distance. While many /r/collapse comments express worry about the impending collapse of society, others express (ironic) excitement about collapse and the concomitant consequences (27) (note the use of exclamation marks to convey sarcasm/irony).

- (26)
 - a. “faster than expected”. Quickly becoming my least favorite set of words (/r/collapse)
 - b. [“faster than expected”] has become a low-effort ”meme” on here; tired of seeing it, no matter how *obviously* true it is. (/r/collapse)
 - c. Faster than (Faster than expected) (/r/collapse)
 - d. Yea, I came after 10 seconds, babe. You know, now everything in the world happens *faster than expected*. (/r/collapse)
 - e. Faster than expected (/r/collapse)
 - f. Faster. Than. Expected. (/r/collapse)
 - g. Faster Than Expected™ (/r/collapse)
 - h. Convergence as expected. FTE but nonetheless expected. (/r/collapse)
- (27)
 - a. Fuck yeah. Chicago is going to be a paradise when all of that pesky arctic ice melts... can’t wait! (/r/collapse)
 - b. I’m not sad. I’m just excited to kick off the great dying!!!!!!!!!!!!!!!!!!!!!!
 - c. A three-way tie! And all the competitors finished faster than expected!

Comments associated with this topic on /r/climateskeptics are primarily dismissive of it. Note the use of the explicit sarcasm marker “/s” in (28b).

- (28)
 - a. Wait ... what? What “sea-level rise unfolding much faster than expected”? We were told in 1988 that the Maldives would be underwater in 30 years (2018). They aren’t. Not even close. In 1988 there were 1196 islands in the Maldives, today there are only ... (you guessed it) 1196 remaining with zero evidence that they are going away anytime soon.
 - b. Sea levels are 50 feet higher, temperatures are 20C higher and oceans are acidic enough to instantly dissolve metal. Yep, the predictions were spot-on. /s

climate_science	climateskeptics	climate	collapse	ClimateOffensive
0.018	0.017	0.015	0.013	0.009

Table 9: Mean comment probabilities for *Increasing and rising*

5.1.10 Problems and solutions

The top eight keywords for the “problems and solutions” topic are *problem, solution, issue, fix, solve, need, be, and address*. The comments associated with this topic have to do with discussion of various issues that are framed as problems (not limited to climate change itself), and discussion of potential solutions.

Many comments associated with these topic are directly related to climate change, its consequences, and potential solutions:

- (29)
 - a. While planting trees is an actual real form of geoengineering that doesn’t mean it is a practical solution to climate change. It’s certainly part of the solution but it is by no means The Solution. (/r/climate)
 - b. I would say overpopulation (and overconsumption) is one of the main drivers of our current miserable predicament. (/r/collapse)
 - c. Can someone explain to me why if CO2 emission is the problem why isn’t our goal for ”tolerable climate” stated in CO2 directly like 410PPM? Why are the goals stated in temperature

units of 2C? (/r/climate_science)

It is useful to compare which issues each community frames as problems, as well as what solutions they propose. Aside from discussing climate change itself as a problem, many posts associated with this topic in /r/ClimateOffensive frame the problem of climate change in terms of wealth inequality (30a) and capitalism (30b). On this framing, climate change is viewed as a symptom of the capitalist economic system rather than as an isolated issue. An opposing frame avoids assigning blame to capitalism or corporations, centering the discussion solely around potential solutions (30c). This is the frame officially “endorsed” by the moderators of the community, via the following statement in the sidebar: “We’re not here to talk about why it’s happening, how bad it is, or who to blame.”

- (30)
- a. The existence of massively concentrated wealth is literally at the root of the problem (/r/ClimateOffensive)
 - b. No need to apologize. Politicians and denial groups being paid by large companies are in fact the problem. And they are only complicit actors in the larger systemic problem that is capitalism. (/r/ClimateOffensive)
 - c. We need to seriously reform or replace capitalism entirely to solve our various ecological crises. It’s a system based upon infinitely increasing production and consumption; inherently contradictory with our limited resources. It won’t be “another commodity” but another economic system entirely which saves us. (/r/ClimateOffensive)
 - d. Everyone on earth is to blame, we have all had a hand in it. I just personally think the blame needs to stop and instead we need to work on solutions instead of placing blame (/r/ClimateOffensive)

On /r/climateskeptics, a common theme is the rejection of problems identified by activists and mainstream scientists. For example, (31a), discussing nuclear power, refers to the issue of transitioning to green energy as “a problem they need to have”, implying that the problem was invented for some ulterior reason. This theme is echoed by (31b). Another common theme is the idea that activists and mainstream scientists’ actions are counterproductive, as in (31), which suggests that they create more problems than they solve.

- (31)
- a. It solves a problem they need to have. (/r/climateskeptics)
 - b. create the problem create the solution, thats how they seem to keep themselves relevant (/r/climateskeptics)
 - c. I’d settle for them fixing more problems than they create. (/r/climateskeptics)

On /r/collapse, many comments dismiss the possibility of solutions entirely. I found a number of comments along the lines of (32a), which flatly state that there is no solution for the climate crisis. Humour is also a common strategy, as in (32b), which jokes about the idea of towing the US (“it”) outside the environment in order to avoid the crisis. As with /r/ClimateOffensive, blame is frequently placed on the rich and on the system that allowed them to become rich, as in (32c), which asserts that collapse cannot be averted without dealing with the ‘elite’, and in (32d), which states that overpopulation would not be a problem if it was not possible for a small number of people to hoard resources.

- (32)
- a. There is no solution. (/r/collapse)
 - b. We towed it outside the environment, thus solving the problem once and for all. (/r/collapse)
 - c. to solve the problem of collapse we must solve the problem of the rapacious, amoral elite. (/r/collapse)
 - d. Overpopulation is not an issue if we disallow resources to be hoarded by the few. But at our current societal structures yes overpopulation will be an issue. (/r/collapse)

ClimateOffensive	climate	collapse	climateskeptics	climate_science
0.019	0.019	0.016	0.013	0.013

Table 10: Mean comment probabilities for *Problems and solutions*

5.2 Principal components analysis

The LDA model resulted in a large number of topics that are taken to explain the variation in the data. Although it is possible to interpret each topic individually, it is complicated to manually identify correlations between these individual topics, which is necessary to get a better idea of how communities relate to one another in terms of the topics they use or don't use. To simplify this process, I conducted a principal components analysis (PCA), which is a dimensionality reduction technique that seeks to explain observed variation using a smaller number of underlying components.

The data used for the PCA was a 5-by-50 dataframe, containing mean probabilities for each topic per subreddit. The mean probabilities were used rather than raw comment probabilities because individual comments tend to score highly on only one topic, so it is not possible to identify correlations between topics using individual comment scores. (As a simple diagnostic, there are no correlations greater than |0.1| between any two topics when using the individual comment scores.)

The first two components of the PCA explained about 80% of the variance in the data. Each subreddit is plotted based on its scores for these two components in Figure 1.

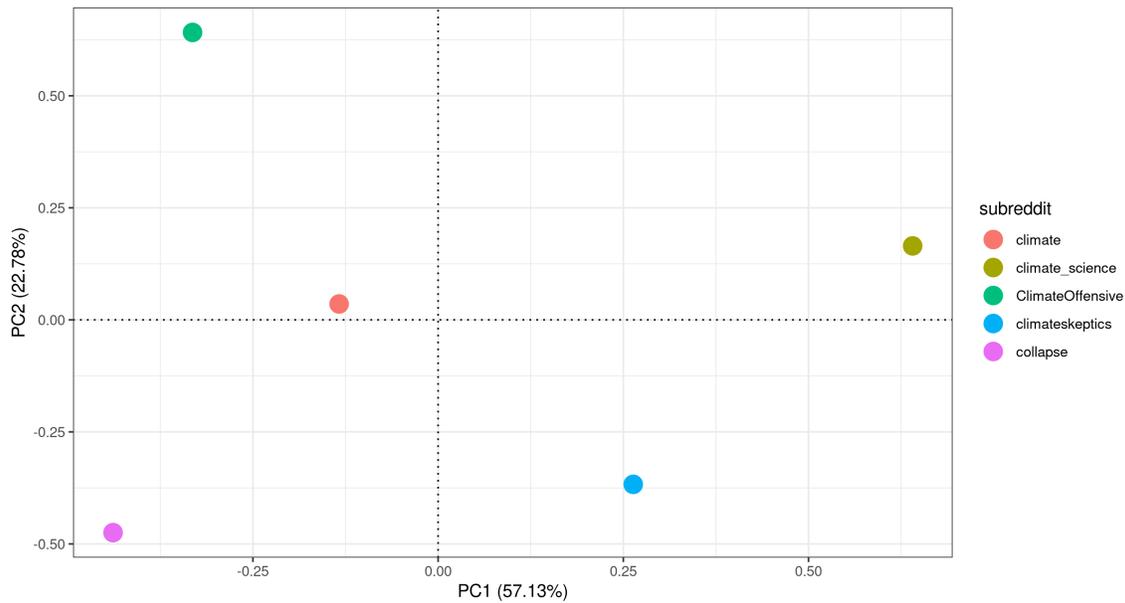


Figure 1: Principal components analysis

The first component (“PC1” in Figure 1) seems to correspond to discourse about data and science:

some of the topics with high scores for this component include *facts, evidence and arguments, global warming, greenhouse effect, increasing and rising*, and *climate science/skepticism*; and some of the comments with low scores for this component include *problems and solutions* and *CO₂ emissions and reduction policies*. The second component (“PC2”) seems to correspond to discourse about solutions and activism: some of the topics with high scores for this component include *energy, CO₂ emissions and reduction policies, individual action*, and *problems and solutions*; and some of the comments with low scores for this component include *collapse of society* and *increasing and rising*. Figure 1 shows how each subreddit scores on these two components.

Unsurprisingly, scores for PC1 (data/science discourse) are highest for */r/climate_science*, followed by */r/climateskeptics*. */r/climate* is near zero, and */r/collapse* and */r/ClimateOffensive* have negative scores for this component. The high score for */r/climateskeptics* is in line with observations above that */r/climateskeptics* frequently employs scientific discourse despite its ideological position against mainstream climate science. Scores for PC2 (activism) are highest for */r/ClimateOffensive*, followed by */r/climate_science*. */r/climate* is near zero, and */r/collapse* and */r/climateskeptics* both have relatively strong negative scores for this component. This component differentiates */r/ClimateOffensive* from */r/collapse*: both discuss science infrequently, but */r/ClimateOffensive* is dedicated to activist discourses whereas the nihilistic stance associated with */r/collapse* disdains activism and individual action as futile. */r/climate*, as a general-purpose climate change discussion forum, is close to zero on both axes.

5.3 Discussion

As outlined in §5.1, the Reddit climate corpus contains a wide variety of topics. The same topic is often discussed in different ways in different communities. For instance, in most of the communities examined here, the “food and agriculture” topic centers on veganism and the environmental effects of eating meat, but on */r/collapse*, the topic is mostly associated with sustainable food growing practices. Similarly, in most communities, the “economics and markets” topic centers on discussion and debate on the extent to which capitalism and wealth inequality impact climate change. However, on */r/climateskeptics*, the topic is mostly associated with accusations of government corruption, perverse financial incentives for publishing research showing that the planet is warming, and conspiracies on the part of the media and elite in order to institute socialism/communism. The same broad discourse topics are being recruited for different rhetorical and/or political ends in different communities. Latent Dirichlet allocation is a useful tool for examining this process because it allows us to automatically learn these topics and automatically score the data on these topics.

Many of the topics examined here, such as capitalism and wealth inequality as root causes of climate change, as well as the potential for societal collapse, have not been identified as topics of discussion in previous work on climate-change discourse (e.g., Boykoff, 2008; Boykoff & Boykoff, 2004; Grundmann & Krishnamurthy, 2010). This speaks to a difference between institutional and non-institutional climate discourses: institutional discourses, such as those found in broadsheet and tabloid newspapers, take the dominant social and economic systems in which they are situated for granted, in line with Fukuyama’s (2006) ‘end of history’ thesis. Herman and Chomsky (2010) outline a number of reasons for this phenomenon, including ownership and profit motive of media corporations, political and economic desires of advertisers, and flak from elected officials. While some of these pressures can be argued to apply to Reddit as well, Reddit only hosts the content that is found on the site, which is created by unpaid users with no financial incentive to endorse institutional views. The non-institutional nature of discourse on Reddit makes it a useful case study for examining how individuals with no (apparent) institutional power discuss climate change, with the caveat that these findings are not necessarily representative of the general public, only

of Reddit users interested in climate change. Future work should investigate climate-change discourse on large ‘default’ subreddits which users are automatically enrolled in when registering, which would provide data on how users who do not deliberately seek out climate change communities behave.

While there are no direct personnel or financial links between powerful institutions and these communities, there are remarkable similarities in discourse strategy and ideology between /r/climateskeptics and think tanks that promote climate skepticism. This analysis found that /r/climateskeptics had high average topic probabilities for a number of topics related to the science of climate change, including the greenhouse effect and global warming, as well as the topic associated with evidence and argumentation. Moreover, in the first component of the principal components analysis (§5.2), which I take to represent science discourse, it scores the second-highest, after /r/climate_science. As noted throughout the previous subsection, comments on /r/climateskeptics commonly employ scientific terminology and jargon in service of climate-skeptic arguments. There are parallels here with Taylor-Neu’s (2019) analysis of the Nongovernmental International Panel on Climate Change (NIPCC) as a parasite of the Intergovernmental Panel on Climate Change (IPCC). Taylor-Neu (2019) describes how, by mimicking the IPCC’s scientific discourse style, the NIPCC “mine[s] scientific authority while undermining scientific consensus regarding anthropogenic climate change”. I return to this idea in the general discussion (§7).

6 Classification

In this section, I discuss the results of unsupervised binary classification, a set of machine learning models that, given a set of training data that is labelled as one of two categories, attempt to determine which category unseen data belongs to.

Classification is a suitable complement to the LDA analysis reported in §5 because LDA focuses on identifying commonalities between groups of the data based on model-generated categories. This sheds light on general topics discussed in these communities (and the transformed data can be used to identify which communities feature these topics more or less frequently), but the output includes a number of topics like *CO₂ emissions* which are frequently discussed in all five communities. While the output can be used to pull out high-scoring comments for each topic from different communities (which can be used for qualitative comparisons, such as what was done in §5), it does not lend itself to direct quantitative comparisons between communities. In contrast, classification directly compares text data from two communities, filtering out features that are common between the two communities and focusing in on what is different. This provides a solid foundation for a comparative analysis which can be further supplemented with qualitative observation.

The classification method used in this paper is as follows. Each classifier is applied to a set of comments from two subreddits. The data is split into two sets, with 20% of the comments from each subreddit in the ‘training’ set and the other 80% in the ‘test’ set. Prior to running the model, each document is transformed into a vector of each word’s *TF – IDF* score. The *TF – IDF* vector transformation aims to represent words based on how frequent they are in a given document, offset by how frequent they are in the corpus as a whole. To calculate this score, we take the product of the word’s term frequency (*TF*) and inverse document frequency (*IDF*):

$$TF(w) = \frac{\text{number of times } w \text{ appears in this document}}{\text{total number of words in the document}}$$

$$IDF(w) = \log_e \left(\frac{\text{total number of documents}}{\text{number of documents containing } w} \right)$$

$$TF - IDF(w) = TF(w) \cdot IDF(w)$$

The model uses this vectorized data and analyzes the comments in the training set to determine which lexical items are most distinctive of each subreddit. It then uses those results to predict which comments in the test set belong to which subreddit.

Using the `scikit-learn` (Pedregosa et al., 2011b) logistic regression classifier, I fit 10 classifiers in total, one for each possible pairing of the five subreddits. While multi-label classification (i.e., a classifier with more than two possible predicted values) is possible in principle, I used pairwise classification to keep the models simple and to facilitate interpretation. The quality of each classifier varied depending on the size of the two datasets (for instance, because there is less data for `/r/climate_science`, models were generally less successful at identifying posts from that community), but all models performed above baseline (50% accuracy).

Below, I summarize the results of each classifier in turn, first comparing `/r/climate` to each of the other four subreddits, then comparing `/r/climateskeptics` to the remaining three subreddits, then `/r/ClimateOffensive` to the remaining two subreddits, then `/r/climate_science` to `/r/collapse`. The full results of all 10 classifiers are available in Appendix A. In many cases, there was overlap between the features associated with a given subreddit in different classifiers. For instance, when comparing `/r/climateskeptics` to `/r/climate`, many of the same features are distinctive as when comparing `/r/climateskeptics` to `/r/ClimateOffensive`. For that reason, I discuss the results of classification in a broad, summative way here, referring to specific models where relevant.

6.1 Political content

In several of the classifier models (`/r/climate` and `/r/climateskeptics`, for example) a number of the most important features have to do with politics. For `/r/climate`, most of these have to do with US electoral politics, with features such as *republicans*, *bernie*, *candidate*, *election*, *trump*, and *lobby*. Electoral methods are frequently discussed as a way to achieve action against climate change.

- (33) `/r/climate`:
- a. Republicans are ignoring the Human-Caused Climate Change elephant in the room, kicking the can down the road until it explodes. Then it will cost us, not just financially but socially and politically.
 - b. Vote for candidates that will address climate change and donate to their campaigns. (Like Bernie Sanders). You can't address climate change without addressing social justice. They're linked, so people are going to have to deal with it.
 - c. Lobbying isn't going to convince republicans. The only hope is winning the senate.

For `/r/climateskeptics`, the important political features have to do with leftist ideology, such as *leftist*, *left*, and *communist*.

- (34) `/r/climateskeptics`
- a. If you look at any of these “green” groups closely and read their manifestos on their websites, you'll see they are actually literal socialist communists.
 - b. Why is it that these same money-grabbing Leftists who are screaming “climate change” are the same ones who were screaming that the Earth was about to have a “new ice age” back in the 70s?

In conjunction with terms like *narrative* and *agenda*, these terms are used to allege that anthropogenic climate change is manufactured or distorted in order to promote left-wing politics.

- (35) /r/climateskeptics
- a. Thank you once again Tony for exposing how NOAA and NASA are deliberately corrupting data to push their communist agenda.
 - b. ‘Uncollegial’ means not going along with the leftist narrative that has no basis in reality.

In contrast to /r/climate’s heavy focus on electoral politics, /r/ClimateOffensive also includes a number of terms related to non-electoral activism and fundraising. For example, *ecosia* refers to a search engine that donates ad revenue to tree-planting initiatives, *strike* refers to worldwide climate strikes that took place starting in 2019, and *ccl* stands for Citizens’ Climate Lobby, an organization that trains and organizes volunteers to lobby their elected representatives on climate-change related issues. Important features from /r/ClimateOffensive have to do with effects and consequences of climate change, such as *scenario*, *disaster*, *flood*, *weather*, *civilization*, and *melt*, as well as U.S. electoral politics (*trump*).

6.2 Skeptic shibboleths

A number of the features that distinguish /r/climateskeptics across classifiers are shibboleths of the climate skeptic/denialist movement. For example, *CAGW* (“catastrophic anthropogenic global warming”) is a term used exclusively by skeptics (it does not appear a single time in any of the other subcorpora) to refer to anthropogenic climate change, with the addition of the term “catastrophic” serving to reorient the debate from the original denialist question (whether or not humans cause climate change) to the current skeptic question (whether or not human-caused climate change will be as bad as mainstream scientists say). The use of this term as shorthand for mainstream climate science serves several functions for skeptics beyond mere shortening. First, it is a convenient method of describing mainstream beliefs about climate science in a nominal way (rather than, e.g., a predicative way, such as a relative clause), as in (36a). This facilitates its use as a pejorative label which can modify other phrases, as in “CAGW scientists” in (36b), similar to the term *SJW* (Massanari & Chess, 2018). Also like *SJW* (Massanari & Chess, 2018), *CAGW* serves as an identity marker and linguistic gatekeeping tool, and is explicitly used as such in, e.g., (36c), wherein a user is admonished for not knowing what it stands for. Finally, the use of the initialism concretizes and officializes the concept, sharpening the distinction between the beliefs denoted by *CAGW* and ideals of science and the scientific method (e.g., in (36a), where the user states that “CAGW isn’t even science”).

- (36) a. Global warming hysteria has stolen attention, momentum and diverted billions of dollars in funding from far more serious local environmental issues where it was actually making a real difference. Yet all that money has yet to produce a CAGW computer model that makes predictions which match real-world measured observations. Until it does, by definition, CAGW isn’t even science, it’s merely a conjecture. I don’t think we should impoverish millions of people in the developing world on an unproven conjecture.
- b. The experiment resulted in a failure for CAGW scientists claiming that CO2 resonant IR is passed from CO2 molecule to CO2 molecule in the atmosphere.
- c. CAGW is Catastrophic Anthropogenic Global Warming. If you don’t know that then why are you here?

The rhetorical shift among skeptics away from outright denial and toward minimization is also evident in the distinction between the terms *denial* and *skeptic/skeptical*—the former is a strong feature for /r/climate, and the latter are strong features for /r/climateskeptics. Users on non-skeptic subreddits tend to describe the ‘skeptic’ position as *denial*, whereas /r/climateskeptics users reject this term, as in (37a), and frame it as skepticism. In (37b), a /r/climate user explicitly contests the use of the term ‘skeptic’ (in a news article

headline) to refer to a Trump EPA appointee, and in (37c), a /r/climate user describes /r/climateskeptics users as deniers.

- (37)
- a. I'm a skeptic not a denier but I think you're right.
 - b. he isn't a fucking 'skeptic'
he's a corrupt denier of blatantly obvious science
bit difference (/r/climate)
 - c. A person really needs to take a short trip over to r/Climateskeptics to get a real pungent sniff of the deniers bullshit. I get such a kick of the ridiculously arrogant ignorance over there. (/r/climate)

The shift is also reflected in the label that /r/climateskeptics users predominantly assign to their political opponents, and the strongest feature by far in the classifier: *alarmist*. Rather than emphasizing belief in warming itself,⁴ the label *alarmist* (and associated terms like *hysteria*) foregrounds (and disdains) the belief that warming is a cause for alarm.

Another climate-skeptic shibboleth is the number 97, which is frequently invoked in reference to Cook et al.'s (2016) finding that 97% of scientific papers expressing a position on anthropogenic global warming endorsed the scientific consensus. Several submissions to /r/climateskeptics over time period analyzed involve refutations of Cook et al. (2016) and similar studies. As stated in (38a), exposure to refutations of the 97% figure can serve as an entry point into the skeptic movement as a whole. References to the number 97 have developed meme/inside joke status on /r/climateskeptics, with some users referring to mainstream scientists as "the 97%" (38b) or joking about other things that 97% of scientists might believe (38c). As noted in §4, 97% is ironically referred to in the /r/climateskeptics sidebar, reproduced in (38d).

- (38)
- a. The best thing to do I think, is have people look into the origin of the 97% number, that's used everywhere to justify CAGW. Since it's so ubiquitous, even a small crack of doubt regarding it's accuracy usually starts the house of cards falling. It's easy to debunk, there are many sites that have already done so, and is easily the biggest mistake the fraudsters made.
 - b. Is yet another scientist outside the 97% claiming data fudging, and that the issue is far more complicated than CO2 only.
 - c. If science just needs a consensus, then all scientists need to do is conspire to agree on something that benefits them to derail scientific progress. It's the perfect cover for scientific fraud, tyranny of the majority and other deleterious scenarios. What is the percentage of scientists who agree that scientific salaries and vacation days should be drastically increased to avoid burnout? I have to think it's up around 97% too. I'm sure the science is settled.
 - d. Around 97% of the people on here agree that CO2 causes warming, that there has been warming, and that humans have contributed to increased CO2 in the atmosphere.

6.3 The climate-science register

Across classifiers (for example, when compared to /r/climate Table 14), the most important features for /r/climate_science are mostly climate-science terminology, such as *model*, *aerosol*, *paper*, *methane*, *ecs*, *data*, *science*, *uncertainty*, *carbon*, and *sequestration*. The distinctiveness of these climate-science features is unsurprising given that the subreddit is dedicated to climate science.

⁴Like in the term "warmist", a previous shibboleth of the climate denial movement which no longer appears to be commonly used.

However, the models also identify some formalisms that are not related directly to (climate) science, but index a scientific/academic discourse style, such as *essentially* (an adverb commonly used when giving a simplified explanation) and *and/or* (a conjunction used to specify the inclusive use of *or* rather than leaving it ambiguous between exclusive and inclusive). The interpretation of these terms as formalisms is supported by examples from the corpus that use them. For instance, (39a) uses *and/or* along with the intensifier *highly*, the count form of *feedback(s)* (which is climate-science jargon), and *suggests*, all of which index this formal register. Similarly, in (39b), *essentially* is used alongside *regarding*, *etc.*, and formal climate-scientific terms like *aerosols* and *albedo*.

- (39) /r/climate_science:
- a. It means that the amount of warming is still highly uncertain, that if warming is being mitigated it may be by cloud feedbacks, and most importantly, that the error, uncertainty, and/or regional variances may explain the rate of warming more than the global average trends Rosenfeld suggests.
 - b. Regarding other pollutants such as aerosols, they affect clouds, which affect local climates. For example, aerosols from factories etc leave a slick of aerosol pollution. This increases the albedo (reflectance) of clouds by essentially changing how condensation works in the clouds.

The importance of these non-contentful features in predicting whether a post comes from /r/climate_science or not demonstrates the utility of classification in identifying not just a community's key content words, but aspects of its linguistic style, and how these aspects can index identity features like community membership (Silverstein, 2003).

6.4 Discourse of collapse

Many of the features that distinguish /r/collapse from the other subreddits are collapse-related terms that do not relate directly to climate change. This is due to /r/collapse's focus on impending collapse itself, rather than being specifically about climate change-related collapse. Terms like *ai*, *recession*, and *homeless* relate to other types of collapse or societal decay, such as an AI singularity, financial collapse, or the homelessness crisis. While the subreddit features a great deal of climate change discussion, /r/collapse users are interested in climate change not in and of itself, but in terms of its potential to lead to societal collapse.

The term *breed* derives from discussion of overpopulation, as in (40a). The use of the term *breed* reflects a tendency on /r/collapse to compare humans to non-human animals, as in (40b), and attribute the purported inevitability of collapse to humans' nature as animals, as in (40c). The term *breeder*, a term used frequently in the "childfree" community, also appears in the /r/collapse data, as in (40d). While overpopulation is discussed on /r/climate, the use of *breed* conveys negative affect, and terms like *have kids* or *have children* seem to be more frequently used, as in (41).

- (40) /r/collapse:
- a. Malthus was right; humans will eat, breed and grow the population till we're taken out by starvation, pestilence and disease.
 - b. It's quite puzzling... why even breed in the first place? I guess people are really just animals: when the hormones dictate it, they just go and mate and breed.
 - c. The discovery and use of radio waves requires an intelligent species; evolution requires selfishness; couple the two and add in the fact that we're animals and have inherited the animal trait of using up whatever resource we find as quickly as possible.
 - d. I tell them often that I regret being born and yes I do call them breeders.

- (41) /r/climate:
- a. I'm in my 50's. I decided 35 years ago I would not have kids because of the degradation of the environment and climate change. I have never regretted my decision, and in fact am incredibly grateful that is what I did. I cannot fathom people who have kids now, with all the data that is available about climate change; it's like they are sentencing their children.
 - b. No, I lost hope a while back. Decided not to have children. I wouldn't subject anyone to the horror that awaits this generation.

The final set of features to be discussed here are those relating to *prepping*, the “practice of anticipating and adaptating to impending conditions of calamity, ranging from low-level crises to extinction-level events” (Garrett, 2020). Features related to prepping in the list of important features above include *garden*, *bunker*, and *permaculture* (sustainable practices of agriculture, construction, etc., emulating features of natural ecosystems). A primary goal of prepping for /r/collapse users is to become self-sufficient and thereby survive after the collapse of civilization:

- (42) /r/collapse:
- a. Most people even here, refuse to give up animal products. Sustainable permaculture will be the rescue of whoever survived
 - b. Unless you have an underground bunker or under the sea station and rich, I don't see you surviving.
 - c. We moved to a off the beaten path homestead last year, and are in the process of setting up a permaculture residence. We also stock between 6 months and a year of shelf stable food, and a month+ of water at any given time. We have enough firearms to arm a significant portion of a company, and 15-20K rounds of ammunition. I also stock medical supplies and antibiotics (I have some EMT training from my days working in a chemical plant) and I'm an engineer who generally can build things from scratch and make broken things work again.

Some users also describe these practices as having mental health benefits:

- (43) /r/collapse
- a. I feel you. I was depressed for about a year. Welcome to being “woke”. Permaculture, stoicism helps, as does time.
 - b. Gardening is good for my soul and as long as there are worms, spiders, beetles, and all manner of insects in and around my plants, I feel like maybe collapse won't happen as soon as I fear that it will...

6.5 Summary

In computational applications, text classifiers are typically used for the purpose of distinguishing between two types of data (e.g., to identify hate speech, Burnap and Williams 2015). The goal of such classifiers is to develop an accurate model that can be then used to classify new data. The present analysis shows the utility of classifiers in cases where there is no new data, and the goal is not to extend the model to new data but to better understand the data that has been already collected. There are many benefits of being able to pick out the words that are most distinctive of a given community's discourse from a quantitative perspective. It allows us to identify the subtopics of climate change that different communities focus on, such as the emphasis on US electoral politics on /r/climate, and the emphasis on political narratives and ulterior agenda on /r/climateskeptics. It also enables the identification of community shibboleths (e.g., /r/climateskeptics's

CAGW and 97%), which are of interest to the study of language and identity. In some cases, words that do not relate directly to the main content of discussion, like adverbs of degree or certainty and conjunctions, may also surface as distinctive features, as is the case with */r/climate_science*, where we identify *essentially*, *highly*, and *and/or* as distinctive. These features allow us to better understand the discourse style of a given community (e.g., given the subreddit they are distinctive of, I interpret the use of these formal terms as indexing a scientific or academic register).

Of course, there are a number of ways that these models could be extended. The classifiers used in the present study were trained using only single-word features, but it is also possible to use bigrams and trigrams to better detect distinctive multi-word phrases. It is also possible to move beyond automatically-learned word features and test, for example, whether use of different word classes (e.g., presence of pronouns of different persons/genders) or orthographic choices (e.g., amount of capitalization). For the present kind of exploratory work, it is useful to be able to process a large amount of data simply and quickly by using only word features, but a goal of future work will be to iterate on these models based on the results presented here.

Tying together the classifier results, the LDA results, and the qualitative observations that I have made throughout the paper, we have enough data available for a thorough and unified analysis of climate-change discourse in these Reddit communities. I take up this task in the following section.

7 General discussion

In this paper, I have attempted, using qualitative and quantitative methods, to give an overview of climate change-related discussion on five Reddit subforums: */r/climate*, */r/climateskeptics*, */r/ClimateOffensive*, */r/climate_science*, and */r/collapse*. In this section, I aim to integrate the specific insights from these findings into more general themes.

7.1 The value of computational methods in critical discourse analysis

This study aimed to integrate computational, quantitative tools into a qualitative critical discourse analysis framework. Throughout the paper, I have stressed the importance of the qualitative aspect when interpreting the computational results, but have not made the contribution of the computational aspect explicit.

A key virtue of the computational approach is that it expedites the process of analyzing large amounts of data, similarly to corpus-linguistic tools (Baker et al., 2008). Rather than manually processing a corpus containing thousands of comments from multiple different communities, I was able to identify broad patterns using computational models, then zero in on and analyze those patterns qualitatively by extracting individual comments. This is particularly useful for initial exploratory research, where little is known in advance and it is not immediately clear where to look for patterns.

The specific tools used in this study also revealed insights that may have been missed using a purely qualitative design. Because LDA is an unsupervised learning method (i.e., it attempts to associate comments with topics without using any human-generated labels or specifications), it enables the extraction and analysis of patterns that may not have been otherwise thought of as potential topics by the analyst (such as the *increasing and rising* topic, which is a ‘topic’ based around the abstract concept of increasing rather than around concrete objects). While classifiers are supervised in the sense that they attempt to solve problems with a ‘correct’ human-specified answer (which subreddit a given comment is from), the feature-generation process allows for the identification of distinctive words emergently—for example, I identified the skeptic shibboleth *CAGW* based on its emergence in */r/climateskeptics* classifier models, rather than first identifying the word and then testing which communities it was associated with.

7.2 Parasitism

As noted in §5, /r/climate_science and /r/climateskeptics, while being ideologically opposed, share some similarities in terms of discourse style and content. For instance, both communities make use of specialized scientific terminology, like *rebut*, *correlation*, *phenomenon*, *data*, and others; and both frequently discuss the physical mechanics of climate change (such as the greenhouse effect, global warming, and CO₂ in the atmosphere). In §5, I drew a parallel with Taylor-Neu’s (2019) analysis of the Nongovernmental International Panel on Climate Change (NIPCC) as a *parasite* of the Intergovernmental Panel on Climate Change: by mimicking the IPCC’s discourse style, the NIPCC “mine[s] scientific authority while undermining scientific consensus regarding anthropogenic climate change”. The scientific terminology serves as a Trojan horse, giving readers the impression that the propositions within are grounded in scientific research, while the actual content of the propositions undermines the scientific consensus on climate change.

As an illustrative example from the Reddit corpus, see (44), which contains two comments about the concept of the *null hypothesis*. The first comment is from /r/climate_science, and the second comment is from /r/climateskeptics, but the two comments are very similar in style, register and content. Both are structured as matter-of-fact explanations of the null hypothesis concept, and both make use of scientific jargon, yet (a) is invoked in support of the scientific consensus on climate change, and (b) is invoked in refutation of it.

- (44)
- a. Peer review is the only method of knowledge acquisition since the dawn of mankind that is predicated on the fundamental principle that everyone and everything can and should be disproved, and that parts of what we theorize which cannot be disproven should be taken as truth until better information and experimentation comes to light. It’s called the null hypothesis, and it’s the foundation of post-enlightenment scientific theory.
 - b. A given proposition is not considered to be more certain than maybe until its *null hypothesis* (opposing claim) has been found to be refuted by evidence. Even then, the proposition is only held to be provisionally true, subject to being refuted by future evidence.

Like the NIPCC, /r/climateskeptics is fundamentally citational. The community’s discourse is centred in opposition to and criticism of the scientific consensus on climate change: a community dedicated to (per its sidebar) “seeing past hyperbole, alarmism and environmentalism driven politics” only makes sense in a context in which an alternate, disputed worldview, characterized here as “hyperbole, alarmism and environmentalism driven politics”, exists. And like the NIPCC, /r/climateskeptics invokes ideals of ‘real science’ to draw favourable contrasts between their own views and the scientific consensus.

A crucial difference between the NIPCC and /r/climateskeptics is that the former is a corporate actor with a centrally-determined strategy, whereas the latter is a group of individuals who (presumably) are not on the same payroll,⁵ and are not overtly affiliated with one another aside from being members of the same online discussion group. We can see this as an ecosystem in which right-wing think tanks as responsible for formulating skeptic arguments and talking points, and giving them a professional sheen; these talking points are then taken up, spread and popularized by individual online skeptics.

While we can analyze the NIPCC as a whole as an organization with a defined goal and a unified discourse strategy used in pursuit of that goal, it is difficult to say that this is the case for /r/climateskeptics. Instead, we can divide /r/climateskeptics broadly into two groups of discourses, one characterized by an professional, NIPCC-like scientific discourse style, and one characterized by extreme vitriol, as in (45).

⁵It is certainly possible that some comments on climate subreddits are generated by paid users or bots, but such propaganda/disinformation campaigns typically involve the intermingling of both organic and orchestrated activity (Starbird, 2019).

- (45) The people that wrote that study are fucking retarded and so are the leftists who support that insane Orwellian doublespeak.

Although /r/climateskeptics users are most likely not taking marching orders directly from the NIPCC and other skeptic think tanks, its scientific discourse style can be seen as deriving from the NIPCC and the broader set of right-wing, climate-skeptical organizations which have, “from the first, invoked a particular idea of capital ‘S’ science in order to offset and undermine unwelcome scientific findings” (Taylor-Neu, 2019: 5). This use of scientific discourse on /r/climateskeptics facilitates their claims to ownership of ‘real’ science, which they frame as being based on skepticism and the scientific method. In the following subsection, I discuss this in greater detail.

7.3 The utility of the term ‘skeptic’

As shown in §6, a key difference between /r/climateskeptics and non-skeptic communities is how they refer to skeptics themselves. Users on /r/climateskeptics make a point of referring to themselves as skeptics and not deniers, whereas they are referred to as deniers on, for example, /r/climate. These differences arise in the classifier models. Skeptics’ avoidance of the term ‘climate change denier’ appears to be based on escaping the stigma attached to the concept of denial. For example, in (46), the term ‘climate change denier’ is compared to the term ‘Holocaust denier’:

- (46) Using the phrase “climate change deniers” is akin to holocaust deniers. It’s loaded and biased. (/r/climateskeptics)

In the same thread, a non-skeptic challenges this characterization:

- (47) To say “oh we are only skeptics not deniers” is stupid, as you have proved yourself, as ur deniers also, just trying to sugar coat it because u know it sounds stupid to the regular person. Ur a denier not a skeptic, and that was the point of my last comment.

Skeptics’ self-characterization as skeptics rather than deniers is generally challenged and rejected by non-skeptic users. For example, the terms *skeptic* and *skepticism* are frequently rendered in quotation marks, denaturalizing them and making their status as a self-ascribed label explicit:

- (48) a. I reckon climate change “skeptics” are successful in propaganda since the myths you just spouted just won’t die. (/r/climate_science)
 b. OP is actually a ‘skeptic’ judging by trolling memes in recent history, perhaps he thinks that this subreddit is behind the Wikipedia page being deleted or something. (/r/climate_science)
 c. Denier, not skeptic. ‘Climate skepticism’ is a frame by Big Oil to put their climate denialism in better light. (/r/climate)
 d. These assholes have gone beyond “skepticism” and are now committing willful crimes against humanity and nature. (/r/climate)
 e. Just so you know DocHarford will never answer these questions directly. Try and talk to him about the evidence for AGW, which is *directly* related to this conversation and he will never answer it. He’s really good at making climate ‘skepticism’ look like that’s not what it is. It drives me crazy. (/r/climatechange)

To disarm this type of criticism, /r/climateskeptics users commonly frame their views as being in line with an abstract or idealized notion of science, such as by invoking the scientific method or the importance of

examining all available evidence. For example, (49a) describes skepticism as being a fundamental component of the scientific method, and (49b) argues that the scientific method requires all evidence to be treated equally, and alleges that the “alarmist camp” favours some pieces of evidence over others. Notice the rhetorical reversal employed in (49b), where the commenter rejects the ‘denier’ label and instead applies it to their non-skeptic interlocutor.

- (49) /r/climateskeptics:
- a. being sceptic about a topic is part of the scientific method.
 - b. The scientific method *requires* you to treat all evidence equally - something the alarmist camp seems proud to deny making you and your “alarmist enemies of truth”, the true science deniers.

Their opponents characterizing them as deniers is actually a source of humour for some /r/climateskeptics users, as in (50), where a user constructs an imaginary conversation between a hypothetical alarmist (italized text) and a skeptic (plain text). The alarmist attempts to defeat the skeptic by accusing them of not believing in climate change, contrary to the scientific consensus. The skeptic responds by stating that they do actually believe in climate change, reducing the alarmist to incoherent screaming. In contrast to the skeptic, who is portrayed as calm and matter-of-fact, the alarmist stutters (*w-w-why*) and screams. The use of the French definite article *le* is an apparent reference to a dated Reddit meme (see here for more details), potentially constructing the alarmist as out of touch or behind the curve. The all-caps *REE* attributed to the alarmist is meant to represent screaming or screeching, and is commonly used in alt-right depictions of their opponents to characterize them as “incoherent and not worthy of engaging” (Jones, 2020: 129).

- (50) *W-w-why dont you believe in climate change? You think you are smarter than 97% of le scientist?*
We never said climate change wasnt real.
REEEEEEEEEEEEEEEEEE

The “skeptic-not-denier” frame is problematic for those who are in favour of climate action because, as Biddle and Leuschner (2015) point out, dissent in science is commonly viewed as beneficial (and, in most cases, is). As they discuss in detail, however, dissent in science is not an inherent good, and can actually be epistemically detrimental. They define detrimental dissent as dissent which is based on low-quality research and which impedes scientific progress (such as by encouraging harassment of scientists).⁶ Based on these criteria, we can identify /r/climateskeptics as a locus of primarily detrimental dissent. Most /r/climateskeptics posts are not based on high-quality scientific research. When research papers are cited, they typically come from right-wing think tanks such as the Global Warming Policy Foundation or the American Enterprise Institute rather than from peer-reviewed journals. And when mainstream scientists are discussed, it is frequently done with a great deal of vitriol. For example, Michael Mann, creator of the well-known “hockey stick graph” showing a steep increase in global temperatures concomitant with an increase in CO₂ emissions, is described as a corrupt idiot who is paid to forge data (51a–b), and mentions of Cook et al.’s (2016) study on the 97% consensus behind anthropogenic global warming are met with ridicule.

- (51) a. It is difficult to tell at times how much Mann is an idiot and how much he is being payed off ... to be an idiot.
b. Mickey Mann, you forged your faux-data and turn it into a surreal cartoon.
c. LOL! This is the John Cook & Dana Nuccitelli stupid 97% study that has been refuted at

⁶According to Biddle and Leuschner (2015), low quality of research is not a sufficient condition on its own, because low-quality research can still generate productive discussion and contribute to the knowledge generation process.

- least 97 times!
- d. Only idiots reference Cook's flawed study.

The 'skeptical' frame thus serves as a way to launder this detrimental dissent as beneficial dissent, while simultaneously casting non-'skeptical' as anti-science for being unwilling to consider opposing viewpoints.

7.4 Reflexive language and community focus

Reflexive language (the use of language to communicate about the activity of using language, see also Lucy 1993) is common on /r/climateskeptics. Keywords associated with reflexive language that appear in the classifier results include *narrative* and *agenda*. These terms are used to characterize or label the intent, content, and manner of others' discourse moves, such as to describe a news article or public statement as a part of the "(alarmist) narrative" or the "(alarmist) agenda".

Labelling a statement or belief as (part of) a *narrative* impacts meaning: it implies that it is fictional and/or constructed, as opposed to real or natural. For instance, in (52), the user characterizes the proposition that coral bleaching was rare prior to recent warming and is a large-scale threat to Australia's Great Barrier Reef as a 'narrative':

- (52) The real issue with your question is the phrase "large scale coral bleaching event". There is now this narrative that coral bleaching was unknown or rare until recent warming and is threatening the great barrier reef at "large scale." The evidence for this was what Peter Ridd contested, which got him booted from his university.

The use of the term 'narrative' here conveys the writer's belief that the proposition is untrue implicitly. This interpretation is supported by manual inspection of all instances of the term 'narrative' on /r/climateskeptics, which found no cases where 'narrative' was used with neutral or positive affect.

Labelling a statement or belief as (part of or in line with) an *agenda* has a similar effect: it implies that it is purposeful and deliberate, or in the service of an ulterior motive (which can be typically inferred to be sinister). An example is given in (53), where the user denounces the term 'climate change' because using it is in line with the "warmist agenda":

- (53) This is a pretty good article overall, but the title is problematic, because to use the term 'climate change' is to follow the warmist agenda. Their current agenda is to confuse and to cover up.

This user polices the use of the term 'climate change' because it is understood to have discursive importance: it conveys alignment with a disfavoured agenda, as opposed to, for example, CAGW (catastrophic anthropogenic global warming).

Why are these terms distinctive of /r/climateskeptics in particular? We might expect that because climate change is a polarized topic, subject to a great deal of public debate, we would find similar uses of reflexive language on /r/climate and other subreddits. While these do exist (e.g., (54a)), they are less frequent and not exclusively negative (54b).

- (54) a. If you see this baloney "individual actions don't matter" narrative being spouted, call it out. Downvote it. Refute it.
 b. He has massively shifted the narrative for this election, and even if he doesn't win, his contribution will have been invaluable.

One explanation has to do with the broad goals of each community. Communities like /r/climate_science and /r/collapse are focused on processes and non-human objects, such as the findings of scientific research

and the possibility of societal collapse, respectively. In contrast to the other four communities, */r/climateskeptics*, and the skeptic community more broadly, are constructed in opposition to other human beings (‘alarmists’) and, consequently, their speech. We can see this in the classifier results: the individual people *Mann* (a prominent climate scientist), (Al) *Gore*, and *Greta* (Thunberg) appear as important features, along with many terms that (pejoratively) describe human beings, such as *alarmist*, *leftist*, and *idiot*. We can thus describe the community of */r/climateskeptics* as centred on antagonism, being devoted to dismantling the ‘alarmist’ view, and this appears to have an impact on the community’s discourse.

7.5 Disdain for normal/ordinary people

Disdain for ordinary people is a common thread across both */r/collapse* and */r/climateskeptics*, both of which are heterodox: */r/collapse* frames climate change as much more severe than the mainstream consensus, while */r/climateskeptics* frames it as much less severe than the mainstream consensus. On both subreddits, the term *normie* is used to pejoratively refer to ‘normal’ people. However, the views attributed to normies by the two subreddits differ. On */r/climateskeptics*, normies are portrayed as gullible rubes who swallow “alarmist” talking points:

- (55) */r/climateskeptics*:
- a. droughts have not been increasing. This is a big fallacy commonly believed by normies. Also the only way alarmists have managed to predict more is with climate models. Water vapor does not leave the planet when evaporated! It has to come down again! Relative humidity is a thing!
 - b. i mean your average normie on the street. ask them about climate change, they believe it.
 - c. Sure we’ve contributed a bit to climate change, but as these normie fucks say that we are the sole cause of this earth going to shit, need to re-evaluate how big earth is and how little we are as a species.
 - d. hm, they always target the youngest generations. those with still pliable minds and full of idealism and illusions. antifa, deep green, sjw democrats, npc types. anyone who went through public education under common core. normies watching msm..

In (55d), normies are attributed leftist/idealist views, such as being “antifa” (anti-fascists), “SJWs” (social-justice warriors) or “NPCs” (non-player characters, i.e., someone who behaves like a computer-controlled character in a video game rather than a real person).

In contrast, on */r/collapse*, normies are portrayed as those who do not believe societal collapse is imminent:

- (56) */r/collapse*:
- a. Society is catered to normies. Most don’t even consider collapse.
 - b. I would rather be happy and ignorant and just be a common normie with common sense than have great critical thinking abilities and externalize all the shittiness I see.
 - c. Well most people are not as aware of how bad the situation is as people on this sub are. Most of the people I talk to are normies. They don’t realize that once system stability goes a lot of really crazy shit can happen.

Note that unlike */r/climateskeptics*, */r/collapse* depicts normies as being ignorant or blind, rather than being brainwashed.

While the inferences associated with the category *normie* differ across the two subreddits, in both cases,

the use of the insider-vs.-normie framing constructs the community members as more conscious and aware than the average person. As non-normies, they are members of a more exclusive group and are able to see the world more clearly. This is evoked using the ‘pill’ metaphor from the *Matrix* movies, in which the protagonist, Neo, is offered a choice between a red pill, which will reveal the painful truth, and the blue pill, which will allow him to remain in peaceful ignorance. The act of ‘taking the red pill’ is a cultural metaphor for the acquisition of a particular ideology (either belief in collapse or climate skepticism):

- (57)
- a. Exactly right. This sub is the red pill to the blue pill the financial interest running Reddit that just want everyone to see on r/aww and sports. (/r/collapse)
 - b. People only want to hear things that make them feel comfortable. If it’s something that will make them uncomfortable, they will cover their ears, shut their eyes, and pretend they didn’t hear it. The truth is not something that’s meant to be pleasant in the first place, and that’s why people are constantly in denial of it. But they can only run away from it for so long before it eventually comes back to bite them. This is another case of the red pill and blue pill dilemma. (/r/collapse)
 - c. Funny story, while talking to a friend of mine about global warming he brought up polar bears dying. I told there are more polar bears now than there has ever been. He calls bullshit and calls it propaganda. I told him to look it up. It was the biggest red pill I have ever seen anyone swallow. (/r/climateskeptics)
 - d. This was my “red pill” regarding the whole man made climate alarmism. They indeed minimise the sun’s impact. That BS right here is what made me a sceptic and I continue to use this argument to educate people about this insanity. It works well! (/r/climateskeptics)

/r/collapse expands the cultural metaphor to include a nihilistic ‘black pill’, representing the belief that collapse is inevitable and there is nothing that can or should be done to avert it. However, it is mostly invoked by users who do *not* subscribe to it. Unlike the ‘red pill’, it does not evoke a contrast between /r/collapse users and non-users, but a contrast between different factions of /r/collapse users.

- (58) /r/collapse:
- a. Ugh I hate the blackpillers on this sub. You need therapy not this subreddit.
 - b. I think they make a valid point, they aren’t attacking people that are talking about how bad it is and we need to do something.....They are attacking the black piller and edglord weirdos that will use this climate report to justify being uncaring about the world or doing anything.
 - c. I keep forgetting that we share this sub with a large group of the black piller accelerationist’s, cheerleaders for no effort and doom.

While intriguing, this pattern of membership categorization was not detected by any of the computational models (for example, “normie” is not one of the most important features when comparing /r/climateskeptics or /r/collapse and /r/climate). Further adapting the models (for example, manually adding a feature for presence of words like ‘normie’ or ‘pill’) to account for this and potentially detect this type of discourse would be a productive extension of this work.

7.6 Climate justice

In contrast to mass-media discourses about climate change (Boykoff, 2008; Boykoff & Boykoff, 2004; Grundmann & Krishnamurthy, 2010), discourse related to climate justice is discussed on several of the subforums included in the Reddit corpus. This includes discussion of justice and risk, attribution of re-

sponsibility for the climate crisis (both to the capitalist economic system and to individual corporations, politicians, and lobbyists) and acknowledgement that while the industrial powers of North America and Europe are largely responsible for the climate crisis, the effects of climate change will be felt most acutely by those living in the Global South.

/r/collapse is a particularly rich site of discourse framed in this way, with frequent mentions of wealth and power inequalities:

- (59) */r/collapse*:
- a. Silly person, laws are only for the middle class and poor. The rich can do whatever they want with no consequences.
 - b. Real congress, on the other hand, is full of rich people trying to get richer, which sometimes requires them to lie about or be wilfully ignorant of facts which are inconvenient for their campaign donors. And the oil industry has a lot of congress critters in its pocket.
 - c. You talk about the gypsy lady raising six on a beggars income like its some noble thing, but its not. Its degrading, humiliating, and unjust. As a global society, we have the wealth, the technological knowhow, every available resource to guarantee everyone on the planet a decent standard of living but we choose not to.
 - d. The poor anywhere have always been the most vulnerable and least equipped. Feel-good anecdotes of plucky heroes who beat the odds doesn't diminish reality. When the floods are done in Bangladesh, it won't be the rich struggling with fever.
 - e. The global south will be (already is) hit first and worst by climate change, for the most part. Northern despots will easily be able to play off the bigoted sentiment they already rely on to justify murdering them.
 - f. Blaming it on "overpopulation" as if we all pollute and consume equally is yet another way for the global north to take a giant steaming shit on the global south.

(59a–c) highlight inequality and class struggle, assigning culpability for the climate crisis to the rich and the oil industry. (59d–e) explicitly points out that climate change is likely to have unequal impacts, with vulnerable communities (e.g., poor Bangladeshis) being at the greatest risk. (59f) foregrounds the injustice of blaming climate change on overpopulation in the Global South.

Similar sentiments are expressed in more mainstream subreddits as well, such as */r/climate*:

- (60) */r/climate*:
- a. It's people in the global south who will be affected first, and if there's anyone big western corporations don't care about...
 - b. The wealthy need to be held accountable for this, starting with the fossil fuel companies.
 - c. The poor and exploited will be first to suffer. The wealthy will be the last.

It is important to make note of these discourses because mass-media portrayals typically frame climate change as a physical or scientific phenomenon and discuss it in those terms, such as by reporting on Arctic ice extent and record global temperatures. This research shows that, while climate justice is largely absent from hegemonic depictions of climate change, it is present in online climate-change discussions. This is in spite of the fact that, in large part, the content which users are commenting on is drawn from mass-media sources. For example, (61) is a top-level comment (i.e., it forms the beginning of its own discussion thread) about a National Geographic article entitled "We have too many fossil-fuel power plants to meet climate goals". Although the article discusses China's and India's fossil fuel emissions, it does not touch on the relationship between 'developed' and 'developing' nations. This illustrates how the content of hegemonic

media sources is reconstructed and reframed by online commenters as a means of expressing more critical views.

- (61) The huge developing countries like China and India would love to stop building new fossil fuel power plants. As long as the developed countries directly pay them for the cost of building renewables. Since they've been emitting their share since the industrial evolution. No pay. No play. Let's not pretend the world works in an utopian way. /r/climate

These frames are not undisputed. Particularly on /r/climateskeptics, users challenge notions that, for example, Western nations are primarily responsible for environmental problems, or that they have a greater moral obligation to address the climate crisis:

- (62) Western nations are all contributing to a less polluted world. Asian economies don't give 2 fucks. The idiots at Davos wants to keep penalizing the West and let Asia of the hook. (/r/climateskeptics)

These frames are also disputed in non-skeptic communities. For instance, in the following example /r/climateOffensive, a user disaligns with another user's statement that the unsustainable nature of capitalism is responsible for the climate crisis, instead attributing it to human nature:

- (63) I just don't understand people like you who constantly blame human nature on capitalism. It does not matter what system is developed if it is run by human beings, because human beings are inherently greedy and throughout all of time wealth has always transferred, either slowly or quickly, to the hands of the few in every system.
The best we can do is regulate things until we have a strong AI running the entire world.

The presence of these contrasting views, even on a subreddit that we might expect to align with anti-capitalist sentiment, underscores the importance of nuance when discussing community stances or community ideologies. While it is the case that membership in a community implies acceptance of certain core beliefs (such as that climate change is or is not taking place, or that it is or is not anthropogenic or catastrophic), not all positions are shared between members. In fact, not all comments in a given community can even be assumed to be from members of that community. In /r/climateskeptics, for instance, a number of posts are from users who explicitly describe themselves as non-skeptics, seeking to debate or better understand the skeptic position. There is potential for interesting work here on how skeptics (for example) communicate their position when speaking to outsiders, as opposed to how they do so when speaking amongst themselves.

Because of the contrasting views held by users within a single subreddit, finding that a topic is frequently discussed in a given community, or that a word is frequently used, tells us little about the stances users take in relation to these objects of discussion. This makes it crucial to investigate the results of computational modelling qualitatively, looking at individual pieces of relevant data in context, in order to better understand how these patterns arise.

8 Conclusion

This study aimed to address the following questions: How is climate change constructed and framed by commenters on public forums? Which frames are dominant in each community, and how can we explain differences in which frames are commonly used in different communities? Are these findings consistent with mass media discourse on climate change, and if not, how and why do they differ?

Using a combination of quantitative computational and qualitative methods, I have laid out the key differences and commonalities between five Reddit climate change-related communities: /r/climate, /r/ClimateOffensive, /r/climateskeptics, /r/climate_science, and /r/collapse, and shown that these correlate with the stated goals and shared viewpoints of each community. I have also shown that while many of the topics discussed and frames used match up with mass-media and institutional discourses (e.g., framing of climate change as a scientific issue), others do not (e.g., framing climate change as a social justice issue and discourse of societal collapse).

It is important to be cautious using climate change-dedicated online communities to draw conclusions about the general public. It is almost certain that members of /r/ClimateOffensive, for instance, are not representative of the general population of, say, the United States. As mentioned in §5, this reason, it would be worthwhile to investigate how climate change is framed on larger, general-purpose subreddits, such as /r/news or /r/worldnews.

Nonetheless, this research contributes to our understanding of climate change discourse—for instance, how frames and discourse practices associated with well-funded corporate climate skeptic organizations are taken up and employed in casual online discussion forums like /r/climateskeptics. This has implications for attempts to address the issue of climate skepticism and to generate popular support for action on climate change. As Taylor-Neu (2019: 21) notes, a popular strategy for addressing climate skepticism and denial has been to “reaffirm scientificity” through Marches for Science and appeals to listen to scientists, but what is disputed by skeptics is not the value of science. In fact, as the present study and Taylor-Neu (2019) both show, climate skeptics actually assert the value of science quite emphatically. What they actually dispute is what counts as scientific, and what does not, and this should have implications for scientists’ and activists’ own discourse strategies.

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A Full classifier results

This appendix presents the results of the ten classifier models.

A.1 /r/climate vs. /r/climateskeptics

	precision	recall	f1-score	support
climate	0.31	0.68	0.43	3030
climateskeptics	0.92	0.73	0.82	16469

Table 11: Classification report for /r/climate vs. /r/climateskeptics

climate		climateskeptics	
-3.46	action	9.03	alarmist
-3.25	republicans	5.45	skeptic
-3.25	denial	5.37	alarmism
-3.24	consumption	4.65	leftist
-3.08	join	4.16	cult
-3.04	bernie	3.95	97
-2.89	candidate	3.89	hysteria
-2.77	election	3.79	left
-2.77	collapse	3.67	co2
-2.61	civilization	3.61	narrative
-2.61	transition	3.57	heller
-2.51	republican	3.40	vapor
-2.37	lobby	3.34	communist
-2.36	scenario	3.32	↑
-2.29	trump	3.31	cagw
-2.28	plan	3.31	l
-2.27	emission	3.22	agw
-2.25	target	3.16	skeptical
-2.24	agriculture	3.10	sub
-2.15	chance	3.06	alarm
-2.13	fast	3.01	mm
-2.13	albedo	2.99	agenda
-2.03	dry	2.96	ecs
-2.01	wave	2.83	ir
-1.98	humanity	2.80	flat

Table 12: Most informative features for classifying /r/climate vs. /r/climateskeptics

A.2 /r/climate vs. /r/climate_science

	precision	recall	f1-score	support
climate	0.92	0.79	0.85	3005
climate_science	0.35	0.63	0.45	545

Table 13: Classification report for /r/climate vs. /r/climate_science

climate	climate_science
-3.35 trump	4.44 model
-2.48 australia	3.84 aerosol
-2.33 child	3.11 rule
-2.25 effort	2.55 paper
-2.21 taxis	2.51 forcing
-2.18 protest	2.47 remove
-2.17 tell	2.46 scientist
-2.09 win	2.45 methane
-2.08 leader	2.43 sensitivity
-2.06 idiot	2.40 ecs
-2.00 republicans	2.32 data
-1.98 care	2.29 near
-1.97 country	2.21 science
-1.94 vote	2.19 mitigate
-1.90 tax	2.14 uncertainty
-1.90 fund	2.09 desert
-1.88 bernie	2.05 sequestration
-1.88 speak	2.02 mann
-1.87 cheap	1.97 computer
-1.86 attack	1.96 temperature
-1.86 election	1.94 civilisation
-1.85 picture	1.94 essentially
-1.84 truth	1.94 carbon
-1.82 blame	1.93 subreddit
-1.81 god	1.92 and/or

Table 14: Most informative features for classifying /r/climate vs. /r/climate_science

A.3 /r/climate vs. /r/ClimateOffensive

	precision	recall	f1-score	support
climate	0.53	0.65	0.59	3016
ClimateOffensive	0.73	0.63	0.68	4588

Table 15: Classification report for /r/climate vs. /r/ClimateOffensive

climate		ClimateOffensive	
-2.77	scenario	3.60	ecosia
-2.70	civilization	2.92	climateoffensive
-2.69	insurance	2.78	donate
-2.53	carbontax	2.59	†
-2.23	author	2.38	^
-2.04	trump	2.35	strike
-1.95	review	2.30	foundation
-1.93	disaster	2.24	livestock
-1.92	flood	2.20	seaweed
-1.88	season	2.19	violate
-1.76	fairly	2.09	conservation
-1.68	percent	2.09	palm
-1.65	weather	2.09	beef
-1.61	moral	2.08	sub
-1.61	usual	2.06	volunteer
-1.55	melt	2.05	plastic
-1.52	wall	2.05	bag
-1.52	decarbonization	1.94	root
-1.52	ride	1.91	ccl
-1.52	ice	1.86	ecological
-1.50	solar	1.86	rule
-1.50	lie	1.84	milk
-1.49	human	1.83	capitalism
-1.48	atmospheric	1.80	bike
-1.45	foot	1.79	awesome

Table 16: Most informative features for classifying /r/climate vs. /r/ClimateOffensive

A.4 /r/climate vs. /r/collapse

	precision	recall	f1-score	support
climate	0.20	0.61	0.31	2961
collapse	0.95	0.74	0.83	27366

Table 17: Classification report for /r/climate vs. /r/collapse

	climate		collapse
-4.42	climate	4.77	collapse
-3.04	fossil	3.98	ai
-2.82	action	3.36	recession
-2.50	science	3.20	homeless
-2.38	republicans	3.12	breed
-2.38	candidate	3.08	shit
-2.37	carbon	3.03	medicine
-2.33	regulation	3.01	universe
-2.33	campaign	2.95	root
-2.28	adult	2.93	fat
-2.21	ipcc	2.92	drug
-2.16	republican	2.84	garden
-2.16	renewable	2.76	debt
-2.15	emission	2.73	wife
-2.15	bernie	2.65	fuck
-2.15	operate	2.62	bunker
-2.07	election	2.61	medical
-1.94	heating	2.51	skill
-1.94	solar	2.48	circumstance
-1.93	involve	2.47	permaculture
-1.93	impact	2.45	fucking
-1.90	temperature	2.45	elite
-1.89	tax	2.44	forever
-1.86	policy	2.43	filter
-1.84	worldwide	2.41	slightly

Table 18: Most informative features for classifying /r/climate vs. /r/collapse

A.5 /r/climateskeptics vs. /r/climate_science

	precision	recall	f1-score	support
climateskeptics	0.99	0.81	0.89	16443
climate_science	0.10	0.67	0.18	551

Table 19: Classification report for /r/climateskeptics vs. /r/climate_science

climateskeptics		climate_science	
-10.16	alarmist	6.00	aerosol
-5.13	china	5.57	collapse
-4.61	winter	4.53	permafrost
-4.57	idiot	4.01	carbon
-4.37	picture	3.98	methane
-4.23	law	3.85	sensitivity
-4.17	leftist	3.81	denial
-4.16	bias	3.71	extent
-4.16	cult	3.51	remove
-4.12	left	3.50	depend
-4.06	gore	3.48	recommend
-4.04	taxis	3.48	local
-4.00	battery	3.47	essentially
-3.95	narrative	3.34	globally
-3.94	97	3.30	desert
-3.93	fake	3.19	rule
-3.93	bullshit	3.16	particularly
-3.89	protest	3.13	release
-3.86	middle	3.10	failure
-3.82	trump	3.08	uncertainty
-3.82	speech	3.07	track
-3.82	funny	3.01	glaciation
-3.78	adjustment	2.97	summary
-3.76	alarm	2.96	feedback
-3.75	attack	2.95	impact

Table 20: Most informative features for classifying /r/climateskeptics vs. /r/climate_science

A.6 /r/climateskeptics vs. /r/ClimateOffensive

	precision	recall	f1-score	support
climateskeptics	0.91	0.78	0.84	16430
ClimateOffensive	0.49	0.73	0.58	4618

Table 21: Classification report for /r/climateskeptics vs. /r/ClimateOffensive

climateskeptics	ClimateOffensive
-8.13 alarmist	5.86 ecosia
-6.21 skeptic	5.25 climateoffensive
-5.12 agw	4.77 donate
-4.92 alarmism	4.32 action
-3.98 skepticism	3.77 ecological
-3.87 prediction	3.61 ccl
-3.82 warming	3.53 tree
-3.78 leftist	3.50 strike
-3.76 cult	3.47 meat
-3.71 warm	3.34 join
-3.59 co2	3.19 candidate
-3.56 mann	3.08 consumption
-3.47 left	3.02 bernie
-3.44 scam	2.99 contact
-3.42 temperature	2.94 capitalism
-3.32 dioxide	2.88 beef
-3.22 model	2.84 soil
-3.18 obama	2.83 help
-3.13 theory	2.81 lobby
-3.12 cold	2.76 vegan
-3.11 science	2.71 sustainable
-3.03 nonsense	2.65 capture
-2.99 weather	2.65 awesome
-2.99 97	2.60 asset
-2.97 alarm	2.60 store

Table 22: Most informative features for classifying /r/climateskeptics vs. /r/ClimateOffensive

A.7 /r/climateskeptics vs. /r/collapse

	precision	recall	f1-score	support
climateskeptics	0.67	0.66	0.66	16399
collapse	0.80	0.80	0.80	27372

Table 23: Classification report for /r/climateskeptics vs. /r/collapse

climateskeptics		collapse	
-9.08	alarmist	9.67	collapse
-7.51	skeptic	4.21	bunker
-6.50	alarmism	3.17	garden
-6.33	agw	3.00	soil
-5.23	co2	2.94	inevitable
-4.90	greta	2.92	survive
-4.73	mann	2.89	consumption
-4.45	climate	2.87	species
-4.30	skepticism	2.75	prepare
-4.12	science	2.70	wage
-4.05	vapor	2.62	debt
-4.03	97	2.58	capitalism
-3.95	warming	2.56	greed
-3.73	skeptical	2.48	resource
-3.72	consensus	2.45	empire
-3.49	activist	2.45	stock
-3.41	datum	2.44	loan
-3.41	agenda	2.36	drug
-3.35	adjustment	2.34	civilization
-3.28	ecs	2.33	fruit
-3.27	temperature	2.30	refugee
-3.22	ir	2.28	sustain
-3.17	left	2.27	food
-3.15	leftist	2.27	suicide
-3.12	cooling	2.26	store

Table 24: Most informative features for classifying /r/climateskeptics vs. /r/collapse

A.8 /r/climate_science vs. /r/ClimateOffensive

	precision	recall	f1-score	support
climate_science	0.31	0.66	0.43	528
ClimateOffensive	0.95	0.84	0.89	4571

Table 25: Classification report for /r/climate_science vs. /r/ClimateOffensive

climate_science	ClimateOffensive		
-5.34	model	3.79	protest
-3.85	aerosol	3.19	ecosia
-3.40	temperature	2.88	animal
-3.39	science	2.76	vegan
-3.36	warming	2.69	country
-3.35	ipcc	2.66	bernie
-3.29	scientist	2.65	option
-3.24	methane	2.56	electricity
-3.07	collapse	2.55	profit
-2.87	data	2.54	eat
-2.78	paper	2.54	oil
-2.66	warm	2.51	strike
-2.64	forcing	2.41	public
-2.60	sensitivity	2.39	win
-2.47	significant	2.34	economy
-2.44	arctic	2.33	tree
-2.43	study	2.30	action
-2.39	statement	2.29	pass
-2.34	author	2.27	idea
-2.33	cloud	2.26	plastic
-2.32	estimate	2.22	campaign
-2.18	computer	2.16	pricing
-2.17	ice	2.16	bill
-2.17	crop	2.14	crisis
-2.16	remove	2.12	hi

Table 26: Most informative features for classifying /r/climate_science vs. /r/ClimateOffensive

A.9 /r/climate_science vs. /r/collapse

	precision	recall	f1-score	support
climate_science	0.08	0.69	0.15	535
collapse	0.99	0.85	0.91	27287

Table 27: Classification report for /r/climate_science vs. /r/collapse

	climate_science		collapse
-5.49	climate	5.62	picture
-5.40	model	5.37	kid
-4.72	paper	4.88	throw
-4.58	carbon	4.84	season
-4.51	civilisation	4.80	story
-4.46	ipcc	4.79	joke
-4.35	aerosol	4.77	middle
-4.29	scientist	4.76	thinking
-4.21	science	4.76	india
-3.91	warming	4.69	elite
-3.81	datum	4.68	impossible
-3.77	lifetime	4.61	china
-3.63	remove	4.35	walk
-3.62	temperature	4.34	attack
-3.56	threaten	4.27	winter
-3.54	rent	4.24	fail
-3.49	co2	4.16	living
-3.44	mitigate	4.13	capitalist
-3.43	reduction	4.10	west
-3.41	desert	4.08	intelligence
-3.38	essentially	4.00	sell
-3.27	conflict	3.97	americans
-3.16	trend	3.96	protest
-3.15	measure	3.95	trade
-3.12	warm	3.95	status

Table 28: Most informative features for classifying /r/climate_science vs. /r/collapse

A.10 /r/ClimateOffensive vs. /r/collapse

	precision	recall	f1-score	support
ClimateOffensive	0.32	0.67	0.43	4546
collapse	0.93	0.76	0.84	27330

Table 29: Classification report for /r/ClimateOffensive vs. /r/collapse

ClimateOffensive	collapse
-6.17 ecasia	8.81 collapse
-4.02 donate	4.17 elite
-3.50 strike	4.10 universe
-3.25 climate	4.10 bunker
-3.07 meat	3.48 border
-3.06 action	3.38 depression
-2.99 lobby	3.31 recession
-2.92 tree	3.22 brain
-2.76 carbon	3.01 drug
-2.71 activist	2.96 civilization
-2.71 beef	2.90 filter
-2.70 bernie	2.90 season
-2.68 bike	2.85 empire
-2.55 contact	2.80 insurance
-2.51 candidate	2.79 refugee
-2.50 sign	2.75 stream
-2.46 organization	2.73 medicine
-2.46 vegan	2.65 radiation
-2.43 project	2.65 scenario
-2.39 website	2.65 rent
-2.37 sustainability	2.56 suicide
-2.37 search	2.50 slave
-2.37 company	2.48 medical
-2.31 rebellion	2.47 survival
-2.30 campaign	2.43 human

Table 30: Most informative features for classifying /r/ClimateOffensive vs. /r/collapse