

Corporate Funding and Ideological Polarization about Climate Change

Supplementary Information

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Social Network Data Collection and Methods

The basis of the network and text data are 164 climate counter-movement organizations. These 164 organizations were aggregated from prior peer-reviewed research and archival analysis of individual organization websites and material. They were identified and collected using the following protocol: First, and most importantly, the majority of organizations were identified from a comprehensive census of climate counter-movement organizations and funding recently published in *Climatic Change* (15). I derived 118 organizations from this particular peer-reviewed census. I then added other organizations that have appeared in other published research on climate change (8–14), as well as lists from reputable non-profits (27–28). Lastly, I then conducted an exhaustive content and link analysis of organization websites using the Internet Archive, which led me to more organizations. For example, the Cooler Heads Coalition, which is an affiliate of the Competitive Enterprise Institute, lists many organizations on their website. I only included these linked organizations (and the organizations they link, etc.) if their organizational material indirectly or directly (1) contained overt arguments climate change about uncertainty, (2) overtly opposed mitigation of carbon emissions, and (3) contained information contrary to scientific consensus on climate change issue. From this process of in-depth primary and secondary source triangulation, I added 46 organizations to the original list, for a total of 164.

It is important to note that some of these organizations were much more involved than others in the climate change counter-movement. Some are still active participants, while others have become defunct or no longer overtly

support contrarian efforts. But for the organizations who no longer overtly participate, the individuals who participated in them often move on to other organizations, which are traced through social network connections.

I also collected variables about each organization, and present frequency statistics in Table S1. In most cases the mission statement of each organization was available from IRS 990 forms or from the organization itself. Using this information, I coded organizations into three straightforward categories: (1) advocacy, (2) think tank, (3) foundation, trade association, and other. I also use mission statements and archival material to classify each organization according to whether or not they are solely focused on climate change, or if they focus on multiple issues. For example, the Center for the Study of Carbon Dioxide and Global Change, a 501(c)(3), is solely focused on climate change, whereas the Cato Institute has been very involved in climate change, but has many other issues of concern. Thus, I coded dichotomously based on the scope of their mission (1=Only Climate Change, 0=Multiple Political Issues). I record the mean assets of each organization using IRS data from GuideStar, the National Center for Charitable Statistics, and the Foundation Center. Twenty six of the organizations were not registered with the IRS, and thus I contacted the organization directly, or was unable to record asset data. The sparsity of the data meant that the mean of the assets for all available years was the most reliable indicator.

Academic researchers have had a very difficult time tracking flows of economic resources between members of this network, especially in recent years because of foundations like DonorTrust, which enables contributors to give

to specific causes while at the same time shielding the identity of the donor (8,15,36). Reliably assessing the influence of corporate benefactors has thus been extremely difficult. To overcome this difficulty, I rely on indicators of giving from two corporate and philanthropic actors in American politics: ExxonMobil (EM) and Koch family foundations (KFFs). With regard to their influence, my argument is that donations from these corporate benefactors is an indicator of entry into a powerful network of influence. They are reliable indicators of a much larger effort of corporate lobbying in the climate change counter-movement. Less important is how much or how often organizations receive money from these actors, but whether they are part of this sub-network of political influence at all. Prior research has suggested this type of influence using historical analysis (8-9,15), but has never been tested quantitatively, especially in relationship to the full network and population of texts. Thus, I create a dichotomous variable recording whether or not an organization has received money from either EM or the KFFs from 1993-2013. The data for this variable come from IRS records aggregated from GuideStar, the National Center for Charitable Statistics, the Foundation Center, peer-reviewed funding data (15), and reputable non-profit reports (27-28). 51 percent of organizations received funding from these corporate benefactors (Table S1).

In addition to these attributes, it is equally important to reliably measure the relational connections between the organizations themselves. I created an affiliation network (36-38) whereby I identified 4,556 individuals with ties to these organizations. This was an exhaustive process that aggregated data from many different sources. I first began by using GuideStar and IRS data to

record every board member in the organization for the last five years. This was an important first step, but only provided one formal dimension of ties between organizations. Using the website and archival material described above, I recorded all names of individuals with past involvement in an organization. For example, the Heartland Institute publishes a list of hundreds of speakers that have served at their annual conference on climate change—many of whom are linked to other organizations in myriad ways. In addition to primary source material, I also collected relational data from reputable non-profit organizations (27–28). These primary and secondary sources of data provided a rich source of overlapping social, political, economic, and scientific ties. Such relationships include serving as a scientific consultant for a think tank, speaking at a conference, political candidates who have publicly supported climate contrarian organizations, individuals who have publicly given and received donations to these groups, individuals who publicly represent an organization in the media, scientists who have signed climate contrarian petitions, and so on. All ties share in common the fact that an individual has, at one time, supported an organization in one way or another. I recognize that there are varying degrees of support, but given the intricate nature of this movement, I reduce complexity and focus on the dichotomous measure rather than creating a network of weighted ties. For example, senator James Inhofe—a chairman on the federal Committee on Environment and Public Works—was an honoree in 2004 at the Annapolis Center for Science-Based Public Policy and a co-plaintiff in a lawsuit with the Competitive Enterprise Institute. Or, the scientist Fred Singer—who was part of a report criticizing EPA research on second hand

smoking—and is now an active climate contrarian, with his own think tank (Science & Environmental Policy Project), as well as serving as a researcher, board member, and consultant for various conservative think tanks who have received money from EM. But other individuals may not be as overtly engaged in climate change issue, and perhaps simply sit on the board of an organization, or spoke once at a conference. But capturing these subtle relationships and varying degrees of participation goes well beyond interlocking board members, toward a more socially oriented, qualitatively rich, and empirically accurate depiction of the different ways in which this network operates. In order to ensure that there were no duplicate names, I cleaned all titles (e.g. ‘Mr’, ‘Dr’), all middle initials, alternate spellings (e.g. Chris vs. Christopher), and adjudicated any misspellings. This was all completed by hand on all 4,556 names.

I calculated betweenness centrality on the network (Year=2013) in Figure 1 of the main paper. Calculations were completed using the `igraph` package in the *R* statistical language.

Structural Topic Model: Data, Estimation, Validation, and Results

Because most of these organizations were very concerned with disseminating uncertainty about climate change, their material was extensive and accessible. For all organizations that produced texts (N=120) I collected documents containing “climate change” or “global warming” between 1993 and 2013.

These include the entirety of press releases, published papers, website articles, scholarly research, policy studies, and conference proceedings transcripts. This massive collection effort was streamlined with customized Python programming scripts for each organization, that scraped, parsed, and organized text from their websites, including historical and online archives (i.e. The Internet Archive). Images and PDFs of text, especially from earlier years, were scanned and converted to plain text using optical character recognition software. The total population of texts includes 40,785 separate documents summing over 39 million words, with an average document length of 957 words.

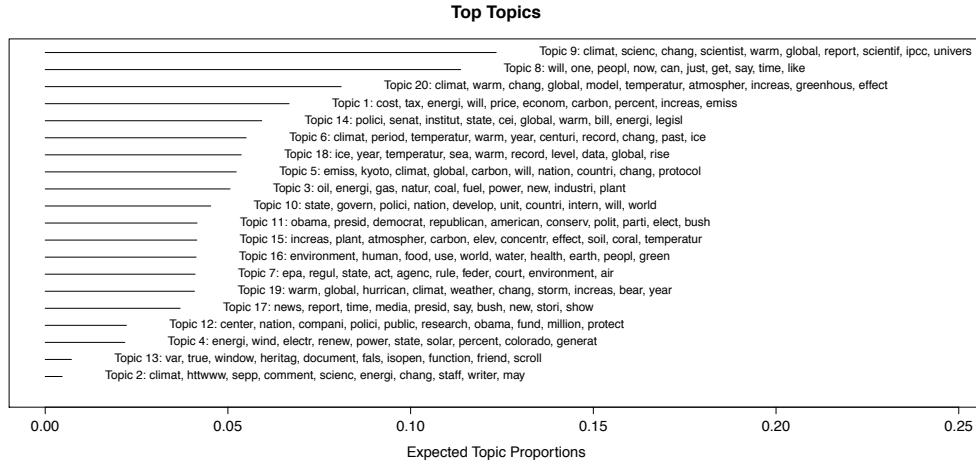
Details about the advantages of the “Structural Topic Model” over and against hand coding—or even traditional unsupervised text analysis approaches such as traditional Latent Dirichlet Allocation topic models—are laid out clearly in the manuscript, given how central they are to the research question. Here I will present important background information about estimation, validation, and results. For in-depth technical details about the popular and well documented LDA approach, see (30). And for technical details about the algorithmic operations of STM, see (31–32). As is common for natural language processing, and topic modeling in particular, I prepared the text for analysis by stripping all whitespace, stemming using the Porter algorithm, converting all words to lower case, and removing all English stop words, sparse terms, numbers, and punctuation.

Because this is an unsupervised approach, the most important analytical decision concerns how many topics to estimate. As noted in the manuscript, this decision is determined by researchers’ deep understanding of the corpus,

and a recursive interpretation of the results based on prior findings (e.g. 8–21). For more detail on choosing the number of topics and model validation, see (39–40). Importantly, the choice of number of topics is simultaneously influenced by post-estimation validation outcomes. Just as in traditional content analysis (41), topic model validation requires considerable *qualitative* discernment by the researchers, as they recursively assess the interpretability and relative efficacy of a model based on their own substantive knowledge of the texts and their contexts. For the present study, the result of this recursive process culminated in a 30 topic solution, which provided the highest external validity and most semantically coherent output of distinctive topics. There were diminishing returns for solutions above 30 topics, as the substantive meaning and coherence of the categories began to break down. This minimized the number of “junk” topics, of which there were four that are not included in the results. DiMaggio et al. (42:p.582) remind social scientists that validating a topic model “is different than evaluating a statistical model based on a population sample. The point is not to estimate population parameters correctly, but to identify the lens through which one can see the data most clearly.” An important validity check is reading documents to assess whether the substantive meaning of the topic and its words align with the qualitative meaning contained in the text. We used the `findThoughts` and `plotQuote` functions in `STM` package to hand read a sample of 50 associated documents for each topic to validate the substantive meaning of the topic output. Another important validation method is assessing how topics hang together in relation with one another. A semantic correlation map is especially useful for assessing this possibility,

because topics can be correlated and grouped into categories that should make substantively meaningful sense, especially in relation to previous findings about climate change politics (8–21). The STM package allows for computing semantic correlation map, which is presented in Figure 3 of the main manuscript. The coherence of the clusters of this semantic network provide further evidence of the validity of the estimated model.

I provide additional evidence here concerning the choice for a 30 topic estimation. First, to show robustness over topic number I have included here an analysis of the multiple models I estimate to compare against the final $K=30$ model. The 30 topic estimation performs very well in relation to estimations with fewer topics (i.e. $K=10$, $K=20$) and increasing topic estimations (i.e. $K=50$, $K=100$). As an illustration, see the 20 topic estimation in the figure below. The problem with fewer topics than 30 is that theoretically meaningful themes are blended, which unnecessarily reduces the complexity and fine-grained nature of the findings. For example, in the 20 topic estimation there is no “Cap & Trade Bills” topic because estimating less topics eliminates variation and lumps a handful of these specific topics into a more generic (and less insightful) politics topic.



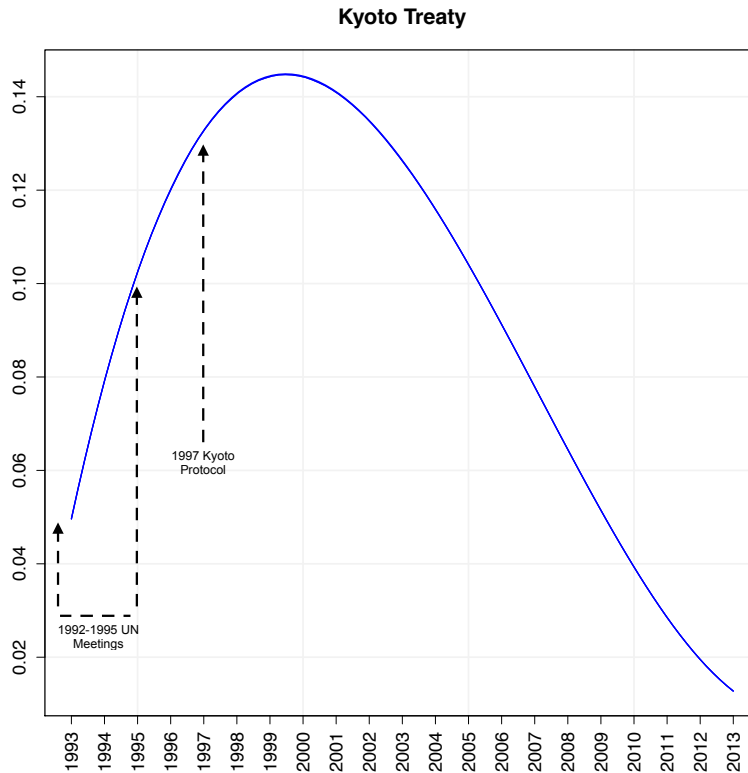
20 Topics for Validity Comparison

On the other end of the spectrum concerning how many topics are too many, I relied on the same strategy by examining 50 and 100 topic estimations. I interpreted these estimations using evidence from prior historical and qualitative research (8–15) to indicate when I reached a saturation point, and had captured all of the dominant themes in climate change politics. Theoretically, it was *not* my intention to capture every possible, inconsequential, or minor theme.

I also relied on Elsasser and Dunlap (2013) and their discovery of 32 total topics in their seminal qualitative analysis of a small sample of climate skeptic discourse. So while the 20 topic estimation above left out themes identified by prior research (e.g. contentious relationship with the IPCC), the 50 and 100 topic estimations began to water down the findings, increased the number of meaningless topics, and distanced the results from what prior research has established as the most important themes. Thus, in relationship to prior research, as well as this internal robustness check against the 20, 30, and 100

models, the 30 topic solutions proves to be considerably robust and valid.

Building from here, I follow Grimmer and Stewart (2013) by assessing predictive validity of topics based on the relationship between topic prevalence and external events. Namely, does the level of attention correspond in time with major events that would lead us to believe that the individual topics discovered are externally valid? One of the most important events in the history of climate change is the Kyoto Treaty. Below is a figure showing the prevalence of the Kyoto Treaty topic over time, which (as noted on the figure), corresponds well with the UN planning and buildup to the protocol in the early 1990s (United Nations Framework Convention on Climate Change), and then shows the decline of the topic over time as the public/media storm surrounding the Kyoto Treaty fades into memory. As shown in Figure 2 of the manuscript, the top 15 words that make up this topic capture the fine grained nature of the Kyoto Treaty process: kyoto, global, climat, emiss, protocol, treati, cei, nation, warm, countri, develop, will, chang, polici, presid



Predictive Validity of the Kyoto Treaty Topic

In addition to the external validity analysis discussed above, the interpretation of the topics is heavily influenced by prior knowledge about why these texts were written and what they intended to accomplish. These organizations are known to be part of a counter-movement to spread uncertainty and skepticism about climate change, and thus this angle provides the most important lens through which to interpret the presence or absence of certain topics/words. For example, the topic labeled “CO2 is Good” includes the words increas, plant, elev, temperatur, coral, effect, studi, soil, speci, chang, concentr, atmospher, growth, tree, respons.

If these documents were written by the 95 percent of scientists who accept anthropogenic climate change, one might think that the topic was about the *negative* influence of the increase of CO₂ in the atmosphere. However, if we know that prior research has shown that a very popular argument made by these climate counter-movement organizations is that increases in CO₂ actually has *positive* effects on plants, trees, and coral reefs, then we would know to label the topic accordingly (e.g. “CO₂ is Good” rather than a value neutral “CO₂ Effects”, which would be incomplete, or “CO₂ is Bad”, which would be inaccurate). Most of the topic labels are straightforward and do not involve significant amount of interpretation. For example, “Human Health” includes the words world, human, environment, health, peopl, death, earth, diseas, live, popul, food, green, caus, risk, environmentalist. There is very little interpretive room here, especially knowing the genre of the discourse, and relying on the wealth of research about prominent themes in the climate change politics—for example (from Figure 2 in the manuscript):

- “Melting Arctic”: ice, sea, level, arctic, rise, polar, glacier, melt, bear, year, greenland, ocean, antarct, sheet, chang
- “Oil and Gas”: oil, gas, energi, natur, industri, product, well, fuel, drill, develop, new, compani, pipelin, use, price
- “Energy Production”: energi, electr, power, wind, renew, coal, state, plant, nuclear, solar, generat, percent, colorado, new, util

- “Al Gore”: gore, nobel, light, movi, film, prize, bulb, inconveni, may, use, peac, cfact, articl, one, truth
- “Extreme Weather”: hurrican, storm, weather, flood, climat, drought, increas, extrem, tropic, event, chang, year, intens, state, atlant

Supplementary Tables and Figures

Table 1: Frequency Statistics for Variables Used in Network and Text Analysis

VARIABLE	N	MEAN	SD
Organizations Data			
Total Organizations	164	–	–
Corporate Funding (EM and/or Koch)	84	.512	.501
Org. Type: Advocacy	61	.372	.439
Org. Type: Think Tank	70	.427	.491
Org. Type: Foundation/Trade Assoc./Company	33	.201	.351
Narrow Mission Focus on C.C.	50	.305	.462
Assets	–	16.9 mil	69.5 mil
Year Founded	–	1983	26.13
Network Data			
Organization Nodes	164	–	–
Individual Person Nodes	4,556	–	–
Bipartite Ties	7,108	–	–
One-mode Ties	1,225	–	–
Betweenness Centrality (Normalized)	–	.013	.019
Text Data			
Org. Texts	40,785	284	816
Total Words in Org. Texts	39.4 mil	957	2,309

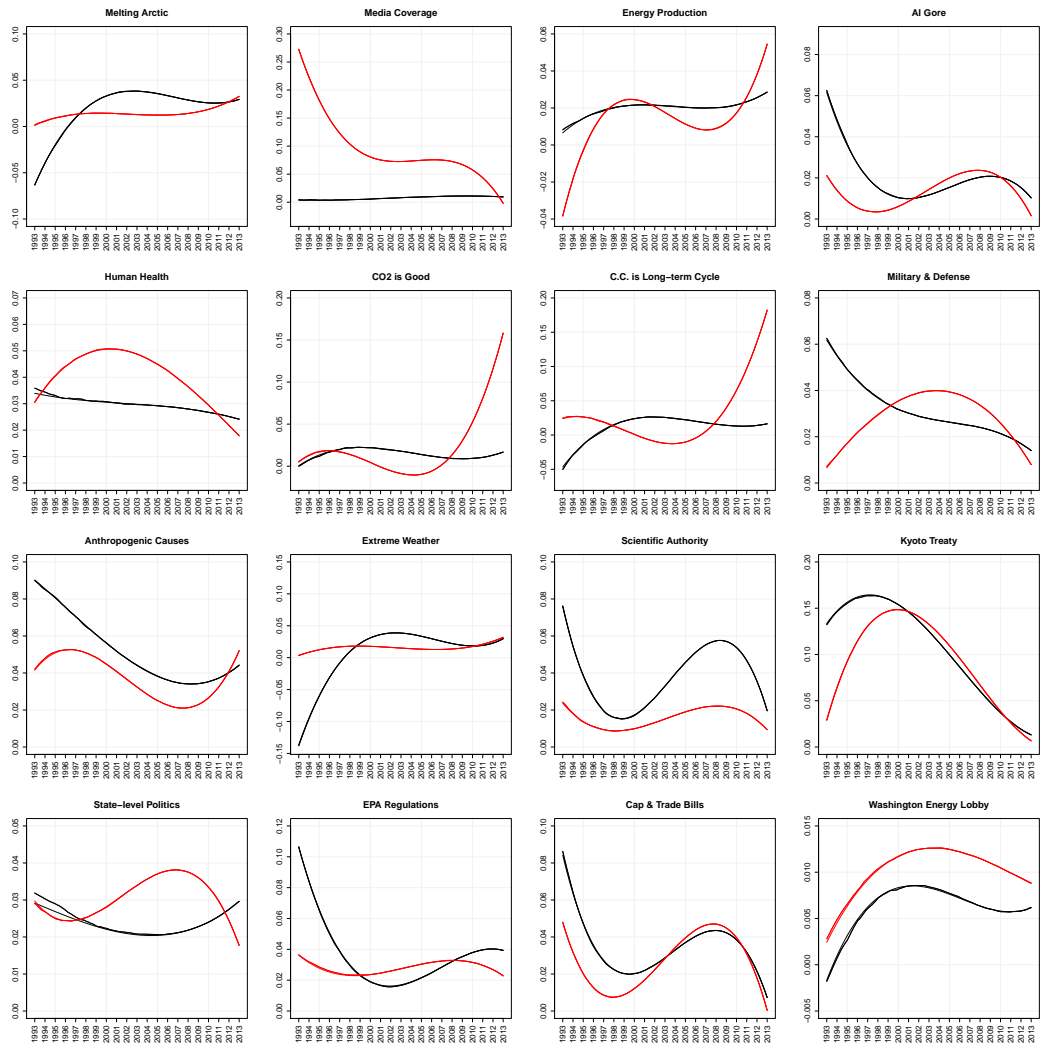


Figure 1: The influence of corporate funding on the use of discursive themes within the climate change contrarian movement, 1993-2013. The y-axis indicates how much a theme was written about. The red line represents the prevalence of the theme in the texts of contrarian organizations who received money, and the black line represents the prevalence of the theme for contrarian organizations who did not receive money. Interaction plots of all other discursive themes are provided in the SI.

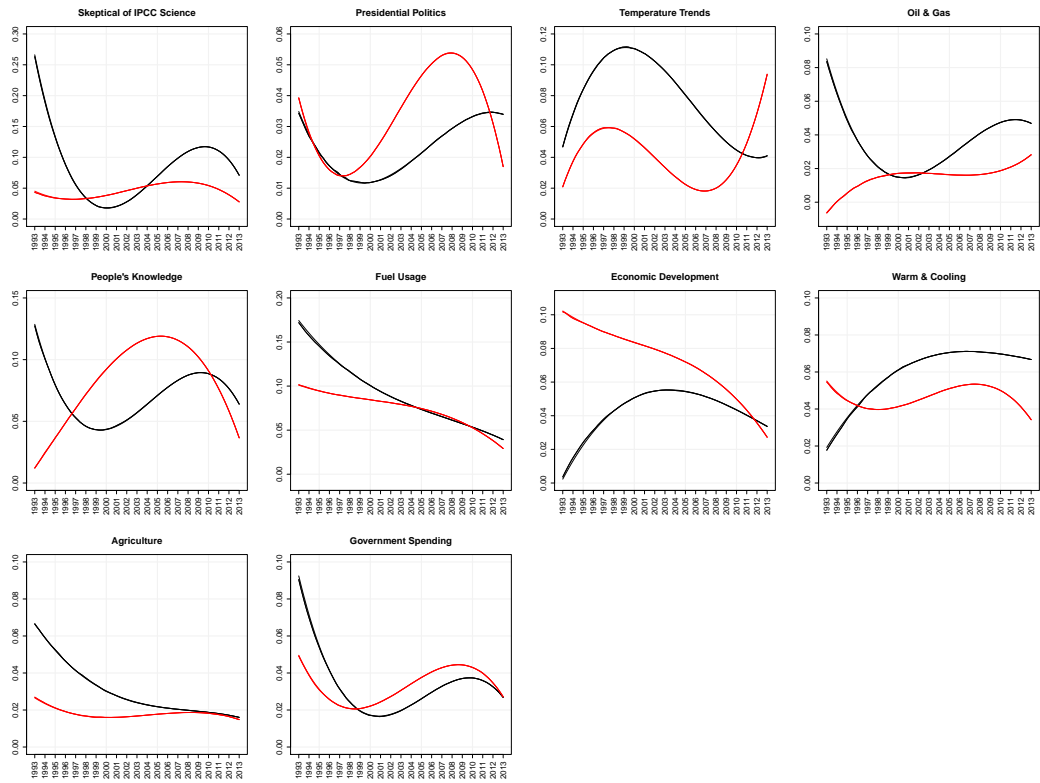


Figure 1 continued

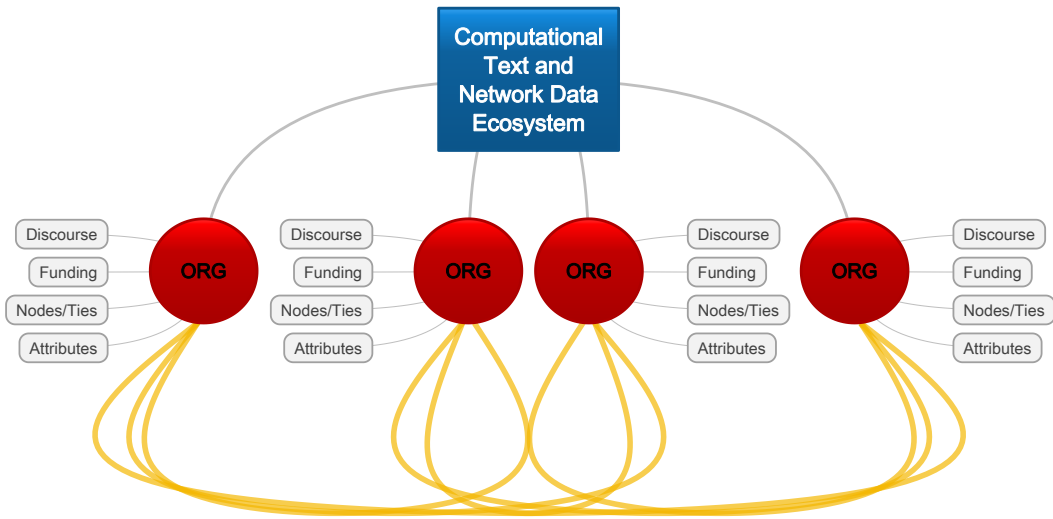


Figure 2: Text and network analytical framework. Embedding large-scale text data within organizations. Analytical focus is given to discursive and ideological variance within organizations, as well as across organizations in the social network framework.

164 organizations aggregated from previous peer-reviewed census and archival research. Some organizations are no longer involved in the climate contrarian movement, and some are no longer in existence. When necessary, some organization names were formatted and abbreviated for analysis. 51 percent of these organizations received funding from EM/KFFs.

60 PLUS ASSOCIATION, ACCURACY IN MEDIA, ACTION INSTITUTE FOR THE STUDY OF RELIGION AND LIBERTY, ADVANCEMENT OF SOUND SCIENCE CENTER INC, ALEXIS DE TOCQUEVILLE INSTITUTION, AMERICAN COAL FOUNDATION, AMERICAN COALITION FOR CLEAN COAL ELECTRICITY, AMERICAN CONSERVATIVE UNION FOUNDATION, AMERICAN COUNCIL FOR CAPITAL FORMATION, AMERICAN COUNCIL ON SCIENCE AND HEALTH, AMERICAN ENERGY ALLIANCE, AMERICAN ENERGY FREEDOM CENTER, AMERICAN ENTERPRISE INSTITUTE FOR PUBLIC POLICY RESEARCH, AMERICAN FARM BUREAU FEDERATION, AMERICAN FRIENDS OF INSTITUTE OF ECONOMIC AFFAIRS, AMERICAN FUEL AND PETROCHEMICAL MANUFACTURERS, AMERICAN GAS ASSOCIATION, AMERICAN LEGISLATIVE EXCHANGE COUNCIL, AMERICAN NATURAL GAS ALLIANCE INC, AMERICAN PETROLEUM INSTITUTE, AMERICAN POLICY CENTER, AMERICAN SPECTATOR FOUNDATION, AMERICAN TRADITION INSTITUTE, AMERICANS FOR A LIMITED GOVERNMENT INC, AMERICANS FOR BALANCED ENERGY CHOICES, AMERICANS FOR PROSPERITY, AMERICANS FOR TAX REFORM, ANNAPOLIS CENTER FOR SCIENCE BASED PUBLIC POLICY INC, ASSOCIATION OF GLOBAL AUTOMOBILE MANUFACTURERS INC, ATLANTIC LEGAL FOUNDATION, ATLAS ECONOMIC RESEARCH FOUNDATION ATLAS, AUSTRALIAN CLIMATE SCIENCE COALITION, CAPITAL RESEARCH CENTER AND GREENWATCH, CASCADE POLICY INSTITUTE, CATO INSTITUTE, CENTER FOR AMERICAN AND INTERNATIONAL LAW, CENTER FOR DEFENSE OF FREE ENTERPRISE, CENTER FOR SECURITY POLICY INC, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES, CENTER FOR STUDY OF CARBON DIOXIDE AND GLOBAL CHANGE, CENTRE FOR NEW EUROPE, CHAMBER OF COMMERCE OF UNITED STATES OF AMERICA, CHARLES KOCH INSTITUTE, CITIZENS FOR A SOUND ECONOMY NOW FREEDOMWORKS, CITIZENS FOR AFFORDABLE ENERGY INC, CO2 IS GREEN INC, COALITION FOR AMERICAN JOBS, COALITION FOR VEHICLE CHOICE INC, COLLEGIANS FOR CONSTRUCTIVE TOMORROW, COMMITTEE FOR CONSTRUCTIVE TOMORROW, COMMUNICATIONS INSTITUTE, COMPETITIVE ENTERPRISE INSTITUTE, CONSUMER ALERT INC, CONSUMER ENERGY ALLIANCE INC, CONSUMERS ALLIANCE FOR GLOBAL PROSPERITY, COOLER HEADS COALITION, CORNWALL ALLIANCE FOR THE STEWARDSHIP OF CREATION, DCI GROUP, DEFENDERS OF PROPERTY RIGHTS, DONORS TRUST DONORS CAPITAL FUND, EDISON ELECTRIC INSTITUTE, ENERGY MAKES AMERICA GREAT, ENVIRONMENTAL CONSERVATION ORGANIZATION, ENVIRONMENTAL LITERACY COUNCIL, EXXONMOBIL, FEDERALIST SOCIETY FOR LAW AND PUBLIC POLICY STUDIES, FEDERATION FOR AMERICAN COAL ENERGY AND SECURITY, FRASER INSTITUTE, FREE ENTERPRISE ACTION INSTITUTE FREE ENTERPRISE EDUCATION INSTITUTE, FREEDOM ACTION, FREEDOMWORKS FOUNDATION, FREEDOMWORKS INC, FRONTIERS OF FREEDOM IN-

STITUTE INC, GEORGE MARSHALL INSTITUTE, GEORGE MASON UNIVERSITY LAW AND ECONOMICS CENTER GMU LEC, GLOBAL CLIMATE COALITION, GLOBAL WARMING POLICY FOUNDATION, GREENING EARTH SOCIETY, HEARTLAND INSTITUTE, HERITAGE FOUNDATION, HOOVER INSTITUTION ON WAR REVOLUTION AND PEACE STANFORD UNIVERSITY, HUDSON INSTITUTE, ILLINOIS POLICY INSTITUTE, INDEPENDENCE INSTITUTE, INDEPENDENT COMMISSION ON ENVIRONMENTAL EDUCATION, INDEPENDENT INSTITUTE, INDEPENDENT PETROLEUM ASSOCIATION OF AMERICA, INDEPENDENT WOMENS FORUM, INDUSTRIAL ENERGY CONSUMERS OF AMERICA, INITIATIVE FOR PUBLIC POLICY ANALYSIS, INSTITUTE FOR BIOSPHERIC RESEARCH, INSTITUTE FOR ENERGY RESEARCH, INSTITUTE FOR LIBERTY, INSTITUTE FOR REGULATORY SCIENCE, INSTITUTE FOR STUDY OF EARTH AND MAN, INSTITUTE OF HUMANE STUDIES GEORGE MASON UNIVERSITY, INSTITUTE OF PUBLIC AFFAIRS, INTERMOUNTAIN RURAL ELECTRIC ASSOCIATION, INTERNATIONAL CLIMATE AND ENVIRONMENTAL CHANGE ASSESSMENT PROJECT, INTERNATIONAL CLIMATE SCIENCE COALITION, INTERNATIONAL COUNCIL FOR CAPITAL FORMATION, INTERNATIONAL POLICY NETWORK, INTERNATIONAL REPUBLICAN INSTITUTE IRI, JAMES MADISON INSTITUTE FOR PUBLIC POLICY STUDIES INC, JOHN LOCKE FOUNDATION INC, JUNKSCIENCE DOT COM, KNOWLEDGE AND PROGRESS FUND, KOCH FOUNDATIONS COMBINED, KOCH INDUSTRIES, LANDMARK LEGAL FOUNDATION, LEXINGTON INSTITUTE, LINDENWOOD UNIVERSITY, LOCKE INSTITUTE, MACKINAC CENTER, MANHATTAN INSTITUTE FOR POLICY RESEARCH INC, MEDIA RESEARCH CENTER INC, MERCATUS CENTER INC GWU, MOUNTAIN STATES LEGAL FOUNDATION, NATIONAL ASSOCIATION OF MANUFACTURERS OF USA, NATIONAL BLACK CHAMBER OF COMMERCE, NATIONAL CENTER FOR POLICY ANALYSIS, NATIONAL CENTER FOR PUBLIC POLICY RESEARCH INC, NATIONAL COUNCIL FOR ENVIRONMENTAL BALANCE, NATIONAL ENVIRONMENTAL POLICY INSTITUTE, NATIONAL LEGAL CENTER FOR PUBLIC INTEREST, NATIONAL MINING ASSOCIATION, NATIONAL PETROLEUM COUNCIL, NATIONAL POLICY FORUM, NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION, NATIONAL TAXPAYERS UNION, NATIONAL TAXPAYERS UNION FOUNDATION, NATIONAL WILDERNESS INSTITUTE, NEW ZEALAND CLIMATE SCIENCE COALITION, OKLAHOMA COUNCIL OF PUBLIC AFFAIRS INC, OREGON INSTITUTE OF SCIENCE AND MEDICINE, PACIFIC LEGAL FOUNDATION, PACIFIC RESEARCH INSTITUTE FOR PUBLIC POLICY, PEABODY ENERGY, PLANTS NEED CO2 ORG, PROPERTY AND ENVIRONMENT RESEARCH CENTER, REASON FOUNDATION, RESPONSIBLE RESOURCES, SCIENCE AND ENVIRONMENTAL POLICY PROJECT, SCIENCE AND PUBLIC POLICY INSTITUTE, SHOOK HARDY AND BACON LLP, SMALL BUSINESS SURVIVAL COMMITTEE, SMITHSONIAN ASTROPHYSICAL OBSERVATORY WILLIE SOON AND SALLIE BALIUNAS, SOUTHEASTERN LEGAL FOUNDATION INC, SOVEREIGNTY INTERNATIONAL INC, STATE POLICY NETWORK, STATISTICAL ASSESSMENT SERVICE STATS, TECH CENTRAL SCIENCE FOUNDATION, TEXAS PUBLIC POLICY FOUNDATION, THOMAS JEFFERSON INSTITUTE FOR PUBLIC POLICY, TS AUGUST, UNITED FOR JOBS, US RUSSIA BUSINESS COUNCIL, VIRGINIA INSTITUTE FOR PUBLIC POLICY, WASHINGTON LEGAL FOUNDATION, WASHINGTON POLICY CENTER, WEIDENBAUM CENTER ON THE ECONOMY GOVERNMENT AND PUBLIC POLICY

CENTER FOR THE STUDY OF AMERICAN BUSINESS, WESTERN FUELS ASSOCIATION, WORLD
AFFAIRS COUNCILS OF AMERICA, WORLD CLIMATE REPORT

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