



Unveiling the dynamics of climate change narratives:

A Google Trends analysis

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Abstract

This study explores public interest and misinformation surrounding climate change through an analysis of Google Trends data. It focuses on online search behaviors related to "climate", "climate change", "climate hoax", and "HAARP" throughout 2023. By tracking search patterns, we aim to understand public perceptions, concerns, and the influence of misinformation on climate change discourse. Our findings indicate a strong temporal and regional variability in search interest, which spikes notably during significant events like Earth Day and in response to public statements by influential figures. The results demonstrate high engagement in regions with direct climate impact, such as Africa and parts of Asia, contrasted with varied engagement in Western nations. Notably, the data reveals significant public intrigue following conspiracy narratives during specific periods, which emphasizes the role of misinformation in shaping public discourse. This analysis underscores the need for targeted communication strategies to effectively address public misconceptions and enhance the understanding of climate-related issues. This research highlights the utility of Google Trends as a tool for real-time monitoring of public interest and misinformation and offers valuable insights for policymakers, educators, and activists to tailor their approaches to combat climate change more effectively. Through its comprehensive analysis, the study contributes to the broader understanding of how digital tools can aid in the ongoing efforts to engage the public in meaningful climate action discussions.

Keywords: climate change, conspiracy narratives, misinformation, Google Trends, search patterns, public discourse.

Introduction

The issue of climate change presents a significant challenge to humanity and requires urgent attention to address its potential consequences. Numerous scientific studies have consistently highlighted the reality of climate change and its potential impacts on our planet (Lynas et al., 2021). These findings have contributed to a growing body of evidence that supports the urgent need for action (IPCC, 2023). The results of sociological surveys show that climate change is a matter of concern and worry for the majority of the population (Ritchie, 2024). This leads to the fact that climate change is becoming one of the popular topics for discussion. One of the places for such discussion today is the Internet, which with its global penetration plays a crucial role in shaping the climate change discussion and can serve as a barometer for public interest

and concern (Troumbis, 2017; Taddicken & Reif, 2016). The internet offers a mixture of public engagement, where genuine concerns about global warming and effective policy responses intersect with misconceptions and misleading narratives. It allows for a rapid dissemination of both accurate scientific data (Camarillo-Naranjo et al., 2019) and misinformation (Treen et al., 2020) and can influence public perceptions and understanding of climate change. For instance, accurate information about the impacts of global warming, necessary mitigation strategies, and new scientific discoveries coexists with unfounded skepticism (Niederer, 2013) and conspiracy theories (Tyagi & Carley, 2021) that challenge the legitimacy of climate science. This dual presence of information and misinformation necessitates targeted communication and educational campaigns to enhance public knowledge and counteract misleading narratives (Komendantova et al., 2023). Effective science communication not only increases awareness but also plays a pivotal role in influencing public behavior and policy decisions (Nisbet, 2009; Moser, 2016).

Investigation of online search behaviors, particularly through platforms like Google, can help us comprehend public perceptions and discussions about climate change (Durmuşoğlu, 2017). The use of search engines is driven by several well-established social psychological theories. One such framework is uses and gratifications theory (Sundar & Limperos, 2013), which posits that individuals turn to search engines to fulfill specific needs, including information-seeking, entertainment, social connection, and self-expression. Additionally, social cognitive theory (Bandura, 1986) highlights the role of self-efficacy, observational learning, and social influence, suggesting that users engage in search behavior not only based on personal needs but also by modeling the behaviors of others in their social environment. For example, trending topics on social media can trigger widespread search activity as individuals seek to align themselves with social norms or gather information on culturally relevant events (Winter et al., 2015).

Another important framework is information foraging theory (Fu & Pirolli, 2007), which conceptualizes search behavior as a cost-benefit analysis, similar to how animals forage for food. Users tend to seek out the most valuable information with the least cognitive effort, often relying on the top-ranked search results or familiar sources. This principle is tightly intertwined with platform algorithms, which are designed to optimize user engagement by delivering results that are both relevant and easily accessible (Hannak et al., 2013). Algorithms also influence user behavior through nudge theory (Thaler & Sunstein, 2008), subtly guiding individuals toward particular outcomes by modifying how information is presented. For instance, search engines may nudge users to click on specific results by highlighting snippets or suggesting popular queries, thus shaping search behavior in a way that aligns with the platform's objectives (Binns et al., 2018). Furthermore, the personalized nature of algorithms can create a filter bubble (Bakshy et al., 2015), wherein users are repeatedly exposed to information that reinforces their existing beliefs.

The creation of filter bubbles can exacerbate the spread of misinformation, and conspiracy theories, in particular. Conspiracy theories thrive on sensationalism, emotional appeal, and narratives of secrecy or hidden truth, which are particularly engaging to users. This makes them highly susceptible to the dynamics of algorithmic content curation on search engines, where algorithms prioritize engaging content. Research shows that conspiracy theories offer cognitively and emotionally satisfying explanations, especially in times of uncertainty or crisis, when individuals seek to make sense of complex events (Douglas et al., 2017).

From a theoretical standpoint, conspiracy theories are popular partly due to their psychological allure. Theories such as cognitive dissonance (Festinger, 1957) and motivated reasoning (Kunda, 1990) suggest that people gravitate towards information that reinforces their pre-existing beliefs and values. When search

engines present content tailored to users' past behaviors, conspiracy theories that align with users' cognitive biases are more likely to be promoted and circulated. Furthermore, the algorithmic design of search engines prioritizes content with high engagement – clicks, shares, and comments – which conspiracy theories often generate due to their sensational and emotionally charged nature. The combination of these psychological drivers and algorithmic incentives creates an environment where conspiracy theories can quickly gain popularity and spread widely through search engines (Vosoughi et al., 2018).

By examining the trends and patterns in online searches, researchers and policymakers can gain insights into the public's concerns, misunderstandings, and interest levels regarding climate change. This data can help tailor communication and educational campaigns to address misconceptions and foster a more informed and engaged public discourse on climate issues.

For our study, we focused on analyzing Google Trends data related to climate change during 2023 to assess the urgency of climate action as reflected by public engagement online. Our primary objectives were to address several research questions through the analysis of search patterns:

- What is the overall trend in searches about climate change during the study period?
- What are the main themes and queries related to climate change that are being searched?
- What is the search behavior in relation to climate change related conspiracy theories?

We employed analytical techniques to interpret the data and to identify key patterns and themes in the searches that shed light on the predominant public concerns and misconceptions about climate change.

This analysis provided a comprehensive understanding of the public's interest and engagement with climate change topics and highlighted the main areas of focus. The value of this study lies not only in the insights gained from analyzing search trends within a specific timeframe but also in the broader understanding it offers regarding the role of online search behavior in shaping public perceptions and discussions related to climate change.

Methods and data

Our research utilized Google Trends to gather and analyze data on public search behavior related to climate change with a specific focus on searches over the year 2023. Google Trends – a tool that analyzes the popularity of search queries in Google Search – offers a range of benefits for research (Jun et al., 2018). It provides real-time and historical data on search term frequencies, which is essential for capturing public interests and behaviors. It has been broadly applied across diverse fields such as IT, communications, medicine, health, business, and economics. It also allows researchers to easily compare data across different times and places. In health and epidemiology, Google Trends has been used to monitor disease outbreaks (Carneiro & Mylonakis, 2009) and public health trends (Nuti et al., 2014), which demonstrates its capability in near real-time surveillance and response. Additionally, the tool provides insights into social changes and transformations by analyzing patterns in search behavior, which can inform social science research (Lolić et al., 2024).

Google Trends score is on a scale of 0 to 100, with 100 indicating the highest level of popularity for a keyword. This score helps understand the relative interest in a keyword over time. Related queries show specific phrases or questions that users searching for the keyword also looked up and provide insights into

user behavior and interest. Related topics offer broader or more niche topics that users searching for the keyword are interested in and help to identify potential content ideas or trends. Interest over time graph visually represents the popularity of a keyword over a specific period and shows peaks and valleys that indicate seasonality or trends. Interest by region breaks down the interest for a keyword by countries, which helps to identify geographic areas where the keyword is most popular.

We chose the timeframe of 2023. By limiting our study to the most recent year, we aimed to provide insights that are directly relevant to current events and policies and enhance the applicability of our findings to current strategies for addressing climate misinformation and public awareness. Our analytical approach included temporal analysis to observe trends over the selected time period, which helped identify significant fluctuations in public interest or attention. We also examined related topics and queries that arose with our initial keywords to gain a broader view of public discourse surrounding climate change. Regional analysis of the search queries provided insights into geographical variations in interest and beliefs about climate change and its conspiracies.

The study was structured around two primary areas of focus. First, we analyzed general search patterns using the keywords "climate" and "climate change". Second, following initial desk research that identified prevalent conspiracy narratives about climate change, we derived specific keywords linked to these narratives for a deeper investigation. These were "climate hoax"¹ and "HAARP". The HAARP (High Frequency Active Auroral Research Program) conspiracy theory posits that this research facility, originally intended to study the ionosphere and improve communications and surveillance technologies, is actually a secret device used by the U.S. government to manipulate the weather, induce natural disasters like earthquakes, and control minds globally (Erokhin & Komendantova, 2024). Climate hoax refers to conspiracy theories that deny the existence, causes, or consequences of anthropogenic climate change (Biddlestone et al., 2022). These theories often include claims that climate change is a fabrication invented by scientists, governments, or global elites to deceive the public or achieve hidden agendas. Such conspiracies may assert that scientific data on climate change is manipulated or entirely fabricated to push political, financial, or ideological goals. The analysis was confined to search queries made in English². Expanding to multiple languages would have significantly increased the complexity and breadth of the study. However, limiting our analysis to English-language searches means that significant dynamics present in non-English-speaking regions were not captured (Dabran-Zivan et al., 2023; Lowe & Steichen, 2017; Lazarinis et al., 2009). Climate change discourse and conspiracy theories are global phenomena, and excluding non-English searches may result in an incomplete understanding of worldwide public perceptions and trends. Cultural differences, regional issues, and localized misinformation campaigns in other languages could offer valuable insights that are absent from an English-only analysis. Future research should consider incorporating multilingual data to achieve a more comprehensive and inclusive understanding of global search behaviors related to climate change and conspiracy theories.

The selection of keywords aimed to comprehensively cover topics related to climate change and associated conspiracy theories, though we acknowledge a limitation in this approach. It is possible that some relevant

¹ It is to note that both "climate change" and "climate hoax" searches are subsets of the "climate" search.

² The HAARP conspiracy theory was an exception because the term "HAARP" is widely recognized and used in multiple languages, which allowed for the analysis of searches from various countries around the world.

search queries might be overlooked if they do not directly include the chosen keywords, which could potentially limit the thoroughness of our analysis (Schultheiß et al., 2023). To partially address this concern, we utilized the related topics and related queries features provided by Google Trends, thereby expanding the scope of our analysis beyond the initial keyword list.

It is important to note that relying solely on Google Trends introduces its own set of limitations. Google Trends provides data based on relative search volumes rather than absolute figures (Rovetta, 2021), and the algorithms determining related queries are proprietary and not fully transparent (Parker et al., 2017). Furthermore, the platform's affordances and algorithms can mediate user search behavior in significant ways. Features such as autocomplete suggestions, personalized search results, and trending topics can influence what users search for by prompting certain queries over others (Epstein et al., 2024). For instance, when a user begins typing a search term, Google's autocomplete may suggest popular or algorithmically prioritized terms, potentially steering the user's search in a particular direction. This can create a feedback loop where certain topics receive more attention not solely due to organic public interest but also due to the platform's design choices. Additionally, personalized search results based on a user's history and location (Le et al., 2019; Kliman-Silver et al., 2015) can further mediate the search experience, making it challenging to generalize Google Trends data as a direct proxy for unmediated public interest.

Another limitation of this study is the temporal granularity of the Google Trends data (Rovetta & Castaldo, 2023), which is restricted to a weekly basis. This constraint hampers our ability to perform more detailed analyses, such as correlating search trends with specific major events in media or politics that may have immediate but short-lived impacts on public interest. Access to more granular data – ideally on a daily or hourly level – would enable more profound research. With finer temporal resolution, we could apply advanced statistical analyses to examine the relationship between real-time events and fluctuations in search behavior more precisely. Future research leveraging more detailed data could provide deeper insights into how specific events influence public engagement with climate change narratives online.

Climate

Fig. 1 illustrates the development of the searches of the keyword "climate" throughout 2023. We see a moderate interest over the year, with a sharp peak in the week of April 16-22. When we look into this week, we see that the increase happened on April 22. The observed increase can likely be attributed to the celebration of Earth Day, which falls on the same date. Earth Day is a global event dedicated to raising awareness about environmental protection and encouraging actions to mitigate the impacts of climate change. It is a day marked by various activities like educational programs, tree planting, clean-up drives, and public discussions. These events often prompt people to seek more information about climate-related topics and could potentially drive up the search volumes.

Figure 1: "Climate" interest over time



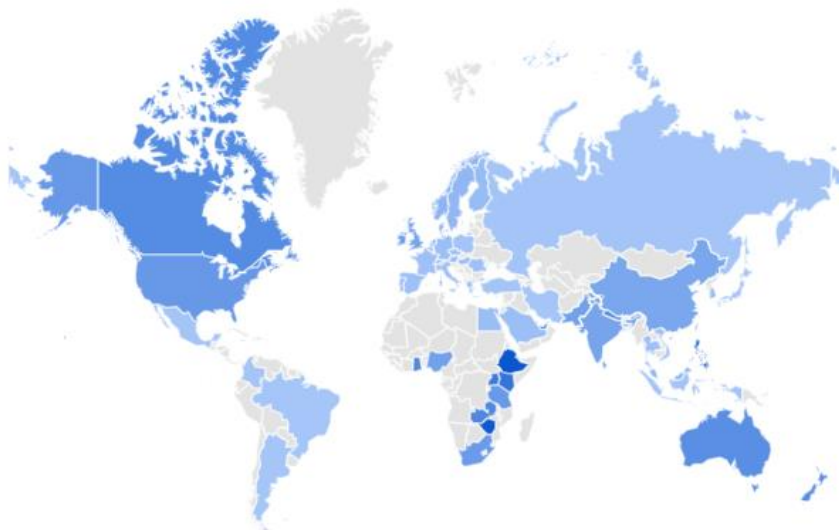
The interest in the topic "climate" showed varying levels of search activity across different countries (see Fig. 2). Ethiopia led with the highest interest score of 100, followed closely by Zimbabwe at 98. Other African countries like Kenya, Uganda, and Zambia also showed significant interest.

In Asia, the Philippines showed a relatively high interest level with a score of 79, while other populous nations like India and China had lower scores of 31 and 29, respectively. This suggests a varying level of public interest or awareness concerning climate issues within the continent.

Western countries exhibited a wide range of interest levels. Canada and New Zealand were on the higher side with scores of 52 and 51, while European nations such as Germany, France, and the UK showed much lower interest levels, with scores ranging from 7 to 32. Similarly, the United States had a moderate score of 41.

The data suggests that countries in Africa and some in Asia show a higher relative interest in climate issues compared to many Western and developed nations, which might indicate different levels of public engagement, awareness, or impact of climate-related issues in these regions.

Figure 2: "Climate" interest by region



Related topics

The "climate movement" topic led the surge in interest and showed a dramatic 600% increase. This reflects a growing global focus on organized efforts to address climate change. Similarly, the topic "moving" saw a 400% rise, though this could potentially relate to various contexts.

Prominent figures in climate activism, like Greta Thunberg, also saw a significant rise in attention, with a 140% increase in search interest. This underscores the impact of individual activists on public engagement with climate issues.

Other topics that gained interest included "future" and "activism", each with increases of 100% and 90%, respectively, which suggests a broader public consideration of the long-term implications of climate change and the roles individuals and groups can play.

Technical and scientific aspects related to climate such as "climate classification" and "greenhouse gas emissions" also saw substantial interest increases by 70%. This indicates a growing public desire to understand the specifics of climate phenomena and their causes.

Furthermore, topics like "wildfire" and "mitigation" each with a 60% increase, reflect concerns over the direct impacts of climate change and the strategies to counteract them. The topic "increased" also showed a 60% rise. This potentially indicates more general discussions around things that are increasing in the context of climate discussions, such as temperatures or sea levels.

Less directly related but still significant topics like "funding" and "self-storage" saw increases of 50% and 40%, respectively. They possibly reflect broader economic and personal impacts associated with climate change or actions taken in response to it.

Related queries

The highest surge in interest was seen in "climate action incentive payment 2023", which increased by 3450%. This indicates strong public interest in financial incentives related to climate action for the year 2023. Similarly, searches for "climate action incentive payment dates for 2023" and "climate action incentive payment dates" also saw substantial increases.

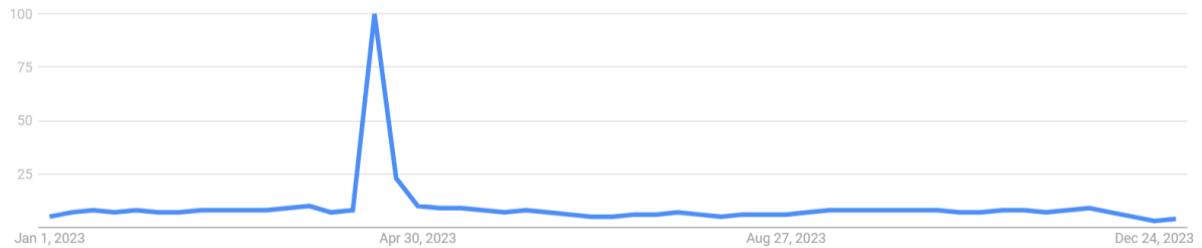
There was also heightened attention on major climate conferences, as indicated by the 2450% increase in searches for "COP28". This points to global discussions and decisions they entail. Searches related to Greta Thunberg, including "climate activist Greta Thunberg" and "Greta Thunberg" also saw significant increases. This reflects the influential role of high-profile activists in driving public discourse on climate issues.

Another area of growing awareness was the health impacts associated with climate change, particularly how it affects disease patterns, evidenced by a 2050% jump in searches for "fungal infections climate change". There was also a rising interest in technological solutions and tools for understanding and mitigating climate impacts, as shown by the increases in searches for "climate tech" and "climate reanalyzer". Additionally, there was curiosity about financial mechanisms designed to support climate initiatives globally, as seen in the increase in interest in "green climate fund". Localized interest in specific regional climate conditions was demonstrated by increases in searches for "Dubai climate" and "Argentina climate". Lastly, broader concepts such as "climate resilience" and "sustainability" also saw increases. This indicates continuous concern with adaptation strategies and sustainable practices.

Climate change

For “climate change”, we observe a similar temporal development as for “climate” above with a moderate search behavior (though at a lower level than on “climate”) with a peak on Earth Day.

Figure 3: “Climate change” interest over time

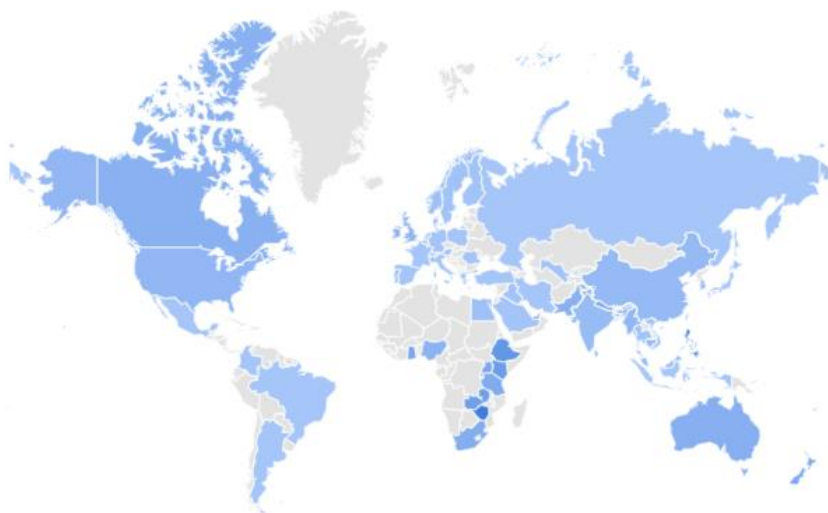


There were varying levels of search interest across different countries (see Fig. 4). Fiji had the greatest relative volume of searches on this topic with the interest score of 100. Other countries with notably high search interest included Zimbabwe, the Philippines, Rwanda, and Ethiopia, with scores ranging from 44 to 67. This suggests a strong awareness and concern about climate change in these regions.

In contrast, many developed countries such as the United States, United Kingdom, Canada, and Australia exhibited moderate to lower search interest scores, ranging from 15 to 21. This might reflect different levels of public engagement or the effectiveness of existing climate change communication strategies in these nations.

Additionally, a group of countries including India, Malaysia, and Hong Kong showed relatively lower search interest, with scores under 10, which could indicate lesser public discourse or awareness regarding climate issues in these regions.

Figure 4: “Climate change” interest by region



Related topics

The topic "moving" led the surge with a remarkable increase of 700%. Other significantly rising topics included "future" and "land" both up by 110%, which suggests an increased focus on future projections of climate change and its effects on land use and management.

"Mitigation" and "greenhouse gas emissions" both saw a 100% increase in search interest. They highlight growing concerns and awareness about strategies to reduce climate impact and the key factors driving climate change. The topic "adaptation" also rose by 100%, which indicates a rising interest in strategies to adjust to actual or expected future climate.

Disasters related to climate change such as "wildfire" were also gaining attention with a 90% increase in searches. This reflects the urgent concerns over the more frequent and severe natural disasters as climate change progresses. Other ecological concerns included "reef" (+80%) and "habitat" (+60%) pointing to specific interest in the effects of climate change on marine ecosystems and wildlife habitats.

Economic and social dimensions were evident in the rising interest in "funding" (+70%), "industry" (+60%), and "population" (+50%), which underscores financial, industrial, and demographic considerations in climate discussions. Topics like "carbon" and "sustainability" both up by 50% were indicative of a broader concern with reducing carbon footprints and promoting sustainable practices.

Related queries

The query showing the most significant spike was "Ryan Garcia vs Tank" with a 4300% increase. It indicates an overlap in timing with a major sports event. This was followed by a strong interest in "fungal infections climate change," which soared by 3650%. This suggests concerns about the impact of climate change on health, particularly the spread of diseases.

The annual United Nations Climate Change Conference, COP28, also saw a notable increase in searches by 2550%, which indicates keen interest in international climate negotiations and policies. The year-specific search "climate change 2023" surged by 2450%. This shows that people were looking for the most current information on climate impacts and responses. Additionally, queries like "list down five most drastic climate change events that you remember?", which increased by 1900%, highlight a desire to understand historical events within the context of climate change.

Other rising queries included practical and educational searches such as "examples of climate change in everyday life", "climate change global boiling", and "climate change performance index 2023". This demonstrates a pursuit of specific and actionable knowledge on climate issues. There was also a growing interest in services and resources like the Copernicus Climate Change Service and various government and international agencies involved in climate policy and research. Searches also extended to queries about the causes, effects, and societal opinions on climate change, including "what are the 10 causes of climate change?" and "what do you think about climate change". This shows that the public was engaging in a broad dialogue to understand and react to this global challenge. Queries about the impact of phenomena like "El Nino", the controversial topic of "climate change hoax", and the link between "deforestation and climate change" further indicated a wide range of concerns and viewpoints that people were eager to explore and discuss.

Climate hoax

The searches for “climate hoax” represented a zig-zag development with interchanging increase and decrease in interest. However, we see at least three larger peaks – July 23-29, August 20-26 as well as December 10-16. After checking each week individually, we found that the peaks were on July 27, August 24, and December 11. These peaks were most likely associated with Vivek Ramaswamy – a well-known American entrepreneur and politician who asserts that the climate change agenda is a hoax. For example, on July 27, he was interviewed on Fox News. On August 24, during the Republican Party presidential debate, Vivek Ramaswamy spoke about his view that climate change is a hoax. On December 11, there were also news articles centered around Vivek Ramaswamy.

Figure 5: “Climate hoax” interest over time



There was a stark regional contrast in interest levels on “climate hoax” (see Fig. 6). New Zealand, Canada, Ireland, and the United States each scored the highest possible interest level of 100, indicating a significant level of searches concerning the topic in these countries.

In contrast, Australia, South Africa, the United Kingdom, and the Netherlands showed a moderate interest with scores of 50, pointing to a less pronounced but still notable level of engagement with the topic.

At the other end of the spectrum, the Philippines, India, and Germany showed virtually no interest (<1) in the search term “climate hoax”. This indicates that the topic is either not as controversial or simply not as discussed in these countries.

Figure 6: "Climate hoax" interest by region



Related topics

American entrepreneur "Vivek Ramaswamy", along with topics like the "Nobel Prize" and "carbon", saw a breakout in searches due to their increasing relevance or newsworthiness in the context of climate discussions (also see above on Vivek Ramaswamy). Similarly, interest in recognitions and awards related to environmental efforts, as well as debates around carbon-related strategies, was becoming more prominent. Among the topics with the most notable increases, the concept of a "climate emergency declaration" led with a 700% rise in interest. This signals a growing acknowledgment of climate issues as urgent crises by the public and governments alike. The topics of "debate" and "crisis" each showed substantial increases of 400% and 250%, respectively, which reflects intensified discussions and polarizations around the validity of and responses to climate change. Additionally, the incorporation of climate themes into popular culture and social media was evident with "memes" seeing a 250% increase in interest.

Political and social dimensions were also prominent, with the "Republican Party" experiencing a 160% increase in searches. Searches related to government actions on climate increased by 150%, and there was a notable demand for factual data and proof in climate discussions, as shown by a 90% increase in searches for "evidence".

The figure of "Joe Biden", the 46th U.S. President, also featured significantly, with a 70% rise in search interest likely tied to his administration's climate-related policies.

Related queries

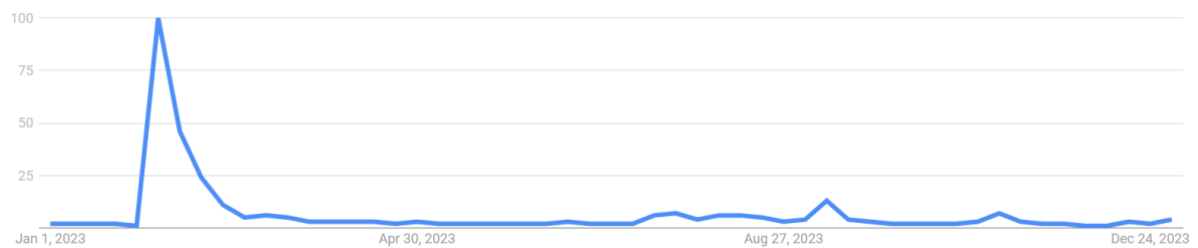
The term "vivek climate change hoax" experienced a breakout in searches, highlighting a strong interest in Vivek Ramaswamy's views or statements regarding climate change as a potential hoax. Similarly, searches for "Vivek Ramaswamy" alone also achieved breakout status. This suggests that the public was keenly interested in his broader opinions and activities related to climate issues. Additionally, "Dr. Judith Curry

climate hoax” emerged as another breakout query. Dr. Judith Curry is known for her skeptical stance on certain aspects of climate science consensus, and this surge in searches reflects significant public curiosity for her views on climate change being misrepresented or exaggerated.

HAARP

The searches for “HAARP” were at a relatively low level with a huge increase in the week of February 5-11, in particular, on February 6 when a 7.8-magnitude earthquake hit Syria and Turkey. We can observe some further smaller peaks, which can also be attributed to natural disasters (Erokhin & Komendantova, 2024). This suggests that an interest to the topic is low in normal times, but it can dramatically increase once a trigger situation happens such as a large-scale earthquake, which can be brought in relation to the conspiracy theory.

Figure 7: “HAARP” interest over time



There were regional differences in curiosity or concern about the program (see Fig. 8). Turkey indicated the peak of regional curiosity, with a score of 100. Following closely were Croatia, Slovenia, Kosovo, Cyprus, and Albania, all with a substantial interest with scores ranging from 54 to 76.

Moderate levels of interest were seen in Lebanon, Romania, Bangladesh, and Bosnia & Herzegovina, where scores ranged from 40 to 50. These countries, along with others in Southeast Europe and some parts of Asia, reflected a strong but not peak level of engagement with the topic of HAARP.

Conversely, countries like Germany, Austria, Netherlands, and Switzerland, along with Western nations such as the United States, Canada, and Australia, exhibited much lower interest levels, with scores around 6 to 20. In other large countries like Russia, India, and Japan, the interest was minimal, with scores dipping to 2 or even 1, which indicates very little public engagement with the topic.

Figure 8: "HAARP" interest by region



Related topics

Significant interest arose in several cities including "Kahramanmaraş", "Kağıthane", "Zonguldak", and "Erzincan" driven by the February 2023 earthquake in Syria and Turkey. The "2023 Turkey-Syria earthquakes" also sparked a major increase in searches, also explaining the surge in interest in the "disaster and emergency management presidency", a key government agency responding to the crisis.

In addition to local interests, there was heightened attention on "NATO", the "USS Nitze", an Arleigh Burke-class destroyer, and "HAARP attack". These searches can be linked to the conspiracy theory of the secret weather-control weapon.

The search interest extended to individuals like "Naci Görür", a Turkish seismologist and geologist who was argued to have predicted the February 2023 earthquake, and companies like "Harp Technologies Oy" in Finland, which may have drawn curiosity due to its name's resemblance to HAARP.

Moreover, broader geological and scientific discussions were evident, as topics like "tectonics" and "fault" in geology saw substantial interest increases. "Frank Hoogerbeets", a researcher known for his seismic predictions, also saw a breakout in searches. It was argued that he had also predicted the earthquake.

Media-related interests were also prominent, with significant engagement with "Beyaz TV", a television channel, "Ekşi Sözlük", a popular Turkish website, and "Kandilli Observatory", a well-known observatory in Istanbul. This reflected strong public engagement with media outlets and scientific institutions for information and discussion regarding ongoing events.

Related queries

Queries like "haarp turkey earthquake", "haarp technology earthquake", and "haarp in turkey" all experienced breakout increases, indicating a surge in curiosity or concern about HAARP's involvement or

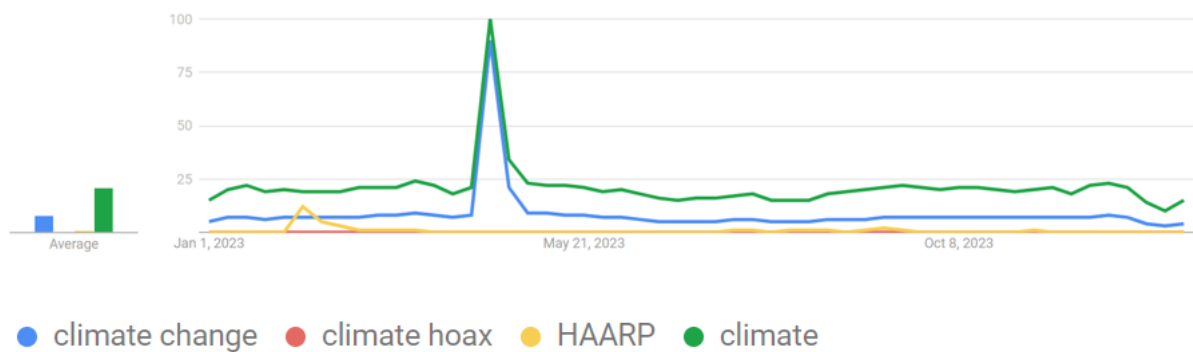
impact on seismic activities in the region. The inclusion of specific locations such as “kahramanmaraş” and “haarp zonguldak” in the searches suggests that people were particularly interested in the potential effects of HAARP in those areas affected by the natural disaster.

Further emphasizing the geopolitical dimensions, terms like “uss Nitze” and “amerikan gemisi” also showed breakout increases, which might reflect conspiracy theories or speculations about American military involvement or experiments related to HAARP in the region. The term “proyecto haarp turquia” suggests that there was also significant Spanish-speaking interest in HAARP activities in Turkey.

The queries extended to a broader international context with variations of the HAARP topic in different languages, such as “haarp erdbeben türkei” (German), “haarp turki” (Indonesian), “haarp turkije” (Dutch), and “haarp turchia” (Italian), showcasing a global spread of interest and concern. Additionally, specific queries like “haarp technology for earthquake” and “haarp technology in bangla” indicated a desire to understand or investigate the technological aspects of HAARP and its alleged capabilities related to earthquakes.

Breakouts such as “Celal Şengör”, a prominent Turkish academic, and “haarp research facility photos” showed that individuals were not only searching for theoretical or speculative information but also for expert opinions and visual evidence regarding HAARP. This pattern of queries underscores a broad and multifaceted engagement with the HAARP topic, driven by recent seismic events, ongoing scientific discourse, and various conspiracy theories circulating globally.

Figure 9: Interest over time for the four topics



When comparing Google Trends data for the four key topics (see Fig. 9), it is evident that “climate” garnered the highest search interest, closely trailed by “climate change”. In contrast, searches related to “climate hoax” were considerably less frequent, which indicated a smaller public engagement with this term. Similarly, “HAARP” showed sporadic peaks in search volume. These increases were typically linked to natural disasters, such as the notable spike observed following the February 2023 earthquake in Syria and Turkey, where searches for “HAARP” momentarily surpassed those for “climate change”.

Discussion

The analysis of Google Trends data on topics related to climate highlights several critical insights and reflects broader public interest trends.

Starting with the keyword “climate”, we observed a notable peak in search interest coinciding with Earth Day, suggesting a temporal linkage between specific environmental events and public engagement. This pattern is congruent with findings from the literature that suggest global events often catalyze public interest in related themes (Zarrabeitia-Bilbao et al., 2022; Gaul & Vincent, 2016). The regional analysis further indicates that African countries show higher search interest compared to Western nations. This discrepancy highlights the varying degrees of public engagement and awareness, which could be influenced by the different vulnerabilities to climate impacts across regions. Climate change is increasingly affecting Africa, thus disproportionately impacting the most vulnerable populations (UN Climate Change News, 2020). This environmental shift is contributing to food scarcity, forcing people to relocate, and placing significant pressure on water supplies.

In the related topics and queries, the substantial rise in searches related to “climate action” and figures like Greta Thunberg underscores the significant role of activism and individual influencers in shaping public discourse. This finding aligns with recent studies that emphasize the growing impact of climate activism on societal awareness and policy advocacy (Damoah et al., 2023; Meuneier, 2021; Raducu et al., 2020).

The topic “climate change” presents a similar trend of heightened interest during Earth Day but exhibits lower overall search volume compared to “climate”. This might suggest a semantic preference or specificity in public interest, where “climate” might be seen as a broader, more inclusive term. The geographical spread for “climate change” with high search volumes in countries like Fiji and Zimbabwe indicates an acute awareness possibly due to their high vulnerability to climate impacts. Fiji and Zimbabwe are also two of only three developing nations that stand out in terms of scientific publications on climate change (Klingelhöfer et al., 2021).

Interestingly, searches for “climate hoax” reveal fluctuating interest with spikes potentially driven by statements from public figures like Vivek Ramaswamy. This pattern suggests how influential personalities can significantly sway public interest and discourse toward skepticism or denial of climate science. Such trends are crucial for understanding the landscape of misinformation, a subject extensively discussed in the literature (Baker & Maddox, 2022; Galvão, 2021; Van Boven & Sherman, 2021). Furthermore, the role of influential personalities in shaping public opinion is not limited to direct statements; it extends to their ability to catalyze broader media coverage and social media discussions, which then drive search behavior. Repeated exposure to misinformation through media amplification can reinforce misconceptions, even after they are debunked (Lewandowsky et al., 2017). This dynamic is often exacerbated by the echo chambers created by social media algorithms, where users are more likely to encounter content that aligns with their pre-existing beliefs (Cinelli et al., 2021). As a result, public figures can serve as nodes within these networks of misinformation, further entrenching conspiracy narratives into public discourse.

The searches related to “HAARP” and its association with conspiracy theories about weather control reflect public curiosity and concern tied to specific events, such as the February 2023 earthquake in Turkey and Syria. This case is a striking example of how misinformation or speculative theories can gain traction in the wake of significant natural disasters. Previous studies documented similar patterns where conspiracy theories often emerge or intensify during periods of societal stress or after high-impact events (e.g., following the monkeypox outbreak in Elroy et al. (2023) or the COVID-19 pandemic in Erokhin et al. (2022)). In the wake of disasters, people tend to engage in increased search activity for explanations, especially those that appear hidden or suppressed. During periods of uncertainty, individuals are more likely to engage

in motivated reasoning and selective search behaviors that confirm their biases toward conspiracy explanations (Pirulli & Fu, 2003; Kunda, 1990). This behavior is further amplified by search engines, which often prioritize highly engaging content, leading to a feedback loop where conspiracy theories gain more visibility (Binns et al., 2018).

From a broader perspective, the comprehensive analysis of these topics via Google Trends provides valuable insights into public interest dynamics in environmental issues. This study contributes to the literature by providing empirical evidence of how global events, regional differences, influential figures, and misinformation can shape public engagement with climate-related topics.

Moreover, the increase in related queries, from financial incentives to technological solutions and health impacts, highlights a multifaceted concern among the public that encompasses economic, technological, and health perspectives. This richness of concerns and the evident engagement with practical aspects of climate change (such as "climate action incentive payment") further underscore the utility of Google Trends as a tool for gauging public interest and its potential for predicting engagement trends.

The findings from this analysis have significant implications for policy development and the formulation of effective communication strategies on climate change. The observed peaks in search interest around events like Earth Day suggest that public engagement is heightened during specific periods, presenting opportunities for policymakers to amplify their messaging. Aligning policy announcements, educational campaigns, and community initiatives with such global events can maximize public attention and facilitate greater awareness and action. Additionally, the higher search interest in African countries highlights the necessity for region-specific policies that address local vulnerabilities and needs. Tailoring communication strategies to reflect the unique socio-economic and environmental contexts of different regions can enhance the effectiveness of policy interventions.

The influence of activists and public figures, exemplified by increased searches related to individuals like Greta Thunberg, underscores the potential of leveraging influential voices to promote climate action. Policymakers and communicators can collaborate with trusted influencers to disseminate information and motivate behavioral change among diverse audiences. Conversely, the rise in searches related to conspiracy theories signals a persistent challenge posed by misinformation. This necessitates policies focused on enhancing digital literacy, regulating false information online, and promoting transparency in communication. Communication strategies should proactively address misinformation by providing clear, accessible, and evidence-based information, thereby helping the public to discern credible information from false narratives. Understanding these dynamics enables the development of more resilient policies and communication approaches that can effectively engage the public and counteract the spread of misleading information.

Conclusions

This study's analysis of Google Trends data significantly illuminates how public engagement with climate change varies according to regions, times, and the influence of high-profile events and personalities. It

reveals distinct patterns of public interest and misinformation, showing that engagement spikes during major events like Earth Day and varies greatly between regions with different vulnerabilities to climate impacts. We found that online searches can serve as a powerful indicator of public awareness and misinformation levels. For instance, African and some Asian regions exhibited higher search frequencies, possibly due to more direct climate impacts, while Western countries displayed more variable engagement levels. This suggests a targeted approach in communication strategies might be necessary to address the specific needs and misconceptions prevalent in different regions.

Additionally, the study highlighted the effect of conspiracy theories on public discourse. Peaks in searches related to "climate hoax" were often aligned with public appearances by influential skeptics, suggesting that public figures can significantly sway public opinion. This underscores the need for informed and proactive responses to counteract misinformation effectively.

Based on these insights, we recommend that policymakers, educators, and activists refine their strategies to better harness the patterns of engagement revealed by our analysis. Strategies should be tailored to address the nuances of regional engagement, capitalize on periods of high public interest, and counteract misinformation more robustly.

By leveraging detailed insights from Google Trends, stakeholders can enhance their outreach and educational efforts and contribute more effectively to the global fight against climate misinformation and fostering a well-informed public ready to take action on climate issues.

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