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Environmental Communication in Social Media: A Bibliometric Study of Climate Change Discourse and Public Engagement

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Abstract
This study uses bibliometric analysis based on the Biblioshiny application in R Programming to explore climate change discourse in social media. Data were obtained from Scopus from 2008-2024, resulting in 57 scientific articles that were analyzed to explore research trends, lead author contributions, collaboration networks, information sources, and country of origin. The study provides an overview of the dataset, publication trends, citations, author profiles, journal analysis, country distribution, and research themes. Using a bibliometric approach, it aims to analyze the evolution of climate change discourse and enhance communication policies on social media. The results show a significant increase in publications each year, with a peak in 2024 High-impact articles by Koteyko N., Jaspal R., and Nerlich B. are key references. The U.S. and U.K. lead in publications and global scientific influence, while developing countries' contributions are lacking, emphasizing the need for international collaboration to enhance global representation in research. Key journals like Science Communication and Geographical Journal are vital for disseminating research on themes such as climate change, social media, and communication. Notable research areas include sentiment analysis, social networks, and environmental management, offering insights that can aid in developing inclusive and sustainable communication policies.
Keywords: *bibliometrix, biblioshiny, climate change, public engagement, communication.*

Paper type: *Research paper*

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INTRODUCTION

Climate change is one of the major problems faced by humanity in the 21st century. According to the IPCC (Intergovernmental Panel on Climate Change 2023) Synthesis Report for 2023, global warming will reach 1.1 degrees Celsius above pre-industrial levels. The report notes that the current climate change is unprecedented, with increased frequency and intensity of extreme weather events, such as heat waves, heavy rains, and regional droughts. The climate crisis decreased in 2020-2022 due to the COVID-19 pandemic outbreak. The Covid-19 pandemic outbreak led to reduced levels of environmental pollution in the first wave of COVID-19 due to demands to stay at home, resulting in reduced transportation use and less cigarette use (Prokopowicz and Gołębiowska 2021). However, the IPCC report in the AR6 Synthesis Report explains that by 2023, the climate crisis triggered by human activities has significantly accelerated climate change, triggering an increase in the intensity of extreme weather around the world. With global temperature rise currently at 1.1°C and projected to reach 2.8°C by 2100 under NDC commitments, the world is at risk of falling short of the Paris Agreement target of 1.5°C (Boehm and Schumer 2023).

The IPCC's AR6 Synthesis Report emphasizes the need for more ambitious climate action to prevent more severe climate disasters. Existing climate change affects sea level rise, ocean warming, increased temperature, increased rainfall, and more frequent tropical storms. Climate change has an impact on human life, especially health problems, because it raises the presence of diseases, such as dengue fever, coughs, colds, and facilitates the spread of these disease outbreaks. The clean water crisis, from the instability of water sources to erratic rainfall due to climate change, can disrupt human life and animal ecosystems (Ainurrohmah and Sudarti 2022). In addition, climate change can provide obstacles for human activities in terms of national development efforts. National development is expected to stagnate or even regress due to the high risks and consequences that a country must bear (Fathiyah 2023).

Currently, between 3.3 billion and 3.6 billion people live in countries that are highly vulnerable to climate impacts, with global hotspots concentrated in the Arctic, Central and South America, Small Island Developing States, South Asia, and much of sub-Saharan Africa, including Indonesia. The large number of people living in climate-vulnerable countries requires human awareness to prevent

widespread impacts and minimize actions that cause climate change (Kah et al. 2021). This should be an issue that is echoed by the community every year, given its huge impact on humans. One of the strategic steps that humans can take is to have an understanding of the urgency of the impacts of climate change.

Communication plays an important role in improving public understanding of climate change discourse. Communication serves as a bridge to simplify complex scientific information, making it accessible to lay audiences (Markowitz 2024)Communication can help increase public awareness of climate change's impacts on daily lives by conveying information clearly, relevantly, and easily. A strategy is needed to convey information to the public so that the communication process runs more effectively. Effective communication can motivate people to take collective actions, such as reducing their carbon footprint, supporting green policies, and adapting to environmental changes.

Communication strategies need to be designed with clear operations and be able to apply various approaches according to the situation and conditions faced (Fathiyah 2023). Communication to the public will shape public opinion, influence policies, and build relationships between governments, organizations, and communities that will encourage action and real action from humans to reduce the occurrence of climate change. It is important to know how people perceive climate change in order to design policies that support the transition to a low-carbon economy (Gokcimen and Das 2024). Public perception of climate change plays an important role in determining the effectiveness of environmental communication. By understanding people's perceptions, environmental communication strategies can be designed more appropriately, relevantly, and according to the needs of the audience.

Environmental communication can be understood as the process of planning and using communication strategies designed to support policy making, encourage public participation, and ensure policy implementation related to environmental issues (Widhagdha et al. 2025). Environmental communication acts as a means to symbolically convey environmental issues, facilitate dialogue, and bridge differences in views in finding common solutions to environmental problems (Milstein and Mocatta 2022). Environmental communication and public

communication are complementary, with both focusing on promoting public understanding, engagement and behavior change towards sustainable solutions.

Environmental communication and social media are closely linked in efforts to increase public engagement on climate change issues. Today, social media is the most frequently used communication tool to understand and access information. Social media plays an important role in shaping pro-environmental opinions, especially for the younger generation (Thanya and C. 2023). Social media provides a broad and accessible platform to effectively convey environmental messages, allowing complex scientific information to be conveyed in a simple, visual, and engaging format. Social media allows for rapid and widespread dissemination of information, creates space for public discussion, and encourages collective action on environmental issues (Lestari et al. 2025). The theory of *social tipping processes* proposed by Winkelmann et al. (2020) highlights how small social changes, often occurring on social media, can trigger major transformations in climate-related policies and behaviors. People can be more easily accessed and invited to participate in climate change mitigation efforts through digital spaces.

Public engagement is a concrete action of public awareness that realizes the problems and risks faced from a global phenomenon. COVID-19 is an example of massive public recognition of the issue as they recognize the problem and potential risks. The network of social media works effectively as a platform for expert scientists and connectors, such as public figures, to spread climate change messages and communicate them to the public (Rahimi 2020). Through platforms such as Twitter, Instagram, and TikTok, people can share information, experiences, and views on climate change impacts and mitigation and adaptation measures. Posts involving the personal aspects of scientists tend to attract more interaction than professional content, while the use of visuals such as images and videos significantly increases public engagement by making scientific content more accessible and relevant (Casiraghi et al. 2024). Representations of climate change on social media are shaped through a combination of visual, symbolic and emotional narratives that vary across cultures. Mooseder et al. (2023) found that images of protests and natural disasters on Twitter attracted more attention than data visualizations, reflecting the social media logic that emphasizes emotional engagement. Meanwhile, Pera and Aiello (2024) showed that on TikTok, content creators use more emotional and action-oriented language, which results in public

responses that are more aligned with the message. This could be a consideration for platform-tailored communication strategies to increase the effectiveness of climate change messages.

Public responses to climate change issues range from support to skepticism, reflecting intra-group conflicts among climate change advocates, particularly in terms of differences between optimism and pessimism about the effectiveness of mitigation measures (van der Linden et al., 2020). Effective communication strategies include inviting discussion, humanizing communication with scientists, and using visual elements and informal language to bridge the communication gap between scientists and the wider public. In this regard, environmental scientists and communicators need to adopt a contextualized approach that connects scientific issues with public concerns, use social media strategically with attention to shareability, and engage the public in discussions through elements of popular culture to create more inclusive and relevant communications (Berglez and Olausson 2023).

The initial concept of "public sphere" was developed by Jürgen Habermas in 1962 in his work *The Structural Transformation of the Public Sphere*, which states that the public sphere is a discursive arena where citizens can rationally discuss public issues without pressure from the state or the market. This theory was further developed in the digital era into the Digital Public Sphere, an online discussion space (such as social media) where the public engages in socio-political debates. Masullo et al. (2022) developed a *normative framework* for the digital *public sphere* that identifies four normative elements that make a *digital* space capable of functioning as a *digital public sphere*: Welcome, which is a space that is open and inclusive to all; Connect, which enables social connections across groups; Understand, which encourages deep understanding rather than mere provocation; Act, which encourages collective action and policy responses. This framework helps evaluate the extent to which social media not only disseminates climate discourse but also promotes collective action and awareness in an ethical and inclusive manner. This framework is particularly relevant in the context of climate change communication, especially on social media, where information and discourse on the issue can spread rapidly. Social media serves not only to spread

information about climate change, but also to encourage collective action and greater public awareness.

In a discussion about digital public engagement on climate change issues, it is important to understand the concept of climate imaginaries, which are collective images of the future of the climate formed through media, narratives, and daily experiences. These imaginaries do not just exist, but are built collectively through media content such as images, videos, memes, and personal stories that touch emotions. Davoudi and Machen (2022) explain that various forms of media, such as videos, images and texts, play an important role in shaping these imaginations, which ultimately influence the way people understand and respond to climate change. Analyses of public engagement on social media therefore need to consider how digital platforms shape collective imaginaries of climate futures and their impact on social action and environmental policy.

Previous research by Abdullah (2023) highlighted significant developments in the study of climate change communication, which experienced rapid growth since 2008, especially after 2020, with the increased use of social media as a key platform. The research revealed that keywords such as *"Climate Change Communication"*, *"Environmental Communication"*, and *"Climate Action"* reflect the recent focus in scientific discourse, which is now more towards the use of social media, scientific communication, and message framing to increase public engagement. In addition, institutions such as Cardiff University, George Mason University, and Yale University are identified as key actors in this research, with significant contributions to the understanding of climate change communication globally. Abdullah also highlights seminal works such as O'Neill & Nicholson-Cole (2009) and Moser (2010) as important foundations in this field. This study shows that climate change communication is increasingly becoming an important and independent field of study, with rapid growth since 2008. The use of social media as a communication platform is gaining prominence, along with communication strategies based on scientific frameworks and climate action. This study shows that climate change communication is evolving into an independent and critical discipline, with an emphasis on digital media and action-based strategies to more effectively address climate change challenges.

The bibliometric approach is used to understand climate change discourse because it allows for quantitative analysis of scientific publications and the

development of knowledge in this field. Using this approach, we can track research trends over time, see how the topic of climate change is evolving, and identify changes in research focus, such as increased attention to social media issues related to climate change. In addition, bibliometric analysis allows us to explore networks of authors who have contributed significantly to the field, as well as patterns of collaboration between researchers, both locally and globally (Machmud et al. 2023). By understanding who plays a major role in this research, researchers can find out who is leading the scientific discourse and how collaborations between institutions or countries affect the development of this topic. Bibliometrics also helps identify the most frequently used sources of information in publications, providing an overview of the most influential journals or articles in shaping the scientific discourse on climate change on social media. In addition, this approach allows us to analyze the country of origin of the research, which is important for understanding the extent to which climate change research on social media is global or local, as well as the different priorities and communication strategies implemented in different countries. Overall, bibliometrics not only provides a deeper understanding of the development of climate change concepts and discourses, but also helps identify trends, challenges, and potential for further research that could lead to more effective climate change communication policies on social media.

METHODS

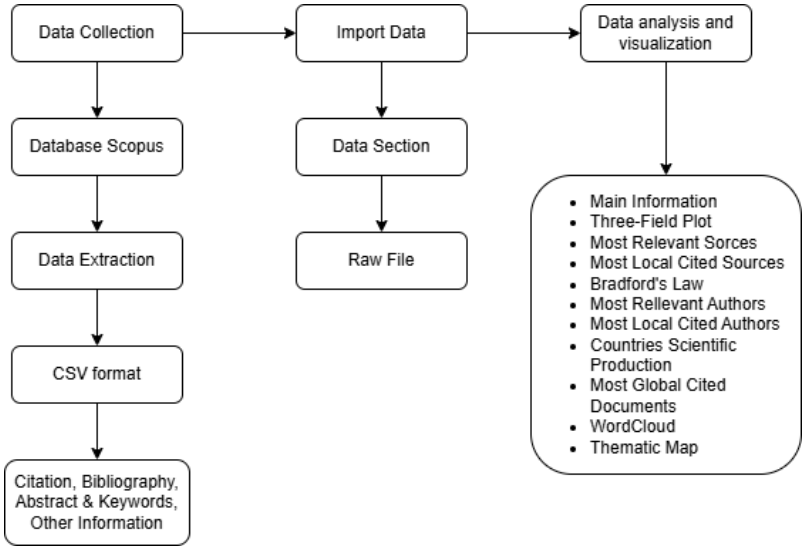
This research study uses a quantitative method with a bibliometric analysis approach. Bibliometrics was first introduced in the 1930s and popularized by Pritchard in 1969. The data at the center of bibliometric analysis is very broad, from hundreds to thousands and objective on the number of citations, keywords, or topics (Passas 2024). Bibliometric research conducted systematically can be a solid foundation in various fields of science (Donthu et al. 2021). This approach helps in understanding and mapping the accumulation of scientific knowledge thoroughly, identifying gaps in previous research, finding new ideas for study development, and placing the expected contribution in the context of relevant fields of study. The bibliometric analysis approach is used to identify and understand global research

trends in a particular field through analyzing academic publications recorded in databases such as Scopus and Web of Science (Alsharif et al. 2020). In bibliometrics, two main approaches are used to explore and understand research fields, namely performance analysis and science mapping. Performance analysis focuses on evaluating scientific impact through citation measurement of the academic output of different actors, such as individuals, institutions, or countries. This approach is often used to assess the quality, productivity, and impact of research on a given scale. Science mapping in bibliometric studies is used to describe the conceptual, social, and intellectual structure of science, as well as identify relationships between themes and their developmental dynamics through techniques such as *co-word analysis* and *science mapping* (Faraji et al. 2022; Karakose et al. 2023).

The research data was taken from the Scopus database on the topic of climate change discourse communication in social media, covering the time span from 2008 to 2024 and limited to scientific articles. A bibliometric approach was used to analyze all documents related to the topic, resulting in visualizations and data tables that include information about authors, year of publication, number of citations, country of origin, source of information, and research trends. This analysis provides a comprehensive overview of the development of the selected scientific topic.

Figure 1.

Research flow using *Biblioshiny*



In this research, the advance search feature of the Scopus database is used to obtain datasets that are relevant to a predefined topic. The initial process involved

screening documents from Scopus to extract important information. The data is then imported into Biblioshiny, a web interface developed using Bibliometrix (Yang et al.,2024). The data retrieved from Scopus was collected on November 26, 2024, with a total of 57 scientific articles obtained using the keywords "Climate AND Change AND Discourses AND Social AND Media AND Communication" through Boolean search techniques. The dataset was exported in CSV (Comma Separated Values) format to facilitate further processing and analysis. All data has gone through a cleaning process before being analyzed.

This research utilizes bibliometric analysis as the main method. The analysis was conducted using software such as Google Sheets for data processing and Biblioshiny for visualization of bibliometric results. Biblioshiny is a Java-based software developed by utilizing the Bibliometrix package and running within the Shiny environment in R Studio (Huang et al. 2021). As a complete tool, Biblioshiny allows researchers to conduct comprehensive scientometric mapping, including exploring conceptual subdomains and identifying thematic developments of specific research topics. The scientometric approach applied in this study combines the performance analysis and mapping tools in bibliometrics. The result is a dataset that includes important information, such as author productivity, publication sources, citations, affiliations, countries of research origin, as well as collaboration networks between countries, institutions, journals, and research areas. In addition, visualizations such as annual scientific production and three-field plots were created to facilitate data interpretation by displaying the linkages between authors, institutions, and main keywords in a single graphical representation (X. Wang et al. 2022). The following are the results of the data collected from the *Scopus database*.

Table 1.

Data source collection and selection

Category	Information
Research Database	Scopus
Time Range	2008-2024
Language	English, Spanish, Chinese, Portuguese
Keyword Search	Climate AND Change AND Discourses AND Social AND Media AND Communication

Document Type	"Article"
Data Extraction	Exported with complete records (cited, bibliography, abstract & keywords, and other information) in CSV format.
Sample Quantity	57

This set of data sources and research subjects was obtained through bibliographic mapping of the literature available on the Scopus platform. To visualize the information from the bibliographic research data, researchers used Bibliometrix Biblioshiny software. This tool aims to present a more diverse, representative, and informative visualization, in accordance with the results obtained from the topic of digital literacy in school libraries in the period 2008-2024. In addition, Biblioshiny was also used to produce visualizations such as *WordCloud* and thematic maps.

RESULTS AND DISCUSSION

The keywords used for the search in the Scopus database were *"Climate AND Change AND Discourses AND Social AND Media AND Communication"*. In addition, the articles included in this dataset were filtered based on the publication time span from 2014 to 2024. The key information from the extracted dataset is summarized in Table 2.

Overview

Table 2.

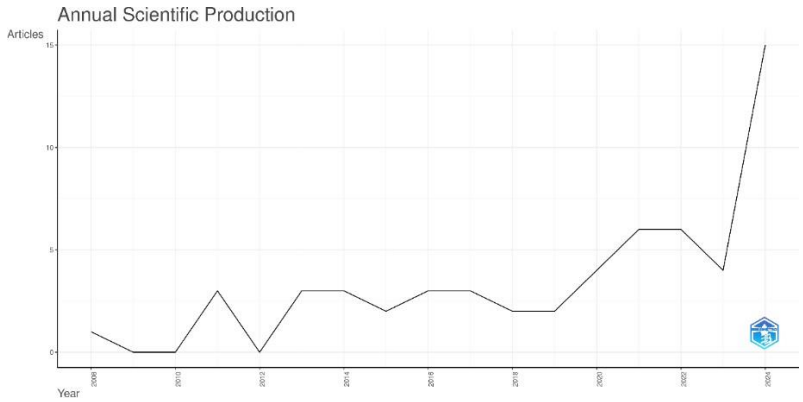
Description	Information
Time Range	2008:2024
Source (Journal, Book, etc.)	42
Document	57
Annual Growth Rate %	18.44
Average Document Age	4.44
Average Citations per	20.26
Reference	3685
Author	157
Documents With One Author	8
Document Author	2.93
International Co-Authoring	22.81

Author Keywords	57

This research focuses on analyzing 57 scientific articles that discuss the topic "Climate AND Change AND Discourses AND Social AND Media AND Communication," which were published from 2008 to 2024. The articles were obtained through a systematic data extraction process from the Scopus database to conduct a bibliometric study on the communication of climate change discourses on social media. The information extraction process was thorough to ensure the quality and relevance of the resulting dataset, which includes trends, patterns, and significant contributions in this field of study.

Figure 2

Annual Scientific Article Production

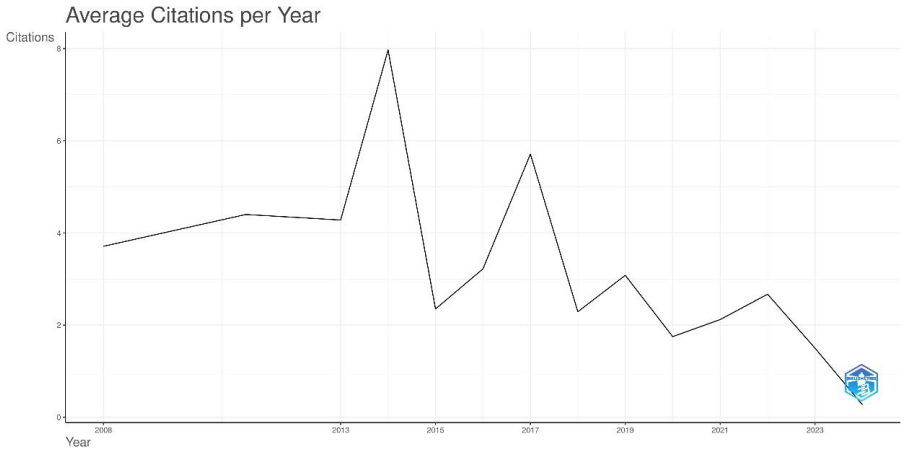


In Figure 2, the overall range of years with the theme of climate change discourse on social media, the trend of scientific article production has grown and peaked in 2024 with 15 articles. Figure 2 interprets the annual scientific production as measured by the number of scientific articles published per year on this topic. There are variations from year to year with significant increases in certain years, including 2011, 2013, 2016, 2021, 2024. The intensity of this increase indicates that in that year period, there was an increase in research production activity or a more intensive focus. The number of articles published each year in this graph shows a fluctuating pattern, especially in the early years, where publication numbers tend to be low. During the middle of the period, scientific productivity appears relatively stable with no significant changes. However, the situation begins to change drastically in the latter years, characterized by a sharp spike in 2024. This increase

reflects the possibility of a major boost in research activity, both due to increased interest in certain topics and advances in overall scientific productivity. While there is a positive correlation between the number of citations and the quality of research in many fields, the correlation varies from weak to strong, meaning that there is no threshold of citations that can be used as an absolute indicator of research quality (Thelwall et al. 2023).

Figure 3

Average Citations per Year



Source: Researcher processing results, 2024

The initial trend of the period shows an increase in citations that peaked in 2014, signaling an important work or influential article published in that year. Thereafter, there was a sharp decline in 2015, although there was an increase again in the following years, particularly between 2017 and 2021. However, the most recent period, 2023, shows a significant drop to its lowest point, which is likely due to new publications that have not had enough time to be widely cited.

Figure 4

Three-Field Plot

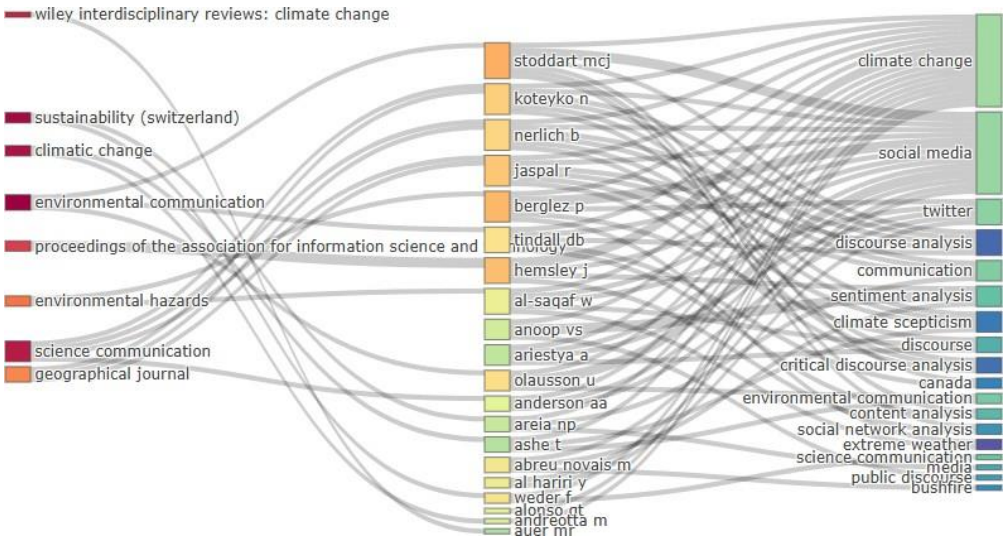


Figure 5 presents the analysis using the *Three-Field Plot* approach consisting of three main fields: journal name (left), author name (center), and research keywords (right). These three fields are connected by gray lines, which represent the linkages between journals, authors, and keywords (Afandi et al.2024). Sankey diagrams aim to reveal and evaluate the flow between authors, sources, and keywords. In this study, the Sankey diagram showed a strong relationship between the three (Khan et al. 2023). According to Nuraini and Thuba Jazil (2023), the size of the square in each field indicates the volume of the element's contribution, whether in the form of the number of journal publications, articles produced by authors, or the frequency of occurrence of keywords in research. This provides a visual representation of how the various elements are interconnected and contribute to a particular research topic.

In the left field, we see that there are eight indexed journals that actively publish scholarly articles on the topic of climate change discourse on social media. One of the most dominant journals is *Science Communication*, which lists four related articles. This dominance is visualized with red boxes connected to several prominent authors, such as Koteyko N, Nerlich B, Jaspal R, and Anderson AA. This shows that the journals *Science Communication* and *Geographical Journal* are important in the dissemination of research on this topic

The center of the diagram maps the names of the authors who contributed to this research. The figure shows the top 20 authors whose work is recorded in the Scopus database for the topic of climate change on social media. The size of the box representing the author indicates the number of scientific articles they have produced. Two authors, Stoddart MCJ and Koteyko N, are the most prolific authors, each represented by an orange box. This indicates that they have played a significant role in research on this topic.

The final field, positioned on the right-hand side, is dedicated to research keywords, which encapsulate the core focus of the study and highlight the authors' active engagement with the topic. This comprehensive analysis has identified 18 primary keywords that are intricately connected to the discourse surrounding climate change on social media platforms. Notably, the keyword 'climate change' emerges as the most prevalent, underscoring its significance as a pressing global issue that demands attention. Following closely is the keyword 'social media,' which ranks second, signifying the importance of these platforms in facilitating discussions about climate change. The third most frequent keyword, 'Twitter,' illustrates its role as a vital medium for not only sharing information but also for conducting data analysis related to climate change conversations. This trend indicates that Twitter serves as a crucial arena for public engagement and dialogue regarding climate-related topics.

Research by Repke et al. (2024) An analysis of 13.5 million tweets posted by 3.2 million users showed that the increase in discussion about the causes and solutions of climate change experienced a significant recovery in 2021, even though attention to climate change had decreased during the COVID-19 pandemic. Studies on argumentative debates on Twitter show that a more informative and polite way of conveying information can increase public understanding and strengthen arguments about climate policies, although it does not always have a direct effect on policy support (Foderaro and Lorentzen 2023).

Author's Analysis

Table 3

Top 10 Most Cited Scientific Articles

No.	Author	Title	Number of Citations	Journal

1	Koteyko N, Jaspal R, Nerlich B (2013)	Climate Change And 'Climategate' In Online Reader Comments: A Mixed Methods Study	86	Geographical Journal
2	Koteyko N, Jaspal R, Nerlich B (2013)	Contesting Science By Appealing To Its Norms: Readers Discuss Climate Science In The Daily Mail	60	Science Communication
3	Stoddart MCJ, Tindall DB (2016).	Canadian News Media Coverage Of Climate Change: Historical Trajectories, Dominant Frames, And International Comparisons	33	Society And Natural Resources
4	Olausson U (2018)	"Stop Blaming The Cows!": How Livestock Production Is Legitimized In Everyday Discourse On Facebook	30	Environmental Communication
5	Berglez P (2021)	Extreme Weather And Climate Change: Social Media Results, 2008-2017	23	Environmental Hazards
6	Berglez P, Olausson U (2023)	Climate Irresponsibility On Social Media. A Critical Approach To "High-Carbon Visibility Discourse"	4	Social Semiotics
7	Stoddart MCJ (2021)	Public Engagement In Climate Communication On China's Weibo: Network Structure And Information Flows	10	Politics And Governance
8	Weder F (2021)	From Ignorance To Resonance: An Analysis Of The Transformative Potential Of Dissensus And Agonistic Deliberation In Sustainability Communication	4	International Journal Of Communication
9	Weder F (2021)	Advocacy For Sustainability Communication: Unseen Potential Of Queer Communicators In Environmental, Climate Change And Sustainability Science	4	Sustainability (Switzerland)
10	Abreu Novais M (2023)	Analyzing And Leveraging Social Media Disaster Communication Of Natural Hazards: Community Sentiment And Messaging Regarding The Australian 2019/20 Bushfires	2	Societies

Source: Researcher processing results, 2024

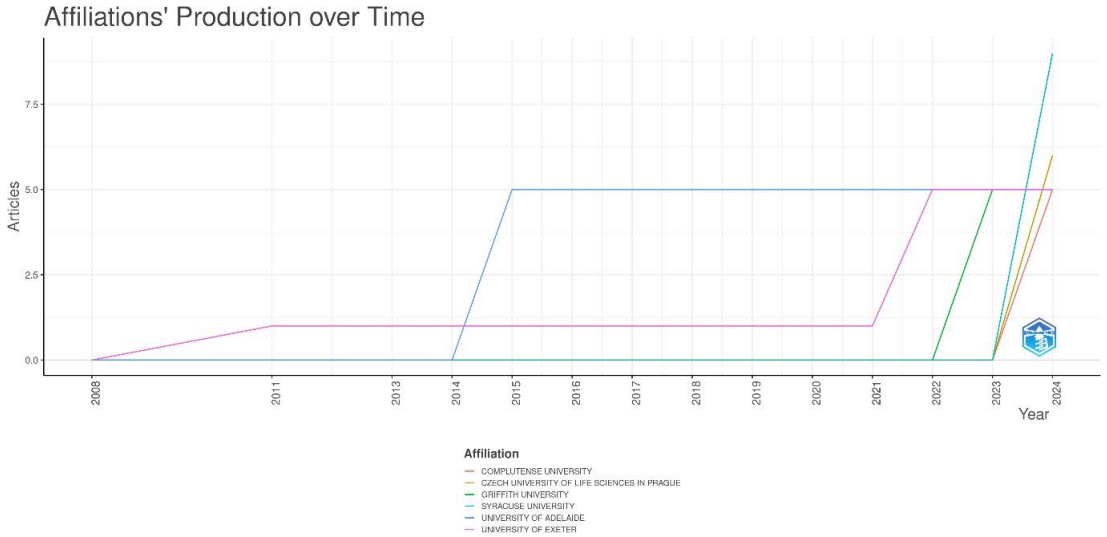
The scientific article entitled *"Climate Change And 'Climategate' in Online Reader Comments: A Mixed Methods Study"* written by Koteyko N, Jaspal R, and Nerlich B in 2013 ranked as the article with the highest number of citations in the field of climate change discourse on social media with a total of 86 citations. This

shows that the article published in the *Geographical Journal* is one of the main references and is very relevant for researchers studying the topic of climate change, especially in the context of discussions on social media. In addition, there is a *Science Communication* journal that has the second highest number of citations with the same leading authors, namely Koteyko N, Jaspal R, and Nerlich B in the same year, 2013. The number of citations this article received confirms its significant influence in the development of academic literature and scientific discussions related to climate change discourse on social media. With its top position in searches on the Scopus database, this article not only reflects a major contribution to the understanding of the topic, but also serves as an important foundation for further research exploring the dynamics of climate change discourse on social media.

Affiliate Analysis

Figure 5

University production over



Source: Researcher processing results, 2024

Figure 5 presents the results of the analysis regarding the trend of scientific article production by universities over time, specifically on the topic of climate change discourse on social media. The data shows that Syracuse University is the institution with the most contributions in one year, 2024, producing nine articles. This places the university as the leader in the number of publications related to this

topic during the observed period. The Czech University of Life Sciences in Prague also showed significant growth, producing six articles in the same period, 2024.

The analysis also revealed that some universities, such as Exeter University, Griffith University, and Complutense University, saw a consistent increase in the number of publications from 2021 to 2024. This trend suggests that more academic institutions are paying more attention to climate change research on social media over time. The biggest spike occurred in 2024, where a number of universities recorded significant increases in their scientific article production.

The results of this analysis indicate a pattern of sustainability in the publishing of scientific articles related to the topic of climate change on social media. With a spike in 2024, there is a good chance that this trend will continue to increase in the coming years. This demonstrates the promising growth potential for research in this area, and reflects the relevance of climate change on social media as a global issue that is attracting the attention of academics from universities around the world.

Figure 6

Most University

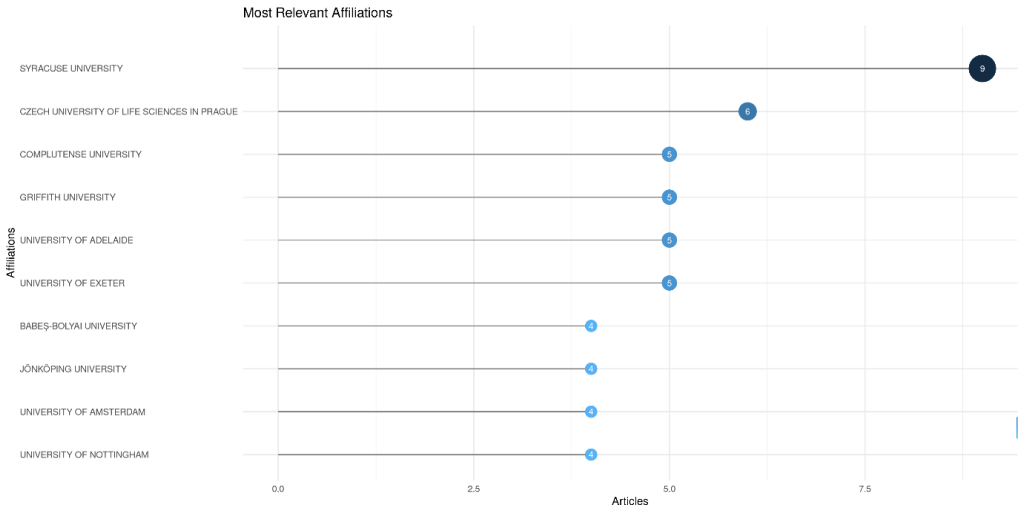


Figure 6, a bibliometric analysis of the most relevant affiliations, presents an overview of the most relevant universities' contributions in publishing articles on climate change discourse on social media. It can be seen that Syracuse University is the highest ranked most relevant university with 9 articles reflecting its leading role in research on this topic. A significant increase is also seen in the Czech

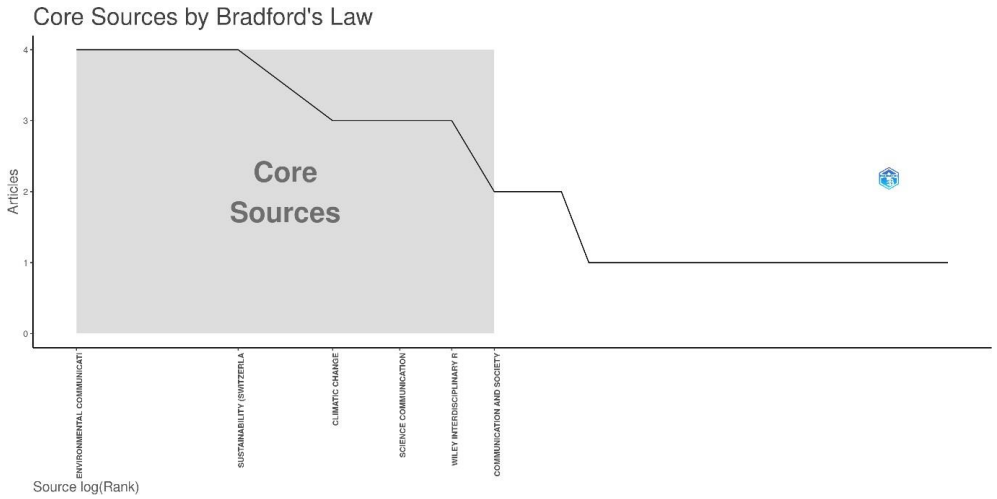
University of Life Sciences in Prague, which could produce 6 articles in 1 year by 2024. Other universities such as Complutense University, Griffith University, University of Adelaide, University of Exeter also stand out with consistent contributions to this topic and show continuity in their engagement with the climate change discourse. In addition, the diversity of institutions from different countries despite being dominated by countries from Europe and Australia confirms that the climate change crisis is becoming a global issue and the contribution of Syracuse University institutions seems to add a dimension of diversity to this research. There was an increase in participation from several universities, namely Syracuse University, the Czech University of Life Science in Prague, Complutense University, and Exeter University. Griffith University, which had increased in 2023 and did not re-publish in 2023 or 2024. The considerable increase in participation from 2023 to 2024 suggests that there is potential for future research expansion on the topic of climate change discourse and opportunities for cross-institutional collaboration.

Analysis

The next step was to analyze the journals with the aim of segmenting the journal publications on the topic of climate change discourse on social media. Bradford's Law was used to determine the journals with the highest publication frequency, known as "core sources" - journals that account for one-third of the total publications on a topic. Based on Bradford's Law, a small number of journals that contain a large number of articles related to a particular topic are referred to as "core sources" (Gourikeremath et al. 2021; Wani et al. 2023).

Figure 7

Journal Clustering with Bradford's law



In this study, out of 57 documents, only 6 journals could be identified as core sources. This indicates that the 6 journals, namely Environmental Communication, Sustainability (Switzerland), Climate Change, Science Communication, Wiley Multidisciplinary R, and Communation and Society are likely to contain most of the articles related to Climate Change in Social Media as well as being the most important journals and core sources. The remaining sources are likely to have fewer relevant articles.

Table 4

Journal *Clustering* with Bradford's law

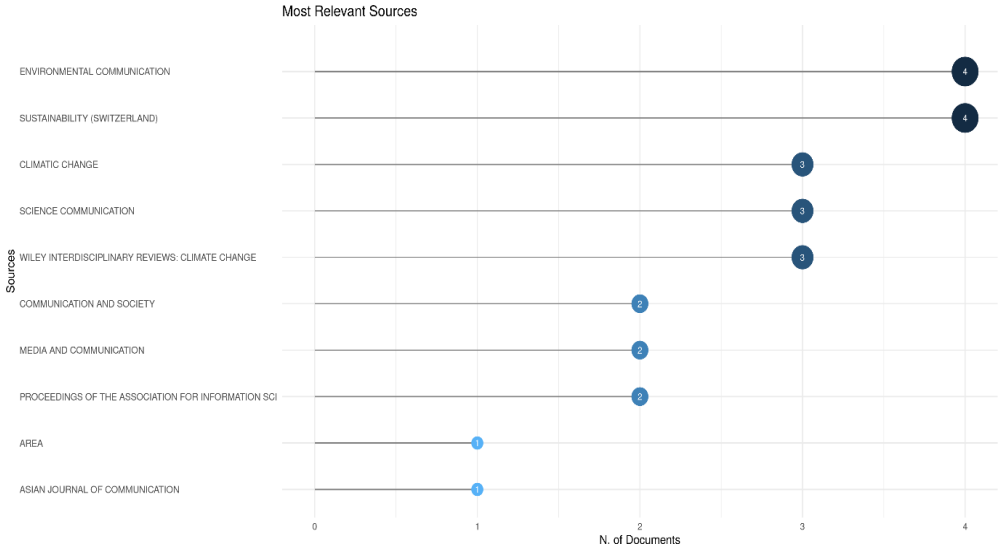
Zone	Rating	Number of Journals	Number of publications
Zone 1	1-6	6	19
Zone 2	7-24	18	20
Zone 3	25-42	18	18

In Table 5, research on climate change discourse on social media divides journals into three zones based on Bradford's Law. This analysis results in the segmentation of journals with varying rankings, which illustrates the distribution of journals in the Scopus literature. Zone 1 consists of the 6 highest-ranked journals, with a total of 19 scholarly articles published. This zone indicates that these journals have an in-depth research focus on the topic of climate change discourse on social media. Zone 2 includes 18 journals ranked 7 to 24, which published a total of 20

scholarly articles. This reflects that the journals in this zone cover a wider range of research topics, including climate change, although not entirely centered on the main topic. Zone 3, on the other hand, includes 18 journals ranked 25 to 42, which produced a total of 18 scholarly articles.

Figure 8

Most Relevant Journals



Source: Researcher processing results, 2024

Figure 8 presents information related to some of the most relevant journals based on the number of articles published based on the topic of articles published on the topic of climate change discourse on social media with a total of 57 documents. The scientific journal *Environmental Communication* and *Sustainability (Switzerland)* with the number of publications of 4 articles on climate change discourse on social media is the first place in the relevant journal information sources. This journal has a significant impact on the 4 articles published

on this topic. In addition, 3 scientific journals published 3 articles on environmental communication, followed by 3 scientific journals that published 2 articles and 2 scientific journals that published 1 article. Analyzing the most relevant journals can help researchers to better understand the publications that have a major impact in communication research on climate change discourse on social media. It also makes it easier to assess how relevant and influential they are to the scientific literature in *Scopus.*

Country Analysis

Figure 9

Country Scientific Production

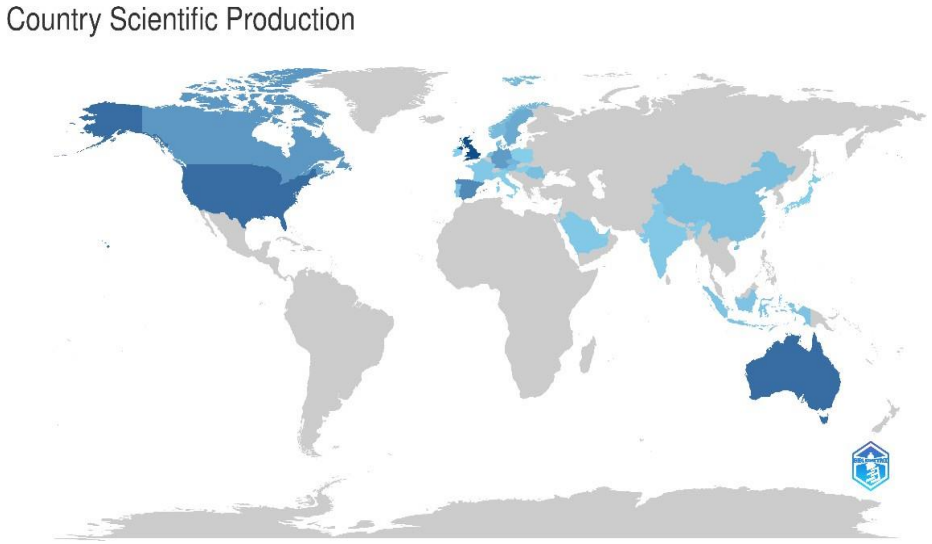


Table 6

Country Scientific Production

No.	Country	Frequency
1	UK	28
2	AUSTRALIA	21

3	USA	21
4	SPAIN	15
5	CANADA	12
6	GERMANY	11
7	SWEDEN	8
8	CZECH REPUBLIC	6
9	NORWAY	5
10	AUSTRIA	4

The data and figure above provide an overview of the distribution of scientific contributions by country in climate change-related research topics on social media. From the table, it can be seen that the United Kingdom (UK) is the country with the highest frequency, with 28 scientific publications. This is followed by Australia and the United States (USA) with 21 publications each. Spain ranked fourth with 15 publications, while Canada contributed 12 publications. Other countries such as Germany, Sweden, the Czech Republic, Norway, and Austria show significant contributions, albeit lower than the top countries.

The image of the scientific distribution map supports this data, with darker blue intensity in countries with larger contributions, such as the UK, Australia and the US. This geographical distribution reflects that research on climate change and social media is more prevalent in developed countries, particularly in Europe, North America and Australia.

These results suggest a pattern that countries with high research capacity and access to scientific resources tend to be more active in producing publications on this topic. This may be influenced by the high level of awareness of climate change issues as well as access to technology and social media that are the focus of the research. The dominance of countries such as the United States, United Kingdom and Australia in climate change discourse on social media is inseparable from several important factors. First, these countries have well-established research infrastructures, access to substantial scientific funding and strong institutional support, enabling high academic productivity. In addition, widespread internet access and massive use of social media also facilitate the dissemination and collection of digital climate communication data

The UK has a long tradition of climate communication research, with institutions such as Cardiff University and the University of Exeter active in this field. Research from Cardiff University shows that media discourses that slow down action on climate change can influence public perceptions of the likelihood of a low-carbon lifestyle (Cherry et al. 2024). In addition, scholars such as Nerlich, Jaspal, and Koteyko have contributed to the analysis of media discourse and public communication on climate change. In the UK, Twitter serves as a key platform for climate policy issues and campaigns, facilitating discussions between scientists, journalists, and activists

Australia, despite being a country with high carbon emissions per capita, shows high awareness of the direct impacts of climate change, such as bushfires and extreme drought. Research after the 2019/2020 bushfires showed that social media was used not only to convey information but also as a means of building community solidarity in disaster situations. Visualizations of the fires and testimonies of victims spread across platforms such as Instagram and Facebook strengthened public empathy for environmental issues and motivated collective action in response to the impacts of climate change (Sorce and Dumitrica 2023).

The United States occupies a strategic position as the country with the highest number of citations in climate change research. The issue of climate change is often a political debate between conservatives and progressives, leading to climate communications often being ideologically framed (Freedman, 2021). In the context of social media, research shows that Twitter and TikTok are two important channels-Twitter is used by scientists and journalists to disseminate IPCC data and reports, while TikTok is a space for young people to express their concerns in an expressive, meme and storytelling style (Padilla-Castillo and Rodríguez-Hernández 2022).

In the context of public engagement, the cultural and political environments in these countries also support active public involvement. The UK and the US, for example, have a long history of environmental activism and strong public science communication, encouraging intensive interaction between researchers, the media, and the general public. High levels of environmental literacy and the presence of

influential environmental NGOs also reinforce critical public discourse on climate change issues.

Public engagement is not uniform across social media platforms and across cultures. In Western countries, Twitter is often used for policy discourse and academic dissemination, while TikTok and Instagram are more utilized for personal and visual climate narratives. Western countries tend to engage in forms of *digital activism, such as online petitions and hashtag campaigns, which have* become popular. In contrast, in Asian countries, platforms like Instagram or local apps like Weibo in China are more widely used, with communication approaches heavily influenced by cultural values, digital literacy levels, and government policies. Platforms like Twitter tend to be used by scientists and journalists to convey data, while TikTok is more utilized by the younger generation with a visual narrative approach, showing the emergence of "climate influencers" as new climate communication actors.

However, contributions from developing countries or other regions such as South Asia, Africa, or Latin America appear to be minimal. This indicates a gap in scientific contributions that may be due to limited resources, technology or research priorities in these regions. Although developing countries are among those affected by climate change, their contributions to climate change remain low. A study by Bera et al. (2025) shows that 93% of authors in communication and environment journals are from developed countries and only 7% are from developing countries. In addition, it was found that only 12% of the studies focused on developing country contexts. This suggests a lack of geographical representation in the scientific literature.

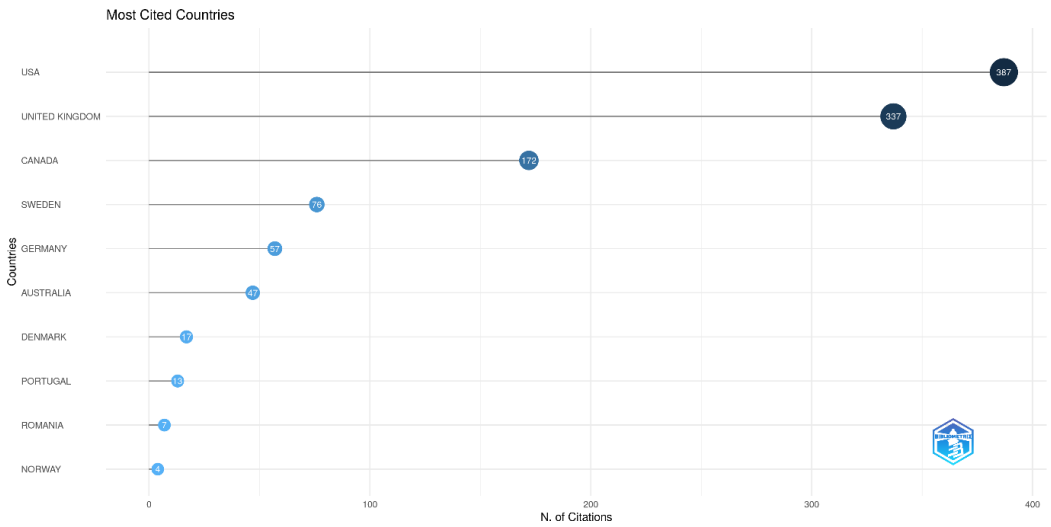
This disparity not only reflects differences in resources but also suggests that there are structural barriers in the global academic system. Researchers from developing countries often face challenges such as limited research funding, limited access to international journals, and language barriers. The dominance of English in scientific publications can hinder the spread of local knowledge. Bahji et al. (2023) highlighted that the use of English as the primary language in global science can lead to marginalization of knowledge from non-English speaking countries. A study by Oramah et al. (2025) in Nigeria, it was shown that the use of complex English led to an understanding gap among local communities due to its difficult-to-understand terminology and Audu (2024) found that the use of local languages

in climate change communication was more effective in increasing community understanding and participation. Amano et al. (2021) explain that more than one-third of scientific publications on biodiversity conversion are in languages other than English. However, these studies are rarely used, leading to the neglect of important evidence and marginalization of knowledge.

Strengthening global collaboration can be a solution to increase scientific contributions from countries that currently do not participate much. Bridging this gap requires a more participatory, collaborative approach to communication policy that takes into account the dynamics of communication across cultures and languages. Efforts like Climate Cardinals that translate climate content into local languages show that climate communication policies based on linguistic and cultural diversity can improve climate information equity globally (Horn-Muller 2023). Climate Cardinals, in collaboration with Google, has translated 500,000 words of climate change resources from English into dozens of other languages. This initiative can help spread important climate information to previously underserved communities.

Figure 10

Most Cited Countries



The United States is listed as the country with the highest number of citations of scientific articles, namely 387 citations. This high number shows that scientific articles published from the United States have great influence and are often referenced by researchers and scientists in various parts of the world,

especially in the Scopus database. The second position is occupied by the United Kingdom with 337 citations, which shows a level of relevance and global recognition that is almost comparable to the United States. Meanwhile, Canada came in third with 172 citations, emphasizing the country's contribution to the topic of climate change discourse on social media.

This difference in the number of citations suggests that articles from the United States and the United Kingdom have a greater scientific influence globally than articles from other countries. This could be due to the quality of the research, the popularity of the topics covered, and the contribution of these countries to the international academic community. Articles from these countries not only reflect their relevance to the topic of climate change on social media but also show how their research is an important reference point in shaping scientific discussions at a global level. As such, this data illustrates the significant recognition and relevance of scientific publications produced by the United States and United Kingdom in the climate change discourse. The analysis of these countries, particularly in relation to this topic, aims to provide an understanding of the impact and importance of research coming from different regions.

Trend Analysis

Figure 11.

Word Cloud

The Word Cloud provides a visual representation of the frequency of use of keywords in the data. Words that are more frequently used are displayed with a larger font size and bold, and are placed in the center for emphasis, while variations in size and color indicate the diversity of keywords used (Mairita et al. 2024). This wordcloud visualization image illustrates the trend analysis on the topic of climate

change discourse in social media on the Scopus database. The word cloud image above provides deep insights into research themes related to climate change discourse on social media. Words such as *climate change*, *social media*, and *communication* appear as the main elements with the largest font size. The word "*climate change*" alone is recorded as appearing 26 times out of a total of 57 scholarly articles in the Scopus database that discuss this topic, indicating a direct link between climate change discourse on social media and the issue of climate change itself. This is in line with the global focus on the impacts of climate change, which is often a major concern in research.

In addition, terms such as *social media*, *communication*, *media role*, *mass media*, *global warming*, *perception*, *social networking (online)*, *sustainability*, and *environmental policy* also appear in fairly large font sizes. The presence of these terms reflects that research in this topic is mainly conducted in five main areas, namely communication, media, sustainability, environmental policy, and social interaction in a digital context. Terms such as *sentiment analysis*, *climate models*, *spatiotemporal analysis*, and *policy making*, although not as large as the main keywords, are still relevant as subthemes that support this research.

Through the *Digital Public Sphere* approach (Masullo et al. 2022), we can understand that social media is not only a medium for disseminating climate change information, but also a deliberative space where the public discusses, forms opinions, and takes a stance on environmental issues. Words such as *communication*, *policy making*, *sentiment analysis*, and *public engagement* that appear in the Word Cloud show that digital spaces function not only to convey messages, but also to *connect*, build shared *understanding*, and motivate collective action (*act*). This is in line with the four normative signals offered by Masullo et al. namely *welcome*, *connect*, *understand,* and *act* as indicators of a healthy digital public space.

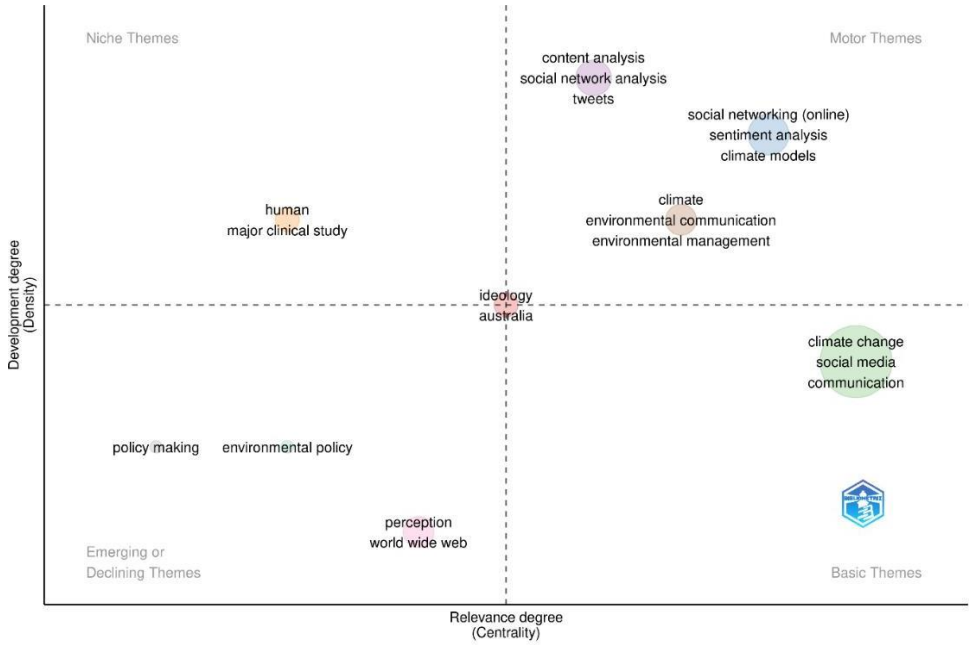
The findings on journal concentration and institutional dominance need to be critically linked to global knowledge asymmetries that influence environmental policymaking. Nanda et al. (2021) argue that developing countries are often in a weak negotiating position in international climate agreements, reflecting power imbalances in knowledge production and distribution. These asymmetries may

hinder their ability to access relevant information and participate effectively in global climate policymaking.

Research on climate change on social media not only addresses climate change issues in general but also integrates various other important aspects, such as sustainability, the role of media, environmental policy, and digital communication analysis. This reflects the complexity and breadth of the topic, which is not only of interest to the academic community but also globally relevant to understanding the issue of climate change discourse on social media

Figure 12

Thematic Map



This Thematic Map image has eight *clusters.* In the topic of climate change discourse on social media, there are *niche themes*, namely *human major clinical study, while emerging themes are 'public making', 'environmental policy', and 'perception worldwide'*. However, the *basic themes* in this study are '*climate*

change', 'social media', and '*communication*'. And *motor themes* are *climate environmental communication, environmental management, content analysis, social network analysis, and tweets. 'digital libraries student learning', 'design/methodology/approach',* and *'questionnaire'*. These four important themes emerged in the thematic development of this research.

This thematic map illustrates the distribution of research topics on climate change discourse in social media based on two main dimensions: *degree of development (density)* and *degree of relevance (centrality)*. These themes are grouped into four quadrants that reflect their respective degree of development and relevance in the research.

In the upper right quadrant, called *Motor Themes*, there are themes such as *content analysis*, *social network analysis*, *tweets*, *social networking (online)*, *sentiment analysis*, *climate models*, *environmental communication*, and *environmental management*. These themes have high density and centrality values, indicating that they are highly relevant and have a major influence on the research. These themes also signify the main focus of climate change research on social media, as they not only appear frequently in the literature, but also play an important role in the development of further studies.

In the upper left quadrant, known as *Niche Themes*, are themes such as *human* and *major clinical study*. These themes have high density but low centrality, indicating that they are deeply developed but only relevant to a specific scope. This means that while they are important to a specific segment, they do not have a strong connection to broader or cross-disciplinary research.

In the bottom right quadrant, *Basic Themes*, we find themes such as *climate change*, *social media*, and *communication*. These themes have high centrality but low density. This shows that these themes are the basis or foundation of various studies, but have not been fully developed in depth. Nonetheless, these themes remain front and center due to their broad scope and relevance in building academic discussions on the topic of climate change.

Meanwhile, in the lower left quadrant, *Emerging or Declining Themes*, there are themes such as *policy making*, *environmental policy*, *perception*, and *world wide web*. These themes have low density and centrality, indicating that they are in

the early stages of development or may be losing relevance in current research. However, these themes still have the potential to grow if they receive more attention from researchers in the future.

This thematic map illustrates that themes such as *climate change*, *social media*, and *communication* are the foundation of research, while themes such as *sentiment analysis* and *content analysis* are the main drivers that drive climate change research on social media. On the other hand, themes such as *policy making* and the *World Wide Web* need strengthening to remain relevant in scientific discussions.

Themes such as sentiment analysis, policy-making, and public engagement have a strategic role in climate change communication through social media. (Nursal et al. 2024) using a corpus-based sentiment analysis approach to examine Malaysian perceptions of climate change showed that the majority of public sentiment was negative or dissatisfied with policymakers' handling of climate issues. From this finding, it is important for policymakers to understand public perceptions in designing effective communication strategies. The study by Rajanen (2021) emphasizes that interactive media. Such as digital platforms, online forums, policy simulations, and educational games can increase public participation in climate change issues. Digital media is not only a channel for information dissemination, but also a dialogical space where people can learn, debate, and contribute to solutions, thus opening up opportunities for the government or policymakers to capture public aspirations and reactions.

To strengthen the contribution to public policy, a deeper integration of policy analysis frameworks is needed. Frameworks such as *intermedia agenda setting* can be used to understand how social media and traditional media influence each other in shaping the climate policy agenda (Z. Wang et al. 2023). In addition, *policy framing* approaches can help identify how climate issues are framed in public discourse and the implications for policy responses.

Climate environmental communication as a basis for research can be related to *environmental communication ethics*, which in the context of social media, ethical challenges become more complex because information spreads quickly and does not always go through a scientific verification process. Greenwashing, disinformation, and manipulative narratives about climate change can mislead the public and undermine collective efforts towards sustainability (Cooper and Coetzee

2020). Therefore, environmental communication on social media needs to be grounded in ethical principles of communication that consider ecological justice, the voices of vulnerable communities, and the public's right to accurate and reliable information. Applying this ethical framework is crucial to avoid politicizing or commercializing climate issues that can obscure the urgency and complexity of the crisis at hand.

CONCLUSION

This study presents a bibliometric analysis of climate change discourse in social media based on 57 scientific articles published between 2008 and 2024. The results show a significant trend of increasing publications, with a high concentration of contributions from developed countries such as the United States, the United Kingdom, and Australia. Through visualization and thematic mapping, it was found that research on climate change in social media is dominated by topics such as climate change, communication, and social media, as well as derivative issues such as sentiment analysis and digital environment management. More than just mapping trends and dominant actors, this study also reveals an imbalance in global knowledge representation, especially from developing countries that still have minimal contributions. This inequality stems not only from access to resources and research infrastructure, but also from language, academic visibility, and the dynamics of social media mediation. This study emphasizes that social media is not only a medium for information dissemination, but also a space where collective climate imaginaries are formed, influenced by symbols, visuals, and narratives that circulate across platforms and cultures. By integrating a bibliometric approach and theoretical frameworks such as the digital public sphere, environmental communication ethics, and climate imaginaries, this article offers a more comprehensive approach to understanding the dynamics of climate change communication in the digital era. This research not only contributes to academic mapping but also opens space for critical reflection on climate information justice, cultural divides, and the potential for global collaboration in shaping a more inclusive and transformative climate change discourse. Future studies are recommended to incorporate a digital ethnography approach to dig deeper into how

local communities interpret and respond to climate change messages on social media.

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