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Climate Change and Human Psychology: A Comprehensive Analysis of Thoughts and Emotions

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Abstract

The paper aims to find out how changes in climate change affect how people think and feel. This paper analyzes 1456 papers published in WOS data from 1964 to 2022 that assessed the impact of climate change on knowledge, attitudes, behaviour, and policy preferences. We used a comprehensive search technique to identify and analyze the articles. VOSviewer, Bibliometrics, and Biblioshiny from R were used in the bibliometric study to reveal new research trends in climate change.The results show five sub-fields of research in this area (climate change, global warming, uncertainty and policy, human activities, land usage, and risk assessment). Other topics comprise the study of trends in this discipline, such as systems, design, snow, river basins, and change impacts.Our analysis indicates several gaps and problems in the climate change literature. There is, for example, a scarcity of studies on climate justice and the social and political components of climate change. Additionally, many studies focus on wealthy countries, leaving out the effects of climate change on vulnerable populations in developing countries.We find that the research areas for climate change trends in those publications give a complete perspective of the climate change research landscape, which may be used to drive future research agendas and policy decisions, etc. Lastly, we suggest different directions that climate change research could go in the future. These include more collaborations between different fields, a stronger focus on the social and political aspects of climate change, and a stronger focus on how climate change affects vulnerable groups.

Keywords: *Climate Change, Human Psychology, Emotional Impact, Cognitive Responses, Bibliometric Analysis.*

Introduction

Climate change is one of the most important problems of our time. It has big effects on ecosystems around the world, people's health, and the economy. In response to this challenge, the scientific community has produced a large body of research on climate change. However, it can be challenging to navigate this vast and complex landscape. Bibliometric analysis, a quantitative approach to analyzing scientific literature, can help identify trends, gaps, and future directions in climate change research.

Previous bibliometric studies have examined climate change research using various databases and methodologies. For example, WoS-based bibliometric analyses have identified key topics, researchers, and institutions in climate change research (Eom et al., 2018; Liu et al., 2021; Zhao et al., 2018). In addition, Scopus-based analyses have provided insights into the interdisciplinary nature of climate change research and the role of international collaborations (van Eck et al., 2017; Zhang et al., 2020).

Even though there have been many bibliometric analyses of climate change research, a full overview of the research landscape is still needed. For instance, past studies have focused on certain parts of climate change research, such as strategies for reducing the effects of climate change or the role of certain countries or institutions. Climate change research needs to be looked at more completely so that new trends and gaps in the research can be found and future research agendas and policy decisions can be made.

The goal of this paper is to use the Web of Science database to do a bibliometric analysis of research on climate change. We will look at how research on climate change has changed over time, which authors and institutions have done the most research, which papers have had the most impact, and what the most

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important research questions are. We will also look at how climate change research crosses over into other fields, where research is happening, and where there are gaps and problems in the literature. By providing a comprehensive overview of the climate change research landscape, this study can help guide future research agendas and inform policy decisions. Therefore, the research objectives of this study are as follows:

R1: Which keywords were used the most often in the WOS database research on climate change?

RQ2: Which authors are most often mentioned in the WOS database research on climate change?

RQ3: Which nations are most interested in seeing climate change research published in the WOS database?

RQ4: Which organizations are most interested in the WOS database's climate change research?

Materials and Methods

Bibliometric Data

The issue of climate change is connected to many different fields of knowledge and scientific disciplines, the researcher must carefully choose the keywords for the research due to the volume, multiplicity, and ramifications of these studies in the Web of Science database.

The WOS database's search for "climate change" and related terms ("climate change process," "climate change examination," "climate change handle," and "climate change treat") returned 1456 studies, which were categorized as follows: Article 1099, Article; Book Chapter 1, Article; Data Paper 1, Article; Proceeding Paper 70, Book Review 9, Proceeding Paper 174, Review 98, Review; Book Chapter 4, and Article; Proceedings Paper 70 The following graph shows the 58 years (1964–2022):

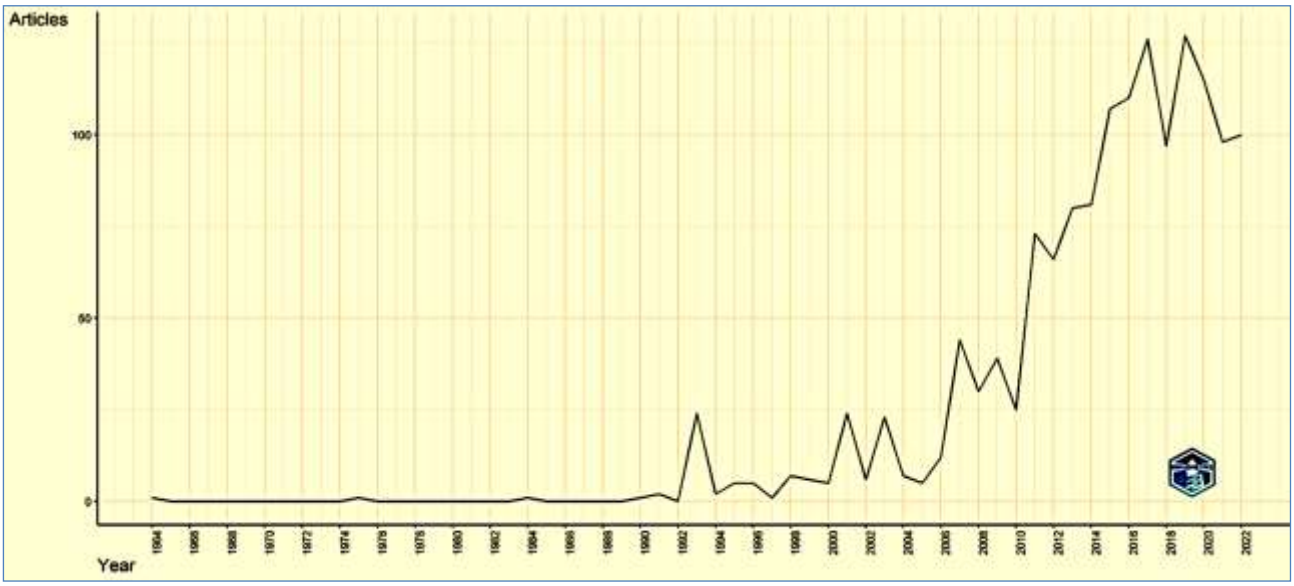

Figure 1. Annual Scientific Production

Figure 1 illustrates how studies and publications on the subject of climate change have been growing every year since 1993, when there were 24 publications, and have reached 126 publications in 2017, 127 publications in 2019, 115 publications in 2020, 98 publications in 2021, and 100 publications in 2022, respectively. Because of major nations' interest in the topic as one of the world's concerns and the organization of several international conferences and summits on the topic, this suggests that researchers and scholars have recently developed a strong interest in it.

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Bibliometric Analysis Methods

Based on the methods and approaches of bibliometric analysis. According to (Zupic & Čater, 2015, p. 04) to build the necessary networks, overlays, and densities that reveal the most significant authors, references, research institutions, and countries in the field of Climate change for the publications of the WOS database, the study relied on five main approaches: co-occurrence, citation, co-citation, co-authorship, and bibliographic coupling. The statistical tools VOSviewer, Bibliometrics, and Biblioshiny from R were used to analyze the publications.

Results

Keywords Analysis Results

Figure 2 depicts the most commonly recurring words in various climate change studies and investigations.

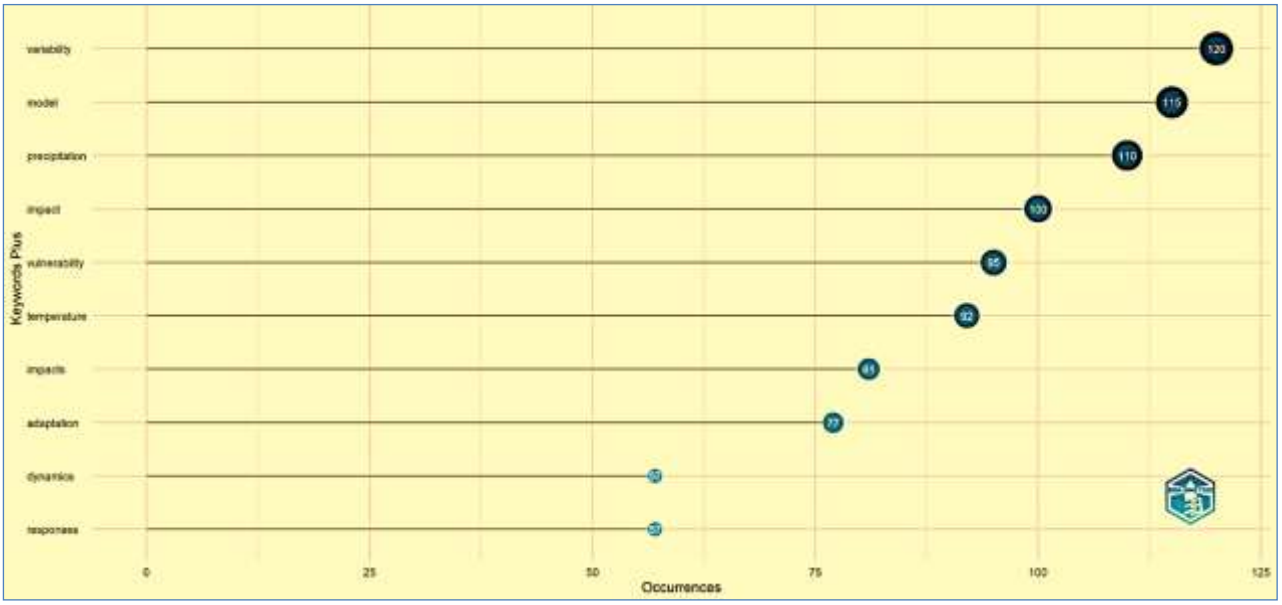

Figure 2. Most Relevant Words

The figure above shows that the most frequently mentioned keywords in climate change research are: variability 120, model 115, precipitation 110, impact 100 and impacts 81, vulnerability 95, temperature 92, adaptation 77, dynamics 57, and responses 57. They constitute major sub-fields of climate change, divided into four clusters as shown in the following network.

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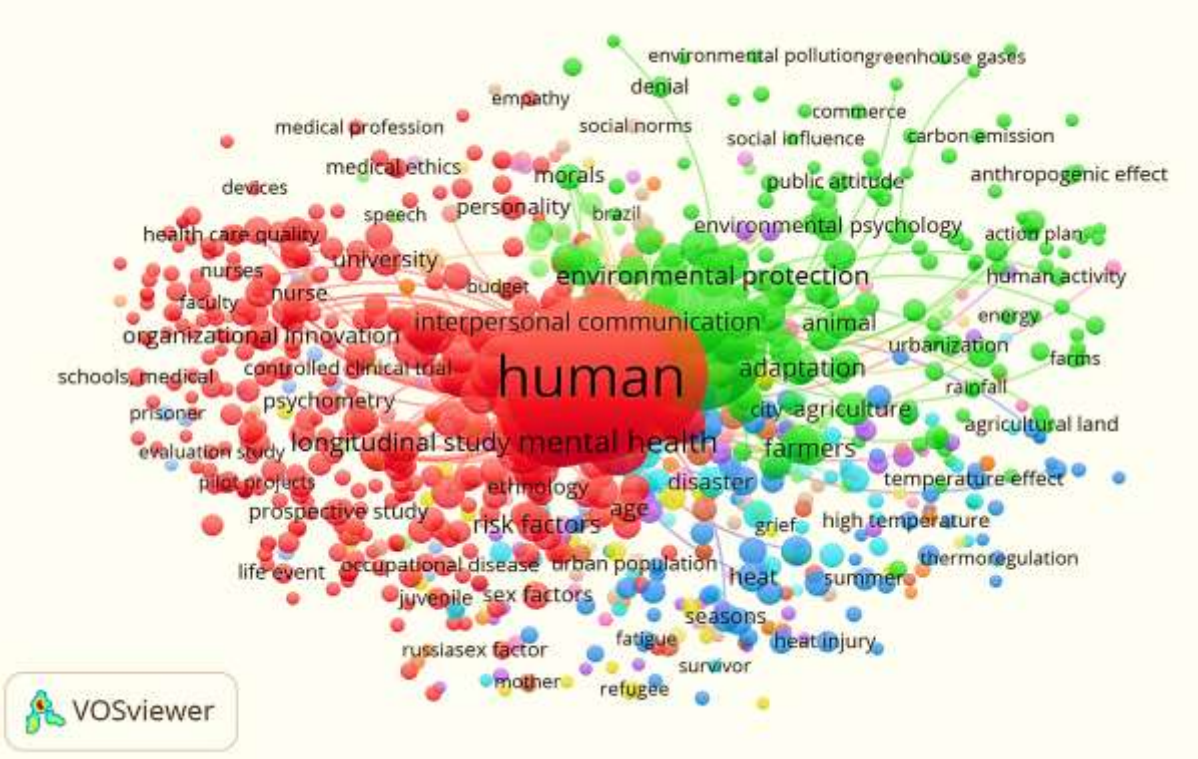

Figure 3a. Network of keywords

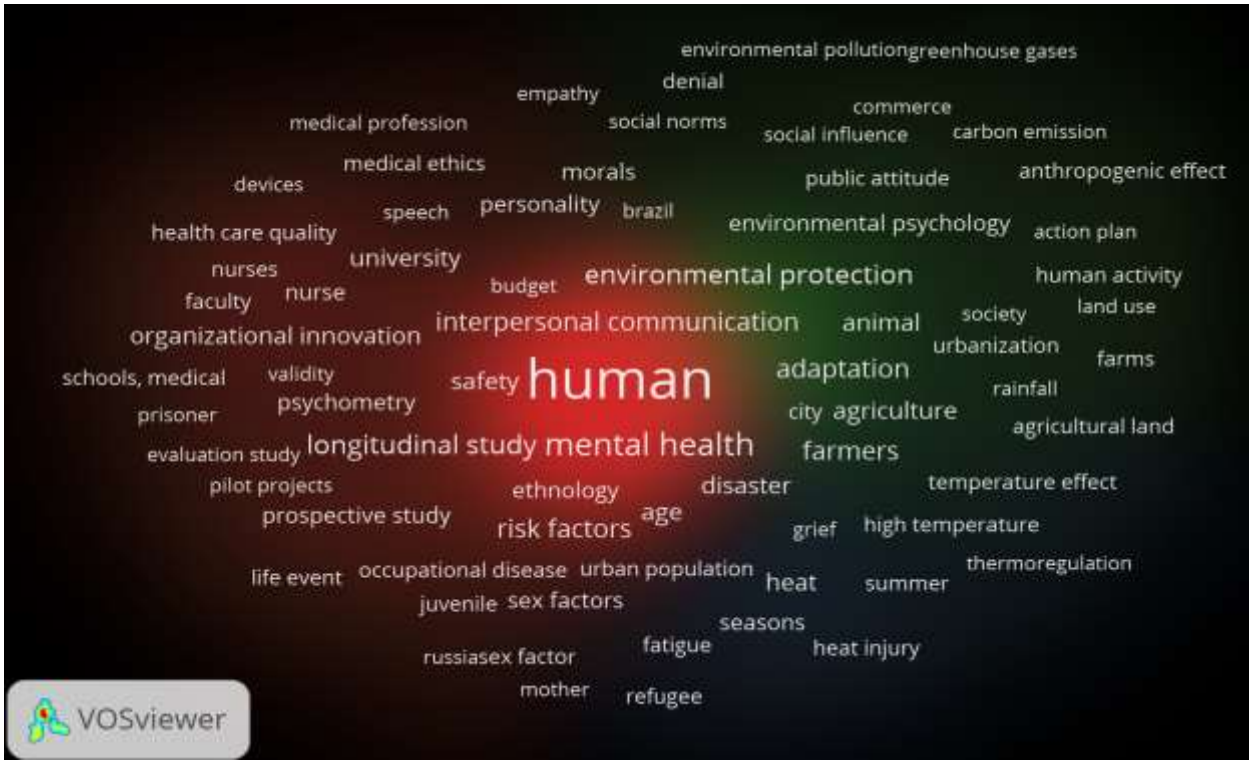

Figure 3b. Density of keywords

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Figure 3a, 3b depicts four sub-fields of research on the topic of climate change. The first is the field of climate change adaptation (the red cluster) and what it is associated with (vulnerability, management, adaptation, policy...), the second is the field of climate consequences (the blue cluster) and what it is associated with (precipitation, river basin, runoff... etc.), the third is the field of the ecosystem (the green cluster) and what it is associated with (elevated CO2, respiration, Carbon... etc.), and the fourth is the field of climate change impacts: environmental and natural impacts, social impacts, economic impacts… (the yellow cluster). The themes that have emerged as research trends in recent years are shown in the following graph.

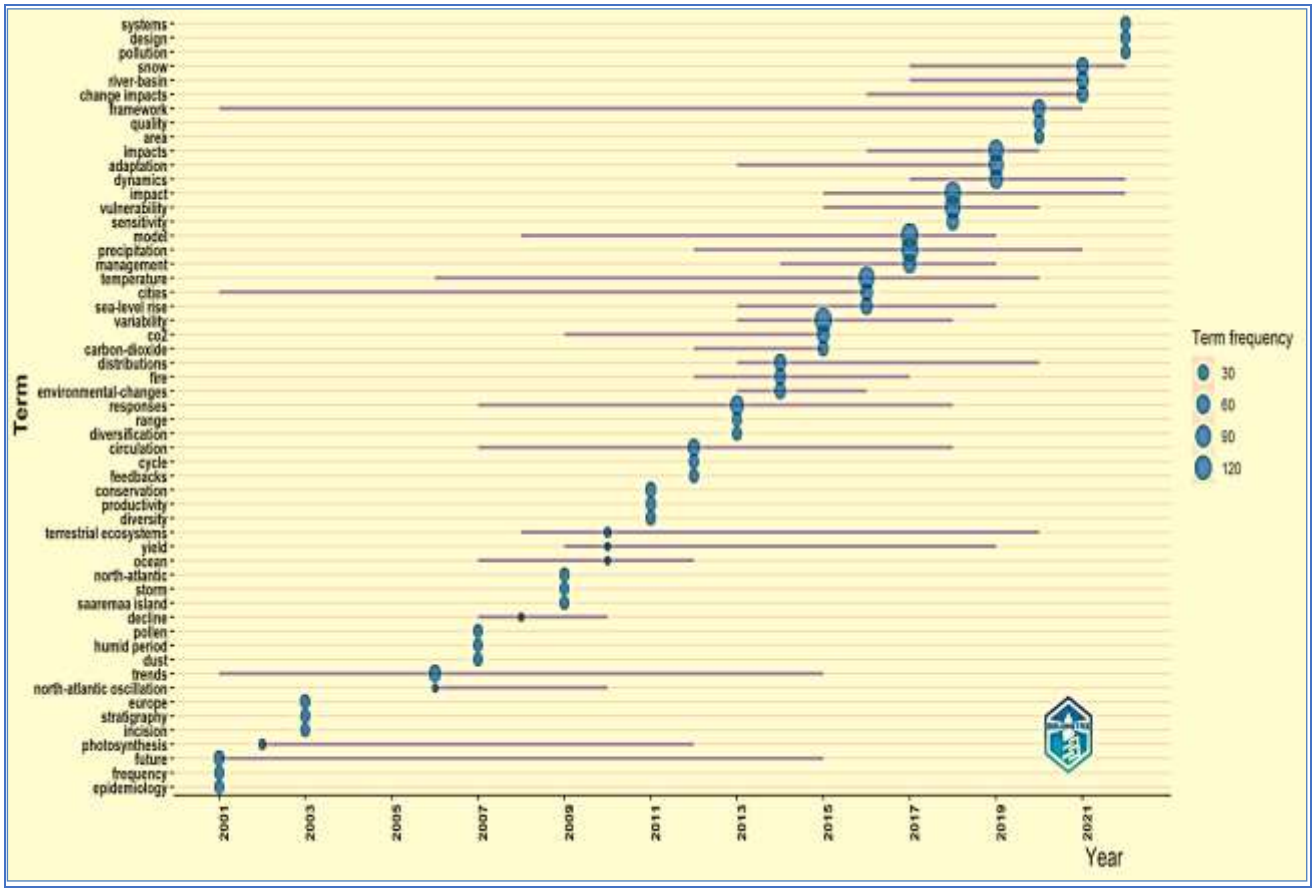

Figure 4. Trend Topics

Figure 4 demonstrates that systems, design, pollution in 2022 and snow, river basin, and change impacts in 2021 are respectively the themes that make up a research trend in climate change in recent years. Researchers should focus on these areas since authors, institutions, and nations are currently interested in them.

Authors' Analysis Results

Several authors have multiple publications in well-known databases, such as the Web of Science, and among them are those who are more influential than others are in terms of publications, citations, co-citation, co-authorship, and bibliographic coupling. This is shown in Figures 5 and 6.

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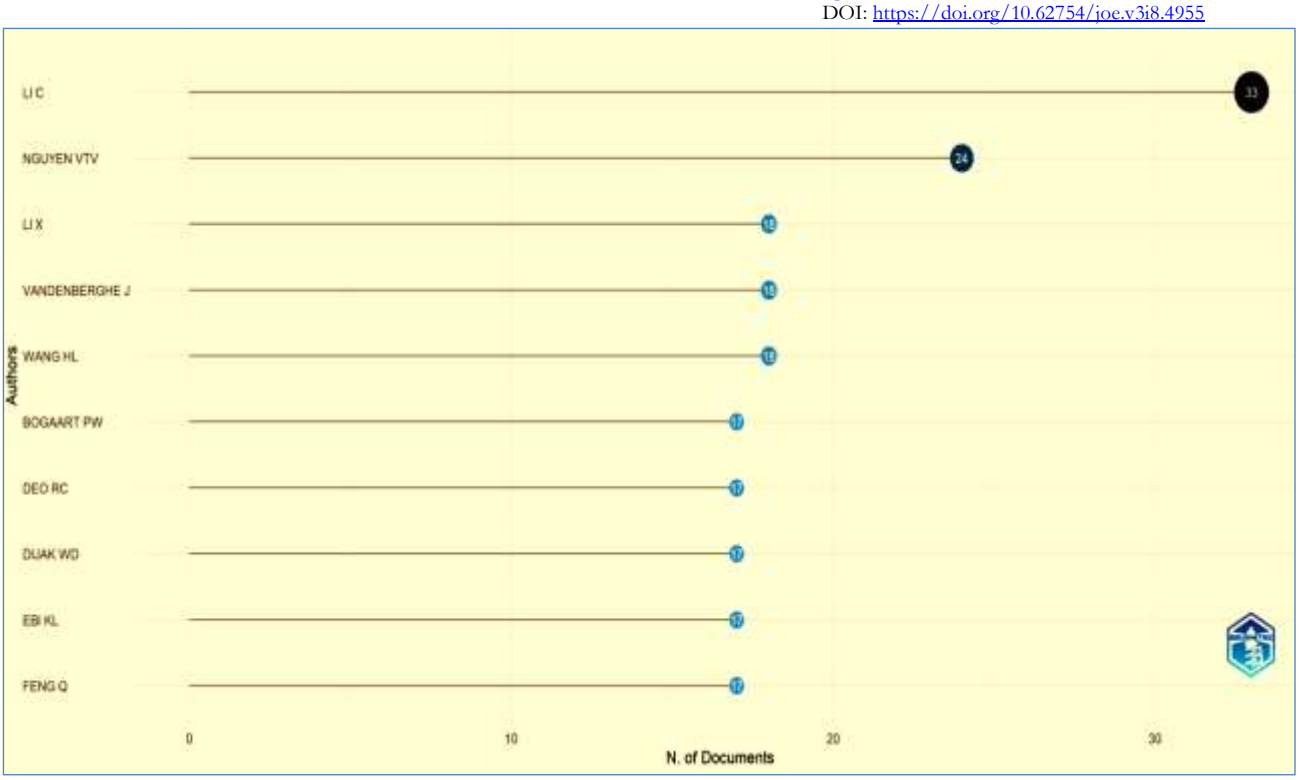

Figure 5. Most Relevant Authors

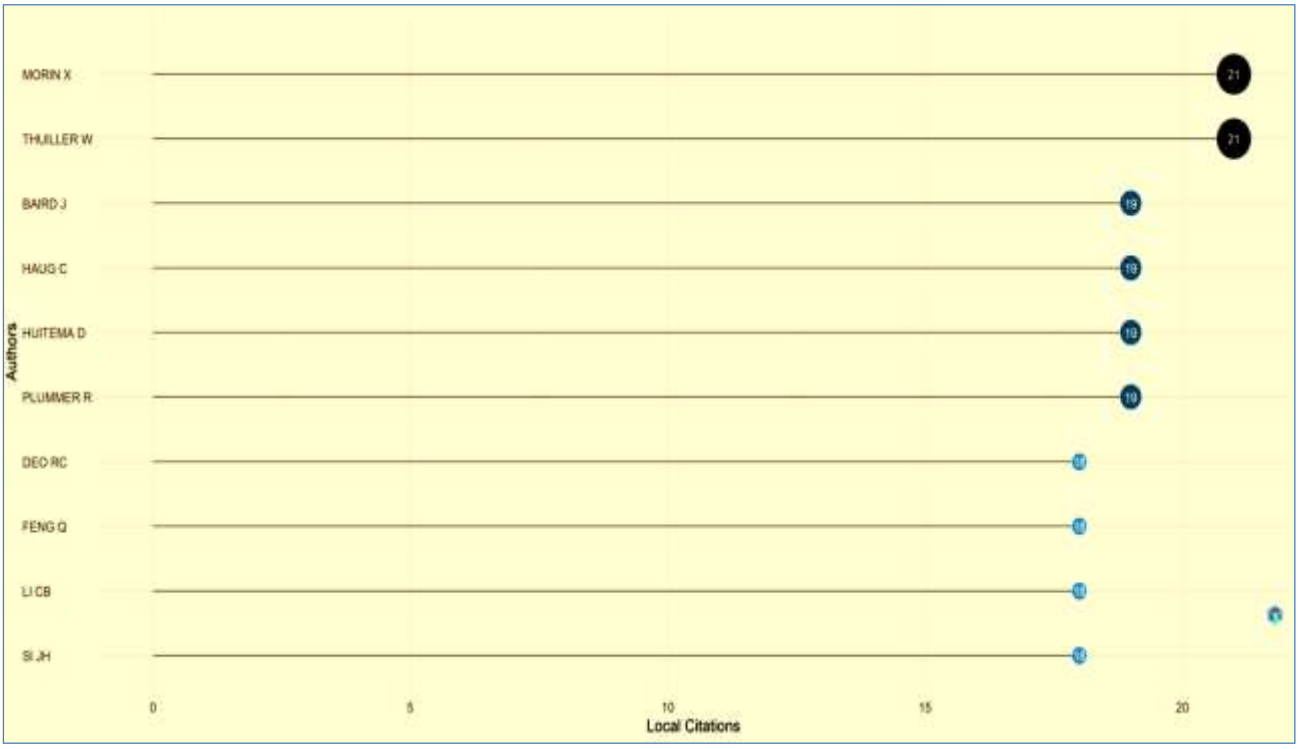

Figure 6. Most Local Cited Authors

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According to the number of publications, Figure 5 identifies the top authors on the topic of climate change as follows: Li C 33 publications, Nguyen VTV 24 publications, Li X, Vandenberghe J, Wang HL with 18 publications, Bogaart PW, Deo RC, Dijak WD, Ebi KL, Feng Q with 17 publications. As for the citation that appears in figure 6, it seems that the most influential authors in the field of climate change are Morin X, and Thuiller W with 21 citations, Baird J, Haug C, Huitema D, and Plummer R with 19 citations, Deo RC, Feng Q, Li CB, and Si JH with 18 citations. While preparing studies on climate change and its different repercussions, these authors should be heavily depended upon. Figure7 shows that, regarding time, certain authors are more persistent with the topic of climate change than others and that some authors publish more in one time period compared to another.

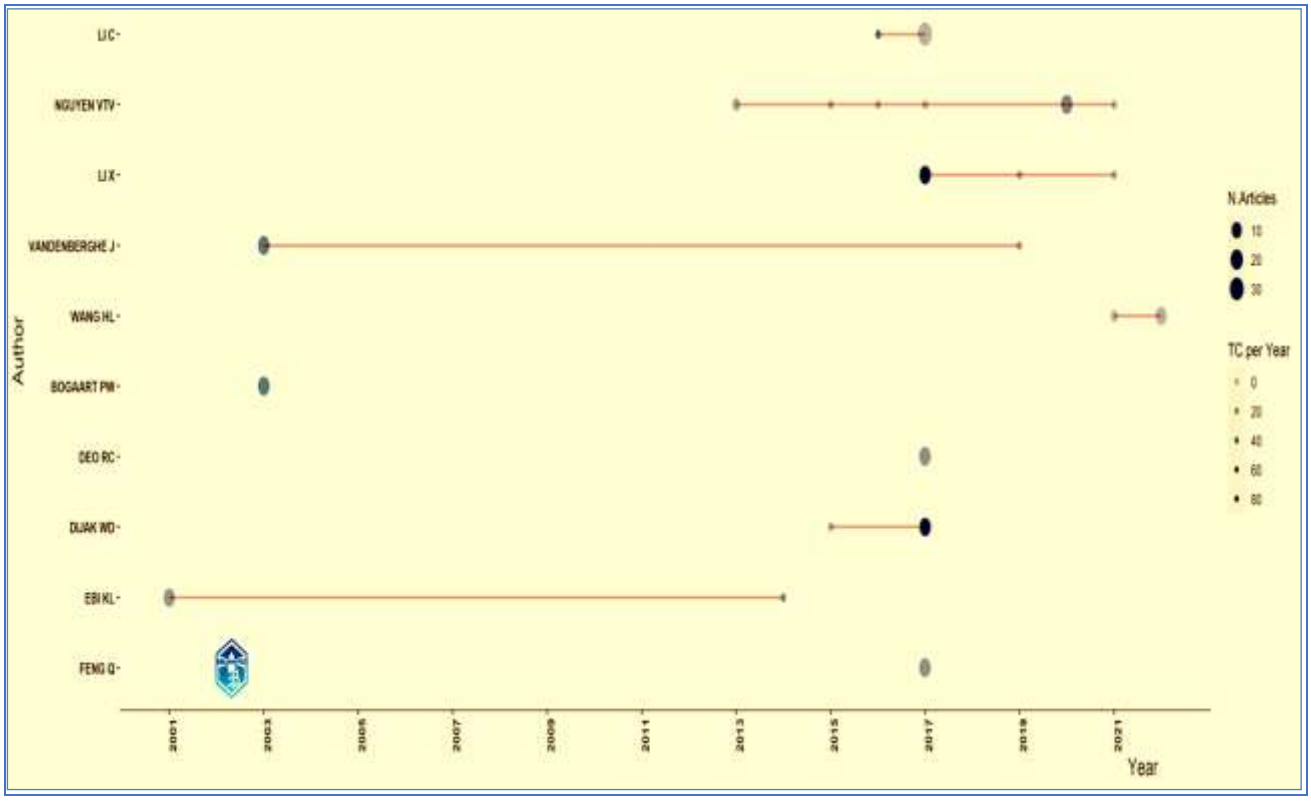

Figure 7. Authors' Production over Time

According to Figure 7, the most consistent authors in scientific research and publication on climate change are Vandenberghe J (2003-2019), Ebi KL (2001-2014), and Nguyen VTV (2013-2021). Wang HL, Nguyen VTV, and Li X are the authors who have been particularly interested in climate change in recent years. The network that depicts the relationship between these investigators is depicted in the figure below:

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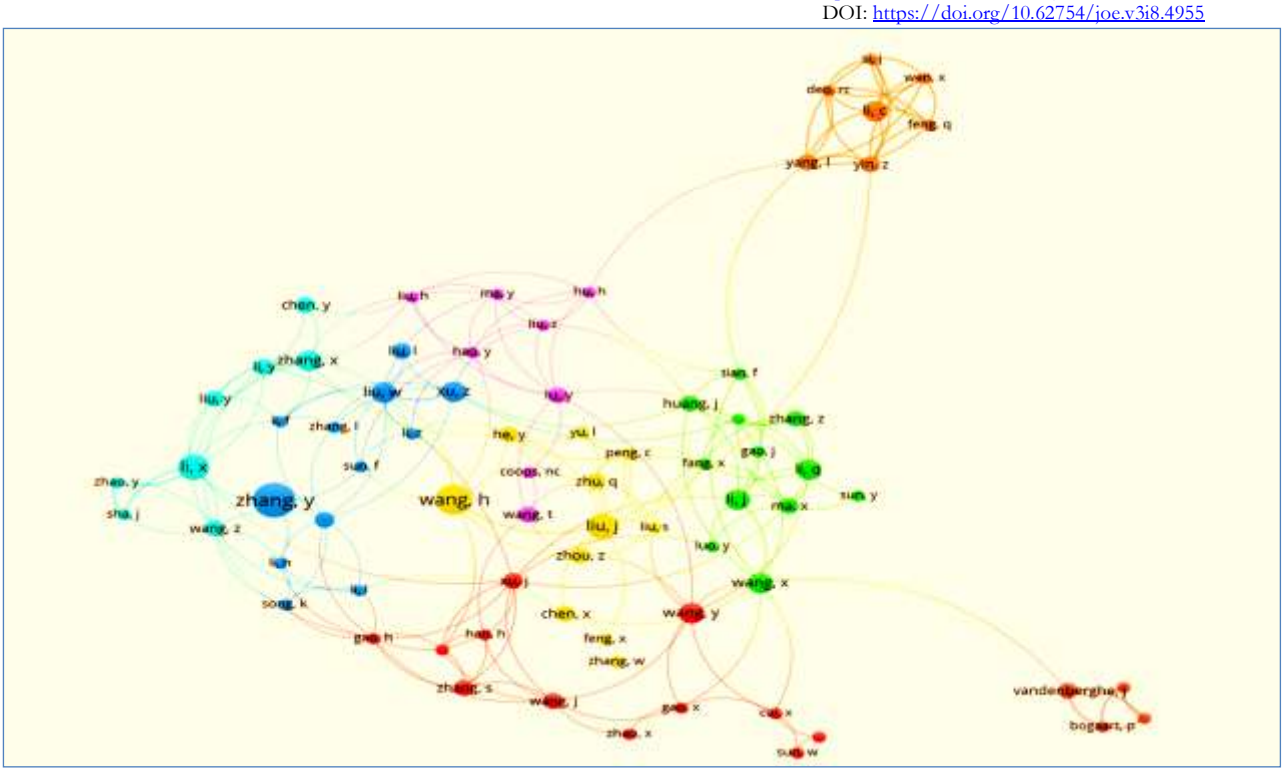

Figure 8. Authors' Network

Figure 8 shows that among the most published and cited authors in the field of climate change; there are 74 who have a research co-authorship, as they form 8 clusters and 217 links. This is interpreted as evidence that this issue is interdisciplinary, and that the articles published on it in Web of Science are interdisciplinary and of high quality.

Sources and Documents Analysis Results

There are several references and sources on climate change, but the following are the most relevant ones.

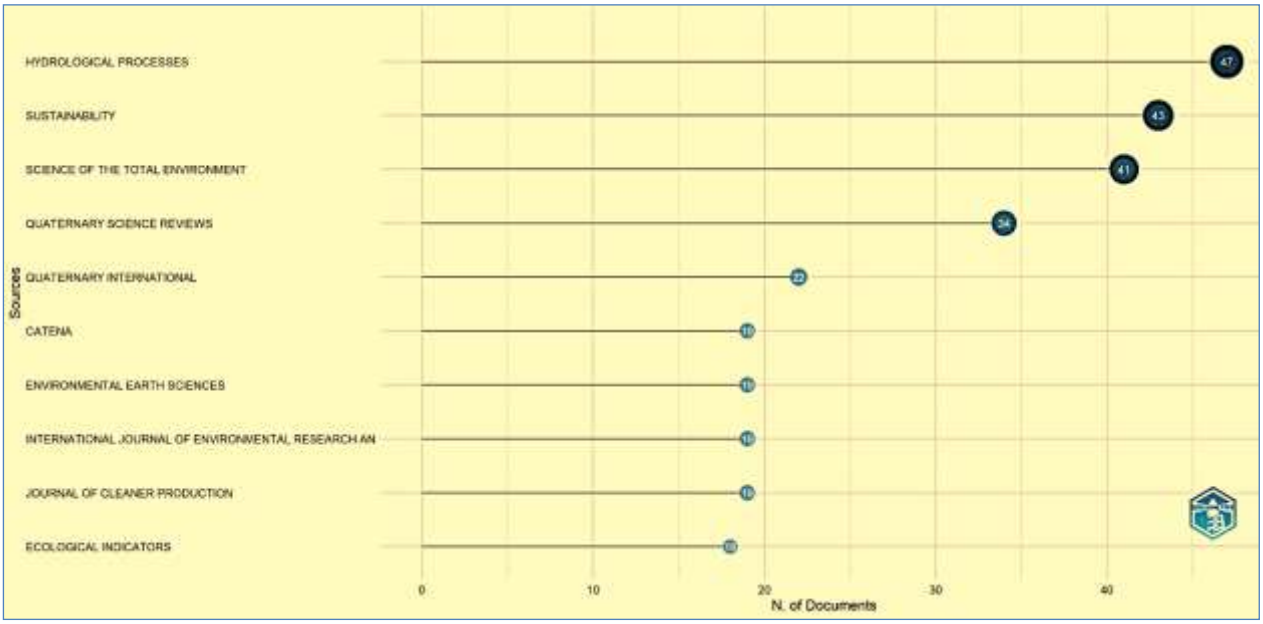

Figure 9. Most Relevant Sources

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The most relevant sources on climate change are shown in Figure 9 to be Hydrological Processes, Sustainability, Science of the Total Environment, Quarternary Science Review, Quarternary International, Catena, Environmental Earth Sciences, International Journal of Environmental Research, Journal of Cleaner Production, Ecological indicators. These sources should be well focused on by the researcher on the subject of climate change. As for the sources whose research returns are high, they appear according to Bradford's Law as follows.

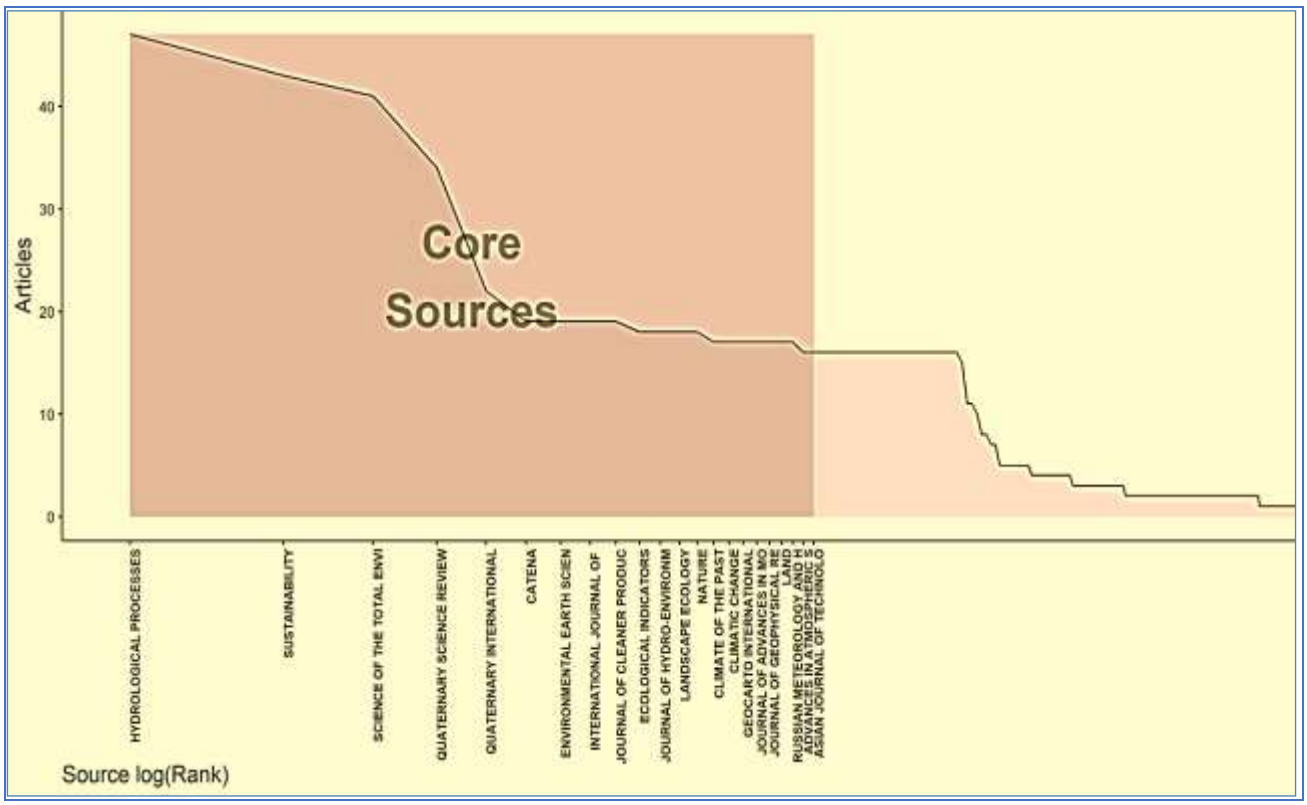

Figure 10. Core Sources by Bradford's Law

Bradford's Law states that the researcher's returns are highest in the journals Hydrological Processes, Sustainability, and Science of the Total Environment, then decline to Quaternary Science Review, Quaternary International, Catena, and finally Asian Journal of Technology, where they become intermittent or even nonexistent after that, therefore, the researcher should focus on the most important sources from according to the citation, as shown in Figure 11.

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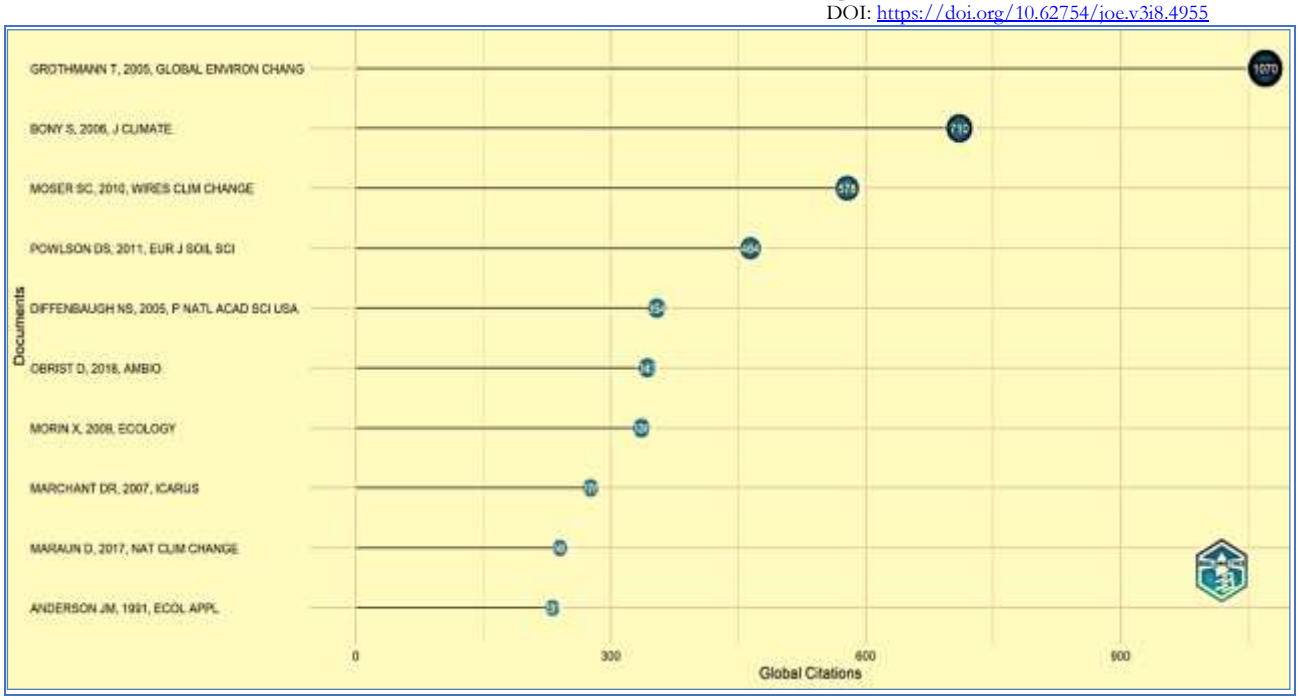

Figure 11. Most Global Cited Documents

Figure 11 demonstrates that the following documents have received the most citations globally: {Anderson, 1991 #10;Bony, 2006 #2;Diffenbaugh, 2005 #5;Grothmann, 2005 #1;Maraun, 2017 #9;Marchant, 2007 #8;Morin, 2009 #7;Moser, 2010 #3;Obrist, 2018 #6;Powlson, 2011 #4}.The first one is (Grothmann & Patt, 2005) with 1070 citations. These publications must be surrounded by a researcher on the subject of climate change with focused and special research care.

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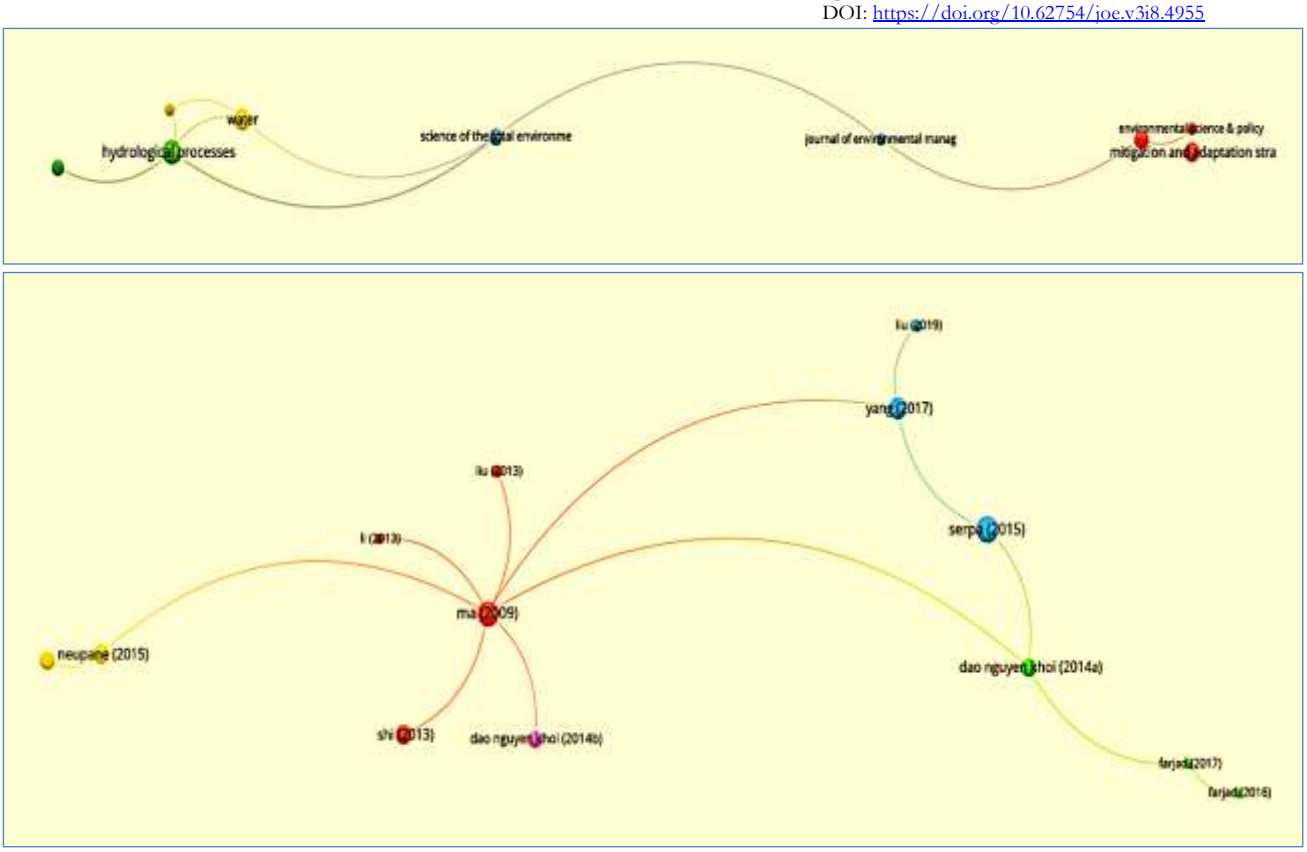

Figure 12. Sources and Documents Networks

The network of sources and documents reveals that the citation is linked to a sizable number of sources, but this is less than what is expected because the citation was made in sources that did not address the topic of climate change or in sources that did.

Institutions and Countries' Results

The following figure shows the network of research institutions and countries most cited on the topic of climate change.

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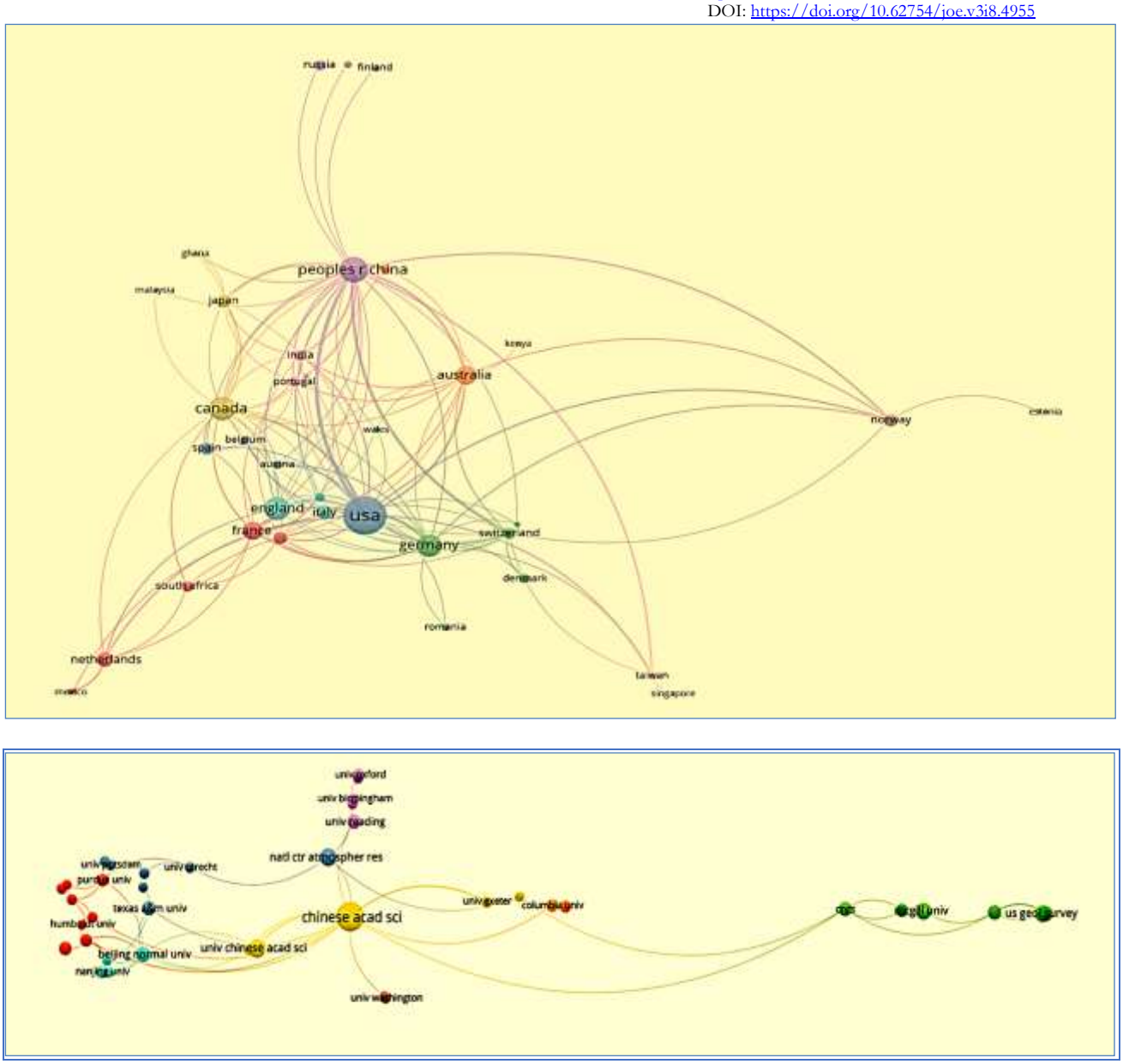

Figure 13. Institutions and Countries Networks

Figure 12 shows that the most important countries in terms of publication and citation on climate change are, respectively: USA, England, Germany, Canada, France, Peoples R China, Australia, Japan, Netherlands, Switzerland, and Spain (see Appendix 1.). The most important research institutions in terms of publication and citation are the National Center for Atmospheric Research, Centre national de la recherche scientific, University of Reading, Potsdam Institute for Climate Impact Research, Columbia University, Colorado State University, University of Washington, University of Oxford, Chinese Academy of Sciences, Purdue University. (Appendix 2.), All of these institutions are based in the top ten countries. Since the subject of climate change is one that concerns leaders, lawmakers, decision-makers, and researchers on a global scale, it should be highlighted that there is a very strong network of relationships between research institutes and nations, as illustrated in the accompanying figure.

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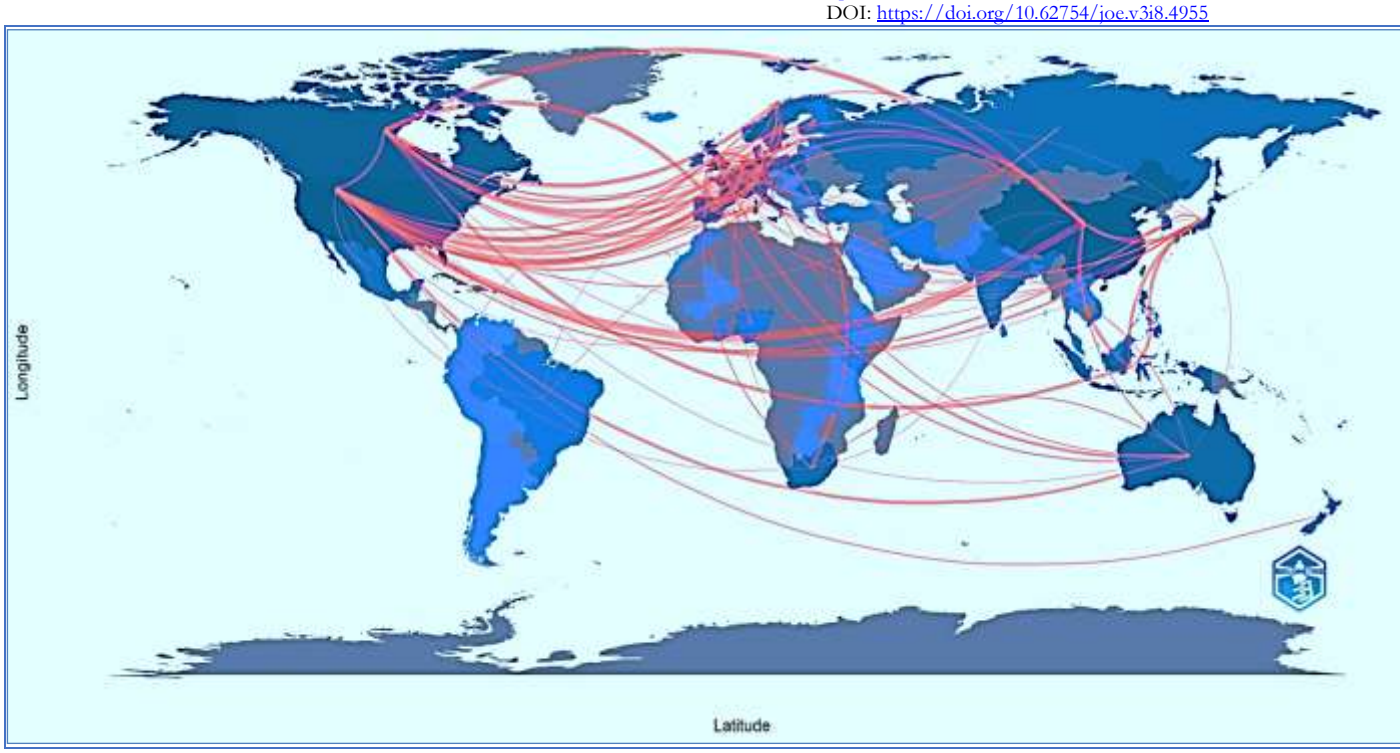

Figure 14. Countries' Collaboration World Map

There is a very strong research collaboration in the field of climate change between America and European countries, between Canada and European countries as well, as between Canada, America and China.

Three-Field Plot

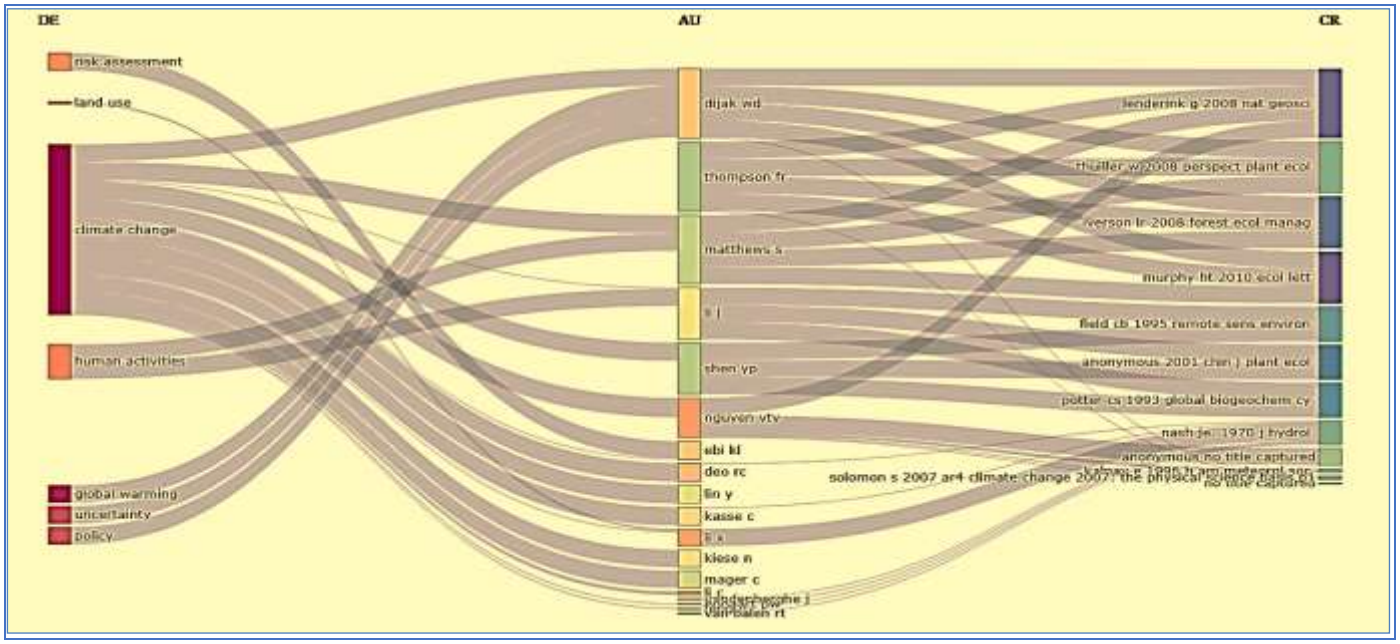

Figure 14. Three-Field Plot

Five primary and sub-fields of research on climate change are depicted in Figure 14. The first is climate

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change, which has attracted numerous authors, including Dijak WD, Matthews S, Shen YP, Nguyen VTV, Deo RC, etc., with a variety of references, including Lenderink (2008), Thuiler (2008), Iverson (2008), etc. The second topic, which was popularized by Dijak WD as the most significant author, is global warming, uncertainty, and policy. The third category is human activities, which was popularized by the two most significant scholars, Matthew S. and Li J. Ebi KL's risk assessment comes in fourth. The last sub-field is land usage, which was made popular by Li X. It is quite subtle.

Discussion

Our bibliometric analysis of climate change research using the Web of Science database reveals several important trends and gaps in the literature. First, we found that climate change research has experienced significant growth over the past few decades, with an average annual growth rate of 6.2%. This is consistent with previous bibliometric analyses of climate change research (Eom et al., 2018; Zhao et al., 2018). The rapid growth of climate change research reflects the increasing urgency of the issue and the need for scientific evidence to inform policy decisions.

Second, our analysis revealed that the most prolific authors and institutions in climate change research are predominantly located in developed countries, particularly the United States, China, and the United Kingdom. This is consistent with previous studies that have identified the dominance of developed countries in climate change research (van Eck et al., 2017; Zhang et al., 2020). The concentration of research in developed countries suggests a need for greater attention to the impacts of climate change on vulnerable populations in developing countries, as well as the role of developing countries in mitigating and adapting to climate change.

Third, we found that the most influential papers in climate change research are those that address key topics such as climate modelling, mitigation and adaptation strategies, and impacts on biodiversity and ecosystems. This is consistent with previous studies that have identified these as key research areas in climate change literature (Liu et al., 2021). However, our analysis also revealed a lack of research on climate justice and the social and political dimensions of climate change. This suggests a need for greater interdisciplinary collaboration and a broader research agenda that takes into account the social and political dimensions of climate change.

Fourth, our analysis revealed that climate change research is highly interdisciplinary, with contributions from a range of disciplines including environmental science, ecology, geography, and engineering. This interdisciplinary nature of climate change research highlights the need for collaboration across disciplinary boundaries to address the complex challenges posed by climate change.

Finally, our analysis identified several gaps and challenges in the climate change literature. These include a lack of research on the social and political dimensions of climate change, as well as the need for greater attention to the impacts of climate change on vulnerable populations in developing countries. These gaps and challenges suggest a need for a broader research agenda that takes into account the diverse perspectives and experiences of those affected by climate change.

In conclusion, our bibliometric analysis provides a comprehensive overview of the climate change research landscape and can inform future research agendas and policy decisions. By identifying trends, gaps, and challenges in the literature, this study highlights the need for interdisciplinary collaboration and a broader research agenda that takes into account the social and political dimensions of climate change.

Conclusion

In conclusion, our bibliometric analysis of climate change research using the Web of Science database provides a comprehensive overview of the landscape literature. Our analysis reveals significant growth in climate change research, with a concentration of research in developed countries and a lack of attention to the social and political dimensions of climate change. These findings suggest a need for greater

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interdisciplinary collaboration and a broader research agenda that takes into account the diverse perspectives and experiences of those affected by climate change.

Our analysis also highlights the need for greater attention to the impacts of climate change on vulnerable populations in developing countries. As climate change continues to have significant impacts on global ecosystems, human health, and the economy, research must address the needs of those who are most affected by its consequences.

By providing a comprehensive overview of the climate change research landscape, this study can inform future research agendas and policy decisions. Our findings can guide interdisciplinary collaborations and highlight areas where further research is needed. Ultimately, our analysis underscores the importance of continued research and action to address the complex challenges posed by climate change.

Acknowledgements

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Conflict of Interest

The authors declare that they have no conflict of interest.

Appendices

Appendix 1. Most Cited Countries

Country	Documents	Citations	Total Link Strength
USA	211	9803	72
England	81	3968	22
Germany	73	3059	36
Canada	84	2754	37
France	50	2704	26
Peoples R China	94	2117	76
Australia	54	1678	30
Japan	25	1277	16
Netherlands	31	1140	8
Switzerland	18	1128	26
Spain	23	1043	7
Norway	23	987	11
Russia	15	922	1
Sweden	22	784	11
Italy	27	761	4
Portugal	14	622	15
Denmark	13	500	4
Austria	11	480	7
Wales	6	480	4
South Korea	14	460	6
India	18	415	19
Scotland	12	409	12
Taiwan	8	341	9
South Africa	17	252	6

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Finland	7	242	1
Ireland	6	208	0
Vietnam	5	206	10
Belgium	9	200	8
Turkey	9	157	0
Brazil	9	153	0

Appendix 2. Most Cited Countries

Organization	Documents	Citations	Total Link Strength
Natl Ctr Atmospher Res	12	1769	3
Cnrs	8	1684	4
Univ Reading	8	1357	2
Potsdam Inst Climate Impact Res	5	1285	4
Columbia Univ	6	1283	2
Colorado State Univ	5	1012	1
Univ Washington	5	810	0
Univ Oxford	6	777	1
Chinese Acad Sci	34	685	14
Purdue Univ	6	451	4
Nanjing Univ	6	420	1
Us Forest Serv	8	410	4
Environm & Climate Change Canada	5	384	0
Mcgill Univ	11	375	3
Us Geol Survey	11	336	2
Univ Birmingham	5	320	1
Beijing Normal Univ	9	312	8
Yale Univ	5	312	1
Univ Lisbon	5	308	2
Cornell Univ	9	293	2
Oregon State Univ	5	280	1
Univ Exeter	5	268	1
Univ Florida	6	239	1
Univ Chinese Acad Sci	13	238	3
Univ Colorado	7	225	0
Arizona State Univ	5	220	0
Vrije Univ Amsterdam	7	220	0
Tsinghua Univ	5	217	2
Noaa	6	216	0
Univ Copenhagen	6	204	0

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