

## Analysis of Climate Change and Tourism Related Studies with Visual Mapping Technique

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### Abstract

Climate change is a subject discussed by researchers in a wide range of aspects. This study aims to investigate the situation of climate change and tourism-related research in the international tourism literature. In doing so, the study employs the document review method within the scope of descriptive analysis. In this context, the study chooses the Web of Science database as the research area, and the visual maps are utilized with the help of Citespace and VosViewer software. Scanning the words climate change and tourism from the Web of Science database, the study considers 393 articles published between 1998-2022 (May). Thus, its research sample consists of 393 articles. Evaluating the study's findings coherently, the study reveals that research published within this context gains momentum, particularly in 2007, while 2011 is the year with the most publications. Within the institution-based evaluation, the League of European Research Universities Leru and the University of Waterloo are the two universities with the highest publication rate on the topic. According to the distribution of WOS categories, the Hospitality Leisure Sport Tourism category has been the field in which most research is published. Besides, the articles are predominantly published in the Journal of Sustainable Tourism. The Social Sciences Citation Index is the index in which the articles are frequently scanned. According to the analysis of collaboration among authors, Scott, Hall, Becken, and Gossling are the pioneer researchers on the subject. On the other side, Citation Explosion Model points out that the most cited researcher is Becken. While the researcher who published on this subject on his own is Scott, the most cited single authors are Elsasser and Burki. Ranking the countries in their publication number among countries, Australia, the United States of America, and Canada are shown to be the most prosperous countries, respectively. When examining the entire sample set of research in terms of keywords, the study shows climate change is the most frequently used keyword.

**Keywords:** Climate Change, Visual Mapping, Tourism.

**Jel Codes:** L83, Q54.

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### Introduction

Climate change is a hot topic issue researched by numerous scientists today. It is a problem arising from the excessive emission of greenhouse gases and has various effects on our daily lives. Its impacts extend from human health and socio-cultural changes to the economy and national welfare. Factors such as increasing temperatures, rising sea levels, and melting of the polar ice trigger extreme events such as drought, forest fires, heat fluctuations, hurricanes, and floods. Such changes urge all countries and governments to take concrete actions and implement them.

As a topic that many researchers have been studying for decades, the possible impacts of climate change continue to be a debated issue. Today's climate change shows its effects across different scales within divergent societies and sectors. Climate change and its potential impacts directly or indirectly affect nearly every sector. At this point, one of the sectors under the influence of climate change is, no doubt, tourism. Since most tourism activities depend on weather conditions, climate change will inevitably affect tourism.

Climate change and tourism are economically and socially interconnected with one another. Given the impacts of climate change on the tourism sector, it should not be hard to anticipate specific changes in touristically active regions. Shrinking freshwater resources, rising temperatures, surges in the frequency of forest fires, and endemic species under extinction threats are the problems springing from climate change. Moreover, the threats awaiting winter tourism due to increasing temperatures,

the seasonality effect of tourism, and the risks of sustainable tourism activities affected by erratically fluctuating weather conditions are among the expected detrimental effects of climate change.

The relationship between climate change and tourism has been a subject that researchers have spent studying for long years. Within the context of this study, the effects of climate change on the tourism sector are investigated, and, accordingly, different models are constructed in the light of suggestions made during the study period. The study's main goal is to determine the current situation of the research conducted between 1998 and 2022 that reveals the relationship between climate change and tourism. 393 articles are gathered which have been published between 1998-2022 (May) in order to realize the objectives mentioned above of this study. The study reaches out to the studies by scanning the keywords climate change and tourism on the Web of Science database. The article comprises three parts. In the first part, the study explains the relationship between climate change and tourism by providing the necessary theoretical background on the subject. In the second part, the methodology used is explained. Besides, the country collaborations, research areas, most cited authors/journals, keywords, and the literature are examined. The last part includes conclusions and recommendations that are achieved based on the findings of the study.

## Conceptual framework

### Climate Change and its Potential Impacts

Climate change represents one of the most important problems for humanity in the 21st century (Yu et al., 2009; Dawson and Scott, 2007; Bigano et al., 2008; Amelung et al., 2007). Climate change results in various changes in temperature rates and precipitation regimes, which affects people socially and economically. Shortly after the industrial revolution, the Carbon Dioxide (CO<sub>2</sub>) emission rates showed a drastically increasing trend in comparison with the pre-industrial era. The increased CO<sub>2</sub> emissions result from the global greenhouse phenomenon. The changes in climate order, along with significant and abrupt alterations in global temperature as a consequence of the greenhouse phenomenon, are defined as climate change (Siddiqui and Imran, 2019). Greenhouse gas emissions lead to further warming and changes in all climate system components (Hall, 2016). Greenhouse gas emissions and the vicious cycle of climate change have become one of the most critical issues debated because it carries remarkably harmful risks on the well-being of the Earth in the long run, and it definitely has a considerable impact on sustainable economic development (Dumitrescu et al., 2021).

Climate change have been taken globally, thus far, the necessary actions against. The negotiations, in this regard, officially started with the Kyoto Protocol adopted in 1997. Under the protocol, 37 developed countries and the European Community agreed to reduce their CO<sub>2</sub>, CH<sub>3</sub>, N<sub>2</sub>O, SF<sub>6</sub>, and two other types of greenhouse gas emissions. Developing countries, including China and India, are exempted from the agreement on emission reductions. Ratifying the Kyoto Protocol, the USA went on the path toward emission reduction. Nevertheless, global emissions continued to rise despite the Kyoto Protocol. In the subsequent years, The United National Framework Convention on Climate Change (UNFCCC) was held in Durban, South Africa, in late 2011, becoming a legally binding agreement (Pang et al., 2012). More recently, it was agreed to keep global warming below 20°C, with the Paris Agreement signed in 2015. The decision was at the end of the negotiations carried out in the scope of the Paris Agreement to determine the roadmap of the entire world about climate change struggle after 2012. Per Paris Agreement, countries are entitled to determine their national contribution declarations for how much greenhouse gas reduction they will achieve in the following decades. With the inclusive and flexible structure built, a new period of commitment and struggle has started for the post-2020 period. Subsequently, all countries are encouraged to limit their greenhouse gases (Bayazit, 2018). In the 2020s, a considerable reduction in the emission curve is claimed to realize the main objective of the UNFCCC. It is vital to abstain from dangerous interventions in the global climate system and to address the emerging climate emergency (Scott, 2021).

The potential effects of climate change are one of the hottest issues that researchers focus on and argue. It is important to remark that the alterations in the global water cycle due to global warming during the 21st century will not be uniform. Although there are regional exceptions, the disparity in precipitation between rainy and dry regions, plus between rainy and dry seasons, will extend (Hall, 2016). That is to say that the intensity of rain and drought events will increase over time. Climate change is expected to bring about significantly higher temperatures and severely affect the mountainous regions. In addition to warming, climate changes are foreseen concerning rain, snowfall, and other aspects (Müller and Webber, 2008). Moreover, more prolonged and intense heat waves will increase due to global warming. These heatwave events will cause extreme drought due to increased evaporation. Besides, it is another dreadful fact that natural snow cover duration and snow depth

have decreased significantly since 1950, particularly in Western and Southern Austria. Without effective climate protection measures, a significant increase in the intensity and frequency of small-scale local natural events such as heavy rain, flood, and storm are likely to happen in the short run. Consequently, landslides and mudflows may occur at increasing rates due to changes in climatic conditions (Pröbstl-Haider et al., 2021).

Another echo of climate change is sea-level rise. Sea level rise is one of the most evident impacts of climate change. The costs of sea-level rise become prominent in the cost estimations due to climate change (Bigano et al., 2008). Additionally, significant and sustained reductions in greenhouse gas emissions are required to minimize the impacts of climate change (Hall, 2016). To understand the severity of the subject, the following anecdotal pieces of evidence should be enlightening. 1998 was the warmest year of the millennium, while the 1990s were the warmest decade. The four hottest years globally are consecutively 1998, 1997, 1995, and 1990. Climate models reveal that there will be a temperature increase of 0.2°C - 0.3°C per decade in the future, and sea levels will rise between 4 and 10 cm per year (Viner and Agnew, 1999).

The possible effects of climate change on humans are also under consideration. The number of people exposed to food insecurity, drought, and clean water-related diseases will increase due to the increasing temperature rates (Caney, 2015). Changes in climatic conditions will lead to the deterioration of the ecological system, which in turn will affect human health. Detrimental environmental changes in conditions for which human biology and culture have adapted throughout the evolutionary process will adversely affect human health. Agricultural pollution, air pollution, together with ecological deterioration will play a role in the growing rates of infectious diseases (McMichael and Haines, 1997). Heat waves will also severely impact vulnerable groups such as children and the elderly. Besides, the pollination season will start earlier, and allergens will increase due to higher global temperatures (Haines and Patz, 2004).

### **The Relationship between Climate Change and Tourism**

Climate is one of the major factors shaping the holiday decisions of tourists. On the other side, climatic conditions become an increasingly significant parameter in the tourists' sense of well-being and satisfaction by affecting the sense of security due to its effects on health. Climate is usually claimed to be the number one factor determining the tourist attractiveness of particular destinations, or it is deemed to be the main variable in affecting people's destination decisions (Yañez, et al., 2020; Valls and Sarda, 2009). The attractiveness of an area for tourist activities is highly dependent on local weather and climate (Friedrich et al., 2020; Perch-Nielsen, 2010). Furthermore, the climate and natural resources strongly influence tourism. While atmospheric conditions affect the participation and experience of tourists in recreational activities, severe weather conditions such as rain, strong wind, fog, and dust storms may kill the joy of the tourism experience (Yu et al., 2009). On the other side, spatial differences in climate change impacts and their subsequent effects on tourism are also critical. Climate change will create heterogeneous risks and opportunities that vary from region to region. The deteriorating direct and indirect impacts of climate change along with comprehensive policies, will determine the competitive success, sustainability, and geography of tourism. Scott et al. (2004) hold that global climate change will alter demand and travel patterns, and it has a vast potential to change the distribution between climate assets and tourism destinations.

Changes in the duration and quality of the tourism season will also affect the competitive relations between the long-term profitability of tourism enterprises and destinations. Dumitrescu et al. (2021) state that climate changes will globally influence tourism. Researchers add that there will be drastic changes in tourist inflow depending on the geographical position of destinations and the degree of fluctuation in climate indicators. This statement is based on the assumption that the destinations famous for summer and sea holidays get affected by rising temperature rates. According to Leal (2022), tourists will no longer have to go south since increasing temperatures in Northern Europe will cause a more mild climate. Therefore, the tourism season may last longer, and working times will likely be extended. On the other side, Hamilton et al. (2005) claim that the tourists from Western Europe will travel less. Researchers have demonstrated that tourists will stay in their own countries; thus, a decrease in the total number of international tourists will occur due to climate change impacts. Furthermore, tourism movements are also expected to gradually shift to the poles and mountainous regions depending on the spatial effects of climate change.

Valls and Sarda (2009) state four possible changes that may occur in the tourism sector due to climate change. First, the average stay of tourists may shorten over time. Second, the demand in the tourism sector will not be concentrated in specific seasons. That is, seasonality will not be a dominant effect. Lastly, the loss of the impacts of mass tourism and aesthetically less appealing coastal destinations

due to sea-level rise are two other transformations expected due to climate change. The researchers conducting global and regional scale studies based on climatic indices indicate that there will be significant global shifts in tourism and that most hot regions will host fewer tourists during the season (Coldrey and Turpie, 2020). In this regard, Amelung et al. (2007) maintain that the summer seasons will extend in the areas situated at higher latitudes while the average holiday duration shortens in the destinations located in the Mediterranean bowl. The researchers also add that the impacts of climate change mentioned will lead to alterations in the tourism sector both spatially and temporally. For instance, there will be a shift towards the south, while a decrease in the climate attractiveness of the northern regions will occur in Australia. Thus, specific suggestions have been proposed so far to invest in indoor activities, improve inner conditions, provide sufficient infrastructure to meet the potential increases in tourist numbers, and adopt mechanisms to reduce the consequences of overuse of facilities (Amelung and Nicholls, 2014).

Although the relationship between climate change and tourism is extraordinarily complicated, the relationship in between has been revealed by researchers across different fields and perspectives. Studies investigating the possible effects of climate change on destinations (Dumitrescu et al., 2021; Pröbstl-Haider et al., 2021; Olefs et al., 2021; Friedrich 2020; Bayazit, 2018; Amelung and Nicholls, 2014; Jenkins and Sarah, 2010; Perch- Nielsen, 2010; Müller and Webber, 2008), those putting forward the advantages and disadvantages of climate changes for the tourism sector (Leal, 2022; Hall, 2016; Pang et al., 2012), research on sustainable tourism and climate change (Alizadeh et al., 2021; Scott, 2021; Palmentieri, 2020; Weaver, 2011) and studies showing the relationship between alternative tourism types and climate change (Salim et al., 2021; Sottini et al., 2021; McCreary et al., 2020; Zang et al., 2020; Nyaupane and Chhetri, 2009) are all examples from around the world that focus on different aspects of this complex subject. The common takeaway of all the studies conducted around this relationship is that climate change directly affects the tourism sector. The studies reveal that numerous types of tourism are directly dependent on climatic conditions and that the changes in the climate have a substantial effect on the tourism sector. Researchers (Pröbstl-Haider et al., 2021; Hall, 2016; Pang et al., 2012; Scott et al., 2004) argue that climate change affects tourism while tourism also impacts climate change. Therefore, there is a bilateral and circular cause-effect relationship between them. Tourism is inherently highly sensitive to changes in climate and natural environment (Jenkins and Sarah, 2010; Müller and Webber, 2008). Even though tourism regions and destinations will be affected differentially by climate change, the expected effect of climate change will be observed on the tourism quality. That is because it will change travel patterns, value chains, and tourism investments in a globalized and increasingly interconnected world (Scott, 2021; Sottini et al., 2021).

Climate change will affect winter tourism as temperatures will increase. Researchers state that winter tourism may be affected the most by climate change (Salim et al., 2021; Tervo, 2008; Dawson and Scott, 2007; Elsasser and Burki, 2002). Dawson and Scott (2007) show that although the entire Vermont ski tourism at the risk of climate change may not be affected, the ski resorts located in the low areas have a higher risk of bankruptcy. Researchers consider the decline in the number of ski resorts in the region possible. In parallel with other studies, Elsasser and Burki (2002) also reveal climate change will detrimentally impact ski tourism. They hold that ski tourism is possible merely in high-altitude areas, and since there will be no snow in low-altitude ski resorts, the activities cannot be sustained in the long run.

Another tourism type that will be impacted by climate change will be sustainable tourism. Researchers (Scott, 2021; Njoroge et al., 2020; Hall, 2016; Scott, 2011; Weaver, 2011; Dodds and Kelma, 2008) interpret climate change as a threat to sustainable tourism. The transportation of tourists to destinations and the services they receive in accommodation businesses build up the current greenhouse gas emission rates (Pröbstl-Haider et al., 2021; Pang et al., 2012). A decline in international tourism and travel could reduce greenhouse gas emissions (Hamilton et al., 2005). There is considerable uncertainty about the evolution of global CO<sub>2</sub> emissions and the ability of their climate impacts to adapt to tourism (Müller and Webber, 2008). Global climate change is a factor that increasingly affects investment decisions in the tourism sector, along with sectoral planning, operations, and demand. The tourism sector is not adequately prepared for the impacts of climate change, and it is not ready to adapt to a decarbonized global economy. The only possible way to overcome the sector's unpreparedness is to enhance communication and information mobilization, increase research capacity and interdisciplinary collaboration, and improve strategic policy and planning (Scott, 2021).

Leal (2022) recently evaluates the effects of climate change on tourism under four distinct categories. Leal categorizes the effects as environmental, economic, social, and political. From an environmental

point of view, climate change plays a vital role in affecting biodiversity and changing the water cycle, plus it increases the sensitivity to extreme events. From an economic point of view, the negative impacts of climate change on tourism will result in large-scale job losses, which in turn brings about discomfort and recession risk in business life. Lastly, climate change impacts will play a politically critical role in that it will deepen the dependence of foreigners on aid, affect food security, and threatens economic and national stability. In social terms, it will cause a dramatic deterioration in socioeconomic problems such as poverty, injuring the existing social structure, and increasing migration risks.

## Method

The study aims to investigate the historical trends of studies by examining the previous studies related to climate change and tourism conducted between 1998 and 2022. In doing so, the study carries out descriptive, document analysis, and bibliometric analysis. Climate change is a concept that has a direct impact on tourism. The study is important and original in that it reveals the current status of the studies on this subject and shows which areas have been mainly studied so far in the literature and which areas lack comprehensive studies in this regard.

The study gathers its publication sample set by scanning the keywords "climate change" and "tourism" together in the article titles found in the Web of Science database. In this context, the study sample consists of 393 articles related to climate change and tourism, scanned in WOS and published between 1998-2022 (May). Moreover, the study data is limited to the WOS database and articles. Within the context of the study, the research questions in the WOS database regarding the relationship between climate change and tourism are as below;

- In which years do climate change and tourism-related studies intensify?
- Which journals are cited the most for the publications focusing on the relation between climate change and tourism?
- Which institution has conducted the most research thus far on climate change and tourism-related studies?
- Which indexes are the most cited journals in climate change and tourism-related studies?
- What kind of distribution do the climate change and tourism-related studies exhibit according to WOS categories?
- How did the authors' cooperation occur based on climate change and tourism-related studies?
- How has the Citation Explosion Model employed in examining the climate change and tourism-related studies been shaped?
- Who are the researchers who publish the most on the subject?
- Who are the most cited researchers on climate change and its impacts on tourism?
- How are the citations historically ordered based on climate change and tourism-related studies?
- How has country cooperation been achieved during climate change and tourism-related studies?
- How are the keywords distributed according to the co-association analysis of climate change and tourism-related studies?
- What is the word cloud distribution of climate change and tourism studies?

When analyzing the data within the scope of the research questions above, the study employs Citespace, VosViwer, and WOS categories, along with Word Cloud. VosViwer is a free access program that enables the visualization of the existing similarities. VosViwer program shows the collaboration between the authors and determines the distribution of keywords with co-association analysis. Another program used in data analysis is Citespace. It is a social network analysis program that facilitates the visualization and analysis of common citation networks. The Citation Explosion Model and the country-based collaborations of researchers publishing in the field of climate change and tourism are conducted through the CiteSpace Program. Finally, WOS Categories demonstrate in which areas the studies are predominantly concentrated. The Word Cloud, on the other side, is used to show the frequency distribution of the keywords.

## Findings

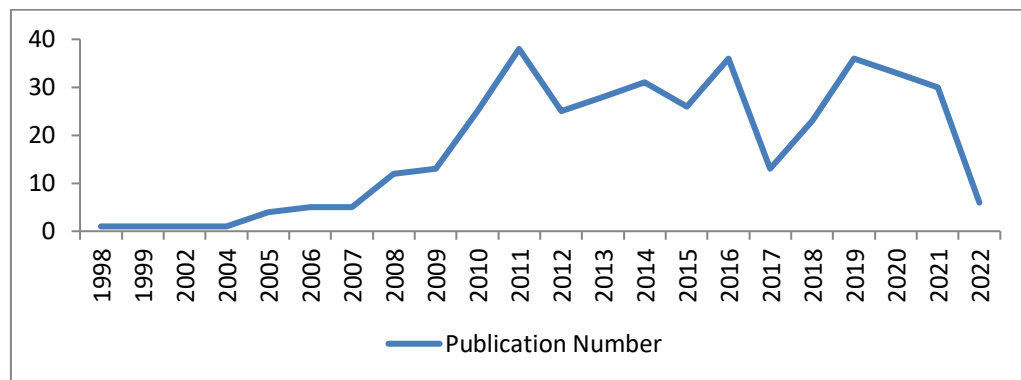
### Findings in the literature

The main goal of this study is to reveal the relationship between climate change and tourism. In this respect, this study collects a total of 383 articles published between 1998 and 2022 (May) after the

words climate change and tourism are scanned in the article titles located in the WOS database. It has been revealed that 189 different journals have published articles on the subject so far. While the total number of authors is 876, the total number of citations of the articles is 4620, and the Hi-index of the articles is 49.

The articles are largely (n=119) two-authored. Two-authored articles are followed by studies with three authors (n=86) and subsequently with the sole author (n=73). On the other side, the number of studies with four, five, six, and seven are 49, 20, 18, and 9, respectively. Moreover, the number of articles with eight, nine, and ten authors is 3. The average number of pages of the articles is approximately 16. The shortest article is 4 pages long, while the longest is 38 pages long.

After examining the studies based on their publication years, it is possible to state that the articles started being published in 1998. During the investigations conducted so far, it is seen that there is not a continuous and uniform publication pattern for the articles between 1998-2022. On the contrary, there are fluctuations observed on specific dates. It is possible to say that the studies on the subject between 1998 and 2007 are limited (ntotal=18). Since 2007, the number of studies on this subject has been increasing numerically. And 2011 has been the year when the relationship between climate change and tourism is most frequently researched. In 2011, a total of 38 studies are conducted. Consequently, 2016 and 2019 are the second-highest years in publication numbers. In both years, a total of 36 articles are published separately. The average number of publications by year is 17.40. Figure 1 shows the historical changes in the number of studies focusing on the relationship between climate change and tourism.



**Figure 1:** Historical Changes in the Number of Publications Regarding Climate Change and Its Impacts on Tourism.

### Number of Publications of Journals and Indexes

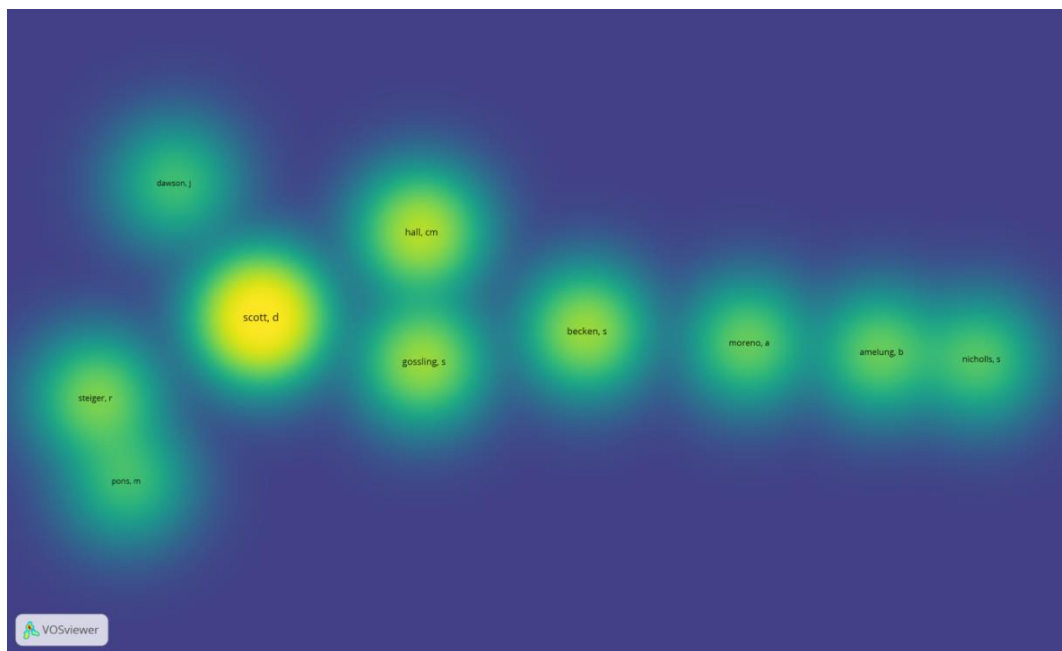
Executing the institution-based citation ranking on climate change and tourism, this article displays that 383 different institutions worldwide have been studying climate change. League of European Research Universities (LERU) and the University of Waterloo comprise the top two institutions in terms of productivity. Both LERU and the University of Waterloo have published 29 articles so far. Furthermore, the University of Oulu, University of Johannesburg, and Griffith University have published 26, 21, and 17 studies, respectively. Besides, the University of Canterbury and Innsbruck has conducted 15 studies each.

Based on the Web of Science categories, 57.66% of the studies cover the Hospitality Leisure Sport Tourism topic, 24.84% belong to the Environmental Sciences category, and 19.3% are in Environmental Studies. Examining these categories based on the journals published, it is displayed that the Journal of Sustainable Tourism has published 30 studies so far while the Tourism Management journal published 14 studies. Moreover, Tourism Planning Development, Journal of Outdoor Recreation and Tourism Research Planning and Management, and Climatic Change journals have published 13, 12, and 11 studies, respectively. These articles constitute the first five research fields. Lastly, the indexes in which the articles are scanned and gathered are; Social Sciences Citation Index (with 179 studies), Emerging Sources Citation Index (with 109 studies), together with Science Citation Index Expanded (with 102 studies). These indexes consist of the three most popular ones.

## Citation Analysis of Studies on Climate Change and Tourism Relation

### Co-author Analysis

Collaboration networks among authors show the co-existence of two documents in other documents. In this respect, Figure 2 displays an inter-author density map. In VosViewer values, the number of documents related to the author is 5 and the minimum number of citations is 1. These values are valid for 23 of all 844 authors. For individual researchers, the study calculates the citation relations with other researchers and selects 10 researchers with the highest connection. During the analysis, the study creates three different clusters. The first cluster consists of the authors; Amelung Becken, Moreno, and Nicholls. The second cluster comprises Dawson, Pons, Scott, and Steiger. Lastly, the third cluster consists of Gossling and Hall. The yellow color in Figure 2 displays the authors with relatively more concentration. It is possible to draw a conclusion here that there is a tight relationship between the sources. According to the intensity map, Scott, Hall, Becken, and Gossling are the researchers who play a prominent role in realizing cooperative academic studies cooperatively on climate change and tourism.



**Figure 2:** Intensity Map by the Cooperation Level Among Researchers

### Attribution Explosion Model

Employing the Citation Explosion Model, this study takes into account only articles regarding climate change and tourism. The study arranges the model so that the article title and the titles are in exact order by their citation burst strength. The year column indicates the study's date while the power part indicates the citation explosion density. Moreover, the beginning part displays the year the study started to get cited, and the ending part shows the year that the study ended with any citation. In the last column, the dates in which the red color is intense demonstrate more intense citation explosion values, while the years indicated with blue color tells the year of citation extinction. Accordingly, the article of Becken in 2013 has become the most cited study within the research period of this study. While this study started to be cited in 2013, the year the explosion ended was 2018. The researcher's citation explosion value is 3.79. In the study conducted by Scott in 2019, it can be inferred that the study continues to be cited because the red area covers the year 2022 as well. The citation explosion value of this researcher is 3.29.

**Table 1:** Citation Explosion Model of Studies Conducted in the Field of Climate Change and Tourism

References	Year	Strength	Start	End	2017-2022
Becken, S., <i>Tour Manag. Perspect</i> , V:6, P:53	2013	3.79	2017	2018	
Scott, D. <i>Ann Tourism Res</i> , V:77, P:49	2019	3,29	2021	2022	
Rossello-Nadal, J. <i>Tourism Management</i> V:42, P:334	2014	2,73	2018	2019	
Dogru, T. <i>Tourism Management</i> V:72, P: 292	2019	2,11	2021	2022	
Schliephack, J. <i>Tourism Management</i> V:59, P:182	2017	2,04	2018	2019	

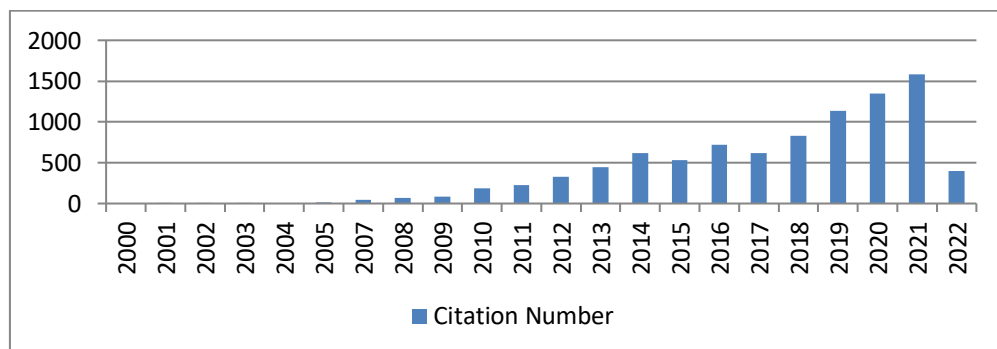
## Direct Citation and Publication Tables

Table 2 presents the researchers with the highest number of publications according to the direct citation. The table indicates that the most cited researchers are Elsasser and Burki, and their publications have received thus far a total of 228 citations. On the other hand, Hamilton et al. is the second-highest author in terms of citation number and received 224 citations. Scott et al. rank the third with 195 citations. According to the direct publication table, the researchers who published the most are Scott with 26 articles, while Hall and Becken have 13 and 12 articles respectively. Additionally, Saarinen, Gossling, and Steiger are the other researchers with the highest number of citations 12, 11, and 9 respectively.

**Table 2:** Direct Publication and Citation Table

Citation Distribution by Researchers		
Researchers	Article Title	Frequency
Elsasser, H. and Burki, R. (2002)	Climate change as a threat to tourism in the Alps	228
Hamilton, J. M., Maddison, D. J. and Tol, R. S. J (2005)	Climate change and international tourism: A simulation study	224
Scott, D. Jones, B. and Konopek, J. (2007)	Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A case study of Waterton Lakes National Park	195
Peeters, P. and Dubois, G. (2010)	Tourism travel under climate change mitigation constraints	192
Scott, D. (2010)	Why sustainable tourism must address climate change	183
Scott, D., McBoyle, G. and Schwartzentruber, M. (2004)	Climate change and the distribution of climatic resources for tourism in North America	183
The Distribution of Publication Number by Researchers		
Researcher	Frequency	Percentage
Scott, D.	26	6.6
Hall, CM.	13	3.3
Becken, S.	12	3.0
Saarinen, J	12	3.0
Gossling, S.	11	2.7
Steiger, R.	9	2.2

Figure 3 displays the total number of citations of 383 articles over the years. The articles started getting citations in 2001 and the year with the highest number of citations for overall articles is 2021 (n=1582). 406 of the complete citations belong to years between 2000 and 2010, while 8873 citations are given between 2011-2022 (May).



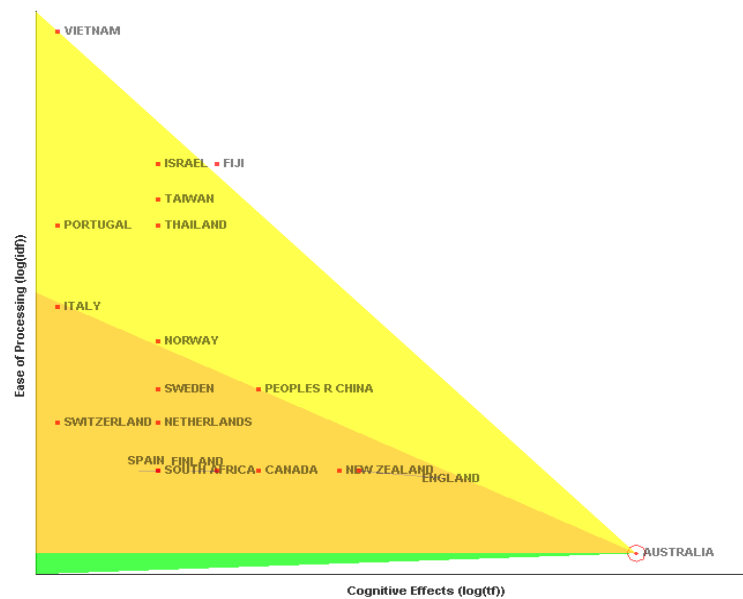
**Figure 3.** Historical Citation Distribution

## Country Collaboration Analysis

After investigating the distribution of researchers published on climate change and tourism following the country cooperation analysis, the study reveals that the researchers based in Australia have the most cooperation with 54 studies. Subsequently, the United States and Canada based researchers have 49 and 42 articles respectively. This rank is followed by the authors based in Spain, Germany, and England with 37, 34, and 33 studies. Figure 5 tells that the green part represents the countries achieving the highest level of cooperation, while the yellow section shows the least number of articles.



Vietnam, Israel, and Fiji are the countries with the least articles in the literature. While the country cooperation modularity value is 0.86, the weighted mean silhouette value is 0.94, and the harmonic mean value is 0.90.



**Figure 4:** Country Collaborations in Studies focusing on Climate Change and Tourism

### Keyword Analysis

#### Co-occurrence Word Network

This study reaches out to 1378 climate change and tourism keywords through co-collaboration analysis. During the data analysis, the study predefines that keywords should be used at least 5 times in an article so that it can be counted. While creating these keywords, the study utilizes a co-occurrence data matrix. The circle size shows the excess usage of the keywords, and the colors of the circles demonstrate which keywords are used together. Lastly, the lines between the circles indicate the link between the keywords. With the help of the network analysis conducted based on the word associations, the study creates a total of 7 clusters and 98 nodes. The knots in question show the keywords revealing the relationship between climate change and tourism, and the links show the relationship between these words. The word climate change has appeared 236 times, and it is centrally located. This is followed by the keywords tourism (n=85), adaptation (n=65), impact (n=56), vulnerability (n=42), weather (n=34), policies (n=34), and management (n=24). During the historical period that this study is interested in, mostly climate change and destinations are investigated between the years 2012-2014. The impacts of climate change, sensitivity, global warming, and sea-level rises stand out between the years 2014-2016. Finally, winter tourism, temperature and resources are the most popular keywords for the period between 2016-2018. Many keywords are also linked to each other on the map, and Figure 5 shows the Co-occurrence word network map.



major limitation of the study. Reaching more resources on the concepts of climate change and tourism and comparing different databases by examining databases such as SCOPUS in future research are strongly suggested. It is possible to expand and generalize the results obtained from various databases and the results related to the subject.

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