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ECONOMIC IMPACTS OF CLIMATE CHANGE AND TOURISM DEVELOPMENT IN SELECTED EUROPEAN COUNTRIES

ABSTRACT

Objectives: *Climate is a fundamental tourism resource that shapes the environmental conditions where tourism services are provided. It is therefore an important determinant of its development and is the subject of cyclical assessments. The relationship between climate and tourism can be bi-directional, i.e. both climate influences tourism and tourism influences climate. The first direction of influence implies a disruptive effect of climate on tourism activities. This means that climate change reduces opportunities for tourism activities. The second direction of impact means the detrimental impact of tourism operators on the climate. This means that tourism operators contribute to environmental degradation. The research undertaken should be attributed to the first group. The following research hypothesis was formulated: climate change materialising in the form of extreme events causes economic losses that negatively affect tourism development. The objective of this article is to analyse the impact of the economic effects of climate change on tourism development, in particular to address the following research question: Does climate change, as measured by the value of economic losses caused by extreme weather events, affect tourism development?*

Material and methods: *Statistical and econometric methods were used to answer this research question. The research was carried out for selected European countries for the period 2014-2023. Financial data was collected from the following databases: Swiss Re Institute (2021, 2024, 2025), World Tourism Organisation (2024), World bank database.*

Results: *The research conducted confirms the negative impact of climate change on the development of tourism in the European countries studied. However, the results obtained are not homogeneous. The group of countries studied is internally diverse both in terms of the value of climate change damage and in terms of the strength of the impact of climate change on the tourism sector. Switzerland is the least threatened by climate change impacts on tourism. The UK and Italy are the most.*

Conclusion: *The research adds to the knowledge base on the impact of the economic effects of climate change on tourism development in selected European countries.*

KEYWORDS: *tourism, climate change, natural disasters, sustainable development*

INTRODUCTION

Climate change and its impact on tourism is a current area of research that encompasses many lines of influence. These range from environmental issues to consumer decisions resulting from climate change. The impacts of climate change on the tourism sector are direct and indirect. The direct impact is that climate change may reduce tourism activities in some regions. The indirect impact is that economic growth will be reduced, and public income will be reduced. Climate change, therefore, represents a significant risk of both a macroeconomic and regional nature. The differences between the two relate to the extent (scale) of the impact. The macroeconomic impact consists in limiting economic growth processes on a national, regional or global scale. It results in changes in demand and disruptions in supply chains. The regional impact relates to the geographical region of the country or the world. It consists in restricting growth processes on a regional scale. The reason for the disruption of growth processes is the vulnerability of the tourism sectors of selected countries or regions of the world to climate change. The relationship between climate and tourism is addressed in two directions, i.e. both climate affects tourism and tourism affects climate. The first direction of influence means the disruptive effect of climate on tourism activities. This means that climate change reduces opportunities for tourism activities. This is confirmed by research conducted by e.g.: Scott et al. (2012), Lenelin et al. (2010), Scott et al. (2019), Scott, Gössling (2022), Gössling, Scott (2024). The second impact direction refers to the detrimental effects of tourism operators on the climate. Research in this aspect refers to environmental degradation by tourism operators. This is confirmed by studies conducted by e.g.: Gössling (2002), Maráková et al. (2016), Lenzen et al. (2018). Furthermore, the impact of climate change on tourism development needs to be updated due to the dynamic and counter-cyclical nature of extreme weather events. This is confirmed by studies by e.g.: Scott, Gössling (2022, 2024, 2025), Becken, Scott (2024), Scott et al. (2019).

The research undertaken should be attributed to the first group, i.e. the disruptive impact of climate on tourism, through the occurrence of extreme weather events and their materialization in the form of economic losses. The aim of the research is to find out the factors shaping the development of the tourism sector and, in particular, concerning the negative impact of

climate change. This is a topical scientific problem as well as an important practical problem for economic policy-making, in particular, contributing to the development of programs that build resilience in the tourism sector.

The objective of this paper is to investigate the impact of the economic effects of climate change on tourism development. In particular, to obtain an answer to the following research question: Does climate change, as measured by the value of economic losses caused by extreme weather events, affect tourism development? The following research hypothesis was tested: climate change materialized in the form of extreme events causes economic losses that negatively affect tourism development.

The research was carried out for selected European countries considered to be most vulnerable to the effects of climate change according to the Swiss Re Institute (2024). The research period covers 2014-2023. The paper uses statistical and econometric methods. The results of the study were compiled using Statistica and Gretl software.

The scope of the study should be considered original, including selected European countries considered to be most vulnerable to the effects of climate change, as well as the study's own methodology, taking into account a wide range of factors determining the development of tourism. No studies of this scope were found in the literature. The research undertaken fills a research gap in the impact of extreme weather events on the development of the tourism sector. In addition, it contributes to the development of knowledge on the impact of climate change on tourism, in particular on the negative impact of extreme weather events on tourism. The results of the research can be used to build resilience programs for the tourism sector, as well as to shape tourism policy in the countries studied, as well as globally.

The article is structured as follows: first part of the article presents a review of specialist literature, second part describes the research methodology and third part reports on empirical findings and discusses the findings.

1. CLIMATE CHANGE AND TOURISM DEVELOPMENT – A REVIEW OF THE RESEARCH

The relationship between climate and tourism is a two-way street. Both climate affects tourism development and tourism affect each other. The first view concerns the impact of climate as a determinant of tourism development. This is confirmed by climate reports such as UNWTO (2003), TPCC (2023), WTTC (2023), and WTO (2025). The studies emphasize the importance of climate for tourism development as an essential factor for tourism development. Tourism destinations are characterized by unique natural landscapes and climatic conditions that shape their attractiveness. This is confirmed, among others, by a study by Scott, Gössling (2022). The authors point out that tourism is vulnerable to the effects of climate change. Climate change also affects the geographical distribution of tourism, e.g. Gössling, Freytag (2012). The second view concerns the negative impact of tourism on the climate. This is related to the fact that tourism operators negatively impact the environment and thus limit the opportunities for tourism activities and development. This is confirmed by studies carried out by e.g., Gössling (2002), Maráková et al. (2016), Lenzen et al. (2018).

The research undertaken falls within the first area of influence, i.e. climate as a determinant of tourism development. The research area thus defined can be divided into two main areas:

1. Research on climate as one of the factors of the tourism business. Research in this area identifies climate as one of the factors in tourism competitiveness. The impact of climate on tourism development can be positive and negative. A positive impact means that the climate influences the attractiveness of the destination and consumer decisions. The more attractive the climatic conditions, the greater the development of tourism. Climate is an important factor in tourism activity. This is confirmed by studies such as de Freitas (2003), Lenelin et al. (2010), Scott et al. (2012). Negative impacts mean that climate change reduces opportunities for tourism activities. Extreme weather events can damage or destroy transport infrastructure and also affect agricultural productivity, leading to fluctuations in food availability.

The increased frequency and intensity of such events also requires investment in adaptation measures. This is confirmed by research conducted by, among others: Scott et al. (2012), Lenelin et al. (2010), Scott et al. (2019), Scott, Gössling (2022), Gössling, Scott (2024).

2. Research on adaptation strategies for selected regions of the world. This is research embedded in resilience programmes. This is a very important and timely area of microeconomic and regional research. According to Scott and Gössling (2022, p. 8) *all destinations and tourism markets will need to adapt to the direct and indirect consequences of accelerating climate change, whether to minimize negative impacts or optimize opportunities.*

The detailed results of the literature survey on the impact of climate on tourism development are presented in Table 1. The literature review was conducted on the basis of a search of the Scopus and WoS databases.

Table 1. *Tourism climate as a factor influencing tourism development – a review of the research*

Year	Authors	Scope of research and results
2025	D. G. Sharma, B. Taheri, R. Chopra, J. S. Parihar	The authors assessed the state of research to date on climate change and tourism. They discuss issues related to adaptation, the characteristics of environmental vulnerability for tourism actors and the implications for local communities. The authors present gaps in knowledge and outline future research and policy objectives
2025	V. Maráková, M. Lament, P. Kríštofik, S. Bukowski	The authors examined the impact of natural disasters on the development of the tourism sector in countries suffering the greatest economic losses due to climate change. The findings suggest that the adverse effects of climate change are more severe for countries with weaker economic development. These countries are more vulnerable to damage caused by climate impacts due to their natural conditions, but they also struggle with underdeveloped insurance sectors. Limited access to insurance exacerbates the destructive impact of climate change on tourism
2025	D. Scott, S. Gössling	The authors analyzed the extent to which the tourism sector has achieved the outcomes associated with the 38 enforceable climate commitments set out in international declarations. There is a clear discrepancy between commitments and results. For 25 climate action pledges, no visible progress on climate action was identified
2025	S. Fatima, I. Khan, M. Z. Rehman, M. H. Khalid	The authors analyzed the impact of renewable energy, inbound tourism, natural resources and regional economic growth on carbon emissions from 1975 to 2020. OPEC countries were studied. The results of the study show that carbon emissions drive regional economic growth, while better management of natural resources and renewable energy boosts inbound tourism
2024	K. Dube	The author examined the impact of climate change on tourism using bibliometric analysis. The results showed that most research on tourism and climate change is conducted in the USA.

2024	M. Alvarez	The author analyses the ability of current governance models to achieve the Sustainable Development Goals (SDGs) in tourism. A multi-level governance model is proposed that advocates the need for a stronger supranational system that limits the power of both governments and the private sector. It also emphasizes the need to identify hyper-norms at the international level
2024	S. Gössling, S. Reinhold	The authors examined the impact of small and medium-sized tourism businesses on climate change mitigation. The authors proposed a model for activating businesses to accelerate decarbonization
2024	S. Becken, D. Scott	The authors analyzed climate action in the tourism sector. The study revealed that the sector is still in the early stages of implementing a climate change response. Targets to reduce emissions from tourism by 2030 will not be met. Tourism policy and investment was found to be inconsistent with climate ambitions, and current adaptation to projected climate change is insufficient, with future impacts limiting tourism development in some locations
2024	D. Scott, S. Gössling	The authors reviewed research on the impact of climate change on tourism on a regional basis. Extreme weather events affect tourism destinations and tourism demand worldwide. The authors predict disruptions in tourism flows over time and space. They recommend that destinations assess their vulnerability to climate change risks and engage in adaptation measures
2024	S. L. Pan, L. Wu, A. M. Morrison	The authors reviewed empirical research on the relationship between climate change and tourism over the period 2007 – 2021. Significant differences were found across periods and between developed and developing countries. The authors believe that further research on climate change and tourism in developing countries should be encouraged
2024	D. Atstāja, E. Cakrani	Authors investigated the impact of climate change on tourism development in the Baltic Sea region. The results showed a negative impact of climate change on tourism in the studied countries.
2023	H. Danneving, T. Rusdal	The authors studied glacier tourism, in particular the impact of knowledge about melting glaciers on raising awareness of climate change. They conducted a survey of mountain guides
2023	R. M. Mateos, R. Sarro, A. Díez-Herrero, C. Reyes-Carmona, J. López-Vinielles, P. Ezquerro, M. Martínez-Corbella, G. Bru, J. A. Luque, A. Barra, P. Martín, A. Millares, M. Ortega, A. López, J. P. Galve, J. M. Azañón, S. Pereira, P. P. Santos, J. L. Zézere, E. Reis, A. C. Garcia, S. C. Oliveira, A. Villatte, A. Chanal, M. Gasc-Barbier, O. Monserrat	The authors studied the impact of extreme weather events on the development of tourism in South West Europe. The results confirm the negative impact of climate change on tourism development in the study region
2022	R. Steiger, N. Knowles, K. Pöll, M. Rutty	The authors investigated the impact of climate change on mountain tourism. They reviewed existing research in this area. The authors found that there is an under-representation of studies on South America and Africa, a lack of relevant data and assessment indicators. There is a lack of research on regulatory risk
2022	D. Scott, S. Gössling	The authors reviewed research in the field of tourism and climate change. They critically examined the capacity to meet future climate change knowledge needs. They expanded on the concept and the interconnections between carbon and physical climate risks. Climate change affects tourism on a regional scale, through differential impacts on natural and cultural heritage and changes in demand patterns. The physical impacts of extreme weather events affect tourism development
2021	U. Pröbstl-Haider, A. Wanner, M. Feilhammer, A. Damm	The authors assessed the impact of climate change on tourism in Austria. The results show that the tourism sector in Austria is very sensitive to climate change – especially with regard to precipitation and temperature. Climate change can therefore have a major impact on tourism demand and on the range of tourism services in Austria

2020	J. Susanto, X. Zheng, Y. Liu, C. Wang	The authors assessed the impact of extreme weather events on the development of international tourism in Indonesia. The findings confirm the relationship between climate change and tourism demand
2019	D. Scott, C. M. Hall, S. Gössling	A study of the impact of climate change on tourism development in 181 countries. Climate change will be an increasing barrier to achieving sustainability goals in the tourism sector. The lowest vulnerability of tourism to climate change is found in OECD countries at higher latitudes. The greatest vulnerability is in regions where tourism growth is expected to be strongest. Less developed countries are more vulnerable to climate change
2018	M. Lenzen, Y. Y. Sun, Y. P. Ting, A. Geschke, A. Malik	Analysis of the carbon footprint in 160 countries. Growth in tourism demand is outpacing the decarbonization of tourism-related technologies. The authors predict that due to its high carbon intensity and continued growth, tourism will account for an increasing proportion of global greenhouse gas emissions
2017	R. Steiger, D. Scott, B. Abegg, M. Pons, C. Aall	The risks associated with climate change in ski tourism were analyzed. Climate change impacts on mountain tourism, including skiing
2014	D. Hopkins, K. McLean	The risks associated with climate change to ski tourism in Scotland have been analyzed. Climate change is affecting mountain tourism, including skiing. Adaptation measures need to be taken
2013	K. Tervo-Kankare, M. C. Hall, J. Saarinen	The authors analyzed the challenges faced by winter tourism operators in adapting to changing environmental conditions. They studied the reaction of tourists to potential changes in winter conditions in Finland. The results indicate that tourists react negatively to estimated changes and planned adaptation mechanisms
2013	R. Steiger, J. Stötter	The authors examined the impact of climate change on the development of ski tourism in the Tyrol. They recommend the development of adaptation strategies
2012	D. Scott, S. Gössling, M. C. Hall	The development of tourism is influenced by the attractiveness of the destination, the length of the season and the satisfaction of the trip. Research indicates optimal climatic conditions and the impact of extreme phenomena on tourism demand
2010	R. H. Lenelin, J. Dawson, M. J. Stewart, P. Maher, M. Lück	An analysis of disappearing destinations and tourism attractiveness. The authors identify opportunities and threats of climate change to tourism development
2009	G. P. Nyaupane, N. P. Chherti	The authors examined the impact of climate change on tourism development in the Himalayas. They recommend the development of adaptation strategies
2008	S. Nicholls, A. Bas	The authors investigated the impact of climate change on tourism in north-western Europe. Climate change affects the amount, spatial distribution and timing of travel within Europe
2007	A. Bigano, J. M. Hamilton, R. J. S. Tol	The authors examined the impact of climate change on consumer decisions in Germany. Climate change is driving up the price of tourism services
2003	De Freitas	The development of tourism is influenced by physical, aesthetic and thermal conditions
2002	S. Gössling	Impact of global tourism on climate change. The impact of tourism on the environment was examined, i.e. on: land cover and land use, energy use, flora and fauna, the spread of disease, the psychological consequences of travel

Source: the author's own compilation.

An analysis of the results of research conducted to date shows that both studies indicating a positive impact of climate on tourism development and studies indicating a negative impact of climate change on tourism development are relevant. It can therefore be assumed that climate is an important factor in tourism development and that its changes can have both positive and negative impacts. This is related, on the one hand, to the deterioration of climatic conditions in some regions of the world or to the improvement of climatic conditions in other regions of the world. Such an assumption can be made

at least in theoretical terms and for a long period of analysis. Assuming that climate change creates new destinations, it will take time for these to develop. Also, it will be possible to assess the impact in the medium or long term. Analyzing the current state of tourism resources, it must be assumed that the impact of climate change is negative. This is indicated both by the analyses of climate reports – e.g. TPCC (2023), WTTC (2023), WTO (2025), as well as by the results of studies conducted to date by e.g.: Scott et al. (2012), Lenelin et al. (2010), Scott et al. (2019), Scott, Gössling (2022, 2025), Gössling, Scott (2024). The analysis of the determinants of tourism development is particularly important in terms of the economic and social development of countries. Learning about the factors shaping economic and social development is a key scientific problem, as well as an important practical problem for economic policy-making. The interplay between countries' economic development and climate change on tourism development remains little studied and needs to be updated due to the dynamic and counter-cyclical nature of extreme weather events. This is confirmed by studies by e.g.: Scott, Gössling (2022, 2024, 2025), Becken, Scott (2024), Scott et al. (2019).

According to the literature analysis carried out, the following research hypothesis was adopted for the purpose of this article: climate change materializing in the form of extreme events causes economic losses that negatively affect the development of tourism.

2. METHODOLOGY

The aim of the research undertaken is to answer the following research question: does climate change affect the development of the tourism sector? The subject scope of the research covers selected European countries. Europe is, on the one hand, a homogeneous structure, but diverse in terms of both the geographical conditions and the socio-economic situation of the countries. It is therefore important to examine individual countries and assess their diversity in terms of the impact of climate change on tourism development. In addition, the relationship between the impact of climate change on tourism development and the socio-economic situation of the countries studied is important. This relationship shows a country's economic resilience. The selection of the

countries studied was purposive – the European countries with the greatest economic losses due to climate change were selected, according to the Swiss Re Institute (2024). These countries are France, Germany, Italy, the UK, and Switzerland. The study period covers the years 2014-2023. Financial data was collected from the following databases: Swiss Re Institute (2021, 2024, 2025), World Tourism Organisation (2024), World bank database.

Statistical and econometric methods were used to achieve the research objective. Econometric models were constructed and estimated using CLSM (Classical Least Squares Method). Student's t-test, F-Snedecor, Breusch-Pagan and White's tests were used to verify the models. The explanatory variable in the model was assumed to be the share of tourism's sector in GDP (Y), which measures the development of a country's tourism sector. Thirteen independent variables were used in the modelling process. These represent the determinants of the development of a country's tourism sector. They were determined based on the analysis of previous research results and own observations. It was assumed that tourism development in a country is influenced by:

- level of socio-economic development of the country measured by GDP per capita (X1), high-technology exports (X2), life expectancy (X3), Gini Index (X4), gross enrolment ratio (X5), agricultural land (X6), political stability index (X7) and regulatory quality index (X8). This is indicated by studies carried out by, amongst others: Pan et al. (2024), Kumar, Melkani (2023), Maráková et al. (2016), Antonakakis et al. (2015),
- resources of the tourism sector, as measured by employment in tourism (X11) and number of bed-places (X12). This is indicated by studies carried out by, amongst others: Gössling, Reinhold (2024), Kumar, Melkani (2023), Maráková et al. (2016),
- effects of tourism activities measured by number of tourists (X12) and income from tourism (X13). This is indicated by studies carried out by, amongst others: Kumar, Melkani (2023), Maráková et al. (2016), Scott et al. (2019), Mateos et al. (2023),
- climate change measured by share of economic losses caused by climate changes to GDP (X9). This is indicated by studies carried out by, amongst others: Scott et al. (2019), Mateos et al. (2023), Atstāja, Cakrani (2024), Dube (2024) Maráková et al. (2025).

Our own research has incorporated more macroeconomic variables than previous studies. There are variables: high-technology exports (X2), life expectancy (X3), Gini Index (X4), Gross enrolment ratio (X5), Agricultural land (X6), Political stability index (X7), Regulatory quality index (X8). This is due to the scope of the study. It covers highly developed countries. The inclusion of a greater number of variables makes it possible to identify differences between them.

The scope of the variables studied and their calculation rules are presented in Table 2.

Table 2. *Methods of calculating the variables analyses*

Variable	Variable designation	Method of calculating the variable
Share of tourism's sector in GDP	Y	Value of tourism services in a country [current international \$/Year] * 100/ Value of goods and services produced in the country [current international \$]/Year]
GDP per capita	X1	GDP[current international \$/Year]/Population[Year]
High-technology exports (% of manufactured exports)	X2	High-technology exports [current international \$/Year] * 100/ manufactured exports [current international \$/Year]
Life expectancy	X3	Life expectancy at birth, total [Years]
Inequality of income distribution – Gini Index	X4	A measure of the inequality of income distribution. It takes a value between 0 and 1. This indicator would reach a value of 0 (homogeneous distribution) if all individuals had the same income, while it would reach a value of 1 if all but one had zero income. Thus, the higher the value of the indicator, the greater the concentration of income and the greater the variation in income. It is defined on the basis of the Lorenz curve, which represents the proportion of the total income of the population. Indicator set by the World Bank
Gross enrolment ratio (%)	X5	Number of students enrolled in higher education* 100/ Population of the official age group for that level 18 – 23 [Year]
Agricultural land (% of land area)	X6	Agricultural land [square kilometres] * 100/Land area[square kilometres] [Year]
Political stability index	X7	Measures the perception of political instability and the likelihood of politically-motivated violence in a country, including terrorism. Quality indicator set by the World Bank
Regulatory quality index	X8	Measures the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Quality indicator set by the World Bank
Share of economic losses caused by climate changes to GDP	X9	Economic losses caused by climate changes [USD bn/Year] * 100/ Value of goods and services produced in the country [current international \$]/Year] Losses caused by climate changes – natural catastrophes such as hurricanes, earthquakes, floods and winter storms.
Employment in tourism	X10	Number of employees in tourism in thousands [Year]
Number of bed-places	X11	Number of bed-places [Year]
Number of tourists	X12	Number of tourists in thousands [Year]
Income from tourism	X13	Income from tourism in US\$ millions [Year]

Source: the author's own compilation.

The basic statistics of the variables studied are shown in Table 3.

Table 3. *Basic statistics of the studied variables for selected countries of the Europe in the years 2014-2023*

Specification	Country				
	France	Germany	Italy	Switzerland	The UK
Y – Share of tourism's sector in GDP					
Average	3.98	3.67	5.43	2.52	3.29
Maximum	5.11	4.68	6.71	2.98	3.99
Minimum	3.01	2.17	3.76	1.06	1.76
X1 – GDP per capita					
Average	4.06e+004	4.80e+004	3.42e+004	8.78 e+004	4.42e+004
Maximum	4.47e+004	5.43e+004	3.90e+004	9.95 e+004	4.94e+004
Minimum	3.67e+004	4.19e+004	3.04e+004	8.21 e+004	4.02e+004
X2 – High-technology exports (% of manufactured exports)					
Average	24.9	16.3	7.9	20.5	23.4
Maximum	28.2	18.1	8.7	28.8	26.5
Minimum	20.8	15.4	7.2	12.8	22.1
X3 – Life expectancy					
Average	82.5	80.9	82.8	83.5	81.2
Maximum	82.9	81.3	83.3	84.1	82.1
Minimum	82.1	80.6	82.2	82.9	80.3
X4 – Gini Index					
Average	31.7	31.9	35.1	33.4	32.8
Maximum	32.7	32.8	35.9	34.6	33.7
Minimum	30.7	30.9	34.6	32.3	32.4
X5 – Gross enrolment ratio (%)					
Average	67.3	71.5	66.4	66.2	66.4
Maximum	71.0	77.8	73.9	78.5	80.3
Minimum	62.0	65.2	60.9	58.1	56.4
X6 – Agricultural land (% of land area)					
Average	52.2	47.7	43.2	38.1	71.3
Maximum	52.5	48.0	44.5	38.5	72.4
Minimum	51.7	47.4	41.9	37.8	69.5

X7 – Political stability index					
Average	54.0	68.1	59.8	93.3	60.0
Maximum	58.1	78.1	64.9	98.1	63.7
Minimum	42.9	64.6	57.1	88.6	50.5
X8 – Regulatory quality index					
Average	84.7	94.4	72.4	95.8	94.4
Maximum	91.0	96.7	77.1	98.1	98.6
Minimum	81.7	92.0	68.1	93.8	90.9
X9 – Share of economic losses caused by climate changes to GDP					
Average	1.48e-010	1.63e-010	2.68e-010	0.2e-010	2.05e-011
Maximum	3.78e-011	9.20e-010	8.69e-010	7.2e-011	7.46e-011
Minimum	3.58e-010	3.81e-011	1.03e-010	0.1e-010	1.02e-011
X10 – Employment in tourism in thousands					
Average	1 346.6	2 040.4	2 107.2	172.3	2 176.4
Maximum	1 495.8	2 611.4	2 571.6	195.3	2 945.2
Minimum	1 254.4	1 587.2	1 632.9	161.0	987.6
X11 – Number of bed-places					
Average	1 304 049	1 905 119	2 243 929	274 388	1 686 037
Maximum	1 316 842	1 959 076	2 260 190	280 471	1 799 844
Minimum	1 282 530	1 832 167	2 229 264	271 168	1 410 580
X12 – Number of tourists in thousands					
Average	89 223.3	72 758.3	69 019.9	56 974.4	29 954.3
Maximum	97 943.4	108 928.0	95 398.7	83 509.2	41 080.0
Minimum	82 683.6	28 844.0	38 419.0	18 933.1	6 383.8
X13 – Income from tourism in US\$ millions					
Average	62 031.6	43 837.5	42 030.4	18 887.6	45 253.7
Maximum	72 574.0	58 769.0	51 984.0	21 995.0	53 094.0
Minimum	35 958.0	22 068.0	20 317.0	10 905.0	18 944.0

Source: the authors' own calculation with Statistica.

The analysis of the basic statistics of the variables studied shows that:

- The best developed tourism market is found in Italy. This is indicated by an analysis of the variable Y – share of tourism's sector in GDP.
- The variables characterizing the tourism market show that the countries studied are differentiated, i.e. the best tourist base (variable X11) and

the highest employment in the tourism sector (variable X10) are found in Italy. The highest number of tourists (variable X12) and the highest tourism revenue (variable X13) are found in France.

- The countries studied have similar indicators confirming a high level of economic development and good governance. The country with the best economic situation during the period under study is Switzerland. This is indicated by both variable X1 – GDP per capita and variable X3 – life expectancy. The lowest level of GDP per capita was achieved by Italy. The country with the highest indicator of political stability (variable X7) is Switzerland. The lowest indicator was achieved by France. The highest indicator of regulatory quality (variable X8) was achieved by Switzerland, the UK and Germany. The lowest indicator occurred in Italy.
- The most innovative country in the sample is France and the UK (variable X2).
- Variable X9 – share of economic losses caused by climate changes to GDP had the highest value in Italy and the lowest in Switzerland during the period under review.

In summary, the countries studied constitute a homogeneous group of countries. This is indicated by their classification by the Swiss Re Institute as one of the most vulnerable countries in Europe to climate change, as well as their high level of economic development. However, the analysis of the variables studied shows their differentiation both in terms of the characteristics of the tourism sector and their socio-economic situation and governance.

3. RESEARCH RESULTS AND DISCUSSION

Five countries were analyzed. For the UK, a model was obtained that did not meet the basic criteria for econometric validity (significance of variables, absence of autocorrelation, homoskedasticity, and compliance with the model specification). This may be due to data quality limitations or specific local conditions that were not fully captured in the adopted model. Such variation in results is typical in international studies, where the impact of structural

institutional and economic differences may limit the universality of regression models. Modeling results for the countries studied are presented in Table 4.

Table 4. CLSM modelling results, observations used 2014-2023 ($N = 10$), $\alpha = 5\%$

Country	Model
France	$\Delta Y = -5.437 + 0.529^* X_9 + 1.63^* X_{12}$
Germany	$\Delta Y = -3.341 + 1.676^* X_9$
Italy	$\Delta Y = -25.4 + 10.872^* X_9 + 1.25^* X_{12}$
Switzerland	$\Delta Y = -25.0 + 0.646^* X_9 + 1.28^* X_{13}$
The UK	Lack of econometric validity

Explanation:

Y – Share of the tourism sector in GDP

X_9 – Share of economic losses caused by climate change to GDP

X_{12} – Number of tourists

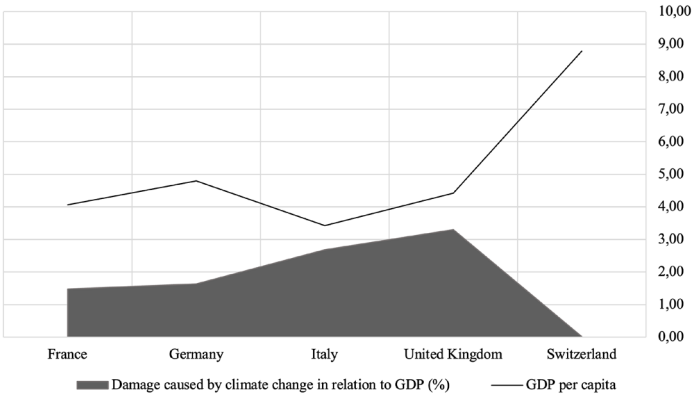
X_{13} – Income from tourism

Source: the authors' own calculation with GRETLM.

The analysis of the estimation results of the models for the countries studied shows that the development of tourism markets is significantly influenced by three variables: X_9 – share of economic losses caused by climate change to GDP, X_{12} – number of tourists, and X_{13} – income from tourism. The other variables proved to be insignificant for the development of tourism in the countries studied. This may be due to the specific national conditions of tourism development, which were not fully captured in the adopted model, or to the developmental similarities of the countries studied. These are countries with a high level of economic development, so a similar level of variables was not a significant determinant of tourism development. The impact of variable X_{12} was confirmed for France and Italy. The impact of variable X_{13} was confirmed for the German tourism market. The impact of damage from climate change on the development of tourism markets has been confirmed for France, Germany, Italy, and Switzerland. This is due to both the high value of damages resulting from climate change and their increasing importance in GDP. The countries studied have similar levels of tourism market development and are also exposed to similar extreme weather events due to their geographical location. This was investigated by the Swiss Re Institute (2024).

The characteristic extreme weather events of the countries studied are: floods, severe convective storms, and winter storms. The differences concern the economic resilience of the countries studied. It is influenced by the country's level of development and the number of damages and value of economic losses from extreme events. Figure 1 summarizes the average value of damage from climate change and the average value of GDP per capita for the period studied in the countries.

Figure 1. Relation between damage caused by climate change to GDP and GDP per capita (10-year average)

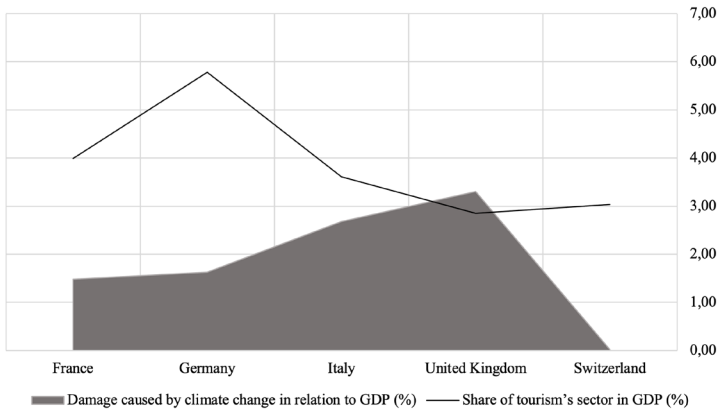


Source: own, based on Swiss Re Institute (2024) and World Bank database.

The analysis of the countries studied shows that although they can be considered a homogeneous group of countries both geographically and in terms of their financial situation, they are diverse. Climate damage affects them differently and poses a different threat to their functioning – economic resilience. Switzerland has the best situation in terms of economic resilience – a high level of economic development and the lowest average climate damage. Italy has the lowest level of economic development in the study group and the highest value of climate damage. A similar situation is found in the UK. France and Germany. These are countries with high climate damage but high GDP per capita, so their economic resilience is better than in Italy, but worse than in Switzerland.

A similar economic resilience of the countries studied was found for the tourism market. Figure 2 summarizes the average value of climate change damages and the average value of tourism's contribution to GDP for the period studied in the countries.

Figure 2. *Relation between damage caused by climate change in relation to GDP and share of tourism sector in GDP (10-years average)*



Source: own, based on Swiss Re Institute (2024) and World Bank database.

The analysis of the economic resilience of the countries studied in relation to the tourism market shows similar correlations to the impact of climate damage on countries. This should be considered a normal pattern, as the development of the tourism market is highly dependent on the level of economic development of the country. An analysis of the average values of climate damage shows that the greatest impact is on the tourism market of the UK and Italy. The smallest impact is in Switzerland. However, it should be remembered that climate damage is difficult to predict and irregular in nature. This applies to both the number and value of climate damage. Therefore, it is not possible to make an accurate forecast to develop a prevention strategy. However, it is possible to build resilience programs that, among other things, secure the development of the tourism market through infrastructure investments, appropriate regulations and other preventive measures. Insurance can also be an important instrument for building resilience in the tourism sector with

regard to climate risk. They provide protection against losses resulting from the effects of extraordinary events. Their main function is to provide financial support in the event of damage to property and loss of assets, as well as in the event of long-term economic disruption that may follow such an event.

The results obtained confirm that economic losses caused by climate change are an important issue for tourism development. This is in line with previous research findings by, among others: Scott, Gössling (2022, 2024), Mateos et al. (2023), Susanto et al. (2020), Scott et al. (2019), Nyaupane et al. (2009). The findings of the indicated Authors confirming the negative impact of climate change on tourism in different territorial scopes. Scott, Gössling (2022, 2024) – studied selected tourism destinations around the world, Mateos et al. (2023) – studied the South West Europe region, Susanto et al. (2020) – studied Indonesia, Scott et al. (2019) – studied OECD countries, Nyaupane et al. (2009) – studied the Himalayan region. The aforementioned studies covered different time periods and different weather phenomena as a result of the geographical scope adopted. The studies conducted to expand the knowledge base on the impact of climate change on tourism in the European countries considered most at risk of extreme weather events and fill a research gap in this area.

CONCLUSIONS

Tourism is an important economic sector that is highly vulnerable to the risks associated with climate change. Physical hazards will become increasingly important, challenging tourism operators (micro-economic perspective) as well as nationally (macro-economic perspective) and regionally (meso-economic perspective). The research conducted confirms the negative impact of climate change on the development of tourism in the European countries surveyed, identified as being most at risk from extreme weather events. Although the research group thus identified appears homogeneous geographically and in terms of level of economic development, the results obtained are not homogeneous. The study group of countries is internally diverse both in terms of the value of damage caused by climate change and in terms of the strength of the impact of climate change on the tourism sector. Switzerland

is the least threatened by climate change impacts on tourism. The UK and Italy are the most. Germany and France, despite the high number and value of damages caused by climate change, appear economically resilient, due to the countries' better economic situation and level of development of the tourism market. The results show that the value of damage caused by climate change is increasing and poses a direct threat to tourism activities in the countries studied. The results obtained are in line with previous research in this area, although conducted for other regions of the world. The scope of the research – countries with the highest values of climatic damage in Europe, as well as the adopted research methodology, taking into account a wide range of factors determining the development of tourism, should be considered original. It is worth emphasizing that due to the irregular range of extreme weather events and their dynamics of change, climate change research needs to be continuously updated. Their results can be used in building resilience programs for countries and regions. Future research may include another group of countries or regions. Building programs to safeguard countries and regions from the effects of climate change may also be an important area of research. This will be the focus of the authors' research.

REFERENCES

- Alvarez, M. (2024). Governance for the implementation of the sustainable development goals in tourism: a 2050 horizon paper. *Tourism Review*, 80(1), 209–220. <https://doi.org/10.1108/TR-12-2023-0872>
- Antonakakis, N., Dragouni, M., Filis, G. (2015). How strong is the linkage between tourism and economic growth in Europe? *Economic Modelling*, 44, 142–155. <https://doi.org/10.1016/j.econmod.2014.10.018>
- Atstāja, D., Cakrani, E. (2024). Impact of climate change on international tourism evidence from Baltic Sea countries. *Sustainability*, 16, 5203. <https://doi.org/10.3390/su16125203>
- Becken, S., Scott, D. (2024). Tourism and climate change stocktake: a call to action. *Journal of Sustainable Tourism*, 32(9), 2018–2038. <https://doi.org/10.1080/09669582.2024.2390577>
- Bigano, A., Hamilton, J. M., Tol, R. J. S. (2007). The impact of climate change on domestic and international tourism: A simulation study. *Integrated Assessment Journal*, 7(1), 25–49. <https://iaj.journals.publicknowledgeproject.org/index.php/iaj/article/view/1102>
- Danneving, H., Rusdal, T. (2023). Caring for melting glaciers. *Tourism Geographies*, 25(6), 1679–1695. <https://doi.org/10.1080/14616688.2023.2278762>
- De Freitas (2003). Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector. *International Journal of Biometeorology*, 48, 45–54. <http://dx.doi.org/10.1007/s00484-003-0177-z>
- Dube, K. (2024). Evolving narratives in tourism and climate change research: trends, gaps, and future directions. *Atmosphere*, 15(4), 455. <https://doi.org/10.3390/atmos15040455>
- Fatima, S., Khan, I., Rehman, M. Z., Khalid, M. H. (2025). The role of tourism, natural resources, and renewable energy in enhancing economic growth and combating climate change in OPEC economies. In: *Environment, Development and Sustainability. A Multidisciplinary Approach to the Theory and Practice of Sustainable Development*, J. Ren (Ed.), Springer, Berlin. <https://doi.org/10.1007/s10668-025-06075-w>
- Gössling, S. (2002). Global environmental consequences of tourism. *Global Environmental Change*, 12(4), 283–302. [https://doi.org/10.1016/S0959-3780\(02\)00044-4](https://doi.org/10.1016/S0959-3780(02)00044-4)
- Gössling, S., Freytag, T. (2012). Die Globalisierung des Tourismus in Europa aus der Perspektive des Klimawandels. *Geographische Rundschau*, 64(3), 36–42.
- Gössling, S., Scott, D. (2024). Climate change and tourism geographies. *Tourism Geographies*. <https://doi.org/10.1080/14616688.2024.2332359>
- Gössling, S., Reinhold, S. (2024). Accelerating small and medium sized tourism enterprises' engagement with climate change. *Journal of Sustainable Tourism*, 33(5), 840–857. <https://doi.org/10.1080/09669582.2024.2350659>
- Hopkins, D., McLean, K. (2014). Climate change perceptions and responses in Scotland's ski industry. *Tourism Geographies*, 16(3), 400–414. <https://doi.org/10.1080/14616688.2013.823457>

- Kumar, A., Melkani, B. Ch. (2023). Assessing the factors influencing tourism growth: An empirical analysis. *European Chemical Bulletin* 12(5), 1634–1650. <https://doi.org/10.48047/ecb/2023.12.5.111>
- Lenelin, R. H., Dawson, J., Stewart, M. J., Maher, P., Lück, M. (2010). Last-chance tourism: The boom, doom, and gloom of visiting vanishing destinations. *Current Issues In Tourism*, 13(5), 477–493. <https://doi.org/10.1080/13683500903406367>
- Lenzen, M., Sun, Y. Y., Ting, Y. P., Geschke, A., Malik, A. (2018). The carbon footprint of global tourism. *Nature Climate Change*, 8, 522–528. <https://doi.org/10.1038/s41558-018-0141-x>
- Maráková, V., Lament, M., Křištofík, P., Bukowski, S. (2025). Climate change as a socio-economic challenge for the tourism sector: an econometric analysis of countries with the highest economic losses. *Technological and Economic Development of Economy*, 31(5), 1644–1664. <https://doi.org/10.3846/tede.2025.24870>
- Maráková, V., Dyr, T., Wolak-Tuzimek, A. (2016). Factors of tourism's competitiveness in the European Union countries. *E+M Ekonomie a Management*, 19(3), 92–109. <https://doi.org/10.15240/tul/001/2016-3-007>
- Mateos, R. M., Sarro, R., Díez-Herrero, A., Reyes-Carmona, C., López-Vinielles, J., Ezquerro, P., Martínez-Corbella, M., Bru, G., Luque, J. A., Barra, A., Martín, P., Millares, A., Ortega, M., López, A., Galve, J. P., Azañón, J. M., Pereira, S., Santos, P. P., Zêzere, J. L., Reis, E., García, A. C., Oliveira, S.C., Villatte, A., Chanal, A., Gasc-Barbier, M., Monserrat, O. (2023). Assessment of the socio-economic impacts of extreme weather events on the Coast of Southwest Europe during the period 2009–2020. *Applied Sciences*, 13, 2640. <https://doi.org/10.3390/app13042640>
- Nicholls, S., Bas, A. (2008). Climate Change and Tourism in Northwestern Europe: Impacts and Adaptation. *Tourism Analysis*, 13(1), 21–31(11). <https://doi.org/10.3727/108354208784548724>
- Nyaupane, G. P., Chherti, N. P. (2009). Vulnerability to Climate Change of Nature-Based Tourism in the Nepalese Himalayas. *Tourism Geographies*, 11(1), 95–119. <https://doi.org/10.1080/14616680802643359>
- Pan, S. L., Wu, L. Morrison, A. M. (2024). A review of studies on tourism and climate change from 2007 to 2021. *International Journal of Contemporary Hospitality Management*, 36(5), 1512–1533. <https://doi.org/10.1108/IJCHM-11-2022-1397>
- Pröbstl-Haider, U., Wanner, A., Feilhammer, M., Damm, A. (2021). Tourism and climate change – An integrated look at the Austrian case. *Journal of Outdoor Recreation and Tourism*, 34, 100361. <https://doi.org/10.1016/j.jort.2020.100361>
- Scott, D., Gössling, S. (2025). Beyond ambition: a review of tourism climate change declaration outcomes and prospects from Baku. *Journal of Sustainable Tourism*, 1–22. <https://doi.org/10.1080/09669582.2025.2508878>
- Scott, D., Gössling, S. (2022). A review of research into tourism and climate change – Launching the Annals of Tourism Research curated collection on tourism and climate change. *Annals of Tourism Research*, 95, 103409. <https://doi.org/10.1016/j.jannals.2022.103409>
- Scott, D., Gössling, S., Hall, M. C. (2012). International tourism and climate change. *WIREs Climate Change*, 3(3), 213–232. <https://doi.org/10.1002/wcc.165>

- Scott, D., Hall, C. M., Gössling, S. (2019). Global tourism vulnerability to climate change. *Annals of Tourism Research*, 77, 49-61. <https://doi.org/10.1016/j.annals.2019.05.007>
- Sharma, D. G., Taheri, B., Chopra, R., Parihar, J. S. (2025). Relationship between climate change and tourism: an integrative review. *The Service Industries Journal*, 25(3-4), 426-453. <https://doi.org/10.1080/02642069.2023.2254714>
- Steiger, R., Knowles, N., Pöll, K., Rutt, M. (2022). Impacts of climate change on mountain tourism: a review. *Journal of Sustainable Tourism*, 32(9), 1984-2017. <https://doi.org/10.1080/09669582.2022.2112204>
- Steiger, R., Stötter, J. (2013). Climate Change Impact Assessment of Ski Tourism in Tyrol. *Tourism Geographies*, 15(4), 577-600. <https://doi.org/10.1080/14616688.2012.762539>
- Steiger, R., Scott, D., Abegg, B., Pons, M., Aall, C. (2017). A critical review of climate change risk for ski tourism. *Current Issues in Tourism*, 22(11), 1343-1379. <https://doi.org/10.1080/13683500.2017.1410110>
- Susanto, J., Zheng, X., Liu, Y., Wang, C. (2020). The impacts of climate variables and climate-related extreme events on island country's tourism: Evidence from Indonesia. *Journal of Cleaner Production*, 276, 124204. <https://doi.org/10.1016/j.jclepro.2020.124204>
- Swiss Re Institute (2025). *Natural catastrophes: insured losses on trend to USD 145 billion in 2025*. Sigma 1/2025. <https://www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html>
- Swiss Re Institute (2024). *How big is the protection gap from natural catastrophes where you are?* <https://www.swissre.com/risk-knowledge/mitigating-climate-risk/natcat-protection-gap-infographic.html#/>
- Swiss Re Institute (2021). *Natural catastrophes in 2020: secondary perils in the spotlight, but don't forget primary-peril risks*. Sigma, 1/2021.
- Tervo-Kankare, K., Hall, M. C., Saarinen, J. (2013). Christmas Tourists' Perceptions to Climate Change in Rovaniemi, Finland. *Tourism Geographies*, 15(2), 292-317. <https://doi.org/10.1080/14616688.2012.726265>
- Tourism Panel On Climate Change (TPCC). (2023). *Tourism and climate change stocktake 2023*. <https://tpcc.info/stocktake-report/>
- United Nations World Tourism Organization (UNWTO). (2003). Djerba Declaration on Tourism and Climate Change. 1st Conference on Climate Change and Tourism. <https://www.unwto.org/archive/global/event/1st-conference-climate-change-and-tourism>
- World bank database. <https://data.worldbank.org/indicator>
- World Tourism Organization (WTO). (2025). *Supporting Climate Action Planning in Tourism Destinations – A Review of Literature and Tools for Local Authorities*, UN Tourism, Madrid. <https://doi.org/10.18111/9789284425228>
- World Tourism Organization (2024). *Tourism Statistics Database*. <https://www.unwto.org/tourism-statistics/tourism-statistics-database>
- World Travel & Tourism Council (WTTC). (2023). *The Environmental Impact of Global Tourism Report*. <https://researchhub.wttc.org/product/the-environmental-impact-of-global-tourism-2023>