

# The Nexus between Climate Change and Tourism Industry in the Island of Crete, Greece

John Vourdoubas

Consultant Engineer, 107B El. Venizelou str., 73132, Chania, Crete, Greece

E-mail: [ivourdoubas@gmail.com](mailto:ivourdoubas@gmail.com)

Received: October 28, 2022 Accepted: November 21, 2022 Published: December 30, 2022

doi:10.5296/ijrd.v10i1.20397

URL: <http://dx.doi.org/10.5296/ijrd.v10i1.20397>

## Abstract

Climate change and tourism industry have close linkages and interconnections. The aim of the current work is the investigation of the nexus between climate change and tourism industry in the island of Crete, Greece. The impacts of climate change on the tourism industry in Crete have been studied as well as the contribution of the local tourism industry to greenhouse gas emissions. It has been indicated that climate change alters various environmental conditions affecting the island's tourism industry while climate change-related natural hazards create damages in the local infrastructure. The tourism-related carbon emissions in Crete are in the same range with other tourism destinations while carbon emissions attributed to air-flights to and from Crete have the highest share in the overall emissions. Several actors in tourism industry should try to mitigate climate change reducing their carbon emissions while various adaptation measures should be taken in order to minimize climate change-related damages. Our results could be useful to local authorities in the design of future policies coping with climate change in Crete as well as to several actors of tourism industry who should try to minimize the undesired impacts of climate change which threatens the prosperity of their enterprises.

**Keywords:** adaptation, carbon emissions, climate change, Crete-Greece, mitigation, tourism industry

## 1. Introduction

Climate change is a severe global environmental problem having painful consequences in all countries. Tourism industry is growing worldwide while it is sensitive and vulnerable to climate change. There are strong linkages between climate change and tourism industry (*Su et al, 2015*). Climate change affects tourism industry (*Leyne et al, 2017, UNEP, 2008*) while tourism industry is a significant contributor to greenhouse gas emissions (*Gossling et al, 2010, UNEP, 2008*). Tourism industry should try to mitigate climate change (*Zeppel et al, 2013, UNEP, 2008, Becken, 2005*) and adapt to it (*UNEP, 2008, Dodds et al, 2008, Saarinen et al,*

2006). Island of Crete, Greece is an attractive tourism destination in Eastern Mediterranean basin with a well-developed tourism industry which has a high share at around 47% in the regional GDP. However, islands are vulnerable to climate change. The current work examines the interrelation and the linkages between climate change and tourism industry in the island. The impacts of climate change on the local tourism industry are investigated as well as the necessity for mitigation and adaptation of Cretan tourism industry to climate change. The research is important since it indicates the impacts of climate change on tourism industry in Crete as well as the necessity of Cretan tourism industry to develop policies for climate change mitigation and adaptation. The text is structured as follows. After the introduction and the literature survey sections the issue of climate change and a short description of the tourism industry in Crete are presented. After that the impacts of climate change to tourism industry in Crete and the contribution of Cretan tourism industry to climate change are mentioned. Next the mitigation of climate impacts due to tourism industry in Crete as well as the industry's adaptation to climate change are stated. The text ends with discussion of the findings, the conclusions drawn and the citation of the literature used.

## **2. Literature Survey**

The literature survey is separated in two sections comprising: a) Climate change and tourism industry worldwide, and b) Climate change and tourism industry in Crete.

### *2.1 Climate Change and Tourism Industry Worldwide*

Gossling (2009) has investigated the concept of carbon neutral destinations. The author stated that this concept needs further clarification while it is unclear how and when destinations can become carbon neutral. He mentioned that this can be obtained in three steps including: a) Calculation of carbon emissions, b) De-carbonization focusing on energy reduction particularly in emission intensive sectors, c) Offsetting any remaining emissions. He also stated that the involvement of all stakeholders is necessary for that. Layne (2017) has analyzed the impacts of climate change on tourism in the coastal and marine environment of Caribbean small islands. The author mentioned that tourism is a climate sensitive industry. Increased temperature and rise in the sea level have negative impacts on tourism including more droughts, coral bleaching and damages in tourism infrastructure. *Hall, 2015* has studied the impacts of climate change on heritage tourism. The author stated that heritage tourism contributes to climate change due to higher transportation needed while it can assist in developing climate change awareness. Zeppel et al. (2013) have studied the mitigation of carbon emissions by environmentally certified tourism enterprises in Australia. The majority of the investigated enterprises believed that climate change was an important issue for tourism while reduction of carbon emissions consists of an integral part of sustainable tourism development. Gossling et al (2010) have investigated the reconciliation of tourism growth and climate policy. The authors stated that tourism industry is a significant contributor to carbon emissions while climate policies require their sharp reduction. They mentioned that a radical change is necessary to reconcile the holiday demand of a growing world population with the climate policy targets of the international community. A report on climate change adaptation and mitigation in the tourism sector has been published, UNEP, 2008. The report

stated the climate change impacts on tourism, the impacts of tourism to climate change and the tourism adaptation to climate change. Hall (2008) has studied the current knowledge and gaps between tourism and climate change. The author stated that climate change mitigation cannot be the main focus of tourism enterprises while there are significant gaps regarding the relationships between tourism and climate change. Dodds et al. (2008) have studied the issue of climate change in sustainable tourism policies with reference the Mediterranean islands of Malta and Mallorca. The authors stated that tourism in both islands is vulnerable to climate change but climate change was rarely mentioned as a significant problem in tourism industry. They proposed several policy recommendations for climate change adaptation while they mentioned that tourism in small islands might not be sustainable in the future due to climate change impacts. Hall (2006) has studied the attitudes of New Zealand tourism enterprises with respect to climate change mitigation and adaptation. The author stated that according to interviews in forty-three rural tourism enterprises climate change was considered as a significant future problem. However, in the short run other issues were more important than climate change in those tourism enterprises. Saarinen et al. (2006) have investigated the adaptation strategies to climate change in Finnish nature-based tourism enterprises. The authors stated that interviews in various Finnish tourism enterprises indicated that the majority of them did not believe to climate change and they have not developed adaptation strategies. Becken (2005) has studied the harmonization of climate change mitigation and adaptation with reference Fiji islands. The author stated that mitigation of carbon emissions due to energy use in tourism accommodation is needed. She also mentioned that various adaptation measures are also required in tourism facilities. Nurse et al. (2005) have studied the adaptation to climate change in small islands. The authors stated that small islands will suffer disproportionately from global warming. The only option that small islands have to cope with climate change is their adaptation to it. Elsasser et al. (2002) have studied the impacts of climate change to tourism enterprises in Alps. The authors stated that the financial viability of winter tourism in Switzerland depends heavily on tourism. They also mentioned that if the assumptions of climate change occur less than 50% of the currently existing ski resorts will be available in the future. Su et al. (2015) have reviewed the relation between tourism and climate change in Asia and the Pacific. The authors stated that the main impacts of extreme weather events to tourism are related with higher temperatures and rise of the sea level. They also mentioned that the main contribution of tourism to climate change is related with accommodation and transportation of visitors. Su et al. (2013) have studied the response of the hospitality industry in Taiwan to climate change. The authors using questionnaires found that hotels have high awareness regarding climate change. However, they are mainly focused on increasing their revenues without developing mitigation and adaptation activities. Nyaupane et al. (2009) have studied the vulnerability of nature-based tourism in Nepalese Himalayas to climate change. The authors stated that Nepalese Himalayas is a Mecca for trekkers while they are highly vulnerable to climate change. They also mentioned that the impact of climate change on tourism in Himalayas is complex depending on several distinct local characteristics. Wolf et al. (2021) have studied the impacts of climate change on tourism development in small pacific island states. The authors stated that climate change has both direct and indirect impacts on tourism varying from damages of tourism assets to loss of

bio-diversity. They also mentioned that climate impacts and related changes in tourism demand may lead to a shrinking tourism sector with severe implications for sustainable development and well-being. *Pathak et al, 2021* have evaluated the impacts of climate change on the tourism sector in Bahamas islands. The authors mentioned that many tourism properties lie nearby the coastline. Severe storms, coastal flooding impacts including coastal erosion and rise in the sea level threaten tourism infrastructure. They also stated that potential climate change impacts on the tourism infrastructure will cause significant losses in revenue and employment in these islands. *Lam-Gonzalez et al. (2022)* have studied the impacts of land degradation in tourism-dominated islands on tourists' travel decisions. The authors investigated the willingness of tourists to have holidays in islands endangered by forest fires, wildlife losses, water shortages and damages to infrastructure and the cultural heritage. They stated that the most important factors which negatively influence the tourists' preference for holidays are forest fires, wildlife losses and damages to cultural heritage.

## *2.2 Climate Change and Tourism Industry in Crete*

*Andriotis (2003)* has studied the tourism industry in Crete. The author stated that tourism in Crete is an irreversible phenomenon which has modernized the society with positive and negative implications. *Tzanakakis et al. (2020)* have examined the sustainable management of water resources in Crete. The authors stated that Crete is water sufficient while the share of agriculture in water usage is at 78% while of the domestic sector at 21%. *Vourdoubas (2020a)* has studied the nexus between tourism and renewable energies in Crete. The author stated that the use of renewable energies in the tourism industry has positive impacts on climate change mitigation. He also mentioned that solar energy is the most popular renewable energy used in tourism industry. *Vourdoubas (2019)* has studied the mitigation and compensation of CO<sub>2</sub> emissions due to international tourism in the island of Crete, Greece. The author has examined various mitigation options in several sectors comprising: a) transportation to and from Crete, b) accommodation, c) catering, and d) several tourist activities at the destination. *Vourdoubas (2018)* has studied the creation of net zero carbon emission hotels due to energy use in Mediterranean region. The author mentioned that several sustainable energy technologies can be used for that including: a) solar thermal, b) solar photovoltaic, c) solid biomass burning, and d) high efficiency heat pumps. *Baltas et al. (2013)* have examined the water resources management in the island of Crete. The authors stated that the island of Crete has limited water resources and growing water demand. They mentioned that 15.5 % of the annual water resources are filtered into the soil while 12.5 % of them are flowing on the surface. The rest 72% is subjected to evapotranspiration. *Giannakopoulos et al. (2009)* have studied the impacts of climate change in the near future in Greece. The authors stated that tourist areas in continental Greece will face more often heat wave episodes. The number of tropical nights will be increased mainly in islands. In coastal areas the high levels of relative humidity can result in uncomfortable conditions for locals and foreigners. *Tapoglou et al. (2019)* have studied the climate change impacts on the frequency of hydro-meteorological extremes in the island of Crete, Greece. The authors stated that during the 21<sup>st</sup> century the extreme weather events due to climate change in Crete including droughts, extreme precipitation and extreme water flow will be increased. *Ravankhah et al. (2019)* have

assessed the natural hazards due to climate change with reference the historic center of Rethymno city, Crete, Greece. The authors developed an integrated natural hazard assessing method including sudden-onset hazards like earthquakes and floods and slow-onset hazards like wetting-drying cycles and biological contamination. Kyriakakis et al. (2020) have studied the tourism in Crete, Greece in the post Covid-19 era. The authors stated that Covid-19 has created big economic losses in the tourism industry. Island of Crete consists of an attractive tourism destination while the local tourism industry is well developed contributing significantly in island's prosperity. The authors mentioned that Crete during recovery from the virus should expand its tourism period achieving many benefits. Vourdoubas (2020b) has investigated the carbon emissions of tourism industry in Crete, Greece. The author stated that tourism-related carbon intensity in Crete is in the same range with other tourist territories. He also mentioned that carbon emissions due to international tourism arrivals by air-flights have a large share in the total tourism-related carbon emissions. Polykretis et al. (2021) have assessed the water-induced soil erosion in Chania prefecture, Crete, Greece. The authors stated that prefecture of Chania and its archeological sites are significantly affected by soil loss while preventive measures should be taken to protect them.

*Aims of the current research are the investigation of:*

- a) *The climate change impacts on tourism industry in Crete,*
- b) *the contribution of tourism industry in Crete to climate change,*
- c) *the adaptation of tourism industry in Crete to climate change, and*
- d) *the mitigation of climate impacts due to tourism industry in Crete*

### **3. Climate Change**

The inter-governmental panel of climate change (IPCC) has declared that most of the observed increase in global average temperatures since the mid-20<sup>th</sup> century is “very likely” the result of human activities that are increasing the concentration of greenhouse gases in the atmosphere (IPCC, 2007a). It is the first time in history that human related activities have profound impacts on the global climate. The IPCC predicts that the global average surface temperature is very likely to rise by 1.8°C to 4°C by the end of the current century (IPCC, 2007b). Climate change has severe impacts on developed, developing and poor countries creating many natural disasters with painful economic and social impacts. Taking into account that the mean global temperature is expected to increase in the coming decades the climate change will become more intense increasing the negative impacts worldwide. Changes in temperatures and in other climate parameters are expected to vary while hot extremes, heat waves, droughts and heavy precipitation events is “very likely” to continue to grow more frequent. Tropical cyclones will become more intense while the sea level is expected to rise. Many countries and regions worldwide are going to be affected by climate change and the extreme weather events including major tourism destinations. The resulted natural hazards are foreseen to have negative impacts on the infrastructure of tourism dominated regions threatening the viability of the tourism industry and the attractiveness of several tourist destinations.

#### 4. The Tourism Industry in Crete

Crete is the second largest island in the Eastern Mediterranean basin with an area at 8 332 Km<sup>2</sup> and population at 621 340 inhabitants. The island has six seaports and three airports which are used for arrival and departure of tourists by air and sea. Crete has many tourist attractions including beautiful landscapes, gorges, mountains, coastlines, and sandy beaches while its culture, history and gastronomy are very rich. It is well-known and popular among travelers all over the world. More than 5 mil. tourists visit Crete annually for vacations while the most of them arrive during the period from April to October when the local climate is mild. Tourism industry is very important for the prosperity in the island. It is estimated that approximately 47% of the GDP in Crete is attributed to tourism while there are many job opportunities in the hospitality sector. Employment in the local tourism industry increases gradually and counterbalances the job losses in the agricultural sector that used to be traditionally the main driver of the regional economy. The majority of visitors arrive in the island with international air-flights travelling via long distances. Carbon emissions from long-haul airplanes have a high share in the total carbon footprint of the local tourism industry. Arrivals of tourists to Crete via different transport modes are presented in table 1.

Table 1. Arrivals of tourists in Crete with international flights, domestic flights and ships (2016)

Mode of transport	Number of tourists	%, of total
Number of tourists arriving with international flights	3 938 580	74.04
Number of tourists arriving with domestic flights	416 790	7.84
Total number of tourists arriving via airplanes	4 355 370	81.88
Number of tourists arriving by ships	963 614	18.12
Total number of tourists arriving in Crete	5 318 984	100

*Source.* Vourdoubas, 2020b.

#### 5. Climate Change Impacts on Tourism Industry in Crete

Climate change is going to affect negatively the tourism industry in Crete. Giannakopoulos et al. (2009) have mentioned that locals and tourists in coastal areas in Greece will suffer from the uncomfortable environmental conditions. Dodds et al. (2008) have stated that Mediterranean islands, with reference to Malta and Mallorca, are sensitive to climate change. The climate change impacts on tourism in Crete can be categorized as: a) direct impacts, b) indirect impacts, c) impacts of mitigation policies on tourism mobility, and d) indirect societal change impacts (Climate change adaptation and mitigation in the tourism sector, UNEP, 2008). The climate change impacts in Mediterranean region are presented in table 2.

Table 2. Impacts of climate change in Mediterranean region

---

Summers will become warmer and dryer

---

Water scarcity will be frequent

Increase in outbreaks of deceases

Loss in land biodiversity

Loss in marine biodiversity

Various natural hazards due to extreme weather events affecting the local infrastructure

---

*Source.* Climate change adaptation and mitigation in the tourism sector, 2008.

### *5.1 Direct Climate Change Impacts*

Climate is an important parameter in a tourist destination that determines its attractiveness and influences its competitiveness. Any change in climate parameters alters the preferences of tourists and the profitability of tourism enterprises. Climate change alters the environmental conditions influencing the attractiveness of Crete as tourist destination. Island's climate is expected to become in the future dryer and warmer. Heat waves, high precipitation, droughts, hot days and tropical nights will result in higher operating expenses of tourism-related organizations. Probably in the future other tourist destinations will become more attractive and competitive to visitors compared to Crete.

### *5.2 Indirect Climate Change Impacts*

Any change in environmental conditions is expected to have profound effect on tourist destinations. The indirect climate change impacts on tourism include water shortages, biodiversity loss, coastal erosion, alterations in agricultural production, natural hazards and damage to infrastructure. Extreme weather events create damages in the local infrastructure including roads and bridges. Rise in the sea level creates erosion in the coastline decreasing the attractiveness of the seaside resorts. All of them negatively affect the attractiveness of the tourism product in the island.

### *5.3 Impacts of Mitigation Policies on Tourism Mobility*

The necessity for climate change mitigation requires the decrease in atmospheric carbon emissions. The majority of visitors in Crete arrive with international long-haul air-flights with airplanes using fossil fuels. Future carbon mitigation policies might introduce a carbon tax to air flights discouraging tourists to travel in long-haul destinations. It is likely also to change the attitude of environmentally conscious tourists to travel in long destinations preferring shorter destinations and less polluting transport modes. These policies will decrease the competitiveness of the tourism industry in Crete.

### *5.4 Indirect Societal Change Impacts*

Climate change might decrease the global GDP and the political stability in some nations reducing the consumer's wealth and discouraging their traveling for leisure. This fact might decrease the number of international visitors to Crete.

## 6. Contribution of Tourism Industry in Crete to Climate Change

Carbon emissions in several sectors of the local tourism industry contribute to climate change. These emissions can be categorized as: a) Carbon emissions due to arrival and departure of tourists in the island mainly with aircrafts and ships, b) Carbon emissions due to accommodation in the island, and c) Carbon emissions due to various activities of tourists in Crete including recreation, travelling inside the island, catering etc. International carbon emissions from tourism industry including transportation, accommodation and several tourism activities account for about 5% of the global CO<sub>2</sub> emissions (UNEP, 2008). The share of transportation-related carbon emissions is very high accounting at around 75% in the overall emissions (UNEP, 2008) while in Crete they account at 80.70% (Vourdoubas, 2020b). Other researchers have also mentioned that the main contribution of tourism to climate change is related with accommodation and transportation (Sue et al, 2015). Carbon emissions due to accommodation in Crete have a share at 13% in the overall carbon emissions while emissions due to other tourist activities including recreation, catering etc have a share at 6.30% in the overall emissions (Vourdoubas, 2020b). The carbon intensity of tourism industry in Crete has been estimated at 0.5618 KgCO<sub>2</sub>/€ (Vourdoubas, 2019) which is in the same range with other EU countries. However, it is almost two and a half times higher than the benchmarking value reported at 0.24 KgCO<sub>2</sub>/€, for achieving global sustainability and an eco-efficient tourism industry (Vourdoubas, 2019). Carbon emissions in several sectors of the tourism industry in Crete are presented in table 3.

Table 3. Carbon emissions in several sectors of the tourism industry in Crete

Tourism sector	CO <sub>2</sub> emissions (ton/year)	%, of total
Arrival and departure of tourists	1 840 368	80.70
Accommodation	296 640	13.00
Various tourist activities in Crete	143 613	6.30
Total	2 280 621	100

*Source.* Vourdoubas, 2020b.

## 7. Adaptation of Tourism Industry in Crete to Climate Change

Adaptive capacity of a system is the ability or the potential to respond successfully to climate variability and change and includes adjustments in behavior, resources and technologies (Climate change adaptation and mitigation in the tourism sector, UNEP, 2008). It has been stated that the only option that small islands have to cope with climate change is their adaptation to it (Nurse et al, 2005, Zeppel et al, 2013). The adaptive capacity of the tourism industry in Crete varies among its different sub-sectors. Visitors in the island have the largest adaptive capacity to climate change since they can respond easily choosing among different tourism destinations. Tourism service suppliers have moderate adaptive capacity to climate change. Tour operators who do not own the infrastructure in Crete are in better position to respond to climate change in the island. However, tourism related enterprises in Crete with



large investments in immobile capital assets, comprising hotels, seaside resorts, camping, tourism-related recreational infrastructure, marina etc, have the least adaptive capacity. They are more vulnerable to climate change since their investments will be affected without having many options to avoid the impacts.

## 8. Mitigation of Climate Impacts due to Tourism Industry in Crete

A decrease in carbon emissions in the tourism and travel industry in Crete could be achieved with various technological and non-technological measures, including: a) Use of more energy-efficient airplanes and ships for tourist arrivals and departures, b) Use of innovative fuels with less carbon emissions during transportation at the destination, c) Improvement of energy performance in accommodation buildings and replacement of conventional fuels and grid electricity used in them with renewable energies including solar thermal energy and solar-PV energy, d) Promotion of public transportation for tourists in Crete, e) Promotion of car sharing among tourists during their activities in the island, f) Promotion of the electrification of the transportation sector in Crete using more electric vehicles, g) Use of local food products instead of food imported from long distances and less use of meat products in tourist-related catering, and h) Sensitization of visitors for behavioral change using more sustainable behavior and activities during their vacations (*Yourdoubas, 2020b*). It has been stated that significant reduction in GHG emissions can only be achieved through behavioral change, given an increasing number of human beings participating in tourism (*UNEP, 2008*). Some of the abovementioned measures can be implemented easily and soon while others can only be implemented in the long run taken into account that they require breakthrough innovations and development of new technologies. Some of them could be implemented by private enterprises and actors related with the local tourism industry while others depend on policy development by regional and national authorities.

## 9. Discussion

Our results indicate that there is a correlation between climate change and tourism industry in Crete. The carbon intensity of the local tourism industry is similar with the carbon intensity in other tourism dominated regions and states. The share of tourism-related carbon emissions due to air-flights in Crete is high and in the same range of values with carbon emissions due to air-flights in other islands. Tourism industry in Crete contributes to climate change while climate change has undesired impacts to local tourism industry. The results fit to the existing knowledge regarding the interrelation between climate change and tourism industry. They can be used from policy makers and several actors of tourism industry to promote mitigation of climate change as well as the adaptation to it. Although the carbon emissions of the local tourism industry have been quantified precise data regarding the current and future impacts of climate change on tourism industry in Crete are not available. It is recommended that future research should be focused on examining the attitude of various actors of the local tourism industry regarding climate change as well as the necessity and their willingness to take measures promoting its mitigation as well as their adaptation to it. It should be also focused towards designing appropriate policies in Crete regarding climate change mitigation in all sectors of the tourism industry.

## 10. Conclusions

The links and the interrelations between climate change and tourism industry in the island of Crete, Greece have been studied. It has been indicated that climate change affects the Cretan tourism industry while the tourism industry contributes to climate change. The impacts of climate change to Cretan tourism industry can be categorized as direct impacts, indirect impacts, impacts on tourism mobility due to climate change mitigation policies and impacts due to societal changes. The impacts of the local tourism industry to climate change are related with carbon emissions attributed to the arrival and departure of tourists, their accommodation in Crete as well as due to several activities of tourists in the island. The capacity of the tourism industry in Crete to adapt to climate change varies among its different sub-sectors. Tourism actors with large investments in immobile capital assets in Crete, comprising hotels, sea resorts, camping, tourism-related recreational infrastructure, marina etc, have low adaptive capacity. Decrease in carbon emissions in the tourism and travel industry in Crete could be achieved with various technological and non-technological measures including behavioral changes. In some sub-sectors like in accommodation the decrease of carbon emissions is technically and economically feasible while in others like in air-transportation is technically and economically difficult in the short and medium period. Our results are important and useful since they indicate the links and the interrelations between climate change and the tourism industry in Crete. They could be used from policy makers and several actors of tourism industry in the island to design and implement the appropriate policies aiming both in minimizing the impacts of climate change to the local tourism industry as well as the contribution of tourism industry to climate change.

## References

- Andriotis, K. (2003). Tourism in Crete. A form of modernization, *Current Issues in Tourism*, 6(1), 23-53.
- Baltas, E., & Tzoraki, O. (2013). Water resources management on the island of Crete: lessons learned. In Tudor Rose (Eds) *Free flow – reaching water security through cooperation* (pp. 285-289). Paris: UNESCO.
- Becken, S. (2005). Harmonizing climate change adaptation and mitigation: The case of tourist resorts in Fiji, *Global Environmental Change*, 15(4), 381-393. <http://dx.doi.org/10.1016/j.gloenvcha.2005.08.001>
- Climate change adaptation and mitigation in the tourism sector: Frameworks, Tools and Practices, United Nations Environment Program, 2008. Retrieved from <https://wedocs.unep.org/20.500.11822/9681>
- Dodds, R., & Kelman, I. (2008). How climate change is considered in sustainable tourism policies: A case of the Mediterranean islands of Malta and Mallorca, *Tourism Review International*, 12, 57-70. <http://dx.doi.org/10.3727/154427208785899920>
- Elsasser, H., & Burki, R. (2002). Climate change as a threat to tourism in the Alps, *Climate Research*, 20, 253-257. <http://dx.doi.org/10.3354/cr020253>

- Giannakopoulos, C., Kostopoulou, E., Varotsos, K., & Plitharas, A. (2009). Climate change impacts in Greece in the near future, WWF.
- Gossling, S. (2009). Carbon neutral destinations: a conceptual analysis. *Journal of Sustainable Tourism*, 17(1), 17-37. <http://dx.doi.org/10.1080/09669580802276018>
- Gossling, S., Hall, C.M., Peters, P., & Scott, D. (2010). The future of Tourism: Can tourism growth and climate policy be reconciled? A mitigation perspective, *Tourism Recreation Research*, 35(2), 119-130. <https://doi.org/10.1080/02508281.2010.11081628>
- Hall, C.M. (2007). New Zealand tourism entrepreneur attitudes and behaviors with respect to climate change adaptation and mitigation, *International Journal of Innovation and Sustainable Development*, 1(3), 229-237. <https://doi.org/10.1504/IJISD.2006.012424>
- Hall, C.M. (2008). Tourism and climate change: Knowledge gaps and issues, *Tourism Recreation Research*, 33(3), 1-12. <https://doi.org/10.1080/02508281.2008.11081557>
- Hall, C.M. (2015). Heritage, Heritage tourism and climate change, *Journal of Heritage Tourism*, 11(1), 1-9. <https://doi.org/10.1080/1743873X.2015.1082576>
- IPCC (2007a). Climate Change 2007: The Physical Science Basis. In Solomon, S., Qin, D., Manning, M., Marquis, M., Averyt, K., Tignor, M.B., LeRoy Mil H., (Eds.), *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- IPCC (2007b). Climate Change 2007: Impacts, Adaptation and Vulnerability. In Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., Hanson, C.E., (Eds.), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- Kyriakakis, A., & Tzirakis, D. (2020). Tourism in the post Covid-19 era: An opportunity for expansion of the tourism season; The case of Crete, *HAPSc Policy Briefs Series*, 1(1), 227-237. <https://doi.org/10.12681/hapscpbs.24970>
- Lam-Gonzalez, Y. E., Leon, C. J., de Leon, J., & Suarez-Rojas, C. (2022). The impact of degradation of islands' land ecosystems due to climate change on tourists' travel decisions, *Land*, 11, 1644. <https://doi.org/10.3390/land11101644>
- Layne, D. (2017). Impacts of climate change on tourism in the coastal and marine environments of Caribbean small island developing States, *Caribbean Marine Climate Change Report Card: Science Review*, 174-184.
- Nyaupane, G.P., & Chhetri, N. (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>
- Nurse, L., & Moore, R. (2005). *Adaptation to global climate change: An urgent requirement for small island development states*, Oxford, Blackwell Publishing Ltd. <https://doi.org/10.1111/j.1467-9388.2005.00430.x>

- Pathak, A., van Beynen, Ph. E., Akiwumi, F.A., & Lindeman, K.C. (2021). Impacts of climate change on the tourism sector of a small island developing state: A case study for the Bahamas, *Environmental Development*, 37, 100556. <https://doi.org/10.1016/j.envdev.2020.100556>
- Polykretis, Ch., Alexakis, D.D., Grillakis, M.G., Agapiou, A., Cuca, B., Papadopoulos, N., & Sarris, A. (2021). Assessment of water-induced soil erosion as a threat to cultural heritage sites: the case of Chania prefecture, Crete island, Greece, *Big Earth Data*. <https://doi.org/10.1080/20964471.2021.1923231>
- Ravankhah, M., de Wit, R., Argyriou, A.V., Chliaoutakis, A., Joao Revez, M., Birkmann, J., .... Giapitsoglou, K. (2019). Integrated assessment of natural hazards, including climate change influences, for cultural heritage sites: The case of historic centre of Rethymno in Greece, *International Journal of Disaster and Risk Sciences*, 10, 343-361. <https://doi.org/10.1007/s13753-019-00235-z>
- Saarinen, J., & Tervo-Kankare, K. (2006). Perceptions and adaptation strategies of the tourism industry to climate change: the case of Finnish nature-based tourism entrepreneurs, *International Journal of Innovation and Sustainable Development*, 1(3), 214-228. <http://dx.doi.org/10.1504/IJISD.2006.012423>
- Su, Y-P., Hall, C.M., & Ozanne, L. (2013). Hospitality industry responses to climate change: A benchmark study of Taiwanese tourist hotels, *Asia Pacific Journal of Tourism Research*, 18(1-2), 92-107. <https://doi.org/10.1080/10941665.2012.688513>
- Su, Y-P., & Hall, C.M. (2015). Climate change and Tourism in Asia: A review, in UNWTO, *Responding to climate change: An examination of Tourism related initiatives in Asia and the Pacific*.
- Tapoglou, E., Vozinaki, A.E., & Tsanis, I. (2019). Climate change impact on the frequency of hydrometeorological extremes in the island of Crete, *Water*, 11, 587. <https://doi.org/10.3390/w11030587>
- Tzanakakis, V.A., Angelakis, A.N., Paranychianakis, N.V., Dialynas, Y.G., & Tchobanoglous, G. (2020). Challenges and opportunities for sustainable management of water resources in the island of Crete, Greece, *Water*, 12, 1538. <https://doi.org/10.3390/w12061538>
- Vourdoubas, J. (2018). Hotels with net zero carbon emissions in the Mediterranean region: Are they feasible? *Journal of Tourism and Hospitality Management*, 6(2), 72-79. <https://doi.org/10.15640/jthm.v6n2a6>
- Vourdoubas, J. (2019). Mitigation and compensation of CO<sub>2</sub> emissions due to international tourism in the island of Crete, Greece, *Energy and Environment Research*, 9(2), 61-69. <https://doi.org/10.5539/eer.v9n2p61>
- Vourdoubas, J. (2020a). The nexus between tourism and renewable energy resources in the island of Crete, Greece, *American Scientific Research Journal for Engineering Technology and Sciences*, 63(1), 28-40.

Vourdoubas, J. (2020b). The tourism industry in the island of Crete, Greece. Is it carbon intensive? *Sustainability in Environment*, 5(1), 23-36. <https://doi.org/10.22158/se.v5n1p23>

Wolf, F., Leal Filho, W., Singh, P., Scherle, N., Reiser, D., Telesford, J., ..... Kovaleva, M. (2021). Influences of climate change on tourism development in small pacific island states, *Sustainability*, 13, 4223. <https://doi.org/10.3390/su13084223>

Zeppel, H., & Beaumont, N. (2013). Climate change and sustainable tourism: carbon mitigation by environmentally certified tourism enterprises, *Tourism Review International*, 17(3), 161-177. <http://dx.doi.org/10.3727/154427213X13838418676961>

### Copyright Disclaimer

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).