UNIVERSITÀ DEGLI STUDI DI PALERMO

Corso di Laurea Magistrale – LM-49 Tourism Systems and Hospitality Management
Dipartimento di Scienze Economiche, Aziendali e Statistiche

CLIMATE CHANGE AND IMPACT ON ISLANDS TOURISM

TESI DI LAUREA DI
Dr. Veronica Fontana

RELATORE
Prof. Giovanni Ruggieri

ANNO ACCADEMICO 2020/2021

MAGISTRALE

Table of Contents

DEDICATION

To my family, and to the grandmother M. to whom I owe everything. To my love Giulio which is a constant source of inspiration. To Aunt A. who taught me to grow up. To my mentor Prof. Giovanni Ruggieri, my wise and trusted advisor. And finally, to my grandfather Simone who has always believed in me and from whom the American dream begins.

Abstract

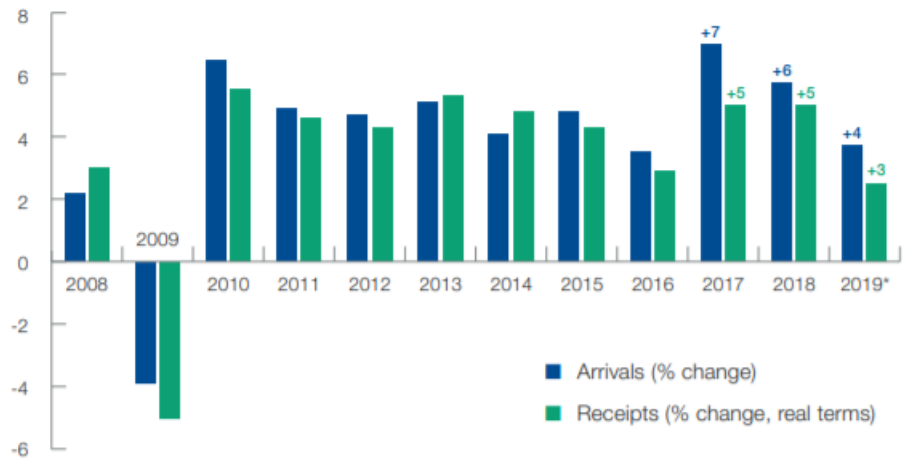
Climate change, understood as "alteration of the global atmosphere that is directly or indirectly attributable to human action" (United nation definition) is a phenomenon that affects our planet and in recent years is one of the greatest challenges facing our world ever dealt with. The increase in global average temperatures is in fact compromising our climate and these effects, if not countered with concrete actions, are destined to worsen in the coming years. Climate change is already affecting the tourism industry and is anticipated to have profound implications for tourism in the twenty-first century, including consumer holiday choices, the geographical patterns of tourism demand, the competitiveness and sustainability of destinations and the contribution of tourism to international development. In this paper we want to analyse the causes, dimensions and evolutions of climate change and the impact this has on the six Mediterranean islands, namely Sicily, Corsica, Crete, Cyprus, Malta and Sardinia. Furthermore, a general framework will be provided of the possible pathways, actions and intervention policies that can be implemented by the public and private authorities in order to control climate change and limit negative impacts on the environment and on the tourism sector.

Chapter 1: Climate change in tourism industry: evolution, dimensions and implication

1.1 An overview on the tourism industry

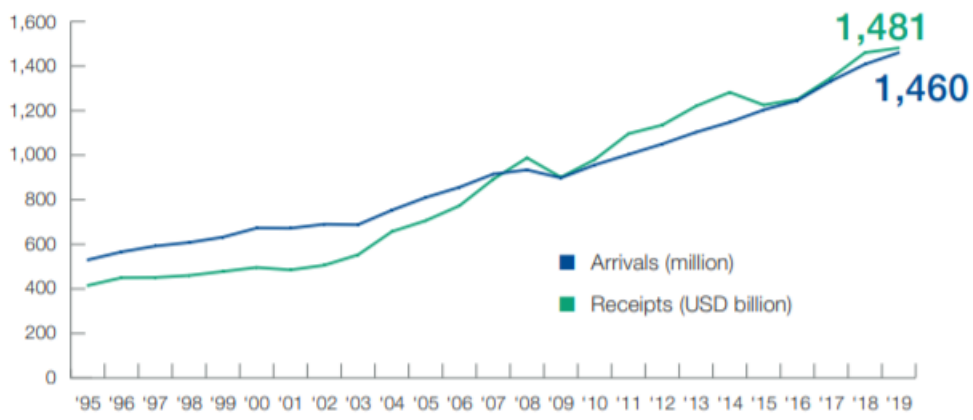
Tourism is one of the world's largest and fastest-growing industries. According to the United Nations World Tourism Organisation (UNWTO), a total of US$1481 billion (+3%) in international tourism receipts were generated by 1400 million international tourism arrivals in 2019 (+ 4%), a higher number recorded if compared with the exceptional rates seen in 2017 (+7%) and 2018 (+6%). Despite the Covid pandemic that has hit the entire planet, the tourism industry continues to prove to be one of the strongest and resilient against a backdrop of global economic slowdown, in fact, tourism spending continued to grow in 2019 (UNWTO).

Img.1: International tourism arrivals and receipts in percentage (UNWTO)



Source: UNTWO 2021

Img. 2: International tourism arrivals and receipts in billion



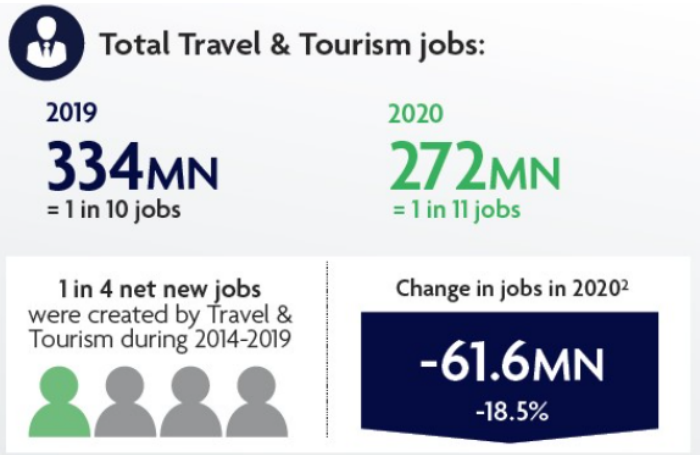
Source: UNWTO 2021

In 2019, travel and tourism accounted for 10.4% of global gross domestic product (GDP), 1 in 10 jobs, 334 million of employed. Between 2009 and 2019, real growth in international tourism receipts (54%) exceeded growth in world GDP (44%). The investment cycle also remained strong throughout 2019, with tourism mobilizing $ 61.8 billion in global FDI, which in turn created more than 135,000 jobs.

Img.3: Total Tourism GDP contribution

Source: UNWTO 2021

Img.4: Total travel and Tourism jobs



Source: UNWTO

The travel industry shows a trend in the annual growth rate, with a yearly growth rate of approximately 5% during 2018-2019. Although in 2020 due to the pandemic there was a 50% drop as leisure travel was banned. However, the pandemic requires new trends and projections. It looks like the market will recover. Revenue should grow further. More precisely, an annual growth rate of 21.1% is expected. (Statista Studies Department). International arrivals are expected to reach nearly 1.8 billion by the year 2030 (UNWTO, 2012).

1.1.1 Climate as motivation for travel

Travel motivation is the inner state of a person, or certain needs and wants of the tourists that can be considered as one of the most important psychological influences of tourist behaviour (IGI Global).

Research on travel motivation has revealed several different motivating factors and patterns. The principal question, “why do people travel?” has occupied

the minds of tourist researchers for many years and although the literature is very rich and extensive, in this paragraph we focus on the climate as a motivation.

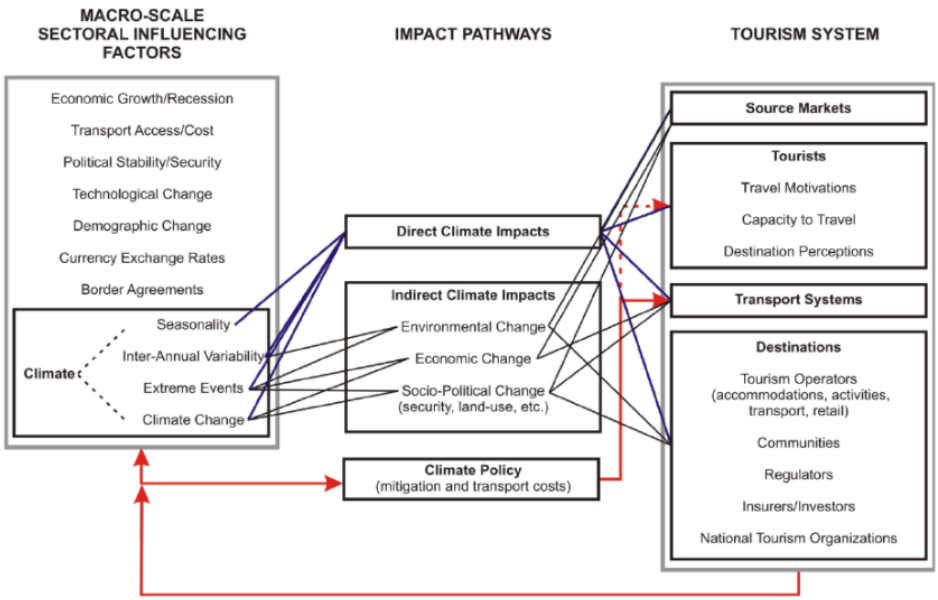
Climate is a key factor considered by tourists, consciously or implicitly during travel planning, and represents both a push and pull factor for tourists. How tourists try to deal with these motivations depends on their physical, financial, and other attitudes and on relevant 'push' and 'pull' factors. (D. Scott, and C. Lemieux, 2010). How tourists try to deal with these motivations depends on their physical, financial and other attitudes and on relevant 'push' and 'pull' factors. Push factors are intrinsic motivators and concern to factors such as travellers' desires and the bad climatic conditions of their region. Pull factors are attributes of destinations that determine their attractiveness, such as their natural resource base, cultural attractions, and climate (Kozak 2002).

Climate and weather are important factors in tourists' decision making and the impacts of climate change may also affect tourism demand directly, and influence the successful operation of tourism businesses, interfering with the choice of destination and the period of the trip, or indirectly affecting the quality of the experience, adverse perception after some extreme event and insecurity about the destination.

There are wide differences in how much Earth's climate will cool or warm after a change in the climate system, and in the ability of tourism institutions and operators worldwide to take terrestrial climate change into account in their decision-making process.

Equally diverse are the segments of the global tourism market, which include sun and beach tourism (strongly influenced by the climate), sports tourism, adventure tourism, nature tourism, cultural tourism, urban tourism, health and wellness tourism, cruises, theme parks, visits to friends and family, meetings and conferences. Tourists within these main market segments have different climate requirements and preferences as well as between groups within each main market segment, create very different climate sensitivities on the demand side in the tourism sector (img.5) For this reason, tourist destinations will benefit from recognizing potential climatic changes in their area and how they might impact on their operations.

Img.5: Influence of climate on tourism subsectors.



Source: Scott, Lemieux 2011

1.1.2 Tourism as a climate dependent industry

Tourism is an industry that largely depends on the climate and the life of many tourist destinations is due to their favourable climatic conditions during a few months of the year or even throughout the year. In fact, some destinations do not know seasonality or have a low seasonality rate thanks to their favourable climate that allows a constant flow of tourists over 365 days.

It is therefore important to dwell on the potential implications of climate change for global tourism, with particular attention to the industries that are part of it. The effects of these changes depend on the reaction and flexibility shown by tourists and industries with respect to the changes themselves, which spill over into the space-time reorganization of tourist activities.

The ability of a given location to attract tourists is largely dependent not only on the climate but also on the environmental conditions it offers, such as, for example, cleanliness and quality of the sea, width of the beaches, snow, drought. Global warming and its negative effects are already conditions capable of changing tourists' behaviours and choices. Mountain resorts where snow cover is no longer guaranteed by nature are abandoned in favour of stations located at greater heights, beaches previously crowded with tourists are now avoided due to the high temperature of the sea water. Try to think of the effect of a 1-meter rise in sea level in the Islands with the consequent loss of available beaches, or the erosion of the coasts. Over time, man has transformed the territory making it much more vulnerable to the occurrence of destructive natural events. In general, the causes of the increase in degradation and consequent damage can be found in the current

models of social and economic development that amplify the vulnerability of settlements characterized by dangerous locations, unsuitable forms of settlement and organizational dysfunctions.

1.1.3 Tourism demand and climate

There are three fundamental characteristics in the tourist demand:

1. It is composite: it consists of goods and services.
2. It is seasonal: it tends to be concentrated in certain periods of the year (summer, holidays, weekends, events, etc.) in relation to the climate, the availability of holidays, etc.
3. It is elastic: it tends to change according to the increase or decrease in prices, social and natural events, changes in fashion, changes in climatic conditions etc ...

The tourist demand is increasing:

1. if the prices of services and goods decrease (accommodation facilities, carriers, museums, etc.)
2. following other favourable events: advertising; important events in the locality itself; favourable climate conditions.

The tourist demand decreases:

1. if the prices of goods and services increase
2. following other adverse events: infectious diseases, epidemics and pandemics such as COVID-19; natural disasters, unfavourable climate conditions; terrorism; wars.

It is replaceable: the tourist can choose from a large number of destinations and offers, different from each other but all useful for satisfying the need to travel. The tourist has certain needs, carefully chooses their destinations, analyses the various proposals and is very attentive to the quality of the services that are offered.

Climatic conditions influence destination choice and as a result national and global tourist flow. They also are important factors in tourists' satisfaction and activity participation, as well as safety.

It is well known that the tourist demand is largely influenced by the climatic factors of a territory towards which it is intended to mitigate. The climatic factor is seen as a key driver and as a peculiarity of the destination capable of attracting visitors only under certain and very specific climatic conditions. For example, in the case of seaside destinations or more specifically in the case of the Islands, the climate acts as a facilitator that makes tourism a possible, accessible, and pleasant activity.

Seasonal declines in demand due to unfavourable climatic conditions has severe economic implications for both sun and sea destinations and the associated resorts, including accommodation businesses and all the industries involved in the tourism sector.

Changes in the spatial and temporal characteristics of climatic resources produce significant effects on tourism demand at different levels. This will happen both because of changing conditions at the destination level and of climatic variables perceived as less or more comfortable by visitors (Gössling & Hall, 2006;

Gössling, Scott, Hall, Ceron, & Dubois, 2012). This is particularly relevant for destinations whose demand largely depends on climate factors such as the Mediterranean Islands. If the perception of what is already with respect to a destination changes, then travel flows could suddenly change. A favourable, warm climate for tourist destinations characterized by a demand for tourists, mostly from very cold northern countries, is essential. However, the conservation of the coasts is equally important, as they could face erosion due to climate change. The same great value possesses the rise / level of marine waters. In the coastal areas of the Islands, it has the power to cause long-term economic impacts on state tourism in industry and its attractiveness as a tourist destination. Despite the negative consequences of climate change impacts on coastal destinations, effective timing and adaptation and mitigation are vital in determining the magnitude of climate change impacts.

The climatic factors that are important include elements such as temperature, wind, rainfall, humidity, and radiation. Climate-influenced tourism demand has been the subject of many studies. The desire to measure the climatic adequacy of a tourist destination that already exists or that could become such, using a unique indicator which considers the meteorological aspects related to beach tourism and the impact of climate change on tourist flows.

An attempt was therefore made to aggregate all the climatic parameters into a single index capable of giving a simple interpretation of the suitability of the destination for carrying out activities related to tourism. A first index called the Tourism Climate Index- TCI is provided to us by Mieczkowski in 1985 which contains seven climatic parameters (maximum air temperature, average air

temperature, minimum relative humidity, average relative humidity, amount of precipitation, hours of sunshine and average wind speed). But the studies are much broader, in fact De Freitas in 2008 proposes a new CTI Climate Index for Tourism in order to integrate the one proposed by Mieczkowski.

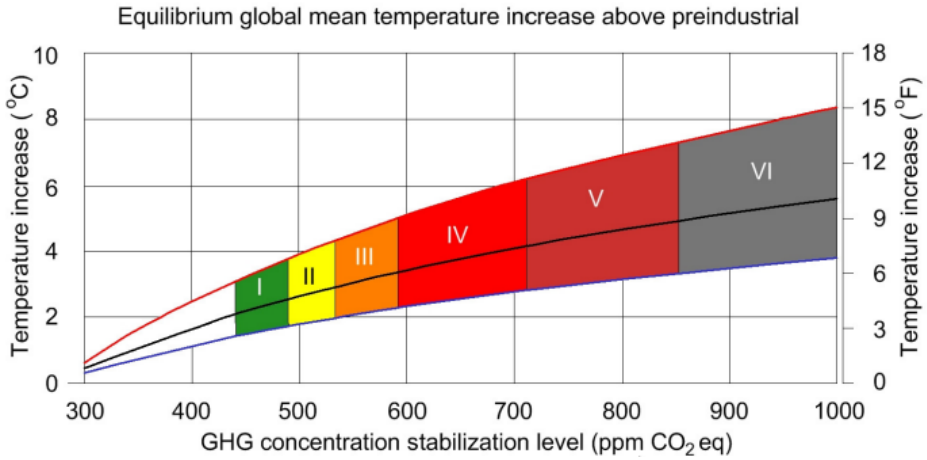
1.2 Causes, evolution, and dimension of Climate Change in Tourism

"Climate change" means a change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable periods of time"

- *United nations framework convention on climate change, 1992*

According to the Intergovernmental Panel on Climate Change (IPCC; 2001), the global mean surface temperature has increased by 0.6 ± 0.2 ° C since 1861. The expected temperatures depend on the atmospheric concentration of greenhouse gases, usually expressed in the form of carbon dioxide equivalent. A stabilized concentration of 500 parts per million would most likely result in a temperature increase of approximately between 2 and 4 degrees Celsius (Susanne Beken,2010). The global mean surface temperature will increase between 1.4 and 5.8 ° C between 1990 and 2100.

Img.6: Temperature increase and concentration of GhG gas



Source: The Stern Review on the Economics of Climate Change

Climate change certainly has an impact on lifestyle and society. But to date, the assessments on these impacts focus mainly on resource sectors such as water, forestry and agriculture. These impacts can damage ecosystems, biodiversity, and landscapes, as well as infrastructure and human wellbeing. On the other hand, the lack of studies evaluating the impact of climate change for tourism and the implications these have on the entire industry is surprising. According to Hall and Higham (2005, p. 21), “[I]n terms of the future of tourism, as well as the societies within which we live, there are probably few policy and development concerns as significant as global climate change.”

In 2016, anthropogenic emissions from tourism related to transport amounted to 5%, which represented 22% of total emissions from transport. By 2030, they are expected to represent 5.3%, that is, 21% of the total transport-related " And “as the volume of tourism and the development of low-carbon travel increases, a drop in emissions per traveler / km is expected over the next decade”.

"Between 2016 and 2030, the CO2 emissions of tourism related to transport should go from 1,597 million tons to 1,998 million tons, which represents an increase of 25%". This is what emerges from the report of the "Transport Related CO2 Emissions of the Tourism Sector" presented by the United Nations world tourism organization (Unwto) and the international transport forum (Itf) at the COP25 Unfccc held in Madrid in 2019.

The increase in emission matches with the increase that will be registered in arrivals. In fact, international and domestic tourist arrivals should increase from 20 to 37 billion between 2016 and 2030 and "the bulk of this figure comes from domestic tourism which goes from 18.8 billion to 35.6 billion arrivals, then from international arrivals (from 1.2 billion to 1.8 billion) "(Untwo / itf).

The problem that arises is to identify tourism as an industry that generates a large part of world GDP but which at the same time depends on the climate but is responsible for climate change itself. Tourism and climate are two sides of the same coin. It is necessary to identify how the tourism sector affects climate change and how climate change affects the tourism industry. Without transport you cannot do tourism, but if transport pollutes too much, the climate changes and climate change does not generate a positive impact on tourism. Certainly, the policies and actions must be pursued and encouraged to reduce the emission of polluting gases and to introduce a way of doing tourism that is sustainable.

"With a view to an effective transformation of tourism for climate action". According to the UNWTO, cooperation between the tourism industry and transport needs to be strengthened.

Commenting on the report presented "Transport Related CO2 Emissions of the Tourism Sector", the executive director of Unwto, Manuel Butler, stressed that it is up to the tourism industry and policy makers to use the data presented by the study efficiently, so that the sector maintain a leading role in the climate emergency.

Governments must present concrete policies for the sector to initiate collective action at the international level to raise the level of global awareness and sustainability. In this regard, the One Planet Sustainable Tourism Program currently represents a vital mechanism for promoting sustainable tourism all over the world. The executive deputy secretary of the United Nations framework Convention on Climate Change (Unfccc), Ovais Sarmad, highlighted the need to redouble efforts and set more ambitious goals to safeguard tourism and the climate.

According to UNTWO, transport-related greenhouse gas emissions from tourism represent a major problem that must be contained at all costs. The tourism sector must be required to cooperate closely with the transport sector in order to support and accelerate the decarbonisation process and implement a high level of ambition, to complete the action of the transport sector. Tourism should take actions to allow its expansion on the one hand and limit its emissions on the other, without forgetting the primary objective which is global growth in compliance with international climate objectives.

"In the face of climate change, the travel and tourism sector, with its significant economic and social benefits, has no choice but to transform to survive and thrive." Thus intervened the UNFCC secretary, Patricia Espinosa, during the World Travel and Tourism Council in Madrid in 2019. Patricia Espinosa stressed

that «Thanks to this industry, millions of people have been able to explore new destinations, reunite with the family and friends and fulfill dreams of exploring the world. In addition, it has created jobs, especially in developing countries, by providing financial freedom for people. It is truly a global economic powerhouse. With this kind of success, why should what has been done? Frankly, because there is no choice. For nobody. The ravages of climate change will soon require all of us, especially governments and businesses, to do things differently. If some companies and industries fail to adapt to this new world, they will no longer exist ".

1.2.1 Climate and seasonality

Some forms of tourism are a consequence of the climate: this is the case of seaside tourism and nautical tourism. It is well known how the choice of the tourist is largely influenced by the climate, with reference to the islands and their latitude and therefore to the climatic variations that find their full manifestation in the seasons. Wanting to make a comparison between islands, located in the same climatic zone, in the Mediterranean Basin, it can be noted that in the twelve months tourism flows are attracted according similar intensities, it depends on the similar climate condition between islands.

The peak tourist season for the islands is summer. Free time coincides with holidays which in turn usually coincide with the closure of schools and / or holidays. As a result, tourist destinations are more or less crowded at certain times of the year. This phenomenon is known as tourism seasonality. This can be defined as a systematic, although not necessarily regular, variation of tourist presences and arrivals during the year. Seasonality in tourism depends on many factors, but in the

case of the islands, destinations where the main element is the sea, the component that most influences seasonality is certainly the climate.

Analysing the seasonal situation of the islands we considered (Sicily, Sardinia, Cyprus, Corsica and Crete) we will see how the climatic component in seasonality is the main factor that determines seasonal peaks of tourist presence where temperatures reach higher degrees for the Islands that are characterized by a balneary and nautical tourism.

We want to demonstrate a correlation between high temperatures and tourist presences in the islands we have taken into consideration, characterized by seaside and nautical tourism. Usually, these destinations have a single seasonality.

In *Sicily*, During the month of August, the presences amounted to 2,999,371, a high peak is also reached during the month of July with 2,522,257 presences in 2019.

For *Sardinia*, the peak is reached during July and August with the maximum average temperature of the year.

Also, for *Cyprus* Island is evident the mono-seasonality with a peak of presences in the month of August, when the temperature reaches maximum levels of 26 degrees.

In *Crete*, the phenomenon that occurs is mono seasonal. We reach peaks in attendance for a total of about 5 and a half million during the month of July and August. Tourism is seaside and nautical. Here too a positive linear correlation (+X; +Y) is demonstrated.

The correlation between temperature increases and tourist presences has also been demonstrated for *Corse* with a maximum of 679.620 visitors in August with 23 degrees.

The *Maltese* situation is typical of cultural tourism destinations where the visitor prefers to visit the city with a mild and not too hot climate. Although we cannot demonstrate a linear correlation between high temperatures and tourist presences since we are not talking about nautical or seaside tourism, we can certainly say that even here the climate influences the tourist's choice to visit the city during the less hot and sultry but not cold periods.

In summary, we can say that the correlation between high temperatures and tourist presences occurs in destinations with greater seaside interest, in destinations with historical-archaeological or cultural interest, tourists prefer to stay for months with milder temperatures and seasonality is absent.

1.3 Implication

In this paragraph we focus on the effects and implications that climate change has in general and more particularly for islands and therefore for coastal areas.

The state of the Mediterranean coasts is constantly changing due to erosive processes as an effect of climate change, both severely compromised by human activities. These erosive, human and subsidence processes cause significant damage of various kinds. We will focus on the economic damage, and on those caused to the tourism sector.

The coastal areas of the Mediterranean Islands are the place of residence of an important part of the population and therefore host numerous economic activities from port activities to industry, passing through agriculture, tourism and communication infrastructures. It is estimated that in the European Union one third of the population lives in areas within 50 km of the coast. In Italy, for example, it is estimated that around 30% of the population lives in coastal areas, which are also home to some of the country's main urban centres. There has been a lowering of the continental shelf of about 6/8 meters in the last 6 thousand years and this is of great concern.

The effects of climate change for the coastal areas, therefore for the islands, mainly concern the rise in sea level and the increase in the frequency of extreme events resulting in floods. Indirect effects must also be considered concerning changes in ecosystems and consequently to human activities on the coasts, due both to the transformation of coastal areas and to the changed climatic conditions foreseen for the Mediterranean area, in terms of frequency of precipitation and variations in the temperatures. Consider that a change in marine biological fauna leads to a decrease in fishing activity along certain coasts. If the species die, there is no fishing, without fishing one of the main economic activities, but also entertainment and attractions for the islands, dies.

We can catalogue the phenomena related to climate change for the Mediterranean area and distinguish them mainly in three lines:

- Rising of the sea level
- Increase in average temperatures

• Increasing frequency of extreme events

Rising of the sea level

For the Mediterranean basin it is estimated a rise in the next century, equal to 0.30 meters in the water level. For the Mediterranean coasts, the damage caused by sea level rise, together with subsidence movements, make the impacts caused by storm surges and tsunamis more incisive, generating an inland migration. According to an IPCC study, 20% of the coasts in Mediterranean areas could disappear by 2080 (Nicholls 2004). The same study also predicts the accentuation of eutrophication and stress problems in coastal biological systems, following the rise in temperatures (EEA 2004; Robinson, Learmonth et al. 2005; SEPA 2005; SEEG 2006).

However, the downscaling of these forecasts must respect some precautions: while at the aggregate level the values deriving from similar simulations can be considered sufficiently valid (Nicholls and Tol 2006), at more detailed levels it is essential to consider specific socio-economic parameters for obtain a robust estimate of the economic values of the impacts and adaptation measures. For all the coasts of the Mediterranean it is therefore important to take into account the socio-economic characteristics and specific behaviours due to the peculiar characteristics of this sea. According to the estimates presented by the UNFCC (2002), based on the results of the Third Report of the IPCC (2001), the rise in the level of the Mediterranean Sea by 2090 should be contained between 18 and 30 cm.

Extreme facts

The studies predict a general increase in events of this kind for the whole Mediterranean basin. Together with the phenomena of sea rise, the extreme events will determine a greater vulnerability of the coasts, due in part to the modification of the relationship between sea level and topographical level of the coasts, with consequent flooding both by the sea and by the mouths of the rivers for greater difficulty in draining the water of rivers into the sea.

Temperatures and rainfall

The increase in average temperatures, as predicted by various studies, will lead to a greater assiduity of heat odes with the consequent shift of climatic characteristics towards northern latitudes not without consequences for human health and for the tourist attractiveness of the different areas. The rise in the average temperature also causes other types of dangerous consequences. In fact, the transformation of marine life is connected to it. Furthermore, the reduction of rainfall in the Mediterranean area, together with the increase in water consumption for tourist use, will cause the reduction of underground freshwater reserves in coastal areas and in particular Insular areas, all this will cause further stress and damage especially during the periods of drought and heat waves. The major implications are summarized in the table below (Table 6)

Tab.7 Impact and implication for tourism

Impact	Implications for tourism
Warmer temperatures	Altered seasonality, heat stress for tourists, cooling costs, changes in plant-wildlife-insect populations and distribution, infectious disease ranges
Sea surface temperatures rise	Increased coral bleaching and marine resource and aesthetics degradation in dive and snorkel destinations
Sea level rise	Coastal erosion, loss of beach area, higher costs to protect and maintain waterfronts
Reduced precipitation and increased evaporation in some regions	Water shortages, competition over water between tourism and other sectors, desertification, increased wildfires threatening infrastructure and affecting demand
Decreasing snow cover and shrinking glaciers	Lack of snow in winter sport destinations, increased snow-making costs, shorter winter sports seasons, aesthetics of landscape reduced
Increasing frequency and intensity of extreme storms	Risk for tourism facilities, increased insurance costs/loss of insurability, business interruption costs
Increased frequency of heavy precipitation in some regions	Flooding damage to historic architectural and cultural assets, damage to tourism infrastructure, altered seasonality
More frequent and larger forest fires.	Loss of natural attractions; increase of flooding risk; damage to tourism infrastructure.
Changes in terrestrial and marine biodiversity	Loss of natural attractions and species from destinations, higher risk of diseases in tropical-subtropical countries
Soil changes (e.g., moisture levels, erosion and acidity)	Loss of archaeological assets and other natural resources, with impacts on destination attractions

Source: Becken 2010.

1.3.1Climate impact and Tourism sustainability

It is well known how the climate impact affects tourism demand through the choice of the tourist but also the offer of the destination, trough resources and attractions that this can offer. But we must note how the very movement of tourist flows to destinations causes, like all transport, strong impacts both in the destination itself and in the transit regions. In fact, global tourism has a significant impact on the climate. Research promoted by the University of Sydney and published in Nature Climate Change, shows how the sector is responsible for 8 percent of total CO2 emissions. The results of the research show how tons of CO2 have gone from

3.9 to 4.4 billion tons in just 4 years (2009-2013) and looking at the increase in tourism in recent years, at a rate of 4.4 % on an annual average, it is easy to assert that more tourism means more transport and therefore the equation more transport more pollution is always true. The aim of "decarbonising" the economy - that is, ensuring that economic activities are no longer accompanied by CO2 emissions - collides with the growing demand for travel that uses a lot of energy per kilometres travelled.

The most polluting impact in the transport sector is represented by air flights, short-haul flights in fact produce 200 grams of CO2 per km traveled by 1 tourist, while long-haul flights around 120 grams per capita. But the analysis also considers emissions not strictly related to transport such as those related to infrastructure, retail and the consumption of food and drink related to tourism.

Researchers' interest in studying climate change and the effects it has on tourism moves its attention to an important issue: sustainability. Sustainable tourism aims to promote knowledge and enhancement of local cultures and traditions, while respecting the environment and the life systems of the host countries, territories, and populations. A not insignificant contribution must also be given by the tourist visitor in his small way. In fact, choosing to stay in eco-friendly structures, built in respect of the environment with an abundant use of natural materials and powered by renewable energy, helps to fight climate change and contribute to supporting the local economy without creating pollution or waste.

Speaking of studies and research on the subject, undoubtedly, we must mention *Weaver* who through his idealized model in 2011 explains how it is

possible to identify the levels of sustainable development in a destination but in fact known as the disproportionate attention to climate change is counterproductive to achieve the real sustainability in tourism and this leads to a failure of the international community regarding concrete actions to be taken to stem the phenomenon of climate change. His thinking was further developed in 2012 when he argued that some contextual factors such as not only environmental but also economic, if well dosed and weighted in the right way, can lead to sustainable growth in the long term, as a response, to stem the problems brought about by climate change. In contrast to this thought, *Peeters* in 2012 emphasized how growth and sustainability are two opposing facts or one or the other exists.

Therefore, to stem the phenomenon of climate change, it is necessary to put in place land management mechanisms, designed to preserve its resources in a long-term perspective by balancing the interests of operators in the tourism sector with those of the local community.

Chapter 2: Analysis of Island Med Tourism and climate influence

2.2.1 Actual climate and risk in Sicily

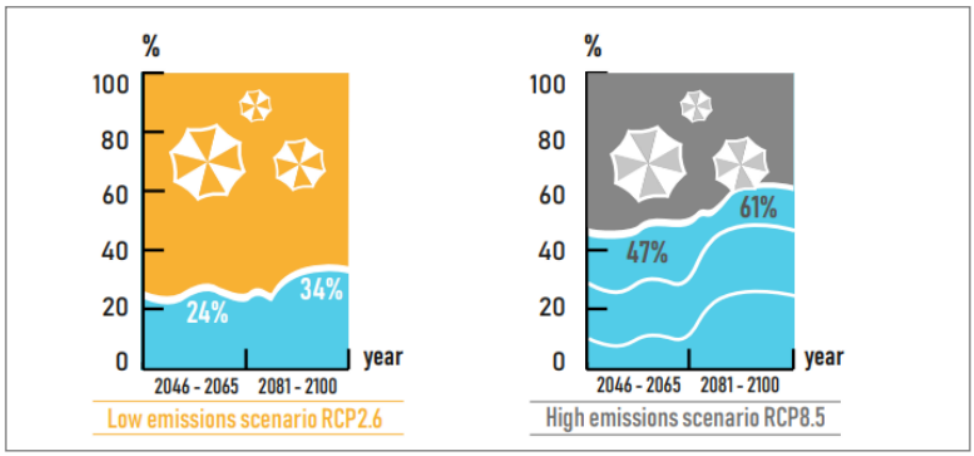
The climate of Sicily is Mediterranean on the costs, as in the archipelago, characterized by hot summers and mild winters. The coasts enjoy a subtropical climate thanks to the influence of the winds coming from Africa, in fact the average annual temperature on the coasts exceeds 18.5 ° C, the average temperature of the coldest month is about 10 ° C, while the temperature of the hottest month exceeds 22 ° C. As a result, a typically subtropical vegetation has developed, alongside the already existing native Mediterranean scrub. In the inland, which is mainly mountainous, the climate is continental on the hills, with winters moderately cold and summers quite torrid. The rains are not frequent even in winter. Snowfalls, on the other hand, exist for altitudes above 1.000 meters and can be frequent and abundant. For example, on Etna volcano, it snows even in summer due to the influence of the Atlantic currents. Under current conditions climatic conditions on the island are associated with medium-high risks.

Tourism sector and related relevant Scenario

According to Soclimpact study, a negative effect of climate change in Sicily is the ***flooding of coastal areas*** due to rising sea water levels. The sandy beaches, which are the main source for tourist activities, will be affected of the Mediterranean Islands. In fact, the tourist activity is concentrated on the coasts

where there are beaches, seaside activities and restaurants. Therefore, the economic risk that is recorded is of considerable importance.

Img.8: Beach reduction Scenario 1, Scenario 2.

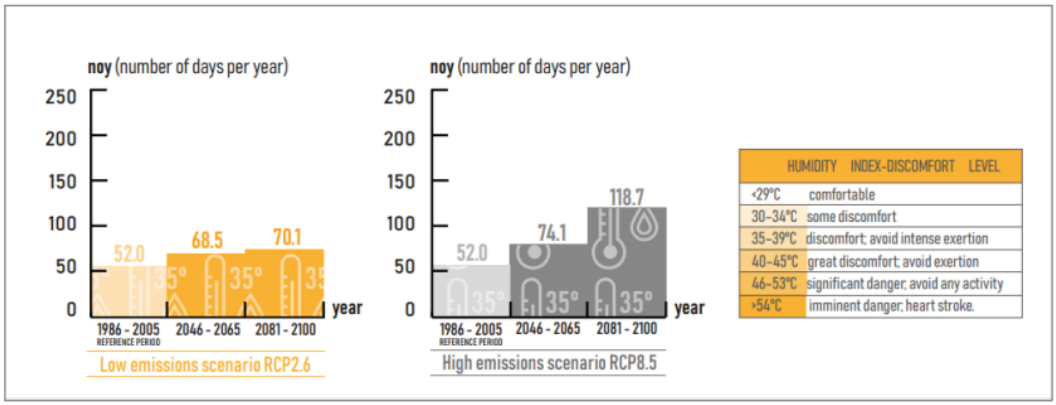


Source: Soclimpact project

It is estimated (Soclimpact datas) that the reduction in beaches will be around 64% by the end of the century due to high emissions.

The Soclimpact study proceeds by using the ***moisture index*** (Masterton and Richardson, 1979) to measure temperature perceived by people given the real air temperature and relative humidity. The number Humidex above 35 ° C describes uncomfortable and impending conditions danger to humans. According to the scenarios of the study, Sicily will have 4 months with uncomfortable conditions by the end of the century. This once again leads to a decrease in tourism.

Img.11: Humidity index Scenario1, Scenario 2.



Source: Soclimpact project

2.3.1 Actual climate and risk of Corse

The climate of Corse is Mediterranean on the costs characterized by hot summers and mild winters. But we can differentiate the climate of the island depending on the altitude and the winds. In fact, it is possible to measure a large variation in temperature depending if we are up to 200 m of altitude, it is a Mediterranean climate with less of 500 mm of rainfall in the costs that are very dry in the summer. Thunderstorms are rare but violent and the maximum temperature is of 30 degrees but in the winter is around 7 degrees. In the island, from 200 to 1000 m of altitude it's called the transition zone. From 1000 and 1500 m of altitude there is a moderate climate with a medium temperature of 0 degree and current rainfall. At the end Corse has a really Alpine climate for more than 1500 m of altitude.

Extreme heat: Corsica is not subtracted from the risk of heat waves. In fact, in 2019 there were record temperatures. The western part of Corsica in 2019 was

fully hit by African hot currents, which, at an altitude of 1500 meters, reached values of + 22/24 ° C, very high for being in early June.

These siroccal winds have caused the temperatures of Corsica to soar upwards, so much so that it reaches 40 ° C. These events are destined to increase due to climate change and cause inconvenience to the population and tourists who do not expect to interface with such high temperatures. Although the risk is currently medium, it is expected to become high in the coming years.

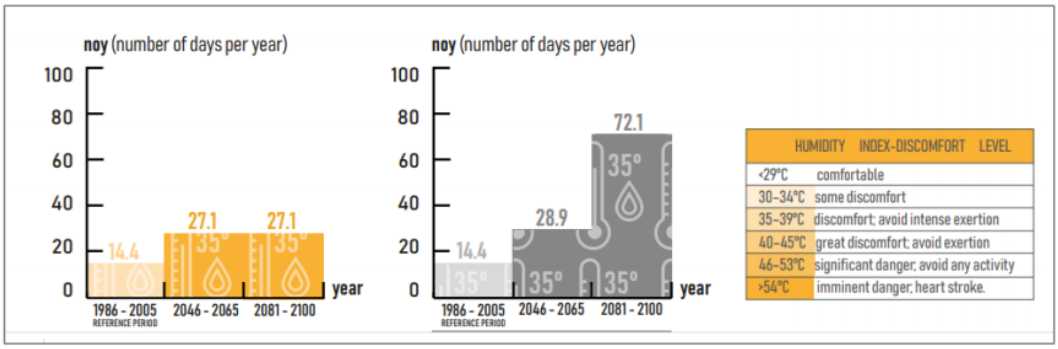
2.3.2 Tourism sector and related relevant Scenario

Tourism for Corse is the leading sector for the entire economy of the region. It depends on favourable climatic conditions for tourism that attracts visitors especially from northern Europe accustomed to cold climates. Economists see tourism, which represents about 10% of the wealth produced, one of the best economic levers on the island. According to the Corsica Tourist Observatory, in 2012 31% of the GDP came from tourism.

A problem linked to climate change and tourism is that of the ***deterioration of the beaches***. estimating the potential risk of beach loss due to climate change is of paramount importance for the economy of those islands. According to Soclimpact study at end of century, the total beach surface loss ranges from 38% under a low emission scenario (Scenario1) to -54% under high emission scenario (Scenario 2). Corse is particularly affected as tourism is almost exclusively of a seaside and coastal nature on the island.

The ***humidity index*** is used to measure the impact of heat on human health. According to the study, the current values do not create inconvenience to tourists as they remain below 30 degrees. The problem arises for the future period 2081-2100 in which the humidity level will increase causing discomfort for the tourist who perceives an index above 35 degrees as not optimal for his health. Future projections even attest to it at around 72 degrees.

Img.18: Humidity Index Scenario1, Scenario 2



Source: Soclimpact project

2.4.1 Actual climate and risk in Crete

The climate of Crete is Mediterranean characterized by hot summers and mild winters. In general, however, there are high levels of humidity especially in coastal areas that are affected by the presence of the sea. In coastal area are reached average temperature of 30-40 degrees in the Summer. More high temperature are reached tin the south coast. Crete is characterized for the large deviation of climate from place to place. The precipitation varies, in fact the western Crete receives more rain if compared to the Easter one.

According to the “Global facility for disaster reduction and recovery”, the risks for Crete can be the follow:

1. Coastal flood: The risk caused by extreme sea levels, recorded for coastal flooding in the island of Crete is very high especially in the western area of the island in the territories of Chania.

2.4.2 Tourism sector and related relevant Scenario

Tourism for Crete represents the driving force for the entire regional economy. Tourism revenues in Crete accounting for 35% of regional GDP. The demand trend is really positive and tourist presences have recorded a dizzying increase (+ 166%) in the last 10 years. The economy of Crete is mainly based on services and tourism. Due to the climate and soil of the island, there was a decline in agricultural production which was the main activity with the consequent expansion of the third service sector (especially in tourism). The island has a per capita income much higher than the Greek average, undoubtedly thanks to the constantly developing tertiary sector. The GDP deriving from tourism in Crete represents 22.9% but it is estimated to grow up to 23.5% in 2100.

Tab.16 Provisional GDP in Crete

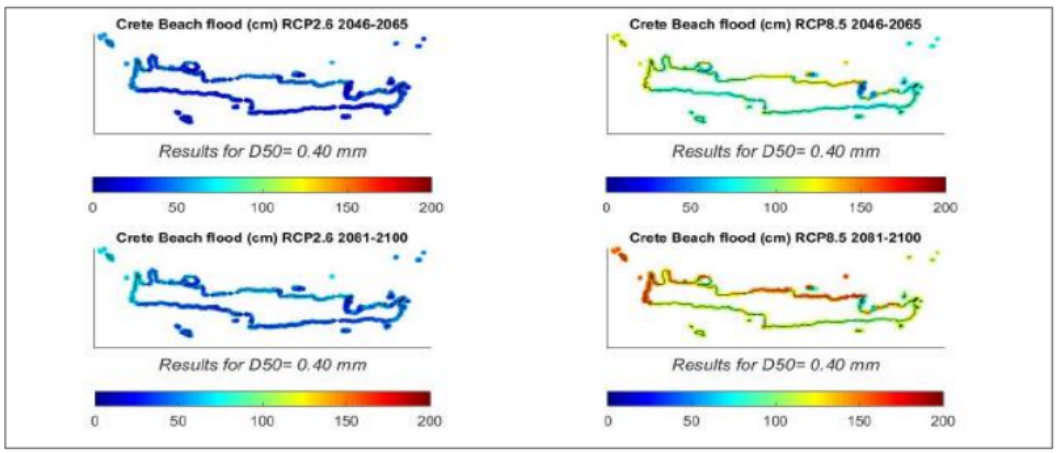
	2020	2025	2030	2035	2040	2045	2050	2060	2070	2100
Tourism	22.9%	22.7%	22.6%	22.4%	22.6%	22.7%	22.7%	22.8%	23.2%	23.5%

Source: Soclimpact project

Tourism is a strong sector, driving the economy and we want to protect from the risks of loss of tourism deriving from the negative effects of climate change.

One of the major problems related to climate change for the Island of Crete is the ***beach flooding***. Because of the increase of the mean sea level the beaches are considerably reduced, causing inconvenience to the tourist who does not find the sand and the right space to enjoy a pleasant day at the beach. According to Second Scenario, an increase in sea level rise is expected by the end of the century with the consequence of the coverage of the beaches, for a value of 116.54 cm.

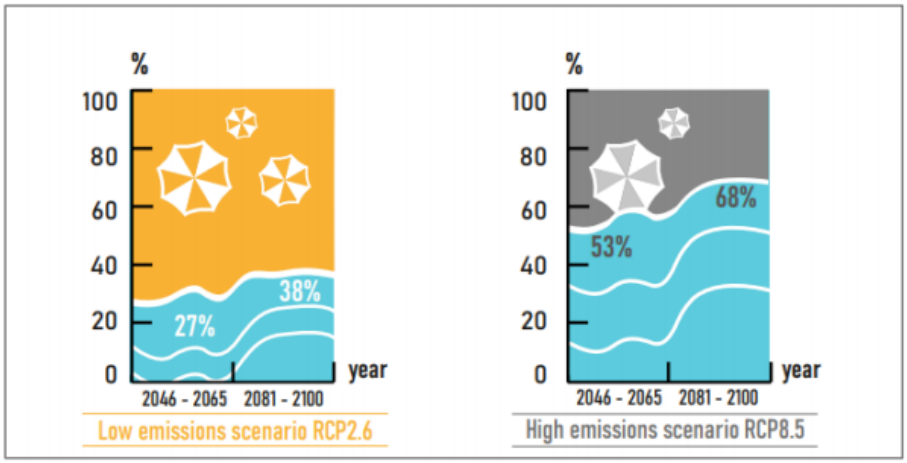
Img.20: Flood level projection Scenario1, Scenario 2.



Source: Soclimpact project

Under the Second scenario, can be observed a loss of 68% of beaches.

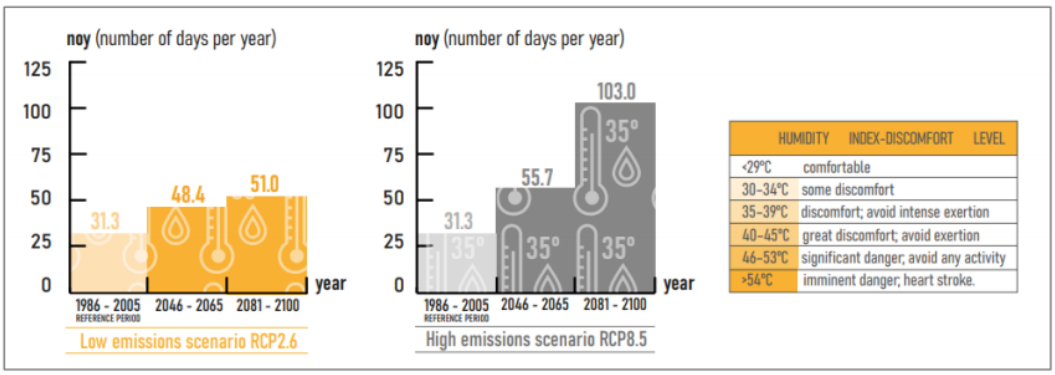
Img.21: Beach reduction Scenario1, Scenario 2.



Source: Soclimpact project

Also, for Crete, the humidity index is taken into consideration to study the temperature perceived by tourists. According to the Second Scenario, Crete will have 3,5 moths with discomfort condition by the end of the century.

Img.25: Humidity index Scenario1, Scenario 2.



Source: Soclimpact project

2.5.1 Actual climate and risk for Cyprus

The climate of Cyprus is Mediterranean characterized by hot and dry summers and mild winters. The climate in the Island is it is generally marked by the seasons. Summer is an early season for some islands in the Mediterranean. In Cyprus we can talk about summer as early as mid-May as the temperature is typically sunny and hot in summer and lasts until mid-September with absence in precipitations (under 5% of total precipitation of the year). We have a mild winter with the ,60% of total rainfall, from mid-November to mid-March and two short spring and autumn seasons with a passing climate.

1. Extreme heat: Medium-risk heatwaves are currently expected for the entire island if we consider today's climatic conditions.

Significant climatic events have hit the island, among the most recent we mention:

- Cyprus in June 2020 issued a weather alert with maximum temperatures expected to reach 40 degrees Celsius, a sign that climate change is current and is affecting the islands more and more intensely. The Department of Meteorology in the same year issued an extremely high temperature warning, "Yellow" awareness level, as a fairly significant heat wave is expected. An important heatwave hit the Island also in 2017.

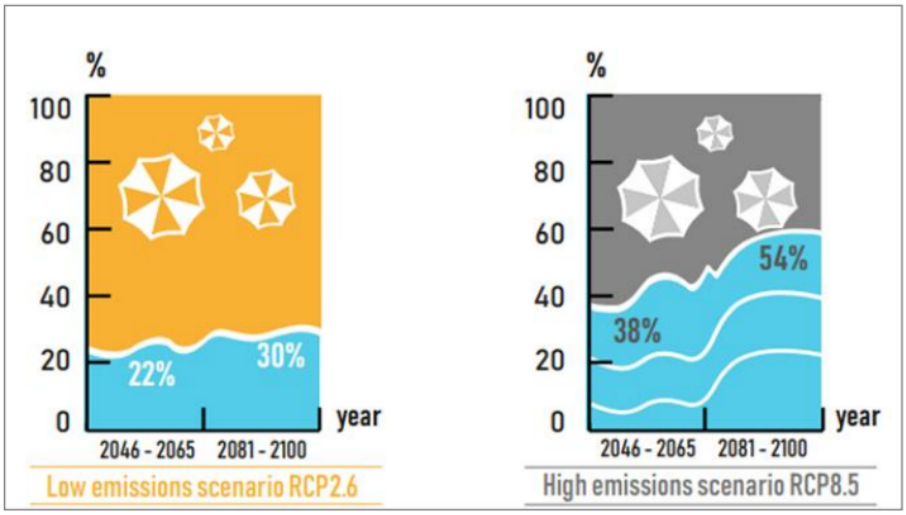
2.5.2 Tourism sector and related relevant Scenario

In Cyprus, marine and archaeological tourism have developed in the last thirty years. The southern coasts of the island represent the symbolic environments

of the Mediterranean Sea and its climate. Cruise tourism has also developed a lot, many cruises choose the beaches of Cyprus as ports to land. The inland landscape manages to fascinate visitors, especially during the summer despite the desolation of its lands. Cyprus in 2018 recorded an increase of 6.1% in arrivals and departures compared to 2017. In 2018, 88.2% of total tourist arrivals were represented by European tourists. The trend in tourist demand is positive so much so that there is an increase in presences of + 52.65% in the last 11 years.

Under Scenario 1 is clear that at the end of the century the beach surface will be loosed for the 30% and under Scenario 2 of 54%.

Img.27: Beach reduction Scenario1, Scenario 2.

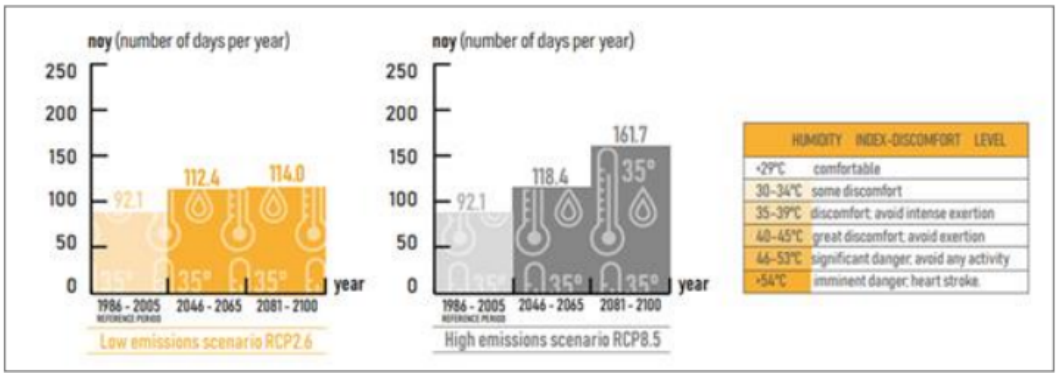


Source: Soclimpact project

According to the current climatic conditions and according to scenario 1, days with 35 degrees correspond to just over three months with a slight increase in

the middle of the century. While if we consider a scenario with high emissions, there will be at least 5 days of discomfort and danger due to humidity.

Img.31: Humidity index Scenario 1, Scenario 2.



Source: Soclimpact project

2.6.1 Actual climate and risk for Malta

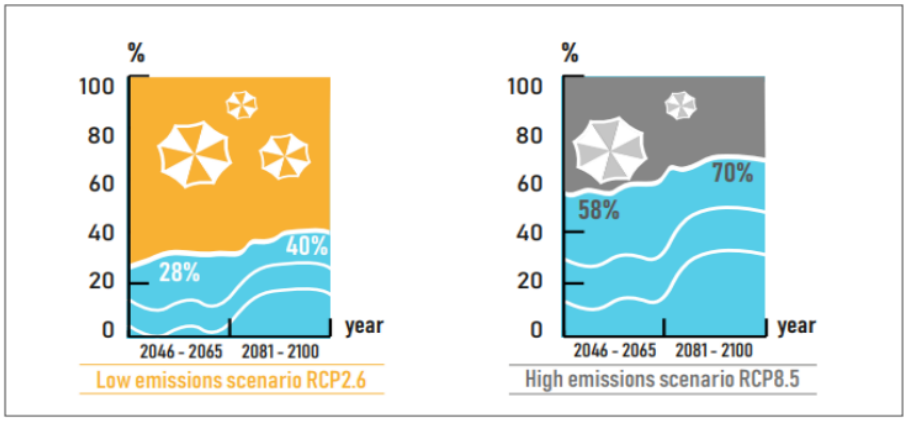
The climate of Malta is a typical Mediterranean climate with very mild and rainy winters and hot and dry summers. The average annual temperature is 19 ° C, among the highest in Europe, Valletta has the mildest winters, with highs reaching 15-16 ° C and lows almost never falling below 10 ° C. L. In 2014 was reached a maximum temperature of 50 degrees. The mean temperature in summer is 35 degrees with more humid coastal areas (75% average) compared with the inland area. At the end of the summer the island is often hit by weather instability with heavy thunder thunderstorms and heavy rains. This happens because the colder air comes from the north, combined with warmer waters it creates climatic discomfort.

2.6.2 Tourism sector and related relevant Scenario

Tourism is one of the main pillars of the Maltese economy thanks to its exclusive casino it attracts many tourists throughout the year. Only the real estate activities produced an aggregate value of 442.2 in 2015 and 531.7 in 2018, a notable increase can be seen. Malta attracts tourists both for its rich artistic and cultural heritage and for leisure activities for young people looking for entertainment and night clubs. Seaside tourism is also highly developed. Malta has recorded an increase of 68,83% of overnights stays from 2008-2019 with an average stay of 7 days, the demand trend is positive.

A consequence of the rising of the sea is given by the erosion of the coasts, by the ***beach flooding***. Considering Scenario 1, we find that there will be a 40% loss of beaches. The risk is aggravated if we consider the second scenario, in fact a loss of 70% of the beaches is expected. This has a negative effect on the demand for seaside tourism, a decrease of 70% is quite significant, the tourist will be led to choose another destination for seaside tourism.

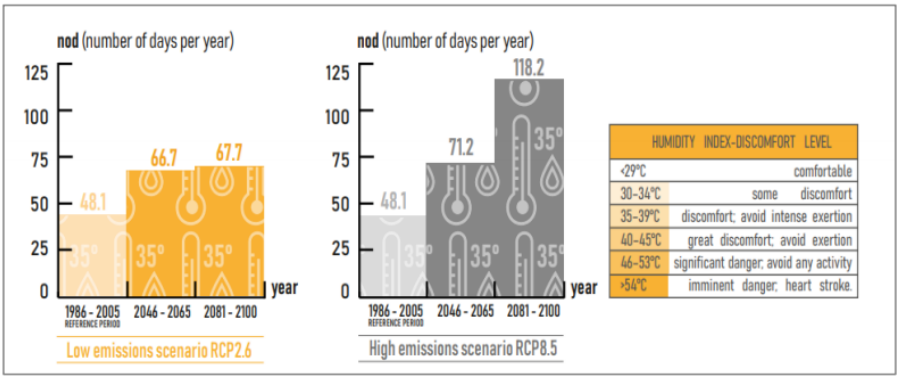
Img. 36 Beach reduction



Source: Soclimpact project

Also, the temperature perceived by the tourist is taken into consideration, using the ***Humidex index***. Under the low-emission scenario, uncomfortable temperatures around 35 degrees will be around 48 days and then increase to 68 by the end of the century. If we consider a scenario 2 with high emissions, temperatures around 35 degrees will hit the island for 118 days by the end of the century. That's a really high number. Regarding the loss of competitiveness of the destination due a decrease in ***thermal comfort***, Malta, according to the Scenario 2, reaches a value of 0.1970, is the second after Cyprus in our analysis. The Sensitivity component contributes 52.3%, this is due to the thermosensitive activities that tourists carry out when visiting the destination, since tourism is cultural but on the other hand, Malta has a good adaptive capacity, medical assistance being active on the island

Img.37: Humidity index



Source: Soclimpact project

2.7.1 Actual climate and risk for Sardinia

The climate of Sardinia is a typical Mediterranean climate with mild winters and hot and dry summers but thanks to the presence of the sea, there is considerable ventilation along the coasts. The sea breezes and constant ventilation allow it to withstand the high summer temperatures that exceed 30 ° C and even reach 35 ° C. In inland areas due to the distance from the sea, lower winter temperatures and higher summer temperatures are recorded than in coastal areas. The climate is mild, but during the year there can be minimum winter temperatures of a few degrees below zero and summer maximums that exceed +40 ° C. On high altitudes in the winter months, it snows frequently and temperatures drop below zero, while in the summer the climate is always cool. Sardinia is generally a very windy island: the dominant winds are the mistral and the west. Rainfall is not abundant and follow the Mediterranean patterns with precipitation in autumn and winter. The climate is changing moving towards a tropical one, with increase in extreme heat and decrease in extreme of cold.

1. Current climate is index of related risks as ***coastal flood.*** For Sardinia the risk is linked to the South region for the areas of Cagliaritans and

middle Campitans. In these areas the presence of paradisiacal beaches is evident. Actions are needed to counter flooding.

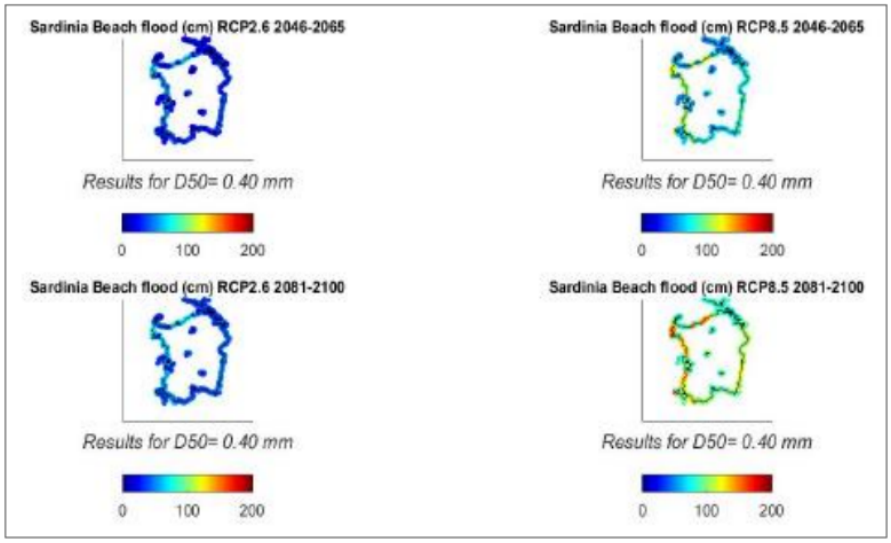
2. For the Sardinian Island a risk deriving from the ***increase in temperatures*** is also foreseeable as medium in the actual climate condition. According to the European Data journalism Network, temperatures have risen by half a degree over the past twenty years and there is a forecast of further growth.

2.7.2 Tourism sector and related relevant Scenario

Demand in Sardinia has increased by 117.3% from 2008 to 2019, only in 11 years. Thanks to the mild climate, the unspoiled landscapes, the purity of the sea waters, Sardinia attracts a large number of vacationers every year. Tourism in Sardinia is worth only 7 percent of the island's domestic product. The data relating to the tourism sector certify that in 2019 "internationalization" improved, seasonality decreased, and the supply of high quality increased (ISTAT). The main ones tourist attractions of the island are beaches (53%) followed from cultural sightings (19%) and attractions related to tradition (12%).

Under Scenario 2, is expected an ***increase of flood level*** at the end of the century, water is expected to flood for 92.47 cm in the Island with a consequence of a loss of beach surface that goes from - 46% under Scenario 1 with low emission to -77% with Scenario 2 of high emission.

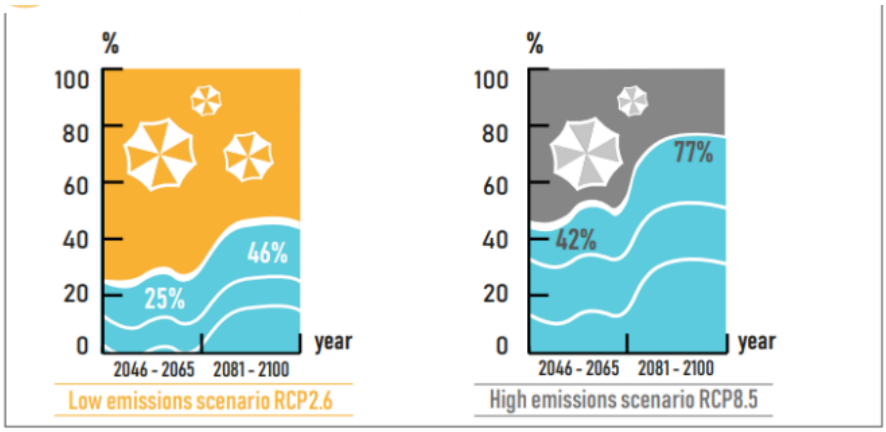
Img.41 Extreme flood level



Source: Soclimpact project

Considering that beaches are a major attraction factor (53%) for tourism, the loss of sandy soil would lead to a reduction in tourist demand linked to seaside tourism.

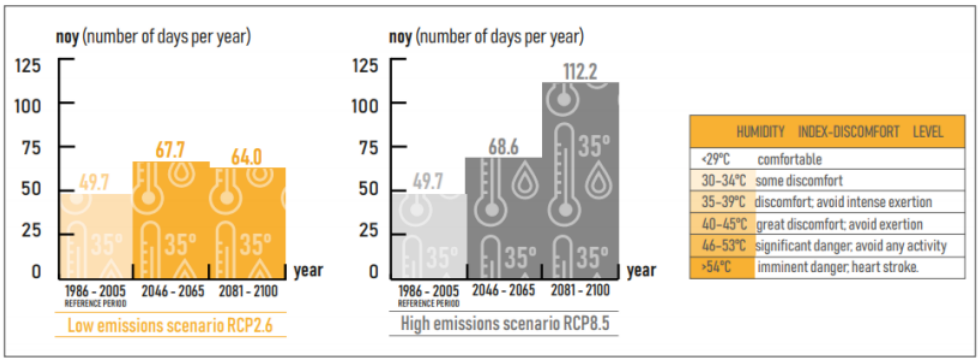
Img.42 Beach reduction



The highest discomfort comes from the ***humidity index***. The current perceived temperature is 35 degrees for only two months, as it is according to Scenario 1. But

if we look at Scenario 2, Sardinia will have four months of discomfort due to humidity.

Img.46 Humidity index



Source: Soclimpact project

Sardinia has the lowest risk to ***loss the competitivity due to a decrease in thermal comfort***. The risk is low in synthesis thanks to the exposure and adaptive capacity of the island. Tourists will not absorb the risks deriving by decrease in thermal comfort.

2.8 Island's comparison and future challenges

Following the data collected for the different islands, is interesting to considers impact chains to compare all data. Various risk indicators have been taken into account (Hazard, Exposure, Vulnerability). Data are after normalized to achieve a final risk index. Let's see the results compared for our Mediterranean islands:

Loss of competitiveness of destinations due to a decrease in thermal comfort.

i. ***Hazard***, considers the:

(a) Humidity index

(b) Days with discomfort level greater than 35°C

All these factors lead to: new niches for disease vectors, Increase of tropical nights. Increase in heat waves, Changes in seasonal regimes.

- The index records the highest value for **Cyprus** with a percentage of 34.6 of risk, **Malta** and **Sardinia** record the same humidex score but the percentage of hazard is respectively of 11.7% and 13.1%.

ii. ***Exposure,*** considers the:

(a) Exposed areas

(b) Vulnerable groups

(c) Tourists' arrivals

Soclimpact study found that:

- For the three islands **Cyprus, Malta** and **Sardinia** the score of the exposed areas is the same 0.007
- The rate of vulnerable groups is high for **Sardinia** that records a value of 0.038, while for the other Island the value is the half 0.017.
- **Sardinia** has highest score for tourists' arrivals followed by **Cyprus** and **Malta.**
- **Sardinia** has the highest value in total exposure 62.9%, **Malta** records value for 21.3% and **Cyprus** 20.9%.

iii. ***Vulnerability*** takes into account the:

(a) Heat-sensitive activities, Economic valuation (factors of sensitivity)

(b) Early-warning systems, Air conditioning, medical attention (factors of adaptive capacity)

Results of sensitivity are the following:

- We see a high heat-sensitive activities score for **Cyprus** and **Malta** (0.074) and a low value for **Sardinia** 0.012.
- The economic valuation score shows respectively 0.015 score for **Cyprus**, 0.028 for **Malta** and 0.010 for **Sardinia**
- **Malta** shows the highest score in sensitivity

Looking at the adaptive capacity we found that:

- **Cyprus** and **Malta** have the same value of early-warning systems score of 0.007 **Sardinia** shows 0.003 as a value
- The air conditioning capacity is higher for **Malta** than for **Cyprus** and **Sardinia**
- The medical attention value is of 0.005 for **Cyprus** and **Sardinia,** for **Malta** is equal to 0.002.
- The total adaptive capacity records a value of 15.2% for **Malta**, 11.4% for **Sardinia** and 9.4% for **Cyprus**

Cyprus it is the island most at risk of loss of competitiveness due to heat waves, this is because the days of heat waves will increase and almost all tourism-related activities are located in areas heavily affected by heat waves. **Sardinia** is the Island the lowest at risk because it has a really low score for sensitivity. **Maltese Islands** have a high risk of temperature increase but a high

percentage of adaptability, moreover the refrigeration system is the most efficient and this allows a lower sensitivity to risk for the tourist.

2.2.4 Economic impact

The risks deriving from climate change are linked to disastrous consequences for our planet. But it is also necessary to consider the types of risks not strictly linked to the land (environmental), risks not to be underestimated. The economic risk and the consequences. From the tourist-economic point of view we must consider the supply and demand.

From demand- side we have the:

- Deterioration of Destination's image
- Loss of tourist experience value
- Increase in water demand
- Increase in health issues
- Excess demand of health services
- Change in tourists' seasons
- Less willingness to pay for aquatic activities

From supply- side we must consider the:

- Cost of renovation of damaged touristic facilities
- Long term increase of insurance costs due to the risks of events
- Costs of technological measure to prevent damages

- Increased costs related to energy consumption (air conditioning)
- Increase in cost associated to health issue

All this leads to the loss in tourism arrivals and receipts.

But Soclimpact research did not focus only on economic risk but questioned the following question: how does the increase in temperatures affect the pricing strategy of tourism companies? it is curious to note how the results seem to contrast those deriving from an economic loss. In fact, the heat wave affects tourists in two ways: they can decide to change destination (in that case there would be an economic loss) but they can also change their behaviour and preferences. Through the change in consumer choice, demand changes and companies are pushed to change prices to re-establish the market. The study took into consideration the prices on Booking and the days when the perceived temperature was more than 35 degrees from May to October.

According to Soclimpact, considering the future scenario, in Sicily, there will be in Sicily an increase in the days in which humidex is perceived more than 35 degrees with a consequent increase in the average price that brings to an increase in total revenues.

Tab.14: Sicily estimation of increase in average price and revenues

Actual share of days in which humidex > 35 degrees	Future scenario considered	Days in the corresponding scenario in which humidex > 35 degrees	Increase in the average price	Increase in the tourism overnight stays	Increase in tourism revenues
28.49%	rcp26near	37.53%	0.4%	0.1%	0.5%
	rcp26far	38.41%	0.5%	0.1%	0.6%
	rcp85near	40.60%	0.6%	0.1%	0.7%
	rcp85far	65.04%	1.7%	0.3%	2.1%

Source: Soclimpact project

Also, for Corse an increase in tourism revenues is assumed following an increase in the perceived temperature. In Corse, 60 hotels were analyzed. The results of the study are shown in the table below.

Tab.14: Corse estimation of increase in average price and revenues

Actual share of days in which humidex > 35 degrees	Future scenario considered	Days in the corresponding scenario in which humidex > 35 degrees	Increase in the average price	Increase in the tourism overnight stays	Increase in tourism revenues
7.89%	rcp26near	14.85%	2.6%	0.5%	3.2%
	rcp26far	14.85%	2.6%	0.5%	3.2%
	rcp85near	15.84%	3.0%	0.6%	3.6%
	rcp85far	39.51%	12.0%	2.4%	14.7%

Source: Soclimpact project

A correlation is assumed for the Island of Crete between an increase in perceived humidex temperature and tourist revenues. For Crete was used the Index of Distance in Destination Image to position each island in a range that goes from Sardinia- Corsica on one side and Sicily on the other side. Here too, as the temperature rises, tourist revenues increase.

Tab.14: Crete estimation of increase in average price and revenues

Actual share of days in which humidex > 35 degrees	Future scenario considered	Days in the corresponding scenario in which humidex > 35 degrees	Increase in the average price	Increase in the tourism overnight stays	Increase in tourism revenues
17.15%%	rcp26near	26.52%	2.2%	0.4%	2.7%
	rcp26far	27.95%	2.6%	0.5%	3.1%
	rcp85near	30.52%	3.2%	0.6%	3.9%
	rcp85far	56.44%	9.4%	1.9%	11.5%

Source: Soclimpact project

The down table instead contains the data relating to the correlation that exists between the increase in temperatures and the increase in revenues for tourists. The correlation is also positive for Cyprus.

Tab.14: Cyprus estimation of increase in average price and revenues

Actual share of days in which humidex > 35 degrees	Future scenario considered	Days in the corresponding scenario in which humidex > 35 degrees	Increase in the average price	Increase in the tourism overnight stays	Increase in tourism revenues
50.47%	rcp26near	61.59%	2.6%	0.5%	3.1%
	rcp26far	62.47%	2.8%	0.6%	3.4%
	rcp85near	64.88%	3.4%	0.7%	4.1%
	rcp85far	88.60%	8.9%	1.8%	10.9%

Source: Soclimpact project

The following table, contains the data relating to the correlation that exists between the increase in temperatures and the increase in revenues for tourists. The correlation is positive for Malta.

Tab.14: Malta estimation of increase in average price and revenues

Actual share of days in which humidex > 35 degrees	Future scenario considered	Days in the corresponding scenario in which humidex > 35 degrees	Increase in the average price	Increase in the tourism overnight stays	Increase in tourism revenues
26.36%	rcp26near	36.55%	1.5%	0.3%	1.8%
	rcp26far	37.10%	1.5%	0.3%	1.9%
	rcp85near	39.01%	1.8%	0.4%	2.2%
	rcp85far	64.77%	5.5%	1.1%	6.7%

Source: Soclimpact project

Also, for the last island we analysed, we see how an increase in temperatures leads to a change in the tourist demand. To restore the balance, traders place a new offer and correct the price. This leads once again to an economic advantage for the destination in terms of tourist revenues.

Tab.14: Sardinia estimation of increase in average price and revenues

Actual share of days in which humidex > 35 degrees	Future scenario considered	Days in the corresponding scenario in which humidex > 35 degrees	Increase in the average price	Increase in the tourism overnight stays	Increase in tourism revenues
27.23%	rcp26near	35.78%	3.3%	0.7%	4.0%
	rcp26far	35.07%	3.0%	0.6%	3.7%
	rcp85near	37.59%	4.0%	0.8%	4.9%
	rcp85far	61.48%	13.3%	2.7%	16.3%

Source: Soclimpact project

In a situation where we are faced with an increase in temperatures during several days in a season, the tourist reacts by lengthening the seasonality and choosing between several days during the year. In coastal destinations, where tourists can enjoy the beaches, there will be a tendency to start the bathing season earlier and finish it later with the consequent increase in attendance throughout the

year. Climate change can have a positive effect as it can decrease seasonality or even reset it for some destinations. For the Mediterranean islands we have seen that there are peaks of presences during the two hottest months: July and August.

Furthermore, the increase in temperatures causes tourists to move from the hinterland towards the coastal areas, hence the increase in tourist presences, that is, in demand. Consequently, operators in the tourism sector must foresee costs to modify and adapt the tourist offer. Through investments in technologies that allow the tourist to be refrigerated when high temperatures are reached.

Chapter 3: Action and intervention policies

3.1 Tourists' perceptions and reactions

There are many intervention policies that can be implemented to safeguard the destination. Among these we find a solution in the introduction, for example, of a tourist tax that could be introduced at the same time as the already existing tourist tax or it could be increased. However, it is curious to investigate and understand the willingness of the tourist to pay to contribute to environmental policies for limiting emissions. The Soclimpact study has proposed an interesting survey to the tourists of the Islands to investigate their preferences and understand if they are willing to participate also through a monetary contribution. Images were administered containing a set of mutually exclusive hypothetical alternatives between which respondents are asked to choose their preferred one. The percentage of tourists that would not visit any European island posed to CC impacts was obtained, which alert on the potential decrease in tourism arrivals for these islands. The results are useful for understanding what kind of policies can be adopted and supported by tourists in order to be more efficient. Let's see results for Med Islands.

- **Temperature becomes uncomfortably hot to me (Results in Tab.22).** Cyprus tourists would change destination for a percentage of 72.30 and the same are willing to pay 8.70€ per day in order to avoid it.
- **Beach disappear (Tab.28).** There is a very important figure for the island of Cyprus whose tourists would give up the destination for 84.50% and the same would pay a very high amount

of € 11 per day for the protection of the beaches. This testifies to the type of tourism strongly linked to the beaches of Cyprus

Tab.22: Increase in temperatures and tourist's reaction in Islands

TEMPERATURE BECOMES UNCONFORTABLY HOT TO ME				
Islands	**Sicily**	**Crete**	**Cyprus**	**Malta**
Would change destination	32,80%	9,40%	72,30%	58,40 €
Would change season	9,70%	27,20%	-	15,70%
Willingness to pay	2,90 €	1,50 €	8,70 €	4,60 €

Tab.28: Beaches disappearance and tourist's reaction in Islands

BEACHES DISAPPEAR				
Islands	**Sicily**	**Crete**	**Cyprus**	**Malta**
Would change destination	37,20%	9,40%	84,50%	59,70%
Would change season	3,10%	41,10%	-	3,60%
Willingness to pay	2,70 €	1,40 €	11,00 €	3,10 €

Source: Self-elaboration on Soclimpact data

Consequently, operators in the tourism sector must foresee costs to modify and adapt the tourist offer. Through investments in technologies that allow the tourist to be refrigerated when high temperatures are reached, through the installation of ventilation and air conditioning systems. Before the erosive phenomenon fuels the disappearance of the beaches, there are policies that can be followed by those who work directly on the coasts. For example, many can choose to become "plastic free", to invest in solar energy, safeguard the dunes, enhance products at zero km, provide ad hoc spaces for those who travel by bike or with electric mobility vehicles, use wood and other natural materials. and light for the structures, allowing the view of the sea without barriers and the coexistence between free and licensed parts.

The interview given to tourists is of great inspiration and help in order to be able to hypothesize local, regional, national or even international policies that obtain consensus among the population. In fact, the prevention policies currently implemented in the European Union do not seem to have had great results. A unifying legislative intervention is hoped for. The survey was carried out only for the European islands, the same could be carried out for other European destinations. It is interesting to see how the participation of the tourist is active and how the tourist has a willingness to pay in order to stem the phenomenon. Especially where the phenomenon is at high risk, in Cypro, one sees a willingness on the part of the tourist to pay even a high amount to preserve the destination. An increase in the tourist tax, a further tax could represent the economic solution to help contain the climate change and the interrelate risks.

3.2 General strategies

We have seen how climate change can affect the choice of destination and how important is the idea and the image that the destination has in the eyes of the tourist. An unsafe destination, which can be easily replaced, causes tourism demand to change. The tourist perceives the destination as dangerous due to adverse climatic events or unattractive due to the effects they have on their main attractions that make up the tourist offer, ie. parks, sea, beaches and elements of the destination. The destination may also appear uncomfortable due to rising temperatures, for example. The problem of climate change and the effect on the destination, although it seemed distant, is now real and needs to be addressed. The solutions to stem climate change can be listed as follows:

1) ***Marketing strategies***: Today the tour operators have a strong tool that if used to the fullest can induce changes in the market conditions in order to favourably alter the perceptions, motivations and possibly behaviour of consumers. We are talking about marketing; operators can use it to move an image of the destination not strictly linked to the classic one in the mind of the tourist. Marketing can also be used to promote campaigns in order to trigger behaviours by tourists that are more friendly to the destination and to pursue a type of tourism that is responsible and respects the destination. However, this tool must not be used only by operators, but also by institutions that, where there is a solution, should undertake re-education and marketing campaigns for the entire world community to stem climate change where it depends on human activity. An awareness-raising measure could include the development of a new generation of tour packages and a new generation of responsible tourists.

2) ***Institution and policies***: Tourist behaviour can be influenced by institutionalized constraints, such as environmental taxation or prices based on the emissions of tourist raw materials. These measures would induce tourists to consider reducing their emissions e support the development and use of non-polluting renewable energies.

Institutional policies can be:

- *EU Directives and legislative proposals*: The European Climate Change Program or ECCP (European Climate Change Program) was launched in 2000 by the European Union Commission. The objective of the ECCP to identify, develop and implement all the necessary elements of a European strategy to implement the Kyoto Protocol. The Kyoto Protocol

is an international environmental treaty concerning global warming. The European Union is the main international supporter, since being at a very high economic level it tries as much as possible to support this protocol. The treaty provides for the obligation to reduce emissions of elements of at least 8.65% compared to emissions recorded in 1990 - considered as a base year - in the period 2008-2012. A political action is represented by "The 2030 climate and energy framework" that includes strategic targets and targets at EU level for the period from 2021 to 2030. Furthermore, the old NEC directive which did not fulfil its emission reduction target was augmented by the Proposal for a Directive on the reduction of national emissions of certain air pollutants - 2013/0443 Establishes new national emission reduction commitments, applicable to starting from 2020 and 2030, for the six main air pollutants.

- *National and Regional plans:* European policies must be supported through institutional political plans envisaged and implemented by each nation and region (as such intervention policies foreseen by Soclimpact project). In Italy is famous the "Piano nazionale di adattamento ai cambiamenti climatici (Pnacc)".

- *Energy and innovative policies:* Energy conversion is fundamental for the reduction of elements of pollution that lead to gas emissions and consequent climate change, in particular: construction of wind and solar farms and updating of the PNIEC (National Integrated Energy and Climate Plan) for a greater reduction of greenhouse gas emissions.

- *Public transport:* An alternative awareness-raising measure could include the creation of new companies that care about eco-friendly and reduce their emissions. As we have seen, in the tourism sector, the transport sector holds the record for the production of CO2 emissions, which is necessary for the very existence of tourism. This is the case of the birth of low-emission airlines, for example, Wizz air which continues to have the lowest CO2 emissions per passenger / km among all European airlines, going from 69.1 gr / km / passenger in 2013 to 57.3 gr / km / passenger in 2019. The need for a systemic approach is highlighted, the importance of switching to low-carbon modes of transport and zero-emission vehicles is highlighted, and the central role of electrification and renewable energy sources is highlighted.

- *Change in the way of moving and improvement of means:* Some signals are already active, especially in large cities, where the use of car sharing is constantly increasing. Even hybrid and electric cars are slowly becoming an alternative to traditional cars. Furthermore, with the development of eco-friendly means of transport such as electric bikes and scooters we are close to an era of change or so hopefully. In fact, these are useful for reaching destinations that are not too far away, but already, moving around the city without using the car but this type of means seems like a good start.

3) ***Responsible tourism****:* was born in the late eighties, characterized by a double concern for the place where one goes. Sustainable tourism and responsible tourism share the same objectives: sustainable tourism occurs when

the environmental conditions of the host territory are not deteriorated by tourism and when the same tourist offer can be re-proposed without suffering and accumulating damage. Responsible tourism, on the other hand, is that implemented by tourists with a conscious attitude who maintain an adequate behaviour in respect of the environment and host cultures following the principles of social and economic justice. Once again, a fundamental role is played by tour operators who have the task of making the offer attractive and complete while maintaining an eco-impact. Tour operators must be aware of the issue of climate change and be able to follow the intervention policies suggested by local and international legislators. Operators can actively contribute through a different, eco, more modern offer. Furthermore, attention must be shifted more and more from mass tourism to responsible tourism. Changing the tourist offer is not easy especially for operators who have existed for many years, investment costs are sometimes high and it would be convenient for operators to invest gradually year by year to change the elements of the offer. It is certainly much easier to offer low-impact eco- and responsible tourism for operators who are now entering the sector who can form the offer from 0 based on current policies and future scenarios in order to contain the phenomenon of impact. environmental and related risks.

Conclusion

As we have seen, the phenomenon of climate change has negative consequences for our planet that should not be underestimated. Climate change also has influences on the most important economic sectors. In this paper we have

focused on the consequences and impact this has for tourism and we have seen how it influences both tourism demand and supply. Through this paper, preliminary knowledge was provided on the causes and phenomenon of climate change, a general view on tourism demand was provided, on how it is influenced by temperature and climate and the evolution of this in the six Mediterranean islands: Sicily, Sardinia, Malta, Corsica and Cyprus and Crete. For the islands themselves, the risks deriving from climate change for tourism and the economic impact they have had and will have in the future have been seen. Through the Soclimpact Study, possible scenarios in the event of low and high emission pollution were provided. In the last chapter, by virtue of the scenarios examined, suggestions and possible intervention policies are provided in order to stem the phenomenon.

References

- *Amelung, Viner (2006) Mediterranean Tourism_exploring the future with the Tourism Climatic Index*
- *Atzori et al (2018) Tourist responses to climate change_Potential impacts and adaptation in Florida's coastal destinations*
- *Barnard et al (2017) Extreme oceanographic forcing and coastal response due to the 2015–2016 El Niño*

- *Basker, Miranda (2014) Taken by Storm_Business Financing, Survival, and Contagion in the Aftermath of Hurricane Katrina*
- *Basu (2009) High ambient temperature and mortality_a review of epidemiologic studies from 2001 to 2008*
- *Bayraktarov et al (2016) The cost and feasibility of marine coastal restoration*
- *Becken (2010) The importance of climate and weather for tourism_Literature review*
- *Bertin et al (2013) A significant increase in wave height in the North Atlantic Ocean over the 20th century*
- *Bitan-Zviely2019_Article_LostValueAssessmentOfBathingBe*
- *Burving et al (2016) Beach response to consecutive extreme storms using LiDAR along the SW coast of England*
- *Buzinde et al (2010) Tourists' Perceptions in a Climate of Change_Eroding Destinations*
- *Bythell et al (2000) Local variability but landscape stability in coral reef communities following repeated hurricane impacts*
- *Cashman et al (2010) Climate change in the Caribbean_the water management implications*
- *Cavallaro et al (2017) The impacts of climate change on tourist mobility in mountain areas*
- *Cheablam et al (2013) Does coral bleaching impact tourists' revisitation_ A case of Mu Ko Surin Marine National Park, Thailand*

- *Cheablam et al (2013) Does coral bleaching impact tourists' revisitation_ A case of Mu Ko Surin Marine National Park, Thailand*
- *Coghlan, Prideaux (2009) Welcome to the Wet Tropics_the importance of weather in reef tourism resilience*
- *Cuttler et al (2018) Response of a fringing reef coastline to the direct impact of a tropical cyclone*
- *Desa a national forest reserve susceptibility to fire under climate change*
- *Donat et al (2011) Reanalysis suggests long-term upward trends in European storminess since 1871*
- *Enríquez et al (2019), Changes in beach shoreline due to sea level rise and waves under climate change scenarios: application to the Balearic Islands (western Mediterranean)*
- *Gabarda-Mallorquí et al (2017) Mass tourism and water efficiency in the hotel industry_A case study*
- *Galbraith et al (2002) Global Climate Change and Sea Level Rise_Potential Losses of Intertidal Habitat for Shorebirds*
- *Ghartey (2013) Effects of Tourism, Economic Growth, Real Exchange Rate, Structural Changes and Hurricanes in Jamaica*
- *Gómez-Martín et al (2014) The Spanish tourist sector facing extreme climate events_a case study of domestic tourism in the heat wave of 2003*
- *Gössling et al (2006) Tourist Perceptions of Climate Change_A Study of International Tourists in Zanzibar*
- *Gössling et al (2012) Tourism and water use_Supply, demand, and security. An international review*

- *Gössling, Hall (eds) (2006) Tourism and Global Environmental Change. Ecological, social, economic and political interrelationships*
- *Grøntoft (2017) Conservation-restoration costs for limestone façades due to air pollution and climate change in Krakow, Poland*
- *Hadjikakou et al (2013) Estimating the direct and indirect water use of tourism in the eastern Mediterranean*
- *Hall (2001) Trends in ocean and coastal tourism_the end of the last frontier*
- *Hall et al (2016) Climate change and cultural heritage_conservation and heritage tourism in the Anthropocene*
- *Hongo et al (2018) Projecting of wave height and water level on reef-lined coasts due to intensified tropical cyclones and sea level rise in Palau to 2100*
- *Hystad, Keller (2008) Towards a destination tourism disaster management framework_Long-term lessons from a forest fire disaster*
- *Koetse, Rietveld (2007) Climate change, adverse weather conditions, and transport_a literature survey*
- *Koetse, Rietveld (2009) The impact of climate change and weather on transport_An overview of empirical findings*
- *Lau et al (2010) Climate change, flooding, urbanisation and leptospirosis_fuelling the fire*
- *Lau et al (2010) Leptospirosis_an emerging disease in travellers*
- *LaVanchy (2017) When wells run dry_Water and tourism in Nicaragua*
- *Lynch (2004) What Do Forest Fires Really Cost*
- *Maddison (2001) In Search of Warmer Climates_ The Impact of Climate Change on Flows of British Tourists*

- *Marshall et al (2011) Preparing for climate change_recognising its early impacts through the perceptions of dive tourists and operators in the Egyptian Red Sea*
- *Martínez-Ibarra (2015) Climate, water and tourism_causes and effects of droughts associated with urban development and tourism in Benidorm (Spain)*
- *Masselink et al (2016) Extreme wave activity during 2013-2014 winter and morphological impacts along the Atlantic coast of Europe*
- *Mavalankar et al (2009) Quantifying the impact of chikungunya and dengue on tourism revenues*
- *Mieczkowski (1985) The tourism climatic index_a method of evaluating world climates for tourism*
- *Moore et al (2010) The supply side effects of climate change on Tourism*
- *Moreno, Amelung (2009) Climate change and tourist comfort on Europe's beaches in summer_A reassessment*
- *Mycoo, Chadwick (2012) Adaptation to climate change_the coastal zone of Barbados*
- *Nemry, Demirel (2012) Impacts of Climate Change on Transport_A focus on road and rail transport infrastructures*
- *Nilsson, Gössling (2013) Tourist responses to extreme environmental events_The case of Baltic Sea algal blooms*
- *Parsons, Thur (2008) Valuing changes in the quality of coral reef ecosystems_a stated preference study of SCUBA diving in the Bonaire National Marine Park*

- *Payet, Obura (2004) The Negative Impacts of Human Activities in the Eastern African Region*
- *Pearlman, Melnik (2008) Hurricane Katrina's effect on the perception of New Orleans leisure tourists*
- *Perch-Nielsen et al (2010) Future climate resources for tourism in Europe based on the daily Tourism Climatic Index*
- *Perry (2006) Will Predicted Climate Change Compromise the Sustainability of Mediterranean Tourism*
- *Philandras et al (2011) Long term precipitation trends and variability within the Mediterranean region*
- *Poloczanska et al (2009) Vulnerability of marine turtles to climate change*
- *Raybould et al (2013) Beach and surf tourism and recreation in Australia_Vulnerability and adaptation (report)*
- *Sagoe-Addy, Addo (2013) Effect of predicted sea level rise on tourism facilities along Ghana's Accra coast*
- *Schleupner (2008) Evaluation of coastal squeeze and its consequences for the Caribbean Island Martinique*
- *Scott et al (2008) Preferred climates for tourism_case studies from Canada*
- *Scott et al (2012a) The vulnerability of Caribbean coastal tourism to scenarios of climate change related sea level rise (1)*
- *Scott et al (2012b) Tourism and Climate Change. Impacts, Adaptation and Mitigation*
- *Shaposhnikov et al (2014) Mortality related to air pollution with the Moscow heat wave and wildfire of 2010*

- *Snoussi et al (2008) Vulnerability assessment of the impact of sea-level rise and flooding on the Moroccan coast_The case of the Mediterranean eastern zone*
- *Thapa et al (2013) Wildfires and tourist behaviors in Florida*
- *Toloo et al (2015) Projecting excess emergency department visits and associated costs in Brisbane under population growth and climate change scenarios*
- *Uyarra et al (2005) Island-specific preferences of tourists for environmental features_implications of climate change for tourism-dependent states*
- *Walsh (1983) Stability of a coral reef fish community following a catastrophic storm*
- *Zeppel (2012) Climate change and tourism in the Great Barrier Reef Marine Park*
- *Zopiatis et al (2017) Quality, satisfaction and customers' future intention_the case of hotels' fitness centers in Cyprus*