

## Article

# Understanding the Heterogeneity of Tourists' Choices under Climate Change Risks: A Segmentation Analysis

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**Abstract:** This paper undertakes a data-driven segmentation analysis on tourists' choice of island destinations in the context of a changing climate. To this end, 2528 tourists visiting ten European islands in the Mediterranean, Baltic, and Atlantic regions were posed hypothetical situations in which diverse impacts caused by CC (i.e., beach loss, heatwaves, storm intensification, etc.) were affecting the islands being visited. In each scenario, tourists' responses ranged from *stay on the island* to *change to an alternative destination*. Cluster analysis allowed the identification of four segments: (1) *LO-loyal oriented*—tourists willing to stay on the island despite any climatic event (in this group, tourists would often change the travel date); (2) *RA-risk-averse*—tourists who would always avoid islands affected by CC; (3) *WIL-risk-specific*—a segment of tourists with a special aversion to the risks associated with wildlife disappearance and damage to infrastructure, and (4) *3S-sun, sea and sand seekers*—tourists who would always avoid visiting islands where CC induced effects are related to beach loss or extreme events. Further analysis is dedicated to comparing segments in regard to their sociodemographic characteristics, the image of the island, and the importance given to the protection of environmental attributes when choosing an island destination. The results alert us about the climate-specific risks and tourist profiles that are relevant to explaining changes in the tourism geography and seasonality of islands. The findings are useful for providing operational marketing recommendations for destination managers, especially for taking competitive advantage of climate services, and for prevention and responsiveness management strategies.

**Keywords:** climate change; islands tourism; tourist behaviour; segmentation; tourism resilience



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## 1. Introduction

Climate change (CC) impacts have a multi-hazard origin [1] and, at the same time, these impacts can affect several ecosystems simultaneously, both marine and land environments [2,3]. For example, the risk of a diminished destination competitiveness due to beach surface loss arises both from sea level rise and from higher erosion caused by the increased energy of seawater beating the shoreline [4] and urbanization and man-made modifications of the coastline. Similarly, higher temperatures lead to heatwaves affecting the thermal comfort of tourists [5], as well as rises in sea level that can affect coastal infrastructures.

From another angle, expectations, reactions and opinions about the climate of a destination vary among tourists, according to their socio-demographic characteristics, travel motivations, and also the climatic conditions of their place of residence [6,7]. In fact, for some tourists, the assessment of climate tends to reflect their personal experience, which may not always coincide with the real average weather conditions of destinations [8].

Research suggests that the same occurs with climate change, as well as climate-related risks, which are perceived differently among tourists, according to their individual travel experience and the type of activities they participate in [9]. Thus, future scenarios will cause important changes in the geography of tourism at a global level [10] and the current

uncertainties and research gaps with regards to the determinants of tourists' behaviour will be worsened [9,11].

The analysis of the relationships between climate and tourist behaviour has been presented as an important research challenge in recent years [12–14]. However, given the multidisciplinary nature of CC, researchers from different fields bring their own analyses, generally focusing on very specific areas of investigation [15,16], from both the climatic and economic perspectives. Most studies focus on the effects of higher temperatures on the intensity and frequency of outdoor tourist activities and destination choice [5,17]. Meanwhile, other authors analyse the impact of forest fires or extreme climatic events on tourism arrivals and expenditure [13,18]. To the best of our knowledge, there are no studies that provide a comprehensive appraisal of the behavioural patterns of tourists when it comes to a multi-risk CC context. Hence, understanding the heterogeneous way in which climate change affects tourist destinations implies the study of tourists' decision-making in relation to a wide spectrum of climate risks simultaneously.

For example, tourists not willing to visit a destination due to their strong aversion to the risk of forest fires may have greater disposition if other climatic events occur at this destination (i.e., extreme temperatures). Hence, the starting point of our study is that tourists' destination choices are conditioned to specific climate risks and not all CC impacts affect tourists' decision-making in the same way. Thus, the main aim of this paper is to conduct a segmentation analysis of tourists' willingness to change the destination being visited if several climate change impacts are likely to occur. The study allows homogeneous tourist groups to be identified according to their aversion to specific climate risks. Thus, this paper aims to provide a new classification of the tourism market according to tourists' choice of destinations in a multi-risk CC context. In addition, the study analyses the differences between the encountered segments in terms of (i) socio-demographic profile, (ii) trip characteristics, (iii) opinions of the island's image and state of conservation, and (iv) the importance given to the conservation of environmental attributes to choose a destination.

Considering that climate is outside the control of tourism managers, this type of analysis has the potential to assist managers in better understanding how to take advantage of their progress on prevention, preparedness and risk management measures. Segmentation analysis is widely employed in the tourism literature [19] to classify travellers according to their expenditure levels, motivations, past destination choices, activities, and the benefits they seek from their travel experience [19–22]. However, there are very few publications conducting segmentation analysis in the context of climate change and tourism.

The study focuses on island destinations. This is done for many reasons. First, islands—including outermost regions—are particularly vulnerable to climate change [23]. The ocean that surrounds them is of crucial importance as ocean waters absorb vast amounts of CO<sub>2</sub>, helping to mitigate man-made global warming, but causing ocean acidification, which leads to dramatic effects on calcifying species [24]. It is expected that islands will face a high risk of impacts well before 2100, even under the low-emissions scenario [25]. Second, islands are biodiversity hotspots, according to the International Union for the Conservation of Nature. They support unique ecosystems which are home to an estimated one-third of the globally threatened species, including many endemic species [26]. Climate change thus contributes to the progressive decline of their extraordinarily rich biodiversity [27]. Third, many islands have no groundwater supplies as all surface water is salinated. They thus rely solely on rainfall. Reduced rainfall caused by CC on certain EU islands—such as on the Greek islands—will result in loss of agricultural land, but also in more forest fires and increased litigation costs [25]. Fourth, island economies rely heavily on the tourism sector, an activity that is expected to be reshaped by climate change [28]. Finally, island destinations are mainly developed around the 3S tourists (tourists considered as sun, sea and sand seekers). This has been for decades the most important tourism segment globally, and one which is extremely weather-sensitive and heavily dependent on the quality of coastal and marine environmental services [29].

The research was conducted with 2528 tourists visiting 10 well-known European island destinations; French West Indies (Martinique and Guadeloupe), Azores (Ilha do Faial, Ilha de Sao Miguel e Ilha do Pico), Balearic Islands (Mallorca), Baltic Islands (Fehmarn), Canary Islands (Gran Canaria), Crete, Cyprus, Madeira, Malta and Sicily. Most of these regions rate among the top most popular destinations for non-EU residents. For example, according to Eurostat 2018, the highest number of nights spent in tourist accommodations in Europe was recorded in Spain's Atlantic destination, The Canary Islands (99.9 million).

The paper is structured as follows. Section 2 presents the literature review, aiming to identify trends and gaps in the study of climate change impacts on destination choice, and segmentation studies with reference to this subject. Section 3 describes the methodology of the study. Section 4 presents the results and, finally, Sections 5 and 6 discuss and conclude.

## 2. Literature Review

Climate is one of the elements of tourist destinations with the greatest potential impact on tourist behaviour [30], although studies are still considered scarce [31], especially with regard to the appraisal of climate impacts and the socio-psychological reactions of tourists in different climate scenarios [32]. The preferences of tourists and their expectations about the climate of a destination influence their motivations to travel [31], the choice of one destination or another [18,30], the planning [6,33], and the duration and season chosen for the trip [34,35].

A literature review on the study of climate change impacts on destination choice was conducted for the period 2000–2019. The review aimed to; (1) identify the research areas that generate the most interest among researchers (in both directions, climate-related and tourist behaviour variables), (2) analyse to what extent the studies focus on a single climate variable to explain tourist behaviour, or take into account multi-risk contexts, and (3) identify the studies with application to island tourism contexts. Finally, previous studies on market segmentation were analysed, aiming to identify contributions to the subject of climate change.

We only focus on previous studies assessing specific climate-related variables that mostly impact coastal and marine tourism activity, such as changes in air temperature, precipitation, waves, wind intensity, floods, heatwaves, ocean acidification, sea-level rise, sea temperature, and extreme weather events [3,36,37]. These risks affect both the value of the recreational experience and the decision-making process of tourists before, during and after visiting the coastal destination. By the tourist behaviour side, only those publications focused on destination choice variables (past visits, arrivals, repetition, and future intentions) were analysed.

For this reason, many publications were not included. The analysis of damage to infrastructure, economic losses, biodiversity degradation, environmental management, expenditure, etc., were excluded. Only the analysis of destination image, thermal comfort, willingness to pay, and tourism expenditure were considered if they also analysed destination choice/repetition. For example, if the study analysed tourists' willingness to pay to reward forest fire prevention at the destination, it was excluded. If the analysis referred to the economic losses due to the occurrence of forest fires, and also referred to the impact on tourism arrivals, it was included. Table 1 presents the previous studies analysed.

The review analysis revealed that studies are highly fragmented. There are not works that depict a complete picture of the causes and effects of climate impacts, the behavioural response of tourists, and the economic impact derived from this. For example, some studies addressing the problem of forest fires risk do not analyse droughts or humidity (very related to this risk). Papers analysing extreme events focus on hurricanes and storms, with the impact of floods being almost non-existent, despite their potential immediate destructive effects on biodiversity and infrastructure, thus affecting tourist activity. Almost 70% of the studies were conducted on the island or coastal destinations. All of them agree that future projections of climate impacts are highly uncertain in these environments [32].

**Table 1.** Publications on the effects of climate change on tourists' destination choice (2000–2019).

Impact of Climate Change	Studied Impact	References
Extreme temperatures	Destination choice, repetition and tourism flows	Cavallaro et al. (2017); Gössling et al. (2006); Amelung, B., & Viner (2006); Yu et al. (2009); Denstadli & Jacobsen (2014); Amengual et al. (2014); Scott et al. (2008); Jones et al. (2006); Gómez-Martín (2005); Richardson & Loomis (2003); Morgan et al. (2000); Scott et al., (2016); Scott & Lemieux (2010) [5,8,10,12,15,17,28,38–43]
Marine or terrestrial wildlife disappearance	Willingness to pay and revisit	Seekamp (2019); Nunes et al. (2015); Uyarra et al. (2005); Hakim et al. (2005); Cheablum et al. (2013); Payet & Obura (2004) [36,44–48]
Beaches affected	Tourist valuation and behaviour	Nilsson & Gössling (2013); Uyarra et al. (2005); Raybould (2013); Ghartey (2013) [4,45,49,50]
Coastal Infrastructures damaged	Trip postponement-seasonality	Hakim et al. (2005); Koetse & Rietveld, (2007); Koetse & Rietveld (2009); Pearlman & Melnik (2008) [46,51–53]
Extreme events (hurricanes, storms and forest fires)	Tourist valuation, Trip postponement-seasonality and choice	Otrachshenko & Nunes (2019); Pearlman & Melnik (2008); Ghartey (2013); Thapa et al. (2013) [13,50,53,54]

### 2.1. Extreme Temperatures

Regarding destination choice, the temperature is the aspect most valued by travellers when choosing a destination [8]. Not surprisingly, there is a larger group of studies focused on analysing how increased temperatures and heatwaves, caused by CC, impact on arrivals and future intentions of tourists towards destinations. Besides, tourists who travel to destinations purchase goods and services because they want to access, in desired quantities and combinations, the services provided by the ecosystems [55]. In the context of CC, these ecosystem services that support the tourist activities will be affected in quantity and quality, which is expected to have negative effects on the perceived value and image of destinations [56]. This relationship is important, as changes in the destination image are good predictors of destination choice [44], although very few studies pin down this type of analysis [4,44,45].

Previous literature focusing on the impact of extreme temperatures caused by CC on changes in tourist flows and repetition concludes that the socio-demographic characteristics of tourists, their personal and travel experiences, and the climatic conditions of their place of residence are factors determining tourists' choice of and perceived comfort at destinations [57]. Further research is needed on the interconnected impacts of air temperatures, droughts and changes in precipitation patterns at destinations, to enhance the predictability of the models of consumer behaviour.

### 2.2. Marine and Terrestrial Wildlife Disappearance

The loss of marine habitats is amongst the indirect environmental effects of CC that may have the most profound implications on a destination's attractiveness, especially if marine wildlife is the main reason for visiting. However, there is a substantial bias in

the literature towards studying the impact of marine wildlife degradation on tourists' destination choice [58].

Concerning the degradation of the land environment biodiversity due to CC, few papers analyse the impact on tourist satisfaction and arrivals. The study of [46] is of great relevance as it reveals thresholds of negative changes to coastal attributes that tourists are willing to tolerate. It also examines tourists' willingness to substitute their future trips.

The lack of research on this area suggests everything that happens in the background, on the land or in the forests, have little importance for tourists visiting coastal destinations, and hence for research. However, this line of investigation on the value of natural capital is in high demand by practitioners and public bodies.

### *2.3. Beaches Affected*

Beaches generally constitute the most valued elements of the coast [59] but are subject to a long list of actions and aggressions that severely limit their capacity to adapt to environmental changes, making them especially vulnerable to the impacts derived from climate change.

Beaches also play a fundamental role in tourism. First, regarding the socioeconomic level, they represent a focus of interest for sun, sea and sand tourism, with great influence on the value of the recreational experience at the destinations, hence affecting tourism demand and expenditure [3]. A second main aspect, but no less important, is that beaches serve as a natural barrier to decrease the energy coming from the storm events associated with high winds, waves and over-rising sea levels, which can cause huge damage to coastal infrastructures.

In the tourism literature, the main conclusion of the works analysed is that beach surface reduction due to sea-level rise has a negative impact on the destination's image, leading to a decrease in tourism arrivals and receipts [45,49,60]. However, tourists "consume" beach ecosystems in a heterogeneous way (swimming, sunbathing, snorkelling, diving, and glass-bottom boating, etc.), and thus further research is required to measure other risks, such as the degradation of coral reefs, the impacts on turtles' nesting sites, etc. Finally, the majority of the studies focus on estimating tourists' willingness to pay for beach protection measures [61], while the analysis of destination choice can be considered limited.

### *2.4. Coastal Infrastructures Damaged*

Infrastructure and facilities play an important role in providing a wide range of amenities that contribute to the attractiveness of a destination. Climate change can have both a direct and indirect effect on transportation, restaurant services, recreation and amusement parks, etc. For example, the quantity and intensity of precipitation affect transport demand through its influence on the choice of transportation mode, trip postponement or cancellation [51,52]. Extreme events are the most damaging and may have severe consequences, especially for small businesses such as hotels or restaurants.

According to the literature, damages to various infrastructures have a negative impact on the destination's image, especially for tourists who have never visited the destination before [53]. Although destination image is widely recognised as an antecedent of tourist repetition and repurchase intentions, very few studies pin down this relationship stemming from a CC context.

### *2.5. Extreme Events*

Coastlines are vulnerable to the combined climate change-induced effects of sea-level rise and of an enhanced frequency of extreme waves, which together determine coastal flooding and erosion [62]. Extreme events are also characterised by storm surge events, which are positive extreme sea levels mechanically forced by atmospheric pressure and wind. Other atmospheric extreme events such as extended droughts, heatwaves and strong winds facilitate the incidence of forest fires, especially if supported by a general lack of

forest management activities. Wildfire outbreaks are likely to occur when humidity is extremely (unusually) low while temperatures are extremely high, resulting not only in physical damage to the forests but also on the severe increase in pollution and excess deaths [63].

In regards to tourism demand, studies on hurricanes and rainstorms have received the greatest attention, as they have a sharp and significant impact on biodiversity and beach surface reduction, which in turn affect tourists' decision making [4]. There is scattered evidence on the impact of forest fires, a topic which is typically evaluated ex-post by local or national authorities with results presented in the form of notes and reports. Besides, the increased frequency of cyclones, hurricanes or typhoons leads to a destruction of coral reefs which may trigger the invasion of algae [64], thus affecting the quality of marine environments and in turn tourism demand, especially when tourist activities are based on these ecosystems. This is a research topic that has received scarce attention in its relation to tourist behaviour. Finally, publications on the subject of changes in precipitation and wind patterns do not usually analyse tourist behaviour. These risks are less noticeable compared to extreme events as their impact is progressive although at the same time, relevant because they influenced the degradation of ecosystems and habitats.

## *2.6. Segmentation Based Analysis on the Subject of Climate Change and Destination Choice*

Market segmentation has been one of the most frequently explored areas in tourism research [21]. A considerable number of studies conduct segmentation analyses by sociodemographic, psychographic variables such as motivations and image [18], and behavioural variables such as expenditure [65,66] and destination choice [19,67], or a combination of all these aspects with lifestyle indicators and the perceived benefit provided by destinations [21].

Broadly classified, approaches include a priori and post-hoc analyses. The a priori approach chooses some variables of interest and then classifies the tourism market accordingly [18]. The post-hoc or a posteriori approach, on the other hand, collects data first depending on a selected set of interrelated variables and then tries to segment the markets into groups where within-group similarities are high and between-group similarities are low [68]. Both methods have received criticism in the literature, and there is no consensus about which is the most appropriate [21]. However, any market segmentation study's value to managers depends less on the methodology than whether or not a segmentation solution is meaningful and useful for marketing action [69].

Concerning climate change, there is a stream of literature on segmentation, although the studies are not often related to tourism. Publications are found in geography and climate-related journals and are focused mainly on (i) audience segmentation and climate change communication [70,71], and (ii) timing and spatial patterns of basin segmentation and perceptions of climate change [72].

Only the studies of [73–75] analyse climate variability relationships with tourism demand segments. The main conclusion of [73] is that the perception of climate variability differs between segment groups based on motivations and activities. Conclusions are similar to other previous studies analysing ideal climate indices for specific types of tourism [76]. On the other hand, [74] and [75] aim to compare activity-based segment groups in relation to the importance given to the weather conditions in the choice of destination. Segments are also compared in regard to tourists' perceptions of climate variability at destinations, and their proactive behaviour (willingness to engage in climate mitigation action). A limitation of these studies is their focus on a very specific case study and type of activities, which substantially reduces the potential generalisation of its results. The main inconsistency of these studies is that they present an analysis of climate change without delimiting a specific climate change scenario. In this study, we aim to fill this gap, by extending the analysis to multiple destinations and tourism niches simultaneously, and by delimitating a climate change scenario in which several interconnected risks and impacts are likely to occur.

### 3. Experiments

#### 3.1. Study Site

European islands can be considered the most important tourist regions worldwide, according to the 2019 European Union Tourism Trends Report. Across the EU, the top four most popular destinations for non-residents are Spain, Italy, France and Greece, which together accounted for more than half (57.2%) of the total nights spent by non-residents in the EU-27. In these countries, islands are the most visited destinations, with Canary Islands (Spain) being the most important tourist region of Europe (in regard to tourist arrivals). Additionally, in 2018, the first 25 tourist regions in the EU, where at least 30.0 million nights were spent in tourist accommodations, are mainly islands and coastal destinations (Eurostat, 2020).

For this reason, we consider European islands and archipelagos as ideal and relevant destinations to conduct this research. Islands included in the study totalled ten: French West Indies (Martinique and Guadeloupe), Azores (Ilha de Sao Miguel), Balearic Islands (Mallorca), Baltic Islands (Fehmarn), Canary Islands (Gran Canaria), Crete, Cyprus, Madeira, Malta and Sicily (Figure 1). Total arrivals in this group were 52.9 million tourists in 2018, representing almost 9% of all tourism arrivals in Europe (EU-27 countries). This figure indicates the important role of these regions in the European tourism sector.



**Figure 1.** European islands selected for the study.

#### 3.2. Questionnaire Development

The first step of the research consisted of designing the questionnaire. Firstly, to obtain the items to be used in the questionnaire, an expert-assisted process was implemented. The main aim of this qualitative stage of the study was to define the climate change risks that are a priority concern for the islands, given their high potential to directly affect the tourist experience value [77]. Focal groups saw the participation of more than one hundred climatologists, environmental economists, geographers, high-level policymakers and practitioners in the tourism sector. The meetings were held at the 10 island destinations over six months (from July to October 2018).

This work was supported by the European Union's Horizon 2020 research and innovation programme, through the innovation action entitled "Soclimpact project". This project is coordinated by the authors of this manuscript. Project partners received training and guidelines to moderate the discussion. Based on the literature review, an initial list of 20 climate-related risks was created. Participants in the focus groups had to define the ten

most significant risks to their islands, considering four main aspects; (1) current situation and evidence of impacts, (2) probability of occurrence, (3) capacity for disruption to tourist activity, and (4) empirical evidence of impacts on tourist behaviour. Each island provided a final list, and all islands' responses were subjected to frequency analysis to define a final list of 12 climate risks.

Transcriptions and recorded audios of the meeting were also collected for each island. The process ended on January 2019, stressing that there are twelve specific measurable climate risks that, although built for European island destinations, can easily be applied to many other tourism locations. All the statements represent severe impacts caused by CC, corresponding to a high emissions scenario (business-as-usual—RCP8.5). The selected risks were defined as follows:

1. Extreme weather events
  - 1.1 Storms intensify throughout the year
  - 1.2 Streets are frequently flooded as a result of rain or tidal surge
  - 1.3 Wind strength becomes uncomfortable
  - 1.4 Rainfall daily duration becomes uncomfortable
  - 1.5 Wildfires occur more often
2. Beaches affected
  - 2.1 Beaches largely disappear
  - 2.2 Beaches are affected by algae blooms
3. Extreme temperatures
  - 3.1 Temperature becomes uncomfortably hot
  - 3.2 Temperature becomes uncomfortably cold
4. Infrastructure damaged
  - 4.1 Coastal infrastructures are damaged due to coastal erosion
5. Wildlife disappearance
  - 5.1 Marine wildlife largely disappears
  - 5.2 Terrestrial wildlife largely disappears

This information was utilised as the main question of the survey. To examine the effects on tourists' destination choice, a contingent travel behaviour method was applied. This method uses hypothetical questions to obtain knowledge about travel behaviour in constructed scenarios by asking visitors directly for the changes in their intended behaviour contingent to changed conditions [78]. The method is directly linked to the theory of Planned Behaviour [79] and assumes that the intention or willingness to engage in a particular behaviour constitutes the best direct predictor of that behaviour [80].

Thus, tourists were posed hypothetical situations in which the island being visited was affected by these twelve impacts. For each potential impact, subjects had to choose one of five options, where 1 was their disposition to stay on the island they were visiting and 5, their intention to change to an alternative destination if the impacts were likely to occur. The questionnaire is shown as Supplementary Material.

To facilitate the data analysis, twelve new categorical variables were calculated with the responses obtained from this question, and considering three levels:

1 = "I would stay on the island (I do not want to change to an alternative destination if the impact occurs)",

2 = "I would stay on the island but I would choose a different date for travelling", and

3 = "I would change to an alternative destination (I would not stay on the island)".

In addition, the survey included other questions regarding (i) sociodemographic characteristics (gender, income level, education level, age, nationality), (ii) trip description (island visited, type of accommodation, number of previous visits, form of organisation), (iii) opinion about the island: the state of conservation and image, and (iv) the importance given by tourists to several environmental attributes when choosing an island destination.



### 3.3. Data Collection

The target population was defined as tourists visiting the 10 island destinations of this study (with any motivation, relaxation, work, cultural visit, nature-based activities, etc.). Previous to the surveying phase, the questionnaire was translated into four languages, and focus groups were conducted on 6 different islands, each one with ten tourists of different nationalities. The purpose was to ensure that the questions could be clearly understood by the respondents. Once the questionnaire was pre-tested and the pertinent corrections were made to the items that raised comprehension difficulties, the interviews were conducted. Surveys were implemented at the different touristic centres at each island, mainly at beaches, airports, hotels and city centres. All tourists were considered regardless of their travel motivation. That is, the sample includes tourists that were on 'sun, sea and sand' holidays and others that were on a business trip.

The interviewers received training sessions prior to the fieldwork, to ensure that the communication of the questions to the respondent was clear and accurate. A random sample of 2528 final surveys were obtained. The fieldwork took four months, from July to October 2019. The percentage of tourists approached that did not agree to participate was around 9%. There were no significant differences between early and late respondents' profiles and non-response rates.

### 3.4. Profile of the Sample

The sample is composed of tourists that are mostly well-educated females, aged around 40 years old and earning between 1200–2800 € per month (55%). Most of them are German (21%), French (17%) and Italian (12%). For 64% of tourists, this was their first time visiting the island where they were interviewed. Travelling with partners or relatives in a self-organized trip were the most frequent options (60%).

### 3.5. Data Analysis

Following [81,82], a data-driven segmentation analysis was employed, following a two-step process. The variables utilised for the clustering were the twelve climate risks previously identified. To avoid the problem of multicollinearity, a reliability measurement analysis using Cronbach alpha coefficients was conducted (Table 2). This type of reliability measurement helps to define whether variables are measuring the same concept and should be combined [83]. The total alpha coefficient of the test was 0.87 and the item-total correlations lower than 0.40. This indicates that the variables are not inter-correlated, thus they do not measure the same concept and should therefore be retained separately for the clustering.

**Table 2.** Reliability analysis of the climate change risks variables.

Climate Change Risks	Item-Total Correlation
Storms intensify throughout the year	<0.4
Streets are frequently flooded as a result of rain or tidal surge	<0.4
Wind strength becomes uncomfortable	<0.4
Rainfall daily duration becomes uncomfortable	<0.4
Wildfires occur more often	<0.4
Beaches largely disappear	<0.4
Beaches are affected by algae blooms	<0.4
Temperature becomes uncomfortably hot	<0.4
Temperature becomes uncomfortably cold	<0.4
Coastal infrastructures are damaged due to coastal erosion	<0.4
Marine wildlife largely disappears	<0.4
Terrestrial wildlife largely disappears	<0.4

In the first stage, a hierarchical cluster analysis using Ward's method with squared Euclidian distance was run. A range of a possible three to five cluster solution was examined from which the four-cluster solution was considered the most meaningful and interpretable result. In the second stage, a non-hierarchical clustering analysis was applied with a single and final solution of 4 clusters, which allows a reliable and plausible result. From the various methods that exist to validate the number of clusters [84], the silhouette analysis was chosen. The mean silhouette values for the second, the non-hierarchical cluster, are shown in Table 3. The four coefficients are higher than 0.5, which means that the set is well clustered [85]. This is thus considered the final solution and is the one utilized for the study.

**Table 3.** Silhouette statistics of the four-cluster solution.

Cluster	Case Count	Mean	Minimum	Maximum
1	739	0.520	0.497	0.543
2	576	0.529	0.412	0.647
3	834	0.562	0.452	0.671
4	375	0.580	0.501	0.658
Total	2524			

Criterion-related validity of the clusters is required [86] by using external variables that can differentiate the segments encountered. In this study, cross-tabulation with chi-square analysis and Analysis of Variance (ANOVA) with Tukey's post-hoc testing were applied. The former analysis was performed using sociodemographic and trip description as independent variables (categorical variables). For the latter, socio-psychological variables such as perceived destination image and the importance given to environmental conditions when choosing destination were employed.

## 4. Results

### 4.1. Segment Identification

The Chi-square test was examined and significant differences were observed between clusters for the 12 climate risk variables ( $p = 0.00$  in all cases). To facilitate the interpretation of results, Figure 2 shows icons instead of percentages. Icons represent the most frequent answer in each case. The clusters were labelled according to the climate risks for which the majority of tourists are averse. Risk-aversion in this study is understood as tourists' reluctance to visit an island potentially affected by climate risk. The four segments were defined as follows: (1) *LO-loyal oriented* for the group that is not averse to any of the risks, (2) *3S-sun, sea and sand seekers*, labelled for a group that is averse to the specific risks related to beaches and comfortable weather conditions for maritime recreation, (3) *RA-risk averse* for the group of tourists that are averse to all risks, and (4) *WIL-risk-specific aversion* to wildlife and infrastructure damage.

According to the results, the LO cluster (739 tourists—29%) is different from the rest, as in this group almost all tourists are willing to stay on the islands where they were interviewed (more than 60%), despite the occurrence of any climatic event. In this group, tourists would change the season for travelling when extreme events (storms, flooding, rainfall and wildfires) are likely to occur. The 3S cluster (576 tourists—23%) is characterised by tourists that are highly averse to the risks related to extreme weather events, temperatures and beaches. That is, more than 80% of tourists in this group declared that they would choose another destination if CC affects beach availability, or if extreme temperatures and events occur more often. In this group, the majority of tourists (more than 60%) consider that coastal infrastructure damage or wildlife disappearance due to CC is not a reason for choosing another destination. The third cluster, RA (834 tourists), is the largest segment among the others with its 33% share. The RA group is the most risk-averse, as they would always avoid staying on the island affected by CC risks (more than 80% would choose an alternative destination in all cases). Finally, the WIL cluster

(375 tourists—15%) can be recognised as tourists with a specific aversion to two types of risks, marine and terrestrial wildlife disappearance and CC damage to infrastructure, for which the majority (85%) would avoid visiting islands. For more than 80% of WIL tourists, the choice of the island would not be affected if other risks occurred.

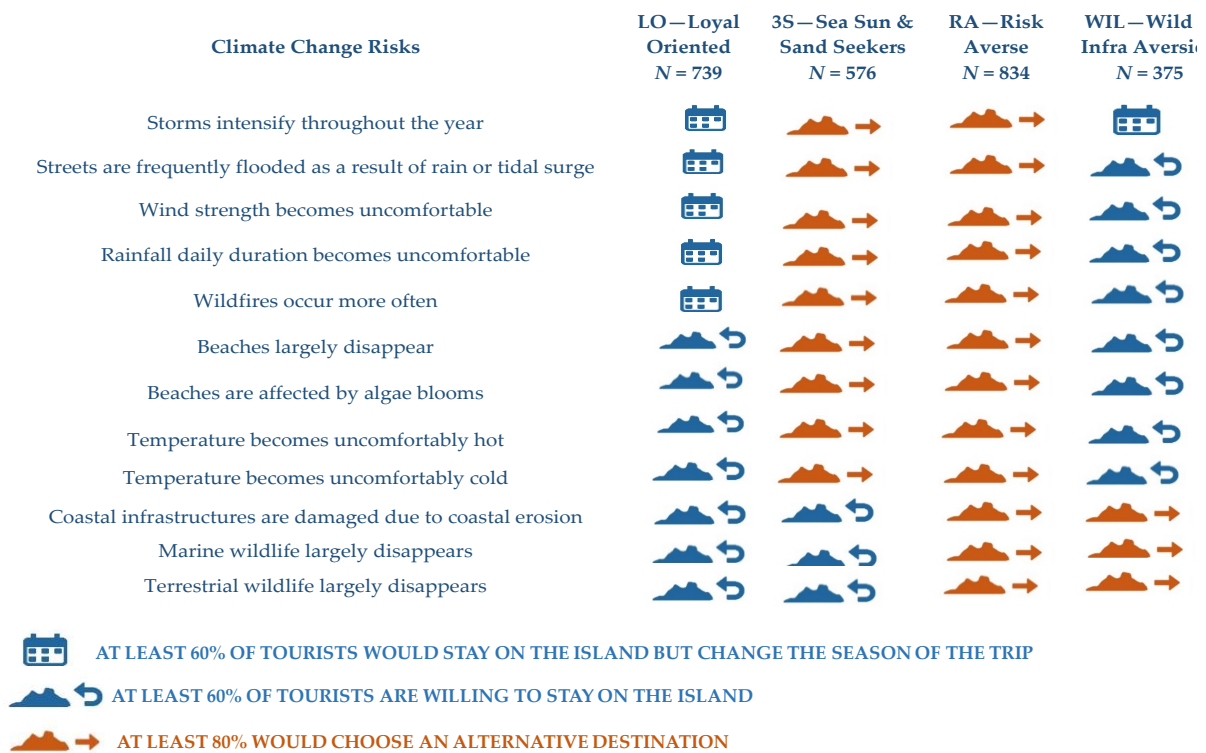


Figure 2. Final cluster structure.

#### 4.2. Cluster Profiling Based on Tourists' Socio-Demographic Characteristics

Potential sociodemographic variables that are expected to vary among clusters (nationality, education level, and monthly income) were used to confirm that there were significant differences among the four segments. The results are listed in Table 4, where only the most frequent categories are shown. Chi-square post-hoc analysis indicated that the LO segment differs from the rest as there are more French tourists (24.6%) with a technical/vocational education level (35.6%). Finally, the RA-risk averse cluster has a relatively higher proportion of tourists with monthly income above 2000 euros.

**Table 4.** Socio-demographics of tourists by segment (\*\*  $p < 0.01$ ).

Variable (%)	LO—Loyal Oriented N = 739	3S—Sea Sun & Sand Seekers N = 576	RA—Risk Averse N = 834	WIL—Wild & Infra Aversion N = 375	Chi-2	Cramer's V
<b>Nationality</b>					386.67 **	0.111 **
French	24.6	13.3	10.7	18.9		
German	20.0	21.1	23.3	18.2		
Italian	18.9	10.1	11.8	5.6		
English	5.4	8.9	13.6	11.6		
<b>Education level</b>					102.71 **	0.066 **
Secondary school	10.1	21.4	26.2	15.8		
Technical/vocational	35.6	15.5	15.0	16.7		
Bachelor degree	24.7	33.2	30.3	38.5		
Master or Doctor	14.2	23.5	17.1	21.7		
<b>Monthly Income level</b>					118.57 **	0.136 **
<1200 €	32.9	30.5	14.2	29.8		
1200–2000 €	40.8	25.1	21.8	26.6		
>2001 €	14.1	17.9	49.0	23.1		

#### 4.3. Cluster Profiling Based on Travel Characteristics

Three variables related to the trip description were analysed across segments (island visited, travel party, and form of organisation). Only the most frequent categories are shown in Table 5. A significantly higher percentage of tourists from the LO segment was visiting Crete at the moment of the interview (38.1%). Meanwhile, Mallorca, Azores and Cyprus were the most frequently visited islands within the segments 3S, RA and WIL, respectively. For the rest of the variables, although there were significant differences across segments, it was observed that the highest percentage of tourists were travelling with family and organised the trip without intermediaries.

**Table 5.** Tourist segments' travel characteristics (\*\*  $p < 0.01$ ).

Variable (%)	LO—Loyal Oriented N = 739	3S—Sea Sun & Sand Seekers N = 576	RA—Risk Averse N = 834	WIL—Wild & Infra Aversion N = 375	Chi-2	Cramer's V
<b>Island Visited</b>					1311.68 **	0.416 **
Mallorca	9.9	20.5	9.6	9.5		
Crete	38.1	-	-	2.3		
Cyprus	4.6	8.5	7.8	22.0		
Azores	1.9	2.9	24.9	3.5		
<b>Travel Party</b>					38.51 **	0.419 **
Alone	11.4	12.3	11.0	12.8		
Family	58.9	50.9	57.0	55.6		
Friends	21.0	22.1	18.1	22.2		
<b>Organization</b>					56.72 **	0.077 **
Myself	73.8	61.7	72.7	77.3		

#### 4.4. Tourist Valuation of Islands' Image and State of Conservation

A one-way ANOVA test was applied to obtain clusters by setting cluster membership as the dependent variable, and tourists' evaluations of the destination image (overall and affective dimensions) and the island's state of conservation as the independent variables.

Since the results of the one-way ANOVA indicated statistically significant differences among groups, a Tukey-HSD test was run to detect the variables that were significantly different from each other. In addition, partial squared Eta ( $\eta^2 p$ ) was calculated to determine the size of the effects.

As a result of this analysis, the variables *overall image*, *state of conservation* and the two dimensions of the affective image (unpleasant-pleasant and boring-inspiring) were observed to have a significant difference among groups (Table 6). Only two variables were not significant and are therefore not shown in the table. They were measuring the affective image in its sad-cheerful, and distressing-relaxing dimensions. For the significant variables, large effects were obtained, with the partial squared Eta ( $\eta^2 p$ ) scores greater than 0.14 [87].

**Table 6.** Cluster differences based on islands' perceived image and state of conservation.

Variable	LO—Loyal Oriented N = 739	3S—Sea Sun & Sand Seekers N = 576	RA—Risk Averse N = 834	WIL—Wild & Infra Aversion N = 375	F-Sig.	$\eta^2 p$	Post-Hoc Results of Tukey-HSD Test
Overall image	6.10	6.23	6.30	6.20	0.013	0.226	LO < 3S, RA, WIL
Unpleasant- Pleasant	6.37	6.23	6.21	6.26	0.003	0.150	LO > 3S, RA, WIL
Boring-Inspiring	6.35	6.06	6.15	5.97	0.003	0.190	WIL < 3S, RA, LO
State of conservation	5.39	5.19	5.32	5.24	0.050	0.324	3S < WIL, RA, LO

Variables measured on seven-point Likert scale: (i) Overall image (1 = very negative; 7 = very positive); (ii) Affective image (semantic bipolar scale unpleasant-pleasant destination; boring-inspiring destination); (iii) State of conservation (1 = very badly preserved; 7 = very well preserved).  $\eta^2 p$ : Partial square Eta.

Data analysis reveals that cluster one (LO tourists) is the one that considers the island visited more pleasant and inspiring. This denotes that these tourists present the most positive affective feelings towards the destination, which is not surprising considering their willingness to stay on the island despite any potential climate-related risks. However, their overall perceived image of the island is relatively lower than for the rest of the segments. On the other side, the 3S segment is characterized as having the most negative opinion of the state of conservation of the natural environment in the island visited. Finally, it was observed that WIL tourists are the ones who consider the island visited less inspiring.

#### 4.5. The Importance of Environmental Attributes for Islands' Choice

A second ANOVA analysis was carried out with 13 environmental attributes of the destinations that were evaluated by tourists. This time, tourists' evaluation refers to the level of importance given to each attribute when choosing island destinations for travelling. Table 7 shows the results of the analysis post-hoc. All variables were significant for explaining differences between segments.

**Table 7.** Cluster differences based on the importance given to the conservation of environmental attributes to visit an island.

Variable	LO—Loyal Oriented N = 739	3S—Sea Sun & Sand Seekers N = 576	RA—Risk Averse N = 834	WIL—Wild & Infra Aversion N = 375	$\eta^2$ p	Post-Hoc Results of Tukey-HSD Test
Comfortable air temperature	5.30	5.46	5.84	5.72	0.295	LO < WIL, RA, 3S
Comfortable water temperature	5.32	5.67	5.52	5.41	0.150	3S > WIL, RA, LO
Lack of infectious diseases	5.49	5.67	5.99	5.86	0.190	RA > WIL, LO, 3S
Beach size	4.72	5.18	4.39	4.85	0.340	3S > WIL, RA, LO
Water availability	5.53	5.63	5.87	5.79	0.222	RA > WIL, 3S, LO
Lack of wildfires	5.13	5.33	5.68	5.23	0.289	RA > WIL, 3S, LO
Well preserved marine wildlife	5.27	5.86	5.57	5.97	0.396	WIL > RA, 3S, LO
Well preserved land flora-fauna	5.29	5.88	5.64	5.94	0.121	WIL > RA, 3S, LO
Well preserved infrastructure	5.15	5.40	5.68	5.45	0.410	RA > 3S, LO, WIL
Cultural heritage in good conditions	5.35	5.52	5.68	5.23	0.157	RA > LO, RA, WIL
Scarce rainfall	4.92	5.42	4.75	5.01	0.200	3S > LO, RA, WIL
Lack of extreme weather events	5.12	5.64	5.67	5.47	0.120	3S-RA > WIL, LO

Variables measured on a seven-point Likert scale, 1 = not important at all when choosing an island destination for travelling; 7 = very important aspect to be considered when choosing islands for travelling.  $\eta^2$  p: Partial square Eta.

Data shows that the LO segment is the group that gives relatively less importance to thermal comfort when choosing to visit an island. For this group, higher temperatures do not seem to be a constraining factor in regards to their island choice. In relative terms, the 3S cluster evaluated beach size and scarce rainfall with the highest importance, which is not surprising given their high risk-aversion to the impacts of CC on beaches and the increase in storms. As was expected, the RA cluster gives relatively high importance to all aspects, this being the group that presents the highest means in almost all cases. Finally, the WIL cluster is the one considering marine and terrestrial wildlife preservation as the most important aspect when choosing islands to travel to. However, WIL tourists give relatively less importance to the condition of infrastructure than tourists belonging to the RA cluster.

## 5. Discussion

What makes this study both novel and useful is the analysis of tourists' behavioural responses to CC through a comprehensive interconnected package of climate risks to which island destinations are exposed. The study results indicate that tourists do not exhibit unified market characteristics in regard to their responses to CC impacts. Indeed, they consist of four market segments that are labelled as the *LO-loyal oriented tourists*, *3S-sun, sea and sand seekers*, *RA-full risk aversion* and *WIL-risk-specific aversion* to wildlife disappearance and infrastructures damage. The segments encountered are also different in regard to their demographic characteristics and the organisation of the trip made to the islands.

This research can be used to develop recommendations for destination managers that come from the interpretation of the segments' characteristics (Table 8). Three main aspects were considered, stemming from the previous sections, at the moment of preparing this information; (i) perceived overall and affective image of the destination, (ii) tourists'

opinions of the state of conservation of the natural environment at the destination, and (iii) the importance given to several attributes of the destinations that encouraged the visit.

**Table 8.** Cluster interpretation for practitioners.

Risk Aversion	Soc-Dem Profile/ Trip Description	Interpretation
<p><b>LO—loyal oriented segment</b> <i>They prefer to stay on the island despite any climatic risk</i></p>	<p>-Mostly French-German -Vocational/ Technical education level -73% with monthly income &lt; 2000 € -Mostly visiting Crete in a family group</p>	<ul style="list-style-type: none"> <li>- Tourist with strong affective feelings to the destination, as they rated the affective image adjectives with the highest scores.</li> <li>- Tourists in this group give relatively lower levels of importance to environmental conservation aspects for visiting islands, and, at the same time, present the most positive opinion in regards to the environmental preservation of the island visited.</li> <li>- Their overall perceived image of the island is relatively lower than for the rest of the segments. It is necessary to further analyse which aspects affect their cognitive evaluations, such as tourist superstructure, service quality, infrastructure, etc.</li> </ul>
<p><b>3S—sun, sea and sand seekers</b> <i>They are not willing to visit islands with damaged beaches and affected by extreme events and temperatures caused by CC.</i></p>	<p>-Mostly German-French- Most of them holds a bachelor degree -56% with monthly income &lt; 2000 € -Mostly visiting Mallorca in a family group</p>	<ul style="list-style-type: none"> <li>- In relative terms, tourists in this group consider that the state of conservation of the island visited is not well preserved.</li> <li>- This group gives relatively higher importance than the rest to the preservation of beaches for travelling to an island. Hence, islands promotion aiming to meet the expectations of these tourists should take advantage of beach nourishment progress and marine environment conservation goals.</li> <li>- The low probability of occurrence of rainfalls and extreme events are aspects of relatively high importance for these tourists when choosing an island. Hence, it is recommended to take advantages of climate services to provide accurate forecasts and guide 3S tourists to the appropriate time and location for the best climatic experience.</li> <li>- 3S tourists give more importance than the rest to the comfortable water temperatures. Thus, this information is crucial for this segment, and smart apps or tourist guides should inform on sea surface temperatures in the different touristic areas and in real-time.</li> </ul>

Table 8. Cont.

Risk Aversion	Soc-Dem Profile/ Trip Description	Interpretation
<p><b>RA—full risk aversion</b> <i>They would avoid visiting islands affected by CC impacts</i></p>	<p>-German-English -Most of them hold a bachelor degree -49% with monthly income &gt; 2001 € -Mostly visiting the Azores in a family group</p>	<ul style="list-style-type: none"> <li>- RA tourists give higher importance than the rest of the segments to the lack of vector born outbreaks, forest fires events and water shortages when choosing an island for travelling. Hence, a destination's efforts to improve the prevention measures and early warning systems in these domains shall enhance its value and image from the RA tourists' perspective.</li> <li>- At the same time, tourist promotion should take advantage on the progress made in the prevention of extreme events, and in regard to coastal infrastructure protection systems and cultural heritage preservation programmes, as these are also aspects of great importance for this segment.</li> </ul>
<p><b>WIL—wild &amp; infra aversion</b> <i>They would avoid visiting islands where CC induced effects affect marine and terrestrial wildlife</i></p>	<p>-French -Most of them hold a bachelor degree -54% with monthly income &lt; 2000 € -Mostly visiting Cyprus in a family group</p>	<ul style="list-style-type: none"> <li>- In relative terms, WIL tourists is the group for which the island visited is less inspiring. From the tourism management perspective, different tour packages with more adventure and experiential tours and activities shall be required.</li> <li>- Well preserved marine wildlife, flora and fauna are important aspects for WIL tourists when choosing an island. Hence, tourist promotion should take advantage of the progress made in regards to marine and terrestrial preservation programmes, and the enhancement of the island's resilient capacities in a CC context.</li> </ul>

Although there are general results that might show some meaningful paths to destination managers, what this study proposes is to differentiate the market depending on tourists' aversion to specific CC risks. Thus, destination managers who would like to know and target these segments can utilize the conclusions of this study. Certainly, recommendations that may be extracted from this research require further study to be effectively implemented at destinations.

Within its scope on islands, this study makes an exploratory effort to discover universal tourist segments so they can be extended to other destinations. The study can also be applied to other regions in the world to identify differences and conduct comparative analyses among countries or widely acknowledged touristic regions. Promising results can be derived through comparison studies, analysing different types of destinations.

## 6. Conclusions

The main contributions of this article are that (i) it provides a new market segmentation based on tourists' behavioural responses to climate change risks, and (ii) it shows that



tourists' choices of island destinations can be explained by their risk-aversion profile. More specifically, the study identifies four homogenous tourism segments, although the research was conducted at 10 different island destinations and included all tourists regardless of their possibly different motivations.

Whilst this study may have some limitations, it has attempted to shed some light on the decision criteria considered by tourists in the context of a changing climate. It is important to note that although situations were hypothetical, the destinations investigated are real and well-known to tourists, which is beneficial for avoiding response-biases. In addition, the islands analysed are likely to experience many of the adverse CC effects enumerated in this study [88].

From the theoretical perspective, this research has shown that the tourism market can be segmented based on tourists' aversion to climate change risks. This evidence is novel and may have a great potential to nourish current models of tourist behaviour. For example, discrete choice methods are widely employed to measure the potential economic losses for destinations by estimating tourists' (reduced) willingness to pay for visiting destinations under CC impacts. In these studies, it is assumed that tourists are always willing to visit the destination affected by CC at a lower price. However, the present study allows understanding that some CC impacts make the tourist decide not to visit the destination. By combining these methods, it is possible to identify not only economic losses by a lower willingness to pay for visiting the island due to CC impacts but also by the decision of not visiting the destination given the occurrence of some specific impacts.

From the managerial perspective, the results of this study will benefit both destination managers and tourism promotion when it comes to the organisation of their practices under the impacts of climate change. Being aware of the heterogeneity of tourists' responses to CC is vital to be able to effectively plan and manage dynamic destinations and revise marketing plans that better meet environmental, as well as tourists' demands. It may also be useful for the design of climate services and promotional messages that can improve the profitability of adaptation strategies.

This study faces various limitations that substantially reduce the potential generalisation of its results and the scope of its conclusions. First, it is based on island destinations, and therefore there is a need to consider evidence on other alternative destinations. Second, the investigation focuses on twelve specific climate risks and does require an examination of other potential risks that could occur on island, coastal and other types of destinations. Finally, it recommends that further similar research on the impacts of climate change on tourists' choices should be combined with choice experiments methods to address multiple socio-economic implications. This assessment might be useful to suggest segmented recommendations that would meet the specific requirements of the various types of tourism. It would also be convenient to advance in the measurement of current climate impacts and measure the gap between tourists' dispositions and actual behaviour. Finally, there might also be a need to evaluate the importance given by tourists to adaptation policies in relation to the choice of the destination.

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