Impact of heat waves on Spanish tourism demand

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Abstract

This study investigates the impact of heat waves on the redistribution of international tourist flows to sun and beach destinations in Spain, focusing on behavioural changes in travel planning and destination choice. The research aims to assess how extreme weather events, particularly heat waves, influence tourists' decisions, with implications for the resilience and competitiveness of coastal tourism. A quantitative methodology was employed, using Structural Equation Modelling (SEM), to analyse causal relationships among four latent variables: country of origin, tourist destination, type of accommodation, and number of overnight stays. The model was applied to two chronological periods – July 2022 (with a heat wave) and July 2023 (without) – using data from the FRONTUR survey National Statistics Institute (NSI) and climatic records from State Meteorological Agency (SMA). The sample comprised 6,556 international tourists from the UK, France, Germany, and the Netherlands. Findings reveal that heat waves significantly influence destination choice and reduce overnight stays, particularly in insular regions such as the Balearic Islands. Tourists from the UK showed a marked decline in travel during heat waves, indicating a shift towards cooler destinations. However, heat waves did not significantly affect the type of accommodation hired. The study confirms that climatic discomfort leads to shorter stays and altered travel behaviour, supporting the emergence of "coolcations" as a growing trend. Practical implications include the need for sun-and-beach destinations to implement climate adaptation strategies to remain competitive. Enhancing accommodation services and promoting thermal comfort can mitigate the negative effects of extreme temperatures. In conclusion, heat waves are a critical factor in shaping tourist behaviour and demand patterns. Their inclusion in predictive models offers valuable insights for tourism planning and policy, especially in the context of climate change.

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Introduction

The Mediterranean stands out as one of the regions most affected by severe weather phenomena – such as heatwaves, droughts, floods, and intense rainfall – linked to climate change (Tuel & Eltahir, 2020). In Southern Europe, the frequency and severity of heatwaves have notably increased (Paredes-Fortuny & Khodayar, 2023), as evidenced during the summer of 2022 in countries like Spain, Greece, and Italy, which experienced unprecedented temperatures since records began (Copernicus Climate Change Service, 2019, 2021; Lorenzo & Álvarez, 2022). The Mediterranean basin is warming at a rate 20% faster than the global average (MedECC, 2020). This trend poses a growing climate vulnerability for extensive coastal zones in Spain, particularly those reliant on sun-and-sea tourism, traditionally favoured for their temperate weather. The socio-economic repercussions are significant, especially considering that tourism contributed 13.5% to Spain's GDP in 2023 (NSI, 2023). In this evolving climate context, heatwaves are increasingly shaping tourists' future travel choices, with some reconsidering destinations in Southern

Europe in favour of cooler alternatives (Marriott Bonvoy, 2024). Preferences are shifting towards locations offering more agreeable thermal conditions and opportunities for outdoor leisure activities without excessive heat (Olcina & Miró, 2017). Recurrent heatwaves are also influencing the duration of stays, prompting adjustments in travel plans (Marriott Bonvoy, 2024). Consequently, elevated temperatures are emerging as a pivotal factor shaping tourists' travel intentions, planning processes, and destination-related behaviours. As the manifestations of climate change become more pronounced, the impact of extreme weather on tourism has garnered increasing scholarly attention, encompassing both supply and demand perspectives (Arabadzhyan et al., 2020; Lam-González et al., 2020; León et al., 2021). Nonetheless, further exploration is required to deepen our understanding of tourists' resilience to climatic challenges and their behavioural adaptations in response to such conditions. This paper seeks to contribute to this discourse by proposing, estimating, and validating a non-linear statistical model—based on structural equation modelling (SEM)—to examine the direct and moderating influence of heatwaves on the behavioural responses of international sun-and-beach tourists during trip planning.

The study evaluates behavioural variations across two distinct temporal scenarios—one characterised by heatwaves and the other without—heatwaves both situated in July, the peak of the summer season. The objective is to ascertain whether shifts in extreme climatic conditions, such as heatwaves, elicit differing behavioural patterns within the same tourism framework. The empirical analysis draws upon data from the FRONTUR survey conducted by Spain's National Statistics Institute (NSI), focusing on inbound tourism to Spanish coastal regions from the four principal source countries during the summer period. Climatic data regarding heatwaves were sourced from the Spanish State Meteorological Agency (SMA). Guided by the Protection Motivation Theory (PMT) formulated by Rogers (1975) and previously applied to tourism to interpret individual responses to environmental risks (Wenjia et al., 2020), this research identifies relevant variables within the FRONTUR dataset that reflect tourists' precautionary planning in the face of elevated temperatures. Ultimately, this study sheds light on how heatwaves influence international tourists' decision-making, particularly regarding adaptation and avoidance strategies aimed at securing greater thermal comfort at their chosen destinations. The findings reveal a decline in overnight stays and tourist arrivals in certain areas during periods of extreme heat. Understanding the behavioural implications of climate-induced crises, such as heatwaves, is essential for anticipating shifts in tourist experiences and loyalty. Moreover, the insights gained can inform the development of climate adaptation strategies to bolster the resilience and competitiveness of sun-and-beach destinations (Buckley, 2008).

Literature review

The following section explores the conceptual underpinnings of the theoretical framework concerning the impact of climate change on the tourism industry, with a particular focus on sun-and-sand destinations. It also examines the various factors influencing the behaviour of international tourists visiting Spain's coastal regions, drawing on variables from the FRONTUR survey (Cross-Border Tourism Flow Survey) incorporated into the proposed model.

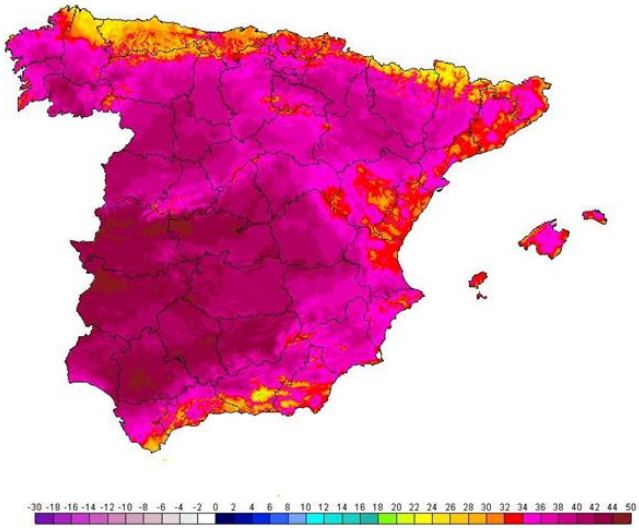
Climate Change and Coastal Tourism

The Mediterranean coastline, long valued for its temperate climate, faces growing challenges from global warming. Rising temperatures, sea-level rise, and water scarcity threaten the competitiveness of sun-and-beach destinations by degrading coastal ecosystems and tourism infrastructure (MedECC, 2020; Lorenzo & Álvarez, 2022; Roson & Sartori, 2014; Gabarda-Mallorquí, 2016). These risks underscore the need for adaptation strategies to maintain destination resilience (Gómez Royuela, 2016).

Focus on Heatwaves

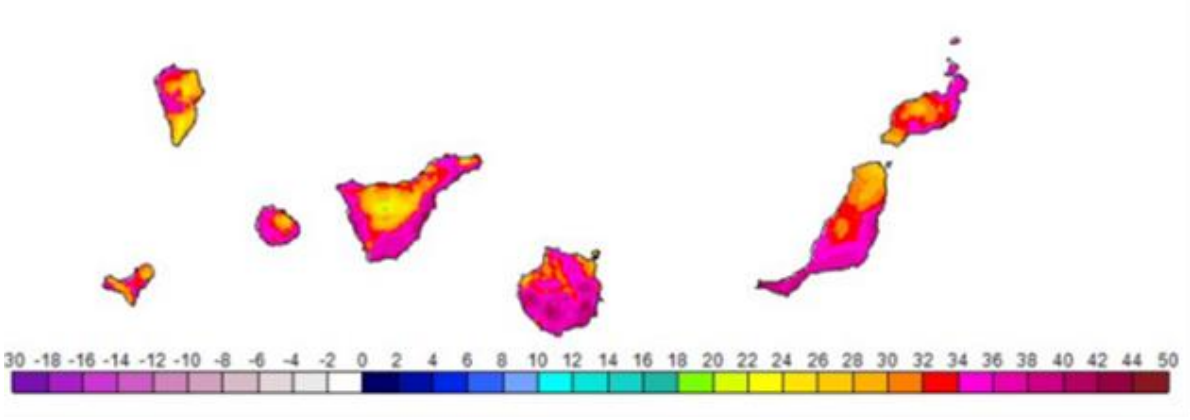
Heatwaves—prolonged periods of extreme heat—are becoming more frequent and intense in Southern Europe (Perkins & Alexander, 2013; SMA, 2022). In Spain, projections indicate temperature increases of 4–6°C by 2100, with longer heatwave durations and "tropical nights" reducing thermal comfort (Olcina et al., 2019; Miró & Olcina, 2021). The July 2022 heatwave, lasting 18 days and affecting 44 provinces, exemplifies this trend (SMA, 2023).

Figure 1. Maximum temperature in mainland Spain and the Balearic Islands (°C) on 14 July 2022



Source: State Meteorological Agency (SMA)

Figure 2. Maximum temperature in the Canary Islands (°C) on 14 July 2022



Source: State Meteorological Agency (SMA)

Influence of Heatwaves on Tourist Behaviour

Tourist behaviour is highly sensitive to weather, with temperature influencing destination choice, activity patterns, and satisfaction (Gössling et al., 2006; Jeuring & Haartsen, 2017). Extreme heat can shorten stays, deter outdoor activities, and reduce repeat visits, particularly among northern European travellers (Moreno et al., 2008; Hsu & Sharma, 2023). Socio-demographic factors and prior experience shape perceptions of climatic comfort (Dubois et al., 2016).

Research confirms that heatwaves affect destination suitability, mobility, and overall experience (Becken & Wilson, 2013; Gómez-Martín et al., 2014; Amengual et al., 2014). Forecasts suggest reduced overnight stays in regions such as the Balearic Islands, Andalusia, and Catalonia, with Spain among the Mediterranean countries most affected by declining tourist flows (European Commission, 2023). Adverse weather also impacts service quality and future travel intentions (De Almeida & Machado, 2019).

Based on these findings, the following hypotheses are proposed:

H1. Heat waves influence tourist flows according to the country of residence.

H2. The tourist's country of residence influences the choice of destination.
H3. Heat waves influence the choice of destination.
H4. The destination influences the type of accommodation contracted.
H5. Heat waves influence the type of accommodation contracted.
H6. The destination influences the number of overnight stays.
H7. Heat waves affect on the number of overnight stays.

Moderating Influence of Heatwaves

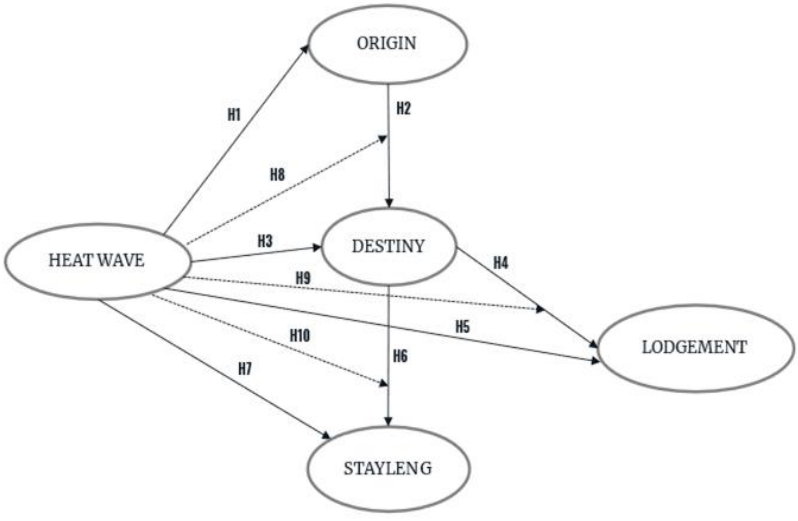
Heatwaves act as a risk factor that shapes tourist behaviour and destination dynamics, necessitating adaptation strategies (Olcina & Vera-Rebollo, 2016; Humagain & Singleton, 2021). In this study, heatwaves are introduced as a moderating variable across two July periods: one with a heatwave (SMA, 2022) and one without (SMA, 2023):

- H8. Heatwaves exert a moderating influence on the relationship between tourists' countries of residence and their destination choices.
- H9. Heatwaves exert a moderating influence on the relationship between destination choice and the type of accommodation selected.
- H10. Heatwaves exert a moderating influence on the relationship between destination and overnight stay duration.

Conceptual Model Proposal

The proposed model (Figure 3) includes four variables: country of residence (Germany, France, Netherlands, UK), destination (Balearic Islands, Catalonia, Andalusia, Canary Islands), overnight stays (five categories), and accommodation type (hotels, market-based, non-market). Sixteen indicators operationalize these variables.

Figure 3. Conceptual Model Proposal



Research methodology

Study Area

Spain's coastline spans approximately 4,830 kilometers along the mainland, with an additional 3,049 kilometers encompassing the Balearic and Canary Islands (National Geographic Institute).

Presently, the beaches along the Mediterranean and in the Canary Islands are among the most prominent international destinations for sun-and-sea tourism. This positioning has established Spain as the leading global destination for travellers motivated by this type of holiday. The principal Autonomous

Communities attracting this influx of tourists are predominantly coastal regions: Catalonia, Andalusia, Valencia, the Balearic Islands, and the Canary Islands (NSI, 2023).

Data

The data utilised to estimate the model and test its hypotheses derive from the FRONTUR Statistical Survey on tourist movements at the border, conducted by Spain's National Statistics Institute (NSI). This survey focuses on international demand and aims to quantify the monthly number of non-resident visitors entering Spain, as well as their modes of entry. It also gathers key trip characteristics, including access route, primary destination, country of residence, travel purpose, and organisation method (Corral Orgaz, 2021). We selected variables from the questionnaire that, based on a literature review, are most likely to be affected by heatwave conditions in terms of trip planning. These include main destination, country of residence, type of accommodation, and number of overnight stays, specifically for leisure-motivated travel. To simplify the model, the analysis of countries of origin focuses on the four leading source markets for international tourists in July 2022 and 2023: the United Kingdom, France, Germany, and the Netherlands. July was chosen as the reference month ~~as~~ because it is the peak season for coastal tourism. Regarding destinations, four key Autonomous Communities were selected for analysis during the specified periods: the Balearic Islands, Catalonia, Andalusia, and the Canary Islands. Accommodation types are categorised into three groups in the questionnaire: hotels and similar establishments, other market-based options (e.g., holiday rentals), and non-market accommodation (NSI, 2016).

Heatwave data were obtained from the Spanish State Meteorological Agency (SMA), focusing on two distinct scenarios: July 2022, recorded as the hottest month since SMA began collecting data, and July 2023, which experienced minimal heatwave activity. The total sample size is 6,556, comprising 3,363 surveys from July 2023 and 2,893 from July 2022. Table 1 outlines the sample characteristics.

Table 1. Sample Characteristics

Type of survey	Continuous on a quarterly basis.
Population scope	Non-residents in Spain who enter or leave Spain, whether or not they have stayed overnight.
Area	The entire national territory.
Reference period	Monthly.
Data collection	Interviews.

Source: National Statistics Institute (2016)

Data Analysis

This study seeks to explore causal relationships among four latent variables: tourist destination, number of overnight stays, accommodation type, and country of origin. These relationships are examined using Structural Equation Modelling (SEM). SEM is appropriate for this exploratory research as it enables the analysis of connections between latent (theoretical) and observed (empirical) variables, guided by hypotheses in predictive research (Henlein & Kaplan, 2004). It is widely used in social sciences such as marketing and management to identify causal links between concepts through indicators (Hair et al., 2019) and is particularly effective in handling issues like non-normal data distributions (Hair et al., 20147). In tourism research, SEM has been employed to investigate behavioural factors among tourists (Yoon & Uysal, 2005; Eusebio & Vieira, 2011; Domínguez et al., 2017; Han et al., 2018; Sánchez-Sánchez-Sánchez et al., 2024). To estimate the model, WarpPLS 8.0 software (Kock, 2019) was used, allowing for the assessment of non-linear relationships and providing a more realistic representation. Parameters were estimated using bootstrapping (Efron & Tibshirani, 1993) with 100 samples, each matching the full sample size (n = 6,556).

WarpPLS was selected for four key reasons: its suitability for exploratory models (Henseler, 2018), its capacity to handle complex models with predictive precision, its minimal sample size requirements, and its tolerance for data that do not meet multivariate normality assumptions (Joreskög & Wold, 1982; Henseler et al., 2009).

Model Estimation and Fit Indices

To assess the quality of the measurement model, reliability and validity tests were conducted on the selected factors. Subsequently, the structural model was applied to test the hypotheses.

Table 2 presents a summary of the results alongside commonly accepted benchmark values. The overall fit of the theoretical model to the sample data was evaluated using the following indices:

Table 2. Model Fit and Quality Indices

Index	Value	Interpretation
Average Path Coefficient (APC)	APC = 0.087, $p < 0.001$	Significant
Average R-squared (ARS)	ARS = 0.053, $p < 0.001$	Significant
Average Adjusted R-squared (AARS)	AARS = 0.053, $p < 0.001$	Significant
Average Block VIF (AVIF)	AVIF = 2.681	Acceptable ≤ 5, ideally ≤ 3.3
Average Full Collinearity VIF (AFVIF)	AFVIF = 6.296	Acceptable ≤ 5, ideally ≤ 3.3
Tenenhaus GoF (GoF)	GoF = 0.201	Small ≥ 0.1, Medium ≥ 0.25, Large ≥ 0.36
Sympson's Paradox Ratio (SPR)	SPR = 0.900	Acceptable ≥ 0.7, ideally = 1
R-squared Contribution Ratio (RSCR)	RSCR = 1.000	Acceptable ≥ 0.9, ideally = 1
Statistical Suppression Ratio (SSR)	SSR = 1.000	Acceptable ≥ 0.7
Nonlinear Bivariate Causality Direction Ratio (NLBCDR)	NLBCDR = 1.000	Acceptable ≥ 0.7

Source: Authors' own analysis using WarpPLS 8.0

Findings/results

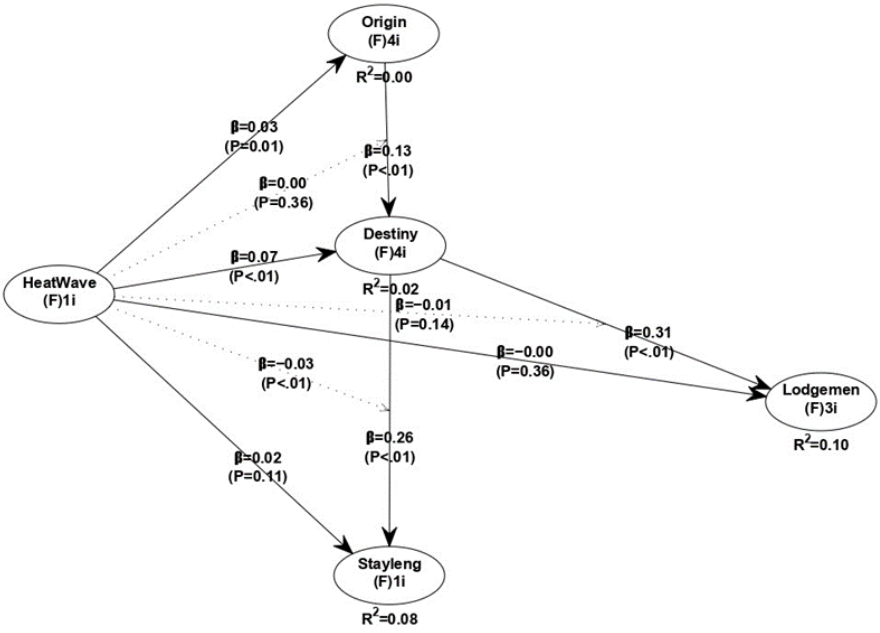
Structural Models and Hypothesis Testing

To assess the overall adequacy of the proposed models, various indicators were employed, including the coefficient of determination (R^2) (Cheah et al., 2019). The R^2 values for the four endogenous variables—country of residence, tourist destination, number of overnight stays, and type of accommodation—relative to the heatwave, reflect the extent of variation explained in the latent constructs (Henseler et al., 2009; Hair et al., 2017). R^2 values range from 0 to 1, with higher values indicating stronger predictive power (Hair et al., 2019). In the context of PLS-SEM, R^2 values of 0.27, 0.13, and 0.02 are interpreted as substantial, moderate, and weak, respectively (Cohen, 1988), although values as low as 0.10 may still be deemed acceptable (Lohmoller, 1989; Raithel et al., 2012).

The graphical representation of the structural model is shown in Figure 3. All latent variables yielded low R^2 values (<0.10): country of origin (0.00), tourist destination (0.02), number of overnight stays (0.08), and type of accommodation (0.010). An R^2 of 0.00 for the country of origin suggests no discernible influence on the selected tourist destination.

For tourist destination, an R^2 of 0.02 indicates that the country of origin accounts for 2% of the variance in this factor. The number of overnight stays shows an R^2 of 0.08, suggesting that the destination influences 8% of this behaviour. Lastly, the R^2 for the type of accommodation is 0.010, implying a minimal impact of destination on accommodation choice.

Figure 4 presents the structural model outcomes, including coefficients of determination.



Source: The authors' process data using WarpPLS 8.0

Of the ten hypotheses proposed, six were supported, having been accepted with a confidence level exceeding 95% ($p<0.05$).

Hypotheses 5 (H5) (β = -0.00, p = 0.36) and 7 (H7) (β = 0.02, p = 0.11) were not validated at the 95% confidence threshold, falling slightly short. This suggests that heatwaves do not significantly influence the type of accommodation selected (H5) or the number of overnight stays (H7).

Similarly, hypotheses 8 (H8) (β = 0.00, p = 0.36) and 9 (H9) (β = 0.01, p = 0.14), which examine the moderating role of heatwaves between country of origin and destination (H8), and between destination and accommodation (H9), were also not supported. The presence or absence of heatwaves does not significantly alter the relationship between country of origin and destination (H8), nor between destination and accommodation type (H9). The remaining hypotheses were accepted ($p<0.05$).

The subsequent analysis interprets the values and signs of the estimated coefficients from the structural equations, which reveal both direct and moderating non-linear relationships among the latent variables. This process validates the theoretical assumptions embedded in the structural equation model.

Hypothesis 1 (H1) is confirmed: a positive relationship exists between heatwaves and tourists' country of origin (β = 0.03, p = 0.01). Despite the overall positive effect, the indicator for the United Kingdom is negative (W = -0.672), indicating fewer UK tourists during heatwave periods. Hypothesis 2 (H2) is supported by a positive relationship between country of origin and destination choice (β = 0.13, $p < 0.01$). Hypothesis 3 (H3) also shows a positive influence of heatwaves on the selected destination (β = 0.07, $p < 0.01$), although the Balearic Islands indicator is negative (W = -0.964), suggesting reduced tourist numbers during high temperatures. Hypotheses 4 (H4) and 6 (H6) both demonstrate positive relationships (β = 0.31, $p < 0.01$ and β = 0.26, $p < 0.01$, respectively). H4 indicates that popular destinations are associated with increased bookings of specific accommodation types, although hotel establishments show a negative indicator (W = -0.964). H6 suggests that higher tourist concentration in certain destinations leads to more overnight stays. Finally, hypothesis 10 (H10) confirms a negative moderating effect of heatwaves on the relationship between destination and overnight stays (β = -0.03, $p < 0.01$), indicating that extreme temperatures reduce the duration of stays, which tend to be longer when temperatures are milder.

Discussion and conclusion

The findings support the hypothesis that heatwaves in tourists' countries of origin generally have a positive impact (H1), indicating that international demand for Spain continues to be driven by the Mediterranean climate, even when temperatures become more extreme. However, there is no clear evidence that the presence or absence of high temperatures significantly affects the decision-making process in the country of origin when selecting a holiday destination (H8). This is illustrated by the 2023 tourism data, which shows a notable rise in foreign visitors following the summer 2022 heatwaves (NSI, 2023). Nonetheless, a decline in tourist arrivals from the UK—Spain's largest source market—during heatwave periods has already been observed (H1). This aligns with studies highlighting a growing preference among European travellers for cooler destinations beyond the Mediterranean region (Marriott Bonvoy, 2024). In connection with this, the direct link between heatwaves and the choice of summer holiday destination is also evident (H3), as is the relationship between the country of origin and the destination selected (H2). Northern European tourists remain largely drawn to sun-and-sea holidays and pleasant weather conditions when choosing where to travel (Gössling et al., 2006; Rosselló-Nadal et al., 2011; Jeuring & Haartsen, 2017). However, heatwaves do appear to reduce tourist flows to certain areas, such as the Balearic Islands, suggesting a modest shift in behaviour during periods of extreme heat.

Regarding accommodation, in high-demand destinations, the data confirm tourists' preference for booking non-hotel options, favouring holiday rentals (H4) (Jiménez et al., 2022). The type of accommodation chosen does not appear to be influenced by the occurrence of heatwaves at the destination (H9), nor by high temperatures in general, regardless of location (H5). As for overnight stays, there is an overall increase in destinations with high tourist volumes (H6), although heatwaves tend to shorten stay duration compared to cooler periods (H10). Forecasts predicting a decline in overnight stays due to reduced climatic comfort in the Mediterranean region are thus validated (European Commission, Joint Research Centre, 2023). Nevertheless, when considering all destinations, high temperatures do not significantly affect the number of overnight stays (H7), a conclusion consistent with previous research (Caldeira & Kastenholz, 2018). The principal outcome of this study is the confirmation that extreme weather phenomena—specifically heatwaves—are already influencing the distribution of tourist demand and the behavioural patterns of travellers whose primary motivation is to visit sun-and-beach destinations during the summer months. By integrating climatic variables into a predictive model, this research contributes valuable insights into how heatwaves affect a particular segment of tourism, with notable implications for the broader industry.

Among the most significant findings is the observed decline in tourist arrivals to the Spanish Mediterranean coastline from traditional source markets, such as the United Kingdom, during periods of elevated temperatures. This shift is accompanied by a growing interest in alternative destinations with milder climates—commonly referred to as "coolcations"—which are emerging as a new trend in response to climate change (Travel Nast, 2024). This trend is reshaping conventional patterns of sun-and-beach tourism. Another noteworthy discovery is the impact of heatwaves on destination choice, particularly in relation to specific geographical features such as insularity. The combination of high temperatures and humidity exceeding 55% in coastal regions can result in perceived temperatures of 45°C-50°C, significantly reducing thermal comfort (SMA, 2023). In this context, heatwaves represent a key variable—among others—that can forecast a downturn in travel demand to certain locations due to reduced satisfaction with the overall tourist experience (Caldeira & Kastenholz, 2018). This, in turn, affects the resilience and competitiveness of tourism destinations (Fitchett et al., 2017). Furthermore, the study concludes that heatwaves, reduce the duration of stays in destinations with a high influx of international visitors compared to cooler periods. This trend appears to be independent of the type of accommodation chosen, which is predominantly holiday rentals. This insight is particularly relevant for hotel operators, who may consider enhancing their amenities and services to offer added value during heatwaves. It underscores the need for the tourism sector to implement adaptive strategies that address tourists' thermal comfort needs, both in destination planning and, in the facilities, provided. The findings confirm that heatwaves are already influencing the distribution of tourist demand and behavioural patterns among international travellers seeking sun-and-beach destinations. This has direct implications for tourism policy and destination management. Policymakers should prioritize investment in infrastructure

and services that mitigate heat stress, such as shaded public spaces, cooling systems in accommodation, and diversified tourism offerings that reduce dependence on peak summer months. These measures not only enhance visitor satisfaction but also align with broader climate adaptation strategies, reinforcing Spain's commitment to sustainable tourism.

Limitations and direction for future research

This study is subject to certain limitations stemming from the nature of the data employed. The FRONTUR survey, which monitors tourist movements at national borders, collects information exclusively on international visitors. Consequently, the findings cannot be extrapolated to reflect the behaviour of domestic travellers under similar conditions. Moreover, the analysis concentrates on Spain's principal European source markets—namely the United Kingdom, France, Germany, and the Netherlands (NSI, 2023). Tourist markets beyond Europe may exhibit distinct behavioural patterns that are not captured within this scope.

Looking ahead, future research could broaden the analytical framework to encompass both outbound tourism markets and inland destinations. This would facilitate comparisons regarding the impact of heatwaves on tourists whose primary motivations are not centered around sun-and-beach holidays. Investigating the various segments of tourist demand could enable destinations to devise tailored strategies for coping with extreme temperatures.

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