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Preferred climates for tourism: case studies from Canada, New Zealand and Sweden

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ABSTRACT: Climate has an important influence on the travel decisions of tourists. This paper reviews the distinct lines of inquiry that have been used to examine the influence of climate on tourist decision making, and attempts to define optimal climatic conditions for tourism. The study examined tourist perceptions of optimal climatic conditions (for temperature, sunshine, wind) and the relative importance of 4 climatic parameters (temperature, precipitation, sunshine, wind) in 3 major tourism environments (beach-coastal, urban, mountains). A survey instrument was administered to university students (n = 831) representing the young-adult travel segment, in 3 countries (Canada, New Zealand, Sweden). Three salient findings include: significant variation in the perceived optimum climatic conditions for the 3 major tourism environments, differences in the relative importance of the 4 climatic parameters in the 3 tourism environments, and similarities as well as differences in the climatic preferences of respondents from the 3 nations. These findings have several implications for the literature on climate and tourism, including the development of climate indices for tourism, destination choice and travel pattern modelling, and climate change impact assessments. When applied to a broader cross-cultural sample of tourist segments, the present approach could potentially reveal the complexities of tourist preferences for climate.

KEY WORDS: Climate · Tourism · Tourism climate index · Weather

1. INTRODUCTION

Weather and climate have an important influence on the global tourism sector. For tourists, weather and climate are an intrinsic component of the vacation experience. They can act as a central motivator in an individual's choice of holiday destinations and timing of travel, and can also be a salient factor in tourism spending and holiday satisfaction. The Mintel International Group (1991) found that 73% of respondents to a UK survey cited 'good weather' as the main reason for going abroad. A survey of Canadians (Ontario Ministry of Tourism and Recreation 2002) similarly found that 'escaping winter weather' was the prime travel motivation for 23% of respondents. Kozak (2002) surveyed the motivations of German and British tourists in Mallorca and Turkey *in situ* and, as expected considering the study area, found that 'enjoying good weather' was the most important motivational factor for their travel. Gössling et al.'s (2006) *in situ* survey of international leisure tourists in Tanzania found that 53% rated climate as a very important or important factor in destination choice, but almost 30% stated climate was not important (presumably because they were visiting friends or relatives, or implicitly assumed that weather in this tropical nation would be suitable for travel any time of the time of year). A survey of German travellers revealed that weather was of major importance in the choice of holiday destinations for 43% of respondents, third in importance behind only landscape (51%) and price (50%) (Lohmann & Kaim 1999). Hamilton & Lau (2005) confirmed these findings in their survey of German tourists, which found climate to be the most fre-

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quently considered destination attribute in destination decision making.

Weather has been found to influence travel patterns and expenditures in several nations. A 1°C warmer than average summer season was found to increase domestic tourism expenditures in Canada by 4% (Wilton & Wirjanto 1998). Jorgensen & Solvoll (1996) argued that demand for summer time inclusive tour charters by Norwegians, >75% of which are to 'sunshine destinations', was not influenced by weather conditions in the summer that travel took place, but rather by weather conditions in the previous summer. Agnew & Palutikof's (2006) analysis of tourism demand in the UK reached similar conclusions. They found that outbound and inbound visitor movements were responsive to both weather during the current year and the previous year.

For many travellers, weather conditions at the destination are central to overall trip satisfaction. This influence of weather on holiday satisfaction was quantified by Williams et al. (1997), who showed that weather conditions influenced the satisfaction of visitors to winter resorts. They concluded that weather was a troublesome source of contamination in studies of holiday satisfaction and destination evaluation. Further studies to confirm the influence of weather on consumer assessments of other forms of tourism are needed.

Weather and climate are also salient for tourism destinations. All tourism destinations are climate-sensitive in that they may be positively or negatively affected by interannual climate variability that brings heat waves, unseasonable cold, drought and heavy rain, which can affect not only tourist comfort but also tourism operations (e.g. water supply, energy costs, irrigation or snowmaking requirements). Tourism operations can also be interrupted or damaged by climate variability (e.g. wildfires) or extreme weather events (e.g. hurricanes, floods). Some tourism destinations can also be considered climate-dependent in that climate is the principal resource on which tourism to the destination is predicated (e.g. many tropical islands). Wall & Badke's (1994) survey of national tourism organizations found that majority of respondents (81%) felt weather and climate were major determinants of tourism in their nation. Indeed, some authors argue that climate is among the most dominant factors affecting global tourist flows (Burton 1995, Boniface & Cooper 2004).

Climate is a key factor considered by tourists, either consciously or implicitly during travel planning. There is general consensus in the tourism literature that destination image is a key determinant of destination choice and this area has been the subject of much research (Gallarza et al. 2002, Pike 2002). Climate is an important aspect of destination image, yet not all studies of destination image include climate as an attribute. For example, of the 25 destination image studies reviewed by Mazanec (1994), only 12 included climate as an attribute, making it the 10th most frequently used attribute out of 20 image-defining variables. However, many destination image studies that have included climate as an attribute found that it is one of the most important attributes. Hu & Ritchie (1993) who also reviewed several destination image studies found that 'natural beauty and climate' were of universal importance in defining destination attractiveness. Similarly, Anderssen & Colberg (1973) concluded that climate was one of the 3 dominant attributes along with cost and scenery. Just as climate affects the destination choice of travellers, it also highly influences the timing of travel. Seasonal climate fluctuations at tourism destinations and at high latitude regions are considered a key driver of the seasonality of global tourism demand (Butler 2001).

The aforementioned evidence indicates that climate is a resource that is exploited by the tourism industry and tourists alike, and as such can be measured and evaluated (de Freitas 2003). Important challenges in doing so are the selection of appropriate meteorological variables (e.g. temperature, rain, wind, sunshine, visibility, humidity, air quality, UV radiation, etc.) and the definition of climatic states from 'optimal' to 'unacceptable', as perceived by tourists.

This study aims to examine these 2 central issues of evaluating climate resources for tourism by using an *ex situ* survey of climatic preferences of a sample of tourists from 3 nations: Canada, New Zealand and Sweden. Four specific research questions guided the study:

(1) What is the range of climate preferences among tourists in terms of the optimal conditions for certain variables, such as temperature? Are tourists homogenous in their climate preferences so that a common 'optimum climate' for tourism could be theoretically identified? If climatic preferences are relatively homogeneous, how does the optimum climate identified by a stated preference approach compare with the optimum temperatures identified by the revealed preference studies of Maddison (2001), Lise & Tol (2002), Hamilton et al. (2005) and Bigano et al. (2006)?

(2) What is the relative importance of different climate parameters to tourists? Is temperature the dominant climate variable as suggested by Mieczkowski (1985), Becker (2000), Maddison (2001), Lise & Tol (2002), Hamilton et al. (2005) and Bigano et al. (2006) or are other variables equally important? We hypothesize based on the notable 'blue sky' bias in tourism marketing products and studies that variables like sunshine, are important to tourists in specific tourism segments, such as 'sun-sand-sea' (3S) holidays (e.g.

de Freitas 1990), and that other variables could be as important as temperature in certain tourism destinations.

(3) In what way, if at all, do the climate preferences of tourists differ among tourism environments or destinations where the dominant tourist activities would differ substantially? An optimal climate for a holiday to the rainforests of Costa Rica could conceivably differ from that for a holiday to the Austrian Alps, or sightseeing in Rome, or the beaches of Greece; and we hypothesize the improbability of a similar optimal climate for all tourism destinations. For example, the preferred temperature for a 3S destination could possibly be warmer than for a sightseeing trip in a large urban centre because of full body exposure to the atmospheric environment in the former and the potential for contact with water and subsequent cooling effects.

(4) Do cultural differences exist in tourist climate preferences? Lise & Tol (2002) and Bigano et al. (2006) concluded that temperature preferences varied little among tourists of different nationalities. Morgan et al. (2000), however, found significant differences in climate preferences and relative rankings of weather parameters among beach tourists coming from Northern Europe and Mediterranean Europe.

2. CLIMATIC PREFERENCE RESEARCH APPROACHES

This section reviews 3 distinct research approaches used to examine the climatic preferences of tourists over the past 30 yr and identifies some of the limitations of each approach.

de Freitas (2003) identified 3 distinct aspects of climate that are relevant to tourism: thermal, physical and aesthetic. The thermal component is primarily physiological in nature and determines the comfort of tourists and whether certain tourist activities are possible. The seasonal variation in the thermal component in temperate regions of the world drives natural seasonality that affects the global tourism industry. The physical aspect of climate also defines what tourism activities are possible at a given location. For example, strong winds and rain may make activities such as golf or sunbathing at the beach highly unpleasant or impossible. The aesthetic component is primarily psychological but is also evidently physiological for some, and includes the appearance of the sky and quality of light in the tourist's environment. It is largely influenced by cloud cover, sunlight and air quality in some locations.

Tourists experience and respond to the integrated effects of the atmospheric environment (Mieczkowski 1985, de Freitas 2003), but our understanding of tourist perceptions of climate remains very limited (Scott & McBoyle 2001, de Freitas 2003, Scott et al. 2004, Bigano et al. 2006, Gomez-Martin 2006, Gössling et al. 2006). It is not certain whether tourists consider, at the planning stages, the climate of a destination holistically or focus on specific attributes of climate (e.g. temperature or wind) when making choices regarding destination and timing of travel. Hamilton & Lau's (2005) survey of German tourists found that 73% had informed themselves about the climate of their selected destination, 42% of them before actually booking their holiday. Of those that sought climate information on their destination, 91% sought information on more than one climate variable and 88% obtained information about temperature. A survey of climate perceptions of tourists in Tanzania confirmed that tourist perceptions of climate were shaped by a set of parameters including temperature, rainfall, humidity and storms, rather than any singular parameter (Gössling et al. 2006).

The preferences of tourists for all aspects of climate have been explored in various ways. Several attempts have been made to identify most favourable or optimal climate conditions for tourism generally and for specific tourism segments or activities (e.g. 3S holidays in beach environments) (Crowe et al. 1973, Besancenot et al. 1978, Mieczkowski 1985, de Freitas 1990, Harlfinger 1991, Becker 1998, Morgan et al. 2000, Maddison 2001, Lise & Tol 2002, Hamilton et al. 2005, Bigano et al. 2006). The purpose of evaluating climate for tourism and identifying optimal climate conditions has varied in the literature. Several studies have endeavoured to assess the suitability of climate for tourism to provide a decision-making tool for travellers (e.g. objective evaluations of the best time and place for vacation travel, travel insurance purchases) and the tourism industry (e.g. infrastructure planning, programming, marketing, insurance) (Mieczkowski 1985, Besancenot 1991, Harlfinger 1991, Becker 2000, Morgan et al. 2000). Other studies have incorporated climate into broader models intended to predict tourist demand and international tourism flows (Maddison 2001, Lise & Tol 2002, Hamilton et al. 2005, Bigano et al. 2006). More recent studies have also examined the implications of global climate change for altering the quality of climate conditions at destinations and possible consequent changes in the competitive relationships among destinations (Scott et al. 2004, Amelung & Viner 2006).

The different approaches to examining tourist climate preferences and defining optimal climates for tourism can be grouped into 3 types: expert-based, revealed preference and stated preference. An overview of these 3 distinct approaches is provided, and the range of optimal climates identified by these studies is summarized in Table 1.

Table 1. Optimal climate conditions for tourism identified in the literature. Studies that only defined climate parameters for a 'suitable' recreation-tourism day and not optimum conditions are not directly comparable and have not been included in this table (e.g. Crowe et al. 1973). Study region includes either location of study or origin of sample data. 3S: 'sun-sand-sea' holidays

Study region	Tourism segment	Temporal scale	Optimal climate conditions: Temperature (°C)	Precipitation (mm mo^{-1})	Sun (h d^{-1})	Cloud (%)	Wind (km h^{-1})	Source
France	General	Daily	Tmax = 25–33	0	>9	≤25	<28.8	Besancenot et al. (1978)
Global	General	Monthly	Tmax = 20–27[a,b]	<15	>10	–	<3	Mieczkowski (1985)
UK and Mediterranean	Beach/3S	Monthly	Tmax = 27–30[a,b]	<15	>10	–	<3	Morgan et al. (2000)
United Kingdom	General	Quarterly	Tmax = 30.7	–	–	–	–	Maddison (2001)
OECD Nations	General	Annual	Tmean for warmest month of year = 21	–	–	–	–	Lise & Tol (2002)
Spain	Beach/3S	Daily	Tmax = 22–28	0	>11	≤25	<28.8	Gomez–Martin (2004)
Germany	General	Monthly	Tmean = 24	–	–	–	–	Hamilton (2005)
Global	General	Annual	Annual mean = 14	–	–	–	–	Hamilton et al. (2005a)
Global	General	Annual	Annual mean = 16	–	–	–	–	Bigano et al. (2006)

[a]Effective temperature; [b]21–32°C when relative humidity is 0% and 19–24°C when relative humidity is 100%; [c]all values adopted from Mieczkowski (1985) with the exception of adjusted temperature for a beach environment

2.1. Expert-based studies of tourism climate preferences

Three types of expert-based studies have been used to evaluate climate conditions for tourism. All 3 conceptually argue for a holistic evaluation of climate for tourism and are against the exclusive use of a single parameter to evaluate the climate suitability of tourism destinations.

In the early 1970s, the Canadian Atmospheric Environment Service was among the first to examine climate resources for recreation and tourism (Crowe et al. 1973, Gates 1975). These studies consulted recreation and tourism professionals to define the minimum climate conditions required for various outdoor recreation activities central to tourism, in order to define the season length for each activity. As these studies defined minimum thresholds but not optimal conditions, they are not compared in Table 1. The climate criteria and thresholds developed by these studies are subjective and were never validated against tourist preferences.

Another expert-based tourist climate preference research tool that was developed in the late 1970s is described as weather typing[1]. Yapp & McDonald (1978) combined 4 thermal comfort classes with 4 weather types (subjectively defined classifications for: rainy, windy, overcast, or sunny) to rate weather conditions for a range of outdoor recreation-tourism activities in Australia as pleasant, indifferent, or unsuitable. Besancenot et al. (1978) developed a very similar approach in France, where they combined 5 meteorological parameters to establish 8 weather types for summer tourism that range from ideal sunny weather (type 1) to bad, unsuitable weather (type 8). The thresholds for a type 1 summer tourism day are summarized in Table 1. This approach has also been utilized in more recent studies of tourism potential (Besancenot 1991, Gomez-Martin 2004, 2006).

As in Crowe et al. (1973), the climate criteria and thresholds in these studies are based on subjective expert opinion. The study of Gomez-Martin (2006) is an exception, as it used the results of a survey of tourists in Catalonia (Spain) to refine the thresholds used to define some of the 8 weather types. The findings of that survey are discussed in section 2.3. Another limitation of this approach is the generalization of the weather types for tourism defined by these studies to the rest of the world.

Another approach devised to represent the multifaceted nature of the climate resource for tourism is the use of integrative indices. These indices aim to permit the holistic rating of climate conditions for tourism. There have been a number of tourism-specific climate indices developed over the last 30 yr (Mieczkowski 1985, Harlfinger 1991, Becker 1998, 2000, Morgan et al. 2000, de Freitas et al. 2008). The highest rated conditions for each of the components of Mieczkowski's (1985) well-used index are summarized Table 1.

Existing climate indices for tourism in the available biometeorological literature are theoretically grounded on weather and human comfort. However, their central limitation is the subjectivity of the rating schemes for

[1]The term 'weather typing' used by these authors is not synonymous with synoptic weather typing, such as that in the Synoptic Classification scheme of Sheridan (2002): DP (dry polar), DM (dry moderate), DT (dry tropical), MP (moist polar), MM (moist moderate), MT (moist tropical), TR (transitional)

each component of the index and the weightings of each variable within the index, these being based on the author's opinion and not empirically tested against tourist preferences nor validated within the tourism marketplace (de Freitas 2003, Scott et al. 2004, Gomez-Martin 2006). These indices also suffer from other important limitations, including: insufficient temporal and spatial scale, reliance on climate means without consideration of variability or probability of key weather conditions, and disregard of the over-riding effect of physical parameters (i.e. rain and wind) under certain conditions (de Freitas et al. 2008).

2.2. Revealed tourism climate preferences

A second distinct approach to evaluating climate for tourism is the so-called revealed preference studies. These studies determine statistical relationships between measures of tourism demand (e.g. visits to a specific destination or national tourist departures and arrivals) and climate to infer the climate preferences of tourists. A particular strength of this approach is its objectivity, the influence of climate on tourists being determined from actual aggregate tourist behaviour and not on subjective expert opinion. The spatial scale of revealed preference studies varies from local to international. At the local scale, studies have modelled statistically significant relationships between weather and specific tourist destinations such as parks (Dwyer 1988, Meyer & Dewar 1999, Jones & Scott 2006a,b), multi-activity recreational areas (Paul 1972) and golf resorts (Scott & Jones 2007). At the regional level, Durden & Silberman (1975) used sunshine hours as the single variable to examine the effect of home-state climate conditions on demand for vacations to the state of Florida (USA) and found it to be a significant determinant. While illustrative of the influence of weather and climate on tourism, the revealed climate preferences in these studies cannot be considered broadly representative of comparable tourism destinations or tourism segments without replication in several other locations and are consequently not included in Table 1.

Another set of studies (Maddison 2001, Lise & Tol 2002, Hamilton et al. 2005, Bigano et al. 2006) have examined the role of climate in destination choice by analysing national or international tourism arrivals data. Using a modified pooled travel cost model, Maddison (2001) found that demand for a country by tourists from the UK peaked when its quarterly maximum daytime temperature was 30.7°C. This was referred to as the 'optimal temperature' for tourism. Lise & Tol (2002) used a similar pooled travel cost model for Dutch tourists, but could not determine any optimal temperature. Hamilton & Lau (2005) found that the demand for a country by German tourists peaked when its mean monthly temperature was 24°C. Using a slightly different modelling approach and data for a cross section of destinations of OECD tourists, Lise & Tol (2002) estimated that the optimal mean temperature of the warmest month of the year was 21°C. They also concluded that perceived optimal temperatures for the warmest month varied only slightly among tourists from different nations, ranging from 21.8 (French) to 24.2°C (Italians). More importantly, the revealed preference approach has not consistently found an optimal temperature and the same temperature variable (i.e. maximum or mean temperature) is not consistently significant in each study (see Table 1). These studies contend that temperature was the most important aspect of climate, as statistical relationships could not be found with other climate parameters such as rain, wind, or sunshine/cloud, at these temporal and spatial scales.

The authors identify a number of limitations of these studies, including the crude temporal and spatial resolution of the available data (quarterly or monthly data at the national level), and the crude way in which the climate of destinations is represented. For example, in Maddison (2001) and Lise & Tol (2002), the climate of capital cities represents the climate of the entire nation, suggesting that Washington, DC is representative of the United States, which contains 10 completely distinct climate zones using the Koppen classification scheme. Because all tourists are included in these national data, leisure tourists cannot be modelled separately from business travellers whose travel decisions are influenced far less by climate (Gössling & Hall 2006). Moreover, not all nonclimate factors that influence leisure tourists' destination choices are incorporated in these models, because many are difficult to parameterise and comparable national data is often unavailable. Nonclimate factors like attractions, rather than climate, may be the principal motivator of many travellers, disregard of which may introduce errors into the models.

Econometric modelling by Hamilton et al. (2005) used annual arrival and departure data for 207 nations from 1995 to explore how projected global climate change and other long-term changes in economic and population growth might affect international tourism flows. Although the specified intent of this study was to explore the potential implications of climate change, it nonetheless defined the optimal annual mean temperature for tourism as 14°C. Bigano et al. (2006) advanced on previous studies of this type by using various forms of annual international tourism data for 45 nations for 1997 to 2001 and argue that the preferred holiday climate is the same for all tourists regardless of origin. They estimate this global optimal holiday temperature to be an average annual temperature of 16.2°C. The limitations of this modelling approach are discussed by Hamilton et al. (2005), Bigano et al. (2006) and Gössling & Hall (2006).

2.3. Stated tourism climate preferences

A third approach to examining the climate preferences of tourists is directly measuring their stated preferences. Only a limited number of studies have surveyed tourists about their climate preferences. Both de Freitas (1990) and Mansfeld et al. (2004) surveyed tourists *in situ* (in Australia and Israel, respectively) about their perceptions of current weather conditions in beach environments in order to compare their satisfaction ratings with simultaneous onsite monitoring. Both studies confirm the importance of multiple weather parameters in determining visitor satisfaction, with de Freitas (1990) demonstrating the over-riding effect of even 30 min of rain. Mansfeld et al. (2004) also argued that domestic Israeli tourists were more sensitive to weather conditions, suggesting different climate preferences or tolerances for marginal conditions than international tourists. A common limitation of *in situ* surveys of visitor satisfaction with current weather conditions is the limited range of weather conditions that can be examined without very significant personnel costs. The Mansfeld et al. (2004) study, for example, is based on data from only 4 d in the month of March. Response bias is also likely in this type of study because surveys with few available visitors on days with marginal weather conditions may produce artificially high ratings. The extent of this potential response bias remains uncertain.

Two other *in situ* surveys did not examine tourist satisfaction with existing weather conditions but investigated tourist climate preferences more generally. Morgan et al. (2000) conducted *in situ* surveys with tourists in a beach environment in Wales, Malta and Turkey. The study found the ranking of the relative importance of 4 climate parameters to be: (1) absence of rain, (2) presence of sunshine, (3) temperature sensation and (4) wind speed. The authors also reported differences in the preferences and rankings of individual climate parameters among respondents from Northern Europe and Mediterranean Europe, but did not elaborate on these differences. Both of these findings stand in contrast to those from revealed-preference approaches. Gomez-Martin (2006) similarly surveyed tourists in Spain and found that majority (75%) of respondents felt the optimal temperature range for tourism in the region to be 22–28°C (temperature ranges of 16–22 and 28–32°C were rated lower). During a summer day, <1 h of rain was deemed acceptable by 69% of respondents, but 3 h was rated unacceptable by 62%. A good sunny day was perceived to be one with the sun shining for ≤75% of the day. All of these studies focused on beach or 3S tourism and cannot be generalized to other major tourism environments or destinations.

To our knowledge, this study is the first *ex situ* investigation of tourist climate preferences, where the survey is administered in an indoor setting free of potential bias from existing weather conditions and where respondents can express their perceived satisfaction with a wide range of climate conditions in very different tourism settings.

3. METHODS

A convenience sample of university students was used for this study of stated climate preferences for tourism. Structured questionnaires were administered to undergraduate students attending upper year classes in the Faculty of Environmental Studies at the University of Waterloo (Waterloo, Canada; April 2005), the School of Geography and Environmental Science at the University of Auckland (Auckland, New Zealand; March 2006) and the Service Management Programme at Lund University, Helsingborg Campus (Helsingborg, Sweden; January 2006). Where possible, students were recruited from courses not taught by the co-authors to avoid any potential conflict of interest or bias in responses. The total survey sample consisted of 831 students, with 333 from Canada, 207 from New Zealand and 291 from Sweden.

A pre-test of the survey instrument (n = 35) was conducted in Canada and slight modifications made to improve the clarity of some questions. The survey was conducted in English in all 3 countries. The questionnaires were structured in 3 sections, focusing on the preferences for specific climate variables (temperature, rain, sky condition, wind) in 3 distinct tourism environments: beach, urban, and mountain (warm-weather season only) destinations. To help students from the 3 countries visualize the environmental settings that each section of the survey examined and ensure similar understanding of beach, urban and mountain destinations, the same set of pictures depicting examples of each type of tourism environment was shown before the students were asked to answer the respective section of the questionnaire. Furthermore, it was emphasized that the questionnaire for mountain destinations referred to summer visits only.

Some limitations of the study include homogeneity in some demographic variables (mainly age and education) and heterogeneity in cultural and geographical backgrounds. Since respondents were university students, the results may represent only the young-adult market segment and not the broader population of leisure tourists. Moreover, students in Canada, New Zealand and Sweden have a wide variety of cultural and geographical backgrounds, and a small proportion of respondents (<5%) are known to have spent part of their lives in a region with a climate different from the region where the survey took place. While the diversity of student origins within the sample is relatively small, it may introduce some error in the conclusions about the specific climatic preferences of the sample from each nation. Some students (n = 24) did not understand that the mountain scenario was only a summer tourism scenario as can be inferred from their answers (i.e. preferred temperatures <0°C) and their responses were therefore removed from the analysis of the mountain environment scenario.

4. RESULTS

4.1. Climate preferences for beach, urban and mountain destinations

Much of the existing literature considers air temperature to be the climate variable of primary importance to tourism (Mieczkowski 1985, Becker 2000, Maddison 2001, Lise & Tol 2002, Hamilton et al. 2005, Bigano et al. 2006). It was therefore deemed important to further explore the range and distribution of temperature preferences among the 3 distinct tourism environments.

Fig. 1 shows the distribution of perceived optimal temperatures for beach, urban and mountain destinations in 2° intervals. Temperature preferences differed significantly for the 3 tourism environments (*t*-tests of tourism environment pairs [beach vs. urban, beach vs. mountain and urban vs. mountain, respectively] = 25.9, 34.9, 12.1; all df = 775; all p = 0.000), and no overlap in 95% CI was found) (Table 2). The median preferred temperature for

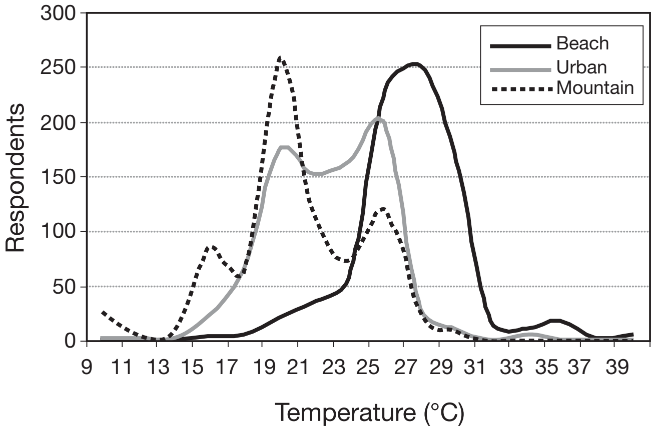

Fig. 1. Distribution of perceived optimal temperatures in different tourism environments

Table 2. Ideal temperature in different tourism environments (°C)

	Mean	Median	SD	95% CI Low	95% CI High
Beach	26.8	27	4.54	26.5	27.1
Urban	22.5	22	4.12	22.2	22.8
Mountain	20.5	20	3.96	20.2	20.8

beach holidays was 27°C, 5° higher than for urban destinations and 7° higher than for mountain destinations (Table 2). For a beach holiday, the majority (58%) preferred a range of 25 to 28°C, while an additional 25% preferred temperatures ≤30°C. For urban destinations, 82% preferred a lower daily maximum temperature of 19 to 26°C. The preference for mountain destinations was even lower, with 84% identifying a daily maximum temperature of 15 to 26°C as ideal and 44% indicating a narrower preferred range of 19 to 22°C. These results appear theoretically reasonable given the types of activities common to each type of tourism destination and are consistent with the biometeorological literature, which indicates that when humidity levels are high, air temperatures as low as 26°C can cause physiological stress in sedentary humans (Thom 1959, Masterson & Richardson 1979). Physical activity raises body temperature, thus strenuous activities like walking/hiking in mountainous terrain could lead to discomfort at lower air temperatures. Clusters of responses in the data are visible at 15, 20, 25 and 30°C, suggesting that these values may be key perceptual thresholds in each of the 3 tourism environments. The differences in the preferred temperature among major tourism environments indicates that no single optimum temperature for tourism can be identified, consequently raising questions about the validity of identified optimum temperatures for tourism in revealed preference studies.

Table 3. Ideal sky conditions in different tourism environments (% of respondents), Canadian and Swedish samples (n = 624); New Zealand sample not included (due to a typographical error in the survey instrument provided to the New Zealand sample, the question differed from that given to the Canadian and Swedish samples. Although the mean for the New Zealand sample was not significantly different from that of the Canadian and Swedish samples in all 3 tourism environments, we have chosen not to use the results in case some misinterpretation by respondents occurred)

	Cloud cover (% of sky) 0	25	50	75	100
Beach	41	54	4	<1	<1
Urban	12	54	31	1	<1
Mountain	23	57	18	3	<1

Table 3 shows that majority of the respondents preferred scattered light cloud cover (25%) for sky condition in all 3 tourism environments. This finding is consistent with de Freitas's (1990) findings in a beach tourism environment, but appears to be applicable in other tourism environments as well. However, differences in the preferences for sky condition in the 3 tourism environments were significant (χ^2 of tourism environment pairs [beach vs. urban, beach vs. mountain and urban vs. mountain, respectively] = 395, 347, 421; all df = 28; all p = 0.000). In a beach environment, an almost equal proportion (41%) of respondents preferred cloudless, blue skies. In urban environments, slightly cloudy (25% cloud cover) to cloudy (50% cloud cover) conditions were the 2 most preferred categories, perhaps due to the cooling effect clouds provide in urban settings or to the lesser importance of the aesthetics of blue skies in urban settings where the built environment dominates. In mountain environments, slightly cloudy is preferred, with approximately equal proportions of respondents preferring clear and cloudy conditions. Results also indicate that cloud coverage of 75–100% is not favourable for tourism in any of the 3 environments.

Regarding ideal wind conditions, Table 4 shows majority preference for light breeze, particularly in beach environments. Here, the cooling effect may be most beneficial, considering the stated preference for warmer temperatures in this environment and the availability of water to enhance the cooling effect of light breeze. In urban and mountain environments, there was more diversity in the stated preferences for wind conditions, as the remaining respondents were almost equally split between a preference for no wind and moderate wind conditions (χ^2 of tourism environment pairs [beach vs. urban, beach vs. mountain and urban vs. mountain, respectively] = 81, 48, 119; all df = 16; all p = 0.000). A higher proportion of respondents preferred no wind in mountain environments, which may be related to the generally cooler temperature preferred in this environment. Why 14% of respondents preferred moderate winds in a mountain environment remains uncertain. Strong and very strong wind conditions were not found to be favourable for tourism in any of the 3 environments.

Table 4. Ideal wind conditions in different tourism environments (% of respondents)

	Wind speed (km h^{-1})				
	No wind	Light breeze (1–9)	Moderate wind (10–40)	Strong wind (41–60)	V. strong wind (61–90)
Beach	7	87	6	<1	<1
Urban	10	78	12	<1	<1
Mountain	18	68	14	<1	<1

Table 5. Importance of weather variables in different tourism environments. Temp: 'comfortable temperature', Rain: 'absence of rain', Wind: 'absence of strong wind', Sunshine: 'presence of sunshine'. Means show relative importance of each variable (from 1 = not important to 7 = extremely important)

	Importance rank			
	1	2	3	4
Beach	Sun	Temp	Rain	Wind
Mean	6.14	6.11	5.87	5.13
Urban	Temp	Rain	Sun	Wind
Mean	5.98	5.77	5.14	4.75
Mountain	Rain	Temp	Sun	Wind
Mean	6.04	5.84	5.55	5.41

Comparing the relative importance of the 4 different weather variables (sunshine, temperature, rain and wind) in each of the tourism environments was an important objective of this study. The relative importance of each variable (from 1 = not important, to 7 = extremely important) (Table 5) was found to be significantly different across the 3 tourism environments (χ^2 for wind, sun, rain, temperature were all significant, p = 0.000). A key finding was that the order of importance of the 4 investigated climate variables differed for the 3 major tourism environments. Consistent with earlier findings by de Freitas (1990), sunshine had the highest mean rating in the beach environment, perhaps because of its aesthetic importance. The absence of rain was the highest rated climate parameter in mountain areas. The importance of all 4 climate variables was rated lower in urban environments, where exposure to atmospheric conditions is reduced. This is because of tourists' being indoors more frequently (i.e. shopping, dining, visiting museums, etc.) and the easy possibility of avoiding unsuitable conditions (i.e. by stepping indoors during a sudden rain shower). These results somewhat contradict the contention of Mieczkowski (1985), Becker (2000), Maddison (2001), Lise & Tol (2002), Hamilton et al. (2005) and Bigano et al. (2006) that temperature is the primary climate parameter for tourism. These findings also support the contention that climate indices that only examine the thermal aspect (e.g. Harlfinger 1991, Becker 1998, 2000, Matzarakis 2001, Blazejczyk 2001, Cegnar & Matzarakis 2004, Morabito et al. 2004, Zaninović & Matzarakis 2004), regardless of their sophistication, are not sufficient to assess the suitability of climate for tourism.

The different climate preferences (temperature, sky condition and importance ranking of climate parameters) indicate that a universal climate index for tourism, as originally conceived by

Mieczkowski (1985), may be conceptually unsound. Instead, the development of climate indices for specific major tourism segments, particularly those that are strongly influenced by weather (e.g. beach tourism, skiing), appears more appropriate and deserves further inquiry. This finding also has implications for studies that have utilized Mieczkowski's (1985) index to explore the potential implications of climate change for the distribution of climate resources for tourism (Scott et al. 2004, Amelung & Viner 2006). While the use of Mieczkowski's (1985) index may be appropriate for urban destinations (cf. Scott et al. 2004) because of similarities in the ranking of climate parameters and the optimal temperatures and wind speed identified for urban environments in this study, it is clearly inappropriate for evaluation of the climate for 3S tourism destinations (cf. Amelung & Viner 2006, Perry 2006).

4.2. Comparison of climate preferences across the three countries

While the findings in the preceding section have salient implications for the literature, some interesting results pertain to the differences in climate preferences among the respondents from the 3 countries. For context, the Koppen climate classification of the 3 survey areas is: Waterloo, Canada is Humid Continental (Dfb–humid with severe winter, no dry season, warm summer); Auckland, New Zealand is Marine West Coast (Cfb–mild with no dry season, warm summer); and Helsingborg, Sweden is at the margins of these 2 classifications (Dfb and Cfb). Specific differences in monthly temperatures and precipitation in the 3 survey locations are outlined in Table 6. Although Helsingborg has the highest number of days of precipitation, Auckland receives the highest amount of precipitation. Waterloo has much warmer summers than either Auckland or Helsingborg, because of the ocean's moderating effects at the latter 2 locations. Winter months in Auckland are typically 15°C warmer than in Waterloo or Helsingborg.

Comparison of the responses from the 3 nations was undertaken to determine if differences in climate preferences were significant. The temperature preferences for urban and mountain tourism environments were not significantly different ($p > 0.05$) among the respondents from the 3 countries (Table 7). However, for a beach holiday, the ideal mean temperature identified by the Swedish respondents is significantly higher by almost 4°C than that preferred by the New Zealand respondents and almost 2°C higher than that of the Canadian respondents ($F = 32$, df = 2, $p = 0.000$). Daily maximum temperatures during the summer months (JJA) are ~4 to 5°C lower in Helsingborg than in Waterloo and ~2°C lower than the summer temperature (DJF) in Auckland. These lower summer temperatures in southern Sweden probably create a desire for even warmer temperatures (temperatures rarely experienced at home) when travelling for 3S holidays. The majority of Swedish respondents preferred a clear blue sky at a beach destination, while majority of the Canadians preferred 25% cloud cover (Table 8) ($\chi^2 = 286.5$, df = 8, $p = 0.000$). Preferences for sky condition did not significantly differ for urban or mountain environments ($p > 0.05$) (Table 8). No significant differences (p >

Table 7. Temperature preferences for all 3 tourism environments among the country samples (mean °C)

	Canada	New Zealand	Sweden
Beach	26.8	24.9	28.5
Urban	22.7	22.1	22.6
Mountain	20.6	20.4	20.4

Table 6. Monthly climate normals at the 3 survey locations (1971–2000). Sources: Meteorological Service of Canada, Meteorological Service of New Zealand, Swedish Meteorological and Hydrological Institute

	J	F	M	A	M	J	J	A	S	O	N	D
Mean Tmax (°C)												
Waterloo	–1.1	–0.2	4.6	11.3	18.5	23.5	26.4	25.3	20.7	13.8	7.4	1.8
Auckland	23.3	23.7	22.4	20	17.4	15.2	14.5	15	16.2	17.8	19.6	21.6
Helsingborg	2	2	5	10	16	20	21	21	17	12	7	4
Mean precipitation (mm)												
Waterloo	61	50	66	70	73	72	68	80	83	65	76	71
Auckland	75	65	94	105	103	139	146	121	116	91	93	91
Helsingborg	49	30	40	38	41	52	61	58	59	57	61	58
Days with precipitation												
Waterloo	15	12	13	12	12	11	10	11	11	11	13	15
Auckland	8	7	9	11	12	15	16	15	14	12	11	9
Helsingborg	17	13	14	12	12	12	14	13	14	15	17	16

Table 8. Sky condition preferences for all 3 tourism environments among the country samples (% of respondents). New Zealand sample not included (see Table 3 for explanation)

	Cloud cover (% of sky)				
	0	25	50	75	100
Beach					
Canada	26	67	7	0	0
Sweden	59	39	1	<1	0
Urban					
Canada	13	56	30	<1	0
Sweden	12	53	33	2	0
Mountain					
Canada	19	60	18	1	0
Sweden	27	53	17	3	0

0.05) were found with regard to wind preferences in beach or urban holiday environments, but Swedish preferences for lower wind speeds in mountain environments differed from Canadian and New Zealand preferences (Table 9), in which higher wind conditions were seemingly tolerated ($\chi^2 = 33$, df = 6, p = 0.000).

The relative importance of the 4 climate parameters for the 3 tourism environments also differed among the 3 national samples. New Zealand respondents ranked the importance of the 4 climate parameters in a beach environment differently, putting the absence of rain first, instead of the presence of sunshine as the Canadian and Swedish respondents did (Table 10). The Canadian and Swedish respondents ranked the importance of climate parameters similarly in the urban environment; while the New Zealand ranking was again different, the absence of rain being ranked highest (Table 10). In the mountain environment, none of the 3 respondent groups ranked the 4 climate parameters in the same order.

Table 10. Relative importance of weather variables for all 3 tourism environments among the country samples. Temp: comfortable temperature, Rain: absence of rain, Wind: absence of strong wind, Sun: presence of sunshine

	Importance rank			
	1	2	3	4
Beach				
Canada	Sun	Temp	Rain	Wind
New Zealand	Rain	Temp	Sun	Wind
Sweden	Sun	Temp	Rain	Wind
Urban				
Canada	Temp	Rain	Sun	Wind
New Zealand	Rain	Temp	Sun	Wind
Sweden	Temp	Rain	Sun	Wind
Mountain				
Canada	Rain	Sun	Temp	Wind
New Zealand	Rain	Temp	Wind	Sun
Sweden	Temp	Rain	Wind	Sun

Overall, the respondents from New Zealand generally preferred slightly cooler temperatures in all tourism environments and placed greater importance on the absence of rain, ranking it first among the climate parameters in all 3 tourism environments. Table 6 illustrates that monthly rain is higher in Auckland than in the other 2 locations, particularly outside of the summer months (JJA in Canada and Sweden and DJF in New Zealand). Although the number of days with precipitation is highest in Helsingborg, the total amount per year is higher in Auckland. Also, the time of year with the most rain in Auckland coincides with the cooler months. Both the low air temperatures and high rain occurrence make the winter very gloomy. These might explain why tourists from Auckland are more cognizant of rainfall when planning holiday travel.

Table 9. Wind preferences for all 3 tourism environments among the country samples (% of respondents)

	Wind speed (km h^{-1})				
	No wind	Light breeze (1–9)	Moderate wind (10–40)	Strong wind (41–60)	V. strong wind (61–90)
Beach					
Canada	8	83	8	<1	0
N Z	8	85	7	0	0
Sweden	6	92	2	0	0
Urban					
Canada	10	74	15	<1	0
N Z	10	78	12	0	0
Sweden	10	81	9	0	0
Mountain					
Canada	14	67	19	0	0
N Z	14	68	17	1	0
Sweden	25	68	7	0	0

5. CONCLUSIONS

Three of our findings were particularly notable. (1) The study established that the perceived optimum climate conditions differed in some ways in the 3 major tourism environments examined. For example, the median preferred temperature for each environment was: beach 27°C, urban 22°C, and mountain 20°C; while a majority of the respondents preferred slightly cloudy conditions (25%) in all 3 tourism environments. (2) The relative importance of the 4 climate variables examined (temperature, sunshine, rain and wind) differed in the 3 major tourism environments. Overall, sunshine was found to be the most important climate variable for a beach visit, perhaps because sunshine or, at least only partially cloudy skies (25% cloud cover), is perceived to have greater aesthetic importance in a beach environment and influences thermal comfort strongly with minimal clothing. The absence of rain was most important in mountain areas. The importance of all 4 climate parameters was rated lower in urban environments, where exposure to atmospheric conditions is reduced, presumably because of tourists' being indoors more frequently (i.e. shopping, dining, visiting museums, etc.) and the easy possibility of avoiding unsuitable conditions (i.e. by stepping indoors during a sudden rain shower). (3) Climate preferences were found to differ among respondents from the 3 nations, with temperature preferences being significantly different in the beach environment, but not in urban or mountain environments. Similarly, preferences for sky and wind conditions were very similar and only the Swedish preferences differed significantly in beach and mountain environments, respectively. The relative importance of the 4 climate parameters in the 3 tourism environments was also found to differ among the respondents from the 3 nations.

The findings have several implications for the literature on tourism and climate. With regard to the use of climate indices for tourism, results suggest that any index of tourism and climate needs to incorporate multiple climate parameters specific to the tourist environment, and not solely measures of thermal comfort. Moreover, the use of universal indices for all tourism segments, as is currently practiced, appears conceptually unsound. Results also oppose the concept of an optimal temperature for all tourism activities and destinations, as tourists appear to prefer different temperatures and weather conditions for holidays in different tourism environments. As noted, the preferred conditions were sometimes found to differ between nationalities; for example, Swedes were found to prefer beach temperatures that were significantly higher than those preferred by Canadian or New Zealand students. As these differences occurred among a limited sample of the tourist market (young-adult market only) from relatively similar cultures and temperate climates, it is likely that climate preferences of a broader range of tourists (all ages, families, etc.) from culturally and climatically more diverse nations may be even more heterogeneous. This contrasts with the findings of revealed preference studies (Lise & Tol 2002, Hamilton et al. 2005 and Bigano et al. 2006) and thus deserves further study.

The main limitations of this study are the relatively narrow tourist market segment examined (young adults) and the restricted spatial coverage of the survey (only 3 nations). However, we believe this limitation is compensated for by the novel ability of the approach to explore the climate preferences of tourists in a detailed manner. Future research with a broader cross-cultural sample from more diverse climatic regions (tropical, temperate, monsoon and semi-arid) remains a potentially productive direction.

This study was designed to examine the details of tourist climate preferences, which we and Bigano et al. (2006) believe may be lost in revealed preference studies that rely on coarse-scale aggregated data in order to obtain multinational comprehensiveness. As this study has yielded several interesting results that both confirm and contradict the findings of revealed preference studies, we contend that the present approach warrants further development. This approach may prove particularly useful in precisely determining thresholds within the continuum of 'optimal' to 'unacceptable' climate conditions for specific types of tourism. This would be highly useful for contemporary evaluation of climate resources for tourism and the assessment of the implications of climate change for the redistribution of global climate assets for tourism. It seems that the existing literature has only begun to unveil the complexities of the interactions between climate and tourism and much more remains to be explored.

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