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DESTINATION CLIMATE ADAPTATION

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Abstract:	A key element in the product mix of destinations is climate. Climate represents a critical part of a destination's economic and resource base such that changes in climate will trigger human responses in terms of demand and type of activities that the climate will support. This threatens the competitiveness, sustainability and economic viability of destinations. This research note focuses on destination adaptation to climate change that is anticipatory not reactive, based upon projecting future climate scenarios for a destination and then assessing the tourism products that the future climate will support. It outlines an original data-driven approach to adaptation, generalizable to other destinations. The research note describes an exploratory research collaboration in Croatia between tourism and climate scientists that allows firstly: the modeling of a destination's projected climate conditions and secondly, the products and activities that can be supported by these climate scenarios using climate indices for tourism.

ABSTRACT

Climate is an important element in the tourism products of a destination and a critical part of a destination's economic base. Any change in climate attributes will trigger human responses and may pose a threat to a destination's competitiveness, sustainability and economic viability. This research note focuses on destination adaptation to climate change that is anticipatory rather than reactive and is based upon projecting future climate scenarios for a destination and then assessing the tourism products that the future climate will support. It outlines an original approach to adaptation which is generalizable to other destinations. The research note describes an exploratory research collaboration between tourism and climate scientists that allows firstly: the modelling of a destination's projected climate conditions and secondly, the products and activities that can be supported by these climate scenarios using climate indices for tourism. The exploratory research was carried out in Croatia.

INTRODUCTION

This Century has seen the tourism sector accept that it is a climate sensitive activity and in particular begin to acknowledge the sustainability challenge of destination adaptation to climate change. Climate is an important element in the tourism products of a destination and a critical part of a destination's economic base. Any change in climate attributes will trigger human responses and may pose a threat to a destination's competitiveness, sustainability and economic viability. This is because it will influence demand through seasonality, the activities and products that can be supported and thus destination choices made by tourists. A destination's vulnerability therefore depends upon exposure to climate change; the sensitivity of the tourism system; and the adaptive capacity of the destination to cope with change. As a result of this realisation, research into climate change adaptation has grown, resulting in a growing number of methods, tools and processes, designed to integrate and mainstream climate change into destination strategies and policies (Simpson et al., 2008). Destination adaptation to climate change involves adjustments in practices, processes or structures to take account of changing climate conditions in order to moderate potential damages, or to benefit from the opportunities associated with climate change (McCarthy et al., 2001). Kajan and Saarinen (2013) have classified this research into approaches to adaptation made by business, the impact on consumer decision-making, destination adaptation and policy for adaptation.

This research note focuses on destination adaptation to climate change that is anticipatory rather than reactive and is based upon projecting future climate scenarios for a destination and then assessing the tourism products that the future climate will support. It illustrates the pivotal importance of climate information for the formulation of destination adaptation plans and outlines an original approach to adaptation which is generalizable to other destinations. The research note describes an exploratory research collaboration between tourism and climate scientists that allows firstly: the modelling of a destination's projected climate conditions and secondly, the products and activities that can be supported by these climate scenarios using climate indices for tourism (CIT) (de Freitas et al., 2008). The collaboration will facilitate a toolkit that can be used for destinations to develop their product portfolios in the future, giving guidance both on where to invest and disinvest as a result of changing climate resources, and also on potentially shifting patterns of seasonality. The exploratory research was carried out on the Croatian Island of Lošinj in the Northern Adriatic.

METHOD

The overall aim of the project was to develop and communicate replicable research methodologies to underpin a toolkit suitable for use in delivering sustainable product planning for tourism destination climate adaptation plans. The research involved international collaboration across tourism and climate specialists from the UK and Croatia, climate scientists from the Meteorological and Hydrological Service of Republic of Croatia, and the local government of the Croatian Island of Lošinj. The research was overtly mixed method in approach and comprised of four key stages. The first was a stakeholder consultation on the Island of Lošinj to gauge the level of awareness of climate change across the tourism sector. It also elicited stakeholder's thoughts on the Island's vulnerability and the tourism sector's social response to climate change. Secondly, a climate scenario was developed for Lošinj up to 2030 using the regional climate model to allow the research team to understand the future climate of the Island as a key resource for tourism. Thirdly, the team then applied tourism climate indices to both the present climate and the future climate till 2030 to assess which of the Island's products would be viable in the near future and in particular how climate change may impact upon seasonality. In other words the future climate scenario was transformed into the Island's future tourism climate resource base. Finally, a seminar was held in Croatia's capital Zagreb to determine a future path for the research collaboration.

1 STAKEHOLDER CONSULTATION

The Island of Lošinj is one of Croatia's most award-wining sustainable destinations, worldwide known as a "climatic spa". The destination is reliant upon a Mediterranean climate to support health, beach, sports and heritage tourism. Thus, the engagement of destination stakeholders in the research was seen as an essential research step, recognising the fact that the implementation of the complex public policy decisions which are demanded by adaptation will require their support and understanding of the issues (Harman et al, 2016; Michailidou, 2016).

A workshop on climate change adaptation was held for Island stakeholders in October 2015. The workshop facilitated stakeholder identification of potential climate risks and vulnerabilities to tourism in Lošinj and sought their commitment to an adaptation plan. Over 60 representatives of the tourism industry, biologists, Government and conservation agencies attended the workshop which was facilitated by the tourism board director of the town of Mali Lošinj and the University of Zagreb. All sessions were held in Croatian and yielded rich, knowledgeable and insightful discussion on the Island's vulnerability to climate change. Particular risks identified included air temperature and sunshine hours; quality of air and aerosols; seawater quality and temperature; fresh water quality; and resilience to extreme climate events.

2 CLIMATE SCENARIO METHOD

The adaptation challenge for destinations is to demonstrate how a global mean temperature change may manifest itself at the local scale. Uncertainties arise due to gaps in our knowledge of interactions between the oceans, biosphere, cryosphere and climate systems, as well as the unpredictability of future emissions levels (Eriksen et al., 2003). The Intergovernmental Panel on Climate Change (IPCC) has produced global circulation models (GCMs) to simulate the geographical and seasonal distribution of global warming. These models can be 'downscaled' further to provide information at the destination level.

The research collaboration allowed the Croatian Meteorological and Hydrological Service to provide climate scenarios in order to establish projected climatic conditions on Lošinj in the period between 2011 and 2030. Climate modelling over Croatia was performed using the Regional Climate Model of the third generation, RegCM3 (Pal et al., 2007). The integration domain was across almost the whole of Europe centred at 45°N, 8.5°E with 35 kilometre grid spacing. More about using RegCM3 settings in modelling can be found in Branković et al. (2012). To take into account the uncertainties mentioned above, the model was forced by two randomly chosen simulations from the GCM model ECHAM5-MPIOM (Rockner et al., 2003). Downscaling was performed for the reference climate (P0) of 1961-1990, as well as for the future period (P1) of 2011-2030. In the P0 climate, concentrations of greenhouse gases in the GCM were specified at observed values, whilst in the P1 climate the IPCC SRES A2 emission scenario was applied. The applied scenario is the so-called strong scenario and it represents the upper limit of anthropogenic impact to the atmosphere and climate in the 21st century. In this study, daily data at 6 and 12 Coordinated Universal Time (UTC) were used. Near surface temperature, wind at 10 metres, specific humidity and cloudiness were selected for the model grid cells that coincide with the locations of meteorological stations. The orography in the model is an approximation of the real one. Therefore to take it into account the difference between the climate station altitude and the model grid height, the temperature is corrected by a vertical rate of 0.65°C/100 metres. Since the centre of gravity of the human body is assumed to be at 1.1 metres, the model wind speed was reduced to this height. Daily precipitation was also used. The abovementioned meteorological data were used for calculation of the touristic index for the present as well as for the future period and for both runs. Mean annual or monthly values in two time spans 2011-2030 and 1961-1990 were subtracted in order to get climate change.

In analysing the results, it has to be kept in mind that climate models are not perfect. One way to assess the model uncertainties is to compare model results for the observed period with the measured data for the same period. Only with this information will the interpretation of expected future climate conditions be complete. However, when discussing climate change in terms of the difference between future and present simulated climate conditions, it can be assumed that model bias is neglected.

3 CLIMATE INDEX FOR TOURISM (CIT)

Climate is a key part of the resource base for destinations, yet the relationship is complex, determining tourist activities, locations and seasonality. Different tourist activities have different weather requirements, particularly in relation to human comfort levels. Researchers have created climate indices specific to tourism activities, allowing the assessment of climate attractiveness for different types of tourism activity. To achieve this, de Freitas et al., 2008 defined the climate index for tourism (CIT) that integrates the thermal, aesthetic and physical facets of the atmospheric environment important for tourism. They also estimated the set of weather thresholds by surveying groups of tourists spending mainly sedentary activities on the beach (sun, sea and sand (3S) and picnicking). Later Bafaluy et al. (2014), based on consultation with experts and practitioners, established a set of thermal, aesthetic and physical thresholds for several other tourist activities including cycling, hiking, golf, nautical sports (motor boating and sailing), football and cultural tourism.

The CIT comprises three components. Firstly, the thermal component is a measure of the body-atmosphere energy balance expressed by a biometeorological index that integrates physiological thermal and environmental variables comprising temperature, relative humidity, wind speed and radiation. Secondly, the aesthetic component includes the condition of the sky, whilst thirdly, physical components include wind and rain, which can have an overriding effect when certain values are exceeded. These thermal, aesthetic and physical states are combined in a weather typology matrix to produce a rating class for the CIT ranging from unacceptable conditions, through acceptable, to ideal conditions for each tourism activity (de Freitas et al., 2008).

The Island's climate data at 06 UTC (7 a.m. local time) and 12 UTC (1 p.m. local time) in the climate period 1961-1990 as well as for the future scenario in the 2011-2030 period were run through the CIT in order to determine the types of tourism activities in the present climate and those that would be supported by the Island's climate resources by the end of 2030. Comparing climate conditions for tourism in the present (1961-1990) and future climate (2011-2030), there is a decrease of unacceptable conditions and an increase of acceptable and ideal conditions. Examining annual data, the mornings show an improvement of climate conditions for all activities in the morning (see Figure 1). However, analyzing on a monthly scale, there are differences between activities. For typical marine activities (3S, motor boating and sailing) more favourable climate conditions are visible for all months during the warm period of the year in the morning as well as in the afternoon. On the other hand, for all other activities (cycling, cultural tourism, hiking, golf and football) in the morning there is an increase in ideal conditions for all months, while in the afternoon there is an increase of ideal conditions for spring and autumn, but a decrease or very small change during the summer (in Figure 2 activities are shown for 3S and cycling).

Table 1 shows the *changes* (trends) of ideal and acceptable days for a range of activities by season in the period 2011-2030. Changes at 06 UTC and 12 UTC (7 a.m. and 1 p.m.) are calculated in order to judge the possible shift of activities during the day in the future. It is clear from the table that the activities and products currently offered by the Island will have even better conditions and possibilities at the end of the analyzed future period. On an annual scale an increase in acceptable and ideal conditions for most activities in the morning can be expected (except cycling and golf) and for all activities in the afternoon. However, more significantly, the seasonality of activities shifts markedly. In the morning the changes are smallest in winter, while for afternoons the changes are smallest in the autumn and for marine activities in winter. For both morning and afternoon the conditions for beach tourism are expected to improve from spring to autumn. The greatest increase in the number of acceptable and ideal days for sport activities and cultural tourism occurs mainly in the spring season.

These results point to a clear opportunity for the Island to extend its tourism season. However, whilst extending the season will boost the profitability of the tourism sector and spread the tourist load away from the highly peaked summer season, utilising the climate information provided by this study will prove challenging. Successful adaptation will depend upon the ability of the Island's many stakeholders to collectively deliver an extended season, a consideration that was not identified in the workshops. This finding reinforces the imperative of involving all the Island's tourism stakeholders throughout the research project.

4 FUTURE APPROACHES

The final stage of the research drew together the research team and representatives of the local government tourism board of Lošinj to focus on the next stage of the project. The group agreed on a two-stage approach. Firstly, communicating the toolkit approach to tourism industry and government stakeholders is critical, but also complex. The group therefore felt that the effective 'practitioner-facing' communication of the toolkit was a priority and so for the next stage of the research, the team will expand to include television and print media communication experts. Secondly, the group agreed that the toolkit research should be applied in the other major destinations and climate zones of Croatia, particularly coastal zones, mountains and rural destinations.

CONCLUSION

This research note has shown the utility of international collaboration between physical and social scientists by importing techniques from climate science to underpin destination adaptation plans. Not only does this approach provide an incontestable climate information base upon which to plan adaptation in the future, but it also offers a strong platform from which to develop an adaptation toolkit applicable to any destination. This approach to climate adaption for destinations is therefore highly original, albeit based upon existing research techniques. It represents a considerable advance in the field of climate change adaptation for tourism which can be applied to destinations, businesses and as an underpinning platform for adaptation policy.

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Table 1

Change in the Number of Ideal and Acceptable Days by Activity in the Period 2011-2030 at 06 UTC (grey) and 12 UTC (white)

Activity	Year		Winter		Spring		Summer		Autumn	
Beach	8.4	8.0	0.0	0.2	1.8	3.2	5.4	4.2	1.4	0.4
Cycling	-1.6	15.0	0.0	2.8	3.6	8.4	0.0	1.2	-5.2	-2.0
Sightseeing	13.0	12.6	0.8	4.2	10.2	7.2	1.4	-1.2	0.8	0.0
Golf	-1.8	9.4	0.0	2.2	3.2	6.2	-1.6	2.2	-3.6	-1.0
Football	10.2	10.2	1.2	5.6	9.0	4.0	-0.2	0.8	0.4	-0.6
Motor boating	10.2	7.8	0.0	0.6	3.8	9.2	5.4	2.0	1.0	-4.2
Sailing	5.8	6.4	0.0	-0.4	1.8	9.6	3.6	-0.8	0.6	-2.0

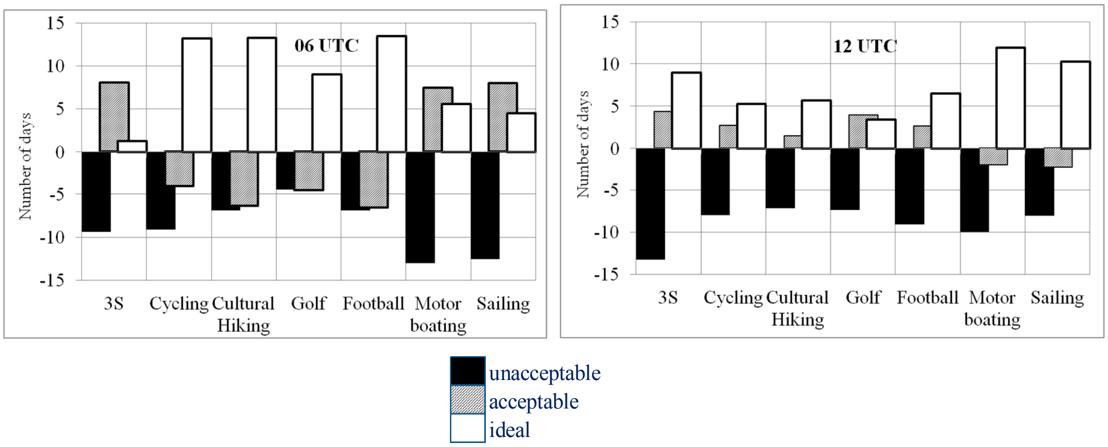

Fig. 1. Annual differences between the number of days with unacceptable, acceptable and ideal climate conditions for various tourism activities between future (2011-2030) and present climate (1961-1990).

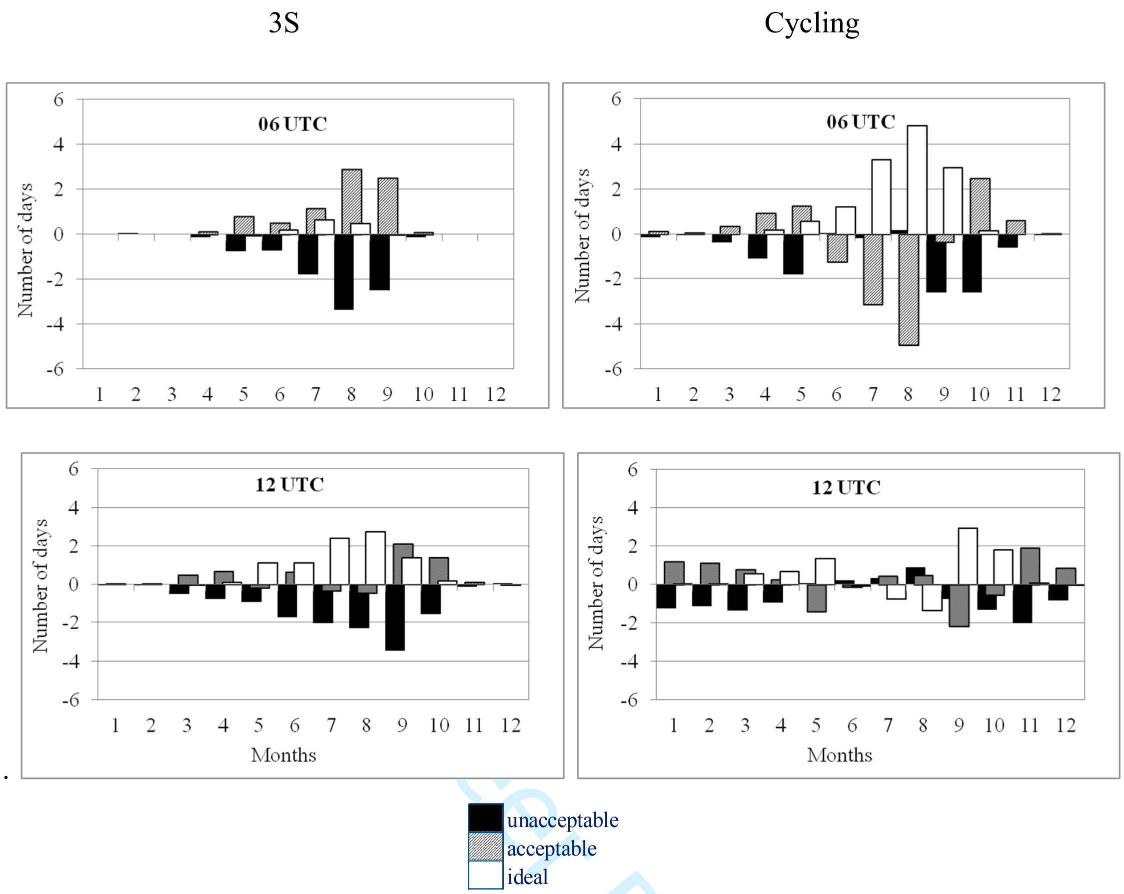

Figure 2. Differences between the number of days with unacceptable, acceptable and ideal climate conditions by months for 3S and cycling between future (2011-2030) and present climate (1961-1990).