

Climate change, the Environment and Tourism: The Interactions

Final Report



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Exploratory Workshop



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To Reference Report:

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Definition of Tourism

For the purpose of the workshop, this report. in the context of the research framework of Climate Change, the Environment and Tourism, for the eCLAT Network and beyond the term tourism is defined as: International tourism as defined by the World Tourism Organization (WTO) and Domestic tourism including, recreation and excursions for leisure based motives.

I. Executive Summary

The study of the interactions of climate, environment and tourism provides a unique catalyst to build a community of scientists from a wide range of scientific disciplines.

Tourism is one of the EU's most important and fastest growing industries. Climate change will impact upon tourism, which in turn impacts (through growing GHG emissions and associated environmental changes) on the climate. The effects and impacts of these complex interactions has to date not attracted either research effort nor gained the attention of stakeholders and policy makers. There is, however, an emerging research community who are initiating the study of climate, environment and tourism interactions.

This *ESF-Exploratory Workshop on Climate Change, the Environment and Tourism: The Interactions*, has spearheaded this new and emerging area of transdisciplinary scientific research whose aim is to study the interactions and resolve the conflicts that exist between climate, the environment and tourism. This workshop had five major aims:

- a - to identify and catalogue the sources of data and metadata;
- b - to identify current research activities in this area;
- c - to raise awareness of the issues surrounding climate change, environmental change and tourism;
- d - to develop the future research agenda;
- e - to build a network of researchers into a virtual centre.

From the outset the workshop set about to increase communication between existing researchers and bring in researchers from a wide variety of scientific disciplines. This workshop spearheaded a new and emerging area of interdisciplinary scientific study whose aim is to study the interactions and resolve the conflicts that exist between climate, the environment and tourism. As a result this workshop realised six major achievements:

- a - the identification of the sources of data and metadata that are required to investigate the interactions between climate change, the environment and tourism;
- b - the building of a virtual network of researchers (eCLAT) designed to foster collaboration who are involved in the attempt to understand the linkages between climate change, the environment and tourism;
- c - the raising of awareness of the issues surrounding climate change, environmental change and tourism and provide information to the stakeholders about the future agenda for this new and emerging research area;
- d - the development of a framework that will outline the future research agenda required to address the issues of impacts, mitigation, adaptation, vulnerability that surround the interactions between climate change, the environment and tourism.
- e - the establishment of the criteria and guidelines for the establishment of a virtual centre that will address the relevant issues surround the interactions between climate, the environment and tourism.
- f - the formulation of a Science Plan that outlined the major research areas and ways forward to address the issues surrounding this workshop.

1.1 Background to the Workshop

Climate Change, the Environment and Tourism: Network Building; Raising Awareness; and Research Framework Development

Climate change will have a range of direct impacts on the tourism industry within the European Union by changing the environment of resorts (e.g., sea-level rise) and it will increase the vulnerability of the tourism industry to other environmental changes. Climate change will also have a range of indirect impacts. For example: raising conflicts in water resources; health effects and vector borne diseases; the built environment; and detrimental impacts on the local environment. Tourism through increasing emissions (aviation emissions are the fastest growing source) of greenhouse gases (GHGs) is in turn having an impact upon the climate system. Therefore, the introduction of GHG mitigation policies will impact on tourism. These interactions between climate change and tourism, have to date not been examined on a large scale.

Tourism is one of the European Union's largest, fastest growing and most important economic sectors, yet the interactions between this industry and climate change have been subject to little scientific investigation. Despite a large research base in the EU that is involved in research of tourism and its associated activities, to date there has been undertaken little research that addresses in the wider context the interactions between the climate and environment and the tourism industry. The tourism industry is highly fragmented and locally based and as such there is little strategic planning, climate change and wider environmental challenges are seen as a long term global problem in a sector in which decisions are made in the short term.

Research to date has shown that tourists plan their holidays in the short term and as a consequence the industry is required to react accordingly. Whilst this is possible in the case of tour operators who are able to shift/close/open their destinations relatively rapidly this is problematic in that the infrastructure of the tourism industry, whether located in the home region or destination resort is based on long-term planning (i.e. transport, airport and resort infrastructure). Climate change is viewed by the components of the industry as a long-term problem, in that its impacts may not be felt for many decades to come. Whilst in part this is a correct assumption it is flawed in that many policy decisions that will impact upon the industry as a whole are being made at present and the rate and magnitude of climate change is increasing. These policies relate to greenhouse gas emissions reductions measures, environmental and biodiversity protection/enhancement.

As tourism as an industry is rapidly growing both within the EU and globally there is, therefore, a pressing need to provide the infrastructure to researchers within the EU so as to ensure a research framework is in place that will allow for the investigation of the direct impacts of climate change and the indirect impacts through a range of policy scenarios upon the environment.

I.2 Conclusions and Recommendations

The range of scientific disciplines represented by the delegates to the workshop was wide and multi-disciplinary. In addition to this, a number of key stakeholder organisations were involved in both the planning and execution of the workshop. The Conclusions and Recommendations reflect the views of this broad community and are, therefore, aimed at both the stakeholder community and research community. A number of them are of relevance to both communities and are included in both categories identified below.

I - Stakeholders and Policy Makers

Address the impacts on small island states and developing countries

Tourism is a vital component of the economies of many small island states and is considered an important means to generate economic growth and foreign currency earnings in many other developing countries. For instance, emission reduction policies implemented by developed countries may raise the price of energy and transport, and thus have a negative impact on the number of tourists visiting developing countries.

Adopt and implement the Djerba declaration

The World Tourism Organisation (WTO) is encouraged to build upon the success of their Djerba Conference and the research community is encouraged to support the actions that will aid the adoption and implementation of the Djerba Declaration.

Take the effects of mitigation policies into account when planning for tourism

Tourism, through emissions of greenhouse gases (GHGs) is a contributor to climate change. Whilst some impacts of climate change may not only appear in the long-term, it is likely that the effects of climate change mitigation policies will be felt in the near-term. Stakeholders need to be aware of the quantifiable impacts of these policies upon their area of interest.

Stakeholders, assess your own vulnerability to climate change!

Stakeholder organisations need to be aware of their vulnerability to the direct impacts of climate change and indirect impacts. We strongly encourage stakeholders to engage the research community as to gain a better understanding of the issues that are likely to impact upon their activities and/or businesses.

Press the IPCC to give tourism a higher profile

To-date the Intergovernmental Panel on Climate Change (IPCC) has not yet addressed the issues that surround the interactions between climate change, the environment and tourism. These issues are likely to be key factors in the successful implementation of climate change mitigation policies, climate change adaptation strategies and the assessment of the vulnerability of many sectors and countries to climate change. We urge governments, intergovernmental organisations (e.g., WTO, UNEP etc.), NGOs and stakeholder organisations to press the IPCC to give tourism a higher profile in the AR4 and to produce a Special Report on Tourism and climate change.

Tourism Industry needs to be aware of new opportunities

Whilst it may appear that climate change may pose many threats to the tourism industry it will also create new opportunities. The tourism industry, therefore needs to be aware of how changes in climate may develop new opportunities for tourism development.

2 - The Research Community

The establishment of an international research network

The study of the interactions between climate change, the environment and tourism is an emerging research area. In order therefore, to enhance and develop this area, the ESF Milan Workshop recommended that an international network be established. This network has now been founded; it has been provisionally titled eCLAT (a virtual Network for the Study of the interactions between Climate and Tourism). The eCLAT community is open and would welcome the participation of other researchers and scientists. The eCLAT network and community will from the outset help disseminate information, exchange ideas and facilitate the collection and exchange of data.

Take on board the Science Plan Produced by the eCLAT Community

A detailed Science Plan that highlights the key research areas that need addressing and are of relevance to a wide range of stakeholders was produced at this workshop. We encourage researchers to take on board and to try and attempt to tackle these issues under the framework of the eCLAT community (see Science Plan below).

Raise the profile of tourism in the IPCC Fourth Assessment Report

There is a pressing need for the IPCC to raise the profile of Tourism within the Fourth Assessment Report (AR4). The interactions between climate change, the environment and tourism provides a unique cross-cutting research area that addresses the issues that are likely to have a major impact upon one of the world's most important industries.

Identify the current baseline conditions

The identification of the current baseline conditions is a pre-requisite for the identification of any future changes and impacts. This is also coupled with the need to identify the major interrelationships between climate change, the environment and tourism.

Carry out assessment studies

There is a need to undertake studies to assess, identify and quantify the possible impacts of climate change on tourism, tourist destinations and tourist's perceptions.

Develop a database of indicators

There is a need to develop a database of indicators and Visual Observed Impacts to help provide advice and information to the stakeholder community (including individual tourists).

Develop and apply methodologies

Develop and apply methodologies that would enhance early warning for the impacts of climate change on tourism at all scales. This kind of methodologies may include computer models and explorative scenarios.

Develop and identify links with other organisations

Develop and identify links with; national and regional governments; international programmes (e.g., WTO, UNEP, IPCC etc.,) and stakeholder organisations.

Be consistent with the IPCC

Future research should be undertaken in the context of climate change and tourism should be consistent with the IPCC. That is: adopt the recommendations and make use of any guidance material and data provided by the IPCC.

1.3 The Science Plan

The following Science Plan represents a synthesis of the research themes, stakeholders and priorities identified by the members of the working group attending the ESF Exploratory Workshop in Milan June 2003.

Research Areas

- A. Climate change on tourism (impacts and adaptation)
- B. Tourism on Climate Change
(greenhouse gas mitigation policies within the sector)
- C. External and Internal Mitigation and Adaptation Policies on Tourism (including other sectors e.g. water, health, forestry etc.)

Stakeholders

- 1. Tourism Industry at Large e.g., tour operators, travel agencies, hotel sector, airlines, SMEs, international companies, railways, etc.
- 2. Governments (national and regional)
- 3. Tourists and the Potential Tourists
- 4. Destinations e.g., host communities, ground operators, local hospitality industry, local tourism bodies, local environmental groups
- 5. Intergovernmental Agencies e.g. UNEP, IPCC, WTO etc
- 6. Non Government Organizations e.g., WWF, Tearfund, CARE, PATA, WTTC etc

Research Priorities

A. Climate change on tourism (impacts and adaptation)

A1 – Tourists and Potential Tourists

- 1) Tourist Perceptions and Responses to Seasonal Climate, Climate Variability and Climate Change
Tourist awareness of climate change as an issue, perceived threat to destination / activity of choice, potential adaptation to climate change (response to impact scenarios)

Analysis of tourism seasonality

Determine the role of climate / weather in individual travel and recreation choices

Behavioral response to climate variability (adaptations such as destination choice or activity substitution)

- 2) Determinants of tourism demand (including climate) and trends affecting future demand

Micro-economic analysis of tourist behavior (econometric models)

Relative importance of climate for macro scale flows of tourists (large scale models)

Changes in lifestyles, demographics, level of infectious diseases (food & vector borne), technology, etc. that may affect tourism flows

A2 – Tourism Industry at Large

- 1) Climate Change Risk Assessment for Industry Stakeholders

vulnerability of tourism and other infrastructure to climatic extremes

infrastructure adaptations (architectural design, landscaping, energy, water supply/conservation technology)

insurance and financial investment implications of climate change

A3 - Destinations

- 1) Climate Change Vulnerability Assessments for Destinations Where Tourism is of Major Importance

tourism dependant economies e.g. AOSIS nations, developing nations, new EU member states
 destinations in high risk environments e.g. low lying coastal zones, mountainous regions, flood
 plains, drought prone regions, coral reefs or other threatened biodiversity
 high volume tourism regions e.g. Mediterranean, Caribbean

2) Observed Climate Change Impacts (Visual Observed Impacts)

Temporal analogue studies (assess impacts of extreme climatic conditions that are representative of the future norms under climate change scenarios)

Develop an inventory of climate change impact indicators relevant to the tourism industry and establish framework for monitoring

case studies that demonstrate impacts especially those relevant to local tourism businesses

3) Holistic Sectoral Assessments

In addition to single sub-sector focused studies e.g., skiing, include holistic sector assessments i.e., assess summer and winter tourism, where appropriate, and range of vulnerabilities e.g., potential changes in tourism flows and the impact on both tourist origin and destination regions, vulnerable resources at the destination – water supply, beach, etc., insurance and other business implications

B. Tourism on climate change (greenhouse gas mitigation policies within the sector)

B1 – Tourists and Potential Tourists

1) Development and evaluation of public education campaigns

Mitigation strategies for tourists

B2 – Tourism Industry at Large

1) Determine greenhouse gas emissions attributable to tourism

Establish baseline situation of tourism sub-sector energy consumption and GHG emissions

Identify and quantify sources of GHG emissions related to tourists' activities, e.g. consumption of transport services (by mode), air conditioning/energy use, artificial snow-making machines etc.

Project future emissions based on tourism demand and flow forecasts

2) Design and evaluate GHG mitigation strategies for the tourism sector

Assess energy efficient technology, fuel substitution, operational changes, carbon sinks (sequestration) and other mitigation policies

C. External and internal mitigation and adaptation policies on tourism (inc. others sectors)

C2 – Tourism Industry at Large

1) Assess implications of post-Kyoto mitigation policies for travel and tourism

Assess impacts of different attribution schemes for GHG emission related to international travel

Assess impact of potential inclusion of aviation in Kyoto provisions

Assess impacts of various mitigation policies (carbon tax, voluntary reductions, etc.)

2) Ensure tourism is part of future integrated regional / national assessments

Assess interactions of impacts and adaptations in other economic sectors with tourism e.g., water, health, forestry etc.

2.1 Aims of the Workshop

This workshop spearheaded a new and emerging area of intradisciplinary scientific study whose aim is to study the interactions and resolve the conflicts that exist between climate, the environment and tourism. This workshop realised six major achievements:

- a - the identification of the sources of data and metadata that are required to investigate the interactions between climate change, the environment and tourism;
- b - the building of a virtual network of researchers (eCLAT) designed to foster collaboration who are involved in the attempt to understand the linkages between climate change, the environment and tourism;
- c - the raising of awareness of the issues surrounding climate change, environmental change and tourism and provide information to the stakeholders about the future agenda for this new and emerging research area;
- d - the development of a framework that will outline the future research agenda required to address the issues of impacts, mitigation, adaptation, vulnerability that surround the interactions between climate change, the environment and tourism.
- e - the establishment of the criteria and guidelines for the establishment of a virtual centre that will address the relevant issues surround the interactions between climate, the environment and tourism.
- f - the formulation of a Science Plan that outlined the major research areas and ways forward to address the issues surrounding this workshop.

2.2 Structure of the Workshop

The workshop ran over three days in FEEM, Milan from the 4th - 6th June, 2003. A press briefing (prepared by CRU with the agreement of ESF) was produced in advance. As anticipated, the workshop attracted interest from the diverse and fragmented research community who are currently addressing the issues surrounding the separate and isolated areas of climate change, the environment and tourism.

The Role of the Position Papers and Commentaries

A key aspect of this workshop was the production in advance of a series of four Position Papers. Each of these described certain aspects of the current state of climate change and tourism research and present strategies for the future. Position Papers 1-3 were prepared by the invited contributors and disseminated in advance of the workshop. Position Paper 4, required production of the other Position Papers and Commentaries and formed the initial basis of Science Plan this was disseminated to the delegates during the Workshop.

Delegates were invited, in advance of the workshop, to provide Commentaries on the Position Papers. These commentaries, completed a week before the workshop provided critiques and additional Building Blocks to the Position Papers in order to produce strengthened and a thorough report/review of the issues addressed. One of the Commentaries was moulded into an additional Position Paper.

As a result the design of the Workshop the following key outputs were produced:

Position Paper 1 Review of current activities, open discussion to identify wider areas and gaps in research.

Position Paper 2 Identification of data sources - building metadatabase - identification of gaps.

Position Paper 3 Research developments and interactions.

Position Paper 4 The interactions between climate change and tourism.

Recommendations and Conclusions

Science Plan

2.3 Position Paper I

Current activities, Areas and Gaps in research

Dr Allen Perry

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Executive Summary

Tourism has a strong international dimension and is sensitive to any changes of climate that alter the competitive balance of holiday destinations. Furthermore, destinations which rely primarily upon their natural resource base to attract visitors, such as mountains and coasts are likely to be more at risk than those which depends upon cultural or historical attractions

Engaging in tourism and recreation is a voluntary activity and particularly sensitive to both fashion and negative publicity regarding the desirability of visiting a particular area

One of the major attributes of most tourist destinations is seasonality. Tourist businesses whether focusing on winter or summer activities with a limited operating period must make their profits in a restricted period. Hence winter sports centres across Europe will be increasingly at risk from shorter seasons and unreliable snow cover, especially those situated at lower altitudes or in areas like Scotland that are already marginal in terms of their profitability and operation

Much tourism is concentrated in high energy environments such as coasts and mountains where changes in the frequency and magnitude of extreme events could have the greatest implications for the safety and enjoyment of tourists

Studies of the effect of climate change and tourism have been rather fragmentary and the vulnerability of the tourist industry has not been comprehensively addressed. There has been a lack of large- scale research projects addressing the subject. Stakeholder involvement by the industry has been very limited and is very much to be encouraged

Introduction and Background Information

Global climate change is probably the most severe environmental threat that we face in the 21st century. Despite the global economic significance of tourism and the important influence of climate on tourism patterns and vital tourism resources, the vulnerability of the tourism sector to climate change remains to be adequately assessed. Climate change is likely to pose a profound challenge to sustainable tourism in some locations, while providing new opportunities in others. Projections of increased beach erosion, lack of reliable snow cover in some ski resorts and extreme heat-waves all suggest that in the future it might be even more difficult than it is today to build a sustainable and flourishing tourist industry. We can use an economic principle that leisure time is a scarce resource and tourists resent interference or curtailment of their holiday enjoyment by adverse meteorological events like heat-waves. They will thus seek to minimise the likelihood that their holiday will be affected by circumstances perceived as adverse, possibly by destination-swapping. More research is needed to quantify the climatic well-being of tourists by developing and extending tourism climatic indices and beach comfort indices. (Mieczkowski 1985) This work needs to recognize that there are three facets of climate that affect tourism—the aesthetic e.g. sunshine, day-length, the physical- rain, wind and the thermal, a comfortable metabolic effect. Past growth and attractiveness are not necessarily a guide to the future and the Mediterranean

tourist industry cannot assume an untroubled and guaranteed future. The primary resources of sun, sea and beaches are likely to be re-evaluated in the light of expected climate change. At present holidaymakers have a quite realistic image of different destinations, but changing weather patterns might lead to a destination substitution for holidays. Tourism is a continuously adapting industry, responding to changing demographic and economic conditions as well as to new demands and technologies. Climate is, and will continue to be, a resource exploited by tourism but the old adage that “weather can ruin a holiday but climate can ruin a holiday destination” needs re-stating. Climate change must be viewed as a catalyst that is reinforcing and accelerating the pace of structural changes in tourism. In view of the fragmented structure of the industry, climate change adaptation is likely to be gradual with new investment in tune with other strategic decisions..

A chronology of Research on Tourism and Climate Change

The earliest research recognizing the potential that CO₂ warming has to affect tourism appeared in the late 1980's. (e.g. McBoyle and Wall 1987), especially in Canada, and often in relation to individual National Parks. At about the same time in Australia there was concern for the snow fields (Galloway 1988), a subject that the same author revisited in 1994 (Whetton, Haylock and Galloway 1994). A whole series of general overall review papers followed throughout the 1990's and beyond (for example, Smith 1990, Wall 1992, Wall and Badke 1994, Abegg, Burki and Elseasser 1998, Agnew and Viner 2001)). By 1993 the Centre des Hautes Etudes Touristiques produced a bibliography of over 200 papers concerned with tourism and climate, although only a small minority of these were concerned with climate change. The earliest paper showing a concern for Mediterranean tourism was probably that of Sestini, Jeftic et al 1989

The beginning of both National, and later regional, impact studies resulted in more detailed and focused studies (e.g. Perry 1996, 2000, Wall 1995). In Europe, the ACACIA report focused on the increased opportunities for leisure and tourism in Northern Europe and the increasing problems that drought and heat-waves were likely to cause in Southern Europe (Perry 2003). Even in a small area like the UK, disparities in the tourist attractions of the South compared with the North, given a projected drier summer in southern areas, were noted in many of the regional and sub-regional UKCIP studies.

There has been a paucity of major EC (and other) funded projects in the field.

The European Tourist Industry

Europe is the world's leading tourist region and 9 million people are employed in the tourist industry. The industry is expected to continue to grow, in part due to higher incomes and more leisure time.. Two-thirds of holidays abroad taken by EC residents are taken in other EC countries.

Predominant tourist flows are from North – South at present and help to transfer capital from core to periphery within Europe. Changes of recreational habits and preferences will lead to opportunities for tourist investment in new areas, and existing major tourist flows to the Mediterranean might be weakened if summer heat-waves increase in frequency, or if prolonged droughts result in water supply problems to tourist areas. (Wheeler 1995). Concerns about forest fires, skin cancer and health problems may also deter tourists. Giles and Perry (1998) have shown that summers as good as that of 1995 in Northern Europe can lead to a drop in the numbers of outbound tourists from donor countries like the UK to traditional Mediterranean sun destinations. .

Smith (1990) showed that the level of tourism from the UK to the Mediterranean was influenced by precipitation in the UK during the previous summer. Maddison (2001) concentrated on temperature impacts on tourist flows. A new study from the Netherlands (Lise and Tol 2003) has extended this analysis and shown how models can be built linking tourist demand to climate. If the current mass travel movement is viewed as a kind of import substitution, then such trends as growth of the domestic short-holiday market in northern European countries could have an impact on the balance of payments of several countries. An interesting study of the amenity value of climate has been carried out by Maddison (2001) who finds that British tourists are attracted by climates which deviate little from an averaged daytime maximum of 29 degrees C. Econometric methods for the examination of the relationship between climate and tourism activity e.g. Engle and Granger cointegration method are very recently being employed.

Changing demographic patterns may lead to an increase in winter and shoulder season tourism to Mediterranean resorts. Health, sports and beauty tourism to spas and mountains is likely to increase in Europe as disposable income rises and the annual numbers of holidays and short-breaks increases.

In Northern Europe short breaks are likely to be taken over a longer season as temperatures rise. Elderly and retired people are more likely to take long-stay winter holidays in more favourable climates. There is likely to be a rise in the numbers engaging in cruising, cultural holidays and holidays involving self-expression and self-improvement.

Coastal zones and their tourist infrastructure are at risk from sea level rise, most notably such tourist attractions as the cities of Venice, Amsterdam and others. Beaches, wetlands and estuaries are also tourist resources that are at risk. Already such tourist amenities as coastal golf courses have required sea defence protection work in several parts of Europe.

Fragile and sensitive areas need to be identified more adequately and work carried out on the future likely visitor carrying capacity of such environments. Wetlands have been targeted for investigation by Wall (1998). Events like outdoor fires could severely impact on the use of areas like commons and woodland. Working to put in place visitor management strategies is likely to become more urgent. Increasingly sophisticated travellers will be alive to green issues and look to a superior holiday experience that includes clean beaches, better air quality and improved tourist environment and infrastructure.

Heat stress and poor urban air quality is likely to lead to cities being seen as undesirable locations in summer, with more tourists, especially at weekends and on public holidays. Escaping to the country and the coast. Outdoor recreational spending on gardening, bar-b-q's and swimming pools is likely to increase alongside more visits to water-based attractions like water parks.

Any increase in the frequency or intensity of extreme events could potentially impact on tourism. Examples of riverine flooding impacting on temporary accommodation like camp sites has been considered by the World Tourist Organization (1998). It is often the high-risk components of the landscape that are the most attractive from the tourist point of view, whether it is for active or passive leisure. Holiday horror stories that follow events like flash-flooding can be extremely damaging to an area's image and the management of such disasters and the publicity that they inevitably receive may become an increasingly important task if the incidence of extreme rainfall events rises.

Mountainous zones are used extensively for recreation, and are the main sites of the European winter sports industry which is based on snow resources that are vulnerable to climate change. Mohnl (1996) has shown that there is a statistically significant trend in snow cover reduction in

the Alps over recent years, while Burki (2002) has also shown the threat to tourism in the Alps. Abegg and Froesch (1994) have suggested that assuming a 3 degree C rise in mean temperatures the snow line in winter will rise by 300m in the Central Alps, the first snowfall of the season will be delayed and below an altitude of 1200m there will not be a winter continuous snow cover. As the season contracts there will be a need to bolster winter tourism with increased use of artificial snow and develop more alternatives to outdoor skiing. A full analysis of climate and tourism in the Alps has been produced by Abegg (1996). In Switzerland alone by 2050 the potential cost of climate change is estimated to be between 1.5 and 2 billion US dollars. Breiling and Charamza have looked at regional snow modelling. Concern on the vulnerability to landslides, debris-flows and rock-falls caused by melting permafrost is being recognised.

In Scotland the skiing industry is likely to experience increased numbers of snow-deficient winters which will impact adversely on the financial viability of the industry. (Harrison and Winterbottom 2001)

With the continued expansion of the European Union comes the potential for new growth destinations and new economic, social and environmental net benefits to be derived for those same destinations and their countries economies and communities. Many of the new members have existing and varied tourism industries but long term sustainable growth will need to consider climate change.

Climate change, tourism and human health

Climate change may affect tourism and human health through a range of mechanisms. Older people, a potentially growing segment of the tourism market, are particularly vulnerable to heat stress, as a result of intrinsic changes in their regulatory system, and more studies of heat tolerance of older people need to be undertaken. Increased episodes of air pollution both in urban areas, and more generally as a result of increasing vegetation fires, could result in more poor air quality with health implications. Infectious intestinal diseases like salmonella are more common at higher temperatures and cases of food poisoning could increase with higher summer temperatures. Rates of salmonella, however, are declining due to active control (food hygiene) measures in most countries -and the implications for climate change are dependent on the underlying incidence of disease.

Warmer sea temperatures increase micro-organism proliferation and pathogens associated with diarrhoeal diseases can flourish so that adverse health outcomes related to bathing water quality are likely. Transmission of vector borne diseases is complex and influenced by economical and biological as well as climatic factors. Diseases that currently have local transmission cycles in Europe and whose transmission dynamics may alter after climate change include Leishmaniasis, Lyme disease and Mediterranean spotted fever. Thus climate change may result in a wide range of adverse health outcomes to EU tourists visiting popular EU destinations and hence weaken the attractiveness of these destinations. Stakeholders need to be aware that healthy tourists equal healthy profits. A Major study of the health impacts of climate change in Europe was included in the ACACIA report (Kovats *et al.* 2000).

Research Needs

New research initiatives are urgently needed into the likely effects of climate change on tourism, and the tourist industry requires research that "translates" the suggested future climate scenarios in terms of their likely future impacts on groups like tour operators and tourist boards." (Perry 2000) Climate change presents opportunities as well as threats to the tourist industry. Changes in global climate beyond the control of the tourism industry may have far-reaching consequences for

many current tourist destinations as well as for places contemplating involvement in tourism. Of particular significance are the contrasting time-scales of climate change predictions and the tourist industry. Tourism suppliers tend to look at the next season and the market for its products. The one area of tourism that has a longer-time horizon relates to investment in infrastructure such as new resorts or hotels by the private sector or new services by the public sector. It is perhaps planning authorities who may be the first to take climate change issues directly into account. There is a need for many more individual case studies to measure changes that have already happened and how climate change has already had an effect on tourism markets and destinations. Of equal importance are case studies of what is likely to happen to a particular destination and its market and by extension the likely shifts of demand. Particularly meaningful would be more research undertaken on destinations that are already vulnerable and where tourism activity is on the margin. Examining destinations where tourism is on the cusp would provide the evidence of the reality of impact that the industry needs

.At present we can see a hierarchy of flexibility to climate change. Namely tourists are most flexible and can quickly change their destination, tour operators have a degree of short-term flexibility e.g. altering flight destinations, and local tourist managers are the least flexible with committed capital installed and not always transportable. New research initiatives are urgently needed and there is an opportunity to work in partnership and to engage with, some of the major stakeholders in the leisure industry. The stakeholder community is fragmented and works to different time-frames and agendas. Abegg (1997) suggested that the methodological approaches used in climate impact studies have been too mechanistic and not interactive enough. We must develop the capacity "to translate" in practical terms expected climate trends. There is a need to address more comprehensively the possible response strategies of different aspects of the tourism industry. Advice on how to construct tourist facilities in harmony with the local climate and to provide the least stress to users is needed

Predicting climate change is complex but even more complex is predicting how people will respond to that change. We have only just begun to investigate how tourism might evolve in relation to the SRES scenarios (Amelung, Martens and Rotmans 2003). These socio-economic scenarios could be highly important in affecting tourist demand. Climate change will affect life-styles and patterns of leisure consumption and this in turn will affect household expenditure priorities. Future consumers may spend more on leisure goods for use at home and less on travel. Almost no research on these issues has been carried out. Societal trends that will impinge on tourism include demographic changes, rises in educational levels, increasing individualisation and smaller family sizes. Climate will affect such trends as the growing market for second homes and the outright migration of older retirees from Northern European countries to warmer Mediterranean climates.

New tourist trends like survival and adventure tourism, where tourists seek to experience extreme conditions, might flourish and the expected enhanced uptake of outdoor pursuits in northern Europe could rejuvenate out-dated seaside resorts and infrastructure. Investigation of how adaptation of recreation businesses to future climate change can take place is needed.

The tourism industry has generally not yet embraced the subject of climate change as an issue that is relevant to its business. Stakeholders complain that information is often fragmented, theoretical, complicated and couched in a scientific language that many do not understand.

Key Issues and Questions

I How will climate change affect the holiday and recreational plans of Europeans? How will the

length and types of trips be affected? Which destinations will benefit and which will suffer? How might demographic and other changes either exacerbate or counter-balance climate change? How will climate change affect the motivation and inclination to travel?

2 How will the role of technological adaptation change e.g. will there be a big increase in snowmaking in Europe? Might southern Europe adopt measures already in use in the Middle East like cooling swimming pools? Will drought demand expensive desalination and water grids? Should water harvesting measures be introduced? How much can recreational provision diversify in particular areas to reduce vulnerability?

3. Will climate change lessen the volume of migration of North Europeans to Southern Europe in summer? Will the season be extended significantly? Will new destinations replace the traditional seaside holiday? Might tourists like to be “thermally challenged” in the future?

4. What are the safe and tolerable limits of the climate of different areas e.g. the Mediterranean, to sustain tourism? What is the likelihood that these limits will be breached and at what time? What is the optimal climate for generating tourism? There is a need to know more about the length of season that is needed to make particular enterprises profitable and how this might change.

5. How will climate change affect entrepreneurs working in the tourist industry? These include travel organisers like, travel agents and consultants, and operators such as tour companies and charter airlines.

6. Will tourism become less sustainable as a result of climate change? (The International Eco-tourism Society defines eco-tourism as “responsible travel to natural areas that conserves the environment and sustains the well-being of local people”.) Which ecosystems are likely to be most sensitive and easily damaged? What new management strategies and policies should be put in place to conserve fragile areas like wetlands, and freshwater ecosystems?

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Climate data for tourism:

Identification of data sources - building a meta database - identification of gaps

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Introduction

Geographic location, topography, landscape, vegetation and fauna are all factors that influence decisions regarding areas to be toured. Weather and climate are two other factors.

Weather/climate and tourism/recreation are interconnected in diverse ways (Lecha and Shackelford 1997, Shackelford and Olsson, 1995), and as such, tourists, tour organisers, travel agencies, tourism planners and stakeholders need to be reliably informed about the role of weather and climate. People are usually disappointed about having to cancel a weekend trip for weather reasons. Or what experience could be worse than a vacation with continuous rainy days? Travel organisers or tour operators are well aware of the important role weather has on tourism experiences: Rainy summers and winters with less than ideal snow conditions can adversely affect the number of tourists and consequently have a major effect on the location and revenues of tourist organizers (Abetz 1996).

Travel to other climate-stressed locations may also result in health problems (e. g. caused by heat stress, UV-radiation, air pollution and heat stroke). A useful climate advisory service will help to prepare and protect travellers and at risk groups (retired, sick people and children) against the above mentioned dangers. Knowledge about and application of climate information is helpful in tourism planning, tourism industry and in reducing negative effects of weather and climate on tourists and this branch of economy.

Methods

Tourism is influenced by many factors, two of which are weather and climate (Fig. 1). For tourism climatology purposes, methods used in climatology and applied climatology can be employed to address the many issues in climate and tourism. For an integrated analysis and assessment in tourism climatology, some definitions are described here.

Definitions

Weather: is the present combination of atmospheric elements (physical condition of the atmosphere) at a specific time and location and the resulting processes in the atmosphere (time scale: days, weeks, months).

Climate: is the typical representation of atmospheric and weather processes at a location or particular region over a long time period, and is characterized by the distribution of frequencies, mean and extreme meteorological values (time scale: normal period).

Tourism: is the entirety of the relationships, phenomena and experiences that arise from the travelling and the stay of people in locations or areas other than where they live and work.

These three definitions imply different times and scales and they assume complex interactions and effects.

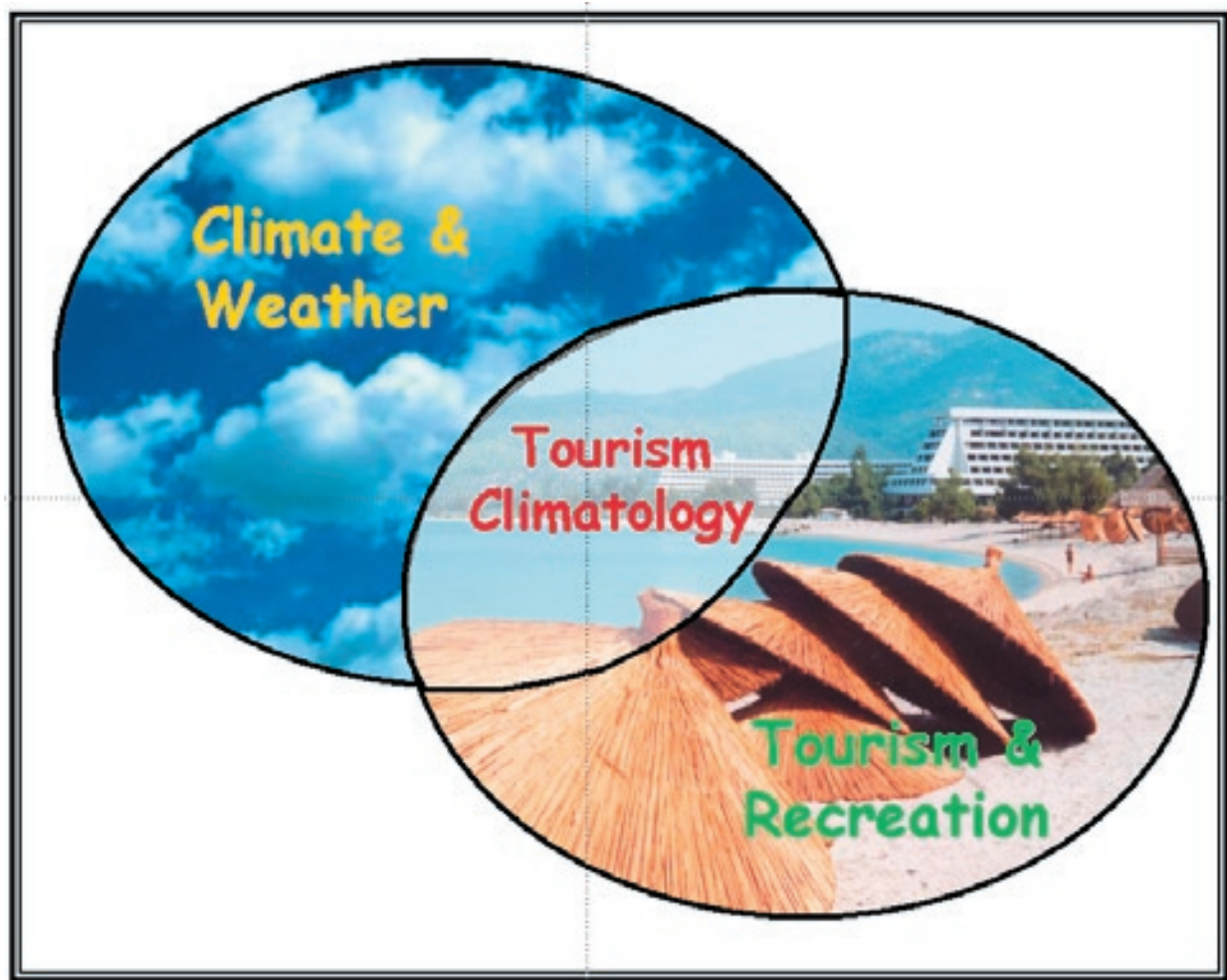


Fig 1: Relations climate, tourism and recreation (<http://www.mif.uni-freiburg.de/isb>)

Identification of Data Sources

Tourism climatology and climate change issues require weather and climate data at different temporal and spatial scales. Sources of meteorological and climatological data include national weather services, private weather services, environmental agencies and governmental authorities running their own measurement networks. From a meteorological perspective, synoptic data are provided by national weather services for weather forecasts. These data provide detail on many parameters with a high degree of temporal availability, but often, do not have the appropriate spatial resolution for tourism climatology. From a spatial perspective, climate networks contain more stations, but not all stations collect the same data on a regular basis (Tab. 2). The quality and the quantity of the climate information differ from one country to another. Both, synoptic and climatological data are partially used for tourism purposes.

Other sources are tourism guidebooks and the internet. Data from these sources have very little temporal or spatial detail (Tab. 1). Climate information from the internet often only describes current conditions or the forecast for the next few days. Some tourism providers offer weather information for the next few days and general information for a range of tourism destinations.

Table 1: Climate values for Santorini/Greece taken from a tourism guide book (Adams 1996)

Month	Mean air temperature (°C)	Mean maximum air temperature (°C)	Sunshine duration/day (h)	Precipitation (mm)	Relative humidity (%)	Water temperature (°C)
Jan	11	15	4	74	74	16
Feb	11	16	5	52	73	15
Mar	12	17	5	41	72	15
Apr	15	20	8	21	71	16
May	19	24	10	12	69	19
Jun	22	28	11	2	65	22
Jul	25	29	13	0.1	61	24
Aug	25	29	12	1.5	60	25
Sep	22	27	9	9	68	23
Oct	19	23	7	26	72	21
Nov	16	20	6	52	73	19
Dec	13	16	4	74	74	17

Table 2: Climate parameters for Santorini taken from the Greek climate network on a monthly basis (Andreakos 1978)

Parameter	Data	Mean value of days of	Data
Air pressure (hPa)	Yes	Precipitation	Yes
Mean air temperature (°C)	Yes	Rain	Yes
Mean max. air temperature (°C)	Yes	Snow	Yes
Mean min. air temperature (°C)	Yes	Snow rain	No
Absolute max. air temperature (°C)	Yes	Rainstorm	Yes
Absolute min. air temperature (°C)	Yes	Hail	Yes
Absolute mean max. air temp. (°C)	Yes	Snow cover	Yes
Absolute mean min. air temp. (°C)	Yes	Fog	No
Mean relative humidity (%)	Yes	Dew	Yes
Mean precipitation (mm)	Yes	Frost	Yes
Maximum precipitation in 24 h (mm)	Yes	Mean min. air temperat. < 0.0 °C	Yes
Mean cloud cover (Octas)	Yes	Mean max. air temperat. < 0.0 °C	No
Sunshine duration (h)	No	Wind speed > 6 Bft	Yes
Cloud cover (0-1.5)/8	Yes	Wind speed > 8 Bft	Yes
Cloud cover (6.5-8)/8	Yes	Wind direction	Yes
		Mean wind speed in Bft	Yes

From the multitude measured meteorological and climatological parameters are relevant for tourism:

- Air temperature
- Humidity Wind speed
- Wind direction
- Cloud cover
- Sunshine duration / Radiation fluxes
- Rain and precipitation

- (Snow cover)
- (water temperature)

Applying climatology to tourism leads to the following questions:

How appropriate is the existing data for use by tourists and tourism planning ?

Are the data appropriate and relevant for tourism planning ?

Are existing data available ?

Is the resolution appropriate, both temporally and spatially ?

How can existing methods, technologies and results be transferred for tourism purposes ?

Building meta data

The term metadata is often defined as 'data about data' in literature. The term is understood to mean structured data about resources that can be used to help support a wide range of operations as well. These might include, for example, resource description and discovery, the management of information resources and its long-term preservation (Day 2001).

While the first use of 'metadata' originated in contexts related to digital information (chiefly with regard to databases), the general understanding of the term has since broadened to include any kind of standardised descriptive information about resources, including non-digital ones. So, for example, library catalogues, abstracting and indexing services, archival finding aids and museum documentation might all be considered metadata. The advantages of this are two fold. Firstly, it allows librarians, archivists and museum documentation specialists to share information across disciplines. Secondly, it enables the cultural heritage professions to communicate more effectively with those domains that have an interest in metadata too: e.g., software developers, publishers, recording industry, television companies, producers of digital educational content and those concerned with geographical and satellite-based information (Day 2001).

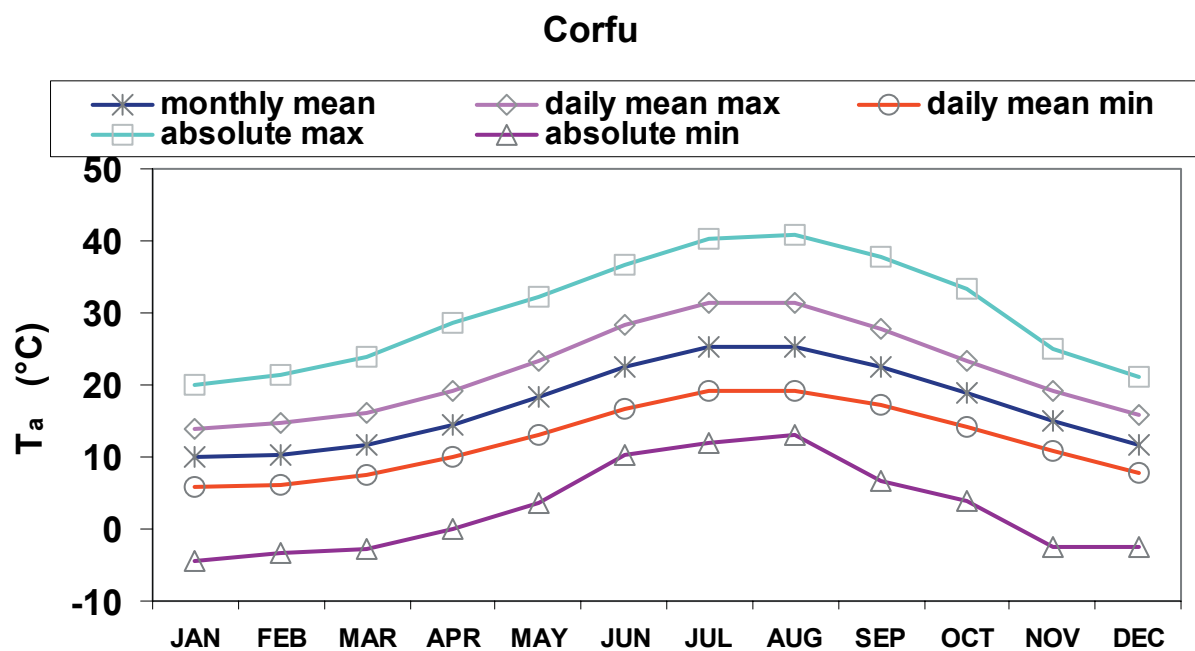


Fig. 2a: Examples for Climate data analysis (air temperature T_a)

Corfu

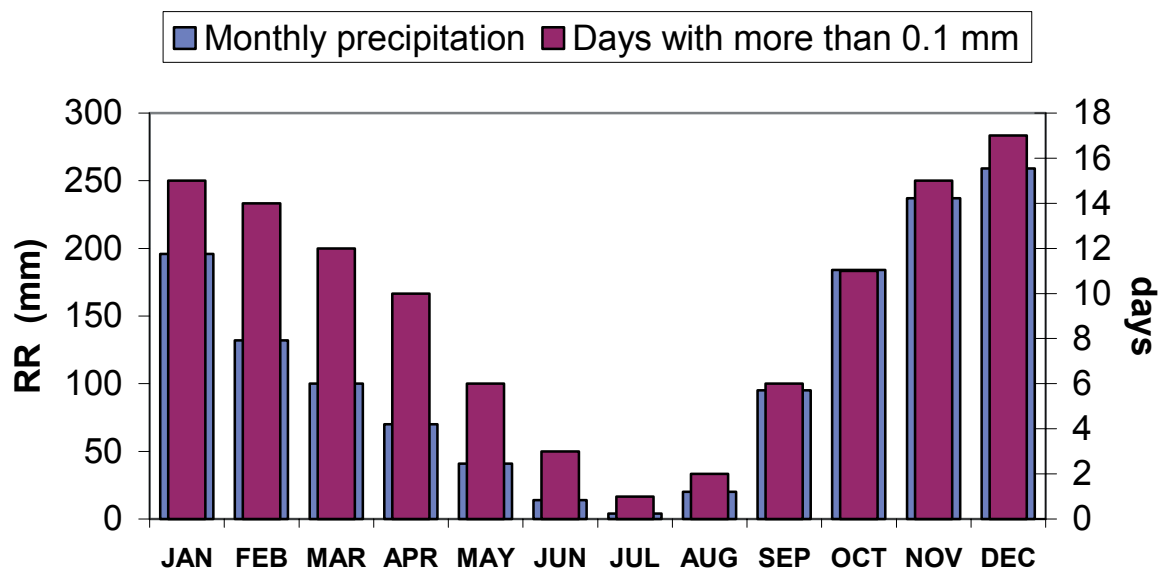


Fig. 2b: Examples for Climate data analysis (precipitation RR and frequency of days with a precipitation greater than 0.1 mm)

Metadata, its presentation and the transfer of this relevant and required information for tourism purposes is an important factor in tourism climatology (Fig. 2a and 2b).

Table 3: Tourism Climate Indices (after Abetz, 1996, modified)

Category	Included parameters	Authors
Elementary	T _a , SD, RR (synthetic value) T _{a,max} , SD, RR	BESANCENOT, 1990 DAVIS, 1968 POULTER, 1962 FERGUSON, 1964 RACKLIFF, 1965 HUGHES, 1967 MURRAY, 1972
Bioclimatic	Windchill (T _a , v) Indices – based on human-energy balance a.e. Predicted Mean Vote Standard Effective Temperature Physiological Equivalent Temperature In general, about 200-300 CI exist	-- TERJUNG, 1968 FANGER, 1972 YAPP and MCDONALD, 1978 REIFSNYDER, 1983 GAGGE and BERGLUND, 1986 DE FREITAS, 1990 HÖPPE, 1984, 1993 DE DEAR and POTTER, 1999 BLAZEJCZYK, 2001
Combined	Combination of Parameters and Factors Cld, Cla, RR, SD, v PET or PMV, RR	MIECZKOWSKI, 1985 HEURTIER, 1968 MATZARAKIS and MOYA, 2002

Additional and detailed information are provided through climate indices such as those found in applied climatology and human-biometeorology. In general, the tourism climate indices can be classified into three categories (after Abetz, 1996, modified). Elementary indices are synthetic values that don't have any thermo-physiological relevance and are generally unproven. The bioclimatic and combined tourism climate indices involve more climatological parameters and consider the combined effects of them (Tab. 3). Some examples of tourism climate indices are provided in Table 3.

One example of an elementary climate index is the Climate Index by Davies (Davies 1968) (Eq. 1). This index encompasses a number of variables for the period June to August, including mean daily maximum air temperature (T_{amax}), sunshine duration (S) and the total of precipitation (N) included. An example of the summer index of Davies (1968) is given in Fig. 3 for the area of Greece.

$$I = 18 * T_{\text{amax}} + 0.217 * S - 0.276 * N + 320 \quad (1)$$

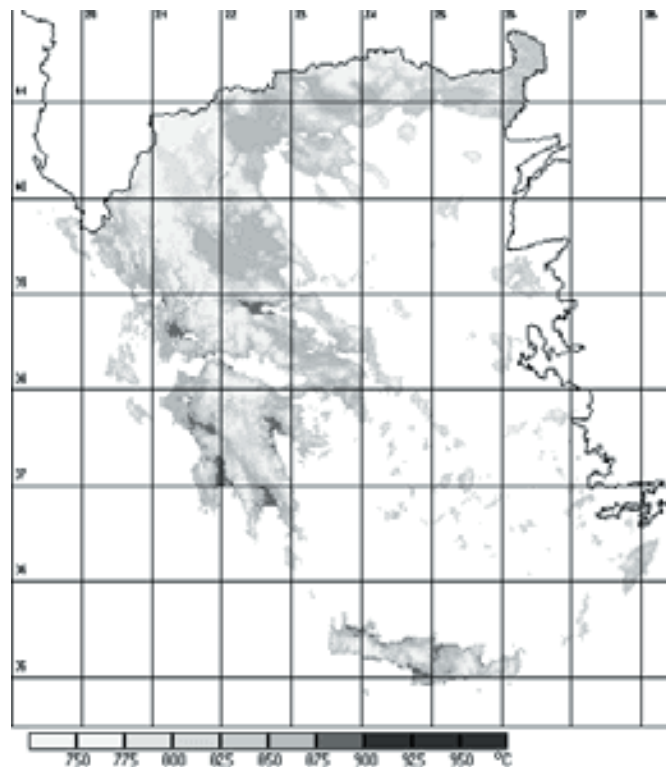


Fig. 3: Geographical distribution of summer climate index I after Davies for Greece

An example of a combined index is the Tourism Climate Index (TCI). Developed by Mieczkowski (1985), the TCI uses a combination of seven parameters, three of which are independent and two in a bioclimatic combination (Eq. 2).

$$TCI = 8 * Cld + 2 * Cla + 4 * R + 4 * S + 2 * W \quad (2)$$

Where Cld is a daytime comfort index, consisting of the mean maximum air temperature $T_{a,max}$ (°C) and the mean minimum relative humidity RH (%), Cla is the daily comfort index, consisting of the mean air temperature (°C) and the mean relative humidity (%), R is the precipitation (mm), S is the daily sunshine duration (h), and W is the mean wind speed (m/s). Contrary to other climate indices every contributing parameter is assessed, every factor can reach 5 points, because of a weighting factor (a value for TCI of 100). TCI values ≥ 80 are excellent, while values between 60 and 79 are regarded to be good to very good. Lower values (40 – 59) are acceptable, but values < 40 imply bad or difficult conditions for tourism (Abetz 1996, Mieczkowski 1985).

Table 4: Threshold values of Predicted Mean Vote (PMV) and Physiologically Equivalent Temperature (PET) Indices for levels of thermal sensitivity and physiological stress in humans. Internal heat production: 80 W, heat transfer resistance of clothing: 0.9 clo (according to Matzarakis and Mayer 1996)

PMV	PET	Thermal Sensivity	Grade of Physiologic Stress
-3.5	4 °C	very cold	extreme cold stress
		-----	-----
		cold	strong cold stress
-2.5	8 °C	-----	-----
		cool	moderate cold stress
		-----	-----
-1.5	13 °C	slightly cool	slight cold stress
		-----	-----
		18 °C	-----
-0.5	18 °C	comfortable	no thermal stress
		-----	-----
		23 °C	-----
0.5	23 °C	slightly warm	slight heat stress
		-----	-----
		29 °C	-----
1.5	29 °C	warm	moderate heat stress
		-----	-----
		35 °C	-----
2.5	35 °C	hot	strong heat stress
		-----	-----
		41 °C	-----
3.5	41 °C	very hot	extreme heat stress
		-----	-----
		-----	-----

The climatic indices shown have a number of weaknesses. They do not include from the point of view of climatology the effects of short and long wave radiation fluxes which are generally not included in climatic records. These required short and long wave radiation fluxes are calculated using synoptic data and theoretical calculations from astronomical data (VDI 1998, Matzarakis

et al 2001). A full application of thermal indices on the energy balance of the human body gives detailed information on the effect of the thermal environment on humans (VDI 1998). Common applications are PMV (Predicted Mean Vote), PET (Physiologic Equivalent Temperature) (Matzarakis and Mayer 1997, VDI 1998, Höppe 1999, Matzarakis et al 1999), SET* (Standard Effective Temperature) (in Matzarakis 2001c) and Perceived Temperature (in Matzarakis 2001c and Tinz and Jendritzky 2003). All these thermal indices are well documented and include the important meteorological and thermo-physiological parameters (Matzarakis 2001a). The advantage of these thermal indices is that they require the same meteorological input parameters: air temperature, humidity of the air, wind speed, short and long wave radiation fluxes. In table 4 threshold values of the thermal indexes Predicted Mean Vote (PMV) and Physiologically Equivalent Temperature (PET) are explained for different levels of thermal sensitivity and physiological stress in humans. Internal heat production: 80 W, heat transfer resistance of clothing: 0.9 clo (according to Matzarakis and Mayer 1996) giving a possibility to access the thermal environment of humans (Table 3).

PET, PMV and SET* which can be calculated by RayMan (Matzarakis et al., 2001, Matzarakis 2002), is suitable for the evaluation of the thermal environment not only for summer conditions, but also throughout the whole year. As an example of such an application in a mediterranean climate, Fig. 4 shows mean, high and low PET values at 12 UTC per day at Corfu, Greece for the period 1980 - 1989. This illustration provides information on the variation of PET on individual days of the year during the period of investigation. The results of Fig. 3 show that cold stress ($PET < 18^{\circ}\text{C}$) occurs mostly from October to April. Mean PET values over 30°C , indicating at least moderate heat stress, occurs between June to September. On some hot summer days from May to September, PET at 12 UTC was over 40°C , thus representing a pronounced thermal stress situation at Corfu island.

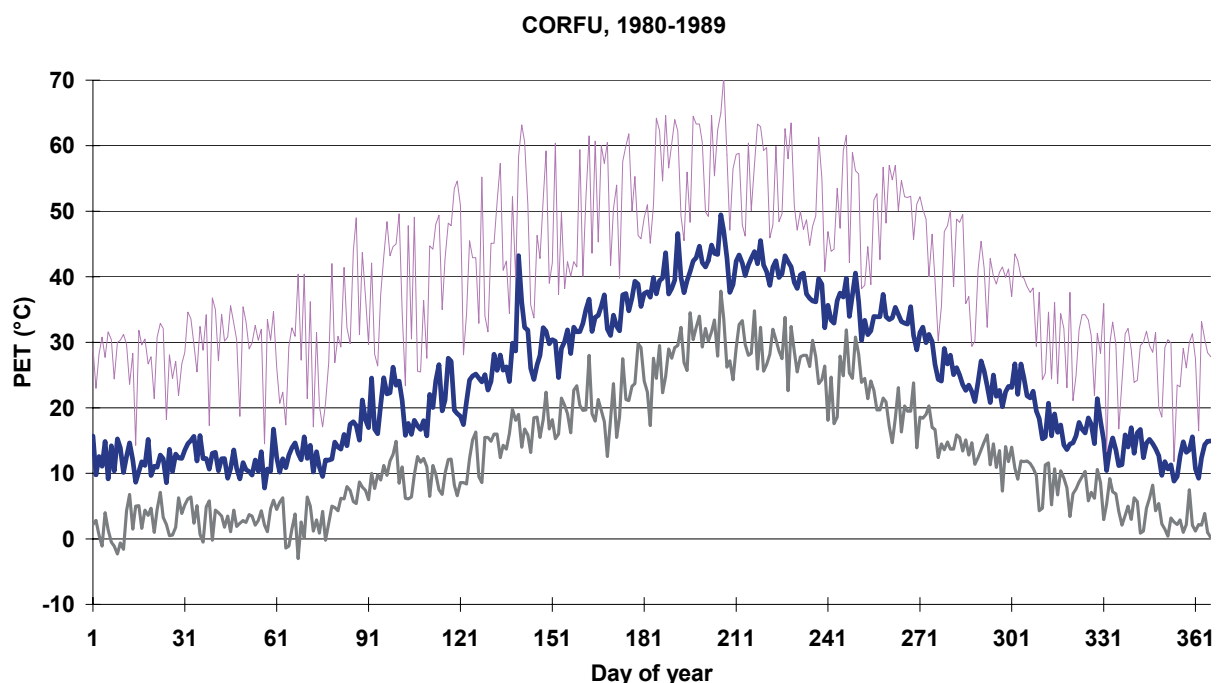


Fig. 4: Mean, highest and lowest daily values of the Physiologically Equivalent Temperature (PET) at Corfu at 12 UTC for the years 1980-1989

In general, the availability of national climatic networks of basic meteorological and climatological data is required. Also data needed for some bioclimatic purposes is available but not in a spatial resolution required for tourism purposes (Matzarakis and de Freitas 2001). The link between the station data as temperature or PET can be performed by the construction of maps. Climatic and bioclimatic maps can be constructed using a stochastic-statistical model, that uses the application of linear multiple regression. On the one hand as input data air temperatures or Physiological Equivalent Temperature of the stations was used as dependent variables on the statistical analysis, while independent variables include the following: latitude, longitude, elevation above the sea level, shortest distance of each grid to the sea (as an indicator for continentality) and a factor of land/sea coverage in percent for parts of the area with a diameter of approximately 40 km were used (Matzarakis 1995, Matzarakis and Mayer 1997).

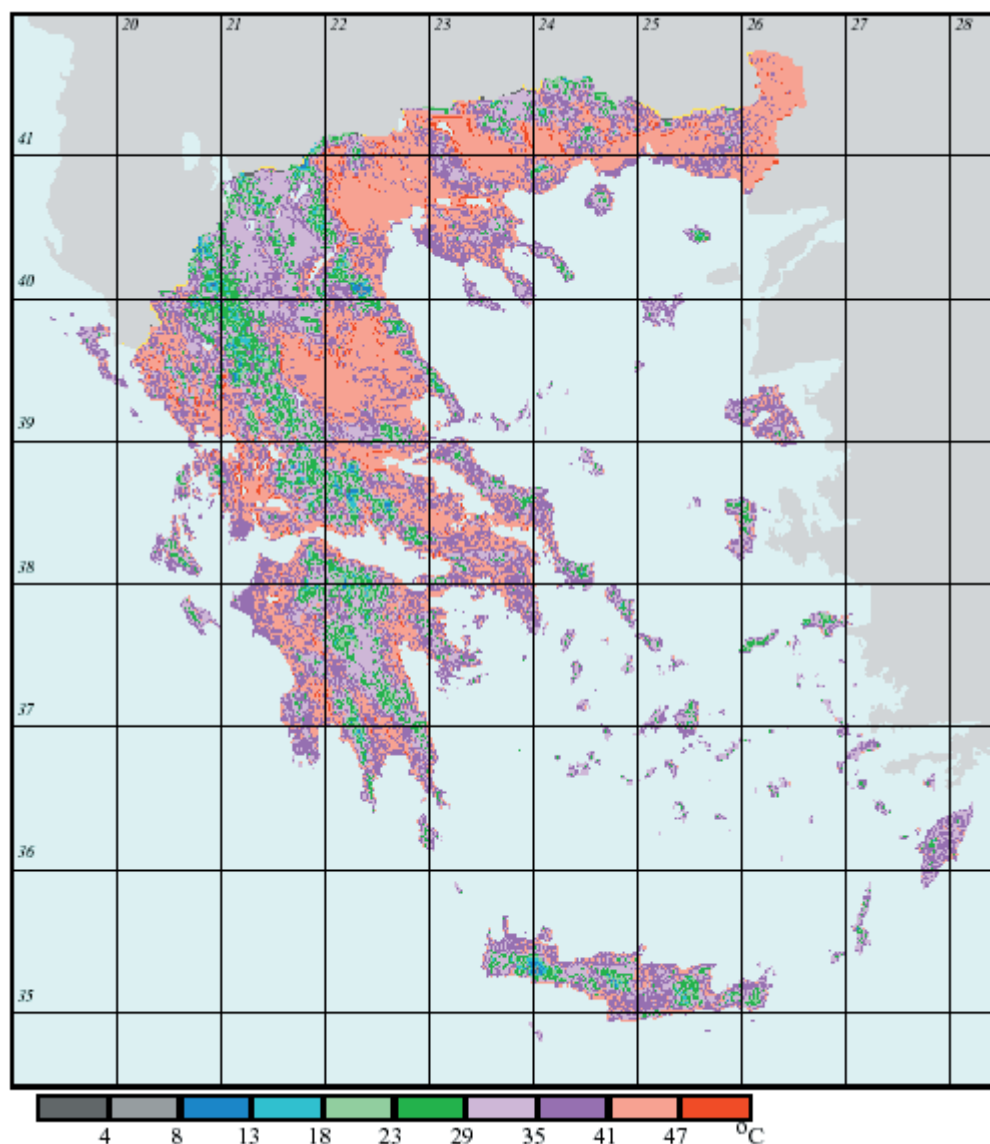


Fig. 5: Geographical distribution of PET in Greece for July (Matzarakis 2001b)

Fig. 5 shows the geographical distribution of PET for the month of July. The distribution shows the differences between the inner mainland of Greece and the coast and the Greek islands. In July, the conditions on the Greek islands are quite comfortable and the PET values are less than those in the inner parts Greece. The frequencies of days with PET > 29 °C for Greece are given

in Fig. 6, thus identifying areas with the possibility of heat stress. Areas with a high heat stress potential coincide with areas where the population of Greece is living and tourists usually spend their vacations. This kind of information is useful for planning new tourism resorts, extension or reduction of tourism periods and health implications on tourists during episodes with heat stress.

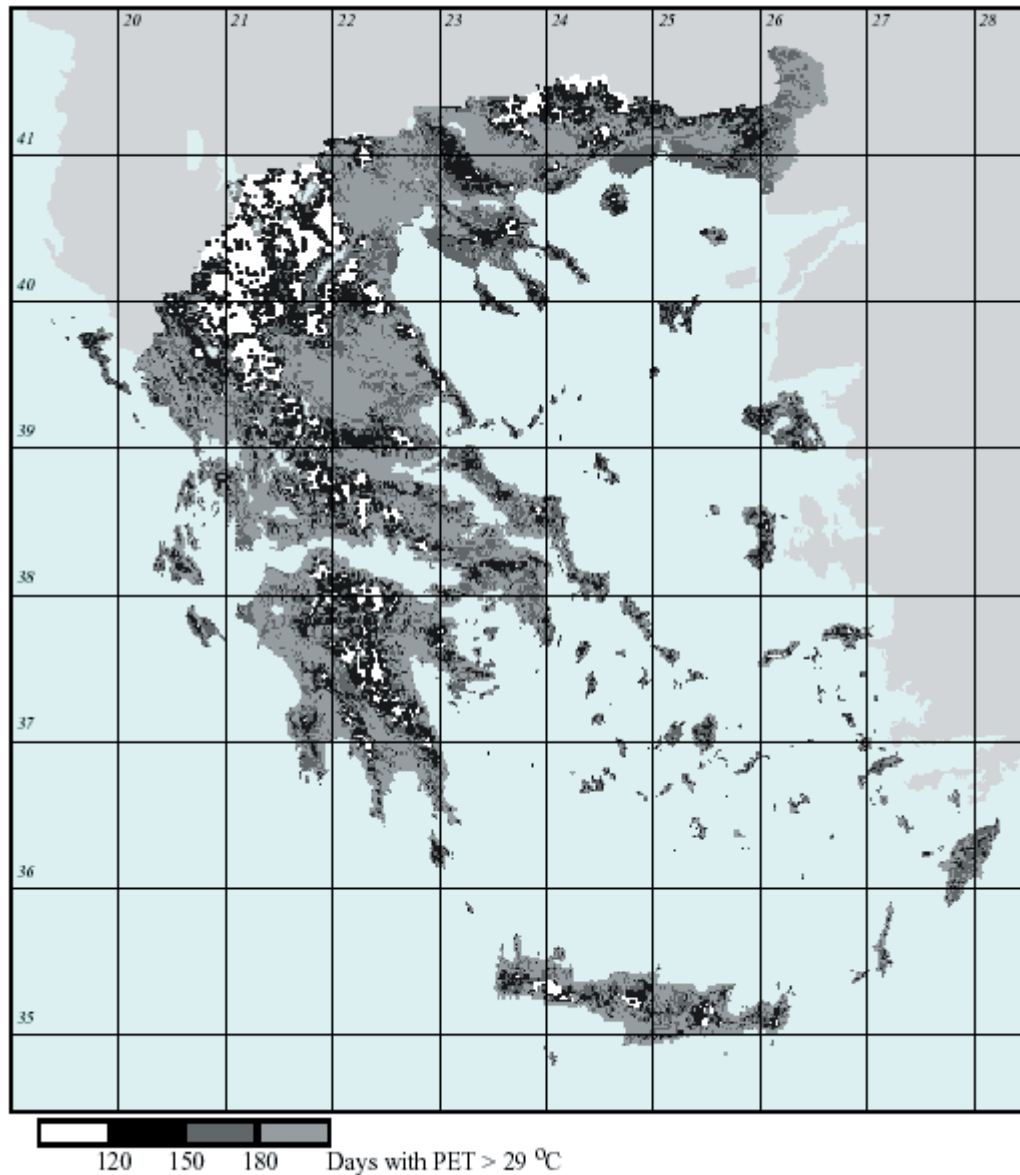


Fig. 6: PET Frequencies (days with Pet > 29 °C) for Greece

Information regarding climate change outputs from global circulation models, i.e air temperature or perceived temperature (Tinz and Jendritzky 2003) can be helpful but does not provide much additional information due largely to the coarse spatial resolution. Tourism climate information are relevant in the meso and micro scale.

Identification of gaps

A range of climate information is needed for tourism climatology, but single meteorological or climatological parameters in form of means (Fig. 3 and 4), extremes (Fig. 4), frequencies (Fig. 6) and possibilities may not be relevant on their own. Climate data and assessed climate

information for tourism shall have also a quantity and not only qualitative character. Combined effects of atmospheric parameters like thermal comfort are of interest, but they do not provide a absolute detailed integral assessment and guidelines of the effects of the atmosphere on humans, or assessment about the planning of new tourism resorts, etc. (Table 4). Physical factors like i.e. ultraviolet or air quality have to be included in the assessments. From the point of view of the aesthetic component, sunshine or visibility is important. Information on climate (including all its atmospheric and physical terms) requires well-prepared and presented information in order to be widely used in tourism climatology (de Freitas 1990).

Table 5: Various facets of tourism climate and their significance and impact (de Freitas, 2001. modified).

Facet of climate	Significance	Impact
Aesthetic Sunshine/cloudiness Visibility Day length	Quality of experience Quality of experience Convenience	Enjoyment, attractiveness of site Enjoyment, attractiveness of site Hours of daylight available
Physical Wind Rain Snow Ice Severe weather Air quality Ultraviolet radiation Odours Noise	Annoyance Annoyance, charm Winter sports/activities Danger Annoyance, danger Annoyance, danger Danger, attraction Annoyance Annoyance	Blown belongings, sand, dust... Wetting, reduced visibility, enjoyment Participation in sports/activities Personal injury, damage to property All of above Health, physical wellbeing, allergies Health, suntan, sunburn Attractiveness of site Attractiveness of site
Thermal Integrated effects of air temperature, wind, solar radiation, humidity, longwave radiation, metabolic rate, clothing.	Thermal comfort Therapeutic, restorative	Environmental stress Physiological strain Hypothermia Hyperthermia Potential for recuperation

Tourism climate indices, and in general, thermal climate indices are not evaluated by specialists and tourists and they don't include the climate adaptation of humans.

An example of the various facets of their significance and impact are given in Table 5 including most of the important relevant climatic factors. Other interactions between the different facets, including recreational behavior and socio-economic factors have to be taken under consideration.

Conclusions and open questions

Many sources of climate data are publicly available. Below, a number of important conclusions and questions regarding climate data and tourism are listed:

- Climate information has to be prepared and provided for tourism planning and tourism industry using mean values, extremes, frequencies, probabilities, with some indication of their possible implications.
- Single parameters (i.e. air temperature) are inadequate for tourism climatology.
- Evaluation of the value of tourism climate indices or thermal indices has not been undertaken.
- Climate adaptation of humans in different climates has to be identified and proved.
- Impacts and climate information can be assessed from the point of view of human-biometeorology.
- Measured data are not the only available data. Modeled data provide additional, relevant and required information.
- Assessments have to integrate implications and interactions.
- Thermal component is a main factor in determining the desirability of weather.
- In the absence of ideal conditions, a personal acceptable microclimate/bioclimate can be created.

Most of above mentioned questions are part of the work of the Commission Climate, Tourism and Recreation of the International Society of Biometeorology (<http://www.mif.uni-freiburg.de/isb>).

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2.3 Position Paper 3

Research developments and interactions.

Bas Amelung

With Contributions from:

Murray Simpson, Martin Lohmann, Susanne Becken, by Ana Iglesias, Richard Tol, David Maddison, David Simmons and Ghislain Dubois

Introduction

Climate and tourism are closely connected phenomena: climatic conditions account for a significant share of international tourist movements, e.g. from northern to southern Europe. These movements are of a huge and growing magnitude. Tourism is even claimed to be the world's largest single industry contributing around eleven percent to gross world product (GWP) and a similar percentage to global employment. Moreover, tourism goes hand in hand with all kinds of effects on society and the environment, both beneficial and detrimental. These range from impacts on the livelihoods of local communities to the contribution of tourism to the emissions of greenhouse gases.

The prominent position of the climate sensitive tourist industry, and the imminence of climate change provide a rationale for submitting the interfaces between climate and tourism to closer scrutiny. So far, this has been done in a rather fragmentary way, with several relatively isolated clusters of activity. The focus of these clusters range from impacts on beaches and ski resorts, to changes in tourist behaviour, and to adaptation options for the tourist industry.

One of the explicit goals of the ESF workshop in Milan and the NATO Advanced Research Workshop in Warsaw later this year is to build a research community around the issue of climate change and tourism. Such a community provides a platform for exchanging ideas, experience and data, and for providing focus. Having a basic overview of the whole field, it is easier for individual researchers and research groups to position themselves and to relate their work to that of others. Unfortunately, such a conceptual overview is lacking. This position paper is meant to be a starting point for closing this gap.

The current paper has benefited greatly from the thoughtful commentaries by Susanne Becken, Martin Lohmann and Murray Simpson, and from the plenary discussions during the Milan workshop.

Martin Lohmann's proposition of splitting up the development of a conceptual framework for "climate change and tourism" into three steps has been happily incorporated into the position paper. These three steps are:

1. to identify the interfaces: where can climate change touch tourism?
2. to research the interfaces: how do these linkages work?
3. to incorporate the results of step two in something like a theory

As the research efforts so far have been quite modest, this position paper will focus on the first two steps.

Climate and tourism: identification of interfaces

"Climate change", "tourism", and "environment" are all very broad notions, and we are only interested in portions of them. In the centre of our interest are the research fields that address the overlap between the notions (see Figure 1).

Climate change, tourism, and the environment: introduction and interfaces

The workshop's focus is on the areas A and D. The area A represents the relation between climate change and tourism, which is two-sided:

- tourism contributes to climate change by emitting CO₂, particularly through transport;
- climate change directly affects (the tourists' perception of) the physical comfort of tourists, and indirectly affects the tourist industry and the communities in the destination areas.

It is important to realise that research into this latter aspect benefits greatly from existing knowledge about the relationship between climate and tourism. However, despite the close relationship between weather and climate on the one hand and tourism and recreation on the other, surprisingly little is known about it. This lack may be partly due to the common assumption that climatic conditions can be treated as a constant factor (Lise et al., 2000).

Area D represents the field of indirect effects of climate change on tourism. These indirect effects occur through a change in the environmental conditions of tourist destinations. A change in climate causes a change in the natural or cultural attractions in a destination, which in turn leads to a change in the conditions for tourism.

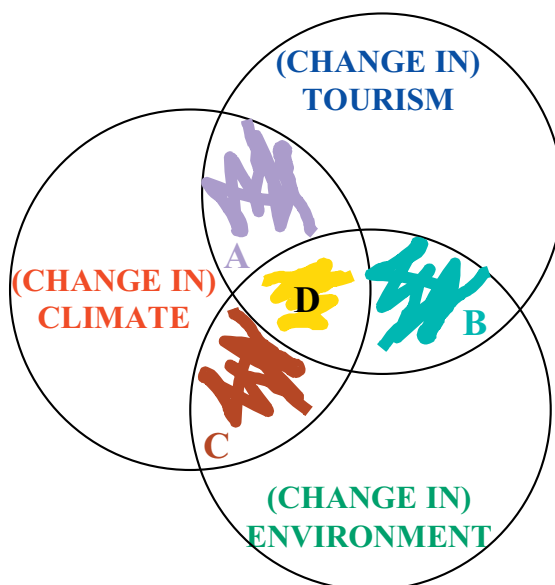


Figure 1: Climate, Tourism, Environment: areas of overlap

The areas B and C in Figure 1 represent fields that are relevant, though not crucial, to the workshop's topic. Area B denotes the broader field of knowledge about how environmental conditions (in the broad sense, including cultural, and natural conditions) and tourism are interrelated. Knowledge about how tourism interacts with attractions is valuable when researching how climate change may alter this interaction.

A similar line of reasoning holds for the adjacent field of the relation between climate and environmental conditions (Area C). Knowledge about how the natural and built environment responds to climate change can be valuable, even though the results are not directly applied to tourism.

Having introduced the partially overlapping research fields of tourism climate change and the environment, we will now focus on the overlaps: the interfaces between climate change and tourism. This interface can be either direct or indirect, through the environment or policies.

Making a generic framework to identify the main interfaces is difficult, because of the multitude of spatial and temporal levels involved. For example, from a global perspective, the contribution of tourism to climate change is very important, while from a local perspective this is not an important factor at all. Here, it is the impact of climate change and options for adaptation that count.

Interfaces: identifying the central elements

Just to make a start, here the individual tourist destination is taken as the level of analysis. To put the main issues and their relationships into perspective, we classify them in three categories of capital: natural capital, manmade capital and human capital. The domain of natural capital contains natural resources, such as landscape (including vegetation), water reserves, and climate. The domain of manmade capital covers structures that were built by people, such as monuments, tourist facilities, and infrastructure. The domain of 'human capital' contains elements that are linked to the physical, mental, social and cultural states of human beings. The entities that are described in the domains are connected through processes. For example, climate change can lead to changing vegetation patterns, and to changing water reserves.

Figure 2 is a very tentative overview of elements that are key to understanding the relationship between climate change, tourism, and the environment. This scheme can and should be extended during the workshop. It can also be further refined, but for this first draft we thought it would be best to focus on the main issues and leave the refining to a later stage.

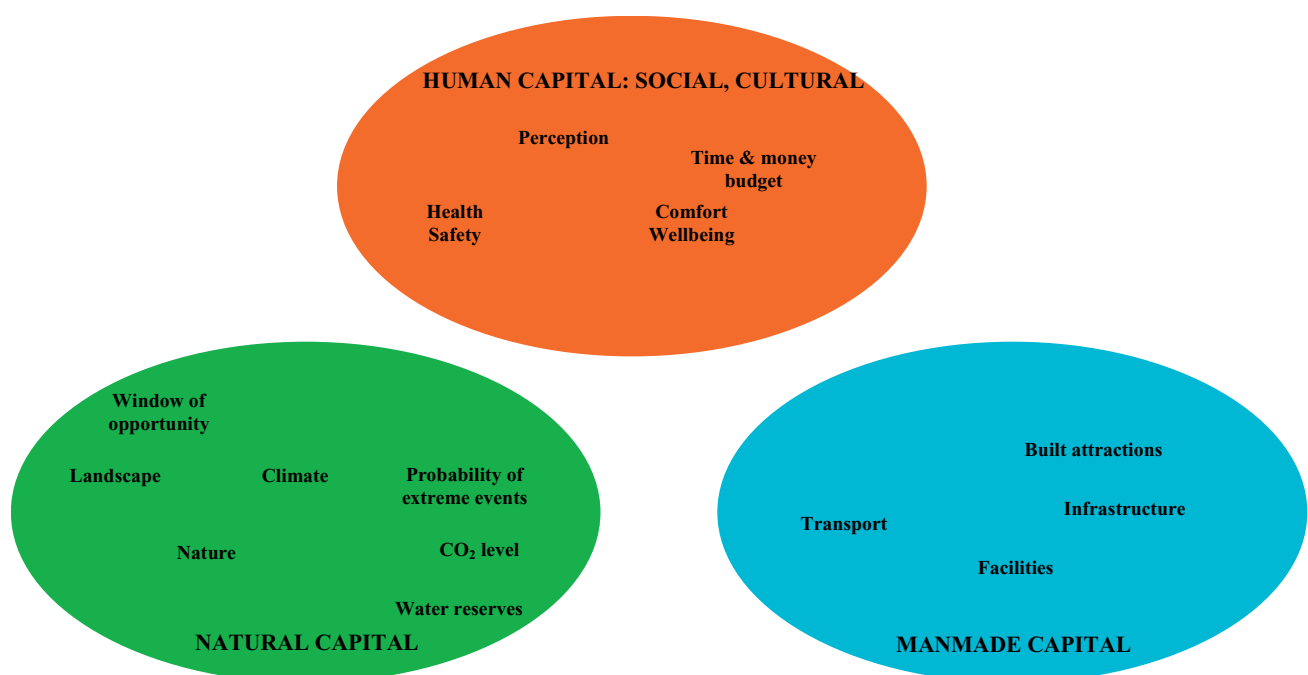


Figure 2: A systems approach to climate change and tourism

Natural capital

In the domain of natural capital, we identify the following key stocks:

- **CO₂ concentration:** this stock not only influences climate, it also plays an important role in processes such as corrosion of built structures; furthermore, there are feedbacks to this stock from tourist activities and tourist facilities
- **Climate:** this 'stock' determines the attractiveness of climate dependent tourist destinations. It is also connected to important elements such as landscape, probability of extreme weather events, health, comfort etc.
- **Probability of extreme events:** this stock is added to the scheme, because many authors point out that changes in climate variability (frequency of extreme events) may well be much more important for tourism than mean changes. Among others it is related to safety, and damage to facilities.
- **Landscape:** to a large extent, the landscape of a destination determines what activities can be performed there. Water is needed for water sports, a beach for beaching etc. Landscape is heavily influenced by mean climate and extreme events
- **Nature:** this stock represents the natural qualities in a destination that attracts tourists, apart from landscape. One example is the presence of species of birds and other animals, and plants. Climate change will shift ecological zones and thus affect the natural resources in a tourist destination.
- **Window of opportunity:** while landscape determines the set of possible activities, weather and climate determine the window of opportunity for these activities. Seasonality is one of the most important issues in tourism.
- **Water reserves:** water is very important for tourism, not only for direct consumption but also to support facilities such as golf courts. It is well known that tourists tend to use much more water (on average) than the local population. In areas that are hit by droughts, competition for water resources may well become a crucial issue for tourism.

Human Capital

In this position paper, the assumption is made that the elements in this domain that are key to understand the relation between climate change and tourism are related to the (potential) visitors of the destination, rather than to the local population. Of course, local cultures, and the wellbeing of locals are important for tourism, but the question is whether these elements are also important in the light of climate change. This should be discussed during the workshop.

In the domain of human capital, we identify the following key elements:

- **Health and safety:** these are key conditions that determine whether potential visitors are actually inclined to visit the destination. These issues are closely related to the climate, both directly (extreme events) and indirectly (changing landscape, e.g. new infectious diseases).
- **Comfort and well-being:** these are elements of the 'utility function' of tourists. They may be influenced by climate both directly (pleasant temperature) and indirectly (beautiful landscape, monuments).
- **Perception of climate (change):** perception of the impacts of climate change may very well differ from the actual impacts; tourist behaviour is usually shaped by perceptions rather than 'facts'.

- **Money and time budget:** tourist decisions are restricted by a number of conditions, important ones of which are the availability of purchasing power and time. Both can be affected by climate change. Purchasing power can be affected through climate policies by which the transport prices may be increased significantly. Because of this, visiting certain (long haul) destinations may become unaffordable for a certain share of tourists. Climate change may also affect temporal conditions, since it may alter the overlap between available holiday periods and the optimal season for visiting certain destination areas.

Manmade capital

In the domain of manmade capital, we identify the following key stocks:

- **Built attractions:** these are the material expressions of a culture. They are often exposed to climate and weather. Atmospheric changes may alter the rate at which these attractions deteriorate, e.g. by corrosion. Moreover, they may be threatened by extreme events (floods, gales). On the other hand, built attractions may also represent an option to decrease the vulnerability of a destination to climate change (e.g. indoor activities).
- **Tourist facilities:** the function of these stocks is to cater for the tourist. They include accommodation, restaurants etc. The distinction between facilities and attractions is sometimes unclear. Since facilities are often capital intensive, investments may be partly guided by expectations about climate change.
- **Infrastructure:** this stock relates to the accessibility of a tourist destination. Investments in infrastructure are characterised by high sunk costs, i.e. they are made for long-term benefits, and are usually retrieved only after an extensive period of time. These characteristics make infrastructure fairly rigid and vulnerable to changes in societal conditions. Climate change can affect infrastructure in at least two ways. First, it can physically damage the infrastructure. Second, it can change the usefulness and usage of infrastructure by changing demand patterns.
- **Transport:** this stock refers to the vehicles and other goods that are needed to use the infrastructure. Transport facilities are usually more footloose than infrastructure and thus less vulnerable to changes in conditions. Nevertheless, climate change can have an impact on transport facilities. First of all, climate change can directly alter the use that can be made of the infrastructure, for example because of more frequent snowstorms or gales. Secondly, climate change can alter the demand for transport to destinations due to the climatic conditions in these destination areas. Thirdly, the price effects of climate policies can have an effect on transport volumes and patterns. Apart from this, transport makes a significant contribution to the whole issue of climate change. Transport volumes are increasing and a large and growing share of transport movements is connected to leisure and tourism. Moreover, the modal split is shifting towards the use of airplanes, which have a relatively large impact on climate change due to emission volumes and the altitude at which emissions take place.

Climate and tourism: research of interfaces

The second step in building a conceptual framework for the research of the interfaces of climate change and tourism is the actual research of the interfaces. A few issues have to be resolved implicitly or explicitly when one of the interfaces between climate change and tourism is studied.

Climate driven versus actor driven

Much of the climate change and tourism research departs from climate change and tries to determine its impact on tourists, the tourist industry, and tourist destinations (see also Figure 3). While such an approach yields important information, it is vulnerable to the criticism that the causal chain between emissions of climate gases and impacts contains many uncertainties. "What about the reliability of your results?" Such criticism can partly be addressed by using scenario analysis, with which the consequences of a wide range of assumptions can be explored. Nevertheless, many actors may have the feeling that the results are so riddled with uncertainties as to make them meaningless.

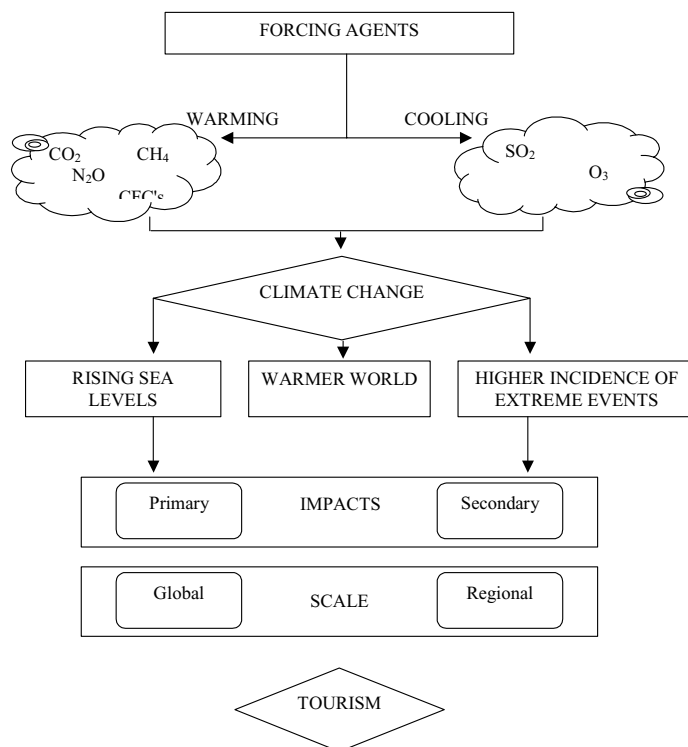


Figure 3: The relationship between climate and tourism in a globally warmed environment

Source: Giles and Perry (1998)

An alternative approach may be to start from the impact side, i.e. from the potential winners and losers. What kind of activities are they involved in? How sensitive to climate change are these activities? How wide are the margins within which climate change can be accommodated without significant structural changes?

Such an approach would be much more participatory than the natural science driven approach starting from climate change. Individuals and organisations involved in tourism could be urged to assess their own dependence on climate and vulnerability to climate change. The results from these assessments could then be compared to climate projections

to see who is most vulnerable and who is least. When combined, actor driven studies and climate driven studies can yield highly complementary results.

Static versus dynamic analysis

A common approach in science is to start from the simplifying assumption that everything remains equal except for the phenomenon under study. Several authors point out that this approach is less useful in the context of climate change and tourism. Climate change is a slow process in comparison to changes in society, such as technological developments, fashion, and fear of terrorist threats.

Abegg et al. (1998) identify four categories of research, defined by four combinations of assumptions about climate change and tourism: current climate, current tourism: focus on variability; current climate, future tourism: traditional explorations of the future of tourism; future climate, current tourism: traditional approach of climate impacts; and future climate, future tourism: integrated explorations of the future.

Amelung et al. (2003) sketch the implications of the SRES scenarios for tourism, taking into account not only climate change, but also the assumptions about societal change underlying the scenarios. In this kind of exercise, climate change can have an accelerating effect on other societal dynamics in one scenario, while it mitigates such dynamics in another.

Climate dependent versus weather sensitive tourism

Smith (1993) makes a distinction between climate dependent and weather sensitive tourism. For climate dependent tourism, climate acts as an attraction in itself (e.g. Spanish costas), while it does not in the case of weather sensitive tourism. In this latter case weather conditions do play a decisive role when activities are planned (Giles and Perry, 1998; Harrison *et al.*, 1999), e.g. visiting the English countryside, or a museum in London.

Climate change can be expected to have very different consequences for each of the kinds of tourism. Climate dependent destinations can experience a change of their whole competitive position, with potentially large changes in numbers of visitors, while weather sensitive destinations may experience changes in behavioural patterns, rather than changes in total numbers of visitors.

Tourism versus recreation

In the scientific literature on tourism, the (implicit) focus is often on international tourism. While international tourism may be relatively easy to register at the border, it is only a small proportion of total tourism. The World Tourism Organisation (WTO) estimates domestic tourism to be 10 times as large as international tourism. Recreation is an even broader issue. The distinctions between international tourism, domestic tourism, and recreation may be quite important in relation to climate change as well.

The distinction between tourism and recreation is not clear-cut. Organisations such as the World Tourism Organisation (WTO) use a list of requirements to decide whether somebody should be counted as a tourist or not (e.g. a tourist must be away from his/her usual environment for at least 24 hours). Not only are these requirements rather arbitrary, but they

also tend to be difficult to check in practice. In many cases the distinction between tourism and recreation does not matter much, as the associated activities are similar or identical (Wall, 1998). For example, both groups may suffer the consequences of beach erosion from sea level rise in similar ways.

In other cases, however, differences may be larger. Since tourism is associated with longer periods of time, being a tourist tends to involve more planning than being a recreationist (IISD, 1997). Therefore, recreational decisions tend to be influenced by the weather forecast, while tourist decision-making (selection of destination and period) benefits more from climate information. A Dutch study into the effects of climate change on tourism and recreation, based on expert opinion, suggests that in the Netherlands the impact on recreation may well be larger than the impact on tourism (Amelung *et al.*, 2003). Weather patterns are expected to change more rapidly than climate, and recreationists can respond much more quickly to changing weather conditions than domestic tourists, let alone international tourists.

Conclusions

Efforts to research the interfaces between climate change and tourism have so far been rather scattered. Structuring these efforts and linking them to each other could make our studies more effective and efficient. A logical way of structuring is a three-step approach consisting of identifying possible interfaces, researching them, and generalising the results into a theory.

In this position paper, the first step, of identifying the interfaces, has been addressed by partially exploring the overlapping research fields of 'climate change', 'the environment' and 'tourism' and consecutively by exploring the overlaps between these fields in more detail. This latter challenge was made more manageable by dividing the main constituting elements into three domains of capital: ecological capital - containing all natural resources and processes, social capital – containing all resources and processes around the human body and human activity, and manmade capital – containing all resources made by mankind.

The second step, of researching the interfaces, was addressed by identifying a number of key issues that researchers will come across. A potentially fruitful extension of this position paper would be to combine it with a review of the research that has already been performed, the data sets that are already available etc. This would allow for a more complete overview of the potentially interesting fields of research, the available results and resources and the most salient gaps in knowledge and resources.

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2.6 Position Paper 4

The interactions between climate change and tourism

**Ghislain Dubois,
Jean Paul Ceron**

introduction: The Interactions.

Regarding tourism, three different types of issues are raised by climatic change.

- The effect of climate change on the climatic and non climatic resources of tourism: changes in climatic conditions according to seasons and regions, effect of climatic change on “environmental resources” (water, landscape, snow for winter sports etc). After an evaluation of potential impacts, the question is “How will tourism adapt?”, according to the different scenarios built for climatic change.

- The contribution of tourism to climate change. Tourism is, though transportation mainly, a major contributor to greenhouse gas emissions, by emitting CO₂, and other gas (mainly CH₄, N₂O), and through specific phenomena (contribution to the formation of cirrus clouds by airplanes for example).

- The possible effects of greenhouse gas (GHG) mitigation policies on tourism. Given the overwhelming importance of the stakes linked to global warming and a contribution by tourism which is far from negligible, this activity is bound to be concerned by mitigation policies. This is a broad issue which is largely ignored but needs to be explored, probably under various and contrasted hypotheses.

I. The impact of climate change on tourism

I.1 A major constraint : the uncertainty on regional and local climate change

At present, research on tourism and climatic change is very dependent on the current state of climate research, since the possibility of tourism research depends on the reliability of climatic scenarios, especially at regional and local level. It is partly bound to remain so, but it should also gain increasing autonomy in formulating specific research questions.

Discussing the future potential impacts of climate change on tourism should be based on a state of the art of current scientific knowledge regarding this phenomenon. Current knowledge on climate change is built through a process gathering within the International Panel on Climatic Change (IPCC or GIEC in French) thousands of scientists worldwide, belonging to the different disciplines implied in studying climate and its effects (www.ipcc.ch). The knowledge produced is discussed by peers and presents the best scientific guarantees one can expect. The current state-of-the-art (IPCC 2001) highlights on a world scale the following points:

- a) The global mean temperature is increasing, at present there is no existing model concludes that the climate could remain stable or cool down;
- b) The current observed rise in global mean temperature is mainly attributable to increasing concentrations of greenhouse gases as a result of anthropogenic emissions;
- c) Globally, the rate of change is likely to be in the region of 1.5 to 5.8°C by the end of the 21st Century. There are, however, regional variations, with northern hemisphere land surface warming at the most rapid rate;
- d) The current rate of change and that predicted for the 21st century is likely to be more rapid

than at anytime previously in human history. We have, therefore, no historical analogues to attempt to understand the impacts of such a rapid climate change;

e) There are likely to be changes in the variability of the climate system. Large scale climate features such as ENSO which has a discernible influence on regions of the Southern hemisphere may change their intensity and frequency. Other climate parameters are changing and are likely to be attributable to anthropogenic warming. For example there has been observed changes in high temperatures and extreme precipitation events. Globally there will be an increase in precipitation, however there will be marked differences on how this manifest itself in different regions and different seasons.

One of the main limitations in determining the impacts of climate change on tourism, is the uncertainty surrounding the magnitude of change spatial patterns of regional temperatures and subsequent local impacts. Given that tourism is very dependent on local features, the lack of consistency of climate change scenarios at the local scale results could produce a high uncertainty in determining the local impacts on tourism.

1.2 Contrasted scenarios rather than forecasting

It is, however, important and there is a pressing need to evaluate the potential impacts of climate change on tourism, since the time of response of the tourism industry to environmental and climate changes is directly related to the life time cycle of the tourism product: that is 20-30 years. As regards to this situation, the recommended approach should be to elaborate contrasted scenarios of local climate change, and to evaluate contrasted impacts. Research should avoid terms like “forecast” and present results as an assessment of the “potential for change regarding tourism”, so that tourism stakeholders can benchmark their activity. A few more questions remain on the validity of this research:

a) Will the range between extreme scenarios remain narrow enough to produce useful results? To the uncertainty on climate evolution, one should add uncertainties on effective impacts, reflected by statements such as “a decrease of 10% of snow cover could lead to a decrease from 10 to 30% of mountain tourism winter frequentation”. The risk could be to produce results like “your climatic future is between 20% more snow and 30% less, and your tourism future is between 40% more tourists and 50% less”, which would actually be of no use for tourism stakeholders;

b) Therefore, prior to any applied research on impacts for a destination or a specific activity, a research program should include a collective expertise of the validity of climate change hypothesis and their implications on the variability of results, for the expected case studies.

1.3 Evaluating the impacts: various approaches

Once this major constraint is known and assumed, it is possible to imagine various perspectives:

A) A global perspective.

The tourism market is more and more global, even if it is somehow regrettable (since tourism destinations should develop relying on their more specific resources, such as cultural diversity, local ecosystems); destinations with the same climatic resources (tropical weather and warm bathing water, warm winters) compete worldwide. The initial task is to attempt to identify to what extent climate change could redistribute climatic assets among macro-regions. Agnew and Viner (2001) and Viner and Agnew (2000) made initial attempts to address how climate change would impact upon a range of tourism destinations and regions and possible impacts upon flows of tourists. A global approach based upon climate change scenarios using large regional grids (e.g., 0.5° longitude and latitude), Hulme *et al.*, (1999) could be sufficient to estimate for instance whether the

Caribbean would be reinforced or weakened, compared to Polynesia or Indian Ocean. Moreover, these global scenarios would provide baseline information for the development of more local scenarios : before envisaging the future of Costa del Sol, it seems useful to know whether tourists are more likely to concentrate in the Mediterranean as a whole, or to fly away to colder regions.

Such an approach should involve a large network of researchers, with a process of scientific validation similar to IPCC. The main factor influencing the repartition of these competitive advantages is the climatic motivations of the tourism demand, which is quite well known, (Besancenot 1989), (Burnet 1970) but should be confronted to the perspective of different climate situations.

B) Regional and local perspectives.

More regional and local surveys, most of them quite exploratory, than global ones have been developed in recent years (Elsasser and Burki 2002), (Department of the environment 1996), (Ceron, 2000), (Ceron and Dubois 2002), (Giles and Perry 1998), (Harrison, Winterbottom and Sheppard 1999), (König and Abegg 1997), (Scott 2003), (Wall 1998). These approaches can be based on a national scale (e.g., France, Great Britain), a geographical perspective (mountain, coastal areas) or an ecosystem approach (wetlands, deserts). The added value and the contribution of a research program could be :

- Comparative research : which are the more endangered ecosystems as regards to tourism, why are some tourism destinations more sensitive to climate change than others (diversity of the tourism supply, presence of man made and cultural attractions), what are the different methodologies employed?
- To gather research which adopted different perspectives so as to produce more thorough evaluation of specific cases. For example, to evaluate the future of tourism in French “Camargue”, a research project could gather specialists of wetlands, of French tourism, of Mediterranean tourism, of coastal resort.

C) Activity-oriented research.

Tourism destinations are a mix of various tourism products, which can drive it difficult to evaluate the effects of climate change on specific activities. Some research concentrated on the impacts on such activities, be it skiing, canoeing and other river sports, bathing activities (Holmes, Palmquist and Steiger 2000), (Mc Boyle and Wall 1987). Most of these research concentrate on “non climatic resources” of tourism : water availability in rivers, landscape evolution, snow for winter sports.

1.4 Adaptation strategies for tourism stakeholders

Once the potential impacts of climate change on the tourism activity are better known, it is possible to concentrate on adaptation strategies for the tourism sector.

The first research question concerns political science, about the governance of the tourism sector in the context of climate change. Owing that climate change is a long term phenomenon, the effects of which cannot yet be predicted in detail, how is it possible to involve stakeholders in adaptation strategies ? Long term precautionary measures are generally out of concern for private operators. So, should only governments endorse adaptation strategies, given the general weakness of tourism policies ? What kind of public-private partnerships can be imagined ?

Indeed, climate change will call, tomorrow or the day after, for policy response from private operators as well as from public stakeholders. The wide range of responses has to be evaluated,

with criteria such as technical feasibility (Scott, Mc Boyle and Mills 2003), profitability, capacity to cope with uncertainty, impacts on the environment. Three main attitudes can be explored as regards to climate change (Ceron and Dubois, 2003).

- To wait until the level of knowledge increase, considering that short term responses will be more efficient than long term precautionary measures, and that responses will be more accurate once the concrete implications of climate change are known.

- To trust the ability of technology to face environmental change. Since the beginning of the 80's, for instance, French ski resorts are engaged in a strong investment of artificial snow cover (more than 160 resorts equipped), aiming to reach a "snow insurance", considered as a strong marketing argument. *Center Parcs* is about to build a third resort (the 15th in Europe), which a "tropical paradise" warranty: i.e. a 28°C bathing water all year long. Natural beaches can be replaced by artificial ones. Some questions surge from this approach: to what extent could tourism operators endorse this additional investment to cope with climate change? Would the profitability of the sector be maintained? Would customers favour these man made environments?

- To adopt a precautionary attitude, which would encourage a flexibility of the tourism sector and improve its ability in responding to environmental changes. The two major factors influencing the adaptability of the tourism sector are the reversibility of planning and the diversity of the tourism supply. The *Erika* oil spill, for instance, clearly showed that destinations with more diversified assets, customers, accommodations and equipments better resisted than destinations only oriented towards camp sites accommodations and bathing activities. Developing off-ski activities (hiking trails, pathways, cultural events) in ski resorts could be more sensible and constitute a better insurance for the future than investing in artificial snow cover. In that perspective, climate change responses can be integrated into a broader risk management policy of the tourism sector (diversification is a way of limiting tourism sensitivity to economic crisis as well).

Evaluating the relevance of these strategies, globally, locally or for specific tourism activities is a new field of research which is seldom explored.

2. The impact of tourism on climate change

Evaluating the impact of tourism on climate change is the second facet of our "interactions". Although transport research is addressing the issue of transports impacts on climate change, tourism research only started recently (Ceron and Dubois 2002), (Hoyer 2000, 2001), (Peeters 2003). Besides, the first evaluation of the case of tourism were produced by public institutions of the Environment, like the French Institute of the Environment (Ifen 2000), the Environment Protection Agency of the US (EPA 2000), or the Environment Directorate of OECD (OECD 2001), rather than by academics.

In spite of a considerable amount of research devoted to the environmental impacts of day-to-day household travel, until recently only little work specifically focused on the environmental impacts of household tourism travel. According to OECD, One source of tourism-related environmental impacts – travel - remains consistently and conspicuously absent from the general discourse on sustainable tourism. (OECD, 2001).

However, these first evaluations underlines the importance of these issues for monitoring the impacts of human activities on climate change. For example, we calculated for Ifen, that the overall French tourism emissions, including accommodation and equipments, represent from 9 to 10% of French Global Warming Potential. Tourism transportation represents about 80% of the total.

These results for tourism are not surprising, since the overall transport sector has a growing responsibility in greenhouse effect : the contribution of transport in French CO₂ emissions climbed from 8% to 39% between 1960 and 1990 (Fontelle, Chang, Allemand 1999). The modal choices (and consequently the infrastructure development policies) have a strong impact on this contribution. In that perspective, studying the dependence of tourism on transports, which is growing in EU countries (more passenger.km travelled for the same amount of overnight stays) seems central, for ecological reason as well as for economic reasons.

2.1 Methodological orientations

- Concentrating on transports. With regards to climate change, the evaluation of transportation impacts should be considered as a priority: the Environment Protection Agency (EPA, 2000), estimated that for the United States 76,5% of CO₂ of the tourism and recreation sector are caused by transportation (against 15% for lodging, 2,7% for restaurants, 1% for retail, and 4,8% which are activity-specific). This share should be even higher if one includes non gaseous sources of radiative forcing from airplanes. On-site travels usually have a lower impact than the travels from home to destination. In Calvia (Balearic Islands) on-site tourist movements represented 73 000 tons of CO₂ in 1995, whereas air transport to the destination contributed eight times more to greenhouse gas emissions (534 000 tonnes) (Ajuntamento de Calvia, no date).

- Linking tourism and leisure mobility. What is the impact of leisure, be it with or without overnight stays ? Even if tourism is defined by WTO as including at least one overnight stay outside permanent residence, with regards to climate change, this definition of the field of research appears too narrow. Actually, the border between leisure and tourism is more and more blurred and porous (Viard, 2002a, 2002b). Moreover, some clear substitutions effects exist between tourism and leisure, which can strongly impact on greenhouse gas emissions : the intensity of the tourism demand depends on the quality of life in the place of residence, and on the possibility of leisure near the home (Ceron and Dubois, 2003, to be published). The initial point should be "how do leisure impact on the atmosphere, what are the respective shares of tourism and leisure near the home, and how do they interrelate?"

- Why should tourism research pay attention to transport research ? One could argue that since transport research is already addressing the issue of climate change, tourism research would be redundant in that field. However, the purpose is here to evaluate the *share* of tourism / leisure in transport impacts, so that to distinguish, for instance between freight transport and passenger transport, and within passenger transport between different motivations (work, shopping, leisure, tourism). The objective is to link data on tourism demand and flows with emissions of GHG, so that transport policies and mitigation policies can distinguish between the different responsibilities in climate change, and undertake differentiated initiatives. Indeed, tourism and leisure relate to issues such as quality of life or freedom to travel, and tourist can surely not be treated like freight. The objective is to go one step beyond macro-sector evaluations, and to insist on the impacts of production and consumption patterns on emissions profiles.

- Road transport in the short term, air transport in the long term : at present, almost 80% of the French travel by car for their holidays. Road transport is responsible of more than 60% of French tourism transport GHG emissions (from France and to France : Ifen 2000). Air transport is not yet part of the Kyoto protocol, although it should be more concerned by mitigation policies in a nearby future (White paper on transports in the EU, 2001). According to Schaefer and Victor (1997) and OECD, there would be, worldwide, five times more passenger.km travelled in 2050 than in 1990. The air transport share should be more or less the same than the road transport

share and, given higher emissions factors, its contribution to climate change should exceed road transport emissions around 2030. The future of tourism by road transport appears clearer (staggering of domestic tourism departures, technological improvements of cars, perspective of European norms for cars emissions...), compared to air transport, which is more uncertain (slow technological improvement, economic health of airlines, sensitivity to crisis, reluctance to environmental regulation and taxation).

- An urgent need for common methodologies. GHG mitigation policies rely on inventory emissions harmonised on common basis, in order to set policy targets. Each round of negotiation of the Kyoto protocol reveals strong debates about what should be evaluated and how. As a major economic sector, tourism should not stay apart from these debates. Methodological collective works, in order to reach experts consensus on evaluating the impacts of tourism on climate change, would be very useful.

2.2 Monitoring the impacts : a priority to national sector-oriented evaluations

Although a few evaluations have been developed for destinations (Ajuntament de Calvia, no date), private operators or individual travellers, (Garrod, Wilson and Bruce, 2002), the priority should be given to sector-based national evaluation.

A) National evaluations.

Methods

Inventories of GHG are national based, since IPCC negotiations are national based. The national scale is a priority so as to allow tourism to be included on broader discussions on climate change. This raises several questions, and calls for different kinds of assessments.

- Who is responsible for the impact of international tourism on the atmosphere ?

Emitting countries, in a consumption approach, receiving countries, in a production approach (since they benefit from tourism), airlines companies, whose nationality is harder and harder to determine? Air transport, like maritime freight transport, poses difficult methodological and ethical problems to the evaluation of GHG emissions. Future research could discuss these questions and introduce ground rooted ethics into the debate (for instance: are remote destinations more legitimate to use air transport because they do not have any possibilities of substitution? should the priority be given to developing countries ? are there differentiated and asymmetric responsibilities among countries?).

- How to improve methods for estimating the impacts ?

Rough evaluations only based upon a number of passengers-km travelled, multiplied by modal average emissions factors, do not seem sufficient to have a clear perception of the impacts. Indeed, real emissions depend on factors such as the load factor of vehicles, age, motorisation, air conditioning of cars, types of travel (speed, altitude, charter or regular flights for air transport), technologies (does the propulsion of trains rely on renewable or non renewable energies ?). The objective is to reach more rigorous and less questionable evaluations (for instance through taking into account the impact of ongoing research on the environmental impacts of air transport (IPCC, 1999)), and to identify and rank the factors of improvement (is the solution to reduce speed on highways, to improve load factors of aircrafts, to tax kerosene). Ifen's experience (Ifen 2000) showed that within the EU data often exists, but that using them requires a important effort of collection and processing.

Possible works

- Country profiles would enable comparative research on production and consumption patterns of tourism/ leisure mobility. What are the factors explaining high-impact situations? The distance from tourism destinations (Australia), infrastructure choices (what is the impact of high speed trains on overall emissions ?), driving forces of the tourism demand (schedule of school vacations along the year), consumers tastes and behaviour (propensity to travel abroad of Germans, reluctance of Spanish, development of short stays)? Elaborating countries profiles on a common basis requires an important work on tourism and transport databases.

- More specific and localised research is required, based upon, for example: comparison on modes of transports (Hoyer 2000, 2001, Ifen 2000), of tourism products (Garrod, Wilson and Bruce 2002), of destinations policies, of tour-operators.

B) Sector-oriented evaluations

The impacts of tourism on the environment can be parted between on-site impacts (including on-site transports) and transportation (to the destination) impacts. Even if the priority should be given to transports to the destination, each step of this consumption pattern contribute to global warming and, legitimately, should be evaluated, though it is not the case yet. Attempts were made as regard to energy consumption (Becken and Simmons 2002) or CO₂ emissions (EPA, 2000). It is all the more important as the different sub sectors (accommodation, transports, equipments, travel agencies) do not always consider themselves as part of the tourism sector (i.e part of the problem and potential contributors to its solution) : the activity is split up in various activities which do not often interrelate. However, "Tourism" seems a relevant category to discuss impacts of economic activities on climate change, and at least as relevant as "services", "hospitality and catering", "transports". In a sustainable development perspective, if one concentrates of the "needs" and their satisfaction, the need of leisure implies transport, accommodation, equipment, which should be evaluated as a whole.

Calculating the total contribution of the overall tourism sector, be it at international, national or local level, remains uncertain because of the lack of required data. The methodology for accommodation and equipment would require a knowledge of the number of overnight stays/ visitors for each type of accommodation/ equipment, allowing to multiply by ratios, such as the average use of energy per overnight stay/visitor. The breaking down between the different energy sources used

(electricity, fuel, gas, etc.) should be known to calculate greenhouse gas emissions.

- For accommodation, these ratios depend on the standard of comfort, the age of accommodation, the climate of the location (implying air conditioning, heaters, etc.). This is why data based on local surveys are not very helpful. Only a few surveys provide such ratios for hotels, camp sites, secondary homes on a national basis. Current research on eco-labelling and its forthcoming monitoring will provide more ratios in a nearby future;

- there is also a great lack of data concerning equipment: very few data are available for theme parks, water parks. EPA research clearly showed this lack of emissions factors, though many sorts of high-impacting equipments develop very quickly (snow cover, boating, theme parks, etc.).

Further, when lodging, catering and equipment are included in an overall evaluation, it seems necessary to consider *total* impacts versus *net* impacts on climate change (one does not consume energy at home while in vacations). It would not be fair to the tourism sector to just consider the *total* estimate. One should rather focus on the incremental emissions caused by tourism, and on the way of reducing them.

2.3 Defining the features of a low-impact tourism

Future research on the evolution of tourism/ leisure mobility demand and its impacts on climate change would be complementary to the evaluation of current impacts. It is then necessary to have a look on the sociology of leisure, tourism and travel. Indeed, the question on behaviours towards travel (propensity to travel, articulation between tourism and leisure times) seems central. This could involve :

- Research on the history of tourism. Past mobility patterns, attitudes to transport (the need for speed). Modal splits evolved quickly. For instance, in Greece, in 1954, 31% of international tourist arrivals used the plane, 30% the train, 31% the boat, and 8% the car. In 1999, this repartition turned to 76% for the plane, 0,2% for the train, 11,8% for the boat, and 12% for the road. These “lessons learned” could help benchmarking the potential of change for tourism in coming decades. Elaborating mobility patterns prospects and calculating their impacts on climate change. Mobility patterns will be more and more individualised in the future, as regards to changes in the organisation of times (diminution of working time), demography (retired people without time constraints). This could lead to contrasted patterns.
- Elaborating scenarios of overall tourism/ leisure mobility demand, and analysing their compliance with sustainability scenarios. In that perspective, even extreme or quite unrealistic utopia should be tested: what would happen if every inhabitants of the earth had mobility patterns of Americans and Australians ? What if each inhabitant did only one cruise trip around the world in his life ?

3. Effects of GHG mitigations policies on tourism

Tourism contributes significantly to the greenhouse effect, and relies more and more on transport: these two statements show the sensitivity of tourism to future transport policies in the context of a reduction of greenhouse gas emissions under the Kyoto protocol, and furthermore in the context of more restrictive transport policies which might emerge in the future.

In that perspective, tourism is not only questioned with regards to its own priorities (how to cope with an increasing mobility demand), but also with regards to its ability to comply with global environmental constraints.

3.1 Possible responses of the tourism sector

Scenarios would provide good opportunities to test possible responses of the tourism sector to the issue of climate change :

A) Technical responses

What are the prospects of technology changes in the transport sector ? Are they sufficient to cope with the impacts, or is the improvement of emissions factors offset by the development of tourism flows ?

B) Socio-Economic and planning responses

What would be the impact of a long term investment in High speed trains within the EU ? Of incentives for longer stays, etc. Is environmental management of tourism operator a practical tool to face climate change ?

C) Cultural change.

Can a low impact tourism utopia be imagined ? Preference given to “slow” tourism (boat transport), to soft mobility (biking, walking), enhancement of leisure and quality of life policies

within the cities. Is the propensity to travel likely to change, and under which conditions ?

3.2 Impacts of Sustainable Development scenarios for the tourism sector

From maximalist perspectives (in which the right to emit greenhouse gas should be equally shared between all inhabitants of the planet), to more pragmatic ones (complying with the Kyoto protocol), tourism will be in the future embedded in a policy context that might impact on its developments.

Here again, scenarios could contribute to assess the implications of various hypothesis.

3.3 Analysing the awareness level of tourism stakeholders

In recent years, the awareness of tourism stakeholders on the impact of tourism on climate change, was upgraded by NGO campaigns (International Friends of Nature “Red card for air transport” campaign, “Carbon neutral initiative”), conferences (WTO Djerba conference). The nature of the response of the tourism sector and its capacity to adapt partly relies on this awareness.

Specific sociology and political science research could insist on the evolution of this issues in stakeholders discourses and representations, for instance by analysing the content and evolution of the environmental reporting of airlines companies and tour operators, opinions and preferences of business leaders.

3.4 Impacts of greenhouse gas mitigation policies

- Air transport : impacts of a kerosene tax on the tourism market. What is at stake ? Competitive advantage and comparative costs between destination, impacts on the tourism demand.

- European infrastructure choices and tourism. High speed train line to Istanbul versus spreading east of the highway networks. Norms of energy consumption and CO₂ emissions for the tourism sector.

- Tradeable permits, possibility of tradeoffs within the tourism market, between tourism and other forms of mobilities, between transports and other activities

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2.7 Post Workshop Plans

The production of a well structured Science Plan to take forward the research on the study of the interaction between, Tourism, climate change and the environment is a major achievement of this workshop and reflects the strong sense of community that existed. In order to exploit the Science Plan the delegates provisionally agreed to establish a virtual network that will address Climate change And Tourism (eCLAT). A Memorandum of Understanding (MoU) has been produced and will be distributed to the workshop delegates (see below).

The eCLAT network will provide a framework to allow researchers and stakeholders to draw upon a wider international community that can provide supporting materials. Such materials include: a scientific reference database; information regarding access to data required for tourism and climate change research; database of researchers undertaking relevant research; information about calls for research funding; meeting announcements; and general background information. Through a collaborative process funding will be sought to enhance eCLAT. eCLAT is not a closed network it will actively encourage participation from other institutes, stakeholders and researchers.

The four Position Papers originally submitted have been strengthened by incorporation of the Building Blocks provided by the Commentaries (and additional informal input). The Position Papers will be submitted *en masse* to a reputable scientific journal for publication in the peer-review literature.

Climate Change and Tourism Network eCLAT

Memorandum of Understanding

Tourism is one of the EU's most important and fastest growing industries. Climate change will impact upon tourism, which in turn impacts (through growing GHG emissions and associated environmental changes) on the climate. The effects and impacts of these complex interactions has to date not attracted either research effort nor gained the attention of stakeholders and policy makers. There is, however, an emerging research community who are initiating the study of climate change, environment and tourism interactions. The study of the interactions of climate change, environment and tourism provides a unique catalyst to bring together scientists from a wide range of scientific disciplines, so as to support governmental, institutional and stakeholder policies.

Accurate and consistent scientific information is required by government and stakeholders to make informed decisions regarding climate change, that will in turn will deliver direct consequences on the environment and tourism industry. The scientific community has a responsibility to put in place appropriate research so that progress towards a better understanding of the interactions between climate change, tourism and the environment can be understood.

The undersigned institutions agree to establish a virtual centre, initially named, The Climate Change and Tourism Network (eCLAT) with the purpose of working together and cooperating towards the development of a European network to enhance our understanding of the interactions and complexities that exist between the climate system, tourism and the environment. These institutions include university departments, research centres, intergovernmental organisations and stakeholder partners.

eCLAT is intended to:

- a) Develop a network of scientists and stakeholders within the international community that draws upon expertise from the wider international community;
- b) Enhance our understanding of systems that impact upon climate change, tourism and the environment;
- c) Encourage exchanges of research ideas, results and collaboration in research proposals;
- d) Construct a gateway through which researchers and stakeholders can access metadata and information concerning research and results that has been undertaken and is in progress.
- e) provide constructive advice to governments and stakeholders to aid them in their decision making process.

The present Memorandum of Understanding will take effect after being signed by at least five partners. Thereafter, eCLAT will be open to additional partners from the international community at a two-third majority of the participating members. The Memorandum of Understanding will remain in force for a period of three years, unless the duration is modified with approval of the eCLAT MOU members at a two-third majority.

June 2003

Signature -

Name -

July 2003

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3. Workshop Agenda

Wednesday 4th June pm

1:30pm

Introduction: David Viner

1:40pm

The role and aims of the ESF. Prof. Gabor Vida

1:50pm

Network building: who we are; what we do; and what we can contribute.

“30 second” introductions about ourselves

2:00 pm

Identification of current research activities:

Position Paper 1: Review of current activities, open discussion to identify wider areas and gaps in research. Allen Perry

Commentaries:

Commentary 1a

Commentary 1b

Commentary 1c

Commentary 1d

Commentary 1e

2:45pm

3:00pm

3:15pm

3:30pm

3:45

Rolf Buerki

Elsa Casmiro

Murray Simpson

Richard Tol

Pedro Iglesias

Sari Kovats

Coffee 4:00pm

4:30pm

Discussion

4:15pm

Position Paper 2: Identification of data sources - building metadatabase - identification of gaps.

Andreas Matzarakis

Commentary 2a

Commentary 2b

5:15pm

5:30pm

Susanne Becken

Sue Mather

Discussion

5:45pm

Thursday 5th June am

9:00am

Commentary 2c

Pedro Iglesias

9:15am

Future Research and Framework Development

Position Paper 3: Research developments and interactions. Bas Amelung

Commentaries:

Commentary 3a

10:00am

Murray Simpson

11:00am

Commentary 3b

10:15am

Martin Lohman

Coffee Break

Commentary 3c

10:30am

Johanna Danielson

Commentary 3d

10:45am

Anna Iglesias

11:30pm Overview Commentary 4: Ghislain Dubois

Questions and Discussion

12:30pm

Lunch

Thursday 5th June pm

2:00pm

Position Paper 4: The development of a strategy to develop a research framework, the building of a research network and identification of a future research pathway. David Viner

Forum Discussion

3:30pm

Coffee

4:00 - 6:00pm

Production of Strategy Paper (Draft Science Plan)

Friday 6th June am

9:00am

Presentation on the Strategy Paper

Murray Simpson and Daniel Scott

9:30am

Discussion

10:00am

Identification of wider community (researchers and stakeholders).

11:00am

Coffee

11:30am

Workshop Recommendations, Conclusion and the Way Forward

4. List of Participants

The delegates invited reflect the diverse nature of the research community distributed across Europe who are interested in the study of the interactions between climate, the environment and tourism and a number of relevant stakeholder organisations. A limited number of other delegates are welcome, however resources for their involvement may be limited.

F=Female, M=Male

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