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### Climate Change & Tourism Literature Review

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Climate  
Change &  
Tourism  
Literature  
Review

2011

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Norma Polovitz Nickerson

Laura Becerra & Phil Zumstein

Research Report 2011-1

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## Contents

Introduction .....	3
Methods.....	3
Findings .....	3
Transportation .....	5
Social Concerns/Initiatives. ....	5
Effects of Climate Change on Tourism. ....	5
Policy.....	6
Books/Proceedings. ....	6
Measurement and Modeling. ....	6
Winter Activities.....	6
Destination Preference and Choice. ....	6
Oceans.....	6
Mountains. ....	6
Weather Change and its' Effect. ....	7
Attitudes.. ....	7
Season Changes/Seasonality.....	7
Miscellaneous.. ....	7
Conclusions and Applications .....	7
Annotated Bibliography – Selected Literature Review on the effects of Climate Change on Tourism ....	8
Climate Change and Tourism: Literature Review References.....	34

## ***Introduction***

Climate change and global warming have become ‘hot’ topics of research over the past decade. Multitudes of research articles have been published documenting the trends and still, there are skeptics. Forty-nine percent of Americans believe that humans are causing climate change, well below the worldwide average of 70-80 percent (Pew Research 2009). Yet, according to the Intergovernmental Panel on Climate Change (IPCC, 2007), “Warming of the climate system is unequivocal as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice...Most of the observed increase in global average temperatures since the mid-20<sup>th</sup> century is very likely [>90% chance] due to the observed increase in anthropogenic greenhouse gas concentrations.” Tourism is intimately a part of the climate change issue. If tourism were a country, it would be in 5<sup>th</sup> place after the USA, China, Russia, and India as a major polluter. Within the tourism industry, aviation accounts for 40 percent, automobiles 32 percent and accommodations 21 percent of tourism related CO<sub>2</sub> emissions (Strasdas, 2010). The purpose of this report was to identify and understand where, how much, and what type of topics related to climate change and tourism currently exists in the literature.

## ***Methods***

Two methods for collecting data were used. First, a literature search was conducted on Google, Google Scholar, and Google Scholar Advanced to determine the extent to which tourism was discussed in the context of climate change. Key words and phrases used were: climate change effects and tourism; climate change effects and travel; climate change and tourism; global warming and travel; global climate change tourism; climate change tourism North America; climate change and outdoor recreation; climate change, nature, travel; climate change, ecology, tourism, economic; climate change, economy, tourism; climate change, winter tourism; climate change tourism oceans; climate change tourism mountains; climate change tourism skiing. Second, climate change publication references were provided by academic researchers around the world.

The literature review was conducted in the fall of 2010 and spring of 2011. Articles written on the topic are not static; therefore this paper represents a snapshot in time on tourism and climate change. Additionally, it is likely that more articles and reports exist on the topic but somehow the key words chosen did not bring them to the forefront. Essentially, this literature review provides the trends in tourism and climate change research but is not an exhaustive review.

## ***Findings***

Two hundred and twenty-one publications were found and are provided in the reference list at the end of this paper. These publications represent 49 different journals, 31 research reports, 26 conference proceedings, 24 edited books, 10 books, and 9 workshops around the world (Table 1).

Forty-five percent of the journal articles were articles specifically published in tourism/recreation journals with 55 percent written in science journals, journals not specifically related to tourism and recreation. In the science journals, *Climate Change* had the most articles (8), followed by seven articles in *Journal of Transport Geography* and six in *Global Environmental Change* (Table 2).

In the tourism and recreation journals, the *Journal of Sustainable Tourism* had the most articles (24), followed by seven in *Tourism Management*, five in *Tourism and Hospitality Planning & development*, three in *Current Issues in Tourism*, and two or one in eleven additional tourism/leisure journals (Table 2).

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**Table 1: Printed Literature on Climate Change and Tourism**

	<u>N</u>	<u>%</u>
Journals	120	55%
Research Reports	31	14%
Conferences	26	12%
Edited books	24	11%
books	10	5%
workshops	<u>9</u>	<u>4%</u>
Total	220	100%

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**Table 2: Number of Articles per Journal**

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<u>Journal</u>	<u>N</u>		<u>N</u>
Journal of Sustainable Tourism	24	Journal of Great Lakes Research	1
Climatic Change	8	Environmental Conservations	1
Journal of Transport Geography	7	The Geographical Journal	1
Tourism Management	7	The Science of the Total Environment	1
Global Environmental Change	6	Journal of Leisure Research	1
Tourism and Hospitality Planning & Development	5	Tourism International	1
Climate Research	4	Economic Geography	1
Transportation Research	4	Tourism Analysis	1
Ecological Economics	4	International Journal Tourism Policy	1
Current Issues in Tourism	3	Energy Policy	1
Applied Geography	2	Third World Quarterly	1
Journal of Travel Research	2	Journal of Transport Management	1
Geographical Research	2	Leisure	1
International Journal of Climatology	2	Arctic	1
Managing Leisure	2	A Journal of the Human Environment	1
International Journal of Biometeorology	2	Natural Hazards	1
Annals of Tourism Research	2	Transport Policy	1
Scandinavian Journal of Hospitality and Tourism	2	Journal of Air Transport Management	1
Tourism Recreation Research	2	Nature	1
Risk Analysis	1	Tourism Review International	1
Regional Environmental Change	1	Journal of Innovation and Sustainable Development	1
Sustainable Development	1	Geophysical Research Letters	1
Mitigation Adaptation Strategies for Global Change	1	British Journal of Sociology	1
Energy Economics	1	Annals of Leisure Research	1
Coastal Management	1		

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Tourism and climate change article topics were categorized into 13 main areas of research and a miscellaneous category (Table 3). Descriptions of each category are provided below.

**Table 3: Publication Categories of Climate Change and Tourism**

	<u>% of total</u>
Transportation	21%
Social concerns/initiatives	11%
Effects of climate change on tourism	7%
Policy	7%
Books/proceedings	7%
Measurement and modeling	6%
winter activities	6%
Destination preference and choice	6%
Oceans & lakes	5%
Mountains	5%
Weather change and its' effects	5%
Attitudes	4%
Season changes/seasonality	2%
Miscellaneous	<u>8%</u>
Total	100%

**Transportation.** Most of the publications in this category related to airline emissions and the need to improve the technology related to air travel. Some articles discussed the idea that our society may need to re-think our mobility and desire to “travel for the sake of travel”. A number of articles highlighted how travelers could be more sustainable in their travels by using buses or trains or staying in one central area. Many of the articles provided a discussion related to how the transportation industry should be more sustainable including the need for technology and behavior change by travelers. Some ask whether transportation can be sustainable at all.

**Social Concerns/Initiatives.** This category represents responses to climate changes issues – either actual responses or the need to act toward positive change. Numerous articles focused on the need for society to work together towards sustainability, for individuals to act differently in their daily lives, and for governments to work on policy changes which may include subsidies to enable efficient private adaptations. Some articles highlighted hotels and what they have been doing to mitigate the climate change problem or how to make decisions for business planning. Adaptation and mitigation was the main theme that ran through this category.

**Effects of Climate Change on Tourism.** Throughout this category discussions of the impacts and consequences of climate change on tourism are provided. Articles presented in this category

ranged from discussions of the effects of a carbon tax on international tourism to the environmental consequences of what tourism does and will continue to do if not addressed.

**Policy.** Policy is discussed in two basic approaches: 1) How current climate change policies impact tourism, and; 2) Policies, programs, and actions related to climate impact and tourism. Many of the articles provide a discussion of how the tourism industry could or should assist in the policy dialog so when policies that may impact their business are being formulated, they will not be caught off guard.

**Books/Proceedings.** Most of the books highlighted here were written around the theme of climate change and tourism providing a variety of topics within the chapters from describing climate change issues, to what tourism could do about climate change. A few of the books use the theme of sustainability and concentrate some chapters on the issue of climate change. One book uses the sustainability concept to discuss slow tourism – tourism that encourages people to stay and play in one area rather than traveling to many different sites throughout a vacation.

**Measurement and Modeling.** Reducing the carbon footprint, offsetting emissions, and becoming carbon neutral are some of the concepts discussed in these publications. Measuring the impacts and then mitigating those impacts are presented in this category.

**Winter Activities.** Most of the winter activity articles identified skiing as the one area that will be or already is affected by climate change. Ski areas will have reduced snow and some seasons with no snow at all. Therefore skiing will not exist unless adaptation strategies are undertaken such as snow-making and moving ski areas to higher elevations. Mountain snowmobiling would also be affected but snow-making is not an option for snowmobiling. Winter seasons will likely vary greatly – some years the season will be longer and others much shorter. This will make business planning extremely difficult.

**Destination Preference and Choice.** In these articles, the concept behind destination choice and preference is analyzed with climate change as an intervening factor. Models showed there would be a shifting of tourists to other areas due to rain, temperatures, and snow. Beaches would erode and no longer be a destination; ski areas would not have snow and therefore fewer ski destinations would be available; wetlands would take over current dry lands and change the destination attributes. Travel behavior indicates that most destinations are chosen because of the type of climate (sun, warmth, snow, ecological diversity). When destinations change, so will the travelers' choice of destination according to these scenarios and models. These models and scenarios projected out to 2050, but some went as far as 2080 to determine change in travel destinations due to climate change.

**Oceans & Lakes.** Implications of climate change effects on oceans and lakes were the main topics within this category. With the onslaught of melting ice at the earth's poles, oceans will rise causing many Island beach resorts to be covered in water according to modeling scenarios. Island destinations will be the hardest hit since building inland may not be an option. Changes in weather patterns suggest more severe weather causing inland waterways to swell over their banks more frequently. This will negatively impact fisheries and wetland habitats and cause changes in recreation use on waterways.

**Mountains.** Many of the articles in this category discussed the ecological impact of climate change in mountains. Impacts discussed included flora and fauna migration, the increase in forest fires, a change

in snowpack, and changes in recreation or tourism opportunities in mountain areas. Positive impacts could be a longer summer season for recreation.

**Weather Change and Effect.** These articles were more destination specific and tended to use case studies to highlight how weather can change tourism in an area. France, Ontario's provincial parks, British tourism, and Bernese Oberland are some examples provided in this category.

**Attitudes.** The main ideas in this category included assessment of travelers' attitudes toward climate change, business owner attitudes, and willingness to address climate change. Travelers seem to be well aware of climate change issues but most are not willing to change their travel. Behavioral change by business owners tends to occur when it affects their bottom line – either through the demands of their clients or through savings in energy and other resources. In order to be effective, educational campaigns on climate change require different approaches for different people. Other studies showed that when the desired attributes of a destination changed, travelers would prefer to go elsewhere.

**Season Changes/Seasonality.** Articles about changes in season due to climate change refer to both the positive impacts, such as, a longer tourism season in Alaska and the negative changes, like longer and drier seasons in Tunisia. Climates have an impact on tourist demand which will affect destination choice and duration of travel.

**Miscellaneous.** Publications that fell into this category generally touched on many topics of climate change within the same article. A few articles called for more climate change and tourism research. One article discussed a historical review of climate change, and another gave examples of how climate is an economic engine.

## ***Conclusions and Applications***

Research and discussions about tourism and climate change began in earnest in the past decade. The literature review shows a dramatic increase in published articles about tourism and climate change after 2005. This demonstrates an awakening by tourism researchers to the phenomenon. Research also shows that certain areas will be affected more by climate change than other areas including mountains (lack of snow), islands and beaches (higher water levels and erosion), warm climates getting too hot, and cold climates warming up. This, in turn, changes the types of tourism such as snow skiing, beach recreation, and hiking, while possibly eliminating some recreation, such as snowmobiling.

The applications of the information gained from this study are numerous. First, visitor numbers will likely increase in the northern part of the northern hemisphere and the southern part of the southern hemisphere. Additionally, destination seasonality will affect length of visitation. Ski areas will shrink in their season, but mountain tourism in the fall and spring will lengthen. Land managers will need to address capacity issues on public lands due to extended seasonal use.

Second, ecological shifts caused by climate change can alter not only the type of recreation, but the subsequent impact visitors could have on the land. For example, fishing opportunities will decrease as rivers and lakes show reduced water levels (lack of snow melt). This, in turn, causes warmer waters which is deadly to many fish. As river and lake water levels fall, conflicts for water use will increase (recreation, irrigation, drinking water). Destinations dependent on water recreation will need to



diversify soon. Experts predict that droughts will happen more frequently with more severity. Designing alternative recreation opportunities now may keep some businesses open.

Third, people in the USA have misconstrued the message and convinced others that climate change does not exist (Anderegg, 2010). This lack of faith in the experts is a fundamental issue in this country. As stated in one article: If you are diagnosed with cancer you go to the experts (oncologists). You may get several opinions, but you still trust the experts since they are most qualified to identify and address the problem. In climate change there is a renewed need to trust the experts.

We would argue that climate change mitigation by the tourism industry should become part of a 'normal' conversation worldwide. Relying solely on business knowledge, economics, and some social sciences is inadequate in a universe where managers must proactively protect and contribute to the ecosystems their operations depend on (Farrell and Twining-Ward, 2004). In summary, an interdisciplinary research-oriented approach is needed to understand climate change and its effects on tourism and vice versa.

## ***Annotated Bibliography - Selected Literature Review on the effects of Climate Change on Tourism***

The following 68 abstracts are an example of some of the articles written about climate change. Following the annotated bibliography is a full listing of the articles discussed in this report.

- 1. Adger, N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography*, 79(4), 387-404.**

This article focuses on the necessary social adaptations in response to climate change. The author argues that a large part of the adaptation process is to act collectively. The author also emphasizes the importance of social capital as a crucial component of collective action. Social capital is important for both private and public adaptive changes including policies which would enable society as a whole to respond to climate change. Moreover, the emphasis on social capital as an integral component of collective action is due to the fact that social capital shapes the way other kinds of capital (natural) are perceived and utilized. The article highlights cases of collective action coping with climate change such as extreme weather in coastal areas in Southeast Asia and of community-based coastal management in the Caribbean. These cases demonstrate the importance of social capital framing both the public and private institutions of resource management that build resilience in the face of the risks of changes in climate. Thus, the cases demonstrate that social capital is an effective and sustainable response to climate change and the risks associated with it.

- 2. Agrawala, S. (Ed.). (2007). *Climate change in the European Alps: Adapting winter tourism and natural hazards management*. Paris, France: Organization for Economic Co-operation and Development.**

This report provides a review of assessments of impacts and adaptations to climate change in winter tourism areas. The Alps are particularly sensitive to climate change, shown by record high temperatures in recent years. Models have shown that this warming trend will continue which creates a critical need to identify and adapt to the impacts of climate change. These changes will have significant effects on the tourism industry within the Alps because of the type of recreation and activities tourists seek within

the area. Some areas are especially vulnerable to climate change effects such as Germany, which will experience a 60 percent decrease in snow reliable ski areas with only a one Celsius temperature increase. The implications of climate change on already existing natural hazards in the Alps is just an additional reason to implement effective management of the hazards. The winter tourism industry of the area is already using certain adaptation measures; however the costs and limitations must be assessed to identify their effectiveness. Adaptation strategy adoption will be an imperative factor for tourism areas to continue being destination areas for Europe.

**3. Amelung, B., Nicholls, S., & Viner, D. (2007). Implications of Global Climate Change for Tourism Flows and Seasonality. *Journal of Travel Research*, 45, 285-296.**

This article identifies the possible future implications of climate change for tourism on a global level with a seasonal emphasis. The study reveals that areas that retain conditions ideal for tourism will be shifting towards the poles due to the increased temperature and sultriness. Areas similar to the Mediterranean will experience a shift from summer being their primary tourism season to the shoulder seasons. Also areas that are higher in elevation will experience a longer summer and a shortening of the winter season. This will result in some places experiencing a decrease in tourism attractiveness while other areas will become substantially more attractive. Note that this article focused primarily on European countries and did not emphasize other popular tourism areas.

**4. Bark, R.H., Colby, B.G., & Dominguez, F. (2009). Snow days? Snowmaking adaptation and the future of low latitude, high elevation skiing in Arizona, USA. *Climatic Change*, Retrieved January 14, 2010 from: <http://www.springerlink.com/content/p25kx35t635871gv/fulltext.pdf>**

This article states that climate change models predict declining snowpack, shorter and more variable snow seasons, warmer winter temperatures with increased snowmelt, and increased snowmelt at higher elevations. These implications are significant for the ski industry since many ski resorts are located at relatively low elevations levels. Poor skiing conditions can deter potential new skiers, or beginner skiers who normally ski in lower elevation levels, thus potentially causing some ski areas to close due to lack of skiers. A possible solution (although short-term) is to make snow. Snowmaking is costly which might be reflected in increased lift ticket prices, also deterring skiers especially if better quality snow is available at higher elevations. In addition to the additional costs of snowmaking, availability might become an issue as well. The article focuses on two, low-latitude, high-elevation ski areas in Arizona (Snowbowl and Sunrise). Using information from USDA, NOAA and IPCC and other worldwide climate research organizations, future predictions of climate change effects were made. The article also emphasizes snow-making economics and capability for the sites and states that visitation will not necessarily increase with more snowmaking. However, the article points out that there are limited choices for the ski areas since the higher elevations areas are not available. Future ski seasons may be a series of skiable weekends and holidays rather than a season characterized by a single opening and closing date. Snowmaking investments provide resorts a window in which to adapt to global warming, and more general climate variability, but it is a temperature, water, and cost constrained adaptation. These challenges may incentivize the snowmaking industry to improve the efficiency of snowmaking and thereby delay future resort closures. It is incumbent on mountain managers, in an era where ski seasons may shorten, to adopt other strategies to ensure that every good snow day is a good revenue day.

**5. Becken, Susanne. (2007). Tourists' perception of international air travel's impact on the global climate and potential climate change policies. *Journal of Sustainable Tourism*, 15 (4); 351-368**

This study sought to explore tourists' knowledge and awareness of aviation's impact on the climate, their sense of personal responsibility and their reactions to specific climate change policies. A focus group approach – informed by interviews with international tourists leaving New Zealand – was chosen to involve tourists in discussing climate change and travel. In the focus groups, three policy options were discussed: voluntary initiatives, a global air travel charge and a per capita carbon budget. The global air travel tax emerged as a realistic compromise between restricting travel and achieving emissions reduction. When discussing individual responsibility for greenhouse gas (GHG) emissions, tourists distinguished between their travel and their everyday life, where responsibility for mitigation was perceived to be greater. The value of freedom to travel is firmly established in the minds of many tourists and limiting travel is considered unacceptable by the (hyper) mobile tourists who participated in this research. Only major societal changes which would bring about traveler behavioral change is likely to reduce air travel's contribution to climate change.

**6. Becken, S. (2004). How tourists and tourism experts perceive climate change and carbon offsetting schemes. *Journal of Sustainable Tourism*, 12 (4), 332-345.**

This article focuses on the perceptions of tourists and tourism experts on climate change and forests carbon sinks as a means to offset carbon dioxide emissions. The study consisted of three different surveys conducted in Australia and New Zealand that contained the same two questions: is climate change seen as an issue for tourism, and would tourists be willing to participate in tree-planting to offset their greenhouse gas emissions. The results of the study demonstrated that nearly half of all tourists questioned a link between climate change and tourism, but nonetheless were willing to plant trees. The study identified five groups of tourists based on their field of interests. The groups were: university/academia, research, industry, education, government. Moreover, the article states that the groups require different approaches for the development of educational campaigns on climate change. Tourists were also categorized into green tourists, skeptics, resisters, and undecided based on the answers to the questionnaires and campaign strategies informing them of climate change differ for each group based on cognitive and, or affective factors. Another component of the study was that of tourism experts, with the vast majority of this group perceiving changing climate as a potential threat for tourism. This group however, did not necessarily see tourism's fossil fuel consumption and the resulting carbon dioxide emissions as a contributor to climate change.

**7. Becken, S. (2004). Harmonizing climate change adaptation and mitigation: the case of tourist resorts in Fiji. *Global Environmental Change*, 15, 381-393.**

This article focuses on the impacts of climate change on island tourism. The article states that islands are under particular threat to climate change because of rising sea level, erosion, deforestation, changes in wind patterns, flooding, etc. In particular, this article profiles the island of Fiji and economic importance of tourism in the island. The article also focuses on a study of resort adaptations to climate change conducted via interviews and site visitations. The study reinforced tourism's dependence and need to maintain and properly manage natural resources since these are the foundation for tourism in the island. The study also demonstrated the current effects of climate change on various natural resources including coral reefs. The study also placed emphasis on adaptations undertaken by resorts to mitigate the effects and impacts of climate change including appropriate construction (sites and materials), water storage, reforestation, energy supply, guest education, reef protection, etc. Some of the adaptations are being followed, but for the most part these adaptations are neglected due to lack of information, proper assessment, and lack of funds to execute such projects. The article states that there is no initiative that

addresses the effects of tourism on climate change and vice-versa. A proper risk assessment plan is necessary for the island with both low and high level technologies available for the implementation of climate change mitigation efforts and projects.

**8. Becken, S., and Hay, J. (2007). *Tourism and climate change: risks and opportunities*. Buffalo, New York: Channel View Publications.**

This book ties the theoretical underpinnings of tourism, climate science and policy. It analyzes the interactions between tourism and climate change using an integrated assessment approach to gain an understanding of the relationship between the two. The book uses multiple cases studies throughout different tourism regions such as alpine Europe and small island countries. It also identifies measures for mitigating climate change within the tourism sector, as well as means of adaptation to its upcoming effects. Finally, the book gives recommendations for best practices and underlying policy principles within the tourism sector.

**9. Beniston, M. (2003). *Climate change in mountain regions: A review of possible impacts*. *Climatic Change*, 59, 5-31.**

This article focuses on mountain regions and the impact of climate change on these importance sources of water, energy, diversity and recreation. Forty percent of the global population lives in the watersheds of rivers originating in mountain ranges. Mountains are also unique areas for the detection of climatic change and its impacts due to the high levels of biodiversity and variety of ecotones and number of isolated species (islands, niches). Economically, mountains present many opportunities, especially related to outdoor recreation. Mountain ecosystems are therefore very susceptible to deterioration. Climate change is likely to have both direct and indirect impacts on tourism in mountain areas. Direct impacts refer to changes in the climatic conditions necessary for specific activities. Indirect changes may result from both changes in mountain landscapes and wider-scale socio-economic changes such as patterns of demand for specific activities or destinations. Warmer winters bring less snow at these low elevations, and the probability of snow lying on the ground at peak vacation periods would decline. Mountaineering and hiking may provide compensation for reduced skiing, and thus certain mountain regions would remain attractive destinations. However, global climate change has wider implications for traditional holiday breaks, with destinations other than mountains in winter becoming at least as competitive if not more. Higher temperatures may imply longer summer seasons in mid-latitude countries. Whatever the ecosystem response to multiple environmental stress factors, adaptation of natural ecosystems to climatic change in many regions cannot be achieved without some kind of human intervention, in the form of ecosystem management.

**10. Berritella, M., Bigano, A., Roson, R. & Tol, R. (2006). *A general equilibrium of climate change impacts on tourism*. *Tourism Management* 27(5), 913-924.**

This article focuses on climate change induced variations in the demand for and the supply of tourism services and provides a projected assessment of the redistribution of tourists and revenue as a result of changes in climate. This article projects international tourists' flows for 2050, which significantly vary due to origin and destination regions. In order to assess the changes in tourism linked to climate change this study employed a multi-country computable general equilibrium model to simulate adjustments and changing economic and travel trends. The model was adjusted to simulate vast economic changes due to climate change effects on tourism. The results demonstrated that economic impacts get more

substantial with time, because of rising temperature levels. Time also plays a role in the distribution of costs and benefits, bringing about a few important qualitative changes. The results also demonstrated that impacts on domestic demand and household income spread to the rest of the economy through substitution with other goods and services, and through induced effects on primary factors demand and prices. Moreover, the simulations show that time plays a critical role for tourism and climate change, and that in 2050 climate change will ultimately lead to a non-negligible global loss. Net losers are Western Europe, energy exporting countries, and the rest of the world.

**11. Bicknell, S., & McManus, P. (2006). The canary in the coalmine: Australian ski resorts and their response to climate change. *Geographical Research*, 44, 386-400.**

This article discusses the effects of climate change on ski resorts in Australia and specifically addresses the perceptions and responses of ski resort managers and operators toward climate change. Skiing is a climate sensitive activity because of its inherent reliance on a constant and predictable amount of snow. Snow deficient winters are seen as evidence of the impact of global warming on skiing, which has prompted investigation into the consequences for the ski industry. The ski industry is one of a number of activities that may be classified as 'snow tourism'. Snow tourism is distinct from 'alpine tourism' because of its seasonal, spatial and temporal concentration. Activities encompassed by snow tourism include downhill skiing, tobogganing, cross-country skiing and snowboarding. This particular study focuses on three case studies conducted to examine how the climate change issue is being addressed in the context of the ski industry. One of the major findings of this study is that a physical meltdown may not lead to a financial meltdown. Another is that business responses to climate changes are more varied than has been represented in the literature to date. It appears that the tension between competing firms and industry cooperation strongly influences the types of response that may develop. The article also highlights the need for constructive climate change dialogue that accounts for the sensitivities of the issue and the financial pressure that businesses face in order to maintain investor confidence.

**12. Braun, O., Lohmann, M., Maksimovic, O., Meyer, M., Merkovic, A., Messerschmidt, E., Riedel, A., & Turner, M. (1999). Potential impact of climate change effects on preferences for tourism destinations. A psychological pilot study. *Climate Research*, 11, 247-254.**

This paper uses a psychological approach to finding preferences for tourism destinations in the northern coastal regions in Germany, and the potential impacts climate change may have upon the preferences. Multiple surveys were created and administered to various groups inquiring about their preference to visit the region with various hypothetical scenarios in effect. The results showed that there is a correlation between the effects of climate change and preference of vacation destinations. Potential tourists are less eager to travel to the North German coastal regions in situations when the outcomes of climate change are in effect. This climate change applied outcome was compared to the preference of visitors when current conditions are in effect. The results of this experiment point towards the changes in natural attractiveness of a tourism destination, the amenities it retains, and visitor attitudes in relation to the impacts of climate change on the area.

**13. Breiling, M., & Charamza, P. (1999). The impact of global warming on winter tourism and skiing: A regionalized model of Austrian snow conditions. *Regional Environmental Change*, 1, 4-14.**

Winter tourism is a significant contributor to the Austrian economy, particularly in rural areas. As a result, the Austrian government ordered a study on climate sensitivity of Austrian districts with

particular concern for winter tourism. The article discusses previous research which discusses adaptations to climate change including snowmaking and the implications of climate change for low versus high altitude areas. The article also elaborates using recent data from new climate modeling results. The model uses monthly temperature and precipitation stations as well as the daily standard deviation relative to the monthly mean. It is particularly useful if there are no or few snow stations but plenty of temperature and precipitation stations available. The modeling demonstrated that there are significant differences in winter tourism in Austria. The Western part of the country and the ski resorts are situated higher up and as a result have more visitors and a longer season. Flatter areas and areas closer to cities have a shorter season and receive more single day visits. The article also suggests and recognizes that despite the climatic modeling, the effects of climate change on economics are difficult to predict. Lower altitudes will most likely feel the effects first with a steep decline in visitation. The economic feasibility of snowmaking is also questioned. Furthermore, there is no way to predict visitor behavior if snow conditions severely degrade. More accurate modeling, the article argues, could help narrow down some potential discrepancies.

**14. Bürki, R., Elsasser, H., & Abegg, B. (2003). *Climate change - Impacts on the tourism industry in mountain areas*. First International Conference on Climate Change and Tourism, Djerba Tunisia, 9-10 April 2003.**

This article emphasizes that mountain areas are sensitive to climate change and the negative impacts associated with it. The article focuses on the impact of climate change on winter tourism in mountain areas. Climate change affects the amount of snow which decreases quality snow conditions, shifts seasonality and exacerbates receding glaciers. Climate studies in Europe and North America demonstrate the vast negative impacts of climate change on tourism in mountain areas. Some of the more devastating effects have been determined to be in snow levels, glaciers, permafrost melts, changing weather conditions, as well as the tourism and agriculture industries. Past research has indicated that ski areas lower altitude ski areas will have to depend on snow-making to compete in the market. However, snow-making is expensive, thus those implementing it would have to assume such a financial risk. Research has also stated that there is potential for over-demand/use of higher altitude areas, leading to more environmental degradation.

The article argues that in order for more efficient planning to occur, ski area representatives must perceive climate change as an issue which must be addressed immediately. Previous research showed that the perceptions of ski industry representatives vary widely and that climate change is at times not seen as a pressing matter but rather as exaggerated by the media. Climate change has also been used to legitimize snow-making. There are also diverging perceptions based on high versus low altitude ski areas since the implications of climate change are expected to differ for them. The article encourages ski representatives to generate strategies that are appropriate for them since adjustments will inevitably have to be made.

**15. Buzinde, C., Navarrete, D., Kerstetter, D., & Redclift, M. (2010). *Representations and adaption to climate change*. *Annals of Tourism Research*, 37 (3), 581-603.**

In an effort to promote tourism, hoteliers and other tourism service providers seek to present what they perceive the travelers will want. However, the image that is presented is rarely what the traveler actually receives. The aforementioned scenario was illustrated in the case of Playacar, Mexico. Visitors did not see pristine beaches, but rather severely degraded beaches as a result of overuse and general pollution. Considering that internet communication is widespread, visitors are able to rate the locations they visit and the experiences they have, threatening the marketing techniques of destination image.

The degradation of the beach is expected to increase as more travelers go to the area and as climate change continues, disrupting water levels and increasing erosion potential. Considering climate change implications on tourism, the article emphasizes that tourism promoters need to provide a realistic version of areas like Playacar. Also encouraged is a change in visitor expectations when considering a site since enjoyment can perhaps be achieved in non-pristine areas. Most of all, the article encourages promoters and visitors to create viable and sustainable alternatives for tourism development and management considering vast changes as a result of climate change. The strategies however, must be generated by both the promoters and the visitors in order to create a tourism destination that is reflective of the area and what it may have to offer.

**16. Casola, J., Kay, J., Snover, A., Norheim, R., & Binder, L. (2005). *Climate impacts on Washington's hydropower, water supply, forests, fish and agriculture*. Seattle: Centre for Science and the Earth System, University of Washington.**

Washington's economy and natural resources are sensitive to climatic changes. This article provides an overview of the potential causes of climate change and its impacts on natural resources. The article discusses the effects of climate change on hydroelectric power production (potential shifts in production and availability of resource), municipal water supplies (availability limitations), flood and storm water management (potential increased frequency), and forests (shifting geographic range- seeking cooler temperatures at higher latitudes/elevations). The article also presents some of the negative impacts of climate change on natural resource dependant industries including fisheries and agriculture. Fisheries are at risk with increasing stream and lake temperatures, as well as, volume and timing of stream-flow. These risks are of particular threat to Salmon populations which thrive in cold waters and are the region's most important fish species. The agriculture industry also faces similar risks with potential decreases in production levels as a result of limited water and shifting seasons. Additionally, the threat of new pests as a response to shifts in climate/temperature could further exacerbate the problem. Considering these threats, the article states that efficient and proactive planning needs to occur rapidly. Washington relies on natural resources ranging from oceans to mountains to forests, thus adaptations and planning need to occur to mitigate the impacts of climate change on these resources.

**17. Dawson, J., & Scott, D. (2007). *Climate change vulnerability of the Vermont ski tourism industry (USA)*. *Annals of Leisure Research*, 10, 550-572.**

Winter recreation is an important part of the cultural identity of the Northeast United States and is a multibillion dollar contributor to the regional economy. This article discusses four climate change scenarios and their impact on the two largest winter recreation industries in the Northeast, snowmobiling and alpine skiing. The diminished natural snow pack had a very negative impact on the snowmobile industry. As early as 2010–2039, 4 to 6 of the 15 snowmobile study areas were projected to lose more than half of the current season. The large investment in snow-making substantially reduced the vulnerability of the ski industry and climate change posed a risk to only 4 of the 14 ski areas in 2010–2039, where average ski seasons declined below 100 days and the probability of being open for the entire Christmas–New Year's holiday declined below 75%. Conversely, by 2070–2099 only four ski study areas had not reached these same economic risk criteria. In order to minimize ski season losses, snow-making requirements are projected to increase substantially, raising important uncertainties about water availability and cost. Climate change represents a notable threat to the winter recreation sector in

the Northeast, and the potential economic ramifications for businesses and communities heavily invested in winter tourism are considerable.

**18. Ceron, J., & Dubois, G. (2005). The Potential Impacts of Climate Change on French Tourism. *Current Issues in Tourism*, 8 (2), 125-139.**

This paper examines the potential implications of the effect of climate change upon the tourism industry within France. Three different tourism issues raised by climatic change are addressed. These issues are: the effect of climate change on tourism resources, tourism's contribution to climate change, and possible outcomes of mitigation policies on tourism. It states that there are certain climatic conditions of an area that are required by tourists, which include safety, presence of sunshine periods, absence of daily rainfalls, thermal comfort, hydrous comfort (low humidity), and minimal health risks associated with the climate. The more an area meets these requirements, the more likely an area is considered a desirable tourism destination. With the use of a regional climate change model, the future of French tourism has been broken down into some key possibilities. First, with a temperature increase, French Mediterranean tourism could have a competitive advantage over already hotter Mediterranean areas. Second, Mediterranean hinterlands may become more desired due to their overall cooler climate. Third, the Atlantic coast's potential increase of winter rainfall could negatively impact the tourism of the area. Fourth, artificial resorts with controlled environments may be favored. And fifth, autumn and spring could become more favored. The article also identifies the impacts of climate change on non-climatic resources of tourism. A decrease of snow for winter sports is a significant constraint for tourism within the winter season. Potential sea level change is driver in a multitude of impacts upon French tourism. There are also indirect impacts on landscapes, biodiversity and water resources that are too variable to be assessed at a national scale, though they may have a long term impact on the attraction of destinations. Overall, there is a call to tourism entities for proactive adaptation to the effects of climate change.

**19. de Freitas, C.R. (2003). Tourism climatology: Evaluating environmental information for decision making and business planning in the recreation and tourism sector. *International Journal of Biometeorology*, 48, 45-54.**

This article reviews the work so far on climate and tourism with a view to identifying useful concepts and theoretical frameworks, and looks to ways these may be drawn together in future research. It proposes that a fundamental "driver" of tourism climatology is the identification and evaluation of environmental information for business planning and decision-making in the recreation and tourism industry. Tourism climatology deals with the concepts of "climate" and "tourism" in the broadest sense. Climate invokes the concept of "weather" in that it is defined as the accumulation of daily and seasonal weather events over a long period of time, where weather is the condition of the atmosphere at any particular time and place. Climate is a resource exploited by tourism, and the resource can be measured. In this way climate can be treated as an economic asset for tourism. Most research on tourism climate appears to be motivated by the potential usefulness of climatological information within planning processes for tourism and recreation. Climate and weather are pervasive factors in many economic activities, agriculture and tourism being foremost among these, and financial returns depend directly on them. In order to bridge the gap between science and business, this article advocates that climatologists should translate their technical work into simple language and explain this in uncomplicated terms for planners, tourist operators, the tourist sector generally, as well as the public.



**20. Elsasser, H., & Bürki, R. (2002). Climate change as a threat to tourism in the Alps. *Climate Research*, 20, 253-257.**

This article states the importance of tourism to Switzerland's economy. In many areas of this country, winter tourism is the most important source of income. Snow reliability is therefore essential for the continuation of tourism in the Alps. The financial viability of winter tourism, therefore, depends on sufficient snow conditions. At the end of the 1980's the tourism industry in the Alps experienced a lack of snow which left a lasting imprint and sense of concern. Currently, 85 percent of Switzerland's current ski resorts can be designated as snow-reliable. If climate changes continue, however, the level of snow-reliability will rise from 1200 m up to 1800 m over the next few decades. Only 44 percent of the ski resorts would be reliable. While some regions may be able to maintain their winter tourism with suitable adaptation strategies, others would lose all winter tourism due to diminishing snow pack. The article argues that climate change must be viewed as a catalyst that reinforces the pace of structural changes in tourism. Currently, a structural adaptation in winter tourism is artificial snow production. This article argues that more needs to be done, not just adaptation but also to developing ways to mitigate climate change, including producing less greenhouse gas emissions.

**21. Endler, C., Oehler, K., & Matzakis, A. (2009). Vertical gradient of climate change and climate tourism conditions in the Black Forest. *International Journal of Biometeorology*, 54, 45-61.**

This article describes the impact global and regional climate change may have on the Black Forest and its subsequent effect on tourism within the area. An emphasis is placed on what these environmental effects may have in the near future specifically. Three different locations in the Black Forest were used within climate simulations to obtain the outcomes. The results show that climate change will have both negative and positive effects on the tourism industry. At higher elevations, winters may shorten while summers may lengthen which provides opportunities for offering more warm weather activities (mountain biking, hiking) in place of winter sports. Moving ski areas to higher elevations is not an option because the highest elevation analyzed shows a high vulnerability to future climate scenarios. The changes in climate will also increase precipitation which can result in increased flooding and consequently reducing outdoor activities. Drier summers pose a risk of increased forest fires which also can be threat to tourism infrastructures. The higher elevations will have a greater prevalence of thermal comfort while lower elevations will experience lower thermal comfort due to heat stress. Overall, the climate simulations of the Black Forest areas show an increase in temperature and subsequent environmental effects will occur. The article calls for more flexibility and adaptability on the part of both the tourism industry and the tourists due to the impending changes.

**22. Flannigan, M., Stocks, B., & Wotton, B. (2000). Climate change and forest fires. *The Science of the Total Environment*, 3, 221-229.**

This paper addresses the impacts of climate change on forest fires in the United States. This paper is relevant to research on climate change and tourism and recreation since national forests are extensively used for recreation purposes. The paper reviews two transient general circulation models (GCMs), namely the Hadley Centre and the Canadian GCMs, to estimate fire season severity in the middle of the next century. Ratios of 2xCO<sub>2</sub> seasonal severity rating (SSR) over present day SSR were calculated for the means and maximums for North America. The results suggest that the SSR will increase by 10-50 percent over most of North America. The paper indicates that increased SSRs translate into increased forest fire activity. Thus, forest fires have the potential to significantly change US forests as the fire

regime will respond rapidly to climate warming. This change in the fire regime has the potential to overshadow the direct effects of climate change on species distribution and migration.

**23. Gómez Martín, MaB. (2005). Weather, climate and tourism A geographical perspective. *Annals of Tourism Research*, 32, 571-591.**

This article discusses the relationship among climate, weather, and tourism from the perspective of the geography of tourism and climatology. Climate is one of the geophysical elements that make up geographical space, contributing to the environmental conditions that facilitate or hinder human settlement. People seek to settle in those spaces that offer the greatest comfort and possibilities of survival in terms of climate. Climate (sun hours, temperature, snow, wind, etc.) is often the main resource upon which a whole series of activities designed to satisfy tourist demand depend. Therefore, climate is an important criterion for locating tourism centers, helping to determine how an area is to be used. Additionally, the article argues that climate and weather have implications for tourism planning. This paper analyses the nature of the influence that climate has on tourism and recreation, stressing the need to improve upon the simplistic descriptions traditionally reported in planning projects, which are often unconnected to the requirements of tourism, and revealing the links that atmospheric elements maintain with different facets of this industry. Specifically, the paper considers the influence that climate and weather exert on the geographical space, demand, supply, and market agents of the tourism system. It also shows the significance of this relationship in the context of climate change. This article highlights the close relationship between climate, weather, and tourism, and shows the need to understand the nature of these relationships. This would result in more effective tourism planning. Further, it asserts that tourism planning should incorporate more than simple, general descriptions of the climate, which are often unconnected to the needs of tourism.

**24. Gongmei, Y., Schwartz, Z., & Walsh, J. (2009) Effects of climate change on the seasonality of weather for tourism in Alaska. *Arctic*, 62 (4), 443-458.**

This article states that tourism is on the largest industries in Alaska's economy. Visitor surveys indicate that more than 80 percent of Alaska's visitors travel for vacation and pleasure (Alaska Office of Tourism Development, 2006). Outdoor activities such as wildlife viewing and sightseeing are considerably more popular (56% and 44% of visitors, respectively) than indoor activities such as cultural attractions (18%). Climate plays a significant role in nature-based tourism, affecting it both indirectly and directly. Indirect impacts include changes in ecosystems and geography on which tourism depends. The direct effects of climate change on tourism arise from the fact that a destination's climate is an aggregate of the weather experienced by tourists. In this respect, climate directly affects demand for tourism and tourists' behavior and expenditures. World-wide studies have stated that climate change leads to the redistribution of tourists among destinations, changing the seasonality and destination image of various locales. An index was developed to assess the impact of climate change on the seasonal pattern of ideal climate conditions for tourism in various regions. The index was based on four weather components: perceived temperature, wind, visibility, and significant weather. This was reported on an hourly basis. Cluster analysis was used to analyze this data. The index demonstrated a new method of quantifying daily-level tourism climate seasonal patterns, which can be calibrated to match the specifics of any outdoor-oriented tourism activity. The results also show that the overall annual frequency of ideal conditions for sightseeing in King Salmon has been significantly improved by more favorable weather during the summer season as well as an earlier start of that season. The practical implication is clear, as several surveys indicate that the quality of the season has considerable impact on tourism activity, participation, and expenditures. The results support the notion that future impacts of climate change on tourism seasonal patterns will most likely vary by activity and could be negative or positive.

Moreover, the impact of climate change on tourism is expected to be diverse and wide-ranging, and to depend upon location, geography, and activity.

**25. Gossling, S. (2002). Global environmental consequences of tourism. *Global Environmental Change*, 12 (4) 283-302.**

In 2000, almost 700 million international tourist arrivals were counted worldwide. Even though a global activity of this scale can be assumed to have a substantial impact on the environment, its consequences have never been assessed and quantified. In this article, five major aspects of the leisure-related alteration of the environment are investigated: (1) the change of land cover and land use, (2) the use of energy and its associated impacts, (3) the exchange of biota over geographical barriers and the extinction of wild species, (4) the exchange and dispersion of diseases, and (5), a psychological consequence of travel, the changes in the perception and the understanding of the environment initiated by travel.

**26. Gossling, S., & Hall, M. (2006). Uncertainties in predicting tourist flows under scenarios of climate change. *Climatic Change*, 79 (3),**

This article reiterates that tourism is largely dependent on climate and natural resources. Generally, tourists prefer environments for recreation and leisure, and natural resources with access to fresh water, biodiversity and beaches. Climate change, however, threatens the environmental foundations that tourism is built on. As a result, this has raised concerns that tourist flows will change to the advantage or disadvantage of destinations. This is of major concern to local and national economies, as tourism is one of the largest economic sectors of the world, and of great importance for many destinations. This article argues that statistical models intending to predict travel trends and reasons for shift in travel are insufficient. This article argues that while weather is important, currently there is no information that travelers base their decisions on weather/climate alone when booking a vacation. Moreover, the article also presents terrorism, war, epidemics and natural disasters as extremely influential in tourism destination planning, all of which could increase with limited access to resources resulting from climate change. Moreover, the article offers case studies (Israel, Tanzania) which indicate that there are a plethora of considerations aside from weather alone in decision making regarding travel and also vast implications of climate change which should be considered in future tourism planning endeavors.

**27. Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change*, 15, 199-213.**

This article focuses on the behavioral components of climate change, predominately, adaptation to climate change. This article argues the importance of measurable and alterable psychological factors in determining adaptation. Drawing from the literature in psychology and behavioral economics, a socio-cognitive Model of Private Proactive Adaptation to Climate Change (MPPACC) was developed. MPPACC separates out the psychological steps to taking action in response to perception, and allows one to see where the most important bottlenecks occur—including risk perception and perceived adaptive capacity, a factor largely neglected in previous climate change research. Two case studies are presented—one from urban Germany and one from rural Zimbabwe—to explore the validity of MPPACC to explaining adaptation. In the German study, it was found that MPPACC provides better statistical power than traditional socio-economic models. In the Zimbabwean case study, a qualitative match between MPPACC and adaptive behavior was found. Finally, the important implications of the findings

are discussed. Topics include both vulnerability and adaptation assessments, and efforts to promote adaptation through outside intervention.

**28. Hall, M. & Higham, J. (2005). *Tourism, recreation and climate change*. Tonowanda, New York: Channel View Publications.**

This book identifies the relationships between tourism, recreation and climate change. The first chapters of the book identify the historic and current research conducted within this context. The book then delves into more specific locations where tourism may be affected by climate change. Specific geographical locations may be affected differently depending on multiple variables such as latitude, elevation and distance from oceans. Certain tourism areas may ultimately benefit from the effects of climate change; particularly more northern latitudes and higher elevations. The volume identifies difficulties and challenges in adapting tourism in a way that maximizes tourism potential in particular areas and minimizes the detrimental effects of climate change. The authors also incorporate the importance of sustainable tourism into the equation, emphasizing that although difficult, it enables the tourism sector to minimize their own climate change impact. This takes on the root of the problem instead of just adapting to the problem's effects.

**29. Hamilton, L., Brown, C., & Keim, B. D. (2007). *Ski areas, weather and climate: Time series models for New England case studies*. *International Journal of Climatology*, 27, 2113-2124.**

This article focuses on the threats to ski areas from wintertime warming trends in recent decades. It presents innovative research in that the research discussed focuses on the local-scale impacts of climate variability, using detailed daily data from two individual ski areas. The article also discusses a time series models that predicts day-to-day variations in skier attendance from a combination of mountain and urban weather, snow cover and cyclical factors. ARMAX (autoregressive moving average with exogenous variables) is used to explain half to two-thirds of the variation in these series. The models discussed in this article explain the direct and indirect impacts and perceptions of climate change. The direct or narrower perspective is easily measurable including; urban snow conditions which significantly affect skier activity. The indirect or wider perspective assesses the larger context of climate change including some adaptation changes. The article advocates for ARMAX or a model to conduct more comprehensive climate change research with viable solutions and recommendations.

**30. Hamilton, J., Maddison, D., & Tol R. (2005). *Effects of climate change on international tourism*. *Climate Research*, 29, 245-254.**

This study uses an international tourism model to simulate the impact of climate change on international tourism. The basis of the model follows 207 countries' tourism flows. What the model showed was that climate change affects international tourism; however the effect is relatively small compared to other changes such as population growth and per capita income fluctuations. Overall, the model shows that the past growth rate of international tourism "may well continue unabated in the medium term, but will saturate in the long term". Climate change will eventually lead to a shift in popular tourism destinations towards the poles and to higher elevations. Countries that are currently cooler will receive more tourism in the future and citizens will be less likely to travel abroad for holidays. The opposite is true for currently warmer countries; less tourism and more citizens travelling abroad. Even so, the overall impact of climate change predicted by the model is minimal.

**31. Hamilton, J., Maddison, D., Tol, R. (2005). Climate change and international tourism: A simulation study. *Global and Environmental Change*, 15, 253-266.**

This article uses a simulation model of international tourism which shows that growth is likely to continue its upward trend at a similar rate to past growth. The primary driver of international tourism is economic growth, and consequently primary growth of international tourism will be concentrated in high economic growth regions. The article also states that climate change will lead to a shift of tourism destinations toward higher latitudes. There is also a prediction that sun and beach seeking tourists of Western Europe will begin to stay closer to home. Even so, the tourism trends induced by climate change are outweighed by the changes resulting from population and economic growth. Note that this simulation was conducted in 2005 and projections may have changed since that time.

**32. Hennessy, K., Bathols, J., Hutchinson, M., Sharples, J., Smith, I., & Whetton, P. (2003). *The impact of climate change on snow conditions in mainland Australia*. Aspendale, Australia: CSIRO Atmospheric Research.**

This report is a very comprehensive assessment of past and future changes in snow condition throughout Australia. The report is composed of various climate databases with particular emphasis on past trends in alpine areas. In addition to assessing past and future trends, this report highlighted the potential of snow-making to counter the estimated effects on the ski industry. The report discussed various scenarios from low to high impact on alpine areas. The impact within each scenario was very dependent on location. The low impact scenario did not appear to have detrimental effects and the greatest impact was generally highest on lower altitude sites. The report also demonstrated that in the shoulder season, it would be increasingly harder to retain snow-pack since the accumulation from the mid season would not be as great and temperatures would be warmer sooner in the shoulder season. In order to mitigate the impacts of such a warming trend, the report considered the use of snow-making technologies as an alternative but also indicated that the current snow-making technology needs improvement. The report also discussed some limitations to snow-making including access to water, and the acceptable levels of environmental impact (energy to produce man-made snow). The report also encouraged more in-depth studies with more frequent monitoring of weather and temperature in alpine areas of Australia in order to design more appropriate solutions, especially considering that many of the articles and studies have been conducted in the Northern Hemisphere.

**33. Irland, L., Adams, D., Alig, R., Betz, C., Chen, C., Hutchins, M., McCarl, B., Skog, K., & Sohngen, B. (2001). Assessing socioeconomic of climate change on US forests, wood product markets, and forest recreation. *Bioscience*, 51 (9), 753-764.**

This paper states that the effects of climate change on forests and forest ecosystems will have drastic biological, social and economic effects. Forest products and recreation are two industries that are discussed in this article, both projected to have spiraling economic effects on the U.S and the world. The article also argues for adapting our current markets to promote what is available, and which in some cases might have to be adapted (i.e.: new species, new technologies). Additionally, the article also emphasizes new ways of utilizing forests and its products including as carbon storing deposits, increasing and widening the scope of land management so that it is accordance to the needs of the present and future for various communities. Forest recreation is a prominent section of this article and

highlights the physiological implications of recreation as the connection of people and the environment. The article also highlights seasonality as a major attribute of tourism destinations and the potential of such a concept to become skewed with increasing climate change. The article argues that climate effects can be both direct and indirect thus threatening various aspects of the tourism/recreation experience. The article offers various examples of potential threats, including Florida beaches, Smoky Mountains, and the ski industry. The article wraps up with suggestions for future research including cost benefit analysis of the effects of climate change on forest products and recreation opportunities and the ability of citizens and industries to adjust their perceptions in a proper fashion.

**34. Jones, B., & Scott, D. (2006). Implications of Climate change for visitation to Ontario's provincial parks. *Leisure, 30 (1), 233-262.***

Climate has a direct connection to tourism, and nature-based tourism in particular. In the Province of Ontario, provincial parks are a major resource for nature-based tourism, with more than 10 million person visits in 2003. Therefore, the implications of global climate change could have significant implications for park conservation policy and management. This article raises awareness of the climate change issue through an empirical assessment of the potential impact of a changed climate on visitation in Ontario's provincial parks. Multiple regression analysis was used to develop a relationship between monthly park visits and climate for six high-visitation parks selected to represent each of Ontario Park's administrative regions. The models were then used to examine the potential direct impact of changes in climate on the total annual number of visitors and the seasonal pattern of visitation to Ontario's parks using climate change scenarios for the 2020s, 2050s and 2080s. Visitation was projected to increase between 11 percent and 27 percent system-wide in the 2020s and between 15percent and 56 percent in the 2050s. When climate change was combined with the potential effects of demographic change, annual visits for the mid-2020s were projected to be even higher than that projected under climate change alone (23% to 41%). Thus, the social and environmental effects of climate and demographic changes will significantly influence park visitation and thus pre-emptive management techniques should be evaluated. The article also advocates for a more comprehensive park management technique that focuses on environmental protection and policy considering climate change implications.

**35. Jones, R. (2001). An environmental risk assessment/management framework for climate change impact assessments. *Natural Hazards, 23, 197-230.***

This article focuses on climate change from a risk assessment perspective. The article stresses the importance of understanding scientific research analysis within a social context. Additionally, the article argues that both risk assessment literature and climate change research requires scientific understanding within a social background. As a result, the risk assessment framework can be easily transferred to better understand the climate change discussion. The article utilizes the risk assessment framework to explain climate change. In particular this article uses climatic variables expressed as projected ranges of climate change with an upper and lower limit. It also demonstrates various impact thresholds as identified collaboratively by researchers. Thus, the article states the problem or risk and also finds a way to state potential risk mitigating solutions, or in the case of climate change, adaptation and mitigation. The application of the risk assessment framework to climate change consists of two complementary actions: 1) adaptation to anticipated changes in climate and, 2) the mitigation of climate change through reductions in greenhouse gas emissions. The intention is that this framework and the process it presents will reduce the risk of critical thresholds being exceeded. The potential of this framework for addressing specific requirements of the United Nations Framework Convention for Climate Change is discussed

**36. Kent, M., Newham, R., & Essex, S. (2002). Tourism and sustainable water supply in Mallorca: a geographical analysis. *Applied Geography*, 22(4), 351-374.**

This article examines the problem of water supply in resort towns and utilizes the island of Mallorca, Spain as a case study. 60 percent of the GDP in Mallorca is directly linked to tourism. At the same time, Mallorca has a lacking and at times faltering water supply, which is exacerbated by the large number of tourists. The sustainability and viability of tourism in the island is assessed in this article. Mallorca is somewhat indicative of other tourism islands in the region, but due to its size, is much more fragile than others. Reports indicate that tourist use more water per capita than do locals and water is also in high demand for landscaping/golf courses in resort areas. In addition, tourists expect higher water quality levels, which at times cannot be achieved in Mallorca (only 30% of the water discharged from Mediterranean islands received treatment prior to discharge). If access and clean supply of water is not available the tourism industry and all that it supports would crumble for Mallorca. The island has tried to increase abstraction from inland aquifers, construction of two main reservoirs, and shipping fresh water from mainland Spain. Salinization, decreased water levels and expense have exacerbated the problem for the intended solutions. In addition, climate change (global warming) has increasingly exacerbated the issue and lured more tourists to the area. Steps toward potential solutions include increased charges for visitors, hotelier taxes, ecotax, however these are in the preliminary stages and their result, if viable, remains to be seen.

**37. Koenig, U., & Abegg, B. (1997). Impacts of climate change upon winter tourism in the Swiss Alps. *Journal of Sustainable Tourism*, 5, 46-58.**

This paper examines the role of the tourism industry in Switzerland, with a particular emphasis on winter tourism and potential threats to it due to climate change. The paper discusses the effects of three past winters that were extremely snow deficient in order to contextualize the potentials of global warming. The article also highlights glacier ski resorts in Switzerland and offers strategies and adaptations for the tourism industry as a whole. The three snow deficient winters (1987, 1988, and 1990) demonstrated an overall negative impact for winter tourism in Switzerland, but the specific impacts differed greatly from region to region. Generally, however, ski resorts at lower altitudes suffered more from the lack of snow, and there was a significant drop across all regions but especially those at lower altitude. Financial losses therefore, were felt all across the country for the three snow deficient winters. Since impacts were specific to each region, this article discusses studies that were conducted at a regional level. The regional studies show that resorts at lower altitudes will suffer greater snow loss and smaller resorts will have difficulty staying open or staying competitive. In middle altitude areas (close to valleys or resorts) resorts will have difficulties. Due to the lack of snow pack at lower altitude, it is predicted that higher altitude areas will receive more visitors than they can handle, leading to garbage and waste water issues. Over-use of glacier ski areas is a potential threat that should be considered. Some of the adaptations to such a warming trend include building resorts at higher altitudes and making snow. These solutions are temporary and each is ridden with a slew of potential problems. The article also argues that ski resorts need to diversify their activities and cooperate with one in order to economically survive and even potentially thrive.

**38. Laternser, M., & Schneebeli, M. (2003). Long-term snow climate trends of the Swiss Alps (1931-99). *International Journal of Climatology*, 23, 733-750.**

This paper presents a historical account of winter climate trends in the Swiss Alps. Particularly, the paper focuses on snowfall days, snow depth and snow duration. The paper indicated that regional and

altitudinal variations were significant. An example of the regional variations is the accumulation and retention of snow in the Northern versus the Southern Alps. The paper also stated that shorter snow duration was mainly due to earlier snow melt in the spring and later snowfalls in fall. Regional and geographical trends have demonstrated precipitation is changing from snow to rain, which is especially prevalent in middle altitude regions. The article expects that this trend of snow to rain will continue since such was the case during a warm spell in the 1980s. The paper seeks further exploration of regional trend studies since there is a vast amount of variation that has not yet been researched.

**39. Lise, W., & Tol, R. (2002). Impact of climate change on tourist demand. *Climatic Change*, 55, 429-449.**

While it is perceived that climate plays a crucial role in nature-based tourism, exact examples are lacking. As a result, this article highlights the importance of tourists' demands for climate/weather and temperature in their ability to choose a vacation spot and the activities that will be performed once there. Three sets of data were presented: the first data-set is rudimentary but covers almost the whole world. The third data-set is very detailed but covers only Dutch tourists. The second data-set is somewhere in between, covering selected OECD countries with some detail. This article clearly states that the demands differ greatly. It also offers global perspectives of tourists' sensitivity to climate change, where the optimal temperatures occur in countries with beaches, and the fact that tourists prefer drier to wetter areas. The article also takes into consideration tourists' perception of temperature and weather in relation to their country of origin. Though the optimal weather was different depending on country of region, there were similar trends to that of the global analysis. The final evaluation was conducted for Dutch tourists. In this case preference or optimal weather as well as activities were evaluated. The article concludes that climate is an important consideration for tourists' choice of destination and that 21 degrees Celsius is the ideal for the large bulk of international tourists. Preference is largely based on country of origin. The article also reported that there is no overwhelming awareness of climate change among tourists. Host regions however must make sure to make adjustments to continue to attract tourists to their areas and be inventive in the kinds of activities that they may be able to offer since they will be competing with many travel destinations

**40. Maddison, D. (2001). In search of warmer climates? The impact of climate change on flows of British tourists. *Climatic Change*, 49 (1-2), 193-208.**

This paper investigates the impact of climate change on the chosen destinations of British tourists. Destinations are deemed attractive on the basis of comfortable climate and reasonable travel and accommodation costs. Climate and cost are proven to be essential variables in explaining the current observed pattern of overseas travel in terms of a model based upon the idea of utility maximization. The article states that there are trade-offs between climate and holiday expenditure which should be analyzed since often tourists will forgo their climate ideal if the costs are too high. The objective of this article is to predict the impact of various climate change scenarios on popular tourist destinations. The methods included the construction and analysis of a model referred to as Pooled Travel Cost Model (PTCM) which encompasses price and environmental quality aspects of travel. Regression models were used to analyze the PTCM. The United Kingdom, Spain and Greece were further examined since the latter two countries are most frequently visited by the former. PTCM demonstrated that quarterly climate variables are able to explain differences in flows of tourists. In particular, it showed that British tourists are attracted to climates which deviate little from an average daytime maximum of 30.7 degrees Celsius. The largest expenditure noted was that of fare, presumably airfare. These costs are likely to be reduced since destinations with close proximity to the United Kingdom including Spain and Greece will have higher temperatures due to climate change, leading to increase in British tourists. The model also



reported that Spain and Greece would experience a lengthening and a flattening of the tourist season. Low-lying islands, however (Indian and Pacific Oceans) would suffer detrimentally since they are very expensive and not frequently visited. The article recommends further work on the analysis of PTCM and other models to evaluate the role of cost and climate on tourism demands and trends.

**41. McBoyle, G., Scott, D., & Jones, B. (2007). Climate change and the future of snowmobiling in non-mountainous regions of Canada. *Managing Leisure*, 12, 237-250.**

This article states that climate change impact assessments of winter recreation have almost exclusively concentrated on alpine ski industry, thus overlooking the potentially greater vulnerability of other winter recreation sectors of large economic value. As a result, the article discusses a particular study which focuses on the potential impact of climate change on the snowmobiling industry in Canada. The study consisted of a snow depth model which examined the potential impact of two climate change scenarios on the length of snowmobiling seasons in the 2020s (2010-2039) and 2050s (2040-69) at 13 non-mountainous study sites in Canada. The studies were concentrated in the Provinces of Ontario and Quebec, which encompass the largest network of snowmobile trails and largest number of registered snowmobiles in the country, average snowmobile seasons in the 2020s were projected to be reduced between 11% and 44% under the low emission climate change scenario and between 39% and 68% under the high emission climate change scenario. Under the high emission scenario for the 2050s, a reliable snowmobiling season would be essentially eliminated from Canada's non-mountainous region.

**42. McKercher, Bob, Bruce Prideaux; Catherine Cheung; Rob Law. (2010). "Achieving voluntary reductions in the carbon footprint of tourism and climate change." *Journal of Sustainable Tourism*, 18 (3): 297 -**

This study examined attitudes to tourism and climate change among residents of Hong Kong and evaluates their willingness to voluntarily modify travel behaviors to reduce environmental impacts. Previous studies on environmental behavioral change identified a significant gap between awareness and action, with some studies even suggesting that the most aware individuals are unlikely to change their behaviors. Similar findings were noted in this study. Cluster analysis identified four cohorts of tourists, ranging from the *regular international tourist* to the *least travel active*. The *regular international tourist* group was most aware of global warming and climate change, but least willing to alter its travel behavior. By contrast, less travel active tourists seem most willing to travel less. The paper concludes that government intervention may be required to create meaningful behavioral change in travel patterns.

**43. Mendelsohn, Robert. (2000). Efficient Adaptation to Climate Change. *Climatic Change*, 45 (3-4)**

The author focuses on the need for adaptation as a result of climate change. He emphasizes private adaptation in various sectors including farming, recreation and energy. He states that while private adaptation is necessary for initial changes to occur, there must also be public support in the form of policies and subsidies that enable efficient private adaptations. A current example the author presents is that of farming, new farming practices by private business and the support through subsidies from government. Governments, the author argues need to be strategic in their future planning strategies. The author recognizes the potential conflicts and general difficulty in reaching collaboration to create and implement change. The author also states that climate change is pervasive and significantly impacts

all aspects of life. Due to the pressing nature of climate change impacts, such collaborative change needs to occur in a speedy and efficient manner.

**44. Moen, J., & Fredman, P. (2007). Effects of climate change on alpine skiing in Sweden. *Journal of Sustainable Tourism*, 15, 418-437.**

This article provides a general overview of the effects of climate change in many parts of the world and specifically focuses on Sweden. The article states that in Sweden, the last decade was wetter and warmer than the preceding 30-year period. These changes have inevitably affected activities that depend on the physical environment, such as alpine winter tourism. This article discusses the future development of the skiing industry in Sweden by reviewing trends in alpine winter tourism in relation to climate change together with regional projections of climate change. The article examines climate trends in Sweden during the last 30 years in relation to downhill skiing. The article also discusses potential projections using regional estimations of climate change. In particular the article discusses the effects of climate change on the number of skiing days and potential monetary loss for the ski industry in Sweden. The article states that the predicted losses are larger than current ski-ticket sales. As a result, and in order to mitigate the economic losses, the article suggests that year-round tourist activities be developed in winter tourism areas as soon as possible.

**45. Moreno, A., Amelung, B. (2009). Climate change and tourist comfort on Europe's beaches in summer: A reassessment. *Coastal Management*, 37(6), 550-568.**

This article focuses on the potential impact of climate change on the popular beach tourism destinations within Europe. It identifies areas that are considered the most visited destinations and also points out which of the areas have the greatest risk due to climate change. Using a climate change simulation model, the study used updated tourism and climate change data to obtain the most current and accurate predictions. The results show that in the next 50 years, areas other than the Mediterranean will most likely have a beneficial outcome from climate change yet will not reach the climate suitability of current Mediterranean temperatures. The article finds that Mediterranean beach tourism will likely not be as impacted as previous studies have concluded. The authors recommend that beach tourism managers focus less on temperature and more on other climate change impacts such as sea level rise.

**46. Nicholls, S. (2006). Climate change, tourism and outdoor recreation in Europe. *Managing Leisure*, 11 (3) 151-163.**

This article poses the relationship between climate change and tourism. While climate change will significantly impact outdoor recreation and tourism as whole, tourism is a major contributor to climate change due to its dependency on fossil fuels. This article aims to predict future tourism trends in Europe in the light of continued climate change. The study employs past climatic data highlighting the changes in temperature and other relevant climatic changes as a reference point and focuses on the potential adjustments regarding travel as a result of such changes. Some of the perceived future trends include declines in current high season for the Mediterranean and increasing numbers of visitors in the current shoulder (spring and autumn) months. These changes in travel will have detrimental economic and environmental effects (lack of water, health safety). The article also expects to see a steep decline for travel to ski areas and offer the potential for ski areas to increase their elevations if possible. Urban tourism would also be impacted in the decreased air quality and increased heat stress. Adaptations on the part of hosts and travelers will be necessary (shifting times of day of travel, improving transportation, or opting for another activity or city). The article also emphasizes the need for alternative transportation and the incorporation of new modes of transportation in tourism development plans.

Moreover, the article calls for continued research on climate change and tourism and asks that policy makers and the tourism industry utilize this research to make effective changes that are more sustainable.

**47. O'Connor, R.E., Bord, R. J., & Fisher, A. (1999). Risk perceptions, general environmental beliefs, and willingness to address climate change. *Risk Analysis*, 19, 461-471.**

This article discusses the relationship between risk perceptions and willingness to address climate change. The article discusses a national study which evaluated a national sample of 1225 mail surveys that included measures of risk perceptions and knowledge tied to climate change. The survey instrument included questions regarding: support for voluntary and government actions to address the problem, general environmental beliefs, and demographic variables. The breakdown of responses was in order to assess personal versus governmental changes to mitigate climate change. The article broke respondents into "believers" (those who will take both personal and legislative action) and "non-believers" (for those who will opt out of either personal or collective action), this breakdown was critical in demonstrating the values associated with believing and action to mitigate current climate change. The survey also highlighted a difference between respondents who believed in voluntary self-action versus those who expected governmental action. The analysis of the questionnaire aimed to identify the different perceptions of what causes global warming since this is an important predictor of behavior. Finally, the success of the risk perception variables to account for behavioral intentions should encourage greater attention to risk perceptions as independent variables. The article concluded that despite the fact that risk perceptions, knowledge, and general environmental beliefs are related, these attributes are also independent predictors of behavioral intentions; thus intentions, values, and action are often not synonymous.

**48. Peeters, P., & Dubois, G. (2010). Tourism travel under climate change mitigation constraints. *Journal of Transport Geography*, 18 (3) 447-457.**

This article presents a simulation study of CO<sub>2</sub> emissions caused by global tourism. The article focuses on inventory for 2005 and provides a 30 year projection based on the 2005 inventory. The objective of this article is to describe the current and future of emissions, demonstrate tourism in the light of reduced emissions, and present scenarios. The article states that emissions are expected to grow by 3.2% per year until 2035. The increase in emissions is a direct contraction to the global push to reduce emission by 3-6% yearly. The study proposed 70 scenarios which are presented in a 'landscape' graph exploring the effect of possible ways to reduce the emissions. Furthermore, the study also explored automated scenario generation as a way to define back casting scenarios that meet the emissions target and promote economics. The study compared the value of different ways to approach a (desired) future and gave insight into the kind of structural changes required within tourism and tourism transport in the event that very strong emission reductions are required. The findings of this study indicate that improvements in technology alone are insufficient to reach sustainability targets for CO<sub>2</sub> emissions. Rather, major shifts in transport modes and destination choice are necessary.

**49. Pickering, C., Castley, G., & Burt, M. (2009). Skiing less often in a warmer world: Attitudes of tourists to climate change in an Austrian ski resort. *Geographical Research*, 48(2), 137-147.**

The article states climate change will be detrimental to ski destinations. The article also states that currently there is limited research into attitudes, intentions and actual visitation patterns of skiers in response to reduced snow cover. In order to address this question, a survey composed of 351 ski

tourists in Australia was designed and executed. The survey, which was conducted in 2007, was also to serve as a comparative study, replicating a survey conducted in 1996. The 2007 survey demonstrated that 90 percent of skiers would ski less often in Australian resorts if the next five years had low natural snow. This is an increase from 1996 when 75 percent said they would ski less often with decreased levels of natural snow. Nearly all skiers thought that climate change would affect the ski industry (87 percent in 2007, compared with 78 percent in 1996). Despite extensive snow-making, visitation in Australian resorts was low in poor snow years and visitors stated that this trend would continue. Thus, the article states that visitor attitudes and perceptions reflect the current changes in climate and such trends will continue unless there are significant changes reversing global warming. The article also states that tourism cannot be generalized since it is activity-based and some may benefit, at least in the short term, from climate change. However, the article states that the changes will inevitably be detrimental.

**50. Richardson, R., & Loomis, J. (2004). Adaptive recreation planning and climate change: a contingent visitation approach. *Ecological Economics*, 50 (1-2), 83-99.**

This paper applies a contingent visitation analysis to estimate the effects of changes in climate and resource variables on nature-based recreation demand. A visitor survey at Rocky Mountain National Park included descriptions of hypothetical climate scenarios (depicting both weather- and resource-related variables), and questions about how respondents' visitation behavior would change contingent upon the scenarios. Survey responses are used to estimate the impact of climate change on park visitation and to test for the relative significance among climate scenarios and resource variables. A relatively small proportion of respondents indicated that their visitation behavior would change under the hypothetical climate scenarios, and the net effect on visitation is slightly positive. Both direct (weather-related) and indirect (resource-related) climate scenario variables are found to be statistically significant determinants of contingent expected changes in visitation. The results of the contingent visitation analysis are compared with the results of a regression analysis of historic visitation and climate variation for methodological assessment, and they were found to be in close agreement.

**51. Richardson, R. & Loomis, J. (2005). Climate change and recreation benefits in an Alpine National Park. *Journal of Leisure Research*, 37(3), 307-320.**

This article presents a study conducted which measures the influence of weather conditions on recreation benefits. This incorporates climate change in that it identifies the gains or losses in recreation due to the phenomenon. This study uses Rocky Mountain National Park as a location to test the effect of climate change on visitors' willingness to pay for their recreation experience. The results identified the current net willingness to pay per trip is \$314.95, with the average group size being 4.3 persons and an average length of stay of 3 days. Based on two different climate change models, the study predicts an increase of willingness to pay in 2020 to \$336.05 and \$330.38 respectively. The study does acknowledge that that different climate change implications may affect certain recreation activities differently (e.g. rock climbing, cross country skiing) due to their associated seasons. The overall conclusion is that recreation effects will not likely be a major factor in evaluating economic feasibility of countering the effects of climate change.

**52. Scott, Daniel. (2011). Why sustainable tourism must address climate change. *Journal of Sustainable Tourism*, 19, (1), 17-34**

This opinion piece examines Weaver's thesis that sustainable tourism's current expanding engagement with climate change may not necessarily be conducive to the interests of tourism sustainability. It critically examines and responds to the seven interrelated issues presented by Weaver to support that opinion. This paper dispels some common climate science myths that continue to hamper scientific progress and complicate debate over climate change policy responses and specifically refutes recent claims of compromised and inaccurate research findings. It is argued that climate change studies reveal a deficiency in past conceptualizations of sustainable tourism that focused almost exclusively on destination scale issues and highlight the need to properly account for the environmental and social impacts of tourism's travel phase. Addressing climate change is considered a prerequisite to sustainable development and therefore germane to advancing sustainable tourism research. Tourism is currently considered among the economic sectors least prepared for the risks and opportunities posed by climate change and is only now developing the capacity to advance knowledge necessary to inform business, communities and government about the issues and potential ways forward. Any retreat from engagement with climate change issues by the tourism industry or its researchers would be to their substantial detriment.

**53. Scott, D., Dawson, J., & Jones, B. (2008). Climate change vulnerability of the US Northeast winter recreation – tourism sector. *Mitigation Adaptation Strategies for Global Change*, 13, 577-596.**

This article emphasizes the fact that winter recreation is an important part of the cultural identity and a multibillion dollar industry in the Northeast United States. The article focuses on the snowmobiling and alpine skiing industries and the potential threats to them under four different climate change scenarios. The results indicated that under all scenarios, natural snow becomes an increasingly scarce resource. The diminished natural snow pack would have a very negative impact on the snowmobile industry. The ski industry would invest in snowmaking to mitigate snowmelt. The scenarios estimate that 4 of the 14 ski areas in 2010–2039 would have ski seasons below 100 days and the probability of being open for the entire Christmas–New Year's holiday declined below 75%. Conversely, by 2070–2099 only four ski study areas had not reached these same economic risk criteria. In order to minimize ski season losses, snowmaking requirements are projected to increase substantially, raising important uncertainties about water availability and cost. Climate change represents a notable threat to the winter recreation sector in the Northeast, and the potential economic ramifications for businesses and communities heavily invested in winter tourism and related real estate is sizeable.

**54. Scott, D., Jones, B., & Konopek, J. (2008). Exploring potential visitor response to climate-induced environmental changes in Canada's Rocky Mountain National Parks. *Tourism International*, 12(1), 43-56.**

The authors emphasize that climate change could have detrimental effects on the natural landscape of mountain parks world-wide and as a result, efficient conservation and planning are necessary. The authors also state that there is limited information on tourists' perceptions of such a projected environmental change. A study was conducted to explore this question in the context of Canada's Rocky Mountain national parks. A visitor survey was administered in two national parks: Banff and Waterton Lakes. Different environmental change scenarios were constructed. The scenarios for the early and mid-decades of the 21st century were found to have minimal influence on intention to visit. The environmental change scenario for the latter decades, under a high emission climate change scenario, was found to have a negative effect on intention to visit, 36 percent of respondents indicated they would visit the parks less often and 25 percent stated they would not visit them at all. Visitors most

likely to be negatively affected by climate-induced environmental change were nature-based tourists from overseas, motivated by the opportunity to view mountain landscapes and wildlife. The study is significant in that it presented a new layer of information regarding tourist's perceptions and response to environmental changes induced by global climate change.

**55. Scott, D., Jones, B., & Konopek, J. (2007). Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A case study of Waterton Lakes National Park. *Tourism Management*, 28 (2) 570-579.**

This article examined how climate change may influence park tourism in the Rocky Mountain region by focusing on both the direct and indirect impacts of climate change for visitors to Waterton Lakes National Park. A statistical model of monthly visitation and climate was developed to examine the direct impact of climate change on visitation. While warmer temperatures would increase visitation length and increase revenues, this extension could also cause detrimental environmental impacts on already fragile and responsive ecosystems. There is much uncertainty about the impact of climate change on park visitation for the Rocky Mountain region although a few studies have been conducted demonstrating an increase in visitation in the first part of the 21<sup>st</sup> century and a decline in the second half, also negative and potentially drastic environmental impacts for the second half. Monthly recorded visitation data (number of person visits) from WLNP for the 1996–2003 (January–December) tourism seasons were used in this study to assess the influence of climate on visitation. Climate change projections for three future timeframes were examined, each of which were based on a 30-year period of climate data (i.e. the 2020s represent the period 2010–2039; the 2050s represent 2040–2069; and, the 2080s represent 2070–2099). All scenarios represent climate changes with respect to the 30-year baseline climate (1961–1990). The environmental change scenarios for the 2020s and 2050s were found to have minimal influence on visitation, however the environmental change scenario for the 2080s (under the warmest climate change conditions) was found to have a negative effect on visitation, as 19 percent of respondents indicated they would not visit the park and 37 percent stated they would visit the park less often. The contrasting result of the two analyses for the longer-term impact of climate change was a key finding.

**56. Scott, D., McBoyle, G., Minogue, A., & Mills, B. (2006). Climate change and the sustainability of ski-based tourism in eastern North America: a reassessment. *Journal of Sustainable Tourism*, 14 (4) 376-398.**

This article discussed the detrimental effects of climate change on the winter tourism industry, and alpine skiing in particular. Many of the studies previously conducted on skiing and climate change did not include the potential of snow-making as potential coping strategy. Considering that snow-making is essential to northeastern U.S. ski resorts, thus the impact for these results would not be as severe. This article discussed the expense, accessibility and dependence of ski resorts on artificial snow and the potential for this system to expand and improve in the future. The study focuses on ski areas in Michigan, Vermont, Quebec and Ontario. Climate change scenarios were obtained from the Canadian Climate Impact Scenarios project, using a potential 25 scenarios representing global climate trends. Specifically, the study focused on distance and elevation and length and quality of records for each ski area. The results indicate that even in the warmest climate change period (2020) there would only be a minor threat to four of the six ski areas. However, the article also indicates a severe threat to the sustainability of three out of the six ski areas in the 2050's. The article also states the potential

consolidation and shift of the ski industry as a whole. Thus, some ski areas will be better equipped than others, as a result, efficient business planning is encouraged.

**57. Scott, D., McBoyle, G., & Schwatzenruber, M. (2004). Climate change and the distribution of climatic resources for tourism in North America. *Climate Research*, 27, 105-117.**

This article identifies potential changes in climate within various tourism areas of North America by using a tourism climate index (TCI) and various potential climate scenarios in the upcoming decades. The overall analysis found a significant redistribution of climate resources for tourism activities throughout the continent. It is apparent that there will be a need to modify and adapt to the climatic changes in order to maintain the destination as a tourism attraction. Some areas will gain attraction due to the warming because it creates a more favorable temperature range for tourism. This is particularly true for northern USA and Canada. The number of cities in the US with a favorable TCI rating in the winter months is expected to increase while TCI ratings in Mexico are expected to decrease due to projected heat and sultriness.

**58. Scott, D., & Suffling, R. (2000). *Climate change and Canada's national park system*. Hull, Quebec: Environment Canada and Parks Canada.**

This article examined the potential impact of climate change on the annual number of visitors and the seasonal pattern of visitation in Canada's national parks. Multivariate regression analysis using four climate variables and monthly visitation data for 1996 to 2003 was used to develop a monthly climate-visitation model for 15 high visitation parks. Each park-specific model was then run with two climate change scenarios to assess potential changes in park visitation under a range of climatic conditions projected for the 2020s, 2050s and 2080s. In the 2020s, overall visitation levels were projected to increase 6 percent to 8 percent, with a number of parks projected to experience larger increases (+12% to 30%). The largest increases in visitation occur during the spring and fall months. Visitation was projected to increase between 9 percent and 29 percent system-wide in the 2050s and between 10 percent and 41 percent in the 2080s. Management implications of the findings include a probable need for more intensive visitor management strategies, especially in parks where additional visitors could significantly stress natural resources or lead to the escalation of conflicts among user groups.

**59. Scott, D., Wall, G., & McBoyle, G. (2005). *Tourism, recreation, and climate change*. Hall, C., & Higham, J. *The evolution of the climate change issue in the tourism sector*. P.44**

This chapter provides a chronological review of the implications of climate change on tourism. This chapter provides an excellent background on the issue and its academic evolution. The chapter is divided into the formative phase (1960's and 70's) where the issue was perceived as a potential problem, the stagnation period (1980's) where climatic studies were redirected toward physical and not social sciences, the emergence of climate change (1990's) where climate change was first discussed in the political sphere and increasing academic articles as a result of international recognition of the issue at a global scale. During this time period, more awareness of climate change and its potential effects on tourism was generated and the issue was further refined to specific regions including mountains, oceans/islands, and aquatic ecosystems. The next phase is that of maturation (2000-present) which maintains the sense of urgency regarding climate change, but also notes the need to incorporate tourism and recreation experts in climate change discussions. Thus, this phase calls for more integration between tourism literature and climate change work. Moreover, this chapter evaluates the UN's Intergovernmental Panel on Climate Change through the decades.

**60. Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability, *Global Environmental Change*, 16, 282-292.**

This paper reviews the concept of adaptation of human communities to global changes, especially climate change, in the context of adaptive capacity and vulnerability. It focuses on scholarship that contributes to practical implementation of adaptations at the community scale. In numerous social science fields, adaptations are considered as responses to risks associated with the interaction of environmental hazards and human vulnerability or adaptive capacity. In the climate change field, adaptation analyses have been undertaken for several distinct purposes. Impact assessments assume adaptations to estimate damages to longer term climate scenarios with and without adjustments. Evaluations of specified adaptation options aim to identify preferred measures. Vulnerability indices seek to provide relative vulnerability scores for countries, regions or communities. The main purpose of participatory vulnerability assessments is to identify adaptation strategies that are feasible and practical in communities. The distinctive features of adaptation analyses with this purpose are outlined, and common elements of this approach are described. Practical adaptation initiatives tend to focus on risks that are already problematic, climate is considered together with other environmental and social stresses, and adaptations are mostly integrated or mainstreamed into other resource management, disaster preparedness and sustainable development programs.

**61. Strasdas, Wolfgang. (2010). "Carbon Management in Tourism – A Smart Strategy in Response to Climate Change." In *Trends and Issues in Global Tourism 2010* by Roland Conrady & Martin Buck. Springer: Verlag Berlin Heidelberg, , p.57-70.**

Worldwide, tourism is responsible for about 5 percent of energy-related CO<sub>2</sub> emissions. If tourism were a country it would be in 5<sup>th</sup> place after the USA, China, Russia and India as a major polluter. Aviation accounts for 40 percent of the tourism pollution and automobile traffic for 32 percent. Accommodations account for 21 percent. If tourism is to continue to thrive as an economic activity, substantial savings in emissions need to be made. Suggestions are made on how carbon management can be implemented. These include technological, managerial, modal shift, behavioral, preferences, social marketing, carbon labeling, and policy. Technological: insulation of pipes/buildings, heat recovery, renewable energies, automated systems in guest rooms. Managerial: optimizing logistics or processes, staff management, customer information, traffic management and purchasing. Modal Shift: shifting tourism mobility from more energy-intensive to less energy-intensive modes of transport. Behavioral: Changes and development of corresponding travel products that are less energy-intensive (especially increased length of stay in exchange for fewer trips and preference of nearby destinations with less energy consumption per day of travel). Preferences: Giving preferences to domestic and nearby regional source markets over long-haul markets. Social Marketing: use as tool to instigate behavioral change and sell climate-friendly travel products. Carbon labeling: label as a communication and management tool. Finally Policy: use of different instruments such as regulation, financial incentives and more investments into climate-friendly public infrastructure (railways, bike paths, etc.).

**62. Uyarra, M., Cote, I., Gill, J., Tinch, R., Viner, D., Watkinson, A. (2005). Island-specific preferences of tourists for environmental features: implications of climate change for tourism-dependent states. *Environmental Conservations*, 32(1), 11-19.**



This article identifies the importance of environmental attributes in determining the choice and enjoyment of tourists in two Caribbean islands. This location was chosen because in recent years it has become one of the most tourism dependent regions in the world. It is therefore an area that has much to lose from the impacts of climate change. Standardized questionnaires were given to 316 participants in Bonaire and 338 in Barbados asking which environmental features were most important in determining holiday destination choice. The questions regarding climate change identified scenarios of severe bleaching and mortality of coral reefs and beaches that have "largely disappeared" due to the rising sea level. 80 percent of the respondents stated they would not be willing to return to the island for the same price if sea surface temperature bleached and destroyed coral reef systems and rising sea levels reduced beach area.

**63. Viner, D. (2006). Editorial: Tourism and its interactions with climate change. *Journal of Sustainable Tourism*, 14 (4), 317-322.**

This article is a good introductory piece to the dilemma of tourism and climate change. The article's author stresses that anthropogenic climate change has been increasingly recognized as the major threat to large sections of the society and the environment. He points out that there has been little research undertaken on the impacts of climate change on tourism and this resulted in the publication of only a small volume of peer-reviewed research to date. He also offers some studies for further research and to provide background on the issue. He argues that studies which are undertaken by climate scientists have shown that it is not only the magnitude of changes which are increasingly unprecedented but also the rate of those changes. Moreover, he argues for continued research on climate change and tourism and for tourism to respond proactively in light of the current climate change situation.

**64. Wall, G. (1998). Implications of global climate change for tourism and recreation in wetland areas. *Climatic Change*, 40 (2), 371-389.**

Tourism and recreation are important economic activities which are major agents of change globally and, more specifically, in wetland areas. There is a regular round of activities associated with the seasons and anything which influences operating seasons is likely to have substantial consequences for tourism businesses. Atmospheric conditions can influence participation and quality of the experience. In marine coasts, wetland recreation may be threatened by rising sea levels but recreation in inland water bodies may be affected more by deficiencies rather than superabundance of water. Marinas and recreational boating are harmed by extremes of both high and low water, particularly the latter which are the most likely situation under global climate change. Two main groups can be considered with respect to the potential to adapt to climate change. These are the participants themselves and the businesses who cater to them. It is argued that the former are likely to be much more adaptable than the latter.

**65. Wall, G., & Badke, C. (1994). Tourism and climate change: An international perspective. *Journal of Sustainable Tourism*, 2, 193-203.**

This paper addresses the implications of climate change for tourism through a survey of national tourism and meteorological organizations. While climate change may have far-reaching consequences for tourism, it is shown that while most respondents felt that climate is important to their country's tourism

industry, very few were aware of climate change research specifically related to tourism. Almost half felt climate change is or could become a significant issue in their country but almost no climate change publications with direct bearing on tourism are available. It is concluded that climate is an important determinant of tourism, and that global climate change may create new challenges and opportunities, for the tourism industry. However, more awareness, research, and policy analysis are necessary to reduce uncertainties, further understanding, assess implications and enable the tourism industry to adapt to changing circumstances.

**66. Weaver, David. (2011). Can sustainable tourism survive climate change? Journal of Sustainable tourism, 19 (1), 5-15.**

This opinion piece contends that tourism's expanding engagement with climate change, as it is currently unfolding, is not necessarily conducive to the interests of tourism sustainability. Inherent unpredictability, long-term timeframes, lack of directly tangible consequences or clearly identifiable villains, issues with credibility and vested interests and cost implications in an era of chronic economic uncertainty all combine to increase the likelihood of unsuccessful climate change policies and strategies. Additional complications arise within the tourism sector from the rudimentary state of knowledge about the relationships between tourism and climate change, an apathetic and fickle travelling public and a reciprocally uncommitted tourism industry. I argue that adaptation is a rational business response to climate change that is not directly related to environmental and sociocultural sustainability, and that mitigation measures should be supported to the extent that they yield practical and tangible short- and medium-term benefits and address local sustainability issues such as air quality and biodiversity protection.

**67. Zeppel, Heather, & Narelle Beaumont. (2011). Climate change and Australian Tourism: A Research Bibliography. Australian Centre for Sustainable Business and Development, University of Southern Queensland.**

This working paper <http://www.usq.edu.au/acsbd/publications/workingpapers> provides a bibliography of nearly 1,000 reports, projects and articles conducted about tourism and climate change in Australia from 1996 to 2010. Reports fall under 14 categories: Climate change and Australian Tourism; Australian Accommodation and Climate Change; Australian Aviation and Climate Change; Carbon footprint of Australian Tourism; Carbon Offsets in Australian Tourism; Conference Papers on Climate Change and Australian Tourism; Journal Articles on Climate Change and Australian Tourism; Sustainable Tourism CRC – Climate Change Research; Government Tourism Agencies and Climate Change; Industry Tourism Organisations and Climate Change; Climate Change Impacts on Australian Tourism Destinations; Great Barrier Reef; States and Territories, and; International Reports on Climate Change and Tourism.

**68. Zeppel, Heather, & Narelle Beaumont. (2011). Green Tourism Futures: Climate Change Responses by Australian Government Tourism Agencies. Australian Centre for Sustainable Business and Development, University of Southern Queensland**

The Australian National Climate Change Adaptation Framework identified tourism as one key sector vulnerable to the impacts of climate change in Australia. This paper evaluates how nine government tourism agencies are responding to the issue of climate change in Australia. Information on climate change, sustainability and going green is drawn from the corporate websites, annual reports, tourism plans, fact sheets, and case studies produced by these government tourism agencies from 2007 to 2010. The paper critically evaluates how government tourism agencies are addressing climate change issues,

by promoting carbon reduction initiatives and carbon offsetting schemes for tourism operators. Climate change tourism responses are more developed in Australian states with climate change policies and in destinations vulnerable to the impacts of climate change or dependent on long-haul travelers.

## Climate Change and Tourism: Literature Review References

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