Tourism Management Perspectives 5 (2013) 51–56

Contents lists available at SciVerse ScienceDirect

Tourism Management Perspectives

journal homepage: www.elsevier.com/locate/tmp

Weather, climate, and tourism performance: A quantitative analysis

Jonathon Day [a,*], Natalie Chin [b], Sandra Sydnor [a], Keith Cherkauer [b]

[a] School of Hospitality and Tourism Management, Purdue University, 900 State Street, West Lafayette, IN 47907, USA
[b] Dept of Agriculture and Biological Engineering, Purdue University, 225 S University St., West Lafayette, IN 47907, USA

ARTICLE INFO

Article history:
Received 6 September 2012
Accepted 5 November 2012

Keywords:
Weather
Climate
Tourism
Destination
Hotel performance
Hospitality

ABSTRACT

Weather is a component of tourism destinations that impacts demand, provision of services, and destination image. As a result, changes in weather can impact destination performance in a variety of ways. The current study examined the impact of weather variations on weekly (revenue per available room or RevPAR) and annual (number of establishments, annual payroll, first quarter payroll, and number of employees) economic indicators for 5 locations in the United States including San Diego, California; Las Vegas, Nevada; Vail, Colorado; Chicago, Illinois and Miami, Florida. Analysis confirmed that weather impacted economic performance in both the short (weekly) and medium (annual) term. These results provide insight into the impacts of weather on tourism destinations and the impact of climate or long term weather change at destinations.

1. Introduction

The relationship between weather, climate, and tourism destinations is broadly acknowledged. Climate plays several important roles in tourism. It can be characterized as an asset for destinations and can be considered an important attraction for visitors. The perception of a destination's climate also can be an important component of the destination's image. As a result of these roles, climate is a common theme in tourism promotion. As Mill and Morrison note, "Climate is perhaps the most common marketing theme used as the basis for selling a tourism region once it has suitable visitor attractions" (Mill & Morrison, 2009, p. 20).

The National Aeronautics and Space Administration (NASA) describes the difference between weather and climate as "…a matter of time. Weather is what conditions are in the atmosphere over a short period of time and climate is how the atmosphere 'behaves' over relatively long periods of time" (NASA, 2005). Weather and climate impact the demand for tourism at destinations and have direct and indirect impacts on industry costs, revenues, and profitability. The purpose of the present study was to examine the impact of weather on the tourism system over an extended period of time. This study examined the impact of unusual weather on 5 destinations over several decades using two time units – weekly and annual – to better understand the short-term and medium-term impacts of specific weather events. The study addressed the following research questions:

1. What impact do significant variations on average weather have on the economic performance of destinations in the short-term (weekly)?
2. What impact do significant variations have on the economic performance of destinations in the medium-term (up to 1 year)?

2. Literature review

2.1. Roles of weather and climate in tourism

"Tourism is a highly climate-sensitive economic sector" (UNWTO & UNEP, 2008) but, as the impacts of climate change become more apparent, it is increasingly important to understand the relationship of climate to the tourism system. Extant research about the relationship between weather and tourism can be categorized into four research streams: weather as a motivator for travel, weather as a component of image, weather as a destination asset, and weather as a disruptor of tourism activities.

Weather is often described as a motivator for travel. One common motivation theory identifies "push" and "pull" factors for travel (Crompton, 1979). Weather is considered a "pull" factor by several authors (Turnbull & Uysal, 1995). In particular, warm weather motivates travelers to visit and climate is a common theme in tourism promotion. As Mills and Morrison note, "Climate is perhaps the most common marketing theme used as the basis for selling a tourism region once it has suitable visitor attractions" (Mill & Morrison, 2009, p. 20). While good weather is a motivator, poor weather can be a disincentive for travel. Over the long term, expectations of poor weather may restrain tourism to a destination (Thapa, 2012). In the short term, weather also can be a significant disruptor of tourism activity. Such is true for both major weather events, such as cyclones, tornadoes and

* Corresponding author. Tel.: +1 765 3377270.
E-mail addresses: jonday@purdue.edu (J. Day), chinn@purdue.edu (N. Chin), ssydnorb@purdue.edu (S. Sydnor), cherkaue@purdue.edu (K. Cherkauer).

2211-9736/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.tmp.2012.11.001

hurricanes as well as seasonal factors. Cook (Cook, Yale, & Marqua, 2010) noted that even mild winters can have an impact on ski-related businesses as in the case of 1999–2000. The impact of short-term weather events can have long-term implications for destinations. For instance, Coghlan and Prideaux (2009) noted that bad weather experiences can more negatively impact visitor satisfaction than good weather experiences positively impact such satisfaction.

Weather is an "intangible asset" for some destinations in two ways — the weather experience as part of the set of experiences of the destination and as part of the image of the destination. Ritchie and Crouch (2003) described climate as a component of the physical resources of a destination that creates comparative advantage. They noted climate often "dominates" other competitive factors. Ritchie and Crouch also noted certain types of climate are preferred by consumers. Indeed, study has been undertaken concerning consumer perceptions of ideal weather conditions by several researchers. Amelung, Nicholls, and Viner (2007) used climate indices to project the impact of climate change on destination attractiveness and seasonal tourism flows. Bigano, Hamilton, and Tol (2006) examined tourists from 45 countries and determined that, in general, tourists prefer countries with sunny yet mild climates. Lise and Tol (2002) asserted that tourists based in Organization of Economic Cooperation and Development (OECD) countries prefer destinations with an average temperature of 21 °Celsius in the hottest month of the year. They noted that changes in temperature may impact tourists' destination choices. Also there is evidence that, while there are general preferences for weather, ideal weather is contingent on expectations and that "good", "bad", and "acceptable" are not absolute terms but dependent on consumer expectations. As such, visitors to the Arctic have different expectations (Steen Jacobsen, Denstadli, Lohmann, & Førland, 2011) than visitors traveling to a beach resort in the Caribbean. Scott, Gossling, and de Freitas (2008) tested perceptions of ideal weather in a variety of conditions resulting in the development of "Tourism Climate Indexes". Other factors, such as motivations for travel, have been shown to impact perceptions of ideal and acceptable weather (Denstadli, Jacobsen, & Lohmann, 2011).

Weather is also an important component of destination image. A review of destination image studies revealed that weather is considered an important component of the image of a destination (Baloglu & Mangaloglu, 2001; Echtner & Ritchie, 1991; Gallarza, Saura, & Garcia, 2002; Hanlan & Kelly, 2005; Pike, 2010). A positive image of the climate of the destination contributes to the positive image of the destination as a whole and that positive image can be considered an intangible asset for the community. Image changes slowly and operators of tourism-dependent companies "trade" on the image of their destination's pleasant climate even when weather is "uncharacteristically" unpleasant. Tasci and Gartner (2007) described the intangible asset that positive images create "image capital".

2.2. Weather and the economic performance of tourism destinations

The weather impacts the profitability of the tourism industry in several ways, including reducing or increasing demand for a destination, reducing or increasing customer satisfaction and loyalty for the destination, and increasing costs associated with providing tourism-related products and services. Extant research indicates that the relationship between climate and demand can be complex. Gossling, Scott, Hall, Ceron, and Dubois (2011) noted that a great variety of factors influence consumer behavior including factors internal to the consumer, such as motivation and expectations, as well as the actual experience. At a macro-level, there is a body of research indicating that some types of climate are generally more appealing than others. Several authors have identified factors that are appealing and increase demand (Bigano et al., 2006; Lise & Tol, 2002). One may suggest that changes in climate will impact demand of destinations (Amelung et al., 2007; Smith, 1990). Several researchers have noted that weather impacts demand in non-linear ways. For instance, poor weather at one destination can increase demand in another several months later (Perry, 2006; Smith, 1990). Also noted, there will be "winners" and "losers" as climate changes in that some countries and regions are likely to become more attractive while others become less attractive (Hamilton & Tol, 2006). In addition, studies also have identified weather as a factor in satisfaction and loyalty. Coghlan and Prideaux (2009) noted that the weather conditions experienced by visitors to the Great Barrier Reef, Australia, impact their satisfaction and behavioral loyalty to the destination.

Economic performance at tourism destinations is influenced by demand and supply issues. Several authors have noted that changes in weather and climate impact costs. Increased costs range from snowmaking in ski locations (Dawson & Scott, 2007; Scott, McBoyle, Minogue, & Mills, 2006) to the need for major infrastructure investments, such as those noted in Clayton's (2009) assessment of the implications of climate change on Caribbean tourism. Weather volatility has become recognized as a critical risk for tourism-related business, companies must face costs in dealing with these risks. Recent research by Tang and Jang (2012) identified that hedging may be a way for tourism-related companies to mitigate the challenges of weather.

Several authors have identified the need for additional research about the economic impacts of weather and climate change on tourism. A review of extant research revealed no systematic examination of the impact of weather on industry profitability and economic performance. Therefore, the present study was developed to provide new insights for practitioners and academics.

2.3. Weather, climate change, and tourism

In recent years, tourism researchers have examined climate change and its impact on tourism activity in a variety of settings. Research has examined the impact of climate change on the Caribbean (Clayton, 2009), the Mediterranean (Perry, 2006) and the United States (Dawson & Scott, 2007; Scott et al., 2006). These studies analyzed mitigation issues and adaptation issues (Patterson, Bastianoni, & Simpson, 2006; Scott & Becken, 2010). The examination of weather has been primarily case-based and descriptive.

Unusual weather is frequently used as a proxy for weather changes expected as climate changes. Understanding the impact on the tourism companies and tourism dependent communities caused by unusual weather is considered a useful surrogate for anticipating impacts. Even the general term "weather" includes many components; some of these components may have greater impact on travel and tourism than others. Recent research about weather-related factors noted that showers and thunderstorms had a greater impact on tourism-related activities than temperature (Yu, Schwartz, & Walsh, 2009).

Despite general recognition of the importance of climate there has been little examination of the impact of climate and, more specifically, weather on the success of tourism destinations. As community leaders develop tourism to generate economic benefits for their destinations, the role of climate needs to be understood thoroughly. This is particularly important for destinations that face changing weather patterns as changes in climate accelerate.

3. Methodology

The potential relationship between the economic performance of the hospitality and tourism industry and historic climate change was researched for five locations in the United States: Chicago, Illinois; Las Vegas, Nevada; Miami, Florida; San Diego, California; and Vail, Colorado (Colorado Ski Area) (see Fig. 1). These particular study sites were selected because they are popular tourist destinations and are likely to experience very different patterns in terms of climate impacts due to their spatial variability.

3.1. Annual analysis

The possibility of a medium-term impact from climate on economic performance was explored by comparing annual data concerning total precipitation, hot degree days, and cold degree days with annual data concerning number of establishments, annual payroll, first quarter payroll, and number of employees for each study site from 1986 to 2008. Climate metrics were calculated using daily observed data from the National Oceanic and Atmospheric Administration's National Climate Data Center's climate database (http://www.ncdc.noaa.gov/oa/ncdc.html) extracted and gridded to the nearest 1/8° latitude by longitude according to the methodology described by Hamlet and Lettenmaier (2005). For each city, total annual precipitation (mm) was calculated by summing the daily precipitation values for each year. The numbers of hot and cold degree days (number of days based on degrees Celsius) were calculated by summing the total number of degrees above and below set temperature threshold values (Table 1) for each day of each year. To better capture "abnormal" climate patterns, the mean value for each metric was calculated and subtracted from the annual values for each year.

Tourism metrics were calculated using the Census Bureau's "Statistics of U.S. Businesses" and "County Business Patterns" databases. These databases contain information about economic performance for each industry by county for the United States since approximately 1946, including the number of establishments, annual payroll (in $ thousands), first quarter payroll (in $ thousands), and the number of employees. Data for the following counties were used for the five cities chosen for the study:

- Chicago, Illinois: Cook County
- Las Vegas, Nevada: Clark County
- Miami, Florida: Miami-Dade County
- San Diego, California: San Diego County
- Vail, Colorado: Eagle County

Table 1
Threshold values used for degree day calculations (degrees Celsius).

City	Cold temperature threshold	Hot temperature threshold
Chicago, IL	−8	30
Las Vegas, NV	0	40
Miami, FL	15	32
San Diego, CA	10	27
Vail, CO	−18	24

Since 1998, data for the hospitality and tourism industry has been grouped under North American Industry Classification System (NAICS) Sector 72 — Accommodation and Food Services. Prior to 1998, the Census Bureau used Standard Industrial Classification (SIC) codes. Based on documentation from the Census Bureau's website, data for the following SIC codes were extracted and summed to get a total value for each of the four indicators that was comparable to the establishments included in NAICS Sector 72:

- 5460 Retail Bakeries
- 5812 Eating Places
- 5813 Drinking Places
- 5963 Direct Selling Organizations
- 7000 Hotels and Other Lodging Places
- 7010 Hotels, Motels, and Tourist Courts
- 7020 Rooming and Boarding Houses
- 7032 Sporting and Recreational Camps
- 7033 Trailer Parks for Transients
- 7040 Membership-Basis Organization Hotels (United States Census Bureau)

Due to the differences in the Census Bureau's classification system before and after 1998, the data sets were split into two time periods

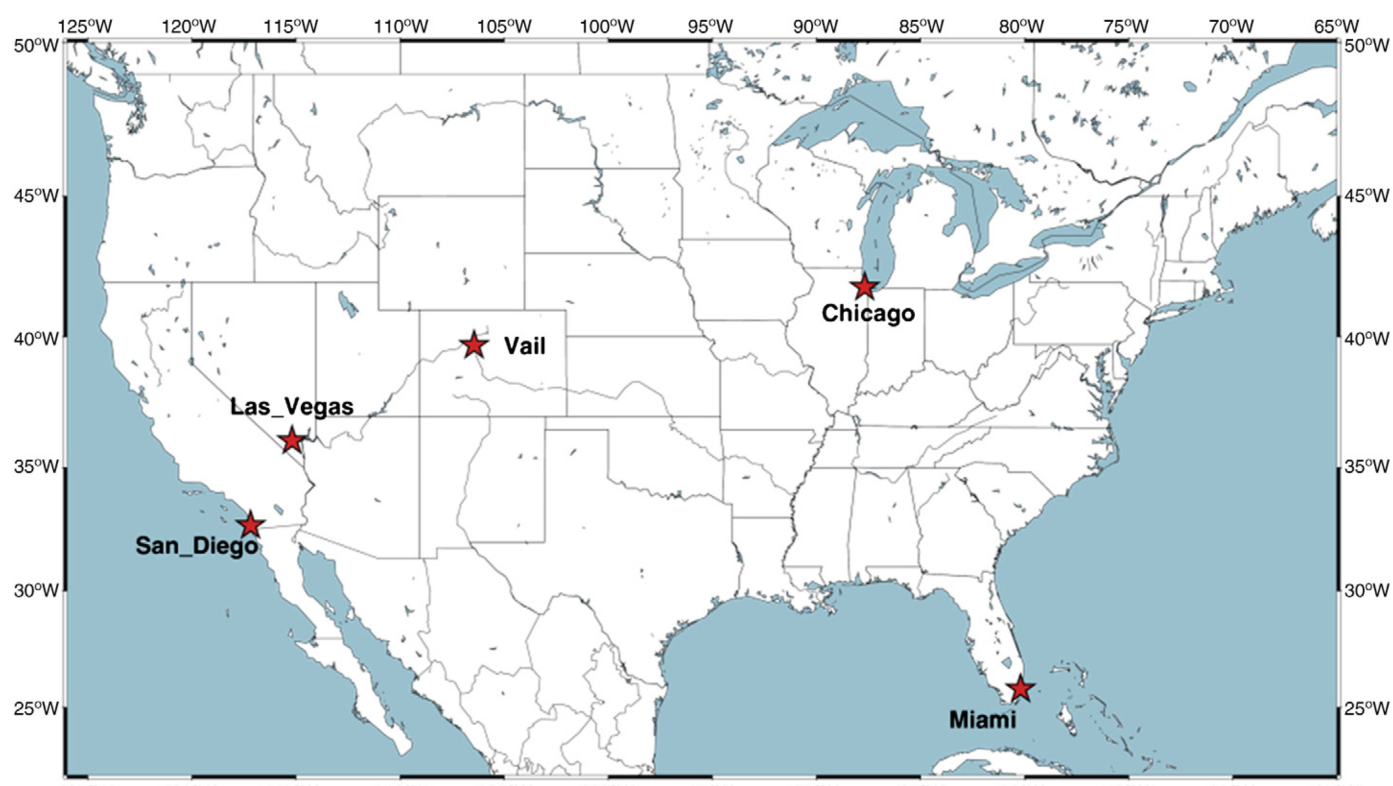

Fig. 1. Locations of the five cities used for the present study.

Table 2
Statistically significant results for 1986–1997.

City	Economic variable(s) with significant regression models	Significant climate variable(s)	Parameter estimate(s)
Chicago	Change in first quarter pay	Total precipitation	4.69888
		Hot degree days	0.92930
	Change in number of establishments	Total precipitation	376.23621
Las Vegas	Change in employees	Total precipitation	0.00935
	Change in first quarter pay	Total precipitation	168.41420
	Change in annual pay	Total precipitation	1162.01939
	Change in number of establishments	Total precipitation	4711.46135
Miami			
San Diego	Change in employees	Total precipitation	0.00707
	Change in first quarter pay	Total precipitation	17.16534
	Change in annual pay	Total precipitation	120.77819
	Change in number of establishments	Total precipitation	495.39401
Vail	Change in employees	Total precipitation	0.09787
	Change in first quarter pay	Total precipitation	40.70896
	Change in annual pay	Total precipitation	258.92129
	Change in number of establishments	Total precipitation	967.77786

for analysis: 1986–1997 and 1998–2008. In addition, any linear trend was removed from these data sets to account for the general upward growth in the tourism industry from 1986–2008. These data sets were analyzed using linear regression in SAS.

3.2. Weekly analysis

The possibility of a short-term impact from climate on economic performance was explored by comparing weekly data for total precipitation, hot degree days, and cold degree days with weekly data on the revenue per available room (RevPAR) (in $) for each location from the week starting December 28, 2003 through the week starting February 26, 2012. Climate metrics were calculated using daily observed data from the National Oceanic and Atmospheric Administration's National Climate Data Center's climate database (http://www.ncdc.noaa.gov/oa/ncdc.html) for each city. Data for the following stations were used for the five cities chosen for the study:

- Chicago: O'Hare International Airport, Station 94846
- Miami: Miami International Airport, Station 12839
- San Diego: San Diego International Airport, Station 23188
- Las Vegas: McCarran International Airport, Station 23169
- Colorado Ski Area: Denver International Airport, Station 3017[1]

Table 3
Statistically significant results for 1998–2008.

City	Economic variable(s) with significant regression models	Significant climate variable(s)	Parameter estimate
Chicago	Change in employees	Total precipitation	0.00653
	Change in first quarter pay	Total precipitation	23.08433
	Change in annual pay	Total precipitation	215.03892
		Cold degree days	1.74576
	Change in number of establishments	Total precipitation	959.66219
		Cold degree days	6.32025
Las Vegas	Change in employees	Total precipitation	0.00564
	Change in first quarter pay	Total precipitation	39.17985
		Hot degree days	1.34079
	Change in annual pay	Total precipitation	515.71335
	Change in number of establishments	Total precipitation	1924.98816
		Cold degree days	0.0127
Miami	Change in employees	Total precipitation	0.01330
	Change in first quarter pay	Total precipitation	24.10266
	Change in annual pay	Total precipitation	262.04480
		Cold degree days	1.10328
	Change in number of establishments	Total precipitation	1043.95192
San Diego	Change in employees	Total precipitation	0.00738
	Change in first quarter pay	Total precipitation	33.87599
		Hot degree days	0.98304
	Change in annual pay	Total precipitation	271.78787
	Change in number of establishments	Total precipitation	1070.25953
Vail	Change in employees	Total precipitation	0.34025
		Hot degree days	−0.00656
	Change in first quarter pay	Total precipitation	36.87060
	Change in annual pay	Total precipitation	805.32251
		Hot degree days	−15.52083
		Cold degree days	2.01479
	Change in number of establishments	Total precipitation	2089.36761
		Hot degree days	−32.57447
		Cold degree days	4.48058

Total weekly precipitation was calculated by summing the daily precipitation values for each week. The numbers of hot and cold degree days were calculated by summing the total number of degrees above and below set temperature threshold values (Table 1) for each day of each week. The seasonal signal evident in each set of climate data was removed using time series analysis in R to isolate patterns in climate outside of seemingly normal seasonal variations.

Revenue per available room (RevPAR) was used as the tourism metric for analysis. The RevPAR data was supplied by STR Global, an international supplier of hotel industry data. STR Global determines RevPAR by dividing the total guest room revenues divided by the total number of rooms (STR, nd). RevPAR is a useful metric as it takes into account the total number of rooms at a destination. The seasonal signal evident in each set of data was removed using time series analysis in R to isolate patterns in RevPAR outside of “normal” seasonal variations. Similar to the annual analysis, these data sets were analyzed using linear regression in SAS.

4. Results

4.1. Annual analysis

For each city, linear regression was used to explore any correlation between the three climate variables (total precipitation, hot degree days, and cold degree days) and the four economic variables (number of establishments, annual payroll, first quarter payroll, and number of employees). There was some evidence of multicollinearity between the different climate metrics, but the variable inflation factors (all below 5) indicated that this was not a problem. The statistically significant results ($p<0.05$) are summarized in Tables 2 and 3.

Results suggest that total precipitation in all of the cities had a significant positive correlation with many of the indicators developed to gauge economic performance of the tourism industry (with the exception of Miami between 1986 and 1997). Hot degree days had a significant positive correlation, albeit a more limited one, with the economic

[1] RevPAR data for Vail, CO was available only through the “Colorado Ski Area” so the area of interest was expanded to include Denver, CO.

performance of the tourism industry for Chicago, Las Vegas, and San Diego. Hot degree days also had a significant negative correlation with three of the metrics used to gauge the economic performance of the tourism industry (change in employees, change in annual pay, and change in the number of establishments) for Vail between 1998 and 2008. Cold degree days had a significant positive correlation with some of the indicators developed to gauge economic performance of the tourism industry for all five cities between 1998 and 2008.

4.2. Weekly analysis

For each city, linear regression was used to explore any correlation between the three climate variables (total precipitation, hot degree days, and cold degree days) and RevPAR for the week starting December 28, 2003 through the week starting February 26, 2012. The statistically significant results ($p<0.05$) are summarized in Table 4.

Results suggest that cold degree days had a significant positive correlation with RevPAR for San Diego and a significant negative correlation with RevPAR for Vail. The relationship between RevPAR and the climate variables was not statistically significant for any of the other three cities or any of the variables other than cold degree days for these two cities.

5. Discussion and conclusion

Based primarily on anecdotal evidence a commonly held perspective is that weather has an impact on tourism. The current study examined short- and medium-term weather-related factors on economic indicators. While there is evidence to support that perspective, the impact is dependent on a wide variety of factors.

One should note that all destinations examined were impacted by weather-related issues. The annual data revealed that, even in destinations where climate is not considered a tourism attraction such as Chicago and Las Vegas, weather showed some level of correlation with performance. The study also reinforced that precipitation rather than only temperature should be considered when assessing weather impacts. All economic indicators showed significant correlations with total precipitation and hot degree days (only once for employees and annual pay); only annual pay and number of establishments showed significant correlations with cold degree days. In the longer term, warmer weather had a positive relationship with economic performance, even at “snow/cold weather” destinations. An exception was when weather defied expectations, in particular hot degree days in Vail as a primarily cold weather destination, tended to have negative impact on annual results.

Perhaps the most important finding of the study was what was not found. In the short term, there was little evidence of impact of weather on economic performance, with the exception of cold days in Vail and San Diego. Over the period examined, there was not statistically significant impact from short-term heat waves or “wet” conditions in the short term (weekly) results.

This study reinforced several previously held assertions. Gossling et al.'s (2011) finding that climate factors should include more than temperature variables is supported. For instance, the tourism industry will be affected differently by climate change depending on location. Additionally, tourism is a complex adaptive system characterized by nonlinear relationships. The impact of weather provides an example of the non-linear relationships and the complexity of predicting impacts.

As noted previously, abnormal weather is often used as a predictor of the impacts of climate change. Based on the findings of the current study using the study's metrics, one may predict that destinations with warming climates may not be severely or negatively impacted and destinations that experience greater precipitation as a result of climate change may be impacted to some degree, at least in the medium-term. One must note that there are clearly a number of factors that contribute to destination demand. Predictions of future scenarios are challenging.

5.1. Limitations and future research

The study is significant because it explored the relationship between weather and economic indicators and examined long-held anecdotal evidence by using current data. Nevertheless, the current research has several limitations. It examined only 5 destinations in the United States. Also the current research examined direct relationships between weather and tourism performance. As noted by Gossling et al. (2011), weather is only one factor in determining consumer demand for destinations. More comprehensive models are required to fully understand the system dynamics. Perhaps other factors are influencing the results. In addition, the current research examined data only from a weekly basis and an annual basis. It may be useful to examine data using other units of analysis; for instance, analysis on a monthly or quarterly basis may better illuminate issues of seasonality. Seasonality may have significant implications for the analysis on economic performance for destinations like Vail, Colorado.

Additional research may examine the sensitivity of economic impacts resulting from specific weather abnormalities. The current study examined relationships between weekly and annual data over long periods of time, 8 years of the weekly data and 22 years for the annual data. It may provide important insight in this field to understand the sensitivities of economic performance to weather abnormalities while accounting for the duration and severity of the weather conditions on performance in specific time periods. Another limitation of the study is that in the short term/weekly data we rely only on revenue data. Weather abnormalities impact energy use and other cost factors and therefore, impact profitability. Future studies should examine both revenue and expenditures to gain a greater understanding of the overall influence of weather on hotel profitability.

Finally, future research should address how weather and climate influence destination image. As climate changes, destination image will change and the attraction of those destinations, based in part on their image, will change. Understanding how consumer perceptions change over time will provide important information for destination marketers and operators of tourism and hospitality organizations.

Table 4
Statistically significant results with RevPAR.

City	Significant climate variable(s)	Parameter estimate
San Diego	Cold degree days	0.48125
Vail	Cold degree days	−1.72693

References

Amelung, B., Nicholls, S., & Viner, D. (2007). Implications of global climate change for tourism flows and seasonality. *Journal of Travel Research*, *45*.
Baloglu, S., & Mangaloglu, M. (2001). Tourism destination images of Turkey, Greece, and Italy as perceived by US-based tour operators and travel agents. *Tourism Management*, *22*, 1–9.
Bigano, A., Hamilton, J., & Tol, R. (2006). The impact of climate on holiday choice. *Climatic Change*, *76*, 389–406.
Clayton, A. (2009). Climate change and tourism: The implications for the Caribbean. *Worldwide Hospitality and Tourism Themes*, *1*(3), 212–230.
Coghlan, A., & Prideaux, B. (2009). Welcome to the wet tropics: The importance of weather in reef tourism resilience. *Current Issues in Tourism*, *12*(2), 89–104.
Cook, R., Yale, L., & Marqua, J. (2010). *Tourism: The business of travel* (4th ed.). New Jersey: Prentice Hall.
Crompton, J. (1979). Motivations for pleasure travel. *Annals of Tourism Research*, *6*, 408–424.
Dawson, J., & Scott, D. (2007). Climate change vulnerability of the Vermont ski tourism industry (USA). *Annals of Leisure Research*, *10*(3/4), 550–572.
Denstadli, J., Jacobsen, J., & Lohmann, M. (2011). Tourist perceptions of summer weather in Scandinavia. *Annals of Tourism Research*, *38*(3), 920–940.

Echtner, C., & Ritchie, J. (1991). The meaning and measurement of destination image. *Journal of Tourism Studies*, *2*(2), 2–12.
Gallarza, M., Saura, I., & Garcia, H. (2002). Destination image: Towards a conceptual framework. *Annals of Tourism Research*, *29*(1), 56–78.
Gossling, S., Scott, D., Hall, M., Ceron, J., & Dubois, G. (2011). Consumer behavior and demand response of tourists to climate change. *Annals of Tourism Research*, *39*(1), 36–58.
Hamilton, J., & Tol, R. (2006). The impact of climate change on tourism in Germany, and UK and Ireland: A simulation study. *Regional Environmental Change*, *7*, 161–172.
Hamlet, A., & Lettenmaier, D. (2005). Production of temporally consistent gridded precipitation and temperature fields for the continental United States. *Journal of Hydrometeorology*, *6*(3), 330–336.
Hanlan, J., & Kelly, S. (2005). Image formation, information sources and an iconic Australian tourist destination. *Journal of Vacation Marketing*, *11*(2), 163–177.
Lise, W., & Tol, R. (2002). Impact of climate on tourist demand. *Climatic Change*, *55*, 429–449.
Mill, R., & Morrison, A. (2009). *The tourism system* (Sixth ed.). Dubuque, IA: Kendall Hunt.
NASA (2005). Current missions: Climate and global change. 02/05/2005, Retrieved 09/03/2012, 2012, from. , http://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html
Patterson, T., Bastianoni, S., & Simpson, M. (2006). Tourism and climate change: Two way street or vicious/virtuous circle? *Journal of Sustainable Tourism*, *14*(4), 339–347.
Perry, A. (2006). Will predicted climate change compromise the sustainability of Mediterranean tourism? *Journal of Sustainable Tourism*, *14*(4), 367–375.
Pike, S. (2010). Destination branding case study: Tracking brand equity for an emerging destination between 2003 and 2007. *Journal of Hospitality and Tourism Research*, *34*(1), 124–139.
Ritchie, J. R. B., & Crouch, G. (2003). *The competitive destination: A sustainable tourism perspective.* Cambridge, MA: CABI Publishing.
Scott, D., & Becken, S. (2010). Adapting to climate change and climate policy: Progress, problems and potentials [editorial introduction]. *Journal of Sustainable Tourism*, *18*(3), 283–295.
Scott, D., Gossling, S., & de Freitas, C. (2008). Preferred climates for tourism: Case studies from Canada, New Zealand and Sweden. *Climate Research*, *38*, 61–73.
Scott, D., McBoyle, G., Minogue, A., & Mills, B. (2006). Climate change and sustainability of ski-based tourism in eastern North America: A reassessment. *Journal of Sustainable Tourism*, *14*(4), 376–398.
Smith, K. (1990). Tourism and climate change [opinion]. *Land Use Policy*, 176–180.
Steen Jacobsen, J., Denstadli, J., Lohmann, M., & Førland, E. (2011). Tourist weather preferences in Europe's Arctic. *Climate Research*, *50*(1), 31–42, http://dx.doi.org/10.3354/cr01033.
STR (nd). Glossary: hotel types: boutique. Retrieved 10/15/2011, 2011, from. , www.str.com/resources/glossary.aspx
Tang, C., & Jang, S. (2012). Hedging weather related risk in nature-based tourism business: An example of ski resorts. *Journal of Hospitality and Tourism Research*, *36*(2), 143–163.
Tasci, A., & Gartner, W. (2007). Destination image and its functional relationships. *Journal of Travel Research*, *45*(4), 413–425.
Thapa, B. (2012). Why did they not visit ? Examining structural constraints to visit Kafue Park, Zambia. *Journal of Ecotourism*, *11*(1), 74–83.
Turnbull, D., & Uysal, M. (1995). An exploratory study of German visitors to the Caribbean: Push and pull motivations. *Journal of Travel and Tourism Marketing*, *4*(2), 85–92.
UNWTO, & UNEP. (2008). *Climate change and tourism — Responding to global challenges: UNWTO.*
Yu, G., Schwartz, Z., & Walsh, J. (2009). A weather-resolving index for assessing the impact of climate change on tourism related climate resources. *Climatic Change*, *95*, 551–573.

Jonathon Day. Dr. Jonathon Day, an Assistant Professor in Purdue's School of Hospitality and Tourism Management, has over 20 years experience in destination management and governance. An award winning marketer, Dr. Day has worked with destination marketing organizations in Australia, New Zealand and the United States. Dr. Day has a Bachelor of Business from Queensland University of Technology, an M.B.A from U.C.L.A.'s Anderson Graduate School of Management and a Ph.D. from James Cook University (Australia). Dr. Day's research interests focus on strategic destination management and include issues of sustainability and competitiveness within the tourism system.

Natalie Chin. Natalie Chin is a Ph.D. student in Agricultural and Biological Engineering and Ecological Sciences and Engineering at Purdue University. She completed a Bachelor's degree in Biological Resources Engineering at the University of Maryland — College Park and a Master's degree in Public Policy at George Mason University. Natalie also has four years of experience working for non-governmental organizations and non-profits in Washington, D.C., in science and technology policy and environmental policy. Some of Natalie's research interests are: the impacts of climate change on groundwater and other hydrologic processes in the Great Lakes, climate change adaptation strategies, and the intersection between science and policy.

Sandra Sydnor. Dr. Sandra Sydnor, an Assistant Professor of Hospitality and Tourism Management, received her BS from Michigan State University (Engineering); her MBA from The University of Miami (FL); and her PhD in Hospitality Management from The Ohio State University. Dr. Sydnor has 20 years combined of QSR corporate and entrepreneurial experience; graduate and undergraduate teaching; and senior level experience in market research and advertising firms. Dr. Sydnor's primary research interests: community and business resilience; entrepreneurship; brand management and strategy.

Keith Cherkauer. Dr. Keith Cherkauer is an Associate Professor of Agricultural and Biological Engineering at Purdue University where he has worked since January 2004. He received a B.A. in Physics from Augustana College, Rock Island, Illinois; an M.S. in Aerospace Engineering (Environmental Remote Sensing) from the University of Colorado, Boulder, Colorado; and a Ph.D. in Civil and Environmental Engineering from the University of Washington, Seattle, Washington. Before joining the ABE department in 2004, he worked for two years as a Research Scientist in Civil and Environmental Engineering at the University of Washington. Dr. Cherkauer's research addresses questions and concerns related to environmental change including climate and land use change impacts on water availability.