



A temporal and spatial analysis of climate change, weather events, and tourism businesses



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HIGHLIGHTS

- Outdoor tourism businesses face opportunities and threats related to climate change and weather conditions.
- Time-series forecasting demonstrated the impact of temperature and precipitation on 13 outdoor tourism locations.
- Adverse weather conditions impacted sales within two weeks in the future.
- The construal level theory is used to demonstrate the temporal and spatial impact of climate and weather.
- The influence of temperature, precipitation, and extreme events on tourism sales is discussed.

ARTICLE INFO

Article history:

Received 9 February 2018

Received in revised form

15 February 2018

Accepted 18 February 2018

Keywords:

Climate change

Construal level theory

Weather

Precipitation

Temperature

Outdoor tourism

Tourism

Management

ABSTRACT

The study explores how precipitation and temperature have changed across the United States at multiple outdoor tourism locations within six unique climate zones from 1990 to 2015 compared to long-term averages from 1901. A multiple-location case-study design is then used to analyze the impact of long-term weather conditions and weather events – both favorable and unfavorable – on daily sales for 13 outdoor tourism locations within the six climate zones. The study is the first to draw on the construal level theory to quantitatively and longitudinally explore the geographic and temporal proximity of climate change and extreme events on business outcomes. The methodologies used, including time-series forecasting, provide a blue-print for at-risk businesses to analyze the impact of climatic factors and weather conditions no matter location.

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1. Introduction

Climate change is commonly drawn upon to validate involvement in sustainability initiatives. Specific to climate change, the narrative evoked by many businesses involved in sustainability is to measurably act (e.g., reduce waste, energy consumption, carbon emission) as to not perpetuate macro-level effects (Allen, 2016; Cox, 2009). The macro-level effects of climate change have been documented and clearly articulated globally through indices including air temperature, sea-ice area, sea-surface temperature,

carbon emissions, and trends in extreme weather disasters (IPCC, 2014; Melillo, , Richmond, , & Yohe, 2014; NOAA, 2017). Local communities, businesses large and small, and progressive states have demonstrated leadership in mitigating efforts to combat the effects of climate change (Allen, 2016; Asensio & Delmas, 2015; Cox, 2009; Craig, Petrun-Sayers, & Feng, 2018; Gilleo et al., 2014). The need for continued active leadership by these groups in climate mitigating efforts is accentuated in the United States by recent administrative actions to halt international and domestic carbon reducing measures.

Despite continued climate mitigating efforts globally, recent resultant extreme weather events in the United States including hurricanes, wildfire, drought, and flooding (NOAA, 2017) demonstrate heightened economic, safety, and health risks for businesses

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and individuals. This study proposes a new way of seeing, where businesses in the at-risk outdoor tourism industry explore how climate change, extreme or adverse weather events, and favorable weather events influence their own economic viability. This in turn can provide a better understanding of the risks that surrounding communities face, and position businesses to become the voice of mitigation and adaptation prior to extreme weather disasters.

This study will longitudinally explore climatic variability and weather events for outdoor tourism businesses across the United States to address the knowledge gap of the lack of integration of climate and business outcomes. The weather and climatic variables are derived from temperature and precipitation, and the focal business outcome is sales. A multiple-location case-study design is used that will provide a blue-print for businesses to analyze the impact of climatic factors on their own salient economic outcomes (Craig et al., 2018). Building on previous methodological perspectives for analyzing the impact of climate and weather on tourism (Rossello-Nadal, 2014), a retrospective time-series forecasting approach is used that assesses both historical sales performance and the impact of adverse and favorable weather events on current sales. This methodology will allow for future temporal and spatial shifts in the tourism industry (Amelung & Nicholls, 2014) to be addressed. The historical climatic and weather benchmark provided can inform business and community response to persistent change and localized extreme events or favorable conditions within a similar climate zone.

The study begins by characterizing the focal outdoor tourism business group. Next, relevant literature is reviewed starting with historic relationships between businesses, climate, and weather. The construal level theory (Trope & Liberman, 2010) is then presented as a theoretical taxonomy for exploring adaption by businesses, and by extension, communities. The construal level theory contends that close spatial, temporal, and social proximity to climate change are more influential on individual perceptions and behaviors than distal proximities, and that a more concrete construal of climate change is more actionable. The study is the first to quantitatively and longitudinally draw on the construal level theory to explore the geographic, temporal, and social proximity of climate change and extreme events on business outcomes in the outdoor tourism industry. The remainder of the study will include a methods section, a results and analysis section, and a theory section followed by a discussion complete with implications, limitations, and future research.

1.1. Business overview

The focal outdoor tourism business group operates campgrounds in the United States and Canada that offer cabin, RV, and tent camping. The business owns and operates 28 corporate-owned locations in six climate zones as defined by Karl and Koss (1984) and adopted by the National Oceanic and Atmospheric Administration (NOAA, 2017). At each of the locations a range of amenities are offered including groceries, camping merchandise, general merchandise, and various outdoor recreation activities. The majority of the business locations are within close proximity to attractions such as state or national parks, beaches, mountains, or entertainment districts. Overall sales for the privately owned business group are estimated to exceed \$100 million. No additional information is provided to protect the identity of the business. Daily sales data was retrieved from each of the 28 locations from January 1, 2007 through November 11th, 2016 and was matched with the climatic variables that are discussed in greater detail in the methods section and Appendix A. High resolution climatic data was

collected from January 1990 through December 2015 and compared to the long-term averages from 1901 to assess longer-term change at locations within climate zones. Based on the wide geographic dispersion of locations, the business group regularly experiences natural disaster events and/or extreme weather. The leadership team was supportive of the study to provide guidance on how to take advantage of favorable conditions and to adapt to unfavorable conditions across the entirety of the United States.

1.2. Business, climate, and weather

Businesses are increasingly facing challenges related to weather conditions and extremes. The focal business group is in the outdoor tourism industry, providing an opportunity to explore how localized conditions impact a range of sales categories with varying vulnerabilities to potentially hazardous conditions. Like other business categories, the tourism industry has experienced changing climatic conditions that effect when and how sales occur, and continued climatic and weather trends will influence the vulnerability and viability of many businesses throughout the world (Craig et al., 2018; Monahan et al., 2016; Yu, Schwartz, & Walsh, 2009). Yet, within the industry the impacts of climate change are often misunderstood (Weir, 2017). Adaptive efforts are needed within the tourism to maintain economic viability in the future (Schliephack & Dickinson, 2017). Seasonality, timing of an event, persistence of an event, and severity of an event can all impact business economic outcomes (Craig et al., 2018; Monahan et al., 2016). Likewise, favorability of conditions, such as cloud cover, precipitation levels, and temperature, can either have positive or negative impacts on business economic outcomes (Craig et al., 2018; Ruddy & Scott, 2016).

Businesses across industries are actively adapting to changing conditions. A common challenge for businesses is in creating a roadmap to address long-term climate mitigation and also to adapt to localized conditions (Allen, 2016; Craig et al., 2018). Linnenluecke and Griffiths (2012) noted that one such challenge for businesses is the perception that climate change or weather events are outside of the organization's coping capabilities. This study will provide a benchmark of historic conditions and a methodological blueprint for studying climatic interactions that will enhance business and community coping capacity to climate change and weather events, both favorable and unfavorable.

Businesses in the past have successfully demonstrated adaptive capacity. For instance, businesses have exhibited adaptive capacities to overcome climate challenges related to public health, sales and sales cycles, and carbon emissions (Allen, 2016; Craig et al., 2018; Scott & McBoyle, 2007). Likewise, many large corporations are now utilizing weather data services for sales forecasting, to inform marketing budgets, and to make distribution decisions with companies such as Planalytics (www.planalytics.com) and Weather Analytics (www.weatheranalytics.com). Yet, the majority of small businesses, particularly those in the outdoor tourism industry, have not planned for adverse weather events and in many cases, are unable to stay in business after experiencing an extreme weather event such as a hurricane or flood (FEMA, 2015; Nationwide, 2015). To understand historical trends across the United States for the business group, temperature and precipitation (including long-term trends and short-term events) are used to assess the impact of weather and climatic variability. Specific to the focal 28 business locations and the regional climate zones represented, the following research question is posed:

Research Question 1. What are the weather and climatic trends for the focal locations and climate zones?

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