

**The Impact of Extreme Weather, Infectious Disease Outbreaks,
and Economic Recession on Caribbean Tourism**

Report submitted to the World Bank
Revisiting Resilience in the Caribbean Project (P172318)

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Terms of Reference

1. Create a database of tourist arrivals for all Caribbean Tourism Organization member states and Mexico for 2004-2019. Integrate data on specified disruptions/shocks to the tourism sector (hurricanes, infectious disease outbreaks – Zika, SARS, and changes in the pricing structure of the UK's Air Passenger Duty).
 1. Raw monthly tourism data will be obtained from the Caribbean Tourism Organization and Government of Mexico and processed for modeling.
 2. Hurricane data (location, strength, landfalls) will be obtained from NOAA's Atlantic hurricane database (HURDAT2) 1851-2019.
 3. Infectious disease outbreak (at destination country) data will be obtained from WHO.
 - o SARS - Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003
 - o ZIKA – Zika cases reported by countries and territories in the Americas 2015-18: cumulative cases
2. Prepare a background paper on the impact of climate-related and health-related shocks on tourist arrival in the Caribbean.
 1. The paper will include a short critical literature review on the impact of different types of shocks on tourism in the Caribbean (including hurricanes, infectious disease outbreaks, and changes in taxes/levies on air travel from Europe), synthesizing what is known and key knowledge gaps.
 2. The paper will propose a methodological framework for assessing the impact of climatic or health-related shocks on the tourism sector in Caribbean countries (including the countries that are members of the Caribbean Tourism Organization and Mexico).
 3. The paper will examine how different shocks (e.g. category 1-3 hurricanes, 4-5 hurricanes, disease outbreaks) differentially impact arrivals. For hurricanes the analysis will include forecast zones (cone of potential path/impact), direct landfall, nearest neighbor islands (do travelers/tour operators avoiding the broader area?), and whether there are deflections of arrivals to other countries in the region (i.e., what is the net impact on the region as travelers/tour operators substitute locations).
 4. In each case the paper will examine immediate impacts (1-2 months) as well as lagged impacts (6 months) and long-term impacts (12 months or longer) as potential evidence of capacity/reputational impact on the country's tourism economy.
3. Provide guidance to the World Bank team on a firm survey questionnaire for the tourism industry in the Caribbean.

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1. Introduction

The occurrence of natural and human-generated disasters and crises are geographically uneven, causing highly differential impacts and socio-economic losses across regions of developed and developing countries. There is increasing recognition that disaster and crisis risk¹ must be addressed as an urgent challenge of sustainable development, not strictly one of humanitarian assistance (World Bank Group 2018, Collins 2018). A multi-hazard study by the World Bank Group (2017) similarly found that many countries have become wealthier over the last three decades, not because their economies have grown faster than poorer countries, but because they have had fewer crisis that contracted their economy.

In global comparisons of natural disasters, Island countries are at particularly high risk. The Caribbean region is ranked by multiple studies as one of the most disaster-prone regions in the world (International Monetary Fund [IMF] 2013, UN Office for the Coordination of Humanitarian Affairs 2020). International Disaster Database (Centre for Research on the Epidemiology of Disasters 2020) lists more than 400 disasters have occurred in the Caribbean between 1950 and 2019. When assessed per land area or population, Rasmussen (2006) found that six eastern Caribbean countries ranked in the top 10 most disaster-prone countries in the world, with much of the rest of the region in the top 50. The multi-hazard Disaster Risk Index (Peduzzi et al. 2009) rated most Caribbean nations (for which 1980–2000 data was available) as high to very high risk. In the 2019 World Risk Index (Institute for International Law of Peace and Armed Conflict 2019) ranking of disaster risk for 180 countries, which considers 27 indicators of exposure and vulnerability, placed six Caribbean countries in the top 50, but in contrast to some other studies, ranked Bahamas (127) and Barbados (175) as low risk.

The economic cost of natural disasters in the Caribbean region are high and estimated to be increasing. For example, in 2017, Hurricane Maria cost Dominica an estimated 225% of its GDP, just two years after Hurricane Erika resulted in a 92% loss of its GDP (Government of the Commonwealth of Dominica 2017). The massive economic disruption and reconstruction needs can persist for years, increasing fiscal deficits and debt. According to the IMF (2013), the economic costs of recurring disasters on the Caribbean region have been increasing over the last three decades, with annual average losses increasing from 0.9% of GDP in the 1980s to 1.3% in the 2000s. Climate change is expected to exacerbate disaster impacts in the region by increasing the number of severe hurricanes (categories 4 and 5) and making droughts more frequent and severe (Intergovernmental Panel on Climate Change [IPCC] (2014). However, as Nurse et al. (2014) and Kelman (2019) emphasize, these impacts will manifest differently in the region, and the assumption that each nation is equally at risk to climate change ignores island specific environmental and socio-economic contexts that must be more clearly assessed.

¹ This report adopts the World Bank Group (2018) taxonomy of crisis risk, which includes six domains: natural hazards, health, political/security, economic, technological, and societal.

The Caribbean is the most tourism-reliant region according to the World Travel and Tourism Council [WTTC] (2020a). The sun-sand-sea [3S] market that dominates the region (Mendoza-Gonzalez et al, 2018; Cameron & Gatewood, 2008) concentrates tourism infrastructure and assets along coastal areas, creating high exposure to tropical storms and storm surge. A global analysis of climate change and the tourism sector (Scott et al. 2019) found the tourism economies of many Caribbean countries to be at the highest risk. As the ongoing devastating impacts of the COVID-19 pandemic has revealed, the region's tourism economy is also at substantial risk to infectious disease outbreaks that highly restrict international travel (Gössling et al. 2020).

The tourism sector is often considered highly resilient at the global scale because of its consistent growth over several decades, as well as the sector's ability to avoid longer-term decline from diverse national, regional, and global crises. Because of the tremendous growth in global tourism as measured by international arrivals (averaging over 6% per year from 1950 to 2010 and approximately 5% since 2010), any period where international arrivals increase by 2% or less is often described as a crisis by the sector (Hall 2010). The COVID-19 pandemic has challenged that assumption, as tourism has been one of the most impacted economic sectors and may require several years to recover in some markets.

The potential effects of global crisis events on international tourism are likely to increase in both size and frequency. As tourism becomes increasingly hypermobile in a more interconnected global economy, habitat encroachment and urbanization continue to increase the potential for pandemics and the impacts of climate change will intensify (Hall 2010, Scott et al. 2019, Gössling et al. 2020). Understanding the differential impacts on regional tourism economies and the implications for tourism to contribute to the United Nations Sustainable Development Goals is a strategic research need.

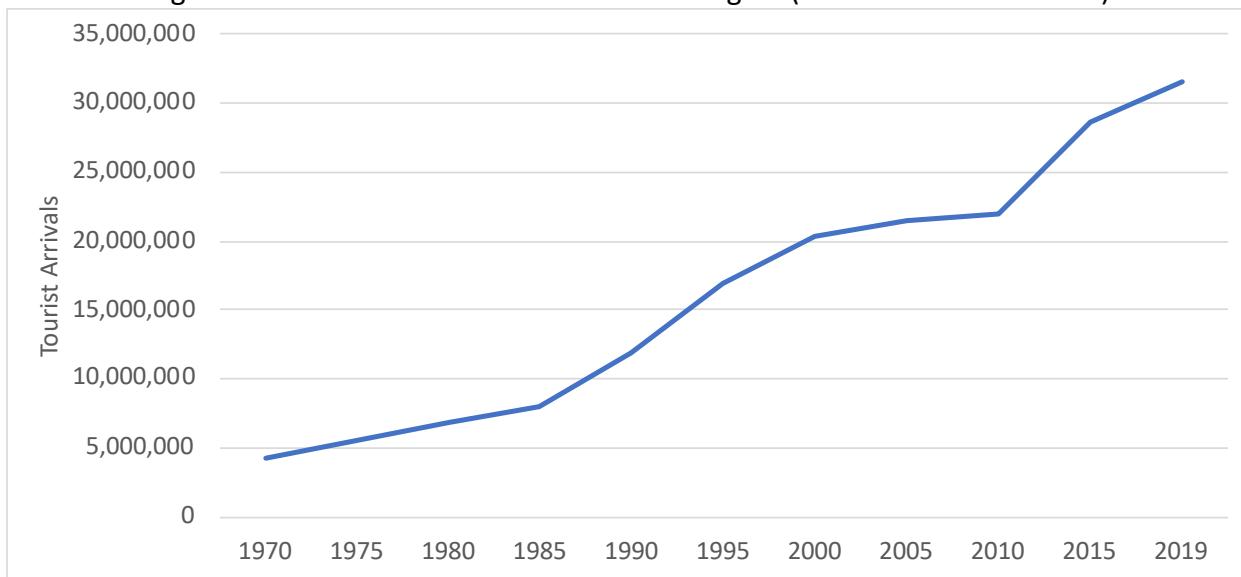
The *Revisiting Resilience in the Caribbean* project (P172318) is a multi-sector analysis of the state of natural disaster resilience in the Caribbean region and foresight into the implications of climate change. This report provides new insights on the impact of climatic and health (infectious disease) events on the Caribbean tourism sector at the country scale. The report is organized into five sections, beginning with a brief overview of the tourism sector in the region. Section 3 provides a critical review of the scientific literature on the impacts of climatic, infectious disease, and economic recession on the tourism sector (see Terms of Reference). A specific subsection on the observed and projected impacts of the COVID-19 pandemic (as of June 2020) has been added. Section 4 describes the data, methodology, and findings of the econometric modeling of the differential impact of climatic and health events and travel policy changes on tourist arrivals between 2004 and 2019.

2. The Caribbean Tourism Economy

The tourism sector has grown to become a central pillar of the Caribbean economy. According to data from the Caribbean Tourism Organization [CTO], annual tourist arrivals have increased from approximately 4.2 million in 1970 to 31.5 million in 2019 (Figure 1). The average annual

growth in arrivals from 1980 to 1995 was very high at 5%. From 1995 to 2010, the growth rate slowed to 2.4%, but 2019 was a record year for Caribbean tourism, with 4.4% growth in international arrivals that exceeded the world growth of 3.8% (UNWTO 2020a). The United Nations World Tourism Organization [UNWTO] (2011) projected the growth rate from 2010 to 2030 would average approximately 2%, slower than the global average. There are notable differences in arrivals growth among countries in the region. There has been a shift in market share over the last 15 years toward gains by Dominican Republic and Jamaica and away from Bahamas, Barbados, and slight declines in several smaller destinations (some following major hurricane events in 2017 and 2019 – see section 4 for analysis). The main source markets include the US, Europe, Canada, and intra-regional travellers. Based on CTO data, the US market has declined from 68% of arrivals in 1980 to 55% in 2019. Europe and Canada have increased from 14% and 9% (respectively) in 1980 to 21% and 12% in 2019.

Figure 1. Tourist Arrivals in the Caribbean Region (CTO member countries)



Data source: Caribbean Tourism Organization

The Caribbean economy is highly dependent on tourism as a main driver of economic growth and employment, as well as an important source of government revenues for public services and debt repayment. The WTTC (2020a) estimates that tourism contributes 13.9 % of GDP (\$58.9 bn) and 15.2 % of employment (2.8 million people) across the region. Although tourism is a vital component of the economy of all countries in the Caribbean, its relative importance and competitiveness varies from country to country. Table 1 presents the percentage GDP and employment tourism represents in each country. In 2019, tourism represented over 30% GDP in 12 of the 23 countries where data is available, and as high as 74% in Aruba. Across CTO countries, tourism accounts for an average of 29% of GDP, which is more than double the world average of just over 10% (WTTC, 2020a). Tourism generated over 30% of employment in 15 of the 23 countries, and as high as 91% in Antigua & Barbuda. Based on projected arrivals growth, it is anticipated that tourism will continue to be a leading contributor to the regional GDP in the

decades ahead. Understanding the sector's vulnerability to the type of unprecedented disruption from the COVID-19 pandemic, as well as growing risks from climate change, will therefore be important to inform development policy.

Differential country trends in arrivals growth, market share and tourism revenue are influenced by the changing dynamics of global tourism flows, which include the emergence of alternative tourism markets and destinations, as well as changes in the competitiveness of the Caribbean region (Mackay & Spencer 2017, UNWTO 2020a, World Economic Forum 2020). The relative ranking of Caribbean countries on the World Economic Forum's (2020) *Travel and Tourism Competitiveness Index* (TTCI) (Table 1), indicates that Dominican Republic ranks the highest in the region at 73 out of 140 countries. While Dominican Republic has improved its competitiveness over the last decade, Jamaica and Haiti's rankings have remained stable (at 76 and 133 respectively), while Trinidad and Tobago has declined from 69 to 87.

With so few of the Caribbean's small islands included in the World Economic Forum's TTCI, the International Monetary Fund's (2014) 'week at the beach' index provides another indicator of regional competitiveness in the global tourism market. Its comparison of 10 Caribbean and 18 other 3S beach destinations around the world found that average holiday costs were highest in the Caribbean (regional average of 78 versus 42 for other regions). Bahamas served as the index benchmark at an index score of 100 and Dominican Republic had the lowest score in the region at 52. The index scores of other international 3S holiday destinations ranged from Seychelles (82) and Cancun, Mexico (64) to Gambia (30) and Phuket, Thailand (20). With the higher nominal cost of an average beach holiday in the Caribbean, non-price factors need to be superior to maintain regional competitiveness (e.g., travel time and convenience, product and service quality).

In addition to the economic and political drivers that influence these competitiveness rankings, the destructive impact of major hurricanes is thought to have set back the competitiveness of several small islands over the last decade. For example, by degrading product quality (at least initially) and destination reputation (see tourist perceptions in section 3.2), and raising prices to support recovery and reconstruction. The impacts of hurricanes and other crises are examined in sections 3 and 4.

The capacity to manage and recover from crises in the tourism sector, as well as adapt to future climate change, is influenced by a range of political and socio-economic factors (IPCC 2014, Hall 2010, Faulkner 2001). Development status is a broad indicator of adaptive capacity and most countries in the Caribbean are classified as high or upper medium countries (Table 1). Governance capacity and stability are also considered salient indicators of adaptive capacity and the Fragile States Index ratings of countries in the Caribbean range from more stable (6) to warning (4) and alert (1) (Table 1).

Table 1. A Comparison of Tourism Reliance and Competitiveness in the Caribbean

Country and World Bank Classification ⁽¹⁾	Travel & Tourism Competitive Index			Tourism % GDP (2019) ⁽³⁾	Tourism % Employment (2019) ⁽³⁾	Fragile States Index Ranking ⁽⁴⁾			
	Global Ranking ⁽²⁾								
	2015	2017	2019						
Anguilla				37	51				
Antigua & Barbuda (H)				43	91	More stable (127)			
Aruba* (H)				74	84				
Bahamas (H)				43	52	More stable (132)			
Barbados (H)	46	n/a	n/a	31	33	More stable (137)			
Belize (UM)				37	39	Warning (114)			
Bermuda* (H)				19	23				
British Virgin Islands (H)				57	66				
Cayman Islands (H)				26	33				
Cuba* (UM)				10	11	More stable (118)			
Curacao (H)									
Dominica (UM)				37	39				
Dominican Republic* (UM)	81	76	73	16	17	Warning (107)			
Grenada (UM)				41	43	More stable (125)			
Guyana (UM)	104	n/a	n/a	5	5	Warning (101)			
Haiti (L)	133	n/a	133	8	9	Alert (18)			
Jamaica (UM)	76	69	76	31	33	Warning (116)			
Martinique				8	9				
Montserrat									
Puerto Rico (H)	55	n/a	n/a	4	10				
St. Kitts & Nevis (H)				28	59				
St. Lucia (UM)				41	78				
St. Maarten (H)									
St. Vincent & the Grenadines (UM)				29	45				
Trinidad & Tobago (H)	69	73	87	8	9	More stable (129)			
Turks & Caicos Islands (H)									
US Virgin Islands* (H)				56	69				

(*) Countries that are not members of the Caribbean Tourism Organization

(1) World Bank Group (2020a) – calendar year 2020: low (L), lower middle (LM), upper middle (UM), high (H)

(2) World Economic Forum (2020)

(3) World Travel and Tourism Council (2020a)

(4) The Fund for Peace (2020) – ranking out of 178 countries (highest ranking = very stable)

3. Tourism and Crises

Tourism is exposed and vulnerable to crisis events that can shock the socio-economic system in which the sector is embedded, including the six crisis domains identified by the World Bank (natural hazards, health, political/security, economic, technological, and societal), that directly and indirectly impact tourism operations, arrivals and spending. Direct impacts, such as the disruption or destruction of critical infrastructure that reduces the capacity to host visitors (e.g.,

flight cancellations from source markets; airport, port or land transport operations; accommodations; electricity and telecommunication networks; food and beverage supply chains), along with damage to natural and cultural assets that are essential to the tourism product (Rosello et al. 2020, WTTC 2018). Second, and equally important, are the indirect impacts associated with tourists subjective perceptions of the crisis event (including warnings or forecast zones), which can alter destination image and reputation, as well as travel motivations and destination choice during and after the crisis (for months or years) (Tavitiyaman & Qu 2013; Walters et al. 2015; Wang et al. 2019, Faulkner 2001, Walters & Clulow 2010, Granvorka & Strobl 2013, Forster et al. 2012, Seekamp et al. 2019). The traveller perception of normalisation is important to explain when and why tourists return to destinations (Morakabati 2007, Saha and Yap 2014). Fletcher and Morakabati (2008) argue that tourists quickly return to destinations that have been struck by terrorism, however there does not appear to be any conclusive literature around the normalisation process following natural disaster and disease outbreaks. The scale of impact depends on the type and magnitude of an event, as well as the resilience of the destination and tourism economy (Cró & Martins 2017, Roselló et al. 2020). The recovery of the tourism sector from a crisis is more complex than some other industries, requiring coordinated efforts that extend well beyond the sector, as well as across national and international boundaries (Cavlek 2006; Steiner et al. 2012).

The impacts, response and preparedness for diverse crises has long been a concern of the tourism research community and the sector. Hall's (2010) review of the literature on tourism and crisis found particular attention given to impact estimation, public relations and crisis management (e.g., pioneering work by Faulkner 2001), as well as recovery strategies (e.g., Mair et al. 2016, Cró & Martins 2017). Tourist perceptions and attitudes towards crises that affect the appeal of the destination (or region) remains poorly understood (Gössling et al. 2012, Mair et al. 2016, Wang et al. 2019).

In terms of the types of crises examined in the tourism literature, Hall (2010) found that economic and financial crises receive the most research attention, followed by terrorism and increased energy costs. Mair et al. (2016) and Jiang et al. (2017) also note a focus on economic rather than health-related crises, with only four out of 64 studies reviewed from 2000 to 2010 specifically related to health crises (Mair et al. 2016). This is surprising considering tourism is well known in the medical community to be a vector for disease dissemination (Rodriguez-Garcia 2001). The limited attention on environmental hazards, including extreme weather, changing climate conditions and infectious disease, were identified as a strategic gap. The reactive nature of the literature (i.e., responding and examining crises after they occur), rather than proactive research to provide foresight for preparedness and resilience was also identified as a concern (Hall 2010), which is echoed by Scott and Gössling (2015) and Rosselló et al. (2020). The limited research on crises caused by global challenges such as climate change and pandemics is disconcerting considering the potential effects are likely to increase in frequency and magnitude (Scott et al. 2019, Gössling et al. 2020), particularly as tourism and the global economy become even more interconnected (Cheer & Lew 2019).

Few studies are available on the impact of crises and crisis management in developing countries, which is an important knowledge gap. The impacts of reduced international tourism can be devastating in tourism dependent economies, including unemployment and lost livelihoods with limited or no social assistance supports, as well as reduced government revenues for public services (e.g., education, health) and debt servicing. How differential capacity to manage recovery following a crisis, particularly in fragile states (The Fund For Peace 2020), remains an important area of inquiry to advance resilience in tourism economies.

3.1 Global Comparisons of Crisis Impacts on Tourism

The literature, until very recently, has taken a case study (destination/country) approach, with regional or global analyses largely absent, as well as very limited research in developing countries. Recent studies by Bhati et al. (2016), Cró & Martins (2017) and Rosselló et al. (2020) compare the impacts of a wider range of crisis events on tourism arrivals at larger geographic scales. Through a series of correlation analyses, Bhati et al. (2016) examined the effect of national disasters on tourism economies from 2001 to 2012 in the ASEAN-5 countries (Singapore, Indonesia, Thailand, Philippines, Malaysia) and found that while the disasters, associated impacts, and government response differed geographically, every country experienced a decline in tourism arrivals, tourism receipts, GDP, and employment. Cró & Martins (2017) used an ex-post analysis of structural breaks in annual tourism arrivals in 25 countries between 1995 and 2014 and found the dates of crises and disasters aligned with corresponding declines in arrivals that could be explained by disease threats (SARS, avian flu), economic recessions, political instability (war, terrorist attacks), and natural disasters (tsunamis, earthquakes).

Using a gravity model that incorporated annual tourist arrivals into 171 countries for the period 1995 to 2013, Rosselló et al. (2020) found that the type of crisis had varying impacts. Geologic events were found to be the most disruptive to tourism. Volcanic eruptions were the most detrimental when measured in economic damage leading to decreased international tourism arrivals, followed by wildfires, earthquakes, and tsunamis. For example, in the eight days following the volcanic eruption in Iceland, over 107,000 flights in 23 European countries were cancelled, which affected the travel plans of an estimated 10 million people (Bye 2011) and reduced airport revenues by £80 million (Jamieson 2010). The volcanic eruption also reduced tourism arrivals to Iceland by 49% in the 12 months following the initial event (from March 14, 2010 to April 28, 2011) (Jónsdóttir 2011). Earthquakes have also led to notable declines in arrivals to destinations across the globe, including the major earthquake in central Italy (Umbria) in 1996 that led to recorded tourism losses for up two years following the event (Mazzocchi & Montini 2001). In 1999, an earthquake hit Taiwan and inbound arrivals did not fully recover until 11 months following the event (Huang and Min 2002). The destruction of United Nations Educational, Scientific and Cultural Organization [UNESCO] listed World Heritage sites following an earthquake and aftershocks in Nepal (Kathmandu) in 2015 resulted in depressed arrivals as several trekking routes were deemed unsafe (Roselló et al. 2020). In 2011, an earthquake in New Zealand (Christchurch) decreased arrivals by 35% immediately following the event (Carlvile 2012), while in Japan, the earthquake and subsequent tsunami

dropped tourism arrivals by two million and took approximately 21 months for arrivals to recover (WTTC 2018). The tsunami at the end of 2004 that impacted much of South East Asia reduced visitation for over a year, costing Thailand an estimated 337,000 visitors between January 2005 to February 2006 (WTTC 2018), including a loss of over 50% of arrivals to Phuket (Tourism Authority of Thailand 2005). The analysis found no significant relationships between tourist arrivals and drought, epidemics, landslides or cold-heat waves. Storms (including hurricanes) showed a complex relationship, with a decrease in arrivals with higher economic costs of damage, but an increase in arrivals where a higher number of people were affected or killed. The latter likely captures the large influx of humanitarian workers that are counted as international arrivals, even though their purpose is not for business or leisure travel. The impact of storms in the Caribbean are discussed in more detail in Section 4.

Rosselló et al. (2020) found no significant relationships between tourist arrivals and drought, epidemics, landslides, or cold-heat waves. However, previous work by Rosselló et al. (2017) argued that the eradication of Ebola, Dengue, Malaria, and Yellow Fever in countries where they are prevalent could add approximately 10 million international tourist arrivals to these countries, yielding economic benefits of USD 12 billion in direct tourism spending.

While reviews by Hall (2010) and Mair et al. (2016) found limited studies specifically related to health crises, the available studies, in contrast to Rosselló et al. (2020), found substantial impacts resulting from infectious disease outbreaks. The evidence suggests that impacts are more pronounced in developing countries where there may be a greater perception of risk to personal safety (see also Section 3.2). Breitsohl and Garrod (2016) argue that due to the infrequency and rapid spread of health epidemics to multiple destinations, disease outbreaks can exert even more negative pressure on tourism demand than terrorism, which usually remains isolated to a specific destination.

The 2003 outbreak of Severe Acute Respiratory Syndrome (SARS) in South-East Asia impacted tourism in the region, as well as in other hotspot clusters that developed as a result of international travel (e.g., Toronto, Canada). The World Travel and Tourism Council (2003) estimated that up to three million tourism jobs were lost in the most affected areas of Asia (China, Hong Kong, Singapore, and Vietnam). Hong Kong saw international arrivals drop precipitously from 1.4 million in March to just over 400,000 in May (Au et al. 2007). Hotel occupancy rates in a number of destinations in China dropped rapidly to between 10-20% (STR 2020). Importantly, with the World Health Organization [WMO] announcement that the SARS outbreak had been contained in July 2003, the impact was relatively short-lived and not as severe as expected, with arrivals rebounding to pre-SARS levels by late 2003 (Siu and Wong 2004). In the travel related SARS hotspot of Toronto, tourism was also significantly affected, with average hotel occupancy rates falling 20% in April, along with a loss of 2.5% of tourism jobs (when seasonal employment usually increases), and an estimated decline of tourism revenues of 28% (in comparison with 2002) (Tufts, 2004). McKercher and Chon (2004) attribute the impacts to sensationalized international media coverage that directly linked tourism to the spread of SARS, including a widely publicized hotel identified as ‘ground zero’ along with ill airline passengers (section 3.2 further discusses media influence on traveller perceptions).

Kuo et al. (2008, 2009) examined the impact of SARS and avian flu (H5N1 avian influenza) on international tourism demand primarily in the Asian-Pacific region. Their econometric comparison of countries affected by both viruses indicate that the numbers of affected cases had a significant impact on arrivals to SARS-affected countries, but not on Avian Flu-affected countries. The analysis of the impact of avian flu on tourism in 12 countries with the most infected poultry and human cases (China, Cambodia, Indonesia, Japan, Korea, Malaysia, Thailand, Turkey, Vietnam, Romania, Hungary, and Egypt), using arrivals data between 2004 and 2006 found a relatively minor reduction in tourism demand (of around 168 international tourist arrivals for each additional poultry outbreak).

The impacts of Ebola outbreaks in Africa have also been the focus of recent studies. Novelli et al. (2018) examined the impact of what they refer to as the ‘Ebola-induced tourism crisis’ in Gambia. Despite having no reported cases of Ebola, tourist arrivals declined 60%, contracting tourism contribution to GDP from 9% to 5.1% in 2014. Similar to SARS, the authors conclude that the decline in arrivals was a result of spillover effects from sensational media reporting. In some cases, the media portrayed the Ebola outbreak as an African health crisis, with public misconceptions of the geography of the continent and the location of countries where the outbreak occurred. As some airlines suspended flights to African countries struck by Ebola (Nyarko et al. 2015), a similar Ebola-induced impact appears to have affected much of the continent. The UNWTO (2015) observed that after increases in pan-African international arrivals of 5% in both 2012 and 2013, following the 2014 Ebola outbreak, arrivals then declined 2% in 2014 and 5% in 2015.

3.2 Tourist Risk Perceptions

While a decline in arrivals in the immediate aftermath of a crisis event can be expected, once a destination has recovered, arrivals may continue to be depressed due to tourists’ risk perceptions and avoidance of regions that are perceived as unsafe. In an analysis of global case studies following a crisis, WTTC (2018) estimated that a 10% reduction in tourism arrivals and a 23-month recovery period is not uncommon after a major natural disaster. Following a crisis event, tourists’ perceptions of safety is one of the most important factors that determines whether or not a tourist will travel to a destination (Jonas & Mansfeld 2017, Karl 2018, Bowen et al. 2014, Rittichainuwat 2013). Re-establishing public perceptions of safety and attractiveness following a disaster is critical to attract and reassure potential visitors to travel to the destination. Negative perceptions are one of the greatest challenges tourism marketers face following a crisis, with problematic safety images of tourist destinations a major constraint to a thriving tourism industry (Law 2006, Arana & León 2007, Avraham & Ketter 2008, Tarlow 2014).

When evaluating risks, people are influenced by a number of qualitative risk features that produce subjective biases and misjudgments of risk assessments, such as the degree to which the risk is familiar or exotic, natural or man-made, geographically limited or catastrophic effects, or whether or not the consequences of the event are not-fatal or fatal (Kapuscinski &

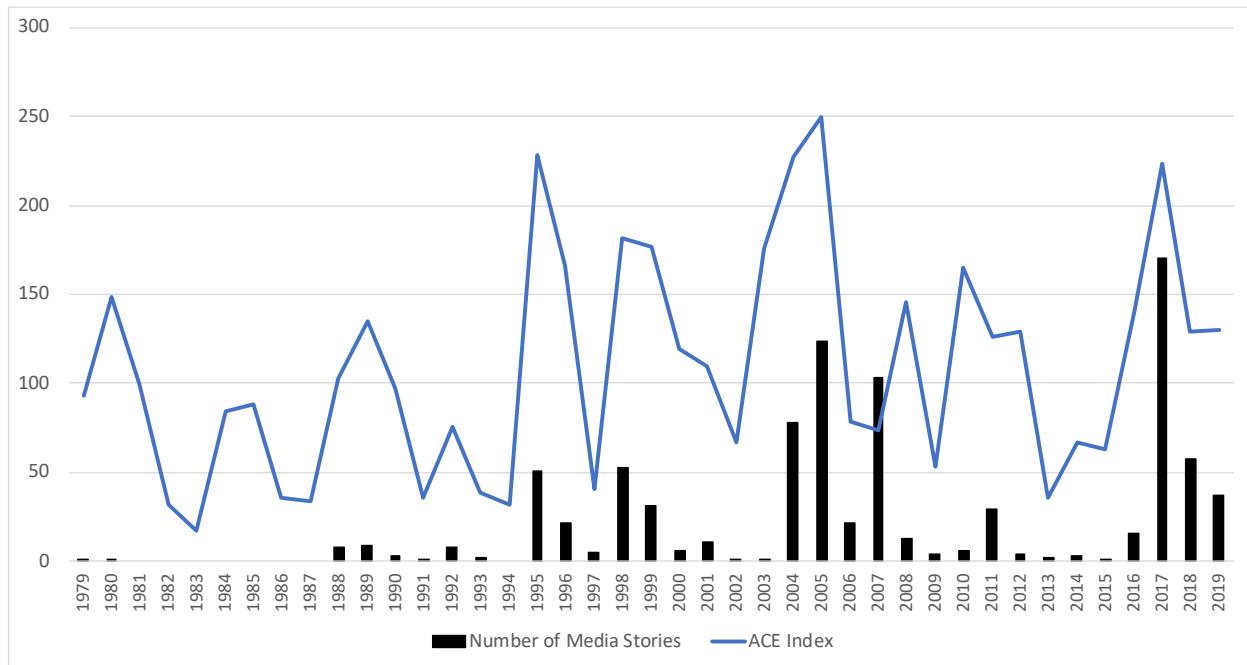
Richards 2016). Tourism research has found perceived risk can differ based on gender (Carr 2001), age (Floyd & Pennington-Gray 2004, Kozak et al. 2007, Walters et al. 2015), travel experience (Sönmez & Grafe 1998a), nationality (Seddighi et al. 2001), religion (Adam 2015, Mansfield et al. 2016), knowledge (Sharifpour et al. 2014) and personality (Lepp & Gibson 2003, Reisinger & Mavondo 2005). Studies have also found that tourists who had frequently visited an area prior to be affected by a crisis event, are more likely to have lower perceptions of risk and thereby higher likelihood to return to the affected destination compared to first time or infrequent visitors (Walters & Clulow 2010, Walters & Mair 2012).

When there is a perceived risk, people are more likely to rely on media sources to get event-related information to help alleviate uncertainty, particularly when traveling to a new or unfamiliar destination, or when a tourist has limited (or no) personal experience with the hazardous event (Cahyanto et al. 2016, Kapuscinski & Richards 2016, Wang et al. 2019). Research has also found that media is an important source for weather information that can influence participation in tourism and recreation activities (Scott & Lemieux 2010, Rutty & Andrey 2014). Regrettably, news media coverage is often associated with producing distorted understandings of safety levels at destinations, with a noticeable one-sidedness that centers on negative narratives because these are considered better news hooks (Boykoff & Smith 2010). In the disaster context, the global availability of information, including cases of misrepresentation and sensationalist coverage by the media, has been attributed to the formation of negative perceptions of a disaster-affected destination, including the degree to which some hazards are perceived as safe or more dangerous (Wahlberg & Sjoberg 2000, Faulkner 2001, Peters & Pikkemaat 2005, Armstrong & Ritchie 2008, Pearlman & Melnik 2008, Walters & Mair 2012, Kapuscinski & Richards 2016).

It is widely agreed that the aspects of an issue that are highlighted in the media (e.g., emphasized by the speaker or an image shown) can influence the way tourists' understand and interpret a disaster or crisis event (Pearlman & Melnik 2008, Cahyanto & Pennington-Gray 2015, Hove et al. 2015, Kapuscinski & Richards 2016). In turn, the media can moderate travel behaviour, with perceived cognitive images (i.e., informed by external stimuli) consistently found to be one of the strongest positive predictors of travel intentions (Liu et al. 2017). Utilizing a keyword search in *LexisNexis*, a comprehensive database of full-text documents, a total of 883 newspaper articles from around the globe were published between 1980-2019 that contained the words 'hurricane', 'tourism', and 'Caribbean.' Figure 2 reveals that the hurricanes in the Caribbean made the most headlines between 2015-2019, with the historic 2017 season yielding the highest number of newspaper publications in a single year at 170. There is also a notable correlation of media coverage in years when the ACE index is higher (Accumulated Cyclone Energy index or ACE). Of the total newspaper publications, 37% of the articles reported widespread damages, with only 9% explicitly stating that tourist areas were unaffected by the respective hurricane. Importantly, 30% of the newspaper articles discuss damage to tourism infrastructure, 24% note damage to beaches (e.g., erosion, loss of vegetation), and 25% state vacations have been 'ruined' as a result of the hurricane. Less than 15% of newspaper articles specify that the hurricane damage is localized to specific areas or islands, and only 13% urge

tourists to visit the region (i.e., businesses are still open despite the region or island being impacted by hurricanes).

Figure 2. Newspaper Coverage of Tourism and Hurricanes in the Caribbean



There is a lack of research that examine destination decision-making in a post-disaster context, including after a climatic or health-related event (Walter et al. 2015, Mair et al. 2016, Atazori et al. 2018, Wang et al. 2019). An exception is Ratty and Scott (2010) who asked respondents whether media headlines that the Mediterranean would become “too hot” for tourism would influence their travel plans. Only 12% of respondents indicated the media would have no influence, while over half of the respondents (52%) stated they would change their travel plans. Another exception is Pearlman and Melnik (2008) which found respondents’ image of New Orleans had changed significantly for the worst following Hurricane Katrina, citing media sensationalism as the main reason for a negative impression of the area. In a follow up study, a gradual improvement in visitor perceptions of New Orleans was found, indicating negative destination image can decay over time (Ryu et al. 2013). This finding underscores the challenge faced by the tourism sector, in that long after the physical damage is addressed, the intangibles – tourists’ risk perceptions and the restoration of destination image – can persist (Mair et al. 2016). Time lags were also recorded in Rosello et al. (2000) gravity model, which found the potential effect of disasters on tourism arrivals was better captured at 12 months versus 6 months, with the exception of floods and storms which had shorter-term impacts.

There has been limited research on tourist perceptions and response to hurricane strikes in the Caribbean (Forester et al. 2012, Villegas et al. 2013) or how perceptions may change if the massive destruction witnessed recently in Puerto Rico, The Bahamas, and Antigua and Barbuda occurs more regularly. In a survey of tourists in Anguilla, Forester et al. (2012) found that over

80% of respondents were aware of when hurricane season occurs (June to November) and 40% considered hurricane season when choosing a destination. Respondents were significantly less likely to choose a holiday where hurricane risk is perceived to increase (either in frequency or strength), particularly among seniors (65+ years old), Americans, and tourists who prioritize beach activities. In Florida, Matyas et al. (2011) assessed tourist perceptions of risk and evacuation likelihood under different hurricane conditions. Tourists that indicated the highest risk and evacuation ratings had not previously been affected by a hurricane and had checked for the possibility of a hurricane strike before departure. Importantly, the study also found that while tourists were somewhat knowledgeable about hurricanes, they commonly misinterpreted the track cone of uncertainty and forecast hurricane conditions, leading to a lower perception of risk and subsequent reduced likelihood to evacuate.

Communications with the Secretary General of the CTO reinforced the strategic value of additional research in the area of tourist risk perceptions. CTO research priorities in this area would examine the following questions. What are some of the factors which would influence a traveler to choose a hurricane threatened area over another area of the world (e.g., price, product, service)? Do travellers perceive the Caribbean region to be adequately prepared for and respond to natural disasters (and are some islands better prepared than others)? With increased media coverage of ‘super storms’, have perceptions changed and how does it influence the choice of the Caribbean for travelers during June to November?

3.3 Crisis Impacts on Caribbean Tourism

3.3.1 Climatic

The influence of climate on the Caribbean travel and tourism market is well documented (Martin 2005, Scott & Lemieux 2010, Rosselló-Nadal 2014). There is significant evidence that climate stimuli have an important influence on tourist motivation, destination attractiveness, destination choice, and seasonal tourism demand. Studies consistently emphasize that, outside of pricing, the suitability or attractiveness of the destination is one of the most critical factors for tourist decision-making and climate is a central characteristic of attractiveness (Hamilton *et al.* 2005, Li *et al.* 2017). The influence of climate (as a pull and push factor – Matthews *et al.* 2020) is particularly pronounced for 3S tourism markets, which dominates the Caribbean tourism sector.

Weather and climate extremes also have an important influence on tourism operations and performance in the Caribbean. Research in the region has been exclusively focused on the impact of hurricanes, not other forms of climate variability or extremes (e.g., drought). Hurricanes disrupt tourism operations and can cause severe damage to both tourism and community infrastructure, as well as natural and cultural tourism assets. Caribbean coastal tourism infrastructure is at particularly high risk to storm surge flooding and wind damage. Hurricanes can also significantly influence tourism demand, including the timing of holidays and the destination choice.

Exposure to hurricane damage is temporally and spatially uneven throughout the Caribbean. The Accumulated Cyclone Energy index (ACE) uses the maximum wind speeds of tropical cyclone to quantify comparable hurricane activity every year. The 1970s to 1990s were a period of relatively low ACE index values in the North Atlantic basin (NOAA 2020a). This is also the period of greatest growth in coastal tourism infrastructure development and annual increases in international arrivals (see section 3.2). This era of relatively low hurricane activity may have lowered perceptions of risk and adversely impacted tourism infrastructure design and planning. Analysis of tropical cyclones world-wide over that last 40 years found that the proportion of storms that reach high intensity is increasing (Kossin et al. 2020).

The heatmaps in Figure 3 and Figure 4 compare the relative exposure of Caribbean countries to tropical storms and hurricanes using the *International Best Track Archive for Climate Stewardship (version 4)* database from the satellite era of 1980 to 2019 (NOAA 2020b) (heatmaps for the historic storm data series 1851 to present are included in Appendix A). Figure 3 includes the number of storms that tracked within 500km of any part of the country's border and is indicative of the number of times a hurricane warning would have been issued for the country (within 2-3 day forecast cone of uncertainty), resulting in disrupted tourism operations from flight cancellations, potential tourist evacuations, and resorts initiating emergency management plans. Figure 4 presents the number of times hurricanes were within 50km of a country's border, where hurricane force winds and associated storm surge would have been experienced on land. This average radius of maximum winds (Rmax) was obtained from Hsu and Yan (1998) and is indicative of potential hurricane damage to tourism infrastructure and assets, with a more prolonged disruption and recovery period.

Most CARICOM countries have an approximately 10% chance of being struck by a hurricane each year, but some, like the Bahamas, are over 20% (see countries at bottom of Figure 3 and 4). Even within a country there is varied exposure to hurricane disruption and damage. Figures 5 and 6 demonstrate the differential hurricane experience of individual tourism resorts in Dominican Republic and The Bahamas during the satellite era of 1980 to 2019. The Bahamas 2019 experience with Hurricane Dorian is illustrative of this differential impact on tourism within a country, as this Category 5 storm made devastating landfall over the northern islands of Grand Bahama and the Abaco Islands, while 14 other tourism dominated islands, including Nassau, were unaffected. With over 4000 coastal hotels-resorts now geocoded within the region, future analyses will be able to assess the impact of hurricane events with greater precision than available in the existing literature. Maps for these countries and the full Caribbean Basin for the historic storm data series 1851 to present are included in Appendix A.

For tourism, there is a comparative advantage for countries south of the hurricane belt, with less disruption and damage, as well as lower operating costs for insurance. A report by PKF Hospitality Research (2008) estimated that Caribbean hotels paid out 3.2% of their total revenue in 2006 for property and general insurance, which as a dollar-per-available room was

Figure 3. Tropical Storm-Hurricane Warning Exposure in the Caribbean (within 500km)

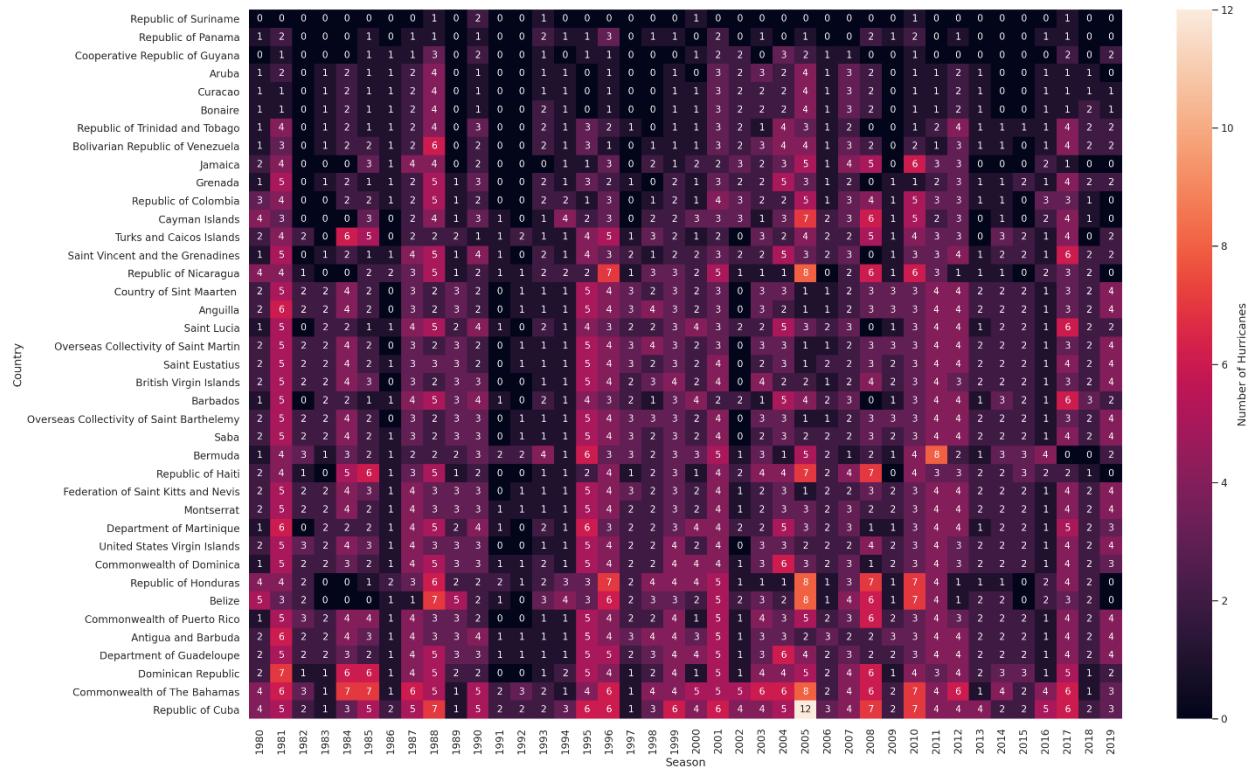
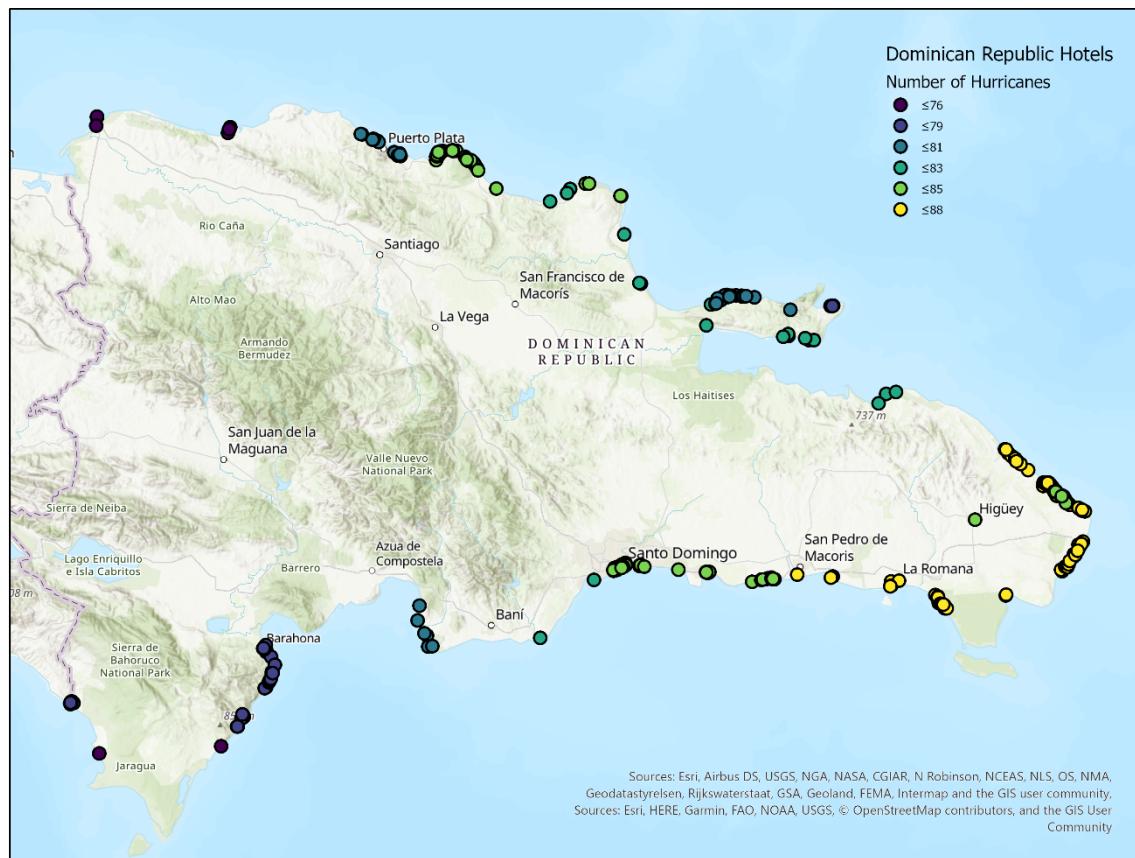


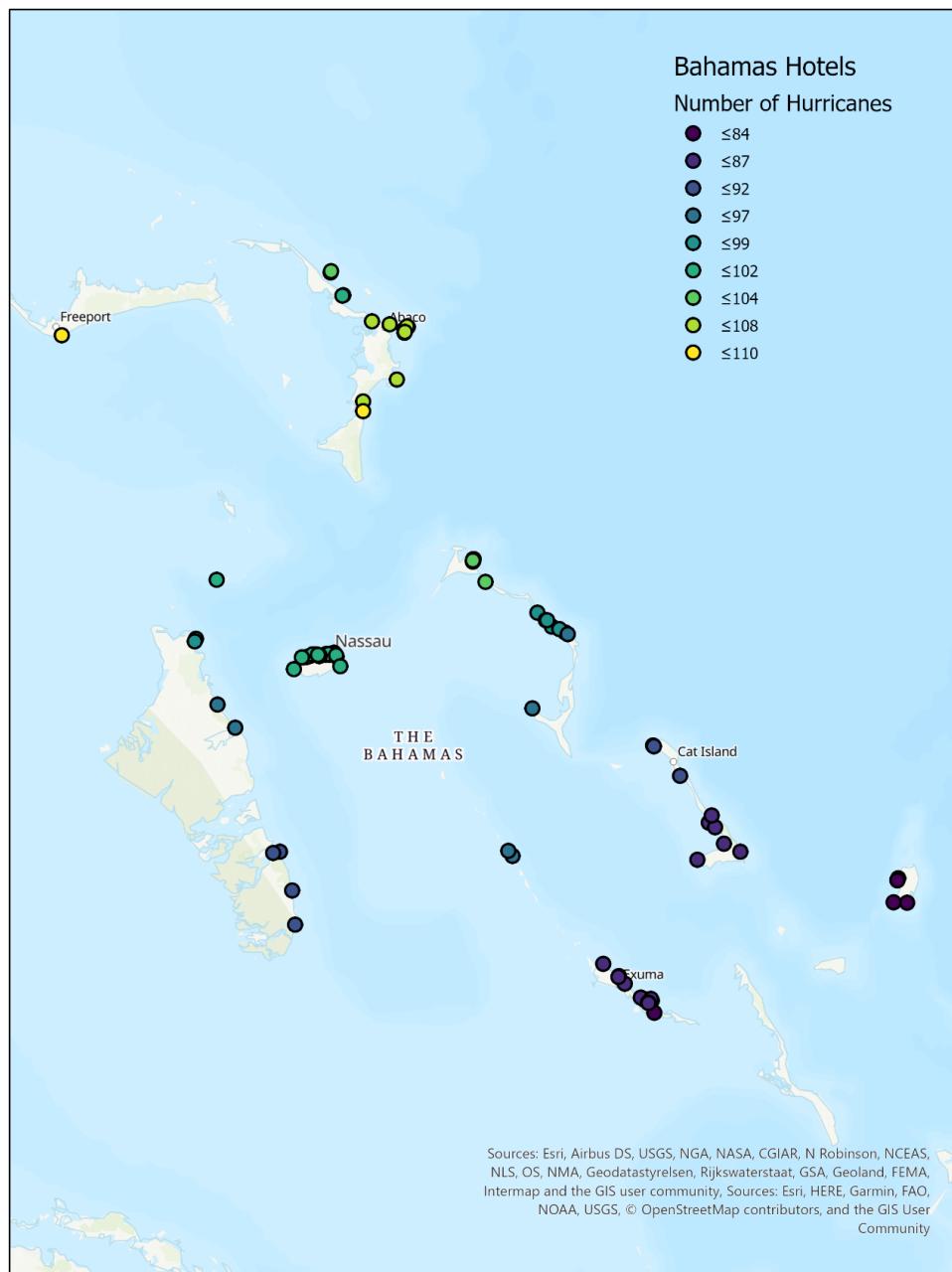
Figure 5. Tropical Storm-Hurricane Exposure of Resorts in Dominican Republic (1980-2019)



6.3% higher than comparable properties in the US. The higher insurance cost ratio was argued to reflect a riskier business location (although evidence of major storm exposure does not support that in some Caribbean countries) and higher reconstruction costs (i.e., higher material and transport costs to islands).

Early tourism studies examined single storms and hurricane impacts on individual Caribbean countries. For example, Benson & Clay (2001) examined hurricanes in Dominica between 1978-1986, recording a relationship between infrastructure destruction and a decline in annual visitor numbers at approximately 30%. Hurricane Lenny, which hit the region in 1999, inflicted severe damage in Anguilla, with an estimated industry loss of US\$26.3 million (ECLAC 2000). Hurricane Wilma struck the Cozumel and Cancun tourism areas of Mexico in 2005, damaging 90% of the hotels and resulting in insured claims of US\$6-12 billion (Lynn et al. 2007). The Mexican government spent over US\$250 million in the reconstruction of Cancun, much of it on improved infrastructure (Lynn et al. 2007), and approximately US\$80 million in 2010 to rebuild the beach (greater than 50% of the beach in front of most resorts was lost during the storm) (Martell et al. 2020).

Figure 6. Tropical Storm-Hurricane Exposure of Resorts in The Bahamas (1980-2019)



The only regionwide analysis (of 26 countries) was completed by Granvorka and Strobl (2013), who examined the impact on country-level tourist arrivals over the 2003-2008 period. The results indicate that an average hurricane strike causes tourism arrival to drop by 2% in the 12 months after the storm, while the largest event (Hurricane Ivan in 2004) was estimated to have reduced arrivals by 20%. Hurricane Ivan hit the Cayman Islands, leading to economic damages estimated at 200% of GDP (Forster et al. 2012), as well as Grenada, resulting in the damage or

loss of 90% of hotel rooms and economic damages of US\$108 million (29% of GDP) (Mimura et al. 2007).

More recent studies have focused on some of the very large and destructive hurricanes to impact the region in the last decade, particularly the historic year of 2017, which was marked by a series of major storms that resulted in the highest incurred losses ever recorded (US\$135 billion) (Munich 2018). These studies also tended to focus on the impact of single storms on a single country. For example, after tropical storm Erika passed over Dominica in 2015, officials claimed it set the country's tourism development back 20 years, with economic damages of US\$482 million (90% of Dominica's GDP), including over one-third of the island's hotel capacity suffering complete losses (GFDRR 2015).

The WTTC's (2018) analysis of multi-storm impacts in 2017 is an important exception. The 2017 hurricane season significantly impacted Caribbean tourism, with hurricanes Harvey (strong Category 4), Irma (Category 5), and Maria (Category 5), causing an estimated loss of over 826,000 visitors (-2.5% of expected visitors and -4% from 2016), and a loss of over \$292 million to the region's GDP (WTTC 2018). It is estimated that recovery in some destinations will take up to four years, during which time the tourism sector will 'miss out' on an additional \$3 billion in tourist spending due to damage to resorts, beaches, attractions, and other infrastructure (WTTC 2018). These major hurricanes in 2017 also had a notable impact on insurance costs, but limited impact on tourism sector investment. Insurance rates for tourism operators increased 10-50% due to losses caused from the 2017 hurricane season (ECLAC 2017), while in other cases, insurers would no longer continue to insure assets in the Caribbean (KPMG 2018). A survey of tourism sector financing in the Caribbean found that the confidence of banks and non-banks was hardly impacted by the 2017 hurricane season (75% of banks and all non-banks financing intentions were unchanged) (KPMG 2018).

Some individual islands experienced much steeper declines in air arrivals following the 2017 hurricane season, such as a 50% decrease in visitor numbers in the three months following the hurricanes in Dominica, St. Maarten, and US Virgin Islands. Other islands undoubtedly benefitted from transfers away from the impacted islands. For example, island substitution was reported by the WTTC (2018) in the three months following the 2017 hurricane season, with an increase in arrivals in the Cayman Islands (+28%), Saint Lucia (+18%) and Saint Vincent and the Grenadines (+18%).

The Caribbean is often promoted as a regional tourism destination by the CTO (in addition to individual countries promotion efforts) and there is insufficient research on how hurricane events on one area or island impact visitation on adjacent islands. Is being in the forecast zone of uncertainty as disruptive to arrivals as an actual landfall? Are arrivals effectively diverted to unaffected destinations, minimizing overall lost arrivals and the impact to the regional economy? For example, Hurricanes Irma and Maria affected 13 Caribbean countries to varying degrees, with reservations cancelled across the region as the international media reported the Caribbean as being devastated. The CTO and industry partners implemented a campaign on the geography of the Caribbean, as well as multi-island countries such as The Bahamas, advocating

that the ‘Caribbean was still open for business,’ advising tourists on which countries were impacted and which non-affected islands were still receiving visitors (Matthews et al. 2020).

In the decades ahead, hurricane risks to Caribbean tourism will intensify, with continued coastal development and accelerating impacts of climate change, including greater frequency of Category 4 and 5 storms and storm surge that will be exacerbated by sea level rise. An analysis of tropical cyclones world-wide over that last 40 years found that the proportion of storms that reach high intensity is increasing (from 30% of storms reaching category 3 and higher to 40%) (Kossin et al. 2020). The trend toward stronger storms was clearest in the north Atlantic and is consistent with projections of hurricane activity in a warming world with higher average sea surface temperatures. Modeling by Knutson et al. (2013) found the occurrence of Category 4 and 5 storms increased from 14 in the control run to 19 under a mid-range emission scenario (RCP4.5) by late-century, with a tendency to shift toward the Gulf of Mexico and Florida region, which may portend decreased exposure for the countries of the West Indies. Importantly, in an analysis of global analysis of physical climate risk, Woetzel et al. (2020: viii) concluded that, “Most of the increase in direct impact from climate hazards to date has come from greater exposure to hazards rather than from increases in the mean and tail intensity of hazards. In the future, hazard intensification will likely assume a greater role.”

3.3.2 Infectious Disease

The impact of two disease outbreaks on Caribbean tourism have been examined. In 2009, a new strain of swine flu emerged (H1N1 influenza virus) and was defined as a pandemic that lasted approximately 18 months. Some estimates indicate as many as 700 million to 1.4 billion people worldwide were infected (Roos 2011), and while most cases remained minor, as many as 150,000 to 575,000 deaths may have occurred (Dawood et al. 2012). When an outbreak in Mexico was confirmed and covered by the international media, occupancy levels in many resorts declined 50% in April and May of 2009 (Monterrue 2010). However, arrivals data shows Mexico had largely recovered to pre-pandemic levels by early 2010 (winter peak months). The Government of Mexico estimated that almost a million international arrivals were lost over a five-month period, which translated into losses of around US\$3.4 billion (Monterrue 2010). European markets were observed to be the slowest to return after the outbreak, but no analysis on differential media coverage nor traveler’s perception of the normalisation process following the virus have been conducted.

Very limited research is available on the impact of Zika virus epidemic on the tourism sector. Gallivan et al. (2019) found evidence that travel intentions of soon to be parents were impacted by the outbreak, using Twitter data related to ‘babymoon’, a holiday taken by parents-to-be before their baby is born. Mentions of locations affected by Zika declined significantly after media coverage of the disease made the risks to unborn and young children well known and the CDC issued a Level 2 travel notice for several countries in Latin America and the Caribbean (January 2016). There is anecdotal evidence of cancellations, as well as airlines, cruise ships and resorts changing cancellation policies because of Zika. A story by Forbes (Canal 2016) speculated that losses could exceed US\$63 billion (US\$11 billion in Caribbean Islands), however

there has been no analysis of Zika's impact on arrivals in any country. We explore the effects of Zika on tourism in section 4.5 below.

3.3.3 Economic

Economic cycles in the source markets of advanced economies have historically transferred rapidly to the Caribbean tourism sector (IMF 2014). The onset of the global economic crisis in late 2008 was no exception. The severe economic contraction in 2009 resulted in a global decline in international arrivals from 916.7 million in 2008 to 883.2 million in 2009 (UNWTO 2020b). The decline of approximately 4% stands in sharp contrast to the sustained 6-7% growth between 2004 and 2007. The Americas region, which includes the Caribbean, also declined at 4.2% in 2009 (from 147.8 million to 141.7 million arrival) but recovered to 150.1 million arrivals in 2010 (UNWTO 2020b).

The Caribbean tourism economy suffered a greater impact from the economic crisis, with a 9% decline in arrivals between 2008 (20.1 million) and 2009 (18.3 million) (see Caribbean tourist arrivals in Figure 1). The recovery also lagged behind the Americas region and global rebound, with arrivals not returning to prerecession levels until 2012. Large differences in recession impacts and recovery were observed at the country level, with arrivals declining 10-15% in Antigua and Barbuda, Bahamas, and Barbados, while Cuba and Jamaica experienced no absolute declines (ECLAC 2010). Similar differential country impacts were reported in the cruise market, with sharp declines of 10-15% in Puerto Rico, Jamaica and US Virgin Islands, but increases in Barbados, Dominica, Belize, Saint Lucia and Grenada (ECLAC 2010). These cross-country differential impacts have not been analyzed for differences in government-industry responses to the economic crisis or the potential role of intra-regional competitiveness (e.g., see rankings in Table 1).

4. Modeling of Hurricane Impacts on Caribbean Tourist Arrivals

In this study, we use hurricane geo-spatial information to identify the causal effect of hurricanes on the tourism arrivals in the Caribbean. While hurricane landfalls can be thought of as random, hurricane impact is a function of the state and capacity of the economy to respond in advance of, or to recover after, the hurricane. We exploit variation in the time and location of hurricanes to estimate the causal effect on tourism arrivals using a difference-in-difference methodology. Our results suggest that, on average, tourism arrivals decrease by 13% in countries affected by hurricanes during the 6 months following the storm in our period of study (2004 to 2018). We extend our difference-in-differences approach and perform an event study that shows the impact across time. We find that hurricanes initially reduce tourism arrivals by over 30%, recovering to the season average in the following 3 months. Our results also reveal that not all hurricane seasons are the same. The 2017 hurricane season, which included major hurricanes Harvey (Category 4), Irma (Category 5) and Maria (Category 5), hit the region in August and September, resulting in a reduction in tourism arrivals of almost 33 percentage points on average for those countries directly affected by the hurricanes.

4.1 Data

4.1.1 Tourism Arrivals

Our analysis begins with monthly tourism arrivals data for the period 2008-2018 from the CTO. The data contains tourist arrivals for 26 countries (and territories) (see Section 2, Figure 1), with the mean and standard deviation of monthly tourist arrivals shown in Table 2. There is large variation in the average arrivals, with Dominican Republic averaging around 420,000 tourist a month, followed by Cuba with over 250,000, Jamaica with over 170,000, Puerto Rico with over 125,000, and Bahamas with almost 120,000. At the same time, there are countries and territories with fewer than 10,000 arrivals per month, such as Anguilla, Dominica, and St. Vincent & the Grenadines. Monserrat has the lowest average arrivals with 631. In larger countries, there is also high monthly variation in arrivals.

Table 2. Tourism Arrivals and Hurricane Landfalls by Country

Country	Tourist Arrivals Mean	Std. Dev.	Hurricane Landings
Anguilla	5,556	2,097	2
Antigua & Barbuda	20,784	4,905	2
Aruba	81,352	13,748	0
Bahamas	119,104	32,436	5
Barbados	47,831	9,776	2
Belize	26,629	9,593	2
Bermuda	20,274	8,587	0
British Virgin Islands	28,361	11,430	3
Cayman Islands	29,351	9,412	1
Cuba	257,972	87,265	6
Dominica	6,371	1,793	3
Dominican Republic	418,101	105,424	5
Grenada	10,715	2,641	0
Guyana	16,168	5,397	0
Jamaica	173,947	44,370	2
Martinique	41,056	10,701	2
Montserrat	631	416	2
Puerto Rico	126,678	29,702	3
St. Kitts & Nevis	9,213	1,943	2
St. Lucia	29,385	22,280	2
St. Maarten	37,377	11,922	0
St. Vincent & the Grenadines	6,310	1,703	2
Suriname	18,826	5,345	0
Trinidad & Tobago	33,915	5,592	0
US Virgin Islands	57,610	16,916	3

4.1.2 Location and Timing of Hurricanes

A dataset of hurricane landings for the North Atlantic Hurricane database (HURDAT) was constructed, which included the geographical position, maximum wind speed, and minimum pressure of tropical cyclones in the North Atlantic Basin (Figure 7). This study focuses on the largest hurricanes that affect the Caribbean region, with sustained winds of more than 177 km/h, which is a strength of three on the Saffir-Simpson scale (consistent with the analysis by Granvorka and Strobl, 2013). The 10 hurricanes across 6 hurricanes seasons fitting this description are listed in Table .

Figure 7 shows the hurricane tracks that occurred during the study period. In Figure 3 and Figure 4, we show that some countries are hit by hurricanes more often than others. For example, Cuba is hit 6 times in study period, while Bahamas and Dominican Republic are hit 5 times each. That is, while hurricane tracks can be considered random, they are not equally distributed across countries. In fact, there is a strong positive correlation between average tourist arrivals and the number of times a country is hit by a hurricane (i.e., high arrivals correlate with high hurricane landfalls). This is problematic from a statistical perspective. As we show in section 4.3, running a simple regression would suggest that hurricanes increase tourist arrivals. Our difference-in-difference strategy addresses this problem by controlling for country time invariant characteristics and for time trends.

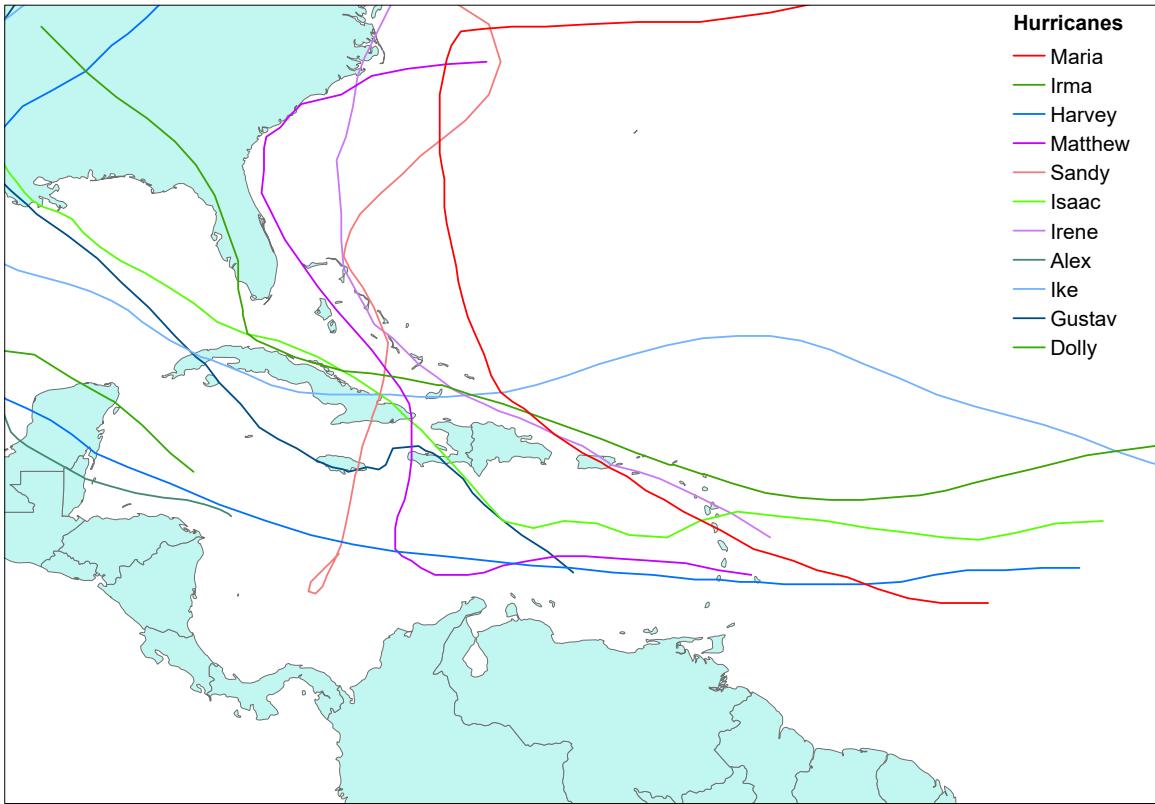
Table 3. Hurricanes

Hurricane	Month	Year	Max Wind [Km/h]	Min Pressure [millibars]
Ike	9	2008	231	935
Gustav	9	2008	250	941
Alex	7	2010	177	946
Irene	8	2011	194	942
Isaac	9	2012	130	965
Sandy	10	2012	185	940
Matthew	10	2016	269	934
Harvey	9	2017	213	937
Irma	9	2017	287	914
Maria	10	2017	278	908

4.2 Method

To investigate the average effects of hurricanes on tourist arrivals in the Caribbean, we a simple strategy to estimate the effects of hurricanes on arrivals could be to measure the change before and after a hurricane and then compare the change in arrivals

Figure 7. Hurricane Tracks



against countries not affected by hurricanes. This comparison yields the well-known difference-in-differences (DD) estimator. Define T as the number of tourist arrivals. In a simplified, conceptual model with two countries (c, c'), and two time periods ($pre, post$), consider the affected country to be z and the unaffected country z' . The DD estimator can be written as

$$\hat{\beta}^{DD} = (\bar{T}_c^{post} - \bar{T}_c^{pre}) - (\bar{T}_{c'}^{post} - \bar{T}_{c'}^{pre}) \quad (\text{Equation 1})$$

where \bar{T}_c^t is the average number of tourist arrivals in country c during period t .

Our identification strategy rests on the assumption that the remaining variation in tourist arrivals is thus attributable to the effects of hurricanes, producing an estimate of the total average effect of hurricanes on arrivals.

We estimate the effect of hurricanes on tourist arrivals using the reduced-form equation

$$\tilde{T}_{cm} = V_{cm} + \beta H_{cm} + \gamma f_{cm} + \mu l_{cm} + \varepsilon_{cm} \quad (\text{Equation 2})$$

where the index c corresponds to the countries and territories in the Caribbean and the index m corresponds to the month and year of arrivals.

The outcome of interest in the previous equation is tourist arrivals to a country in a particular month, denoted as T_{cm} . A common approach for diminishing the influence of extreme values

within Ordinary Least Squares (OLS) estimation is to log-transform the dependent variable, bringing extreme values closer to the average, which is denoted as \tilde{T}_{cm} .

We use $V_{cm} = \lambda_m + \delta_c$ as shorthand to represent the fixed effects terms in the model. We include time period fixed effects λ_m to control for time-varying secular patterns in the Caribbean that may have influenced tourist arrivals, such as fluctuations in global economic trends or disease epidemics. We include country fixed effects δ_c to control for unobserved, time invariant factors that may have influenced the impact of a hurricane in a particular country, such as institutional capacity and adaptation investment. Finally, f_{cm} and l_{cm} are variables indicating if a country or territory was hit by a hurricane in the year preceding or following the hurricane in month m .

In the main analysis, we treat the hurricane variable H_{cm} as a binary variable taking values

$$H_{cm} = \begin{cases} 0 & \text{if } m < \eta^h \\ 1 & \text{if } m > \eta^h \end{cases}$$

Where η^h represents the month when the hurricane landed in country c . The parameter of interest is β which measures the average effect of hurricanes on tourist arrivals. Our identification of this effect relies on the assumption that, other than what we have already controlled for in equation, there are no other idiosyncratic shocks occurring around the landing of a hurricane that influence arrivals. The parameter β is equivalent to the DD estimator $\hat{\beta}$ given in equation (1) if our identifying assumption holds, and is identified from within country comparisons over time. The negative effect of hurricanes on tourist arrivals is given requires $\hat{\beta} < 0$.

4.3 Results

We estimate equation (2) using Ordinary Least Squares (OLS). The estimates of the impact of hurricanes on tourist arrivals are reported in Table 4, where we present the results from estimating a pooled regression and our difference-in-differences (DD) model as shown in Equation (2).

Table 4. Difference-in-Differences

	OLS	DD
Hurricane Impact	0.449 (0.329)	-0.117 ^a (0.036)
Time FE	X	X
Country FE		X
Observations	2870	2870
Adjusted R ²	0.017	0.97

Notes: The dependent variable is the log transformation of tourist arrivals. Standard errors reported in parenthesis. The OLS model does not contain any fixed effects. ^a shows significance at the 99% level, ^b significance at the 95% level, and ^c significance at the 90% level.

We see the inadequacy of using pooled estimates to describe the effects of hurricanes on tourist arrivals. The pooled result suggests that hurricanes *increase* tourist arrivals. This counterintuitive result can be explained by the fact that islands with more arrivals can be larger or located in a part of the Caribbean region that is more prone to hurricanes. It can also follow from the fact that the hurricane season is associated with early peak tourism arrivals (Nov-Dec) (late peak season includes Jan-Feb-March in most destinations). For this reason, while the result is statistically significant, we cannot interpret it as causal. Our DD estimation accounts for country and time fixed effects, suggesting that hurricanes decrease tourist arrivals 11% during 12 months following the hurricane damage. We should caution here that our results are to be interpreted as changes relative to a year with low damage or no hurricanes.

4.3.1 Differential Impact of Hurricane Seasons

In the difference-in-differences approach above we present the average effect to all hurricanes in our sample on tourism. Yet, not all seasons have the same impact on tourism as some have more intense hurricanes or more hurricanes. For example, in 2016 only Hurricane Matthew had a force to cause substantial damage, while in 2017 Hurricanes Harvey, Irma and Maria all cause substantial damages in the countries and territories in the Caribbean. To explore these differential impacts, we estimate the following model:

$$\tilde{T}_{cm} = V_{cm} + \sum_{year} \beta_{year} H_{cm} * I_y + \varepsilon_{cm} \quad \text{Equation (3)}$$

where all variables and parameters are defined as above and I_y is an indicator that equals one when the hurricane lands in year is y .

Among the years in our study sample with major hurricanes affecting the Caribbean, only 4 seasons have statistically and economically significant impacts on tourist arrivals (Table 5). The excluded year is 2013 and we only report the years with hurricanes in our sample. In 2008, hurricanes Ike and Gustav caused an average reduction in tourist arrivals of around 20 percentage in affected countries. In 2010, hurricane Alex caused a reduction of almost 25 percentage arrivals in Belize. The 2011 season affected several countries in the Caribbean and resulted in a reduction of 9 percentage points in tourism arrivals. The 2017 hurricane season is the most damaging in study period, with Hurricane Harvey, Irma and Maria hitting one each month (and Maria had the highest sustained wind speed in our sample), averaging a reduction in tourist arrivals by 33 percentage points.

Table 5. Differential Impacts by Hurricane Season

Hurricane Name	Ike and Gustav	Alex	Irene	Isaac and Sandy	Matthew	Harvey, Irma and Maria	Florence and Michael
Year	2008	2010	2011	2012	2016	2017	2018
Tourism	-0.199 ^a (0.059)	-0.252 ^a (0.027)	-0.091 ^b (0.039)	0.040 (0.055)	-0.082 (0.085)	-0.331 ^b (0.153)	-0.176 (0.109)

Notes: The dependent variable is the log transformation of tourist arrivals. All regressions include country and time fixed effects. Standard errors clustered at the country level are reported in parenthesis. N=2870 and Adjusted R²=0.97. ^a Shows significance at the 99% level, ^b significance at the 95% level, and ^c significance at the 90% level.

4.3.2 Flexible Estimates

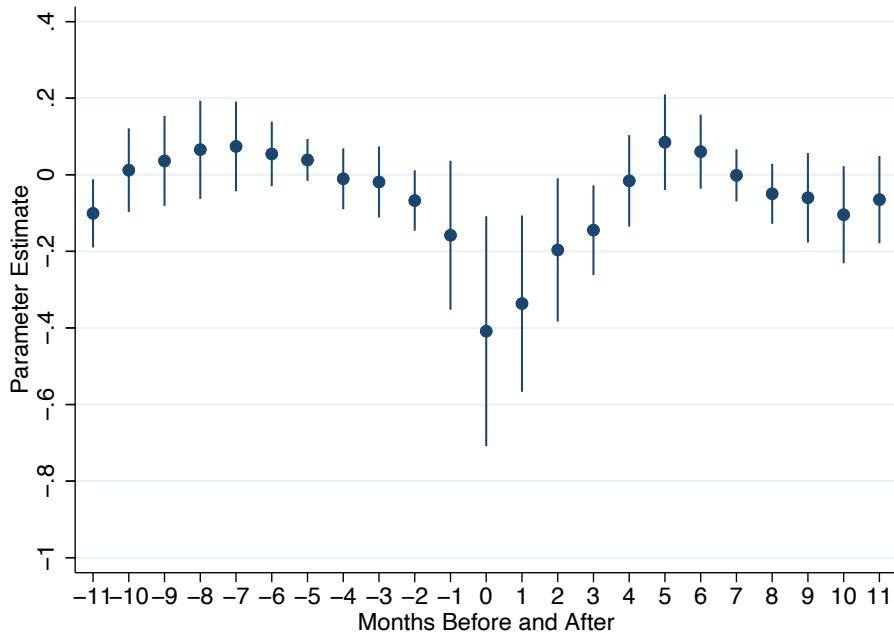
Our analysis above shows the average decline in tourist arrivals during the 6 month period following the hurricane landing. In this section we evaluate how countries recover after a hurricane using an extension of our estimation framework that allows for each month before and after the hurricane event to have a different average impact on tourist arrivals. To do this, we estimate the following specification:

$$\tilde{T}_{cm} = V_{cm} + \sum_k \beta_k H_{c(m+k)} + \varepsilon_{cm} \quad \text{Equation (3)}$$

In the specification above, we center the time period a hurricane lands at $k = 0$ and evaluate the impact of hurricanes from $k = -12$ months before and $k = 12$ months following this date. The choice of leads and lags ensures we do not overlap hurricane seasons. The results of this analysis are presented in Figure 8. In Figure 8 we show the parameter estimates β_k for each k . Because we have centered the events at $k = 0$, we see – as we expected – that all estimates before the hurricane events are statistically zero. This result is also important for our empirical approach. For difference-in-differences to work, we require that the countries affected and not-affected follow the parallel trends assumption. That is, both the countries that are affected by a hurricane and those that are not-affected by the same hurricane, should follow the same trends before the event. While this assumption cannot be directly tested, we can see in the regression results that the two set of countries behave as expected, resulting in statistically insignificant results before the hurricane.

When the hurricane strikes, we see an immediate reduction in tourist arrivals. On average, we observe a reduction of 40% in tourist arrivals in the month the hurricane occurs and a reduction of 34% the month after. Important to note that, because hurricanes sometimes land in the middle of the month, we only see a partial reduction in tourism during the initial month. Importantly, the effect of a hurricane remains negative and significant for three months after the initial hit. The effect of a hurricane landing dissipates 5 months after the hurricane when tourist arrivals return to a seasonal normal.

Figure 8. Event Study All Hurricanes



Note: Bars show 95% confidence intervals.

5. Modeling of Zika Impacts on Caribbean Tourist Arrivals

Zika has affected most countries in the Americas. Between August 2016 and January 2018 more than 800,000 cases were reported. Every single country in our Caribbean sample was affected by Zika, with a country average of 378 cases. We can follow a similar approach as in the previous sections to estimate the impact of Zika on tourist arrivals. Because all countries are affected, our estimates are necessarily imprecise and cannot be interpreted as causal.

The estimating equation of the effect of Zika on tourist arrivals takes the form:

$$\tilde{T}_{cm} = V_{cm} + \beta \tilde{Z}_{cm} + \varepsilon_{cm} \quad \text{Equation (5)}$$

where \tilde{Z}_{cm} is the log-transform cumulative count of cases in country c and month m .

The results of this regression are presented in column 1 of Table 6. The results are both economically and statistically insignificant. That is, there is no discernible effect of Zika on tourism in the Caribbean. In column 2 we compare highly affected countries to less affected (lower 50%) and find the same result. This finding is consistent with analysis by the Inter-American Development Bank (2020), which also found a non-significant impact from Zika on tourism in the LAC region.

Table 6. Zika

	DD	Within DD
Zika	0.0066 (0.0064)	0.0022 (0.0035)
Country and Time Fixed-effects	Yes	Yes
Observations	3279	3279

6. The Impact of the Covid-19 Pandemic on Caribbean Tourism

For 60 years, industry and government leaders have pushed for increasingly interconnected global tourism system. When barriers prevent people travelling, including the goods that support them from reaching markets, the system falls apart. Warnings of the potential for mass disruption from a pandemic and the role of international air travel in pandemic spread have been sounded for the tourism sector over the last two decades (Colizza et al. 2006, Hall 2010, Gössling et al. 2020), cautioning the need to thoroughly examine scenarios where “[...] a persistent virulent pandemic that makes international travel a personal risk and is highly regulated to prevent the spread of the biohazard” (Scott & Gössling, 2015: 278). Recommendations for pandemic risk assessments and the role of international travel in pandemic containment went largely unheeded.

A pneumonia of unknown cause detected in Wuhan, China, was first reported to the World Health Organization (WHO) Country Office in China on 31 December 2019. Since late 2019, the novel coronavirus (COVID-19) has spread, with over 8.4 million confirmed cases in 213 countries and territories (as of 17 June 2020) (ECDC 2020a). COVID-19 was declared a global pandemic by the WHO on 11 March 2020. The COVID-19 pandemic is challenging the world with unprecedented public health responses and economic disruption. Travel is major contributor to pandemic disease spread and salient to understand epidemiology and disease surveillance (Hon, 2013; Khan et al., 2009). With no vaccine and limited medical capacity to treat the disease, nonpharmaceutical interventions (NPI) are the main strategy to contain the pandemic. Tourism is particularly impacted by NPI measures that restrict mobility and require physical distancing that strictly limits public gatherings.

Unprecedented travel restrictions and stay-at-home orders have caused the most severe disruption of the global tourism economy since World War II. International, regional and local travel restrictions (including travel bans from selective countries, arrival quarantines, and/or health certificate requirements) immediately affected international and domestic tourism, including segments as diverse as air transport, cruises, public transport, accommodation, cafes and restaurants, conventions, festivals, meetings, or sports events. With international travel bans affecting over 90% of the world population at the end of March (Gössling et al. 2020) and wide-spread restrictions on public gatherings and community travel, tourism largely ceased in most countries in late March 2020.

Tourism has been one of the worst affected sectors worldwide. Early evidence on impacts on air travel, cruises, and accommodations have been devastating (Gössling et al. 2020). The number of global flights declined from 179,000 (7 day moving average) on 9 March 2020 to a low of 63,700 on 14 April (Flightrader24 2020). Many of these flights operated as near-empty ‘ghost flights’ that required airlines to operate some connections to guarantee they would keep their landing slots in the future. International Air Transport Association (IATA) (2020a) reported global passenger demand (revenue passenger kilometers) had declined 94% in April (relative to 2019). Another indicator of the dramatic reduction in air travel is the number of passengers screened by the US Transportation Security Administration (2020), which declined from over 2.2 million on 1 March to 953,000 on 17 March and reached a low of 87,000 on 14 April (down from 2.2 million the year before). The impact on the cruise industry has also been similarly far reaching, with major cruise companies reporting multi-billion-dollar losses in the first quarter of 2020. On 14 March, a no sail order was imposed on the cruise industry by the US Centres for Disease Control and Prevention, which collapsed the large Caribbean cruise industry. This order was renewed on 9 April and will be reviewed again in 100 days (24 July), although the industry association (Cruise Lines International Association) has indicated it will voluntarily not restart operations from US ports until at least mid-September. With the cruise industry facing intense criticism for the way it has handled the COVID-19 pandemic, thousands of stranded passengers on quarantined ships, some denied port for weeks, and ‘super spreader’ events causing ships to be referred to as ‘floating petri dishes’, the impact on reputation and long-term recovery remains uncertain. The accommodation sector has also suffered historic damage. Hotel occupancy levels reached historic lows in most countries in April and May 2020 (STR 2020) and 2020 average occupancy rates in countries with long data records are projected to be the lowest since the Great Depression of the 1930s (Business Travel News 2020).

The uncertainty and dynamics of the pandemic, including public health and economic recovery policy responses, make projections of the impacts of COVID-19 on the tourism sector extremely challenging, with all estimates of eventual consequences interpreted with extreme caution. While no organization has a crystal ball, it is clear that COVID-19 is not an ordinary shock to global tourism, with no analogue since the massive expansion of international tourism began in the 1950s (Gössling et al 2020). IATA (2020a) has warned that international passenger demand may not recover to pre-COVID-19 levels until 2024. The uncertainty of estimates of COVID-19 impacts on the sector is exemplified by rapidly changing projections from the UNWTO. An initial press release from UNWTO (2020a) on 6 March estimated the pandemic would cause international tourist arrivals in 2020 to decline 1-3% (compared to 2019) rather than the forecasted 3-4% growth. Three weeks later, on 26 March, this projection was updated to a 20-30% loss in international arrivals (UNWTO 2020b). On 7 May, UNWTO (2020c) released updated projections with three scenarios ranging from 58% to 78% decline in international arrivals, based on the potential opening of national borders and lifting of travel restrictions. Such massive declines would see international arrivals reduced to levels of 1999 and 1986 respectively. UNWTO (2020c) also conducted a global survey with industry experts and found that the majority expects to see signs of domestic market recovery by the final quarter of 2020

and recovery in international demand in 2021. Importantly for the Caribbean market recovery, experts in the Americas were the least optimistic and least likely to believe in recovery in 2020.

The worldwide impacts of the COVID-19 pandemic on tourism have been unprecedented, however the most prolonged disruption and economic devastation will likely occur in the tourism reliant economies of many small island nations. Of the top 20 countries most dependent on tourism as a source of GDP, 15 are small island nations (WTTC 2020a) and several are located in the Caribbean region. While these countries can influence the conditions necessary to successfully restart their tourism economies (e.g., reopen borders to international arrivals; implement policies on inbound quarantine and health screening requirements; develop new public health regulations and surveillance programmes for hotel/resorts; provide health coverage/insurance for travellers; increase marketing campaigns), they are largely dependent on the policies of source market countries for the recovery of their tourism economy. Examples include the removal/reintroduction of outbound travel restrictions and return quarantine requirements, travel health screening requirements and experience (and costs), development and implementation of an effective vaccine, and the success of economic stimulus and other policies to reduce unemployment and rebuilt consumer confidence and travel sentiments.

6.1 COVID-19 in the Caribbean

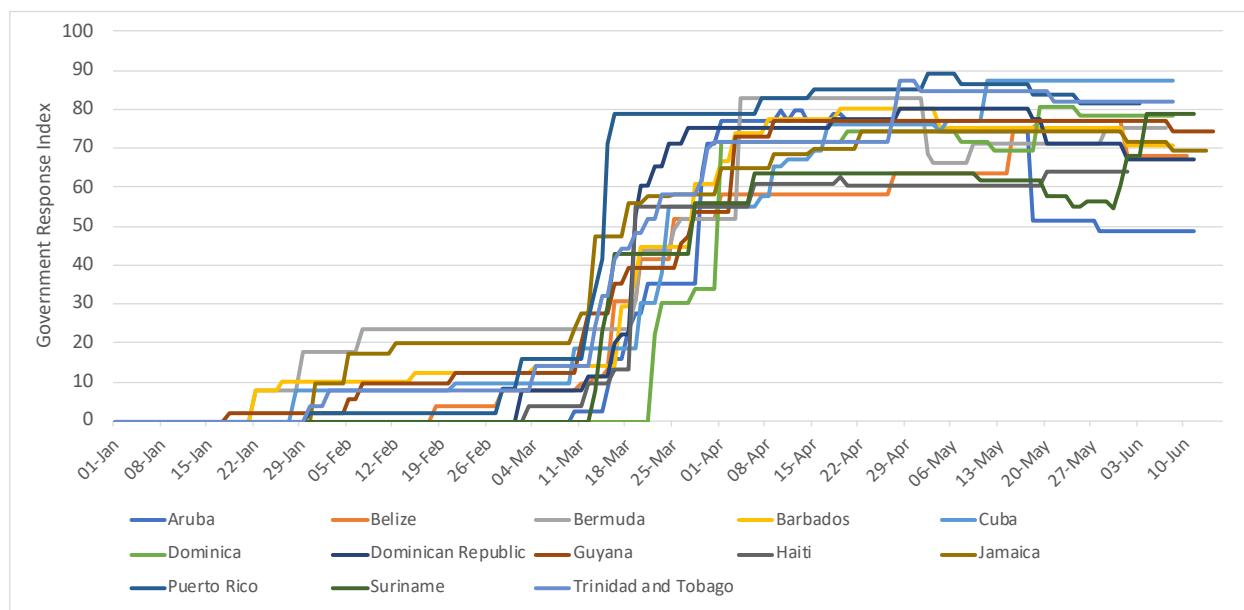
The first imported cases of COVID-19 into the Caribbean were confirmed in early March 2020, with Dominican Republic, Jamaica, Saint Martin, and Saint-Barthelemy each identifying less than 5 cases and no local transmission on 11 March. Imported cases from tourists and Caribbean nationals travelling abroad have continued, with some local transmission hotspots established. As of 17 June, the 14 CARICOM countries reported a total of 6,050 cases and 139 deaths. The number of confirmed cases and recent growth rates (as of 17 June) for these countries and others are provided for each country in Table 8.

Caribbean countries began diverse responses to the COVID-19 pandemic as early as mid-January. The Oxford COVID-19 Government Response Tracker has systematically compiled information on common policy responses to the pandemic, including health systems, economic, and containment policies. Indicators of 17 policy responses are integrated into an overall ‘government response index.’ Figure 9 records how the response of governments in the Caribbean has developed and varied from January to June 2020. Like most governments around the world, there was a substantial escalation in policy response between mid and late March. As most source market countries introduced restrictions on international travel in late March of 2020, Caribbean countries also began to introduce travel restrictions that further impacted the tourism sector. Table 8 summarizes the type and date that travel restrictions were introduced.

Countries are beginning to reopen their borders to international tourists. As of 25 June, 48 countries had begun reducing travel restrictions, but 141 countries remain closed to non-essential international travel (UNWTO 2020d). In the Caribbean, as in other regions, there remain different requirements for entry (e.g., predeparture or onsite test for COVID-19) and restrictions on activities (i.e., quarantine period, curfews and beach access, health screening at

resorts): Antigua and Barbuda June 1, Aruba July 1, The Bahamas July 1, Barbados open with quarantine for 14 days, Bermuda July 1, Cayman Islands September 1, Cuba June 30, Jamaica June 15, Puerto Rico July 15, and Saint Lucia June 4. The travel restrictions from the main source markets to the Caribbean are also varied. While UK nationals can travel to those countries accepting international tourists, they must quarantine for 14 days upon return to the UK (VisitBritian 2020). The Government of Canada advises to avoid all non-essential travel outside of Canada and avoid all travel on cruise ships until further notice. Canadians returning from overseas travel

Figure 9. Oxford COVID-19 Government Response Index Scores by Country



must quarantine for 14 days upon return. The US Department of State remains in a Global Level 4 Health Advisory, which advises all citizens to avoid travel due to COVID-19. A 17 June advisory also notes that the majority of countries in the Eastern Caribbean have put into place travel restrictions that either prohibit entry to visitors arriving from the United States or require mandatory 14-day quarantine.

A recent (early June 2020) survey of travellers in 11 countries by International Air Transport Association (IATA) (2020b) found that the prospect of being quarantined either at a destination (85% concerned or very concerned) or upon returning home (81%), is as concerning for travelers as the risk of contracting COVID-19 while traveling (84%). IATA's analysis of declines in year over year air travel bookings further indicates that quarantine requirements have the same impact as border closures. Until travel restrictions, including border closures and quarantine requirements, are reduced from major source markets, the number of commercial flights and cruises into the Caribbean region are expected to remain very limited.

Many of the countries in the region that have had very few COVID-19 cases and/or very few recent new cases (Table 7), face a significant public health and economic dilemma as they begin to reopen to international tourists, especially as the US, the leading source market for many countries, has the most COVID-19 cases in the world (at time of writing in late June), with significant increases in new cases in several of its highest population states (Texas, Florida, California). A statement by Antigua and Barbuda's Tourism Minister (Charles Fernandez) summarizes the predicament: "What are we going to wait for? A vaccine? Shut down the country for two years?" (Reuters 2020).

Table 7. Confirmed COVID-19 Cases and Travel Restrictions in Caribbean Countries

Country *	Total Cases ⁽¹⁾ (17 June)	Confirmed Cases in the Last 14 days ⁽¹⁾	International Travel Restrictions ²⁾
Anguilla	3	0	ND
Antigua & Barbuda *	26	1	ND
Aruba	101	0	3=15 Mar
Bahamas *	104	2	ND
Barbados *	97	5	2=4 Mar
Belize *	21	3	3=15 Mar, 4=20 Mar
Bermuda	144	3	3=7 Feb, 4=20 Mar
British Virgin Islands	8	0	ND
Cayman Islands	193	42	ND
Cuba	2273	181	3=20 Mar, 4=17 Apr
Curacao	22	2	ND
Dominica *	18	0	3=28 Mar, 4=1 Apr
Dominican Republic	23686	5934	3=16 Mar, 4=20 Mar
Grenada *	23	0	ND
Guyana *	171	18	3=18 Mar, 4=27 Mar
Haiti *	4547	2040	3=16 Mar, 4=19 Apr
Jamaica *	621	31	3=21 Jan, 4=21 Mar
Martinique	-	-	ND
Montserrat *	11	0	ND
Puerto Rico	5951	2016	3=15 Mar,
St. Kitts & Nevis *	15	0	ND
St. Lucia *	19	1	ND
St. Maarten	77	0	ND
St. Vincent & the Grenadines*	29	3	ND
Suriname *	261	187	4=14 Mar
Trinidad & Tobago *	123	6	2=30 Jan, 4=23 Mar
Turks & Caicos Islands	12	0	ND
US Virgin Islands	73	3	ND
Major Inbound Markets			
United States	2137731	305910	2=2 Feb, 3=2 Mar
United Kingdom	298136	20151	2=8 June
Canada	99456	7057	4=18 Mar

* - Member of CARICOM

(1) Data source: European Centre for Disease Control 2020.

(2) Type of international travel controls: 2 = quarantine arrivals from some or all regions, 3 = ban arrivals from some regions, 4 = ban on all regions or total border closure. Data Source: Oxford Covid-19 Government Response Tracker (2020).

Restarting the tourism economy while ensuring the safety of international tourists, tourism workers, and the citizens of small island nations with often limited health care resources, will be a delicate balancing act. A review of studies on the effectiveness of entry and exit screening for infectious disease by Mouchtouri et al. (2019) found these practises largely ineffective. For example, exit screening measures for Ebola in the three most affected African countries did not identify any cases. Similarly, entry screening for SARS did not detect any confirmed cases in Australia, Canada, or Singapore (predictive value of screening was essentially zero). The ECDC (2020b:4) similarly concluded that, "Current evidence, including evidence acquired in the early phases of the COVID-19 pandemic in Europe, indicates that entry screening procedures are ineffective in preventing virus introduction." With growing evidence that asymptomatic (or pre-symptomatic and mild) cases have a significant role in the transmission of COVID-19 (ECDC 2020c), only a small portion of imported case will probably be detected by available screening tools and protocols. Both Mouchtouri et al. (2019) and ECDC (2020b) conclude that the potential value in traveller screening is in dissuading ill persons from travelling and raising public health awareness among the travelling public. However, screening of travellers can be very expensive and divert limited resources from other health care priorities in small island state. For example, Canada spent an estimated \$5.7 million on its SARS entry screening and in spite of intensive screening, no SARS cases were detected (St John et al. 2005). Limited pandemic management resources would be more effectively allocated to pre-vaccine information strategies, epidemiological investigation, contact tracing (Mouchtouri et al. 2019), and the eventual cost of national vaccinations.

6.2 COIVD-19 Impacts on Caribbean Tourism

The dynamic state of COVID-19 infection trends and public health containment measures mean that a systematic assessment of the damage inflicted by the pandemic on the Caribbean tourism economy cannot yet be completed. Substantial uncertainties in the restarting and recovery of the tourism sector will persist over the next 6 to 18 months. Early evidence nonetheless points to a devastating and unprecedented impact of the COVID-19 pandemic on Caribbean tourism. There is no analogue among the many crises discussed in Section 3. Indeed, some projections suggest the eventual impact of the COVID-19 pandemic may be 6 to 10 times that of the 2008-09 global economic crisis. The CTO (2020) reported that tourist arrivals in the first quarter (Jan-March) of 2020 were down over 15% compared to 2019. This decline only captures the cancellations occurring in late March as travel restrictions began to be imposed (see Table 8). Air and cruise arrivals for the month of March were down 40% and 57% respectively, with hotel/resort occupancy averaging approximately 10% the last week of the month. Second quarter results are not yet fully available from CTO, but as the region shifts to

the low season, absolute losses in arrivals and spending will not be as significant as the high season losses. Nonetheless, unprecedented contractions in second quarter arrivals are being reported in a number of countries: international arrivals January to July 2020 - Puerto Rico (-65%), Saint Lucia (-64%) and the Dominican Republic (-63%) (CTO 2020).

Against this background of the rapidly evolving global pandemic, projections of the pre-vaccine era impact on Caribbean tourism indicate it is disproportionately vulnerable because it has a limited domestic market, has the largest cruise market (with over 35% of the global fleet bed days in 2018 - Cruise Lines International Association (2019)), limited unemployment supports, and higher debt burden that limits domestic recovery or stimulus supports. Travel intention surveys in major Caribbean markets (US, Europe, Canada) all indicate that domestic tourism will lead the recovery due to higher anxiety over international travel (Conference Board of Canada 2020, MMGY Travel Intelligence 2020). A survey of travel plans between May and October 2020 from the Caribbean's largest markets found that US travelers were the most likely to travel in the next six months (55%), compared to 39% and 35% of travelers from the UK and Canada (Skift 2020). A US travel survey found 66% of Americans planned to book a leisure trip within six months and 67% planned to travel by personal car (more than double those planning to travel by air) (MMGY Travel Intelligence 2020). A similar survey by the Conference Board of Canada (2020) confirmed travel intentions were lower (46% planned to travel in May-Oct, down from 80% the year before) and many more planned to take their summer holiday trip in Canada (66% versus 52% the year before). In the UK, 58% felt confident they would be able to take a short trip within the UK between October and December this year (58%), while 45% anticipated fewer overseas holidays in 2020 (24% about the same, 27% were unsure) (Visit Britain 2020). None of these travel intention surveys considered the possibility of a second wave of COVID-19 infections in the fall, nor did they account for how the travel experience will have changed, in particular air travel and international health protocols. Writing in the Atlantic, an extensive global traveller (Coppins 2020) described their travel experience in May as, "...more stressful—and surreal—than I'd planned for. ... my fraught travel experience highlighted an unwelcome truth: The glittering allure of "normalcy" that waits on the other end of these stay-at-home orders is a mirage."

The dominance of a domestic tourism led pre-vaccine recovery disadvantages the Caribbean region, which has a limited domestic market. Unlike countries such as Canada, Germany, China and the UK, which stand to gain if spending on international tourism was redirected to domestic tourism (by reducing international travel deficits in these countries), Caribbean small states stand to lose billions of dollars if international tourists stay home. Analysis by S&P Global (2020) indicated that small 3S island destinations would be the worst affected by a COVID-19 slowdown in global tourism, with implications for GDP as well as sovereign credit metrics and debt. Of the 122 countries ranked, the Caribbean countries rated in the top 25 at greatest risk included: Aruba (1), Belize (3), Bahamas (5), Barbados (7), Jamaica (9), Curacao (11), Dominican Republic (23), Bermuda (25).

There is a range of specific projections on the impacts of the COVID-19 pandemic on the Caribbean tourisms sector. The CTO's (2020) preliminary projection of 50% reduction in

regional stayover arrivals in 2020 would take the Caribbean back to 1995/1996 levels, a reversal of 25 years of growth. Other organizations have provided a range of scenarios depending on the timing of relaxed travel restrictions and the shape of the economic recovery. IATA (2020a) projected 2020 air passengers in the Latin America and Caribbean region to decline between 34% and 65%. The WTTC's (2020b) best- and worst-case scenarios project a reduction in international arrivals of 45% to 71% respectively, translating to an estimated 1.2 to 2.0 million job losses and US\$27 and 44 billion in travel and tourism GDP. The Inter-American Development Bank (IADB) (2020) developed three arbitrary scenarios of differential reductions in tourist arrivals in each quarter of 2020, ranging from cumulative 2020 losses of 43.8% to 68.6%. These scenarios result in GDP losses (relative to pre-pandemic expectations) as high as 13% (Bahamas) to 19% (Aruba) under the largest arrivals decline. The same scenario result in GDP loss of less than 3% in 14 of 31 countries examined. Employment loss was similarly diverse, ranging from highs of 18-20 in St. Lucia, Bahamas and Aruba to less than 3% in 14 other countries. The effects of the decline in tourism will be felt in particular by micro- and small enterprises, which represent a huge proportion of the hotel and restaurant sector: 99% of enterprises and 77% of employment (ECLAC, 2020). Should a major second wave of COVID-19 infections occur in late fall/early winter that require travel restrictions to be reintroduced or strengthened, the impacts of a lost high season (generally October to April) would be much more severe than the impacts on the low volume season (generally May to September). If the development of an effective vaccine takes longer than the 12-18 month accelerated timeline, a second winter high season (Nov 2021-April 2022) would also be put at risk.

As the public health crisis of COVID-19 is eventually brought under control through NPI and vaccine development and implementation, the decline in economic activity and design of fiscal recovery packages will also have a major influence on the recovery of the travel and tourism sector. Consumer confidence has fallen precipitously in many jurisdictions (OECD, 2020) and the depth and length of unemployment will strongly influence tourism related spending contractions. Many countries have already implemented sizeable employment support and economic stimulus measures to address immediate human welfare concerns during lockdown periods, reduce bankruptcies, and aid job retention strategies to enable a more rapid restart of businesses. As some temporary job furlough and employment support programs begin to end, higher unemployment will impact tourism spending and holiday type/destination choice over the next 2-5 years. The differential impact on tourism market segments and international demand patterns remains highly uncertain. However, the delayed recovery of tourism in the Caribbean after the Global Financial Crisis suggests the COVID-19 recovery period will initially disadvantage the Caribbean region. Furthermore, a survey of over 200 finance ministry officials, central bank officials, and other economists from 53 countries found that airline bailouts was the lowest ranked of the 25 recovery policies in terms of long-term economic multiplier and climate impact (Hepburn et al. 2020). This suggests that international travel cost and access will enter a phase of substantial restructuring over the next 6-18 months, with unknown impacts for air travel supply in the Caribbean even as countries reopen to travelers.

The COVID-19 pandemic has been devastating for tourism-reliant economies around the world. As the IADB (2020:3) concluded, COVID-19 has been a unprecedented shock to the tourism

economy of the LAC region and government responses will need to similarly unparalleled and “... look beyond traditional policy tools to safeguard their economies and citizens, and to ensure that the tourism sector—both operators and those employed by the sector—will be in a position to resume its substantial contribution when the crisis dissipates.”

Governments around the world are responding to the COVID-19 crisis impacts on the tourism sector in different ways. Many remain focused on safely restarting the tourism economy, with some policies emerging to preserve tourism operators to enable the longer-term recovery. Calls for policy innovation and collations of good practice have been provided by the World Bank Group (2020b) and the United Nations (2020). This remains a dynamic area of policy development in several areas, including: business support (payroll and tax), communications (reopening and travel restrictions), public health protocols (screening, new sanitation regulations), product development and capacity enhancements, destination marketing/collaboration, digitization (contact less payments, check-in, etc) and skills retraining.

7. Conclusion

Natural disasters and crises are increasingly recognized as a salient barrier to economic growth and an urgent challenge of sustainable development (World Bank Group 2018, Collins 2018). The scientific literature on the impact of diverse crises on the global tourism economy has tended to focus on economic crises (Hall 2010, Mair et al. 2016, Jiang et al. 2017) with limited analysis of physical risks, such as extreme climatic or health events. Understanding tourist perceptions of risk, including personal safety, value placed on potential holiday disruption, insurance uncertainties, visitor experience, destination image, and the ethics of travel in destinations impacted by different crises, and how these factors collectively influence destination competitiveness and travel choices remain limited. The unprecedented devastating impact of the COVID-19 pandemic on tourism worldwide is likely to significantly increase research on the many public health implications and concomitant economic impacts in the coming years.

This report has synthesized the available literature pertaining to the known impacts of hurricane and infectious disease outbreaks on Caribbean tourism. The most extensive study available on the impact on country-level tourist arrivals, examined the 2003-2008 period and found the average hurricane strike caused tourism arrivals to decline 2% in 12 months after the storm and the largest event reducing arrivals by 20% (Granvorka and Strobl 2013). Our new econometric modeling using a difference-in-difference technique found that the average hurricane in the 2004 to 2018 period reduced arrivals by 40% in the month the hurricane occurs and 34% in the month after, with the effect of a hurricane landing dissipating after 5 months on average. Our results also revealed that not all hurricane seasons are the same and that consecutive storm events can magnify impacts on arrivals. The 2017 hurricane season, which included three major hurricanes of Category 4-5 in successive months of August and September, resulted in an average reduction in tourism arrivals of almost 100% for those countries directly affected by the hurricanes. Following the major destruction, some islands

have struggled to return to pre-2017 major hurricane arrival levels. Insurance rates for tourism operators increased 10-50% due to losses caused from the 2017 hurricane season (ECLAC 2017), while in other cases, insurers would no longer continue to insure assets in the Caribbean (KPMG 2018). Overall, the results suggest there is a large spillover across countries so that when an island, or group of islands, are affected by a hurricane, there is a negative impact on all the Caribbean islands. Additional research is needed to better understand the conditions that produce this overall decline in tourist arrivals and explore opportunities to diminish the spatial extent of hurricane impacts.

The differential hurricane exposure of over 3000 coastal resorts across the region was examined using GIS, with heatmaps revealing the much greater risk of disruption and damage in major destination countries such as Cuba, The Bahamas, and Dominican Republic. There is strong potential to use this new subnational dataset of hurricane impacts to better understand the temporal and spatial impacts of hurricanes, as well as inform travellers of Caribbean destinations unlikely to be disrupted by hurricanes (there are many online recommendations, but none are based on high resolution hurricane exposure at the destination/resort level).

This study has also provided an overview of media coverage of hurricane impacts on tourism in the region and how it tracks the ACE index of yearly hurricane activity. The potential impact of media coverage, including sensationalized narratives, on traveller decisions remains an area for further examination. It remains unclear how media coverage contributes to public misconceptions of the geography of the Caribbean, including the interpretation of the cone of impact where damage has occurred, as well as the degree of island substitution.

Communications with the Secretary General of the CTO reinforced the strategic value of additional research to examine the following questions. With increased media [and social media] coverage of ‘super storms’ [or super seasons like 2017], have perceptions changed and how does it influence the choice of the Caribbean for travelers during June to November? Do travellers perceive the Caribbean region to be adequately prepared for and respond to natural disasters (and are some islands better prepared than others)? What are some of the factors which would influence a traveler to choose a hurricane threatened area over another area of the world (e.g., price, product, service)? Addressing these questions can inform coordinated social marketing by CTO, member countries, and the tourism industry.

Additional research into the effectiveness of recovery strategies (e.g., for marketing and insurance, disaster relief supports for operators and tourism workers, land use planning, building codes) would provide much needed insight into the differential impact of similar magnitude storms and improve resilience. Lynn et al. (2007) argue that the destruction from Hurricane Wilma was the catalyst for investment and redevelopment that repositioned Cancun as a higher scale destination in the coastal tourism marketplace. Rebuilding to higher standards, higher star ratings, and with sustainability principles, will have increased Cancun’s resilience to future storms of similar magnitude. Improved resilience of coastal tourism infrastructure will be needed in the decades ahead, as the observed trend of a greater proportion of tropical storms reaching high intensity over the last 40 years (Kossin et al. 2020) is projected to continue under climate change (Knutson et al. 2013), with damages exacerbated by sea level rise.

Very limited research was found on the impact of infectious disease outbreaks (H1N1 influenza, SARS, and Zika) on tourism in the Caribbean. SARS did not affect the Caribbean region directly, but rather outbreaks occurred in some of its major source markets (the most notable being Toronto, Canada with a major international airport servicing travel to the region). Analysis of Zika cases (as reported to the WHO) did not reveal any significant relationships. This finding may reflect the quality of the available data. A data set of global country-to-country arrivals would be needed to determine any effect of the Zika virus on travel patterns in the Latin America and Caribbean region.

The COVID-19 pandemic has revealed extensive vulnerabilities for Caribbean tourism. While the worldwide impacts of the pandemic on tourism have been unprecedented, the most prolonged disruption and economic devastation is expected to occur in the tourism reliant economies of many small island nations, including the Caribbean. With limited domestic tourism markets to fall back on, the WTTC's (2020b) best- and worst-case scenarios project a reduction in 2020 international arrivals of 45% to 71% respectively, translating into an estimated 1.2 to 2.0 million job losses and US\$27 and 44 billion in travel and tourism GDP in the region. While the projections of tourism demand models are limited by the novel conditions of the pandemic (i.e., conventional economic models do not represent changed air and cruise access, new traveler anxieties, or record low consumer confidence), it is clear that the scale of impact will be unprecedented. Should a major second wave of COVID-19 infections occur in late fall/early winter, it would endanger the 2020-21 high season (generally October to April). If the development of an effective vaccine takes longer than the 12-18 month accelerated timeline, a second winter high season 2021-22 could also be put at risk.

The potential effects of global and regional crisis events on international tourism are likely to increase in both size and frequency as tourism becomes increasingly hypermobile in a global economy that is more interconnected, while continued habitat encroachment increases the potential for pandemics and the impacts of climate change intensify (Hall 2010, Scott et al. 2019, Gossling et al. 2020). After the global economic crisis of 2008-09 and its impact on the tourism economy, the Economic Commission for Latin America and the Caribbean (2010) argued for the need to reflect on the overall approach to economic development in the Caribbean and the region's response to the crisis. With the unprecedented and much more devastating impact of the COVID-19 pandemic, similar calls are sure to emerge. Indeed, some have begun to question the long-term reliance of a tourism-dependent economy in an era of pandemics and climate change. For example, Thompson (2020) stated, "the COVID-19 pandemic is the worst economic turbulence that Barbados has encountered since forever, but we have become so economically reliant on our tourist industry that many people find it difficult to imagine something that can replace it. Yet replace it we must. The current pandemic may last for months, or it may last for years. Whatever its duration, it has had, and will have further devastating effects on our tourist industry. ... We need to think beyond tourism." ECLAC (2020:19) similarly affirmed that, "As never before in the past 30 years, the region's prevailing model of engagement with the international economy —based on specialization in raw materials, assembly manufacturing and sun and sea tourism— is open to discussion today."

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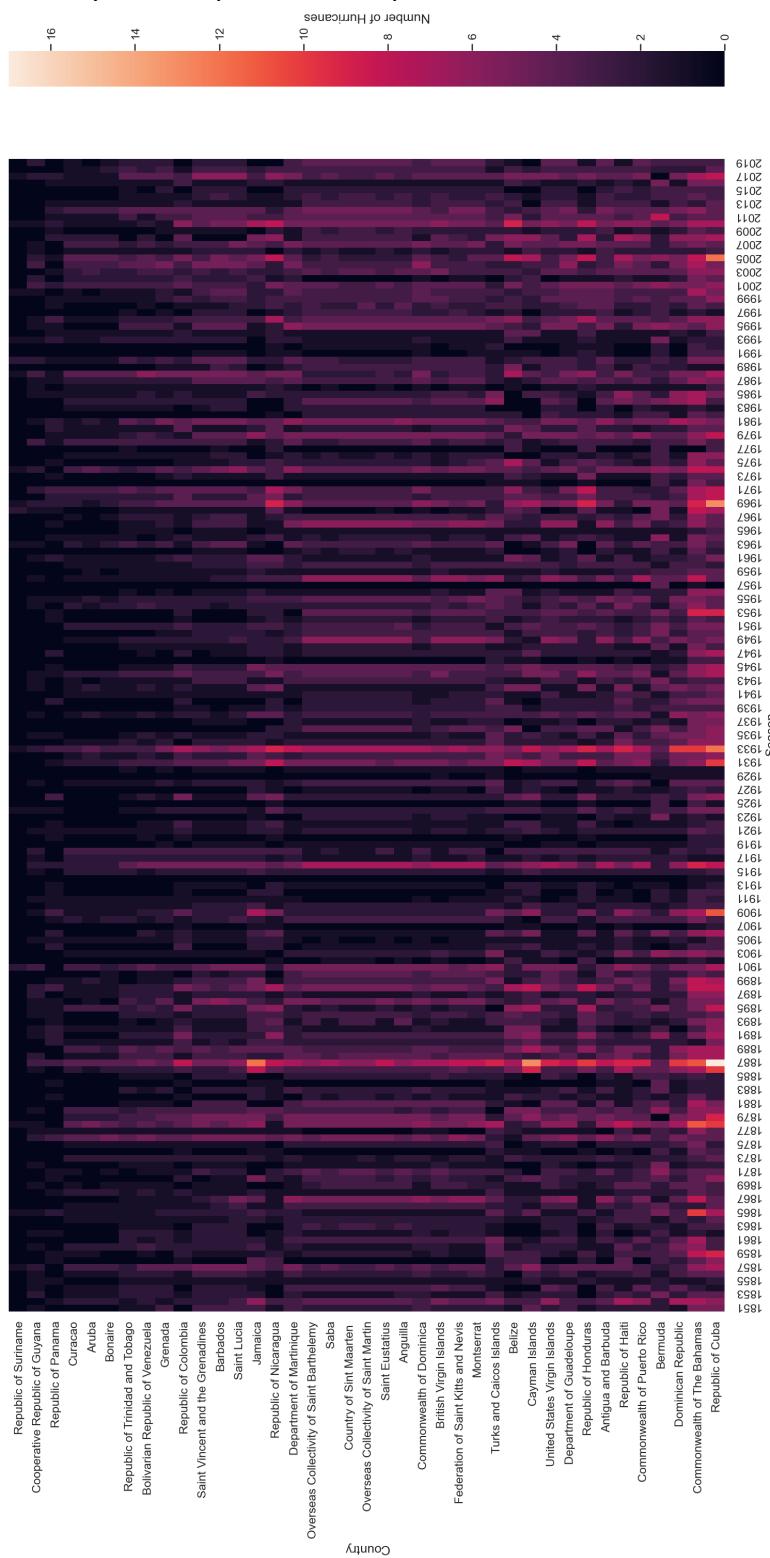
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Appendix A

Country Scale Exposure to Tropical Storm-Hurricane Warnings in the Caribbean (within 500km)



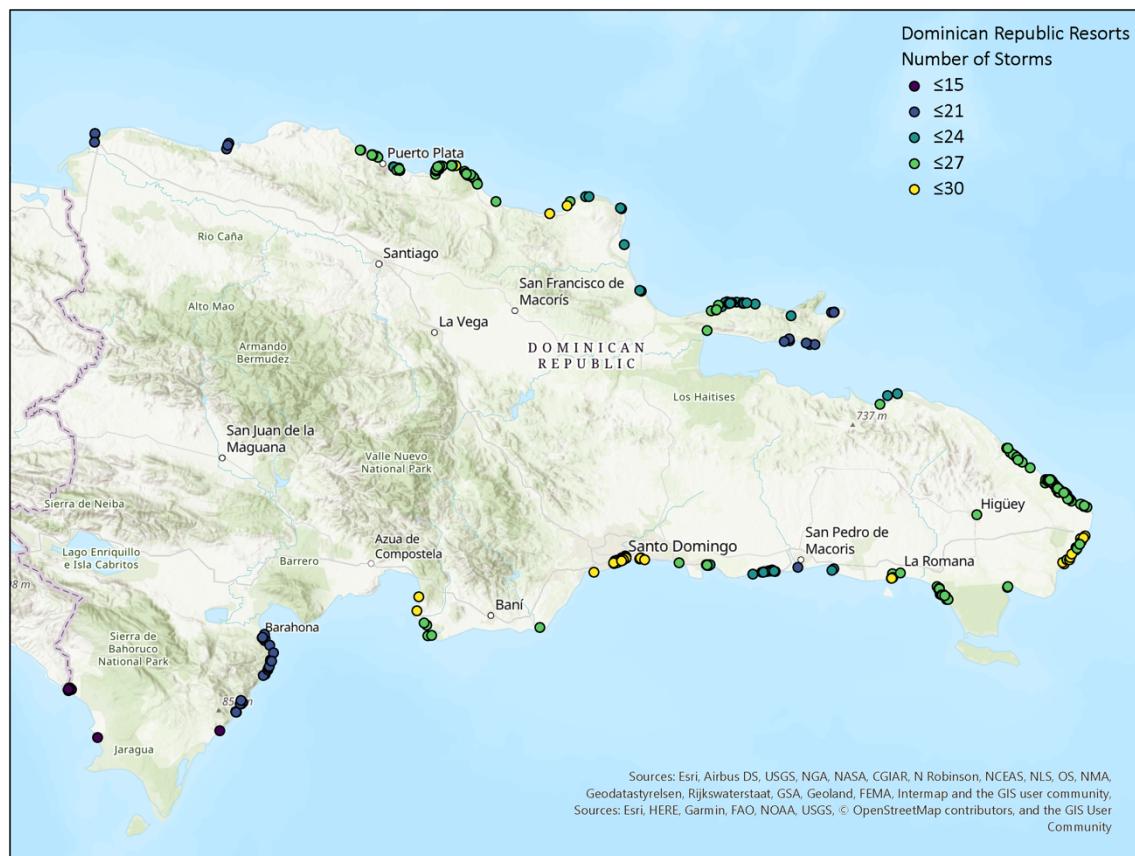
Country Scale Exposure to Tropical Storm-Hurricane Landfall in the Caribbean (within 50km)



Tropical Storm-Hurricane Exposure of Resorts in Caribbean Basin (50km) (1850-present)



Tropical Storm-Hurricane Exposure of Resorts in Dominican Republic (50km) (1850-present)



Tropical Storm-Hurricane Exposure of Resorts in The Bahamas (50km) (1850-present)

