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# Exploring the climate sensitivity of tourists to South Africa through TripAdvisor reviews

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**ABSTRACT**

Climate is considered a key determinant of where and when tourists travel, and their enjoyment of the trip. Climate change threats to tourism include sudden damages from natural disasters, and more gradual changes in temperature, precipitation amount and seasonality, sunshine hours and humidity. Tourism Climatic Indices (TCI) consider the latter, classifying the contemporary suitability of destinations for tourism, and projecting changes in suitability under climate change. Scores are seldom compared to tourists' objective experiences of climate during vacations, or tourists' sensitivity to climate. This study assesses 5898 TripAdvisor reviews to determine the frequency of climate mentions in unstructured reviews, and the distribution of climate mentions relative to the TCI. These findings are compared to TCI results for 19 destinations in South Africa. A total of 464 TripAdvisor reviews, accounting for 7.9% of the sample, mentioned climatic conditions, highlighting the climatic suitability of South Africa for tourism. The distribution of climatic conditions mentioned in these reviews largely aligns with the TCI, but slight modifications particularly for wind speed are suggested for an improved modelling in the South African context. TripAdvisor reviews are argued to provide a valuable source of information for the tourism sector to facilitate effective adaptation to climate change.

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Climate; weather; tourism; TripAdvisor; Tourism Climatic Index

## 1. Introduction

The climate of a location is argued to influence the selection of destination, the timing of travel, and the overall enjoyment of the vacation (Becken, 2005; Gössling, Scott, Hall, Ceron, & Dubois, 2012). Changes in local climate thus have the potential to alter the tourist offerings, the seasonality of peak tourism, and to reduce the competitive advantage of a destination (Amelung, Nicholls, & Viner, 2007; Enright & Newton, 2004; Gössling & Hall, 2006; Kyriakidis & Felton, 2008). Research exploring the threats of climate change to tourism sectors across the world has increased rapidly during the past decade (Hoogendoorn & Fitchett, 2018a; Kaján & Saarinen, 2013). This research has been conducted through two primary methodological approaches. The first explores the perceptions of tourists, accom-

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modation establishment managers and tourism operators regarding climate change threats to the tourism sector, and opportunities for adaptation (cf. Dillimono & Dickinson, 2015; Gössling & Hall, 2006; Hambira & Saarinen, 2015). The second approach involves the quantitative analysis of climatic data to assess the climatic suitability of a region for tourism, and the sustainability of the sector under climate change scenarios (cf. Amelung & Viner, 2006; Fitchett, Robinson, & Hoogendoorn, 2017; Perch-Nielsen, Amelung, & Knutti, 2010). These approaches have concur that climate change poses a threat to tourism, directly through flooding due to storm surges and sea level rise, and more indirectly through a reduction in the climatic suitability of a region, particularly for outdoor activities often sought by tourists (Agnew & Viner, 2001; Moreno & Amelung, 2009). There is often, though, a disjuncture in the perception of the severity of the threat, and the time frame under which it will be realized, with tourism accommodation establishments in particular often being criticized for being under-prepared (Hoogendoorn, Grant, & Fitchett, 2016; Kaján & Saarinen, 2013).

Although agreeing on the nature of the threats of climate change to the tourism sector, the severity of climate change induced impacts considered under each approach is varied (Hoogendoorn & Fitchett, 2018a). Perception-based studies largely focus on extreme events and disaster scenarios. Although tourism operators and accommodation establishments should begin to adapt to these future challenges immediately, they often remain a concern for the future (cf. Hoogendoorn et al., 2016; Kaján & Saarinen, 2013; Saarinen, Hambira, Atlhopheng, & Manwa, 2013). In developing countries in particular, such adaptations are of less priority than urgent infrastructural development at a governmental level, and entrepreneurial development at the scale of the tourism operator (Fitchett, Hoogendoorn, & Swemmer, 2016; Mertz, Halsnæs, Oleson, & Rasmussen, 2009). In these cases, the threat is tangible, there is agreement that there will be an ultimate detriment to the tourism sector, and there are concrete approaches to rectify the problem (Simpson, Gössling, Scott, Hall, & Gladin, 2008). The climatic suitability models, by contrast, focus on small amplitude, immediate changes in the climatic suitability of a location, due to on-going climate variability and change (Perch-Nielsen et al., 2010). Such studies conclude that continued changes in the climate of a region will reduce the climatic suitability for tourism, particularly where a region relies heavily on outdoor tourism (Becker, 1998; Kovács & Unger, 2014; Scott, McBoyle, & Schwartzentruber, 2004). Thus, arguably, the tourism sector of a region could be decimated by lower amplitude climatic changes long before any natural disasters occur (Fitchett, Grant, & Hoogendoorn, 2016).

Considerable work has been conducted in the development of tourism-climate indices, and there remain on-going efforts to refine these to more accurately capture the climatic conditions of individual locations and varied tourist offerings (cf. De Freitas, Scott, & McBoyle, 2008; Mieczkowski, 1985; Perch-Nielsen et al., 2010; Yu, Schwartz, & Walsh, 2009). These models and indices are valuable in providing an objective, quantitative measure of the relative climatic suitability of a given destination, and to facilitate comparison between more than one destination (Perch-Nielsen et al., 2010). However, less comprehensive work has been conducted to 'ground-truth' these models (De Freitas et al., 2008; Fitchett et al., 2017). Where an effort has been made to test the reliability of the model outputs in terms of the contemporary climatic suitability of a region for tourism, this has largely relied on interviews of tourist's perceptions of climate and experiences of weather during their vacation, biometeorological measures of human comfort, and weightings obtained from 'expert opinion' (cf. Becken &

Wilson, 2013; De Freitas et al., 2008; Rossello-Nadal, 2014). Perceptions and experiences are important in determining the relative climatic strength of otherwise comparable destinations, and in quantifying the relative significance of individual climatic variables, but does not capture the overall objective sensitivity of tourists to the weather that they are experiencing (Fitchett, Hoogendoorn, & Robinson, 2016). Similarly, measures of human biometeorology are arguably less relevant in the context of touristic activities (Rossello-Nadal, 2014). There is thus impetus for the exploration of methods to more objectively assess tourists' experiences of and preferences regarding the day-to-day weather and mean climate of a destination (Hoogendoorn & Fitchett, 2018b). The open-ended nature of reviews such as those posted on user-driven, opt-in platforms including TripAdvisor may provide value in contributing to a more objective understanding of weather and climatic preferences amongst tourists (Ayeh, Au, & Law, 2013).

Literature on climate change and tourism emerged relatively late in southern Africa, compared to the global North, yet remains the most significant body of research on the intersection of these topics for the African continent (Hoogendoorn & Fitchett, 2018a). Initial studies made theoretical contributions to the theme, hypothesizing on the potential impact of climate change to a range of tourism offerings across the diverse southern African landscape (Preston-Whyte & Watson, 2005; Steyn & Spencer, 2012). Subsequent research was largely centred around perceptions of tourists and tourism operators regarding the direct threats that climate change posed to specific locations or activities (Fitchett et al., 2016; Giddy, Fitchett, & Hoogendoorn, 2017a; Hoogendoorn et al., 2016). The Tourism Climatic Index (TCI), which has been widely adopted across the global North (Perch-Nielsen et al., 2010), has been used to quantitatively assess the climatic suitability of South African destinations for tourism (Fitchett et al., 2016, 2017). On the basis of the strength of the model, these calculations provided a means for comparing the climate of South Africa to that of regions in Europe, confirming the long-held belief that the South African climate is 'ideal' for tourism (Fitchett et al., 2017). However, the homogeneity of the index output scores for the 19 South African destinations studied was presented with caution, given the considerable variability of the climates of each destination (Fitchett et al., 2016). Concurrent to this are emerging concerns regarding the disjunct perceptions held by local and foreign tourists, and tourists and accommodation establishment proprietors concerning the relative threats of climate change to tourism, and the comparative role of different climatic variables in ensuring an enjoyable tourist experience (Giddy, Fitchett, & Hoogendoorn, 2017b; Hoogendoorn et al., 2016). Given these methodological limitations in the analysis of the threats of climate change to tourism in South Africa, the need to objectively explore climatic sensitivity amongst tourists and to assess the validity of TCI scores calculated in the South African context is arguably heightened.

The primary objective of this study is to explore the potential of TripAdvisor (URL: www.tripadvisor.com) to capture the sensitivity of tourists to the weather experienced during their vacations in South Africa, through analysing the frequency with which weather is mentioned and an investigation of the climatic variables that appear in the review content. These data on the frequency of mentions of weather experiences are then used to achieve the second objective: a first attempt to ground-truth Tourism Climatic Index scores for South Africa (as presented in Fitchett et al., 2017), to better discriminate between the relative climatic suitability of each destination for tourism, to determine the success of the TCI in quantifying climatic suitability as it is felt on the

ground, and to determine whether the rating of the input factors is representative given the touristic activities on offer.

## 2. TripAdvisor reviews as a data source

TripAdvisor is considered to be the worlds' leading information and advisory platform for travel related decisions, representing the largest global network of tourists (Law, 2006; Litvin & Dowling, 2017; O'Connor, 2008). Established in 2000, the website allows for independent travellers to publish reviews on the quality of their visit to a hotel, restaurant or tourist attraction (Amaral, Tiago, & Tiago, 2014; Miguéns, Baggio, & Costa, 2008). Prospective tourists are then able to read the collection of reviews for a tourist offering of interest, and obtain an arguably objective report on a fellow tourists' experience (Ayeh et al., 2013). The platform allows for word-of-mouth recommendations regarding travel experiences to be disseminated far more widely, and to persons who often do not know the commentator outside of the online platform; a phenomena which is now referred to as e-Word-of-Mouth or eWOM (Cox, Burgess, Sellitto, & Buultjens, 2009; Cunningham, Smyth, Wu, & Greene, 2010; Jeacle & Carterm, 2011). This has developed from a shift in the early 1990s away from a sole reliance on travel agents and hard copy travel brochures, to the pursual of additional information on a destination of interest via the internet (Amaral et al., 2014). This was followed by the development of web 2.0 applications, which involve bi-directional engagement with information, and the production of user generated content, including reviews on TripAdvisor (Amaral et al., 2014; Schegg, Liebrich, Scaglione, & Ahmad, 2008). Key to the success of TripAdvisor, relative to less popular platforms including Yahoo! Travel, Igougo and Lonely Planet (Lee, Law, & Murphy, 2011), has been the development of ranking systems to provide a sense of order to an extremely large collection of destinations and tourist offerings, as well as varied levels of experience and value provided by reviewers (Cunningham et al., 2010; Jeacle & Carterm, 2011). TripAdvisor is believed to have a significant impact on the decision-making of prospective tourists (Jeacle & Carterm, 2011), allowing them to access a large pool of data to evaluate alternatives, and assess the accuracy of promotional material (Buzinde, Manuel-Navarrete, Kerstetter, & Redclift, 2010; O'Connor, 2008).

The influence of TripAdvisor reviews in tourists' decision-making draws from the perceived lack of bias in the reviews posted (Gretzel & Yoo, 2008; O'Connor, 2008). The opinion of laypersons, often with relatively little travel experience, is deemed to be credible as reviewers present their personal views on a destination, providing an authentic voice, with content determined by the author and not classified or constrained by the site manager (Jeacle & Carterm, 2011; O'Connor, 2008). As reviewers do not have a vested commercial interest in the business (reviews of this nature are filtered by TripAdvisor), and have nothing to lose or gain in writing a review, TripAdvisor is seen to provide a degree of rationality and truth (Amaral et al., 2014; Ayeh et al., 2013; Jeacle & Carterm, 2011). While TripAdvisor does allow for management of tourist operations to respond to posts, they cannot remove or edit reviews written about their operation (O'Connor, 2008). TripAdvisor reviews also provide a far greater wealth of information than could previously have been obtained, and value is reported in the inclusion of negative commentary or 'warnings' to future tourists (Amaral et al., 2014; Gössling, Hall & Andersson, 2018a). The immediacy of review posting, often with tourists reviewing attractions or accommodation establishments during their visits, yields the content on TripAdvisor more relevant, comprehensive and up-to-date than most guide books or

promotional material provided online or hard copy by travel agents (Buzinde et al., 2010; Gretzel & Yoo, 2008; O'Connor, 2008). This is particularly important in the context of global change, where destinations that were once considered as ideal environments for leisure are becoming rapidly altered by the changing climate and associated landscape stressors (Buzinde et al., 2010). The communication of reviewers' experiences is thus of benefit both to the prospective tourist in enabling near-perfect knowledge in their choice of destination, but also facilitates the identification of key threats to a tourism sector by the managers of the tourist operation being reviewed (Cunningham et al., 2010; Miguéns et al., 2008).

There is an increasing body of literature that explores the content of TripAdvisor reviews to better understand the perceptions of tourists on a range of topics, unconstrained by standard interview techniques (cf. Amaral et al., 2014; Ayeh et al., 2013; Buzinde et al., 2010; Miguéns et al., 2008; O'Connor, 2008, 2010; Vásquez, 2011). This approach, termed by Jeacle and Carterm (2011: p. 293) as 'netnographic research' allows a perspective into the key needs, preferences and reactions of tourists, without leading questions resulting in deliberate reflection on topics which may not otherwise have been of concern (Miguéns et al., 2008; O'Connor, 2008; Vásquez, 2011). The personal data relating to the reviewer that is communicated to the reader focusses on the previous contributions to the site to rank the 'experience' of the reviewer, rather than true demographics, which are restricted to the city of origin and a screen name (Amaral et al., 2014; Ayeh et al., 2013; Lee et al., 2011). This is important in circumventing ethical issues pertaining to the capture, analysis and reproduction of an individual's opinion without their consent, where anonymity and confidentiality cannot be guaranteed (Hammett, Twyman, & Graham, 2015).

To date, netnographic research on TripAdvisor reviews has not explicitly focused on reviewers' experiences of climate or weather during their vacations. Buzinde et al. (2010) compare promotional material to TripAdvisor reviews of Playacar, Mexico, interrogating the disparity in the communication of the environmental degradation occurring due to climate change induced accelerated coastal erosion. Reviews mentioning experiences of climate and weather are occasionally mentioned in broader content analyses of TripAdvisor reviews. Exploring the most commonly mentioned topics on TripAdvisor reviews of hotels in Lisbon, Miguéns et al. (2008) report that weather ranked amongst the seven most common themes. By contrast, in an investigation of TripAdvisor reviews of London hotels, none of the 100 most frequently mentioned terms were related to climate or weather, yet the temperature of hotel rooms was mentioned as a point of dissatisfaction by reviewers (O'Connor, 2010). In a thematic analysis of complaints contained in TripAdvisor reviews, the temperature of the destination was mentioned in one of the 61 direct quotes captured (Vásquez, 2011). Climatic conditions therefore are included in TripAdvisor reviews across the world, featuring within the more commonly cited themes.

## 3. Methods

As the study explores the climatic sensitivity of tourists in South Africa relative to the counterpoint of TCI scores calculated through an internationally accepted approach, the selection of study locations was made on the basis of previously conducted work in the region (Fitchett et al., 2017). Consequently, the sample of 19 tourist destinations for which TCI scores were calculated (Fitchett et al., 2017), which were constrained by the availability of the requisite climate data for the index calculation (Fitchett et al., 2016), are used in this study (Table 1). As

**Table 1.** Tourism Climatic Index scores for the destinations used in this study (after Fitchett et al., 2017).

| Destination | GPS co-ordinates | TCI score | TCI classification |
|---|---|---|---|
| Johannesburg | 26.2044° S, 28.0456° E | 85.2 | Excellent |
| Pretoria | 25.7461° S, 28.1881° E | 87.5 | Excellent |
| Pilanesberg | 25.2611° S, 27.1008° E | 93 | Ideal |
| Cape Town | 33.9253° S, 18.4239° E | 83.5 | Excellent |
| Paarl | 33.7274° S, 18.9558° E | 88.3 | Excellent |
| Knysna | 34.0356° S, 23.0489° E | 85.5 | Excellent |
| Polokwane | 23.9000° S, 29.4500° E | 86.8 | Excellent |
| St Lucia | 28.3833° S, 32.4167° E | 84.3 | Excellent |
| Durban | 29.8833° S, 31.0500° E | 84.2 | Excellent |
| Ladysmith | 29.5597° S, 29.7806 ° E | 87.8 | Excellent |
| Kimberley | 28.7419° S, 24.7719° E | 87.4 | Excellent |
| Port Nolloth | 29.2500° S, 16.8667° E | 76.5 | Very good |
| Port Elizabeth | 33.9581° S, 25.6000° E | 80.2 | Excellent |
| East London | 32.9833° S, 27.8667° E | 79.2 | Very good |
| Bloemfontein | 29.1167° S, 26.2167° E | 84 | Excellent |
| Bethlehem | 28.2333° S, 28.3000° E | 80.9 | Excellent |
| Nelspruit | 25.4658° S, 30.9853° E | 87.1 | Excellent |
| Belfast | 25.6833° S, 30.0167° E | 74.9 | Very good |

these 19 destinations are distributed spatially across the nine provinces of South Africa, and across a range of tourist attractions, a representative sample is achieved. To ensure homogeneity in the data capturing approach between destinations, TripAdvisor reviews were consulted for accommodation establishments rather than activities. First, reviews of activities emerged only recently and remain poorly represented in many of the smaller towns. Second, an analysis of reviews of accommodation establishments facilitates direct comparison with previous tourism and climate change studies conducted in South Africa, centred on these facilities (cf. Fitchett, Hoogendoorn et al., 2016, Fitchett, Grant et al., 2016). For each location, TripAdvisor reviews of a minimum of three accommodation establishments were consulted; including a four/five star hotel, a guesthouse or BnB, and a 'motel' type one star resort (Amaral et al., 2014). Reviews were consulted in chronological order, working back in time year by year across the three accommodation types from December 2016 (Amaral et al., 2014; Buzinde et al., 2010), until at minimum, 100 reviews were counted per destination and 20 mentions of climate were captured. The sample size was determined in consultation with similar studies employing content analysis of TripAdvisor reviews (cf. O'Connor, 2008, 2010). Note was taken for each review, where disclosed, of the date of posting, the date of travel (if mentioned), the country of origin of the reviewer (or province if South African), to determine basic demographics of the sample (Vásquez, 2011). Additionally, utilising textual analysis, each review was classified as either containing mentions of climatic factors or not; in cases where climate was mentioned, the quote was captured (Amaral et al., 2014; Buzinde et al., 2010). Climatic mentions were identified using a grounded approach of content analysis, analyzing the reviews for both recurring themes and pre-identified terms (O'Connor, 2010). Content identified as being a climate mention had to involve a statement pertaining specifically to weather or climatic conditions, including the temperature, rainfall, wind, humidity and cloudy/sunny conditions. Proxy statements, including the functioning of air-conditioners, undercover parking and black our blinds were not captured as climate mentions, due to difficulty in attributing these directly to an experience of pleasant or adverse weather during the reviewer's stay (O'Connor, 2010). TripAdvisor independently screens for reviews that have been written by persons employed by or associated directly with the

accommodation establishment in question via fraud detection software (O'Connor, 2008; Reiter, 2007). TripAdvisor reviews that were solicited by the accommodation establishment are flagged on TripAdvisor, and are excluded from this study to prevent any consequential biases (Ayeh et al., 2013; O'Connor, 2008). Reviews that were written by visitors who did not stay in the accommodation establishment, but rather visited it for a meal or function, were excluded to prevent a skewing of results by local residents who would be more accustomed to the climate of their home town, and who have greater flexibility in the timing of their visit. However, reviews visitors who originate from the same province as the accommodation establishment but did stay in the establishment were captured, as any comments on climate likely reveal local variability in climatic conditions.

From these raw data, the proportion of reviews that mention climatic factors is calculated, and frequency distributions of the climatic conditions mentioned are explored for each accommodation establishment, and each destination. Principal Component Analysis (PCA) is then used to explore the spatial clustering of destinations on the basis of the climate mentions. These statistics are then compared to the TCI output for the years covered by the TripAdvisor review for each destination (Table 1), as originally calculated and presented in Fitchett et al. (2017), using Pearson's Correlation Coefficient. Reflection is then made on the accuracy of the TCI score in classifying the climatic suitability of each destination for tourism. The climate variables associated with the greatest number of positive and negative comments relating to the weather experienced will be compared with the factor that contributed most significantly to increasing or reducing the TCI score, respectively. Where there is a notable discrepancy in the suitability of the climate or the climatic factor of greatest significance to the suitability, alterations to the TCI weightings will be explored. Spatial analysis is then performed to determine whether specific bioclimatic zones may require different alterations of the TCI weightings to more accurately reflect the climatic suitability for tourism in that region.

## 4. Results

### 4.1. Sample size and demographics

A total of 5898 TripAdvisor reviews were consulted from 168 tourist accommodation establishments, spanning the 19 tourist destinations. Of these accommodation establishments, the majority (104) had a three, four or five star rating with the Tourism Grading Council of South Africa, while a further 55 were not presently rated. 2604 of these reviews were written by South Africans, with almost half of these penned by residents of Gauteng (1163), revealing a large contingent of local residents visiting and reviewing tourist accommodation establishments in South Africa, and a considerable presence of tourists from the economic hub of the country. Less than a sixth of the reviewers (858) did not reveal their residential location in their TripAdvisor profile. The remaining reviews span 96 countries of origin (Figure 1); with the greatest number of reviews authored by residents of the United Kingdom (579), the United States of America (209) and Australia (120).

The majority of reviews were written for visits to South Africa during October (539), August (528) and February (526), while the least number of reviews captured experiences for the month of June (395) and May (463). This notably does not align with

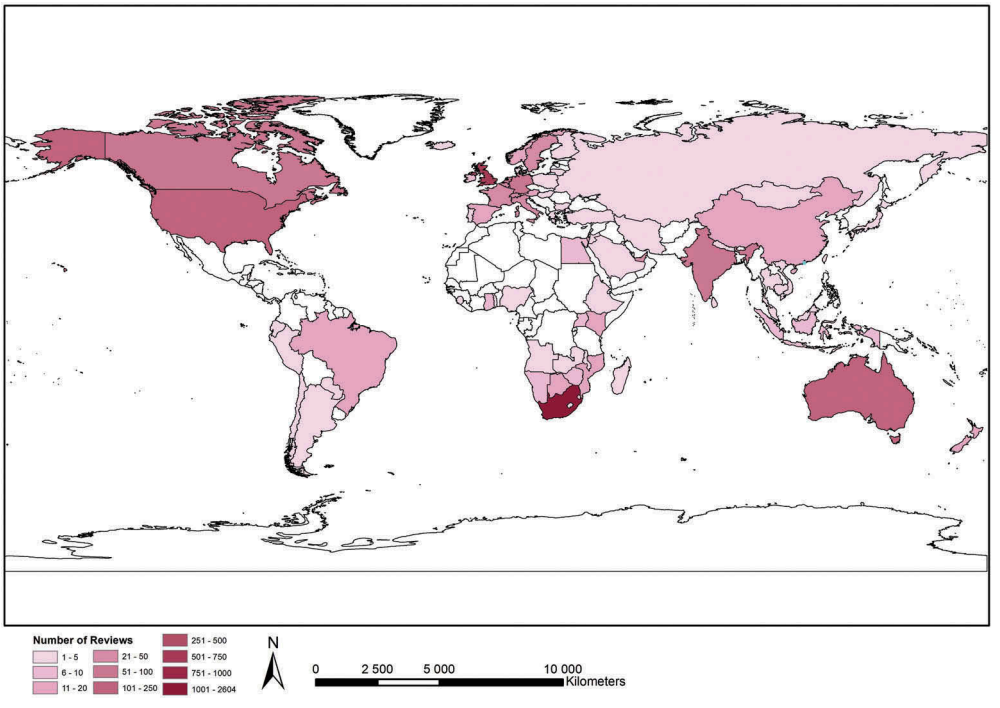


**Figure 1.** Map demonstrating proportional representation of TripAdvisor reviews from each country.

typical patterns in peak tourist visitation to South Africa, or South African school holidays which represent most common vacation periods for local tourists. However, comparing these results to international tourist arrivals to South Africa in 2016 (the year for which the majority of reviews were captured), similar patterns are observed, particularly from May through December (Figure 2). For the months of January through April, an inverse relationship between the two variables is observed. This

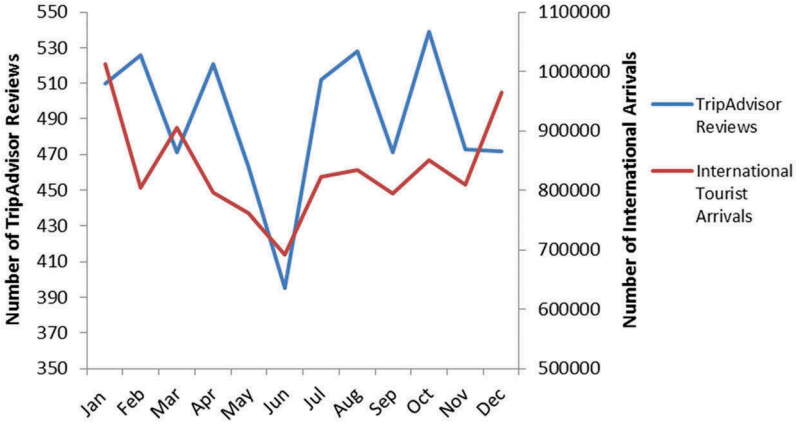


**Figure 2.** Monthly distribution of TripAdvisor reviews for the 19 South African destinations, relative to the international tourist arrivals to South Africa.

reveals seasonality in either review-worthy conditions or events, or in the visitation of review active tourists to the country. These patterns potentially reveal a bias in climate comments towards the months for which the most reviews were collected.

### 4.2. Climatic sensitivity

From the 5898 TripAdvisor reviews, a total of 464 reviews containing climate mentions were recorded, yielding a mean sensitivity to the weather of 7.9% (Table 2). As some reviews contained mentions of more than one climatic factor, a slightly larger total of 497 individual climate mentions in total were recorded. Of the 497 mentions of weather in TripAdvisor reviews, cold conditions appeared most frequently (180), followed by hot conditions (134). This reflects a high sensitivity among tourists to thermal comfort (Figure 3). Cloud, mist and humid conditions were mentioned least frequently, at a total of three, five and seven counts respectively across the country (Figure 3). Rain received a total of 59 mentions, while sun was mentioned 56 times (Figure 3).

The sensitivity of tourists to the weather of each destination may provide some evidence of the climatic suitability of a destination, as a greater number of mentions indicates a more memorable experience with weather. The greatest proportion of climate mentions, relative to the total number of reviews for a destination, was observed for Port Nolloth (25.5%, n = 47; Figure 4). While this is over 60% larger than the next highest value, the low sample number warrants caution. In the instance of Port Nolloth, all unsolicited reviews spanning the past four year for all tourism accommodation establishments in the town were considered, and thus it was not possible to increase the sample size. Among the remaining destinations, the greatest proportion of climate mentions is observed for Bethlehem (15.2%, n = 172), Ladysmith (14%, n = 179) and

**Table 2.** Climatic mentions in TripAdvisor reviews.

| Tourist Destination | Number of Reviews Consulted | Number of Mentions of Climate | Percentage of Climate mentions | Most frequently mentioned climatic factor | Proportion within climate mentions |
|---|---|---|---|---|---|
| Belfast | 172 | 24 | 14% | Cold | 0.83 |
| Bethlehem | 171 | 26 | 15.2% | Cold | 0.85 |
| Bloemfontein | 470 | 26 | 5.5% | Cold | 0.62 |
| Cape Town | 604 | 33 | 5.5% | Hot | 0.39 |
| Durban | 304 | 25 | 8.2% | Sun | 0.24 |
| East London | 462 | 25 | 5.4% | Hot | 0.36 |
| Johannesburg | 345 | 23 | 6.7% | Hot | 0.35 |
| Kimberly | 360 | 29 | 8.1% | Hot | 0.59 |
| Knysna | 603 | 32 | 5.3% | Cold | 0.41 |
| Ladysmith | 179 | 25 | 14.0% | Cold | 0.56 |
| Nelspruit | 251 | 25 | 10.0% | Cold | 0.40 |
| Paarl | 202 | 25 | 12.4% | Hot | 0.36 |
| Pilanesberg | 327 | 28 | 8.6% | Cold | 0.43 |
| Polokwane | 249 | 16 | 6.4% | Hot | 0.63 |
| Port Elizabeth | 423 | 20 | 4.7% | Cold | 0.55 |
| Port Nolloth | 47 | 12 | 25.5% | Cold | 0.50 |
| Pretoria | 299 | 25 | 8.36% | Hot | 0.52 |
| St Lucia | 273 | 25 | 9.16% | Hot, rain | 0.32 |
| St Francis | 157 | 20 | 12.7% | Cold | 0.50 |
| **Total** | **5898** | **464** | **7.9%** | **Cold** | **0.39** |

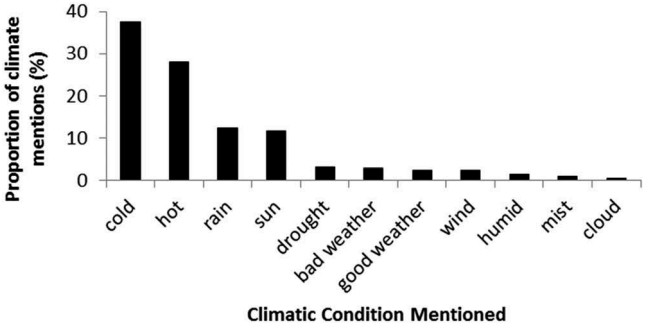


**Figure 3.** Proportion of climate mentions within the summed TripAdvisor reviews for 19 destinations in South Africa.

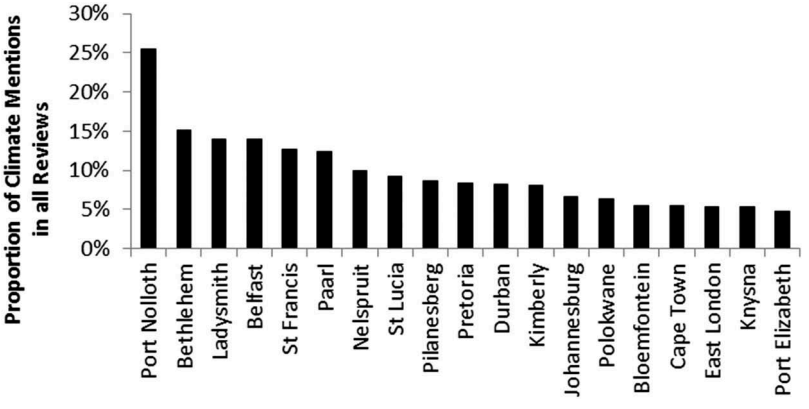


**Figure 4.** The proportion of TripAdvisor reviews mentioning climatic conditions, by destination.

Belfast (14%, n = 172; Figure 4). The lowest proportion of climate mentions is observed for Port Elizabeth (4.7%, n = 423), Knysna (5.3%, n = 603) and East London (5.4%, n = 462; Figure 4). This is a notable clustering, as it separates the inland towns with high climatic sensitivity from those located along the south coast. Although the climate of the interior is harsher than that of the coastal region which is moderated by the influence of the oceans, the South Coast of South Africa relies on favourable climatic conditions for the almost exclusively outdoor selection of attractions. Moreover, the South Coast experiences year round rainfall, compromising the possibility for beach activities. The low percentage of climate mentions for this region is thus promising to the tourism sector.

Exploring variation in climatic mentions by location, commentary on hot and cold conditions becomes segregated, with very few destinations demonstrating high proportions of both hot and cold conditions (Table 1). For Cape Town, East London, Johannesburg, Kimberley, Paarl, Pretoria and St Lucia, hot conditions were most frequently mentioned (Figure 5). Sun was most frequent among the climate mentions for Durban, while rain was mentioned most frequently for St Lucia, together with hot conditions (Figure 5). For the remaining 10 locations, cold conditions were mentioned most frequently (Figure 5). Cold conditions were mentioned most frequently for Belfast

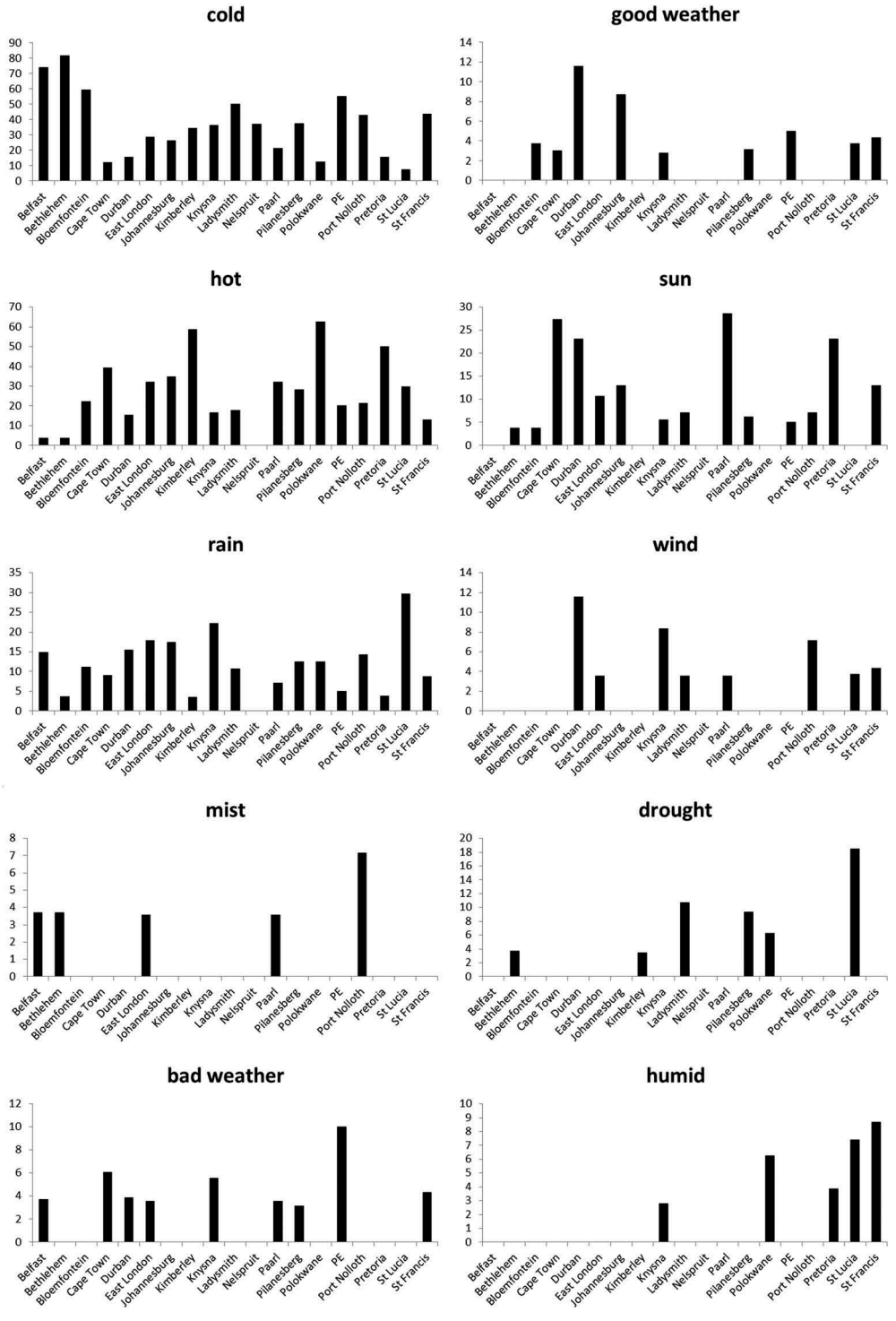


**Figure 5.** Proportions of each climatic factor mentioned by location.

and Bethlehem, both of which are ranked amongst the locations for which the greatest climate mentions are observed, while hot conditions were mentioned most frequently for Kimberley and Polokwane (Figure 5). Each of these locations are known for extreme temperature conditions. Bad weather was most frequently mentioned in Port Elizabeth, while good weather was mentioned most often in Durban (Figure 5). Paradoxically, drought and rain were both mentioned most frequently in St Lucia, although the awareness of rain may have been due to the prolonged drought, and in each case these represent relatively low total counts (Figure 5).

The results of PCA allow for the data in Figure 5 to be clustered by climatic influence. Principal Component 1 accounts for 33.07% of the variation in the dataset, segregating at extremes the towns of Belfast, Nelspruit, Bethlehem and Bloemfontein, driven by the cold conditions vector, from Johannesburg, Pretoria, St Lucia, Polokwane and Cape Town driven by the hot conditions vector. This supports observations made from the frequency distributions in Figure 5. Principal Component 2 accounts for a further 23.23% of the variability in the dataset, segregating at extremes Durban, Paarl and Cape Town driven by the sun mentions vector from Polokwane, St Lucia and Kimberley driven by the drought and hot conditions vectors (Figure 6). The clustering of locations on the basis of climatic factors reveals a spatially consistent pattern, with relatively successful separation of coastal and inland locations, and of small towns relative to large cities. The dominant vectors representing the climatic factors most frequently mentioned is of importance in understanding the climate sensitivity within each destination, and in turn determining the key threats under climate change.

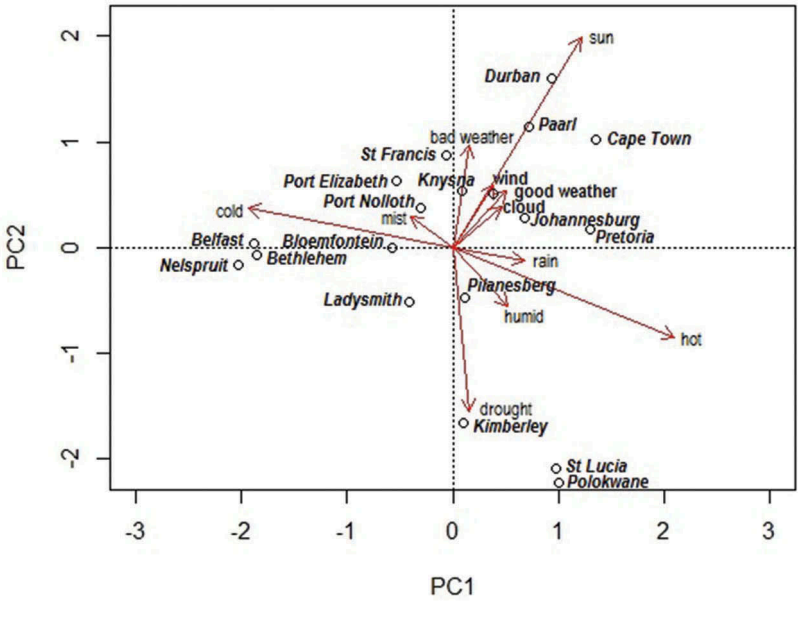


**Figure 6.** PCA biplot demonstrating clustering in the climate mentions per location.

## 5. Discussion

### 5.1. Comparison of TripAdvisor results to the Tourism Climatic Index

The climatic sensitivity of tourists, inferred from the number of climate mentions relative to the total number of reviews, supports the TCI output of excellent to ideal climatic conditions for tourism across South Africa (Fitchett et al., 2017). However, when exploring these previously published TCI outputs relative to the climatic sensitivity per location, this correlation is less strong. For example, Pilanesberg is calculated as having the highest TCI score of 93, is ranked 11th out of the 19 destinations with an 8.6% mention rate, while Belfast, which has the lowest TCI score at 74.9, has the 4th highest climate mentions at 14% (Fitchett et al., 2017: 857; Figure 4). Excluding Port Nolloth, for which a very small sample size of reviews could be consulted, Bethlehem received the highest proportion of climate mentions in TripAdvisor reviews has a TCI score of 80.4, while Port Elizabeth which has the lowest proportion of climate mentions has a very similar TCI score of 80.2. The relationship between the mean annual TCI values and the total percentage climate mentions per location returns a Pearson Correlation Coefficient of −0.37 ($p = 0.075$), which while not statistically significant, does capture the inverse relationship between the climatic suitability of a location for tourism as calculated by the TCI, and the number of mentions of climatic factors in TripAdvisor reviews. This is notable, as the literature would suggest that a destination with a significant proportion of outdoor attractions, such as the coastal city of Port Elizabeth, should be more sensitive to the daily weather fluctuations (Yu et al., 2009). The position of Johannesburg and Pretoria among the lower half of destinations ranked by climatic sensitivity (Figure 4) is notable, as the climatic suitability of these cities are argued to be less important to tourists due to the predominance of business tourism activities (Gössling & Hall, 2006; Rogerson, 2016). This may point to climatic sensitivity during after-hours activities, including visits to tourist attractions after business commitments, or experiencing adverse weather during the night. A contributor to this relatively poor correlation lies in the fact that both positive and negative weather experiences contribute to the proportion of climate mentions within the sample of TripAdvisor reviews. Thus, mentions of sunshine and good weather, which would contribute to a heightened TCI score, are being grouped with the factors that could reduce the TCI score such as rain, cloudy conditions, mist and bad weather, while hot and cold conditions could both improve and hinder thermal comfort. Importantly, TripAdvisor reviews represent noteworthy experiences, and thus arguably additionally reflect on the degree to which the weather experienced was unexpected. This inherently includes a comparison of experienced weather relative to mean climate, which the TCI does not consider.

The TCI equation, developed by Mieczkowski (1985) and adapted by Perch-Nielsen et al. (2010), is presented as: $TCI = 2(4CD+CA+2R+2S+W)$; where CD is the daytime thermal comfort; CA is the average thermal comfort; R is the total monthly rainfall; S is the monthly average sunshine hours; and W is the monthly average wind speed. Consistent with the findings of the TripAdvisor reviews, thermal comfort (represented by comments of hot or cold weather) is the climatic factor of greatest importance to tourists. Similarly, sunshine and rain are of secondary importance, weighing in significantly lower than factors of thermal comfort. The combined total of cold and hot

mentions accounts for 65.6% of all climatic mentions within TripAdvisor reviews for the country. Rain accounts for 12.3% of climatic mentions, while sun accounts for 11.7%. Wind accounts for 2.5% of all mentions. Adjusted proportions for South Africa are thus not a significant departure from the standard TCI, at:

$$\mathrm{TCI} = 2(6.6(\mathrm{CD} + \mathrm{CA}) + 1.2\mathrm{R} + 1.2\mathrm{S} + 0.3\mathrm{W})$$

The revised TCI would thus provide a more accurate quantification of the climatic suitability for tourism in South Africa, yet is not significantly different to the traditional TCI to inhibit comparison with TCI scores for other countries elsewhere. Moreover, the similarity in proportional weighting of climatic factors warrants the TripAdvisor reviews as a reasonably reliable source in reconstructing the climatic suitability of destinations for tourism in instances where climatic data are not available.

### 5.2. Sensitivity of tourists: extreme reviews

TripAdvisor reviews are characterized by the predominance of extreme viewpoints, recording experiences that were either significantly above or below expectation (Buzinde et al., 2010), and in many cases complaints (Vásquez, 2011). This includes commentary about cleanliness of the establishment, loud noise, feelings of safety and insecurity, and poor service from personnel (O'Connor, 2010; Scott & Orlikowski, 2009). Amaral et al. (2014) explore three motivations behind reviewers: altruism, personal growth, and displaying superior knowledge. The time commitment to submit a review on an accommodation establishment, and the selection of content, requires a memorable experience (Scott & Orlikowski, 2009). In the case of whether, and in aggregated form climate, reviews appear to be driven by experiences of particularly poor weather (e.g. rain preventing outdoor activities), unexpected weather (a seasonal weather, or exceeding the expectation of visitors), or climatic conditions which were either exacerbated or overcome by the offerings of the accommodation establishment (e.g. heaters taking the chill off the night, offering umbrellas on arrival on a rainy day). We would argue that such commentary captures the objective sensitivity of tourists to the climatic conditions that they experience. Where a purely quantitative approach, such as the Tourism Climatic Index, accounts only for the climatic conditions occurring at a given place over a specified time period, objective reports of an experience untangle the degree to which these climatic effects influence the experience of the tourist. This in turn would influence their likelihood of returning to the destination, and recommending it to others, which arguably is already occurring through their TripAdvisor review (Brown, Broderick, & Lee, 2007). Furthermore, where a climatic condition may be detrimental to one visitor, it may be beneficial to another. A key example here is wind, which according to the TripAdvisor reviews analyzed, should receive a lower weighting in the TCI. While wind may be unpleasant for some tourists, relatively strong winds are required for good surfing conditions, a key tourist attraction in many of the coastal towns in South Africa. Likewise, in towns plagued by prolonged drought, tourists were delighted by the rain that they experienced. A degree of nuance is thus brought to the discipline of tourism and climate change.

TripAdvisor reviews are posited to promote improvement within accommodation establishments and attractions (cf. Cunningham et al., 2010; Miguéns et al., 2008;

O'Connor, 2010). Tourists often engage in reviewing activities to lodge their complaints (Vásquez, 2011), and to guide future travellers in their decision making (Amaral et al., 2014). Reviews thus provide an up-to-date, accurate account of the aspects of an accommodation establishment that tourists enjoy, and issues requiring improvement (Gretzel & Yoo, 2008; O'Connor, 2008). This is important when considering issues of climate change and tourism. Research conducted in two small coastal towns in South Africa highlighted a significant disjunction between the concerns of tourists and accommodation establishments with regards to the threats of climate change (Hoogendoorn et al., 2016). Tourist accommodation establishments were concerned about the day to day weather, installing air conditioning and providing games and satellite television for rainy days indoors; by contrast, tourists were very concerned about the absence of infrastructure to mitigate against sea level rise (Hoogendoorn et al., 2016). A better understanding of tourists' experiences of climatic factors, on a real-time basis, would thus aid in reducing this disjunction, and facilitate more cost effective and appropriate adaptation mechanisms. The objective, open-ended nature of TripAdvisor reviews thus provides a valuable resource in effectively adapting to climate change in the tourism sector.

The use of textual analysis from TripAdvisor reviews in affecting long-term management strategies should be cautioned by critical reflections on the validity of this platform as a data source. The primary critiques of TripAdvisor reviews as information sources pertain to the ability for the accommodation establishment to manipulate the review content (Gössling et al., 2018a; Gössling et al., 2018b). Although TripAdvisor has filters to detect and remove content that has been authored by the establishment under review (Amaral et al., 2014), these filters cannot detect more subversive efforts to heighten the number of positive reviews (Gössling et al., 2018a). These approaches include, but are not limited to, encouraging guests to submit reviews on check-out, the owner or manager asking their family and friends to submit reviews, the employment of professional raters and brand managers, and composing derogatory reviews of competitor's offerings (Gössling et al., 2018b). This has a tangible impact of the validity of these reviews in accurately communicating the quality of the accommodation establishment in question; the significance in terms of the validity of any commentary on the weather contained in such reviews is less obvious. However, the capacity for manipulation and the introduction of bias into a dataset must be treated with concern (Poddar, Hsu, & Lee, 2017). A second limitation, pertinent to this particular study, is that reviews are taken of accommodation establishments rather than outdoor tourist activities. While tourists are certainly affected by the ambient climate within their accommodation establishment, these effects can often be muted by adaptationary measures such as air conditioning (Fitchett & Hoogendoorn, 2018). A more direct link to experiential climate may be better facilitated by a more comprehensive uptake of the reviewing process for outdoor tourist attractions in South Africa.

## 6. Conclusion

A total of 5898 TripAdvisor reviews were consulted in this study, of which 464 contained mention of climate, yielding a 7.9% mean sensitivity to climate. This confirms the widely publicized perception that South Africa has ideal climatic conditions

for tourism, and the TCI output classification of excellent to ideal climatic conditions for tourism. Comparing the climatic conditions most frequently mentioned at a national scale to the weightings of climatic variables within the TCI, wind speed is consistently over-weighted. We would suggest that this re-weighted TCI model be used in the South African context, particularly when differentiating between the climatic suitability of more than one possible destination in the country. Comparing the TCI output to the TripAdvisor reviews, the variations between locations are less consistent, with locations of very similar TCI scores reflecting diverse reports of weather experiences within TripAdvisor reviews. This pattern moreover challenges the perception that tourists are most sensitive to climatic conditions when visiting destinations with a large proportion of outdoor attractions, including beaches and nature reserves, and least sensitive when visiting business districts.

These findings are important in informing a more tourist-centred adaptation to the contemporary challenges that weather is posing to the tourist experience, and the long-term threats of climate change to the sustained climatic suitability of a destination. Research in the South African context and more globally has indicated a disjunction in the responses of tourists and accommodation establishments regarding climate change; a factor which results in misplaced efforts to heighten the comfort of tourists during their vacation. Exploring tourist's self-reported satisfaction of a destination, and the extent to which this is reliant on the weather, enables accommodation establishments to address specific points of concern in a more targeted and efficient manner. At a broader scale, the comparison of reports of weather for destinations across South Africa, and the analysis of the climatic factors of interest, enables a governmental level identification of destinations that are under particular threat under climate change. Responses can then include measures to effectively adapt to direct threats of climate change at a municipal through provincial level. They can also involve improving the marketing of destinations to more accurately represent contemporary weather conditions, while speaking to the points of interest of the target tourist group. We encourage the use of TripAdvisor reviews in understanding tourists' experiences and concerns relating to climate, particularly in informing effective adaptation.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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