

Mapping Tourism Stakeholders' Weather and Climate Information-Seeking Behavior in Fiji

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ABSTRACT

Tourism is inherently dependent on weather and climate, and its sustainability and resilience to adverse weather and climate impacts is greatly enhanced by providing tailored climate services to tourism sector stakeholders. Climate services need to integrate standard weather forecasts, with early warning systems, seasonal forecasts, and long-term projections of climatic changes in order to meet the information needs of the sector. While a growing number of studies address the potential climate change impacts on tourism, little is known about how the tourism sector accesses, uses, and analyses the available weather and climate information.

This research presents findings from an exploratory study on weather and climate information-seeking behavior of 15 private and public tourism sector stakeholders in the Republic of Fiji. The results show a variety of weather and climate information-seeking paths in use, which differ depending on levels of professional responsibility, weather and climate literacy, and information and digital competency. Those with high weather information literacy access a broader variety of sources. Hence, their interpretation does not focus only on their own location, but “weather” is seen as a broad spatial phenomenon that might or might not result in adverse effects in their location. Understanding diverse weather and climate information-seeking paths can aid in better targeting climate and adaptation services across different stakeholder groups. Especially in the context of small island developing states (SIDS), the integration of traditional, local, and scientific knowledge as information sources is likely to provide a more useful and context-specific basis for climate adaptation planning within the sector.

1. Introduction

Weather is one of the driving factors in tourism decision-making (de Freitas 2003; Endler et al. 2010; Gomez Martin 2005; Hewer et al. 2015; Matzarakis 2006; Tervo 2008). At a broader scale, Scott and Lemieux (2010) argue that climate is the most decisive attraction and risk for the tourism industry as a whole. At the same time, the poorly understood nexus between tourism, weather, and climate, along with the limited availability of information on weather events and

climatic trends could undermine the industry's short- and long-term viability (Hughey and Becken 2014). The World Meteorological Organization (WMO) has recognized that most users refer to weather and climate as interchangeable, and information services need to seamlessly cover relevant information from short- to longer-term time scales (WMO 2016).

A long-term aspect of climate services relates to global climate change. Climate change due to increasing atmospheric greenhouse concentrations from anthropogenic emissions is leading to rising temperatures, shifting rainfall patterns, and an increase in the intensity and/or frequency of extreme weather events, along with secondary impacts, such as sea level rise and ocean acidification

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(IPCC 2013). Climate change impacts tourism in four main ways: “direct impacts of a changed climate; indirect impacts of environmental change; mitigation policy and tourist mobility; and societal change related to reduced economic growth, consumer cultures and social-political stability” (Gössling et al. 2012, p. 37). Other impacts include changes in visitor comfort in terms of increased heat stress due to increased temperatures (Matzarakis 2006), increased precipitation leading to “bad weather” (Dubois et al. 2016), changes in seasons with impacts on the range of available leisure activities (Hopkins et al. 2013; Yu et al. 2009), destination competitiveness (Bonzanigo et al. 2016; Rosselló and Santana-Gallego 2014), changing perceptions of “safe” destinations (Jeuring and Becken 2013), and increased operational costs (Becken and Hay 2012). Further, extreme events can damage those ecosystems on which tourism depends (WMO et al. 2008). Changes in weather and climatic conditions such as prolonged seasons may, however, also open up new areas and opportunities for tourism (Bonzanigo et al. 2016; Johnston et al. 2012; Uyarra et al. 2005).

Tourism operators are facing an uncertain operational environment within which they have to operate now and in the future, and adaptation to weather, climate variability, and change is crucial (Becken and Wilson 2016; Curtis et al. 2011; Michailidou et al. 2016). A well-adapted tourism sector can be competitive as it innovates destination products and services, uses less weather and climate dependent resources, and integrates climate information in its planning and development processes (Michailidou et al. 2016; Pütz et al. 2011). There has simultaneously been a growing institutional support and demand to integrate climate information into decision-making (Weaver et al. 2013), and local climate information in particular is seen as helpful in climate adaptation planning (Bafaluy et al. 2014; Hazeleger et al. 2015). Yet, such integration has, for the most part, not translated into tangible actions and planning within the sector (Scott et al. 2016).

Currently, only limited research exists on the tourism industry’s use of weather forecasts (Rutty and Andrey 2014), and even less is known about the climate information systems that tourism operators use (Scott and Lemieux 2010), their skills and capabilities in accessing, interpreting, and evaluating weather and climate information, the reasons for needing particular information in operational and strategic decision-making, including climate change (Rutty and Andrey 2014; Scott et al. 2011; Wilson and Becken 2011), and the role of context in decision-making (Dilling et al. 2015; Finucane et al. 2013; Weaver et al. 2013).

Understanding how and why tourism stakeholders access and use weather and climate information is important for a number of reasons. A more targeted approach

to supporting stakeholder needs for weather and climate information services can be designed through better understanding of what counts as “useful” information (Dilling and Lemos 2011), the skills needed to access, use, and evaluate information’s validity, and the kind of information that is used as the basis for operational and strategic decisions in the tourism sector (Scott et al. 2011; WMO et al. 2008). Weather and climate information has economic value as, for example, medium- to long-term forecasts can enable businesses to plan ahead and make decisions on weather-dependent activities (Ayscue et al. 2015).

Research on the science policy interface has shown, however, that information does not simply enter into decision-making processes in a streamlined fashion, but its use is highly contingent on a variety of factors (Lemos 2015; Sarewitz et al. 2004; Sarewitz and Pielke 2007; Pielke 2007). Such factors include, for instance, the education and experience of the decision-maker, the form, content, and accessibility of the available information, and the governance context within which that decision is made (Finucane et al. 2013, p. 294). The literature on risk has also long demonstrated that information-seeking behavior influences greatly what information gets interpreted and the impact this has for decision-making in the long term (Kahlor 2007; Shakeela and Becken 2015).

Even when information is widely available, not everyone is able to access, use, and interpret it in a comparable fashion (Catts 2012). Much depends on access to offline and online resources and on the individual’s skills, such as “information literacy,” which is defined as “an understanding and a set of abilities enabling individuals to recognise when information is needed and have the capacity to locate, evaluate, and use effectively the needed information” (Council of Australian University Librarians 2001, p. 1). Similarly, a person’s level of “digital competency” or information communication technology skills (ICT) also determines what information sources can be accessed (Catts 2012). ICT includes “the capacity to use all forms of information communication technologies including computers, digital phones and other portable devices” (Catts 2012, 6–7). Digital competency includes, therefore, the use of and access to different technologies to find, disseminate, and use information through computers, smartphone apps, networks, and websites (Bawden 2001). Such skills are considered essential in today’s knowledge society and are closely linked to economic success (Catts 2012).

Tourism businesses, especially in small island developing states (SIDS), are highly dependent on weather and climate (Mahon et al. 2013). In the Pacific island states and territories, tourism is the only economic

sector to grow relatively consistently over recent years, the only exception being 2013, as a result of severe tropical cyclones in the region. In 2012 the sector peaked at 1.77 million international arrivals in 2012 and grew, after the setback in 2013, in one year to 1.69 million arrivals in 2014. Collectively, the 17 member nations, which are either African, Caribbean, and Pacific Group of States (ACP)¹ countries in the Pacific or South Pacific Tourism Organisation (SPTO) member countries, recorded 1 975 120 visitor arrivals in 2015, up 5.6% from 2014 (SPTO 2016). Simultaneously SIDS are highly vulnerable to climate change impacts, including increase in extreme events, sea level rise, saltwater intrusion, increases in temperature, and subsequent land loss and inhabitation of islands (Nurse et al. 2014). The unique characteristics of SIDS further increase their vulnerability, as they often include a large number of remote low-lying islands, rural–urban migration, high population growth rates, and high dependency on external economic inputs, including remittances, international trade, and development aid (Hay et al. 2013; Kuruppu and Willie 2015).

Given high dependency on tourism as a catalyst for economic growth in combination with the expected increases in climate-change-related impacts in the region, this paper investigates how tourism stakeholders in the Republic of Fiji make use of the available weather and climate information systems. Specifically, the aim of this paper is to examine factors pertinent to the use and access of weather and climate information within a small select sample of tourism stakeholders, to ascertain the extent to which such information is used in operational and strategic decision-making and planning processes, and to identify lessons that might be useful for climate related planning and decision-making within the sector.

The paper is structured as follows. The following section reviews relevant concepts and devises an analytical framework based on the scale at which weather and climate is relevant to the tourism sector. We then describe the methods for and present the findings of the stakeholder interviews. The final section discusses the results and considers their relevance to adaptation planning and management in the tourism sector in particular as it relates to small island developing states. The paper concludes with suggestions for further research and recommendations on how to strengthen

the use of climate information services by the tourist sector.

2. Analytical frameworks

Based on our prior research (Becken 2005, 2013; Becken et al. 2014; Hughey and Becken 2014; Mahon et al. 2013) and other professional engagements in the Pacific with a wide variety of stakeholders and projects focused on climate adaptation planning (Conway and Mustelin 2014; Nalau et al. 2015; Nalau and Handmer 2015), it is expected that weather and climate services will play an important role in how the sector can adapt to changes in both weather and climate (de Freitas 2003; WMO et al. 2008). To better understand the different types of information-seeking paths, we followed Wilson's (1981) suggestion to theoretically examine *why* users seek particular information and practically research *how* users seek information. This dual approach is examined further from a theoretical perspective, with the findings reflected in the empirical part of this research. We make a further distinction between our information-seeking paths and climate information systems: our information-seeking paths reflect how individuals seek information based on the kinds of skillsets they have in information literacy and based on the kinds of sources they can access and trust. Meteorological services and traditional knowledge-based information in our path are different kinds of sources that individuals use, which are, in effect, parts of external climate information systems (the kind of information that is available, including the providers).

a. Using different types of climate services

Several different types of relevant climatic events and conditions can be distinguished. Weather affects the daily operating environment for all outdoor tourism operations and is defined as the state of the atmosphere at a given time and place. Coastal and summer tourism is, in particular, dependent on different weather and climate variables, given main attractions of sea (water temperature, wind speed, and air temperature), sun (sunshine duration, sun intensity, cloud cover, air humidity and temperature, wind speed, thermal comfort, and UV exposure), and sand (surface temperature, wind speed, and albedo) (Matzarakis 2006). These parameters encompass a wide range of weather conditions and events, which from a human perspective are often encapsulated generically into “good” or “bad” weather (Jeuring and Peters 2013).

Information and warnings about extreme events are critical for tourism stakeholders, particularly in exposed tropical islands (Becken et al. 2014), and the benefits of

¹ ACP countries are African, Caribbean, and Pacific countries that are recognized by the European Union under the Cotonou Agreement, a 20-yr development partnership (2000–20) between developing economies and Europe.

better information about extreme events have been broadly discussed in literature (e.g., Becken et al. 2014; Bloodhart et al. 2015; Klint et al. 2012). Extreme weather events, such as cyclones, droughts, and heat waves typically occur relatively infrequently, but can be highly disruptive and destructive. Changes in climatic conditions that deviate from mean conditions of climate (climatic norms are measured across a 30-yr period) are referred to as climate variability. The El Niño, currently causing considerable impacts (including mass coral bleaching at the Great Barrier Reef), is an example of naturally occurring variability at a roughly decadal frequency, though there is now evidence of a strong climate change signal (King et al. 2016). Longer-term and systematic changes from the climatic norm are indicative of climate change (Bloodhart et al. 2015), and they occur over the course of several decades and shift the probability distribution curve of climate parameters, resulting in changes to their range, mean, and frequency (IPCC 2013).

The tourism sector needs weather and climate information at different scales, with different user groups in mind, and for different purposes (de Freitas 2003; Endler et al. 2010; Scott et al. 2011; Wilson and Becken 2011). Climate data are used for operational decision-making, risk assessments, marketing, investment decisions, siting and design of tourism developments, and finance and budgeting (de Freitas 2003). Local stakeholders, especially those who depend on natural resources, such as boat operators, are interested in knowing prevailing weather conditions, as their priority is securing current business continuity rather than preparing for future long term (Lourenco et al. 2016). For resort and hotel managers, accurate information can help in optimizing operational efficiency with cost savings, such as reduced energy bills (e.g., thermal comfort management), reduced wastage (e.g., informed stocking of food and water), and lower costs for staff (optimized staffing schedules). Slightly longer-term forecasts (e.g., seasonal) assist in developing weather-adjusted product portfolios, diversification activities, and marketing.

Issues, however, remain about the quality and type of weather and climate information and how it is communicated and distributed to and between different user groups (de Freitas; 2003; Rutty and Andrey 2014; Wilson 2011; Zabini et al. 2015). The majority of weather and climate information is produced by a range of public and private sector stakeholders, such as national weather services and private weather consultancies (Matzarakis 2006). Most weather-related information provided by national meteorological services is very short term, focused on a specific geographical area, and covers only the very near future (Scott et al. 2011). Sometimes this information might not be specific enough (Matzarakis

2006), and other times the way the information is communicated can be misinterpreted (Zabini et al. 2015).

b. How climate services are accessed

To further explore weather and climate information systems for tourism operators, an information-seeking framework adapted from Wilson (1981) was used to examine the information-seeking paths and the range of different attributes involved in this process (Fig. 1). The framework provides a generic description of information-seeking behavior and the components of the user, the information system, and the source. The user includes the individual, the reference group (colleagues/peers in a professional group), and the user's lifeworld, which consists of "the totality of experiences centered around the individual as an information user" (Wilson 1981, p. 6).

The information system in turn consists of two subsystems: a mediator (often an individual) and technology (all techniques and tools necessary to access information). The "embodiments of knowledge" includes all the information sources available. In our modification of the framework, we also include the concept of "weather salience" (what weather means to a person), as it is intimately tied to the kind of information that they seek (Stewart et al. 2012).

The information-seeking paths show a number of ways users access and seek information: some users are independent in their information-seeking behavior, whereas others rely on mediators to access and evaluate available information. This framework was used as a basis in identifying the different information-seeking paths from the interview data that might be at work among tourism stakeholders in Fiji. It was also used to identify key variables in the ways people perceived themselves to be able to understand, use, and access weather and climate information and for what purposes.

3. Methodology

The research approach adopted was an exploratory social science study, which sought to engage a small number of diverse tourism-sector stakeholders in order to explore the information-seeking behavior regarding weather information. Small-scale explorative studies are often used when the aim is to derive an understanding of multiple points of view on an issue and test or develop a model or framework (Shakeela and Becken 2015; Warren and Karner 2010). To obtain detailed descriptions of the research themes during 10–20 February 2015 in Nadi and Suva, Republic of Fiji fifteen individual semistructured interviews with small and large tourism operators and other relevant stakeholders were used. Semistructured interviews are well suited to produce

Information Seeking Paths

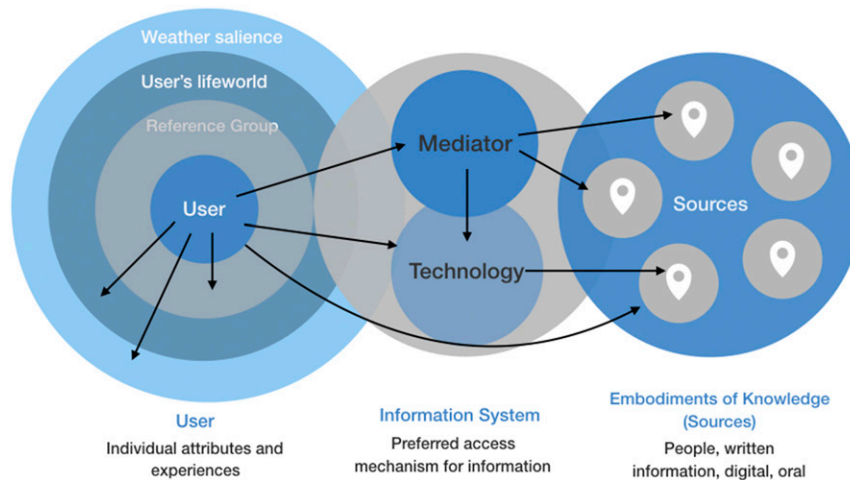


FIG. 1. Information-seeking paths and the different components/mechanisms involved [adapted from Wilson (1981)].

information on different responses and experiences (Gaskell 2000; Fontana and Frey 2003; Holstein and Gubrium 2003). In this research, interviews were approached as conversations where knowledge is constructed through both participants’ and researchers’ shared meanings (Warren and Karner 2010).

The interviews followed a schedule that had been developed by the team of researchers working on the project. While following the schedule, each interview allowed the exploration of additional topics and further probing questions where necessary. All interviews were audio recorded with a digital recorder as MP3 files, which were transcribed and then imported to the qualitative data program NVivo 10 for analysis (Bazeley 2007). The interviews were transcribed verbatim to enable a general analysis of what was said (Gibbs 2007), and the transcripts were saved under an interview number (e.g., Interview 9) to preserve the anonymity of the respondents. The stakeholders were selected initially by their role and position in the tourism sector in Nadi and/or Suva, and additional stakeholders were identified through snowball sampling where one stakeholder recommends the next (Table 1).

The analysis consisted of categorizing and classifying concepts through coding. Codes can be made based on specific acts and behaviors, events, strategies, meanings, and activities (Ezzy 2002; Lewins and Silver 2007) and can be descriptive (specific) or inferential (abstract) (Punch 2005, p. 204). The coding process of the interview transcripts in this research initially relied on the predetermined themes based on the research questions and the reviewed literature.

In NVivo, “nodes” are used to store ideas that are essentially codes for different aspects: nodes can be created either based on a quote from the text to reflect an idea or based on concepts from literature. Nodes are constantly merged, deleted, or renamed as the conceptual and theoretical development advances (Bazeley 2007; Ezzy 2002; Miles and Huberman 1994). The initial coding of the transcripts produced “free nodes,” which were just placed in a list and were not arranged to represent hierarchical relationships (Bazeley 2007). The “open coding” (Ezzy 2002) approach is about finding patterns and themes (Miles and Huberman 1994). In NVivo 10, grouping nodes

TABLE 1. Locations, respondents’ roles, and business focus of the operations.

Location	Role	Business
Nadi	General manager	Hotel
Nadi	Chief executive officer	Marine-related activities
Nadi	Managing director	Marine-related activities
Nadi	General manager	Marine-related activities
Nadi	Owner and manager	Marine-related activities
Nadi	Owner and manager	Marine-related activities
Nadi	Employees	Marine-related activities
Nadi	Marine operations manager	Marine-related activities
Suva	Manager	Tourism consultancy
Suva	Chief executive officer	Stakeholder association
Suva	Owner and manager	Weather information consultancy
Suva	Manager	Marine consultancy
Suva	Owner and director	Trekking company
Suva	Professor	University
Suva	General manager	Hotel

under themes creates “node trees,” which signify hierarchical relationships between concepts and delineate further the boundaries between different concepts. In this research, several main node trees were developed based on interview data, such as “information sources” (which sources respondents’ access, why, and how) and “climate change” (mentions of climate change), which were further used in the construction of information-seeking paths.

There are several limitations to this study worth noting. First, as exploratory research, we focused on a small sample of select stakeholders from major tourist sector activities but which therefore are not representative of the entire Fiji tourism sector or the Pacific in general. We focused mainly on how the available information is used and accessed within the sector and hence did not include the main supply side (e.g., national meteorological services). Second, the majority of the respondents were of Western heritage, as managerial positions are often held by expatriates in the Pacific, which reduces the scope for examining traditional knowledge in weather-related decision-making in the Fijian context. Third, the analytical process is qualitative, as the social science analysis employed here rests on the subjective interpretations of the researchers. The results are not necessarily transferable to other contexts but are likely to represent common elements in the tourism sector, specifically in the SIDS context. The information-seeking pathways could be different in other Pacific countries with a different setup of meteorological services, hotel associations, or private sector actors. Cultural and institutional variation also exists as to what knowledge is available and how it is used.

4. Results on the use of weather and climate information services in the tourism sector in Fiji

a. Timescales and information sources

Most operators noted that they used weather information to make operational decisions. Adverse weather could lead to cancellations of trips and evacuation of tourists from smaller islands or result in increased operational costs, such as sandbagging of property and disrupting services by giving leave to staff to go home (Interview 15). The main reasons for needing weather information across all participant answers were therefore guest safety, passenger comfort, and risks for business operations and assets.

The frequency of needing updated weather information in tourism operations ranges from constant monitoring to six-hourly checks to daily updates, depending on the weather dependency of the operations. Those in charge of larger operations, such as hotels or marinas, monitored the weather constantly either through receiving e-mail

and phone updates from weather information providers or actively seeking information online through checking websites and weather radars (Interviews 3 and 15). Tourism operators who arranged boat rides or walk tours checked weather every six hours: once in the morning and once in the afternoon, to plan for the day and the next day’s operations (Interviews 4, 8, and 13). Some operators, such as dive operators, needed weather information only in the morning (Interview 12).

In addition to short-term weather, people also searched for information on extreme events. However, long-term variability, such as El Niño and climate change, were not searched for, and none of the tourism operators were considering climate change in their operations. When prompted, responses related to climate change focused on mitigation and environmental issues, such as sustainability programs or raising environmental awareness on, for example, coral reefs. The main climate change concern for marine tour operators related to coral reefs and bleaching events and the potential of these to decrease the attractiveness of Fiji as a destination (Interviews 3 and 4). Coastal erosion due to sea level rise, changing tide heights, and lack of freshwater (Interviews 1, 3, and 10) were also identified. These were issues that needed to be talked about and monitored but were framed as slow-onset processes rather than current concerns for the sector.

Interviewee 9 noted that the lack of such long-term perspectives was mainly due to the short-term business investment horizons and plans:

Too big, too complex, too hard to model off. Too hard to project forward into business projections. . . I have seen a lot of plans. . . investments are coming in—none of them are taking any of that into consideration. Most developers are not looking at 20- to 30-year plans, as most investment horizons are 5 to 10 years max.

Yet five respondents (Interviews 1, 9, 11, 13, and 14) noted that longer-term weather information could be useful in planning the next tourist season. The limited ability to forecast El Niño and La Niña events, or the extent of the next cyclone season, is an important information gap. From a climate services point of view, such information is going to become exceedingly important for strategic asset management, because seasonal and even decadal information could allow people to plan more accurately and effectively:

That allows people to make some pretty strategic types of decision-making. We are going to want to close for 3 months to renovate and replace all of our bathroom fittings or something like that. We want to make some sort of fundamental strategic move; for example, we want to build another 50 bures—we want to change the whole

TABLE 2. Sources and knowledge of weather and extreme events information and their use based on participant responses.

Source	Frequency (times mentioned)	Type of information
Fiji Meteorological Service	10	Rain radars, infrared satellite picture, weather radar, forecast for seven days, marine forecast, weather charts, surface charts, monthly digests on weather occurrences, weather maps, national disaster notification
NaDraki Weather Service	10	Daily e-mail updates on weather events to subscribers
Fiji Hotel Association (FHA)	3	Agreement with NaDraki Weather to provide daily tailored weather information for association members
Denarau Corporation	1	Emergency information
U.S. Earthquake Centre	1	Earthquake and tsunami information
Hawai'i-based cyclone tracking website	1	Tracking maps and forecasts
Pacific Tsunami Centre	1	NaDraki uses as a source for information; FHA subscribes
Commercial warning centers for earthquakes and tsunamis	1	Commercial warning centers in Peru and Germany; paid service
Private weather station using PredictWind platform [New Zealand (NZ) company]	1	Webcam; records weather data and trends; publishes information on a private website
MetVUW (NZ website; http://www.metvuw.com)	1	Thumbnail page for Fiji
FreeMeteo.com	1	7-day weather meteogram
Wind Guru (https://www.windguru.cz)	1	Weather updates
National radio station	3	Considered too generic, but used
National TV	3	Considered too generic, but used
Earth-Now	1	NASA's Earth-Now application, uses Earth Science satellites to visualise latest global weather data
Family and friends	2	Family in, e.g., Australia, who phone and give information; friends working in institutions with access to weather data
Weather gurus	2	People who are "into" weather (e.g., tornado chasers); those with extensive experience in observing weather (aviation)
Traditional knowledge	4	Observing signs, such as the clouds, the stars, the sun, and the harvest (e.g., plenty of mangoes signals a pending cyclone)

thing from mains electricity to solar. So when is a good time to do that and start building? (Interview 11)

A case was noted where a company decided to start building a new hotel in Suva just at the start of the rainy season, against the advice from weather and climate service providers. The construction was significantly delayed and became costlier as a result of rain filling the newly dug foundations and making it impossible to build on particular days and even weeks (Interview 11). However, seasonality of weather already directs some tourism activities: dive operators would close down business for parts of the cyclone season to do maintenance, as divers were reluctant to book trips if there was a possibility of interruption (e.g., cyclone) to diving activities (Interview 12).

The respondents noted a variety of different sources from which they received or actively sought weather information (Table 2). The most frequent sources were the Fiji Meteorological Service and the NaDraki Weather Service. The Fiji Meteorological Service provides a range of different forecasts at different time intervals ranging

from daily to monthly through different mediums (e.g., Internet, emails, and summaries), whereas the NaDraki Weather Service offers tailored weather information to the tourism sector, which is comprised from multiple sources and delivered daily by e-mail to the customers, who pay for the service. The tourism stakeholder association had a contract with NaDraki, which meant that all of the members had access to the NaDraki tailored weather information.

The most popular medium for weather information communication was the Internet, either through websites, e-mail alerts, or smartphone applications. Radio and television were also mentioned as sources, but they were generally considered to present information in a too general and inaccurate manner. Those respondents with less experience with accessing weather information online (lacking information literacy) mostly relied on a few sources, such as the NaDraki Weather and the Fiji Meteorological Service.

One former dive operator noted that weather information was really more about reassuring tourists than anything else:

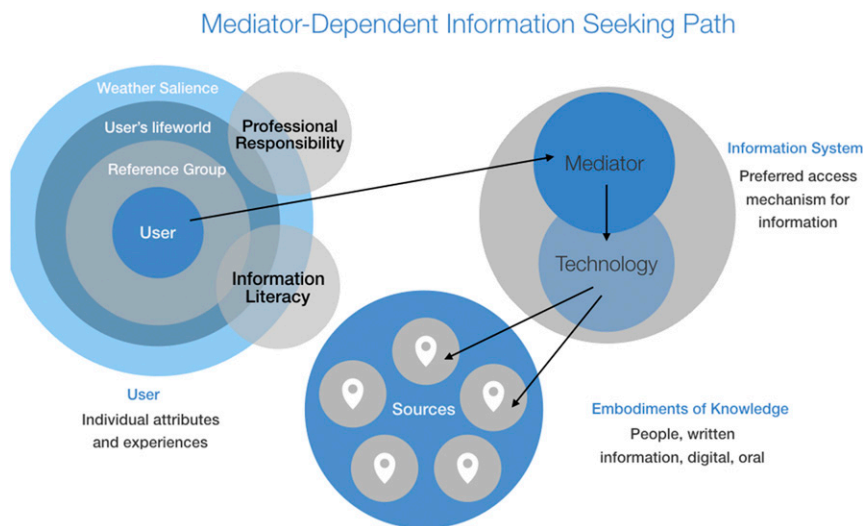


FIG. 2. Mediator-dependent information-seeking path, wherein the users are highly dependent on another person to access sources and interpret the information for them.

To be perfectly honest, it was mostly to reassure the tourists, because for me in Fiji the long-term weather forecast was never terribly reliable, so we used to operate more on the open the window and stick your head out the door type perspective. But for tourists, they are used to more long-term reliable thinking, so it was something they wished to see every day. (Interview 12)

The company in question displayed daily weather forecasts on their notice board, more for the information of tourists than as a direct company need.

b. Information-seeking paths

A number of different information-seeking paths emerged during the analysis, with a set of key variables influencing information needs, use, and access. The strongest and most significant factors influencing how well people were perceived to be able to use and understand weather-related information had to do with level of professional responsibility, personal experience with weather information, and level of information literacy, including digital competency/ICT skills (e.g., using technology and information networks). Three different information-seeking paths emerged in the analysis: mediator-dependent, independent, and observational information-seeking paths. These paths are general characterizations, and individuals can use several of these paths depending on their information needs.

The mediator-dependent information-seeking path includes, in particular, individuals with low digital competence who are more likely to rely on mediators for weather information, such as family and friends in Australia and New Zealand or “weather gurus” who reside in Fiji (Fig. 2). Weather gurus were predominantly

Western educated and of nonindigenous cultural background and described as reliable sources for weather information as they were “into it” (Interview 9). Some of the respondents would call such gurus if they wanted to know what was *really* going on with weather, in comparison to official announcements. The role of digital competency, or its lack, was noted particularly by one manager, who lamented his lack of skills to access online information:

The saddest thing is, I am not a computer whiz kid. There are people out there saying “oh go onto this site, go onto that site,” and it is so difficult. People say, go onto the American site. . . it is so difficult. What we need is someone to come and make it simple for simple people like me. (Interview 5)

These individuals often utilized their social networks to access information: for example, one respondent noted he kept in touch with friends working in embassies during extreme events, as they had access to better data than the public (Interview 15). In other cases, family and friends would phone or could be phoned when a particular extreme event (tsunami, earthquake, or storm) was developing, as the weather information available in Australia or New Zealand was deemed faster and more accurate than the Fijian information sources (Interview 5).

Individuals, often with a long-term background in sailing or aviation and operating enterprises heavily dependent on/impacted by weather, utilize the independent information-seeking path (Fig. 3). They were more apt to use and analyze multiple weather information sources and construct their own analysis of what

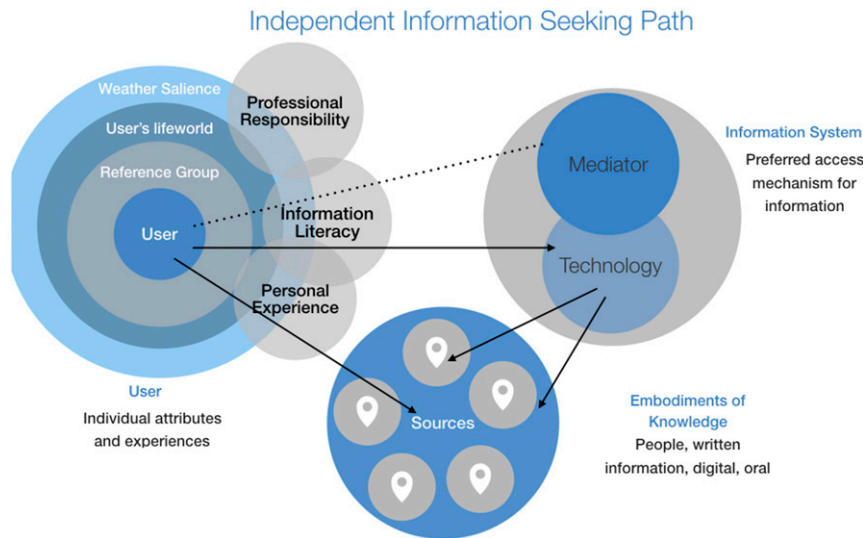


FIG. 3. Independent information-seeking path, used by individuals who were strongly influenced by professional responsibility, information literacy, and personal experience with weather.

multiple sources indicated (e.g., in terms of how to rate the likelihood of extreme weather events).

Individuals preferring the independent information-seeking path often saw their own role as that of a mediator of weather and climate information. As one respondent noted,

I was a super yacht skipper for 10 years—I have a great interest in the weather with ocean racing and navigator so I know the weather fairly well. We do use NaDraki—we get NaDraki forecast, but everyone here relies on me so I have about 320 people on our mailing list for weather and cyclone correspondence, and I do all my own weather. (Interview 3)

This particular respondent had developed his own weather station and used that information combined with online sources to create his “own weather” and distribute the information to others. The respondent noted, however, that he always advised people to go to the Fiji Meteorological Services site to check the official announcements before making a weather-related decision. These respondents with a strong perceived ability to accurately understand weather phenomena also had some form of additional responsibility, such as making decisions of when to advise tourism operators to evacuate tourists to the mainland, distributing weather information to others, and making specific operational decisions (e.g., evacuating a marina before a cyclone).

Individuals with the observational information-seeking path were more likely to rely on direct observational evidence, such as traditional knowledge (TK), on

changes in weather (Fig. 4). For example, two indigenous Fijians who worked in a diving company used TK as their main and most trusted source for weather information (e.g., watching clouds and star formations) instead of using online sources. TK sources cited were observations of, for example, plants, animal and insect behavior, cloud formations, stars, and wind directions, which have become particular indicators for predicting extreme events over the generations. In this information-seeking path, the observations are the sources, which are part of the daily life and often communally observed and discussed.

Yet the Western tourism operators often perceived TK as an unreliable information source: some regarded it as “hocus-pocus” (Interview 5) and something that needs to be always validated by science (Interviews 11 and 14). Many respondents could, however, give examples of TK indicators in Fiji relating to cyclone prediction:

Here in Fiji there is a story that if the mangoes come early in the season it means we are going to have a cyclone. There are stories about the behavior of the fish and so forth, if the palolo come here. You can see that there are some physical connections because oceans and atmosphere behaviors affect the growth of plants and the behaviors of certain types of animals. So, I’m not a skeptic by any means, but I also want to see the evidence of how they are connected. (Interview 11)

This year’s been a fun for mangoes crops. One of the villages, they never get mangoes, or they’re very few,

Observational Information Seeking Path

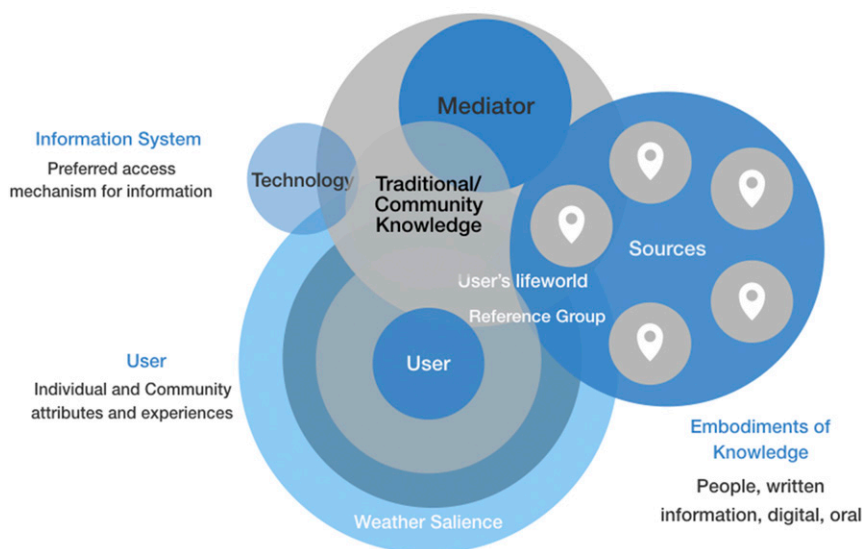


FIG. 4. Observational information-seeking path, wherein the user, mediator, and sources are closely connected, and knowledge is often more collectively created than individually held and accessed.

and they'll be all eaten by bats. This year, they're just inundated in mangoes. Very unusual. It doesn't happen very often according to the community, and they say it's a precursor to bad weather in the future. (Interview 13)

It's interesting when you talk to the guys and you say to them "What do you reckon, is it going to rain tonight?" and some of them will say the rain only comes in when the tide is coming up, and then they will say the birds are going—they are pretty on it because they have lived here all their lives and there are cyclones and floods, and there is certainly a sense from them whether this is right or wrong. (Interview 1)

Some respondents displayed also a good understanding of *place-specific local knowledge* of weather conditions that they themselves had accumulated over time:

I started off starting to notice weather in 2009 when we bought ballooning into the business—hot air balloons. It has been my own sort of experience in looking to weather, and one thing I notice is, when I look into the clouds in the morning or during the day, I see the clouds starting to stretch, and then I notice that if they all point into the one direction immediately it comes into my mind that there is a low pressure that has developed for that area, and as it moves, the low pressure moves with it. (Interview 8)

Hence, the observational information-seeking path is not only limited to TK but is a daily practice of directly

observing weather without the help of mediators or technology.

c. Constraints and enablers in accessing and using weather and climate information

The main constraints regarding the usability of weather and climate information are related to information delivery, quality of information, and lack of particular information. For example, some respondents, who needed constant information on wind conditions to operate marine-related activities, said the relevant information online was not updated quickly enough (Interview 8). The directly observable changes in wind conditions often differed from what was predicted on the Internet: the website Wind Guru, for example, did not update information quickly enough to reflect real-time conditions. Another constraint is the lack of information on short- and long-term temperature estimates in rural inland areas, as weather reports focused on the urban coastal areas. In particular, information on night temperatures in inland rural areas is considered important for one operator who arranged walking tours. Such information, if available, would help the company with many strategic decisions:

The challenge is that there's practically enough weather stations around so that it can be a rainy day in Suva, but 20 kilometers up the road it can be blue skies. And so the weather reports tend to be focused on the tiny centers, and we don't really get specialized reports

from rural areas, except when there's a flood warning. (Interview 13)

Another respondent operating boat tours felt that even tailored weather information delivered through a customized weather service was often "too basic and too flowery" to make operational decisions (Interview 5). The respondent acknowledged he had limited capacity in using and searching information online and did not really know where to go and which sources to trust. Another boat operator (Interviewee 2) noted that often the available daily marine forecast was too imprecise:

Here in Fiji, in terms of the marine forecast—it's not broken down into divisions of ocean areas, so quite often I will read a weather forecast, and it will say a strong wind warning with 25 knots expected, and I'll go out there on my boat on the weekend and it will be as flat as a pancake. So with Fiji geographically spreads out over quite a large area and there is not often specific forecasting for regions. (Interview 2)

This made decision-making difficult at times, as it was not always clear what areas were going to be impacted by what kind of weather and whether passenger safety and comfort could be guaranteed. Also mentioned was a lack of wind models that could show the "intensity and direction of the wind in specific regions" (Interview 2), information that would be very useful for marine tour operators. A broader problem was noted by several respondents regarding the IT capacity of the existing online weather information systems in Fiji: before and during an extreme weather event the system would crash as a result of so many people trying to access information online.

5. Discussion

This paper has examined the weather and climate information-seeking paths in the context of tourism stakeholders in the Republic of Fiji. We examined several factors, which seem to explain tourism operators' needs for and ability to use weather and climate information services. The most needed time scale was, in general, the day-to-day weather and operations, especially among those operators highly dependent on weather for their activities. Climate change was still perceived as mitigation and sustainability actions, rather than a cause for considering adaptive actions in planning and decision-making processes at longer time scales. This research also uncovered three different paths where the degree of professional responsibility, weather and climate literacy, cultural background, and information and digital competency all play key roles in shaping the ways people prefer and are able to seek and access weather- and climate-related information.

Although climate change is often perceived as a distant future phenomenon (Leiserowitz 2006; Lorenzoni et al. 2007) and not a current concern, the respondents still noted its potential to negatively impact tourism resources, such as the state of coral reefs, the future availability of freshwater, and the aesthetics of the island because of coastal erosion. While information on long-term trends was not actively sought after, forecasting the impacts of El Niño and La Niña and their implications for the next tourist season were noted as useful information for longer-term tourism planning. Greater weather and climate literacy could indeed benefit the tourism sector in preparing for current and future changes in their operational environment and adaptation to climate change (Ayscue et al. 2015; Becken 2005; de Freitas 2003; Scott et al. 2011). Weather and climate proofing of tourist resources is likely to become a necessity given, for example, increases in hotter days and less rainfall (Aylen et al. 2014). This can be an opportunity to increase the range of tourism-related activities on offer to ensure business continuity (Bonzanigo et al. 2016; Endler et al. 2010).

Yet, better and more accurate climate modeling information in particular over long time scales might not become available, given the difficulties in modeling a global complex phenomenon within a changing societal context (Weaver et al. 2013). Therefore, investigations into decision-making contexts (Finucane et al. 2013) and the concept of "useful" information (Dilling and Lemos 2011) particular to the tourism sector is required to further enrich our understanding of science-policy-practice linkages and related opportunities. The emerging concept of "adaptation services," which are generally defined as "a stepwise approach supporting the assessment of vulnerability in a wider perspective" and subsequent planning (Goosen et al. 2014) will most likely also play a role in what the sector can do with the outputs of climate information services.

The three different information-seeking paths that emerged from the analysis demonstrate the range of factors that contribute to individuals' capacity to access and use weather and climate information. Individuals with an independent information-seeking path were often in positions of high professional responsibility (Finucane et al. 2013), with high information literacy (Catts 2012) and extensive prior professional experience with weather. These individuals had higher information needs but also the expertise that enabled them to find, access, evaluate, use, and communicate the information to construct an understanding of weather patterns that is useful for their decision-making context. The underlying information literacy and digital competency as parts of the individual's life experience contributed also to a high perception of self-efficacy in dealing with and

understanding the weather. Such stakeholders saw themselves as mediators in interpreting and disseminating weather-related advice.

Other studies on climate information have also identified the level of professional responsibility as a key variable for explaining the extent that people are interested or willing to consider longer time scales in decision-making. In [Finucane et al.'s \(2013\)](#) study on the use and need for climate information among water managers in Hawai'i, professional responsibility emerged as a key influencing factor in deciding what climate change impacts a water manager was most concerned about. Evidence that those with higher professional responsibilities have higher information literacy (IL) skills should not be surprising, as "the level of IL skills required is dependent upon both the domain of practice and on the level of performance required of an individual" ([Catts 2012](#), p. 4). [Finucane et al.'s \(2013\)](#) study also found that people with high climate literacy (i.e., their understanding of climate change) were more ready to make decisions with the current knowledge and were less concerned about the extent of uncertainty in that knowledge, whereas water managers with lower climate literacy rated familiar or personal sources as more valuable and trustworthy. In the current study, individuals with high perceived self-efficacy in understanding weather were more ready to make decisions on, for example, evacuation advice.

Users following the mediator-dependent information-seeking path were highly reliant on personal contacts as mediators for their weather and climate information needs, such as family members or weather gurus. Often these individuals also had lower information literacy skills and hence preferred for someone else to access the information and interpret its significance. In contrast to the mediator-dependent model, the observational model built on the capability of individuals to interpret weather without relying on technology and was strongly linked to personal direct observations, which could also be validated by discussions with others. In small island states, a significant information source for indigenous people is TK, which is knowledge passed on from generation to generation. This knowledge often includes potential signs of a future cyclone ([Chand et al. 2014](#)), such as mango trees fruiting, wind directions, and stars, as noted also in this research. Yet some of the TK signs for anticipating extreme events are likely to change as a result of the impacts of climate change ([Chand et al. 2014](#)). Hence, the observational model purely relying on TK might become a weaker source of accurate prediction in the future.

The results indicate that interpreting weather information is shaped by people's risk perception of the probability of the event or, in some cases, the probability of climate change being a decisive impacting factor for their

operations. Forecast providers need to also keep in mind that the public, which may include potential tourists as well as those working in the industry, can be fickle in their interpretation of weather information and in the interpretation of uncertainty and risk ([Zabini et al. 2015](#)). Cultural context [e.g., a level of fatalism, as was observed for some locals in the Maldives ([Shakeela and Becken 2015](#))] impacts how people interpret and respond to weather or weather warnings. This is because much of weather and climate knowledge is localized, as [Wilson \(2011, p. 24\)](#) remarks: "Tourism operators are normally resident in a particular area and are familiar with the local climate and weather and in the case study interviews they emphasized the importance of this local knowledge." No doubt this "local" knowledge, as in "knowledge that individuals develop over time without necessarily having generational connections to a place," plays an important role in regards to the extent individuals feel confident about their personal interpretations of weather in the place they live. This type of knowledge also relates to the social and political contexts of the place ([Lebel 2013](#)).

Regarding constraints to use and access weather and climate information, several respondents noted the low capacity of Fijian online information systems during extreme events. This has clear repercussions to the identified information-seeking models. The most proficient users of information who utilize the independent model appear highly reliant on functioning technology (information streaming from multiple real-time websites and apps) to construct their interpretations of weather and the related decisions they have to make. In times of disasters, the mediator-dependent and observational paths might prove more feasible in a SIDS context if the technological capacity and sources of information suddenly are no longer accessible.

Yet, while there now exists a range of online services, tools, and applications to access weather and climate data, there are also pitfalls in using such technologies. One danger with detailed web and app weather information is that people only look at a particular location and do not necessarily understand the broader weather patterns in the area ([Zabini et al. 2015](#)). This may be so for those with lower weather literacy, but our results suggest that those with high weather information literacy access and validate a variety of sources. This means their interpretation does not focus only on their own location, but "weather" is seen as a broad spatial phenomenon that might or might not result in adverse effects in their location. The key here is also the connection of the perceived hazard and its impact on the operational decision-making. This is crucial, as "gaps or incomplete information connecting hazards to operations can lead to inadequate understanding of evolving

risk and diminished support for decision-making” (Montz et al. 2015, p. 323). Given that information literacy is assumed to enable economic success (Catts 2012), understanding the use of and needs for such skills in the tourism sector would seem to be a crucial area for tourism sector development, particularly in the context of small island developing states, where some of the climate change impacts seem to be already materializing (Nurse et al. 2014).

6. Conclusions

This paper has examined selected tourism stakeholders’ behavior related to weather and climate information in the Republic of Fiji. We investigated in particular why stakeholders need weather and climate information, how they seek it, and from where they obtain it. We also investigated the constraints and enablers in this process. The results demonstrate clear differences in information-seeking behavior. These differences stem partly from varying professional responsibility, but also from different levels of information-seeking skills and climate literacy. In addition, the use of local and traditional knowledge is important in determining what information path is followed and for what reasons. Understanding this diversity is significant in particular for the supply side of weather and climate information: that is, climate services and, subsequently, climate adaptation services.

As Linnenluecke et al. (2012) note, in organizational adaptation it would be crucial to develop capabilities that help operators identify vulnerabilities and understand changes in weather and climate and how these impact the organizational activities. Being able to access, use, and evaluate relevant climate information about risks at multiple time scales is particularly important, given that the operational contexts are highly weather dependent (Becken 2013; Becken et al. 2014; Finucane et al. 2013; Hopkins et al. 2013; Mahon et al. 2013). Future research should therefore investigate the linkages between tourism operators and weather and climate service providers, such as national meteorological services, and identify the skill-sets necessary for tourism decision-makers to be able to use the available information in a robust manner. A crucial task then would be to train decision-makers to access and interpret the available information within their operational and strategic decision-making context.

Yet, as our research also demonstrates, the tourism industry is not a homogenous group but includes multiple activities and information needs (Curtis et al. 2011). Further detailed investigations on how information should be communicated based on the different information-seeking paths and information needs could increase the salience and effectiveness of climate

services that are tailored to the different needs and levels of professional responsibility.

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