

Dear Anonymous Referee #2,

We would like to thank you for your thoughtful and considered comments, which will ultimately improve our paper. We have addressed each of your comments (*in blue*) below and made a series of additions/amendments to the paper (*in red*).

1. *The abstract part needs to be rearranged and integrate all results presented (risk perception results are not mentioned).*

Response: The abstract has been reworked accordingly to read:

“The destruction caused by TC Pam in March 2015 is considered one of the worst natural disasters in the history of Vanuatu and has highlighted the need for better understanding of TC impacts and adaptation in the Southwest Pacific (SWP) region. Therefore, the key aims of this study are to: (i) understand local perceptions of TC activity, (ii) investigate impacts of TC activity, and (iii) uncover adaptation strategies used to offset the impacts of TCs. To address these aims a survey (with 130 participants from urban areas) was conducted across three SWP Small Island States (SIS); Fiji, Vanuatu and Tonga (FVT). It was found that respondents generally had a high level of risk perception and awareness of TCs and the associated physical impacts, but lacked an understanding of the underlying weather conditions. Responses highlighted that current methods of adaptation generally occur at the local level, immediately prior to a TC event (preparation of property, gathering of food, finding a safe place to shelter). However higher level adaptation measures (such as the modification to building structures) may reduce vulnerability further. Finally, we discuss the potential of utilising weather related traditional knowledge and non-traditional knowledge of empirical and climate mode based weather forecasts to improve TC outlooks, which would ultimately reduce vulnerability and increase adaptive capacity. Importantly, lessons learned from this study may result in the modification and/or development of existing adaptation strategies.”

2. *The introduction part should be better focused in explaining the results (i.e. on the value of knowing risk perception, TK with NTK strategies for disaster mitigation, early source of information, education). Moreover it lacks to describe indigenous people that live in the region and some socio cultural descriptors of the population. Moreover I suggest putting some data about past TC events prior to this work.*

Response: The authors will incorporate these suggestions into the revised introduction of the manuscript. We will discuss the benefits of risk perception studies and how they can be used by decision makers to assess/modify risk management procedures. Other studies that use public perceptions to understand a range of environmental extremes and natural hazards will also be reviewed in the introduction, including drought (Ashraf and Routray, 2013; Udmale et al., 2014), climate change (Acquah, 2011; Deressa et al., 2011; Manandhar et al., 2011, 2015; Vedwan and Rhoades, 2001) and tropical cyclones (Li, 2009). See the paragraph below to be included in revised manuscript:

“The impacts of TCs in the SWP mean that viable and effective adaptation and mitigation strategies are needed (Mataki et al., 2006; Mortreux and Barnett, 2009; Rasmussen et al., 2009). El-Masri and Tipple (2002) discuss how such methods should be multi-disciplinary and based on a range of engineering, land management, social and economic improvements. One such measure relevant to this study includes the use of community participation. Gathering the opinions and perceptions of extreme events from the people at risk of natural disasters

provides emergency management agencies the opportunity to assess and modify risk management procedures (Bird, 2009). The benefits of this information, which can result in a more resilient nation that is less vulnerable to the threat of an extreme event is demonstrated by Wachinger et al. (2010, 2013). Across the world, surveys have also been used to understand public perception on a range of environmental extremes and hazards including: drought (Ashraf and Routray, 2013; Udmale et al., 2014), climate change (Acquah, 2011; Deressa et al., 2011; Manandhar et al., 2011, 2015; Vedwan and Rhoades, 2001) and tropical cyclones (Li, 2009). Weather related traditional knowledge (TK) has also been shown to be a cost-effective, participatory and sustainable method of adaptation (Nyong et al., 2007; Robinson and Herbert, 2011). The use of weather related TK, involves documenting the response of the land (flora and fauna) and sea to specific meteorological phenomenon. Numerous studies have demonstrated the usefulness of TK in improving our understanding of environmental prediction and meteorological phenomenon in the South Pacific (Chand et al., 2014; Lefale, 2009; Waiwai and Malsale, 2013), and in other areas around the world including, Africa (Chang'a, 2010; Nyong et al., 2007; Shoko and Shoko, 2013), India (Chinlapianga, 2011) and Australia (Green et al., 2010). These studies demonstrate that personal experiences and knowledge of extreme events (such as TCs) from those living in affected regions represents a crucial source of information. It offers scientists, policy makers and social development workers the opportunity to incorporate a comprehensive insight into local-scale weather systems, impacts and coping strategies.”

Further, the introduction will explore the idea of utilising weather related TK as a method of improving adaptation practices and strategies for disaster mitigation. Data from previous TC events, TC Kina (December 1992/January 1993), TC Evan (December 2012) and TC Pam (2015) will also be included in the introduction. See new paragraph below:

“Fiji, Vanuatu and Tonga (FVT) are three SIS that are highly vulnerable to the impacts of TCs. Of the 12.9 TCs that occur in the SWP per year, 3.3, 3.9 and 2.7 TCs cross within 5° (550km) of FVT respectively (Diamond et al., 2013). Vanuatu is considered the most vulnerable nation in the world to the threat of natural hazards (World Bank, 2015), and is the most economically disadvantaged country due to the impact of natural hazards (World Bank, 2006). Between 1950-2005, Vanuatu’s losses due to natural hazards were equivalent to 30% of its GDP in disaster years (World Bank, 2006). Vanuatu’s relative TC risk (a calculation of the exposure and vulnerability to TC activity) is the highest in the world (8/10), with 30-100 deaths per million per year (Peduzzi et al., 2012). Moreover, 100% of Vanuatu’s population and GDP are located in a TC prone area. The impact of TCs in Vanuatu are exacerbated by Vanuatu’s medium Human Development Index ranking (HDI; United Nations Development Program 2015), ranked 134 out of 188 countries and territories and GDP per capita of US\$3277. Fiji and Tonga are similarly vulnerable to TCs. Both have relative TC risk of 7/10; a mortality risk of 10-100 people per million and 100% of their population and GDP is situated in a TC prone area. However, in comparison with Vanuatu, the economic impact of TCs on Fiji and Tonga is quite different. Fiji and Tonga are considered high human development nations, ranked 90/188 and 100/188 respectively (United Nations Development Program, 2015), with higher a GDP per capita: US\$4375 (Fiji) and US\$4427 (Tonga). Between 1950-2005, natural disasters cost Fiji 7.7% and Tonga 14.2% GDP during disaster years (World Bank, 2006).”

- 3. There is a general lack of quantitative data about respondents’ perceptions and adaptation strategies. Some percentages could be useful to enrich the study. In addition demographic characteristics are not related to the results of the present study. It would be interest to explore if male or female, young or adult have higher/different perceived risk of TC activity and*

preparedness strategies. This information may be useful for practitioners and government to target specific management actions.

Response: Additional quantitative data in various forms (percentage of respondents/age and gender breakdowns) will be added to the manuscript. In particular, the percentage of respondents has been used to investigate the impacts of TCs (Question 5), how respondents get information about when a TC is about to hit (Question 6), and if they are happy with the information they receive (Question 7). Age has been used to investigate the responses to question 6 and has resulted in a new table (Table 3) that summarises the results (see below).

Table 3. Percentage and mean age of respondents who responded to question 6, 'How do you get information about when a tropical cyclone is about to hit'. Blank values suggest no answer has been given.

Nation	Radio		TV/News		Met Office		Word of Mouth		Phone/Text Message		Internet		Weather Observations	
	%	Age	%	Age	%	Age	%	Age	%	Age	%	Age	%	Age
Fiji	72%	37	38%	38	23%	43	6%	55	13%	33	4%	50	9%	39
Vanuatu	88%	36	28%	43	64%	39	28%	37	28%	39	-	-	16%	32
Tonga	91%	39	57%	38	-	-	-	-	12%	29	10%	32	2%	40

Age is also used to investigate the answers from question 7. This extra analysis has produced some interesting findings. For example, older respondents were more likely to be satisfied with the TC information they receive, compared to younger respondents. Disaster communication media and the age group that mentioned them also varied considerably. All of this information will be included in the revised manuscript and discussed accordingly.

4. In the methodological part there are some weak points:

4.1. Missing details about the types of questions (close ended, multiple choice, open etc...)

Response: Questions 1-3 of the manuscript are closed questions, while Questions 4-8 are open ended questions. This will be clarified in the manuscript.

4.2. It is not clear if the interview was addressed only to people speaking in English or wheatear if the authors translated the answers. Which are the languages spoken in the FVT region? Maybe some clarifications are needed in the methodological part. For sure language problems/deficiencies could affect the results of the "word cloud" presented in chapter 3.2.

Response: The survey was delivered in English and answers recorded in English. The FVT region all have English listed as an official language amongst many other languages and dialects. The manuscript does highlight that communication challenges arose whilst conducting the survey, including, a language barrier (poor spoken English), which resulted in varying levels of engagement. In the initial instance where participants were recruited, they needed to have an adequate level of English to understand what the survey entailed and if they would like to take part. As such, people with poor spoken English were unable to take part in the study. However, given that the survey was conducted in urban regions (rather than remote/rural regions) the proportion of people this affected was low (less than 10%).

Language problems/deficiencies could affect the results of the word cloud. Additional text will be inserted that discusses the limitations of using word clouds as outlined below:

“Word clouds work on the principle of text size, with the text size proportional to the number of responses that use a particular word or phrase. Despite the benefits, there are also a number of limitations of using word clouds (Kiem and Austin, 2013), such as, words being used out of context, spelling mistakes or different synonyms for the same ‘key’ word.”

4.3. *The authors took the first 40 more frequent words in the answers of people. Respondents were supposed to express a fixed number of words they had in mind in relation with TC events or they were supposed to talk freely? Please add these information.*

Response: Section 2 (Methodology) confirms that question 5 is an open ended question which allowed the participants to share as much (or as little) information as they wanted. The purpose of the word cloud is to give a visual representation of the forty most commonly used words in response to this question, in this case, to represent the impacts of TCs. As per the response to comment 4.2, the limitations of this method will be discussed.

4.4. *Tonga: The words in the word cloud figure do not match the text. In detail the author state that “personal safety, including fatalities, shock and disruption” were the most common concepts expressed by respondents. However the cloud seems to do not confirm the figure provided. Please explain.*

Response: The authors did not mean to imply that Tongan responses were vastly different from those from Fiji and Vanuatu. The inclusion of percentages that summarises specific themes that were discussed confirms this. The fact that fatalities, shock and disruption were discussed is a point of difference from the other responses. This will be clarified in the manuscript.

5. *Chapter 3.2. About religion nothing is mentioned in the text, whereas is showed in figure 2. Provide a sentence explaining what this word mean in relation of a TC event.*

Response: This has been mentioned in the text. *“A small number of respondents (two from Vanuatu and one from Fiji) believed that TCs were an ‘act of God’. One respondent from Vanuatu stated that ‘God brings a cyclone to warrant change’”.*

6. *Chapter 3.4.1. What about TV this is the second most popular source of information? It is common for residents in FTV to have access to a TV?*

Response: On consideration of this comment, an investigation of TV ownership per household for the FVT region produced the following results. Please note that these figures (with the exception of Vanuatu) are for each island nation as a whole, including urban, peri-urban and rural areas.

- Fiji – 57.9% of Fijian households have a TV (World Development Indicators database, 2014)
- Vanuatu – Vanuatu – 36.2% of ni-Vanuatu households have a TV. 72.7% of households in Port-Vila have a TV (Vanuatu National Statistics Office, 2010)
- Tonga - 72% of Tongan households have a TV – 83% on Tongatapu (Tongan Statistics Department, 2008)

This information will be included in the revised manuscript in relation to the use of TV programs for capacity building and education. See paragraph below:

“Recent work has been carried out to enable capacity building and increased awareness of weather related issues through education programs in the SWP (though none are specifically focused on tropical cyclones). Two such programs, ‘Cloud Nasara’ and ‘Climate Crabs’ are a collaboration between the Red Cross and the Australian Government’s Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) Program. These animations aired on TV and during community education outreach programs explain various weather extremes caused by El Niño/Southern Oscillation (ENSO) in the Pacific. Cloud Nasara is specifically for ni-Vanuatu people, translated into Bislama, French and English (PACCSAP, 2015). A similar framework could be used to provide community education of TCs, how they form and most importantly, what to expect from TC activity in a changing climate. The reliance on television ownership for this sort of capacity building must also be considered with only 58% of Fijian (World Development Indicators database, 2014), 36% of ni-Vanuatu (Vanuatu National Statistics Office, 2010) and 72% of Tongan households owning a television (Tongan Statistics Department, 2008). However this may be somewhat overcome by introducing such programs in schools and during community education events.”

7. Chapter 4.2, line 10-12 Awareness between participants should be not mention in the previous chapter (4.1)? According to the title I would expect a discussion about preparation and adaptation strategies for DRR.

Response: The authors agree and we will rearrange the Discussion section such that Section 4.1 deals with awareness and perception, while Section 4.2 deals with adaptation and preparation.

8. One of the objectives of this work was to provide knowledge of TK activities in FTV region. However, in the results part, this argument is not explored so much (if not at all). It is therefore difficult to understand the reasons of exploring it in the discussion part. Moreover, the aim of the study is to explore urban people affected by TC without considering rural individuals, those that mostly use TK (page 7151 line 9). However, according to lines 13-15 (page 7151) it seems that TK activities are widely used even in the survey “urban population”. For dealing this argument apart in the discussion part, there is a need of more results of the studied population and to better introduce the argument in the introduction section.

Response: We did not specifically ask respondents about TK during the survey, however, the final question of the survey was open-ended asking participants if they had anything else they wished to share. It was found that many respondents wanted to share weather related TK, including changes in plant or animal activity that they used to forecast a TC. This will be discussed in the results section of the revised paper to better set the scene for the discussion of TK in Section 4. See new paragraph below:

*“The final question of the survey was open-ended asking participants if they had anything else they wished to share. It was found that many respondents wanted to share weather related TK, specifically changes in plant or animal activity. A large number of respondents noted a relationship between increased fruit yields and TC activity. In particular, harvests of mangos and breadfruit were noted as fruits that were in abundance preceding the TC season. The shape of tomatoes (*Solanum lycopersicum*) were also mentioned as a sign of potential TC activity (they are often smaller in size and can fall from the vine earlier than usual). Many*

respondents mentioned seeing birds native to smaller island groups (e.g. Mamanuca island group) flying overhead the mainland, and cattle and dogs being very vocal in the days leading to a TC event. The quantity and variety of fish preceding a TC event was also noted as being significantly lower than normal, particularly Barracuda, a popular catch, is significantly reduced and crabs are reportedly washed ashore. A number of respondents also mentioned bee activity and the movement of their hive as a positive indicator of TC activity. Generally, and under normal weather conditions bees build their hives on branches close to the ground. However, before a TC, it is reported that bees can often relocate their hive to higher ground or branches much higher above ground level (away from flooding). Fijians also discussed how using their own observational skills and experiences can be a useful and accurate metric of TC behaviour. Unrelenting hot and humid conditions throughout the day and night are a tell-tale sign of a future TC event, coupled with unsettled ocean/atmospheric conditions. The use of TK to improve TC forecasting will be explored further in Section 4.”

Additionally, in response to this comment the following text changes will also be made:

- The title for section 4.3 will be modified as follows: *“Improving adaptation practices for Small Island States (SIS): A Conceptual Framework”*.
- The aim of the study will be reworded and the text modified as follows: *“Therefore, the key aims of this study are to: (i) understand local perceptions of TC activity, (ii) investigate impacts of TC activity, and (iii) uncover adaptation strategies used to offset the impacts of TCs.”*

9. Tables and figures

9.1. Table 1, I suggest change the table as follows:

Column field 1 - Question number

Column field 2- Section area (Demographic factors, Risk perception, Adaptation strategies etc)

Column field 3 - Questions related to each section area

Column 4 - Type of question (multiple choice, close ended, open questions)

Response: This will be modified accordingly in the manuscript. However, the sequence of the column fields will be slightly different:

Column field 1 – Question Number

Column field 2 – Question related to section area

Column field 3 – Section area (demographic, perceptions of TCs, physical impact of TC activity, TC related adaptation strategies)

Column field 4 – Type of question (open questions, close ended).

9.2. TK and NTK in accordance to weather related disasters or is a general classification? Please mention if appropriate.

Response: This table refers to a classification of traditional and non-traditional knowledge in terms of ecological knowledge and is therefore applicable to this study. This table has been reworked (according to an in-text comment). The headings will subsequently read ‘Traditional Knowledge (TK)’ and ‘Scientific Knowledge (TK)’.

9.3. Figure 8 – I suggest rearranging Figure 8 since it is not so clear. The caption express the preparation actions (“after”, I guess are “before) a TC event. The title “TC warning” is not in line with the rest. It seems there are two different preparedness actions: property protection actions and personal preventive practices (the latter include listen to TC warnings, helping the

others and find for a shelter). This figure could be transformed as a table or change its layout if the authors want to keep it as a figure.

Response: This will now be Figure 7 in the manuscript. The caption and figure have both been modified according to the reviewer's suggestion. The authors will liaise with the type-setters if the paper is accepted to ensure all figures can be read with ease. This figure can be seen below:

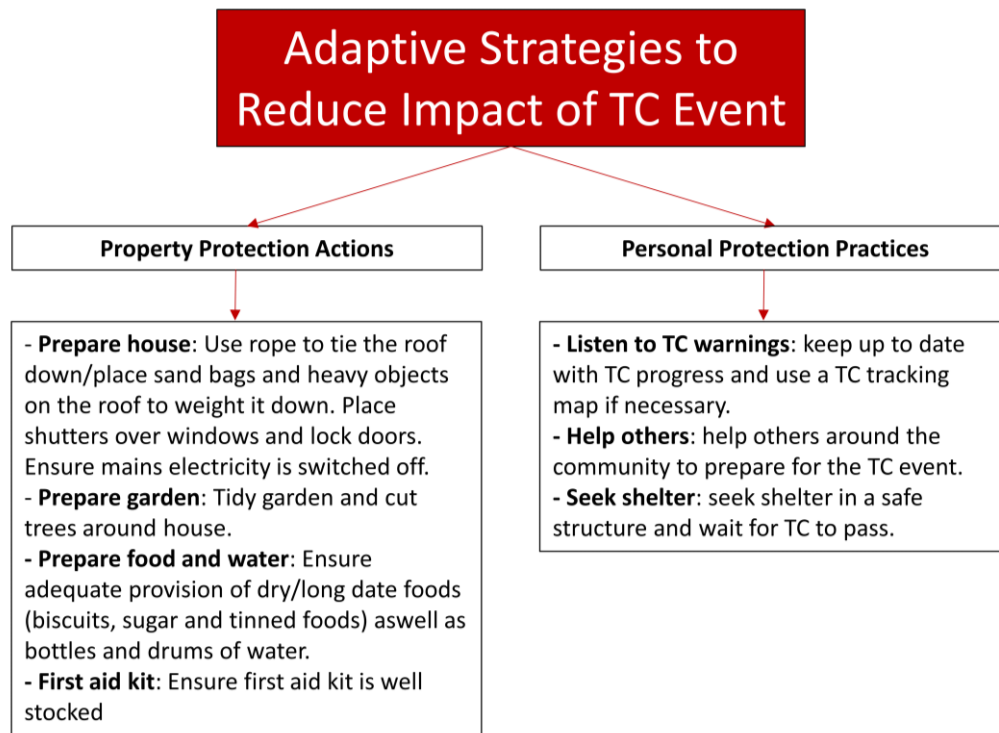


Figure 7. Schematic summarising methods adaptive strategies to reduce the impact of a TC event.

9.4. A lot of sentences need to be rephrased, since are difficult to understand or they are too long and complex. My other comments are made through the file.

Response: Where the comment 'please rephrase' was made, the sentence will be rephrased and restructured accordingly. All of the comments on the PDF attachment will be addressed accordingly.

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