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# Understanding storm surge risk in Fiji due to climate variability and change

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Global warming induced sea level rise and changes in tropical cyclone behaviour have the potential to significantly alter the risk of extreme sea level and coastal inundation events in the future. However, in the southwestern Pacific, the El Nino Southern Oscillation (ENSO) also causes significant variability in tropical cyclone behaviour. In El Niño years, cyclone genesis is greater east of the dateline, with the highest density occurring around 10oS, 180oE while in La Niña years, the region of greatest formation is near 15oS 170oE, as well as to the south of Fiji. There are three preferred tracks of cyclones during the El Niño phase: one passing over the Fiji islands moving southeast, another recurving east of Vanuatu and a third near Samoa, tracking towards the southeast. During La Niña, the typical track is from a point east of Vanuatu to a location south of Fiji (Chand and Walsh, 2009).

ENSO is also associated with variations in local mean sea level. During El Niño years, sea levels to the west of about 165°W and to about 10° either side of the equator are lower than average by up to several cms while in the eastern equatorial Pacific, sea levels are several cms higher than average (e.g. Church et al, 2006). Confidence in future projections of tropical cyclones and regional sea level therefore will depend to an extent the ability of climate models to simulate ENSO behaviour now and into the future.

Tropical cyclone storm surge risk in the Pacific is of interest for impact assessment and adaptation planning despite the high uncertainty surrounding its possible future changes. This study aims to explore how ENSO and plausible scenarios of future climate change affect storm surge risk in Fiji using a statistical and hydrodynamical modelling approach similar to that described in McInnes et al (2003). Cyclone-induced storm surge risk under average climate conditions is firstly quantified by developing a statistical model of cyclones for the region of interest through an analysis of the historical cyclone records of the region. A simple cyclone vortex model is used to simulate the surface wind and pressure field associated with each cyclone and a hydrodynamic model is used to simulate the storm surges. With hundreds of plausible cyclones simulated, a map of storm surge hazard can be constructed. The sensitivity of this pattern of surge hazard to different modes of climate variability as well as climate change can then be investigated. Results of this study will be presented for Fiji.

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