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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Projecting the risk of damage to reef-lined coasts due to intensified tropical cyclones and sea level rise in Palau to 2100" *by* Chuki Hongo et al.

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The paper by Hongo and co-authors addresses the problem of projecting toward the end of the present century the impact of increased tropical cyclones (TC), sea level rise (SLR) and storm surges on the reef-lined coasts of Palau (western Pacific Ocean), with special focus on the coasts of the Melekeok state (Babeldaob island). The paper has three main objectives: 1) evaluating the effectiveness of coral reefs as a natural breakwater in the present conditions, 2) assessing quantitatively the impact, on the reef and at the shore, of waves forced by increased meteo-hydro-ocean extreme phenomena in the conditions forecasted for the end of the 21th century; 3) estimating the reef production rate necessary to cope with the increased hazard and to maintain the

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effectiveness of the reef itself in attenuating the wave impact at the shore. The effects of the above-mentioned meteo-hydro-ocean increased forcing terms are investigated numerically by means of the numerical code CADMAS-SURF. The effects of increased TC, SLR and storm surges are treated separately by means of several different scenarios, in each of which a set of values for the significant wave height offshore, for the significant wave period offshore, for the SLR value and the storm surge "height" are provided as input. The outputs are the significant wave height at the reef flat and the water level at the shore, calculated in conditions both of healthy and degraded reef. The most hazardous scenarios are those for which the water level at the shore is larger than the minimum topographic height at which the local communities are found (local road presently at 2.86 m above MSL). The authors find two of these scenarios in their projection to 2050 and four in the projection to 2100. Another important conclusion regards the coral growth rate needed to cope with the increased hazard. A Corymbose Acropora growth rate of âĽČ1% will be needed for RCP 2.6, a growth rate >8% will be needed for RCP 8.5.

Although the topic and conclusions are important and relevant, I see a number of issues that need to be solved before the paper can be considered for publication.

1) A first issue regards the title, which contains the terms "risk" and "damage". Neither "risk" nor "damage" are assessed in this paper. Rather, only hazard is assessed in terms of significant wave height at the reef flat and of water level at the shore. Risk and damage make sense only if some kind of vulnerability is assessed and if this vulnerability is combined with the hazard. This operation is not part of the study, so it is important that no mention to damage and risk is made in the paper.

2) A clear statement of the reasons motivating the choice of Melekeok as test site is missing. Section 2.1 "Study site" is too short and no sufficient justification is given for the choice. The only obvious one is that a reef is present. But what about the history of Palau? What about its demographics, what about its cultural/historical/environmental/. . . assets?

3) Is there any evidence regarding the maximum inundation line relative to Typhoon Bopha in 2012 and Typhoon Haiyan in 2013? Were these two events simulated with CADMAS-SURF? They would represent a good benchmark for all the scenarios provided in this paper.

4) In my understanding, in the paper the term “degraded” is used to indicate a reef that is not going to grow, but that is anyway present. If my understanding is wrong, then ignore this point. But if it is correct, then since it is clearly stated that the 2012 and 2013 typhoons caused severe loss of coral cover, why a scenario in which a large portion of the reef is destroyed and hence the relative protection effect is missing, is not taken into account?

5) Is there any historical evidence of tsunami impact/damage on the reef? If so, this should be another factor to be considered as possible responsible for degrading the reef.

6) Why is a single cross-section considered? Can you make any estimate of how your results may change should other cross-sections be considered in the same area, or even if another coastal area along the island would be taken into account?

7) Regarding the modelling with CADMAS-SURF, if I understood correctly the forcing terms are impulsive, or maybe even steady-state. Can you clarify? Is this approximation well fit to TC? And to SLR? And to storm surges?

8) What are the uncertainties associated with the estimates in Tables 1 and 2 (and S1 and S2 as well)? All measures are provided at the centimetre scale. Is this sound?

I ask the authors to carefully take into account the above comments and requests and to address them in the revised version of the manuscript.

I am also attaching an annotated version of the manuscript with some corrections and further minor comments.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-3/nhess-2017-3-RC2-supplement.pdf

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