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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.

Anonymous Referee #1

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This paper proposes an assessment of the risk of coastal flooding and submersion by waves in one of the Palau islands surrounded by a coral reef in 2100, in a context of climate change. The study is certainly of interest, the study is rather comprehensive, well conducted and the paper is concise, clear and well written. The objectives of the paper are clearly exposed and the conclusions correspond to these objectives. I have however two main concerns, that in my opinion prevent the acceptance of the paper in its present state: 1- The authors state that their fisrt objective is to assess the present-day efficiency of the Palau coral reef as wave breaker and natural barrier against water level rise during a tropical cyclone (TC). They give (from what I understand) the corresponding figures obtained from a numerical hydrodynamic modelling, using as forcings

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Discussion paper

the outer wave significant height (SWHo), the outer significant wave period, and the outer water level. These forcings are taken from a GFS simulation and observations of SWH in similar conditions. The percent of reduction of wave height due to the reef is 85.7% (87.9%) with (without) storm surge. As these values are used as a reference in the projective part of the paper, it would be relevant to confirm them (at least at first order) using observations. Recent TCs (Bopha and Haiyan) hit Palau, and it is maybe possible to find even crude observations of (outer) SWHo and (reef) SWHr to check either the value of SWHr or the percentage of reduction (Table 1). The same applies to the flooding risk (Table 2). Especially, the authors mention in the discussion that some of the values obtained in 2100 would result in a flooding of the coastal road: did such flooding occur in the recent years? in the historical period? Has the value of 2.10 m for the present-day coastal flooding with storm surge already been observed? The authors did a rather good job in estimating the various contributions (even if it is first order) and their uncertainties but it would be more convincing if the accuracy (and not only uncertainty) was estimated (by comparing with observations). 2- The conclusion of the projective part of the study is twofold. Firstly, the health of the reef does not impact significantly the risk of flooding - in some cases, an healthy reef will result in higher water level at the shoreline than a damaged reef. Secondly, there is an impact of the state of the reef on SWHr, which varies according to the climatic scenarios (sea level rise), to the wave conditions, and to the presence of storm surge. Its maximum value (SWHr at degraded reef - SWHr at healthy reef) is 0.30m (0.44m with storm surge), corresponding to a change of the percentage of reduction from 88.2 to 85.2% (85.5 to 81.3%). I wonder whether this 3-4% change is significant, and whether the corresponding change in SWHr will really have an impact at the shoreline. Providing such estimates is certainly interesting per se, but their significance justify the discussion about the use of coral reef to mitigate the future coastal risk (4.2, 4.3). So, even though this study actually proves that an healthy reef slightly reduces the SWH at the shoreline with respect to a damaged reef, this reduction is maybe not enough to provide an efficient protection against high waves at the shore. Is theer any (observed)

difference between a SWHr of 1.24 m and 1.05 m (present-day values with / without surge) ? This could help to assess whether a 0.30 m change in the 2100 scenarios would have an impact or not and justify the recommendation of using of coral reef as an efficient barrier.

Minor comments: p.1, l. 21-24: the role of the reef crest / entire reef in reducing the wave height is not clear here (much clearer in part 3.1), please improve. p. 4, l. 8 to 31: the values and uncertainties of the forcings given here correspond to order of magnitude rather than precise values. This is not an issue, as the impact on the final results (SWHr and water level) is probably very weak, but this should be specified more clearly. p. 4, l.10: the values of SWHo and wind speed are model outputs? 27 m/s seems rather "low" for cyclonic wind. I wonder whether this is due to the rather crude resolution of the (global) atmospheric model. Are the corresponding wind observations (possibly satellite products) available? p. 4, l. 27: about the SLR, if the level of precision of the discussion is 0.1m or below, you should also take into account a possible effect of El Nino/La Nina. This could result regionally (tropical Pacific) in 0.3 m difference or more. p. 6, l. 30-31: how comes that these cases show a decrease of SWHr with a degraded reef? In cases 5, 11, 18, the reduction is comparable to the opposite reductions obtained with an healthy reef. Please elaborate. p. 7, l. 30-31: the cases leading to the road flooding give similar results with a degraded and healthy reef. p. 9, 4.2: I really appreciate the discussion on the effects of the reef growth on the wave dissipation. p. 9, 15: this sentence is not clear. You mean that ther is no significant WLs change in response to upward reef growth? Please rephrase. Table 1, also table 2: the readability of the results would be improved if the forecasts were more clearly related to the present-day values. For instance, present-day value without storm surge and projected (2050 and 2100) values without storm surge and different scenarios, then present-day value with storm surge, and projected values with storm surge.

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