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Discussions

Interactive comment on "Extreme water levels, waves and coastal impacts during a severe tropical cyclone in Northeast Australia: a case study for cross-sector data sharing" *by* Thomas R. Mortlock et al.

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The reviewer's comments relate to the contribution of wave effects to total water levels during TC Debbie, and the sensitivity of the parametric formulation of Stockdon et al. to beach foreshore slope in estimating wave runup contribution to coastal water levels.

Regarding the reviewer's first point: "it is stated throughout the paper that storm surge and tides are the largest contributor to the total water level; it appears that this is true but supporting evidence is not really presented."

The average astronomic tide (from observations of all the gauges in the area), at time of maximum water levels, was 2.15 m; the average surge residual, at the time of maximum water levels, was 0.98 m. In terms of waves, the contribution to maximum coastal water levels - in the absence of detailed modelling - can only be inferred through parametric estimates, or (even better) by subtracting the observed storm tide (tide + surge) from total coastal water levels inferred from field measurements. In this study, we did both, and used the latter as a check on the parametric estimates (see section 5.3).

We would argue that [total coastal water level observations – storm tide observations] is the best supporting evidence possible for the contribution of wave effects to total coastal water levels. Results from this approach suggested that, on average, wave effects contributed $\sim$ 16 % to water levels on the open coast. Conceptually, this fits with the wide, shallow shelf of this locality – which produces a large tidal range, is conductive to large surge events but dissipates wave energy.

Regarding the reviewer's second point: "Whereas the foreshore slopes employed at each of the sites seem reasonable, tanB could have been quite different when TC Debbie made landfall, since the measurements were obtained 5 months prior. I recommend that a sensitivity test of the relative contribution of the wave runup, inclusive of a range of plausible foreshore slopes, to the total water level be included in the study."

The Stockdon formula was chosen because of its development for cyclone-like conditions, and largely successful application in E Australia. The reviewer is quite correct, however, that it is simplistic and very sensitive to foreshore slope - and this is something that is discussed particularly in terms of the Wilson Beach site, where the upper and lower foreshore slopes are very different (see section 5.3). It is also true that the foreshore slope was obtained from LiDAR transects flown $\sim$ 5 months prior to Debbie and thus may have been different to when Debbie made landfall. This point is also highlighted in the paper (see sections 4.6).

However, our analysis of buoy data (section 5.2), indicates a very low wave energy regime prevailed during the months preceding Debbie in this region, and likewise low wave energy, and very small beach profile change, was observed five months post Debbie (as discussed in section 5.6). Both indicate there is very little beach morphological change - particularly with regard to significant changes in beach foreshope slope - outside cyclonic events, at least on sub-annual timescales.

Therefore, we believe the reviewer's suggestion of using a range of plausible pre-Debbie foreshore slopes, while a useful exercise for wave-dominated coasts with a moderate modal wave energy climate, will not differ significantly from our pre-storm values at this location.

In writing the paper, we did consider using a range of upper and lower foreshore slopes, and the mean of the two, to derive runup estimates (as discussed briefly in section 5.3). This is because, as highlighted in Stockdon et al 2006 and 2007, the surf zone widens considerably during cyclone (or hurricane) events and thus the 'mean foreshore slope' as parameterized, is not necessarily equal to the upper high-tide beach slope.

However, we were unable to explore this because the lower foreshore slope was not captured entirely by the LiDAR. The LiDAR was flown for terrestrial purposes at mid-tide, thus not capturing the entire low-tide beach.

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