THE RELATIVE CONTRIBUTION OF SEA LEVEL RISE AND STORM EROSION TO LONG TERM NET COASTLINE RECESSION

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INTRODUCTION

The potential Climate change (CC) impacts on coasts and associated socio-economic and environmental risks are widely recognised internationally. One of the most talked about CC impacts is coastline recession. Any increase in mean sea level is expected to result in an upward and landward shift of the entire active profile causing net coastline recession (Bruun, 1962). Another phenomenon that can result in net coastline recession is the cumulative effect of storm erosion. This is due to the hysteresis effect in the storm erosion/dune recovery cycle (Ranasinghe et al., 2012). But what causes more recession: storms or sea level rise? This is a commonly asked question, to which science-backed answers have not been presented to date. This paper addresses this question via the application of a physics based, probabilistic numerical model at a typical swell and storm beaches located in SE Australia and The Netherlands, respectively.

METHODS

The model applied here is the Probabilistic Coastline Recession (PCR) model presented by Ranasinghe et al. (2012). The basic physical philosophy underpinning the PCR model is that any net long-term recession of the coastal dune is due to the combined effect of storm erosion and SLR. The computational procedure of the PCR model is fully described in Ranasinghe et al. (2012). In this study the PCR model was applied at the swell dominated Narrabeen beach, Sydney, Australia and at storm dominated Noordwijk beach, The Netherlands with a range of forcing conditions: contemporary storm wave forcing only; contemporary storm wave forcing and strong deterministic SLR (A2 GHG emissions scenario; ~1 m of SLR by 2100 relative to 1990); contemporary storm wave forcing and stochastic SLR; CC modified storm wave forcing and strong deterministic SLR; and CC modified wave forcing and stochastic SLR (using the results of Hemer et al., 2012). The model has previously been validated for Narrabeen beach by Ranasinghe et al. (2012).

RESULTS AND CONCLUSIONS

The results obtained with contemporary storm wave forcing only and with the combination of contemporary storm wave forcing and strong deterministic SLR for Narrabeen beach are shown in Fig. 1, which shows the dominant effect of Sea level rise over storm erosion on net coastline recession by 2100 (relative to 1990) at all exceedance probabilities greater than 2.5%. Results also show that, at Narrabeen, compared to strong deterministic SLR, stochastic wave forcing results in slightly lower net recession at all exceedance probabilities, while the CC modified storm wave conditions do not appear to have much impact on net recession. At Noordwijk beach, the impact of storms on net recession begins to dominate over that of SLR at about 30% exceedance probability.

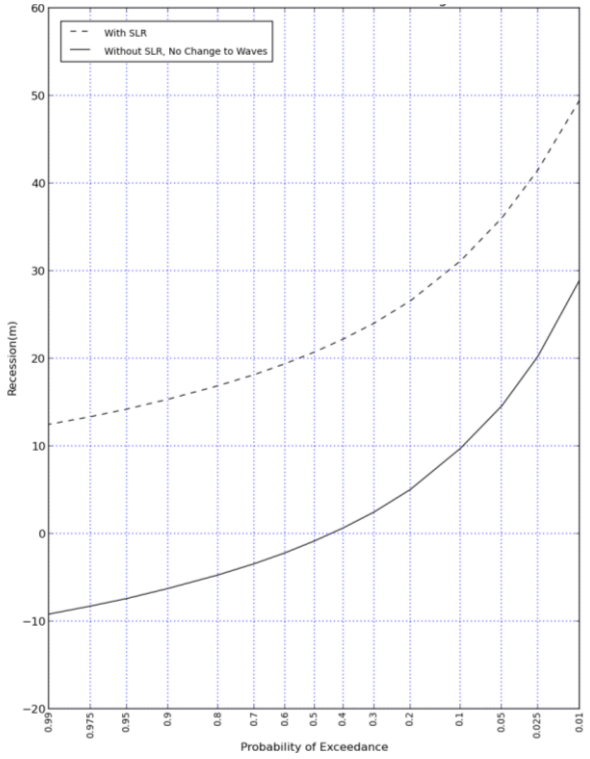

Figure 1 - Net coastline recession by 2100 (relative to 1990) at Narrabeen beach, Australia; with and without sea level rise

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