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Sea-level rise induced amplification of coastal protection design heights

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Coastal protection design heights typically consider the superimposed effects of tides, surges, waves, and relative sea-level rise (SLR), neglecting non-linear feedbacks between these forcing factors. Here, we use hydrodynamic modelling and multivariate statistics to show that shallow coastal areas are extremely sensitive to changing non-linear interactions between individual components caused by SLR. As sea-level increases, the depth-limitation of waves relaxes, resulting in waves with larger periods, greater amplitudes, and higher run-up; moreover, depth and frictional changes affect tide, surge, and wave characteristics, altering the relative importance of other risk factors. Consequently, sea-level driven changes in wave characteristics, and to a lesser extent, tides, amplify the resulting design heights by an average of 48–56%, relative to design changes caused by SLR alone. Since many of the world's most vulnerable coastlines are impacted by depth-limited waves, our results suggest that the overall influence of SLR may be greatly underestimated in many regions.

Reference:
Arns, A.; Dangendorf, S., Jensen, J., Talke, S., Bender, J., Pattiaratchi, C.: Sea-level rise induced amplification of coastal protection design heights. Sci. Rep. 6, 40171; doi: 10.1038/srep40171 (2016).