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# Wave dynamics for a tropical reefal island: does an upper level threshold of reef protection exist?

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Coral reefs help reduce incoming wave energy by up to 90% and decrease wave related hazards for coastal communities. Acting as a submarine breakwater, the sudden change from oceanic depths to shallow reef bathymetry reduces wave heights and modifies their frequency. Coastal communities benefitting from coral reef protections are now at risk with increased storm event frequency from climate change, supplemented by the intensification of coral reef bleaching events.
Anegada Island is situated at the limit between the Caribbean Sea and the Atlantic Ocean basins. The Horseshoe Reef, the third biggest in the world, surrounds the island, which is situated in the tropical convergence zone and has been regularly impacted by storms and hurricanes. A total of 28 storms and hurricanes have been recorded between 1852 and 2010 with the strongest, Hurricane Donna in 1960, which was a level 4 on the Saffir-Simpson scale. Recently, in the 2017 hurricane season, both Hurricanes Irma and Maria (reaching level 5 and 4 respectively) have made landfall over Anegada during September.
We use SWAN wave modelling, a third generation model and input wind and wave data from three buoys, two Atlantic and one Caribbean, as well as from historical storm records. The modelling approach represents a range of wind and wave conditions representing fair weather to extreme hurricane events.
The results demonstrate variability along the North coast to the South coast, mainly due to the difference of reef shape and incoming event direction. With the increase of event power, along the North coast, there is a shift from westerly longshore transport dominating to swash-aligned processes. The South coast (Caribbean side) is largely impacted by low, refracted waves as the main wave train approaches from the east. Further, for both coasts, as the level of the storm increases, any further influence of the reef appears to reach a maximum from hurricane level 3 onward. Under these conditions, swash processes are more effective along the northern shoreline, whilst the southern coastline is more sheltered regardless of the incoming event.