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Nearshore and coastal impact of Hurricane Irma (2017) on Barbuda, eastern Caribbean

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Hurricane Irma, after building to a category 5, struck the island of Barbuda in 2017, causing widespread devastation and dramatic coastal and nearshore alteration. Pre-and post-event airborne (terrestrial) LiDAR, along with satellite-derived bathymetry for the site provided detailed topographical quantification of the seabed and landform response to this extraordinary event, and presented a unique set of forcing conditions with which to observe Category 5 impacts on low lying island environments.

Using pre-hurricane bathymetry, Hurricane-generated waves were simulated across the nearshore using in situ and far field measurements of initial wave conditions. An initial SWAN simulation was conducted from the offshore using the WW3 wave climate as boundary conditions to develop the wave spectrum for nested, nearshore high-resolution (10m) grids focussed on the island. Water levels from the local tidal cycle were also accounted for using a set of non-stationary runs and local tide gauge information with an input grid of every 6 hours to simulate tides during the passage of the storm.

Significant bathymetric changes were noted throughout the nearshore zone as a result of the Hurricane event with distinctive erosion and accumulation patterns observed. We highlight direct wave forcing (bed shear stress) and its coincidence with these patterns of sediment dispersal. Terrestrial dune ridge topography was also dramatically altered with severe flattening of relief (and vegetation) during the Category 5 event.

Our study helps demonstrate the heterogeneous nature of the impact that hurricanes of this magnitude have on low lying island environments and shows the dramatic before and after changes they can have on the local coastal landscape.