EGU24-9395, updated on 27 Jul 2024
https://doi.org/10.5194/egusphere-egu24-9395
EGU General Assembly 2024

Tropical cyclone induced coastal flooding under current and future climates: A novel model framework for continental scale applications.

Niall Quinn[1], Thomas Collings[1], Ignatius Pranantyo[2], Nicolas Bruneau[2], Hamish Wilkinson[1], Ivan Haigh[3], and Malcolm Haylock[1]

[1]Fathom, Bristol, United Kingdom of Great Britain – England, Scotland, Wales (n.quinn@fathom.global)

[2]Reask, London, United Kingdom of Great Britain - England, Scotland, Wales (nico@reask.earth)

[3]National Oceanographic Centre, University of Southampton, Southampton, United Kingdom of Great Britain - England, Scotland, Wales (i.d.haigh@soton.ac.uk)

Coastal flooding, often triggered by the convergence of high tides and intense storm surges and waves, poses a grave threat to global coastal communities, leading to widespread property damage and loss of life. Tropical cyclones (TCs) in particular have been responsible for the majority of the most devastating coastal flood events in the recent years, causing billions of dollars in damages over the last decade within the US alone. Further, the compounded impact of rising sea levels, fuelled by a warming climate, along with projected population growth and continued development in the flood zone, is widely expected to increase these risks to coastal communities in the future.

It is essential to many end users, from environmental mangers to (re)insurers, to accurately characterize the risk of coastal flooding over large, often national scales, both under current and highly uncertain, future climate conditions. This poses a number of challenges. For instance, in many of the most heavily impacted regions of the world, the majority of the coastal flooding stems from severe TC induced storm surge events. The rarity of these events means that the historical record alone is insufficient to truly capture the current risk, let alone represent the vast range of potential future climate conditions and their subsequent impacts upon TC-induced flood risk. To provide the information required catastrophe model frameworks that can efficiently represent the full range of potential flooding events, from hazard generation through to financial impacts, and how their frequencies might change through time, are essential.

This research introduces a comprehensive TC-induced storm surge catastrophe modelling framework. An extensive catalogue of synthetic TC wind and pressure fields, under current and future climate forcing, is utilised. The SCHISM model suite is used to numerically model surge and waves to generate boundary conditions to the reduced physical solver, SFINCS, which is used to model the nearshore and overland inundation processes. Using an example US implementation, novel approaches developed to enable the efficient representation of approximately 2.5 million unique TC events are discussed, and preliminary results presented. The proposed catastrophe model framework offers a valuable tool for those interested in coastal flooding, enabling a robust

evaluation of TC-induced risk under any climate scenario, over extensive geographical domains.