EGU24-2106, updated on 07 Dec 2024
https://doi.org/10.5194/egusphere-egu24-2106
EGU General Assembly 2024

Integrating incident and infragravity wave effects in a fast compound flood model

Tim Leijnse[1,2], Ap van Dongeren[2,3], Maarten van Ormondt[4], Jeroen Aerts[1,2], and Sanne Muis[1,2]
[1]Institute for Environmental Studies (IVM), Department of Water and Climate Risk, Vrije Universiteit Amsterdam, Amsterdam, the Netherlands
[2]Marine and Coastal Systems, Deltares, Delft, the Netherlands
[3]Coastal and Urban Risk and Resilience, Water Science and Engineering Department, IHE Delft, Delft, The Netherlands
[4]Deltares USA, Silver Spring, MD, USA

Coastal communities worldwide are under threat of flooding due to multiple hazards (Mousavi et al., 2011). In some coastal areas, waves are the dominant driver of extreme water levels (Parker et al., 2023). However, for regional to continental scales coastal flooding assessments, waves are often not or only crudely accounted for, due to the high computational expense of wave resolving numerical models (e.g., XBeach; Roelvink et al., 2009).

Recently, Leijnse et al. (2021) has shown that it is possible to model waves in a fast reduced-complexity compound flood model such as SFINCS. However, boundary conditions for SFINCS are still derived from a computationally expensive numerical model like XBeach or are generated using 1D based (meta) models (e.g., Bertoncelj et al., 2021), that do not (fully) account for alongshore varying 2D effects. To be able to include dynamic wave runup and overtopping in a 2D fast flooding model, we need to derive nearshore infragravity wave conditions also in a fast way.

To overcome this challenge, we introduce an integrated model approach, where we couple a fast stationary wave spectral model (SnapWave) to the fast compound flood model SFINCS. Besides incident waves, the SnapWave model can also efficiently estimates nearshore infragravity wave conditions (Leijnse et al. 2024, in review). Together with a nearshore wave generating boundary condition (van Ormondt et al., 2023), our new integrated wave-resolving approach internally drives the flood model SFINCS with waves and can therefore assess the effects of waves on coastal flooding. The performance is validated for several laboratory tests and against XBeach simulations of van Ormondt et al. (2021).

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