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CoastFLOOD: a reduced complexity, high-resolution, flood model for coastal inundation due to storm surges.

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Abstract

Storm surges due to severe weather events threaten low-land littoral areas by increasing the risk of seawater inundation of coastal floodplains. The latter is mainly responsible for land loss, coastal erosion, damages on onshore infrastructure and properties, environmental degradation of coastal aquatic ecosystems, saltwater intrusion in coastal aquifers, and occasionally human casualties, etc. We hereby present recent developments of a numerical modelling system for coastal inundation induced by sea level elevation due to storm surges, potentially enhanced by astronomical tides and/or Mean Sea Level (MSL) rise. CoastFLOOD is a reduced complexity numerical model for high-resolution simulations of coastal inundation in local-scale littoral floodplains. It is a 2-D horizontal, GIS raster-based storage-cell, mass balance flood model for low-land coastal areas, following a simplified formulation for the Shallow Water Equations (SWEs). The storm surge on the shoreline drives the seawater flow on the coastal floodplain via Manning-type equations in decoupled 2-D formulation. Therefore, CoastFLOOD can be fed either by outputs of regional-scale simulations for storm surges with operational forecast model HiReSS, or by field data for Sea Level Anomaly (SLA) from satellite altimetry and *in situ* observations at the coastal zone.
CoastFLOOD performs highly detailed modelling seawater uprush and flood routing due to episodic, mid- or long-term, sea level elevation on the coastline over a 1-5m resolution ortho-regular Cartesian raster grid. New updated features of the model are discussed herein concerning the detailed surveying of terrain roughness and bottom friction, expansion of Dirichlet boundary conditions for coastal currents (besides sea level), enhancement of wet/dry cell techniques for flood front propagation over steep water slopes, etc. Furthermore, several issues are discussed about the proper inclusion of coastal structures, port infrastructure, beach formations, and rocky shores in the model grid. Land elevation grids are derived by post-processing of available geospatial datasets from freely available high-resolution Digital Elevation Models (DEMs). The operational flood forecast model validation is performed with the use of satellite observations (Sentinel-2 images) producing the Normalized Difference Water Index (NDWI). CoastFLOOD results are also compared to a simplified, static level, “bathtub” inundation approach with hydraulic connectivity. The model output refers to flood hazard maps on areas of classified land elevation for different SLA scenarios. Applications over low-land areas along the Greek coastline are provided. These refer to both short-term operational forecasts and long-term climatic studies.