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An European historical reconstruction of sea surface dynamics (waves and storm surge) for coastal impact studies

Melisa Menendez, Jorge Perez, Alba Cid, Sonia Castanedo, Inigo Losada, Raul Medina, and Fernando Mendez
Environmental Hydraulics Institute (IH-Cantabria). Universidad de Cantabria, Santander (Spain)

Despite their outstanding relevance in coastal processes, a study of the sea surface dynamics due to atmospheric wind and pressure variations are rather limited in comparison with the mean sea level rise. Data of waves and surges along the European region are scarce and in-homogeneous, not only in terms of spatial coverage but also in terms of temporal coverage. This study presents two databases focused on a historical reconstruction of: (i) the wind-generated waves (GOW) and (ii) the meteorological sea level component (GOS). The GOW and GOS datasets cover the whole European coast (North Atlantic, North Sea, Baltic Sea, Mediterranean Sea and Black Sea) at high-spatial resolution from 1979 to present.
The meteorological sea level component (storm surge) has been generated by the Regional Ocean Model System (ROMS). To take into account non-linear interactions between tides and surges, both dynamics were simulated jointly. Final results of meteorological component of sea level were obtained by subtracting the astronomical tide from the simulated sea surface. The model was set-up for Europe using an orthogonal grid, with a horizontal resolution ranging between 3.5 to 11 km. A spatial domain of approximately 5 km was used for the Black Sea.
Local coastal waves can be the integrated result of the ocean surface over a large region of influence. GOW-Europe is designed from a multigrid approach based on the overlapping of two-way nested domains. The coarser spatial resolution along the European coast of GOW is 15 km. The generation and propagation of the sea surface waves of GOW-Europe are simulated with the model WAVEWATCH III v4.18. Effects of non-linear wave-wave interactions, whitecapping and depth-induced refraction are considered in the propagation model.
In order to validate GOW and GOS over Europe with available observations, an exhaustive comparison with in-situ and remote measurements was developed. In-situ buoys and tide-gauges are used to compare hourly time series of surge sea level component and waves (significant wave height, period and direction) at coastal locations. Altimeter observations are also considered for a spatial validation of surge and wave heights. Results obtained from this validation process show a general good agreement with observations for the European region.
Finally, the hourly time series of surge and wave climate along the European coast grid-points are analyzed. Historical changes in the waves and storm surge provide a useful information for coastal impact studies since coastal flooding, beach erosion, coastal structures and physical damages in ecosystems can be affected by long-term changes in wave climate and sea levels.

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