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A first global-scale hindcast of extreme sea levels induced by extra-tropical storms

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Flood risk in coastal areas has been increasing in past years. This can be partly attributed to climate change and rising sea levels that increase the likelihood of coastal flood hazards, but also to increasing flood exposure because the global population and capital is increasingly concentrated in coastal zones. Without action, the increasing trends in flood hazard and exposure will be associated with catastrophic flood losses in the future. The adequate allocation of global investments and prioritization of adaptation actions requires an accurate understanding of the current and future coastal flood risk on a global-scale.
Despite this, global data on extreme sea levels are scarce. A few studies have assessed coastal flood risk at the global-scale. To date, these have been either based on extreme water levels in the DIVA database or on observations from tide gauges. Both datasets have limitations when assessing flood risk, including low-probability events, on a fully global scale. Hence, there is a need for an improved estimation of extreme sea level on a global-scale. Therefore, we are developing the first global hindcast of coastal water levels which covers the period 1979-2013. To do this, we apply a global hydrodynamic model which is based on the Delft3D Flexible Mesh software from Deltares. By forcing the model with the tidal potential and meteorological fields derived from the ERA-Interim global reanalysis, we are able to simulate the water levels resulting from tides and surges. Subsequently, we apply extreme value statistics to estimate exceedance probabilities. Similar hydrodynamic modelling efforts have been carried out at the regional scale, but as the modelling of surges in shallow coastal areas requires a high-resolution model grid, generally this approach is computationally too costly on a global-scale. However, the recent application of unstructured grids (or flexible mesh) in hydrodynamic models, allowing local refinement of the grid, has enabled the development of a global tide and surge model with a sufficient resolution in coastal areas, while maintaining the computational efficiency. Here, we present first insights in the performance of the model by a comparison of the simulated water levels with observations.