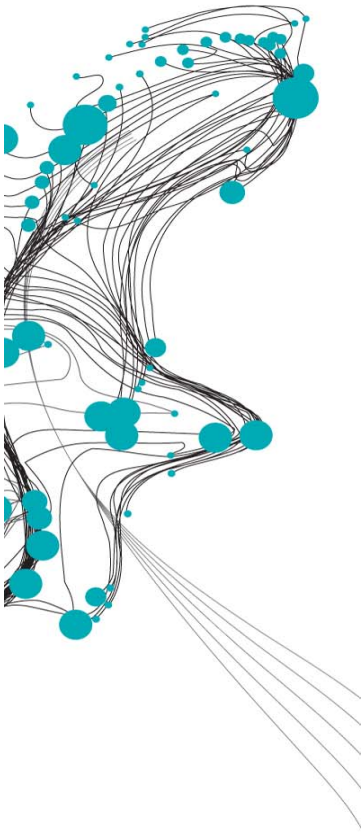
EVALUATING METHODS TO ASSESS THE COASTAL FLOOD HAZARD ON A GLOBAL SCALE

A COMPARATIVE ANALYSIS BETWEEN THE BATHTUB APPROACH AND THE LISFLOOD-AC MODEL



This study investigated global inundation estimations from the Bathtub approach, and critically compared the approach and results to the outcomes of the more detailed, process-based, reduced complexity model LISFLOOD-AC. The LISFLOOD-AC model used for coastal flood inundation estimates on a global scale is a relatively computationally expensive model. The commonly used Bathtub approach does not have this limitation, although this model can overestimate the flood magnitude (Vousdoukas et al., 2016).

Results from this study show that the Bathtub modelling approach overestimates the flooded area significantly compared to the process-based reduced-complexity model LISFLOOD-AC. This holds for most countries on Earth (subquestion 1), every coastal typology (subquestion 2) and every terrain class (subquestion 3). The Bathtub approach estimates a global EAFA (Expected Annual Flooded Area [km²/yr]) that is 5.9 times larger than the estimate by the LISFLOOD-AC model. Furthermore, overestimation was observed for all baseline return periods included, although the factor difference (Bathtub/LISFLOOD-AC) reduced when moving to higher return periods of extreme sea levels. When comparing the global flood maps of the Bathtub approach with those from the LISFLOOD-AC model, the global pattern in estimated flooded area is relatively similar while the magnitude differs significantly. This implies that the topography, which is the only variable included in the Bathtub approach, largely determines whether an area will be flooded or not. However, other variables like surface roughness are crucial to estimate the magnitude of the flood extent.

Smaller differences were observed for steeper coastlines, for which the influence of the topography is larger. This results in less overestimation by the Bathtub approach. The propagation of the coastal flood is only limited by the topography in the Bathtub approach, while the LISFLOOD-AC model also incorporates the effect of landscape roughness. Therefore, in flat terrains like plains, the flood propagation in the Bathtub approach experiences no deceleration which causes significant extents of the flood. This especially holds in combination with the fact that the Bathtub approach does not include conservation of mass and therefore assumes an unlimited amount of water that can propagate inland.

According to the findings of this study, it appears to be ill-advised to use the Bathtub approach in quantitative assessments of the coastal flood hazard at large spatial scales.

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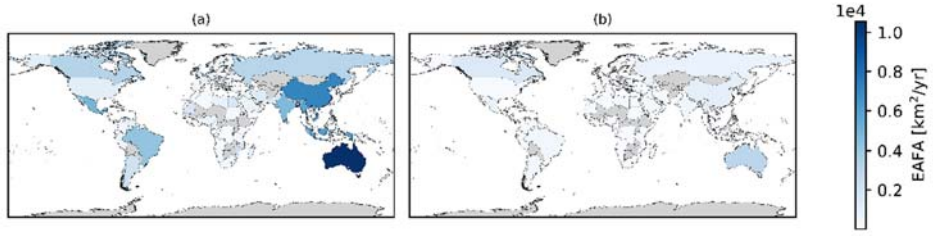

Figure 1: EAFA estimates from (a) the Bathtub approach and (b) the LISFLOOD-AC model, spanning all baseline return Periods. Both EAFA maps are shown using the same colorbar.

Vousdoukas, M., Voukouvalas, E., Mentaschi, L., Dottori, F., Giardino, A., Bouziotas, D., Bianchi, A., Salamon, P. & Feyen, L. (2016). Developments in large-scale coastal flood hazard mapping. Natural Hazards and Earth System Sciences, 16 (8), 1841–1853. https://doi.org/1 0.5194/nhess-16-1841-2016

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