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Modelling the influence of temporal variability of storm surges on coastal flood characteristics

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Assessment of flood exposure and risk are becoming increasingly important for coastal management and planning due to climate induced sea-level rise. These assessments however are often conducted for specific events and do not consider the implications of variations in the temporal evolution (duration and intensity) of storm surges for coastal flooding. This study investigates how the temporal variability of storm surge events with a 200-year return period can influence flood characteristics, namely flood extent and inundation depth, and associated flood exposure of affected properties for the municipality of Eckernförde. A nested hydrodynamic model is applied to simulate five physically plausible, stochastically modelled storm surge events with varying intensities in Eckernförde Bay. Additionally, the events are coupled with a RCP 8.5 high-end sea level rise scenario to analyse if the influence of temporal variability changes with higher water levels. The results demonstrate that flood extent differs by more than 5% when comparing the storm surges simulated with the highest and lowest intensity. The related number of properties inundated differs by approximately 20%. Deviations in flood extent increase substantially depending on the sea level rise scenario, amounting to more than 20%, whereas differences in number of properties exposed decreases. The variances in mean and maximum inundation depth are around 5% for both scenarios. The results indicate that the temporal variability of storm surges can have considerable influence on flood characteristics, especially the flood extent. Taking into account that the influence of the variability on flood extent increases with higher water levels, uncertainty related to the temporal variability of storm surges should be represented in future flood risk assessments to ensure efficient planning.