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TITLE: Investigating compound flooding in an estuary using hydrodynamic modelling: A case study from the Shoalhaven River, Australia

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ABSTRACT:

Abstract. Previous modelling studies have considered storm-tide and riverine flooding independently, even though joint-probability analysis highlighted significant dependence between extreme rainfall and extreme storm surges in estuarine environments. This study investigates compound flooding by quantifying horizontal and vertical differences in coastal flood risk estimates resulting from a separation of storm-tide and riverine flooding processes. We used an open source version of the Delft3D model to simulate flood extent and inundation depth due to a storm event that occurred in June 2016 in the Shoalhaven Estuary, southeast Australia. Time series of observed water levels and discharge measurements are used to force model boundaries, whereas observational data such as satellite imagery, aerial photographs, tidal gauges and water level logger measurements are used to validate modelling results. The comparison of simulation results including and excluding riverine discharge demonstrated large differences in modelled flood extents and inundation depths. A flood risk assessment accounting only for storm-tide flooding would have underestimated the flood extent of the June 2016 storm event by of 30 % (20.5 km²). Furthermore, inundation depths would have been underestimated on average by 0.34 m and by up to 1.5 m locally. We recommend to consider storm-tide and riverine flooding processes jointly in estuaries with large catchment areas, which are known to have a quick response time to extreme rainfall. In addition, comparison of different entrance conditions indicated that permanently opening the intermittent entrance, in order to reduce exposure to riverine flooding, would increase tidal range and exposure to both storm-tide flooding and wave action.

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