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Coastal inundation hazard in the North Adriatic Sea under Climate Change

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On the 12th of November of 2019, flood levels in the Venice Lagoon have reached the mark of 1.87 metres, the second-highest level since records began in 1923. Although a recurrent problem in Venice, the significance of this event have raise awareness of the issue of coastal inundation hazard in Italy, particularly at the highly vulnerable territory of the regions facing the North Adriatic Sea. Several are the processes that contribute to a costal inundation event. On the short term, processes such as high tide and storm surge events can result in sea levels, potentially triggering devastating impacts on human settlements and activities. On the long term, the land subsidence and mean sea level (MSL) changes are important factors; in fact, in some regions such as Jakarta and Bangkok the land is expected to subside by more than 1 meter, while MSL is expected to rise during the next decades, reaching global mean absolute values ranging from 0.3–0.6m (RCP 2.6) to 0.5–1.1m (RCP 8.5) by the end of the century. The combined effect of global sea level rise, local subsidence, and short term phenomena can potentially increase the frequency and intensity of extreme sea levels (ESL), posing a major threat to coastal areas. Currently, almost 700 million people live in low-lying coastal areas, and about 13% of them are exposed to a 100-year flood. In Italy, a territory that is highly vulnerable to coastal flooding are the Regions facing the North Adriatic Sea, mainly due to two factors: the morphological characteristic of this territory, characterised by low-lying areas, and the bathymetry and shape of the Adriatic basin, which cause water level to accumulate and increase rapidly during storm surge events, especially during winter. In this paper, we evaluate two different coastal inundation modelling techniques, one hydrostatic (as part of the EIT Climate-KIC SaferPLACES project) and another hydrodynamic (the ANUGA model), by stressing the models with different ESL, both for the historical mean sea level and for MSL projections at 2050 and 2100. The two different inundation models are tested on three pilot sites particularly vulnerable to coastal flooding located in the North Adriatic Sea: Venice, Cesenatico, and Rimini. We compare our modelling results with existing hazard records and previous hazard and risk assessments. Finally, we apply a flood damage model developed for Italy to estimate the potential economic damages linked to the different flood scenarios, and we calculate the change in expected annual damages according to the relative extreme sea levels.