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An analysis of the effects of climate change on the probability of disastrous floods in Venice

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The Monumental city of Venice, with its lagoon (an UNESCO world heritage site), its port and the surrounding industrial plants are a most evident example of a large value (in general terms) exposed and vulnerable to storm surges and sea level rise. This study discusses how climate change is going to change the likelihood of disastrous floods, such as that which took place in 1966.
Two factors needs to be considered: change of storminess and sea level rise.
This contribution briefly review previous studies on storminess evolution and add new information on the a basis of a 4-member model ensemble covering the period 1951-2050 under the A1B emission scenario. The results are obtained by forcing a hydro-dynamical shallow water model (HYPSE) with meteorological fields produced by state-of-the-art climate models. Results show that the observed spatial distribution of surge extremes is well reproduced by model simulations and that extreme values are not expected to significantly change during the next decades because of changes in storminess.
Mean sea level evolution is studied using a linear regression model, which computes SL variations using sea level pressure over European and North-Atlantic area (MSLP), Adriatic sea surface temperature (SST) and salinity (SSS). The linear regression model is demonstrated to be consistent with the physical mechanisms responsible for sea level evolution and very successful at explaining interannual SL variations. When the linear regression model is used with the MSLP, SST and SSS from climate model simulations for the 21st century and the A1B scenario, it produces a SL rise from 2.3 to 14.1 cm, with a best estimate of 8.9cm. However, results show that sea level in the 20th century has an important residual trend, which cannot be explained by regional factors, and is interpreted as the superposition of land movement and a remote cause (such as ice melting). The behavior of the remotely forced sea level rise during the 21st century is the main source of uncertainty expands the uncertainty range from 16 to 60cm, without considering extreme interpretation of the data , which could produce higher values.
This sea level rise value is practically important. Today the value of 105 cm (which implies that 54% of the city is flooded) is reached for an average duration of 1hour per year and it would be reached for 6 days in a year with a 50cm sea level rise. Therefore future changes in mean sea level and local subsidence are likely to increase significantly the hazard posed by coastal floods, in spite of the low sensitivity of storminess to climate change.