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Impact of mass addition on extreme water level statistics during storms along the coast of the Mediterranean Sea

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In the Mediterranean Sea there are two contrasting factors affecting the maximum level that water will reach during a storm in the next decades: the increase of mean sea level and the decrease of storminess. Future reduction of storminess, which is associated with a decreased intensity of the Mediterranean branch on the north hemisphere storm track, will determine a reduction of maxima of wind wave height and storm surge levels. Changes of mean sea level are produced by regional steric effects and by net mass addition. While it is possible to compute the steric effects with regional models, mass addition is ultimately the consequence of a remote cause: the melting of Greenland and Antarctica ice caps. This study considers four indicators of extreme water levels, which, ranked in order of increasing values: the average of the 10 largest annual maxima (wlind10), the largest annual maximum (wlind1), the 5 (rv5) and 50 (rv50) year return level. The analysis is based on a coordinated set of wave and storm surge simulation forced by inputs provided by regional climate model simulations that were carried out in the CIRCE EU-fp7 and cover the period 1951-2050. Accounting for all affecting factors but the mass addition, in about 60% of the Mediterranean coast reduced storminess and steric expansion will compensate each other and produce no significant change of maximum water level statistics. The remaining 40% of the coastline is almost equally divided between significant positive and negative changes. However, if a supplementary sea level increase, representing the effect of water mass addition, is added, the fraction of the coast with significant positive/negative changes increase/decrease quickly. If mass addition would contribute 10cm, there will be no significant negative changes and for any indicator. With a 20cm addition the increase would be significant for wlind10, wlind1, rv5 along more than 75% of the Mediterranean coastline. With a 35cm addition the increase will be positive along the whole coastline for all indicators, but for rv50, for which, however, a significant positive change will affect more than 50% of the coastline.

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