Mapping cumulative compound coastal risk to multi-scale climate hazards in the Mediterranean

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Risk assessments in coastal zones usually address the maritime and continental domains separately by considering marine hazards and hydrometeorological extreme drivers individually. Although this may be reasonable for many coastlines, there are environments where this uncoupled approach will underestimate their overall risk to climate hazards and, in consequence, will affect the development of efficient adaptation plans. One of these environments is the Mediterranean, due to the magnitude of individual climate hazards, the frequency of compound events (it has been identified as one of the European areas with the highest probability of compound flooding), as well as the level of exposure along its coastal zone.

In this sense, there is an increasing number of studies addressing compound risks in the coastal zone, with most of them dealing with compound flooding. In this work, we adopt a complementary approach to help coastal managers to identify hotspot areas by classifying the coastal zone into management units of homogeneous cumulative compound risk. To this end, a Compound Coastal Zone Risk index has been developed which integrates the risks associated with the impact of marine and extreme hydrometeorological hazards. Here the risk is defined in terms of three components characterizing hazards, vulnerability and exposure, with the first two ones being specific to the intrinsic characteristics of each subdomain (marine and hydro-meteorological), whereas the last one characterizes exposed values of the coastal zone, being this area affected by both hazards.

The marine composite sub-index assesses the magnitude of hazards in terms of a sea-storm indicator (in terms of waves and storm-surge conditions), background decadal-scale shoreline evolution (to characterize erosion hazards), and SLR (both inundation and erosion). This is combined with an indicator that accounts for the “coastal” system vulnerability, which includes the geomorphology, beach width (which acts as buffer zone) and the existence of accommodation space at a given time, since both variables are t-dependent.

The hydrometeorological composite sub-index assesses the magnitude of hazards in terms of a rainfall indicator (to characterize short very-intense episodes, cumulative daily values and extreme
events associated to a given probability), maximum wind gust and lightning density. This is combined with an indicator that accounts for the “terrestrial” system vulnerability, similar to the flash flood potential index.

All these indicators are assessed at the smallest possible spatial scale to be as accurate as possible. Then, they are integrated at municipal scale to characterize each management unit with a representative value which permits to classify them in terms of their integrated risk while retaining information on the partial contribution of each component. The final work will present the compound index in detail, as well as the partial sub-indexes, and it will be applied along about 800 km of the Spanish Mediterranean coast to identify the most risky stretches to cumulative compound climate hazards. The index is validated by comparing obtained values with damage data recorded along the study area after the impact of marine and hydrometeorological hazards.

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