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Assessing the impacts induced by global climate change through a multi-risk approach: lessons learned from the North Adriatic coast (Italy)

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Climate change is expected to pose a wide range of impacts on natural and human systems worldwide, increasing risks from long-term climate trends and disasters triggered by weather extremes. Accordingly, in the future, one region could be potentially affected by interactions, synergies and trade-offs of multiple hazards and impacts. A multi-risk risk approach is needed to effectively address multiple threats posed by climate change across regions and targets supporting decision-makers toward a new paradigm of multi-hazard and risk management.

Relevant initiatives have been already developed for the assessment of multiple hazards and risks affecting the same area in a defined timeframe by means of quantitative and semi-quantitative approaches. Most of them are addressing the relations of different natural hazards, however, the effect of future climate change is usually not considered.

In order to fill this gap, an advanced multi-risk methodology was developed at the Euro-Mediterranean Centre on Climate Change (CMCC) for estimating cumulative impacts related to climate change at the regional (i.e. sub-national) scale. This methodology was implemented into an assessment tool which allows to scan and classify quickly natural systems and human assets at risk resulting from different interacting hazards.

A multi-hazard index is proposed to evaluate the relationships of different climate-related hazards (e.g. sea-level rise, coastal erosion, storm surge) occurring in the same spatial and temporal area, by means of an influence matrix and the disjoint probability function. Future hazard scenarios provided by regional climate models are used as input for this step in order to consider possible effects of future climate change scenarios. Then, the multi-vulnerability of different exposed receptors (e.g. natural systems, beaches, agricultural and urban areas) is estimated through a variety of vulnerability indicators (e.g. vegetation cover, sediment budget, % of urbanization), tailored case by case to different sets of natural hazards and elements at risk. Finally, the multi-risk assessment integrates the multi-hazard with the multi-vulnerability index of exposed receptors, providing a relative ranking of areas and targets potentially affected by multiple risks in the considered region.

The methodology was applied to the North Adriatic coast (Italy) producing a range of GIS-based multi-hazard, exposure, multi-vulnerability and multi-risk maps that can be used by policy-makers to define risk management and adaptation strategies. Results show that areas affected by higher multi-hazard scores are located close to the coastline where all the investigated hazards are present. Multi-vulnerability assumes relatively high scores in the whole case study, showing that beaches, wetlands, protected areas and river mouths are the more sensible targets.

The final estimate of multi-risk for coastal municipalities provides useful information for local public authorities to set future priorities for adaptation and define future plans for shoreline and coastal management in view of climate change.