On the Combined Use of Sea Level Rise, Waves and Storm Surges in Impact Assessment and Decision Making

Losada, Iñigo J.; Toimil, Alexandra; Camus, Paula; Espejo, Antonio; Izaguirre, Cristina

Fundacion Instituto de Hidraulica Ambiental de Cantabria, Spain

E-Mail: inigo.losada@unican.es

Decision making for coastal adaptation and risk reduction requires the use of risk assessment frameworks in which the combined effect of a range of climatic and non-climatic drivers need to be accounted for. Over the years, sea level rise has been the major driver considered in many of the existing coastal impact assessments at different geographical scales: global, regional and local scales, This demand has resulted in improved information of relative sea level rise projections at regional scale, a better analysis of associated uncertainties and improved communication to relevant stakeholders and decision makers.

Much less information is available on the projections of storm surges, ocean waves or river discharge despite the fact that many decision makers are interested most notably on the impact of extreme conditions associated to climate change rather than on the long-term effects of SLR. As a consequence, several alternatives have been considered in the past to address this problem, like the superposition of historical flooding heights associated to the combined effect of SS and waves for different return periods to SLR scenarios. (Hallegatte et al., 2013).

However, given the continuous growth of coastal communities and assets along the world coastlines, there is an urgent need to define ensemble modelling frameworks able to deal with the combined effect of the different environmental forcings both at regional and local scales at different time scale (e.g., SLR and storms) in an increasing spatial resolution. The climate change impact assessment framework should include the quantification of cascade uncertainty associated with various global and regional circulation models and greenhouse gas emission scenarios (Ranasinghe, 2016). The risk framework also requires to be quantified in a probabilistic way.

In this work, we identify existing approaches especially oriented towards, but not only the analysis of coastal flooding and erosion and covering from RCP scenarios to local scale high complex impact models with especial emphasis on probabilistic risk frameworks useful to inform the decision-making process. We will discuss limitations and uncertainties behind the most extended modelling approaches, suggesting ways to overcome those and identifying the research needs towards a fully probabilistic approach integrating the all the environmental drivers. Hurdles on moving beyond the indicator-based approach to quantify risk in ports and other controversial issues such as how to introduce the yet unclear climate change effects on tropical cyclone activity modelling will be also tackled.

Based on several case studies we will show different approaches and applications at different time and spatial scales considering uncertainty quantification.

Hallegatte S, Green C, Nicholls RJ. Corfee-Morlot (2013) Nature Clim Change. doi:10.1038/nclimate1979.

Ranasinghe, R. (2016). Assessing climate change impacts on open sandy coasts: A review. Earth-Science Reviews, 160, pp. 320-332.

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