CLIMATE CHANGE KEY-CHALLENGES IN COASTAL ENGINEERING

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INTRODUCTION

Coastal engineers play a leading role in assessing climate change impacts in coastal and low-lying areas and in the design and implementation of adaptation solutions to build resilient coastal systems. Given the continuous growth of coastal communities and assets along the world coastlines, the need to protect and preserve natural and socioeconomic coastal systems and the escalating impacts of climate change (Wong et al. 2014), there is an urgent demand by decision makers for coastal engineering practice dealing with risk assessment and adaptation under high levels of uncertainty.

Over the years, sea level rise has been the major driver considered in many of the existing coastal impact assessments at different geographic scales. This demand has resulted in improved information on relative sea level rise projections at regional scale; better analysis of associated uncertainties and improved communication to relevant stakeholders and decision makers.

However, storm surge and wave projections have not been yet fully incorporated neglecting important drivers for many coastal applications. Besides Global and Regional Climate Models fail to provide the required high resolution information for most relevant applications in coastal engineering what demands the combination of statistical, dynamic or hybrid modelling approaches to project impacts in port operations or coastal protection or the use of strong assumptions introducing high uncertainties, Camus et al. (2017).

As with regard to impact modelling, flooding is probably the most explored climate change induced effect, but there are still open questions. The combination of the projected sea level components or the nonlinearities between sea level rise and storm surge produced by the projected tropical cyclone activity still remain unclear in most of the approaches used in climate change studies. This methodological heterogeneity is even wider in coastal erosion studies. Most of these studies are still based on simple models (i.e. Bruun's rule) trying to reduce and fence uncertainties when trying to project the state of the coast in the long-term future. A robust probabilistic approach combining long-term sea level changes with the occurrence of storms in the future would certainly help to reduce part of the current uncertainties in decision making. This situation could also be extended to coastal structures and ports where there are still a series of challenges on how to address the risks of climate change on structure functionality and stability or how to account for non-stationary reliability or structures' resilience to climate change evolution.

Acceptable risk, adaptive capacity, flexible adaptation or the analysis of the efficiency and timing of adaptation options are also topics still not fully understood in coastal engineering. In our presentation, we intend to shed a light on some of these issues based on our ongoing research and experience in real applications.

OBJECTIVES

In this work, we will address what we believe to be the most relevant challenges to be faced by the coastal engineering community in order to deal with the climate change imposed risk and adaptation in coastal areas.

METHODOLOGY

Along the presentation we will introduce a series of key challenges including for each of them: motivation, current state of the art in scientific knowledge and engineering practice, knowledge gaps and potential approaches and solutions. Examples addressing real coastal engineering problems will be provided in order to illustrate each of the different topics to be discussed including applications in different geographic regions, methods, data and tools. Some recommendations will be provided on the next steps to take.

Some of the issues to be considered will be: the need to develop an integrated "probabilistic" risk framework for coastal engineering applications including future climate projections; the application of non-stationary reliability analysis to account for climate change in coastal structures design; relevant climate driver projections (sources and limitations, extremes); the assessment of probabilistic sea level rise projections; the assessment of methods for downscaling projections of sea level, waves, etc. to relevant high spatial resolutions; process-based impact modelling (flooding, erosion, operations, stability, etc) under future scenarios or on the attribution of observed impacts to climate change. Other topics to be discussed will include: building resilient pathways; nature based solutions and resilient infrastructures. The presentation will also include a discussion on dealing with uncertainty in decision making and suggesting ways to overcome existing limitations.

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