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COASTAL ADAPTATION UNDER CLIMATE CHANGE

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Addressing coastal adaptation to the future climate and its management is becoming particularly urgent for vulnerable coastal systems such as deltas and other low-line areas, which are suffering from sediment starvation and accelerated sea level rise. Such a combination of pressures makes them forerunners in experiencing climatic risks that, associated to the increase of flooding and erosion, and the degradation of natural and man-made protection interventions, will lead to a progressive degradation which may become irreversible in the near future, when accelerated climate change will progressively increase coastal risks. This climate acceleration is illustrated in Figs. 1 and 2 in terms of sea level rise and incident wave conditions. Fig. 1 shows sea level rise projections from the Intergovernmental Panel on Climate Change (IPCC) while Fig. 2 depicts the high-end values of sea level rise and the downscaled changes in wave conditions from the Maritime Engineering Laboratory of the Universitat Politècnica de Catalunya (LIM/UPC) work.

Figure 1: Visual summary of IPCC sea level rise global projections

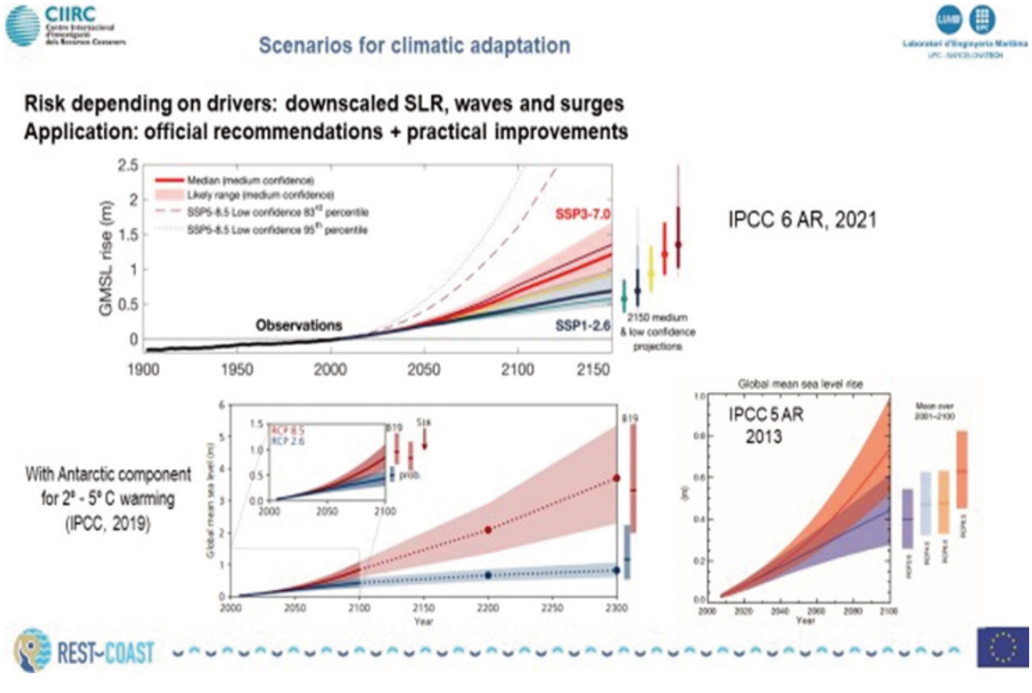

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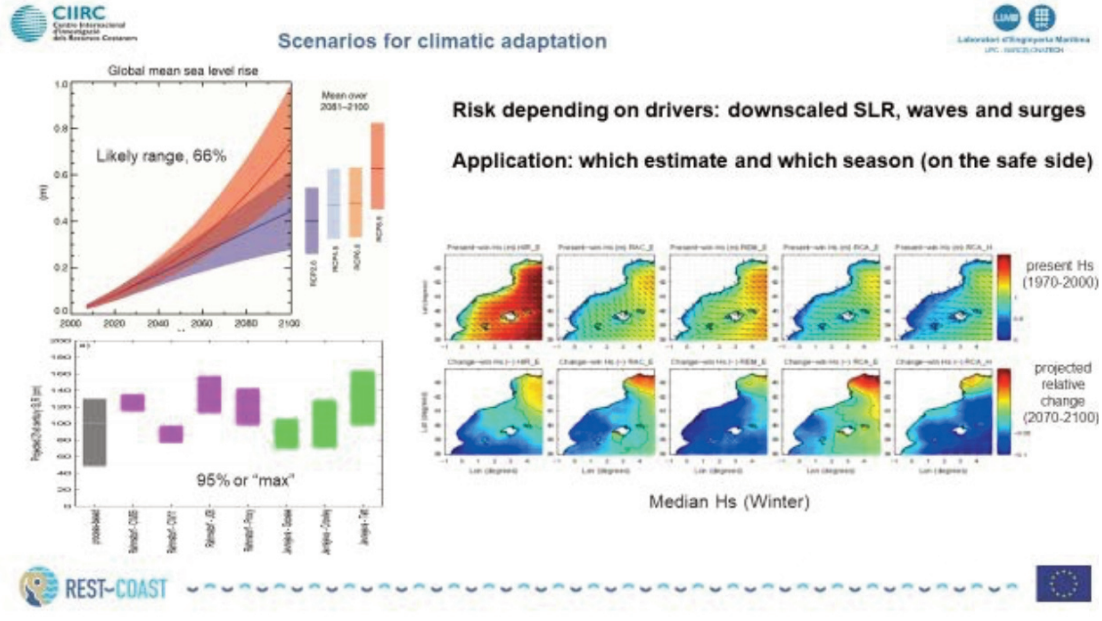
Figure 2: Sample results of high-end sea level rise and downscaled regional wave projections for the Western Mediterranean, after results from the RISES-AM project



The main families of possible interventions for coastal adaptation and protection appear summarised in Fig. 3. There is a range of options available for adaptation, depending on the selected time scale and the considered domains. This means that, depending on the horizon for the adaptation measures and as a function of the longshore and cross-shore distance that we select for the coastal stretch to be adapted, the range of options may go from doing nothing to rigid interventions, including sand nourishment or solutions based on natural ecosystems. These different types of intervention, including combinations especially suited to the characteristics of the analysed coastal system, are discussed in terms of initial design, monitoring, and maintenance plans.

These interventions consist of rigid, soft or nature-based solutions, as illustrated in Figs. 4 and 5. Such combinations should be tailored to the biophysical and socioeconomic characteristics of each considered coastal stretch (Sanchez-Arcilla et al, 2022).

Coasts affected by human action will need adaptation to such an accelerated sea level rise, compounded by possible changes in wave conditions, in probability of storm surges, and increasing urbanization and coastal rigidization, which altogether aggravate the resulting meteo-oceanographic impacts. This adaptation can be efficiently supported by early warning systems, as illustrated in Fig. 6 by the system developed for the iCoast project.

Figure 3: Summary of the main types of coastal interventions for enhancing protection and reducing risks under present and future meteo-oceanographic factors

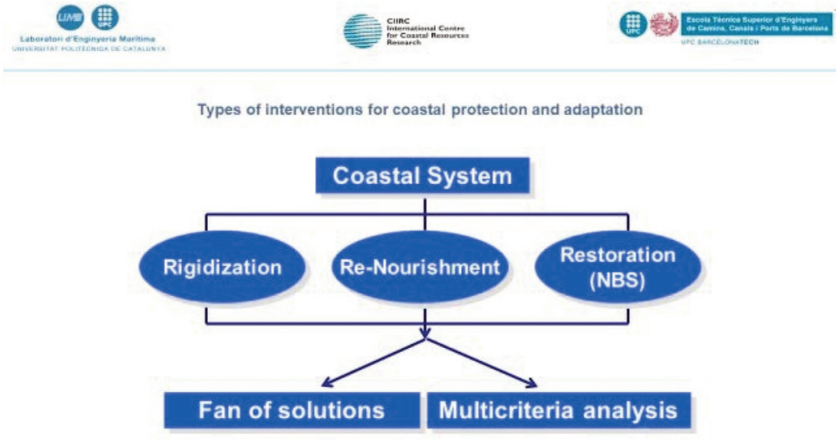
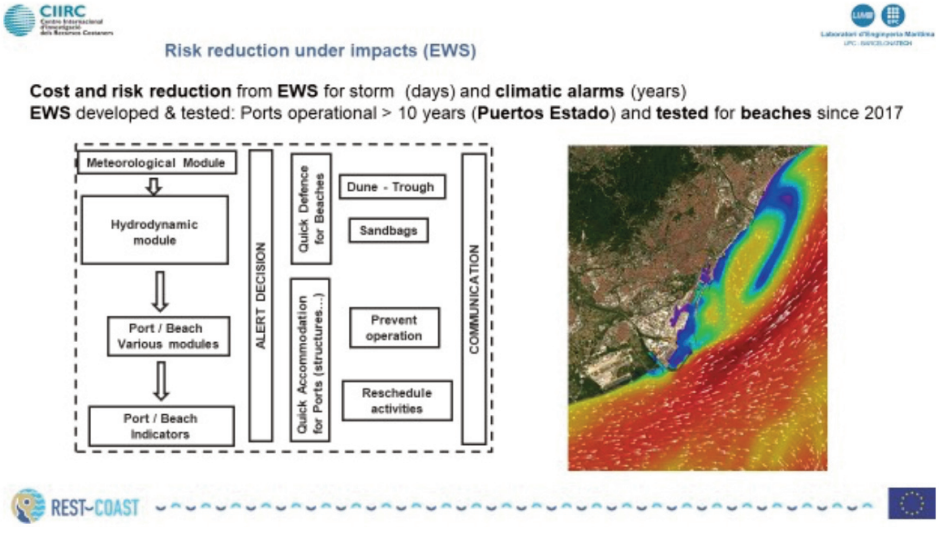


Figure 4: Illustration of rigid coastal protection by groynes and alongshore revetment for a stretch of heavily urbanised coast in the Spanish Mediterranean

For that purpose, the developed early warning system can also support the monitoring, the analyses, through hydraulic model tests or numerical simulations and the required integration for an integrated assessment of coastal risks, and the performance of the proposed or implemented coastal protection measures.

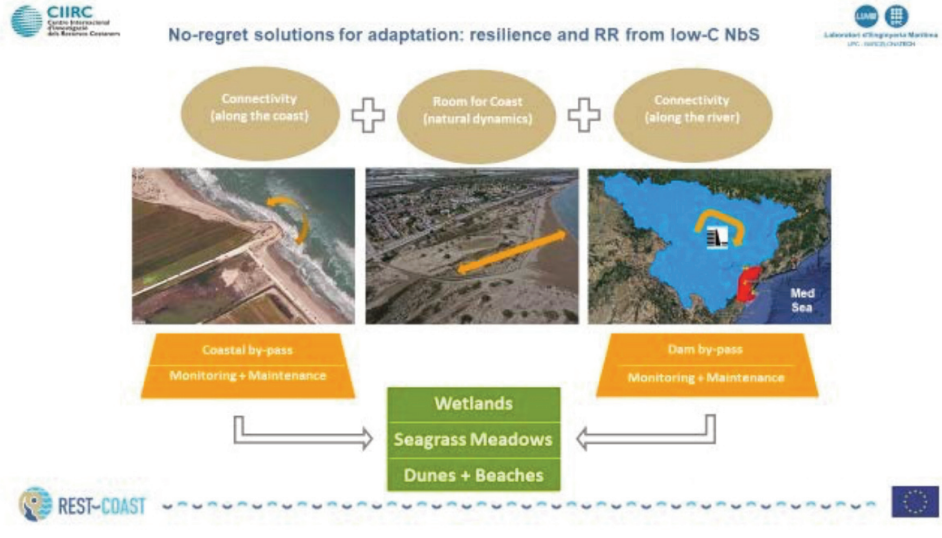
Figure 5: Illustration of soft coastal protection by artificial nourishment for a stretch of heavily urbanised coast in the Spanish Mediterranean

Figure 6: Schematic representation of an early warning system developed for the Catalan coast within the iCoast project. The image corresponds to the SAMOA system developed by Puertos del Estado with the support of the main Spanish Universities working in this field.



The gain in resilience due to a combination of Nature-based Solutions, that enhance connectivity, is schematised in Fig. 7. The below figure summarises the need for coastal and river connectivity together whilst allowing space for the coast to enable the natural resilience of coastal systems.

Figure 7: Summary diagram showing the importance of connectivity for coastal systems and river-to-coast systems, together with enough room for coastal processes to develop and enhance natural resilience



Ensuring the development of adaptation plans that are focused on the benefits of restoration within those plans is essential. These plans should combine advanced techniques for upscaling restoration, financial plans to ensure the implementation and maintenance, and supportive governance that helps to maintain those natural interventions since nature-based solutions require a longer time and space scale to deliver the expected benefits.

Increasing the resilience of coastal systems and making them resilient with solutions that have limited costs and carbon footprint, can be beneficial to the coastal adaptation to climate change. This way, adaptation becomes aligned with mitigation and therefore enhances the overall coastal sustainability.

Reference

A. SANCHEZ-ARCILLA, C. IBAÑEZ, V. GRACIA, L. GARROTE, I. CACERES, D. LOPEZ, J.M. DE LA PEÑA, N. CAIOLA, A. MUNNE, A. ESPANYA, A. IGLESIAS, A. ROVIRA, D.G. MARCO, and J.M. GRASSA, 2022, Nature based Solutions for Sediment Starved deltas. The Ebro case in the Spanish Mediterranean coast, https://doi.org/10.1142/9789811275135_0212