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PhD project: Resilience and sustainable use of Iberian west coast port infrastructures under climate challenges

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Summary: Ports have a significant impact on the economic activity in coastal areas and are linked with several port-related emissions sources of local pollution. The port activities and structures make the ports challenging to be inclusive and promote sustainable development with resilient infrastructure and innovation. The ports of Aveiro, Lisbon, Vigo and A Coruña Outer Port are considered in this work due to their location in different environments, which brings distinct climate challenges. Drawing on the above, this study is based on the conceptual analysis of historical, present and future climate, aiming to assess the climate change impact on port structures and the feasibility of new energy resources to reduce the ports carbon footprint. High-resolution hydrodynamic models (Delft3D, SWAN and XBeach) were developed to accurately research the impact of climate change in the ports' structures and assess the marine energy resources available. The energy resource assessment was performed by applying a Delphi method based on physical point of view indices to facilitate the classification of the viability of exploiting the hybrid wind-wave energy and wave energy resource. A study of the efficiency and cost of energy over the life-cycle of two wave energy devices was also performed. The risk of flooding at the port facilities for return periods of 10, 25 and 100 years was performed. In the case of the Outer Port of A Coruña, overtopping in extreme weather conditions was also studied through the development of a local operational model which constitutes a risk analysis tool. In general, conditions for the exploitation of wave and hybrid wind-wave energy will decrease by the end of the century due to the increase in energy variability. The risk factor will also increase due to the major frequency of extreme ocean waves. Despite this, the energy resource is classified as excellent along the NW coast where Aveiro and Lisbon Ports are located, and as outstanding in the NW extreme of the NW coast, close to Vigo and A Coruña Outer Ports. The flood pattern varies significantly according to the location of the ports. Lagoons and estuaries are more prone to floods. Ria de Vigo, makes the Vigo port resilient to floods. This resilience is more evident for the A Coruña Outer port, where no floods occurred due to the breakwater, which may cause overtopping under high energetic waves.

