

CE2COAST - Downscaling Climate and Ocean Change to Services: Thresholds and Opportunities

project summary

The rapid changes in Earth's climate disproportionately affect coastal environments compared to other parts of the global ocean. The development and implementation of long-term environmental strategies to combat these changes and mitigate their negative impacts on regional economies are necessary to ensure sustainable development in the future. Achieving this requires insights into the driving mechanisms behind these environmental changes. One of the tools traditionally used in this regard has been coupled Earth System Models (ESMs). However, their grid resolution has often been insufficient to enable predictions of sufficient quality to support regional management.

The European project CE2COAST focuses on downscaling ESM results for the coastal European seas by employing higher-resolution regional models (RCOMs) to evaluate long-term environmental pressure trends specific to each sea and assess the evolution of the ecological services these seas provide. The University of Liège's role in the project has been to assess the effect of regional pressures (e.g. warming, eutrophication, offshore wind farm construction) on ecosystems and associated services in the North Sea (e.g. primary production and carbon sequestration, including that from filter feeders at offshore artificial installations, such as wind farms). This evaluation was carried out using a coupled benthic-pelagic hydrodynamic-biogeochemical model calibrated for the North Sea, covering both the recent historical period (1993 – 2023) and the future projection (until the end of the XXI century) under the IPCC's "regional rivalry" Shared Socioeconomic Pathway scenario.

A comparison of model results between the ESM and the RCOM showed that the RCOM outperformed the ESM in capturing both spatial and temporal variability in sea surface temperature. The ability of the North Sea to sequester carbon is expected to be negatively impacted by rising water temperatures. At the same time, warming may create opportunities for certain species (e.g. blue mussels, macroalgae) to expand their spatial distribution northward. Primary production is not expected to change drastically, with reduced nutrient inputs from regional rivers partially offsetting the impact of warming on plankton reproduction. Bivalves fouling offshore wind farms have shown a significant contribution to regional carbon sequestration. However, further analysis will be conducted to account for the removal of hard substrates during wind farm decommissioning.

The various objectives of the project contribute valuable knowledge for addressing the Sustainable Development Goals.

Keywords: downscaling, ocean modelling, climate projection, North Sea, carbon sequestration, heat waves, offshore wind farms, blue mussels, macroalgae.