Modelling ocean acidification in marginal seas: the North Western European shelf case study

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Variability of carbonate chemistry in marginal seas is often high due to their exposure to several concurring stressors such as air-sea CO_2 flux, river discharges, high biological activity and benthic-pelagic interactions. All these combined processes also make it more challenging to quantify the impact of ocean acidification in these regions asthese processes can either exacerbate or mitigate the impact of the increasing atmospheric pCO_2. The coupled physical-ecosystem model POLCOMS-ERSEM has been recently improved to take into account most of these processes and therefore to give a more realistic description of the evolution of carbonate chemistry.

The model has been implemented in the North Western European shelf in two different set-ups: a hindcast (1970-2004), to assess present day spatial and temporal variability and trends presently occurring in the carbonate system, and climate forced (2080-2099 under the IPCC SRES-A1B scenario) to estimate long term impacts.

The hindcast has been validated against in situ data derived from the CANOBA dataset, and it proves to adequately simulate most of the variables of the carbonate system. The evaluated model shows a high spatial and temporal heterogeneity in the carbonate system, with recent trends of acidification ranging between -0.001 and -0.003 pH units per year and high inter-annual variability. Similarly, the climate run evidences how ocean acidification can vary between -0.15 and -0.35 pH units in the annual mean surface pH, with high seasonal and inter-annual variability. The model can also be used to attribute the contribution of the different processes driving the carbonate system.

This high variability can play a key role in defining the impact of ocean acidification on the biological compartment of the shelf sea ecosystem, we show how the interaction between warming, hydrodynamics and nutrient supply on one hand and the potential enhancement of photosynthesis under high CO_2 interact across the region.