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Physical processes mediating climate impacts in shelf sea ecosystems

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How global scale climate change might impact coastal and shelf seas is far from straightforward. A myriad of physical processes can potentially act as vectors transferring the larger scale oceanic and atmospheric variability and change to shelf sea physics, biogeochemistry and lower trophic level ecosystems. These act on a wide range of time scales, being strongly dependent on the prevailing conditions of an individual shelf sea basin. Examples of the physical processes include upper ocean warming, seasonal/permanent stratification, wind mixing, convective mixing, light climate, terrestrial input, circulation and ocean-shelf exchange. These potentially impact ecosystem processes such as primary production, plankton community structured, bloom timing, and mid-water production. However, different processes often act in a different sense and are not necessarily additive, leading to damping or amplification effects. During the MEECE project (www.meece.eu) we conducted a series of coordinated downscaled coupled physics-ecosystem model experiments to explore these issues. Here, we review the prevailing physical processes, contrasting five very different shelf sea regions: North Sea, Celtic seas, Baltic Sea, Black sea and Barents Sea, using results from three different model systems: POLCOMS-ERSEM, ECOSMO, BIMS-ECO. Using this ensemble of simulations, along with process sensitivity studies and multiple forcing studies, we are able to identify which physical processes are important in which region, and how they interact. This builds up a picture of contrasting vulnerability of these regions to different vectors of change.