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Modelling temporal and spatial dynamics of benthic fauna in North-West-European shelf seas

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Benthic zones of shallow shelf seas receive high amounts of organic material. Physical processes such as resuspension, as well as complex transformations mediated by diverse faunal and microbial communities, define fate of this material, which can be returned to the water column, reworked within sediments or ultimately buried. In recent years, numerical models of various complexity and serving different goals have been developed and applied in order to better understand and predict dynamics of benthic processes. ERSEM includes explicit parameterisations of several groups of benthic biota, which makes it particularly applicable for studies of benthic biodiversity, biological interactions within sediments and benthic-pelagic coupling. To assess model skill in reproducing temporal (inter-annual and seasonal) dynamics of major benthic macrofaunal groups, 1D model simulation results were compared with data from the Western Channel Observatory (WCO) benthic survey. The benthic model was forced with organic matter deposition rates inferred from observed phytoplankton abundance and model parameters were subsequently recalibrated. Based on model results and WCO data comparison, deposit-feeders exert clear seasonal variability, while for suspension-feeders inter-annual variability is more pronounced. Spatial distribution of benthic fauna was investigated using results of a full-scale NEMO-ERSEM hindcast simulation of the North-West European Shelf Seas area, covering the period of 1981-2014. Results suggest close relationship between spatial distribution of biomass of benthic faunal functional groups in relation to bathymetry, hydrodynamic conditions and organic matter supply. Our work highlights that it is feasible to construct, implement and validate models that explicitly include functional groups of benthic macrofauna. Moreover, the modelling approach delivers detailed information on benthic biogeochemistry and food-web at spatial and temporal scales that are unavailable through other sources but highly relevant to marine management, planning and policy.