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Modelling the inter-annual variability of carbon fluxes and budgets on the northwest European continental shelf

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Shelf seas can be regions of exceptionally high biological production because of the high levels of turbulence, nutrient recycling and riverine inputs. How this biological activity effects the exchange of carbon at the air-sea and shelf-ocean interfaces depends on the spatial and temporal relationship between photosynthesis and respiration (P-R), and the hydrodynamic transport mechanisms (turbulent mixing and circulation). Coupled hydrodynamic-ecosystems models provide an important tool for investigating variability in this system as they allow flux estimates and balanced budgets under a range of forcing scenarios. In this work, conducted for CASIX (Centre for observation of air-sea interactions and fluxes), we employ POLCOMS (Proudman Oceanographic Laboratory Coastal-Ocean Modelling System) coupled to ERSEM (European Regional Seas Ecosystem Model) in a 15 year simulation of the northwest European shelf (from 20W to 13E and 40N to 62N at ˜12km resolution;see www.metoffice.gov.uk/research/ncof/shelf/browser.html). The ERSEM model partitions the ecosystem into four phytoplankton, three zooplankton classes and a bacteria class, the growth, consumption and death of which are simulated by the fluxes of C, N, P and Si between these compartments and four detrital classes and a separate benthic model. Couple to the POLCOMS hydrodynamics simulations, this allows us to establish volume integrals of the pelagic organic and in-organic carbon budgets, being made up of advective, P-R, settling, and benthic respiration components, for the 15 years 1988 to 2002. Numerical experiments are used to investigate the sensitivity of the inter-annual variability of these fluxes to the external forcing, namely the meteorology, light climate and riverine inputs.