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North-west European shelf-ocean fluxes and budgets

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Exchanges between the North-East Atlantic and adjacent shelf have been considered as part of a global review by LOICZ and JGOFS (Continental Margin Task Team). Various physical exchanges amount to an average 2-3 x 10**6 m**3/s between ocean and shelf. Large contributions come from Iberian summer upwelling and especially associated filaments; further north from prevailing westerly winds; secondary circulation associated with a poleward current along most of the upper slope from Portugal to Scotland and Norway; slope current meanders and eddies; internal tides in several areas. Total tidal transports are larger but their reversal within a half-day tidal period makes the exchange ineffective.

LOICZ budgeting methodology for constituents in the water does not work well in this large area: inference of ocean-shelf exchange from salinity is uncertain; fresh-water inputs are relatively small; shelf areas are too large for homogeneity. Flux quantification, integrating over the complex processes and domains, needs numerical models.

To explore biogeochemical cycles and budgets, the POL Coastal Ocean Modelling System with the European Regional Seas Ecosystem Model (POLCOMS-ERSEM) has been applied: to the NW European shelf and adjacent Atlantic for 1988-2005 with ∼12km resolution and 42 levels. Overall production and respiration nearly balance; budgets are dominated by advection (including riverine and some atmospheric inputs of inorganic carbon); benthic contributions are significant (settling of organic carbon; respiration to inorganic forms – a source for the water column) but net burial is small.

The NW European shelf is found to be a net sink of atmospheric CO2: shelf-edge regions tend to be strong sinks; open stratified regions are neutral or weaker sinks; coastal regions are either sources or sinks. The circulation is vital in maintaining the “shelf sea pump”: tidally active shelf seas lack “export production” or burial; regions of weak or convergent dissolved inorganic carbon transport have very weak air-sea fluxes. There is no simple relation between productivity and air-sea CO2 flux.