Biogeochemical implications of potential future changes in shelf sea circulation

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Simulations of the NEMO-ERSEM Atlantic Margin Model (AMM7) of the NW European continental shelf driven by climate models out to 2100 have shown the potential for substantial changes to the ocean-shelf exchange and shelf scale circulation, drawing on simulations from the ROAM and RECICLE projects. In one realisation of future conditions the inflows into the North Sea through the Fair Isle channel and east of Shetland are found to substantially decrease, and the Shetland shelf current largely by-passes the North Sea. This significantly reduces the cyclonic North Sea circulation and shifts the balance between oceanic and terrestrial influence in this region, seen by a substantial decrease in salinity. In this presentation we consider what the biogeochemical implications of this might be. Using output from the ERSEM model in this simulation, we explore the spatial distribution of these changes and consequent changes in nutrient ratios, and other factors in play that may mitigate or aggravate this view (Holt et al 2016). We use the driving ¼° global NEMO model (Yool et al 2015) to explore whether other semi-enclosed shelf sea basins around the world might show similar behaviour under this future scenario. The long-term nutrient budgets in shelf-seas are set by the relative balance of oceanic and riverine inputs, augmented by atmospheric inputs and modulated by exchanges between benthic and pelagic systems. A simple mixing box estimate suggests that in the North Sea case, this change in circulation leads to an increase in nitrate by 15% and the flushing time increases from 1.8 years to 2.5 years; this potentially mitigates against the effects of a reduction in oceanic nutrient concentrations being advected on-shelf, which have previously been identified (Holt et al 2012).

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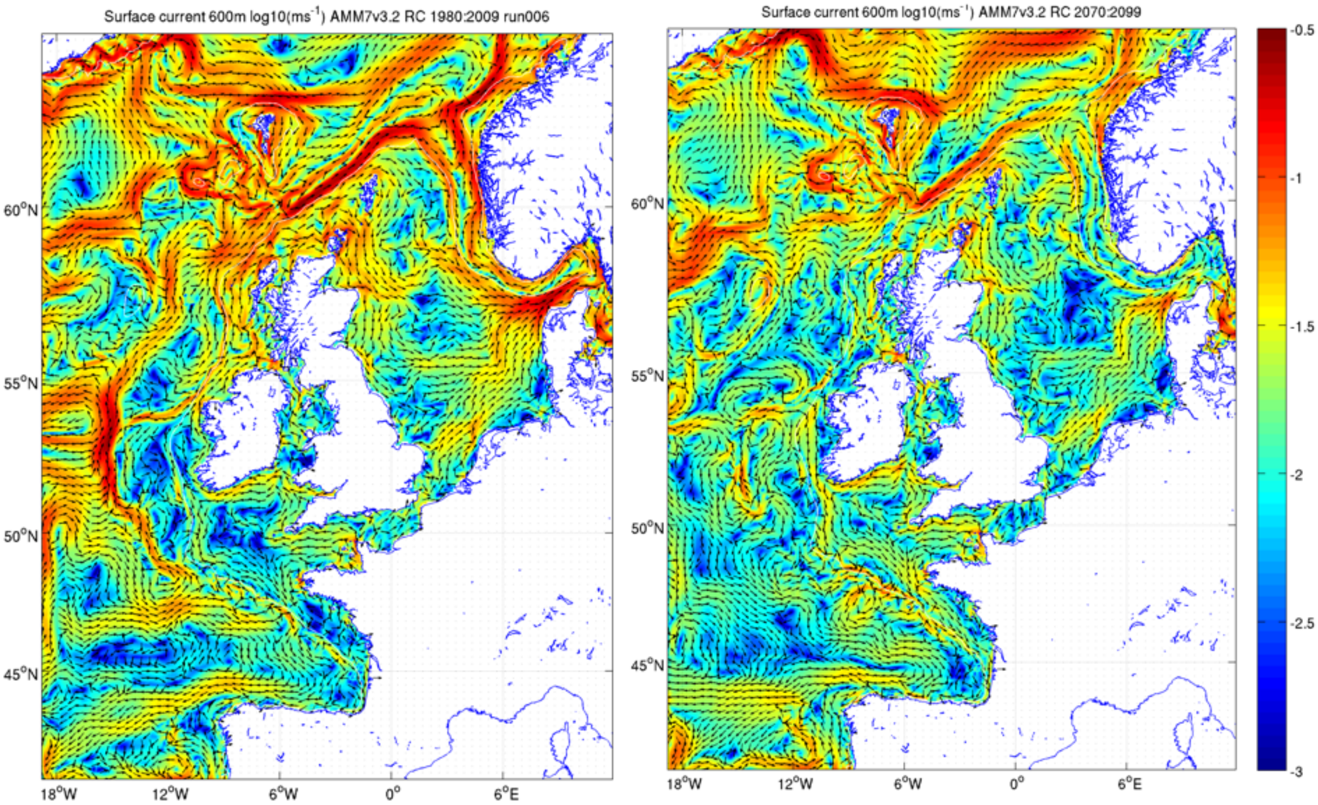
Surface current 600m log10(ms^-1) AMM7v3.2 RC 1980:2009 run006
Surface current 600m log10(ms^-1) AMM7v3.2 RC 2070:2099
60°N
55°N
50°N
45°N
18°W
12°W
6°W
0°
6°E
-0.5
-1
-1.5
-2
-2.5
-3