EGU22-4096
https://doi.org/10.5194/egusphere-egu22-4096
EGU General Assembly 2022

Oceanic and atmospheric drivers of interannual variability in shelf sea nitrate supply

Xiaoyan Wei[1], Joanne Hopkins[1], Marilena Oltmanns[2], Clare Johnson[3], and Mark Inall[3]
[1]National Oceanography Centre, Liverpool, UK
[2]National Oceanography Centre, Southampton, UK
[3]Scottish Association for Marine Science, Oban, UK

Strong interannual variability in pre-spring nitrate concentrations have been observed in shelf seas. These variations contribute to interannual variability in net primary production during the following spring and summer and thus also regulate the biological uptake of atmospheric carbon dioxide. Most of the nitrate required by shelf seas to maintain their high productivity is supplied from the open ocean. In this study, we investigate for the first time the importance of variability in the depth of winter mixing along the shelf edge and subsequent wind-driven across-shelf Ekman transport in setting the pre-spring nitrate concentrations across the NW European shelf.

Monthly EN4 temperature data is used to identify the maximum depth of winter mixing along the NW European shelf edge between 2000 and 2016 and monthly climatologies of nitrate from the World Ocean Atlas are used to estimate the resulting concentration of surface water nitrate. The wind-driven across-shelf nitrate transport for each sector of the shelf during late winter is then derived using wind velocities from ERA5. The deepest winter mixing close to the shelf edge occurs in the Rockall Trough. However, the largest interannual variations in winter mixed layer depth occur in the Bay of Biscay and Porcupine Sea Bight. The smallest variations are seen in the Faroe-Shetland channel. The estimated nitrate concentration near the shelf edge after winter mixing (i.e., recharge of surface water nitrate concentrations) shows strong interannual variability in the Bay of Biscay and Porcupine Sea Bight (interannual differences of 1- 2.5 mmol/m3), comparable to variability that has been observed on the shelf in this region. Further north, despite deeper winter mixing, there are much smaller interannual differences in surface water nitrate concentrations at the end of winter. This is because the vertical gradients in nitrate concentration within the range of maximum winter mixed layer depths are much weaker. Over the northern sectors of the NW European Shelf large interannual differences in wind-driven Ekman transport drive between 1 and 6 mmol N m-1 s-1 on-shelf during the winter. Further south wind-driven nitrate transport during the winter is typically off-shelf, weaker (typically 1 mmol N m-1 s-1), and much less variable between years.