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Interannual variability in larval dispersal in a shelf sea front region

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Shelf-sea fronts are formed by the interplay of heating by the sun, and mixing by the tides and the wind, and separate fully mixed and stratified oceanographic regions. The strong currents associated with a front play an important role in concentrating and transporting marine matter (larvae, pollutants etc.) but it has also been suggested they could act as a barrier between oceanographic regions, limiting the connectivity between populations on either side of the front and preventing the spread of invasive species.
Here, we use the example of the Celtic Sea Front which separates the Irish Sea from the Celtic Sea and compare the dispersal variability of larvae from four bivalve species with populations across the Irish Sea, Celtic Sea and Celtic Deep: one offshore species, the king scallop, Pecten Maximus, a near-coastal species, the common cockle, Cerastoderma edule, and the coastal species, Mytilus edulis and Mytilus galloprovincialis.
With current speeds from the regional AMM15 (Atlantic Margin Model, 1.5km) setup of NEMO v3.6, we simulate larval dispersal for the year 2014 using hourly data and a suite of depth distribution scenarios. As connectivity patterns are very similar using daily averaged velocities, in the next stage we investigate interannual variability using daily averaged velocities for the period 2006 to 2014.
We show that the front indeed represents a barrier to species crossing from the Celtic Sea and Celtic Deep into the Irish Sea; however, our work also highlights some key populations which can act as 'connectors' across the front. Furthermore, our results also indicate that the frontal system experiences large interannual variability which considerably alters transport pathways and population connectivity patterns from year to year. This bares implications in the light of future climate change where timing and strength of stratification is expected to be altered with stronger heating but also stormier conditions. Using a suite of shelf-scale future projections for the period up to 2100 we will briefly elaborate on potential future changes in shelf oceanography and their impacts on bivalve population dynamics.