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Shear dispersion and delayed propagation of temperature anomalies in the Nordic Seas

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The Nordic Seas is a relatively closed ocean area, situated in between the North Atlantic and the Arctic Ocean. It is an important connection between the two oceans and the main mediator of ocean heat and sea ice in and out of the Arctic. The route for northward ocean heat transport through the Nordic Seas is not, however, straightforward, but complicated by strong ocean bathymetric features, ocean dynamics and air-sea interaction.

The main path for northward heat transport in the Nordic Seas is in the eastern boundary current system. Due to the relatively weak stratification the currents are strongly steered by the bottom topography and the current cores are often found on the continental slope as intense cyclonic boundary currents. We use satellite altimetric sea surface height to analyze propagation of hydrographic anomalies along the path of the Norwegian Atlantic Slope Current (NwASC). We find propagating anomalies, related to low-frequency temperature variations, which are remarkably slow compared to the mean current speed. The estimated propagation speed of about 2 cm s^{-1}, which is in agreement with previous estimates, is nearly an order of magnitude smaller than the mean speed of the NwASC.

We introduce a conceptual tracer advection model, in which a thin high-speed current core interacts with an adjacent slow moving reservoir. This two-compartment representation of a classical shear-dispersion effect is able to quantitatively predict the low propagation speeds in the NwASC; the effective velocity of low-frequency temperature anomalies corresponds to a mean velocity across the entire Atlantic Water layer rather than the speed of the current core.