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Application of a Regional Thermohaline Inverse Method to observational reanalyses in an Arctic domain

Neill Mackay (1), Chris Wilson (1), and Jan Zika (2)

(1) National Oceanography Centre, Liverpool, United Kingdom (nmack@noc.ac.uk), (2) UNSW, Sydney, Australia (J.Zika@unsw.edu.au)

The Overturning in the Subpolar North Atlantic Program (OSNAP) aims to quantify the subpolar AMOC and its variability, including associated fluxes of heat and freshwater, using a combination of observations and models. In contribution OSNAP, we have developed a novel inverse method that diagnoses the interior mixing and advective flux at the boundary of an enclosed volume in the ocean. This Regional Thermohaline Inverse Method (RTHIM) operates in salinity-temperature (S-T) coordinates, a framework which allows us to gain insights into water mass transformation within the control volume and boundary fluxes of heat and freshwater. RTHIM will use multiple long-term observational datasets and reanalyses, including Argo, to provide a set of inverse estimates to be used to understand the sub-annual transport timescales sampled by the OSNAP array.

Having validated the method using the NEMO model, we apply RTHIM to an Arctic domain using temperature and salinity and surface flux data from reanalyses. We also use AVISO surface absolute geostrophic velocities which, combined with thermal wind balance, provide an initial estimate for the inflow and outflow through the boundary. We diagnose the interior mixing in S-T coordinates and the boundary flow, calculating the transformation rates of well-known water masses and the individual contributions to these rates from surface flux processes, boundary flow and interior mixing. Outputs from RTHIM are compared with similar metrics from previous literature on the region. The inverse solution reproduces an observed pattern of warm, saline Atlantic waters entering the Arctic volume and cooler, fresher waters leaving. Meanwhile, surface fluxes act to create waters at the extremes of the S-T distribution and interior mixing acts in opposition, creating water masses at intermediate S-T and destroying them at the extremes. RTHIM has the potential to be compared directly with the OSNAP array observations by defining a domain boundary which coincides with the arrays, and this comparison will be made when the analysed observations become available in summer 2017.