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On the connection between the sinking of water along the North Atlantic boundaries and the AMOC lower limb: a Lagrangian-based high-resolution model approach.

Juan-Manuel Sayol (1), Caroline A. Katsman (1), Nils Brüggemann (2), and Henk A. Dijkstra (3)

(1) Hydraulic Engineering, Faculty of Civil Engineering & Geosciences, Delft University of Technology, Delft, Netherlands (J.M.SayolEspana@tudelft.nl)), (2) Faculty of Mathematics, Informatics and Natural Sciences, University of Hamburg, Hamburg, Germany, (3) Institute for Marine and Atmospheric Research, Utrecht University, Utrecht, The Netherlands

Recent studies suggest that most of the sinking associated with the Atlantic Meridional Overturning Circulation (AMOC) occurs below the mixed layer depth in the vicinity of the subpolar North Atlantic boundaries. More process-oriented numerical studies indicate that this sinking depends on several factors; e.g. the bathymetric slope profile, the existence of along-shore and cross-shore density gradients and/or the position and structure of the boundary current, and is favored in those regions where slopes are steep and the along-shore and cross-shore density gradients are large. Also mesoscale eddies seem to play an active role for the sinking due to the occurrence of strong vertical velocities during their formation, or by modulating the horizontal density gradients through their active role in the exchange mass and heat properties between the interior and the margins of the basin. However, it still remains unclear how these sinking waters contribute to the lower limb of the AMOC.

To bring some light on this question we have tracked the water-masses that sink near the boundaries using a high resolution global ocean simulation. This simulation has been performed with the POP (Parallel Ocean Program) model and includes two years of daily data with a nominal spatial resolution of 0.1 degree at the Equator and 42 vertical z-levels in curvilinear coordinates. To isolate the ocean dynamics from high-frequency atmospheric events, wind, heat fluxes and river run-off are imposed as a repeated climatological annual cycle. Water-mass pathways have been computed by tracking a large set of passive particles deployed in a narrow band at a distance between 0 and 300 km to the coast, and below the mixed layer depth forward and backward in time. Based on this Lagrangian view of the circulation, we assess the preferred routes of the sinking waters, their properties (temperature, salinity, potential density) and how these characteristics change over time.