Inferring Advective Timescales and Overturning Pathways of the Deep Western Boundary Current in the North Atlantic through Labrador Sea Water Advection

Authors: Leah Chomiak, Igor Yashayaev, and Denis Volkov

The Subpolar North Atlantic plays a critical role in the formation of the cold, dense deep-water masses that drive the Atlantic Meridional Overturning Circulation (AMOC). Labrador Sea Water (LSW) is formed in the Labrador Sea and advected out predominantly via the Deep Western Boundary Current (DWBC). The DWBC is an essential component of the AMOC carrying cold and dense deep waters southward, flowing at depth along the continental shelf of the western Atlantic. Fifty years of hydrographic observations in the Labrador Sea have revealed considerable changes in the temperature, salinity, and density of LSW through extreme wintertime convective and freshening events. Here, we combine sustained hydrographic observations throughout the North Atlantic to investigate the signal propagation and advective timescale of LSW via the DWBC from the source region to the Tropical Atlantic through various methods. The onset of LSW classes with distinguishable cold, fresh pulses are observed to pass through all monitored locations, advecting at timescales that support a new plausible hydrographically-observed route of the DWBC – one that ventures into the central Atlantic via a recirculation pathway on timescales of approximately ten years prior to arriving at 26.5°N four years later. This alternate route is further supported through Argo-derived mid-depth circulation. Using these LSW convective signals as advective tracers along the DWBC permit the estimation of advective timescales from the Subpolar North Atlantic to the lower latitudes, shedding new light to multiple deep water advection pathways across the North Atlantic and the lower-limb of AMOC as a whole.