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Lagrangian pathways connecting the subtropical and subpolar gyres in the North Atlantic

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Our understanding of the ocean's meridional overturning circulation – a crucial component of our climate system – involves warm water moving poleward at the surface and cold water moving equatorward at depth. Such movement requires a meridional "throughput" from the cyclonic subpolar gyre to the anticyclonic subtropical gyre at depth; vice versa at the ocean surface. Not surprisingly, observed Lagrangian pathways, as well as those constructed from highly time-dependent model flow fields, depict throughputs that are not always manifest from Eulerian representations of the mean flow field in the North Atlantic, a basin with a multitude of high-latitude water masses that spread equatorward. Recent studies of the throughput in the North Atlantic have focused on Labrador Sea Water pathways using RAFOS float observations and simulated floats from an ocean circulation model. Here we extend these studies to explore the gyre-gyre throughput at the depth of the overflow waters and for the thermocline waters in the North Atlantic. Using observational subsurface floats and surface drifters and fifteen years of output from the 1/12° FLAME model to construct modeled pathways, we explore the extent to which the overflow waters are exported to the subtropics from the subpolar gyre within the Deep Western Boundary Current. Additionally, our analysis of the subtropical to subpolar throughput in the thermocline waters is focused on ascertaining the structure and strength of this throughput and the extent to which it can be measured from the observed surface drifter data set.