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Physical nutrient transport in the North Atlantic Subtropical Gyre

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Use of the helium-3 flux gauge to estimate the physically mediated flux of new nutrients to the euphotic zone of the North Atlantic subtropical gyre broadly suggests a pathway whereby inorganic nutrients that have been remineralized within the main thermocline may be returned to the seasonally accessible layer in the Sargasso Sea: the so-called "Nutrient Spiral" (Jenkins and Doney (2003), Glob. Biog. Cyc., 17(4), doi:1110.1029/2003GB002085.) The challenge, however, is identifying the exact mechanism whereby this occurs. One possible process is that of "obduction", whereby the combination of strong advection and rapidly deepening winter mixed layers result in the effective outcropping of substantial amounts of thermocline nutrients and tritiugenic helium-3. We present here a quantitative estimate based on hydrographic sections and geostrophic transports of the fluxes and transformations of both tritugenic helium-3 and nitrate within the basin, and attempt to relate these estimates to the specific shallow-water behaviors of these tracers, and their global and regional physical transports. An important constraint for these estimates lies in the evolving distributions of the transient tracers tritium and helium-3. We compare these results with other tracer-based estimates of new, net-community, and export production.