Abstract View

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Four Views of a Portion of the North Atlantic Subtropical Gyre

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ABSTRACT

Data from four cruises to the "β-triangle" centered at 27°N, 32°30′W were smoothed by fitting second-degree polynomials at each of about 30 different density surfaces. The density intervals were $\Delta\sigma_p$=0.3‰, corresponding to about 50 db intervals in pressure. From the polynomials, determination was made of central values, horizontal derivatives and Laplacians of the fields of pressure, salt, oxygen and dynamic height. In addition, maps of the fits and deviations of each nation from the smoothed fits were produced.

From the steady advective diffusive equation and the smoothed fits to the age oxygen and dynamic height fields, the lateral isopycnal diffusivity as estimated to be $K_H \sim 0.5 \times 10^3$ m^2 s^{-1}. Although the salt field was reasonably stable from cruise to cruise, the variability of the baroclinic velocity shear was found to be as large as the baroclinic shear itself. The maps suggest a wobble of the gyre. The standard deviation of the fluctuations at each nation from the smoothed fits, when normalized by the gradient $l' = s'/|\nabla S'|$ gives the mixing length of the horizontal turbulence. This was found to be ~ 80 km, presumably due to mesoscale turbulence. These fluctuations were all Found, with one exception, to be normally distributed, suggesting the suitability in the subtropical gyre of a Fickian gradient transport diffusion. The one notable exception to the normal distribution was the discovery at one out of 143 stations of relatively undiluted Mediterranean water. The anomaly of salinity was as large as 0.65‰ or 20 standard deviations. A crude estimate suggests that the flux divergence due to the anomaly is approximately an order of magnitude less than either the advective or diffusive flux divergence.

There is a range of densities over which horizontal gradients of potential vorticity are small or nearly indeterminate. This range of densities intersects the ocean surface where the wind stress curl produces downwelling at the base of the Ekman layer. Deep density surface that intersect farther north at upwelling latitudes have strong potential vorticity

gradients.