Abstract View

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Meso- to Large-Scale Structure of Subducting Water in the Subtropical Gyre of the Eastern North Atlantic Ocean

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ABSTRACT

As part of an observational study of ocean subduction, SeaSoar surveys were carried out following subducting water tagged by bobber floats during their deployment in the spring of 1991 and again in the fall of 1992 and spring of 1993. In the latter two cases, real-time tracking limitations made it difficult to accurately locate bobbers, so the focus was on SeaSoaring over a few of the floats that were deployed in the shallow, near-surface layer initially. A total of 13 surveys were made over the course of the experiment. They were designed to map the mesoscale (in the meteorological sense) or submesoscale, as the term is generally used in oceanography. In addition, opportunity was taken to acquire other hydrographic data collocated with the floats in order to fill in the gaps in the above temporal sampling. The density mode locally found in the northeastern part of the North Atlantic subtropical gyre is Madeira mode water, with a mode near a potential density of 26.5. Results indicate that following the bobber floats, mean potential temperature decreases in time from 18.7° to 18.0° C on this density surface, while the mean pressure of this surface increases from about 120 to 200 dbars. The latter, associated with the vertical sinking of density surfaces in the eastern part of the subtropical gyre, was expected on the basis of previous studies of subduction in this region, while the former was initially unexpected. Recent hydrographic climatologies of region, however, clearly show that a local maximum in temperature is found in the area just “downstream” of the late winter outcrop of this density surface, and this is substantiated with hydrographic data collected during the period of the subduction

experiment. Thus, it appears that mixing after initial formation of this water mass is essential in determining the water mass properties of the subducting water. Quantities such as potential vorticity (PV) display a different characteristic for change in the region: Initial layer thickness and mesoscale variability decrease substantially during the first few months, then do not change significantly except in concert with changes in latitude so as to make PV constant. Finally, the mesoscale variability for all quantities except potential vorticity, which is spatially uniform, does not support the authors' original hypothesis that variability would decay from that originally laid down when the late winter mode was formed. Rather, there appears to be a ready supply of eddy activity that maintains both the θ–S and pressure variability on density surfaces in the region, the former most likely deriving from the existing large-scale gradients found on this density surface.

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