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Wintertime Oceanic Convection in the Gulf Stream: looking beyond 1-D physics

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Convective cooling in the Gulf Stream (GS) is observed by shipboard SeaSoar and ADCP surveys in CLIMODE aboard the R/V Knorr in Feb/Mar 2007. Deepest mixed layers of Subtropical Mode, or Eighteen Degree Water (EDW) have been observed just south of the strong zonal flow of the GS in the Northern Sargasso Sea. While the formation of EDW might be viewed as a 1-D process away from the strong flow, here we examine the physics of convection within the strong flow, and in particular within the anticyclonic portion of the flow to the immediate south of the GS jet. In this region of strong vertical and lateral shear of the flow, signatures of vertical convection and ventilation are more evident using the Ertel Potential Vorticity (EPV) than vertical stability (N^2). Using observations projected in streamwise coordinates, evidence is presented showing that below the upper 100m, inertial or symmetric instabilities with EPV$<$0 are more frequent than those with gravitational instability: N^2 $<$0, due to both occasionally vanishing small values of the vertical component of absolute vorticity and to low Richardson numbers. It is strongly suggested that this region is the origin for deep, anticyclonic EDW eddies observed in the Sargasso Sea and that these non-1-D dynamics may be key to the overall formation of new EDW: and by implication, for all oceanic types of Subtropical Mode Water, which are invariably found equatorward of strong zonal currents.