WOODS HOLE OCEANOGRAPHIC INSTITUTION
Department of Physical Oceanography
Woods Hole, MA 02543

May 19, 1994

Dr. Steven Ramp
ONR Code 322ML
Ballston Towers One
800 N. Quincy St.
Arlington, VA 22217-5660

Dr. Alan Weinstein
ONR Code 322
Ballston Towers One
800 N. Quincy St.
Arlington, VA 22217-5660

Re: Final Report for ONR Grant #N00014-89-J-1056 and Contract #N00014-88-K-0612

Dear Alan and Steve:

This is the final report on my grants (one with N. Fofonoff) to analyze a CTD/XBT data set acquired in the Gulf Stream in late March of 1988. The major activity comprised an exhaustive description, analysis, and comparison of the two CTD sections at 68°W and 55°W. This work, which appeared in *JPO* in 1993, identified five distinct density layers, characterized by potential vorticity distributions and the degree to which potential density transport is conserved downstream. The important implication, particularly for modeling studies, is that five active layers and steep bottom topography are required to fully describe downstream evolution of the Gulf Stream as an open ocean eastward jet. Another interesting result, from a comparison of recently formed Eighteen Degree Water properties at the two sections, is that water parcels in the exposed surface layers experience downstream density and potential vorticity changes consistent with surface forcing.

A second project used 3 of the 6 XBT crossings of the Gulf Stream to synthesize the thermal structure of the Gulf Stream near 65°W, using a method earlier introduced by Hendry (1988). With temperature as a proxy for density, it was then possible to compute a potential vorticity section analytically and compare it with Hendry's model thermocline at 59°W. The model comparison identifies a significant downstream modification in the potential vorticity structure – namely the disappearance of a relative minimum at the axis near 350 dbar – which is consistent with observed Gulf Stream potential vorticity sections from 68°to 55°W. The change has implications for the longitudinal variability of the current's stability properties. The work was previewed in a 1992 issue of the community newsletter *SYNOPtician*, and a more complete article is in press at *JPO* (preprint enclosed).

Finally, the two CTD sections, all 6 of the XBT sections, and 5 CTD sections of R. Pickart's near Cape Hatteras, were used to examine baroclinic mass, momentum and kinetic energy fluxes of the Gulf Stream. This work was presented at the Fall 1992 AGU meeting, and a brief report is enclosed. The investigation concluded that the time varying canonical baroclinic Gulf Stream (characterized by its mass, momentum and kinetic energy fluxes) can be successfully modeled by a 1-1/2 layer inertial jet, and a method was proposed for monitoring the structure with a simple IES array. In addition, the analysis pointed out that station spacing of less than 10 km in the core of the current is required for accurate calculation of the fluxes, or alternatively, for accurately reproducing horizontal shear.

Besides the results that appeared in print, numerous AGU presentations and seminars were presented as the analysis progressed. Furthermore, other investigators have been able to use the data in analyzing complementary data sets, as well as folding it into historical data sets to extend temporal and spatial coverage. In addition, the data set was made available for class work here at Woods Hole, in which students learned computational techniques for analyzing observational datasets. It was a great experience (and still is) to participate in the SYNOP experiment, and have the opportunity to work within such a cooperative community. Although I currently have no funding for Gulf Stream work explicitly, I expect to keep abreast of progress and developments in this area, both theoretically and experimentally.

Sincerely yours,

Melinda Hall

Melinda M. Hall
Principal Investigator

cc: Steven Ramp (3), Alan Weinstein (3)
Robert Tanner (1)
Director, Naval Research Laboratory (6)
Defense Technical Information Center (12)