ATELIER « ÉQUILIBRE, LIMITES ET MÉLANGE DANS LE PROBLÈME CLIMATIQUE »
28–30 SEPTEMBRE 2011

WORKSHOP ON "BALANCE, BOUNDARIES AND MIXING IN THE CLIMATE PROBLEM"
SEPTEMBER 28–30, 2011

Loss of balance in a strong unforced front

T. Nagai *
tnagai@kaiyodai.ac.jp

A. Tandon †
atandon@umassd.edu

E. Kunze ‡
kunze@apl.washington.edu

A. Mahadevan §
amahadevan@whoi.edu

Observations in 2008 at the Kuroshio front showed banded structures in a geostrophic shear, which could be a signature of loss of balance and near-inertial waves radiating away from this front. We explore this hypothesis by non-hydrostatic and hydrostatic modeling of the strong Kuroshio front. The model is initialized by an observed hydrographic section from summer 2008, assumed to be in thermal wind balance. The unforced front goes baroclinically unstable to both mesoscale meanders and sub-mesoscale eddies and filaments. In addition, there is spontaneous generation of near inertial waves from the unstable front in bursts and at specific locations of the mesoscale meander, particularly east of the Kuroshio meander trough. Banded structures in horizontal divergence also signify near inertial wave generation. The variability in the strong Kuroshio current affects the wave frequency in an Eulerian description due to Doppler shifting, resulting in a broad band of frequencies (f to 3f). The associated wave energy fluxes show clockwise turning in the anticyclonic trapping regions as expected from interaction of near inertial waves with a baroclinic jet. The average internal wave flux magnitudes are higher during frontogenetic events. The radiated energy flux from the frontogenetic Kuroshio front trough in our unforced simulations is comparable to the canonical wind generated near inertial internal waves fluxes. We posit that frontogenesis along strong fronts can lead to a loss of cyclostrophic balance and radiation of IWs that provide a route for energy transfer to the ocean interior.

*Department of Ocean Sciences, Tokyo University of Marine Science and Technology, 4-5-7, Konan, Minato-ku, Tokyo, 108-8477, Japan.

†Department of Physics, University of Massachusetts Dartmouth, 285 Old Westport Rd, North Dartmouth, MA 02747, USA.

‡Department of Ocean Physics, Applied Physics Laboratory, University of Washington, 1013 NE 40th Street, Seattle, WA 98105-6698, USA.

§Department of Physical Oceanography, Woods Hole Oceanographic Institution, 266 Woods Hole Rd., MS# 29, Woods Hole, MA 02543-1050, USA.