Coastal Mixing

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LONG-TERM GOALS

We seek to understand the mechanisms of turbulence and mixing in shallow water sufficiently well to be able to specify useful parameterizations for coastal circulation models. We seek to understand the links between mixing rates, the circulation and productivity of the coastal ocean. We seek to develop the technology to make accurate Lagrangian measurement of ocean processes and the analysis techniques to use it.

OBJECTIVES

The short-term objective is to analyze mixing and circulation measurements made in the Oregon upwelling system during the summers of 2000 and 2001 and publish papers.

APPROACH

Neutrally buoyant Lagrangian floats were deployed on the Oregon Shelf during the summers of 2000 and 2001. The float motion measures water parcel trajectories. High frequency measurements along the float trajectory is used to infer mixing dynamics. Our primary task in FY06 was to publish completed analyses.

WORK COMPLETED

A*. D'Asaro, E. A., R.C. Lien, F. Henyey, 2005, High Frequency internal waves on the Oregon continental shelf**, ***in revision JPO. This paper describes the internal wave field on the Oregon shelf as measured by the floats. It took nearly a year in review at JPO and is now being revised/

B.* D'Asaro, E. A., 2006**, **Convection and the seeding of the North Atlantic bloom, *accepted, J. Marine Systems. This short paper results from the ONR supported Labrador Sea Convection Experiment. It is lost somewhere in the editorial process for a special issue of J. Marine Systems.

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Mixing on the Oregon Shelf -

Two new methods for estimating ocean mixing rates from an isopycnal float carrying a CTD have been developed and published (D'Asaro and Lien 2006, Lien and D'Asaro, 2005). These use vertical velocity and density measurements to estimate ε, the kinetic energy dissipation rate, and χ, the potential density dissipation rate, respectively, and compute diffusivity from these using standard methods.

The techniques have been applied to float data from the Oregon Shelf. The noise level of the χ technique was lower, so it was used for the analysis, with the ε technique used as a check. Multivariate linear analysis was used to determine the dependence of mixing in the main thermocline on the shelf on various factors. The results were:

- Mixing varies by a factor of 4 with the Spring/Neap tidal cycle, being higher at Spring
- Mixing varies by a factor of 4 with water depth, decreasing with water depth
- χ varies by a factor of 10 with N2, the stratification, increasing with N.
- Mixing probably varies with wind by a factor of 4, being stronger during upwelling

Taking these factors into account, the mean diffusivity on the shelf is 0.4-0.8 m2/s. Fig. 1 shows that there are also significant deviations from these relationships, i.e. "Hot Spots".

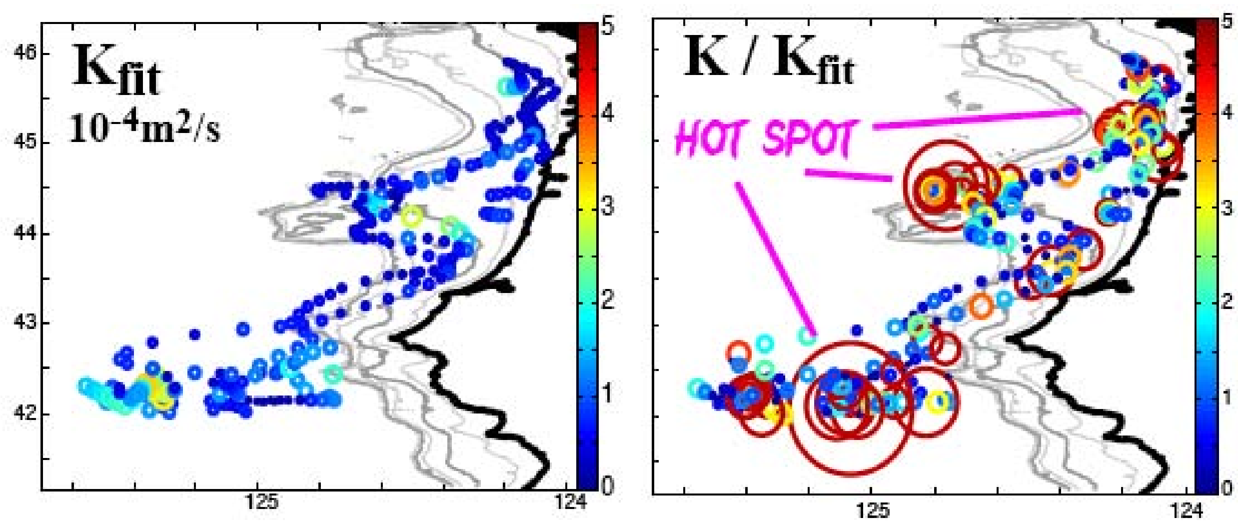

Fig. 1. Left: Diapycnal diffusivity from multivariate linear model evaluated at the float mixing data points. Right: Ratio of measured diffusivity to the model results. Clear hot spots are apparent, near the shelf break and in offshore eddies.

IMPACT/APPLICATIONS

The overall thrust of this work has been to develop a variety of complementary analysis techniques for characterizing internal waves and mixing rates using data from autonomous Lagrangian floats. These methods are rapidly maturing and will soon be able to provide long-term automous measurements of these quantities.

TRANSITIONS

None

RELATED PROJECTS

These floats are nearly identical to used in the CBLAST study of air-sea interaction in hurricanes and used in the NLIWI project in the South China Sea.

REFERENCES

Lien, R.C. and E. D'Asaro, 2005, Measurement of Turbulent Kinetic Energy Dissipation Rate with A Lagrangian Float, *J. Atmos. Ocean. Tech.,* Volume 23, Issue 7 (July 2006) pp. 964–976

D'Asaro, E., Lien, R.C. 2006, Measurement of Scalar Variance Dissipation from Lagrangian Floats, *J. Atmos. Ocean. Tech,* submitted

PUBLICATIONS

D'Asaro, E. A., R.C. Lien, F. Henyey**,** 2005, High Frequency internal waves on the Oregon continental shelf. *J. Phys. Oceanogr*, submitted

D'Asaro, E. A., 2006, Convection and the seeding of the North Atlantic bloom, accepted, *J. Marine Systems*