



Oceanography and Turbulence Measurements using AUVs

Michael Chernys and Manhar Dhanak
Center for Hydrodynamics and Physical Oceanography
Florida Atlantic University



Objectives:

- Develop custom AUV platforms and sensors systems for oceanographic observations in support of ocean modeling and prediction
- To study microstructure processes including, TKE dissipation, rate of mixing and bubble distribution in the water column over a range of scales, associated with air-sea interaction and the structure and variability of the Gulf Stream

AUV Platforms:

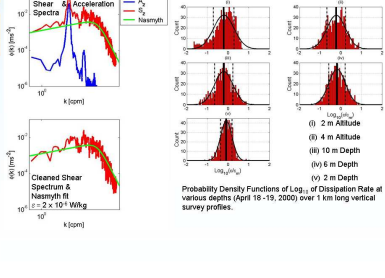
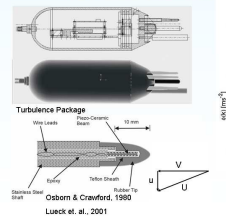
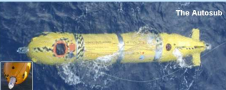
- The Ocean Explorer (FAU)
- The AutoSub (SOC, UK)
- The Odyssey III (Bluefin Robotics)

Missions to Date:

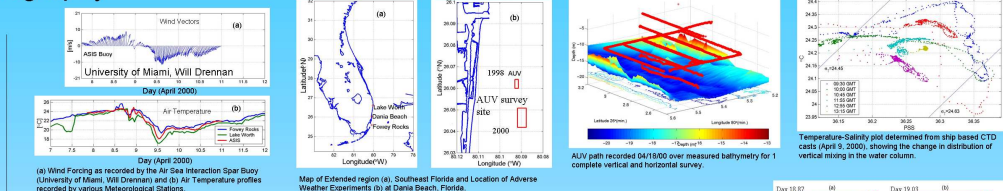
- Sargasso Sea Variability, Bermuda 7/98
- Mixed Layer Mission, Oban, Scotland 5/99
- Gulf Stream Edge Turbulence 7/99
- Straits of Sicily 6/00
- Adverse Weather Exp. 12/98, 4/00, & 1/01
- Thermocline Following Exp. 3/03

Sensor Systems:

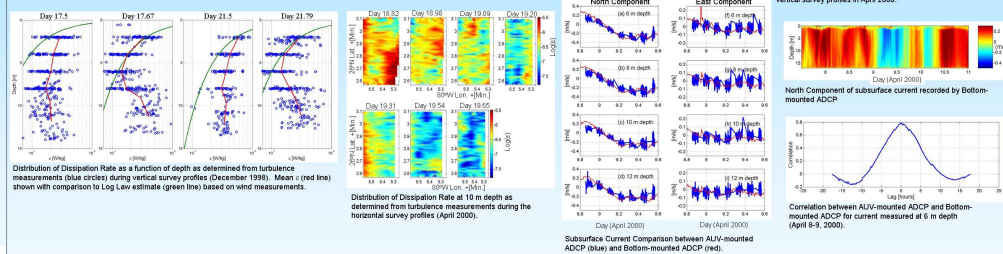
- Upward and downward looking ADCPs and a CTD package
- Small-scale Turbulence package, including two shear probes, micro-conductivity, micro-temperature and pressure sensors
- Bubble Sensor System, including a bubble resonator (Vagle and Farmer, 1998), two sidescan and vertical look 300kHz sonars



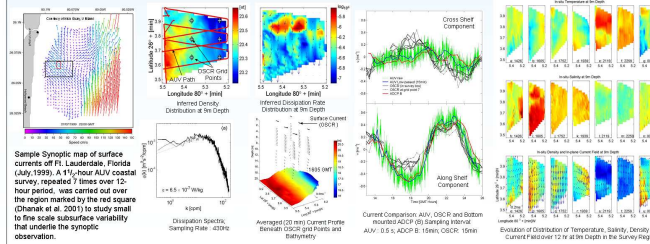
Adverse Weather Experiments



- Three cold atmospheric fronts, which passed through the region during December 14-22, 1998, April 8-9, 2000, and April 18-19, 2000, were studied.
- December 14-22, 1998: Contributions to dissipation rates from wind-induced shear evident within a factor as low as 1.5 during the front's presence and increasing with the passage of the front to a factor of 4 near the surface and increasing with increasing depth.
- April 8-9, 2000: Contributions to observed subsurface current can be attributed to wind effects.
- April 18-19, 2000: Dissipation rates showed a marked decrease with passage of the atmospheric front.
- Initial dissipation rate observations in good agreement with estimates based on the Log Law.
- Departure from the Log Law evident with passage of the front and increase in Buoyancy Flux.
- Dissipation rates vary at depth suggesting influence from interaction with the bottom boundary layer.



Small-Scale Subsurface Variability beneath OSCAR Grid Cells (July, 1999)



Summary

- An AUV provides a versatile platform for making quality measurement of small scale turbulence and meso-scale flows and developing maps of the measured variables.
- Continuous surveys of a of a large region (~20km²) or repeated surveys (~24 hrs) of a small region possible.
- Vehicle navigation good to within 50m per 1km of travel
- Onboard sensors measure six-degrees-of-freedom body motion
- Acoustic tracking provides vehicle position in deep waters
- Observations compare well with fixed instruments.

Acknowledgement: This research is supported by the Office of Naval Research under Program Managers Drs. Tom Curtin and Tom Swain.