FILIS (<u>FI</u>nescale <u>L</u>agrangian <u>I</u>nstrument <u>S</u>ystem) Deployments in CLIMODE

The FILIS represents a new deployment scheme for the Moored Profiler (MP) instrument in which the Profiler operates on a freely-drifting vertical tether. In CLIMODE, the FILIS will be deployed in conjunction with ASIS (the Air–Sea Interaction Spar).

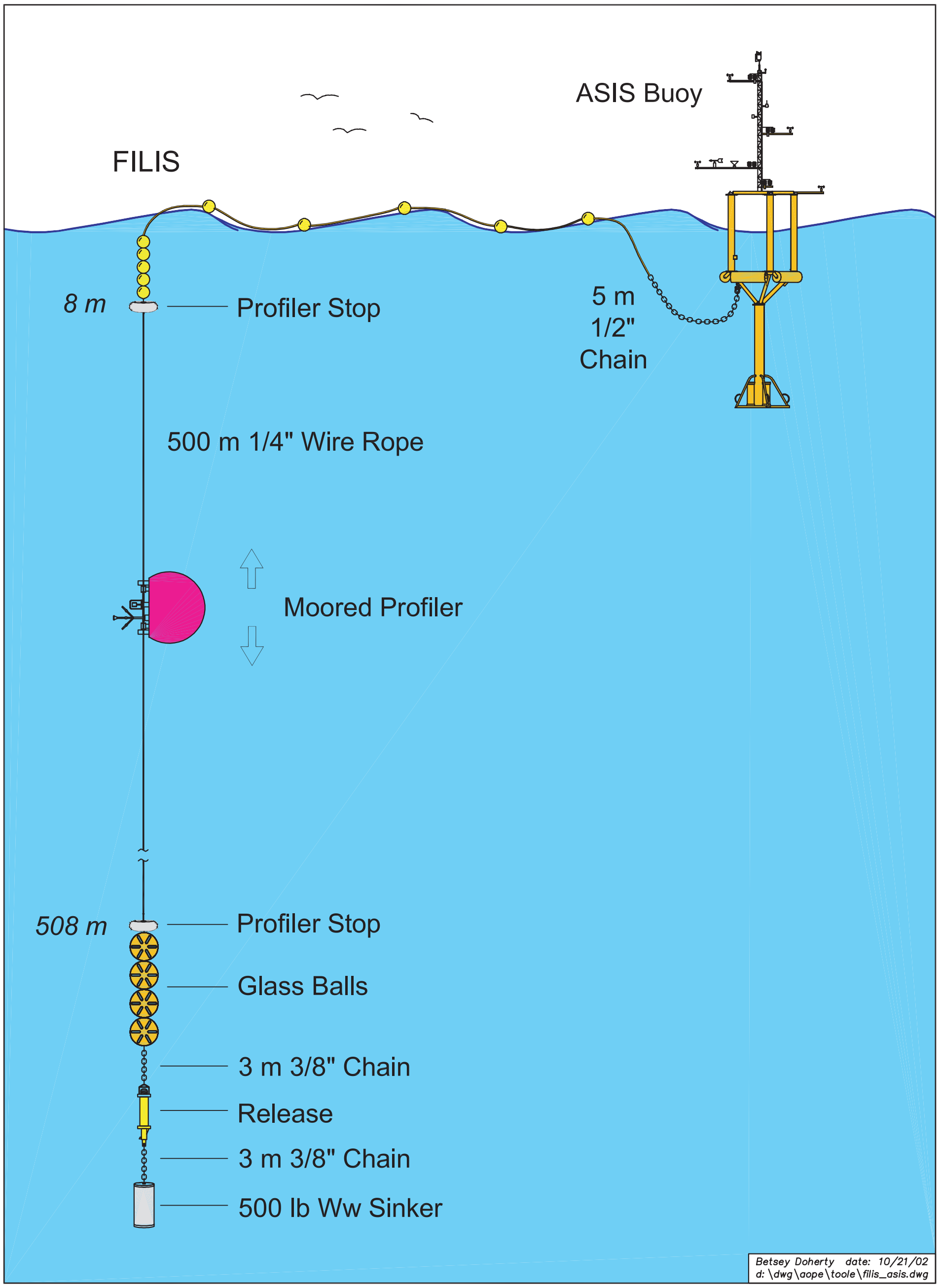

Figure 1. Schematic of the ASIS-FILIS to be deployed during CLIMODE

The MP was originally designed for use on subsurface moorings. For upper-ocean measurements, the FILIS drifting tether is designed to decouple the MP from surface wave heave. The system employs a string of glass ball floats and distributed buoyancy elements above the main floatation to maintain the profiling segment just below the surface. The tether segment that the MP travels along is a conventional plastic-jacketed wire rope, held vertical by a 500-pound ballast weight and the compensating array of buoyancy spheres. Buoyancy and ballast are adjusted so that the full tether arrangement is nearly neutral (a few pounds negative).

During CLIMODE, the ASIS-FILIS will be deployed for three nominal nine-day drifts. The first will occur during the February 2006 cruise; the other two will be on the two-leg February/ March 2007 expedition (one drift per leg). Finescale velocity, temperature and salinity observations in a Lagrangian framework obtained from FILIS in conjunction with the air–sea flux estimates from ASIS will help us better diagnose the physical processes driving stirring and mixing in the upper ocean.

A field trial of the FILIS system was carried out in November 2001 from the R/V *Weatherbird* offshore from Bermuda. The test was done in conjunction with a regularly scheduled cruise to deploy a drifting sediment trap as part of the Bermuda Atlantic Time Series program. One WHOI technician (Scott Worrilow) joined this trip to deploy and recover the FILIS on a not-to-interfere basis. The system was deployed late on November 8, 2001 with a sampling program calling for continuous profiling between 12 and 280 dbars beginning at 0000 GMT on the 9th. The instrument performed well, completing 69 profiles (approximately two profiles per hour) before recovery around 1200 GMT on the 10th. Leading up to the cruise, strong winds and large seas buffeted Bermuda, delaying the scheduled departure date by several days. During the trial, winds had relaxed to 10–15 knots out of the northwest supporting wind waves of around 1 m, on top of a 0.6 to 1.2 m swell.

Though short in duration, the FILIS field test demonstrated the viability of this instrument system for CLIMODE. The distributed buoyancy arrangement appeared to work well; tether heave was limited to less than 1 m peak to peak at swell period of 12 seconds with near total suppression of wind wave motions. The resultant wire motions were well within the operating capability of the Moored Profiler. Importantly, the peak vertical velocity of the tether did not greatly exceed the profile speed of the MP so that large vehicle reversals (and the sensor data anomalies that result) were rare. The tether also proved to be quite stiff, thanks to the large buoyancy and ballast weight at either end of the tether. Maximum wire angles from the vertical experienced during the trial were just four degrees.

The scalar data logged by the MP (temperature and salinity) were of good quality throughout the profiling depth interval and clearly documented diurnal stratification changes at the surface. Inertial oscillations in the surface mixed layer were clearly evident modest temporal and depth filtering.

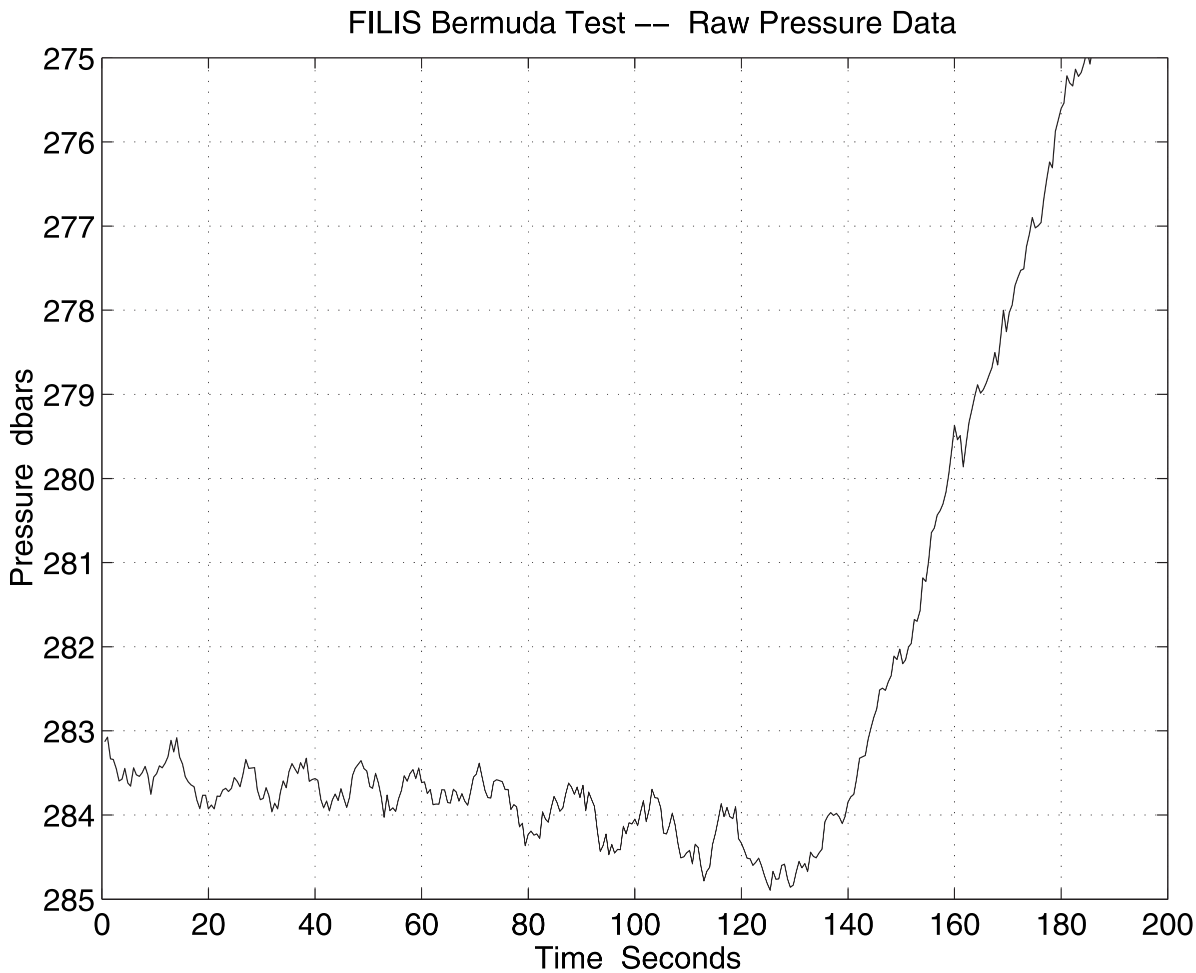

Figure 2. Time series of pressure measured by the FILIS Profiler at the start of one of its up-going cycles. The Profiler does a two-minute warmup at the start of each cycle before starting to move. The pressure oscillations seen during this period represent vertical heave of the tether by surface waves.

Individual velocity profile data exhibited significant “noise” in the upper 50–75 m due to surface wave motions. At greater depth this noise was much reduced and significant persistence of velocity features, profile to profile, were observed in the thermocline.

The 300-m length of profile wire used in this trial combined with the strong inertial shear between the surface layer and interior challenged the Lagrangian character of the FILIS. The instrument had a non-zero drift relative to the depth-average flow over the upper 300 m of the water column – the interval occupied by the FILIS tether. The depth-averaged relative velocity was approximately 8 cm/s for the ~2 hour period of the figure above; the zero-relative-velocity depth was ~60 m. Drag and windage of the surface float and tether biased the FILIS drift more with the waters of the surface mixed layer than the depth-average over the tether length. Relative motion between the FILIS and the waters in the seasonal pycnocline was responsible

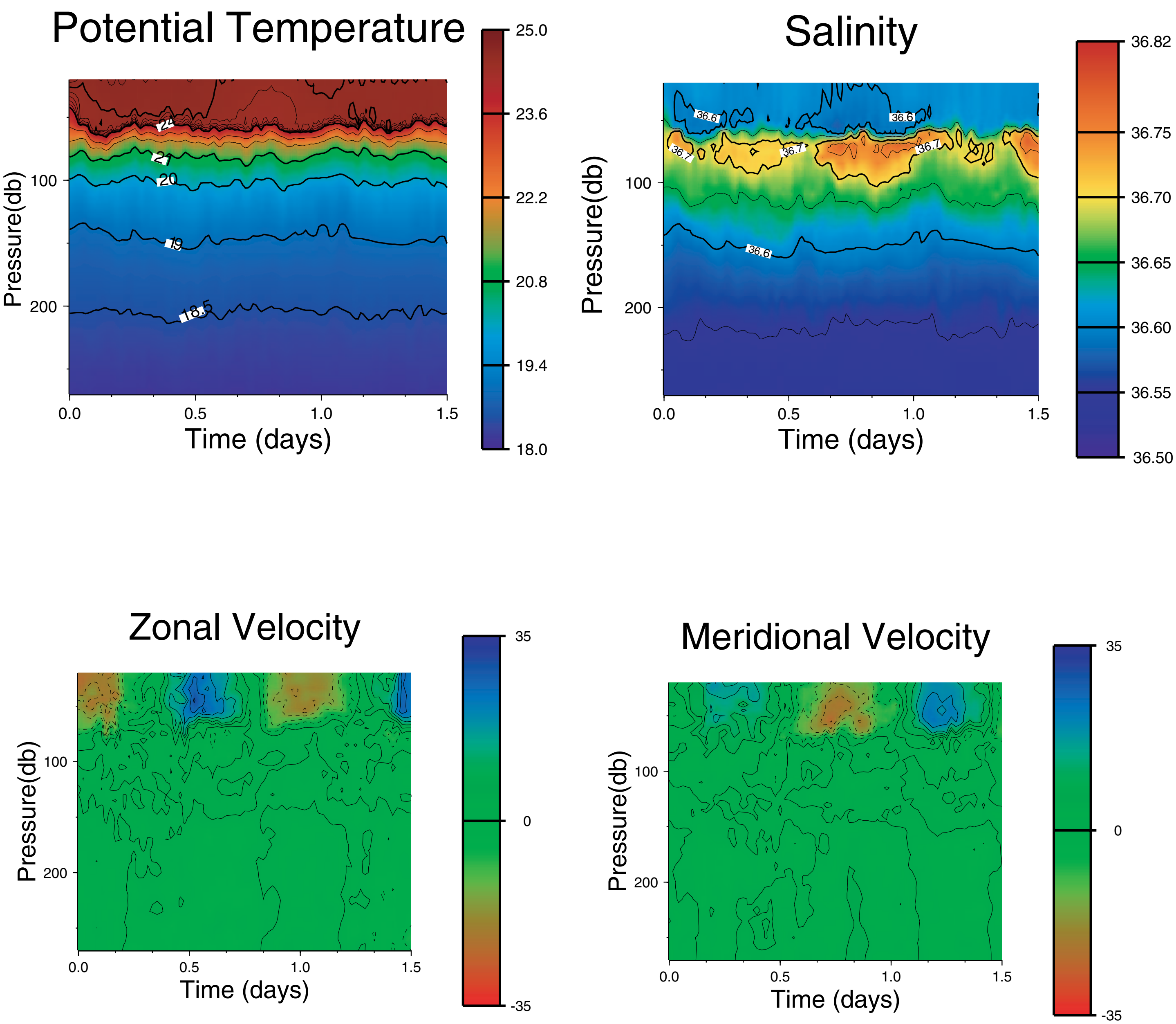

Figure 3. Depth-time contour plots of temperature (a), salinity (b), and the east and north components of velocity (c,d) relative to the FILIS.

for the salinity variations on inertial time scales seen in the depth-time contour plot above. But even in this strongly sheared environment, the FILIS platform reduced relative motion between the surface layer and sensors by a factor of two on inertial time scales as compared to a bottom-anchored mooring. Moreover, tracking on longer time scales (where the shear is much reduced) is greatly improved. Indeed, the mean relative velocities over the full test deployment period were less than 3 cm/s at all depths sampled. We expect similar performance during CLIMODE.

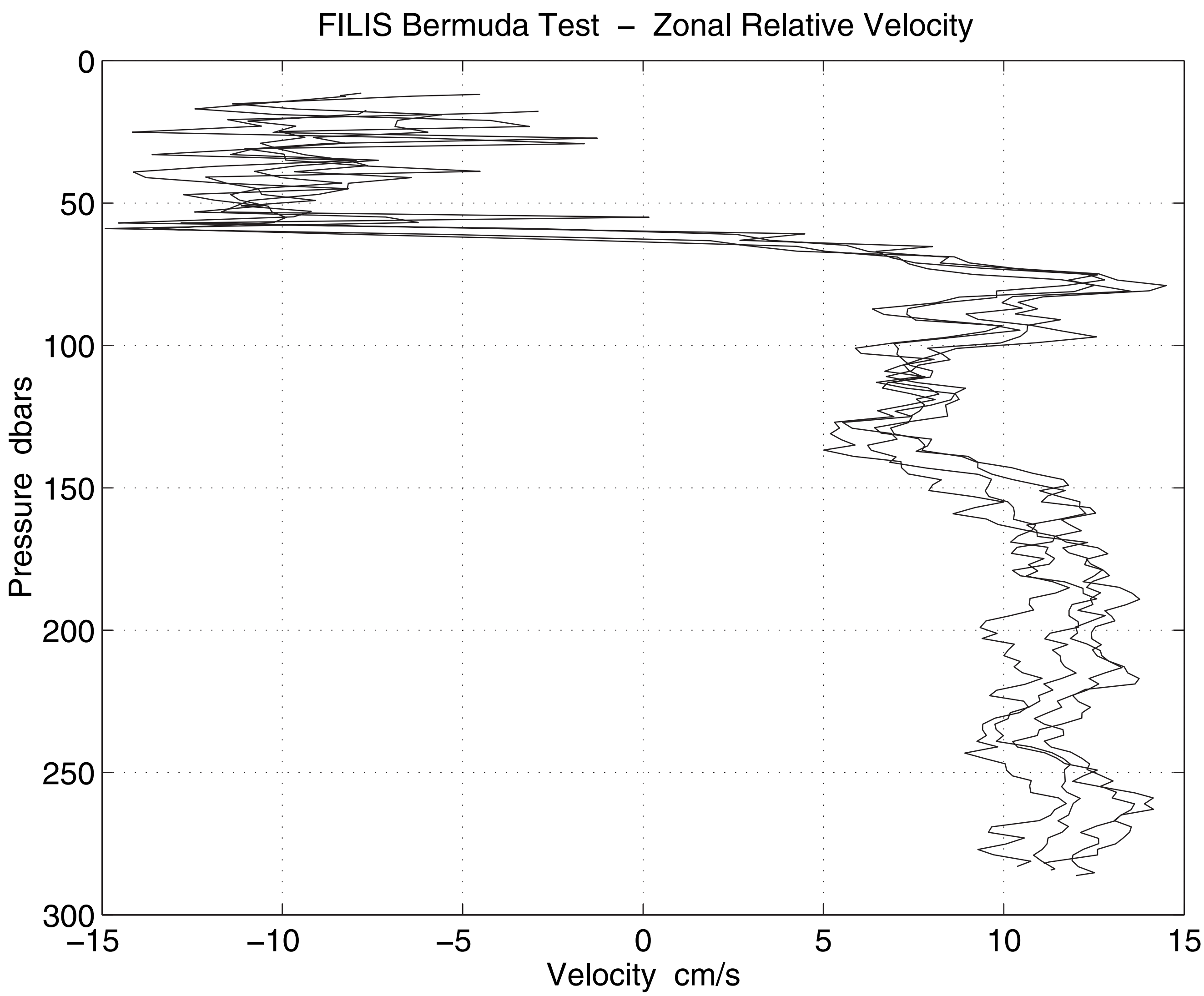

Figure 4. Overplot of successive east-component velocity profiles from FILIS. Time between each profile was approximately 30 minutes.