Fluid Mechanical Measurements within the Bottom Boundary Layer During Coastal Mixing and Optics

by

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Technical Report

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SECTION I. INTRODUCTION

To quantify and understand the role of vertical mixing processes in determining mid-shelf vertical structure of hydrographic and optical properties and particulate matter, the Office of Naval Research (ONR) funded a program called Coastal Mixing and Optics (CMO), which was conducted at a mid-shelf location in the Mid-Atlantic Bight, south of Martha’s Vineyard, Massachusetts. (See Figure 1.)

As part of the CMO program, a tall tripod, called 'SuperBASS', was equipped to collect a year-long, near-bottom time-series of velocity, temperature, salinity and pressure. The BASS sensors (Williams et al., 1987) were modified to measure absolute as well as differential acoustic travel time (Shaw et al., 1996, Voulgaris et al., 1997, and Trivett, 1991), to provide sound speed (a surrogate for temperature) and velocity in a single sample volume. Seven BASS velocity and travel time sensors were placed between 0.4 and 7 meters above bottom (mab). Three acoustic Doppler velocity (ADV) meters were mounted near the bottom-most BASS sensor at 0.3 meters above bottom. The ADV meters were separated horizontally to permit a technique for removing contamination by surface waves from estimates of turbulent Reynolds stress by differing measurements from spatially separated sensors (Trowbridge, 1998, Voulgaris et al., 1997, Shaw and Trowbridge, submitted). The sensors were sampled rapidly (25 Hz for the ADVs and 1.2 Hz for the other sensors) and the measurements were recorded by synchronized in-situ loggers. The tripod was deployed at the central CMO site on the New England shelf (Figure 2), at a water depth of approximately 70 m, in August 1996. It was recovered and redeployed, for the purpose of offloading data and changing batteries, in October 1996, January 1997, April 1997, and June 1997. The final recovery was in August 1997.

The primary objectives of this component of the project were (1) to obtain high-quality time-series measurements of velocity and temperature throughout a large fraction of the bottom boundary layer on the New England shelf; (2) to use the measurements to determine the vertical structure of the Reynolds-averaged velocity and temperature fields, to obtain direct covariance estimates of turbulent Reynolds stress and turbulent heat flux, and to obtain indirect inertial range estimates of dissipation rate for turbulent kinetic energy and temperature variance; (3) to test simplified budgets for turbulent kinetic energy and temperature variance; and (4) to test empirical flux-profile relationships for momentum and heat. These data will also be used (5) to test vertically integrated budgets for momentum and heat; (6) to compare estimates of flow characteristics obtained from velocity and temperature measurements with corresponding estimates obtained from a near-bottom tracer-release experiment and shipboard microstructure measurements; and (7) to understand the interaction between the dynamics of the boundary layer and the resuspension and transport of fine sediments.

The purpose of this report is to describe the SuperBASS instrumentation and deployments, to provide summaries of the data collected, and to document the processing, preliminary analysis and archival of the data collected for this component of the program.
Figure 2. The superBASS tripod was deployed at the central mooring site near the sub-surface mooring deployed by the Upper Ocean Processes Group (WHOI).
SECTION II. INSTRUMENTATION & DEPLOYMENTS

This section describes the instrumentation of the SuperBASS tripod together with the sampling schemes and details of each deployment. Figure 2 shows the SuperBASS deployment sites relative to each other and the subsurface mooring at the central site, which is described in Galbraith et al. (1997). The structural design of the tripod and issues relating to the tripod structure are discussed in detail in Williams et al. (1997). Schematics of the instrumentation are in Figures 3-5.

Central to the SuperBASS tripod was a tower of BASS acoustic current meter (ACM) sensors. The BASS electronics measure differenced travel time to provide three-dimensional velocity (Williams et al., 1987). The electronics were modified to also provide absolute travel time in counts along each direction of the C path of each BASS sensor. The average of the absolute travel times is proportional to sound speed and can be used to estimate temperature fluctuations at the same frequency as velocity. A Tattletale® Model 6 logger, Onset Computers¹, recorded data from the ACM and acoustic travel time (AT) sensors at 1.2 Hz. The BASS logger also recorded data collected using a counter (Williams and Fraenkel, 1995) which sampled data from the Seabird² temperature and conductivity pairs strapped to the legs at the bottom-most and top-most ACM sensors (pods) and from a ParoScientific³ pressure sensor, which was mounted on the platform at 4.2 mab. BASS logger data were recorded for approximately 29 minutes, beginning at 0:01, 0:31, 1:01, 2:01, 2:31, 3:01, 4:01, 4:31, 5:01 etc., providing 36 bursts per day. A compass and tilt meter were placed in the BASS. The luffer-line was aligned with path D (Figure 5). To convert velocity data for Deployment I, for example, to real world coordinates, we subtracted the magnetic deviation, 15.5°, from the compass reading, 50°. Therefore, path D was +34.5° from North True. Figure 6 shows the tripod orientation for each deployment. Compass readings were updated hourly, but recorded with each record. Tilt was updated with each record at 1.2 Hz. Each BASS ACM path was adjusted for a zero offset (Morrison et al., 1993). Each pre- or post-cruise zero determination was conducted by wrapping the sensor in stiff plastic sheets to minimize flow through the sensing volume and deploying the tripod alongside the dock at the Woods Hole Oceanographic Institution (WHOI), where flow is minimal. For Deployments IV & V, the bottom most BASS ACM & travel time sensors were not logged and eight YSI⁴ thermistors were placed alongside the BASS tower at the heights of the remaining pods.

Three SonTek®⁵ acoustic Doppler velocity (ADV) meters were mounted on each of the 5 cm x 15 cm channels at the base of the SuperBASS tripod. (See Figures 3-6.) These side-looking 10 MHz field probes were mounted facing upward and oriented such that each +x was along the channel toward the center of the tripod; y was perpendicular in the horizontal plane; and +z was downward. The serial numbers of each probe are given in Figure 5. Data were collected at 25 Hz for 9.6 minutes beginning at the top of each hour, providing 24 bursts per day. The three ADV sensors were logged using three separate Tattletale® Model 6F loggers. A master/slave relationship was used to synchronize the observations: the master logger checked the clock and at each designated start time (on the hour), the logger began sampling and simultaneously sent a sync pulse to signal the slave loggers to begin sampling and logging.

¹Onset Computer Corporation, Pocasset, MA 02559  
²Seabird Electronics, Inc., Bellevue, WA 98005  
³ParoScientific, Inc., Redmond, WA 98052  
⁴YSI Inc., Yellow Springs, OH 45387  
⁵SonTek, Inc., San Diego, CA 92121
Figure 3. The configuration for Deployments I - III is shown here. ADV_A, ADV_B & ADV_C were mounted on the channel adjacent to the cabled leg, the white leg and the blue leg, respectively. For Deployment V, no ADV sensors were deployed. For Deployments IV & V, the bottom-most BASS sensor was not recorded and the corresponding temperature/conductivity sensors were moved up to the height of the second BASS sensor, and the top-most conductivity was rotated to lie along-side the channel, rather than perpendicular to the channel, as shown here.
Figure 4. The configuration of ADV_A is shown below. ADV_B and ADV_C were similarly placed, but did not have the cabling above the sensors or the temperature/conductivity pair on the leg near the sensors. For Deployments IV & V, the temperature/conductivity pair were moved up to 0.55 m above the channel.

Figure 5. Top-view showing SuperBASS orientation with Serial Numbers of ADVs and ACM path orientation.
Deployment I: 8/18/96 - 9/27/96

Instrumentation:
Three ADV loggers sampled 9.6 minutes hourly at 25 Hz:
3 - ADV velocity sensors at 0.35 meters above bottom
The BASS logger recorded data at 840 msec intervals (1.2 Hz), sampling 3 half-hours every two hours:
7 - BASS (ACM) velocity sensors at (0.38, 0.72, 1.1, 2.2, 3.3, 5.4 & 7.0 mab)
7 - BASS travel-time sensors at the BASS ACM heights
2 - Seabird temperature, conductivity sensor pairs
   7.0 mab: SN/041482, SN/032101
   0.4 mab: SN/041425, SN/032100
1 - ParoScientific pressure sensor (SN/59118) at 4.2mab
1 - Compass, pitch & roll

Deployment Description: The tripod was deployed on August 18 at 14:31 GMT at approximately 40° 29.359’ N and 70° 30.281’ W. The tripod compass reading was 50° from magnetic north; pitch and roll was less than 1° with the standard deviation within each burst below 0.2°. Two hurricanes (Edouard and Hortense) passed over the deployment site during September. Due to a power supply failure, the ADV system failed on 9/1/96. Upon recovery, it was found that many guy wires had corroded and broken away from the BASS central tower. The structure was reassembled before redeployment.

Deployment II: 10/7/96 - 12/27/96

Instrumentation:
Same configuration as Deployment I, except the Seabird conductivity cell SN/041425 was replaced with SN/041481.

Deployment Description: The SuperBASS tripod was deployed at approximately the same site on October 7, 18:48 GMT, at 40° 29.42’ N, 70° 30.25’ W. The compass reading was 250° from magnetic north; pitch and roll was less than 1° with the standard deviation within each burst below 0.2°. Upon recovery of the tripod, it could be seen that the whole structure was covered with 1-2 cm of 'furry' growth. Both the ADV and BASS velocity and acoustic travel-time systems worked throughout the deployment, although after mid-November the data are noisy and the ADV correlation coefficients are primarily below the 70% threshold recommended by the manufacturer as the minimum for acceptable data. For reasons not fully understood, the counter failed on 10/16, after which there are no salinity, temperature or pressure data for Deployment II.

Deployment III: 1/6/97 - 4/9/97

Instrumentation:
(Same configuration as Deployment I).

Deployment Description: The tripod was deployed on 1/6/97, 8:16 GMT, at 40° 29.413’ N and 70° 30.222’ W. The BASS logger disk failed and data (including compass) were lost for this deployment. ADV records were oriented using comparisons with concurrently sampled moored data. The original conductivity cell (SN/041425) was replaced on the tripod at 0.4 mab.
Deployment IV: 4/17/97 - 6/10/97

*Instrumentation:*
The ADV sensors did not function during this deployment. The BASS logger recorded data at 850 m/sec\(^6\) intervals (1.2 Hz), sampling 3 half-hours every two hours:

- 6 - BASS (ACM) velocity sensors at 0.7, 1.1, 2.2, 3.3, 5.4 & 7.0 mab
- 6 - BASS travel-time sensors at BASS ACM heights
- 2 - Seabird temp, salinity sensors at 0.7 & 7 mab
  - 7.0 mab: SN/041482, SN/032101.
  - 0.7 mab: SN/041481, SN/032100.
- 1 - ParoScientific pressure sensor (SN/59118) at 4.2 mab
- 8 - YSI thermistors between 0.7 & 7 mab

*Deployment Description:* The tripod was deployed on 4/16/97, 23:40 GMT, at 40° 29.387' N, 70° 30.236' W. The compass reading was 82° from magnetic north, pitch was less than 1° with the standard deviation within each burst below 0.2°; and, the roll was approximately -1.4°. After the beginning of May, the observed pitch would intermittently spike to about -1°, with standard deviations approaching 1°. It is believed that these observations reflect problems with digitization of the tilt sensor, rather than shifting of the SuperBASS tripod. The bottom-most BASS pod (0.4 m) was disconnected to accommodate eight (8) YSI thermistors, which were attached to the BASS tower at the same height as each of the remaining BASS pods. The yellow and white ACM connectors (for pods 4 & 5) were switched; therefore, the ACM data stream (1:6) represented data from pod 2, 3, 5, 4, 6 and 7, respectively. The thermistor stream (1:8) represented data from YSI thermistors (11,12,14,13,15 to 18) and were mounted at 0.7, 1.1, 2.18, 2.2, 3.3, 5.4, 5.4 and 7.0 mab. No ADV data were recorded during this deployment, due to a broken pin on the master data logger. The BASS clock had gained 5 seconds by the recovery date (6/10/97). The upper tower was bent, most likely during recovery.

Deployment V: 6/16/97 - 8/14/97

*Instrumentation:*
The ADV sensors were not deployed. The BASS logger and instrumentation was the same as Deployment IV, with the following exception: the Seabird sensors at 0.7 mab were SN/041425, SN/032100.

*Deployment Description:* The tripod was deployed on 6/16/97, 10:15 GMT, at 40° 29.411' N, 70° 30.228' W. The compass reading was 97° from magnetic north; roll was about 1.4°; and pitch was less than 1° with the standard deviation within each burst below 0.2°. The digitization problem in the pitch, as described in Deployment IV, persisted during Deployment V. The BASS clock had gained 5 seconds by the recovery date (8/14/97). The bottom-most Seabird temperature sensor failed and the pressure and Seabird conductivity cells also appear to be corrupted. The YSI data stream (1:7) represents data from YSI thermistors (11:18) at 0.7, 1.1, 2.18, 2.2, 3.3, 5.4 and 7.0 mab, respectively. The eighth YSI thermistor, which was also at 7.0 mab, failed during Deployment V.

\(^6\)The sampling interval was increased to accommodate the longer data stream.
Figure 6. Schematics relating the instrument frame to world coordinates for each deployment.
SECTION III. DATA PROCESSING

This section describes the steps which were taken in processing the data from the SuperBASS tripod.

Due to BASS logger disk I/O problems, there are periods during Deployments I & II, when some of the bursts were truncated, causing loss of up to 1-2 minutes of the half-hour burst at the end of those records. (See Figure 7.) Therefore, the user must be aware of changing record lengths in the BASS logger data.

![Figure 7](image)

**Figure 7.** Data loss from faulty disk writes during Deployments I & II. The disk was replaced and the problem did not persist in Deployments IV & V.

**BASS Velocity**

BASS velocity data were converted to meters per second, using 2.4 m/s per 32768 counts, and zeros were subtracted from each path. Table 1 provides a summary of the pre- and post-cruise zeros taken from the WHOI dock, along with the actual zeros used for each deployment. At times, the pre- and post-cruise zeros differed. To determine the best zero adjustment, it was assumed that in situ vertical velocity from the D and B paths should be close to the vertical velocity from the C and A paths and both should be centered around zero. Some paths drifted throughout the experiment and were reconstructed when possible. The remaining uncertainties in the zero drift problem are documented in the plots of vertical velocity in Section IV. For Deployment V, the pre-cruise and post-cruise zeros were significantly different and for that deployment we assumed a circular tidal ellipse and that the mean vertical velocity was zero.
Table 1. BASS ACM zeros (m/s) from pre- and post-cruise tests along with values used in processing

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<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.006</td>
<td>0.014</td>
<td>0.002</td>
<td>-0.015</td>
</tr>
<tr>
<td>22</td>
<td>0.031</td>
<td>0.030</td>
<td>*</td>
<td>0.031</td>
<td>0.015</td>
<td>0.012</td>
<td>-0.001</td>
<td>-0.008</td>
<td>-0.007</td>
</tr>
<tr>
<td>23</td>
<td>-0.001</td>
<td>-0.001</td>
<td>0.001</td>
<td>-0.001</td>
<td>-0.001</td>
<td>*</td>
<td>0.002</td>
<td>-0.006</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>-0.007</td>
<td>-0.007</td>
<td>-0.005</td>
<td>-0.008</td>
<td>-0.007</td>
<td>-0.003</td>
<td>-0.008</td>
<td>0.005</td>
<td>-0.009</td>
</tr>
<tr>
<td>Pod 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>-0.001</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.007</td>
<td>0.011</td>
<td>0.039</td>
<td>0.007</td>
</tr>
<tr>
<td>26</td>
<td>0.001</td>
<td>-0.000</td>
<td>-0.012</td>
<td>-0.011</td>
<td>-0.011</td>
<td>0.008</td>
<td>*</td>
<td>-0.038</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>0.001</td>
<td>0.000</td>
<td>0.002</td>
<td>0.007</td>
<td>0.007</td>
<td>-0.003</td>
<td>*</td>
<td>-0.008</td>
<td>-0.008</td>
</tr>
<tr>
<td>28</td>
<td>0.004</td>
<td>0.008</td>
<td>0.007</td>
<td>-0.003</td>
<td>-0.003</td>
<td>0.000</td>
<td>-0.003</td>
<td>-0.017</td>
<td>-0.002</td>
</tr>
</tbody>
</table>

* indicates acoustic paths rejected during analysis because of low quality and then reconstructed from the remaining three paths.
Velocities were converted from the instrument frame to real world coordinates (Figure 6) using the compass which was mounted in the logger. Points which were more than four times the burst standard deviation away from the burst average were replaced with NaN's, usually accounting for less than 1% of the data.

Bottom orbital velocities within each burst were computed as the square-root of the sum of the variance of each component of the horizontal velocity, which represents wave induced velocity.

Half-hour burst averaged estimates of stress were computed using a wave filtering technique (Shaw and Trowbridge, in press) developed to remove the waves from the spectral estimates by differencing pairs of sensors. For Deployments I and II, sensors 1 through 7 were paired with sensors 4, 5, 6, 1, 2, 3, 4, respectively. For Deployment IV, sensors 2 through 7 were paired with sensors 5, 6, 7, 2, 3, 4. For Deployment V, since sensor 7 failed at the beginning of the deployment, sensors 2 through 7 were paired with sensors 5, 6, 2, 2, 3, 4. The stress estimates were derived from the filtered estimates of covariance, \( \text{cov}(\Delta U, W) \).

Dissipation rates for turbulent kinetic energy and sound speed variance, \( \varepsilon \) and \( \lambda \), were corrected for spatial filtering, temporal aliasing and noise floor (Shaw et al., 2001). The inertial sub-range model fits were limited at low frequencies by large surface wave peaks below 0.2 Hz. Dissipation from each of the four acoustic paths was computed; cleaned up by removing any points where there was an imaginary component (indicating a negative slope in the inertial sub-range) and any points greater than \( 5 \times 10^{-5} \) (outliers); and, then, the four paths were averaged to provide one estimate per sensor.

Sound speed flux, \( \langle c'w' \rangle \), was estimated directly using the eddy correlation technique. Because of problems with contamination from internal waves (Shaw et al., 2001), the flux estimates were also made using a technique involving time derivatives. The flux estimates from the time derivatives were empirically corrected to match the original estimates by fitting the two estimates during times when there were no internal waves. This quantity is denoted \( \langle c_t'w_t' \rangle/\omega^2 \).

Flow disturbance from the tripod legs was apparent when the angle of flow was plotted with the normalized variance in horizontal acceleration (Shaw et al., 2001). To detect the wake, a quantity was computed from each burst by taking the square root of the sum of the variances of each component of the horizontal acceleration at each sensor. This quantity was then normalized by dividing each estimate by the same quantity averaged over the bottom three sensors, which were assumed to be well away from the tripod legs. In Figures 8 - 11, black points identify data flagged bad by assuming a cutoff of 1.5 in the normalized variances. This affected a Gaussian shaped histogram between 0.5 and 1.5, producing the following percentages of data loss:

<table>
<thead>
<tr>
<th>Sensor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>meters from leg:</td>
<td>2.3</td>
<td>2.2</td>
<td>2.0</td>
<td>1.8</td>
<td>1.4</td>
<td>0.8</td>
<td>0.3</td>
</tr>
<tr>
<td>Deployment I:</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
<td>2.4</td>
<td>7.3</td>
<td>25.7</td>
<td>40.9</td>
</tr>
<tr>
<td>Deployment II:</td>
<td>5.2</td>
<td>5.3</td>
<td>2.4</td>
<td>8.1</td>
<td>24</td>
<td>18.9</td>
<td>38.8</td>
</tr>
<tr>
<td>Deployment IV:</td>
<td>0</td>
<td>0.1</td>
<td>0.3</td>
<td>3.5</td>
<td>12.3</td>
<td>16.7</td>
<td>30.5</td>
</tr>
<tr>
<td>Deployment V:</td>
<td>0</td>
<td>0</td>
<td>26.2</td>
<td>6</td>
<td>35</td>
<td>16.6</td>
<td></td>
</tr>
</tbody>
</table>
Figure 8. Deployment I: Measure of flow disturbance from legs.
Figure 9. Deployment II: Measure of flow disturbance from legs

Deployment II: Horizontal Flow (m/s) at 3.3 mab

Angle of Flow (degrees) – 0 is Eastward, 90 is Northward
Figure 10. Deployment IV: Measure of flow disturbance from legs

Sensor Height (m)

Deployment IV: Horizontal Flow (m/s) at 3.3 mab

Angle of Flow (degrees) – 0 is Eastward, 90 is Northward
Figure 11. Deployment V: Measure of flow disturbance from legs

Deployment V: Horizontal Flow (m/s) at 3.3 mab

Angle of Flow (degrees) – 0 is Eastward, 90 is Northward
ADV Velocity

All ADV records were truncated to 14400 points. The velocity data were recorded as 0.1 mm/s in the x, y and z instrument coordinate system. These data were unpacked and converted to north, east and upward components. For Deployments I & II, rotations to world coordinates were based on the relationship of the ADVs with the instrument frame and the BASS compass. For Deployment III, there were no data from the BASS, so data were converted by comparing horizontal variances of these data to the data from the VMCM 10 meters above bottom at the central mooring site. For verification, the technique was applied to the data for Deployments I & II, when the tripod orientation was known. A summary follows:

During Deployment I, the orientation of the principal axes were:
\[
\text{ADV}_a = 51.1^\circ; \text{ADV}_b = 40.0^\circ, \text{ADV}_c = 38.7^\circ \quad (\text{Average ADV} = 43.3^\circ)
\]
\[
\text{VMCM}, \text{at 10 mab} = 47.4^\circ
\]

During Deployment II:
\[
\text{ADV}_a = 66.6^\circ, \text{ADV}_b = 63.7^\circ, \text{ADV}_c = 58.6^\circ \quad (\text{Average ADV} = 63.0^\circ)
\]
\[
\text{VMCM at 10 mab} = 60.8^\circ
\]

During Deployment III (after applying a 303.5° rotation for the ADVs):
\[
\text{ADV}_a = 57.8^\circ, \text{ADV}_b = 64.8^\circ, \text{ADV}_c = 65.9^\circ \quad (\text{Average ADV} = 62.8^\circ)
\]
\[
\text{VMCM at 10 mab} = 59.9^\circ
\]

A quality index (between 0 & 10) was defined as the average correlation coefficient from the three radial beams of the sensor divided by ten and then rounded to the nearest integer. Values greater than 7 denote good data. This parameter was not used in processing the data. Data which were four standard deviations away from the mean were replaced by linear interpolation of the surrounding points. More than 99% of the time fewer than 2% were removed. During the remaining 1% of the time, less than 10% of the data were removed as outliers.

As with the BASS velocity data, bottom orbital velocities within each burst were computed as the square-root of the sum of the square of each component of the horizontal velocity minus its burst average.

Estimates of stress and dissipation were computed from the ADV measurements, by using the differencing procedure described by Shaw and Trowbridge (in press) for stress and the procedure described by Shaw et al. (2001) for dissipation. As seen in Figures 12 - 13, flow distortion along the channel and over the processing units caused apparent over-estimates of these parameters and time series are not included in Section IV.
Figure 12. Deployment I

Figure 13. Deployment II

\[ m = 1.1 \]
\[ R^2 = 0.88 \]

\[ m = 1.1 \]
\[ R^2 = 0.92 \]

\[ m = 1.4 \]
\[ R^2 = 0.68 \]

\[ m = 1.6 \]
\[ R^2 = 0.72 \]

\[ m = 2.2 \]
\[ R^2 = 0.66 \]

\[ m = 1.6 \]
\[ R^2 = 0.39 \]
Pressure

Pressure counts were converted to psia using the calibration from ParoScientific (Appendix A) and then converted to meters. The sensor returned banded pressure values, which were up to 2 meters apart, making even burst averages meaningless. The pressure also seemed to be correlated to temperature in a non-physical way, affording another reason to suspect that the pressure measurements are inaccurate.

Seabird Temperature

Temperature data were converted from counts to degrees centigrade using lab calibrations provided by Seabird, Inc, and included in Appendix A.

YSI Temperature

Eight YSI thermistors provided temperature during Deployments IV & V. The thermistors were calibrated in the lab using SeaBird temperature sensors SN/032100, SN/032101 and SN/032103. A third order polynomial fit of approximately 12 hours of data, between 5 - 15°C, provided the following calibration coefficients provided in Table 3. These coefficients were used to compute temperature, as follows:

\[
\text{temperature} = A_0 \times \text{counts}^3 + A_1 \times \text{counts}^2 + A_2 \times \text{counts} + A_3
\]

<table>
<thead>
<tr>
<th>sensor</th>
<th>1.0e-13 x</th>
<th>1.0e-08 x</th>
<th>1.0e-03 x</th>
<th>1.0 x</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.3967</td>
<td>-0.3281</td>
<td>0.5686</td>
<td>0.3205</td>
</tr>
<tr>
<td>2</td>
<td>0.4380</td>
<td>-0.3475</td>
<td>0.5715</td>
<td>0.3324</td>
</tr>
<tr>
<td>3</td>
<td>0.2501</td>
<td>-0.2777</td>
<td>0.5630</td>
<td>0.3500</td>
</tr>
<tr>
<td>4</td>
<td>0.2485</td>
<td>-0.2728</td>
<td>0.5623</td>
<td>0.3648</td>
</tr>
<tr>
<td>5</td>
<td>0.3829</td>
<td>-0.3280</td>
<td>0.5687</td>
<td>0.3434</td>
</tr>
<tr>
<td>6</td>
<td>0.1874</td>
<td>-0.2525</td>
<td>0.5597</td>
<td>0.3714</td>
</tr>
<tr>
<td>7</td>
<td>0.3524</td>
<td>-0.3125</td>
<td>0.5664</td>
<td>0.3428</td>
</tr>
<tr>
<td>8</td>
<td>0.3340</td>
<td>-0.3119</td>
<td>0.5672</td>
<td>0.3386</td>
</tr>
</tbody>
</table>

Seabird Salinity

Conversion of the counts to conductivity was made using calibration coefficients from Seabird, Inc., which are included in Appendix A. The conductivity was converted to salinity using the temperature from the Seabird thermistors. Depth was estimated from the pressure record, when appropriate, or hard coded, when no pressure record was available.
Sound Speed Calibration:

It can be shown that travel time counts are inversely proportional to sound speed (Figures 14 a-d). Fresh water calibration of one pod was conducted providing counts in fresh water between 0° and 32°C. Prior to deployment of the SuperBASS tripod at the CMO site, the SeaBird temperature/conductivity sensors were mounted in proximity to each acoustic travel time sensor and deployed from the dock at Woods Hole Oceanographic Institution. For reasons not understood, it was apparent that the calibration for each sensor varied from deployment to deployment. Therefore, in situ calibrations were used to calibrate each deployment, making the following assumptions:

- When the difference in temperature between the top-most and bottom-most sensors (approximately 6.5 m apart) is less than 0.01°C, the bottom seven meters are well mixed. Note: due to problems with the conductivity cells, we could not verify this premise as it relates to salinity.
- When the salinity was observed to be less than 32.1 PSU, the Seabird conductivity cell is fouled and these data cannot be used in the calibration. This condition appeared to occur after storm conditions and proper behavior would return when the flow was strong enough to flush the sensors. (See Section V.)
- The sensitivity of the sound speed calculation to depth is insignificant. During Deployments II, IV and V, it was assumed that the depth was 67 meters, and this could cause an error in the sound speed computation from salinity, temperature and depth of about ±0.01 m/s due to the tidal range and ±0.02 m/s as an offset due to the uncertainty in the actual depth to perhaps 1 meter. It was also apparent that the pressure measurement was sensitive to the temperature, which could also bias the sound speed calculation for calibration of the acoustic travel time sensors.

Using these assumptions, the sound speed was computed from the salinity, temperature and depth (Mackenzie, 1981), inverted to 1/c and fit to the sum of the travel time counts from each direction along path C.

To convert data from counts (AT) to sound speed (m/s), for each sensor and each deployment, use the respective slope (M) and intercept (B), shown in Table 4, as follows:

\[ \text{SOUND\_SPEED} = \frac{1}{(\text{AT}*\text{M} + \text{B})} \]

Pod 6 shifted at the end of each day during Deployment II, so data after 18:00 of each day were replaced with NaN for pod 6. For Deployment V, the same sensor (pod 6) malfunctioned before July 28 (year day 209), 1997, but seemed to recover for the remainder of the deployment.
Table 4 (below) lists the slope and intercept for the calibration of sound speed counts (AT) with the computed sound speed from the salinity, temperature and pressure data. The 95% confidence interval (CI) of the slope and intercept is also included. N represents the number of samples used and min(c) and max(c) represent the range of the sound speed data used in fitting the data. (Also see Figures 14 a-d.).

<table>
<thead>
<tr>
<th>Sensor</th>
<th>slope ± CI 1e-09 x</th>
<th>intercept ± CI 1e-09 x</th>
<th>N</th>
<th>R^2</th>
<th>min(c)</th>
<th>max(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/96</td>
<td>-0.7761 ± 0.0056</td>
<td>0.7235 ± 0.0004</td>
<td>134</td>
<td>0.9991</td>
<td>1478.7</td>
<td>1488.7</td>
</tr>
<tr>
<td></td>
<td>-0.7735 ± 0.0052</td>
<td>0.7234 ± 0.0003</td>
<td>134</td>
<td>0.9992</td>
<td>1478.7</td>
<td>1488.7</td>
</tr>
<tr>
<td></td>
<td>-0.7783 ± 0.0043</td>
<td>0.7278 ± 0.0003</td>
<td>134</td>
<td>0.9995</td>
<td>1478.7</td>
<td>1488.7</td>
</tr>
<tr>
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<td>-0.7643 ± 0.0039</td>
<td>0.7263 ± 0.0003</td>
<td>134</td>
<td>0.9996</td>
<td>1478.7</td>
<td>1488.7</td>
</tr>
<tr>
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<td>-0.7818 ± 0.0036</td>
<td>0.7264 ± 0.0002</td>
<td>134</td>
<td>0.9996</td>
<td>1478.7</td>
<td>1488.7</td>
</tr>
<tr>
<td></td>
<td>-0.7624 ± 0.0037</td>
<td>0.7253 ± 0.0002</td>
<td>134</td>
<td>0.9996</td>
<td>1478.7</td>
<td>1488.7</td>
</tr>
<tr>
<td></td>
<td>-0.7571 ± 0.0035</td>
<td>0.7279 ± 0.0002</td>
<td>134</td>
<td>0.9996</td>
<td>1478.7</td>
<td>1488.7</td>
</tr>
<tr>
<td>10/96</td>
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<td>0.7239 ± 0.0022</td>
<td>44</td>
<td>0.9900</td>
<td>1486.1</td>
<td>1488.5</td>
</tr>
<tr>
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<td>-0.7778 ± 0.0342</td>
<td>0.7232 ± 0.0022</td>
<td>44</td>
<td>0.9896</td>
<td>1486.1</td>
<td>1488.6</td>
</tr>
<tr>
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<td>-0.7773 ± 0.0335</td>
<td>0.7244 ± 0.0022</td>
<td>44</td>
<td>0.9900</td>
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</tr>
<tr>
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<td>-0.7571 ± 0.0330</td>
<td>0.7258 ± 0.0023</td>
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<td>0.9898</td>
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<td>1488.6</td>
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<tr>
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<td>-0.7651 ± 0.0343</td>
<td>0.7251 ± 0.0024</td>
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<td>0.9892</td>
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<tr>
<td></td>
<td>-0.7469 ± 0.0543</td>
<td>0.7241 ± 0.0038</td>
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<td>0.9723</td>
<td>1486.1</td>
<td>1488.5</td>
</tr>
<tr>
<td></td>
<td>-0.7326 ± 0.0338</td>
<td>0.7260 ± 0.0025</td>
<td>44</td>
<td>0.9885</td>
<td>1486.1</td>
<td>1488.6</td>
</tr>
<tr>
<td>4/97</td>
<td>-0.7713 ± 0.0031</td>
<td>0.7229 ± 0.0002</td>
<td>646</td>
<td>0.9986</td>
<td>1470.0</td>
<td>1475.4</td>
</tr>
<tr>
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<td>-0.8017 ± 0.0021</td>
<td>0.7270 ± 0.0001</td>
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<td>0.9994</td>
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<td>-0.7760 ± 0.0030</td>
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<td>1475.4</td>
</tr>
<tr>
<td></td>
<td>-0.7589 ± 0.0029</td>
<td>0.7265 ± 0.0002</td>
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<td>0.9988</td>
<td>1470.0</td>
<td>1475.4</td>
</tr>
<tr>
<td></td>
<td>-0.7763 ± 0.0019</td>
<td>0.7265 ± 0.0001</td>
<td>646</td>
<td>0.9995</td>
<td>1470.0</td>
<td>1475.4</td>
</tr>
<tr>
<td></td>
<td>-0.7643 ± 0.0015</td>
<td>0.7286 ± 0.0001</td>
<td>646</td>
<td>0.9997</td>
<td>1472.3</td>
<td>1475.4</td>
</tr>
<tr>
<td>6/97</td>
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<td>0.7228 ± 0.0001</td>
<td>671</td>
<td>0.9998</td>
<td>1483.8</td>
<td>1490.4</td>
</tr>
<tr>
<td></td>
<td>-0.7827 ± 0.0010</td>
<td>0.7261 ± 0.0001</td>
<td>671</td>
<td>0.9999</td>
<td>1483.8</td>
<td>1490.5</td>
</tr>
<tr>
<td></td>
<td>-0.7743 ± 0.0011</td>
<td>0.7259 ± 0.0001</td>
<td>671</td>
<td>0.9998</td>
<td>1483.8</td>
<td>1490.5</td>
</tr>
<tr>
<td></td>
<td>-0.7672 ± 0.0012</td>
<td>0.7289 ± 0.0001</td>
<td>671</td>
<td>0.9998</td>
<td>1483.8</td>
<td>1490.4</td>
</tr>
<tr>
<td></td>
<td>-0.7690 ± 0.0010</td>
<td>0.7261 ± 0.0001</td>
<td>671</td>
<td>0.9999</td>
<td>1483.8</td>
<td>1490.5</td>
</tr>
<tr>
<td></td>
<td>-0.7762 ± 0.0044</td>
<td>0.7269 ± 0.0003</td>
<td>100</td>
<td>0.9996</td>
<td>1483.8</td>
<td>1490.6</td>
</tr>
</tbody>
</table>
SECTION IV: DATA SUMMARIES

This section provides time series of the data collected during the five deployments of the SuperBASS tripod. Year day is the day of the year with 0.5 representing January 1, at noon. These data are presented as follows:

- stick plots of the low-pass filtered velocity (m/s)
  (based on filter pl64t, half-power point 38 hours,
  see, e.g., Limeburner, 1985),
- eastward velocity (m/s), northward velocity (m/s), vertical velocity (m/s),
- bottom-orbital (wave induced) velocity (m/s),
- stress (Pa), covariance of the filtered horizontal velocities with the vertical velocity:
  \( \tau_{bx} \) - East-west component of stress
  \( \tau_{by} \) - North-south component of stress,
- dissipation (W/kg),
- temperature (°C) from SeaBirds and YSI thermistors, salinity (PSU) from SeaBirds,
  sound speed from the acoustic travel time observations (m/s), and
  amplitude of the ADV signal strength (dB), as an uncalibrated indicator of suspended sediment concentration,
- sound speed flux (m²/s²) with the gradient of density (from central mooring data) with
  sound speed, and
- dissipation of the sound speed variance (m²/s³).

As described in Section II, during Deployment II, BASS data after year day 321 and ADV data after day 315 were degraded and are not presented here.
Low-pass Filtered Velocity
Deployment I: Low-pass filtered velocity (continued on next page)

0.5 m/s

Flow (m/s)

Year day 1996

220 223 226 229 232 235 238 241 244 247 250

7.0 mab
5.4 mab
3.3 mab
2.2 mab
1.1 mab
0.7 mab
0.4 mab
avg adv
Deployment I  Low-pass filtered velocity

Flow (m/s)

Year day 1996

Figure 15
Deployment II Low-pass filtered velocity (continued on next page)

Flow (m/s)

Year day 1996

276 279 282 285 288 291 294 297 300 303 306

0.5 m/s

7.0 mab

5.4 mab

3.3 mab

2.2 mab

1.1 mab

0.7 mab

0.4 mab

avg adv
Deployment II  Low-pass filtered velocity

Figure 16
Deployment III  Low-pass filtered velocity

Figure 17 (continued)
Deployment IV  Low-pass filtered velocity

Flow (m/s)

Year day 1997

Figure 18
Deployment V  Low-pass filtered velocity (continued on next page)

0.5 m/s

Flow (m/s)

7.0 mab:

5.4 mab:

3.3 mab:

2.2 mab:

1.1 mab:

0.7 mab:

0.4 mab:

avg adv

Year day 1997

167 170 173 176 179 182 185 188 191 194 197
Deployment V Low-pass filtered velocity

Figure 19
Eastward Velocity
Deployment I (continued on next page)

Eastward Velocity (m/s)

Year day 1996

220  223  226  229  232  235  238  241  244  247  250
Deployment I

Figure 20
Deployment III

Eastward Velocity (m/s)

Year day 1997

Figure 22 (cont.)
Northward Velocity
Figure 25
Deployment II (continued on next page)
Figure 27 (cont.)
Figure 28
Vertical Velocity
Figure 32 (cont.)
Figure 33
Bottom-orbital Velocity
Deployment II

Bottom orbital velocity (m/s)

Year day 1996

Figure 36
Deployment III (continued on next page)

Figure 37
— THIS PAGE INTENTIONALLY LEFT BLANK —
Reynolds Stress

$\tau_{bx}$ - East-West component

$\tau_{by}$ - North-South component
Dissipation of
Turbulent Kinetic Energy ($\varepsilon$)
Deployment I

Dissipation (W/kg)

Year day 1996

![Graph showing dissipation over year day 1996](image)

Figure 44
Deployment II

Dissipation (W/kg)

Year day 1996

Figure 45
Salinity, Temperature, Sound Speed & ADV Signal Strength
Deployment I (continued on next page)

Temperature (deg C)

0.4 mab (--) / 7 mab (solid)

Salinity (PSU)

NOTE: Fouling of sensors

Sound speed (m/s)

Signal strength (dB)

Year day 1996
Deployment I

Temperature (deg C)

Salinity (PSU)

Sound speed (m/s)

Signal strength (dB)

Year day 1996

Figure 48
Deployment II (continued on next page)

Temperature (deg C)

0.4 mab (- -) / 7 mab (solid)

Salinity (PSU)

Sound speed (m/s)

Signal strength (dB)

Year day 1996
Figure 49
Deployment III (continued on next page)

Temperature (deg C)

0.4 mab (--) / 7 mab (solid)

Salinity (PSU)

Year day 1997

Sound speed (m/s)

Signal strength (dB)
— THIS PAGE INTENTIONALLY LEFT BLANK —
Deployment III

Temperature (deg C)

Salinity (PSU)

Sound speed (m/s)

Signal strength (dB)

Figure 50 (cont.)
Deployment IV (continued on next page)

0.4 mab (--) / 7 mab (solid)

NOTE: Fouling of sensors

Year day 1997
Sound Speed Flux and the Gradient of Density with Sound Speed \( (\partial \rho / \partial c) \)
Dissipation of
Turbulent Temperature Variance ($\chi$)
Figure 58
SECTION V: DATA COMPARISONS

Evaluation of ADV and BASS velocity data

When each ADV is compared with the mean of the other two ADVs (Figures 61 - 63), flow reduction is evident when flow is along the channel in either direction. ADV_B was tipped during Deployment III, as seen in Figures 64a-d. Figures 65a-d show that the BASS sensor, at the same height as the ADVs, logged lower mean velocities than were observed by the ADV sensors.

Comparisons of velocity from the central mooring and the SuperBASS tripod

Vertical profiles of the burst averaged data from the SuperBASS tripod and the bottom 30 meters of the central mooring VMCMs are presented in Figures 66 - 69, along with vertical profiles of the standard deviation of the low-pass filtered (pl64) mean velocities. For these plots, we interpolated over the times when the sensor was in the wake of the leg. Figures 70 - 73 present the empirical orthogonal function (EOF) for these data. A vane on the bottom-most VMCM failed, so we have omitted the data from the central mooring site at 65.5 meters depth. (Personal communication, Steve Lentz, WHOI)

Comparisons of salinity and temperature from the central mooring and the SuperBASS tripod

Data from Seacat 1878, which was mounted on the mooring at 67.5 m depth, are compared with SeaBird derived salinities and temperatures from the SuperBASS tripod in Figures 74a-b and Figures 75a-b. The moored salinity data were corrected for drift (personal communication, N. Galbraith, WHOI), with adjustment up to 0.06 S/m. As seen in the figures, the SeaBird data from the SuperBASS tripod are also fouled from sediment trapping.

Comparisons of temperatures from YSI thermistors and the SeaBirds

Figures 76a-c show the comparison of the bottom-most and top-most YSI temperatures with those from the SeaBird temperatures at the same height.
Figure 61

Deployment I: Comparison of the burst average speed of each ADV with the mean of the other two ADVs

Angle of flow from east (0°) (mean(ADVs))
Figure 62

Comparison of the burst average speed of each ADV with the mean of the other two ADVs.

Angle of flow from east (0°) (mean(ADVs))
Figure 64. ADV_B was rotated in the vertical plane.
Figure 65
Comparison of bottom-most salinity at central mooring, SuperBASS salinity and observed shipboard salinity

- SuperBASS @ 7 mab
- SuperBASS < 1 mab
- Central mooring

NOTE: Fouling of sensors

○ - Shipboard CTD observations (Ledwell)

PSU

Year day in 1996

Year day in 1997
SECTION VI: DATA FILE DESCRIPTIONS

BASS Binary File Formats

Data were recorded in 229,376 byte blocks. Two formats describe the raw data files of the BASS logger. The first format was used during Deployments I - III, when there were seven ACM sensors and no YSI thermistors, and the sampling interval was 840 ms. The second format was implemented for later deployments, when the bottom-most ACM was dropped and eight YSI thermistors were added, and the sampling interval was 850 ms. All deployments sampled three half-hour bursts every two hours. (See Section II.)

<table>
<thead>
<tr>
<th>Deployment I-III</th>
<th>Deployment IV-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td># variables</td>
</tr>
<tr>
<td>Key word(ABC1)</td>
<td>1</td>
</tr>
<tr>
<td>Time word</td>
<td>5</td>
</tr>
<tr>
<td>Travel Time</td>
<td>14</td>
</tr>
<tr>
<td>pitch</td>
<td>1</td>
</tr>
<tr>
<td>roll</td>
<td>1</td>
</tr>
<tr>
<td>ACM</td>
<td>28</td>
</tr>
<tr>
<td>compass</td>
<td>1</td>
</tr>
<tr>
<td>pressure</td>
<td>1</td>
</tr>
<tr>
<td>SeaBirds</td>
<td>4</td>
</tr>
<tr>
<td>PresTemp</td>
<td>1</td>
</tr>
<tr>
<td>Total bytes/record:</td>
<td></td>
</tr>
</tbody>
</table>

Processed BASS Data

Processed data were archived as Matlab® files, creating a set of the following files (on CDs) for each deployment:

Half-day files (see loadnew.m, Appendix B.)
- v_ne_NNn.mat  north & east velocity
- v_w_NNn.mat  vertical velocity in m/s
- v_doy_NNn.mat  time file (day of month, GMT)

Daily files:
- v_vel_NN.mat  along-path velocity (see loadpaths.m, Appendix B.)
- v_doy_NNn.mat  time file (day of month, GMT)
- v_therm_NN.mat  acoustic travel time data (counts) (See loadss.m, Appendix B.)
- v_ysi_NN.mat  YSI thermistor data (°C) (for deployments IV & V)

where NN is an arbitrary file number and can be related to day of month using file fnumlist.doc, and n represents 'a' or 'b' denoting whether it is the first or second part of the day.

1Mathworks, Inc., Natick, MA 01760
Burst Averaged BASS Data

Burst averaged data were stored in the files below:

**BASSmeans_MMYY.mat**, where MMYY indicates the month and year in which the deployment began.

Variables include:

- `tdoy`: year day (0.5 = 1/1/96 noon GMT) (representing the burst average time)
- `real(wne)`: eastward flow (m/s)
- `imag(wne)`: northward flow (m/s)
- `wstd`: standard deviation of detrended velocity (east +i* north, as above)
- `dmean`: height of water above platform (4.2 m)
- `urns`: bottom orbital velocity (m/s)
- `z`: height above bottom of soundsd & BASS sensors (m)
- `wacmean`: burst average of vertical vel from C+A (m/s)
- `wbdmean`: burst average of vertical vel from D+B
- `wPPstd`: standard deviation of detrended vertical velocities, as above
- `lrec`: number of records in burst
- `dispn`: dissipation (mean of all four paths) (W/kg)
- `smean`: salinity (PSU) at z(1) & z(7)
- `tmean`: temperature (deg C) at z(1) & z(7)
- `soundsd`: sound speed (m/s) at z mab
- `Tu, Tv`: Reynolds stress, east-west(u) & north-south(v) (PA)
- `mask`: ones.nowake NaN=in wake of tripod
- `cw`: sound speed (c) flux (m^2/s^2)
- `cwd`: sound speed flux (normalized time derivative technique)
- `drhodc`: ∂ρ/∂c (density from central mooring)
- `Chi`: dissipation of sound speed flux (m^2/s^3)

For Deployments IV & V:

- `tempmean`: mean YSI temperatures (Deg C)
- `tempstsd`: burst standard deviation of detrended YSI temperatures
- `tz`: height of YSI thermistors

**mask.mat** contains the mask that identifies wake contaminated points in the burst averaged files. The mask is an array of ones and NaNs, which provides a means to identify the bad points by taking the product of a burst statistic with the mask. Eg., by multiplying `abs(wne)* mask`, the flow speed will contain NaNs when the sensor is in the wake of the leg.
ADV Binary File Formats

All three loggers placed a time stamp at the beginning of each 529288 byte block. Each block contained two records, one collected at the hour specified at the beginning of the block and one collected one hour later. Data were logged continuously for 9.6 minutes at 25 Hz and formatted as described below.

<table>
<thead>
<tr>
<th>Variable</th>
<th># variables</th>
<th>bytes/variable</th>
<th>bytes</th>
<th>units</th>
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<tbody>
<tr>
<td>Keyword(8112)</td>
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<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Sample Id</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1 - number of samples in burst</td>
</tr>
<tr>
<td>Velocity</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>(0.1 mm/sec)</td>
</tr>
<tr>
<td>Signal Strength</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>(counts, where 0.43 dB/count)</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>(0 to 100, where &gt; 70 is considered ok)</td>
</tr>
<tr>
<td>Checksum</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>sum of bytes plus base (0xa596)</td>
</tr>
<tr>
<td>Total bytes/record:</td>
<td></td>
<td></td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

Processed ADV Data

Using the time stamp, data were unpacked, processed and stored on a set of three CDs, one for each deployment. Data files are named according to the date and instrument: xMMDDHHH.mat, where x represents the ADV sensor (a, b or c) and MMDDHH represents month, day, and hour (GMT) when sampling began. The data are stored as follows:

Ix - quality index (mean(correlation coefficient)/10), where > 7 is recommended as being acceptable.
Ux - northerly flow (0.10 mm/sec)
Vx - easterly flow (0.10 mm/sec)
Wx - vertical flow (upwards) (0.10 mm/sec)

where x is a, b or c, which specifies the ADV sensor.

A second set of CDs was created containing signal strength and vertical velocity:

xz - vertical velocity in 0.1 mm/sec for sensor x (a, b or c)
xamp - signal strength of three paths (dB * 100)
xnz - indices into xz where outliers had been detected
Burst Averaged ADV Data

For each deployment, a file exists as ADVmeans_MMYY.mat, where MMYY is the month and year of the beginning of the deployment (0896, 1096, 0197). Each file includes the following variables:

- mmon, mday, mhr - month, day and year of beginning of burst (tdoy is the day of year (GMT), 0.5 is noon on 1/1)
- Ex - average Easterly flow (1/10 mm/sec)
- Nx - average Northerly flow (1/10 mm/sec)
- Vtx - average upward flow (1/10 mm/sec)
- Lx - number of 'good' samples in each burst (maximum = 144000) and 'good' is defined as $L_x > 7$
- Nx_std, Ex_std, Vtx_std - standard deviation of detrended velocities
- urms - bottom orbital velocity (urms) in m$^2$/s$^2$
- ngood_x - number of valid points used in burst statistics

where x is a, b or c, which specifies the ADV sensor.

A secondary burst averaged file exists containing signal strength statistics (ampmeans_MMYY.mat):

- xampmean - average signal strength (dB) at ADV_x
- xampstd - standard deviation of signal strength (dB) at ADV_x
SECTION VII: ACKNOWLEDGMENTS

We gratefully acknowledge the capable, enthusiastic support of Don Peters, who designed and oversaw the construction of the SuperBASS structure. Our appreciation for those who helped in the assembly of the tripod and its instrumentation is extended to Glen McDonald, Alan Gordon, and Anna Harlow. And we also appreciate the patience and support of the WHOI dock crew, during the testing and calibration of the instrumentation throughout the program. We appreciate the generosity of Dr. Steve Anderson, who provided the Sontek field probes for this component of the Coastal Mixing & Optics program. Special thanks go to Betsey Doherty for the graphic illustration of the tripod and its instrumentation.

We also thank the crews of the R/V Oceanus, the R/V Endeavor and the R/V Steward Johnson for their role in the deployments and recoveries. Our ability to deploy, recover and redeploy the tripod, with minimal interruption and down-time was also due to the willingness of other CMO principal investigators to take responsibility for deployments during each of their respective legs: Dr. Thomas Gross for deploying the SuperBASS tripod in October, 1996.

This work was supported by the Office of Naval Research Grant No. N00014-95-1-0373.
SECTION VIII: REFERENCES


**Sensor Serial Number**: 1425  
**Calibration Date**: 11-Dec-96s

**GHIJ Coefficients**
- \( g = -4.07796026e+00 \)
- \( h = 4.99401015e-01 \)
- \( i = -2.08399078e-04 \)
- \( j = 3.55267889e-05 \)
- \( CP_{cor} = -9.57e-08 \) (nominal)
- \( CT_{cor} = 3.25e-06 \) (nominal)

**Conductivity Calibration Data**
- PSS 1978: \( C(35,15,0) = 4.2914 \) Siemens/meter

**ABCDM Coefficients**
- \( a = 8.21880894e-06 \)
- \( b = 4.98774171e-01 \)
- \( c = -4.07617241e+00 \)
- \( d = -8.54995759e-05 \)
- \( m = 4.4 \)
- \( CP_{cor} = -9.57e-08 \) (nominal)

<table>
<thead>
<tr>
<th>Bath Temp (IPTS-68 °C)</th>
<th>Bath Sal (PSU)</th>
<th>Bath Cond (Siemens/m)</th>
<th>Inst Freq (kHz)</th>
<th>Inst Cond (Siemens/m)</th>
<th>Residual (Siemens/m)</th>
</tr>
</thead>
<tbody>
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<td>0.0000</td>
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<td>-0.00000</td>
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<td>8.03338</td>
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<td>8.29162</td>
<td>3.03054</td>
<td>0.00002</td>
</tr>
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<td>4.70281</td>
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<td>29.1955</td>
<td>35.3877</td>
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<td>11.13155</td>
<td>5.80560</td>
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<tr>
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<td>6.17754</td>
<td>11.45768</td>
<td>6.17748</td>
<td>-0.00006</td>
</tr>
</tbody>
</table>

Conductivity = \((g + hf^2 + if^3 + jf^4) / [10(1 + \delta t + \epsilon p)]\) Siemens/meter
Conductivity = \((af^m + hf^2 + c + dt) / [10(1 + ep)]\) Siemens/meter

\( t = \) temperature [deg C]; \( p = \) pressure [decibars]; \( \delta = CT_{cor}; \epsilon = CP_{cor}; \)
Residual = (instrument conductivity - bath conductivity) using \( g, h, i, j \) coefficients

**Calibration Slope Correction**
- 27-Sep-95s, 0.998629
- 11-Dec-96s, 1.000000
**CONDUCTIVITY CALIBRATION DATA**

PSS 1978: $C(35,15,0) = 4.2914$ Siemens/meter

**ABCDM COEFFICIENTS**

- $a = 1.08019880e-05$
- $b = 4.98002927e-01$
- $c = -4.06984378e+00$
- $d = -9.02124366e-05$
- $m = 4.3$

$C_{\text{cor}} = -9.57e-08$ (nominal)

**GHU COEFFICIENTS**

- $g = -4.07046884e+00$
- $h = 4.98356171e-01$
- $i = -1.39076038e-04$
- $j = 3.21297599e-05$

$C_{\text{cor}} = -9.57e-08$ (nominal)

**SENSOR SERIAL NUMBER = 1425**

**CALIBRATION DATE: 20-Dec-96s**

**BATH TEMP (IPTS-68 °C)** | **BATH SAL (PSU)** | **BATH COND (Siemens/m)** | **INST FREQ (kHz)** | **INST COND (Siemens/m)** | **RESIDUAL (Siemens/m)**
--- | --- | --- | --- | --- | ---
0.0000 | 0.0000 | 0.0000 | 2.85832 | -0.00000 | -0.00000
-1.2766 | 34.8611 | 2.78444 | 7.90925 | 2.78444 | 0.00000
1.0967 | 34.8625 | 2.98790 | 8.24512 | 2.98792 | 0.00002
15.2138 | 34.8591 | 4.29692 | 9.68930 | 4.29685 | -0.00007
18.6511 | 34.8519 | 4.63729 | 10.04255 | 4.63732 | 0.00003
29.1943 | 34.8332 | 5.72464 | 11.06625 | 5.72471 | 0.00007
32.6340 | 34.8137 | 6.08915 | 11.38825 | 6.08910 | -0.00005

Conductivity = \( (g + hf^2 + if^3 + jet) / [10(l + \delta + \epsilon p)] \) Siemens/meter

Conductivity = \( (af^m + bf^2 + c + dt) / [10(l + \epsilon p)] \) Siemens/meter

- $t =$ temperature [deg C]; $p =$ pressure [decibars]; $\delta =$ CTcor; $\epsilon =$ CCor;

Residual = (instrument conductivity - bath conductivity) using $g$, $h$, $i$, $j$ coefficients

- **CALIBRATION**
  - **DATE: 27-Sep-95s**
  - **SLOPE CORRECTION:** 0.999979
- **DATE: 20-Dec-96s**
  - **SLOPE CORRECTION:** 1.000000

CALIBRATION CLEANING REPLATINIZING
**Sea-Bird Electronics, Inc.**

1808 136th Place N.E., Bellevue, Washington 98005 USA  
Phone: (206) 643 - 9866 Fax: (206) 643 - 9954 Internet: seabird@seabird.com

**Sensor Serial Number** = 1481  
**Calibration Date:** 27-Sep-95s

**GHIJ Coefficients**

- \( g = -4.17961125e+00 \)  
- \( h = 5.08438178e-01 \)  
- \( i = -1.06971045e-04 \)  
- \( j = 3.33368219e-05 \)

**CPcor** = -9.57e-08 (nominal)  
**CTcor** = 3.25e-06 (nominal)

**Conductivity Calibration Data**

PSS 1978: \( C(35,15,0) = 4.2914 \) Siemens/meter

**ABCDM Coefficients**

- \( a = 1.58091542e-05 \)  
- \( b = 5.08178116e-01 \)  
- \( c = -4.17920075e+00 \)  
- \( d = -8.89644797e-05 \)  
- \( m = 4.2 \)

**CPcor** = -9.57e-08 (nominal)

<table>
<thead>
<tr>
<th>Bath Temp [deg C]</th>
<th>Bath Sal [PSU]</th>
<th>Bath Cond [Siemens/m]</th>
<th>Inst Freq [kHz]</th>
<th>Inst Cond [Siemens/m]</th>
<th>Residual [Siemens/m]</th>
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</thead>
<tbody>
<tr>
<td>0.0000</td>
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<td>2.86723</td>
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</tbody>
</table>

Conductivity = \((g + hf^2 + if^3 + jf^4)/[10(1 + \delta + \epsilon)]\) Siemens/meter  

Conductivity = \((af^m + bf^2 + c + dt)/[10(1 + \epsilon)]\) Siemens/meter  

t = temperature [deg C]; p = pressure [decibars]; \( \delta = CTcor \); \( \epsilon = CPcor \);  
Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients

**Calibration After Cleaning and Replatinizing Cell**

- **Calibration Date:** 08-Dec-94  
- **Correction:** 1.000693  
- **Calibration Date:** 27-Sep-95s  
- **Correction:** 1.000000

**Graph:**  
- Conductivity vs. Residual (Siemens/meter)  
- Data points are marked with a plus sign (+)
**SEA-BIRD ELECTRONICS, INC.**
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (206) 643-9886 Fax: (206) 643-9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1482
CALIBRATION DATE: 20-Sep-95s

**CONDUCTIVITY CALIBRATION DATA**
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

**GHUU COEFFICIENTS**
g = -4.07016387e+00
h = 4.96980326e-01
i = -1.89232187e-04
j = 3.54699078e-05
CPcor = -9.57e-08 (nominal)
CTcor = 3.25e-06 (nominal)

<table>
<thead>
<tr>
<th>BATH TEMP [deg C]</th>
<th>BATH SAL [PSU]</th>
<th>BATH COND [Siemens/m]</th>
<th>INST FREQ [kHz]</th>
<th>INST COND [Siemens/m]</th>
<th>RESIDUAL [Siemens/m]</th>
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<td>0.0000</td>
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<td>0.000000</td>
<td>2.86251</td>
<td>0.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>-1.4025</td>
<td>35.0106</td>
<td>2.78460</td>
<td>8.00763</td>
<td>2.78461</td>
<td>0.000001</td>
</tr>
<tr>
<td>1.0538</td>
<td>35.0122</td>
<td>2.99577</td>
<td>8.26742</td>
<td>2.99572</td>
<td>-0.00005</td>
</tr>
<tr>
<td>18.6474</td>
<td>34.9990</td>
<td>4.65437</td>
<td>10.07498</td>
<td>4.65451</td>
<td>0.00014</td>
</tr>
<tr>
<td>29.0346</td>
<td>34.9957</td>
<td>5.73132</td>
<td>11.08864</td>
<td>5.73104</td>
<td>-0.00028</td>
</tr>
<tr>
<td>32.5848</td>
<td>34.9884</td>
<td>6.11091</td>
<td>11.42450</td>
<td>6.11109</td>
<td>0.00018</td>
</tr>
</tbody>
</table>

Conductivity = \( (g + h t^2 + i t^3 + j t^4) / [10(1 + \delta + \epsilon)] \) Siemens/meter
Conductivity = \( (a t^n + b t^2 + c + d t) / [10(1 + \epsilon)] \) Siemens/meter

\( t \) = temperature [deg C]; \( p \) = pressure [decibars]; \( \delta = \text{CTcor}; \epsilon = \text{CPcor}; \)
Residual = (instrument conductivity - bath conductivity) using \( g, h, i, j \) coefficients

---

**POST CRUISE CALIBRATION**

<table>
<thead>
<tr>
<th>calibration date</th>
<th>slope correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>08-Dec-94</td>
<td>0.998990</td>
</tr>
<tr>
<td>20-Sep-95s</td>
<td>1.000000</td>
</tr>
</tbody>
</table>
CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

GHIJ COEFFICIENTS

\[ g = -4.06218749e+00 \]
\[ h = 4.96813670e-01 \]
\[ i = -2.77286831e-04 \]
\[ j = 4.01122591e-05 \]
\[ C_{P_{cor}} = -9.57e-08 \text{ (nominal)} \]
\[ C_{T_{cor}} = 3.25e-06 \text{ (nominal)} \]

ABCDM COEFFICIENTS

\[ a = 6.57167965e-06 \]
\[ b = 4.95933803e-01 \]
\[ c = -4.05945334e+00 \]
\[ d = -8.37269288e-05 \]
\[ m = 4.5 \]
\[ C_{P_{cor}} = -9.57e-08 \text{ (nominal)} \]

<table>
<thead>
<tr>
<th>BATH TEMP [deg C]</th>
<th>BATH SAL [PSU]</th>
<th>BATH COND [Siemens/m]</th>
<th>INST FREQ [kHz]</th>
<th>INST COND [Siemens/m]</th>
<th>RESIDUAL [Siemens/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>2.86079</td>
<td>-0.00000</td>
<td>-0.00000</td>
</tr>
<tr>
<td>-1.4604</td>
<td>35.5667</td>
<td>2.81970</td>
<td>8.05505</td>
<td>2.81971</td>
<td>0.00001</td>
</tr>
<tr>
<td>1.0800</td>
<td>35.5677</td>
<td>3.04103</td>
<td>8.32596</td>
<td>3.04103</td>
<td>0.00000</td>
</tr>
<tr>
<td>15.1941</td>
<td>35.5687</td>
<td>4.37301</td>
<td>9.79703</td>
<td>4.37295</td>
<td>-0.00006</td>
</tr>
<tr>
<td>18.6308</td>
<td>35.5679</td>
<td>4.72006</td>
<td>10.14482</td>
<td>4.72011</td>
<td>0.00005</td>
</tr>
<tr>
<td>29.1726</td>
<td>35.5667</td>
<td>5.82908</td>
<td>11.18192</td>
<td>5.82910</td>
<td>0.00002</td>
</tr>
<tr>
<td>32.6114</td>
<td>35.5626</td>
<td>6.20254</td>
<td>11.50956</td>
<td>6.20252</td>
<td>-0.00002</td>
</tr>
</tbody>
</table>

Conductivity = \( \frac{(g + hf^2 + if^3 + jf^4)}{[10(1 + \delta t + \epsilon p)\]} \) Siemens/meter

Conductivity = \( \frac{(af^m + bf^2 + c + dt)}{[10(1 + ep)\]} \) Siemens/meter

\( t \) = temperature [deg C]; \( p \) = pressure [decibars]; \( \delta = C_{T_{cor}}; \epsilon = C_{P_{cor}}; \)

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients

<table>
<thead>
<tr>
<th>CALIBRATION AFTER CLEANING AND REPLATINIZING CELL</th>
<th>calibration date</th>
<th>slope correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>08-Dec-94</td>
<td>1.000057</td>
<td></td>
</tr>
<tr>
<td>29-Sep-95s</td>
<td>1.000000</td>
<td></td>
</tr>
</tbody>
</table>
SENSOR SERIAL NUMBER = 2100
CALIBRATION DATE: 23-Feb-96s

ITS-90 COEFFICIENTS
\[ g = 4.14627034 e^{-03} \]
\[ h = 6.27125153 e^{-04} \]
\[ i = 2.10467819 e^{-05} \]
\[ j = 2.27215955 e^{-06} \]
\[ f_0 = 1000.000 \]

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

IPTS-68 COEFFICIENTS
\[ a = 3.68027895 e^{-03} \]
\[ b = 5.99187907 e^{-04} \]
\[ c = 1.58873738 e^{-05} \]
\[ d = 2.27369108 e^{-06} \]
\[ f_0 = 2140.205 \]

<table>
<thead>
<tr>
<th>BATH TEMP (ITS-90 °C)</th>
<th>INSTRUMENT FREQ (Hz)</th>
<th>INST TEMP (ITS-90 °C)</th>
<th>RESIDUAL (ITS-90 °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.4311</td>
<td>2140.205</td>
<td>-1.4311</td>
<td>-0.00002</td>
</tr>
<tr>
<td>1.0794</td>
<td>2264.220</td>
<td>1.0795</td>
<td>0.00005</td>
</tr>
<tr>
<td>4.5701</td>
<td>2445.179</td>
<td>4.5701</td>
<td>0.00001</td>
</tr>
<tr>
<td>8.1689</td>
<td>2642.410</td>
<td>8.1688</td>
<td>0.00007</td>
</tr>
<tr>
<td>11.6014</td>
<td>2840.890</td>
<td>11.6013</td>
<td>0.00005</td>
</tr>
<tr>
<td>15.1589</td>
<td>3057.563</td>
<td>15.1590</td>
<td>0.00006</td>
</tr>
<tr>
<td>18.6629</td>
<td>3282.127</td>
<td>18.6630</td>
<td>0.00009</td>
</tr>
<tr>
<td>22.1618</td>
<td>3517.653</td>
<td>22.1618</td>
<td>0.00001</td>
</tr>
<tr>
<td>25.7212</td>
<td>3769.100</td>
<td>25.7212</td>
<td>0.00005</td>
</tr>
<tr>
<td>29.1362</td>
<td>4021.790</td>
<td>29.1361</td>
<td>0.00007</td>
</tr>
<tr>
<td>32.6701</td>
<td>4295.316</td>
<td>32.6702</td>
<td>0.00006</td>
</tr>
</tbody>
</table>

Temperature ITS-90 = \[ \frac{1}{g + h[\ln(f_0/f)] + i[\ln^2(f_0/f)] + j[\ln^3(f_0/f)]} - 273.15 \) (°C)

Temperature IPTS-68 = \[ \frac{1}{a + b[\ln(f_0/f)] + c[\ln^2(f_0/f)] + d[\ln^3(f_0/f)]} - 273.15 \) (°C)

Following the recommendation of JPOTS: \( T_{68} \) is assumed to be 1.00024 * \( T_{90} \) (-2 to 35 °C).

Residual = instrument temperature - bath temperature

<table>
<thead>
<tr>
<th>RESIDUAL (Degrees C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
</tr>
<tr>
<td>0.0100</td>
</tr>
<tr>
<td>0.0200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEMPERATURE (Degrees C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>35</td>
</tr>
</tbody>
</table>

23-Feb-96s 0.00
SENSOR SERIAL NUMBER = 2101
CALIBRATION DATE: 23-Feb-96s

ITS-90 COEFFICIENTS

\[ g = 4.11663341e-03 \]
\[ h = 6.28308761e-04 \]
\[ i = 2.09641616e-05 \]
\[ j = 2.20772351e-06 \]
\[ f_0 = 1000.000 \]

<table>
<thead>
<tr>
<th>BATH TEMP (ITS-90 °C)</th>
<th>INSTRUMENT FREQ (Hz)</th>
<th>INST TEMP (ITS-90 °C)</th>
<th>RESIDUAL (ITS-90 °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.4311</td>
<td>2034.119</td>
<td>-1.4311</td>
<td>0.00002</td>
</tr>
<tr>
<td>1.0794</td>
<td>2151.419</td>
<td>1.0795</td>
<td>0.00003</td>
</tr>
<tr>
<td>4.5701</td>
<td>2322.537</td>
<td>4.5701</td>
<td>0.00002</td>
</tr>
<tr>
<td>8.1689</td>
<td>2508.991</td>
<td>8.1689</td>
<td>0.00005</td>
</tr>
<tr>
<td>11.6014</td>
<td>2696.576</td>
<td>11.6013</td>
<td>0.00003</td>
</tr>
<tr>
<td>15.1589</td>
<td>2901.304</td>
<td>15.1590</td>
<td>0.00005</td>
</tr>
<tr>
<td>18.6629</td>
<td>3113.439</td>
<td>18.6630</td>
<td>0.00002</td>
</tr>
<tr>
<td>22.1618</td>
<td>3335.892</td>
<td>22.1618</td>
<td>0.00000</td>
</tr>
<tr>
<td>25.7212</td>
<td>3573.334</td>
<td>25.7212</td>
<td>0.00001</td>
</tr>
<tr>
<td>29.1362</td>
<td>3811.906</td>
<td>29.1362</td>
<td>0.00002</td>
</tr>
<tr>
<td>32.6701</td>
<td>4070.102</td>
<td>32.6701</td>
<td>0.00002</td>
</tr>
</tbody>
</table>

Temperature ITS-90 = \( 1/[g + h(ln(f_0/f)) + i(ln^2(f_0/f)) + j(ln^3(f_0/f))] - 273.15 \) (°C)

Temperature IPTS-68 = \( 1/[a + b(ln(f_0/f)) + c(ln^2(f_0/f)) + d(ln^3(f_0/f))] - 273.15 \) (°C)

Following the recommendation of JPOTS: \( T_{68} \) is assumed to be 1.00024 * \( T_{90} \) (-2 to 35 °C).

Residual = instrument temperature - bath temperature

Temperature (Degrees C)
CALIBRATION COEFFICIENTS
PRESSURE TRANSUDCER

MODEL: 8DP0700-2
PRESSURE RANGE: 0 to 700 meters
TEMP. RANGE: -2 to 40 deg C
PORT: oil filled

SERIAL NO: 59118
DATE: 01-31-1997

PRESSURE COEFFICIENTS

\[ U = \text{temperature} \quad (\text{deg C}) \]
\[ C = C_1 + C_2 U + C_3 U^2 \]
\[ D = D_1 + D_2 U \]
\[ T_0 = T_1 + T_2 U + T_3 U^2 + T_4 U^3 + T_5 U^4 \]
\[ T = \text{pressure period} \quad (\mu\text{sec}) \]

Pressure: (psia)

\[ P = C \left( 1 - \frac{T_0^2}{T^2} \right) \left( 1 - D \left( 1 - \frac{T_0^2}{T^2} \right) \right) \]

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_1 )</td>
<td>-4053.351 psia</td>
</tr>
<tr>
<td>( C_2 )</td>
<td>-3.68873E-02 psia/deg C</td>
</tr>
<tr>
<td>( C_3 )</td>
<td>7.68770E-04 psia/deg C^2</td>
</tr>
<tr>
<td>( D_1 )</td>
<td>0.062747</td>
</tr>
<tr>
<td>( D_2 )</td>
<td>0</td>
</tr>
<tr>
<td>( T_1 )</td>
<td>28.42048 ( \mu \text{sec} )</td>
</tr>
<tr>
<td>( T_2 )</td>
<td>-3.24660E-04 ( \mu \text{sec}/\text{deg C} )</td>
</tr>
<tr>
<td>( T_3 )</td>
<td>2.55656E-06 ( \mu \text{sec}/\text{deg C}^2 )</td>
</tr>
<tr>
<td>( T_4 )</td>
<td>6.62367E-10 ( \mu \text{sec}/\text{deg C}^3 )</td>
</tr>
<tr>
<td>( T_5 )</td>
<td>0</td>
</tr>
</tbody>
</table>

(01-31-1997)

PAROSCIENTIFIC, INC.
4500 148th AVENUE N.E.
REDMOND, WA. 98052

CUSTOMER: WOODS HOLE OCEANOGRAPHIC INST.
SALES ORDER: 59118
PREPARED BY: T.C.
loadnew.m

% loadiv - to load u_iuv and v_doy & convert to m/s
eval(['load /mnt/cdrome/v_doy_'.afn])
eval(['load /mnt/cdrome/v_ne_'.afn])
eval(['load /mnt/cdrome/v_w_'.afn])

wAC=iwac./1000;
wBD=iwbd./1000;
	nbad=find(iu()>2000);
%disp(['percent bad: ',num2str(length(nbad)./length(iu())*.100)])
if (length(nbad))
iu(nbad)=NaN*ones(length(nbad),1);
wBD(nbad)=NaN*ones(length(nbad),1);
end

nbad=find(iv()>2000);
%disp(['percent bad: ',num2str(length(nbad)./length(iv())*.100)])
if (length(nbad))
iv(nbad)=NaN*ones(length(nbad),1);
wAC(nbad)=NaN*ones(length(nbad),1);
end

usiu./1000;
v=iv./1000;

clear iu iv iwac iwbd

loadss.m

% fix soundspeed
eval(['load /mnt/cdrom/oct/thrm_',num2str(fn)])
eval(['load /mnt/cdrom/oct/doy_'.num2str(fn)])
nc=1:2:14;nc2=2:2:14;

% below are slopes & intercepts specific to Deployment II
% See Table 3 for other deployments
sloape=[0.7872 0.7778 0.7773 0.7571 0.7651 0.7469 0.7326]*1e-9;
b= [0.7239 0.7232 0.7244 0.7258 0.7251 0.7241 0.7260]*1e-3;

ss1=reshape(therm,14,length(doy))';
tt=tt(:,nc)+tt(:,nc2);
ss1=(slope.ones(length(doy),1,1,:).*tt + b.ones(length(doy),1,:));
ss=rmoutliers(ss,4,0);
loadpaths.m

da='a';
nt=nt1;
for ihalf=1:2
eval(['load /mnt/cdrom/velsabcd/v_doy_',num2str(fn),ida])
eval(['load /mnt/cdrom/velsabcd/v_vels_',num2str(fn),ida])
disp(['fn: ',num2str(fn),', mind: ',num2str(min(doy)),', maxd: ',num2str(max(doy)),', mean: ',num2str(mean(doy))])

nbad=find(ia(:,1) > 2000);
ia(nbad)=NaN*ones(size(nbad));
nbad=find(ib(:,1) > 2000);
ib(nbad)=NaN*ones(size(nbad));
nbad=find(ic(:,1) > 2000);
ic(nbad)=NaN*ones(size(nbad));
nbad=find(id(:,1) > 2000);
id(nbad)=NaN*ones(size(nbad));

ia=ia./1000-ia(ones(length(doy),1),:);
ib=ib./1000-ib(ones(length(doy),1),:);
ic=ic./1000-ic(ones(length(doy),1),:);
id=id./1000-id(ones(length(doy),1),:);

% below is specific to Deployment II
% check Table 1 for other deployments
% id(:,1)=ic(:,1)+ia(:,1)-ib(:,1);
% ib(:,2)=ic(:,2)+ia(:,2)-id(:,2);
% ic(:,5)=id(:,5)+ib(:,5)-ia(:,5);
% ib(:,4) was already substituted in vels data
ia=rmoutliers(ia,4,0);
ib=rmoutliers(ib,4,0);
ic=rmoutliers(ic,4,0);
id=rmoutliers(id,4,0);

u=(id-ib)./sqrt(2);
v=(ic-ia)./sqrt(2);
wAC=(ic+ia)./sqrt(2);
wBD=(id+ib)./sqrt(2);

.............. processing body ..............

ida='b';
nt=nt2;
end % each half day
University of California, San Diego  
SIO Library 0175C  
9500 Gilman Drive  
La Jolla, CA 92039-0175

Hancock Library of Biology & Oceanography  
Alan Hancock Laboratory  
University of Southern California  
University Park  
Los Angeles, CA 90089-0371

Gifts & Exchanges  
Library  
Bedford Institute of Oceanography  
P.O. Box 1006  
Dartmouth, NS, B2Y 4A2, CANADA

NOAA/EDIS Miami Library Center  
4301 Rickenbacker Causeway  
Miami, FL 33149

Research Library  
U.S. Army Corps of Engineers  
Waterways Experiment Station  
3909 Halls Ferry Road  
Vicksburg, MS 39180-6199

Marine Resources Information Center  
Building E38-320  
MIT  
Cambridge, MA 02139

Library  
Lamont-Doherty Geological Observatory  
Columbia University  
Palisades, NY 10964

Library  
Serials Department  
Oregon State University  
Corvallis, OR 97331

Pell Marine Science Library  
University of Rhode Island  
Narragansett Bay Campus  
Narragansett, RI 02882

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Dept. of Oceanography  
College Station, TX 77843

Fisheries-Oceanography Library  
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Seattle, WA 98195

Library  
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University of Miami  
4600 Rickenbacker Causeway  
Miami, FL 33149

Maury Oceanographic Library  
Naval Oceanographic Office  
Building 1003 South  
1002 Balch Blvd.  
Stennis Space Center, MS, 39522-5001

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Institute of Ocean Sciences  
P.O. Box 6000  
Sidney, B.C. V8L 4B2  
CANADA

National Oceanographic Library  
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Southampton SO14 3ZH  
UK

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FRANCE
4. Title and Subtitle
Fluid Mechanical Measurements within the Bottom Boundary Layer During Coastal Mixing and Optics

7. Author(s)

9. Performing Organization Name and Address
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

12. Sponsoring Organization Name and Address
Office of Naval Research

15. Supplementary Notes
This report should be cited as: Woods Hole Oceanog. Inst. Tech. Rept., WHOI-2001-08.

16. Abstract (Limit: 200 words)
To quantify and understand the role of vertical mixing processes in determining mid-shelf vertical structure of hydrographic and optical properties and particulate matter, the Office of Naval Research (ONR) funded a program called Coastal Mixing and Optics (CMO), which was conducted at a mid-shelf location in the Mid-Atlantic Bight, south of Martha's Vineyard, Massachusetts. As part of the CMO program, a tall tripod, called 'SuperBASS,' was equipped to collect a year-long, near-bottom time-series of velocity, temperature, salinity and pressure. The BASS sensors were modified to measure absolute as well as differential acoustic travel time, to provide sound speed (a surrogate for temperature) and velocity in a single sample volume. Seven BASS velocity and travel time sensors were placed between 0.4 and 7 meters above bottom (mab). Three acoustic Doppler velocity (ADV) meters were mounted near the bottom-most BASS sensor at 0.3 meters above bottom. The sensors were used to obtain high-quality time-series measurements of velocity and temperature throughout a large fraction of the bottom boundary layer on the New England shelf. The measurements provide vertical structure of the Reynolds-averaged velocity and temperature fields, direct covariance estimates of turbulent Reynolds stress and turbulent heat flux, and indirect inertial range estimates of dissipation rate for turbulent kinetic energy and temperature variance. The purpose of this report is to describe the SuperBASS instrumentation and deployments, to provide summaries of the data collected, and to document the processing, preliminary analysis and archival of the data collected for this component of the program.

18. Availability Statement
Approved for public release; distribution unlimited.

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20. Security Class (This Page)
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21. No. of Pages
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22. Price