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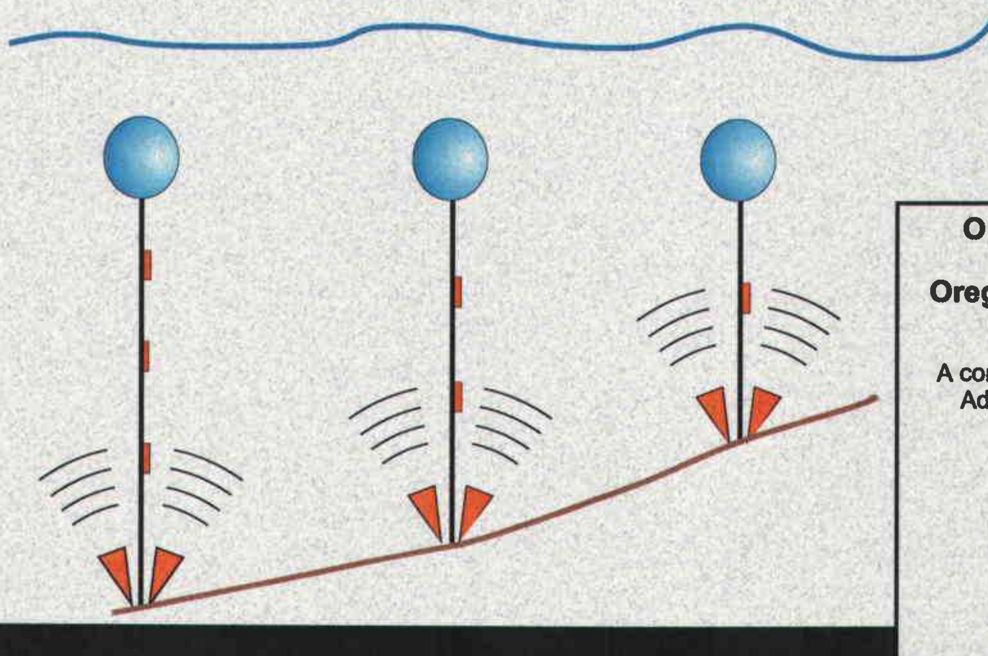
COAST

Coastal Ocean Advances in Shelf Transport



Observations from Moorings on the Oregon Continental Shelf
January-March 2003

A component of Coastal Ocean Advances in Shelf Transport (COAST)

by
Timothy Boyd
Murray D. Levine
P. Michael Kosro
Steve R. Gard
Walt Waldorf

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OREGON STATE UNIVERSITY

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I. OVERVIEW

1. INTRODUCTION

This report documents the oceanographic and meteorological measurements made by the Mooring Observations component of the Coastal Ocean Advances in Shelf Transport (COAST) project during the downwelling experiment from January to March 2003. The focus of COAST is to study the cross-shelf transport processes in a wind-driven system by making field observations together with ocean and atmospheric modeling.

The downwelling field program included measurements of the physical, biological, and chemical fields made from moorings, ships, and coastal radar. The downwelling experiment in 2003 focused on the region north of Newport around 45°N, where the narrow shelf exhibits little north-south (alongshelf) variability. Mooring observations made at the same locations during an upwelling experiment in May-August 2001 as part of the COAST project are documented in Boyd *et al.*, 2002.

The data time series are reported and plotted with reference to UTC (Coordinated Universal Time). However, for convenience the time reference of the logistic information in this report is local (Pacific Standard Time = UTC - 8).

2. DEPLOYMENT and RECOVERY

Three oceanographic moorings and one meteorological mooring were deployed on the continental shelf as part of the COAST 2003 downwelling experiment. The moorings were deployed on an east-west line across the shelf along 45 °N; this is the same latitude as the northern line during COAST 2001 (Figure 1). The three oceanographic moorings are designated as Downwelling Inner Shelf (DIS), Mid Shelf (DMS) and Shelf Break (DSB) to indicate their location. The meteorological ("Met") mooring was deployed near the Mid Shelf mooring. The mooring positions, as well as the instrument locations on each mooring and sampling parameters are given in Table 1. Technical data for each acoustic current profiler are given in Table 2. The technical details of the meteorological instruments are given in Table 3. The locations of the oceanographic variables sampled at each mooring are illustrated in Figures 2 and 3. For reference, a day of year calendar is provided in Table 4.

The deployment of moorings was done from the R/V Wecoma on cruise W0301A leaving Newport on January 11, 2003. Addendum A is a log of the deployment cruise activities; Table 5 shows the times, locations, and station names of deployment cruise CTD casts. The weather was not ideal: strong winds (30 knots), large sea and swell, and some rain. Nonetheless, the Met buoy was successfully deployed in the afternoon. The decks were then prepared for deploying the DMS mooring. The after dinner weather report indicated that weather would be no worse the next day, so it was decided to wait until morning for deployment. In the evening, the ship did an ADCP survey with both 150 kHz and new 75kHz units. The cruise track was westward along 45°N to 125°10'W and back. The weather had indeed improved, and in the morning of 12 January we deployed the DMS mooring. The DMS mooring was located in deeper water than the NMS mooring deployed during COAST 2001 because it was discovered that the earlier location was in the middle of a tow lane for barge traffic (see publication by Washington Sea Grant). Both the DIS and DSB moorings were deployed by 1830. Starting at 1900 an ADCP survey was conducted along a 97 nm track, ending at the site of Kosro's Globec mooring at NH-10 (44° 39'N, 124° 18'W). In the morning of 13 January the Globec mooring was recovered. After some refurbishment of equipment and sensors the mooring was redeployed at the same location. CTD casts (casts 1 to 7) were made along the Newport line at NH-5, -10, -15, -20, -25, -35, -45 ending just after midnight. This was followed by an ADCP survey along 45°N ending at DMS. After breakfast a CTD survey was conducted along the Cascade Head line at CH-1, -2, -3, -4, -5, -5.5,-6, -6.5, -7, -8,-9,-10 (casts 8-19). This was followed by a final CTD cast at a station to the south of CH-10, designated L3-12 (leg 3, station 12) by the COAST survey group. The locations of all CTD casts are shown in Figure 4. We returned to Newport and docked just after midnight in the early morning of 15 January.

The recovery cruise W0303A on R/V Wecoma began on 16 March. Addendum B is a log of the recovery cruise activities; Table 6 shows the times, locations, and station names of recovery cruise CTD casts. After lunch we arrived at the Met mooring, where we found at the surface the small floats attached by Spectra line to the anchor. This line was not supposed to be released until the anchor was released from the acoustic release. We pulled on the Spectra line, but it parted. The Met buoy was then retrieved on deck without releasing the anchor. The chain was spooled onto the trawl winch and the anchor recovered. At the DMS mooring the TSRB (Total Spectral Radiation Buoy) was deployed at the surface for about 20 minutes. Next the DMS mooring was recovered, leaving the anchor recovery line floating at the surface. After dinner the anchor was recovered. A CTD cast (1) was done near the site of DMS with water samples taken for Y. Alleau. An ADCP survey was done along 45°N throughout the night. In the morning of 17 March the DSB mooring was recovered along with its anchor. The TSRB was deployed for 20 minutes near the DSB site, and a CTD cast (2) was made. The TSRB was deployed again at the DIS site. The DIS mooring was recovered along with the anchor. A CTD cast (3) was done at the DIS mooring site. All of the Tidbit air temperature recorders were put on the doghouse for cross calibration purposes. The AUV operations began, moving the AUV to outside deck. After dinner an ADCP survey was performed following a radiator pattern. On the morning of 18 March the weather was too rough for AUV operations. Instead CTD casts (4 to 15) were made along Cascade Head line at CH-1, -2, -3, 4-, -5, -5.5, -6, -6.5, - 7, -8, -9 -10. In the evening a radiator pattern ADCP survey of about 100 nm was done. In the morning of 19 March AUV operations were attempted. The weather deteriorated, with windspeed increasing to 30+ knots, and the AUV was secured. An intercalibration was performed by attaching Microcats, Vemco sensors, and MDRs to the CTD during cast 16. An ADCP survey was done along the CH line toward CH-1. Soon after the start of the survey we heard that the war with Iraq had begun. We returned to Newport and docked just after midnight in the early morning of 20 March.

The mooring locations were sent to the US Coast Guard, District 13, for publication in the Local Notice to Mariners. In addition, in an effort to eliminate the occurrence of moorings and mooring instruments as trawler bycatch, and to reduce equipment loss to area fishermen, notice of our activities was sent to Sea Grant agents for posting and distribution. Laminated business-card size "reminders" with the mooring locations and contact information were provided with the "heads up" posters (Addendum C) in the hope that these would be posted on the bridge of fishing vessels.

3. MOORINGS and INSTRUMENTATION

3a. Mooring Construction

The oceanographic moorings were constructed with the following elements (from the bottom up): 3-wheel anchor, acoustic release with anchor recovery canister, Doppler profiler, acoustic baffle, 3/8" jacketed wire rope, steel float, spectra line, surface spar buoy. The working schematics showing details of the mooring elements are given in Figure 5. The anchors weighed about 2700 lbs in air. The acoustic releases were Edgetech (formerly InterOcean, now ORE) models BACS 8242XS and 8242. The Doppler profilers were mounted in stainless steel cages manufactured by Flotation Technology. The wire rope lengths with swaged terminations were purchased from Woods Hole Oceanographic Institution. Universal plastic clamps designed by Walt Waldorf and Jay Simpkins were used to attach the instruments to the wire. Nylon straps with cable ties were used to attach the instruments to the clamps. A single 37" steel float provided about 700 lbs net buoyancy for each mooring. Spectra line (1/2" diameter) loosely connected the top of the subsurface float to the surface spar buoy. Some flotation and weights were attached to the line to maintain an "N" shape so that the line would not tangle with the subsurface float or spar buoy. The spar buoy weighs more than 600 lbs. in air and is about 5.5 m long. The purpose of the buoy is to serve as an aid to navigation, warning of the presence of the mooring. A radar reflector and battery-powered flashing light (recharged by a solar panel) were located 3.5 m above the waterline. Oceanographic sensors and atmospheric sensors (Roger Samelson's) were attached to the spar buoys, about 2 m below and above the waterline, respectively.

The acoustic baffles were designed in discussion with Joel Gast and Darryl Simons of RDI for use on the HOME Nearfield moorings (see Boyd *et al.*, 2005). The baffles were radially symmetric in-line mooring elements built around a 1" diameter 316 stainless rod with welded eyes. The baffles were designed to sit outside the main lobes of all four beams and knock down the signal returning vertically along the mooring line using a stack of materials with a variety of acoustic impedances and asborptions. From top to bottom the baffle consisted of ½" layers of lead (4 sheets at 1/8"), blended neoprene/cork gasketing (2 sheets at ¼"), and silicone rubber (2 sheets at ¼"), each of which were separated by ¼" thick sheets of high density polyethylene, and all of which were sandwiched between a ¼" stainless steel bottom plate (welded to the ss rod with braces below) and a ½" plywood lid. The baffles are 12 inches in diameter and were mounted 2.25 meters above the upward-looking DIS, DMS, and DSB ADCPs (see Figure 5). In order to avoid a 15° cone above the transducers, the minimum separation between the baffle and 300 kHz ADCPs is 1m.

The Met mooring was constructed of a three wheel anchor, 135 m of ½" long-link chain, an acoustic release with an anchor recovery canister, Doppler profiler, and a surface toroidal buoy with a 2 m bridle. This length of chain results in a scope of 1.4 in 100 m of water. The Met buoy is a 1.78 m diameter toroid constructed of DuPont Surlyn foam (Gilman Corp.), providing a maximum 2580 lbs of buoyancy at total submergence. Instruments were attached to the bridle of the buoy and to the chain in the upper part of the water column.

The moorings were deployed float first behind the slowly moving ship. The wire rope (or chain) was then spooled out using the trawl winch. Instruments were attached as the wire (or chain) passed over the stern. The anchor was lifted with the trawl wire and then lowered to the bottom on a custom, spring-loaded hook, with the ship still moving slowly. After the anchor hit bottom, the ship stopped and the spring-loaded hook released the anchor from the trawl wire.

3b. Instrument Calibration

The dates of the instrument calibrations are given in Table 1. Vertical profiles of the mean temperatures with standard deviations are shown in Figure 6 for the ocean and meteorological instruments on each mooring. The Met and NMS mooring data are combined in one plot.

Ocean Temperature and Salinity Sensors

The SBE 39 (temperature recorder, T) and SBE 37 (Microcat, T & C) instruments were calibrated by the manufacturer at the SeaBird Electronics calibration facility.

The MTR and MDR temperature sensors were calibrated in the COAS temperature calibration tank on 18-20 December 2002. The temperature standard used is a SeaBird Electronics SBE 38 Digital Oceanographic Thermometer, s/n 0088, which was calibrated most recently on 21 Nov 2002. The pre-deployment calibration covered the temperature range 1.5 - 21 °C in nine steps (1.5, 2.5, 3.5, 4.5, 5.5 7.0, 9.0, 12.0, and 21.0 °C), holding for 2.5 hours at each step. The long duration of these steps was chosen due to the less than satisfactory results obtained using calibration steps of 0.5 hours in 2001. Longer steps allow the MTRs and MDRs to fully adjust to the bath temperature long before the end of the step, resulting in more usable data from each step.

MTR Calibration coefficients are obtained by least squares fit of the polynomial $T = (a + b*R + c*R^2 + d*R^3)^{-1} - 273.15$, where $R=\ln(rs/f0)$, f0=1000.0, and $rs=4.0x10^8/(\text{MTR counts})$. Differences between temperatures obtained by using the present and previous calibration constants is a measure of the sensor drift over the period between calibrations. Comparison of MTR calibrations from December 2002 (after the NSF-funded HOME Nearfield experiment) to calibrations from April 1996 (before the ONR-funded PRIMER experiment) revealed long term stability in all of the MTRs used in both calibrations. The difference between post-HOME and pre-PRIMER calibrated temperatures was about $4.5 +/- 0.5 \times 10^{-3}$ °C over the temperature range $6 \leq T \leq 16$ °C. Due to closer proximity of the post-HOME calibration to the COAST 2003 sampling, these calibrations were used for the MTRs throughout. The dates of the calibrations used are shown in Table 1.

At-Sea Sensor Inter-comparison

Conductivity. All SBE 39 (Microcat) conductivity sensors used in the moorings were calibrated at the SeaBird Electronics calibration facility during 2002 (see Table 1). As a check of possible conductivity sensor drift over the duration of the mooring deployments, all of these sensors were attached to the CTD rosette and deployed together during recovery cruise cast #16. The calibration consisted of holding the CTD at fixed depth for 10 minutes at four separate depths. The ocean was remarkably well-mixed at three of these depths (20, 40, 60 m). The conductivity comparison among the sensors and the CTD is shown in Figure 7. The CTD values are from the primary sensor (# 1030) with the bottle calibration factor (1.000099) applied (see CTD conductivity calibration section below). Overall the agreement is very good. While this inter-comparison is not intended to be a recalibration, it does give some indication of the stability of the observations. The newer Microcats (#18xx) agree quite well with the CTD and with each other. There are greater differences between the CTD and the older Microcats, specifically #39 and #42. Based on Figure 7, it was decided to apply an offset of -0.01 mS/cm (-.001 S/m) to sensor #39 (moored on DSB at 12 m). This offset was consistent with a comparison of moored time series data from sensor #39 and sensor #43, at 2.4 m on the same mooring, during times when the upper ocean appeared to be well mixed. Based on Figure 7, it was also decided to apply an offset of +0.01 mS/m (+.001 S/m) to sensor #42, although in this case an *in situ* comparison was not possible.

Temperature. Temperatures from the Microcats were also compared with each other and the CTD during cast #16. At each of the three depths (20, 40, and 60 m) where the water was most well-mixed, the average T difference between the Microcats and the CTD was no greater than .002°C (T from the CTD was always higher). Hence, no offsets were applied to the temperature data.

The two MDRs deployed on the moorings were also attached to the CTD rosette for the calibration cast (recovery cruise cast # 16). Although the T deviations of the two MDRs from the CTD were greater than for the Microcats, the calibration cast data were not used to correct the MDR temperature record. This is because digitization error for the MDRs, for which temperature resolution is only about 0.0045°C, is an issue when calculating the average T in a nearly homogeneous T step. Instead, short sections of the mooring time series, over which T was nearly uniform in a region of depth around the MDRs, were used to identify a bias in the MDR data. By averaging the T of the nearest sensors above and below each MDR, an estimate of the MDR offset was made. The offsets found and applied to the data were:
MDR #100 add -.002°C and MDR #116 add -.005°C.

Meteorological Sensors

The Vaisala air temperature and relative humidity sensor (model HMP45C-L; #T4810014), also used on COAST '01 deployment, was calibrated 8/20/02 by Campbell Scientific. This sensor failed within 11 days of deployment for reasons that have not been determined.

Two Li-Cor pyranometers (short-wave radiation sensors; model LI200) were deployed on the Met mooring. One sensor (#PY32771) was used on COAST '01 and recalibrated 9/10/02 by Campbell Scientific. The other sensor (#PY43272) was purchased for this experiment.

Frequently, one of the two sensors was shadowed by the anemometer mount. For this reason, we created a composite short wave radiation time series by choosing the larger of the two values at each time.

Near-real-time access to Met buoy data via cellular phone worked well, with data transmitted every few days.

Doppler Profiler Compasses

Self calibrations of the compasses of the RDI 300 kHz ADCP Doppler current profilers were performed prior to deployment on 6 Jan 2003, per manufacturer's specifications and in the deployment orientation (up or down) in the OSU stadium parking lot. The Nortek 1 MHz and 2 MHz Aquadopp profilers were not calibrated prior to deployment. At the time of deployment, Nortek did not provide software for user calibration of the compass.

Comparison of velocity data from overlapping and nearly-overlapping bins of the RDI ADCP and Nortek Aquadopp profilers deployed on the COAST 2001 NMS mooring prompted calibration of the Nortek AquaDopp compasses on the OSU compass stand (Boyd *et al.*, 2002). The Aquadopps were fixed to the stand and rotated through 360°. These calibrations were conducted on 15 Sept 2003 (much after the 2003 deployment) and with alkaline battery packs on hand, rather than the lithium battery packs used in the deployment. The heading-dependent heading errors are shown in Figure 8. Velocities were corrected for heading error under the assumption that the heading was constant within an ensemble averaging interval. After rotating headings to correct for the heading error, the mean difference in headings between the Nortek and RDI bins were reduced from as much as 10° for the 1 MHz (upper) instrument, depending on depth bin and velocity magnitude (Figure 9). Minimal change in direction difference was obtained for the 2 MHz (lower) instrument. In this report, velocities from the Nortek AquaDopps are shown rotated by the amounts indicated in Figure 8.

Doppler Profiler Battery Capacity

Estimates of the energy consumed by the Doppler current profilers during the mooring deployments are shown in Table 2. The energy consumed by the RDI Workhorse 300kHz ADCPs was estimated using the RDI "Plan" software. None of the ADCP energy usage values exceed the 400 Watt hour nominal capacity of the RDI-supplied alkaline battery packs. The energy consumed by the Nortek 1MHz and 2MHz Aquadopps was estimated using the Nortek "AquaPro" software. Neither of the AquaPro energy usage values exceeded the 175 Watt hour nominal capacity of the Nortek-supplied lithium battery packs.

Pressure Sensors

On each of the 3 oceanographic moorings, pressure was measured in the depth range 16-17 m. Two additional pressure records were recorded on the DMS mooring by the 2 Nortek Aquadopps deployed at 19m (1MHz) and 87m (2MHz). One additional pressure was measured on the DSB mooring at 28m.

An inter-calibration of the four pressure sensors, 2 MDRs and 2 SBE 39s, was performed during CTD cast #16 after recovery (the Nortek sensors were not calibrated). The CTD with sensors attached was stopped for 10 minutes at four steps. The results are summarized as follows:

- Both MDR showed some hysteresis at 0 pressure. The instruments indicated a change of (+1.3m , +.94m) at 0 pressure from before cast to after cast. The hysteresis in the SBE 39's was negligible.
- Since #662 and #663 were calibrated just before deployment at SBE, they are assumed correct. Also, the average difference between the 2 sensors was less than 0.5 db: (.03, .52, .14, -.07, -.25 db) at (0, 20, 40, 62, 127 db).
- The most significant difference was with MDR #116 which was (.16, 1.98, 1.3, 2.02 db) at (20, 40 62, 127 db) respectively.

The average pressure recorded by the Aquadopps was within 1 m of the expected depth, so no correction was applied.

The following calibrations were used:

Sensor	Serial #	Adjustment
SBE 39	662	factory calibration (17 Nov 02)
SBE 39	663	factory calibration (17 Nov 02)
MDR	100	A = 0.09551, B = -20.427 (same as previous calibration)*
MDR	116	A = 0.09554, B = -15.664 (+1 db to B from previous calibration)*
Nortek 2MHz		no adjustment
Nortek 1MHz		no adjustment

(*Note: MDR calibration is as follows: P(db)=A + B x counts.)

CTD Sensors

Temperature and salinity data were collected using the same SBE 911*plus* CTD on both the deployment (W0301A) and recovery (W0303A) cruises. Two temperature and conductivity sensor pairs were used on the *Wecoma*'s CTD. The primary sensors were T0 (#1369) and C0 (#1030); the secondary pair were T1 (#1371) and C1 (#2356). All of these sensors were calibrated 17 December 2002. Bottle samples were collected for calibration of the conductivity cells during the cruises.

During each cruise, Niskin bottle samples were taken on CTD upcasts within regions that were relatively well mixed in salinity, as determined by the real-time display during the downcasts. Duplicate water samples were drawn from the Niskin bottles and the salinity was subsequently measured with a Guildline 8400B Autosal (OSU #6) in Corvallis. Pat Collier of OSU ran the salinities for both cruises. Jane Fleischbein of OSU did the analysis of the deployment data; she has done calibrations of this CTD system for many years. The analysis of the recovery cruise data followed Fleischbein's methodology, which is outlined below.

1. Determine bottle salinity (S_{Bot}) by Autosal.
2. Average P,T,C, and S corresponding to the depth of the bottle sample from each cast using SBE data processing module BOTTLESUM.
3. Compute bottle conductivity (C_{Bot}) from CTD P and T, and bottle Salinity S_{Bot}.
4. Compute conductivity difference: $\Delta C = C_{Bot} - C_{CTD}$.
5. Compute statistics of conductivity difference ΔC over all bottle samples, removing outlier bottle data as necessary.
6. Compute conductivity correction by which to multiply C_{CTD} prior to final computation of salinity: $C_{Corr} = C_{CTD} * C_{Mult}$, where $C_{Mult} = 1 + (\Sigma \Delta C / \Sigma C_{Bot})$. Positive errors in conductivity ($\Delta C>0$), result in a multiplication factor of greater than 1.

Salinities were determined for 27 bottle samples collected during the deployment cruise; two samples were not included in the final bottle statistics due to anomalously large ΔC. Since the large ΔC occurs for both sensor pairs, it is assumed to result from a problem with the bottle samples. Statistics for the bottle-CTD comparison for the deployment cruise are shown below. Conductivity units are $mmhos/cm^2$(=mS/cm).

Sensors	Mean ΔC	Std ΔC	Mean ΔS	Std ΔS
Primary	0.001	0.003	0.001	0.003
Secondary	0.001	0.003	0.001	0.003

The corrections to the measured conductivity from the sensors during the deployment cruse are:
Primary: C_{Mult} = 1.0000403 Secondary: C_{Mult} = 1.0000190

Salinities were determined for 14 bottle samples collected during the recovery cruise; two outliers were removed due to large ΔC for both sensor pairs. Statistics for the bottle-CTD comparison for the recovery cruise are shown below.

Sensors	Mean ΔC	Std ΔC	Mean ΔS	Std ΔS
Primary	-0.0035	0.0013	-0.0036	0.0012
Secondary	-0.0078	0.0015	-0.0077	0.0012

The corrections to the measured conductivity from the sensors during the recovery cruise are:
Primary: C_{Mult} = 1.000099336 Secondary: C_{Mult} = 1.00021783

Introducing these multiplication factors into test data (C=36, T=10.7°C, and P=40dbar, C'=C* C_{Mult}), yields salinity corrections of the order of 0.0014 and 0.0007 for the primary and secondary sensor pairs, respectively, during the deployment cruise, and yields corrections of order 0.0035 and 0.0078 for primary and secondary sensor pairs, respectively, during the recovery cruise.

The analysis of the deployment sample and CTD conductivity differences showed no correction was needed for either pair. The primary pair was the sensor pair used for final processing of all deployment casts. The analysis of recovery sample and CTD conductivity differences revealed errors in CTD conductivities that were twice as large as during the deployment cruise. Although the error for conductivity from the primary sensor pair are right around the accuracy of the sensors (0.003 mS/cm), a conductivity correction of 1.000099336 was applied to bring the error in line with the errors observed during the deployment cruise. The primary sensor pair was used for final processing of all recovery cruise casts.

The processing of both deployment and recovery CTD data used the algorithms and parameter values recommended for standard processing of SBE 911 data, as given in the SBE Data Processing v5.32a manual. In particular, secondary conductivity was lagged 0.073 seconds relative to pressure (primary conductivity is lagged the same amount in the deck unit) in module ALIGNCTD; conductivity cell thermal mass errors were corrected using parameters alpha = 0.03 and 1/beta = 7.0 in module CELLTM; pressure was low-pass filtered with a time constant of 0.03 seconds and conductivity with a time constant of 0.15 seconds in FILTER. Finally, the downcast data were averaged into 1 db bins.

3c. Doppler Profiler Data Processing and Quality

Vector currents shown were rotated from magnetic coordinates to geographic coordinates using the magnetic declination of 17.87° E, derived using the Geomagix program (http://www.interpex.com/magfield.htm) for 45°N 124°10'W.

Data Quality

Measurements of water velocity were made with acoustic Doppler velocity profilers: instruments that measure the Doppler shift of acoustic energy reflected by scatterers assumed to be moving passively within the water column. In recording the reflected acoustic energy, the acoustic Doppler profilers also record the effects of nearfield reverberation, reflections from the surface or bottom, and reflection from spurious targets within the water column. Diagnostic variables generated by the velocity profilers are used, together with the velocity data, to assess the quality of the velocity data within each range bin. We have used these diagnostics to eliminate spurious or excessively noisy data, thereby reducing the data set to include only range bins with high quality data. The record averages of the amplitudes of velocity components from all of the velocity profilers are shown in Figure 10, where velocity data is shown out to the range of the boundaries, and the extent of the acceptable data is indicated by shading

300 kHz RD Instruments (RDI, now Teledyne RD Instruments) Acoustic Doppler Current Profilers (ADCPs) were used to make the primary velocity measurements on each of the moorings. The RDI ADCPs generated a number of diagnostic variables, including: beam amplitude, signal correlation, percentage of good 4- or 3-beam solutions, and error velocity. These diagnostics are described in the RDI primer on ADCP operating principles and on the RDI website (RDI, 1996; www.rdinstruments.com/tips/tips.html). Plots of record averages of amplitude and correlation for all 4 beams are shown as a function of depth in Figures 11 and 12 for the ADCPs on each mooring. Each ADCP record sample is an average over an ensemble of velocity estimates derived from 19-26 acoustic pings over a period of 2 minutes (Table 2). The record averages of the percentages of those pings that yielded valid velocity estimates (either via a 4-beam solution, or a 3-beam solution, when a 4-beam solution was not possible) are shown as a function of depth in Figure 13 for each of the ADCPs. In Figure 14 the percentage of

ensembles for which the fraction of accepted pings (i.e. pings yielding valid velocity estimates) falls within a few, broad percentile classes is shown as a function of range.

1MHz and 2MHz Nortek Aquadopps were deployed on the DMS mooring for high vertical resolution measurements of the upper and lower boundary layers. The Aquadopps report only signal amplitude as a diagnostic. The beam amplitudes for the 1 MHz and 2 MHz Aquadopps are shown as a function of depth in a single panel with the DMS ADCP in Figure 10. The RDI velocity magnitudes from 12-18 m depth typically exceed by 10%-30% the velocity magnitudes from the 1 MHz AquaDopp over that depth range (Figure 9c). The distribution of velocity magnitude differences is much broader (with a less well-defined peak) near the bottom, but in this case there are no truly overlapping RDI and 2 MHz AquaDopp bins (Figure 9d). In the velocity figures shown in this report, the magnitude of the 1 MHz Nortek velocities have been increased relative to the measured values by a factor of 1.15 for depths shallower than 16 m and by 1.3 for depths greater than 16 m. The 2 MHz velocities are shown at the measured amplitudes. Time series of velocity from the upward-looking 1 MHz AquaDopp exhibit some banding, i.e. obvious difference between signals in adjacent bins, which remains unexplained.

Three types of phenomena typically impact the quality of data within the vertical range of the profilers: (1) near-field effects, (2) , side-lobe reflection from instrumentation on the mooring line, and (3) surface or bottom reflection of side-lobe energy (depending on up/down orientation). The bins with acceptable data (that is, with data which have not been adversely impacted by the above phenomena) are shown in Table 2 for each velocity profiler. The selection criteria for each profiler are discussed briefly below.

RDI Near-field Effects The RDI ADCPs are particularly susceptible to near-field errors. This is apparent in the record-average beam amplitudes, which can be significantly larger for the closest one or two bins (e.g. DIS in Figure 11) than for nearby bins at greater range. In contrast, RDI ADCP beam correlation is lower for the closest one to three bins than for nearby bins at greater range (Figure 12).

RDI Inline Reflections In past deployments, we found that the RDI ADCPs are susceptible to signal contamination by reflection of sidelobe energy from other instruments on the mooring line at relatively close range. This problem is more commonplace in deeper, lower scattering environments, where the low energy sidelobe reflections from hard targets represent a larger fraction of the reflected energy from a given range bin. In data from the relatively shallow deployments during the COAST 2001 experiment, all of the identified problems with sidelobe reflections occurred within 10-11 m of the transducers. The reflection from a hard target on the mooring wire has a characteristic signature in both correlation and velocity. The characteristic correlation signature is an oscillation with depth around the range of the target – larger and smaller than that from neighboring, non-contaminated bins. The sidelobe energy, although much lower energy than the main lobes, represents a significant fraction of the energy reflected to the transducer and biases the velocity toward zero, because the hard target on the wire is not moving relative to the Doppler profiler.

Following the successful reduction of sidelobe hard-target reflections on the HOME (Hawaii Ocean Mixing Experiment) Nearfield moorings of 2002, we deployed an acoustic baffle in the nearfield of each upward-looking ADCP deployed in COAST 2003. We found no indication of sidelobe reflection from in-line mooring elements in either the mean velocity (Figure 10) or correlation (Figure 12) profiles from COAST 2003.

<u>RDI Surface Reflections</u> The approximate range at which sidelobe acoustic energy reflects from a boundary goes as D cos(θ) where D is the distance to the boundary and θ is the angle of the acoustic beams from vertical. In practice, however, the proximity of good data bins to the surface is determined by reviewing a combination of the velocity data (Figure 10) and the diagnostic variables, shown in Figures 11-14 and discussed briefly here.

Beam amplitude decays with range and then increases dramatically when the beam encounters a boundary (Figure 11). Typical values for RDI beam amplitude go from 120-135 at close range to 50-75 at maximum range. Nortek Aquadopp values are somewhat lower at both close (~100-110) and at maximum (~30-40) range. Beam correlation (RDI ADCP only) decreases weakly with increasing range (~125-100) until the sidelobe encounters the surface, at which point the correlation decreases rapidly with increasing range (Figure 12).

The percentage of good solutions (4-beam, 3-beam, 3- & 4-beam) is another indicator of the quality of the ensemble averaged velocity in each bin for the RDI instruments. Throughout most of the water column, the record average of the ensemble-percentage of good 4-beam solutions is very close to 100%. This percentage drops rapidly for bins at greater range than the closest bin identified with the sidelobe reflection from the surface.

The amplitudes of the mean velocity components usually change dramatically within the first two bins at greater range than the sidelobe reflection from the surface (Figure 13). In this report, we show data from one bin beyond the range of surface reflection for the DIS, DMS, and DSB ADCPs, as determined using the diagnostics. The velocities still look good at these ranges, however the statistics indicate the data are noisier.

The mean amplitude of the downward-looking near-surface ADCP on the DMET mooring falls off more rapidly with range than does the upward-looking near-bottom ADCP on the nearby DMS mooring. This may be due in part to the difference in scattering concentrations at large range. The near-bottom upward-looking DMS ADCP may encounter a higher density of scatterers close to the surface, than the near-surface downward-looking DMET ADCP encounters close to the bottom. Since radial spreading decreases the amplitude of the acoustic signal at greater ranges, this may lead to a significantly higher amplitude returned signal from greater ranges for the near-bottom upward-looking ADCP. The surface buoy to which the DMET ADCP was mounted was subjected to much more motion that the subsurface buoys, and the resulting DMET ADCP data set is much noisier at high frequencies than data from the nearby DMS ADCP. For this reason, only low-pass filtered DMET ADCP data is shown in this report, for comparison with the DMS ADCP data.

<u>Nortek Surface Reflections</u> In determining the depths of the surface and bottom reflections for the Nortek Aquadopps, we have relied on the amplitude of the reflected signal and the mean and std deviations of the velocity components. For the downward-looking 2MHz Aquadopp, the mean and standard deviation of all velocity components (u, v, w) increase rapidly with increasing

range beyond bin 12 (z = 77.25 m), although the amplitude shows no sign of the bottom reflection until bin 16 (z = 79.25 m). It is possible that this discrepancy is related to sampling of turbulent eddies within the bottom boundary layer. Since the eddy size decreases as the boundary is approached, the observed increased variability may represent a breakdown in the assumption of a homogeneous velocity field over the horizontal separation of the beams. In contrast, beam amplitude from the upward-looking 1 MHz Aquadopp indicates the surface reflection occurs farther from the surface (~ 3.5 m, bin 14) than do the velocity component means and standard deviations (~2.5 m, bin 16). We have selected bin 15 as the farthest good bin for both the 1MHz upward-looking and 2MHz downward-looking Aquadopps.

3d. Data Filtering

We have included plots of 1-hour and 40-hour low pass filtered data in this report and on the data CD. The 1-hour low-pass filter has a window ½ width of 8 hours, and ¼ power point of 1 hour. The 40-hour low-pass filter has a window ½ width of 61.33 hours, and ¼ power point of 40 hours. These window widths are a reduction by ½ over the filter widths used in processing previous mooring time series, such as NOPP (Boyd *et al.*, 2000) and PRIMER (Boyd *et al.*, 1997). The low pass filter is a symmetric, finite impulse response filter with a Lanczos taper.

The filter output is $\overline{T_i} = \frac{\sum_{k=-M}^{M} h_k T_{k+i}}{\sum h_k}$, where the kth filter weight is $h_k = \frac{\sin(\pi F_c / F_N k\Delta t)}{(\pi F_c / F_N \Delta t)}$, in which F_c is the cutoff frequency, F_N is the Nyquist frequency and Δt is the sample interval. There is no filter output within one filter ½ width of the start or stop times of the time series. The filter permits data gaps, but requires at least 50% of data within each side of the window, and filter weights are adjusted accordingly such that the sum of weights on each side = ½.

4. REFERENCES

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5. TABLES

Table 1a.

Downwelling Inner Shelf   45° 0.25' N, 124° 4.10' W   Water depth 50 m

Sensor	Serial #	Depth, m	Del t, min	Calibrations	Comments *
Air T	448600	-3	7.5		RS
Air T	448601	-3	7.5		RS
Microcat	41	2.4	1	20 May 02	on spar, -16s
Vemco	7309	4.5	6		-120s
Vemco	7329	4.5	6		-130s
Radiometer	152	10.2			RL
Microcat	1818	12	1	20 May 02	-24s
Fluor/BS	067/044B	15			TC
MDR	100	16	4	20 Dec 02	w/ press, +108
SBE 39	87	20	1	23 May 02	+9s
SBE 39	665	28	1	23 May 02	+9s
BS	054B	35			ZC
Vemco	7331	35	6		NR
Microcat	42	40	1	16 Mar 02	-10s
MTR	3095	45	2	20 Dec 02	+66s
RDI xducer	67	46	2		
Fluor/BS	068/049B	47			TC
SBE 39	654	48	1	17 Nov 02	on release, NR

* Note: times shown are clock drift over duration of experiment, defined as reference minus instrument. NR = not recorded.

* Note: shading indicates responsibility for instrument by other COAST PIs.

RS = Roger Samelson
RL = Ricardo Letelier
TC = Timothy Cowles
ZC = Zanna Chase

Table 1b.

Downwelling Mid Shelf 45° 0.25' N, 124° 8.67' W Water depth 97 m

Sensor	Serial #	Depth, m	Del t, min	Calibrations	Comments *
Radiometer	153	11.2			RL
Microcat	1823	13	1	14 Nov 02	-23s
Fluor/BS	069/050B	16			TC
SBE 39	663	17	2	17 Nov 02	w/ press, +14s
Aquadopp 1M	P035-2/01	19	4		
SBE 39	88	21	1	22 May 02	NR
Microcat	1816	29	1	20 May 02	-13s
MTR	3085	41	2	20 Dec 02	+85s
SBE 39	667	51	1	18 Nov 02	+10s
MTR	3094	61	2	20 Dec 02	+57s
MTR	3078	71	2	20 Dec 02	+91s
Vemco	7300	76	6		-97s
BS	053B	81			ZC
MTR	3088	81	2	20 Dec 02	-8s
Microcat	1822	86	1	14 Nov 02	-16s
Aquadopp 2M	P035-1/01	87	2		
MTR	3084	91	2	20 Dec 02	on baffle chain, +78s
RDI xducer	1944	92	2		
Fluor/BS	066/047B	93			TC
SBE 39	655	94	1	16 Nov 02	on release, +10s

* Note: times shown are clock drift over duration of experiment, defined as reference minus instrument. NR = not recorded.

* Note: shading indicates responsibility for instrument by other COAST PIs.
RS = Roger Samelson
RL = Ricardo Letelier
TC = Timothy Cowles
ZC = Zanna Chase

Table 1c.

Downwelling Shelf Break   45° 0.26' N, 124° 12.70' W   Water depth 129 m

Sensor	Serial #	Depth, m	Del t, min	Calibrations	Comments *
Air T	448604	-3	7.5		RS
Air T	448602	-3	7.5		RS
Microcat	43	2.4	1	20 May 02	on spar, -14s
Vemco	7298	4.5	6		-109s
Vemco	7314	4.5	6		-115s
Radiometer	154	10.2			RL
Microcat	39	12	1	20 May 02	-9s
Fluor/BS	071/052B	15			TC
SBE 39	662	16	2	17 Nov 02	w/ press, +13s
SBE 39	666	20	1	22 May 02	+10s
MDR	116	28	4	20 Dec 02	w/ press, +227s
SBE 39	664	36	1	22 May 02	+9s
MTR	3082	48	2	20 Dec 02	+31s
Microcat	1821	60	1	14 Nov 02	-8s
Vemco	7316	70	6		-111s
MTR	3080	80	2	20 Dec 02	+70s
Vemco	7323	90	6		NR
SBE 39	657	100	1	17 Nov 02	+11s
SBE 39	668	110	2	24 May 02	+16s, pr. broken
Microcat	1820	120	1	14 Nov 02	-14s
MTR	3079	125	2	20 Dec 02	on baffle chain, +68s
RDI xducer	1969	126	2		
Fluor/BS	070/051B	127			TC
SBE 39	656	128	1	17 Nov 02	on release,+131s

* Note: times shown are clock drift over duration of experiment, defined as reference minus instrument. NR = not recorded.

* Note: shading indicates responsibility for instrument by other COAST PIs.
RS = Roger Samelson
RL = Ricardo Letelier
TC = Timothy Cowles
ZC = Zanna Chase

Table 1d.

Downwelling Meteorological Buoy **45° 0.24' N, 124° 9.62' W** **Water depth 102 m**

Sensor	Serial #	Depth, m	Del t, min	Calibrations	Comments *
Young Wind		-3.0	15	New bearings	
Vaisala T/RH	T4810014	-2.1	15	20 Aug 02	T & RH failed
Li-Cor Li-Cor	PY43272 PY32771	-2.1 -2.1	15 15	New this expt. 10 Sept 02	
Air T Air T	448599 448598	-2.1 -2.1	7.5 7.5		RS much noisier
Barometer	T3830003	0	15		
Microcat IM	1824	1.5	1	11 Nov 02	on bridle
RDI xducer	1847	2.5	2		
MTR	3099	4	2	20 Dec 02	+62s
SBE 39	659	6	1	17 Nov 02	+11s
MTR	3010	8	2	20 Dec 02	+60s
SBE 39	661	10	1	16 Nov 02	+11s

Table 1e. Mooring Instrumentation

Sensor Name	Model / description	Manufacturer	Variables measured
SBE 39 plastic	SBE 39 Temperature Recorder, Celcon plastic case (350 m)	Sea-Bird Electronics	T, some with pressure
SBE 39 Ti	SBE 39 Temperature Recorder, Titanium case (7000 m)	Sea-Bird Electronics	T, some with pressure
Microcat	SBE 37-SM MicroCAT (Serial interface & memory)	Sea-Bird Electronics	T, C, some with pressure
Microcat IM	SBE 37-IM MicroCAT (Inductive Modem)	Sea-Bird Electronics	T, C
MTR	Miniature Temperature Recorder	NOAA	T
Vemco	Minilog TR (8-bit)	Vemco Limited	T
Air T	TBI32-05+37 StowAway TidbiT Temp Logger	Onset	Air T
RDI xducer	ADCP 300 kHz	RDI, Inc	Velocity profiles
Aquadopp 1M	1 MHz Doppler profiler	Nortek	Velocity profiles
Aquadopp 2M	2 MHz Doppler profiler	Nortek	Velocity profiles
Radiometer	OCI-200 with MVD StorDat	Satlantic	Downwelling Irradiance
Fluor/BS	ECO-DFLS/ECO-VSFS	WET Labs, Inc.	Fluorescence / Optical backscatter
Vaisala T/RH	HMP45C	Vaisala, Inc.	Air T & relative humidity
Young Wind	05106-5	RM Young	Wind speed & direction
Li-Cor	LI200X / pyranometer	Li-Cor	Solar radiation
Baro Pressure	CS105	Vaisala, Inc.	Barometric pressure

Table 2. Sampling Parameters for Doppler Current Profilers

A. Downwelling Inner Shelf (DIS) Mooring - water depth 50 m
45° 0.25' N, 124° 4.10' W

Parameter	Value	Comment
Manufacturer	RDI, Inc.	Purchased by Levine / Boyd
Model / Serial no. / CPU firmware	Workhorse / 0067 / 8.35	
Frequency / Configuration	307.2 kHz / 4 beam, Janus	
Beam Angle, Pattern / Orientation	20 degrees, Convex / Up	
Sensors	Heading, Tilt1, Tilt2,	Temperature
Temp Sensor Offset	-0.22 degrees C	
Mode	Wide	Command – WB 0
Number of Bins	25	Command – WN 025
Bin Size (m)	2	Command – WS 0200
Number of pings / ensemble	26	Command – WP 00026
Time between ping	4.80 sec	Command – TP 00:04.80 (Set by PLAN)
Ensemble interval (actual)	2 min (124.8 s)	Command – TE 00:02:00.00
Time of first ping	03/01/11, 01:59:00	Command – TF 03/01/11,01:59:00
Salinity (PSU)	35	Command – ES 35
Depth (m)	46	Command – ED 00460
Data out	Vel Cor Amp PG	Command – WD 111100000
Blank transmit (cm)	176	Command – WF 0176
Ambiguity velocity (cm/s radial)	170	Command – WV 170 (Mode 1 Ambiguity)
Heading Align (1/100 deg)	+00000	Command – EA 00000
Heading Bias (1/100 deg)	+00000	Command – EB 00000
Coordinate Transform	Earth,Tilt,3Bm,BinMap	Command – EX 11111
Sensor Source	C,D,H,P,R,S,T	Command – EZ 1111111
Raw Data: Last Ensemble	03/03/18, 18:05:34	46158 ensembles, 66 days 16:06:33
Final Data: Good Bins (depth)	First: 2 (40 m)	Last: 19 (6 m)
Final Data: Good Ensembles	First: 03/01/12, 22:27:38	Last: 03/03/17,20:40:07 (44257 ensembles)
Energy Used	RDI Plan est.: 377 Wh	Duration: 66.67 days; temperature 5 °C

Table 2. Sampling Parameters for Acoustic Doppler Current Profilers

B. Downwelling Mid Shelf (DMS) Mooring - water depth 97 m
45° 0.25' N, 124° 8.67' W

Parameter	Value	Comment
Manufacturer	RDI, Inc.	Purchased by Levine / Boyd / Kosro
Model / Serial no. / CPU firmware	Workhorse / 1944 / 16.12	
Frequency / Configuration	307.2 kHz / 4 beam, Janus	
Beam angle, Pattern / Orientation	20 degrees, Convex / Up	
Sensors	Heading, Tilt1, Tilt2,	Temperature
Temp Sensor Offset	-0.24 C	
Mode	Wide	Command – WB 0
Number of Bins	45	Command – WN 045
Bin Size (m)	2	Command – WS 0200
Number of pings / ensemble	22	Command – WP 00022
Time between ping	5.71 sec	Command – TP 00:05.71 (Set by PLAN)
Ensemble interval (actual)	2 min (125.2 s)	Command – TE 00:02:00.00
Time of first ping (first ensemble)	03/01/11, 01:59:00	Command – TF 03/01/11,01:59:00
Salinity (PSU)	35	Command – ES 35
Depth (m)	91	Command – ED 00910
Data out	Vel Cor Amp PG	Command – WD 111100000
Blank transmit (cm)	176	Command – WF 0176
Ambiguity velocity (cm/s radial)	170	Command – WV 170 (Mode 1 Ambiguity)
Heading Align (1/100 deg)	+00000	Command – EA 00000
Heading Bias (1/100 deg)	+00000	Command – EB 00000
Coordinate Transform	Earth,Tilt,3Bm,BinMap	Command – EX 11111
Sensor Source	C,D,H,P,R,S,T	Command – EZ 1111111
Raw Data: Last Ensemble	03/03/19, 03:04:15	46114 ensembles, 67 days 02:05:00
Final Data: Good Bins (depth)	First: 2 (86 m)	Last: 40 (10 m)
Final Data: Good Ensembles	First: 03/01/12, 18:40:12	Last: 03/03/17, 00:30:31 (43499 ensembles)
Energy Used	RDI Plan est.: 385 Wh	duration: 67.09 days; temperature: 5 °C

Table 2. Sampling Parameters for Acoustic Doppler Current Profilers

C. Downwelling Shelf Break (DSB) Mooring - water depth 129 m
45° 0.26' N, 124° 12.70' W

Parameter	Value	Comment
Manufacturer	RDI, Inc.	Purchased by Levine / Boyd / Kosro
Model / Serial no. / CPU firmware	Workhorse / 1969 / 16.12	
Frequency / Configuration	307.2 kHz / 4 beam, Janus	
Beam Angle, Pattern / Orientation	20 degrees, Convex / Up	
Sensors	Heading, Tilt1, Tilt2,	Temperature
Temp Sensor Offset	-0.22 degrees C	
Mode	Wide	Command – WB 0
Number of Bins	58	Command – WN 058
Bin Size (m)	2	Command – WS 0200
Number of pings / ensemble	19	Command – WP 00019
Time between ping	6.31 sec	Command – TP 00:06.31 (Set by PLAN)
Ensemble interval (actual)	2 min (120.0 s)	Command – TE 00:02:00.00
Time of first ping	03/01/11, 01:59:00	Command – TF 03/01/11,01:59:00
Salinity (PSU)	35	Command – ES 35
Depth (m)	126	Command – ED 01260
Data out	Vel Cor Amp PG	Command – WD 111100000
Blank transmit (cm)	176	Command – WF 0176
Ambiguity velocity (cm/s radial)	170	Command – WV 170 (Mode 1 Ambiguity)
Heading Align (1/100 deg)	+00000	Command – EA 00000
Heading Bias (1/100 deg)	+00000	Command – EB 00000
Coordinate Transform	Earth,Tilt,3Bm,BinMap	Command – EX 11111
Sensor Source	C,D,H,P,R,S,T	Command – EZ 1111111
Raw Data: Last Ensemble	03/03/18, 20:13:00	48068 ensembles, 66 days 18:14:00
Final Data: Good Bins (depth)	First: 2 (120 m)	Last: 56 (12 m)
Final Data: Good Ensembles	First: 03/01/13, 01:29:00	Last: 03/03/17, 15:59:00 (45796 ensembles)
Energy Used	RDI Plan est.: 367 Wh	Duration: 66.76 days; temperature 5 °C

Table 2. Sampling Parameters for Acoustic Doppler Current Profilers

D. Downwelling Meteorological (DMET) Mooring - water depth 102 m
45° 0.24' N, 124° 9.62' W

Parameter	Value	Comment
Manufacturer	RDI, Inc.	Purchased by Levine / Boyd / Kosro
Model / Serial no. / CPU firmware	Workhorse / 1847 / 16.12	
Frequency / Configuration	307.2 kHz / 4 beam, Janus	
Beam angle, Pattern / Orientation	20 degrees, Convex /Down	
Sensors	Heading, Tilt1, Tilt2,	Temperature
Temp Sensor Offset	-0.24 C	
Mode	Wide	Command – WB 0
Number of Bins	50	Command – WN 050
Bin Size (m)	2	Command – WS 0200
Number of pings / ensemble	21	Command – WP 00021
Time between ping	6.00 sec	Command – TP 00:06.00 (Set by PLAN)
Ensemble interval (actual)	2 min (126.0 s)	Command – TE 00:02:00.00
Time of first ping (first ensemble)	03/01/11, 01:59:00	Command – TF 03/01/11,01:59:00
Salinity (PSU)	35	Command – ES 35
Depth (m)	2	Command – ED 00020
Data out	Vel Cor Amp PG	Command – WD 111100000
Blank transmit (cm)	176	Command – WF 0176
Ambiguity velocity (cm/s radial)	170	Command – WV 170 (Mode 1 Ambiguity)
Heading Align (1/100 deg)	+00000	Command – EA 00000
Heading Bias (1/100 deg)	+00000	Command – EB 00000
Coordinate Transform	Earth,Tilt,3Bm,BinMap	Command – EX 11111
Sensor Source	C,D,H,P,R,S,T	Command – EZ 1111111
Raw Data: Last Ensemble	03/03/19, 06:15:30	46066 ensembles*, 67 days 04:16:30
Final Data: Good Bins (depth)	First: 1** (6.5 m)	Last: 45** (94.5 m)
Final Data: Good Ensembles	First: 03/01/11, 31:42	Last: 03/03/16, 22:05:00 (43874 ensembles)
Energy Used	RDI Plan est.: 383 Wh	duration: 67.18 days; temperature: 5 °C

* NOTE: an error appears to have occurred in writing to disk ensemble 13933 at time 03/01/31 09:36:12. Two data files were created by the ADCP the first of which is 15,620KB in size and includes ensembles 1-13,933, and the second of which is 36,028KB in size and includes ensembles 13,394-46,066.

** NOTE: the numbering of DMET bins has been reversed from that shown in the table, so that bin number increases with height above the bottom, as for the other ADCPs. With this renumbering, the first good bin is number 6 at 94.5 m depth and the last good bin is number 50 at 6.5 m depth.

Table 2. Sampling Parameters for Acoustic Doppler Current Profilers

E. Downwelling Mid Shelf (DMS) Mooring - water depth 97 m
45° 0.25' N, 124° 8.67' W

Parameter	Value	Comment
Manufacturer	Nortek	Aquadopp Profiler
Acoustic frequency	2MHz / 3 beams	purchased by Levine / Boyd / Kosro
Model / serial no.	AQP / 0359	Firmware version: 1.10
Slant angle	25 degrees	Bottom reflect. at z = 96.1 m (0.9 mab)
Power level	High	
Cell size / number of cells	0.5 m / 23 bins	
Profile interval	120 sec	
Average interval	28 sec	
Measurement load	17%	
Blanking distance	0.23 m	0.73 m to center of 1st bin
Wave mode (burst sampling)	Disabled	
Coordinate system	Earth	
Data filename (binary)	cst32M01.prf	
First profile Last profile	6:59:49 1/11/03 UTC 9:15:49 3/19/03 UTC	First good profile: 18:42:03 1/12/03 Last good profile: 00:31:49 3/17/03
Number of good profiles	45536	Velocity Precision: vertical = 0.9 cm/s, horizontal = 2.8 cm/s (per AquaPro)
Transducer depth	87 m	Downward-looking
Bin depths (m, center) ~~strikeout~~ = unreliable [bin #]	87.75, 88.25, 88.75, 89.25, ..., 93.75, 94.25, 94.75, ~~95.25~~ [16], ~~95.75~~ [17], ~~96.25~~ [18], ~~96.75~~ [19]	
Salinity used in c_{sound}	33.5 ppt	not very sensitive to S; 1.2 m/s per ppt
Auxiliary sensors	temperature, tilt (2), compass heading, pressure	
Battery type	Lithium	source: NortekUSA
Energy available (est.)	175 Wh	specified by: NortekUSA
Energy used (est.)	146 Wh	67.09 days, per Nortek AquaPro software

Table 2. Sampling Parameters for Acoustic Doppler Current Profilers

F. Downwelling Mid Shelf (DMS) Mooring - water depth 97 m
45° 0.25' N, 124° 8.67' W

Parameter	Value	Comment
Manufacturer	Nortek	Aquadopp Profiler
Acoustic frequency	1MHz / 3 beams	purchased by Levine / Boyd / Kosro
Model / serial no.	AQP / 0360	Firmware version: 1.10
Slant angle	25 degrees	Surface reflection at z = 1.8 m
Power level	High	
Cell size / number of cells	1.0 m / 22 bins	
Profile interval	240 sec	
Average interval	55 sec	
Measurement load	25%	
Blanking distance	0.46 m	1.46 m to center of 1st bin
Wave mode (burst sampling)	Disabled	
Coordinate system	Earth	
Data filename (binary)	cst31M01.prf	
First profile Last profile	6:59:32 1/11/03 UTC 3:19:32 3/19/03 UTC	First good profile: 18:43:12 1/12/03 Last good profile: 00:31:32 3/17/03
Number of good profiles	22768	Velocity Precision: vertical = 0.9 cm/s, horizontal = 2.8 cm/s (per AquaPro)
Transducer depth	19 m	Upward-looking
Bin depths (m, center) ~~strikeout~~ = unreliable [bin #]	17.5, 16.5, 15.5, 14.5, ..., 6.5, 5.5, 4.5, 3.5, ~~2.5~~ [16], ~~1.5~~ [17]	
Salinity used in c_{sound}	32 ppt	
Auxiliary sensors	temperature, tilt (2), compass heading, pressure	
Battery type	Lithium	source: NortekUSA
Energy available (est.)	175 Wh	Specified by: NortekUSA
Energy used (est.)	147 Wh	66.85 days, per Nortek AquaPro software

Table 3. Meteorological Buoy Components (purchased from Campbell Scientific Inc.)

Sensors:	
Air Temperature & Relative Humidity	Model HMP45C; Vaisala, Inc.
Wind speed & Direction	Model 05103-5; RM Young
Barometric Pressure	Model CS105; Li-Cor
Pyranometer (solar radiation) (2)	Model LI200X; Li-Cor
Buoy Compass	Model C100; KVH
Controller:	
Data Logger	Model CR10X; Campbell Scientific Inc.
Sampling Program (COAST2) – written by Dennis Root	
Data are averaged over 15 minutes, using samples taken every	
5 seconds (wind speed, vane direction & buoy compass)	
1 minute (air temperature, relative humidity, barometric pressure & radiation)	
Data from Microcat IM is polled for temperature and conductivity every 15 minutes	
Battery voltage is sampled and recorded once per day	
Communication:	
Cell phone package	Model CDM100; Motorola
Powered on between 1600 and 1700 UT each day	

Table 4. Day of year calendar for 2003

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
	---	---	---	---	---	---	---	---	---	---	---	---	
Day # 1	1	32	60	91	121	152	182	213	244	274	305	335	Day # 1
Day # 2	2	33	61	92	122	153	183	214	245	275	306	336	Day # 2
Day # 3	3	34	62	93	123	154	184	215	246	276	307	337	Day # 3
Day # 4	4	35	63	94	124	155	185	216	247	277	308	338	Day # 4
Day # 5	5	36	64	95	125	156	186	217	248	278	309	339	Day # 5
Day # 6	6	37	65	96	126	157	187	218	249	279	310	340	Day # 6
Day # 7	7	38	66	97	127	158	188	219	250	280	311	341	Day # 7
Day # 8	8	39	67	98	128	159	189	220	251	281	312	342	Day # 8
Day # 9	9	40	68	99	129	160	190	221	252	282	313	343	Day # 9
Day #10	10	41	69	100	130	161	191	222	253	283	314	344	Day #10
Day #11	11	42	70	101	131	162	192	223	254	284	315	345	Day #11
Day #12	12	43	71	102	132	163	193	224	255	285	316	346	Day #12
Day #13	13	44	72	103	133	164	194	225	256	286	317	347	Day #13
Day #14	14	45	73	104	134	165	195	226	257	287	318	348	Day #14
Day #15	15	46	74	105	135	166	196	227	258	288	319	349	Day #15
Day #16	16	47	75	106	136	167	197	228	259	289	320	350	Day #16
Day #17	17	48	76	107	137	168	198	229	260	290	321	351	Day #17
Day #18	18	49	77	108	138	169	199	230	261	291	322	352	Day #18
Day #19	19	50	78	109	139	170	200	231	262	292	323	353	Day #19
Day #20	20	51	79	110	140	171	201	232	263	293	324	354	Day #20
Day #21	21	52	80	111	141	172	202	233	264	294	325	355	Day #21
Day #22	22	53	81	112	142	173	203	234	265	295	326	356	Day #22
Day #23	23	54	82	113	143	174	204	235	266	296	327	357	Day #23
Day #24	24	55	83	114	144	175	205	236	267	297	328	358	Day #24
Day #25	25	56	84	115	145	176	206	237	268	298	329	359	Day #25
Day #26	26	57	85	116	146	177	207	238	269	299	330	360	Day #26
Day #27	27	58	86	117	147	178	208	239	270	300	331	361	Day #27
Day #28	28	59	87	118	148	179	209	240	271	301	332	362	Day #28
Day #29	29		88	119	149	180	210	241	272	302	333	363	Day #29
Day #30	30		89	120	150	181	211	242	273	303	334	364	Day #30
Day #31	31		90		151		212	243		304		365	Day #31

Table 5. Deployment Cruise (W0301A) CTD Log

Station Number	Station Name	File Name	Latitude	Longitude	Date (UTC) 2003	Time (UTC)	Water Depth (m)
1	NH-5	cast01	44 39.15	124 10.63	14-Jan	1:20	58
2	NH-10	cast02	44 39.02	124 17.72	14-Jan	2:16	81
3	NH-15	cast03	44 39.10	124 24.69	14-Jan	3:06	94
4	NH-20	cast04	44 39.09	124 31.66	14-Jan	3:53	141
5	NH-25	cast05	44 39.09	124 38.96	14-Jan	4:43	297
6	NH-35	cast06	44 39.08	124 52.97	14-Jan	6:00	436
7	NH-45	cast07	44 39.00	125 7.01	14-Jan	7:36	700
8	CH-1	cast08	45 0.01	124 02.54	14-Jan	16:30	30
9	CH-2	cast09	45 0.03	124 4.32	14-Jan	16:58	52
10	CH-3	cast10	45 0.04	124 7.36	14-Jan	17:37	84
11	CH-4	cast11	44 59.98	124 10.01	14-Jan	18:08	106
12	CH-5	cast12	45 0.0	124 13.51	14-Jan	18:42	136
13	CH-5.5	cast13	45 0.03	124 16.83	14-Jan	19:16	160
14	CH-6	cast14	45 0.0	124 20.06	14-Jan	19:49	183
15	CH-6.5	cast15	45 0.0	124 23.36	14-Jan	20:20	235
16	CH-7	cast16	45 0.0	124 27.00	14-Jan	20:59	315
17	CH-8	cast17	45 0.0	124 44.03	14-Jan	22:30	527
18	CH-9	cast18	45 0.0	124 52.16	14-Jan	23:38	799
19	CH-10	cast19	45 0.0	125 01.19	15-Jan	0:58	970
20	L3-12	cast20	44 50.02	124 59.48	15-Jan	2:51	983

Table 6. Recovery Cruise (W0303A) CTD Log

Station Number	Station Name	File Name	Latitude	Longitude	Date (UTC) 2003	Time (UTC)	Water Depth (m)
1	DNM	cast01	45 00.25	124 8.70	17-Mar	3:45	95
2	DNS	cast02	45 00.27	124 12.70	17-Mar	19:00	134
3	DNI	cast03	45 00.27	124 4.10	17-Mar	23:25	50
4	CH-1	cast04	45 00.05	124 02.54	18-Mar	18:33	36
5	CH-2	cast05	45 0.00	124 4.26	18-Mar	18:59	52
6	CH-3	cast06	45 0.00	124 07.29	18-Mar	19:34	83
7	CH-4	cast07	45 0.02	124 10.04	18-Mar	20:10	106
8	CH-5	cast08	45 0.00	124 13.52	18-Mar	20:49	137
9	CH-5.5	cast09	45 0.00	124 16.75	18-Mar	21:27	160
10	CH-6	cast10	45 0.00	124 20.02	18-Mar	22:02	181
11	CH-6.5	cast11	45 0.00	124 23.4	18-Mar	22:36	235
12	CH-7	cast12	45 0.00	124 26.97	18-Mar	23:13	316
13	CH-8	cast13	45 0.00	124 44.00	19-Mar	0:47	517
14	CH-9	cast14	45 0.00	124 52.24	19-Mar	1:51	809
15	CH-10	cast15	45 0.00	125 01.12	19-Mar	3:23	959
16	AUV	cast16	44 37.99	124 32.67	19-Mar	22:48	150

6. ADDENDA

6a. Mooring Deployment Cruise (W0103A) on RV Wecoma

All times local, except as noted.

11 Jan 2003, Saturday

Left dock at 1000
Drills after lunch
1315 at Met buoy site (Dmet) to deploy Met buoy. Laying out chain on deck
Wind strong (30 knots), swell and sea large, some rain.
1445 letting out chain over fantail
1513 Anchor away

Dmet 45deg 0.24'N; 124deg 9.62'W

Ready decks for DNM [DMS] (Mid shelf mooring). Wind and rain persists.

1715 Eat dinner. Weather report forecasts winds and sea state no worse than current state, so decided to wait until morning to proceed with deployment.

2000 do ADCP survey along 45 deg line from Dmet to 125deg 10'W running both 150 and new 75 kHz ADCPs. Return along 45 deg line and on station in morning.

12 Jan 2003, Sunday

On station near DNM [DMS] by 0630.
0830 start deploying spar buoy over side.
1027 anchor away

DNM [DMS] **45deg 0.250'N; 124deg 8.665'W**

Proceed to DNI [DIS]
1420 anchor away

DNI [DIS] **45deg 0.248'N; 124deg 4.10'W**

Head for DNS [DSB] site.
1824 anchor away

DNB [DSB] **45deg 0.257'N; 124deg 12.704'W**

1900 start ADCP survey through waypoints 1 and 2 ending up near Kosro's Globec mooring to see if weather is good enough to recover and re-deploy. Total length of track 97 nm.

13 Jan 2003, Monday

At Globec mooring at breakfast.
0815 Released anchor
1015 Mooring and anchor recovered
After lunch, downloading data, new hardware attached, spar buoy repaired
Microcats not opened; SBE39s new desicants and closed with dry air
Respooled chain on trawl wire
Redeployed
0028 UTC Jan 14 – anchor away

Globec 44deg 38.621'N; 124deg 18.380'W in 81 m water

CTD's along NH line until 1230 am local

NH-5	cast01	0120 utc	1/14/03
NH-10	cast02	0216 utc	1/14/03
NH-15	cast03	0306 utc	1/14/03
NH-20	cast04	0353 utc	1/14/03
NH-25	cast05	0443 utc	1/14/03
NH-35	cast06	0600 utc	1/14/03
NH-45	cast07	0736 utc	1/14/03

14 Jan 2003, Tuesday

ADCP survey along 45 deg line ending at DNM [DMS] at breakfast

0830 Start CTD survey along CH line

(Note: CH numbers are those amended by J. Barth after the cruise)

			Expected Depth	Actual Depth
CH-1	cast08	1630 utc 1/14/03	30m	30m
CH-2	cast09	1658 utc 1/14/03	50m	52m
CH-3	cast10	1737 utc 1/14/03	80m	84m
CH-4	cast11	1808 utc 1/14/03	100m	106m
CH-5	cast12	1842 utc 1/14/03	130m	136m
CH-5.5	cast13	1916 utc 1/14/03	160m	160m
CH-6	cast14	1949 utc 1/14/03	185m	183m
CH-6.5	cast15	2020 utc 1/14/03	250m	235m
CH-7	cast16	2059 utc 1/14/03	300m	315m
CH-8	cast17	2230 utc 1/14/03	550m	527m
CH-9	cast18	2338 utc 1/14/03	800m	799m
CH-10	cast19	0058 utc 1/15/03	1000m	970m
L3-12	cast20	0251 utc 1/15/03	1000m	983m

Rick Verlini (mate) reports talking to 3 crab boats while in vicinity of CH-3

"Timmy Boy" Denny Burke

" Mark Richardson

"Jaka B" ?

Rick told them about the floating log with crab gear on it.

Gary the mate overheard a call from a fishing boat to the Coast Guard about a buoy on the loose. The bridge made contact with the fisherman, but most of the communication was garbled: something about a buoy with solar panels and line. Much speculation regarding what was wrong and what to do. We went by the Globec mooring on our way into Newport. The flashing light was not working. Using the ship's flood lights, we looked at the spar buoy which was found in the expected location. No evidence of line from the canister.

15 Jan 2003

0030 Docked at Newport

Science party:

Murray Levine
Tim Boyd
Mike Kosro
Walt Waldorf
Dennis Root
Lynn Wilkins
Clint Morrison

Marine Tech:

Daryl Swensen

6b. Log of COAST Mooring recovery cruise W0303A

All times local except where noted

3/16/2003 Sunday

1000 – leave dock
1045 – finished fire drill
1110 – Drills over; wait for lunch at 1130; swell not too bac
1330 – at Met buoy; small balls on deck; pulled on spectra and it broke; pulled up buoy then chain with anchor
1500 – All Met mooring on board; go to mid shelf mooring (DNM) [DMS]
TSRB total spectral radiation buoy deployed for 20 min.
1632 – released Mid Shelf Mooring
1645 – spar on deck
1706 – JimBuoy on deck
1745 – release on deck
dinner
1835 – begin pulling anchor
1900 – anchor on board
CTD #1 at DNM w/bottles for Yvan
2000 – start of ADCP survey along 45 deg N

3/17/2003 Monday

0800- at (DNB) [DSB] shelf break mooring; begin recovery ops
0805 – released Shelf Break mooring
0915 – all mooring on deck
go for anchor
1030 – begin TSRB ops
CTD #2 at DNB [DSB]
1120 – head for Inner shelf (DNI) [DIS]
TSRB ops

1246 - released Inner Shelf mooring
1315 – spar on deck
1350 – mooring on deck
go for anchor
1520 – all tidbits on top of doghouse for cross calibration
1525 – CTD #3 at DNI [DIS]

AUV work on deck; moved outside

1830 – begin Mike's radiator pattern; dump microcats

3/18/2003 Tuesday

at CH7 after breakfast; too rough weather for AUV ops
go to CH1 to start CH line

cast #	station	(new)	time, UTC	
4	CH1	(CH1)	3/18	1833
5	CH2	(CH2)		1859
6	CH3	(CH3)		1934
7	CH4	(CH4)		2010
8	CH5	(CH5)		2049
9	CH6	(CH5.5)		2127
10	CH7	(CH6)		2202
11	CH8	(CH6.5)		2236
12	CH9	(CH7)		2313
13	CH10	(CH8)	3/19	0047
14	CH11	(CH9)		0151
15	CH12	(CH10)		0323

2000 – start of ADCP survey along CH, then Mike's radiator, then NH 20 by morning (100 nm)

3/19/2003 Wednesday

at NH-20 in morning
AUV ops after breakfast; winds picking up to 30+ knots
First AUV launch and recovery – not enough weight
1030 second AUV launch
1145 recovery of AUV – some damage to AUV; much experience gained

cast #	station	time, UTC	
16	44deg 37.99N; 124deg 32.67W	078 2248	Calibration cast with Microcats. Vemcos, MTRs

1700 Start ADCP survey north to CH line and toward CH1 as far as possible before breaking off to get us to Whistle buoy by midnight
1900 War with Irag begins

Midnight at the Jaws
At dock – good night

3/20/2003 Thursday
Load truck, finish data downloads, clean rooms
1230 back in Corvallis

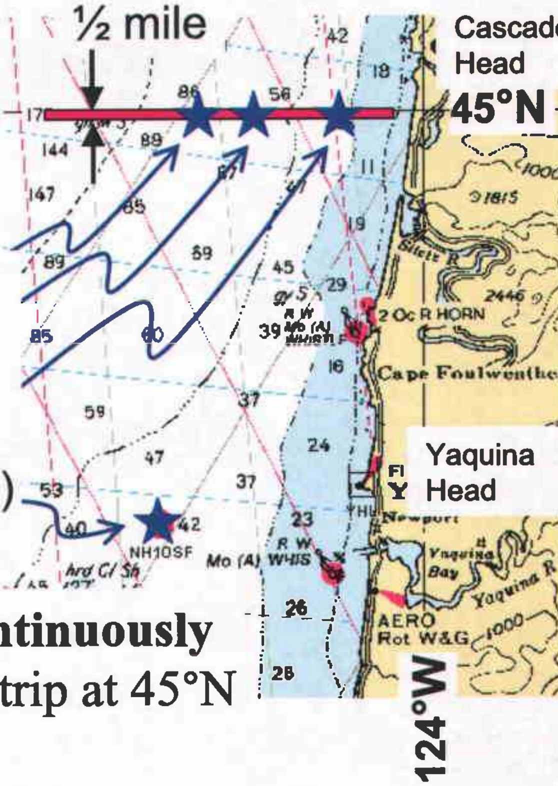
Heads Up!

Study by oceanographers at
Oregon State University
http://damp.coas.oregonstate.edu/buoys

5 Buoys

- **11 Jan to 21 Mar 2003**
- Radar reflector
- Flashing amber light (4s)

45° 0'N, 124° 12.7'W (**71fm**)
45° 0'N, 124° 09.0'W (**51fm**)
(2 buoys)
45° 0'N, 124° 04.1'W (**27fm**)
44° 38.8'N, 124° 18.4'W (**44fm**)



Towing Operations

- **19 Jan to 9 Feb 2003 continuously**
- E-W along ½ mile wide strip at 45°N
- From 15 fm to 110 fm

Help us minimize gear conflicts

Murray Levine, Oregon State University
541-737-3047 levine@coas.oregonstate.edu
Ginny Goblirsch, OSU Extension Service Lincoln Co.
1-888-350-2125 Ginny.Goblirsch@orst.edu

7. FIGURES

Figure 1. Oregon shelf bathymetry and mooring location map. The locations of the four COAST downwelling experiment moorings are indicated with filled circles. Also shown are the May - August 2001 COAST upwelling experiment mooring locations, which are indicated with X's. The COAST 2001 Met mooring co-located with the northern mid shelf mooring. The locations of the April-September 1999 NOPP moorings are shown with filled stars. The NOPP shelf-break mooring was dragged from southward from its initial location and then redeployed at the initial site. The locations of the deployment and recovery after dragging are shown as two stars.

Figure 2. Mooring instrumentation distribution. The vertical distribution of instruments is shown separately for each mooring, with instrument type and serial number listed at the deployment depths. The table on the lower left shows the sample rates used for each instrument type, with exceptions listed alongside particular instruments. Instruments contributed by other PIs are not shown.

The angled lines spreading away from both sides of the center line represent the extent of doppler velocity data for each mooring. Cross hatches along across the diagonal lines mark the boundaries of the nominal depth bins. Note that the bin numbers have been reversed (from the original) for the downward looking ADCP on the MET mooring in order to facilitate comparison with the mid-shelf mooring ADCP. All archived data for the MET ADCP use this reversed bin order. The ADCP series-mean percentage of ensembles with at least 90% accepted pings is shown as a function of depth in the left hand color bar, with color scale is shown at the top of each page.

Figure 3. Oceanographic data distribution schematic. The vertical distribution of instruments and data variables is shown collectively for all moorings. Instruments contributed by other PIs are also shown.

Figure 4. Deployment and Recovery cruise CTD station location map. Locations of CTD stations conducted during the January 2003 mooring deployment and March 2003 mooring recovery cruises. Deployment cruise CTD station locations are indicated by an open triangle; recovery cruise CTD stations are indicated with a filled triangle.

Figure 5. Mooring component schematics. Detailed schematics for each of the COAST 2003 mooring, including mechanical components, acoustic release details, and instrument details.

Figure 6. Record average temperatures. Vertical profiles of record-mean temperatures for instruments on each mooring. Mean Temperatures for instruments on the Met and Mid-shelf moorings have been combined in one panel. Mean temperatures +/- one standard deviation are shown with green lines; maximum and minimum temperatures are shown with red lines. Mean temperatures from the Vemco instruments are indicated with green dots.

Figure 7. Conductivity sensor comparison. Comparison of conductivities from all deployed SBE 39 Microcats to conductivity from the R/V Wecoma CTD sensor during recovery cruise

CTD cast #16. Comparison is between average conductivities over 10 minutes at 3 separate depths within well-mixed regions. Microcat sensor number is shown on the x-axis, step-average conductivity is shown on the y-axis. The range of conductivities for each step/sensor is shown as a shaded region for steps 2 and 4. The conductivity average and range for the CTD sensor for each step are shown as solid and dashed lines respectively.

Figure 8. Nortek AquaDopp compass heading errors. Difference between magnetic headings from the OSU compass stand (i.e. corrected for magnetic declination) and the magnetic headings from the Nortek 1 MHz (red line) and 2 MHz (blue line) AquaDopps as a function of the AquaDopp headings.

Figure 9. Nortek AquaDopp velocity errors: histograms of the differences between the directions and magnitudes of velocity measurements from the RDI ADCP and from the Nortek AquaDopp current profilers on the mid-shelf mooring. (a) Difference between velocity direction from the RDI ADCP and from the upward-looking shallow Nortek 1MHz AquaDopp; (b) direction difference between the ADCP and from the downward-looking deep Nortek 2MHz AquaDopp; (c) fractional difference between magnitudes of ADCP and 1MHz AquaDopp velocities; and (d) fractional difference between ADCP and 2MHz AquaDopp velocity magnitudes.

Velocity direction and magnitude differences are shown for three ranges of velocity magnitude. In (a) direction difference histograms are shown for velocity ranges: $|u| < 20$ cm/s red (orange), 20 cm/s $< |u| <$ 40 cm/s dark green (light green), and $40 < |u|$ cm/s blue (cyan) for the corrected (and uncorrected) compass headings of the 1MHz AquaDopp. Nortek 1 MHz bins 1 (17.5 m), 2-3 (16.5 and 15.5 m), 4-5 (14.5 and 13.5 m), and 6-7 (12.5 and 11.5 m) are compared to RDI bins 36 (18 m), 37 (16 m), 38 (14 m), and 39 (12 m), respectively. The 4 minute sampled Nortek data is linearly interpolated for comparison to the 2 minute sampled RDI data. The compass corrections reduce the size of the mean compass offset significantly for the 20-40 cm/s band. In (b) direction difference histograms are shown for velocity ranges: $|u| < 10$ cm/s red (orange), 10 cm/s $< |u| <$ 20 cm/s dark green (light green), and $20 < |u|$ cm/s blue (cyan) for the corrected (and uncorrected) compass headings of the 2MHz AquaDopp. Comparison of data from the first good ADCP bin (#2 at 86 m) is made to data from 2MHz Nortek bins 2-8 (0.5 m bins) over the depth range 88.25 to 91.25 m. The compass correction for the lower instrument is quite small and makes little difference.

In (c) and (d) fractional velocity magnitude differences are shown for the same ranges of magnitude as the direction differences of (a) and (b). Fractional difference is $(|u_{RDI}|-|u_{Nortek}|)/|u_{RDI}|$. At all overlapping depths, the RDI velocity magnitudes are systematically larger by 0.1-0.3 than the 1MHz Nortek velocity magnitudes. The distribution of magnitude differences between the RDI and downward-looking 2MHz AquaDopp is broader (greater range of differences), with less well-defined maxima at all depths, although none of the (good) RDI bins are truly overlapping with the 2MHz AquaDopp bins.

Figure 10. Record-average velocity components. Vertical profiles of the record-means of velocity components for each acoustic Doppler velocity profiler. Velocity component averages are shown for all data regardless of data quality.

Figure 11. Record-average ADCP beam amplitudes. Vertical profiles of the record-means of beam amplitudes for each acoustic Doppler velocity profiler. Average beam amplitudes are shown for all data regardless of data quality. Shading (RDI, grey; Nortek, yellow) indicates the region in which data are of poor quality.

Figure 12. Record-average ADCP beam autocorrelations. Vertical profiles of the record means of beam autocorrelation for each RDI ADCP. Average beam autocorrelations are shown for all data regardless of data quality. Shading indicates the region in which data are of poor quality.

Figure 13. Record-average ADCP percent good pings per ensemble. Vertical profiles of the record means of accepted pings per ensemble for each RDI ADCP. Average percentages of accepted pings are shown for all range bins. Shading indicates the bins in which data are of poor quality. Valid data results from either a 4-beam solution or a 3-beam solution when a 4-beam solution is not possible. The green line indicates the record average of 3-beam solutions per ensemble. The red line indicates the record average of the percentage of valid solutions, both 4-beam and 3-beam, per ensemble. Shading indicates the region in which data are of poor quality.

Figure 14. Distribution of ADCP percent good pings per ensemble. Vertical distribution of percentage (over the entire record) of ensembles for which the percent of pings per ensemble yielded valid solutions (both 3-beam and 4-beam) within several broad categories: 0%, 1-50%, 50-90%, and >90%.

Figure 1

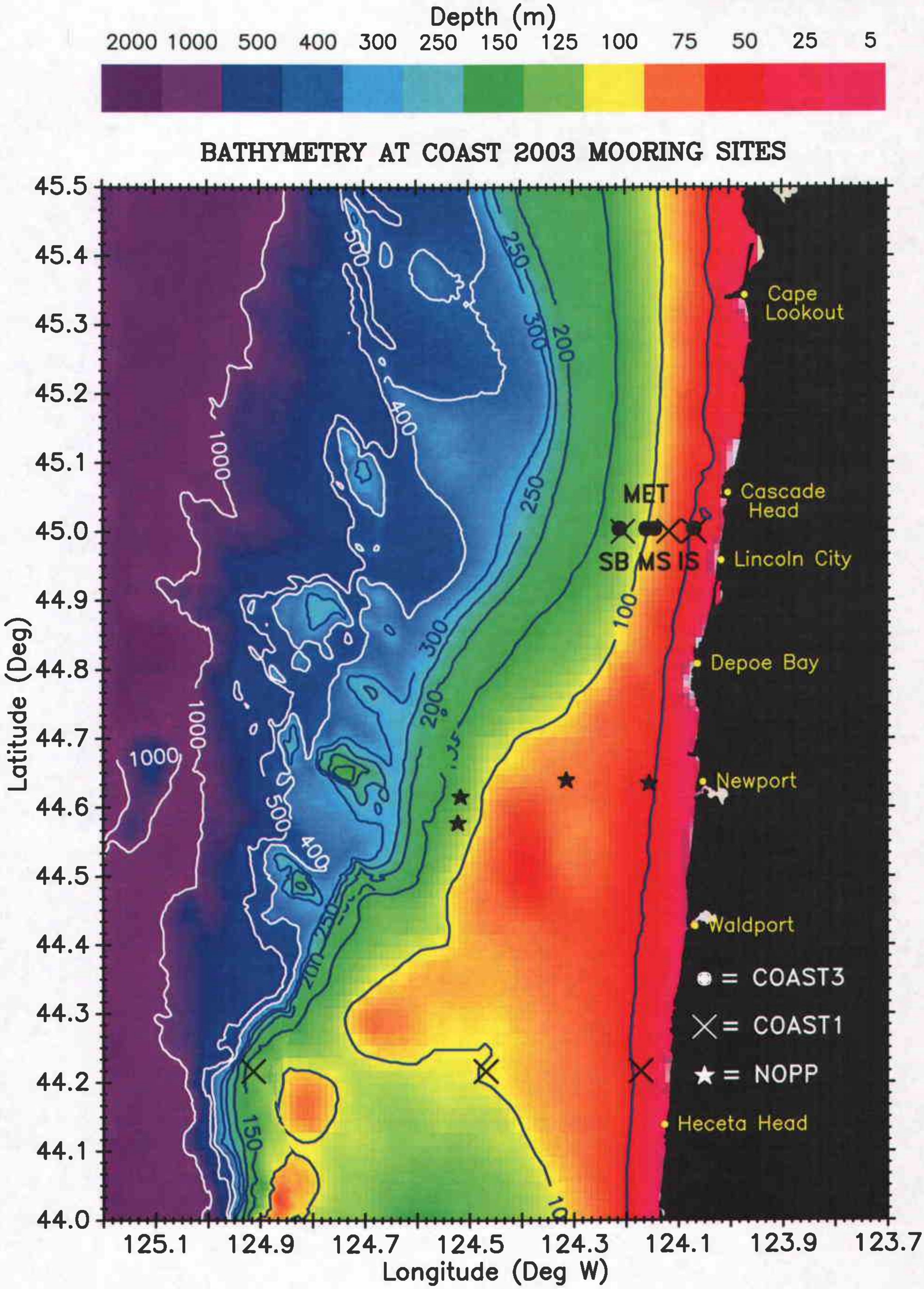
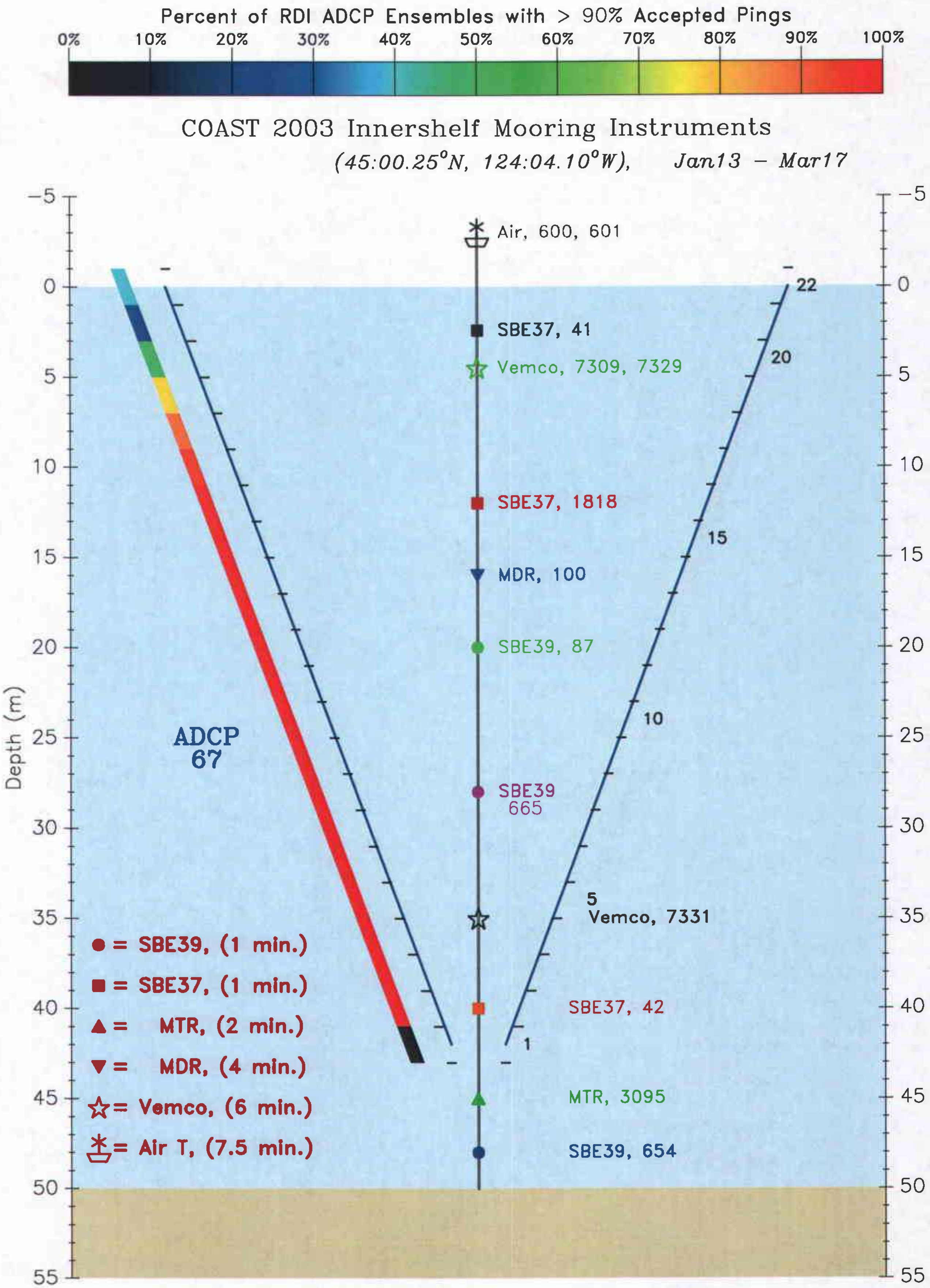

Depth (m)
2000 1000 500 400 300 250 150 125 100 75 50 25 5
BATHYMETRY AT COAST 2003 MOORING SITES
Cape Lookout
Cascade Head
Lincoln City
Depoe Bay
Newport
Waldport
Heceta Head
MET
SB MS IS
= COAST3
= COAST1
= NOPP
Latitude (Deg)
Longitude (Deg W)
45.5
45.4
45.3
45.2
45.1
45.0
44.9
44.8
44.7
44.6
44.5
44.4
44.3
44.2
44.1
44.0
125.1
124.9
124.7
124.5
124.3
124.1
123.9
123.7

Figure 2a



Percent of RDI ADCP Ensembles with > 90% Accepted Pings
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
COAST 2003 Innershelf Mooring Instruments
(45:00.25°N, 124:04.10°W), Jan13 – Mar17
Depth (m)
Air, 600, 601
SBE37, 41
Vemco, 7309, 7329
SBE37, 1818
MDR, 100
SBE39, 87
SBE39
665
Vemco, 7331
SBE37, 42
MTR, 3095
SBE39, 654
ADCP
67
● = SBE39, (1 min.)
■ = SBE37, (1 min.)
▲ = MTR, (2 min.)
▼ = MDR, (4 min.)
☆= Vemco, (6 min.)
= Air T, (7.5 min.)

Figure 2b

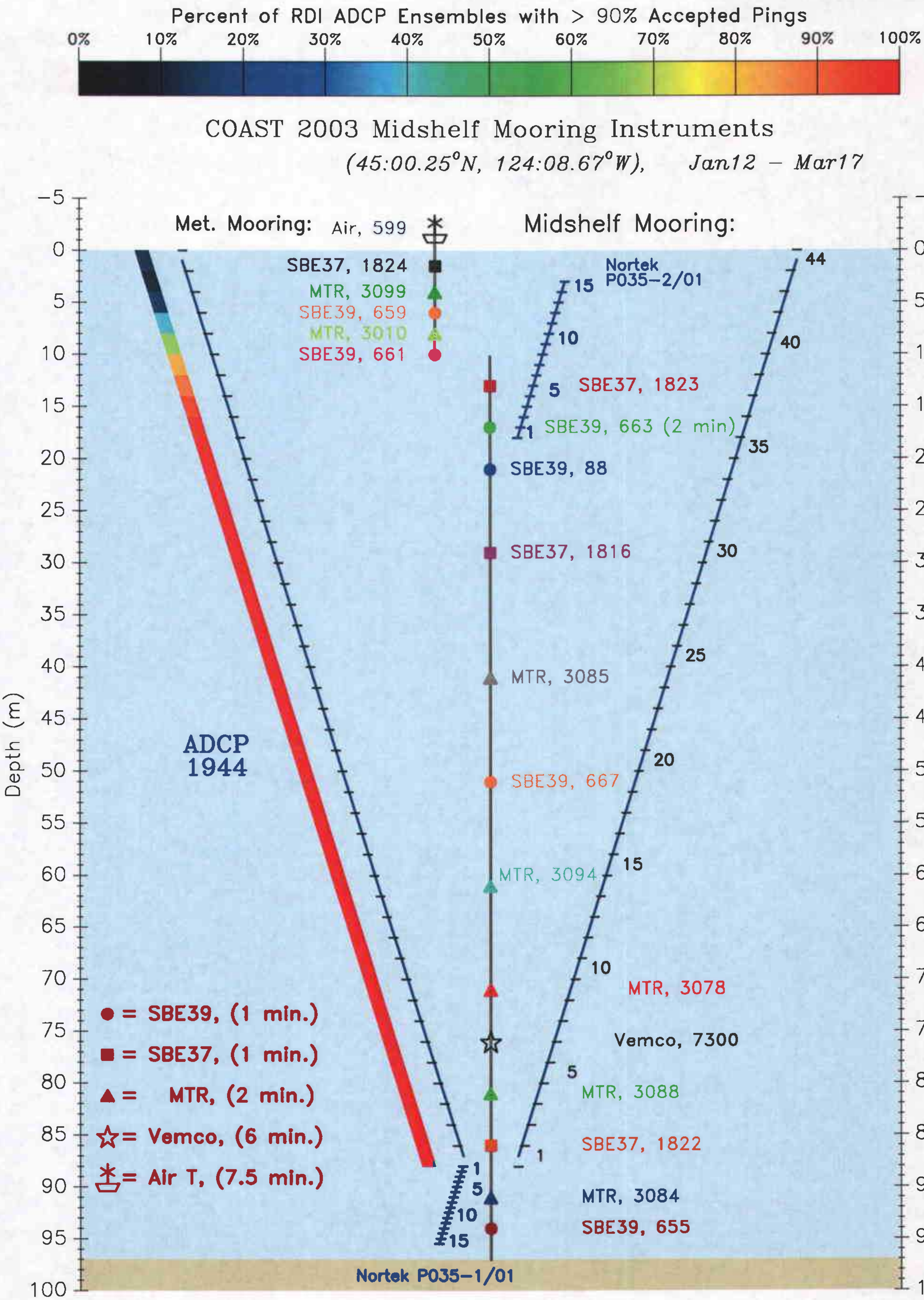
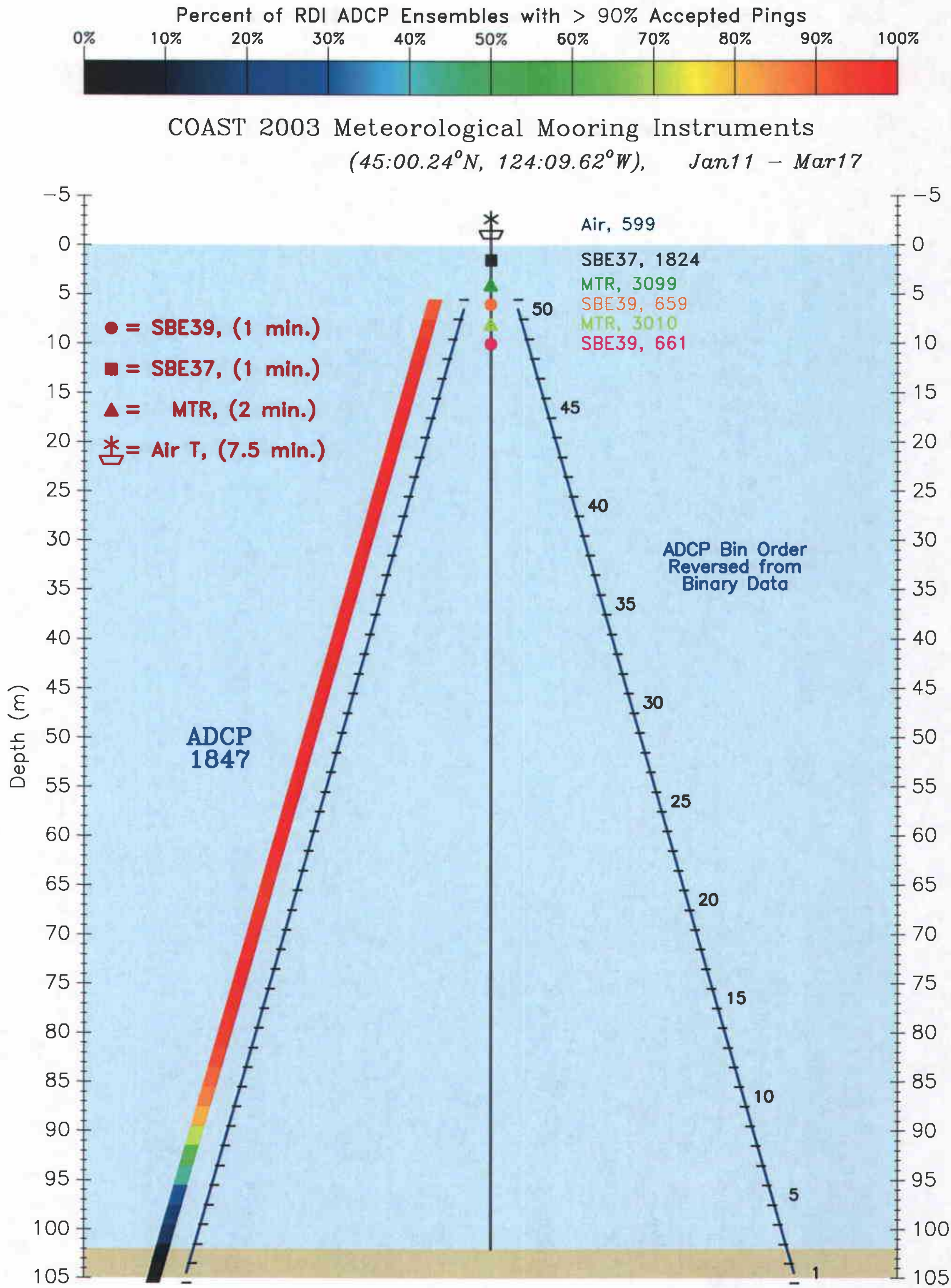
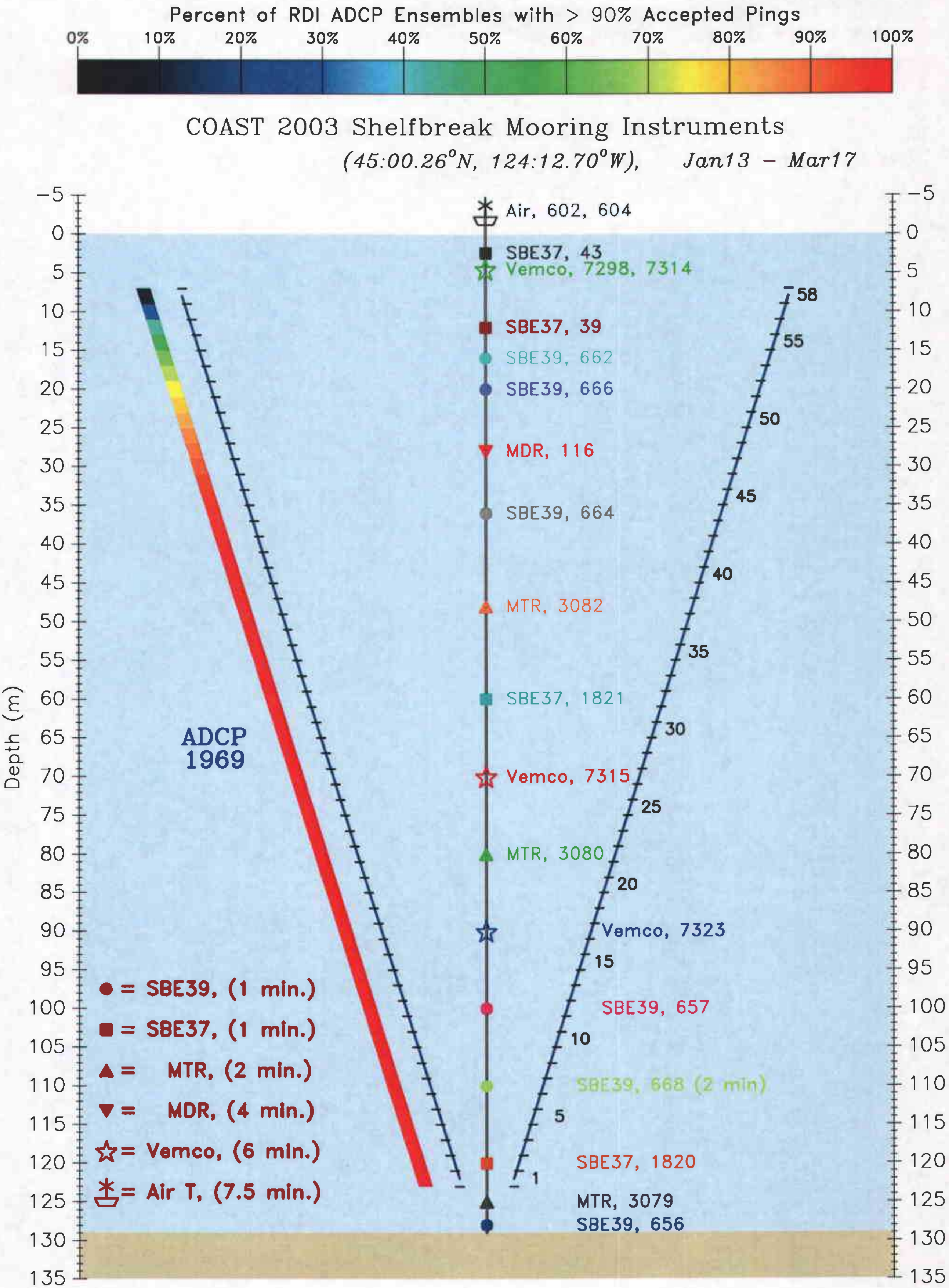

Percent of RDI ADCP Ensembles with > 90% Accepted Pings
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
COAST 2003 Midshelf Mooring Instruments
(45:00.25°N, 124:08.67°W), Jan12 – Mar17
Met. Mooring: Air, 599
Midshelf Mooring:
SBE37, 1824
MTR, 3099
SBE39, 659
MTR, 3010
SBE39, 661
Nortek P035-2/01
SBE37, 1823
SBE39, 663 (2 min)
SBE39, 88
SBE37, 1816
MTR, 3085
SBE39, 667
MTR, 3094
MTR, 3078
Vemco, 7300
MTR, 3088
SBE37, 1822
MTR, 3084
SBE39, 655
Nortek P035-1/01
ADCP 1944
Depth (m)
● = SBE39, (1 min.)
■ = SBE37, (1 min.)
▲ = MTR, (2 min.)
☆ = Vemco, (6 min.)
= Air T, (7.5 min.)

Figure 2c



Percent of RDI ADCP Ensembles with > 90% Accepted Pings
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
COAST 2003 Meteorological Mooring Instruments
(45:00.24°N, 124:09.62°W), Jan11 – Mar17
Air, 599
SBE37, 1824
MTR, 3099
SBE39, 659
MTR, 3010
SBE39, 661
● = SBE39, (1 min.)
■ = SBE37, (1 min.)
▲ = MTR, (2 min.)
= Air T, (7.5 min.)
ADCP
1847
ADCP Bin Order
Reversed from
Binary Data
Depth (m)
50
45
40
35
30
25
20
15
10
5
1

Figure 2d



Percent of RDI ADCP Ensembles with > 90% Accepted Pings
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
COAST 2003 Shelfbreak Mooring Instruments
(45:00.26°N, 124:12.70°W), Jan13 – Mar17
Depth (m)
ADCP 1969
Air, 602, 604
SBE37, 43
Vemco, 7298, 7314
SBE37, 39
SBE39, 662
SBE39, 666
MDR, 116
SBE39, 664
MTR, 3082
SBE37, 1821
Vemco, 7315
MTR, 3080
Vemco, 7323
SBE39, 657
SBE39, 668 (2 min)
SBE37, 1820
MTR, 3079
SBE39, 656
● = SBE39, (1 min.)
■ = SBE37, (1 min.)
▲ = MTR, (2 min.)
▼ = MDR, (4 min.)
☆ = Vemco, (6 min.)
= Air T, (7.5 min.)

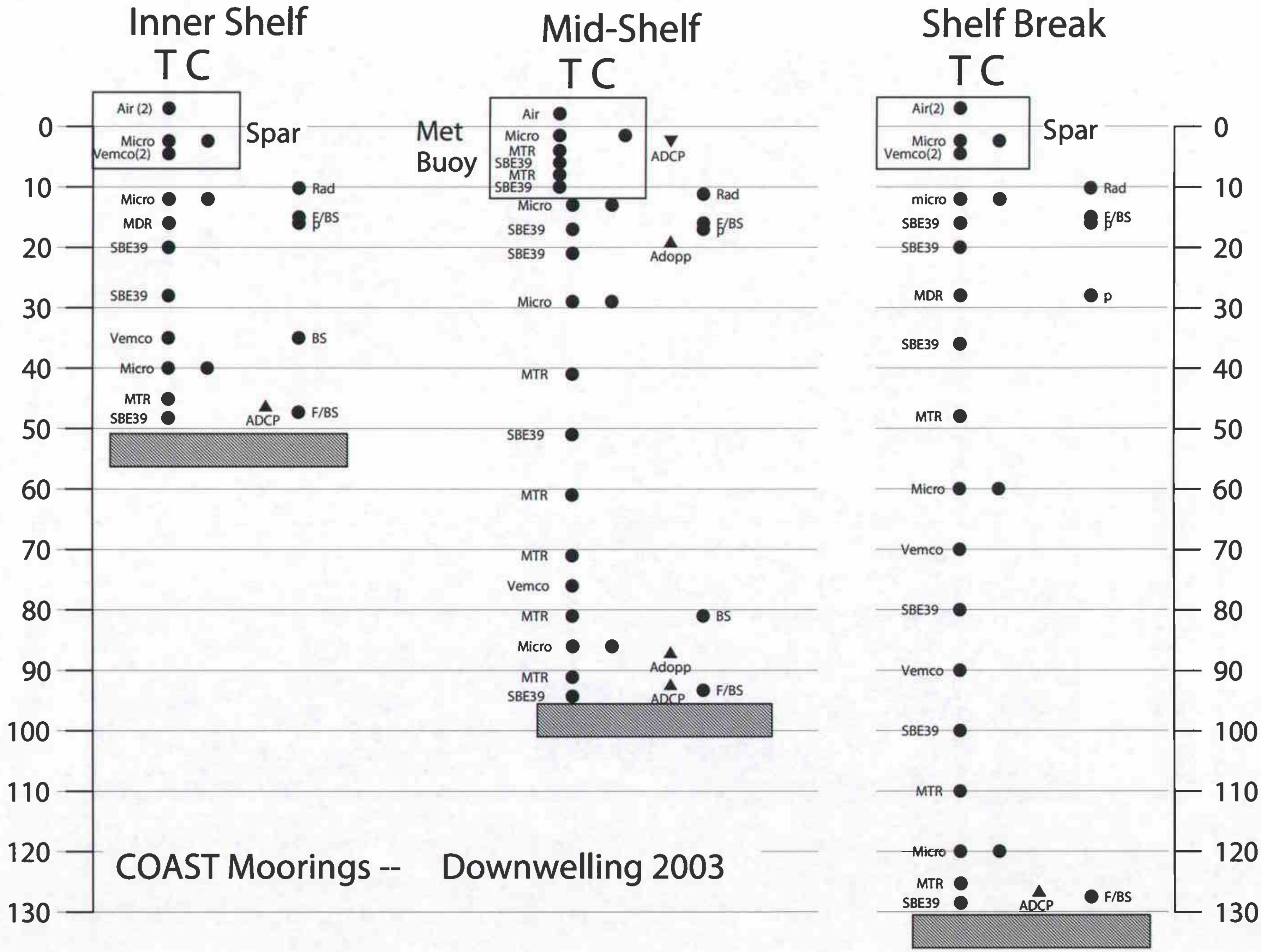

Inner Shelf
T C
Air (2)
Micro
Vemco(2)
Spar
Micro
MDR
SBE39
SBE39
Vemco
Micro
MTR
SBE39
ADCP
Rad
F/BS
p
BS
F/BS
Mid-Shelf
T C
Met
Buoy
Air
Micro
MTR
SBE39
MTR
SBE39
ADCP
Micro
SBE39
SBE39
Adopp
Rad
F/BS
p
Micro
MTR
SBE39
MTR
MTR
Vemco
MTR
BS
Micro
Adopp
MTR
SBE39
ADCP
F/BS
Shelf Break
T C
Air(2)
Micro
Vemco(2)
Spar
micro
SBE39
SBE39
MDR
SBE39
MTR
Micro
Vemco
SBE39
Vemco
SBE39
MTR
Micro
MTR
SBE39
ADCP
Rad
F/BS
p
p
F/BS
0
10
20
30
40
50
60
70
80
90
100
110
120
130
COAST Moorings -- Downwelling 2003

Figure 3

Figure 4

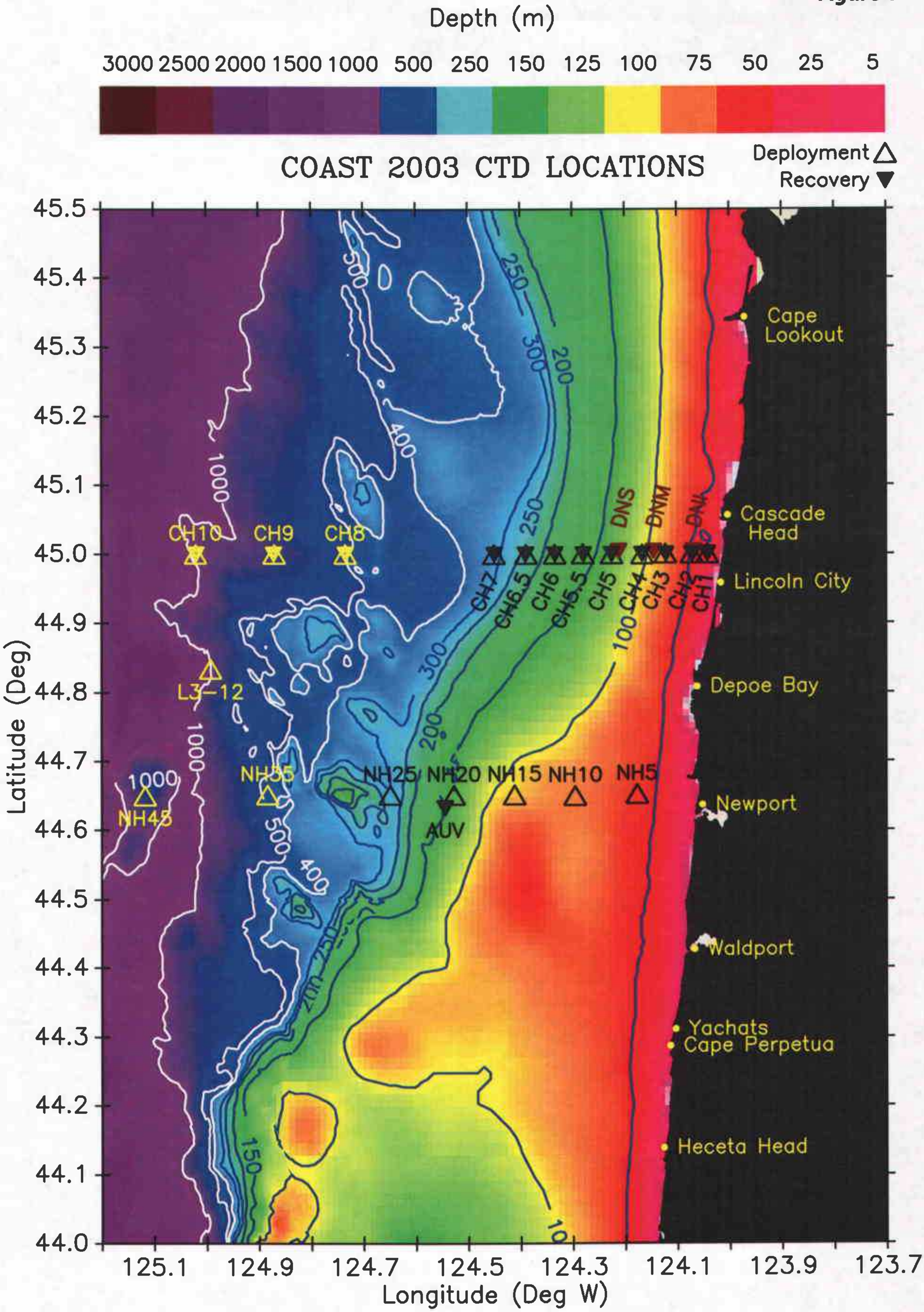

Depth (m)
3000 2500 2000 1500 1000 500 250 150 125 100 75 50 25 5
COAST 2003 CTD LOCATIONS
Deployment
Recovery
Latitude (Deg)
Longitude (Deg W)
45.5
45.4
45.3
45.2
45.1
45.0
44.9
44.8
44.7
44.6
44.5
44.4
44.3
44.2
44.1
44.0
125.1 124.9 124.7 124.5 124.3 124.1 123.9 123.7
Cape Lookout
Cascade Head
Lincoln City
Depoe Bay
Newport
Waldport
Yachats
Cape Perpetua
Heceta Head
CH10
CH9
CH8
CH7
CH6.5
CH6
CH5.5
CH5
CH4
CH3
CH2
CH1
DNS
DNM
L3-12
NH45
NH55
NH25
NH20
NH15
NH10
NH5
AUV

Figure 5a

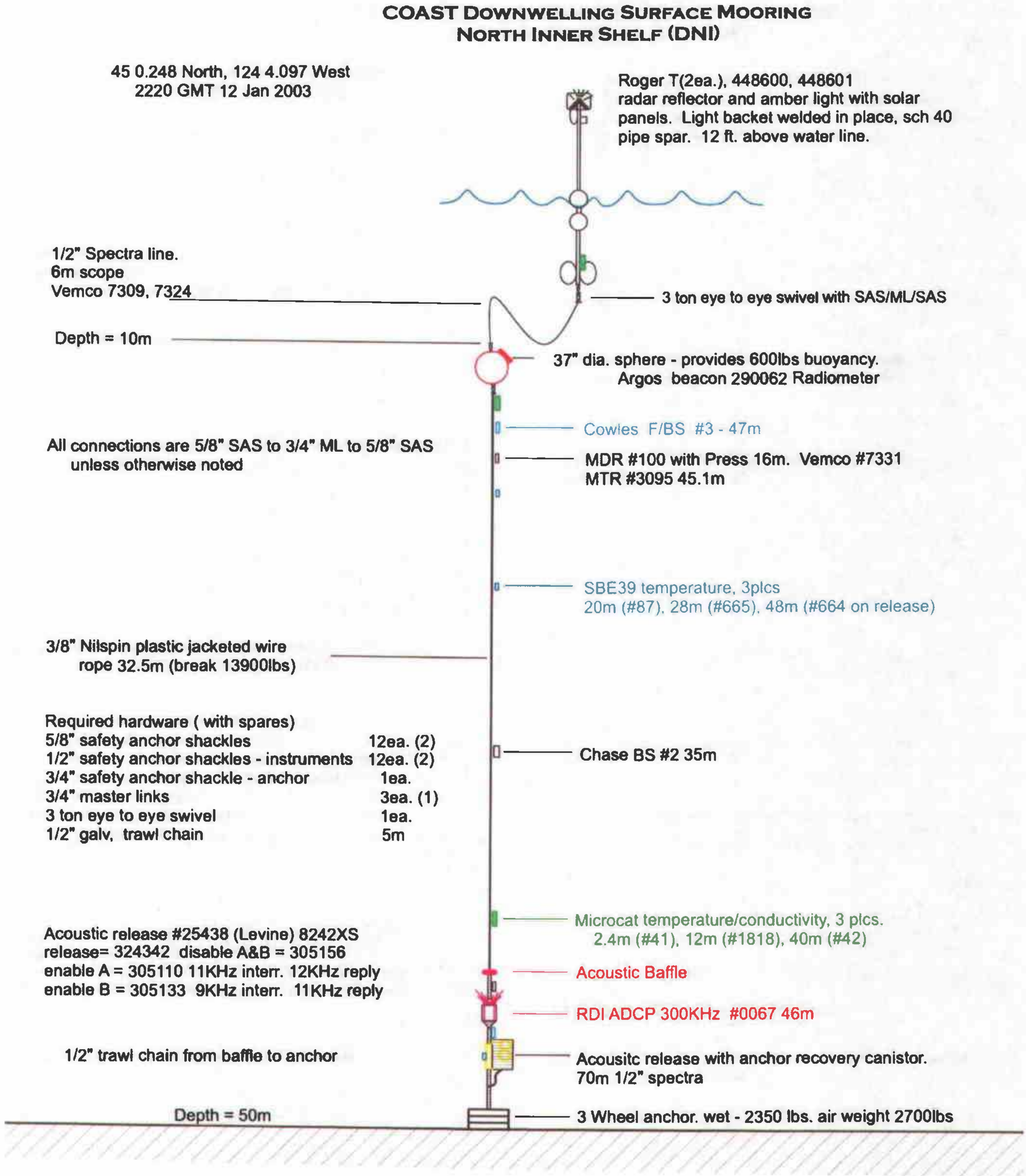

COAST Downwelling Surface Mooring
North Inner Shelf (DNI)
45 0.248 North, 124 4.097 West
2220 GMT 12 Jan 2003
Roger T(2ea.), 448600, 448601
radar reflector and amber light with solar panels. Light backet welded in place, sch 40 pipe spar. 12 ft. above water line.
1/2" Spectra line.
6m scope
Vemco 7309, 7324
3 ton eye to eye swivel with SAS/ML/SAS
Depth = 10m
37" dia. sphere - provides 600lbs buoyancy.
Argos beacon 290062 Radiometer
Cowles F/BS #3 - 47m
All connections are 5/8" SAS to 3/4" ML to 5/8" SAS unless otherwise noted
MDR #100 with Press 16m. Vemco #7331
MTR #3095 45.1m
SBE39 temperature, 3plcs
20m (#87), 28m (#665), 48m (#664 on release)
3/8" Nilspin plastic jacketed wire rope 32.5m (break 13900lbs)
Required hardware (with spares)
5/8" safety anchor shackles 12ea. (2)
1/2" safety anchor shackles - instruments 12ea. (2)
3/4" safety anchor shackle - anchor 1ea.
3/4" master links 3ea. (1)
3 ton eye to eye swivel 1ea.
1/2" galv, trawl chain 5m
Chase BS #2 35m
Microcat temperature/conductivity, 3 plcs.
2.4m (#41), 12m (#1818), 40m (#42)
Acoustic release #25438 (Levine) 8242XS
release= 324342 disable A&B = 305156
enable A = 305110 11KHz interr. 12KHz reply
enable B = 305133 9KHz interr. 11KHz reply
Acoustic Baffle
RDI ADCP 300KHz #0067 46m
1/2" trawl chain from baffle to anchor
Acousitc release with anchor recovery canistor.
70m 1/2" spectra
Depth = 50m
3 Wheel anchor. wet - 2350 lbs. air weight 2700lbs

Figure 5b

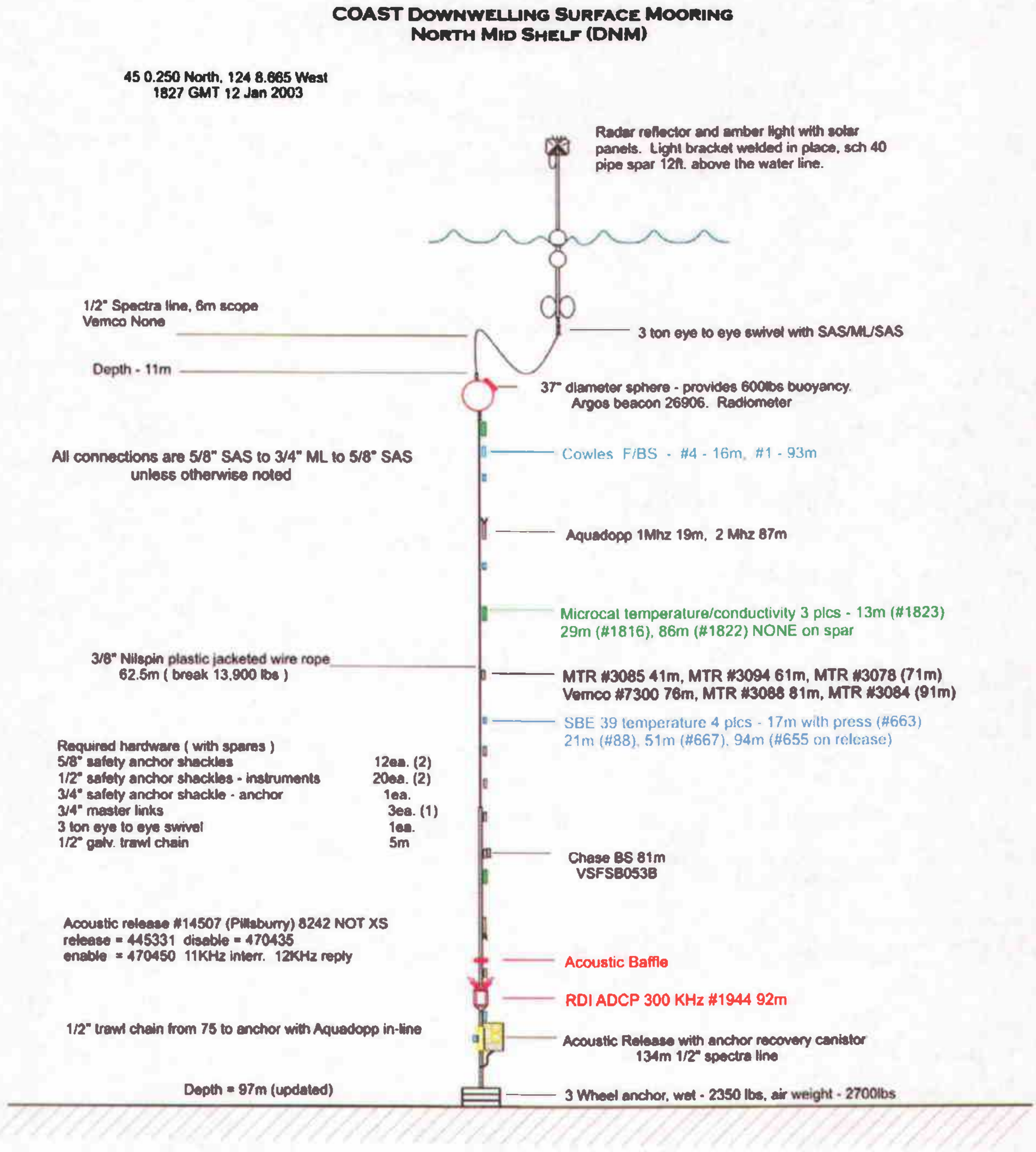
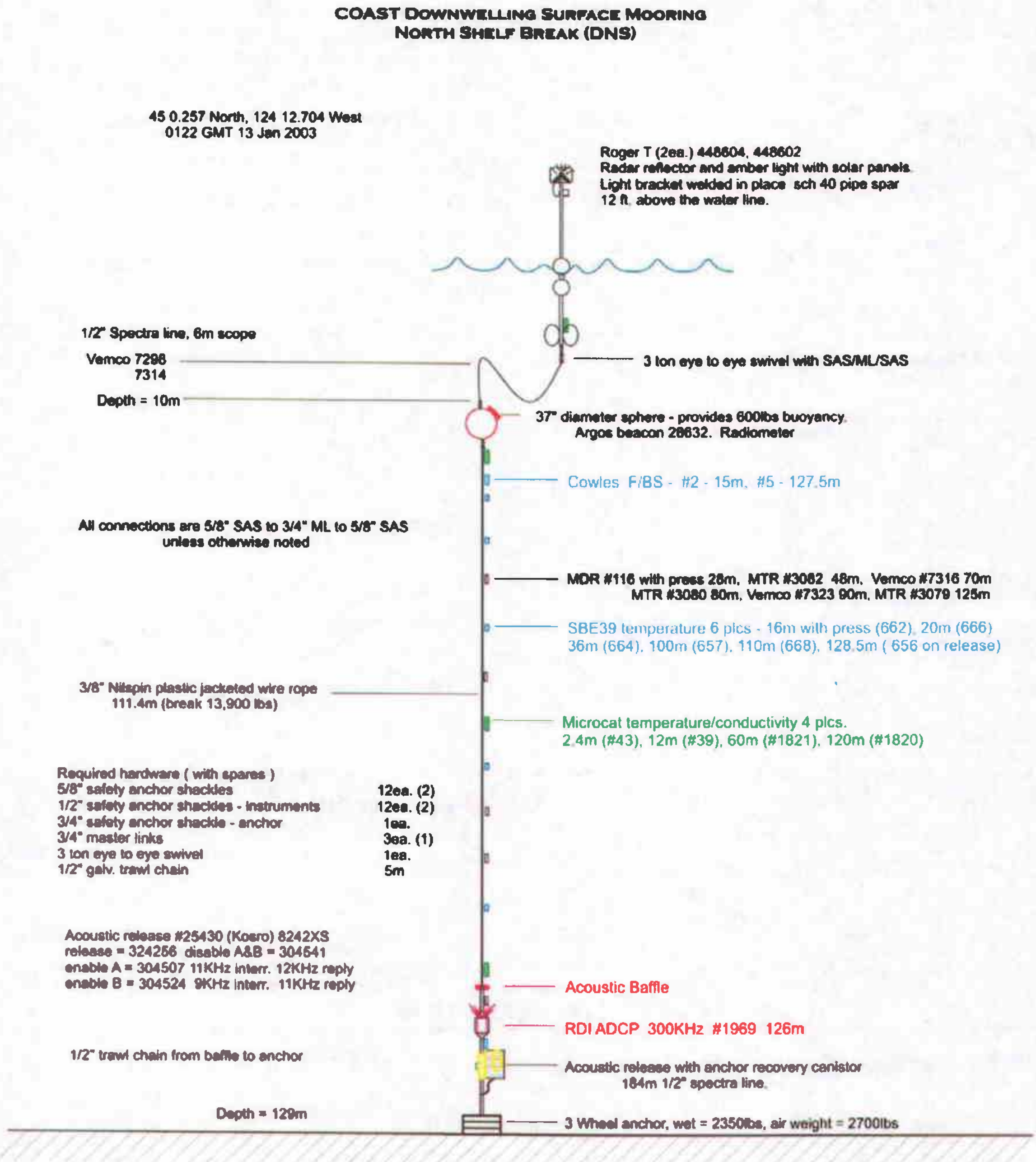

COAST Downwelling Surface Mooring
North Mid Shelf (DNM)
45 0.250 North, 124 8.665 West
1827 GMT 12 Jan 2003
Radar reflector and amber light with solar panels. Light bracket welded in place, sch 40 pipe spar 12ft. above the water line.
1/2" Spectra line, 6m scope
Vemco None
3 ton eye to eye swivel with SAS/ML/SAS
Depth - 11m
37" diameter sphere - provides 600lbs buoyancy.
Argos beacon 26906. Radiometer
All connections are 5/8" SAS to 3/4" ML to 5/8" SAS unless otherwise noted
Cowles F/BS - #4 - 16m, #1 - 93m
Aquadopp 1Mhz 19m, 2 Mhz 87m
Microcat temperature/conductivity 3 plcs - 13m (#1823) 29m (#1816), 86m (#1822) NONE on spar
3/8" Nilspin plastic jacketed wire rope 62.5m (break 13,900 lbs)
MTR #3085 41m, MTR #3094 61m, MTR #3078 (71m)
Vemco #7300 76m, MTR #3088 81m, MTR #3084 (91m)
SBE 39 temperature 4 plcs - 17m with press (#663)
21m (#88), 51m (#667), 94m (#655 on release)
Required hardware (with spares)
5/8" safety anchor shackles 12ea. (2)
1/2" safety anchor shackles - instruments 20ea. (2)
3/4" safety anchor shackle - anchor 1ea.
3/4" master links 3ea. (1)
3 ton eye to eye swivel 1ea.
1/2" galv. trawl chain 5m
Chase BS 81m
VSFSB053B
Acoustic release #14507 (Pillsburry) 8242 NOT XS
release = 445331 disable = 470435
enable = 470450 11KHz interr. 12KHz reply
Acoustic Baffle
RDI ADCP 300 KHz #1944 92m
1/2" trawl chain from 75 to anchor with Aquadopp in-line
Acoustic Release with anchor recovery canister
134m 1/2" spectra line
Depth = 97m (updated)
3 Wheel anchor, wet - 2350 lbs, air weight - 2700lbs

Figure 5c



COAST DOWNWELLING SURFACE MOORING
NORTH SHELF BREAK (DNS)
45 0.257 North, 124 12.704 West
0122 GMT 13 Jan 2003
Roger T (2ea.) 448604, 448602
Radar reflector and amber light with solar panels.
Light bracket welded in place sch 40 pipe spar
12 ft. above the water line.
1/2" Spectra line, 6m scope
Vemco 7298
7314
Depth = 10m
3 ton eye to eye swivel with SAS/ML/SAS
37" diameter sphere - provides 600lbs buoyancy.
Argos beacon 28632. Radiometer
Cowles F/BS - #2 - 15m, #5 - 127.5m
All connections are 5/8" SAS to 3/4" ML to 5/8" SAS
unless otherwise noted
MDR #116 with press 28m, MTR #3082 48m, Vemco #7316 70m
MTR #3080 80m, Vemco #7323 90m, MTR #3079 125m
SBE39 temperature 6 plcs - 16m with press (662), 20m (666)
36m (664), 100m (657), 110m (668), 128.5m (656 on release)
3/8" Nilspin plastic jacketed wire rope
111.4m (break 13,900 lbs)
Microcat temperature/conductivity 4 plcs.
2.4m (#43), 12m (#39), 60m (#1821), 120m (#1820)
Required hardware (with spares)
5/8" safety anchor shackles 12ea. (2)
1/2" safety anchor shackles - instruments 12ea. (2)
3/4" safety anchor shackle - anchor 1ea.
3/4" master links 3ea. (1)
3 ton eye to eye swivel 1ea.
1/2" galv. trawl chain 5m
Acoustic release #25430 (Koero) 8242XS
release = 324256 disable A&B = 304541
enable A = 304507 11KHz interr. 12KHz reply
enable B = 304524 9KHz interr. 11KHz reply
Acoustic Baffle
RDI ADCP 300KHz #1969 126m
1/2" trawl chain from baffle to anchor
Acoustic release with anchor recovery canistor
184m 1/2" spectra line.
Depth = 129m
3 Wheel anchor, wet = 2350lbs, air weight = 2700lbs

Figure 5d

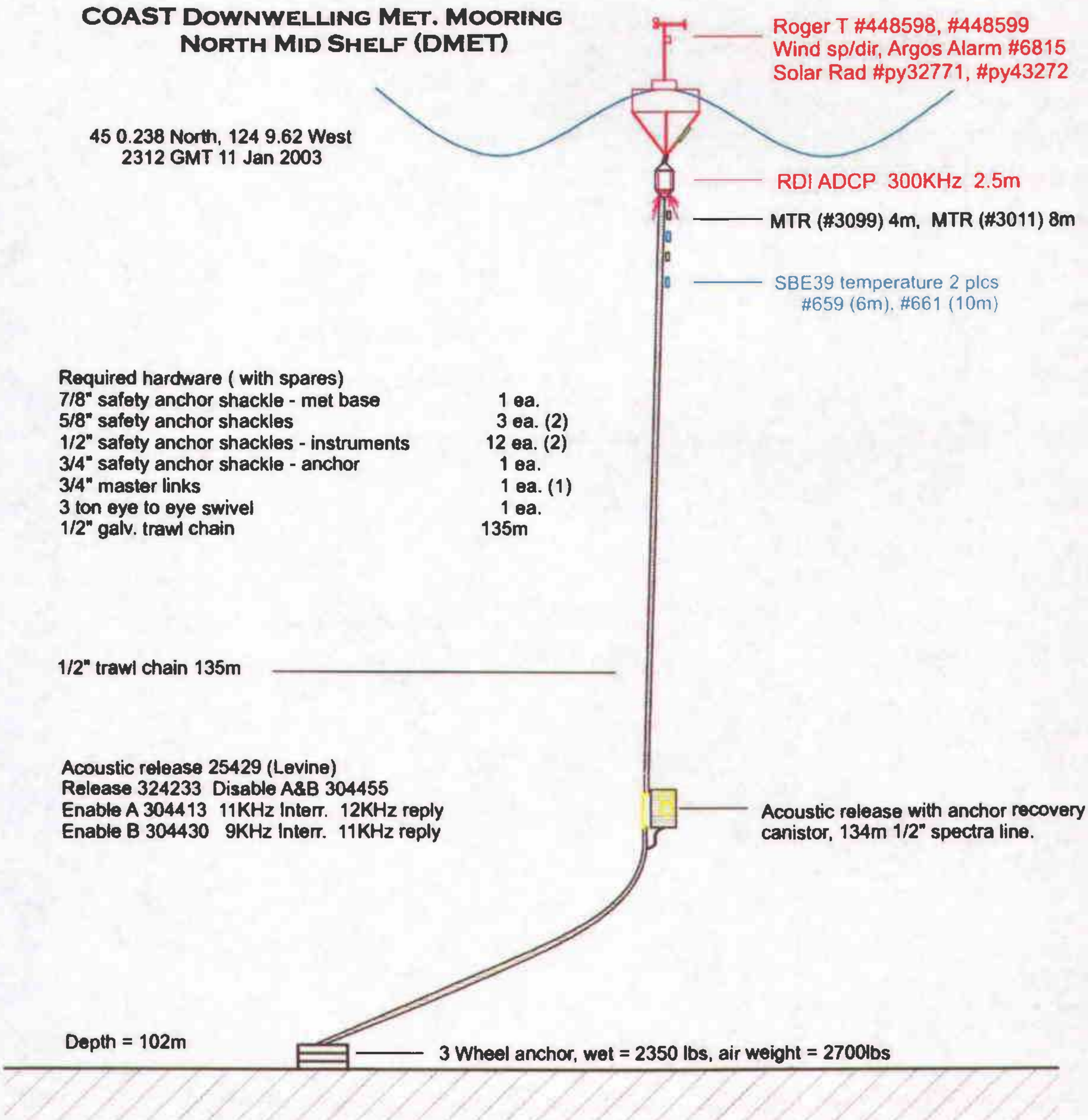
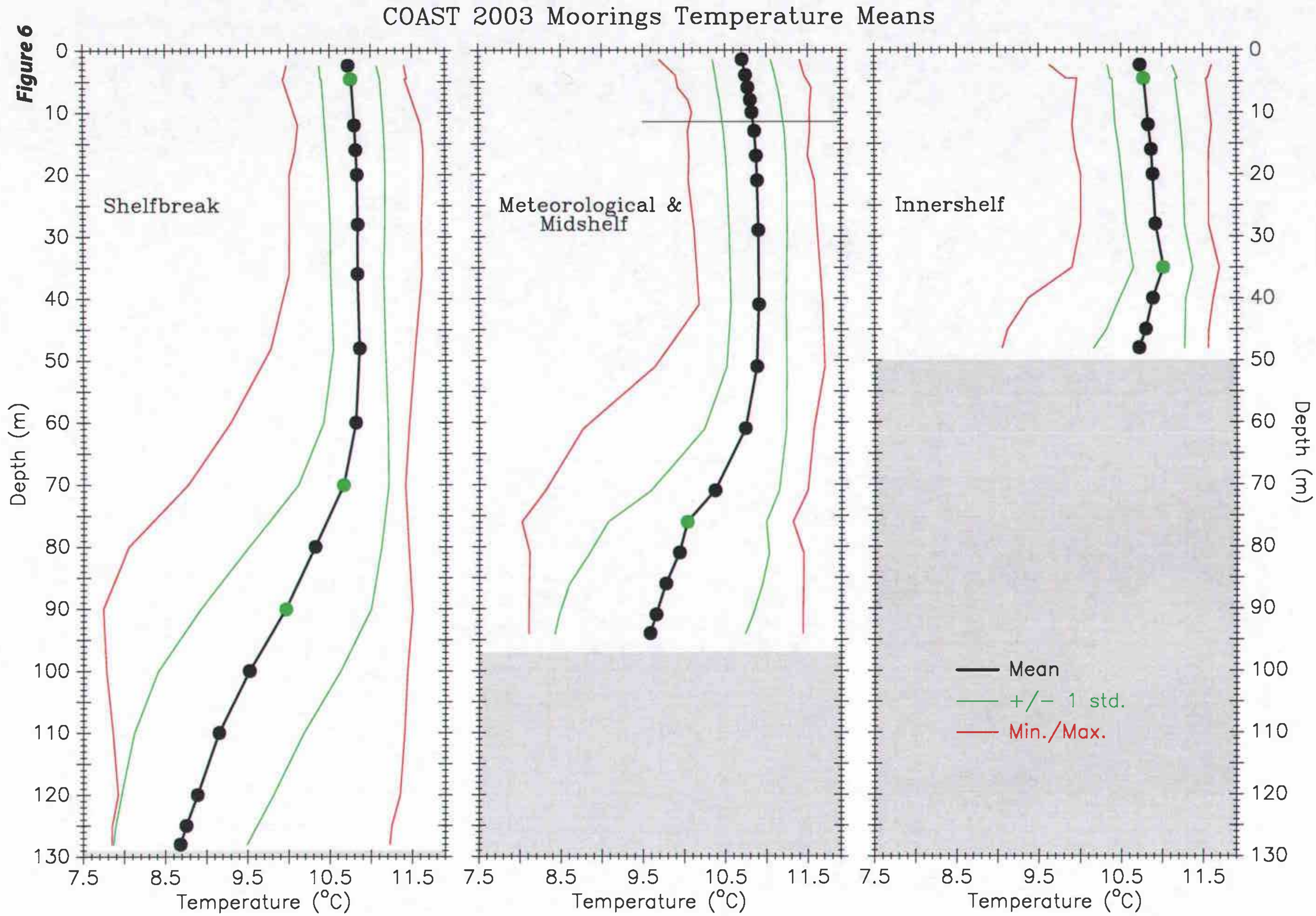

COAST DOWNWELLING MET. MOORING
NORTH MID SHELF (DMET)
45 0.238 North, 124 9.62 West
2312 GMT 11 Jan 2003
Roger T #448598, #448599
Wind sp/dir, Argos Alarm #6815
Solar Rad #py32771, #py43272
RDI ADCP 300KHz 2.5m
MTR (#3099) 4m, MTR (#3011) 8m
SBE39 temperature 2 plcs
#659 (6m), #661 (10m)
Required hardware (with spares)
7/8" safety anchor shackle - met base 1 ea.
5/8" safety anchor shackles 3 ea. (2)
1/2" safety anchor shackles - instruments 12 ea. (2)
3/4" safety anchor shackle - anchor 1 ea.
3/4" master links 1 ea. (1)
3 ton eye to eye swivel 1 ea.
1/2" galv. trawl chain 135m
1/2" trawl chain 135m
Acoustic release 25429 (Levine)
Release 324233 Disable A&B 304455
Enable A 304413 11KHz Interr. 12KHz reply
Enable B 304430 9KHz Interr. 11KHz reply
Acoustic release with anchor recovery
canister, 134m 1/2" spectra line.
Depth = 102m
3 Wheel anchor, wet = 2350 lbs, air weight = 2700lbs

Figure 6



COAST 2003 Moorings Temperature Means
Shelfbreak
Meteorological & Midshelf
Innershelf
Depth (m)
Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
7.5
8.5
9.5
10.5
11.5
Mean
+/- 1 std.
Min./Max.

Figure 7

Conductivity Intercomparison of Microcats with CTD Cast 16u

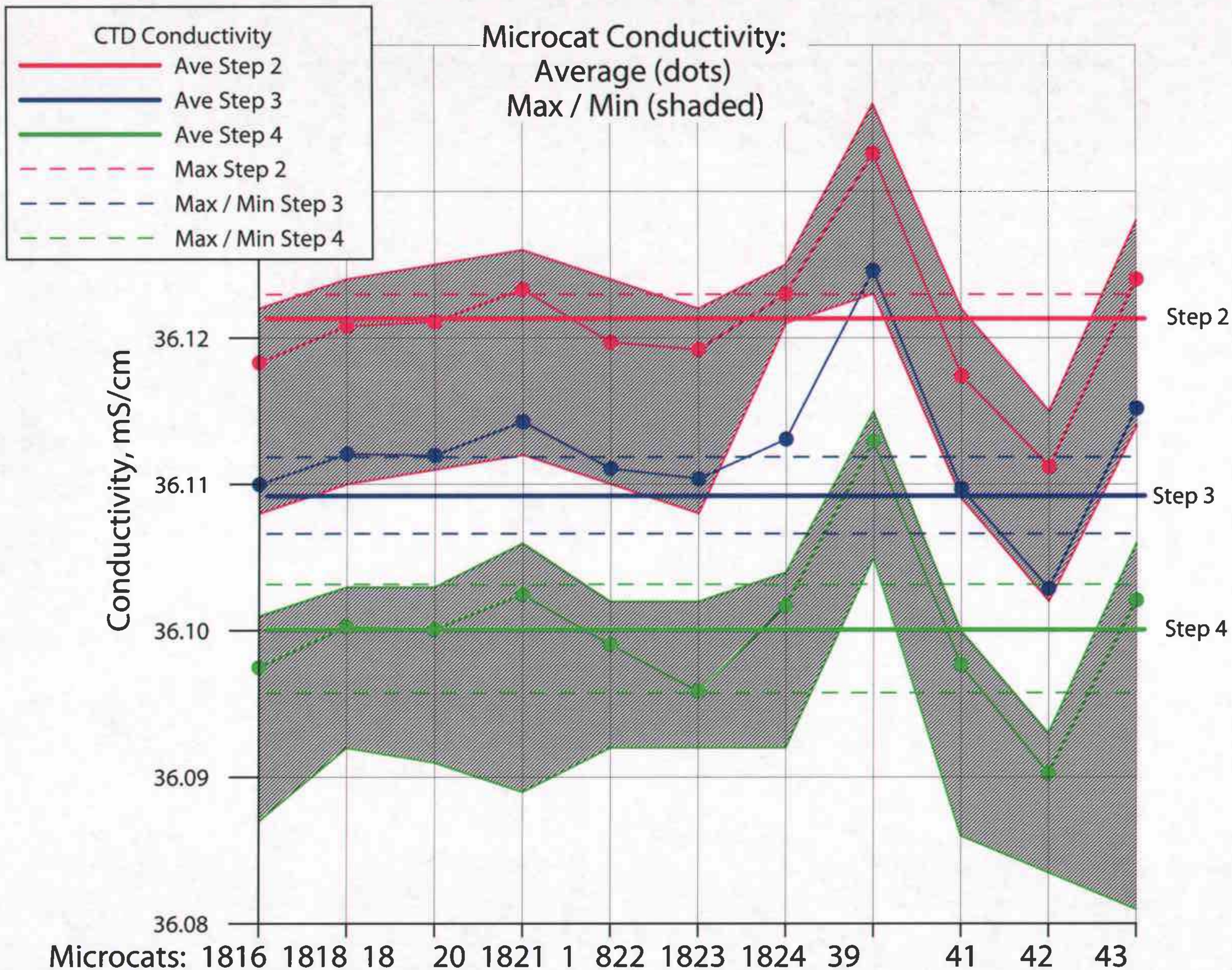
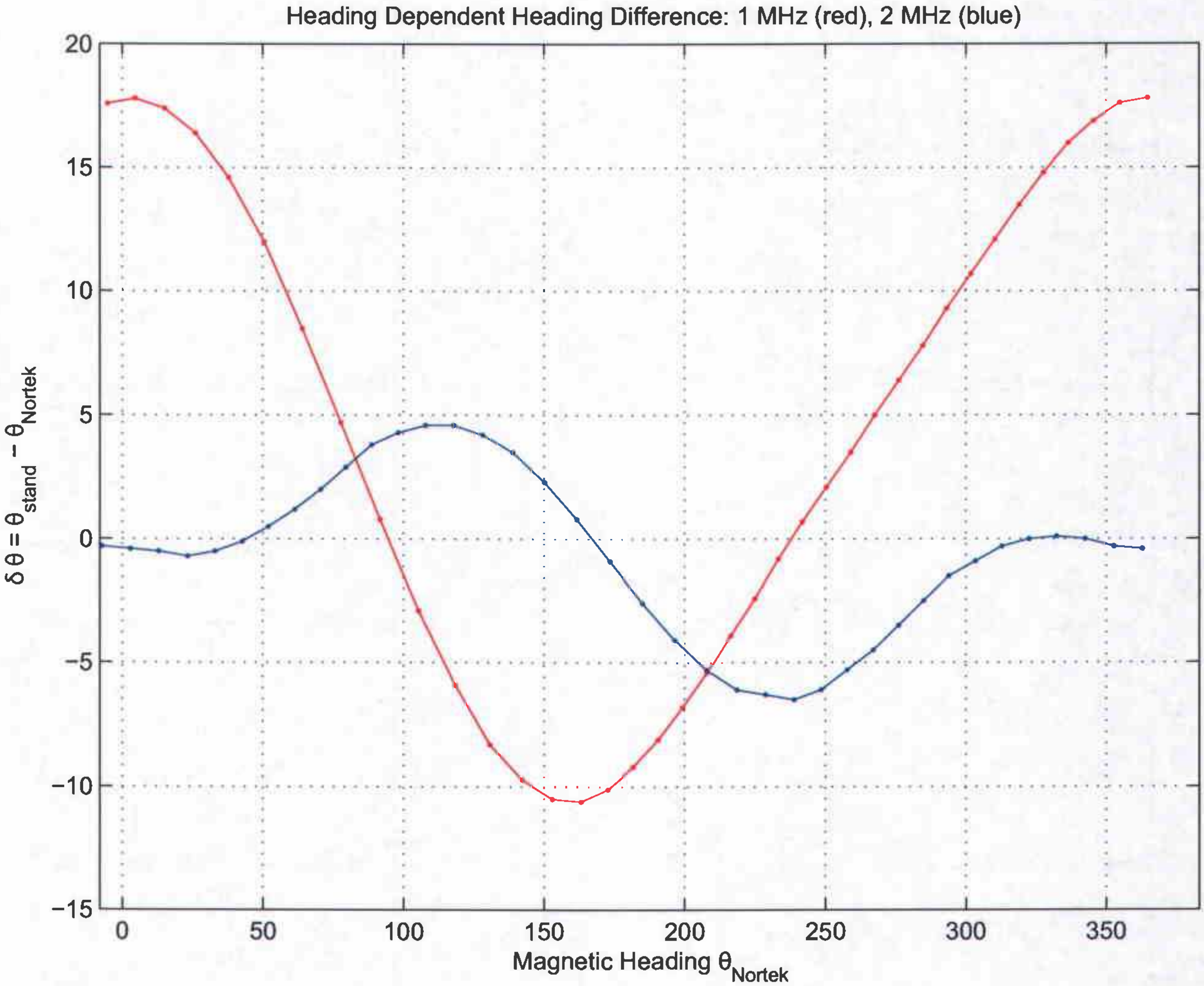


Figure 8



Heading Dependent Heading Difference: 1 MHz (red), 2 MHz (blue)
20
15
10
5
0
−5
−10
−15
0
50
100
150
200
250
300
350
Magnetic Heading θ_Nortek
δθ = θ_stand − θ_Nortek

Figure 9a

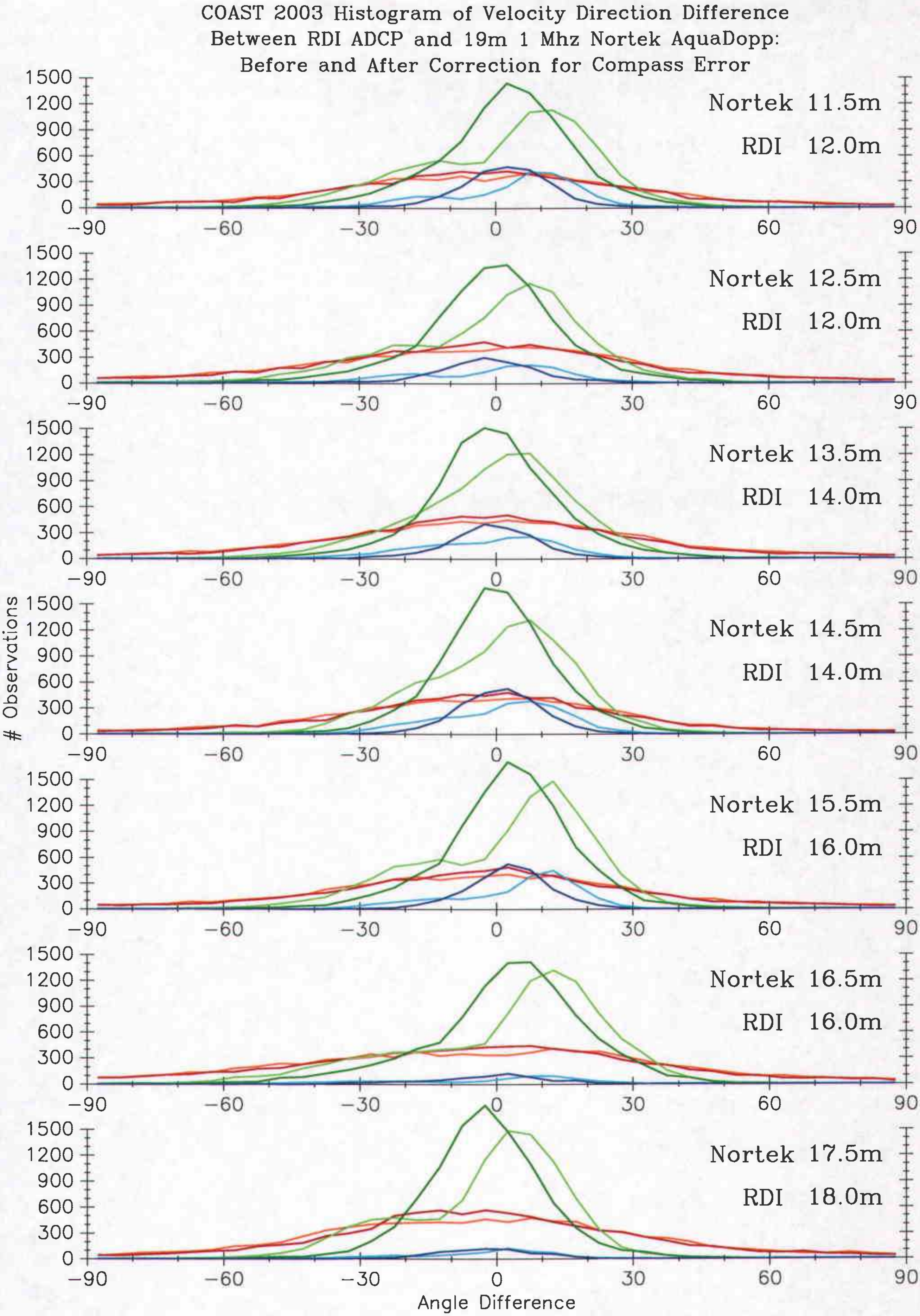

COAST 2003 Histogram of Velocity Direction Difference
Between RDI ADCP and 19m 1 Mhz Nortek AquaDopp:
Before and After Correction for Compass Error
Nortek 11.5m
RDI 12.0m
Nortek 12.5m
RDI 12.0m
Nortek 13.5m
RDI 14.0m
Nortek 14.5m
RDI 14.0m
Nortek 15.5m
RDI 16.0m
Nortek 16.5m
RDI 16.0m
Nortek 17.5m
RDI 18.0m
Observations
Angle Difference
0
300
600
900
1200
1500
−90
−60
−30
0
30
60
90

Figure 9b

COAST 2003 Histogram of Vector Angle Difference
Between RDI ADCP and 87m 2Mhz Nortek AquaDopp
Before and After Correction for Compass Error

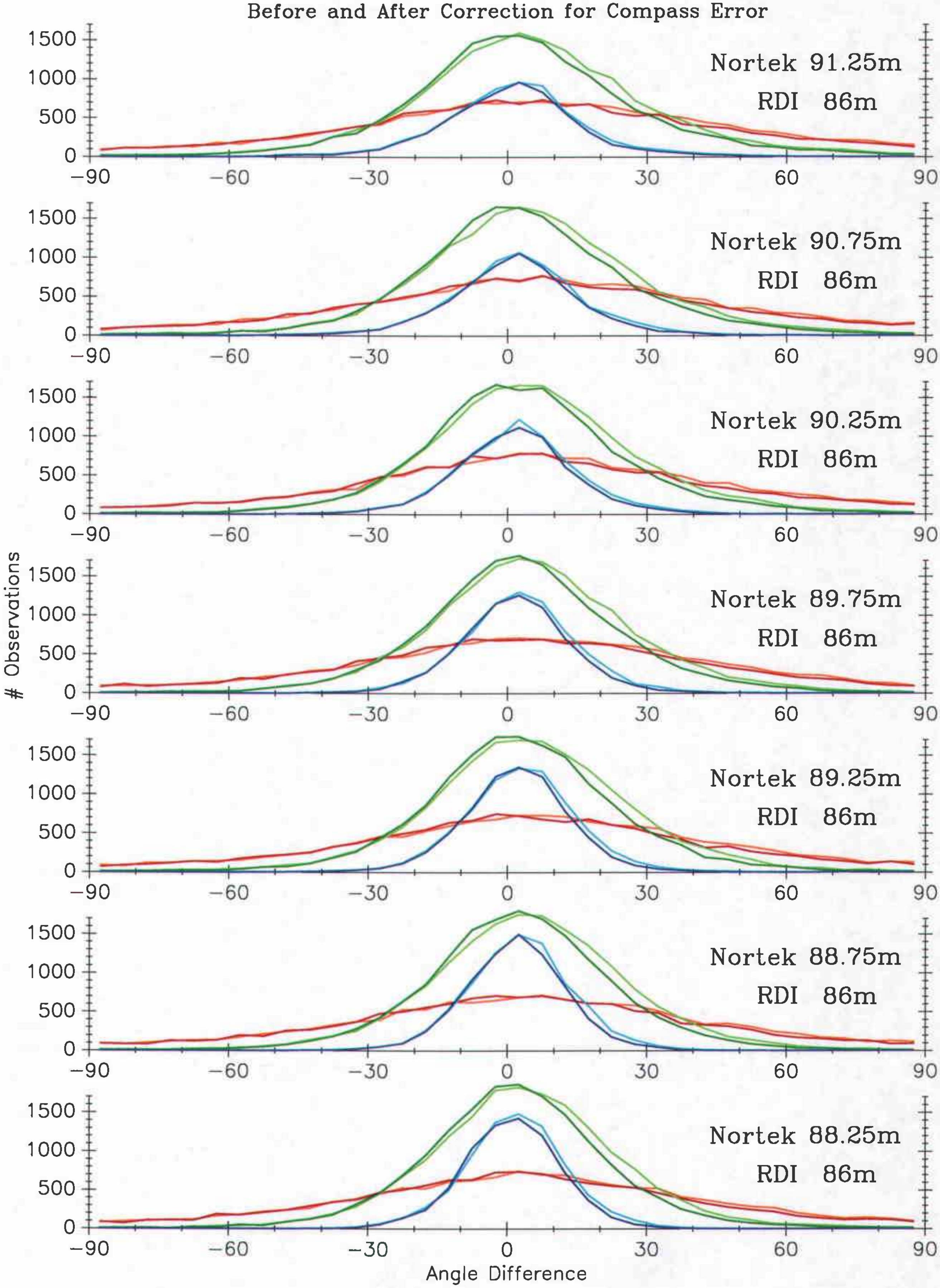


Figure 9c

COAST 2003 Histogram of Ratio of Velocity Magnitude Difference to RDI Velocity Magnitude, for 19m 1Mhz Nortek AquaDopp

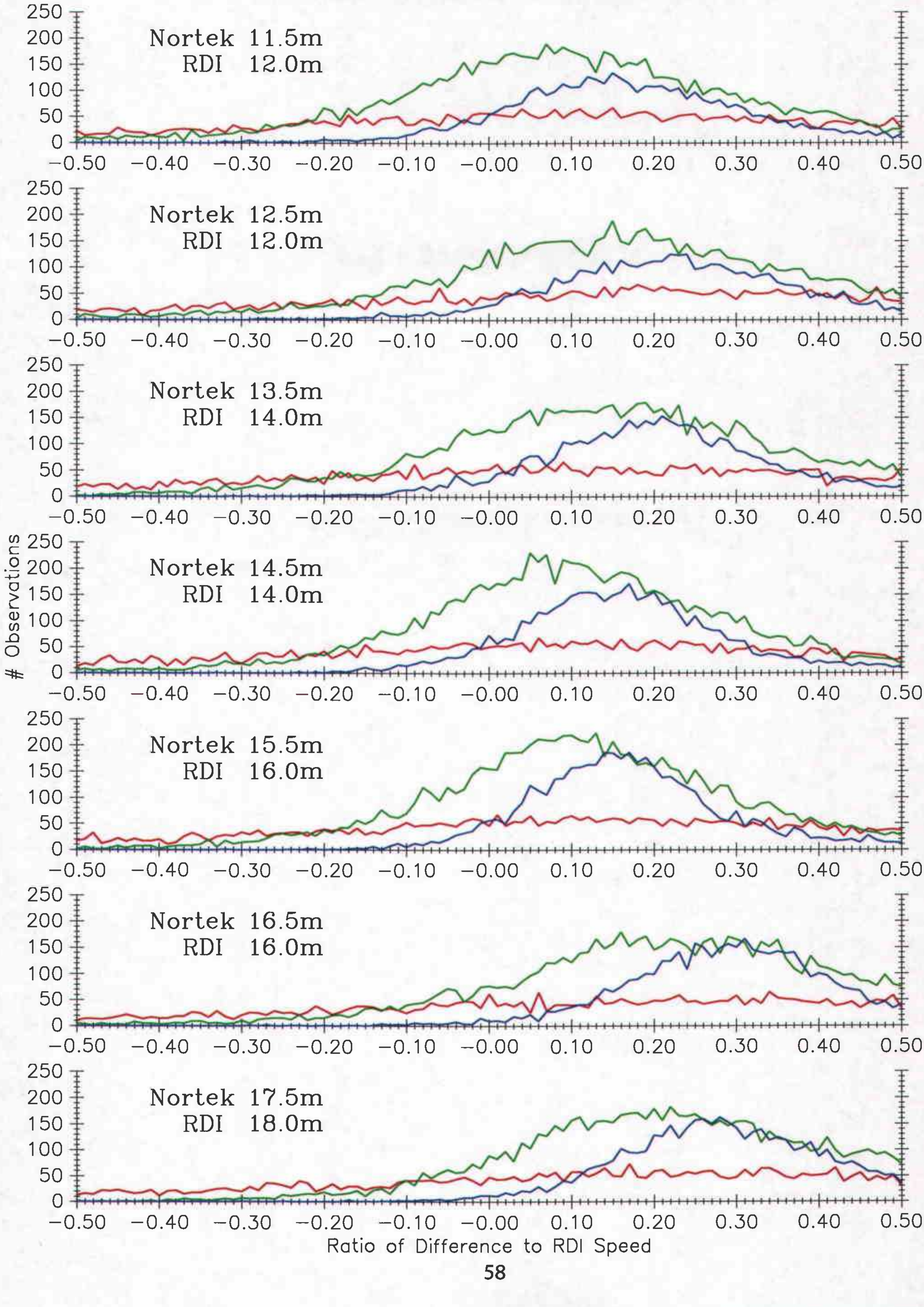


Figure 9d

COAST 2003 Histogram of Ratio of Velocity Magnitude Difference to RDI Velocity Magnitude, for 87m 2Mhz Nortek AquaDopp

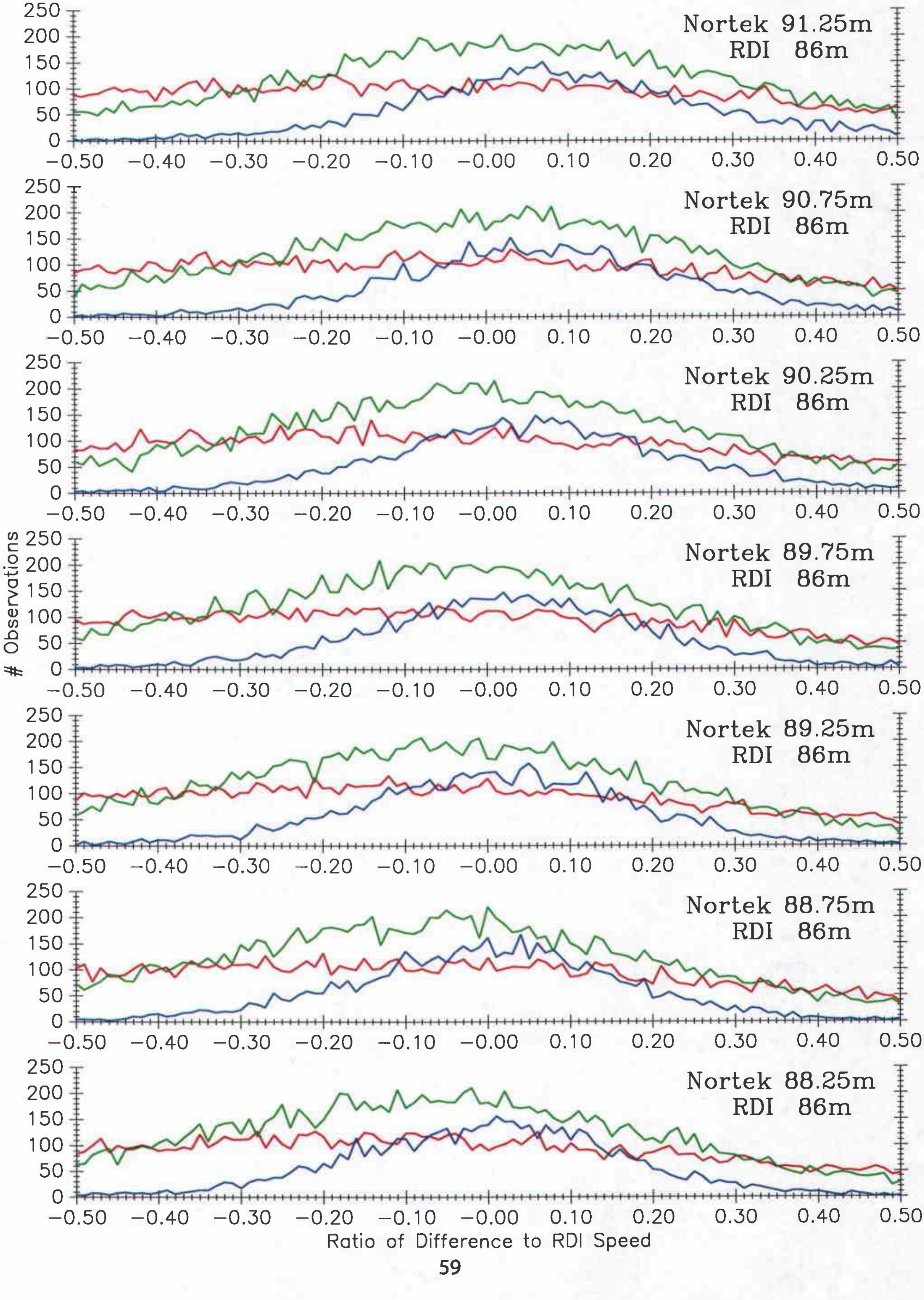


Figure 10

COAST 2003 Moorings
Acoustic Doppler Average Velocity Components (cm/sec)

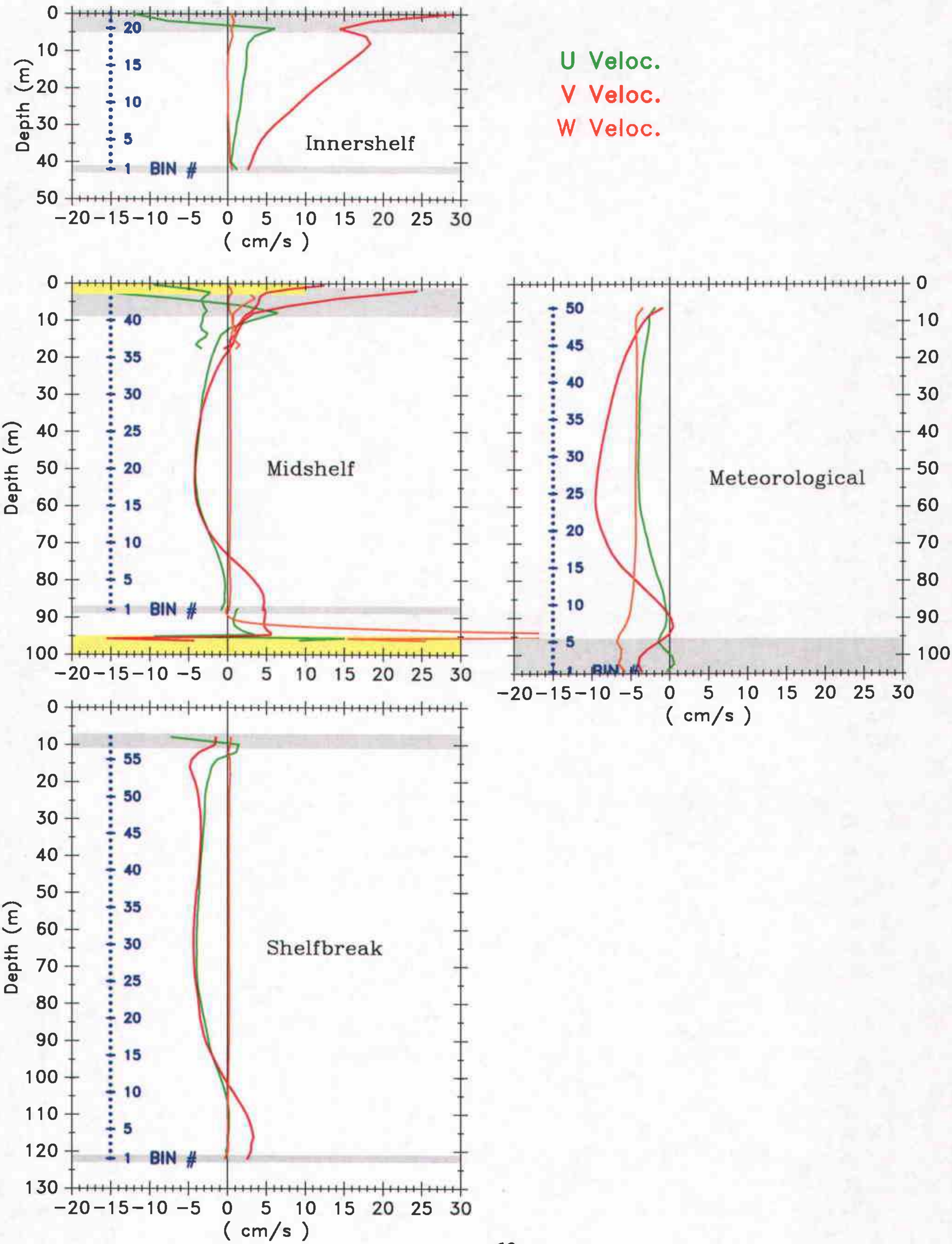


Figure 11

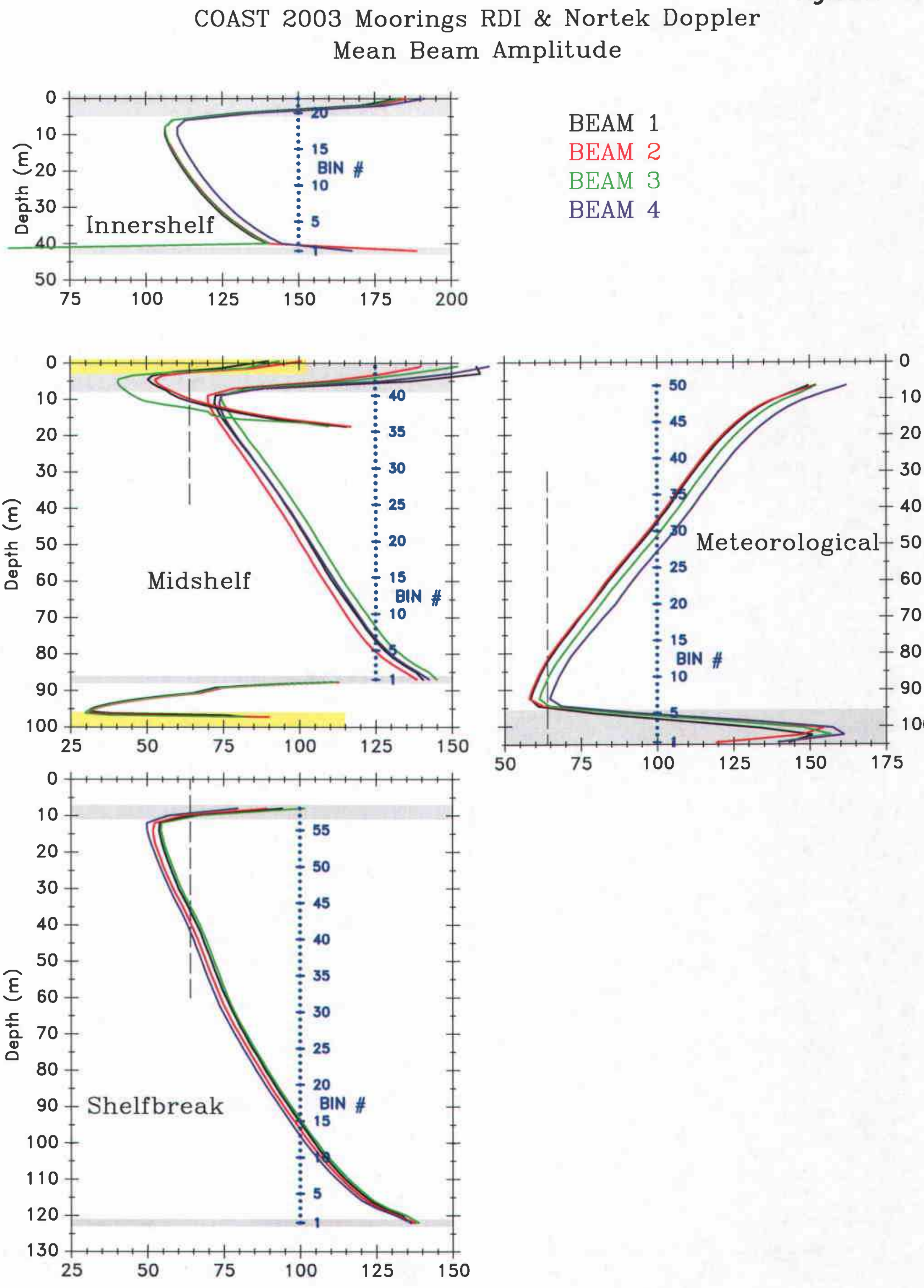

COAST 2003 Moorings RDI & Nortek Doppler
Mean Beam Amplitude
BEAM 1
BEAM 2
BEAM 3
BEAM 4
Innershelf
Midshelf
Meteorological
Shelfbreak
Depth (m)
BIN #

Figure 12

COAST 2003 Moorings RDI Acoustic Doppler
Per–Beam Mean Auto–Correlation Per–Ensemble

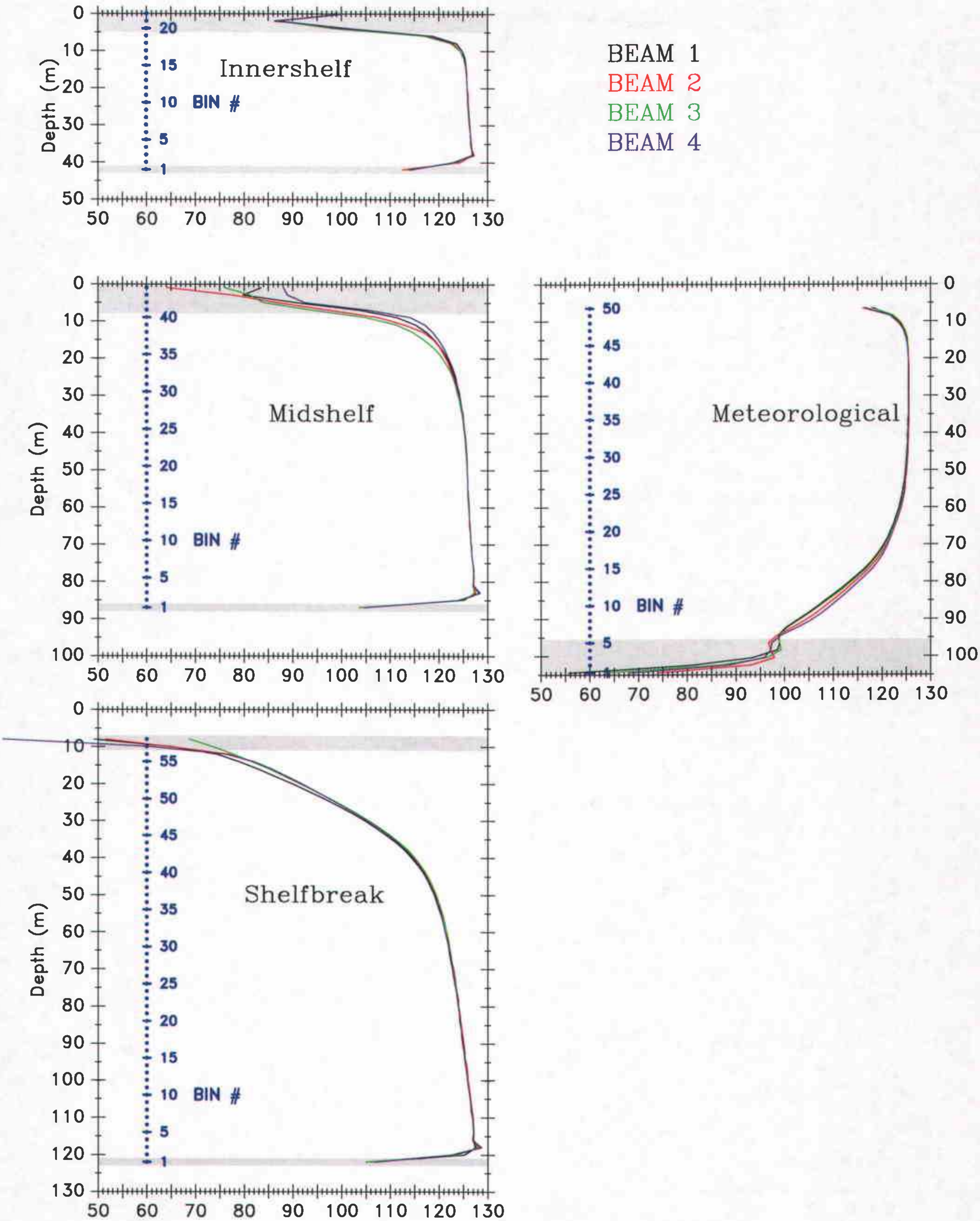
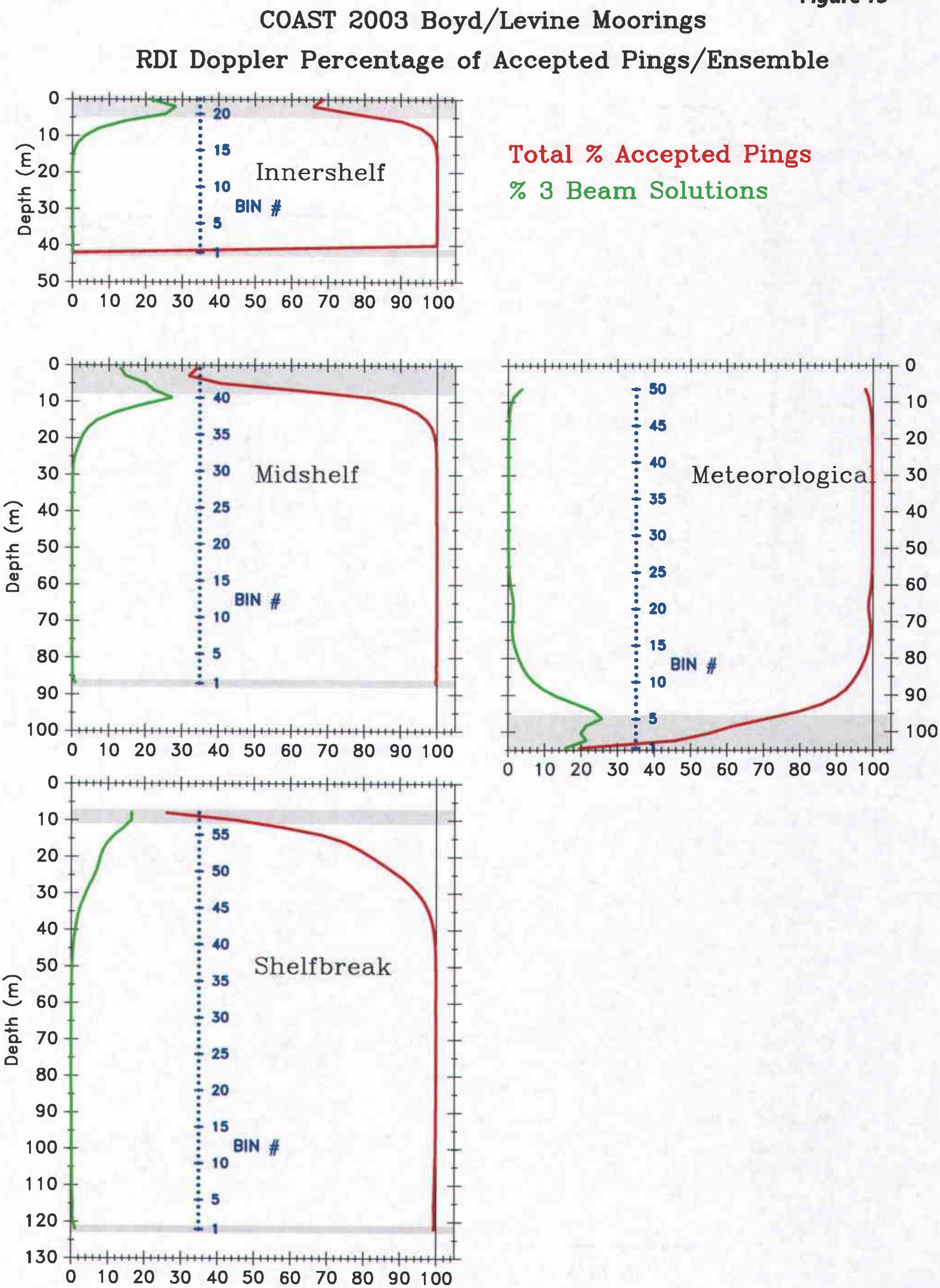


Figure 13



COAST 2003 Boyd/Levine Moorings
RDI Doppler Percentage of Accepted Pings/Ensemble
Total % Accepted Pings
% 3 Beam Solutions
Innershelf
Midshelf
Meteorological
Shelfbreak
BIN #
Depth (m)

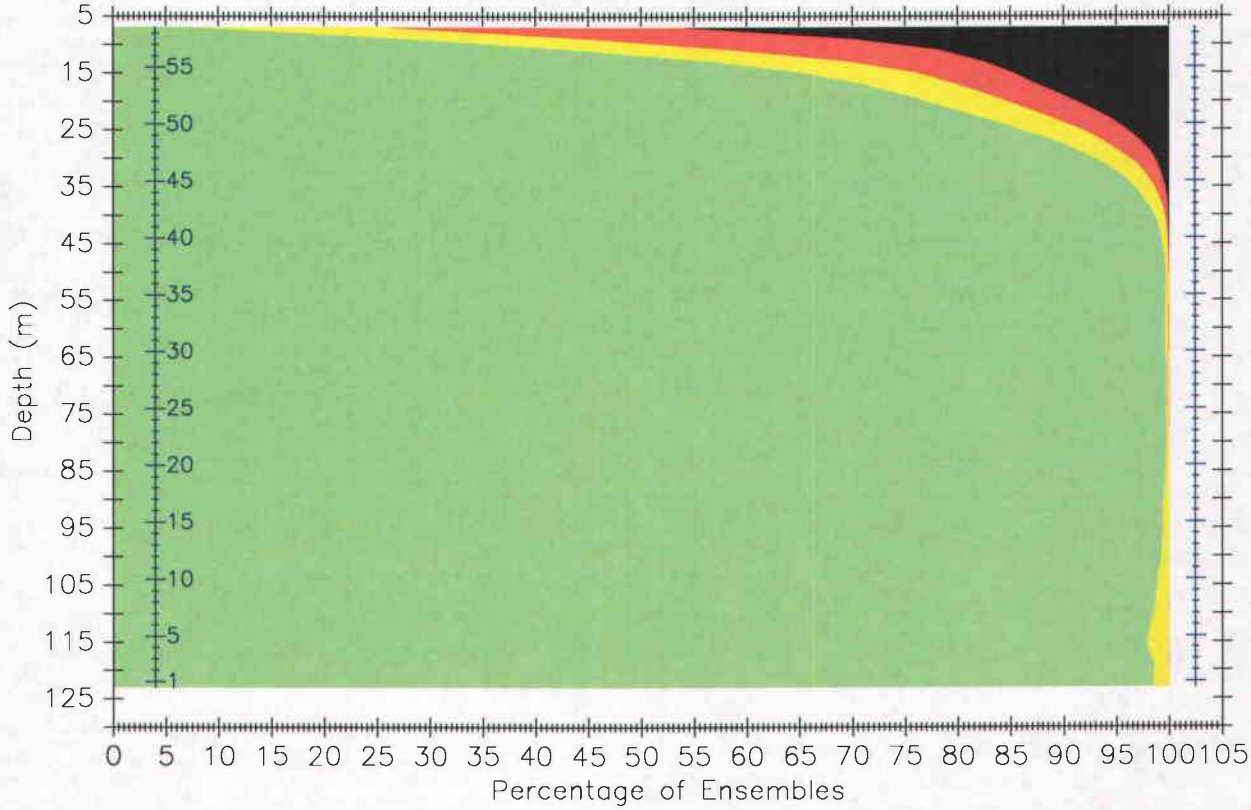
Figure 14a

COAST 2003 Moorings RDI ADCP Doppler

Percentage of Observations that have
Percent Accepted Pings/Ensemble within given range

≧90%	≧50% <90%	≧1% <50%	No Data

DSB, Shelfbreak Mooring RDI 1969



DMS, Midshelf Mooring RDI 1944

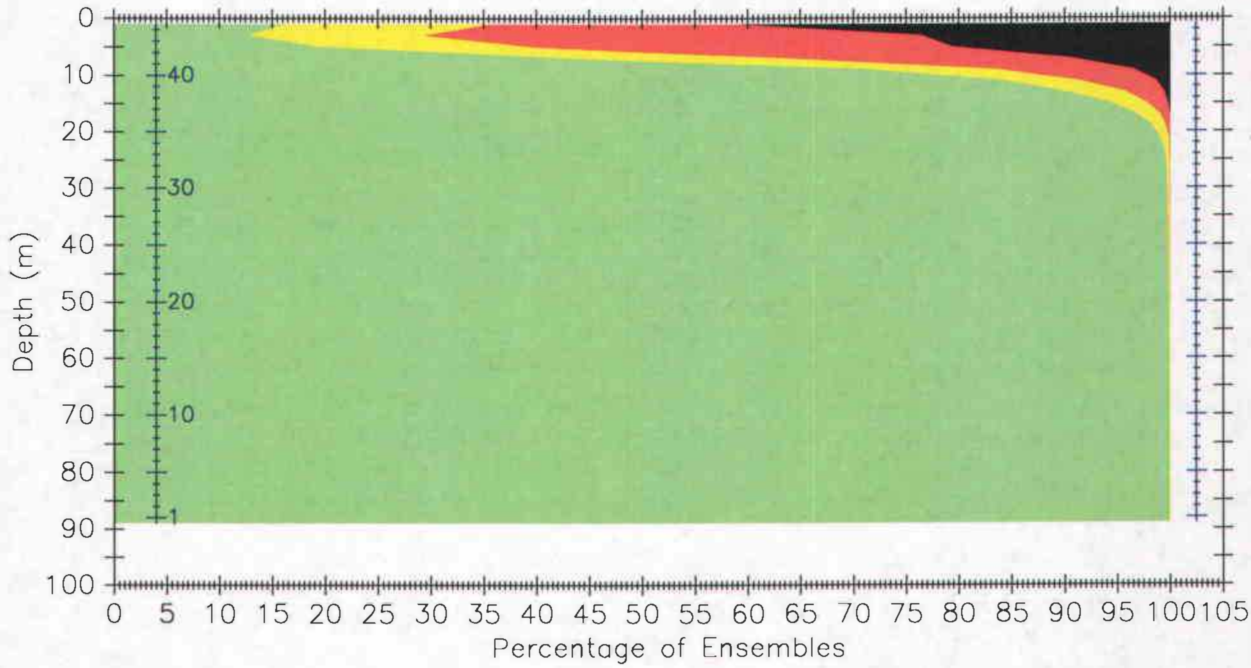
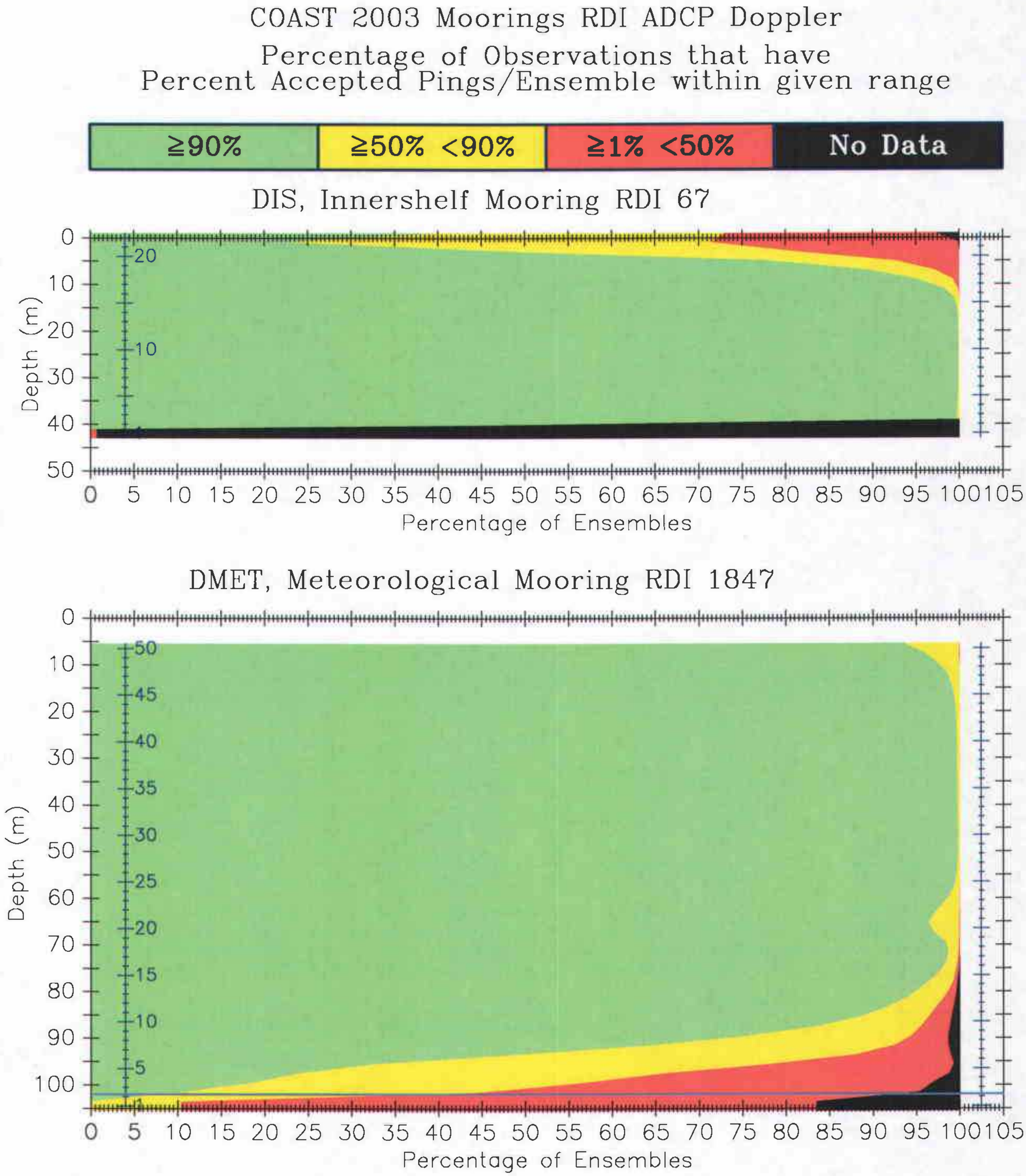


Figure 14b

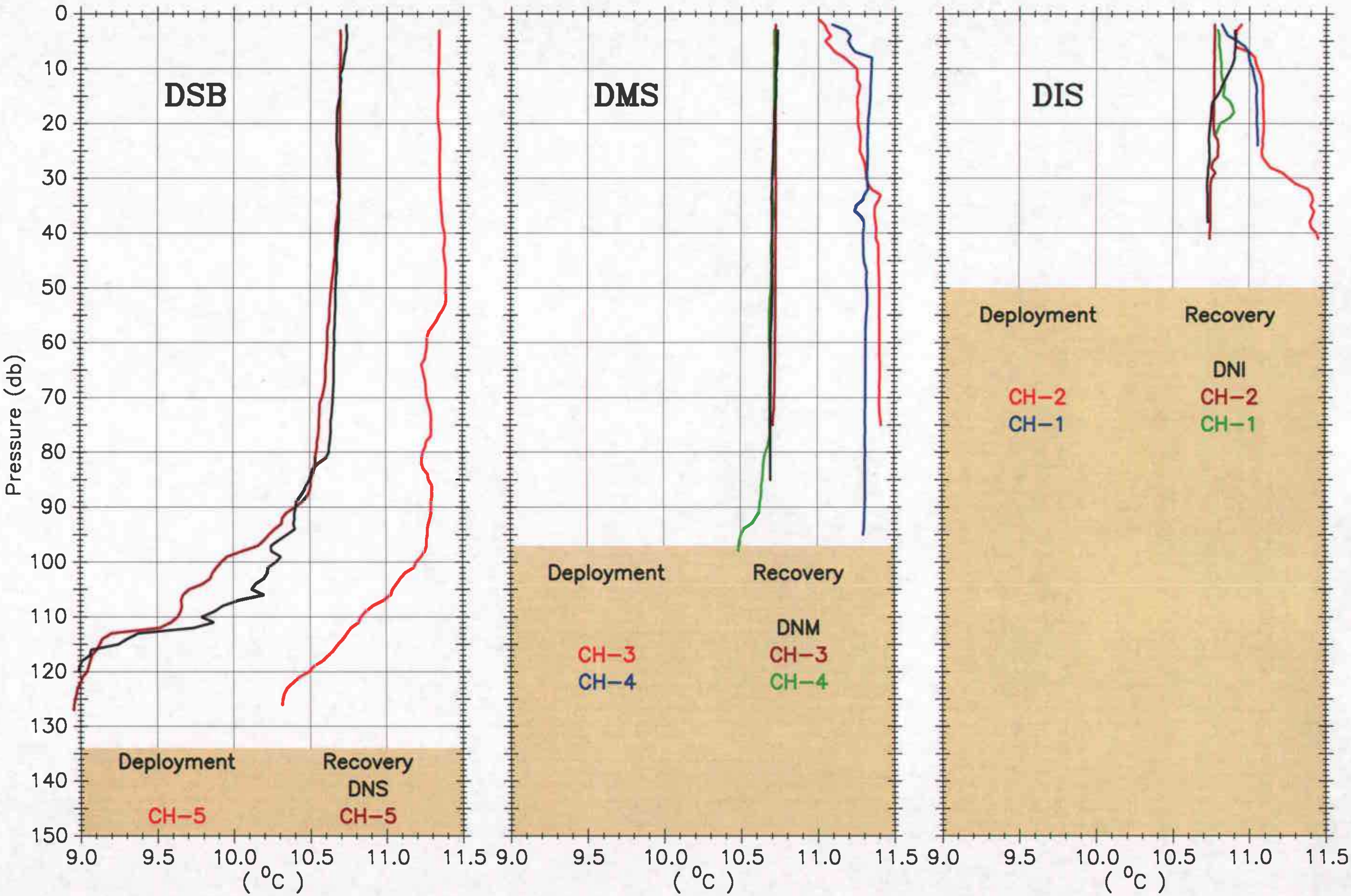

COAST 2003 Moorings RDI ADCP Doppler
Percentage of Observations that have
Percent Accepted Pings/Ensemble within given range
≧90%
≧50% <90%
≧1% <50%
No Data
DIS, Innershelf Mooring RDI 67
Depth (m)
Percentage of Ensembles
DMET, Meteorological Mooring RDI 1847
Depth (m)
Percentage of Ensembles

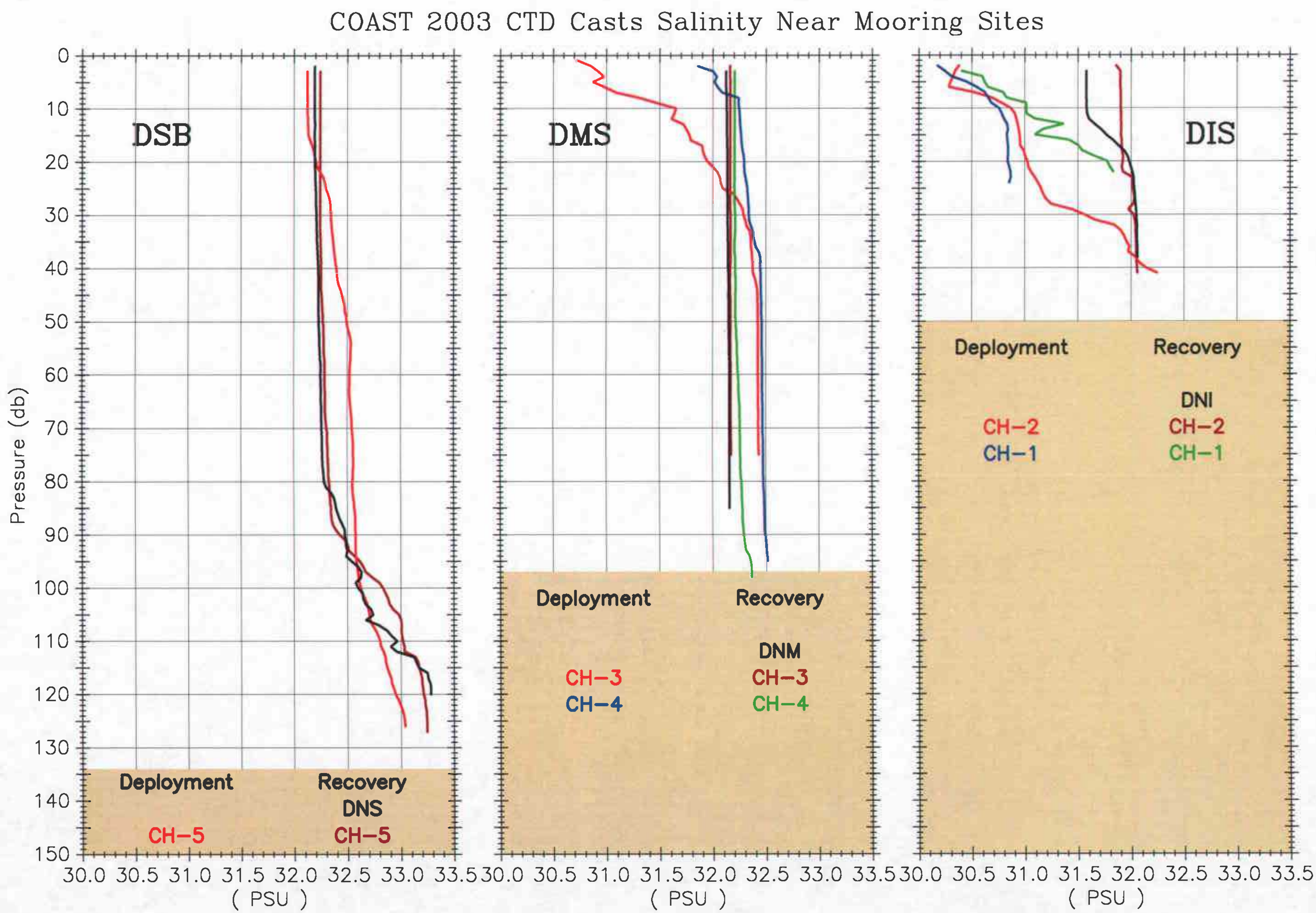
II. CTD AND TIME SERIES PLOTS

A. CTD PROFILES from near the Mooring Locations

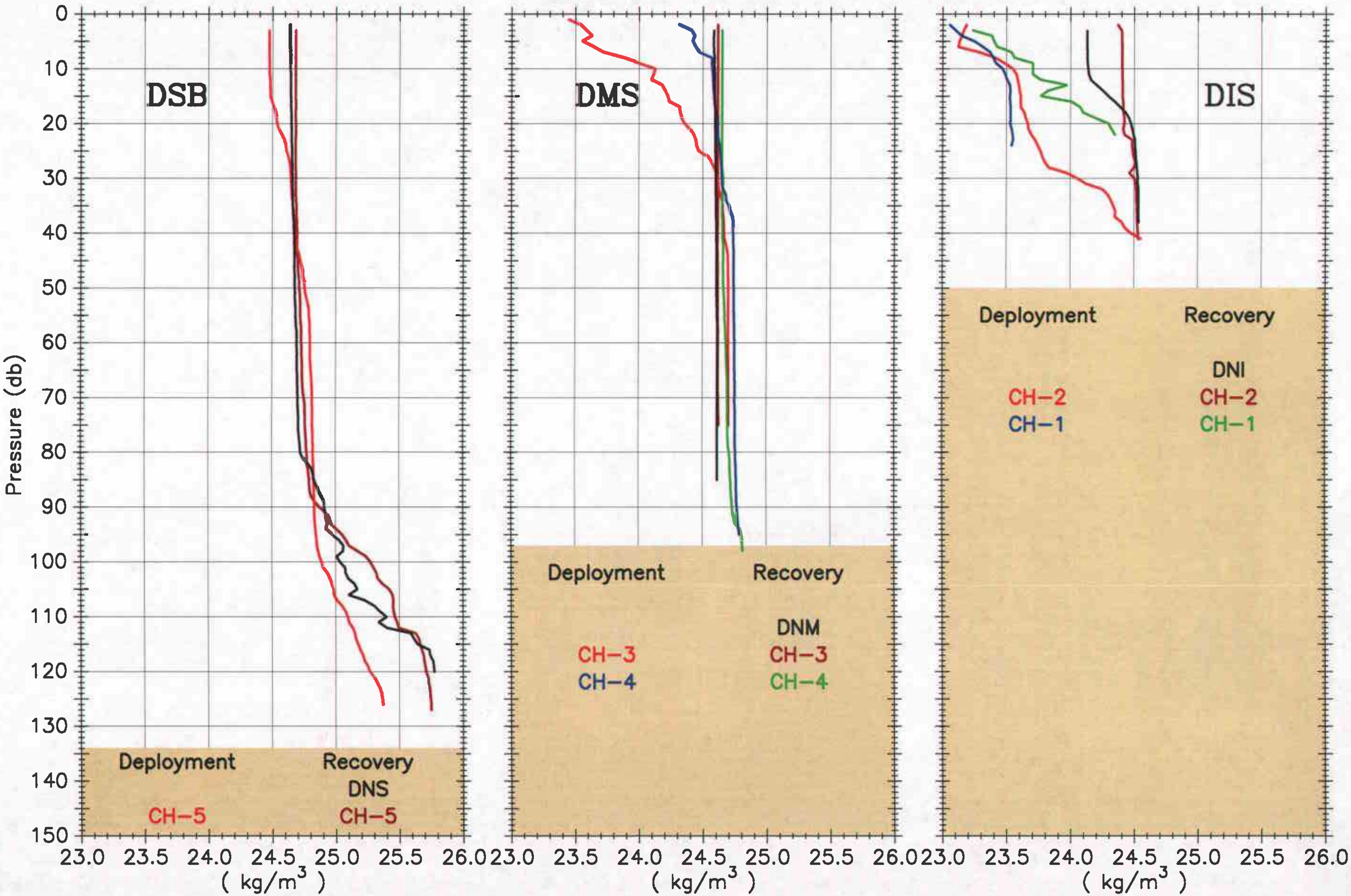
Potential temperature, salinity, and potential density (sigma theta) profiles are shown for the CTD casts taken near the COAST 2003 mooring locations during the mooring deployment and recovery cruises. Profiles are color coded by station name; the shaded area at the figure bottom indicates water depth at the mooring location, which is not necessarily the same as water depth at the CTD station location (see Tables 5 and 6).

COAST 2003 CTD Casts θ Near Mooring Sites




COAST 2003 CTD Casts Salinity Near Mooring Sites
DSB
DMS
DIS
Pressure (db)
(PSU)
Deployment
Recovery
DNS
CH−5
CH−5
Deployment
Recovery
DNM
CH−3
CH−4
CH−3
CH−4
Deployment
Recovery
DNI
CH−2
CH−1
CH−2
CH−1

COAST 2003 CTD Casts σ_θ Near Mooring Sites

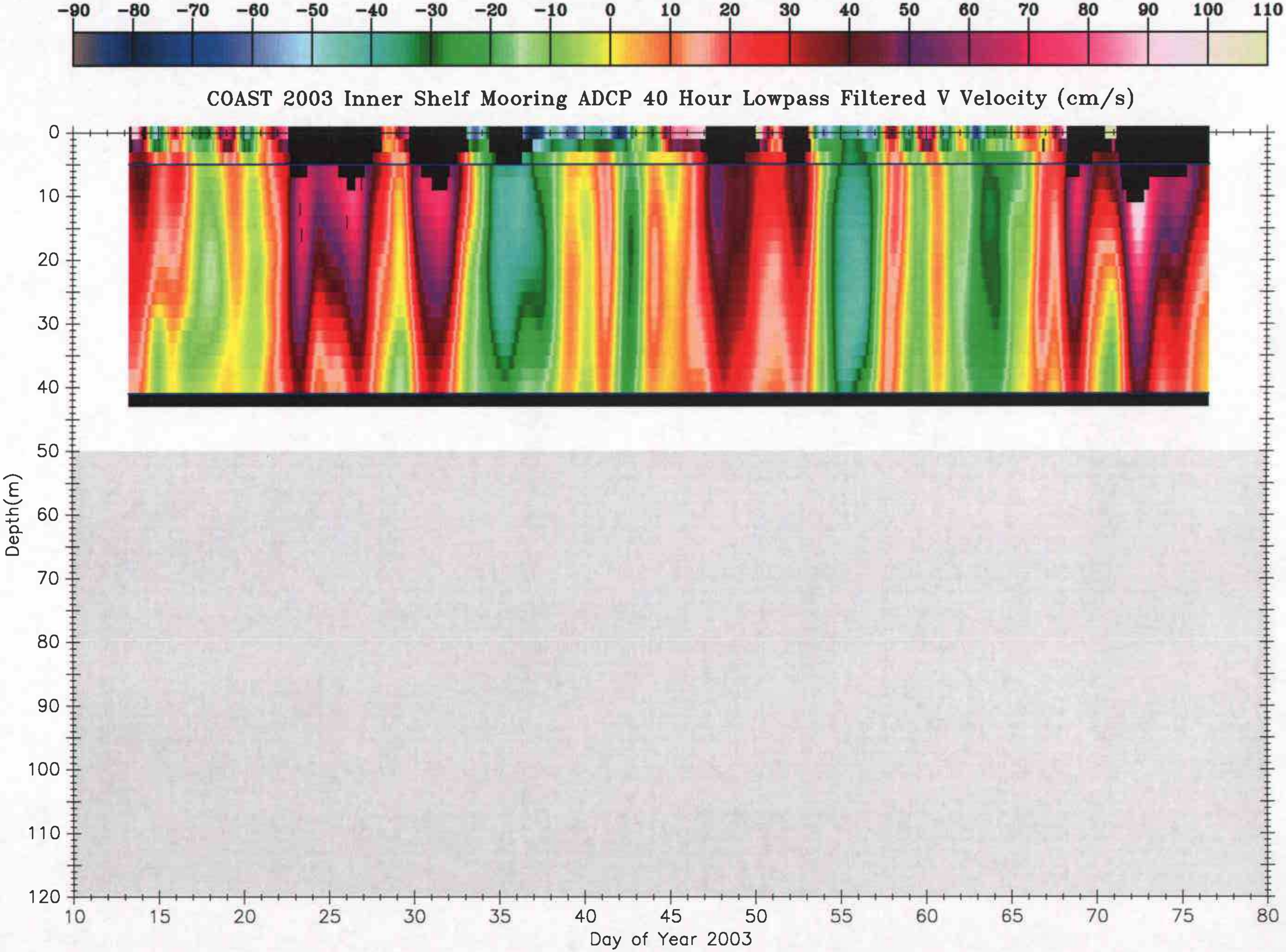


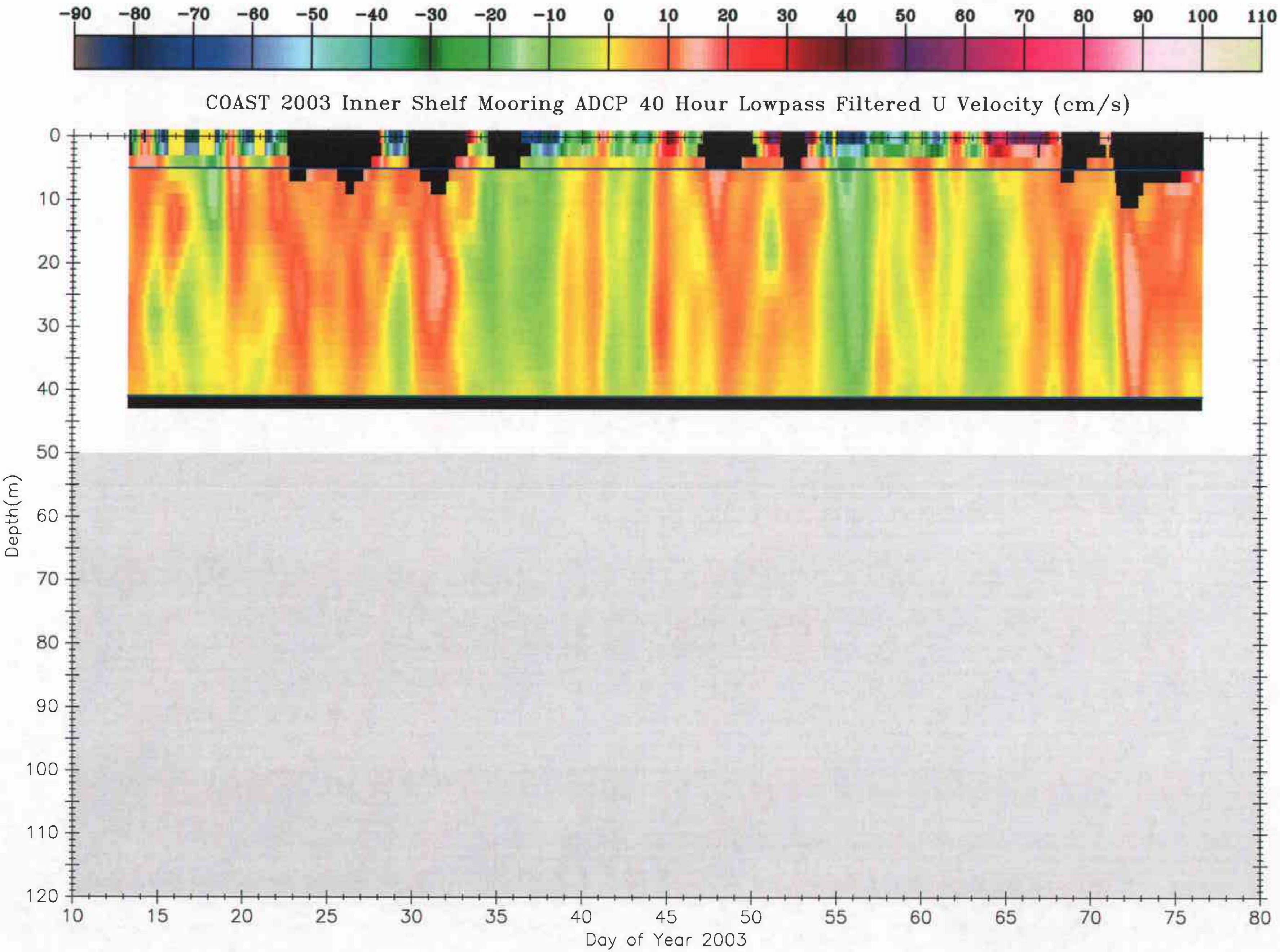
B. VELOCITY Color Contour Depth/Time Plots

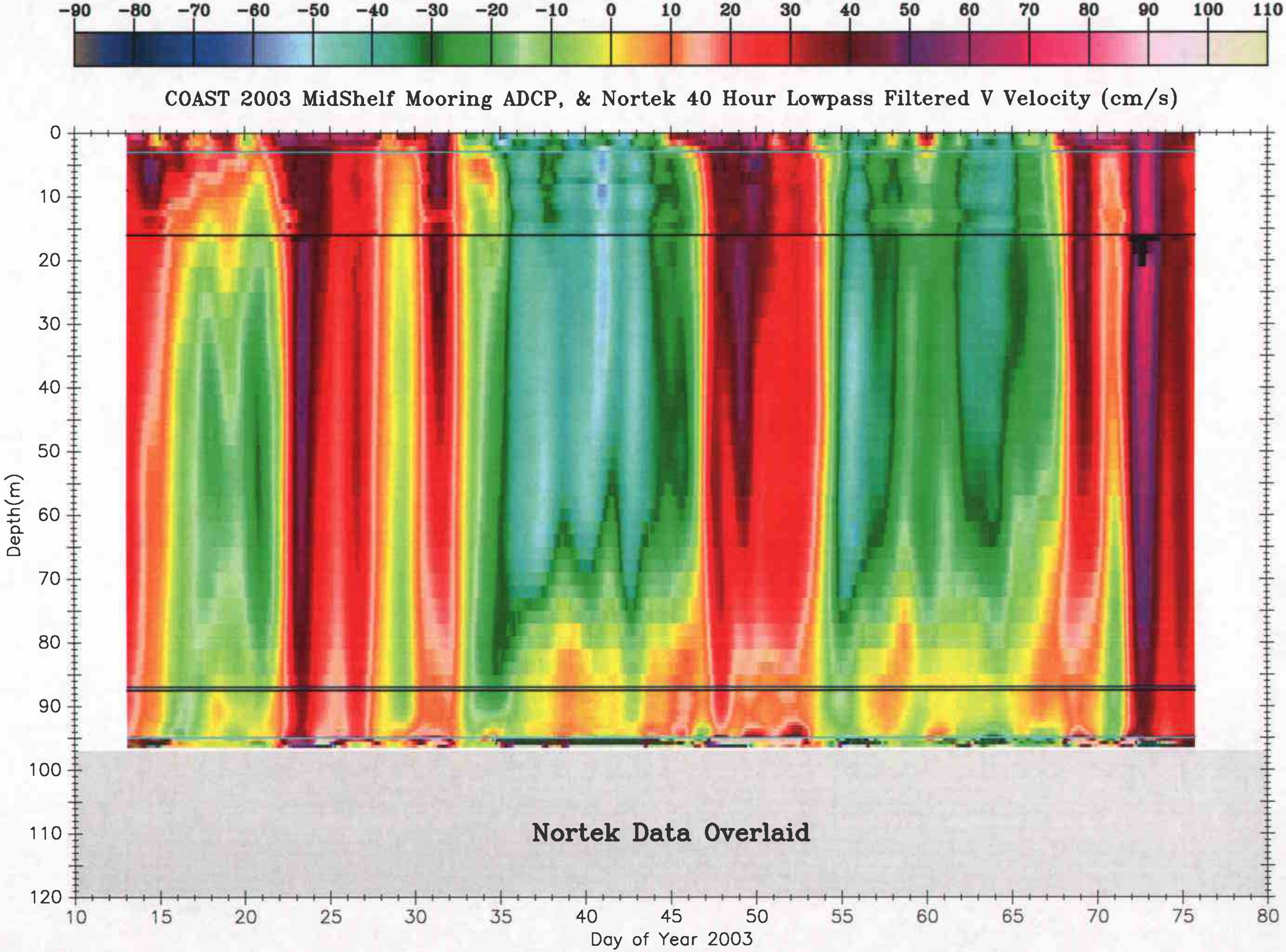
Filtered northward (V) and eastward (U) velocity components are shown for each of the COAST 2003 moorings. Data are shown from all depth bins nominally within the water column. Horizontal blue lines mark the range of good quality velocity data, corresponding to the bins identified in Table 2. The gray shaded regions at the page bottoms indicate the water depth for each mooring location.

Velocity components are shown at one page per component per mooring for the Inner-shelf, Mid-shelf, and Shelf-break moorings. RDI ADCP velocity data for the Mid-shelf mooring are shown with Nortek AquaDopp data overlain. In these figures, the range of good Nortek data extends from the black line to the light blue line. In addition, the Mid-shelf and Met mooring velocity components and component differences are shown on separate pages for depth bins that overlap.

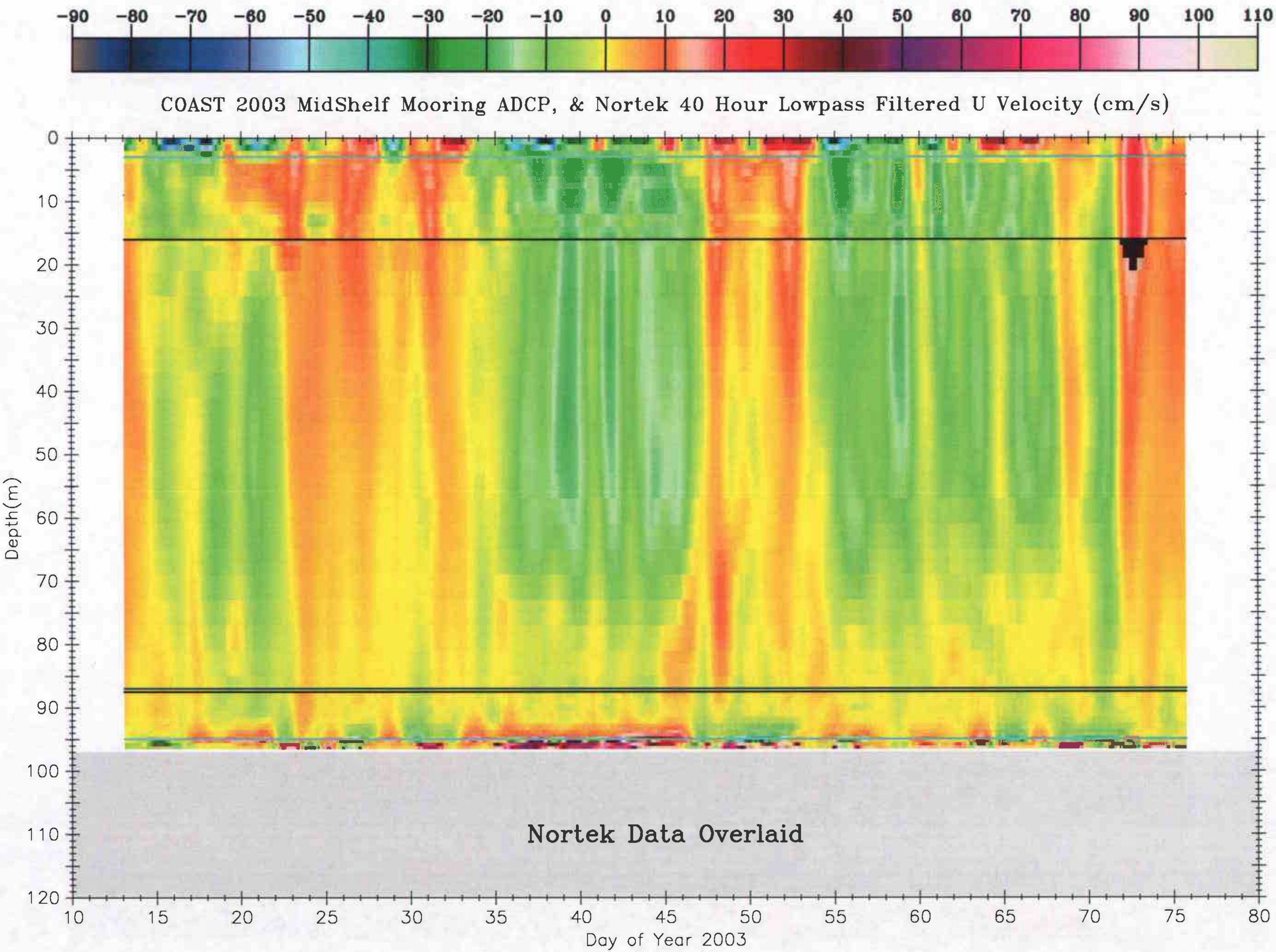
The data represented in these figures are the outputs from a 40-hour lowpass filter, interpolated to 1-hour intervals. Velocity data was obtained at various sample rates ranging from approximately 2 to 4 minutes (see Table 2). The filter employs a Lanczos taper with a half width of 1840 minutes. For the ADCP data, the filter inputs are time series of velocity ensemble averages for which the percentage of accepted pings/ensemble exceeds 50%; near the maximum of the instrument ranges these time series are gappy. All Nortek data is input to the filter. There is no filter output at times for which there is less than 50% data coverage in each side of the filter window. In addition, there is no data output at times within one filter half-width of the start and stop times of the time series.

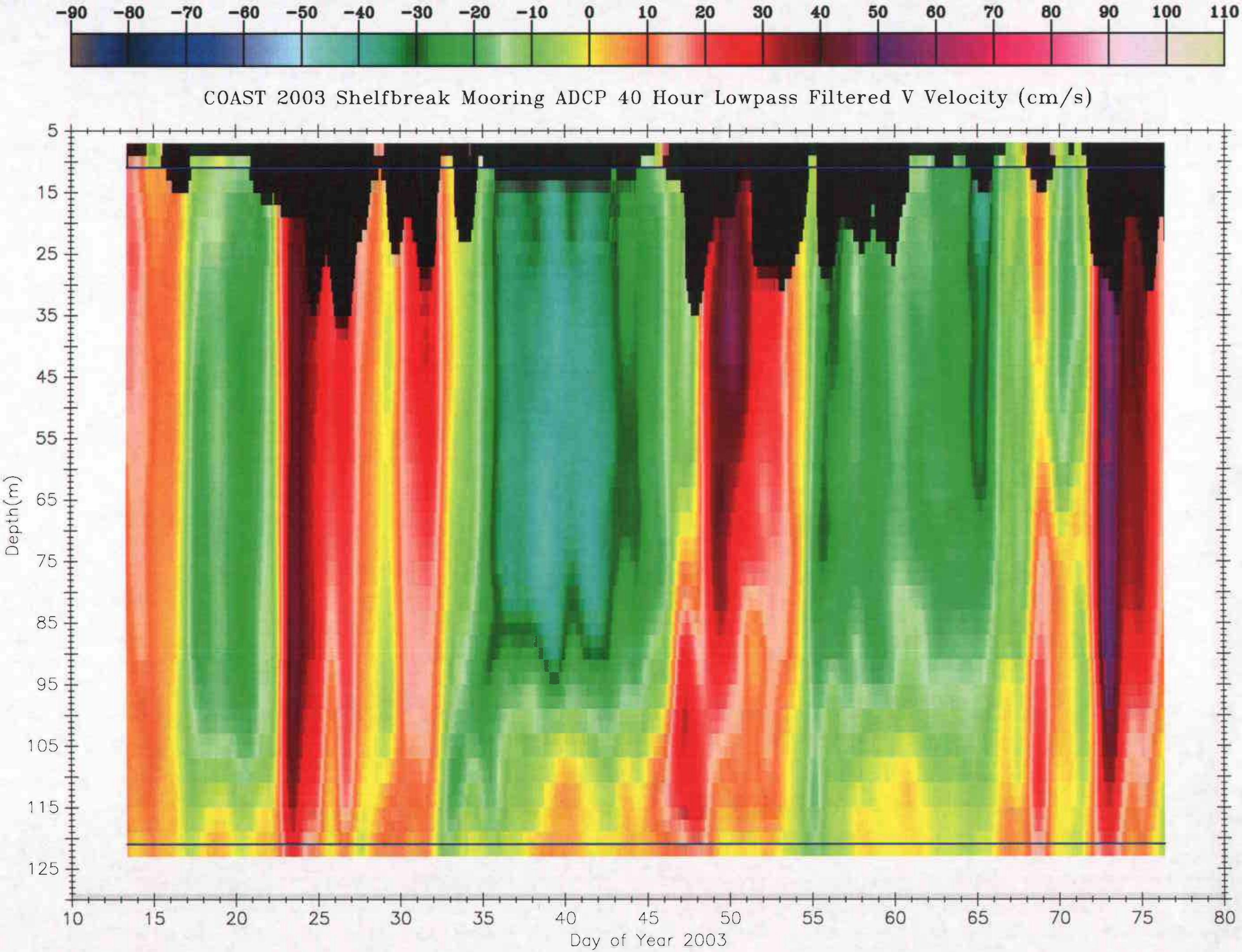

-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
COAST 2003 Inner Shelf Mooring ADCP 40 Hour Lowpass Filtered V Velocity (cm/s)
Depth(m)
0 10 20 30 40 50 60 70 80 90 100 110 120
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Day of Year 2003


-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
COAST 2003 Inner Shelf Mooring ADCP 40 Hour Lowpass Filtered U Velocity (cm/s)
Depth(m)
0 10 20 30 40 50 60 70 80 90 100 110 120
Day of Year 2003
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

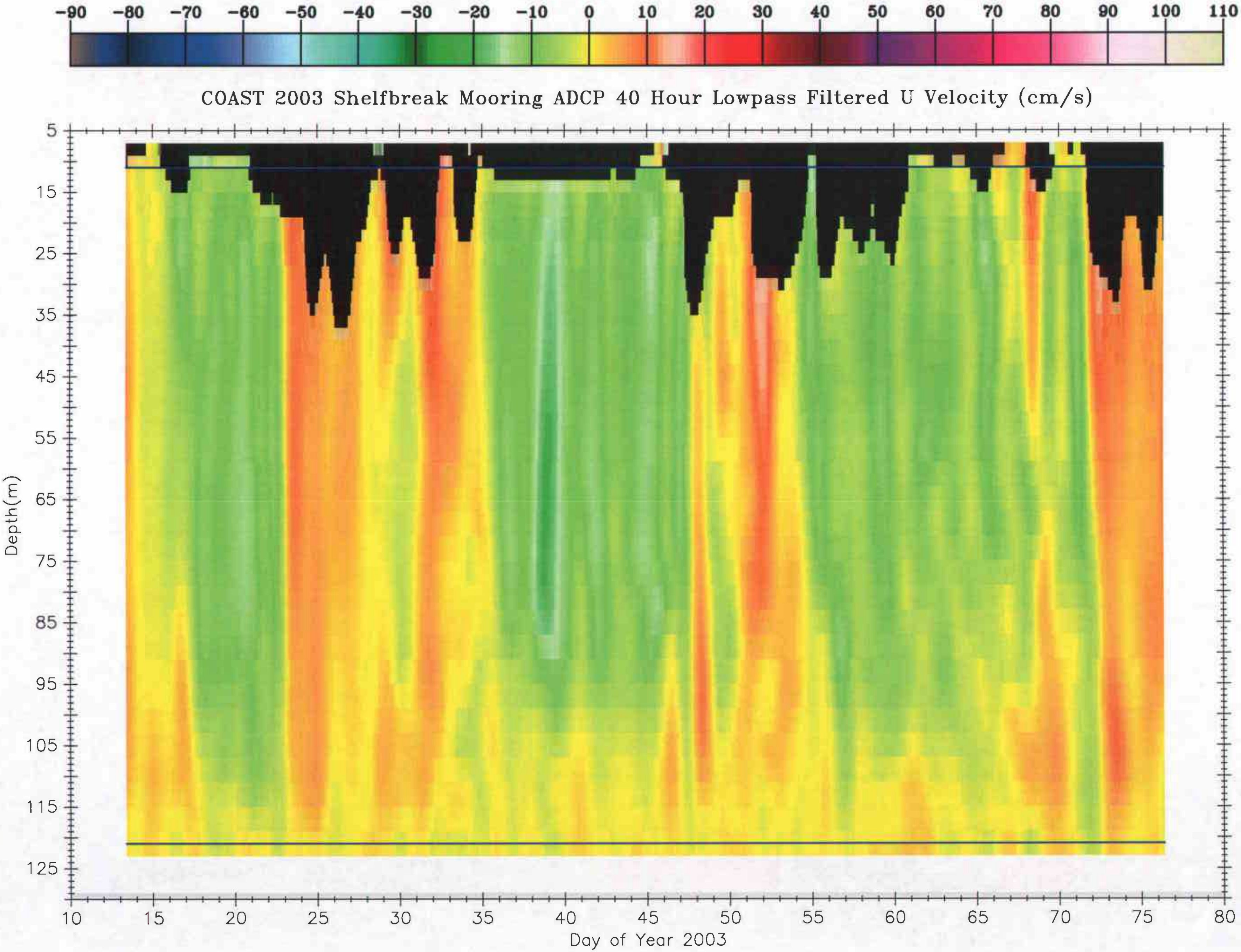


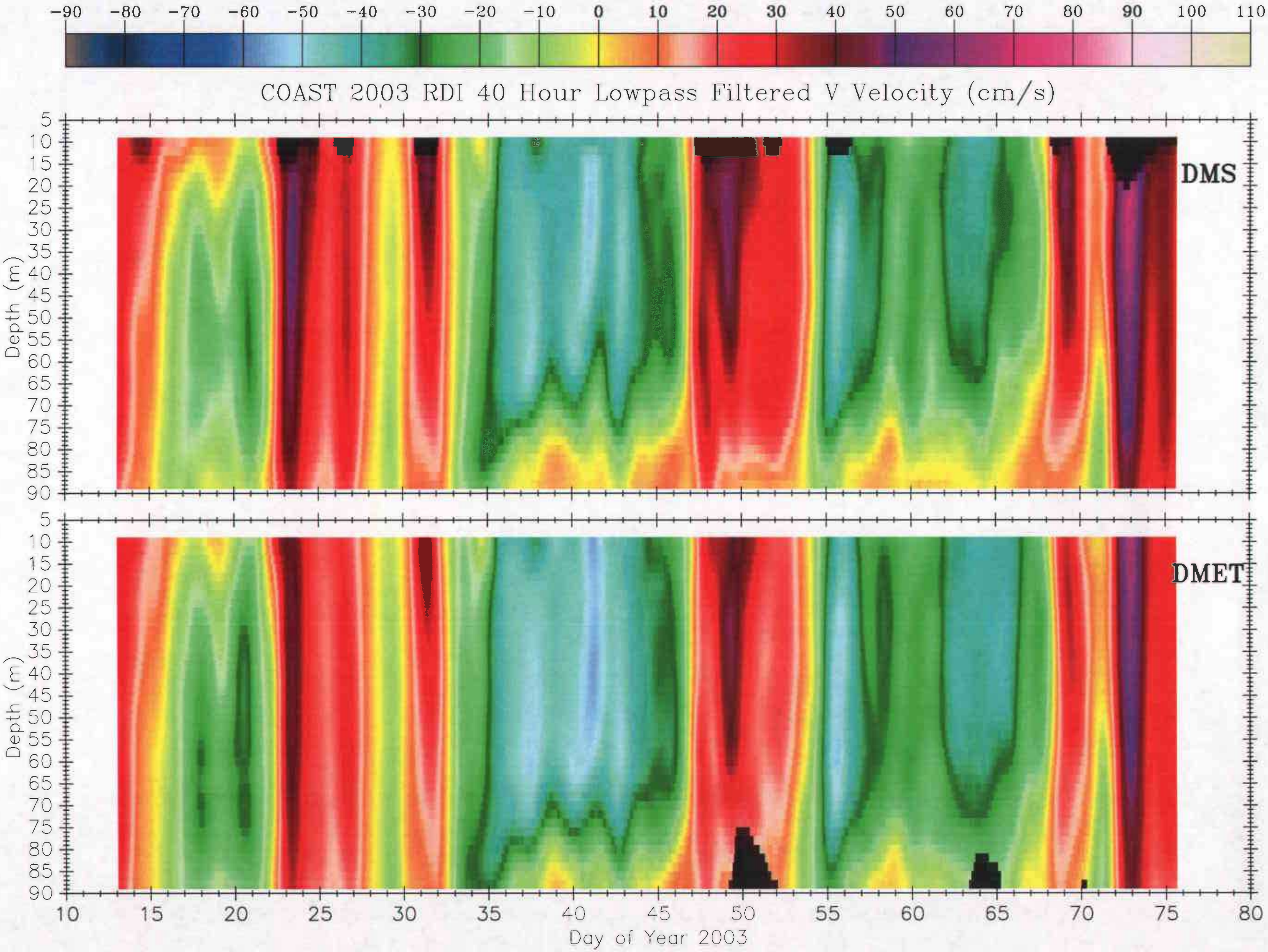
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
COAST 2003 MidShelf Mooring ADCP, & Nortek 40 Hour Lowpass Filtered V Velocity (cm/s)
Depth(m)
0 10 20 30 40 50 60 70 80 90 100 110 120
Nortek Data Overlaid
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Day of Year 2003

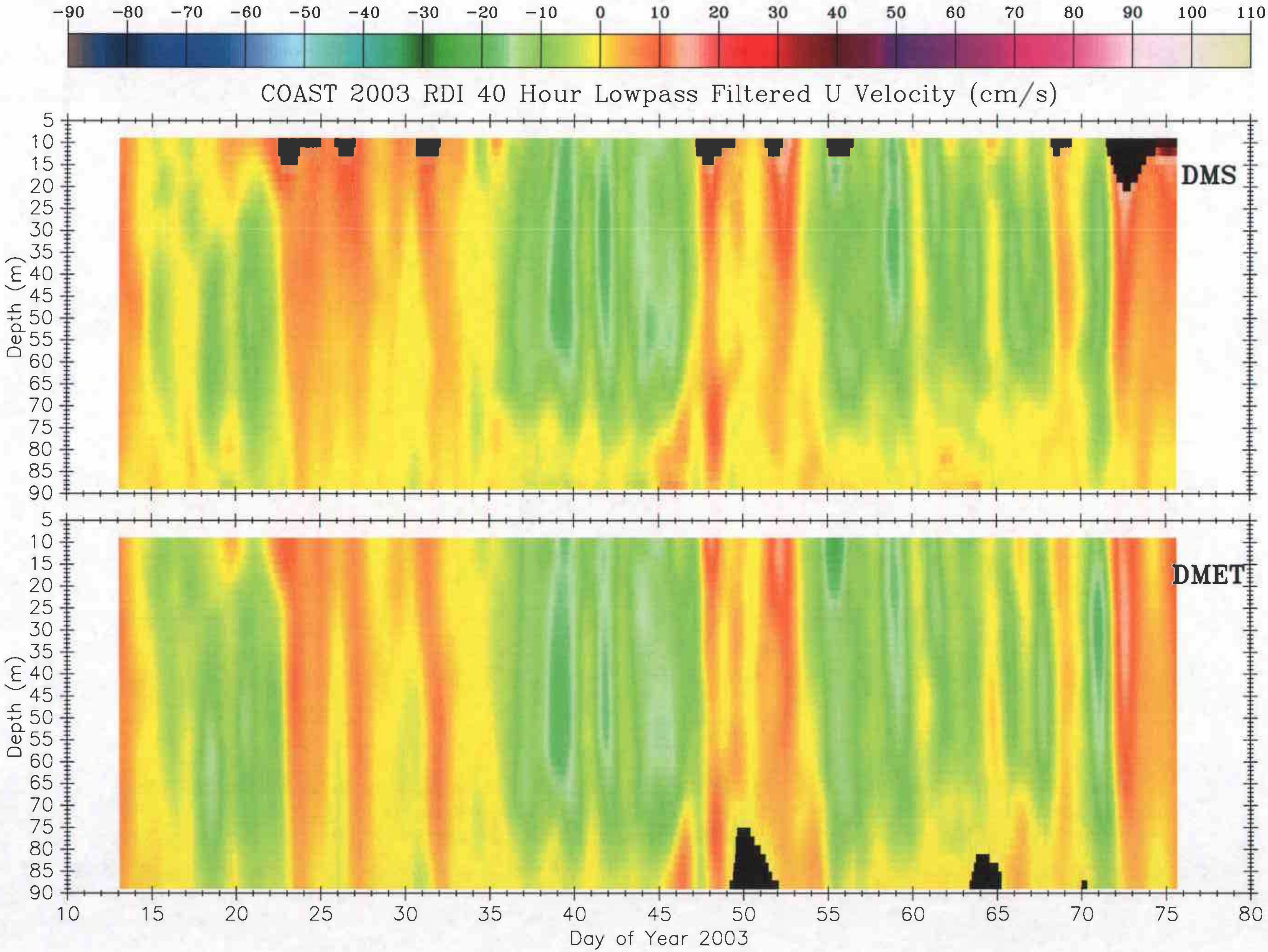

-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
COAST 2003 MidShelf Mooring ADCP, & Nortek 40 Hour Lowpass Filtered U Velocity (cm/s)
Depth(m)
0 10 20 30 40 50 60 70 80 90 100 110 120
Nortek Data Overlaid
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Day of Year 2003



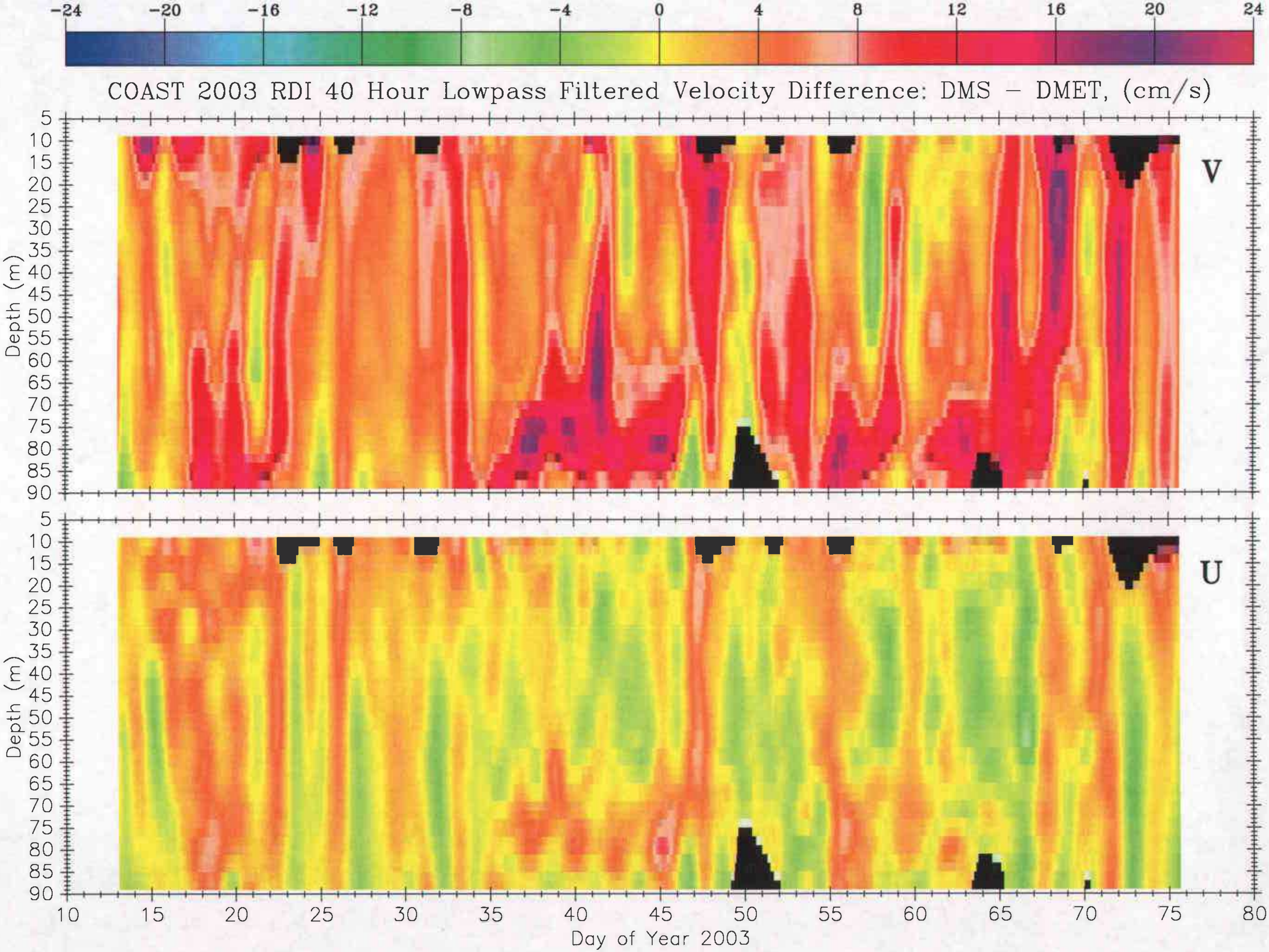
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
COAST 2003 Shelfbreak Mooring ADCP 40 Hour Lowpass Filtered V Velocity (cm/s)
Depth(m)
5 15 25 35 45 55 65 75 85 95 105 115 125
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Day of Year 2003


-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
COAST 2003 Shelfbreak Mooring ADCP 40 Hour Lowpass Filtered U Velocity (cm/s)
Depth(m)
5 15 25 35 45 55 65 75 85 95 105 115 125
Day of Year 2003
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80


−90 −80 −70 −60 −50 −40 −30 −20 −10 0 10 20 30 40 50 60 70 80 90 100 110
COAST 2003 RDI 40 Hour Lowpass Filtered V Velocity (cm/s)
DMS
DMET
Depth (m)
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Day of Year 2003



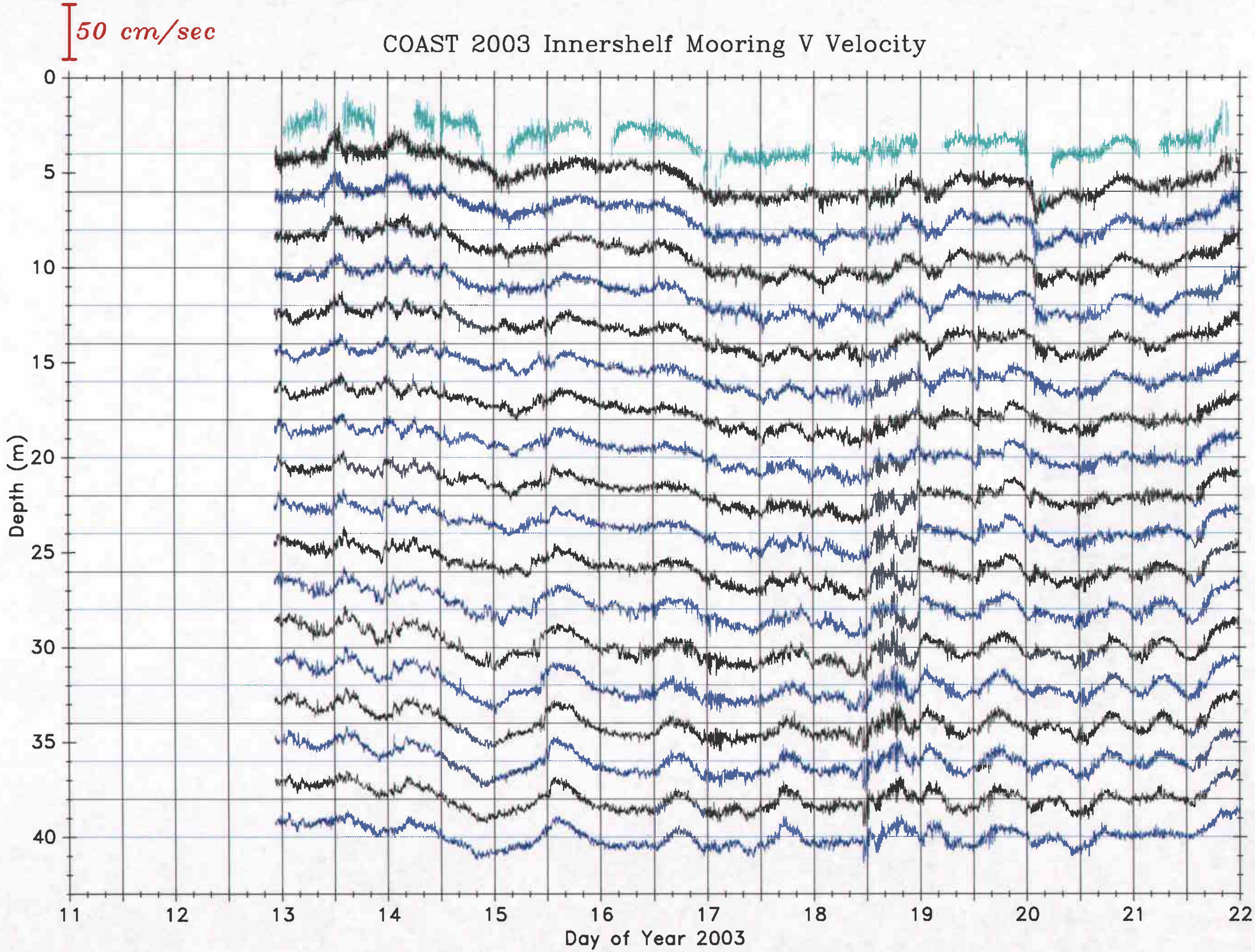
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
COAST 2003 RDI 40 Hour Lowpass Filtered U Velocity (cm/s)
DMS
DMET
Depth (m)
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Day of Year 2003

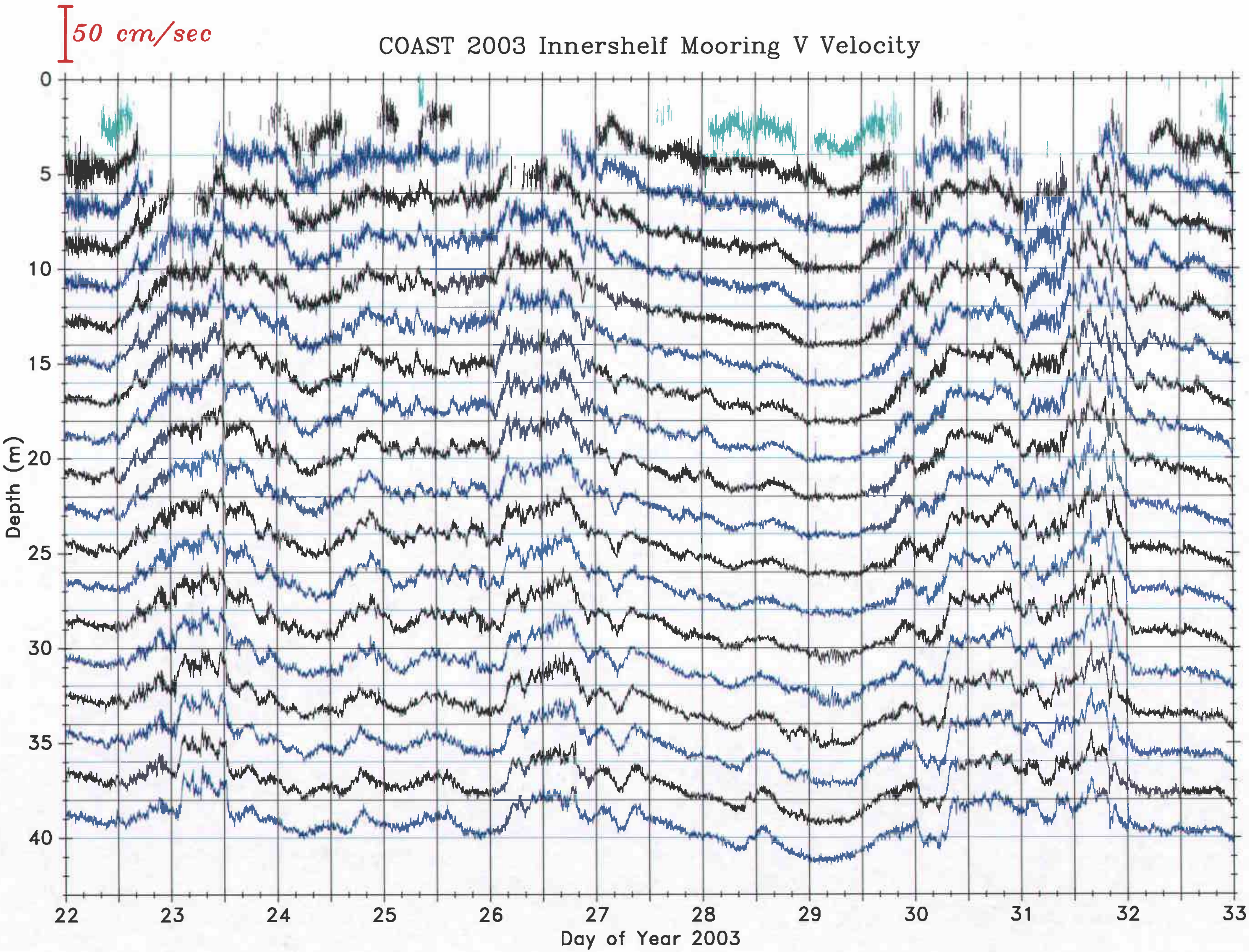

-24 -20 -16 -12 -8 -4 0 4 8 12 16 20 24
COAST 2003 RDI 40 Hour Lowpass Filtered Velocity Difference: DMS – DMET, (cm/s)
V
U
Depth (m)
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Day of Year 2003

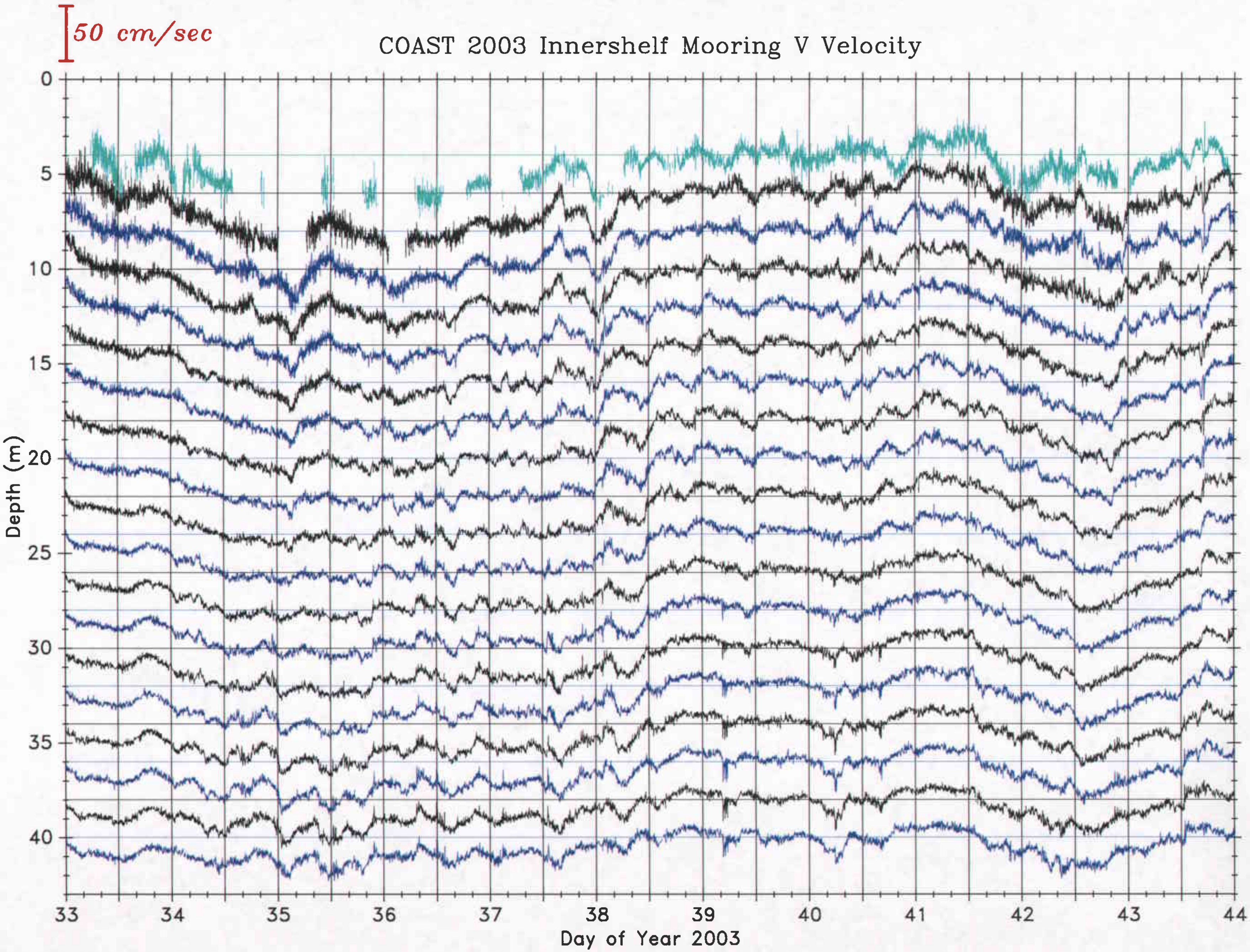
C. VELOCITY Time Series: Offset Line Plots

Unfiltered northward (V), eastward (U), and upward (W) velocity components are shown for each of the COAST 2003 moorings. Data are shown from all even-numbered depth bins within the range of good quality data: Inner-shelf bins 2-19, Mid-shelf bins 2-40, Shelf-break bins 2-56 (Table 2). Data is shown only for ensembles for which the percentage of accepted pings exceeds 90%; other ensembles are represented by gaps. The velocity components are offset in the vertical, with horizontal lines corresponding to the respective zeros of velocity offset to the depths of the bins. Positive velocity fluctuations are upward from the zero lines. The velocity scale is shown in red at the upper left.

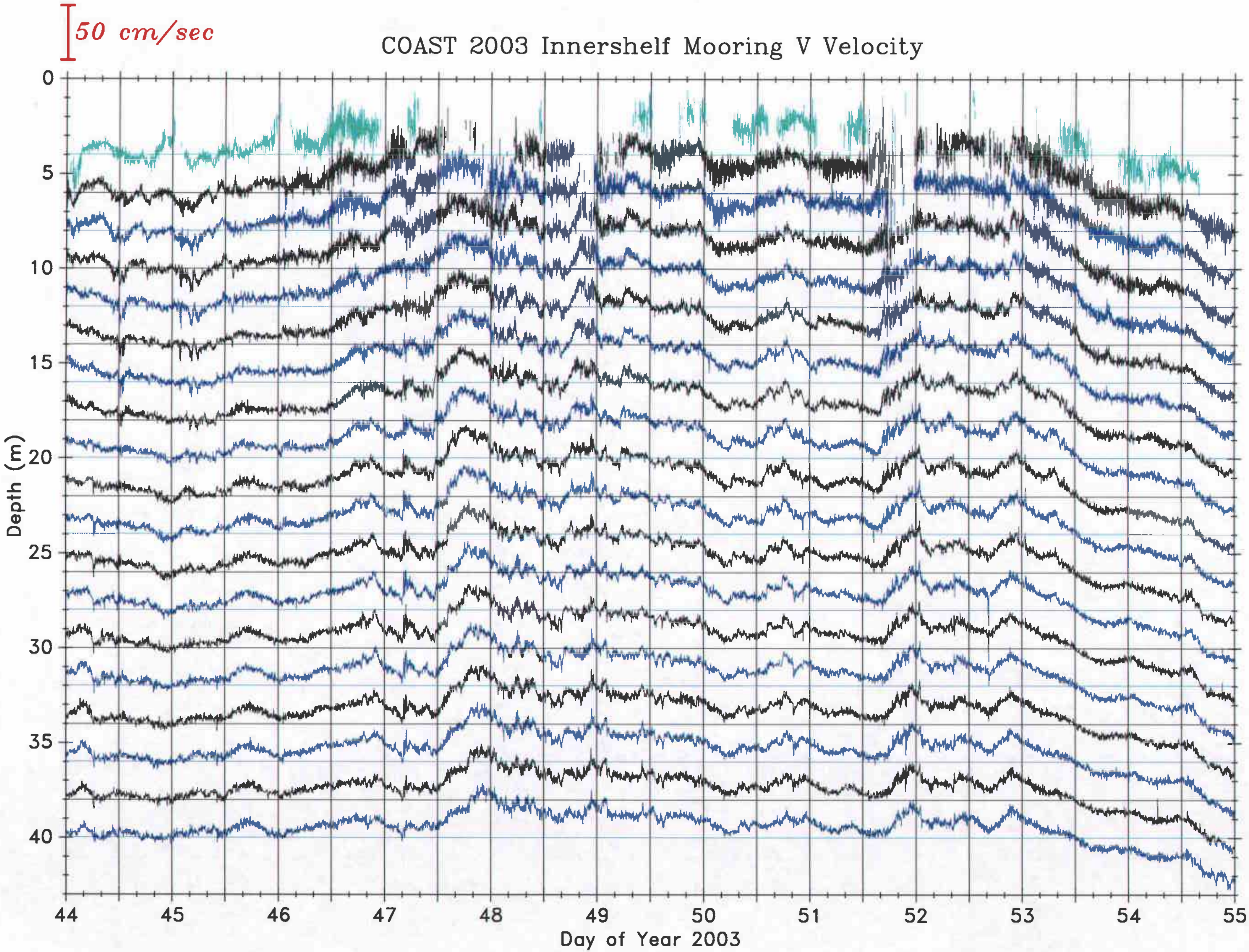
Data from the ADCP bins are shown as alternating blue and black lines. Data from one bin (#20) beyond the range of good quality data is shown in cyan for the Inner-shelf mooring. Data from every 4th bin of the Nortek AquaDopps on the Mid-shelf mooring are shown as alternating red and orange lines: 1 MHz bins 3,7,11, and 15; 2 MHz bins 1, 5, and 9 (Table 2). Velocity data were obtained at various sample rates ranging from approximately 2 to 4 minutes (see Table 2).

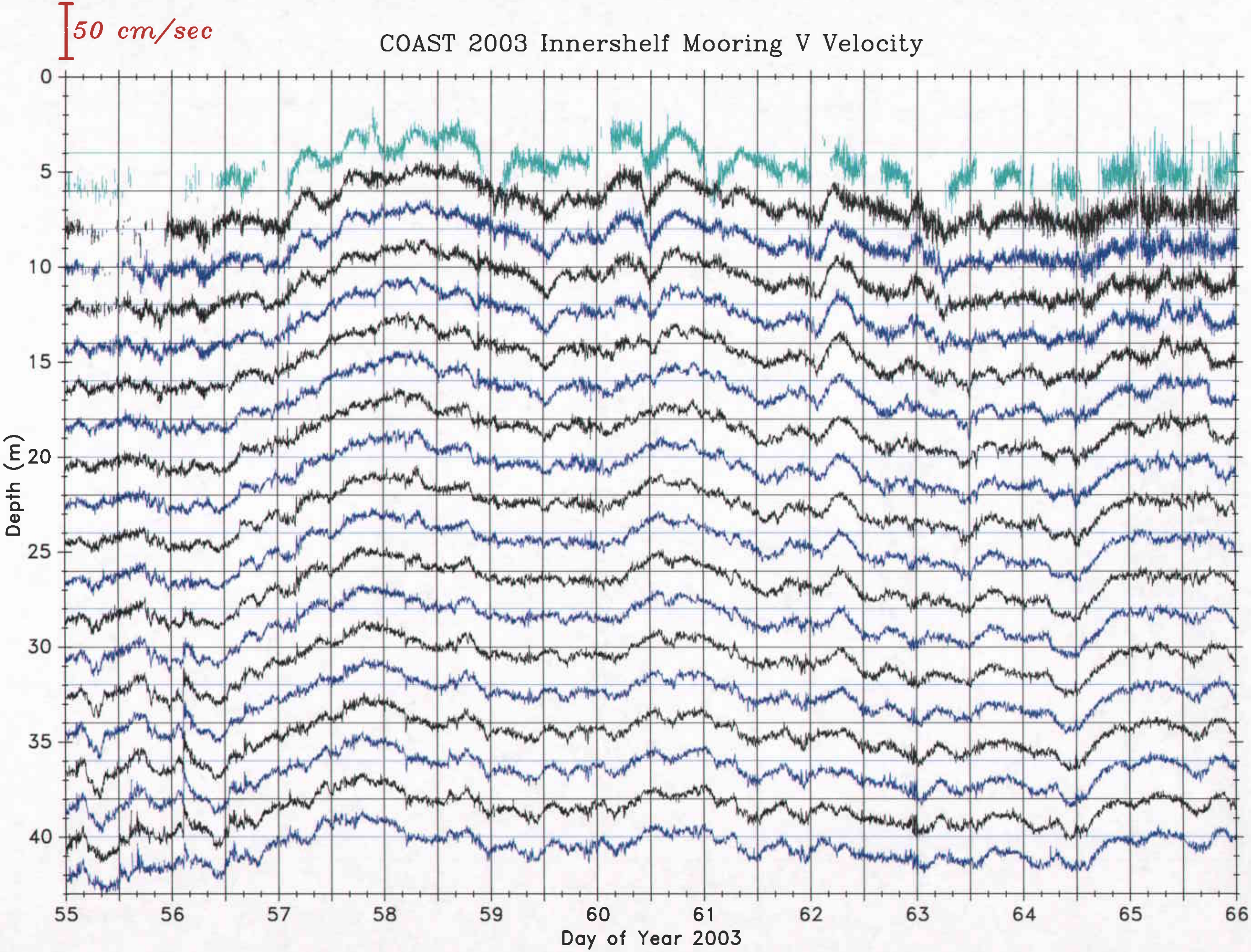

50 cm/sec
COAST 2003 Innershelf Mooring V Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
11
12
13
14
15
16
17
18
19
20
21
22
Day of Year 2003

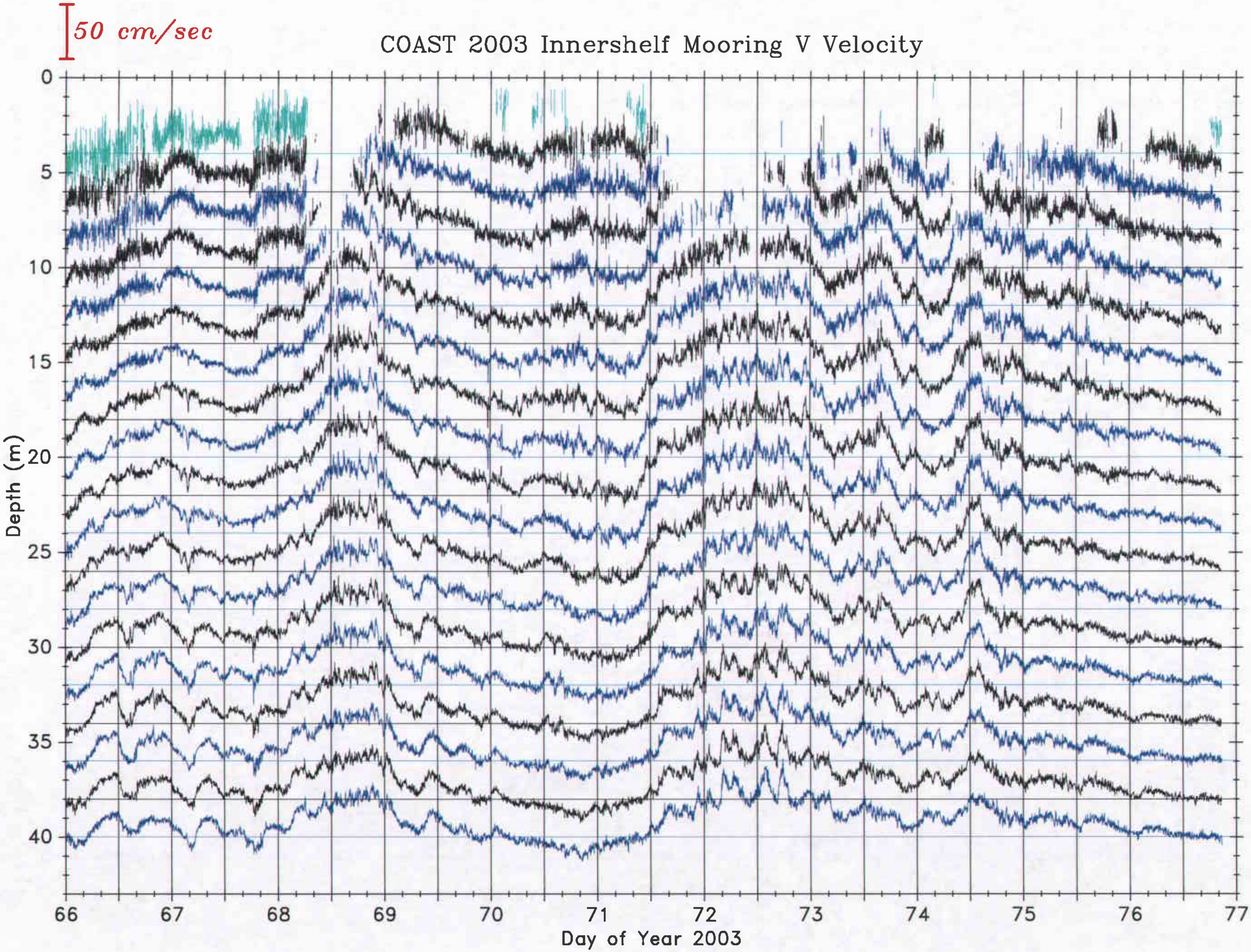

50 cm/sec
COAST 2003 Innershelf Mooring V Velocity
0
5
10
15
20
25
30
35
40
Depth (m)
22
23
24
25
26
27
28
29
30
31
32
33
Day of Year 2003

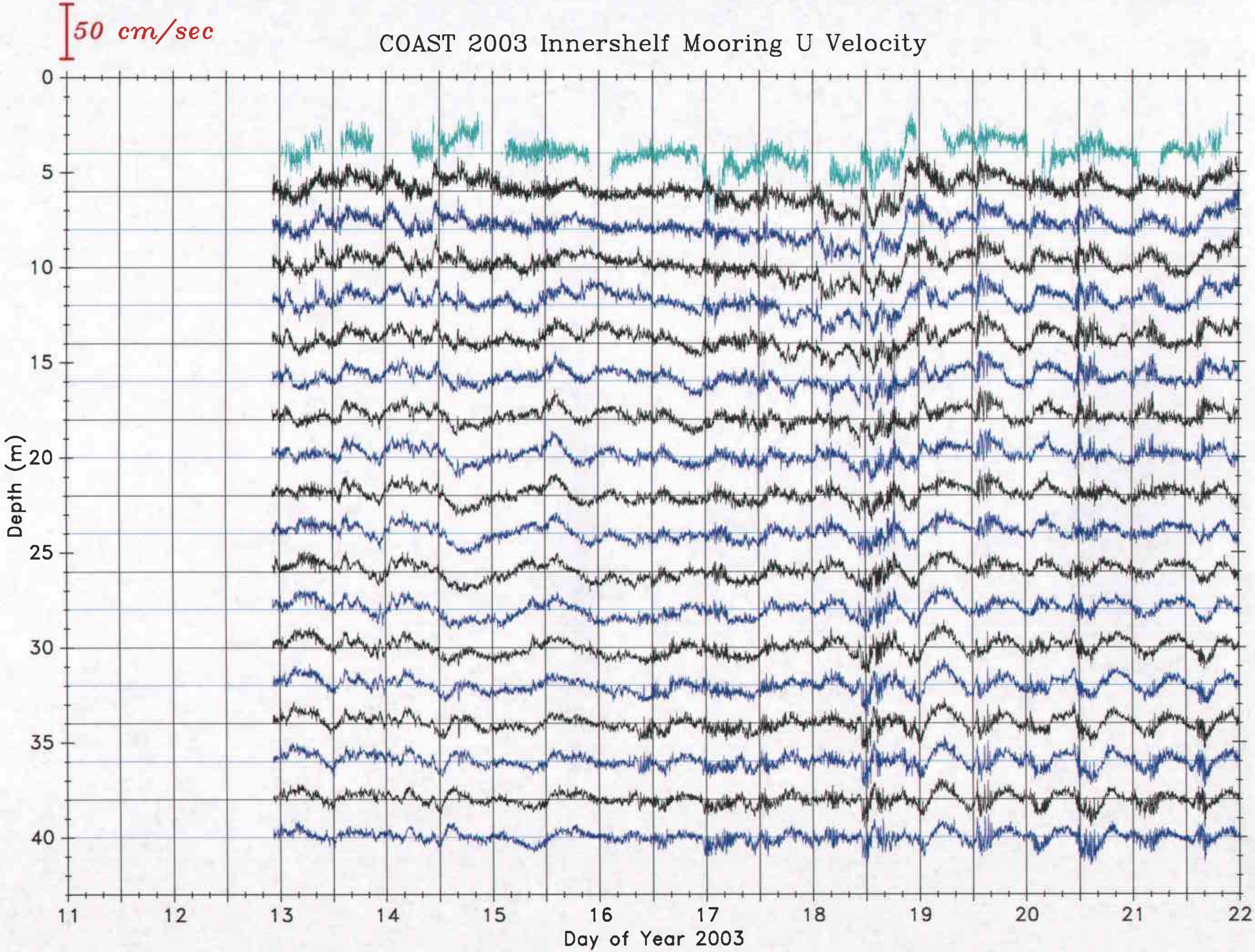


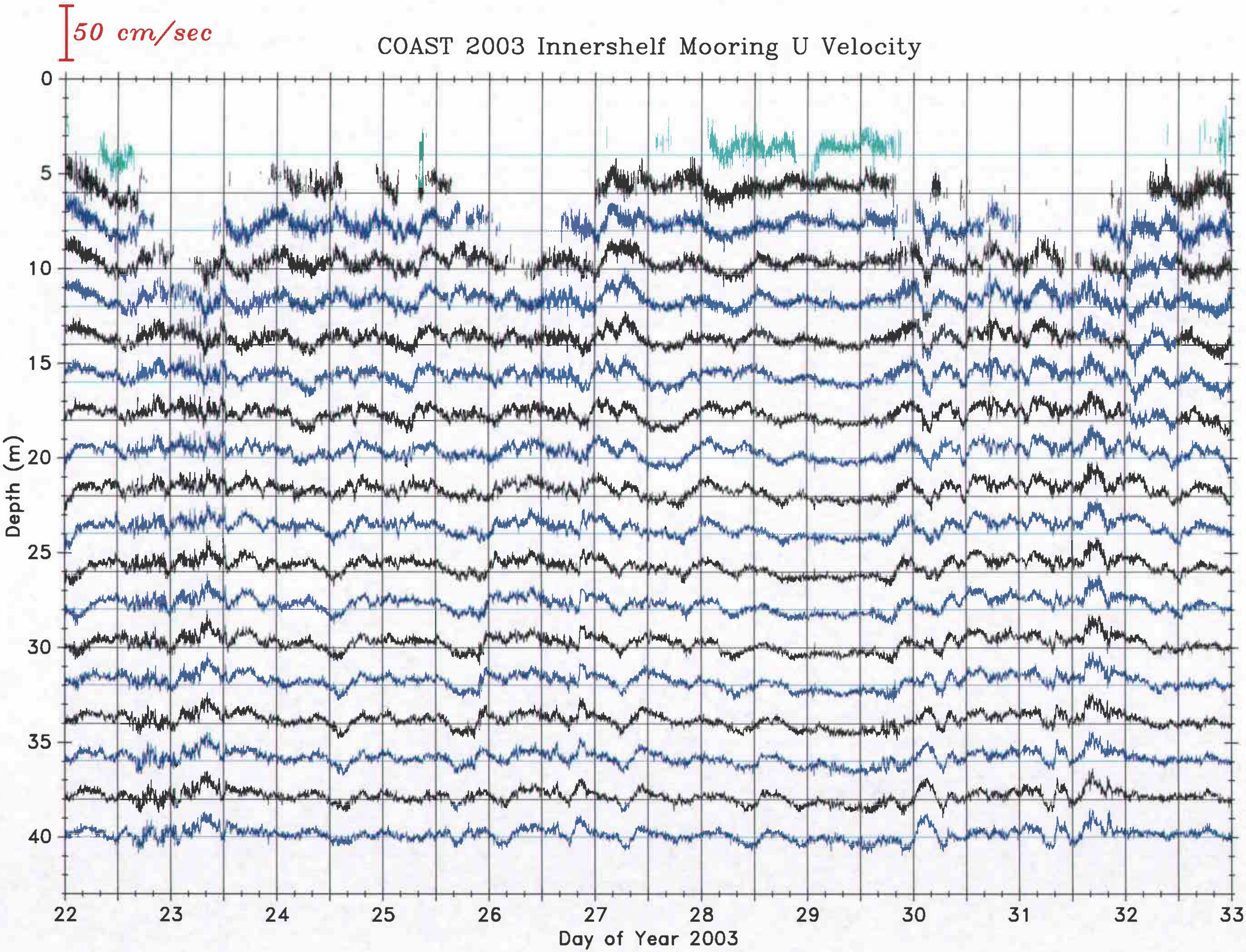
50 cm/sec
COAST 2003 Innershelf Mooring V Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
33
34
35
36
37
38
39
40
41
42
43
44
Day of Year 2003

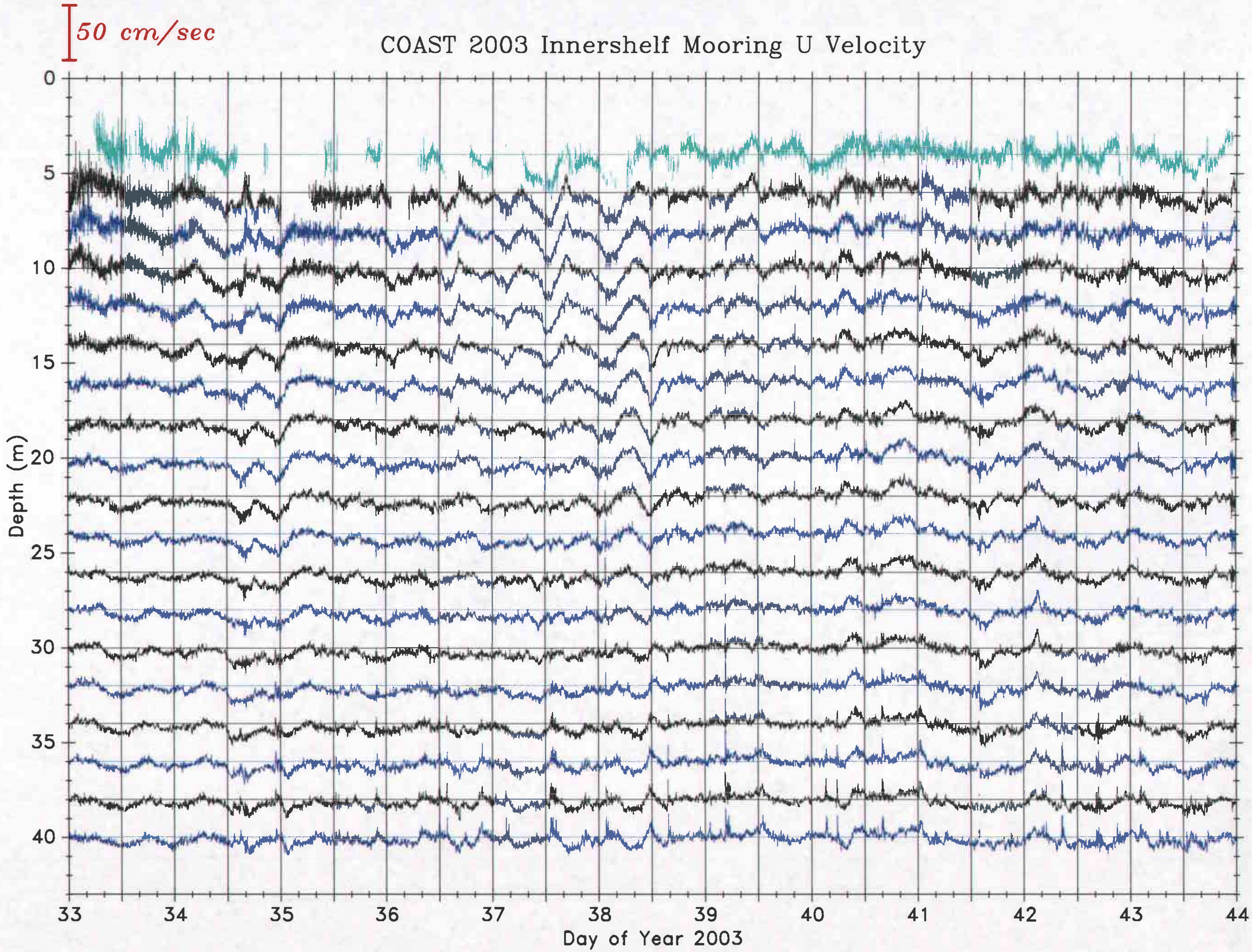

50 cm/sec
COAST 2003 Innershelf Mooring V Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
44
45
46
47
48
49
50
51
52
53
54
55
Day of Year 2003

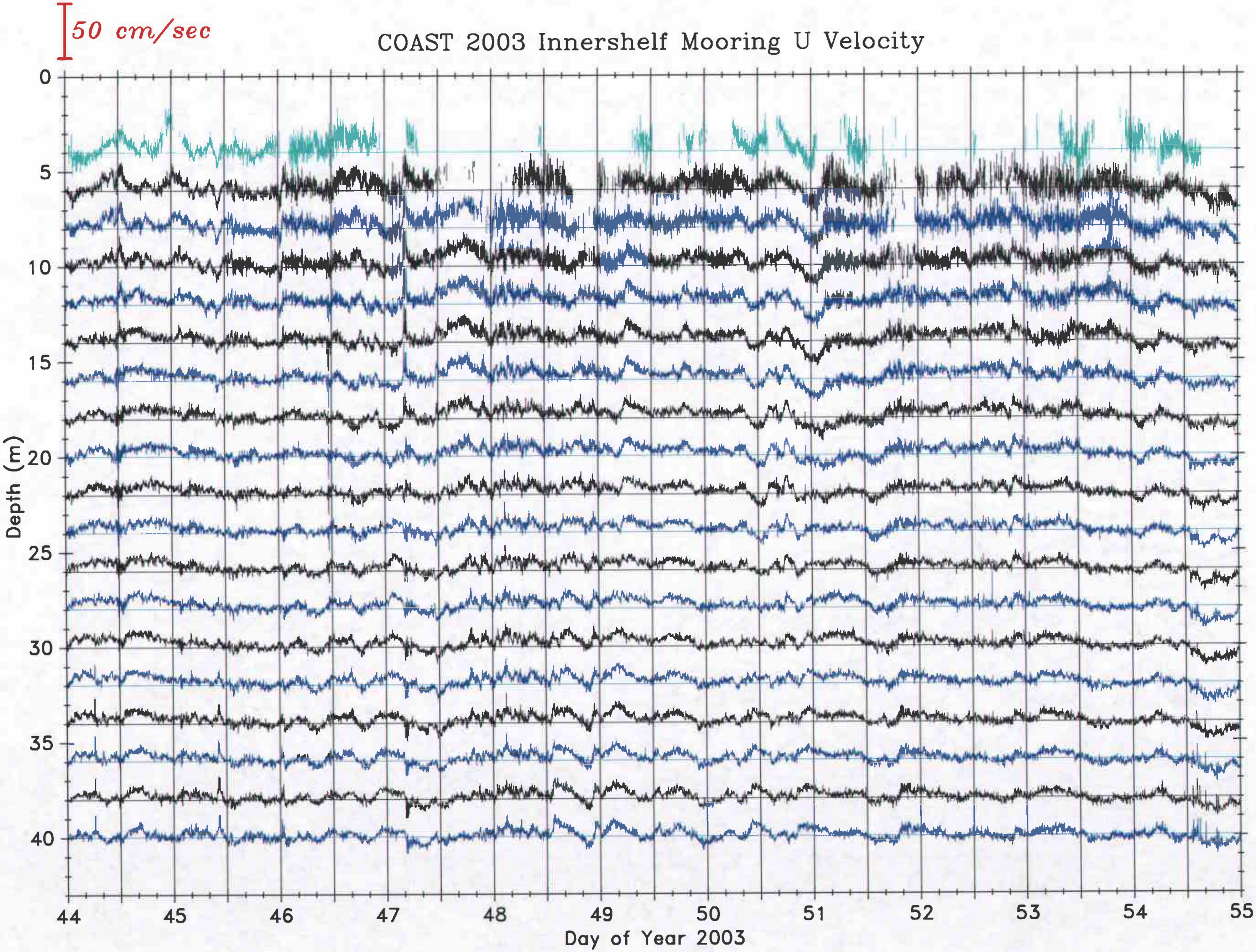

50 cm/sec
COAST 2003 Innershelf Mooring V Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
55
56
57
58
59
60
61
62
63
64
65
66
Day of Year 2003

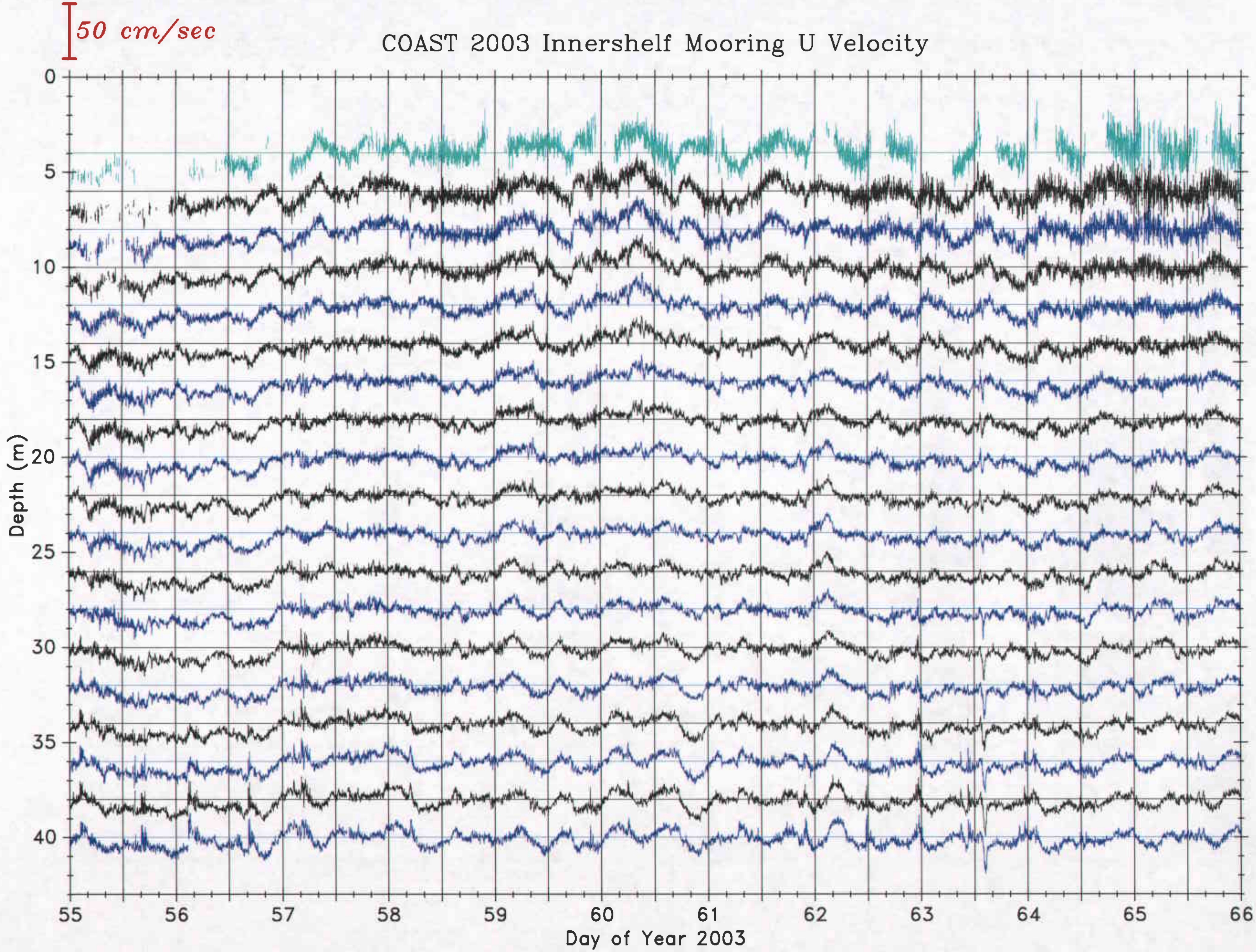

50 cm/sec
COAST 2003 Innershelf Mooring V Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
66
67
68
69
70
71
72
73
74
75
76
77
Day of Year 2003


50 cm/sec
COAST 2003 Innershelf Mooring U Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
11
12
13
14
15
16
17
18
19
20
21
22
Day of Year 2003

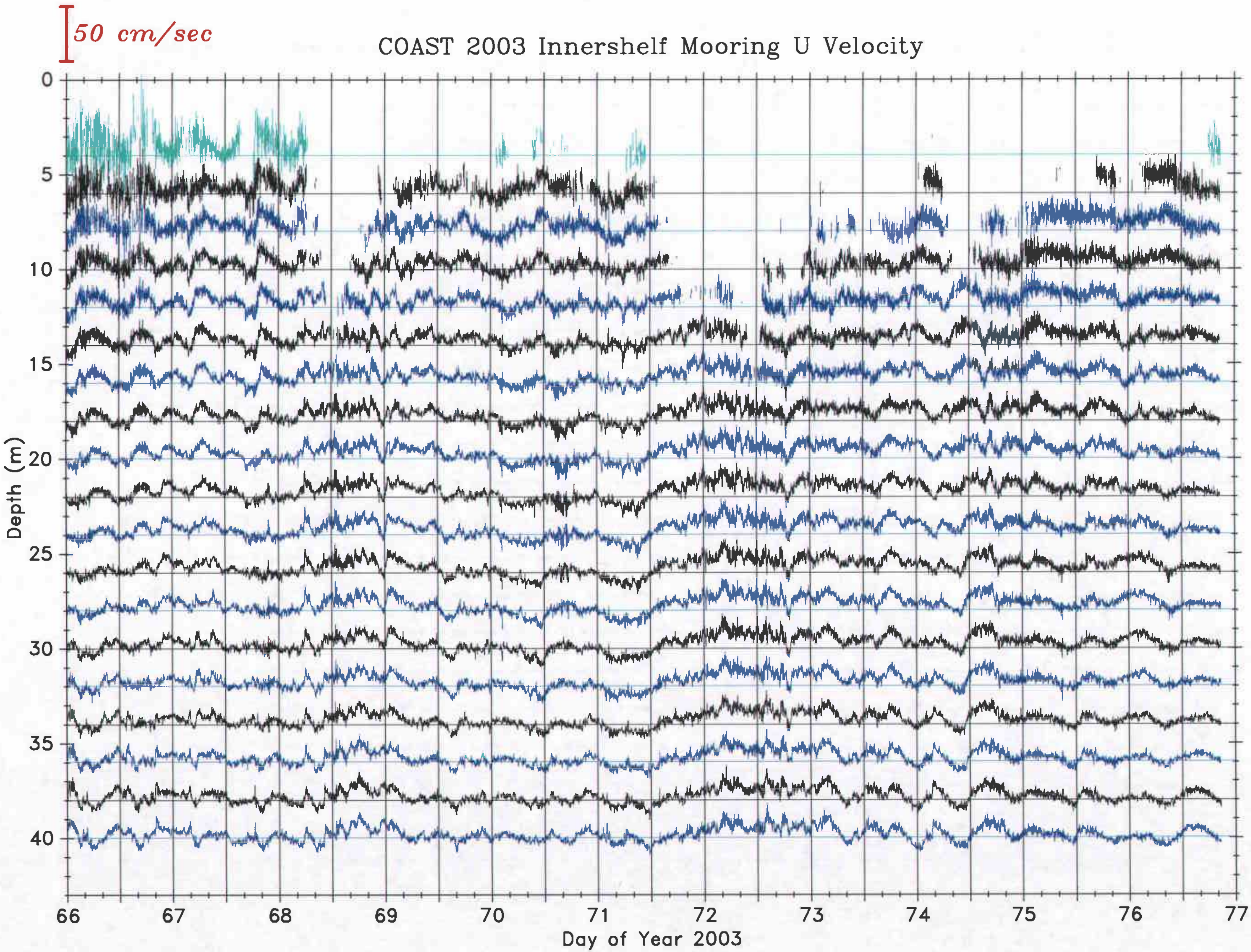

50 cm/sec
COAST 2003 Innershelf Mooring U Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
22
23
24
25
26
27
28
29
30
31
32
33
Day of Year 2003

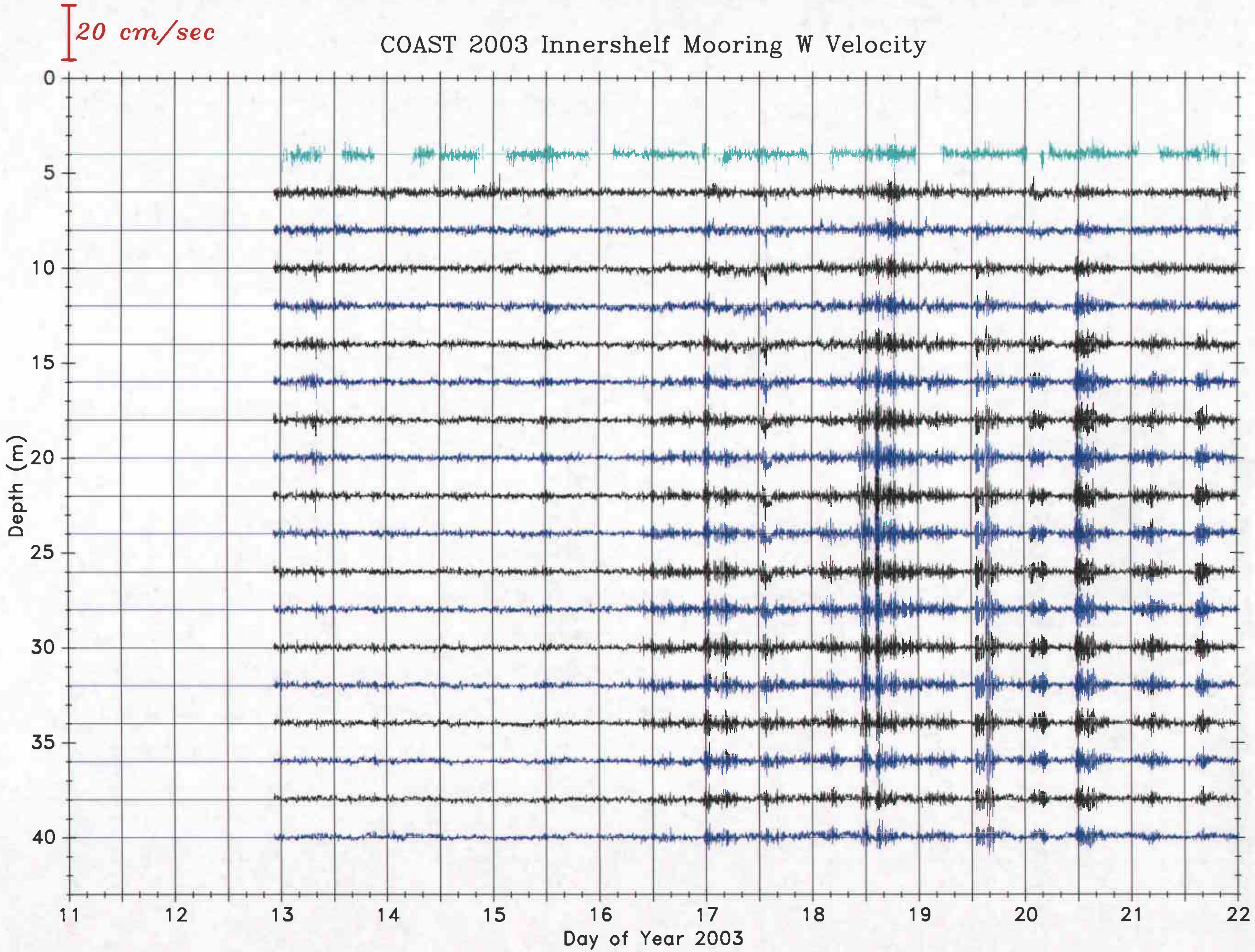

50 cm/sec
COAST 2003 Innershelf Mooring U Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
33
34
35
36
37
38
39
40
41
42
43
44
Day of Year 2003

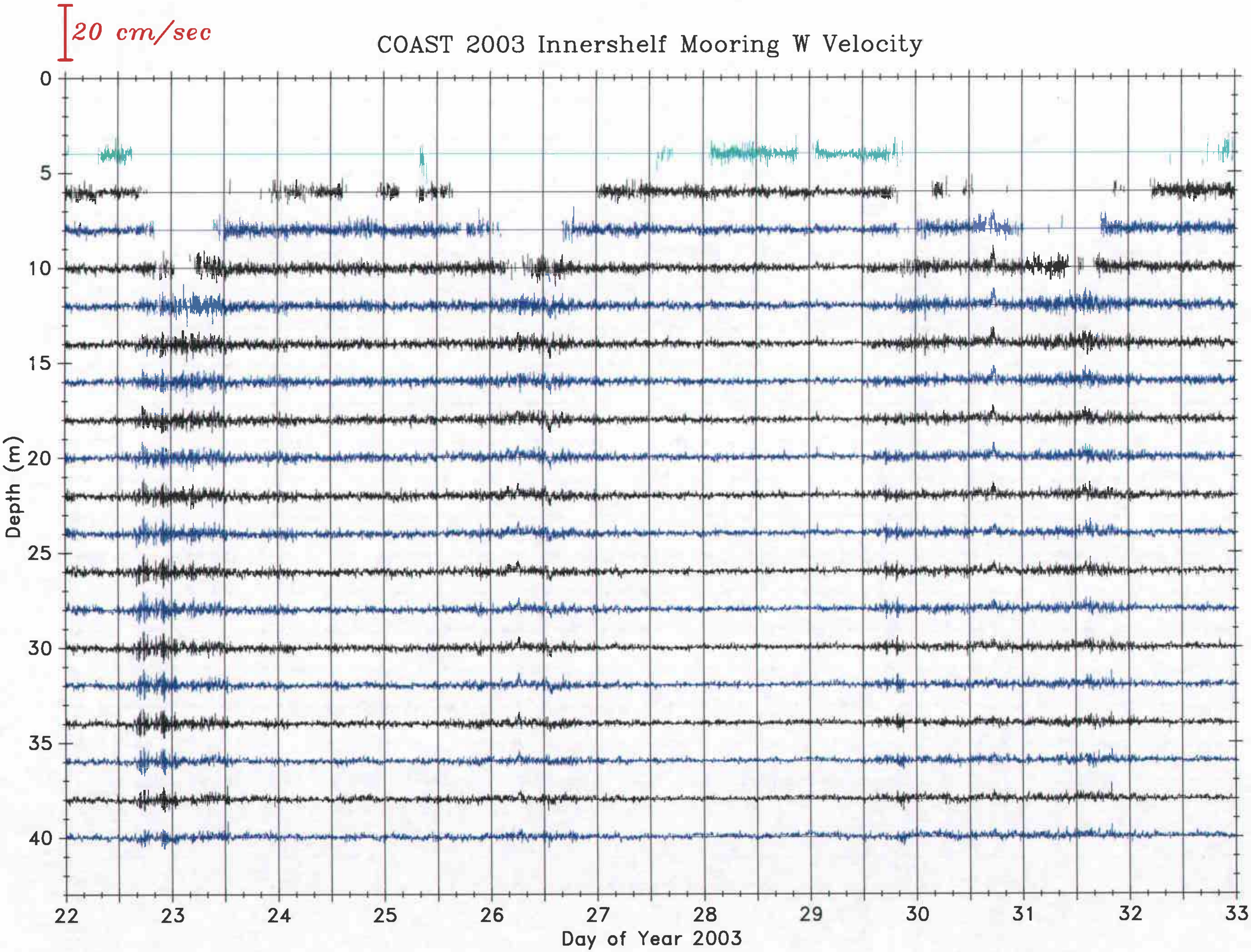

50 cm/sec
COAST 2003 Innershelf Mooring U Velocity
0
5
10
15
20
25
30
35
40
Depth (m)
44
45
46
47
48
49
50
51
52
53
54
55
Day of Year 2003



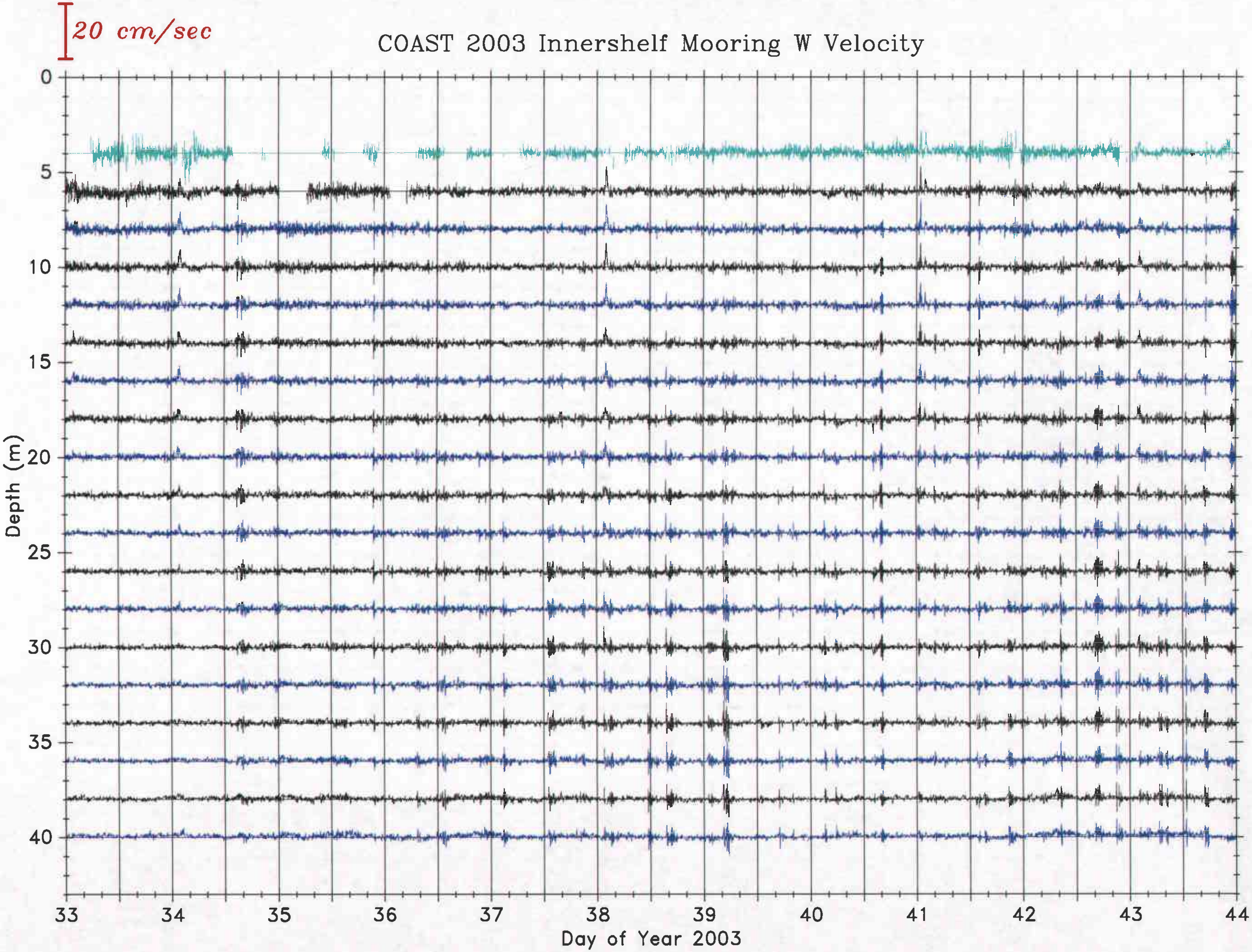
50 cm/sec
COAST 2003 Innershelf Mooring U Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
55
56
57
58
59
60
61
62
63
64
65
66
Day of Year 2003

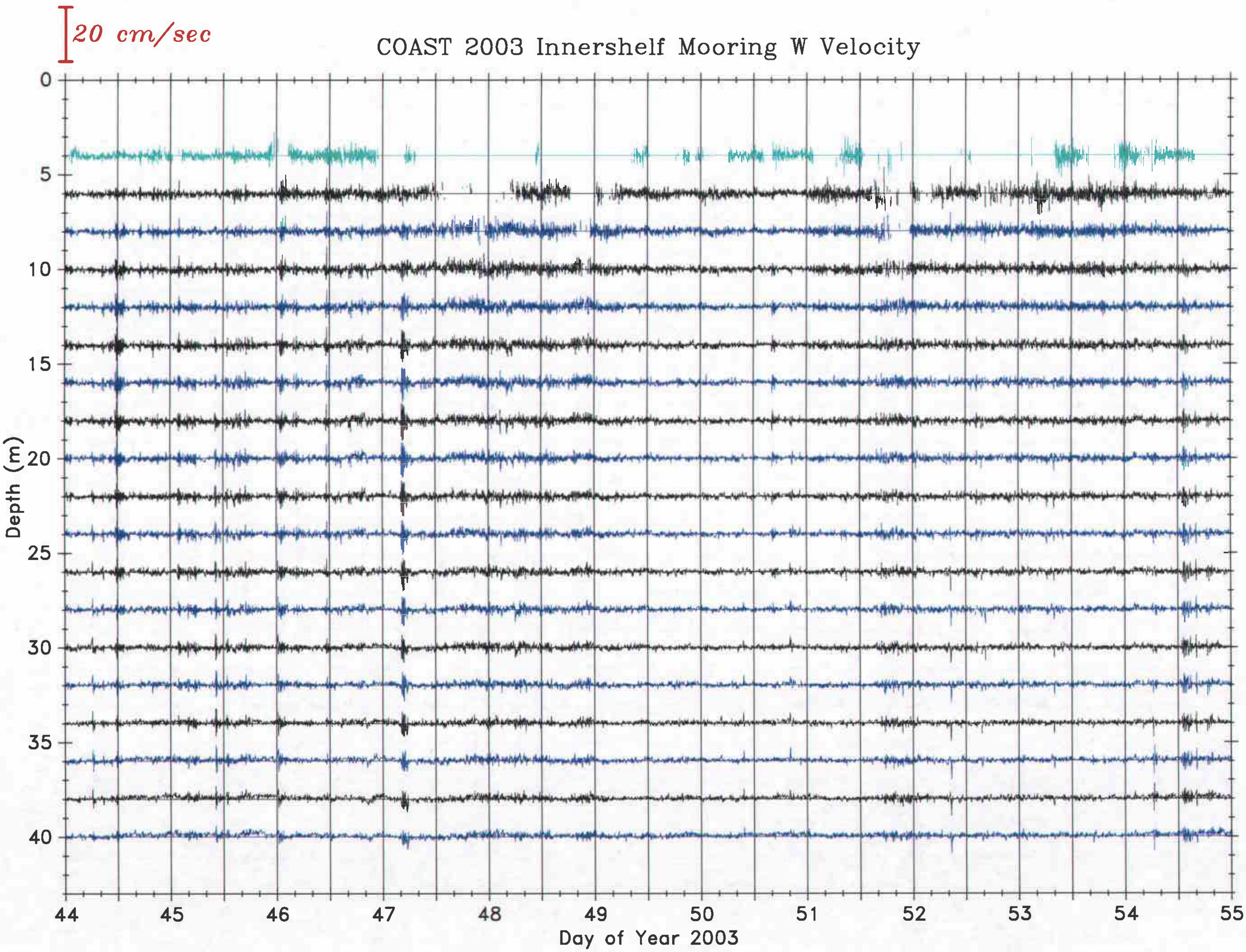

50 cm/sec
COAST 2003 Innershelf Mooring U Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
66
67
68
69
70
71
72
73
74
75
76
77
Day of Year 2003

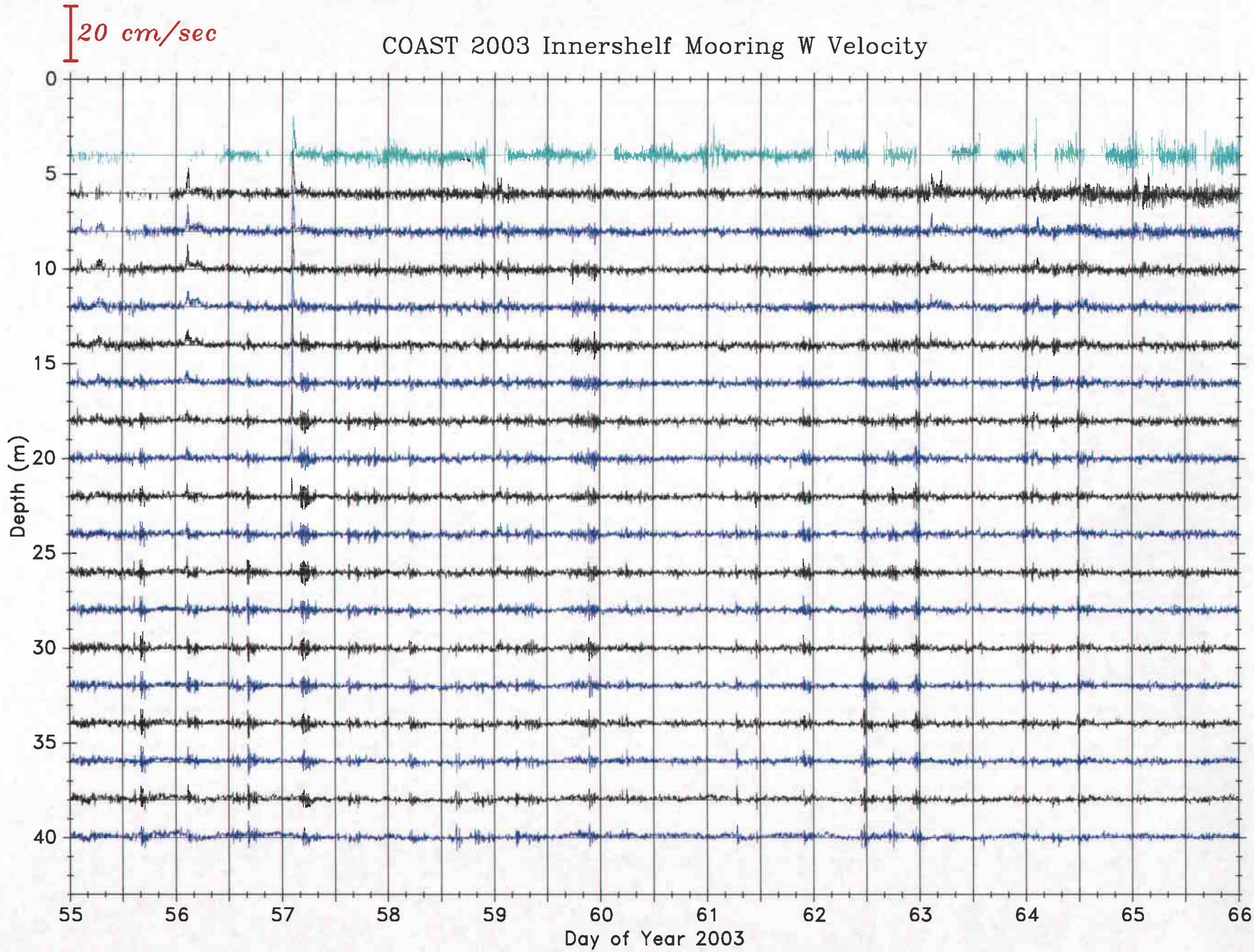

20 cm/sec
COAST 2003 Innershelf Mooring W Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
11
12
13
14
15
16
17
18
19
20
21
22
Day of Year 2003



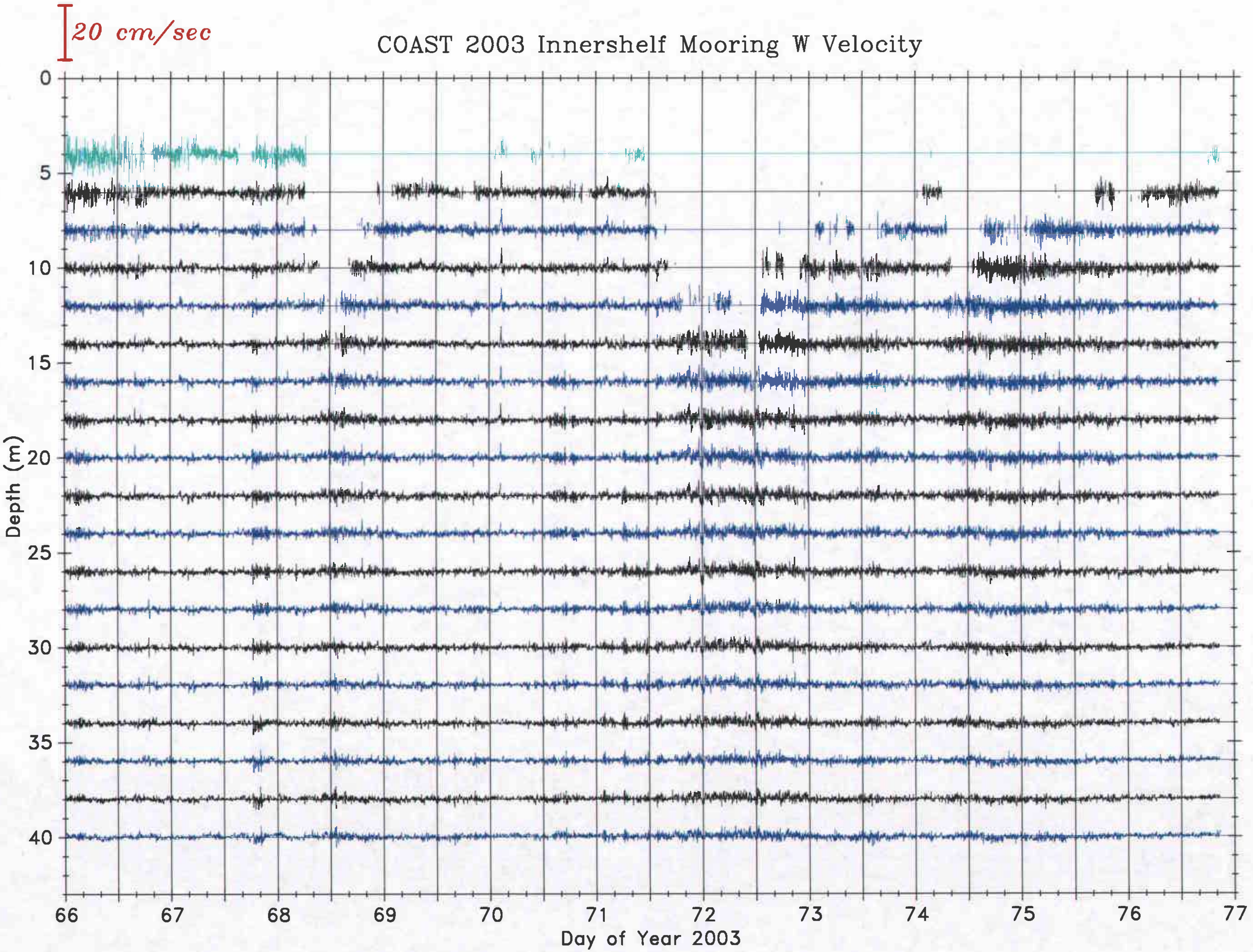
20 cm/sec
COAST 2003 Innershelf Mooring W Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
22
23
24
25
26
27
28
29
30
31
32
33
Day of Year 2003

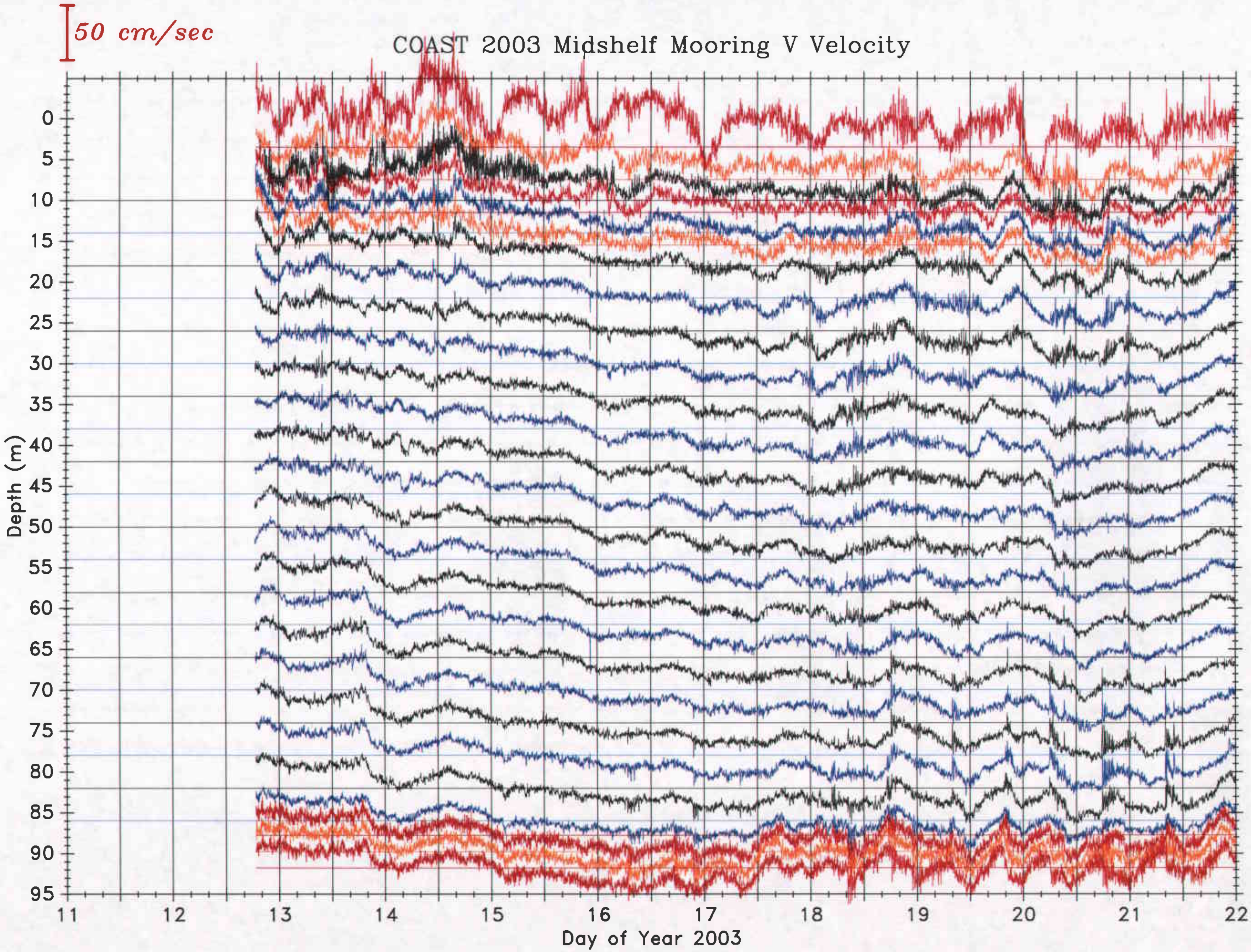

20 cm/sec
COAST 2003 Innershelf Mooring W Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
33
34
35
36
37
38
39
40
41
42
43
44
Day of Year 2003


20 cm/sec
COAST 2003 Innershelf Mooring W Velocity
0
5
10
15
20
25
30
35
40
Depth (m)
44
45
46
47
48
49
50
51
52
53
54
55
Day of Year 2003


20 cm/sec
COAST 2003 Innershelf Mooring W Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
55
56
57
58
59
60
61
62
63
64
65
66
Day of Year 2003

86


20 cm/sec
COAST 2003 Innershelf Mooring W Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
66
67
68
69
70
71
72
73
74
75
76
77
Day of Year 2003


50 cm/sec
COAST 2003 Midshelf Mooring V Velocity
Depth (m)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
11
12
13
14
15
16
17
18
19
20
21
22
Day of Year 2003