Data report: Physical oceanography data from the UFO-09 mooring, southern Norwegian Basin, 26 August 2024 – 21 August 2025

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1 Background

The data set described herein was collected as a part of the Upstream pathways of the Faroe Overflow (UFO) project. UFO is a multi-institutional, interdisciplinary effort to study the origin and pathways of the dense water that feeds the Faroe Bank Channel overflow. The UFO program, led by Woods Hole Oceanographic Institution (WHOI, R. Pickart) includes a mooring array, gliders, hydrographic surveys, and modeling. The overall objective is to determine where the densest water is formed in the Nordic Seas, how this water progresses to the Greenland-Scotland Ridge, and how it is modified along the way including the role of atmospheric forcing.

An array of 10 moorings was deployed across the Iceland-Faroe Ridge out to the Norwegian Sea, the locations shown in Figure 1. The array was deployed in autumn 2024. The first 8 tightly spaced profiling moorings (WHOI) aim to resolve and bracket the two previously documented Iceland Faroe Slope Jet branches. The Norwegian Sea Gyre Rim are measured simultaneously by UFO-09 (University of Bergen, Norway), and UFO-10 (Faroe Marine Research Institute, Faroe Islands).

This report summarizes the details of the UFO-09 mooring, instrument setups and processing, and gives an overview of the data collected. The UFO-09 mooring was deployed in the southern Norwegian Basin at 7.070°W (7° 04.210′W) and 64.0658°N (64° 03.950′N), at a depth of 2417 m, from R/V Neil Armstrong (cruise AR84-03) and recovered from R/V Roger Revelle (cruise RR2506). The data set covers the period from 2024-08-26 17:00:00 to 2025-08-21 08:00:00, and includes time series of ocean temperature, salinity and currents. The data are openly available from the Norwegian Marine Data Centre, from https://doi.org/10.21335/NMDC-630401122, under a CC BY 4.0 license.

This report is an attachment for the data set:
Fer, Ilker; Brakstad, Ailin; Lid, Daniel (2026), Physical oceanography data from the UFO-09 mooring, southern Norwegian Basin, 26 August 2024 – 21 August 2025 [dataset] Norwegian Marine Data Centre https://doi.org/10.21335/NMDC-630401122.

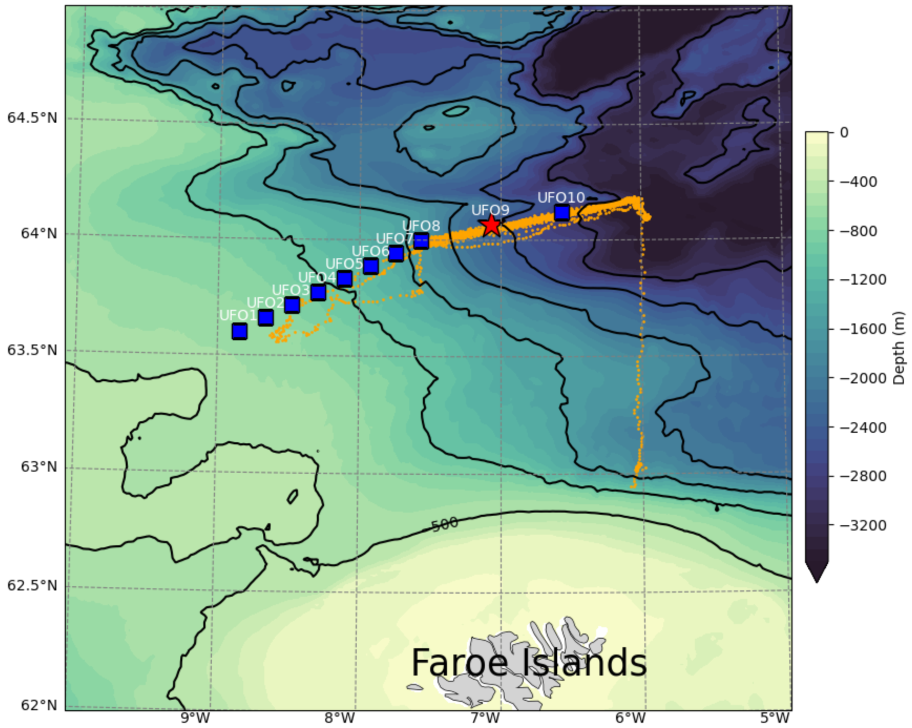

Figure 1. Map showing the location of the UFO-09 mooring (red star), glider profiles (orange dots) and the other moorings (blue squares) of the array deployed during UFO.

2 Mooring overview

The UFO-09 mooring was deployed anchor last from R/V Neil Armstrong (cruise AR84-03) on 26.08.2024 15:35 UTC and recovered from R/V Roger Revelle (cruise RR2506) on 21.08.2025 11:06 UTC. The location of the mooring was 7.070°W (7° 04.210′W); 64.0658°N (64° 03.950′N), and the total depth was 2417 m. The mooring diagram is shown in Figure 2, while an overview of the instruments mounted on the mooring is given in Tables 2 and 3. Instruments in the upper part of the mooring (200 to 400 m) were lost, presumably because of fishing activity at the site.

Temperature, and in some instruments salinity and pressure, were measured using Sea-Bird Scientific (SBE) instruments (MicroCats, unpumped SBE37 and temperature loggers, SBE39 and SBE56, RBR-solo). Additionally, the current profilers and meters had temperature and pressure sensor, and two Aanderaa SeaGuards were equipped with conductivity sensors.

Ocean currents were measured using acoustic Doppler current profilers (ADCPs) from RDI and Nortek, at different frequencies and two point-current meters (Aanderaa SeaGuards). Two Nortek Signature ADCPs were mounted on the same flotation approximately at 367 m (Signature S55 facing downward and S100 facing upward). A RDI 75kHz Workhorse Long Ranger ADCP was mounted in a spherical flotation facing downward at 1206 m. Detailed sampling setup for each instrument is described in the corresponding sections.

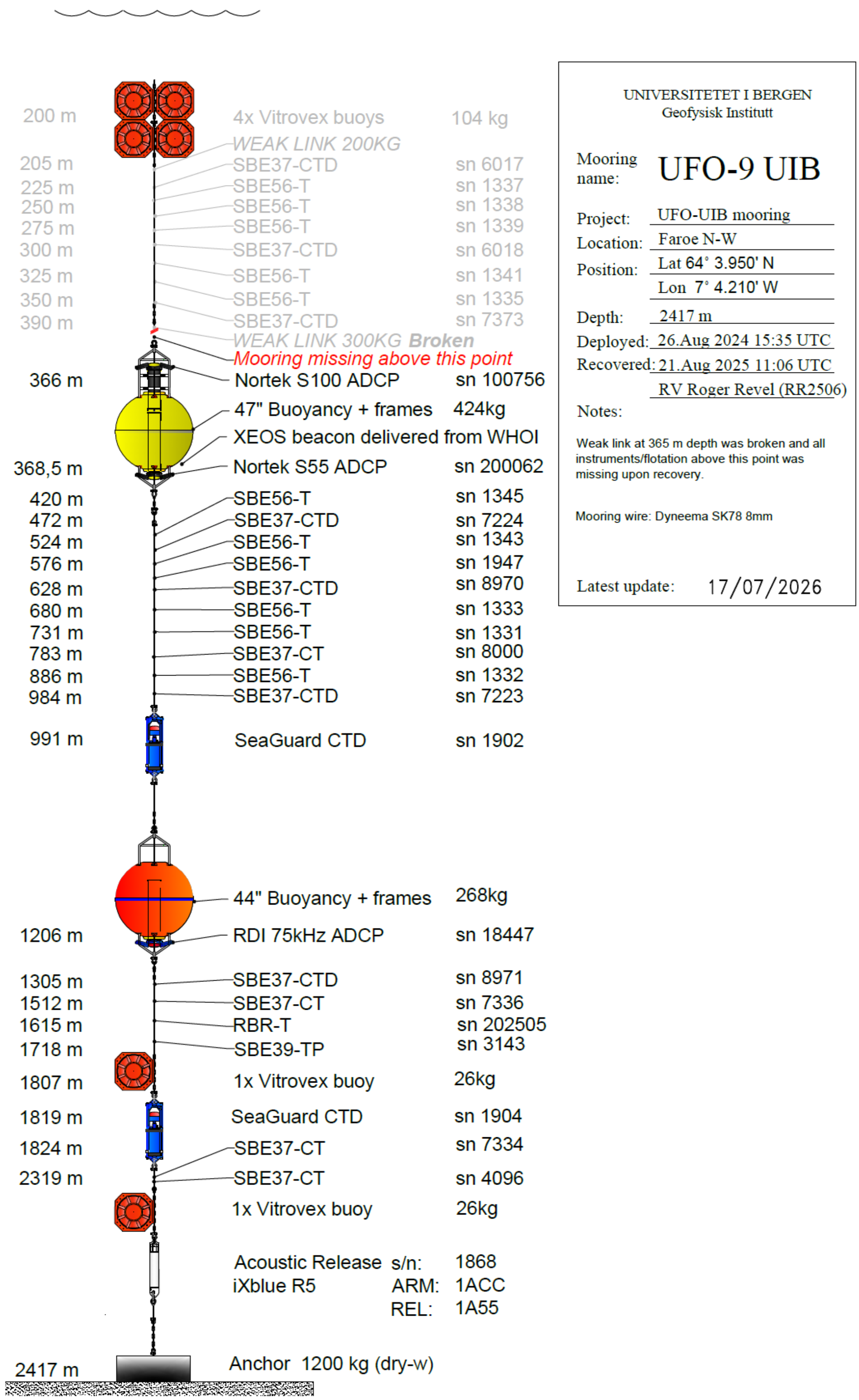

Figure 2. Mooring diagram. Instrument details are given in relevant sections.

3 Data collection and data processing

3.1 Instrument nominal depth estimates

Target depths are estimated using mooring line lengths and pressure records from the instruments. When pressure (or depth) record is available, we use the lowest 5th percentile of the pressure (or depth) records and convert to saltwater depth using the UNESCO 1983 algorithm and the mooring latitude to assign a time-averaged target depth. Only including the lowest 5th percentile ensures that the time-averaged target depth represent the instrument depth with minimal mooring blowdown. Measurement uncertainty can be large, especially for large pressure-rated instruments, e.g. the 1500 m rated RDI 75kHz. In some cases, we adjusted the target depth to fit the intended mooring design. Using the piecewise known target depth for these instruments and the mooring construction details, we estimate the target depth of the remaining instruments.

Statistics of measured depth from instruments equipped with pressure sensors are given in Table 1. Final estimates of the target depth for each instrument are listed in Table 2 for temperature and/or salinity measurements, and in Table 3 for current meters and current profilers.

Table 1: Statistics of depth in m (converted from pressure) from instruments with pressure sensor.

Instrument	SN	5 percentile	Median	95 percentile	Mean	STD
S100U	100756	366.0	366.8	368.8	367.0	0.9
S55D	200062	368.4	369.2	371.3	369.4	0.9
SBE37	7224	472.1	472.8	475.0	473.1	0.9
SBE37	8970	628.0	629.5	631.1	629.5	0.9
SBE37	7223	984.2	984.8	986.7	985.0	0.8
SeaGuard	1902	990.9	991.5	993.3	991.7	0.8
RDI75D	18447	1205.6	1206.3	1208.5	1206.6	1.0
SBE37	8971	1304.7	1305.2	1306.7	1305.4	0.7
SBE39	3143	1717.7	1718.1	1719.2	1718.2	0.5
SeaGuard	1904	1818.9	1919.6	1821.6	1819.9	0.9

Table 2: List of (accurate) C/T/D instruments from top to bottom. Target depth is estimated as described in the text. C = conductivity, T = temperature, D = depth (P = pressure). Bottom depth is 2417m.

C/T/D instrument	Serial number	Target depth [m]	Variables
SBE56	1345	420	T, time
SBE37	7224	472	T, P, C, time
SBE56	1343	524	T, time
SBE56	1947	576	T, time
SBE37	8970	628	T, P, C, time
SBE56	1333	680	T, time
SBE56	1331	731	T, time
SBE37	8000	783	T, C, time
SBE56	1332	886	T, time
SBE37	7223	984	T, P, C, time
SBE37	8971	1305	T, P, C, time
SBE37	7336	1512	T, C, time
RBR-Solo	202505	1615	T, time
SBE39	3143	1718	T, P
SBE37	7334	1824	T, C, time
SBE37	4096	2319	T, C, time

Table 3: List of current instruments from top to bottom. Target depth is estimated as described in the text. T = temperature, D = depth (P = pressure), V = velocity. Bottom depth is 2417 m

Instrument	Serial number	Target depth [m]	Variables
Nortek S100 ADCP, upward pointing	100756	366	T, P, V, time
Nortek S55 ADCP, downward pointing	200062	368.5	T*, P, V, time
Aanderaa SeaGuard RCM with CTD	1902	991	T*, P, C*, V, time
RDI 75kHz ADCP, downward pointing	18447	1206	T*, P, V, time
Aanderaa SeaGuard RCM with CTD	1904	1819	T*, P, C*, V, time

* Measurements from this sensor were not included in the respective gridded product

3.2 Temperature and salinity measurements

SBE37s and SBE39s sampled every 5 min and SBE56s and the RBR-Solo measured at 1 min intervals, all starting from 26 Aug 2024 1200 UTC. The data were downloaded, converted and exported using the manufacturers' standard software. All SBE and RBR instruments measured as scheduled throughout the yearlong deployment.

In initial treatment of the data (for quality screening, despiking etc.), all SBE and RBR measurements were temporally averaged to a common 5-min time array. In this 5-min resolution data set, temperature and pressure records were free from outliers and spikes. From the salinity records outliers were removed by imposing instrument dependent hard limits by inspecting the time series, and then despiked. Temporal drift in salinity records varied between the sensors, but was typically small, ranging between -$2x10^{-3}$ to -$10x10^{-3}$ per year in practical salinity scale. The linear trend was removed from all salinity time series. The resulting records were inspected and short segments of suspect data (time ranges detected manually) were replaced with NaNs. Finally, constant offset corrections were applied to salinity after comparing them to shipboard CTD profiles. No correction to temperature was necessary. The data are provided in the SBE_CTPrecorder.NC file. The data file also includes the original practical salinity record (PSAL_meas), before quality screening, despiking, detrending and offset correction.

Monthly averaged temperature and salinity profiles were inspected to confirm that the profiles were vertically inter-consistent (e.g., no outstanding sensors resulting in gravitationally unstable layers) and no additional adjustment was needed for a particular instrument.

In Figure 3, the temperature and salinity records from the Aanderaa SeaGuards (SG) are compared to the reliable records from the nearest SBE MicroCats (SBE37 SN7223, 5 m above SG SN1902, and SBE37 SN7334, 5 m below SG SN1904). Salinities obtained from the SeaGuards' conductivity sensors showed substantial differences from the SBE records, including nonstationary trends and numerous jumps, to the extent that a reliable correction was not possible. We provide the salinity values in the data files but advise caution against using them.

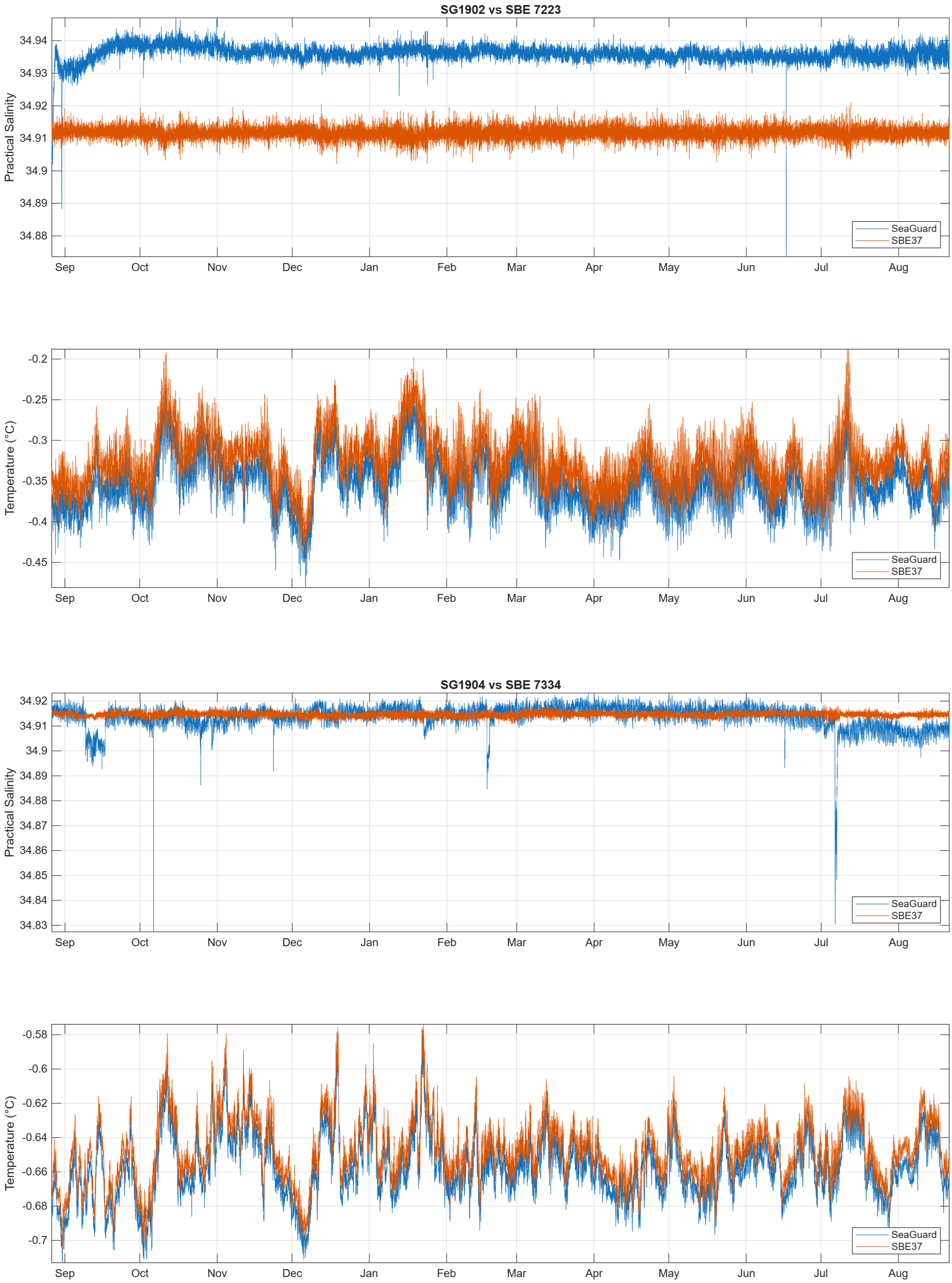

Figure 3. Comparison of salinity and temperature records from the SeaGuards (SG) with the nearest SBE37 MicroCats. Salinity measurements from SeaGuards are not reliable.

3.2.1 Comparison with shipboard CTD

During the deployment and recovery cruises (AR84-03 and RR2506, respectively), reference CTD profiles were collected within 1 km to the mooring location when the mooring was in water. In addition, before deployment and after recovery, a calibration cast was taken with all C/T/P loggers attached to the CTD rosette, with 10-20 min stops at approximately 1000, 400 and 150 dbar. Furthermore, two CTD casts were available from FAMRI cruises in 2024 and 2025 for comparison; however, these profiles were 20 to 50 km away from the mooring position. Using all available information, we inferred offset corrections for salinity (Table 4). No correction for temperature or pressure was needed.

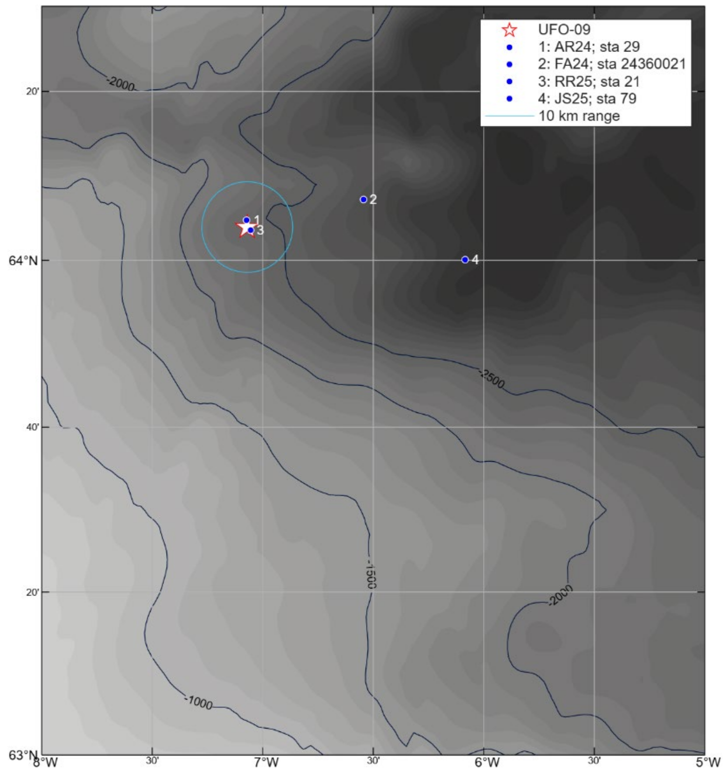

Figure 4. Location of the relevant shipboard CTD stations (blue dots, 1 to 4) relative to the mooring location (red star). AR24 is AR84-03; RR25 is RR2506. FA24 and JS25 are profiles provided by FAMRI.

Table 4: List of SBE37 instruments and corresponding salinity offset. The salinity offset was estimated by comparing the SBE37 data to nearby shipboard CTD profiles (Figure 5).

SBE37 serial number	Practical Salinity offset
7224	0.0150
8970	0.0140
8000	0.0100
7223	0.0050
8971	0.0090
7336	0.0095
7334	0.0180
4096	0.0030

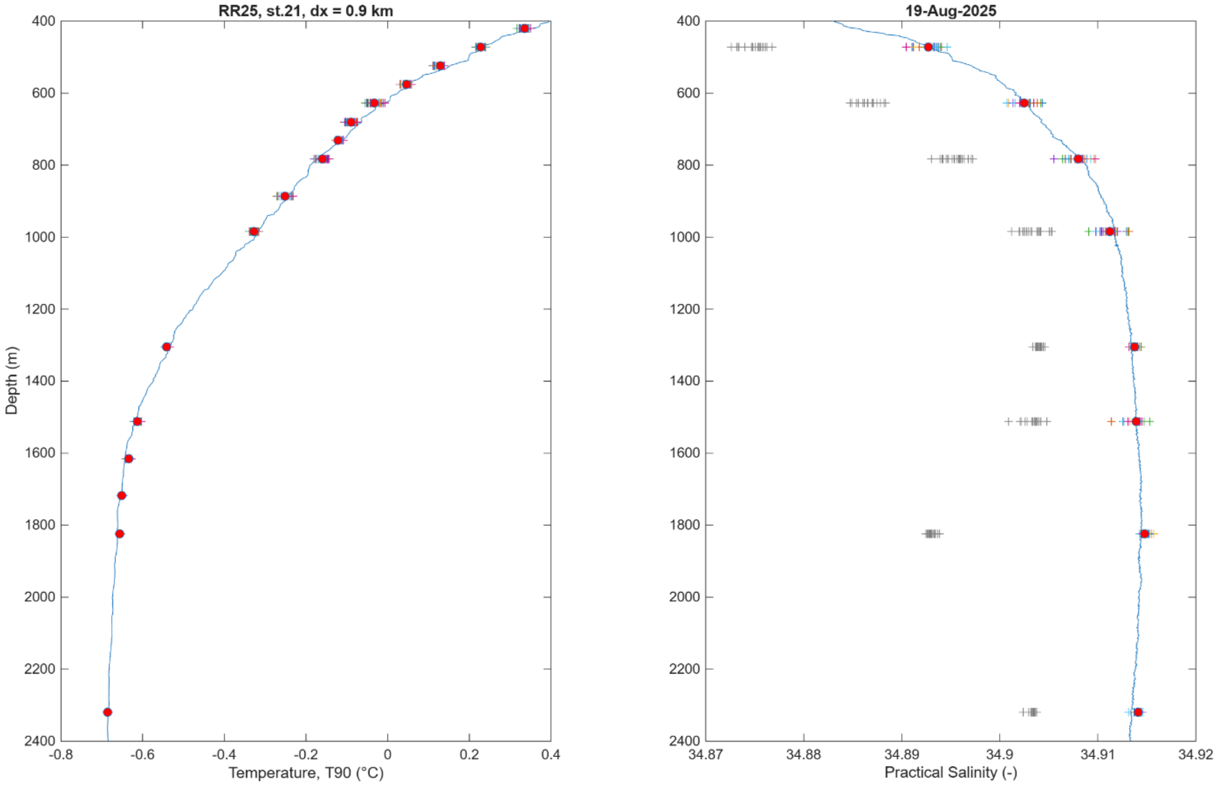

Figure 5. Temperature (left) and salinity (right) from station 21 (blue) of the RR2506 cruise, approximately 900 m from the mooring location, compared to the SBE37 CTD instruments (circles) averaged ±1 hour around the time of the CTD profiling. No offset correction was required for temperature. The corrected salinity (colored markers) is obtained after detrending the uncorrected SBE37 data (gray) data and adding the salinity offset (Table 4).

3.3 Ocean current measurements

Ocean currents were measured using ADCPs from RDI and Nortek, at different frequencies and two current meters (AADI SeaGuards). Two Nortek Signature ADCPs were mounted on the same flotation approximately at 367 m (Signature S55 facing downward and S100 facing upward). A RDI 75kHz Workshorse Long Ranger ADCP was mounted in a spherical flotation facing downward at 1206 m. Vertical coverage for velocity measurements is from 36 to 1819 m.

All current measurements are corrected for magnetic declination using the value of -3.6°. Using the WMM-2025 model at the mooring location the declination on 01 September 2025 was 3.6° W ± 0.60° changing by 0.34° E per year.

RDI 75 kHz Workhorse Long Ranger ADCP, serial number 18447. It was deployed with transducers facing downward in a 44'' spherical flotation at 1206 m depth. The instrument was configured in broadband mode (short range and high accuracy), collecting an ensemble of 40 profiles (pings) at 3 s intervals every one hour (i.e. profiled the first 3 minutes, starting on the hour), in 8-m thick vertical cells (bins). Single ping standard deviation is 1.2 cm/s. The instrument recorded in Earth coordinates and performed ensemble averaging internally.

Data are exported using the WinADCP software and further treated in MATLAB. An automated quality control flagged velocity measurements collected before deployment and after recovery times, with large tilt (pitch or roll greater than 20°), with percent good of 3 beam solutions less than 50, with error velocity or velocity components greater than 1 m/s, and in bins within 10% of the range to the sea surface or the seafloor. Additionally, individual bins were flagged after inspection, if echo amplitude or beam correlation values suggested poor data quality. The first bin had bad data due to ringing effect and bins 11 and 12 were slightly obstructed by the instruments on the mooring line. Depth record is offset by -5 m so that its time average matches the instrument depth.

Measurements as recorded by the instrument, without applying quality control flags or interpolation, are provided in the UCUR_meas, VCUR_meas, and WCUR_meas variables. The variables UCUR, VCUR and WCUR are edited velocity data. In the edited data, magnetic declination (3.6W) was corrected, and the flagged bad data points were replaced with NaNs. The missing values were then linearly interpolated if temporal gaps were less than 2 hours or vertical gaps less than 3 bins. Finally, fragmentary measurements with lengths less than 6 hours, typically in the outer bins, were removed.

Nortek Signature 100 kHz ADCP, serial number 100756. It was deployed at 366 m depth with transducers facing upward in a 47'' spherical flotation (at 367 m), which was also equipped with a Signature 55 facing downward

The instrument has 4 beams and recorded every profile (ping) in beam coordinates and was configured with 5-m thick vertical cells (bins) in narrow bandwidth mode. S100 sampled every 30 min over 2.5 minutes, starting on the hour. (The S55 was set to start 3 minutes past the hour to ensure the two ADCPs do not cross talk.) We post-processed the data using the Ocean Contour software (V2.1.5 R2272). Compass was 2D in situ calibrated during post-processing, using a selection of data giving excellent quality and coverage. During quality screening side lobe interference was removed and minimum correlation of 20%, maximum acceleration of 2 m/s, max amplitude spike of 50 dB/s and a maximum tilt of 15° thresholds were applied. In averaging, percent good threshold of 30% and a maximum interpolation gap of 2 were used. Final ensemble averaging was done in Earth coordinates as 30 min averages (75 samples). Data were then exported using the Ocean Contour software and further treated in MATLAB.

Measurements as exported by the Ocean Contour software are provided in the UCUR_meas, VCUR_meas, WCUR1_meas and WCUR2_meas variables. In these exported fields, flagged values picked by the software are set to NaN and the magnetic declination (3.6W) is corrected. The variables UCUR, VCUR and WCUR (average of the two vertical velocity estimates) are the edited velocity data. The edited data are based on the _meas variables, and additional manual flagged bad data points replaced with NaNs. The missing values were then linearly interpolated if temporal gaps were less than 2 hours or vertical gaps less than 3 bins. Finally, fragmentary measurements with lengths less than 6 hours, typically in the outer bins, were removed. Additionally, in the period between 10 Jan 2025 13:00 and 19 Jan 2025 21:00, the data from the first bin were suspect and were masked.

Nortek Signature 55 kHz ADCP, serial number 200062. It was deployed at 368.5 m depth with transducers facing downward in a 47'' spherical flotation (at 367 m), which was also equipped with a Signature 100 facing upward.

The instrument has 3 beams and recorded every profile (ping) in beam coordinates and was configured with 8-m thick vertical cells (bins) in broadband mode. S55 sampled every 30 min over 5 minutes, starting 3 minutes past the hour. (The S100 on the same flotation was set to start on the hour to ensure the two ADCPs do not cross talk.) We post-processed the data using the Ocean Contour software (V2.1.5 R2272). Compass was 2D in situ calibrated during post-processing, using a selection of data giving excellent quality and coverage. During quality screening side lobe interference was removed and minimum correlation of 50%, maximum acceleration of 2 m/s, max amplitude spike of 50 dB/s and a maximum tilt of 15deg thresholds were applied. In averaging, percent good threshold of 50% and a maximum interpolation gap of 2 were used. Final ensemble averaging was done in Earth coordinates as 30 min averages (50 samples).

Measurements as exported by the Ocean Contour software are provided in the UCUR_meas, VCUR_meas, and WCUR_meas variables. In these exported fields, flagged values picked by the software are set to NaN and the magnetic declination (3.6W) is corrected. The variables UCUR, VCUR and WCUR are the edited velocity data. The edited data are based on the _meas variables, and additional manual flagged bad data points replaced with NaNs. The missing values were then linearly interpolated if temporal gaps were less than 2 hours or vertical gaps less than 3 bins. Finally, fragmentary measurements with lengths less than 6 hours, typically in the outer bins, were removed. In the period between 9 Jan 2025 14:00 and 2 Mar 2025 00:00, the data from the first 18 bins were suspect and were masked.

Aanderaa SeaGuard Recording Current Meters. The mooring was equipped with two SeaGuards (SG), each with conductivity, temperature and pressure sensors. The SG SN1902 was at 991 m and SN 1904 was at 1819 m depth. Both instruments sampled every 20 minutes, starting on 26 Aug 2024 1200 UTC, averaging 200 pings in burst mode. Data recorded by the instrument was converted to physical units and exported using the manufacturer's software. Additionally, we removed the measurements collected before deployment and after recovery times, and corrected the horizontal velocities for the magnetic declination (3.6W). No further despiking or interpolation was applied.

4 Construction of the gridded data file

We used the cleaned, quality controlled, and corrected data files (5-min averaged temperature/salinity data set, SBE_CTPrecorders.NC, and instrument specific ADCP and SeaGuard NC files). Records from all instruments are bin-averaged and interpolated to a common time array with uniform 1-hour resolution.

The time-constant target depth list (with minimal mooring blowdown) is then used to vertically interpolate, at each time step, the instrument positions in a time-variable depth level (using the time-variable depth record with instruments equipped with pressure sensors). This results in profiles every hour, with a vertical range that varies with the mooring blowdown.

The vertical grid is 5-m resolution between 40 m and 2315 m depth. For pressure data we used all available records. For temperature, we used measurements from the sensors of SBEs and the RBR. The ADCPs and SeaGuards typically had adjacent SBE T-recorders, therefore we used the reliable SBE record, except the temperature from the uppermost ADCP (Nortek Signature S100) at 366 m depth is also included to improve the vertical coverage of temperature measurements. S100 temperature record showed reliable time variability, but a large offset correction of -1.48°C was required. This corrected record is included in the gridded data. For salinity we used only the SBE records. Vertical coverage for temperature is 366 to 2319 m (17 sensors including the uppermost ADCP) and for salinity 472 to 2319 m (8 sensors). We strongly advise caution when using the gridded salinity dataset where the vertical structure is not resolved. The vertically interpolated profiles may not be representative of the water column when the vertical separation between sensors is substantial.

In this hourly, 5-m gridded data set, short gaps with less than 6 hour are interpolated linearly in time.

5 Acknowledgment

We thank Helge Bryhni for his support with mooring design and logistics, and the captain, crew, and UFO participants for their assistance during the deployment and recovery cruises. We thank John Kemp, James Ryder, and Eric Hutt for their assistance with mooring operations. Karin Margretha Larsen and Hjálmar Hátún kindly provided FAMRI CTD data.

6 Overview of data

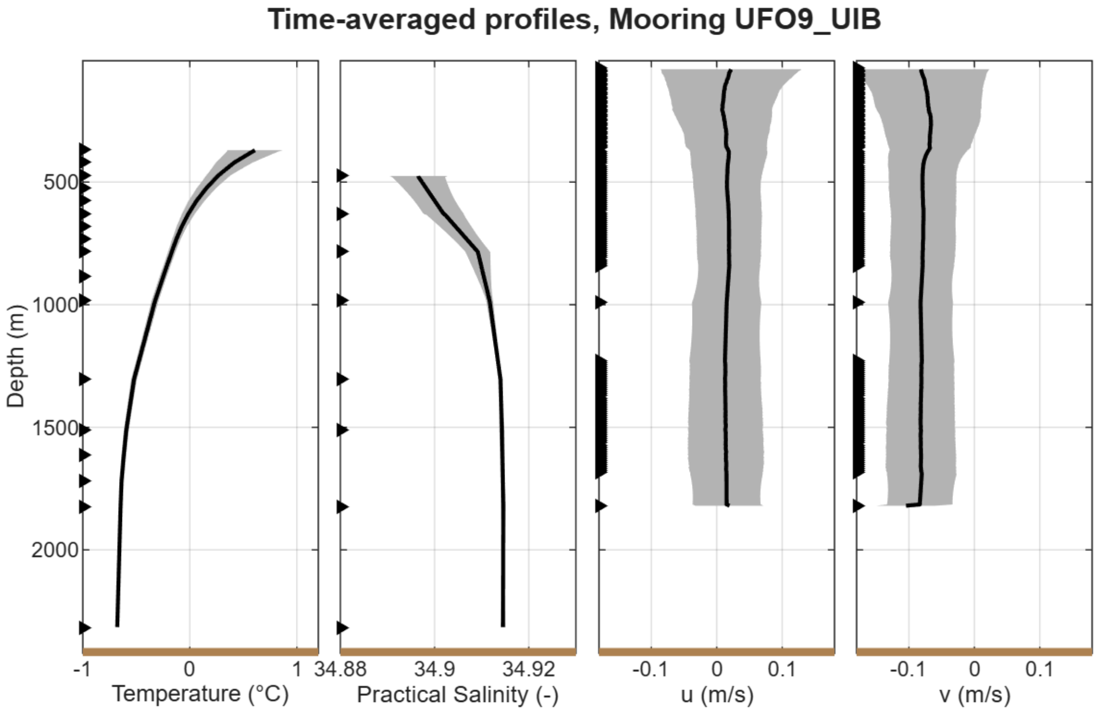

Figure 6. Time averaged profiles of temperature, salinity, eastward velocity (u), and northward velocity (v). The black triangles indicate measurement depths. Brown line is the seafloor.

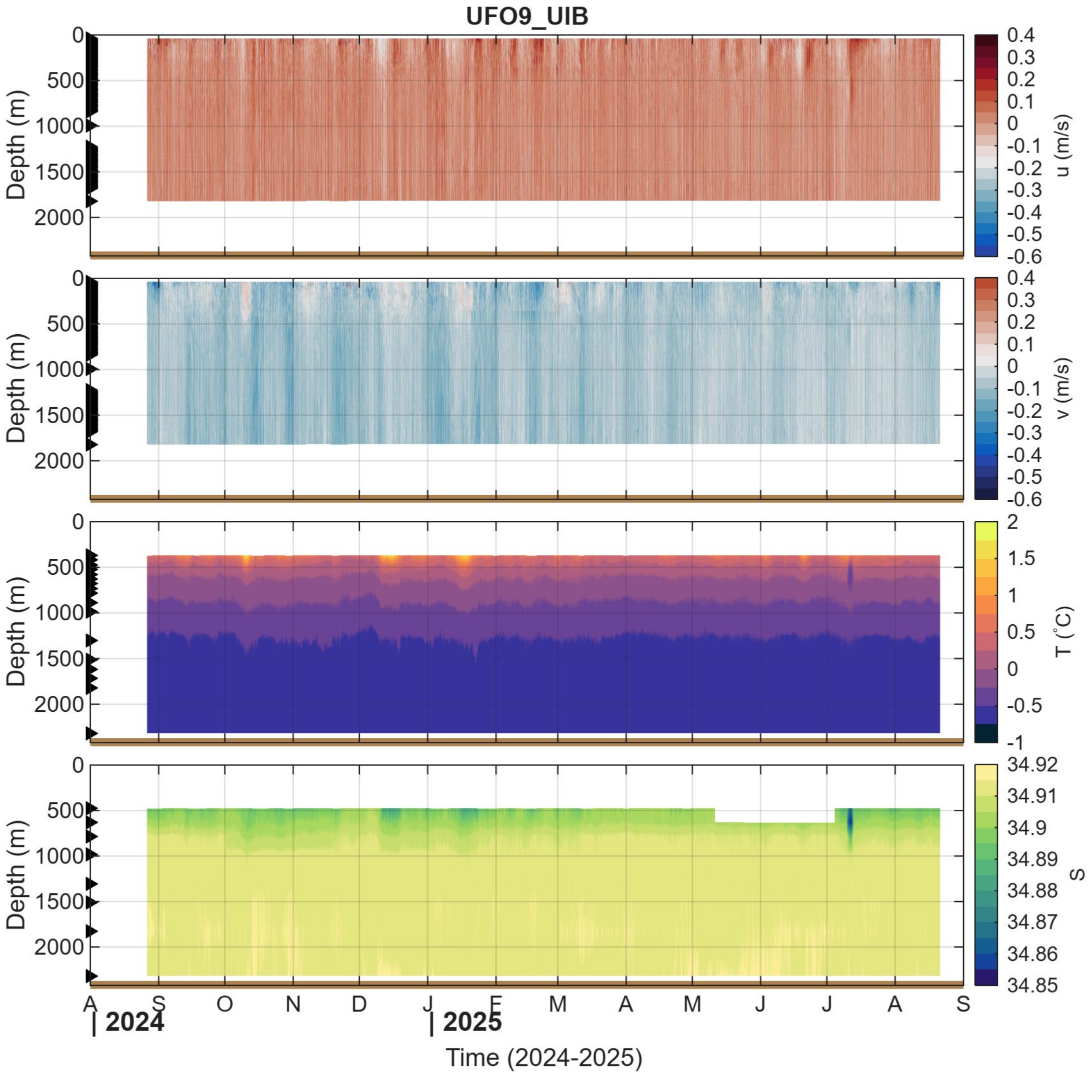

Figure 7. Time-depth fields from the hourly-gridded data set: eastward velocity (u), northward velocity (v), temperature (T), and practical salinity (S). The black triangles indicate measurement depths. Brown line is the seafloor.

7 Summary plots of time series from the gridded data file

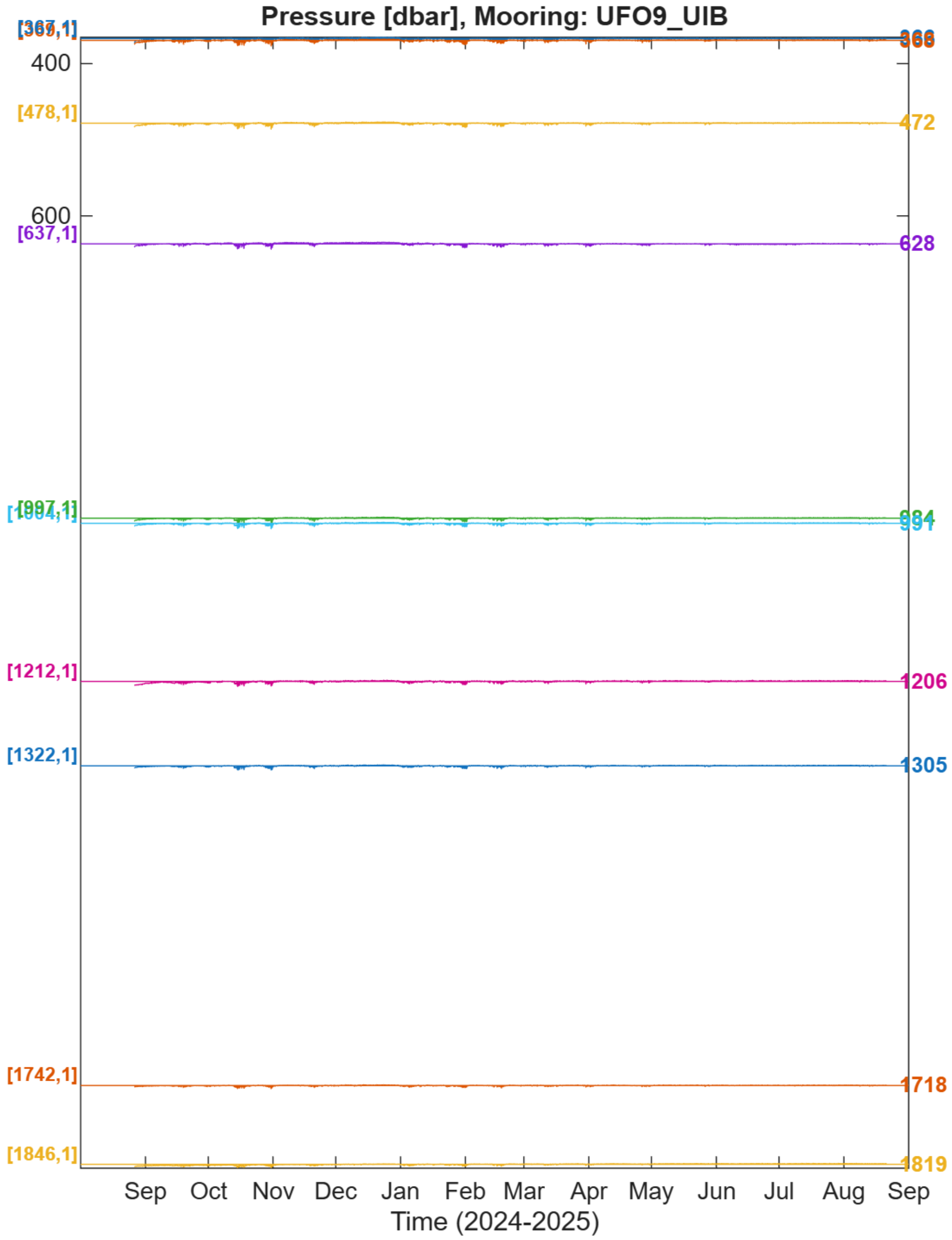

Figure 8. Time series of pressure. Numbers on the right (and the reference line) are the target depths. Numbers on the left show the time-averaged and 1 standard deviation values for the pressure records.

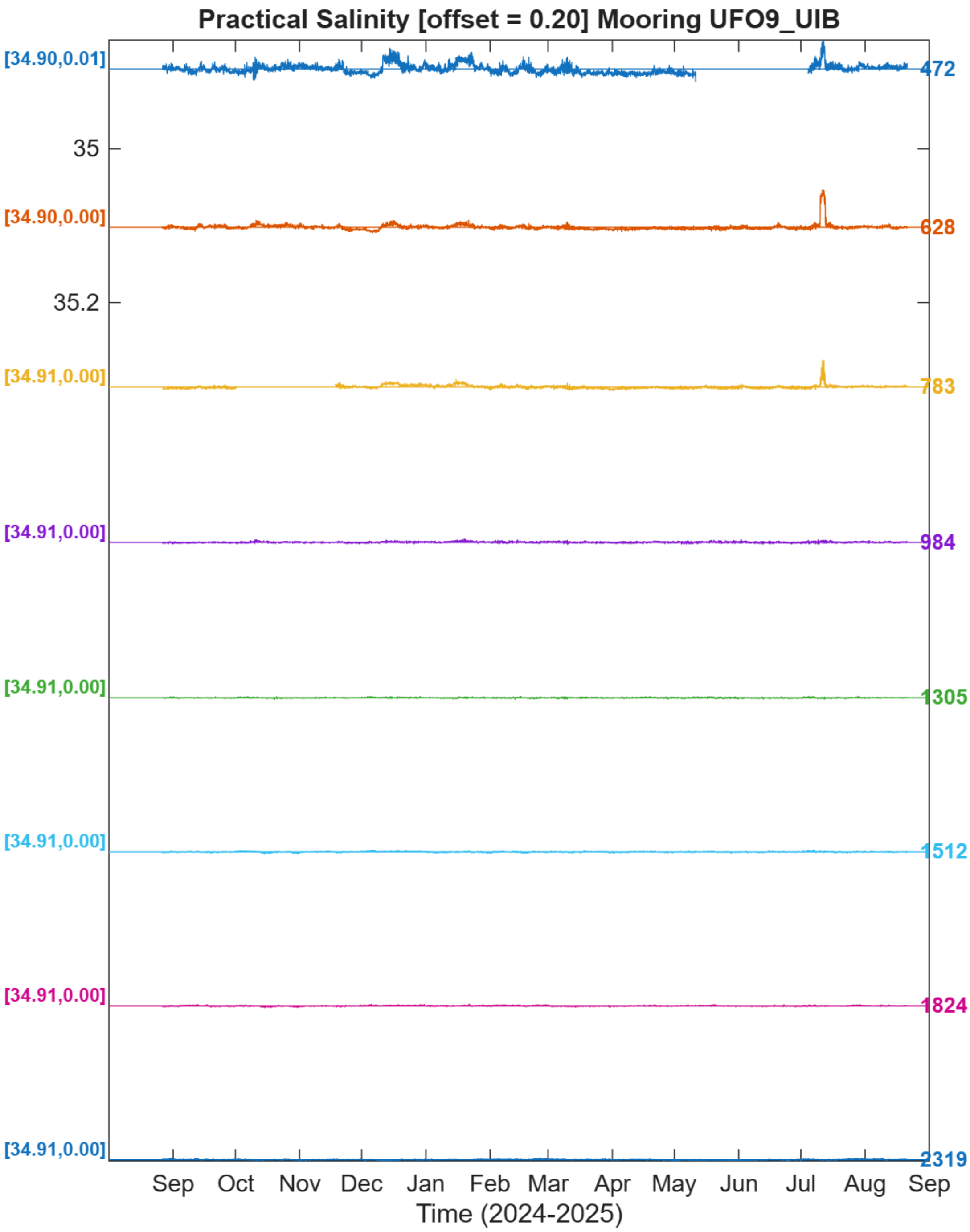

Figure 9. Time series of salinity. Numbers on the right (and the reference line) are the target depths. Numbers on the left show the time-averaged and 1 standard deviation values for the salinity records. The salinity records are shifted vertically by an offset of 0.20 for visualization purposes.

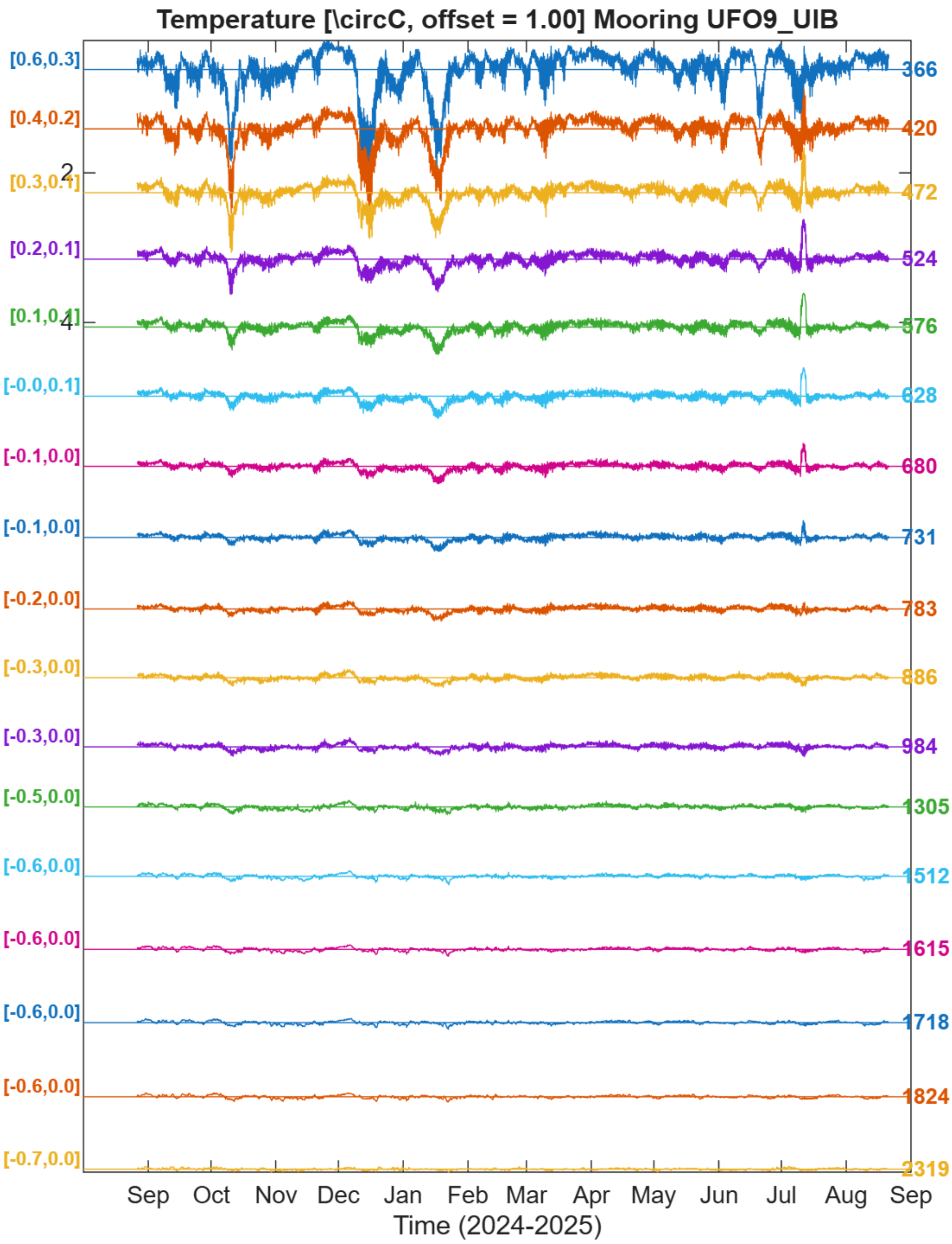

Figure 10. Time series of temperature. Numbers on the right (and the reference line) are the target depths. Numbers on the left show the time-averaged and 1 standard deviation values for the temperature records. The temperature records are shifted vertically by an offset of 1.00 ˚C for visualization purposes.

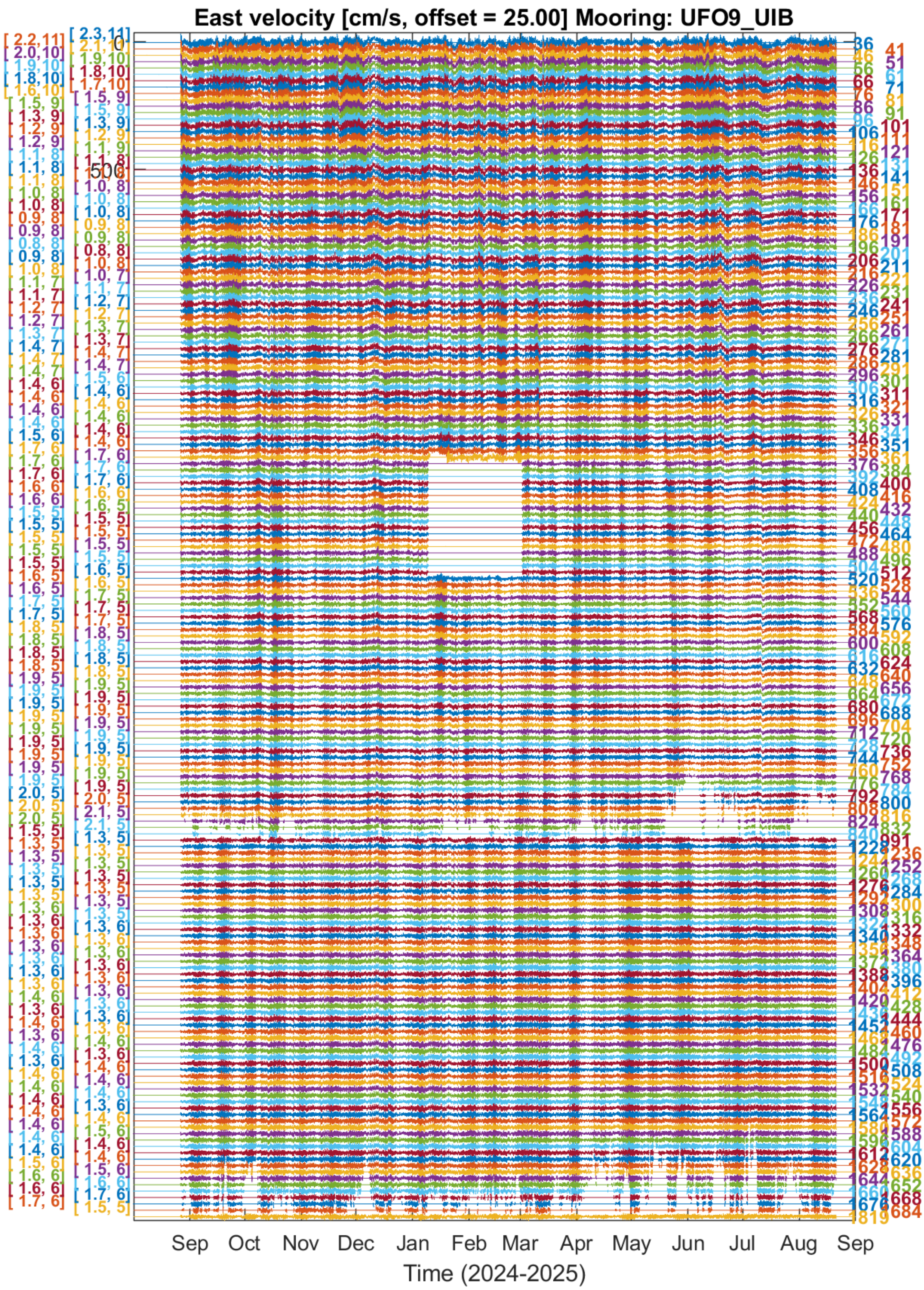

Figure 11. Time series of eastward velocity. Numbers on the right (and the reference line) are the target depths. Numbers on the left show the time-averaged and 1 standard deviation values for the velocity records. The velocity records are shifted vertically by an offset of 25.00 cm/s for visualization purposes.

Figure 12. Time series of northward velocity. Numbers on the right (and the reference line) are the target depths. Numbers on the left show the time-averaged and 1 standard deviation values for the velocity records. The velocity records are shifted vertically by an offset of 25.00 cm/s for visualization purposes.

8 Overview plots from the instrument data files

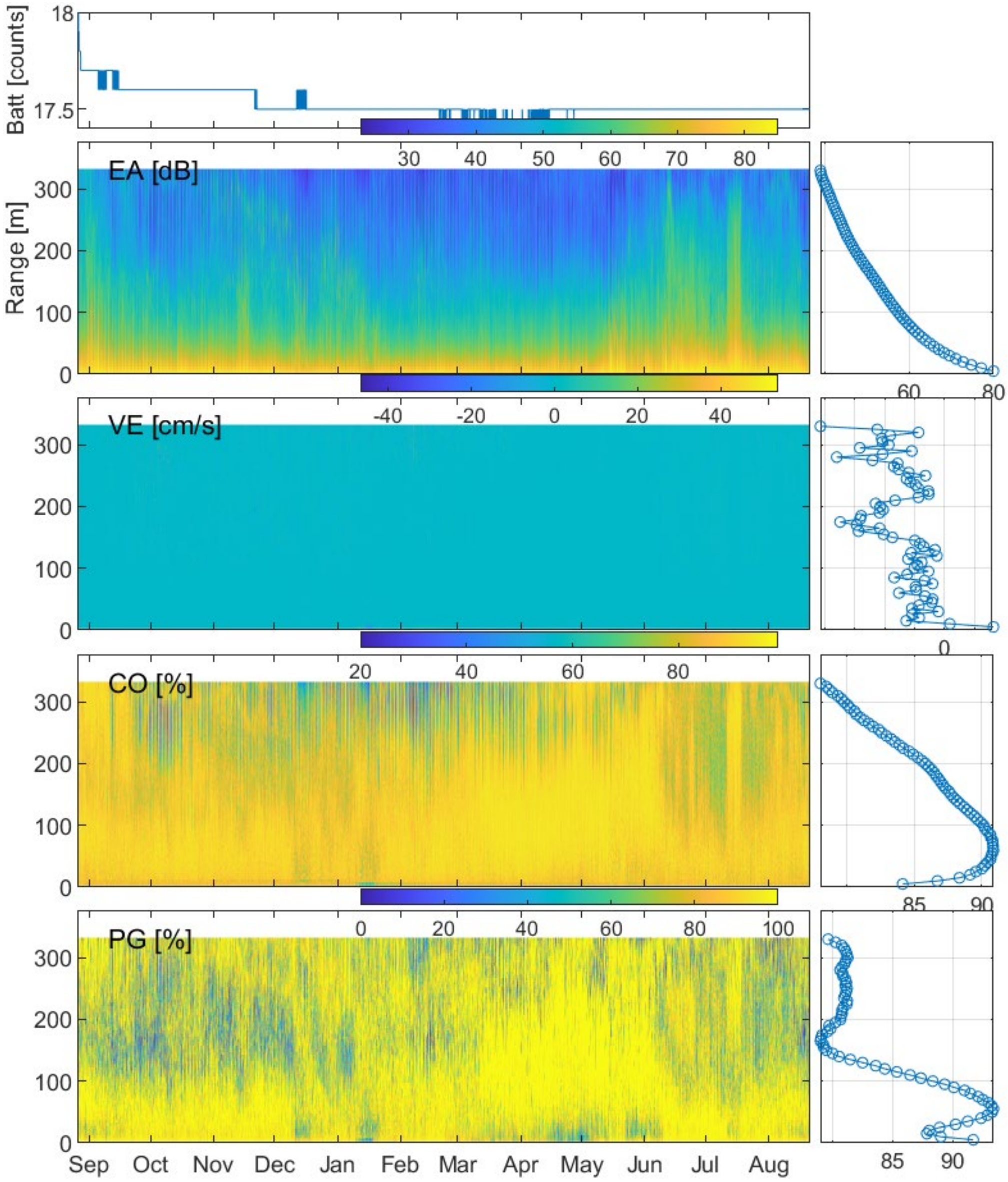

Figure 13. Time series of battery, average echo amplitude (EA), error velocity (VE), average correlation (CO), and percent good (PG) for **Nortek instrument SN100756**. The panels on the right show the time-averaged distribution.

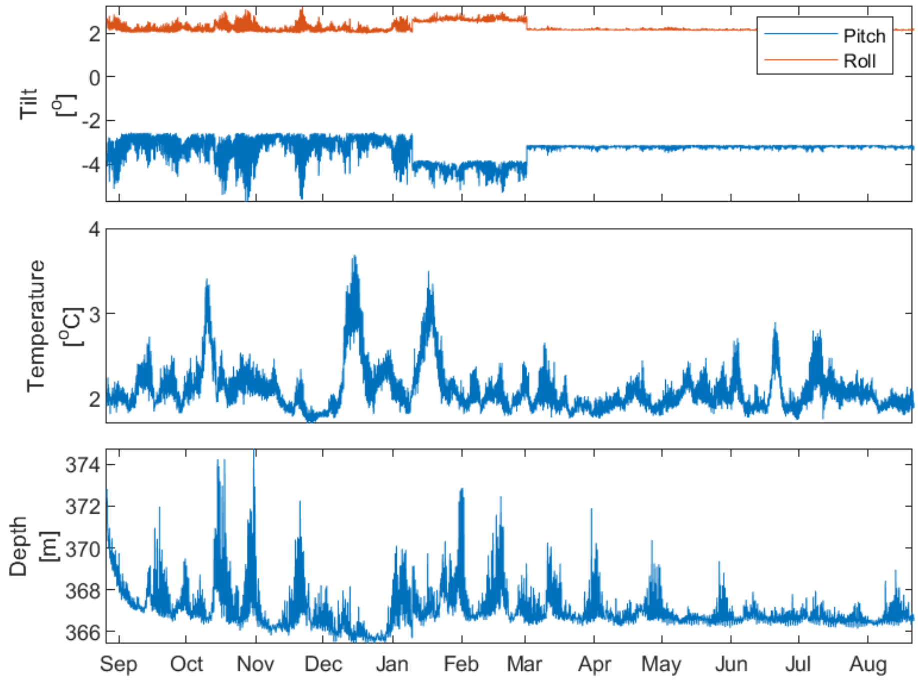

Figure 14. Time series of tilt (pitch and roll), temperature, and depth for **Nortek instrument SN100756**.

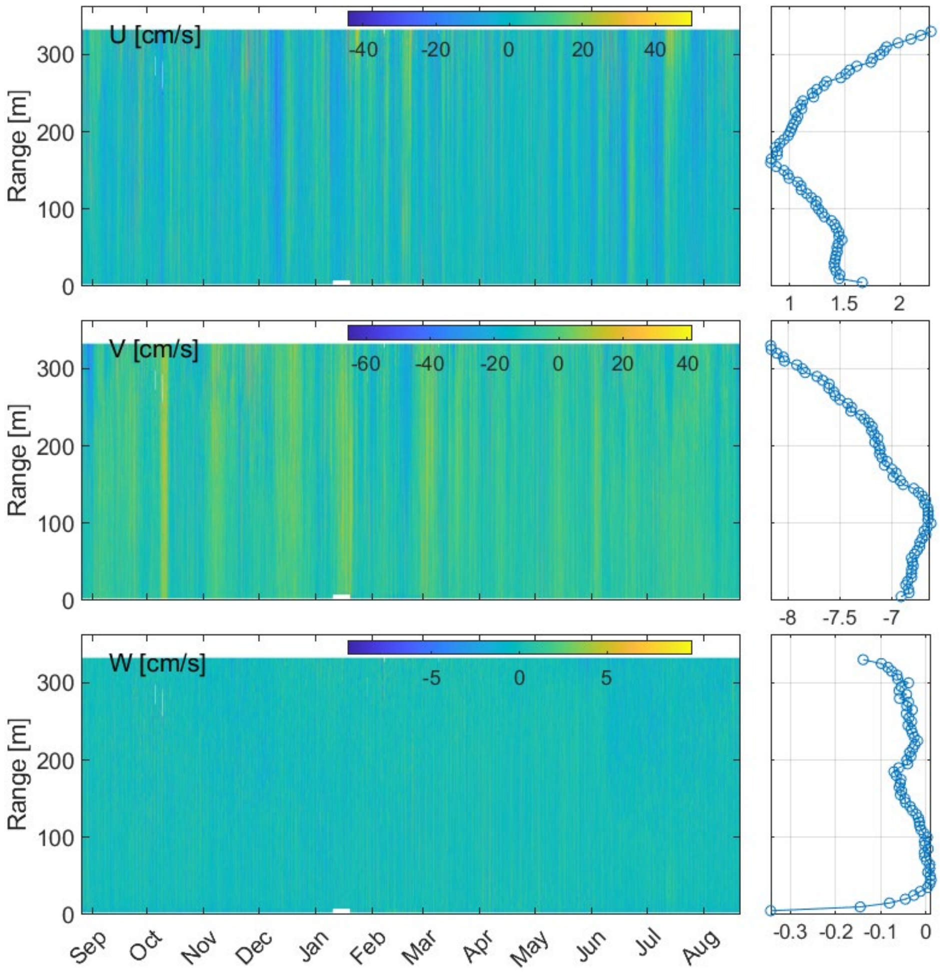

Figure 15. Time series of the eastward (U), northward (V), and vertical (W) velocity components after quality control and interpolation were performed for **Nortek instrument SN100756**. The panels on the right show time-averaged profiles.

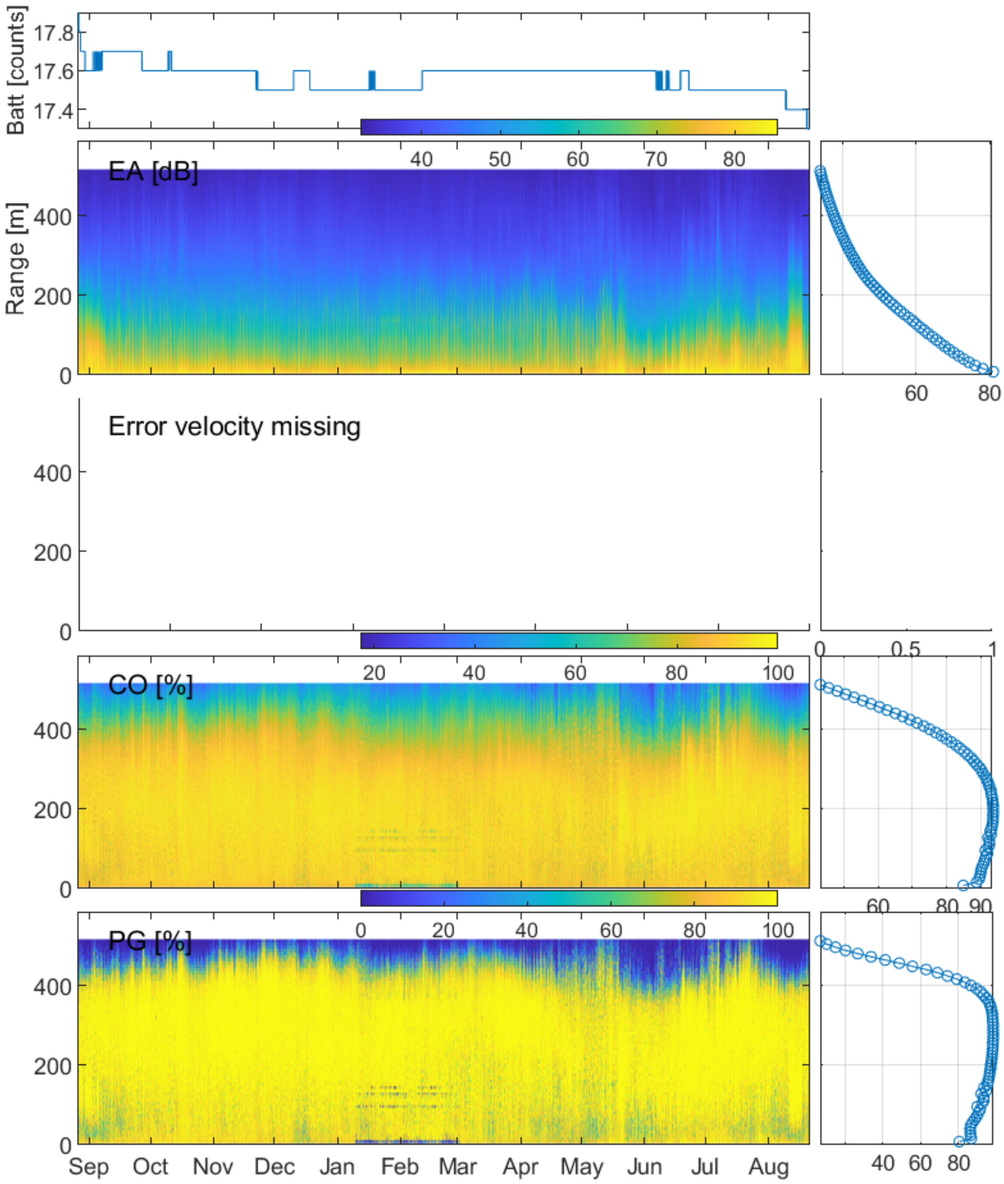

Figure 16. Time series of battery, average echo amplitude (EA), error velocity (missing), average correlation (CO), and percent good (PG) for **Nortek S55 instrument SN200062**. The panels on the right show the time-averaged distribution. Since the instrument only has three beams, no error velocity is available.

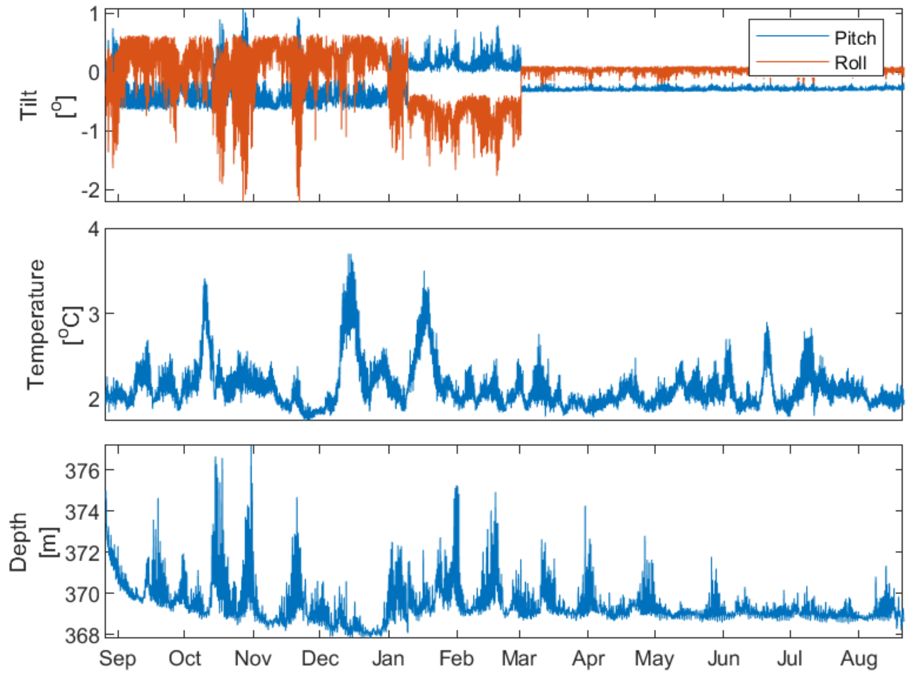

Figure 17. Time series of tilt (pitch and roll), temperature, and depth for **Nortek S55 SN200062**.

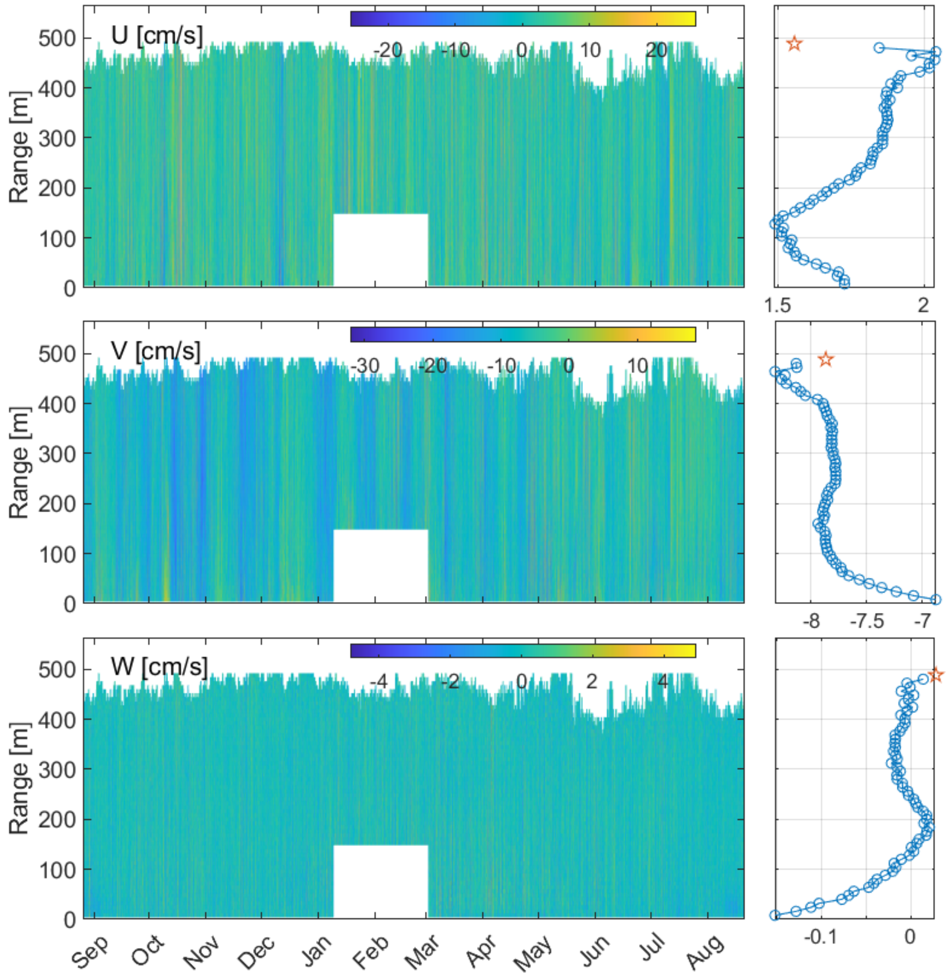

Figure 18. Time series of the eastward (U), northward (V), and vertical (W) velocity components after quality control and interpolation were performed for **Nortek S55 instrument SN200062**. The panels on the right show time-averaged profiles.

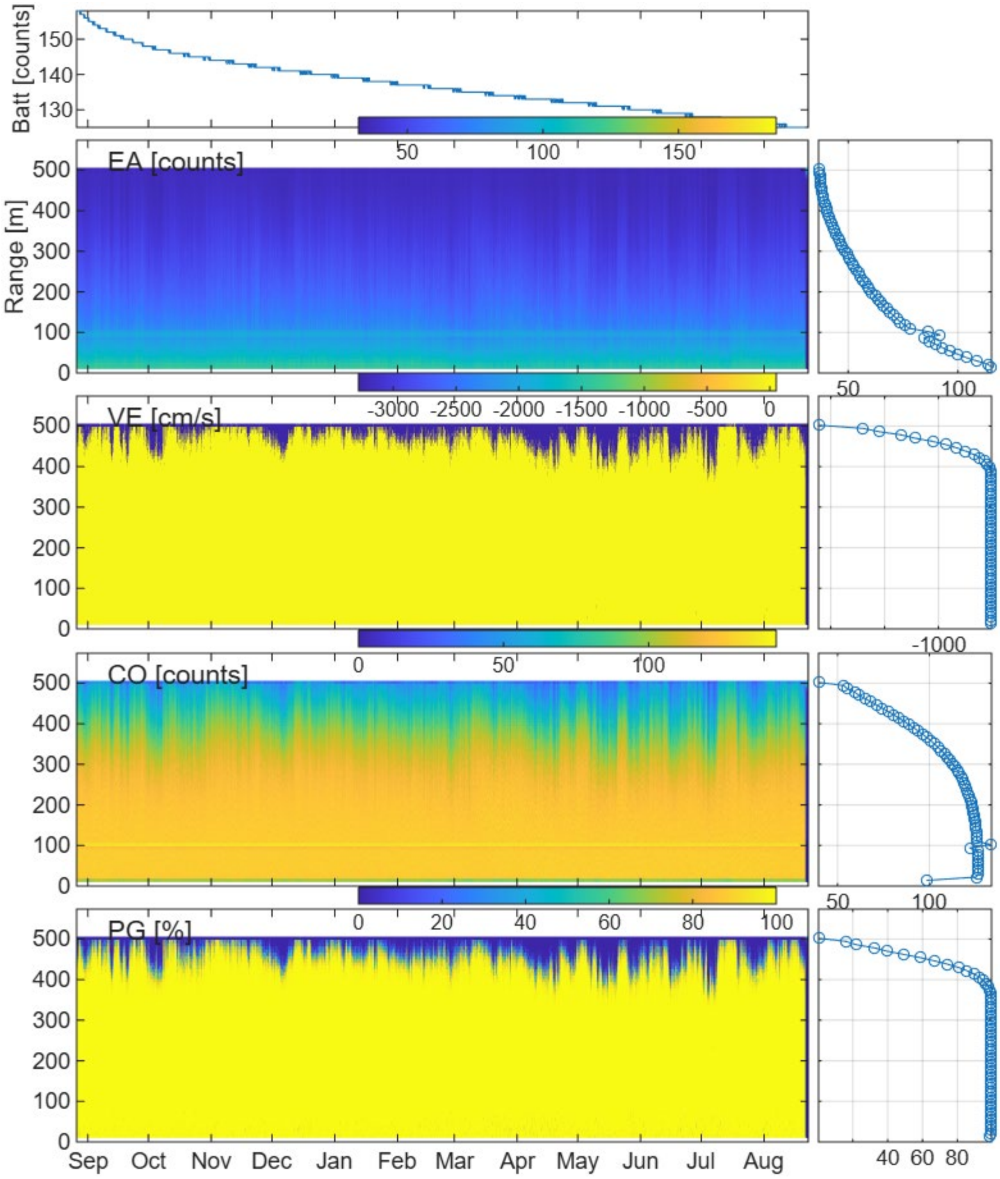

Figure 19. Time series of battery, average echo amplitude (EA), error velocity (VE), average correlation (CO), and percent good (PG) for **RDI 75kHz instrument SN18447**. The panels on the right show the time-averaged distribution.

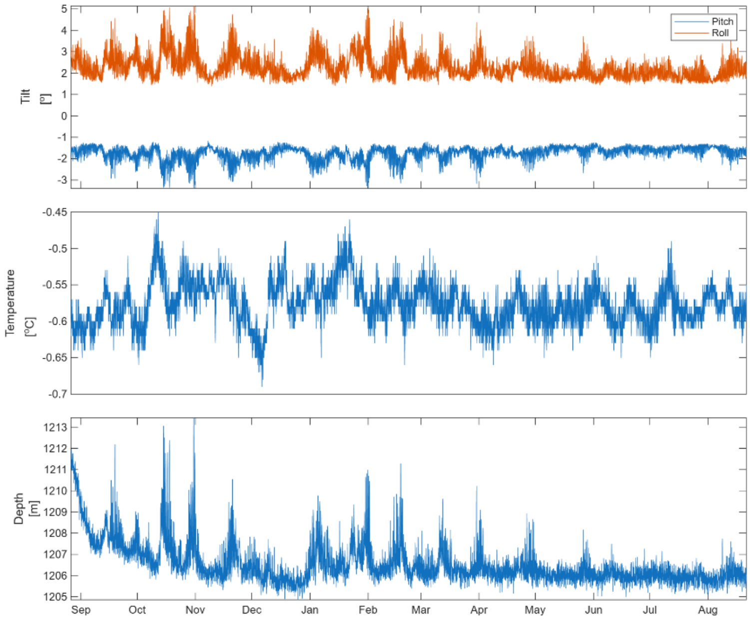

Figure 20. Time series of tilt (pitch and roll), temperature, and depth for **RDI 75kHz instrument SN18447**.

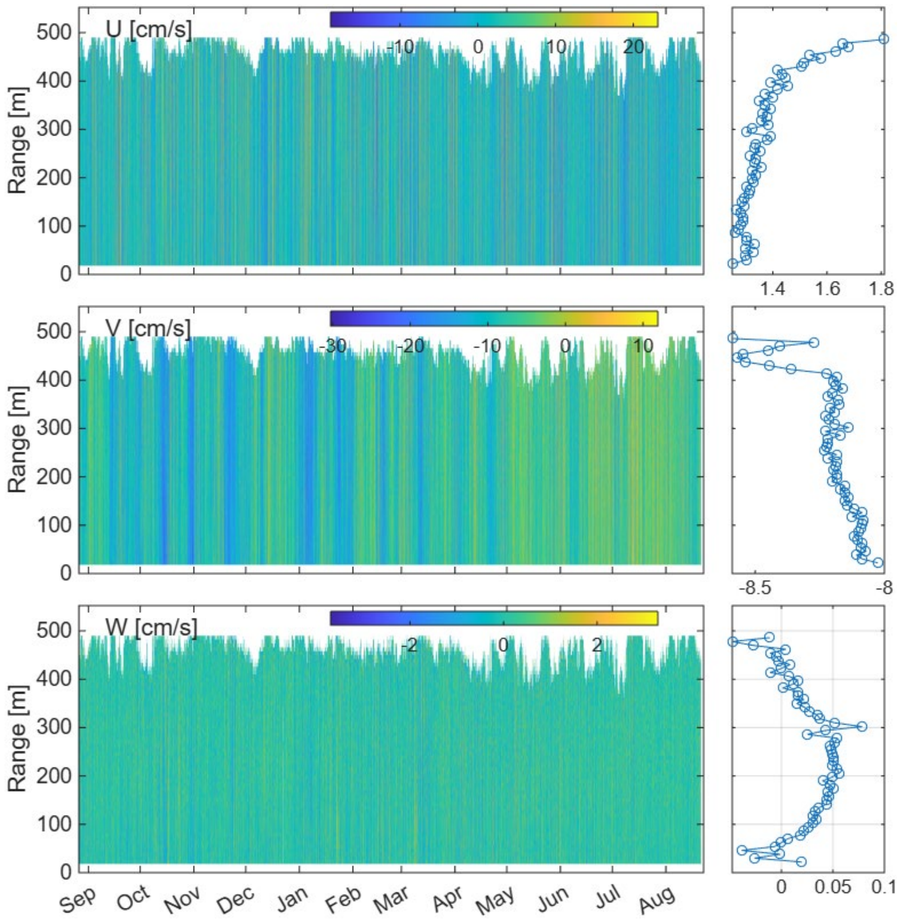

Figure 21. Time series of the eastward (U), northward (V), and vertical (W) velocity components after quality control and interpolation were performed for **RDI 75kHz instrument SN18447**. The panels on the right show time-averaged profiles.

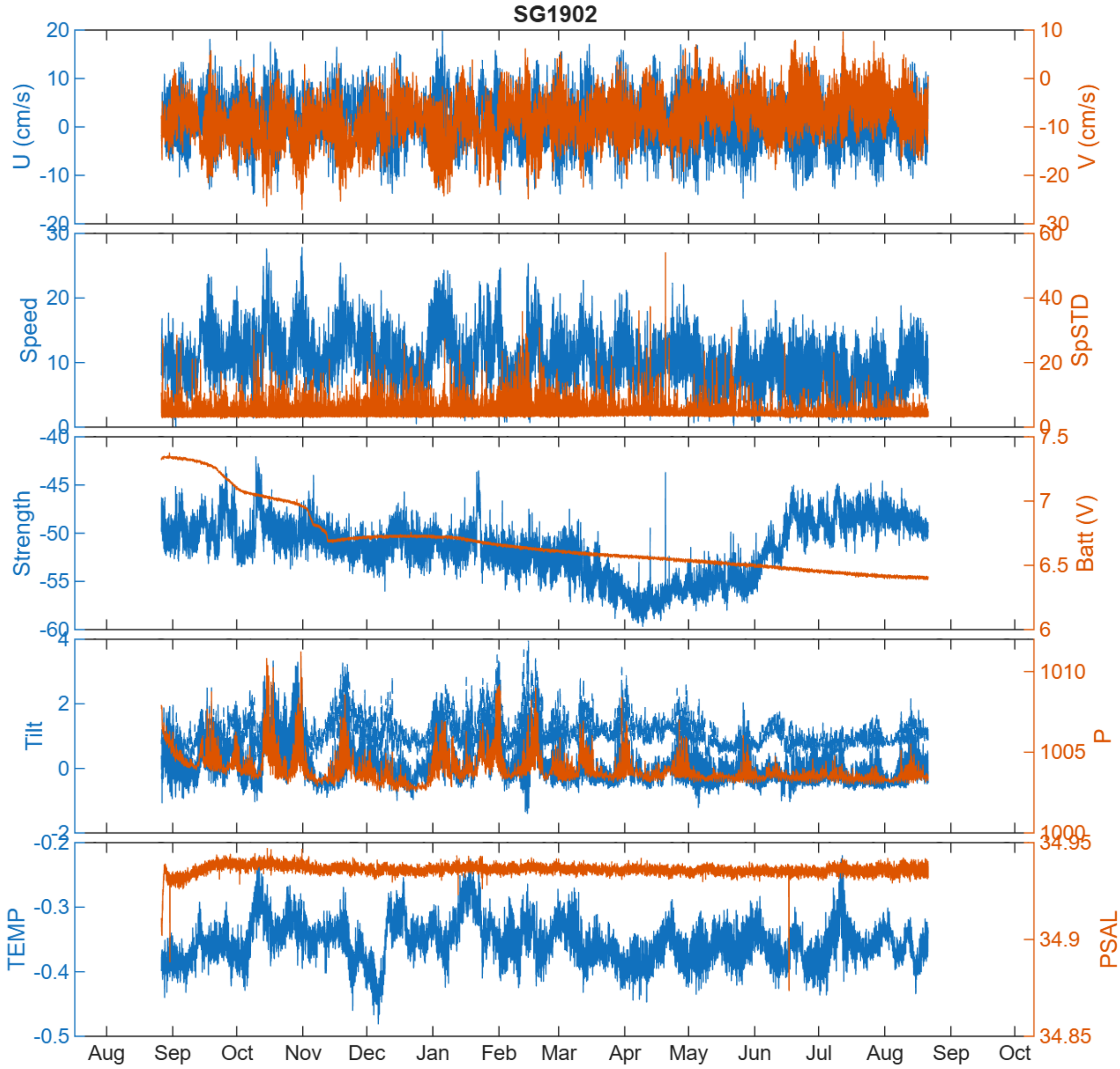

Figure 22. Time series of eastward (U) and northward (V) velocity, speed and its standard deviation (SpSTD), strength in dB and battery voltage, tilt and pressure (P), temperature (T) and salinity (S) for **Seaguard instrument SN 1902**.

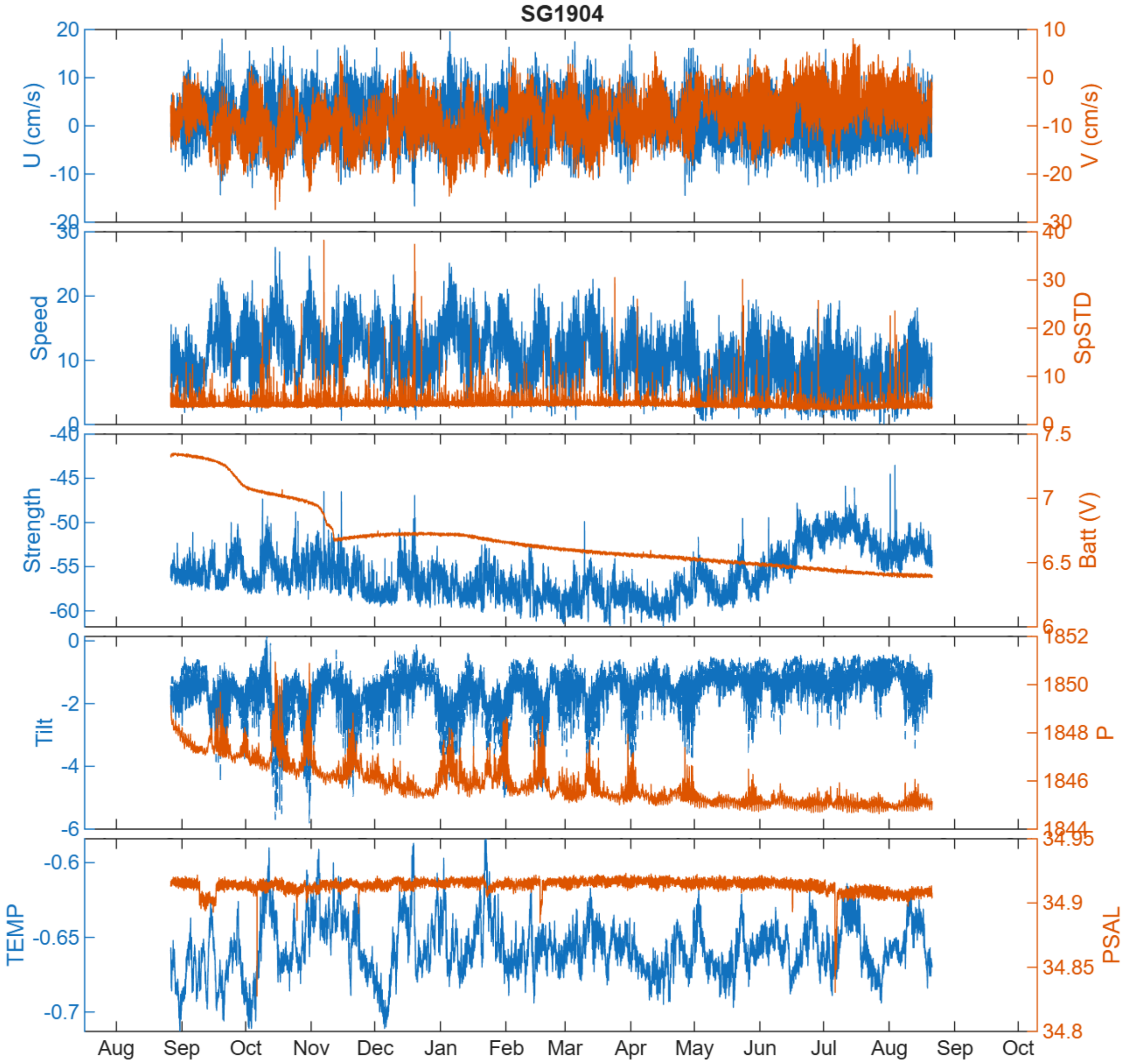

Figure 23. Time series of eastward (U) and northward (V) velocity, speed (cm/s) and its standard deviation (SpSTD), strength in dB and battery voltage, tilt and pressure (P), temperature (T) and salinity (S) for **Seaguard instrument SN 1904**.