Yermak Mooring data report

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November 13, 2019

Contents

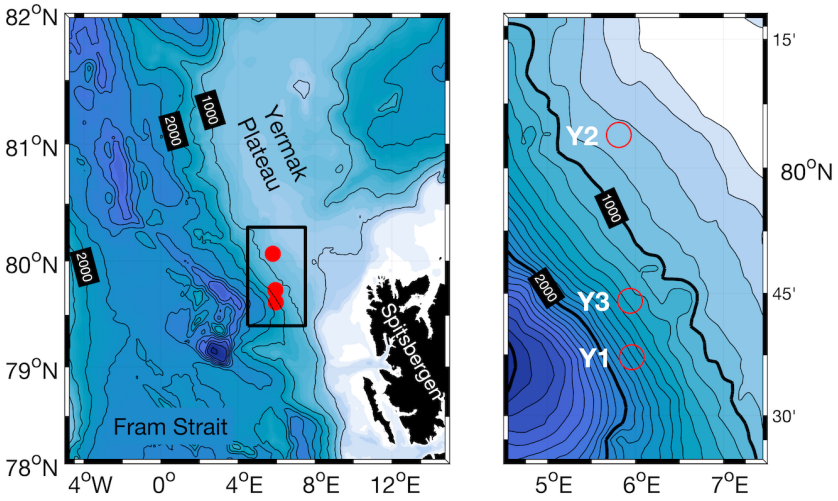


Figure 1: Map of the mooring locations

Mooring	Y1	Y2	Y3
Longitude	5E 57.541	5E 48.733	5E 56.333
Latitude	79N 37.209'	80N 03.876'	79N 44.093'
Echo depth	1535 m	850 m	1209 m
Recovery depth	1609 m	863 m	1327 m
Deployed (UTC)	10.09.2014 18:55	10.09.2014 09:05	11.09.2014 10:47
Recovered (UTC)	13.08.2015 17:00	13.08.2015 08:00	13.08.2015 13:00

Table 1: Mooring deployment and recovery details.

1 Deployment

1.1 Location

Three moorings were deployed on the western slope of Spitsbergen, at about 80°N. The moorings were deployed from the Norwegian coast guard vessel KV Svalbard in September 2014, and recovered in August 2015 by research vessel (RV) Håkon Mosby. The moorings were placed in a south to north line along the slope (Figure 1). Placement of the moorings were limited by unusually large sea ice cover in the region in September 2014. Exact locations, depths and deployment times are given in Table 1. As the echo sounder of KV Svalbard is unreliable, depths from RV Håkon Mosby's echo sounder upon retrieval are also given.

1.2 Instrumentation

The moorings were equipped with temperature, salinity, pressure and current sensors, designed to capture near-inertial internal waves. See the mooring drawings (Appendix) for detailed overview of instruments, serial numbers and planned deployment depth.

SeaGuards sampled 20 min averages (burst mode, 200 pings). SBE-39 recorded at 5 min intervals. Microcats (SBE37) recorded at 2 min intervals. SBE56-Tloggers recorded at 15-s intervals.

All RDI ADCPs recorded ocean currents in Earth coordinates after internally processing and averaging single ping profiles into ensembles, and allowing for 3-beam solutions. 75 kHz instruments profiled in 8 m bins, 40-ping burst (3 s pings) averages every 1 h. 150 kHz instruments profiled in 4 m bins, 40 ping burst (2 s pings) ensembles every 20 min. 300 kHz instruments profiled in 4 m bins, 50 ping burst (1 s pings) ensembles every 1 hour.

With one exception, all instrument positions agree with deployment drawings and tables. At Y3, SBE37 SN7821 is near 798 m (close to RDI150) instead of 750 m. It slid down or was deployed in error.

Three thermistors (SBE39) and one current meter (RCM7) did not log data:

- SBE39: SN6148 on Y3 at 500mab
- SBE39: SN6143 on Y2
- SBE39: SN1736 on Y1
- RCM7: SN 4223 at Y1 50 mab

2 Data Processing

2.1 Mooring blowdown and pressure drift

Strong currents can blow down the mooring lines. To account for this, we created a pressure matrix from the SBE37 and SBE39 pressure sensors. For each hourly time step, pressure is linearly interpolated to the other instrument depths, based on the planned distance along the wire from the pressure sensors.

Pressure readings can drift through the deployment. A check of pressure of all SBE instruments before and after recovery reveals drift of about 1dBar in one sensor (SBE37, SN6018). The other sensors show pressure within 0.2dBar of pre-deploymen values. 1dBar is considered to be acceptable, as other error sources are larger, and we do nothing to correct for this drift.

2.2 Time resolution and vertical resolution

The instruments sampled at different intervals, and to create a unified structure, we adjusted this to 1 hour intervals. Instruments with a higher frequency were bin-averaged

Mooring	Height (m.a.b)	Parameter	Instrument
Y2	793, 768, 738, 713, 693, 643, 618, 568, 513, 253, 153, 48	T	SBE56 (SN: 4313, 4252, 4330, 4314, 4328, 4312, 4326, 1965, 1953, 4334, 4321, 4315)
	803*, 673*, 463, 98*	C, T, P*	SBE 37 (SN: 5448*, 5451*, 8000, 5452*)
	692↑	U, W	RDI 150 kHz (SN: 17226)
	690↓	U, W	RDI 75 kHz (SN: 18447)
	48	T, C, U	RCM7 (SN: 10983)
	808		SS37 ORE
Y3	177, 602, 702, 857, 962, 1062, 1087, 1132, 1182, 1122, 1132, 1237, 1247	T	SBE56 (SN: 4320, 4310, 4319, 4317, 4311, 4318, 4316, 4232, 4327, 4200, 4335, 4203, 4333)
	273*, 447, 552, 907, 1117*, 1217*	C, T, P*	SBE37 (SN: 7373*, 7222*, 7821, 7335, 8971*, 5446*)
	503↑, 1128↑	U, W	RDI 150 kHz (SN: 18595, 17227)
	501↓, 1012↓, 1126↓	U, W	RDI 300 kHz (SN: 17319, 10149, 15331)
	122, 1152*, 1252*	C, T, P, U, O*	SeaGuard (SN: 240, 1321*, 1318*)
	287	U, T	RCM7 (SN: 11064)
Y1	639, 744, 844, 944, 1089, 1194, 1299, 1324, 1399, 1424, 1459, 1469, 1479, 1489	T	SBE56 (SN: 1340, 1955 1347 1962 1951 1328 1954 1948 4331 4329 4332 4322 4323 4325)
	1039, 1244	T, P	SBE39 (SN: 6144, 6146)
	114*, 534, 794*, 1144, 1349*, 1449*, 1499*	C, T, P*	SBE37 (SN: 6018*, 8973, 7372*, 8975, 8970*, 7334*, 6097*)
	1449↑	U, W	RDI 300 kHz (SN: 13771)
	941↓, 943↑	U, W	RDI 75 kHz (SN: 21447, 21444)
	219, 444	T, C, U	RCM7 (SN: 4223, 1586)

Table 2: Mooring instrument details. Note that Y2 is shallowest, Y3 is deepest mooring. Height is measured in meters above bottom (m.a.b.), and corrected using mooring line lengths and pressure record from instruments. Parameters are temperature (T), conductivity (C), pressure (P), horizontal velocity (U), vertical velocity (W) and dissolved oxygen (O). Instruments are given with their serial numbers (SN), and arrows indicate up/downlooking ADCPs.

to 1 hour, and instruments with 1 hour intervals were linearly interpolated to the common time-stamp. No instruments had lower sampling frequency than 1 hour.

Data was interpolated to a 5m vertical grid.

2.3 Offset corrections

We compared mooring data to CTD casts performed shortly after each mooring deployment. The CTD cast was compared to mooring data within 3 hours, and to the deployment-averaged profiles. Some instruments showed a systematic offset (particularly when looking at month/yearlong vertical profiles). If these were covered by other instruments that we deemed more reliable (consistent), the offset data were discarded. When there was no overlap, and it seemed otherwise reasonable to do so (particularly at depth), we corrected the offset in comparison with nearby sensors.

2.3.1 Salinity corrections

Y1 was the only mooring which had systematic offsets in salinity. We corrected all sensors systematically with +0.006, to better match the CTD data. In addition, one sensor (SBE-CT, sn 8973) had an offset of -0.04 relative to the others, which we corrected for.

On Y2, some of the salinity sensors made temporary offsets, lasting for up to a few weeks. This was presumably due to blocking of the salinity cell, preventing throughflow. We made an attempt at correcting for this, but the offset was not constant in time, so we decided to discard these data. This shows as data gaps in the final contour plots.

2.4 Current data – Compass corrections

In some places, ADCP data overlap with other instuments, such as SeaGuards or RCM-7s. Here we checked for consistency, and then used one of the data sets. If the data sets agree well, we typically used the ADCP data because of better spatial coverage.

One ADCP, the uplooking RCM longranger 21444 on Y1, had compass issues. After comparing to the nearby current measurements on the same mooring, and to current measurements on the other two moorings, we corrected the compass for an offset. This was done by matching its first 3 bins to the first 3 bins of the downlooking ADCP on the same buoy.

Because of compass calibration errors, we needed to correct current direction on a number of instruments. A downlooking Longranger ADCP compass on Y2 (SN 18447) was corrected against the uplooking Longranger mounted on the same buoy (SN 17226) by matching the three first bins of the two instruments. Similar corrections were made for

We do not correct for magnetic declination. The declination in mid-deployment (Feb 24, 2015) at 79.621°N, 5.9590°E is 0.84°E, with an error margin of 0.83°, and changing by 0.41°E per year. Compass uncertainty is about 5°. Declination is calculated

	Corrected instrument			Corrected against		
Mooring	Instrument	S/N	Type	Instument	S/N	Type
Y1	RDI75 kHz	21444	Uplooker	RDI 75 kHz	21447	Downlooker
Y2	RDI 75 kHz	18447	Downlooker	RDI 150 kHz	17226	Uplooker
Y3	RDI 300 kHz	15331	Downlooker	RDI 150 kHz	17227	Uplooker
Y3	RDI 150 kHz	18595	Uplooker	RDI 300 kHz	17319	Downlooker
Y3	RCM-7	11064	Point	RDI 300 kHz / SeaGuard	17319 / 240	Downlooker / Point
Y3	RDI 300 kHz	10149	Downlooker	RDI 150 kHz	18595	Uplooker
Y3	SeaGuard	1321	Point			60° CW

Table 3: Overview of instruments corrected for compass error or calibration errors.

using NOAA's magnetic field calculator at `http://www.ngdc.noaa.gov/geomag-web/#declination`.

3 Contour plots

Basic displays of the measured data at each of the three moorings are shown below as contour plots of temperature, salinity and horizontal currents. Color scales are the same for each variable to simplify comparison, but the vertical axis differs between the moorings.

3.1 Temperature

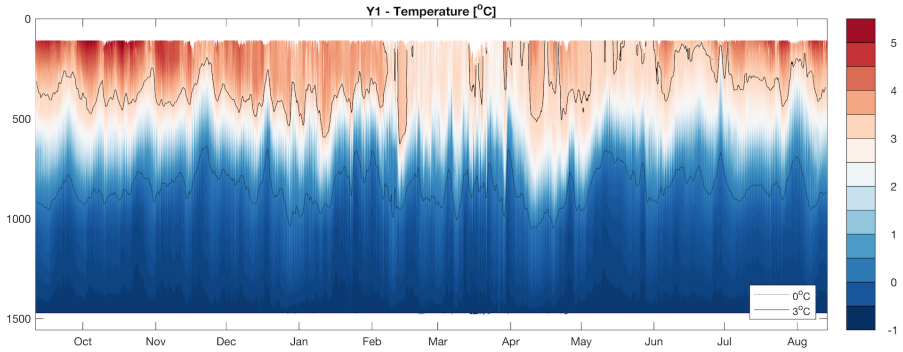


Figure 2: Time evolution of temperature at mooring Y1.

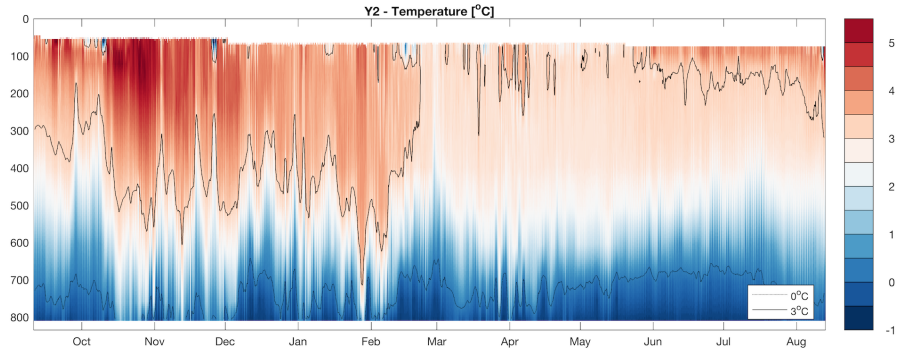


Figure 3: Time evolution of temperature at mooring Y2.

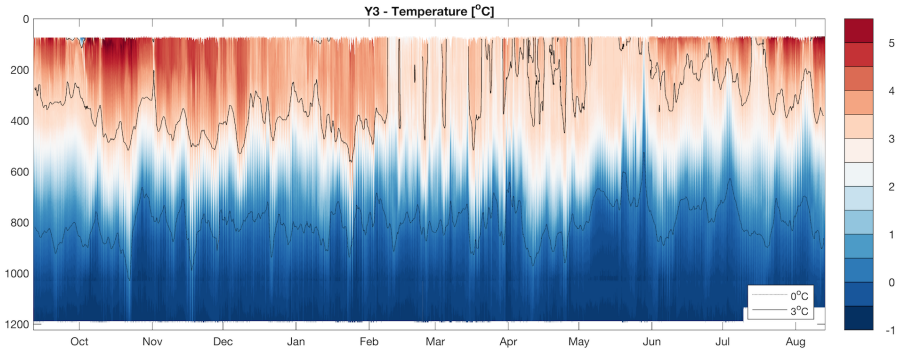


Figure 4: Time evolution of temperature at mooring Y3.

3.2 Salinity

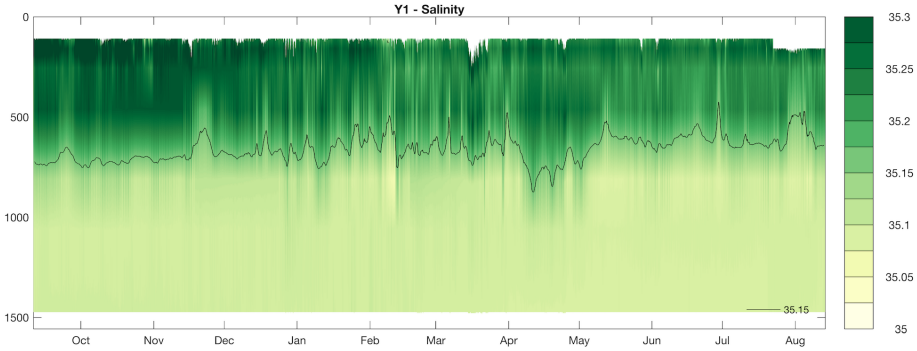


Figure 5: Time evolution of salinity at mooring Y1.

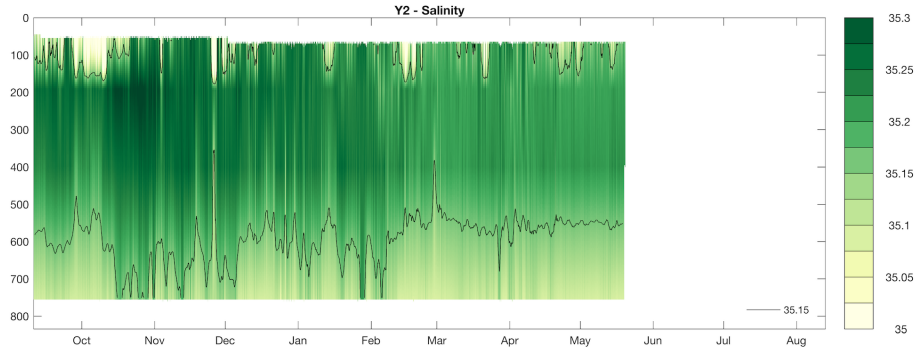


Figure 6: Time evolution of salinity at mooring Y2.

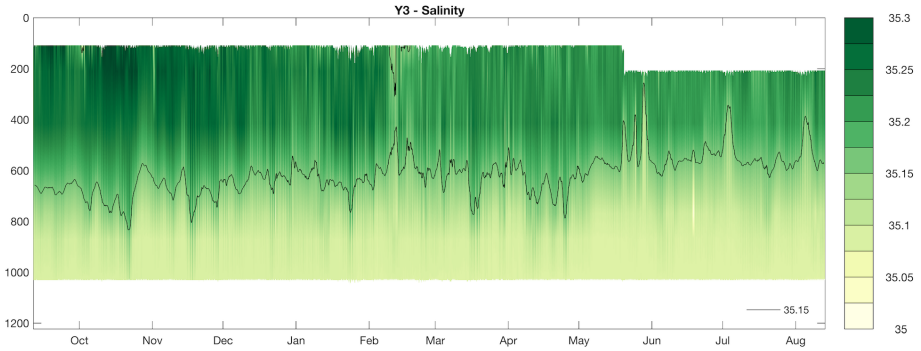


Figure 7: Time evolution of salinity at mooring Y3.

3.3 Currents

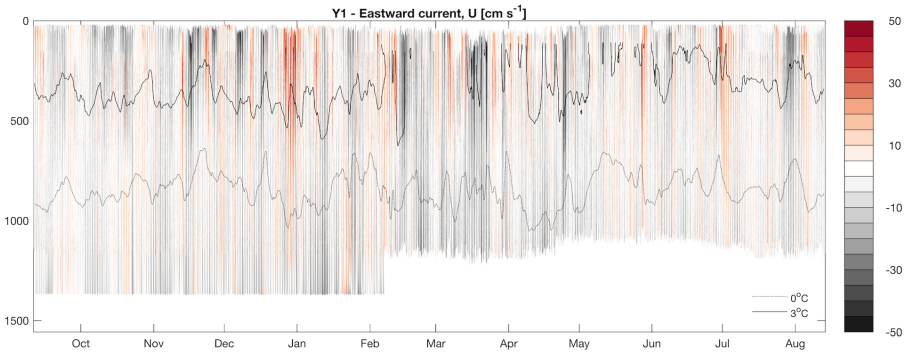


Figure 8: Time evolution of eastward current speed at mooring Y1.

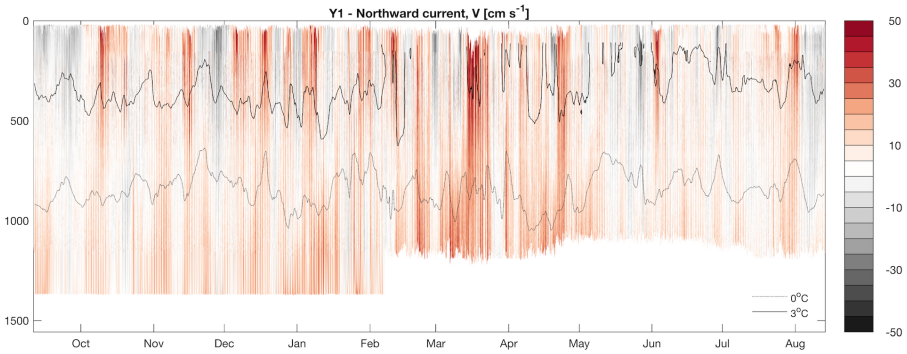


Figure 9: Time evolution of northward current speed at mooring Y1.

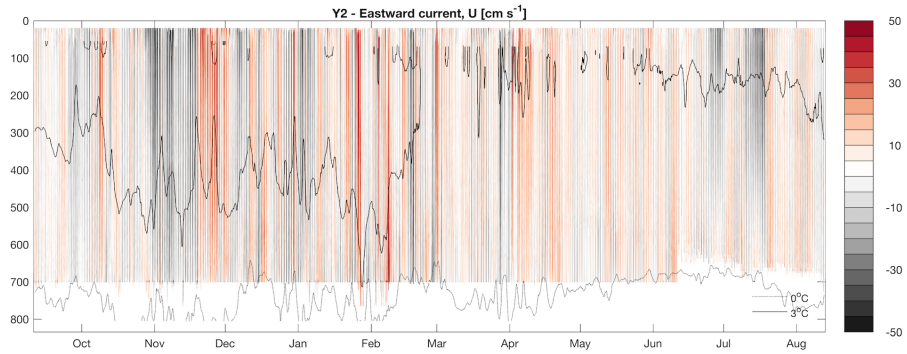


Figure 10: Time evolution of eastward current speed at mooring Y2.

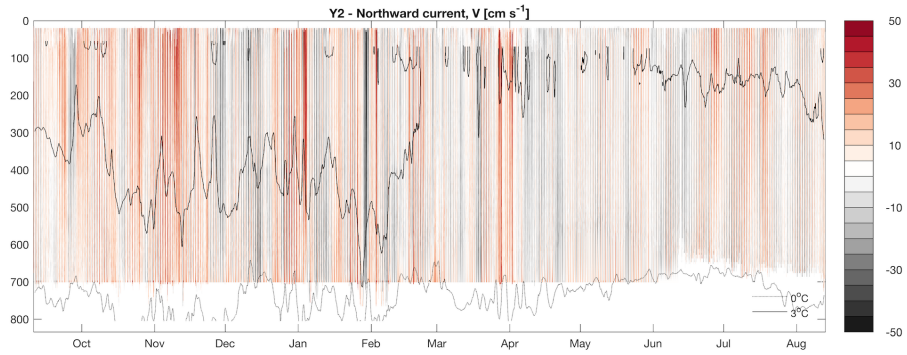


Figure 11: Time evolution of northward current speed at mooring Y2.

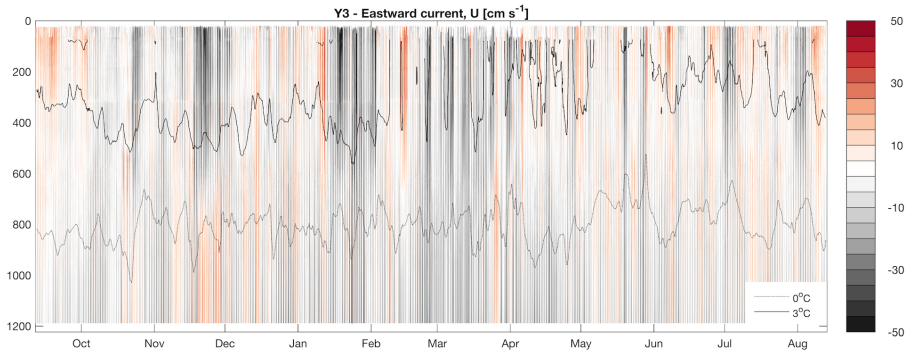


Figure 12: Time evolution of eastward current speed at mooring Y3.

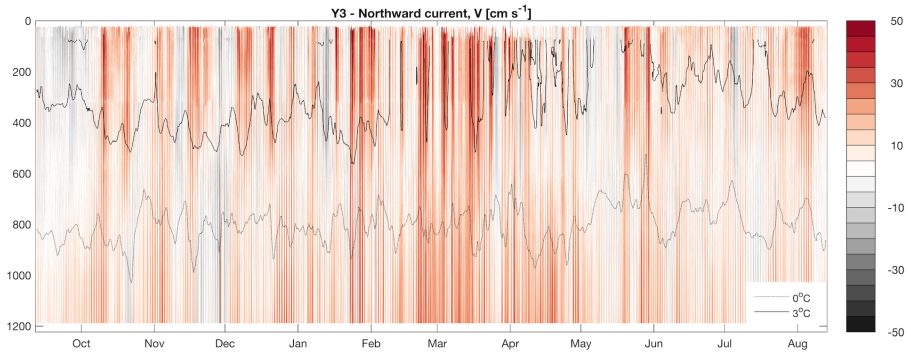
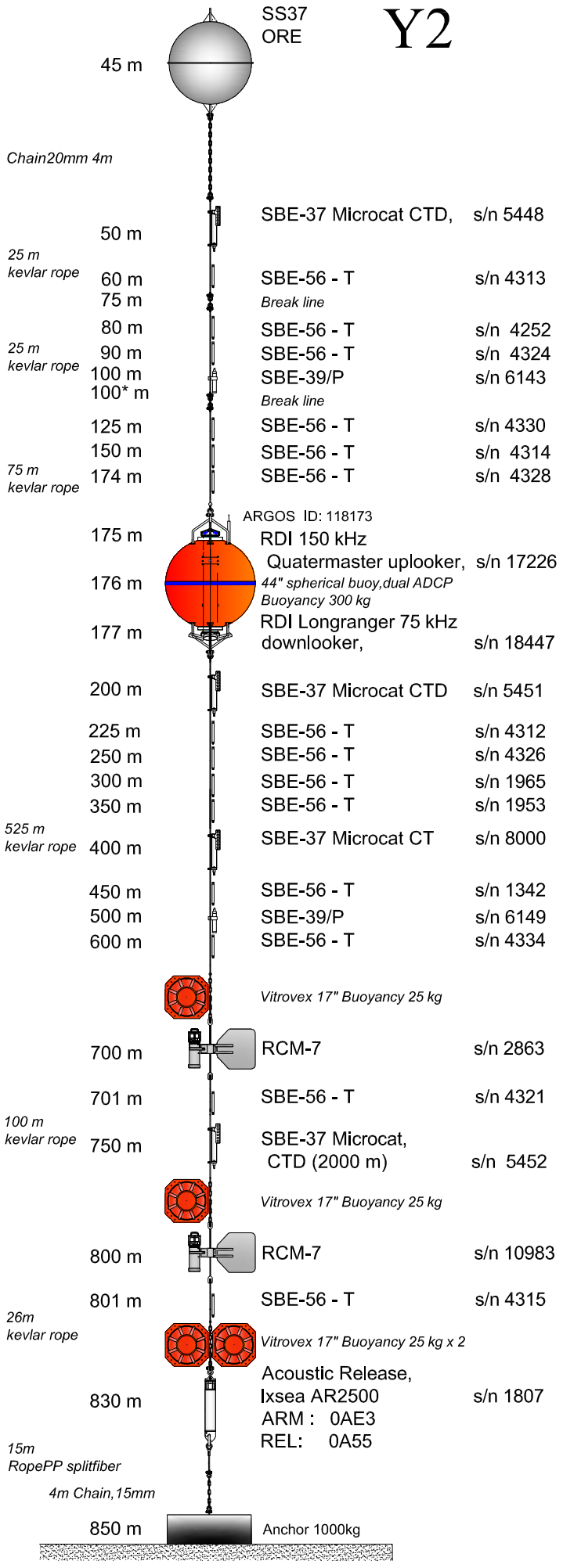


Figure 13: Time evolution of northward current speed at mooring Y3.

4 Mooring drawings

The following are techical drawings used in the planning and deployment of the moorings and give an overview of the moorings and the placement of instruments on the lines.



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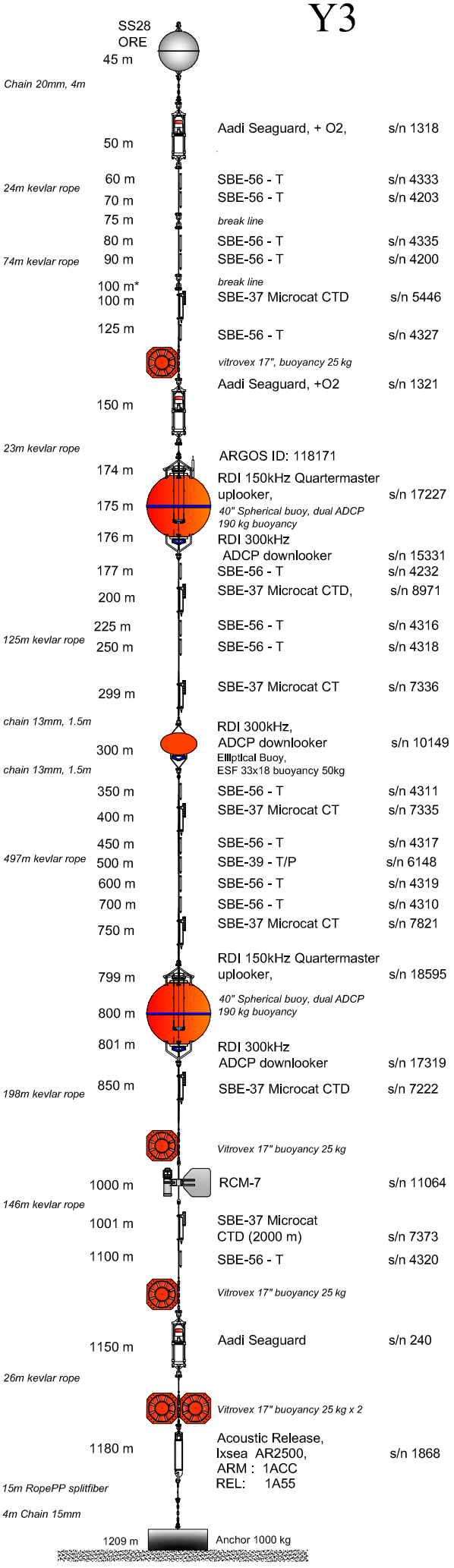
Project:
Location: Yermak Plateau
Position: N 80 03.876 E 005 48.733
Depth: 850 m
Deployment:
Recover:

SBE37- CTD	3
SBE37 - CT	1
SBE56	16
ADCP LR	1
ADCP 150kHz	1
RCM Aadi	2
Argos,ID:118173	1
Ixsea AR 2500 s/n 1807	1

Arm code: **0AE3**
Release Arm + 0A55
Release with ping Arm + 0A56
Pinger on Arm + 0A47
Pinger of Arm + 0A48
Diagnostic Arm + 0A49

Y3



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Project:
Location: Yermak Plateau
Position: N 79 44.093 E 005 56.333
Depth: 1209 m
Deployment:
Recover:

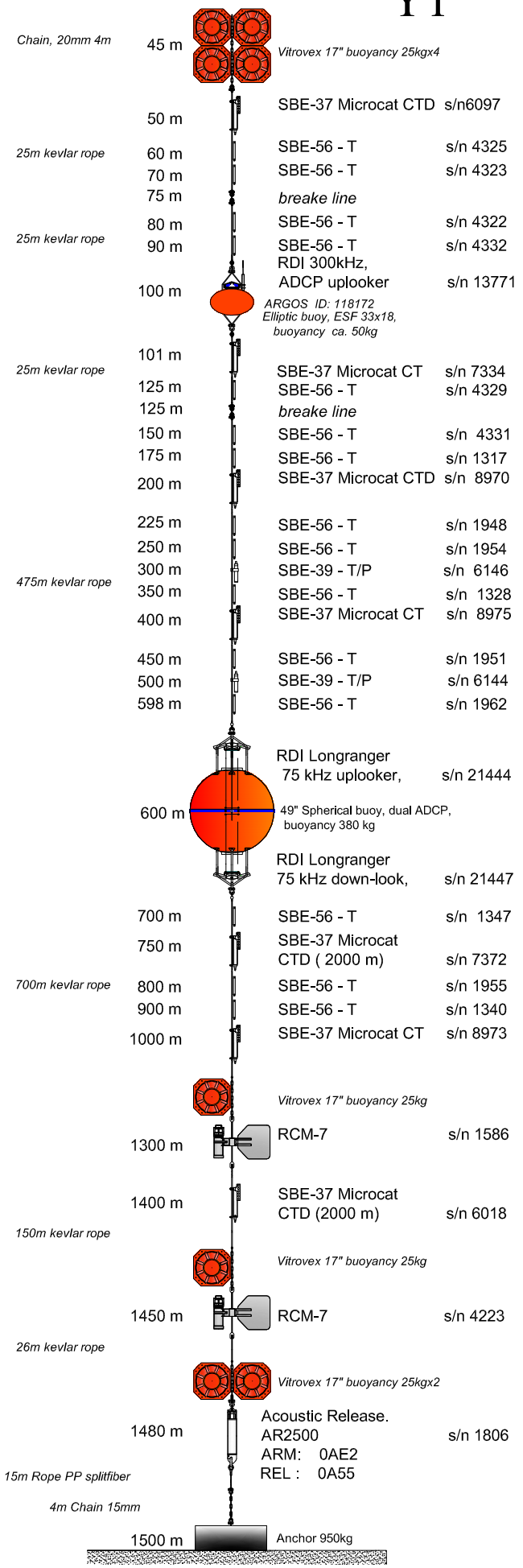
SBE37- CTD	4
SBE37 - CT	3
SBE56	13
SBE39 T/P	1
ADCP 150kHz	2
ADCP 300kHz	3
RCM-7 Aadi	1
Seaguard Aadi	3

Argos,ID:118171 1

Ixsea AR 2500 1
s/n 1868

Arm code:	1**ACC**
Release	Arm + 1A55
Release with ping	Arm + 1A56
Pinger on	Arm + 1A47
Pinger of	Arm + 1A48
Diagnostic	Arm + 1A49

Y1



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Project:
Location: Yermak Plateau
Position: N 79 37.209 E 005 57.541
Depth: 1535 m
Deployment:
Recover:

SBE37- CTD	4
SBE37 - CT	3
SBE56	15
SBE39 T/P	2
ADCP LR	2
ADCP 300kHz	1
RCM Aadi	2
Argos,ID:118172	1
Ixsea AR 2500 s/n 1806	1

Arm code:	**0AE2**
Release	Arm + 0A55
Release with ping	Arm + 0A56
Pinger on	Arm + 0A47
Pinger of	Arm + 0A48
Diagnostic	Arm + 0A49