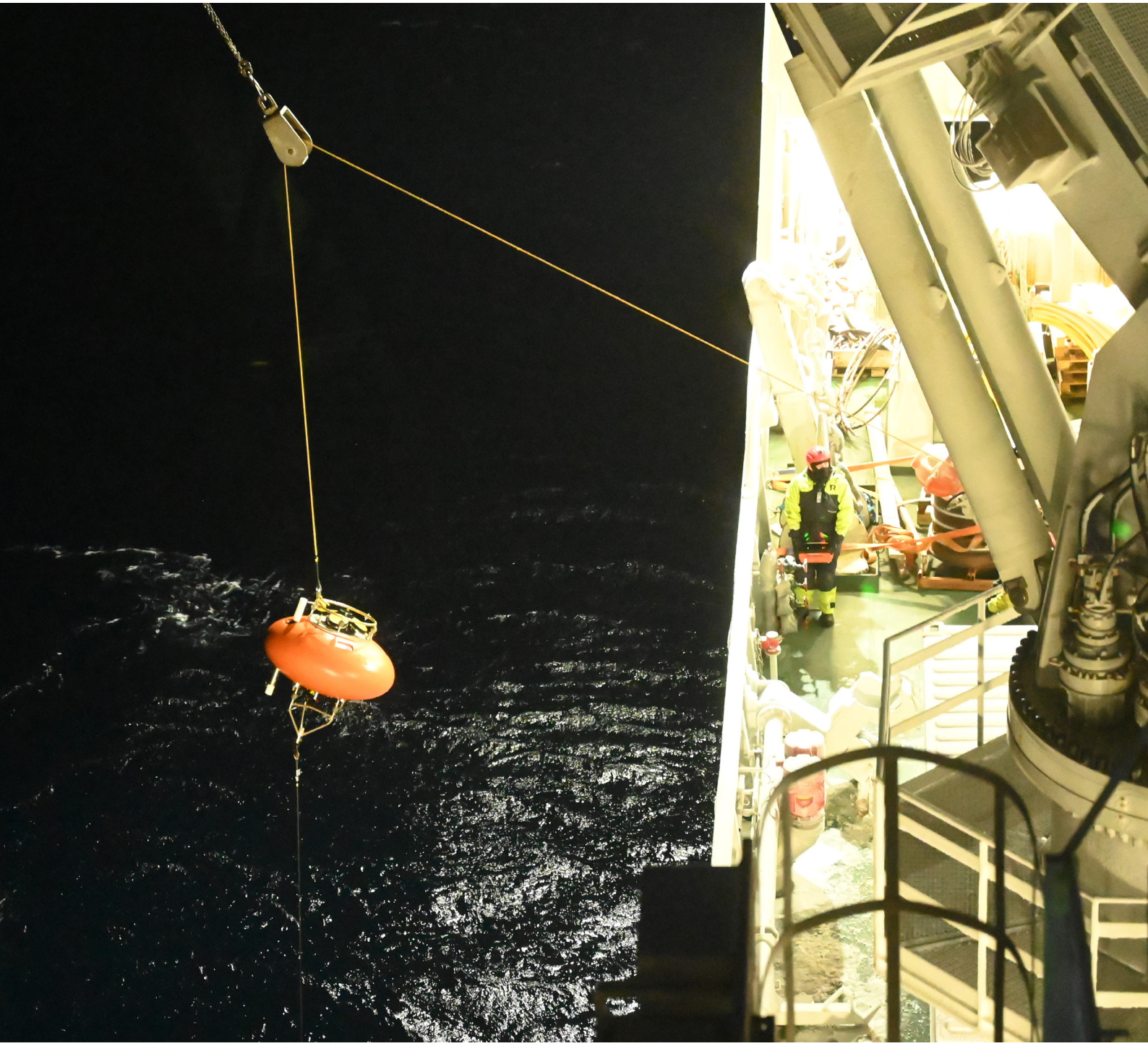
the Nansen LEGACY

Mooring service cruise 2021

Cruise Report



The Nansen Legacy Report Series 28/2022

Mooring service cruise 2021

Cruise 2021713

R/V Kronprins Haakon
Longyearbyen - Tromsø
November 06 -16, 2021

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Contents

Executive summary

The main objective of the joint Nansen Legacy and A-TWAIN/SIOS-InfraNor mooring service cruise was the recovery and deployment of the projects' moorings in the Barents Sea and north of Svalbard. Additionally, CTD stations with water sampling for both projects, a Seaglider deployment for Nansen Legacy, and mooring recoveries and deployments for partner projects were planned depending on sea ice conditions and time available. The cruise left from Longyearbyen 06.11.2021 heading first to the northern Barents Sea slope for A-TWAIN and partner mooring operations.

On the way to the main northern working area, two moorings were deployed at 22E. At 31E, the main A-TWAIN line, two moorings were recovered and five deployed. A short transect covering the upper slope (200-2000 m bottom depth) was made during the night between moorings operations.

After two days of work in the A-TWAIN area the ship moved south to start Nansen Legacy mooring operations. In the M1 inflow area, four moorings were recovered and two redeployed. A transect crossing the slope was done in between mooring operations. During night a transect from M1 to the Austfonna glacier was done, before steaming onwards to recover more moorings. The following ones were recovered in the following days: M2, M5-BioAc, M5, F3-1, F2. Inclement weather prevented recovery of moorings F3-2, C, S1, S2, S3-1 and S3-2.

Despite the very short duration of the cruise it was successful in the sense that many of the planned mooring recoveries were done. The number of redeployed moorings had to be reduced, and fewer CTD and L-ADCP casts and transects were made. The high efficiency would not have been possible without the capabilities of the vessel, the crew and the cruise participants, who all collaborated very well.

1 Background

This cruise is a joint venture between two main projects; Nansen Legacy (NLEG) and A-TWAIN/ SIOS-InfraNor. Nansen Legacy RF1 has mooring components in two sub-tasks; T1-1.2 (large scale advection) and T1-2.1 (ocean process studies). The NLEG moorings cover a) advection of water masses and sea ice into the northern Barents Sea (T1-1.2, T2-1.1, T3-2.2, T3-3.2, and T3-4.4) and b) processes controlling the stability of and exchange across the "Polar Front" area in the central Barents Sea (T1-2.1). The A-TWAIN project has had moorings over the continental slope north-east of Svalbard for several years. The overarching goal of this project is to detect seasonality, variability and long-term trends in the Fram Strait branch of the Atlantic Water inflow entering the Arctic Ocean. In addition to the extensive mooring operations, CTD and L-ADCP profiles and transects at selected locations were made to improve the vertical and geographical resolution of the mooring time series. In situ sea ice observations are made for comparison with satellite-derived sea ice products (T1-2.2 and RA-C). Water samples for analysis of nutrients, POC/PON, chl-a and carbonate chemistry, and for calibration of the CTD dissolved oxygen sensor were collected at selected locations, mostly near key moorings (NLEG T2-1.1, T3-1.2).

2 Survey area

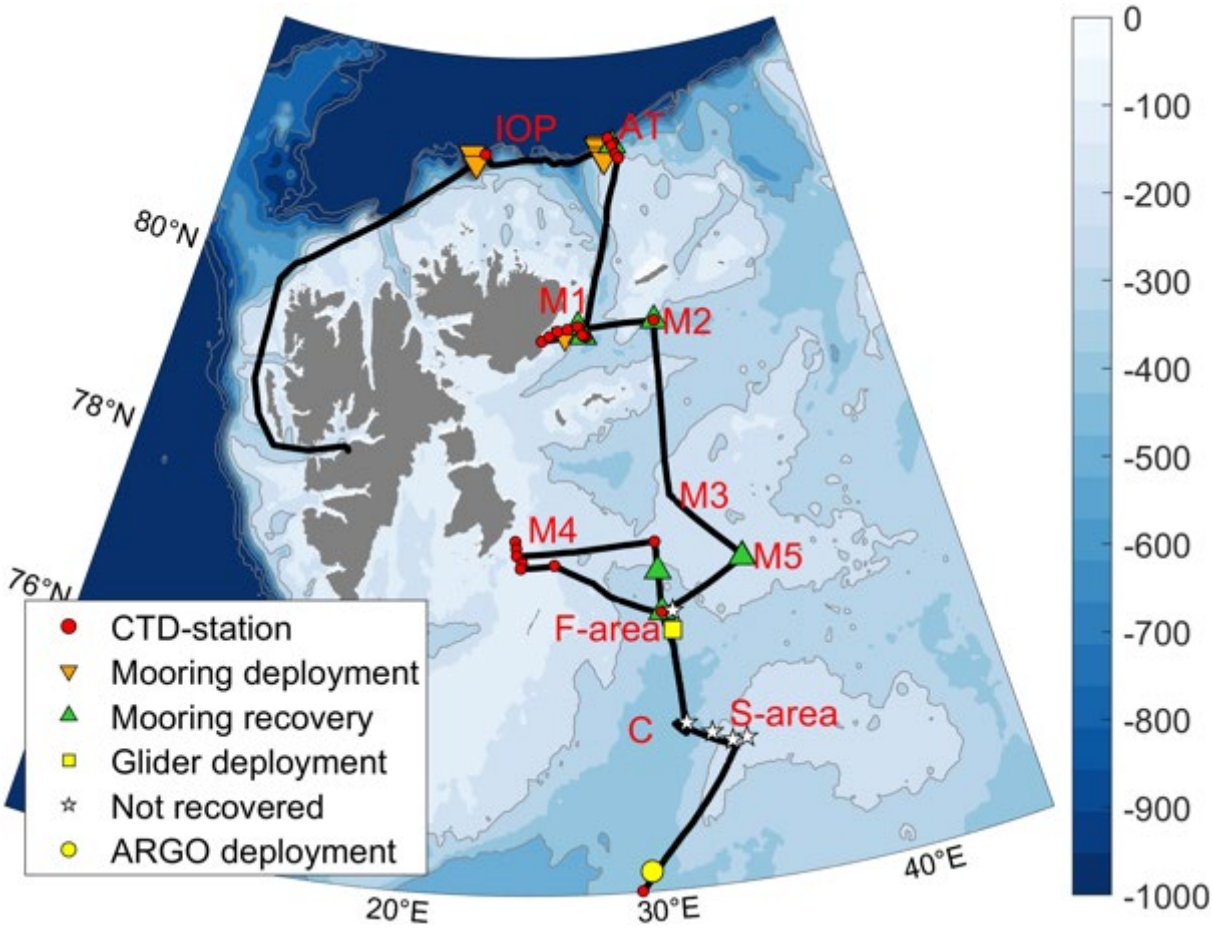

Figure 1. Map of cruise track, mooring operations, glider and Argo float deployments and CTD stations.

3 Activity reports

3.1 Sampling program

Since this cruise was a collaborative effort between different projects, project name and, where relevant, Nansen Legacy sub-task numbers, are given in the tables in the different sub-sections.

3.1.1 Mooring recoveries and deployments

For the Fram Centre A-TWAIN/SIOS-Infranor project, two moorings were recovered and seven (including two for the partner institute IOPAN and one for CNRS-LOCEAN) were successfully deployed over the continental slope north-east of Svalbard. The moorings AT-800-BioAc-1 (A-TWAIN/SIOS) and AT200-5 could not be found and are considered lost.

For the Nansen Legacy project, nine moorings were recovered. Due to the short duration of the cruise only M1 and its neighbour M1-BioAc was redeployed. Moorings M1, M2 and M5 carried instruments also for T2-1.1, T3-2.2, T3-3.2, T3-4.4.
The following NLEG moorings were not recovered: M3, F1, M4-3, F3-2, C, S1, S2, S3-1, and S3-2. The two first were not found, neither on echosounder nor through acoustic pinging, and are considered lost. M4-3 clearly sent and received signals at the deployment location and is assumed to have been turned upside-down by a trawler before this cruise. The previously deployed and similarly upside down lying M4-2 also responded to acoustic pinging. Triangulation was done to confirm precise positions of both M4 bottom landers (Appendix VII) for later recovery. The C- and all S-mooring received and sent signals through acoustic pinging and are assumed to be in their original deployment location. Recovery was not possible due to strong winds and waves that did not allow operations on deck.

Table 1. Mooring recoveries during cruise number 2021713.

Mooring ID	Date	Time [UTC]	Latitude	Longitude	Depth	Project	Mooring info
AT800-6	2021-11-08	11:51	81.5498	30.8968	880	SIOS-IN/ A-TWAIN	ADCPs, CTDs, sea ice, BGC & OA sensors
AT800-BioAc-2	2021-11-08	13:45	81.5507	30.9286	875	INTAROS/ A-TWAIN	Bio-acoustics ADCP
NLEG M1-2-BioAc	2021-11-10	07:40	79.5863	28.0829	256	NLEG	Bio-acoustics ADCP
NLEG M1-3	2021-11-10	08:09	79.5828	28.0591	264	NLEG	ADCPs, CTDs, BGC & OA, sediment trap, sea ice
NLEG M1-b	2021-11-10	12:23	79.5679	28.1138	298	NLEG	BPS and hydrography mooring
NLEG M1-a	2021-11-10	15:37	79.6730	27.8433	102	NLEG	BPS and hydrography mooring
NLEG M2-3	2021-11-11	12:18	79.6720	32.3158	355	NLEG	ADCPs, CTDs, BGC sensors, sea ice
NLEG M5 BioAc	2021-11-12	05:34	77.0825	35.0578	144	NLEG	Bio-acoustics ADCP
NLEG M5	2021-11-12	06:15	77.0747	35.0368	140	NLEG	ADCP and CTDs
NLEG F3-1	2021-11-12	14:40	76.6169	31.0309	277	NLEG	CTDs
NLEG F2	2021-11-12	19:55	77.0488	31.0284	237	NLEG	ADCP and CTDs

Table 2. Mooring deployments during cruise number 2021713.

Mooring ID	Date	Time	Latitude	Longitude	Depth	Project	Mooring info
IOPAS14	2021-11-07	21:04	81.4858	21.9436	860.4	INTAROS	ADCPs, MMP, CTD
CNRS24	2021-11-08	00:51	81.3807	22.2834	496.5	INTAROS	CTDs
IOPAS23	2021-11-09	01:28	81.5758	30.9988	1226	INTAROS /A-TWAIN	ADCP, CTDer, sea ice draft
AT800-7	2021-11-09	11:20	81.5501	30.8777	889	SIOS-IN/ A-TWAIN	ADCPs, CTDs, sea ice, BGC & OA sensors
AT800-BioAc-2-3	2021-11-09	13:51	81.5482	30.8893	872	INTAROS/ A-TWAIN	Bio-acoustics ADCP
AT500-2	2021-11-09	16:38	81.4577	31.0753	488	SIOS-IN/ A-TWAIN	Bottom frame; ADCP, CTD
AT200-6	2021-11-09	19:39	81.4105	31.2433	205	SIOS-IN/ A-TWAIN	ADCPs, CTDs, sea ice
NLEG M1-2-BioAc	2021-11-10	17:29	79.5888	28.0879	259	NLEG	Bio-acoustics ADCP
NLEG M1-4	2021-11-10	20:05	79.5829	28.0717	263	NLEG	ADCPs, CTDs, BGC & OA, sediment trap, sea ice

3.1.2 CTD measurements

A total of 31 CTD profiles were taken (see Appendix III). Some of these were individual profiles at mooring locations while others were transects covering topography near key moorings (NLEG M1, M2, M4, F1, F3, A-TWAIN) or towards Austfonna. CTD profiles 516-523 (evening of 09. Nov) were taken for A-TWAIN, profiles 524-545 for NLEG. For all casts, the big 24-bottle rosette was used and lowered through the moonpool.

An additional CTD cast (#546) was done en route to Tromsø for opportunistic fjord and coastal monitoring (IMR).

The CTD package mounted on the CTD frame was a SBE911plus with the following sensors:

- SBE 3P Temperature sensor, s/n 03-4535 (primary)
- SBE 4C Conductivity sensor, s/n 04-4386 (primary)
- SBE 5T submersible pump, s/n 05-9378 (primary)
- Digiquartz Temperature Compensated Pressure Sensor, s/n 141612
- SBE 3P Temperature sensor, s/n 03-4306 (secondary)
- SBE 4C Conductivity sensor, s/n 04-2799 (secondary)
- SBE 5T submersible pump, s/n 05-9379 (secondary)
- SBE 43 Oxygen sensor, s/n 3774 (primary)
- Benthos Altimeter, s/n 73084
- WET Labs C-Star Transmissometer, s/n CST-2003DR
- WET Labs ECO-AFL/FL Fluorometer, s/n FLRTD-6506
- WET Labs CDOM Fluorometer, s/n FLCDRTC-4885
- Biospherical/Licor PAR/Irradiance sensor, s/n 70736

Temperature, conductivity, and oxygen sensors were factory calibrated in January and February 2020. Data from the ship-mounted SPAR sensor (Biospherical/Licor, s/n 20568) was integrated in the CTD data stream.

The CTD was controlled by the instrument engineers through SBE Seasave software, version 7.26. GPS data (NMEA string) from the ship's navigation system was logged with every scan for later LADCP processing.

During a CTD cast, the CTD package was lowered to 10 m depth for a 1 minute soak before lowering to the bottom. Niskin bottles were fired on the upcast after a 1 minute stop at the desired bottle depth. All CTD sensors worked well throughout the cruise. Offset between primary and secondary T and S sensors were in acceptable range. The oxygen sensor was compared to dissolved oxygen from water samples measured onboard by Winkler titration (see section 3.1.7 Biological and chemical sampling). Error and drift in the sensor profiles was in acceptable range (<5%).

At CTD stations 517 and 526, CTD sensors from recovered moorings were attached to the rosette and lowered with the ship CTD for later calibration of the mooring sensors.

3.1.3 Lowered ADCP measurements

Dual Lowered ADCP measurements were made at all CTD casts; in total 30 dual profiles. Information on individual profiles is given in the cruise Sample Log. These data will be used in T1-1.2 and T1-2.1 for the same profiles as for CTDs (see above) and the remaining ones for A-TWAIN.

Two RD Instrument 300 kHz Workhorse ADCPs and an external battery package were mounted on the CTD rosette (s/n 24472 looking upward; s/n 24474 looking downward). The ADCPs were started and stopped by the instrument engineers using BBTalk on a laptop in the fine electronics workshop before and after each cast. The downward looker was set up as master and the upward looker as slave. The following configurations were used:

Master: `CR1 WM15 RN M0517_ CF11101 EX00100 EZ0011101 TC2 WP1 TB 00:00:01.20 TE 00:00:00.80 TP 00:00.00 WN015 WS0800 WF0000 WV250 LZ30,220 LW1 SM1 SA011 SW05500 SI0 CK T? W? CS`

15 bins with 8 m bin depth, 2.5 m s-1 ambiguity velocity, automatic ping cycling, narrowband, bottom detection.

Slave: `CR1 WM15 RN S0517_ CF11101 EX00100 EZ0011101 TC2 WP1 TB 00:00:01.20 TE 00:00:00.80 TP 00:00.00 WN015 WS0800 WF0000 WV250 LZ30,220 LW1 SM2 SA011 SS0 ST0300 CK T? W? CS`

15 bins with 8 m bin depth, 2.5 m s-1 ambiguity velocity, automatic ping cycling, narrowband

Further information on sensor configuration can be obtained from the IMR instrument engineers.

Processing of the data will take place on land using the latest available version of the LDEA LADCP processing routines.

3.1.4 Sea ice observations

(T1-1.2) Sea ice was first encountered near the IOPAN mooring northeast of Svalbard (thin first-year ice and cake ice). A consolidated ice cover was located just before the IOPAN mooring site, but the ATWAIN site was mostly ice-free. More consolidated ice was found near the M1 area, east of Svalbard. Water temperature was above freezing temperature until the M1 mooring site was reached. Here we encountered a large amount of thin first-year ice, but also slush and pancakes. When the ice was present, opportunistic ship-based sea ice observations were done following the ASSIST setup up to three times a day. Observations of ice concentration, type, thickness, topography, and meteorology were entered directly in the browser-based form. Observations were done to the best ability but were limited by complete darkness and thus limited visibility. The range of visibility was largely dictated by the range of the ship's beams and ambient light from the deck. Sea ice was assessed from the bridge, and photos were taken pointing port, ahead, and starboard. A total of 11 observations were done.

3.1.5 Glider deployment

A glider was deployed to further increase data coverage in the ice-free area near the Polar Front in the central Barents Sea (T1-2.1). The glider, operated by University of Bergen, was assembled, tested and deployed by Algot K. Peterson in collaboration with pilot on land, at University of Bergen. It was deployed 12. Nov 2021 at 13:19 UTC at 78.617 N, 31.033 E.

3.1.6 Argo float deployment

Two Argo floats were deployed by Terje Hovland for the NorArgo project (IMR) on 15. Nov 2021 at 73.7030N, 29.2725E.

3.1.7 Water samples

Salt samples

Salt samples were taken by the IMR instrument engineers from the bottom Niskin at each CTD for calibration of the conductivity sensors on the CTD. The samples will be sent to IMR Bergen for analysis and calculation of a calibration coefficient.

Biological and chemical sampling

T2-1-1: Current variability and drivers of ocean acidification / IMR Ocean Acidification Monitoring / A-TWAIN repeat section

Seawater samples for assessment of ocean acidification state (OA)/ carbonate chemistry (Total Alkalinity (AT) and Dissolved Inorganic Carbon (DIC)), nutrients, and oxygen isotopes ($\delta^{18}O$) were taken from the Niskin bottles mounted on the large 24-bottle CTD rosette at 5-15 depths throughout the water column at X stations, including NL mooring location M1 and stations on the A-TWAIN transect line (Table 3). A total of 103 AT/DIC, 63 $\delta^{18}O$ and 103+79 nutrient samples (following IMR and Nansen Legacy Sampling protocols, respectively) were taken and stored in the cold room, in the fridge or in the freezer.

The CTD was deployed through the moonpool at all stations, which meant that surface/5 m and 10 m samples could not be taken. Due to the problems with the underway system, surface samples could not be obtained from the seawater intake either. The following depths were sampled:

a) shallow stations (up to around 350 m): 20, 30, 40, 50, 60, 90, 120, 150, 200 m and bottom depth. In addition, water from seawater intake was taken to get sample from around 5m depth.
b) deep stations: 20, 30, 60, 90, 120, 150, 200, 300, 500 m and bottom depth.

Samples for carbonate chemistry from the Niskin bottles were taken before any other samples. They were filled into 250ml borosilicate bottles which were rinsed with at least one bottle volume, filled to the rim, and closed with tight plastic screw caps. 50 µl $HgCl_2$ was added after the sampling. Sampling and analysis followed the protocol described in *Nansen Legacy Sampling Protocol version 9, chapter 7.2,* and Dickson et al., 2007. The TA/DIC samples will be shipped to IMR Tromsø for analysis after the cruise.

Oxygen isotopes $\delta^{18}O$ samples were filled into plastic vials, which were rinsed three times and then filled to the rim. The bottles were additionally sealed with parafilm (*Nansen Legacy Sampling Protocol version 9, chapter 7.3)*.

Dissolved oxygen concentration in sea water was analysed on board following the Winkler procedure (Dickson 1995) on four selected stations (see Table 3; 37 samples in total), to estimate the drift of the CTD oxygen sensor.

The average of the offset between the CTD Oxygen and the Winkler method is -3,0%. If the drift is inside ±5%, the oxygen value from the CTD oxygen sensor do not need any correction.

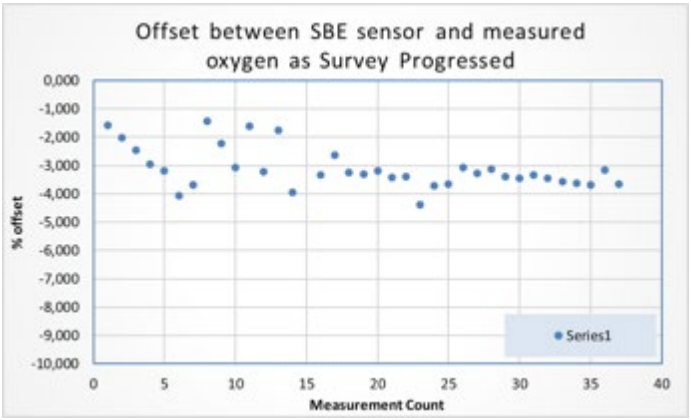

Figure 2: percentage offset between the CTD oxygen sensor and the Dissolved Oxygen concentration determinate by the Winkler method function of the measurement count

Nutrient samples (following IMR sampling protocol/ *Nansen Legacy Sampling Protocol version 9, chapter 7.12*) were filled into plastic vials, which were rinsed three times, and 200 µl Chloroform were added. The samples will be analysed at IMR Bergen. For continuation of the A-TWAIN biological time series and a method comparison, nutrient samples were also taken following UiT sampling protocol at A-TWAIN transect stations and at M1; the samples were stored frozen in 100 ml bottles and will be send to UiT for analysis.

Samples for chlorophyll a total (GF/F filters) and POC/PON (pre-burned GF/F filters; *Nansen Legacy Sampling Protocol version 9, chapters 7.4 and 7.13*) were taken at the A-TWAIN transect for A-TWAIN long-term monitoring, at M1 for NLEG T3.1-2 and at F3-2 for glider sensor calibration (NLEG T1-2.1). 200 ml of water for each sample (three replicates) was filtrated for chl a total and 500ml for POC/PON samples. Filters were stored frozen and will be processed further at UiT.

Table 3: Overview of sampling depths for biological and chemical sampling from the CTD.

Date, time (UTC)	CTD stn #	Station description	Latitude (N)	Longitude (E)	Bottom depth (m)	Sampling depths (db)	Samples taken
07/11/2021, 21:12	516	IOPAS14	81.4853	21.9043	877	869, 500, 300, 200, 120, 60, 11	DO
09/11/2021, 01:55	518	IOPAS14 / ATWAIN transect	81.5723	30.9791	1206	1215, 500, 300, 200, 150, 120, 90, 60, 30, 20	DO, AT/DIC/pH, nutrients (IMR & UiT), chl a, POC/PON
09/11/2021, 04:03	519	ATWAIN transect	81.6100	30.6762	1854	1915, 500, 300, 200, 150, 120, 90, 60, 30, 20	AT/DIC/pH, nutrients (IMR & UiT), chl a, POC/PON
09/11/2021, 06:39	520	ATWAIN transect	81.6318	30.6519	2049	2107, 500, 300, 200, 150, 120, 90, 60, 30, 20	AT/DIC/pH, nutrients (IMR & UiT), chl a, POC/PON, $\delta^{18}O$
09/11/2021, 11:42	521	ATWAIN 800	81.5483	30.8654	880	885, 500, 300, 200, 150, 120, 90, 60, 30, 20	AT/DIC/pH, nutrients (IMR & UiT), chl a, POC/PON
09/11/2021, 15:04	522	ATWAIN 500	81.4577	31.0754	488	478, 300, 200, 150, 120, 90, 60, 30, 20	AT/DIC/pH, nutrients (IMR & UiT), chl a, POC/PON
09/11/2021, 19:48	523	ATWAIN 200	81.4105	31.2373	208	203, 150, 120, 90, 60, 50, 40, 30, 20	AT/DIC/pH, nutrients (IMR & UiT), chl a, POC/PON
10/11/2021, 20:20	530	M1	79.5837	28.0740	263	258, 200, 150, 120, 90, 60, 50, 40, 30, 20	DO, AT/DIC/pH, nutrients (IMR & UiT), chl a, POC/PON, $\delta^{18}O$
10/11/2021, 23:17	531	Glacier front transect	79.5280	25.7198	113	105, 90, 60, 50, 40, 30, 20	AT/DIC/pH, nutrients (IMR), $\delta^{18}O$
11/11/2021, 00:44	532	Glacier front transect	79.5765	26.1682	147	140, 120, 90, 60, 50, 40, 30, 20	AT/DIC/pH, nutrients (IMR), $\delta^{18}O$
11/11/2021, 02:09	533	Glacier front transect	79.6293	26.6477	193	189, 150, 120, 90, 60, 50, 40, 30, 20	AT/DIC/pH, nutrients (IMR), $\delta^{18}O$
11/11/2021, 03:35	534	Glacier front transect	79.6449	27.2240	215	209, 150, 120, 90, 60, 50, 40, 30, 20	AT/DIC/pH, nutrients (IMR), $\delta^{18}O$
12/11/2021	536	Glider deployment at F3-2	76.6173	31.0337	278	274, 200, 150, 120, 90, 60, 50, 40, 30, 20	DO, chl a, POC/PON

3.1.8 Underway sampling

METEOROLOGICAL MEASUREMENTS FROM VAISALA AWS430 WEATHER STATION
Meteorological parameters including air temperature, wind speed and direction, air pressure, and humidity were measured continuously by the Vaisala AWS430 weather station mounted atop the uppermost deck.

THERMOSALINOGRAPH
The sea water intake for underway measurements was opened directly after leaving Longyearbyen, using the intake at 4 m depth. Close to the intake, a SBE38 temperature sensor records the temperature before the water is heated up as it continues towards the Clean Seawater Lab. There, a SBE21 SeaCAT thermosalinograph monitors temperature, salinity, and fluorescence (WET Labs WET star fluorometer). Due to sea ice, the intake had to be closed 08. November. No dedicated log was kept of times of starting and stopping the intake pump, and the record therefore has to be processed carefully. Additional problems occurred due to water leakage in the pump system for the sea water intake and at the thermosalinograph which led to loss of data after 09. November.

OCEAN CURRENT MEASUREMENTS FROM 38KHZ and 150 KHZ VM ADCPs
Vessel mounted ADCPs (38 kHz and 150 kHz) measured continuously from shortly after leaving port until the end of the cruise. Standard configuration was used throughout the cruise:
38 kHz ADCP: `CR1 CB611 WP00000 NP00001 NN128 NS800 NF1600 CX 1,0 BP000 BX17000 ND111100000 TP000300 TE00000300 EZ1020001 EX00000 EA004688 EJ-009 EI001 ED00084 ES35 CK`
(narrowband profiling, 128 bins with 8 m bin depth, 16 m blanking distance, no bottom track, synchronised pinging with K-Sync, transducer misalignment of 46.88 degrees, transducer depth 8.4 m)

150kHz ADCP: `CR1 CB611 WP00000 NP00001 NN065 NS0800 NF0800 CX 1,0 BP000 BX08000 ND111100000 TP000100 TE00000200 EZ1020001 EX00000 EA004642 EJ0008 EI-017 ED00084 ES35 CK`
(narrowband profiling, 65 bins with 08 m bin depth, 8 m blanking distance, no bottom track, synchronised pinging with K-Sync, transducer misalignment of 46.42 degrees, transducer depth 8.4 m)

Final processing of the data will be done after the cruise.

PCO2 MEASUREMENTS
T2.1.1
The underway instrumentation for autonomous high-frequency surface water measurements of partial pressure of CO_2, pCO_2, (General Oceanics), dissolved oxygen (DO) (Aanderaa sensor), salinity, temperature, CDOM and chlorophyll a fluorescence are used to investigate the variability in these parameters in the surface water along the cruise track. The atmospheric CO2 is also measured from the same pCO2 system. The main objectives are 1) estimate the air-sea CO2 flux and the role of polar ocean's CO2 uptake, 2) major drivers of pCO2 variability such as primary production, temperature and influence of freshwater (sea ice, river, glacial runoff). The pCO2 instrument and data contributes to global carbon projects such as the Integrated Carbon Observatory Systems (ICOS) aiming to estimate the ocean's role in the carbon budget and estimates of anthropogenic CO2 uptake.
As described above, the seawater intake was closed during large parts of the cruise due to heavy sea ice, and leakages in the system further reduced data recording.
Annual maintenance and upgrade of the pCO2 system was done toward the end of the cruise by Ceslav Czyz.

POSITION LOG

GPS-based position logs for each day are available through the toktlogger.

3.2 Data set and sample log

All activities and samples were logged and labelled following Nansen Legacy procedures (*Nansen Legacy Sampling Protocol version 9, chapter 2*). The metadata will be published on https://sios-svalbard.org/aen/tools.

3.3 Communication and Outreach

Several posts for the Nansen Legacy blog on forskning.no / sciencenorway.no and social media (Facebook, Instagram, Twitter) were written by the cruise participants and published by the project office. See Appendix VII for an overview of submitted and published posts.

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Dickson, A.G., Sabine, C.L. and Christian, J.R. (eds), 2007: Guide to best practices for ocean CO2 measurement. Sidney, British Columbia, North Pacific Marine Science Organization, 191pp. (PICES Special Publication 3; IOCCP Report 8).

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Appendix I: List of participants

Name	Institute	Task
Angelika Renner	IMR	Cruise leader/oceanography
Arild Sundfjord	NPI	Cruise leader/oceanography
Kristen Fossan	NPI	Mooring engineer
Ceslav Czyz	NPI	Mooring engineer
Morven Muilwijk	NPI	Oceanography, sea ice observations
Terje Hovland	IMR	Mooring engineer
Claire Mourgues	IMR	Water/chemical samples/chemical sensors
Marcos Porcires	UNIS	Mooring engineer
Kjersti Kalhagen	UNIS	NLEG PhD fellow, oceanography
Frank Nilsen	UNIS	Oceanography
Algot K. Peterson	UiB	Mooring engineer
Agnieszka Beszczynska-Möller	IOPAN	Oceanography, mooring operations
Piotr Wieczorek	IOPAN	Mooring engineer
Clement Bensimon	Seatech/IMR	MSc student, water sampling
Clea Pavillon	Seatech/IMR	MSc student, water sampling

Appendix II: Cruise program

Cruise timeline - for more details please refer to Sample log. All times in UTC.

06 Nov

Started loading at 0730, left port at 1330

Steaming north, mooring preparations

07 Nov

Steaming to 22E, preparing instruments

Meetings to plan mooring operations

Encountered first sea ice at approx. 81° 20N, 20° 48E; pretty thin, snow-covered grey ice

Deployed IOPAS14, CTD w/water samples – in open water surrounded by sea ice

08 Nov

Deployed CNRS24 – in open water surrounded by sea ice

Steaming to 31 E

Recovery of AT800-5 and AT800-BioAc (ATWAIN/INTAROS) in 16m/s northerly wind, snow and sea fog

Searched for ATWAIN/SIOS BioAc; no response through acoustic pinging, potentially weak sign of the releaser on the EK80 but very uncertain. Likely lost

Searched for AT-200-5; no sign on echo sounder or through releaser system; considered lost

09 Nov

Deployment of IOPAS23 at night, in open water just off the ice edge

CTD transect from N to S over slope

Deployment of AT800-6, AT800-BioAc-2-2, AT500-2 and AT200-6, followed by CTDs w/water samples at each site

Steaming to M1 area

10 Nov

CTD at M1 main site

Recovery of NLEG M1-2-BioAc, M1-3, M1-b, M1-a

Up-slope CTD transect in-between recovery operations with lots of pancake ice

Deployment of NLEG M1-3-BioAc and M1-4

CTD at M1 site w/water samples

CTD transect towards glacier front during night and morning

Steaming to M2 area

11 Nov

Steaming to M2

CTD at M2

Recovered M2-3 in newly frozen pancake slush – KPH had to clear a recovery hole first; still windy, drifting at ~1knot during mooring recovery

Steaming to M3, leaving the ice

12 Nov

M3 not found on echosounder or through acoustic pinging; considered lost

Steaming to M5 area

Recovered M5-BioAc and M5; surrounded by birds

Steaming to F3

Glider deployment in windy and wavey conditions, followed by CTD w/water samples

Recovered F3-1; F3-2 was seen on echosounder but did not respond to acoustics

Recovered F2

Searched for F1 – not found on echosounder, no response to acoustic pinging; considered lost

13 Nov

Steaming to M4

M4 responded to acoustic pinging and release but did not surface. Assumed to be turned upside-down by trawler. Triangulated accurately for future ROV recovery.

N-S CTD transect at M4

Steaming for F3-2 second attempt with different releaser number & codes

14 Nov

Successful acoustic pinging for F3-2 (through the moonpool), but no recovery due to weather; 21m/s wind with gusts, no work on deck possible

Steaming to C and S moorings; successful pinging of all of the C and S moorings through moonpool, but wind (30 knots), waves (~6m) and snow showers not cooperative

Decision to return to Tromsø made at 23:00 when wind picked up again and sufficient weather improvement for mooring operations could not be expected before turning around was necessary to arrive in Tromsø on the agreed time.

15 Nov

Argo deployments followed by CTD during a short weather window.

Steaming to Tromsø through the next low pressure system with strong headwinds.

16 Nov

Steaming to Tromsø

Opportunistic CTD at Kvænangen for fjord and coastal monitoring

Arrived in Tromsø at 20:00

Appendix III: CTD stations

Date	Time (UTC)	Latitude (N)	Longitude (E)	Bottom depth (m)	Ship CTD station number	Comments
07/11/21	21:12	81.4853	21.9043	877	516	At IOPAS14
08/11/21	17:21	81.4133	31.2370	208	517	At AT-200
09/11/21	01:55	81.5723	30.9791	1206	518	At IOPAS23
09/11/21	04:03	81.6100	30.6762	1854	519	ATWAIN transect
09/11/21	06:39	81.6318	30.6519	2049	520	ATWAIN transect
09/11/21	11:42	81.5483	30.8654	880	521	At AT-800-6
09/11/2021	15:04	81.4577	31.0754	488	522	At AT-500-2
09/11/2021	19:48	81.4105	31.2373	208	523	At AT-200-6
10/11/2021	06:47	79.5886	28.0892	262	524	At M1-3
10/11/2021	09:20	79.5601	28.2861	320	525	M1 transect
10/11/2021	10:03	79.5694	28.1593	306	526	At M1b
10/11/2021	12:51	79.5886	28.0891	258	527	M1 transect
10/11/2021	13:57	79.6480	27.9672	141	528	M1 transect
10/11/2021	14:41	79.6736	27.8343	98	529	At M1a
10/11/2021	20:20	79.5837	28.0740	263	530	At M1-4
10/11/2021	23:17	79.5280	25.7198	114	531	Glacier front transect
11/11/2021	00:44	79.5765	26.1682	148	532	Glacier front transect
11/11/2021	02:09	79.6293	26.6477	193	533	Glacier front transect
11/11/2021	03:35	79.6449	27.2240	215	534	Glacier front transect
11/11/2021	09:37	79.6772	32.3101	355	535	At M2-3
12/11/2021	13:27	76.6173	31.0337	278	536	At F3
12/11/2021	22:33	77.3592	31.0270	194	537	At F1
13/11/2021	09:24	77.2686	24.4079	68	538	At M4
13/11/2021	13:33	77.4198	24.3262	46	539	M4 transect
13/11/2021	14:35	77.3448	24.3764	62	540	M4 transect
13/11/2021	15:29	77.2688	24.4024	72	541	M4 transect
13/11/2021	16:28	77.1963	24.6511	72	542	M4 transect
13/11/2021	17:15	77.1346	24.5915	64	543	M4 transect
13/11/2021	19:49	77.1668	26.1832	109	544	M4 transect
15/11/2021	10:26	73.7067	29.2666	373	545	At Argo deployment
16/11/2021	14:50	70.1702	21.0676	351	546	Kvænangen

Appendix IV: Recovered Nansen Legacy and A-TWAIN moorings

Rigg ATWAIN800-6 81 33,000N
Satt ut 27.09.20 , kl 14:40 030 52,761E

			Dyp:	Fra bunn:	Ned i vann:
Signature 250 m batteri SNR			30	850	15:13
2 glasskuler					
SEAPHOX	SNR. PHS2035		38	842	15:13
IXUS	SNR.		41	839	15:13
5 m Kevlar					
RBR Concerto+cl+par	SNR. 66091		45	835	15:13
0,5 m Kjetting Galv.					
50 m Kevlar					
4 glasskuler			97	783	15:13
0,5 m Kjetting Galv.					
RBR Concerto	SNR. 60594		99	781	15:05
100 m Kevlar					
RBR Concerto	SNR. 60597		151	729	15:03
RBR Concerto	SNR.60598		201	679	15:03
0,5 m Kjetting Galv.					
50 + 50(51)m Kevlar					
RBR Concerto	SNR.60596		302	578	15:00
ADCP150	SNR: 24636		304	576	15:00
1 m Kjetting Galv.					
100 (102) m Kevlar					
RBR Solo	SNR.102491		408	472	14:52
200 (207)m Kevlar					
RBR Solo	SNR.102489		615	265	14:48
50(51) m Kevlar					
100+100(104) m Kevlar					
RBR Concerto	SNR.204987		867	13	14:42
SBE37/SEAFET	SNR. 2004				
4 Glasskuler					
4 m Kjetting Galv.					
Svivel					
AR861B2S	SNR. 2426	Arm: 1BDF Release: 1B55			
5 m Kevlar					
2 m Kjetting					
ANKER 1000 kg			880	0	

Mooring AT800-6

Institute of Marine Research
Mooring Instruments

Ship plat orm:	KPH		
Stat on name:	Atwain-Ateros-BIOAC-02		
Lat tude:	N 81° 32.892	Longitude:	E 30°53.358
Bot om depth [m]	872m	Total height [m]	
Outgoing date:	09.NOV.2021	Outgoing t me:	13:51utc
Incoming date:		Incoming t me:	

Argos		S/N:	154
PTTID:	29532	Hex:	
Acoust c Release Ixblue			
Type:	R5	S/N:	21350036
Bat type:	Alk. original	Bat exp:	Aprox. june2025
Range code:	3525	Release code:	3555

Comments for deployment operat ons:

Instrument start 10.11.21 kl12utc

Comments for recovery operat ons:

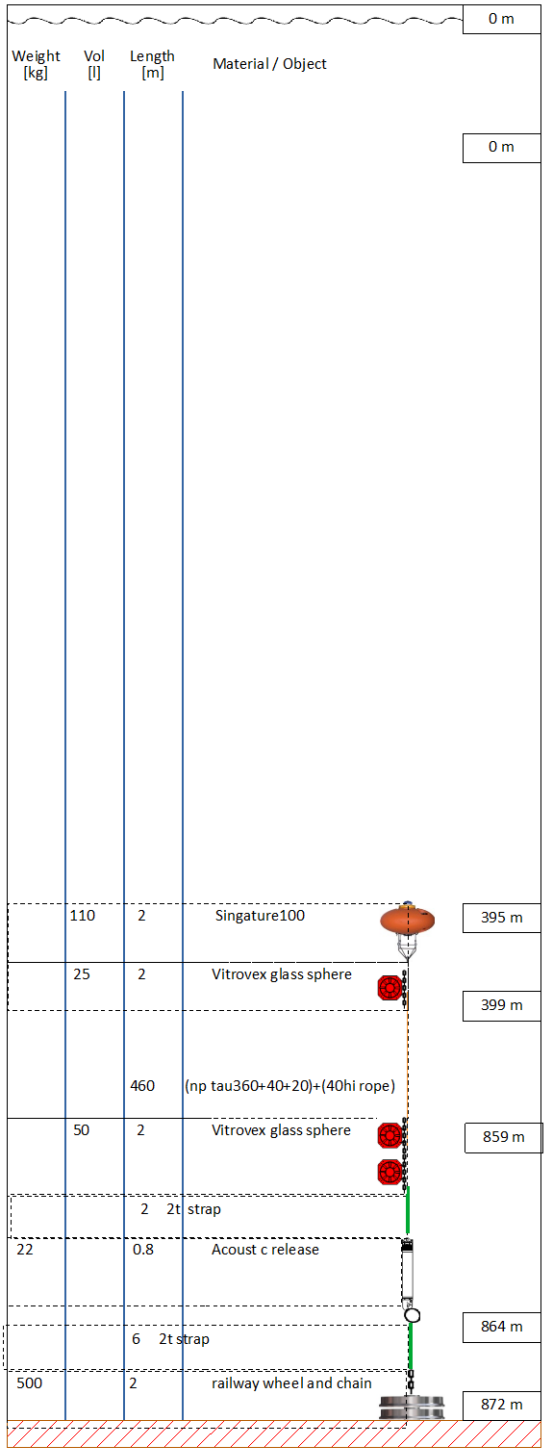
All rope from NP should be change out with 200+200m
Blinking light start blinking approx 10min af er surfacing
Bat ery on release must be changed next recovery

Instruments / sensors					
#	Brand	Type	S/N	Depth	Comment
1	Nortek	Signature 100	101598	395	2års utset
2	Novatech	Blinkelys	F10-061	395	New bat
3	SIS	ArgoTx	154	395	New saf LS20
4	t				
5	t				
6	t				
7	t				

Instruments conf g info					
#	Type/sn	Ping/ Time/cell	Record interval	Bat ery info	Comment
1	Sig100adcp	180s/10m	2t	lithium	2xlithium
2	Sig100echo		20sek		400m range
3	t				
4	t				
5	t				
6	t				

Rigging parts		
#	Type	Qty
1	Shackle galvanized steel	
2	Shackle stainless steel 3.25 T	
3	Kevlar tau	
4	Strope	
5	Ring (plast c/metal)	
6	Strope	
7	Ring (plast c/metal)	

Responsible for deployment or recovery operat ons:



Mooring AT800-BioAc-2 (ATWAIN/INTAROS BioAc; same setup as outgoing)

Institute of Marine Research
Mooring Instruments

Ship plat orm:	KPH		
Stat on name:	M1-BIOAC		
Lat tude:	N 79° 35.178	Longitude:	E 28° 24.974
Bot om depth [m]	265	Total height [m]	
Outgoing date:	10.11.21	Outgoing t me:	07:40utc
Incoming date:		Incoming t me:	

Argos		S/N:	181
PTTID:	1577	Hex:	
Acoust c Release Ixblue			
Type:	R5	S/N:	21350035
Bat type:	Alk. original	Bat exp:	Approx june2025
Range code:	3524	Release code:	3555

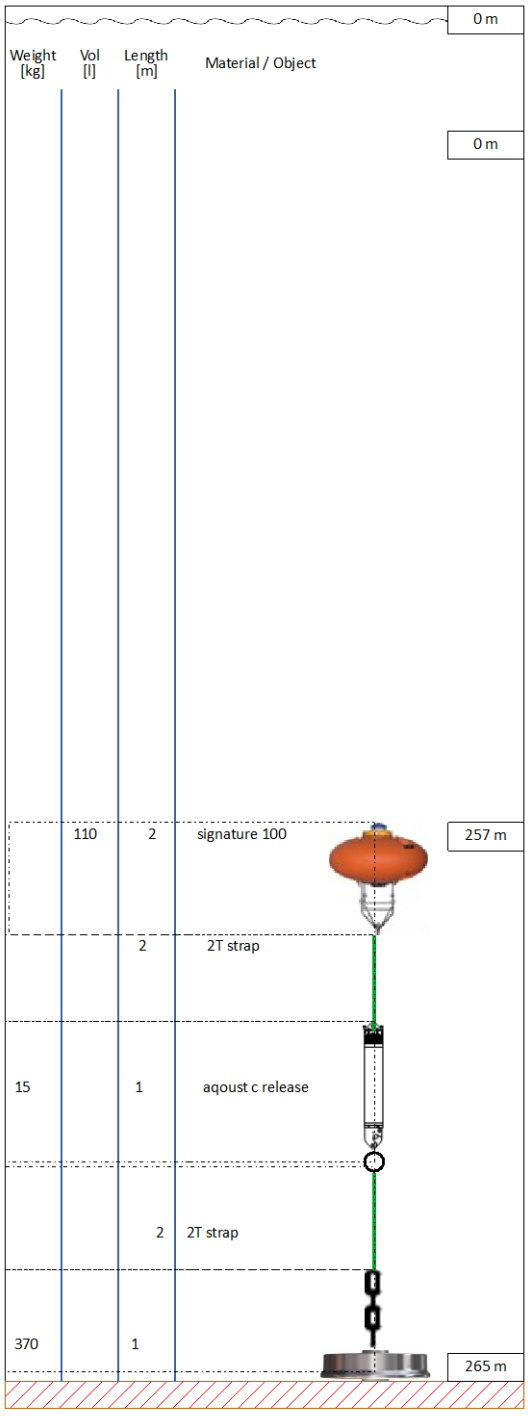
Comments for deployment operat ons:
Start recording 11novkl1800utc
Comments for recovery operat ons:
Bat ery on next release must be changed af er next recovery

Instruments / sensors					
#	Brand	Type	S/N	Depth	Comment
1	Nortek	Signature 100	101764	244	2års utset
2	Novatech	Blinkelys	F10-062	244	New bat
3	SIS	ArgoTx	181	244	New saf LS20
4	t				
5	t				
6	t				
7	t				

Instruments conf g info					
#	Type/sn	Ping/ Time/cell	Record interval	Bat ery info	Comment
1	Sig100adcp	180s/10m	2t	lithium	2xlithium
2	Sig100echo		20sek		400m range
3	t				
4	t				
5	t				
6	t				

Rigging parts		
#	Type	Qty
1	Shackle galvanized steel	
2	Shackle stainless steel 3.25 T	
3	Kevlar tau	
4	Strope	
5	Ring (plast c/metal)	
6	Strope	
7	Ring (plast c/metal)	

Responsible for deployment or recovery operat ons:

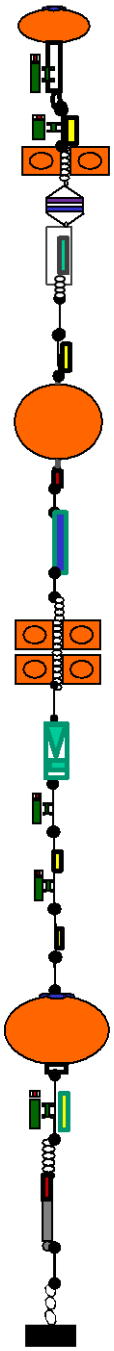


Mooring NLEG M1-2-BioAc (same setup as outgoing)

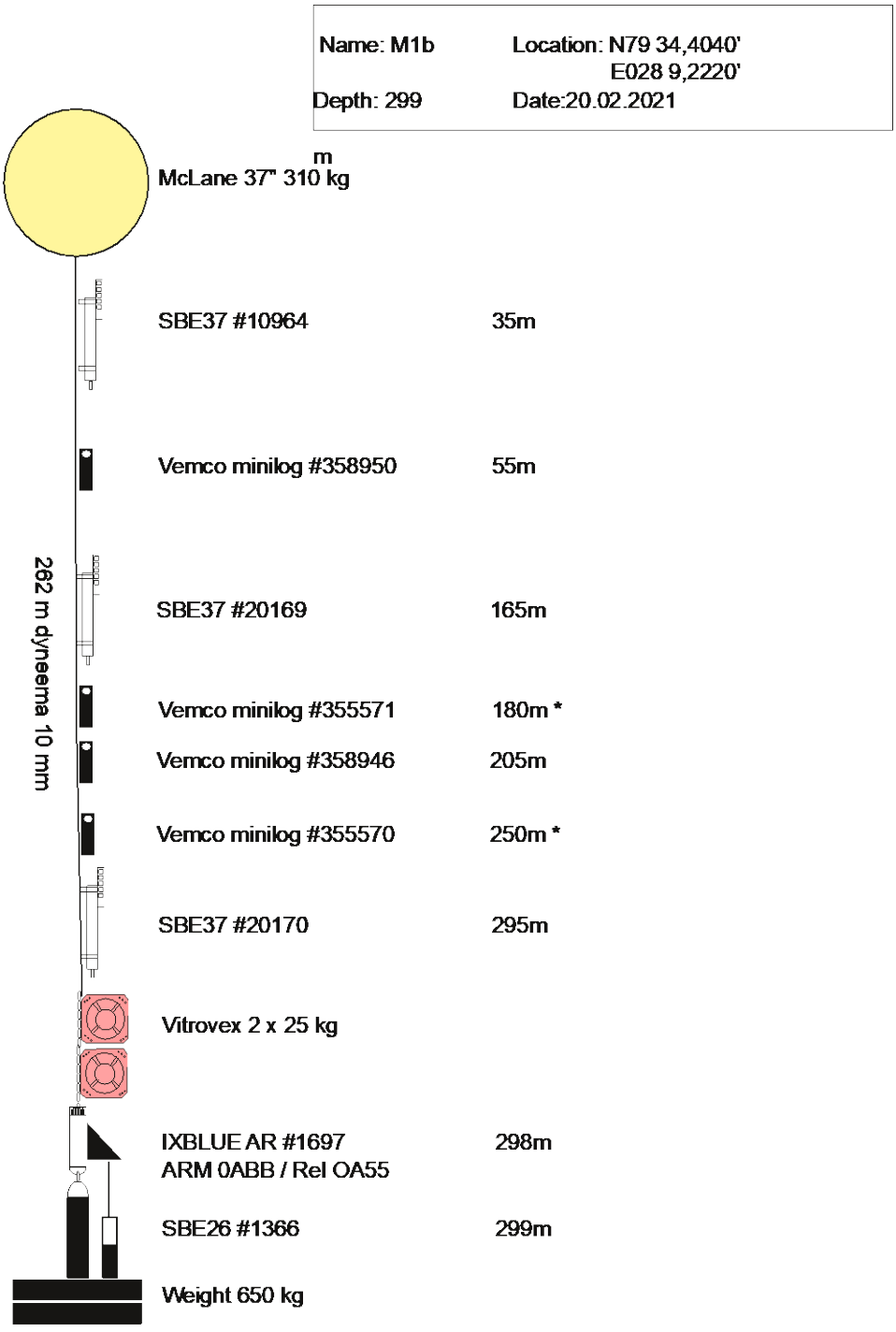
Rigg M1-3

Satt ut 20 .FEB .2021 , kl 19:00:

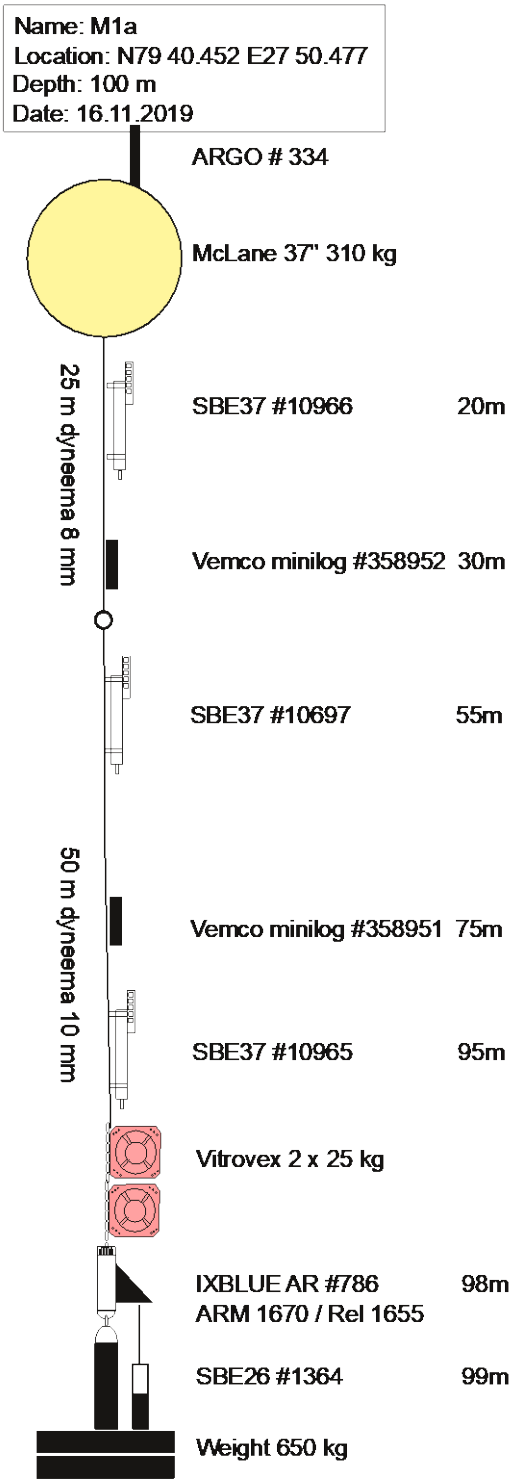
79 35.034 N
028 03.937 E



		Dyp:	Fra bunn:	Ut:
Nortek S500	SNR. 812	19	233	20:00
RBR Concerto	NR.201415	20	232	
SeaFET 2033, uCAT 22418		22	230	
2 Glasskuler i 1 m Kjetting galv.				
Sedimenteksperiment Nadjejda Espinel		24	228	
Concerto 204985 + ECO 5804		25	227	
0,5 m Kjetting galv.				
20 m Kevlar				
10 m Kevlar				
RBR SoloT	SNR. 102949	55	197	
HF36		56	196	
Svivel				
2 m Kevlar				
Aural Hvallyd	SNR. 288	60	192	
2 m Kjetting galv				
1 m Kjetting galv.				
4 Glasskuler i 2 m Kjetting galv.				
0,5 m Kjetting galv.				
20 m Kevlar				
McLane Sedim.	SNR. 14449-02	88	164	
RBR Concerto	SNR. 204982	89	163	
50 (51) m Kevlar				
RBR SOLO	SNR. 102490	149	113	
20 (21) + 10 m Kevlar				
RBR Concerto	SNR. 204979			
40 (41) m Kevlar		170	82	
RBR SOLO	SNR. 102476	209	43	
20 + 10 (11) m Kevlar				
ADCP150	SNR. 16493	240	12	
2 m Kevlar				
SeaPhox	SNR. 20172/2004	241	11	19:00
RBR Concerto	SNR. 204986			
	242	10	19:05	
AR861B2S	SNR. 2632	Ping on:	2B47	
		Release:	2B55	
2 m Kjetting.		Arm:	2BEB	
2 m Kjetting galv.				
ANKER	700/(600)kg	252	0	



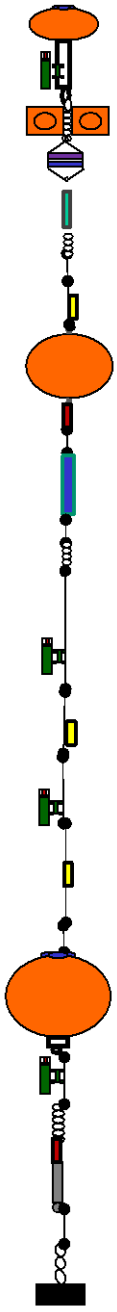
Mooring NLEG M1-b



Mooring NLEG M1-a

Rigg M2-3 79 40.536 N

Satt ut 24.SEP 2020, kl 13:00 032 18.884 E



			Dyp:	Fra bunn:	Ut:
Nortek S500	SNR. 809		30	330	13:18
RBR Concerto	NR.60599		30	330	13:18
2 Glasskuler i 1 m Kjetting galv.					
ISUS	NR.232		32	328	13:14
RBR Concerto+cl+par66090			33	327	13:08
0,5 m Kjetting galv.					
20 m Kevlar					
10 m Kevlar					
RBR SoloT	SNR. 102485		63	297	13:06
HF36			64	296	
Svivel					
2 m Kevlar					
Aural Hvallyd	SNR.		67	293	13:04
2 m Kevlar					
0,5 m Kjetting galv.					
40 (41)m Kevlar					
RBR Concerto	SNR. 60601		95	265	12:53
100 (104) m Kevlar					
RBR SOLO	SNR. 102483		165	195	12:51
RBR Concerto	SNR. 60593		215	145	12:49
100 (107) m Kevlar					
RBR SOLO	SNR. 102479		277	83	12:46
20 m Kevlar					
ADCP150	SNR. 24637		347	13	12:42
RBR Concerto	SNR. 60590		350	10	12:42
AR861B2S	SNR. 2425	Ping on:	1B47		
		Release:	1B55		
5 m Kevlar.		Arm:	1BDE		
2 m Kjetting galv.					
ANKER	760/(670)kg		360	0	

Mooring M2-3

Institute of Marine Research

Data Record Book for Mooring Instruments

Ship:KPH
Location: M5-BIOAC
Latitude: N 77° 04.947
Longitude: E 035° 03.47

Instruments / Sensors

#	Brand	Type	Serial No.	Depth	Comments
1	Nortek	Signature 100	101121		
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					

Bottom depth: 144 m
Outgoing date: 2020.10.12
Outgoing time (UTC): 22:52
Incoming date: 2021.11.12
Incoming time (UTC): 05:34

Comments:

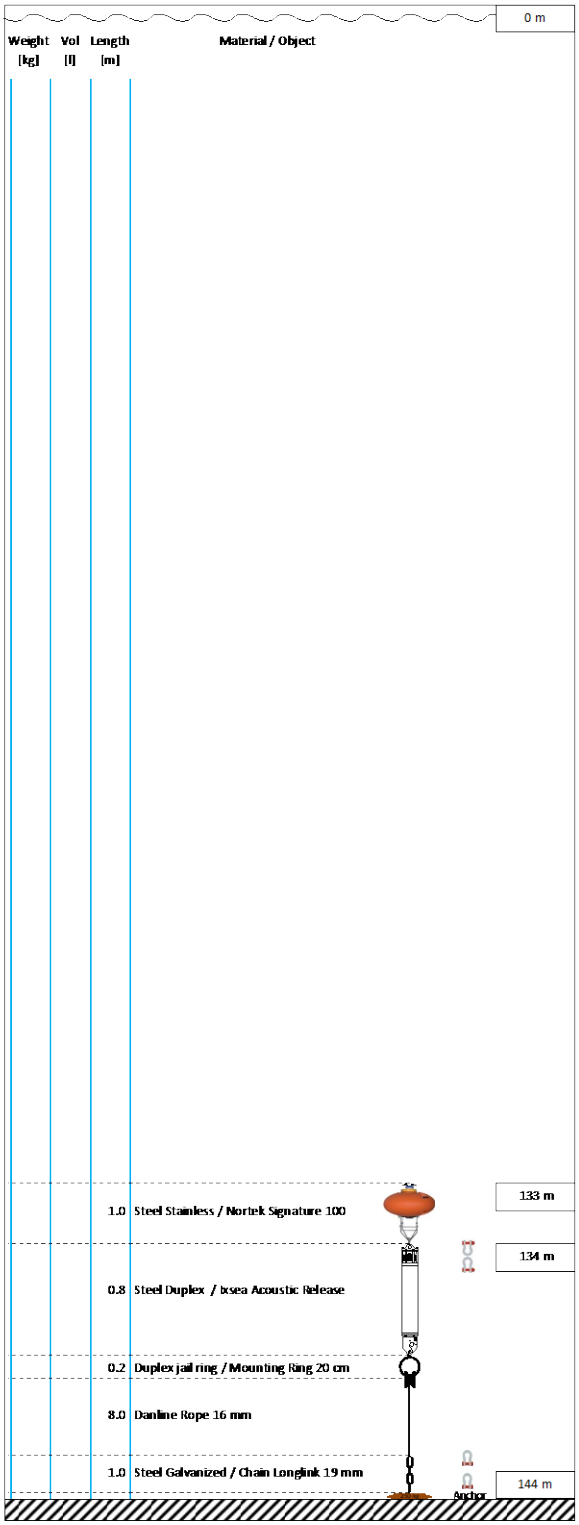
Responsible: Terje Hovland

ARGOS
PTTID:

Acoustic release: IXSEA ARX61
Serial no: 2123 Battery expire: 2024.01.19
Range code: 0BAA
Release code: 0B55

Station Name M5-BIOAC		
Sum weight (incl. anchor):	[kg]	
Sum weight (excl. anchor):	[kg]	
Sum volume:	[l]	
Buoyancy (anchor on):	[kg]	
Buoyancy (anchor off):	[kg]	
Shackle Stainless Steel		
Shackle Galvanized Steel		
Thimble Stainless Steel		
Thimble Galvanized Steel		
Thimble Nylon		

Equipment		
Description	Spec.	No.
Shackle Stainless Steel		
Shackle Stainless Steel	2.50	
Shackle Galvanized Steel	0.50	
Shackle Galvanized Steel	2.00	1
Shackle Galvanized Steel	3.25	4
Shackle Galvanized Steel	4.75	
Shackle Galvanized Steel	6.50	
Thimble Stainless Steel		
Thimble Stainless Steel		
Thimble Galvanized Steel		
Thimble Galvanized Steel		
Thimble Galvanized Steel		
Thimble Nylon		



Mooring M5 BioAc

Institute of Marine Research

Data Record Book for Mooring Instruments

Ship: KPH
Location: M5
Latitude: N 77° 04.48
Longitude: E 035° 02.208

Instruments / Sensors					
#	Brand	Type	Serial No.	Depth	Comments
1	Sea Bird	SBE 37-SMP	37-20354	47	With exhaust plumbing new batt
2		SeapHOx pH	PHS-2068		Max 50 m
3	Sea Bird	SBE 37-SMP	37-20179	126	New batt
4	Nortek	Signature 250	100562	127	Lith.Batt
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Bottom depth: 140 m
Outgoing date: 2020.10.13
Outgoing time (UTC): 00:19
Incoming date: 2021.11.12
Incoming time (UTC): 0615

Comments:

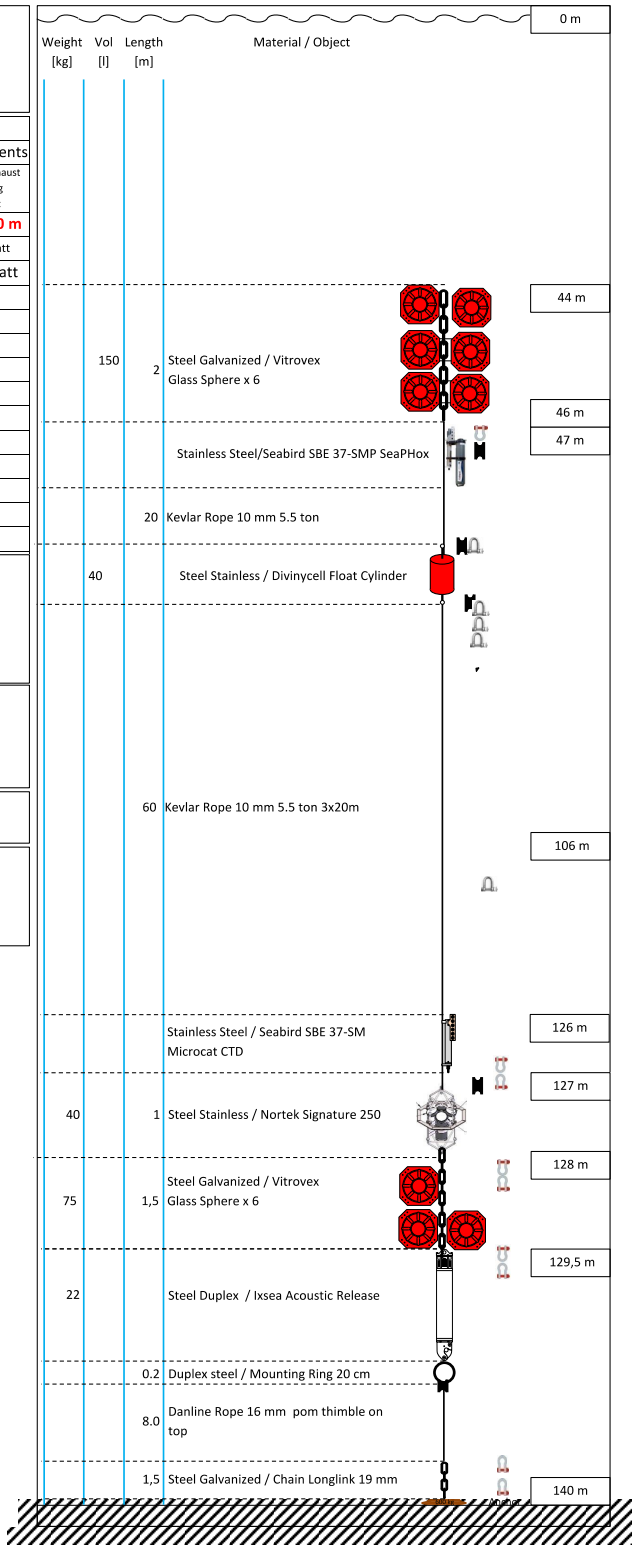
Responsible: Terje Hovland

ARGOS
PTTID:

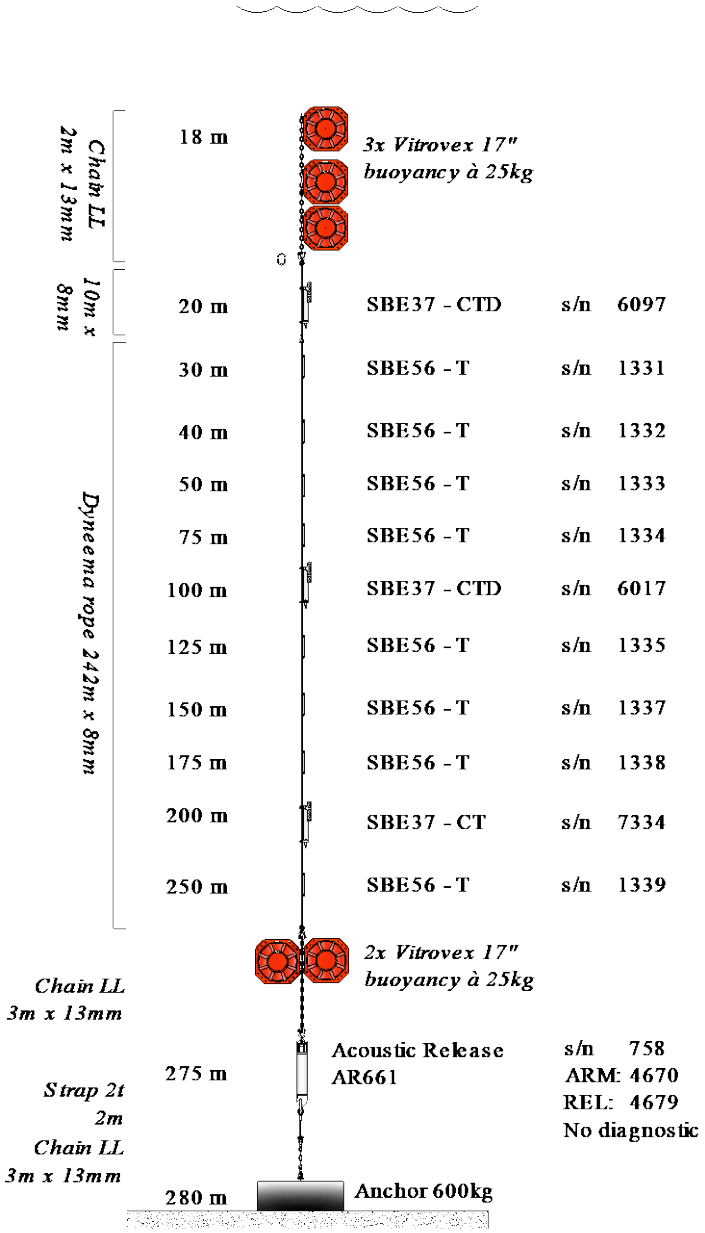
Acoustic release: IXSEA ARX61
Serial no: 300 Battery expire: 2028.03.23
Range code: 1420
Release code: 1455

tation Name	M5	
Sum weight (incl. anchor):	[kg]	
Sum weight (excl. anchor):	[kg]	
Sum volume:	[l]	
Buoyancy (anchor on):	[kg]	
Buoyancy (anchor off):	[kg]	
Shackle Stainless Steel		
Shackle Galvanized Steel		
Thimble Stainless Steel		
Thimble Galvanized Steel		
Thimble Nylon		

Equipment		
Description	Spec.	No.
Shackle Stainless Steel		
Shackle Stainless Steel	2.50	7
Shackle Galvanized Steel	0.50	
Shackle Galvanized Steel	2.00	
Shackle Galvanized Steel	3.25	11
Shackle Galvanized Steel	4.75	
Shackle Galvanized Steel	6.50	
Thimble Stainless Steel		
Thimble Stainless Steel		
Thimble Galvanized Steel		
Thimble Galvanized Steel		
Thimble Galvanized Steel		
Thimble Nylon		6



Mooring M5



UNIVERSITETET I BERGEN
Geofysisk Institutt

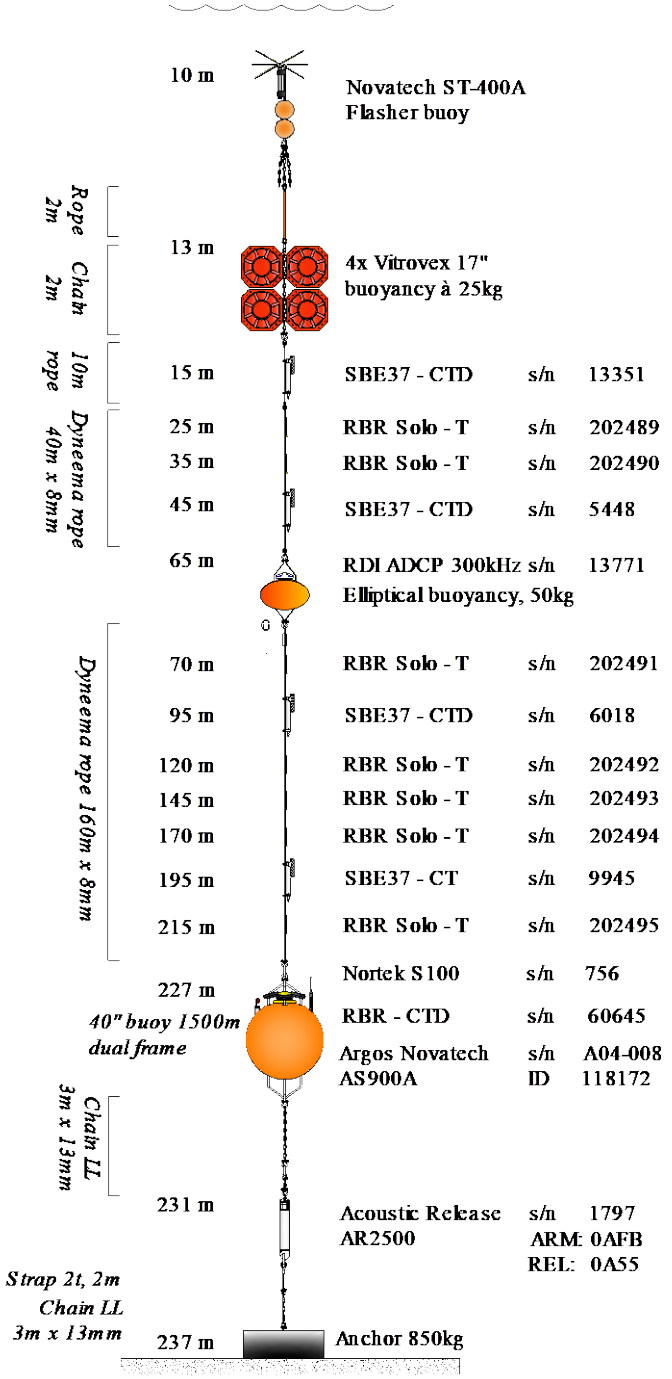
Mooring name: **F3-1**

Project:	Arven etter Nansen
Location:	Barents sea
Position:	Lat 76° 37.012' N
	Lon 31° 01.854' E
Depth:	277 m
Deployed:	2020.10.10 16:50 UTC
	G O Sars
Recover:	2021

Notes:

Latest update: 17/10/2020

Mooring NLEG F3-1



UNIVERSITETET I BERGEN
Geofysisk Institutt

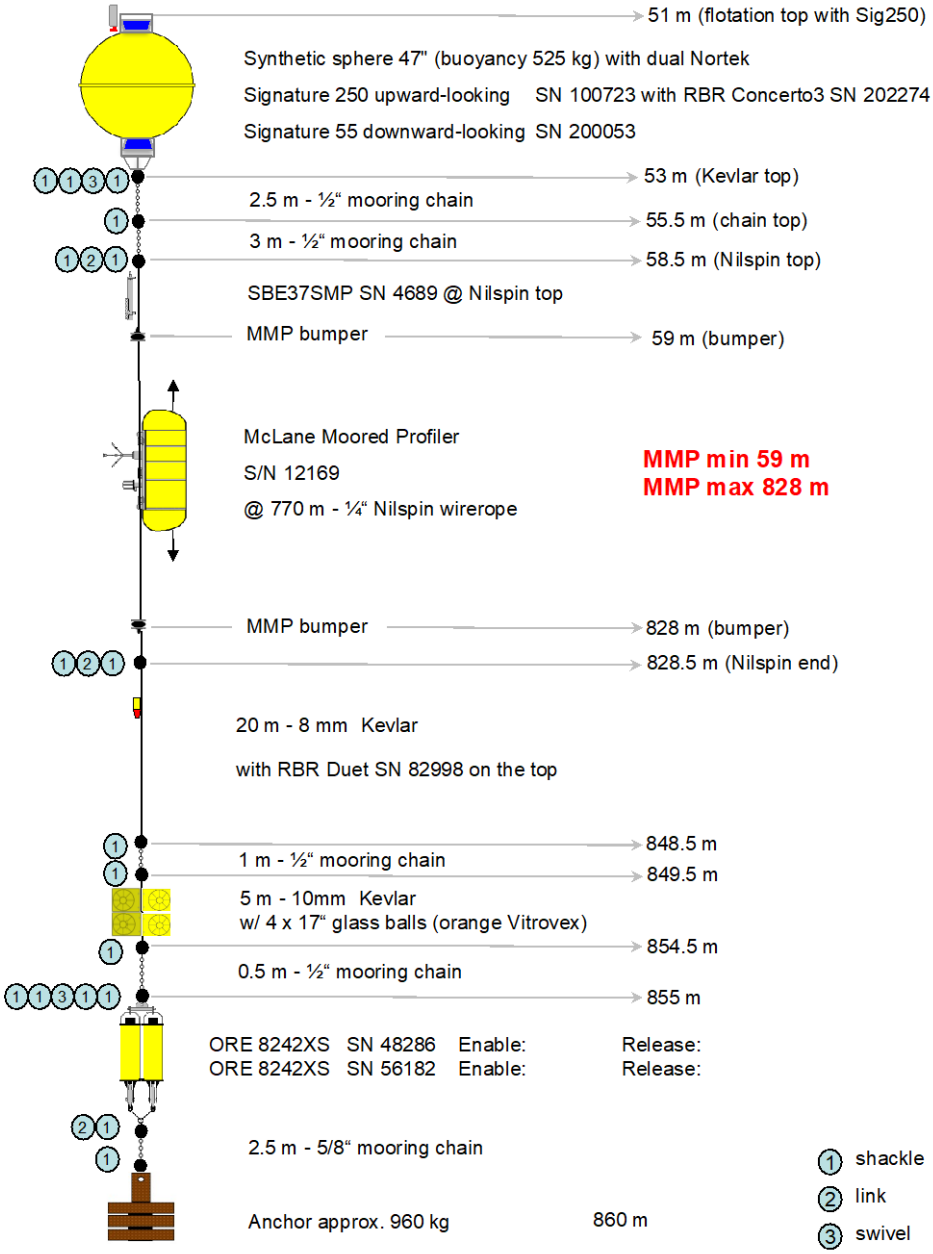
Mooring name: **F2**

Project:	Arven etter Nansen
Location:	Barents sea
Position:	Lat 77° 02.925' N
	Lon 31° 01.706' E
Depth:	237 m
Deployed:	2020.10.10
	G O Sars
Recover:	2021
Notes:	
Latest update:	17/10/2020

Mooring NLEG F2

Appendix V: Deployed Nansen Legacy and A-TWAIN moorings

Mooring ID	**IOPAS14**	Latitude	81° 29.148'N
Deployed	07.11.2021 21:02 UTC	Longitude	021° 56.616'E
Release method: lowered to bottom and released with release at about 50m working rope length		Water depth	860 m



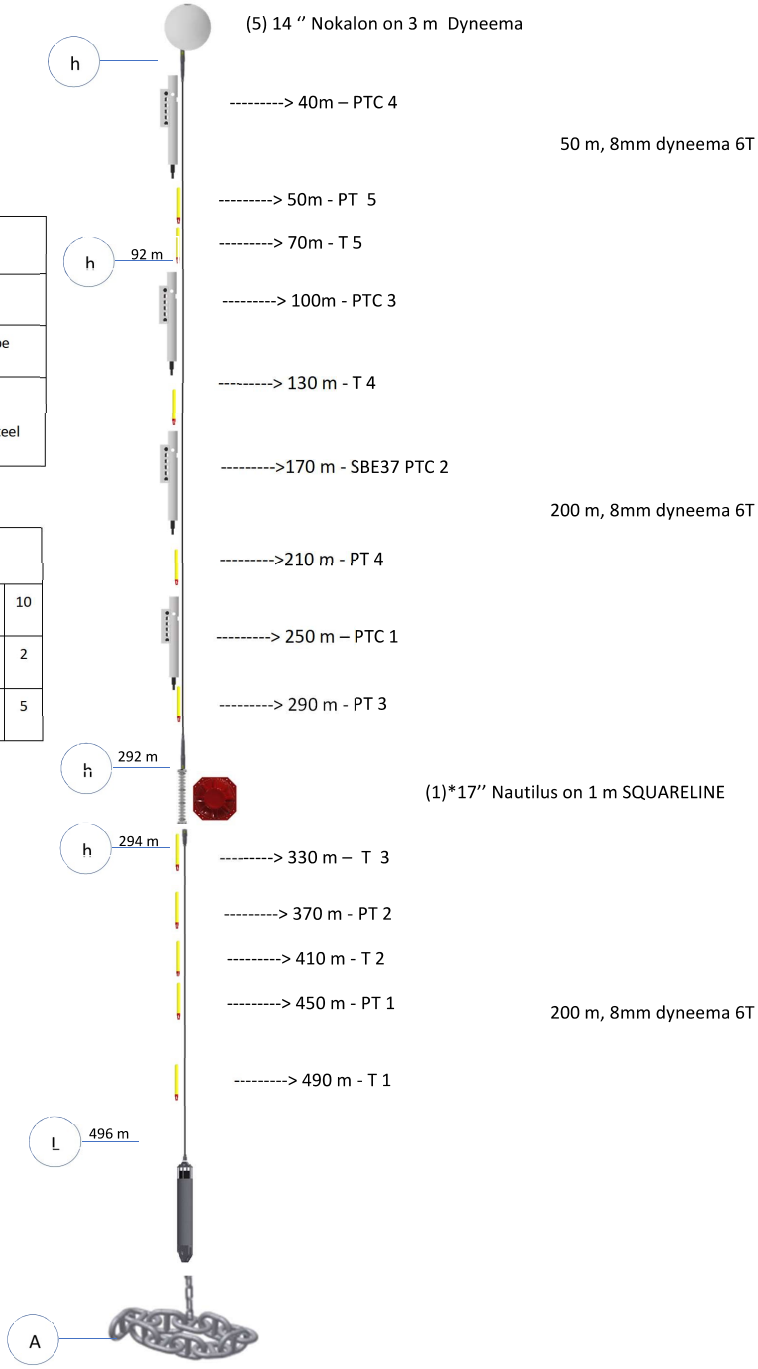
Mooring IOPAS14

INTAROS 2021 – Labaste Matthieu

I) Mooring design

Hardware description	
h	(1) 5/8''SL - (2) 1/2'' SH
A	350 Kg anchor (1) 5/8 ''SH (1) 2 m rope
L	(2) 1/2'' SH (1) 5/8''SL (1) 1 m rope (1) 1 SH in stainless steel 1 SH galvanised steel

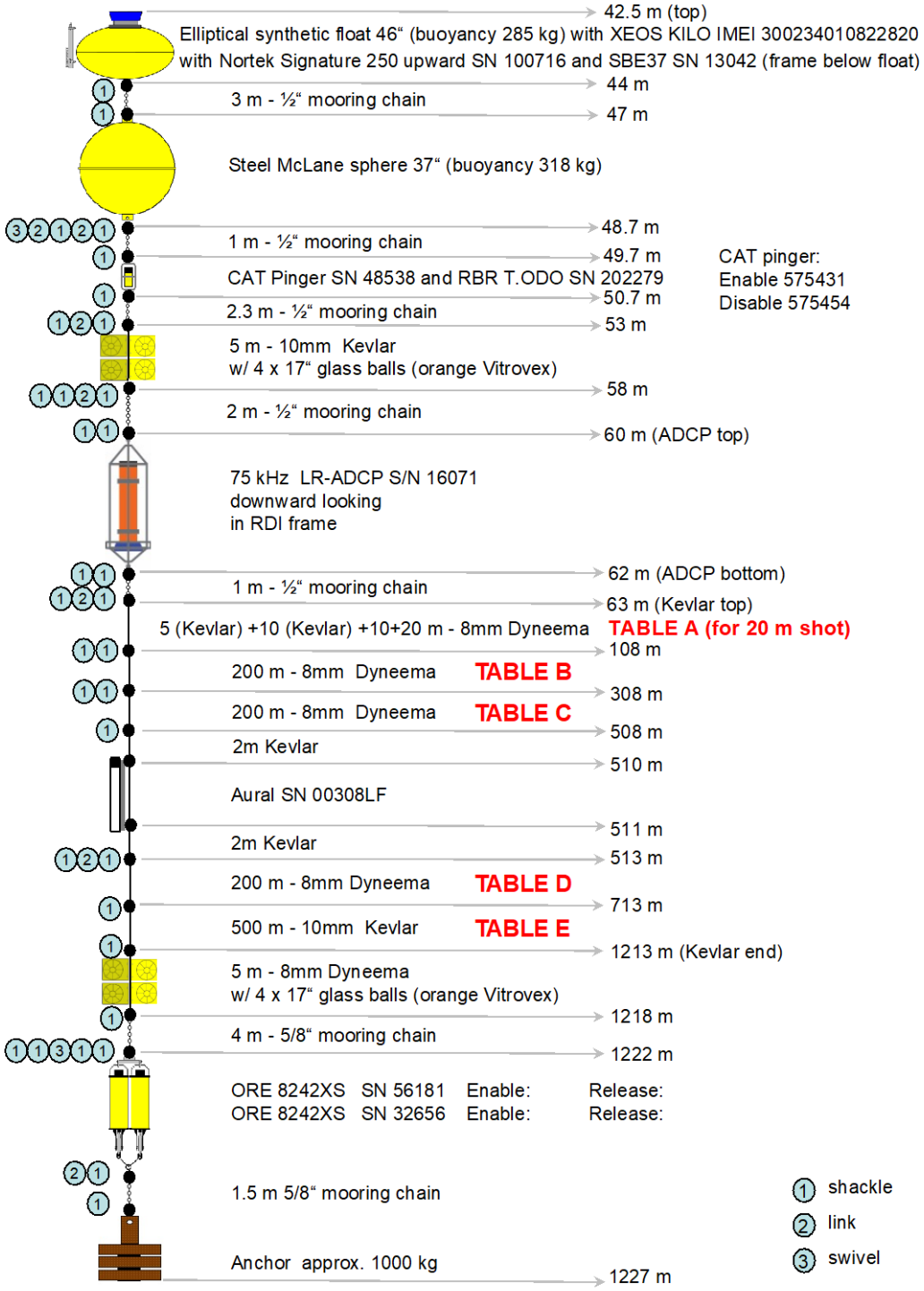
Gear description		
½'' SH	Crossby shackle ½'' 2T galvanized	10
5/8'' SH	Crossby shackle ½'' 5T galvanized	2
5/8''SL	Crossby slinglinck 5/8'' 4,2 T galvanized	5



CNRS 24
Deployed from KPH
08.11.2021 00:50 UTC
Depth: 496 m
Lat: 81° 22.842' N
Lon: 22° 17.011' E

Mooring CNRS24

Mooring ID	IOPAS23	Latitude	81° 34.545' N
Deployed	09.11.2021 01:30 UTC	Longitude	031° 00.000' E
Dropped with release hook with both spheres lowered to the surface (free fall about 40 m)		Water depth	1227 m



Mooring IOPAS23

Rigg ATWAIN800-6 81 33,006N (81.5501)

Satt ut 9.11.2021 , kl 11:20 030 52,662E(30,8777)

			Dyp:	Fra bunn:	Ned i vann:
Nortek Sign 250 SNR 828			13(1)	867	19:20
4 glasskuler					
ISUS	SNR. 0294		41	839	19:20
RBR Concerto CL+PAR SN. 204992 2 m Kevlar		45	835	19:20	
ADCP300	SNR 24485		97	783	19:10
0,5 m Kjetting Galv.					
50 m Kevlar					
4 glasskuler 2 m Kjetting					
0,5 m Kjetting Galv.					
RBR Concerto	SNR. 60594		99	781	19:10
100 m Kevlar					
RBR Concerto	SNR. 201413		151	729	18:59
RBR Concerto	SNR.201414		201	679	18:55
0,5 m Kjetting Galv.					
50 + 50(51)m Kevlar					
RBR Concerto	SNR.201403		302	578	18:47
4 Glasskuler 2 m Kjetting Gulv. 0,5 m Kjetting Galv. 100 (102) m Kevlar					
RBR Solo	SNR.102492		408	472	18:40
200 (207)m Kevlar					
RBR Solo	SNR.102487		615	265	18:33
50(51) m Kevlar					
100+100(104) m Kevlar					
NORTEK Sig 55	SNR:		304	576	18:47
SBE37 2 m Kevlar	SNR. 23177				
Contros	SNR. 1220-001				
Svivel AR861B2S	SNR. 2630	Arm: 2BE9 Release: 2B55			
3 m Kevlar					
2 m Kjetting ANKER 1100 kg			880	0	

Mooring AT800-7

Institute of Marine Research
Mooring Instruments

Ship plat orm:	KPH		
Stat on name:	Atwain-Ateros-BIOAC-02		
Lat tude:	N 81° 32.892	Longitude:	E 30°53.358
Bot om depth [m]	872m	Total height [m]	
Outgoing date:	09.NOV.2021	Outgoing t me:	13:51utc
Incoming date:		Incoming t me:	

Argos		S/N:	154
PTTID:	29532	Hex:	
Acoust c Release Ixblue			
Type:	R5	S/N:	21350036
Bat type:	Alk. original	Bat exp:	Aprox. june2025
Range code:	3525	Release code:	3555

Comments for deployment operat ons:

Instrument start 10.11.21 kl12utc

Comments for recovery operat ons:

All rope from NP should be change out with 200+200m
Blinking light start blinking approx 10min af er surfacing
Bat ery on release must be changed next recovery

Instruments / sensors

#	Brand	Type	S/N	Depth	Comment
1	Nortek	Signature 100	101598	395	2års utset
2	Novatech	Blinkelys	F10-061	395	New bat
3	SIS	ArgoTx	154	395	New saf LS20
4	t				
5	t				
6	t				
7	t				

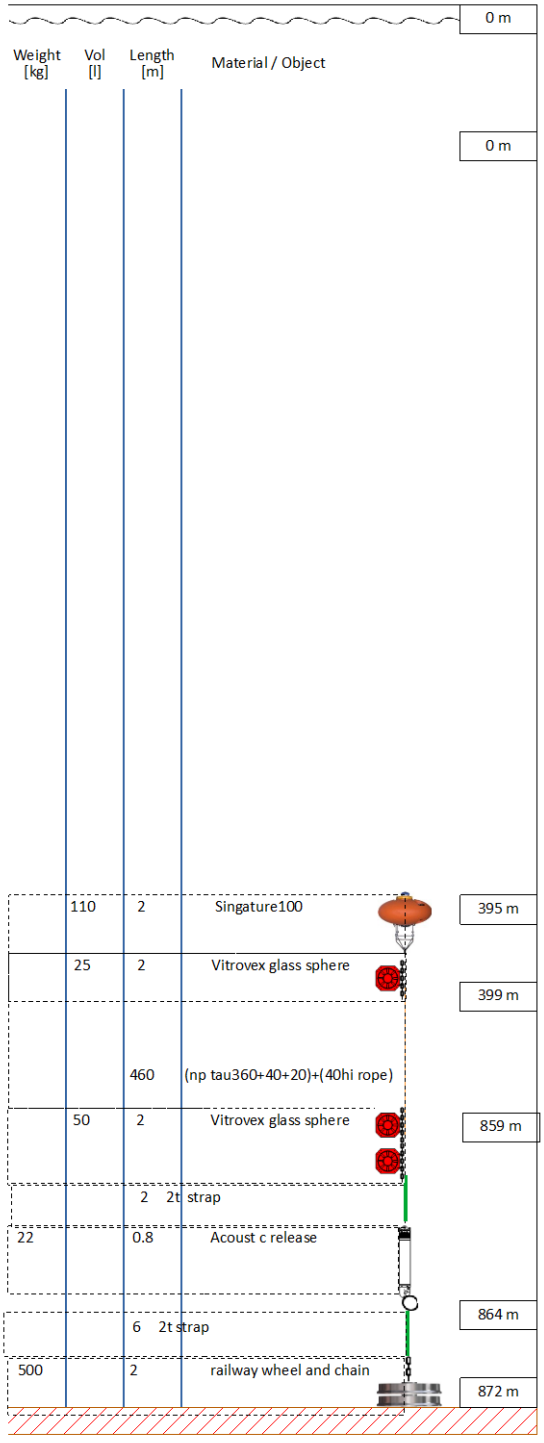
Instruments conf g info

#	Type/sn	Ping/ Time/cell	Record interval	Bat ery info	Comment
1	Sig100adcp	180s/10m	2t	lithium	2xlithium
2	Sig100echo		20sek		400m range
3	t				
4	t				
5	t				
6	t				

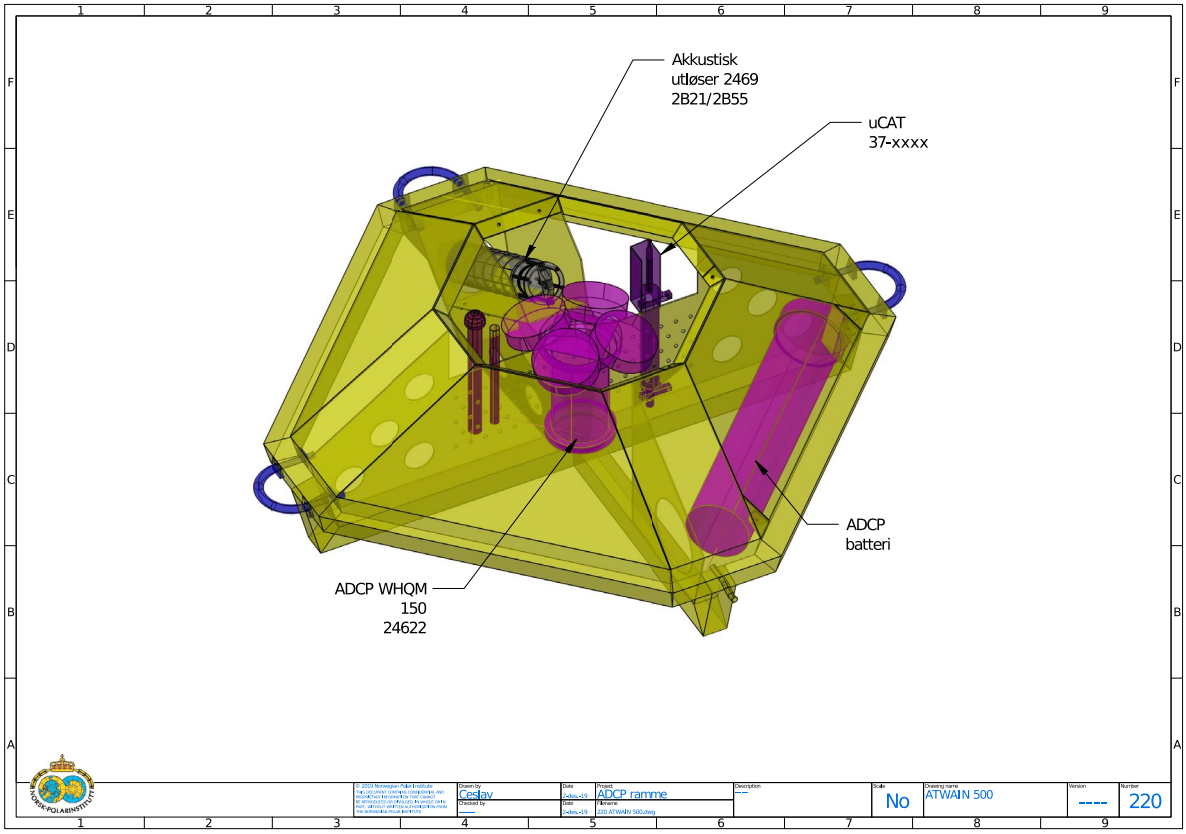
Rigging parts

#	Type	Qty
1	Shackle galvanized steel	
2	Shackle stainless steel 3.25 T	
3	Kevlar tau	
4	Strope	
5	Ring (plast c/metal)	
6	Strope	
7	Ring (plast c/metal)	

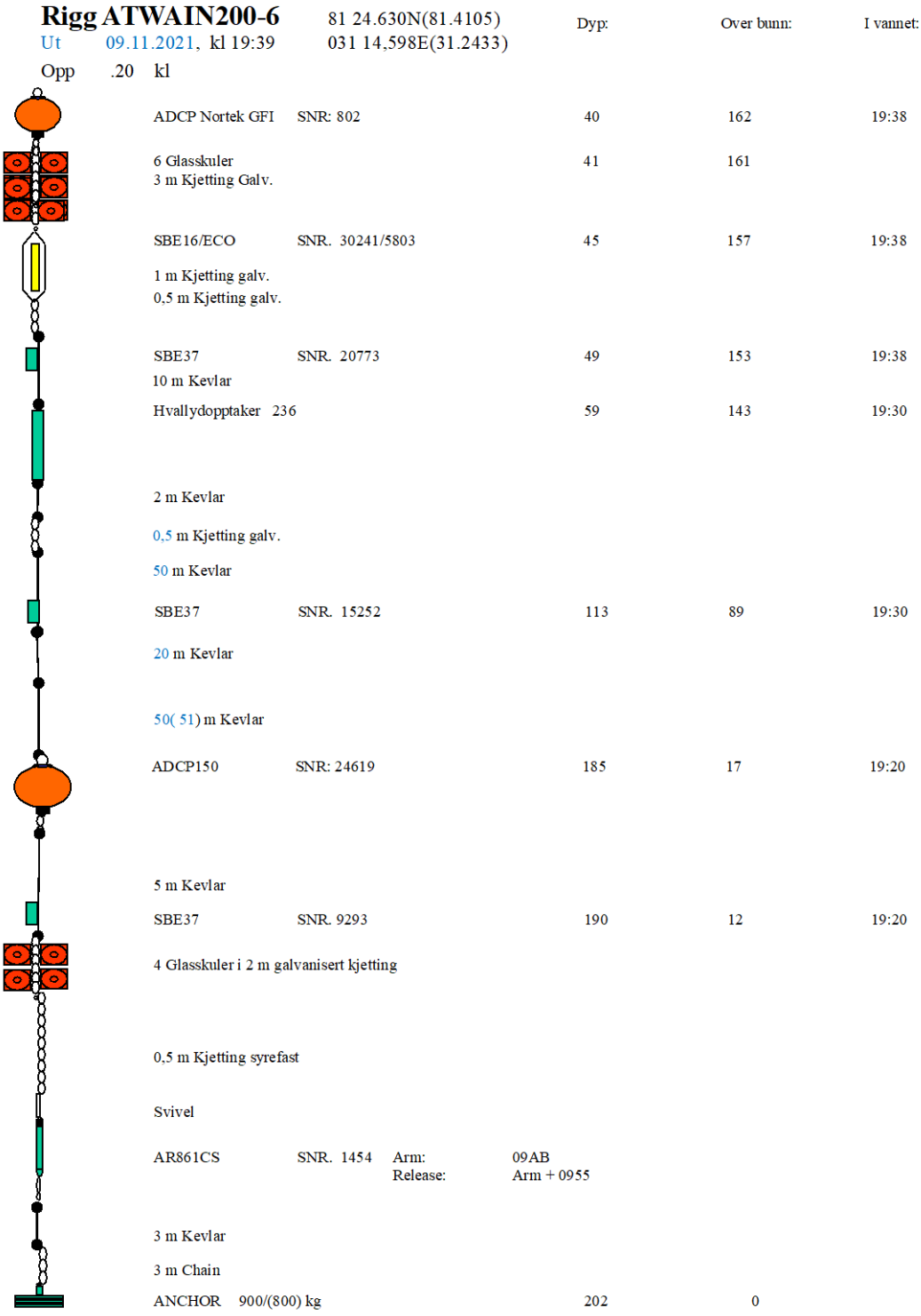
Responsible for deployment or recovery operat ons:



Mooring AT800-BioAc-2-3 (ATWAIN/INTAROS BioAc)



Mooring AT500-2



Mooring AT200-6

Institute of Marine Research
Mooring Instruments

Ship plat orm:	KPH		
Stat on name:	M1-BIOAC		
Lat tude:	N 79° 35.178	Longitude:	E 28° 24.974
Bot om depth [m]	265	Total height [m]	
Outgoing date:	10.11.21	Outgoing t me:	07:40utc
Incoming date:		Incoming t me:	

Argos		S/N:	181
PTTID:	1577	Hex:	
Acoust c Release Ixblue			
Type:	R5	S/N:	21350035
Bat type:	Alk. original	Bat exp:	Approx june2025
Range code:	3524	Release code:	3555

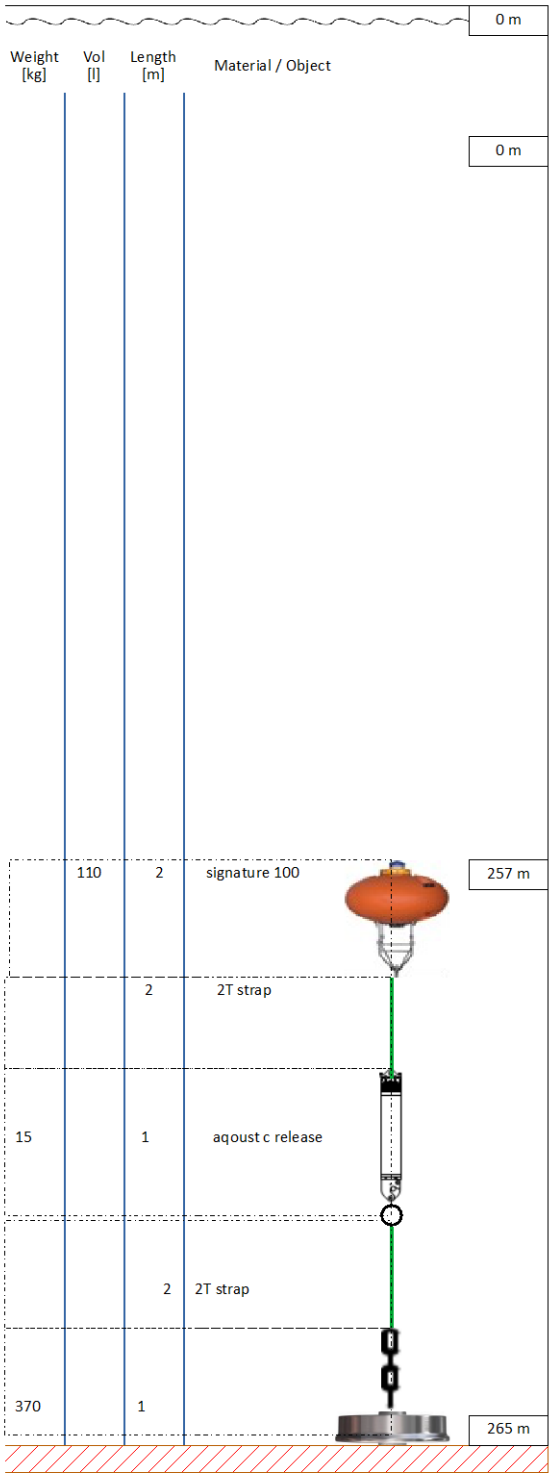
Comments for deployment operat ons:
Start recording 11novkl1800utc
Comments for recovery operat ons:
Bat ery on next release must be changed af er next recovery

Instruments / sensors					
#	Brand	Type	S/N	Depth	Comment
1	Nortek	Signature 100	101764	244	2års utset
2	Novatech	Blinkelys	F10-062	244	New bat
3	SIS	ArgoTx	181	244	New saf LS20
4	t				
5	t				
6	t				
7	t				

Instruments conf g info					
#	Type/sn	Ping/ Time/cell	Record interval	Bat ery info	Comment
1	Sig100adcp	180s/10m	2t	lithium	2xlithium
2	Sig100echo		20sek		400m range
3	t				
4	t				
5	t				
6	t				

Rigging parts		
#	Type	Qty
1	Shackle galvanized steel	
2	Shackle stainless steel 3.25 T	
3	Kevlar tau	
4	Strope	
5	Ring (plast c/metal)	
6	Strope	
7	Ring (plast c/metal)	

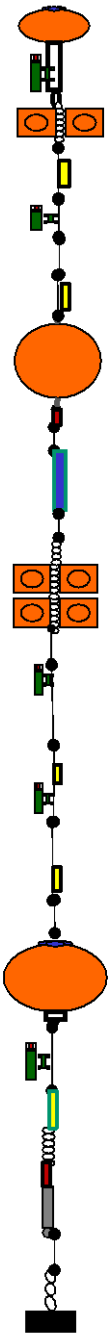
Responsible for deployment or recovery operat ons:



Mooring NLEG M1-2-BioAc

Rigg M1-4
Satt ut 10.11.2021, kl 20:05

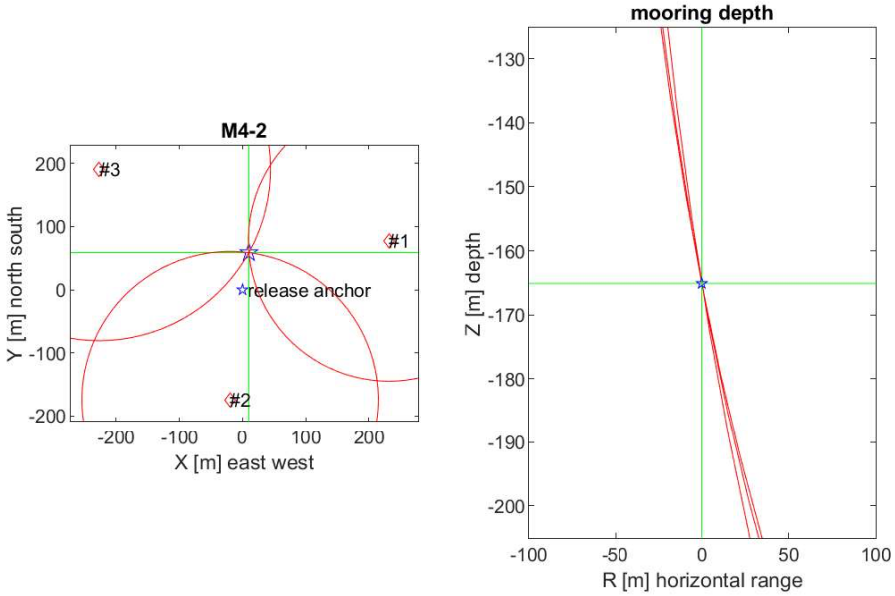
79 34.974 N(79.5829)
028 04.302 E(28.0717)



			Dyp:	Fra bunn:	Ut:
Nortek S500	SNR. 809		22	230	19:47
RBR Concerto	NR.60600		23	229	19:47
2 Glasskuler i 2 m Kjetting galv.					
SeaPhox	NR.2035		26	226	19:47
RBR CL + PAR	SNR. 204991		27	225	19:47
2 m Kevlar					
0,5 m Kjetting galv.					
20 m Kevlar					
10 m Kevlar					
RBR Concerto	SNR. 201403		57	195	19:36
HF36			58	194	
Svivel					
2 m Kevlar					
Aural Hvallyd	SNR. 288		61	191	19:35
2 m Kevlar					
4 Glasskuler i 2 m Kjetting galv.					
0,5 m Kjetting galv.					
20 m Kevlar					
RBR Concerto	SNR. 60591		87	165	19:27
50 (51) m Kevlar					
RBR SOLO	SNR. 102486		150	102	19:26
20 (21) + 10 m Kevlar					
RBR Concerto	SNR. 60592		170	82	19:24
40 (41) m Kevlar					
RBR SOLO	SNR. 102477		210	42	19:22
20 + 10 (11) m Kevlar					
ADCP150	SNR. 16640		240	12	19:20
SBE 37	SNR. 23180		242	10	19:20
Contros CO2	SNR. 1220-002		244	08	19:20
AR861B2S	SNR. 2426	Ping on:	1B47		
		Release:	1B55		
3 m Kevlar.		Arm:	1BDF		
2 m Kjetting galv.					
ANKER	825/(700)kg		252	0	

Mooring NLEG M1-4

Appendix VI: Triangulation results for M4



3D mooring pos.: 77°N 16.148' ; 24°E 24.427' ; Mooring Depth: 165 [m]

Errors [m] Slant / Horizontal / Vertical : 0 / 0 / 0

2D mooring pos.: 77°N 16.160' ; 24°E 24.429' ; Horiz. error: 36 [m]

Anchor release pos.: 77°N 16.116' 24°E 24.402' ; Depth: 68 [m]

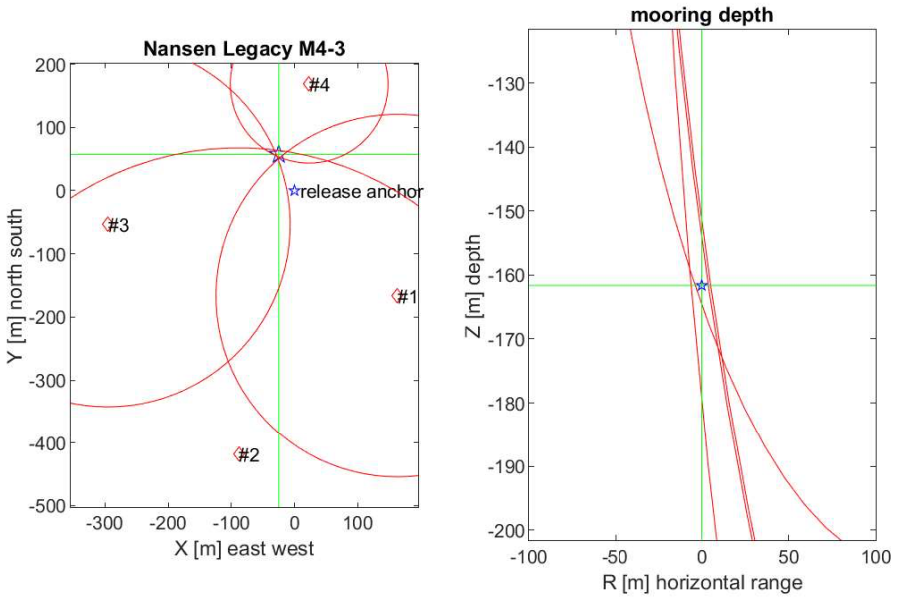
Drift: 60[m]; Heading: 10 [o]

Sound speed at site: 1480 [m/s]

#1 pos: 77°N 16.158' 24°E 24.970' range: 273[m] range soundspeed 1480

#2 pos: 77°N 16.022' 24°E 24.354' range: 283[m] range soundspeed 1480

#3 pos: 77°N 16.219' 24°E 23.846' range: 314[m] range soundspeed 1480



3D mooring pos.: 77°N 16.279' ; 24°E 24.509' ; Mooring Depth: 162 [m]

Errors [m] Slant / Horizontal / Vertical : 4 / 2 / 4

2D mooring pos.: 77°N 16.282' ; 24°E 24.479' ; Horiz. error: 31 [m]

Anchor release pos.: 77°N 16.248' 24°E 24.570' ; Depth: 80 [m]

Drift: 63[m]; Heading: 337 [o]

Sound speed at site: 1480 [m/s]

#1 pos: 77°N 16.158' 24°E 24.970' range: 326[m] range soundspeed 1480

#2 pos: 77°N 16.022' 24°E 24.354' range: 510[m] range soundspeed 1480

#3 pos: 77°N 16.219' 24°E 23.846' range: 327[m] range soundspeed 1480

#4 pos: 77°N 16.339' 24°E 24.627' range: 198[m] range soundspeed 1480

Appendix VII: Science blogs

Blogs published on https://blogg.forskning.no/blogg-arven-etter-nansen:

https://blogg.forskning.no/arven-etter-nansen/sa-kjorer-vi-i-gang-igjen-jakten-pa-utstyr-i-morke-polarnatten/1948441

Blogs published on https://sciencenorway.no/blog-nansen-legacy-project:

https://sciencenorway.no/blog-nansen-legacy-project-blog-researchers-zone/a-new-round-of-hunting-for-instruments-in-the-dark-polar-night/1948405

https://sciencenorway.no/blog-environment-nansen-legacy-project-blog/hunting-moorings-in-the-dark/1964386

(also published on arvenetternansen.com)

Social media:

- Various Facebook posts on the Arven etter Nansen, IMR, NPI and Oceanography & Sea Ice FB pages during November 2021-January 2022
- Instagram and Twitter posts on Oceanography & Sea Ice NPI (November 2021)

The Nansen Legacy in numbers

6 years

The Nansen Legacy is a six-year project, running from 2018 to 2023.

1 400 000 km² of sea

The Nansen Legacy investigates the physical and biological environment of the northern Barents Sea and adjacent Arctic Ocean.

>10 fields

The Nansen Legacy includes scientists from the fields of biology, chemistry, climate research, ecosystem modelling, ecotoxicology, geology, ice physics, meteorology, observational technology, and physical oceanography.

>350 days at sea

The Nansen Legacy will conduct 15 scientific cruises and spend more than 350 days in the northern Barents Sea and adjacent Arctic Ocean between 2018 and 2022. Most of these cruises are conducted on the new Norwegian research icebreaker RV *Kronprins Haakon*.

280 people

There are about 230 researchers working with the Nansen Legacy, of which 73 are early career scientists. In addition, 50 persons are involved as technicians, project coordinators, communication advisers and board members.

10 institutions

The Nansen Legacy unites the complimentary scientific expertise of ten Norwegian institutions dedicated to Arctic research.

Norwegian Meteorological Institute

UNIS
The University Centre in Svalbard

NTNU

NERSC

Akvaplan niva

50/50 financing

The Nansen Legacy has a total budget of 740 million NOK. Half the budget comes from the consortiums' own funding, while the other half is provided by the Research Council of Norway and the Ministry of Education and Research.

Norwegian Ministry of Education and Research

With funding from The Research Council of Norway

nansenlegacy.org

nansenlegacy

nansenlegacy@uit.no

Photo cover: Angelika Renner