INTAROS
General Assembly
January 10, 2018
Helsinki

WP3

Enhancement of multidisciplinary *in situ* observing systems

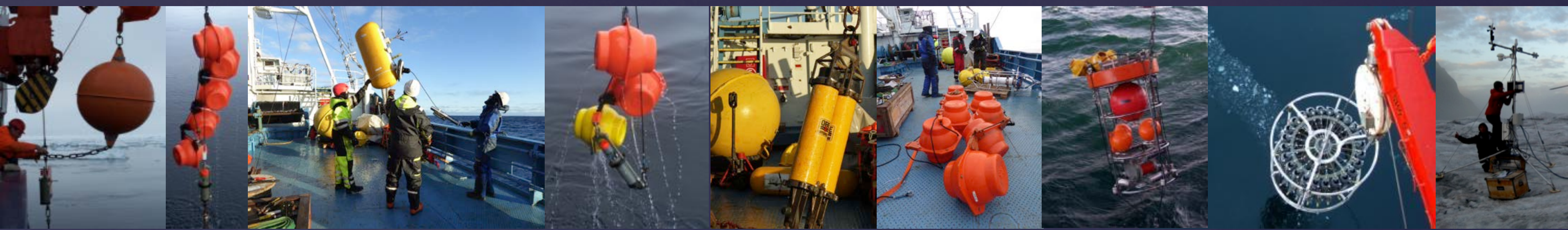
to improve critical gaps in the existing observing systems by integration of new and mature technologies for multidisciplinary Arctic observations

Agnieszka Beszczynska-Möller, IOPAN

Peter Voss, GEUS

WP3 main objectives:

- To improve critical gaps in the Arctic observation system
- To build additional capacity of pan-Arctic monitoring networks



How to achieve them…

- make best use of existing reference sites and distributed observatories providing the critical data for Arctic climate and ecosystems, but still missing multidisciplinary dimension or technical advancement

- extend temporal and geographic coverage of available infrastructures and add new key geophysical and biogeochemical variables through implementing novel technologies integrated with standard observations

WP3 *In situ* observing systems

Task 3.0
Scientific and operational coordination

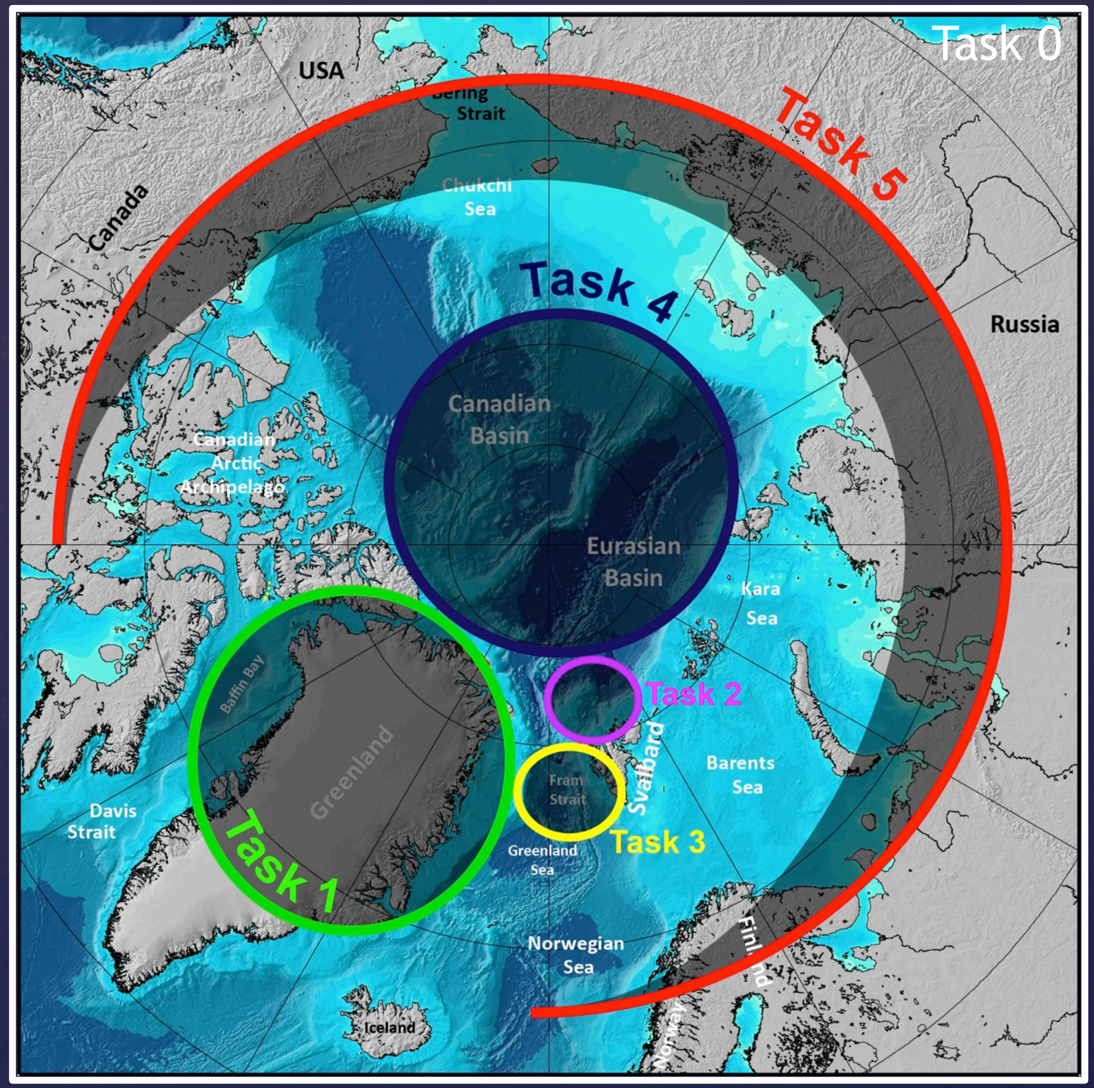
Task 3.1
Coastal Greenland

Task 3.2
North of Svalbard towards the deep Nansen Basin

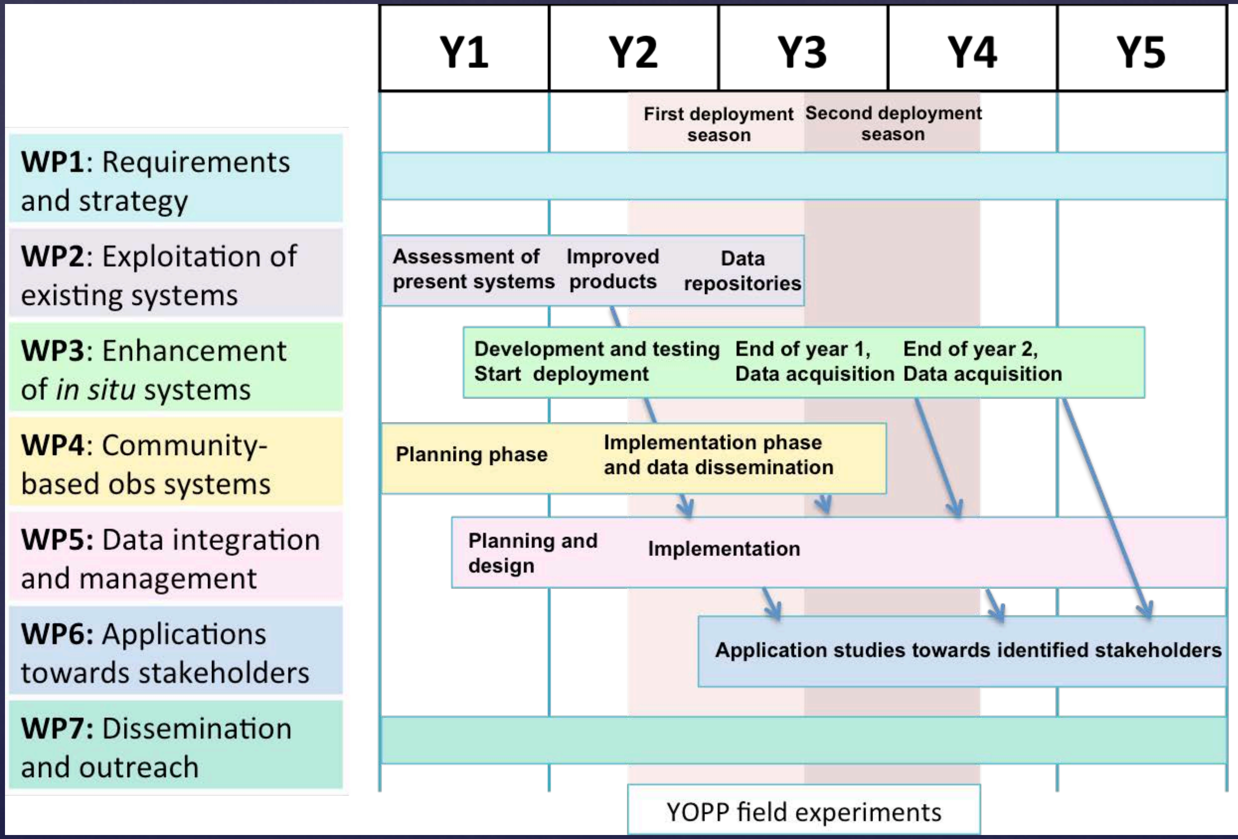
Task 3.3
Fram Strait

Task 3.4
Distributed systems for ocean and sea ice

Task 3.5
Distributed systems for atmosphere and land



- **Phase 1:** Development of new technologies and integration of multidisciplinary sensors for autonomous in situ monitoring systems in the Arctic (M6-18)
- **Phase 2:** Implementation of integrated multidisciplinary sensors and platforms for year-round measurements in the selected reference sites and distributed observatories (M19-48)
- **Phase 3:** Preparation and delivery of preprocessed new data to WP5 and WP6 (M19-54, overlap with Phase 2 due to the NRT data delivery from some sensors)



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WP3 *In situ* observing systems

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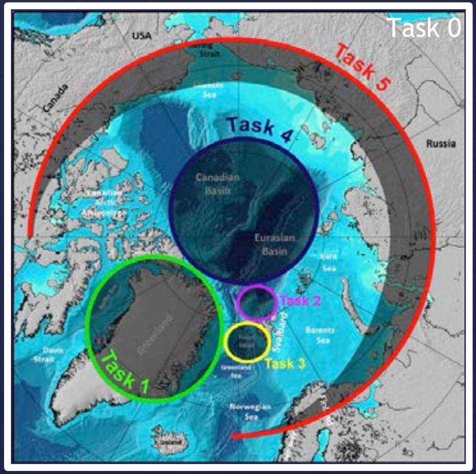
Task 3.1
Coastal Greenland:

- ocean moorings with freshwater focus in NE Greenland (AU)
- properties of snow cover on sea ice in NE Greenland (GEUS/AU)
- surface pCO_2 and ocean acidification in the Greenland coastal zone (AU)
- on-ice weather station network for snow-water equivalent (GEUS)
- precise positioning system for ice sheet dynamics (GEUS)
- novel ground penetrating radar system for ice sheet (UPM)
- multidisciplinary acoustic observatory in the Young Sound with passive acoustic (CNRS-IUEM)



Task 3.1 Coastal Greenland:

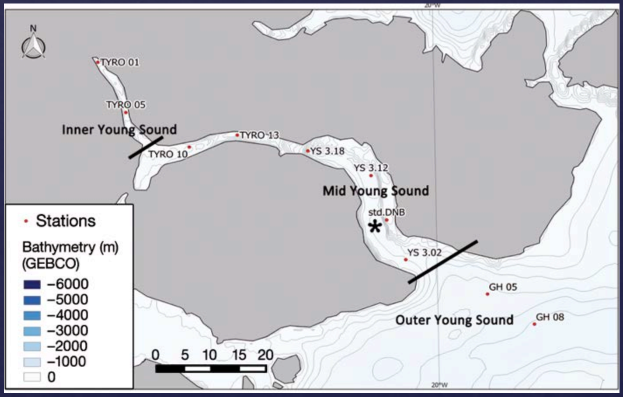
Ocean moorings with freshwater focus in NE Greenland (AU)

Surface pCO2 and ocean acidification in the Greenland coastal zone (AU)

Field work in Young Sound 2017:

- Analysis of spatial and temporal changes in freshwater 2003-2015
- Test deployment of mooring to monitor surface water (30 m) dynamics in the East Greenland Current (T and S)
- Test of two camera systems to monitor sea ice, sea birds and walruses
- Test of light loggers to monitor seasonal underwater light availability
- ICOS CO_2 eddy co-variation tower for marine system
- Cruise in Fram Strait for collection of ocean CO2 data and analysis of freshwater distribution

Young Sound fjord (74°18'N, 10°15'W), NE Greenland, ice-covered for about 280 days per year



Task 3.1 Coastal Greenland:

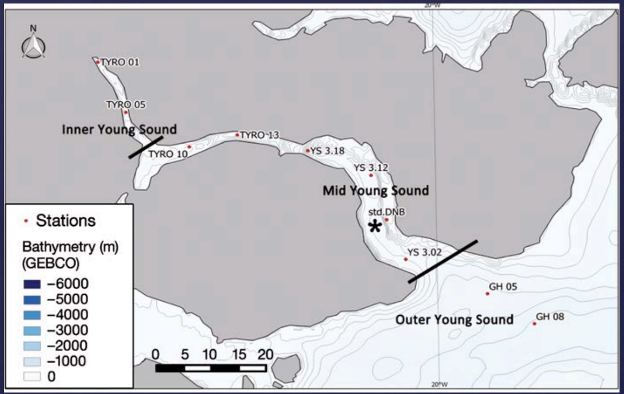
Ocean moorings with freshwater focus in NE Greenland (AU)

surface pCO2 and ocean acidification in the Greenland coastal zone (AU)

Plans for the field season 2018:

- Retrieve (hopefully) and redeploy surface mooring outside Young Sound
- Upgrade sensor package on existing mooring (PAR, Fluorescence, Turbidity)
- Purchase and implement camera systems
- Coastal cruise along East Greenland for ocean CO_2 data
- Continue time series on underwater light in Young Sound

Young Sound fjord (74°18'N, 10°15'W), NE Greenland, ice-covered for about 280 days per year



Task 3.1 Coastal Greenland:

High Accuracy GNSS AWS positioning (GEUS)

- To provide *in situ* validation data for satellite SAR velocity & altimetry products
- To constrain elevation of barometer for downstream weather prediction users
- To support local strain network for ice dynamics

System specifications - NOT OFF THE SHELF SOLUTION

- rate: at least one accurate position per day in winter, 24/7 in summer
- accuracy: 0.5 m (near real time), cm (postprocessed)
- power: operate through polar night on 500 Wh, solar power during summer
- operation: standalone or connected to PROMICE AWS

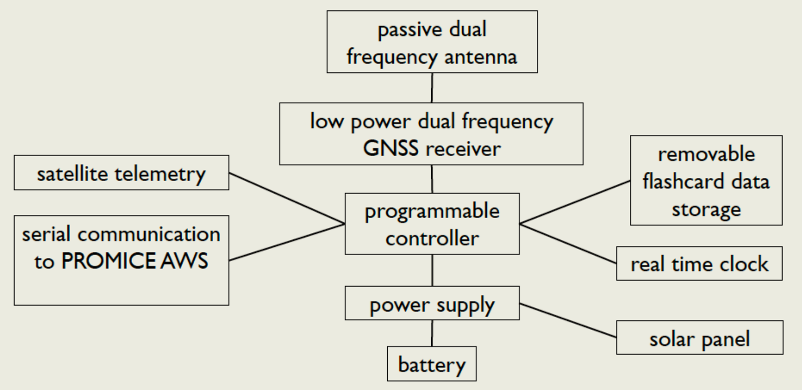
Done in 2017:

- system specification and conceptual design → ok
- evaluation of receivers and antennas → ok
- start of prototyping → ok

Planned for 2018:

- prototype production & lab test → this spring
- field test deployment → this summer

Conceptual design



Task 3.1 Coastal Greenland:

INTAROS improvement of AWS radiation measurements (GEUS)

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- To improve the correction for radiometer tilt to account for changes in azimuth and remove alignment error between radiometer and tilt sensors
- To provide in situ validation data for satellite albedo products

System specifications - NOT OFF THE SHELF SOLUTION

- rate: 10 minutes, instantaneous, winter & summer
- accuracy: 0.2 degrees pitch and roll, 3 degrees magnetic heading
- power: < 100 mW when powered on
- operation: mechanically mounted on radiometer body and electrically connected to PROMICE AWS data logger

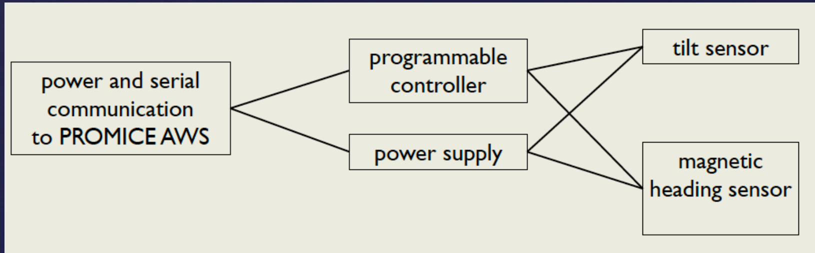
Done in 2017:

- system specification and conceptual design → ok
- evaluation of tilt and azimuth sensors → ok
- start of prototyping → ok

Planned for 2018:

- prototype production & lab test → this spring
- field test deployment → this summer

Conceptual design



Task 3.1 Coastal Greenland:
Snow water equivalent (SWE) measurements (GEUS)

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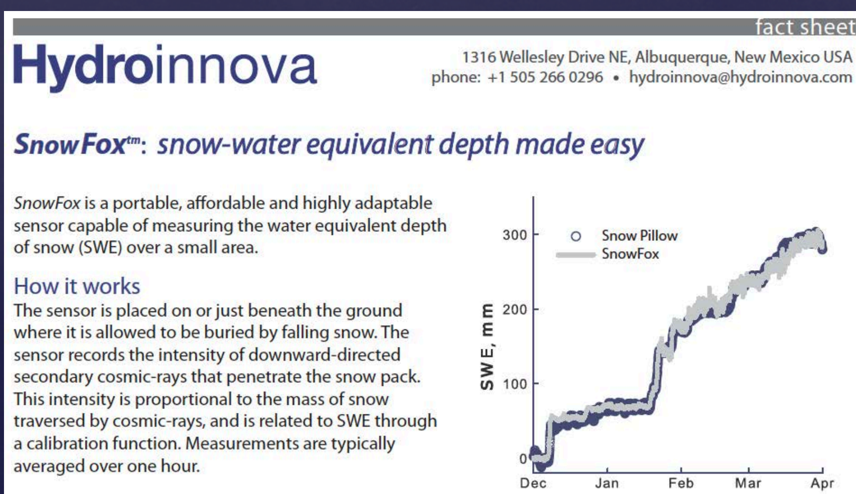
Planned work in 2018

- Fieldwork preparation and SnowFox instrument testing
- Plans to install three-five SnowFox at PROMICE locations during summer 2018 depending on the PROMICE field campaign
- Target locations:
  THU, KAN, NUK, QAS, and TAS


fact sheet

Hydroinnova

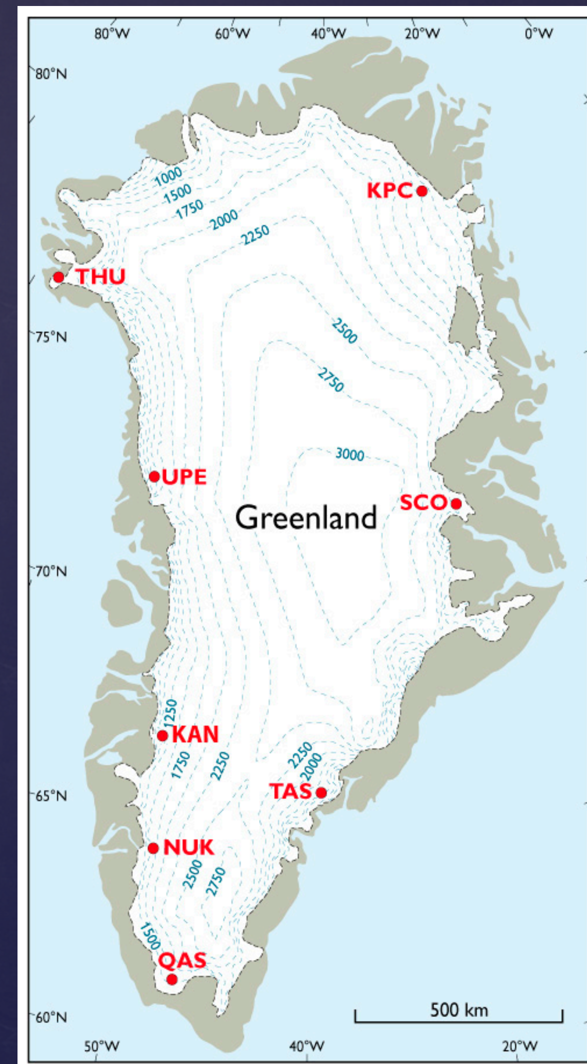
1316 Wellesley Drive NE, Albuquerque, New Mexico USA
phone: +1 505 266 0296 • hydroinnova@hydroinnova.com

SnowFox™: *snow-water equivalent depth made easy*

SnowFox is a portable, affordable and highly adaptable sensor capable of measuring the water equivalent depth of snow (SWE) over a small area.

How it works

The sensor is placed on or just beneath the ground where it is allowed to be buried by falling snow. The sensor records the intensity of downward-directed secondary cosmic-rays that penetrate the snow pack. This intensity is proportional to the mass of snow traversed by cosmic-rays, and is related to SWE through a calibration function. Measurements are typically averaged over one hour.



Task 3.1 Coastal Greenland:

Ecological monitoring using underwater passive acoustics (CNRS-IUEM)

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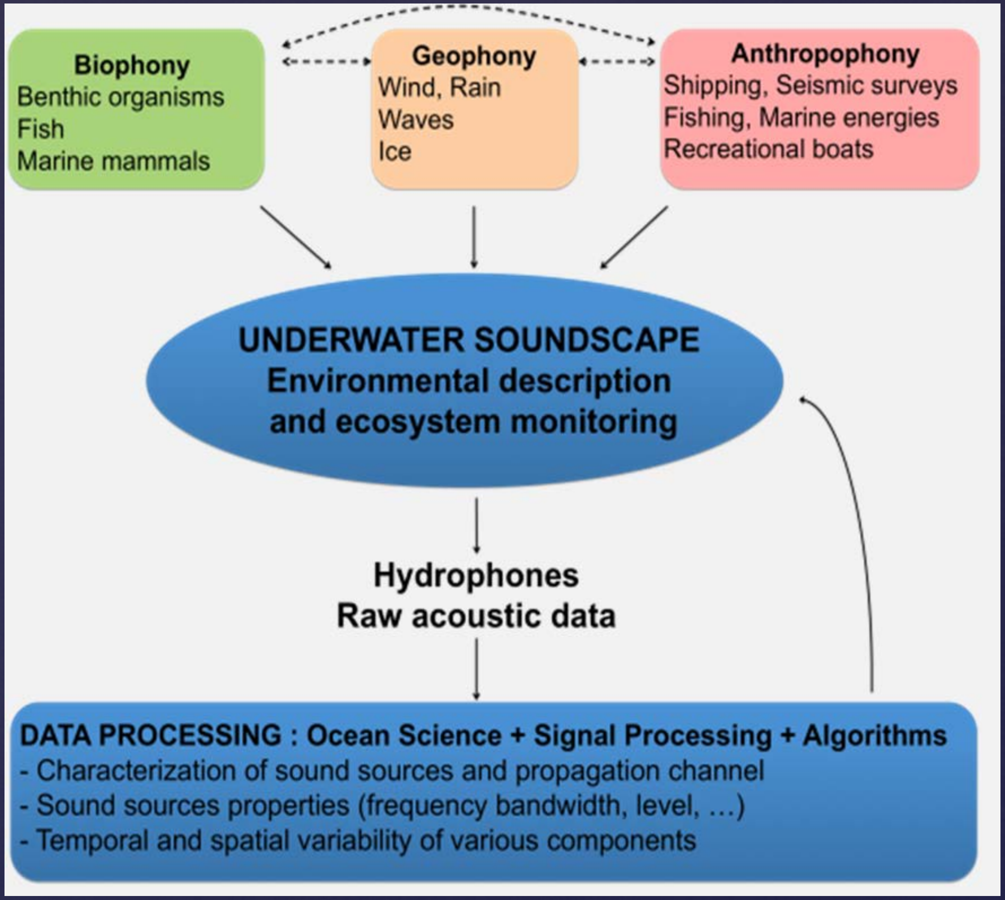
- Non invasive method
- Long-term monitoring
- Low costs



- Bio-sounds: benthos, fish, mammals…
- Geo-sounds: rain, waves, ice…
- Anthropogenic sounds: boats…

Greenland, Young Sound

funded within French projects started in 2016

Svalbard, Kongsfjorden

funded within Task 3.3 to be implemented

Task 3.1 Coastal Greenland:
Ecological monitoring using underwater passive acoustics (CNRS-IUEM)

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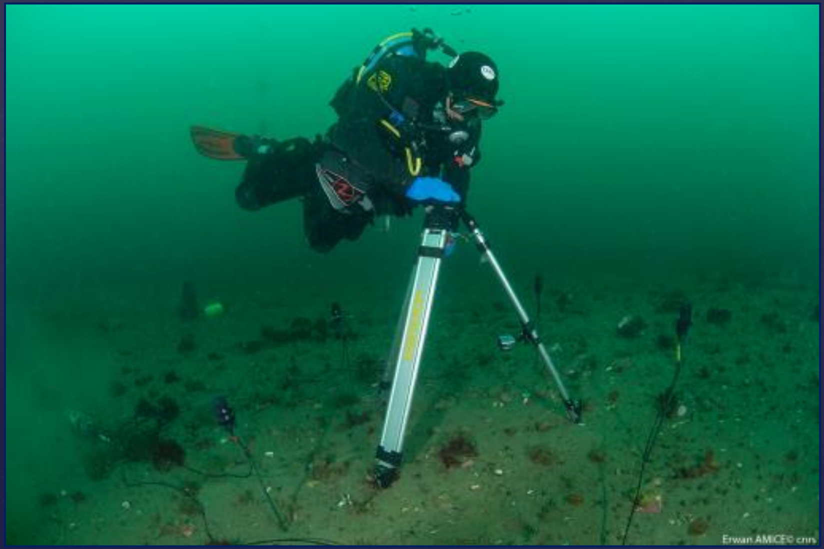
Young Sound (Eastern Greenland)

2017

- Passive acoustics equipment already calibrated and tested (within associated project ASTRID) May 2017
- Deployment in autonomous mode for routine operations during summer 2017
- Test and calibration of the similar system to be deployed in Kongsfjorden in 2018
- Data processing for ecological monitoring started
- Work on algorithm for sea ice-waves interaction started



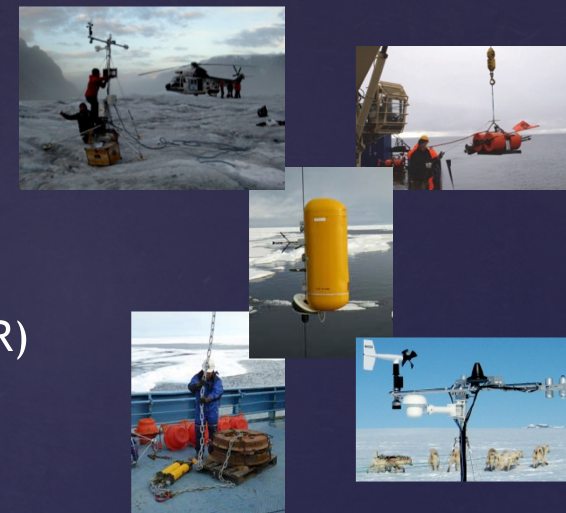
2018

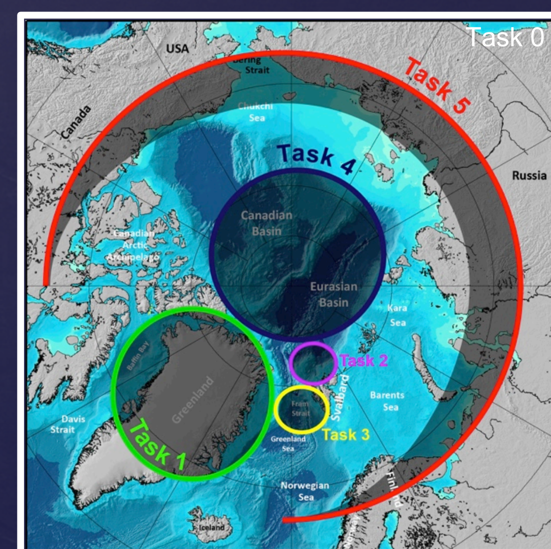
- First results to be presented during the Polar 2018 conference in June 2018
- Long term cabled version deployment for year round operations

WP3 *In situ* observing systems

Task 3.2
North of Svalbard towards the deep Nansen Basin:

- array of multidisciplinary moorings with profiling instruments and point measurements of ocean physical variables (IOPAN, CNRS-LOCEAN, IMR)
- a suite of biogeochemical measurements and sampling (IMR)
- pCO2 and pH sensors for carbon system variables (UiB-GFI)
- autonomous passive contaminant samplers (NIVA)
- sediment traps, underwater vision profiler, FRRF fluorimeter (AWI)
- combined ADCP-echosounders for currents and zooplankton (IMR)
- upward-looking sonars for sea ice (UiB-GFI)
- bottom pressure recorders (UNIS)
- passive acoustics recorders for ocean soundscape in the Arctic (NERSC)
- ocean bottom seismometers for solid Earth processes and geohazards (GEUS/UiB-GEO)

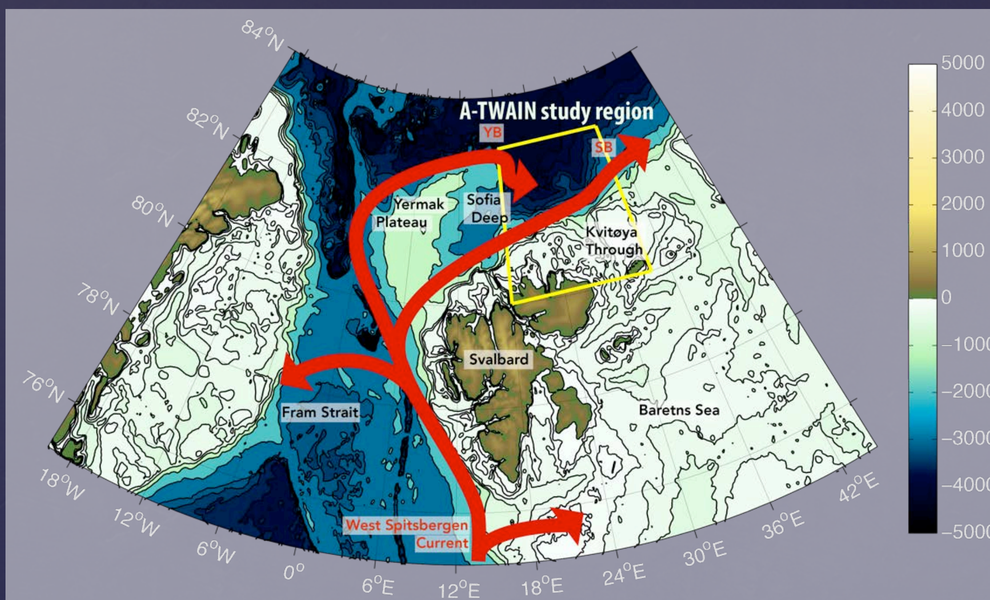


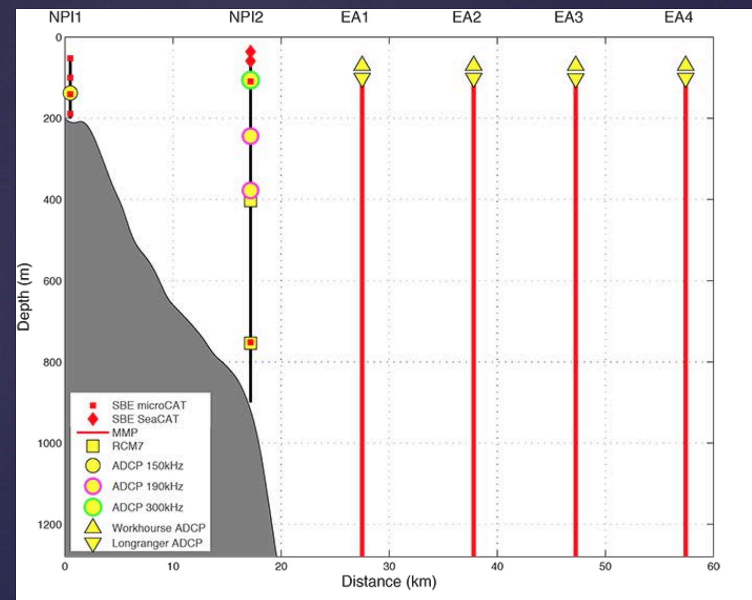


Task 3.2 North of Svalbard towards the deep Nansen Basin

Multidisciplinary moored array (IOPAN, CNRS-LOCEAN, IMR, UiB, NERSC)

Building on the A-TWAIN moored array deployed since 2012 under the project
'Long-term variability and trends in the Atlantic Water inflow region'
Main partners IMR and NPI, collaborating partners WHOI, IOPAN





Map and array scheme from http://atwain.whoi.edu/php/index.php

2012-2013: 9 moorings (8 recovered)
2013-2015: 5 moorings (4 recovered)
2015-2017: 3 moorings deployed

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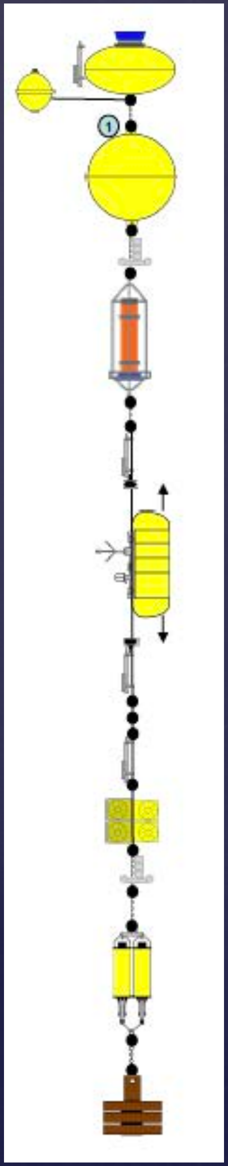
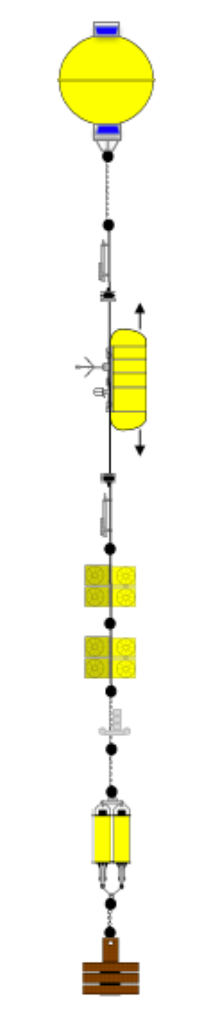
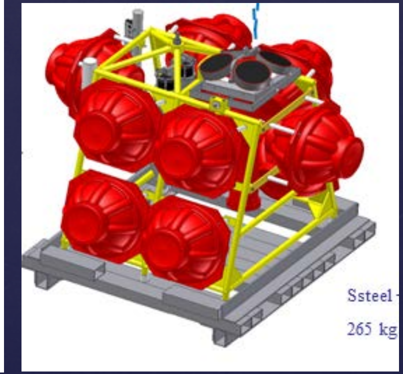
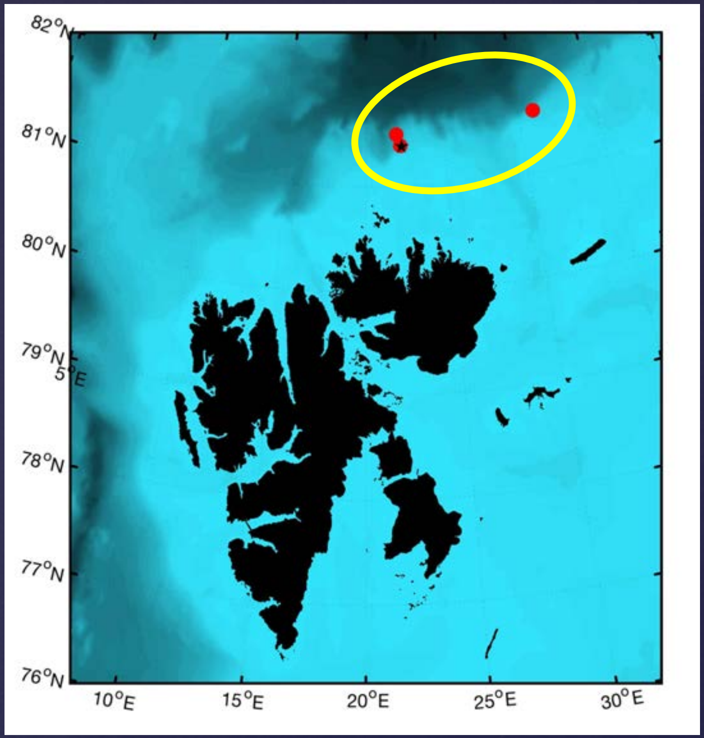
Task 3.2 North of Svalbard towards the deep Nansen Basin

Multidisciplinary moored array (IOPAN, CNRA-LOCEAN)







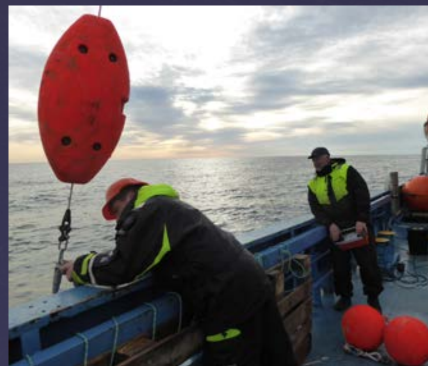


Four moorings deployed during A-TWAIN cruise of RV Lance in September 2017

To be recovered and redeployed in summer 2018 from KV Svalbard

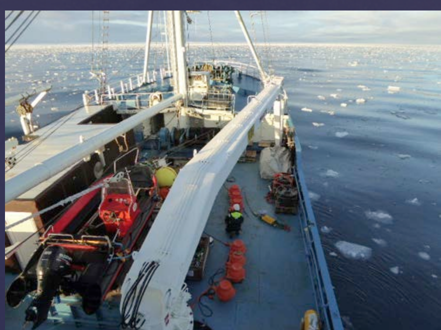
Task 3.2 North of Svalbard towards the deep Nansen Basin

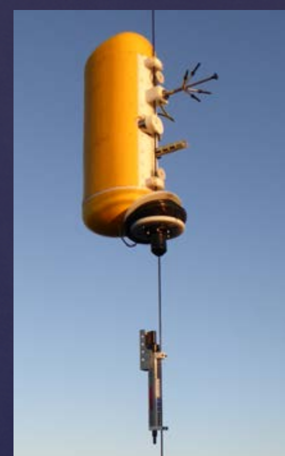
Multidisciplinary moored array (IOPAN, CNRS-LOCEAN, IMR)



Moorings from IOPAN and CNRS-LOCEAN equipped with:

- Moored McLane Profilers
- TRDI QM ADCPs
- Signature 55 Dual Freq Nortek ADCP
- Signatures 250 for currents and sea ice
- Microcats SBE37 CTD sensors
- Temperature recorders





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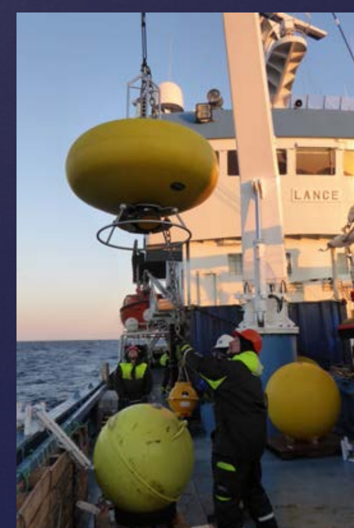
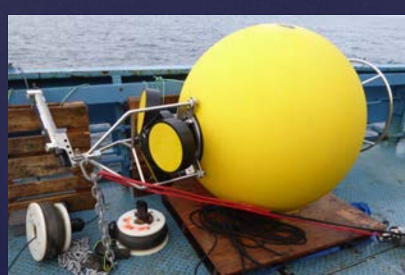
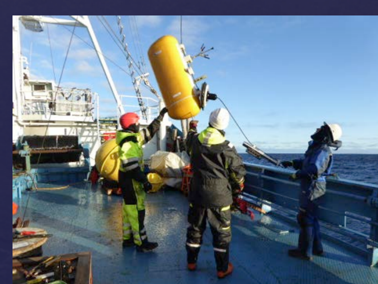
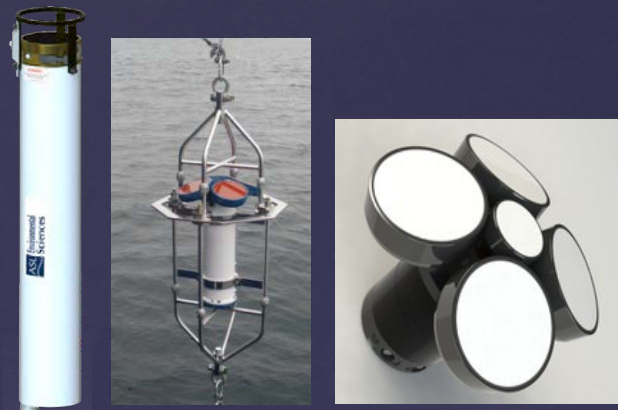






Task 3.2 North of Svalbard towards the deep Nansen Basin

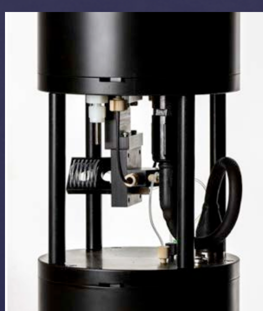
Multidisciplinary moored array (IOPAN, CNRS-LOCEAN, IMR, UiB, NERSC, AWI, NIVA)



ADCPs/echo sounders/ice sonars

To be added to INTAROS moorings to be deployed from KV Svalbard in summer 2018:

Bottom pressures sensors



SAMI pCO2

SAMI pH

SUNA V2 UV nitrate sensor

Underwater Vision Profiler

Sediment trap

FRR Fluorymeter

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Task 3.2 North of Svalbard towards the deep Nansen Basin

Ocean bottom seismometers (GEUS, UiB-GEO)

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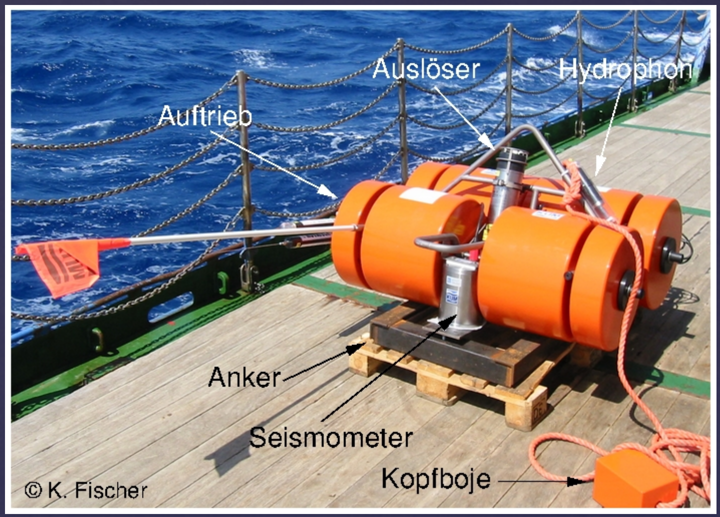
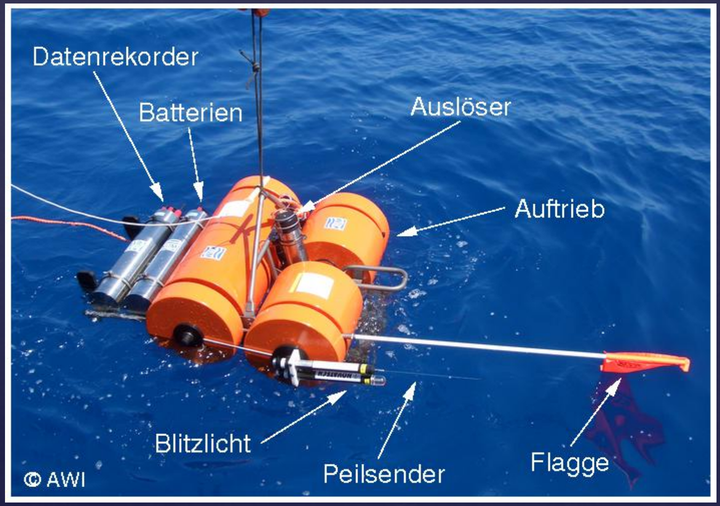


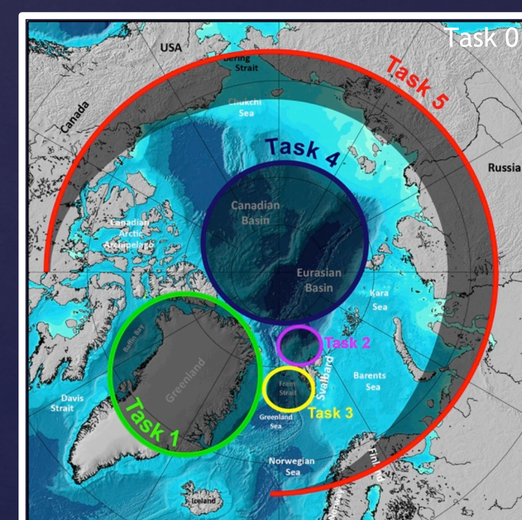


Ocean bottom seismometers will be deployed north of Svalbard in summer 2018

INTAROS WP3 *In situ* observing systems

Task 3.3 Fram Strait:

- extending the LTER observatory Hausgarten with experimental autonomous system for impacts of ocean acidification on benthic biology arcFOCE - Arctic Free Ocean Carbon Enrichment (AWI)
- real-time measurements of pCO_2 and pH, monitoring of carbon cycle parameters in Kongsfjorden (CNRS-LOV)
- directional acoustic system to monitor benthic species and dynamics of sea ice and icebergs in Kongsfjorden (CNRS-UIEM)

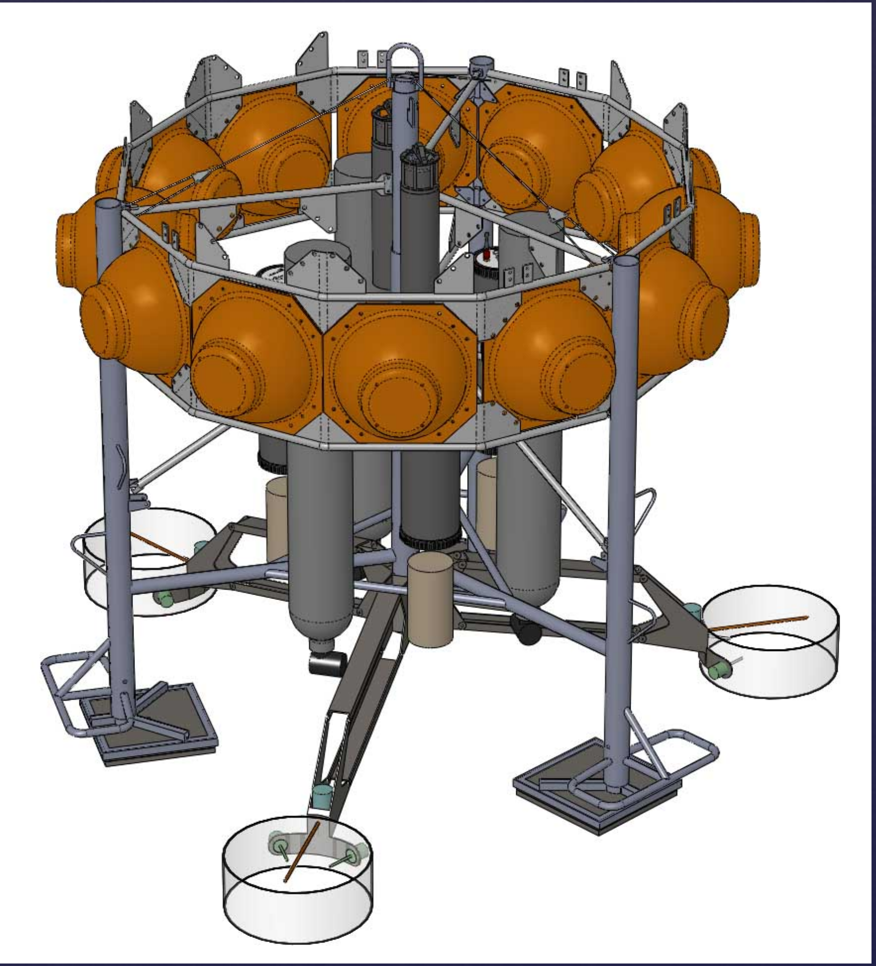


Task 3.3 Fram Strait

ArcFOCE - Arctic Free Ocean Carbon Enrichment (AWI)

Acidification Experiment (High CO_2 / low pH Ocean)

to assess the effects of future changes in ocean chemistry, including ocean acidification, on the diversity and abundance of deep-sea benthic organisms and communities



Major challenges:

- Autonomy
- Energy demand
- Seawater acidification
- Sensor stability
- Installation / sampling

Task 3.3 Fram Strait

ArcFOCE - Arctic Free Ocean Carbon Enrichment (AWI)

Acidification Experiment (High CO_2 / low pH Ocean)

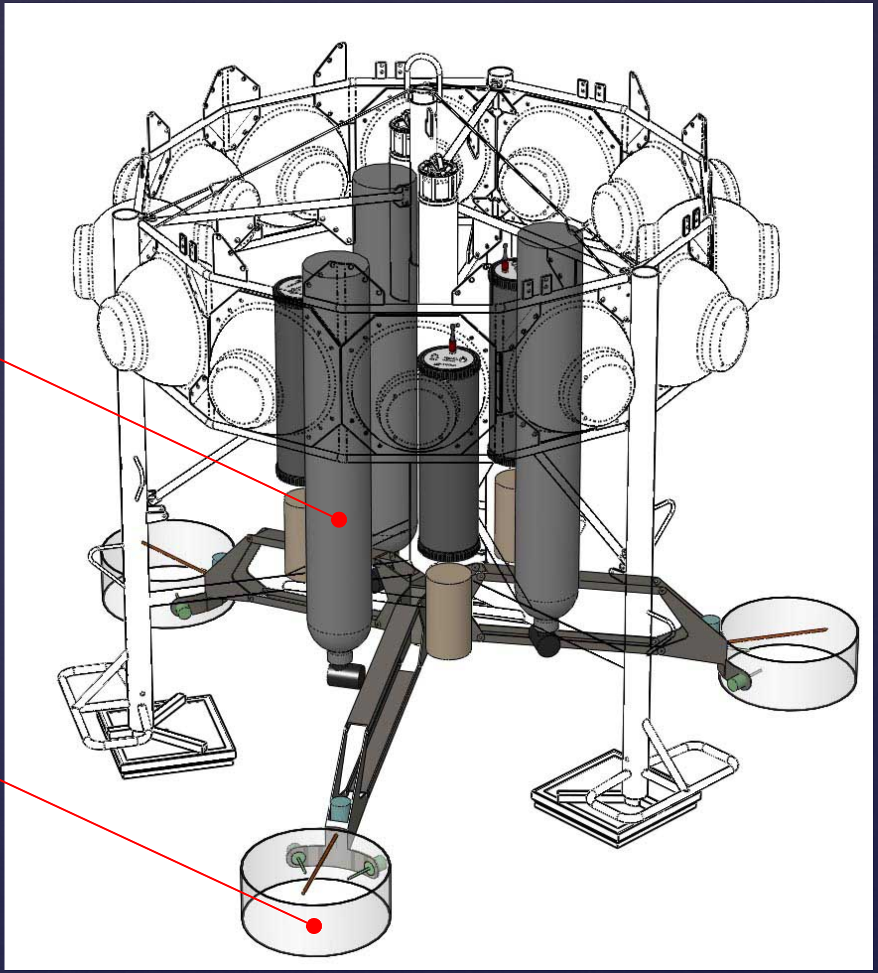
- **Seawater acidification**

CO_2 from carbon fibre composite pressure cylinders partially filled with inert gas, which increases the internal pressure of the cylinders.

CO_2 mixed with seawater in pressure-less tanks to reach the desired pH concentration.

Pumps will transfer the mixture to the mesocosms (50 cm in diameter, 40 cm in height).

pH values in the mesocosms kept constant by control loops.



- **Sensor stability**
- **Glass electrodes**

Task 3.3 Fram Strait

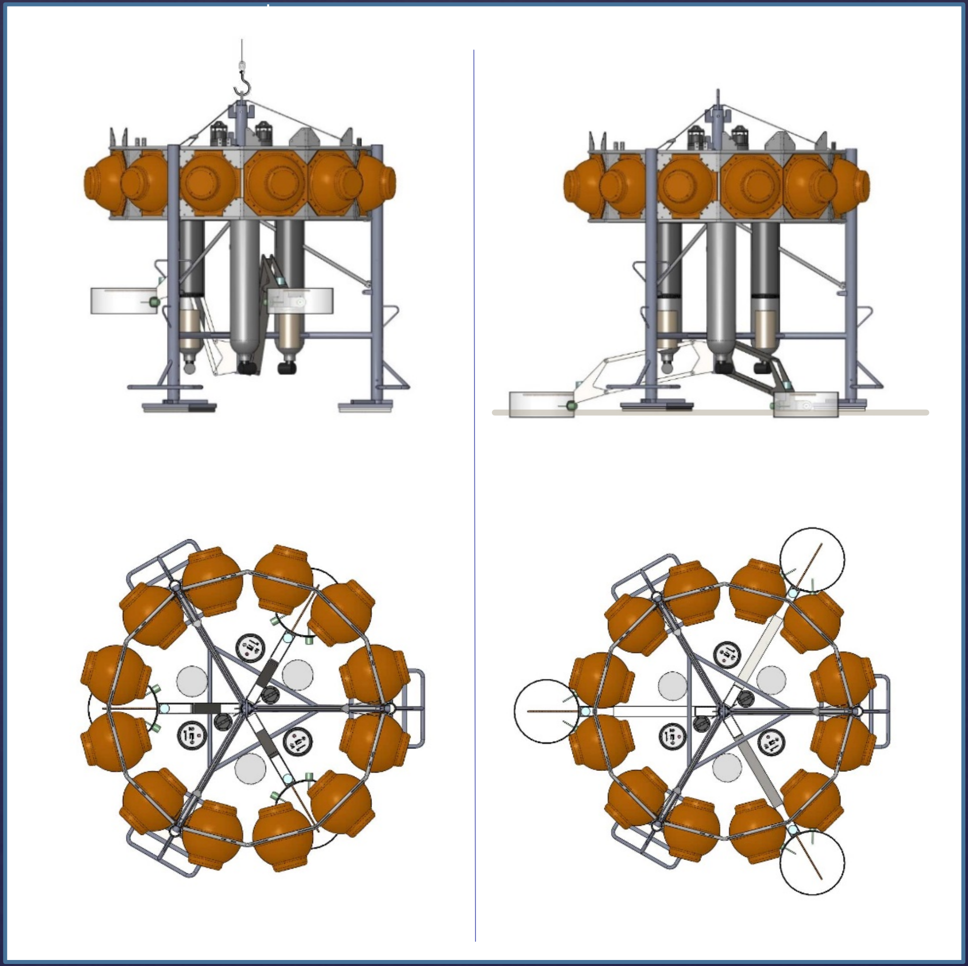
ArcFOCE - Arctic Free Ocean Carbon Enrichment (AWI)

Acidification Experiment (High CO_2 / low pH Ocean)

Installation / sampling

First deployment during the RV „Maria S. Merian“ expedition MSM77 in September / October 2018.

Sampling of sediments and inhabiting organisms with a Remotely Operated Vehicle in summer 2019.



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Task 3.3 Fram Strait

Time-series of carbonate chemistry in the Arctic Ocean (CNRS-LOV)

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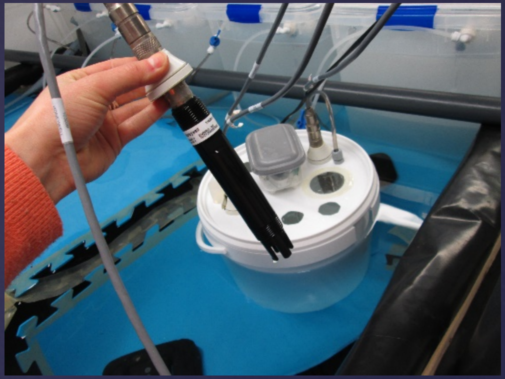
Underwater observatory (AWIPEV) Kongsfjorden

- Water pumped from 12 m water depth at Ny-Ålesund
- **Since July 2015:** Two pCO_2 sensors rotating every year (every minute)
- **Since February 2016:** Total alkalinity analyser (every hour)
- For calibration and quality insurance: collection of discrete samples once a week for high-precision measurements of dissolved inorganic carbon and total alkalinity at the home lab



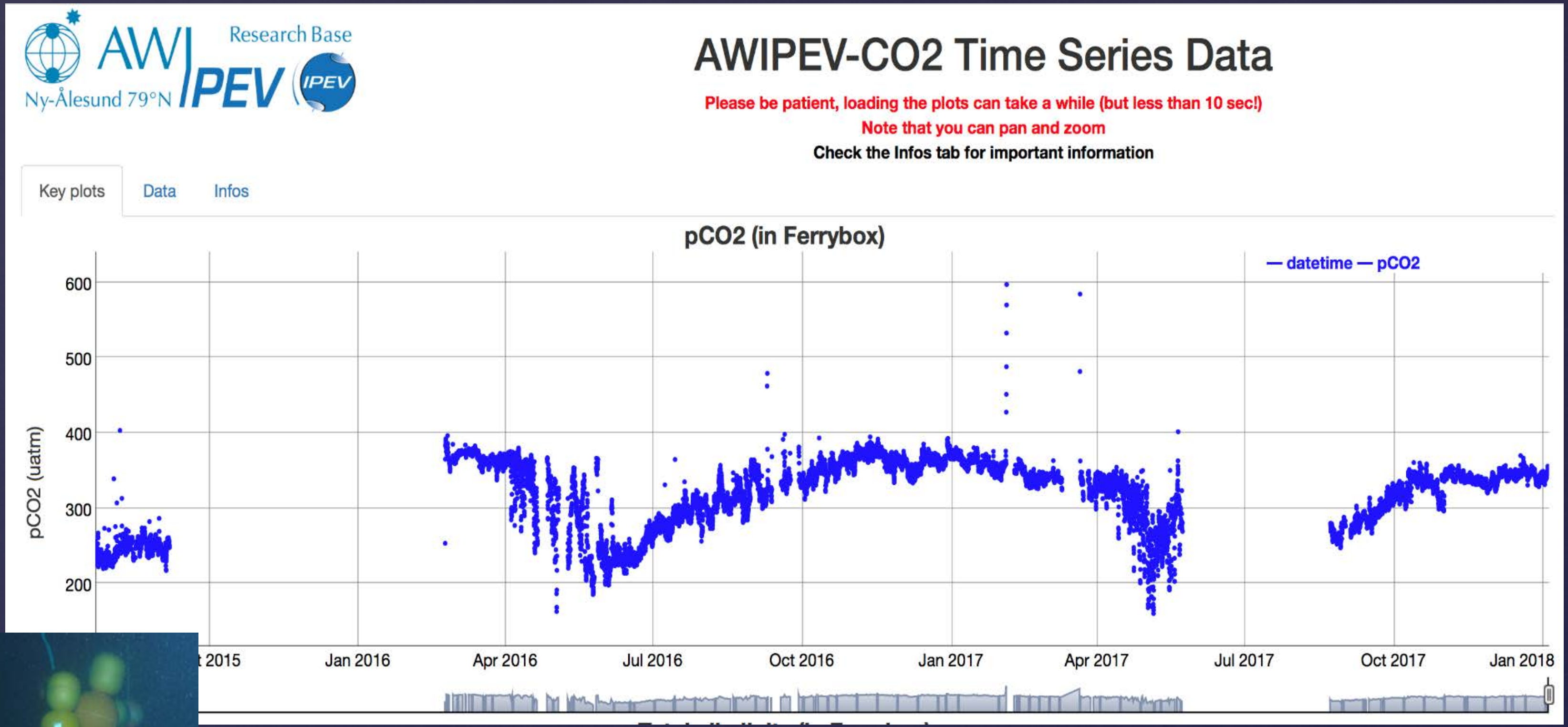
Since August 2017: pH measurements

- Continuous measurements in fjord water (seaFET)
- DURAFET pH sensor in the FerryBox
- Discrete pH samples once a month for calibration

Task 3.3 Fram Strait

Time-series of carbonate chemistry in the Arctic Ocean (CNRS-LOV)

Data available in near real-time (https://gattuso.shinyapps.io/AWIPEV-CO2)



To do in 2018

- Fix issue of power supply of the seaFET sensor
- Re-install (3rd time…) the alkalinity analyser
- Analyse discrete pH samples (shipment on its way)
- Evaluate consistency of measured and derived parameters

Task 3.3 Fram Strait

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Ecological monitoring using underwater passive acoustics (CNRS-IUEM)

Kongsfjorden (Svalbard)

Done in 2017

System choice: hydrophone RTSYS (HTI-92-WB 50 Hz model)
acoustics recorder RTSYS EA-SD414-320
pressure/depth sensor/recorder (RBR Solo3 D model)

Test and calibration in Brest (April 2017)

Test and calibration in Young Sound, close to the similar system deployed there (May 2017)

Algorithm adaptation (for ecological monitoring)

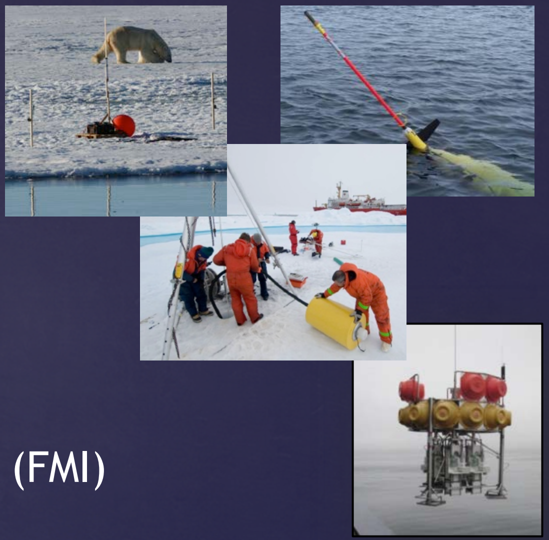
Planned for 2018

Deployment in autonomous mode:
- springtime and summer 2018
- recovery in autumn 2018

Implementation site validation

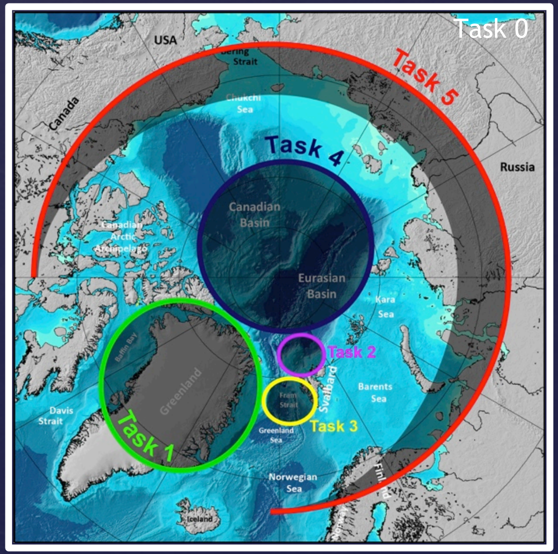
Long term cabled version planned 2019

WP3 *In situ* observing systems



Task 3.4
Distributed systems for ocean and sea ice:

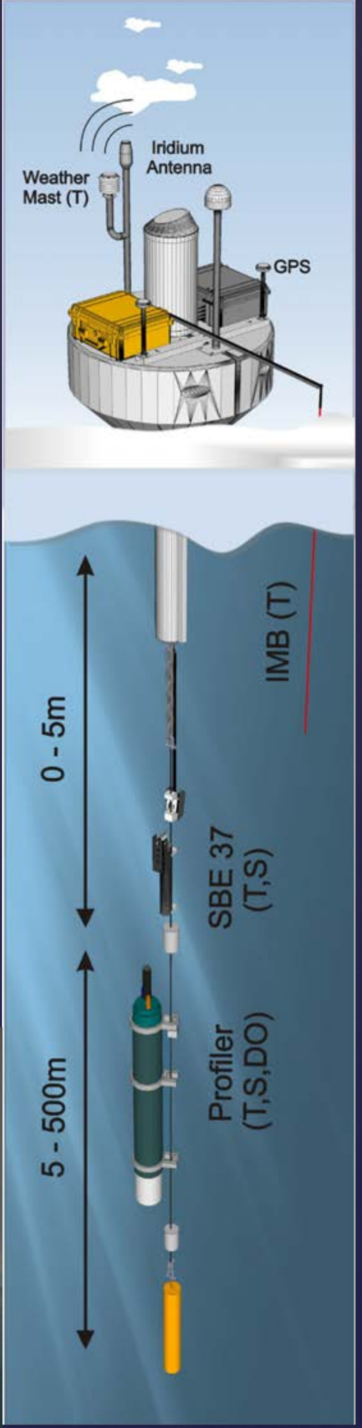
- ice-tethered platforms for measurements of ocean physical variables with meteorological and biogeochemical sensors for multidisciplinary ITP measurements (IOPAN)
- sea-ice mass balance buoys clustered with ITPs and standalone (FMI)
- measurements of snow properties and ABL observations from SOOs (FMI)
- quadrocopter measurements of broadband and surface albedo (FMI)
- novel sensors for FerryBoxes (ocean acidification and carbonate chemistry, inherent optical properties, microplastic sampler) (NIVA)
- endurance glider lines in the open water Arctic regions (CNRS-LOCEAN)
- BioArgo floats in Baffin Bay (CNRS-Takuvik)

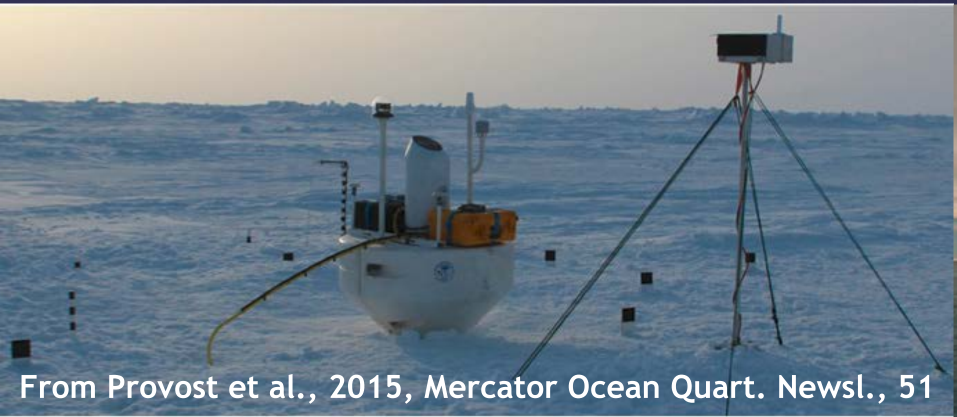


Task 3.4 Distributed systems for ocean and sea ice:

Ice-tethered platforms for multidisciplinary measurements (IOPAN)

- Ice-tethered IAOOS platform will be acquired from the French EQUIPEX IAOOS consortium for deployment in 2018
- Specification agreed, tender process to be concluded this month
- IAOOS platform will be equipped with:
  - ⟾ CTDO profiler travelling along the 800 m wire (Koenig et al., 2016)
  - ⟾ Ice mass balance instrument (Mariage et al., 2016)
  - ⟾ Atmospheric package: microlidar, weather mast and GPS (Mariage et al, 2017)
- Deployment planned during the 2018 CHINARE cruise in the central Arctic in summer/autumn 2018





From Provost et al., 2015, Mercator Ocean Quart. Newsl., 51

Task 3.4 Distributed systems for ocean and sea ice:

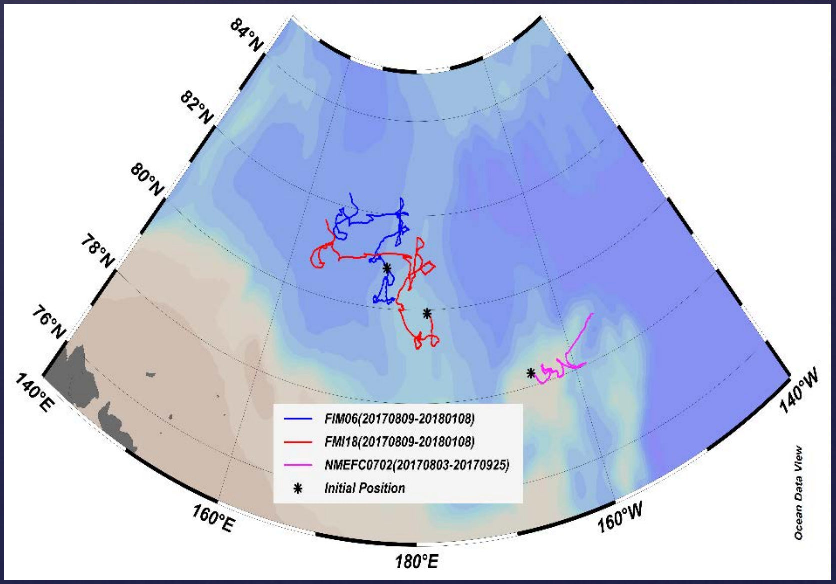
Snow and Ice Mass Balance Arrays (SIMBA) measurements (FMI)

INTAROS

SIMBA Technical configurations
(latest update 2018)

- New GPS chip - better accuracy of drift position.
- A barometer for provision of surface pressure. The measurement has been taken at the same time as GPS positions.
- Inclusion of a magnetometer providing information on tilt (ice break-up/unit disturbance) and rotation/heading. The measurement has been taken at the same time as GPS positions.
- Vertical spatial resolution of thermistor string: 2 cm.
- Additional air temperature sensor for accurate air temperature (2m) measurement.

SIMBA deployment during CHINARE2017 and buoy drift trajectories until 8.01.2018



Task 3.4 Distributed systems for ocean and sea ice:

Snow and Ice Mass Balance Arrays (SIMBA) measurements (FMI)

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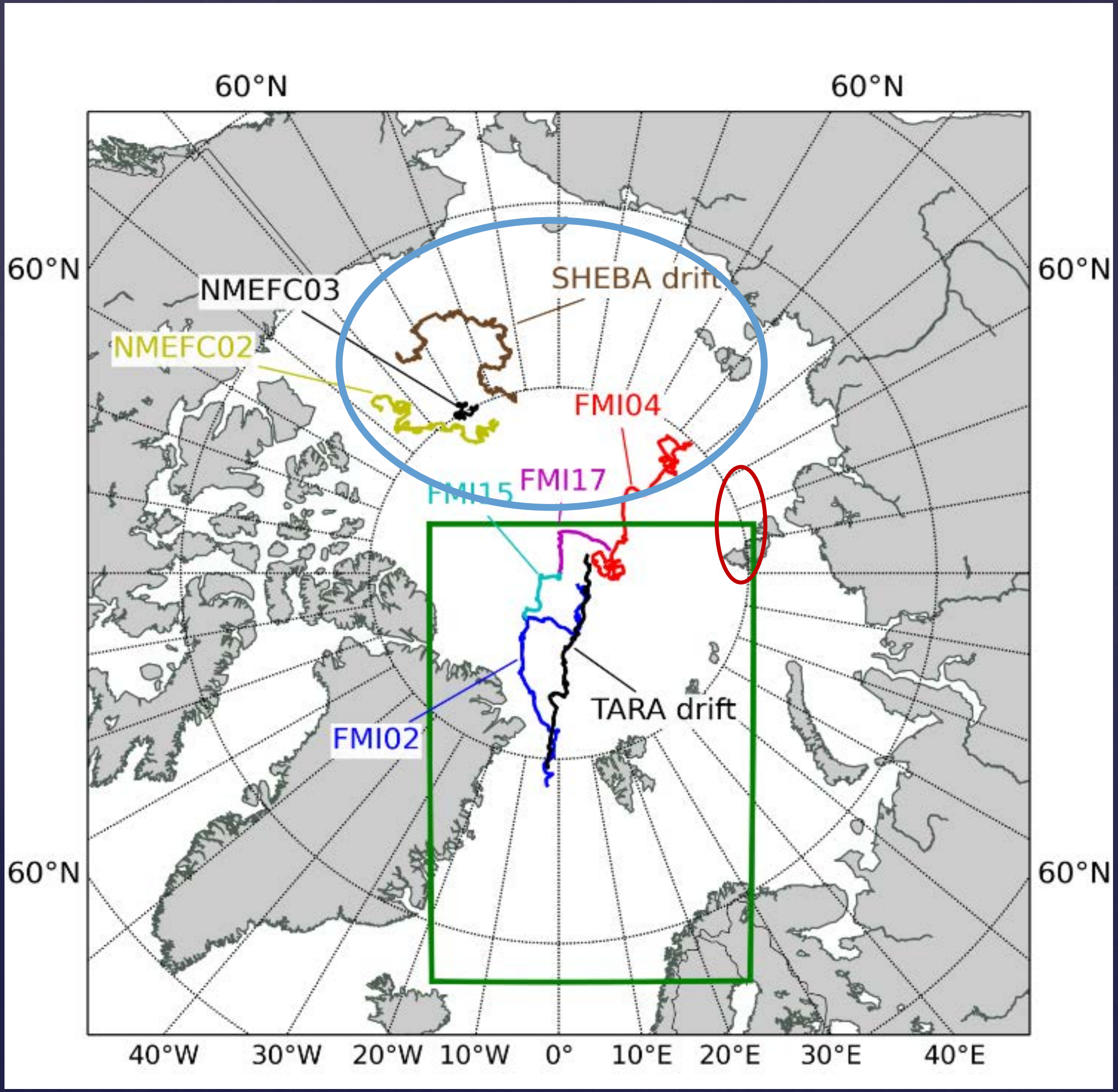


Existing and planned SIMBA deployment domains:

- Chinese Arctic research expedition (CHINARE) major domain
- Russia Ice Base Cape Baranova, land fast ice observation
- NWP model domain: Improve Numerical Weather Prediction (NWP) Model boundary parameterization of snow and sea ice.

We will deploy 8 SIMBA during CHINARE2018 along the cruise trajectory

Task 3.4 Distributed systems for ocean and sea ice:

Endurance glider lines along the Atlantic Water pathways in Fram Strait (CNRS-LOCEAN)

INTAROS

- One Teledyne Slocum glider (CNRS-INSU National Glider Facility) deployed for 2 months (July 25 - September 22, 2017) in the West Spitsbergen Current, Fram Strait
- Deployment by IOPAN from R/V Oceania and recovery by SHOM from N/O Pourquoi Pas ?
- Glider preparation and piloting by DT INSU
- Glider equipped with Seabird T,C,P sensors, optode for DO, Chl-a and CDOM fluorimeters, and optical backscatter for turbidity.
- Dives between surface and 1000 m (or ocean floor if < 1000 m).

Photos : A. Beszczynska

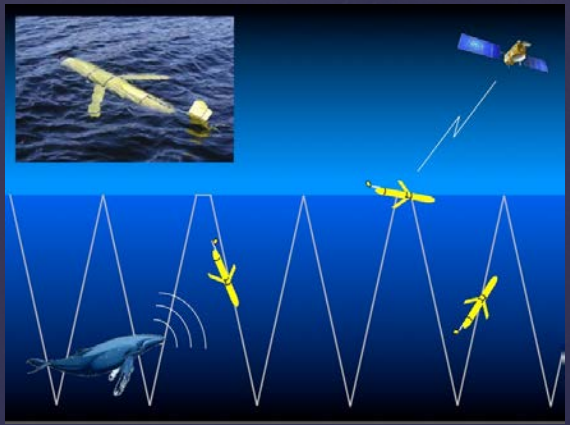
Photos T. Garlan

Task 3.4 Distributed systems for ocean and sea ice:

Endurance glider lines along the Atlantic Water pathways in Fram Strait (CNRS-LOCEAN)

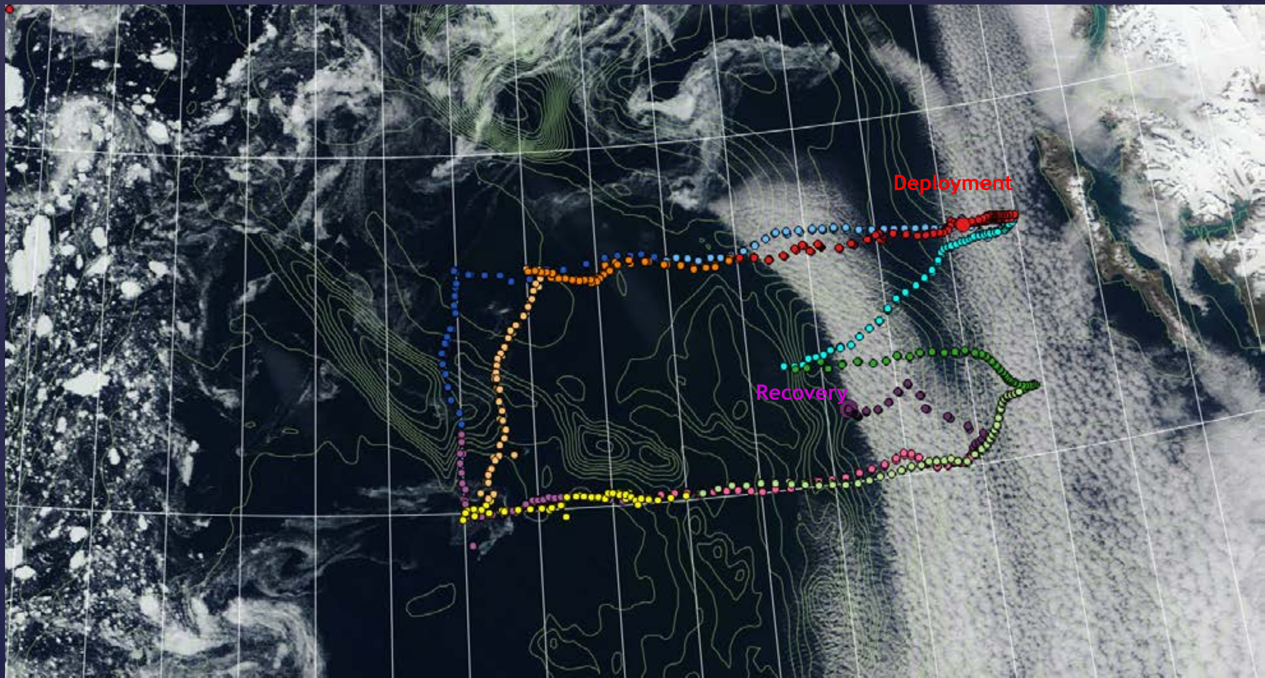
INTAROS

Monitoring the cross-flow structure, meridional changes and recirculations in the eastern Fram Strait



- Two zonal sections (at 78°N and 78° 40'N)
- Two "meridional sections" (over the Svalbard slope and along the ice edge)
- Two repeat quadrangles separated by 1 month

Fram Strait : glider trajectory
2017/07/25 – 2017/09/22, 5-days color change



Task 3.4 Distributed systems for ocean and sea ice:

Endurance glider lines along the Atlantic Water pathways in Fram Strait (CNRS-LOCEAN)

INTAROS

Plans for 2018:

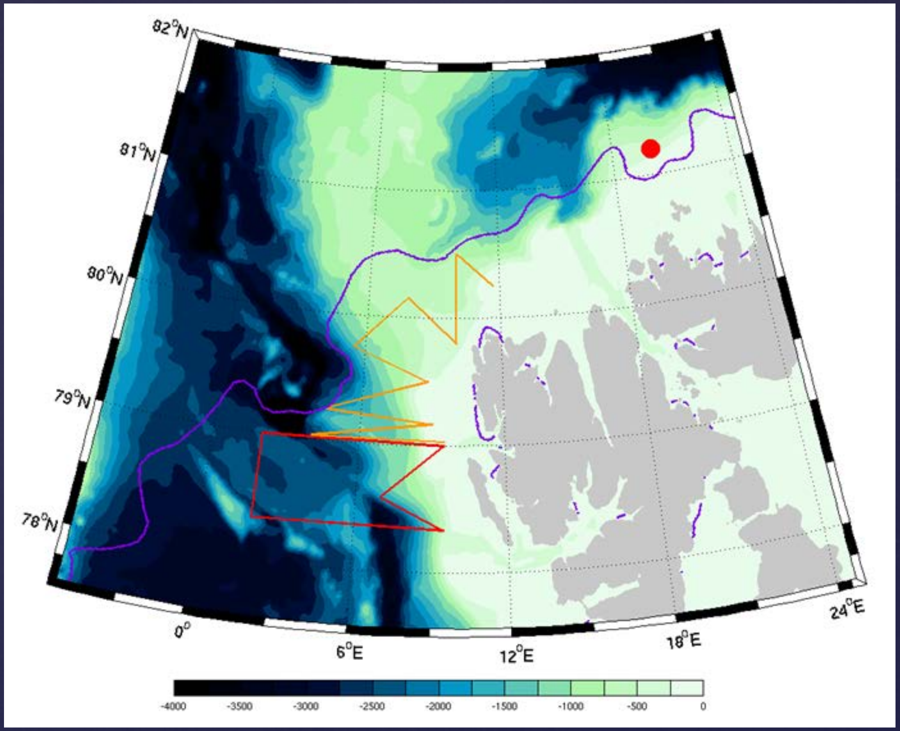
Deployment of 1 (or 2 ?) gliders in Fram Strait and north of Svalbard in summer

- Fram Strait : repeat the 2017 cruise track (August-September)

⟹ Deployment/recovery from Kongsfjorden (proposal French Polar Institute under evaluation)

- North of Svalbard: investigate the Svalbard and Yermak branches of the AW inflow

⟹ Deployment/recovery during the KV Svalbard cruise



Task 3.4 Distributed systems for ocean and sea ice:

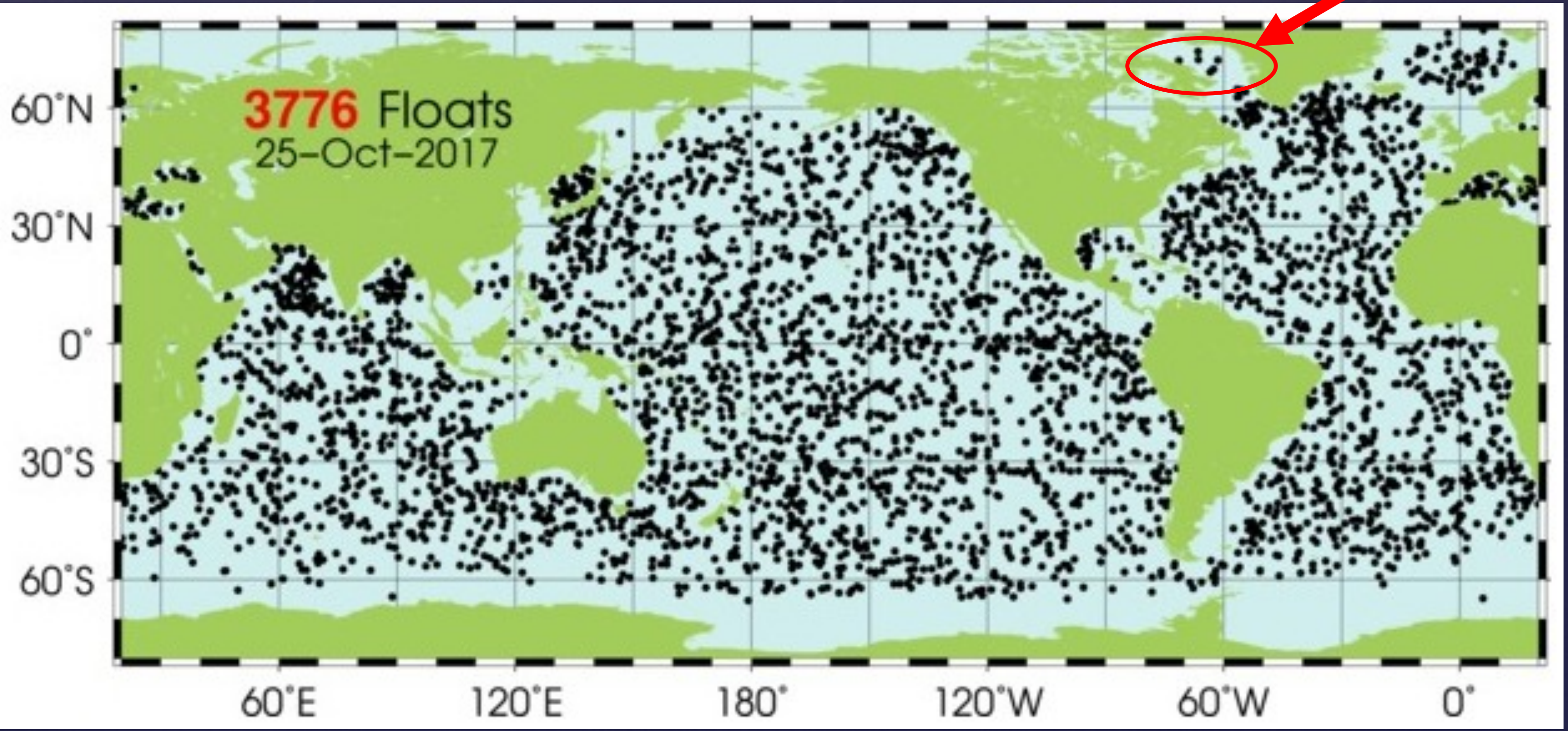
BioArgo floats in Baffin Bay (CNRS-Takuvik)

INTAROS

7 BGC-Argo floats (PRO-ICE) deployed in Baffin Bay in July 2017

O2 / Ed 380, 412 and 490nm + PAR / FL-chl*a* / FL-CDOM / BB / nitrates.

ULaval-CNRS, Canada-France



INTAROS | INNOVATION.CA CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION | NAOS Novel Argo Ocean observing System | ArcticNet | NSERC CRSNG | TAKUVIK | cnrs | UNIVERSITÉ LAVAL

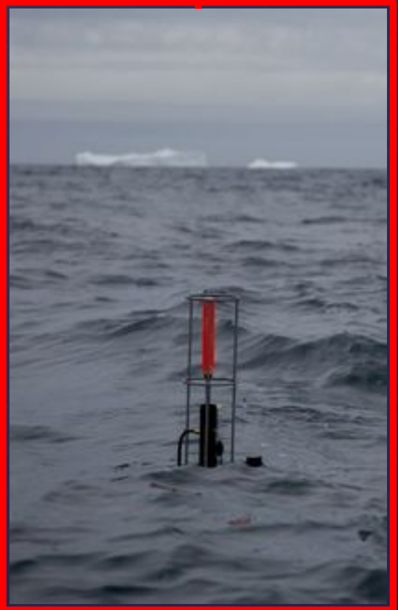
Task 3.4 Distributed systems for ocean and sea ice:

BioArgo floats in Baffin Bay (CNRS-Takuvik)

INTAROS

2018: BGC-Argo floats in Baffin Bay

- 4 BGC-Argo floats to be deployed during the Canadian scientific ice-breaker Amundsen's 2018 campaign
- Validated Biogeochemical database from the GreenEdge expedition available
- Continue research efforts in ice detection for BGC-Argo floats
- Increase international collaboration



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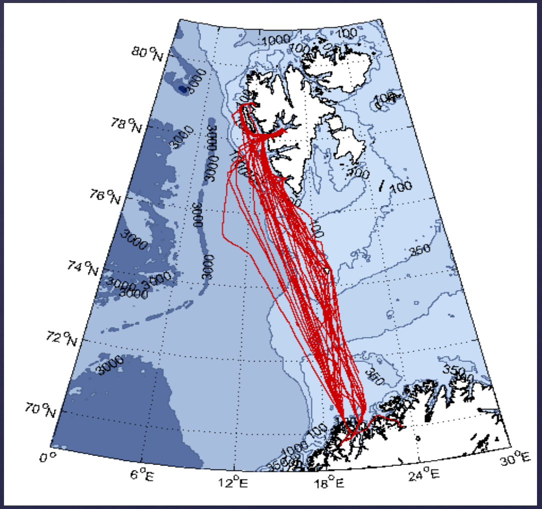
Task 3.4 Distributed systems for ocean and sea ice

Novel sensors for FerryBoxes (NIVA)

INTAROS

30-35 round trips/year



Barents Sea opening FerryBox biogeochemical sensors

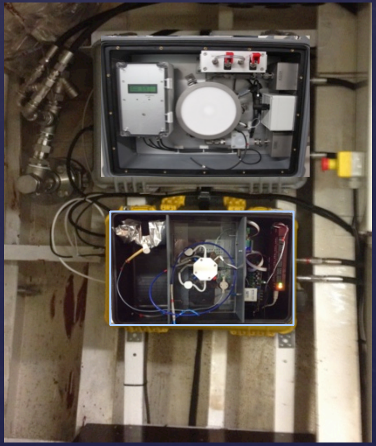
- pH/CO3 sensor - fabrication and development underway. We are aiming for late 2017 deployment.
- multi-wavelength spectral absorbance sensor - we are in the process of purchasing this from the sensor company TriOS. Also aiming for deployment by the end of 2017.

Barents Sea opening FerryBox microplastics sampler

- Plans and drawings have been made.
  Prototype version from Equatorial Pacific project re-designed.
- Aiming for late 2017/early 2018 deployment.

The core FerryBox system is operational and core observations (S, T, chl, O2, turbidity) are ongoing.

Task 3.4 sensors/samplers to be ready for the 2018 field season.



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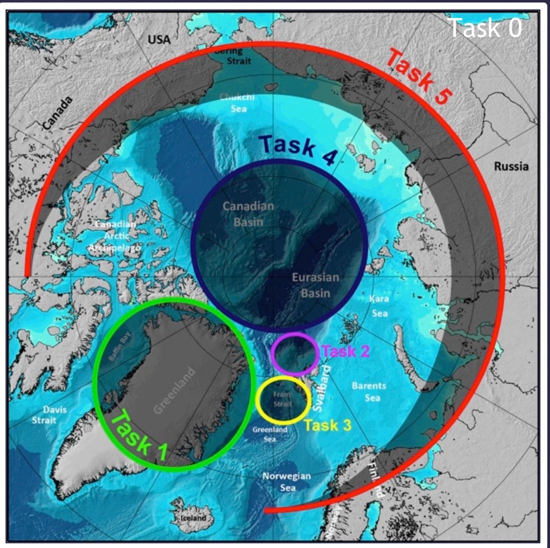
WP3 *In situ* observing systems

Task 3.5
Distributed systems for atmosphere and land:

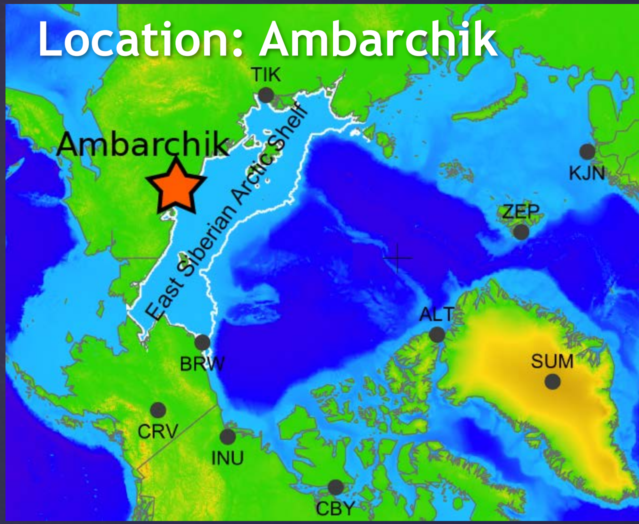


- extending continuous monitoring of atmospheric GHGs with additional trace gases and isotopes measurements (automated flask sampling system) (MPG)
- vertical profiles of ABL state variables from airborne measurements along the Alaskan and Canadian Arctic (GFZ)
- de-icing system for atmospheric instruments, novel temperature sensing system, new soil diffusivity system for trace gases in the Barrow site cluster (OU, USFD)
- novel *in situ* and remote sensing of snow physical properties along a latitudinal transect in the Eastern Canadian Arctic, drone-based pulsed LIDAR observations (CNRS-Takuvik)
- improved ground-truthing of satellite remote sensing products in the Northern Finland (automatic spectro-albedometer, VNA-based radar system to monitor soil, snow and surface vegetation properties) (FMI)
- semi-autonomous system for atmospheric observations in the central Arctic for icebreaker Oden and SOOs (MISU)

Task 3.5 Distributed systems for atmosphere and land:

GHG automated flask sampling system (MPG)

- Extend existing observation program: CH_4, CO_2 (cont.)
- Separate emission sources based on isotope data (e.g. $^{13}C\text{-}CO_2$, $^{13}C\text{-}CH_4$, $^{2}H\text{-}CH_4$, ..)
- Evaluate and improve atmospheric transport model results using multiple species fingerprints (e.g. SF_6, N_2O, O_2/N_2, ..)



- Instrument customized, ordered at ICOS lab
- Test runs with prototypes underway
  - Collaboration with ICOS to upgrade software
- Delay in production requires re-scheduling
  - Original installation planned for late summer 2018
  - Now, instrument likely be completed ~Jul 2018
    - Too late for test runs, shipment to Siberia
  - Extensive test runs planned in Jena for 2018/19
  - Installation in Ambarchik in early summer 2019

Collect gas samples (1-3L)

- At fixed intervals
- For specific boundary conditions (e.g. wind direction)
- Integrated over longer periods

Semi-autonomous operation

Task 3.5 Distributed systems for atmosphere and land:

Eddy-covariance towers with de-icing system, soil diffusivity system (Uni Exeter)

Importance of cold period

need to keep the instruments ice free

De-icing of sonic anemometers:

- Uni Exeter still waiting for the heated CSAT-3
- Instrument will be tested in the field in summer 2019

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Task 3.5 Distributed systems for atmosphere and land:

High-resolution temperature sensing systems (Sheffield)

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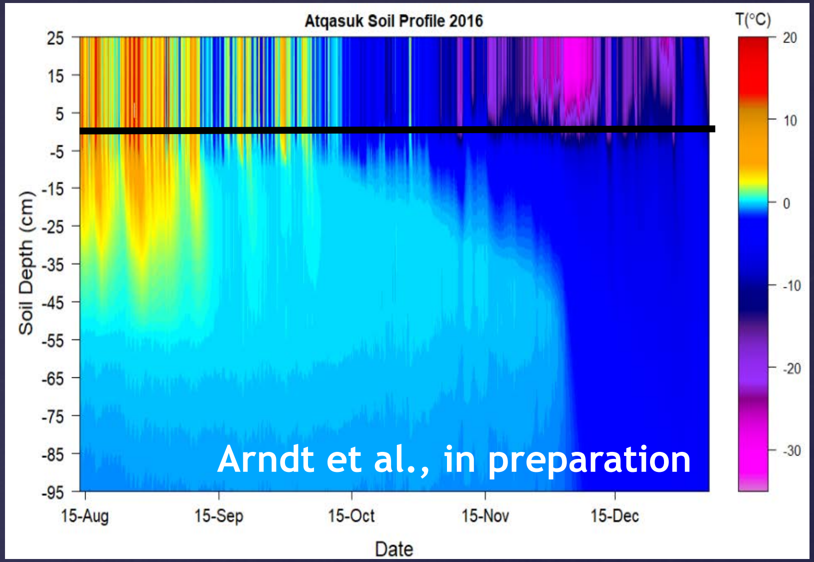
High resolution temperature profile:
thermocouples are located every 5 cm which will enable continuous measurement of water table and thaw depth



Plans for 2018

- Install another profile system in another site and estimate difference
- Look at interannual variability
- Evaluate if we can resolve also the water table level

Task 3.5 Distributed systems for atmosphere and land:
Thermal and carbon budget of permafrost (CNRS-Takuvik)

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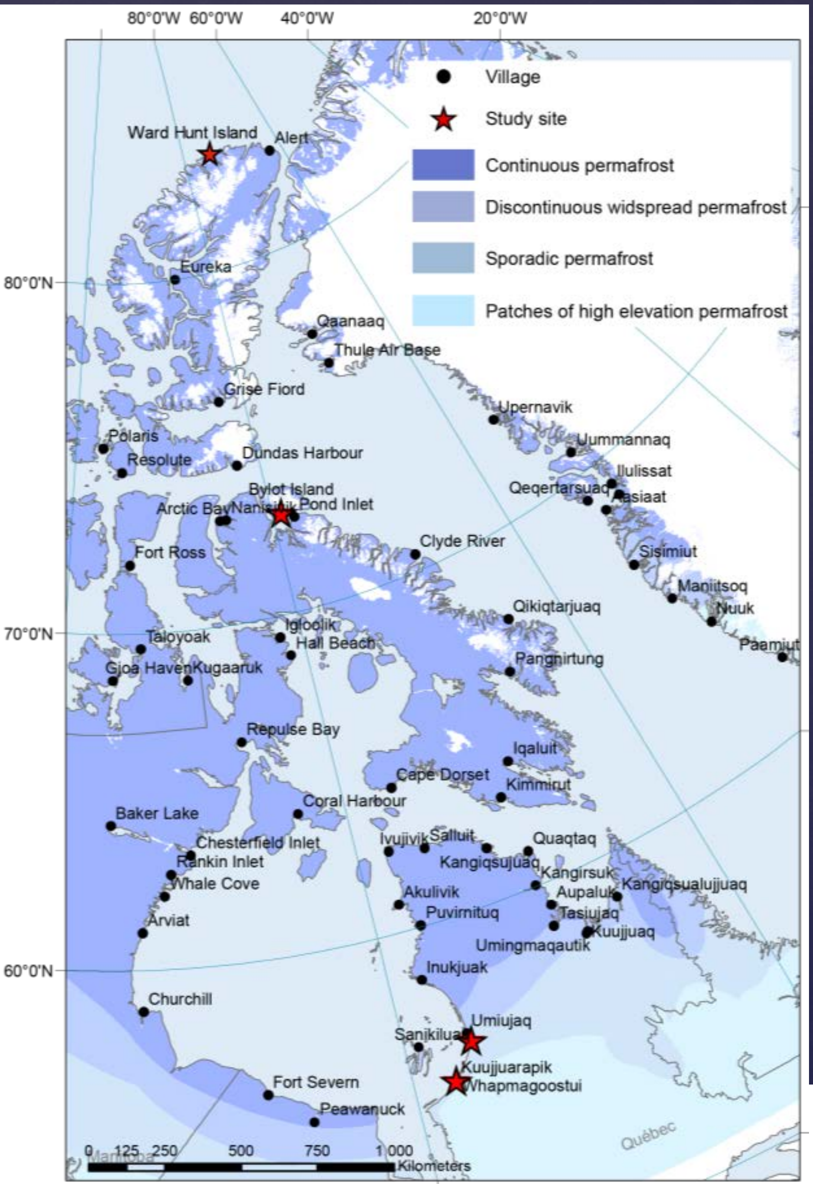

4 sites in the Canadian Arctic: 55, 56, 73 and 83°N

Monitoring of:

- Air T, RH, wind, radiation
- Snow temperature, thermal conductivity, height
- Soil temperature, therm. conduct., water content

Field campaign measurement of:

- Snow density
- Soil carbon
- Vegetation biomass

Modeling of:

- Permafrost thermal regime

TAKUVIK cnrs UNIVERSITÉ LAVAL NSERC CRSNG ArcticNet ᐅᐸᐅᖅᑕᖅᑐᒥᒃ ᑐᑭᓯᓂᐊᖃᑎᖦ

Task 3.5 Distributed systems for atmosphere and land:

Thermal and carbon budget of permafrost (CNRS-Takuvik)

Plans for 2018:

Relationship between vegetation height and snow height: drone-borne lidar study
⇨ impact of shrub growth on permafrost thermal regime

Impact of shrub growth on soil carbon stocks
⇨ Can shrub growth mitigate permafrost GHG emissions?

Continued monitoring of snow and soil physical variables
⇨ Observation of a wide range of meteorological conditions (e.g. melting events)

Modeling of permafrost thermal regime with novel feedbacks
⇨ Improved prediction of permafrost thermal evolution (and GHG emissions)

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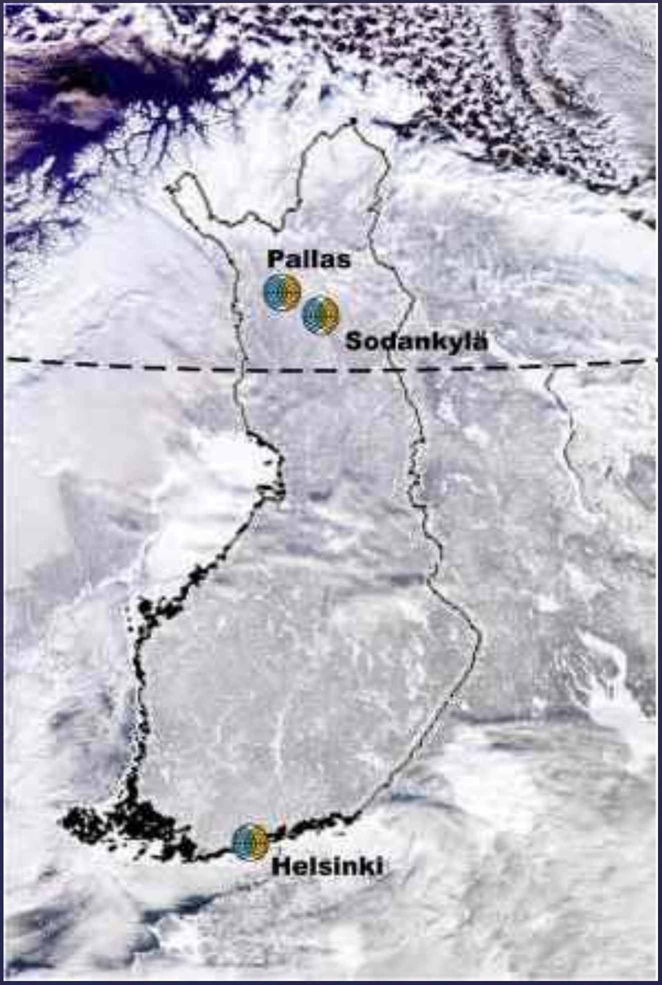
Task 3.5 Distributed systems for atmosphere and land:

Sodankylä-Pallas Supersite (FMI)

Increase the observational capability by integrating novel instruments to the present infrastructure:

- automatic spectro-albedometer,
- fully polarimetric VNA-based radar,
- network of standardized but low-cost measurement stations for tracking snow and soil at spatial scale of satellite observations (cal/val).

For the new instruments we will develop the data acquisition and processing chain.



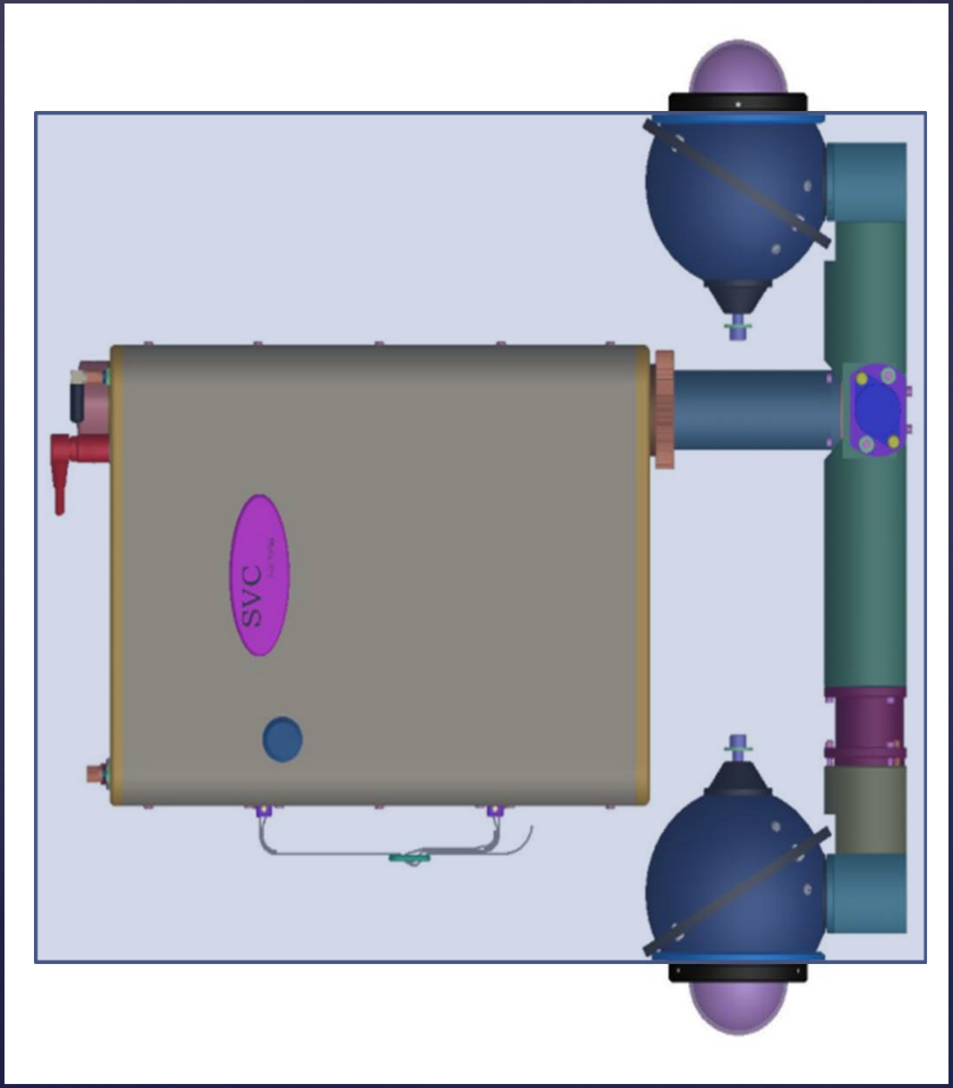
Present:

- Snow Brightness temperature
- Snow backscattering
- Snow VIS-NIR reflectance
- Snow broadband albedo
- Snow temperature profile
- Snow depth
- Snow water equivalent
- Manual snow measurements (vertical profile od density, grain size and shape, specific surface area)
- Soil temperature and moisture profiles

New:

- Snow Spectral albedo
- Spatial variability of snow macrophysical properties

Task 3.5 Distributed systems for atmosphere and land:
Sodankylä-Pallas Supersite (FMI)



DUAL SPHERE SPECTRO-ALBEDOMETER

Continuous albedo measurements at high temporal resolution (min) and high spectral resolution (3-10nm in the range 350-2500nm)

The instrument was bought/built with FMI internal resources.

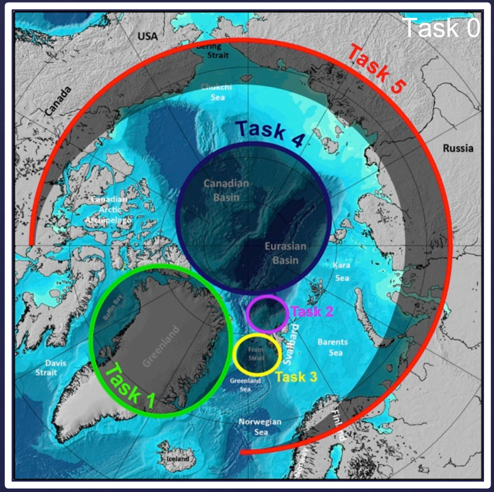
For INTAROS it will be tested in the radiometric lab and in the field, possibly during winter 2017/18.

It will be then installed in Sodankylä.

WP3 *In situ* observing systems

Next steps in WP3:

- Review of all planned activities (WP3 breakout session tomorrow)
- Review of ship time for 2018 (secured, applied for, still needed)
- Online meetings of the task teams to discuss details of preparations for the first INTAROS field season 2018-2019
- Conclude tenders and acquire INTAROS equipment
- Development of new technologies, integration of multidisciplinary sensors for autonomous in situ monitoring systems (M6-M18)
- Design of observing systems/components for each reference site and distributed observatory, testing phase (M6-M18)




THANK YOU FOR YOUR ATTENTION
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