BIO-ARGO FLOATS IN THE ARCTIC OCEA

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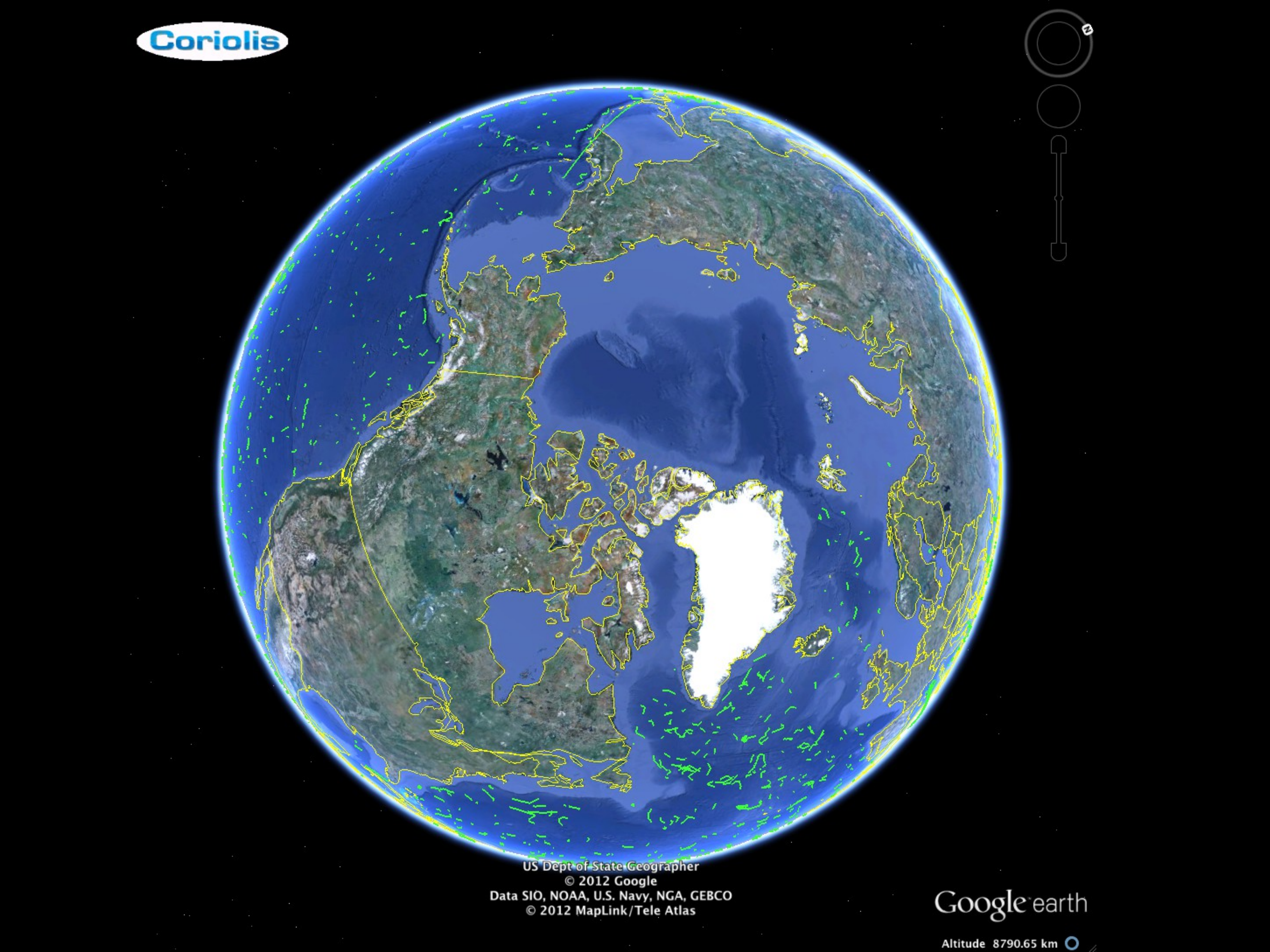
Presented by: M. Babin

TAKUVIK LOV cnrs UNIVERSITÉ LAVAL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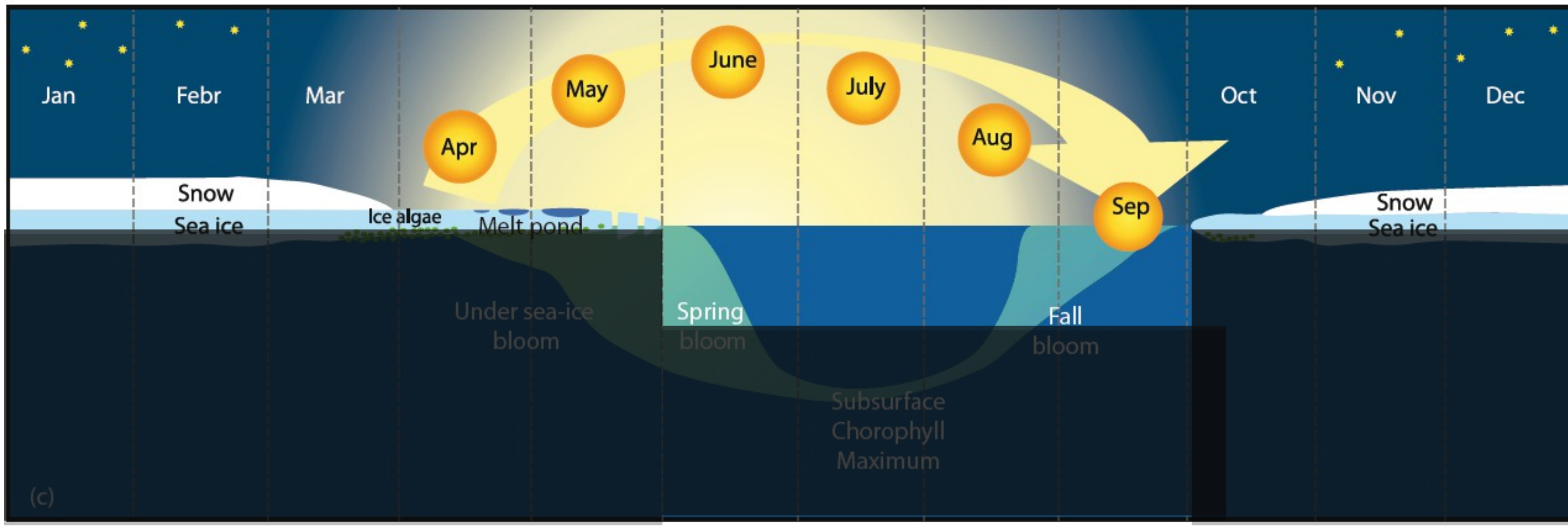
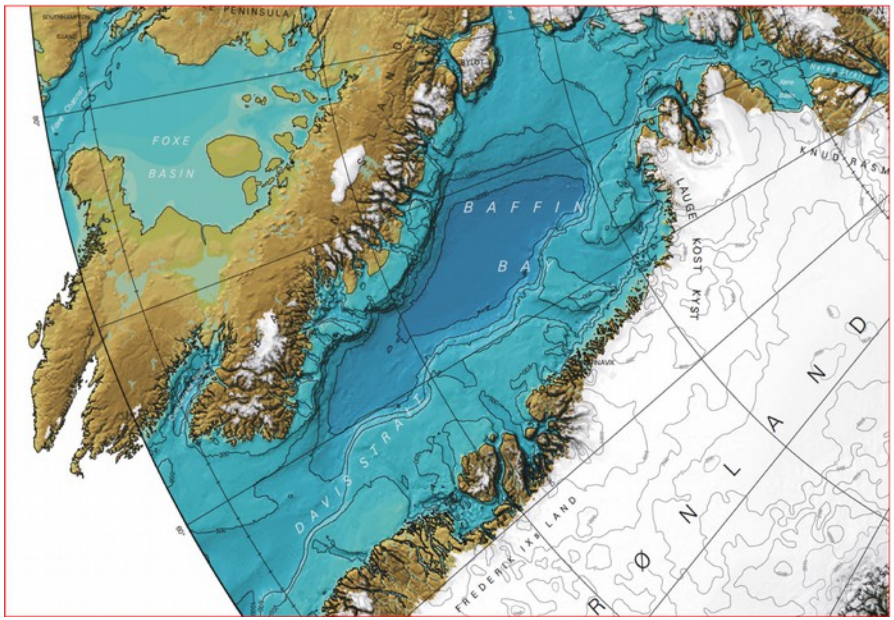
Altitude 8790.65 km

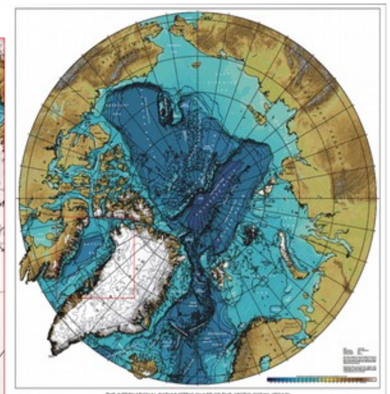
To understand the dynamics of the phytoplankton spring bloom in Arctic



BIO-ARGO floats in Arctic Ocean

Where?





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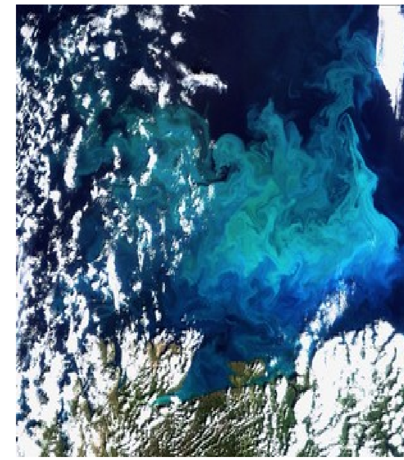

Why the Baffin Bay? : Ice edge blooms are systematically observed there. And, observations by Ocean Remote Sensing show that the spring blooms occur now 50 days earlier than in1997.

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Novel Argo Ocean observing System

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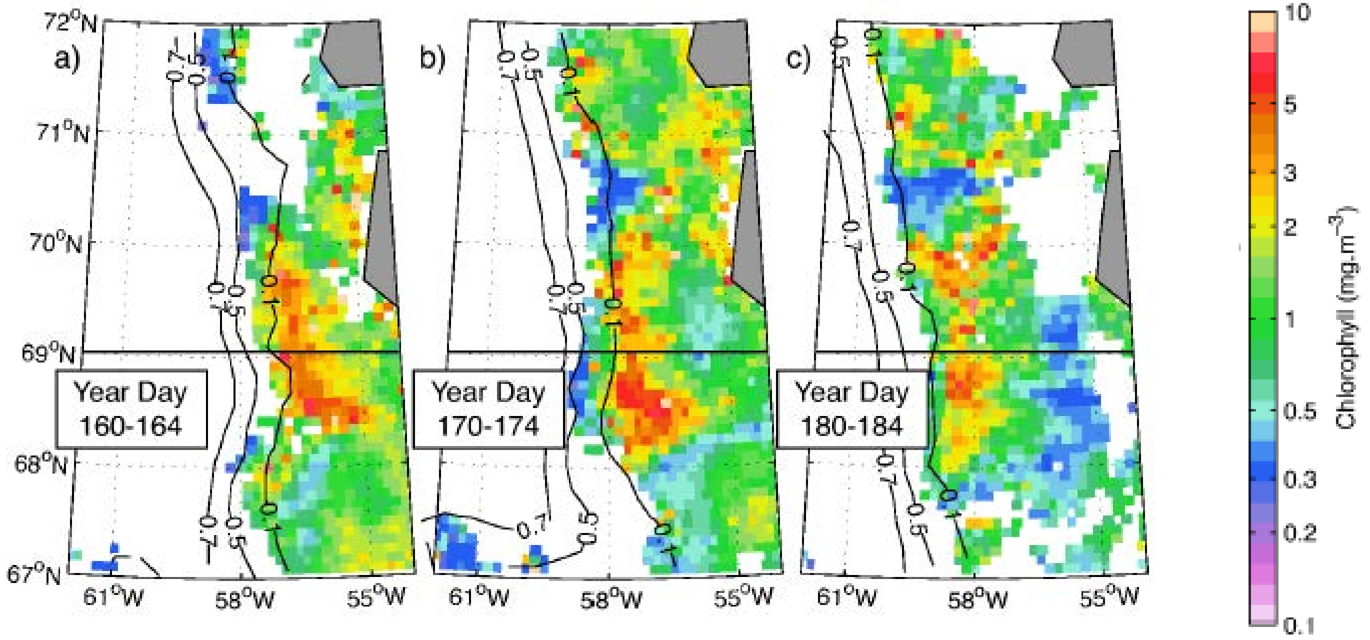

Perrette et al. 2011)

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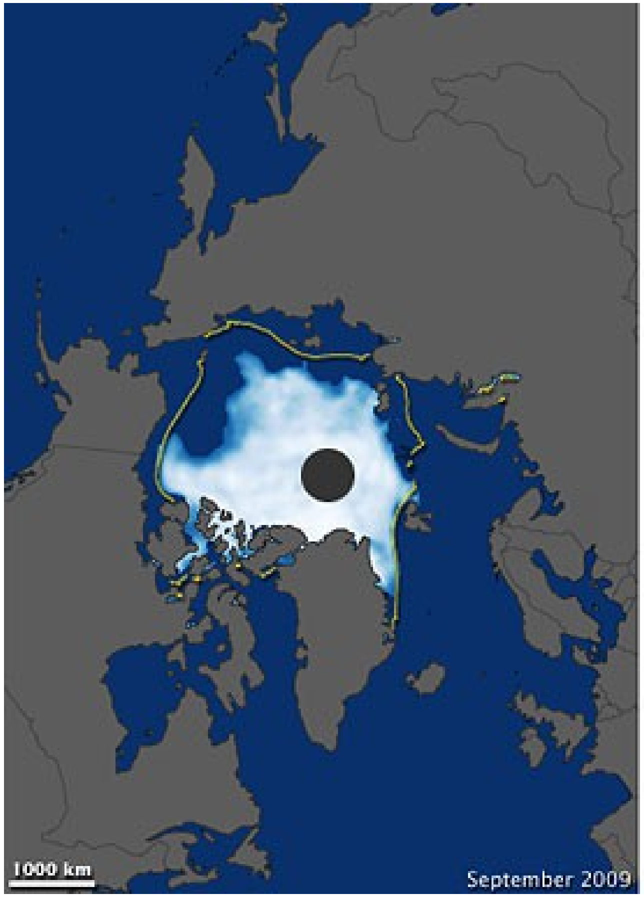
Sea ice



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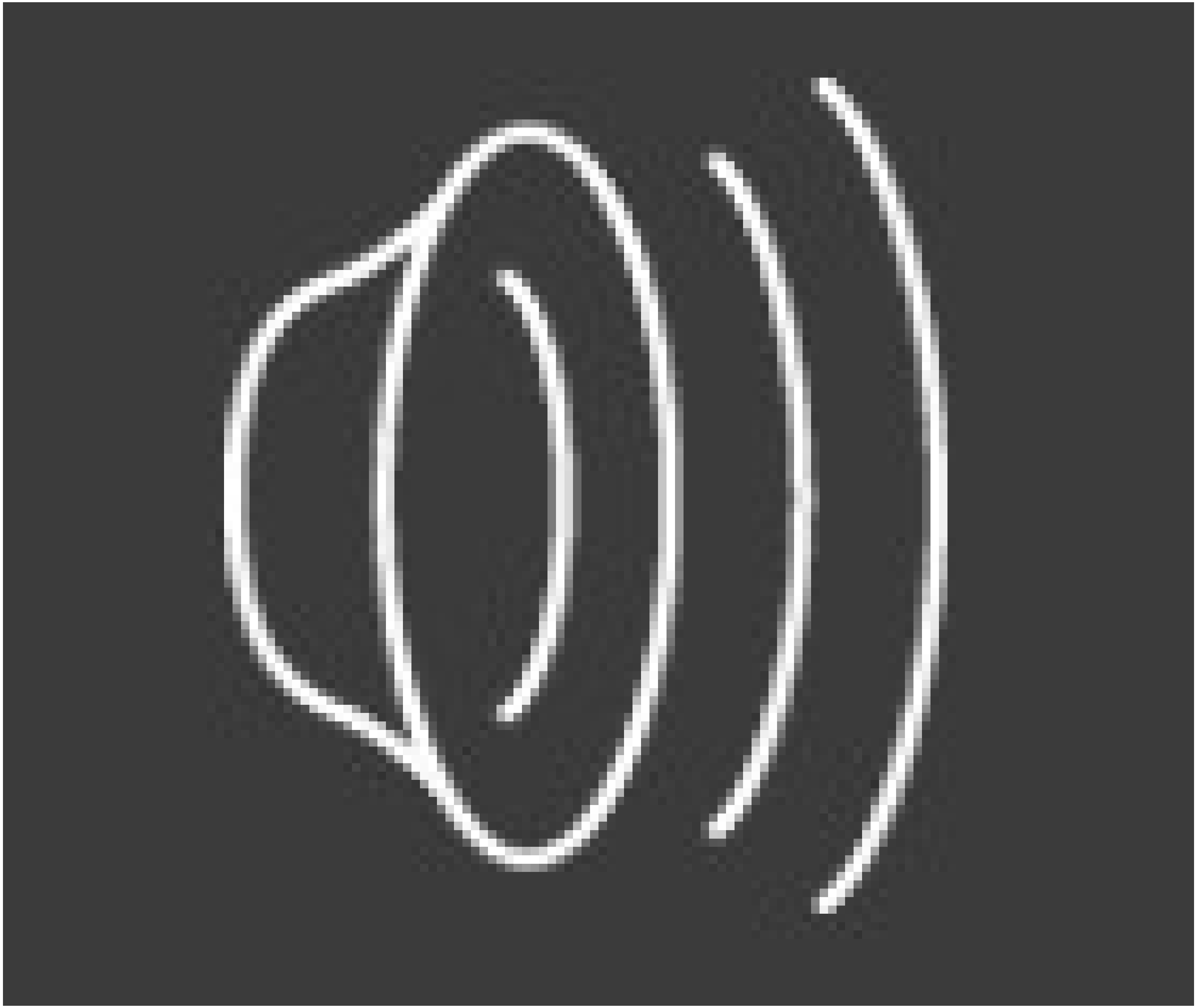

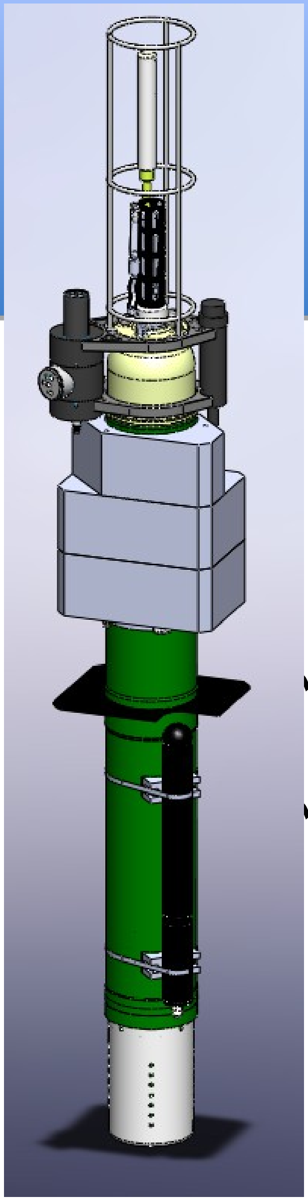

BIO-ARGO floats in Arctic Ocean

How?

Provor CTS5* (CTD O2**) + additional payload:

- ✓ SUNA (nitrates)
- ✓ OCR 504 (Ed 3 wavelengths: 380, 410, 490nm) + PAR (400-700nm)
- ✓ FLBBCD (fluo chl*a*, fluo CDOM, backscattering)

* New generation of NKE float

** Aanderaa Optode

Credit LOV

Ice avoidance

BIO-ARGO floats in Arctic Ocean

Challenge : sea-ice detection

Main issue in icy waters: detecting ice
if present, to postpone the surfacing of the floats.

Sea-ice detection techniques: complementary,
each contributing to different situations and ranges.

- ISA (Ice Sensing Algorithm)
- Active acoustic technique
- Optical technique

Credit AWI

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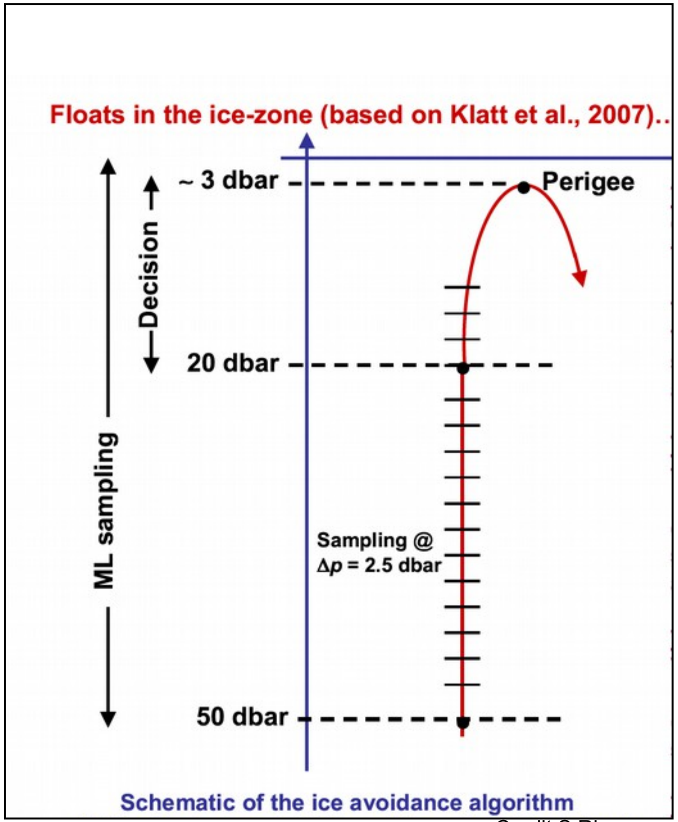
Ice detection

- **ISA:** Ice Sensing Algorithm (Klatt et al 2007) adapted to Baffin Bay conditions to detect sea ice
- Active acoustic (altimeter range 100m) for detection of icebergs and thick sea-ice
- Optical sensor detection (close range: 20m) to detect thin sea-ice



Credit S.Riser

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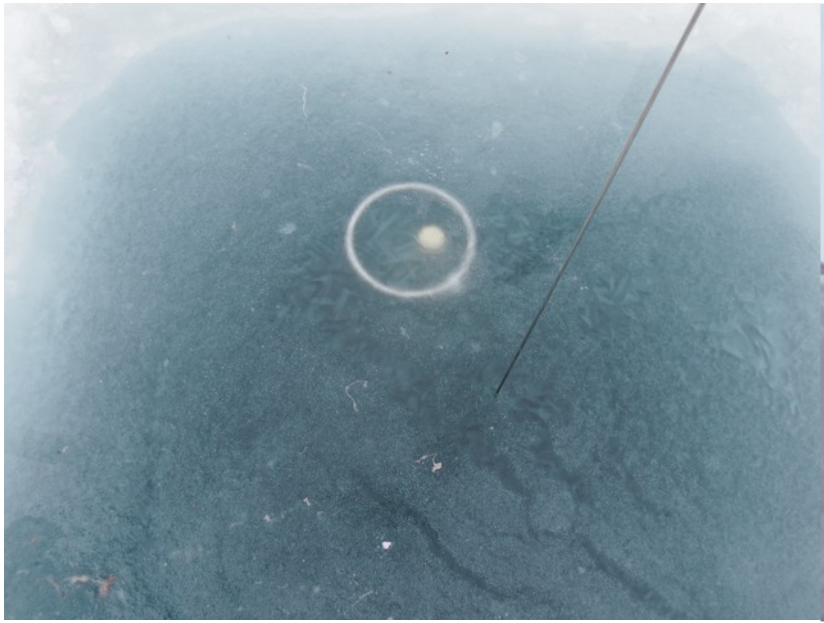
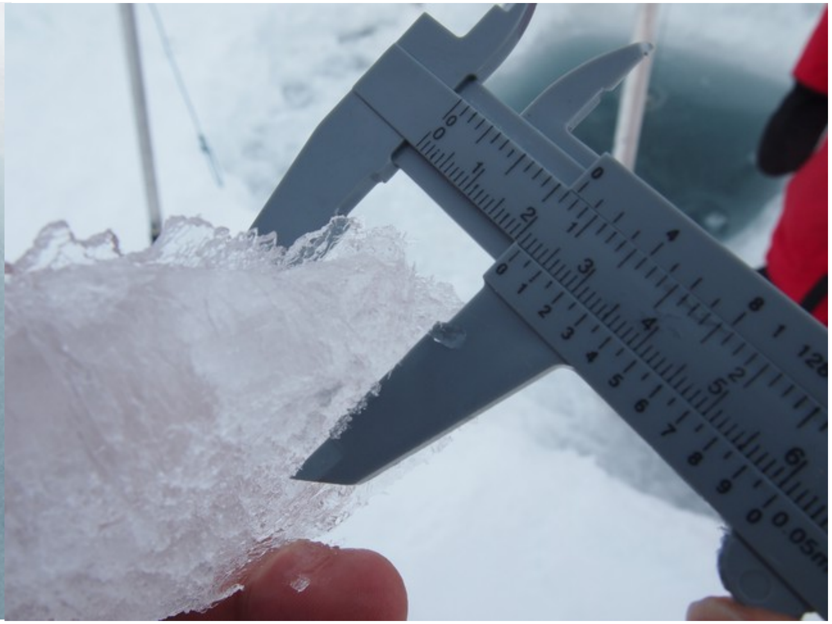
Ice detection



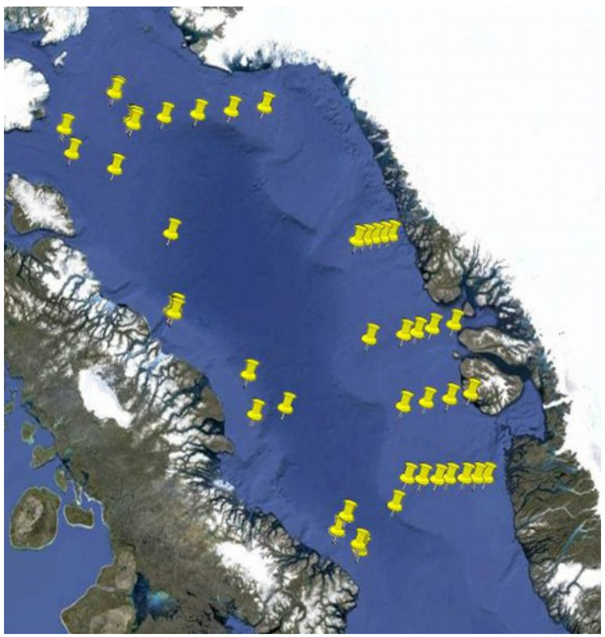


An ice layer as thin as 2 cm. (0.81 in.) prevents the float from surfacing. The Floats has only a 500-600 g pull when ascending.

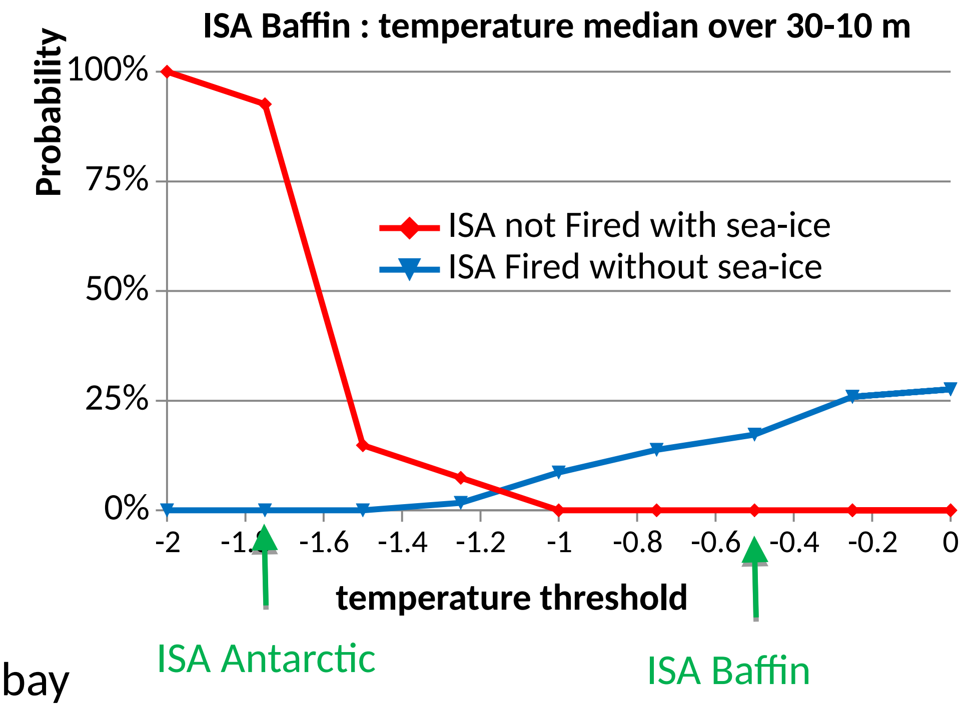
BIO-ARGO floats in Arctic Ocean

- **ISA:** Ice Sensing Algorithm(Klatt et al 2007)

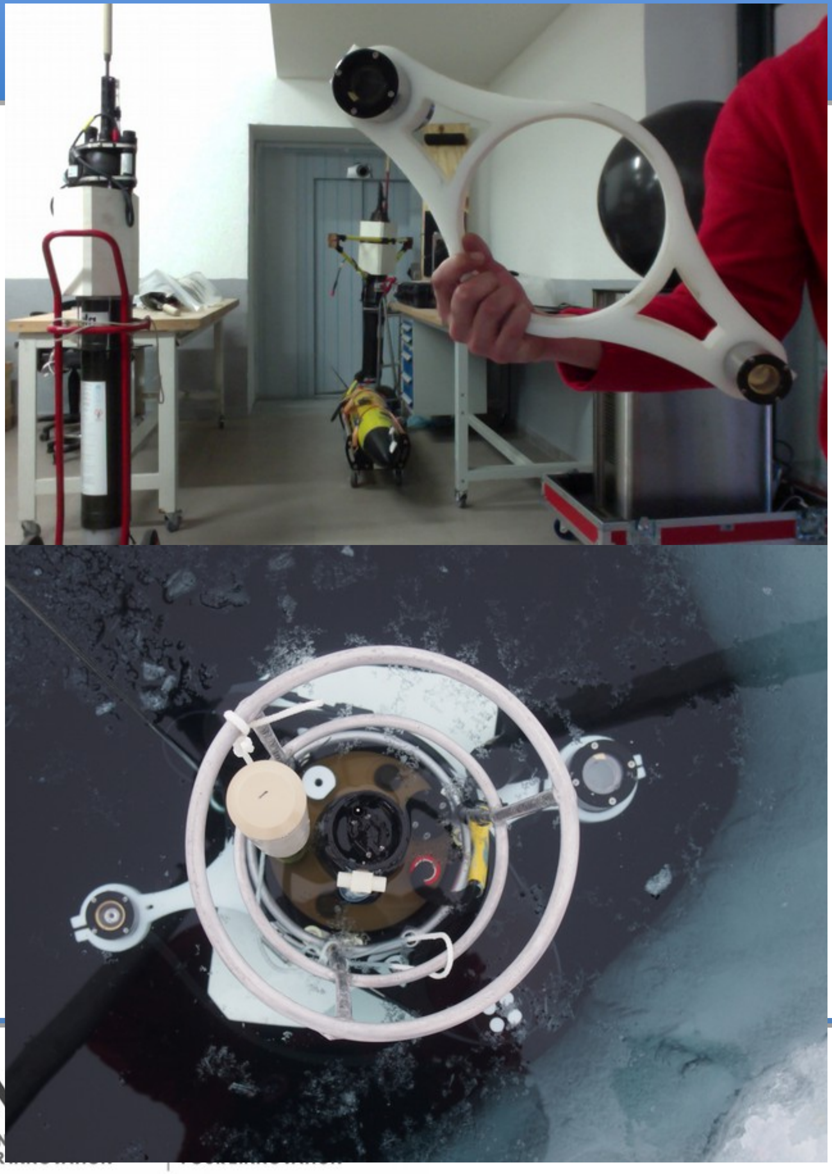
Adapted to Baffin Bay conditions. Dedicated to sea-ice detection



CTD profiles used to adapte ISA to Baffin bay

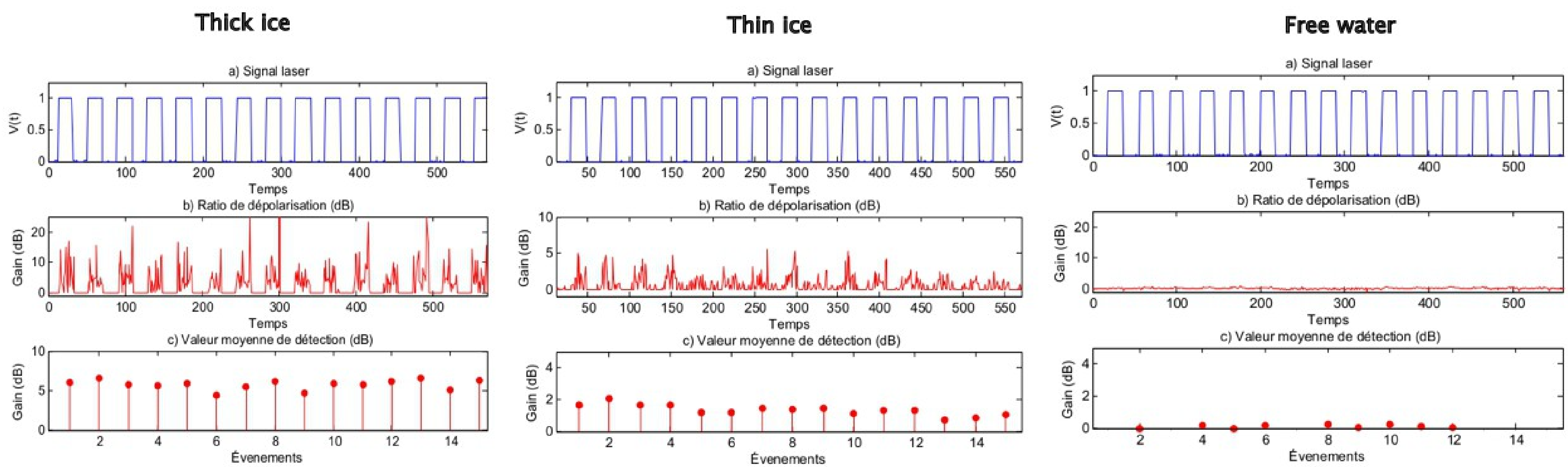


Ice detection by laser depolarization



- Sea ice depolarizes light.
- **Ice detection system :** Linearly polarized source (500 mW @ 532 nm) + Optical detector (polarizing beamsplitter)
- **Optical detector :**Two amplified photodiodes are used to receive the vertical (Ep) and horizontal (Es) components separated by the polarizing beamsplitter.
- The ratio Es/Ep indicates the presence or absence of sea ice in the surface

Previous Results



Next on the timeline

- Find and set an efficient ice detection depth for BioArgo floats.
- Reduce weight (currently the housings are made of stainless steel).

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ENHANCED FEATURES:

Sea-ice detection will benefit of enhanced features of the new generation of floats, designed under the NAOS project especially using the **feedback between the sensors and the vector** (LOV).

Use of **iridium** communication:

- Shortened surfacing time (high volume of data)
- **Two-way** iridium communication modify the schedule by remote operator

- **Storage** of data in case no surfacing is possible for transmission
- Modification of the mission without communication (date criteria)
- Protective frame for sensors

TESTS

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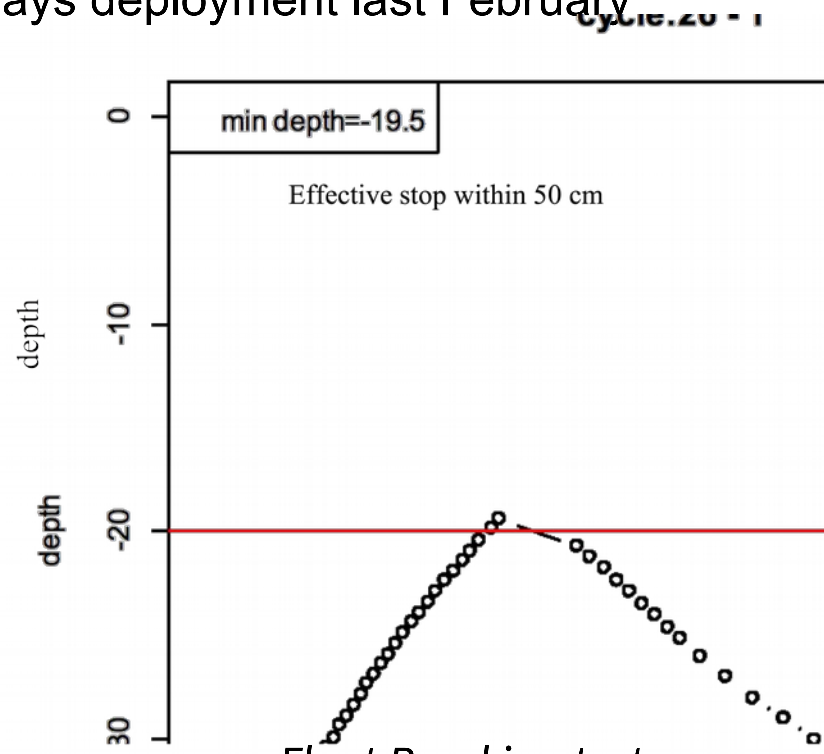
Tests: general functioning in the Med sea : 10 days deployment last February

10 days out of Villefranche



Float Breaking test

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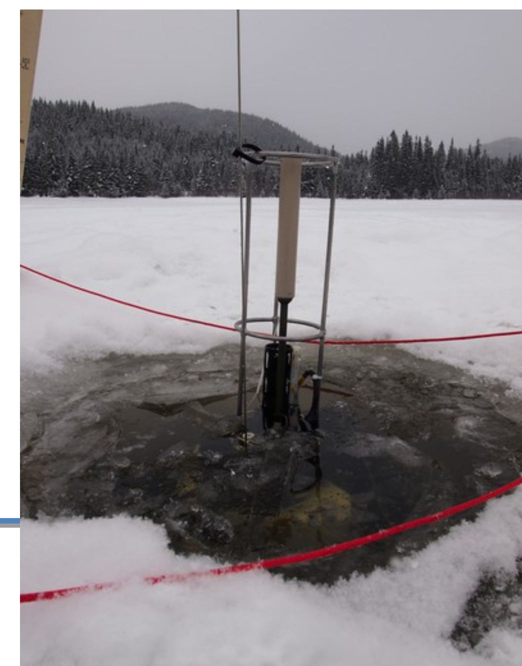
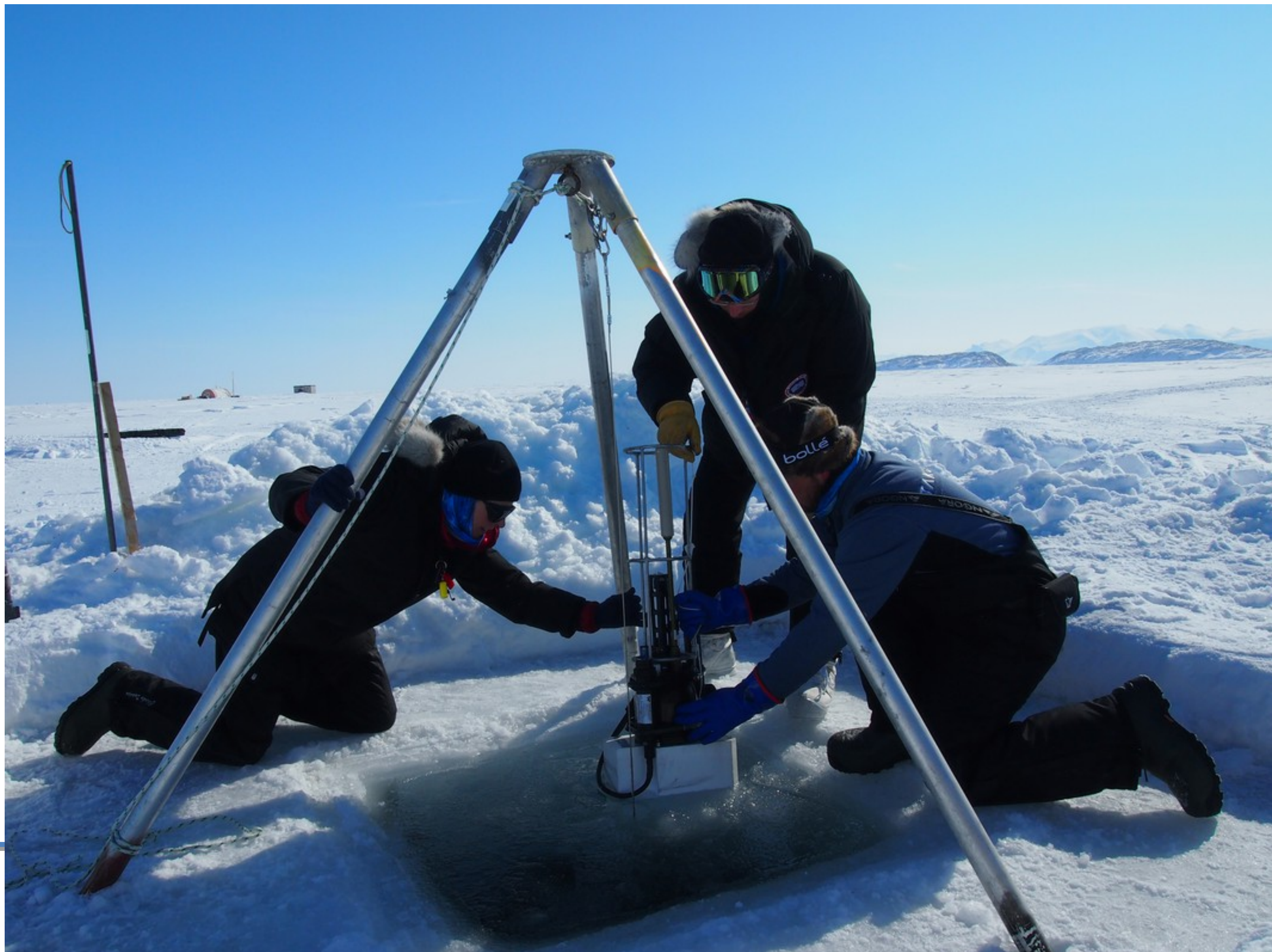
Tests: behaviour of the float and sensors in cold conditions during 2 experiments

- During wintertime (feb 2015) in a lake close to Quebec City - freshwater – in a captive mode
- Profiling to and from 8 m
- All sensors were active during ascension & performed well

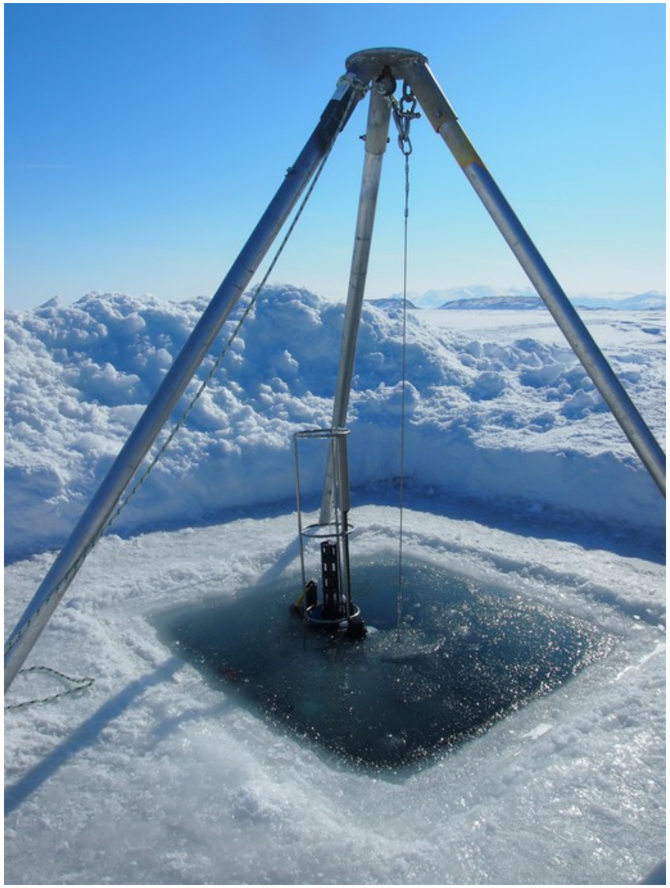


BioArgo float tests during GreenEdge 2015
Qikiqtarjuaq, Nunavut



A BioArgo float was deployed on a mooring line during the Green Edge 2015 Ice camp campaign.

BioArgo float tests during GreenEdge 2015
Qikiqtarjuaq, Nunavut



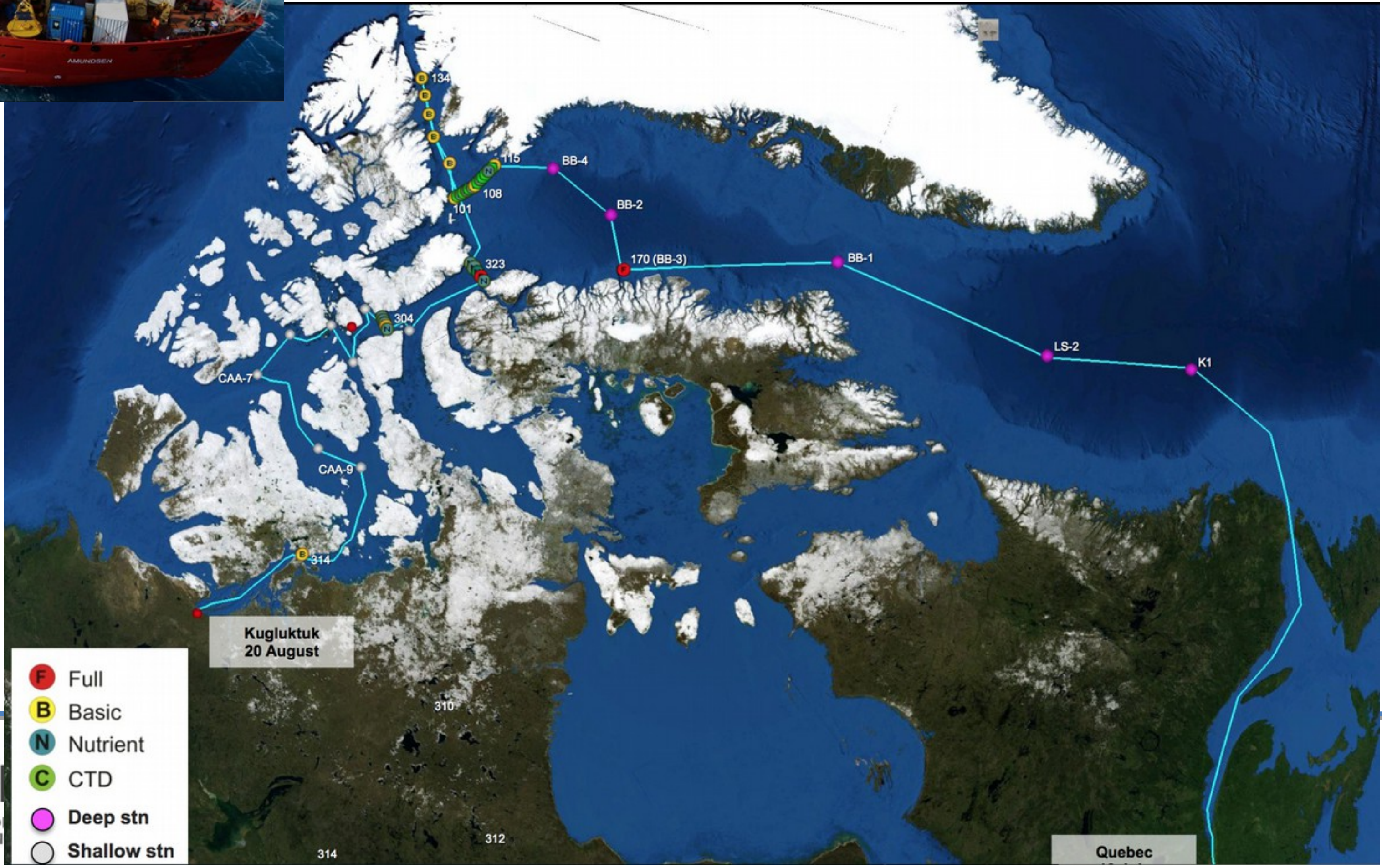
Environment
- Water temperature : -1.7 deg C
- Surface temperature : -20 to -30 deg. C
- Snow layer : 40 cm
- Ice thickness : 110 cm
- Bottom depth : 360 m

Tests:
- Profiled to and from 80 m
- All sensors were active during ascension and performed well

Planned deployments

BIO-ARGO floats in Arctic Ocean

Upcoming deployments:
summer 2015: 4 Pro-ice floats (stations BB4, BB2)



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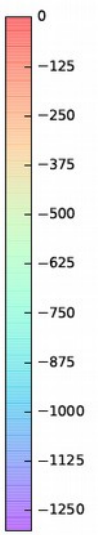
BIO-ARGO floats in Arctic Ocean

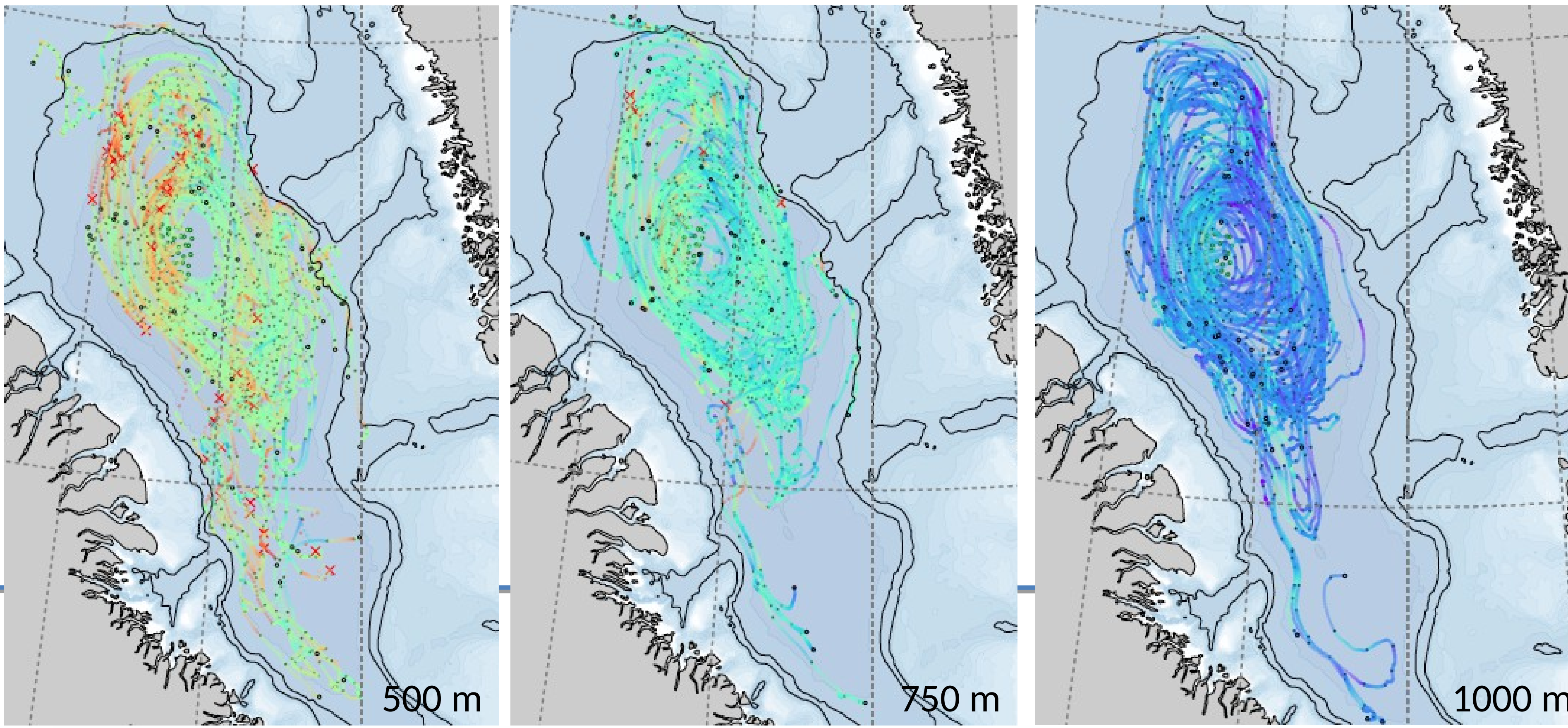
Upcoming deployments: 20 floats (12 NAOS + 8 FCI)

- ✓ Summer 2015: 4 Pro-ice floats (stations BB4, BB2)
- ✓ Summer 2016 / summer 2017: 16 Pro-ice floats



BB2: 500m, 750m, 1000m (21 d)

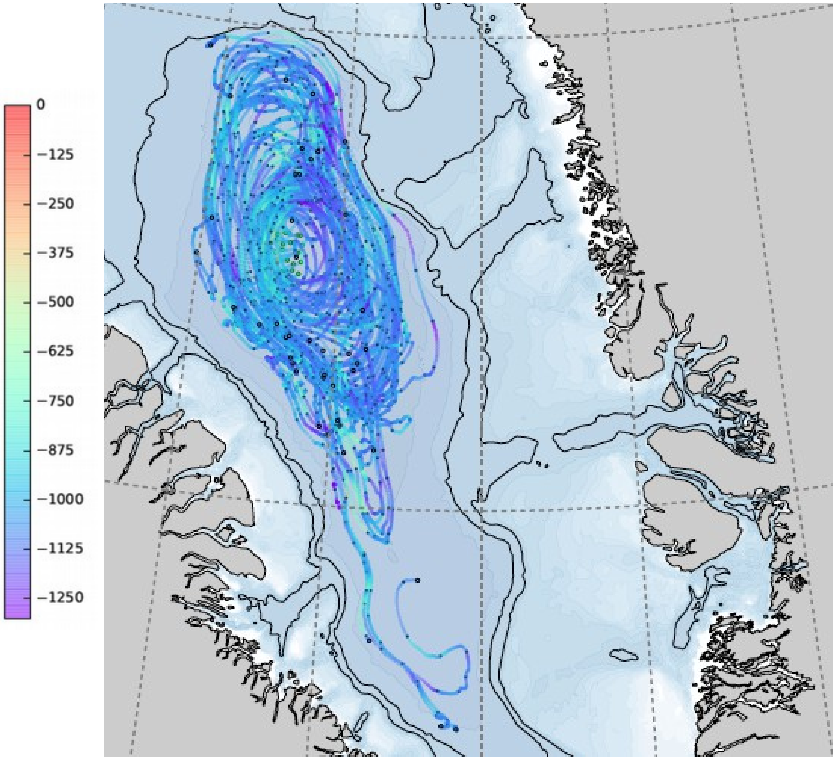
Note that probability of ejection to Labrador Sea via southern trajectories is reduced with increasing drift/profiling depth.



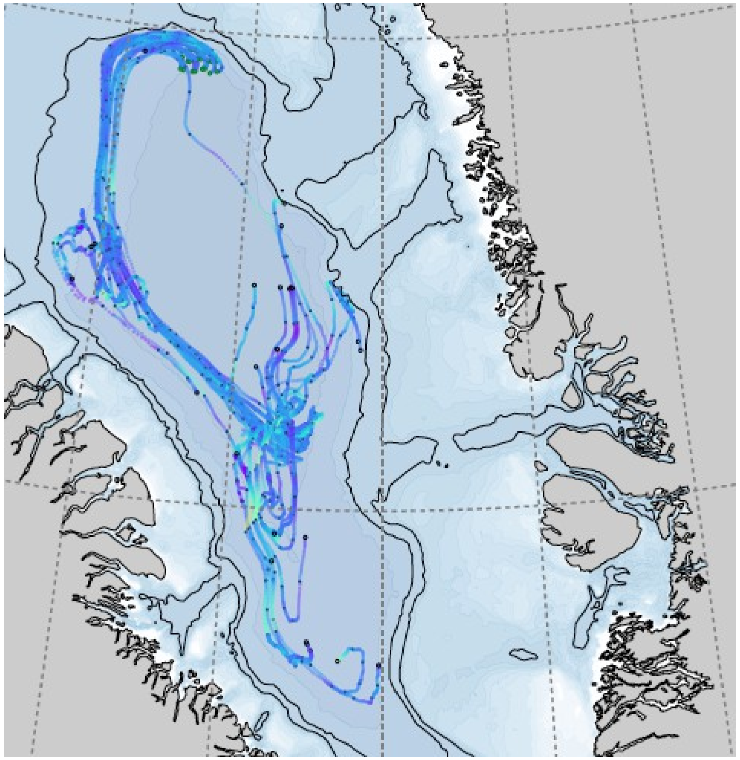
1. Reset Zp = 1000m every 21d

Notes: Vertical excursions are greatly reduced. Duration is ~ 580 d.
Launch location makes a big difference. BB4 = 50% coast crashes.

BB2



BB4



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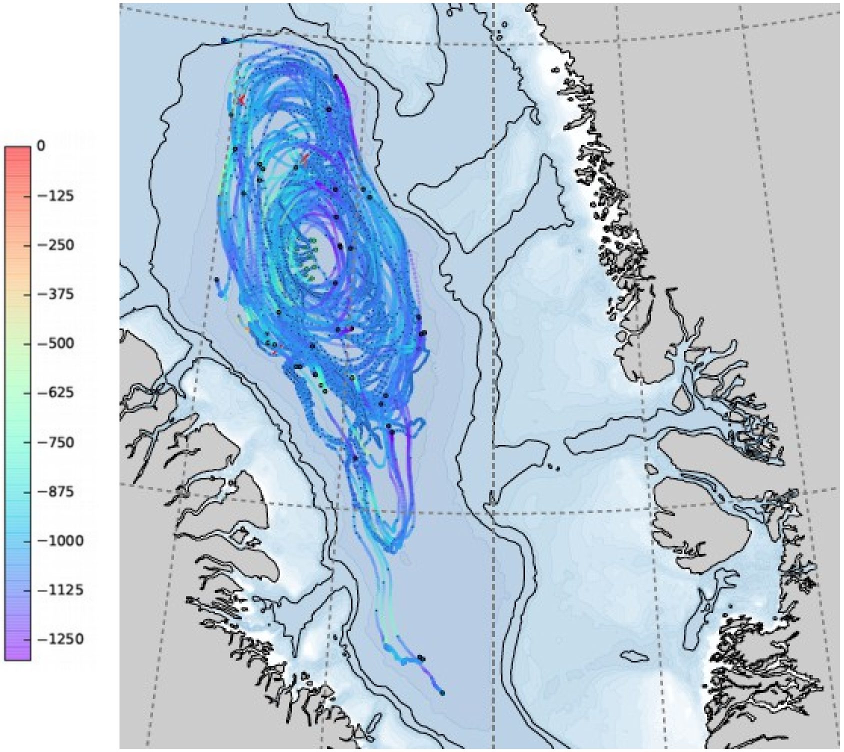
2. NAOS Mission Schedule, 1000m

BB2



BB4

- tbs

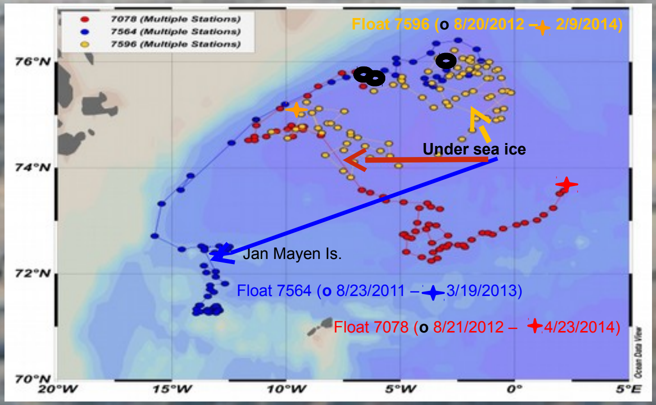
Thanks to Jinshan Xu, DFO, St. Johns for getting this all started.

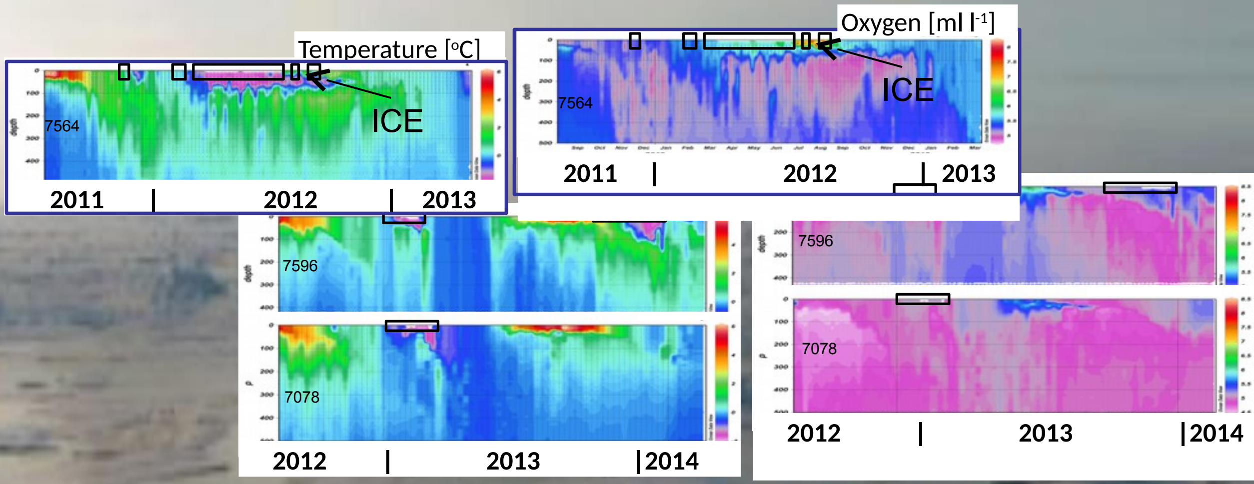
Phytoplankton activity in the Greenland Sea*: Bio-float observations in ice-covered waters

P. Matrai[1], M. Steele[2], D.Swift[2], S. Riser[2], K. Johnson[3] and J. Nutt[1]
[1]Bigelow Laboratory for Ocean Sciences, [2]University of Washington, [3]MBARI

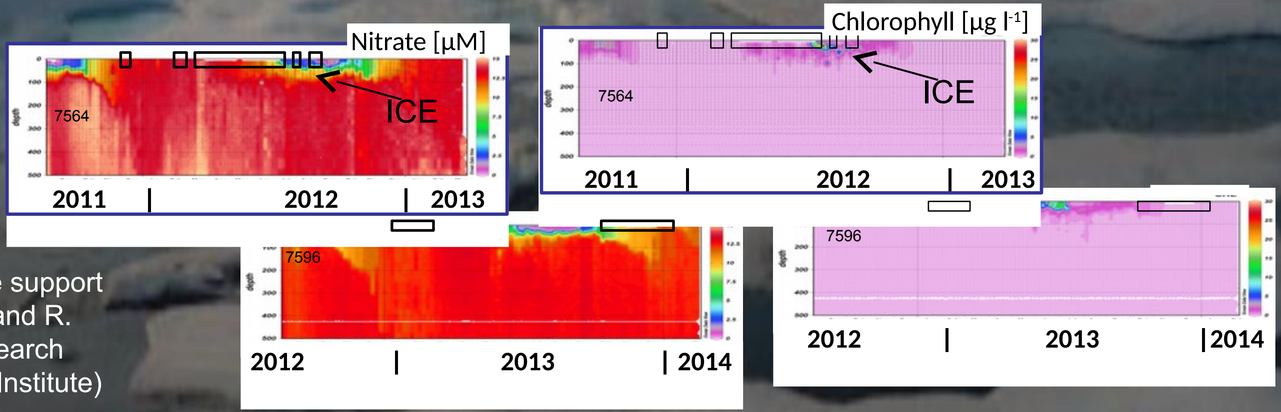
Arctic ARGO bio-floats survive stratification* and sea ice!

***Just not Chukchi Sea stratification**





T, S, NO_3, O_2, fluorescence, backscatter => chl, POC, PP, NCP



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Lagrangian particle simulations

- Release ~45 particles at two CGCS Amundsen stations: BB2, BB4
- Three drift depths: 500 m, 750m, 1000m
- Three profiling scenarios:
  1. No profiling (pure Lagrangian drift), 638 day sim
  2. Profiling every 21 days
  3. Profiling according to proposed NAOS mission
- Iteratively remove particles from the initial set that crash into the coast, i.e., particle depth > bottom depth. (Ariane crashes when this happens.)
  - Note that these « crashes » represent the real likelihood that a float may bump or touch bottom during drift or profiling due to the steep bathymetry of Baffin Bay.
- Thanks to Jinshan Xu, DFO, St. Johns for getting this all started.