Sopot

27-30 September 2014

AWAKE-2

Arctic climate system study of ocean, sea ice and glaciers interactions in Svalbard area.

Midterm meeting

1. *Introduction*
2. *Organisation of meeting*
3. *AWAKE-midterm*
4. *Measurements 2014*
5. *Time series*
6. *Necessary additional measurements*
7. *Data*
8. *Databases*
9. *WPs – deliverables, milestones*
10. *Synthesis*
11. *Papers !!!!!*
12. *GROCE*
13. *ASSW*
14. *Financial issues (Sylwia)*
15. *WP1 (Gosia)*

AWAKE-2 Project Structure

WP 1: Project management and dissemination
Leader: IOPAS, Waldemar Walczowski

T1.1. Leader: IOPAS	T1.2. Leader: IOPAS	T1.3. Leader: NERSC	T1.4. Leader: IOPAS

WP 2: Open ocean oceanography
Leader: IOPAS
Agnieszka Beszczyńska-Möller

T2.1. Leader: IOPAS	T2.2. Leader: IOPAS	T2.3. Leader: UNIS

WP 3: Fjord oceanography
Leader: UNIS
Eva Falck

T3.1. Leader: IOPAS	T3.2. Leader: UNIS	T3.3. Leader: IOPAS/NPI

WP 4: Sea Ice
Leader: UNIS, Frank Nilsen

T4.1. Leader: NERSC	T4.2. Leader: NERSC	T4.3. Leader: UNIS	T4.4. Leader: NERSC/met.no/UNIS

WP 5: Freshwater from the land
Leader: US, Mariusz Grabiec

T5.1. Leader: US/IGF	T5.2. Leader: IGF	T5.3. Leader: US/IGF	T5.4. Leader: US	T5.5. Leader: US/IGF

WP 6: Atmosphere and climate change
Leader: NCU, Rajmund Przybylak

T6.1. Leader: NCU	T6.2. Leader: met.no/NCU	T6.3. Leader: met.no	T6.4. Leader: met.no	T6.5. Leader: NCU	T6.6. Leader: NCU

WP 7: Synthesis
Leader: NERSC, Stein Sandven

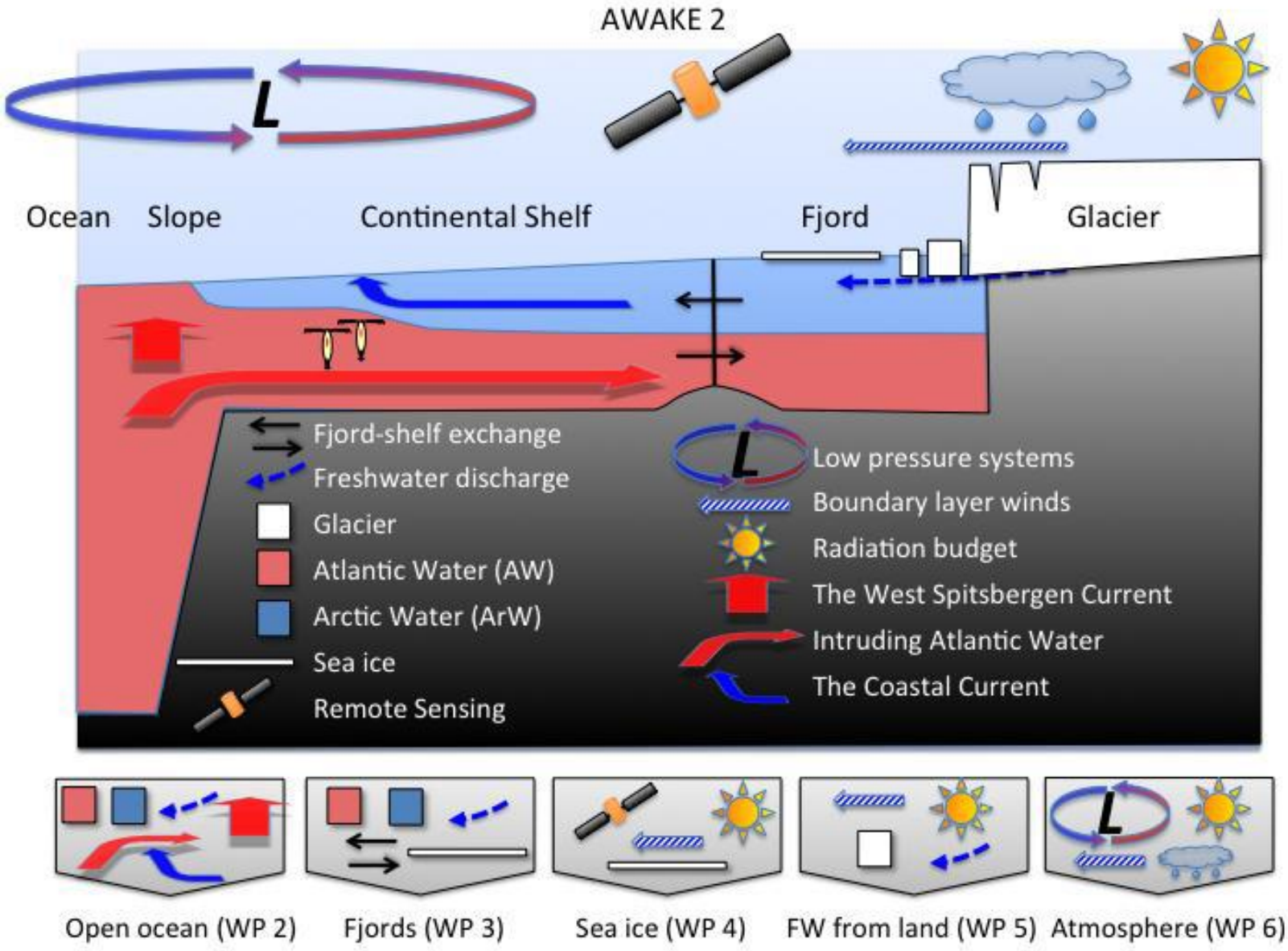
T7.1. Leader: NERSC	T7.2. Leader: NERSC	T7.3. Leader: NERSC

Time	Session	Topic	Responsible
09:00 – 10:30	Session 4,	Introduction WP1 Project management and dissemination	Waldemar
10:30	Coffee break		
11:00 12:00	Session 5	WP2 Open ocean oceanography	Agnieszka
12:00-13:00		WP3 Fjord oceanography	Eva
13:00-14:00		WP4 Sea Ice	Frank
	LUNCH		
15:00:16:00	Session 6	WP5 Freshwater from the land	Mariusz
16:00:17:00		WP6 Atmosphere and climate change	Rajmund
17:00-18:00		WP7 Synthesis	Stein
19:00	Conference Dinner		

The aim of the AWAKE-2 is to understand the interactions between the main components of the climate system in the Svalbard area: ocean, atmosphere and ice to identify mechanisms of interannual climate variability and long-term trends.

Research assumptions

- *The significant role of the ocean (Westspitsbergen Current) for creating a climate of Western Spitsbergen;*
- *The significant role of the Atlantic origin waters inflow in the shaping of the physical conditions in the fjords (temperature, salinity);*


AWAKE 2
L
Ocean
Slope
Continental Shelf
Fjord
Glacier
Fjord-shelf exchange
Freshwater discharge
Glacier
Atlantic Water (AW)
Arctic Water (ArW)
Sea ice
Remote Sensing
L
Low pressure systems
Boundary layer winds
Radiation budget
The West Spitsbergen Current
Intruding Atlantic Water
The Coastal Current
L
Open ocean (WP 2)
Fjords (WP 3)
Sea ice (WP 4)
FW from land (WP 5)
Atmosphere (WP 6)

Ocean – glacier - atmosphere

The leading hypothesis is that the acceleration and retreat of glaciers is a response to forcing in the maritime part of the glacier due to the variability of oceanic, atmospheric forcing, or both.

Mechanisms:

- ***The increase in the intensity of the underwater melting on the border of the ice/ocean.***
- ***Reduction and weakening of the ice pack on the forehead of the glacier;***
- ***Increasing the number of cracks, reduced structural integrity of glacier due to increased surface heating and melting.***

For verification

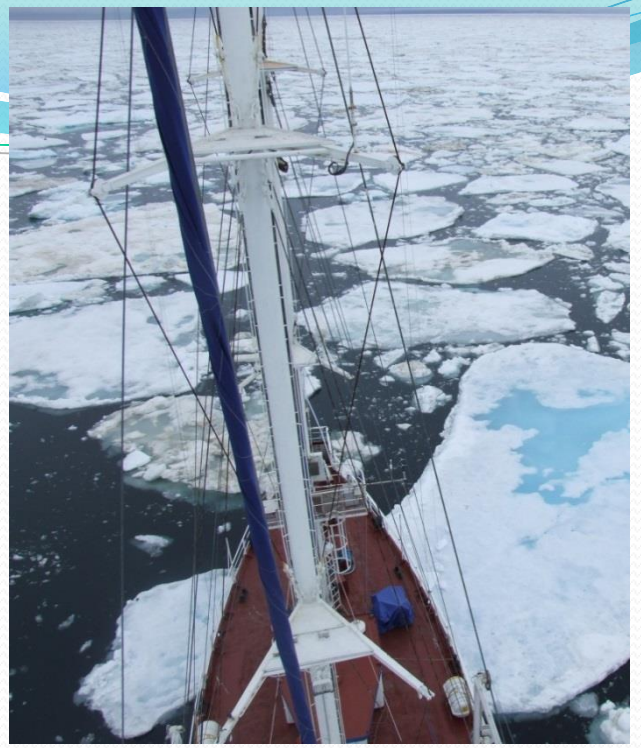
Mechanisms:

- ***Check that the Atlantic water directly interacts with the glacier;***
- ***If so - how it contributes to the intensification of glaciers calving;***
- ***How important is the ocean-atmosphere heat exchange (dominant, subsidiary?)***
- ***What is the importance of freshwater runoff from the land.***

AWAKE-2 will focus on specific processes in the Svalbard area using historical data, new observations and dedicated model runs

- *Impact of the Atlantic Water variability in the West Spitsbergen Current on the adjacent shelf- and fjord ocean climate;*
- *Exchange processes between shelf and fjord;*
- *Freshwater input and distribution in an Arctic fjord (Hornsund);*
- *Sea ice variability and its impact on fjord circulation;*
- *Glaciers dynamics and interactions between ocean and glaciers;*
- *Atmospheric climate variability and trends in the coastal areas of the western Spitsbergen.*

Advantages of the project



- *Own vessel (Oceania);*
- *Base in Hornsund;*
- *WSC observations time series;*
- *Time series of hydrographic surveys in Hornsund;*
- *Time series of meteorological observations in Hornsund;*
- *Time series of glaciological observations in Hornsund (Hans Glacier);*
- *The diverse conditions in different parts of Hornsund.*

deficiencies

- *Time series do not overlap;*
- *No oceanographic measurements outside the summer season;*
- *Difficult access to Hornsund outside the summer season;*
- *The high cost of field research;*
- *Difficulties of research because of the Norwegian national park*

AWAKE-2 is divided into four phases

2013 Preparatory Phase

- *Field measurements to extent the main meteorological, glaciological and oceanographic time series* ***OK***
- *Analysis of historical data* ***OK***
- *Preparatory phase for the core campaign* ***OK***
- *Recognition of a main features of the Hornsund hydro-glaciological basin* ***OK***

2014

The main campaign in fjords and in the open ocean

The main goal is to achieve a complete picture of all climatic components in Hornsund and in the region potentially influencing the Hornsund conditions, i.e. the West Spitsbergen Current, slope and shelf, the Spitsbergen Coastal Current.

The main observed processes will include:

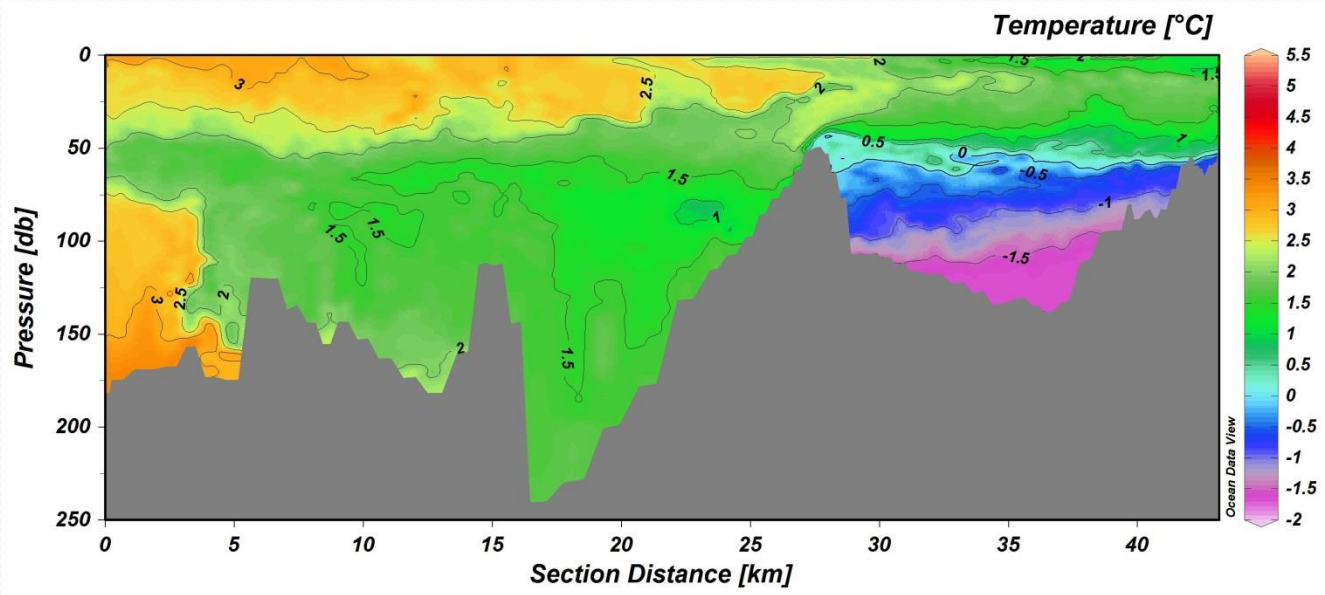
- *exchange of water masses between open ocean, shelf area and fjords;*
- *ocean-atmosphere fluxes in the open ocean, shelf and in fjords;*
- *melting and calving of glaciers, river discharge and precipitation/evaporation;*
- *variability of sea-ice concentration on the shelf and in fjords.*

2015

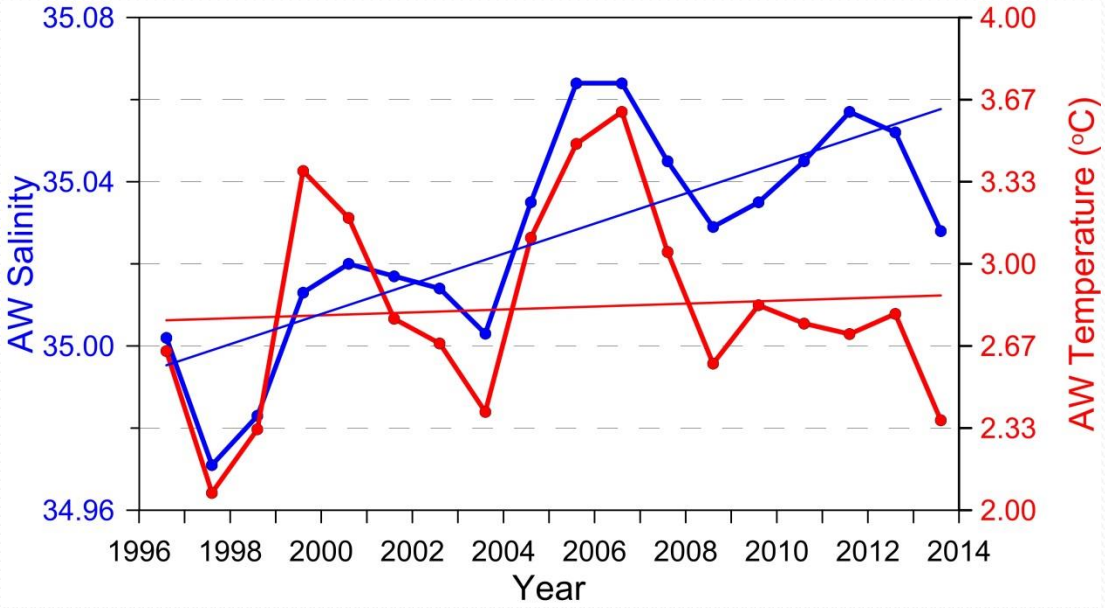
- *Further extension of the core parameters time series.*
- *Analysis and synthesis of the new data provided by the core field campaign.*
- *Potential possibility to repeat measurements failed in 2014.*

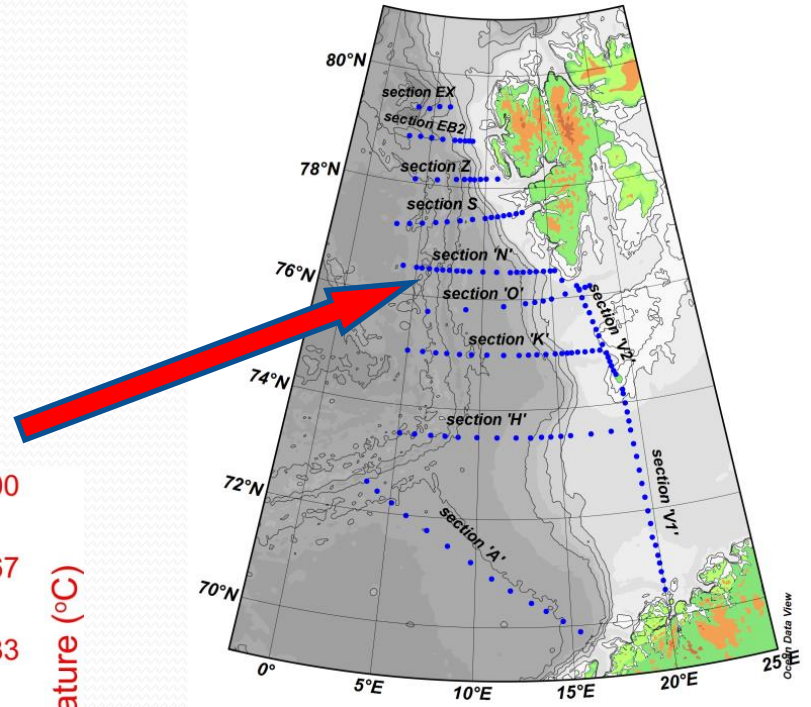
2016

- *Joint analysis of the project data and a synthesis of the new results obtained in different spheres (hydro-, cryo- and atmosphere) of the studied fjord system.*

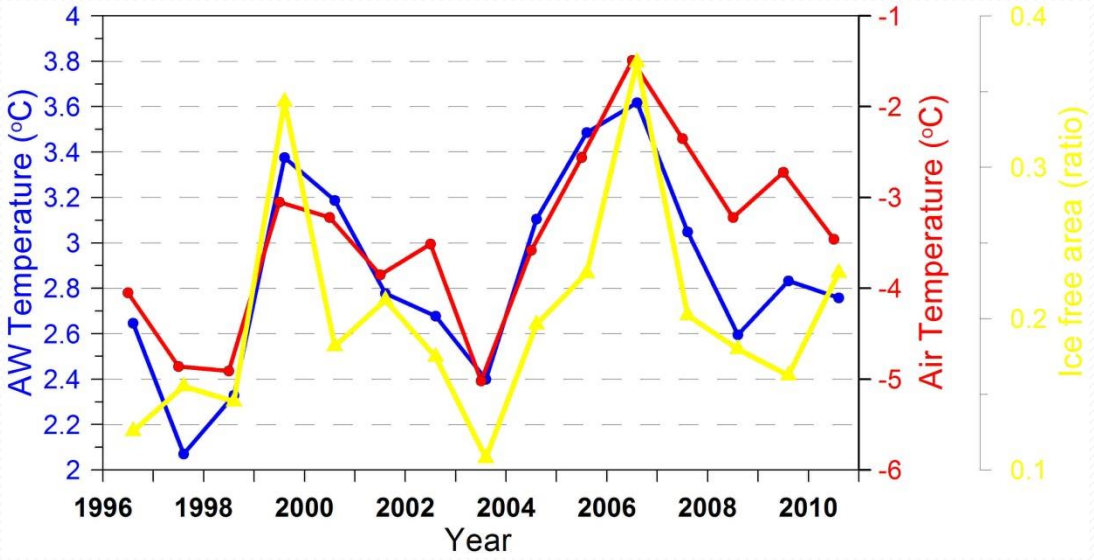


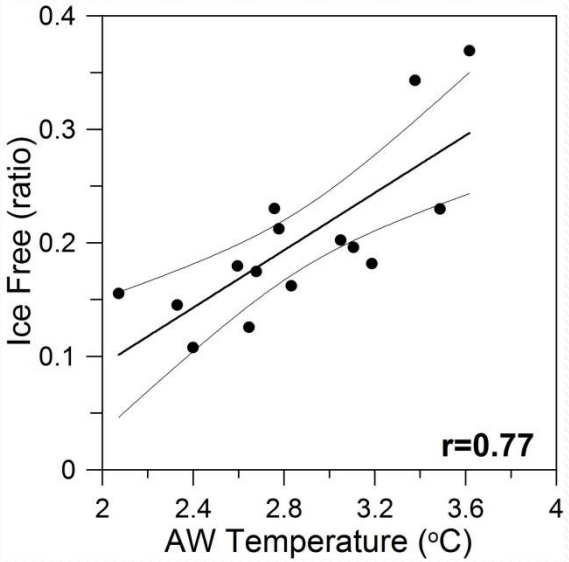
Temperature and salinity at section ‚N'



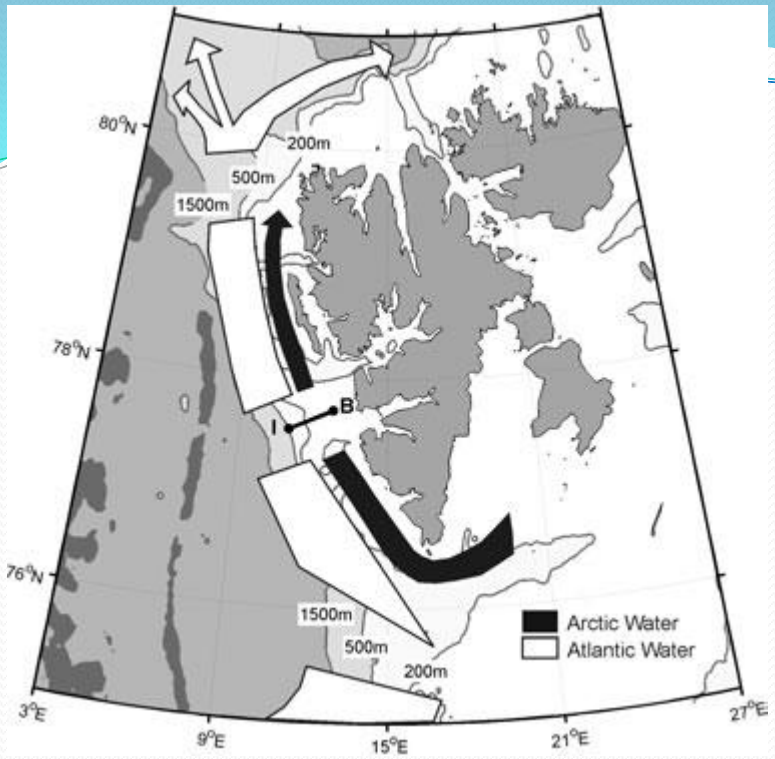


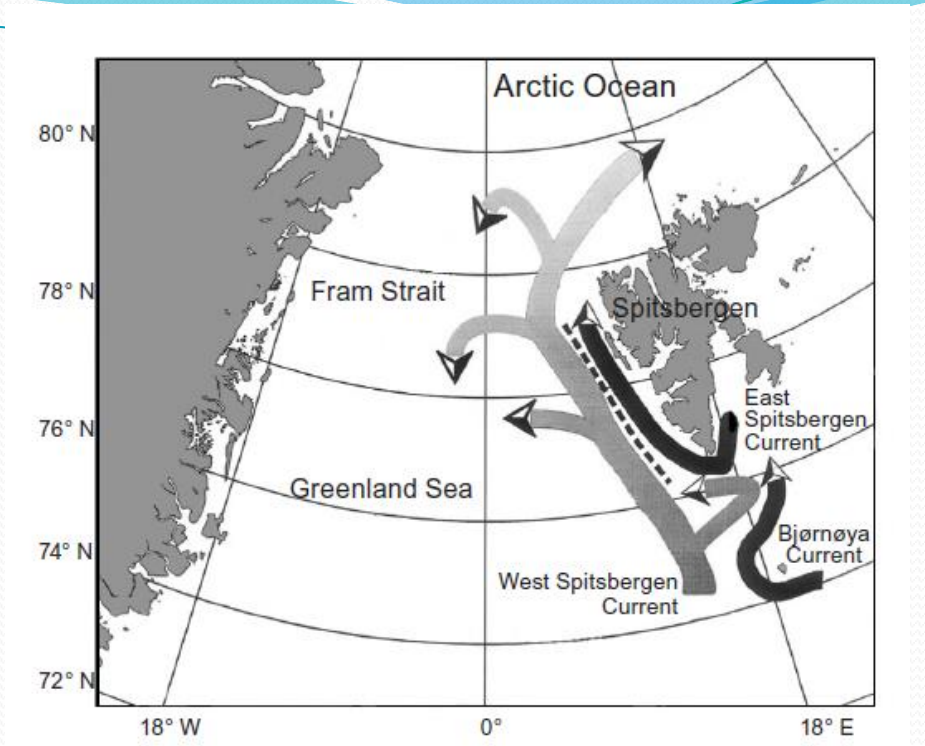
Inflow of the Atlantic Water shapes the Svalbard climate and ice conditions

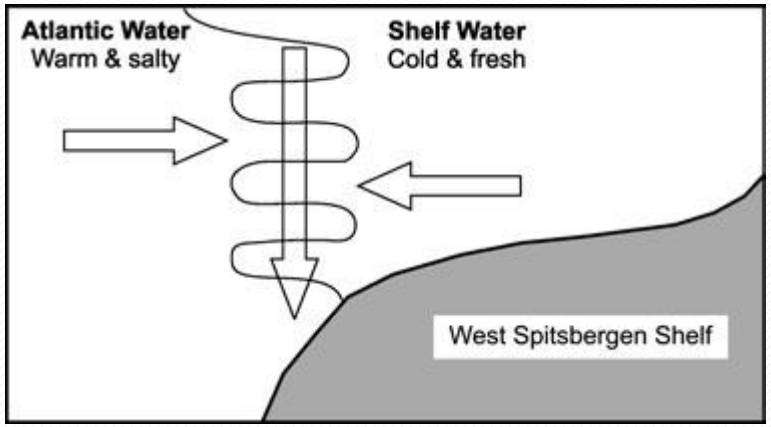




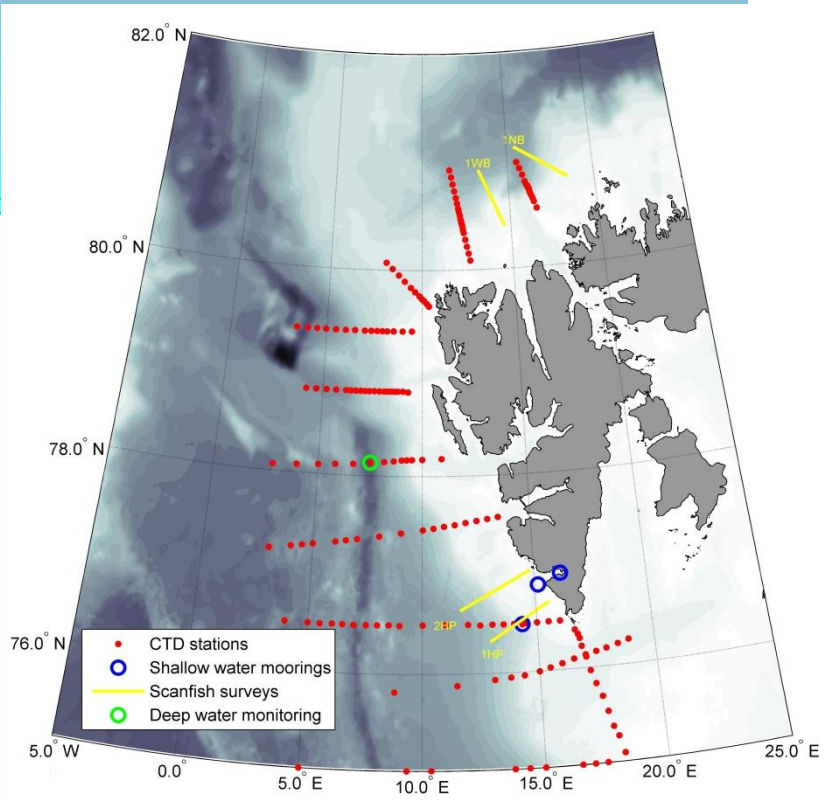
Temperature of Atlantic Water at section along the 76°90’ N parallel (blue), yearly mean air temperature in Polish Polar Station in Hornsund (red), and ice free area (ratio) north of Svalbard.

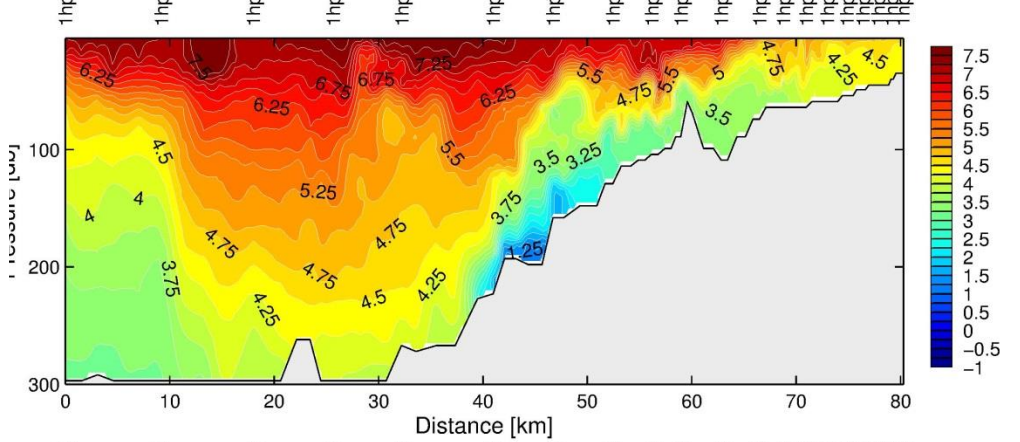


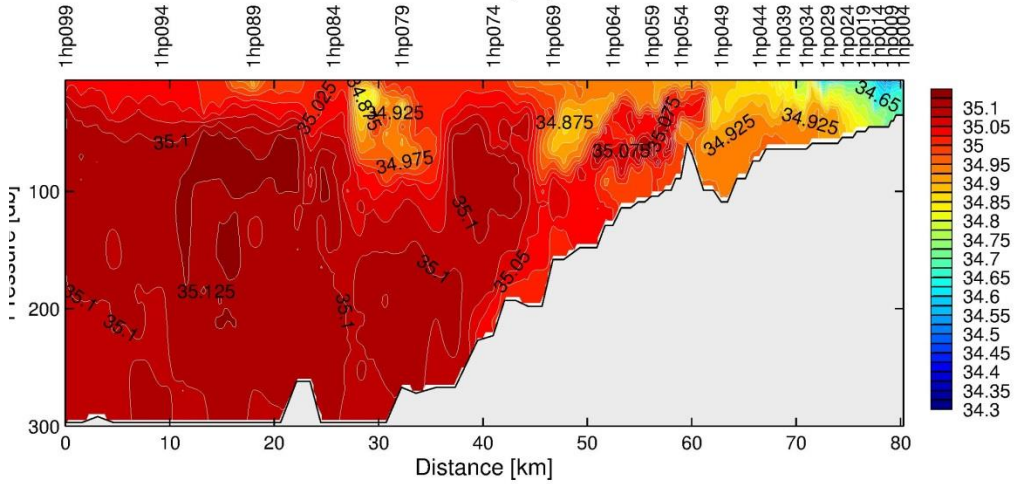




On the double-diffusive and cabbeling environment of the Arctic Front, West Spitsbergen
Finlo R. Cottier & Emily J. Venables


82.0° N
80.0° N
78.0° N
76.0° N
5.0° W
0.0
5.0° E
10.0° E
15.0° E
20.0° E
25.0° E
1NB
1WB
1HP
CTD stations
Shallow water moorings
Scanfish surveys
Deep water monitoring


Distance [km]
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
−0.5
−1


Distance [km]
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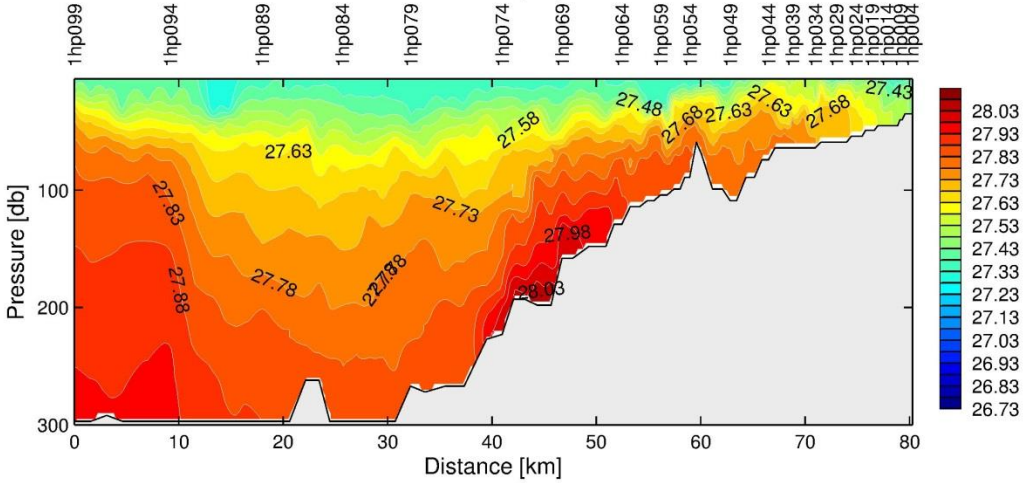
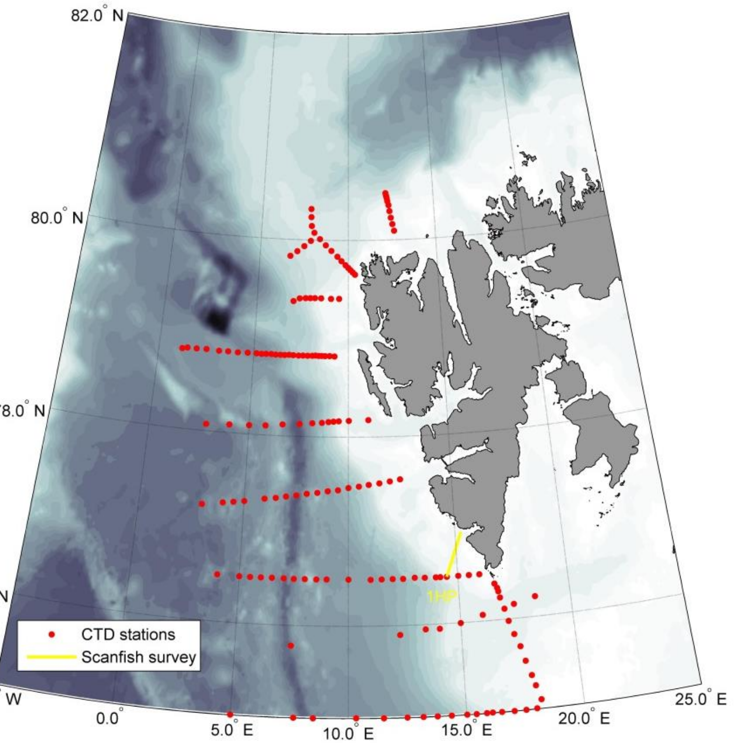
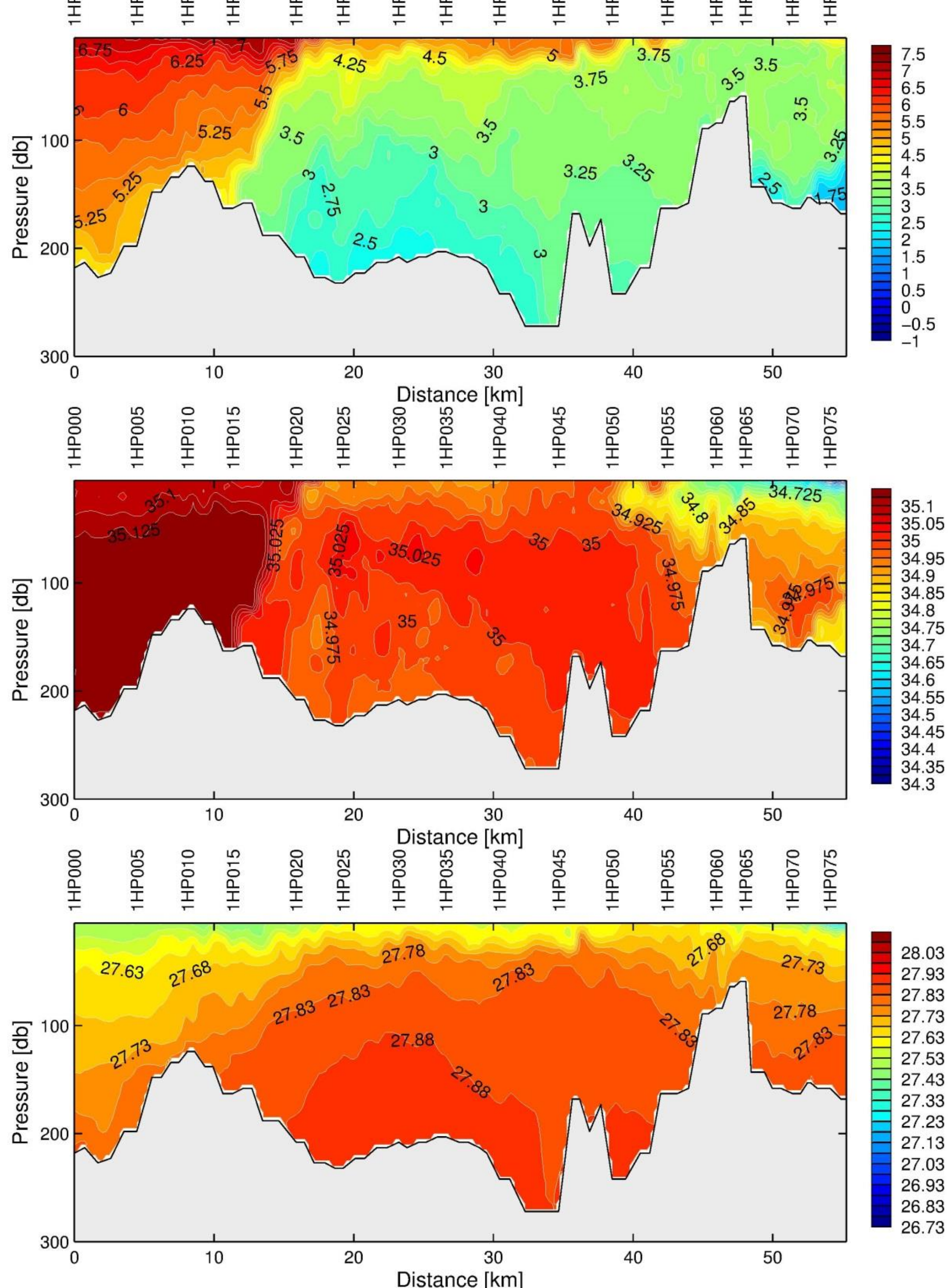
35.05
35
34.95
34.9
34.85
34.8
34.75
34.7
34.65
34.6
34.55
34.5
34.45
34.4
34.35
34.3


Pressure [db]
Distance [km]
28.03
27.93
27.83
27.73
27.63
27.53
27.43
27.33
27.23
27.13
27.03
26.93
26.83
26.73

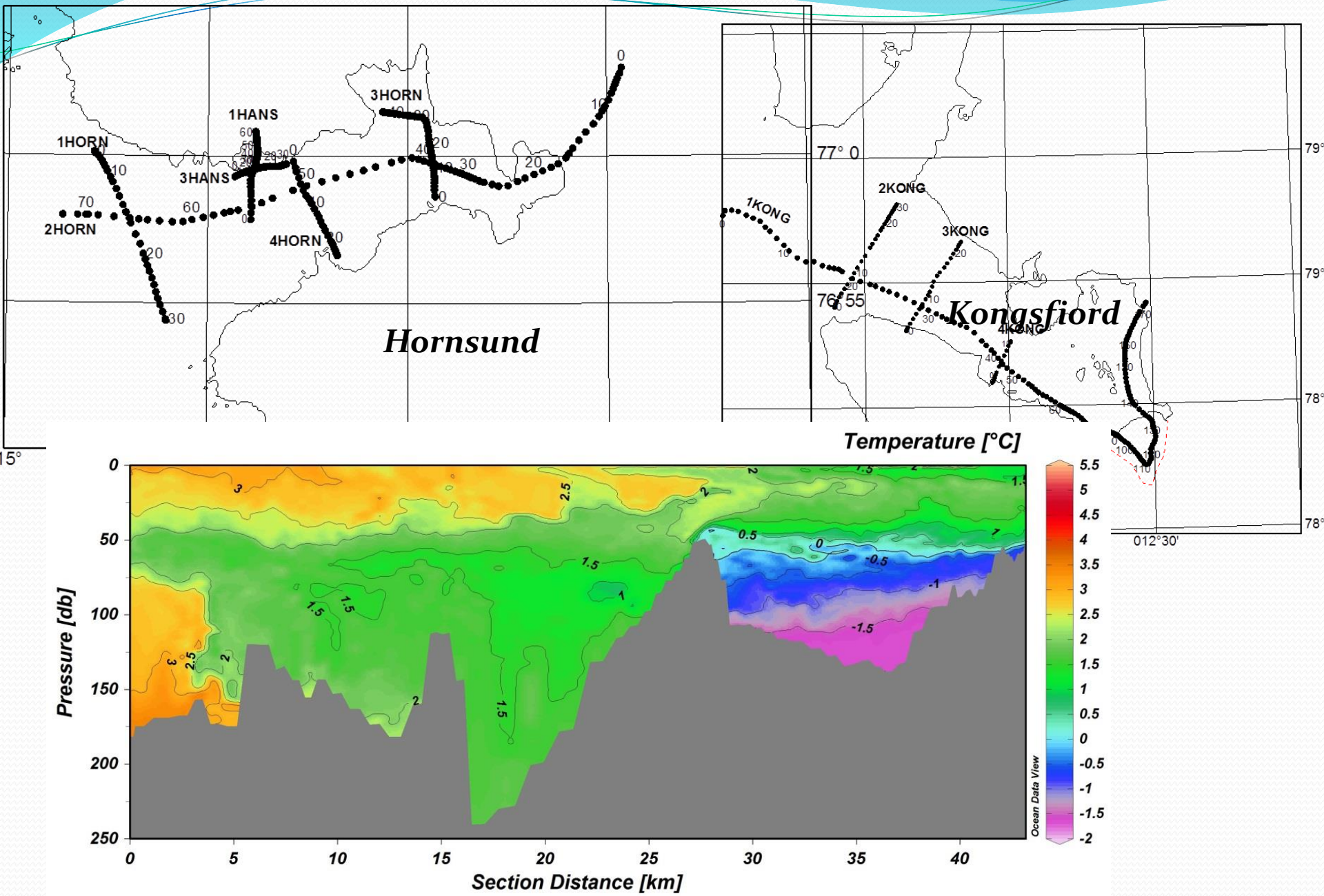


82.0° N
80.0° N
8.0° N
CTD stations
Scanfish survey
1HP
0.0°
5.0° E
10.0° E
15.0° E
20.0° E
25.0° E



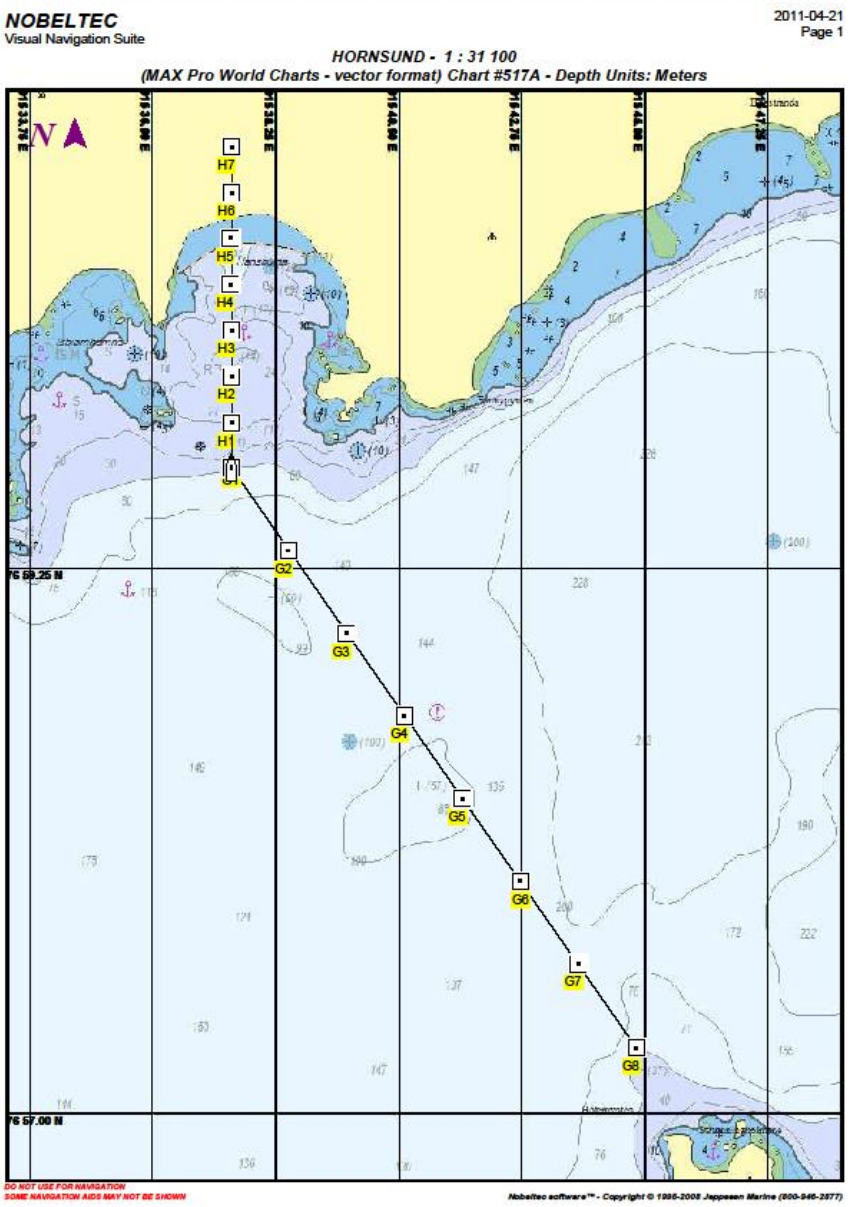
1HP000
1HP005
1HP010
1HP015
1HP020
1HP025
1HP030
1HP035
1HP040
1HP045
1HP050
1HP055
1HP060
1HP065
1HP070
1HP075
Pressure [db]
Distance [km]

Oceanographic measurements



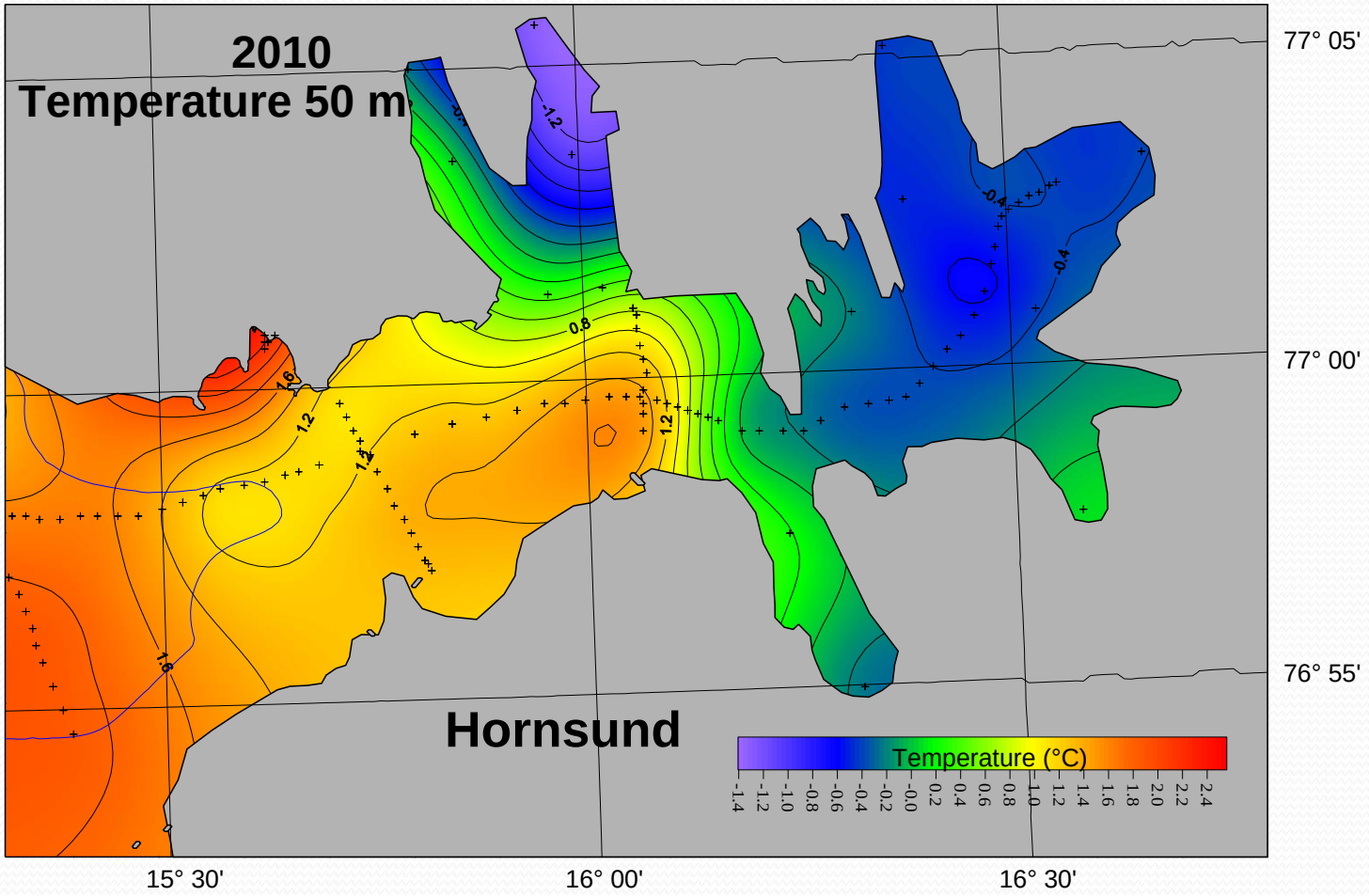
Oceanographic measurements

Serie czasowe w Hornsundzie uzyskane w ekspedycjach Fiordowych (2010-2013)

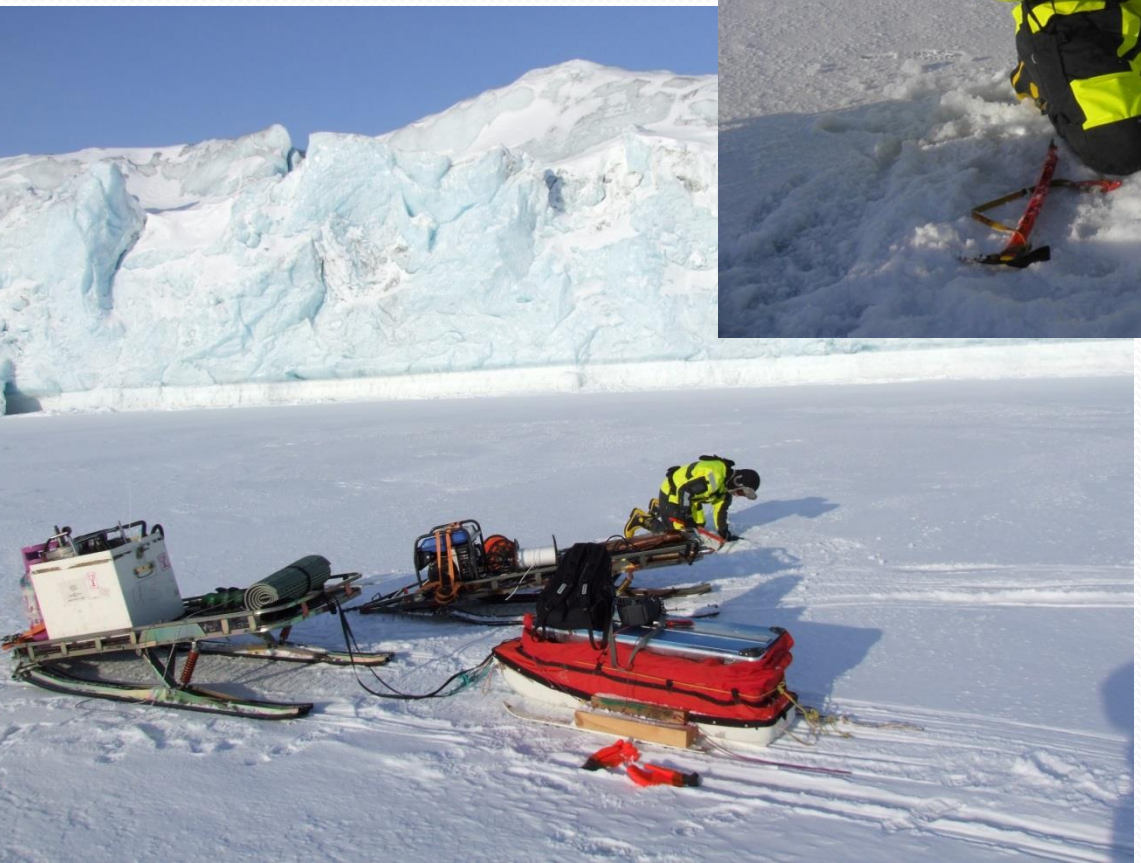


Oceanographic measurements

Zdjęcia synoptyczne w Hornsundzie

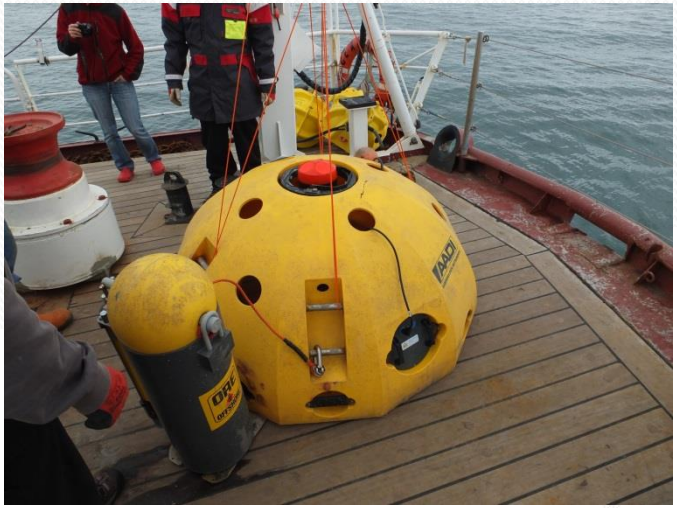


Oceanographic measurements

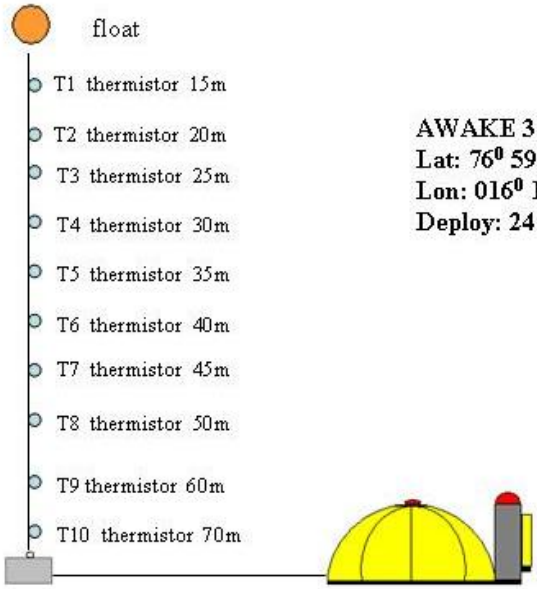


Oceanographic measurements

Moorings



AWAKE 1
Lat: 76⁰ 59.651' N
Lon: 015⁰ 10.474' E
Deploy: 03.07.2010

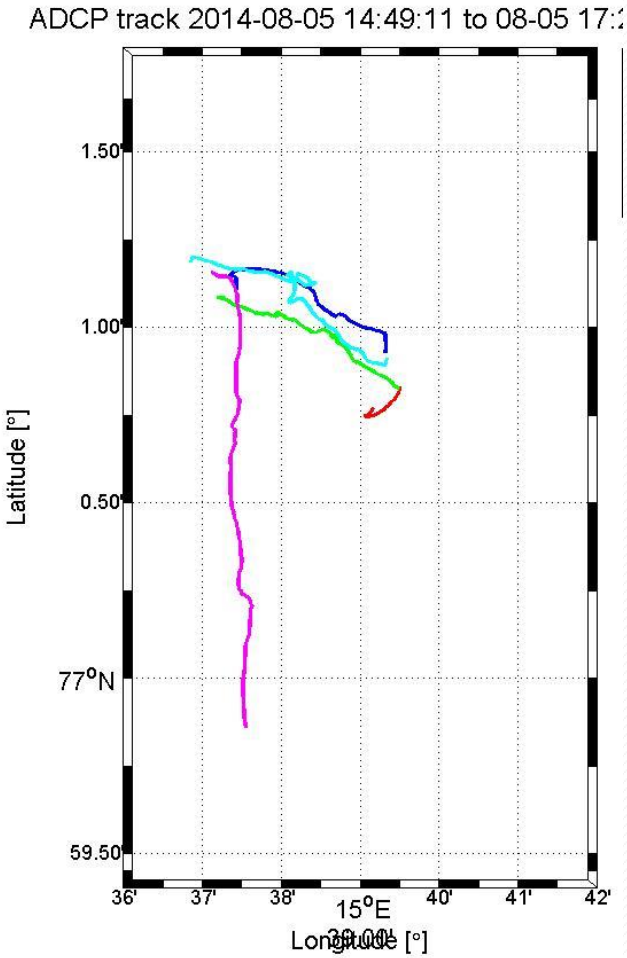


AWAKE 3
Lat: 76⁰ 59.107' N
Lon: 016⁰ 10.495' E
Deploy: 24.07.2010

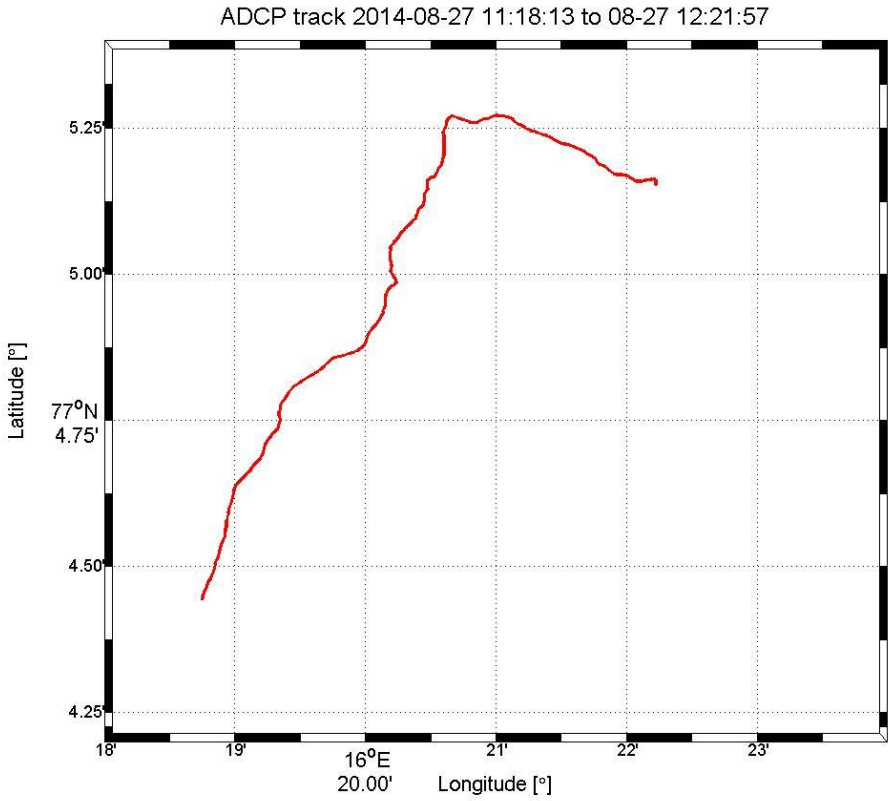

MARINE

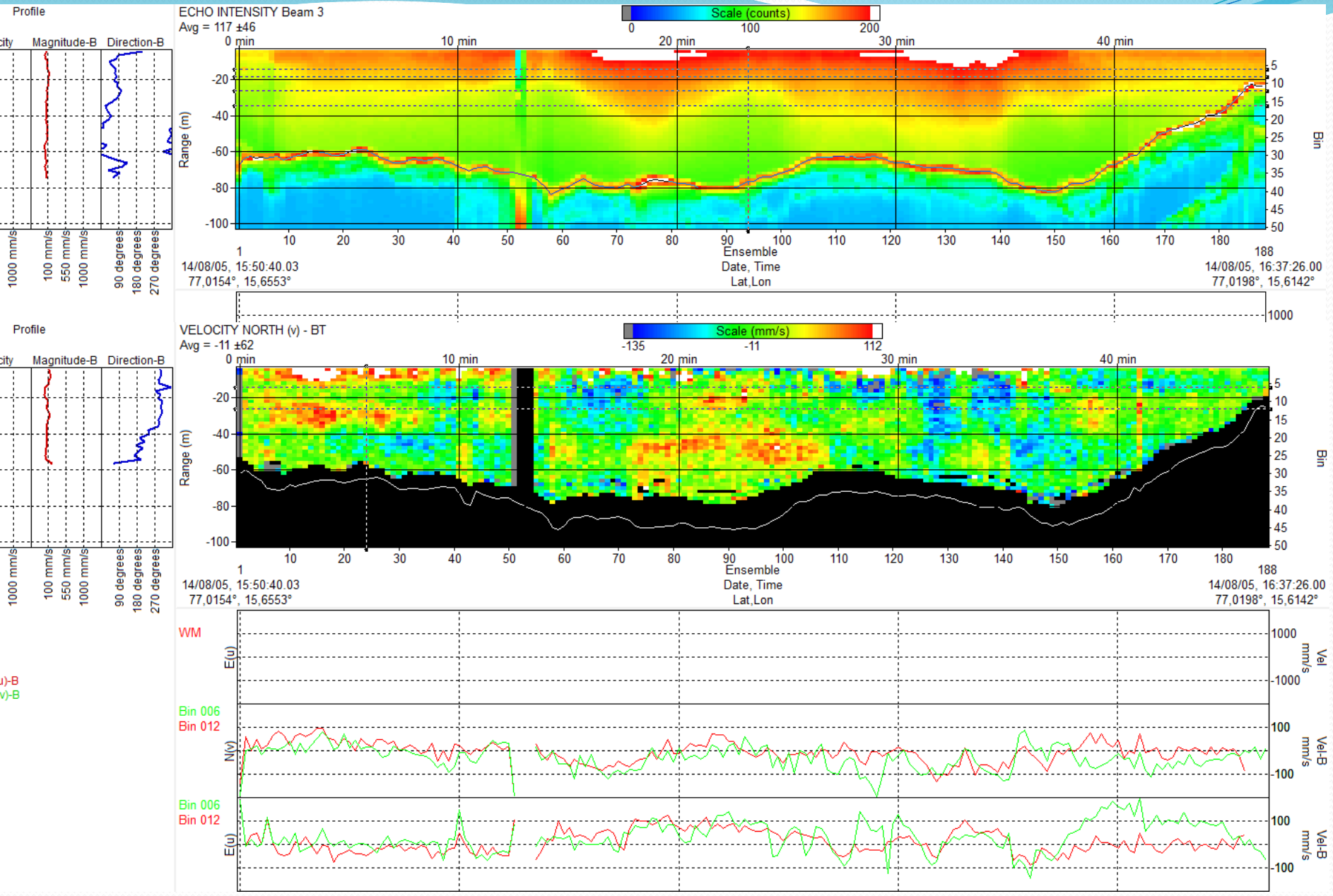
ADCP sections

Hansbreen



Stronbreen




Profile
Magnitude-B
Direction-B
1000 mm/s
100 mm/s
550 mm/s
1000 mm/s
90 degrees
180 degrees
270 degrees
ECHO INTENSITY Beam 3
Avg = 117 ±46
Scale (counts)
0
100
200
0 min
10 min
20 min
30 min
40 min
Range (m)
Bin
Ensemble
1
188
14/08/05, 15:50:40.03
77,0154°, 15,6553°
Date, Time
Lat,Lon
14/08/05, 16:37:26.00
77,0198°, 15,6142°
VELOCITY NORTH (v) - BT
Avg = -11 ±62
Scale (mm/s)
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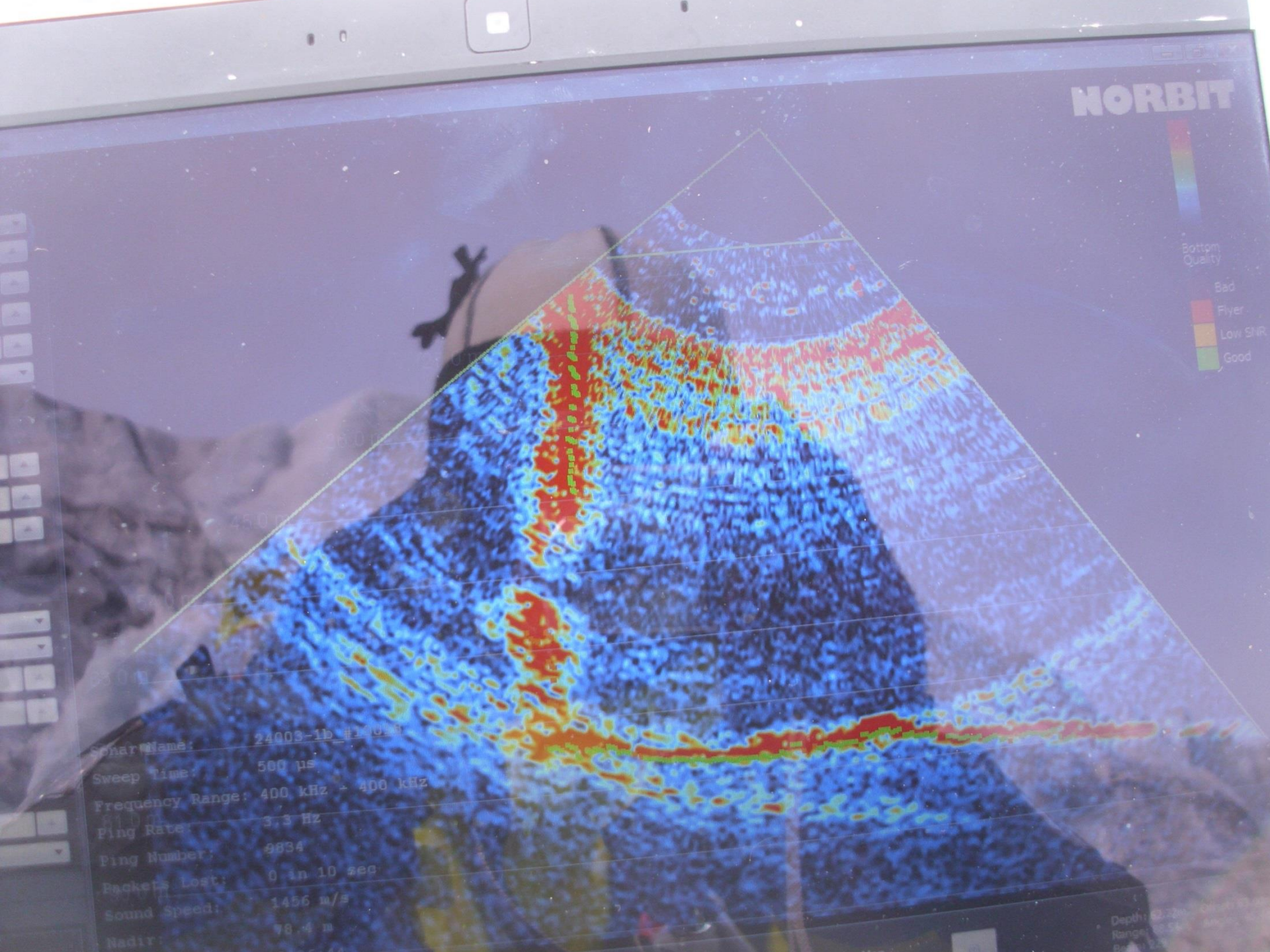
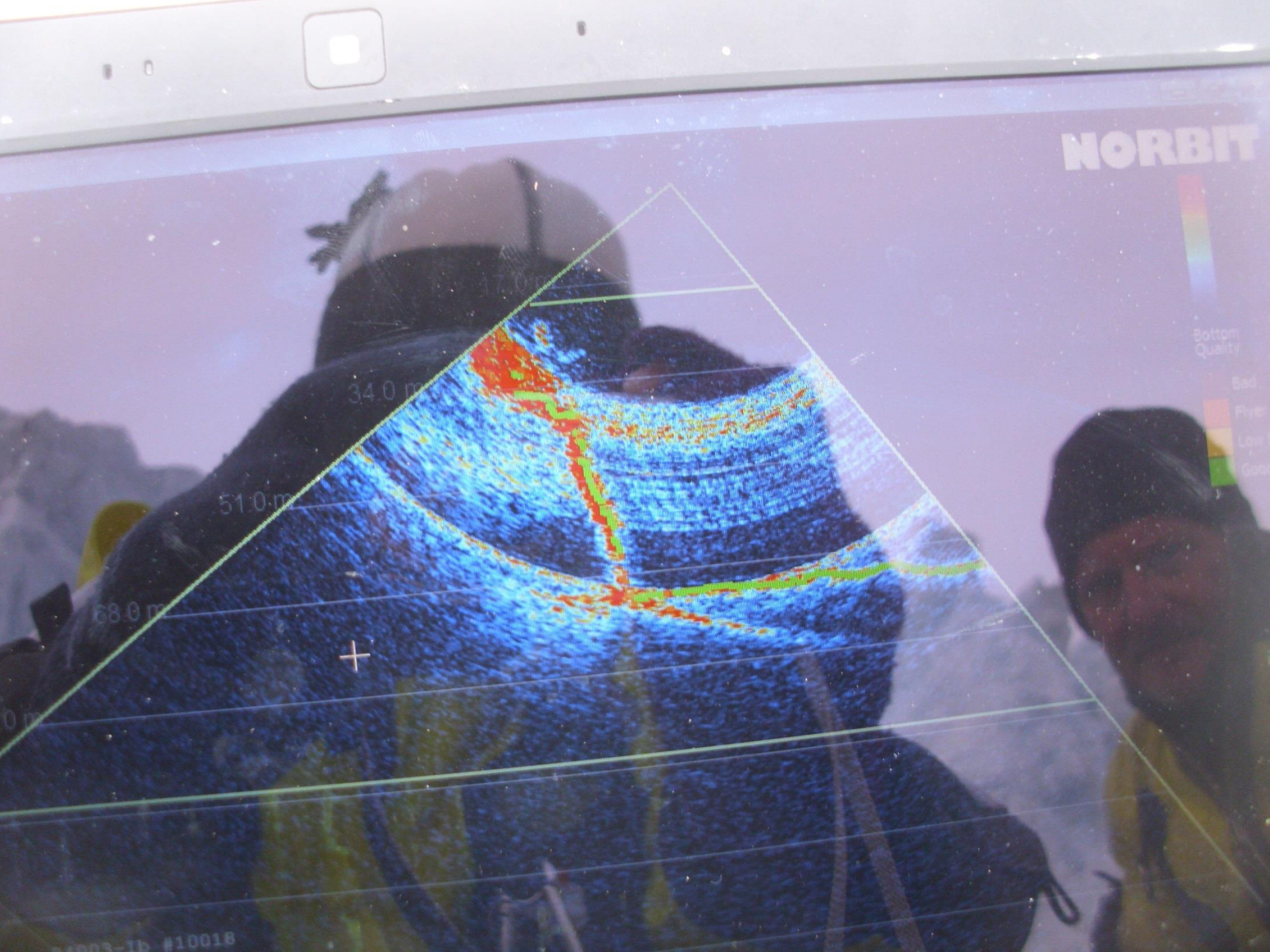
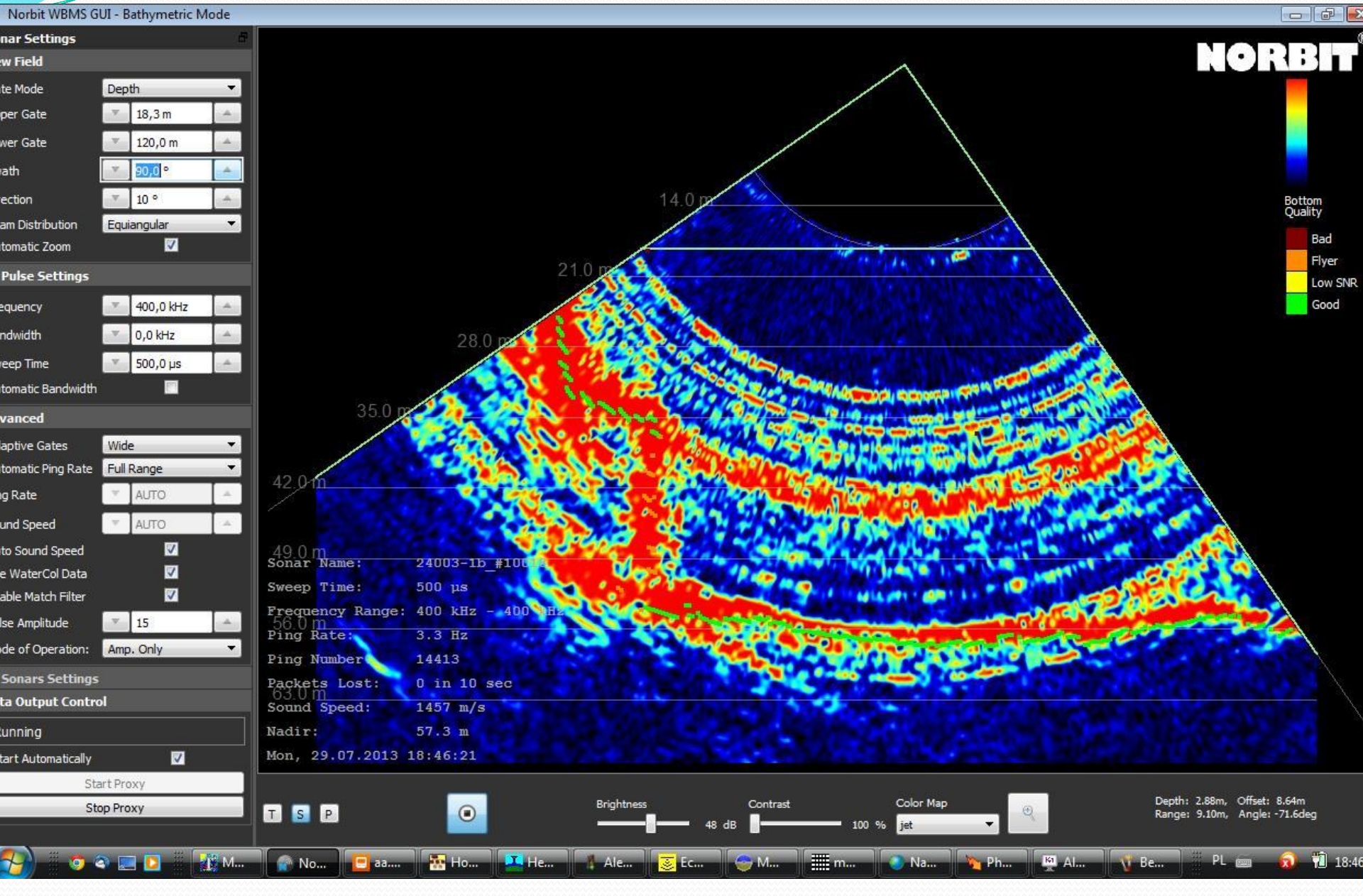
-11
112
WM
E(u)
N(v)
Bin 006
Bin 012
Vel
Vel-B
mm/s


NOMAD


NORBIT
Bottom Quality
Bad
Flyer
Low SNR
Good
Sweep Time: 500 µs
Frequency Range: 400 kHz - 400 kHz
Ping Rate: 3.3 Hz
Ping Number: 9834
Packets Lost: 0 in 10 sec
Sound Speed: 1456 m/s
Nadir: 78.4 m


NORBIT
Bottom Quality
Bad
34.0 m
51.0 m
68.0 m


Norbit WBMS GUI - Bathymetric Mode
nar Settings
w Field
te Mode
Depth
per Gate
18,3 m
wer Gate
120,0 m
ath
90,0 °
ection
10 °
am Distribution
Equiangular
tomatic Zoom
Pulse Settings
equency
400,0 kHz
ndwidth
0,0 kHz
eep Time
500,0 µs
tomatic Bandwidth
vanced
aptive Gates
Wide
tomatic Ping Rate
Full Range
g Rate
AUTO
und Speed
AUTO
to Sound Speed
e WaterCol Data
able Match Filter
lse Amplitude
15
de of Operation:
Amp. Only
Sonars Settings
ta Output Control
unning
tart Automatically
Start Proxy
Stop Proxy
NORBIT
Bottom Quality
Bad
Flyer
Low SNR
Good
14.0 m
21.0 m
28.0 m
35.0 m
42.0 m
49.0 m
56.0 m
63.0 m
Sonar Name: 24003-1b_#100
Sweep Time: 500 µs
Frequency Range: 400 kHz - 400 kHz
Ping Rate: 3.3 Hz
Ping Number 14413
Packets Lost: 0 in 10 sec
Sound Speed: 1457 m/s
Nadir: 57.3 m
Mon, 29.07.2013 18:46:21
T
S
P
Brightness
48 dB
Contrast
100 %
Color Map
jet
Depth: 2.88m, Offset: 8.64m
Range: 9.10m, Angle: -71.6deg
PL
18:46

Where are we ?

Where are the others ?

- *Evidence suggests maritime boundaries glaciers, as a region, where changes propagate toward the land;*
- *The rapid weight loss of Arctic glaciers may be caused by disturbances on the contact zone of ocean water;*
- *Oceanic forcing and glaciers dynamic reaction mechanisms must be included in global climate models;*
- *This concerns mainly the Greenland ice sheet*

A White Paper by the U.S. CLIVAR Working Group on Greenland Ice Sheet-Ocean Interactions (GRISO), 2012

US CLIVAR
Climate Variability & Predictability

INTERNATIONAL WORKSHOP ON UNDERSTANDING THE RESPONSES OF GREENLAND'S MARINE-TERMINATING GLACIERS TO OCEANIC AND ATMOSPHERIC FORCING

Challenges to improving observations, process understanding and modeling

June 4-7, 2013

Wylie Inn & Conference Center

Beverly, Massachusetts

The community's leading hypothesis is that changes in submarine melting or in the ice mélange (mixture of icebergs and sea ice typically found in fjords near the glacier termini) may have triggered the retreat of Greenland's glaciers. However, our present understanding of how glaciers respond to these forcings is too rude to draw any conclusions.

There are very few observations to test the parameterizations due to the difficulty of accessing the base of ice shelves and the challenges in sampling near a calving ice face. Observational capabilities need to be improved, in particular with respect to measuring ice-ocean boundary processes of tidewater glaciers.

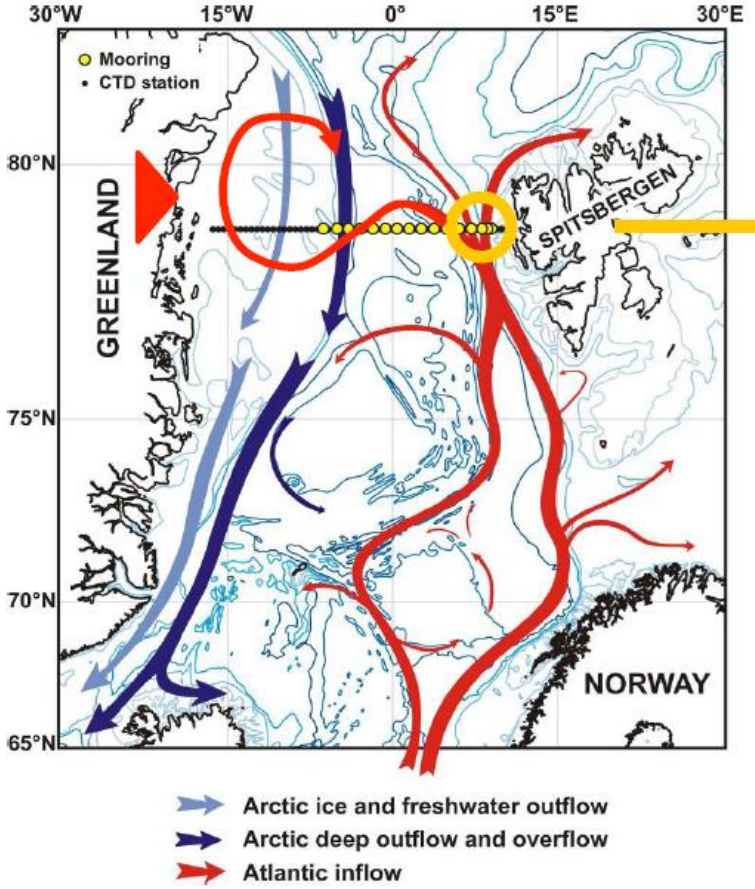
Where are the others ?

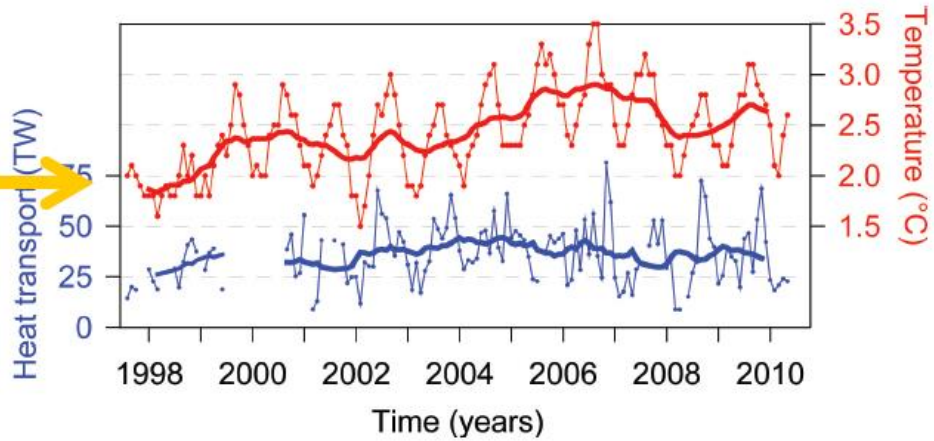
GROCE project

GREENLAND ICESHEET/OCEAN INTERACTION

The mass loss from the Greenland ice sheet has increased rapidly over the last few decades. One candidate for the ice sheet mass loss is the dynamics of marine terminating outlet glaciers which have a direct link to warming ocean waters. Uniting national and disciplinary studies towards better understanding the interaction between Greenland ice sheet and ocean will therefore be one challenge of future Arctic research.

Temperature of Atlantic Water in Fram Strait





Warming of the Atlantic Water in WSC by 0.5K

Ursula Schauer
GROCE workshop,
Bremen 2014

- **Greenland Glacier-Ocean Interaction**

1. Atlantic waters reach glaciers and drive melting
2. Submarine melt rate varies with
   - Subglacial discharge
   - Fjord stratification
   - Circulation
3. **Fjord circulation is complex**
   - **Shelf-driven flows**
   - **Glacier-driven flows**

Fiamma Straneo

ASSW 2015 Toyama
Arctic Science Summit Week

Session Themes (A: ISAR-4, B: ISAR-4 / ICARP III, C: ICARP III)	
A1:	Understanding the Arctic climate change and its global influences: Japan's contributions and suggestions for the future
A2:	Paleoclimatic perspective on Arctic changes and polar amplification
A3:	Ice mass loss in Greenland and Arctic glaciers under the influence of changing atmosphere and the ocean
A4:	Geospace over and related to the Arctic region
A5:	The climatic threat from Arctic offshore methane
A6:	Climate and ecosystem vulnerability in the terrestrial northern high-latitudes
B1:	Arctic climate change and potential mid-latitude weather linkages: large-scale atmospheric circulation and storm track dynamics
B2:	Current and future observing strategies for understanding the evolving Arctic climate and ecological system
B3:	Changing permafrost and its impact on the physical, ecological, economic and cultural Earth system
B4:	Arctic snow cover changes and their consequences
B5:	Remote sensing of the Arctic system
B6:	A pan-Arctic challenge: predicting the future of marine biota and ecosystem connectivity through field studies and data integration
B7:	Atmosphere-ocean-ice interactions and aspects related to a future, seasonally ice free Arctic Ocean
B8:	From human security to geopolitical dynamics in the Global Arctic: the global implications of rapid environmental, economic, and societal change
B9:	Arctic governance, sustainable development of local communities and non-Arctic state's contribution
C1:	Sharing Arctic data, observations and knowledge: understanding the global system through international exchange
C2:	Arctic in rapid transition - future research directions from the perspective of early career scientists
C3:	Emerging questions in Arctic geoscience
C4:	Co-design, co-production, co-communication of scientific knowledge – how to frame concerted research for sustainable development in times of change
C5:	Advances in transdisciplinary Arctic research: progress on building collaborative agendas for research supporting solutions for sustainability
C6:	Understanding sustainability in the Arctic: from patchwork to framework
C7:	Arctic freshwater system, changes and effects with emphasis on Arctic freshwater ecosystems
C8:	Circumpolar Arctic Coastal Communities Observatory Network: knowledge hubs for northern coastal sustainability
C9 :	Navigation and fisheries in the Arctic: prospects, problems and international policies
C10:	Consulting Arctic communities on research planning

The call for abstracts closes **November 10, 2014.**

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A3: Ice mass loss in Greenland and Arctic glaciers under the influence of changing atmosphere and the ocean

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