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Expanding Argo float measurements into the Arctic

EU-Project MOCCA

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INTRODUCTION

An ice-free Arctic summer is likely to occur within the next decades and the ongoing decrease of sea ice coverage is already leading to extended periods of open water in parts of Arctic.
This development facilitates measurements with profiling Argo floats in the Arctic.
The Euro-Argo ERIC has therefore started to investigate the use of profiling floats in the Arctic. First deployments are intended for summer 2018 in the Barents Sea and north of Svalbard within the national Argo programs of Finland, Norway and Poland.

To avoid damage to the floats by surfacing under ice-conditions it is necessary to hold them in ice-free areas and/or to equip them with ice-sensing algorithms (ISA), which prevent the ascent all the way to the surface.
Within the EU funded MOCCA project (Monitoring the Oceans and Climate Change with Argo) of the Euro-Argo ERIC the development of ISAs for hydrographic conditions in different areas of the Arctic has started. First deployments of floats with ISA will take place in summer 2018 in the Barents Sea, north of Svalbard and in the Greenland Sea.

CONCEPT

Detect areas which are progressively ice-free
(ice statistic)

Compare hydrographic characteristics
from ice-covered/ice-free areas
(hydrography)

Select and test hydrographic threshold
to detect “ice on top”
(ice sensing algorithm - ISA)

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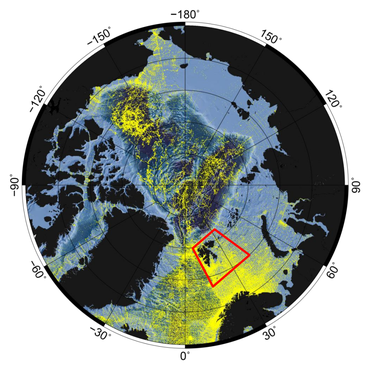
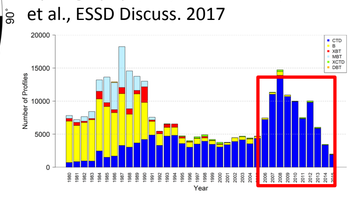
This was done examplarily for the Barents Sea, since
Argo-floats with ISA will be deployed there in summer 2018.

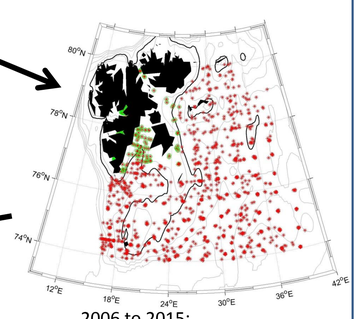
HYDROGRAPHY



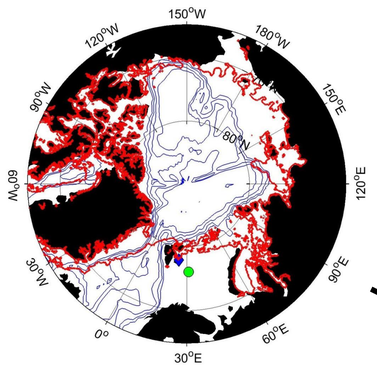
Compilation of hydrographic data from the area of interest

CTD data from 1980 to 2015, north of 65°N, from UDASH - Unified Database for Arctic and Subarctic Hydrography. (left) and (bottom) from A.Behrendt et al., ESSD Discuss. 2017





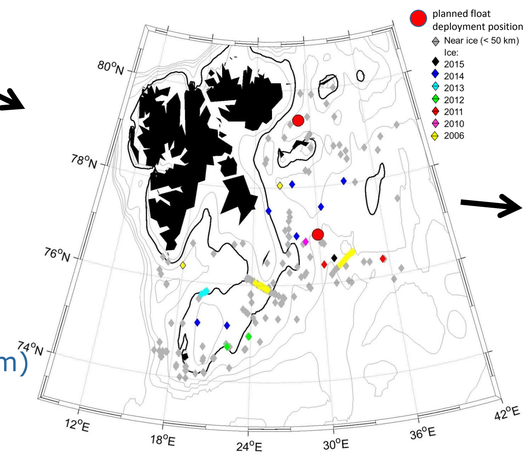
2006 to 2015:
2022 Profiles
417 near Svalbard/
in Fjords are excluded



Combination of profile data with MASIE ice information

Algorithm determines in ice: true/false and min distance to ice edge.

Position of CTD-profile and ice-edge from the day of CTD-measurement from Masie-NH (Fetterer et al., 2010)
The marks the shortest distance between profile and ice edge.



Final data set 2006-2015
(out of 2022 profiles)
38 profiles in ice
186 profiles near ice (<50km)

PRINCIPLE OF ICE SENSING

1
If temperature measured on the ascent to the surface is lower than TISA the float stops rising, stays below the ice and stores profile data internally.

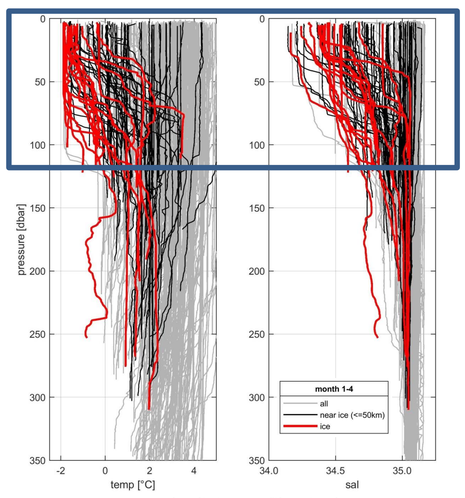
2
If temperature is higher than TISA the float ascents all to the surface and sends data via satellite ashore.

Painting by Prof Dr Jan O Backhaus, Hamburg

ICE SENSING ALGORITHM (ISA) for the Barents Sea

Select treshold and layer depth to detect „ice on top“:

TISA: -1.75 °C or -1.0°C,
Median or Minimum
of depth layer
20 – 50 dbar or 10 – 20 dbar



Temperature and salinity profiles in the Barents Sea from UDASH 2006 to 2015 January to April

ISA-Test:
First row: as much ice profiles as possible shall be detected as ice profiles!
Second row: uncertainties in the ice edge from the MASIE ice data can show up as false detection; no problem if we want to be „on the save side“.
Third row: as much open water profiles as possible shall be detected as open water profiles (equivalent to false detection of ice).

true detection **false detection (month 1-4)**

	Tmedian -1.75 °C 50-20 dbar	Tmedian -1.0 °C 50-20 dbar	Tmin -1.75 °C 20-10 dbar	Tmin -1.0 °C 20-10 dbar
Ice	38% / 62%	19% / 81%	48% / 52%	14% / 86%
near Ice	7% / 93%	30% / 70%	4% / 95%	34% / 66%
ice Free	1% / 99%	4% / 96%	1% / 99%	5% / 95%

ISA: temperature treshold: -1.0 °C
minimum of 10 – 20 dbar

ICE STATISTIC

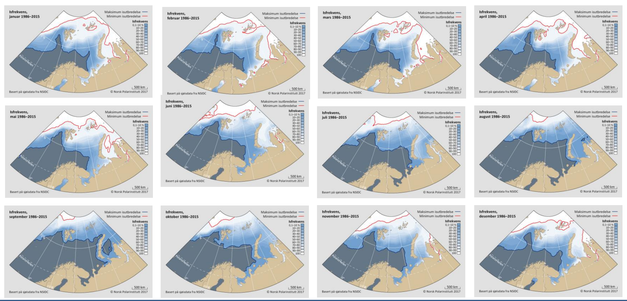
On the basis of the analyses of Arctic sea ice frequency (M.König et al., Norwegian Polar Institute 2014) areas, which are progressively ice-free,will be detected

Frequency of ice coverage
for the time span 1986-2015,
for individual months

month 1 – 4

month 5 – 8

month 9 - 12



POLAR2018 - Davos 19 – 23 June 2018
Session TE-1:
Oberserving with autonomous vehicles in polar regions
Poster Code: Wed_335_TE-1_2354
EU-Project MOCCA
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References

UDASH: Axel Behrendt, Hiroshi Sumata, Benjamin Rabe and Ursula Schauer (2017) UDASH – Unified Database for Arctic and Subarctic Hydrography. Earth System Science Data Discussion, https://doi.org/10.5194/essd-2017-92

Masie: National Ice Center and National Snow and Ice Data Center. Compiled by F. Fetterer, M. Savoie, S. Helfrich, and P. Clemente-Colón. 2010, updated daily. Multisensor Analyzed Sea Ice Extent - Northern Hemisphere (MASIE-NH), Version 1, 2006 to present, 0-90°N, 180°W – 180°E. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center, https:://doi.org/10.7265/N5GT5K3K

Arctic sea ice frequency: Max König, Mikhail Itkin, Gunnar Spreen, Dag Vongraven (2014) Arctic sea ice frequnecy with maximum and minimum extents [Data set] .Norwegian Polar Institute. https://doi.org/10.21334/npolar.2014.a89b2682