

# Norwegian Antarctic Research

by

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with contribution from

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Norwegian Polar Institute



and

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Research Council of Norway



Norwegian Parliament white paper



Research Council strategy



National Program priorities



European Research Projects



Tipping points



International cooperation



Observing systems - Weddell Watch

“Research Cooperation from Pole to Pole”  
AANCHOR side event to the All Atlantic 2022 Ministerial Meeting

- ❖ White Paper aims to explain Norway's key policy considerations in the Antarctic and what the policy should be in the years ahead.
- ❖ White Paper points to a number of key principles, for example (relevant for context of this meeting):
  - ❖ A well-defined, **science-based** policy.
  - ❖ **Research and knowledge acquisition**
  - ❖ The Antarctic as a **natural reserve**, devoted to peace and science.
  - ❖ Norway as a **responsible** maritime nation
  - ❖ **Responsible** commercial actor in the south

## Meld. St. 32

(2014–2015)

Melding til Stortinget

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### Norske interesser og politikk i Antarktis



Norges forskningsinnsats  
i Antarktis 2013–2022

Rapport  
Divisjon for energi, ressurser og miljø



# The Norwegian Research Council's report on Norwegian research efforts in Antarctica 2013-22

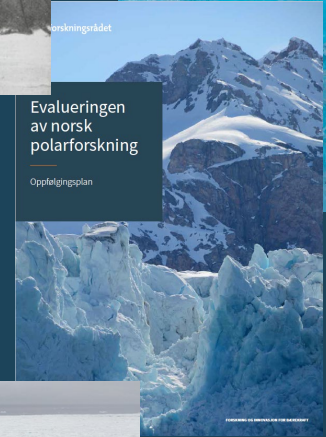
Identifies the following priorities:

- ❖ Research and monitoring relating to **the impacts of global changes on Antarctica and Antarctica's role in the climate system**, in particular research relating to **changes in the ice masses** and its **influence on global sea level**.
- ❖ Research and monitoring strengthening knowledge base relating to atmospheric challenges, in particular **atmospheric dynamics and climate change**, and **transport mechanisms for air pollution**
- ❖ Research and monitoring that contributes to **strengthening the knowledge base for the marine ecosystems**, in order to contribute to a sustainable management of the marine resources
- ❖ Research that will strengthen conservation of and understanding around the remains telling the history of Norway in Antarctica.



# Ambitions for Norwegian research in Antarctica and the Southern Ocean:

- **Evaluation of Norwegian Polar Research (2017) + Follow-up plan (2020)**
  - **Antarctica:** Upgrade of Troll, strengthen quality in research and lift the Norwegian contribution to **Top 10 in publication output**.
  - **Large multidisciplinary initiatives:** Improved and efficient use of **existing resources**. **Infrastructure** combined with improved **research funding**
  - **Effective use of existing research facilities:** Focus on systems understanding connecting Norwegian observations in a larger perspective.
  - **Permanent observations:** **Long time series**, re-use of **data** and dataproducts.
- **Projects looking at**
  - **International legal frameworks:** Processes in which Norway is/was a driving force for ocean, resource and environmental management in polar areas
  - **Bio- and geodiversity:** Past, present and future
  - **Technology:** Autonomous systems, reduced footprint, costs, EO, drones, models
  - **Ocean and hotspots:** Mapping, water column and circulation, ocean<->ice shelves.
  - **Living resources:** How **human activity** influences the local **environment**.



# Present and past projects in the Southern Ocean with support from RCN:

## • Ecosystem and living Resources:

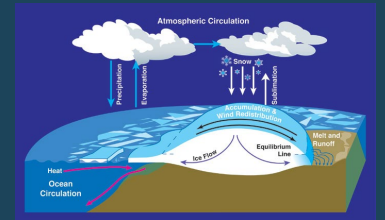
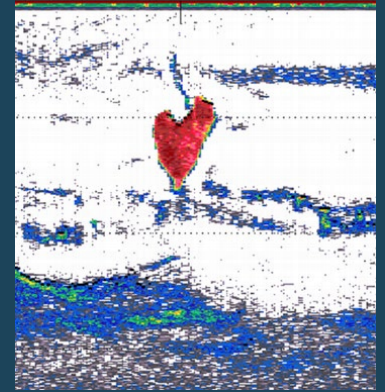
- **Krill:** *From swarming behaviour to trophic interactions: forecasting dynamics of Antarctic krill in ecosystem hotspots...(2017-2021).* Thor Aleksander Klevjer, Institute of Marine Research.
- **Primary production:** *Southern Ocean phytoplankton community characteristics, primary prod., CO2 flux and the effects of climate change (2019-2022).* Agneta Fransson, Norw. Polar Institute

## • Observing systems:

- **Sailbuoy for krill (2019-2022).** Olaf Rune Godøy, Aker Biomarine (+IMR, NORCE)
- **Troll Observing Network – TONe (2022->).** Christina Pedersen, Norwegian Polar Institute

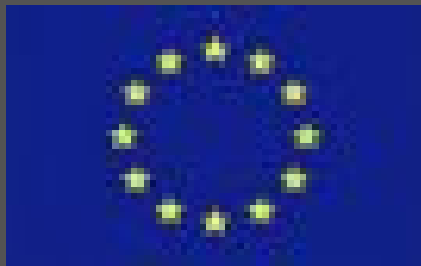
## • Ocean <-> Ice Shelves:

- **What happens with the Ice Shelves around Antarctica?** *Topographic barriers controlling warm water inflow and Antarctic ice shelf melting (2017-2022).* Elin Darelius Cliche , Univ. of Bergen
- **Ocean circulation and melting of Ice Shelves in DML:** *Ocean-ice shelf Interaction and channelized Melting in Dronning Maud Land (2019-2023).* Laura de Steur, Norw. Polar Institute
- **Tipping points in the Climate System:** *TiPACCs - Tipping Points in Antarctic Climate Components (2019-2023).* EU-H2020, Svein Østerhus, Petra Langebroek, NORCE
- **Sea Ice – Ice shelf variability:** *Late Quaternary Antarctic cryosphere interactions (2022->).* Stijn De Schepper, NORCE



# European Antarctic Research Cooperation

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*Tipping Points in Antarctic  
Climate Components*



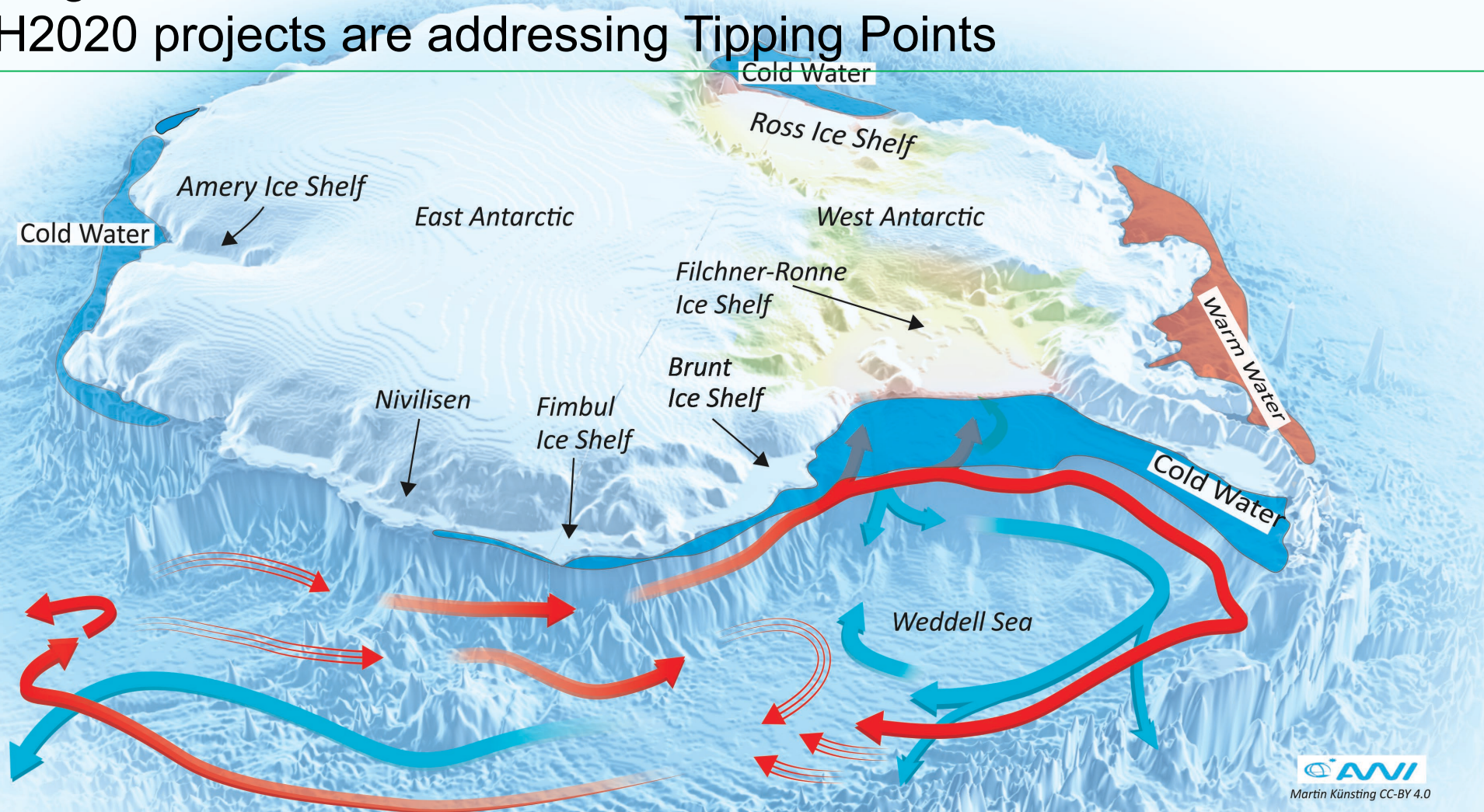
**PolarRES**  
Exploring future polar climates



**OCEAN:ICE**

# Are the big ice shelves stable?

## Three H2020 projects are addressing Tipping Points



AWI  
Martin Küsting CC-BY 4.0

**letters to nature**

**Predicted reduction in basal melt rates of an Antarctic ice shelf in a warmer climate**

**K. W. Nicholls**  
British Antarctic Survey, Natural Environment Research Council,  
Cambridge CB3 0ET, UK

**LETTER**

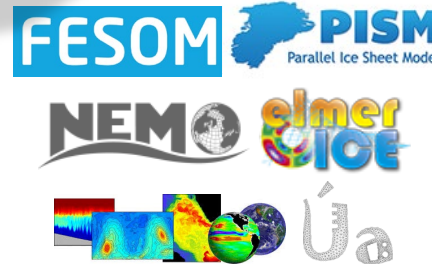
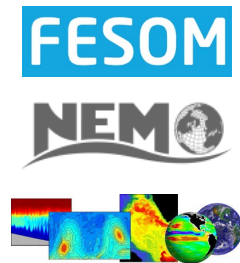
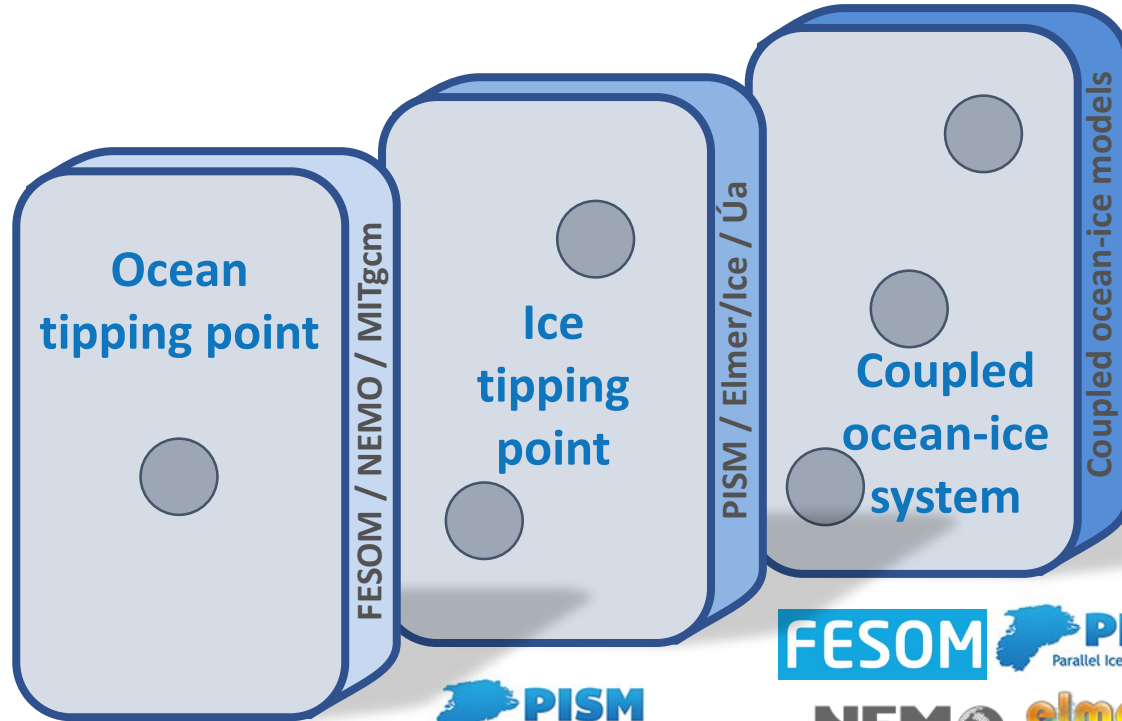
doi:10.1038/nature11064

**Twenty-first-century warming of a large Antarctic ice-shelf cavity by a redirected coastal current**

Hartmut H. Hellmer<sup>1</sup>, Frank Kauker<sup>1,2</sup>, Ralph Timmermann<sup>1</sup>, Jürgen Determann<sup>1</sup> & Jamie Rae<sup>3</sup>

# TiPACCs Scientific Methodology

## Models to study possible tipping point in Ocean, Ice and coupled ocean-ice system



**But long-term observing systems are also needed**

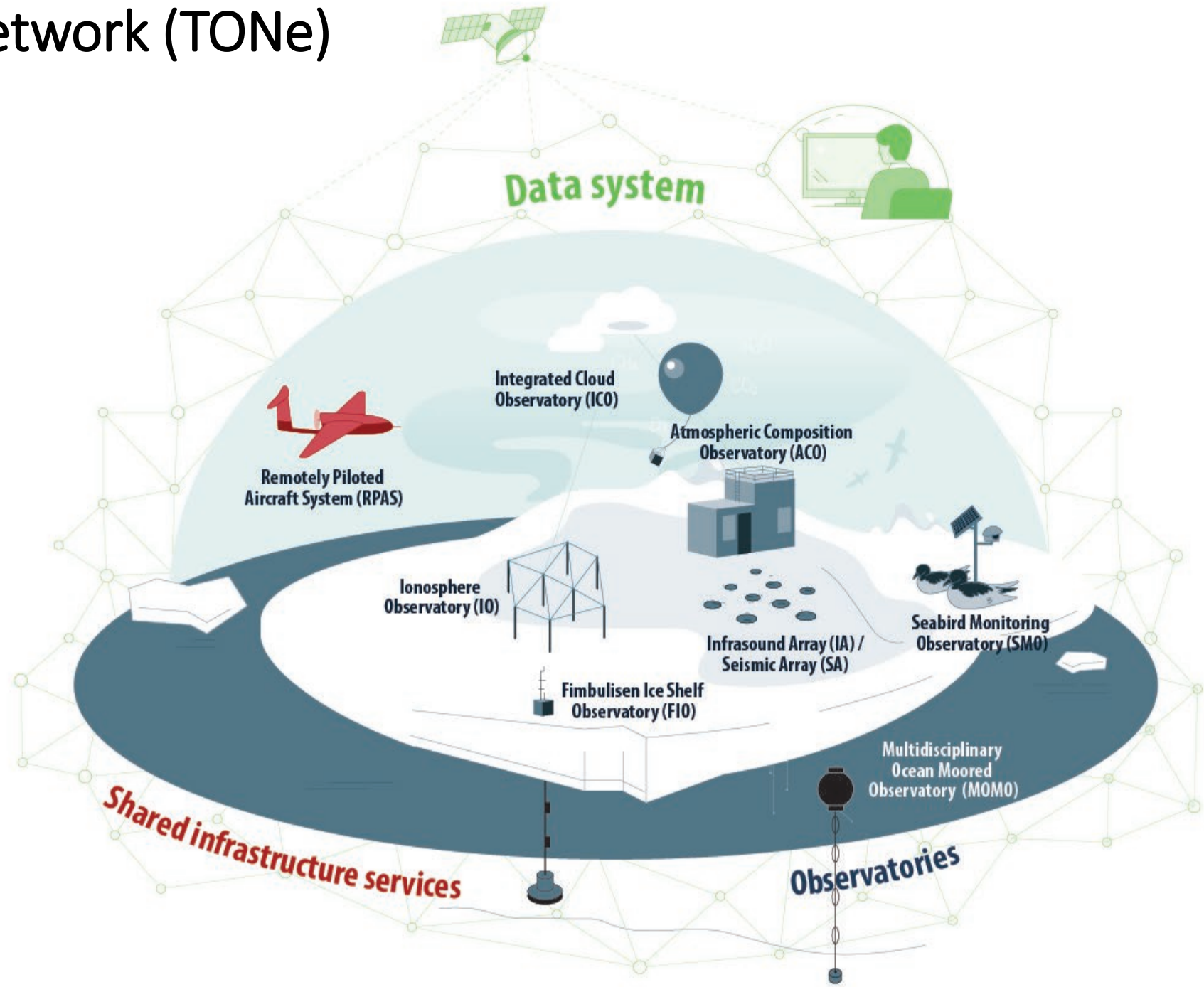




# Troll Observing Network (TONE)

A state-of-the-art, multi-platform, multidisciplinary observing network in the data-sparse region of Dronning Maud Land, Antarctica

Aims to secure and make available key observational data for the national and international science community in order to address key questions about environmental and climate changes and their implications for society.



# TrollTransect



- Regular observations:
  - oceanography
  - lower trophic levels
  - acoustics/soundscape
  - seaice
- Bouvetøya

# Cruise with Kronprins Haakon

Tentatively planned for 2025/26



# International Weddell Sea Oceanographic Expedition

Supported by [NATO Subcommittee of Oceanographic Research](#) Norwegian scientists initiated a program for the development of automatic recording current meters. The outcome of the project was the “Bergen current meter”, today known as the Aanderaa RCM.

During the [SCAR](#) meeting in Santiago, Chile, in 1966, [Håkon Mosby](#) from [Norway](#) presented his theory for the formation of [Antarctic Deep Water](#) and proposed to investigate the issue by using the newly developed current meters. He was supported by [Henry Stommel](#) from [National Science Foundation \(NSF\)](#).

It was agreed that a scientific expedition to the southern Weddell Sea should be organized under the auspices of the **US Coast Guard and the NSF**

The first expedition to the Weddell Sea with “Glacier” took place in 1968, followed by expeditions in 1969, 70 and 73.

Moorings equipped with “Bergen/Aanderaa” current meters were deployed in 1968 and successfully recovered in 1973. **This is the first year-long oceanographic time series from Antarctica.**

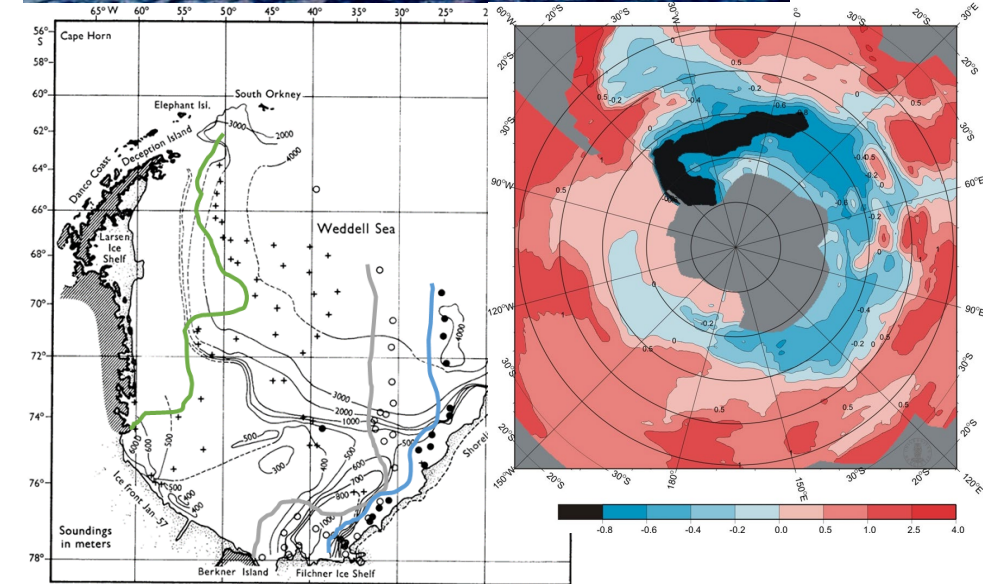


FIG. 3. Glacier bottom topography and stations: + 1968, o 1969, ● 1970.



Basler



Twin otter



Pisten Bullies



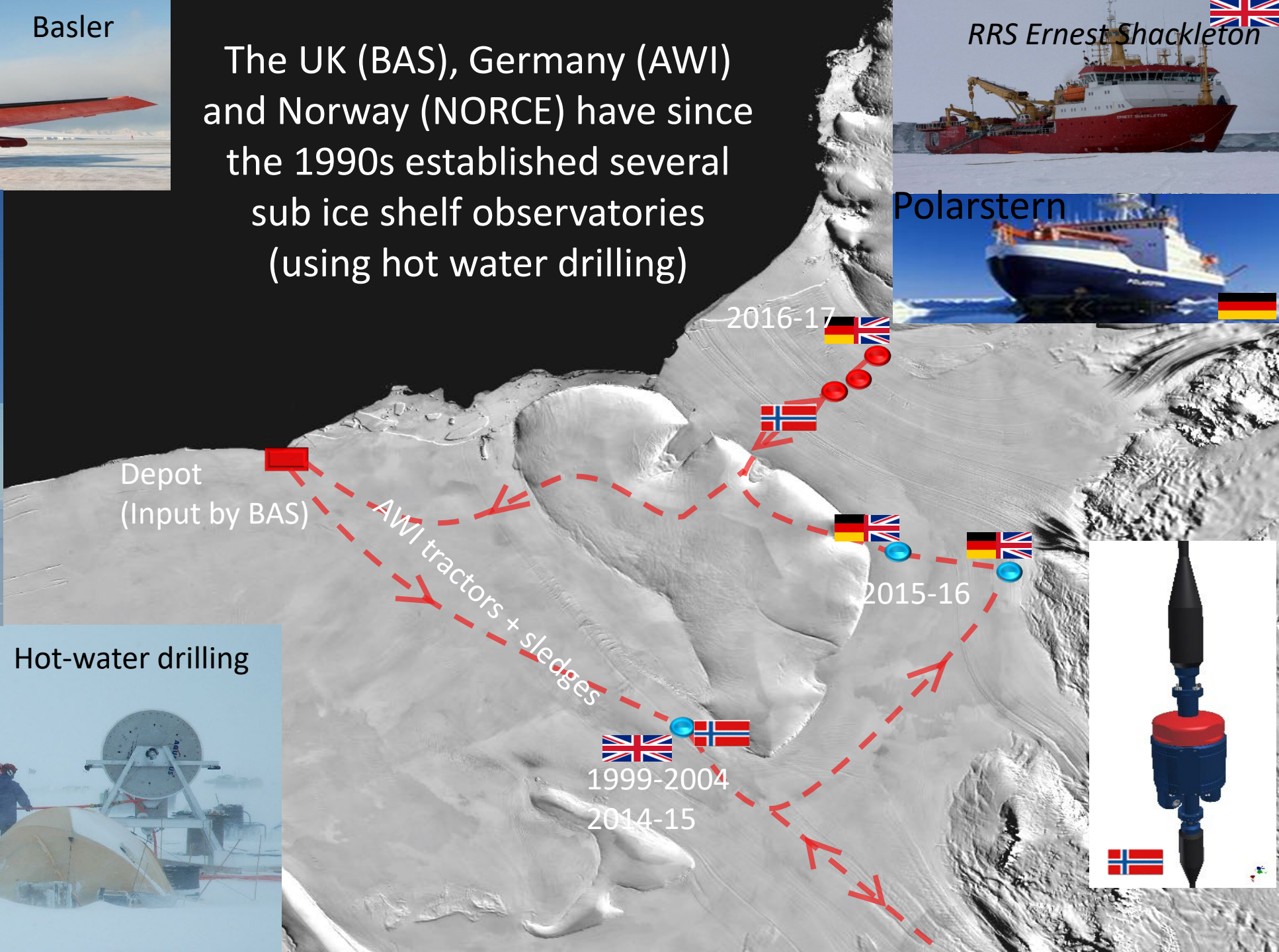
Hot-water drilling

The UK (BAS), Germany (AWI) and Norway (NORCE) have since the 1990s established several sub ice shelf observatories (using hot water drilling)



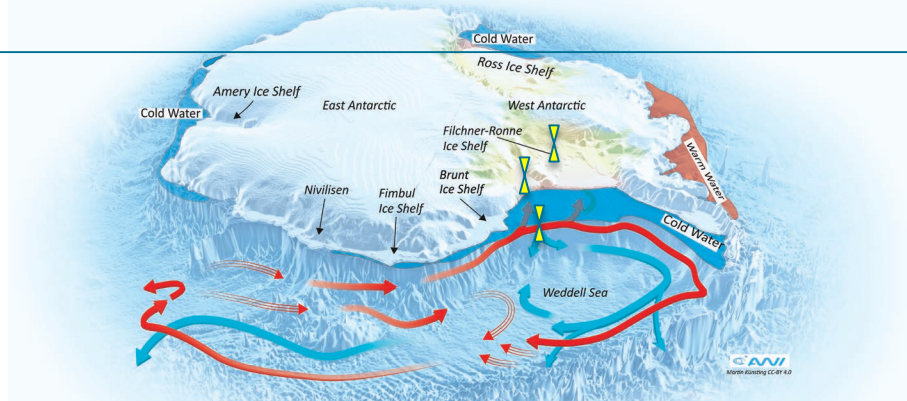
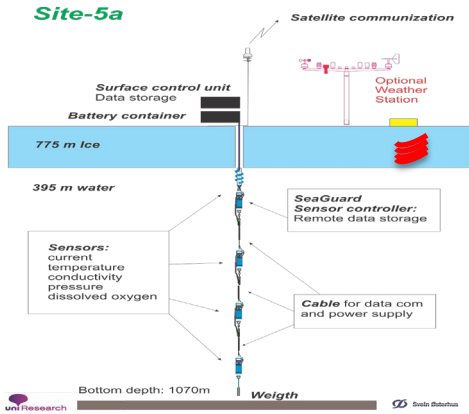
RRS Ernest Shackleton

Polarstern

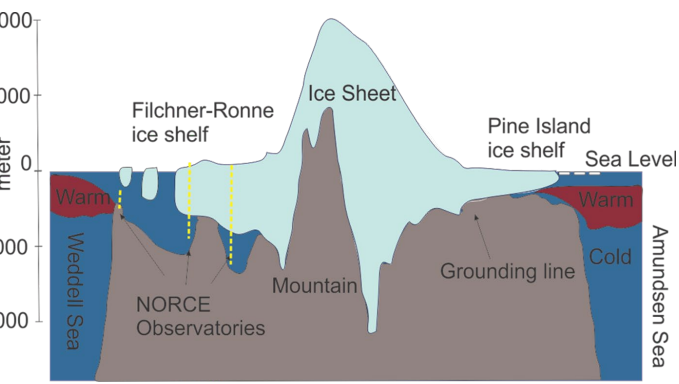
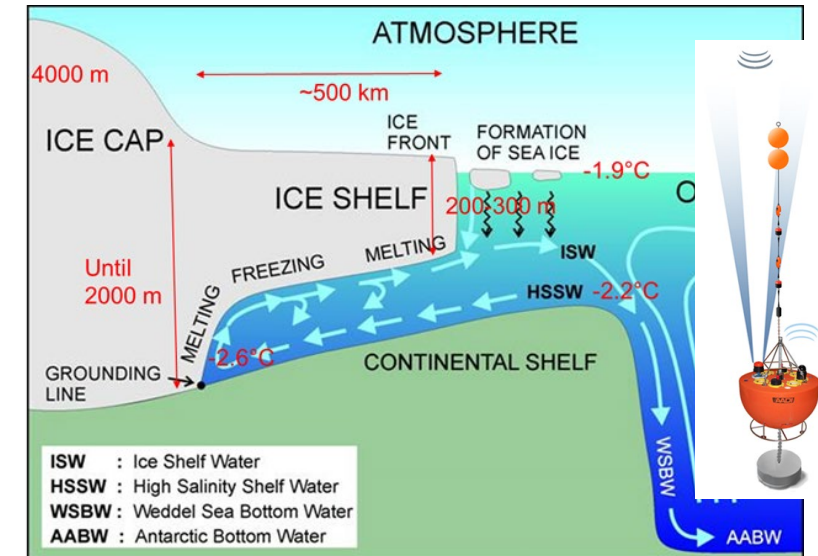
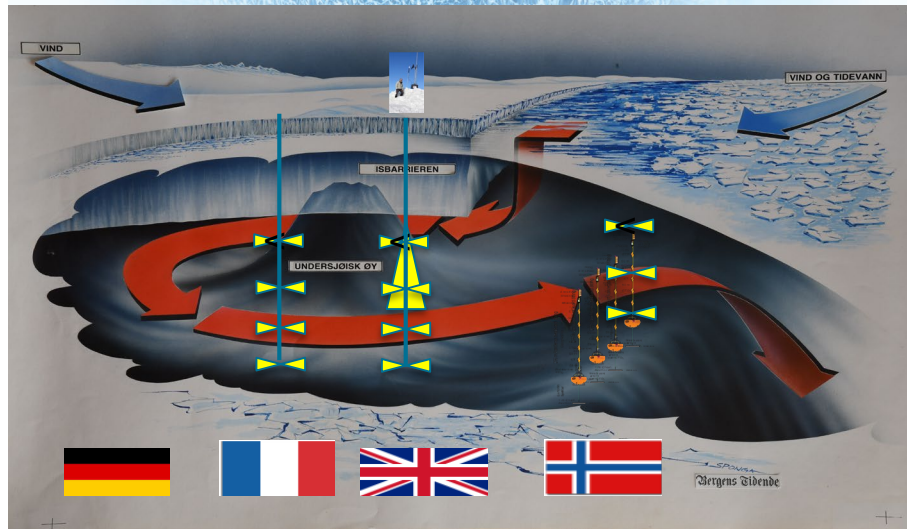


# Long-term observing system for the oceanic regime of Filchner-Ronne Ice Shelf, Antarctica

## Weddell Watch



AWI LOCEAN BAS NORCE



**observatories beneath the ice shelf are operated by AWI, BAS and NORCE**  
**Year-long time series back to the 1990s**

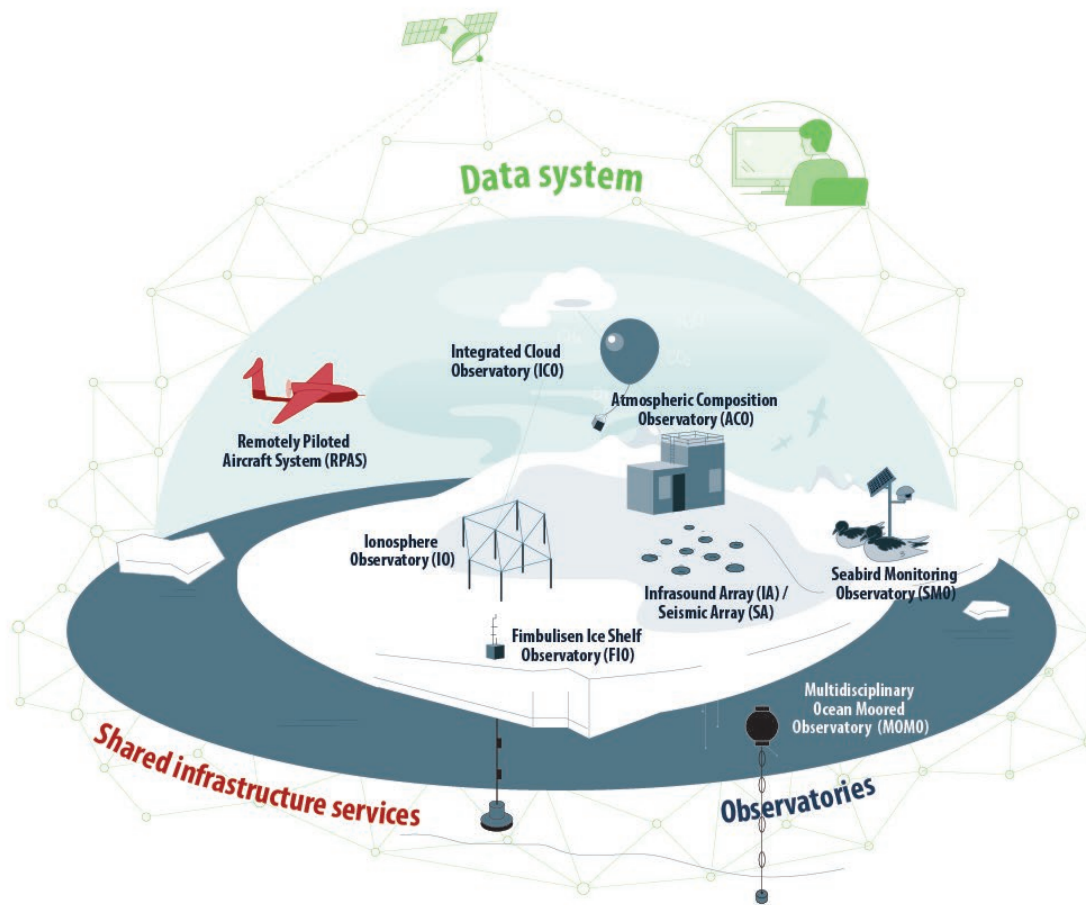
**observatories under the sea ice are operated by AWI, LOCEAN and NORCE**  
**Year-long time series back to 1968/77**

# Thank you

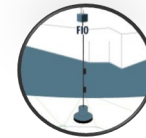
[svein.osterhus@norceresearch.no](mailto:svein.osterhus@norceresearch.no)



# TONE-modules



**ICO:** will look at the coupling between clouds and aerosols and their role in the surface energy balance



**FIO:** measurements of mass balance and ocean properties on and beneath the ice-shelf



**MOMO:** monitor ocean properties in the Antarctic Slope Current and Weddell Gyre inflow section over the continental shelf break at 6° East



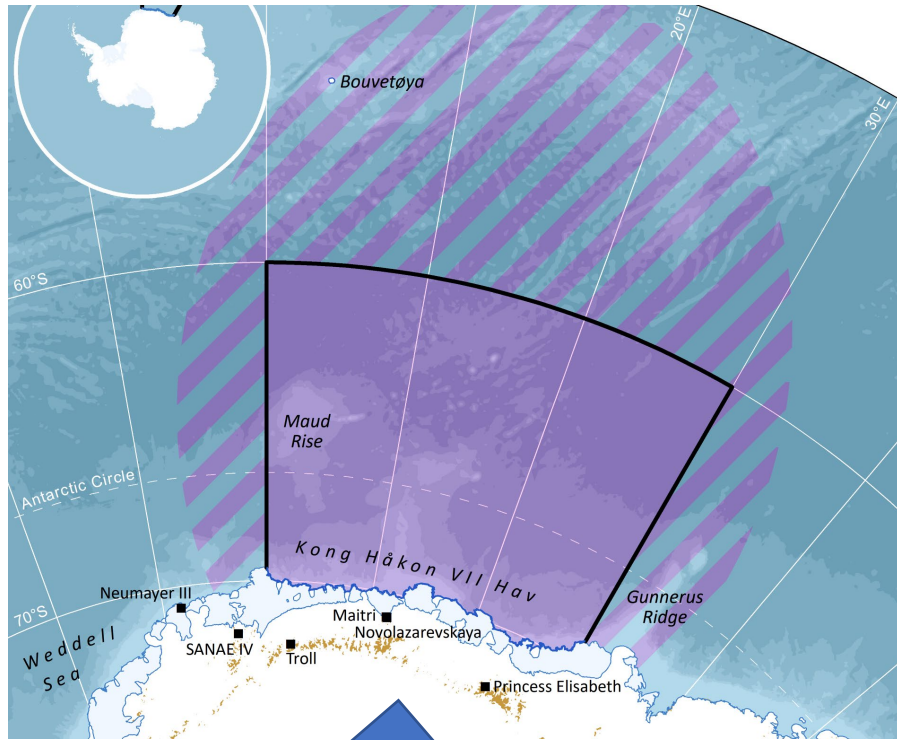
**SMO:** seabird distribution, status and trends in DML



**RPAS:** two fixed-wing long-range RPA with large payload capacity. VHF radar, GHz radar, aerial cameras, sensors for meteorological, cloud and aerosol profile measurements and hyperspectral sensors.



# Ecosystem knowledge Kong Håkon VII Hav





## Research to set conditions for Norwegian management and activity

- ❖ Work to ensure that Norway can make a significant contribution towards increasing environmental **knowledge that can serve as a basis for environmental management** in the Antarctic.
- ❖ Actively help to ensure that CCAMLR has a **sound scientific basis for making decisions and developing its management regime for the Antarctic marine ecosystem.**
- ❖ Help to develop and improve efficiency in CCAMLR fisheries management by **expanding the knowledge base for krill management.**
- ❖ Seek to ensure that **sufficient mapping and monitoring** are carried out to safeguard Norwegian interests and fulfil Norway's international obligations.





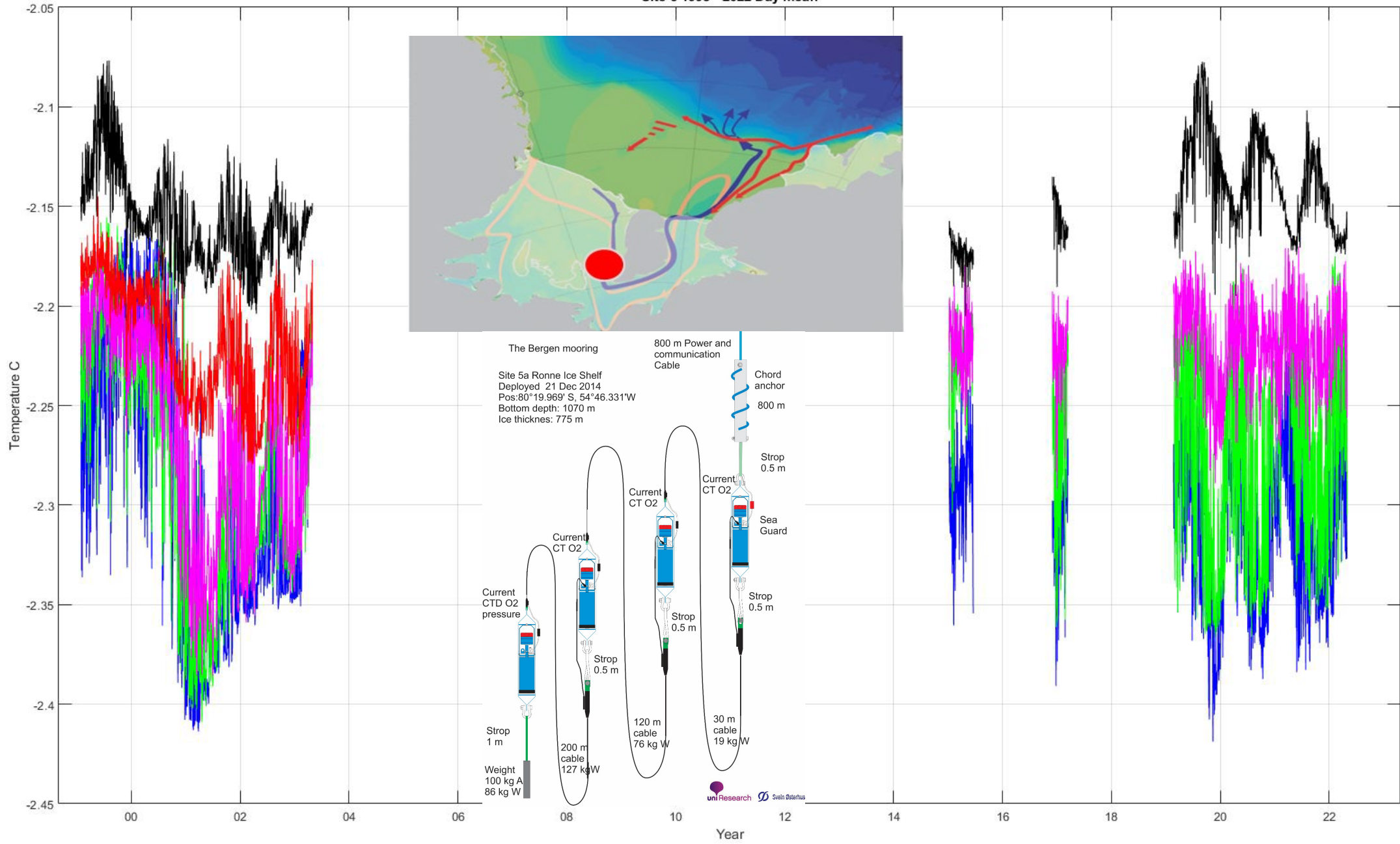
# RINGS

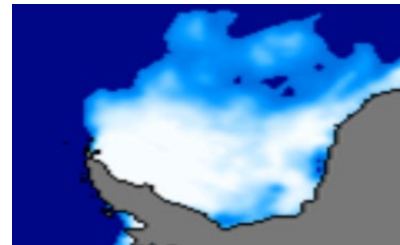
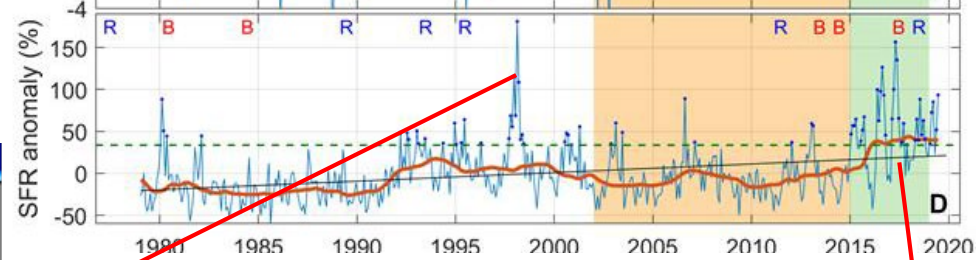
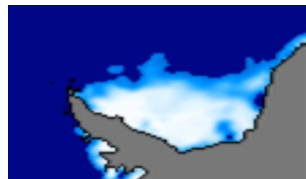
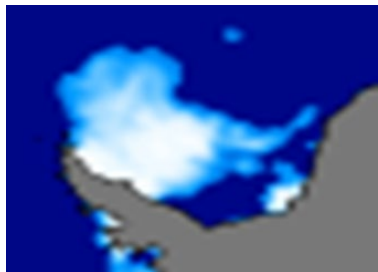
**The primary goal** is to provide more accurate and complete reference bed topography data for robust assessments of ice discharge from all around Antarctica



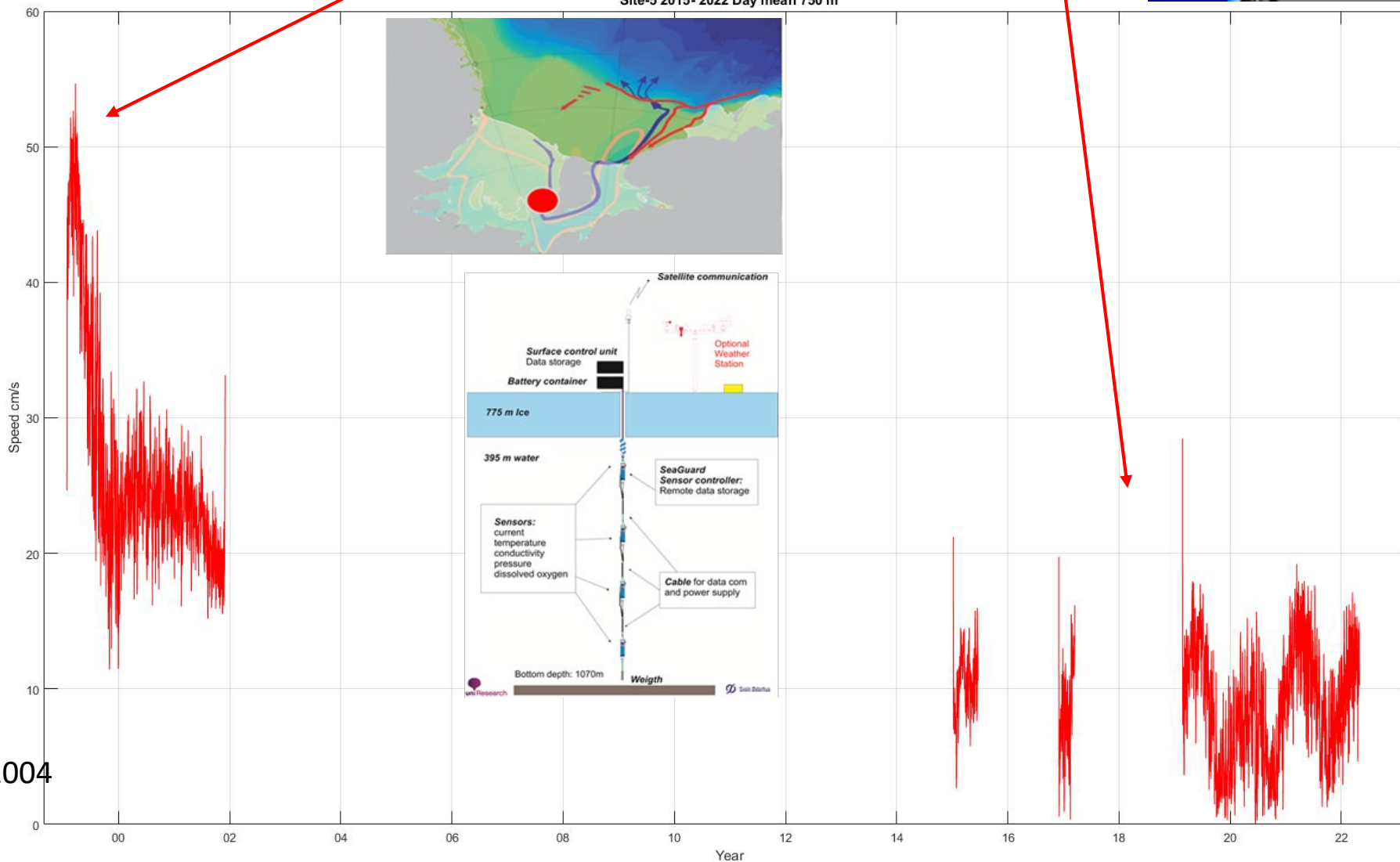
# Temperature variations at Site-5 1998 – 2022 (Apr).

Site-5 1998 - 2022 Day mean



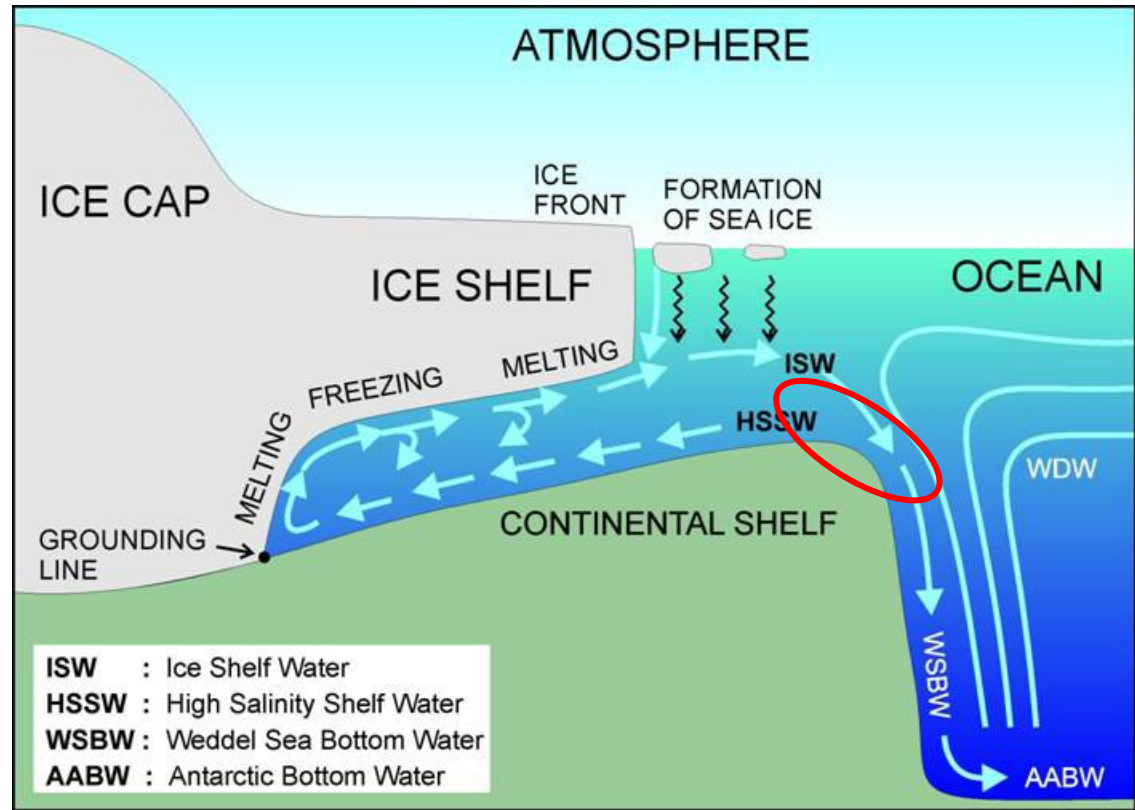
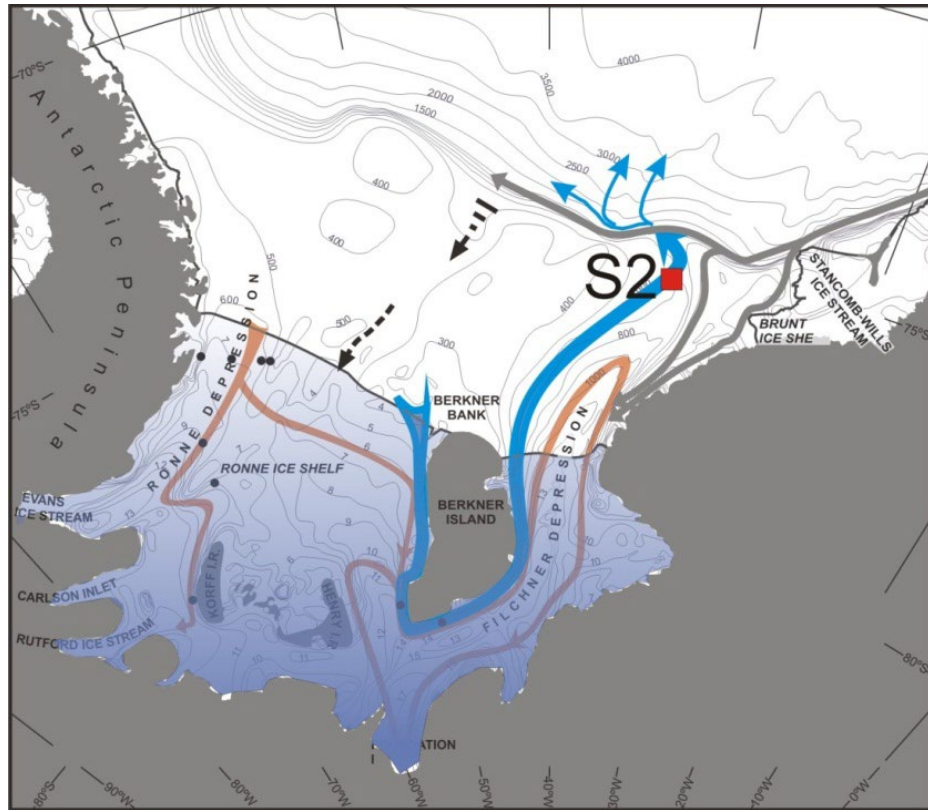


Site-5 2015-2022 Day mean 750 m



Nicholls and Østerhus, 2004

# The Ice Shelf Water (ISW) Plume on the continental shelf break 1977 - 2021



# Temperature in the Overflow Water (ISW HSSW) at S2

