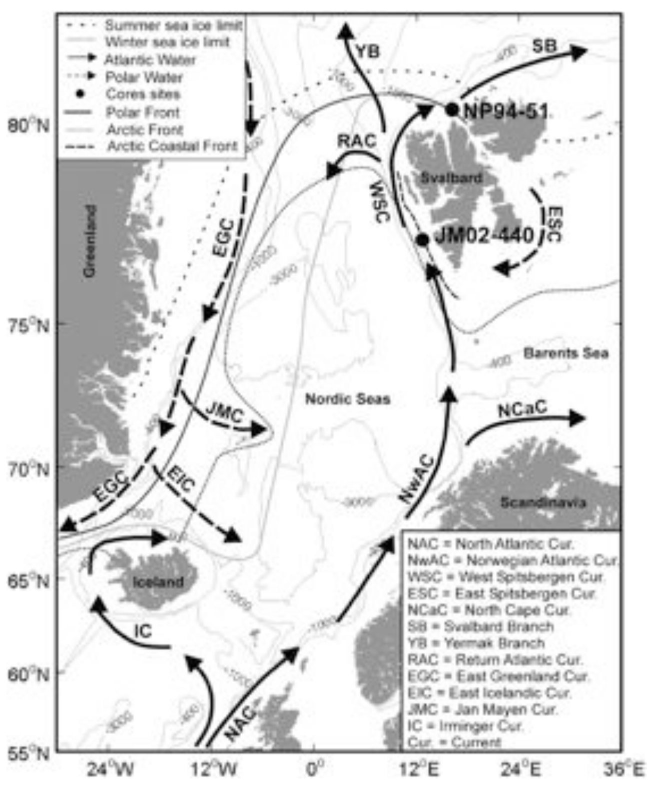
Project Objectives

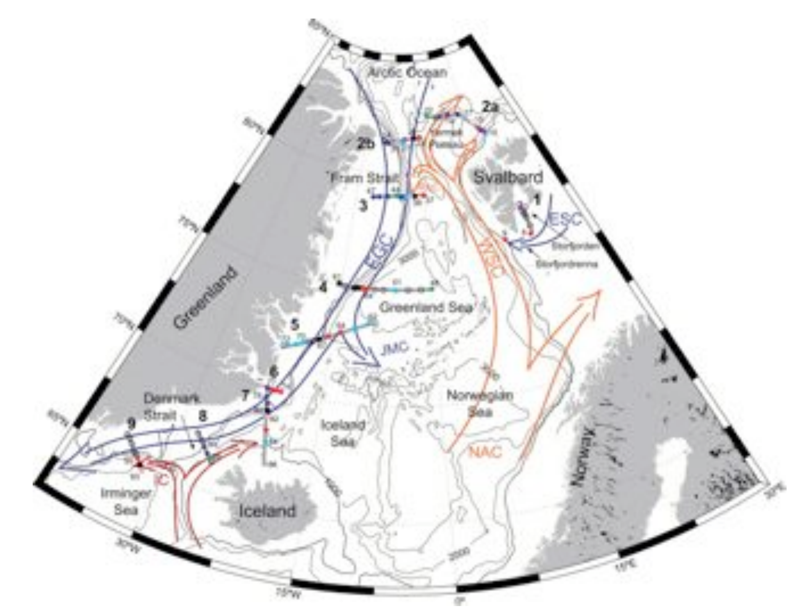
- Demonstrate & deploy observatory lander technology for dissociating hydrate studies in high latitude, but warming Arctic Ocean shelf sites.
- Design and evaluate data acquisition and real time transmission methodologies for Fram Strait oceanography, including and acoustic network for future ocean tomography and glider navigation and docking.
- Develop the scientific and policy case for the Arctic ESONET site to become a sustained cabled observatory network within ESONET/EMSO initiatives, and Norwegian SIOS and EU ESFRI programmes.

AOEM Arctic Ocean ESONET Mission

Study Site

Fram Strait and western Svalbard shelf are critical locations for assessing climate induced change in the Arctic Ocean. Fram Strait is the major gateway for water mass exchange between cold Arctic waters and warmer North Atlantic waters while western Svalbard shelf is a site of methane hydrates.

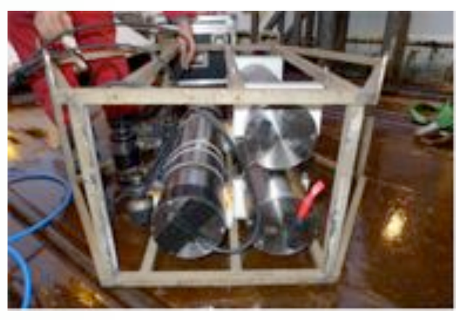




Maps showing study area, left from Slubowska-Woldengen et al (2007) and above from Rudels et al (2005)

WP1 Sensor/lander integration

The AOEM lander (shown below) was successfully deployed in Oct 2010 from the R/V Jan Mayen and will remain deployed for 2 years. Within the hexagonal structure is a stainless steel cage (see right) containing most of the scientific instruments.



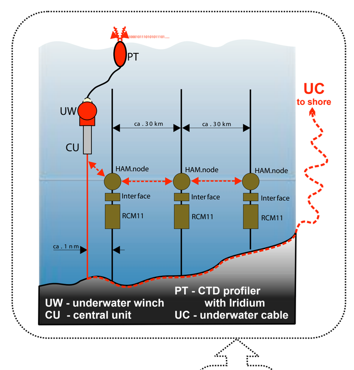
Within the steel cage are titanium pressure cylinders containing batteries & data loggers, camera & lights., hydrophone and a seismometer). Current meters, CTD and sensors to measure oxygen & turbidity and ADCP are mounted on the outside of the lander.

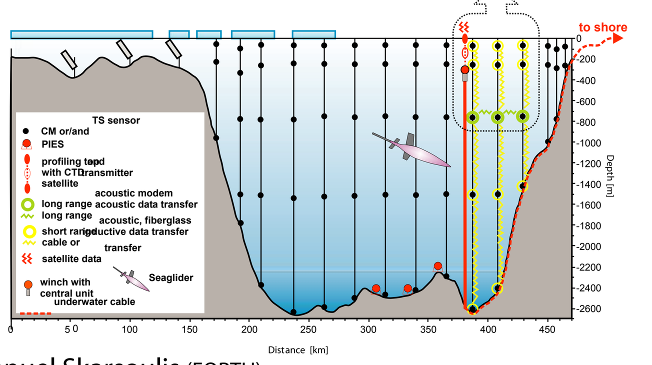
Ian Wright, Doug Connelly, Rachel James, Veit Huhnerbach (NOC), Jürgen Mienert (UiT)

WP4 Data transfer technology & formats/protocols

Results of planning, testing and assessing the functionality of the components of a network for transfer of data from moored systems in Fram Strait to shore:

- Technical solutions exist but not yet in an operational mode.
- Beyond technical feasibility data requirements by the potential users and cost efficiency have to be considered.
- Data formats and protocols are proposed for transmission via the cabled observatory



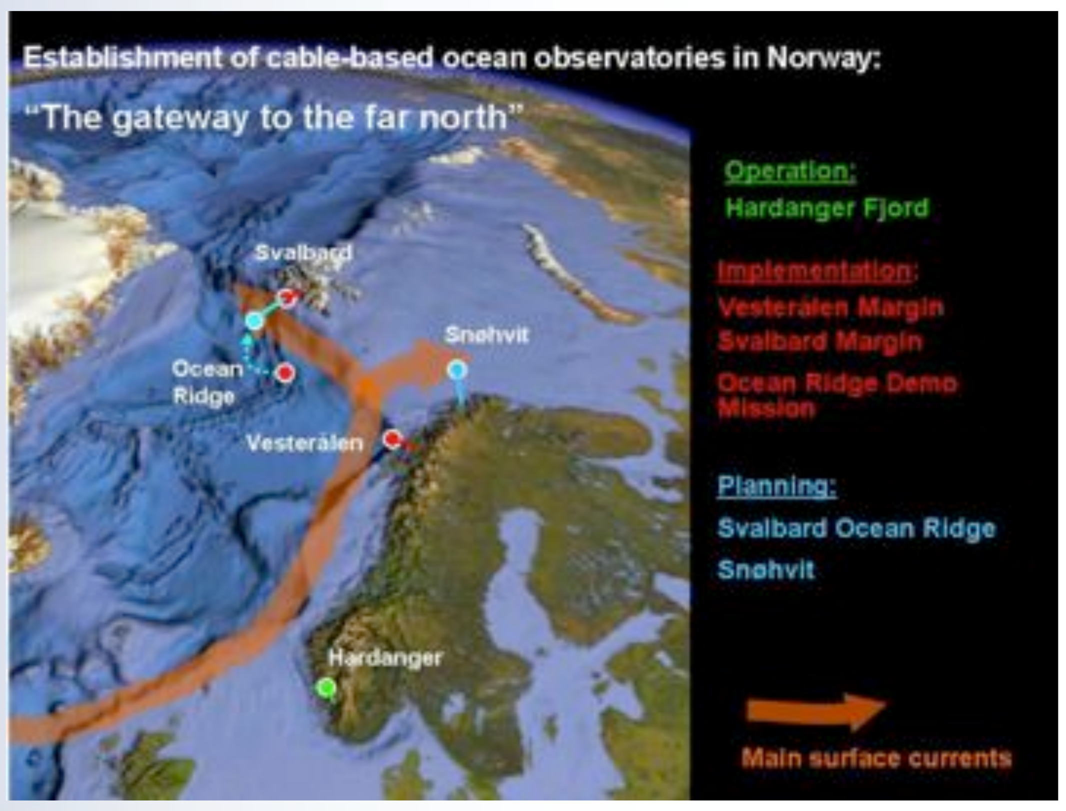


Eberhard Fahrbach (AWI), Agnieszka Beszczynska-Möller (AWI), Emmanuel Skarsoulis (FORTH)

WP2 Operational Oceanography

A cabled observatory opens new perspectives to observe the ocean's physical state by providing continuous power supply with almost real time data transfer to the users. Of primary interest for the needs of operational oceanography are water column deliverables of:

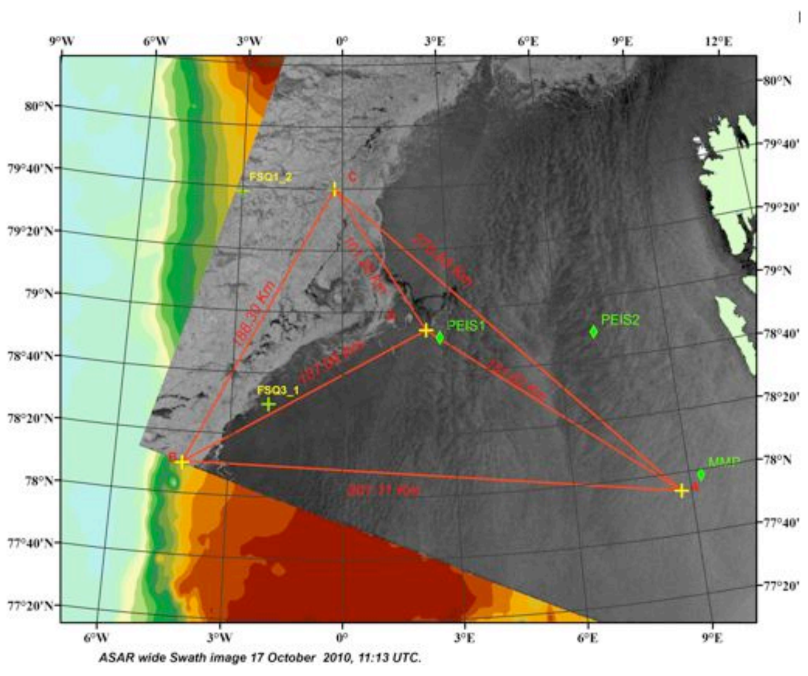
- hydrography (temperature, salinity, pressure)
- ocean current speed and direction
- turbulent fluxes of momentum and heat
- acoustics (ambient noise, sound velocity and tomography, backscatter)



Peter M. Haugan (UiB), Ilker Fer (UiB), Stein Sandven (NERSC)

WP5 Acoustic Network

Acoustic navigation or tracking of gliders and floats in ice-covered regions are evolving at several locations such as in the Antarctica, Davis Strait, and in the Fram Strait. Current navigation accuracy is in the order of kilometres, but this can be improved to 100-200 m with new acoustic technology.
Acoustic tomography is mature technology providing acoustic travel time measurements, which can be inverted to mean ocean temperature and current, or assimilated directly into ocean models.
Passive acoustics can be used for monitoring of sea ice and ocean processes, and for localization and tracking of marine mammals.
Acoustic technology as used in the Fram Strait acoustic system can be used both in cabled and un-cabled networks.
A future perspective of a cabled acoustic observatory covering the entire Arctic Ocean is defined. Implementation of cabled systems in the Arctic can be developed through international collaboration. The Svalbard Integrated Observing System can offer opportunities to develop a system in the European sector of the Arctic.

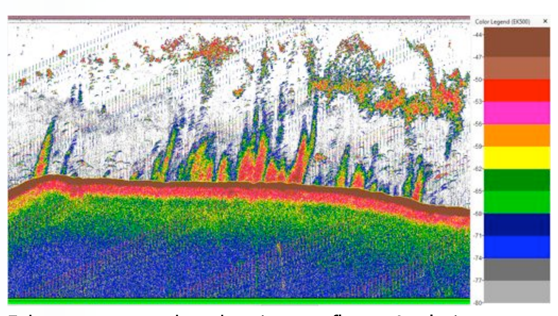


In summer 2010 an un-cabled multipurpose acoustic system was deployed the central and deep parts of the Fram Strait. The system formed as a triangle of three transceivers (A, B, C) and a receiver array (D) in the center are used for 3 D tomography, navigation of gliders and passive listening to ambient noise from sea ice and marine mammals. The mooring locations are superimposed on a satellite radar image from ENVISAT in grey tone showing the detailed sea ice extent in the western part of the strait and open water in the eastern part. The colour code in the background indicate water depth, where light blue is the Greenland shelf (< 400 m) and brown-red represent depths above 3000m. The acoustic system in the Fram Strait is supported by the ACOBAR project.

Stein Sandven, Hanne Sagen (NERSC)

WP3 Geochemical & flux experiments

Key Questions:
- Where does the methane come from? (e.g. dissociation of gas hydrates or migration from deep thermogenic sources.
- What happens to the methane?



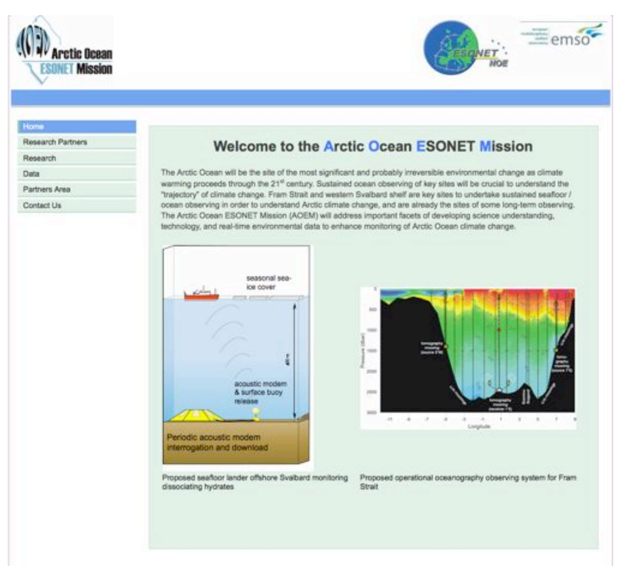
Echogram screenshot showing gas flares. Analysis confirms the gas is methane.

To help answer these questions, fluid flow is being measured (see flow meter, left) & sensors on the lander are measuring dissolved O_2, temperature and salinity. Additional measurements including methane are being made on sediment cores.

Ian Wright, Doug Connelly, Rachel James, Veit Huhnerbach (NOC)

WP6 Publications & Outreach

website: www.eu-aoem.net



Sagen, H. et al. (2009). Acoustic technologies for observing the interior of the Arctic Ocean. In Proceedings of the "Ocean Obs'09: Sustained Ocean Observations and Information for Society" Conference (Annex), Venice, Italy, 21-25 September 2009, Hall.D.E. and Stammer, D., Eds., ESA Publication WPP-306, 2010.

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