Eurofleets+ Floating University

Mapping the Ocean Floor: An Introduction to Practical Aspects of Hydrographic Surveying

RV Celtic Voyager

About myself

- 2015-2019: BSc Marine Sciences at the University of Barcelona (Spain)
- 2019-2021: MSc in Polar and Marine Sciences (POMOR) at Saint Petersburg State University (Russia) and Bremen University (Germany)
- 2021: MSc thesis at the University Centre in Svalbard (Svalbard, Norway)
- 2021-2023 Temporal academic staff at UNIS

- *06/2021: GASGEM cruise. Onboard RV Clione*.
- 11/2022: AeN Closing the Gap research cruise. Onboard the G.O.Sars as part of the Nansen Legacy Project in the Barents Sea.
- 03/2023: Arctic Submarine Groundwater Discharge (KH2023-7003). Onboard RV Kronprins Haakon in Isfjorden and Hornsund (Svalbard archipelago)
- ***09/2023*: FJORDGAS (HE628). Onboard FS Heincke in the fjords of Svalbard.**

Cork, Ireland - 19th to 25th February 2020

Eurofleets+ Floating University 2020

- Focused on hydrographic data acquisition in Cork harbor and the South Coast of Ireland.

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  - Data process
  - Data analysis.

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- Improved our knowledge on scientific instrumentation – multibeam (MBES) and subbottom profilers
- We covered MBES:
  - Data acquisition
  - Data process
  - Data analysis.
- Learned about the amazing Irish hydrographic service and Marine Institute.

Shared our research

Made a little project with outreach purposes

- I gained valuable knowledge about hydrographic instrumentation such as MBES and subbottom profilers, and how they are used to map and characterize the ocean floor.
- I also had the opportunity to learn about the marine surveying activities performed in Ireland.
- It was a fun and enlightening experience, and I was able to meet some amazing people whom I still keep in touch with.
- **Overall, this experience has enhanced my career.**

Active gas seepage in western Spitsbergen fjords, Svalbard archipelago: spatial extent and geological controls

Nil Rodes[1,2]*, Peter Betlem[1,3], Kim Senger[1], Miriam Römer[2,4], Andy Hodson[1], Martin Liira[5], Riko Noormets[1], Srikumar Roy[6], Aleksandra Smyrak-Sikora[1], Gerhard Bohrmann[2,4]

*Contact information: **nilr@unis.no**

[1]The University Centre In Svalbard

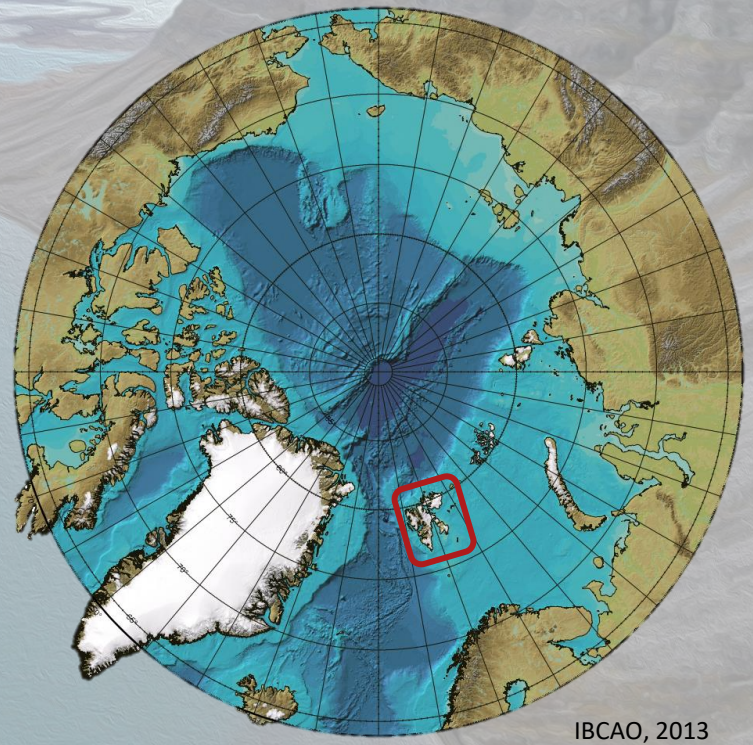
[2]University of Bremen

[3]University of Oslo

[4]MARUM – Center for Marine Environmental Sciences

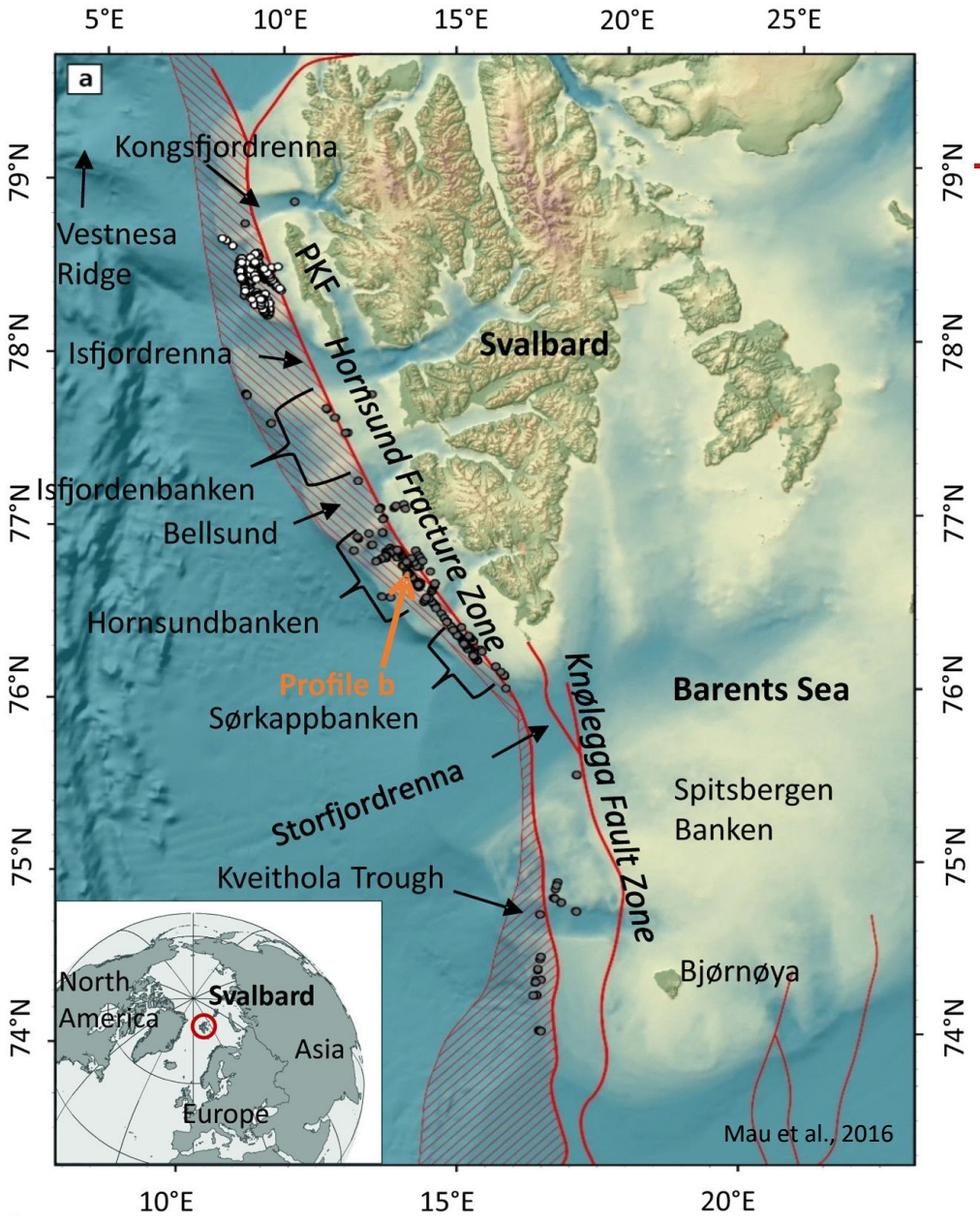
[5]University of Tartu

[6]University College Dublin

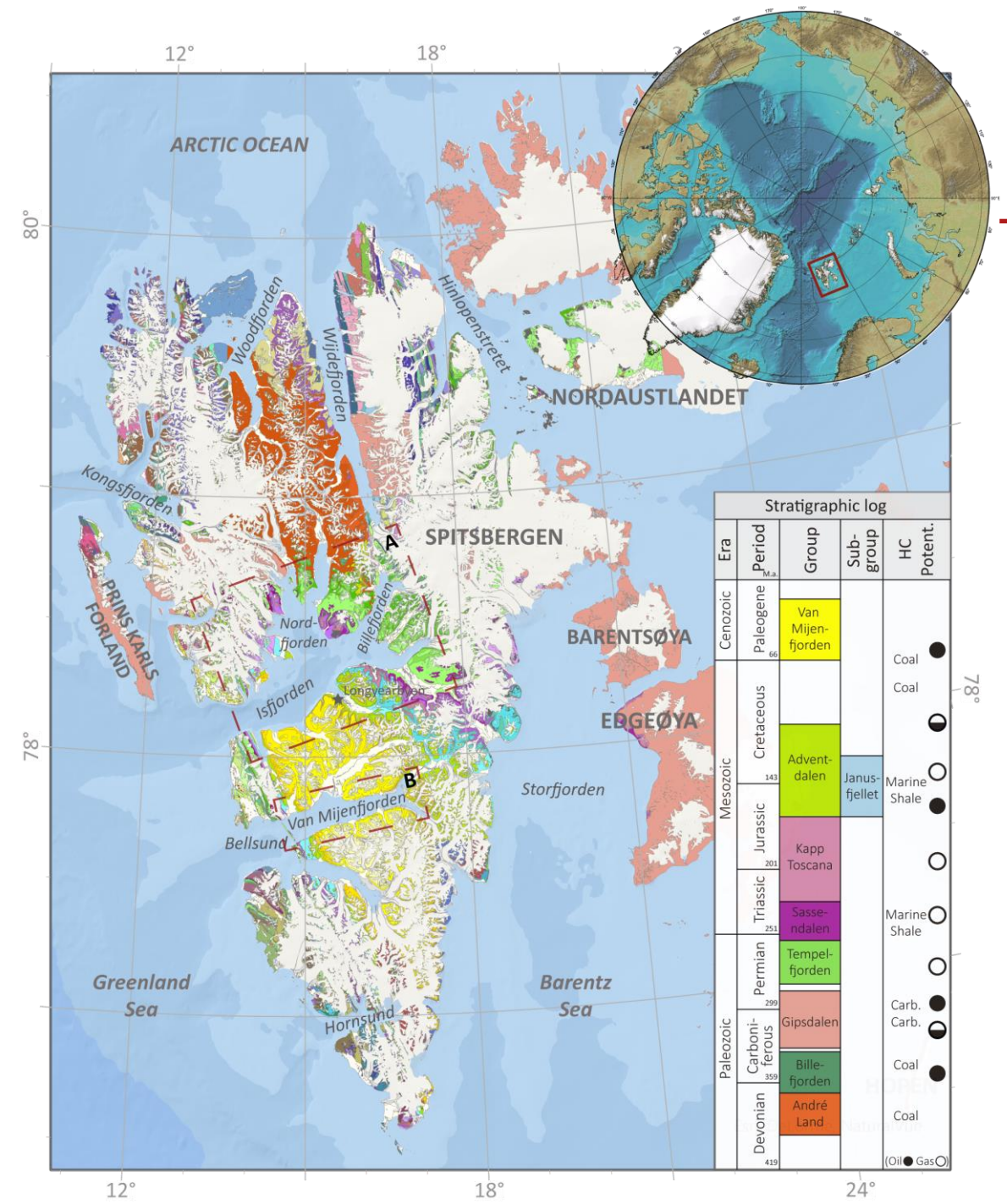


IBCAO, 2013

STATE-OF-THE-ART BACKGROUND



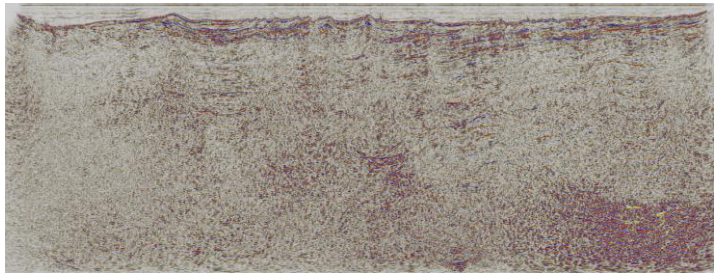
- Gas seepage along **continental margins**.
- Extensively studied **offshore** Svalbard. And in the **fjords**?
- HE449 cruise August 2015 → **gas seepage in the fjords of Spitsbergen**!
  - **Shallow** marine environment
  - Early climate change **warning** system

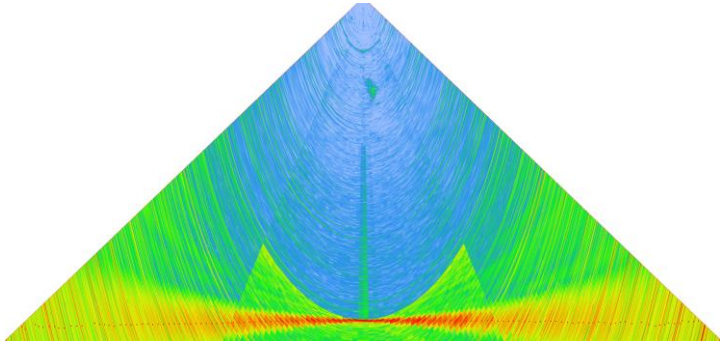


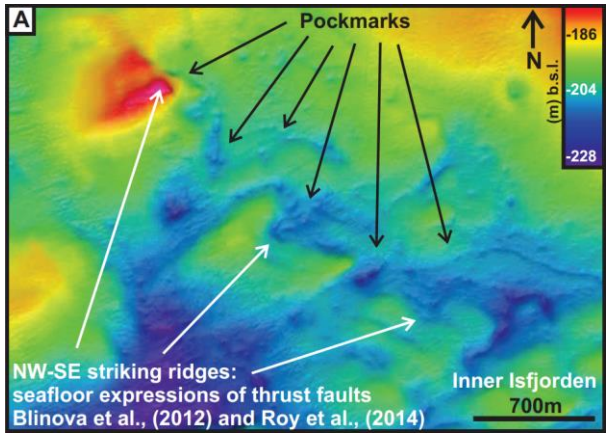
RESEARCH OBJECTIVES

1. **Gas seepage distribution and seasonality.**
2. **Stratigraphic units -Mesozoic organic-rich formations-.**
3. **Geologic control of present-day fluid expulsion.**

DATA & METHOD







EXISTING DATA

2D seismic profiles
Data source:
STATOIL: NH8509, ST8515, ST8815
SVALVEX: 2005-2009
TGS: SVA-IS-85
Seismic data interpretation
Petrel E&P Software 2019.1
Export surfaces to GIS
ArcGIS Pro 2.7.0
Map of geological units outcropping in the fjords
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Hydroacoustic water column data (2015)
Data source:
Cruise HE-449
(Uni Bremen & MARUM)
Flare detection in hydrographic profiles
Fledermaus 7.7.2
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FMMidwater 7.7.2
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Bathymetry & Backscatter
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NEW DATA COLLECTION - GASGEM Cruise 2021

Water column data
Sea Bird SBE19+
Data processing
Ocean Data View 5.4.0
Python 3.8.8

Surface water samples
Samples analysis
Uni Bremen

Atmospheric CO2 & CH4 concentrations
LGR-ICOS gas analyzer
Data processing
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Hydroacoustic water column data
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DATA ANALYSIS
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Data normalization
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Plot results
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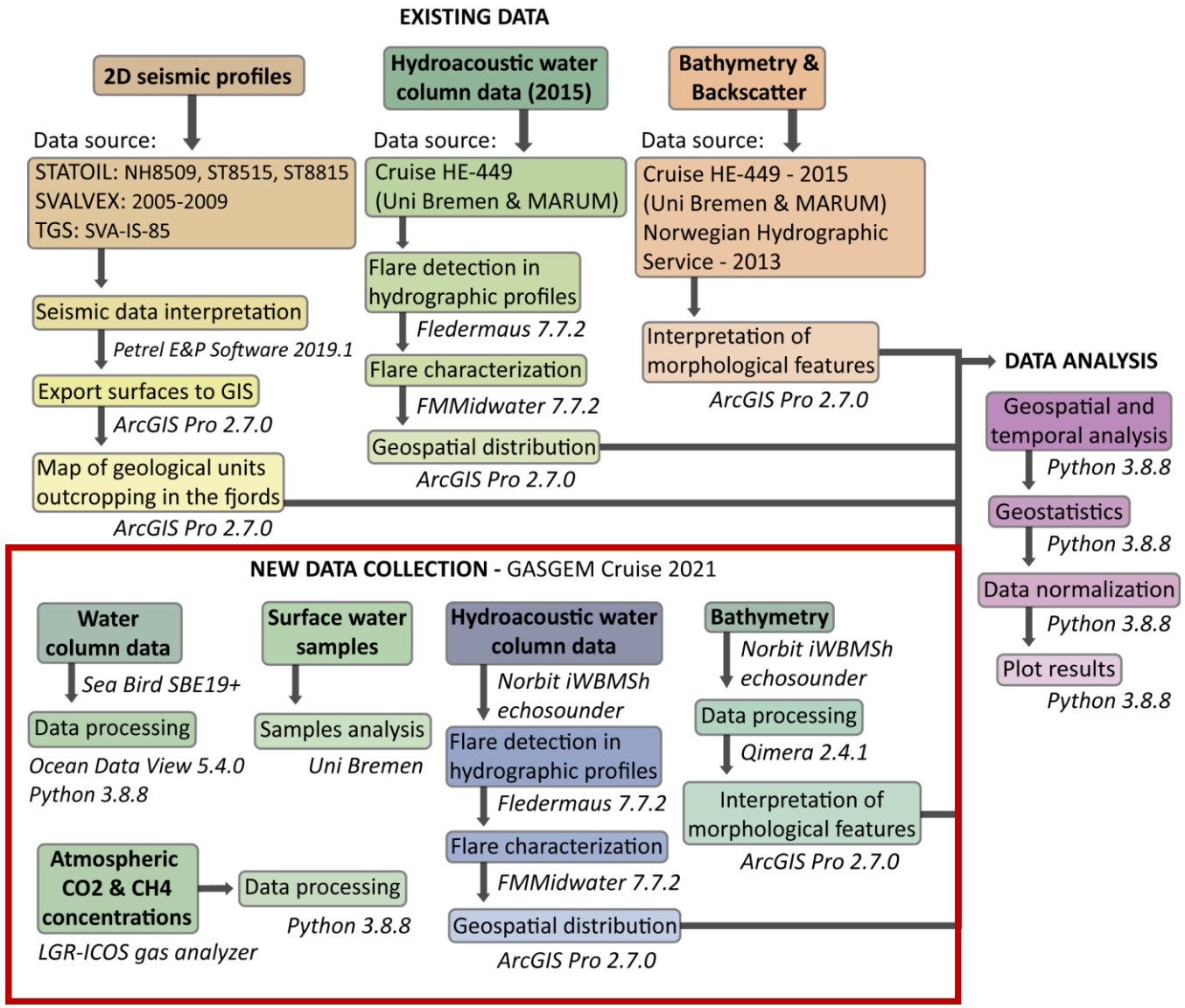
DATA & METHOD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DATA & METHOD

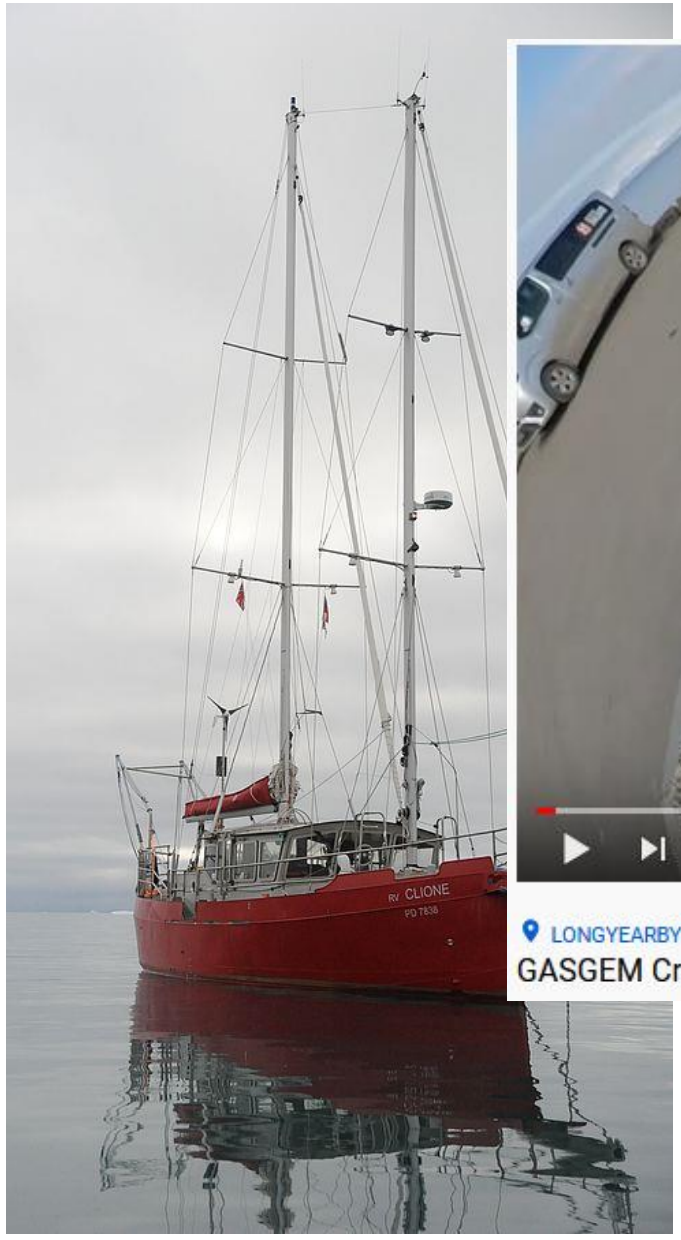
Research Grant

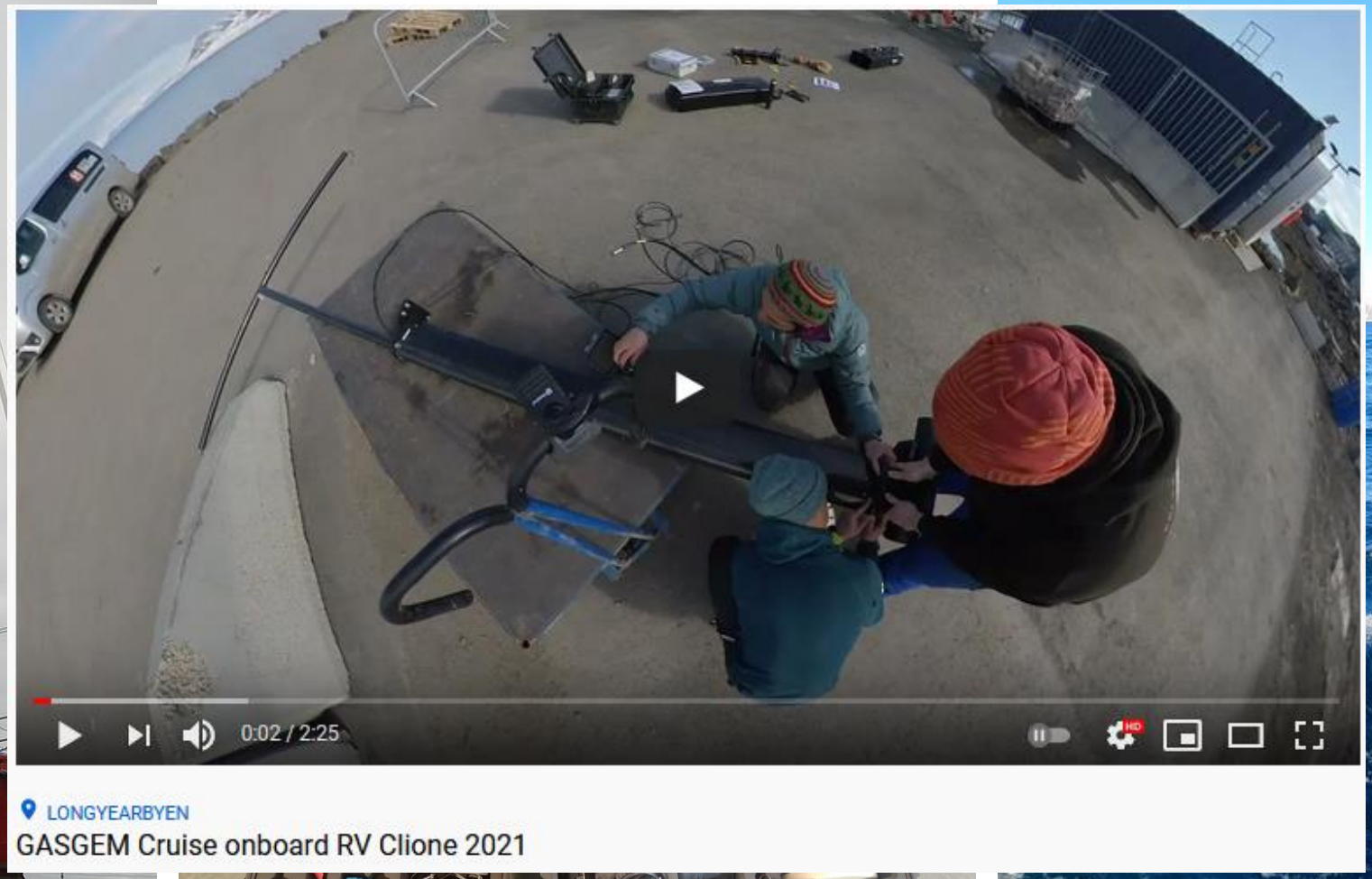
Research Vessel – Arctic Czech Station

Norbit Subsea

Great team and motivation!

DATA & METHOD


RV CLIONE
PD 7838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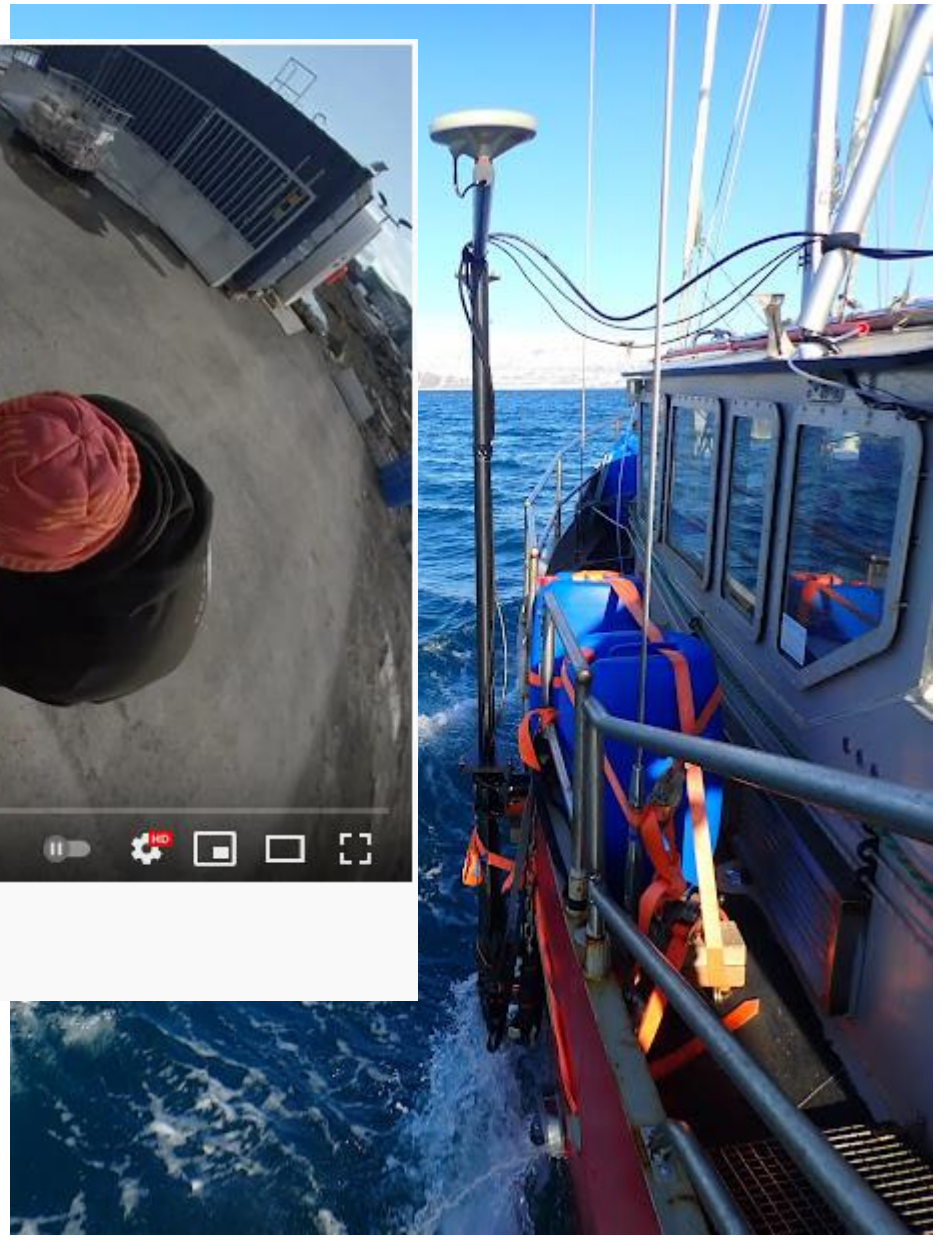
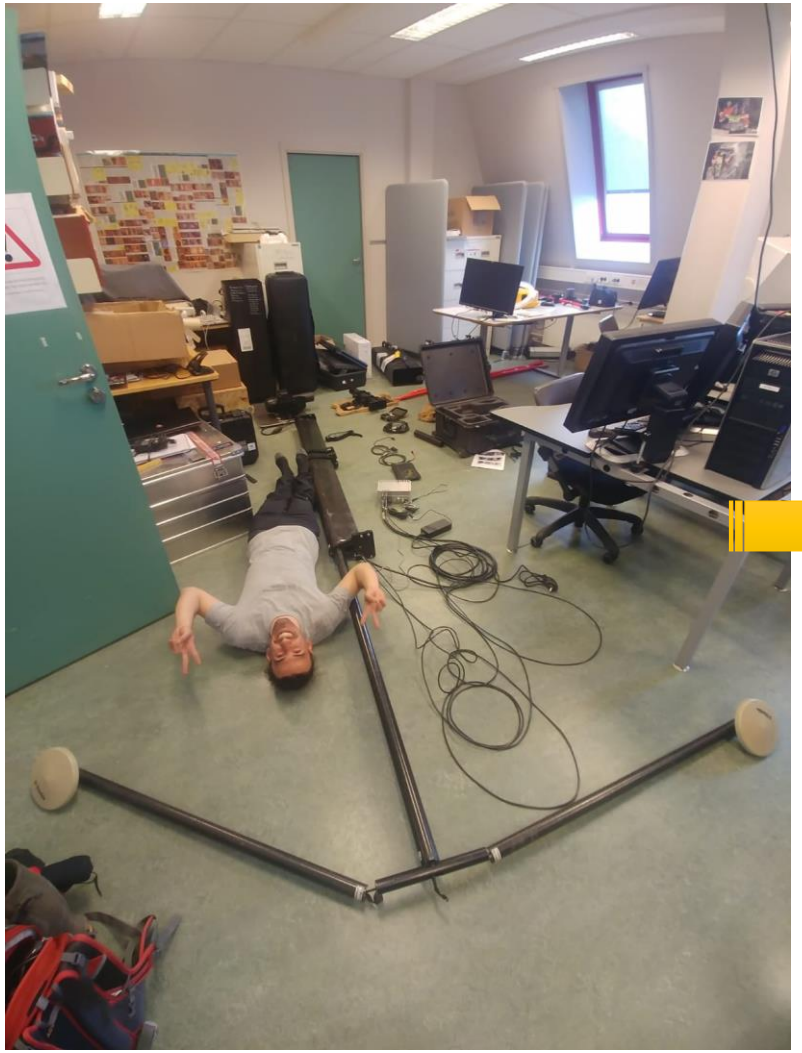
LONGYEARBYEN
GASGEM Cruise onboard RV Clione 2021

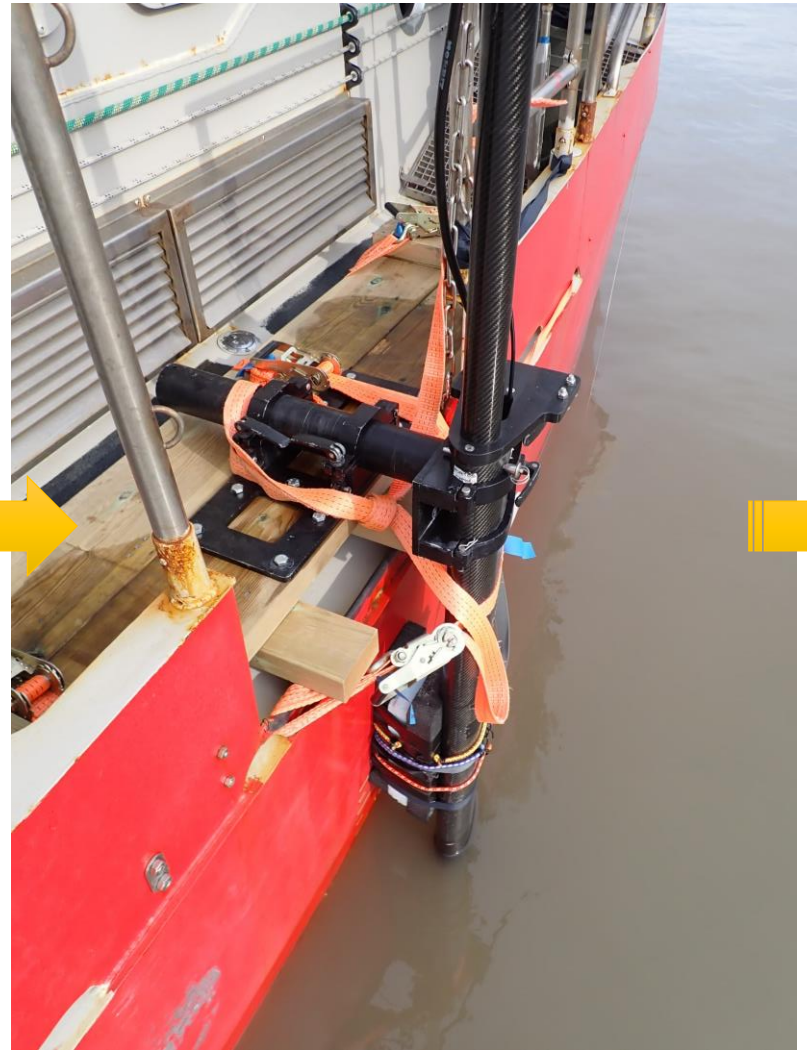


Set up of the NORBIT iWBMSh system

Set up of the equipment on the lab

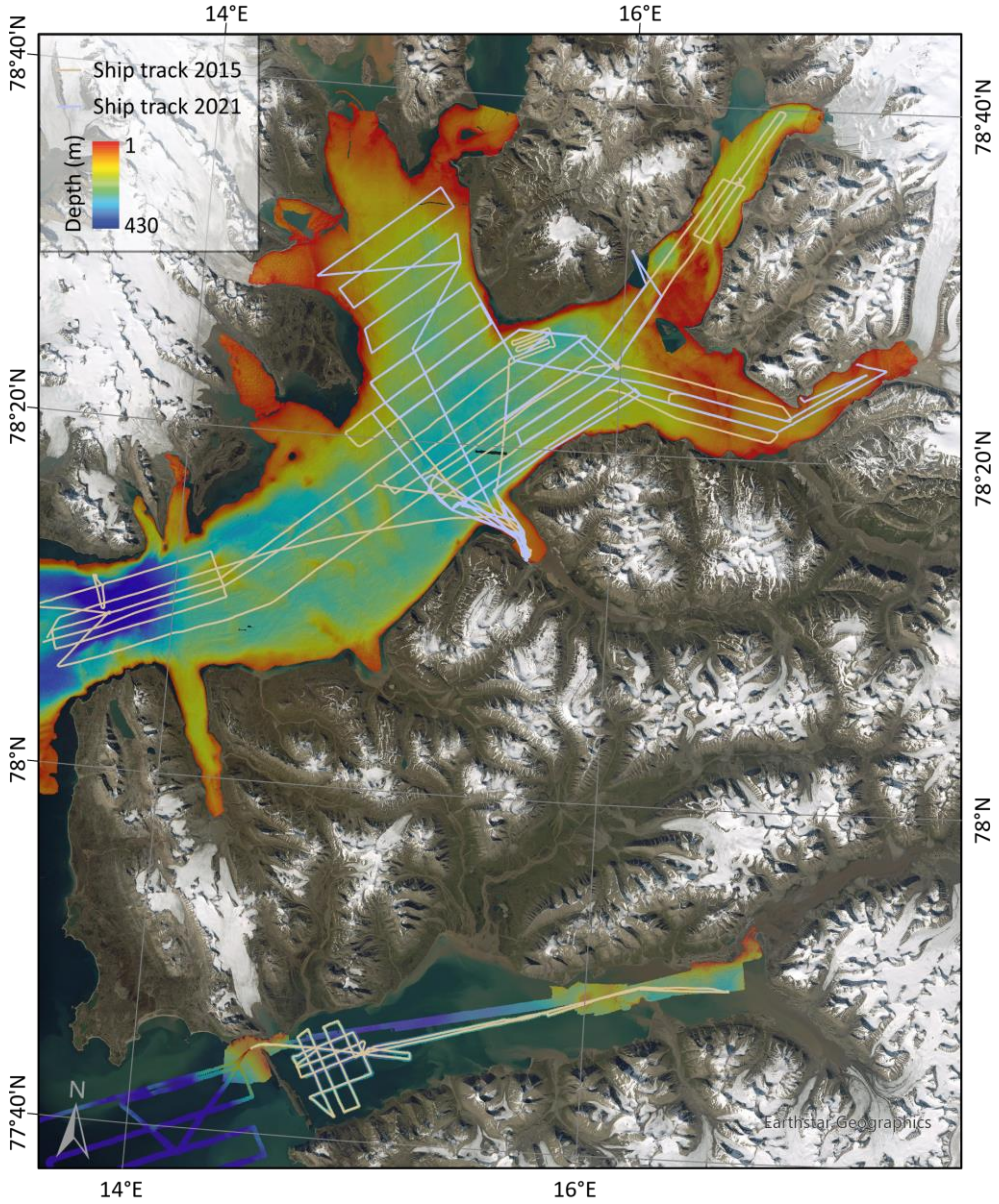


Assemble the MBES to the vessel

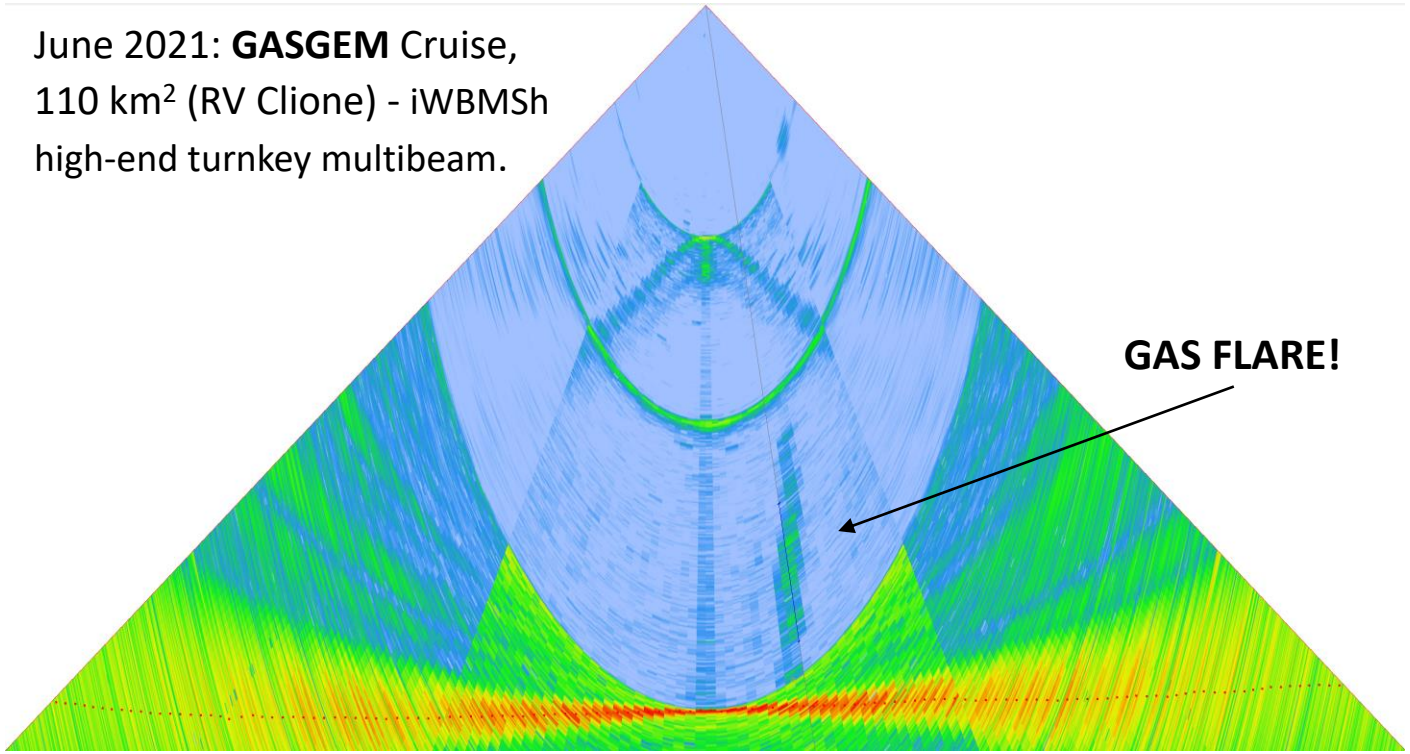


Data acquisition

WATER COLUMN IMAGING



- August 2015: **HE449** Cruise, 176 km^2 (RV Heincke) - Kongsberg EM710.
- June 2021: **GASGEM** Cruise, 110 km^2 (RV Clione) - iWBMSh high-end turnkey multibeam.



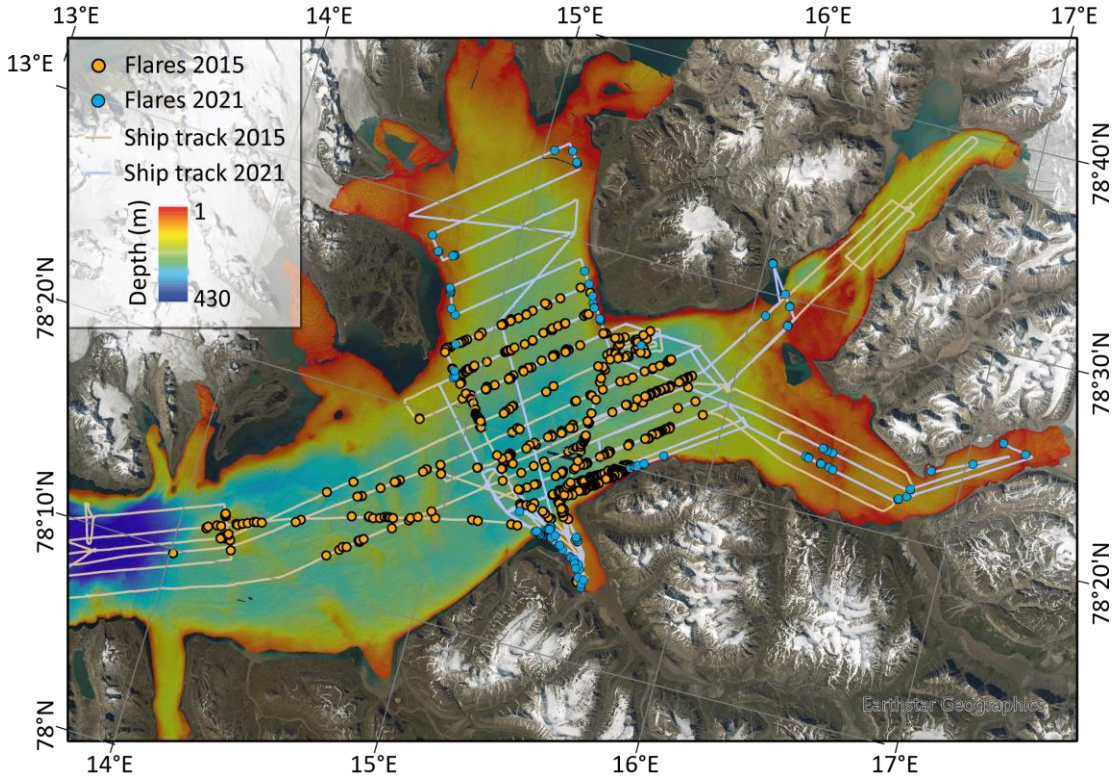
WATER COLUMN IMAGING

Results 2015

- Isfjorden: **668 flares** (176 km^2).

Results 2021

- Isfjorden: **152 flares** (110 km^2).



PUBLISHED MANUSCRIPT

Active gas seepage in western Spitsbergen fjords, Svalbard archipelago: spatial extent and geological controls

Nil Rodes[1*] Peter Betlem[1,2] Kim Senger[1]  Miriam Römer[3,4] Andy Hodson[1,5] Martin Liira[6,7] Tom Birchall[1] Srikumar Roy[8]  Riko Noormets[1] Aleksandra Smyrak-Sikora[1] Snorre Olaussen[1] Gerhard Bohrmann[3,4]

[1] Department of Arctic Geology, The University Centre in Svalbard, Longyearbyen, Norway
[2] Department of Geosciences, University of Oslo, Oslo, Norway
[3] Department of Geosciences, University of Bremen, Bremen, Germany
[4] General Geology–Marine Geology, MARUM–Center for Marine Environmental Sciences, Bremen, Germany
[5] Department of Environmental Sciences, Western Norway University of Applied Sciences, Bergen, Norway
[6] Department of Geology, University of Tartu, Tartu, Estonia
[7] The Geological Survey of Estonia, Rakvere, Estonia
[8] Irish Centre for Research in Applied Geosciences, University College Dublin, School of Earth Sciences, Dublin, Ireland

This study presents the first systematic observations of active gas seepage from the seafloor in the main fjords of western Spitsbergen in the Svalbard archipelago. High-resolution acoustic water column data were acquired throughout two research cruises in August 2015 and June 2021. 883 gas flares have been identified and characterized in Isfjorden, and 115 gas flares in Van Mijenfjorden. The hydroacoustic data indicate active fluid migration into the water column. Interpretation of 1943 km of regional offshore 2D seismic profiles supplemented the water column and existing gas geochemical data by providing geological control on the distribution of source rocks and potential migration pathways for fluids. In the study area, bedrock architecture controls the fluid migration from deep source rocks. Faults, high permeability layers, heavily fractured units and igneous intrusions channel the gas seepage into the water column. The observations of gas seepage presented in this study are an important step towards the assessment of how near-shore seepage impacts upon the carbon budget of Svalbard fjords, which constitute a globally recognized early climate change warning system for the High Arctic.

Frontiers in Earth Science

ORIGINAL RESEARCH article, 20 June 2023

Volume 11 - 2023 |Natural Methane Emissions in a Changing Arctic - Implications for Climate and Environment

https://doi.org/10.3389/feart.2023.1173477

ONGOING RESEARCH

- **FJORDGAS** project.
- **September 2023**, main fjords of **Spitsbergen**.
- **FS Heincke (AWI)**.
- Investigate **gas seep system** in Svalbard's fjords.
  - **Distribution** of gas bubble emissions.
  - **Quantitatively** estimate gas seepage.
  - Gas associated with **permafrost**.
  - **Gas hydrates** in the sediments.
  - Fluid flux **seafloor-hydrosphere-atmosphere**.

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Thank you for your attention!