



INTAROS

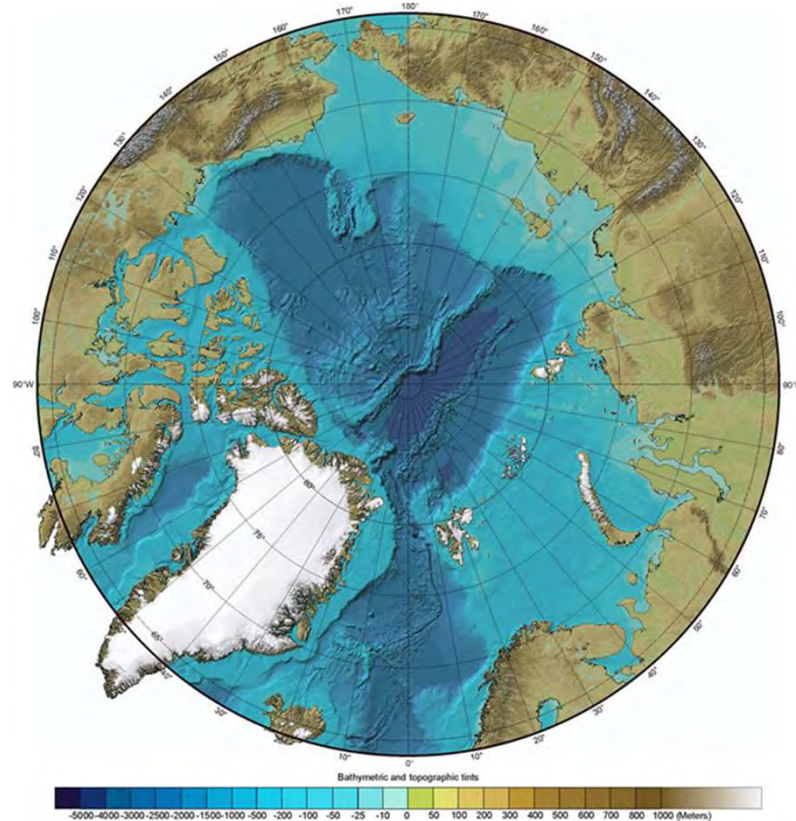
Natural Hazards in the Arctic

The hazards, data collection, data management

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Dept. of Earth Science, University of Bergen, Norway

Natural hazards in the Arctic



«Direct events»

- Earthquakes
- Landslides/submarine slides/snow avalanches
- Volcanic eruptions
- Extreme meteorological events
- Floods

«Triggered events»

- Tsunamis
- Landslides/submarine slides/snow avalanches
- (Volcanic) earthquakes

Climate change effects

- Thawing of permafrost
- Increased rainfall
- Melting of land ice
- Changes in sea ice cover
- ...



Natural hazards become a problem when they interact with human infrastructure

Snow avalanche, Svalbard, 2015



Large calving event in Greenland

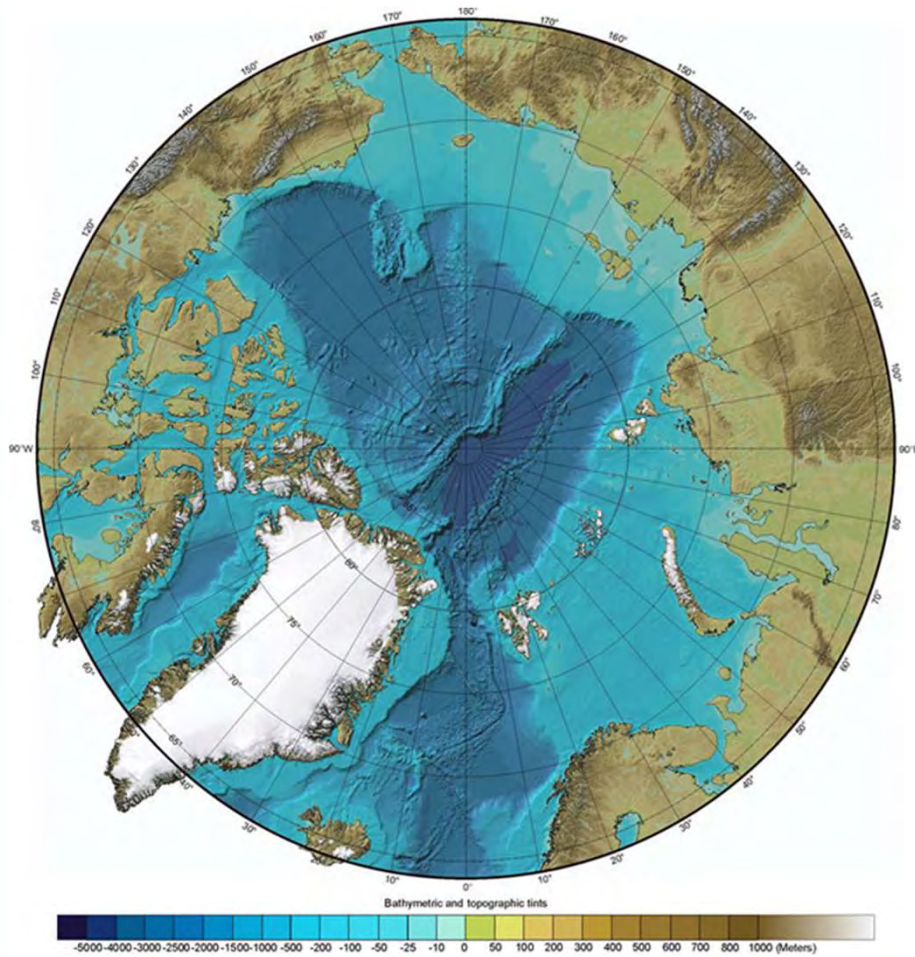
<https://www.youtube.com/watch?v=wcurEjHWs9g>

(0:40)

Trans Alaska Pipeline

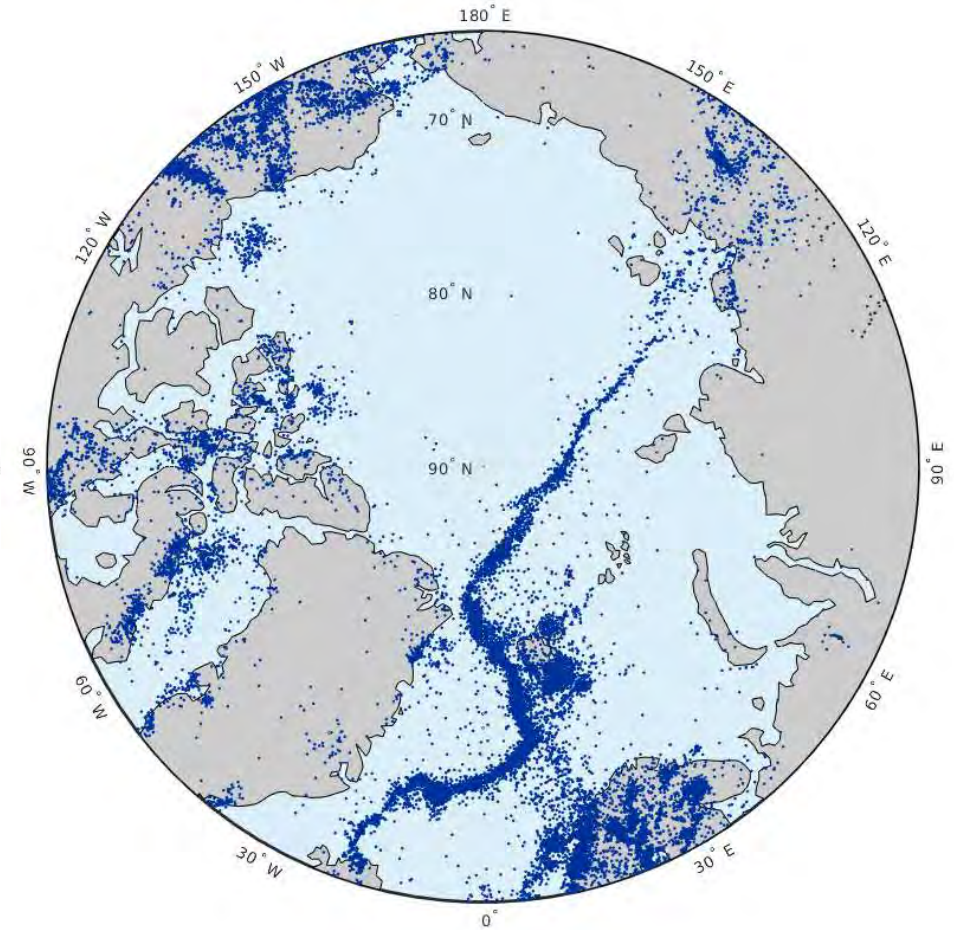


European Plate Boundary in the Arctic



(from NOAA)

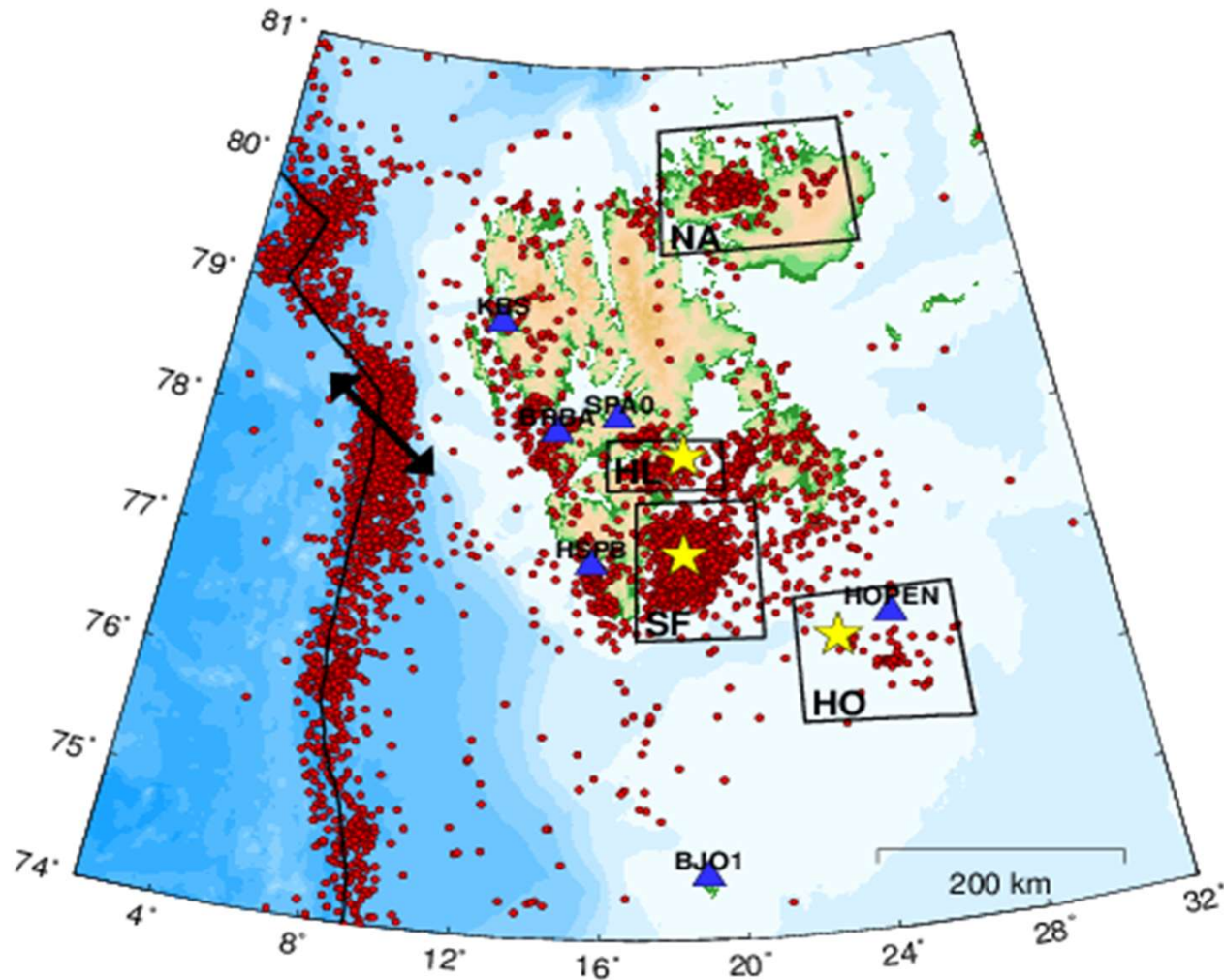
Seismicity in the Arctic



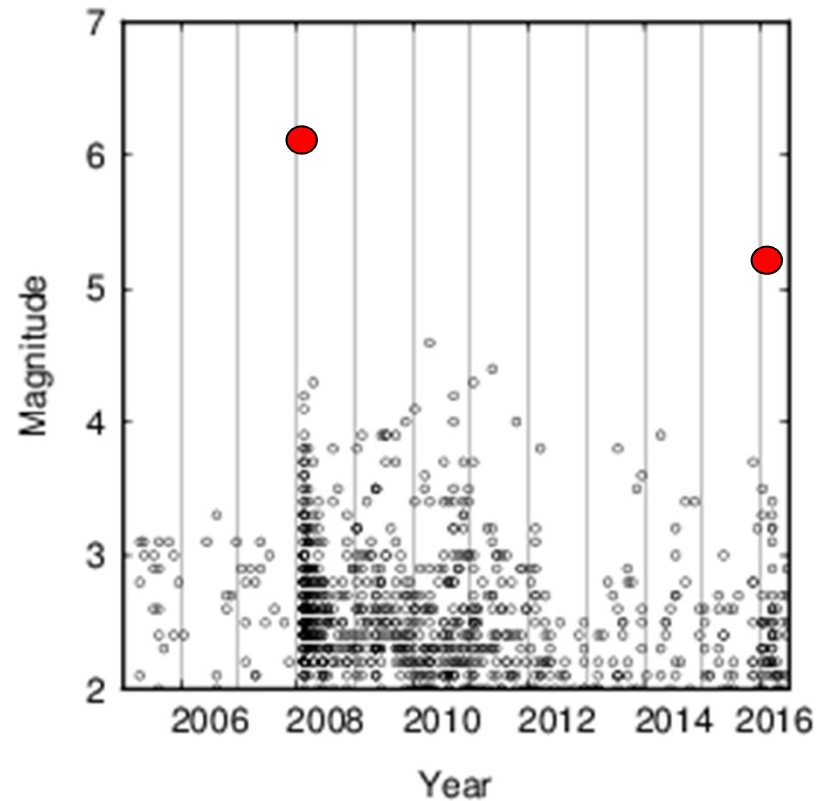
(data from INTAROS)



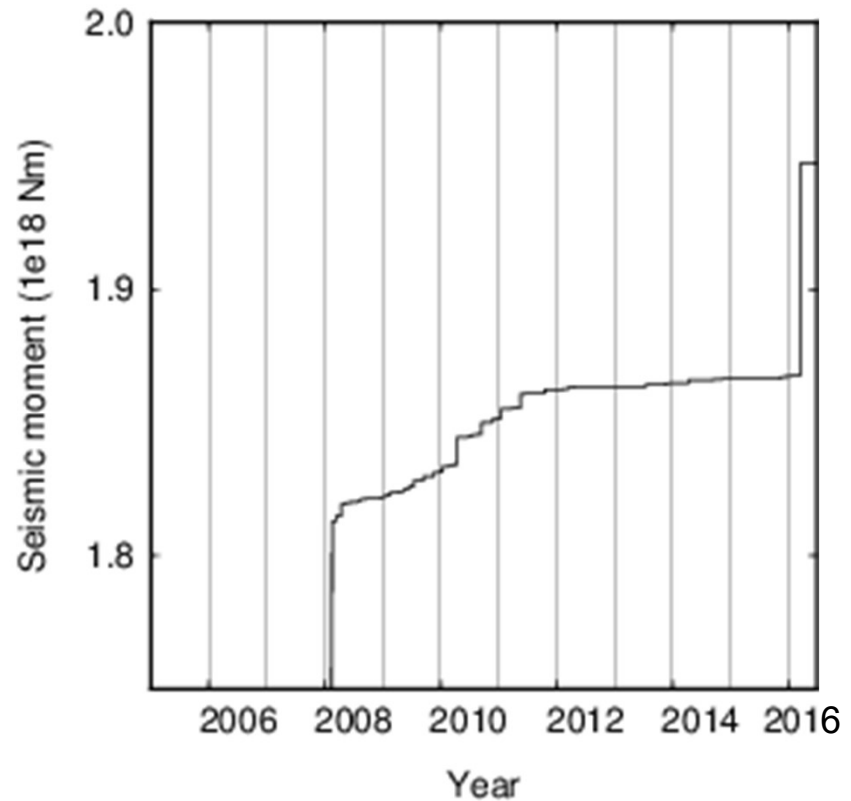
Earthquake activity Svalbard



Storfjorden seismicity over time

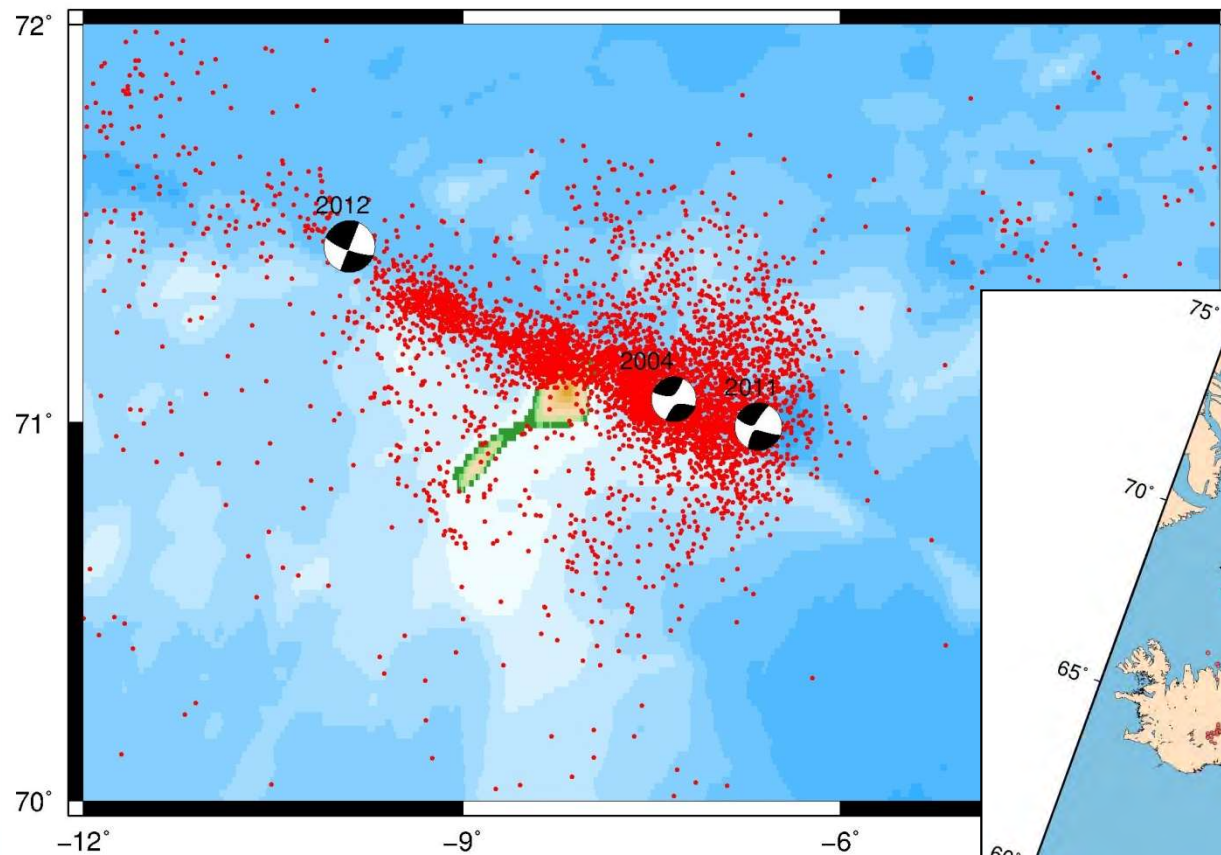


Magnitude

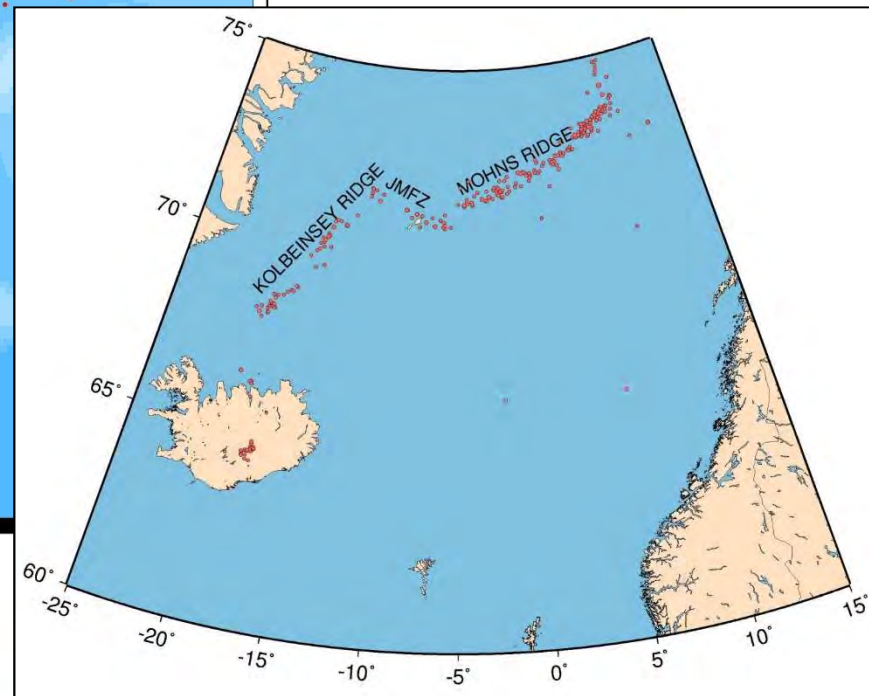


Seismic Moment

Jan Mayen earthquakes

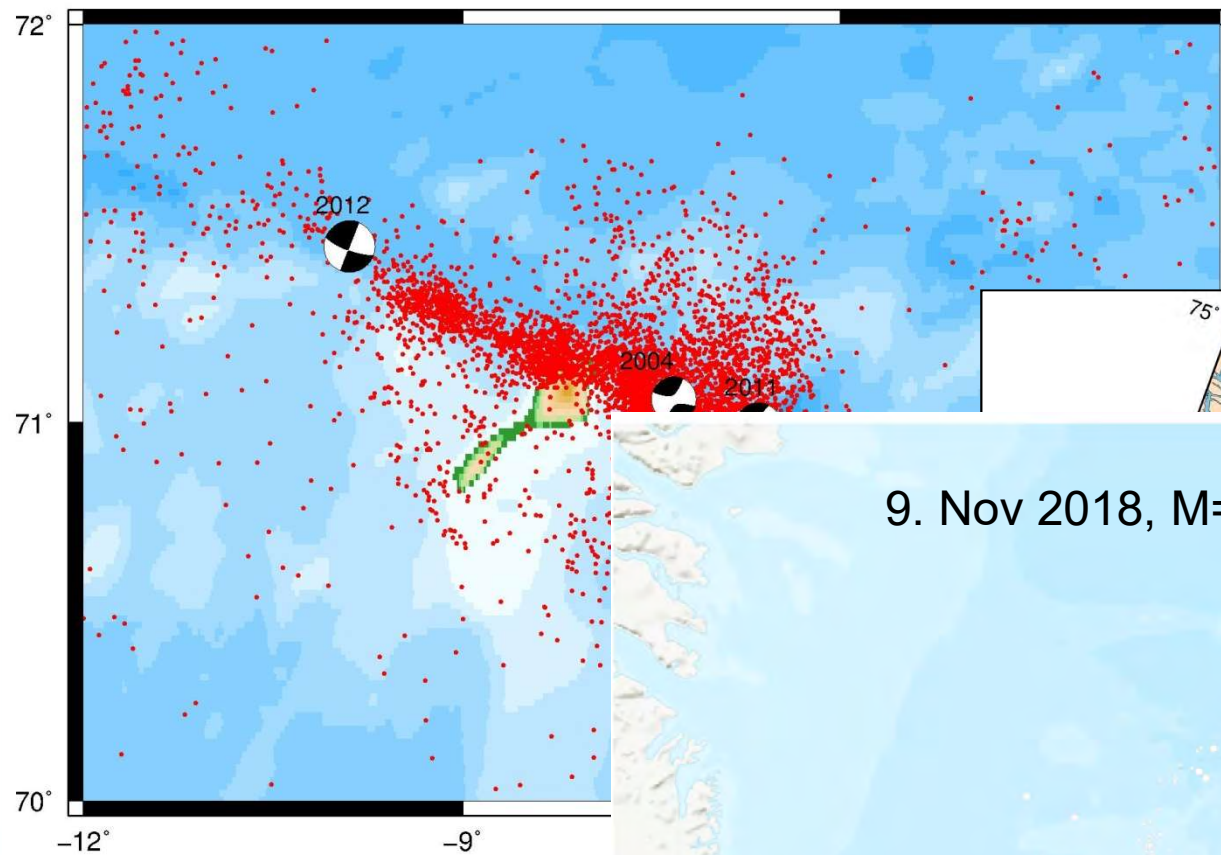


14. Apr 2004, $M = 6.0$
29. Jan 2011, $M = 6.1$
30. Aug 2012, $M = 6.6$

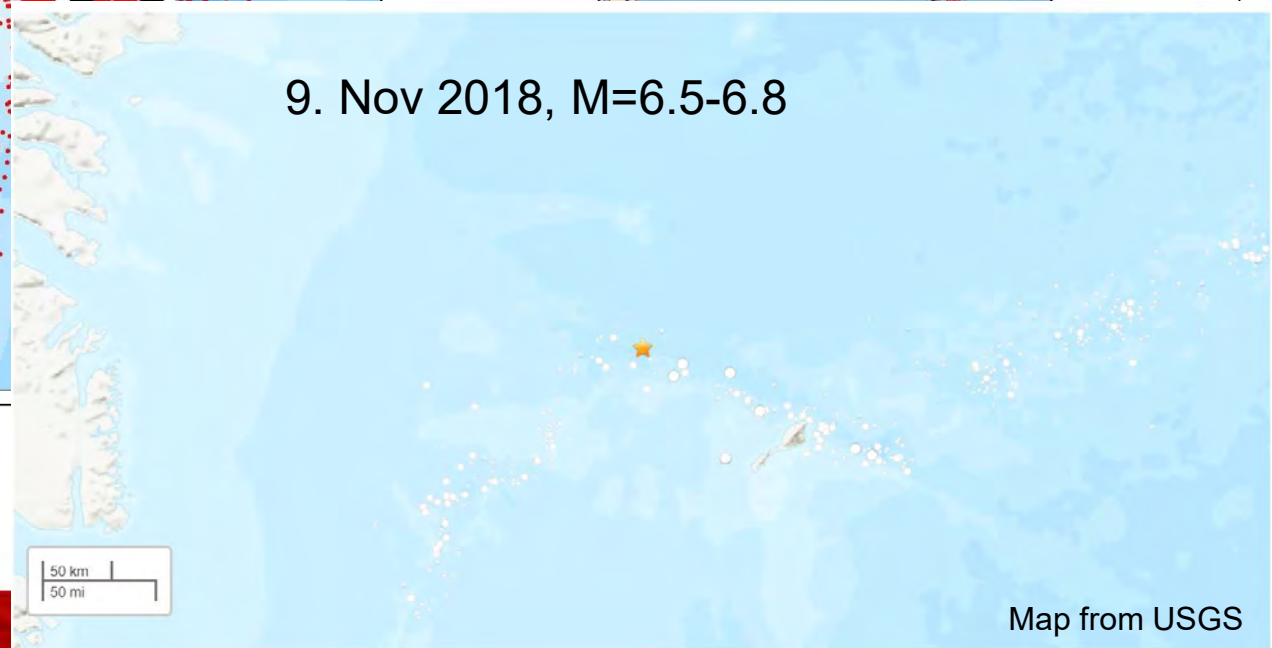


Jan Mayen earthquakes

14. Apr 2004, $M = 6.0$
29. Jan 2011, $M = 6.1$
30. Aug 2012, $M = 6.6$

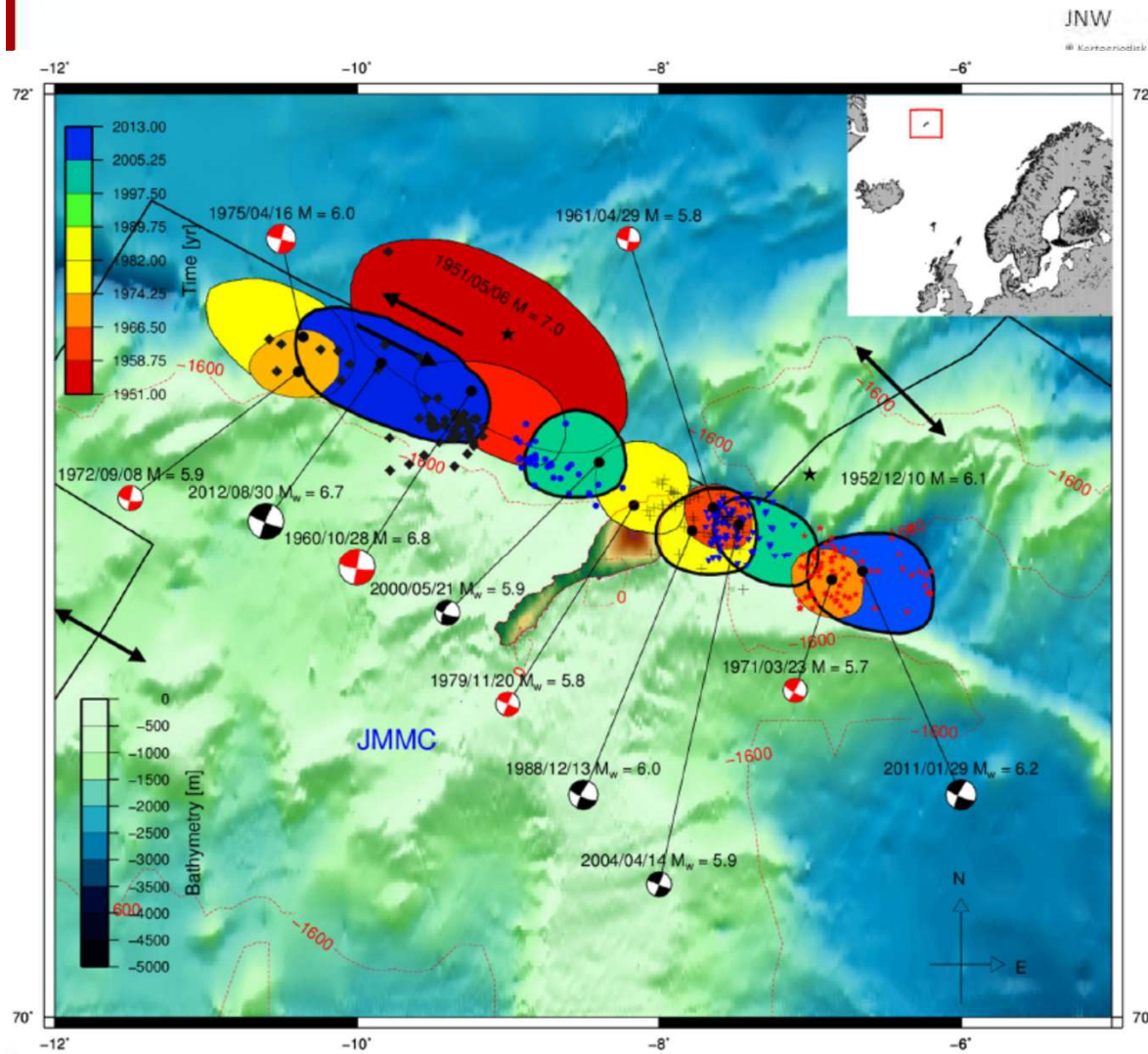


9. Nov 2018, $M=6.5-6.8$

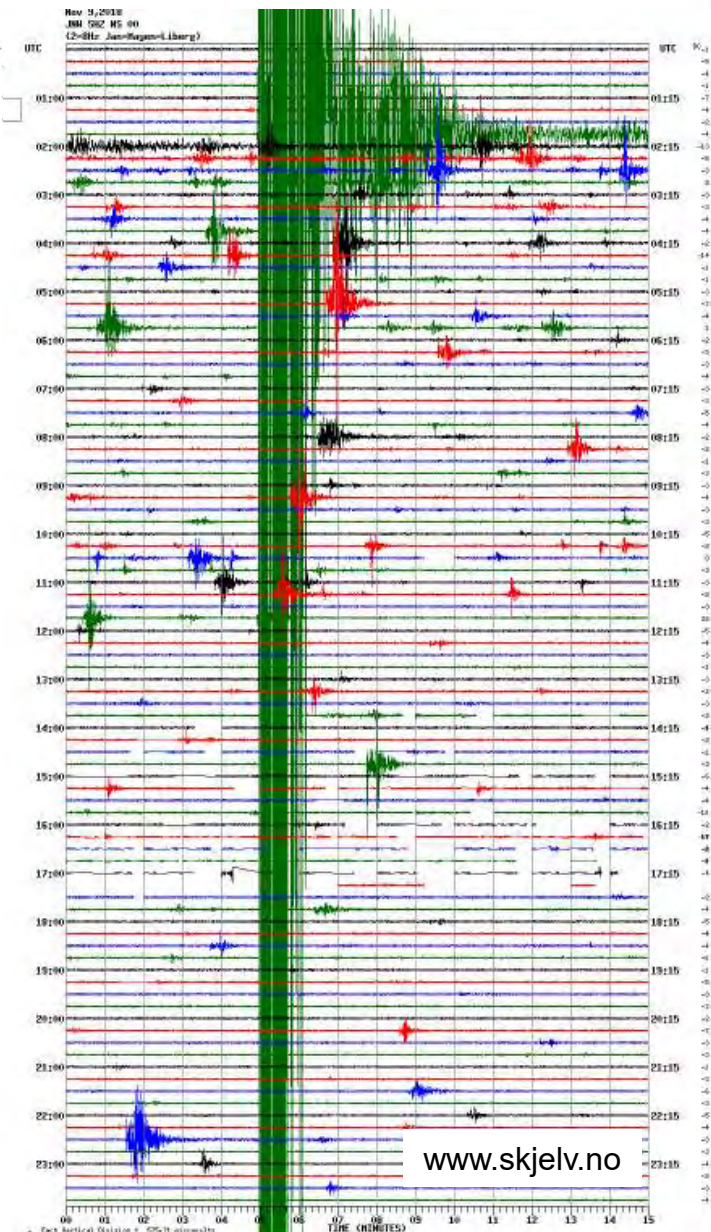


Map from USGS

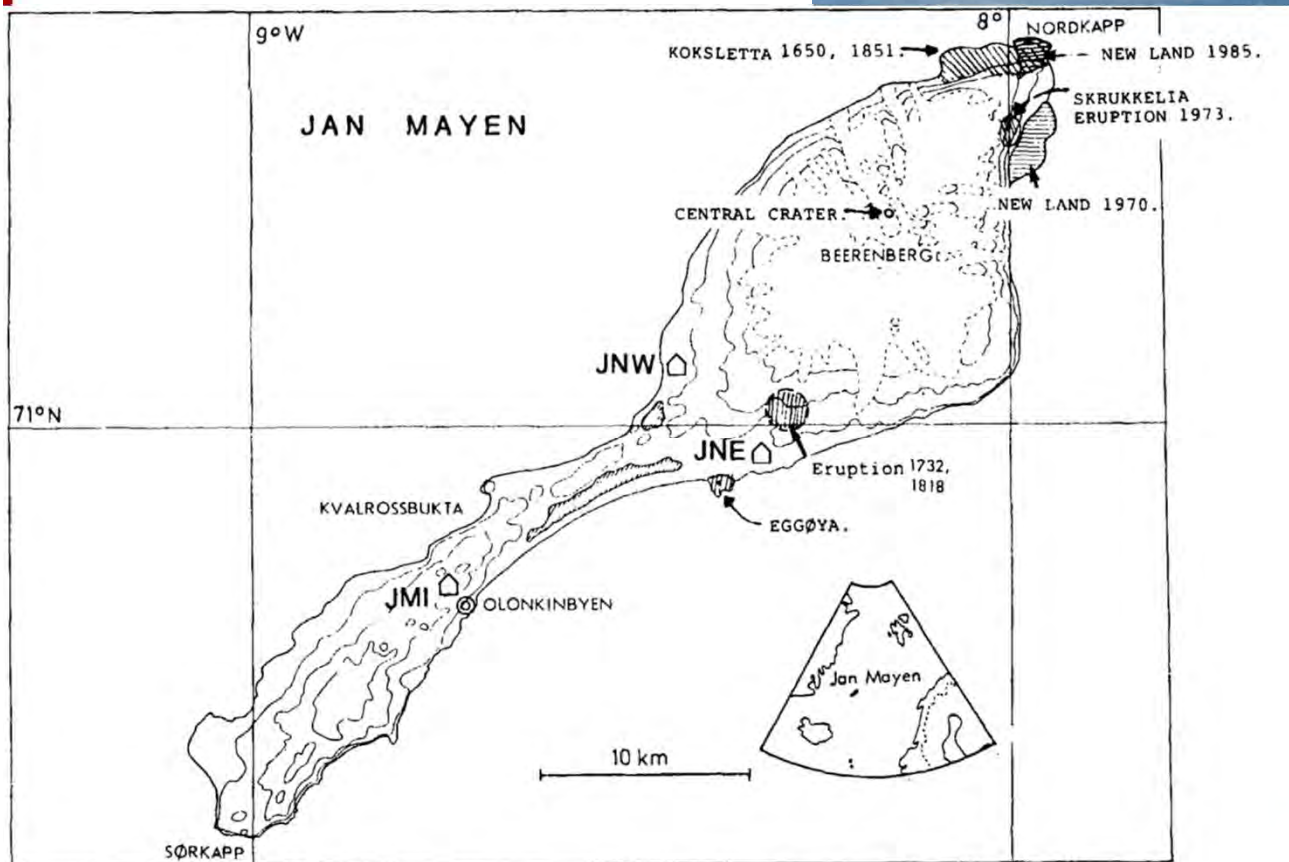
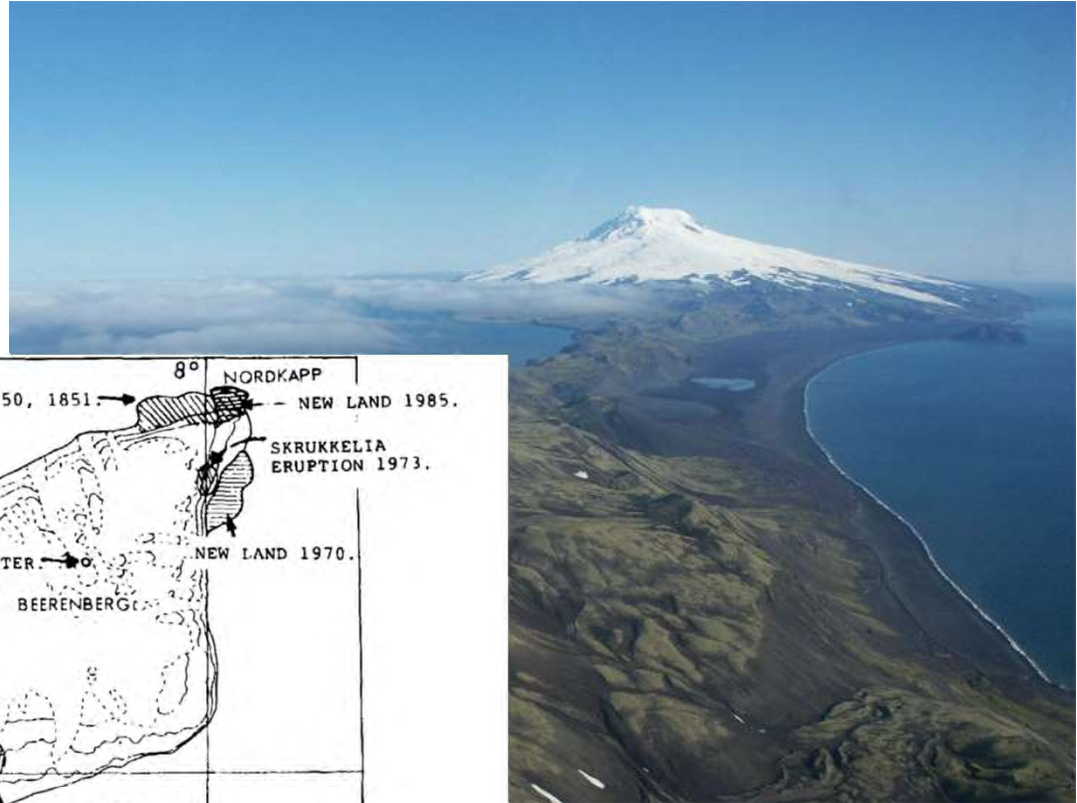
2018 Jan Mayen earthquake



Rodriguez-Perez and Ottemöller, 2014



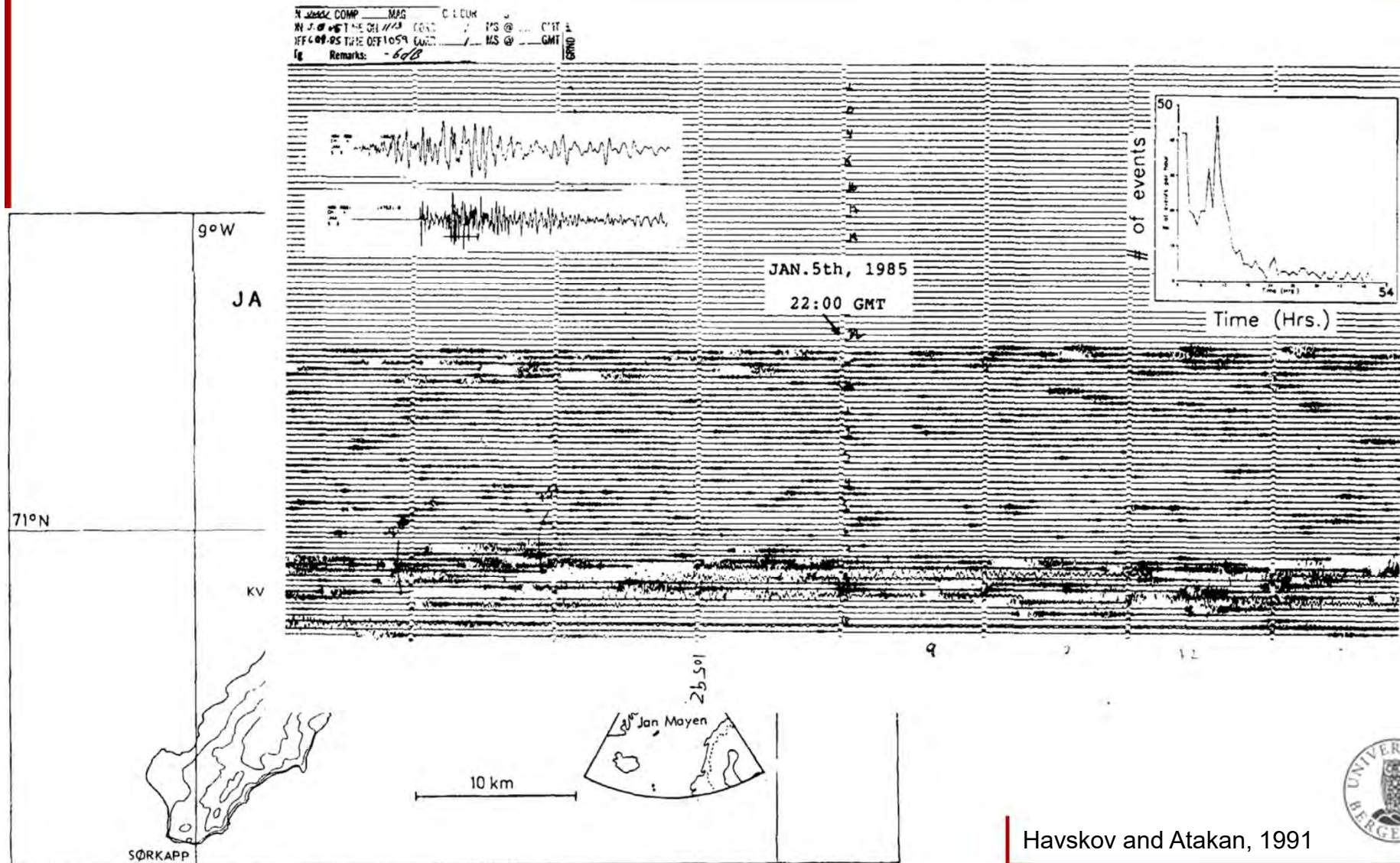
Volcanic activity at Jan Mayen



Havskov and Atakan, 1991



Volcanic activity at Jan Mayen



Havskov and Atakan, 1991



17.06.2017 Greenland landslide

- Energy release corresponding to M4.2 earthquake
- Triggered large tsunami
- 3 villages severely affected, 4 people killed



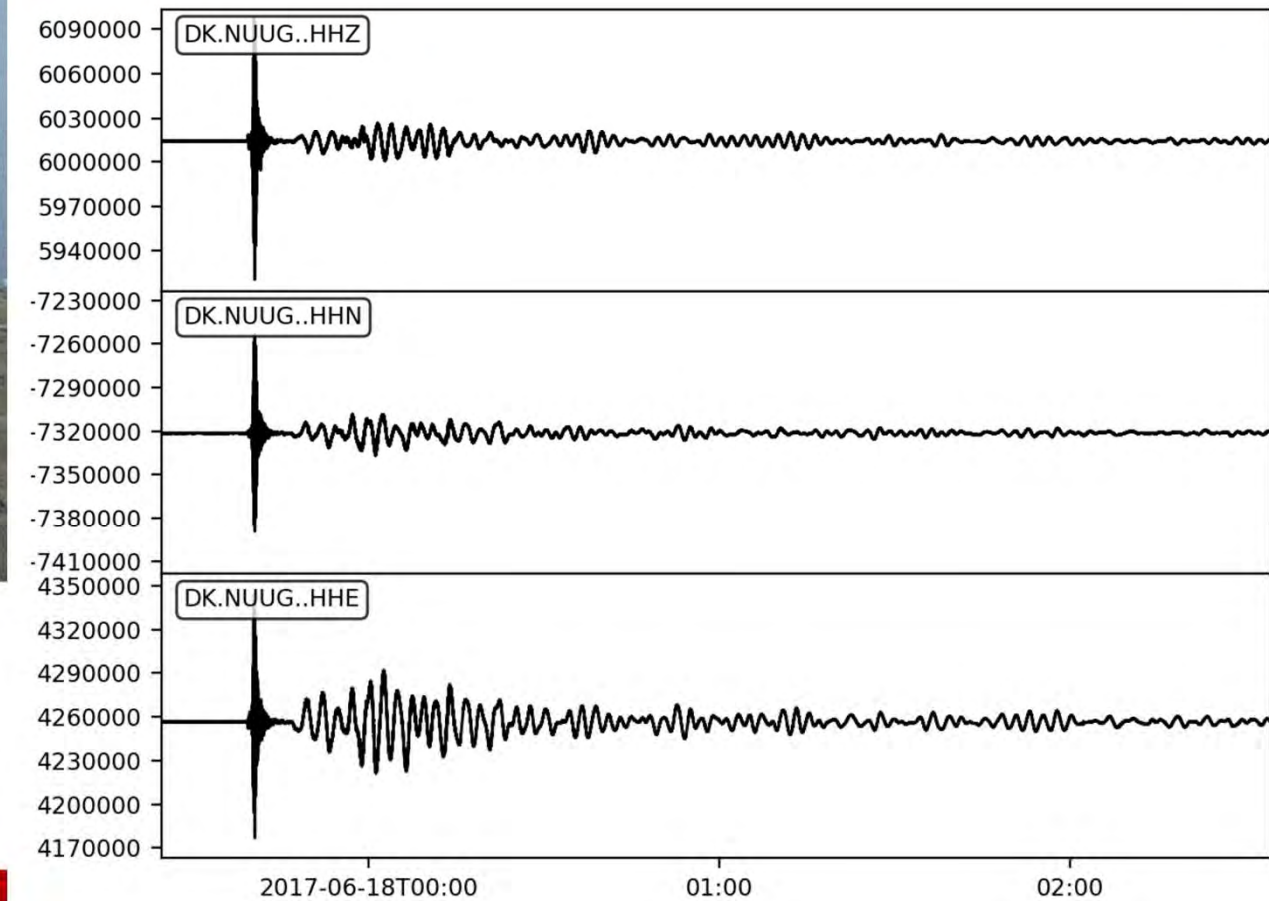
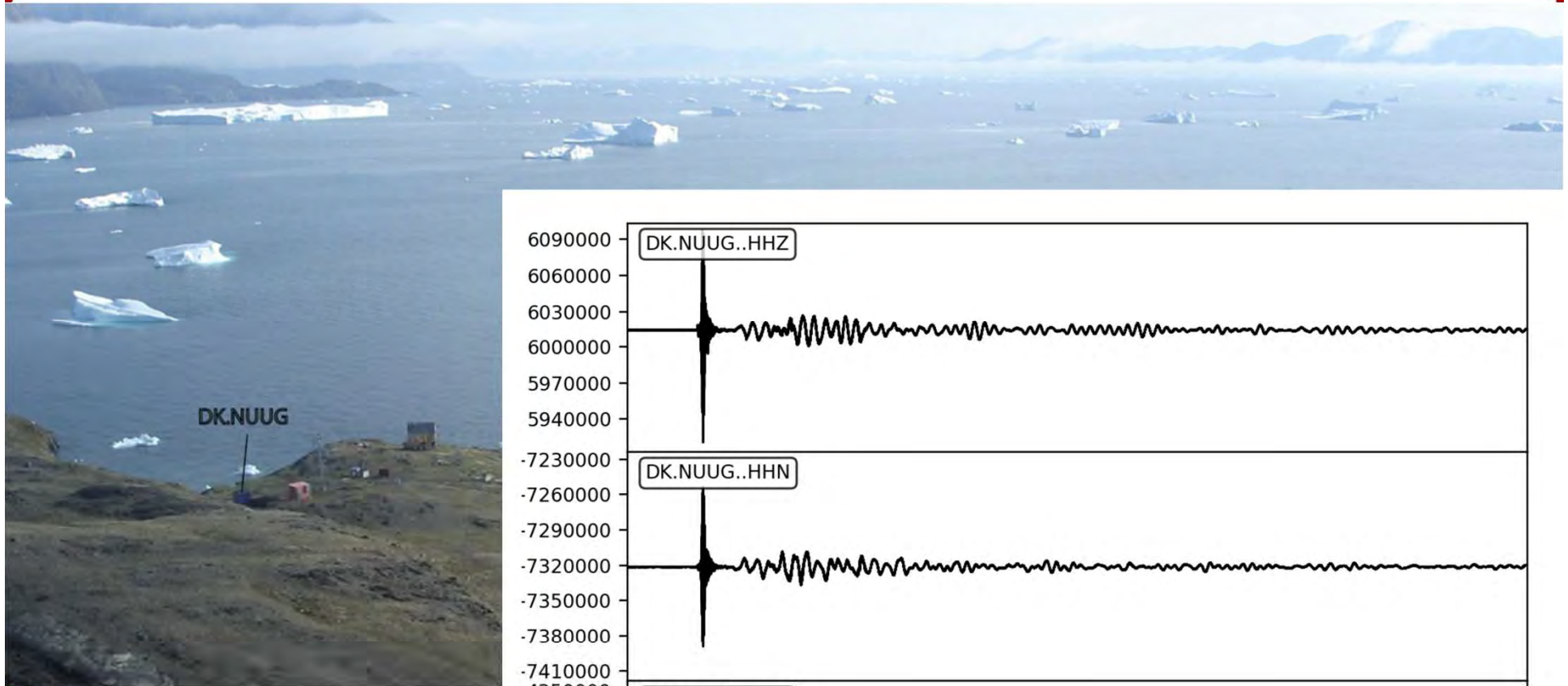
17.06.2017 Greenland landslide



DK.NUUG



17.06.2017 Greenland landslide



Debris flows and snow avalanches

Longyearbyen



Debris flows and snow avalanches Longyearbyen



Monitoring – what are we looking for?

Observing events when they occur

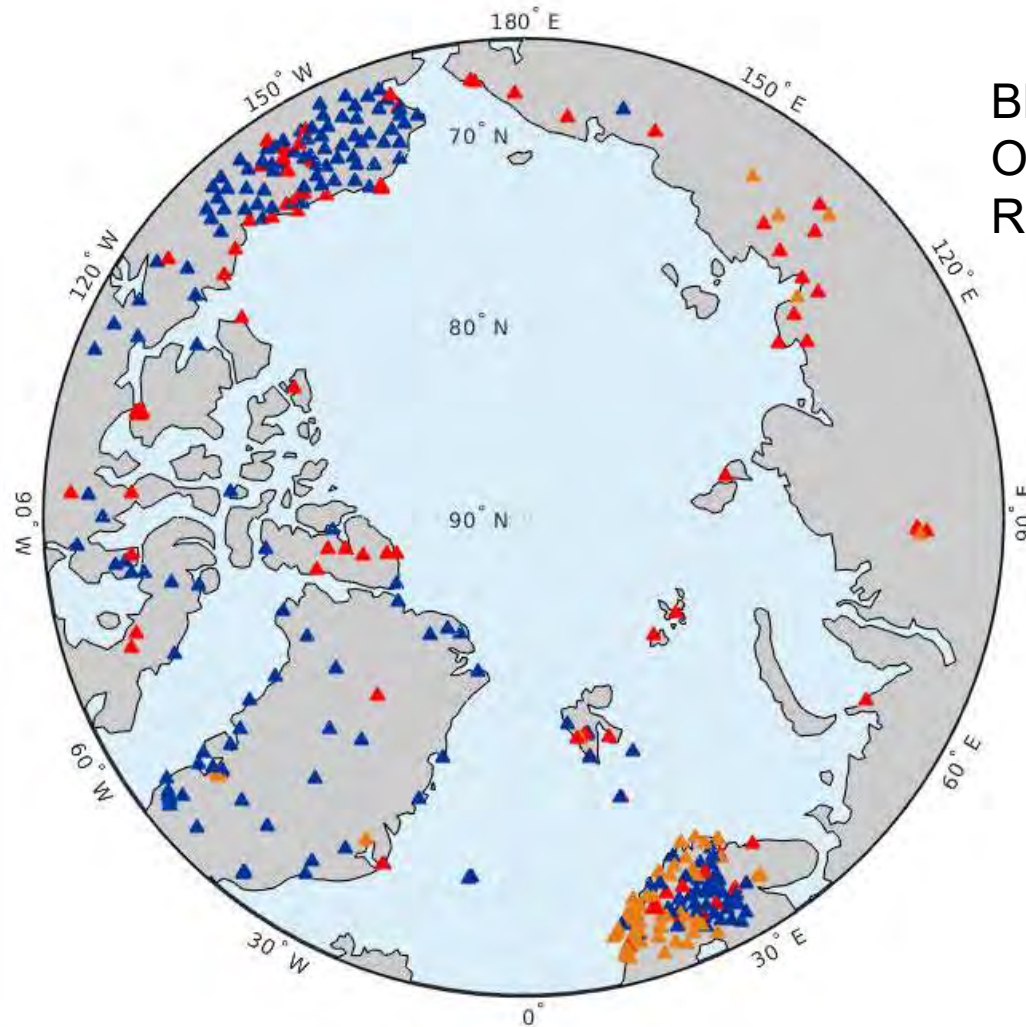
Monitoring temporal changes

Mapping previous events

Forecasting and/or detecting precursors



Monitoring: seismic networks



Blue: Currently active
Orange: Restricted/unavailable data
Red: No data (station closed)

Jeddi et al., 2018



Vault design



Community based seismic network



Community based seismic network

← → ↻ 🏠 <https://raspberryshake.net/stationview/> ☆ M ⋮

17:01  **cempa** geosciences **raspberry shake**
powered by cempa GmbH

 **Raspberry Shake**
 Online Shop



Ground motion

- Not set
- $\leq 0.2 \mu\text{m/s}$
- $0.4 \mu\text{m/s}$
- $0.8 \mu\text{m/s}$
- $1.5 \mu\text{m/s}$
- $4 \mu\text{m/s}$
- $12 \mu\text{m/s}$
- $30 \mu\text{m/s}$
- $60 \mu\text{m/s}$
- $\geq 150 \mu\text{m/s}$

Finland

Communi

30. November 2018 M7.0 Alaska

nic network

17:01 cempa raspberry shake powered by cempa GmbH

Raspberry Shake Online Shop

Southern Alaska

0.7 to 2.0 Hz

RD8D1.SHZ
Distance 4473km Traveltime +07:32
PGV 7.48 µm/s

Ground motion

- Not set
- $\leq 0.2 \mu\text{m/s}$
- $0.4 \mu\text{m/s}$
- $0.8 \mu\text{m/s}$
- $1.5 \mu\text{m/s}$
- $4 \mu\text{m/s}$
- $12 \mu\text{m/s}$
- $30 \mu\text{m/s}$
- $60 \mu\text{m/s}$
- $\geq 150 \mu\text{m/s}$

7.0 GFZ gfz2018xLtd



Communi

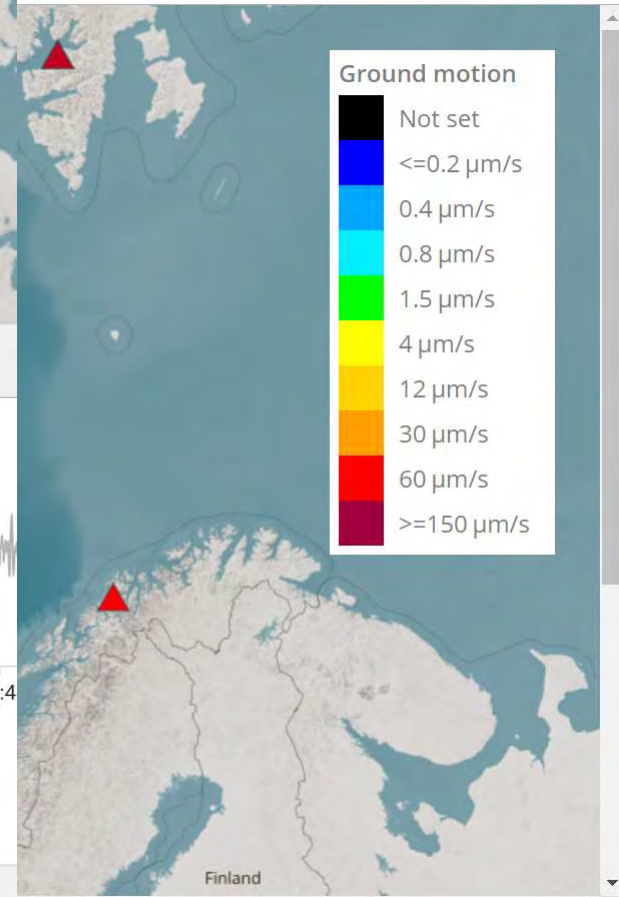
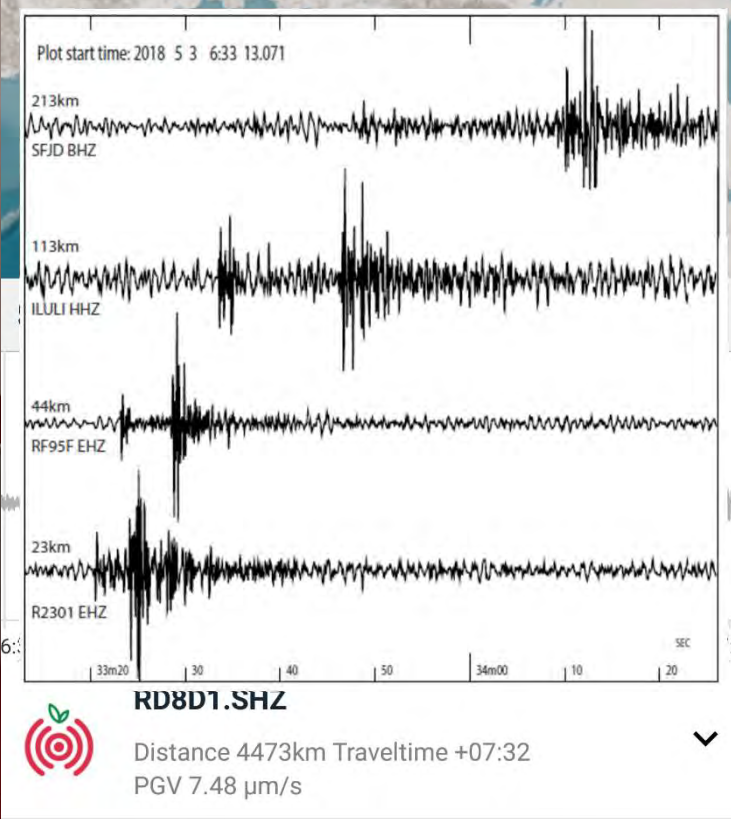
30. November 2018 M7.0 Alaska

onic network

17:01

cempa raspberry shake
powered by cempa GmbH

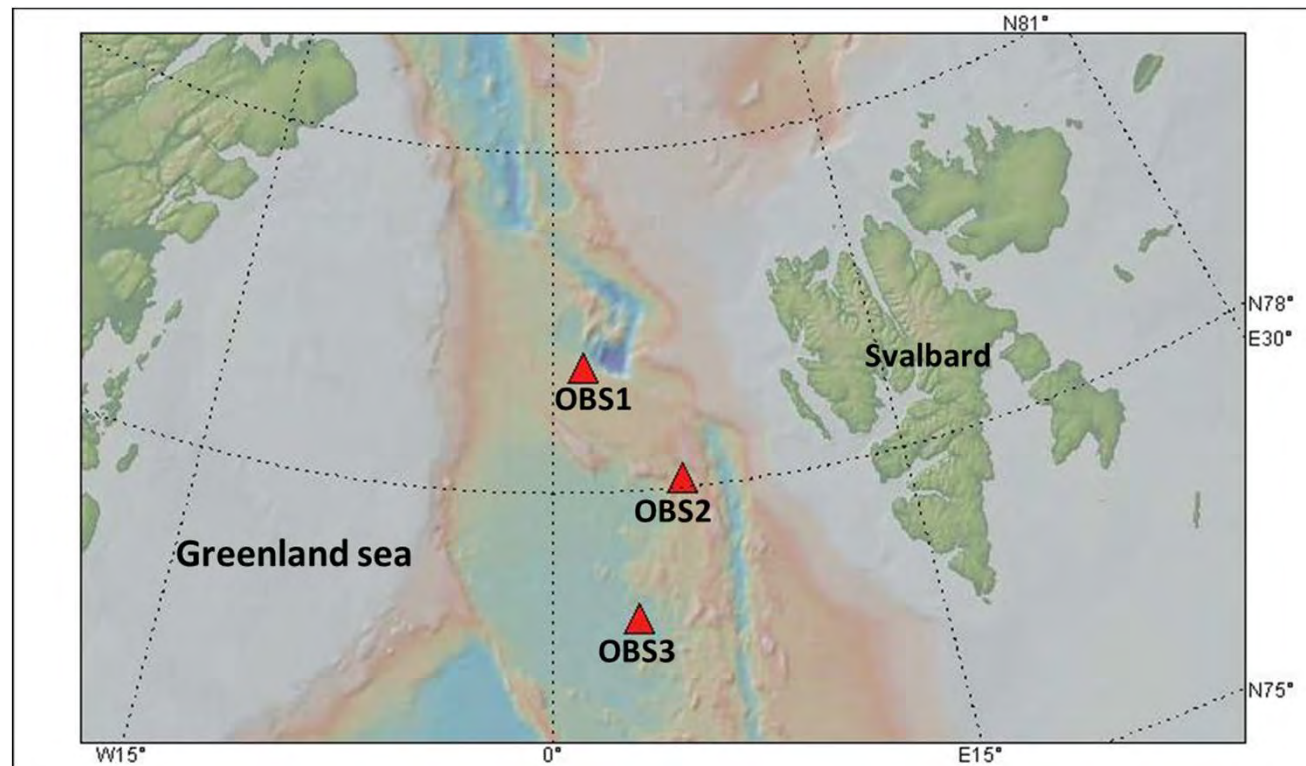
Raspberry Shake
Online Shop



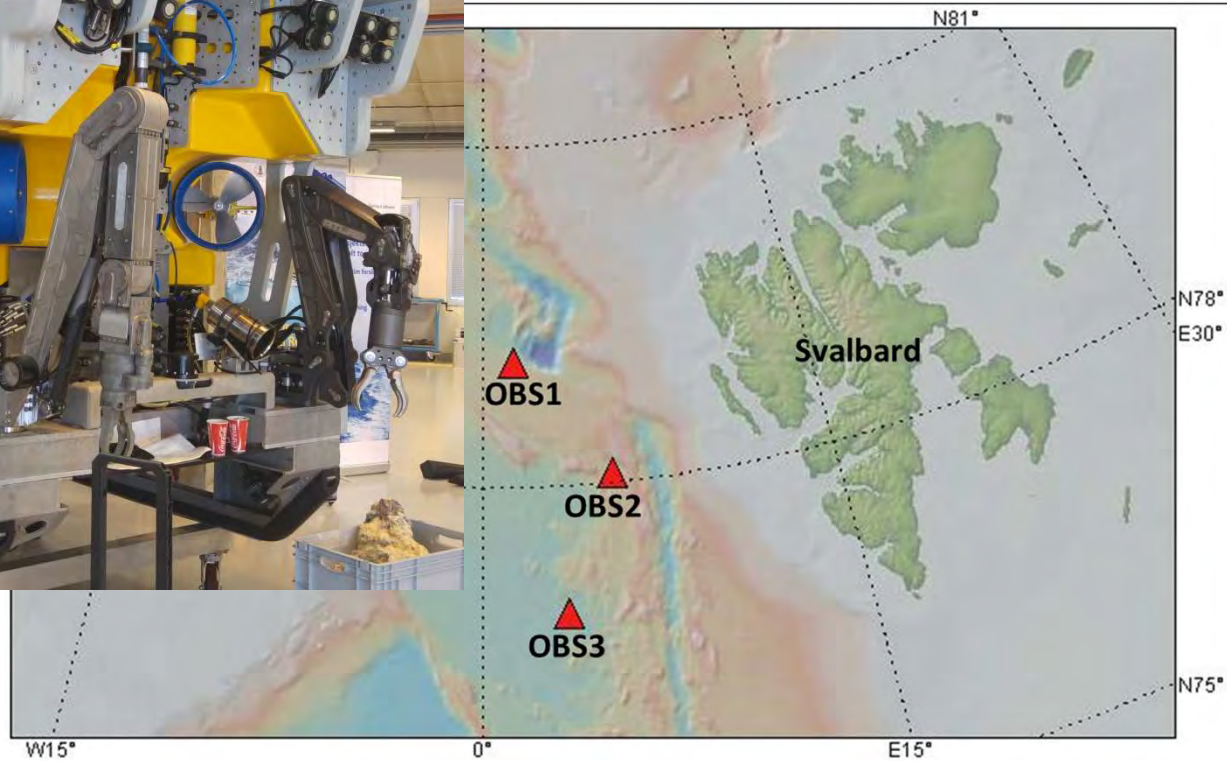
7.0 **GFZ** gfz2018xLtd



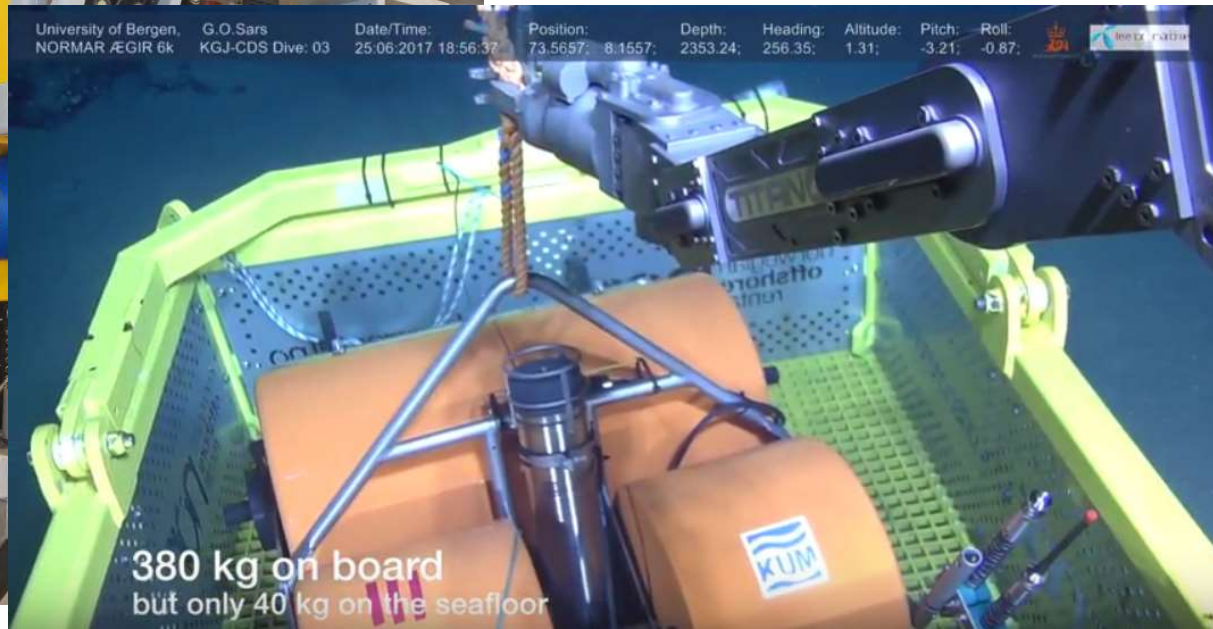
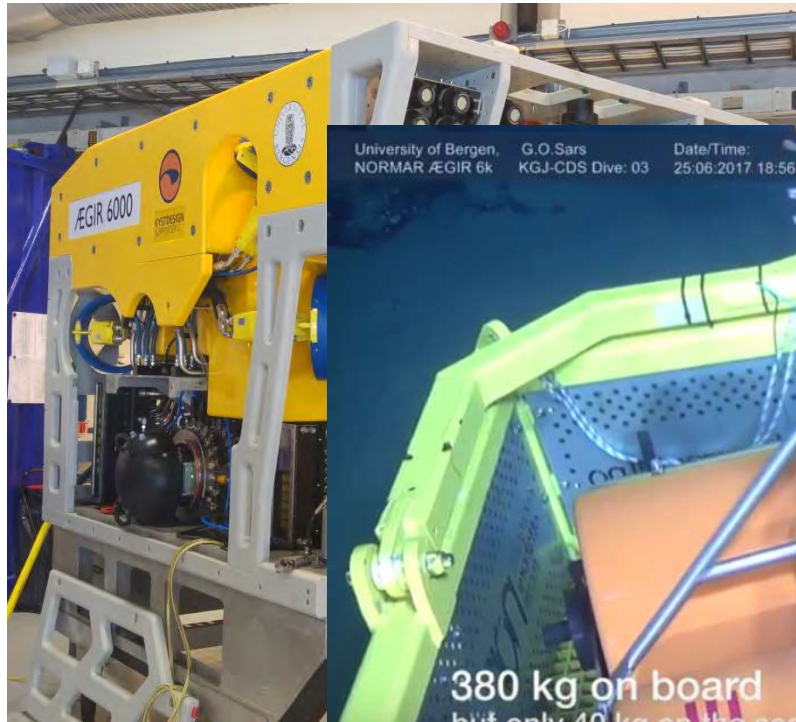
Ocean bottom observation



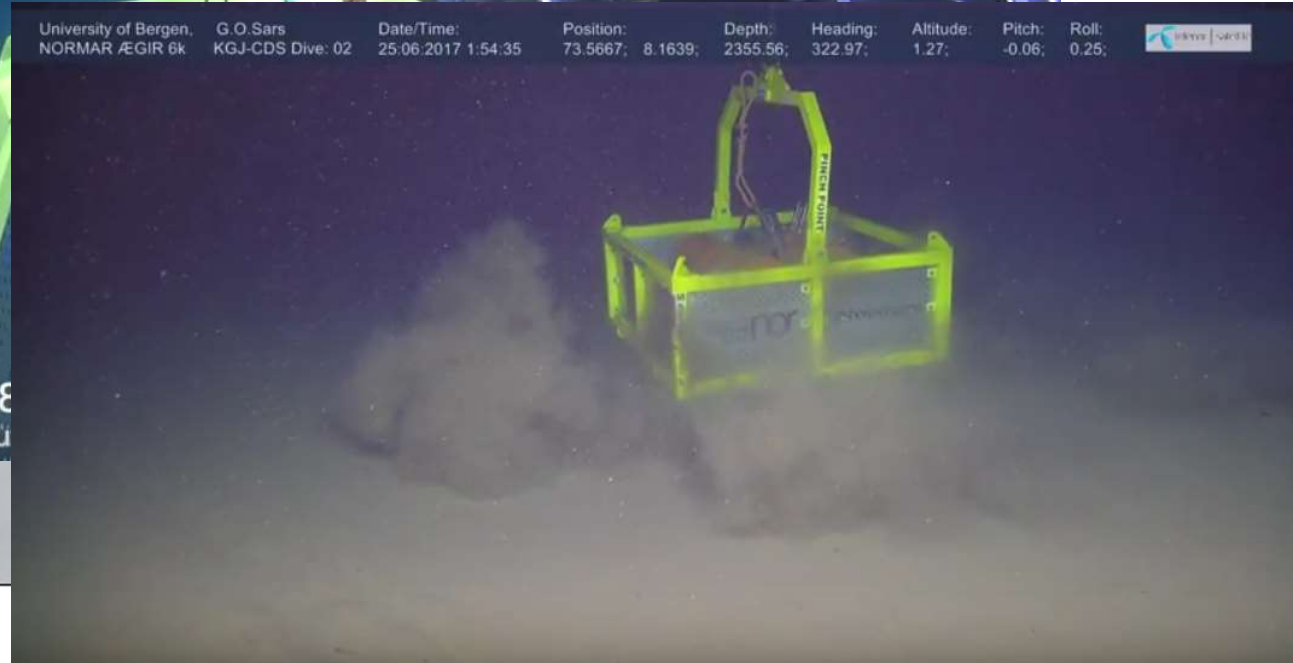
Ocean bottom observation



Ocean bottom observation



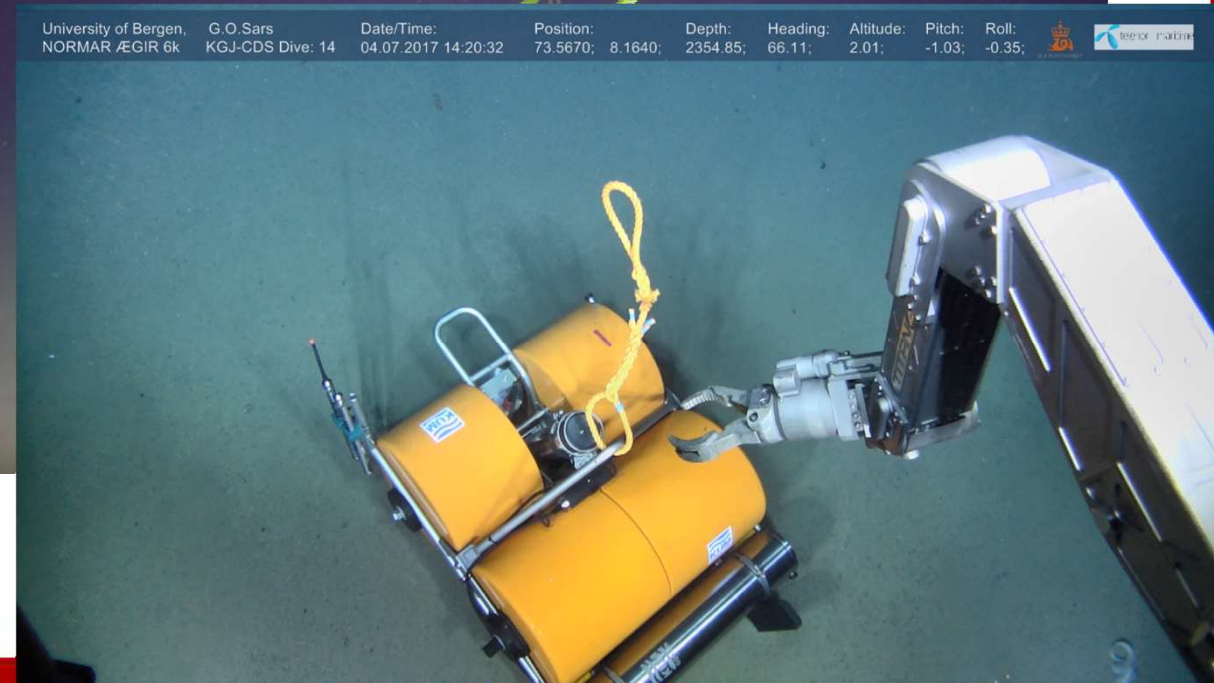
Ocean bottom observation



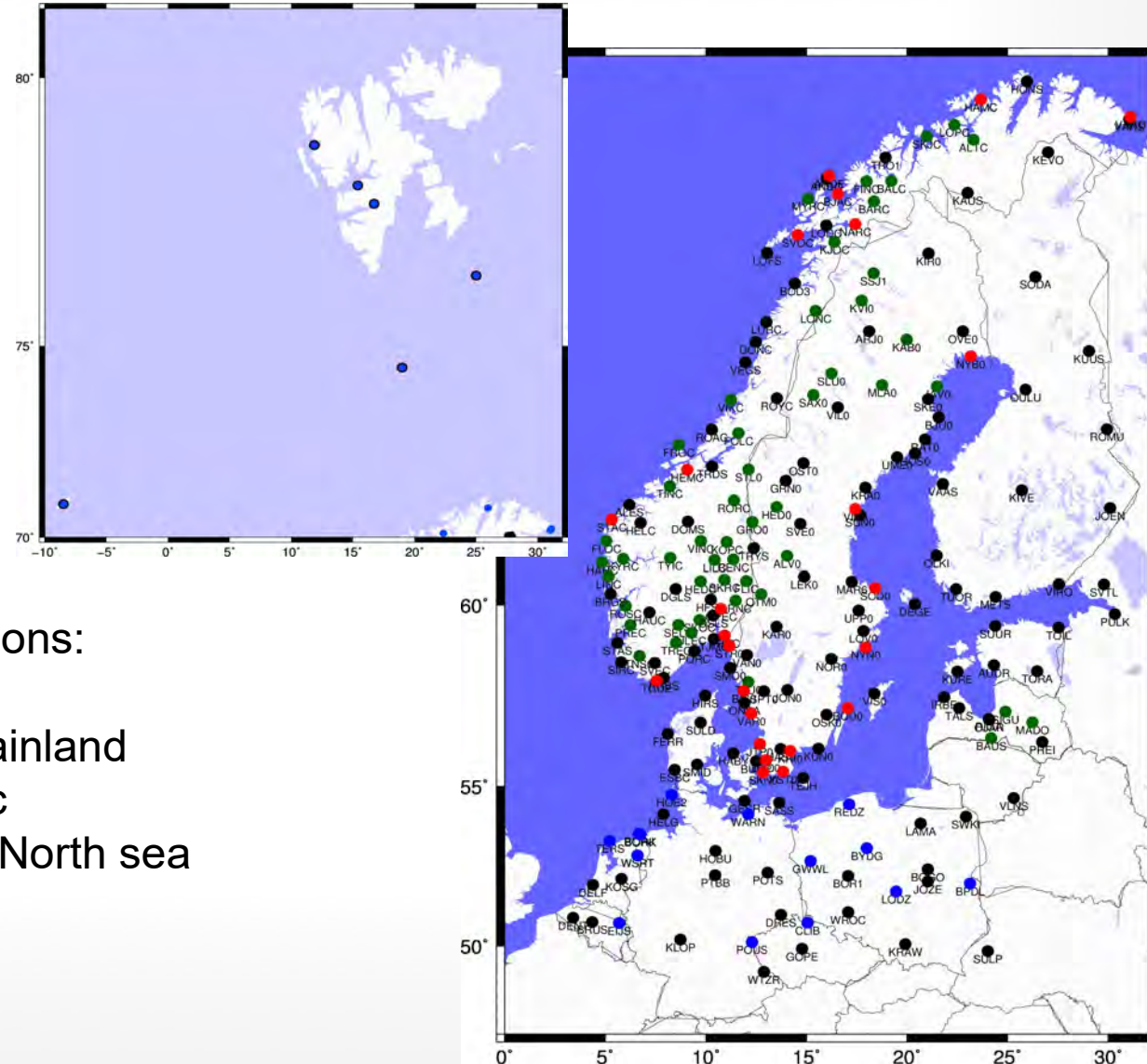
W15°



Ocean bottom observation



GNSS (GPS) infrastructure in Norway and Northern Europe



Kartverket GPS stations:
~ 200 stations on
the Norwegian mainland
~ 9 stations in Arctic
~ 25 stations in the North sea

GNSS (GPS) infrastructure in Norway and Northern Europe

← → ↻ 🏠 ⓘ Not secure | www.igs.org/network

☆ M ⋮



Network

Products

Working Groups

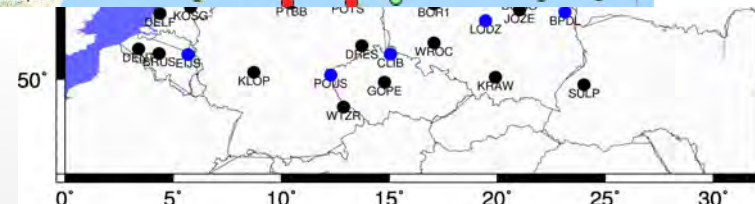
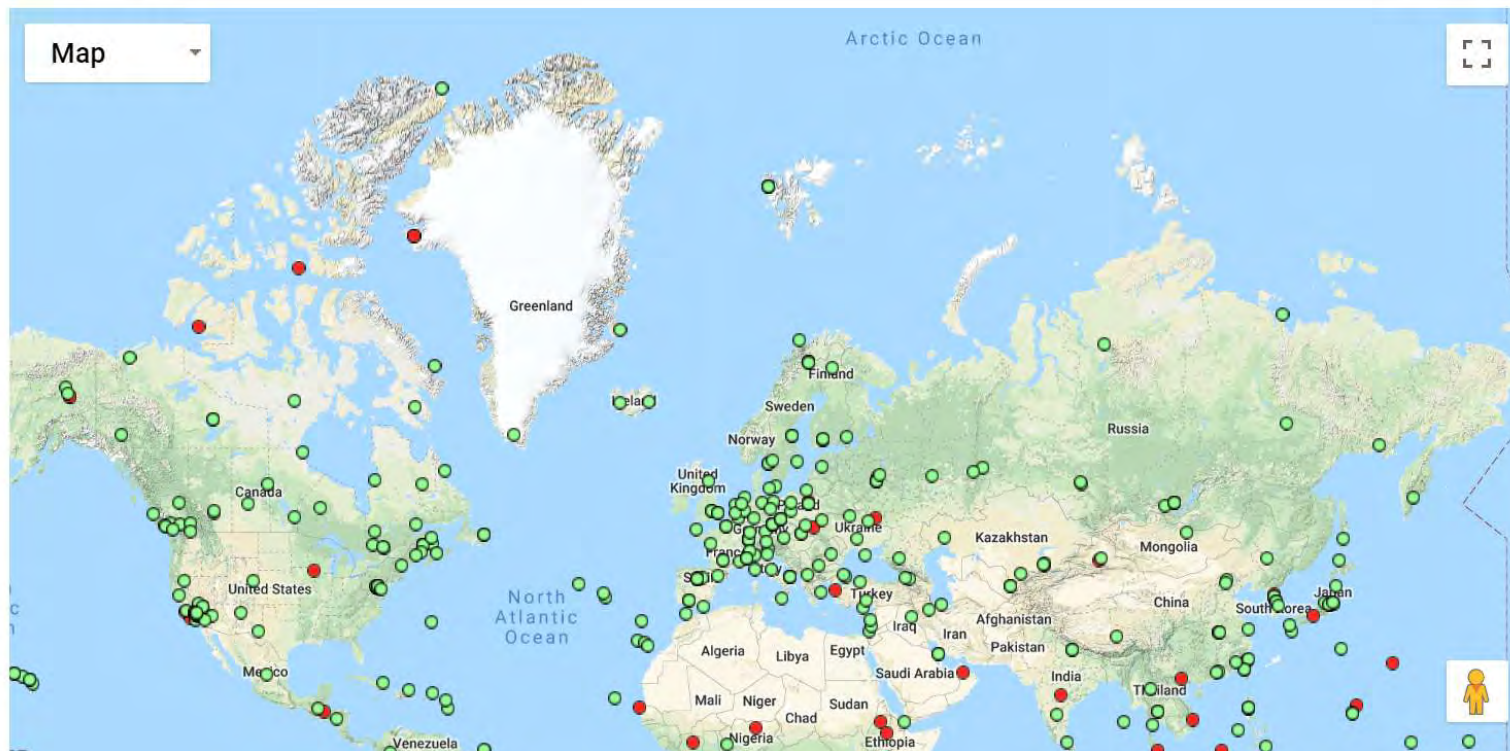
Resources

About

Search

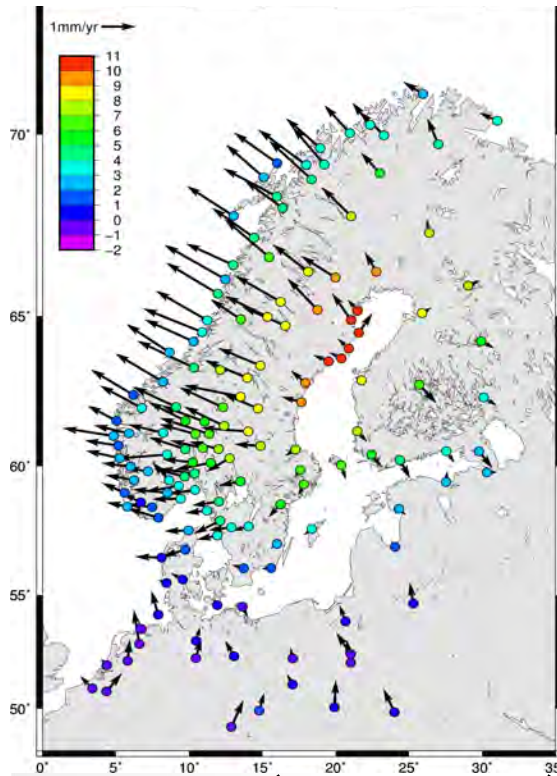
Network

Information



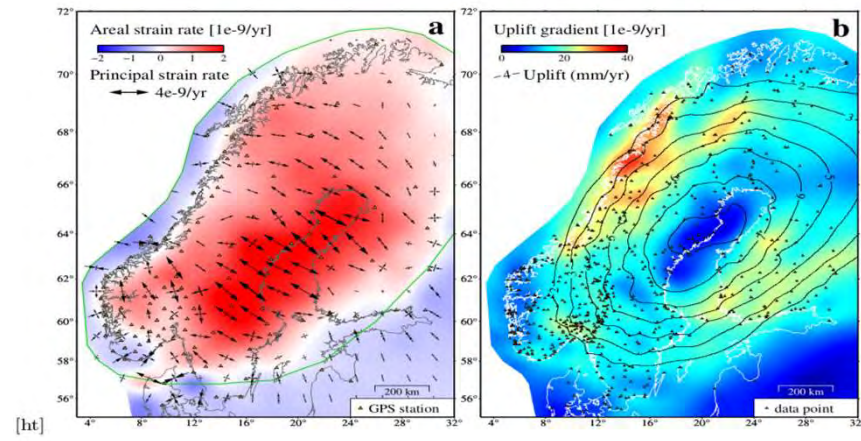
Kartverket H. Kierulf

GPS derived velocity fields have several geophysical applications



Neotectonic

Glacier massbalance



Strain rate (from Keiding et al 2015)

Earthquakes

Sea Level Change for Norway

Past and Present Observations and Projections to 2100
NCCS report no. 1001



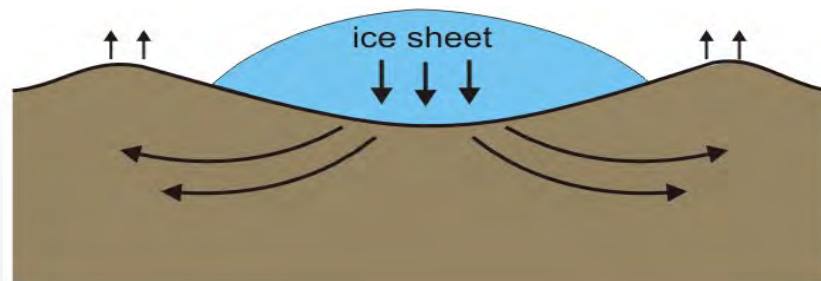
Authors

M.J.R. Simpson, J.E.B. Nilsen, O.R. Revordal, K. Brøtt, H. Sande, H.P. Karset, H. Staffen,
E. Jansen, M. Carlson, D. Vester



Hydrological loadings

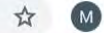
GIA, Ice history and rheology



H. Kierulf, Kartverket

Sea level monitoring

← → ↻ 🏠 ⓘ Not secure | www.ioc-sealevelmonitoring.org/map.php



SEA LEVEL STATION MONITORING FACILITY

Intro **Map** Station lists Station details Services & FAQ GLOSS Catalog

Sealevel stations

Status at 2018-12-01 16:44 GMT

[Disclaimer](#)

Plot

Show

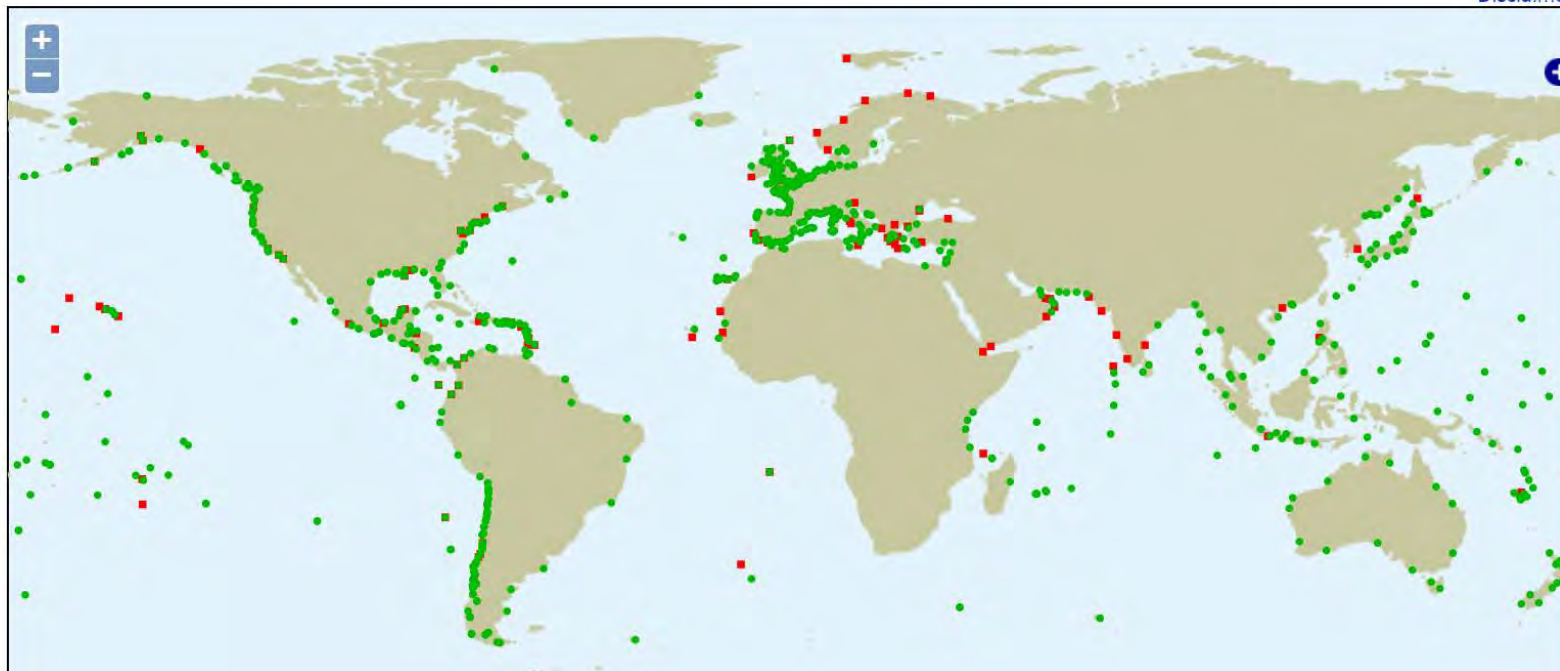
Legend:

- Station is offline, or data is outdated
- Station is online
- Station is not available at this site

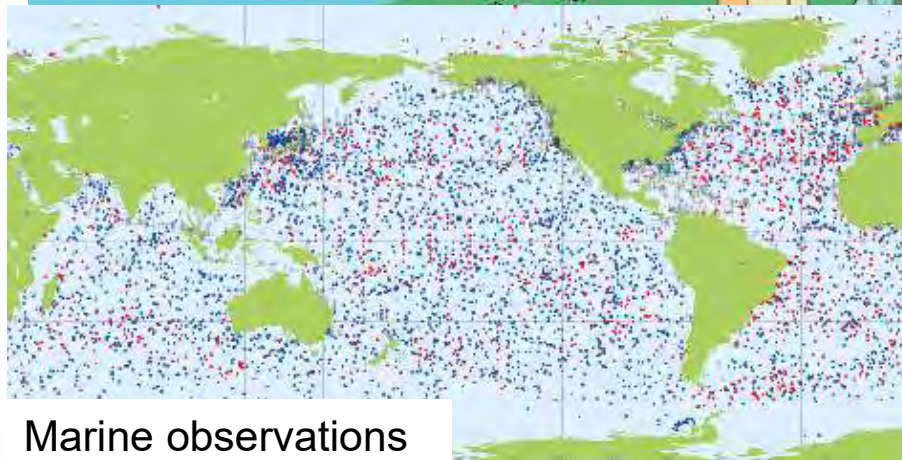
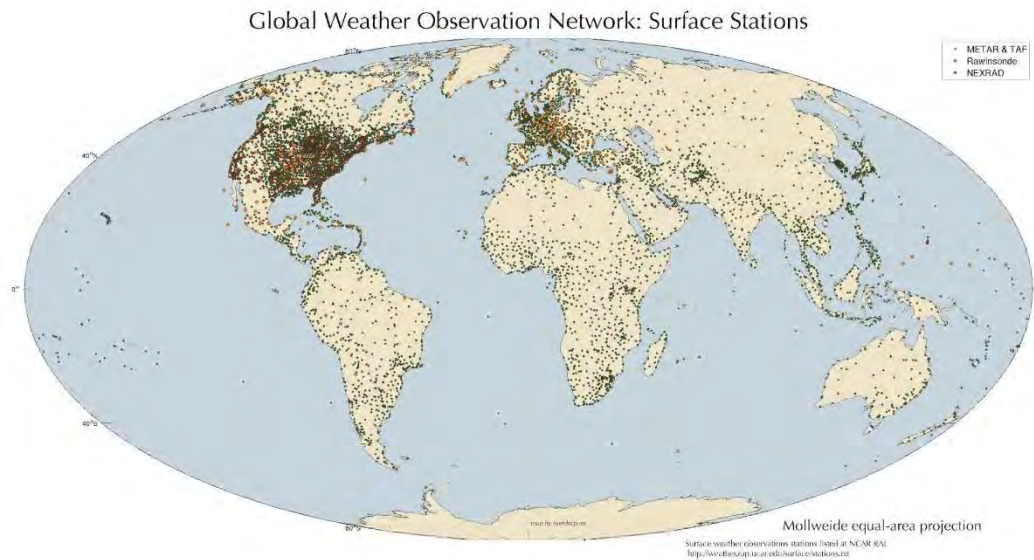
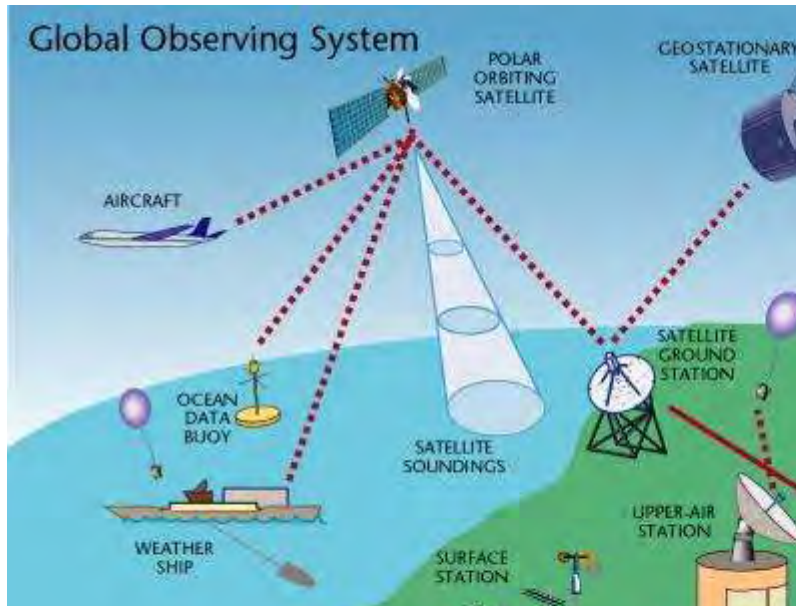
Offline = No data received since 3 times the transmit interval.

The quality of the transmitted data is not checked.

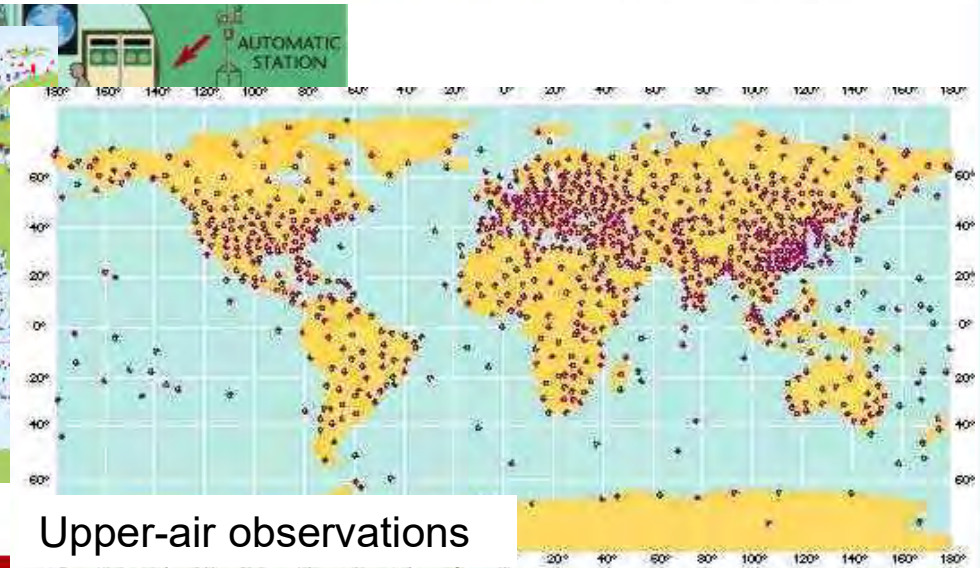
- To obtain more details about a station - move mouse over station and click.
- To zoom in - hold down the Shift-key while holding down the mouse button and drawing a rectangle or use the Scroll mouse button, or use the control buttons in upper left part of map.
- To pan - drag the map, or use the control buttons in upper left part of map.



Global Weather Observation Network

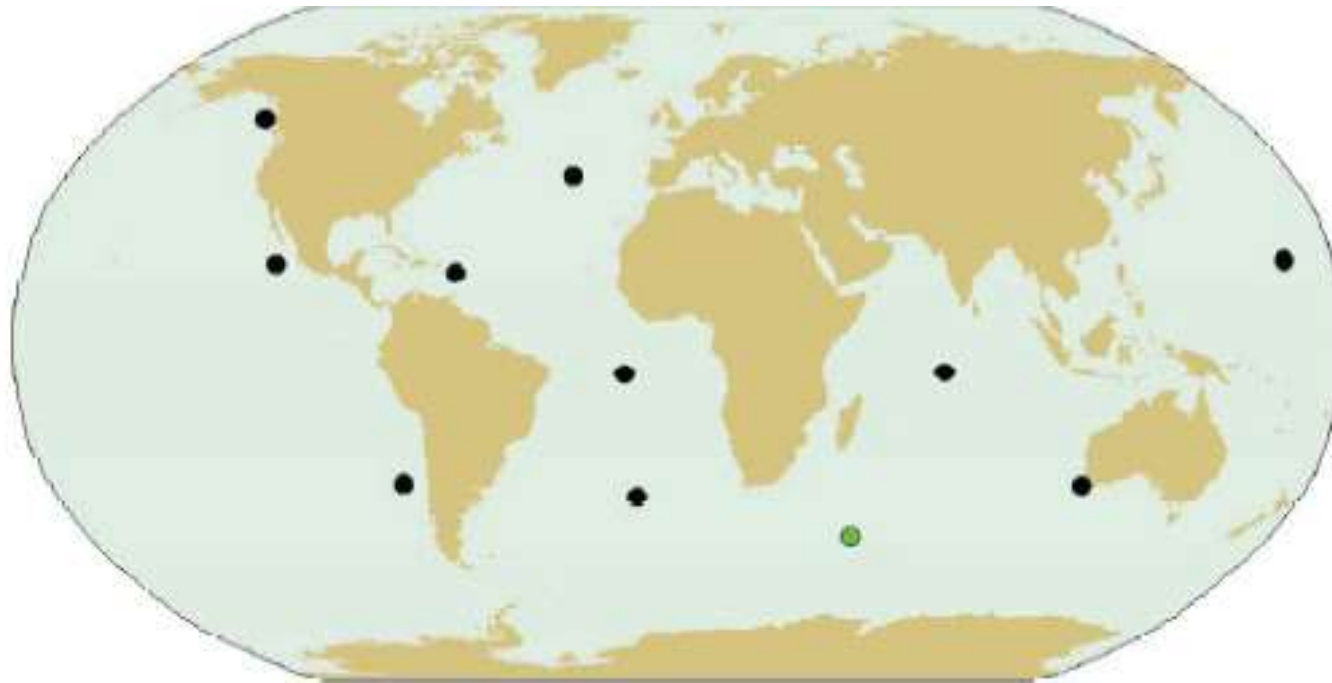


Marine observations



Upper-air observations

Acoustic data for natural hazards



CTBTO IMS hydroacoustic network
Detects earthquakes, volcanic eruptions, tsunamis - and explosions



Data management and access to data

- Very extensive datasets, growing data volume
- Getting access to data may be problematic due to data policy and/or logistical reasons
- Increasing focus on open data and data availability
- Repositories are developing within many fields
- Practical issues related to data access are still a problem



Online data platforms are developing

The screenshot shows the INTAROS data catalogue website. The browser address bar displays <https://catalog-intaros.nersc.no>. The website header features the INTAROS logo on the left and navigation links for Datasets, Organizations, Groups, and About on the right, along with a search bar. The main content area is divided into two columns. The left column contains a 'Search data' section with a search input field containing 'E.g. environment' and a magnifying glass icon, and a 'Popular tags' section with buttons for 'climate research', 'HAUSGARTEN', and 'Hansbreen'. Below this is a 'STATISTICS' section titled 'INTAROS Data Catalogue statistics' showing '38 datasets', '20 organizations', and '0 groups'. The right column features a 'Welcome to the INTAROS data catalogue' message, followed by a paragraph stating 'INTAROS collects data within key regions of the Arctic, and provides access to these datasets and other datasets of relevance to our targeted stakeholders.' Below the text is a map of the Arctic region with several overlapping colored circles representing data basins: a large red circle for 'Land and atmosphere', a blue circle for 'Ocean and sea ice', a purple circle for 'Canadian Basin', and a pink circle for 'Eurasian Basin'. Other labels on the map include 'USA', 'Canada', 'Chukchi Sea', 'Kara Sea', and 'Russia'.



Online data platforms are developing

The image displays two overlapping browser windows. The top window shows the INTAROS data catalogue website. The browser address bar contains the URL `https://catalog-intaros.nersc.no`. The website header features the INTAROS logo, navigation links for 'Datasets', 'Organizations', 'Groups', and 'About', and a search bar. A 'Search data' button is visible on the left, and a welcome message reads 'Welcome to the INTAROS data catalogue'. The bottom window shows the EPOS-N website. The browser address bar contains the URL `epos-no.geo.uib.no:81/#/view`. The website header includes the logos for 'Enlighten', 'NORCE', and 'EPOS-N EUROPEAN PLATE OBSERVING SYSTEM - NORWAY'. A left sidebar contains navigation options: 'Views', 'Dataset List', and 'Dataset'. The main content area is divided into two panels. The left panel is a 3D topographic map of the Arctic region, overlaid with numerous white and yellow circular markers representing seismic events. A scale bar at the bottom indicates '100 km'. The right panel is a scatter plot titled 'seismic_EQ_ARCTIC/magnitude:' showing the magnitude of seismic events over time. The y-axis represents magnitude, ranging from 0.5 to 6.5. The x-axis represents time, with labels for 1970, 1980, 1990, and 2000. A horizontal dashed line is drawn at a magnitude of approximately 5.0. The plot shows a high density of events between 4.5 and 5.5 magnitude from 1970 to 2000, with fewer events below 4.5 magnitude and above 5.5 magnitude.



Questions?

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