

- what is NACO?
- what is a glider?
- NACO glider operations
- gliders in the Iceland Sea
- glider operations at high latitudes

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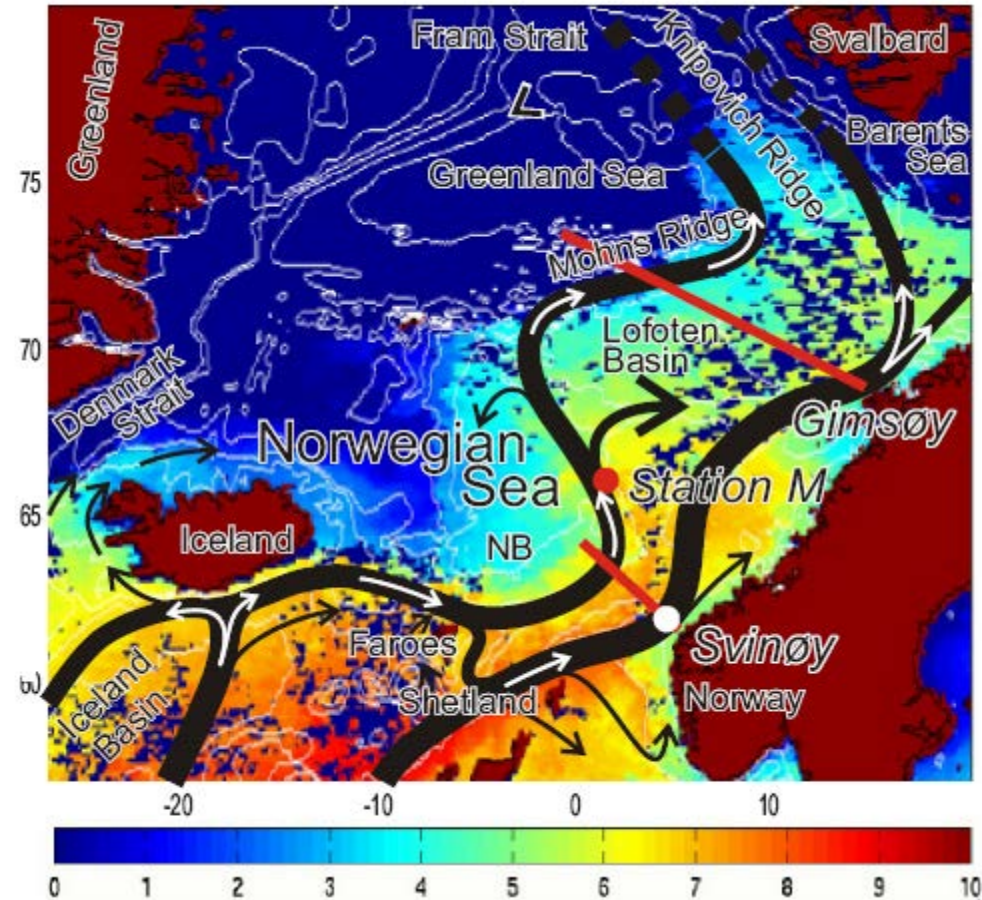
NACO: Norwegian Atlantic Current Observatory

National research infrastructure facility since 2011



As part of the NACO proposal

- A real-time mooring at Svinøy
- A national facility for gliders to monitor the Norwegian Atlantic Current
- Build-up of competence and service to research projects



Run by GFI/UoB with IMR and Runde Environmental Centre as partners

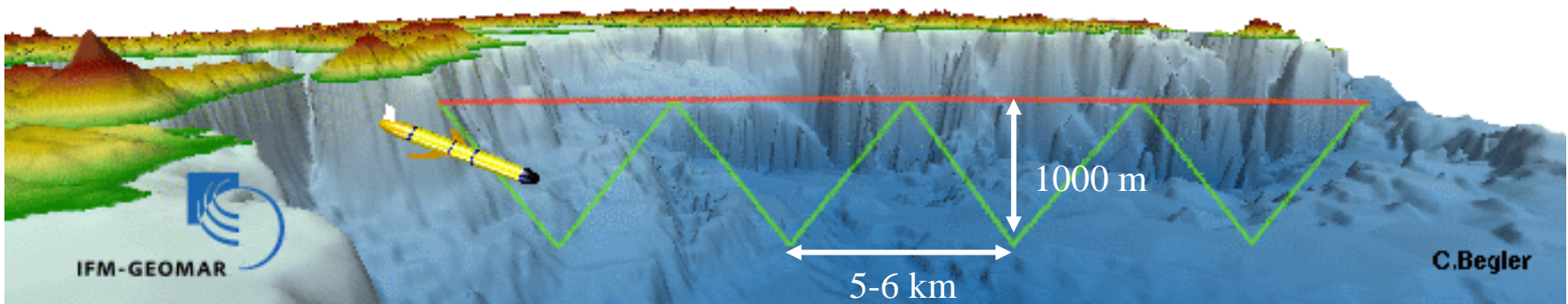
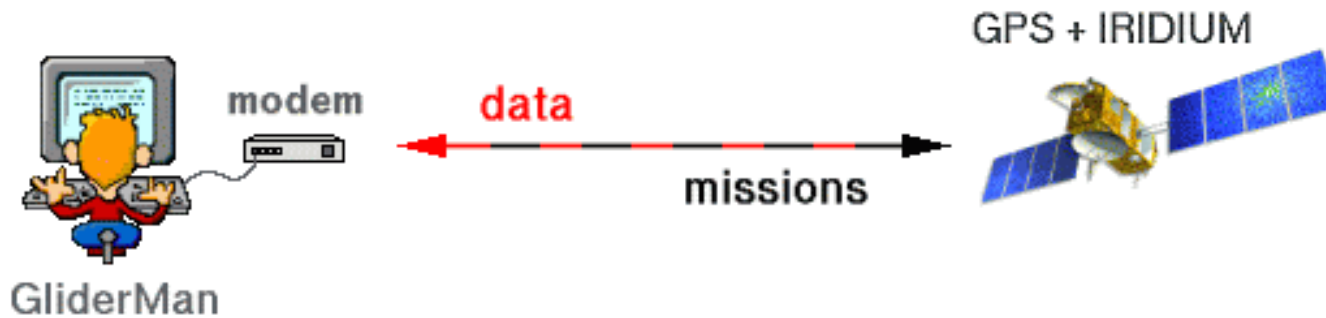
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Key figures:

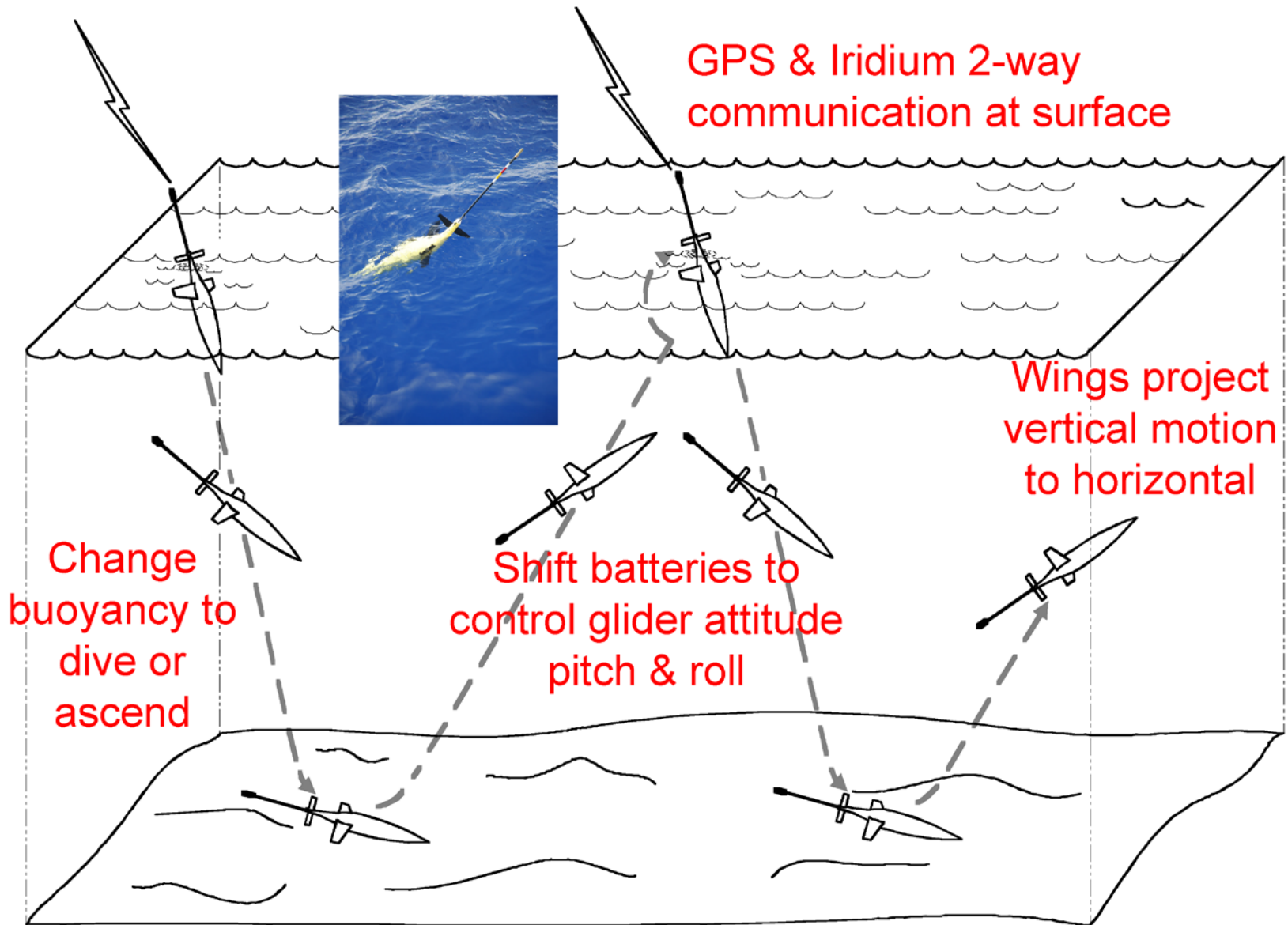
- Time per dive: 8-9 hours
- Velocity: 15-20 km/day ($\sim 1/24$ of a research vessel)
- Duration of mission: up to 9-10 months



from IFM-GEOMAR

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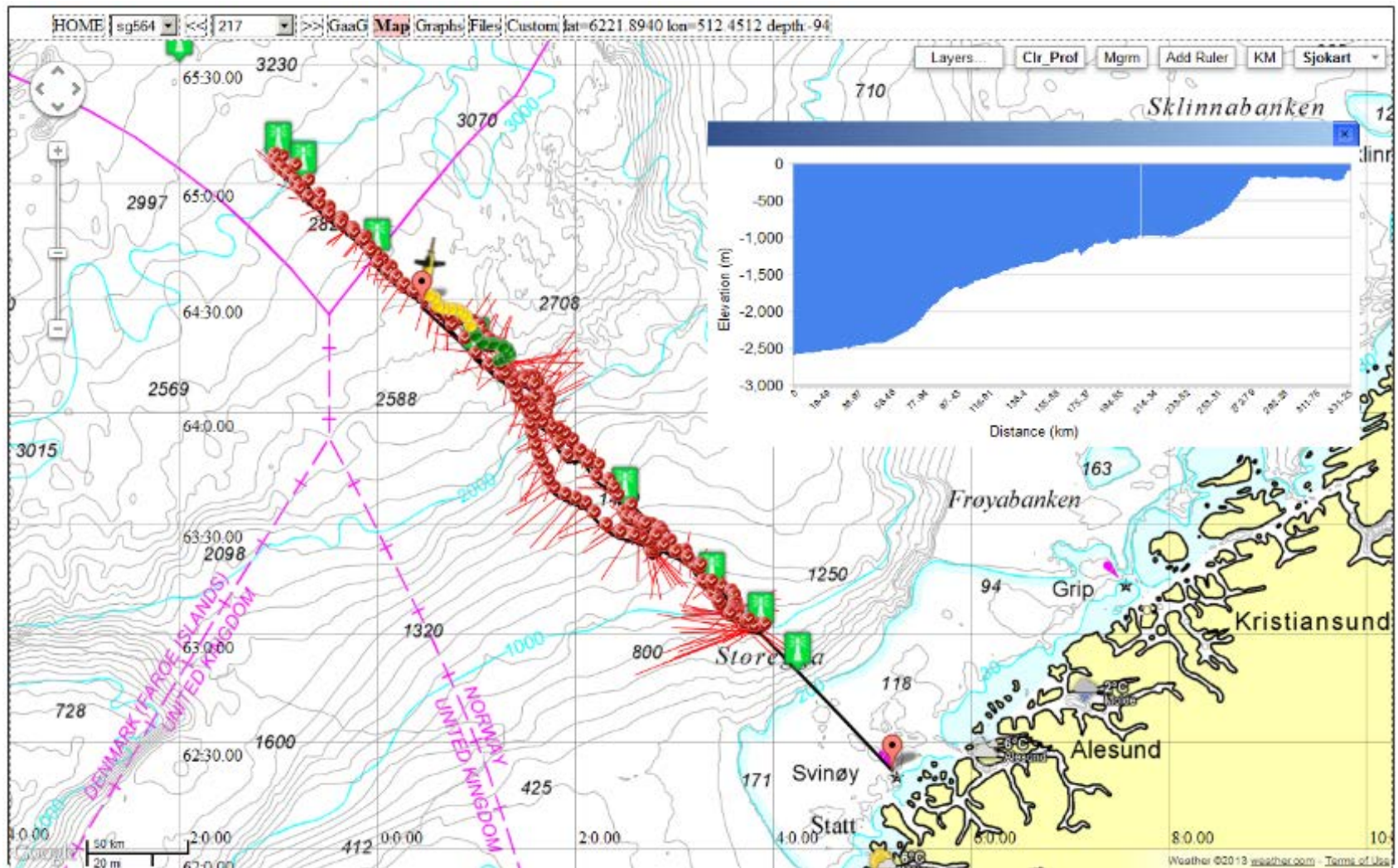


Monitoring at key locations



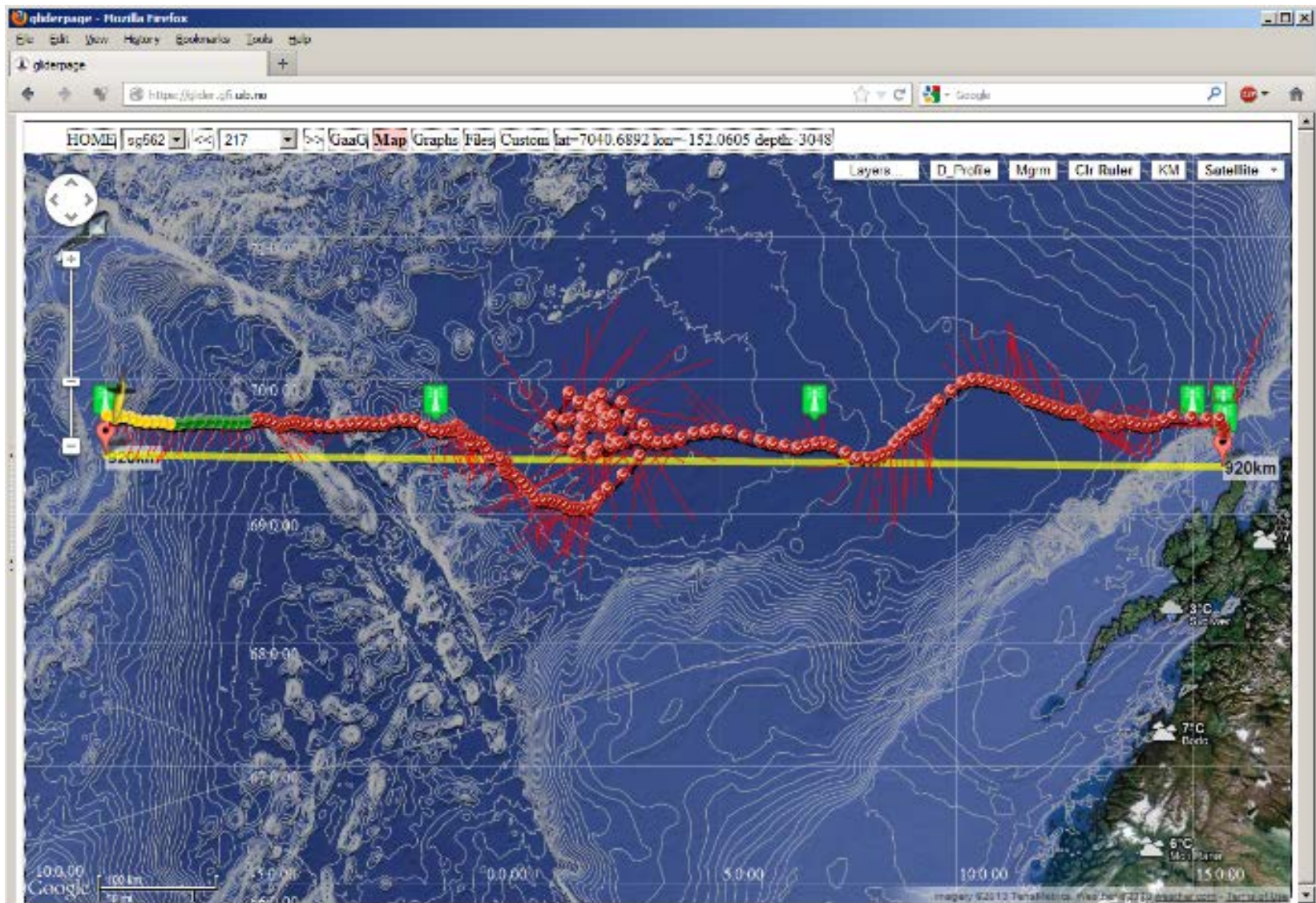
Svinøy repeat glider transect in Gliderpage

<http://naco.gfi.uib.no>



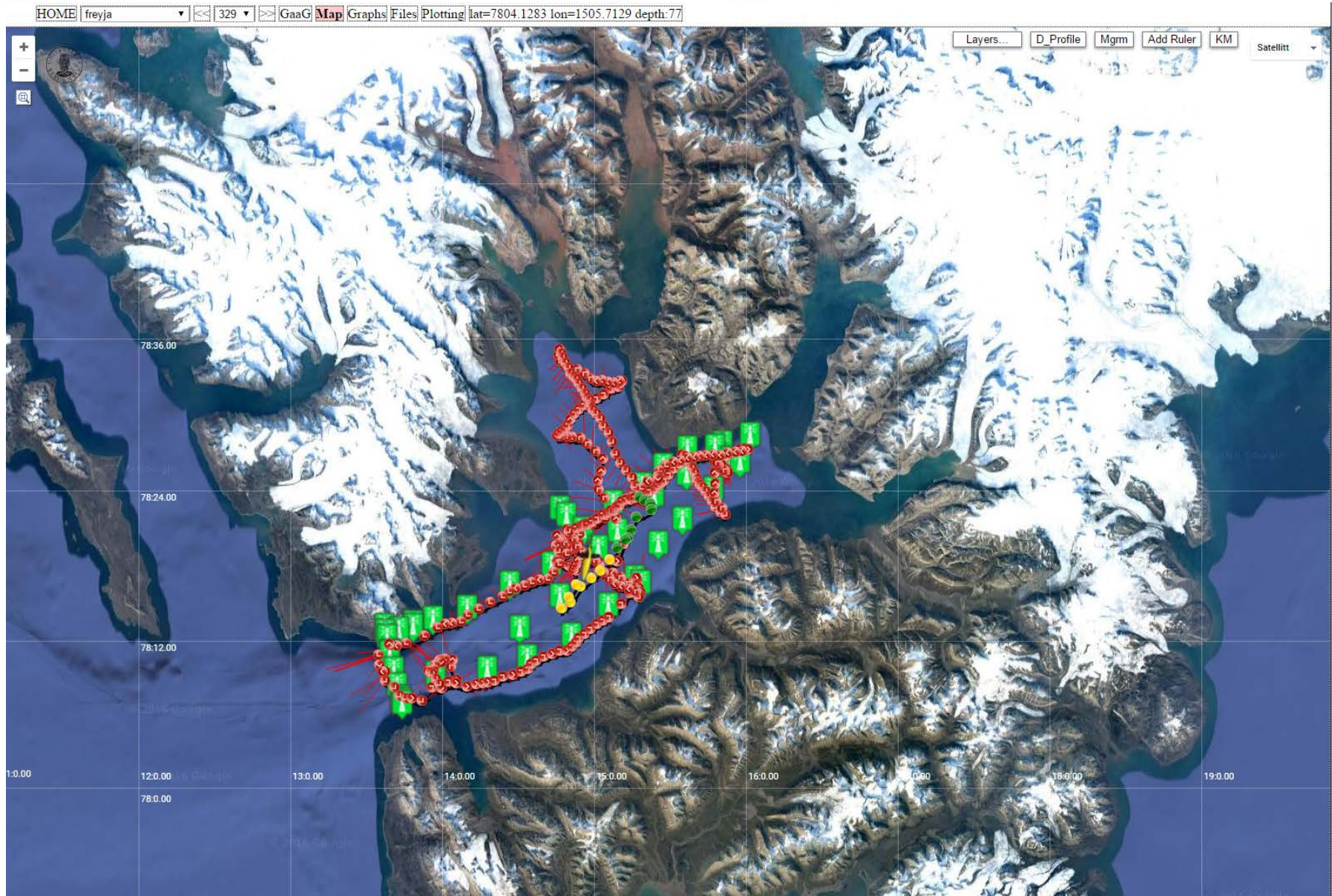
Lofoten Basin repeat glider transect in Gliderpage

Combination with process studies of semi-permanent eddy in the Lofoten Basin



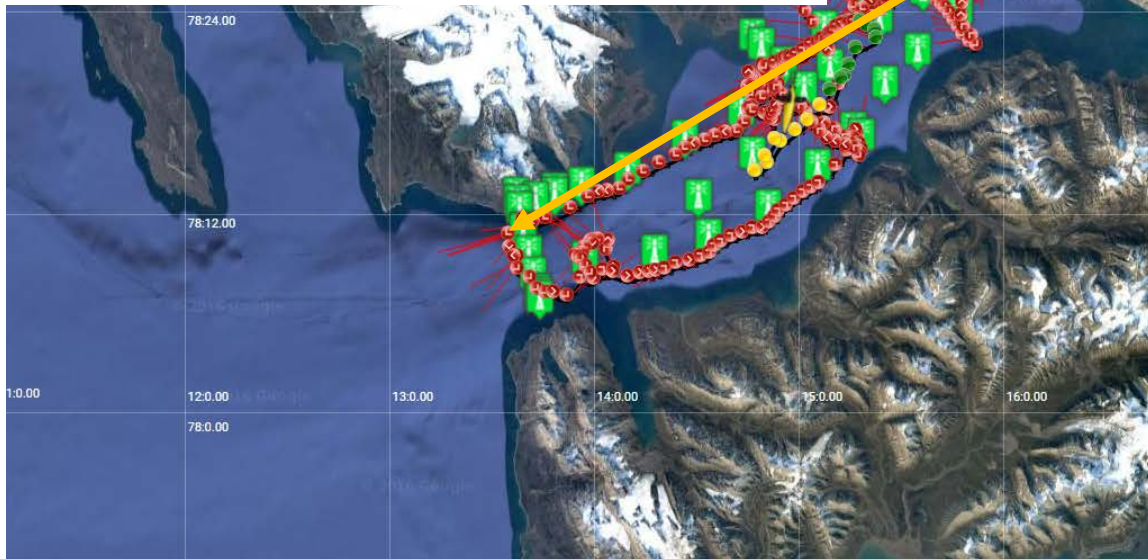
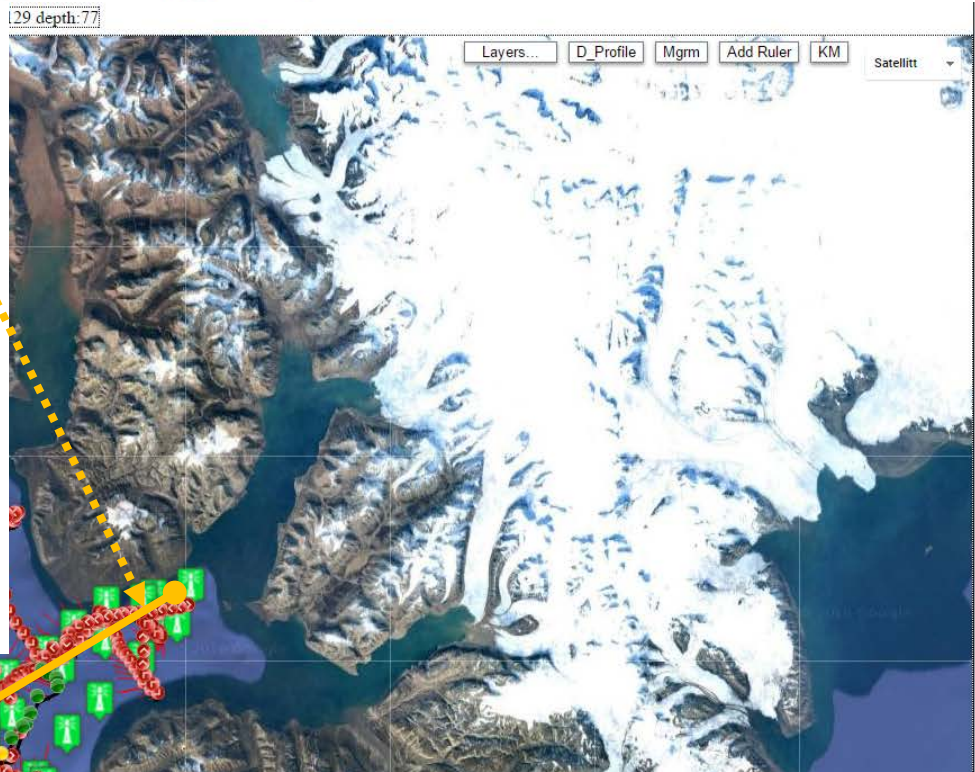
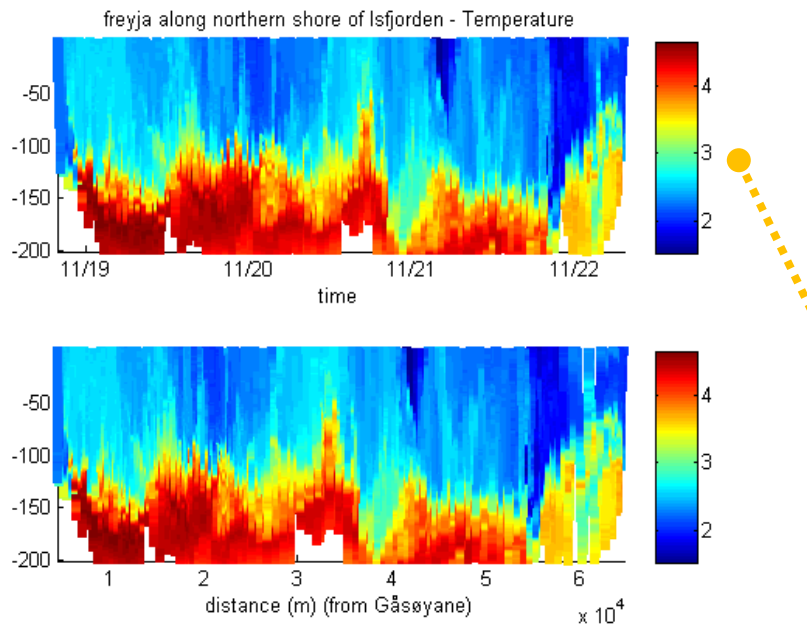
Slocum glider operations in Isfjorden

Collaboration with UNIS, November 2014 and November 2016



Slocum glider operations in Isfjorden

Collaboration with UNIS, November 2014 and November 2016



Challenges

- Narrow fjord
- Shallow sills
- Cold air temperatures (prior to launch)

Piloting tool: glider page developed at GFI

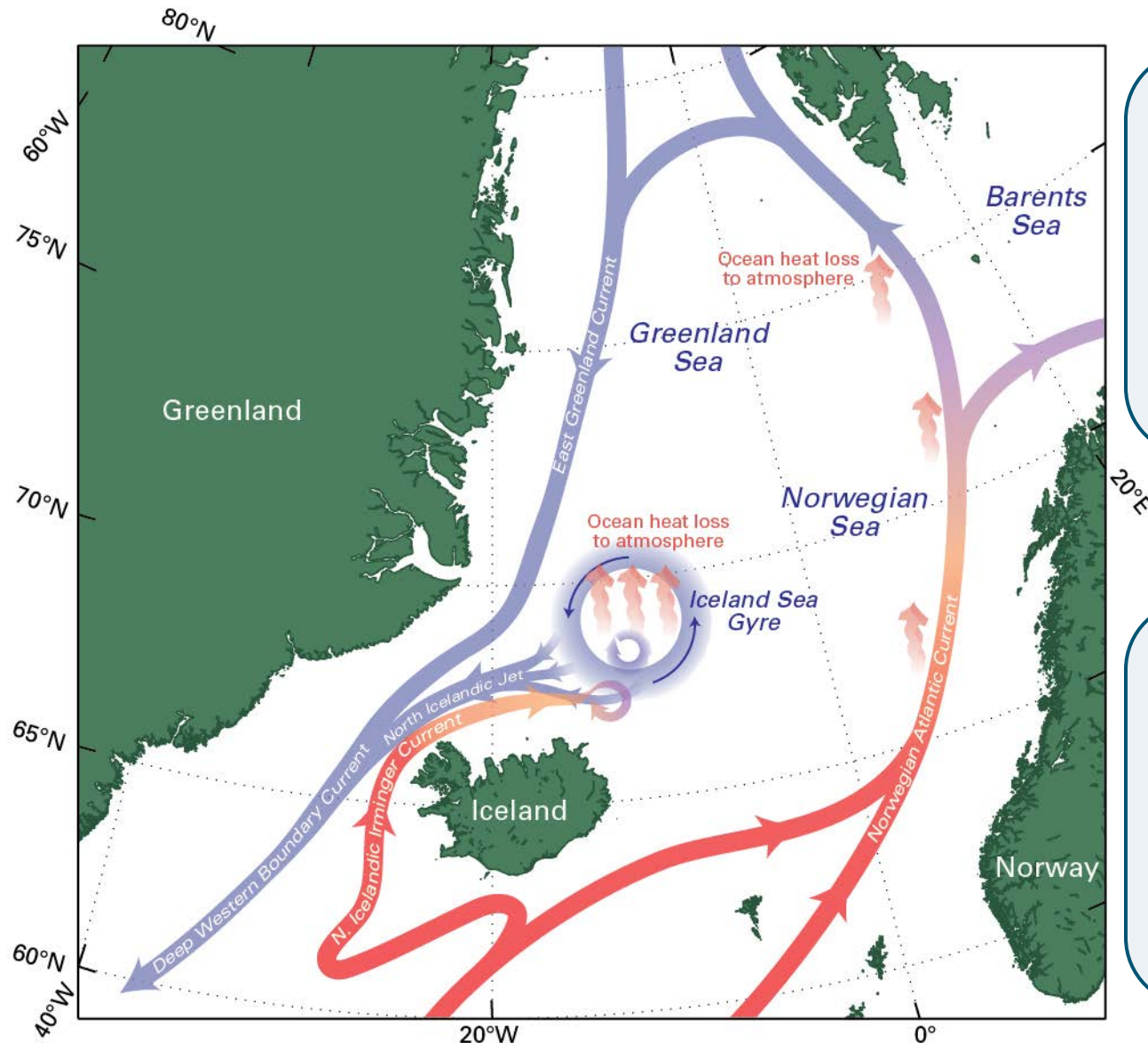
- Web client based on Google Maps API v.3
- Integration between Google Maps and open wms map data from statkart.no/geonorge.no, weather data from met.no/yr.no, etc
- Integration between map application and technical matlab plots, communication with base station for editing of cmd/science/target files, copy of data and log files, monitoring of technical condition of glider

NACO glider infrastructure

- 6 Seagliders and 3 Slocum gliders
- Distance covered since 2012: > 40000 km
- No loss of equipment
- Applied to projects in the Norwegian Sea, Faroe-Shetland Channel, Iceland Sea, Svalbard, coastal and fjord areas, fresh water lake

Iceland Sea glider operations

Schematic overturning circulations in the Nordic Seas



Water mass transformation in the interior Iceland Sea is an important source of dense water to the lower limb of the overturning circulation

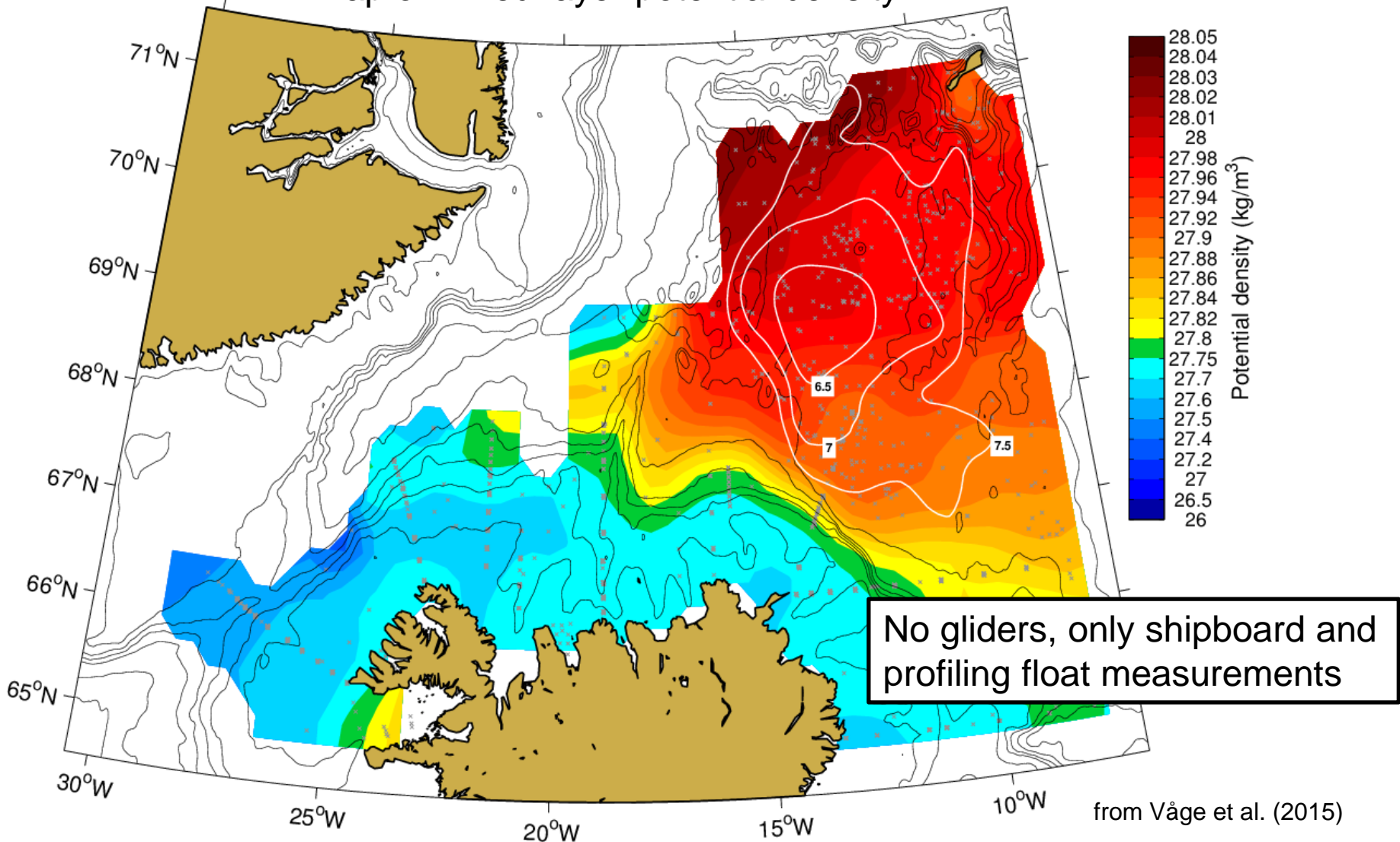
3 gliders were deployed in the Iceland Sea for 9 months through winter 2015-16 to study the wintertime evolution of the mixed layer

What we know about convection in the Iceland Sea

February-April mixed-layer potential densities



Map of mixed-layer potential density

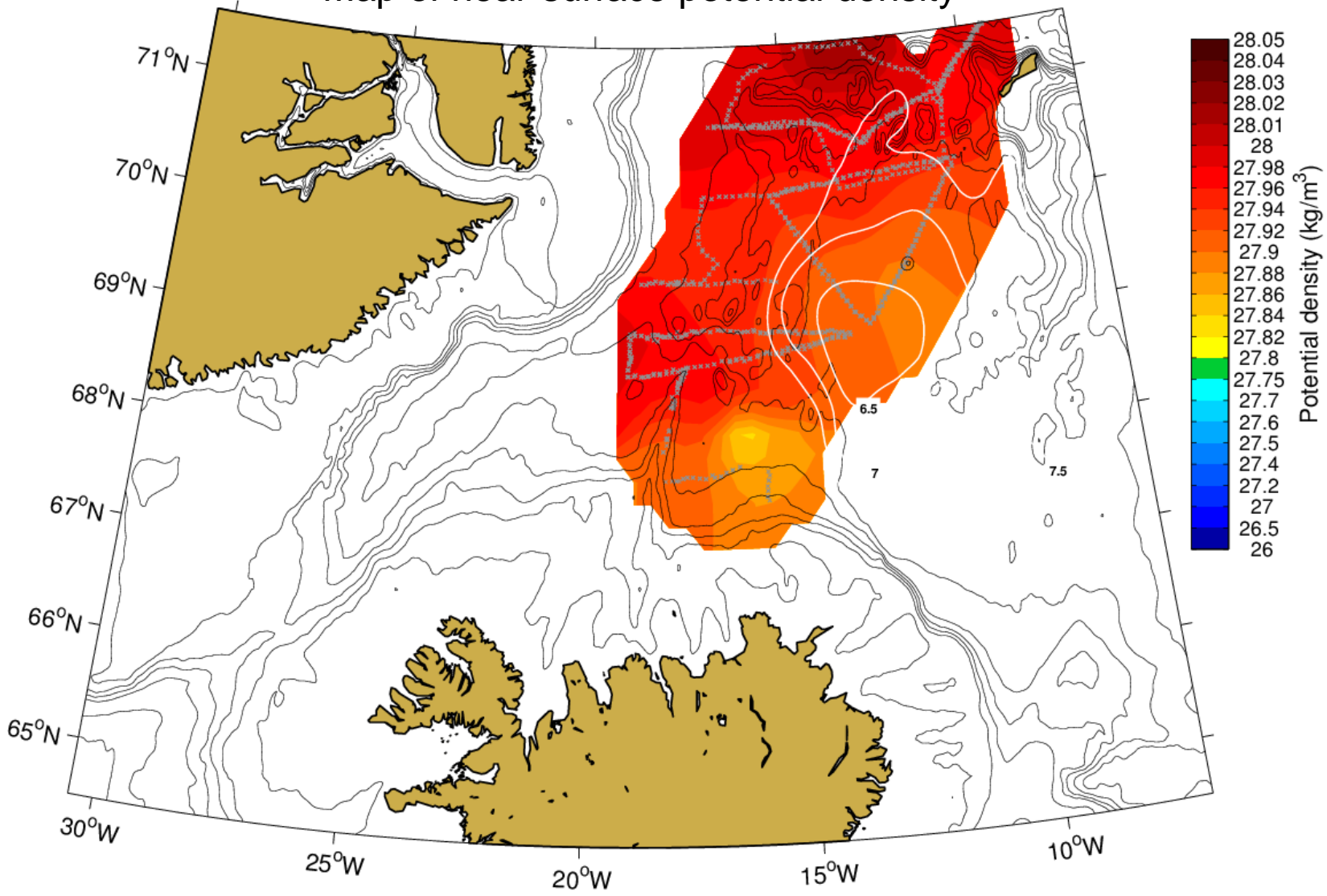


Potential density at 50 m using glider data from 2016

February-April near-surface potential density



Map of near-surface potential density

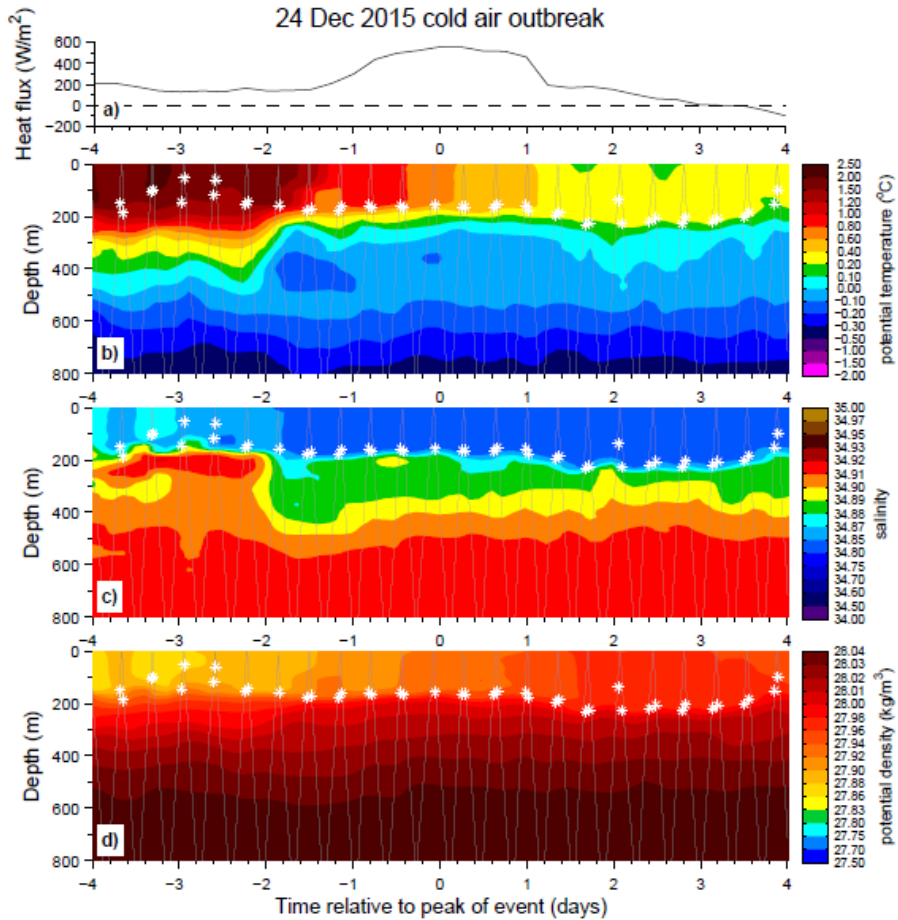


Cold air outbreaks play important roles in convection

The highest heat flux events in this region

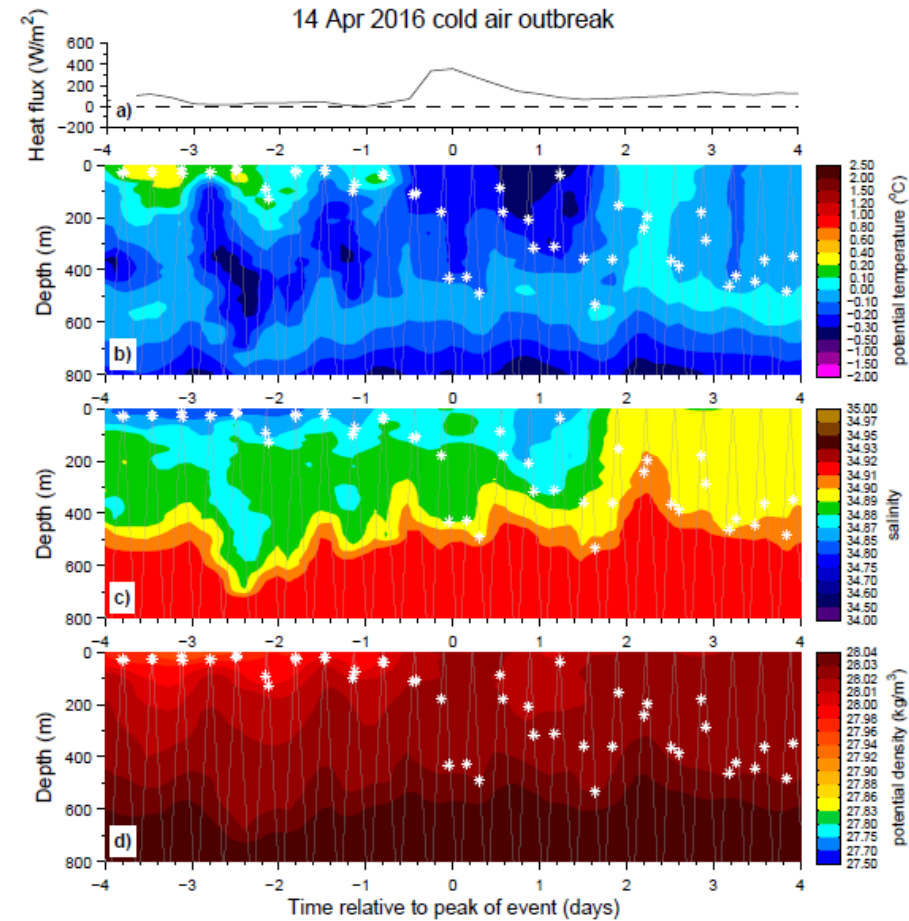
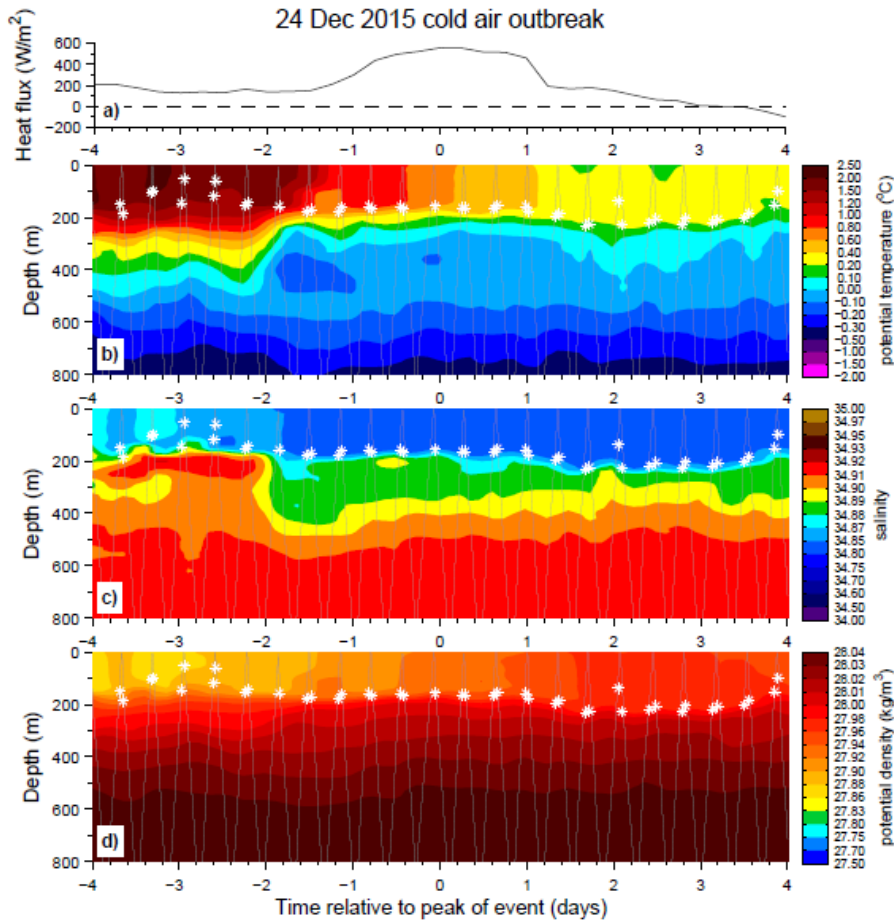


24 Dec 2015 cold air outbreak



Cold air outbreaks play important roles in convection

The highest heat flux events in this region



Gliders enable us to observe these events and can operate in conditions that may be too adverse for even large research ships

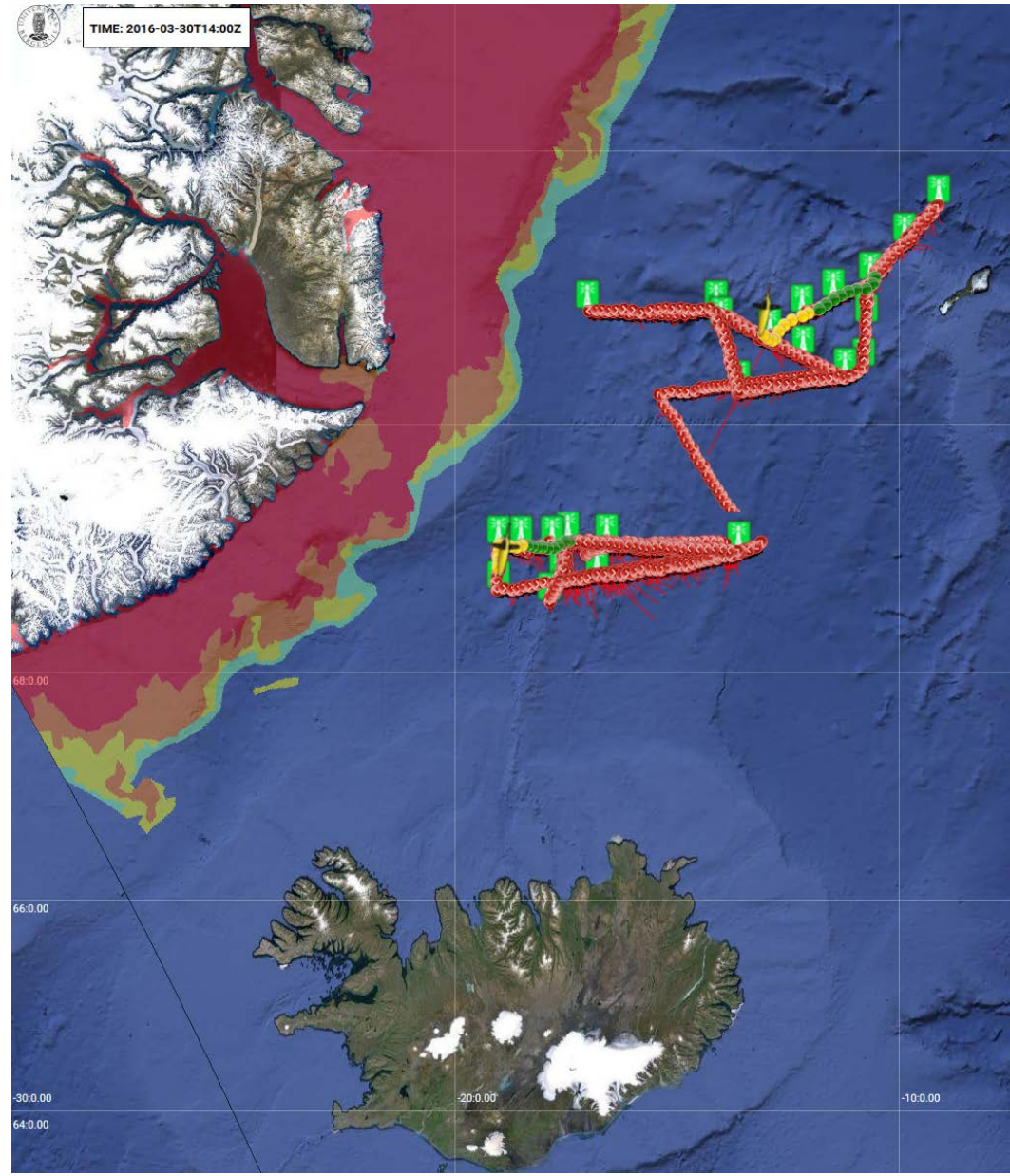
Operations in the vicinity of the marginal ice zone



Sea ice concentration in Gliderpage

Problems with sea ice

- Navigation and communication
- Collisions
- Entrapment
- Cold temperatures

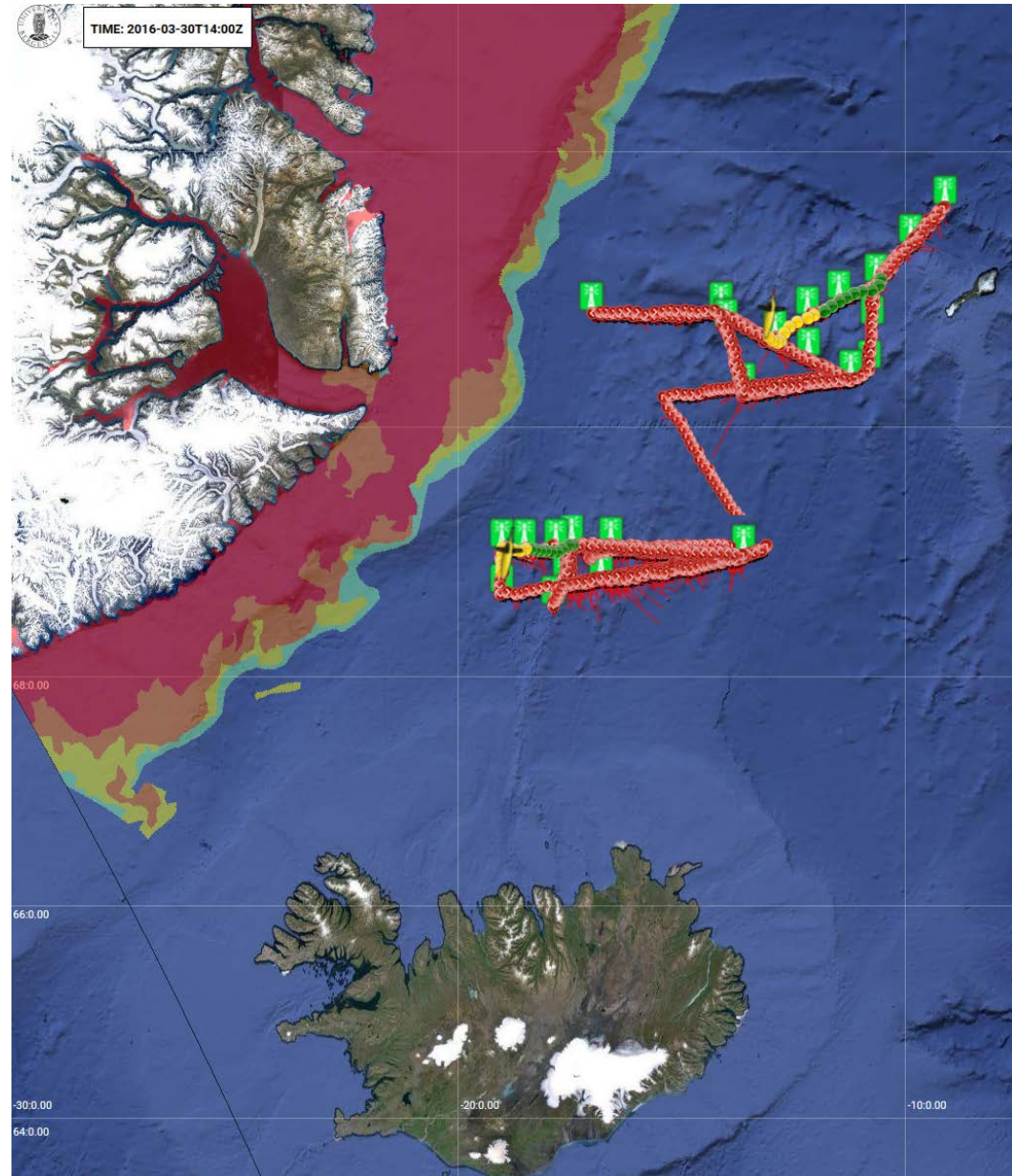


Operations close to the marginal ice zone



Iceland Greenland Seas project

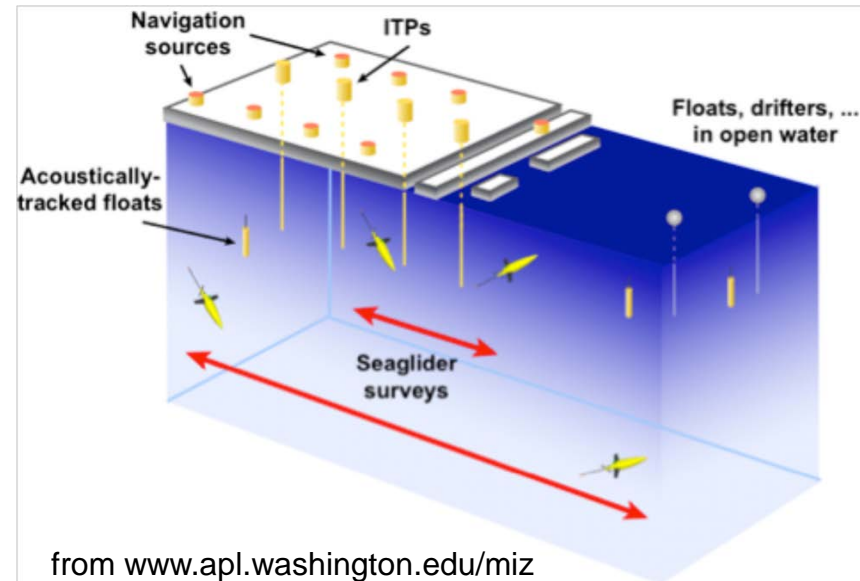
- Winter 2017-18
- Coordinated atmosphere-ocean field campaign
- Investigate the coupled system that forces oceanic convection and supplies dense water to the lower limb of the overturning circulation
- At least 2 gliders will be deployed for a 9-month mission
- Ice avoidance algorithms will enable safe glider operations closer to the ice edge



- Avoid ice covered areas
- Terrain Aided Navigation and Digital Elevation Models
- Acoustic navigation by RAFOS
 - limited range
 - expensive

Acoustic under ice navigation

- Marginal ice zone project
- Davis Strait
- Fram Strait



from www.apl.washington.edu/miz

- Use gliders (and other vehicles) in the ice free season to develop Digital Elevation Models for Terrain Aided Navigation
- Supplement with acoustic sources where necessary
- Keep an eye on battery performance and other aspects of cold climate operations
- Deploy and recover at convenient locations to keep cost down

NACO

- gaining experience with operations in seasonally ice covered waters
- expressed interest in operating gliders near/in the marginal ice zone