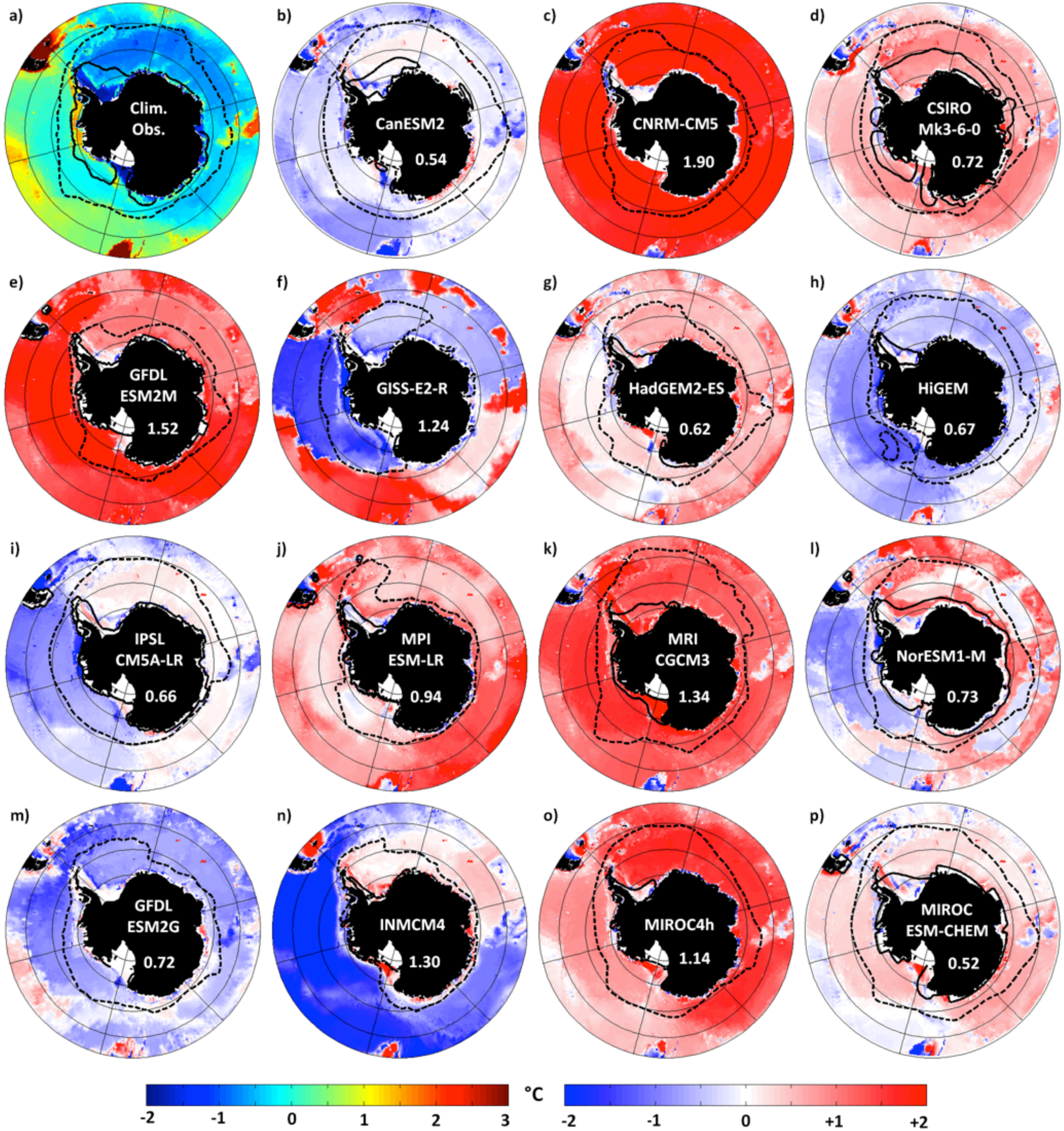
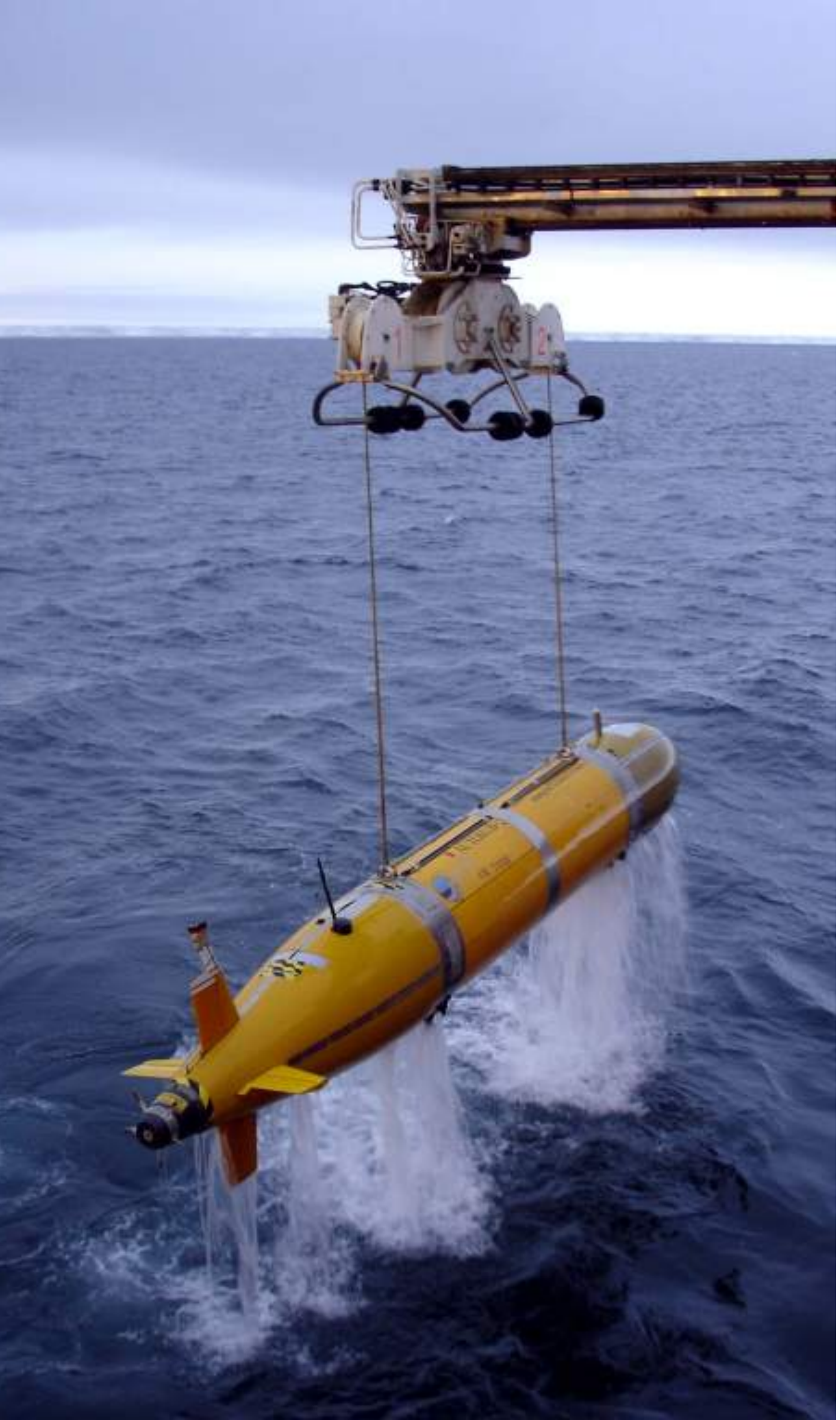


How well do CMIP5 climate models reproduce Southern Ocean bottom temperature?

Model - climatology (colours) plus August (dashed) & February (solid) sea ice edge.

Heuzé et al. (2013, GRL)



Autosub autonomous underwater vehicle

Designed and built by NOC Southampton

Speed ~1.7 m s^{-1}

Use dead reckoning to navigate subsurface (accuracy 1 m for each 1 km travelled)

Sensors include CTD, microstructure, current velocity, swath bathymetry (up and down)

Fully autonomous

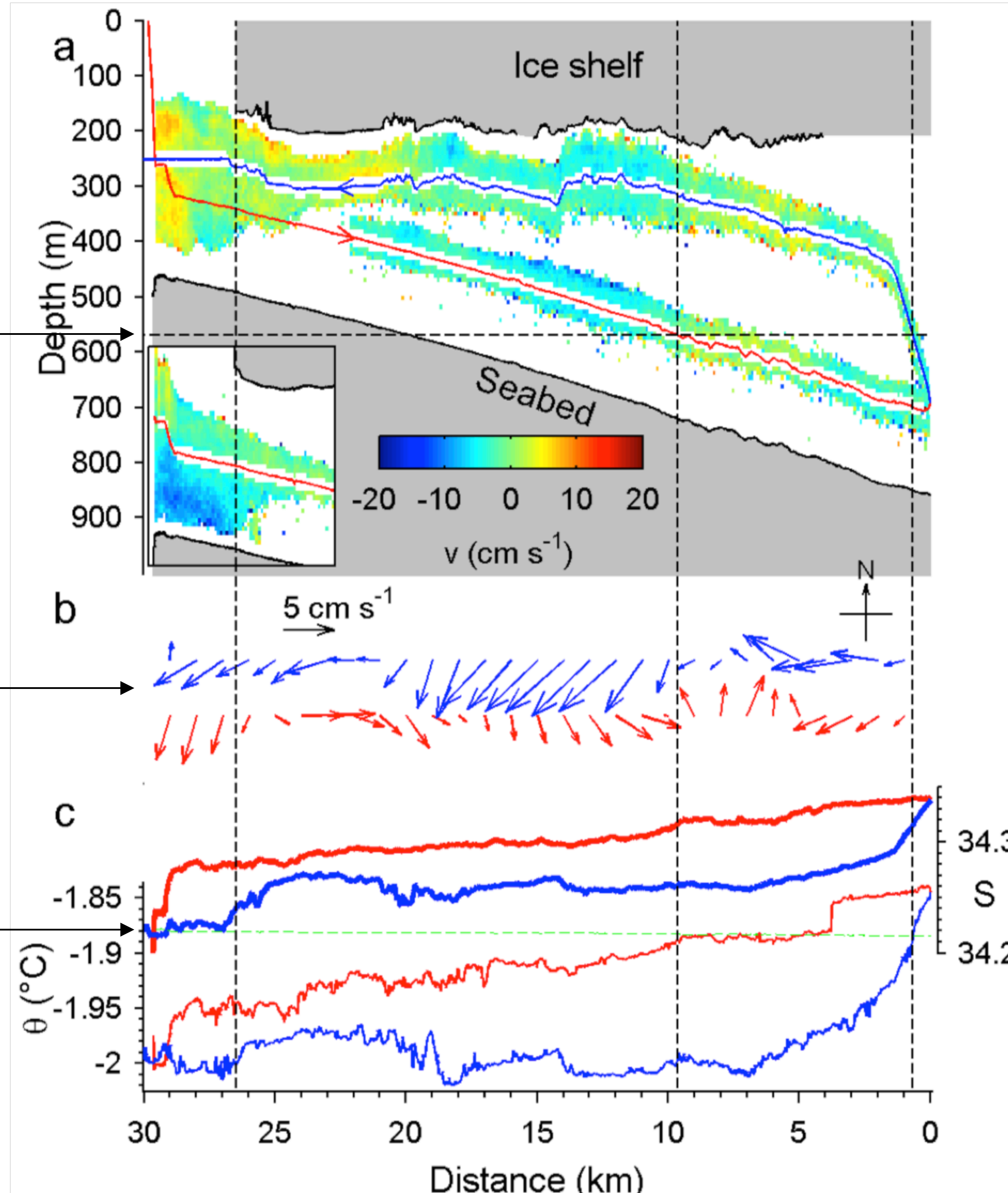
Autosub3 was designed to go beneath ice shelves and sea ice.
Total displacement of 3.6 tonnes
Range up to 400 km on a set of batteries.
It can dive to a depth of 1600 metres.

Spatial variability in Autosub data beneath Fimbul

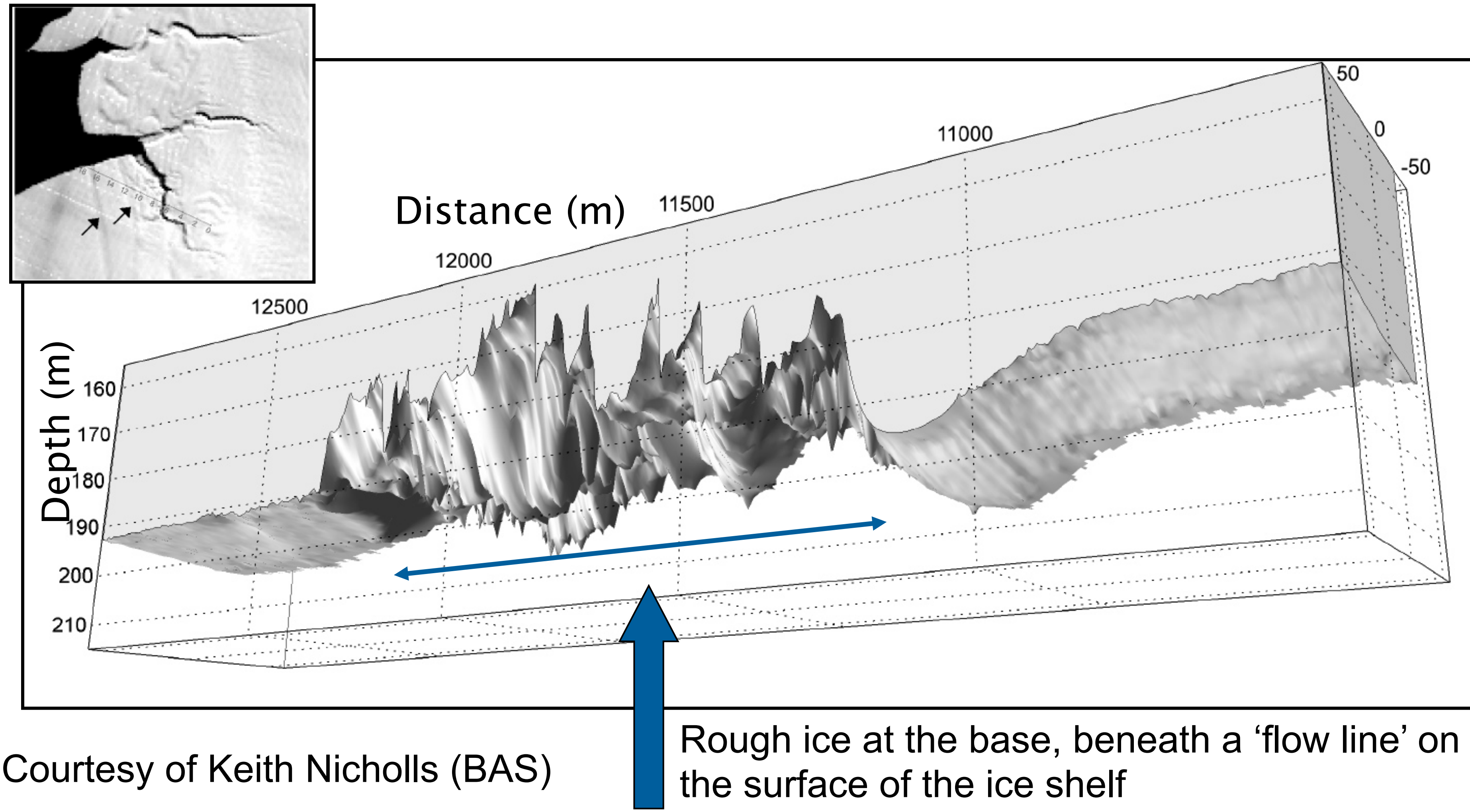
Max. sill depth

Detided currents

Freezing point



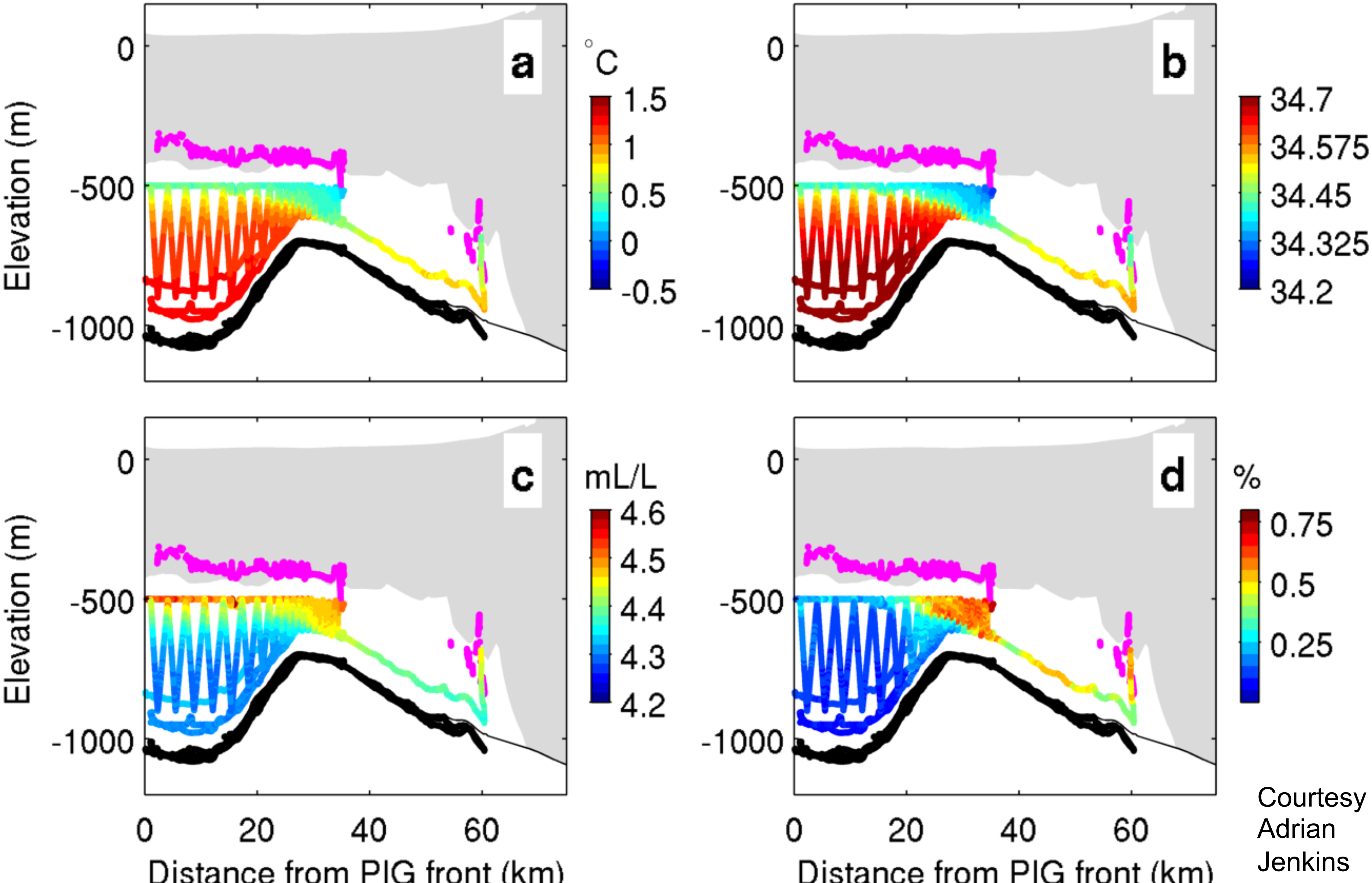
Swath bathymetry image of the underside of the Fimbul at ~11.5km



Courtesy of Keith Nicholls (BAS)

Rough ice at the base, beneath a ‘flow line’ on the surface of the ice shelf

Water properties and ice base and seabed draft beneath Pine Island Glacier ice shelf



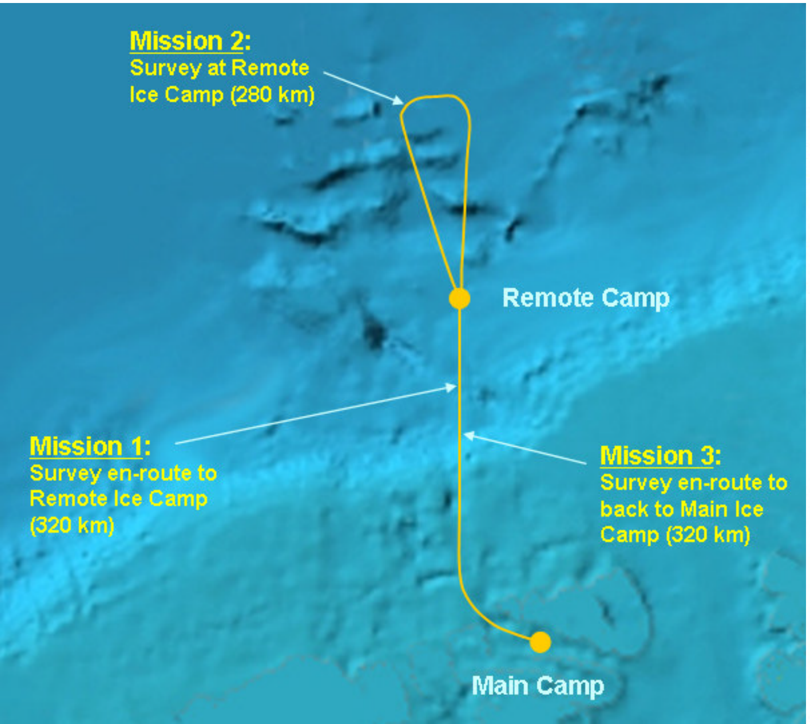
Courtesy Adrian Jenkins

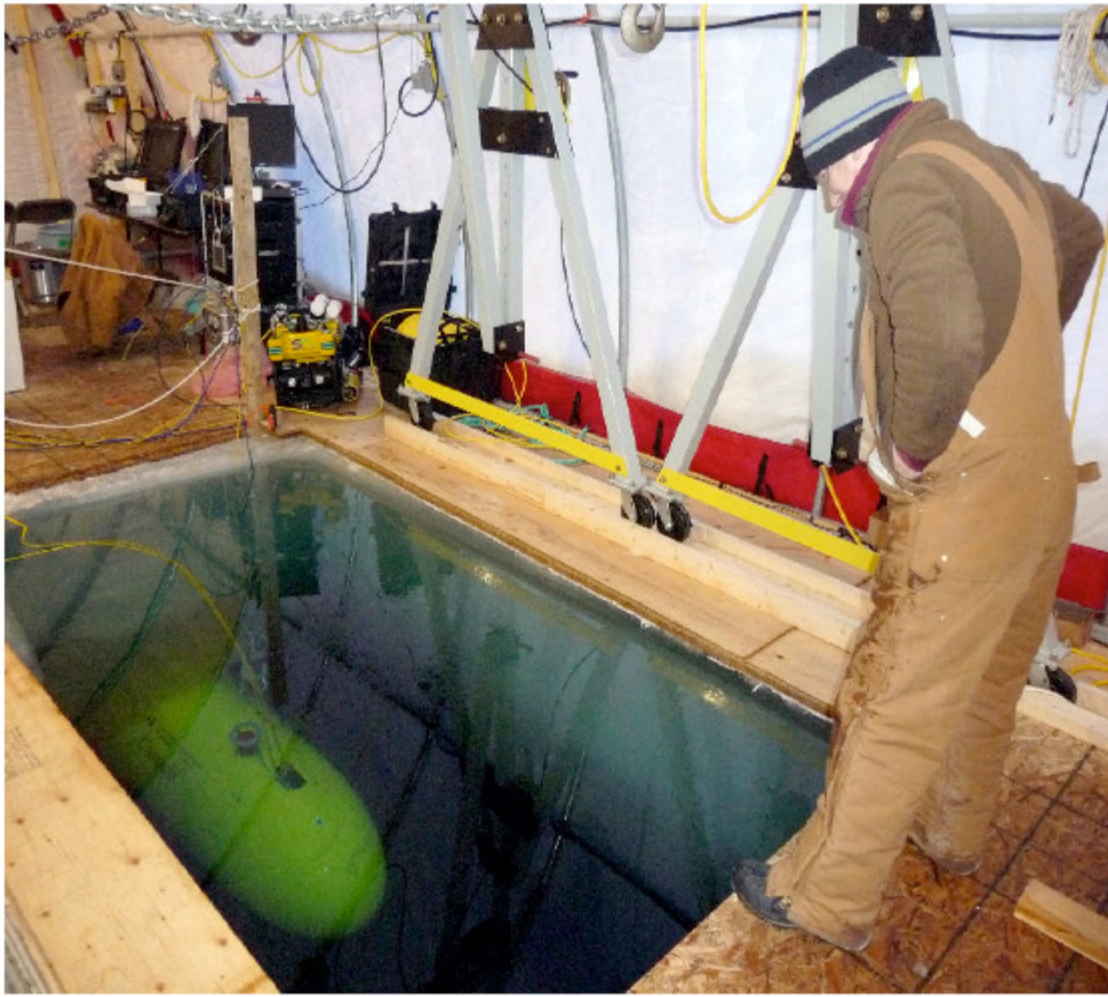
WHOI Seabed class AUV operations to depths 3500 m in the Arctic Ocean, in 2007.

Kunz et al., Journal of Field Robotics, 2009

ISE Explorer AUV operations in the Canadian Arctic, in 2010, traversing between ice camps.

Crees et al., 2010





Current AUVs: *(from Adrian Jenkins)*

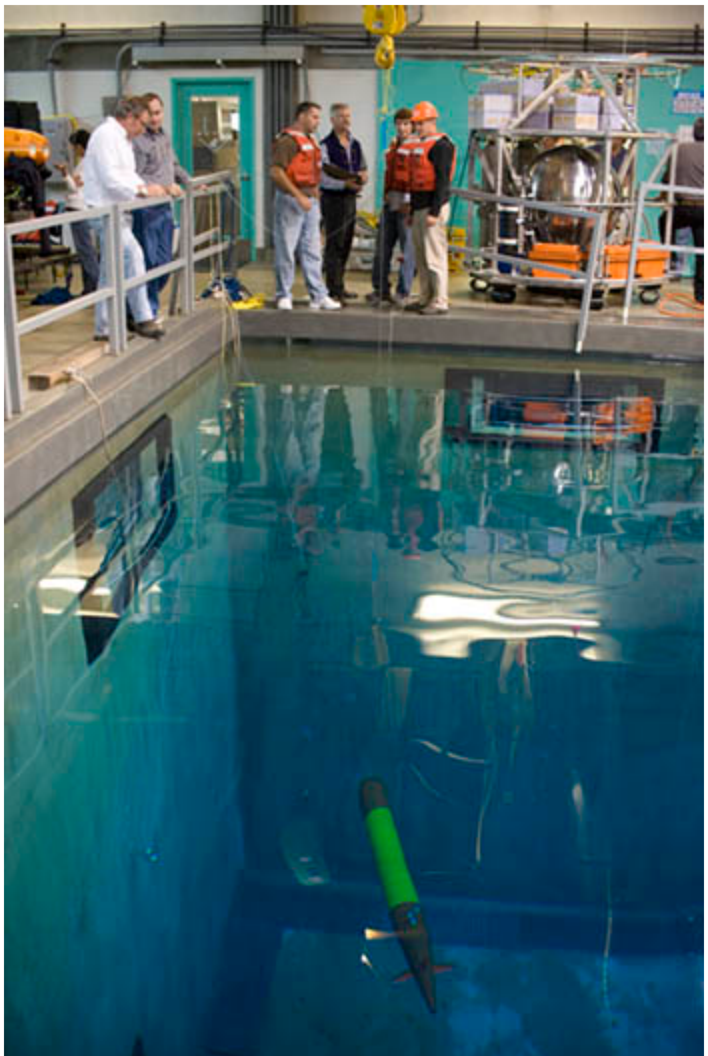
1) Under-ice work with AUV’s, particularly for detailed studies within a ~10 km of a support ship, are becoming more “routine”.

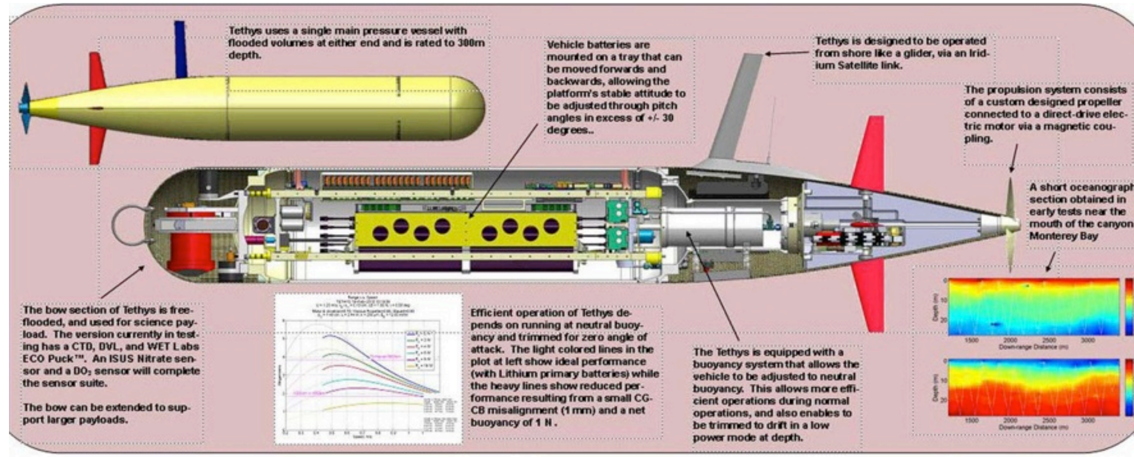
2) Longer deployments, ~100 km, beneath solid ice cover have also been achieved.

3) Powered propulsion give great flexibility in flight planning and the possibility of running relatively power-hungry instrumentation.

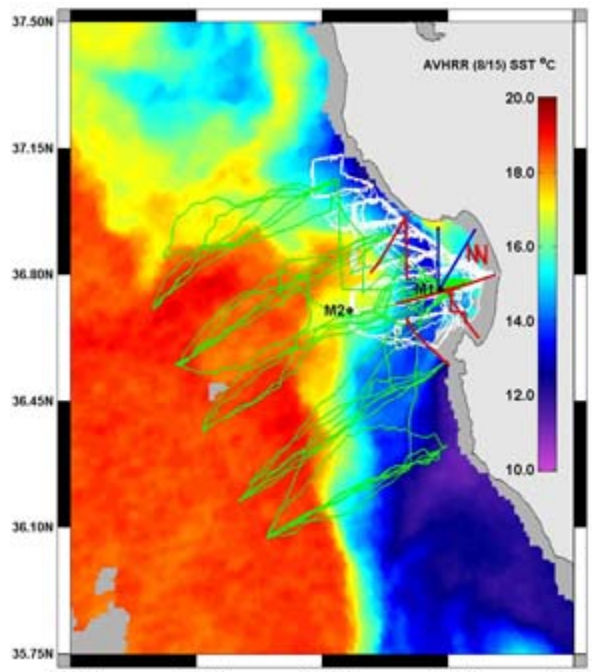
4) Despite high levels of autonomy, limited endurance means that most AUV’s cannot operate for more than a few days way from a support ship/camp.

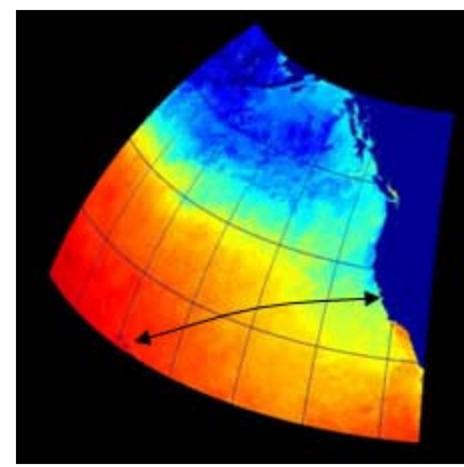
Tethys: a small, long-range AUV with flexible speed and payload, J.G. Bellingham et al. 2010, Ocean Sciences



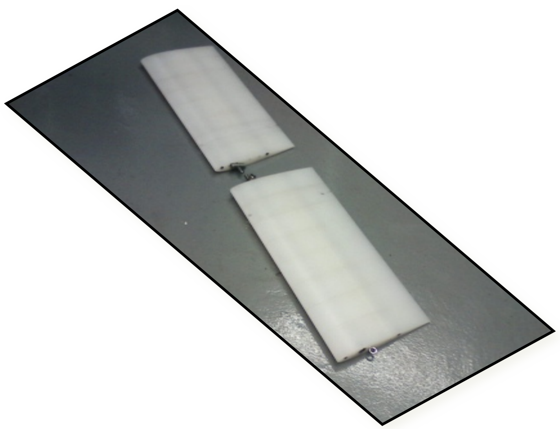


Travel over 1,000 km at ~1 m s^{-1} with sensors drawing 8 Watts.
Cover more than 3,000 km with minimal sensors and slow speeds (0.5 m s^{-1}).





Autosub Long Range



Key Specifications

Mass	600 kg
Maximum Depth	6000 m
Maximum Range	6000 km, 6 months
Speed range	0.3 to 1.4 ms^{-1}
On-board energy	70 MJ (primary lithium)
Flight Modes	Depth, Altitude, Profiling
Hibernation & Parking	Up to 1 year
Communications	Iridium modem at surface
Standard Payload	CTD (SBE 52), 300 kHz ADCP

Maaten Furlong

Future AUVs: *(from Adrian Jenkins)*

1) Long-range (endurance of months, range of 1000’s km) are being developed.

2) Having a sleep/park mode allows endurance to be extended beyond a year.

3) With through-ice communication, year-round deployment beneath ice becomes possible.

4) The vision is for vehicle that can spend a full year beneath an ice shelf, communicating via a surface-mounted station, running missions throughout the winter, hibernating between missions, with annual recovery, servicing, battery charging and redeployment by ship.

Seaglider

- Dissolved oxygen O_2 from Aanderaa optode
- CTD – temperature, salinity and pressure
- Chlorophyll and CDOM fluorescence (Wetlabs triplet puck)
- Optical backscatter for particulate carbon (Wetlabs puck)
- PAR
- Dive-average current

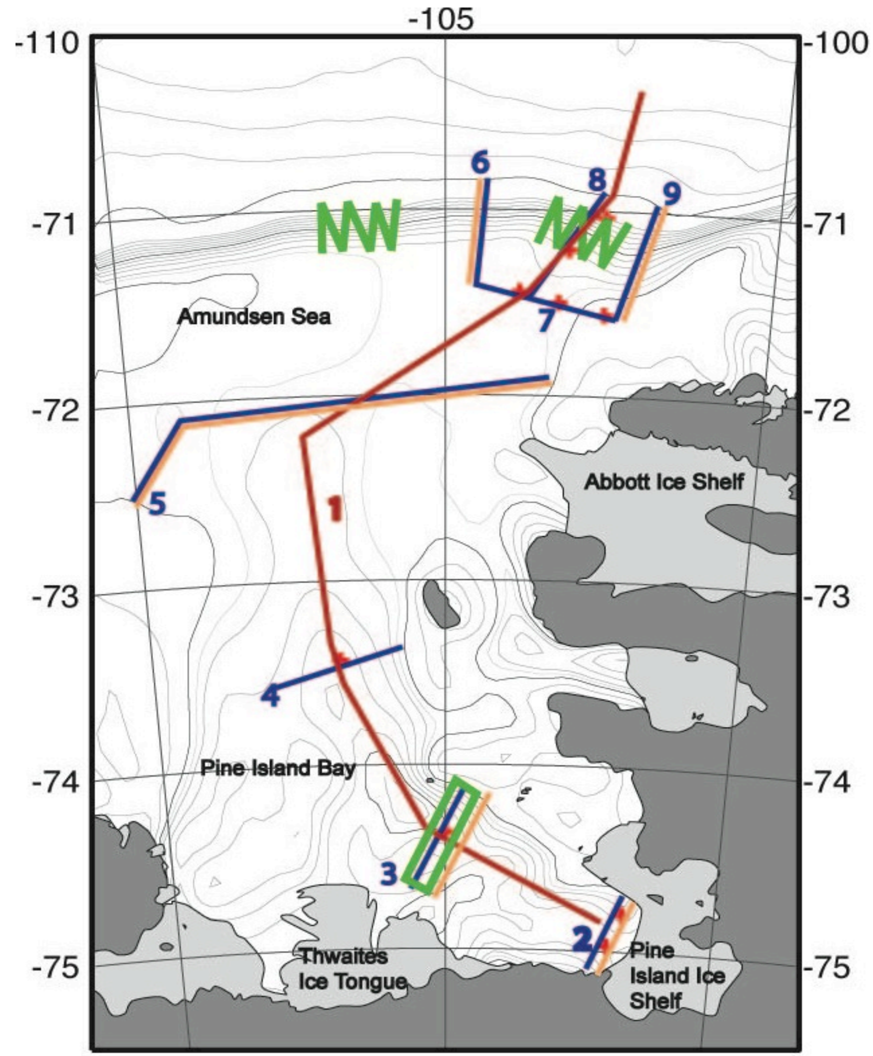
- Horizontal speed ~20 cm/s
- Maximum depth 1000 m
- Mission length ~6 months

NERC Ice Sheet Stability (iSTAR) programme
http://www.istar.ac.uk

Two ocean projects looking at delivery of heat from the open ocean to the ice shelf; two ice-based projects looking at ice shelf processes

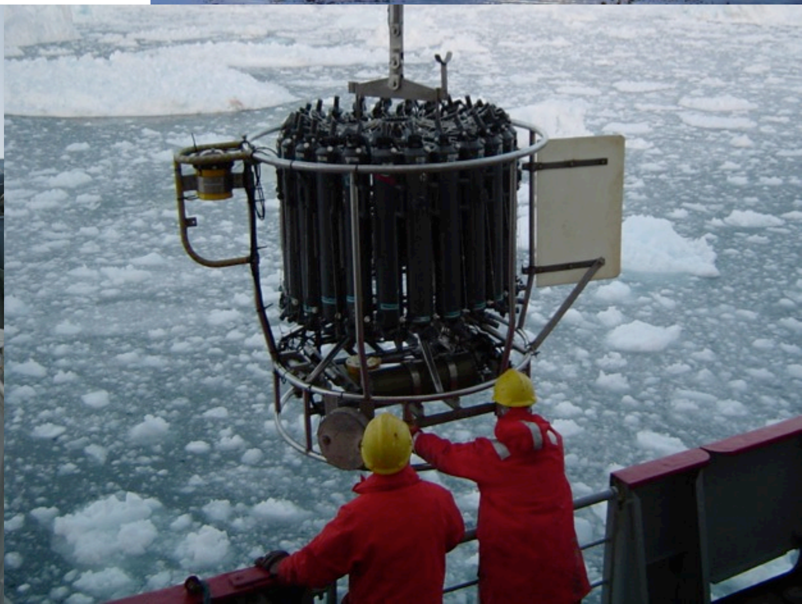
Ocean2ice – campaign in the Amundsen Sea Embayment, Jan-Mar 2014
Observations planned if sea ice permits

- *red & blue sections = ship-based CTDO2/LADCP, microstructure, MVP.*
- *Red crosses = planned moorings (actually further west)*
- *Orange lines = Autosub3 contingency.*
- *Green = potential Seaglider surveys.*



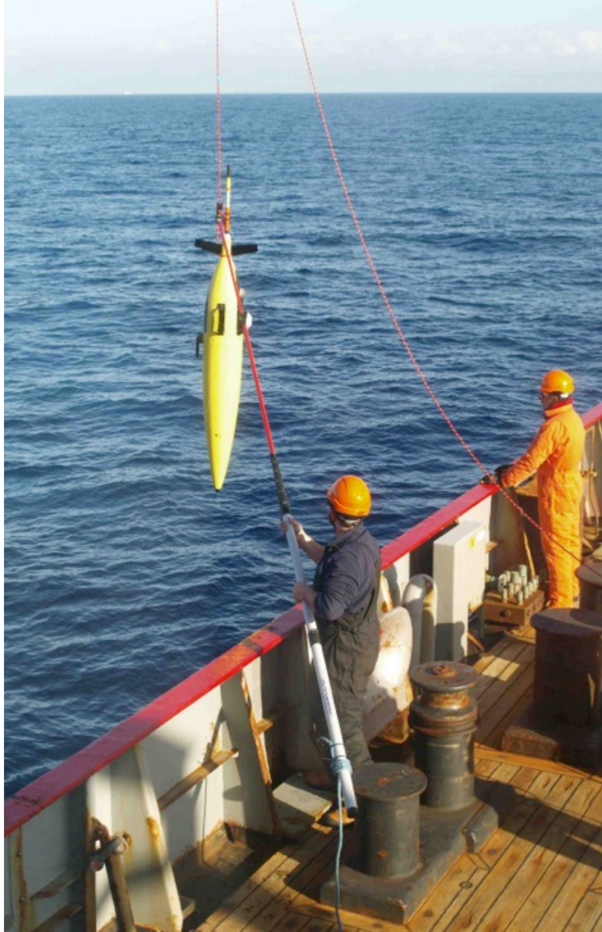
Ocean2ice
Ship-based measurements

- Measure T, S, O2, v, microstructure, noble gases, atmospheric profiles
- Hydrographic stations and underway measurements
- Deployment of Seagliders



Ocean2ice
Seal tags and Seagliders

- Measure T, S profiles
- In place over the winter
- Elephant and Weddell seals



- Measure T, S, O2, v
- www.ueaglider.uea.ac.uk