



**National Oceanography  
Centre, Southampton**

UNIVERSITY OF SOUTHAMPTON AND  
NATURAL ENVIRONMENT RESEARCH COUNCIL

# **Autosub Operations in the Arctic and Antarctic**

**Steve McPhail, National Oceanography Centre, Southampton UK**

- **First Under-Ice Operations - 2001**
- **Current Vehicle configuration and capabilities**
- **Highlights Autosub Under Ice**

*Funded by the Natural Environment Research Council (UK)*

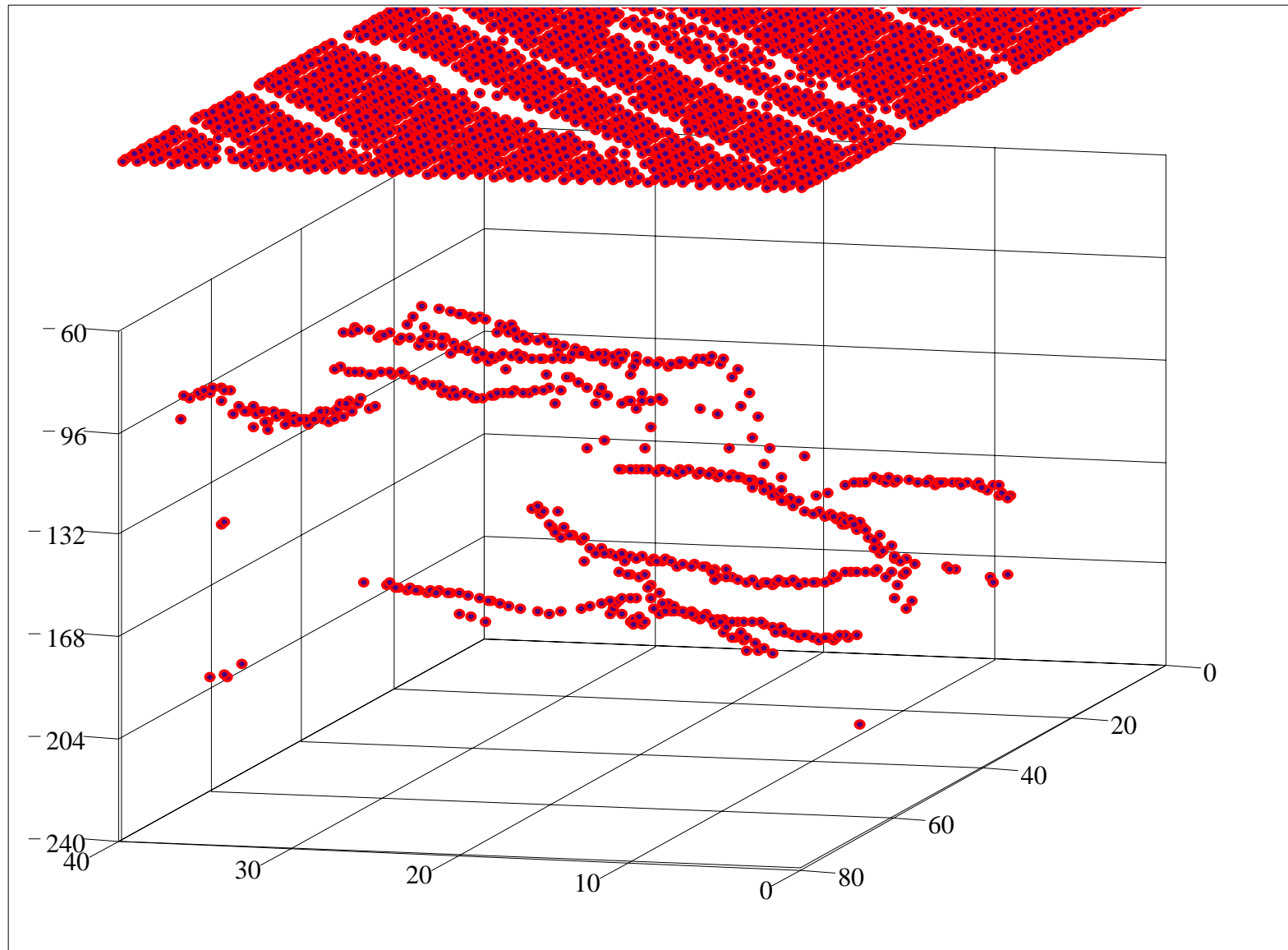


**February 2001. RRS James Clark Ross. Measurement of Krill Populations under sea ice, sea ice thickness and ice berg draught**

**Do you think we can get under it this time ??**



# Autosub Iceberg Transect. Depths of Iceberg lower surface.



Z

Rotation of 105 deg. Tilt 30 deg.

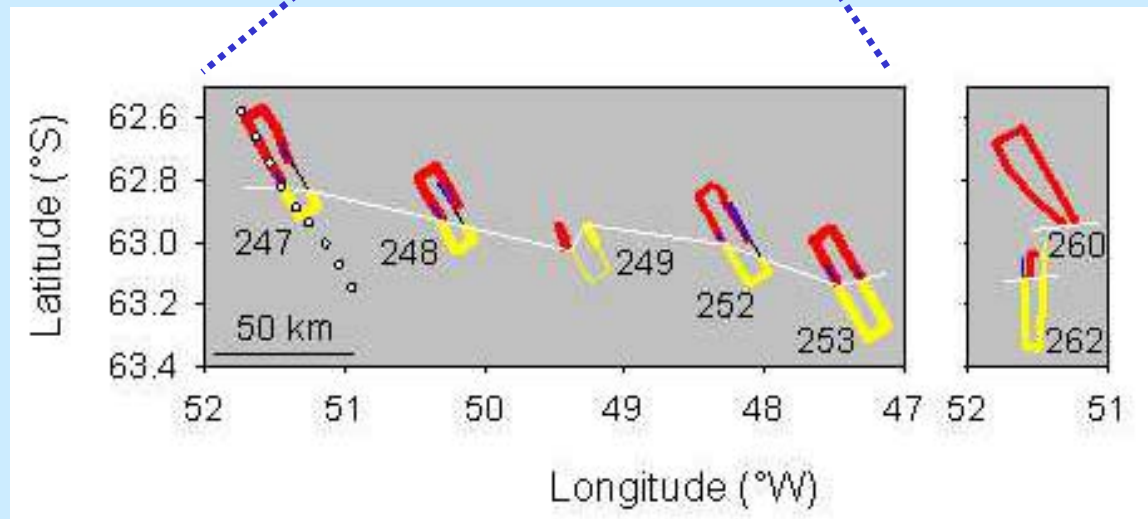
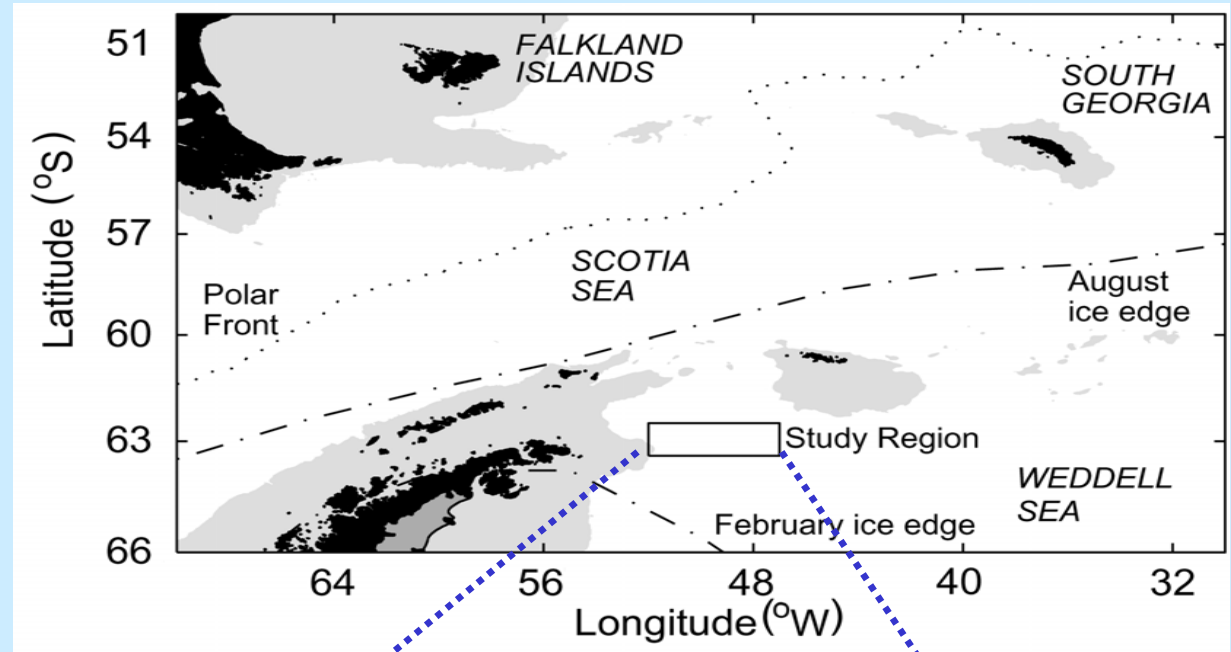
**No one could be that unlucky .. Could we ???**





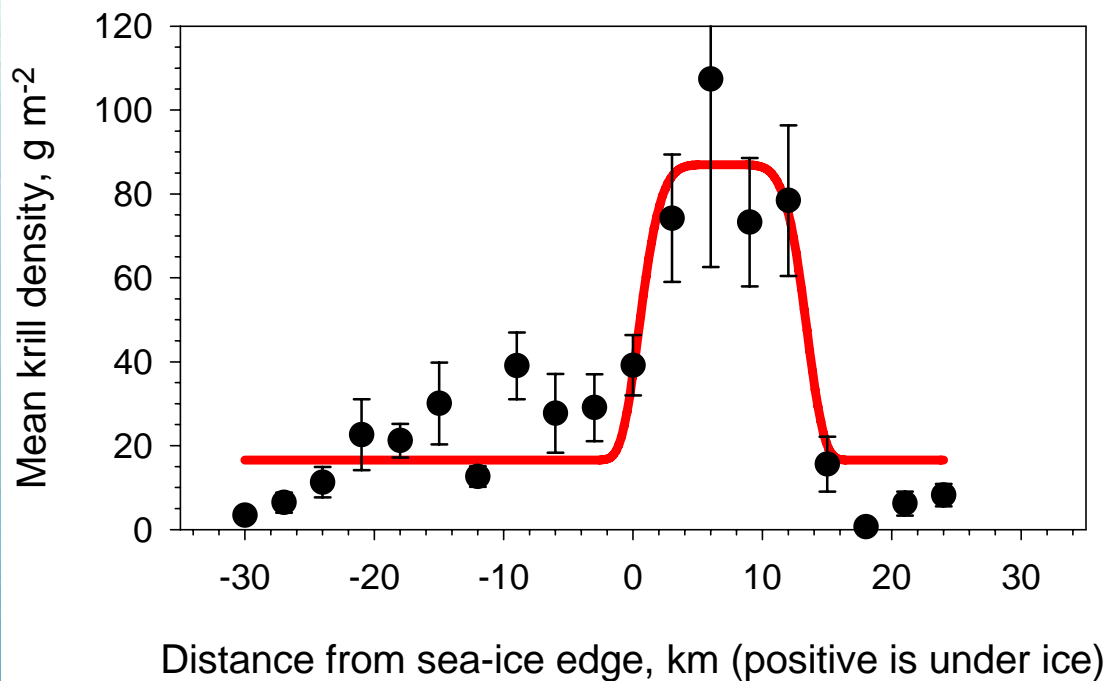


February 2001. Measurement of Krill population density underneath Sea Ice.



# Increased Krill population density underneath Sea Ice.

EK500: 120 kHz/ 45 kHz sonar.

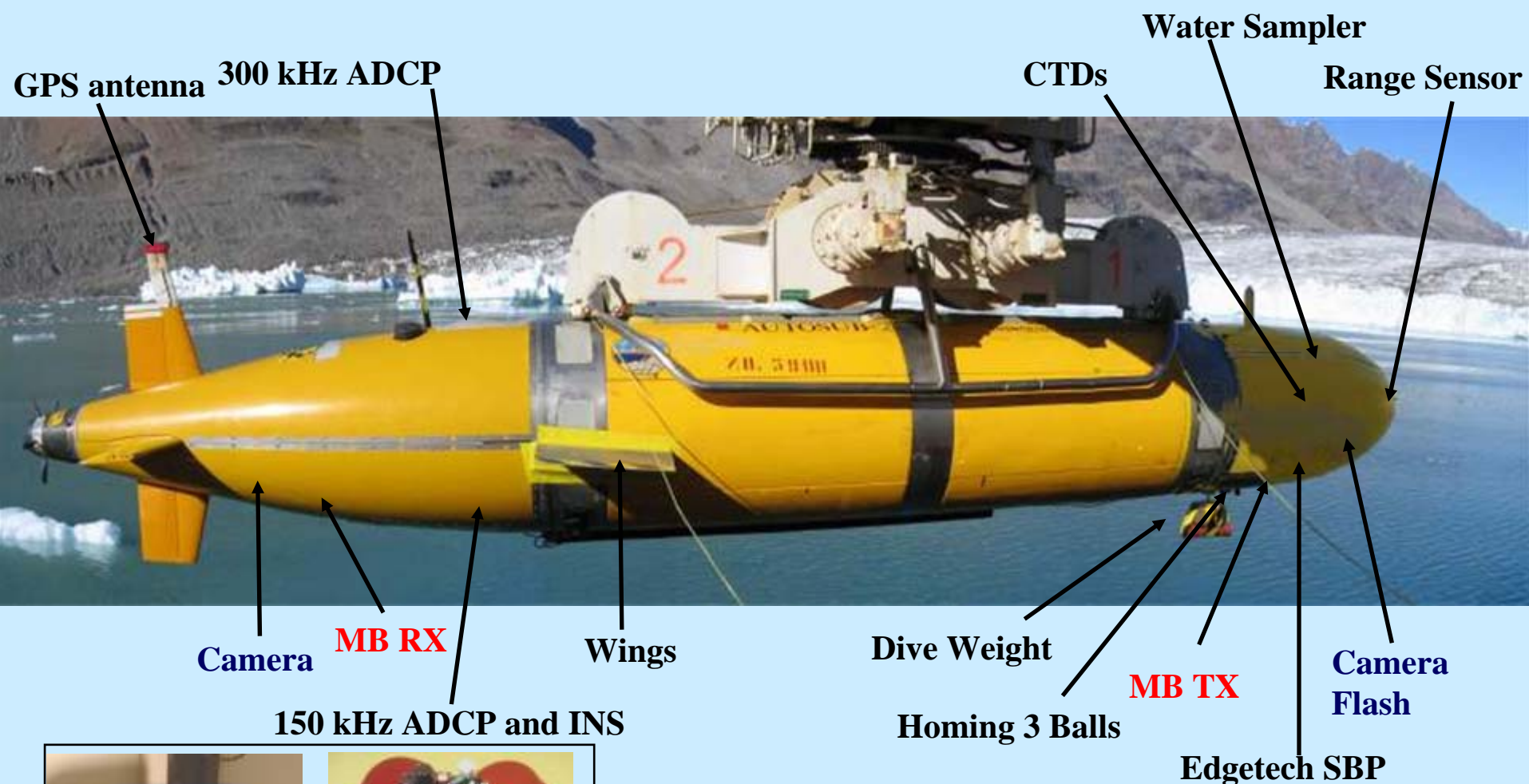


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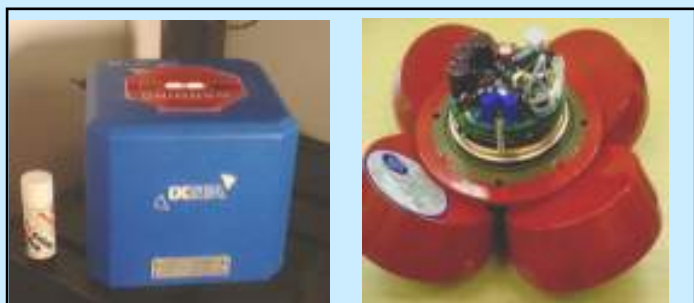
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# Autosub Configuration (recent)



150 kHz ADCP and INS

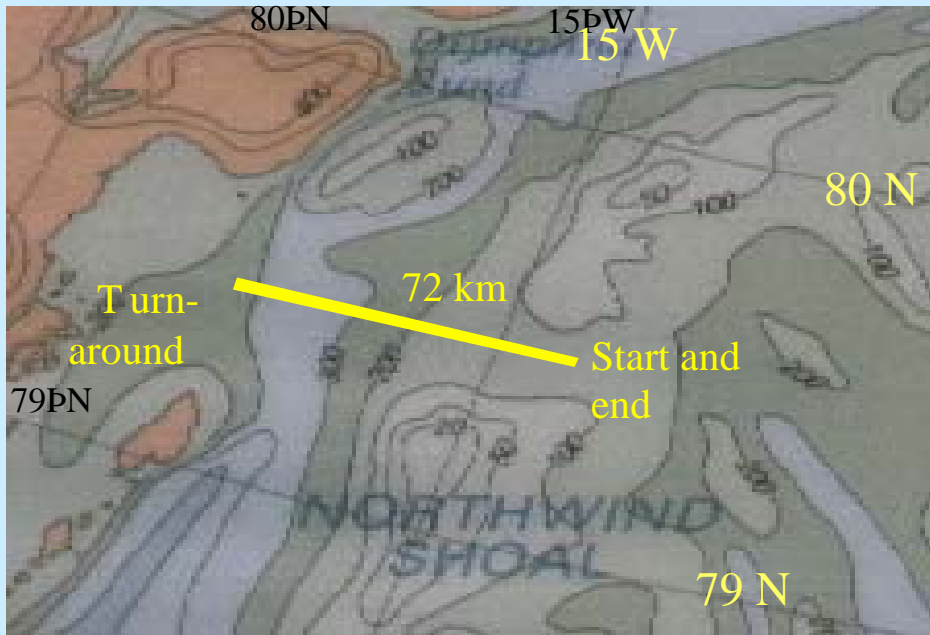


7m long, 3600 kg  
60 hour (400 km) endurance  
1600 m depth limit  
0.1% Navigation Accuracy

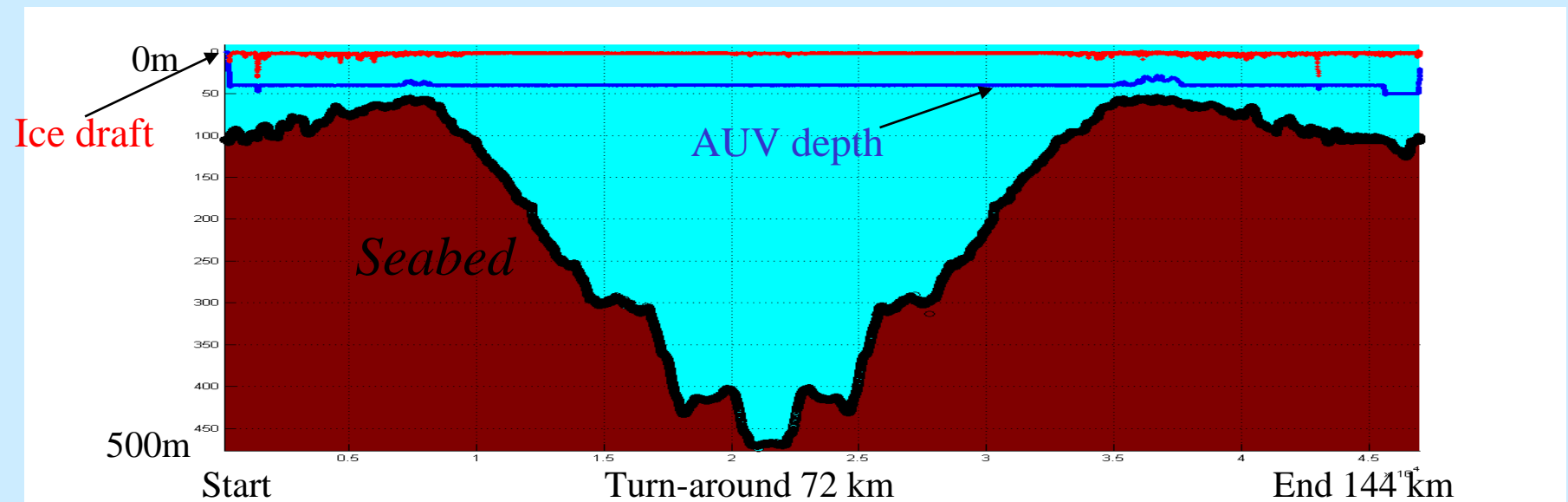




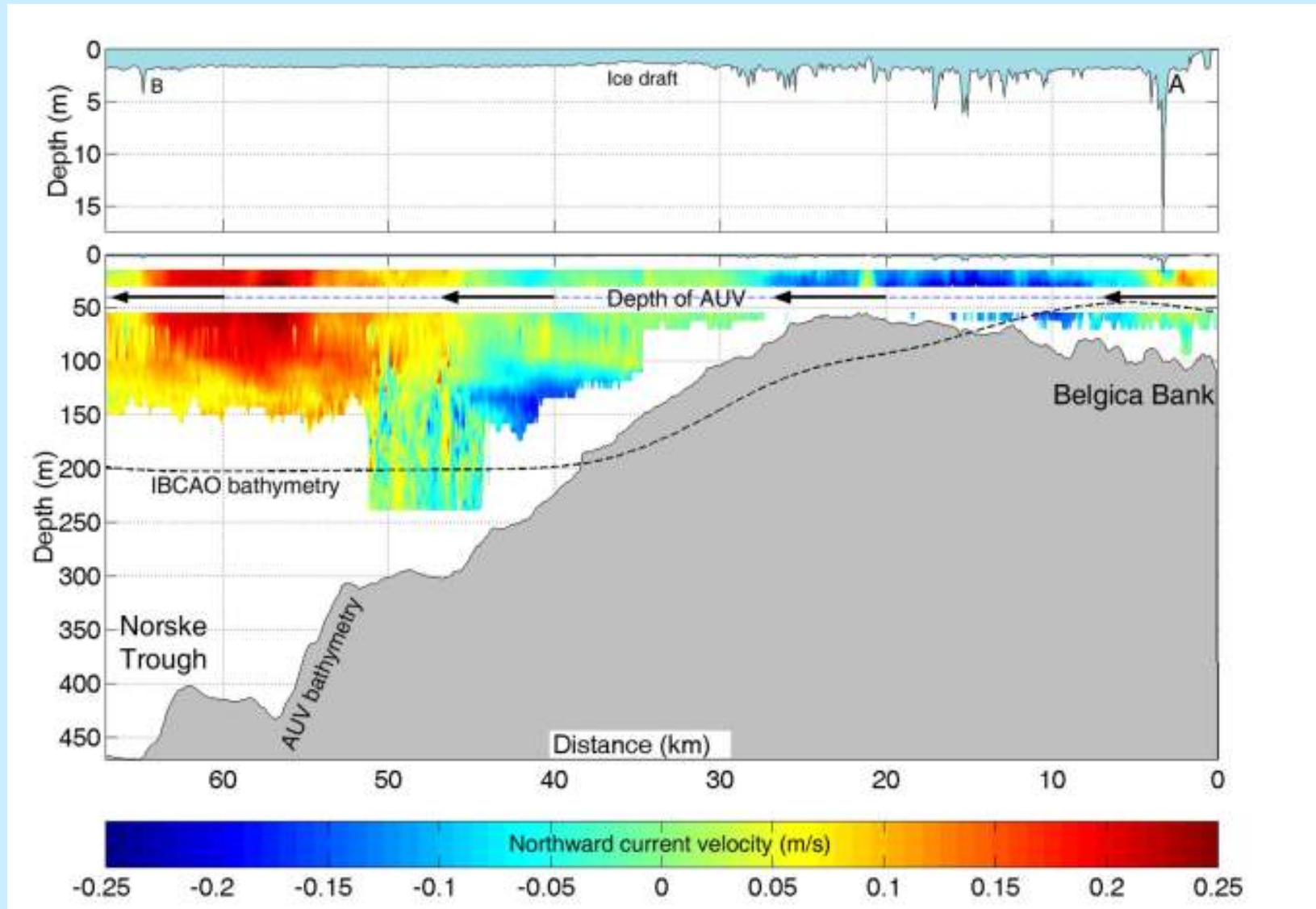
# NE Greenland 2004. Study of Fast Ice thickness (PI Prof. Peter Wadhams)



Map Source: N Z Cherkis and P R Vogt, NRL, 1994



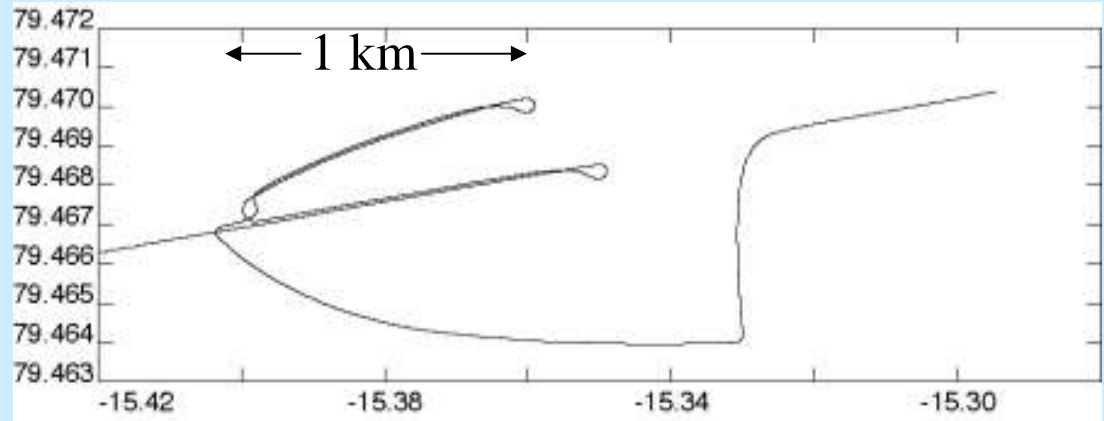
# NE Greenland 2004.



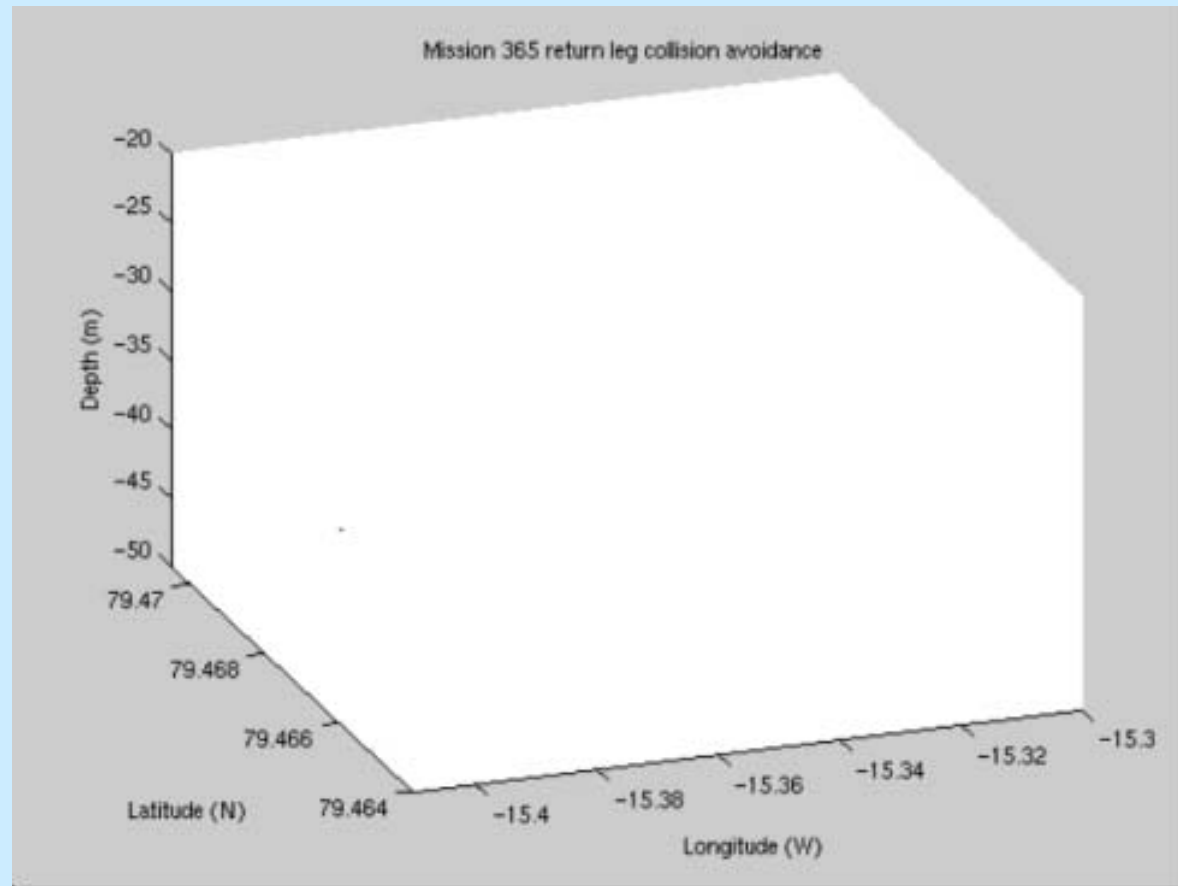
*Figure courtesy of Peter Wadhams DAMTP, Cambridge and Jeremy Wilkinson SAMS UK.  
Submitted to Geophysical Research Letters*

# M365 collision avoidance - a 3 D strategy

❑ Autosub turns around and repeatedly tries again at a “safer” altitude...and random heading offsets



❑ It took 3 attempts



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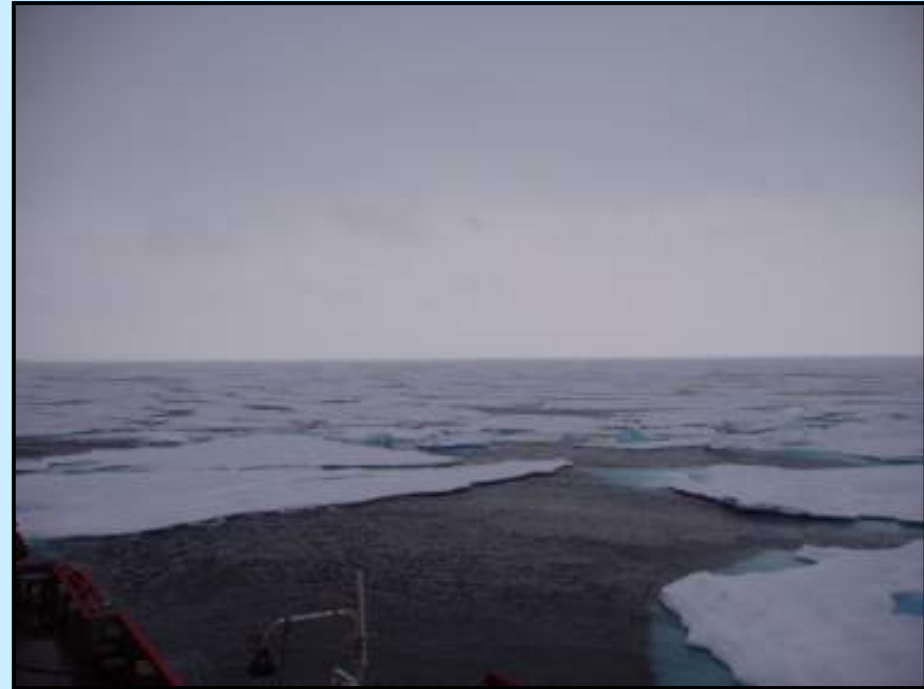
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# Mission 365: Recovery - Its troubles weren't over yet!

Change in conditions over 24 hour period



Start of Mission 365



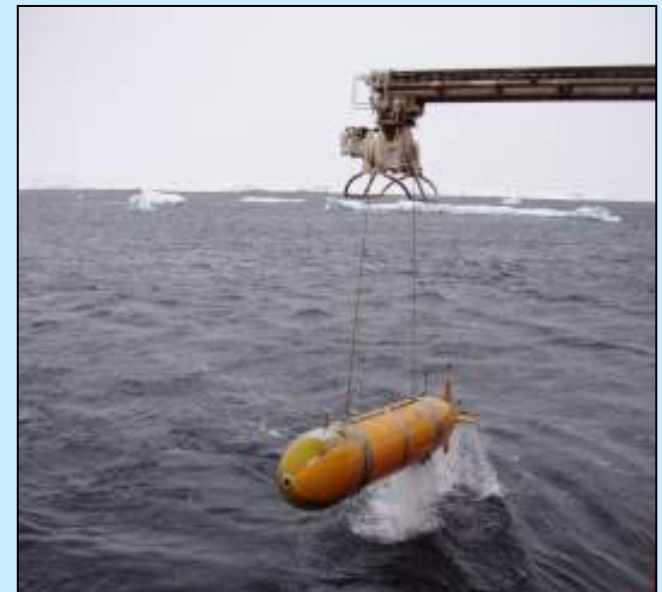
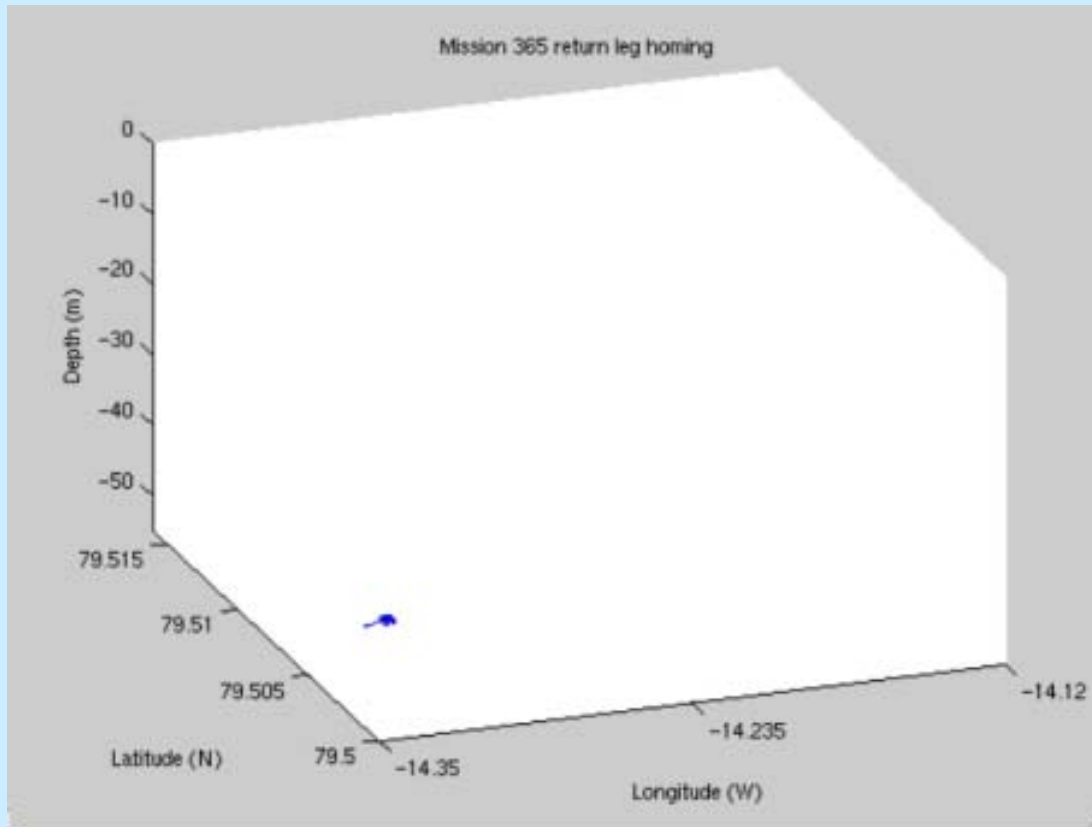
End of Mission 365



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# Mission 365: Recovery: Shepherding Autosub to safety

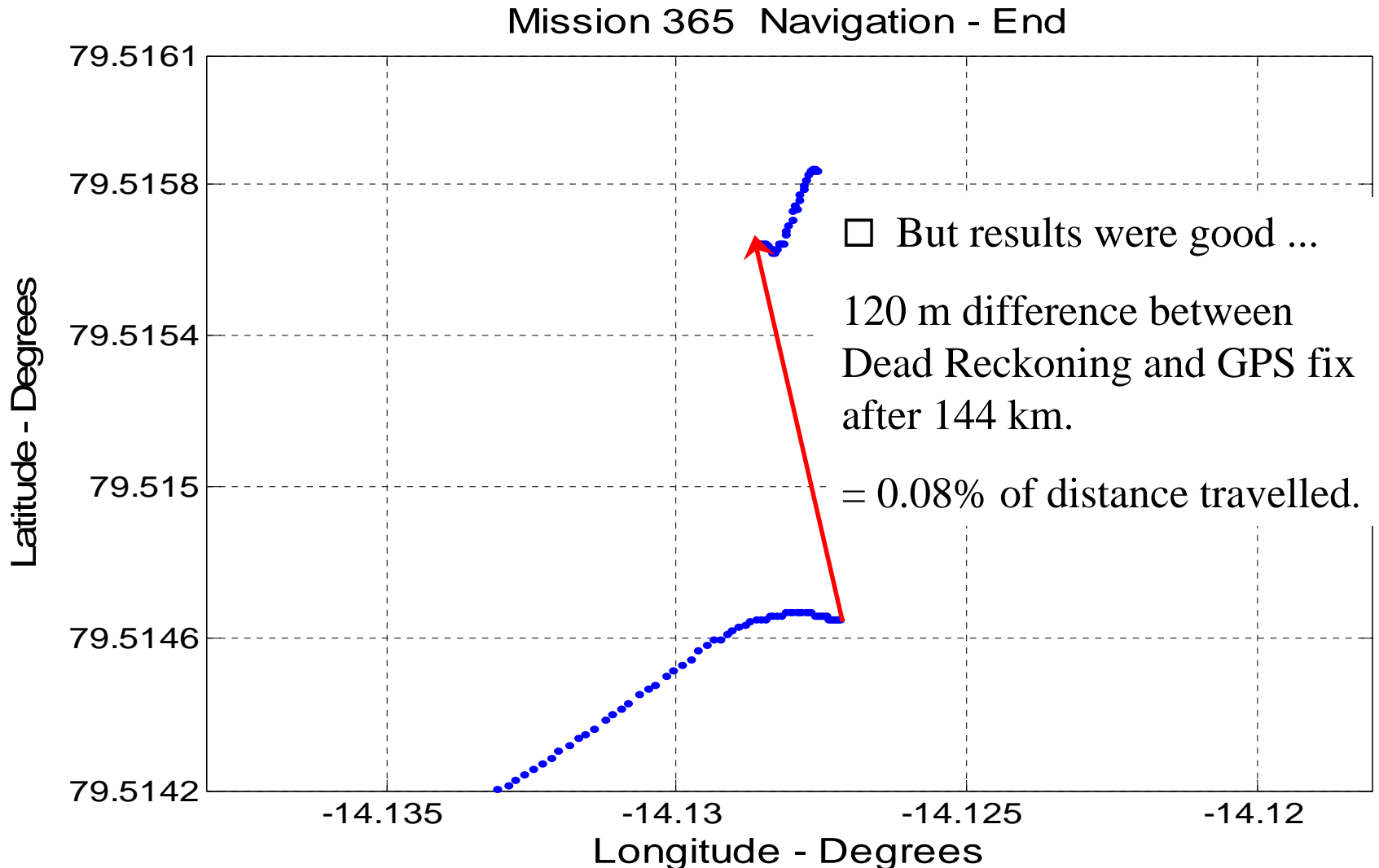


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# Navigation Performance for Arctic Missions

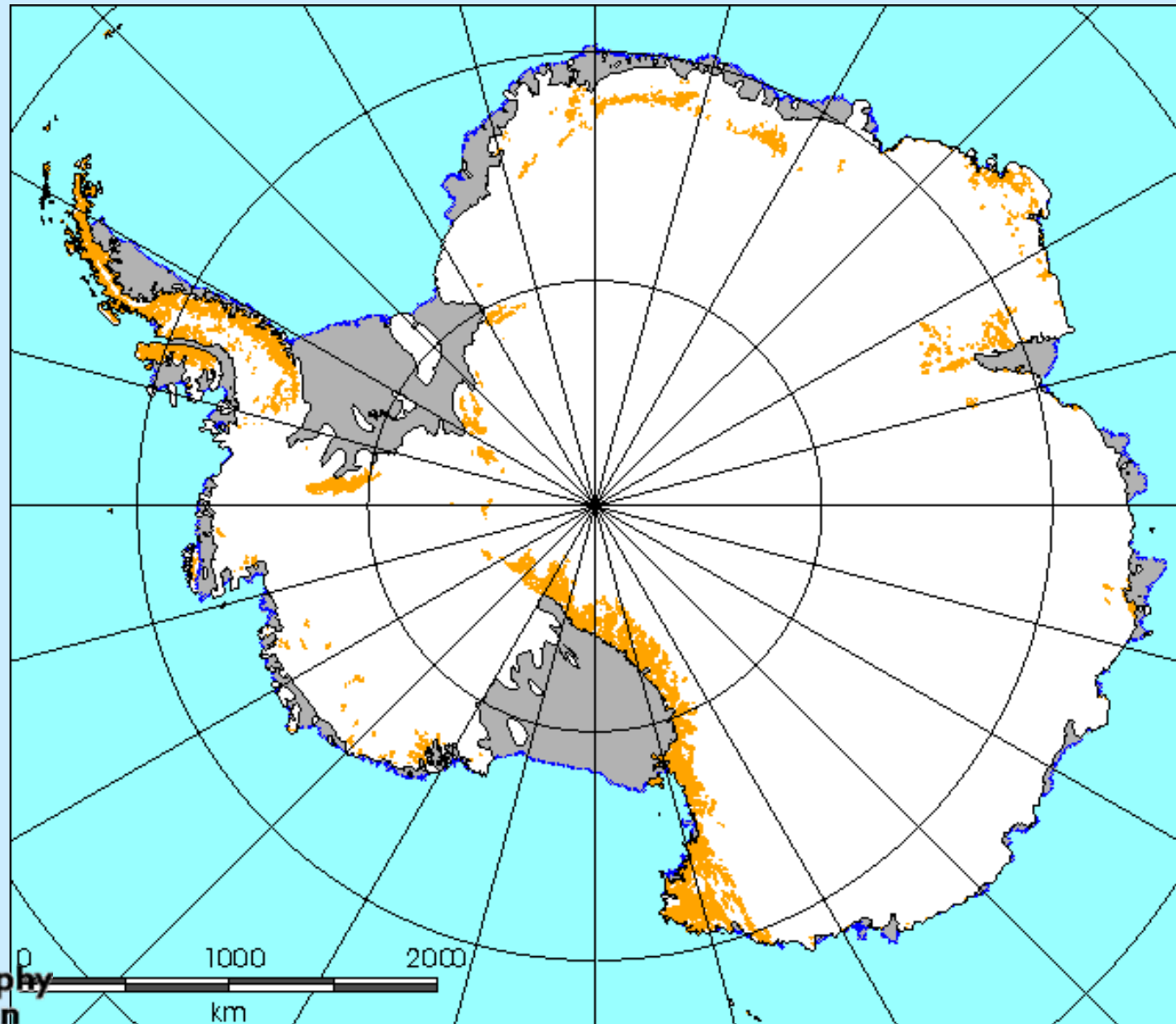
- Pre-cruise there were concerns about the performance of the INS at such a high latitude (80 N)



# The Antarctic Campaign of February 2005

(PI : Dr Keith Nichols BAS)

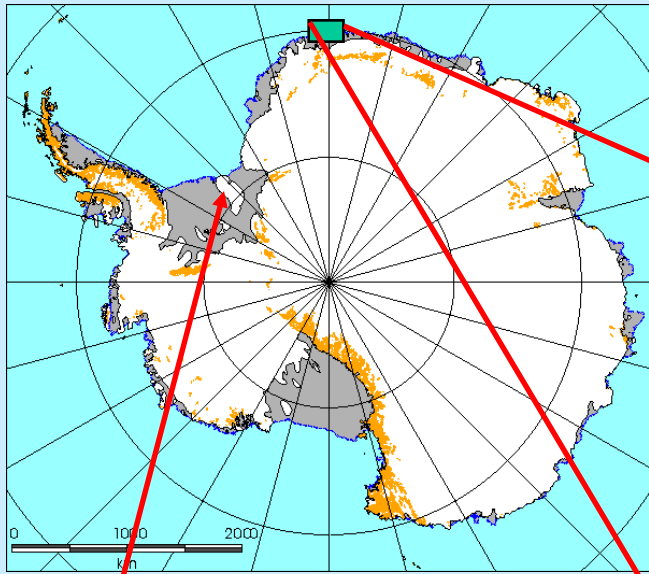
□ Investigation of the Oceanography, Physics, Morphology and Biology under an Antarctic ice shelf



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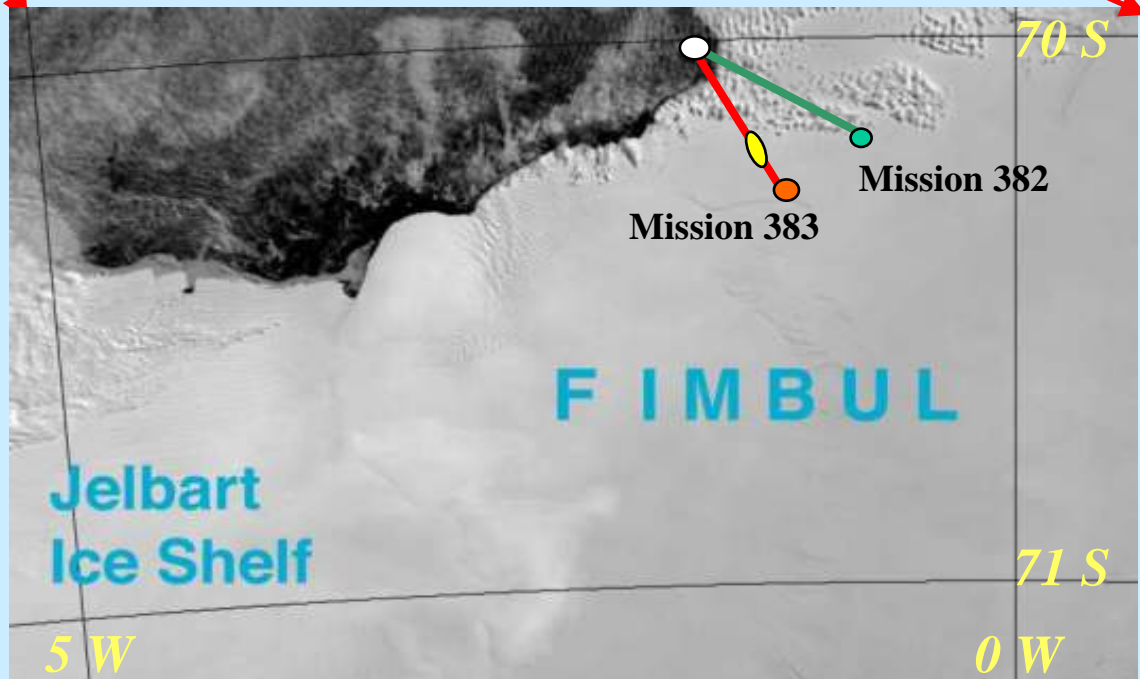
# Location of Autosub Missions 382 / 383



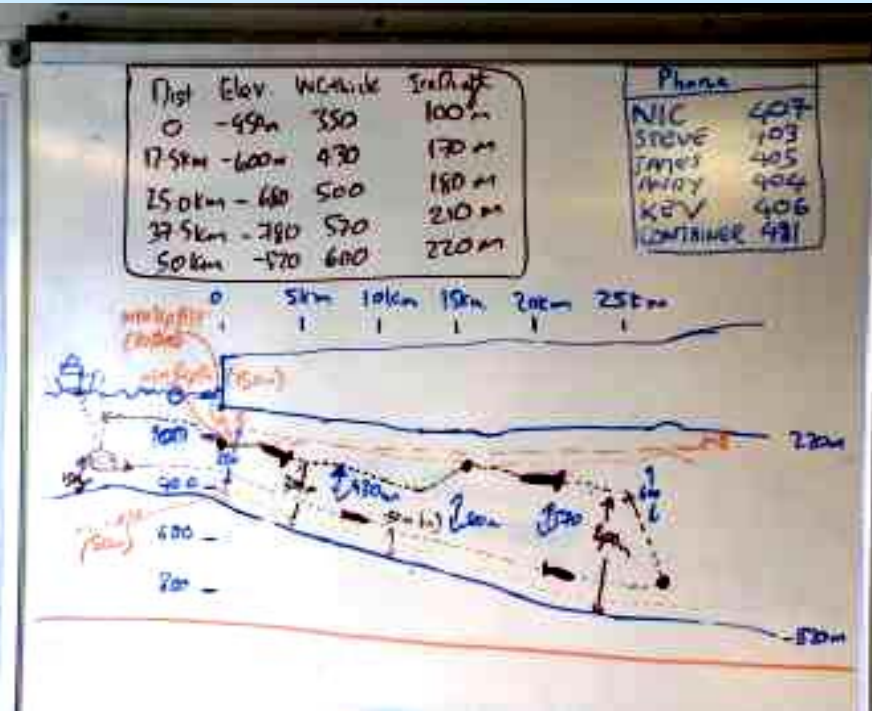
2nd Choice - the Fimbul ice-shelf.

The primary targets were the Ronne or Filchner ice-shelves.

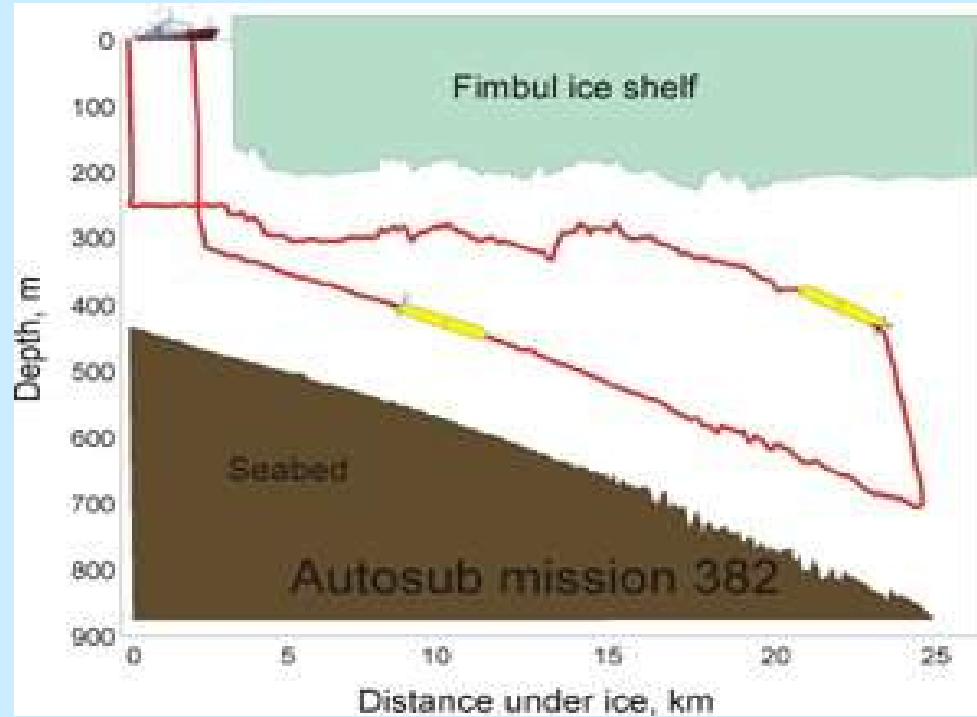
But these were inaccessible...



# Autosub mission 382. 25 km Under the Fimbul Ice shelf



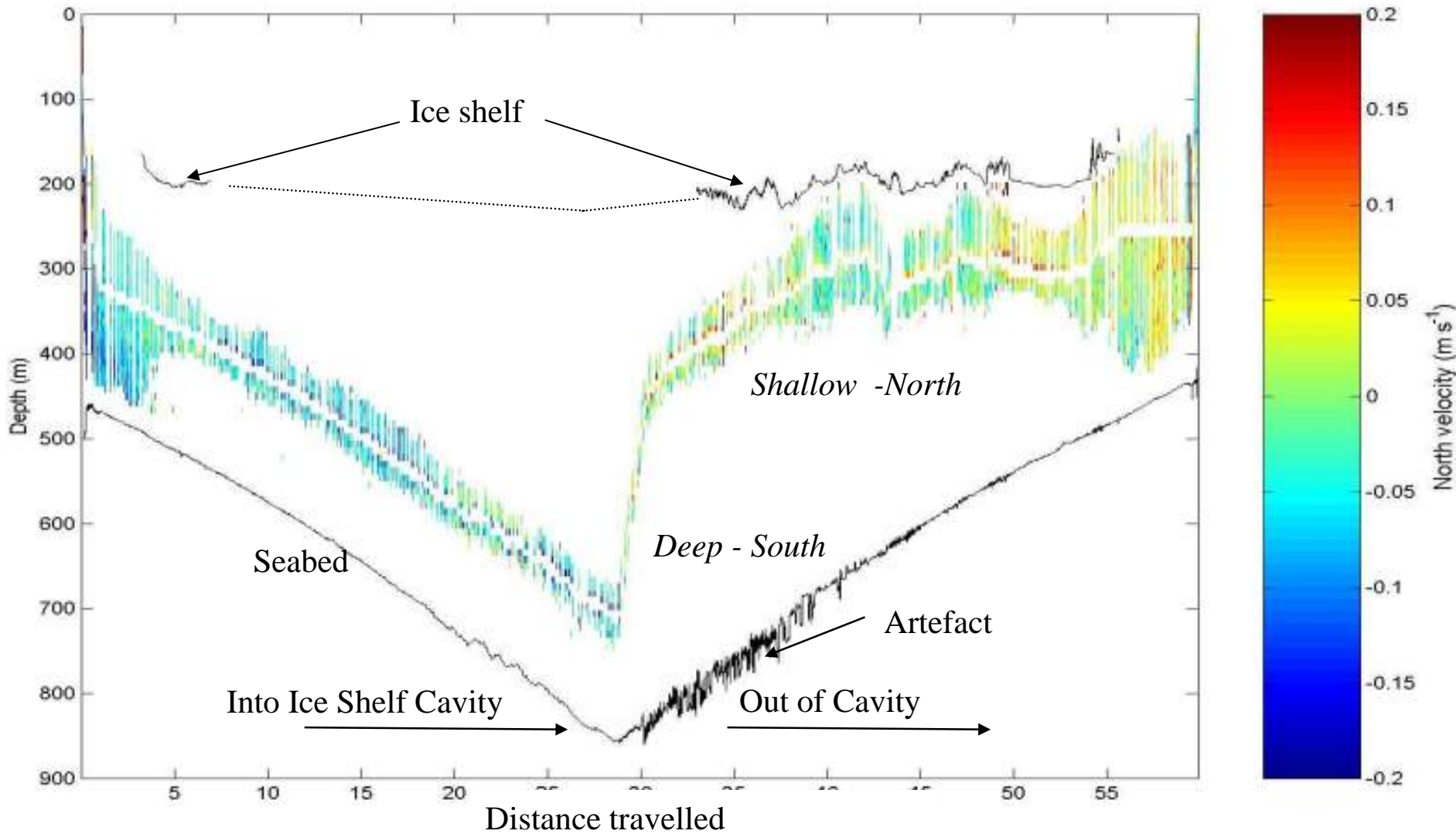
*The plan*



*What it actually did*



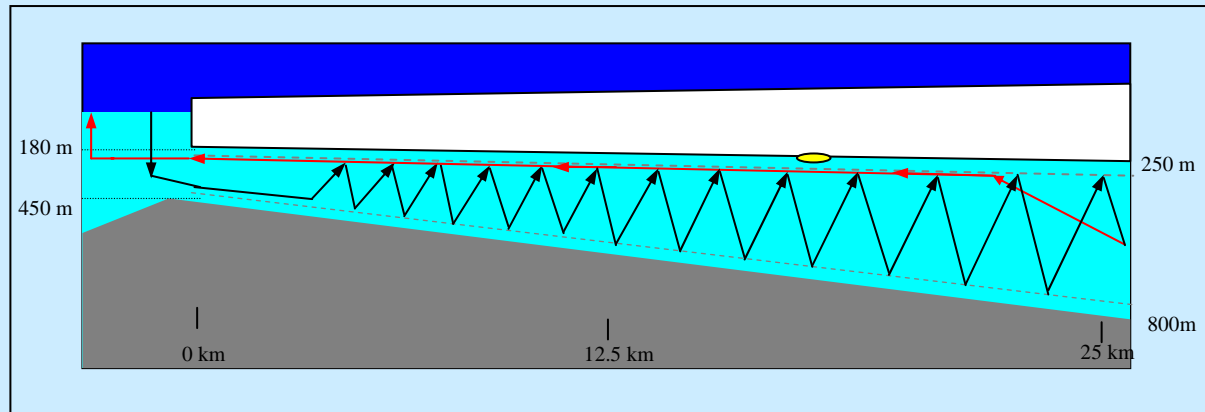
# M382 ADCP velocities - North component



Data courtesy of Keith Nichols and Povl Abrahamson (British Antarctic Survey).  
Kate Stansfield (National Oceanography Centre, Southampton, UK)

# Mission 383

- Mission plan was similar to M382
- Main Difference was profiling mode

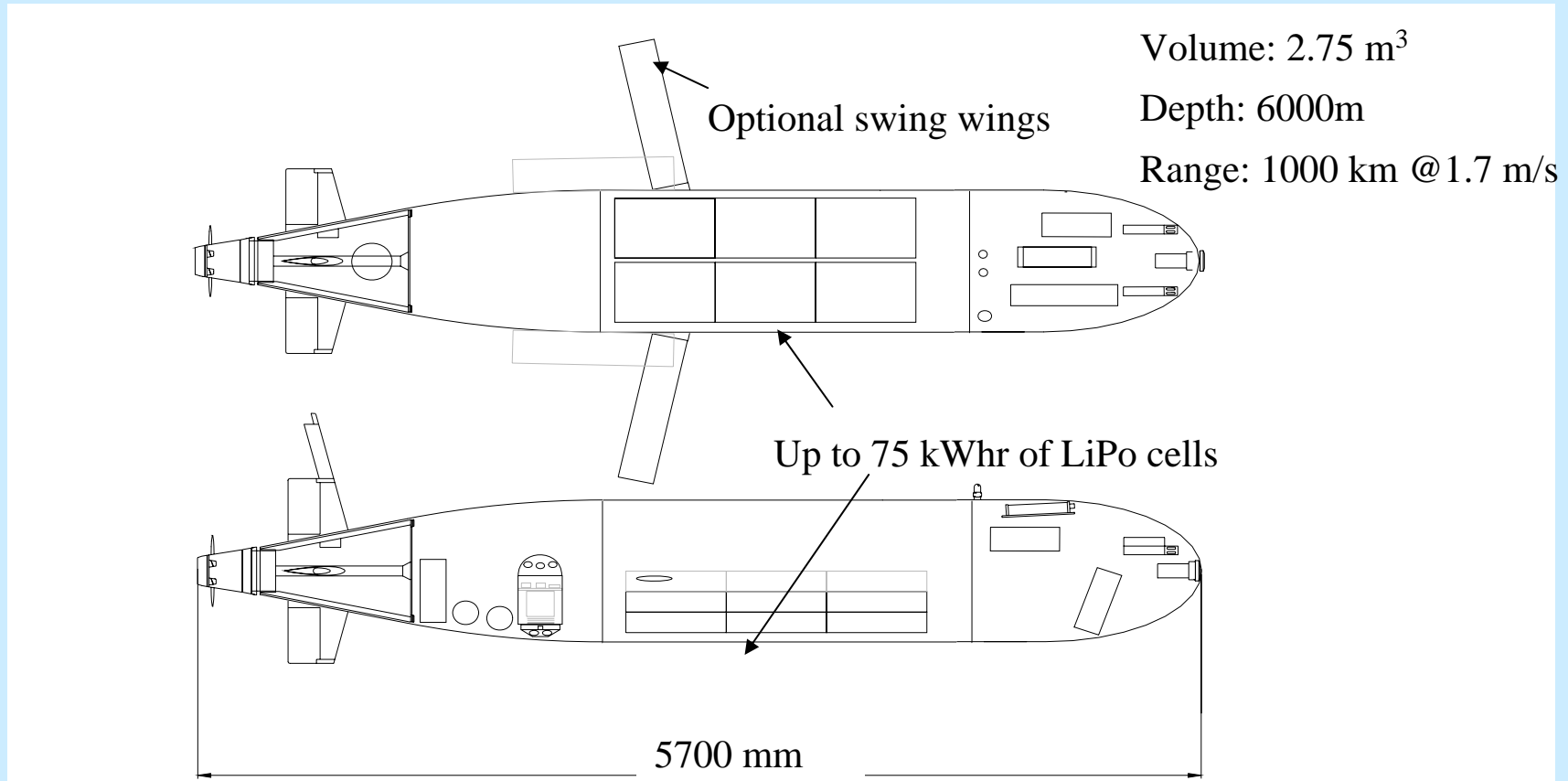


- 6 hours we heard the emergency beacon transmission - It was stuck!
- Emergency beacon transmission (4.5 kHz) coming in clearly at 25 km range suggests that Autosub is floating (due to presence of good acoustic path)



# Next generation

- Autosub6000 is scheduled for trials in 2007



# Upward looking swath data from Mission 365

Shows benefit of multibeam and long track to build up quality statistics on ice thickness

Red trace is PDF ice thickness for track shown.

Black for whole of the track

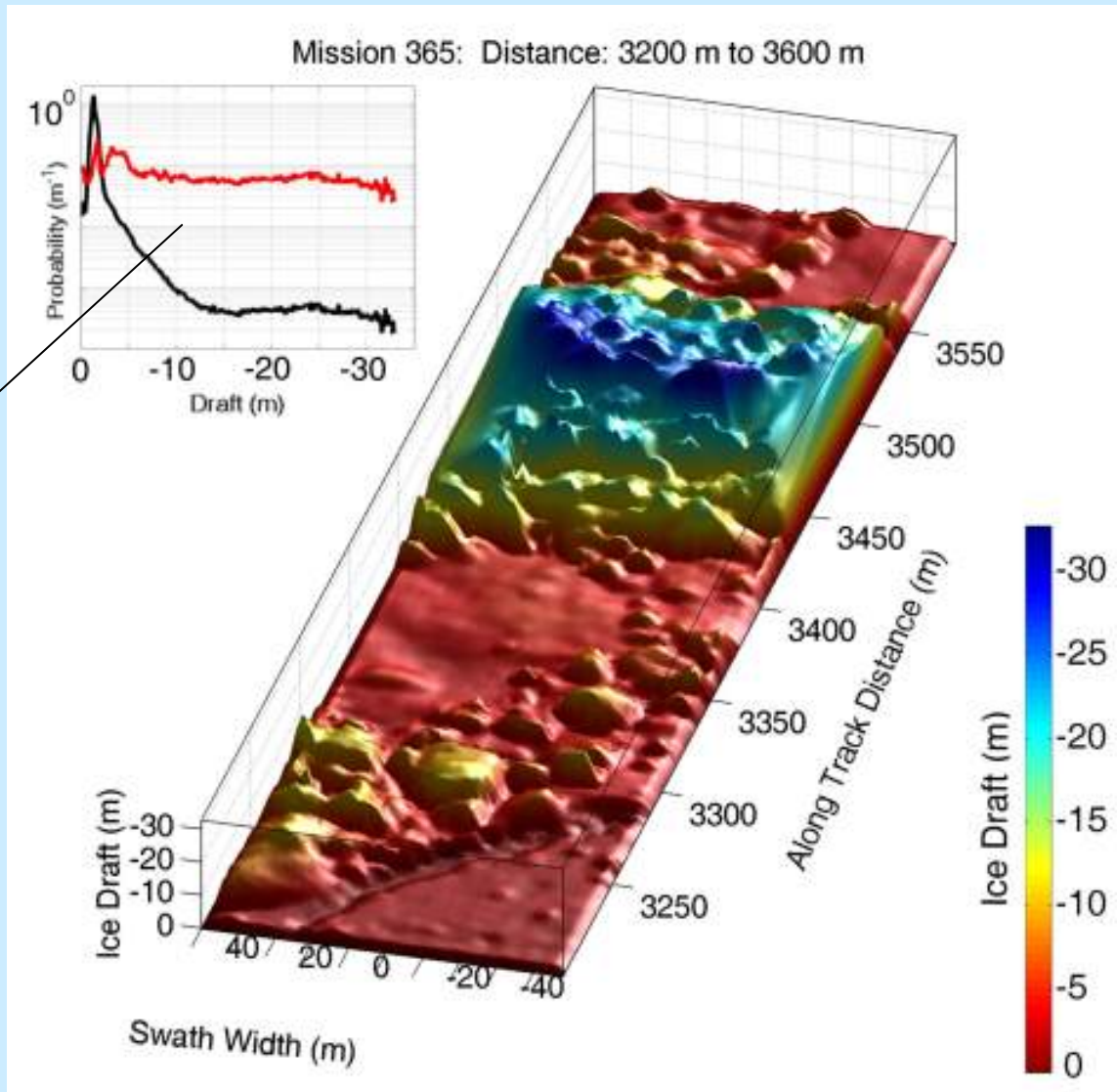


Figure courtesy of Peter Wadhams DAMTP, Cambridge and Jeremy Wilkinson SAMS UK. Submitted to Geophysical Research Letters



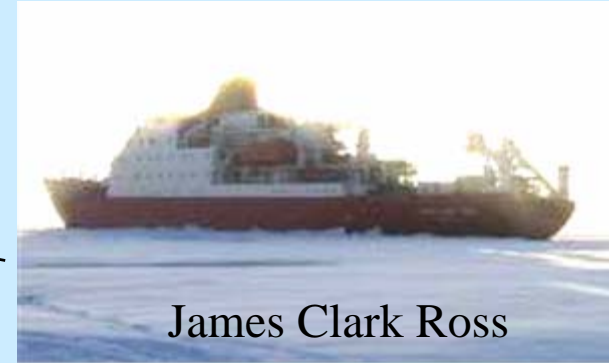
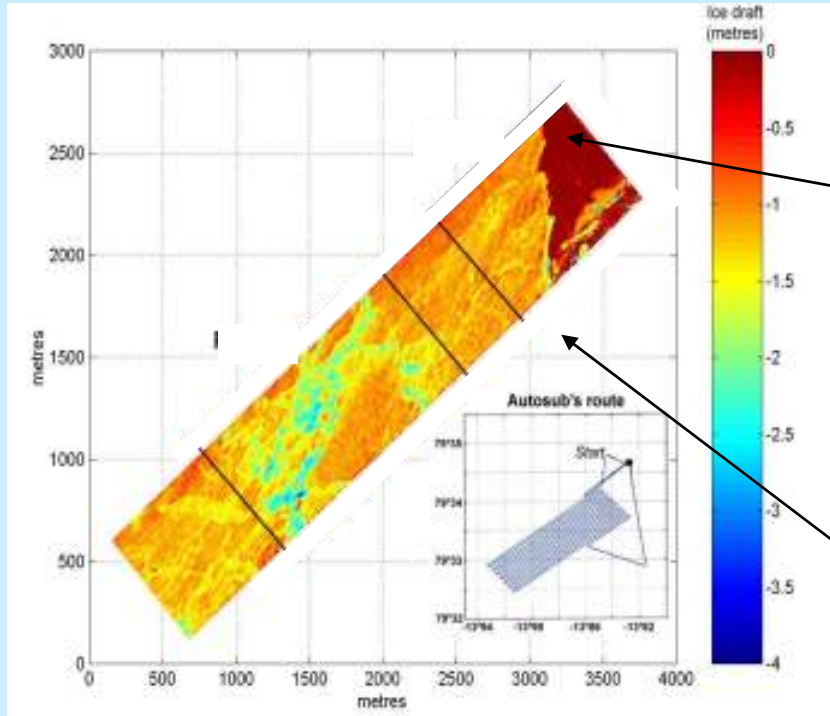
# NE Greenland fast lawn mower ice survey. August 2004

Autosub 'lawnmower' surveys the underside of land fast ice using upward looking EM2000 multibeam sonar.

With simultaneous operations on ice and from the air.



Simultaneous "Helio" EM sounder of ice thickness



James Clark Ross



Polar Stern

*Data Courtesy of Professor Peter Wadhams (DAMTP, Cambridge).*

*Dr Jeremy Wilkinson and Arthur Kaletzky (Scottish Association for Marine Science).*



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## Ice drilling - ground truthing





# And on a different scale ...

M377

Altitude 10.4 m

Depth 570 m

N 68.02642, W 31.80570

H,P,R 37.99,0.59,-2.25

1.6m



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