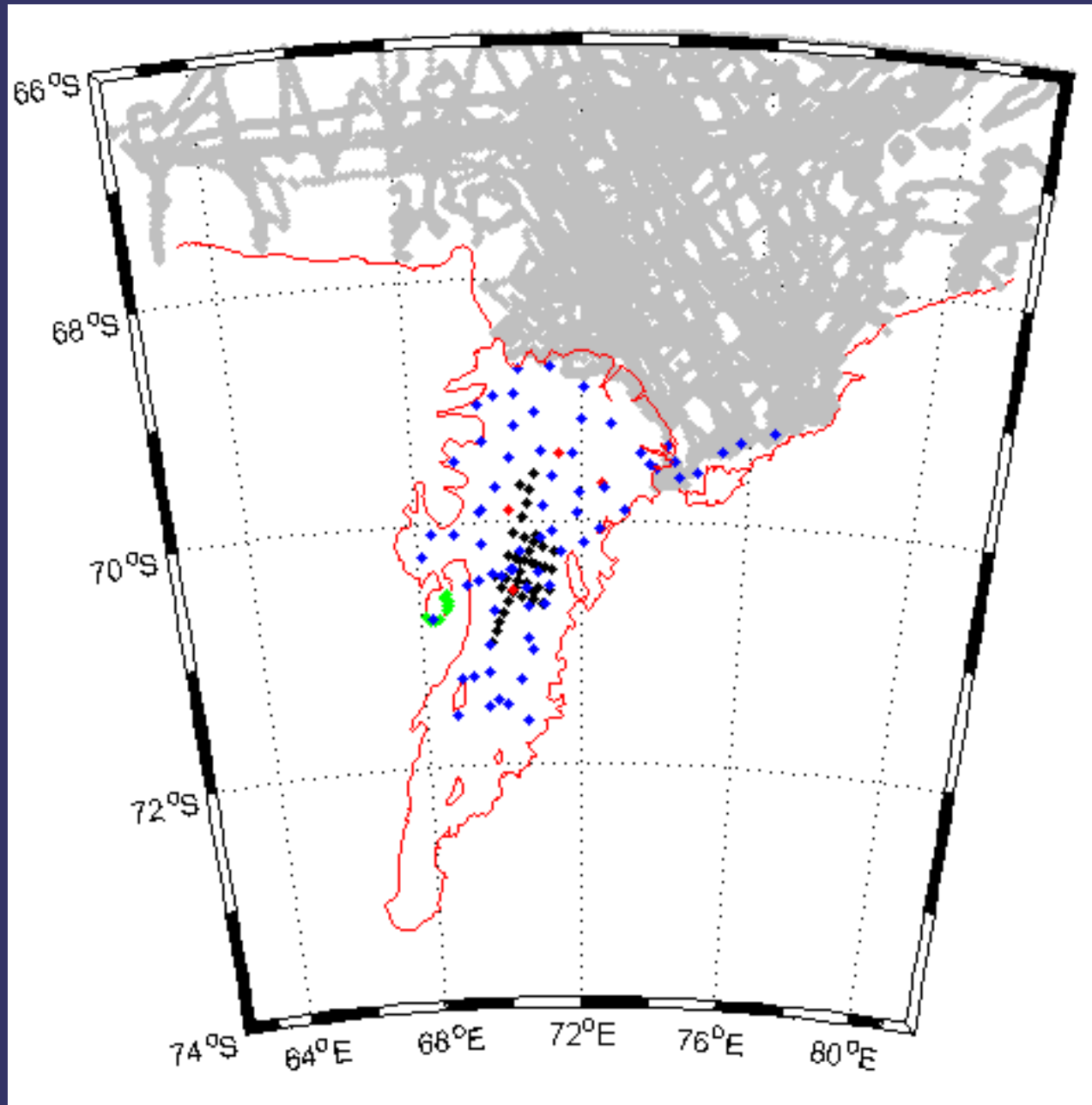


Bathymetry- tides

Ben Galton-Fenzi

Acknowledgments: Ian Allison, Richard Coleman, Mike Craven, Helen Fricker, Mark Hemer, John Hunter, Rachael Hurd, Benoit Legresey, Claire Maraldi, Andrew Meijers, Kath McMahan, Laurie Padman, Joel Pedro, David Rasch, Hugh Tassell & Neal Young

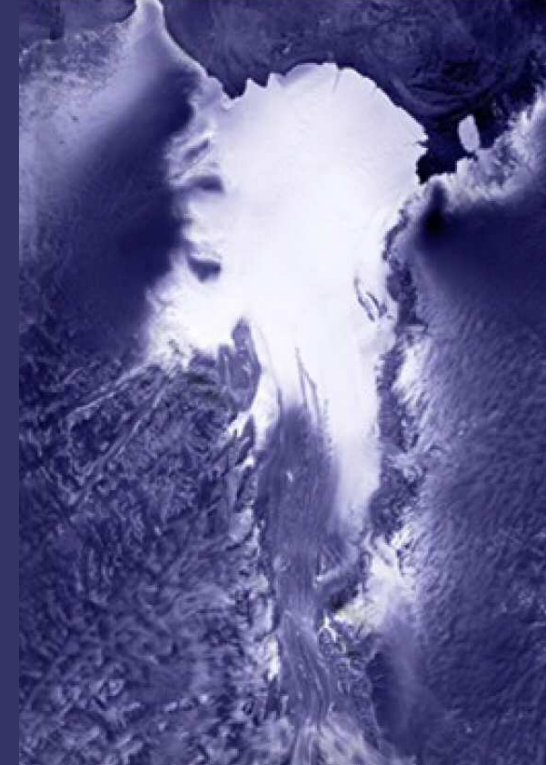
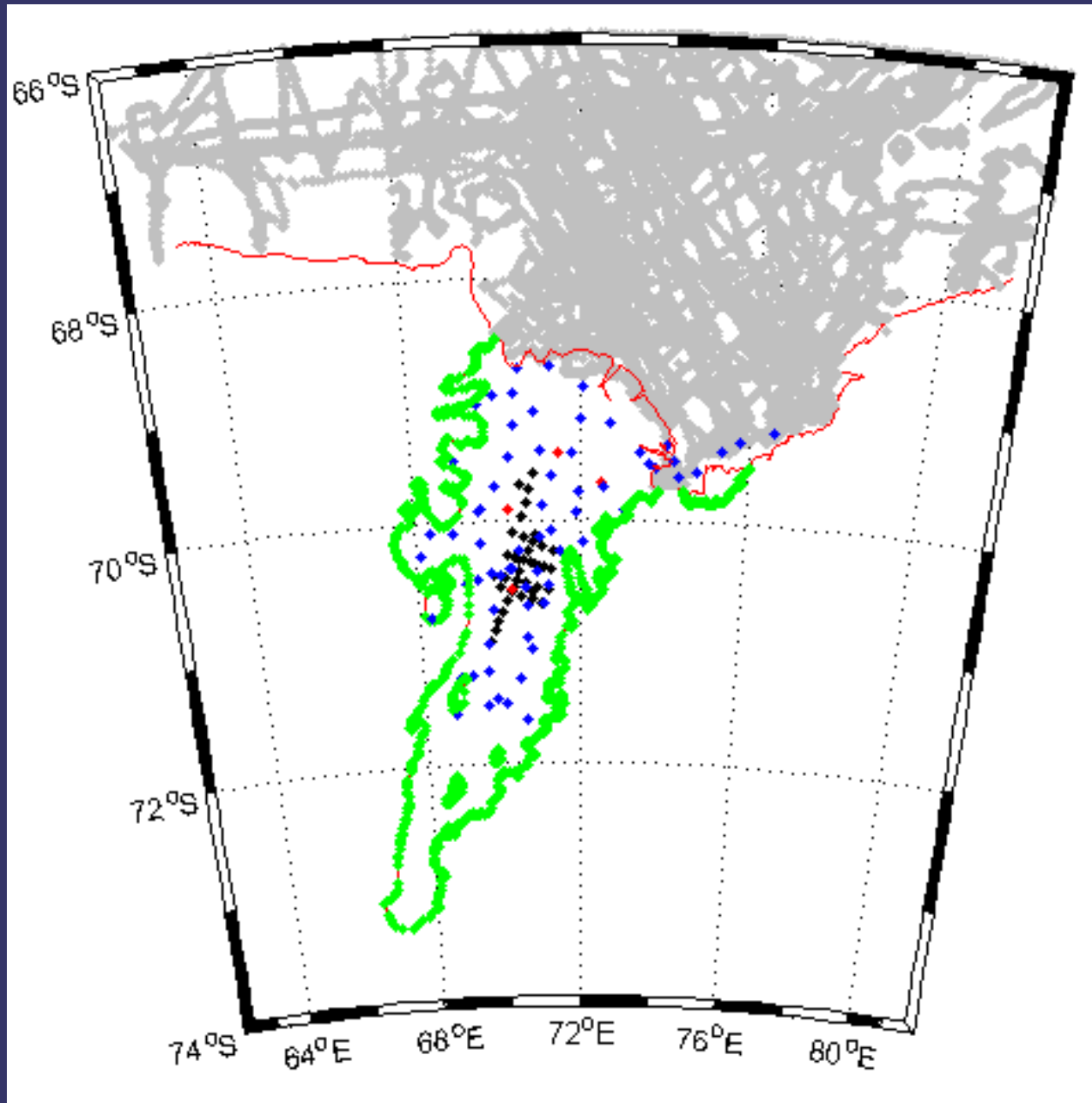
Bathymetry



Data

- **Seismics (Ruddell)**
- **Seismics (Tassell, McMahon etal)**
- **GEBCO & Ship tracks (AADC)**
- **Borehole (AMISOR)**
- **Beaver Lake (Baudin)**

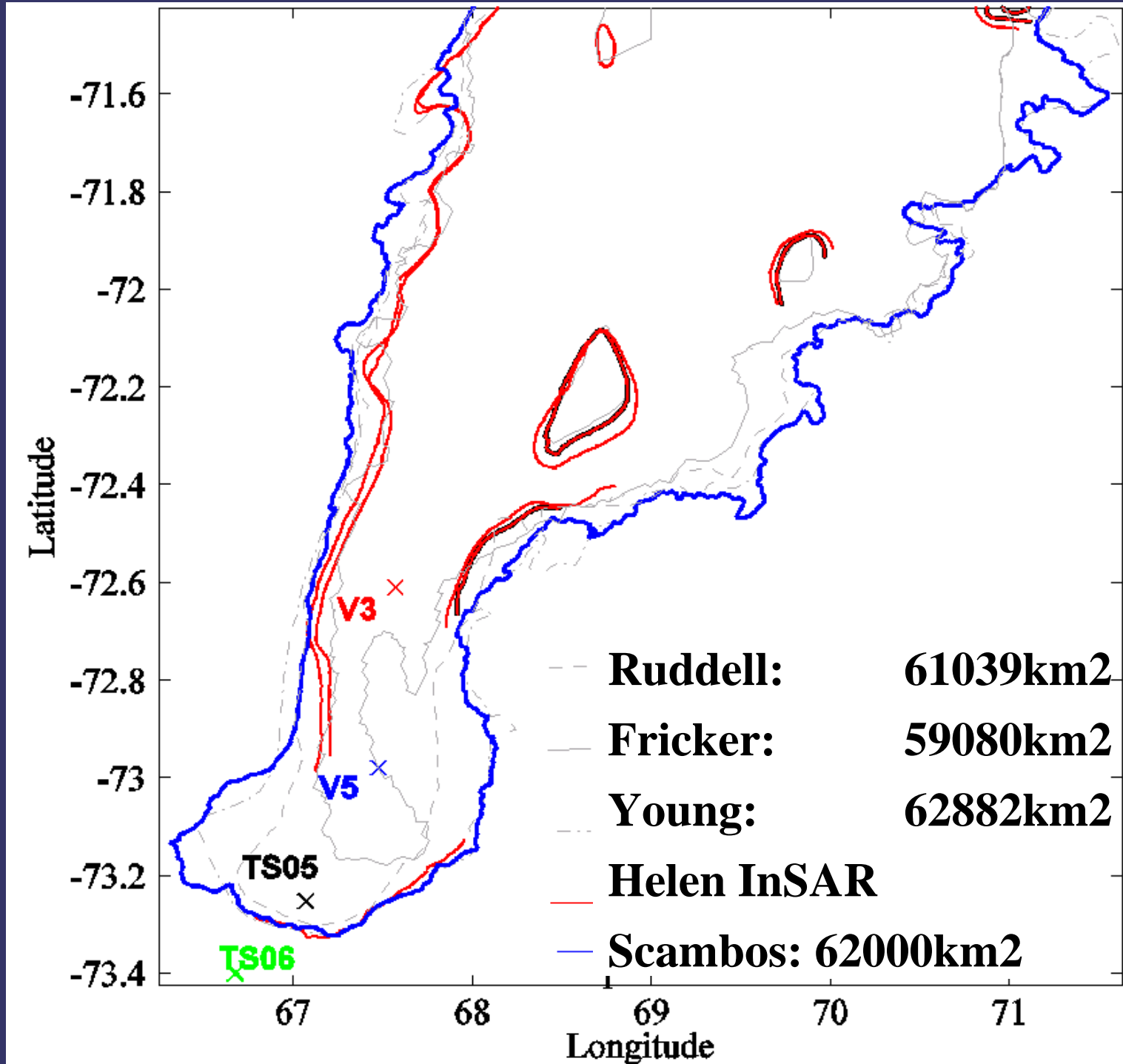
Bathymetry



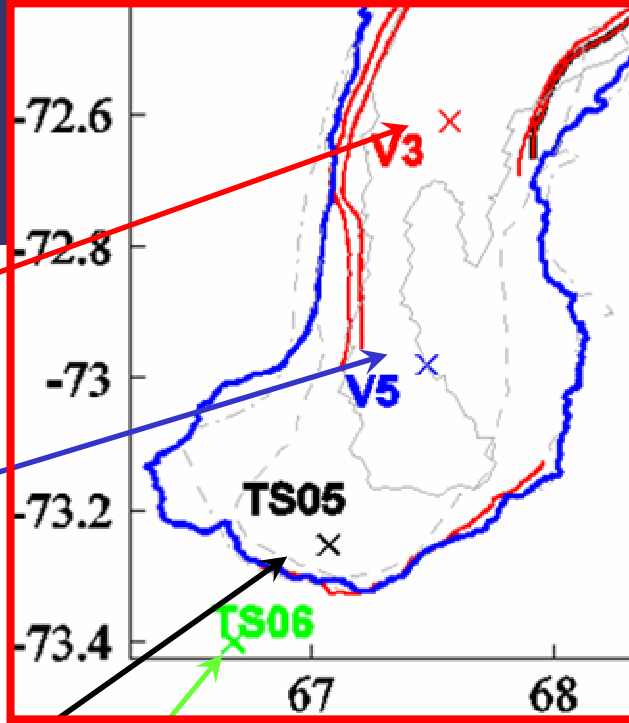
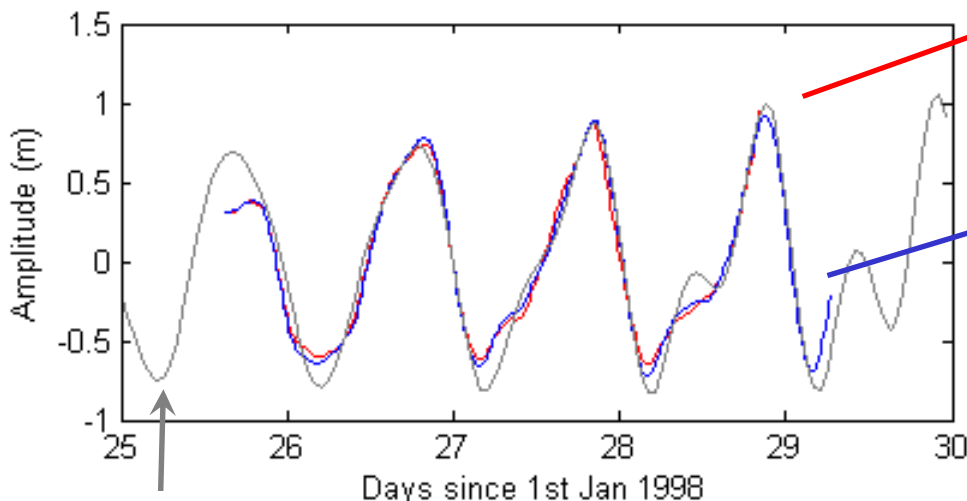
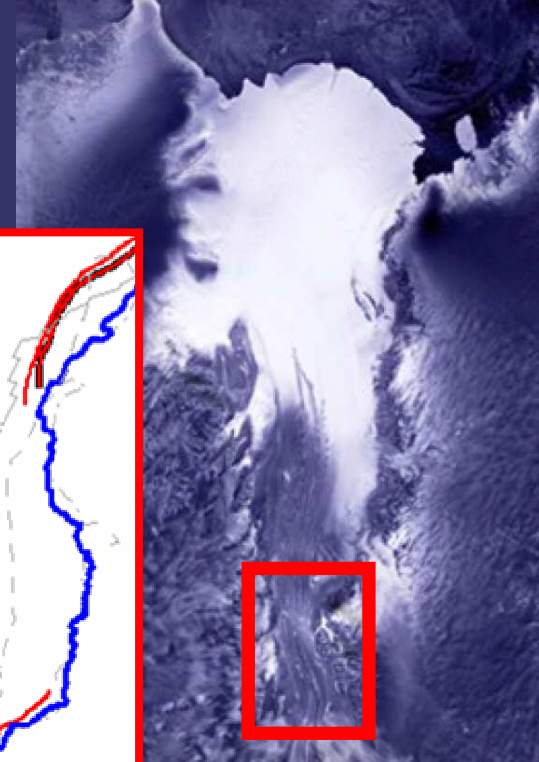
Data

- **Seismics (Ruddell)**
- **Seismics (Tassell, McMahon etal)**
- **GEBCO & Ship tracks (AADC)**
- **Borehole (AMISOR)**
- **Beaver Lake (Baudin)**
- **Grounding (Fricker)**

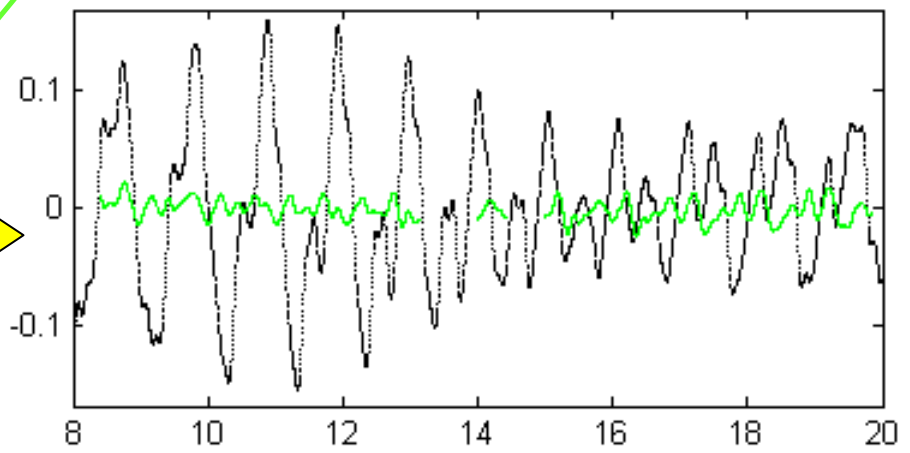
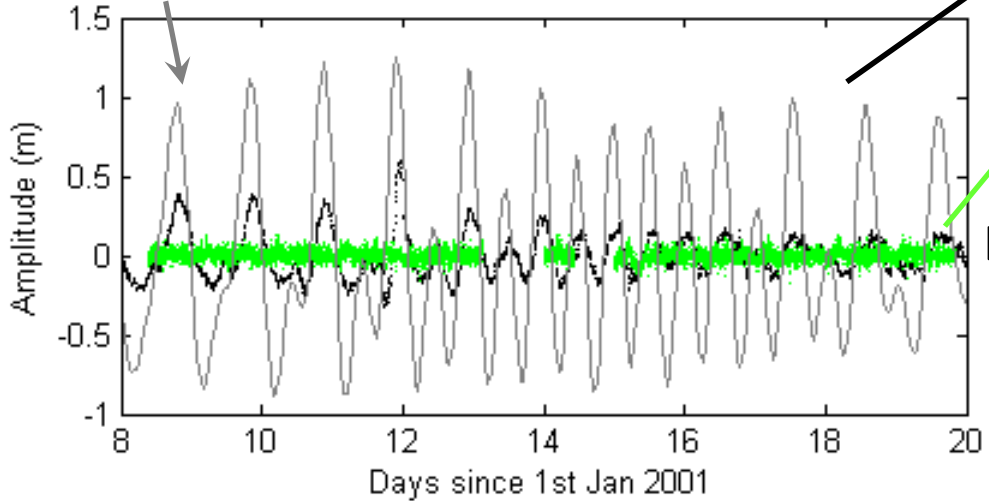
Lambert Glacier Grounding Zone



Grounding Zone – tides!

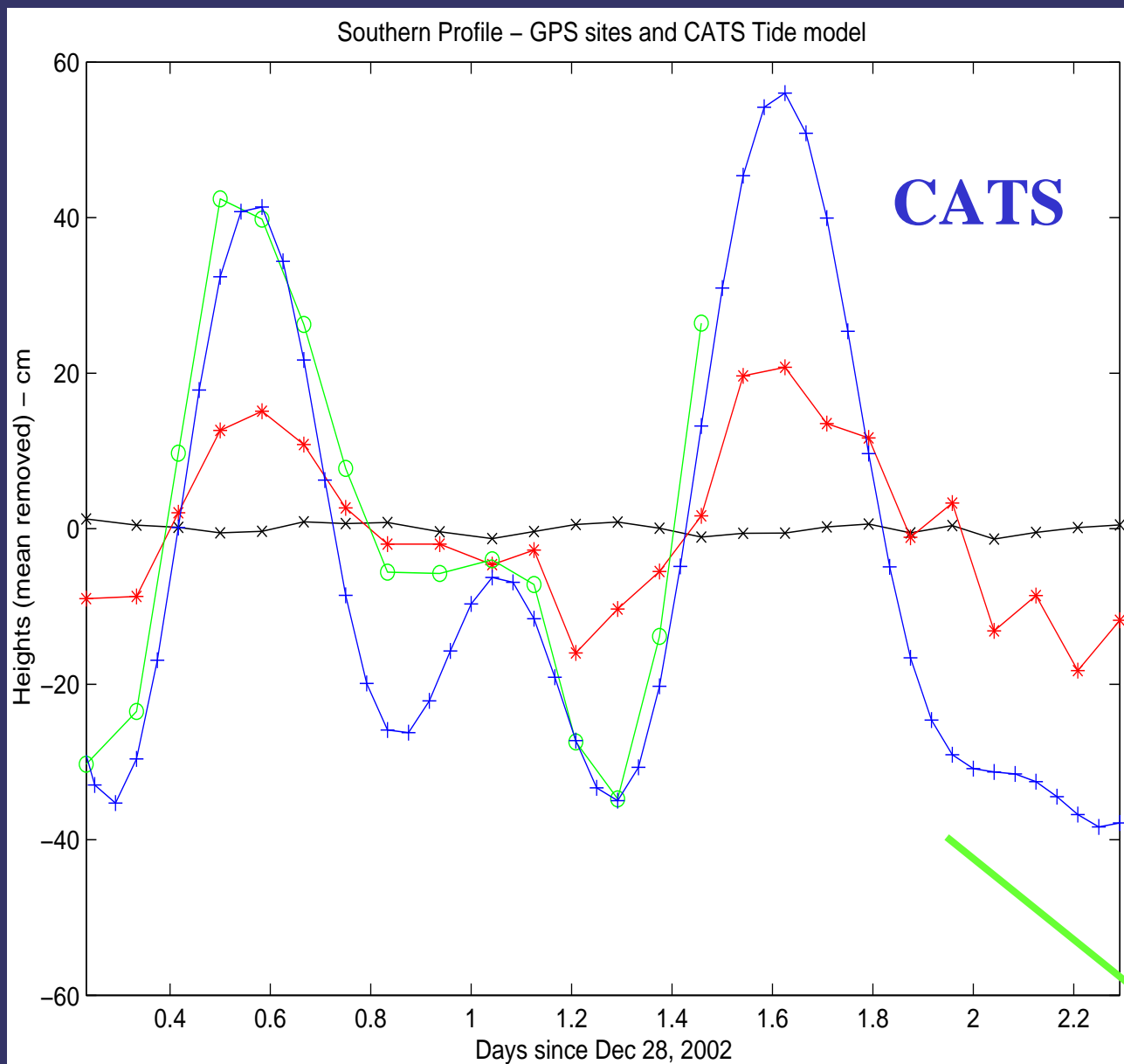


CATS predictions



North of Gillock Island

Blue line on right image is the limit of flexure, red line is the seaward edge of the flexural boundary layer.



Beaver Lake

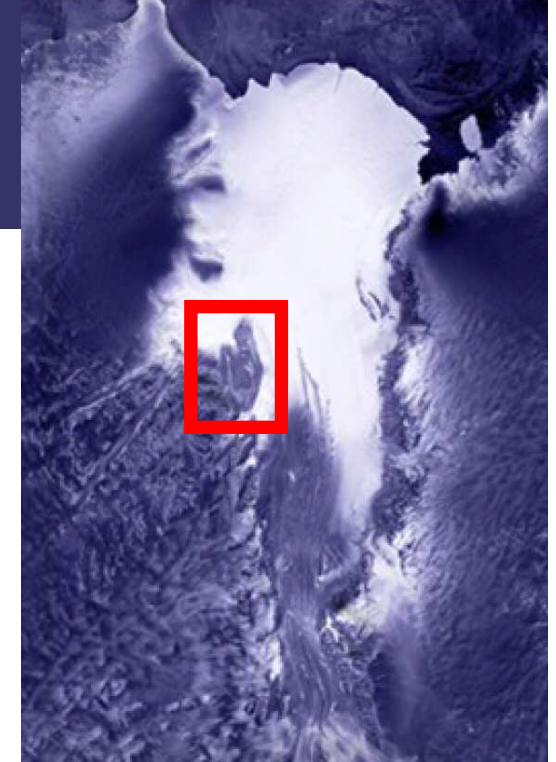
Table 2: The phase difference and amplitude attenuation observations within Beaver Lake and simulated tides beneath the Amery Ice Shelf: a. The major diurnal tides K1 and O1; and, b. The major semi-diurnal tides M2 and S2. These 4 constituents contribute about 80% of the tide in Beaver Lake.

a. Diurnal

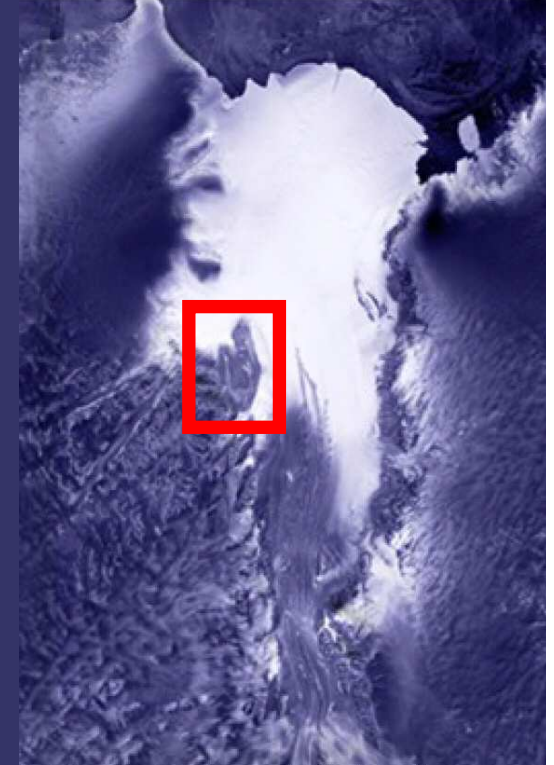
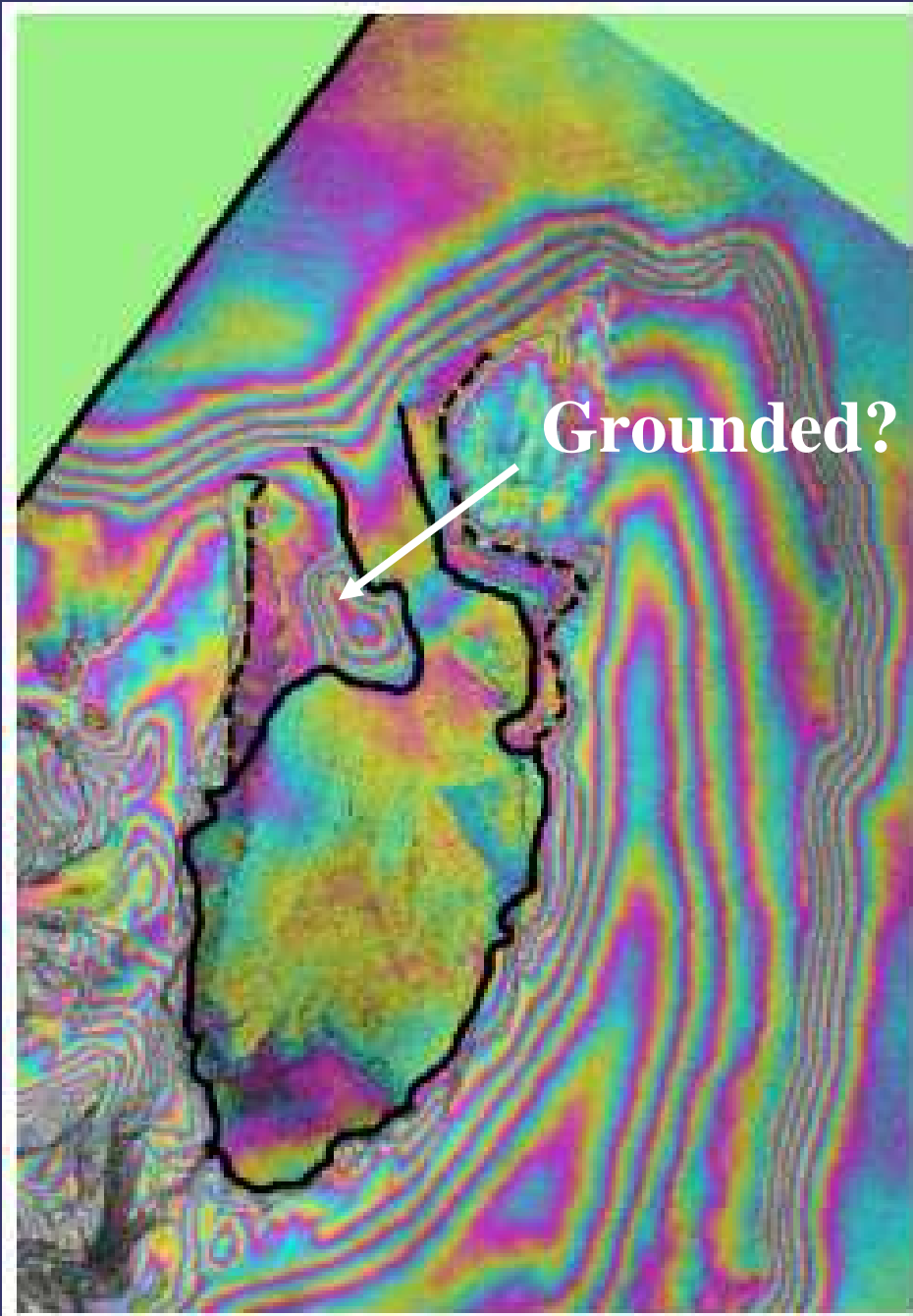
Year	O1		K1	
	Attenuation	Phase	Attenuation	Phase
1990/91	0.952 ± 0.021	-4.643 ± 1.186	0.898 ± 0.024	-9.953 ± 1.515
1997/98	0.934 ± 0.012	-9.803 ± 0.653	0.912 ± 0.009	-4.665 ± 0.612
2002	0.923 ± 0.018	-13.613 ± 0.908	0.917 ± 0.016	-11.093 ± 0.997

b. Semi-diurnal

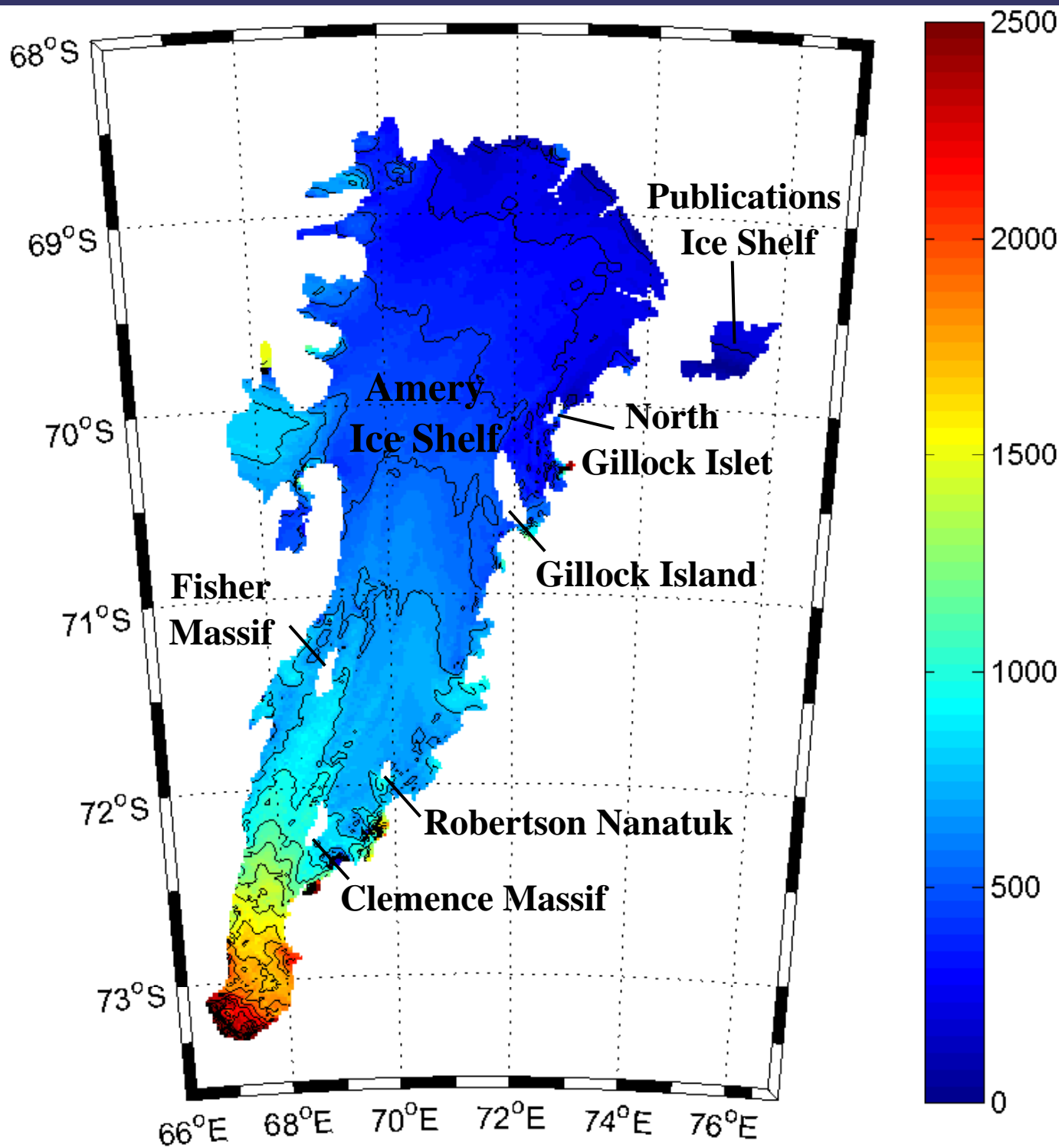
Year	M2		S2	
	Attenuation	Phase	Attenuation	Phase
1990/91	0.974 ± 0.029	-4.166 ± 1.740	1.033 ± 0.031	-3.018 ± 1.658
1997/98	0.943 ± 0.011	-24.430 ± 0.619	1.031 ± 0.012	-28.893 ± 0.568
2002	0.887 ± 0.022	-28.848 ± 1.281	1.021 ± 0.026	-29.178 ± 1.363



Beaver Lake



- Epishelf lake, in hydraulic connection with the ocean beneath the Amery Ice Shelf
- A narrow/long inlet might act as a linear damped oscillator and cause the phase lag and attenuation
- What is causing the inlet to thicken?

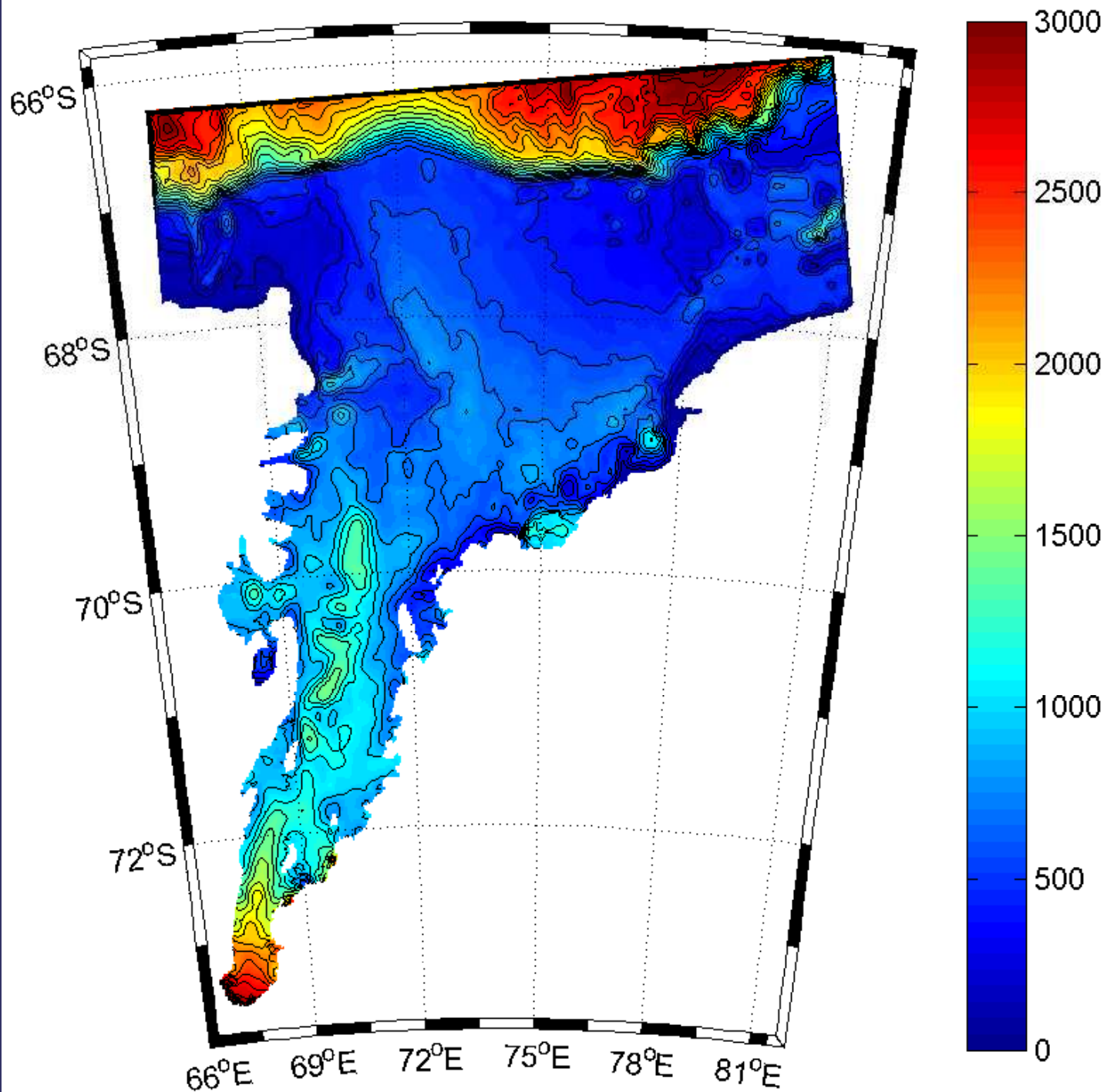


Ice Draft

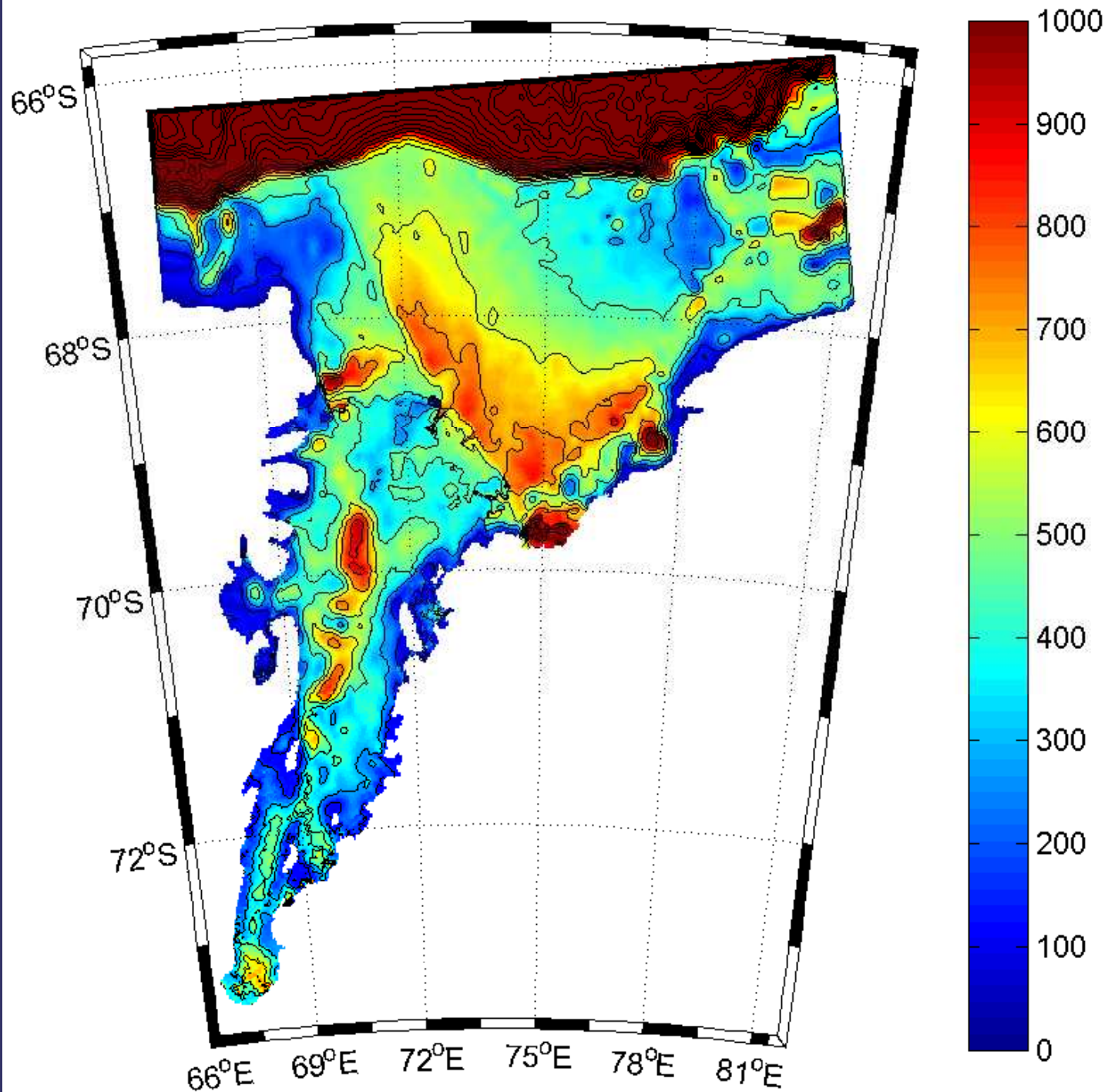
Areas

- Amery Ice Shelf: 62882 km²
- Publications Ice Shelf: 1106.2 km²
- Clemence Massif: 166.83 km²
- Gillock Island: 470.78 km²
- North Gillock Island: 72.771 km²

72.771 km²

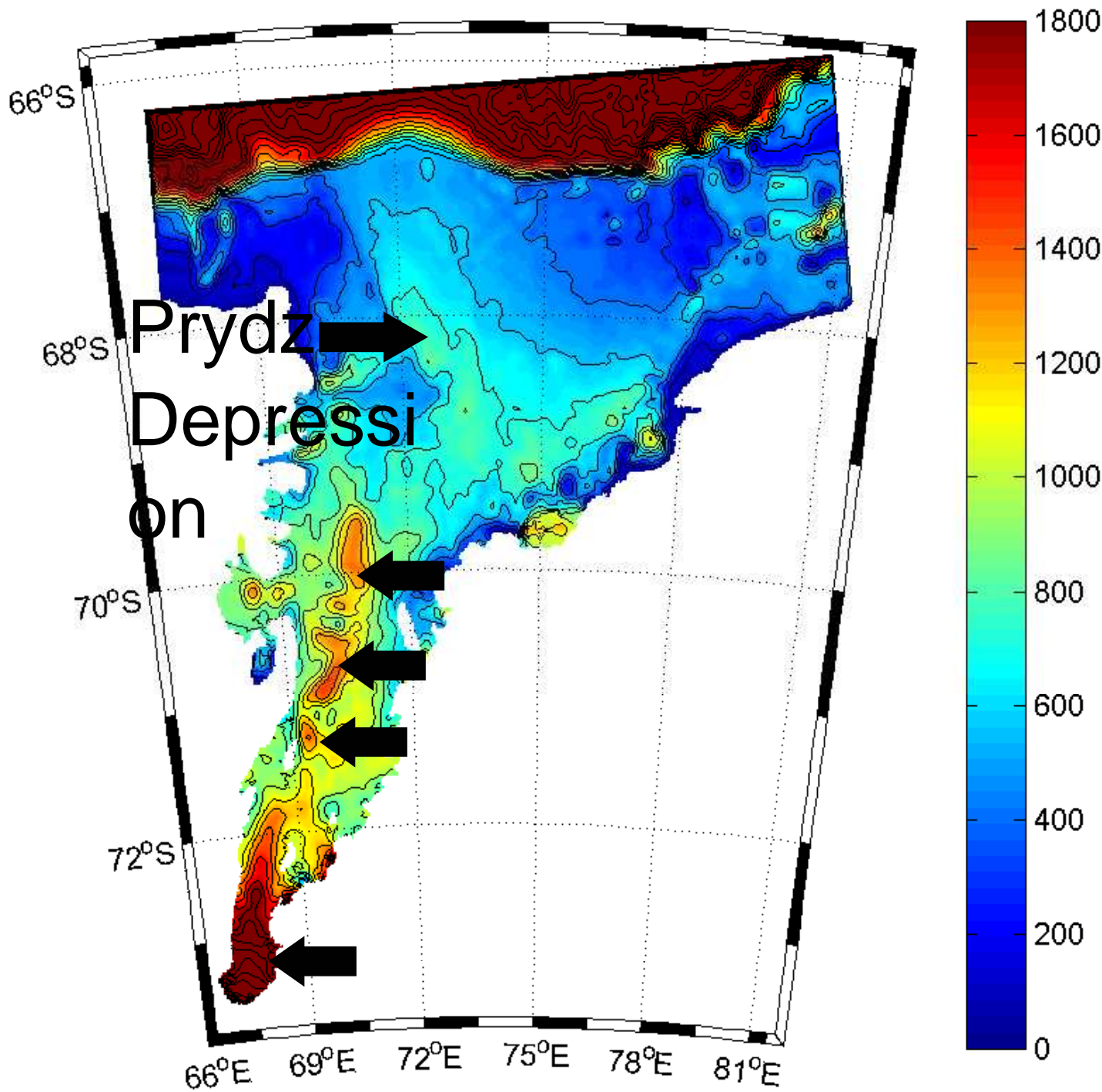


Bathymetry
2 x 2 km grid
WGS84



Water
Column
Thickness
= Bathymetry -
Draft

- Mean depth beneath AIS ~ 235 m
- Total volume beneath AIS ~ 23108 km³



Bathymetry

Features

- Depressions!
- Sites of high sedimentation?
- Anoxic?
- Historic grounding sites?

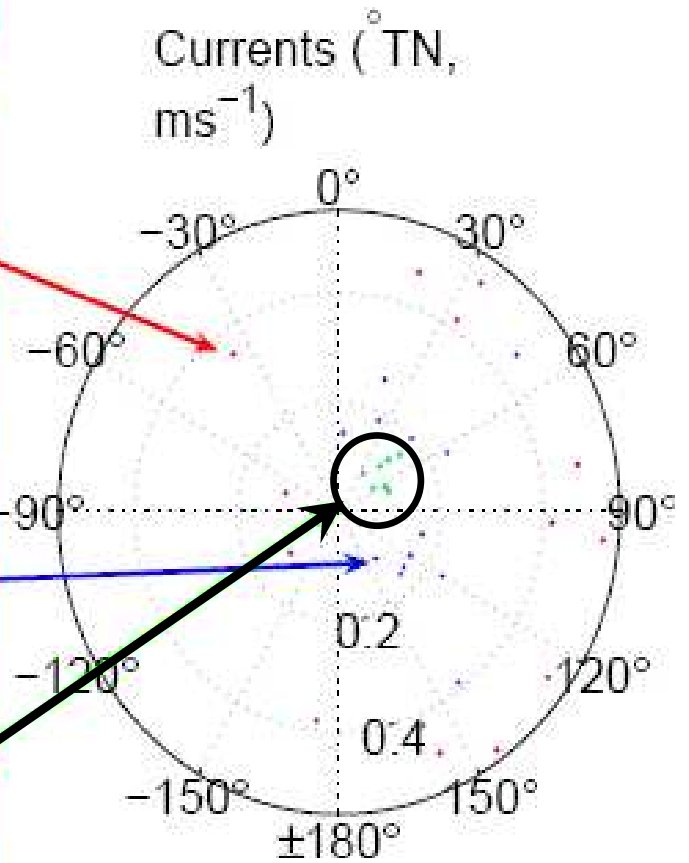
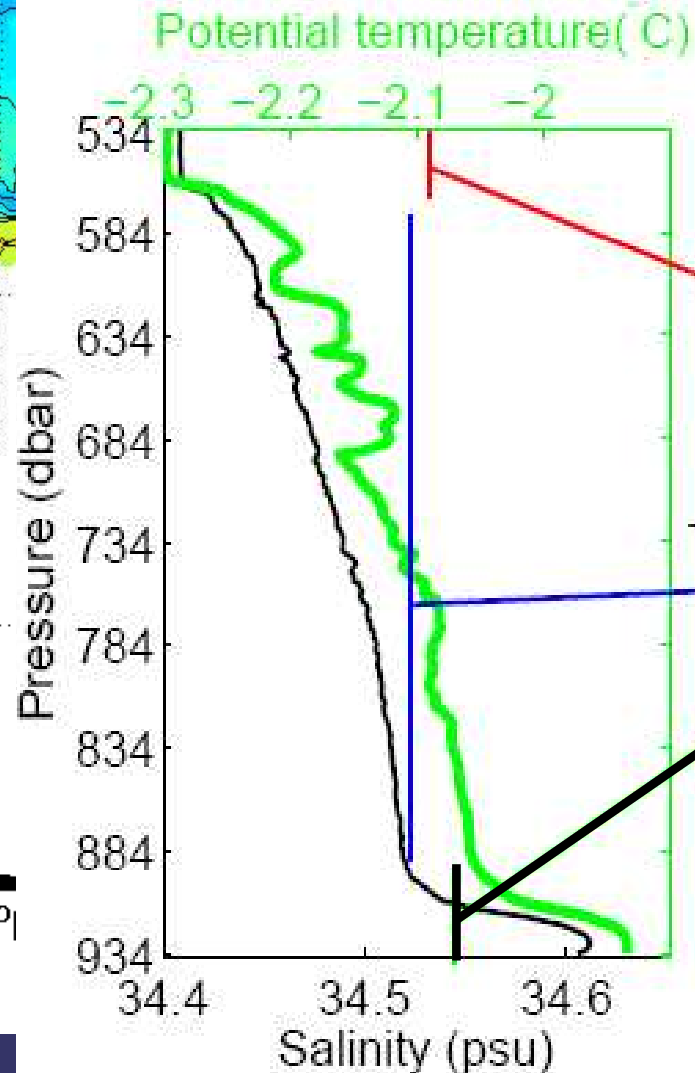
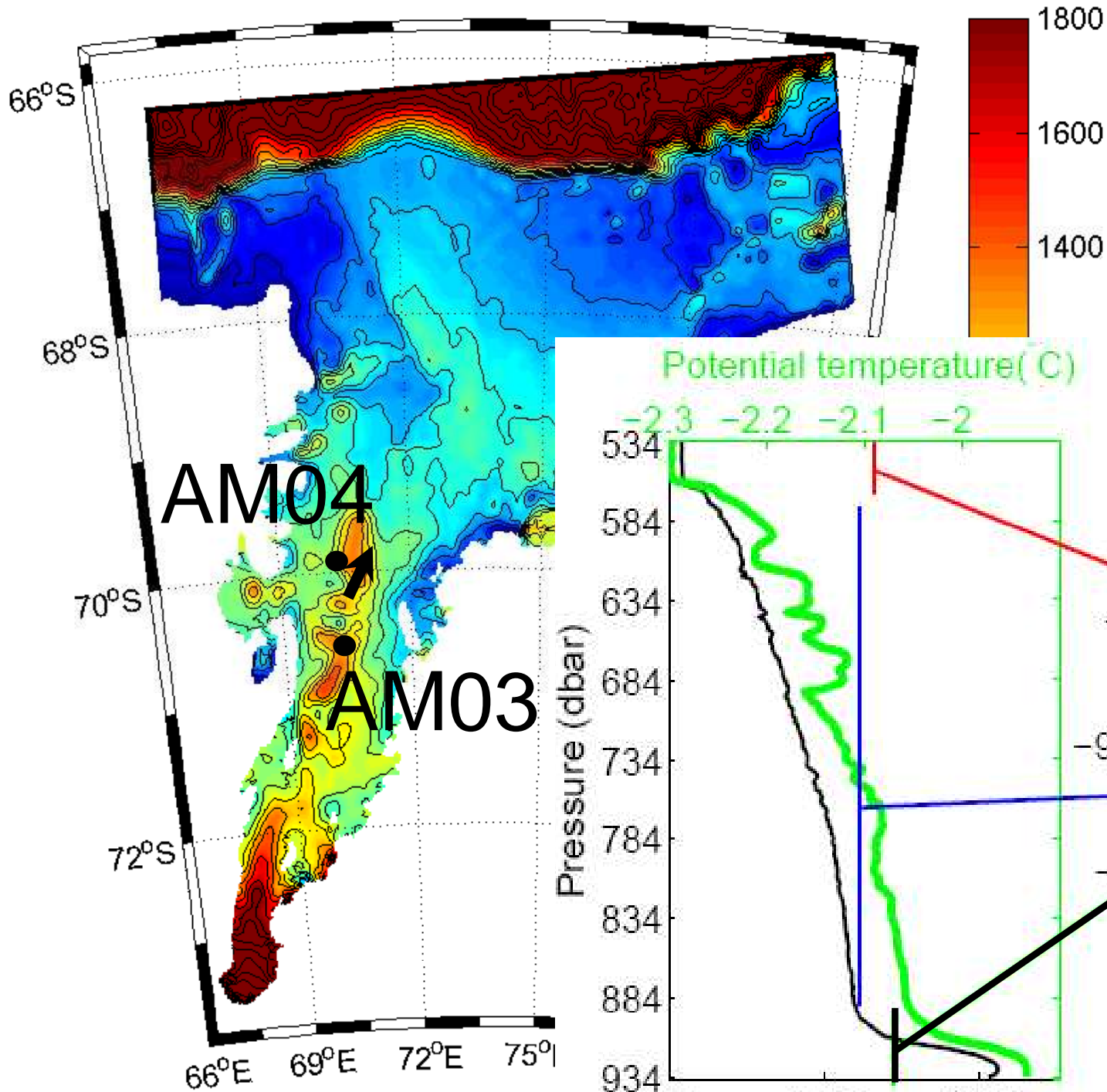
Bathymetry – Features

- **Paternoster:** series of 'connected' (terrestrial) lakes located down a glacier valley

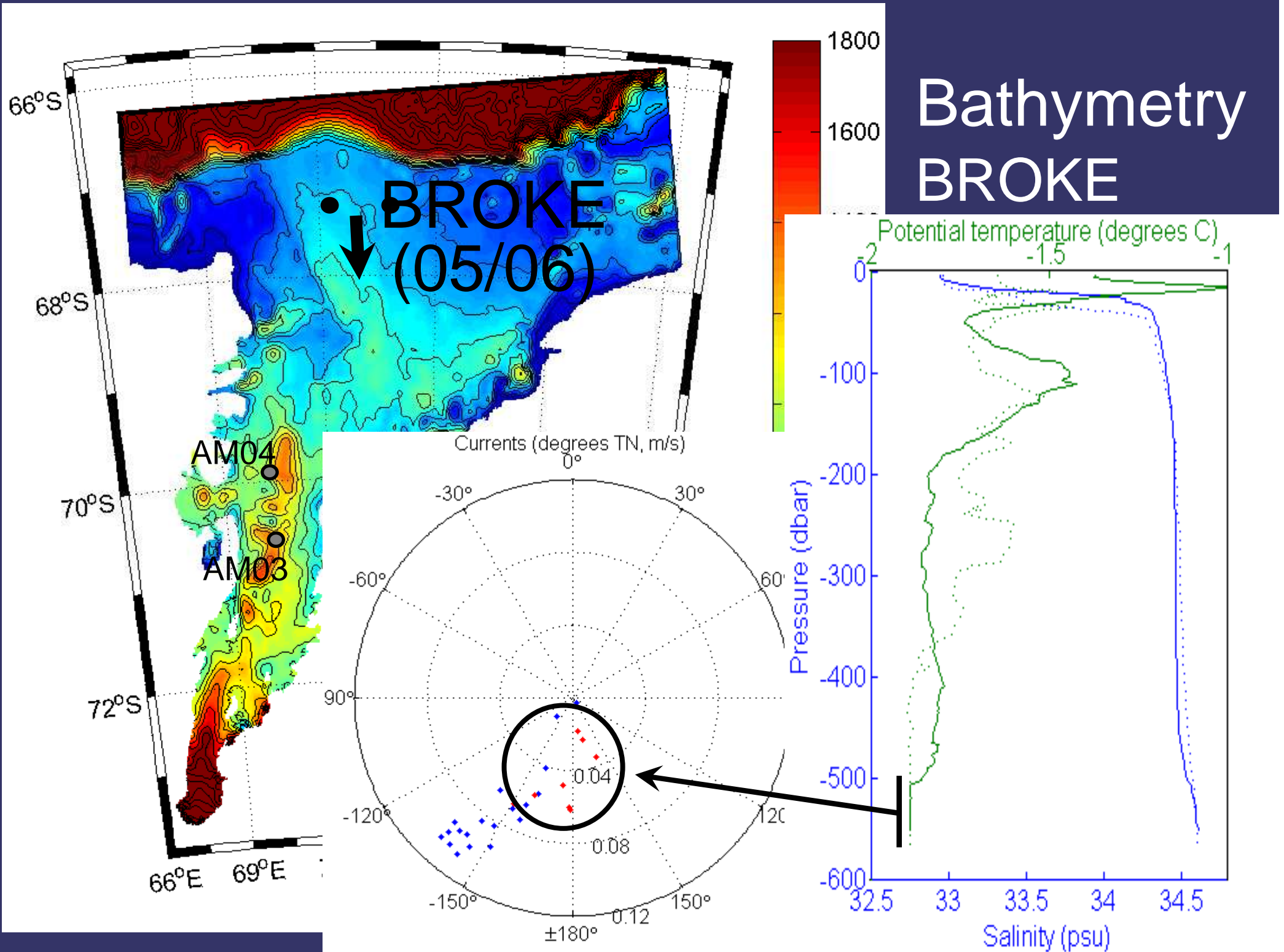
Questions

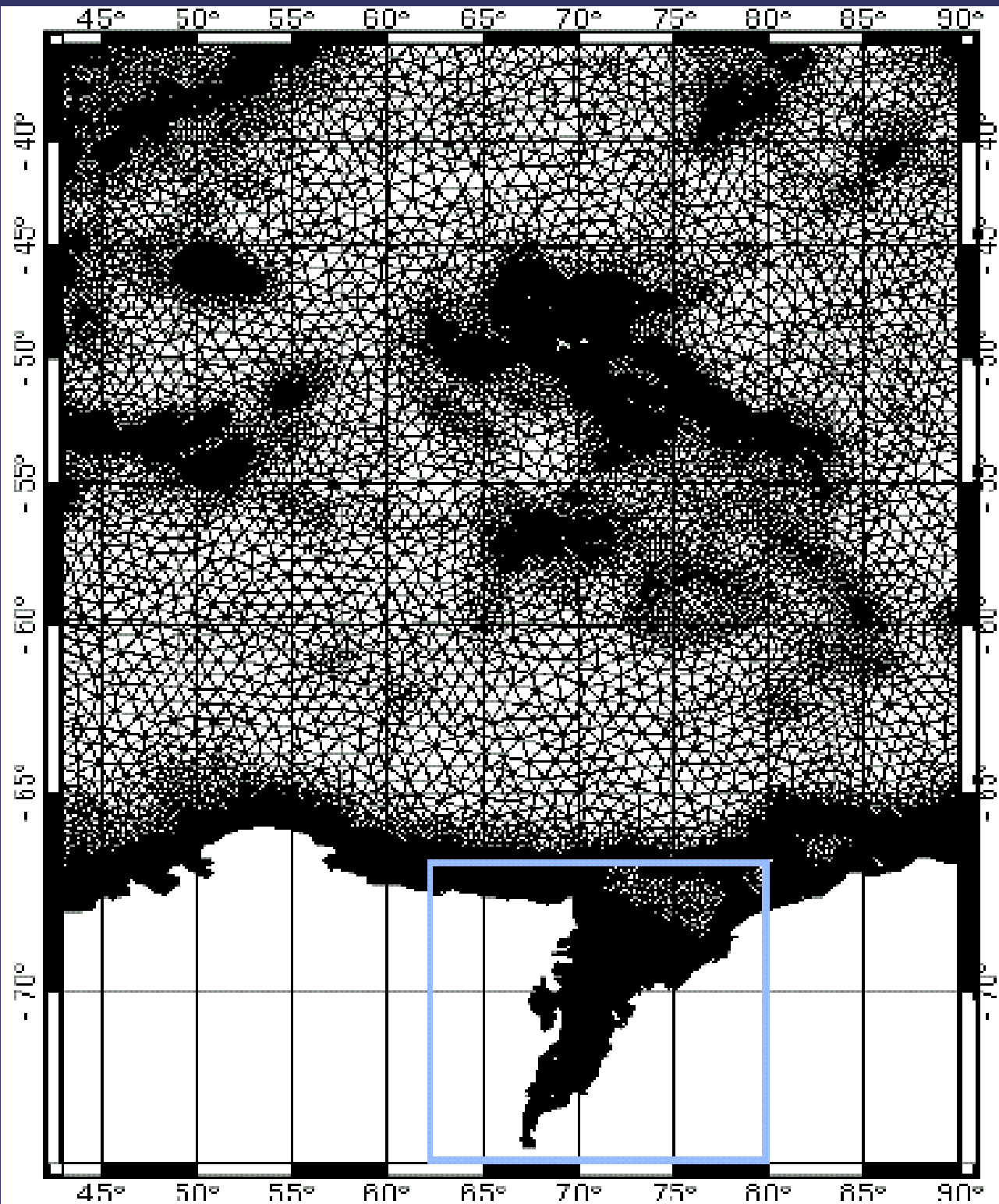
- Do dense waters pool in the depressions?
- If so, are the waters in the depressions slow moving and isolated by high density gradients from the cavity waters?

Bathymetry AM04



(AMISOR 05/06)

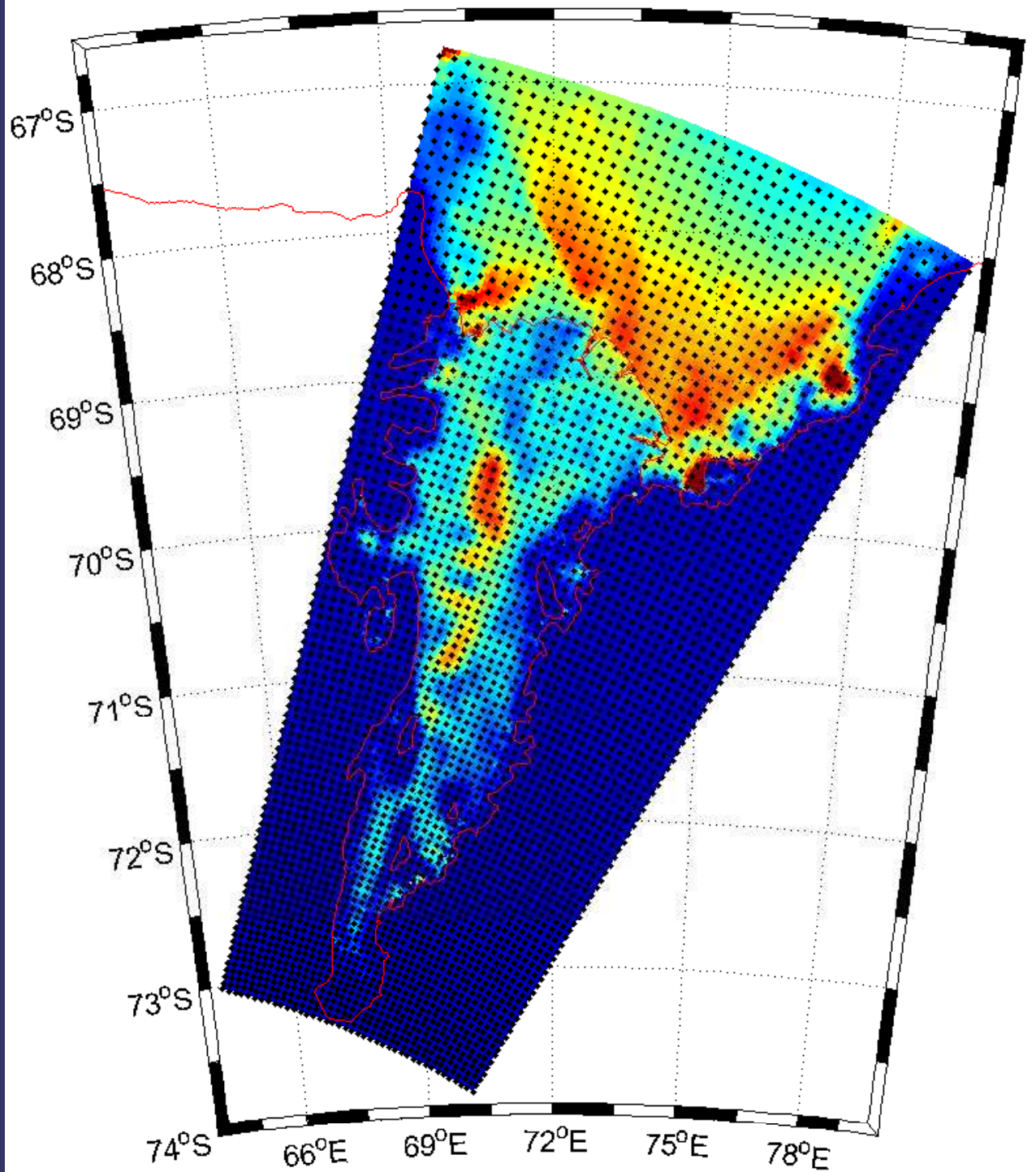




HUGO (ex MOG2D)

Claire Maraldi

- 2D gravity wave model
- Finite element
- High resolution
- Forced with FES2004
Global tidal solution
- Bottom friction is
doubled beneath the ice
- Short run times (days)



ROMS

Regional Ocean Modelling System

- 3-d Ocean Model
- ~1.5 to 5 km grid
- Tidal forcing with TPXO6.2
- Thermodynamics
- 16 vertical layers
- 121 x 288 cells
- run time ~ 1 month

Amery tides

M. Hemer, J. Hunter and R. Coleman (2006).
Barotropic tides beneath the Amery Ice Shelf. JGR.

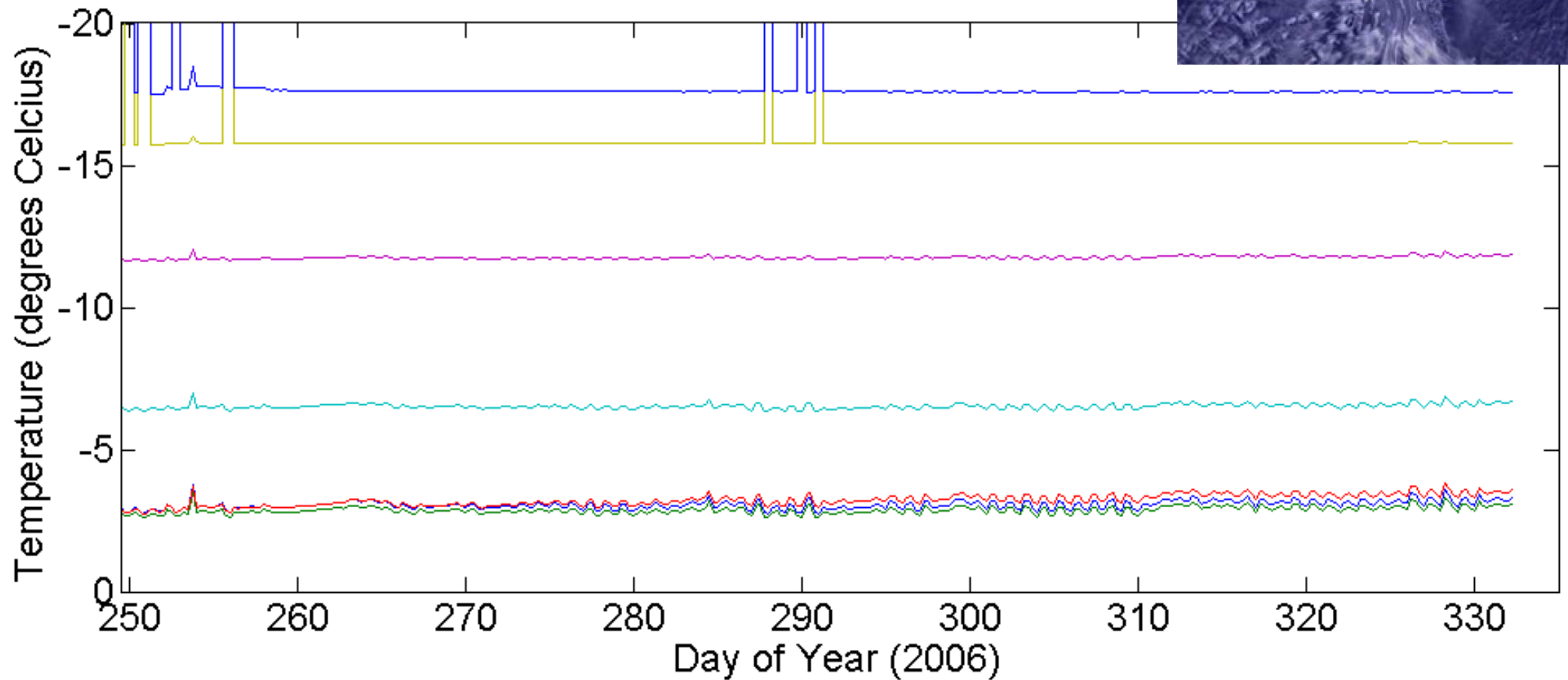
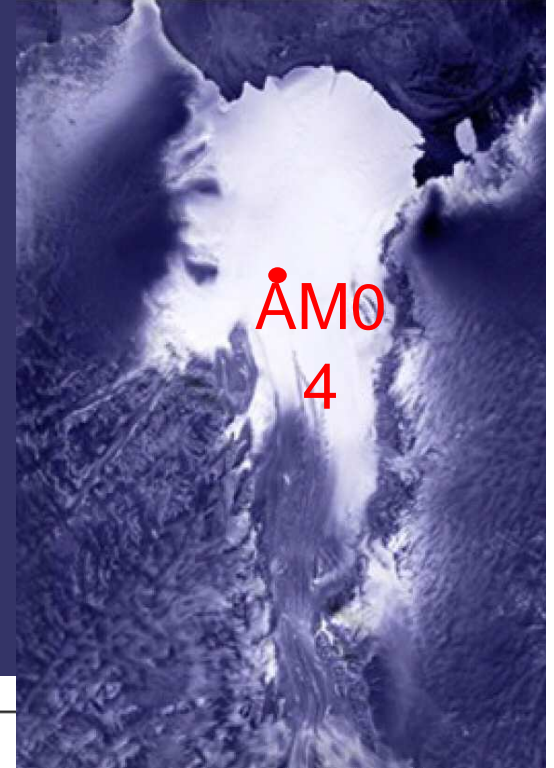
However

- Area is now ~5 % larger than Hemer et al
- Volume is ~10 % smaller...

Future

- Barotropic tides & 'tune' WCT (HUGO and ROMS)
- Incorporate ice shelf flexure physics (HUGO)
- Mixing processes (ROMS)
- Internal tides (ROMS)

AM04 – Thermistor data (6 hour sample rate) Marine Ice accretion site



AM01 – Thermistor data

(10 minute sample rate)

Marine Ice accretion site

Thermistor nearest the ocean

CATS tide predictions

