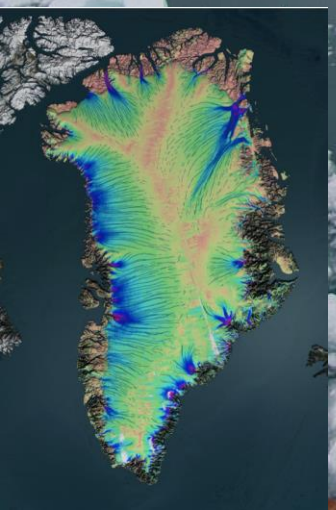
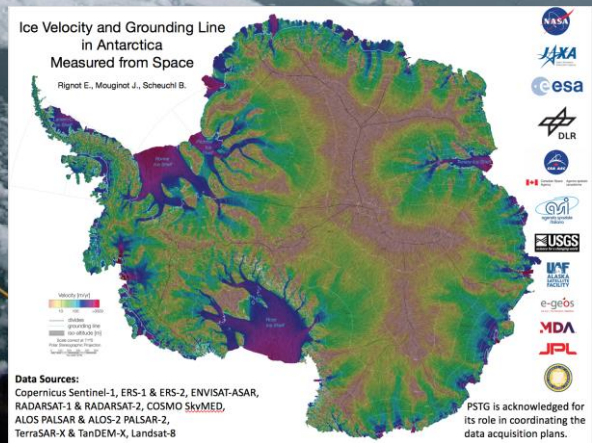
OMG bathymetry in Greenland and OIB gravity work in Antarctica

Eric Rignot

[1]Dept. Earth System Science, University of California, Irvine;

[2]NASA's Jet Propulsion Laboratory, Pasadena

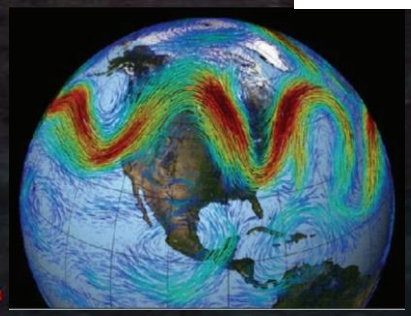


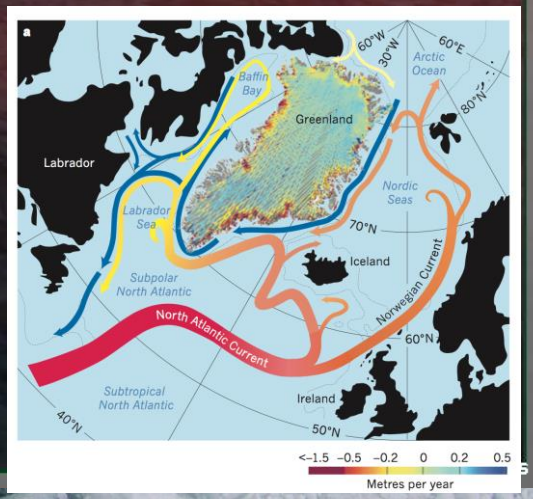


OMG bathymetry in Greenland and OIB gravity work in Antarctica

1 m/year on top

1 m/day at bottom!





Land ice: 150 m horizontal (450 m Antarctica), 10-50 m vertical
Fjords: 150 m (25 m high); continental shelf 1km, vertical: sill depth

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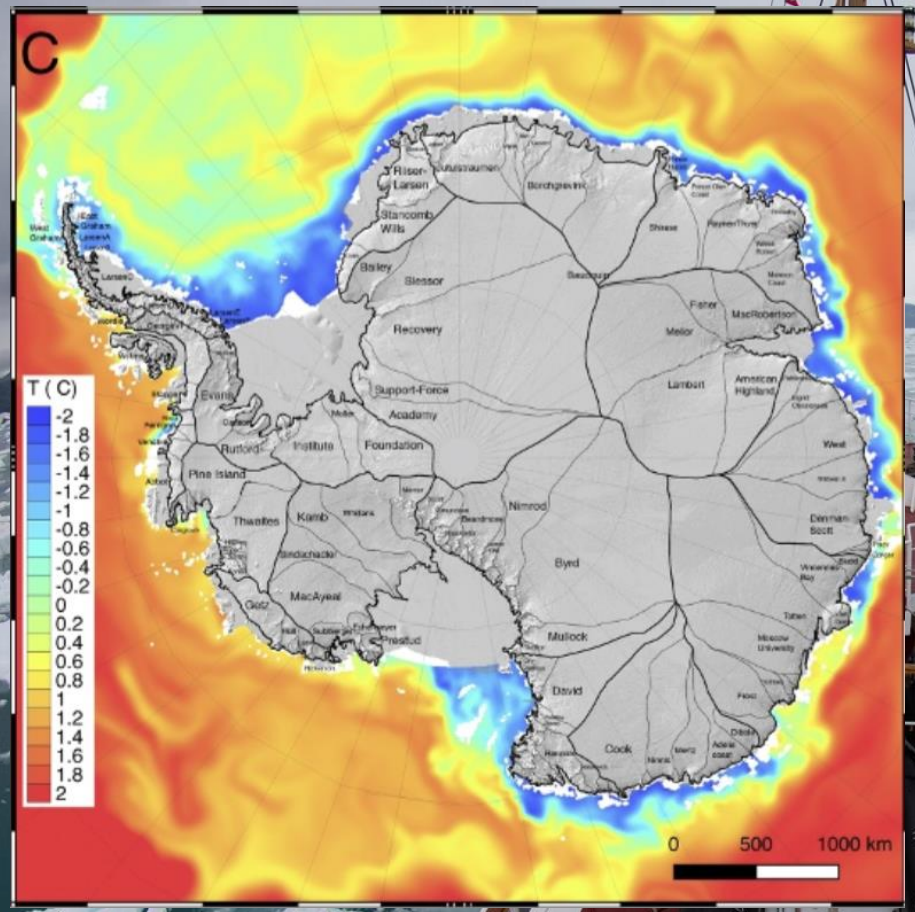
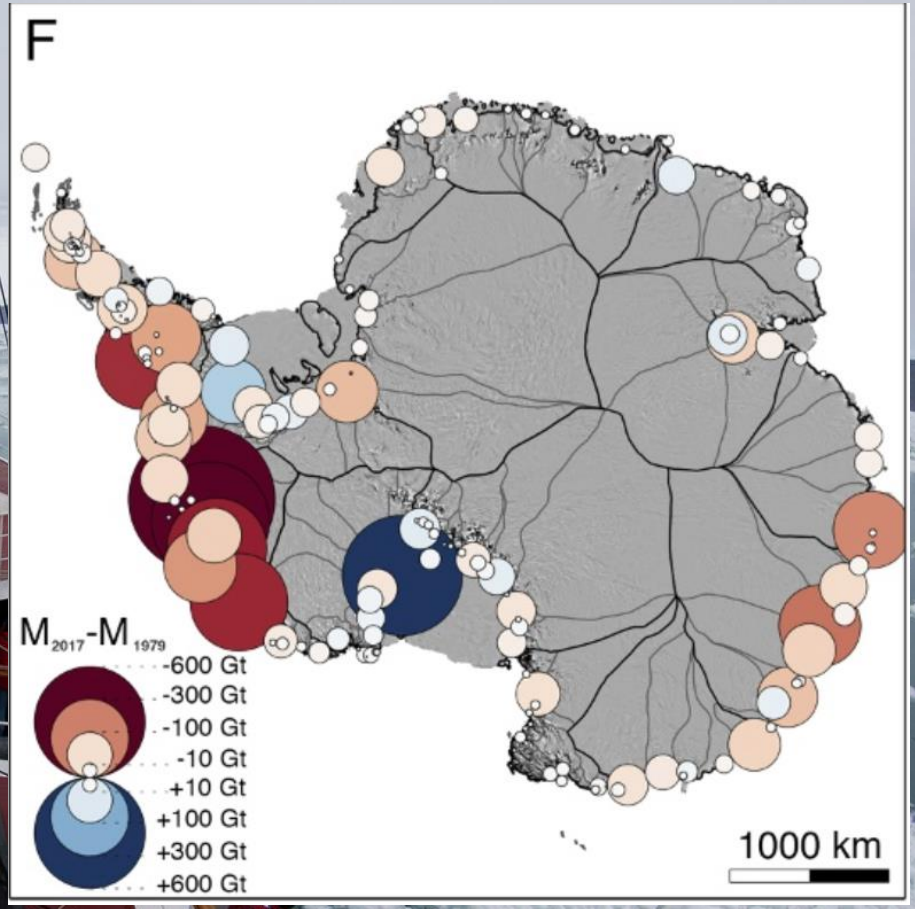
Mass loss near sources of warm water (CDW)

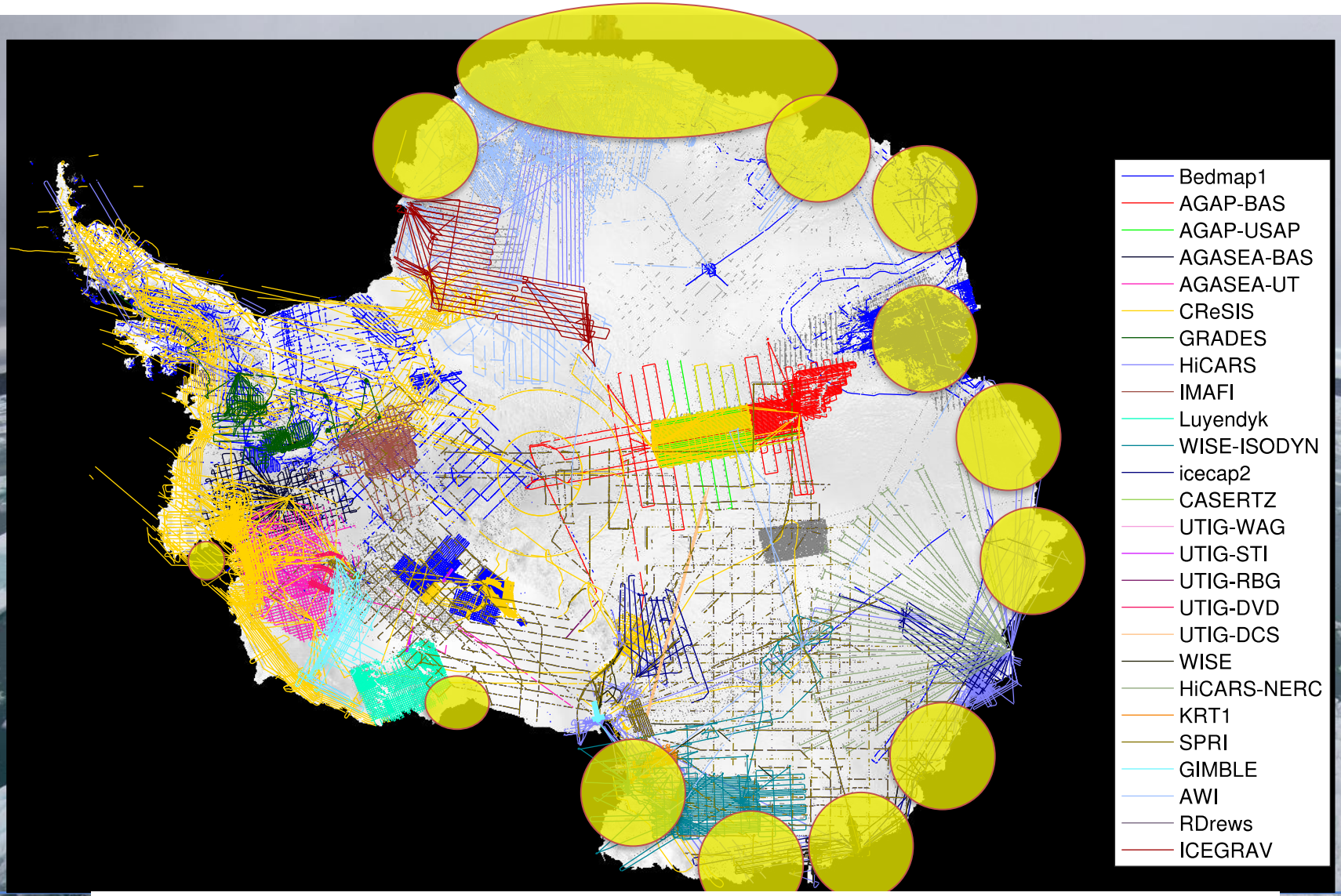




SOSE (Mazloff et al., 2018)

Mass balance (Rignot et al., 2019)

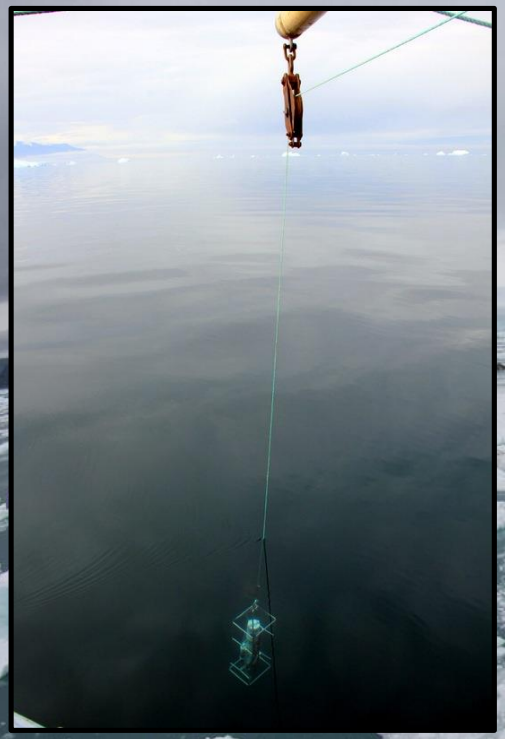
Where do we need more ice shelf bathymetry?

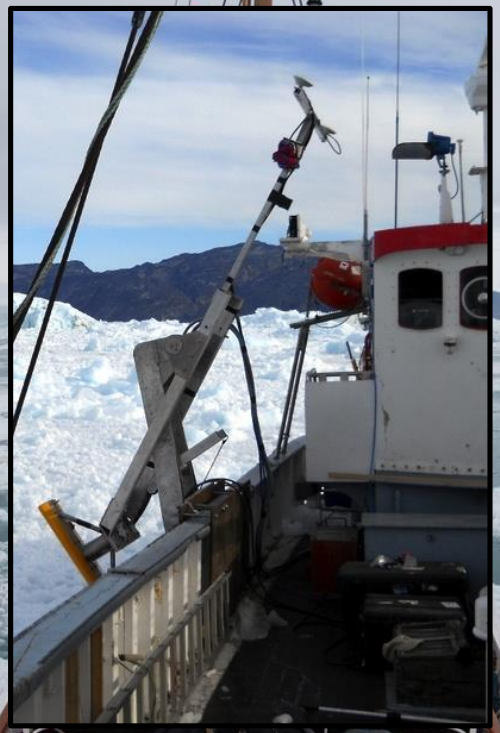


Ice shelves: airborne gravity + discrete data (seismic, autosub, gliders, etc.)

OMG bathymetry in Greenland and OIB

CTD and MBES DCP Instrumentation





Ocean Temperature and Salinity
CTD (Conductivity, temperature depth)

Seafloor Topography
MBES (Multi-beam Echo Sounder)

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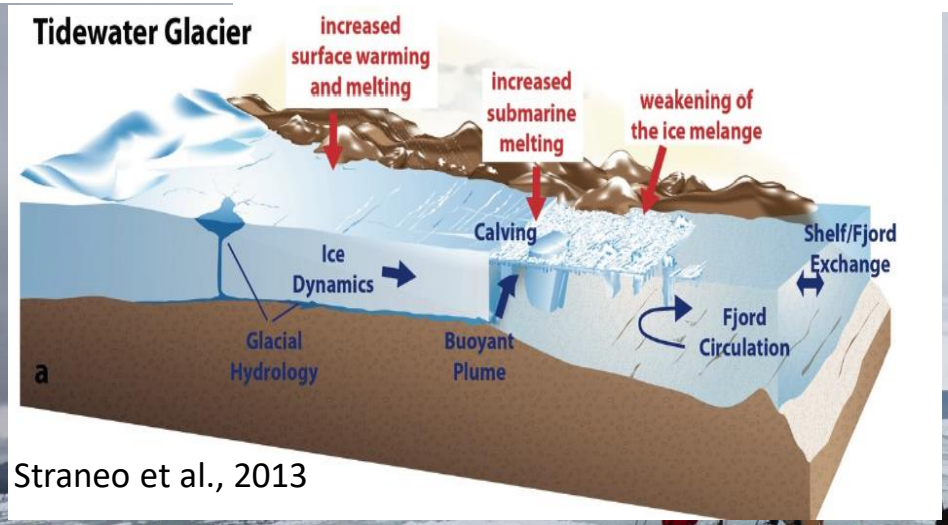
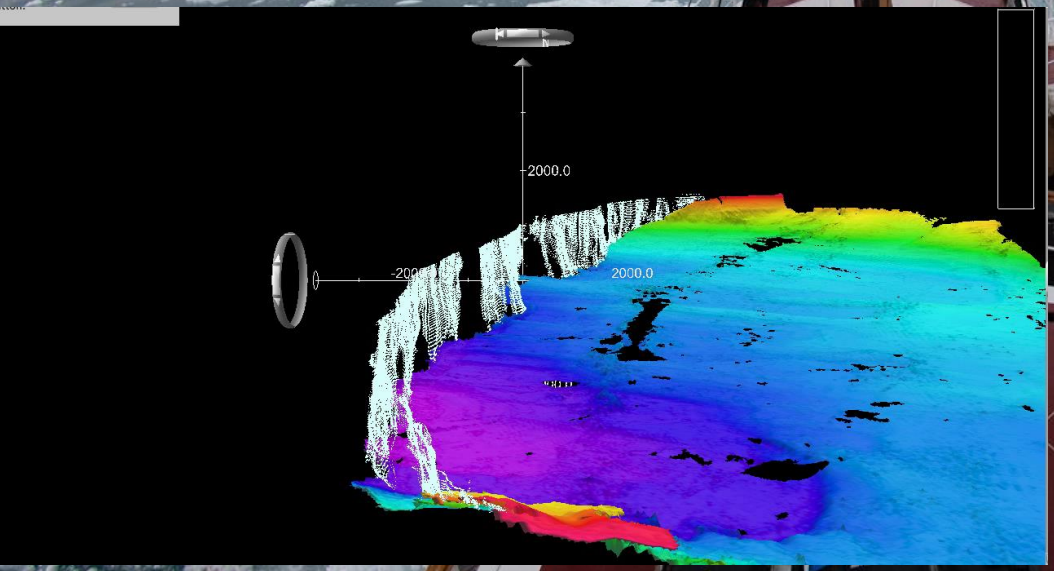
E. Rignot[1,2], Y. Xu[1], D. Menemenlis[2], J. Mouginot[1], B. Scheuchl[1], X. Li[1], M. Morlighem[1], H. Seroussi[1], M. van den Broeke[3], I. Fenty[2], C. Cai[1], L. An[1], and B. de Fleurian[1]



Straneo et al., 2013

Murray et al., 2011



Motyka et al., 2013

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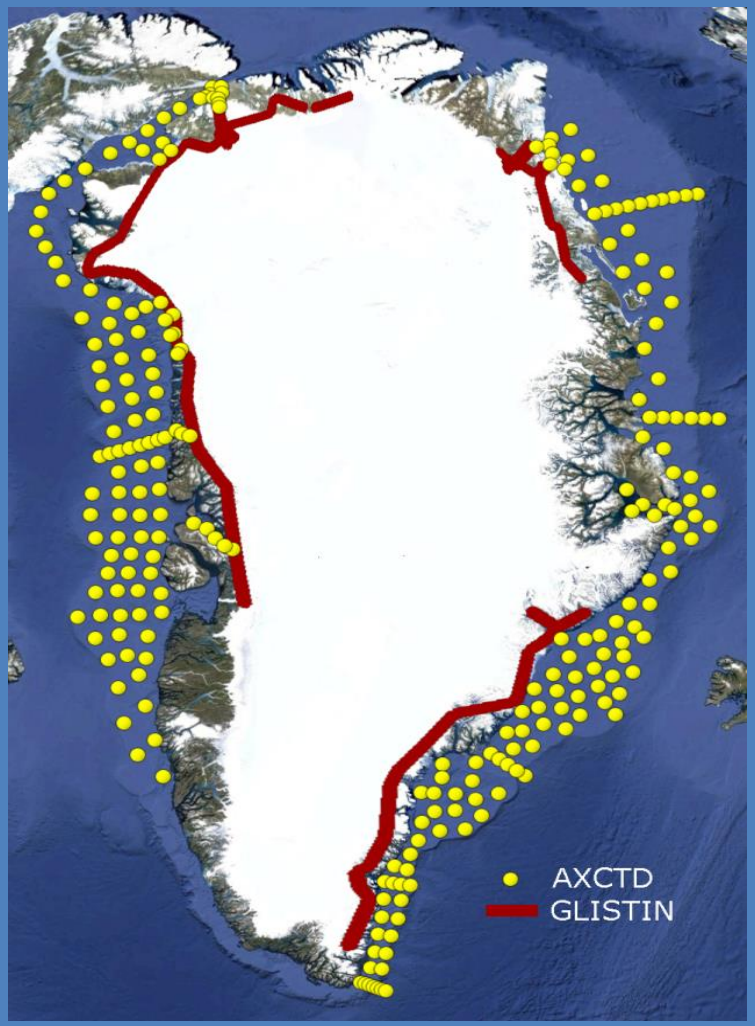
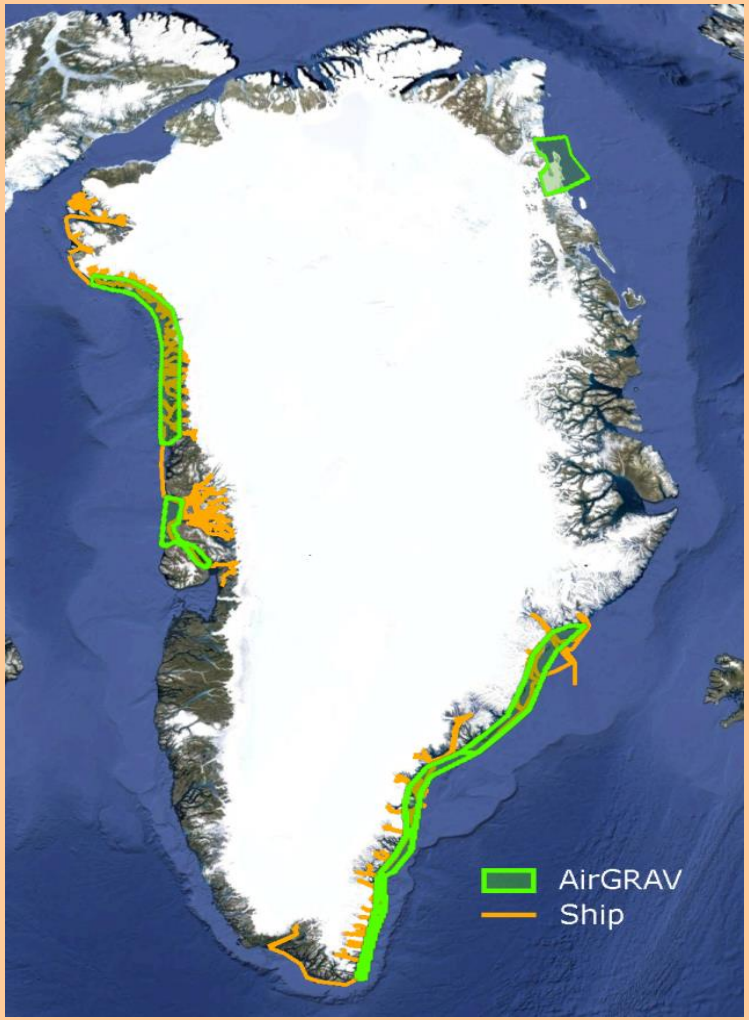
NASA EVS-2 OMG Observations: 2015-2020

Ocean & Ice



Once per year surveys

Sea Floor



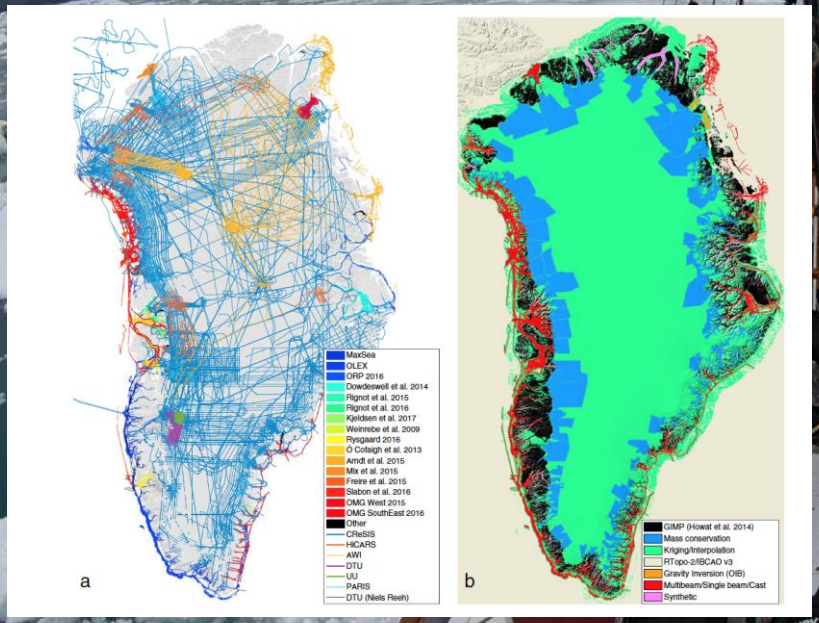
One time surveys

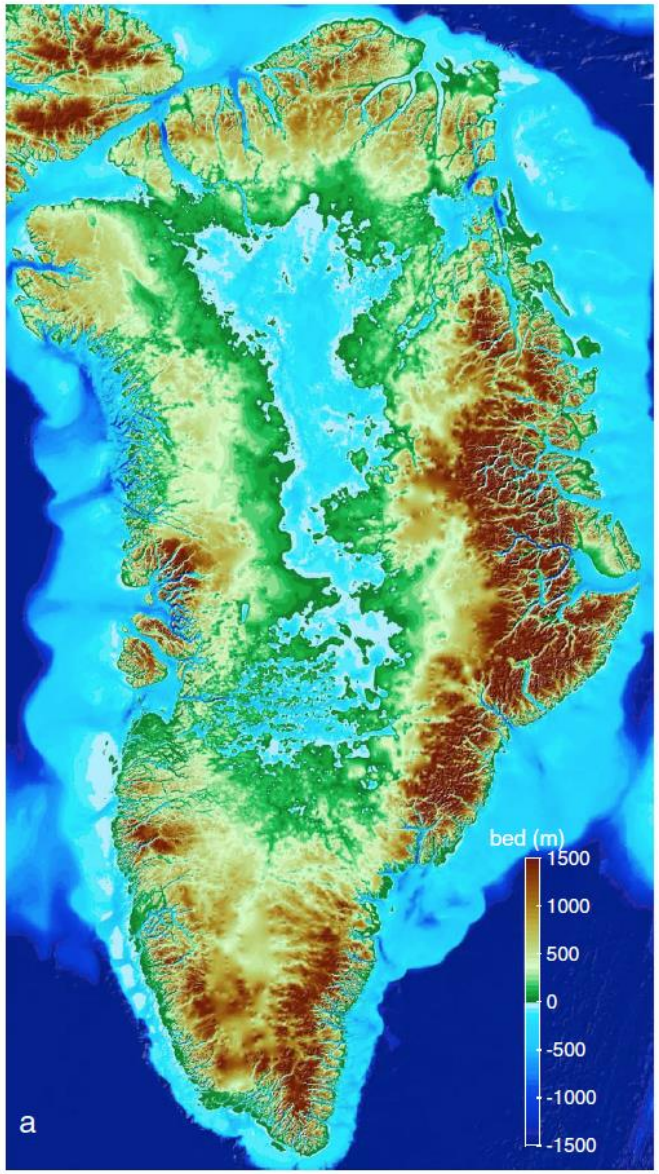
OMG bathymetry in Greenland and OIB gravity work in Antarctica

BedMachine Greenland

BedMachine v3: Complete Bed Topography and Ocean Bathymetry Mapping of Greenland From Multibeam Echo Sounding Combined With Mass Conservation

M. Morlighem[1], C. N. Williams[2,3], E. Rignot[1,4], L. An[1], J. E. Arndt[5], J. L. Bamber[2], G. Catania[6], N. Chauché[7], J. A. Dowdeswell[8], B. Dorschel[5], I. Fenty[4], K. Hogan[9], I. Howat[10], A. Hubbard[7,11], M. Jakobsson[12], T. M. Jordan[2], K. K. Kjeldsen[13,14,15], R. Millan[1], L. Mayer[16], J. Mouginot[1], B. P. Y. Noël[17], C. O'Cofaigh[18], S. Palmer[19], S. Rysgaard[20,21,22], H. Seroussi[4], M. J. Siegert[23], P. Slabon[5], F. Straneo[24], M. R. van den Broeke[17], W. Weinrebe[5], M. Wood[1], and K. B. Zinglersen[21]





OIB, OMG and other data MC reconstruction in blue

019

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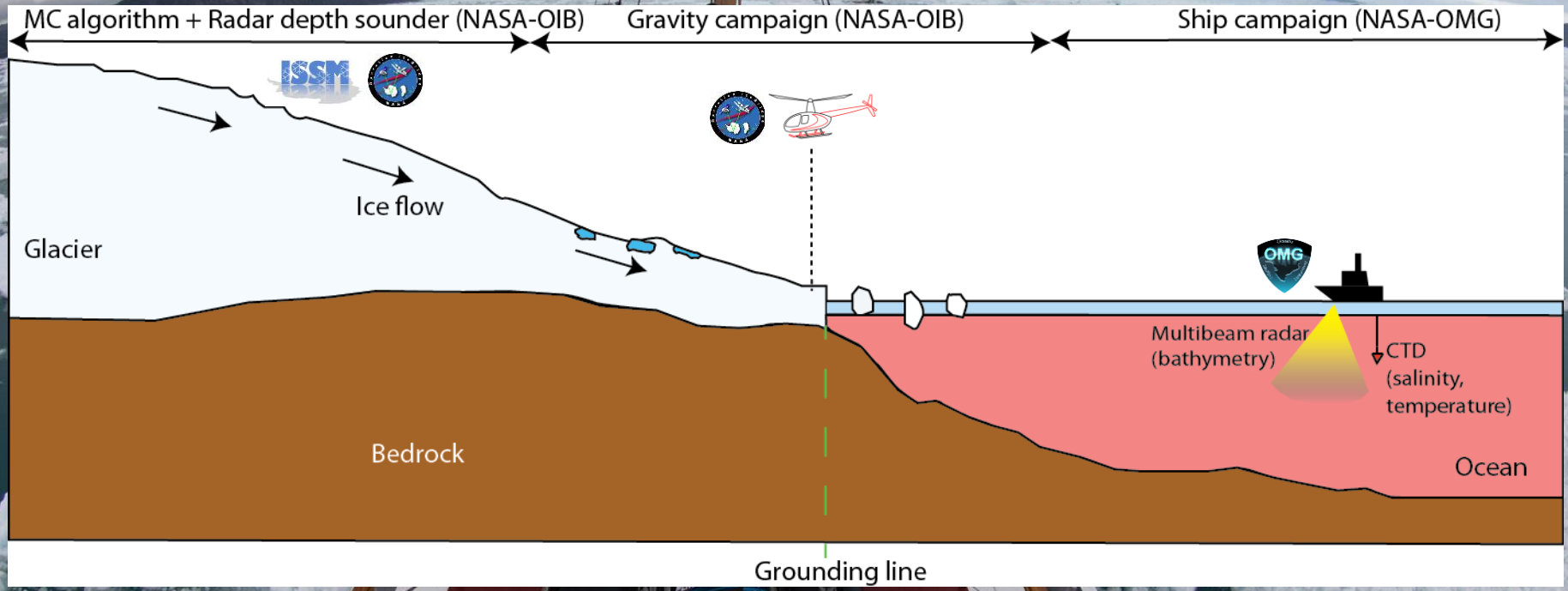
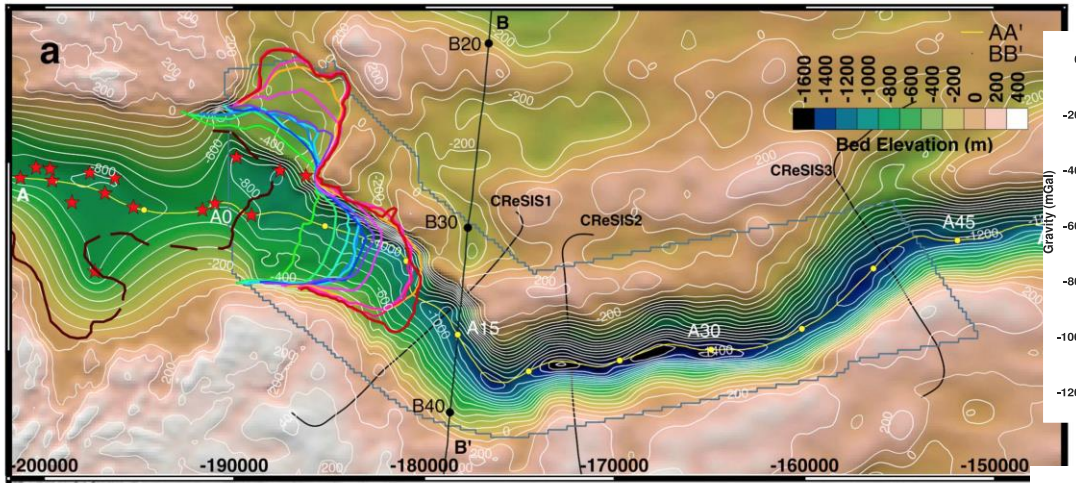
Multi-sensor approach to solve thickness mapping

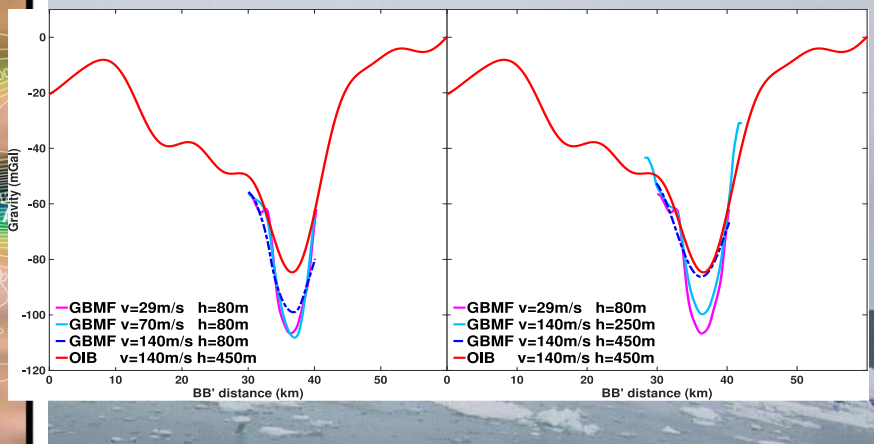


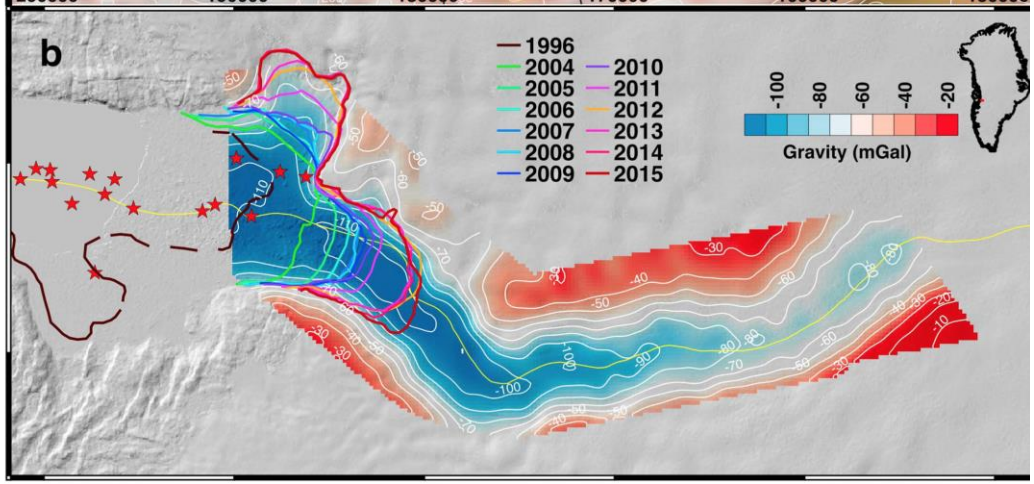
OMG bathymetry in Greenland and OIB gravity work in Antarctica

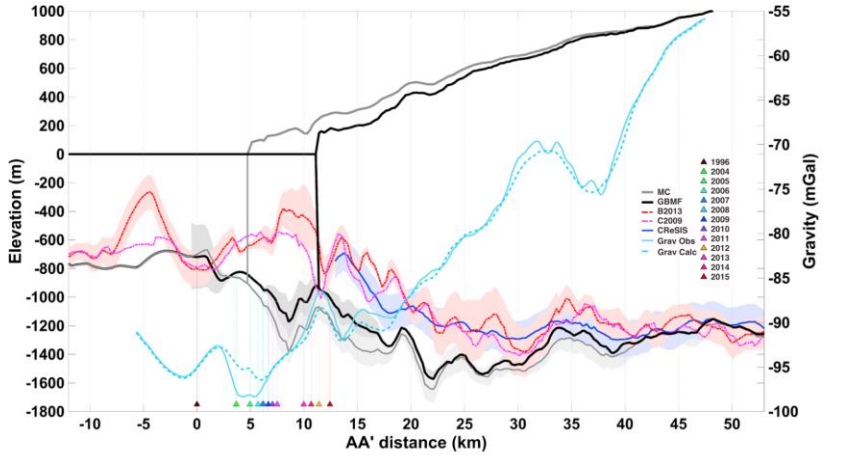
Jakobshavn Glacier, Greenland

An et al., Geophysical Research Letters, 2017.

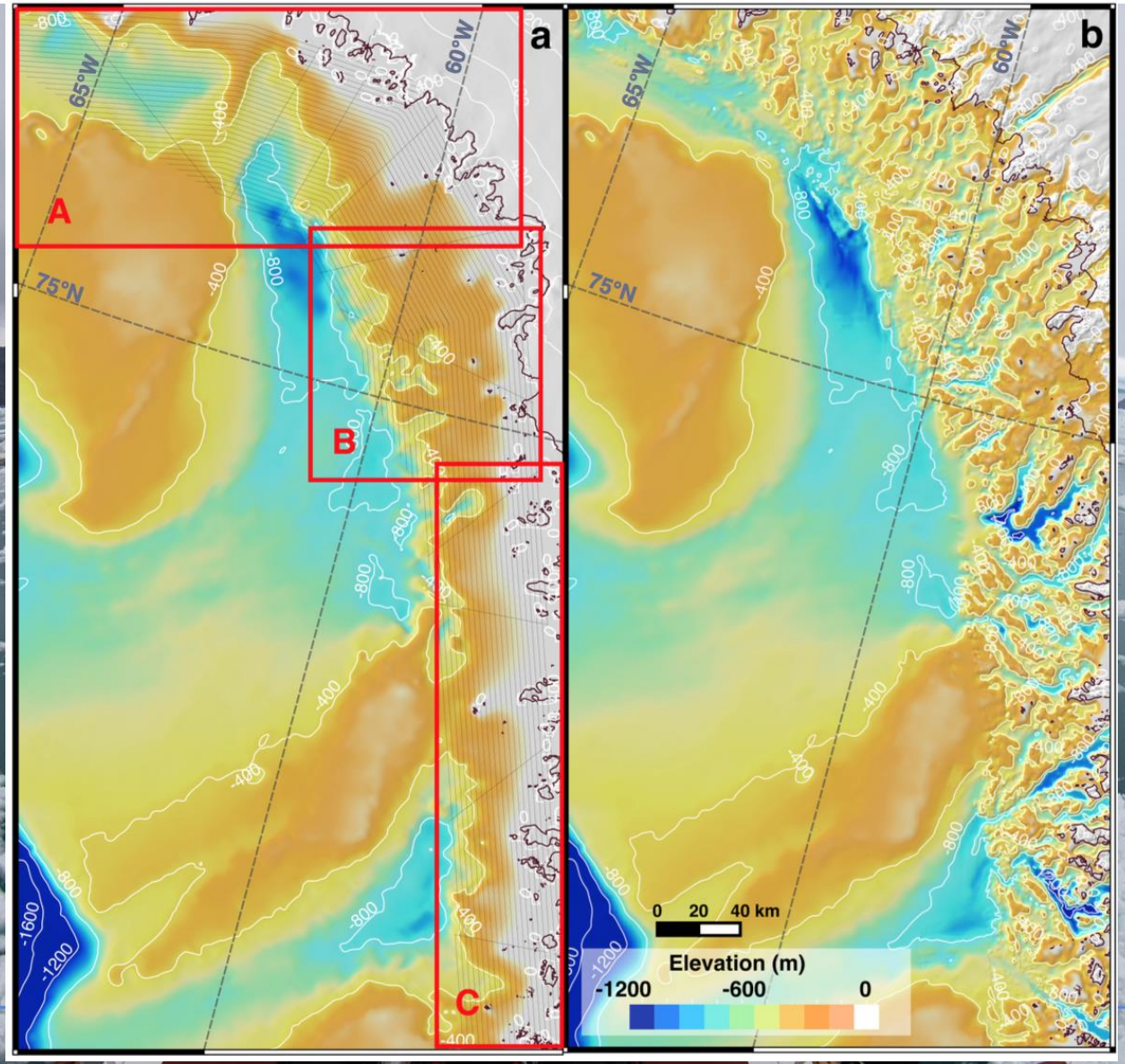








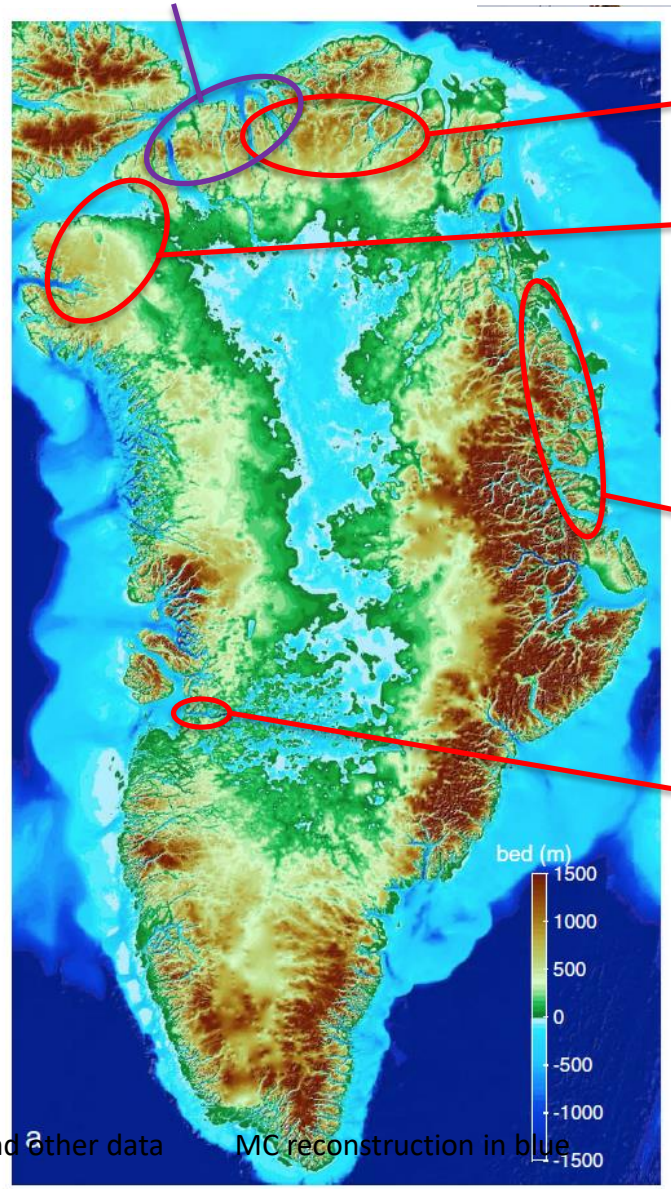
IBCAO Ver. 3.0



OMG

OMG bathymetry in Greenland and OIB gravity work in Antarctica

Gravity Summer 2020



GLACE 2021

Northwest summer 2019

Northeast summer 2020

Jakobshavn April 2020

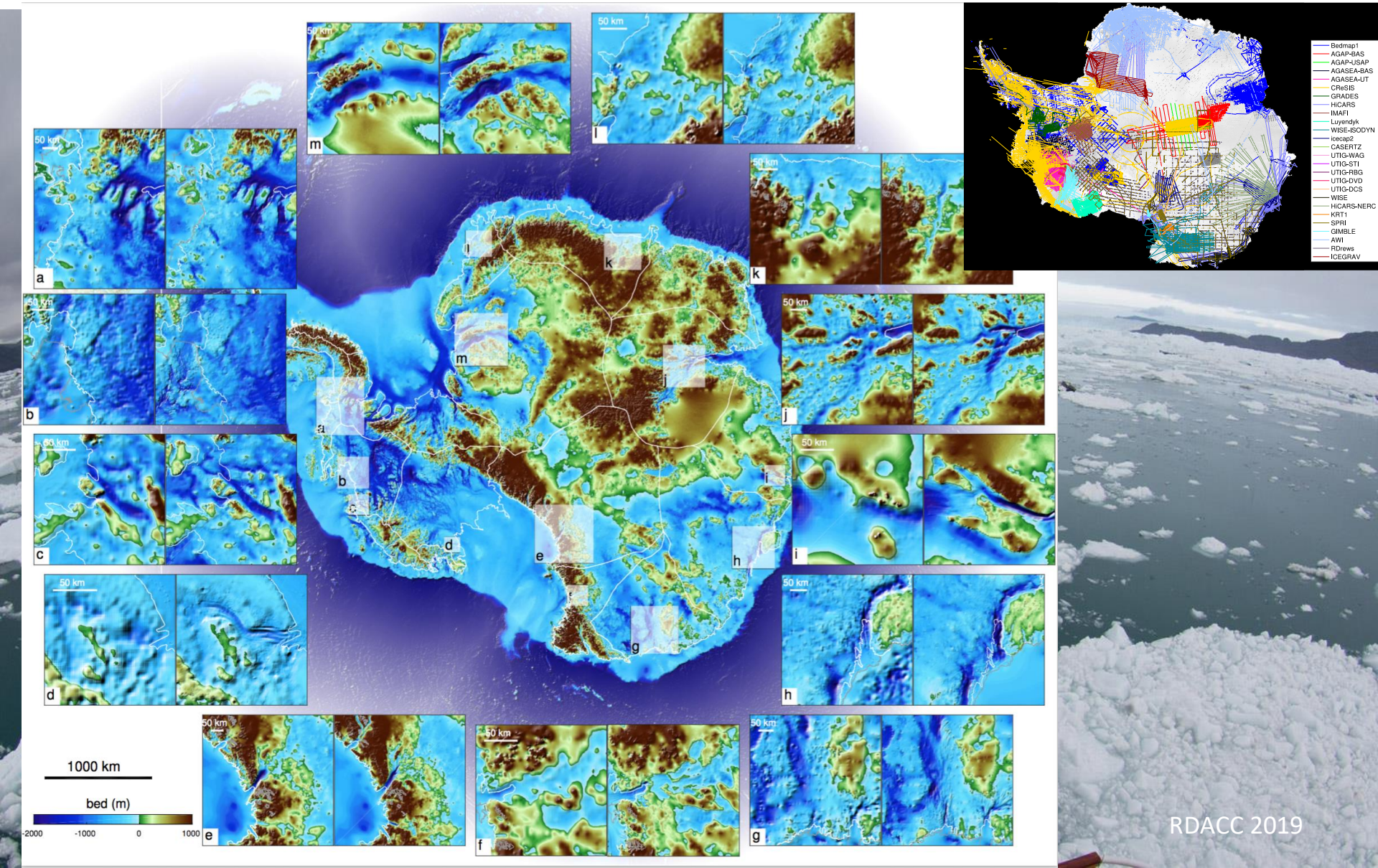
OIB, OMG and other data

MC reconstruction in blue

RDACC 2019

OMG bathymetry in Greenland and OIB gravity work in Antarctica

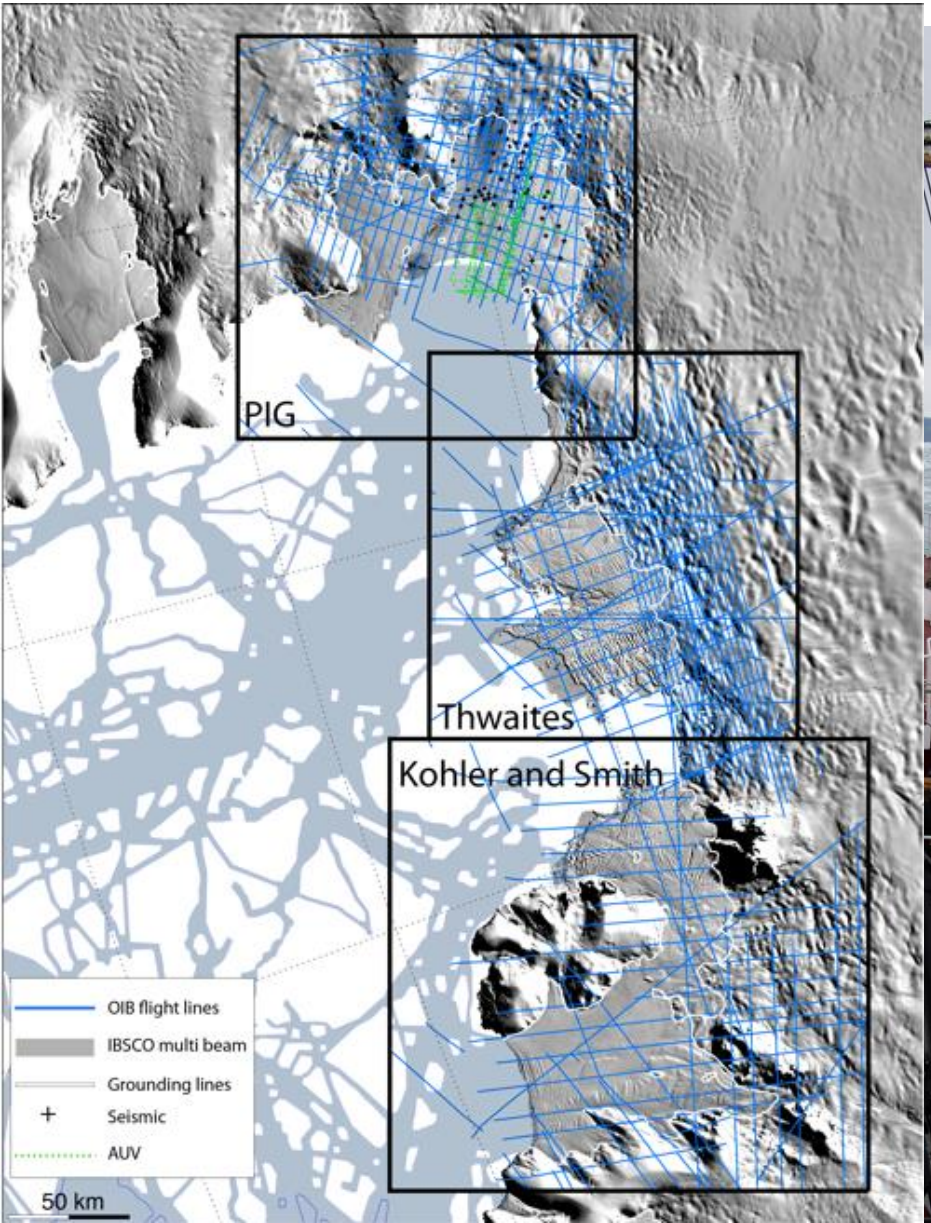
Morlighem et al., BedMachine Antarctica, Nature Geosci. 2019

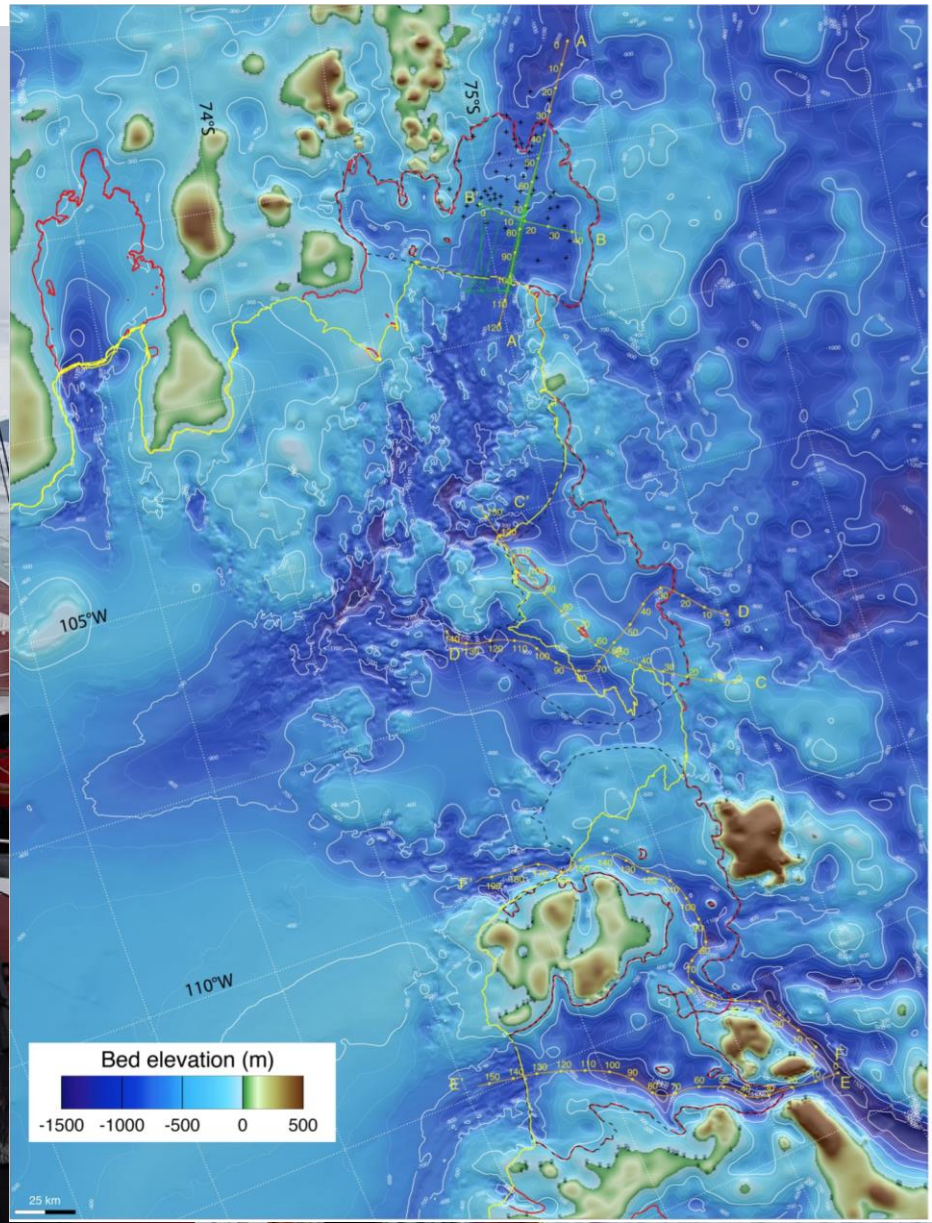


RDACC 2019

OMG bathymetry in Greenland and OIB gravity work in Antarctica

R. Millan[1], E. Rignot[1,2], V. Bernier[1], M. Morlighem[1], P. Dutrieux[3], Geophysical Research Letters, 2017.

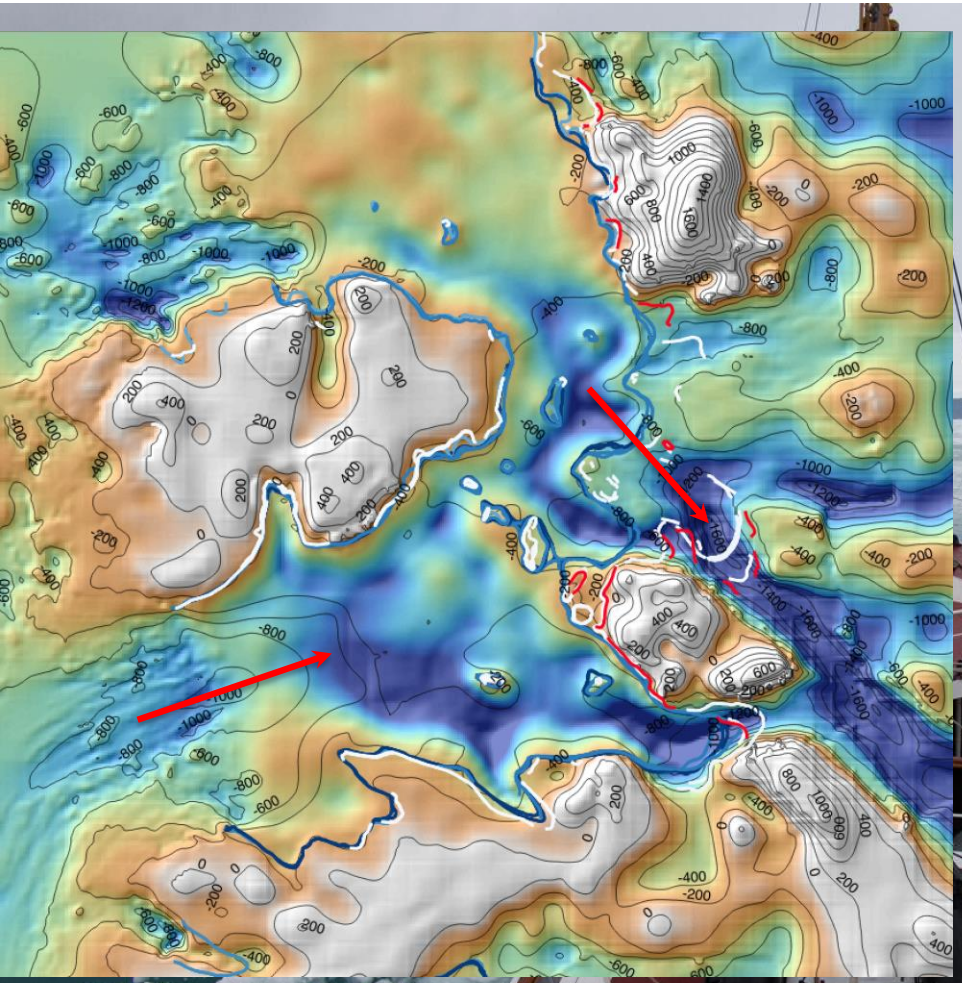


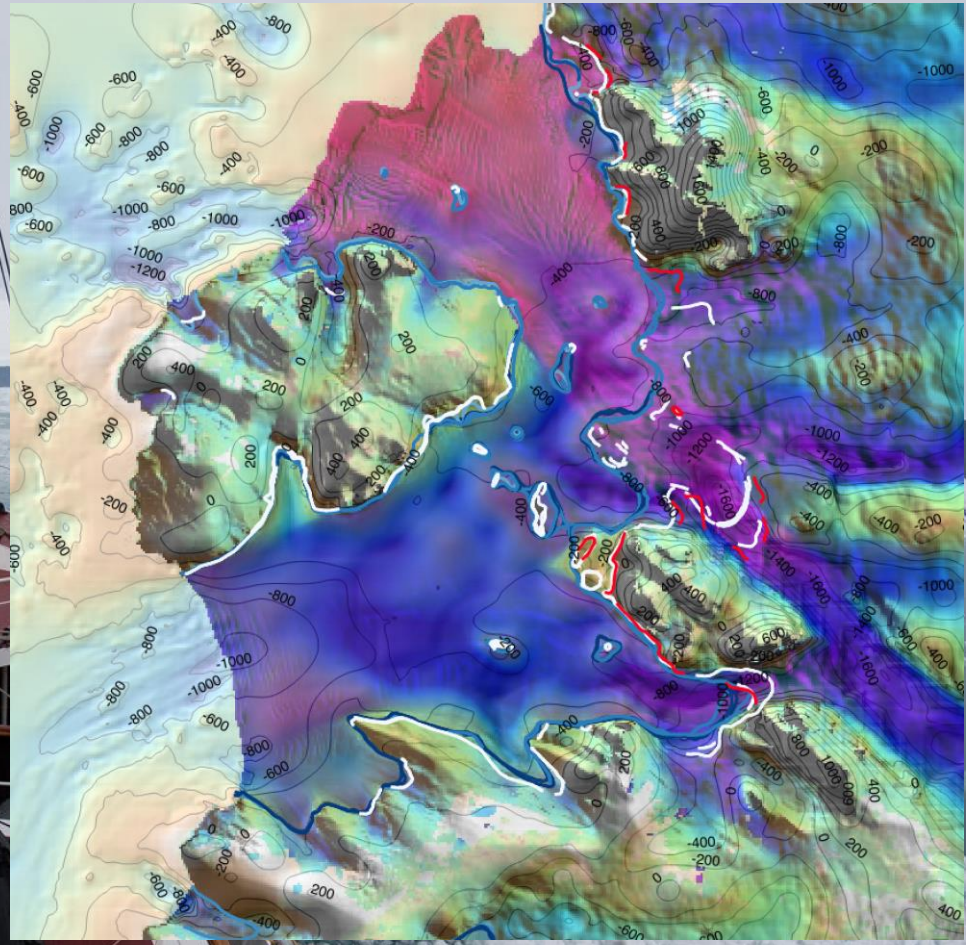


OMG bathymetry in Greenland and OIB gravity work in Antarctica

Flood gate#1, Amundsen Sea Sector, WAIS **(1.2m SLR)**

~ 88 km to go … 44 years?





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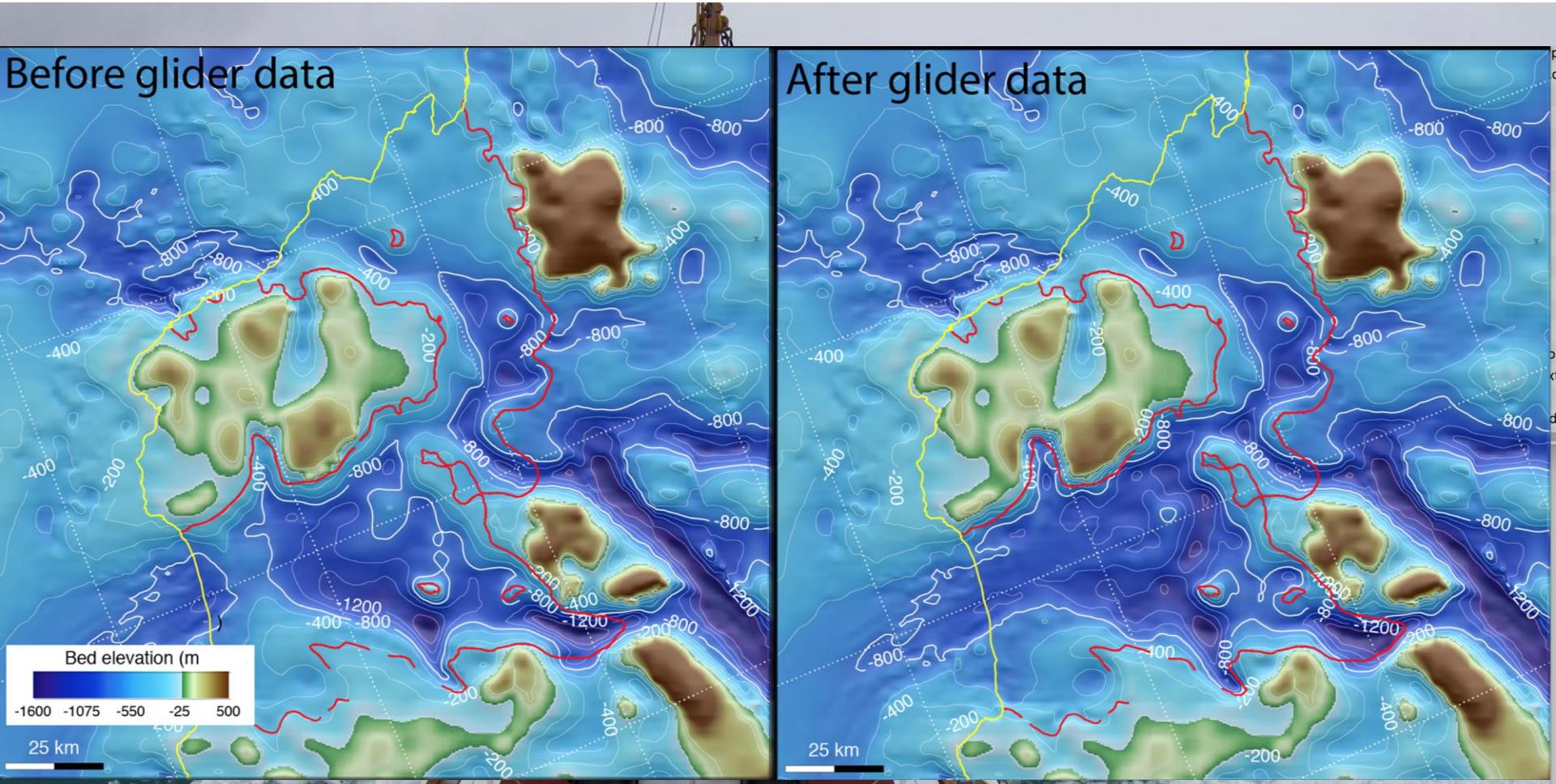
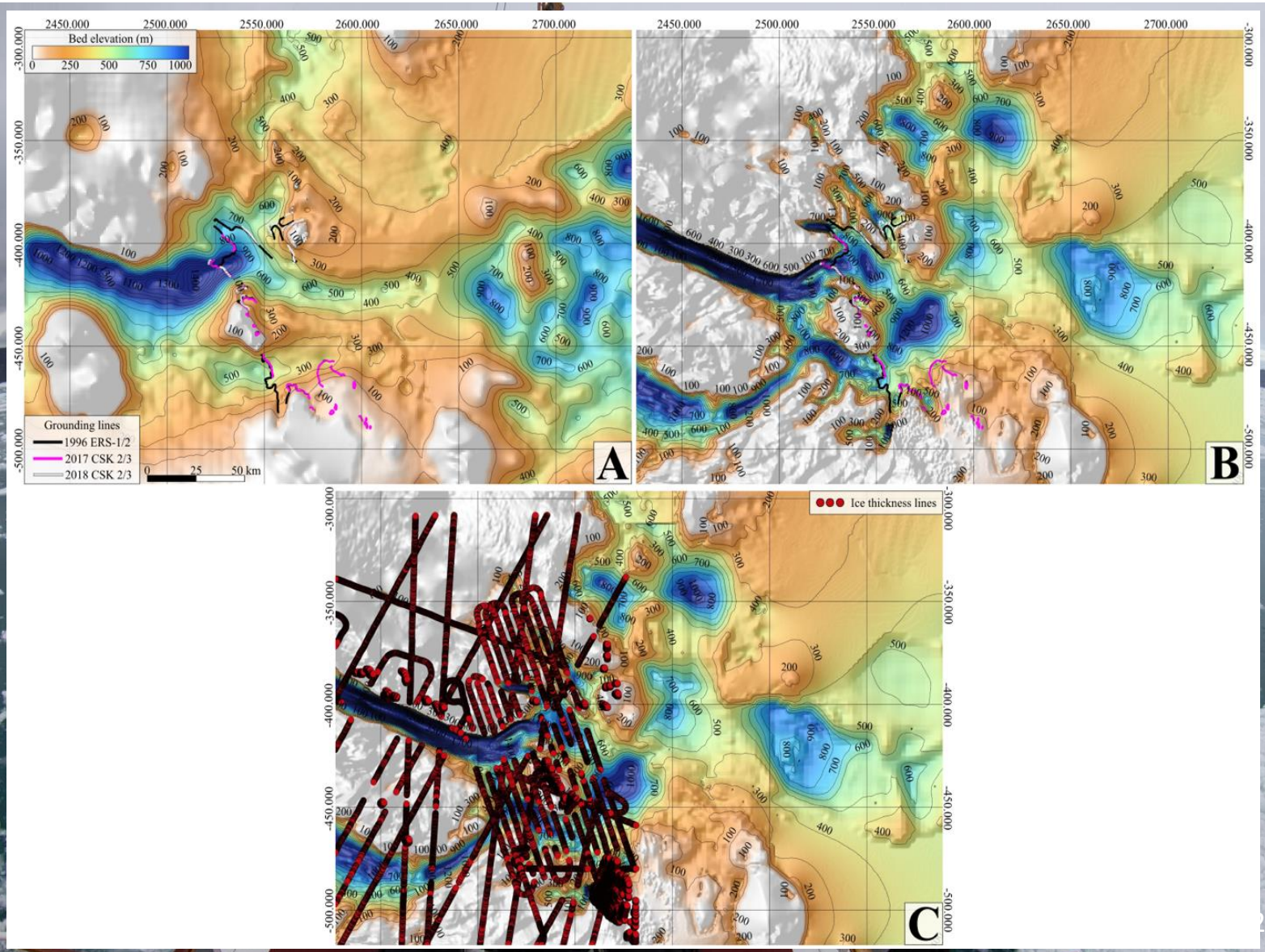
Dotson Ice Shelf: The glider story

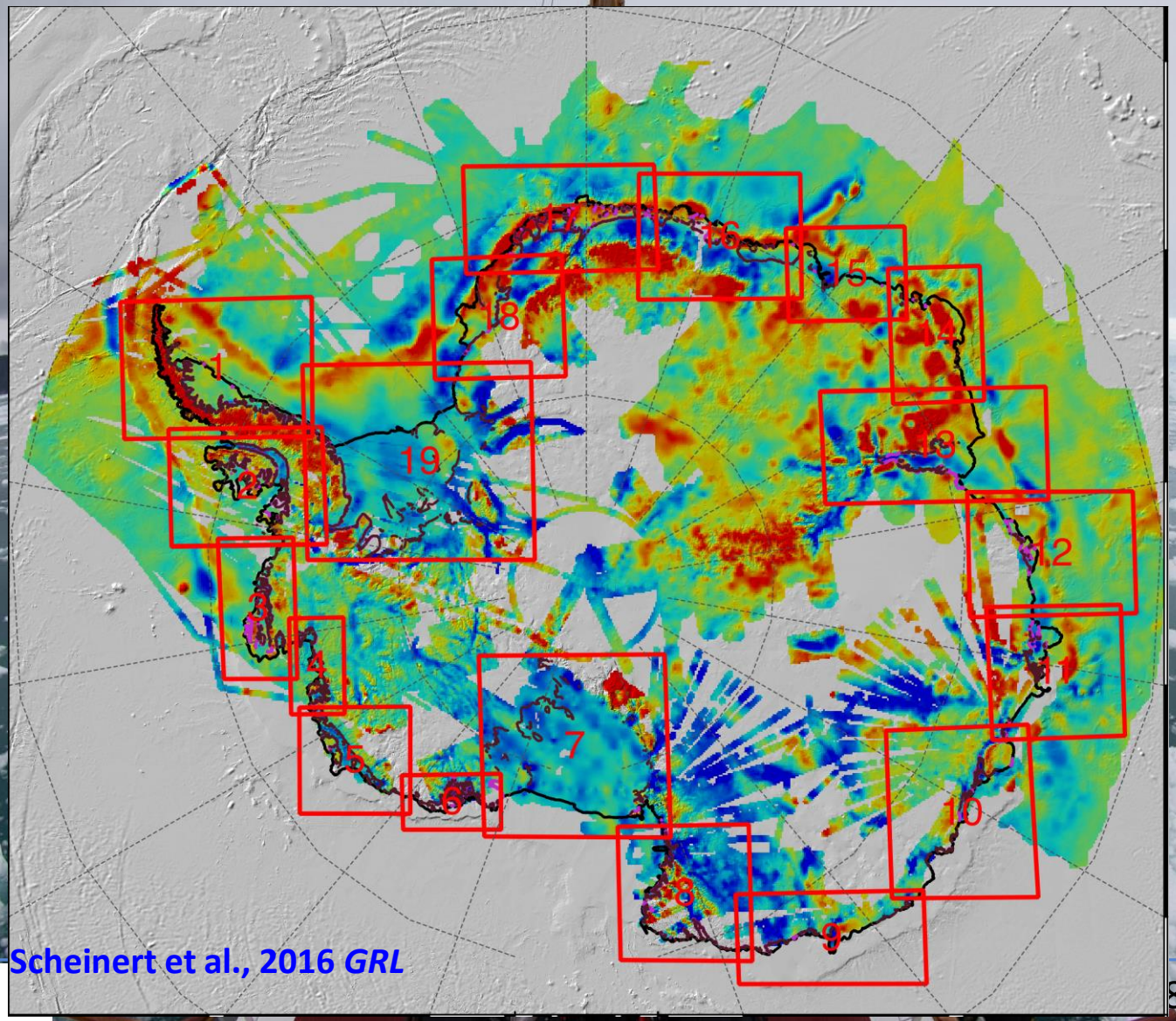


OMG bathymetry in Greenland and OIB gravity work in Antarctica

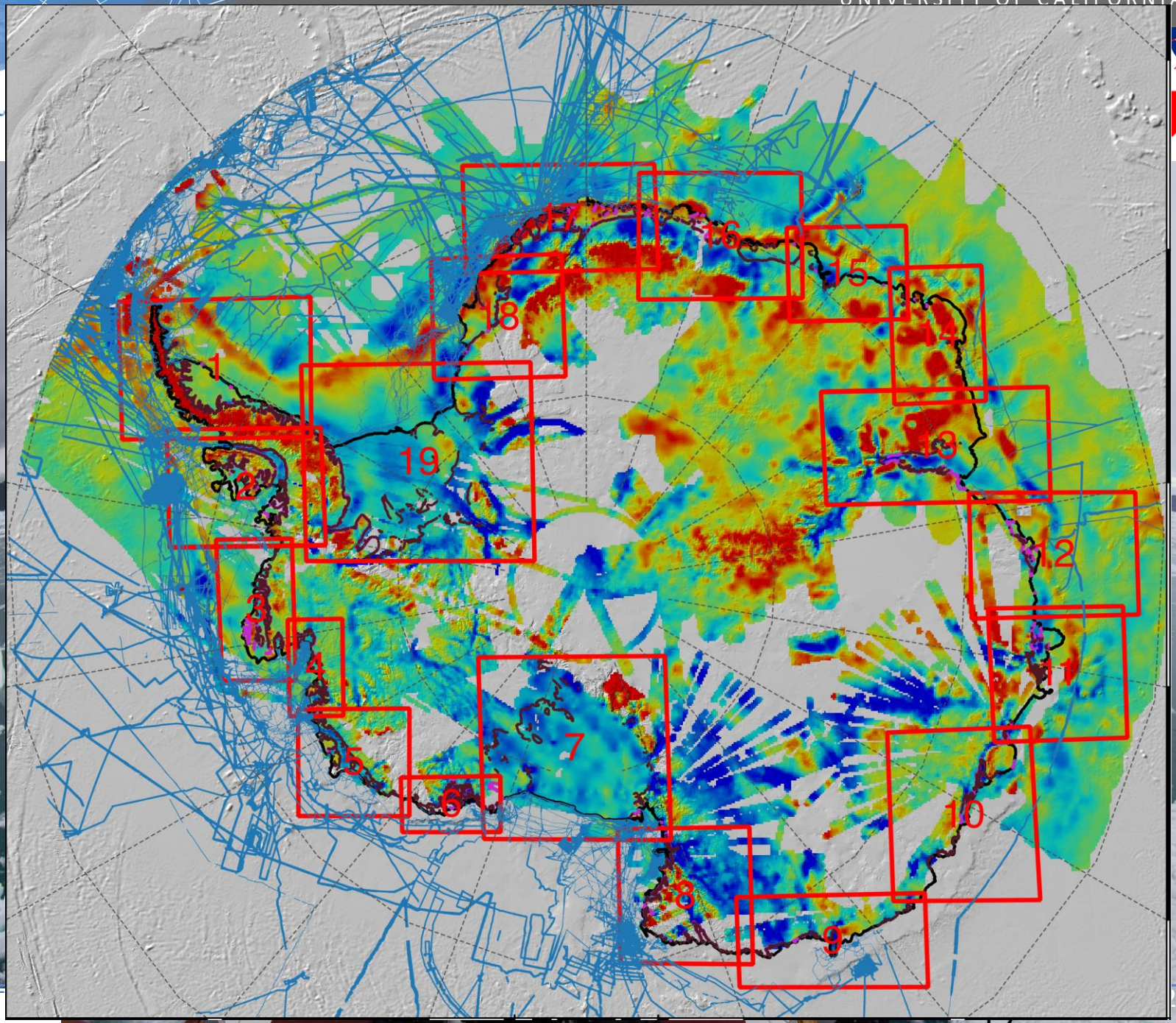
Brancatto et al., GRL, 2019 – Denman/Shackleton Ice Shelf



How about the rest of Antarctica?



Scheinert et al., 2016 *GRL*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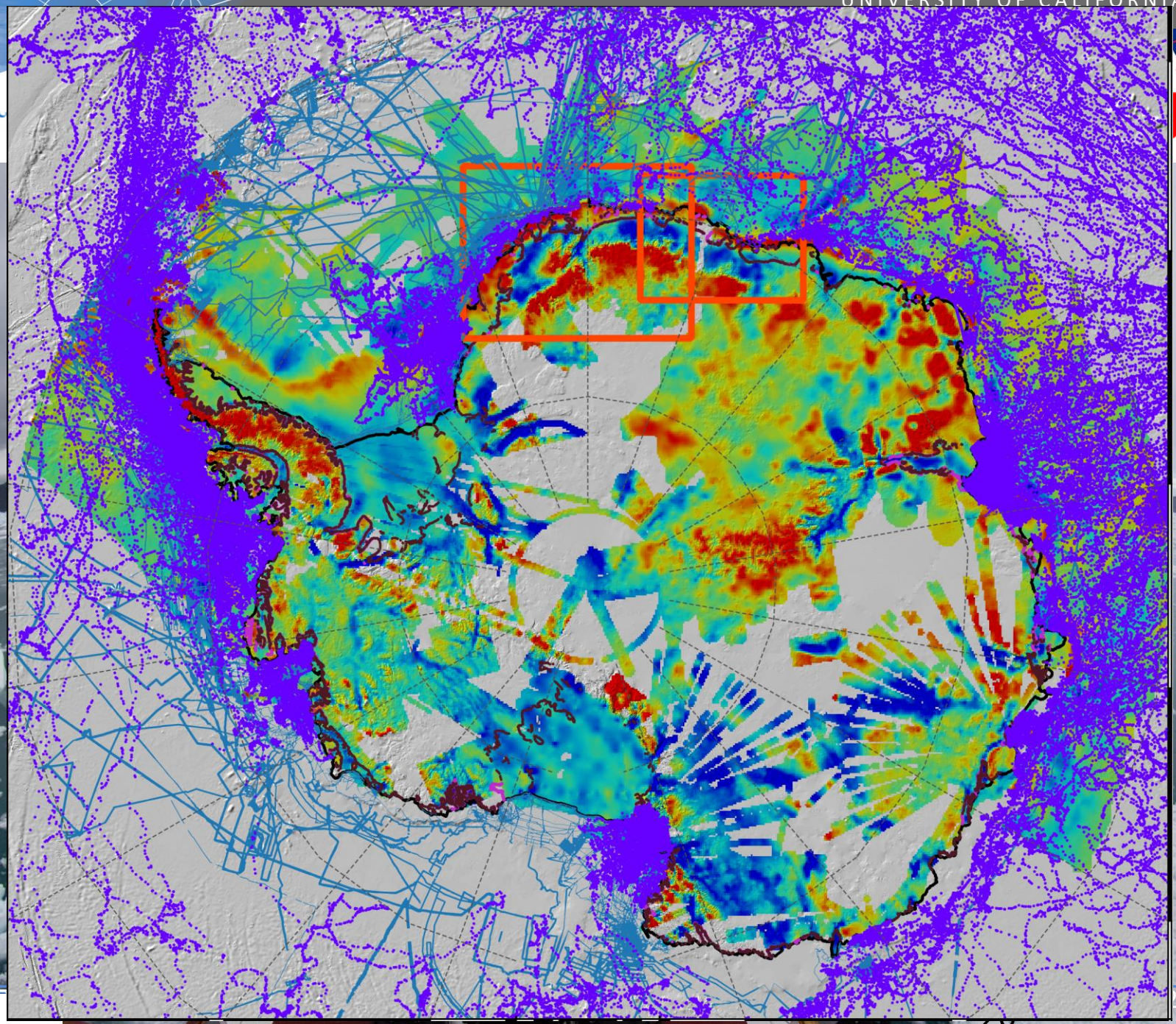
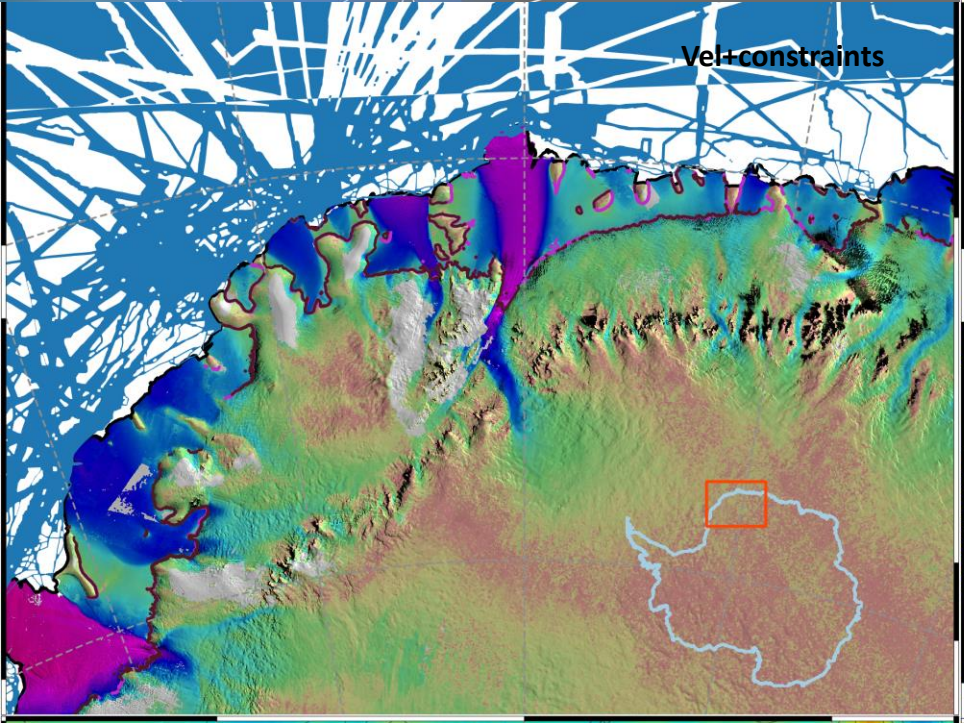
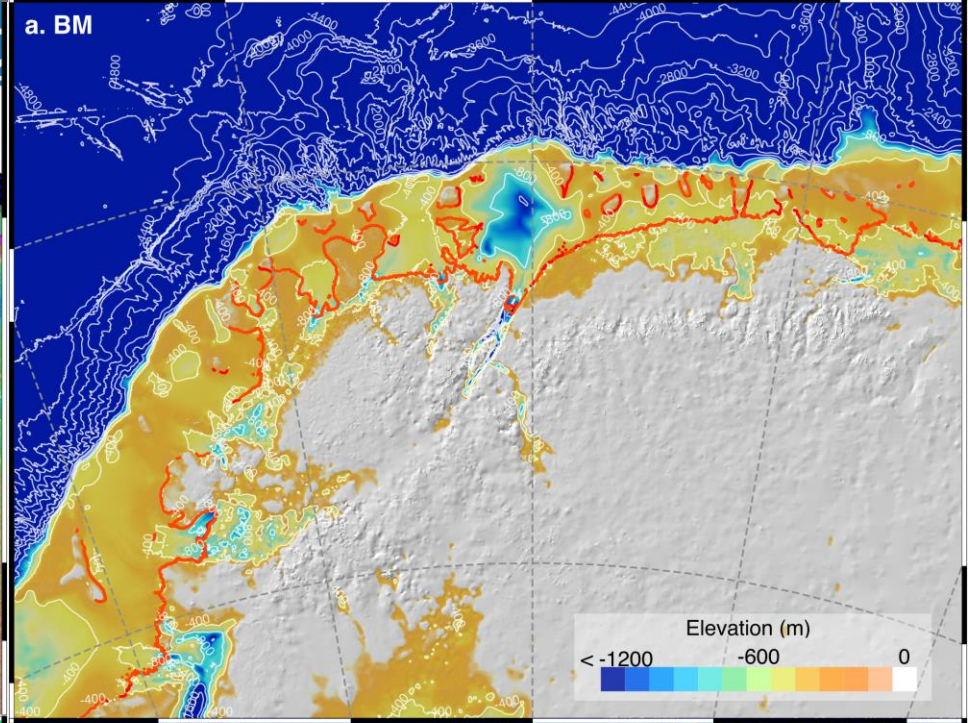
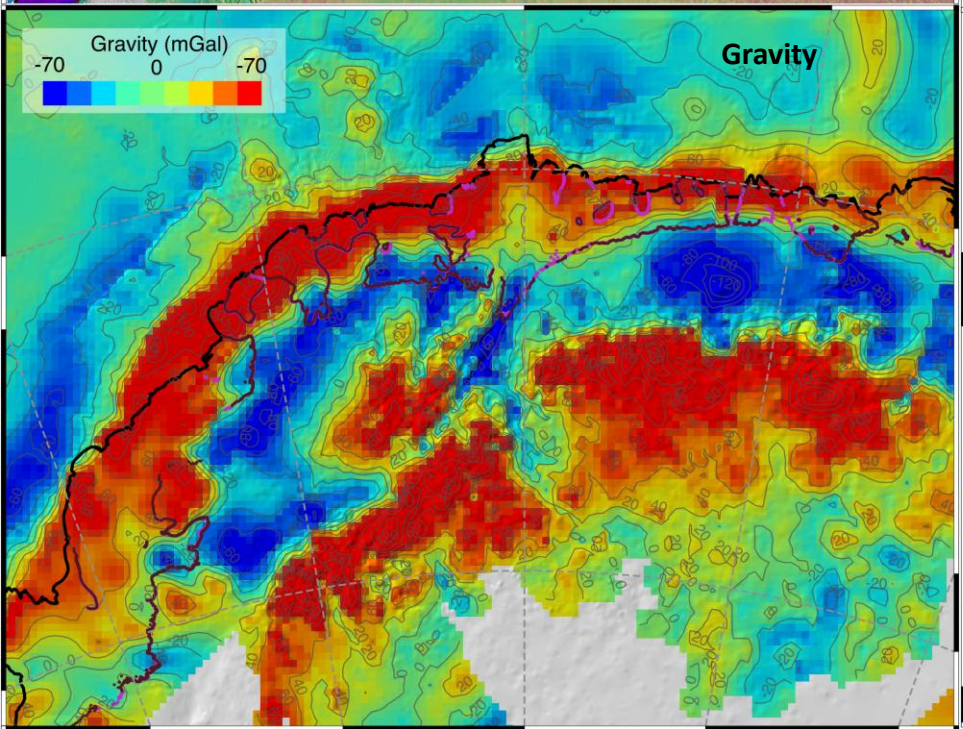
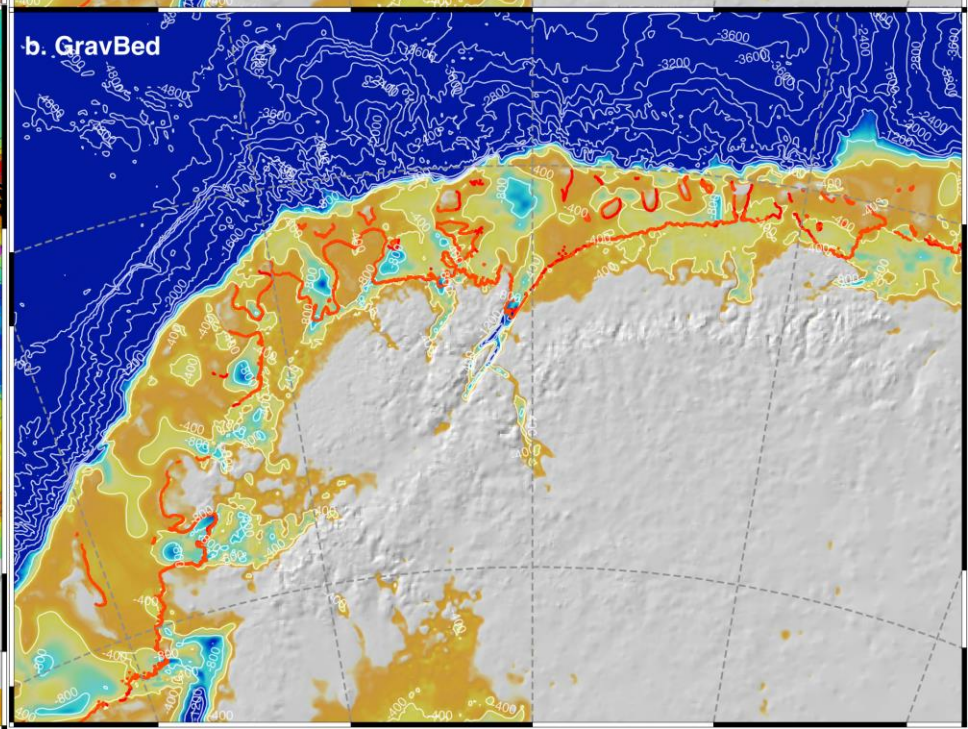
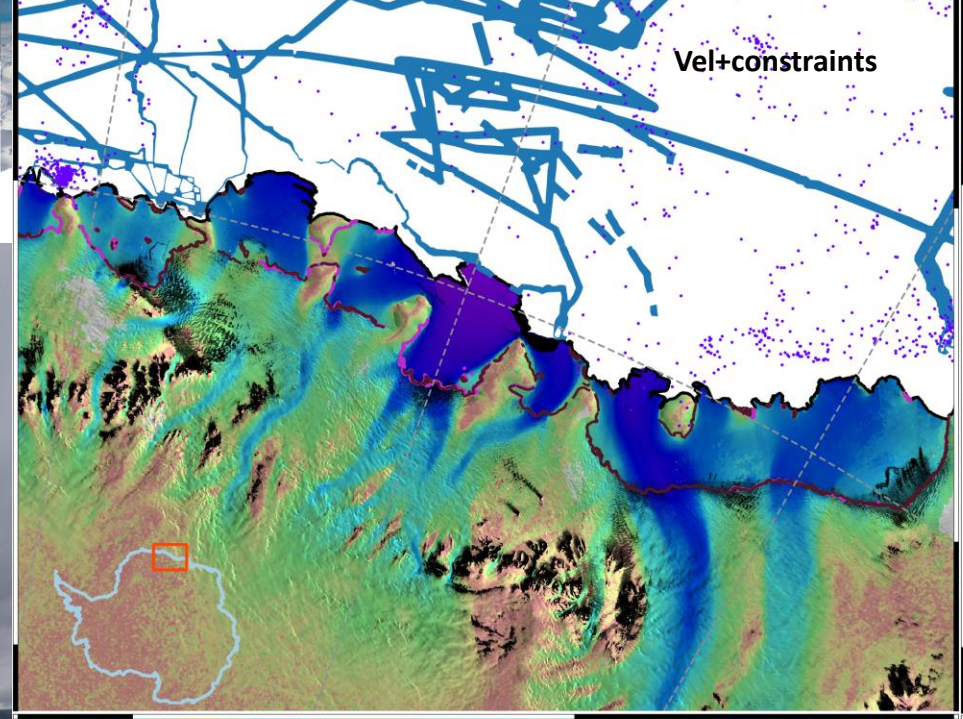


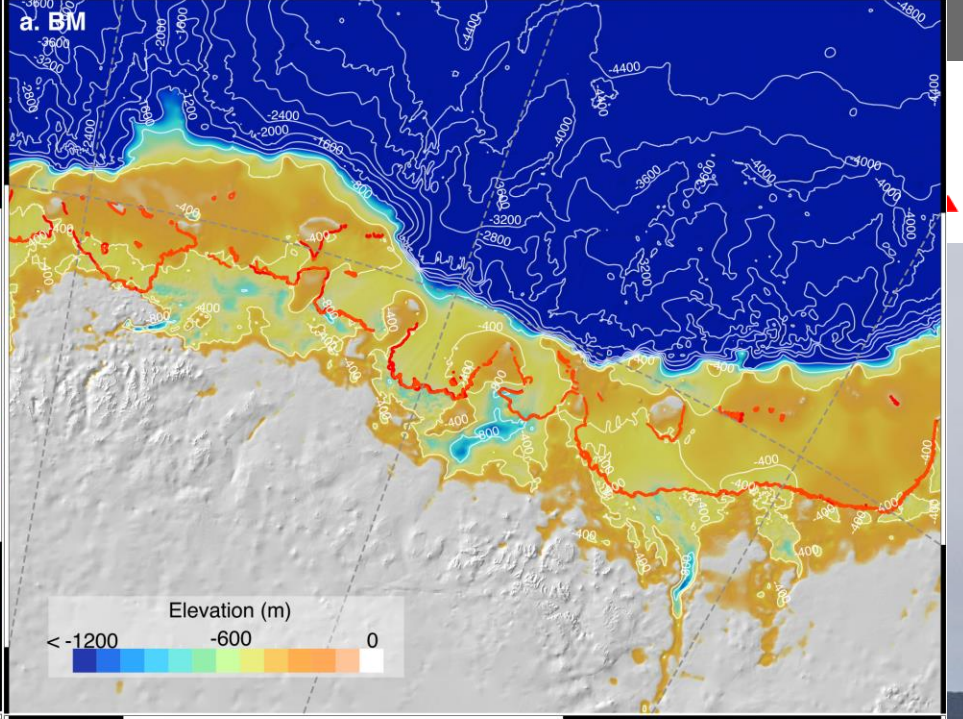

Vel+constraints

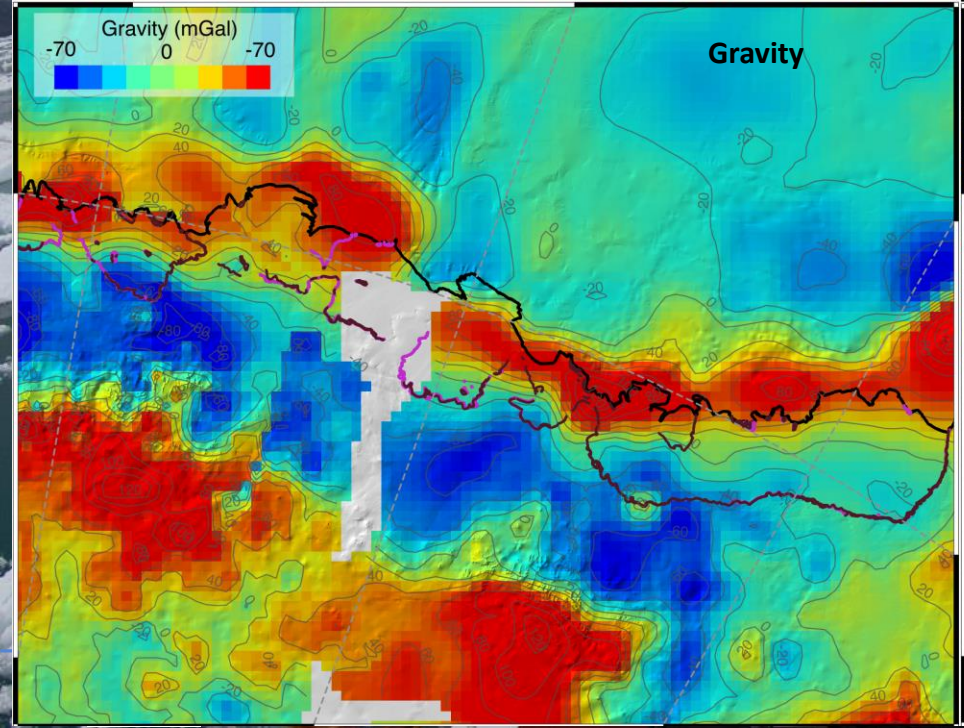

a. BM
Elevation (m)
< -1200
-600
0

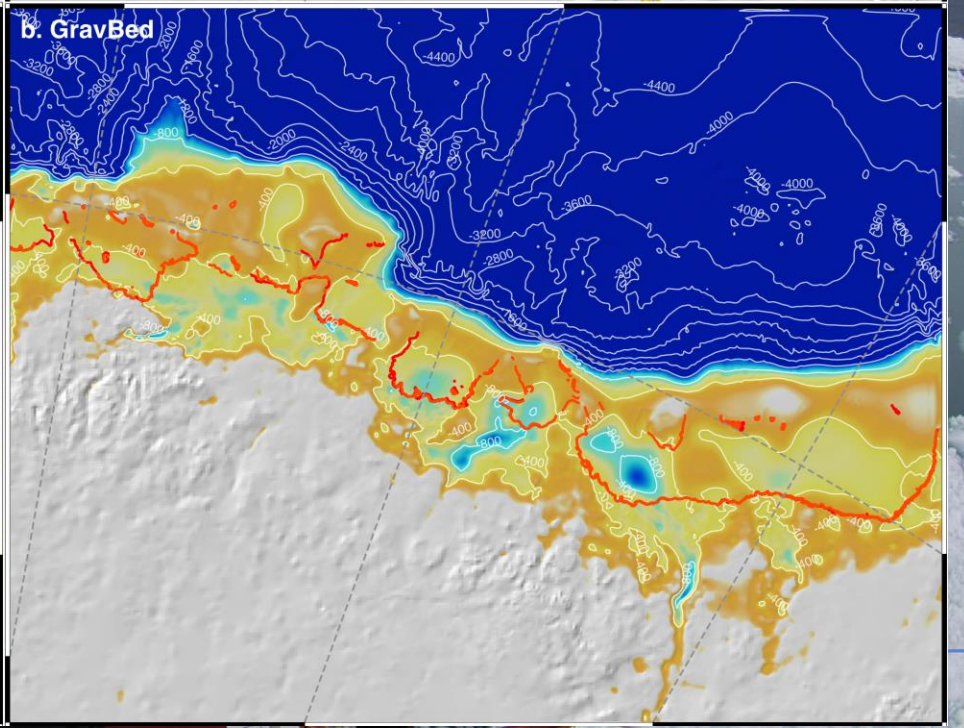

Gravity (mGal)
-70
0
-70
Gravity


b. GravBed


Vel+constraints


a. BM
Elevation (m)
< -1200
-600
0


Gravity (mGal)
-70
0
-70
Gravity


b. GravBed

Conclusions

- Bathymetry along the continental shelf, glacial fjords, and ice shelf cavities is critical for projections of sea level rise from melting ice sheets.
- OMG + other international efforts improved Greenland coastlines, with gaps in north and ice chocked fjords.
- Antarctica: ANTGG+MEOP+BedMachine is a potential approach for a circumpolar mapping at 10 km resolution, awaiting more MBES.
- We appreciate every effort made to contribute to a pole-to-pole bathymetry.