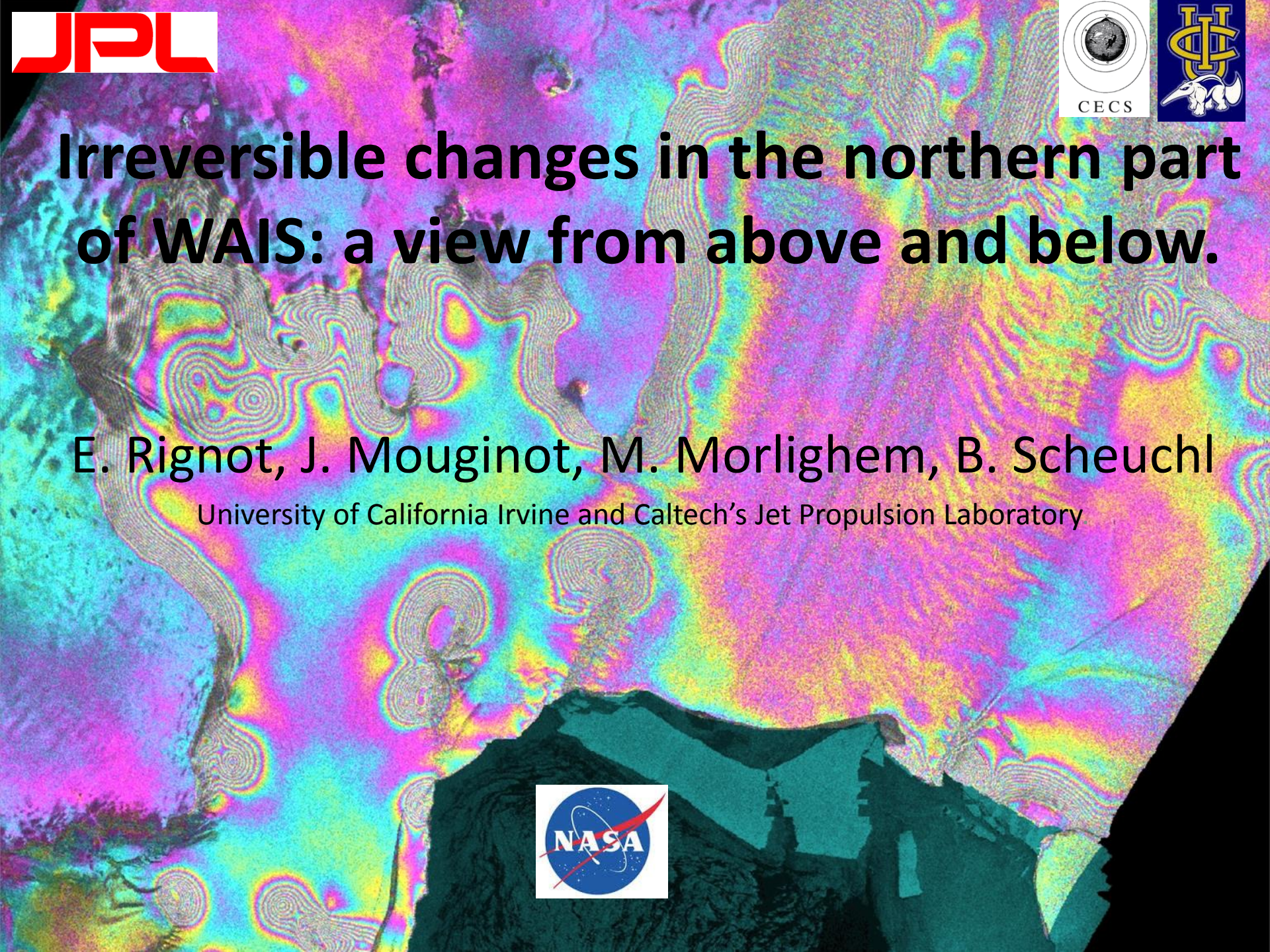
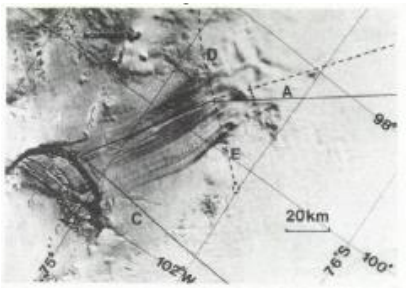


Irreversible changes in the northern part of WAIS: a view from above and below.

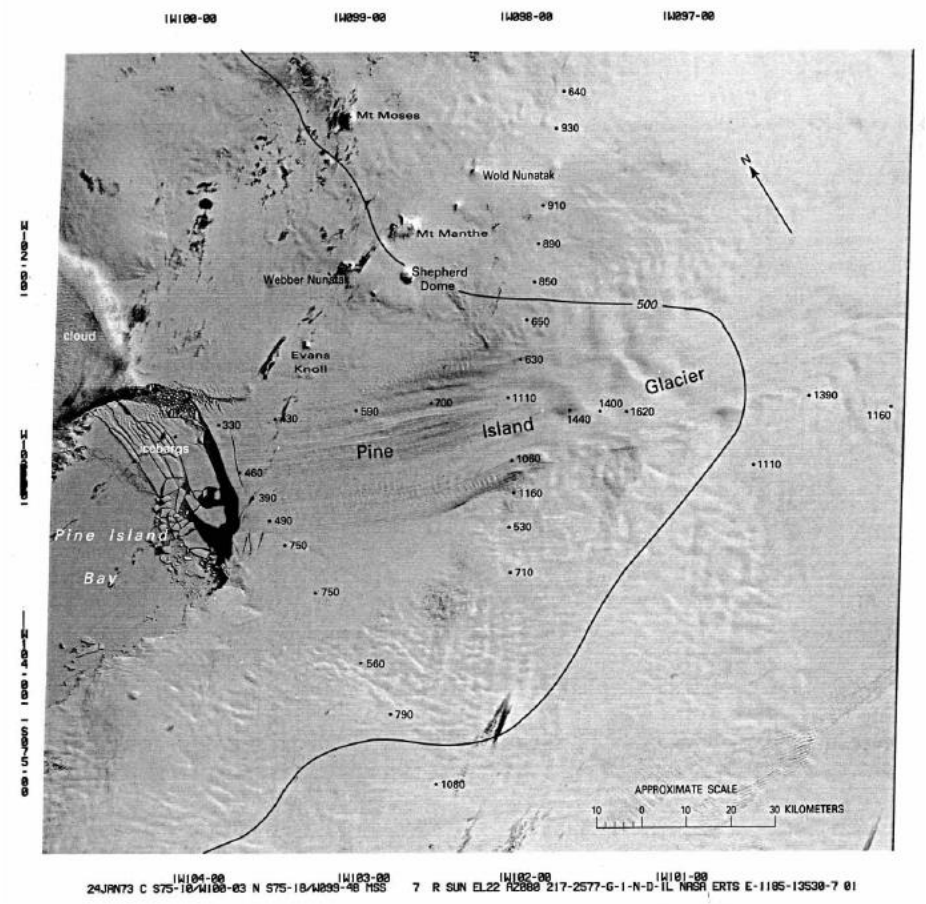
E. Rignot, J. Mouginot, M. Morlighem, B. Scheuchl

University of California Irvine and Caltech's Jet Propulsion Laboratory

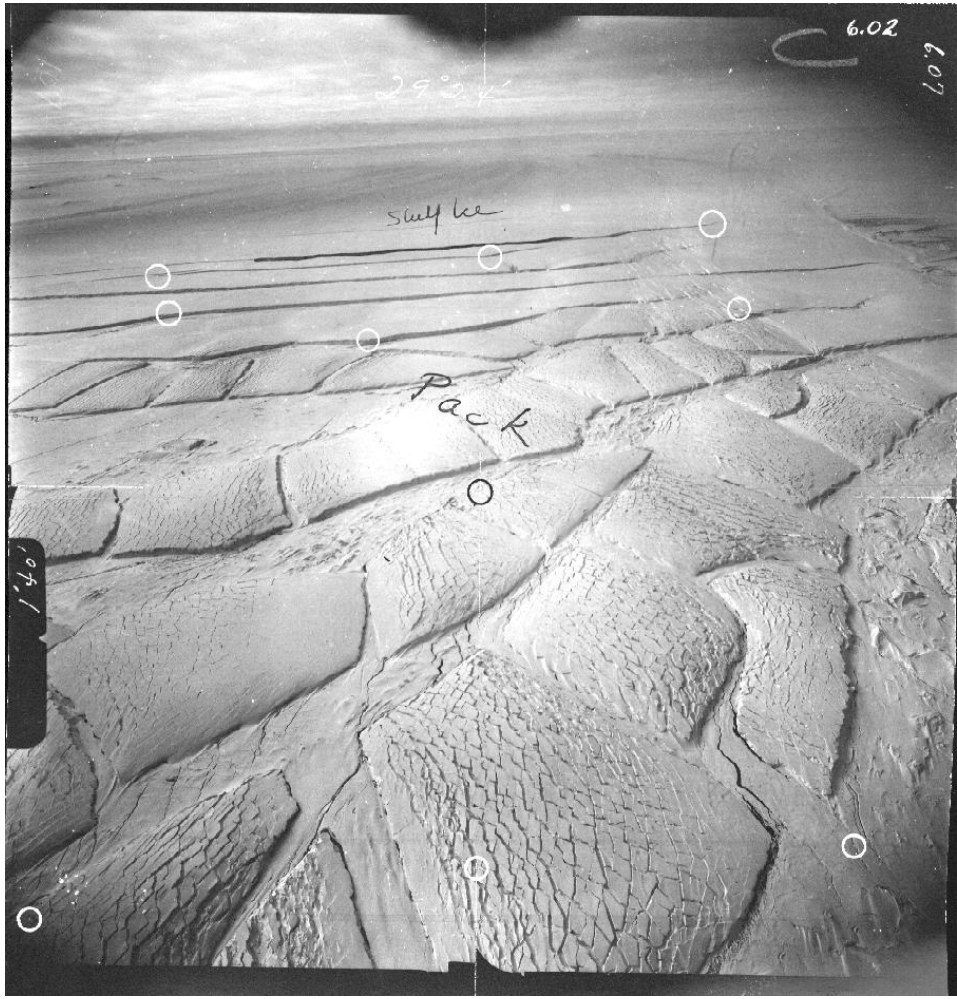
Pine Island Glacier



Crabtree and Doake, 1982

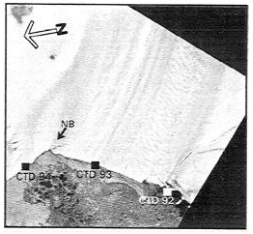


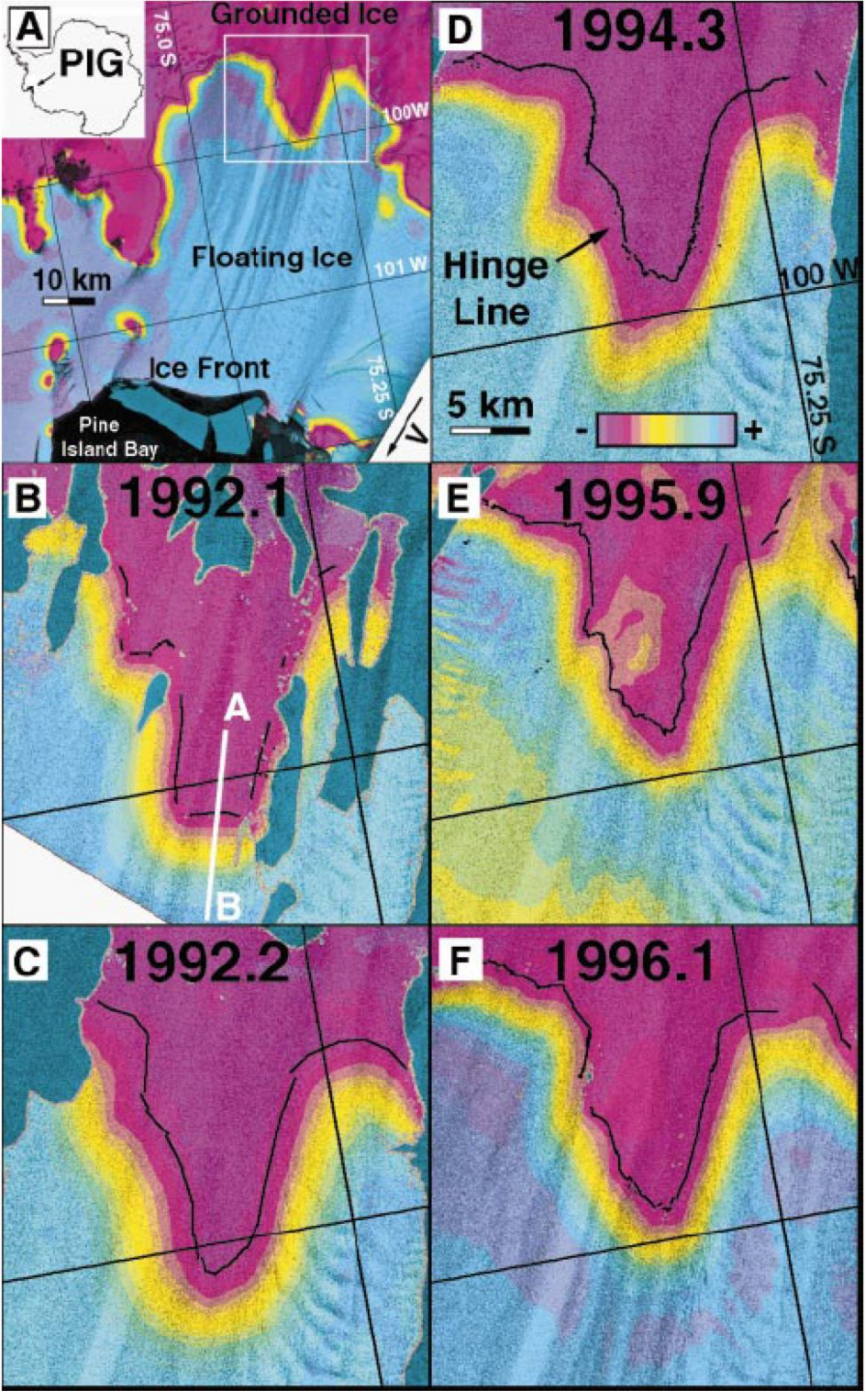
C. Swithinbank, USGS An. Atlas P1386.

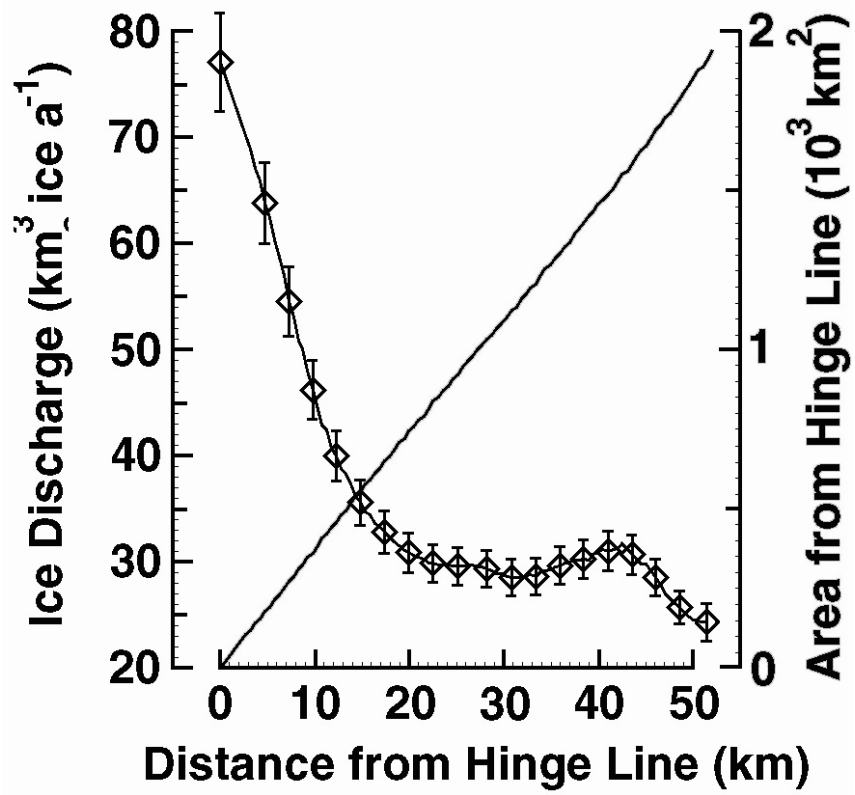


Operation High Jump, 1947

Antarctic ice sheet melting in the southeast Pacific, S. Jacobs and A. Jenkins, 1996: PIG melts @10-15 m/yr







- 1.2 km/yr GL retreat.
- 3.5 m/yr ice thinning
- 50 m/yr basal melting near GL
- (26 m/yr on average)

Rignot, 1998

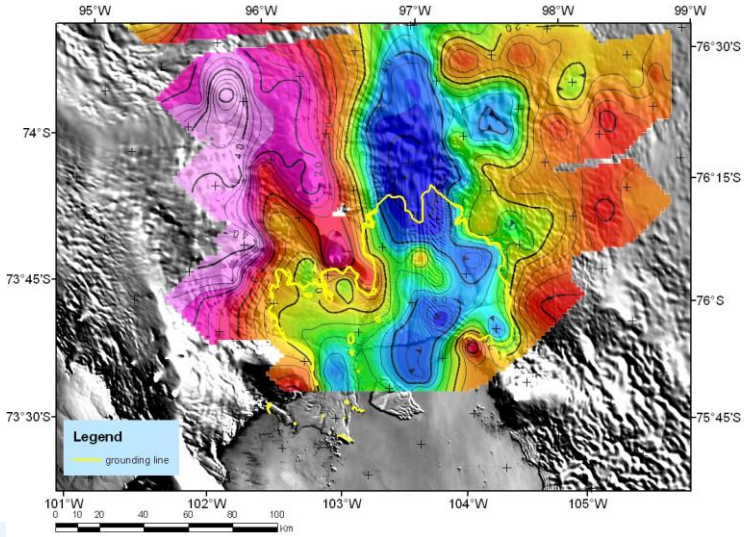
The CECS/NASA Airborne Campaign of Nov-Dec 2002

- C. Teitelbaum (CECS), B. Thomas (EG&G), W. Abdalati (NASA HQ)
- Plane on loan from Chilean Armada
- Instruments from NASA/Wallops and University of Kansas

CECS

NASA

JPL

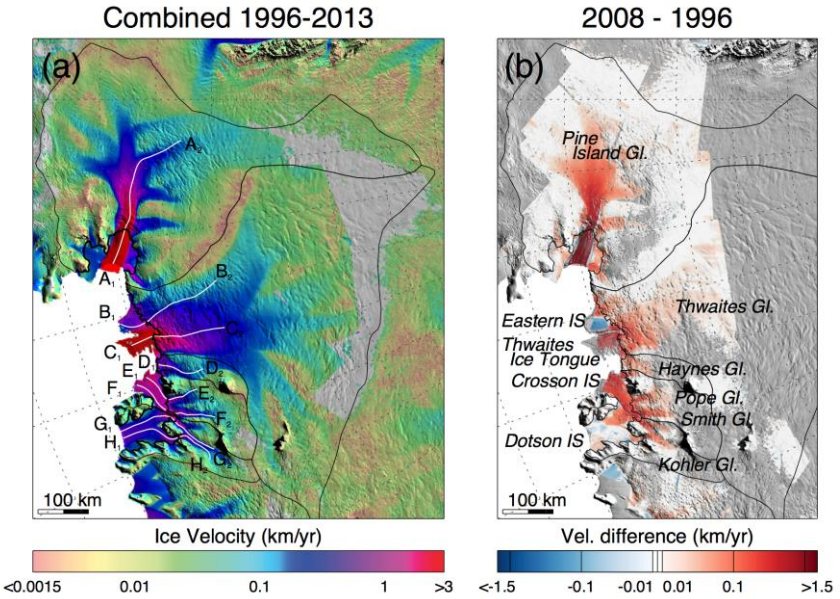


http://icebridge.gsfc.nasa.gov/?page_id=1360

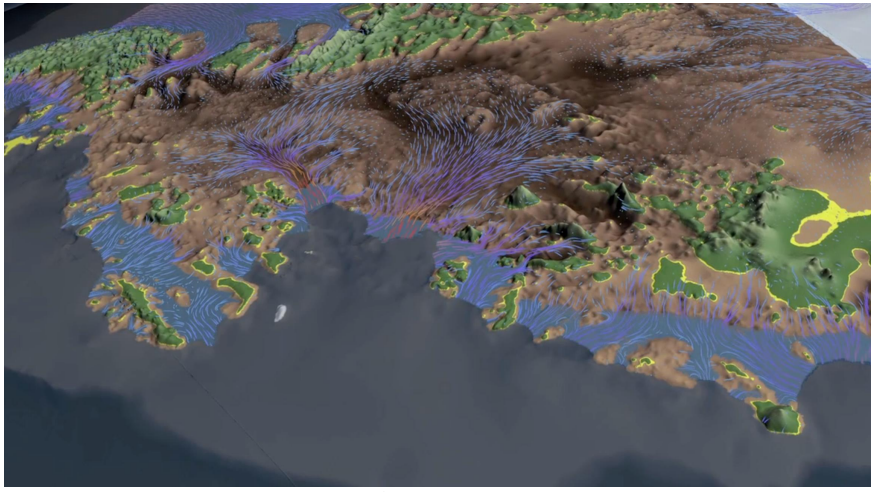

2002-044

West Antarctic glaciers passed the point of no return

- 40-yr acceleration in flow (L+InSAR) +77% since 1973, half of that in 2003-2009.
- 20-yr rapid grounding line retreat (InSAR) of 1 km/yr
- No hill in the bed upstream of 2011 GL.
- 1.2 m sea level rise equivalent.



ERS-1/2 InSAR ALOS PALSAR-ERS

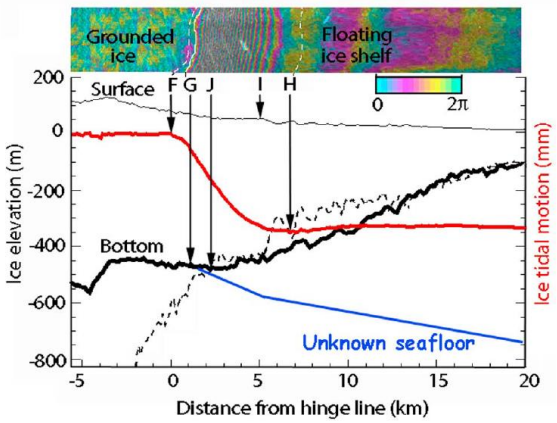


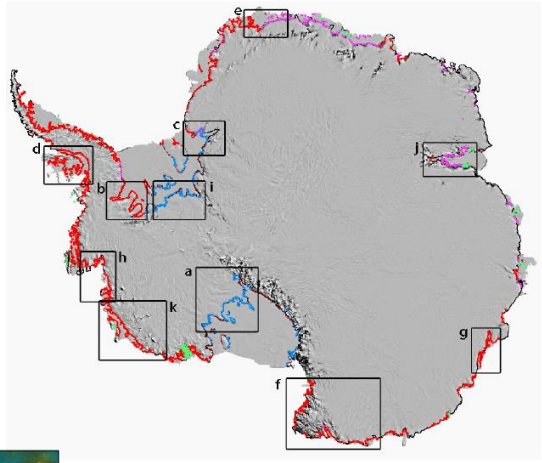
Bed topography from OIB data and InSAR

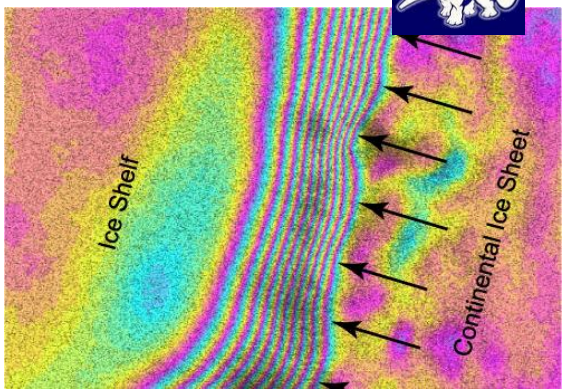
Rignot, E., J. Mouginot, M. Morlighem, H. Seroussi, and B. Scheuchl (2014), Widespread, rapid grounding line retreat of Pine Island, Thwaites, Smith, and Kohler glaciers, West Antarctica, from 1992 to 2011, Geophys. Res. Lett., 41, 3502–3509.

J. Mouginot, E. Rignot, B. Scheuchl, Sustained increase in ice discharge from the Amundsen Sea Embayment, West Antarctica, Geophys. Res. Lett. 41, 1576-1584.

Grounding line mapping

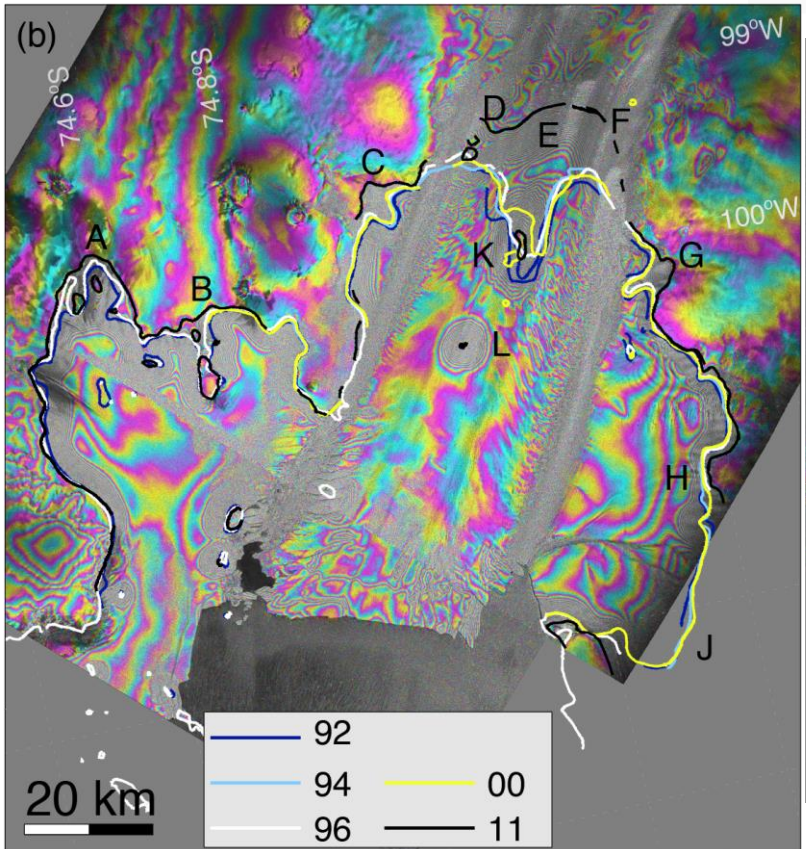


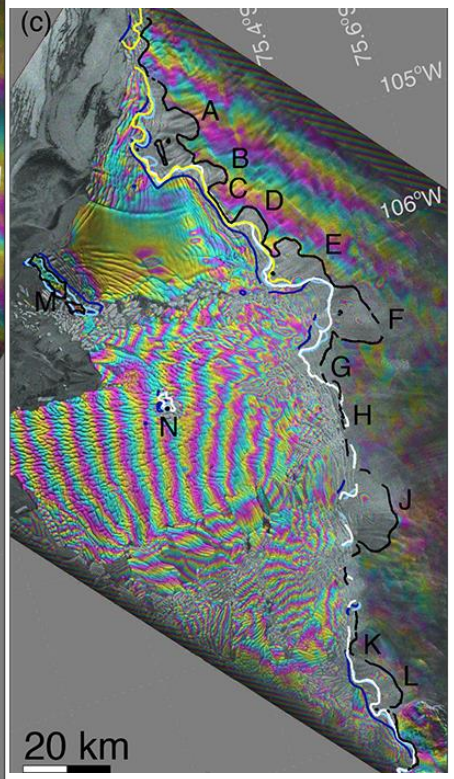


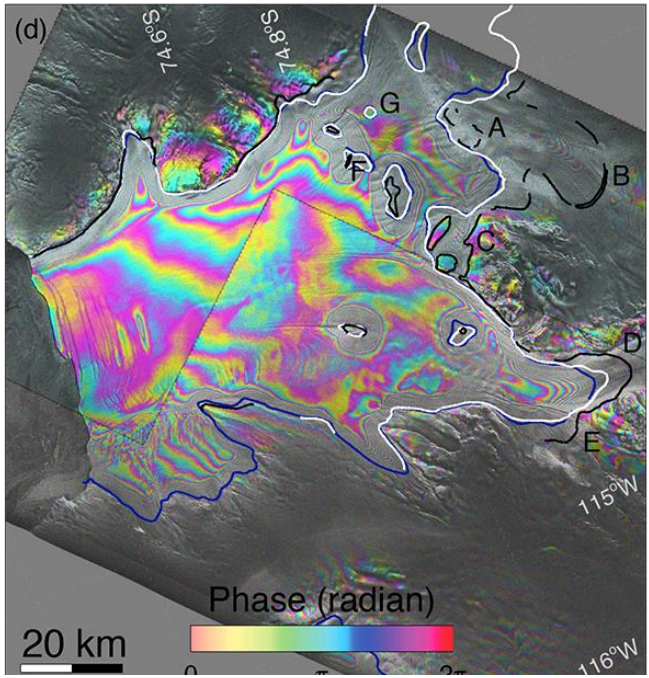


Rignot et al., GRL 2011; GRL 2014

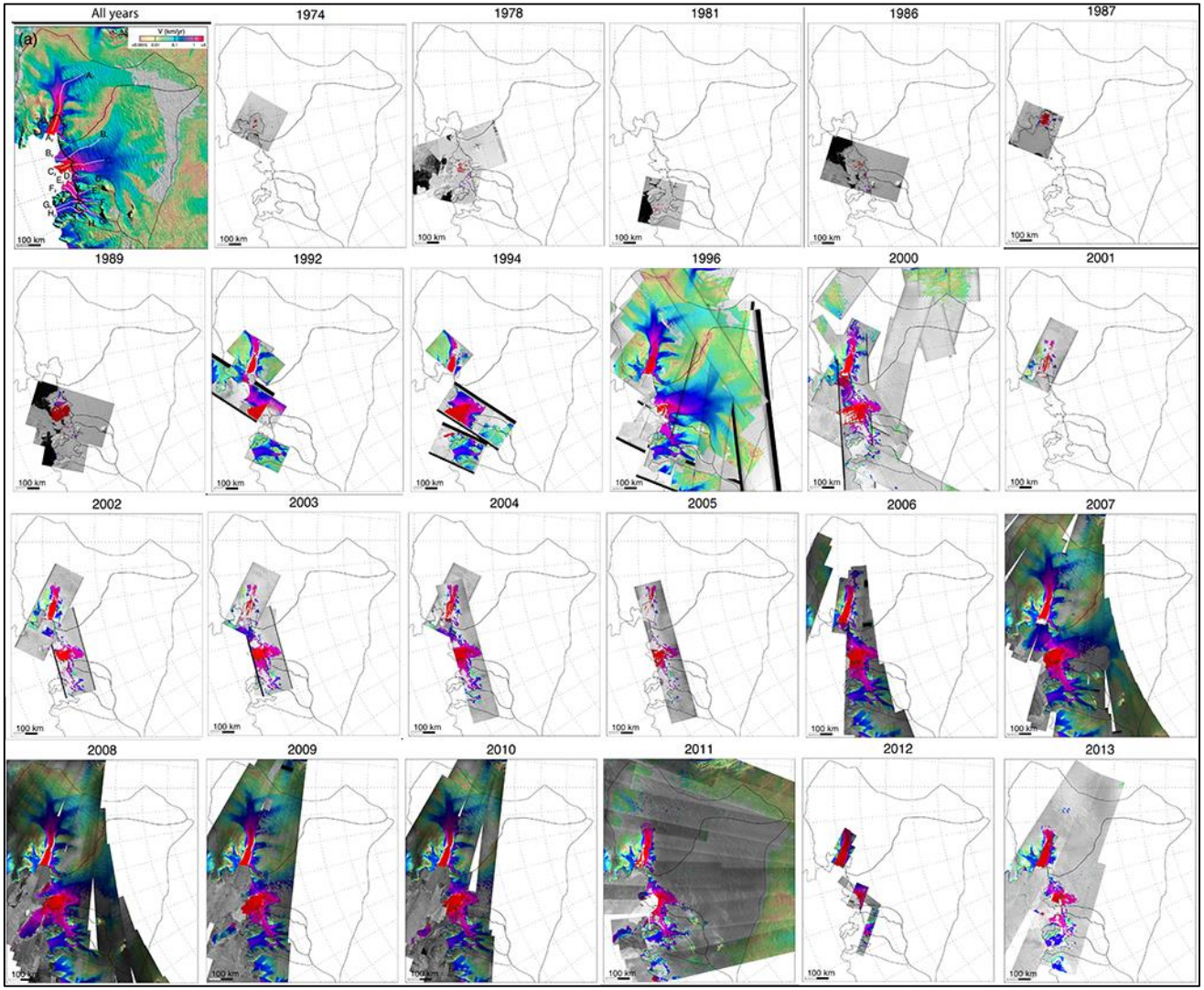
ERS-1/2 1992, 1994, 1996, 2000 and 2011.





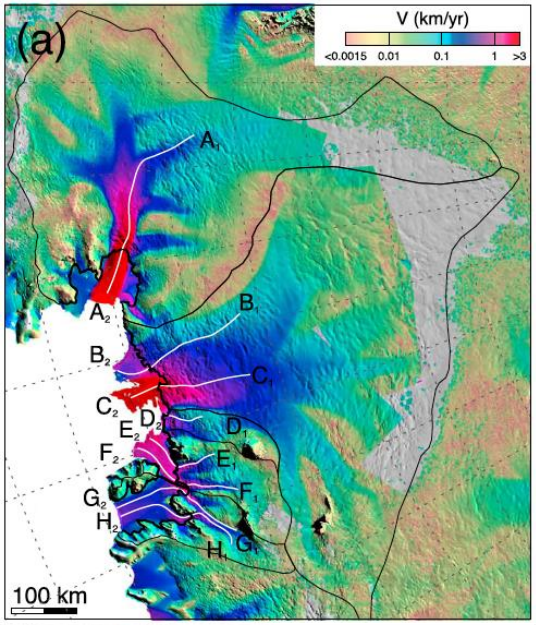


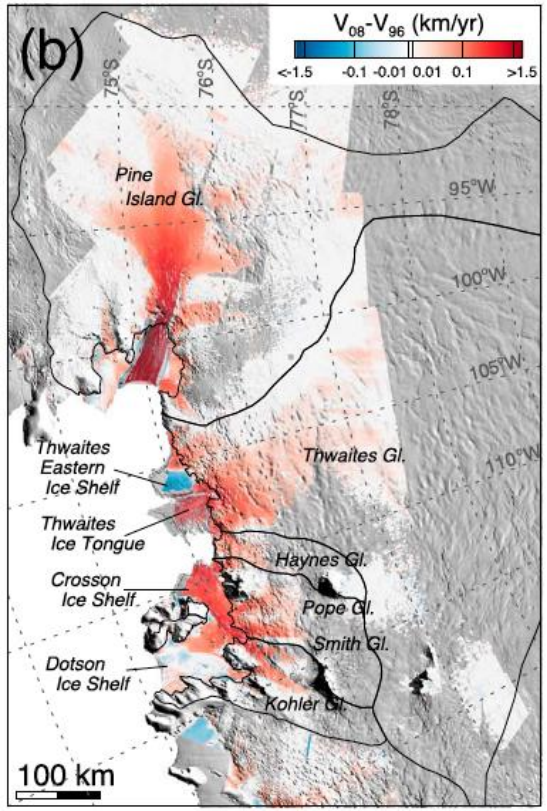
40 years of satellite data in West Antarctica

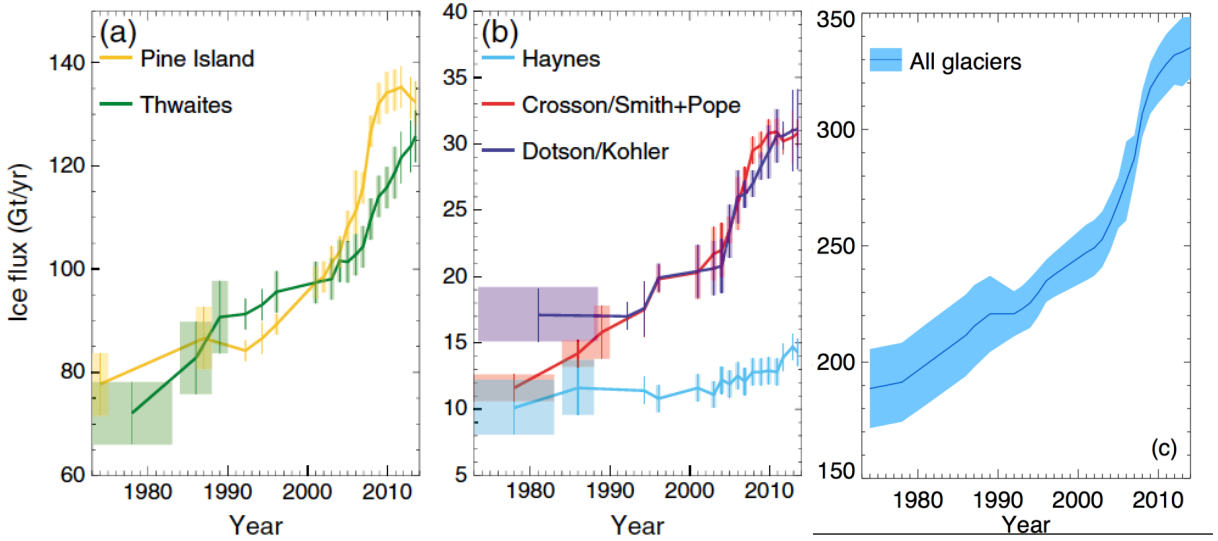


- In 40 years, only 2 near-complete mappings of ASE (1996 and 2008).
- Other collection are sporadic, sparse, of variable quality and cannot be used to constrain numerical ice sheet models (too many gaps).

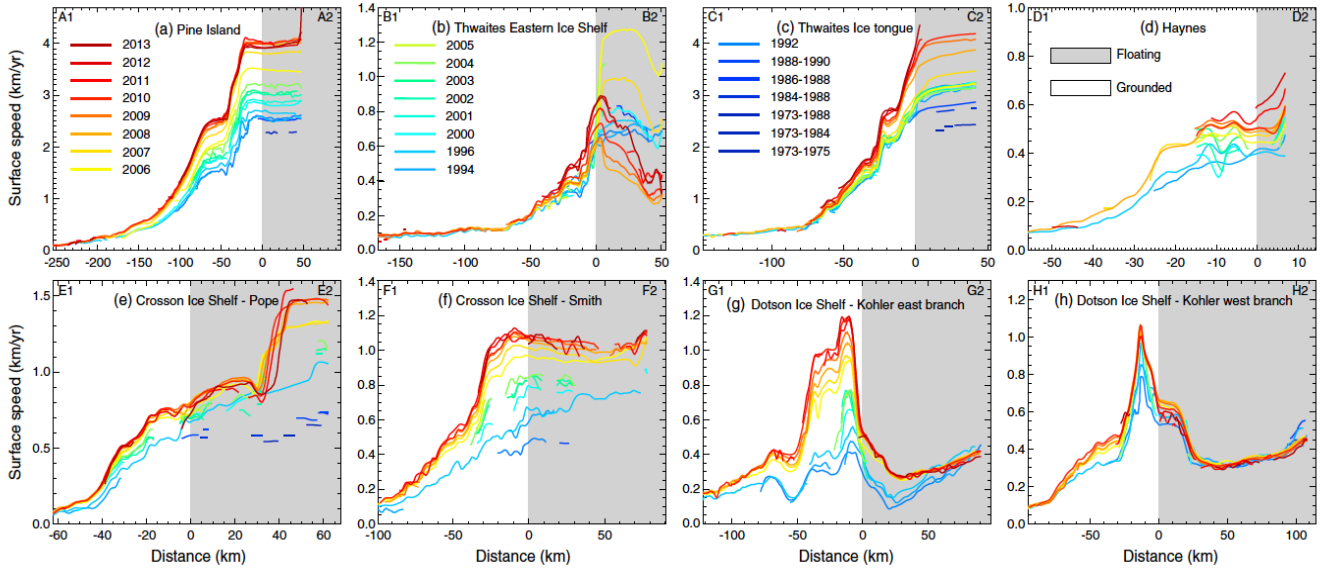
Time series of ice velocities: Amundsen Sea sector, West Antarctica.



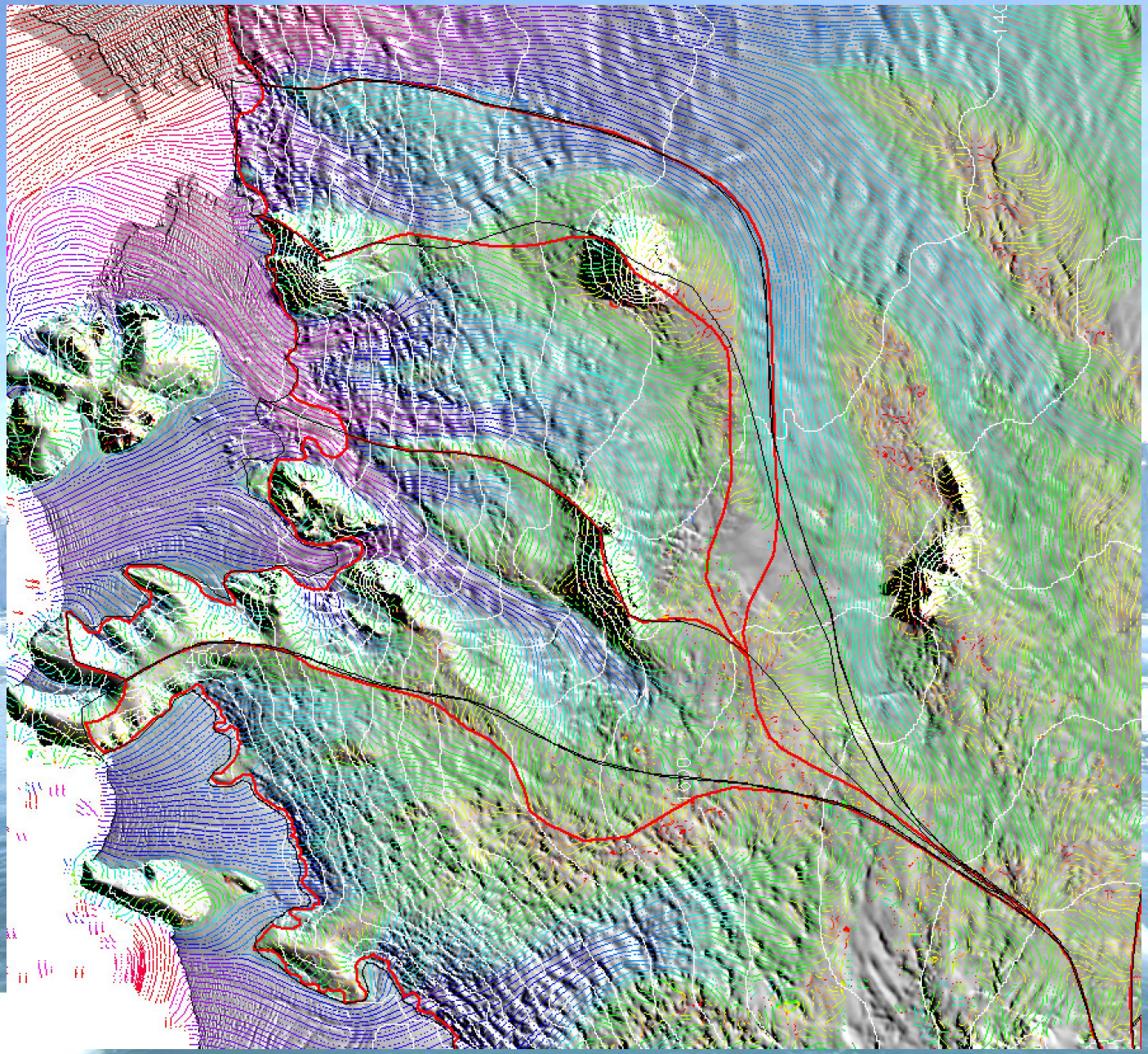




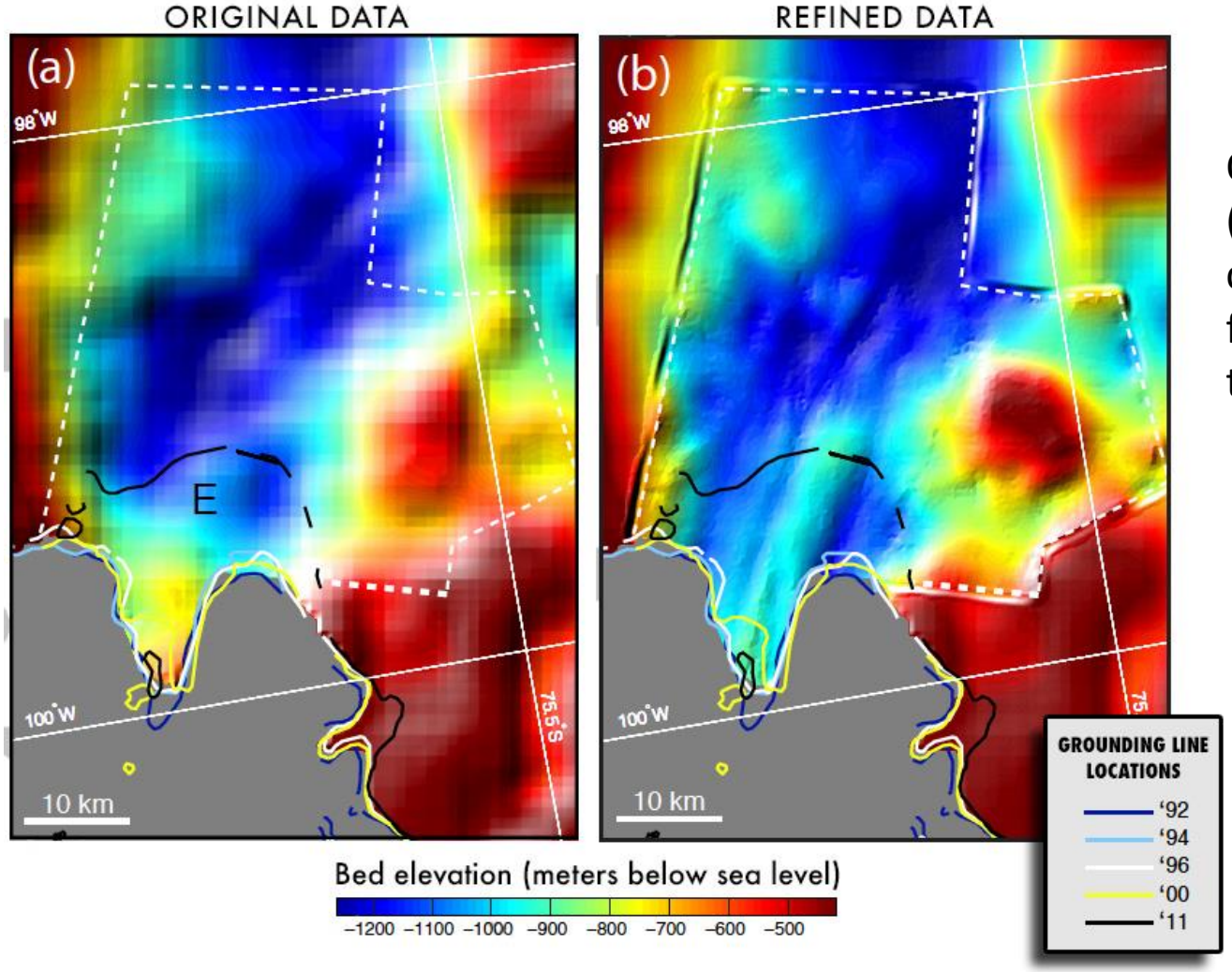
Mouginot et al., GRL 2014.



Redefinition of the ice divides.

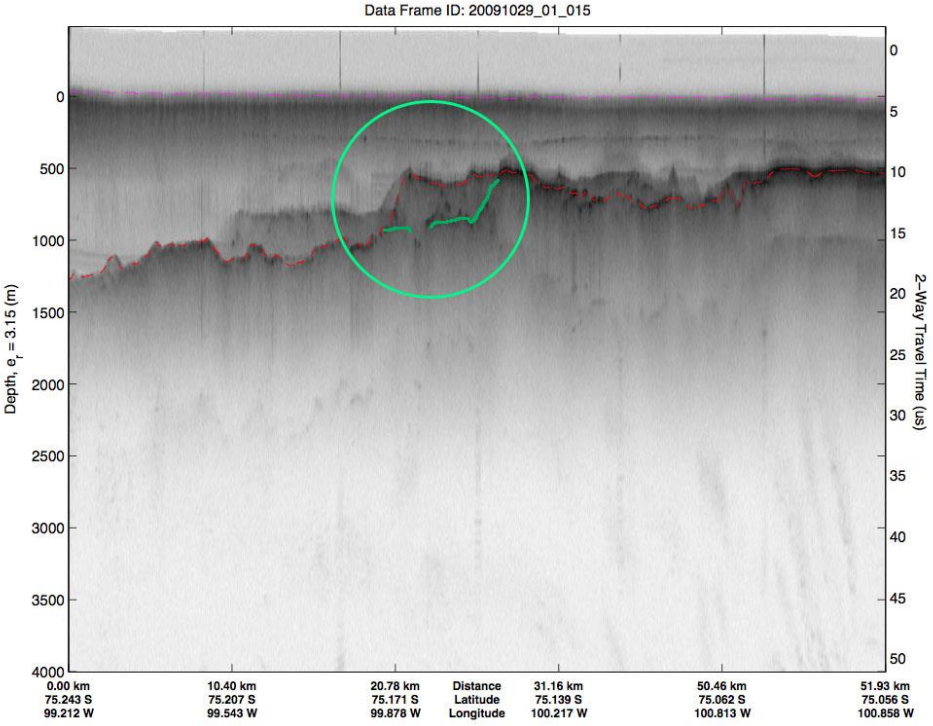


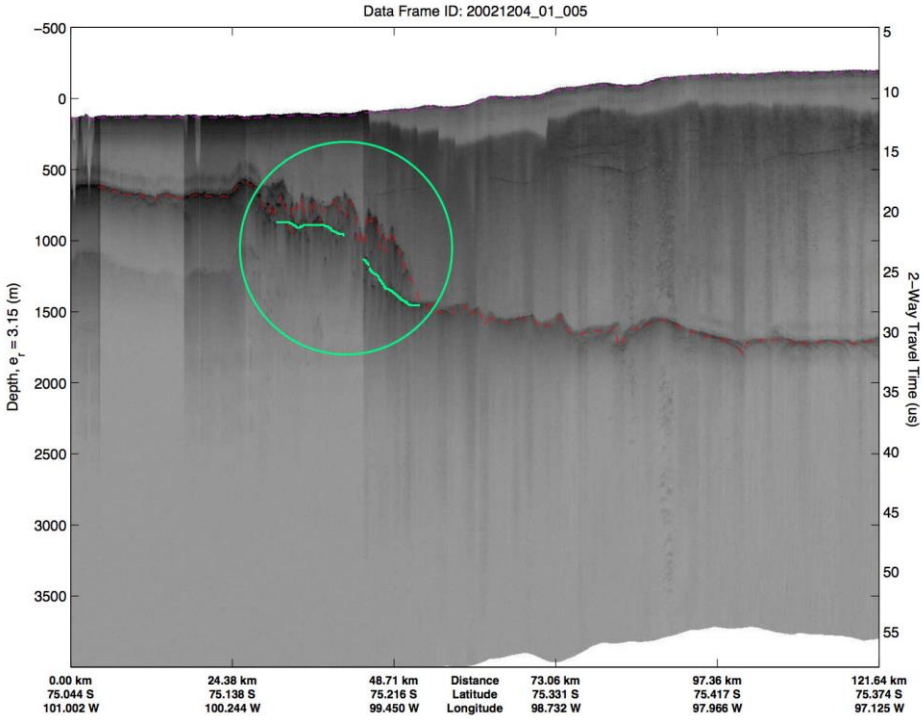
Bed topography of Pine Island - revised



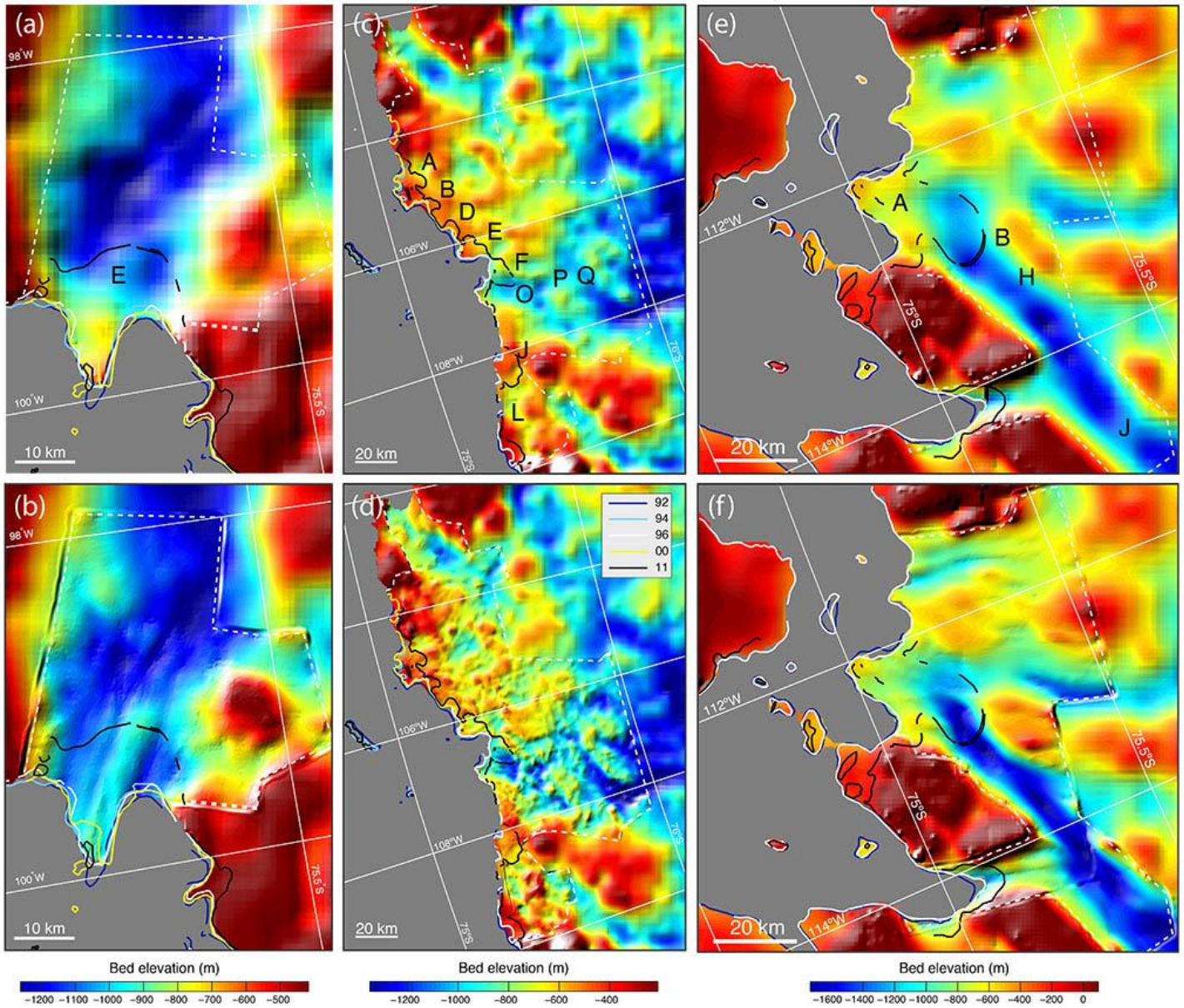
Original data (large bump) contradicts the fast retreat of the glacier.

Ice thickness on PIG



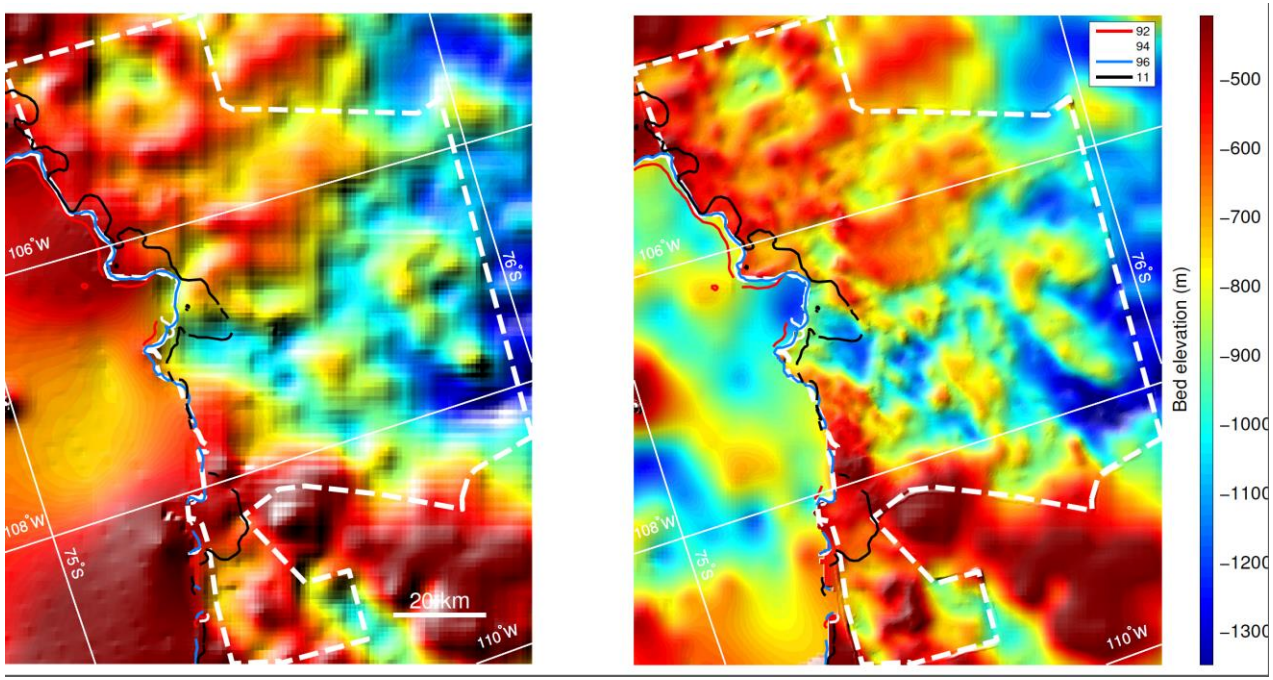


Bed topography Amundsen Sea Sector



(major) Modeling issues

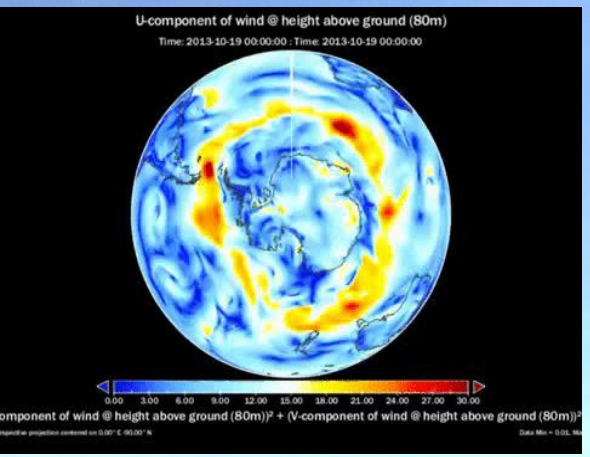
- Seamless bed topography and sea floor topography

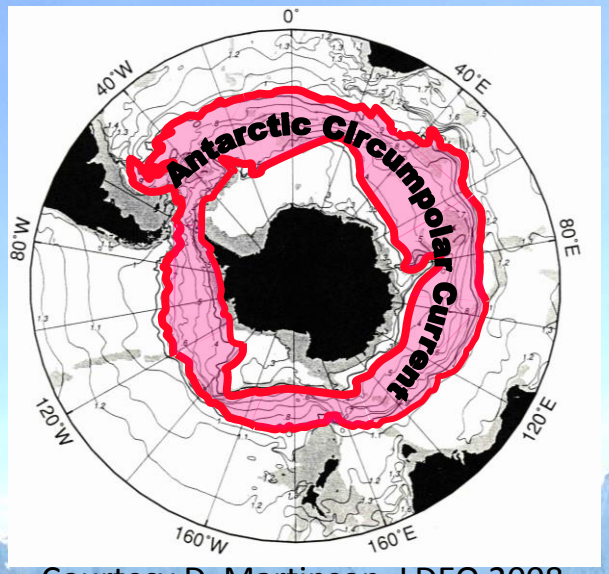


- Thermal forcing from the ocean (ad-hoc?)
- Ice sheet – ocean coupled models (cavity-dependent melt?)
- Calving law (the eternal missing!).

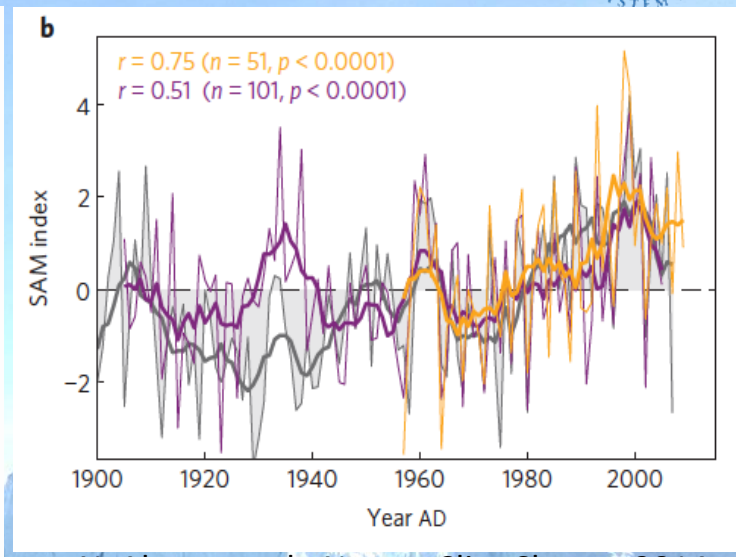
- Current modeling efforts “well intended” but do not go beyond sensitivity test.
- Time scale of collapse: 100 yr (Pollard et al., 2014), 200+ yr (present rate), 200-900 yr (model studies published in 2014). THIS IS OUR CHALLENGE!

Relationship to human activities

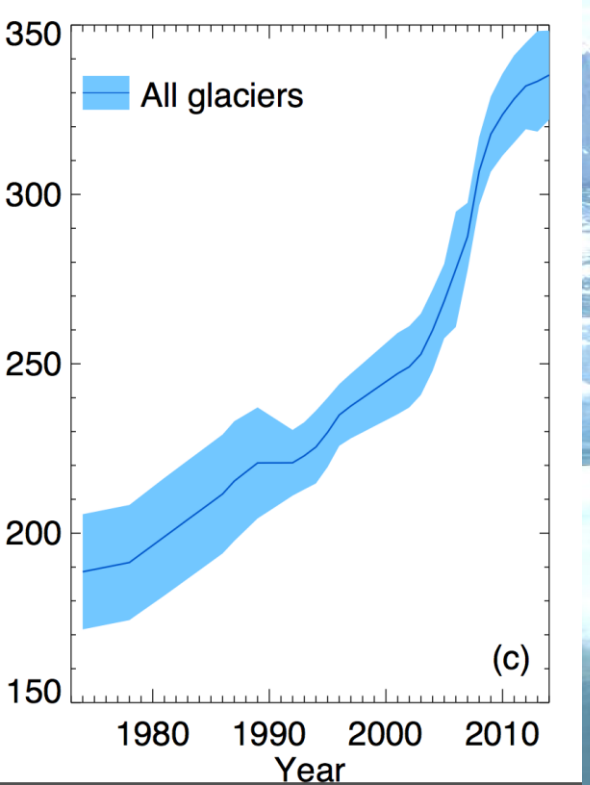


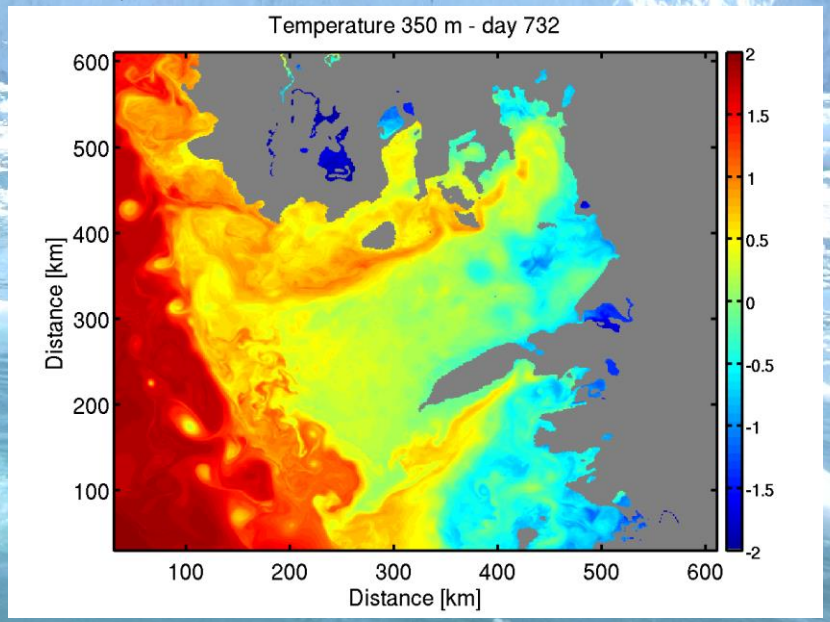


Courtesy D. Martinson, LDEO 2008



N. Abram et al., Nature Clim Chang., 2014





Schodlok, Menemenlis et al., unpublished, 2012.

Amundsen Sea Sector