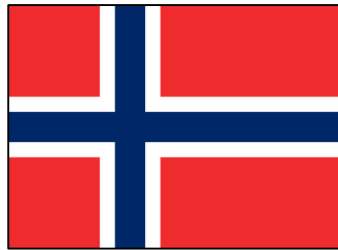
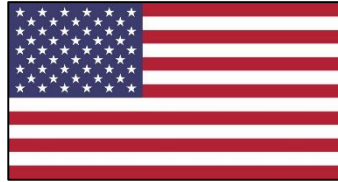
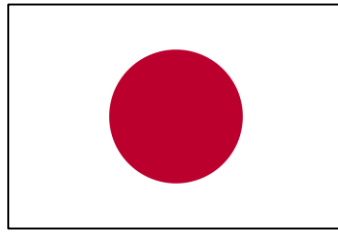




Hunting the Oldest Ice on the earth: ongoing Japan-Norway collaboration in Antarctica

Kenny Matsuoka (Norwegian Polar Institute)



Little bit about myself



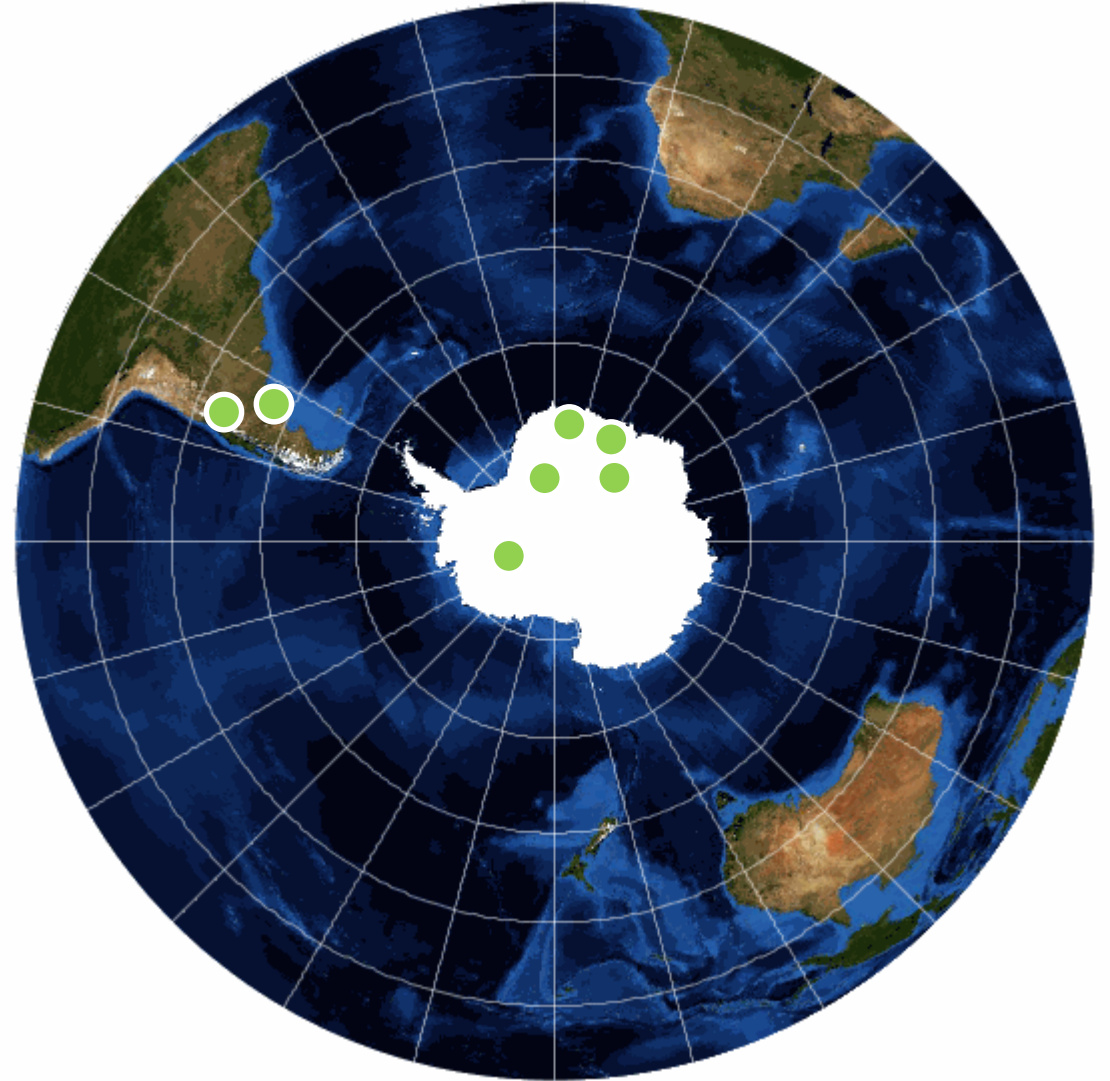
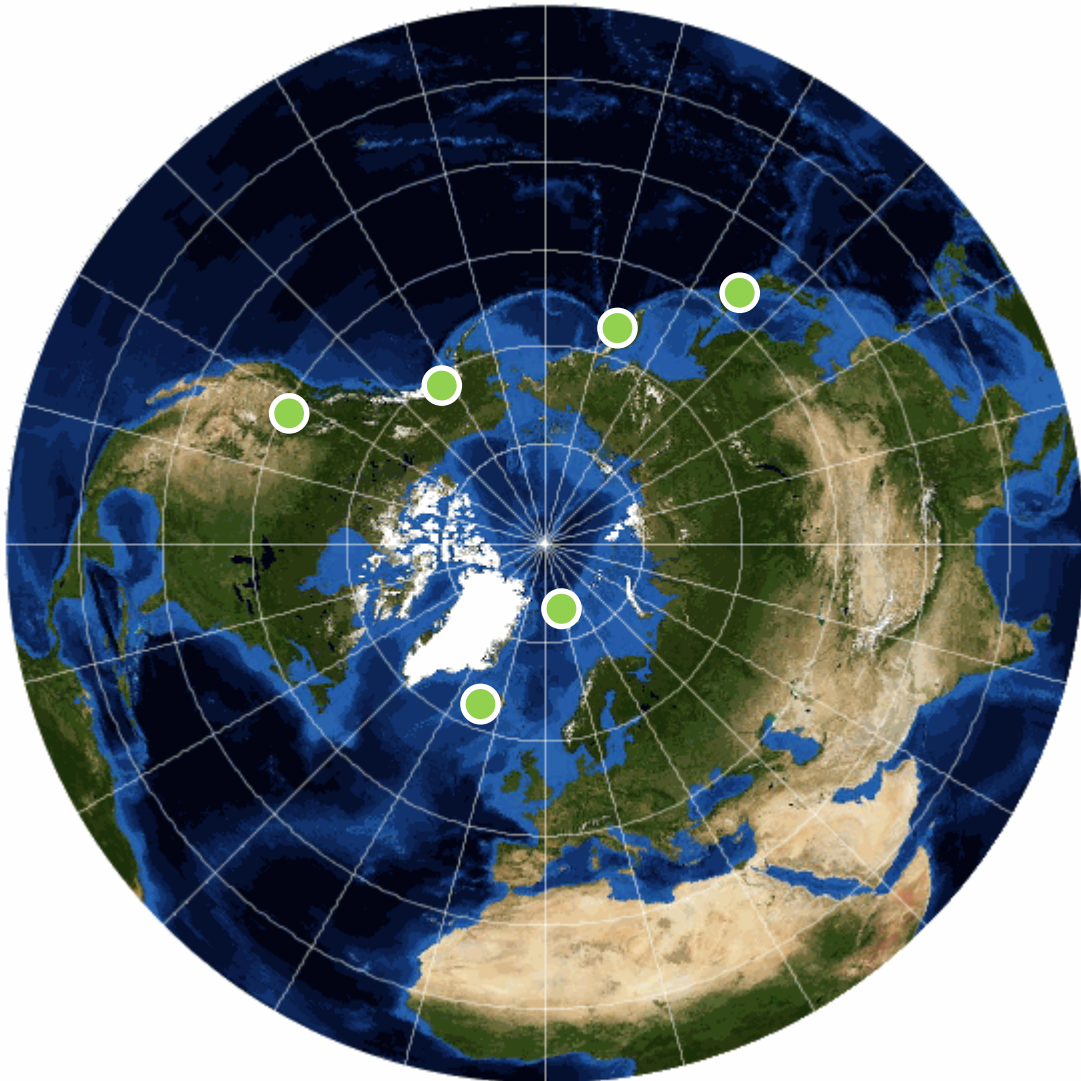
**2010-
Norwegian
Polar
Institute
*Senior scientist***

**2002-10
Univ.
Washington
Postdoc
*Assistant prof***

**2002
Hokkaido
Univ.
*PhD***



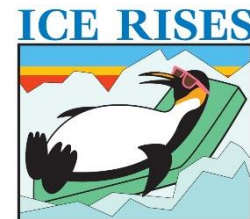
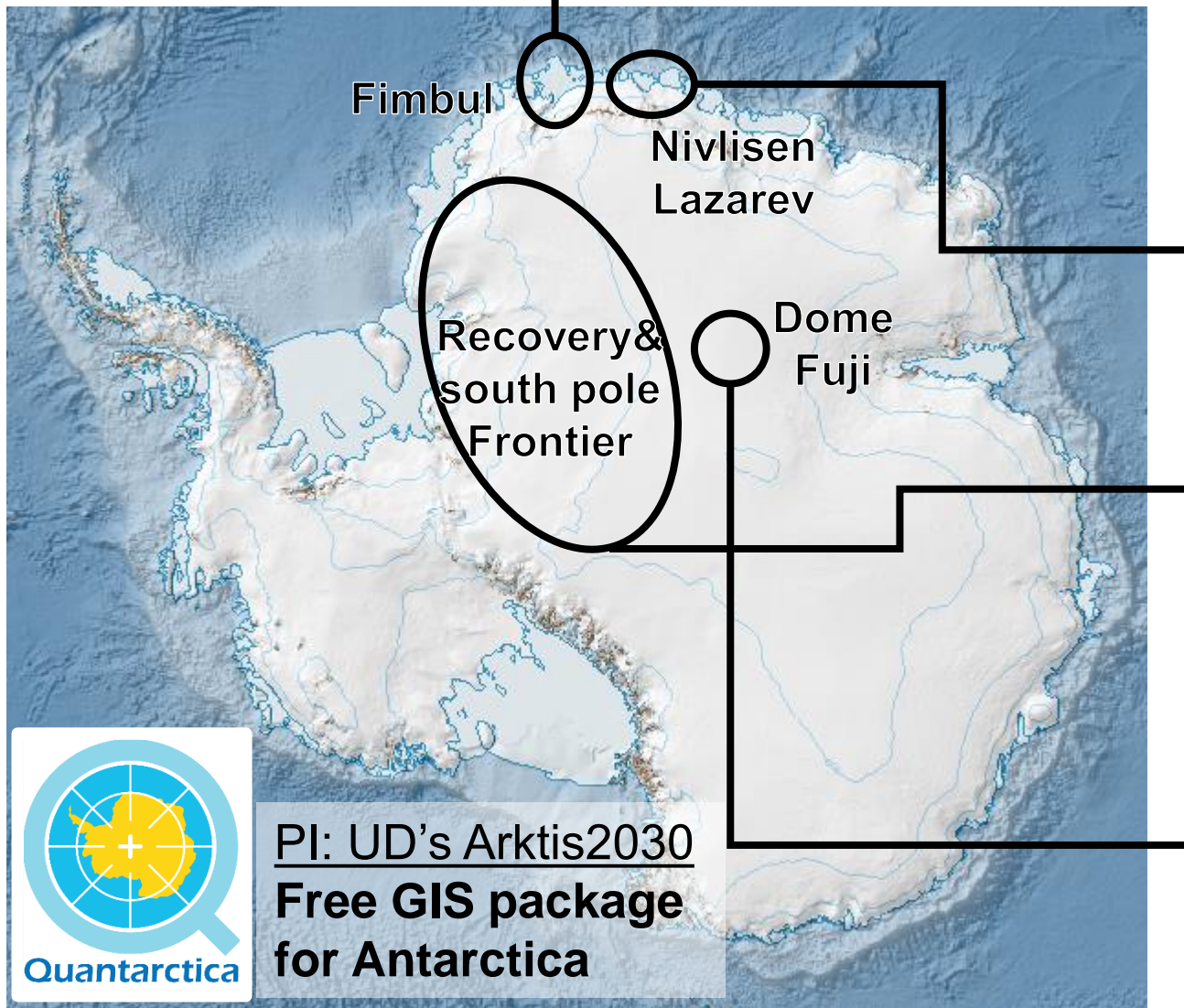
Research activities in remote, cold places



The only one Antarctic Glaciologist living in the Arctic



Kenny Matsuoka, Antarctic glaciologist, NPI



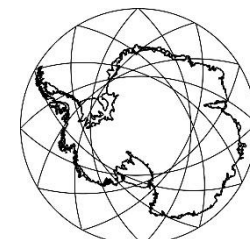
PI: NARE

Evolution and dynamics of ice rises



PI: NFR's POLARPROG

Mass balance, dynamics and climate of the central DML



PolarGAP

PI: NFR's FRINATEK

Subglacial-lake network in one of "poles of ignorance"



British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL



DTU Space
National Space Institute



WP leader: internally funded

Site survey for 2M-old ice cores in the Dome Fuji area

THE UNIVERSITY OF
ALABAMA

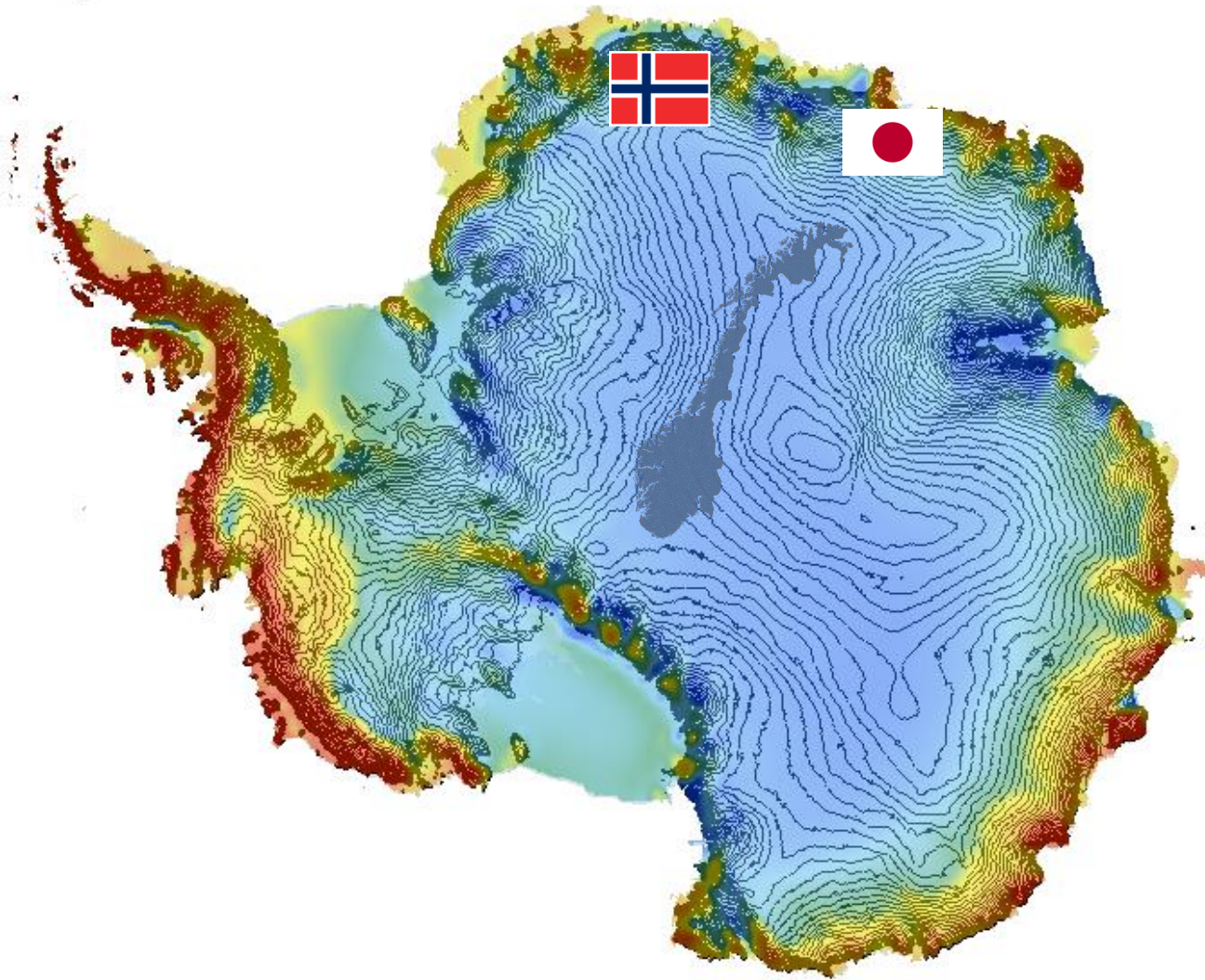
CRISIS
Center for Remote Sensing of Ice Sheets



NiPR

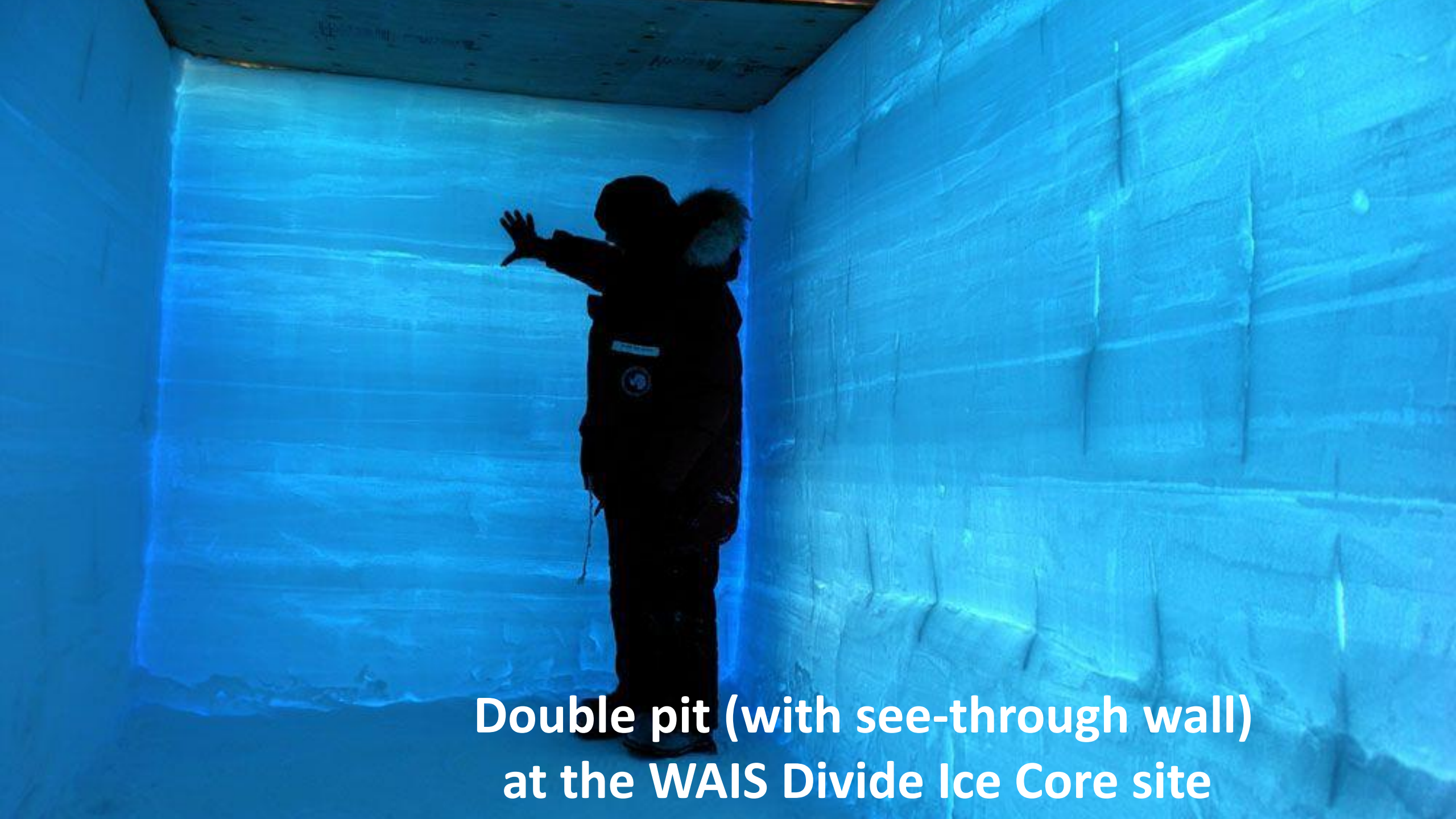


Antarctica: x36 of Norway's main land



**Tallest (mean: ~2 km),
driest (white desert),
whitest, coldest, windiest,
and least populated continent**

Visualized with Quantarctica
quantarctica.npolar.no

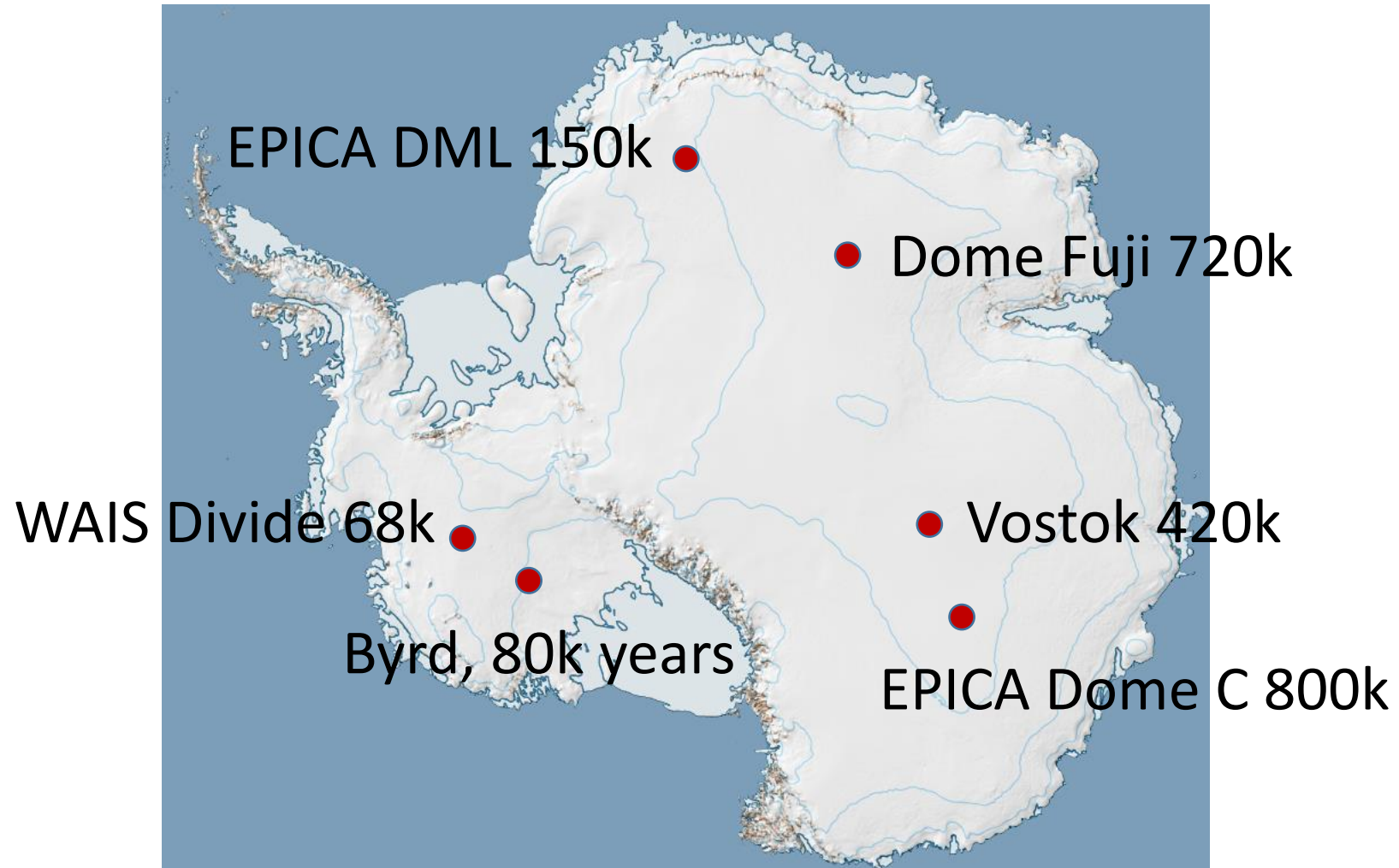


**Double pit (with see-through wall)
at the WAIS Divide Ice Core site**

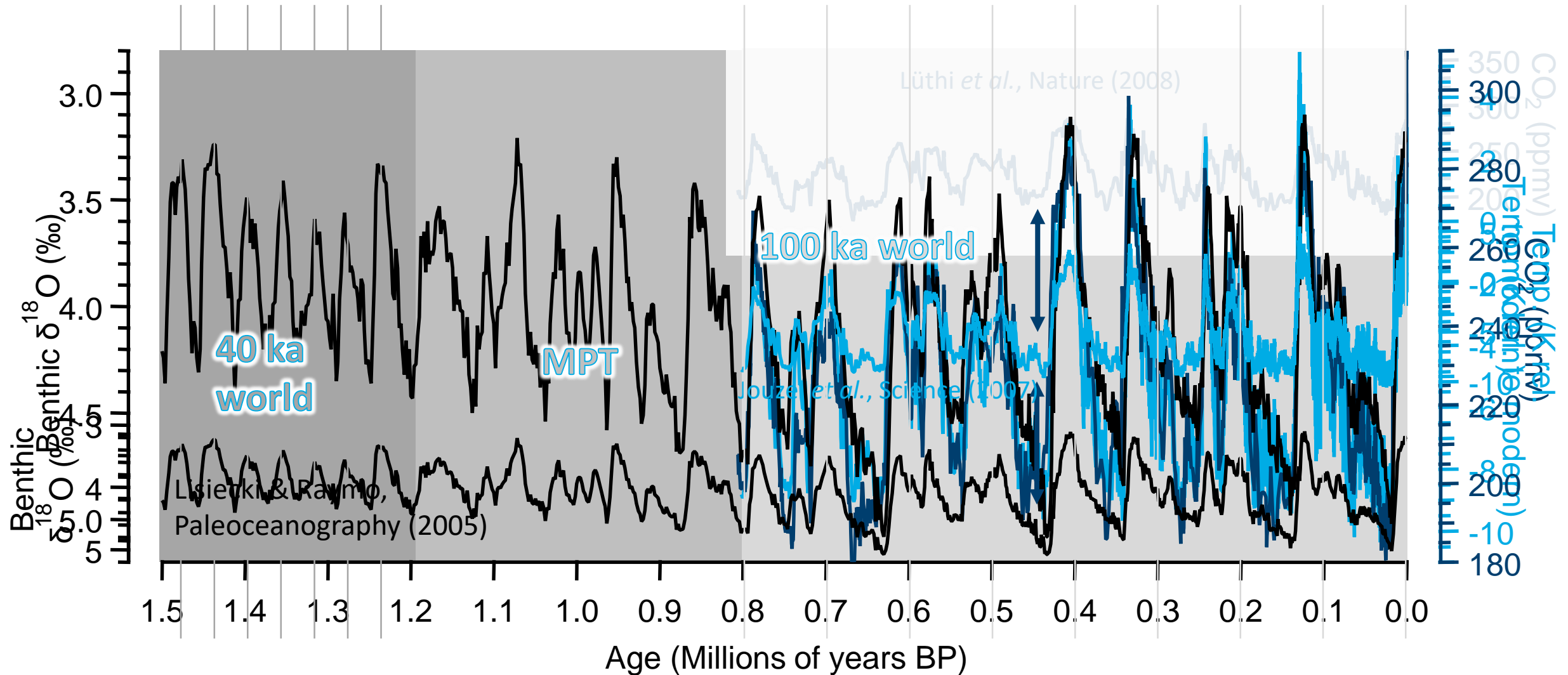


WAIS Divide Ice Core photo archive

Deep ice cores drilled in Antarctica and their oldest ages



Climate rhythms changed from 40ka to 100ka cycles during the Mid-Pleistocene Transition

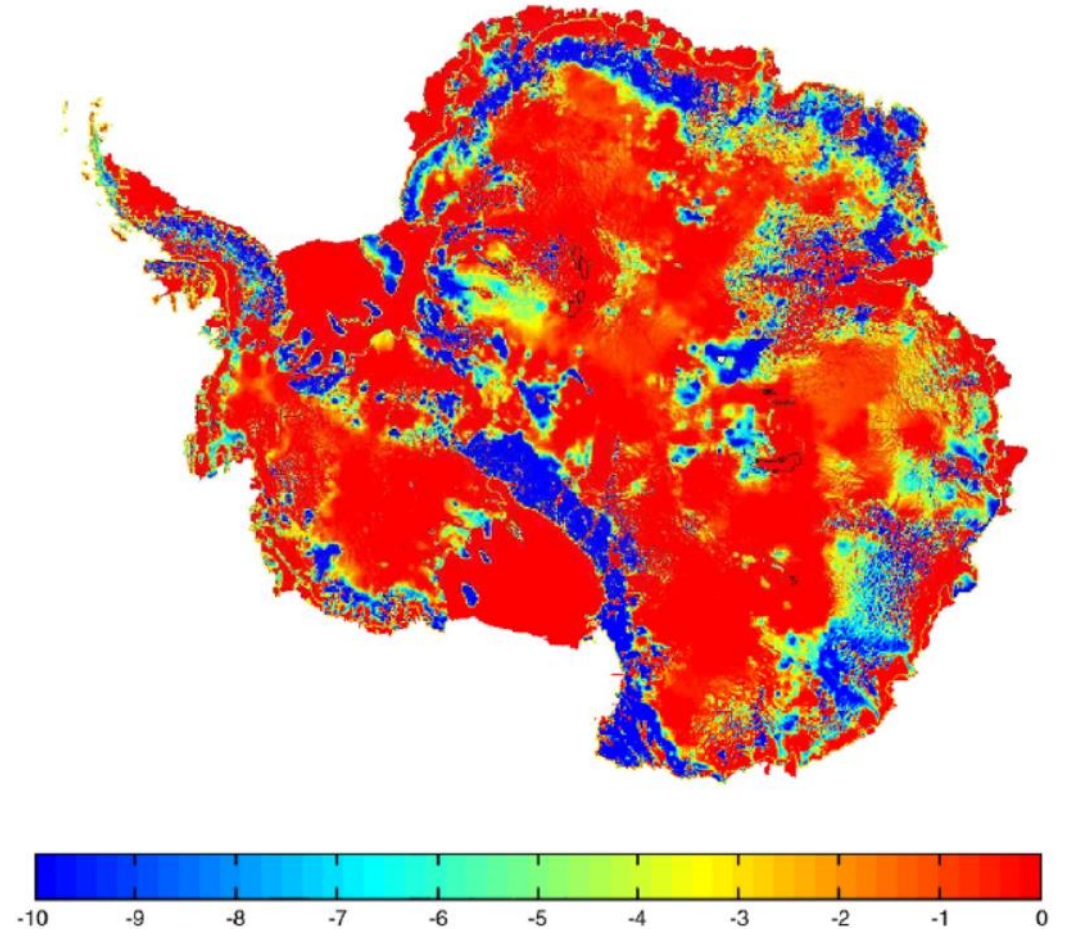


Slide courtesy: Olaf Eisen (Alfred Wegener Institute)

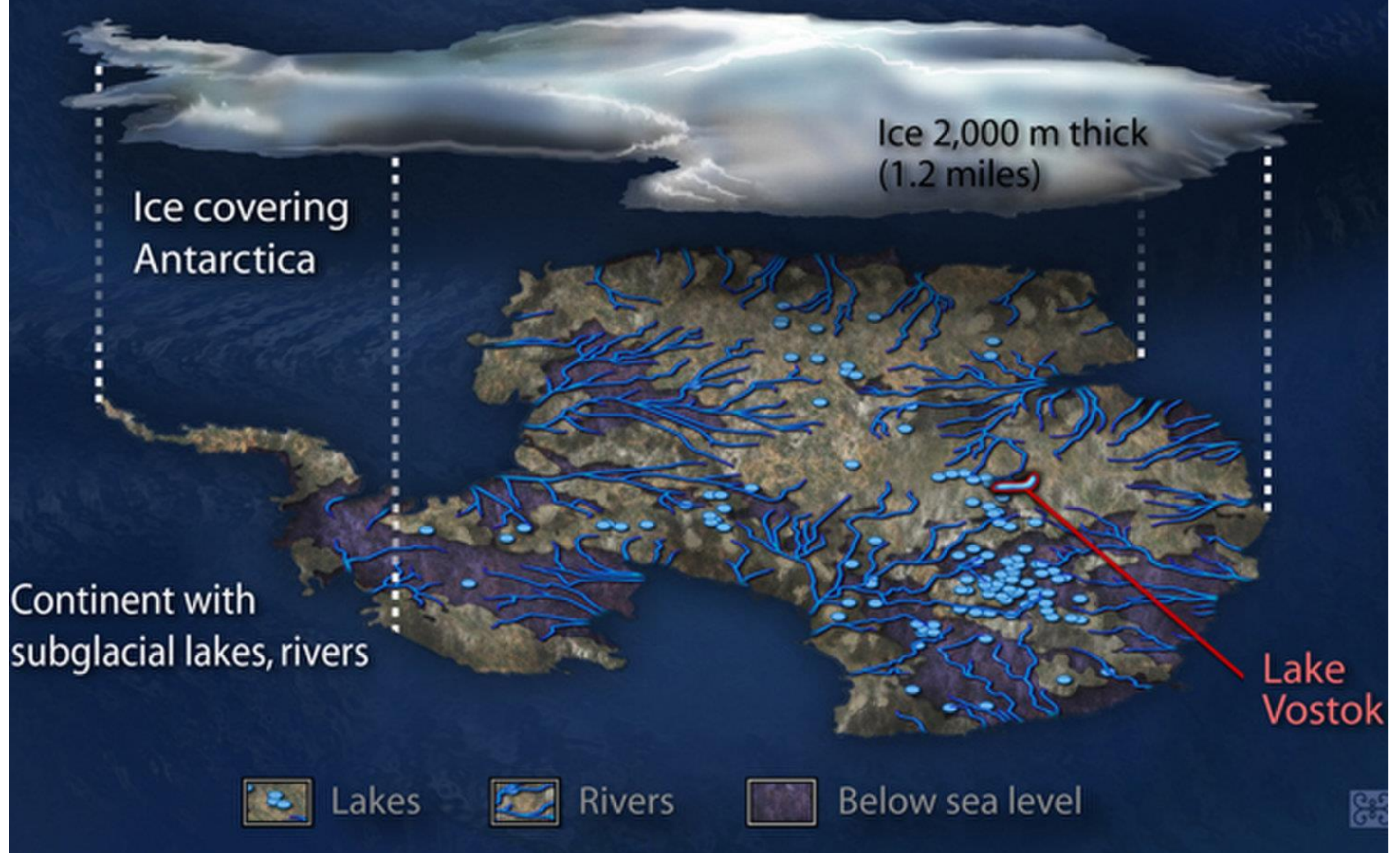
Where is the million-years old ice?

- Ice becomes older as it gets closer to the bed.
 - Thick ice
 - Smaller surface mass balance (snow accumulation)
- This “apparent” conditions do not cause oldest ice.
- Thicker ice is more efficient blanket, which warms up the base of the ice sheet, and melts the ancient ice away.

**Ice temperature
at the basal interface**

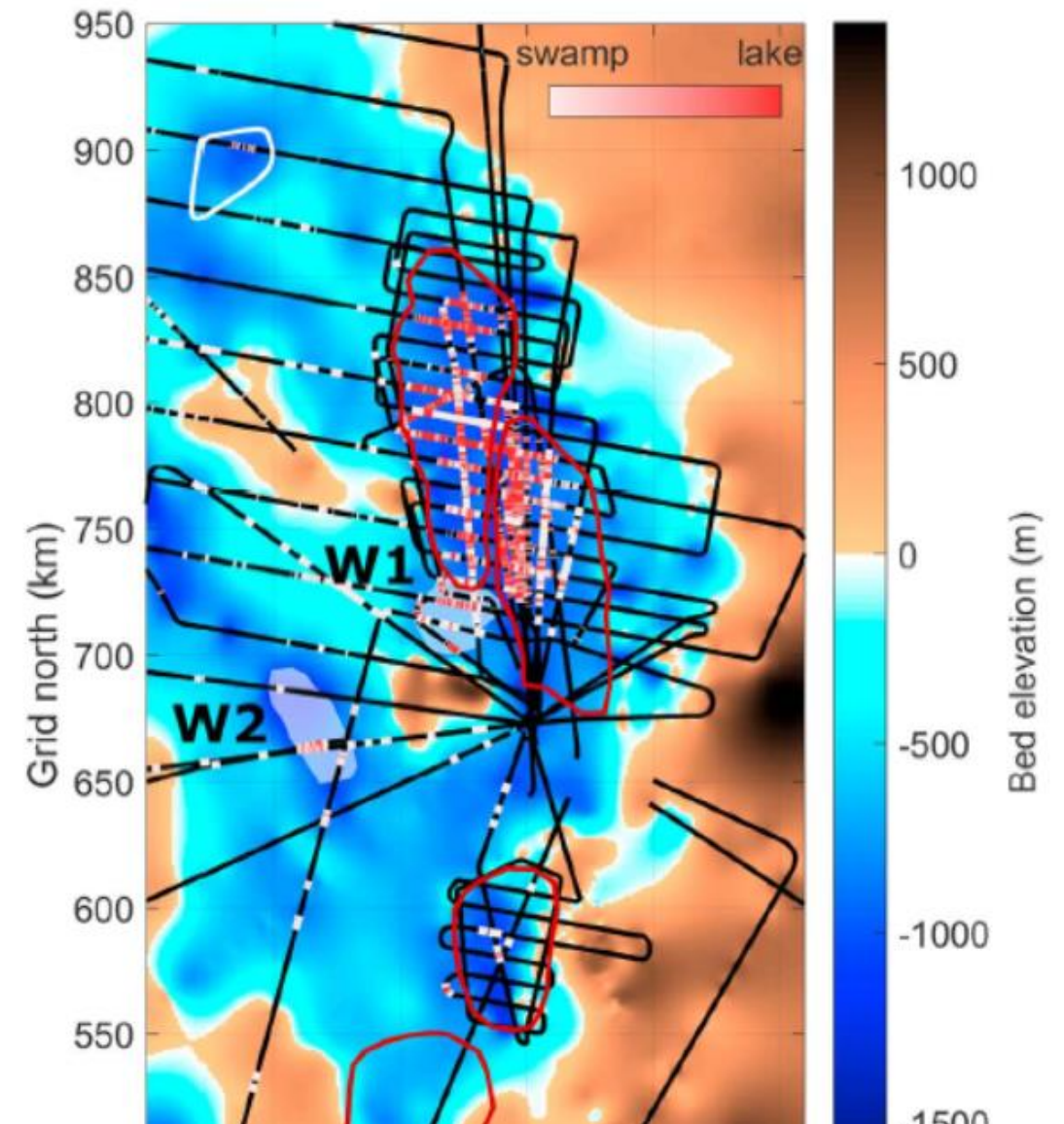
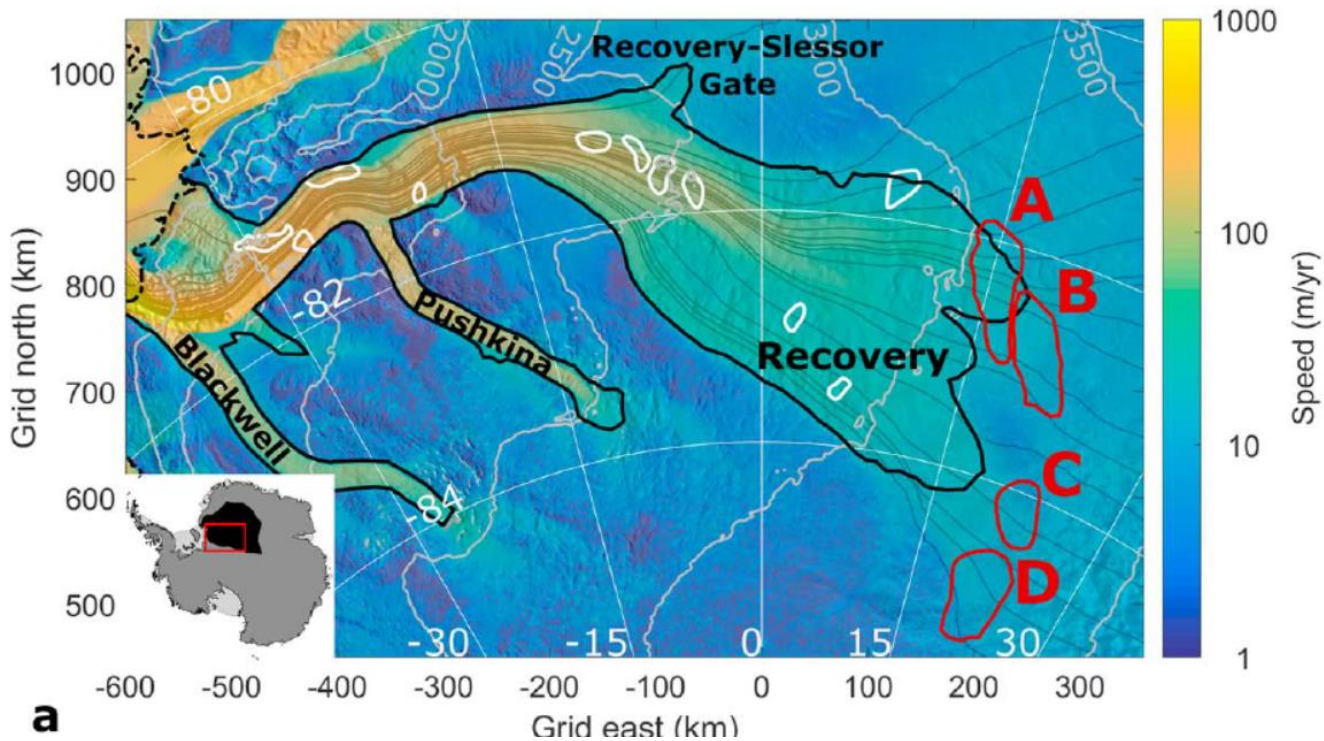


Pattyn (2010, EPSL)



Radar diagnosis of bed conditions

(Freshest paper from NPI glaciology last week)



Diez, Matsuoka et al. (2019, JGR)
NFR's FRINATEK project

Potential Oldest Ice sites

- Dome Fuji
 - Japan + USA + Norway
 - Germany, Belgium
- Dome A
 - China
- Dome C
 - Beyond EPICA
 - Australia
- Titan Dome
 - USA?

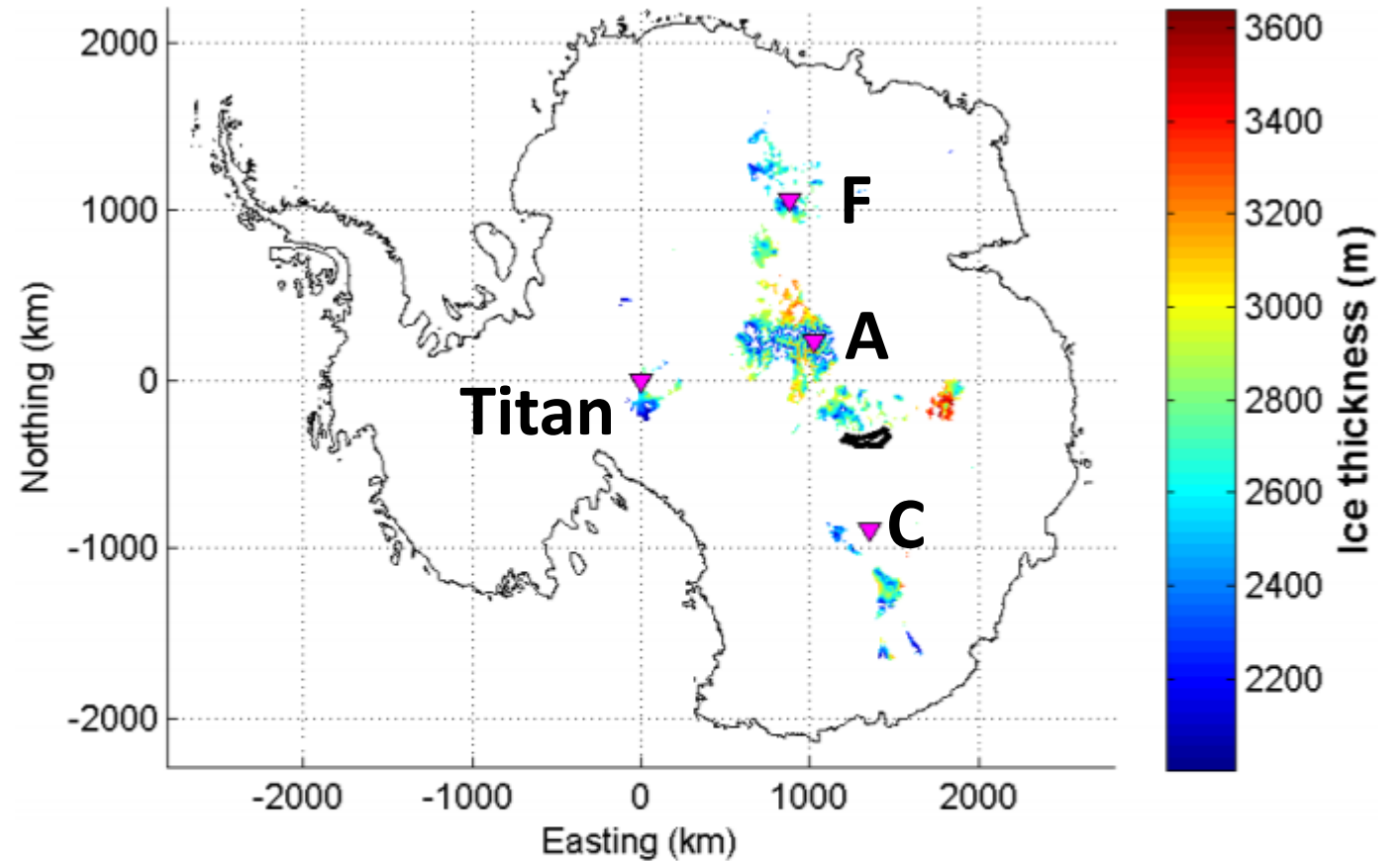


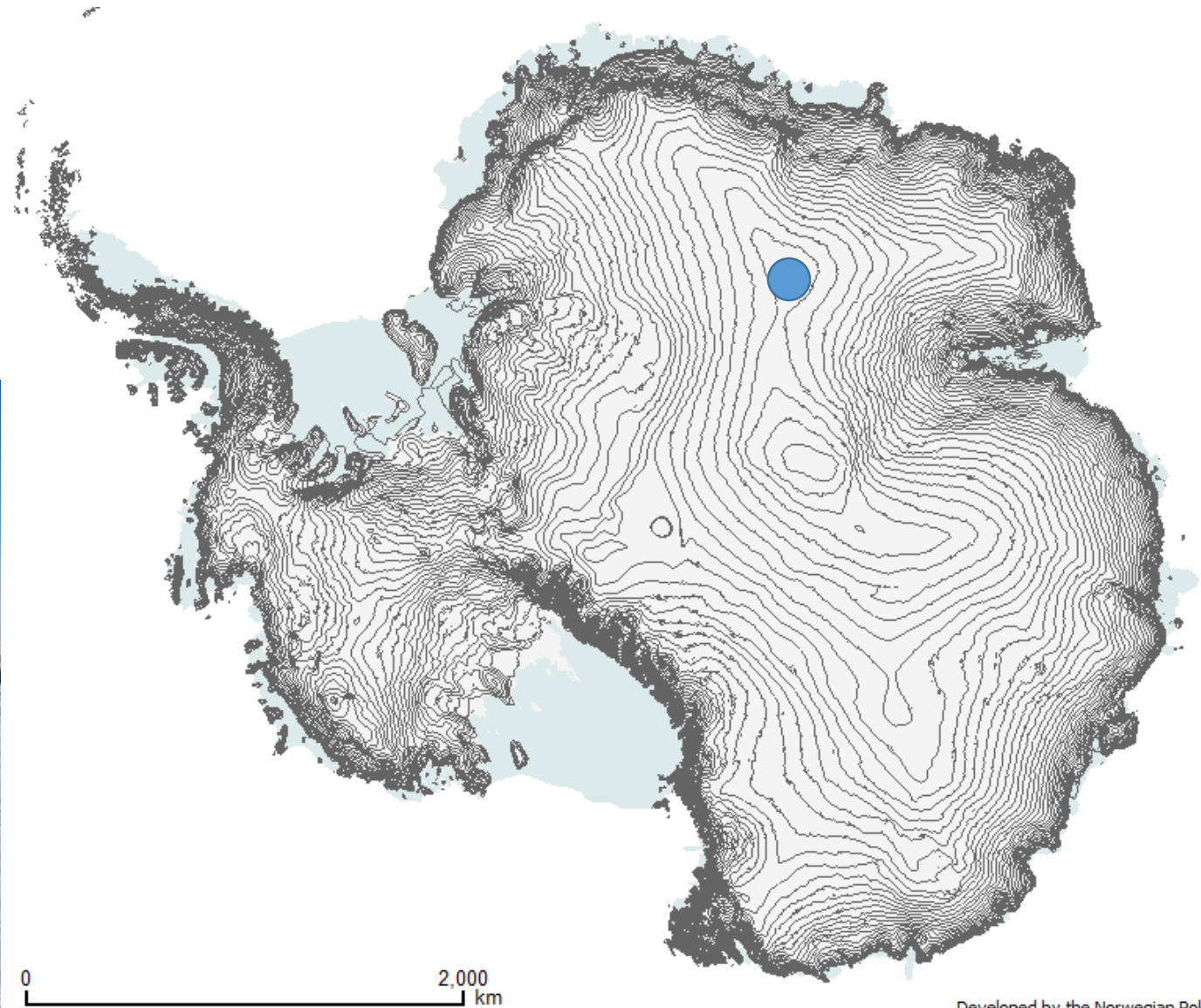
Fig. 5. Potential locations of cold basal conditions in areas with ice thickness $H > 2000$ m (colorbar) and horizontal flow speeds $< 2 \text{ m yr}^{-1}$, for $\Delta G > 5 \text{ mW m}^{-2}$ and $\sigma_G < 25 \text{ mW m}^{-2}$, and as calculated with the simple model.

van Liefferinge and Pattyn (2013)

Dome Fuji (3,810 m a.s.l.)

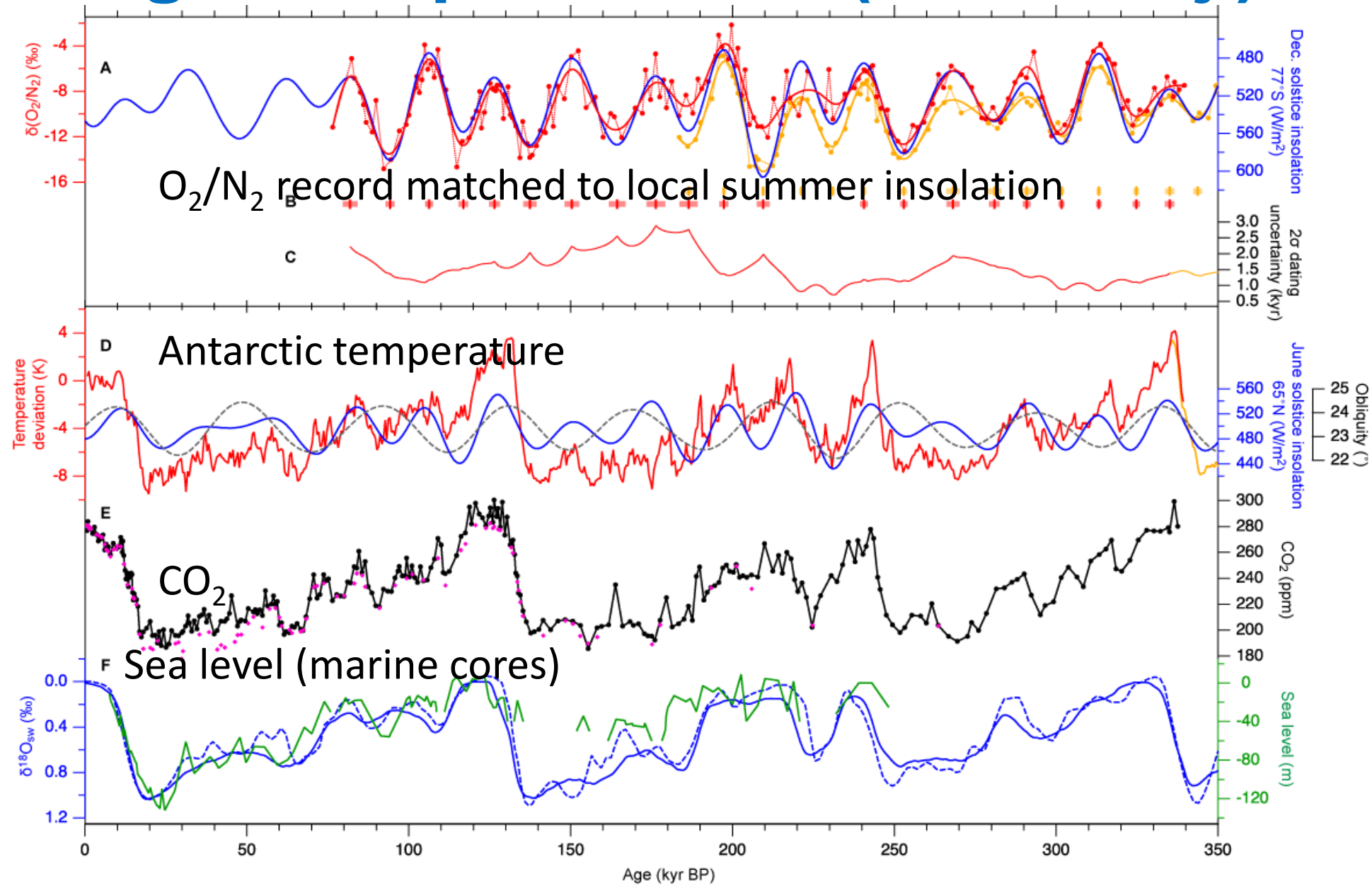
JARE/NIPR deep drilling

- **DF-I: 1995-1997**
(2503 m, 360 ka)
- **DF-II: 2003-2007**
(3035 m, 720 ka)



Developed by the Norwegian Polar Research Centre

Precise dating of deep ice cores (Dome Fuji)



Kawamura et al.
(2007 *Nature*)

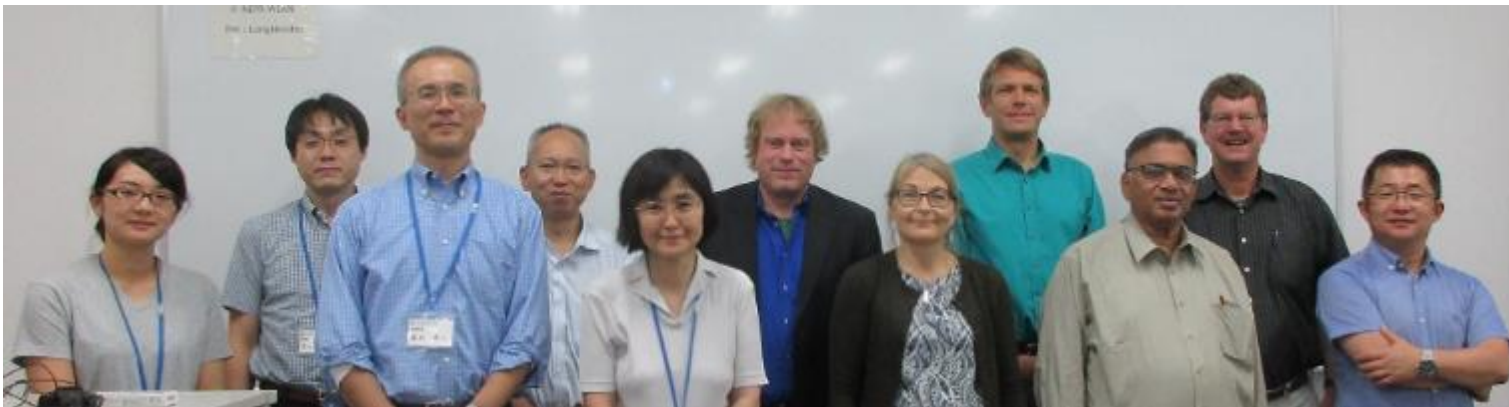
Radar surveys of the Dome Fuji region

- **1987-91:** Regional airborne surveys (former Soviet Union)
- **86/87, 92/93:** Ground-based radar surveys (NIPR)
- **96/97, 99/2000:** Multi-frequency/polarization, ground-based (NIPR)
- **2002/3:** Airborne surveys (AWI)
- **07/08:** Japan-Sweden ground traverse during IPY
- **12/13:** Dome South ground-based survey (NIPR)
- **14/15:** NW blob airborne (AWI)




Seeking collaboration (not competition)


- NPI-CReSIS discussion started in June 2015 to make joint surveys in Dome Fuji.
- NIPR-CReSIS-NPI joint surveys were discussed at NIPR in July 2016.
- AWI, NIPR, CReSIS, and NPI had the first meeting at NIPR in September 2016.



Radar surveys for Oldest Ice in Dome Fuji

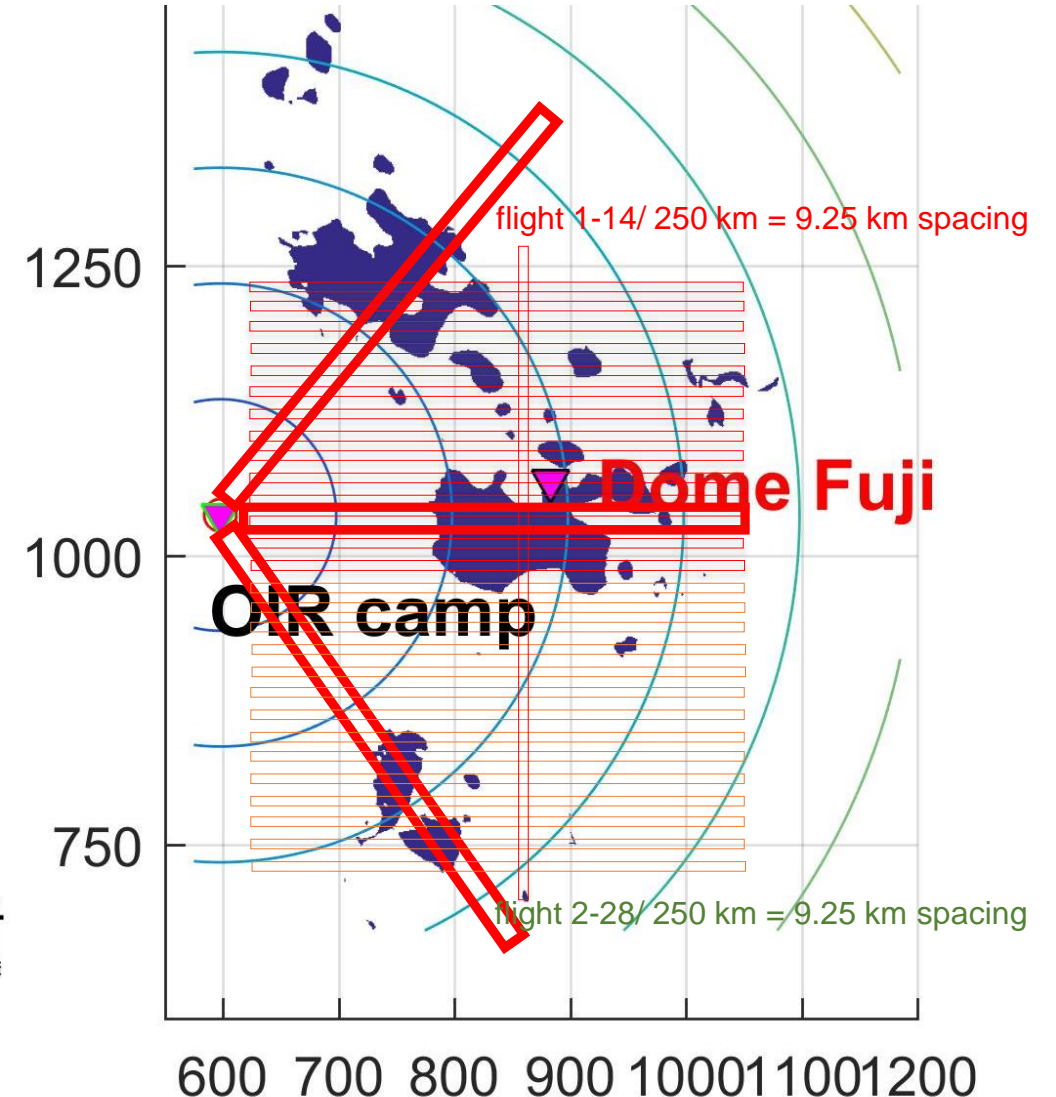
- **2016/17:**  AWI's airborne surveys
(Karlsson et al., 2017, TC)

- **2017/18:**  国立極地研究所
大学共同利用機関法人 情報・システム研究機構
NIPR's ground surveys
(Fujita, Kawamura et al.)

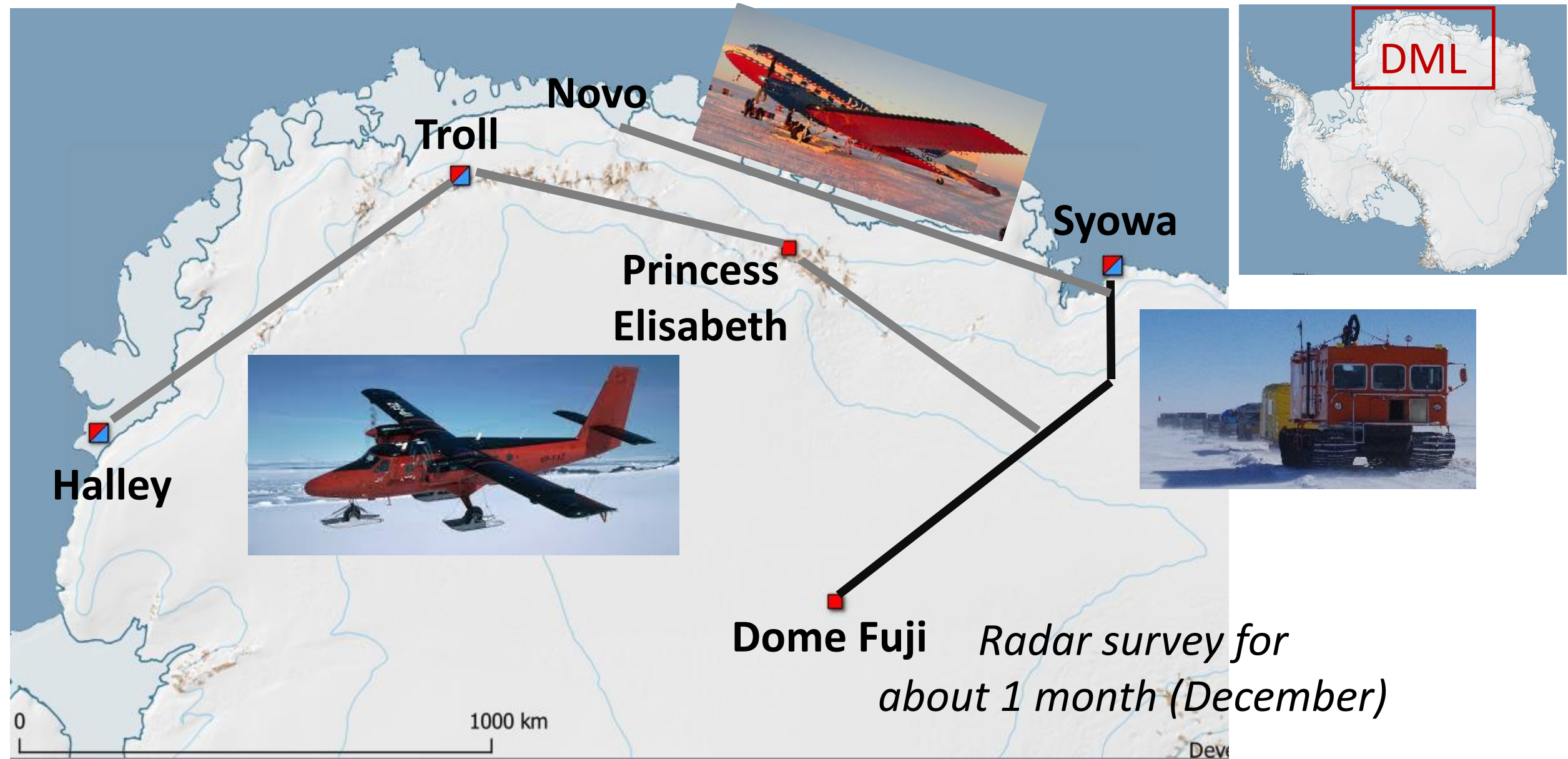
- **2018/19:**
NIPR/CReSIS/UA/NPI
joint ground surveys




国立極地研究所
大学共同利用機関法人 情報・システム研究機構



Field operation Nov 2018 – Jan 2019

























JSPS and RCN have fueled my research

- **JSPS fellowships**



日本学術振興会
Japan Society for the Promotion of Science

- DC2 Fellowship (1998)
- Postdoctoral Fellowship (2002-04)
- **Researcher's Visitorship (2 months in 2016, hosted by Prof. Kawamura of NIPR)**

- **Research Council of Norway's research grants**



The Research Council
of Norway

- POLARPROG (2016-20) MADICE with India
- FRINATEK (2015-19) IceGRAV/PolarGAP with Denmark and UK
- ROMFORSKNING (2014-19) Satellite remote sensing



