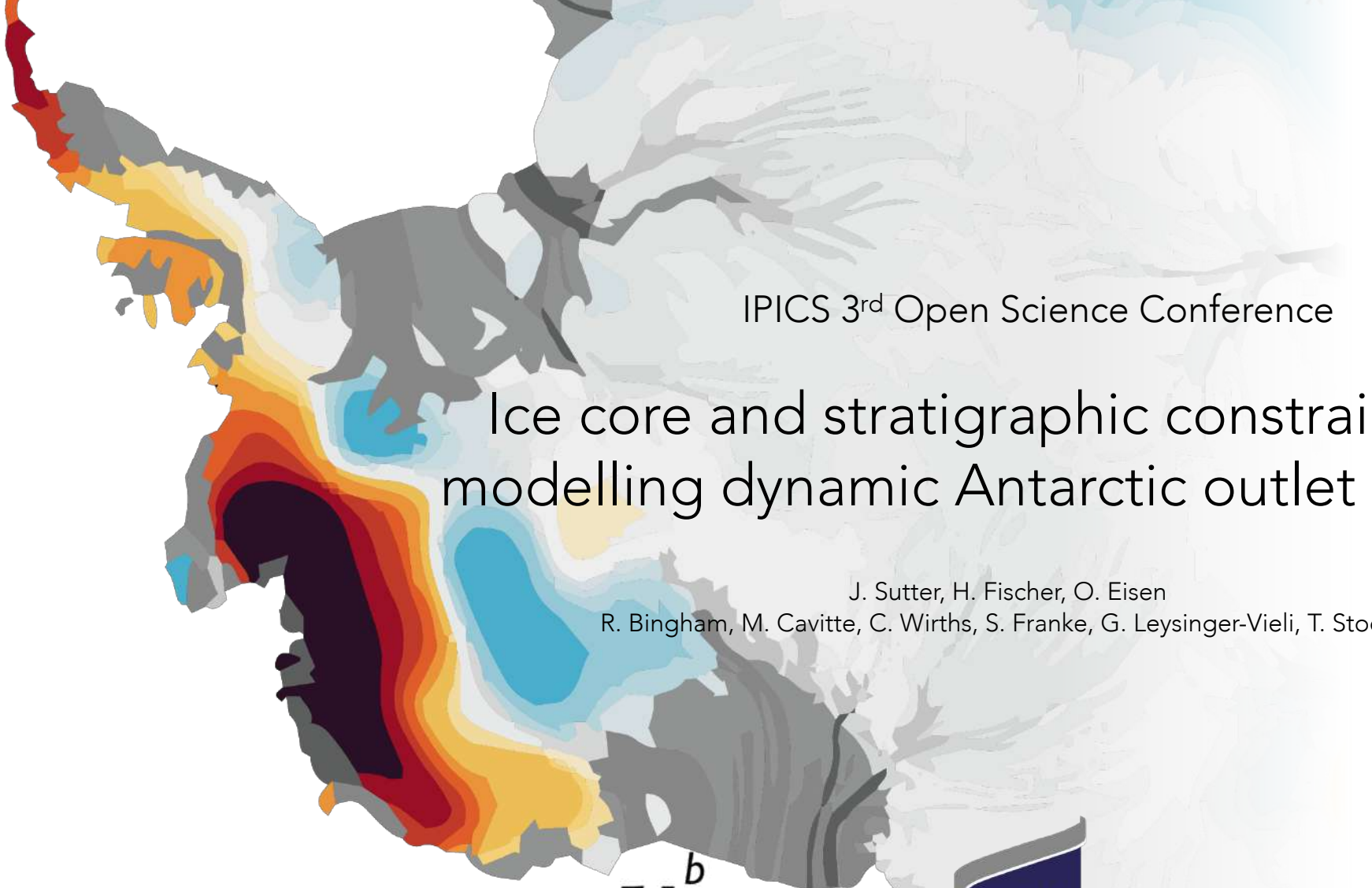

IPICS 3rd Open Science Conference

Ice core and stratigraphic constraints on modelling dynamic Antarctic outlet systems

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R. Bingham, M. Cavitte, C. Wirths, S. Franke, G. Leysinger-Vieli, T. Stocker

DFG Deutsche Forschungsgemeinschaft

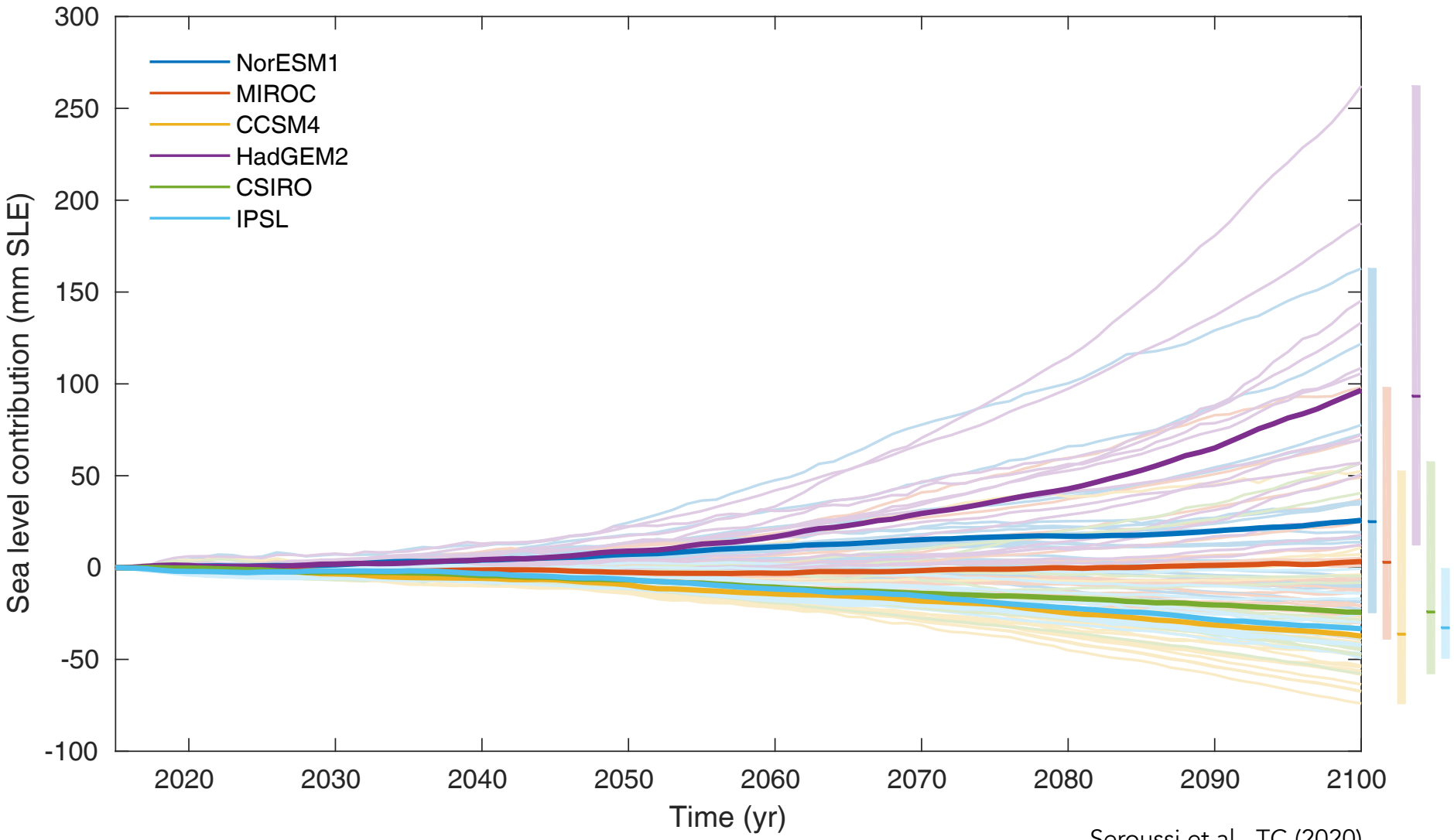
UNIVERSITÄT BERN
OESCHGER CENTRE CLIMATE CHANGE RESEARCH

BEYOND EPICA OLDEST ICE

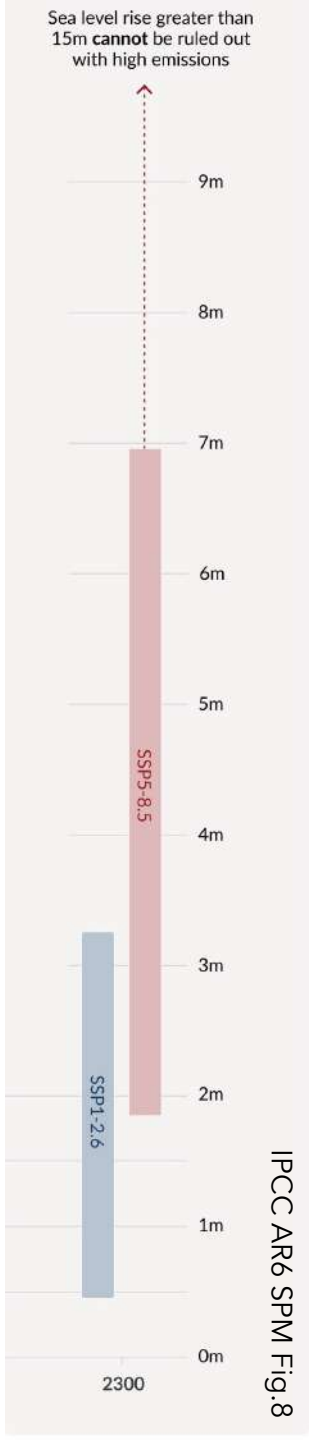
AWI

Ant Architecture

Model projections – uncertainties galore

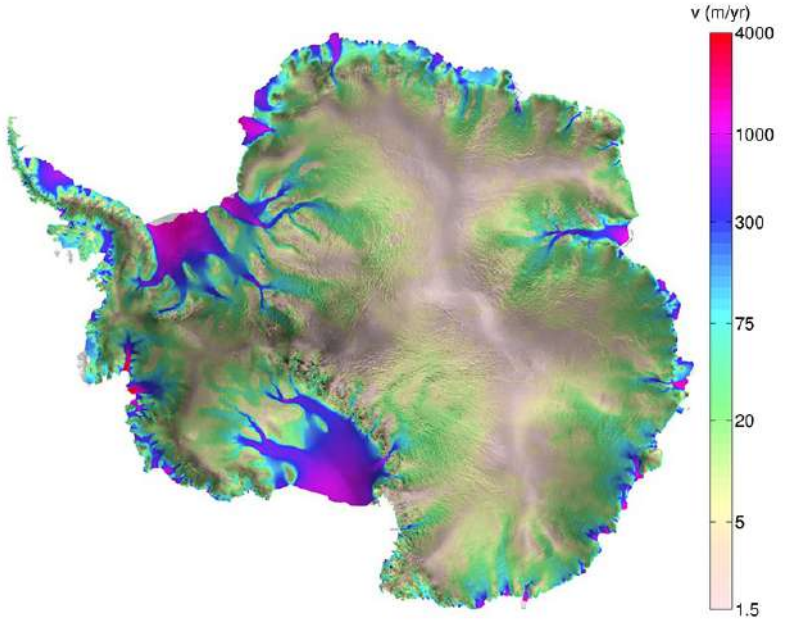


Seroussi et al., TC (2020)

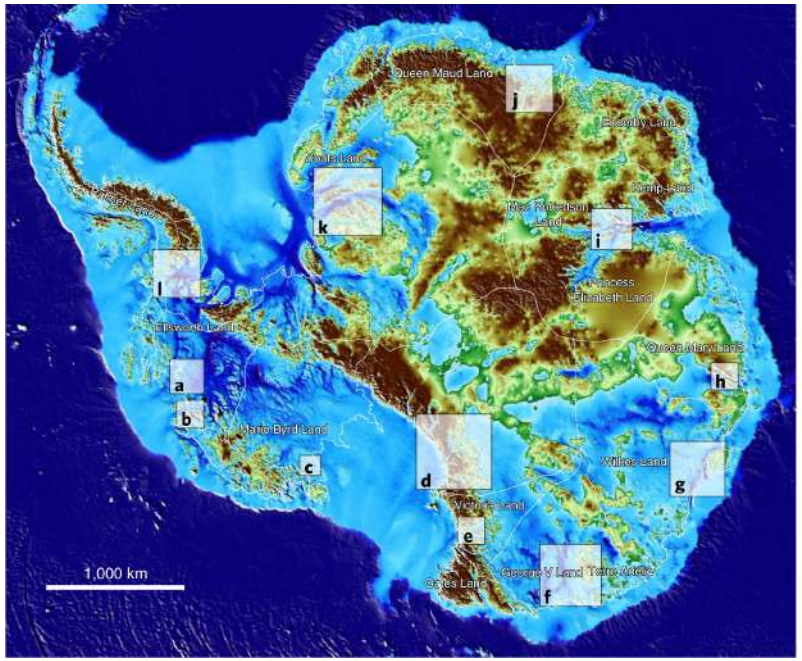


IPCC AR6 SPM Fig.8

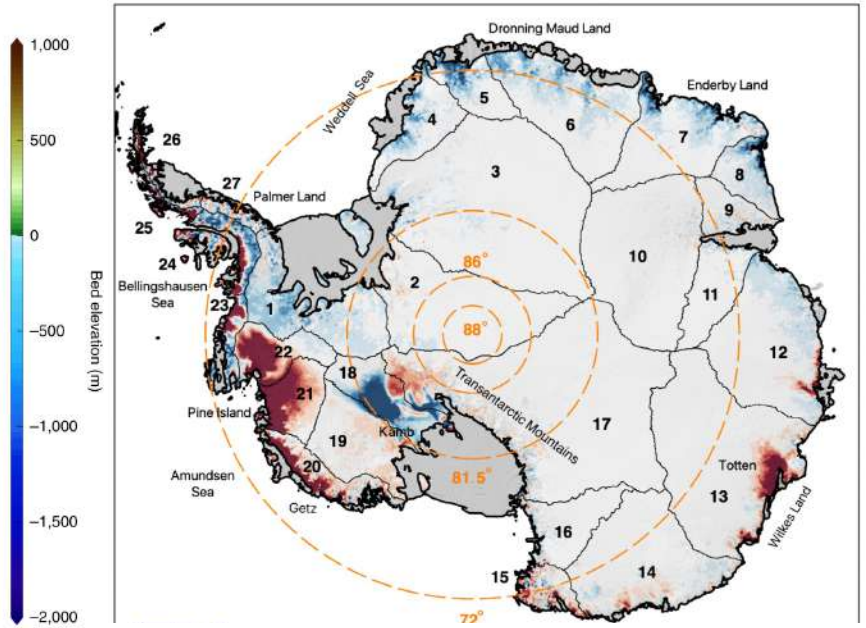
The status quo: ice sheet models uncaged



Rignot et al., 2011, Science



Morlighem et al, 2020, Geophysical Research Letters



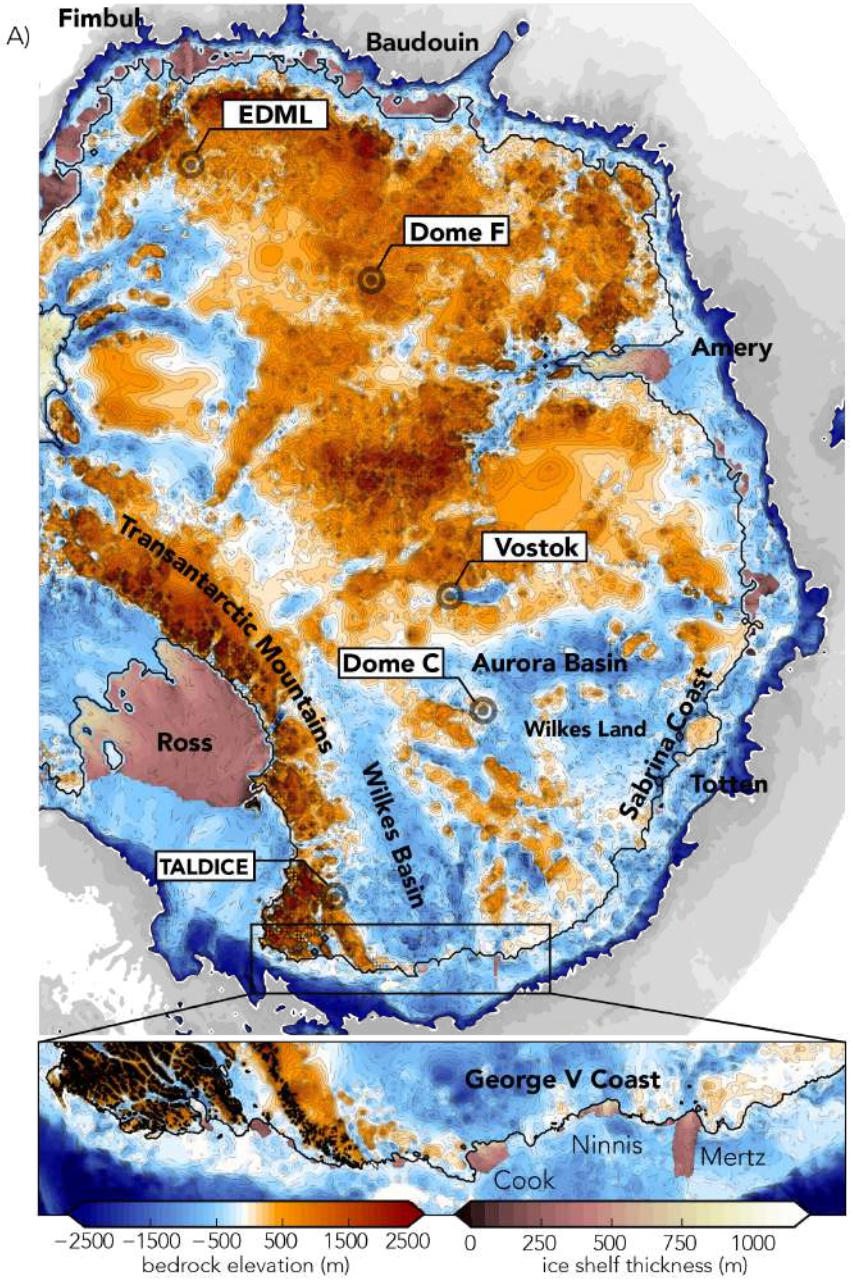
Nilsson et al., 2022, Earth Syst. Sci. Data

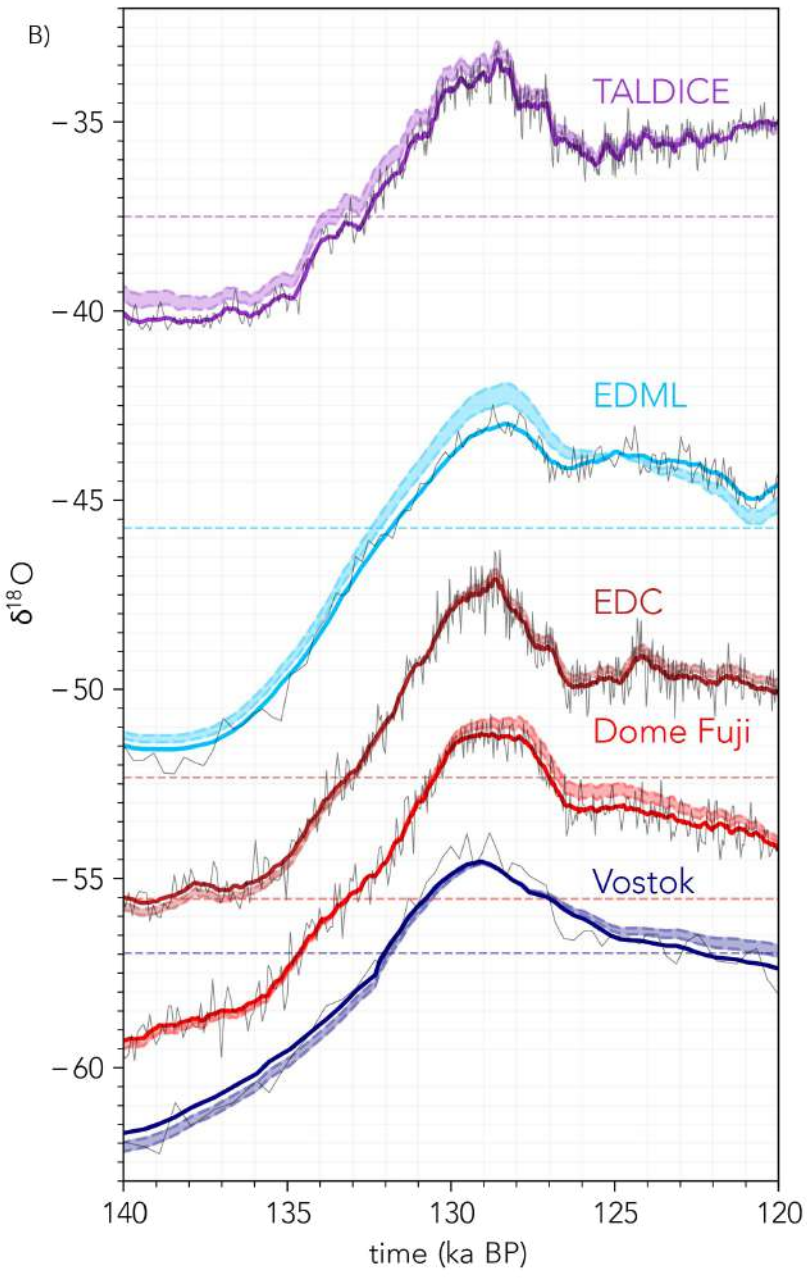
1. Ice sheet models are heavily parameterised
2. Parameter space largely unconstrained by observations
3. spatiotemporal limitations of observations

Observational benchmark needed covering both space and time

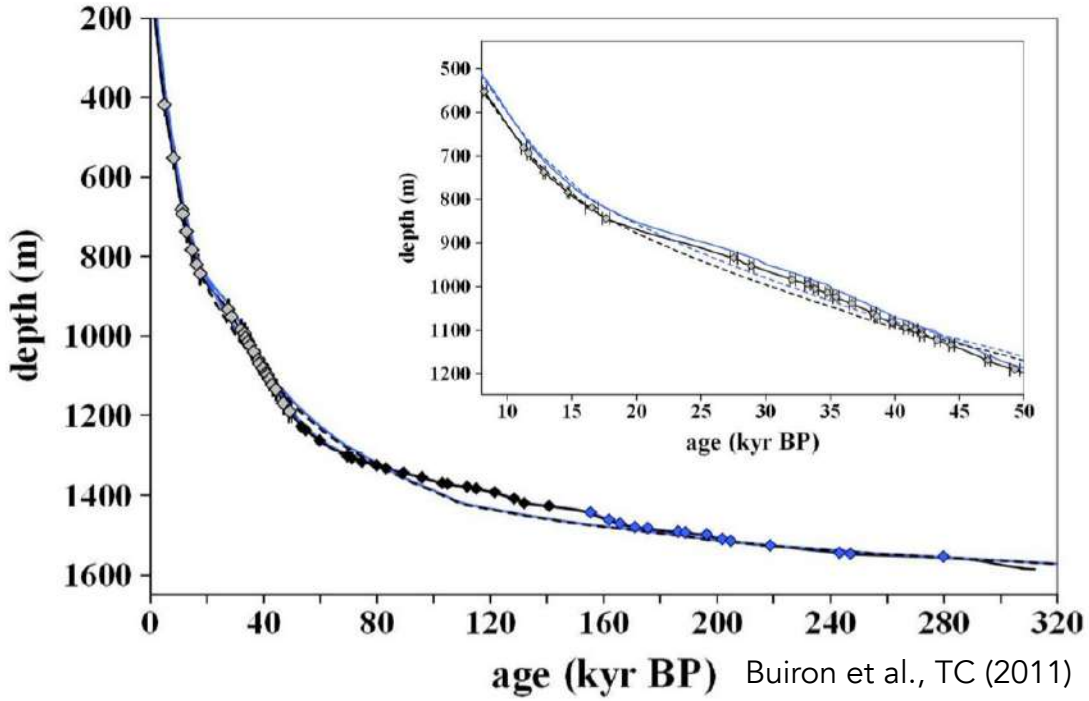
Solution:
Ice Cores (Sutter et al., 2020)
Isochrones (Sutter et al., 2021)

Constraining marine ice sheet dynamics via ice cores?

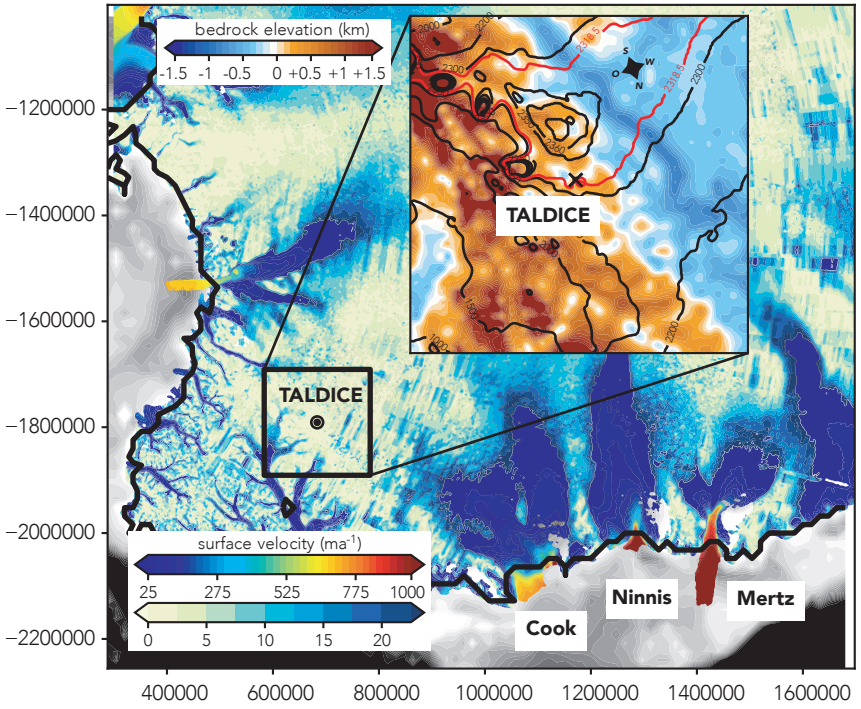




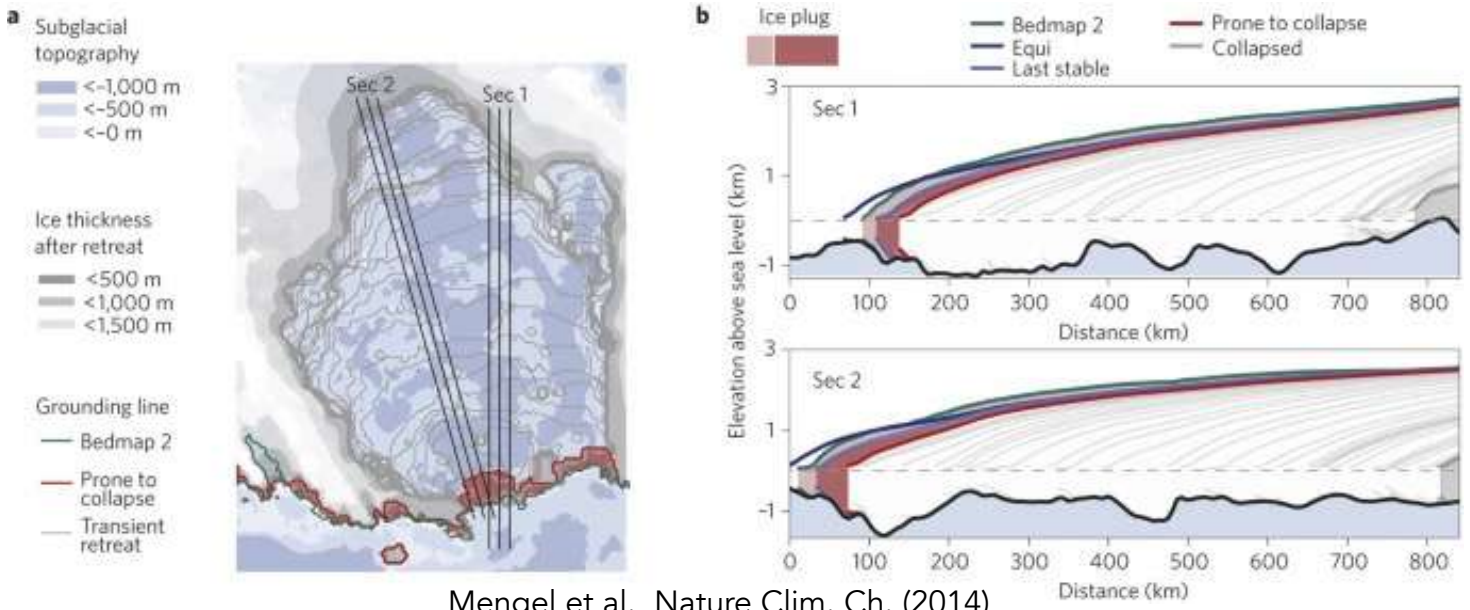
Sutter et al., GRL (2020)



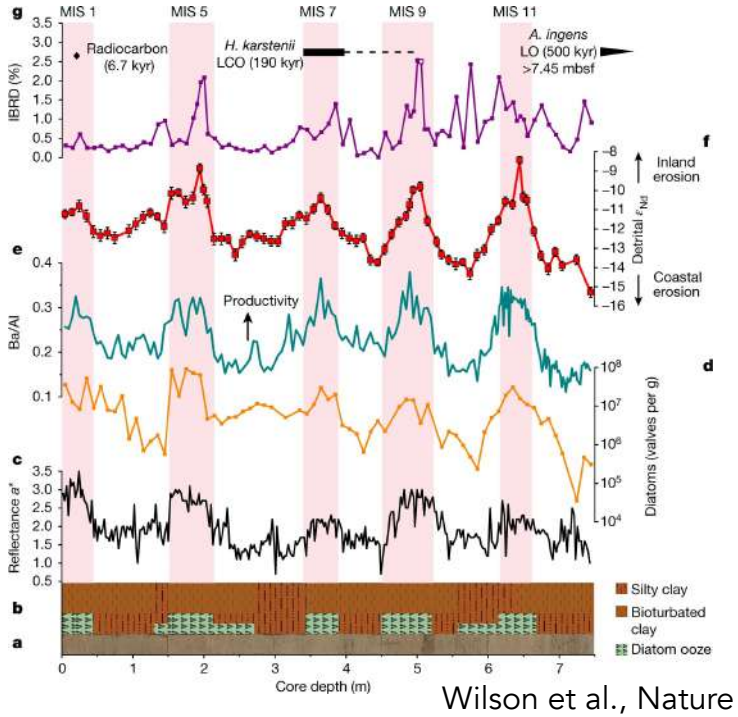
Buiron et al., TC (2011)



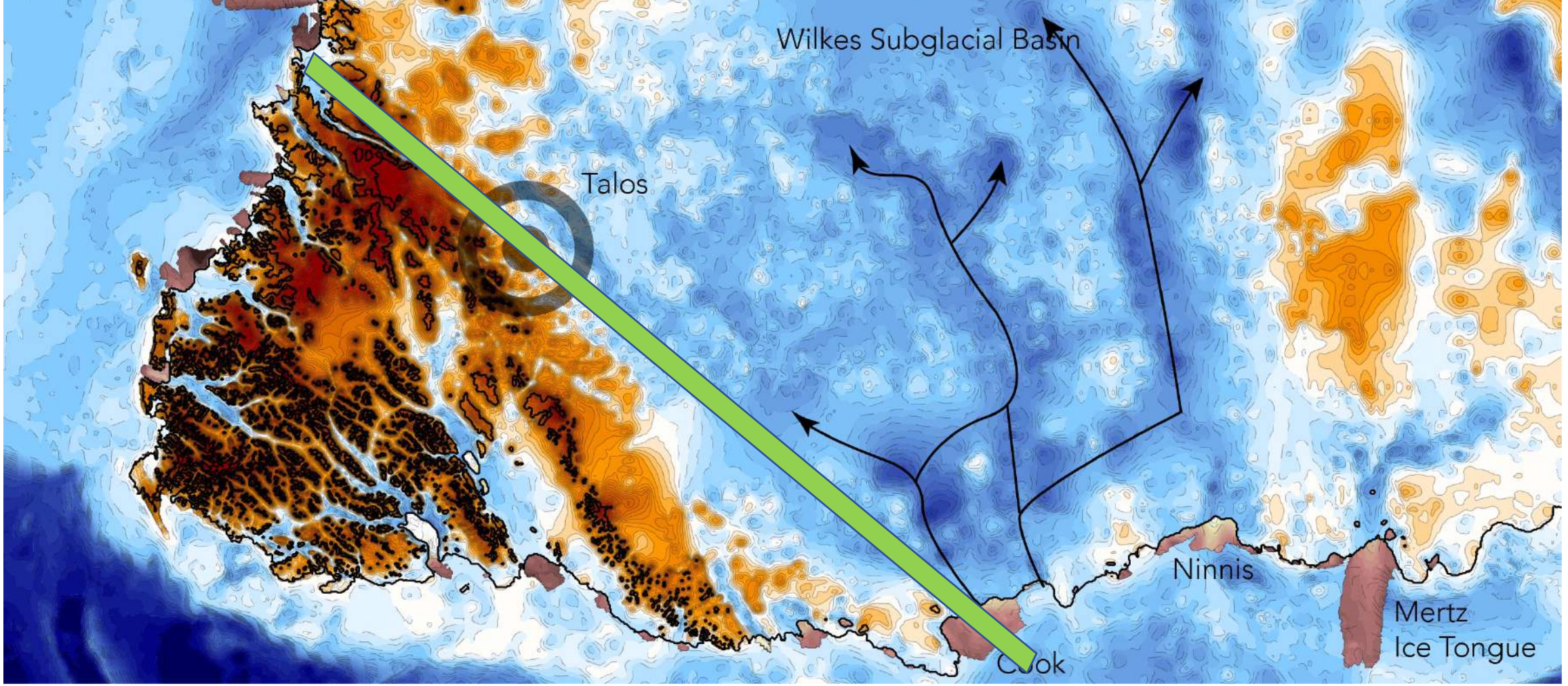
Sutter et al., GRL (2020)

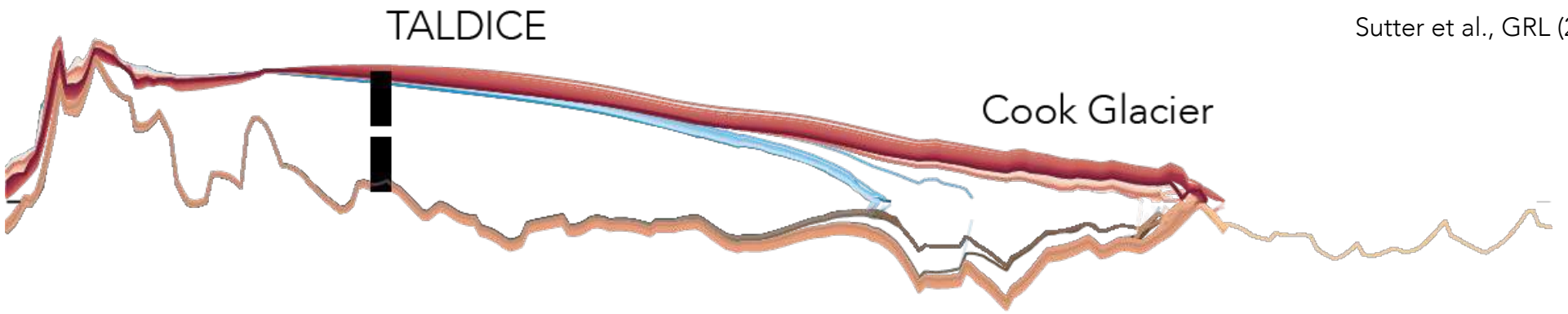


Mengel et al., Nature Clim. Ch. (2014)

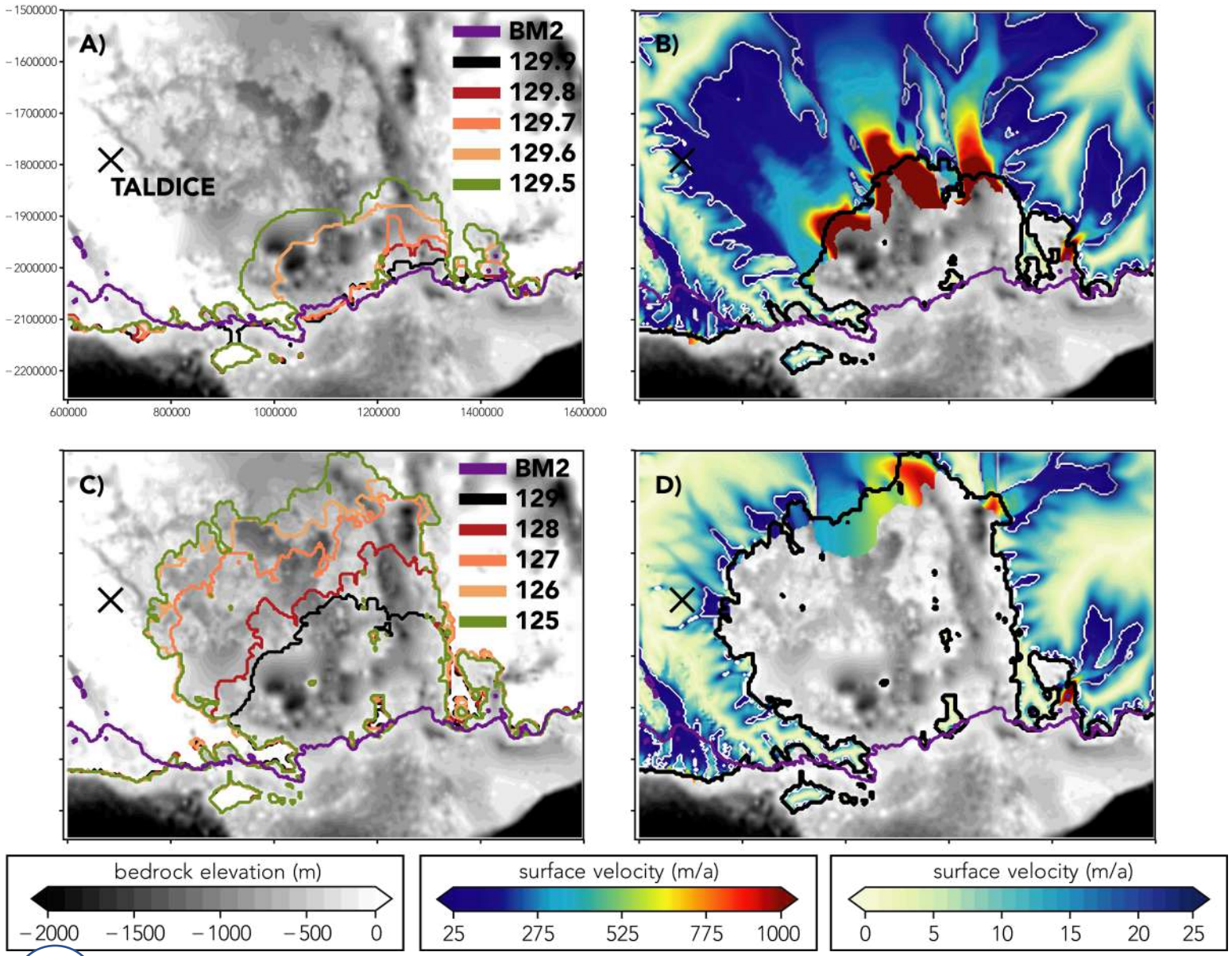


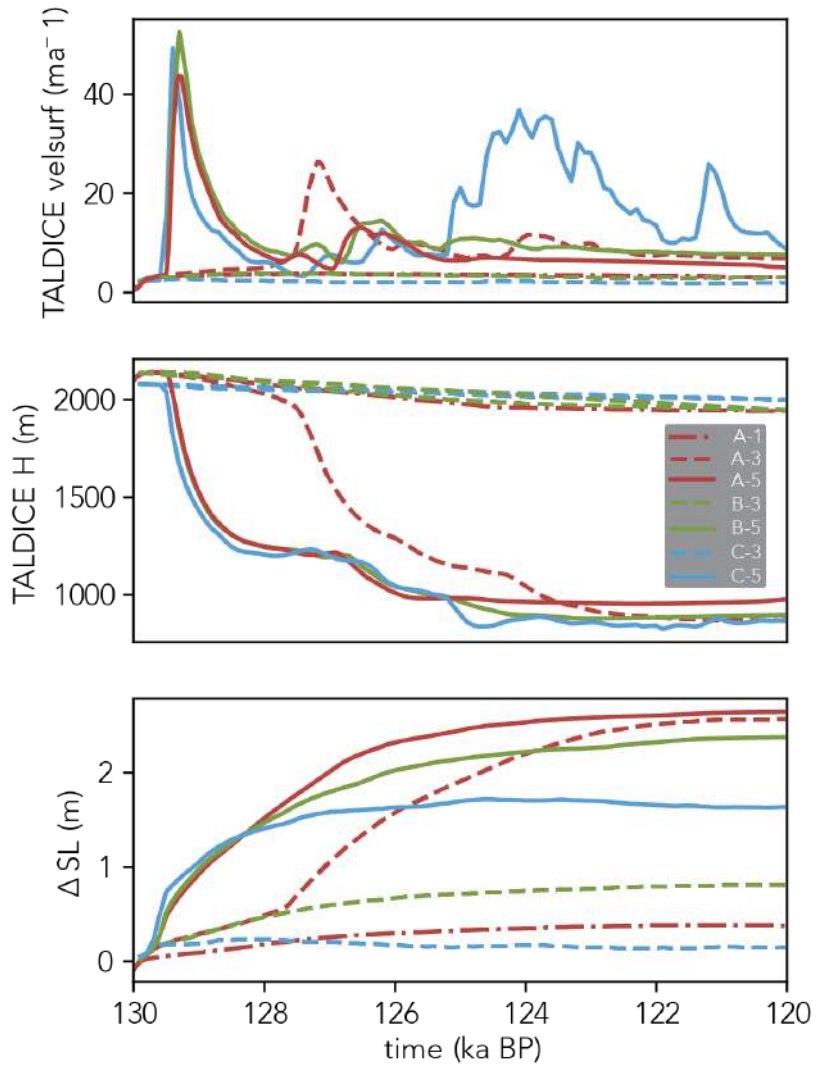
Wilson et al., Nature (2018)



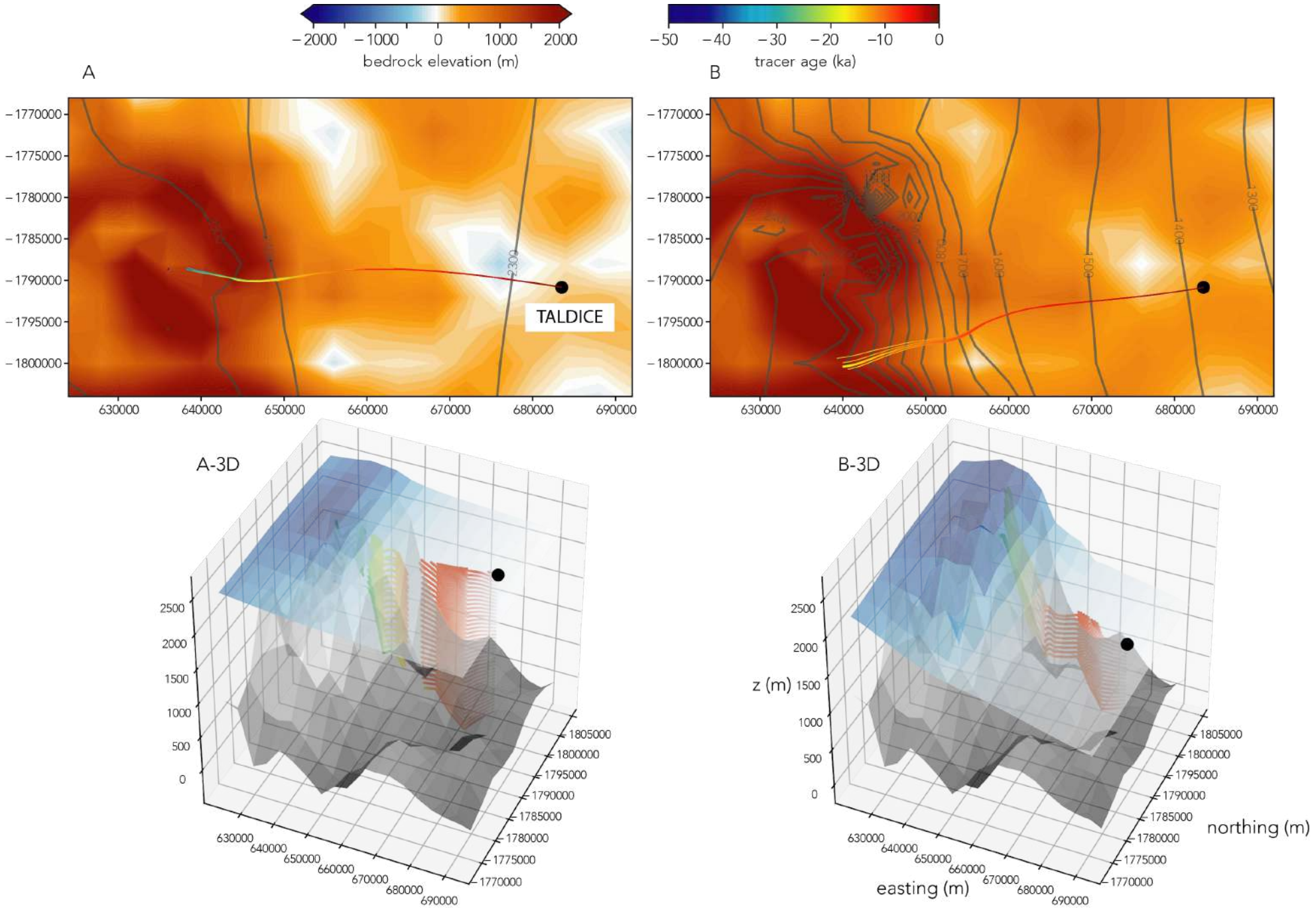


Sutter et al., GRL (2020)





Sutter et al., GRL (2020)


−2000 −1000 0 1000 2000
bedrock elevation (m)
−50 −40 −30 −20 −10 0
tracer age (ka)
A
B
TALDICE
A-3D
B-3D
z (m)
easting (m)
northing (m)

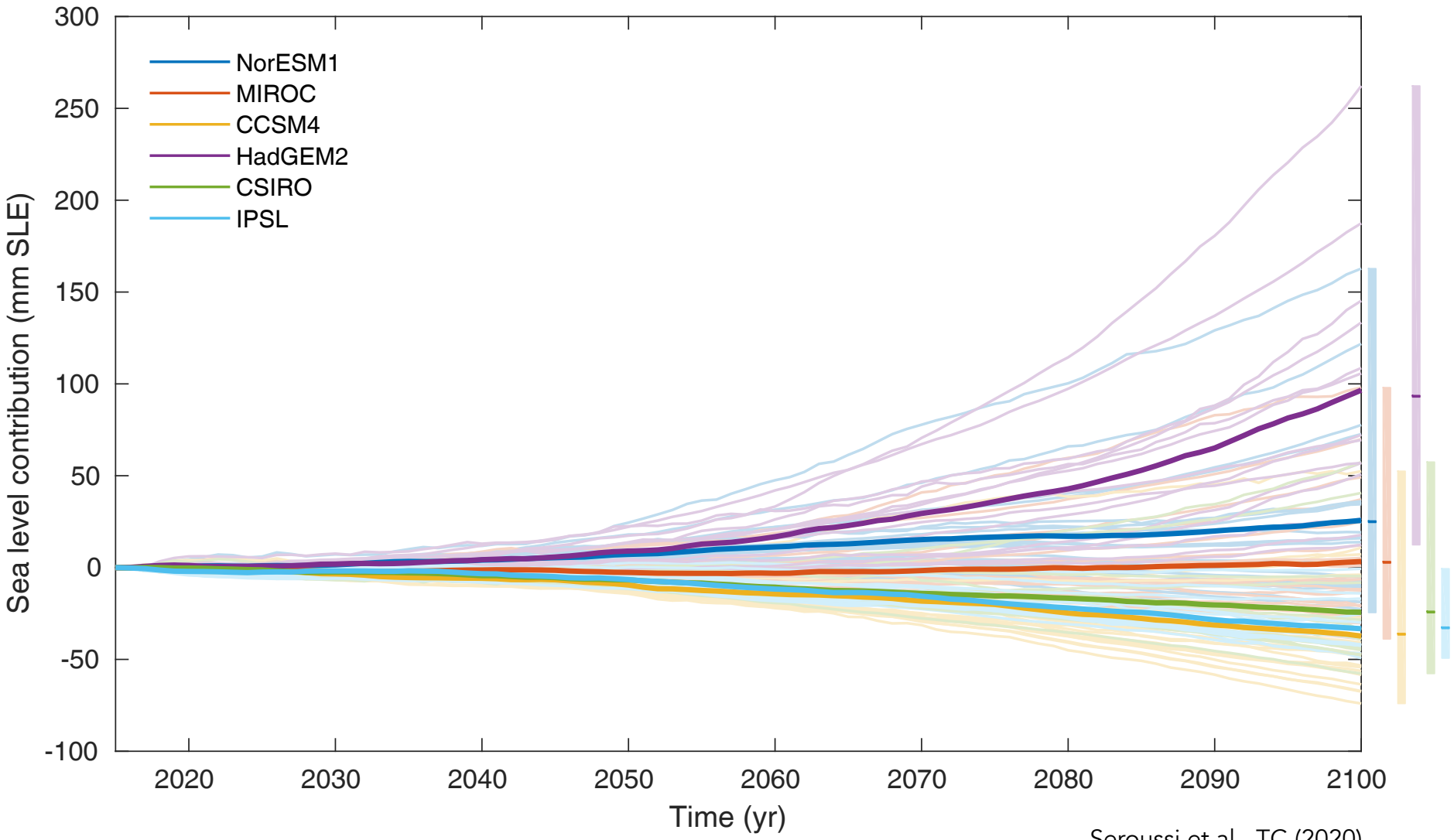
Bi-stable state of the Wilkes Basin ice-sheet

Collapsed state not consistent with the Talos Dome ice core record!

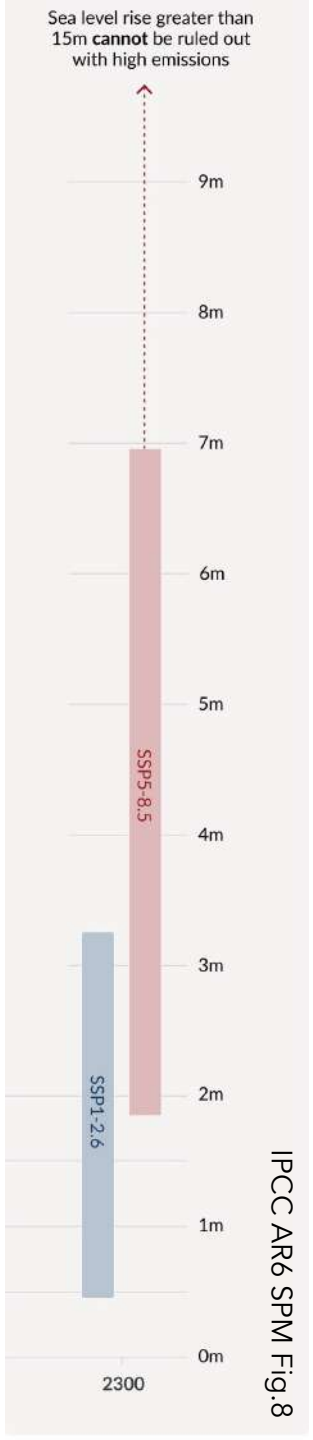
Last Interglacial sea level contribution from the Wilkes Basin ice-sheet limited to < 0.4 - 0.8 m.

More potential deep ice core locations near dynamics outlet systems?

Model projections – uncertainties galore



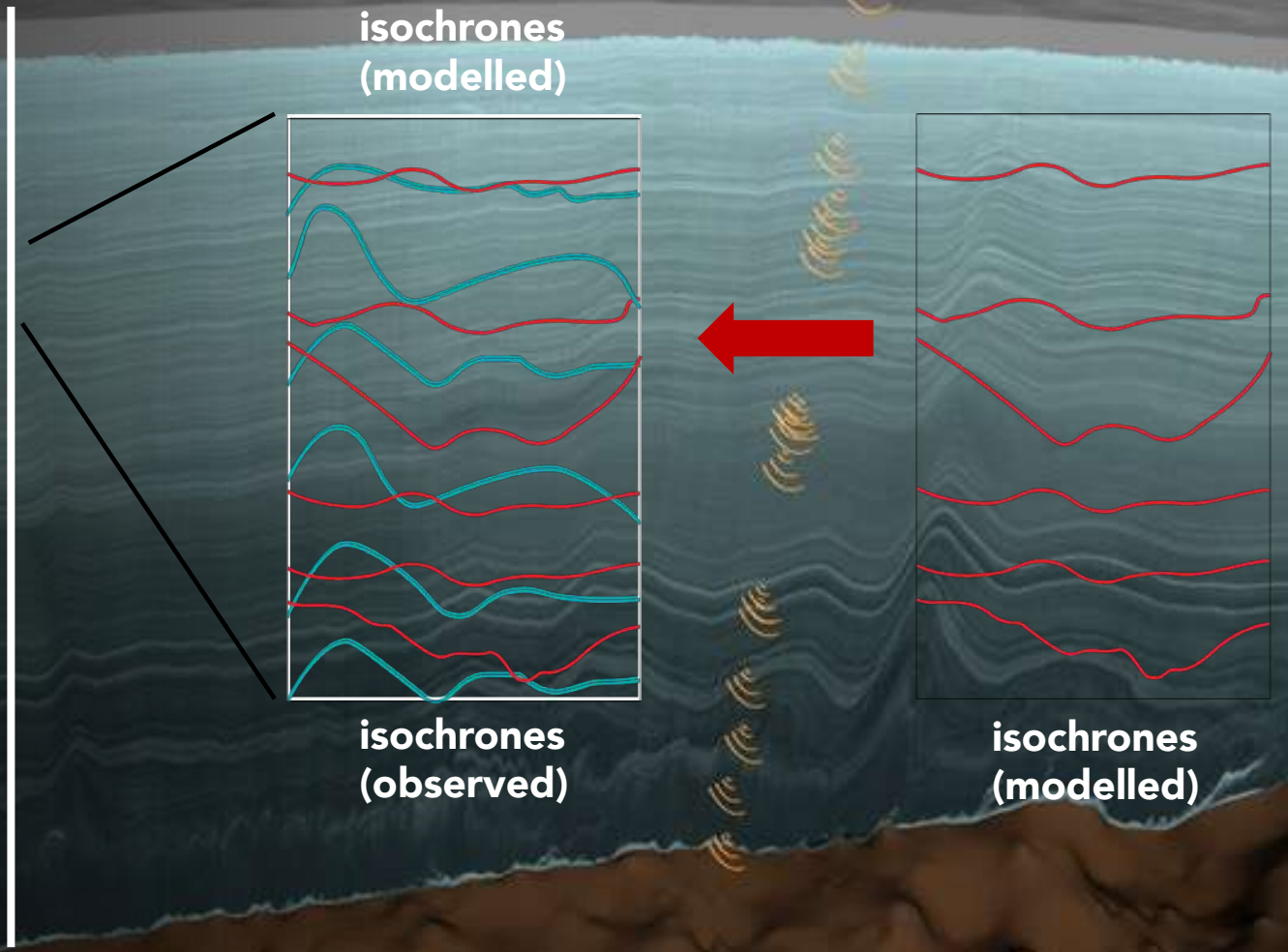
Seroussi et al., TC (2020)



IPCC AR6 SPM Fig.8

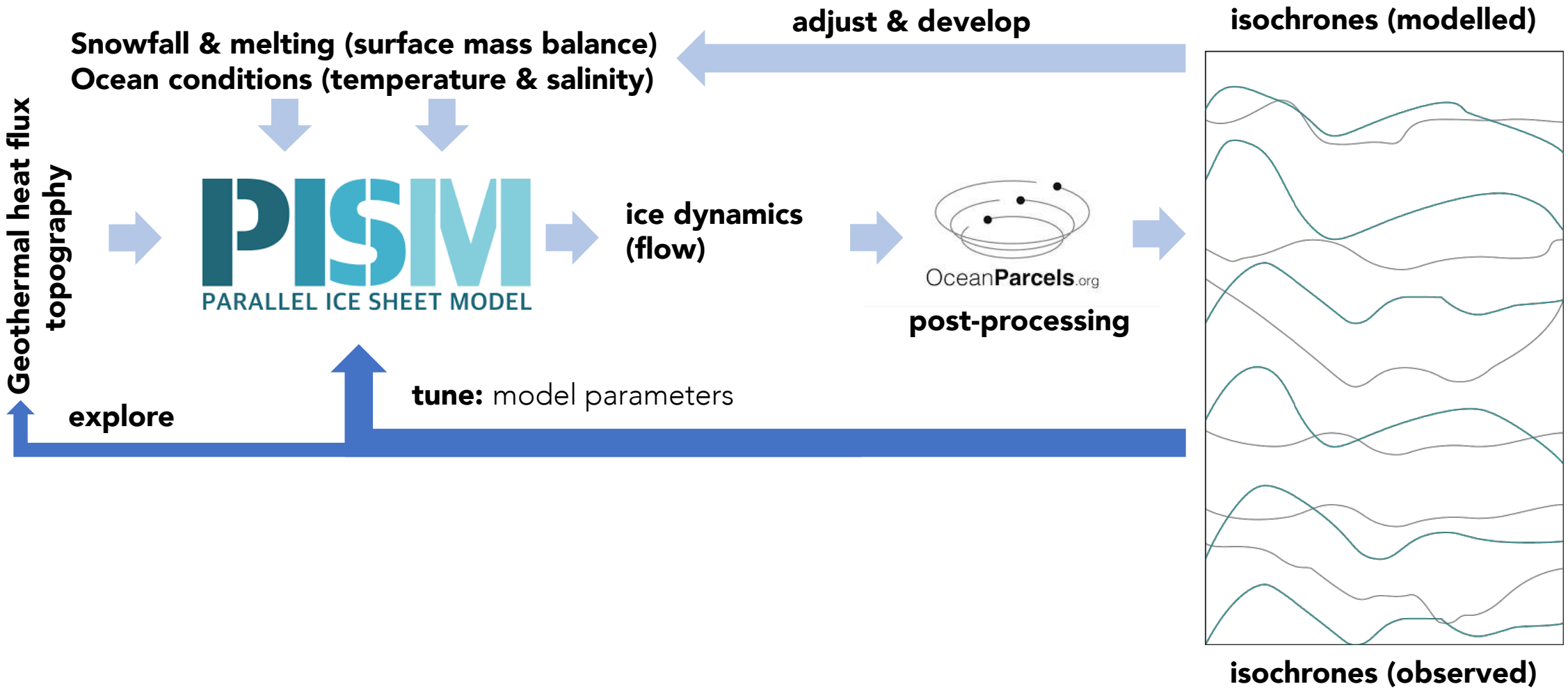
The leap forward: isochronal model calibration

Why Isochrones are a perfect data benchmark for ice sheet model calibration



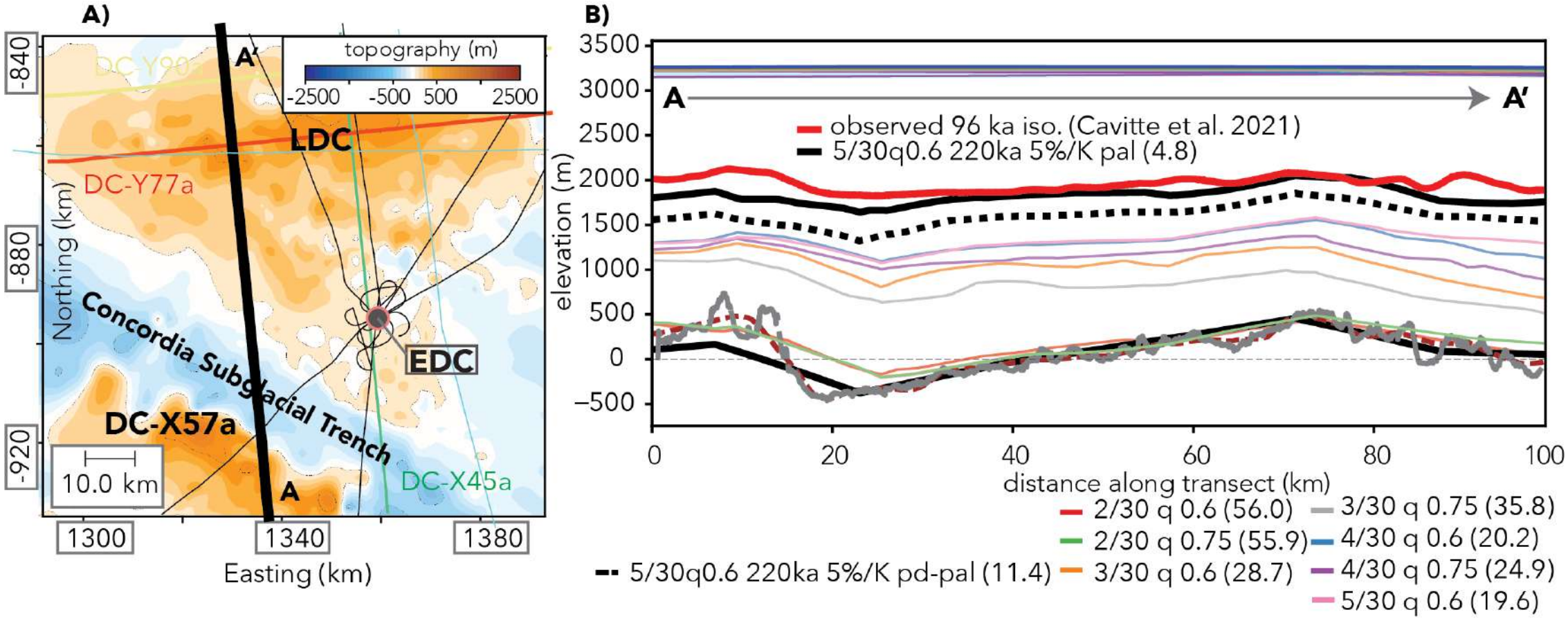
visualization by NASA

Isochronal Calibration, how-to?

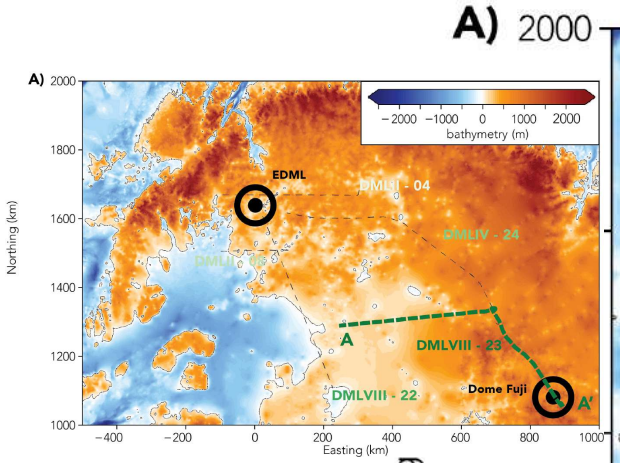


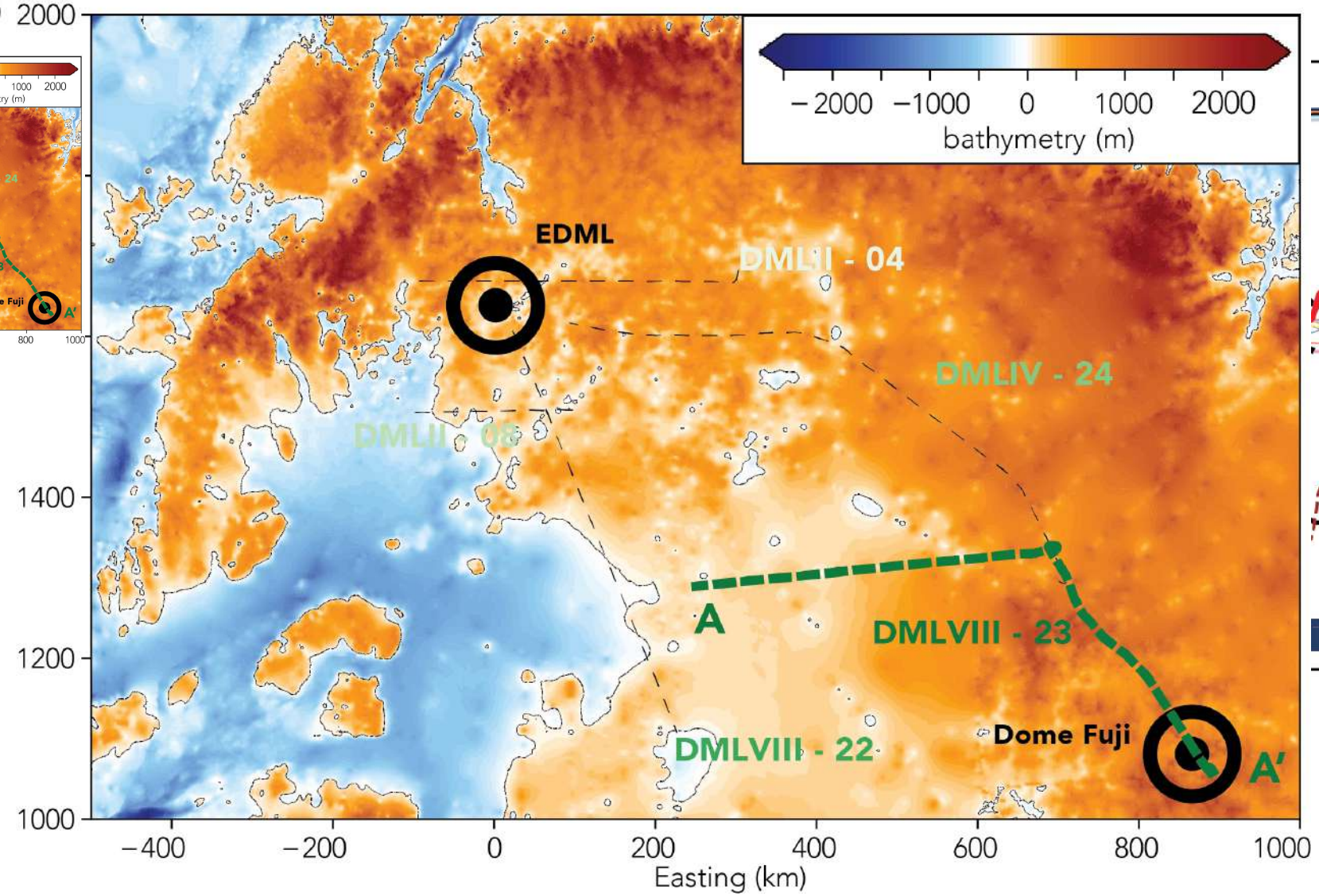
Test-Case Dome C

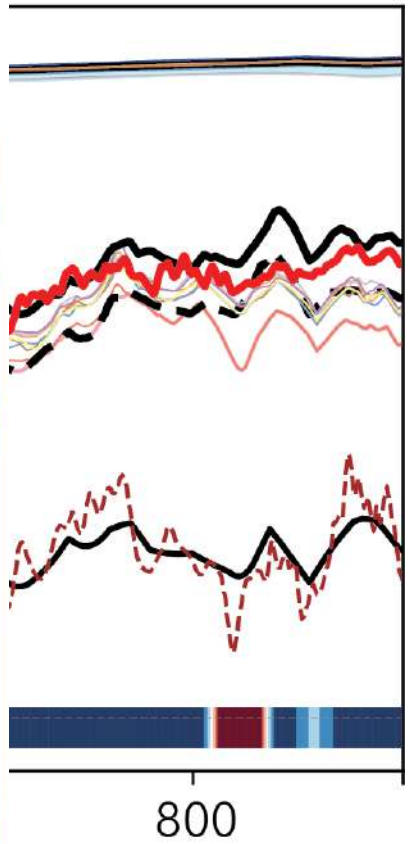
PISM on 16 km resolution (I know …)
paleoclimate forcing over the last 220 ka (with pre-ceeding 1.3 Ma paleo-spinup)
vs.
present-day equilibrium spinup



Test-Case Dronning Maud Land

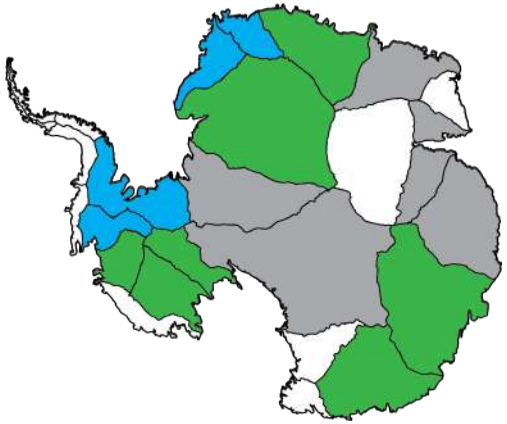


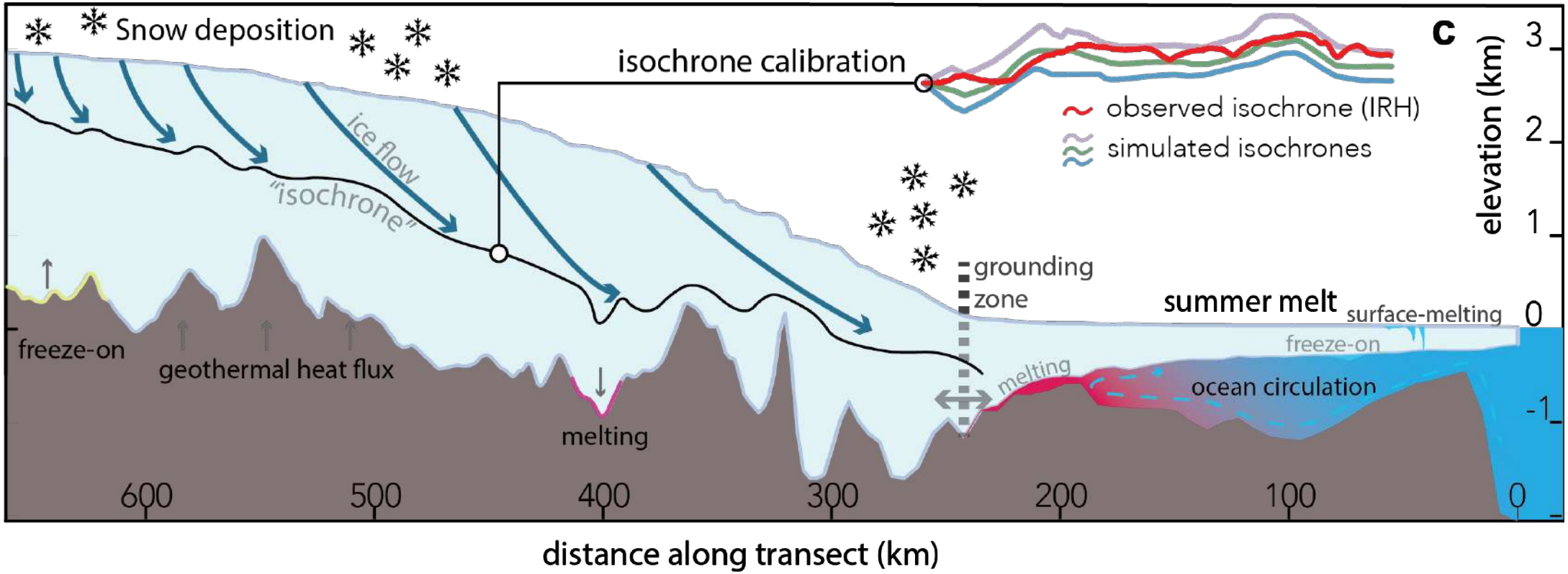


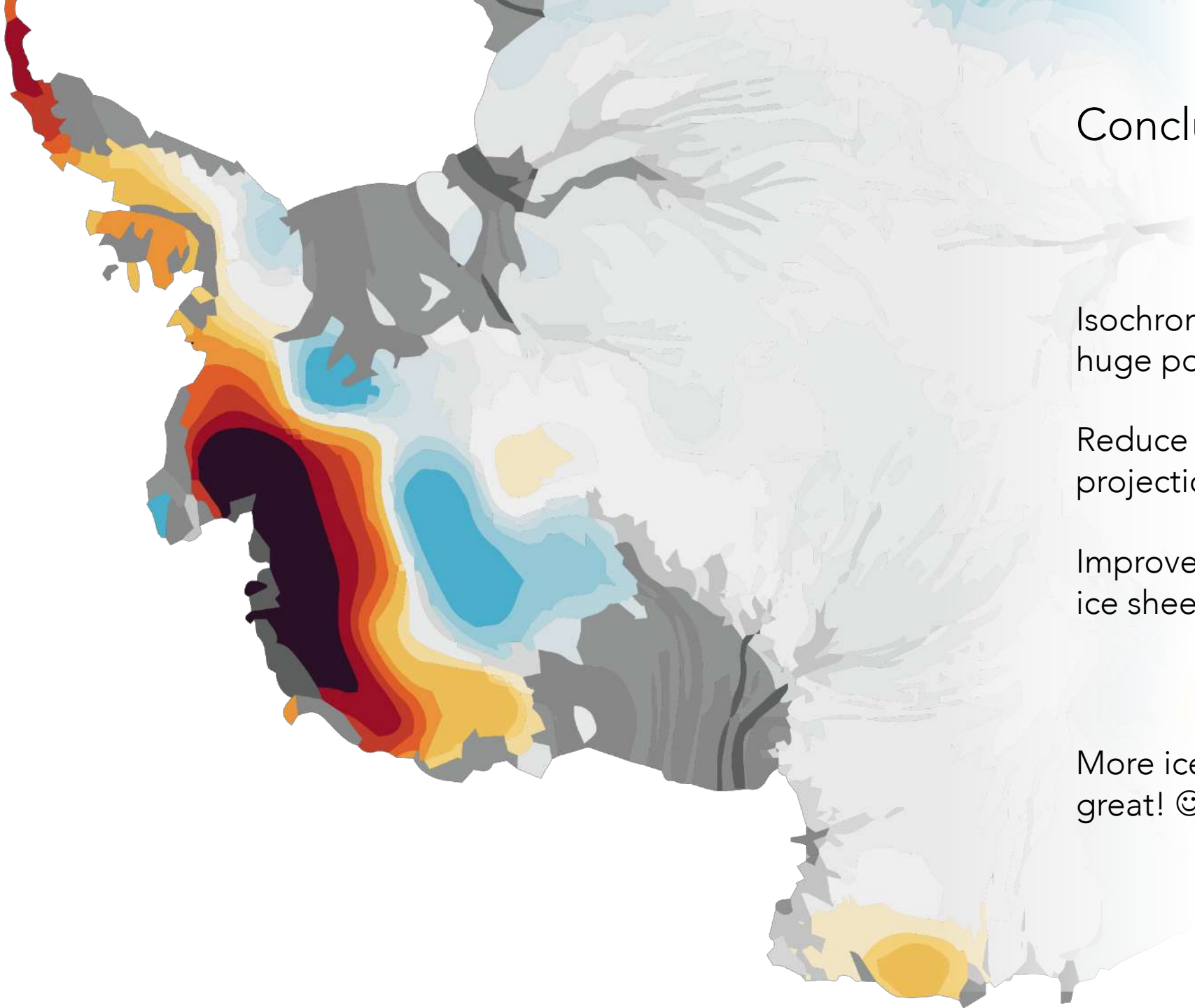


Exploration of ice sheet dynamics through the lens of the stratigraphic record

1. Spatial attribution of isochrone mismatches.
2. Novel heuristics of basal friction.
3. Generalisation to all drainage sectors.
4. Isochronally constrained Antarctic-wide reconstructions of past ice sheet dynamics.







Conclusions

Isochrones and “coastal ice cores” hold huge potential for ISM calibration to :

Reduce uncertainties in sea level projections.

Improve parameterisations of ice flow in ice sheet models.

More ice cores & isochrones would be great! ☺