Last Interglacial subsurface warming on the Antarctic shelf triggered by reduced deep-ocean convection

Nicholas Yeung, **Laurie Menviel**, Katrin Meissner,

Dipayan Choudhury, Tilo Ziehn, Matthew A. Chamberlain

David Hutchinson, Gabriel Pontes, Himadri Saini

UNSW
Climate Change
Research Centre

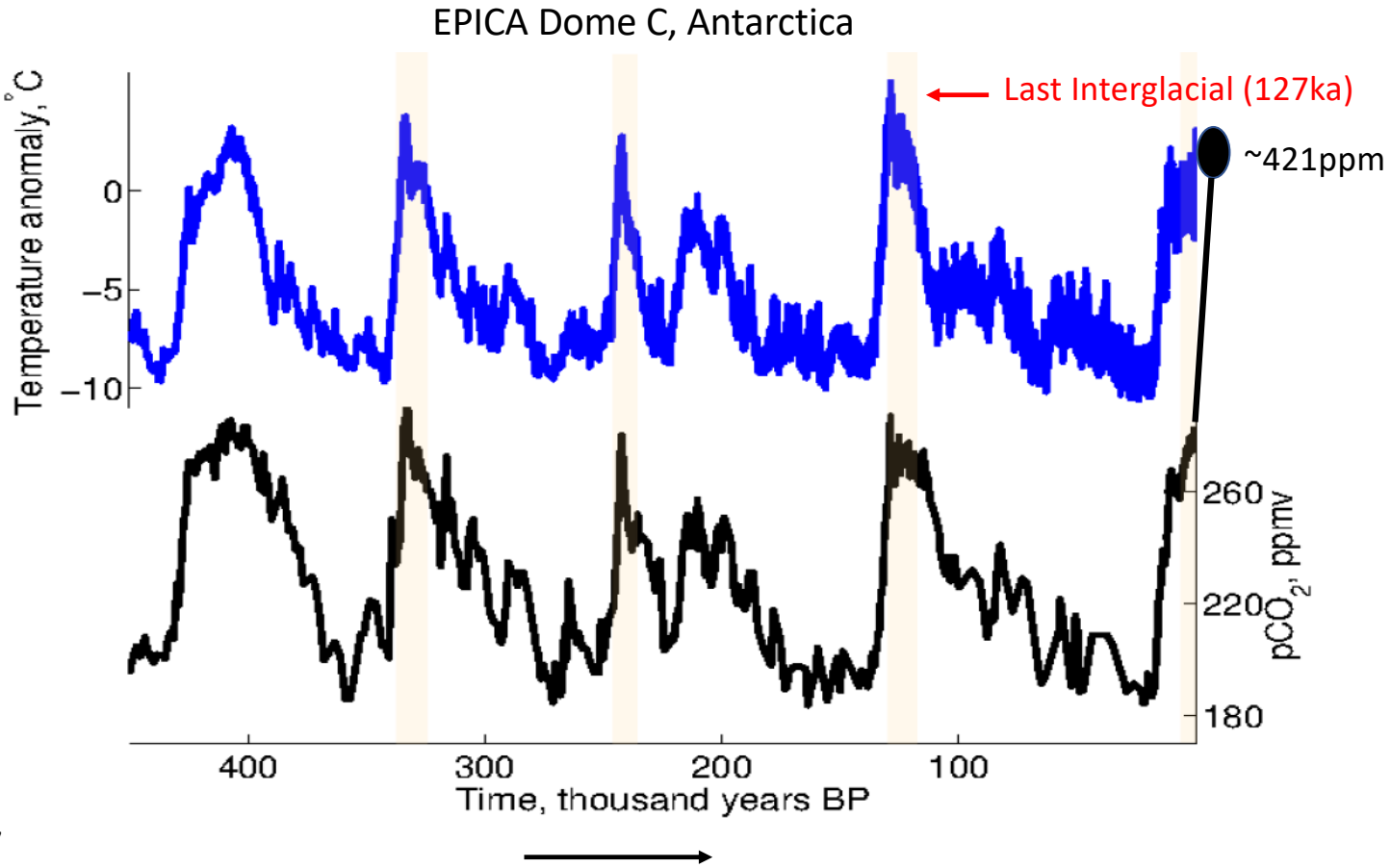
Australian Government

Australian Research Council

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA

ACEAS
Australian Centre for Excellence
in Antarctic Science

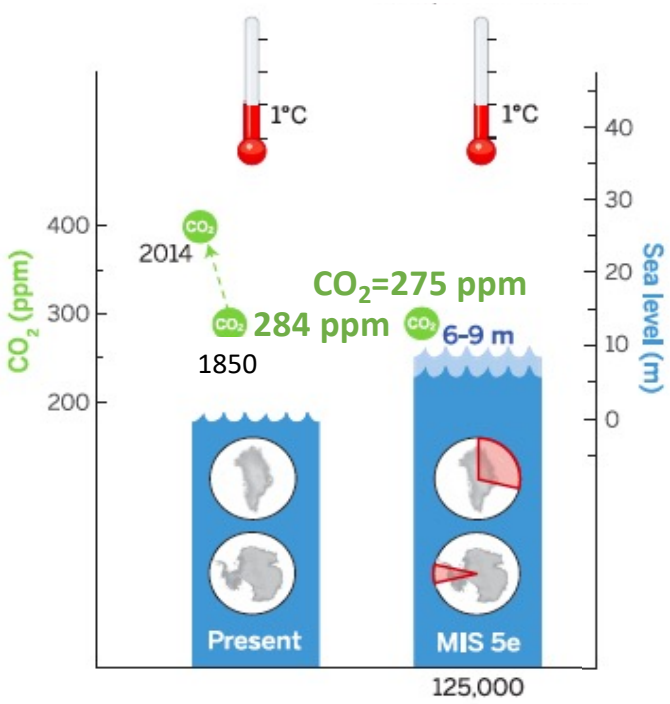
Glacial - Interglacial cycles



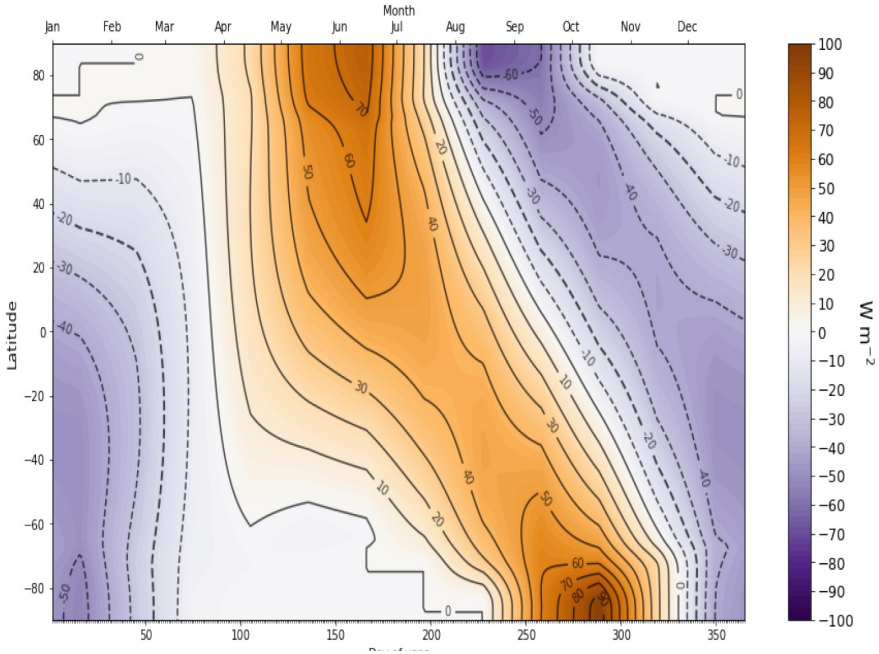
Jouzel *et al.*, 2007

Last Interglacial (127ka)

Temperature relative to Pre-Industrial



Insolation anomalies compared to pre-industrial

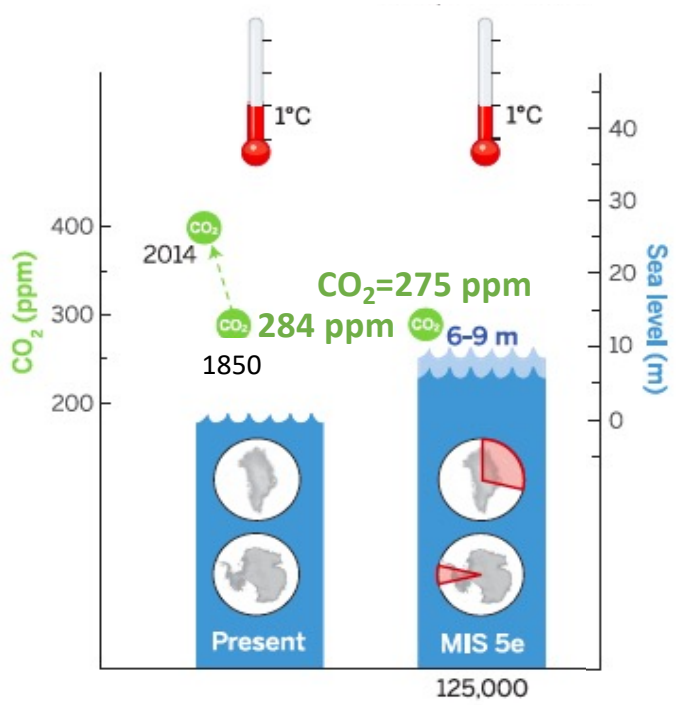


Day of the year

Dutton, 2015

Last Interglacial (127ka)

Temperature relative to Pre-Industrial

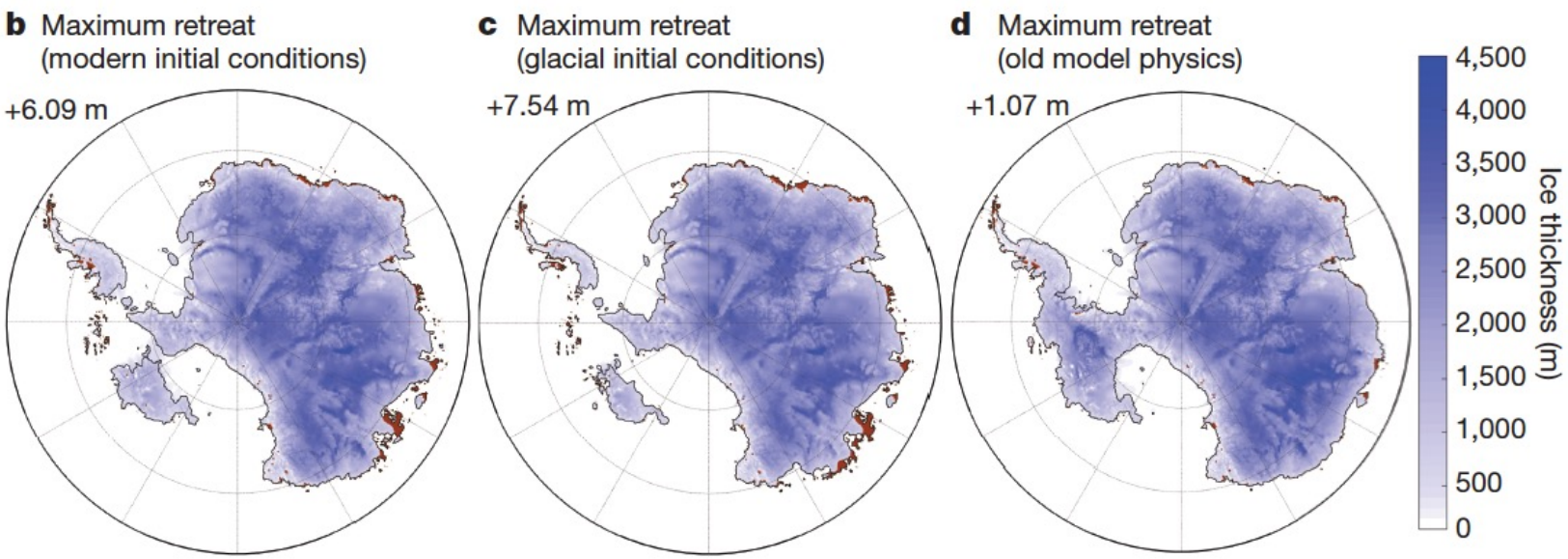


Mean LIG sea-level anomaly ~5m

Antarctic ice-sheet contribution of ~ 3 to 5 m sle

Dutton, 2015

Retreat of the Antarctic ice-sheet at the LIG necessitates a ~3degC subsurface warming



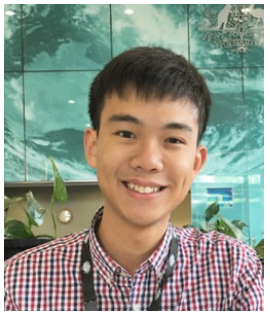
DeConto & Pollard, 2016

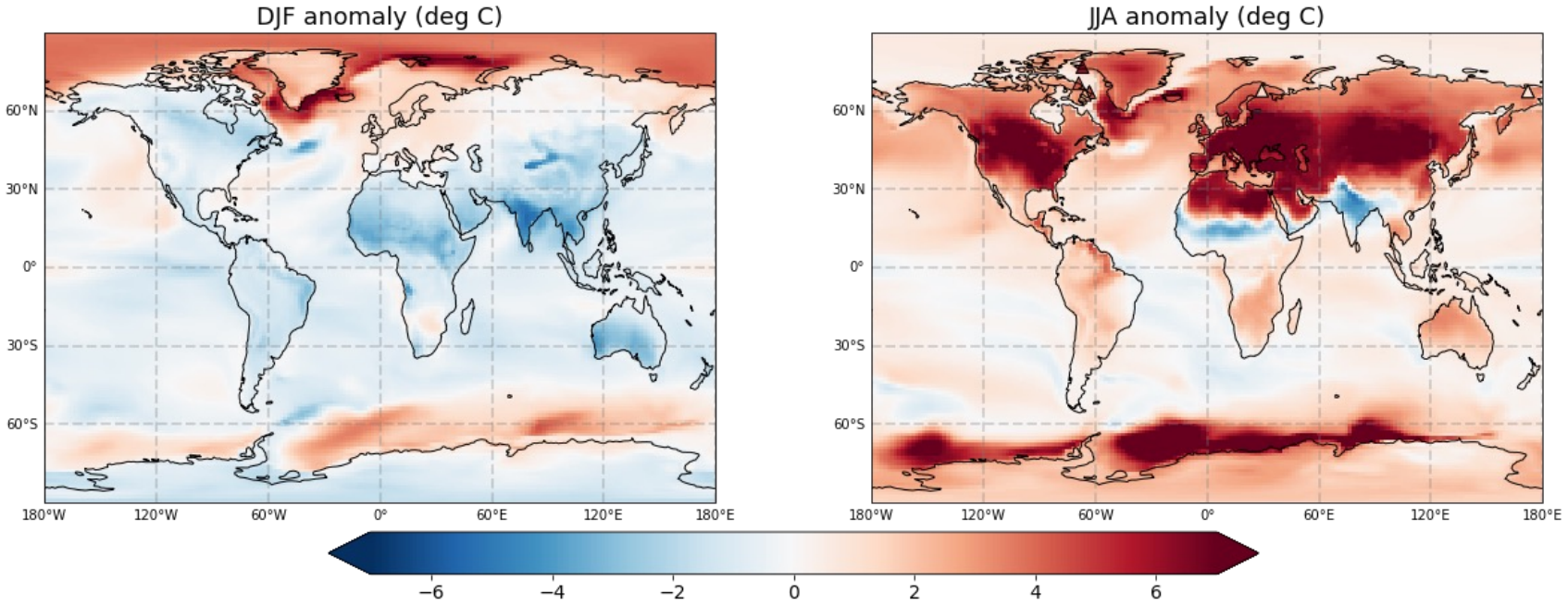
PMIP4 submission

Last interglacial climate

Simulated surface air temperature anomalies

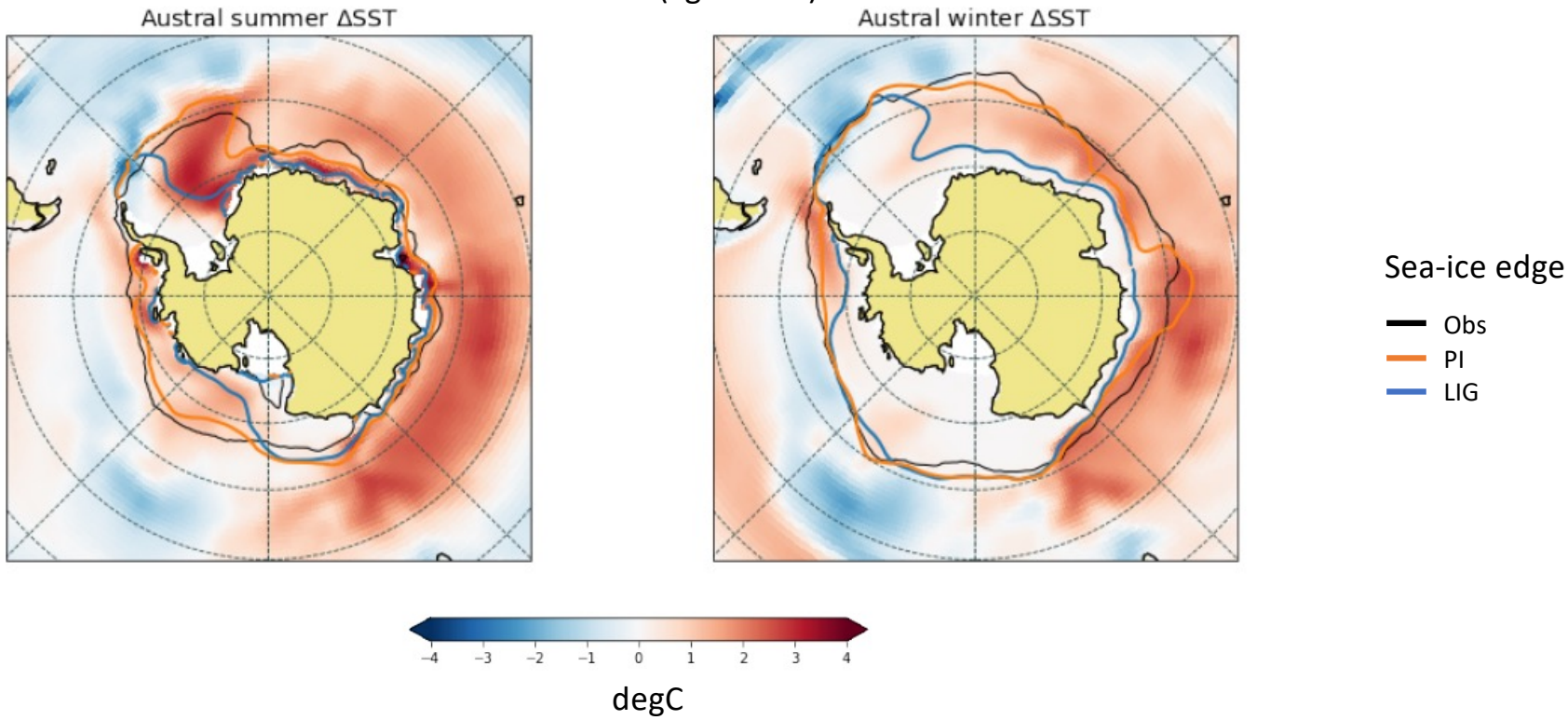
lig127k compared to pre-industrial (PI)





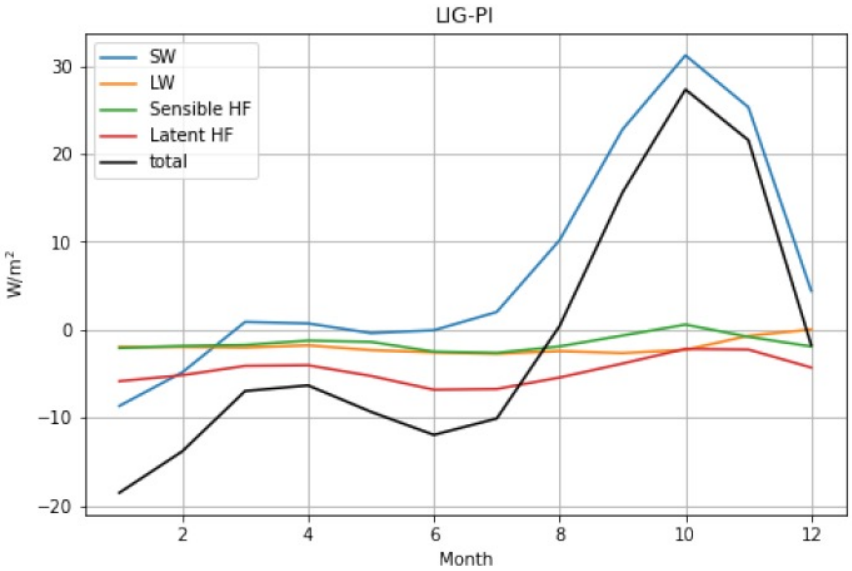
Warmer conditions south of 65S

SST anomalies (lig127k-PI)

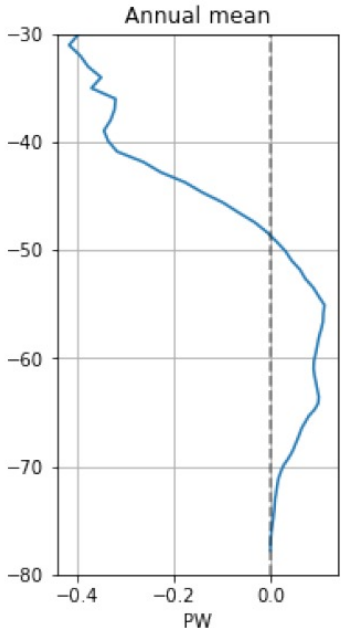


Why is the Southern Ocean warming?

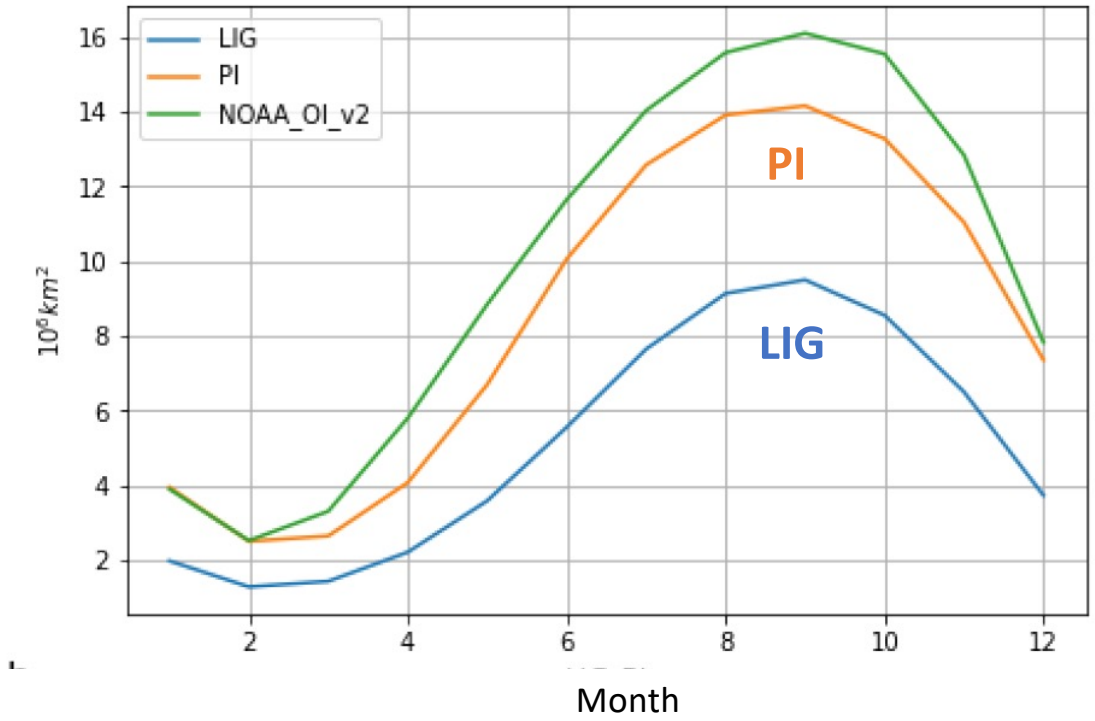
Surface energy flux anomaly averaged over 75S-60S



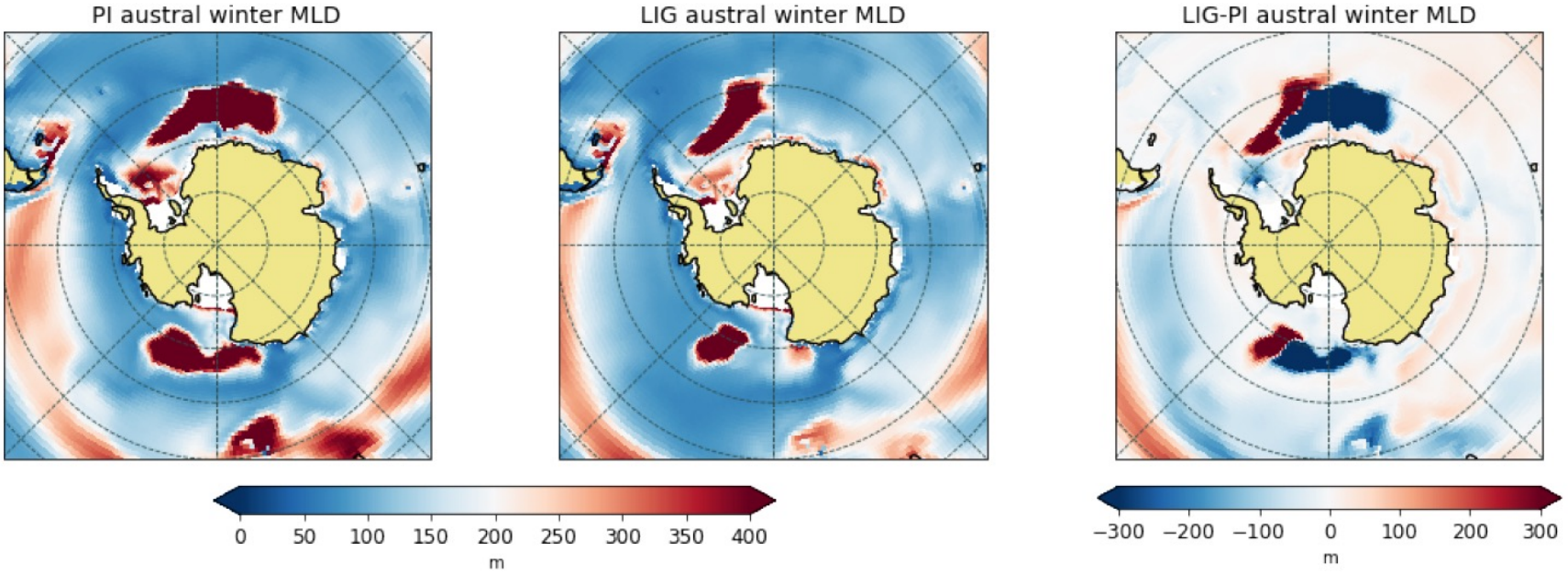
Zonally integrated meridional oceanic heat transport anomaly LIG-PI



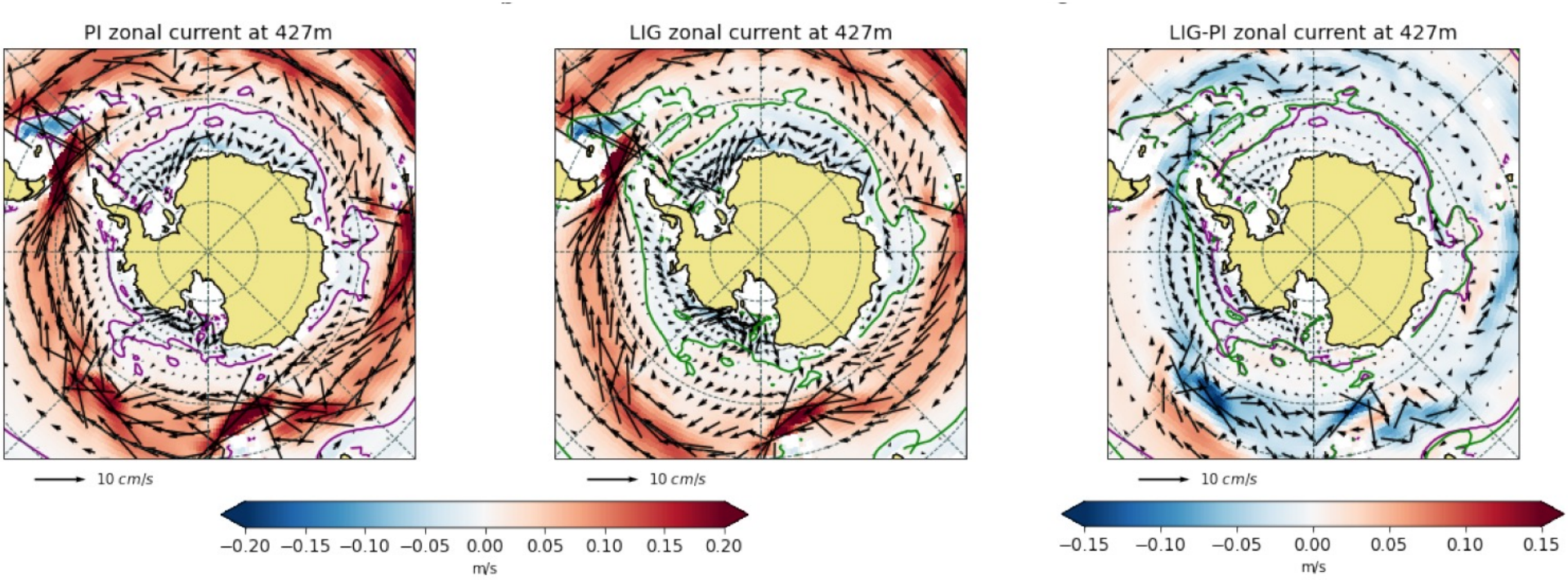
Reduced Southern Ocean sea-ice area



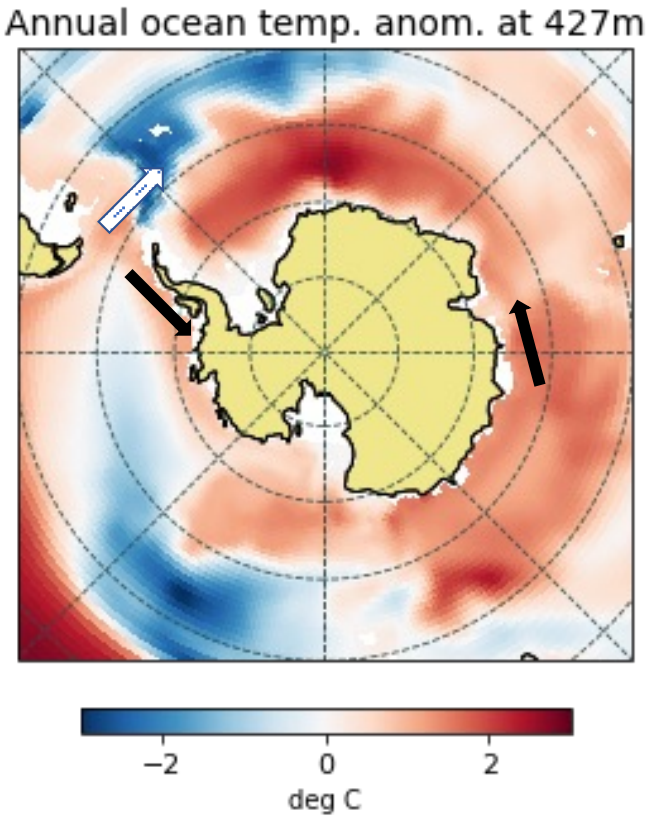
Greater stratification & reduced deep-ocean convection



Weakening of the Antarctic Circumpolar Current and strengthening of the Antarctic Slope Current



~3C ℃ sub-surface warming



Reduced deep-ocean convection
Strengthening of Antarctic slope current

Conclusions

- Enhanced meridional ocean heat transport and higher austral spring insolation

  → reduced SO sea-ice cover

- Fresher and warmer conditions

  → higher stratification and weaker AABW formation

  → subsurface warming around Antarctica.

- Positive feedback

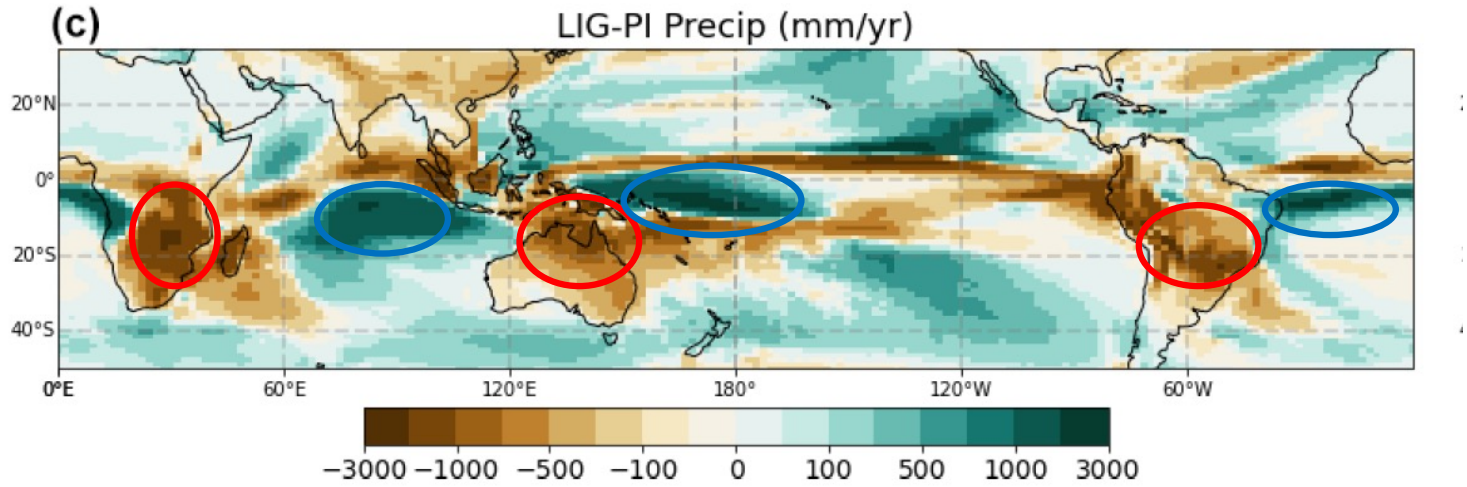
Yeung et al. submitted

Land–sea temperature contrasts at the Last Interglacial and their impact on the hydrological cycle

Climate of the Past 2021

Nicholas King-Hei Yeung[1,2], Laurie Menviel[1], Katrin J. Meissner[1,2], Andréa S. Taschetto[1,2], Tilo Ziehn[3], and Matthew Chamberlain[4]

Austral summer precipitation anomaly

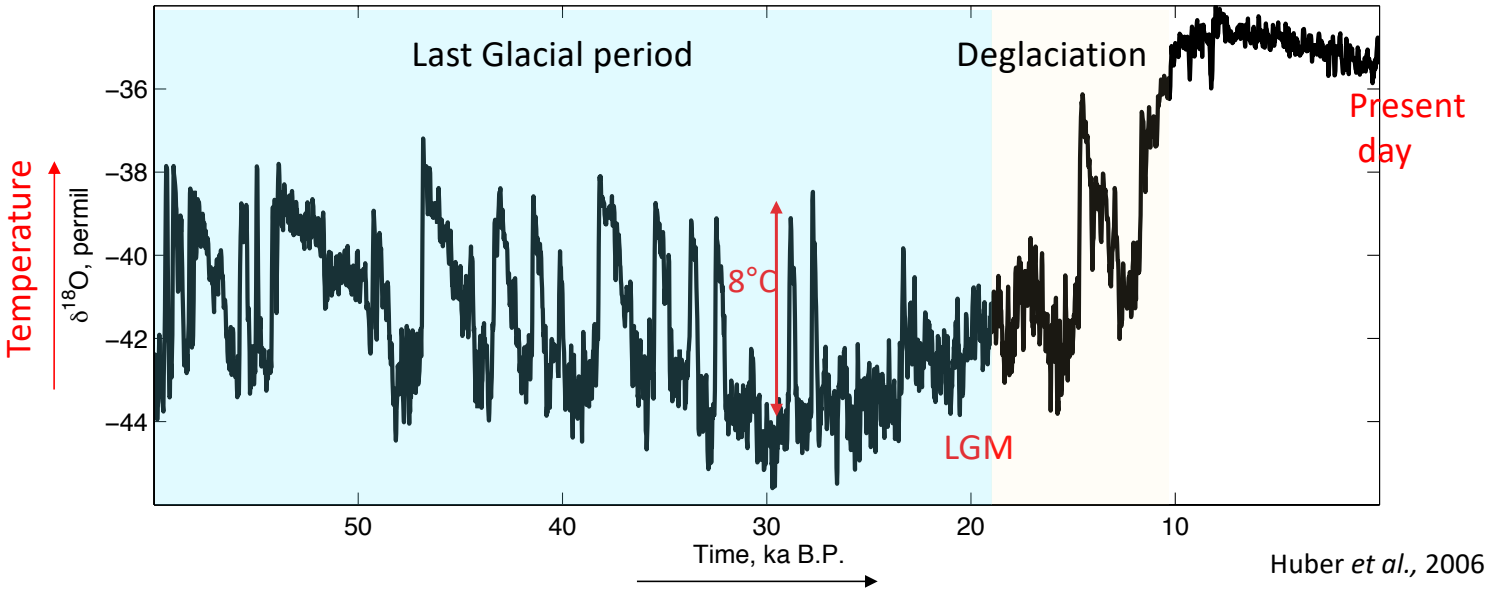


Weakened Australian, Sth. African & Sth American monsoons (-20 to -60%)

Higher precipitation over the ocean

Heinrich variability

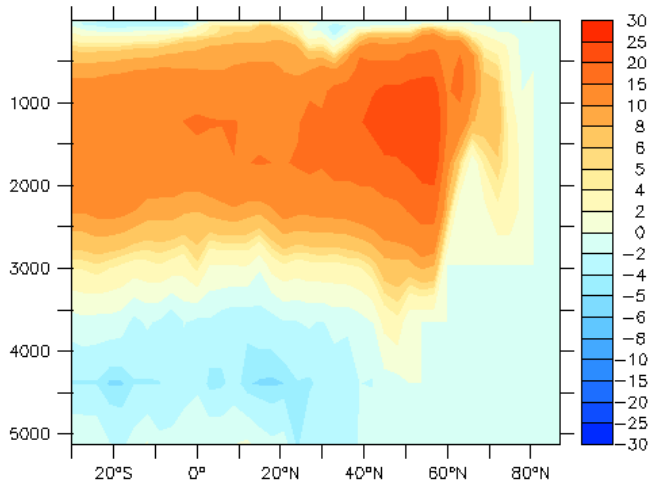
NGRIP Ice Core $\delta^{18}O$, Greenland



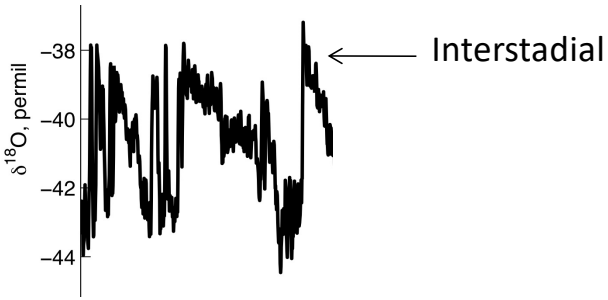
Huber *et al.,* 2006

Heinrich variability

Interstadial (warm): strong North Atlantic Deep Water

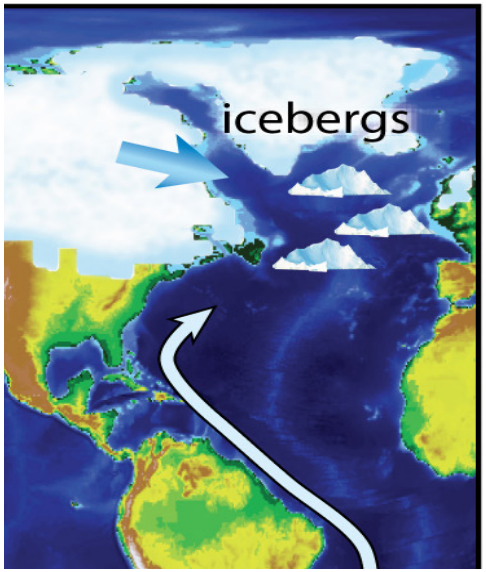


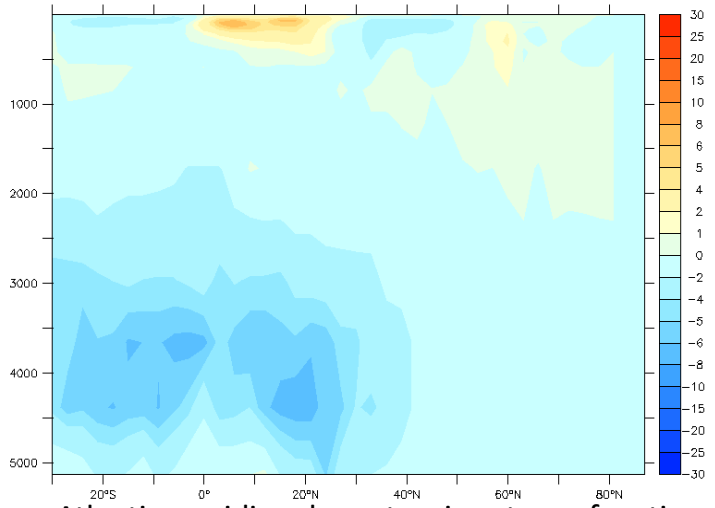
Atlantic meridional overturning streamfunction



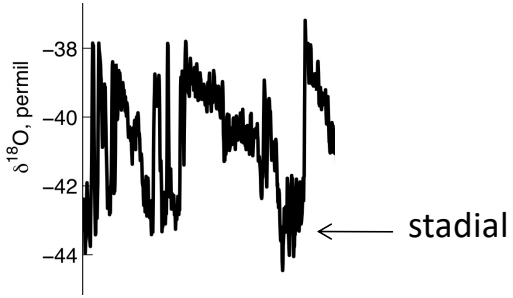
Heinrich variability

Stadial (cold): weak North Atlantic Deep Water





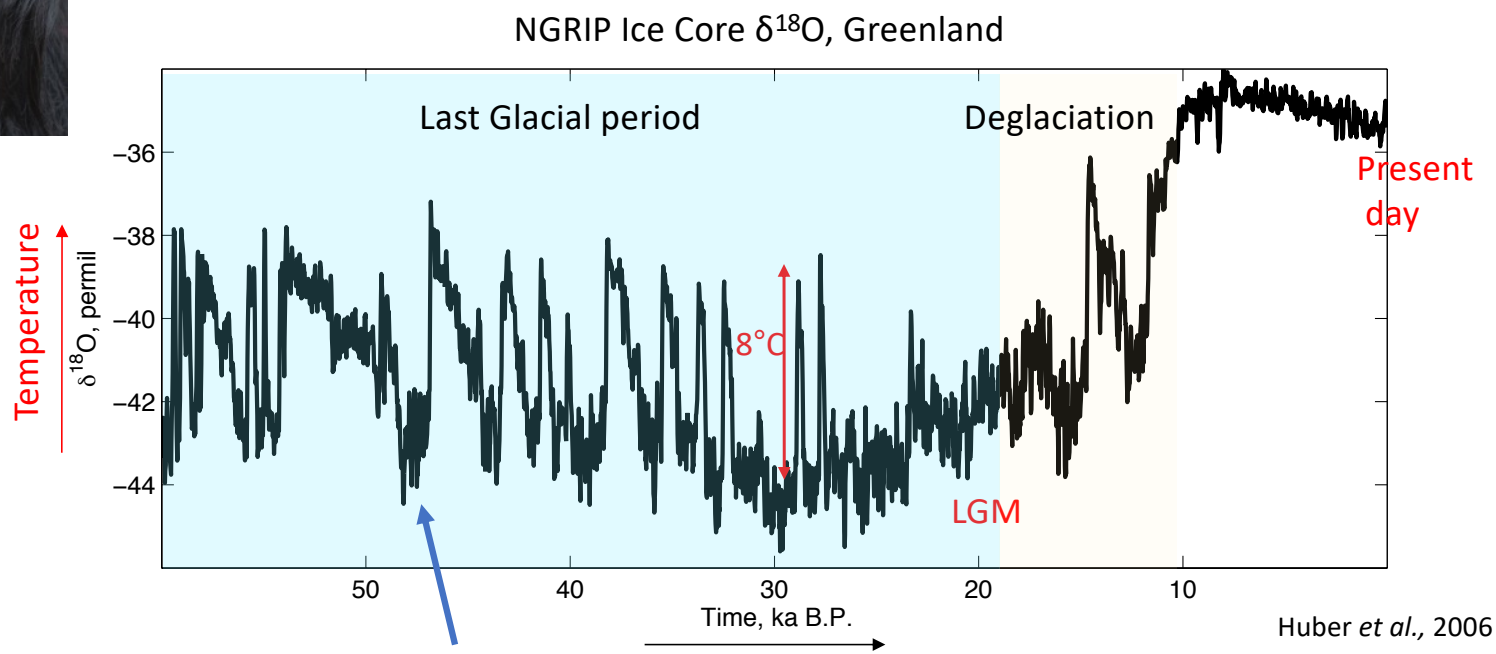
Atlantic meridional overturning streamfunction



Himadri Saini

Past changes in Australian and NZ rainfall

DP: Drysdale R., Brown J., Trebble P., Bostock H.



Huber *et al.*, 2006

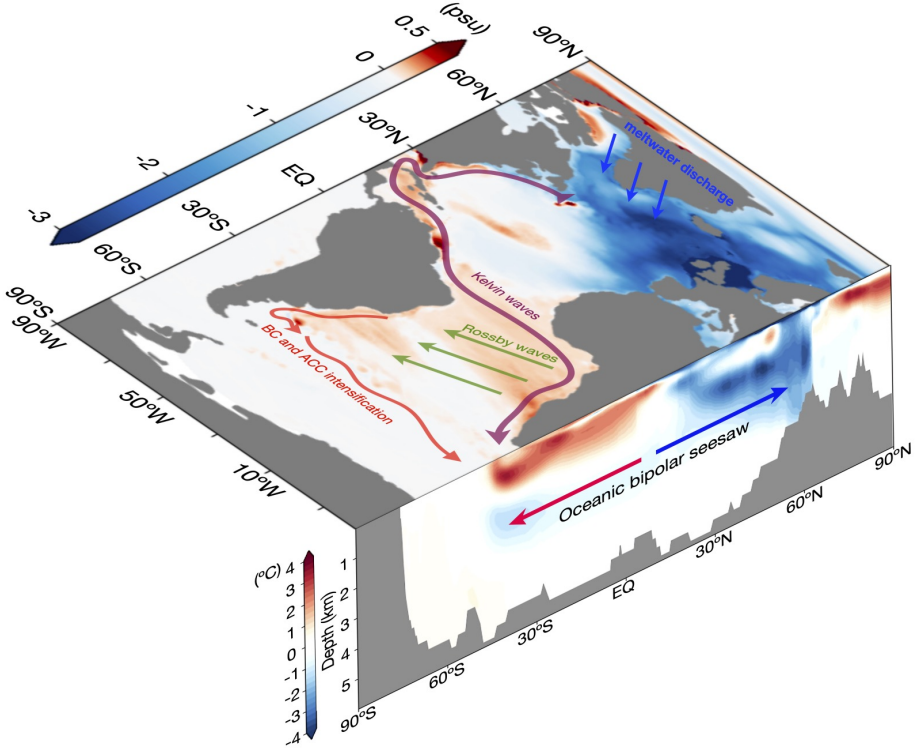
Heinrich stadial 5
49ka

1) Orbital parameter + GHG
2) Ice mask and vegetation
3) Ice orography

Gabriel
Pontes

Oceanic and atmospheric teleconnections resulting from an AMOC weakening

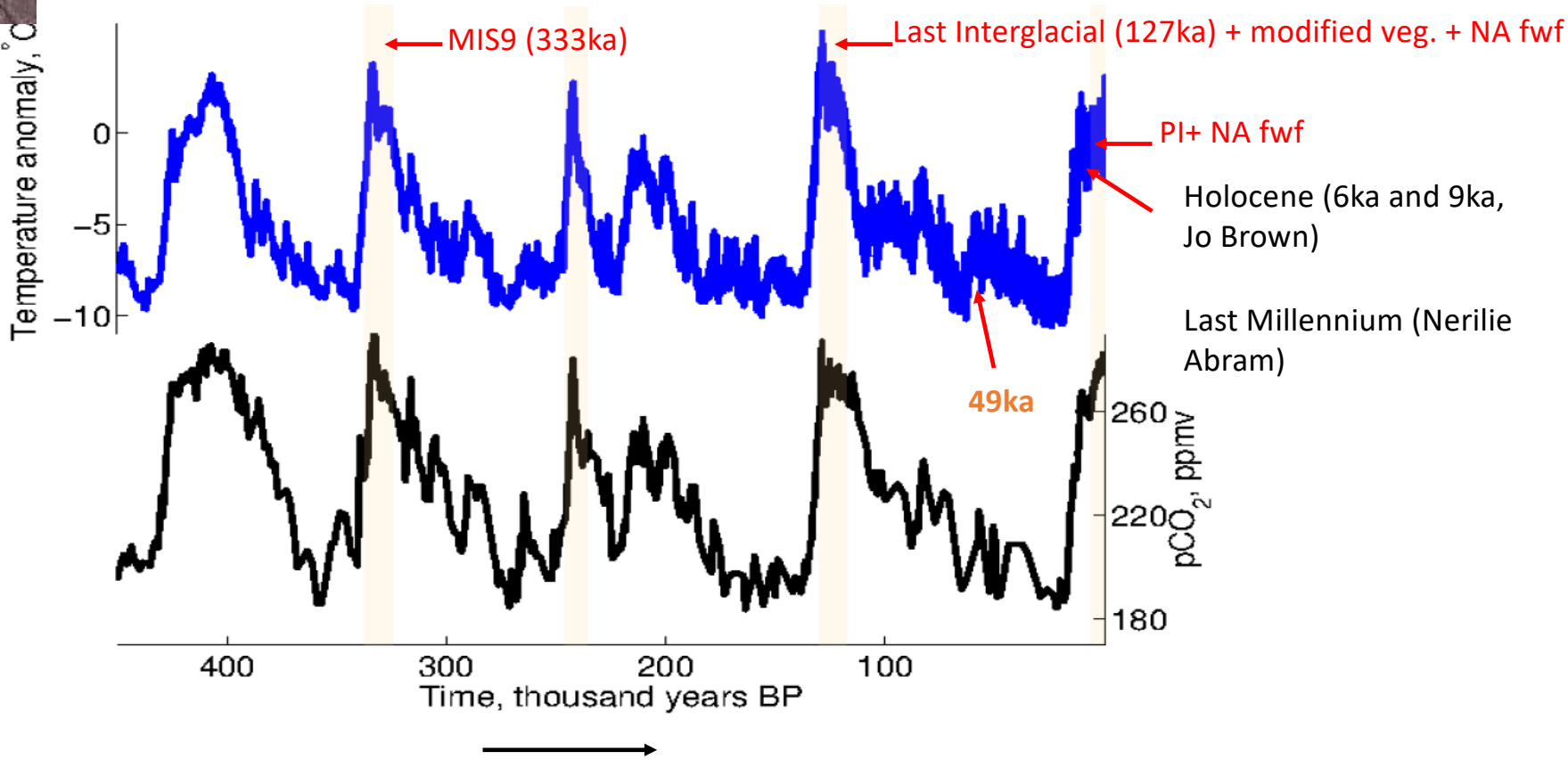
ACEAS
Australian Centre for Excellence in Antarctic Science



David Hutchinson
Warm periods of deep time

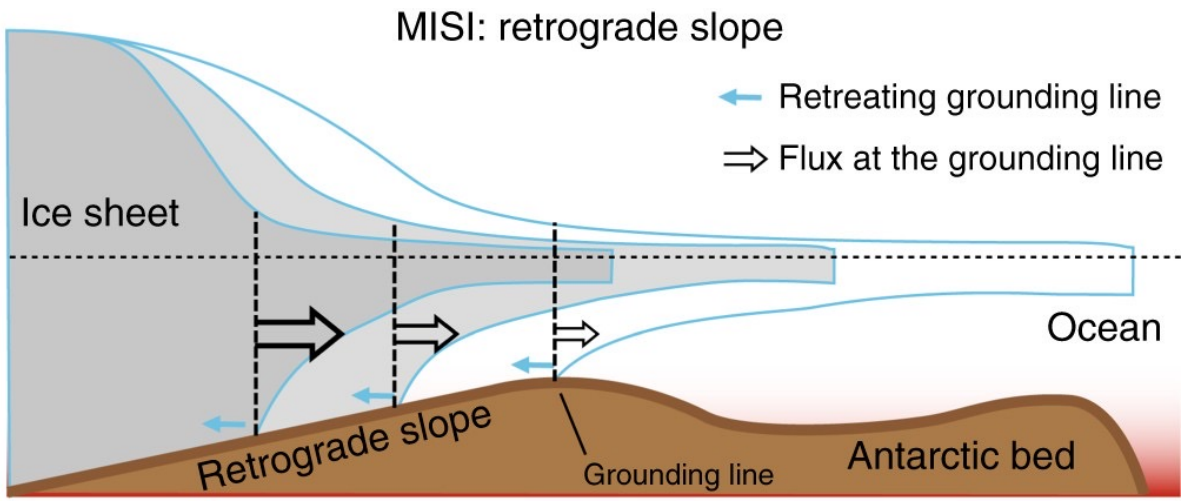
ACCESS-ESM1.5 experiments

EPICA Dome C, Antarctica



Jouzel *et al.*, 2007

Marine ice-sheet instability



Pattyn 2018