

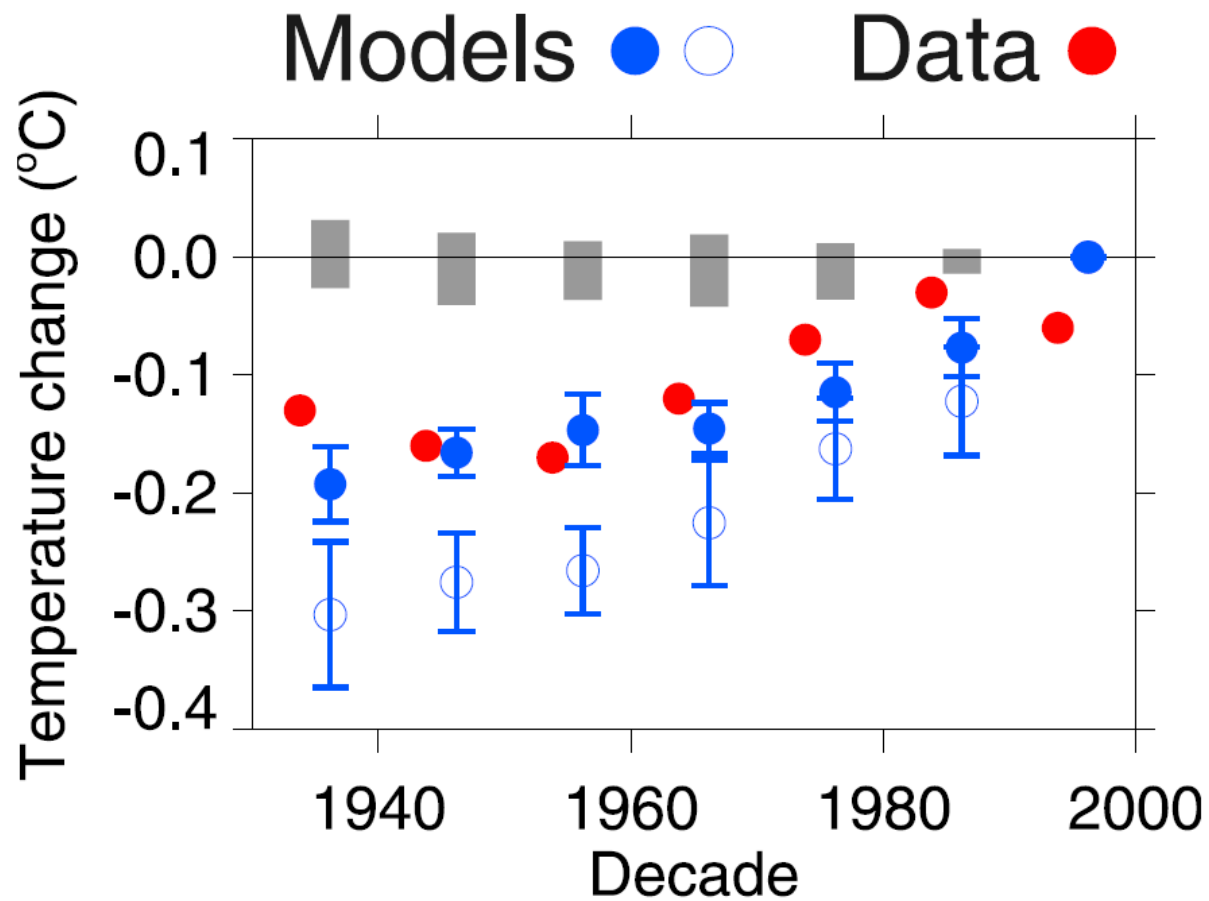
Southern Ocean Temperature Attribution

Neil Swart, John Fyfe
& Sarah Gille



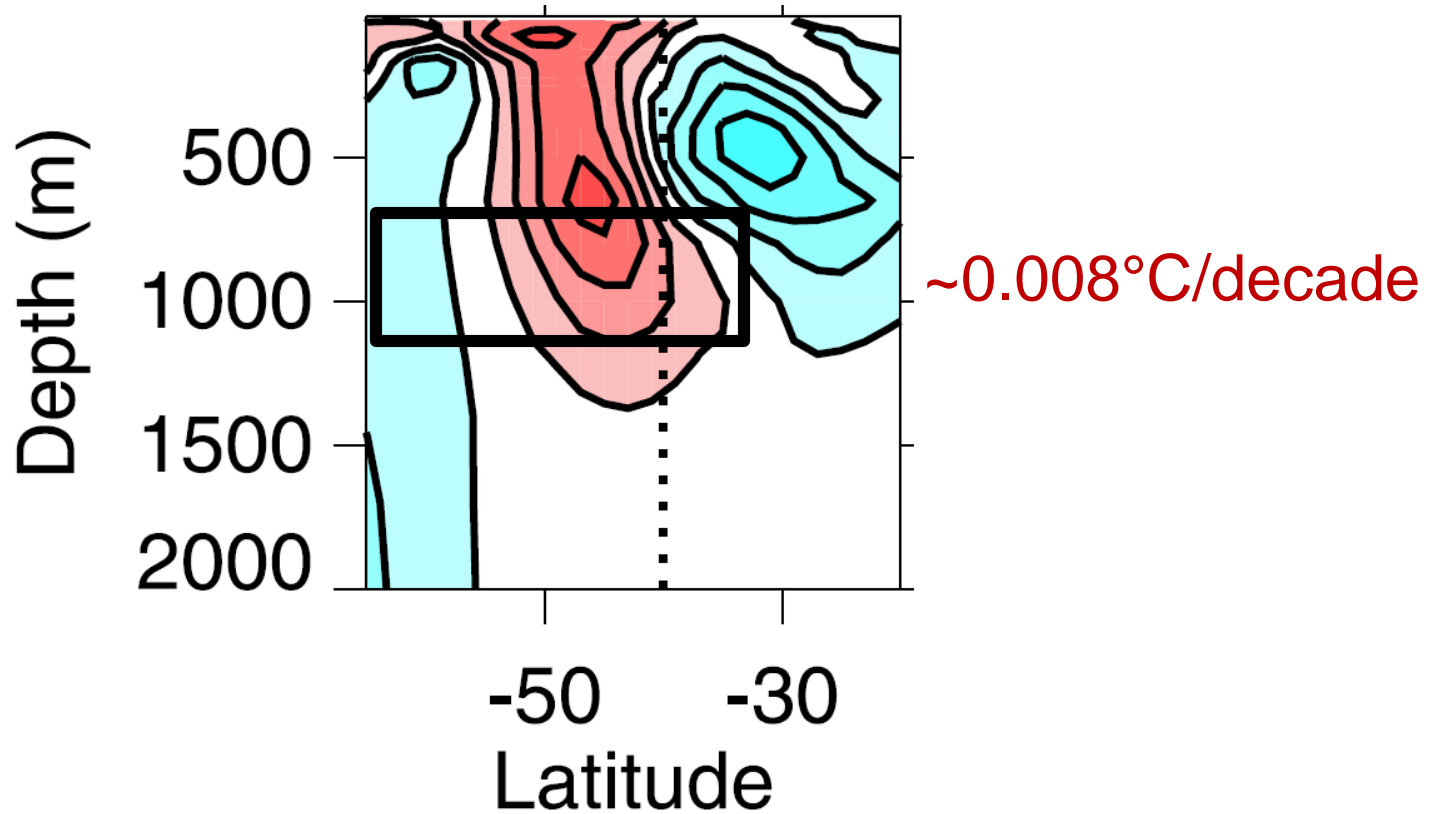
Environment and
Climate Change Canada

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Changement climatique Canada



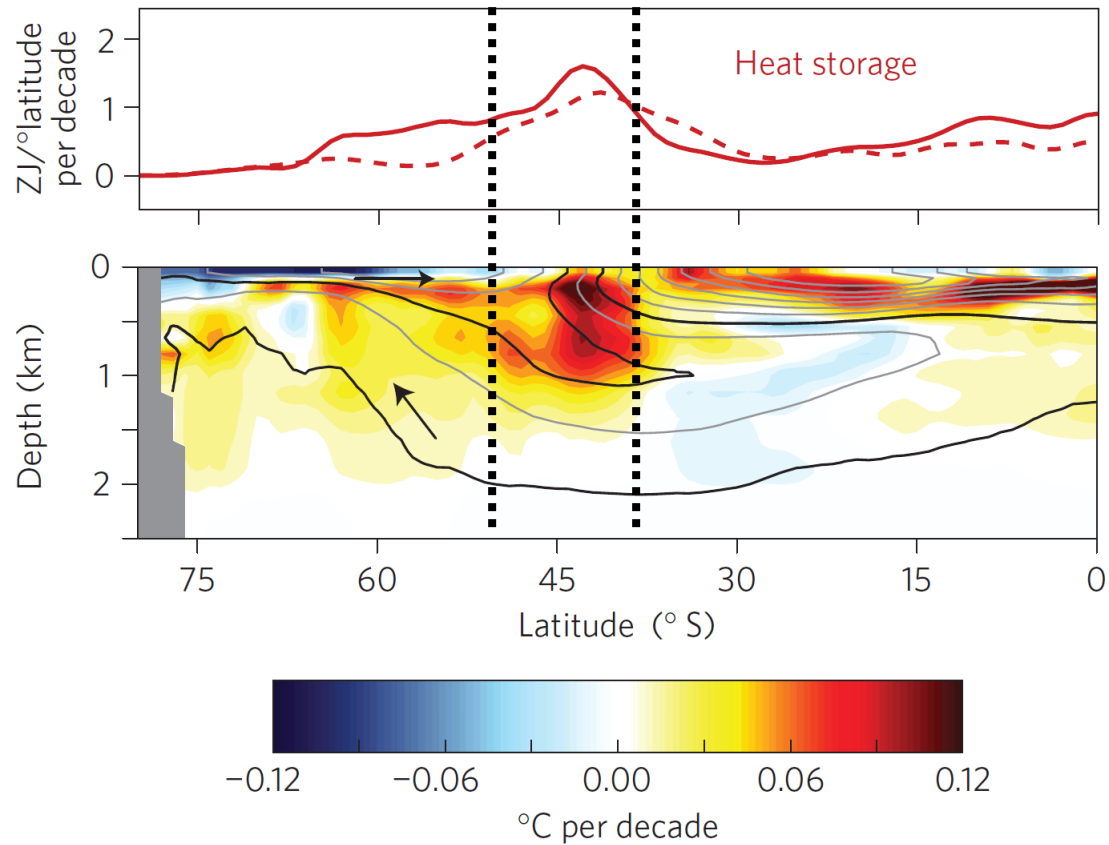
Fyfe (*Geophys. Res. Lett.*, 2006)

Wind-induced trend (1930-2000)



Fyfe (*Geophys. Res. Lett.*, 2006)

Trends from 1982 to 2012

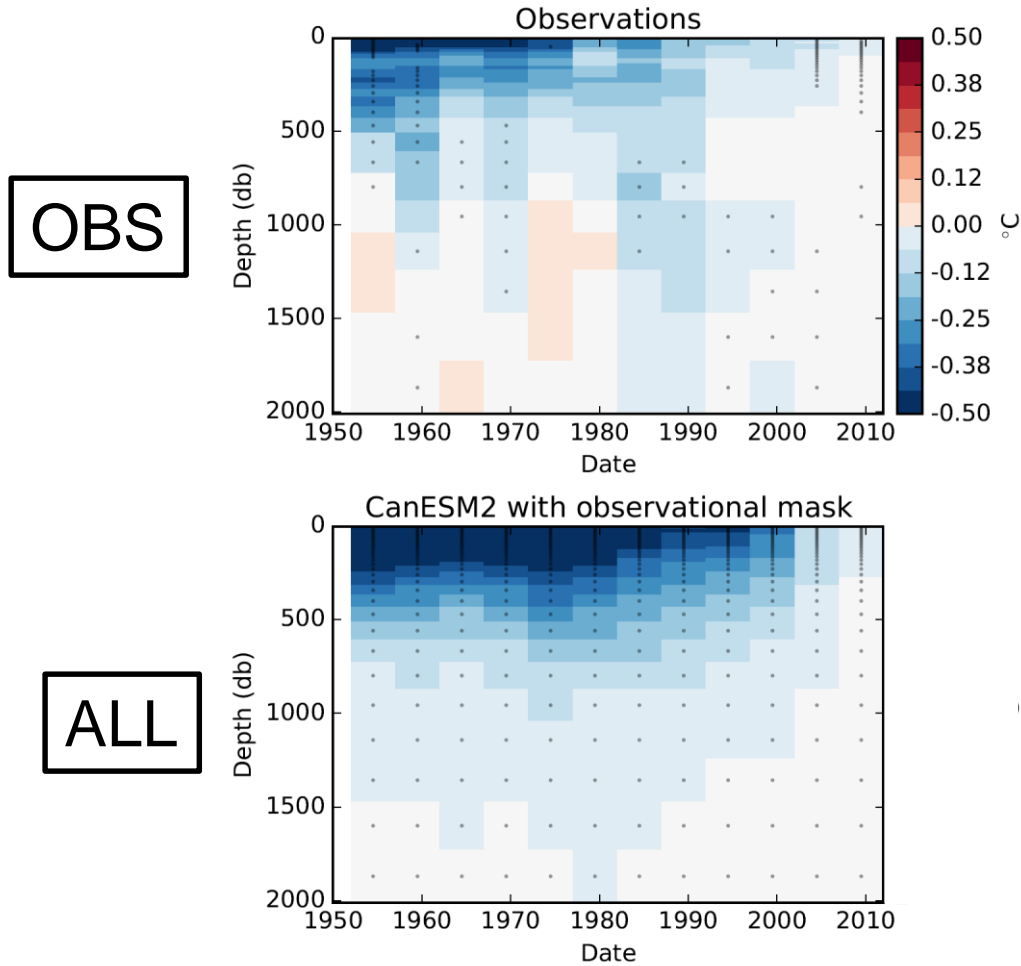


Armour *et al.* (*Nature Geosci.*, 2016)

Four 50-member ensembles

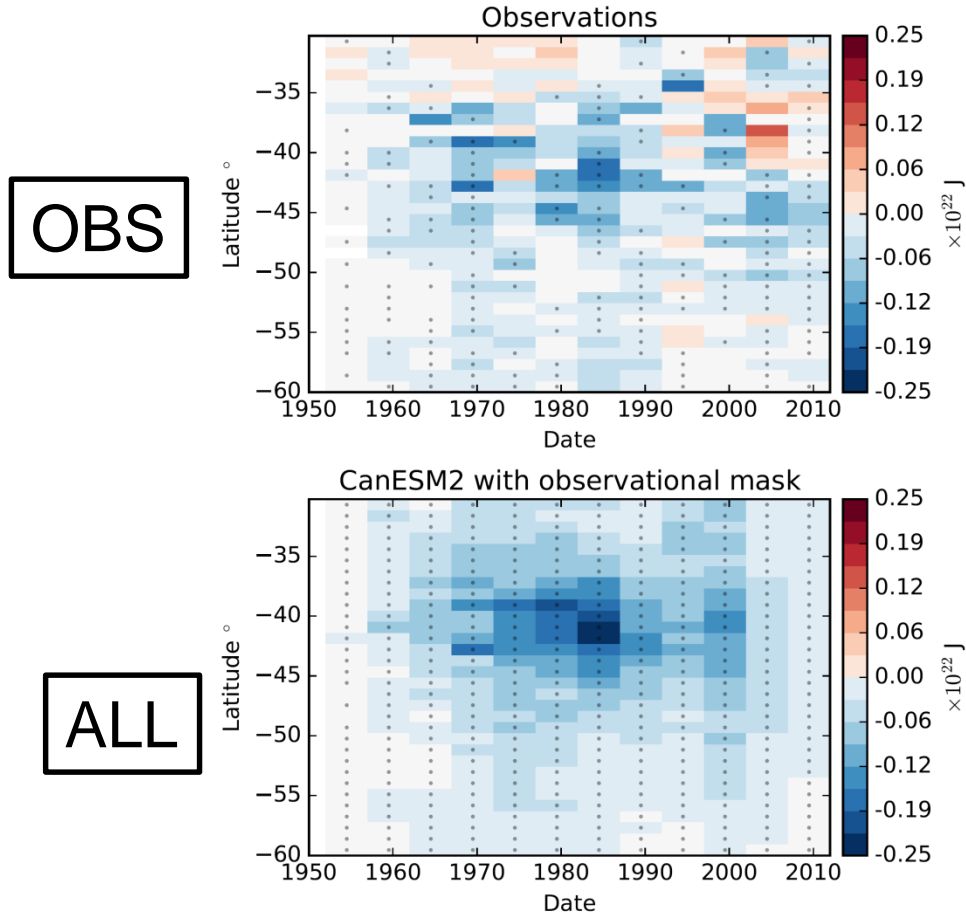
ALL: GHG, AER, NAT, OZ, LU
NAT: VOL, SOL
AER: SA, OC, BC
SOZ: SOZ

Temperature anomalies (depth-year)



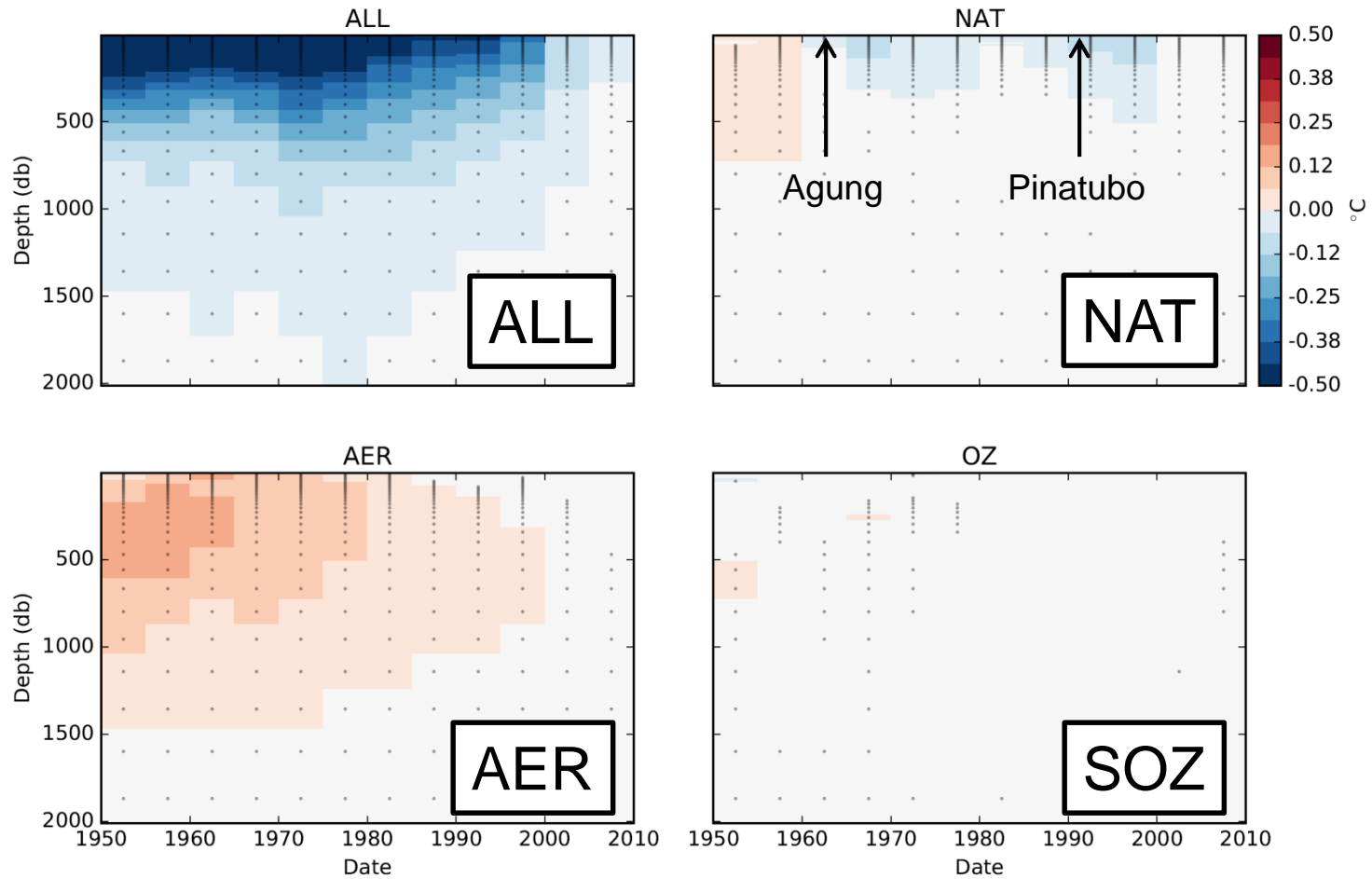
Swart, Fyfe & Gille (*in progress*)

Heat storage anomalies (latitude-year)



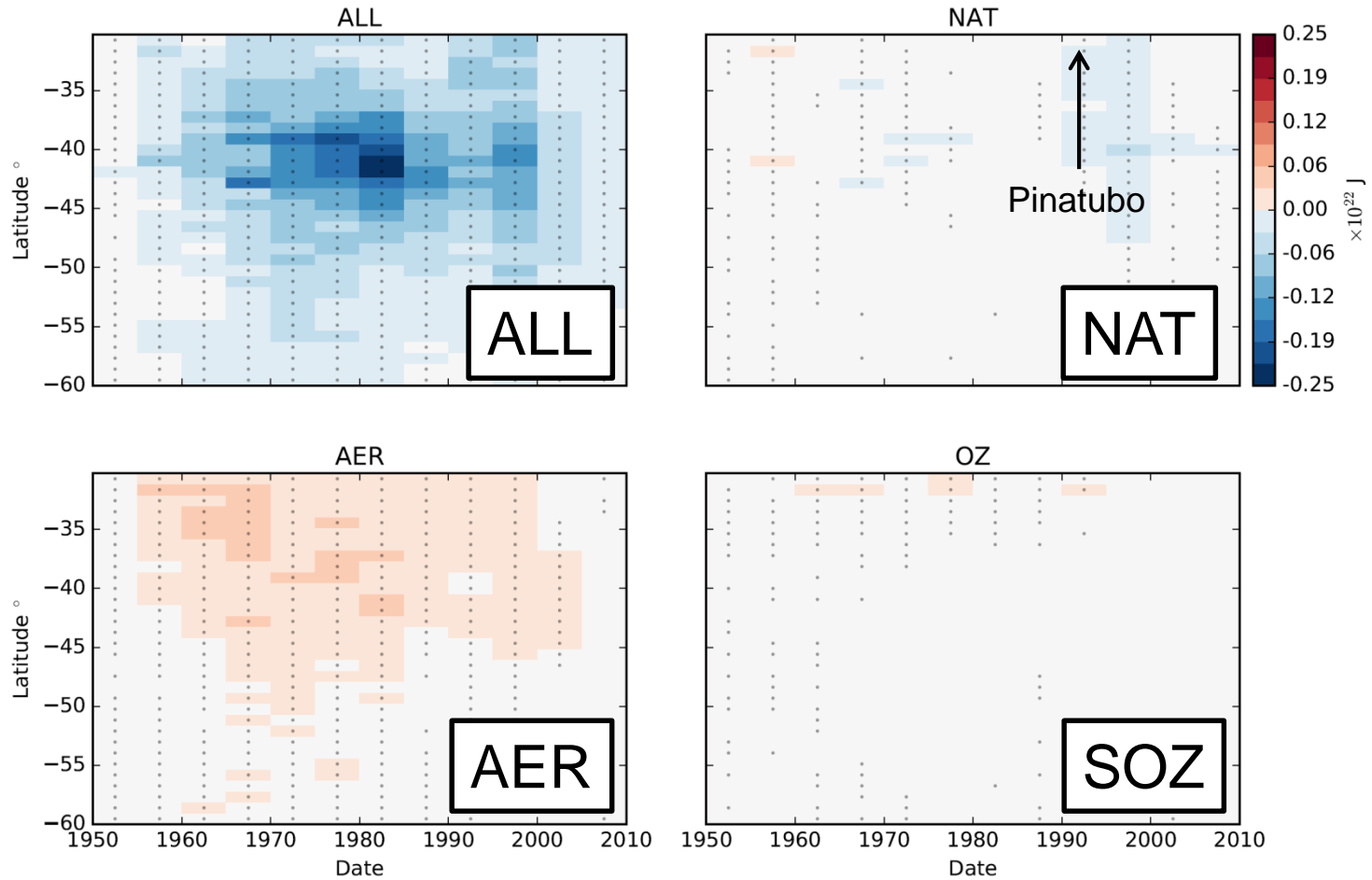
Swart, Fyfe & Gille (*in progress*)

Temperature anomalies (depth-year)



Swart, Fyfe & Gille (*in progress*)

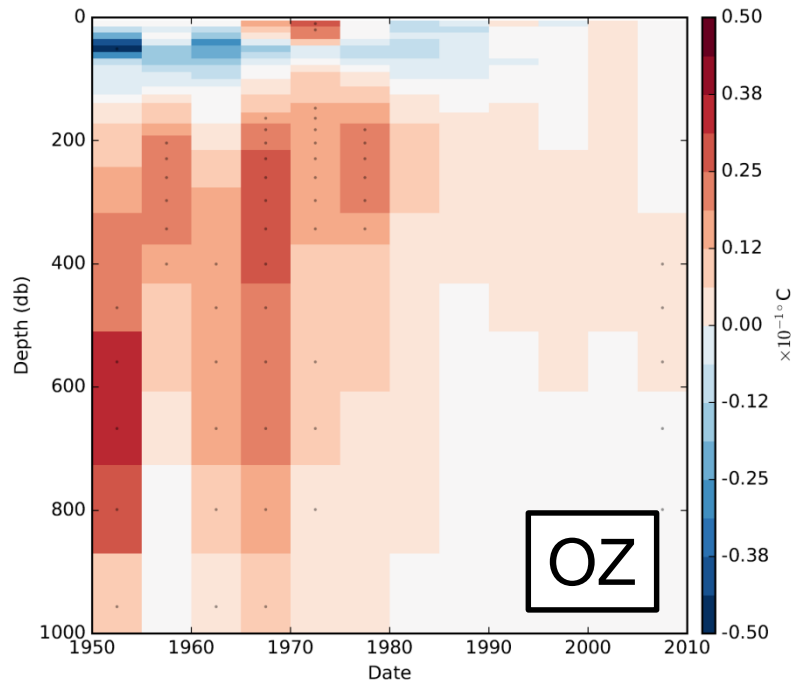
Heat storage anomalies (latitude-year)



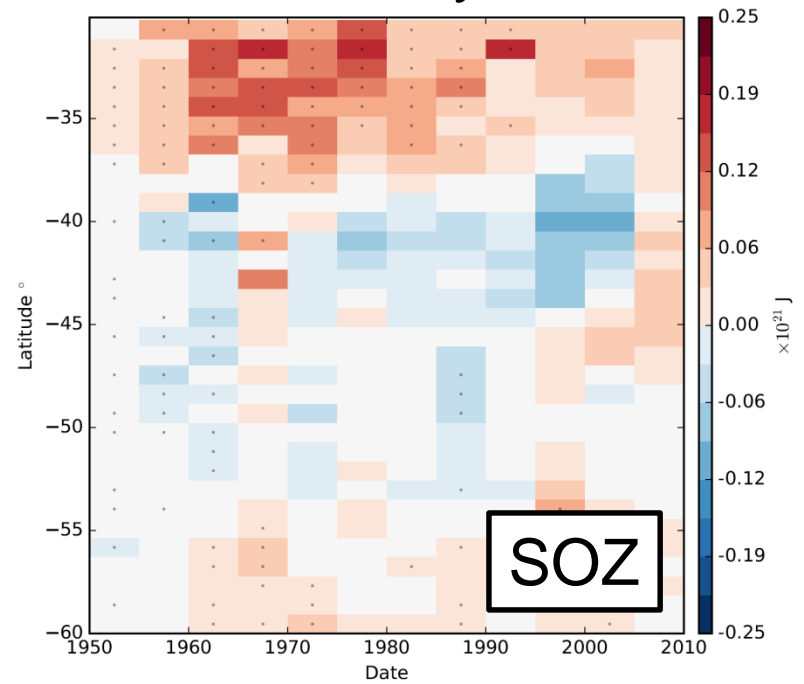
Swart, Fyfe & Gille (*in progress*)

Temperature and heat storage anomalies

Depth-year



Latitude-year

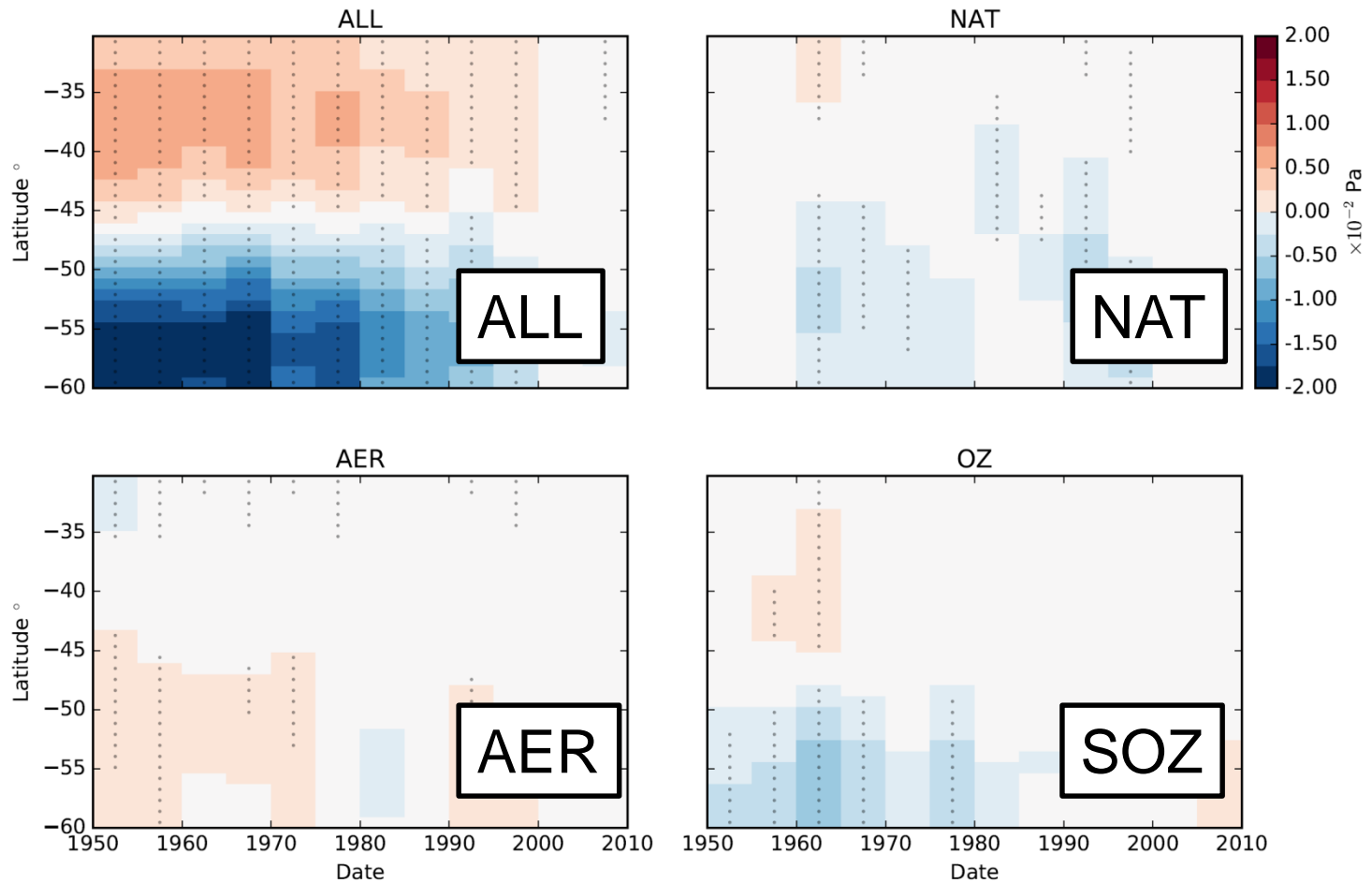


Swart, Fyfe & Gille (*in progress*)

Summary

- Warming due to increasing GHG emissions with an aerosol offset
- Slight but robust ozone-induced cooling below about 150 meters

Zonal wind stress anomalies (latitude-year)



Swart, Fyfe & Gille (*in progress*)