# The influence of the South Pacific and Tropical Atlantic on Tropical Pacific variability in ACCESS-CM2j

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Background

- Inter-basin interactions important for ENSO and decadal variability in the tropical Pacific

- Decoupling oceanic regions can help identify impacts of individual regions

- Liguori & di Lorenzo (2019), Liu (2006)
  - North & South Pacific

- McGregor et al (2014), Chikamoto et al (2016)
  - Atlantic

- Dommenget & Yu (2017)
 - Indian & Atlantic

- Santoso et al (2012)
  - Indian
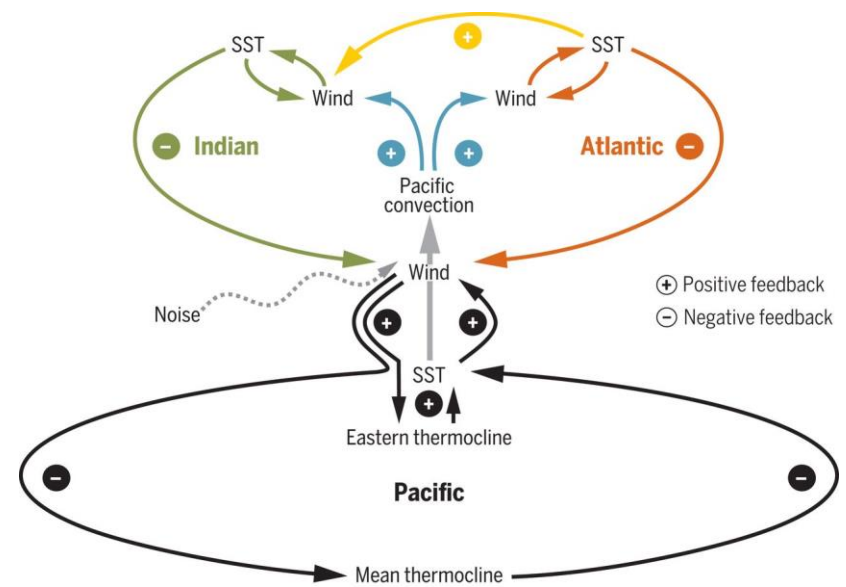
Cai et al (2019) Pantropical climate interactions, Science

Pacemaker-style runs with ACCESS-CM2j

- ACCESS-CM2j: GA7.1 with JULES land surface scheme, MOM5 ocean model, CICE5.1.2 ice model

Runs

- 400-year control run under pre-Industrial conditions

- 400-year SouthPac run: switched off South Pacific variability
  - restored temperature and salinity at all ocean levels to model climatology (year 50-100) from control run
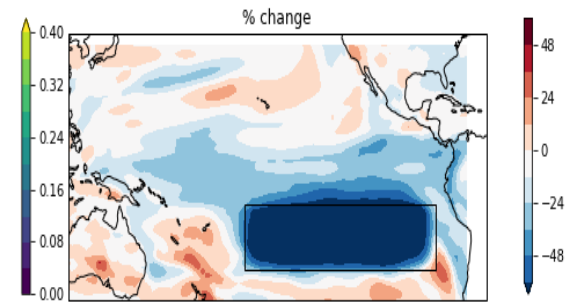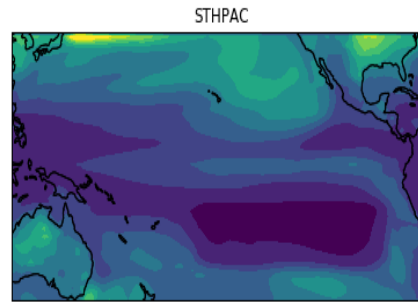 - *under review, Scientific Reports*
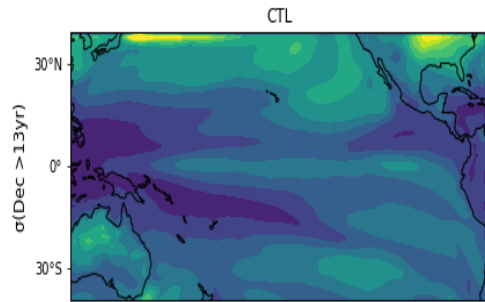
- 400-year TropAtl run:
  - 377 years so far
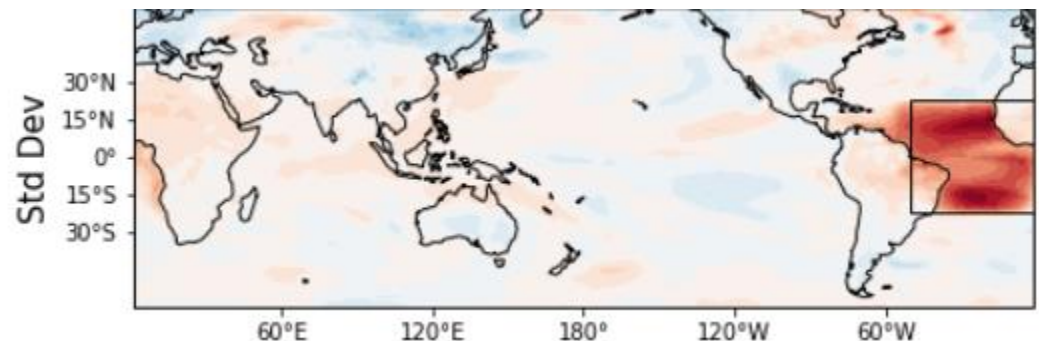
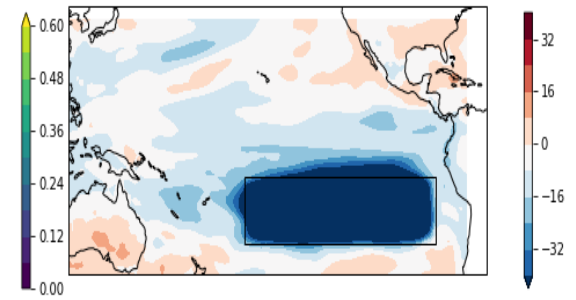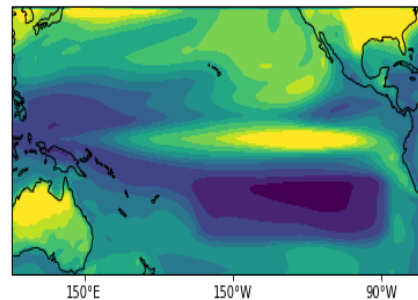# STHPAC: Changes to Tropical Pacific variability

CTL σ   STHPAC σ   STHPAC-CTL σ

Dec (>13yr)

Interann (<4yr)

Earth Sytems and Climate Change Hub
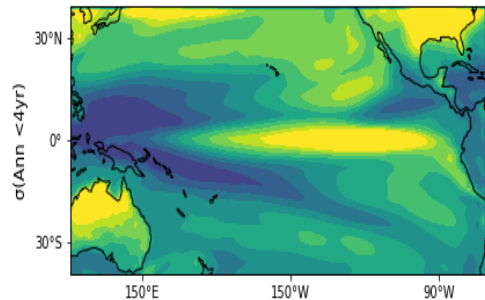
STHPAC: Changes to equatorial Pacific variability
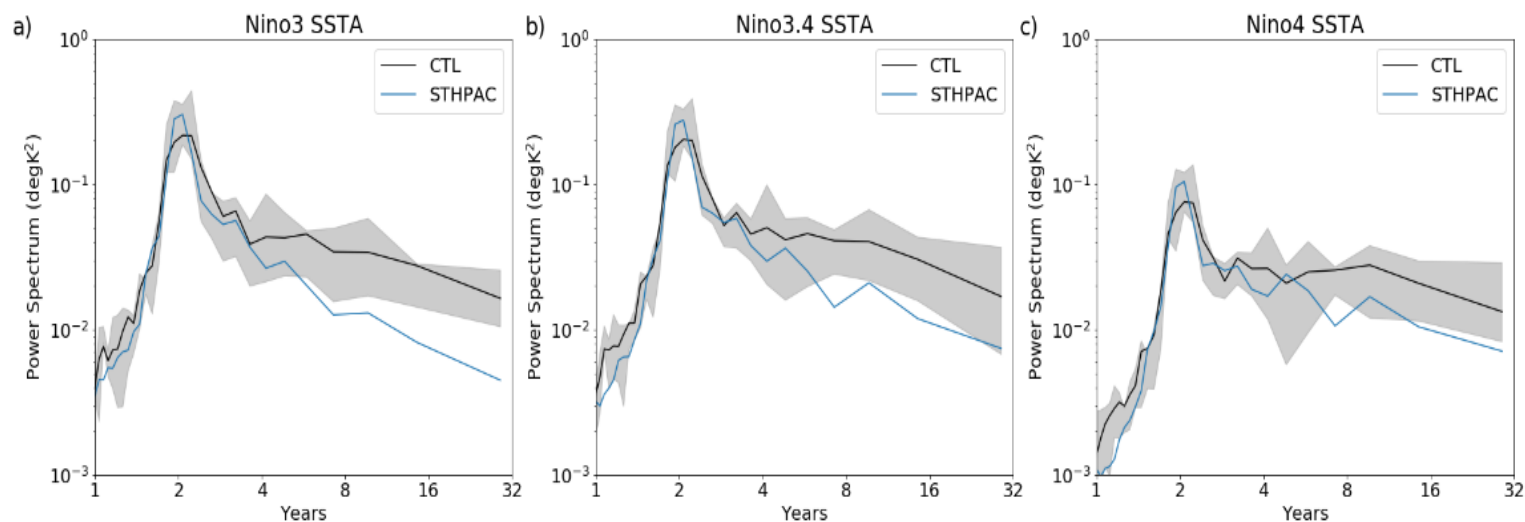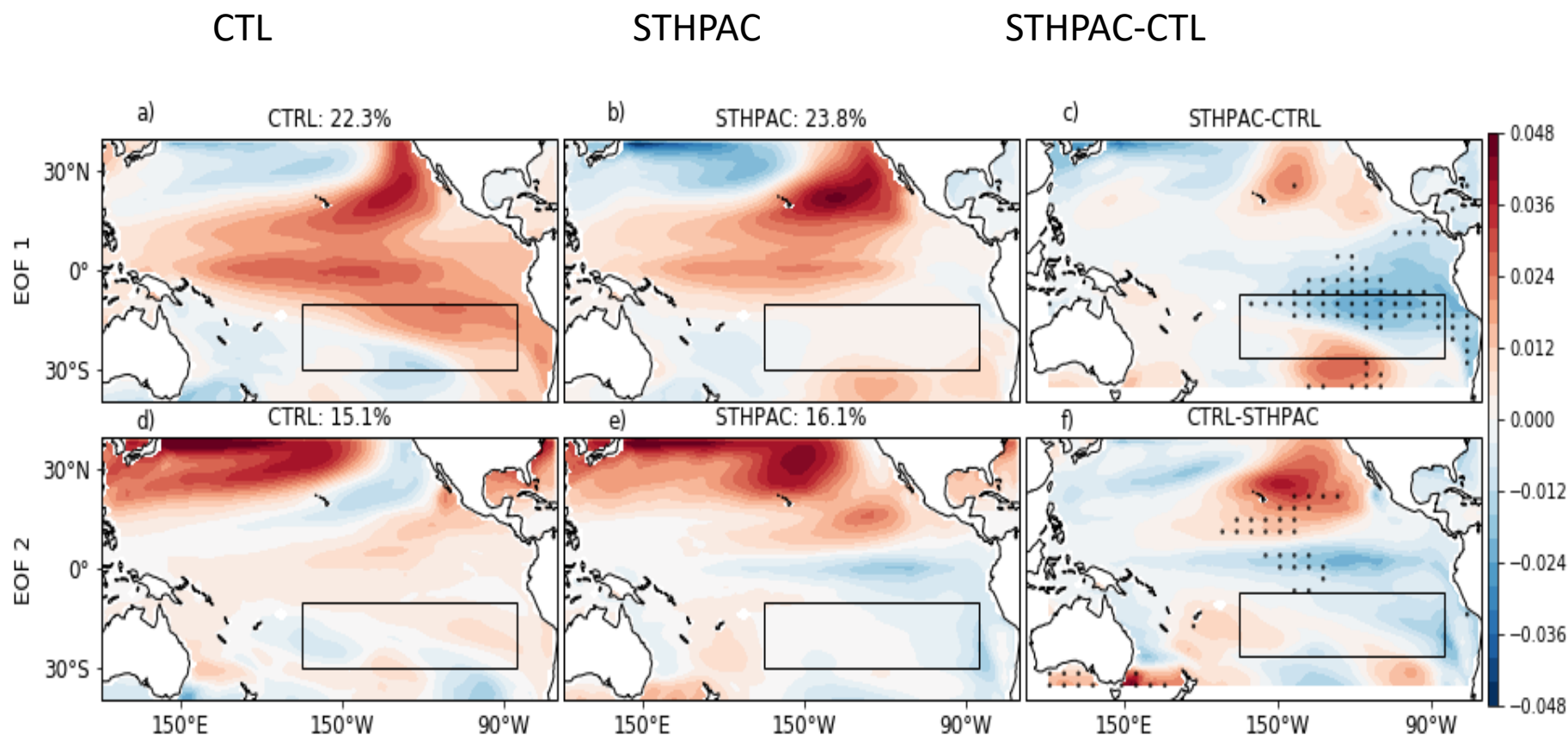

Decadal: ~30% reduction

Interannual: ~6% reduction (not significant)

Consistent with
Liguori & Di Lorenzo 2019
(CESM1)
Liu et al 2006 (FOAM1.0)

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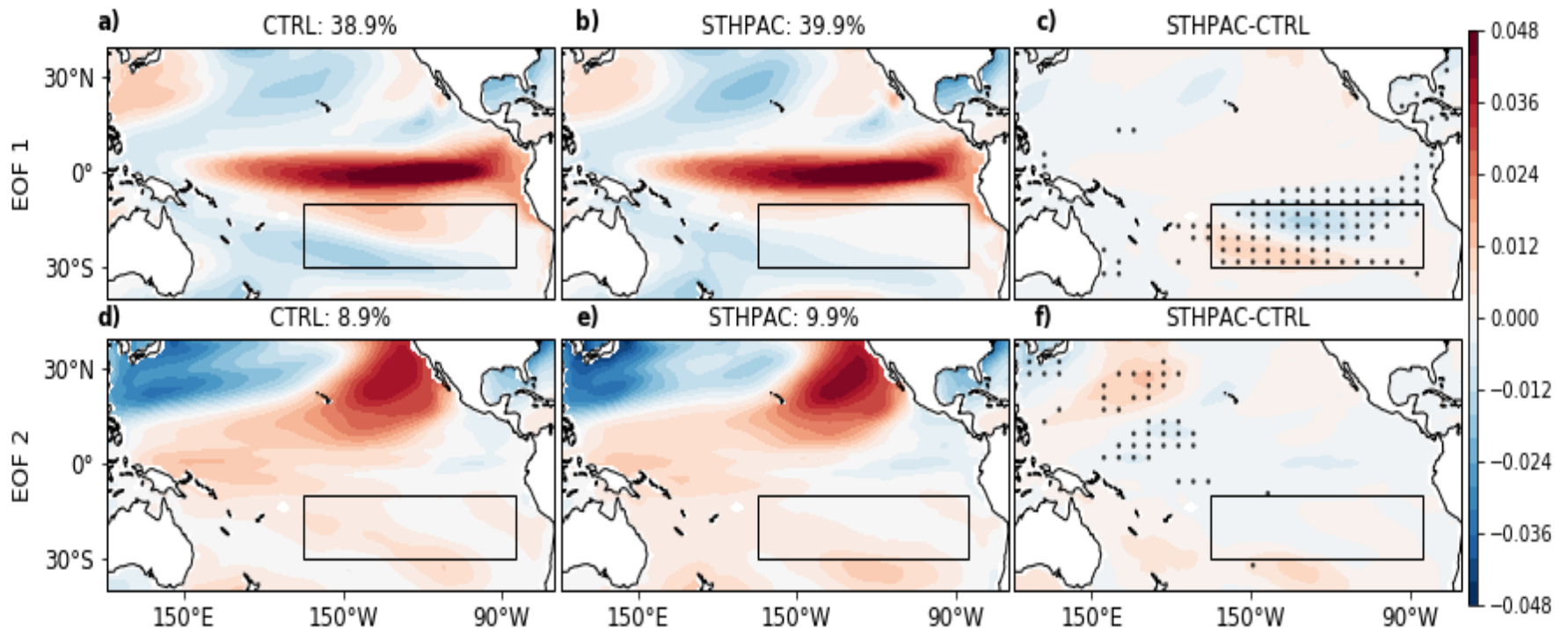Hub

STHPAC: Disruption of the IPO

CTL STHPAC STHPAC-CTL

STHPAC: ENSO remains unchanged…
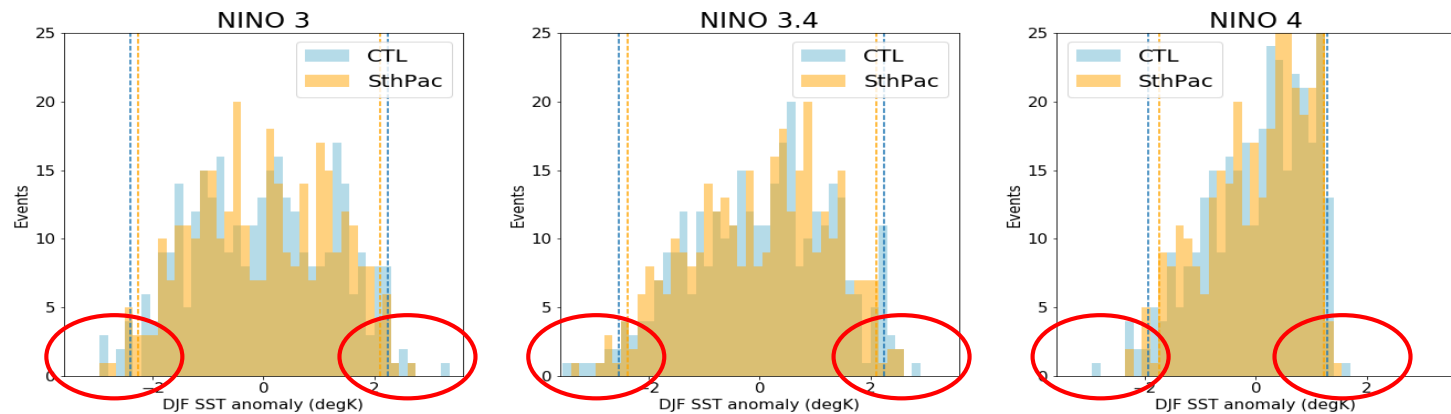
… or does it?

- STHPAC run has weaker extreme ENSO SSTAs
  - Weaker decadal variability
  - Disruption of coupled feedback processes linking the South Pacific to the equatorial Pacific
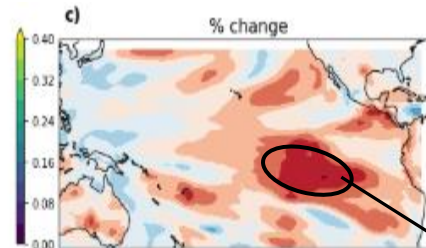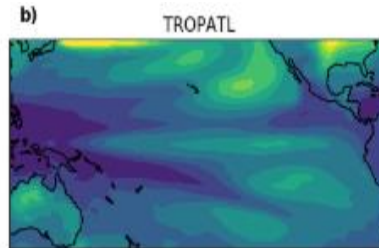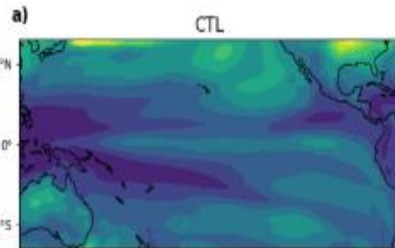 - Change in mean state

TROPATL: Changes to Tropical Pacific variability
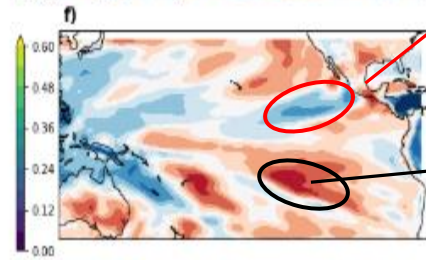

CTL σ   TROPATL σ   TROPATL-CTL σ
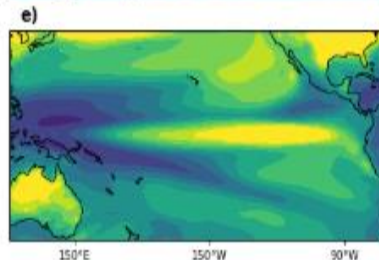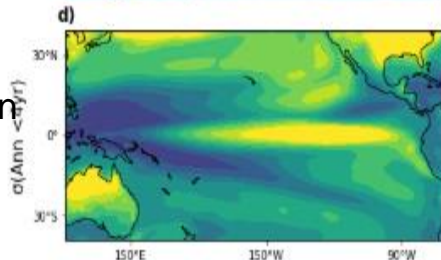
Dec (>13yr)

InterAnn (<4yr)

North Pac Meridional Mode

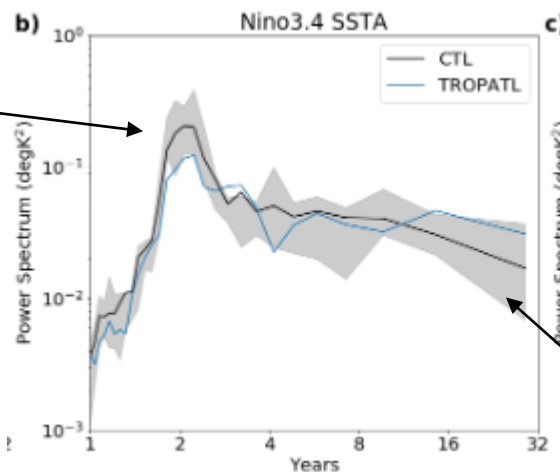South Pac Meridional Mode

North Pac Meridional Mode

South Pac Meridional Mode

SPMM: decadal timescales

NPMM: interannual timescales

Liguori & Di Lorenzo 2019
Liu et al 2006
Min et al 2017

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TROPATL: Changes to the IPO
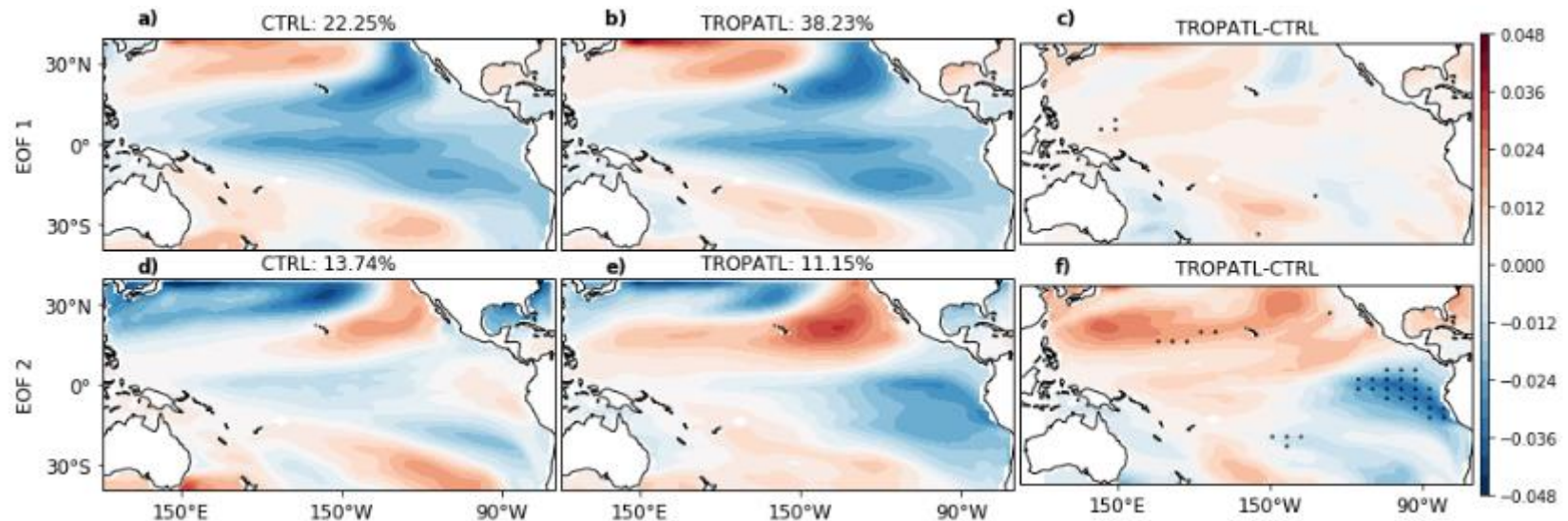
- EOF 1 (IPO) becomes more dominant

- EOF 2 changes structure in eastern equatorial Pacific

TROPATL: Changes to ENSO

- EOF 1 (ENSO) becomes less dominant

- Not much change in spatial structure

TROPATL: Changes to DJF SSTAs

- TROPATL – weaker SSTAs

- More neutral years, weaker EN/LNs

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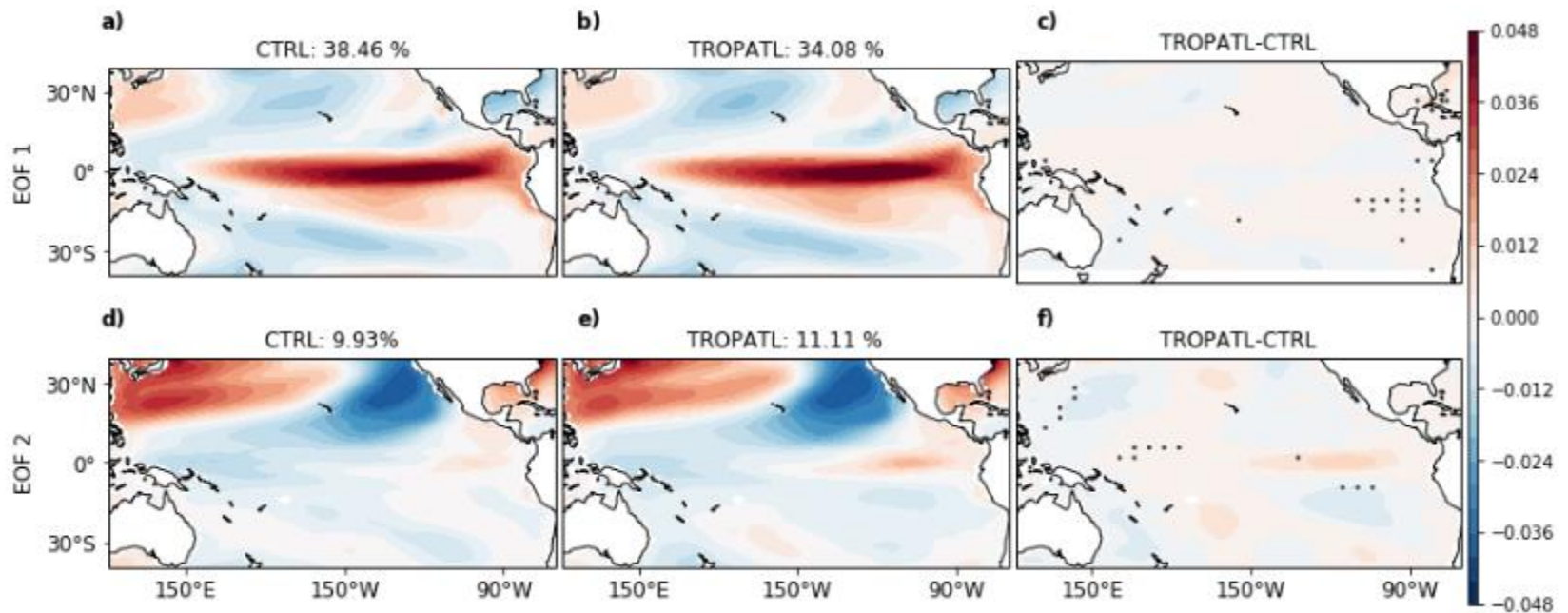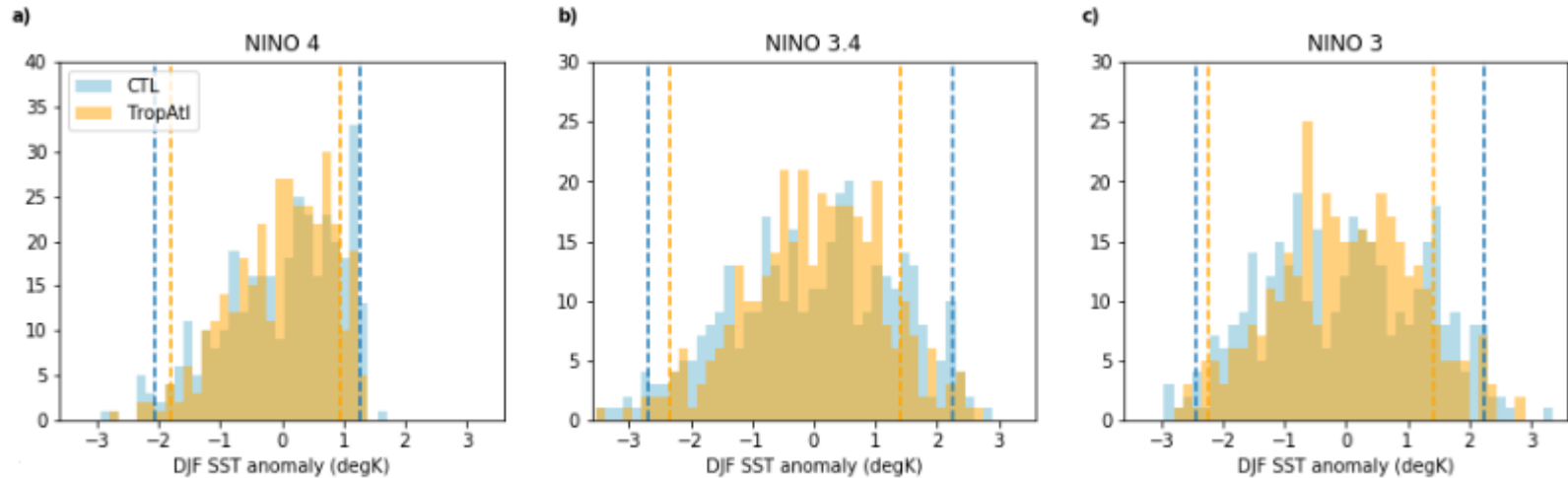# The AMO and the Western Tropical Pacific*

Sun et al (2017) Western tropical Pacific multidecadal variability forced by the AMO, Nature Comms
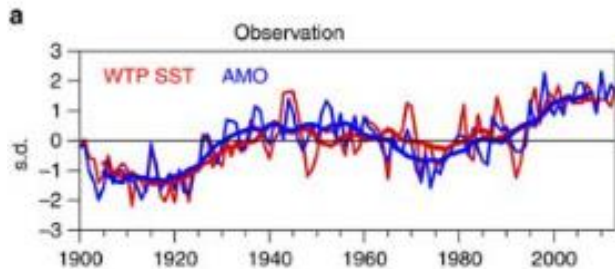
- WTP_obs = 0°-25°N, 130°E-170°E

- WTP_model = 0°-25°N, 100°E-140°E
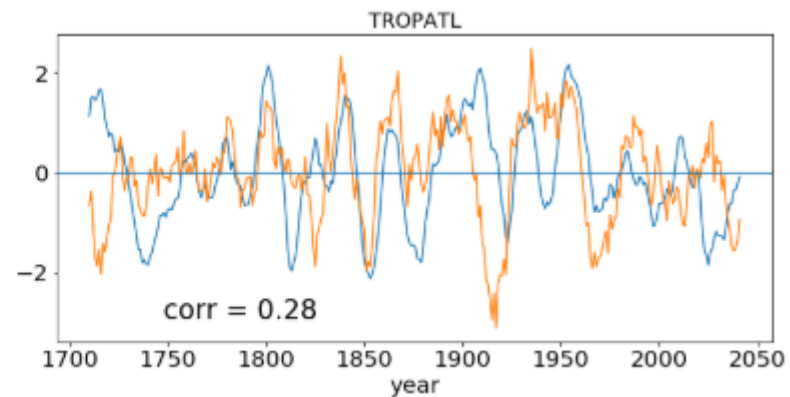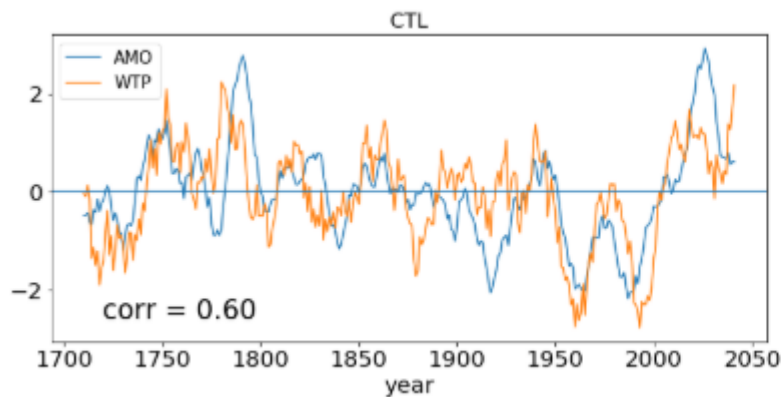
* Very preliminary, possibly dodgy!

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Indian Ocean & North Pacific
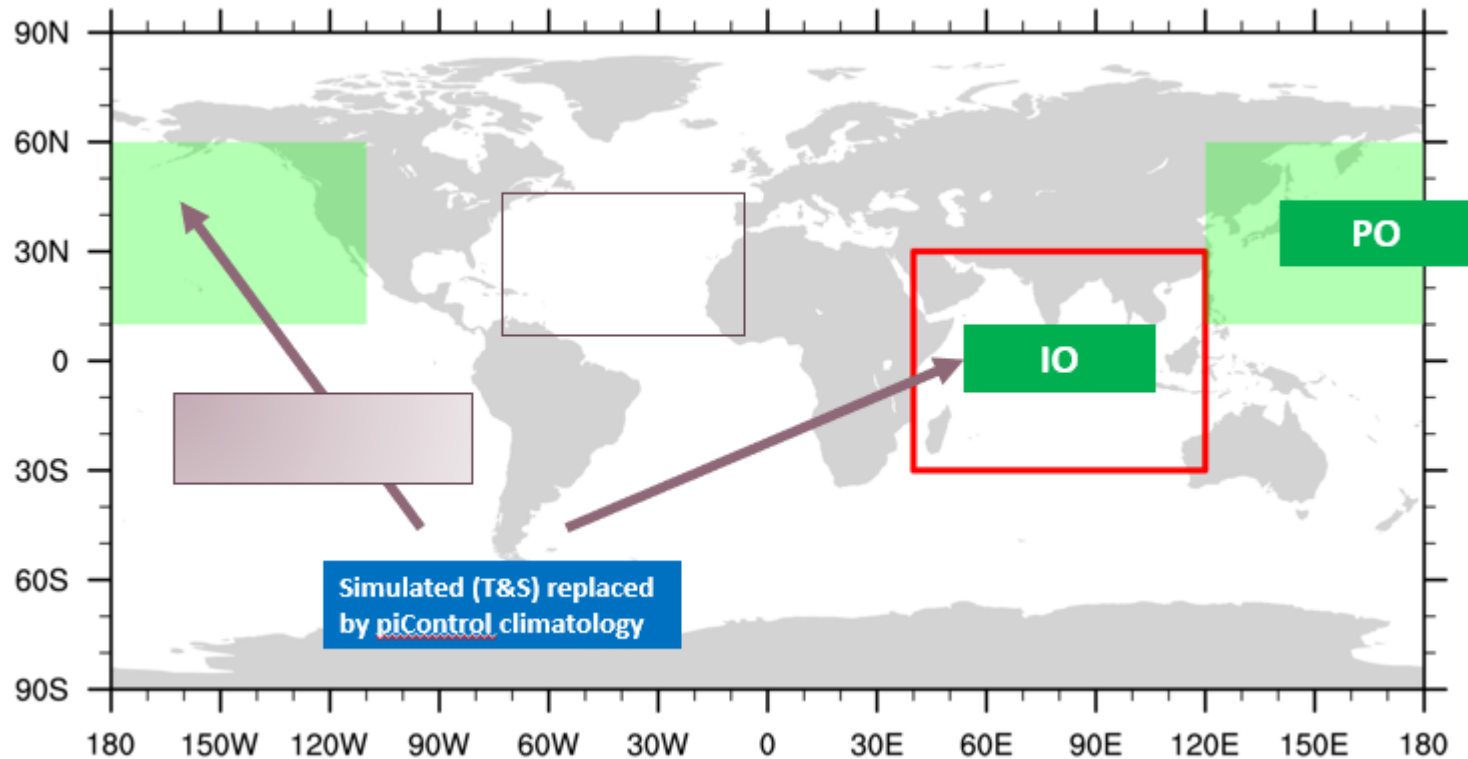
70-80 years using ACCESS-CM2 (CABLE)

Power spectra of N3.4
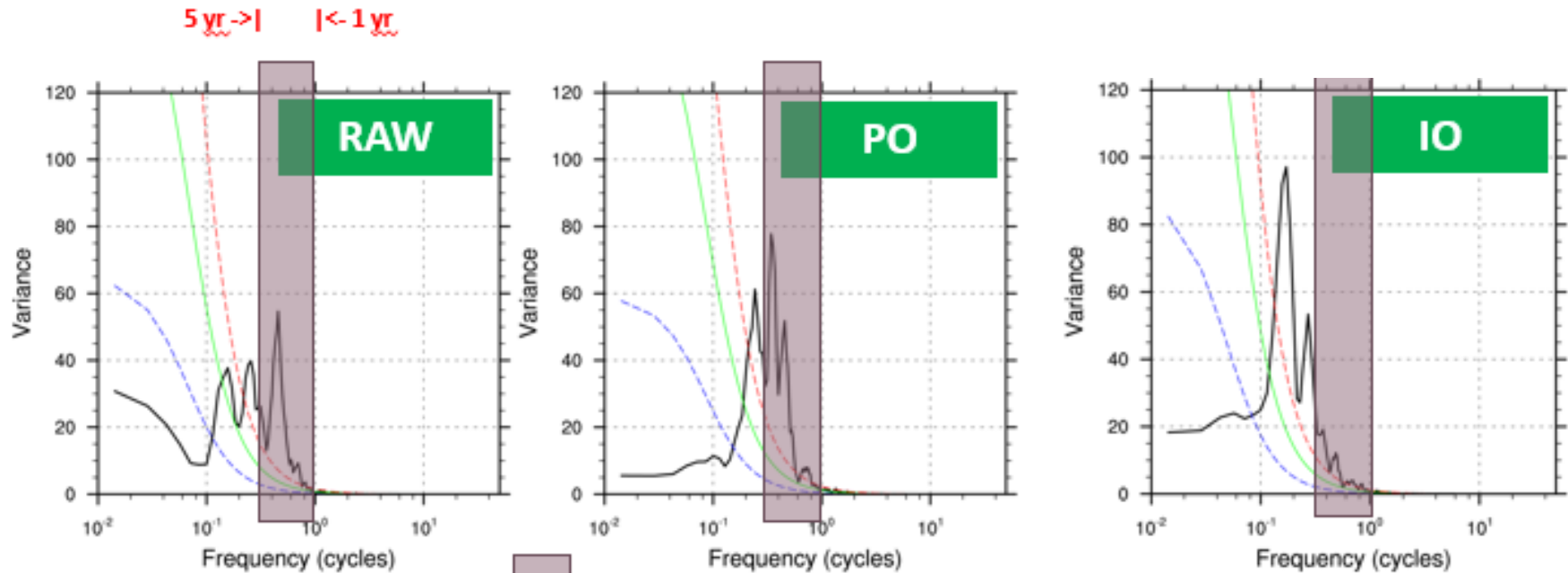
North Pacific (PO): ENSO is stronger?
Indian Ocean (IO): Biennial ENSO 'fixed'
Contact Arnold for more info

Caveats & further analysis

- Model has biennial ENSO & skewed towards stronger La Ninas, but so far results are consistent with literature

- Second CTL run to improve analysis of statistical significance

- Further analysis of TROPATL, ENSO diversity, physical mechanisms, mean state change, Atlantic Nino & ENSO – collaborations welcome!

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STHPAC summary

- Clamping variability in the South Pacific reduces decadal variability along the equatorial Pacific by ~30% and has no significant impact on overall interannual variability…

- … but it does reduce the magnitude of *extreme* El Ninos and La Ninas.

- Different changes in SST pattern for extreme La Ninas and El Ninos

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TROPATL summary

- Suppressing variability in the Tropical Atlantic impacts the Tropical Pacific in the following ways:
  - Decrease in interannual-scale variability linked to NPMM
  - Increase in decadal-scale variability linked to SPMM
  - Weaker EN/LNs, more neutral years
  - Relationship between AMO and Western Tropical Pacific SSTs is weakened*

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FOR MORE INFORMATION

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