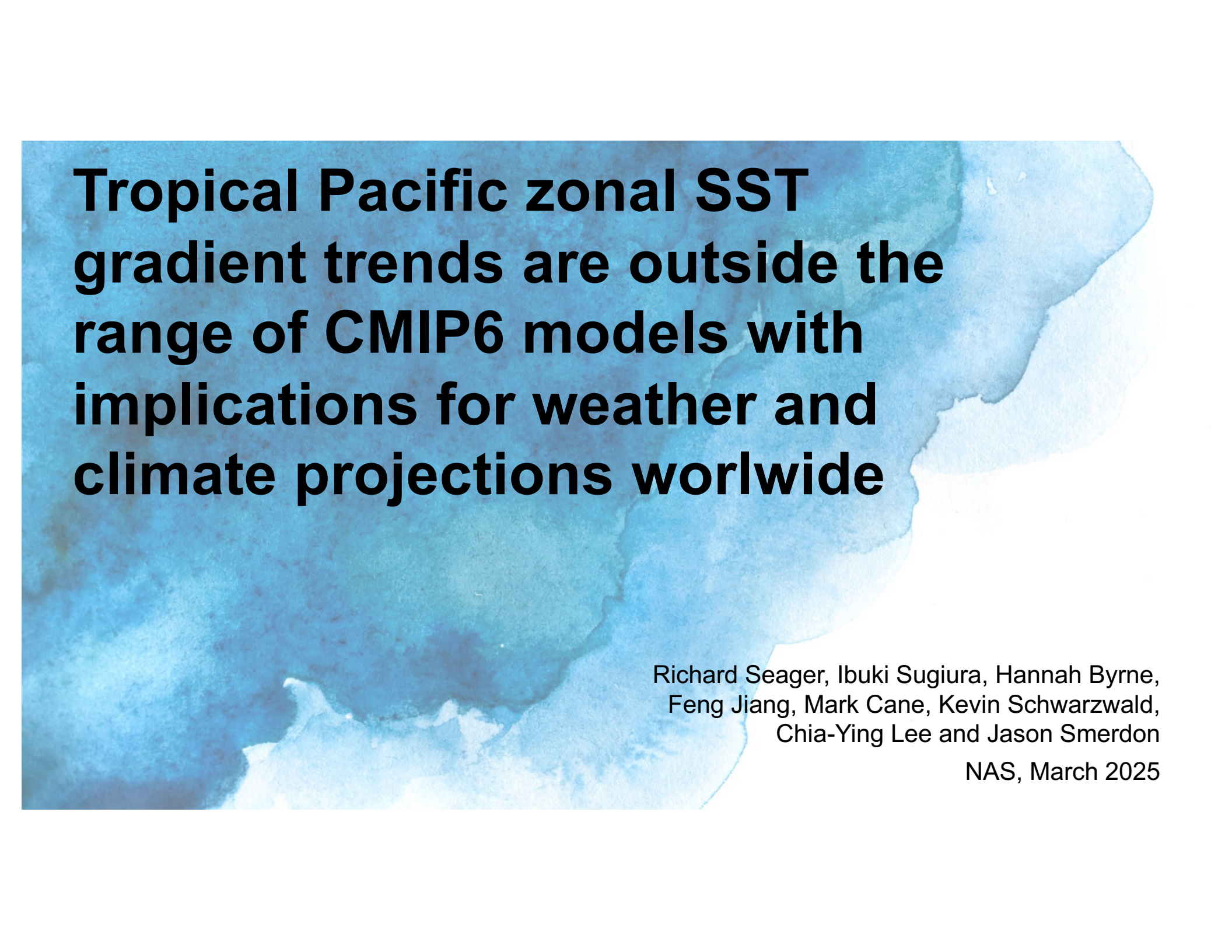


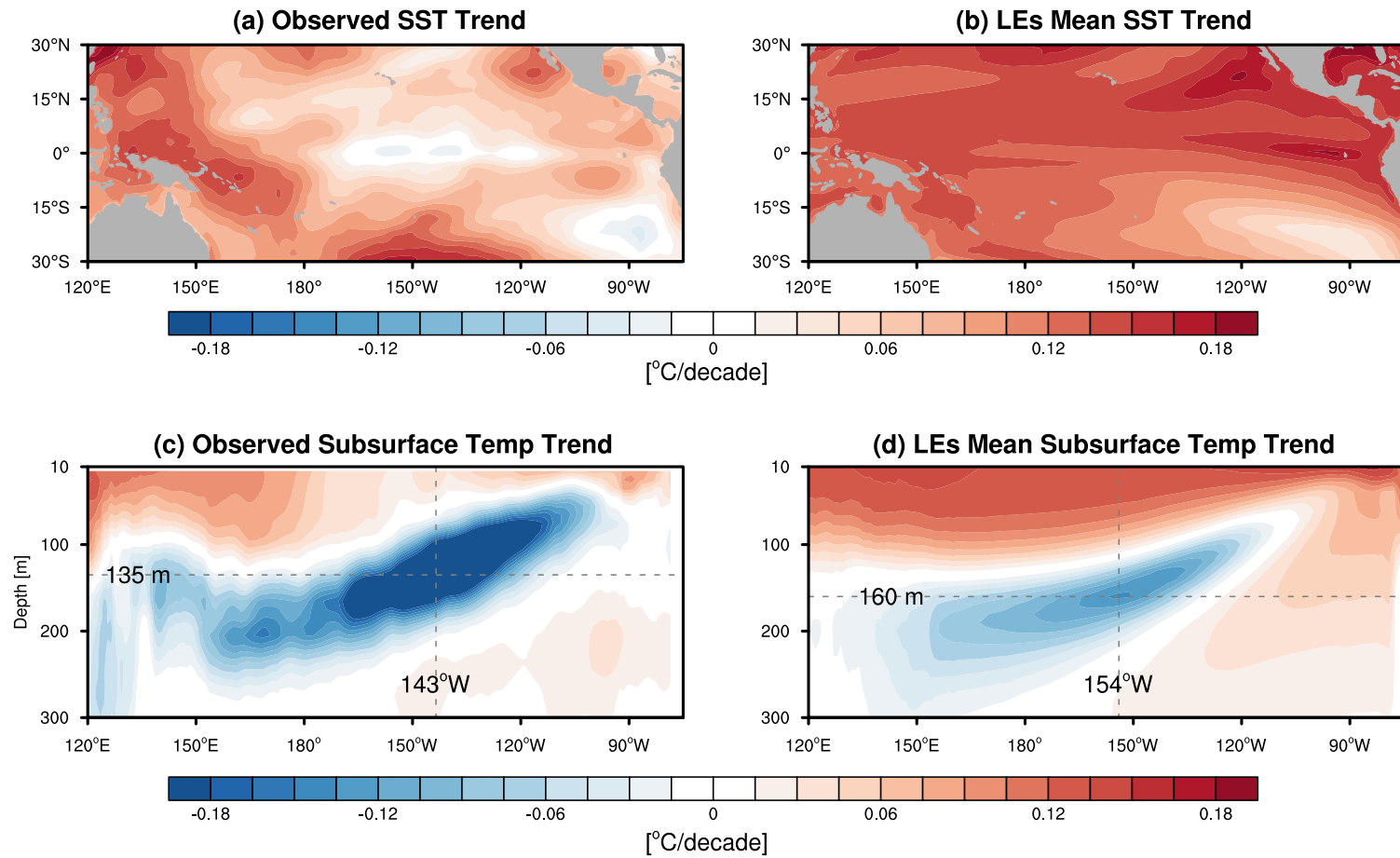


Tropical Pacific zonal SST gradient trends are outside the range of CMIP6 models with implications for weather and climate projections worldwide

Richard Seager, Ibuki Sugiura, Hannah Byrne,
Feng Jiang, Mark Cane, Kevin Schwarzwald,
Chia-Ying Lee and Jason Smerdon

NAS, March 2025

Trends 1958 to 2023



Models fail to match trends ending in recent decades

Observations and Models

- 14 CMIP6 Large Ensembles
- 5 observational datasets (HadiSST, COBE, COBE2, Kaplan, ERSSTv5)
- All trends of 20 years or longer between 1870 and 2023

Results

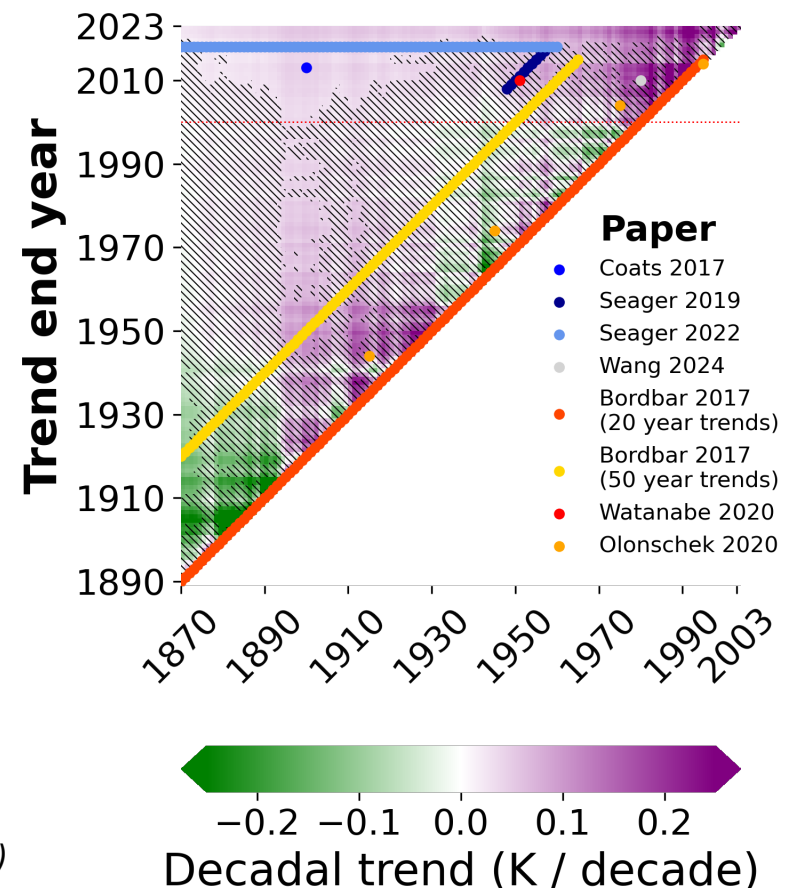
- Gradient strengthening predominates, especially in recent years
- Hatched - observed trends within the 5-95% of model trends
- **All** models fail to capture **all** 30-yr and longer trends that end in the last 10 years

Possible causes of wrong model response to GHGs:

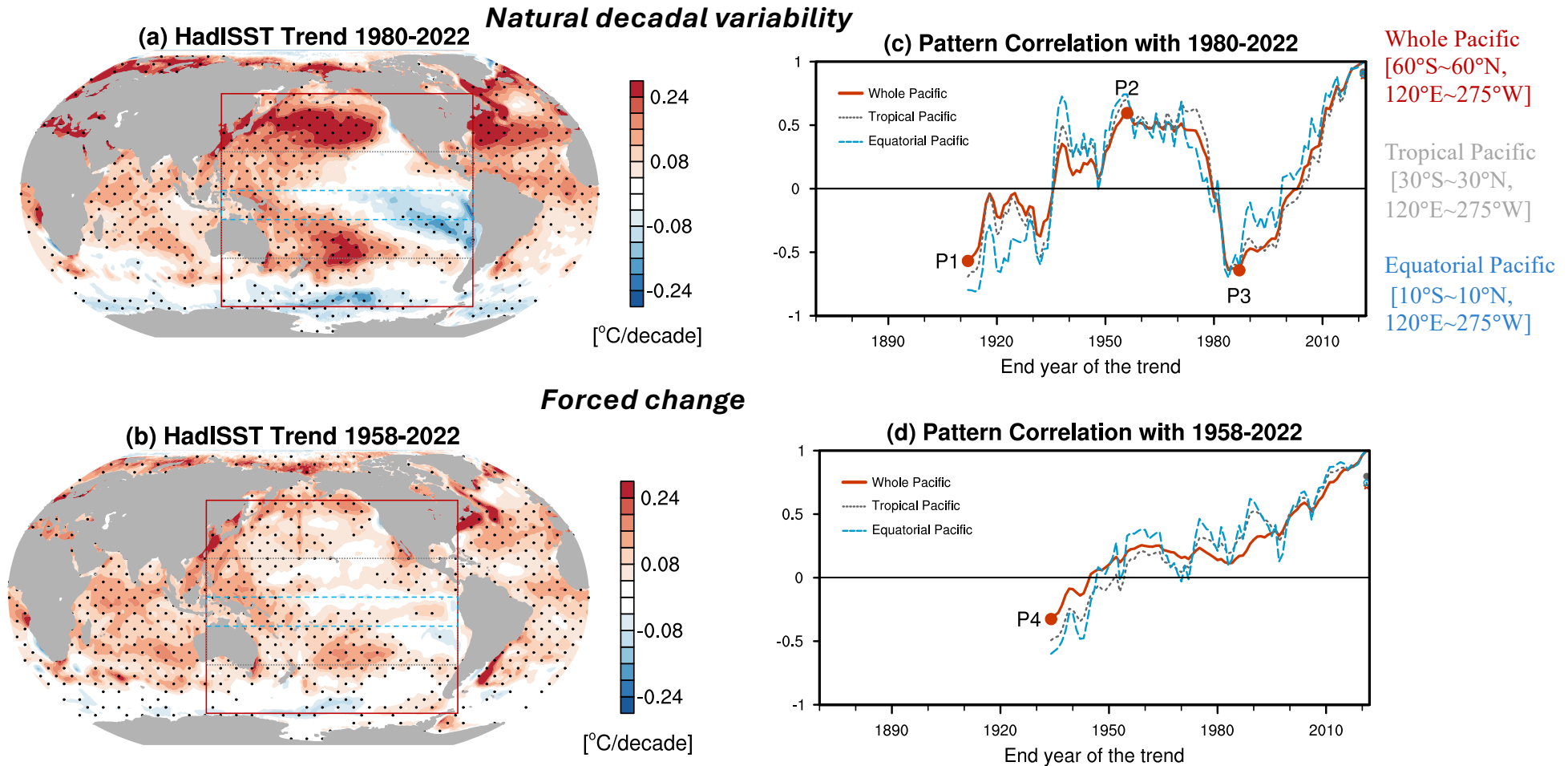
Double ITCZ-cold tongue mean state bias (Seager et al. 2019)

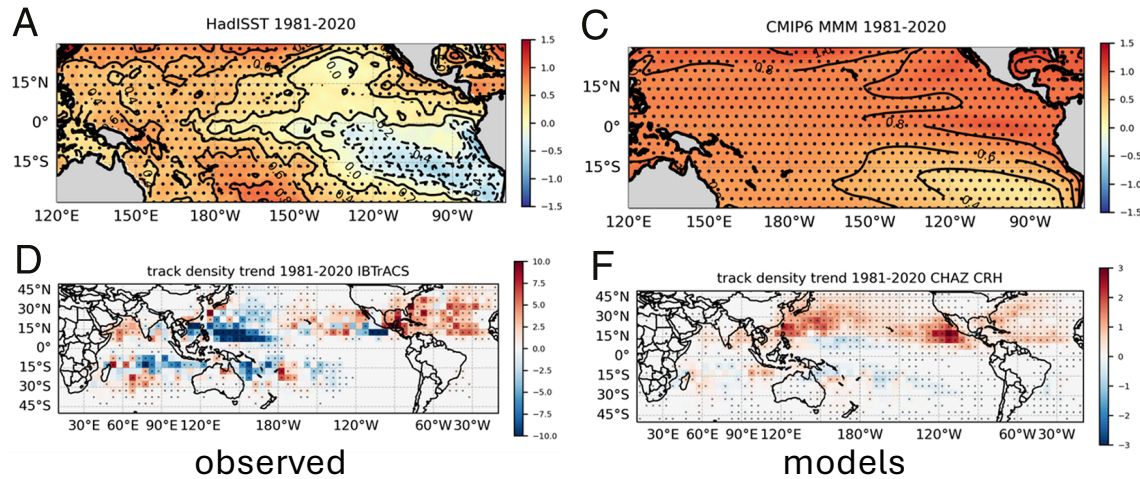
Vertical ocean mixing of heat (Jiang, Seager, Cane 2024a,b, 2025a,b)

Misrepresenting Southern Ocean driving (Kang, Dong ...)



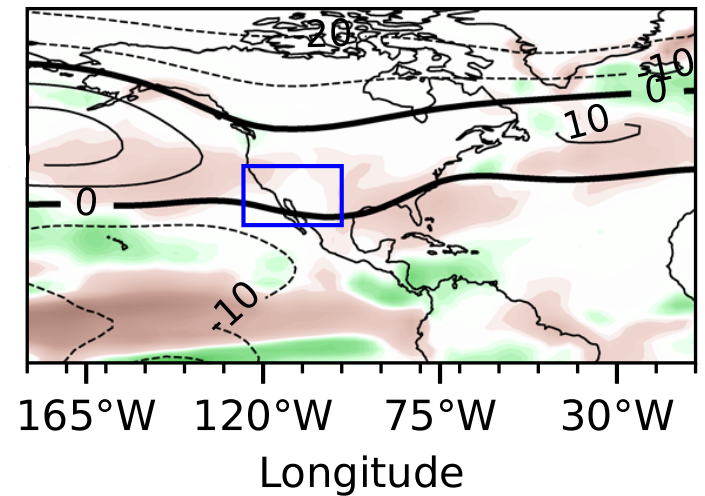
SST Trend Pattern during 1980-2022 vs. 1958-2022





wrong SST - wrong tropical cyclones trend

Precip difference 2031-40: SW drier
extrapolated observed - CMIP6 SST



1982 - 2022 MAM trends

East Africa has been drying cos
of Indian-Pacific SST trends.
Models miss this - and predict
future wetting.

