

On the influence of GCM biases on seasonal prediction skill in the tropical Atlantic

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under review at Climate Dynamics



Rationale for studying biases

- *“GCM biases negatively affect prediction skill and undermine confidence in climate change projections”*
- statements to this effect are often used as motivation to examine GCM biases
- rationale: understand bias sources → improve model → improve predictions and projections
- few studies have tested these notions

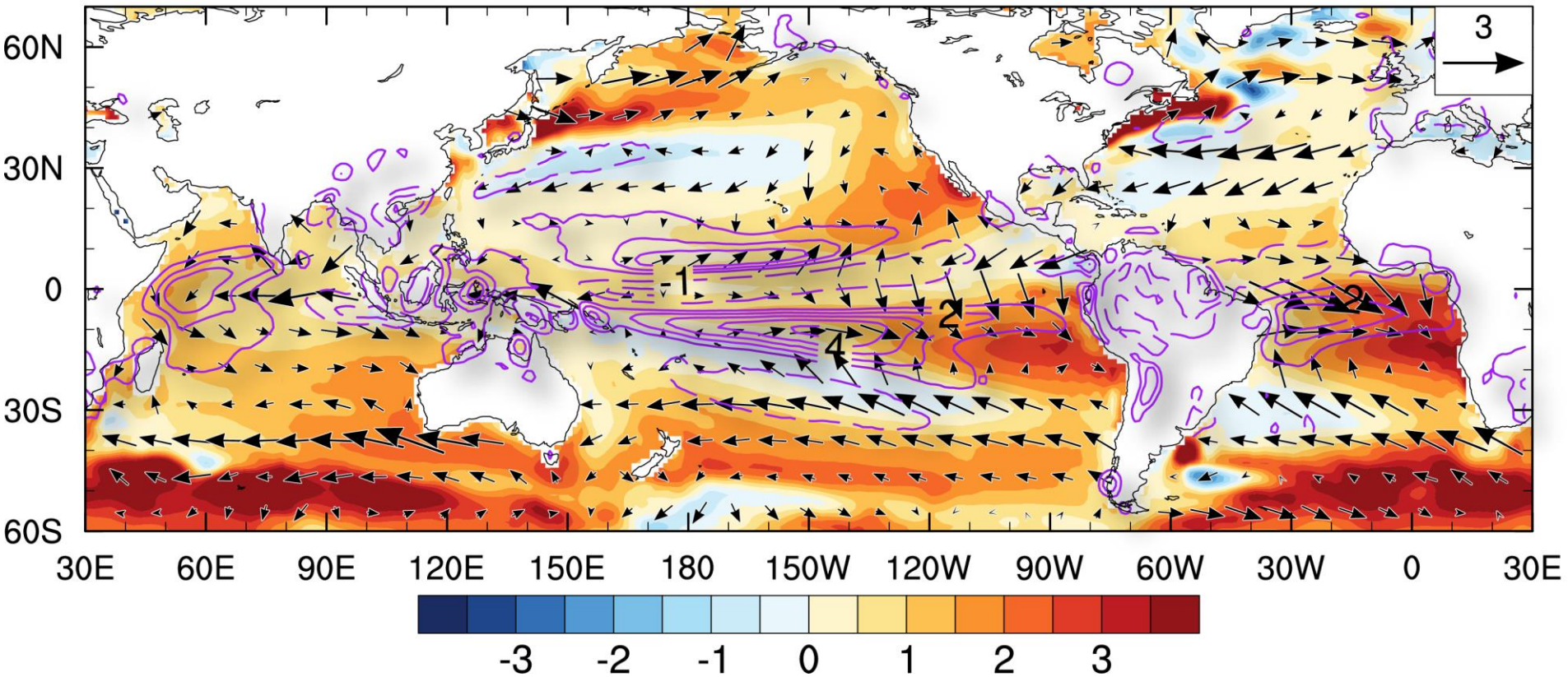
Approach of this study

- focus on seasonal predictions (easier than projections due to verification problem)
- focus on surface wind and precipitation biases (important elements of prediction)
- focus on AMIP-style runs (easy to experiment)
- this amounts to assessing 0-lead predictions or “nowcasts”

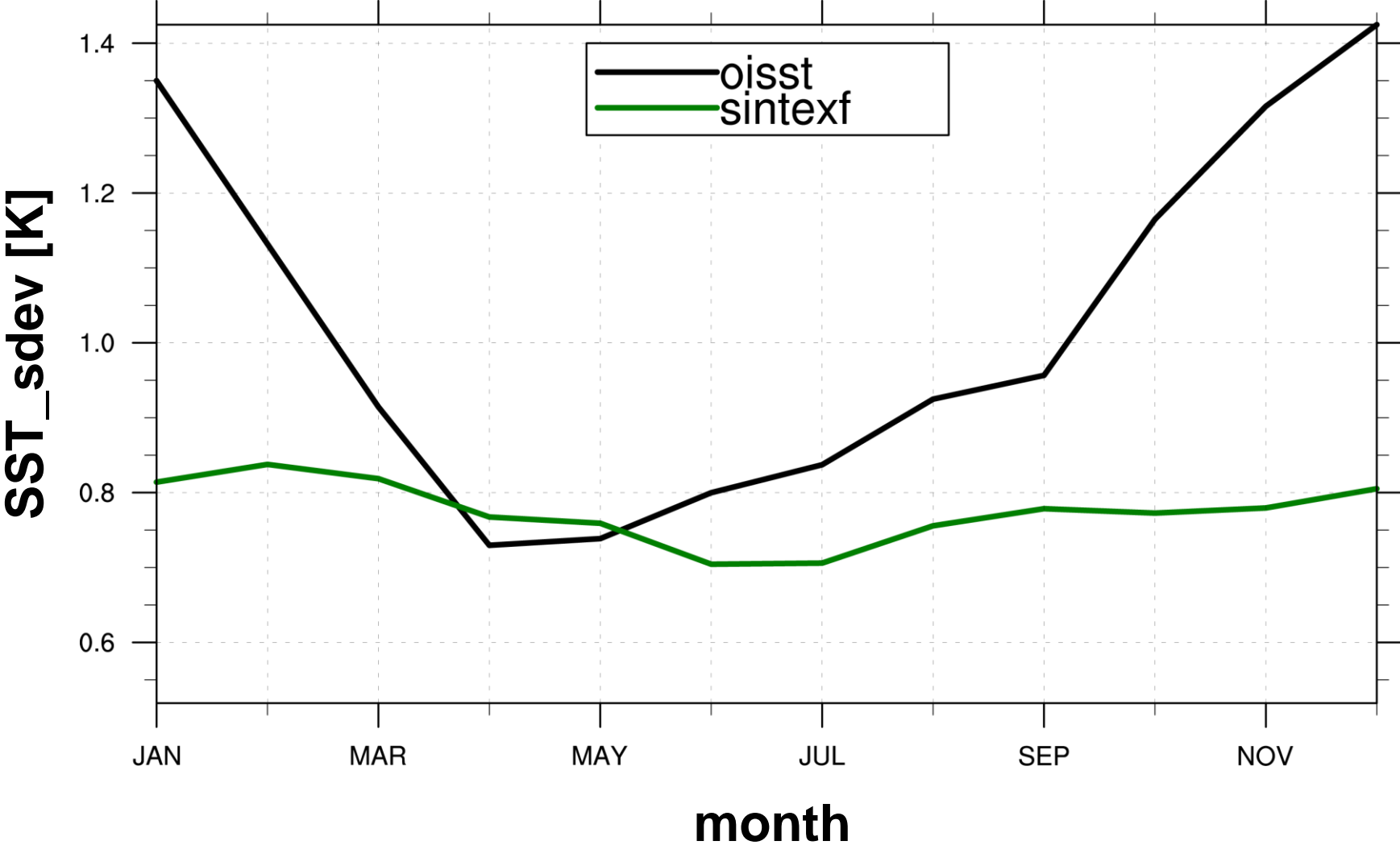
A quick look at coupled biases and prediction skill

Example: Biases in free-running SINTEX-F

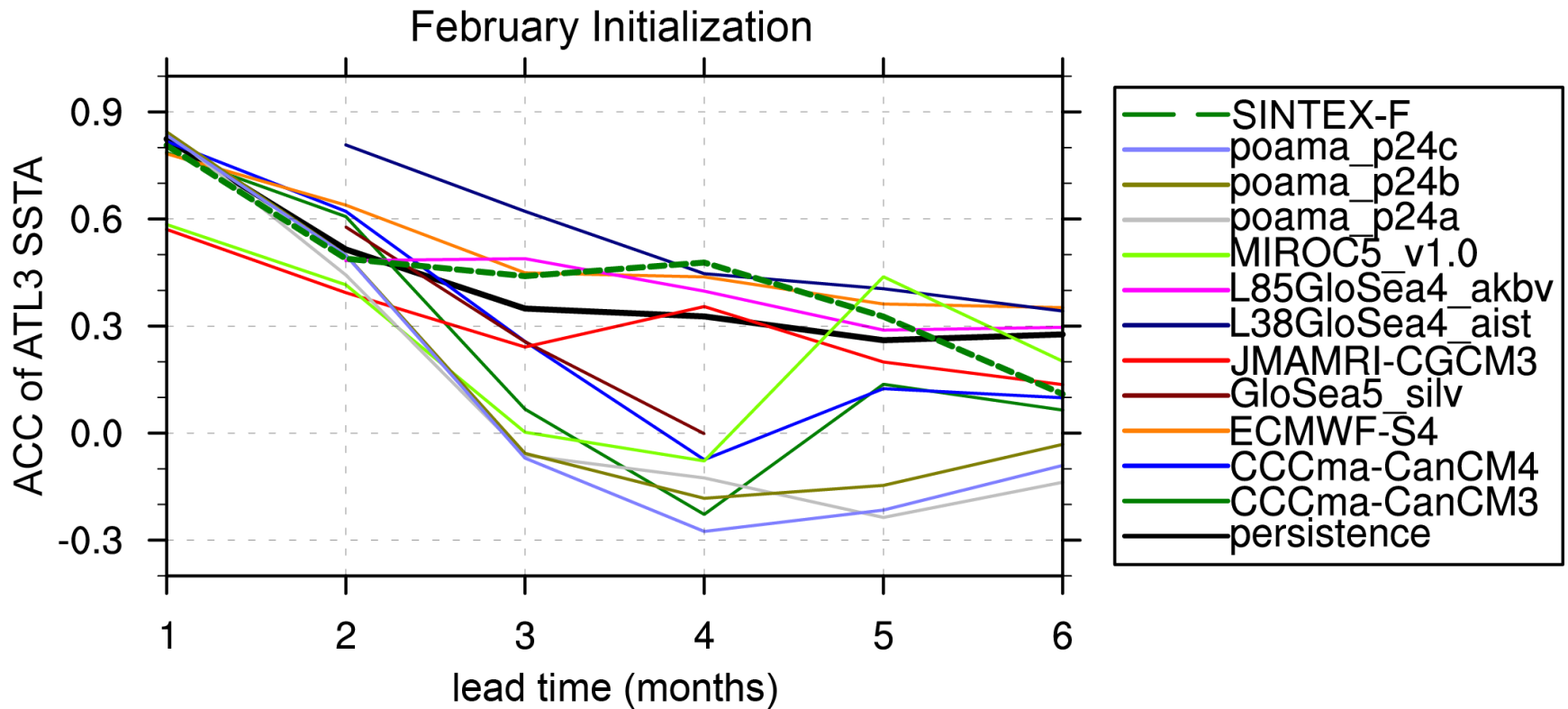
Annual mean SST, sfc wind, and precip error in SINTEX-F



Standard deviation of nino 3.4 SST



Prediction skill in the equatorial Atlantic



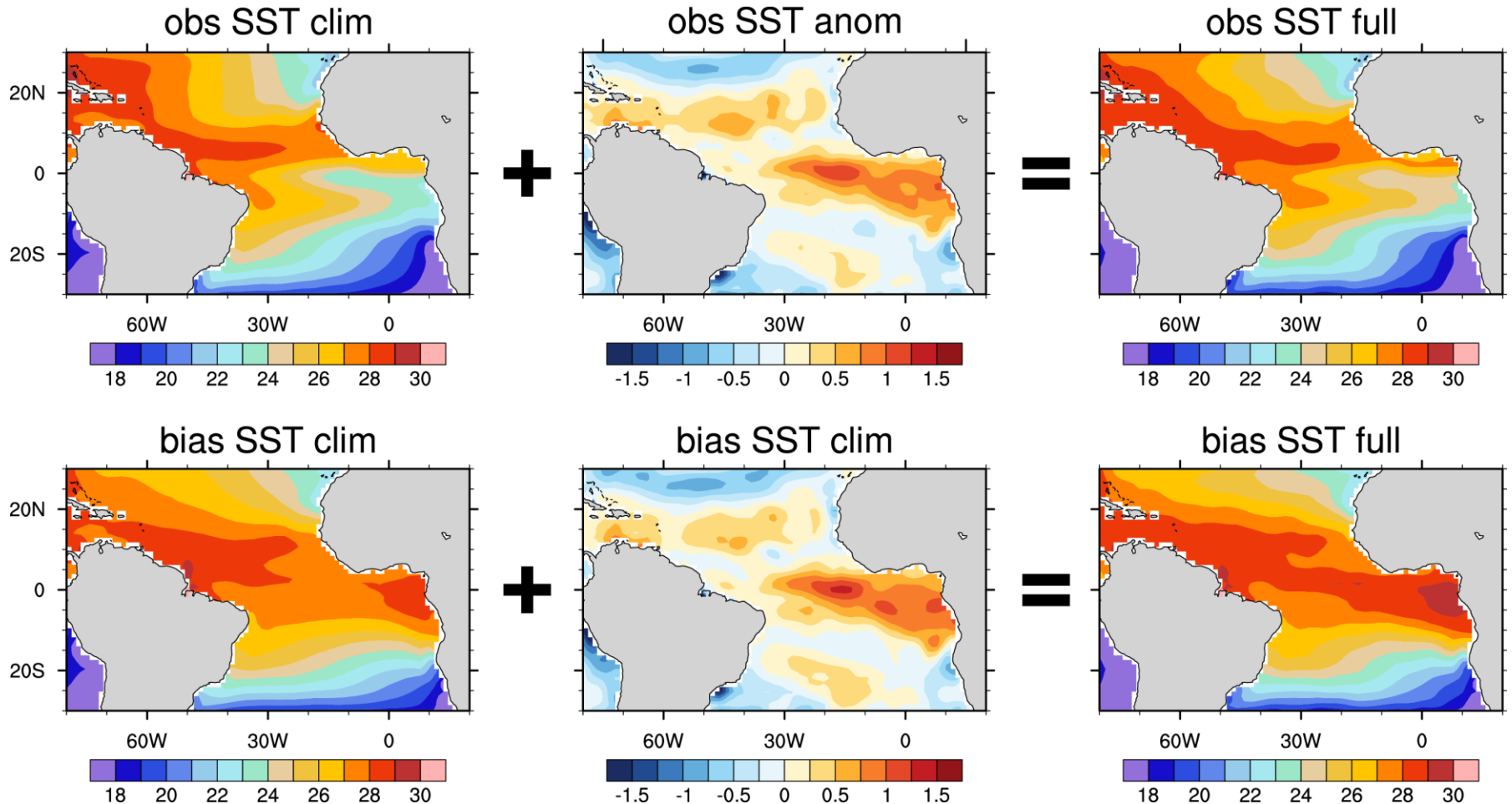
from *Richter et al. 2016*

Experiment design

- use SINTEX-F1 runs with strong SST restoring (SST nudging runs, 1-d time scale)
- CTRL: SST restored to OISST obs.
- sensitivity tests: replace OISST climatology with that from SINTEX-F1 free-running control simulation
- test to what extent SST biases deteriorate “predictions”
- Atl_bias: SST biases in tropical Atlantic
- Pac_bias: SST biases in tropical Pacific

July 1988 SST in CTRL and Atl_bias

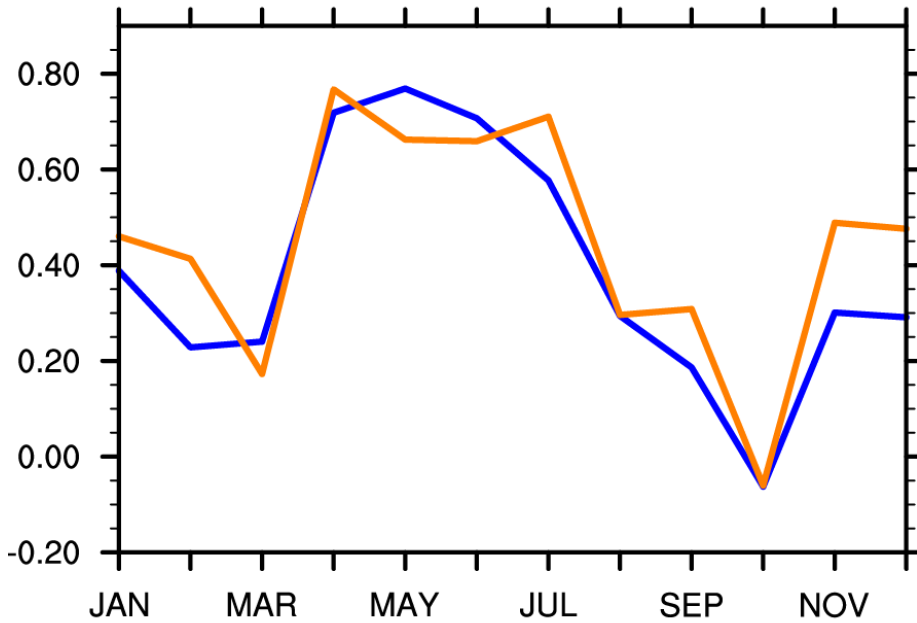
Atlantic Niño event



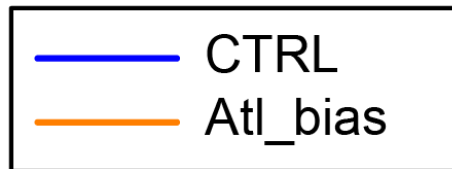
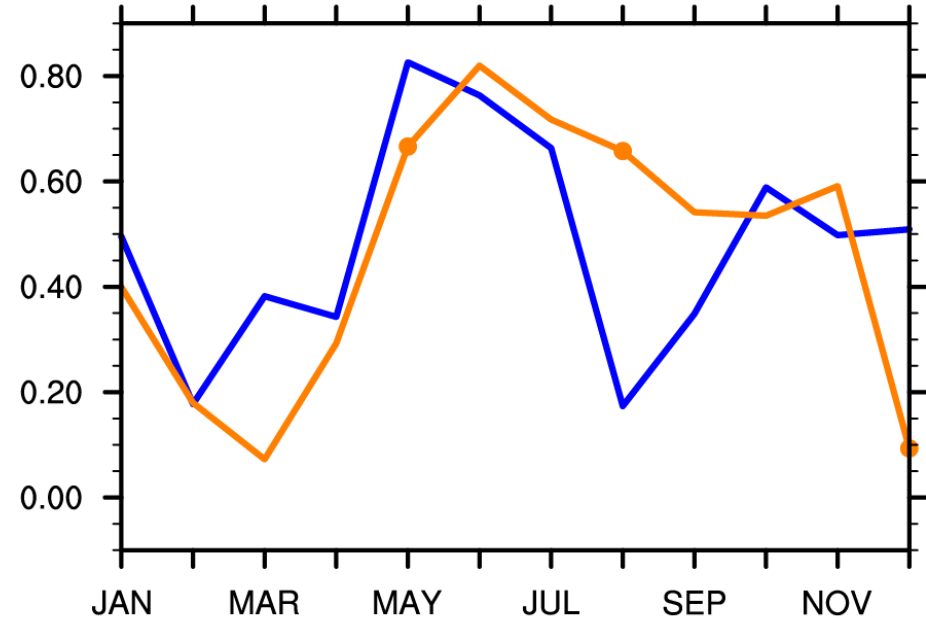
Equatorial Atlantic

ACC of WEA u_sfc and eqAtl precip

ACC of WEA u_sfc (ref=ERA-Int)

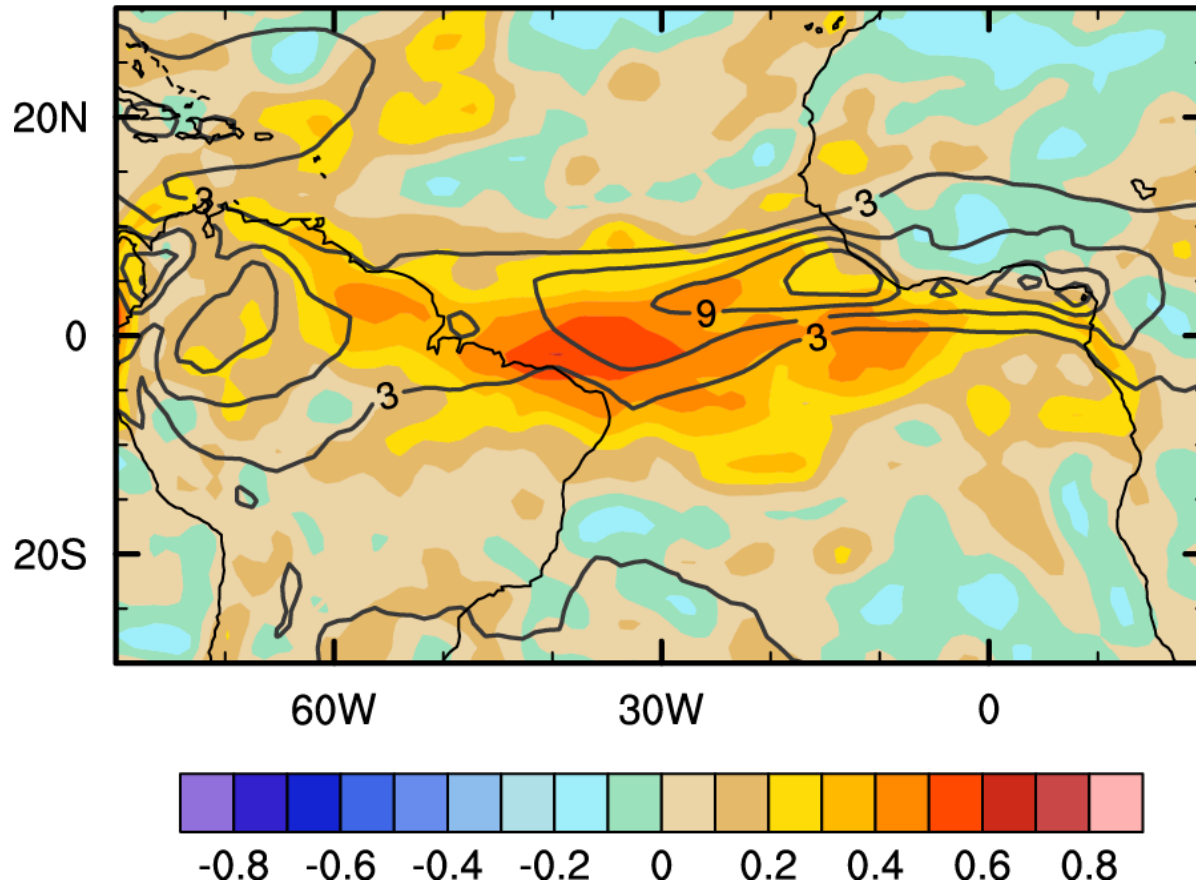


ACC of EQATL precip (ref=GPCP)



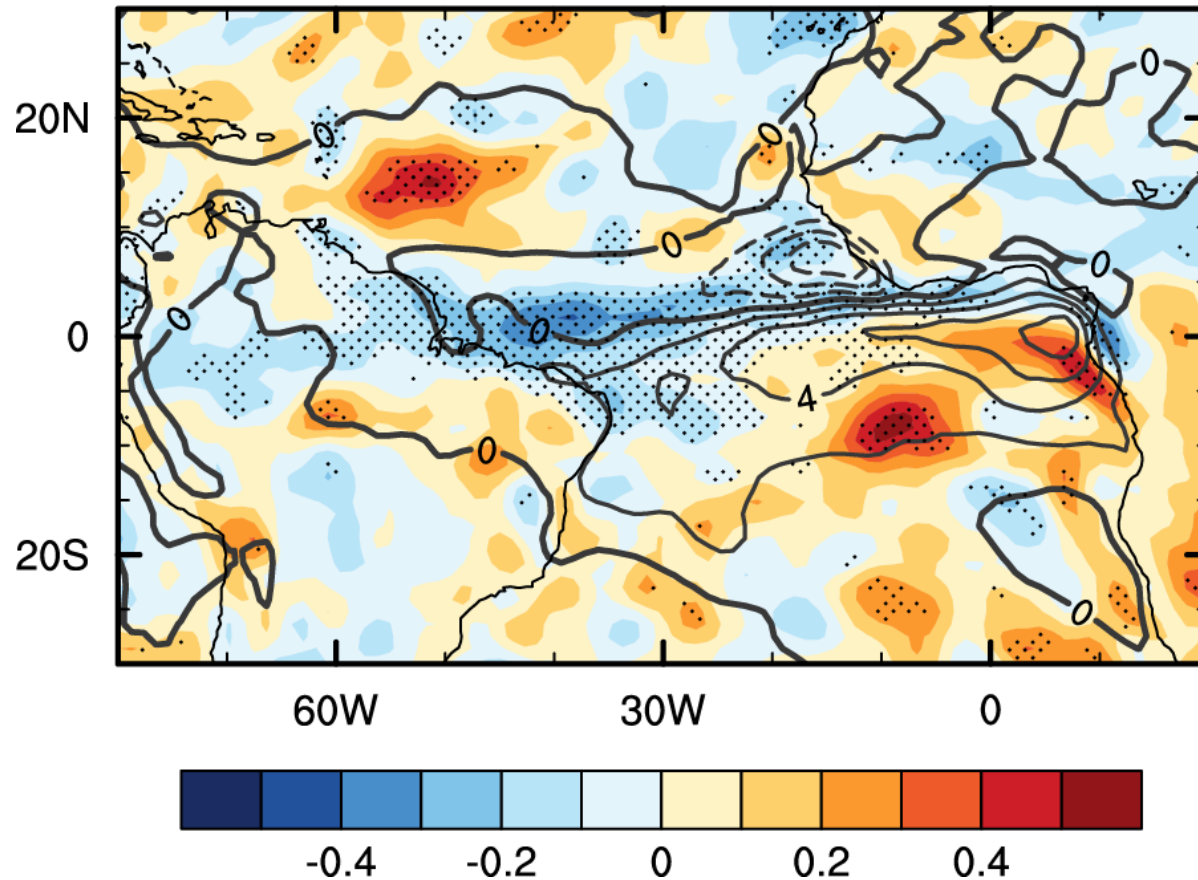
ACC of precipitation in CTRL

AMJ



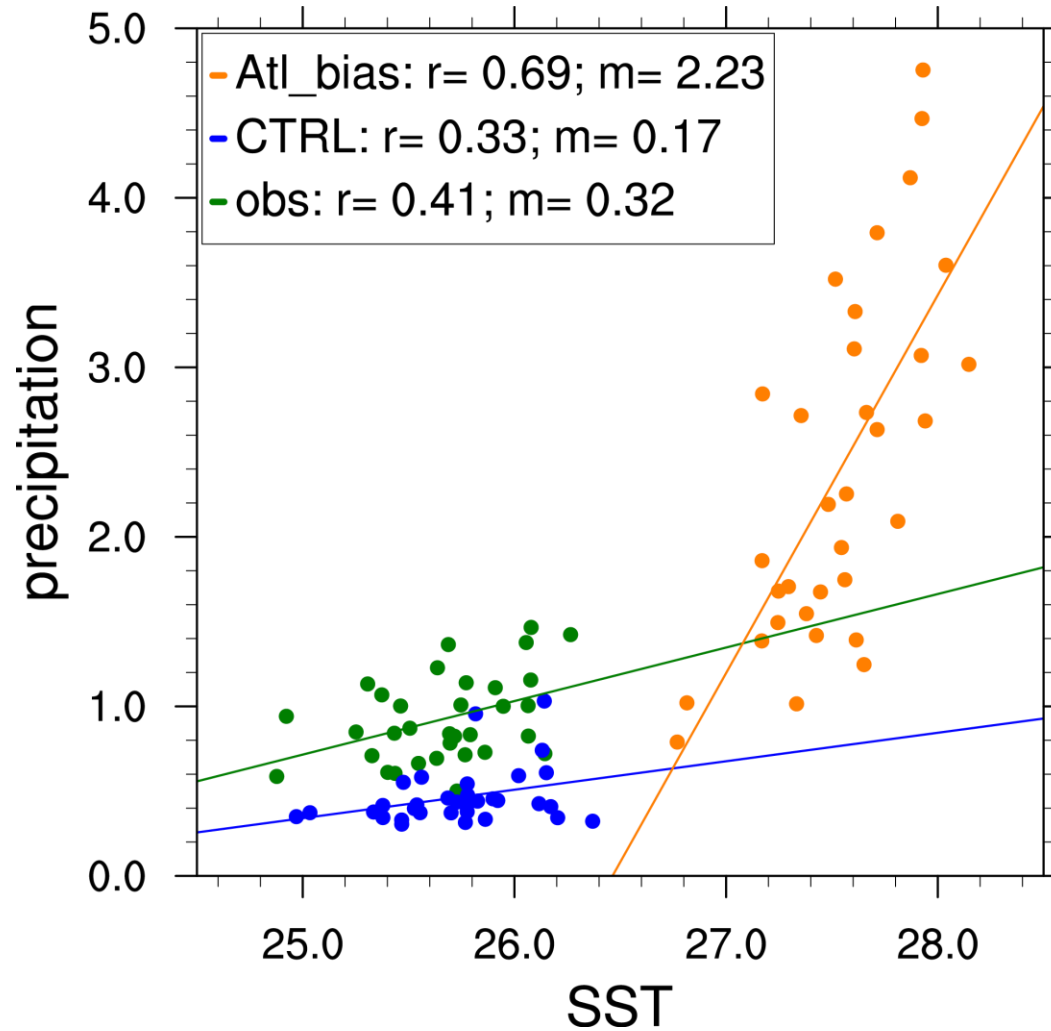
ACC of precipitation: Atl_bias – CTRL

AMJ



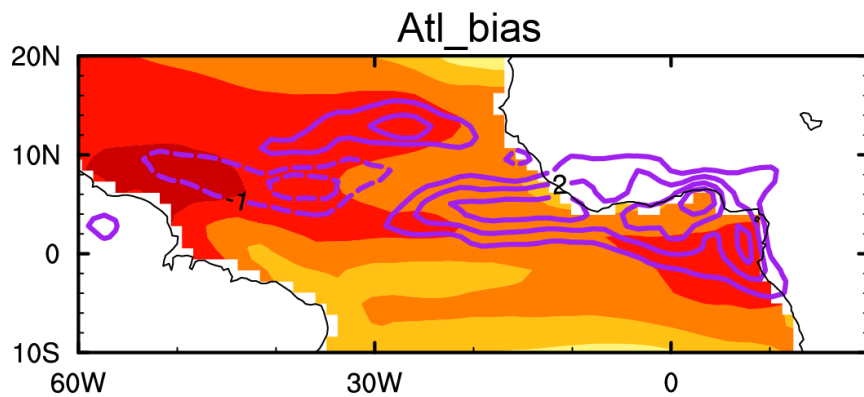
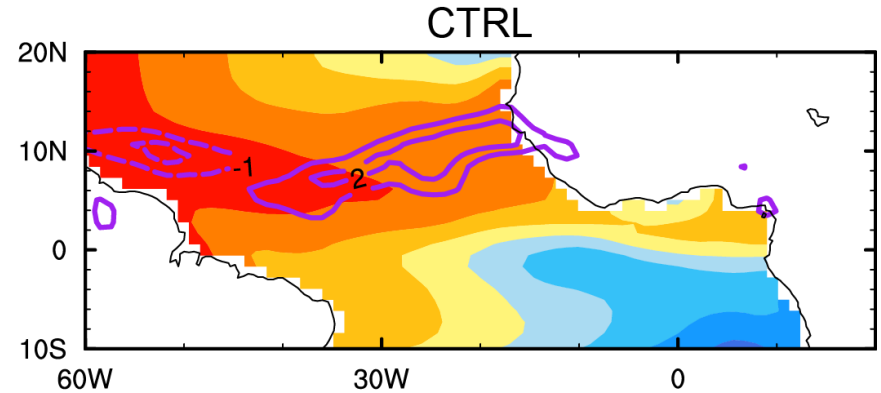
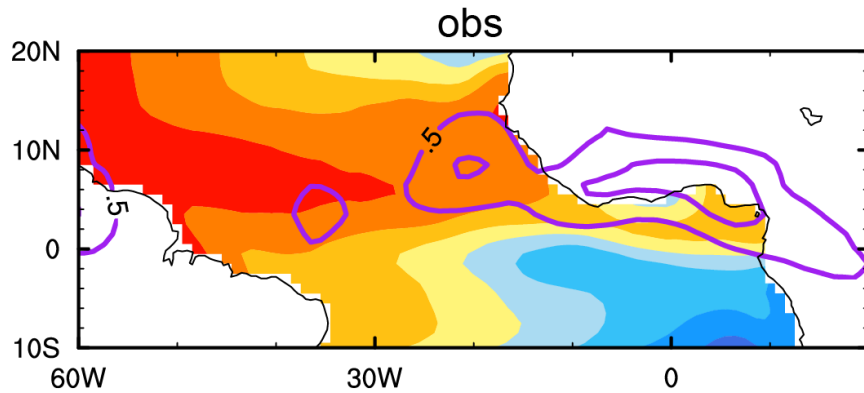
Simulated vs. observed precipitation

EQATL: 50W-10E, 5S-5N; August

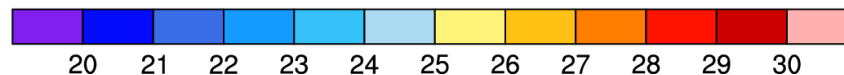


SST (shading) and precipitation (cnt)

composited on 0.5 std of EQATL precip

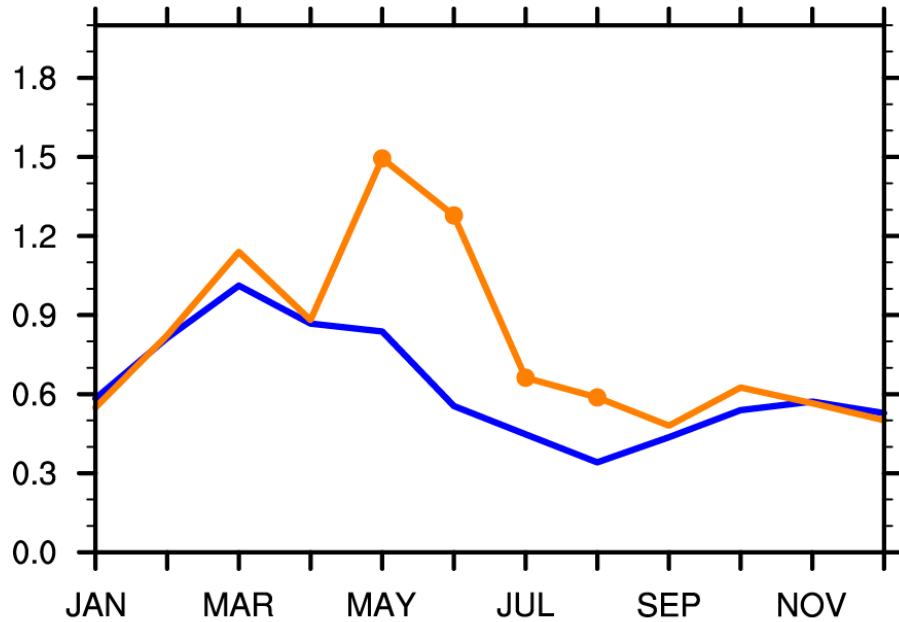


pattern correlation with GPCP:
CTRL: 0.25
Atl_bias: 0.45

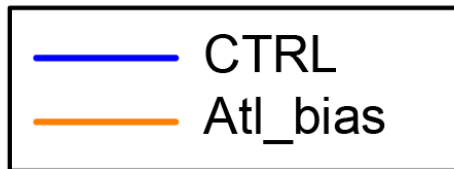
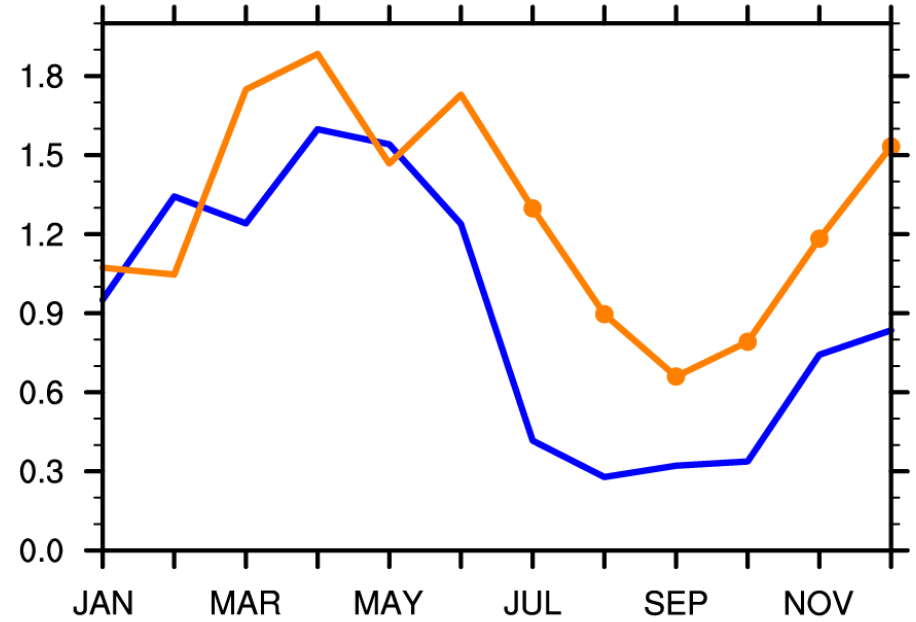


RMSE of WEA u_sfc and eqAtl precip

RMSE of WEA u_sfc (ref=ERA-Int)



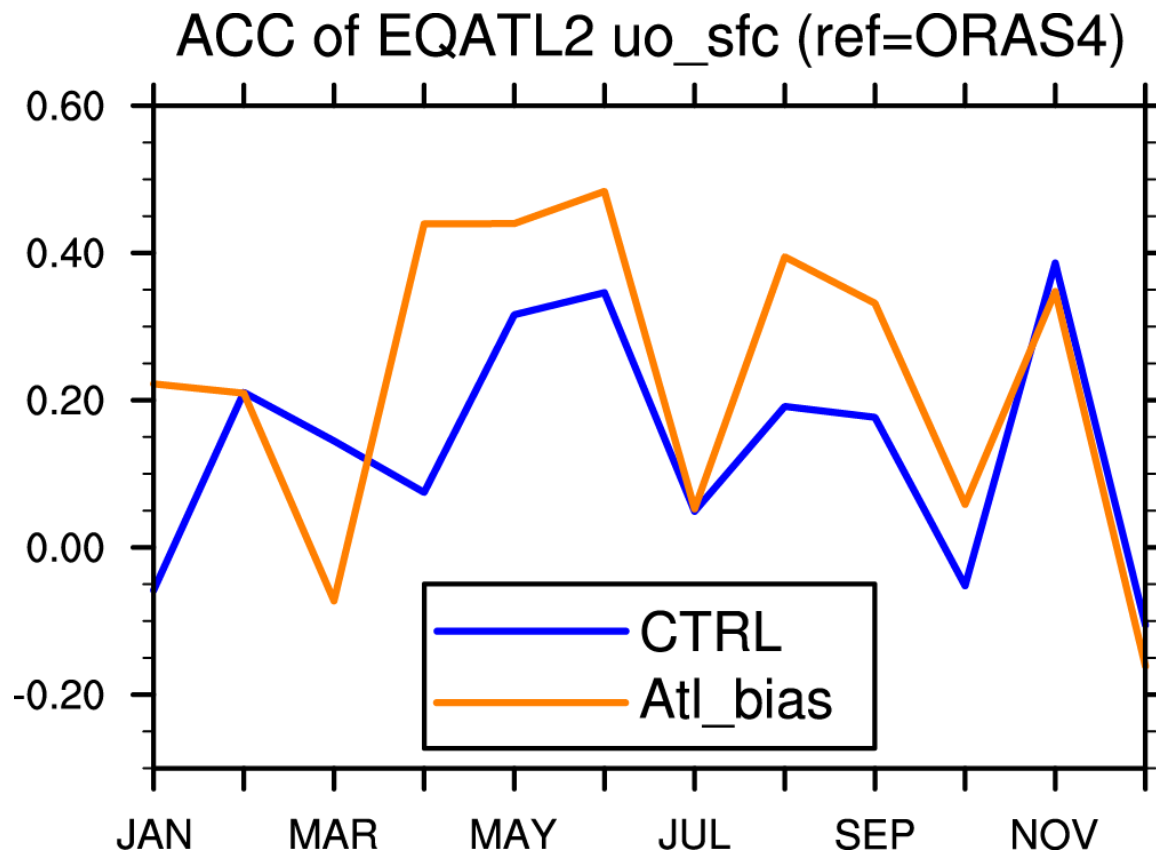
RMSE of EQATL precip (ref=GPCP)



Surface Currents

ACC of surface zonal currents

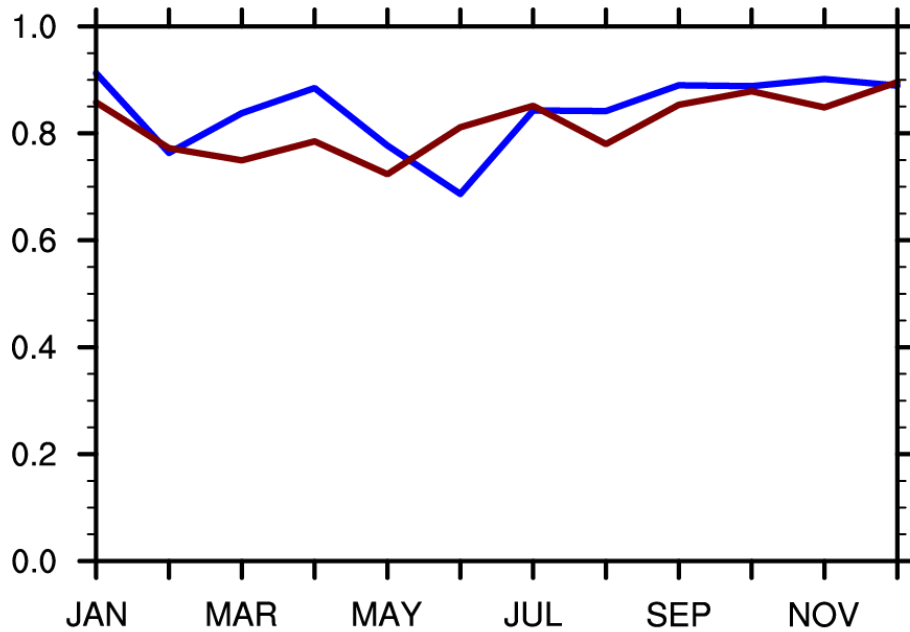
equatorial Atlantic (50-10E, 5S-5N)



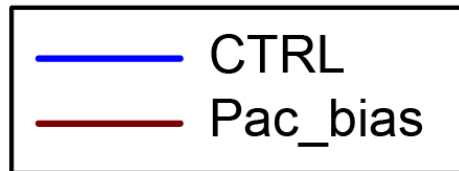
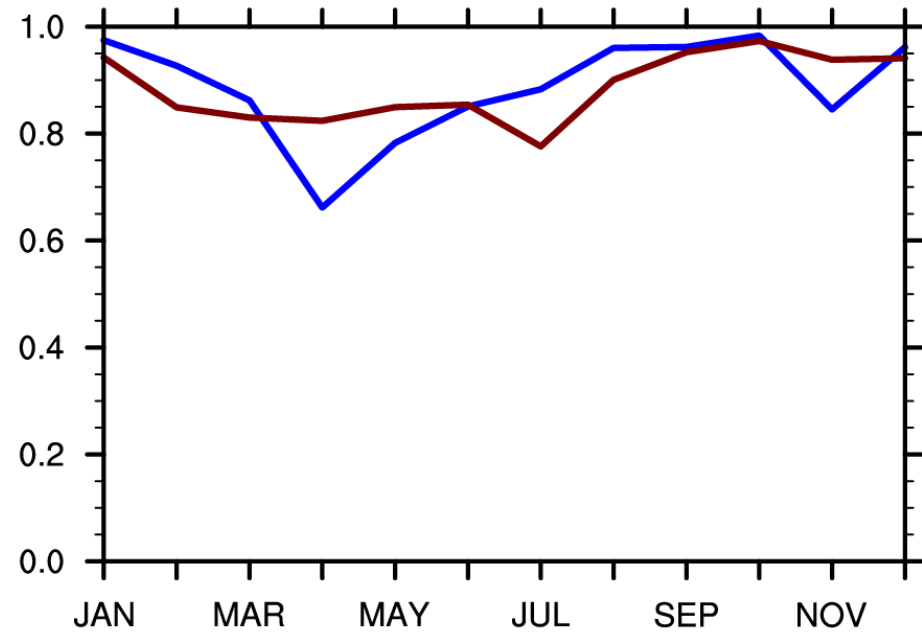
Equatorial Pacific

ACC of Niño 4 u_sfc and Niño 3.4 precip

ACC of Nino4 u_sfc (ref=ERA-Int)



ACC of Nino3.4 precip (ref=GPCP)



Conclusions

- skill of precip and sfc winds in the equatorial Atlantic quite robust to prescribed SST biases
- anomaly initialization may overcome some problems of current prediction models
- in SINTEX-F, ACC tends to decrease where mean precip is low and vice versa → fixing excessive precip may deteriorate skill
- increased ACC of precip comes at a price: root-mean-square-error increases
- role of coupled errors not discussed here

Tropical Atlantic Blog

(www.jamstec.go.jp/aplinfo/climate)

more advertising:
JpGU meeting on
"Climate variations in the Atlantic Ocean
and their representation in climate
models"
Chiba, Japan
21-25 May 2017

Climate Watch – October 2016 Edition: Spring is here again
(here in South Africa)

Author: SINTEX E Team | 2016-11-04
I'm so excited to be in South Africa for a project on infectious diseases
(see here for English description) The phot...

Seasonal Prediction

Tropical Atlantic Post #2 – Something's cooking on the West
Coast

Center | 2016-09-29

After a long break (I'd rather not call it a hiatus) I'm finally back
to blogging on the tropical Atlantic. In...

Atlantic

 Climate Prediction

Recent Posts

- Climate Watch – audit season: verifying the
summer 2016 forecast

- Climate Watch – October 2016 Edition:
Spring is here in (here in South Africa)

- Tropical Atlantic Post #2 – Something's
cooking on the West Coast

- Climate Watch – September 2016 Edition:
Typhoon season

- Climate Watch – August 2016 Edition: Fall is
calling

Category

- Atlantic (2)

- Seasonal Prediction (6)

- verification (2)

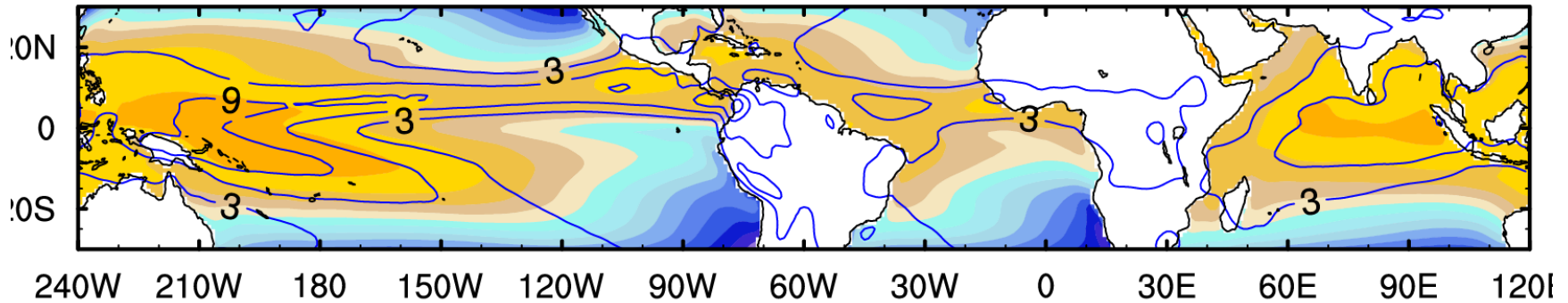


**AMIP Experiments with
prescribed SST warming**

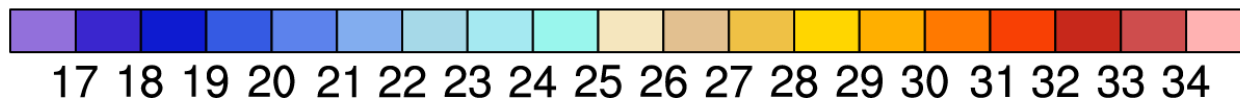
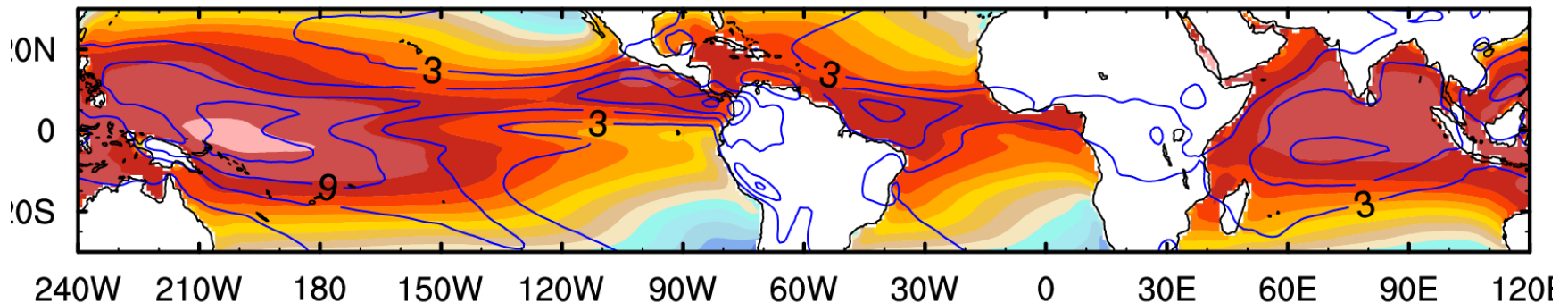
AMIP and amipFuture

SST and precipitation (annual mean)

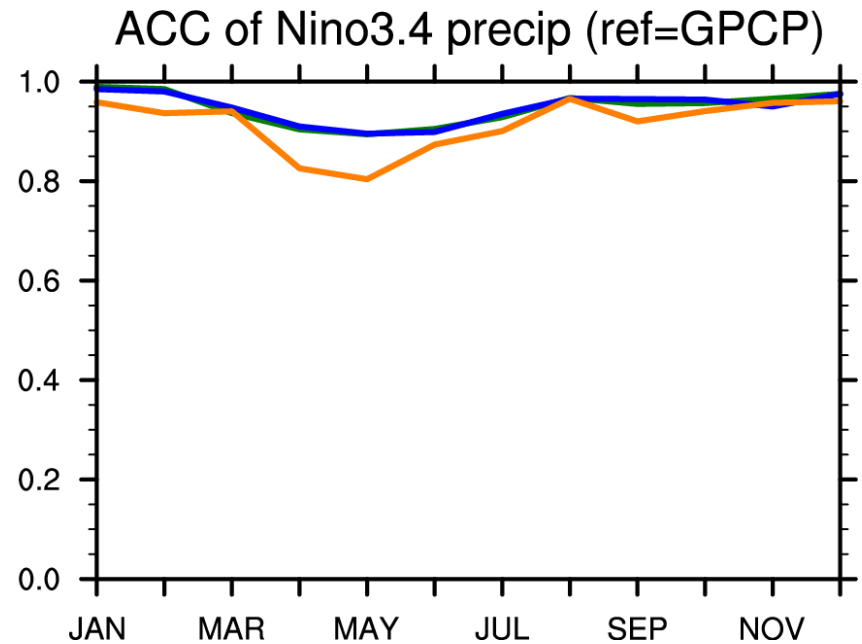
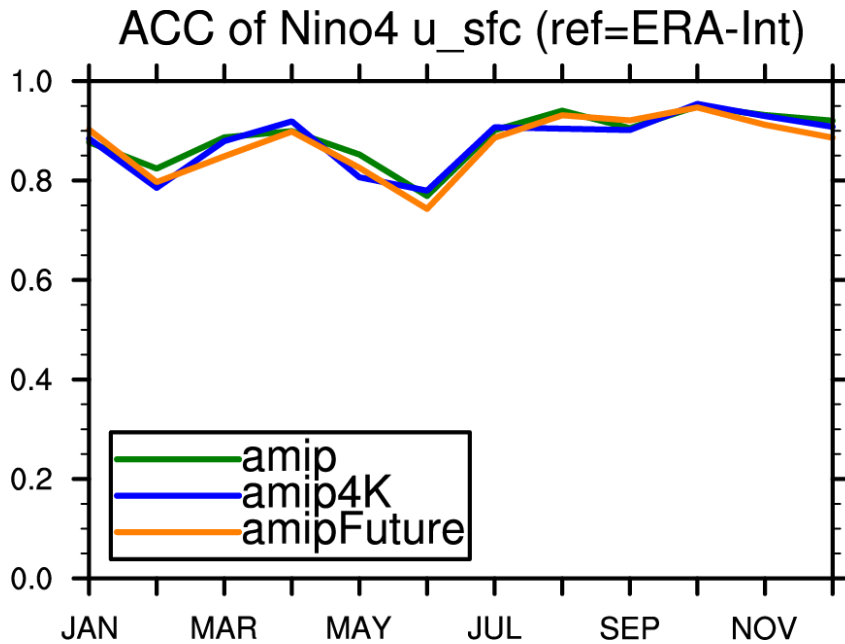
amip



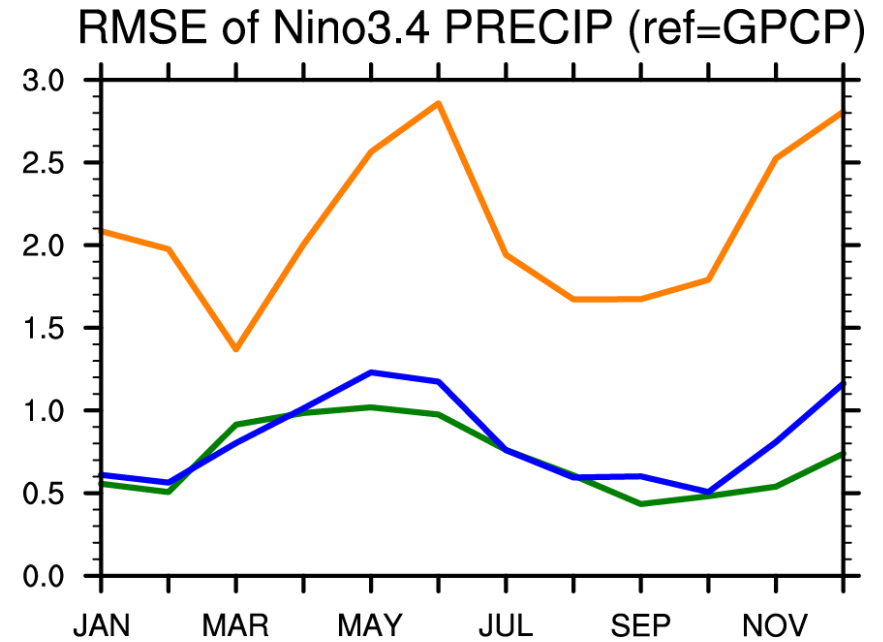
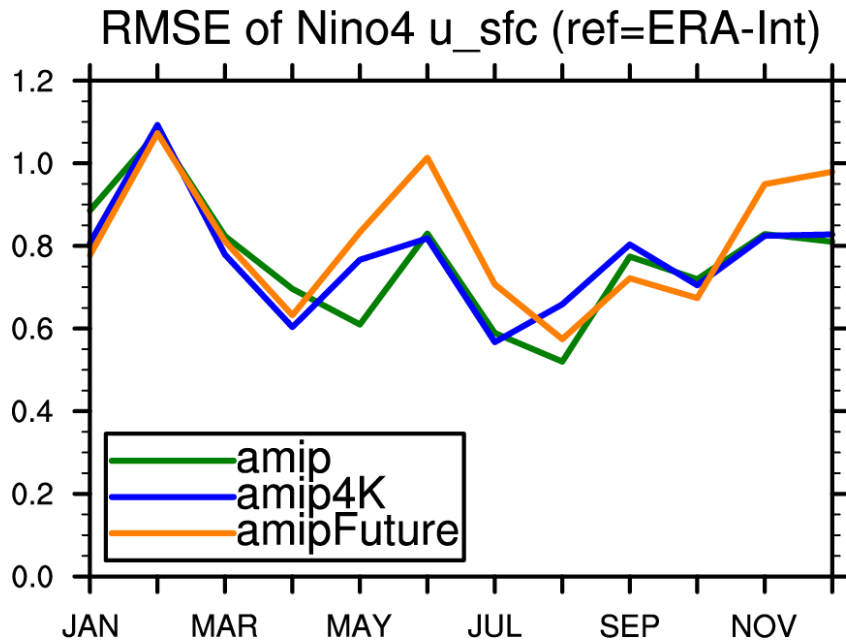
amipFuture



ACC of Niño 4 u_sfc and Niño 3.4 precip

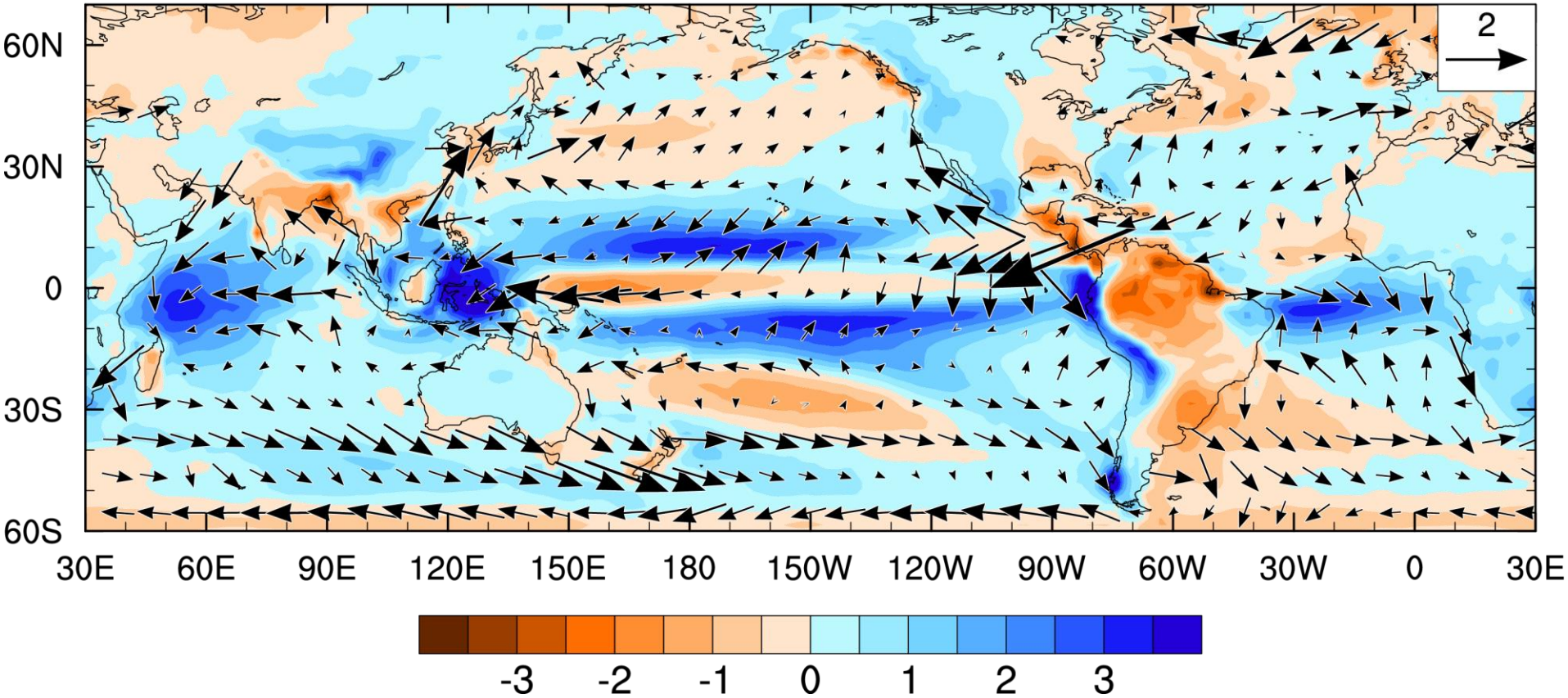


RMSE of Niño 4 u_sfc and Niño 3.4 precip



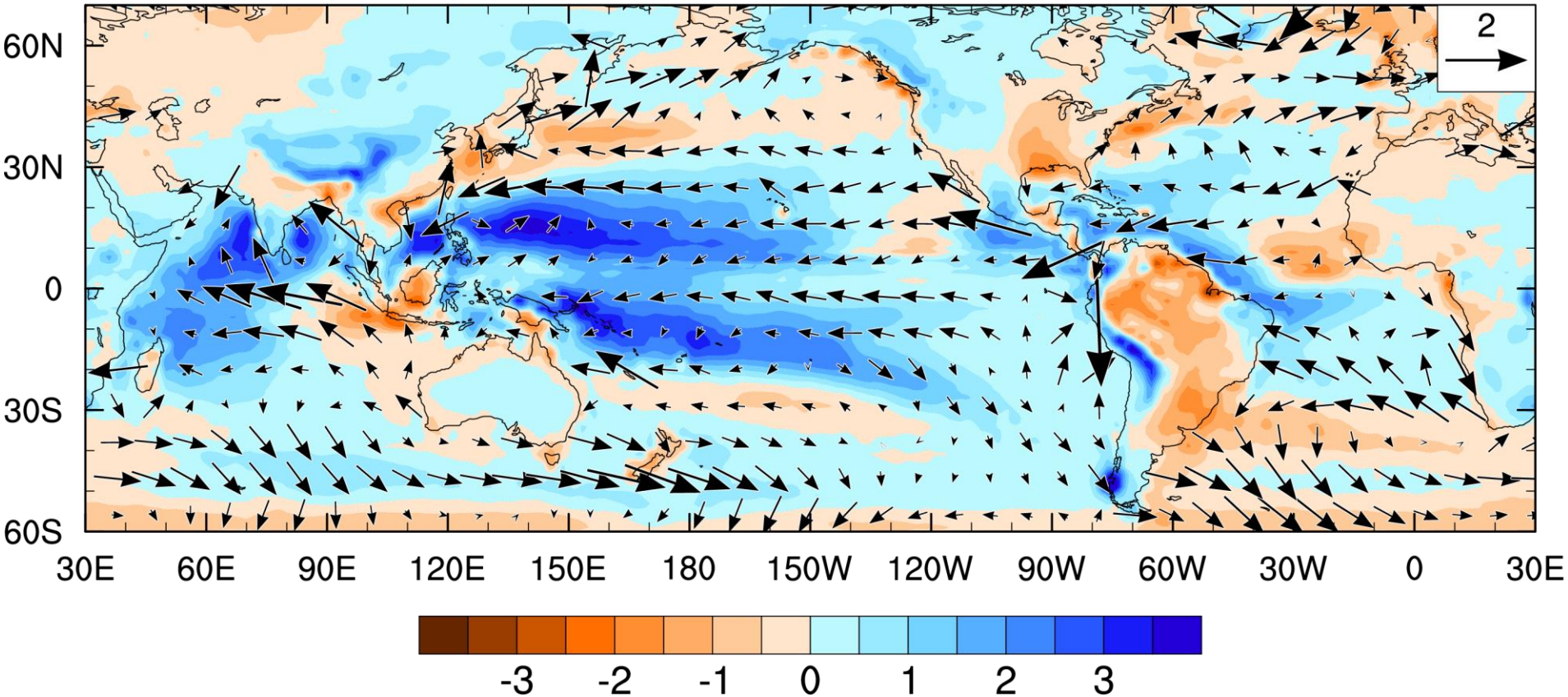
Precip and Wind Biases in Coupled GCMs

Annual mean precip and sfc wind error in CMIP5 ensemble



Precip and Wind Biases in **atmospheric** GCMs

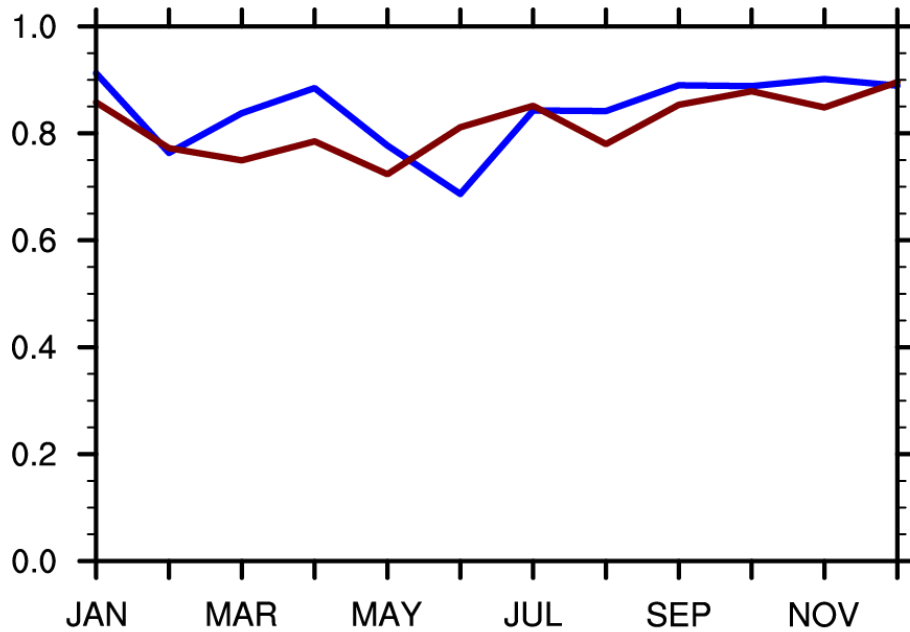
Annual mean precip and sfc wind error in **AMIP** ensemble



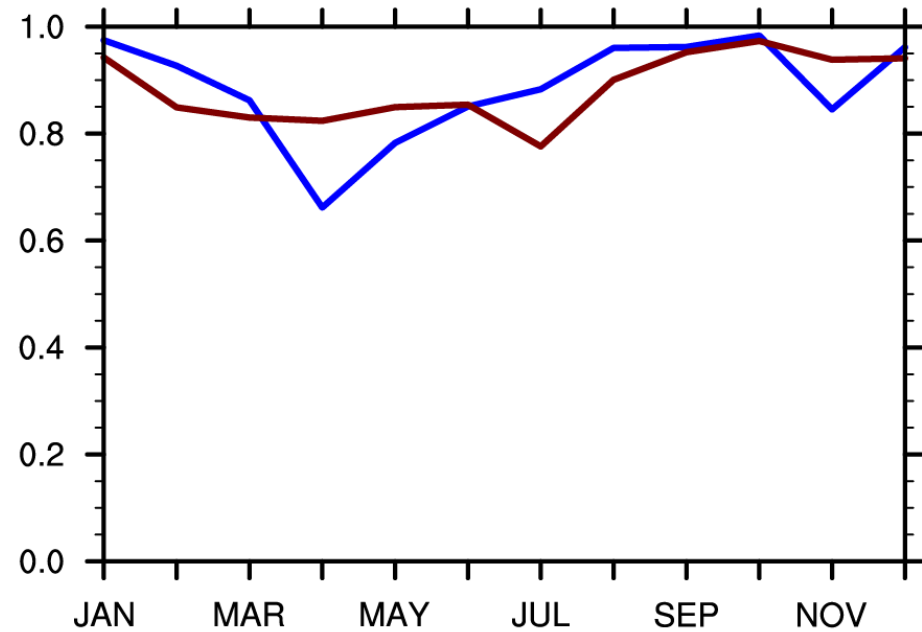
Equatorial Pacific

ACC of Niño 4 u_sfc and Niño 3.4 precip

ACC of Nino4 u_sfc (ref=ERA-Int)

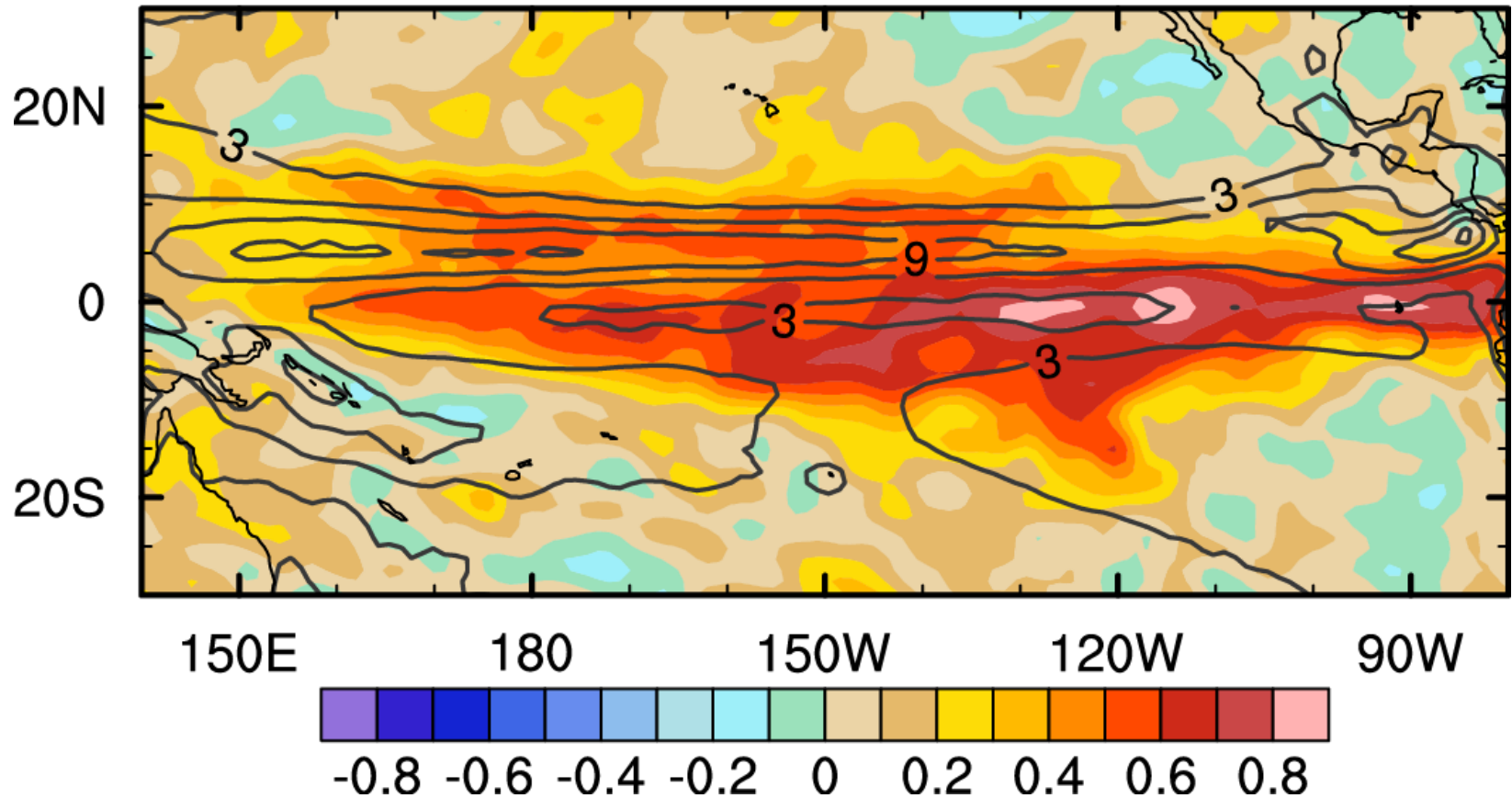


ACC of Nino3.4 precip (ref=GPCP)



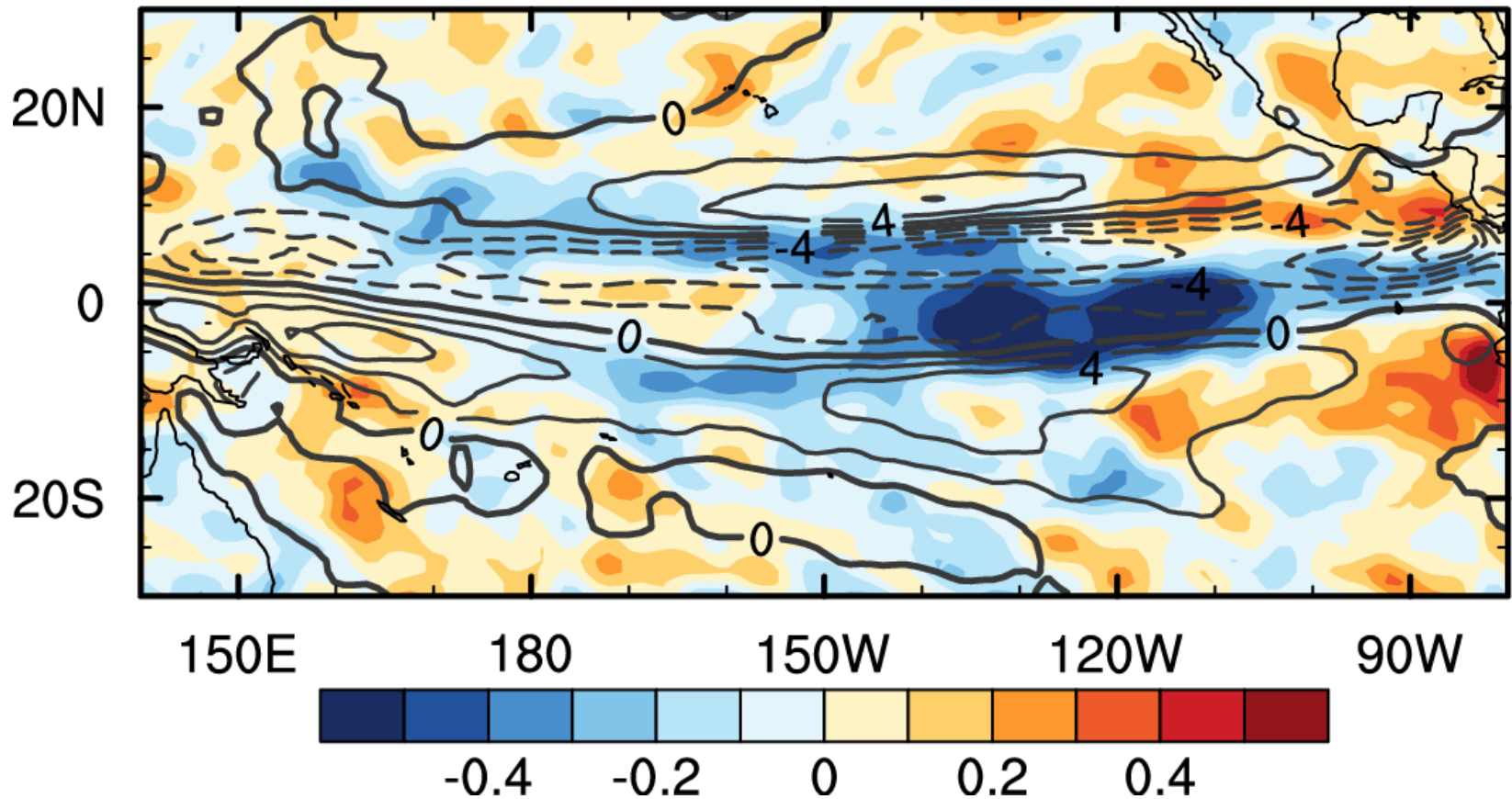
ACC of precipitation in CTRL

amip_ctl



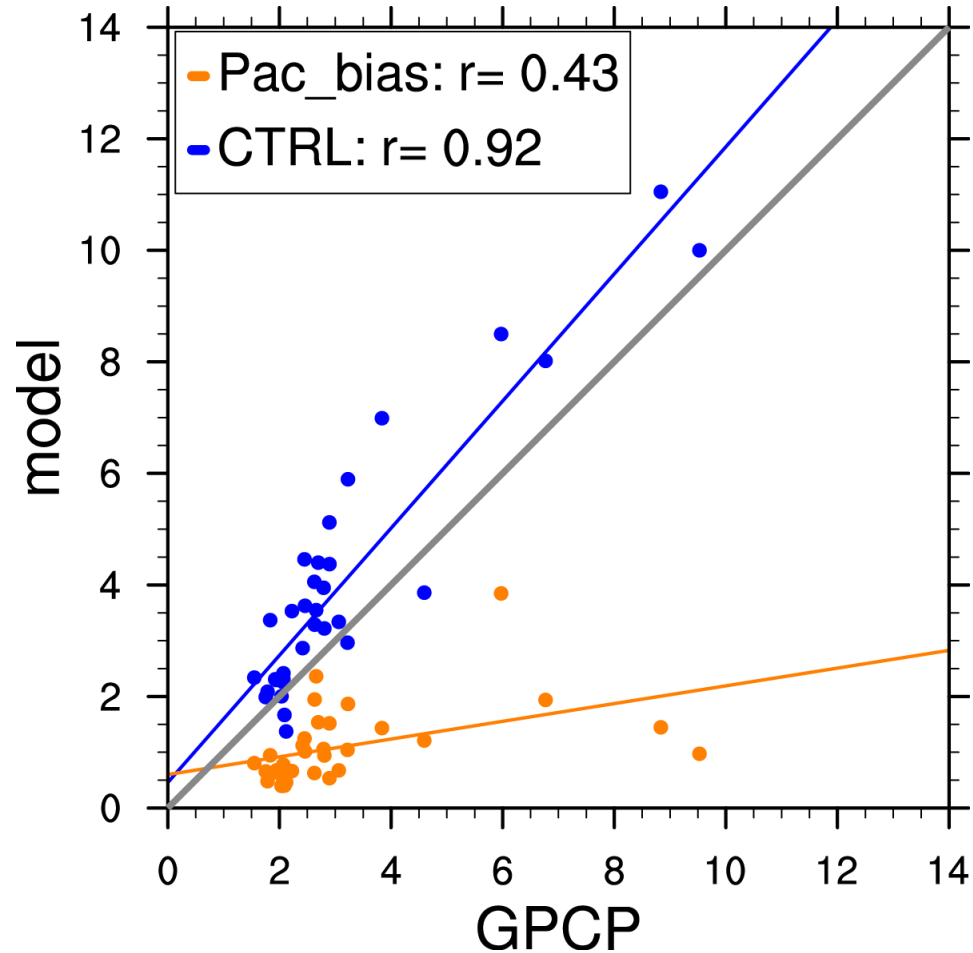
ACC of precipitation: Pac_bias - CTRL

Pac_bias - amip_ctl



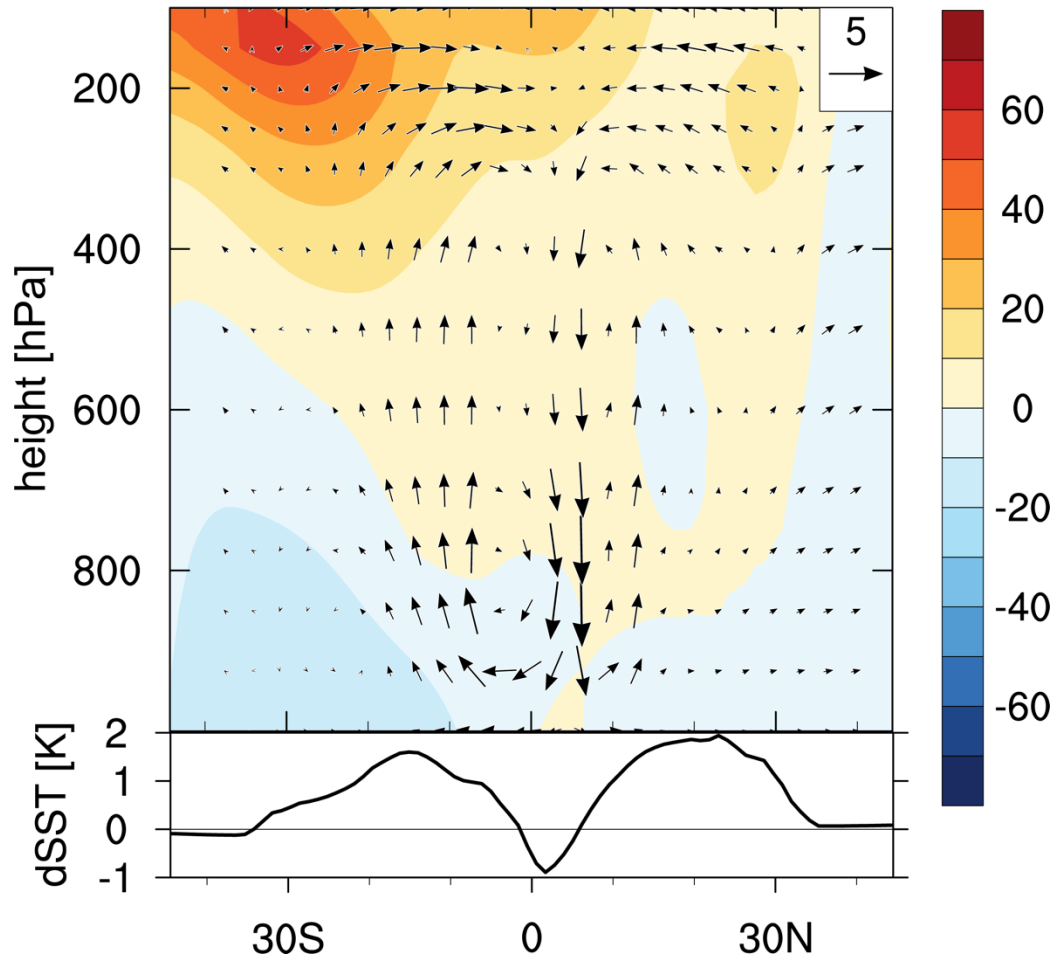
Simulated vs. observed precipitation

140-105W, 5S-5N; MAM



Geopotential (shading) and V/Ω

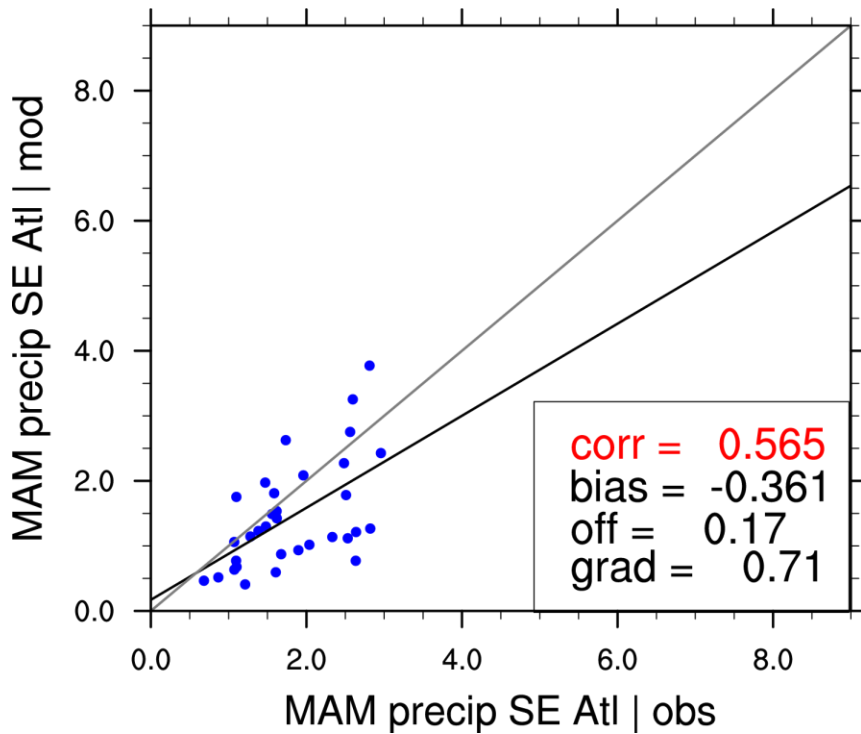
average: 140-105W; difference Pac_bias-CTRL



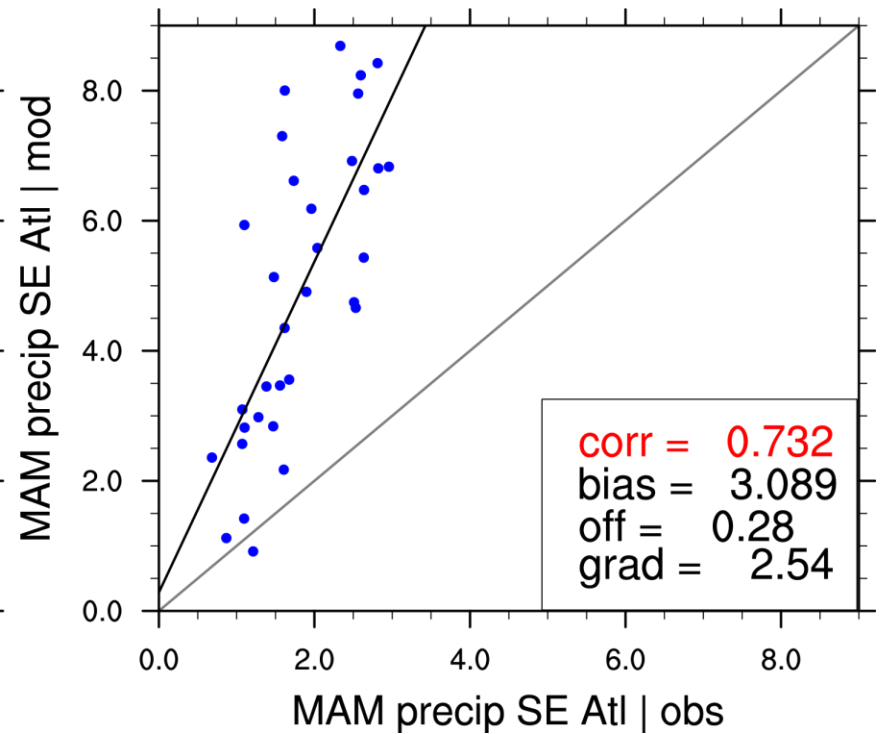
Simulated vs. observed precipitation

10W-10E, 10S-EQ; MAM

CTRL

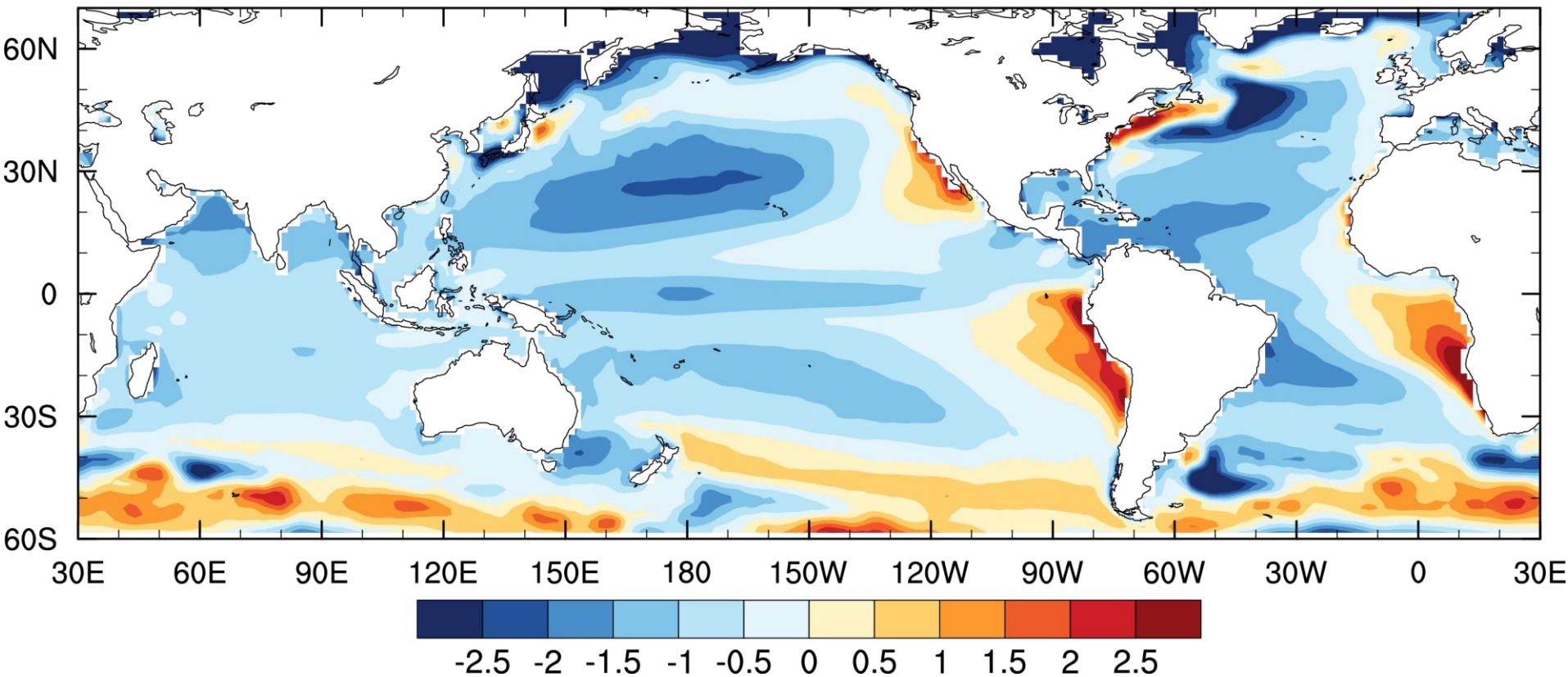


Atl_bias



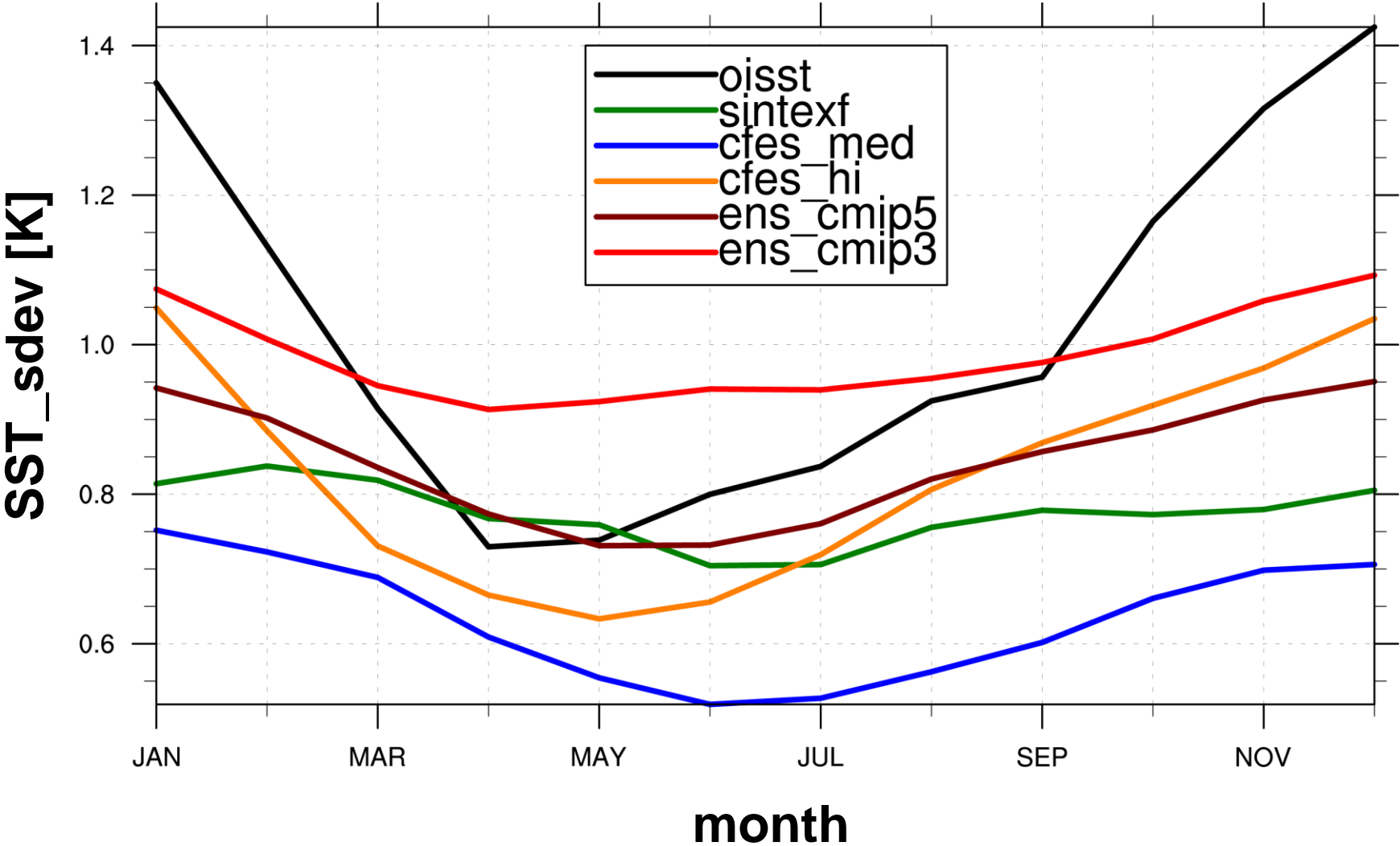
Example: SST Biases in Coupled GCMs

Annual mean SST error in CMIP5 ensemble (degC)



from *Richter et al. 2016a*

Standard deviation of nino 3.4 SST



SINTEX-F prediction skill for nino3.4 SSTA

ENSO prediction skill of 10 coupled GCMs

