

Impacts of NCEP Reanalysis R2 and CFSR Fluxes on MOM4 Simulations

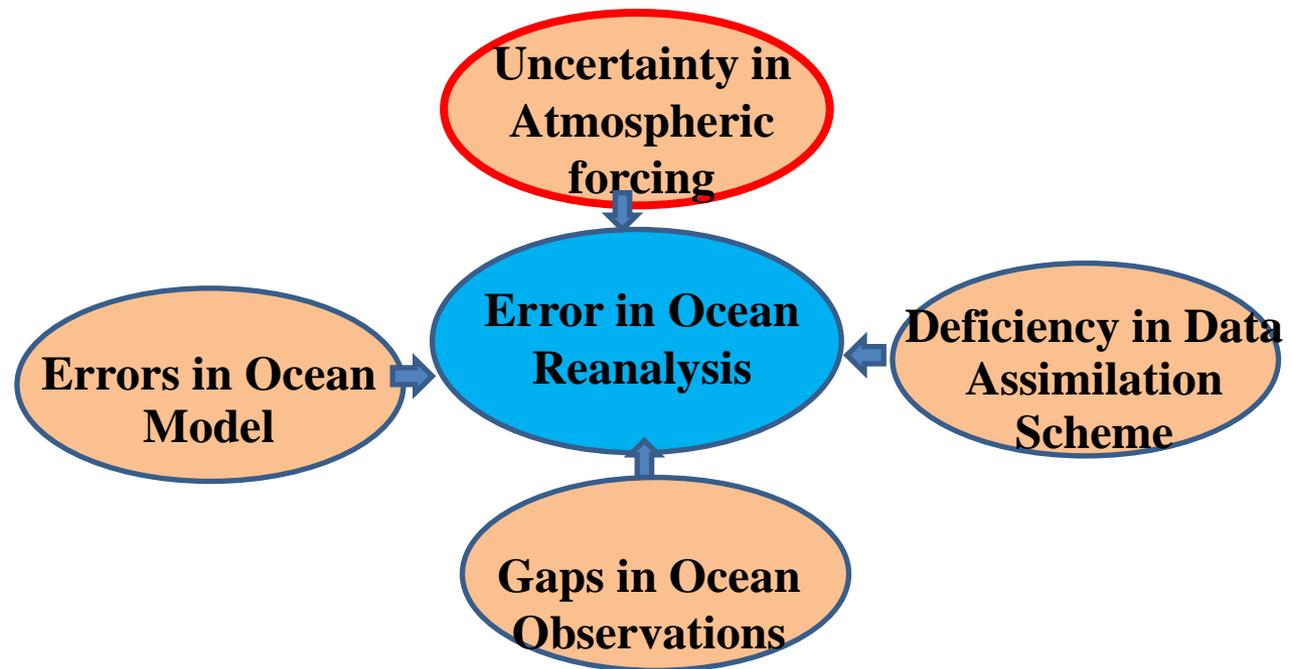
Caihong Wen
NOAA/NCEP/CPC & INNOVIM

With acknowledge to Yan Xue, Arun Kumar, David Behringer and Lisan Yu

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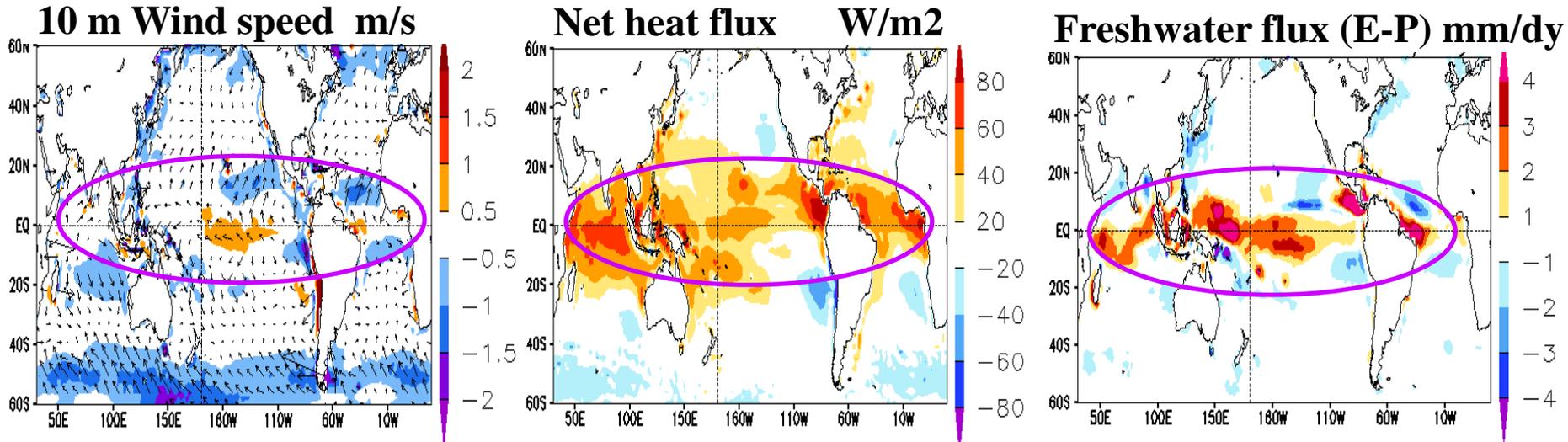
Questions:

- How does uncertainties in surface fluxes (momentum, heat and water fluxes) contribute to uncertainties in the background states to be corrected by NCEP GODAS?

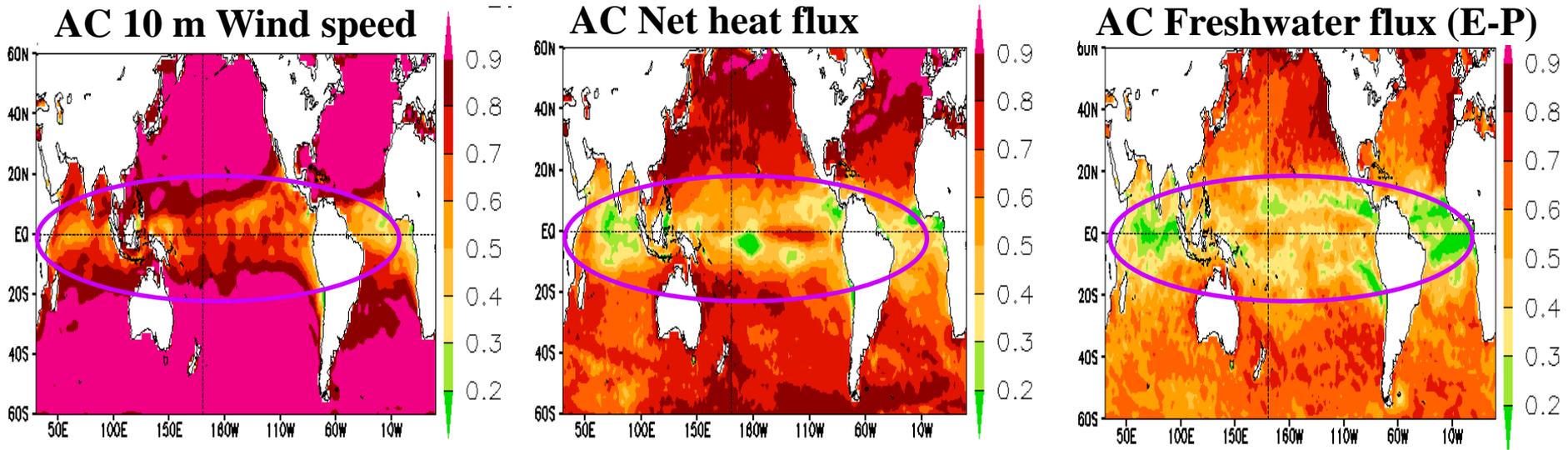


Surface fluxes comparison between R2 and CFSR (1986-2013)

Annual mean difference (CFSR – R2)



Anomaly correlation (R2&CFSR)



Significant difference between R2 and CFSR occur over tropical regions.

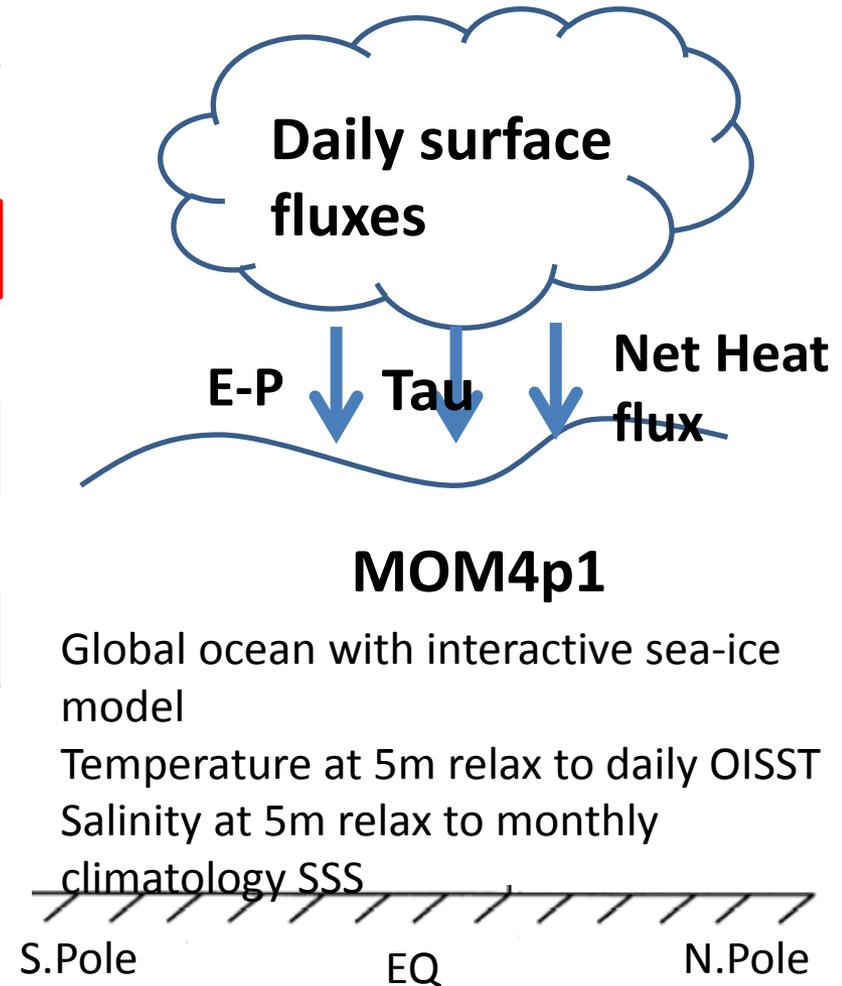
Experiment design :

	Wind stress	Net heat flux	E - P
R2_forcing	R2	R2	R2
CFSR_forcing	CFSR	CFSR	CFSR
R2_CTAU	CFSR	R2	R2
R2_CNET	R2	CFSR	R2
R2_CEP	R2	R2	CFSR

Reference run (R2_forcing): MOM4p1 forced by R2 surface fluxes

Impact of surface forcing is measured by **uncertainty of model simulations**

Large simulation difference \longrightarrow **Strong impact of surface forcing**



Data and Methods

Model Data:

- Monthly R2_forcing, CFSR_forcing, R2_CTAU, R2_CNET, R2_CEP simulations from 1982-2014
- Variables: SST, SSS, D20, Temperature

Observations:

- Operational GODAS
- EN4 analysis (salinity)
- OISST

Model simulation period: 1982-2014

Analysis period: 1986-2013

Climatology base period: 1986-2013

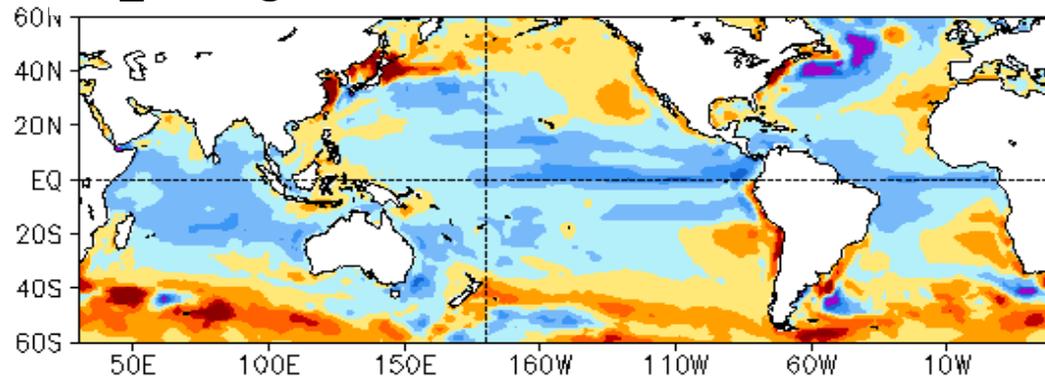
Model performance:

Climatology mean bias

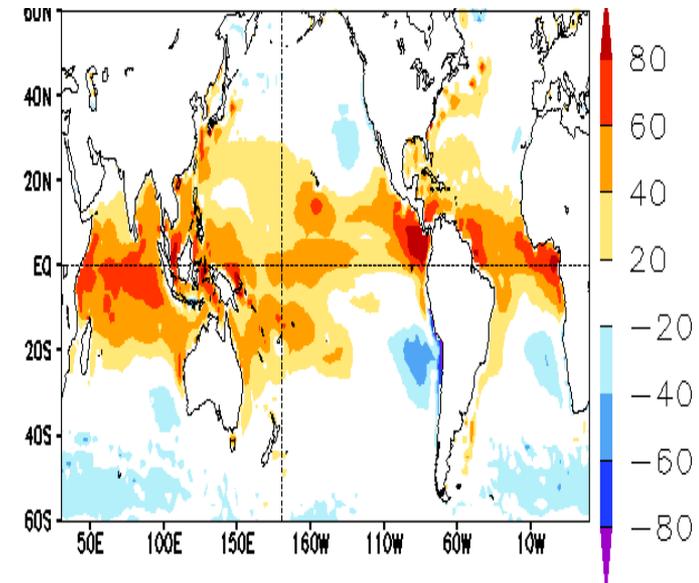
Interannual variations : Anomaly Correlation(AC), RMS

SST climatology mean bias compared with OISST(°C)

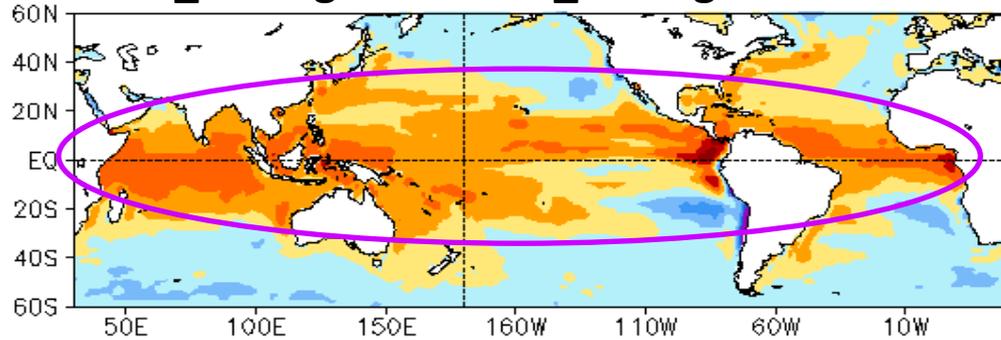
R2_forcing bias



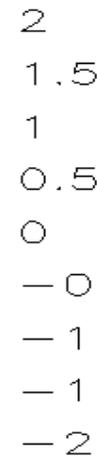
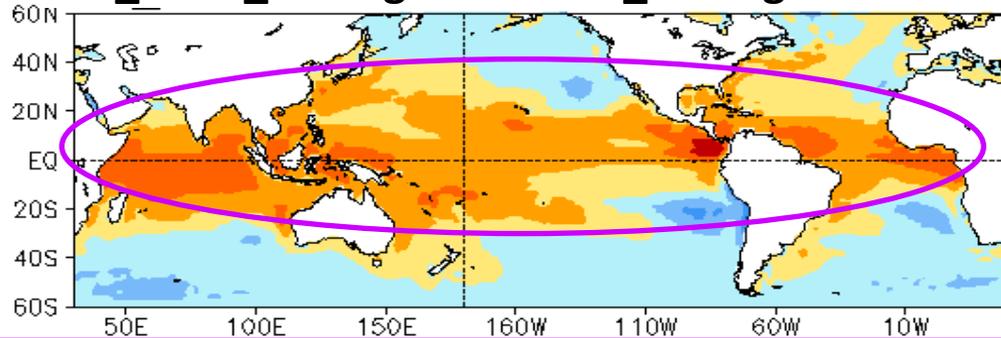
Net heat flux Difference (w/m²) CFSR- R2



CFSR_forcing minus R2_forcing



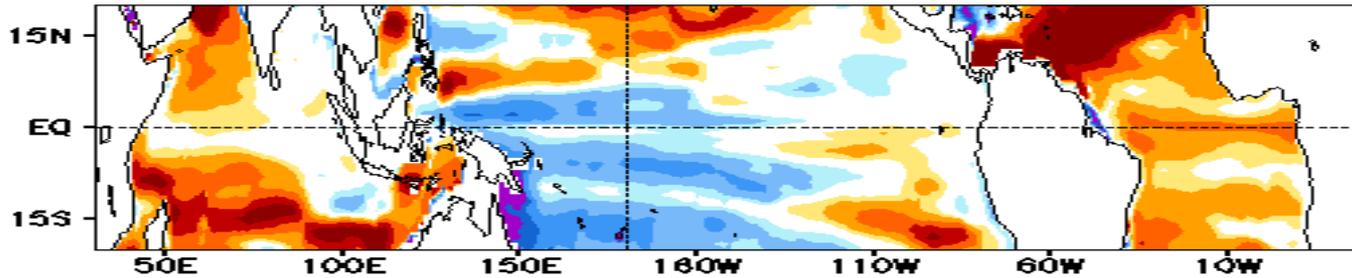
R2_CNET_forcing minus R2_forcing



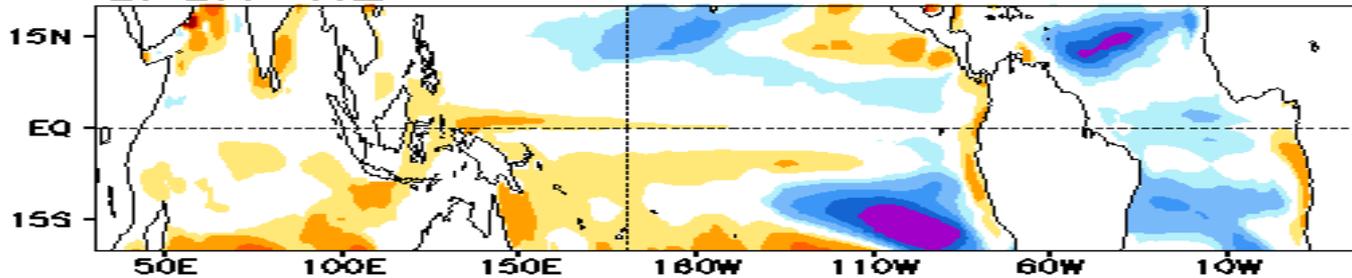
Uncertainty of surface net heat flux is an important factor contributing SST mean bias.

D20 Climatology mean bias compared with GODAS (m)

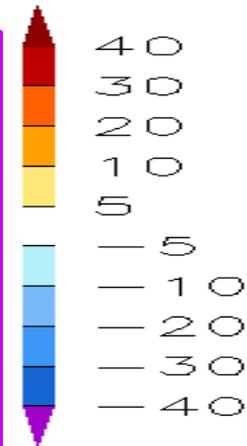
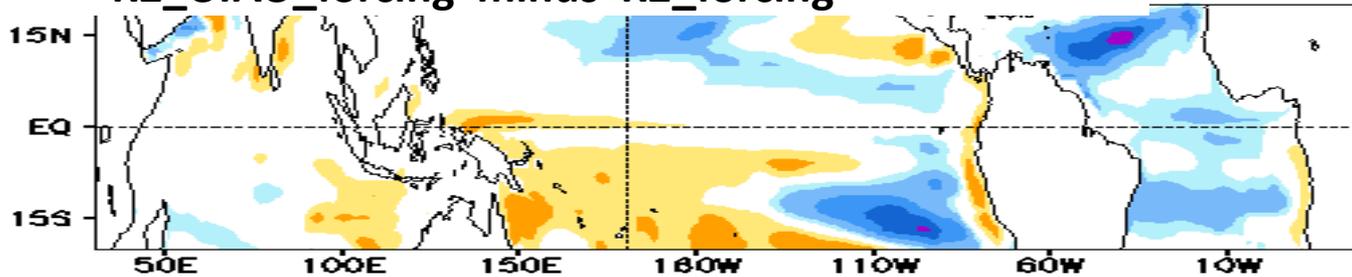
R2_forcing bias



CFSR_forcing minus R2_forcing



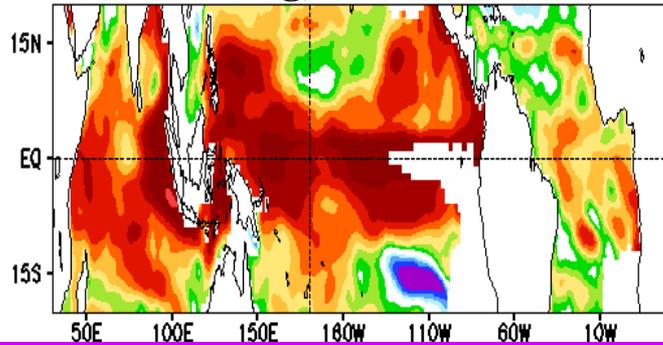
R2_CTAU_forcing minus R2_forcing



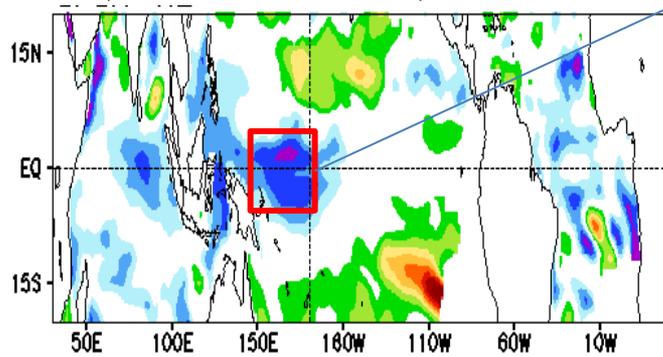
Uncertainty of surface wind stress is an important factor contributing D20 mean bias at off-equatorial Pacific and Atlantic Oceans.

D20 Anomaly correlation(AC) with GODAS

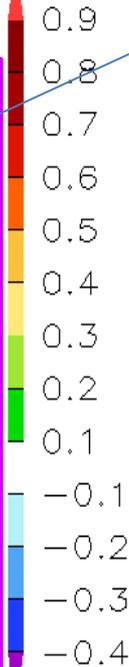
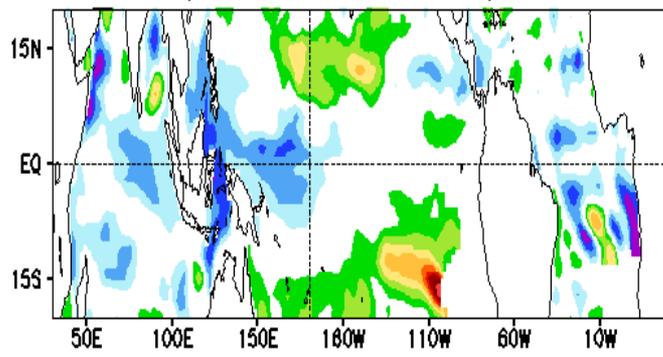
<R2_forcing, GODAS>



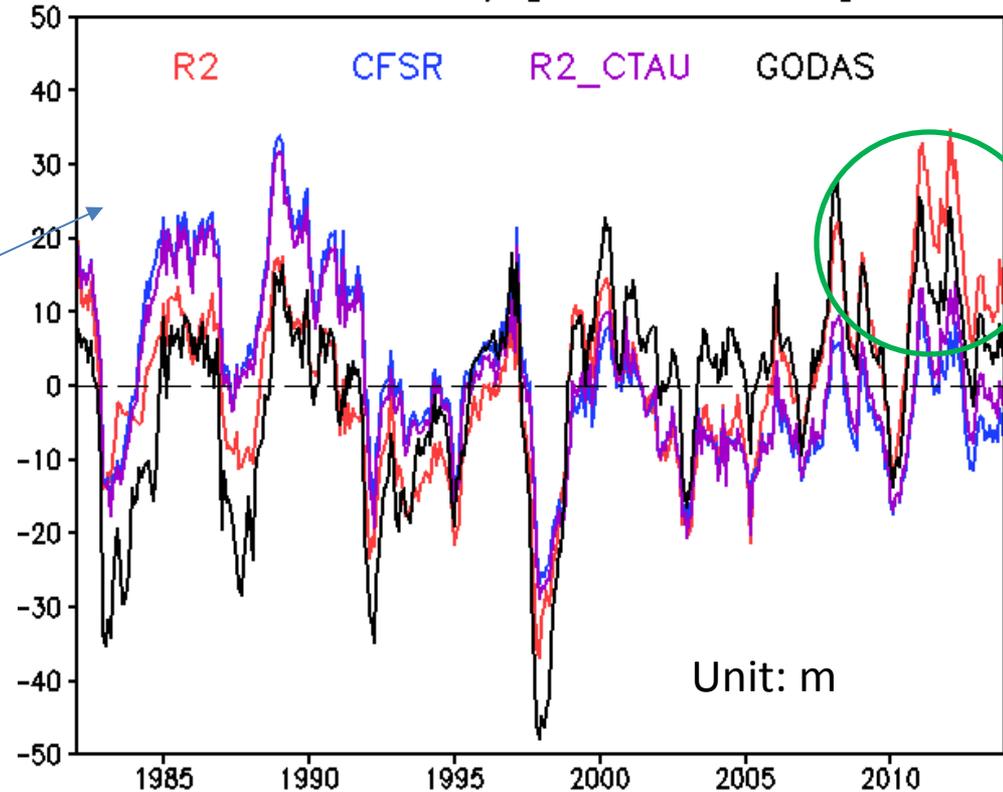
<CFSR, GODAS> - <R2,GODAS>



<R2_CTAU, GODAS> - <R2,GODAS>



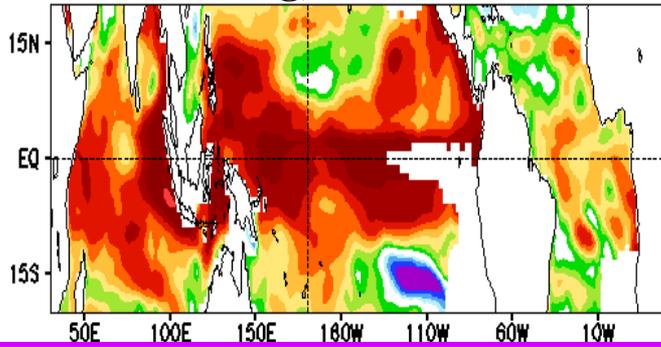
D20 anomaly [155-180, -5-5]



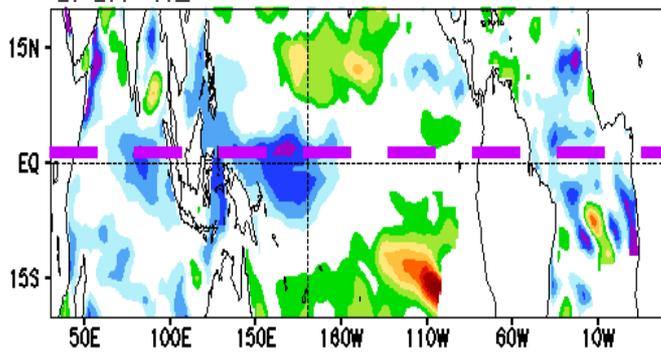
CFSR winds degrade D20 anomalies in the equatorial western Pacific region, while improve the model at off-equatorial Pacific regions.

D20 Anomaly correlation(AC) with GODAS

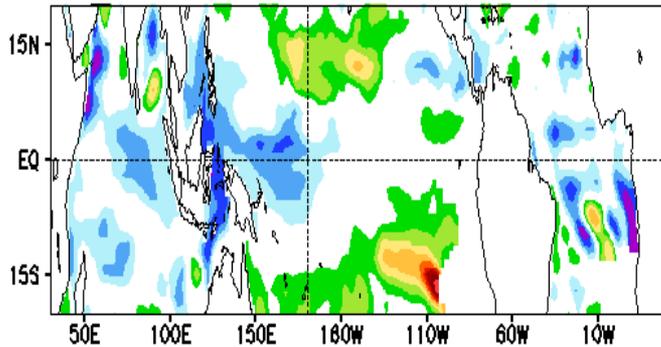
<R2_forcing, GODAS>



<CFSR, GODAS> - <R2,GODAS>



<R2_CTAU, GODAS> - <R2,GODAS>

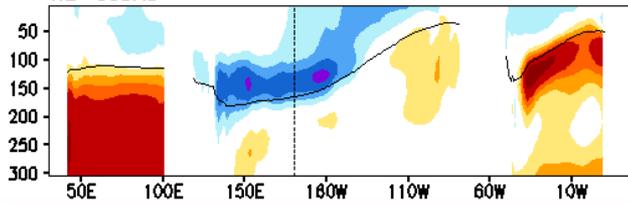


Temperature at EQ compared with GODAS (°C)

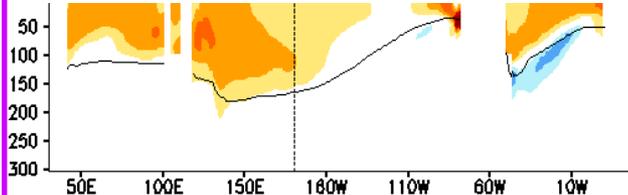
Climatology mean bias

RMS

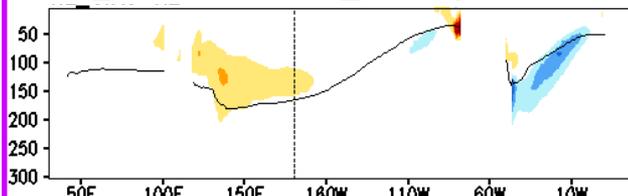
R2_forcing bias



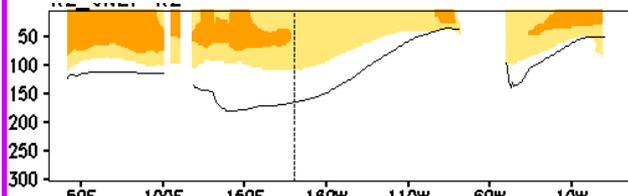
CFSR_forcing - R2_forcing



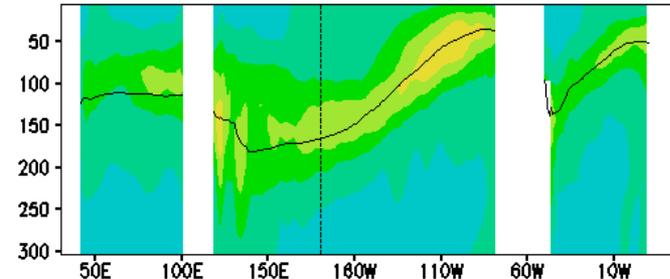
R2_CTAU bias - R2_forcing bias



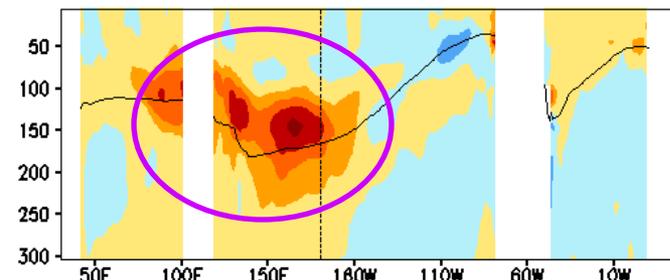
R2_CNET bias - R2_forcing bias



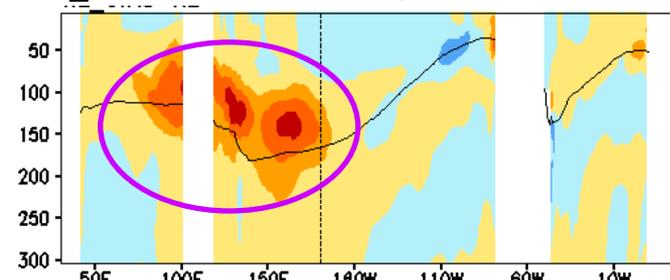
<R2, GODAS>



<CFSR,GODAS> - <R2, GODAS>



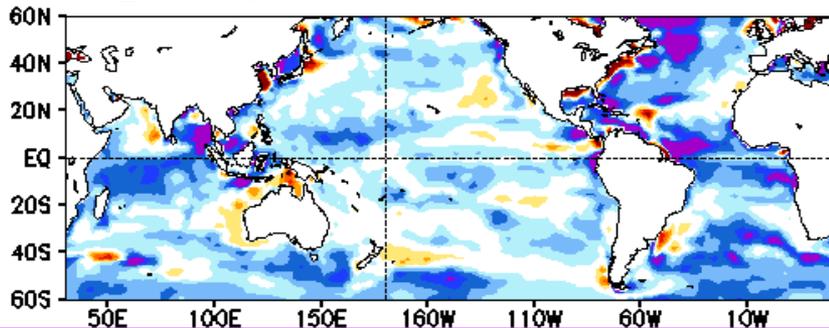
<R2_CTAU,GODR2> - <R2, GODAS>



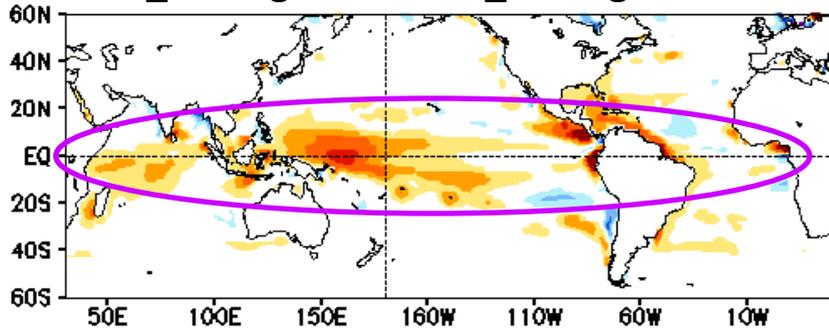
- Uncertainty in surface net heat fluxes has strong impact on temperature mean in the upper ocean (<150m).
- Subsurface temperature anomalies near thermocline in the Indian-western Pacific are sensitive to surface wind forcing.

SSS climatology mean bias compared with EN4 (psu)

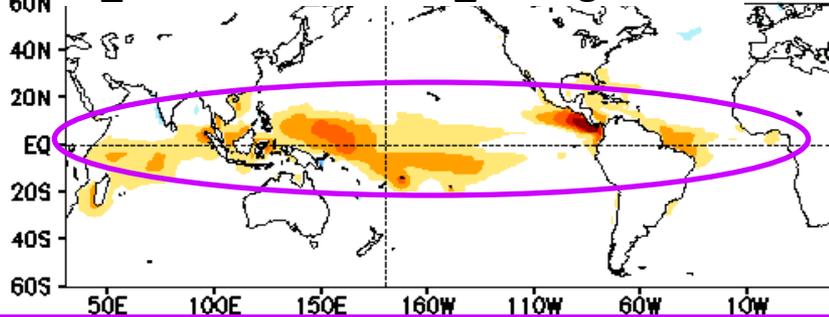
R2_forcing bias



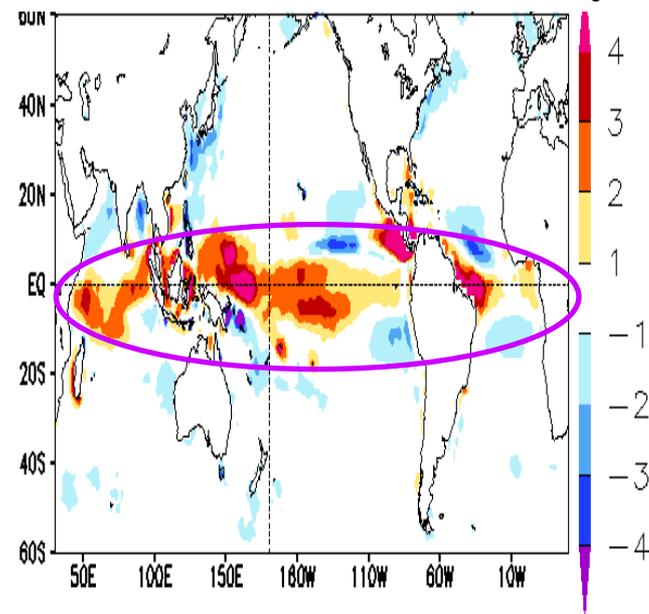
CFSR_forcing minus R2_forcing



R2_CEP bias minus R2_forcing bias

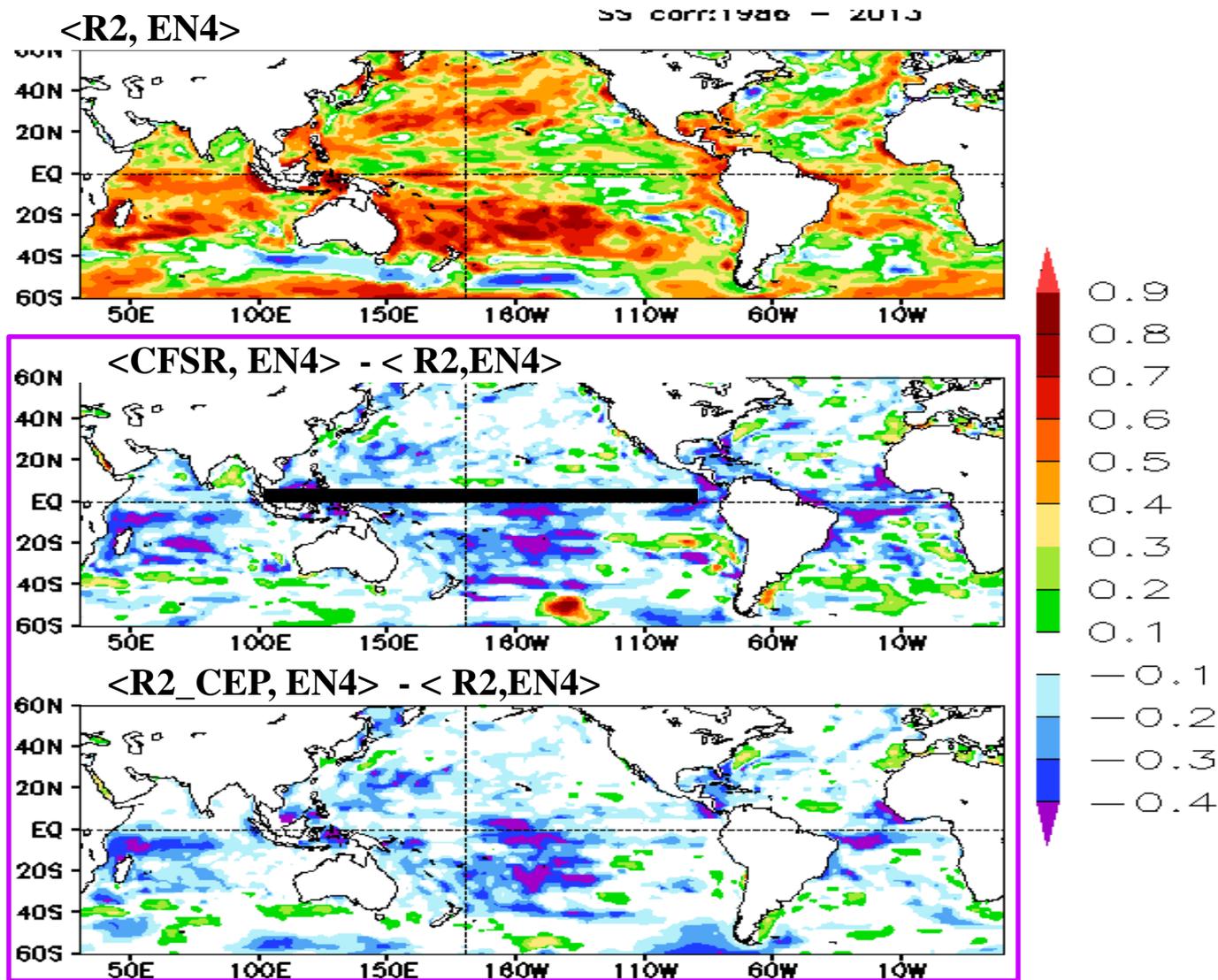


Freshwater flux (E-P) mm/dy



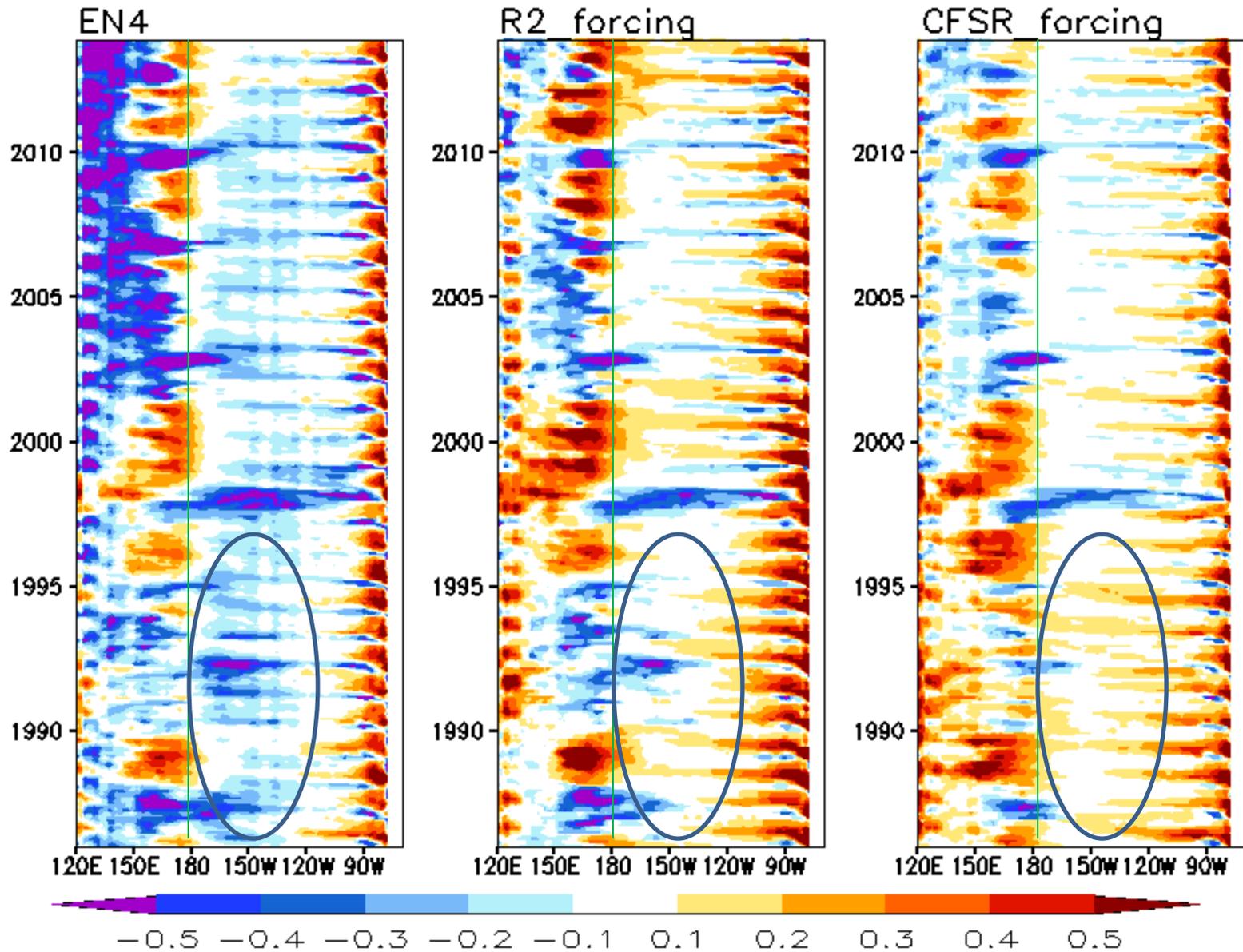
Uncertainty of E-P is the primary factor contribute to SSS climatology mean difference between R2_forcing and CFSR_forcing runs.

SSS Anomaly correlation(AC) with EN4

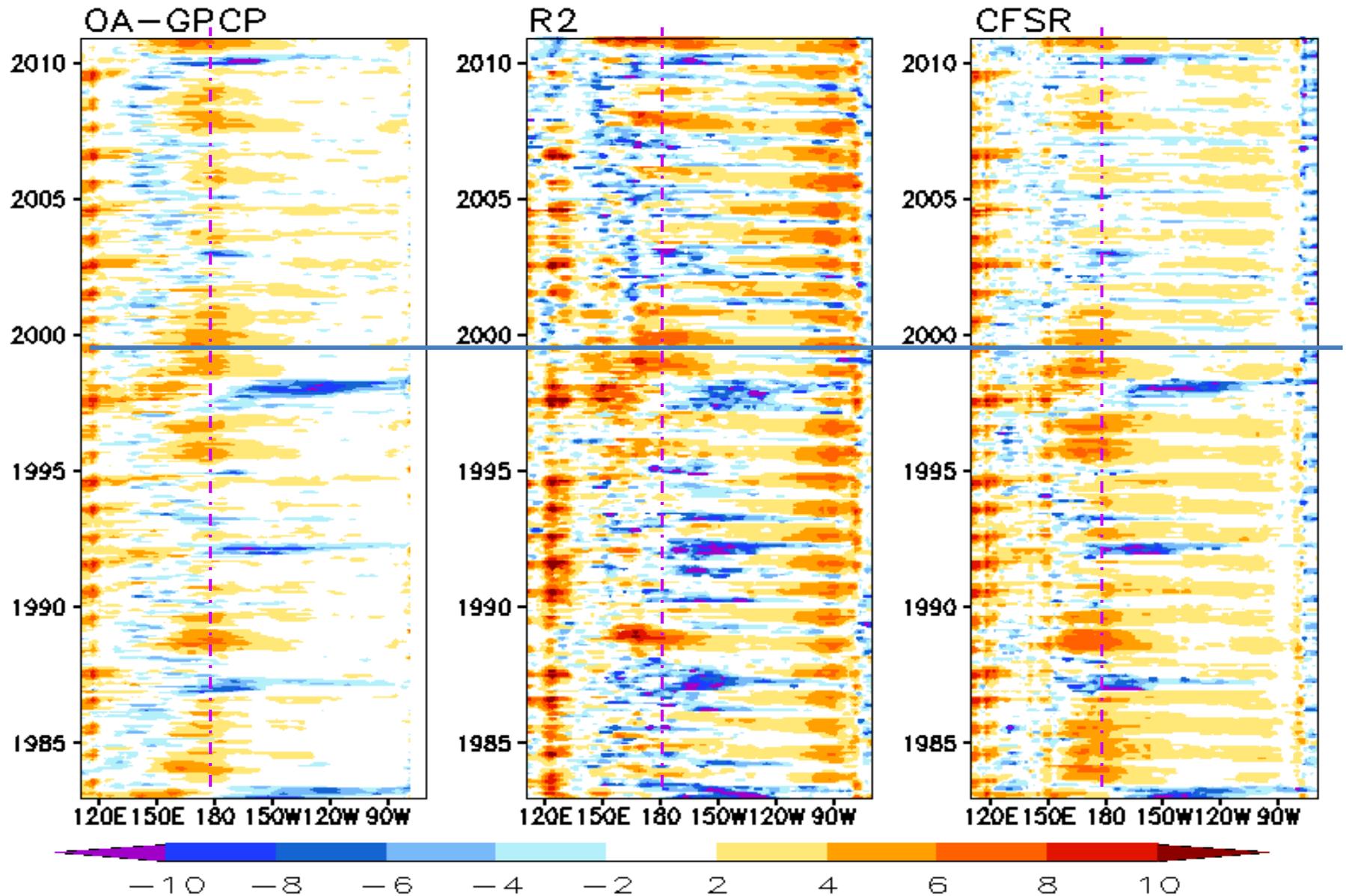


Uncertainty in E-P flux has significant impact on SSS anomaly near the equator and southern tropical oceans.

SSS anomaly averaged in 5S-5N (PSU)



Freshwater flux (E-P) anomaly averaged in 5S-5N (mm/day)



Summaries:

- Clear differences among model experiments mainly occur in the tropical regions, where significant differences between CFSR and R2 surface fluxes are observed.
- Surface net heat flux is an important factor contributing temperature mean bias in the upper ocean (<150m).
- Subsurface temperature biases near thermocline are sensitive to surface turbulence fluxes over western tropical Pacific and off-equatorial tropical Pacific regions.
- Climatology mean and interannual variation of SSS is sensitive to E-P flux forcing.

Thank you