SST Impacts on the Seasonal Precipitation over the Tropical Indian Ocean

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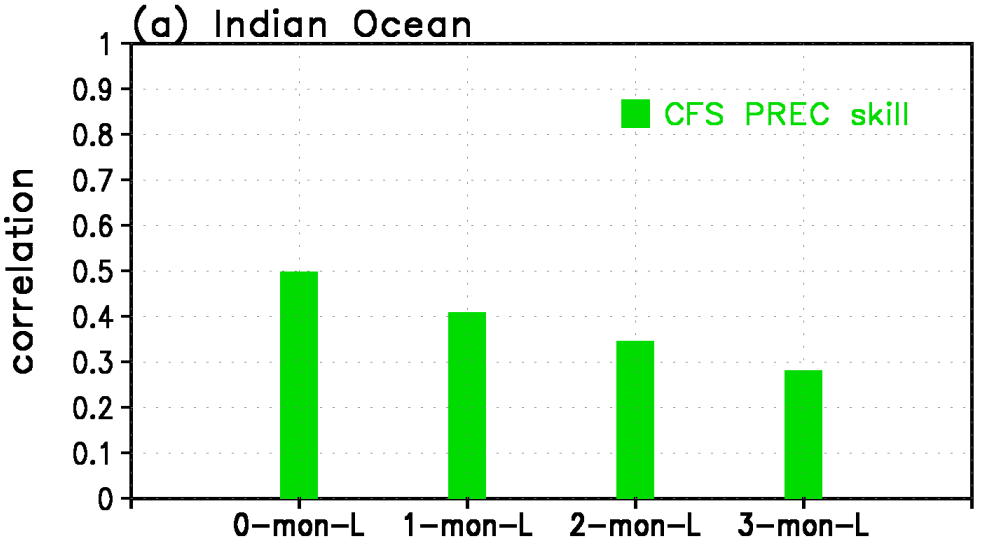
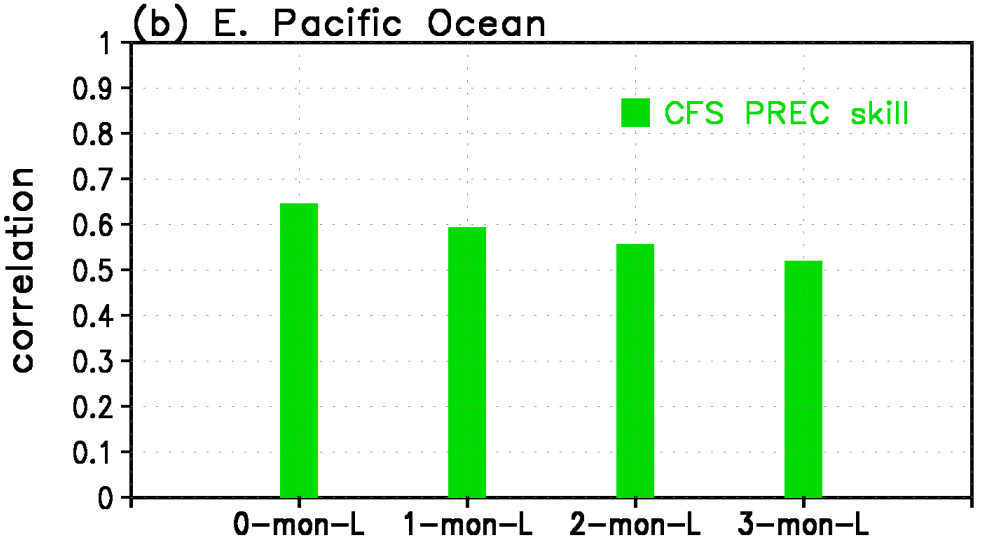
Outline

- What is the issue?
- The experimental set up
- Analysis and results
- Conclusions

Predictability of Precipitation over the Indian Ocean --Precipitation prediction skill from CFS

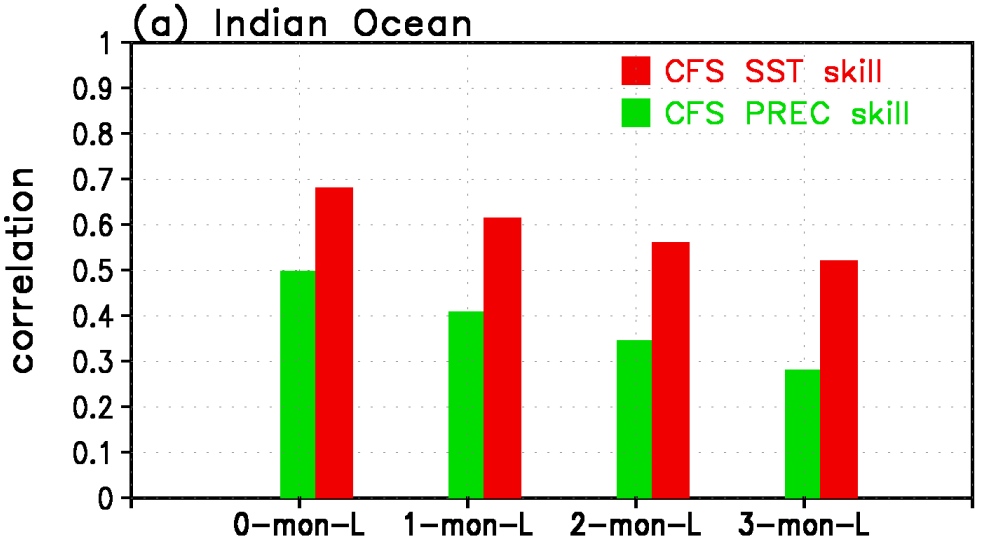
- Prec skill is lower over IO;
- Prec skill decays more quickly over the tropical IO than E. Pacific;

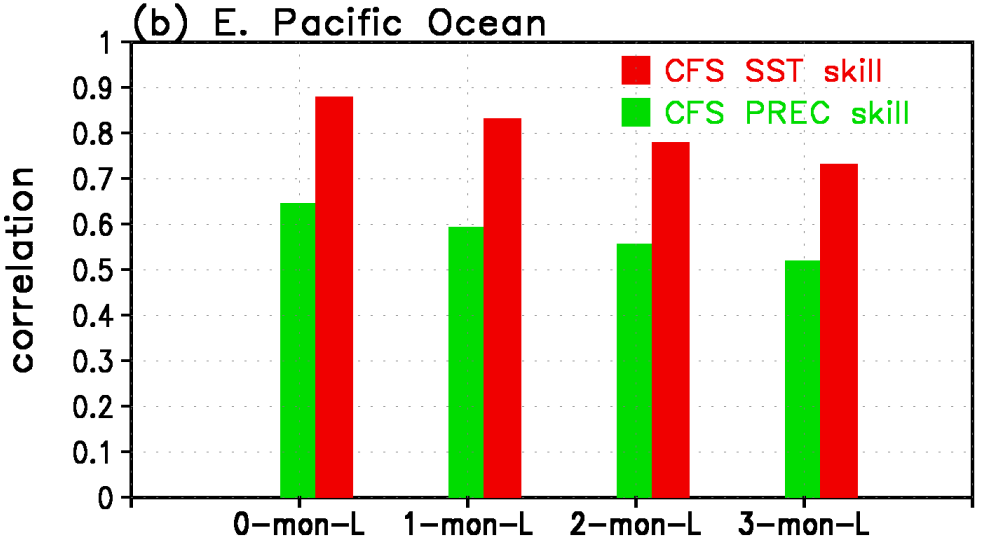




Predictability of Precipitation over the Indian Ocean --SST prediction skill from CFS

- SST skill is higher than that of Prec;
- SST skill decays in lead time;
- Decays more quickly in IO than in E. Pacific;
- SST skill is substantially lower over IO;





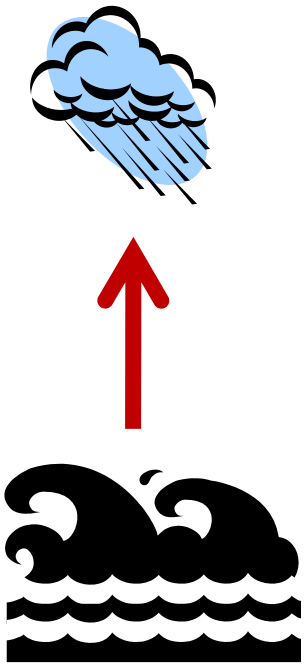
Predictability of Precipitation over the Indian Ocean -- Issues

- **Is the lower precipitation skill over the IO and its faster decay, due to**
  - Lower skill of SST predictions
  - Or due to inherent predictability limits (in that the interannual SST variability does not constrain the precipitation variability)

- **Will precipitation skill over the IO go up if skill of SST prediction improves?**

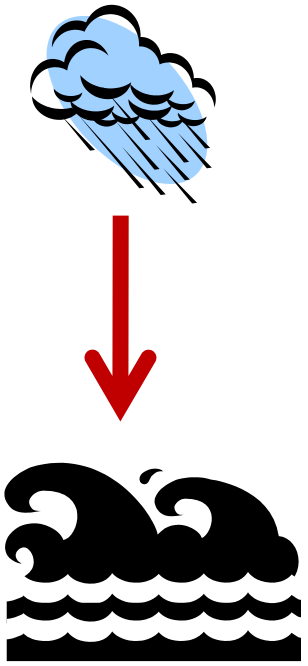
Connections Between Precipitation and SST Variability

- **Local interannual SST variability forces atmospheric variability**
  - <SST, P> positive
  - High prediction skill for P



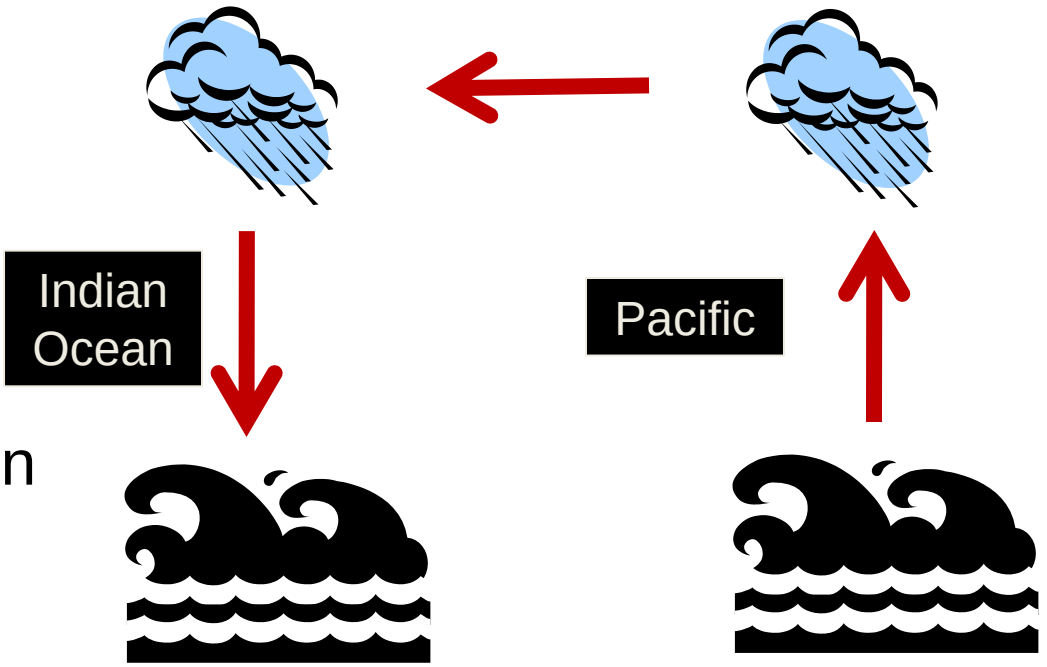
Connections Between Precipitation and SST Variability

- **Local atmospheric variability forces the SST variability**
  - <SST, P> negative
  - Low prediction skill for P



Connections Between Precipitation and SST Variability

- **Atmospheric variability is forced by remote SST variability (atmospheric bridge), that in turn forces local SSTs**



  - <SST, P> negative
  - Intermediate prediction skill for P

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Model Simulations

- **Coupled Predictions**
  - SST skill is not perfect and has its own predictability limits.
  - Coupled air-sea interactions, and feedback, is included.

- **AMIP simulations (forced with observed SSTs)**
  - SST is observed, and is perfect.
  - Coupled air-sea interaction, and feedback, is not included.

- **Design model simulations that are in between the above two extremes**

Model Simulations (1996 -2008)

Simulation	SST Specification	Ocean-Atmosphere Feedback (IO)	SST Variability (IO)	Primary source for P variability (IO)
GSSTR	SST relaxed to Obs. (Global)	√	Closed to Observed	(1), (2), (3)
PSSTR	SST relaxed to Obs. (Trop. Pac.)	√	Predicted	(1), (3)
GOGA	Specified SST (Global)	x	Observed	(1), (2)
POGA	Specified SST (Trop. Pac.)	x	Climatology	(1)

Primary source for P variability in IO:

(1) Dynamical response to remote ENSO-related SST variability via atmospheric circulation;

(2) Local SST interannual variability;

(3) Local SST interannual variability that itself is driven by the remote ENSO-related SST variability;

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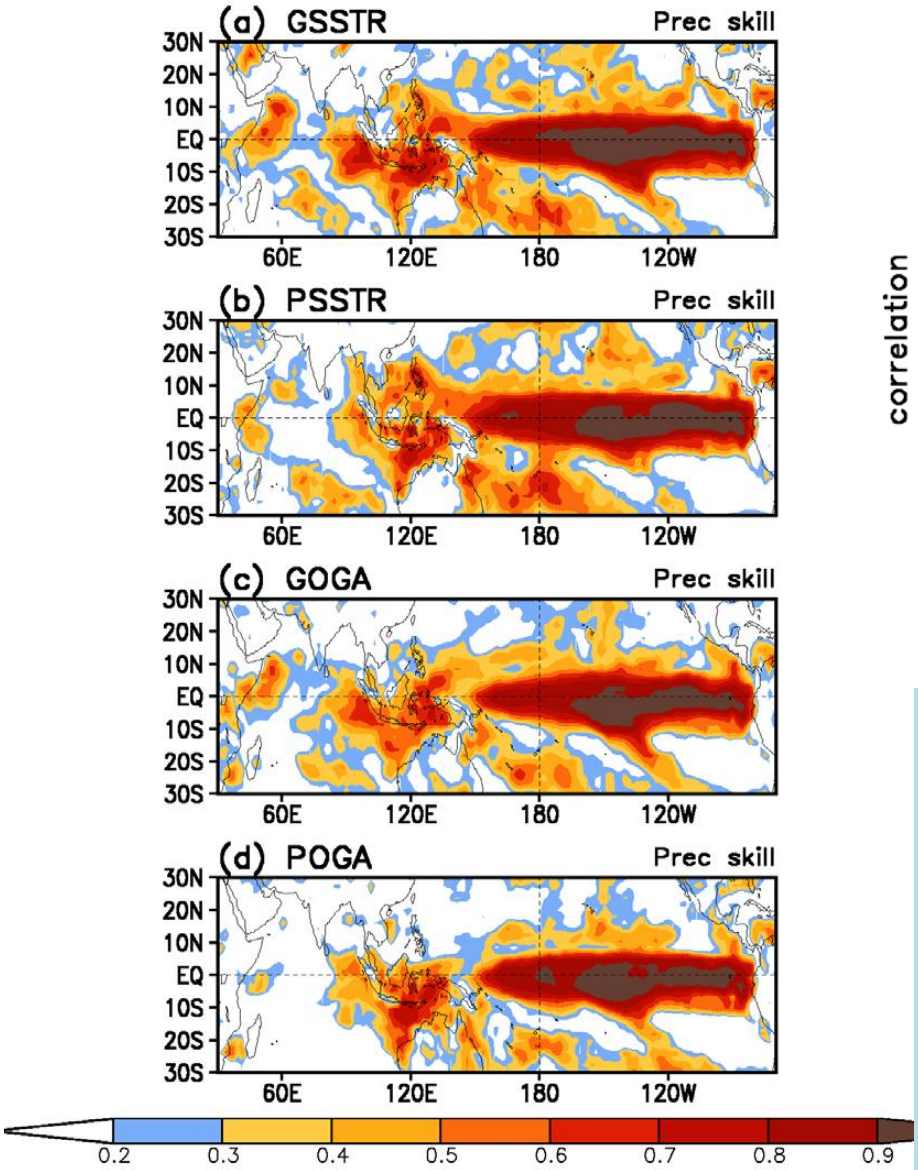
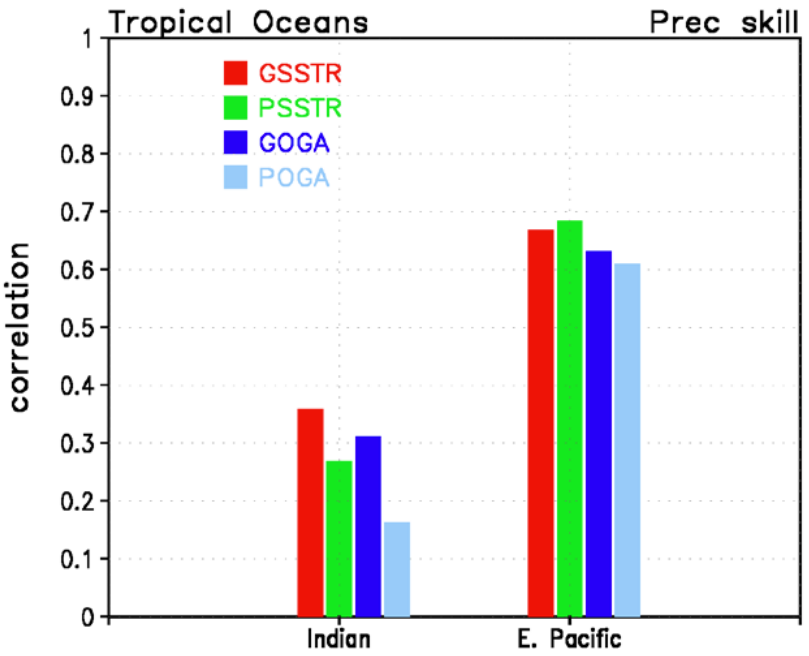
Precipitation Skill

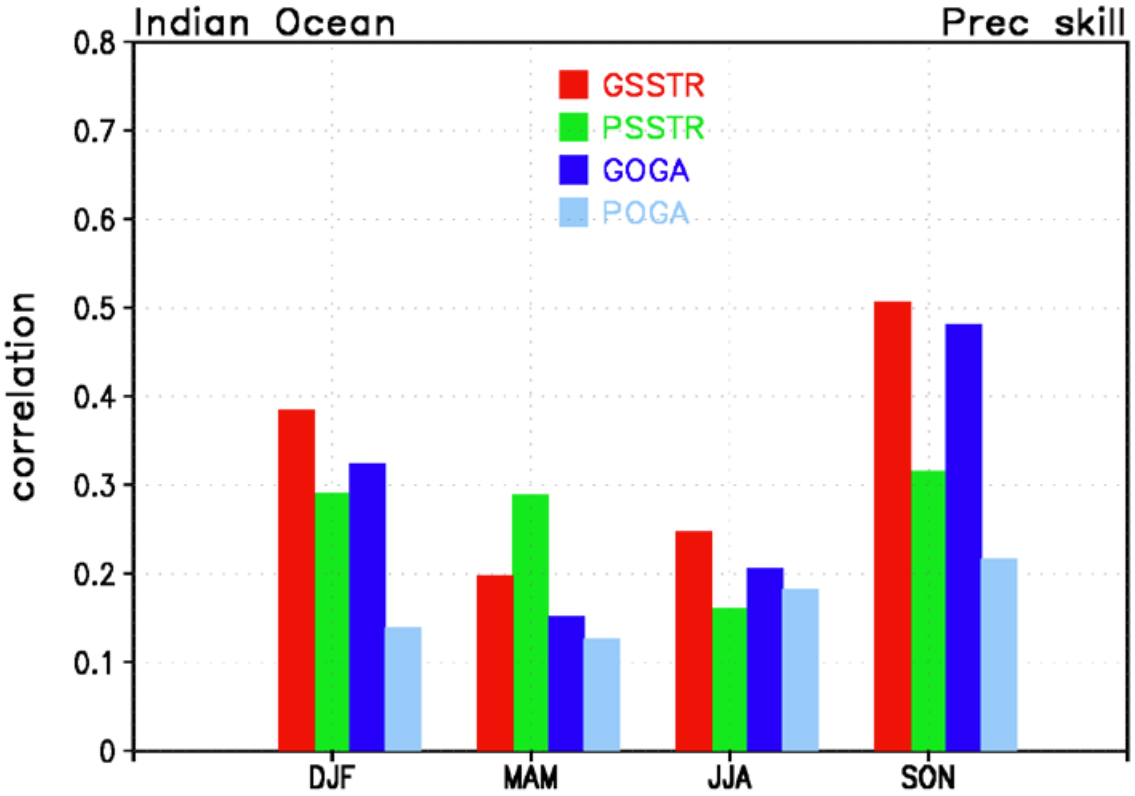




- The highest P skill in E. Pacific➔;
- Low P skill over IO➔;
- PSSTR > POGA due to SST variability from ENSO;
- GOGA > POGA, PSSTR, due to specification of correct SST;
- Small improvement in GSSTR comparing with GOGA;
- Both the accuracy of SST and the air-sea active coupling are important for P skill.

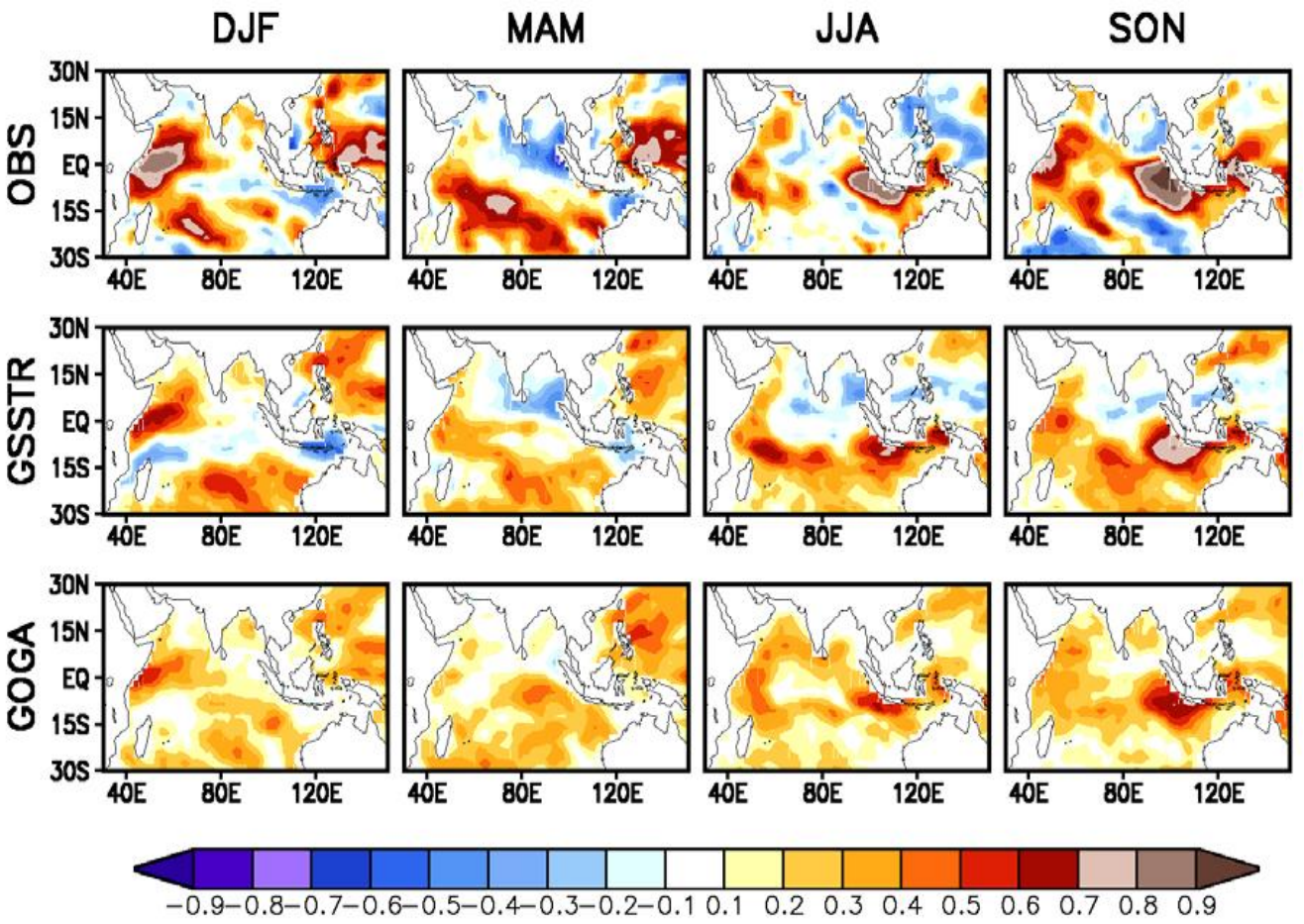
Seasonality of Precipitation Skill

- Distinct seasonality in P skill with higher skill in DJF/SON, lower in MAM/JJA;
- Diff simulation shows diff skill ➔;
- DJF/SON, POGA <GOGA /GSSTR ➔ importance of having correct SST;
- MAM, PSSTR shows more skill than others;
- JJA no much skill;

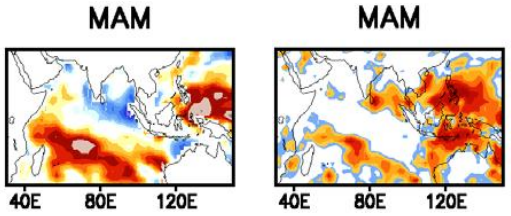


Local Air-Sea Interaction

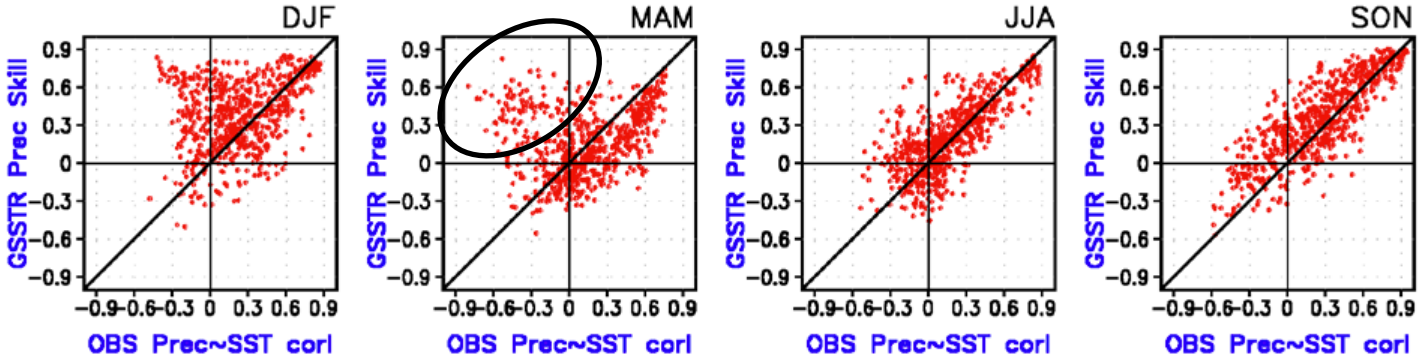
- <SST,P> shows considerable geographical and seasonal variation;
- DJF, positive over W. IO;
- MAM, positive over SE IO, and negative NE to the coast of Sumatra;
- JJA &SON, strong positive west coast of Sumatra;
- Near zero over large area of IO➔;
- GSSTR replicates the observed seasonal cycle;
- Positive everywhere in GOGA;

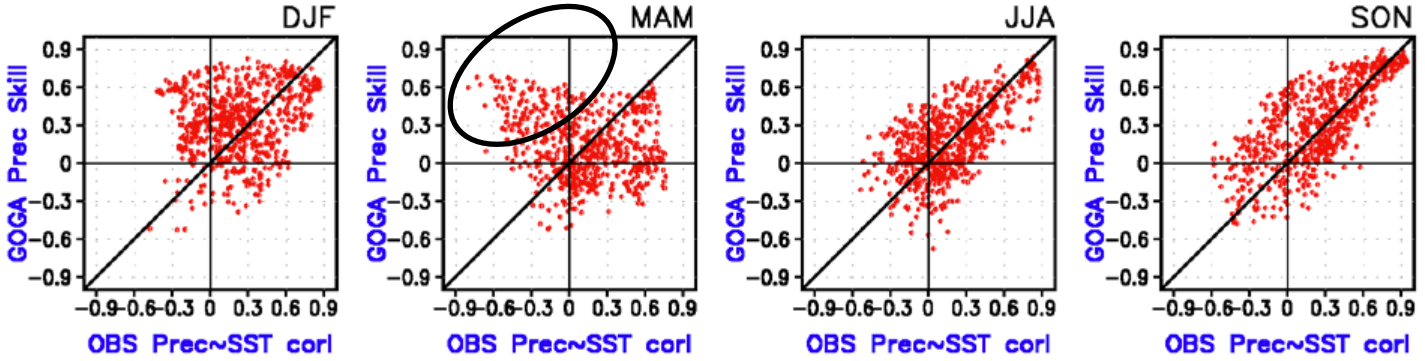


Precipitation Skill vs. P-SST Local Correlation (obs)



GSSTR



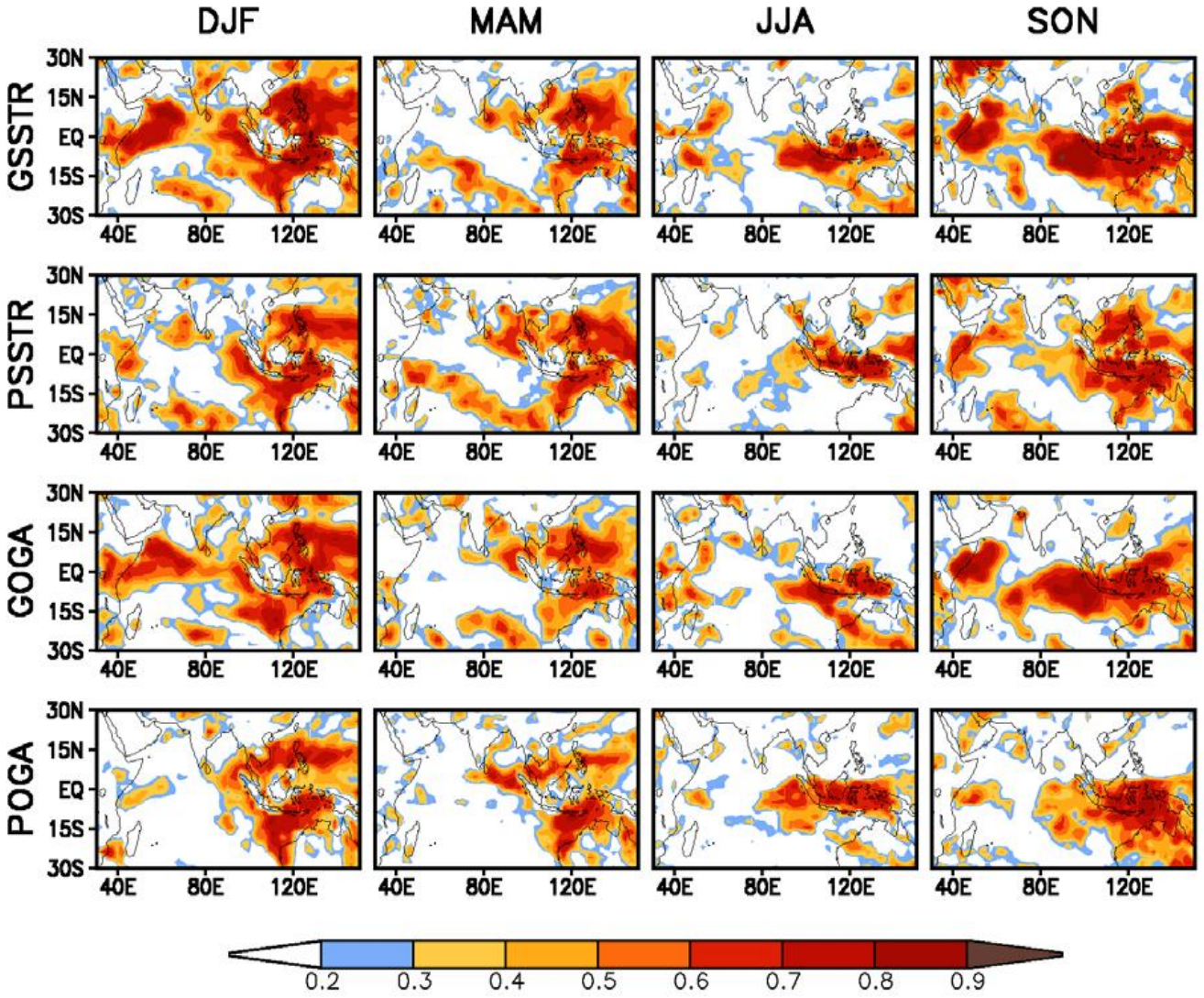


GOGA

- A quasi-linear relationship P skill & <SST,P>;
- <SST,P> positive ➔ high P skill;
- <SST,P> negative ➔ low P skill;
- <SST,P> negative ➔ intermediate P skill;

Summary

- The conceptual model of SST-precipitation relationship, and its influence on the precipitation skill and <SST, P> fits results from the model simulation.
- Precipitation skill and <SST, P> relationship over the IO has considerable spatial and seasonal variation.
- Low precipitation skill over the IO may be because of inherent predictability limits (i.e., seasonal precipitation is controlled more by the atmospheric variability that is unpredictable).
- But the results could be model dependent, and need to be confirmed based on other models.


DJF
MAM
JJA
SON
GSSTR
PSSTR
GOGA
POGA
30N
15N
EQ
15S
30S
40E
80E
120E
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9