



A Dominant Mode in the First Phase of the Asian Summer Monsoon: Role of Antecedent Remote Land Surface Temperature

by

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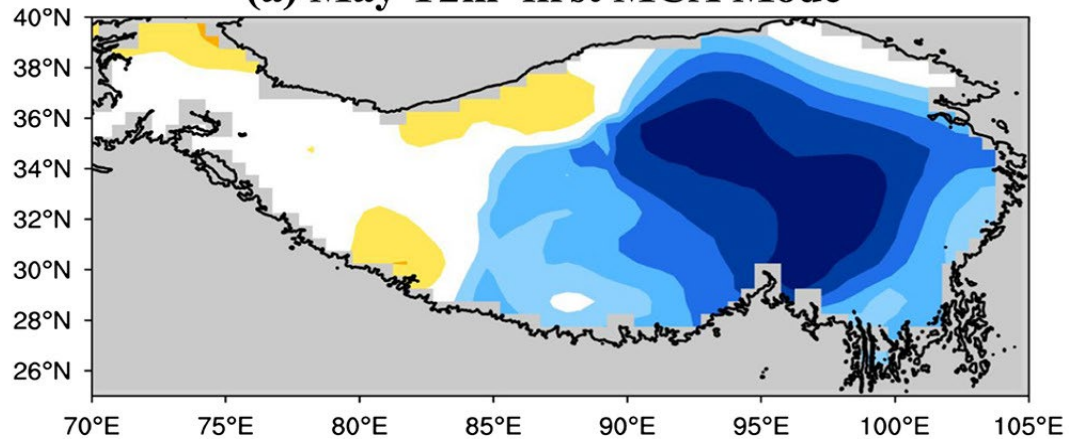
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Contributors:

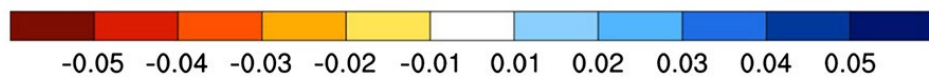
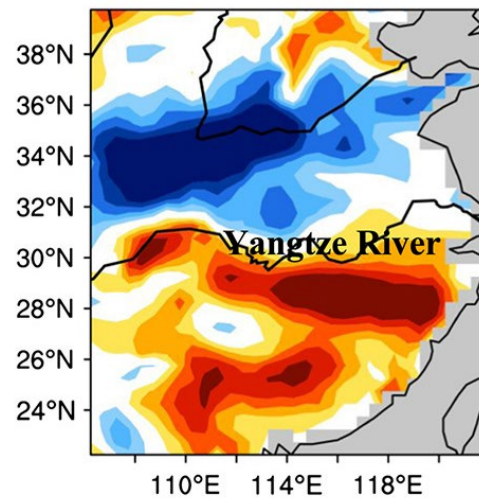
Yongkang Xue, Sujith Krishnakumar, Ismaila Diallo, Yashas Shivamurthy, Tetsu Nakamura, Qi Tang and Hemantkumar Chaudhari

Association of June rainfall with antecedent temperature/precipitation

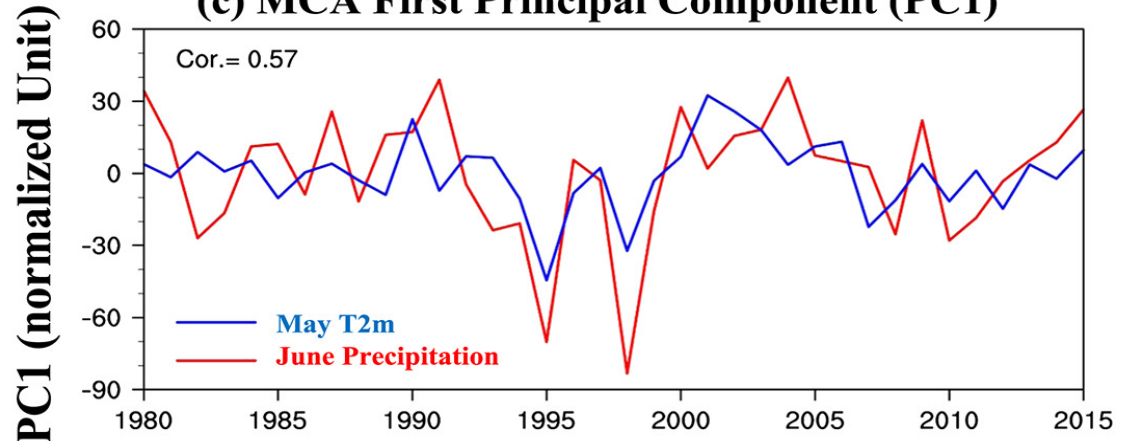
(a) May T2m first MCA Mode



(b) June Precipitation first MCA Mode

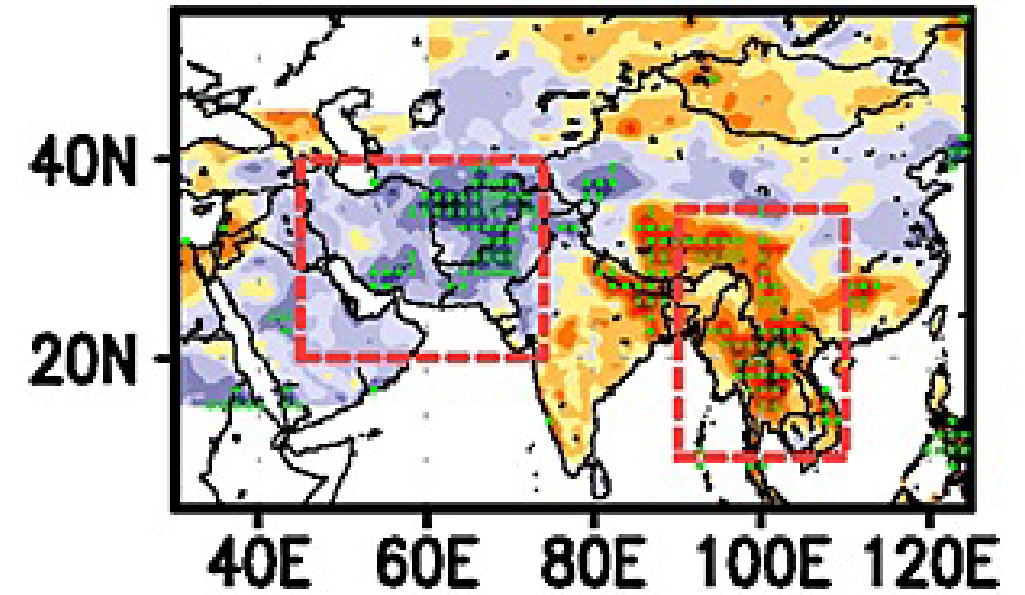


(c) MCA First Principal Component (PC1)

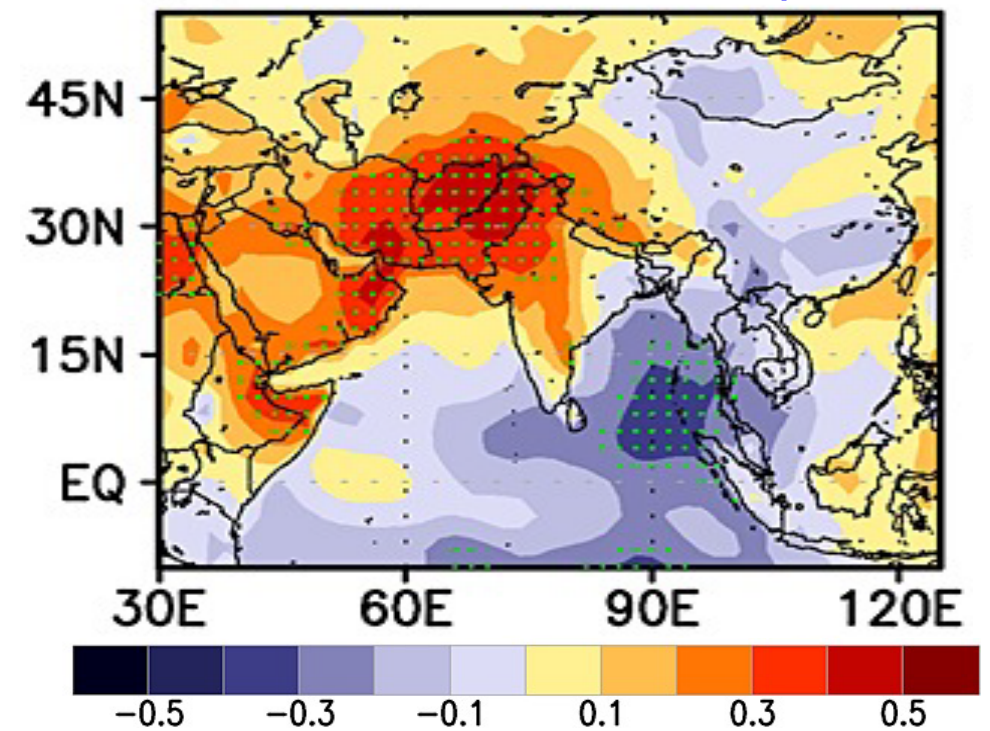


Xue et al., 2018, GRL

Corr. with precipitation



Corr. with 2m air temp.

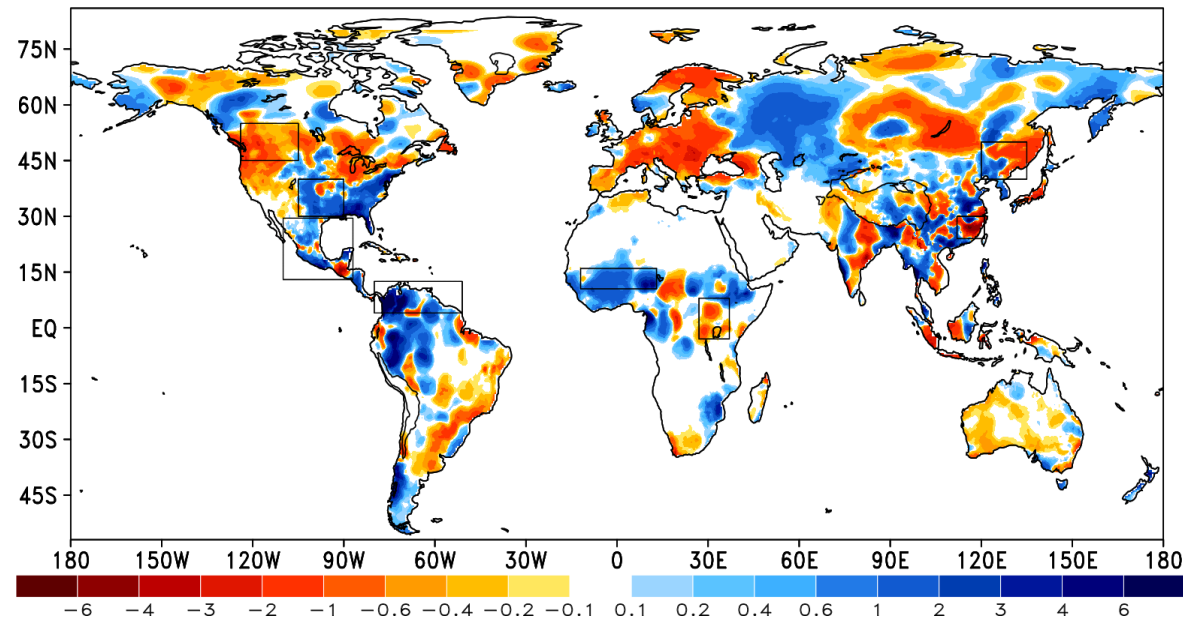


Central India averaged June rainfall is correlated with April-May averaged precipitation & 2m air temperature

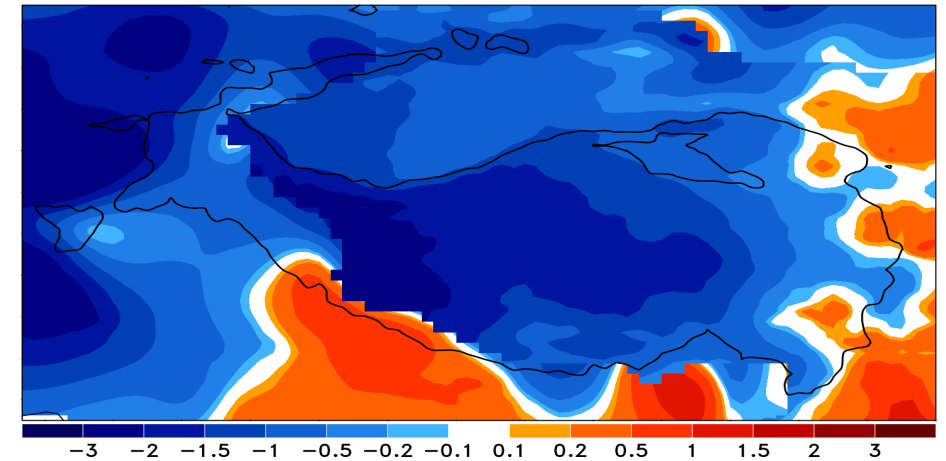
Rai et al., 2015, JGR

Temperature and Precipitation anomaly in 2003

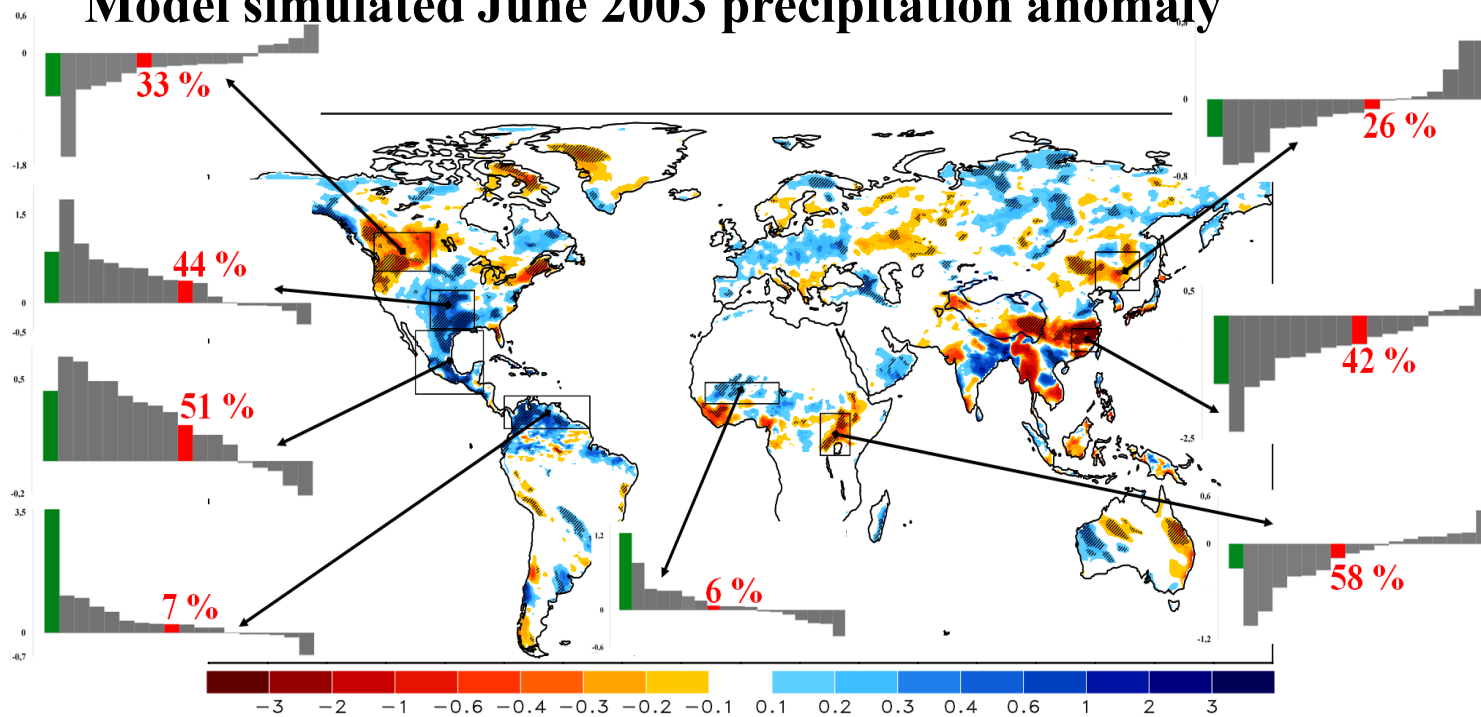
Observed June 2003 precipitation anomaly



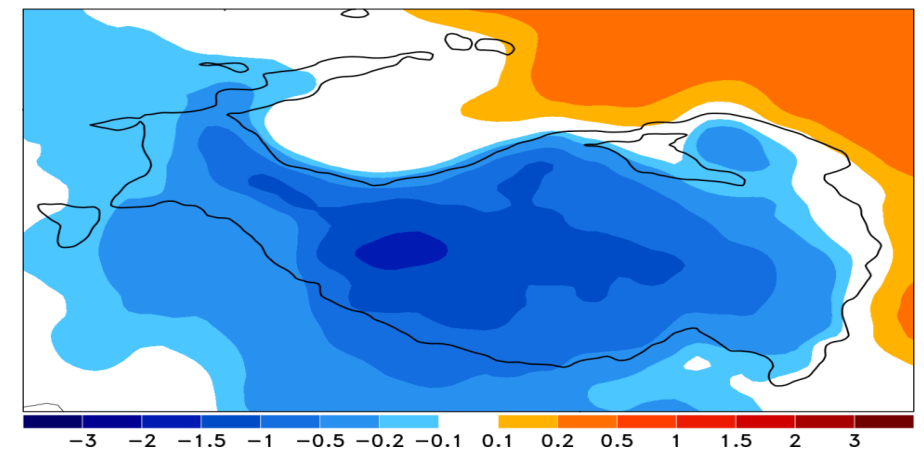
May 2003 T2m anomaly (°C) Observed



Model simulated June 2003 precipitation anomaly



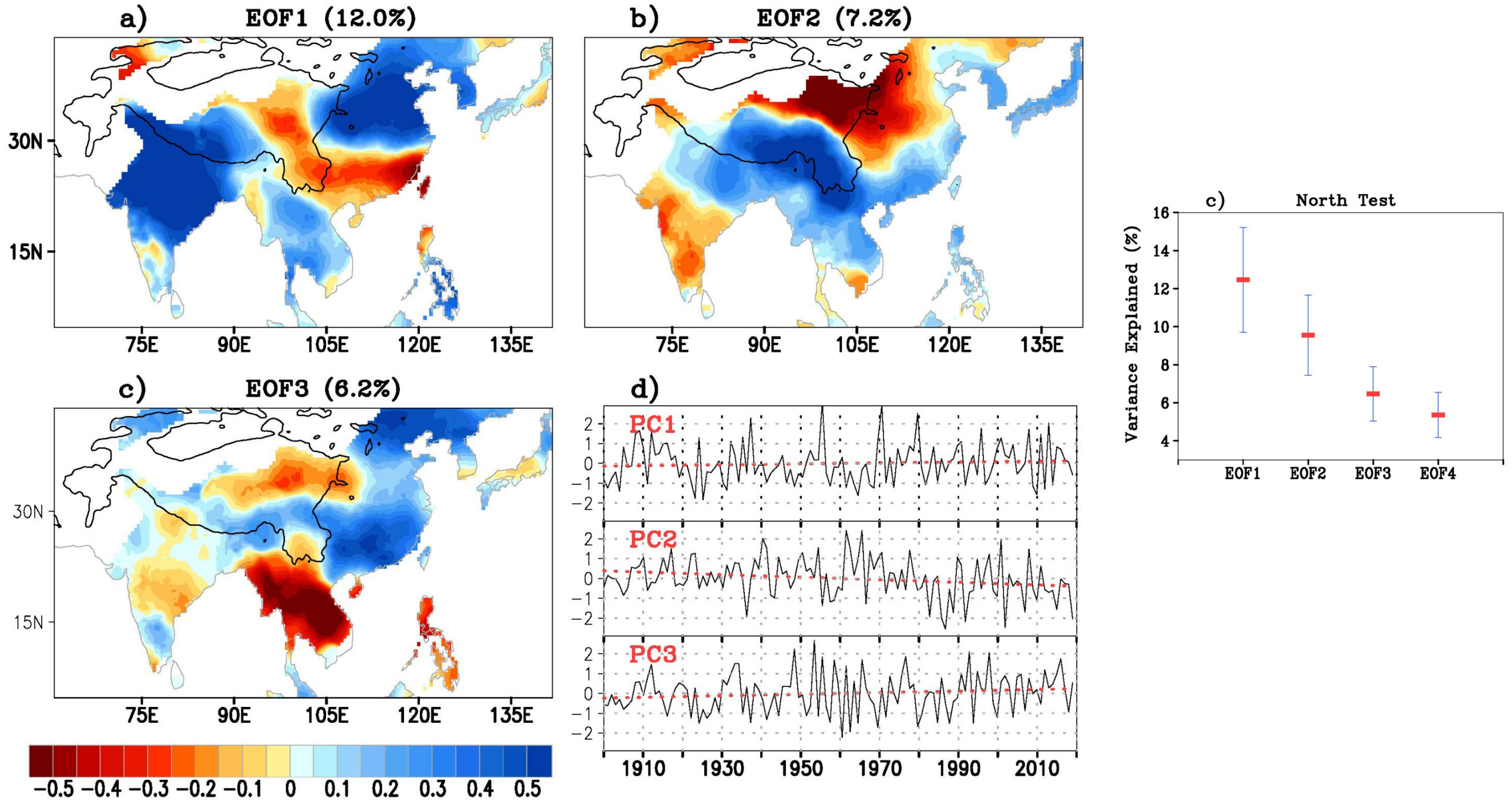
Ensemble mean produced after LST/SUBT initializations.



Xue et al., 2022, BAMS

Is there a dominant mode in June precipitation over the Asian monsoon region associated with LST ?

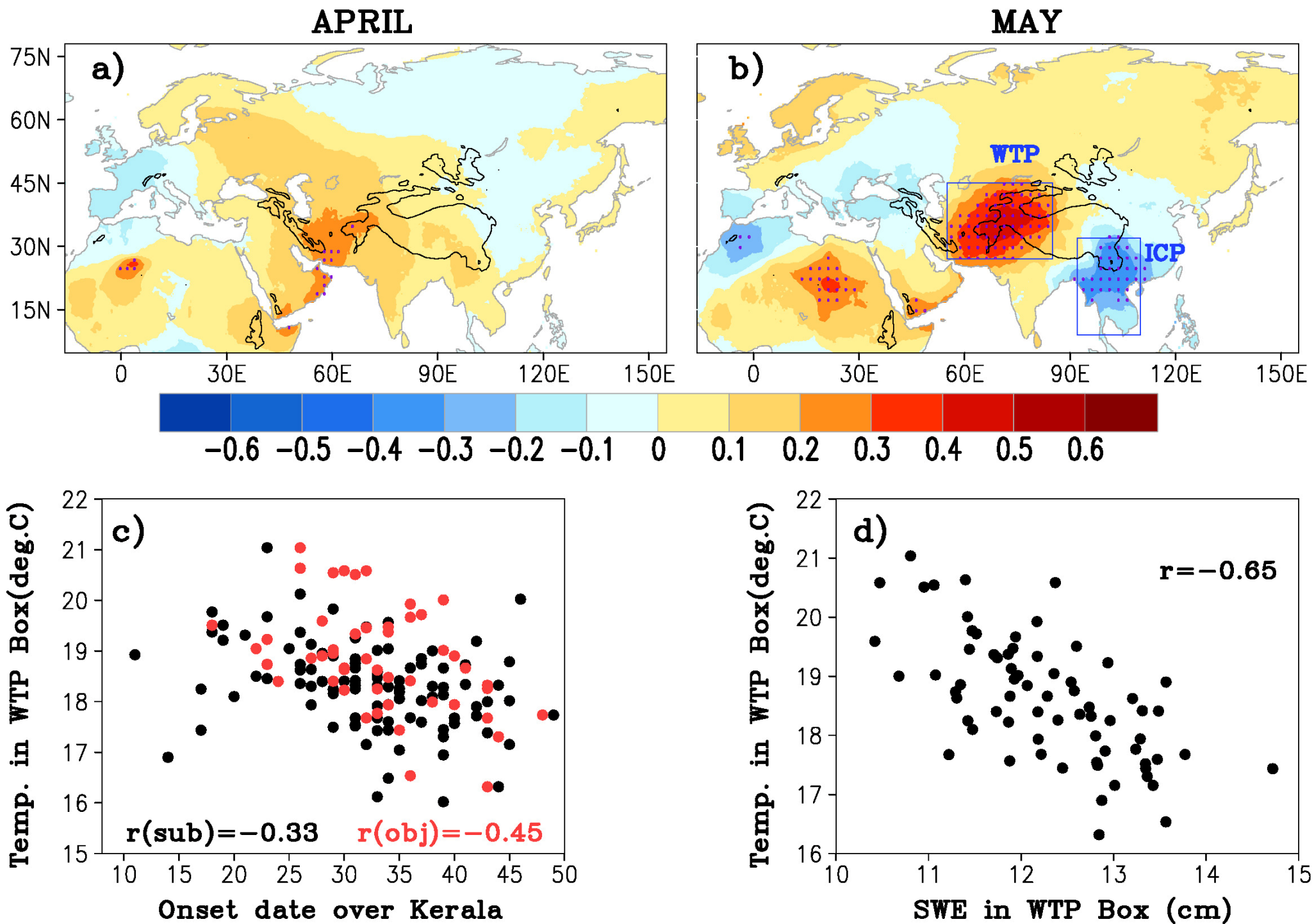
EOFs of June Rainfall (1901-2019)



First three EOFs and PCs using June rainfall of 119 years (1901-2019)

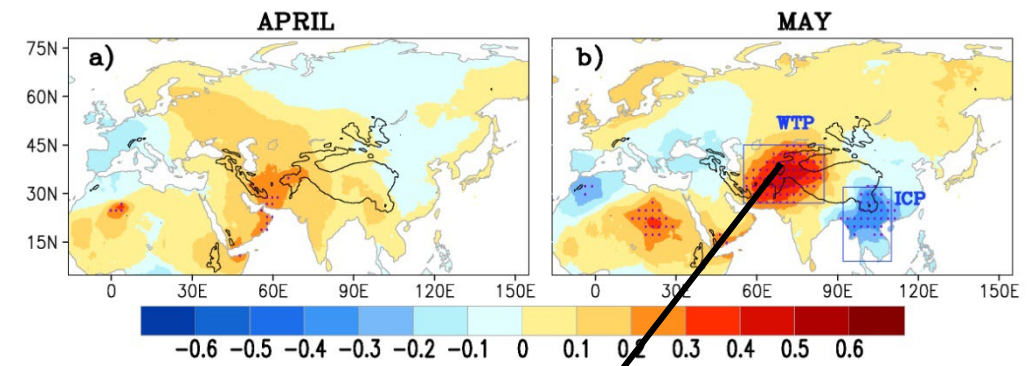
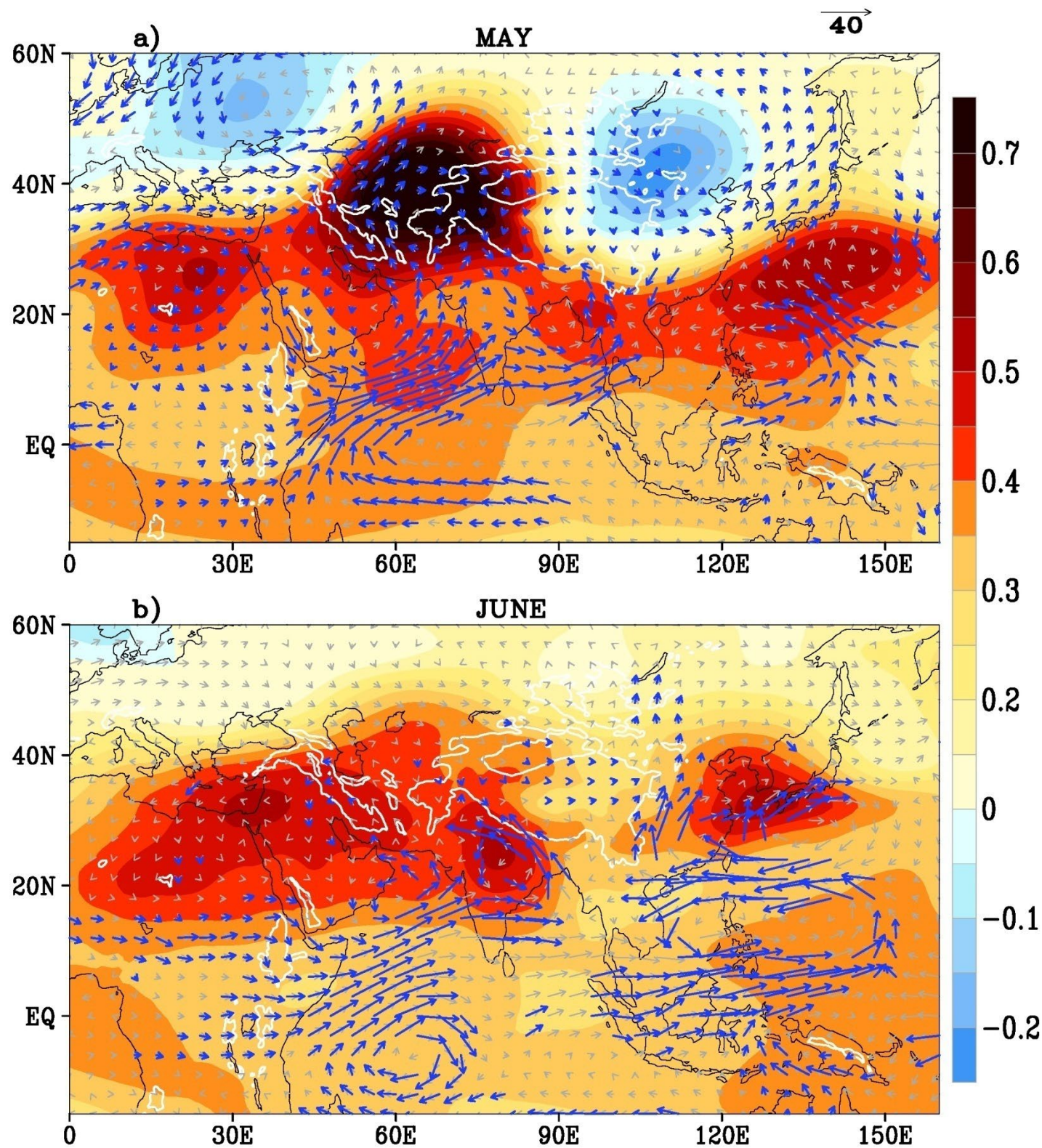
PC1 and Antecedent Surface Temperature

Western Third Pole (WTP); Indochina Peninsula (ICP)

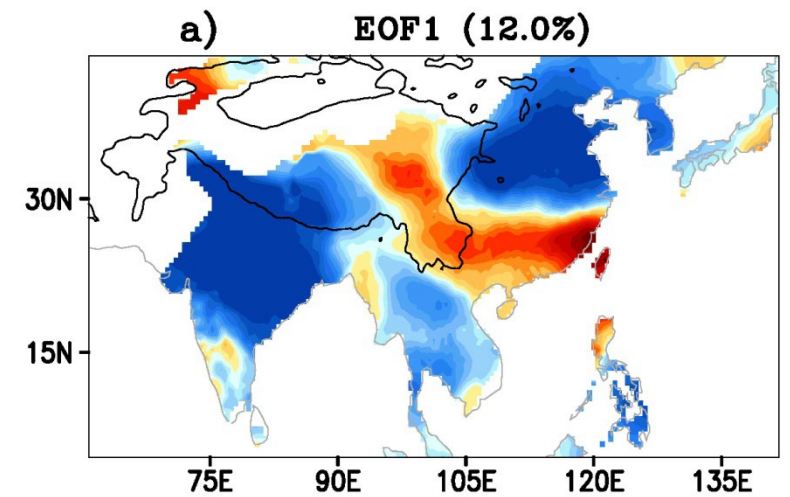


PC1 correlated with April and May 2m temperature (a,b). Onset date over Kerala, SWE over WTP are correlated With WTP averaged 2m temperature (c,d).

Influence of WTP on Tropospheric Temperature & Moisture Flux

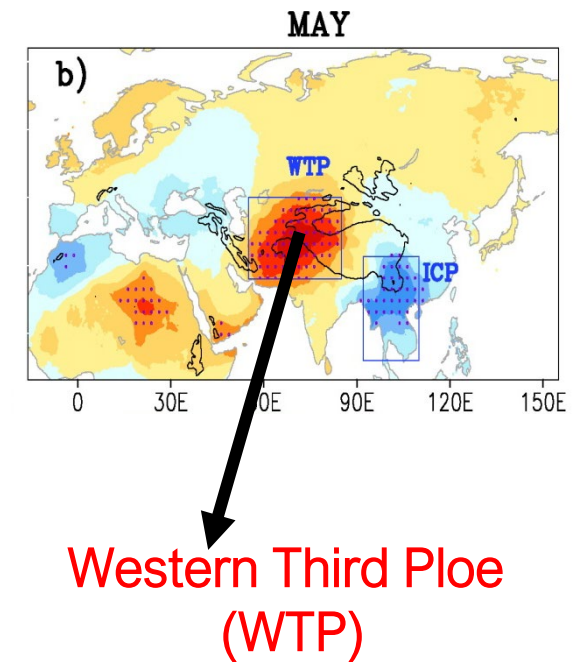
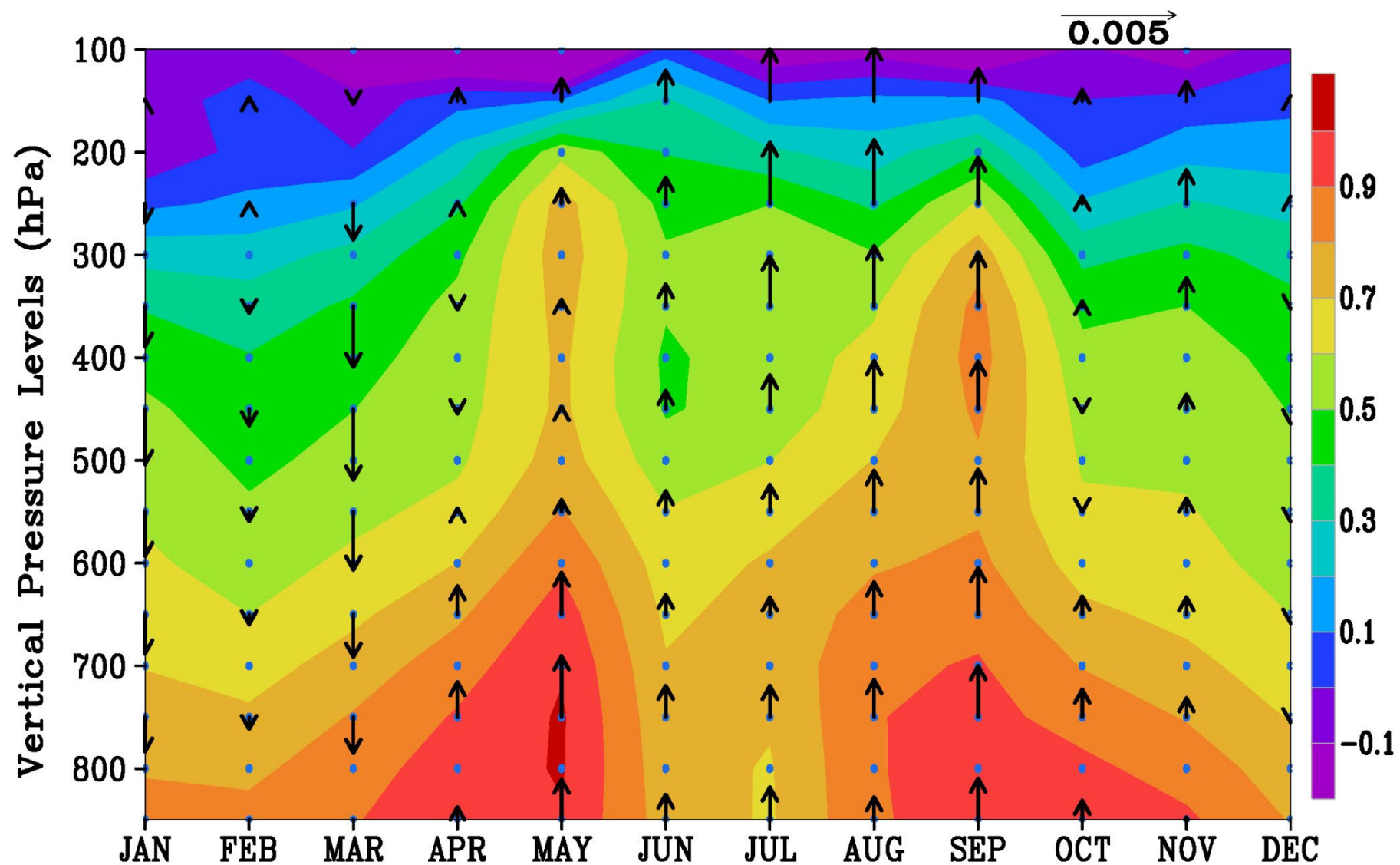


Western Third Pole (WTP)



Surface temperature over WTP region during May is correlated (regressed) with tropospheric temperature (vertically integrated moisture flux).

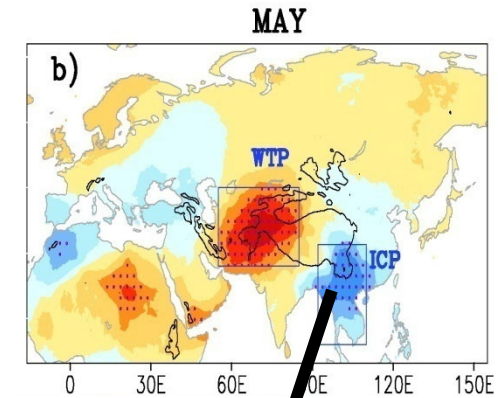
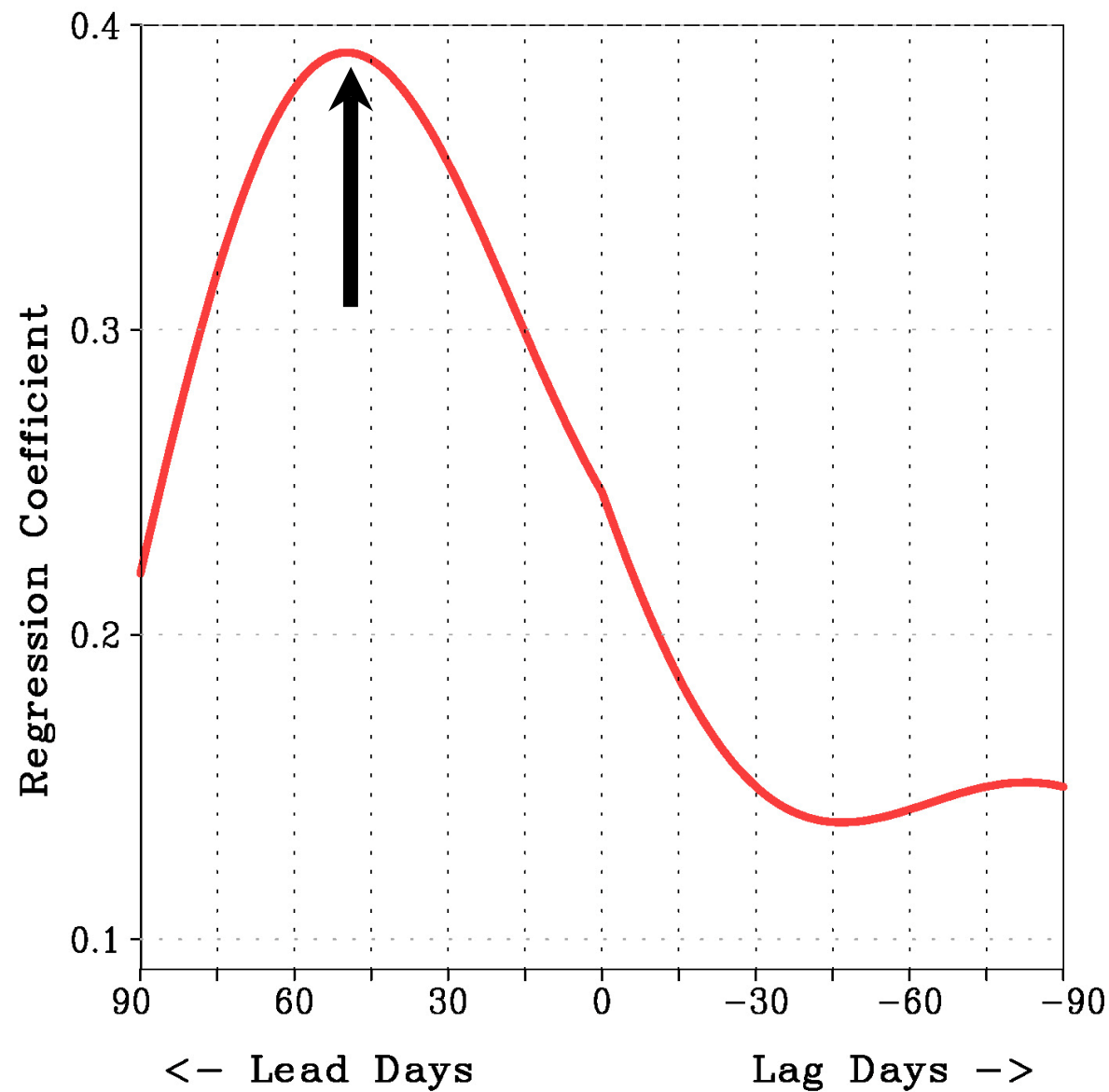
Association of WTP Surface Temperature with Overlaying Atmosphere



Monthly WTP surface temperature is correlated (regressed) with the air temperature (shaded) and Omega (arrow) in the vertical levels (1901-2015; CRU Temp. and NOAA's 20C Reanalysis temperature, Omega).

A strong ascending motion during spring and fall season

Role of ICP/BoB Convection on the WTP Surface Conditions ?



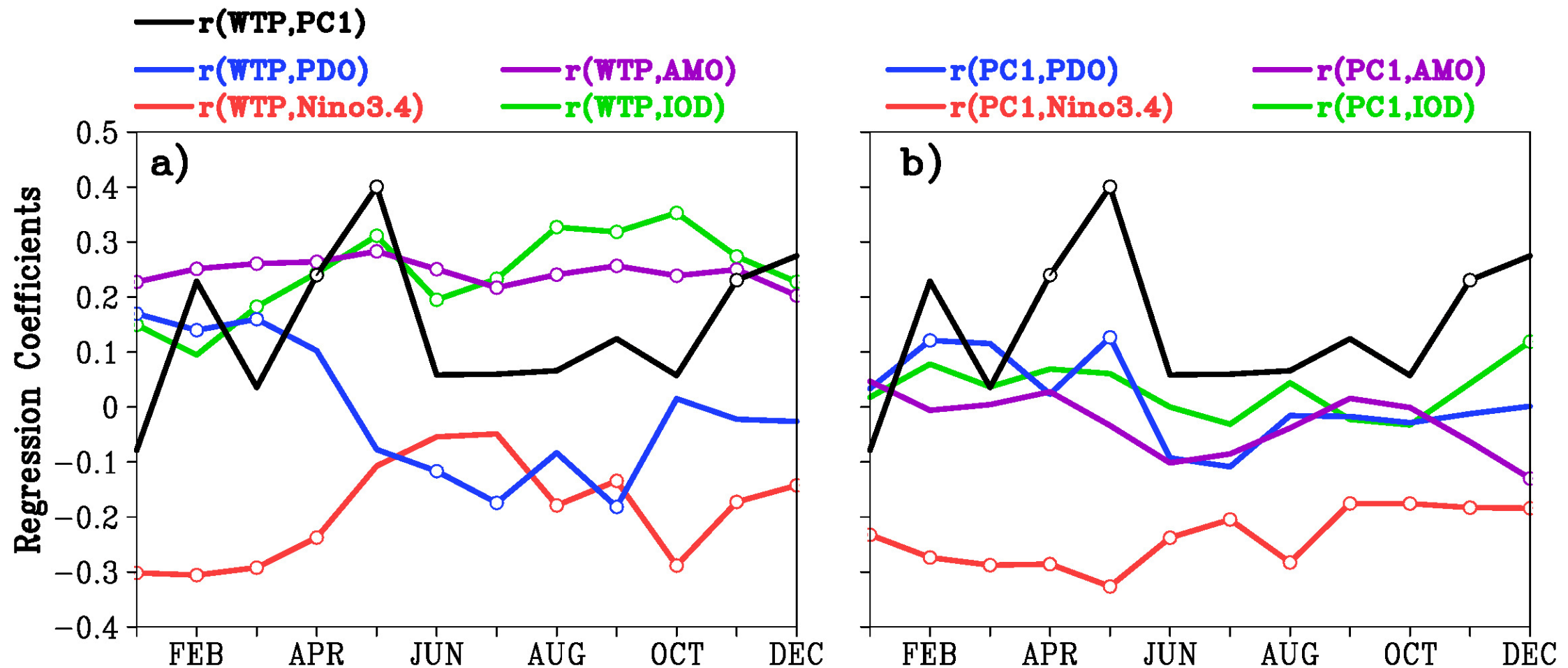
Indochina Peninsula (ICP)

Whether westward propagating Rossby waves associated with ICP/BoB convection can affect the WTP surface temperature ?

Lead/lag regression of WTP temperature anomaly with ICP rainfall anomaly (regressed values are significant at above 99% level).

WTP surface temperature leads the convection over ICP by about 50 days

Association of WTP/PC1 with Global Predictors (Multiple Regression)



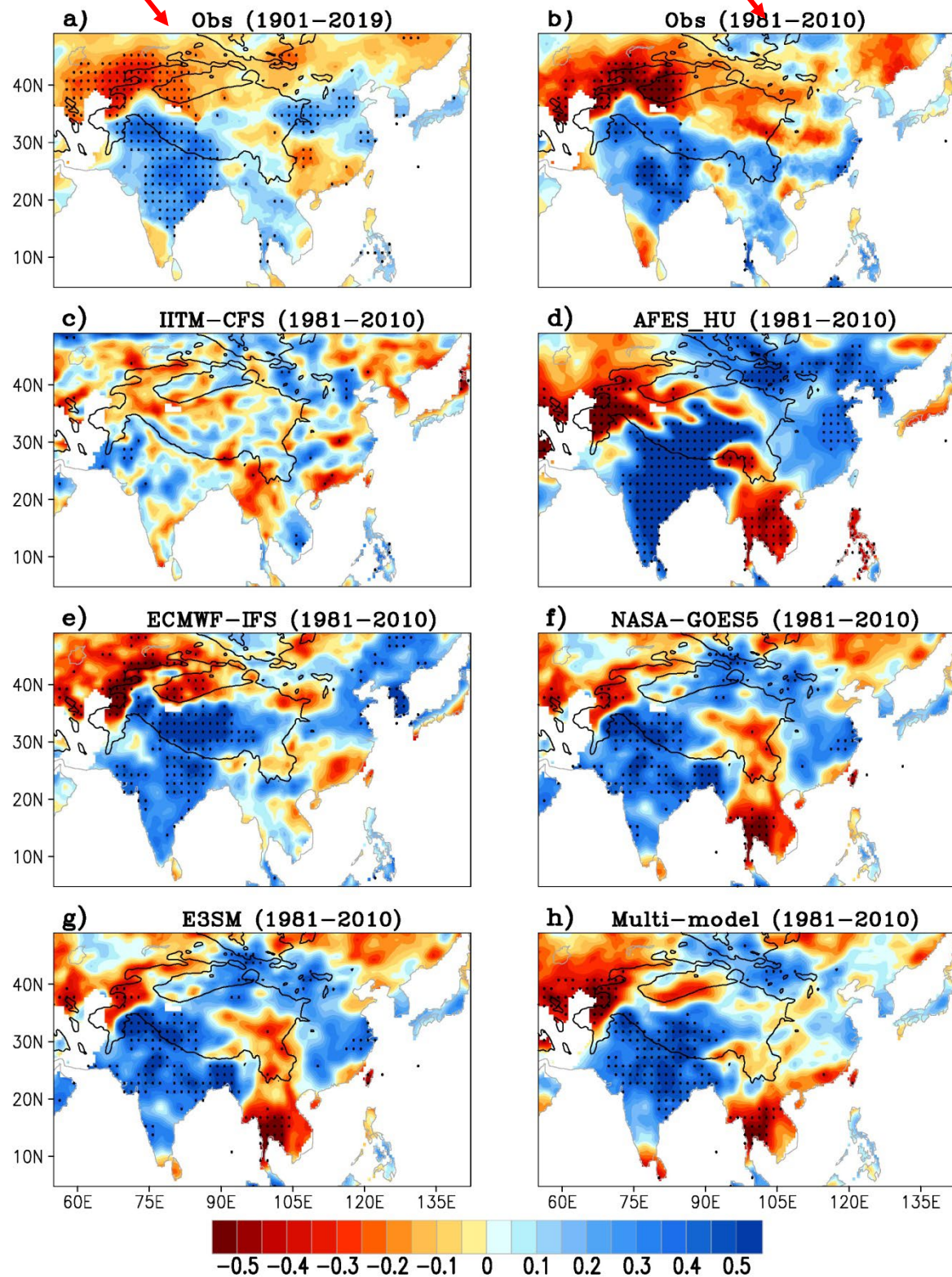
PC1 of June rainfall is regressed with WTP averaged temperature during all the lead/lag months (black lines). The global oceanic modes of the predictors (AMO, PDO, IOD, Niño3.4) in all months are regressed (multiple regression) with a) WTP averaged temperature during May, and b) PC1 of June rainfall. Open circles represent regressions significant at 95% level using two-tailed Student's t-test.

ENSO, AMO, IOD may have influences on WTP land surface conditions.

Evaluation of Models Participating in ILS4P

Performance of ILS4P Models (1981-2010)

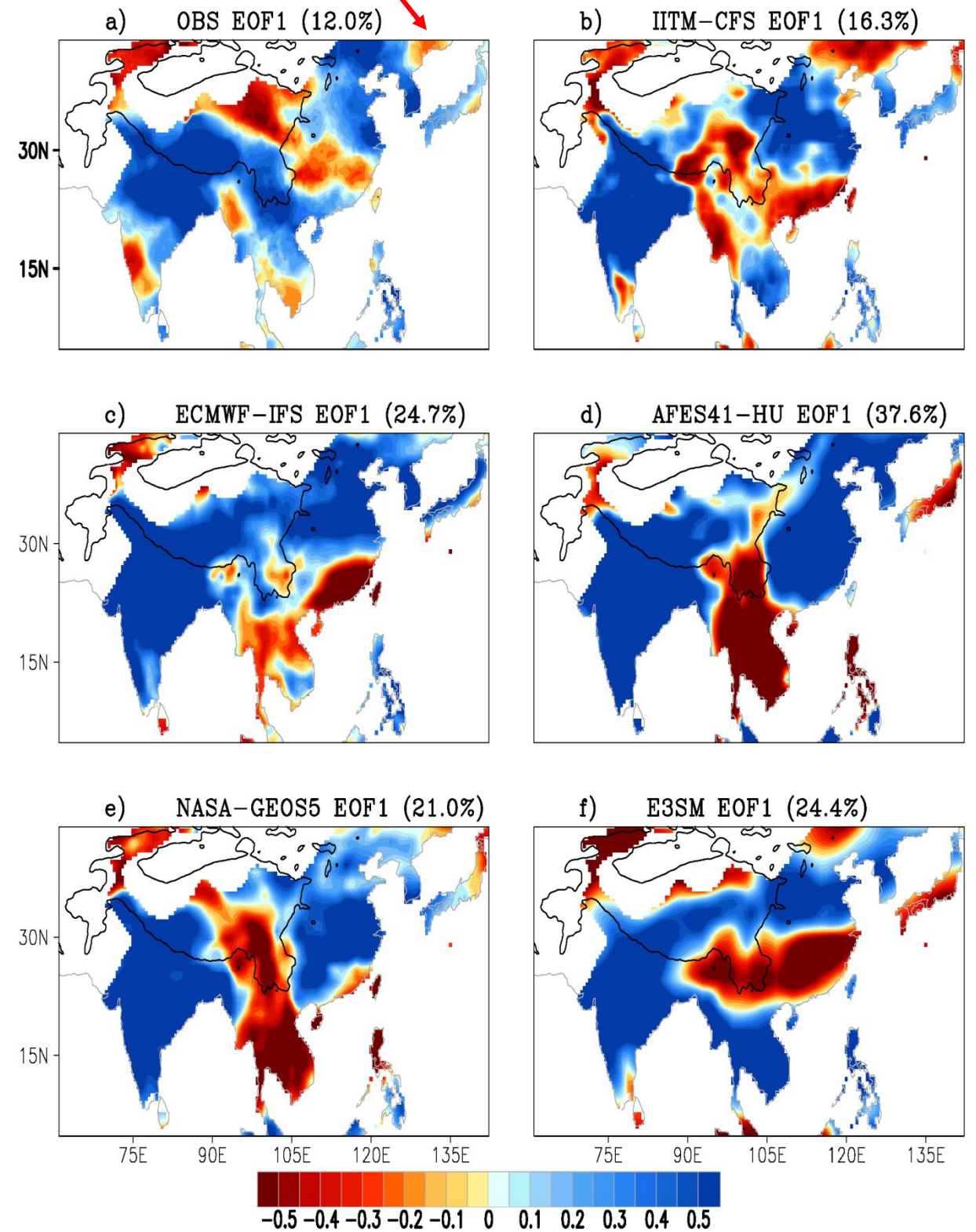
Observations (1901-2019)



WTP averaged surface temperature (May) correlated with precepitation (June)

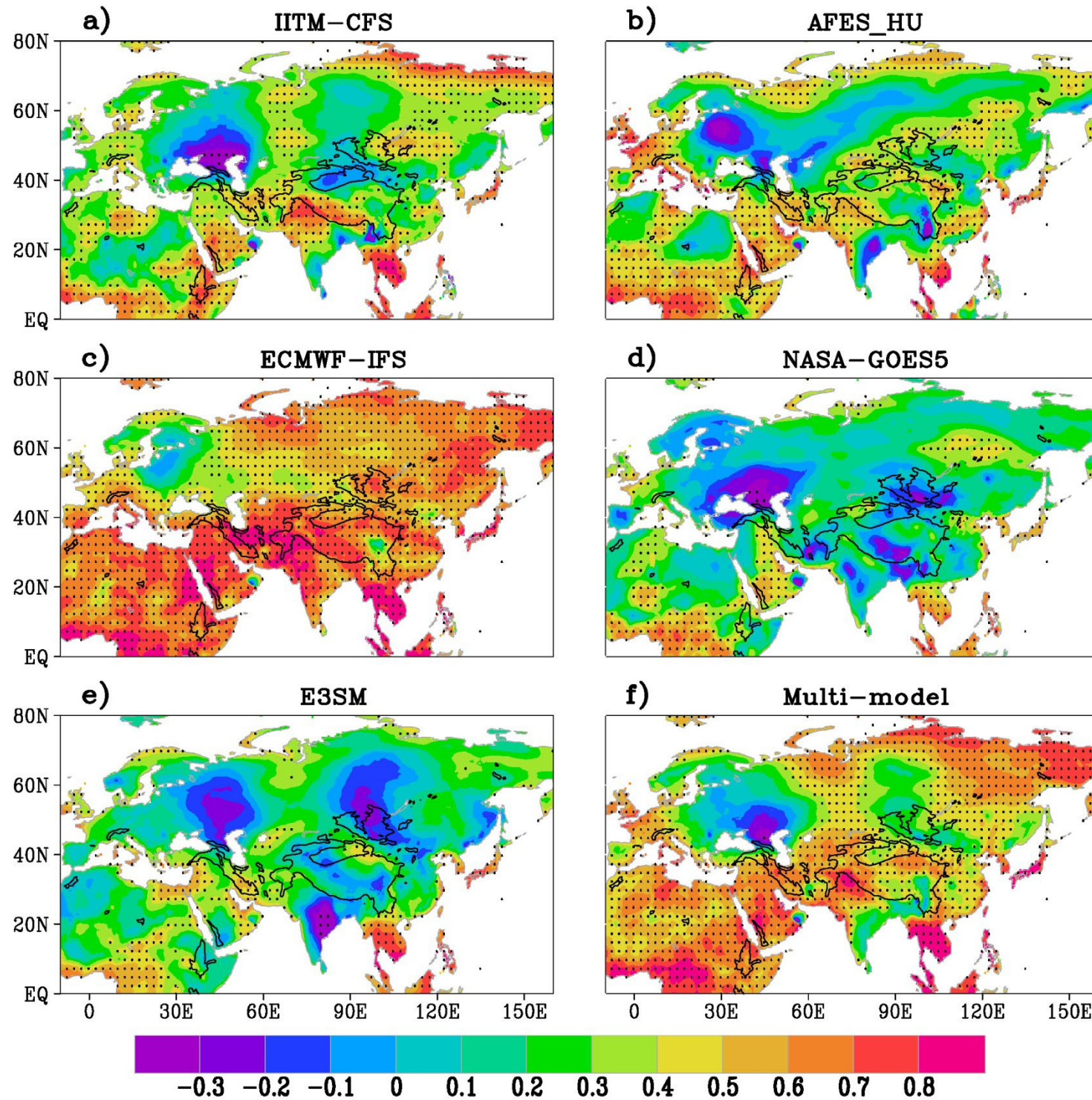
Observations (1981-2010)

Observations



First EOF from Observations & Model

Performance of ILS4P Models (1981-2010)



Gridpoint correlation of 2m temperature between Observations and Models (May)

Conclusions

A dominant mode of variability (EOF1) in June rainfall over the entire Asian monsoon region is evident.

The dominant mode (i.e. EOF1) is found to be linked with the spring (April, May) land surface temperature (LST) of the areas centred around the Western Third Pole (WTP).

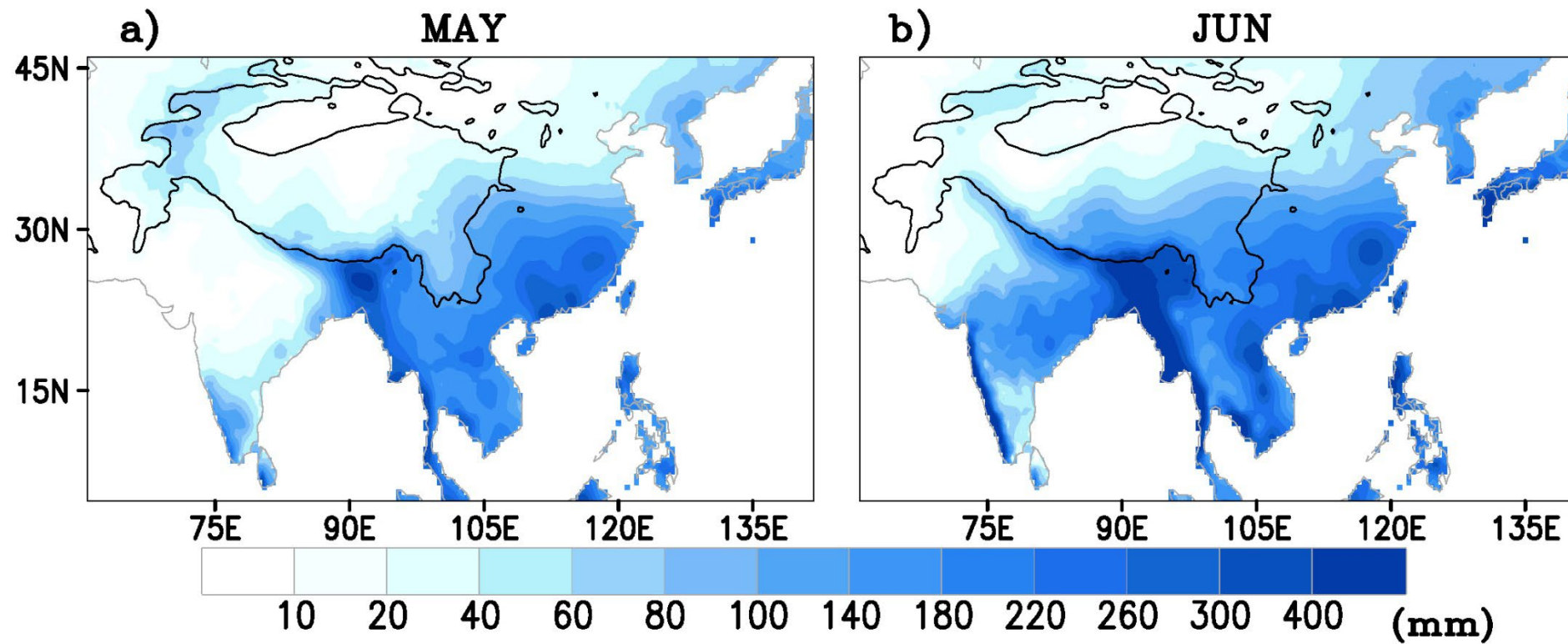
As WTP is home to many glaciers and mountains, spring LST of this area has a strong inverse relationship with snow water equivalent ($r=-0.65$; 1950-2019 ERA5 land), suggesting a seminal role of land surface processes in the first phase of ASM variability.

Data from five ESMs participating in ILS4P is used. In general, models show a significant bias in simulating the LST and the dominant modes of rainfall variability.

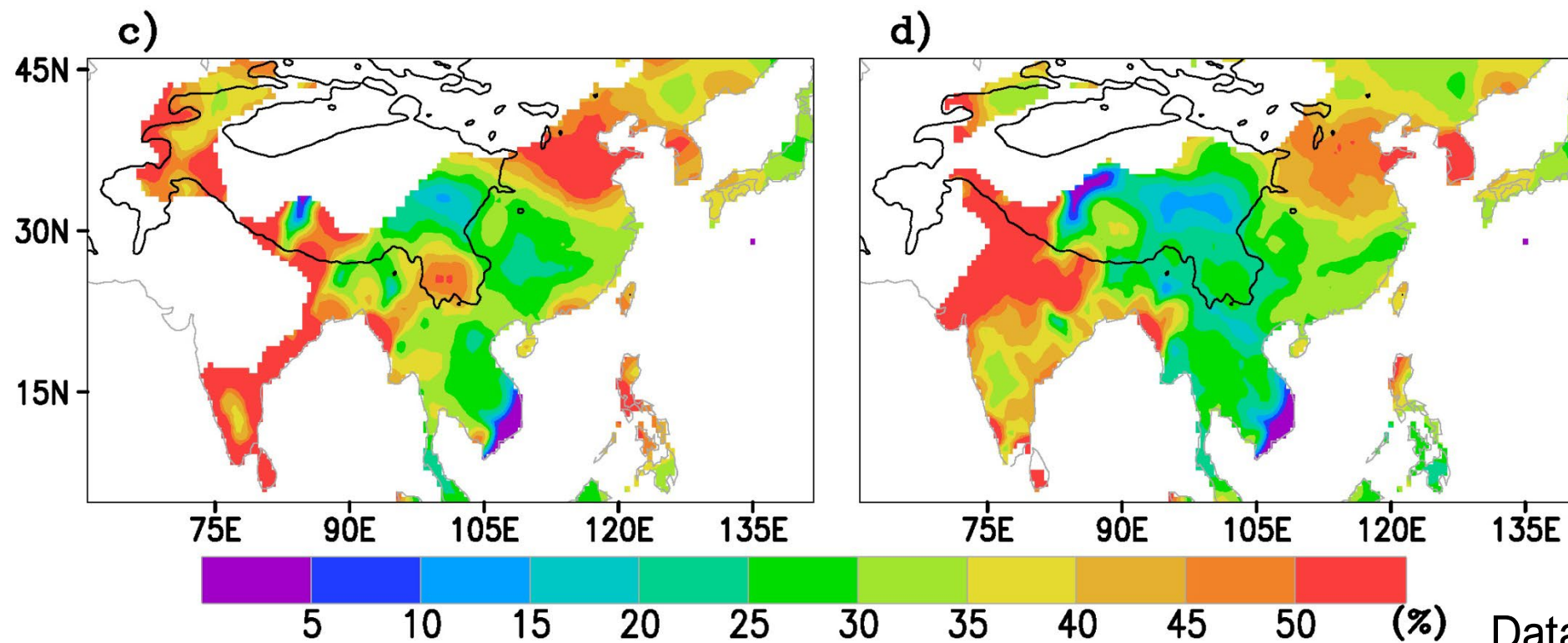
Improvements in the simulation of land surface temperature (i.e. temperature memory in the soil), may improve the simulation of the first phase (i.e. June) of Asian summer monsoon.

Thank You!

Climatological Mean and Interannual SD of Precipitation



Mean



Interannual
SD.

Data:
CRU monthly precipitation
(1901-2019)