Impact of Initial Land Temperature over Tibetan Plateau on the Eastern China Summer Rainfall prediction

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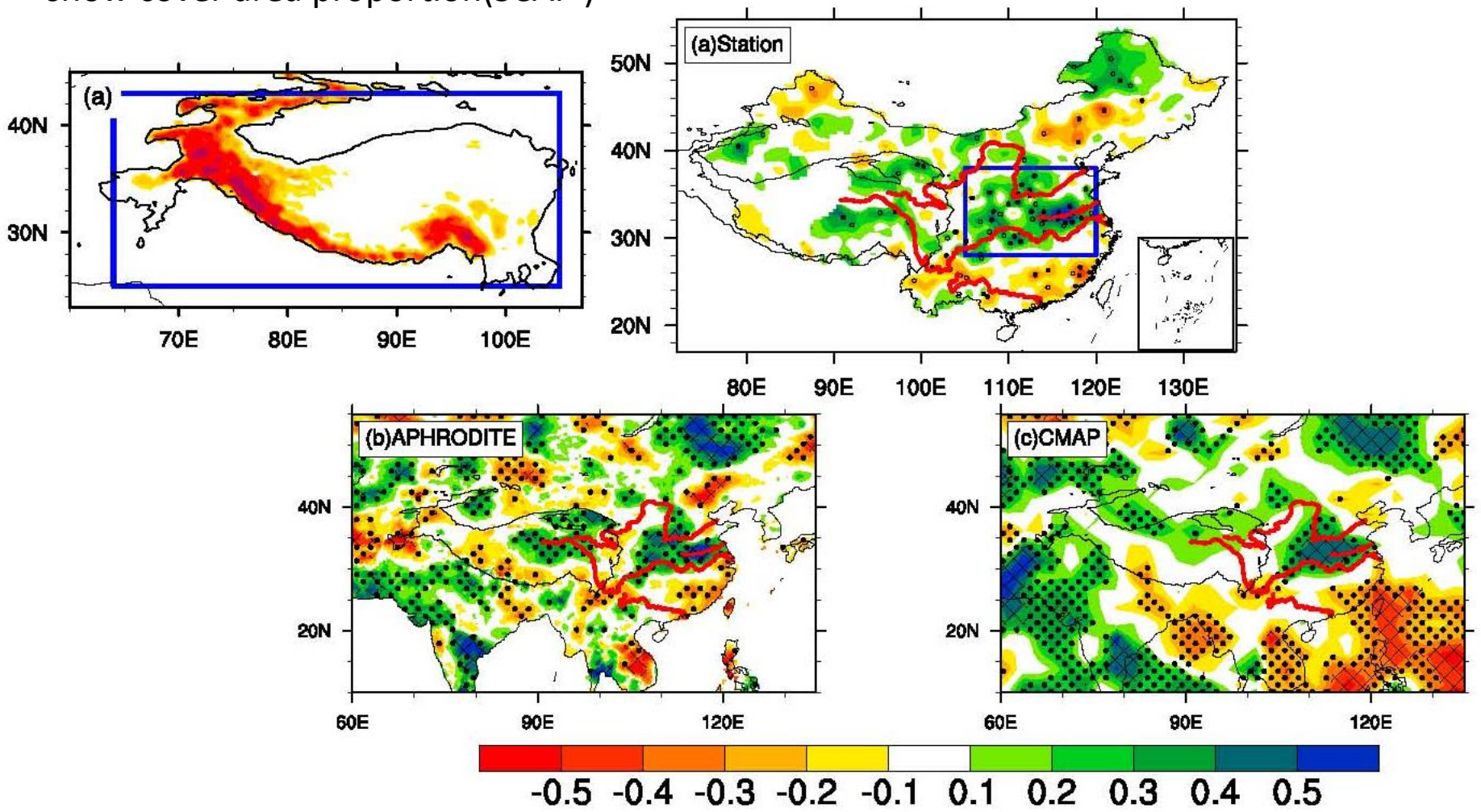
Outline

1. Motivation
2. Relationship between May Temp. over TP region and June rainfall in Eastern China by IAP AGCM
3. Impact of Initial condition of Land temperature on the prediction of Eastern China rainfall
4. Summary

Importance of L-A interaction in Tibetan Plateau

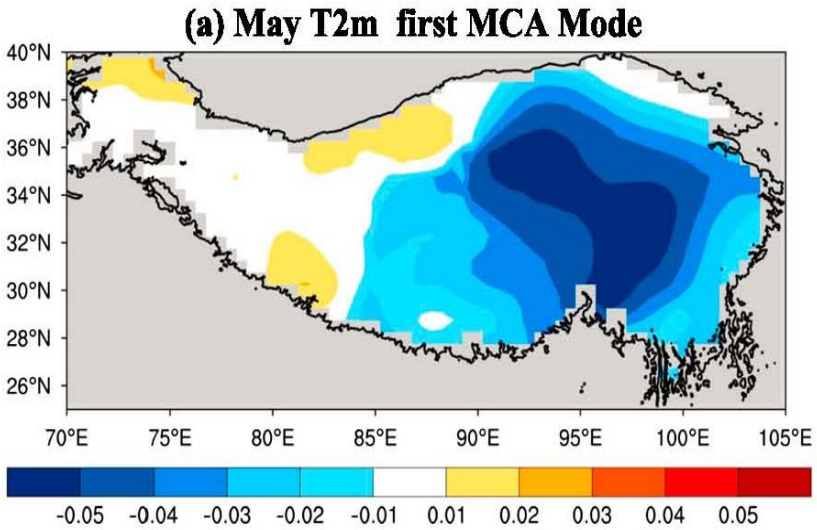
snow cover area proportion(SCAP)

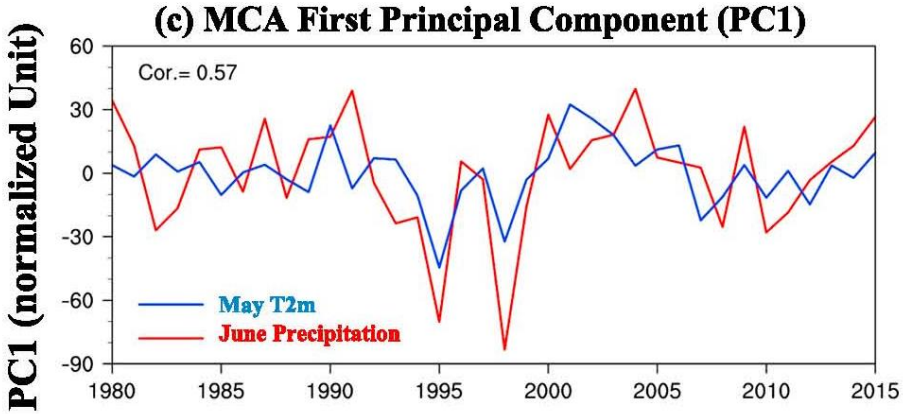


High correlation between SCAP index and summer precipitation

Zhang and Tao (2001), Xiao and Duan, 2016

Relationship between May T2m over TP and Jun Precip





ILSTSS2S Initiative is proposed

(Xue et al., 2018)

Questions

- Whether the IAP model can reproduce the observed relationship between land condition anomalies in TP region and the rainfall anomalies in East Asia?
- Whether the initial land temperature perturbation can persist in the IAP seasonal forecast model, and how does it exert impact on S2S predictability of summer rainfall in East Asian region?

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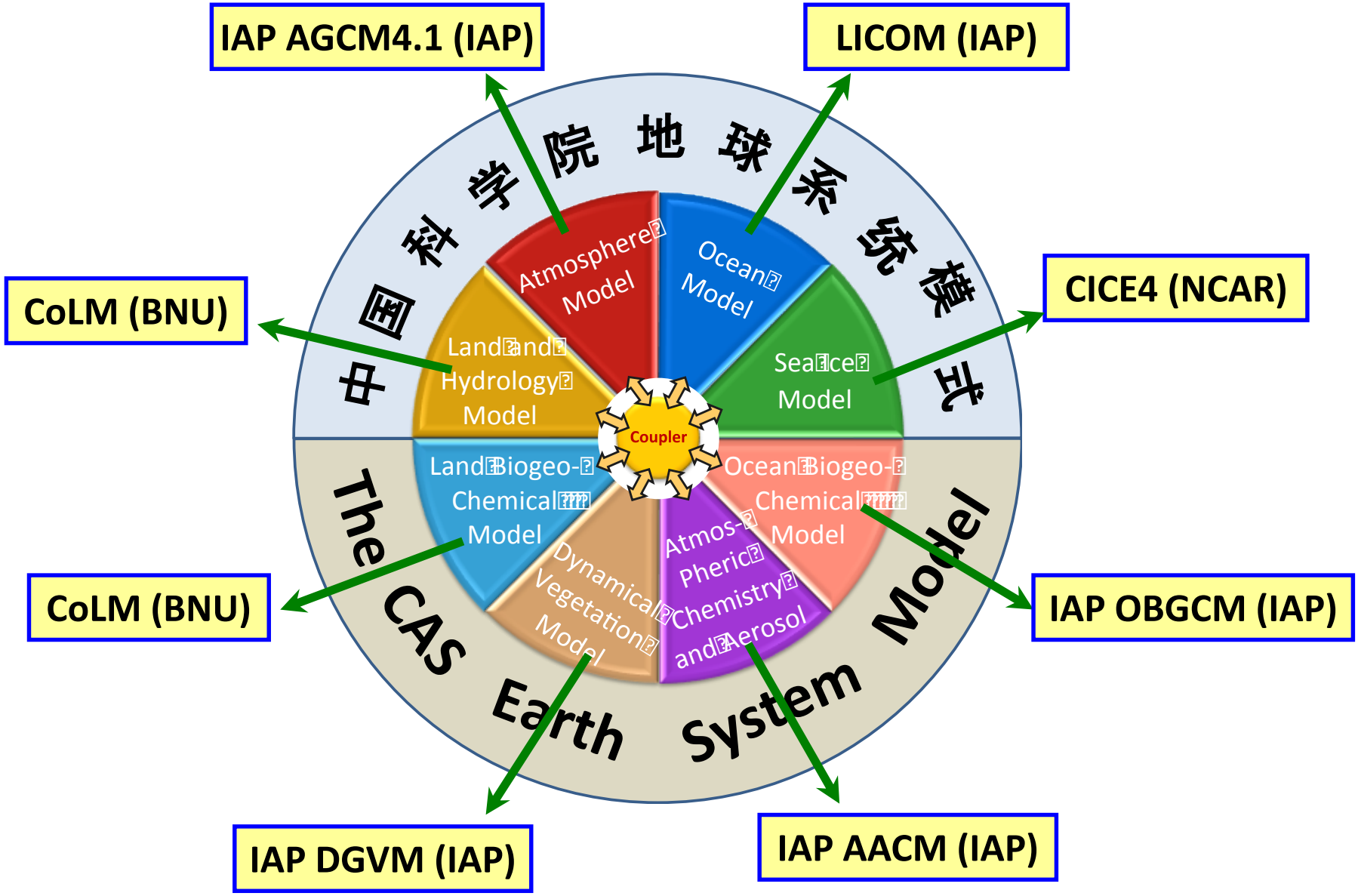
Framework of the CAS-ESM



CAS-ESM V1 Configurations

AGCM: IAP AGCM, Zhang et al. (2013, MWR)

IAP

OGCM: LICOM, Liu et el. (2012, Acta. Meteo. Sinica)

Ocean biogeochemistry: IAP/LAPC, Xu et al. (2013, AAS)

Atmospheric Chemistry and Aerosol: GEATM, Chen et al. (2013)

Dynamic Vegetation Model: IAP DGVM, Zeng et al. (2013, AAS)

Fire model: IAP Fire Model, Li and Zeng (2012, JGR)

Land Model: CoLM, Dai et al. (2003, J. Hydro.), Ji and Dai (2013)

Land biogeochemistry: CoLM, Ji and Dai (2013)

BNU/SYSU

Land ice and sea ice: CISM and CICE,

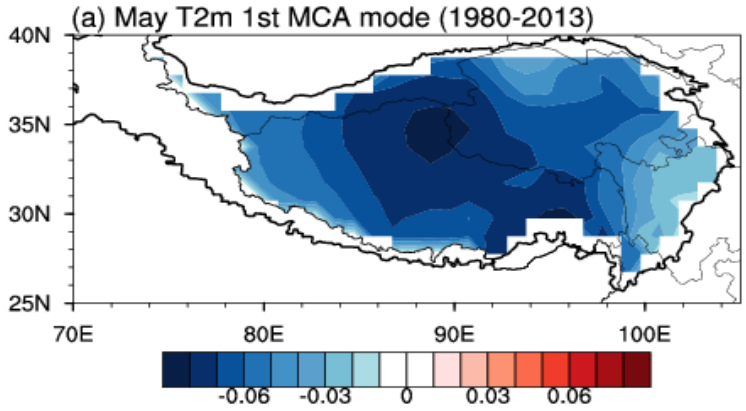
NCAR

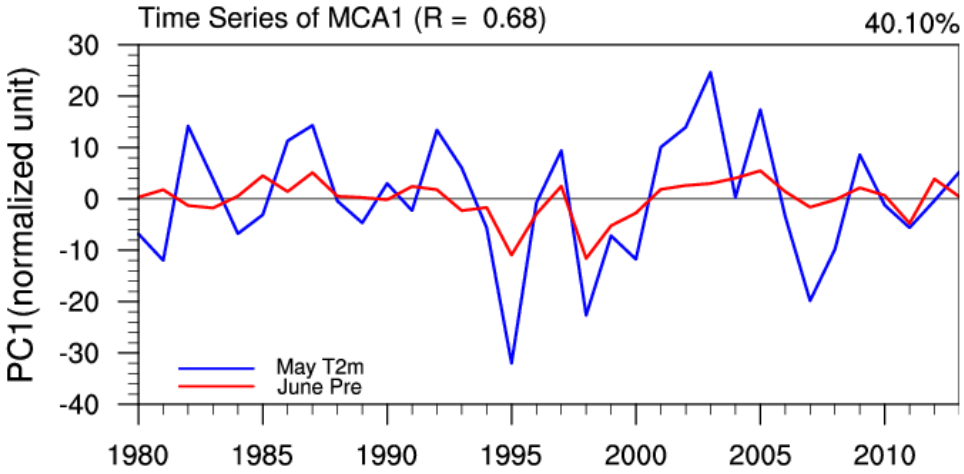
Model experiment and Data

- AMIP type simulation
  - SST: Taken from HadISST dataset
  - 34 years from 1980-2013

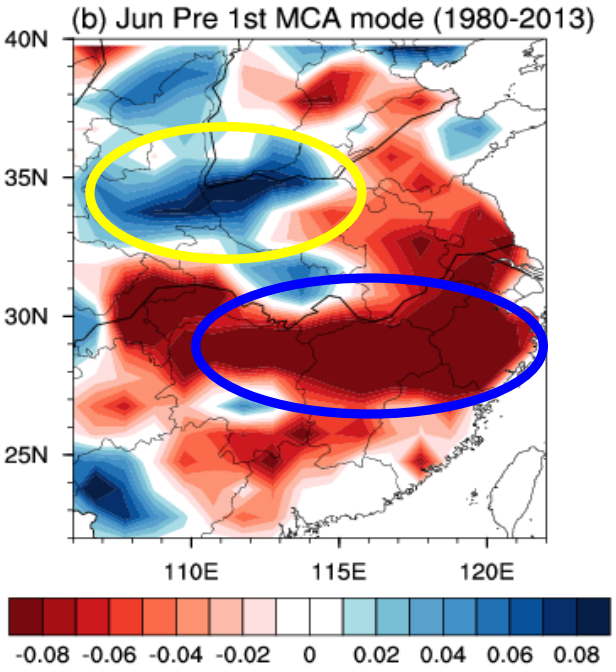
- Hindcast experiment (Hind_Ctrl)
  - 2-tier fashion
  - SSTA: Predicted
  - 20 ensemble members
  - 34 years from 1980-2013

1st MCA mode for CMA observation





MCA First Principle Component (PC1)

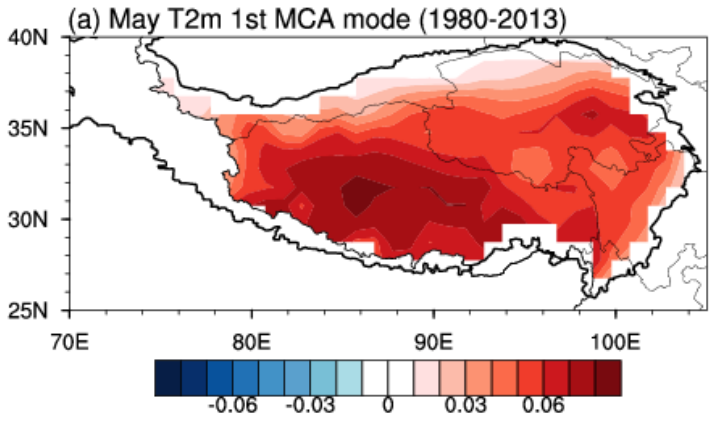


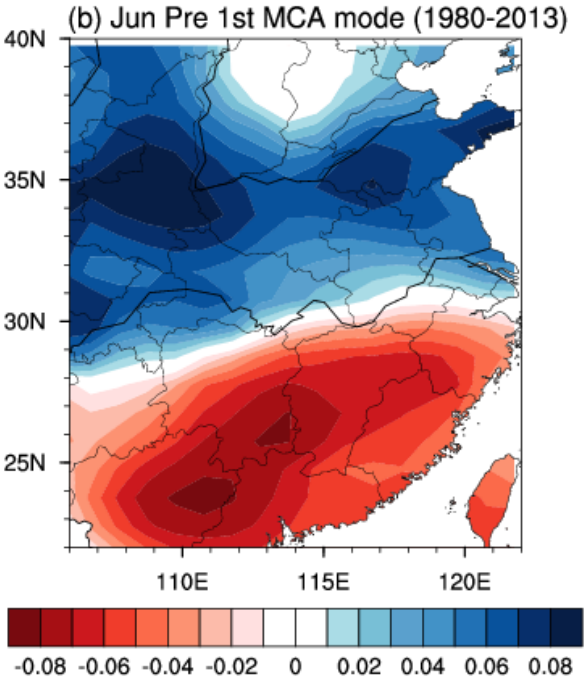
May Temp in TP region: Negative TP T2 m MCA1 anomaly (cool)

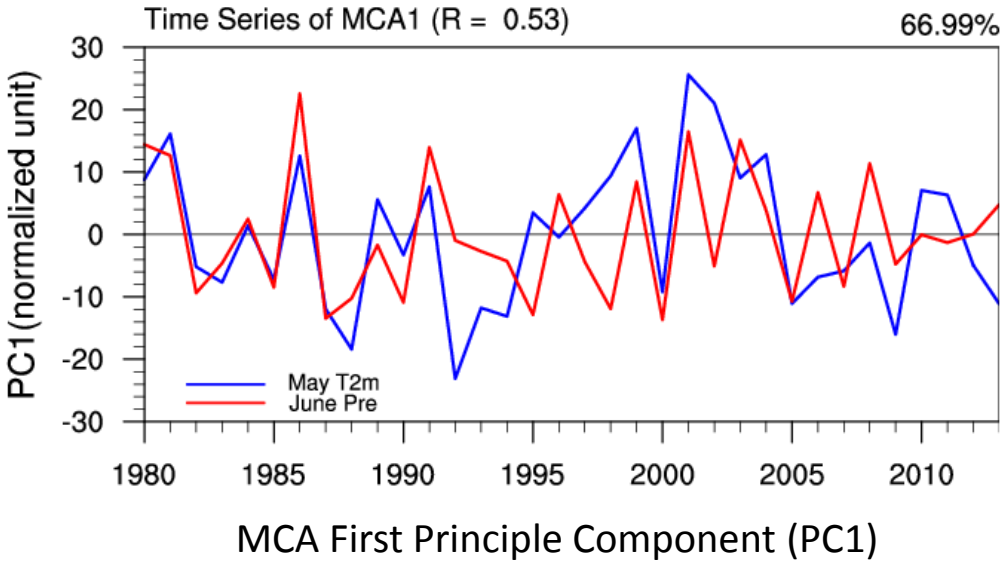
June Precip. in East China: Dipole pattern with the drought over the region in the lower reach of Yangtze River basin and south of the Yangtze River, and wet conditions to the north of the Yangtze Rive

Similar with Xue et al. (2018)

1st MCA mode for IAP-AGCM AMIP simulation



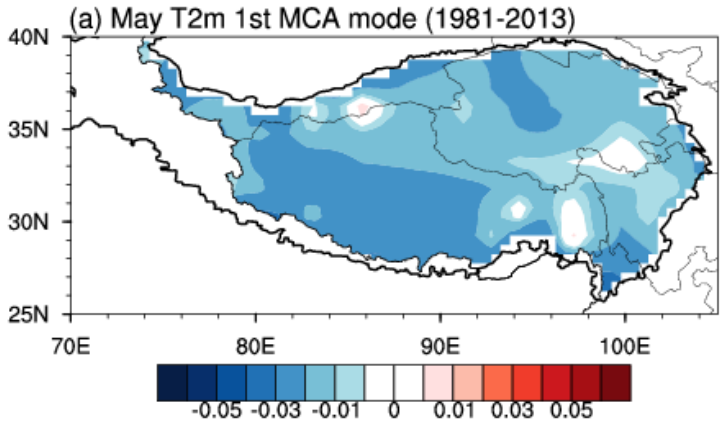


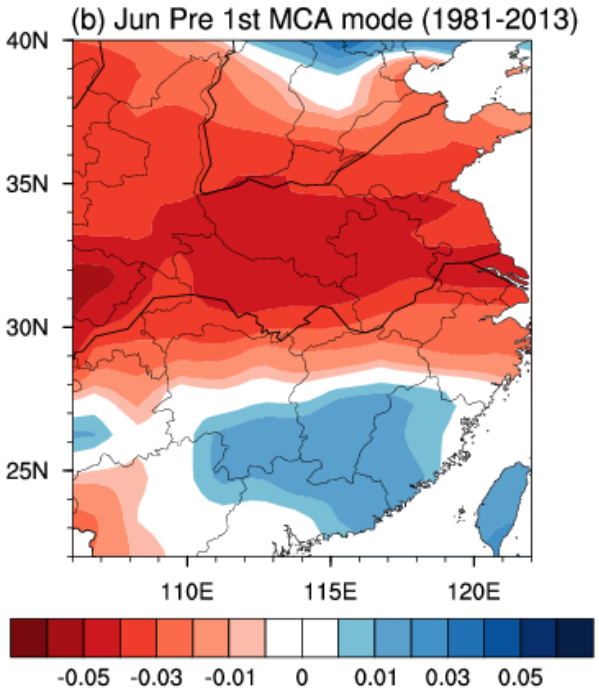


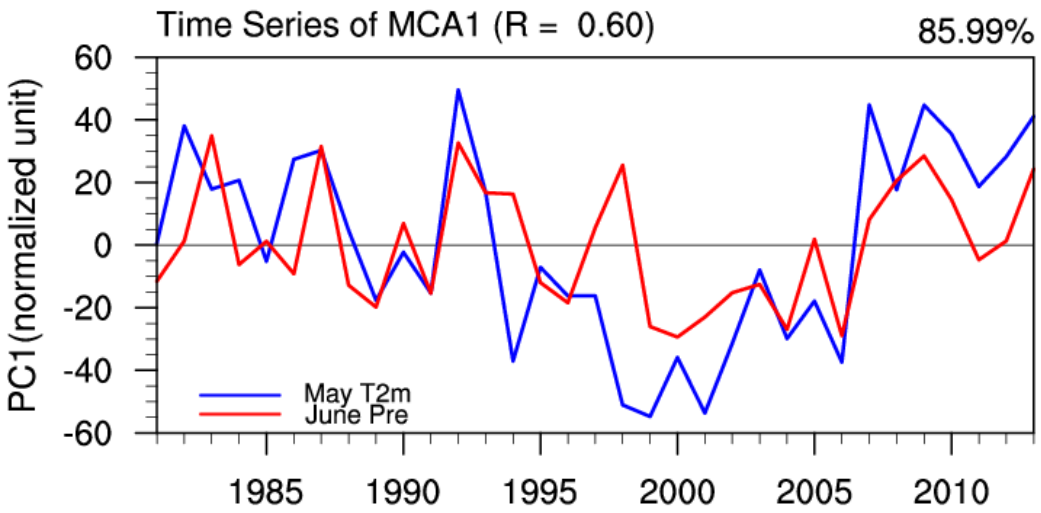
MCA First Principle Component (PC1)

Positive TP May T2 m anomaly (warming) is associated with the dipole pattern of June precipitation, with the drought over the region south of the Yangtze River, and wet conditions to the north of the Yangtze Rive

1st MCA mode for IAP-AGCM Hindcast_Ctrl





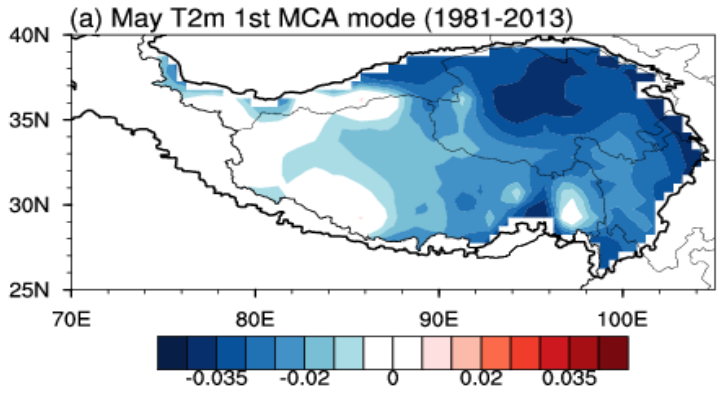


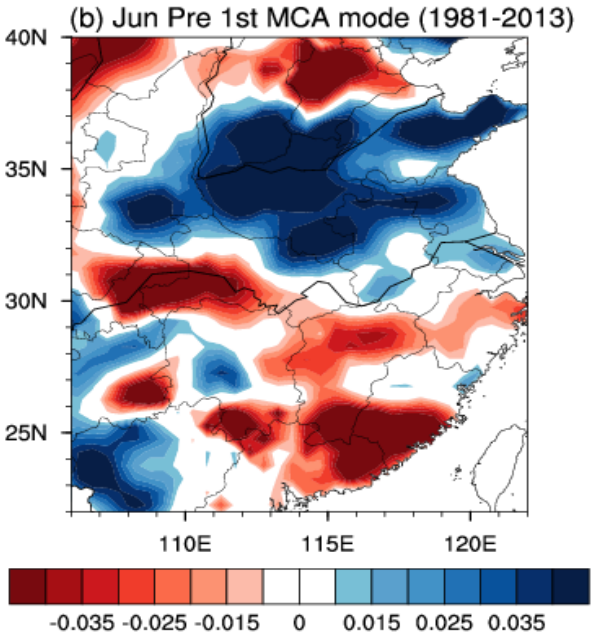
MCA First Principle Component (PC1)

Negative TP May T2 m anomaly (Cooling) is associated with the dipole pattern of June precipitation, with the wet conditions over the region south of the Yangtze River, and drought to the north of the Yangtze River

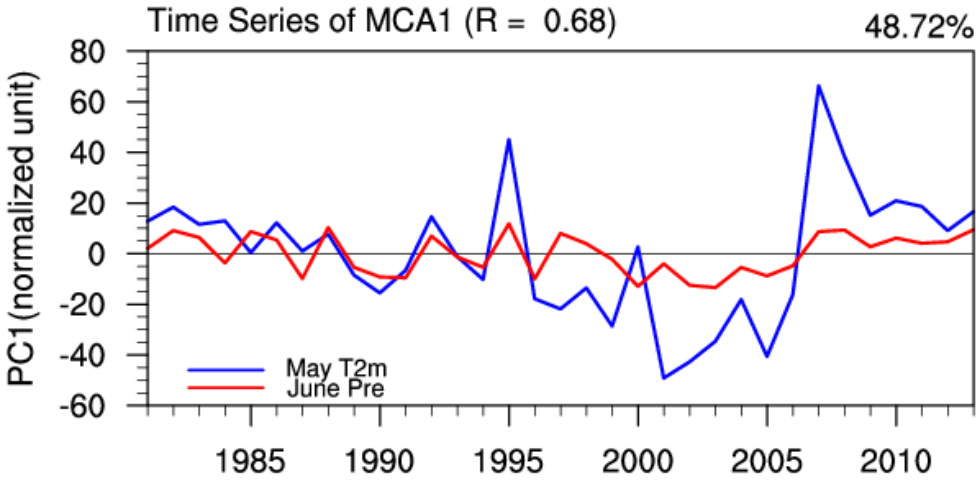
1st MCA mode for bias of IAP-AGCM Hindcast

Spatial pattern of May T2m Bias





Spatial pattern of June Precip. Bias



MCA first PC for May T2m bias and June precipitation bias for IAP AGCM Hindcast results during 1980-2013

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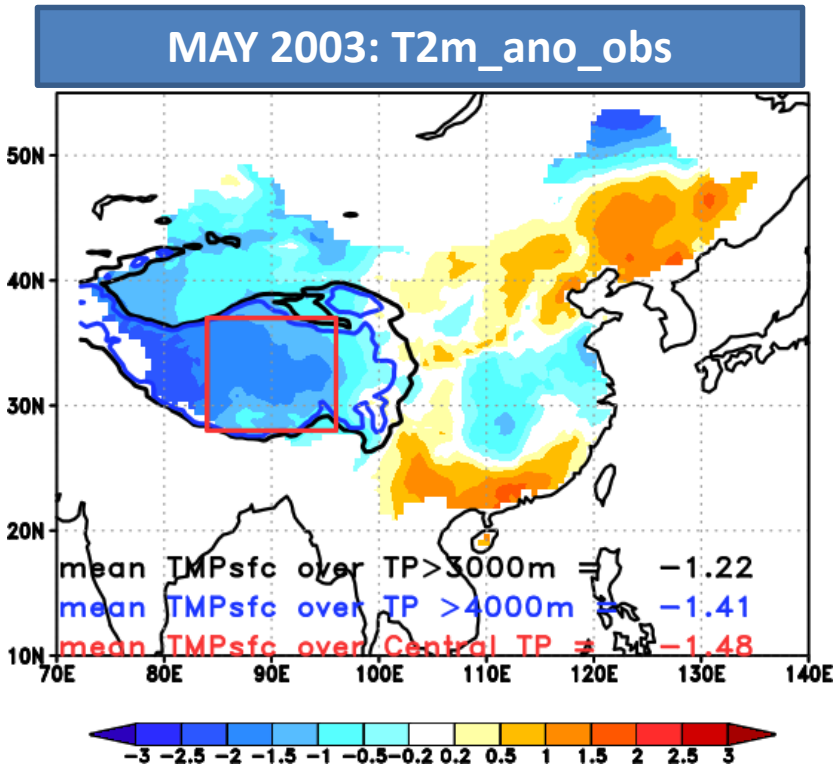
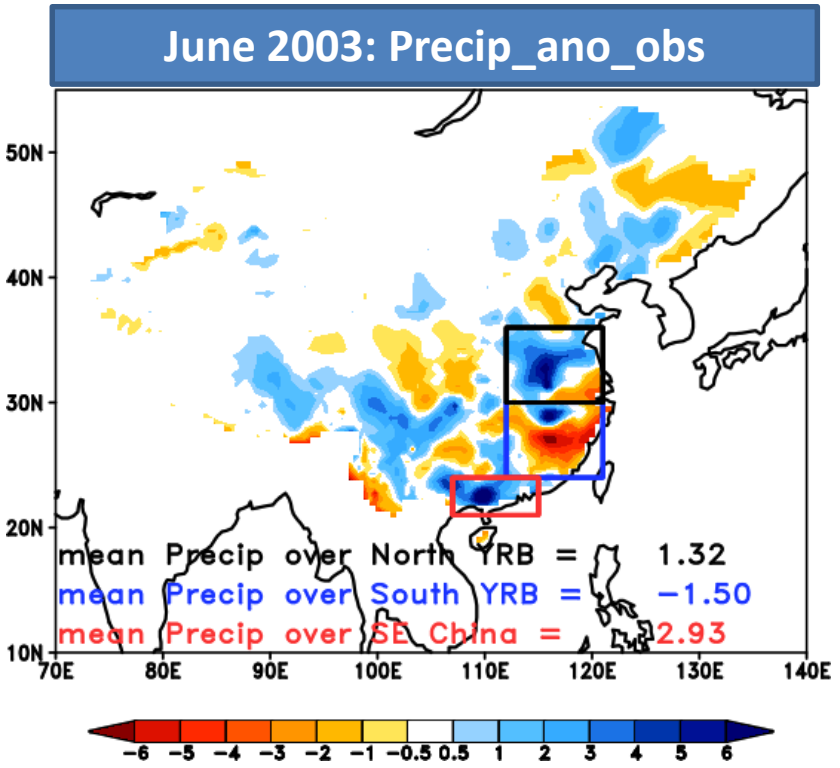
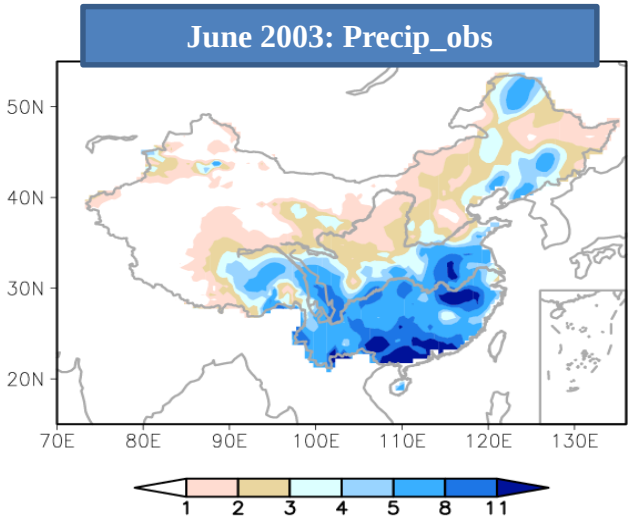
Observed Anomaly of May T2m and Jun Precip. in 2003

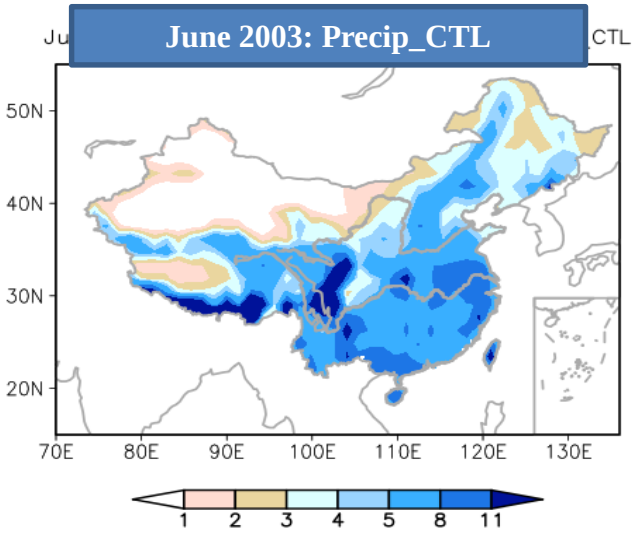




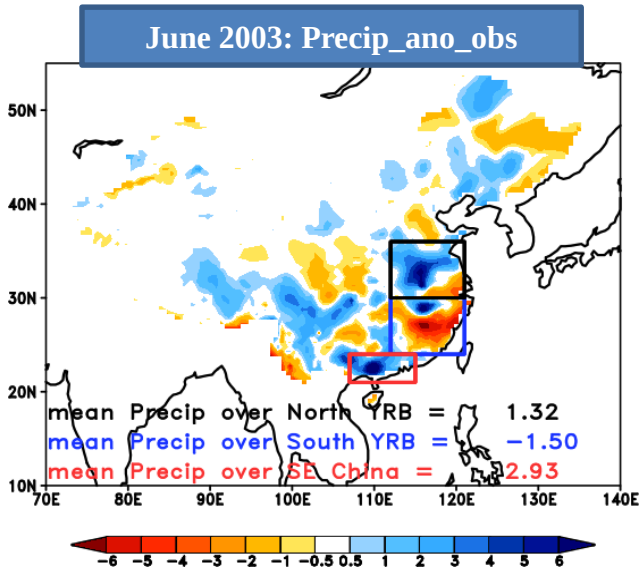
The temperature over Tibet Plateau is lower than normal in May 2003, and the precipitation over the South of Yangtze River Basin is less than normal, and more than nomral over the Huaihe River Basin and Guangdong and Guangxi provinces in June.

Jun. precip and anomaly in 2003 from Hindcast_Ctrl

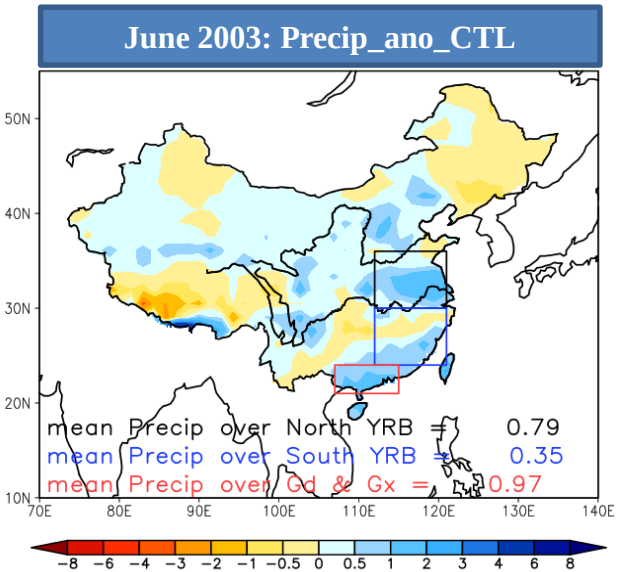




Precipitation



Precip_CTL_2003 – Precip_Obs_clim



Precip_CTL_2003 – Precip_CTL_clim

Anomaly

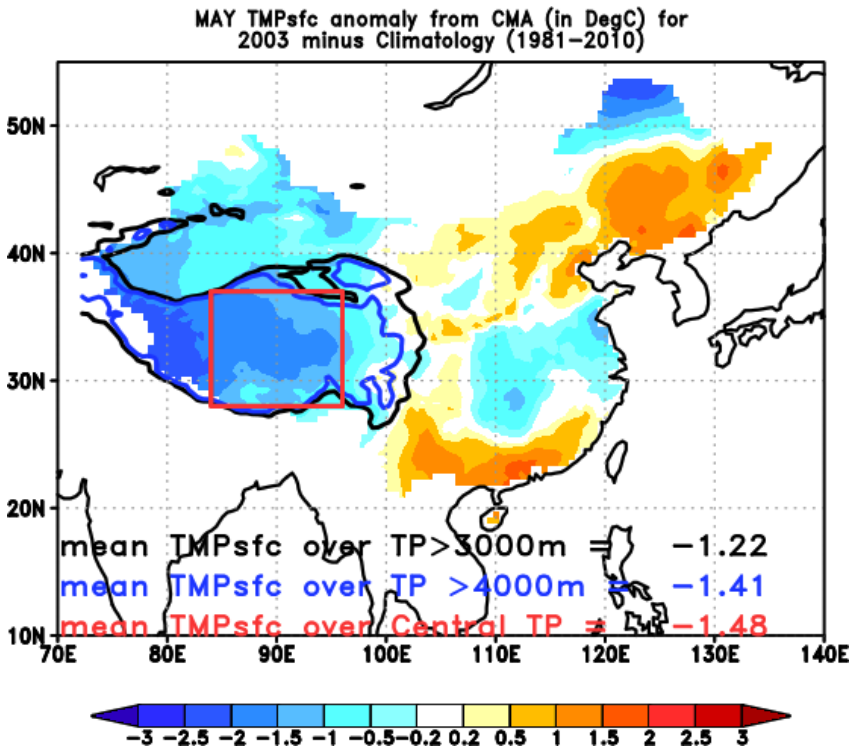
Anomaly is based on the model hindcast climatology

Observation

Prediction

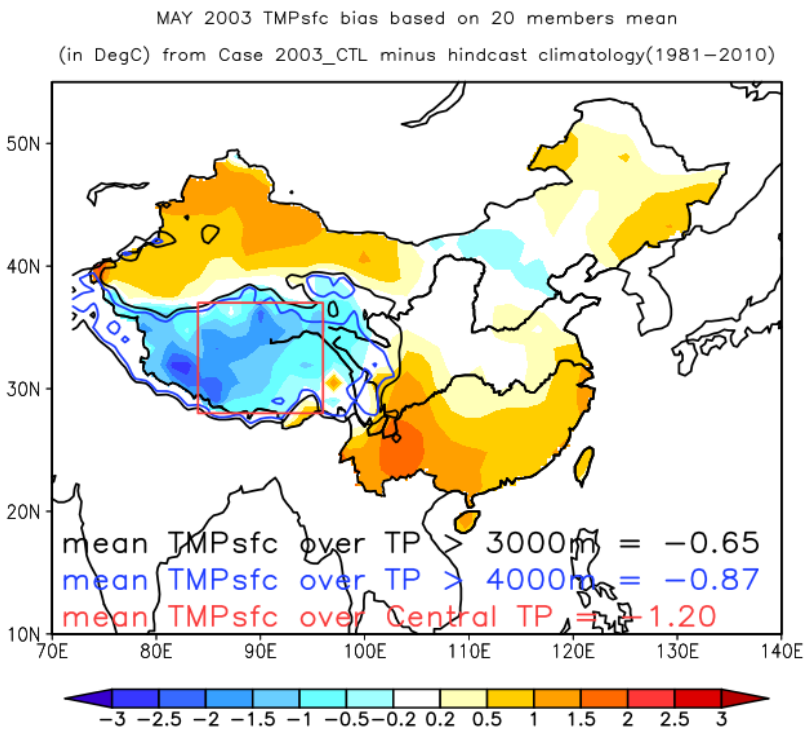
Obs and hindcast T2 m and its anomaly in May 2003

MAY 2003: T2m_ano_obs



T2m_obs_2003 – T2m_obs_clim

MAY 2003: T2m_ano_CTL



T2m_CTL_2003 – T2m_CTL_clim

The hindcast temp. anomaly is warmer than observation in TP region

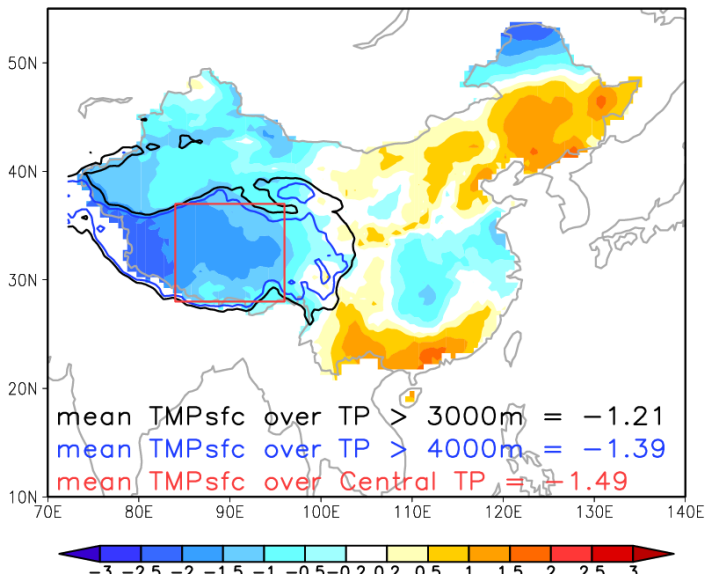
Initial Land temperature experiments

Experiment	Initial land temperature perturbation
Hind_DeltaT0	Restore the magnitude of obs. T2m anomaly (Model anomaly is based on its own climatology)
Hind_DeltaT1	Bias removed firstly, then imposed the observed T2m anomaly

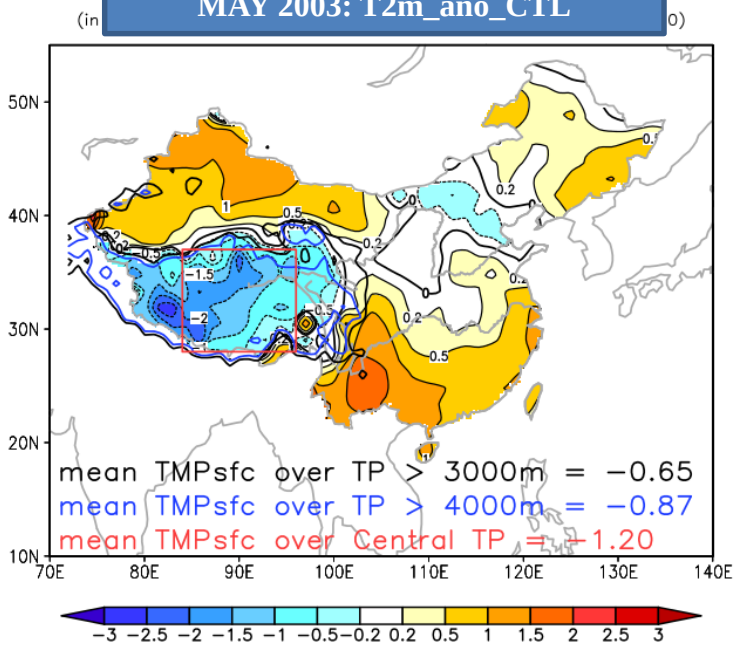
- All other configurations are the same as hindcast_Ctrl for 2003

T2m anomalies in May 2003 for Hind_DeltaT0

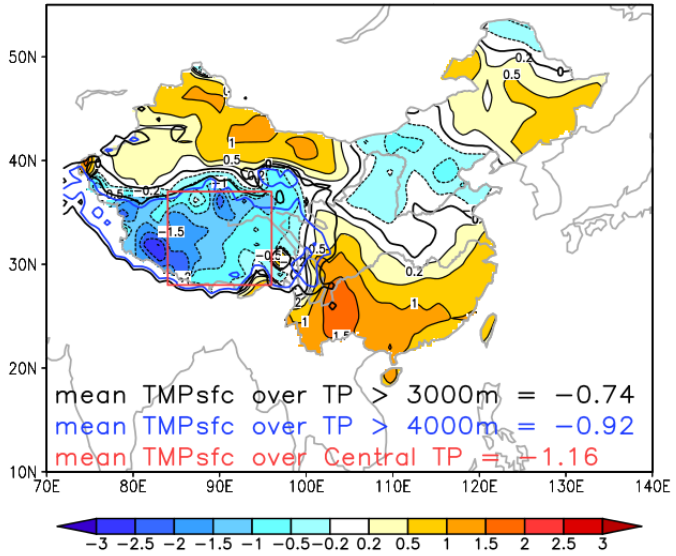
MAY 2003: T2m_ano_obs



MAY 2003: T2m_ano_CTL



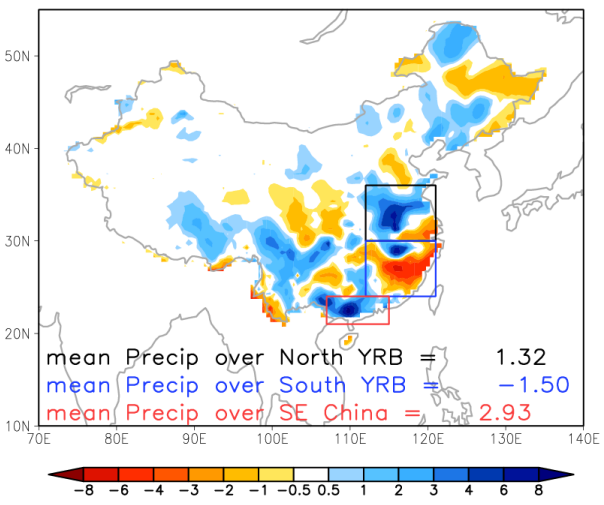
MAY 2003: T2m_ano_DeltaT0



The predicted May T2m is generally closer to the observation in magnitude

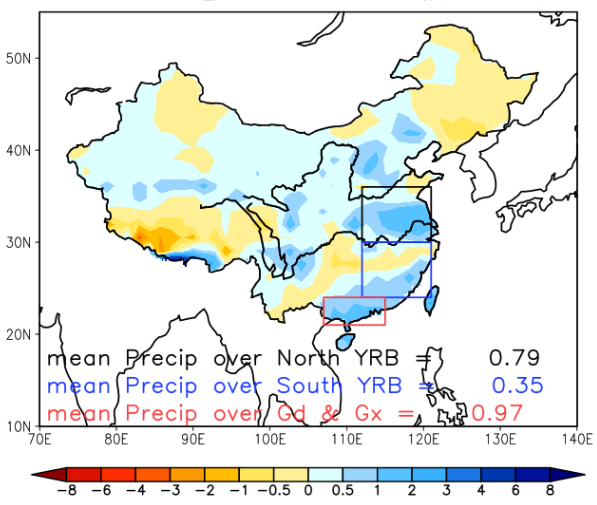
June precip. prediction for DeltaT0

June 2003: Precip_ano_obs



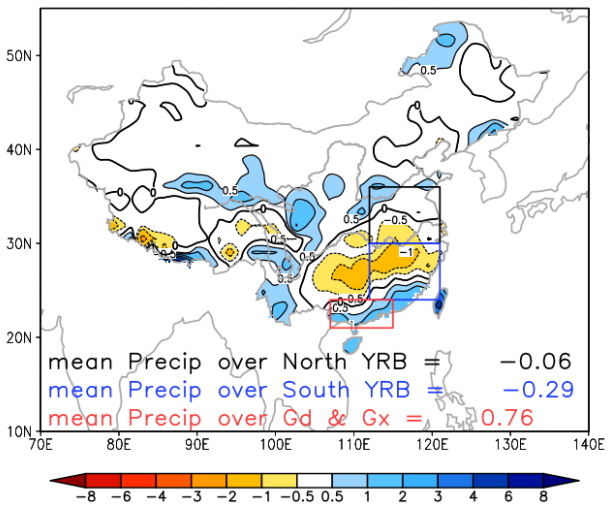
Precip_obs_2003 – Precip_obs_clim

June 2003: Precip_ano_CTL



Precip_CTL_2003 – Precip_ctl_clim

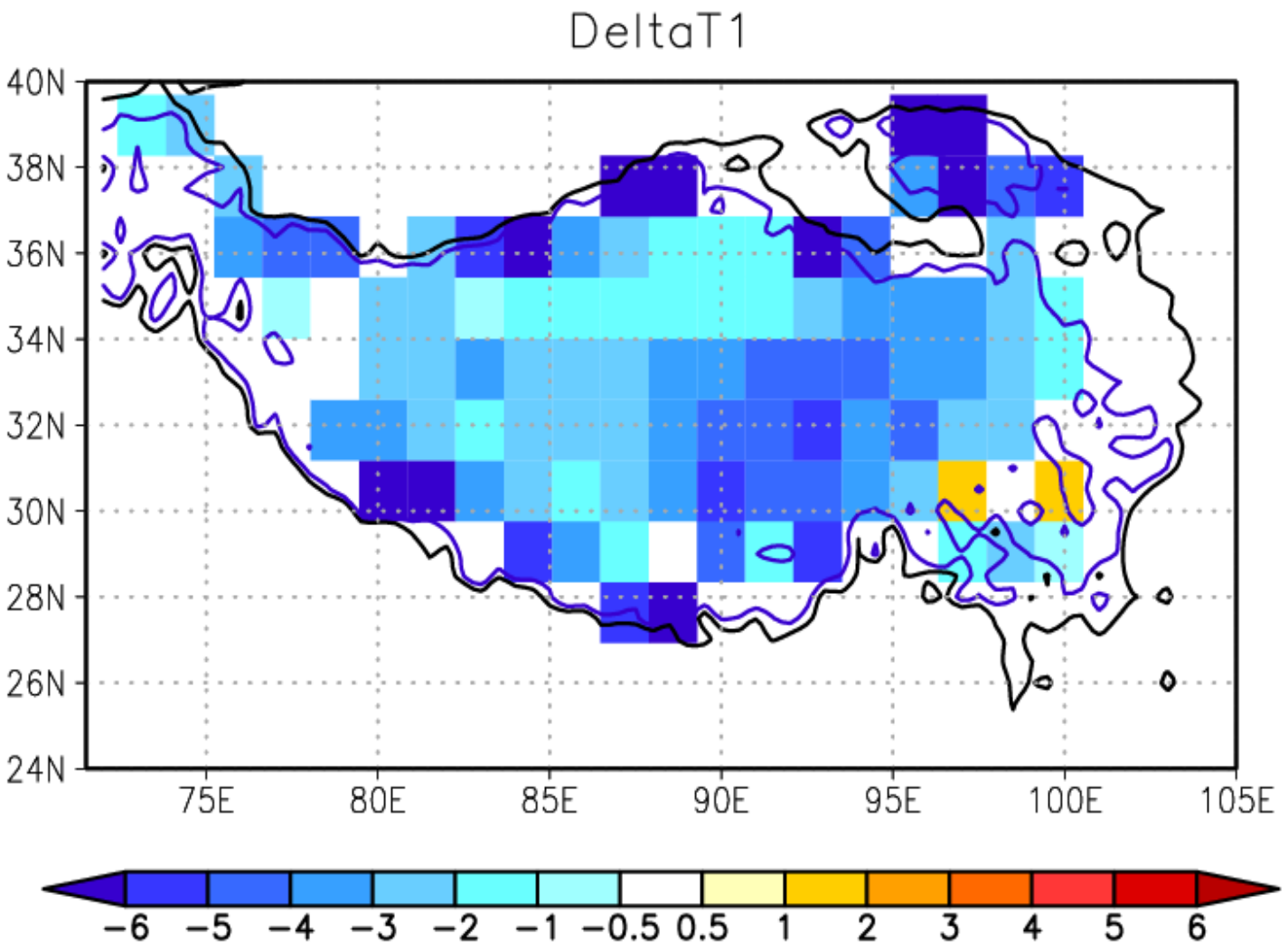
June 2003: Precip_ano_DeltaT0



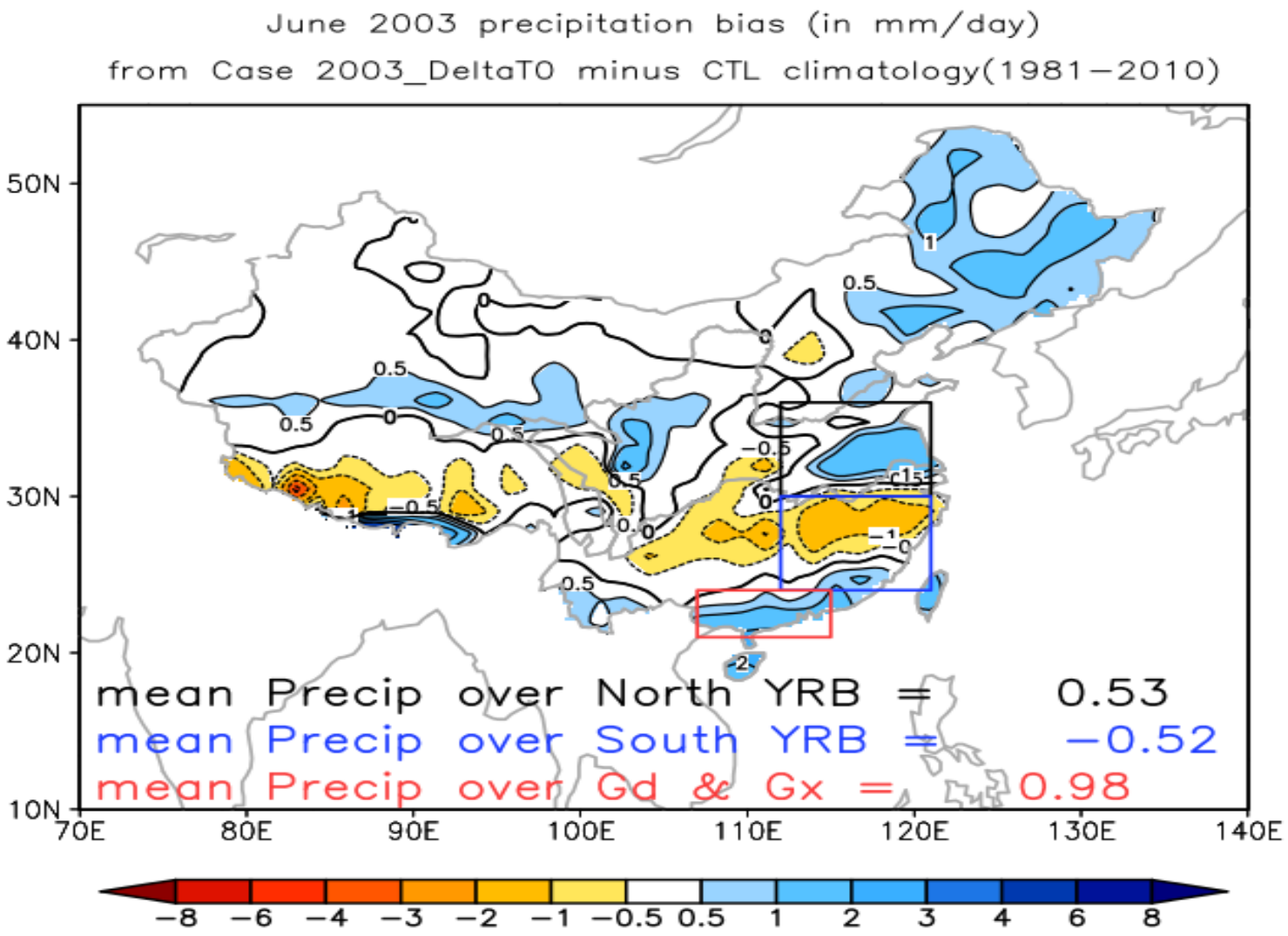
Precip_DeltaT0_2003 – Precip_ctl_clim

DeltaT1: The initial LST/SUBT Ano. for 2003_DeltaT1

DeltaT1 = 2x[T2m_ano_obs] - [T2m_bias_CTL]



DeltaT1： Predicted June precip. and its anomaly in 2003



Brief Summary

1) **The relationship pattern between the model bias in temp. and precipitation is similar with the observed.**
2) **The initialized soil temperature in TP regions in May can exert impact on the June rainfall anomalies. With cooler land temp. in TP region, the model will produce less rainfall in South of Yangtze river basin.**