

ICRC-CORDEX 2019, 14-18 October 2019 Beijing, China

Simulated diurnal cycle of summer precipitation over the Tibetan Plateau at gray-zone grid spacing

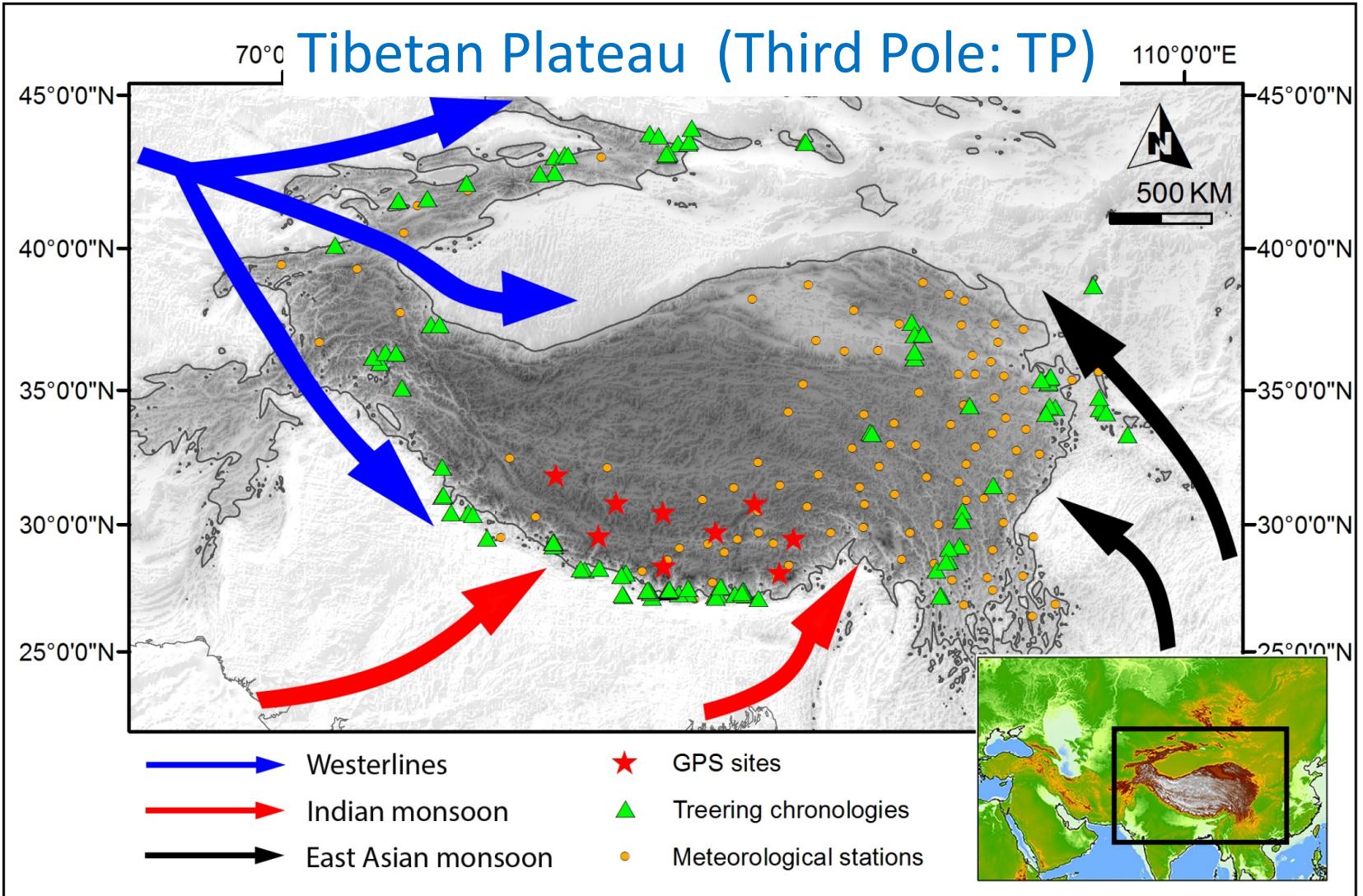
Tinghai Ou

Deliang Chen, Xingchao Chen, Changgui Lin, Kun Yang,
Hui-Wen Lai, and Fuqing Zhang



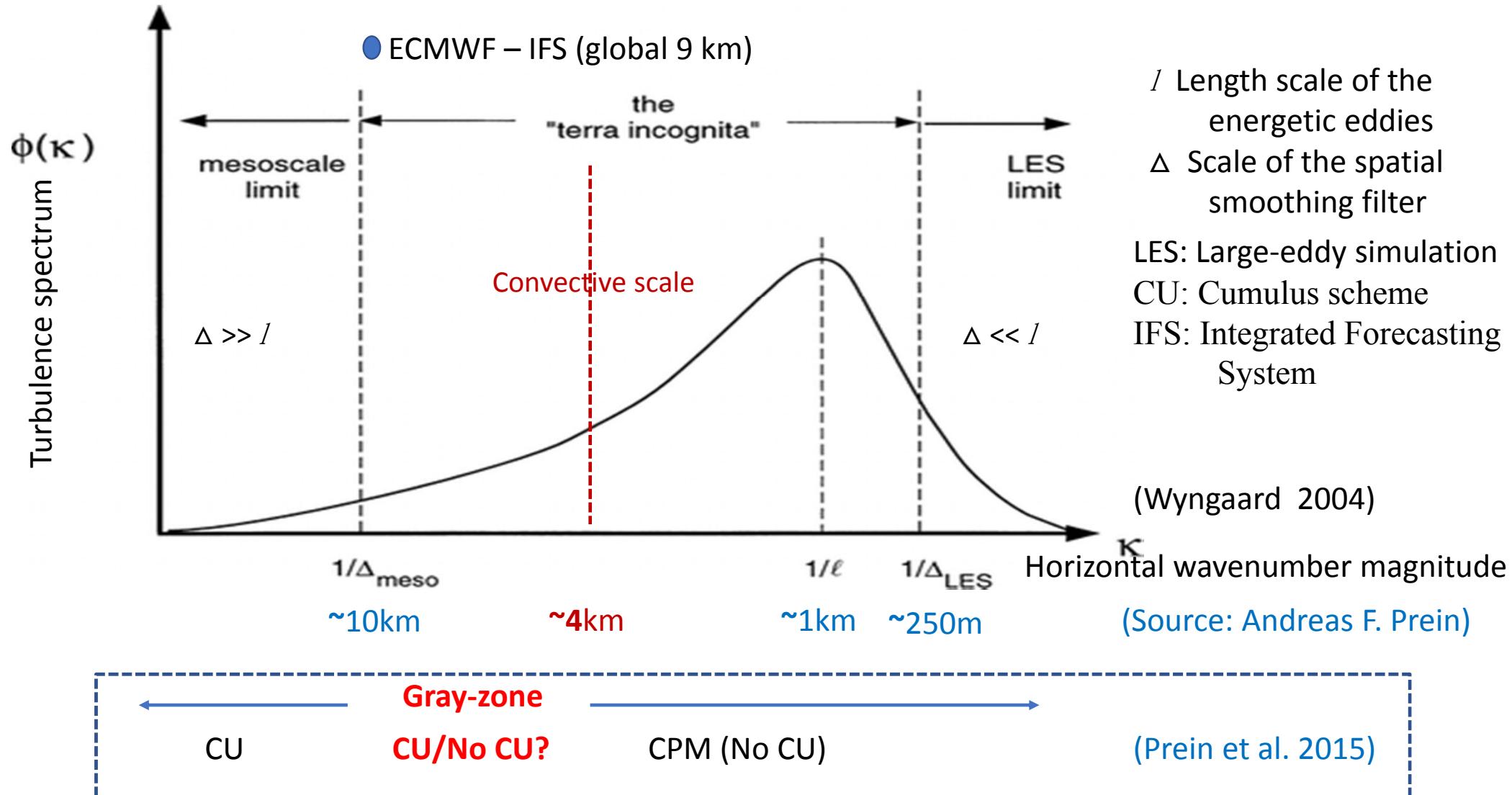
SMHI





A high-resolution regional **dynamical downscaling** is required.

Spatial scale and CU related to precipitation simulation



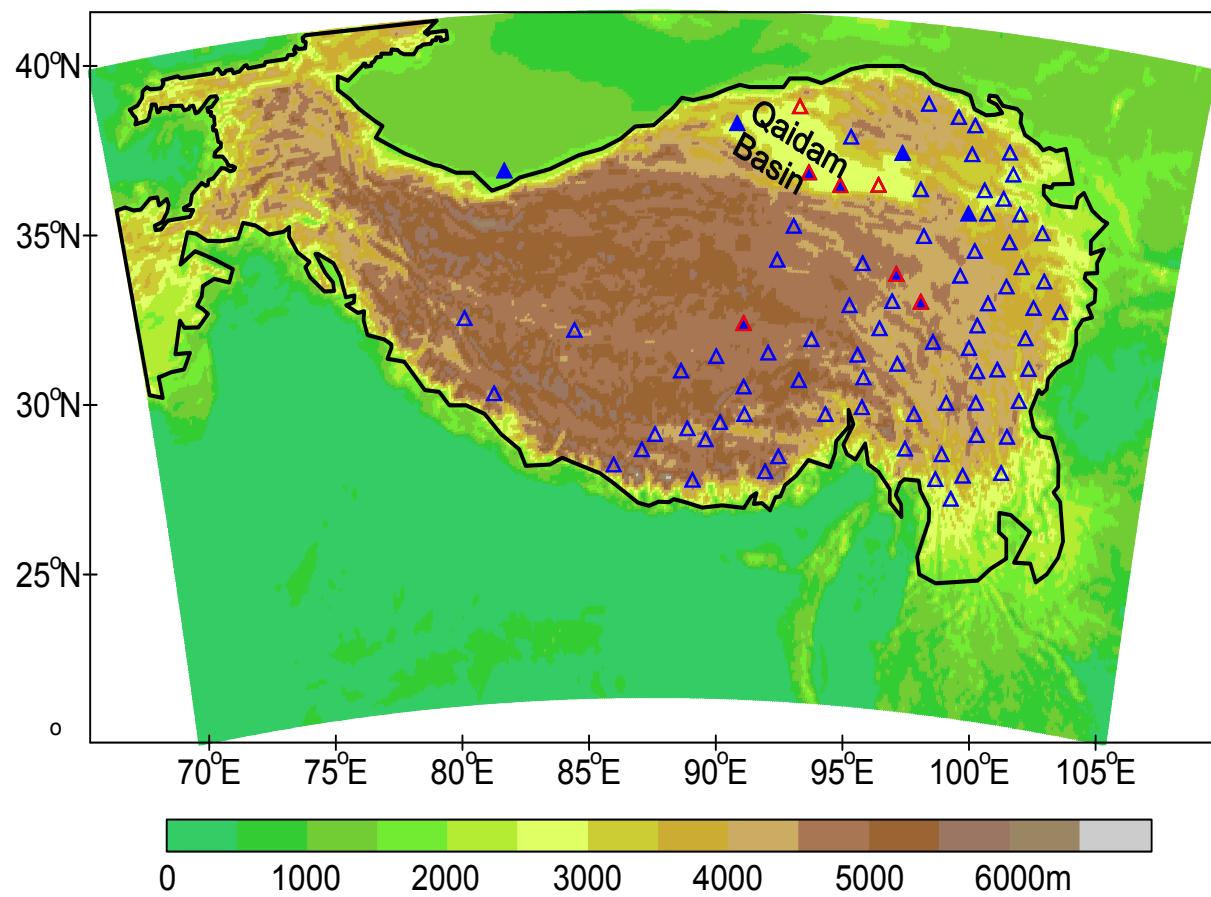
Question:

Is it necessary to use CU to realistically simulate diurnal cycle of precipitation at the gray-zone grid spacing (9 km) over the TP

Aim:

To investigate the impact of CUs on the simulations of summer rainfall diurnal cycle over the TP at the gray-zone grid spacing (9 km).

Model set up



WRF 3.7.1 – ERA5

9km, 60 level up to 10hp

Spectral nudging (3 hr)

X ~1900km, Y ~2200km

U/V, T, Φ , No Q

Nudging coefficient: 0.0003

No nudging in the PBL

No nudging below level 5

Limit nudging from above level 5

PBL: Yonsei University (YSU)

Land surface: Unified Noah Land Surface Model

Microphysics: Double Moment 6-class

Cus:

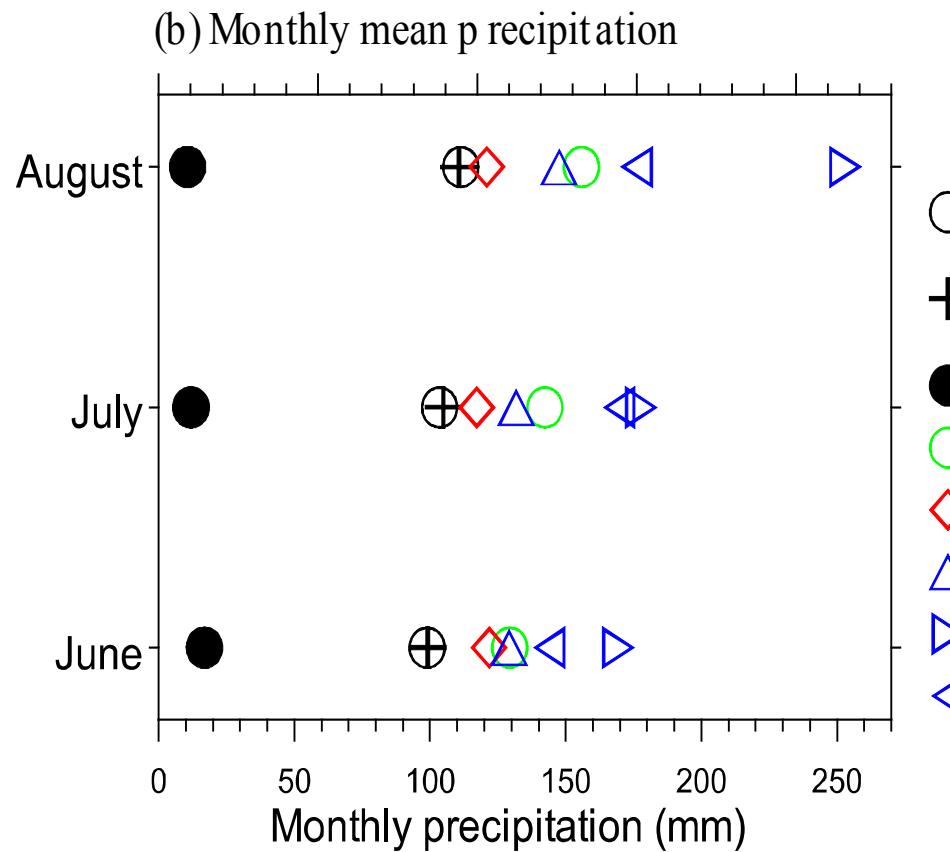
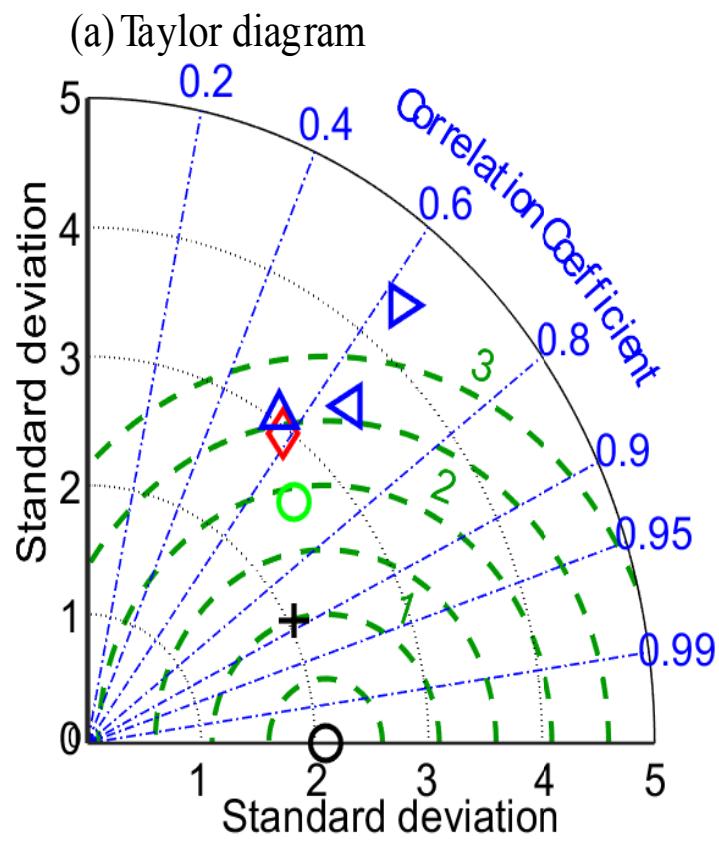
Without CU (no CU)

Multiscale Kain-Fritsch Scheme (MSKF)

Grell 3D Ensemble Scheme (Grell)

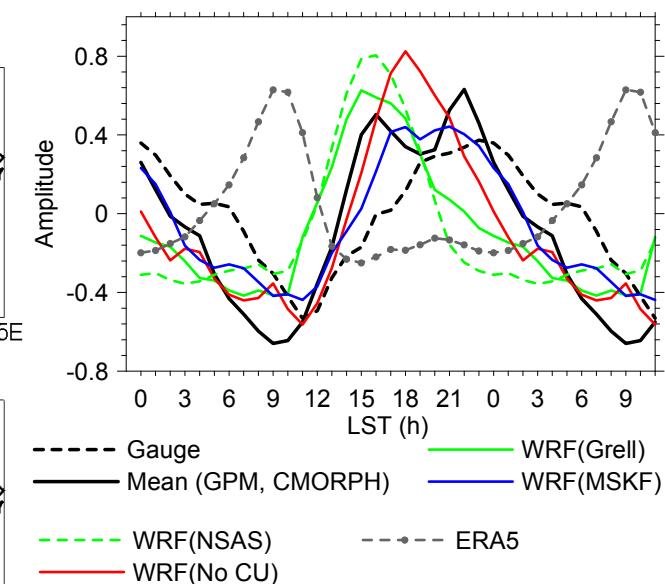
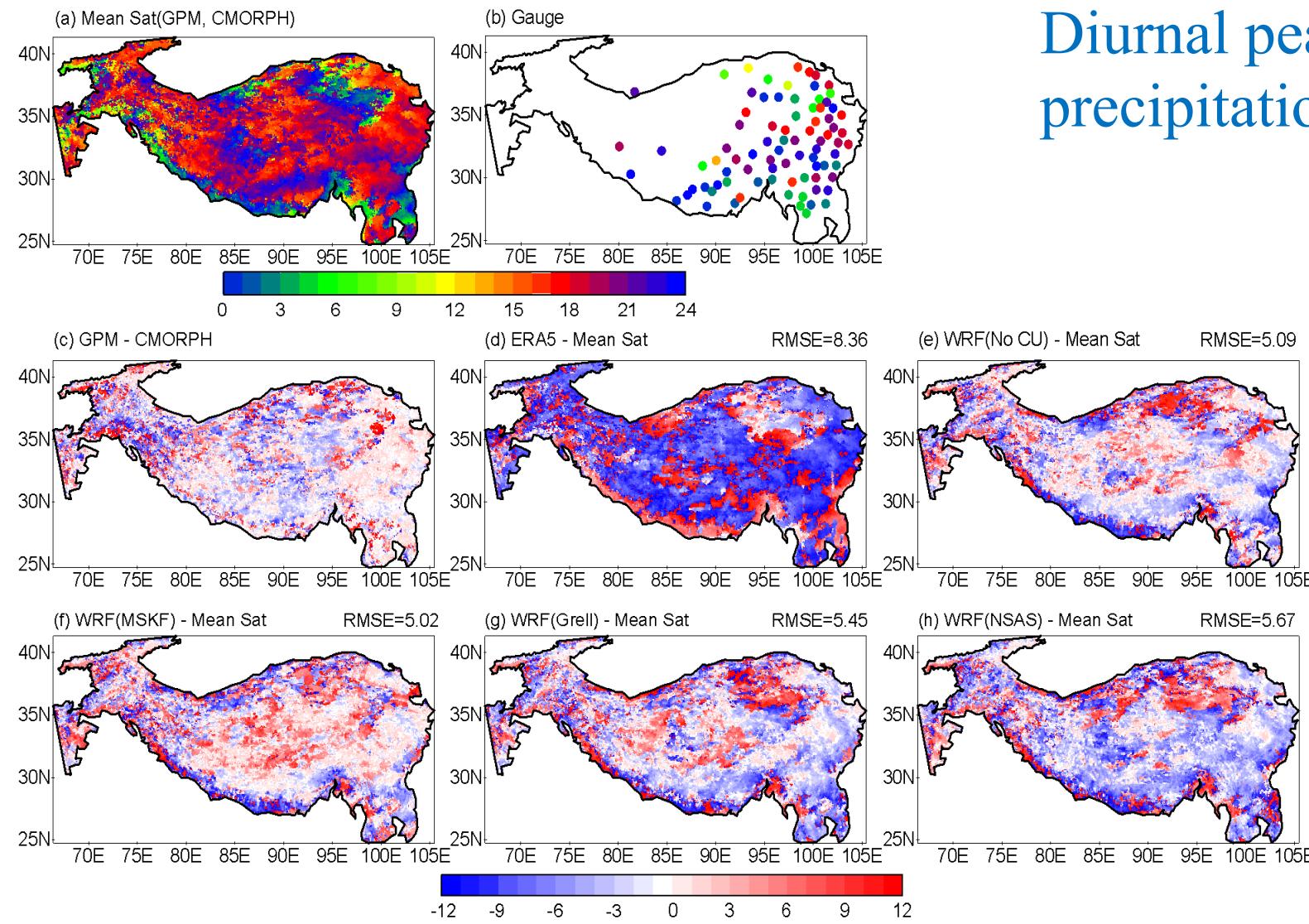
New Simplified Arakawa–Schubert Scheme (NSAS)

Simulated monthly mean precipitation



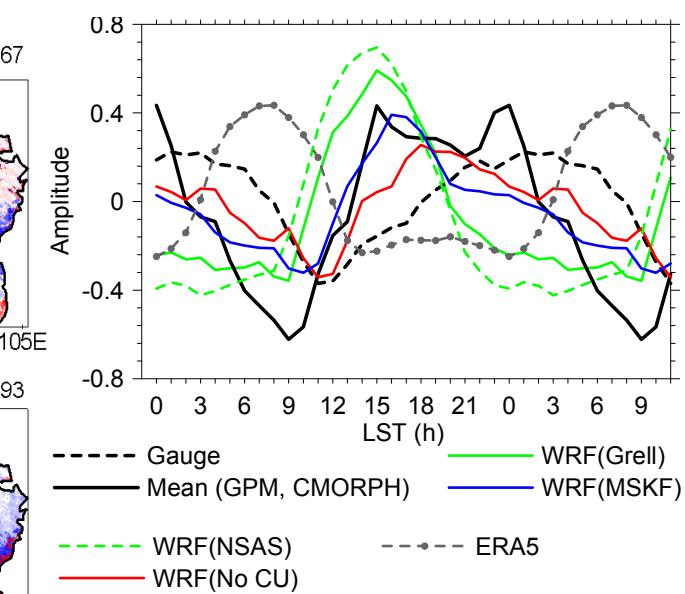
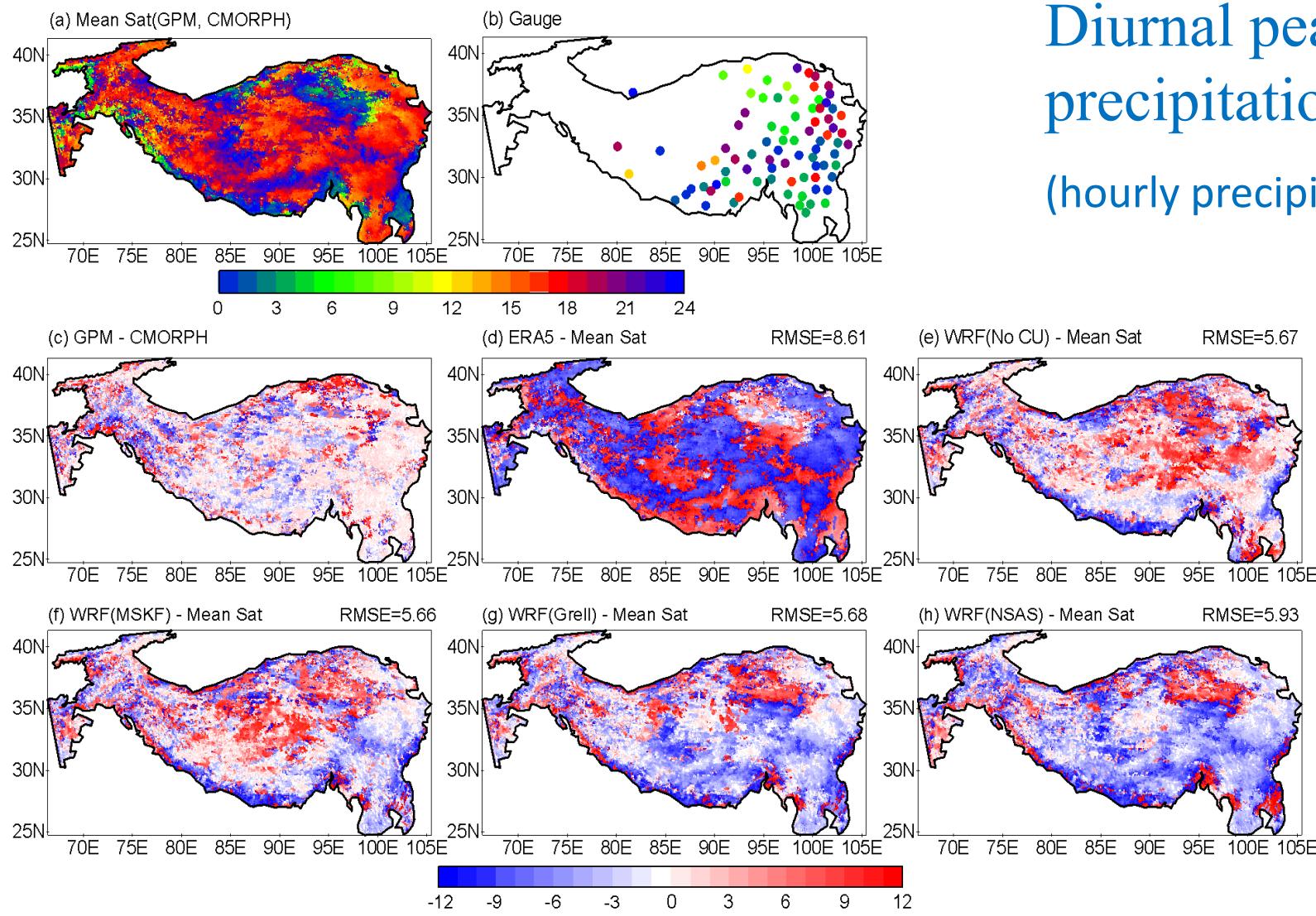
- Gauge
- ⊕ Mean Sat
(GPM, CMORPH)
- GPM - CMORPH
- ERA5
- ◆ WRF(No CU)
- △ WRF(MSKF)
- ▽ WRF(Grell)
- ▷ WRF(NSAS)

Diurnal peak time of precipitation amount (LST)

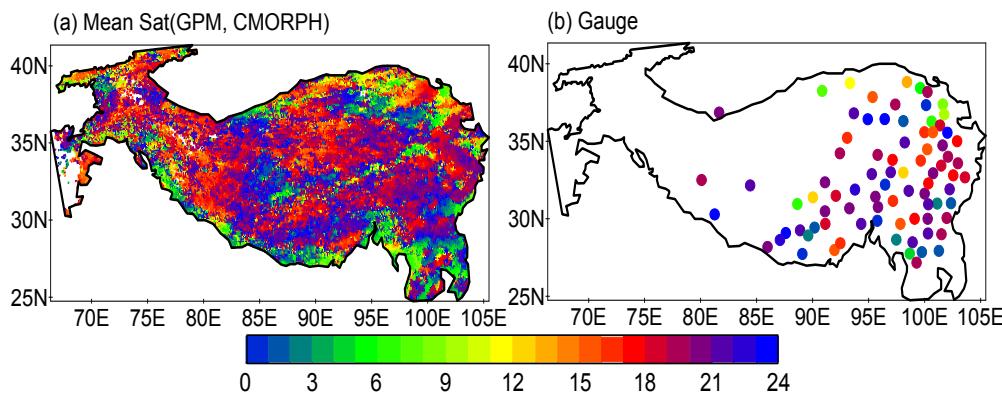


Diurnal peak time of precipitation frequency (LST)

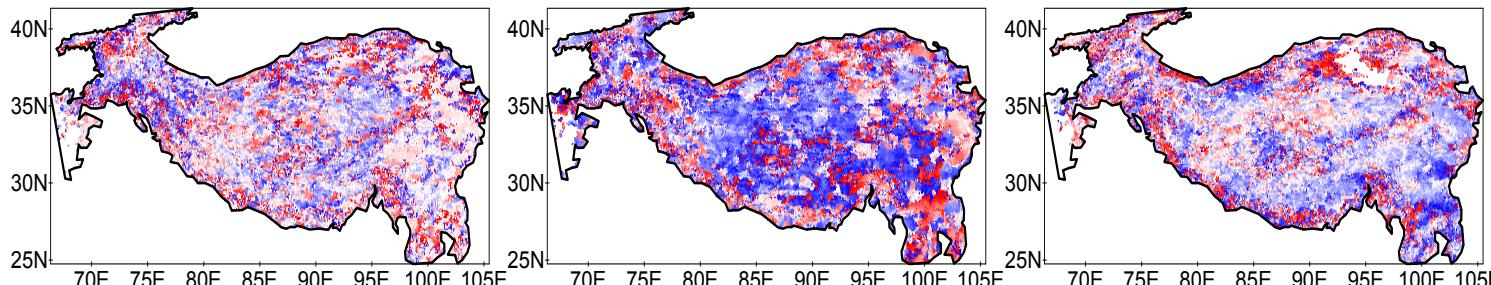
(hourly precipitation $\geq 0.1 \text{ mm h}^{-1}$)



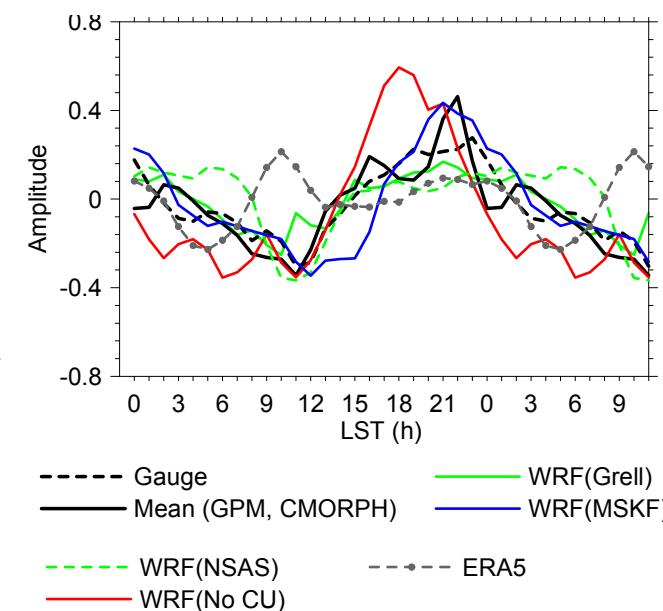
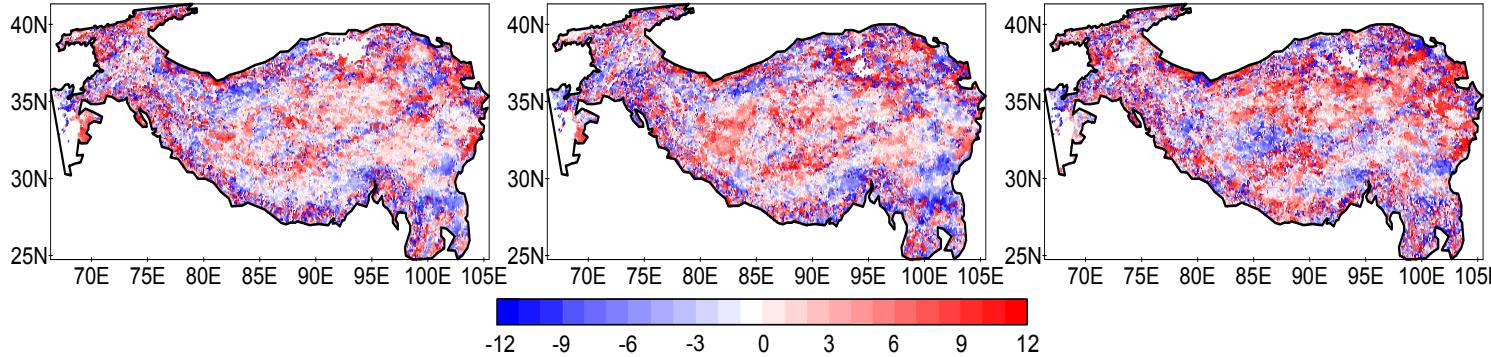
Diurnal peak time of precipitation intensity (LST)



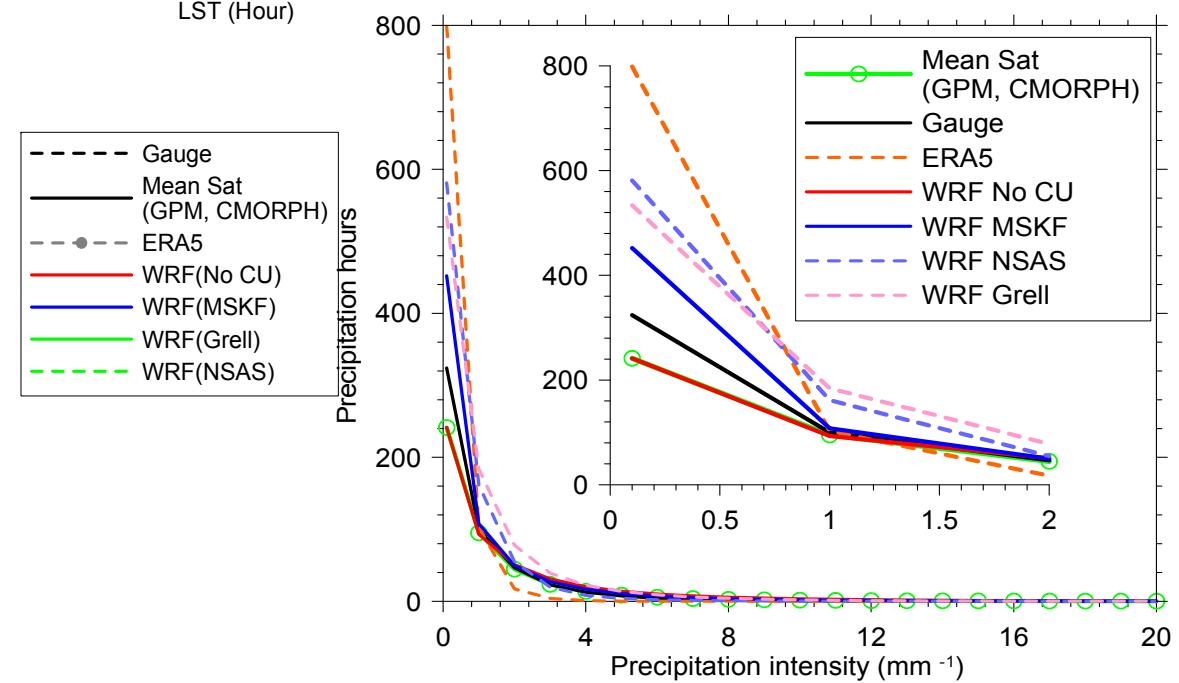
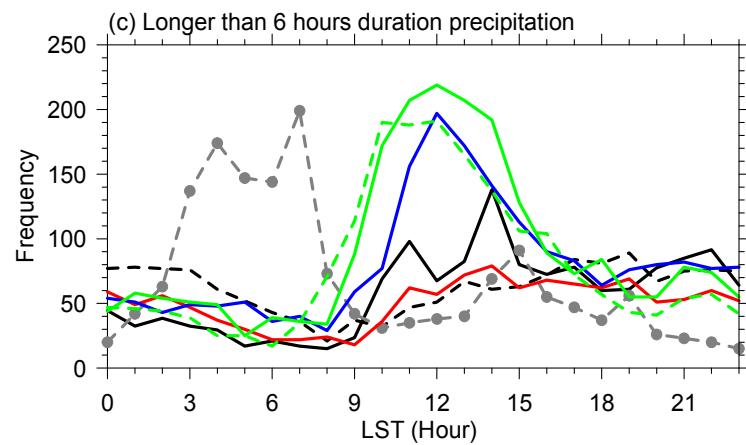
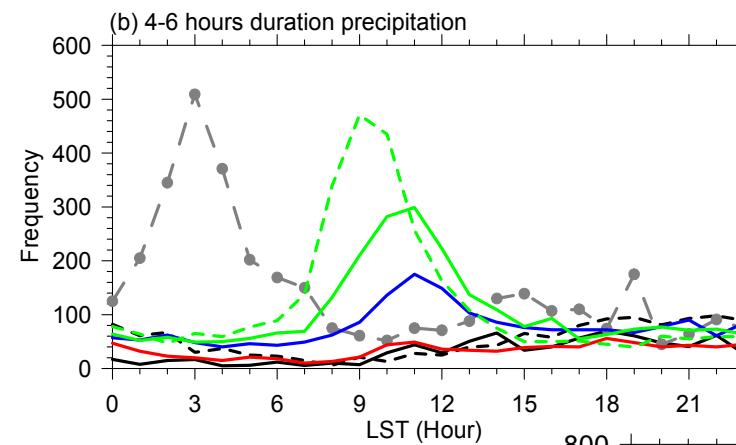
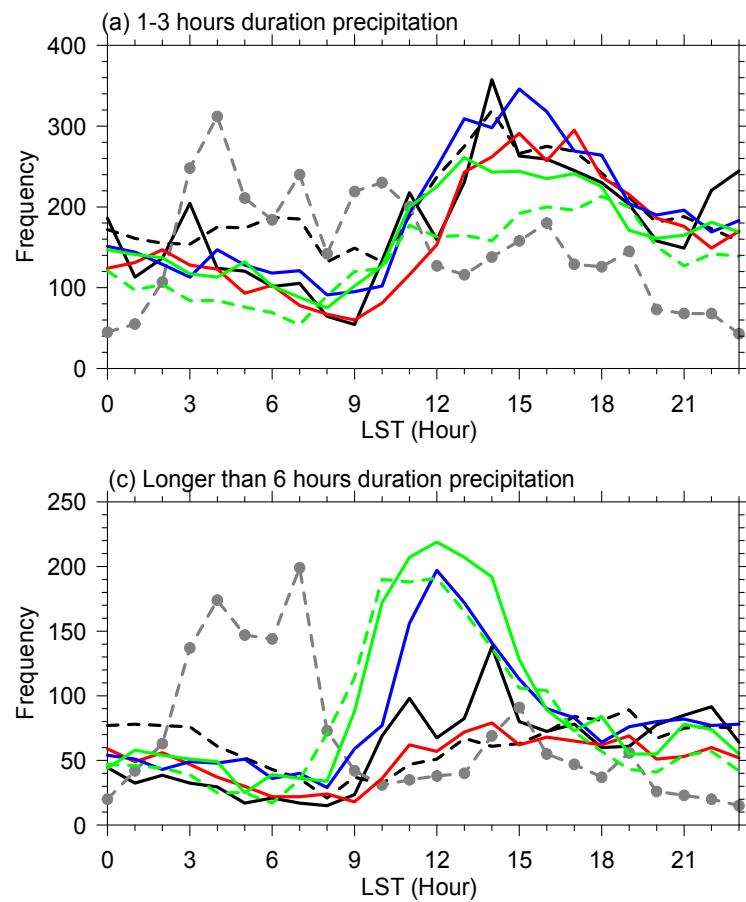
(c) GPM - CMORPH (d) ERA5 - Mean Sat RMSE=6.97 (e) WRF(No CU) - Mean Sat RMSE=5.51



(f) WRF(MSKF) - Mean Sat RMSE=5.31 (g) WRF(Grell) - Mean Sat RMSE=5.51 (h) WRF(NSAS) - Mean Sat RMSE=5.89



Diurnal distribution of the frequency of the start hour of precipitation events



Conclusions

- Simulations with CUs, especially the Grell and NSAS, tend to overestimate summer precipitation with an early peak of hourly precipitation frequency compared to observation;
- Both no-CU experiment and experiment with a scale aware CU, namely the MSKF, have their advantage in simulating the diurnal cycle of summer precipitation over the TP, with the no-CU experiment more realistically captured the diurnal cycle of precipitation frequency and the MSKF experiments better reproduced the diurnal cycle of precipitation intensity;
- No-CU works fine at 9km resolution.