The summertime warm bias over the central U.S. as examined in the short-term hindcast approach

Hsi-Yen Ma, Stephen A. Klein, Shaocheng Xie, Yunyan Zhang, Yuying Zhang (PCMDI/LLNL)

Min-Hui Lo (National Taiwan University)

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Lawrence Livermore National Laboratory

PCMDI

CAPT Cloud-Associated Parameterizations Testbed

LLNL-PRES-649401

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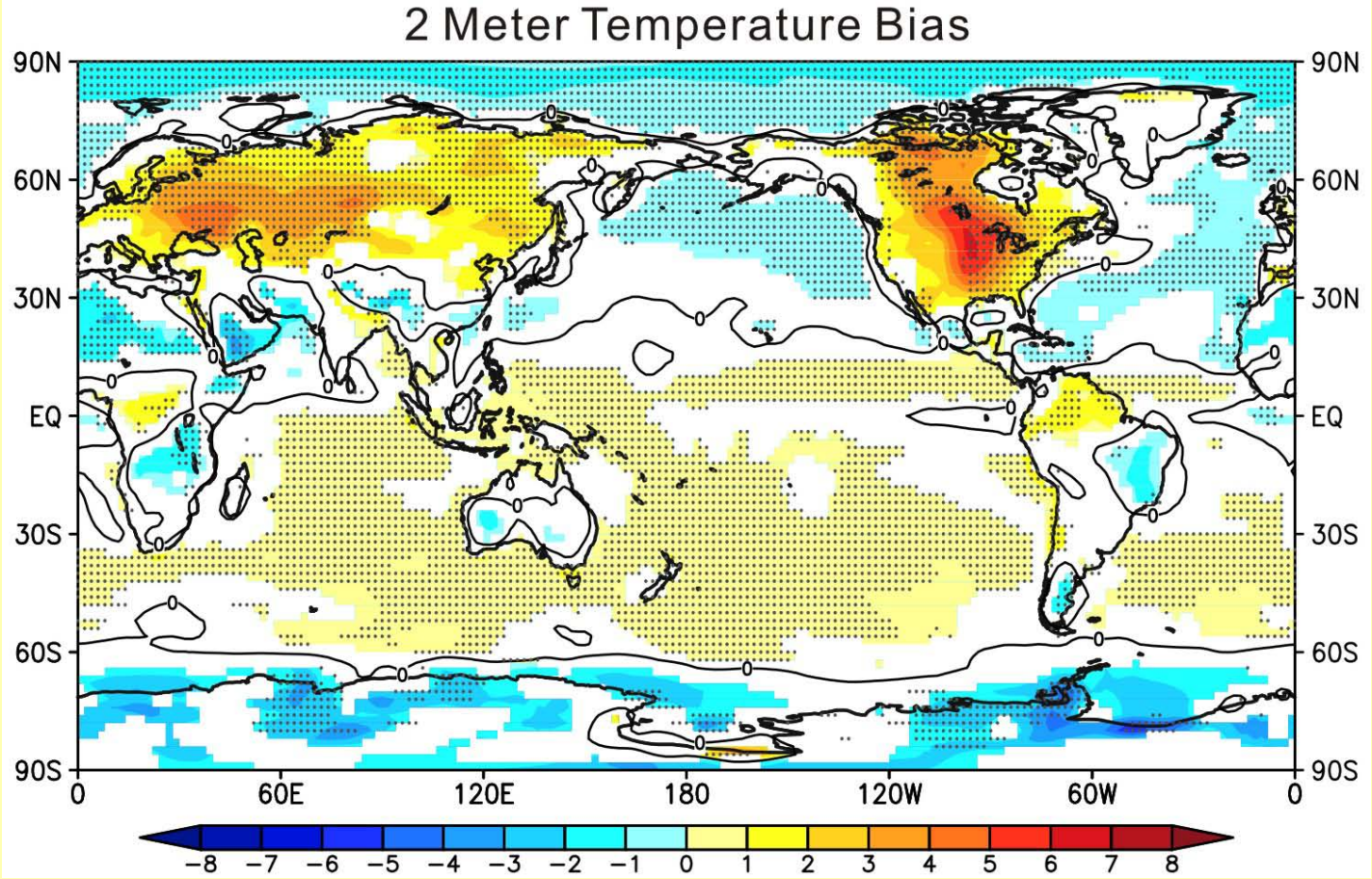
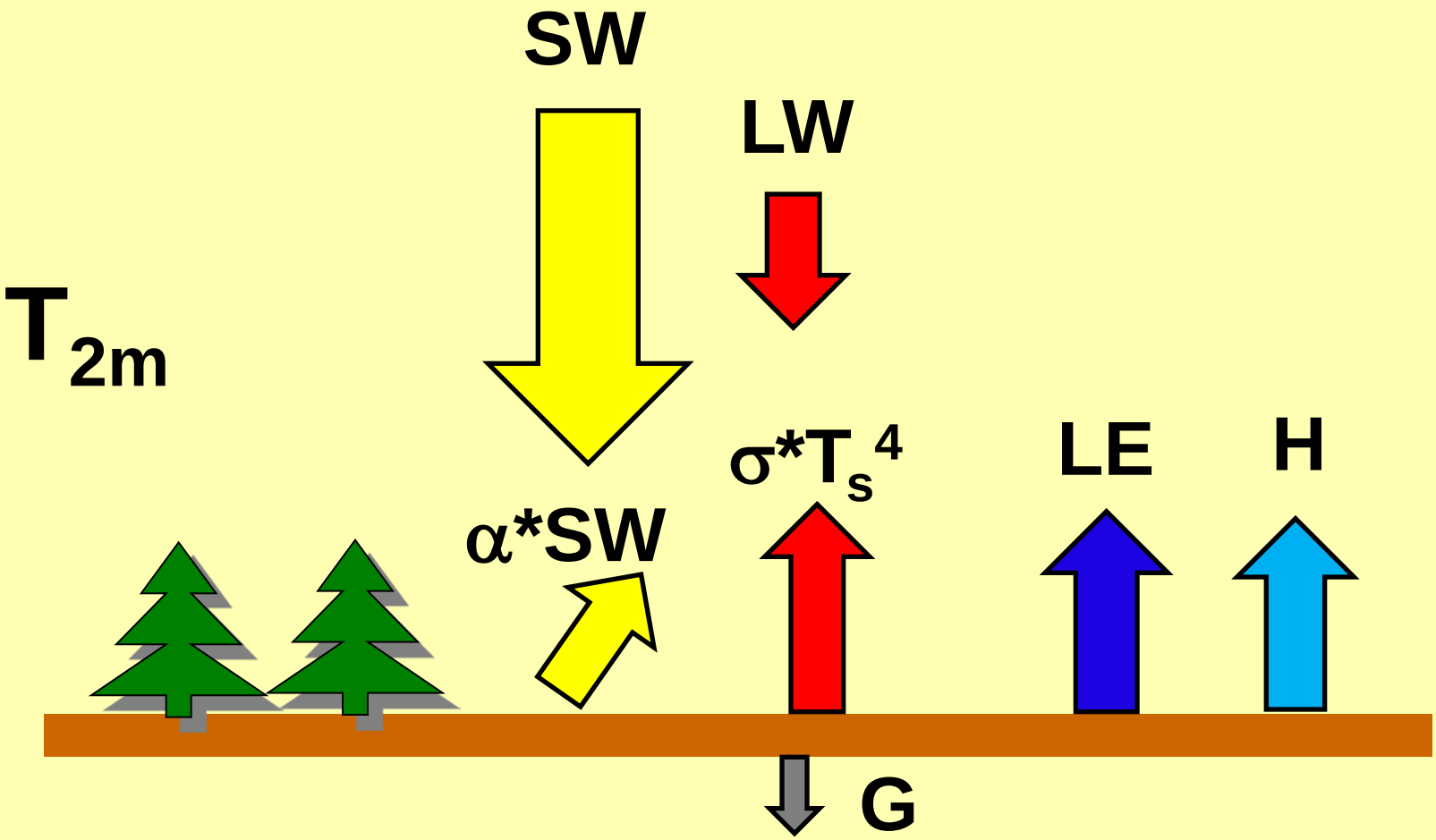
Large summertime near surface warm bias over mid-latitude continents



- CMIP5/AMIP vs Transpose AMIP II (Ma et. al. 2014, JCLI)

Surface air temperature (T_{2m}) and energy budget



Hypotheses:

Potential issues include:

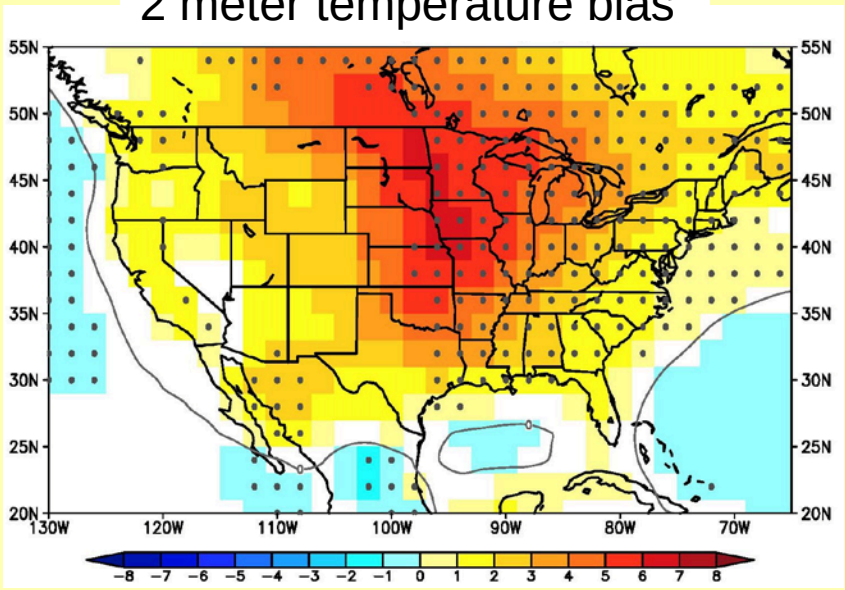
- The diurnal cycle of convection,
- Organization and propagation of convection,
- Timing of precipitation and how much evaporates,
- Radiative impact of convective cores, detrained cloud and anvils,
- Shallow convection,
- Surface fluxes,
- Soil moisture,
- .....

Clouds Above the United States and Errors at the Surface (CAUSES)

Aims:

A joint GASS/ASR intercomparison project aiming to evaluate clouds, radiation, and precipitation in hindcast mode and compare to ground-based and other observations.

2 meter temperature bias



- Focus on the errors in clouds and radiation

  Met Office: Cyril Morcrette and Jon Petch

- Focus on the simulated precipitation and surface energy budget

  LLNL: Hsi-Yen Ma, Steve Klein, Shaocheng Xie

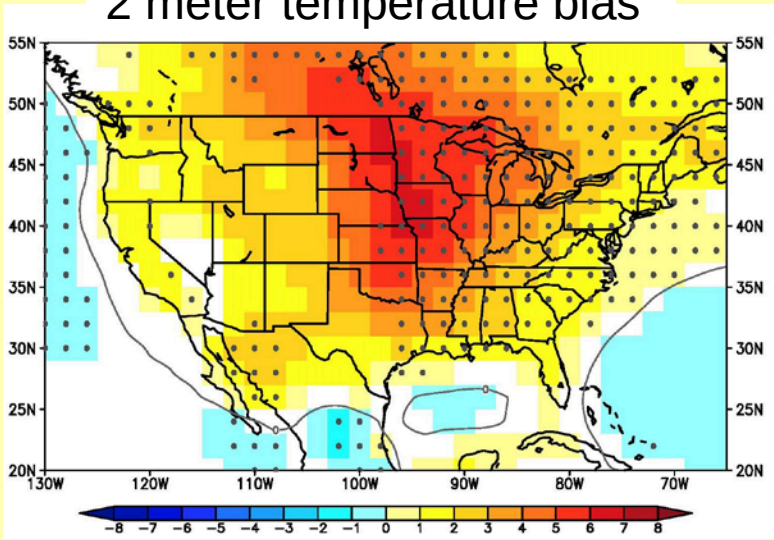
Scientific Questions?

- What is the relative contribution of precipitation errors to the temperature errors?
- Which type of precipitating convection systems dominate the errors in the surface precipitation?
- Does this atmosphere provide the correct amount of precipitation for the soil?
- Does the surface energy balance reveal signs that evaporation is underestimated due to the lack of soil moisture?

Model experiments

- CAM5 FV (0.9x1.25L30)
- Two sets of 2-day hindcasts
  - June-August of 2008
  - Same CAM initial conditions from YOTC analysis
  - Different CLM initial conditions
- The analysis will focus on Day 2 ensembles (24-48 hrs) of US summer time warm bias

2 meter temperature bias



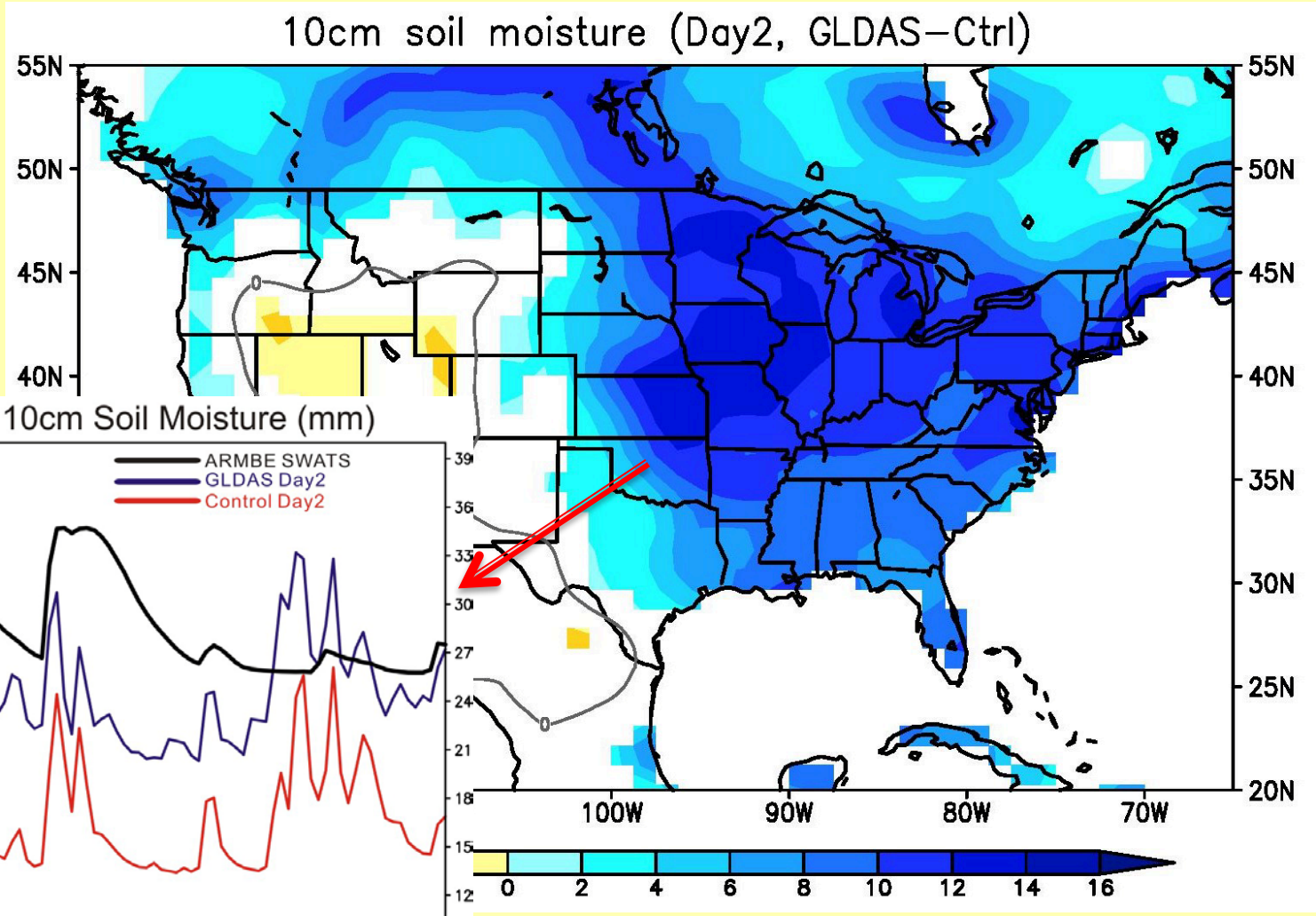
CLM initial conditions for CAPT experiments

- Control: Nudging method (Boyle et al. 2005), nudging start from Jan 2008 (CAM with CLM)
- GLDAS: CLM offline forced with GLDAS analysis from Jan 01, 1950

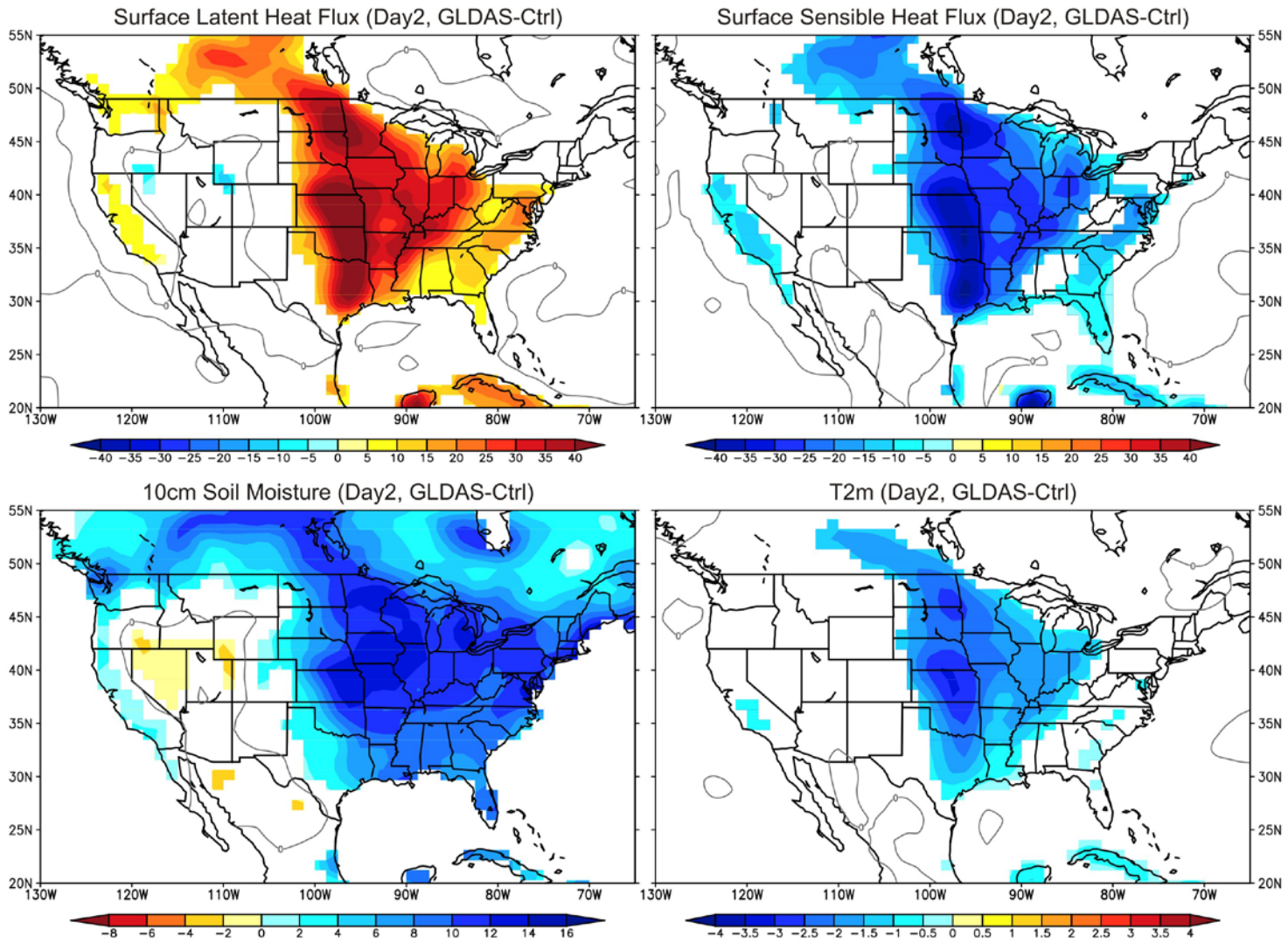
CLM restart files are saved as CAPT CLM initial conditions at 00Z every day from the hindcast period

GLDAS: Global Land Data Assimilation System (Fang et al. 2008)

10 CM Soil Water difference (Day2, JJA)



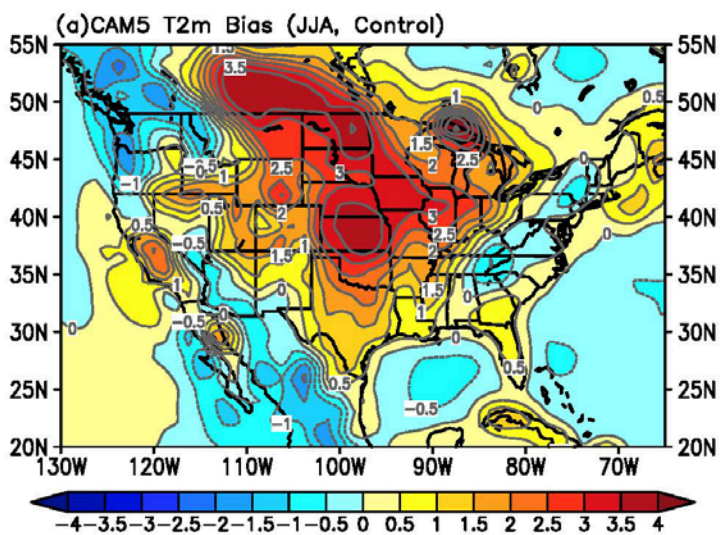
Surface Fluxes vs T_{2m} (Day 2, JJA)

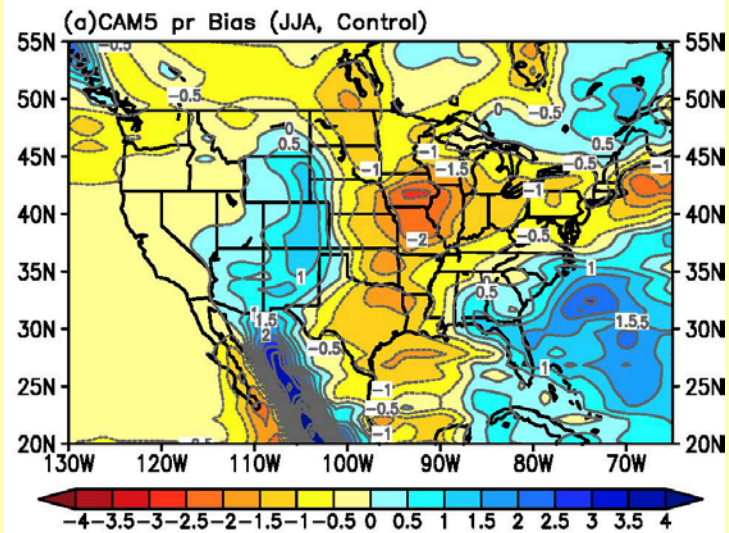


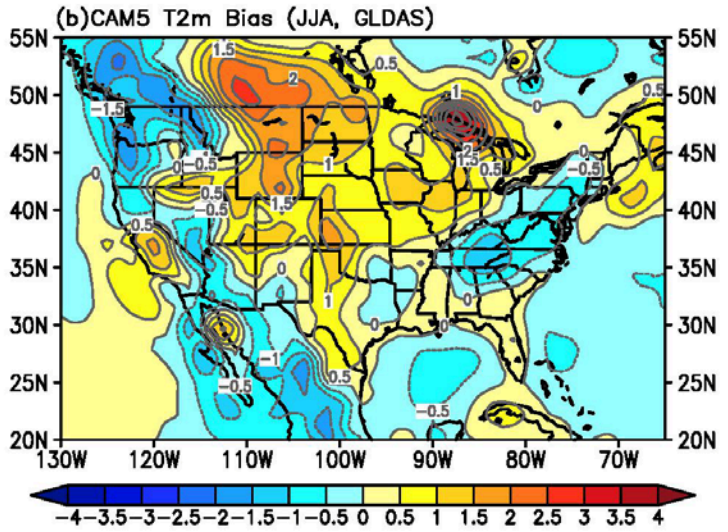
2 meter temperature / Precip Biases (Day 2)

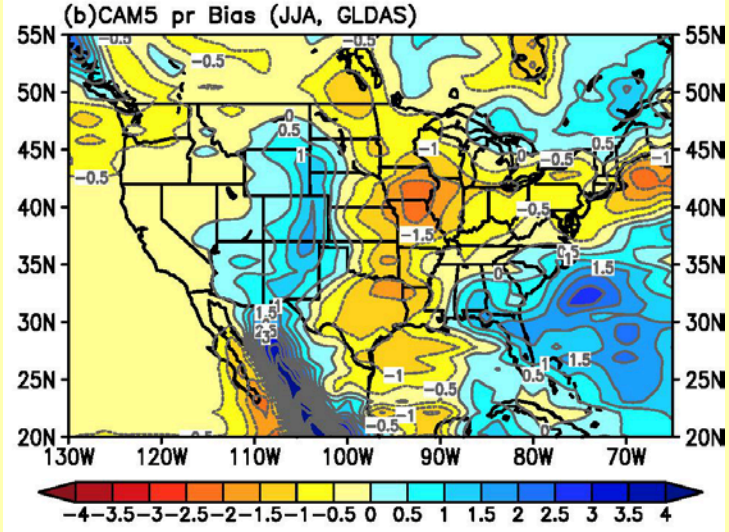
Control

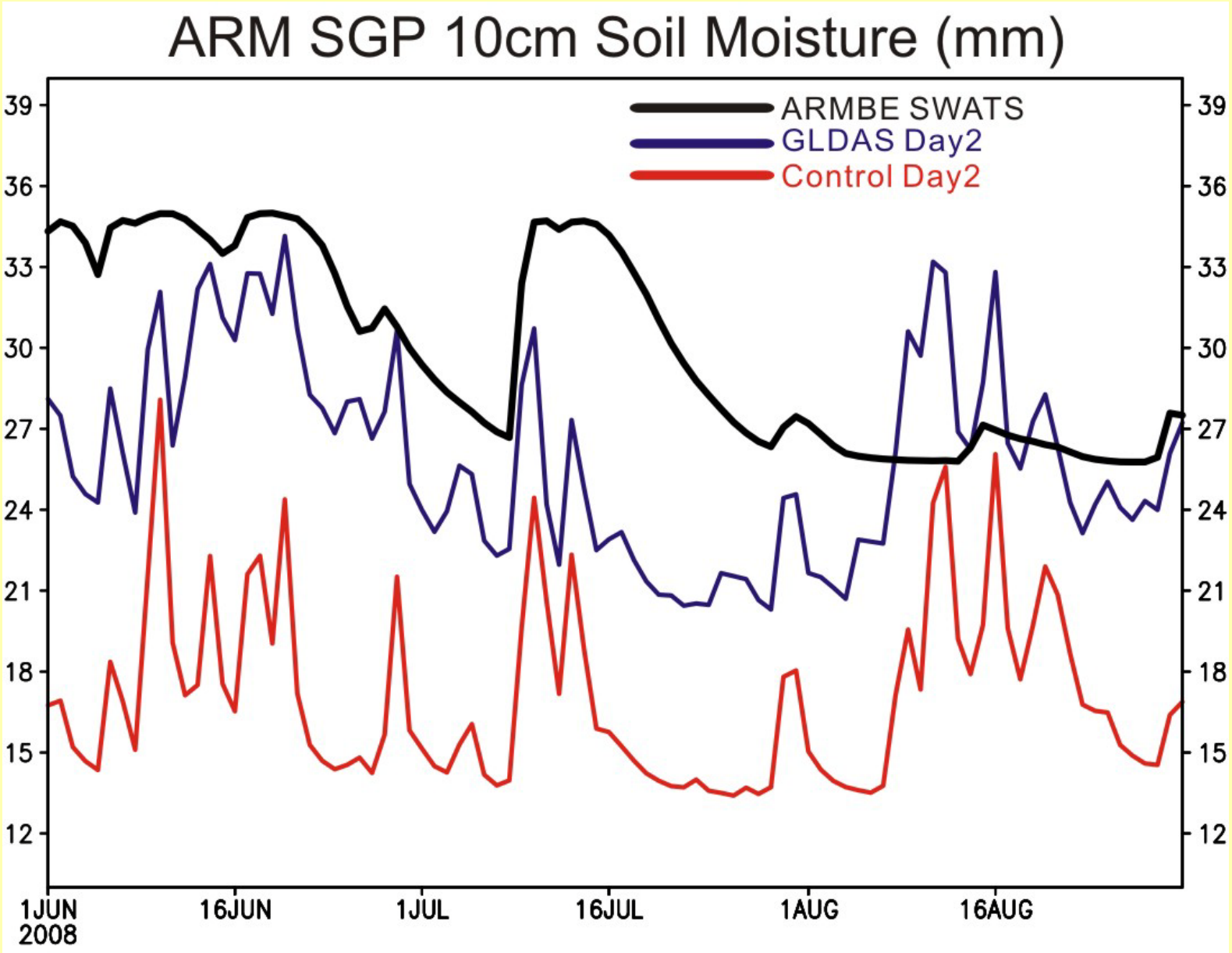
GLDAS







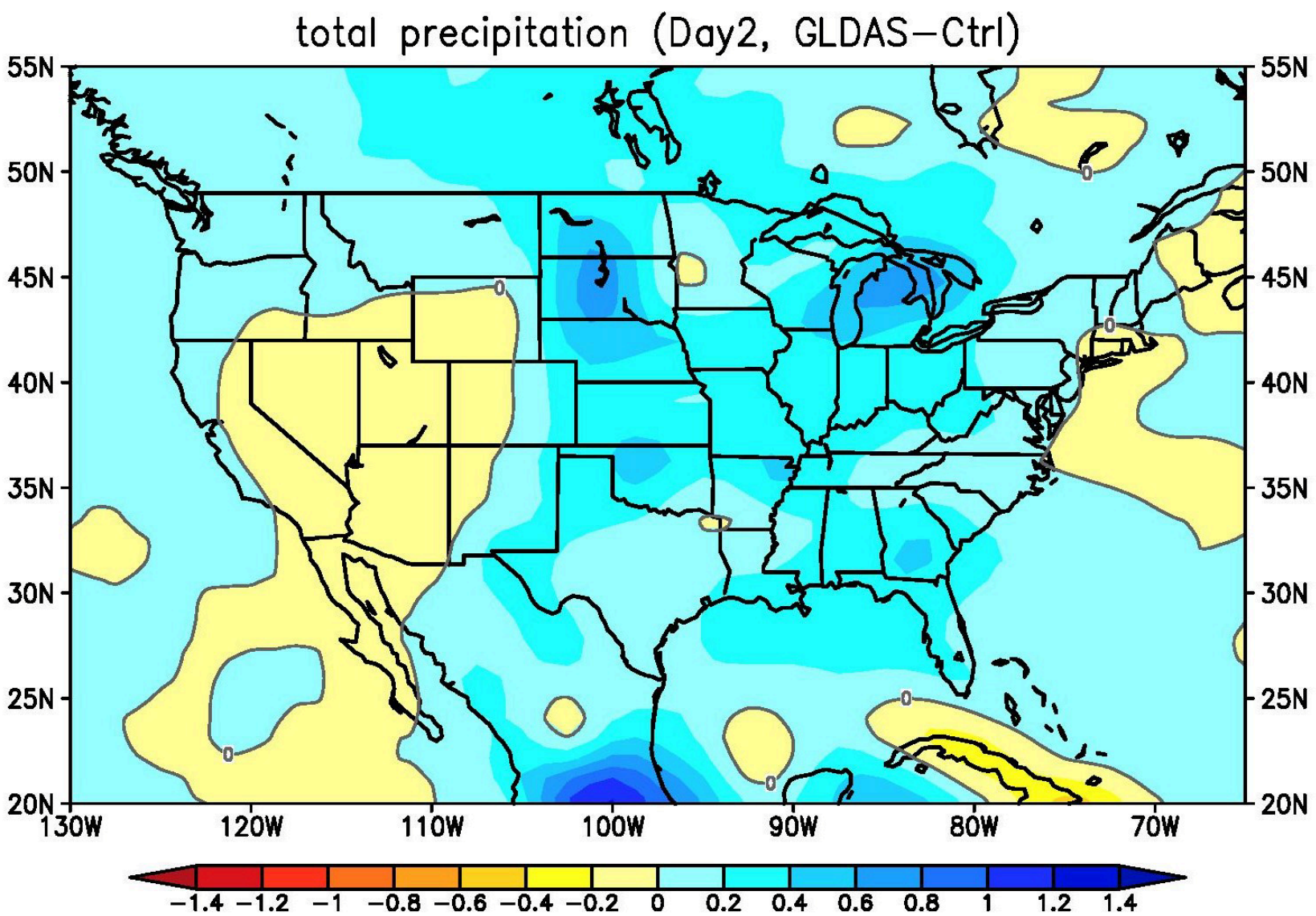



ARM SGP 10cm Soil Moisture (mm)
ARMBE SWATS
GLDAS Day2
Control Day2
39
36
33
30
27
24
21
18
15
12
1JUN
2008
16JUN
1JUL
16JUL
1AUG
16AUG

Summary and Future Plan:

- Does the surface energy balance reveal signs that evaporation is underestimated due to the lack of soil moisture?
  - The low soil moisture in the land model is likely the cause of surface warm temperature biases.
  - We will switch the soil moisture, temperature or other key variables one by one in the CLM from the GLDAS initial condition to Ctrl initial condition, and then perform the hindcasts.
- Does this atmosphere provide the correct amount of precipitation for the soil?
  - The biased low precipitation is likely one the key.
  - Organization and propagation of convection, or ...?

Precipitation difference



SGP Daily Precipitation