Precipitation at High Resolution. What does resolution buy us ?

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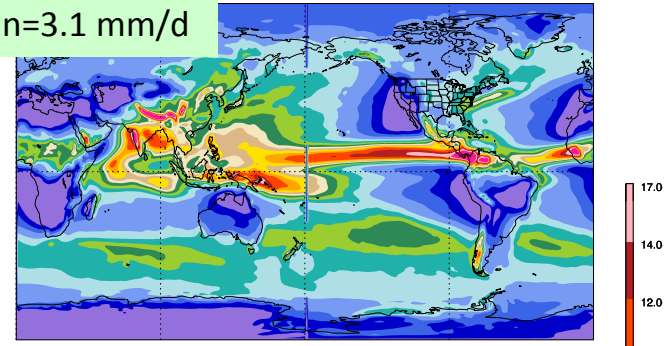
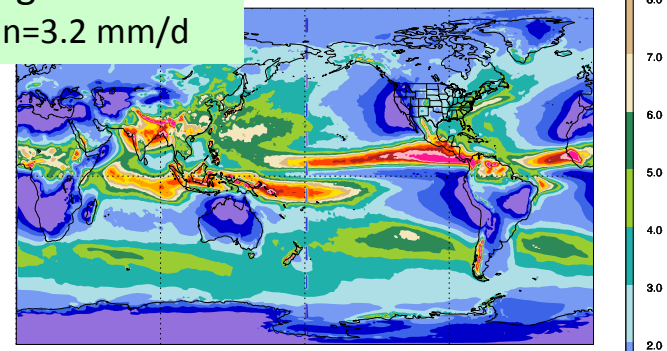
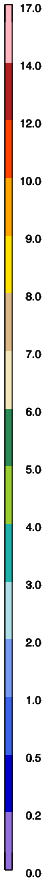
1980-2005 JJA mean precipitation in CAM5 AMIP runs

1 degree
mean=3.1 mm/d

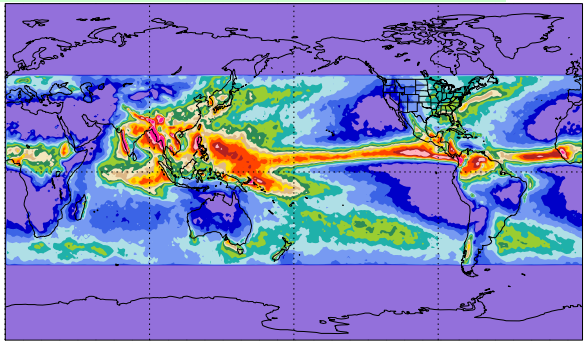


¼ degree
mean=3.2 mm/d

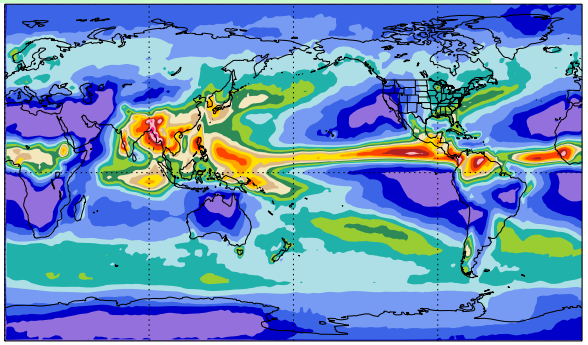


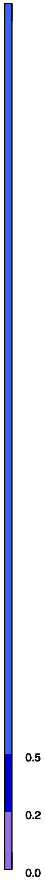


Observed (TRMM 2000-2005)



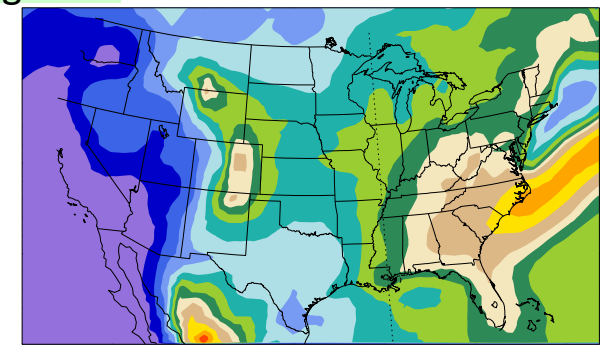
Observed (GPCP 1998-2005)



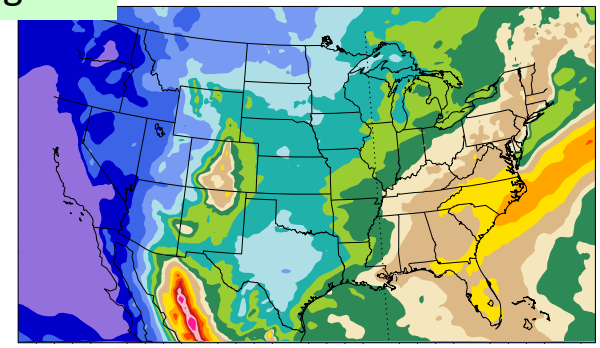


JJA

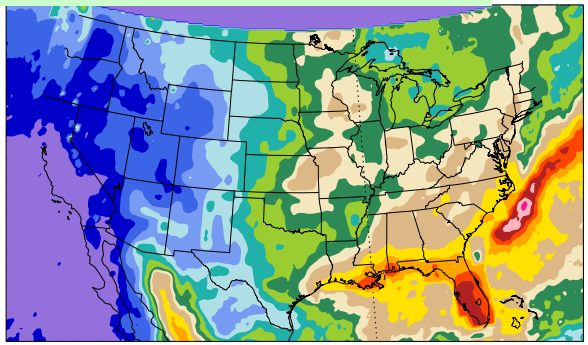
1 degree

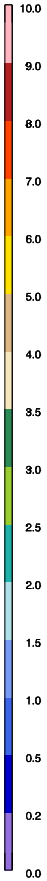


¼ degree



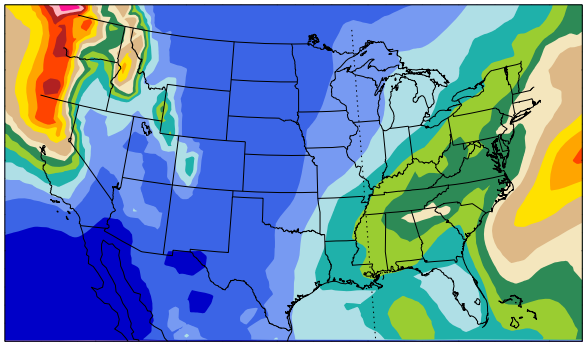
Observed (TRMM 2000-2005)



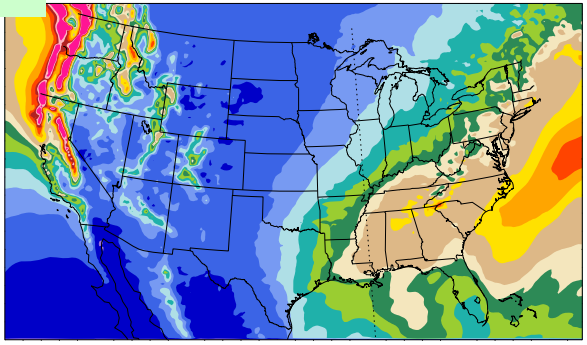


DJF

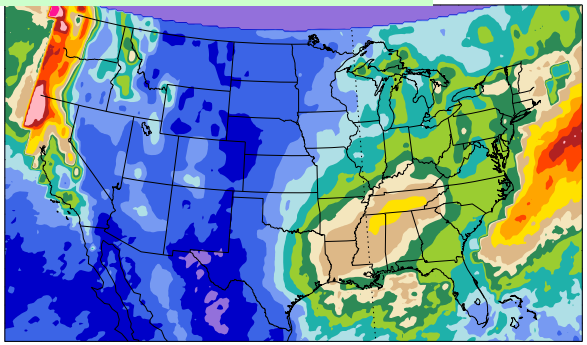
1 degree

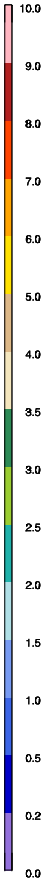


¼ degree

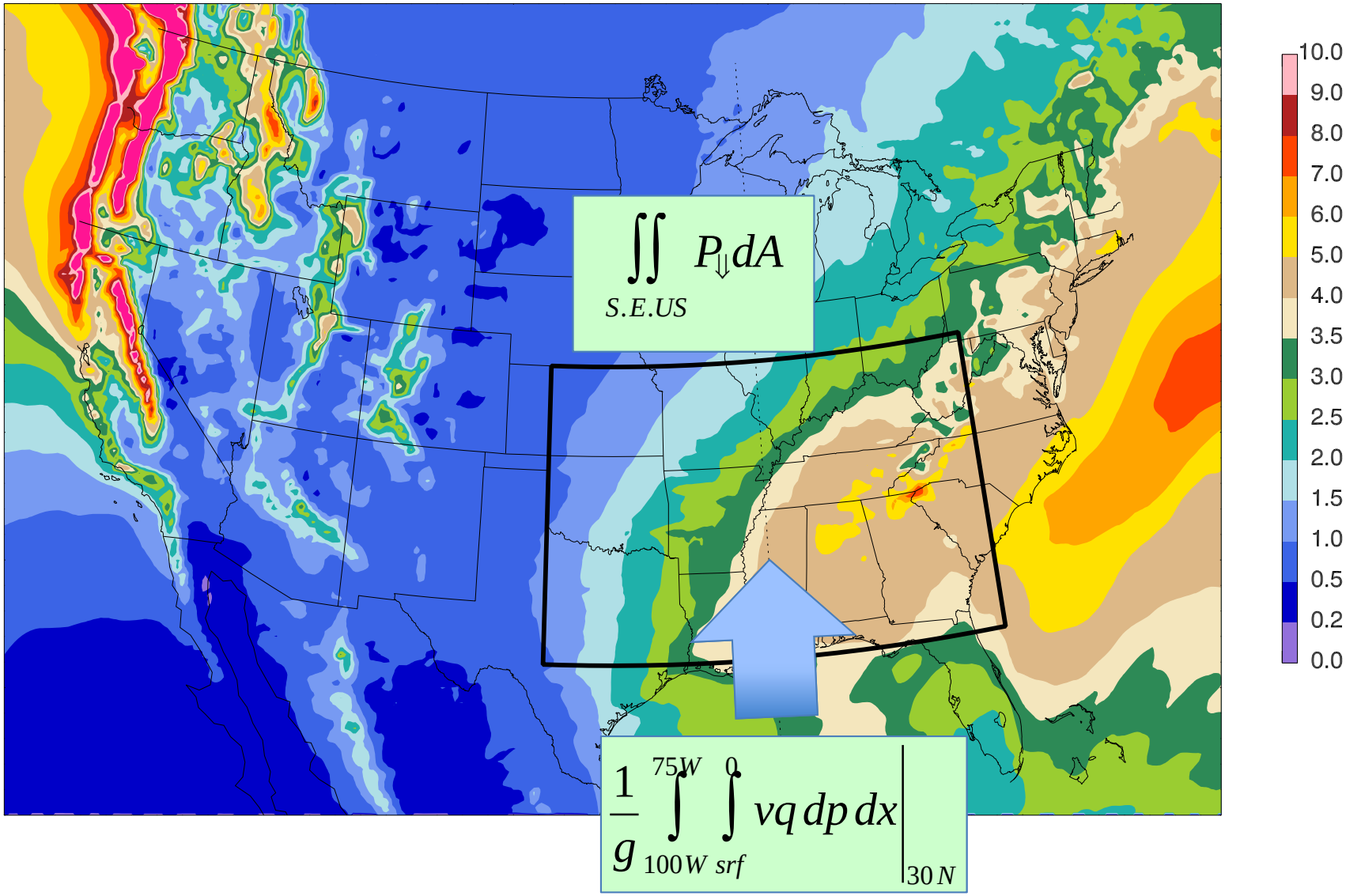


Observed (TRMM 2000-2005)



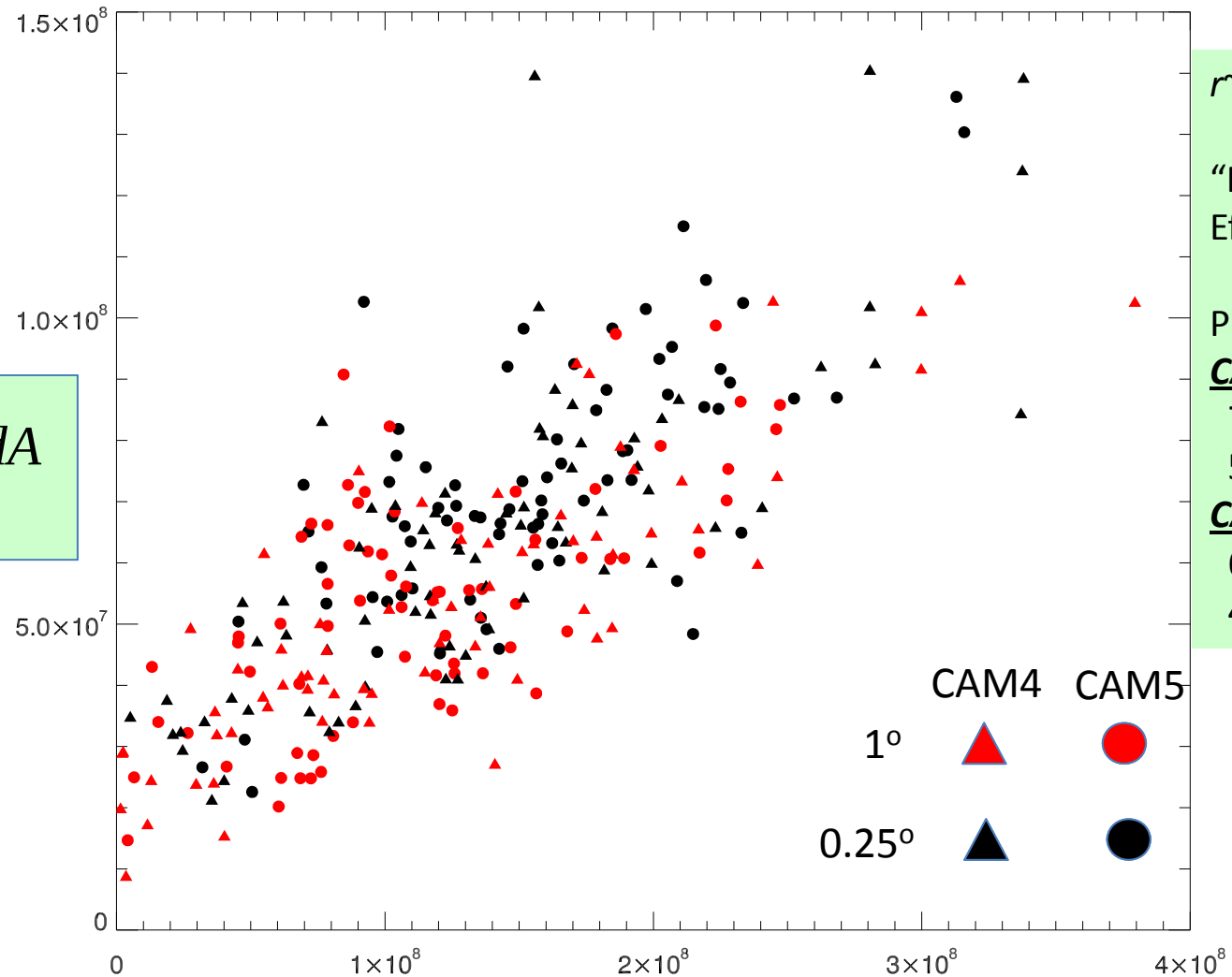


Winter-early spring precipitation over SE US is a bright spot for high-resolution simulations in CAM. (Other models?)


$\iint_{S.E.US} P_{\Downarrow} dA$
$\frac{1}{g} \int_{100W}^{75W} \int_{srf}^{0} vq\, dp\, dx \Big|_{30N}$
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.2
0.0

DJF Northward moisture transport into SE US vs. area integrated precipitation

$$\iint_{S.E.US} P_{\Downarrow} dA$$



$$\frac{1}{g}\int_{100W}^{75W}\int_{srf}^{0} vq\,dp\,dx\Big|_{30N}$$

r~0.7 for all cases

"Regional Efficiency" ~0.3-0.4

Precip means

CAM5

7.3e7 kg/s (1/4 deg)

5.2e7 (1 deg)

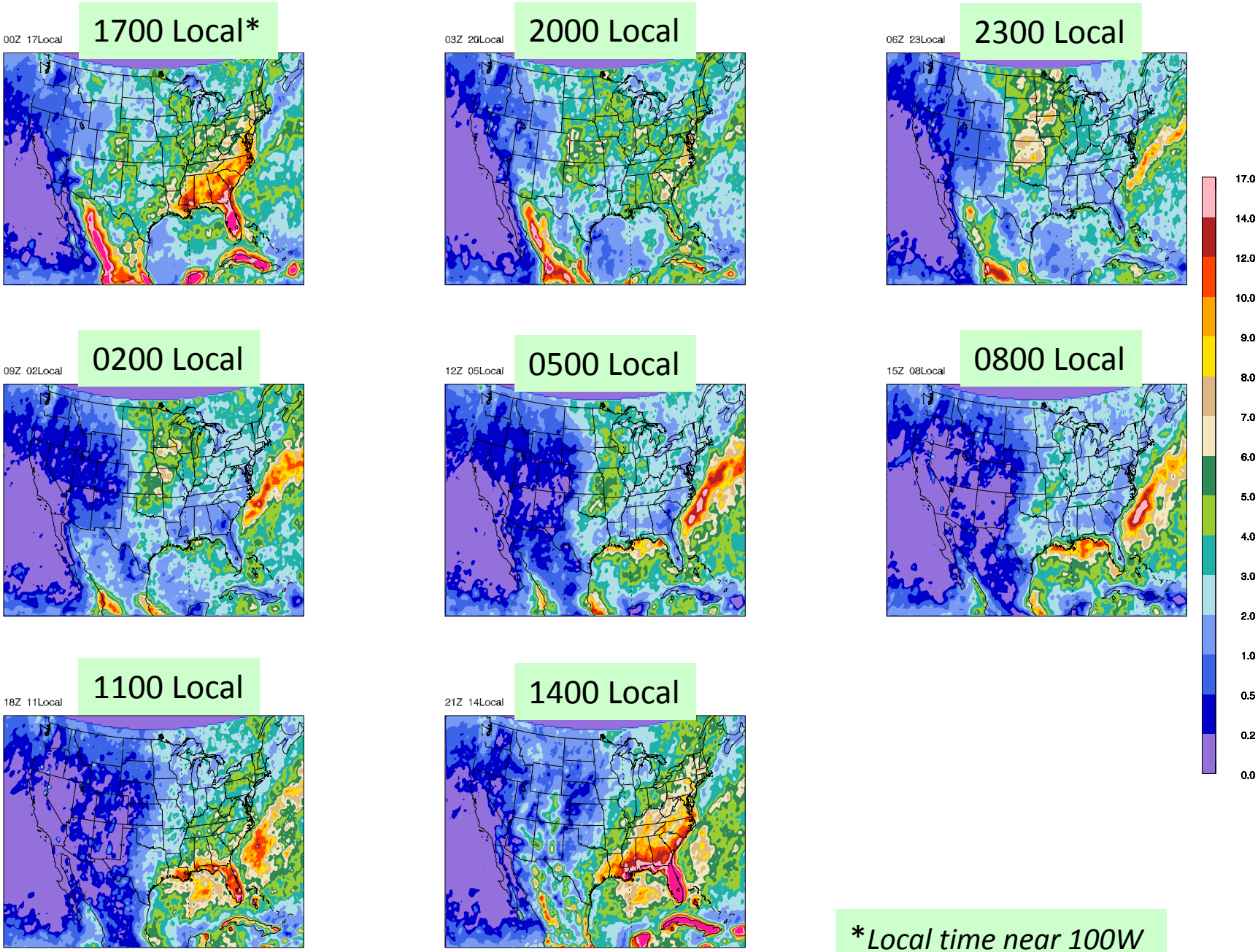
CAM4

6.2e7 (1/4 deg)

4.9e7 (1 deg)

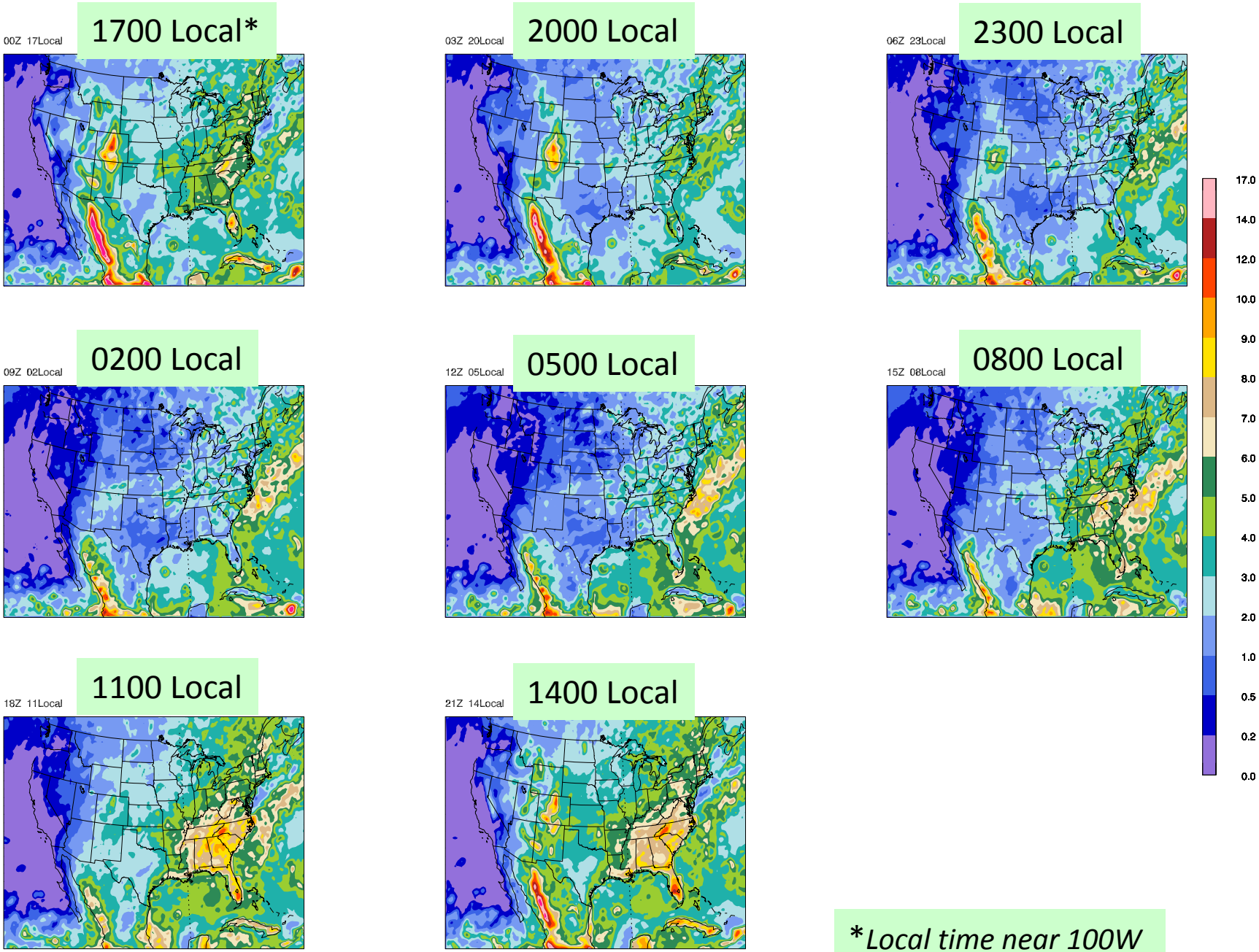
Simulated summer precipitation over US in CAM misses upper-midwest maximum at 1 and ¼ degree. (Other models?)

Mean diurnal cycle of precipitation in JJA 2000-2005 TRMM



**Local time near 100W*

Mean diurnal cycle of precipitation in JJA 2000-2005 CAM5



**Local time near 100W*

What is the impact of resolution for future projections ?

- **Present-day time-slice: Observed SSTs**

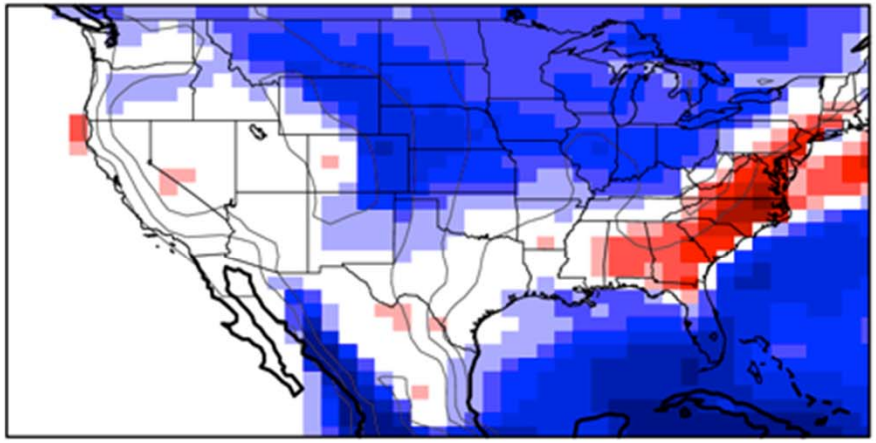
- **Future time-slice: SSTs from RCP8.5**
  + use correction for CESM SST bias
  + use correction for sea-ice cover (Hurrell *et al*, 2008)

- **Precipitation change = Prec[2081-2100] – Prec[1981-2000]**

Change in precipitation over the US

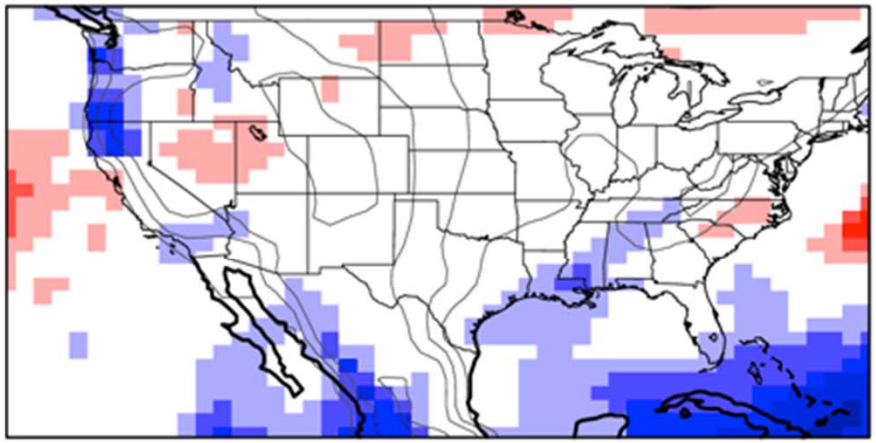
CAM4 (1°)

J
J
A

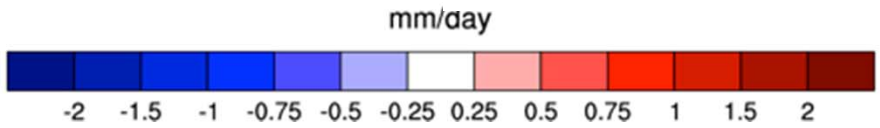


Summer drought

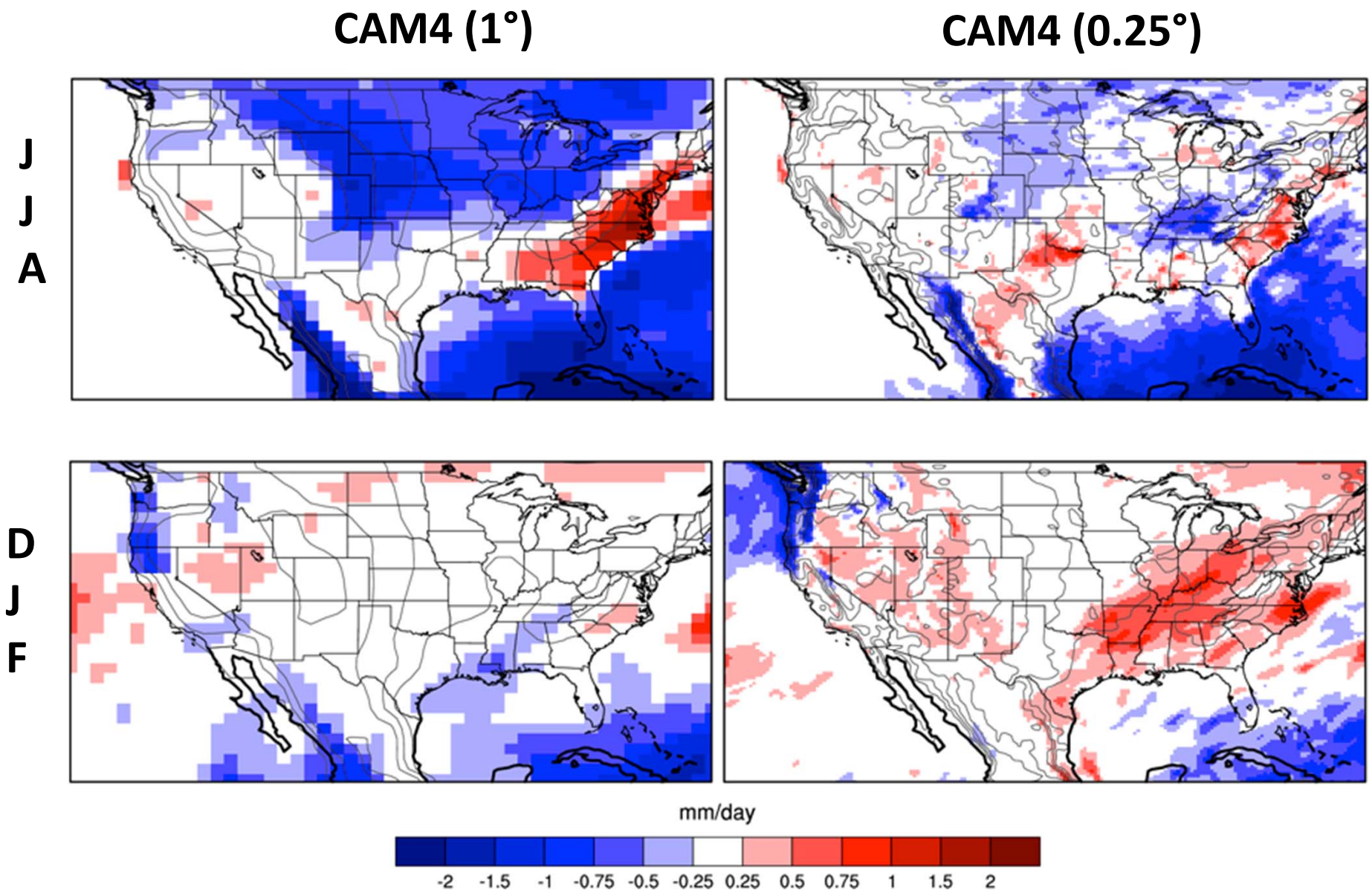
D
J
F



Changes are less dramatic in winter



Change in precipitation over the US



Seasonal pattern ⇔ High frequency data (daily)

- Seasonal pattern of precipitation → Precipitation frequency / Precipitation intensity

- How often does it rain ?

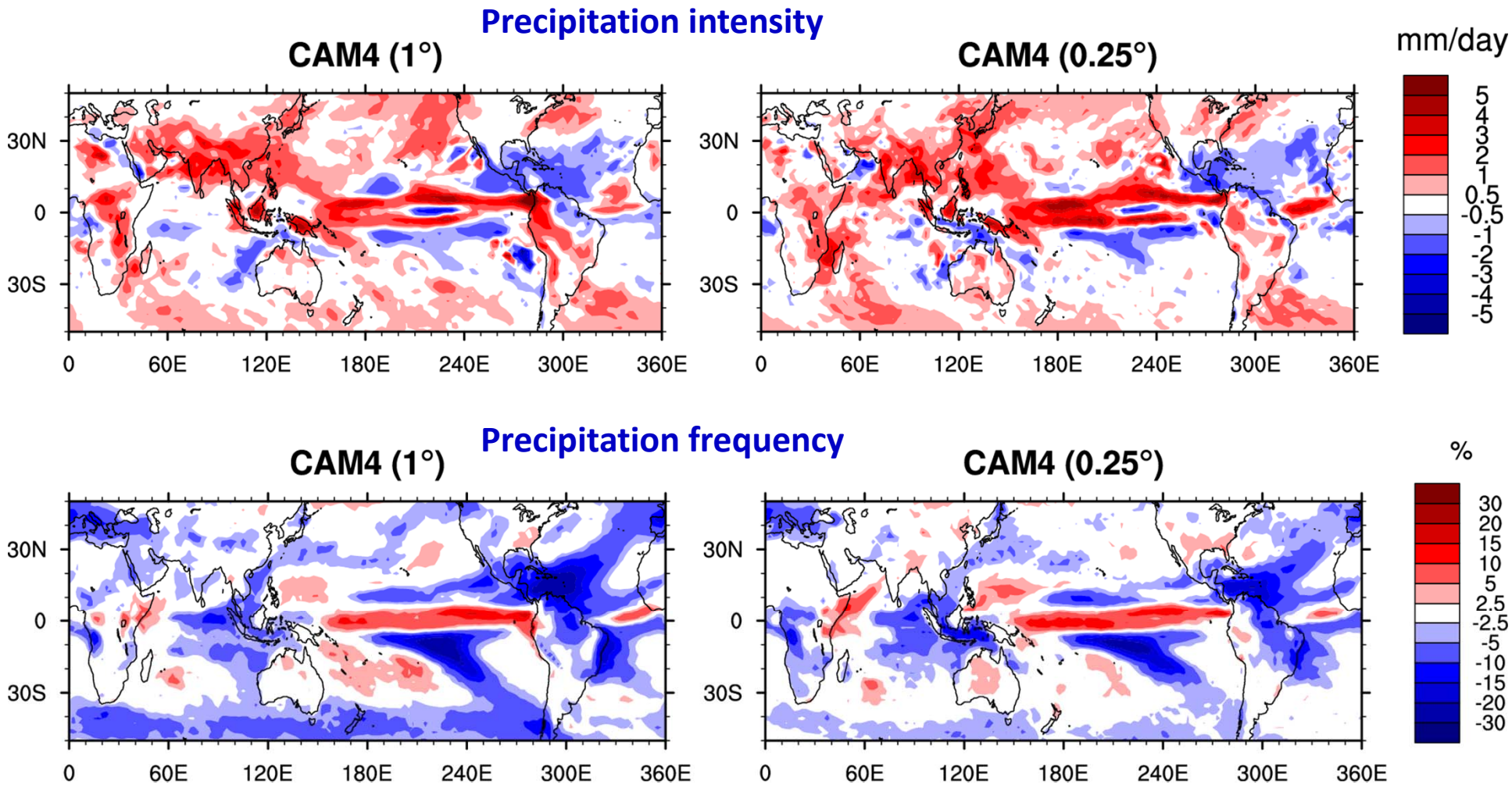
$$\text{Precipitation frequency (\%)} = \frac{\text{Number of rainy days (>1 mm/day)}}{\text{Total number of days}}$$

- How hard does it rain?

$$\text{Precipitation intensity (mm/day)} = \frac{\text{Total amount of precipitation}}{\text{Number of rainy days (>1 mm/day)}}$$

Dai et al. (2007)

Change in precip intensity/frequency



In warmer climate: it rains harder but less frequently

(Trenberth et al. 2003)

Thank You