North American Hydroclimate Variability in CAM3 Simulations

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Data Sets

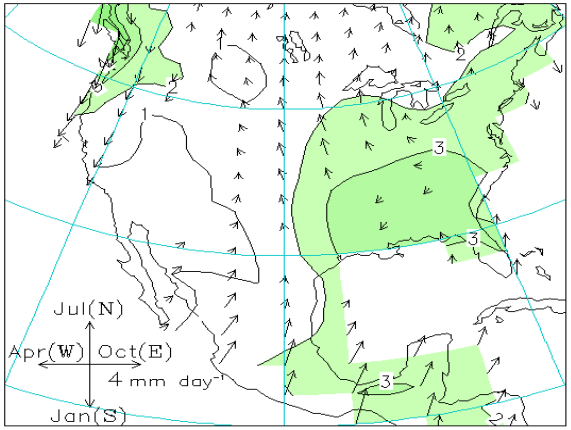
- North American Regional Reanalysis, NARR:
  - It is used for hydroclimate validation
  - Successfully assimilates precipitation
- AMIP integrations from NCAR's Community Atmospheric Model, version 3.0:
  - Control: 5-member ensemble mean for the seasonal cycle CAM3(mean), and ensemble # 1 for interannual variability CAM3(ens01).
  - Developmental Simulations: CAM3(isufvcam6), CAM3(isufvcam8), and CAM3(3_fv_cmt2_dilute).
- Diagnostics Period: 1979-2000 on a 5x2.5 grid. Focus on Winter (D,J,F), and Summer (J,J,A) climatologies, and summer interannual variability.
- Fields of study: Precipitation, Vertically Integrated Moisture Fluxes and Vertically Integrated Moisture Flux Convergence (Surface to 300mb), Evaporation.

1st Harmonic of Precipitation

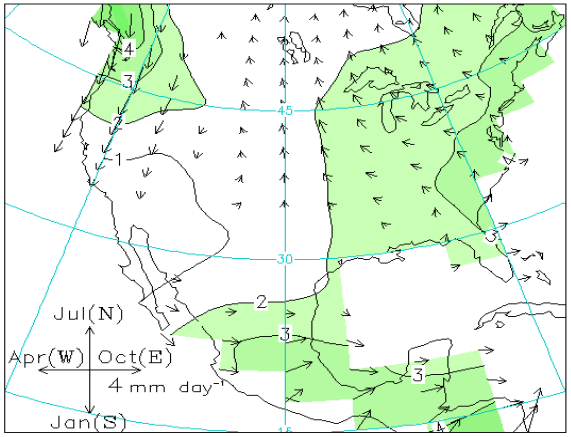
Background:
Mean Annual Precipitation

CI = 1mm/day
Shaded ≥ 2mm/day

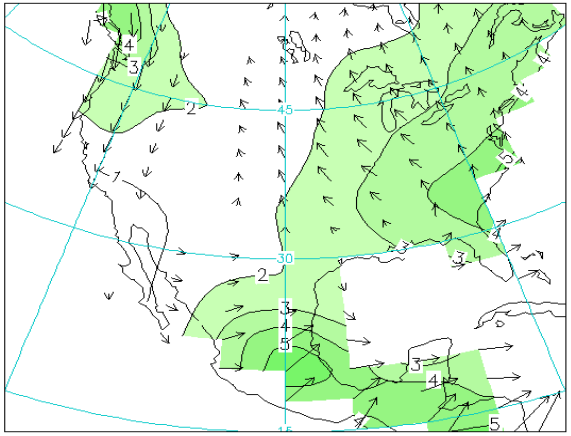
NARR



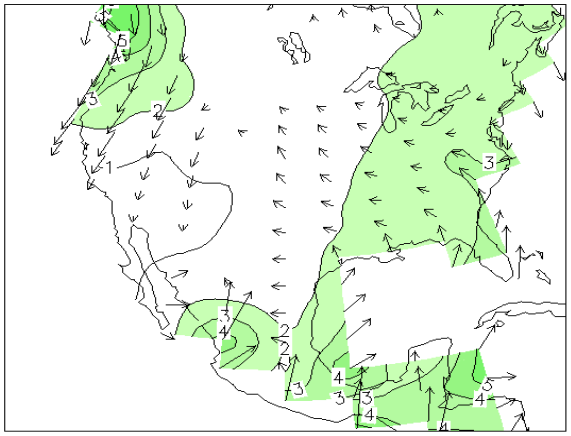
CAM3 isufvcam6



CAM3 isufvcam8

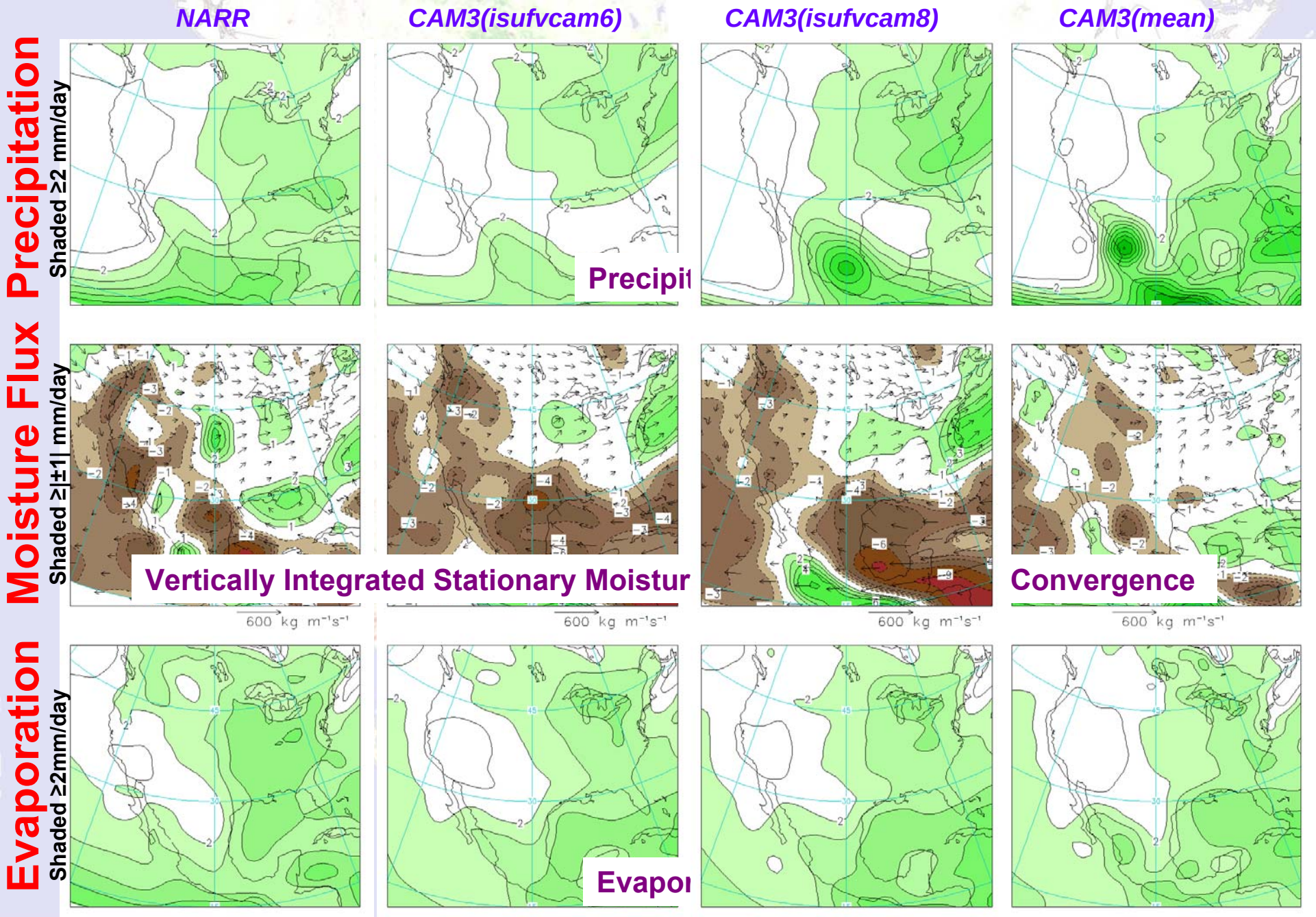


CAM3 mean



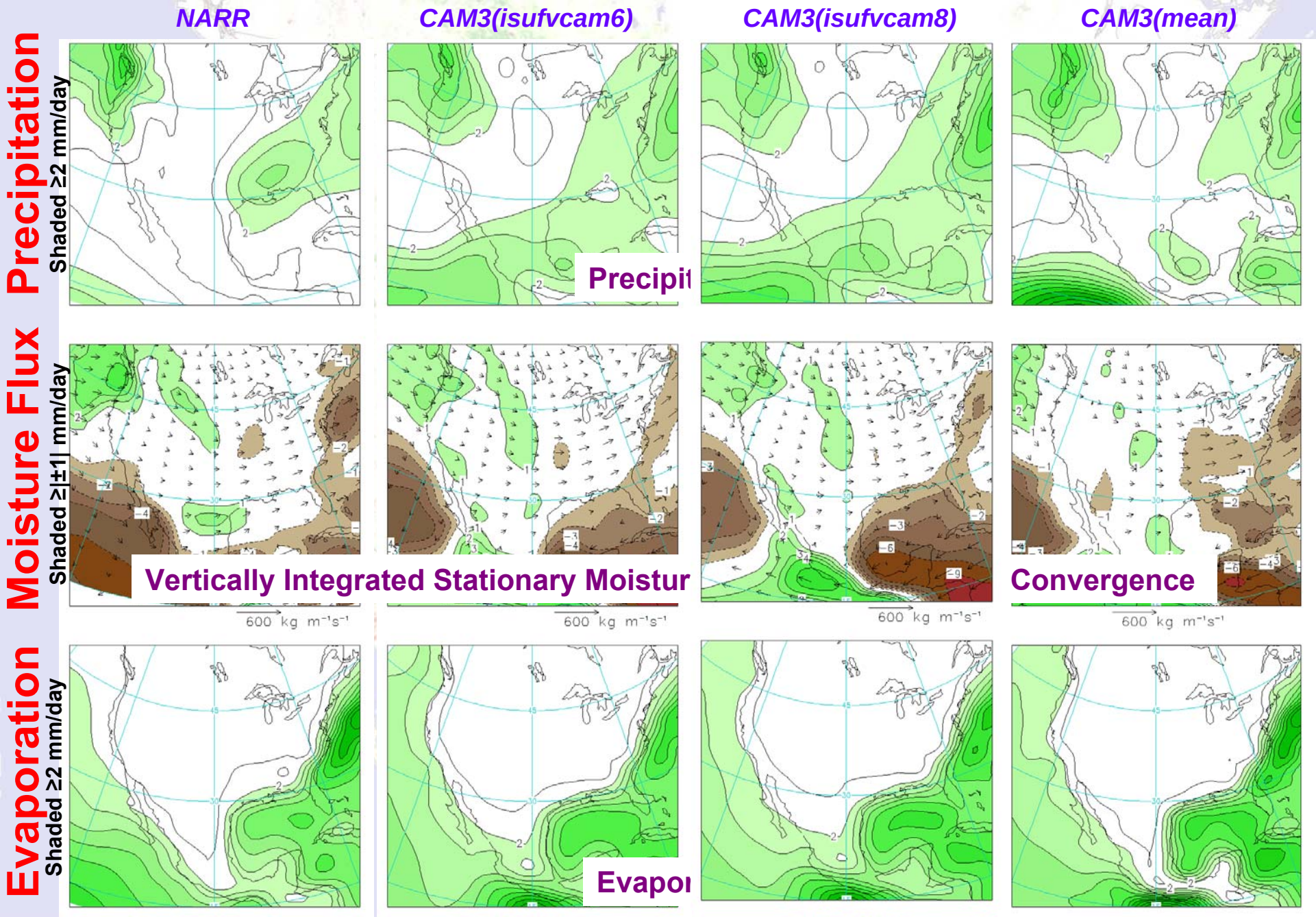
CI = 1mm/day

Summer Climatology



CI=1mm/day

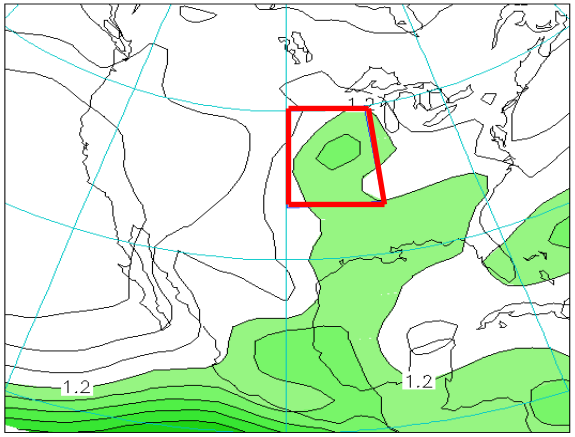
Winter Climatology



Standard Deviation of Summer Precipitation

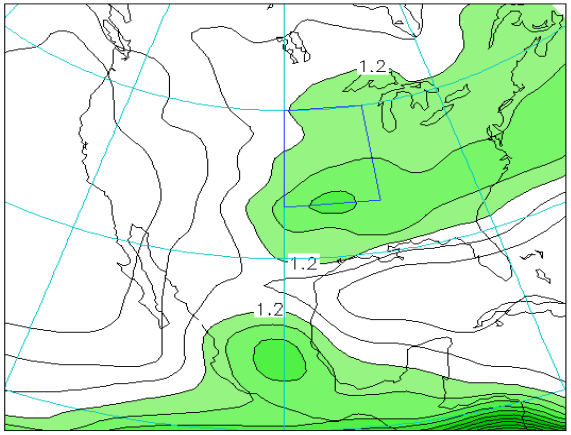
CI=0.3mm/day
Shaded ≥1.2 mm/day

NARR

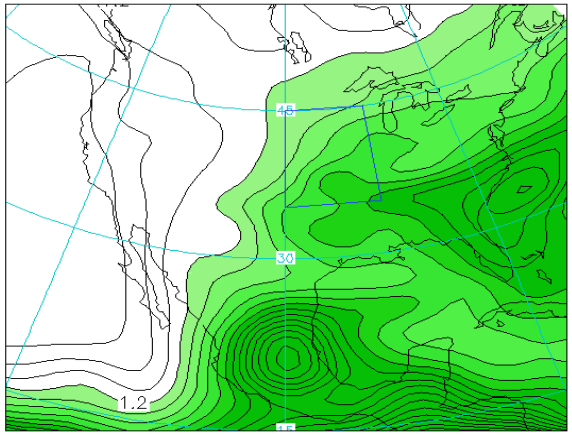


The red box defines the Great Plains Precipitation (GPP) Index as area-averaged (100°-90°W,35°-45°N) precipitation anomalies.

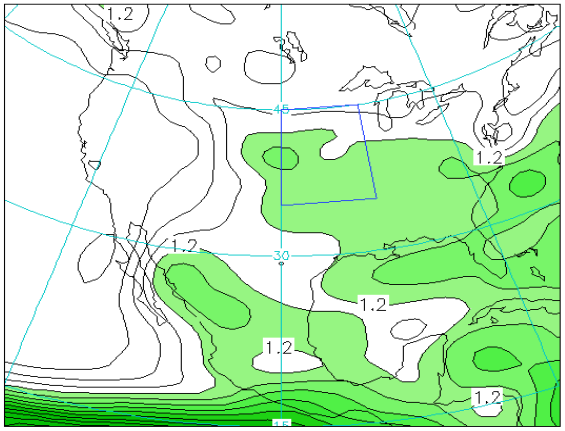
CAM3 isufvcam6



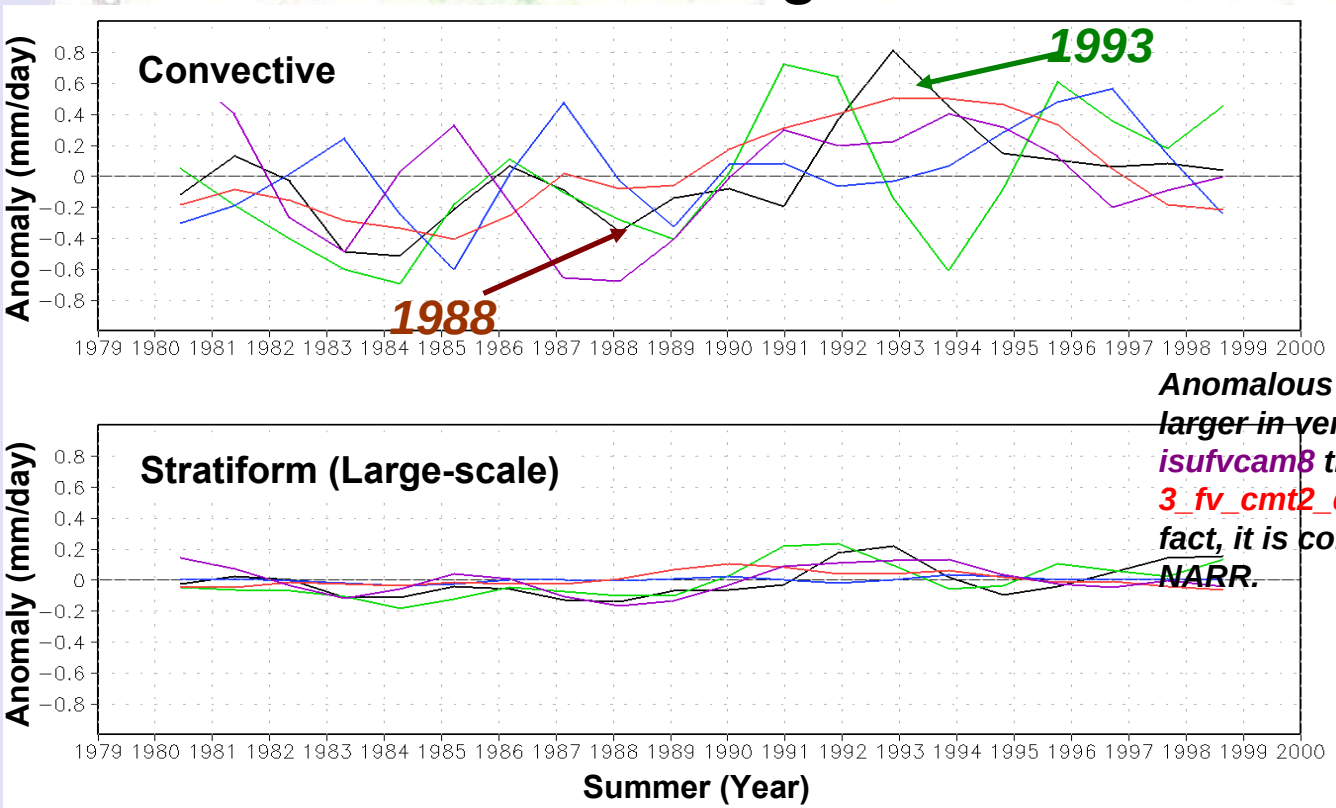
CAM3 isufvcam8



CAM3 ens01



Smoothed GPP Indices during the warm-season months



Anomalous stratiform rainfall is larger in versions isufvcam6 and isufvcam8 than in versions 3_fv_cmt2_dilute and ens01. In fact, it is comparable to that in NARR.

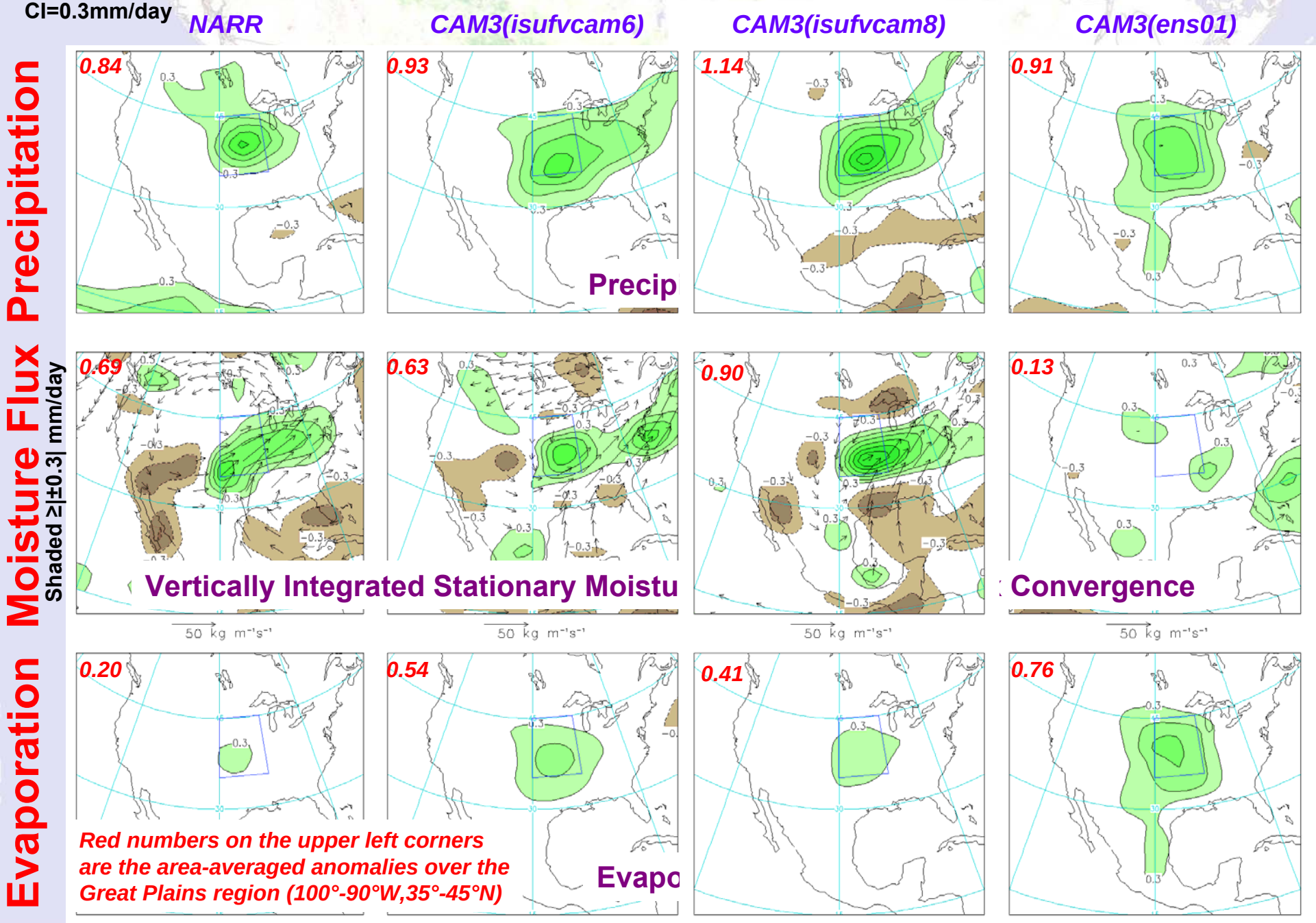
NARR ***CAM3(isufvcam6)*** ***CAM3(3_fv_cmt2_dilute)*** ***CAM3(ens01)***
CAM3(isufvcam6)

Correlations wrt NARR's GPP Index (Total Precip)

	isufvcam6	isufvcam8	3_fv_cmt2-dilute	ens01
Monthly J,J,A	-0.03	0.02	0.06	0.02
Smoothed JJA	0.38	0.47	0.58	0.10

Warm-season Regression Anomalies on Monthly GPP Indices

CI=0.3mm/day



Conclusions

- Annual precipitation in CAM3 is more realistic in new simulations; the dry bias has been mitigated to some extent. Over the eastern continent, precipitation is large along the Gulf Coast and Florida pan-handle in NARR, but along the Eastern Seaboard in simulations, especially in ‘isufvcam8’. Along the Gulf Coast and Great Plains Low Level Jet region, precipitation is better in the ‘isufvcam8’ simulations. Over the western continent, the model does a reasonable simulation over the Pacific Northwest in all of its versions.
- Seasonal variation amplitude is definitely more realistic in the 'isufvcam6' simulation, especially, over the eastern continent; ‘isufvcam8’ displays larger seasonal variation amplitude than ‘isufvcam6’ and observations over the same region.

SUMMER

- 'Dilute' and ‘siufvcam8’ simulations are a bit more realistic over central United States but both of them are compromised by excessive precipitation over southeastern US and western/central Mexico. The eastern Pacific ITCZ stays farther to the south in ‘isufvcam8’ simulation than in the ‘dilute’ simulation.
- Although the 'dilute' simulation's evaporation is in better accord with NARR's, NARR's is known to be too high and so evaporation from ‘isufvcam6’ and ‘isufvcam8’ simulations may well be the more realistic one. It is interesting to note that the increase in precipitation in ‘isufvcam8’ simulation with respect to ‘isufvcam6’ simulation is not matched by an increase in evaporation.

WINTER

- Given the Gulf coast focus over the eastern continent, the 'isufvcam6' and ‘isufvcam8’ simulations are a shade better. However, it is evident in all simulations that the eastern Pacific ITCZ is situated northward of its summer position!

Conclusions

SUMMER INTERANNUAL VARIABILITY

- Precipitation variability, via standard deviation, is reasonably well depicted in the ‘dilute’ simulation, however, it is not the case for the ‘isufvcam8’ simulation that displays extremely large values to the east of the continental divide and over Mexico; ‘isufvcam6’ simulation has more reasonable standard deviation though.
- The 'dilute' model has a more realistic precipitation anomaly footprint over the Great Plains but weaker amplitude. Moisture fluxes and associated convergence have improved. However, the related moisture fluxes and convergence have a somewhat unrealistic structure though, especially in the ‘dilute’ simulation. The structure of moisture flux convergence has improved in the ‘isufvcam8‘ simulation with respect to that in ‘isufvcam6’ simulation, however, its amplitude is very large. Evaporation anomalies, have decreased in the new simulations, especially in ‘isufvcam8’ however it seems to be a response to the excessive moisture flux convergence.

- Overall Assessment: Seasonal variability is better represented in the 'isufvcam6' simulation. Not clear which is better in context of interannual variability, given the limited analysis on this front; however, one could say that ‘isufvcam8’ is not the front runner.

May the next simulations include in their output of monthly fields, in addition to the meridional water vapor transport (VQ), the zonal water vapor transport (UQ).