

Soil Moisture Variability

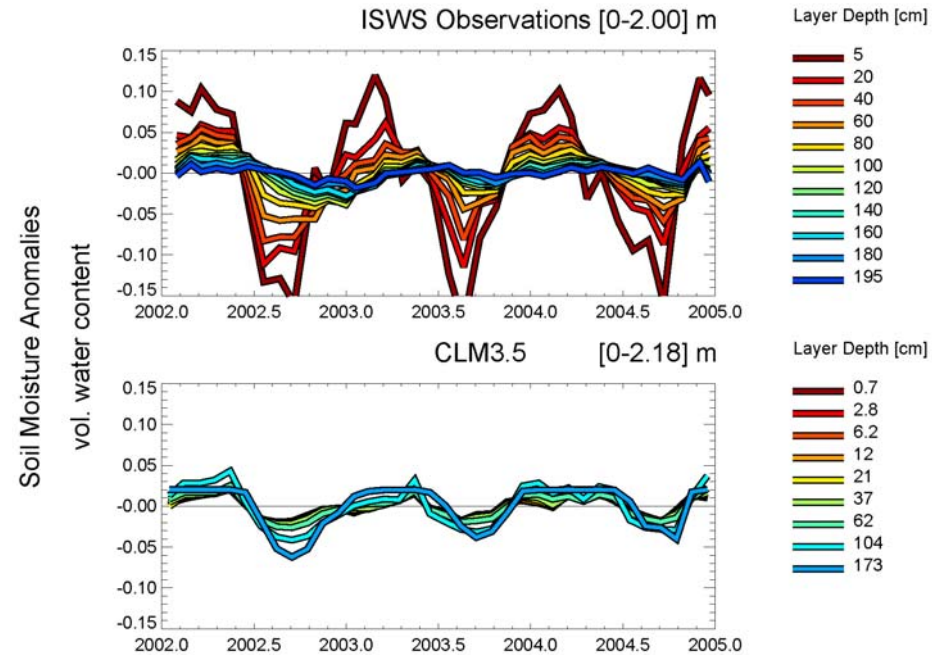
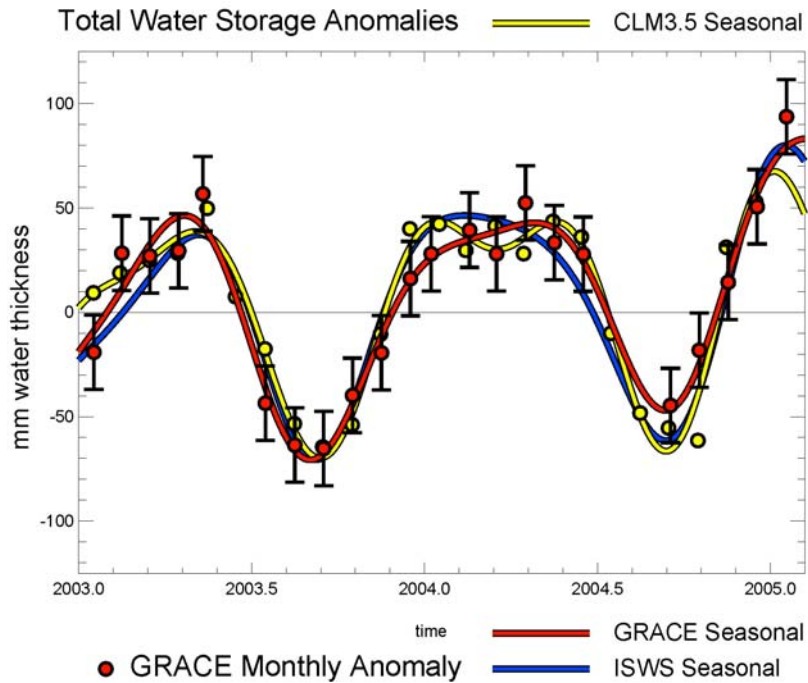
CLM3.0 - A dry model that is difficult to wet up?

CLM3.5 - A wet model that is difficult to dry out?

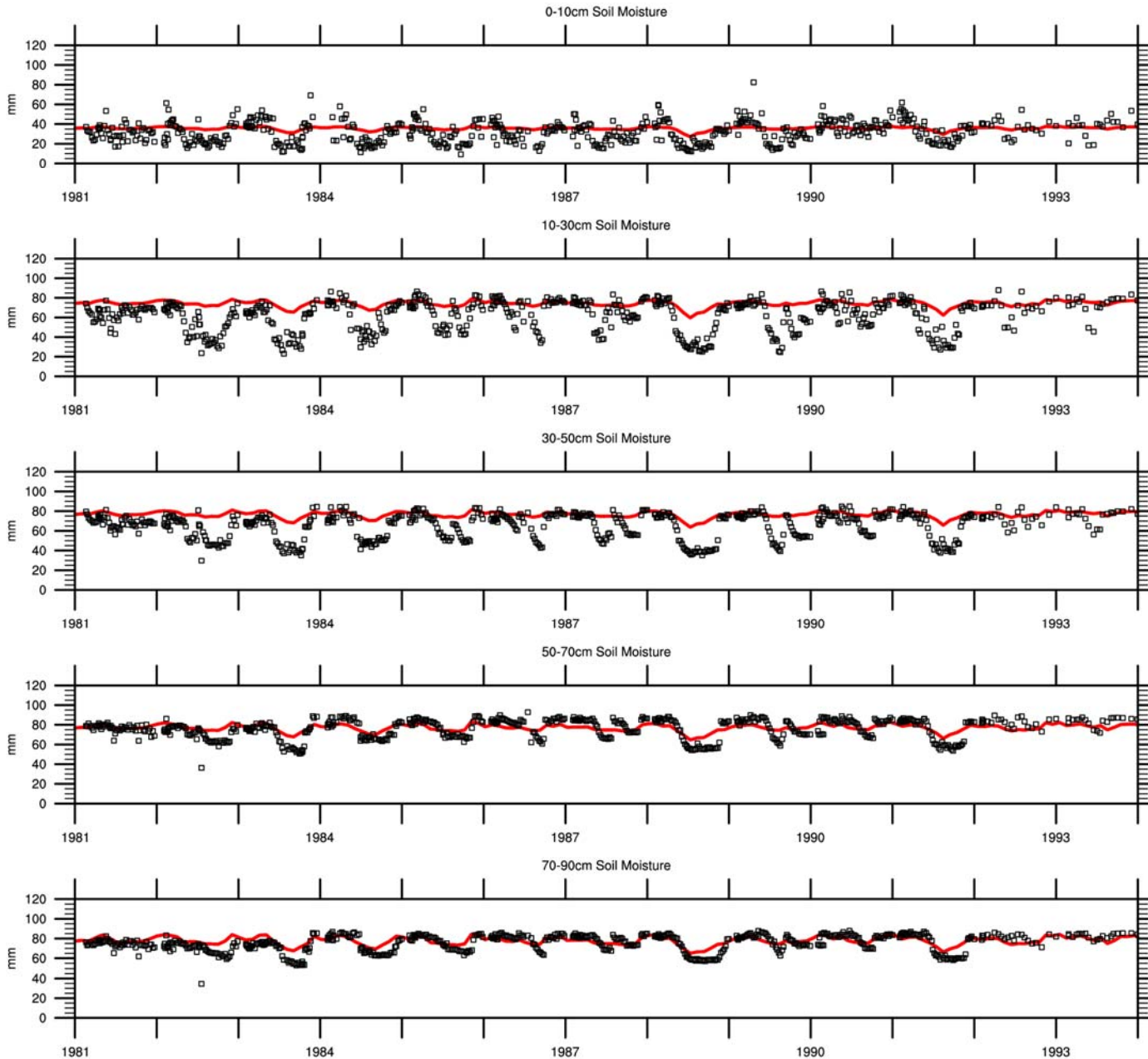
CLM3.5 has lower soil moisture variability in the rooting zone than observed (weak annual cycle and interannual) in some regions (Illinois, FSU, China).

Potentially adverse implications for carbon cycle, dust, simulating droughts, land-atmosphere coupling, etc.

Illinois Total Water Storage and Soil Moisture, CLM3.5



Bondville Illinois Soil Moisture, CLM3.5



Similar behavior for other 15 sites

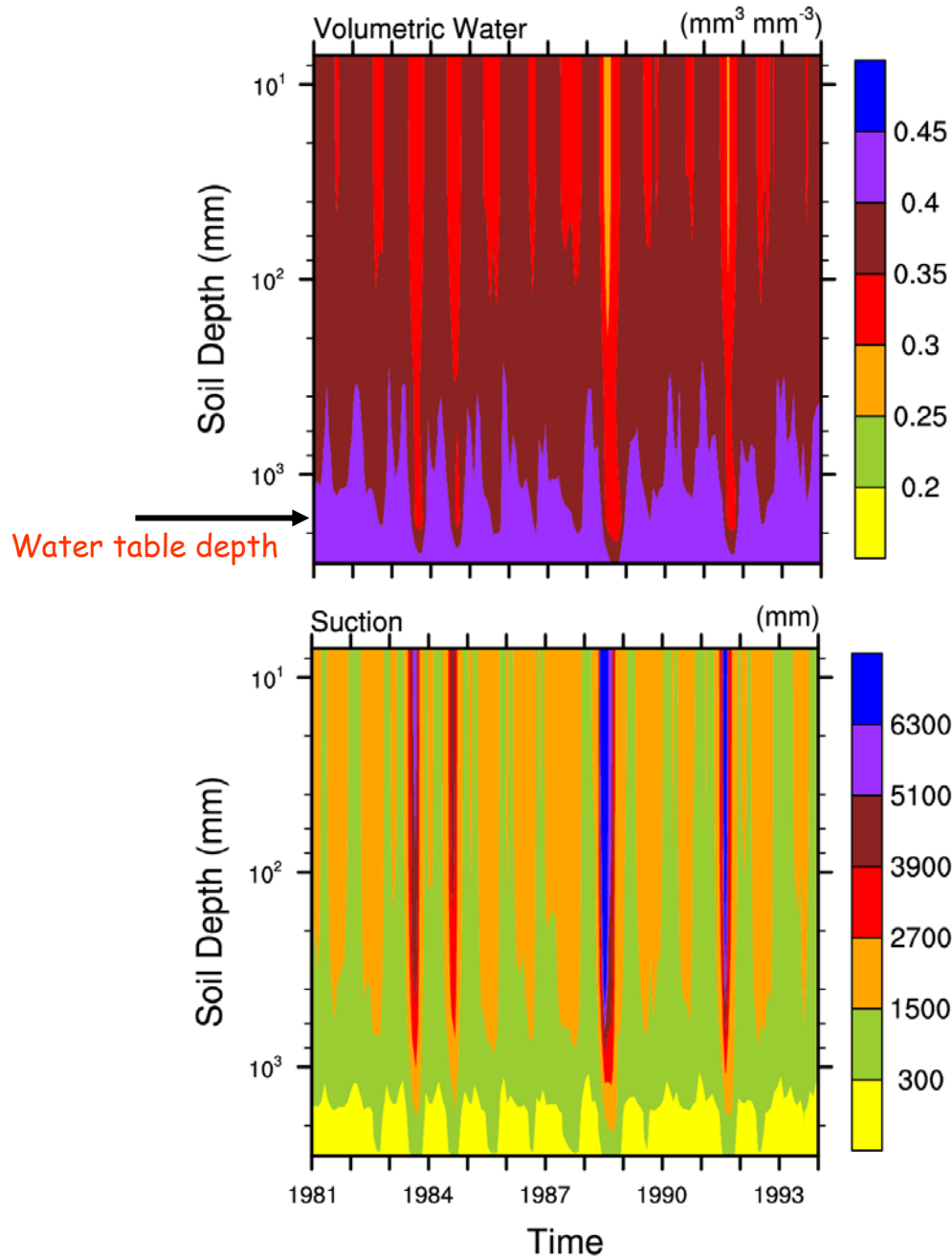
What doesn't help (much)

- Various values of decay factor f
- Various values of rsb_{max}
- Increase interception coefficient
- Remove r_{soil}
- No nitrogen limitation, boost LAI
- Macropores
- Various formulations of aquifer hydraulic conductivity
- Various soil texture types (uniform)
- Shallower roots
- Saturation excess to runoff
- Taking out some of the changes Dave and I put in

What does help (some)

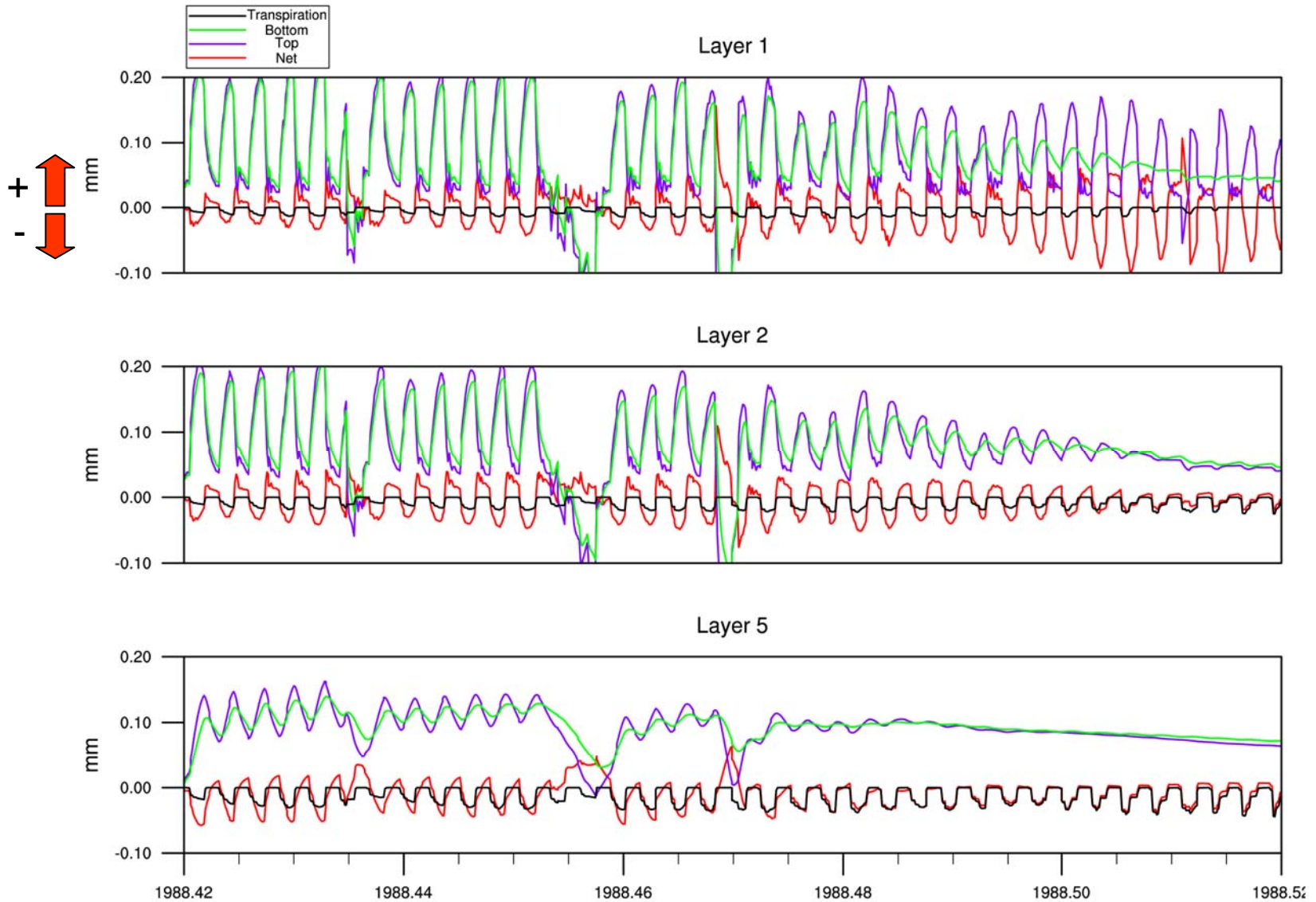
- Exponential decrease in hydraulic conductivity

Bondville Illinois Soil Moisture and Suction, CLM3.5



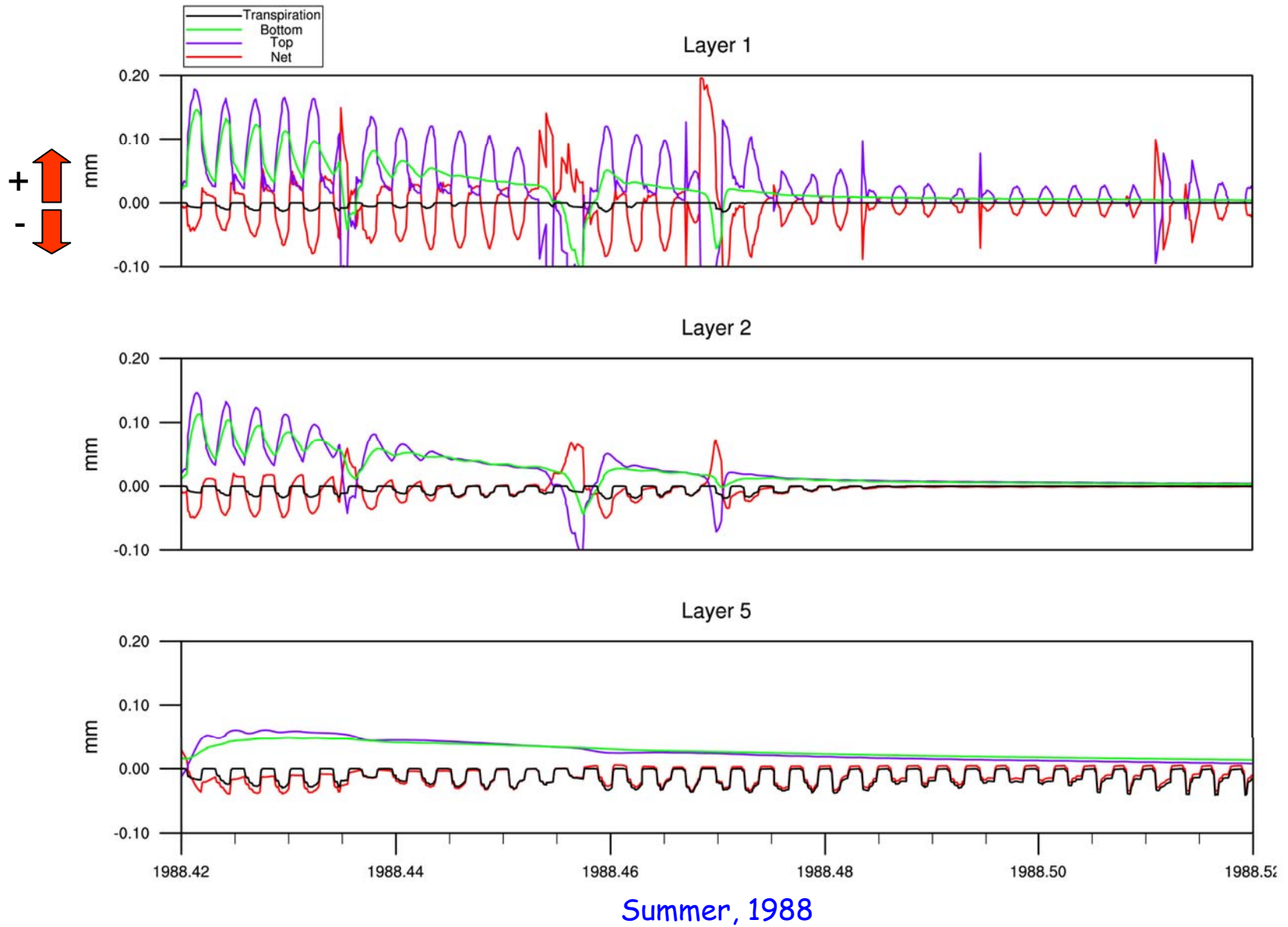
Strong gradient in soil water suction combined with large hydraulic conductivity produces large upward water fluxes and prevents drying.

Bondville Illinois Soil Layer Fluxes, CLM3.5



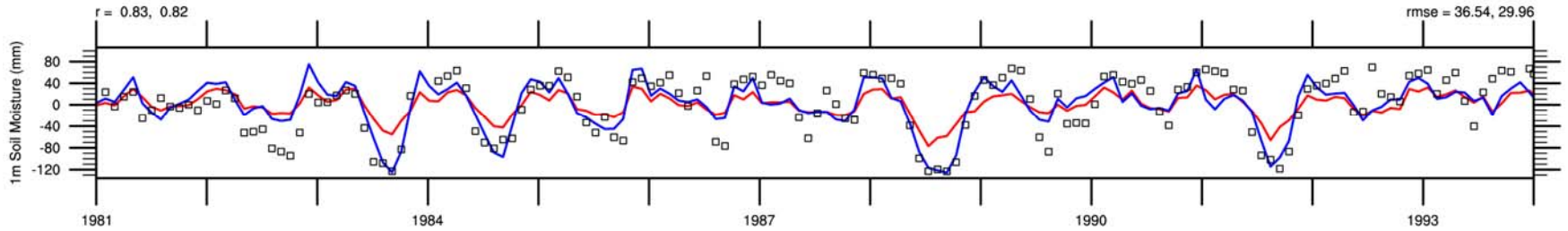
Summer, 1988

Bondville Illinois Soil Layer Fluxes, CLM3.5 w/exp(k)

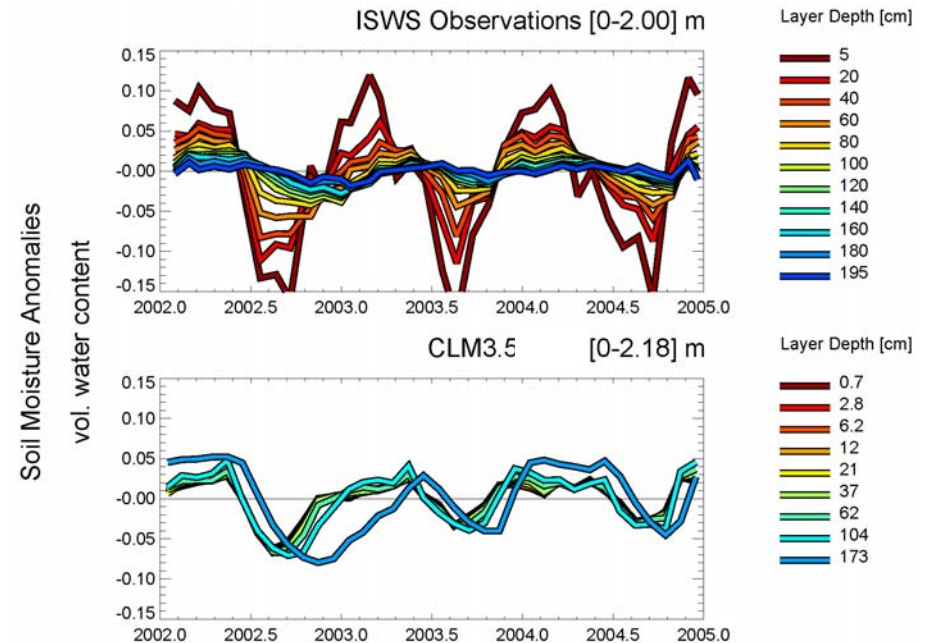
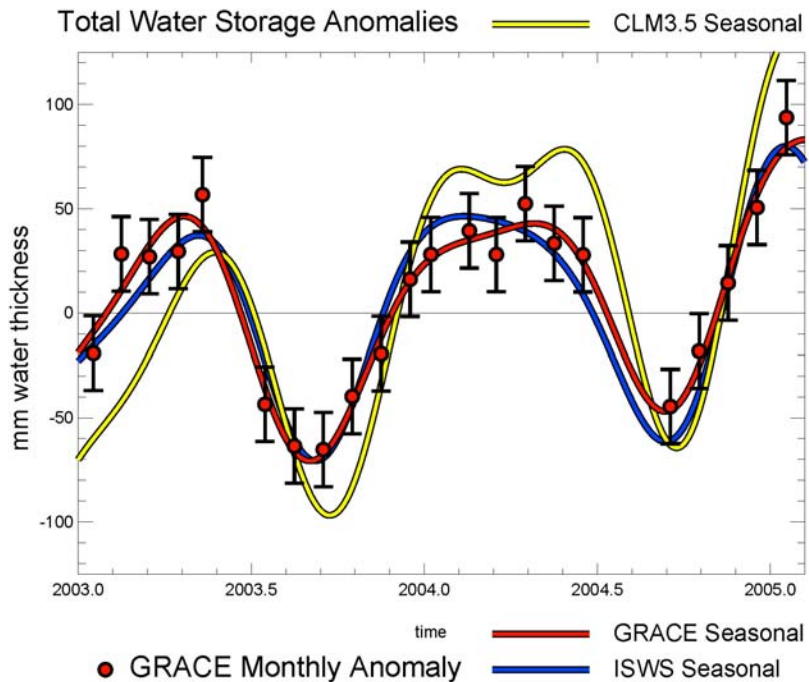


Bondville Illinois 1m Soil Moisture Anomaly

CLM3.5, CLM3.5 w/exp(k)



Illinois Total Water Storage and Soil Moisture, CLM3.5 w/exp(k)

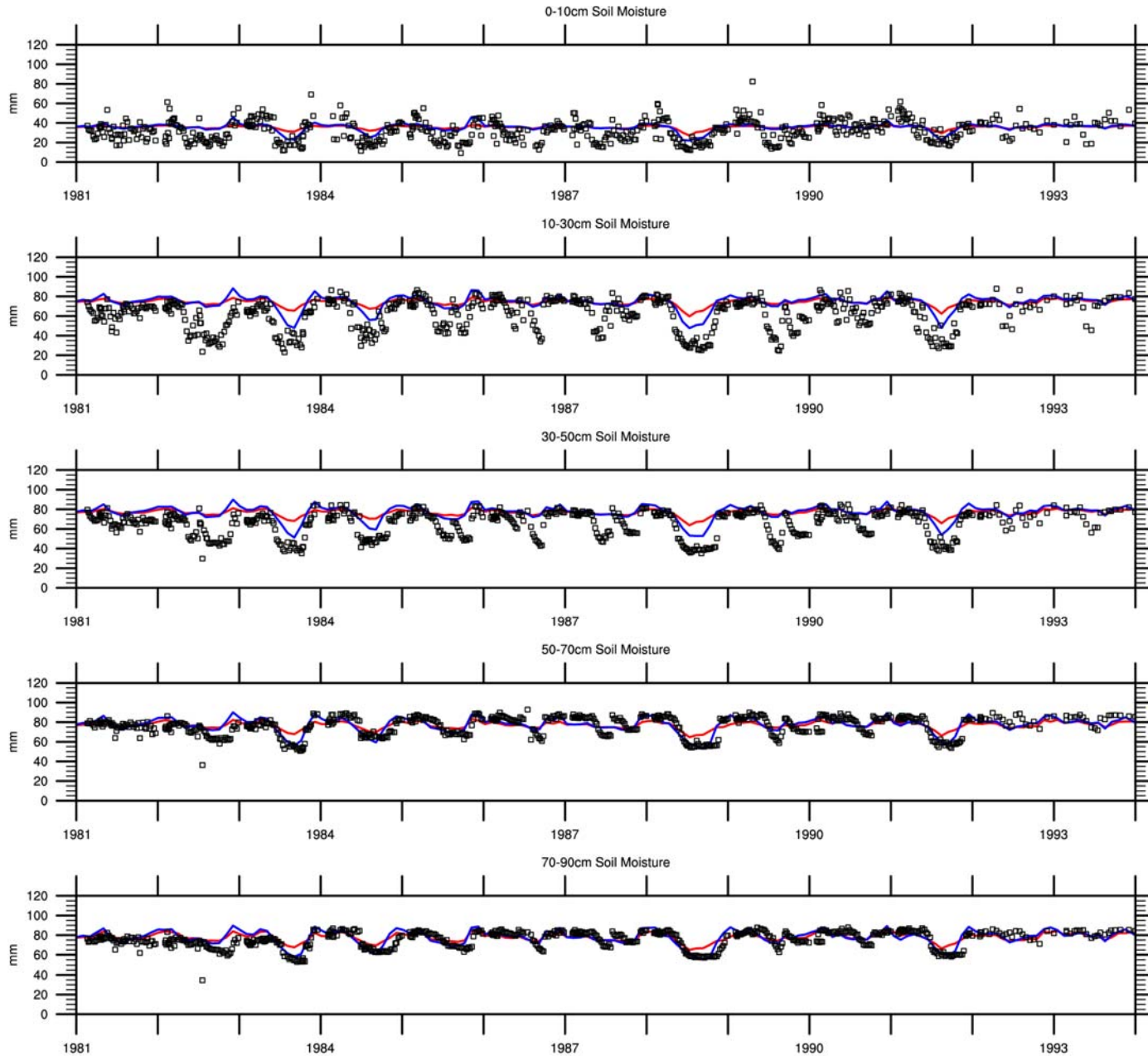


Conclusions

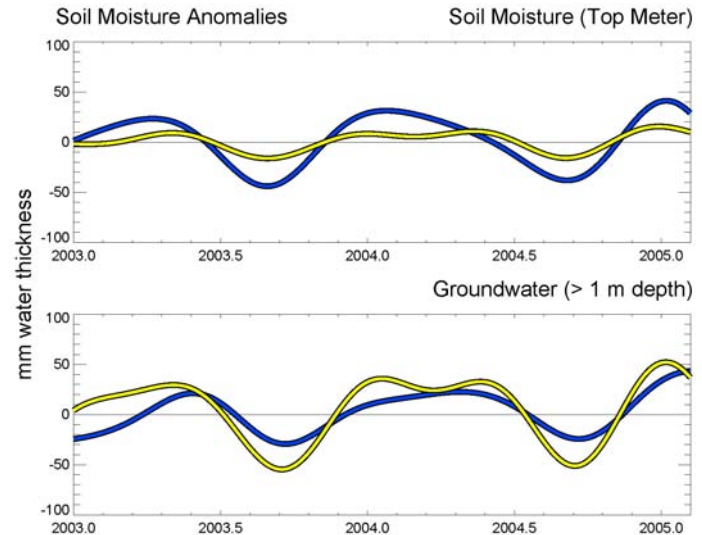
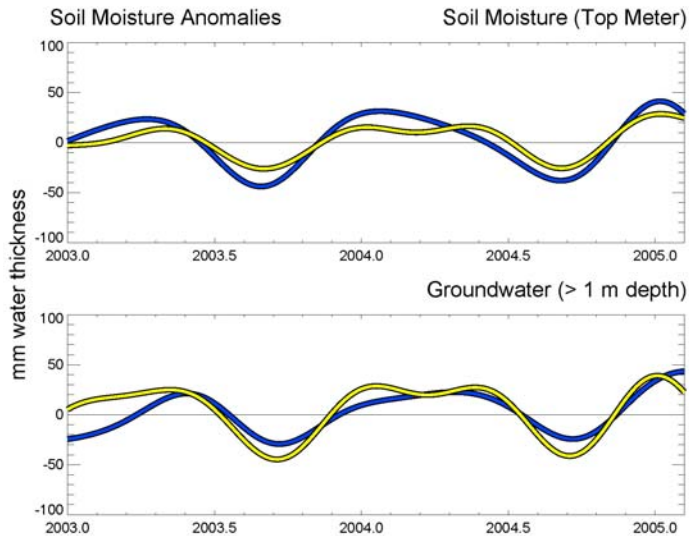
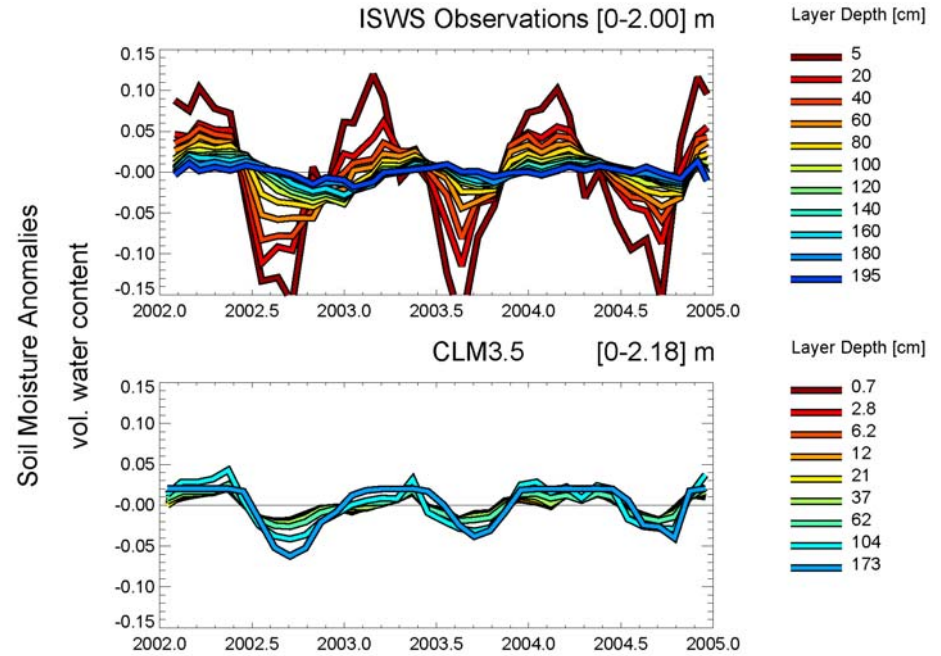
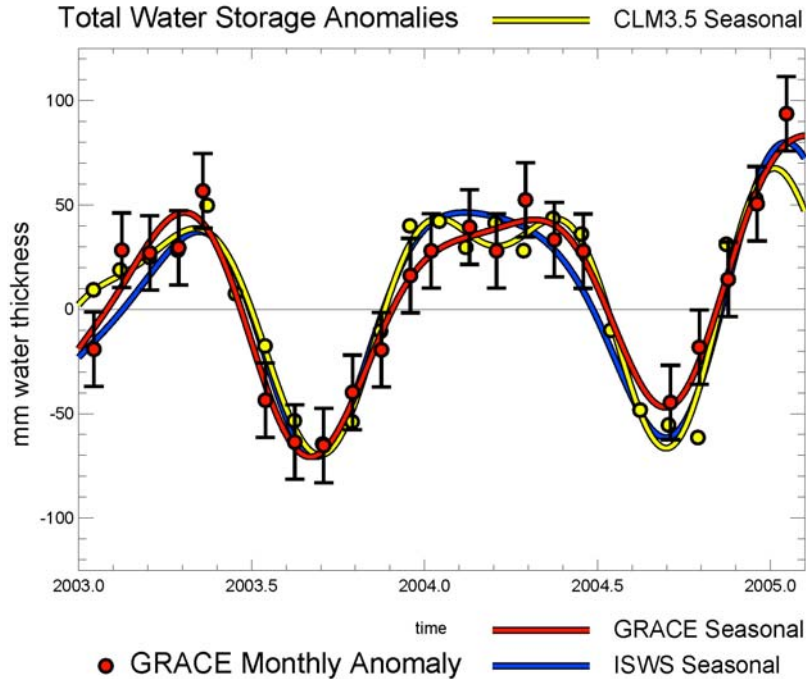
- In regions with water table within soil column, upward flux of water may prevent drying of root zone.
- Exponential decrease in hydraulic conductivity allows for some drying in root zone, but doesn't produce proper depth-dependence of drying and may degrade total water storage.
- Some regions with similarly shallow water tables do not appear to have this problem because of some combination of e.g., more pronounced annual cycle of precipitation, more clay in deep soil layers, stronger evaporation.
- Other solutions? (Robert/Guo-Yue, X. Zeng)

Extra slides

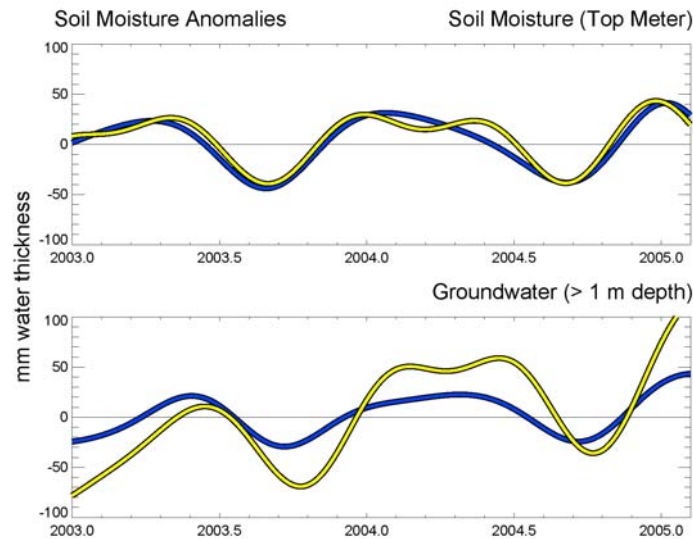
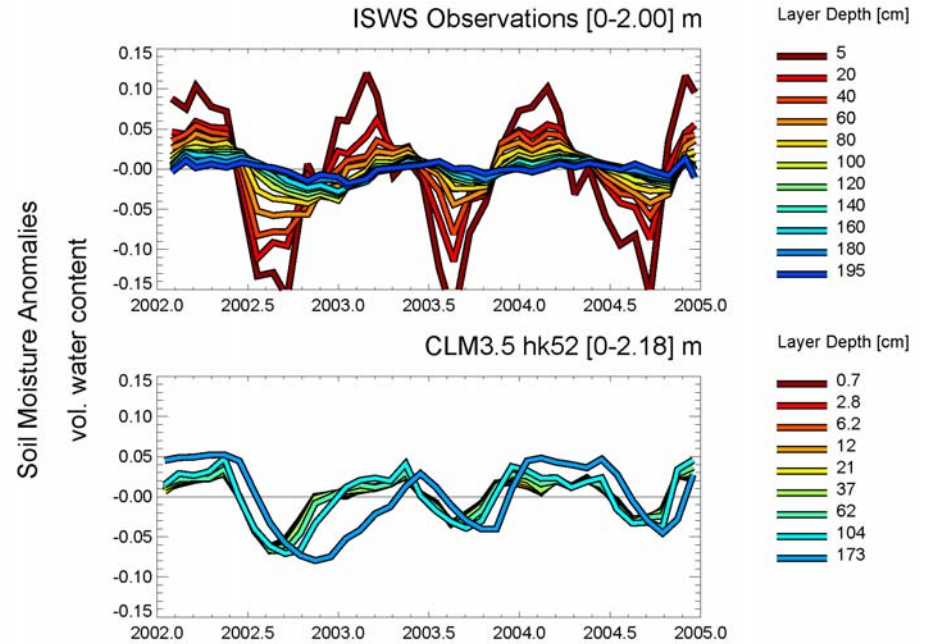
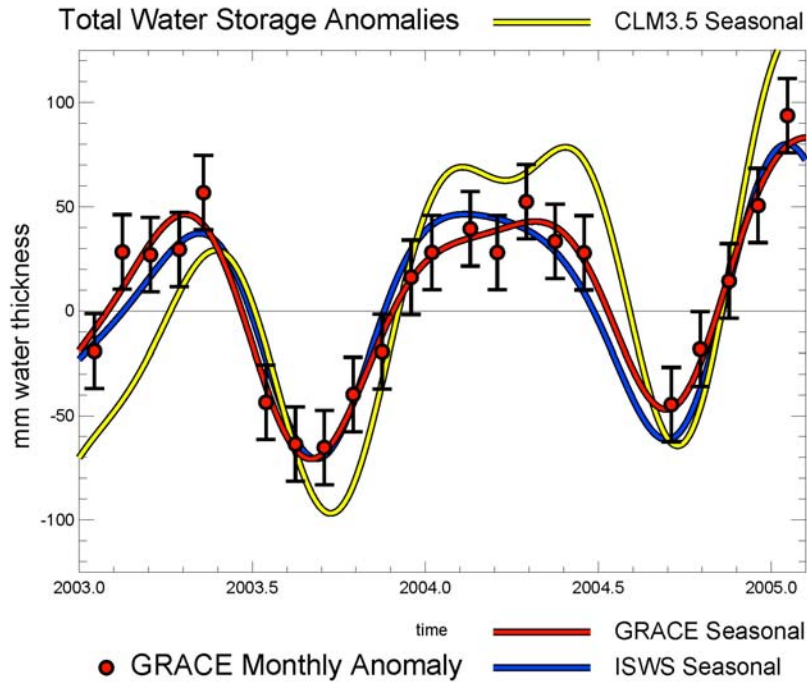
Bondville Illinois Soil Moisture, CLM3.5, CLM3.5 w/exp(k)



Illinois Total Water Storage and Soil Moisture, CLM3.5



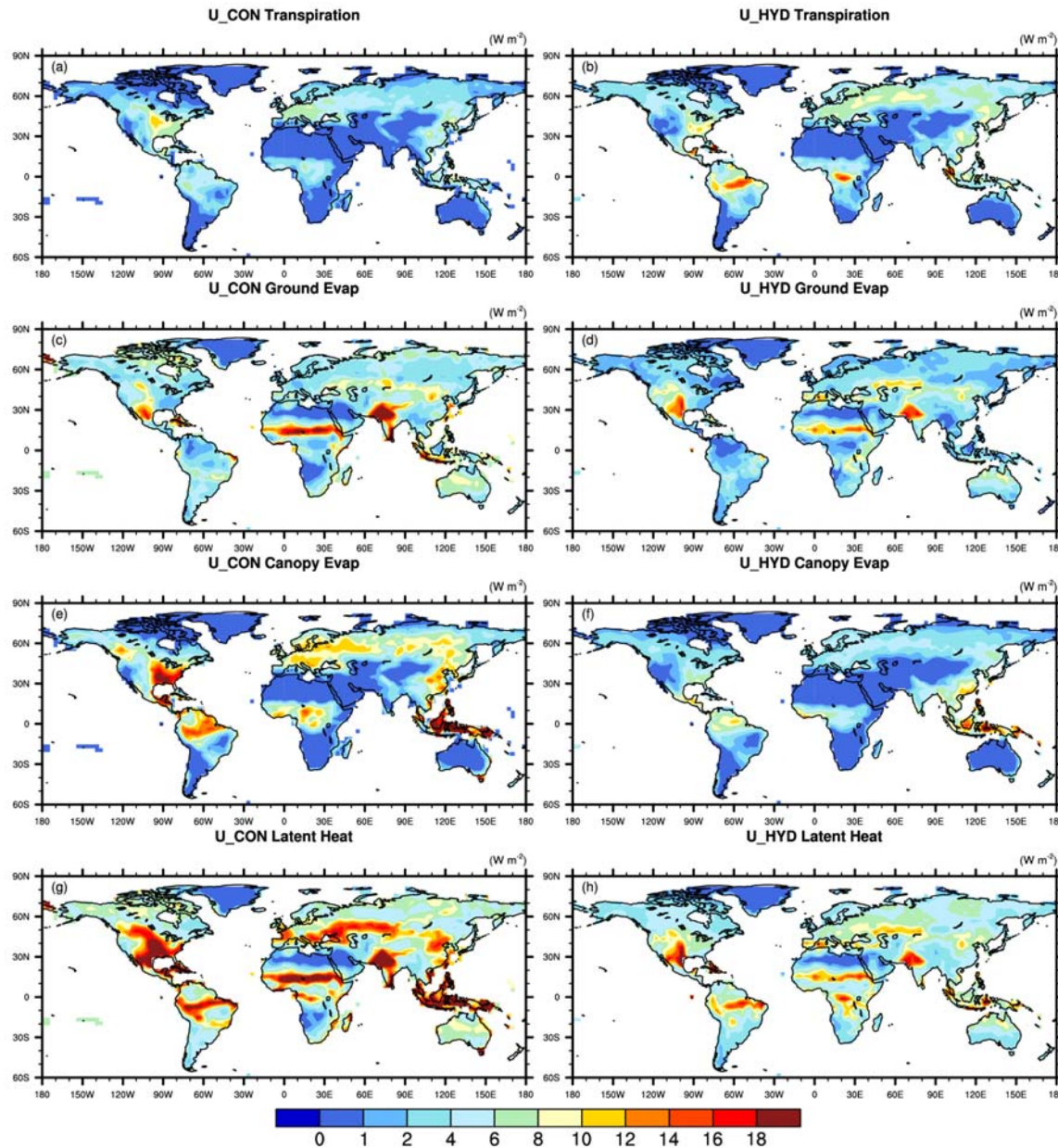
CLM3.5 w/exp(k)



Interannual Variability: July (1948-2004)

CLM3

CLM3.5

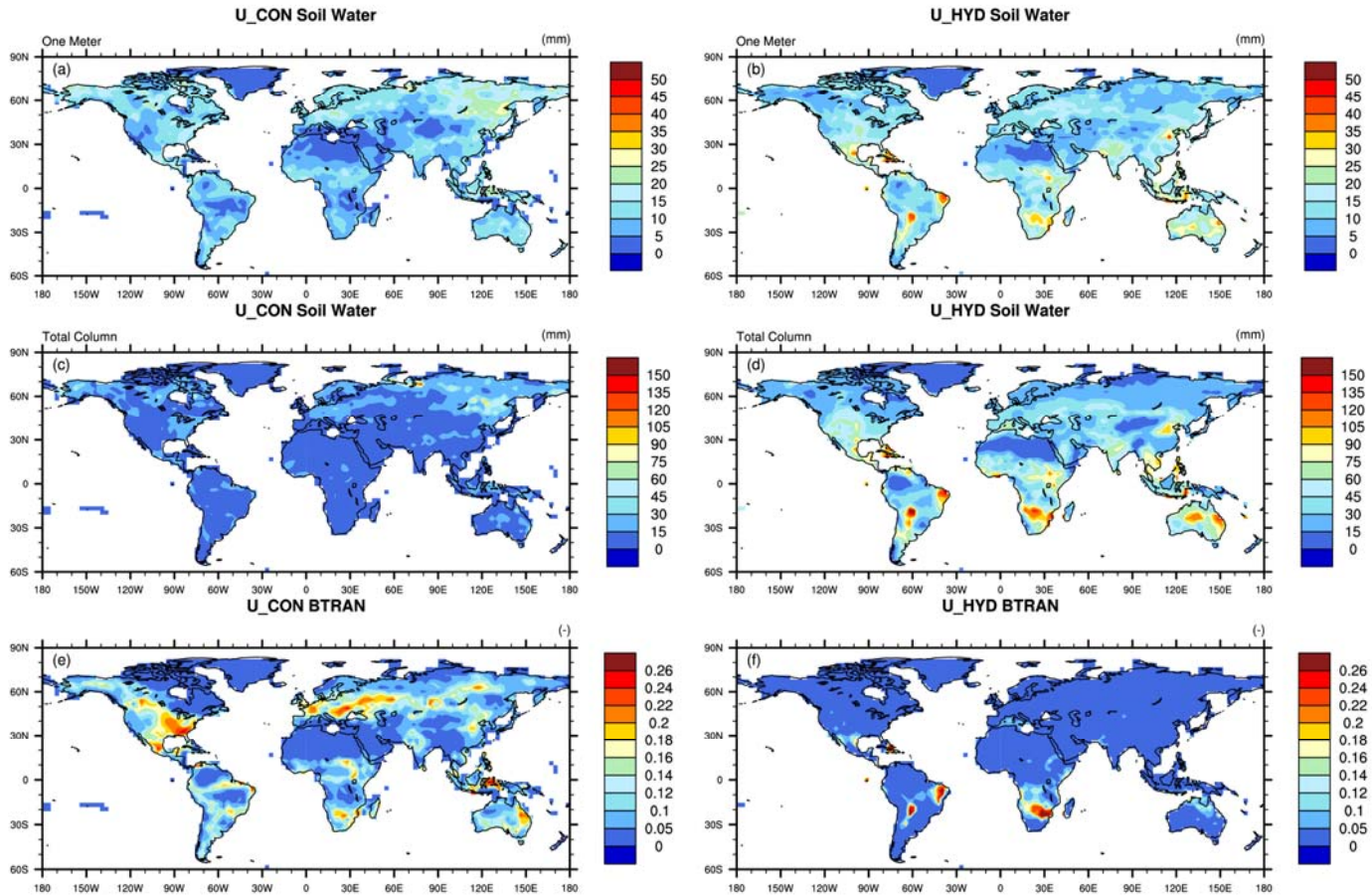


Interannual Variability: July (1948-2004)

CLM3

CLM3.5

July Standard Deviation (1948-2004)



Interannual Variability: July (1948-2004)

CLM3

CLM3.5

July Standard Deviation (1948-2004)

