

Soil Moisture Sensitivity in CCSM2

Marcia Branstetter*

David Erickson,* Matthew Wolinsky**

Robert Oglesby,* Susan Marshall*****

***Climate and Carbon Research, Oak Ridge National Lab**

****KRELL Institute/Duke University**

*****NASA Marshall Spaceflight Center**

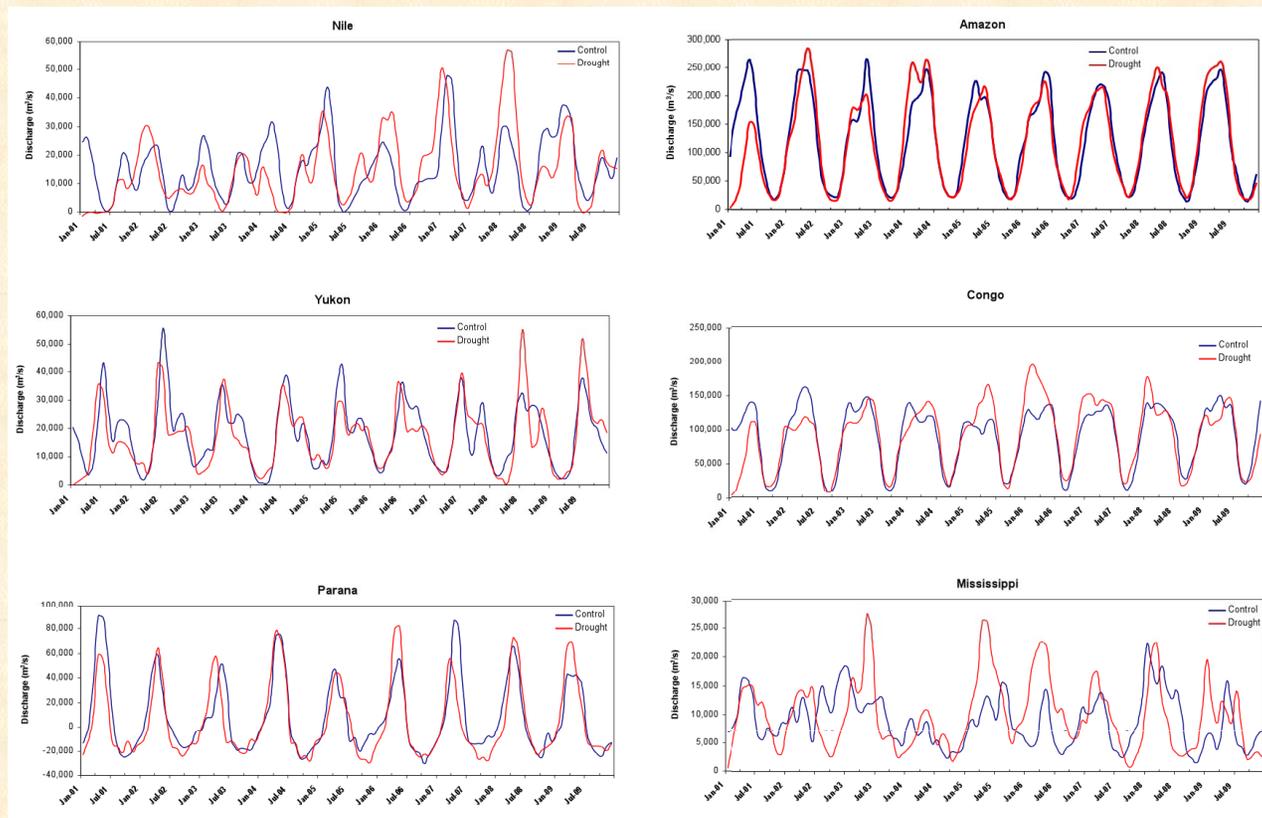
Overview

- **Experimental design**
- **River discharge results**
- **Global results**
- **Focus on GCIP region**
- **Rainfall results**
- **Conclusions**

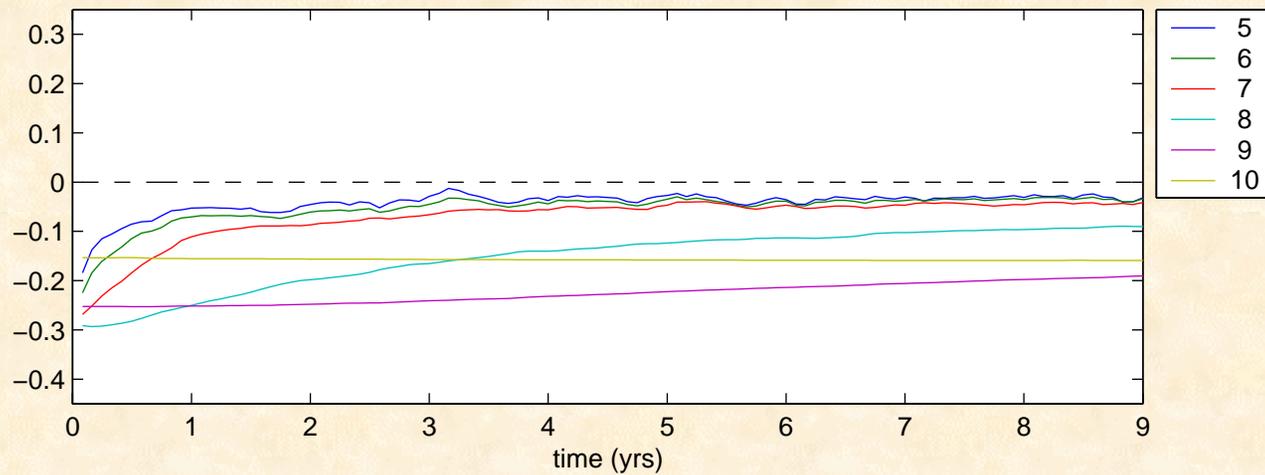
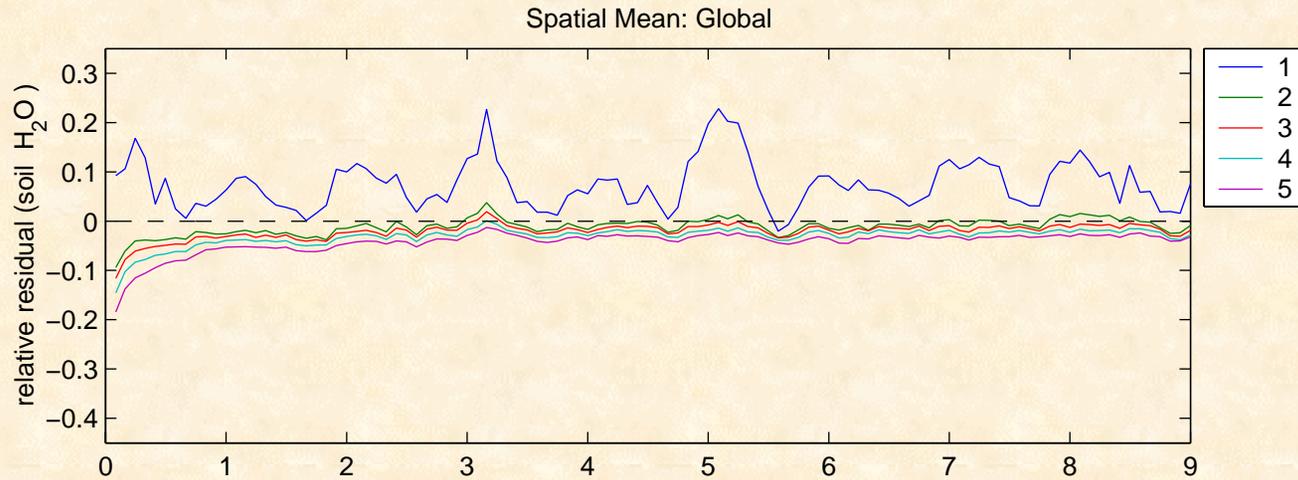
Experimental Design

- **Change initial soil moisture conditions in January**
- **Half control value**
- **Globally, all ten soil levels**
- **Nine year simulation**

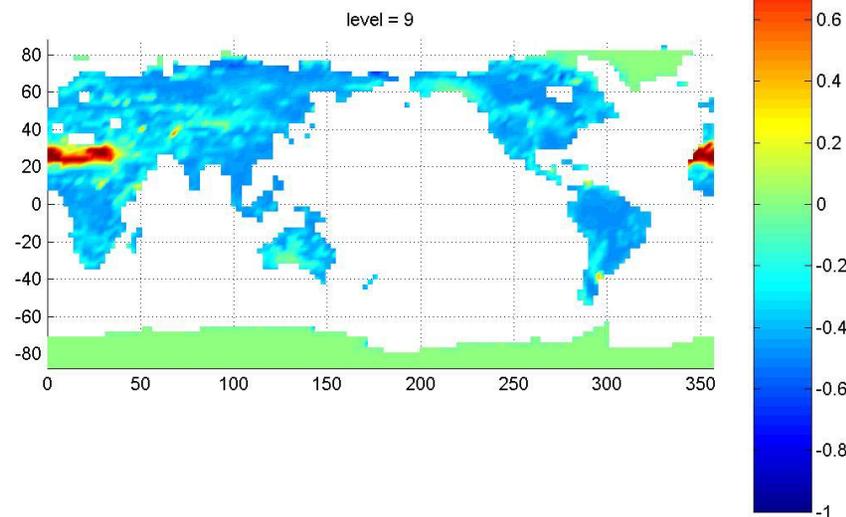
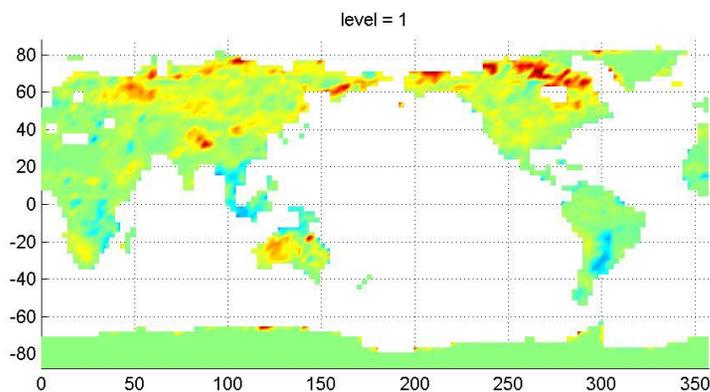
River Discharge Time Series



Global soil moisture difference time series

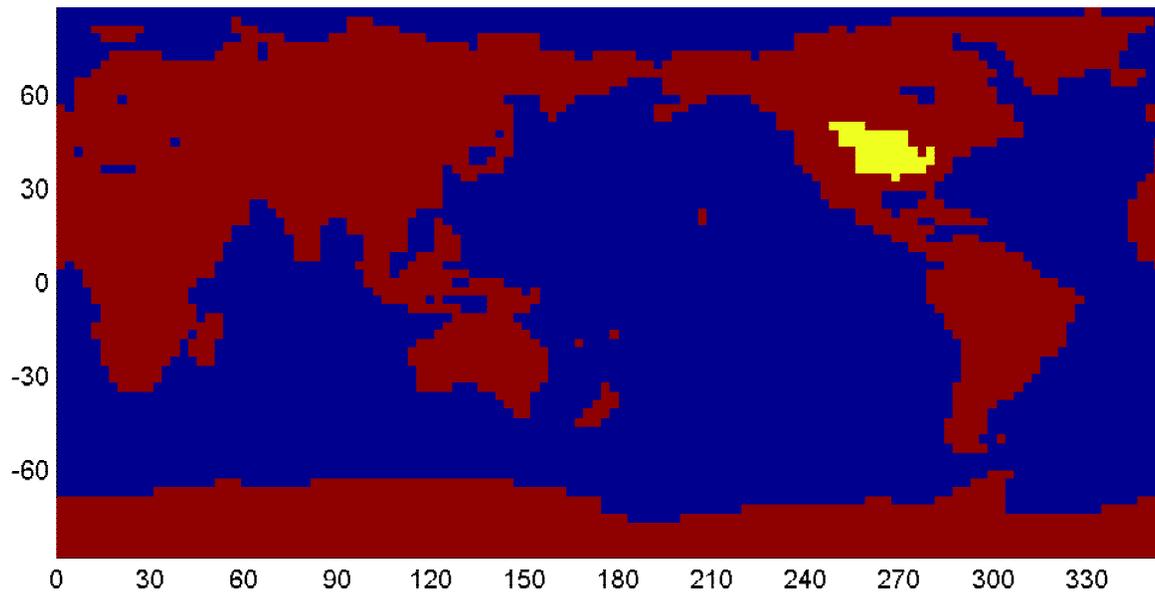


Time averaged global soil moisture difference



Experiment - control

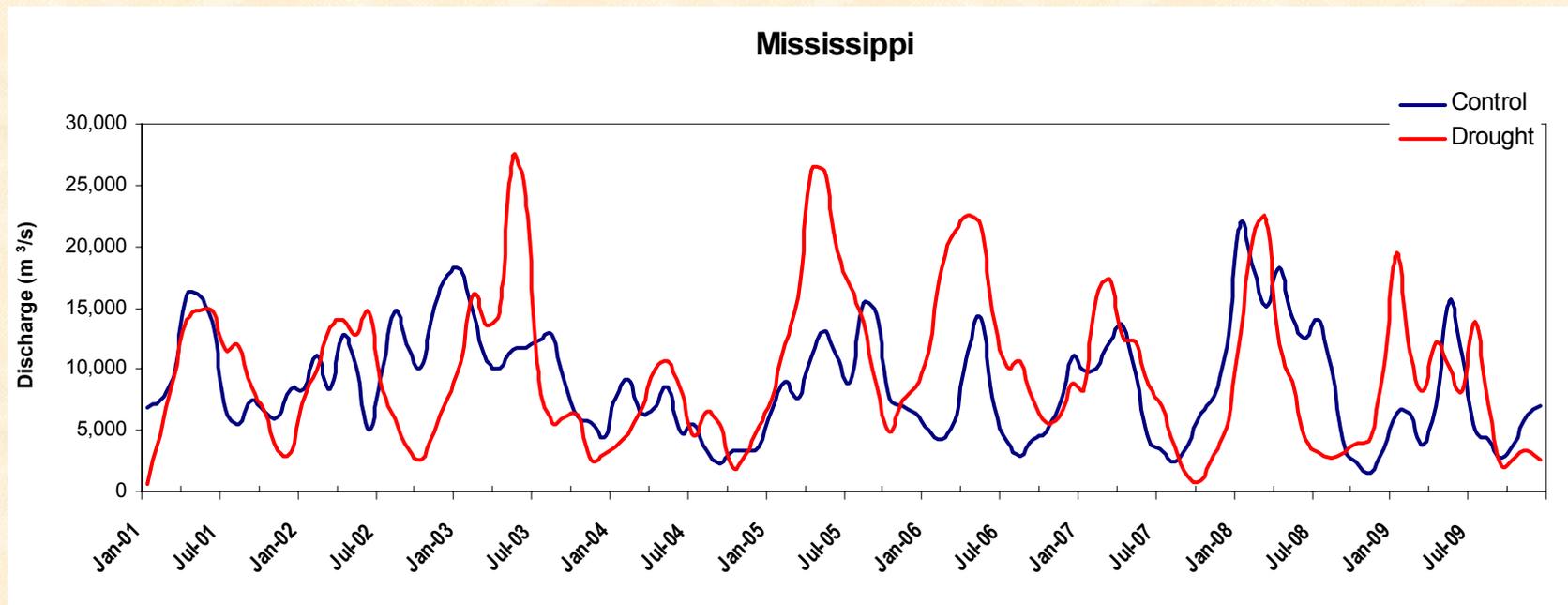
GCIP Region



OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

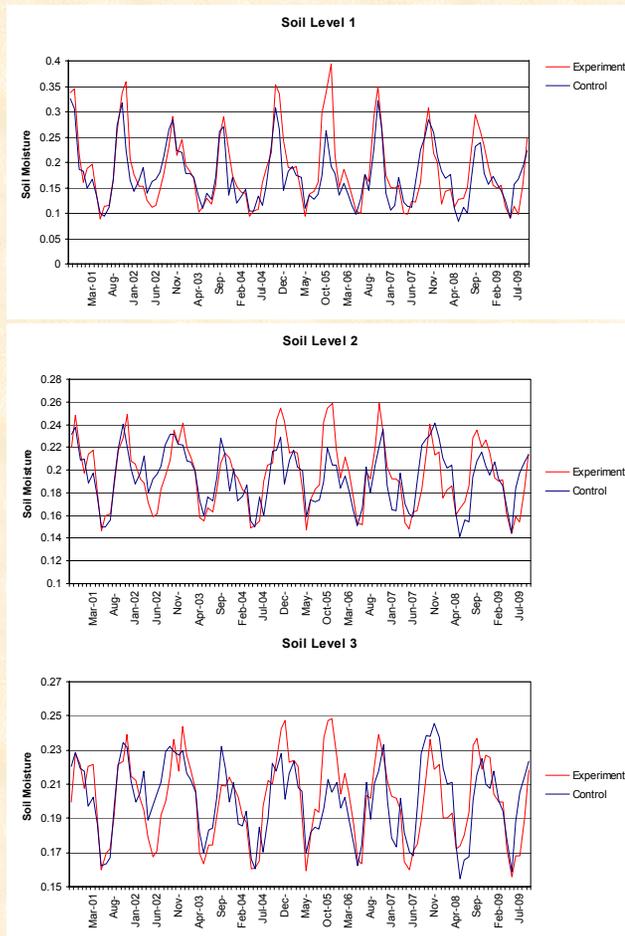

UT-BATTELLE

Mississippi River Discharge



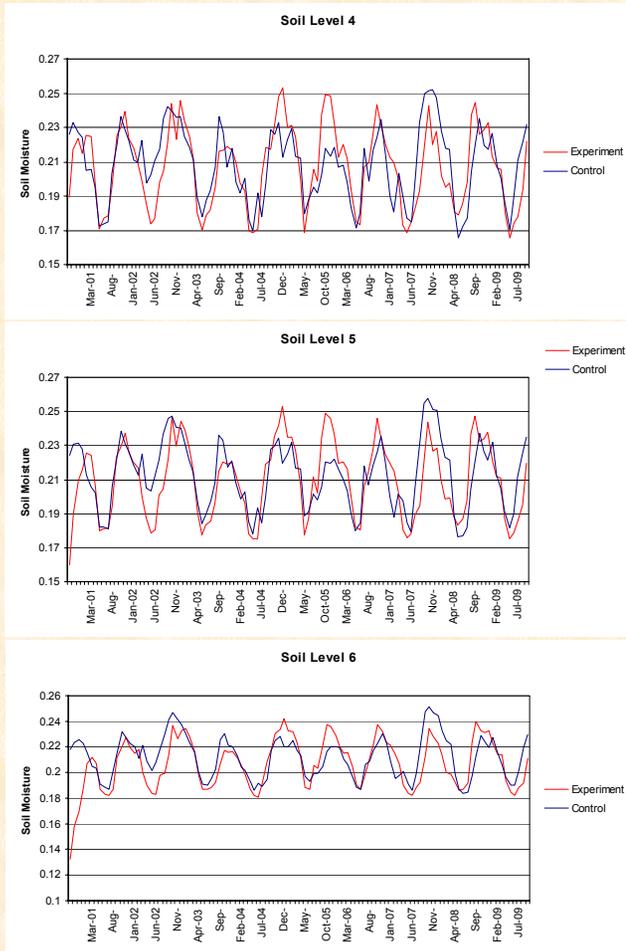
- Highly chaotic compared to other river basins

Top 3 soil layers



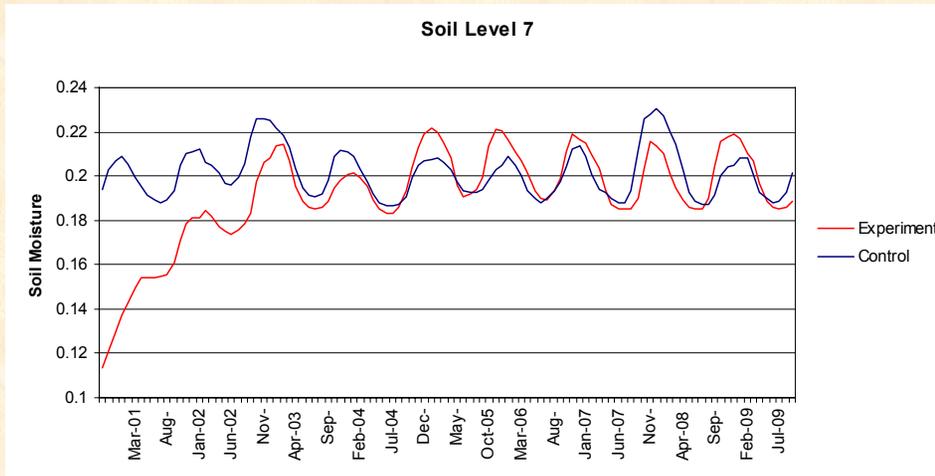
- Quick recovery of top layers
- Experiment has more variability—higher peaks and lower troughs in seasonal cycle

Middle soil layers

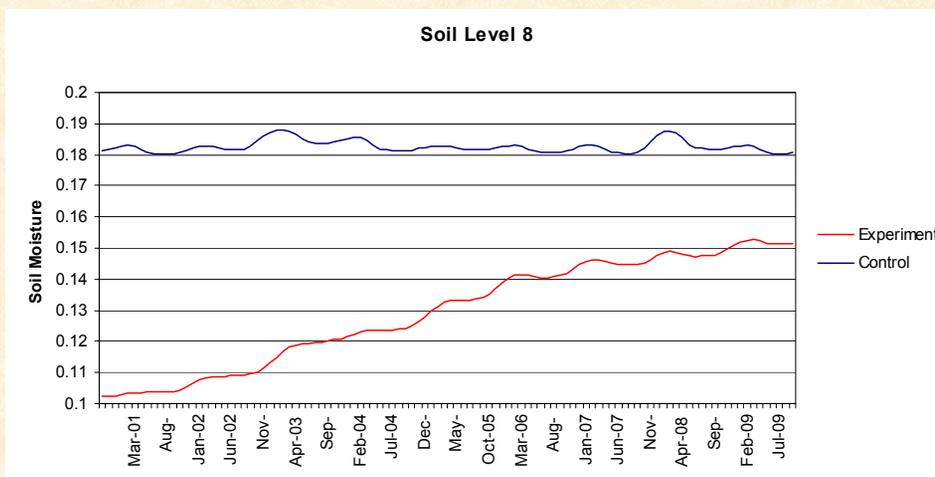


- **Still less than one year required for recovery**
- **Often, range of experimental values exceeds control (higher peaks, lower troughs)**

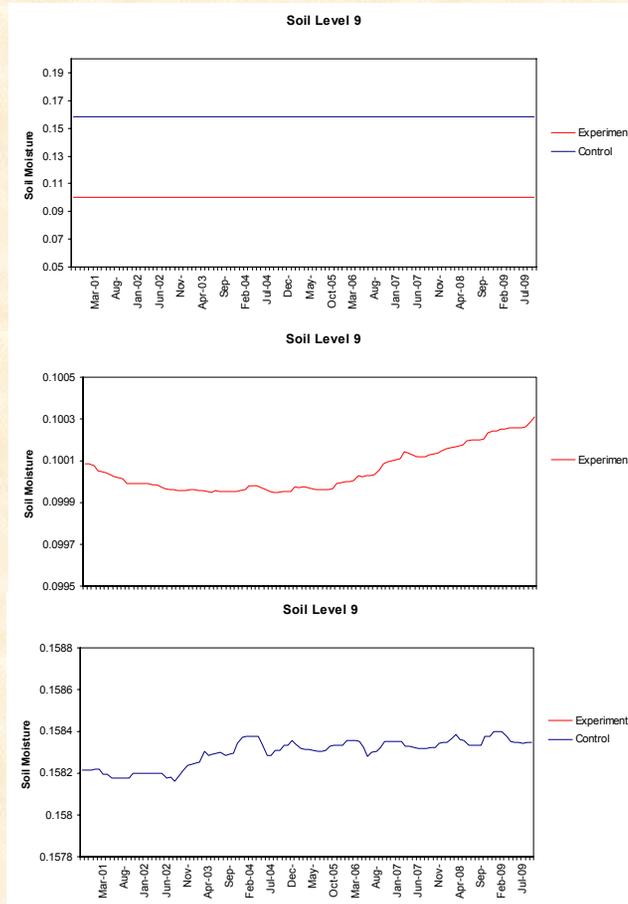
Lower soil levels



- Multiple years required for recovery
- Level 8: more than nine years
 - Seasonal cycle barely perceptible

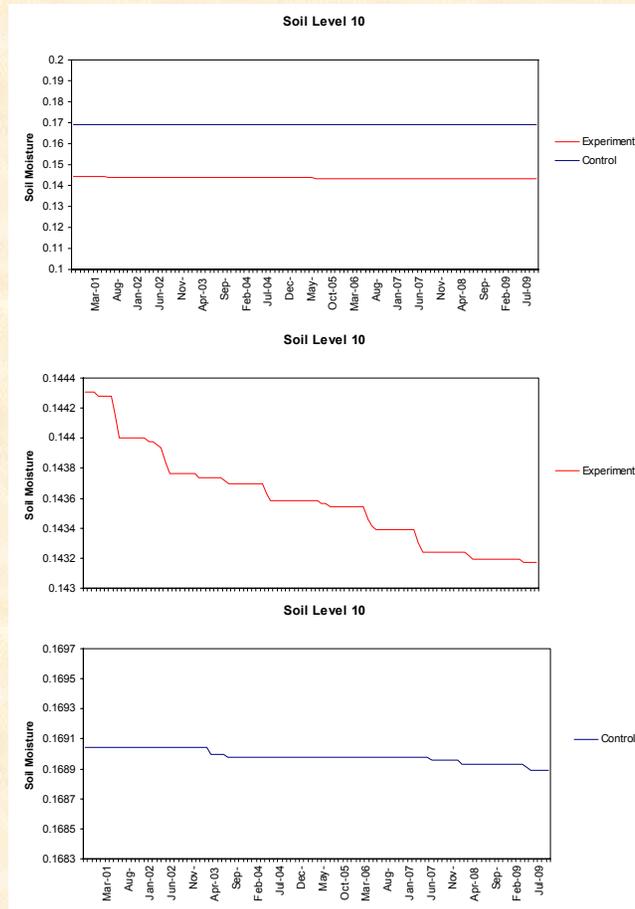


Soil layer 9



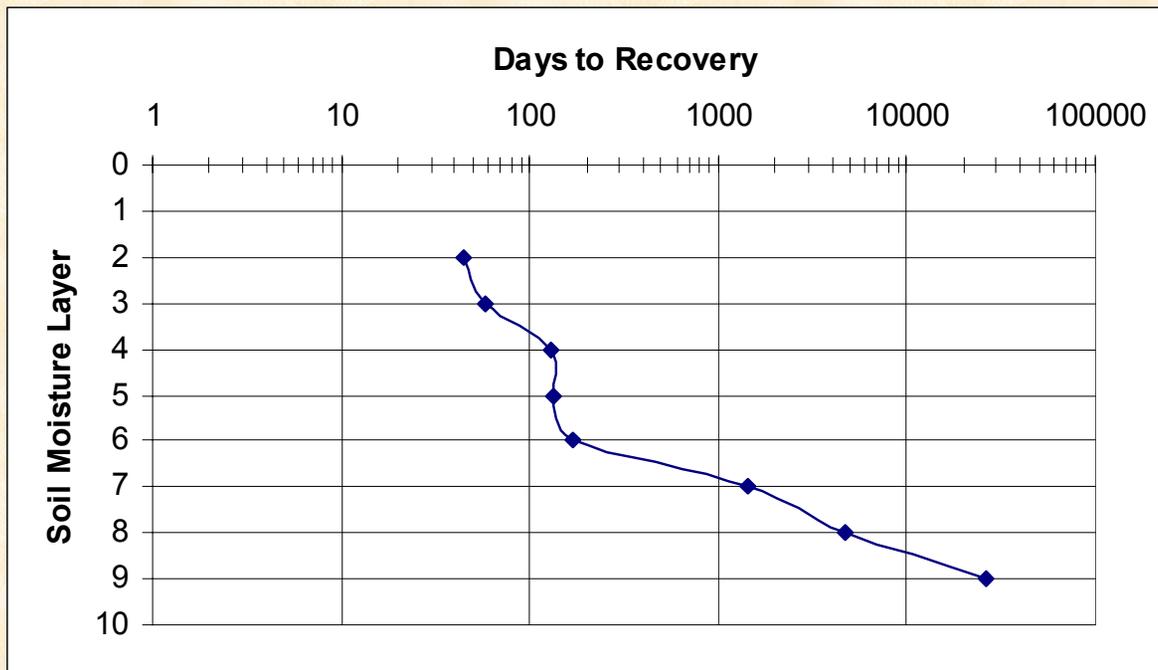
- The soil moisture begins to recover slightly, but after nine years, the change is almost imperceptible
- No seasonal cycle

Bottom soil layer



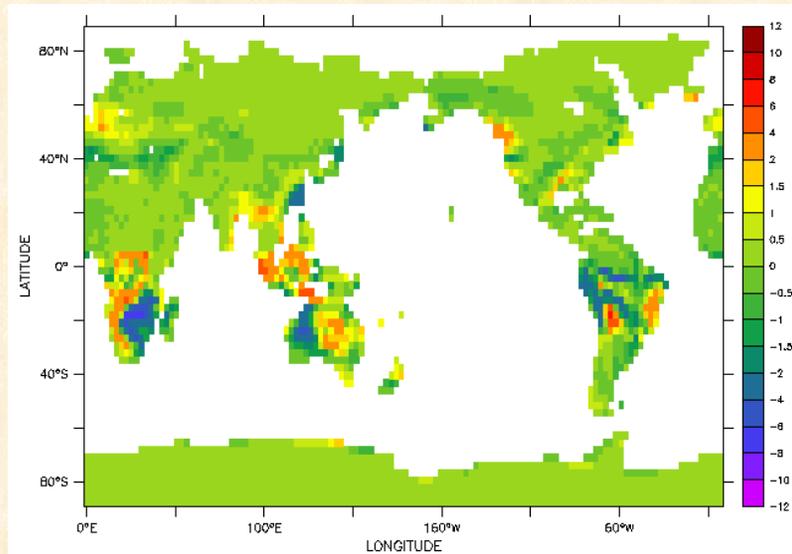
- After nine years of the simulation, the soil moisture is still decreasing
- The control also shows a slight decreasing trend over the nine years

Time for Soil Moisture to Recover to Control Conditions

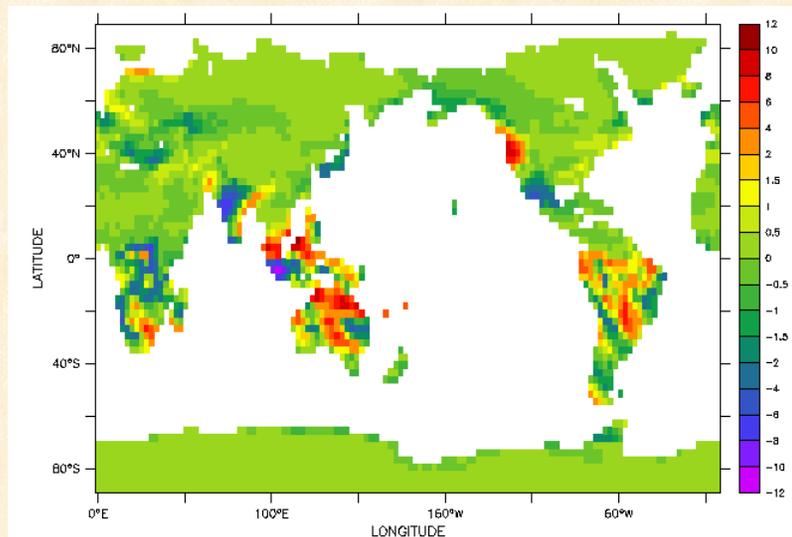


- Top and bottom levels excluded
- Levels 8 and 9 extrapolated from pattern during first nine years

Rainfall



Year 1
January difference (experiment – control)



Year 9
January difference (experiment – control)

- **Most variation in tropical regions**

Conclusions

- **Small difference in river discharges**
- **Some basins more chaotic response than others**
- **GCIP region top soil layers recover quickly, but lower levels recover very slowly**
- **Rainfall differences mainly in tropics**

Acknowledgements

- **DOE SciDAC**
- **DOE Laboratory Directed Research & Development**
- **ORNL CCS resources**
- **UT-ORNL Joint Institute for Computational Sciences**
- **This research was supported by Oak Ridge National Laboratory, managed by UT-Battelle, LLC for the U.S. Department of Energy under contract DE-AC05-00OR22725.**