

CCSM2 Sensitivity to a Single Global Soil Moisture Perturbation

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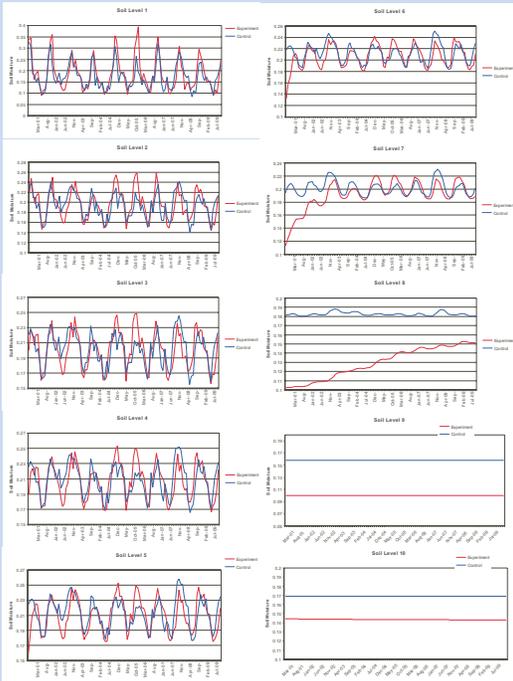
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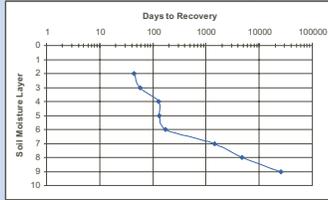
ABSTRACT

A nine-year simulation of CCSM2 was conducted in which an initial soil moisture perturbation was introduced. The soil moisture at all levels and all geographical locations was set to half of the value used for the control simulation to test the sensitivity of the model to such a perturbation. The results were compared to the control simulation (b20.007). The Mississippi River Basin (GCIP region) was specifically targeted for analysis. The resulting river discharge response to the perturbation varied from region to region, but the Mississippi River was particularly chaotic. A slight freshening of the Gulf of Mexico and surrounding regions was evident. The time it took for the soil moisture in the GCIP region to recover to its original value was determined for each soil level. The upper levels recovered quickly, recovery time for the lower levels was extrapolated from the nine years of the simulation, the lowest level never recovered, and the top level had a higher soil moisture average than the control run by the end of the first month of the simulation.

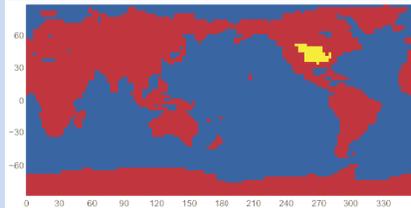
Soil Moisture Time Series at Each Level



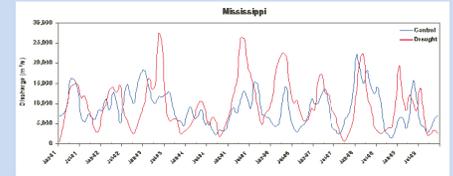
Time to Recovery



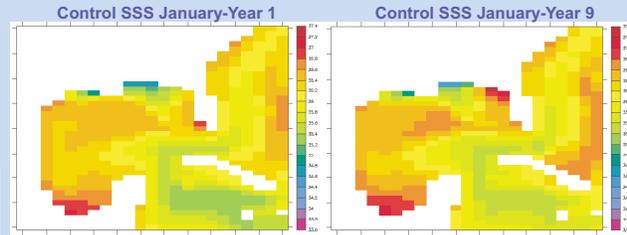
GCIP REGION



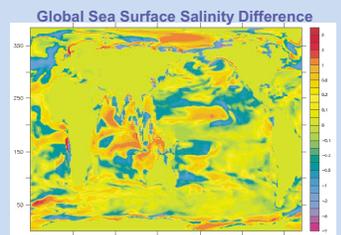
Time Series of Mississippi River Discharge



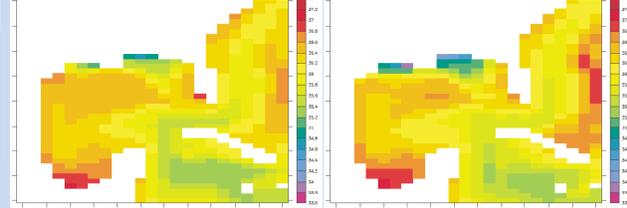
Sea Surface Salinity in the Gulf of Mexico



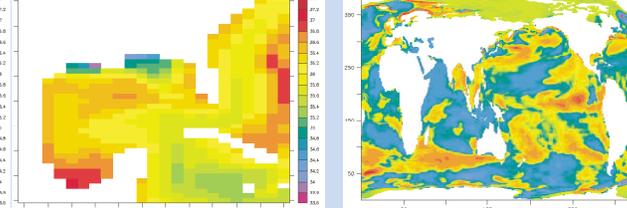
Global Ocean Differences



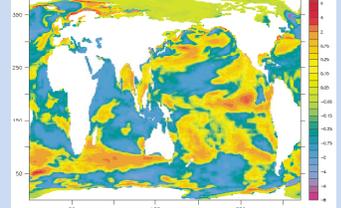
Experiment SSS January-Year 1



Experiment SSS January-Year 9

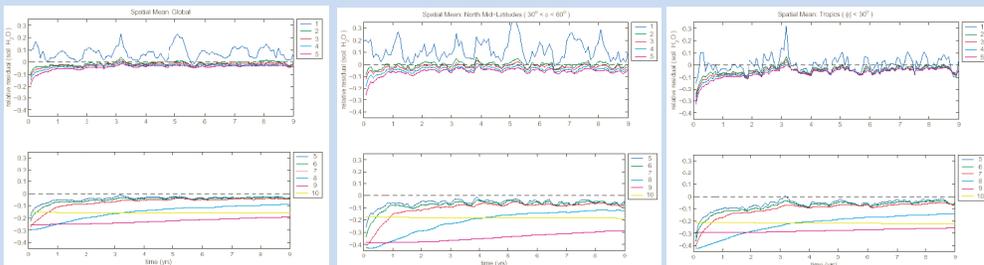


Global Sea Surface Temperature Difference



The graphs in the upper left show the soil moisture averaged over the entire GCIP region for both experimental simulation (red) and the control simulation (blue) at each soil level as it evolved over the time period of the simulation. The figure below that estimates the number of days it took for each level to return to the equilibrium of the control. The map on the top shows the GCIP region in yellow. To the right of that is the Mississippi River discharge throughout the nine years for both experiment and control. As with the top soil level, the river discharge is not noticeably decreased in response to the soil moisture perturbation introduced in the experiment. The response is chaotic, however, unlike other river basins that have been analyzed from this experiment (not shown here). Above are four maps of sea surface salinity in the Gulf of Mexico and surrounding areas. The experiment results (bottom two) are somewhat fresher. The two maps to the right show the differences between January of the first year and January of the ninth year (experiment - control) for sea surface salinity (top) and sea surface temperature (bottom) globally for comparison.

SOIL MOISTURE TIME SERIES



The above three graphs show the relative residual soil moisture averaged over three different regions (global, northern mid-latitudes, and tropics). The maps below show the time averaged soil moisture differences at the top, fifth, ninth, and tenth levels.

CONCLUSIONS

The sensitivity of CCSM2 to an initial soil moisture perturbation was tested with this experimental simulation. The time to recovery to initial conditions in the GCIP region was determined for each soil level. The residual soil moisture differences between experiment and control for each level was calculated over various geographical regions. The tropics and north mid-latitudes are shown as well as the global average. The response of the oceans to soil moisture changes was also examined.

ACKNOWLEDGMENTS

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