

Interactive comment on “Contribution of soil moisture feedback to hydroclimatic variability” by N. Y. Krakauer et al.

Anonymous Referee #3

Received and published: 13 January 2010

This paper examines the impact of dynamic soil moisture (compared to a climatology of soil moisture) on hydrologically relevant variables, including precipitation, evapotranspiration, temperature, and cloud cover using GISS GCM ModelE. Specifically, the effects of dynamic soil moisture on the interannual variability of evapotranspiration, temperature, precipitation, and cloudiness; the correlation length scale of seasonal to annual temperature and precipitation fluctuations; the persistence of seasonal temperature and precipitation anomalies; and the correlation between precipitation and surface temperature were examined.

General Comments

This is a very well written and interesting paper. The layout and presentation are clear

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and logical. I have two overall comments:

1. While you thoroughly address differences between your results and those of other studies in the Discussion section, I would encourage you to elaborate on how your experiments differ from past work and why the inconsistencies/weaknesses of previous findings make this study relevant (which I believe it is) in your Introduction.

2. Because a portion of the Results and Discussion hinges on the representation of evapotranspiration in GISS GCM ModelE, it would be nice to have another few sentences in the Methods section describing the relationship between soil moisture and evaporation/transpiration in ModelE.

Specific Comments

Pg. 6968, Ln. 7 - Why is “evaporation” (as opposed to “evapotranspiration”) used throughout the paper? I assume you are using the terms interchangeably, but it would be good to note that in the manuscript.

Pg. 6973 - Do the CLIM runs close the water budget? If so, how? Was excess precipitation run off? And was water added when precipitation was not available to wet soils?

Pg. 6978, Ln. 20 - I am unclear as to why the correlation length scale of temperature over the ocean should change at all given fixed SSTs. Possibly the difference is surface versus near-surface temperature?

Pg. 6981, Ln. 2-8 - This statement is interesting, but may need further qualification. If you have a high soil water capacity and a relatively insensitive evapotranspiration response to soil moisture, then this is likely true. But depending on your representation of soil moisture you might also dry out your soils on a soil water fraction basis. One way I thought of your experiment was that you were basically assigning a seasonal cycle to the response of evapotranspiration to soil moisture.

Table 1 - Why is standard deviation normalized by the mean for all variables except

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temperature?

Figures 1-10 - Font of titles, axes numbers/labels, and scale numbers needs to be larger.

Figure 5 - Break into multiple figures, panels are too small.

Technical Corrections

Pg. 6970, Ln. 2 - Missing period between sentences.

Pg. 6970, Ln. 10 - “However, correlations that are not local are hard to detect with this approach, and care needs to be exercised not to attribute meteorological persistence to soil moisture feedback when it may in fact have other causes (e.g. Wei et al., 2008).”

Pg. 6971, Ln. 25 - I have never seen gridcell written as one word. Is this grammatically correct?

Pg. 6971, Ln. 25 - Change “seperate” to “separate”.

Pg. 6975, 6976 - Reiterate what you are comparing (DYNA vs. CLIM) more often. For example, Pg. 6976, Ln. 12: “In the gridcell in the western Sahel (17oN, 1oE), precipitation is lower in the DYNA simulation from the beginning to the peak of the wet season (April to August), as is cloud fraction.”

Pg. 6976, Ln. 21 - I believe that for tense consistency you want to use “doubles” as opposed to “doubled”.

Pg. 6976, Ln. 24 - “Temperature variability in the summer extratropics and year-round in the tropics showed a large increase of some 50% (Fig. 7), suggesting, as also found in previous studies (e.g. x, y, z), that through its control on the fraction of incident energy used for evaporation, soil moisture is an important contributor to summer heat waves.”

Pg. 6981, Ln. 2 - “The substantial change observed in the mean state, especially

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in summer temperature and precipitation, is interesting in that our formulation of interannually fixed soil moisture can be thought of as similar to high soil water capacity (which would also lead to reduced synoptic and interannual variability in volumetric soil moisture).”

Pg. 6982, Ln. 7 - “Water stored within trees can also be important in seasonally dry tropical forests (Borchert, 1994), as can hydraulic redistribution (active vertical transport of water within the soil profile by plant roots) (Oliveira et al., 2005). You may also want to consider “seasonably dry parts of the Amazon rainforest” a few lines above, but I think what you have is correct.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 6967, 2009.

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