Hydrol. Earth Syst. Sci. Discuss., 5, S478–S481, 2008
www.hydrol-earth-syst-sci-discuss.net/5/S478/2008/

Hydrology and Earth System Sciences Discussions

Interactive comment on "A coupled atmosphere and multi-layer land surface model forimproving heavy rainfall simulation" *by* M. Haggag et al.

Anonymous Referee #2

Received and published: 9 June 2008

General comments

The manuscript "A coupled atmosphere and multi-layer land surface model for improving heavy rainfall simulation" by Haggag et al. deals with the important topic of land surface impacts on atmospheric variability. The authors show that using different land surface models coupled to an atmospheric circulation model yields considerable differences in simulated precipitation, with the most complex land surface model being closest to the observed precipitation. While the results are presented in a clear and structured fashion, the paper in its present form has some important shortcomings.

Firstly, with the results being sensitive to the choice of land surface model, this is likely also true for the choice of initial conditions (specially because the simulation period is

rather short-although this is nowhere mentioned). With different model structures, it is a non-trivial exercise to initialize all models similarly, and the arbitrary choice of initial conditions might have a large impact on the results. This is not discussed.

Secondly, the presented evidence for the proposed causal link between the special patterns of heat fluxes and the precipitation is rather weak, or at least not well presented. If MM5-CPL would produce different land surface temperatures, this would be the case all over Japan (not just on the Kyushu Island), and the surface pressure differences (Fig 9) should be noticable over a larger area. The fact that this is not the case suggest a strong interaction between precipitation and surface temperature. This however is not investigated. It is also not shown that the spatial patterns of soil moisture and heat fluxes are indeed more realistic than the CTRL simulation. Thus, there is little evidence for the proposed mechanism (Page 1081, which does not include the impact of precipitation).

In its present form, the paper is neither a model description nor a complete process study, so the question remains what the reader can learn from it besides that different model setups give different results. However when improvements are made on the analysis of the linkage between the the improved soil moisture and flux simulations and rainfall, the paper can make a valuable contribution to the already existing literature on this topic.

In its present form, i think the paper needs major revisions in order to meet the standards of HESS. Some specific comments and suggestions for improving the manuscript are given below.

Specific comments

Title: The title suggests that the paper deals with the presentation of a new model, while in fact most of the manuscript is filled with the application and the model is described only briefly. I would therefore suggest to use a different title that covers that content of the manuscipt better.

HESSD

5, S478–S481, 2008

Page 1075: Model setup. How was soil moisture initialized in the model? This is relevant since it is the soil moisture that impacts the spatial and temporal variations in latent and sensible heat fluxes in the model. Please describe this in sufficient detail, along with possible impacts of the choice of initialization for the results. Fig 4 suggests that no "spin-up" was performed, and that the soil moisture was initialized as a function of soil texture (spatial pattern of soil moisture is similar to texture). However this correspondence rapidly disappears, suggesting that the tight relation between soil moisture and texture is not realistic, since other factors (i.e. rainfall) also impact soil moisture variability.

Page 1077, Line 14. Does this feedback really exist? Higher ground temperatures do heat up the surface layer air (only is this is higher than the surface temp!), but this also leads to a heat transport from the soil to the atmosphere (and thus cooling of the surface). This suggests a link with radiation differences between the model runs, which result in surface temperature differences.

Page 1081, Line 14. Can slightly higher soil temperature really impact the upper model layers? The heat capacity of the soil is limited, so any heat transport to the atmosphere will in turn lead to a decrease in surface temperature. Differences in soil temperature can only be sustained by differences in air temperature or radiation, non of which is investigated in the paper.

Page 1083, Line 22. It is not shown that the MOST profound differences are in the rainfall, but only that the differences in rainfall are profound.

Page 1099, Figure 9.

Technical corrections

Page 1068, Line 2: better represent, not represent better

Page 1068, Line 5: Earth

Page 1068, Line 18/19: "This paper shows.."

HESSD

5, S478–S481, 2008

Interactive Comment

Page 1069, Line 20: It is not the parameters that are exchanged, but rather the fluxes.

Page 1070, Line 4: TOPMODEL is a concept or framework rather than a complete hydrological model. The correct reference is to Beven and Kirkby, 1979.

Page 1073, Line 21: again states, or fluxes, rather than parameters

Page 1077, Line 7: SOLEVEG

Page 1078, Line 19: In contrast to...

Page 1082, Line 23: "state-of-the-art"

Figures: The color bars are very small, sometimes i had to look twice to see that in fact they were not missing!

Some usefull references:

Taylor, C. M., D. J. Parker, and P. P. Harris (2007), An observational case study of mesoscale atmospheric circulations induced by soil moisture, Geophys. Res. Lett., 34, L15801, doi:10.1029/2007GL030572.

Taylor, C. M., and R. J. Ellis (2006), Satellite detection of soil moisture impacts on convection at the mesoscale, Geophys. Res. Lett., 33, L03404, doi:10.1029/2005GL025252.

Quinn, P., K. Beven, and A. Culy (1995), The introduction of macroscale hydrological complexity into land surface-atmosphere transfer models and the effect on planetary boundary layer development. J. Hydrol. 166, 421-444.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 1067, 2008.