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Geoscientific Model Development Discussions
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# *Interactive comment on* "Coupling the high complexity land surface model ACASA to the mesoscale model WRF" *by* L. Xu et al.

**Anonymous Referee #3**

Received and published: 9 June 2014

The main contribution of this study is the coupling of ACASA to WRF, which enables a more sophisticated and accurate view of the land-atmosphere interactions and the carbon cycle. I think this is a valeable contribution and worth publishing. The paper details the effects of this change on simulated near-surface temperature and moisture. I recommend this paper for publication in GMD with some revision. Mostly my suggestions have to do with improving the structure of the paper.Review of: Coupling the high complexity land surface model ACASA to the mesoscale model WRF, by L. Xu et al. for Geoscientific Model Development Discussions.

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the effects of this change on simulated near-surface temperature and moisture. I recommend this paper for publication in GMD with some revision. Mostly my suggestions have to do with improving the structure of the paper.

General Comments: 1. I suggest the Introduction be made more concise and include some more recent references. I am not sure if the necessity of land surface models should be so thoroughly discussed and defended, it makes the Introduction unnecessarily long in my opinion. For example, the majority of earth system models/coupled GCM now use land models with interactive carbon cycles (see for example Table 2 in Anav et al. 2013 which lists CMIP5 models and their relevant land components, attached as a supplement to this review). It should be clear that the limitations in the land surface models discussed in the Intro refer specifically to the land models of WRF, and not LSMs in general.

2. How are biophysical parameters set in each model (for example, land cover type, the LAI and canopy height?).

3. In regards to the issue with the measurement heights and what "2m" temperature is in the model: Is it not possible to use above-canopy simulated temperatures, and would these be more analogous to the observed temperatures? Also, what were the measurement heights for the four stations and how do these influence the results?

4. At some points the text in this section is repetitive, or else it does not follow a logical order. I suggest breaking up the results section to help the reader. Either divide it by the meteorological variable discussed (e.g. 3.1 Temperature; 3.2 Dew point temperature, etc), or by the regions (e.g. 3.1 Northeast Plateau; 3.2 Mojave desert, etc.). Another suggestion is to segregate all discussion of reasons for model-obs mismatch from the results – either separately for each variable or together at the end of this section. This would reduce the repetition.

5. Since relative humidity is a function of the temperature and Td, it makes sense to me to combine the Td and RH results/discussion. This is another place where repetition



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could be reduced.

Specific comments Page 2834, Lines 13-16: It is not clear to me how the study addressed objective 1, since model parameters are barely covered in this paper.

Pg. 2834, Lines 1-2: "The mass-based terrain following coordinate in WRF improves the surface processes." This sentence is vague, which surface processes are improved with the terrain-following coordinate?

Page 2840, Line 28: Precipitation is not included in the results/discussion.

Page 2841, Lines 16-22: Figure 4 is not entirely necessary. The reasoning behind only using days with 24 hours of data is well explained and well justified without these sentences and the figure.

Page 2842: For the reader unaccustomed to maps of California, it would be helpful to explain where the Central Valley is – for example by stating that it is seen as the oval region of relatively warm temperatures (if true . . .). Otherwise, if Fig. 2 included a topographic map it would probably be more clear where the valley is.

Page 2843 Line 12-14: Related to the above, the meaning of this sentence is not entirely clear if you don't know exactly where the Central Valley is. The LAI is highest in the middle of the Central Valley, so ACASA simulates a higher latent heat flux and cooler temperatures than NOAH. Even though NOAH is a big-leaf model, does it scale the fluxes to get canopy level fluxes (i.e. by leaf area index or absorbed PAR)? And are the LAIs the same for NOAH and ACASA?

Page 2843, Lines 27-29: How are LAI values in ACASA determined?

Page 2844, Line 24 – Page 2845, Line 2: What is the height of the lowest sigma layer? Also can it be shown that the turbulent mixing is lower in ACASA or is this just conjecture? Do the two models have similar night-time sensible heat fluxes?

Page 2845, Line 24-25: Is this a typo, it seems visible in Fig. 6 that the diurnal range



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is smaller in WRF-ACASA.

Page 2845, Line 29: I do not see a warm bias in NOAH during these times at the MC site.

Page 2848: I am not sure what Table 2/Figure 9 add. Through the rest of the paper, there are 4 basins discussed and now there are 13 – how do these relate? It seems this figure just confirms the previous analysis. If it's retained, the authors should show the equation used for the Degree of Agreement statistic. Also, in Fig. 9 the convention used in the other figures of red for WRF-NOAH and blue for WRF-ACASA is reversed.

Page 2850, Line 5: The choice of land surface model clearly does affect the simulation (as is shown in Fig. 10-11), but maybe not the overall basin-wide biases.

Page 2850, Line 8: What is meant by "This" at the beginning of the sentence? Do you mean the poor model performance in both NOAH and ACASA? It is a little unclear since the previous sentence addresses atmospheric processes, but this sentence refers to surface properties. Also the following sentence is hard to understand as its written.

Figure/Table Comments: 1. Fig. 2: Replace the numbers in Fig. 2a with labels for each vegetation type.

2. Figures 6 and 10 would be easier to interpret as difference plots (ie: Show the Model-Observations for each model). Or, plot the daily averages in Figures 6 and 10 since the diurnal cycle is examined in Figures 7 and 11.

3. It would be useful for the four basins to be shown in Fig. 2 or 3.

4. Fig. 3: Show the 4 stations used in the analysis in a different color/symbol.

5. Table 1: Remove the column for "Vegetation" since these numbers have little meaning to non-ACASA users.

Technical comments: Page 2850, Line 13: Typo ("pervious") Page 2849, Line 28: Remove the first part of this sentence ( "Figure 12 shows . . . surface temperature,").



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Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/7/C870/2014/gmdd-7-C870-2014-supplement.pdf

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Interactive comment on Geosci. Model Dev. Discuss., 7, 2829, 2014.