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Geoscientific Model Development Discussions
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Interactive comment on "A subbasin-based framework to represent land surface processes in an Earth System Model" *by* H.-Y. Li et al.

H.-Y. Li et al.

hongyi.li@pnl.gov

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This paper is correctly written, but the scientific content is of low interest, and I recommend to reject it.

The authors compare two versions of the Community Land Model (CLM) which share the exact same equations and parameters, the only difference being in the spatial discretization of the modeled domain (here the Columbia River basin). The standard CLM version uses a regular grid-mesh (at the 0.125_ resolution), and the SCLM version (with an S for Subbasin-based) uses hydrological basins as elementary spatial units. Since these hydrological basins are defined in this paper to have an average area close to the one of a 0.125_ grid-cell, these two versions produce very similar results, as anyone with a bit of geoscientific modeling experience would have expected. Moreover,

the largest differences (which remain weak from my point of view) are i) not explained nor discussed, ii) said to be "more significant" than the weakest differences, without any statistical inference test.

The technical aspects of forcing data processing for the subbasin discretization do not reveal any innovation compared to the state of the art. The indexing system could have been an interesting point, but it is just mentioned and not explained. A notoriously difficult input parameter for hydrological modeling is soil depth, and it is not even mentioned in section 3.2 "Land surface parameters".

Response: We thank the reviewer for these major concerns. Even though we agree with the reviewer that the paper is not scientific in nature, we would like to point out that given the journal's focus on model development, we submitted this paper more to illustrate the feasibility and technical details of how to apply a land surface model within an Earth system modeling framework in a way that is typical in hydrologic modeling. As discussed in the paper, up to now, there are only limited attempts (i.e., Koster et al., 2000; Goteti et al., 2008) toward this direction, each subject to its own limitations.

This study constitutes technical advances over these previous studies in two ways: 1) deriving input forcings and land parameters from high resolution datasets; and 2) coupling a new physically based river routing model in the subbasin-based framework. Even though these are again, typical in the field of hydrology, we argue that they are still new and innovate in the field of land surface modeling, or broadly, climate and earth system modeling, especially given the increasing complexity in software engineering in these models. As discussed in the summary section of the paper, CLM4 is the land component of the Community Climate System model and the Community Earth System model (i.e., CCSM4 and CESM1), which contain other components of the earth system (i.e., atmosphere and ocean). In order to ensure proper coupling between the component models, it is critical to make sure that discretization of each components is carefully designed so that mapping between the components could be achieved. In fact, the capability of using unstructured grids (such as the subbasin boundaries) in component models of the CCSM/CESM has only been recently achieved through the design of the coupler CPL7 (Craig et al., 2012), which makes the subbasin-based execution of CLM4 feasibility. And to our knowledge, a subbasin-based application of CLM4 has never been achieved by anybody else.

Nevertheless, as pointed out by the reviewer, we failed to clearly explain the indexing system, which is critical for understand the coupling between SCLM and MOSART. We will add detailed discussion to the revised manuscript if we are offered a chance.

In addition, as pointed out by reviewer, soil depth is a notoriously difficult input parameter for hydrology modeling. It is, however, greatly simplified in CLM4 by assuming that soil depth has a globally uniform value of 3.8m (Oleson et al, 2010). Even though it is a bold assumption, it is typical in the field of land surface modeling due to lack of soil depth data globally.

Above said, we have decided to redirect our study to focus on the scientific content. The technical aspects will be shortened into an appendix. We will, however, add some discussion on the indexing system and the soil depth issue. For more details about our revision plan, please refer to our letter to the editor (attached as supplement).

A complementary part is about the influence of DEM resolution on fmax and runoff generation, but i) fmax is not even defined nor its link to topography, ii), we need to go the caption of Fig 10 to understand the nature of the sensitivity test, iii) the results are not explained nor linked to the abundant related bibliography.

Response: As discussed in Li et al., 2011, the runoff generation scheme in CLM4 is based on a simplified TOPMODEL-based representation [Niu et al., 2005; Oleson et al., 2010]. As defined in typical TOPMODEL applications, Fmax is the maximum possible saturated area fraction, We will add explanations of hydrologic parameterizations in CLM4 as an appendix, and articulate better the nature of sensitivity test and linkage to the related bibliography in the revised manuscript if offered a chance.

Minor comments on the Figures: Fig. 2: normally, in land surface models, it is air temperature and not surface temperature that is a forcing data.

Response: Agreed. It is a typo is the caption. What we plotted was the air temperature. We will correct it.

Fig. 5: the colors are difficult to discriminate, and the caption is not informative. Response: We will pay great attention to the quality of figures and captions in the revision.

Fig 7: Soil moisture is not a term of runoff, and this panel is not commented in the text. Response: We consider soil moisture very closely related to runoff. But the reviewer is right that it may lead to confusion. We will reorganize our panel, or at least add some explanation in the caption part.

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Craig, A.P., M. Vertenstein, R. Jacob (2012): A new flexible coupler for earth system modeling developed for CCSM4 and CESM1, International Journal of High Performance Computing Applications, 26: 31 Goteti, G., J. S. Famiglietti, K. Asante (2008): A Catchment-Based Hydrologic and Routing Modeling System with explicit river channels. J. Geophys. Res., 113:d14, D14116 Koster, R. D., M. J. Suarez, A. Ducharne, M. Stieglitz, and P. Kumar (2000): A catchment-based approach to modeling land surface processes in a GCM: 1. Model structure, J. Geophys. Res., 105, 24,809–24,822. Niu, G.-Y., Z.-L. Yang, R. E. Dickinson, and L. E. Gulden (2005), A simple TOPMODEL-based runoff parameterization (SIMTOP) for use in global climate models, J. Geophys. Res., 110(D21), D21106. Niu, G.-Y., Z.-L. Yang, R. E. Dickinson, L. E. Gulden, and H. Su (2007), Development of a simple groundwater model for use in climate models and evaluation with Gravity Recovery and Climate Experiment data, J. Geophys. Res., 112(D7), D07103. Oleson, K. W., D. M. Lawrence, G. B. Bonan, M. G. Flanner, E. Kluzek, P. J. Lawrence, S. Levis, S. C. Swenson, and P. E. Thornton (2010), Technical Description of version 4.0 of the Community Land Model (CLM), NCAR/TN-478+STR, National Center for Atmospheric Research, Boulder.

Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/6/C1200/2013/gmdd-6-C1200-2013-supplement.pdf

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Interactive comment on Geosci. Model Dev. Discuss., 6, 2699, 2013.