

## ***Interactive comment on “Exploring New Topography-based Subgrid Spatial Structures for Land Surface Modeling” by Teklu K. Tesfa and Lai-Yung Leung***

**Anonymous Referee #1**

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This manuscript evaluated a new approach in representing the spatial heterogeneity of topography and pointed out that the representation based on a more flexible classification using hypsometric analyses (local) and spatially non-contiguous (non-geo-located) subgrid structures is more robust. The manuscript is generally well written and I think it is ready to be published after the major points are answered.

Major comments:

1. In the atmospheric science field, the importance of land-surface processes to the evolution of temperature and moisture distribution in the atmospheric boundary layer is generally well recognized. The impact of spatial distribution of topography on the atmospheric motion and precipitation distribution, on the other hand, is a major topic in

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the field (see, for example, the review paper by Houze 2012). With the new approach in representing subgrid structure of topography, can the atmospheric modeler benefit from the parameters used in the new approach for better representing subgrid scale land-topographic-precipitation processes?

2. The comparisons among various approaches (Global vs. Local, geo-located vs non-geolocated, etc.) in the paper are generally qualitatively rather than quantitative. For example, in line 240, I can understand the local method is better but I cannot understand how much better it is. Judging from the variability of the data, I can also argue that the two methods are roughly the same.

3. The purpose of using precipitation in the implications to representation of land surface processes is not clear to me. I think the goal of the new approach is to better capture the subgrid variability of the topography. Precipitation, on the other hand, is the overall results of land-atmosphere-topography interactions. Does that mean the atmospheric model should also have similar grid structure as the land surface model? In addition, I don't understand how the results in Figure 13b are better than Figure 13a.

Minor comments:

1. Line 61: Does the definition of subgrid affect the results? For example, the subgrid for the general circulation model grid size or the cloud resolving model grid size?

2. Line 83: Does the choice of study area affect the results?

3. Line 175: Can you be more specific on what area threshold means?

4. In line 230: “the spatial pattern of the number of SUs per subbasin for the SUs from the Local method follows the topographic pattern in the study area better than those of the Global method”. In Fig.5, it's difficult for me to recognize such point. Is it a result of coloring the number of SUs into 5 categories rather than 13 categories?

5. The Y-axis in Figures 7, 8, 9 and 12 is blurry and difficult to read.

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Houze, R.A., 2012. Orographic effects on precipitating clouds. *Reviews of Geophysics*, 50(1).

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