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Interactive comment on "Enhancing the representation of subgrid land surface characteristics in land surface models" *by* Y. Ke et al.

Anonymous Referee #3

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This manuscript develops a novel sub-grid classification approach of combining the joint distributions of both topography and vegetation cover for the application of land surface modeling. The presentation is nice; English writing is professional. However, the purpose of this manuscript is not clear at all. This paper can be published AF-TER the authors can provide convincing arguments on the following important points. I wish the authors can achieve it successfully, and I will be glad to review this paper again - First, most of the current LSMs do not represent topography in their parame-terization, therefore it is clear to me what is the potential usefulness for the proposed subgrid approach. The authors argue that there is usually strong correlation between topography and vegetation, but they were able to provide any evidence based on the

data used in this study. The high-resolution land cover maps (e.g., MODIS products) are currently available, so the specification of realistic fractional coverage of vegeta-tion types is straightforward, then what is the purpose of this study? Can the Authors please demonstrate how the results of this study can really improve the LSM simula-tions? Although the authors cited their previous work Leung an Ghan (1998) in which the influences of topography on precipitation was accounted for by a sub-grid approach as the motivation of this study, the issue in the present study, namely the relation be-tween vegetation and topography, does not influence the LSM simulation as long as the vegetation cover is faithfully specified. If the authors' purpose is to demonstrate how to incorporate the effects of micro-scale topography on the macro-scale hydrologic sim-ulations, then the work presented in this study cannot justified they have reached this purpose at all. Specifically, I suggest much more clear explanations on the following rather vague statements - (Page 2080, lines 16-19) "...This representation mainly fo-cused on the fractional coverage of each PFT........ The location of the PFTs, however, has seldom been explicitly described (Niu et al., 2011)". But, why it is important to know the exact locations of each PFT in LSM simulations? Can the knowledge of that improve the quality of simulation? Can the authors provide the evidence? (In line 19-24, authors provided some related sentences, but in fact none of them can really answer the above key questions - why need explicit information on the spatial location of topography and vegetation? On line 25, the authors further stated "When combined, topography and vegetation have coupled effects on surface water and energy fluxes." This is true, but in reality how can these effect to be presented in the LSMs? If this is difficult to achieve as most of LSMs were unable to do so, then what is the use-fulness of the proposed subgrid classification approach? Of course the authors can test LSMs simulation with different land cover maps as produced from this studies, but without any explicit representation of topography in LSMs, can the identified sensitivity to different vegetation classification be attributed to the "strong" correlation between vegetation and topography? I do not think so. Therefore, on page 2181, line 13-16, the authors state the purpose of this study., but as the above reason I do not understand

at all what is the purpose to "enhance the representation of both vegetation cover and topography"? Definitely going for higher grid-resolution of LSM modeling is not the main point to be recommended by the authors in this paper. On page 2182, line 10-12, "The method developed in this study assigned a flexible number of elevation bands and PFTs for each model grid and optimized to explain a maximal amount of elevation and vegetation variations in a computationally efficient manner". Why need to be "flexible"? any advantages from being flexible in the number of classes? Not explain at all... Finally, this paper is way too lengthy. It is indeed a paint o read through it from the beginning to the end (but the English writing is not the problem). I wish the authors can re-organize the key points of this study concisely (because the idea behind this work is not complicated at all, so really no need to repeat many similar arguments and figures, and cut the length and the number of figures 50%. I strongly believe this is achievable, and it will make this manuscript in a much better shape.

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