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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A WRF simulation of the impact of 3-D radiative transfer on surface hydrology over the Rocky–Sierra Mountains" *by* K. N. Liou et al.

Anonymous Referee #2

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This study examines how surface topography impacts the radiative fluxes and surface hydrology over Western US mountain regions. As most global circulation models (GCMs) use "plane-parallel" (PP) radiative transfer approach, potential errors may arise due to 3-D interactions between radiation and mountains. By implementing a 3-D radiative transfer code in the WRF model at 30 km horizontal resolution, the authors provide a detailed account of the deviations of the radiative fluxes and snow-water-equivalent (SWE) as a function of local time, elevation and time of a year in the 3-D radiation model from those in the PP model. The deviations, up to 40-60 Wm-2 in surface solar flux and 18% in SWE, are quite substantial. The paper is clearly presented.

It is publishable after addressing the following comments and suggestions from me.

(1) The abstract is too long. It should be shortened to emphasize main findings and reduce words on background and implications.

(2) The analysis box in Figure 1 should be marked darker and thicker. Figure 2d is of poor quality. The labels are not legible.

(3) Page 19394, why do you choose 30 km resolution? It seems to me that 30 km is too coarse to resolve the topography over the Western US. 4 km would be better. You need to justify the use of 30 km.

(4) It would be better to add the WRF-PP simulations of SWE together with WRF-3D in Figure 2. I am curious whether the WRF-3D simulates better SWE than WRF-PP.

(5) Page 19397, Line 6, define "LT".

(6) The descriptions of diurnal variation of solar fluxes on page 19397 are confusing. My understanding is that the topographical impact to the surface fluxes is related to the distance of the mountains. For example, the decreases in solar fluxes in the northeast region are due to the mountains to the southwest, but the distance of the mountain matters! How does surface flux be affected by mountains a few hundreds kilometers away?

(7) Figure 4 labels are not clear. I was also wondering what is the size of the mountain relative to the 30km grid-boxes. It would be better to overlay a few contours of elevation height (1.5, 2, 2.5, 3 km) on the map.

(8) It would be better to compare the WRF-3D surface fluxes with in-situ measurements to validate the results, although I am not sure about the data sources.

(9) Page 19401, Line 9, I think it should be "reduce" instead of "enhance" "the SWE in higher elevation regions".

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 19389, 2013.