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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A global model simulation for 3-D radiative transfer impact on surface hydrology over Sierra Nevada and Rocky Mountains" *by* W.-L. Lee et al.

Anonymous Referee #2

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The manuscript nicely demonstrates how small scale effects (topography) propagate to larger scales, by running a General Circulation model and studying the effects over the Rocky Mountains. It has been hypothesized over and over that 3D radiative transfer effects might affect weather and climate, and this is one of the first studies which actually proof that. I recommend publication of the manuscript after consideration of a number of minor points. I had some troubles understanding some points and ask the authors to clarify those - in particular it should be possible to understand the current manuscript without having to read several of the papers referenced.

Specific:

page 31609, line 1: It is not immediately clear why changes in the upward flux should be insignificant while changes in the downward flux are significant; could you please explain?

page 31609, line 10: It is not clear to me what is actually done. Somehow the surface albedo is adjusted - does that mean that an effective albedo is calculated to account for the effect of topography? Please explain.

page 31609, equation (1): The equation for F_{rdir} looks wrong at first glance, but looking up Lee et al (2011) reveals that it is actually correct and makes sense. From reading the current manuscript it was not clear to me that all fluxes are downward fluxes. I assumed e.g. F_{rdir} to be an upward flux. Please explain so that one can understand the basics without referring to Lee et al (2011)

page 31610, line 8: Why are direct and diffuse fluxes treated separately? I guess to understand that one would need some information about the treatment of albedo in CCSM4: Are there actually different albedos for direct and diffuse radiation?

page 31610, line 22: should be "2f" (not 3f)

page 31611, line 5: Could you discuss the "cloud fraction" issue a bit more? It seems logical that the cloud fraction is increased over south-facing mountain slopes since the insolation in the 3D model is higher than in the 1D approximation which causes orographic convection. But it seems a bit contra-intuitive that the cloud fraction increase might be so large that the insolation is actually decreased compared to the 1D approximation.

page 31612, line 6: The statement about reduced solar flux below 2.5km is not really supported by Figure 4a: On average there is an increase at all altitudes, although the increase is smaller at low altitudes.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 31603, 2014.