Atmos. Chem. Phys. Discuss., 12, C7612–C7614, 2012
www.atmos-chem-phys-discuss.net/12/C7612/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simulating 3-D radiative transfer effects over the Sierra Nevada mountains using WRF" *by* Y. Gu et al.

Anonymous Referee #1

Received and published: 29 September 2012

General Comments

This paper has proposed a method for handling sub-grid reflections of solar radiation in complex terrain. The idea looks good and original, and is worth publishing. I had several questions about the technique that I will list below. The results described some plausible effects, but there may be places where more explanation is needed, because the reasons for some results must have depended on features of the local sub-grid topography. The paper is generally well written and organized.

Specific Comments

1. p19902, line 16, should say "configuration factor, Ct," because Ct has not been defined.

2. p19902. What is the difference between Vd and Ct? Vd is sky view factor, and Ct is the area of surrounding mountains. This seems like the same information or at least highly correlated, so it needs to be made clearer why both are needed.

3. p19903. It is surprising that all the angular effects for direct radiation can be represented by one mean angle, mu. I would expect at least a seasonal dependence to account for the solar elevation for a given time of day. This needs to be explained. For example noon in midsummer would have different slope effects from noon in midwinter, and it is not clear a single mean parameter can represent this.

4. p19905, line 23. The model grid is 30 km, but the data were derived on a 20 km grid. It is not clear how this mismatch would be handled. Since the matrices were only derived for 80 20km squares, presumably only a subset of the domain has this treatment. Is it the sub-area plotted?

5. p19907. It would have been useful to have maps showing (a) the full domain with the plotted sub-domain marked, and (b) the detailed topography used to derive the data. The plots given do not indicate how complex the topography is in that region. If this can be overlaid with the boundaries of the 80 sub-regions, it would be even more useful.

6. p19908, line 10. This explanation only works if the morning was clear, and these convective clouds formed as a result of direct radiation effects. Also, were these high clouds from the convective scheme or low clouds from the microphysics only, e.g. upslope flow? This needs to be checked and stated.

7. p19910, line 4. It is not easy to imagine why higher elevations have a maximum reduction at 2pm, while lower elevations have a reduction at 10am. Was this due to the geometry of the mountains or cloud formation timing? It would improve this paper to have an explanation of this result. Presumably the lower elevation areas also include the higher elevation areas as a subset.

8. Figure 2d. The southern area seems to be generally cooler. Is this due to the

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geometry of the slopes that might favor a northward slope in that area? It also appears in the day-averaged result, and should be explained.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 19897, 2012.