Atmos. Chem. Phys. Discuss., 8, S2547–S2549, 2008
www.atmos-chem-phys-discuss.net/8/S2547/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "How small is a small cloud?" *by* I. Koren et al.

Anonymous Referee #2

Received and published: 12 May 2008

Overall, from my point of view, this paper is very interesting and well written, and addresses a novel and important scientific aspect, i.e. the interaction of the radiation fields of cloud-free and cloudy regions in fields of scattered low-level clouds. I therefore fully support the publication of the paper. A few minor points for improvement are suggested below

Minor points:

1. Abstract: "When changing the resolution from 30 m to 1 km (Landsat to MODIS) the average 'cloud-free' reflectance at 1.65 micron increases more than 25%, the cloud reflectance decreases by half, and the cloud coverage doubles, resulting in an important impact on climate forcing estimations." I find the use of relative changes somewhat confusing, and would suggest to additionally quote absolute changes: the increase of cloud-free reflectance should be pretty independent of e.g. the surface albedo, at least

to first order. However, changes of surface albedo will strongly modify the cloud-free reflectance, and cause large differences in the relative numbers. Similar arguments can probably be made for cloud reflectance/cover.

2. Introduction: "when changing pixel size from 10 km to 100 km": please clarify whether is this area (then units of kmˆ2), or some effective diameter?

3. Current operational cloud masks (e.g. MODIS) do not only use absolute thresholds in reflectance, but also thermal channels and spatial variability thresholds. How are the conclusions of the paper affected by the choice of cloud masking algorithm?

4. As additional quantitative estimate of the impact, consider adding SW cloud radiative forcing to the cloud-covered parts of the image, to complement the cloud-free "aerosol radiative forcing". Or is this simply the aerosol radiative forcing multiplied by -1?

5. Eq. 1, and prior statement: "the nadir reflectance observed by ETM+ is a good surrogate for the radiative energy reflected back to space."In other words, the authors assume that the anisotropy of individual pixels does not change with resolution, and TOA albedo and reflectance are directly related. However, using the Independent Pixel approximation as conceptual model to understand the resolution reduction, the anisotropy is expected to change non-linearly, due to changes of anisotropy with cloud properties (thin clouds have a more inhomogeneous radiation field than thick clouds). This point should be at least discussed. (see e.g. Kato, S., L. M. Hinkelman, and A. Cheng (2006), Estimate of satellite-derived cloud optical thickness and effective radius errors and their effect on computed domain-averaged irradiances, J. Geophys. Res., 111, D17201, doi:10.1029/2005JD006668.) Overall, the difference between directional and hemispheric radiances/reflectances should be discussed more explicitly.

6. Appendix B, paragraph above formula B6: rich->reach, bottom of same page, "form the 3D effect" -> "from the 3D effect"

7. Size of clouds: how is the size of a cloud calculated exactly (when are two cloudy

ACPD

8, S2547–S2549, 2008

pixels connected: only if they are neighbors in horizontal/vertical direction, or also if neighbors along the diagonal directions? Are the results sensitive to this choice?)

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 6379, 2008.