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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Scale dependence of cirrus heterogeneity effects. Part II: MODIS VNIR and SWIR channels" *by* Thomas Fauchez et al.

**Anonymous Referee #1**

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## 1 General Comments

In this paper, the authors performed a set of 3D and 1D radiative transfer simulations with varying solar and measurement viewing angles. The goal of the study is to characterize and disentangle the various effects, problems and shortcoming that stem from 1D compared to 3D radiative transfer. The simulations seem appropriate for this endeavor, the results seem reasonable and I liked the review of possible 3D effects.

However, I think the manuscript falls a bit short on the discussion and future implications of the results. The manuscript could include the following two key points before I would want to recommend to publish it.



1. Could you please discuss the magnitude of errors that you find in reflectances compared to current satellite observations? I guess that todays reflectance measurements are on the order of 5 to 10%? How does that relate to or impact your findings?
2. I think the manuscript would greatly benefit from a short discussion or sensitivity test regarding the impact of your findings on actual retrievals. Could you for example provide estimates for errors in retrieved effective radius. I know you promise a future study grounded on optial estimates with spectral information from all ranges but could you not provide or discuss first estimates for a retrieval like Nakjima-King?

### 1.0.1 Specific Comments

- *p.*4 l.20-26 Please state if the domain has cyclic boundary conditions. I guess this is important because the interaction radius may be quite far?
- *p.*4 l.28-33 Please give a more detailed description of the simulation so that one could reproduce your setup. What is the surface albedo? Was aerosol used? Water vapor background profile?
- *p.*5 l.24 IPA does not necessarily mean that the scene is vertically homogeneous. 1D RT is very well capable of simulating vertically inhomogeneous atmospheres numerically. This phrasing of yours kept me wondering till the end of the manuscript if you actually averaged the ice water content vertically or not. Please make that more clear.
- *p.*9 l.4 I think a schematic would be very helpful for the tilted part. I am wondering which slanted path you used, i.e. did you take the optical properties along the sun angle or from viewing geometry. Out of the two, which one would you think

is better? Also, did you use an interlaced grid like for example Wissmeier2013 https://doi.org/10.1175/JAMC-D-12-0227.1?

- *p.*10 l.21-26 Would it not make sense to have a look at 45°and 45°+90°? Is there a particular reason you did not examine that?
- *p.*12 l.19-21 Isn't that particularly interesting for retrievals that use both channels? Wouldn't Nakajima King for example suffer from this even if there would be a linear relationship between the errors in those two channels?

### 1.0.2 Minor remarks

- *p.*1 l.15 "by" should be with?
- *p.*2 l.12 "thicknesses" should be singular
- *p.*5 l.01 shown "in" table
- *p.*5 l.16 I assume you meant 100e9 for all simulations? This is impressive if that is a single core performance which would be 2e6 photons per sec. Or was that parallelized on multiple cores/nodes? If so please state the number of core hours.
- *p.*5 l.27 Conversely?
- *p.*7 l.12 "more" should be "higher"?
- *p.*7 l.16 + fig.2 Please change the color of the 1D markers and put them on top, I could not see your claims.
- *p.*7 l.20 effects should be singular?
- *p.*8 l.24 green? . . . and I thought I am not colorblind. . .



- *p.*9 l.02 temperatures should be singular
- *p.*10 l.7 remove "issue"?
- *p.*11 l.6 remove "view"?
- *p.*11 l.34 remove the "a" in "for a various view"
- *p.*12 l.08 process should be plural
- *p.*12 l.09 Simulation should be plural?
- *p.*12 l.12 take should be taken
- *p.*12 l.13 maybe change "here are ranged to" "here range from"
- *p.*12 l.21 "shown" should be "show"?
- *p.*13 l.06 "this" should be "these"?
- *p.*13 l.20 insert "from" after "ranging"
- *f*ig.1 Error in caption, reference to (f) is (e)
- *f*ig.2 if you mention 50m here I am wondering was it something else in fig1?
- *f*ig.3 I would like it very much if you could provide short conclusions here already in the caption
- *f*ig.4 As mentioned earlier, please update the colors so that a reader can distinguish the markers
- *f*ig.5 please add the idea of the panels and colors to the caption. I.e. left to right are zenith angles, colors are view zenith angles

- *f*ig.6 put brackets around equation references? Change null to $\Phi_s = 0$
- *t*able 1 MOD06 optical properties please write out the names and symbols
- *t*able 1 why use diameter here when you use radius everywhere else?
- *t*able 1 $\lambda$ for channel 2 differs. . . is $.83$ micron correct?