

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

Anonymous Referee #2

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In principle, this manuscript will make a contribution because the 3D effects of cirrus have not been studied very extensively. It essentially seeks to translate findings of earlier studies by Zinner, Davis and others, which were done for low clouds, to thin, high clouds. The issue with the manuscript in its current state is that language shortcomings make it very hard to follow, particularly in section 4. The manuscript overall reads like a draft that has not been vetted by the co-authors. Some of the figures speak for themselves, but the text tends to confuse in many places, rather than guiding the readers' eyes. The interpretation of 3D effects is also questionable (see comments #1, #10, #11). Given the multitude of typos, grammatical errors, and non-idiomatic or semantically wrong use of the language (for which examples are provided below), I recommend to reconsider the manuscript after major revisions, or reject it to give

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the authors more time to edit. While it was not possible to give this a full review for the aforementioned reasons, the factual content does seem promising - with a few reservations listed below. The only major ones are #1, #2, and #10.

1) p7, l11: “photons in thin columns have less chance to be absorbed” ... “photons in neighboring columns with stronger scattering have more chance to leave the cloud if they are scattered toward a neighboring column with smaller extinction coefficient”.

This seems to advocate for the flawed notion of photons moving along contrasts in extinction coefficients or optical thickness, a common misconception that does not pass muster upon closer examination. Perhaps a few figures showing the spatial distribution of some of the discussed biases would elucidate this issue.

2) p4, l31: Is a CER of 10 micron really representative? It's very small, although not outside the climatology. Even in collection 6, 30 micron is the median value of the global distribution of ice clouds.

3) p3,l34: “. . .because side illumination and shadowing almost cancel out each other, there is an overall agreement between CER retrieved using 2.1 or 3.7 micron.”

This is unclear: is that relative to 1.6 micron? Why do “side illumination” and “shadowing” cancel each other? Does that refer to the domain average, and if so, over how large a domain does one need to average?

4) p5,l21: At the beginning of this section, a more general description of 3D effects and their differences in the thermal and solar range would be in order. The “3D paths” that “radiation follow” [sic] are associated with fundamentally different physics, which deserves a thorough discussion. For example, scattering is much less important in the thermal wavelength range. This paper quickly dives into the details without providing a more general overview first. Furthermore, the observed dependencies on scale deserve a thorough justification.

5) [abstract] “This strong wavelength dependency [sic] of cirrus cloud radiative effects”

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Does this refer to the contrast between solar and thermal IR bands?

6) p7,l15-17: The figure does not support this explanation. Isn't there a much simpler one? For lower sun elevation, satellites are more likely to pick up side scattering than for high sun elevation, especially for optically thin clouds. While this is in the realm of speculation, the explanation by the authors, finding different effects in different optical thickness ranges, is not supported by the figures. See also comment 1.

7) In many places, the manuscript talks about an "increase" or "decrease" of reflectance without specifying the direction (e.g., p7,l21). It is important to include this information because 3D effects redistribute radiation differently - which can lead to a reflectance enhancement in one direction, and a decrease in another.

8) Eq. 1: On the left hand side, there is a difference between a quantify with index "R" (reflectance) and a quantity with index "tau" (optical thickness). While not explained, it is assumed that the latter really means the reflectance calculated for a certain "tau", but the use of a retrieval parameter on par with a reflectance is a bit confusing, as is the nomenclature of the formulae in general. Simplifications would help tremendously.

9) "PPHB increases as the spatial resolution increases": This is misleading throughout the manuscript. What is meant here is "aggregation pixel size", not spatial resolution. Higher spatial resolution actually means a smaller size of the individual pixels.

10) p8,l25: "Note that for sun at zenith . . . [sic]". When speaking about the PPHB in particular, it is hard to see why the sun angle would have an impact. Isn't the argument here that the optical thickness is small, which means that the retrievals are done in the linear (non-asymptotic) range of the LUT? PPHB is ultimately due to the morphology of the LUT, so it is hard to picture a role for SZA.

11) "The THEAB is therefore a consequence of the PPHB for oblique view". The statement before does not support this assertion. The PPHB is fundamentally different from IPA/THEA; the latter two, on the other hand, are related.

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12) p9,l16: This seems to be a somewhat unfortunate description of a version of TIPA. Would it be easier to just refer to one of the TIPA papers - for example, Várnai 99?

13) p10,l8: Why does "non-aggregated" have coarser resolution? Isn't it just the opposite?

Summarizing, the factual problems seem to lie in a rather superficial interpretation of the findings, and they could benefit from discussion with co-author Tamas Varnai and other experts in the field. The problems are compounded by many language errors, and I advise to run a spell and grammar check, and further to go through punctuation and semantic/idiomatic use of words. Such issues are not within the purview of manuscript reviewers. The time spent on this review is somewhat out of proportion with the current overall level of maturity of the manuscript.

Examples in no particular order:

Figure 8 caption: In 1D (top panel) [missing comma] the right column can be highlighted [should be "illuminated" - semantic error] by the photon coming from the Sun [missing comma] while in 3D, a [an optically] thick neighbor region intercept [intercepts?] first the photon [first intercepts ?] and scatted [scattered] it back to space. Aside from the errors, this statement is also hard to understand. Also, what is the difference between "intercept" and "scatter"? Physically accurate would be "scatter" or "attenuate".

"the variety of voxel extinctions from a line of sight to another can be quite similar". (In this case, it's unclear what this means - perhaps that the extinction along the line of sight varies little from one tilted column to the next?)

"This is because of the THEAB which is a positive bias, stronger at high resolutions and large view angles." Not a sentence.

"are more highlighted from the side" - this should be "illuminated" throughout the manuscript, unless the intention was to say "highlight", but that doesn't seem to make sense.

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“depriving neighbor cloudy columns from [of] incoming photons” – aside from the wrong preposition, using “deprive” seems inappropriate for an inanimate object.

“an important factor that constrains the impact of these assumptions” - “determines” instead of “constrain”?

“To compare reflectances issue from a 3D radiative transfer. . .” use of “issue” is unclear [as noun or verb]

“conversevely” [sic] - several such typos that a spell checker would pick up

“have an almost nil effect” - wrong semantic context for “nil”

“which becomes almost null” - zero? idiomatic/semantic error

“since less different cloudy columns are crossed” - it should be “fewer” instead of “less”

“the PPHB increases as the spatial resolution increases” (the intended phrasing was probably: “the PPHB increases as the spatial resolution decreases (pixel size/aggregation level increases)”.

“the absolute 3D effects are slightly smaller and follow the same decreasing with coarsening spatial resolution” - “follow the same decreasing with coarsening” does not seem to work. Perhaps “also decreases with coarser resolution”?

“fallstreaks or not” - “whether fallstreaks are included or excluded”?

W.m-2: What is the meaning of the dot - found throughout the manuscript?

“can be extrapolated to other cirrus clouds” - “generalized” instead of “extrapolated”?

“spatial resolutions considered here are ranged from . . .” - spatial resolutions considered here range from . . .

“most of the figures shown [showed] the”

“THEAB and PPHB is [are] complicated”

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“view zenith angle” - “viewing” instead?

“because of no THEAB” - because THEAB is turned off [or some qualifier instead of a “no”]

p2,l22-23: What is the difference between “information content” and “retrieval methods” in this case? They are two different categories.

p4,l2: “LES domain” - was LES introduced before?

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-38>, 2018.

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