Atmospheric Measurement Techniques Discussions

Interactive comment on "Droplet vertical sizing in warm clouds using passive optical measurements from a satellite" *by* A. Kokhanovsky and V. V. Rozanov

Anonymous Referee #2

Received and published: 25 October 2011

Review of "Droplet vertical sizing in warm clouds using passive optical measurements from a satellite" by A. Kokhanovsky and V. V. Rozanov

****

A good manuscript. Nonetheless a long list of mostly minor issues should be considered before publication.

The authors describe in a mathematically thorough way a new remote sensing implementation based on an established radiative transfer and retrieval environment around the SCIATRAN radiative transfer tool and the SACURA retrieval.

To my knowledge it is the first application of an optimal estimation approach after Rodgers (2008) to the ideas of retrieving a warm cloud's effective droplet size profile using 3 or more near-infrared wavelengths (Chang and Li 2002, 2003).

Capabilities and limitations are demonstrated to a sufficient extent using a pure radiative transfer simulation based testing environment and in comparison with other remote sensing methods. Discussion of the limitations is not sufficient yet (see major issues further on).

The title is somewhat unspecific. I would prefer to read the "optimal estimation" already in the title.

****

Specific:

Major issues:

GENERAL issue: Please avoid acronyms which you define in your text only for reasons of convenience in writing. They are generally not useful for the reader unless it is a (in the atmospheric community) well established and widely used one as, e.g., LWC for liquid water content. Please replace them with the full terms. Examples are: ER for effective radius, VPER for vertical profile of effective radius, SCR = spectral cloud reflectance, WF = weighting function, LFD = log. functional derivatives, LUT (might even be ok) for lookup table

GENERAL issue: The notation used in the equations is in some respect uncommon and hampers reading, too. E.g. to use an "a" instead of an "r" for the radius. E.g. do you really need to define "gamma = deltaR/R" for the relative variation of reflectance. Why don't you simply use "deltaR/R" in the few locations you write "gamma". The same is true for "p_N(z)" and "p_a(z)". Please change.

GENERAL issue: Limitations of the presented method and limitations of the test cases are hardly discussed in the paper: (1) Your arguments and test cases concentrate

on rather thick water clouds. But clouds with warm microphysics, simple droplet size profiles and optical thickness >15 are a rather rare phenomenon, I think. This should be mentioned, at least, in the discussion section. (2) All test cases use linear profiles ONLY! You might want to show a test with an inverted linear profile at least. (3) Your test with synthetic data only proofs that you are able to invert your RT simulation tool. This is not bad as it proofs the technical correct operation of your retrieval, but it is not very suprising. (4) No real validation of your retrieval is given. The cross comparison with other passive retrievals is not enough (as you mention yourself in the very end). –> You don't have to extend the paper following all 4 points, e.g., a full in-situ validation of the retrieval is not necessary at this point, but you should at least discuss these points to put your work into the right perspective.

Abstract/ Page 5598: Too short. Please be more specific. On what findings is your paper based? What's new in you paper? A few more details about the results would be nice.

Page 5604, eq (15): Why did you decide to move 5 equations on which the rest of the method is based into an appendix? Please change or clarify.

Page 5612, l 5-12: This paragraph widely refers to the standard vertically homogeneous retrieval, doesn't it? This is confusing as this was not your topic up to these lines. Please clarify.

Page 5615, l.1: "Therefore, we conclude that THE new algorithm provides more information on the cloud internal structure as compared to the operational MODIS retrieval algorithm." This is a bold statement given that you just compared a new retrieval under strong assumptions to two rather uncommon cloud situations, in which you do not have any real validation like in-situ data. This means, it could be totally miss-leading additional information you get from your retrieval due to the assumptions. Please be more cautious with your wording and discuss theses issues.

Page 5615: DISCUSSION: The "discussion" is not discussing much at the moment. It

C1844

is mainly a summary. Please discuss limitations of your method as presented in this manuscript and of the verifications you presented. See general points.

****

Minor issues:

Page 5598, l.10: Your general introduction is short as well. Tell us, at least, why the effective radius is an interesting parameter and why it is a difficult one?

Page 5598, l.19: Platnick (2000) belongs to the list of core publications at this point, doesn't it?

Page 5600, eq. (2): Where does the "log" come from? Please explain.

Page 5601, sentence in l. 7 and 8 and l. 13-15: Very strong statements without explanation. Please explain what you mean.

Page 5602, eq (9): "f(a,z)" is only explained later in the text. Please introduce it here.

Page 5603, 2 and following: When you write "C_ext= 2 pi aˆ2" please refer to the fact that this is nothing else but the extinction efficiency = 2 for the geometrical limit of scattering. For me THE related standard publication is Hansen and Travis (1974, "Light scattering in planetary atmospheres"). Please change or at least note this.

Page 5603, 5 and following: Could you show a measured droplet profiles compared to your parametrization?

Page 5604, eq (14): It is confusing to write "N(z)" in the equation, although you just stated one sentence before that N=const. Please change.

Page 5605, eq (19): Where went the second integral from eq (15)? I only see the one of eq (6). Am I wrong? Please clarify.

Page 5606, l.1: Where does the weight "w_k" come from? Please clarify.

Page 5606, l. 20: "It is other way around for other wavelengths studied." Why is this

C1845

the case? Can you comment?

Page 5607, l.15: What is ER(a_ef)? Strange notation. Better "effective radius a_ef"?

Page 5608, eq 29: Why is here a term for the retrieval of COT? Didn't you state that COT is assumed fixed (e.g. from independent retrievals) somewhat earlier? Please clarify.

Page 5611, l.22: "This is the worse scenario (see Fig. 4a) because not only cloud top height but also cloud bottom height used in the retrieval process are biased": Didn't you use the exact same cloud bottom and cloud top as in Fig 4a? 0.5 - 1 km? Please clarify.

Page 5613, l.3: "The COT retrieved by SACURA ...": Please tell us in a few words, what SACURA is and why you use it for comparison.

l.26: "However, generally, the MODIS results are too high as compared to our retrievals.": MODIS values are not "too high", but "higher", as nobody knows whose assumptions are more correct. At this point you should say that this is a surprising result as you would expect the standard retrieval to produce smaller values from a deeper penetration depth.

Page 5614, l.24: "The droplets decrease to the cloud bottom, which signiïňĄes absence of precipitation although droplets are quite large at the cloud top.": 1) "The droplet size decreases towards ..." 2) That drizzle formation leads to increasing droplet size towards cloud bottom in passive retrievals is still an issue under discussion/ not fully understood and it's not the topic of your manuscript. Simply change it to a more careful statement: "... which could signify the absence of ...".

Figure 5: Do you need this plot? There is not a lot to see.

Figure 7a: Why does PEROMT resemble MODIS and SACURA does not?

Figure 8: Please add an overview image for this case (like Fig.6).

C1846

****

Technical issues:

Page 5600, l. 22/23: The "is" should move from "important IS the variation" to "important the variation... IS at a given level"

Page 5607, l.14: An "a" is missing: "is the reflectance of A cloud for an"

Page 5608, l.23: "rewrite THE linear model"

Page 5608, l.17: Article missing in "Profile of the Effective Radius using "AN or THE" Optimal estiMation Technique (PEROMT)"

l.23: Articles missing: "channel at 3.7 um to be less sensitive to THE a priori unknown cloud position in THE atmosphere"

Page 5612, l.18: "Therefore, we ARE sure that crystals do not occur in this cloud."

Page 5612, paragraph starting l.19: Please replace the slang like wording with the verb "gave" with something else.

Page 5613, l.21: Article missing: "It follows from Fig. 7a that THE PEROMT algorithm retrieves COTs, "

Page 5614, l 13: Should be "The results of retrievals using A MODIS scene over ocean (west of ChilE, ..."

Page 5615, l.1: Should read "Therefore, we conclude that THE new algorithm ...".

Page 5615. l.5: "The technique to retrieve cloud droplet vertlical profile has been developed." should read " A technique to retrieve cloud droplet vertical profileS has been developed."

―――――――――――――――――――