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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Cloud thermodynamic phase inferred from merged POLDER and MODIS data" *by* J. Riedi et al.

**J. Riedi et al.**

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**Response to Interactive comment on "Cloud thermodynamic phase inferred from merged POLDER and MODIS data" by J. Riedi et al. Anonymous Referee 1**
Received and published: 21 November 2007

*General Comments The paper presents a good start in combining the features of the three different approaches to phase discrimination using two different satellite instruments. The authors appear to have a solid methodology in combining the separate techniques and exploiting the strengths of each, but the presentation of the combination scheme is weak. Additionally, other than the last sentence of the paper, the relevance of the resultant algorithm to current and/or future retrieval needs is not mentioned, hence a discussion of why this issue should be addressed is needed up*

*front. The authors provide a coherent introduction to the phase retrieval topic and discuss the strengths and weaknesses of the component algorithms, but the pragmatic motivation for combining POLDER and MODIS and how that stride forward can be or needs to be utilized on current or future platforms would clarify the study's purpose.*

Motivation has been more clearly stated in the introduction. Specifically our motivation for developping the merged POLDER/MODIS product is twofold. First, it aims at creating a reference dataset that can be used for model evaluation or other cloud climatologies assessment. Second, the present study provides a framework for algorithm development of the upcoming GLORY mission and can be used to define mission requirements for potential development of other future missions that would include multispectral, multiangle and multipolarisation measurements.

*Specific Comments :*
*The algorithm description should include more detailed information about how the final phase decision is made and how the phase confidence index is computed. This should be addressed. The necessary background in the development of a phase decision (water or ice) is presented, but in a haphazard fashion that makes it very difficult to follow. Conversely, almost no solid discussion is devoted to the construction of the phase confidence itself. In section 3.2, the vague presentation of the index computation should include a logic tree figure or flow chart that indicates how the confidence is computed. Table 1, mysteriously mentioned in Section 4.4. does summarize much of the relevance of the component algorithms, but much more explanation is needed. Additionally, an example of the index computation for some small portion of the case study would lend credence to its validity. At this point, the confidence index seems quite subjective so it is difficult to imagine exactly how it could be used in the future.*

The definition and interpretation of the phase index has been identified by both reviewers as not clearly described and the authors agree that ample space existed for



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improvements. In particular, the initial text was confusing regarding the phase index and the associated confidence level which may have appeared as two distincts values. In practice, there is only one index ranging from 0 to 200 and the confidence is carried by the exact index value within thie range. This is now clearly stated in the text.
We have made significant changes in the text to explain better how the individual results of the three methods are being merged to provide a unique phase index. The logic used to create the final index is described in more details and the interpretation of the index values has been improved. Also a flowchart of the logical decision tree has been included to help in the understanding. We have now included a better description of the phase index and specifically addressed the case of "Mixed" phase which should clarify the interpretation. The difference between "Mixed" and "Undetermined" is also discussed. It is made clear in the paper now that "Mixed" is an indication of inconsistent decision from the individual methods whereas "Undetermined" results of none of the three methods being able to provide information. The value of 100 for Mixed cases therefore stands at equal distance between the high confident liquid (0) and the high confident ice (200) to indicate not the lack of information but rather the occurence of both liquid and ice signature in observations.

*You should address the impact of thin cirrus over snow/sea ice surfaces on each retrieval, if any, and whether or not it can impact the combined logic.*

A subsection has been added in the theoretical performance discussion section that address specifically the problem of thin clouds (both liquid and ice) over snow/sea ice.

*Generally, the paper also needs some careful attention to organization and detail. There are too many distracting organizational errors and a lack of attention to assuring that figures, references and related matters are properly ordered, sited and utilized.*



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The first author would like to thank personnaly reviewer 2 for having done a very careful and thorough review, specifically regarding organization of the paper. We believe that the paper is now presented and organized in a much cleaner way thanks to these comments.

*Technical Corrections*

We are responding only to questions or request for modifications. Simple corrections and typos have all been addressed carefuly in the paper.

*14111-09: "While there are limitations..." could make your point better if you said "Despite these limitations..."*

Agreed. Thanks.

*14111-14: Here you discuss the fact that a SWIR/TIR/mask product is 1-km and TIR is 5-km. Is the SWIR/TIR/mask product the same as the SWIR product you are using from MODIS? Also, how do you average MODIS products, e.g., phase, when placing them onto the sinusoidal grid?*

We have improved the description of the data merging and clarify the resolution used for data processing which corresponds to POLDER level 1 resolution (6km x 6km on sinusoidal grid). All individual and final indices are derived at this resolution.

*14112-7: You use "Fig. 4" here, but have not yet mentioned Fig. 3. Figure 3 is appropriately mentioned at 14115-13, so all figures need to be renumbered.*



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Thanks. We have reorganized carefuly the different figures.

*14114:25: should "lower" be "raise"?*

No. If SWIR and IR indices agree (erroneously) that a thin cirrus is liquid, the final index will be liquid but the polarisation-based index indicating ice will tend to lower the confidence of the overall decision.

*14115-13: Figure 3 discussion should include discussion of how this figure was produced, e.g., what type of ice crystal and water spheres were used. You give some of these details later in Section 4.3 for the simulations, but I found myself wanting to know what you did when looking at Figure 3.*

We explain that simulations were done similarly to what is used for MODIS optical properties retrievals and references to Platnick et al (2003) for further details.

*14116-5: an optical thickness of 3 is not the same as the very top of the cloud. This sentence is confusing.*
This has been clarified in the following way : "The main limitation remaining is that polarization provides information for the top of the cloud and won't be sensitive to anything below an optical depth of 3."

*14116-16: Why do you mention the recent works on multi-layer detection here?*
That was a mistake. This has been removed as it is already mentionned in introduction.

*14117-28: I do not understand the reasoning for the "variations" or departures from the mean values you are considering. Are you referring to variations in the cloud*



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*properties or the previously mentioned variation "one would expect from a set of realistic cloud conditions" or the angular variations?*

We refer to variation of the SWIR/VIS ratios and evaluate the corresponding cirrus optical thickness that would be needed to produce such a deviation from the reference SWIR/VIS threshold value.

*14117-29: You start using 0.1 (0.2) and 0.2 (0.5) here. I assume these to indicate the solar angle?*

No. The "0.1 (0.2)" values correspond to deviation from the reference SWIR/VIS ratio mentionned at the beginning of the sentence. The "0.2 (0.5)" values correspond to thin cirrus optical thicknesses that yield a deviation of the SWIR/VIS ratio earlier mentionned.

*14120-1: You use "TIR" here for the first time. Shouldn't that be defined in Section 2.3?*
Yes. This has been corrected.

*Fig. 1: This figure caption could use better indication of what MODIS sees and what POLDER sees. Additionally, a latitude-longitude label would help provide location information.*

We have modified figure caption to clarify that the image corresponds to the common part of the POLDER/MODIS swaths.

*Fig. 2: For those that are not familiar with MODIS and/or POLDER, you could reiterate in these captions which comes from MODIS and which comes from POLDER. Additionally, the 4 plots should be ordered in the way they are discussed in the text, i.e, you discuss POLDER first so perhaps it should be (a)*



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Thanks for the suggestions. These were taken into account.

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 14103, 2007.



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