

Interactive comment on “Quantifying retrieval uncertainties in the CM-SAF cloud physical property algorithm with simulated SEVIRI observations” by B. J. Jonkheid et al.

Anonymous Referee #2

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OVERVIEW:

The manuscript investigates the cloud water path (CWP) retrieval uncertainty derived with the cloud physical properties retrieval algorithm (CPP) of the climate monitoring satellite application facility (CM-SAF) using a simulator.

I thank the authors for responding to many of the questions I raised in the pre-discussion review. However, I still have several major concerns and consider the manuscript to require a major revision.

MAJOR COMMENTS:

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1. Terminology

A couple of terms in the title (and throughout) are a potential source of confusion.

First, I believe the term “quantify retrieval uncertainties” – which ultimately can only be assessed via independent validation measurements having known uncertainties and/or by forward modeling the full physical space that governs SEVIRI resolution retrievals – overstates the goal of the paper. While I understand what the authors are trying to convey, the terminology “quantify retrieval uncertainties” is used throughout the manuscript and can be misleading.

Second, the term “simulator” with regard to retrievals can have a number of meanings. Throughout the introductory part of the manuscript, “simulate” refers to applying a forward radiative code to model cloud fields. This seems a fair definition in the context of the introductory material. But from my reading (see Section 4 comment below), most of the manuscript effort is in discussing a retrieval sensitivity assessment using forward reflectance calculations of two SEVIRI channels (0.64 and 1.63 μm) across a limited range of the parameter space set by the authors. A model simulation isn’t invoked until the two paragraphs of Section 4.2 and a single figure (Fig. 9). A retrieval sensitivity study of the type done for the vast majority of the work doesn’t seem like a justification for writing a “simulator of SEVIRI observations”. My concern/frustration is that the introduction and Section 3 implies that a model is used to drive the simulations, no clarification is otherwise given, and there is frequent mention of models and simulations together also convey this notion ... and then the reader gets to Section 4.1.

A title such as “A sensitivity study of SEVIRI retrieval uncertainties with the CM-SAF cloud physical property algorithm” is more to the point in my opinion.

2. Section 4, results

2.1 Model-driven vs author-driven?

When finally arriving at Section 4 and 4.1, I kept waiting to read that the simulator used

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in the sensitivity studies was being driven by a climate or Wx model (L104, Fig. 3, Section 3, ...). The introductory paragraphs at the beginning of Section 4 and 4.1 must clear this up, as well as abstract, introductory text, and elsewhere.

Please understand that I agree that the preferred way to get at a subset of the retrieval uncertainties is the author's approach of spanning the cloud 4 degrees of freedom, surface albedo, etc. It's just a question of reconciling expectations against previous text (and the title).

Section 4.2 and L321: Since the simulator forces a simple vertical structure of two cloud layers at 2 and 6 km, remind the readers that the model cloud fields are approximated. This section is in need of further analysis. Is there a reason this wasn't done? Is there anything further (relative to Section 4.1) to be gained from a histogram of COT, reff, and CWP mean errors vs. simulator output? If not, what is the purpose of Fig. 9?

2.2. Section 4.1 error sources?

It is not clear what error calculations are actually being done in the various sub-sections. In Section 4.1.1 for example, the results are discussed before we get to read that the sole error source is apparently interpolation error (I think). There are no other error sources for Fig. 4? If so, I suggest stating this explicitly in the caption. Similar question with regard to the other results in Section 4, where the error sources are even less clear to me. Re-write these sections with a statement upfront about the error sources that account for the uncertainties in the figures. Include some statement of error sources, if feasible, in the captions.

Without looking at biases in COT and reff separately, not sure how much a reader can learn from this study.

OTHER COMMENTS:

L45, etc.: The use of the term "image" in the Stage II description isn't technical. Presumably, the authors are referring to direct intercomparison of multi-spectral radiances

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or reflectances. If that's the case, be explicit. Some combination of Stage III and IV describes the ISCCP and COSP-type simulator approach. If so, should be explicit and (by the way, the COSP package doesn't appear to be referenced anywhere).

L95 and Section 4.1.3: Sensitivity studies are done as a function of "viewing geometry, multiple layer clouds and broken clouds. Note that three-dimensional cloud effects are not considered in this study; this paper focuses on providing information for the evaluation of climate models that are run over large domains at moderate resolutions ($\sim 25 \times 25$ km²), at which the uncertainties due to three-dimensional effects are supposed to be generally small (Zinner and Mayer, 2006)." The clarification that we are not dealing with 3D transport helps (the sensitivity to broken clouds that most readers would assume) but not clear at this point what the authors are getting at. In Section 4.1.3 the term "fractional cloud cover" is used. So we are dealing with partly covered pixels consisting of plane-parallel cloud layer elements? Such cases are important for study, but are a rather unique subset of "broken" clouds. This could be said more explicitly in L95. Is 3D transport within the pixel considered or is the partly cloudy reflectance just the plane-parallel cloud reflectance multiplied by the cloud cover fraction? Please explain.

L253: "This project provides the first global climatology of cloud cover and cloud properties (COT, reff, CWP)". The latter two are not true – especially in the context of SEVIRI retrievals. ISCCP CWP is for fixed reff assumptions. ISCCP has started to provide reff for the time record (certainly not for the references cited)? "Spatial resolution of 30×30 km²" – that is referring to sampling (if it is correct, seems too small) not resolution.

L351: "CWP is a more relevant quantity in climate models than COT and reff, and the underlying purpose is to gauge the usefulness of CPP in model evaluation." Radiation (COT) isn't an important model quantity to validate? What is probably meant is that models prognosticate CWP and that COT is derived from CWP and an reff assumption (most models). This doesn't detract from the "usefulness" (necessity) of comparing model COT with observations. As mentioned previously, the remote sensing scientist

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and many users would want to see COT and reff uncertainties, which also allows for a better understanding of CWP biases. Consider this.

“Fig. 6. As Figure 5 . . .”. As Figure 4?

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