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Atmospheric Measurement Techniques Discussions

Interactive comment on "APOLLO_NG – a probabilistic interpretation of the APOLLO legacy for AVHRR heritage channels" *by* L. Klüser et al.

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We thank the referee for his/her detailed comments to our manuscript. We understand the point of the referee that the manuscript lacks a description of the reason for the updates to the APOLLO method. In the revised manuscript we will describe the outcomes from a couple of applications, for example from aerosol remote sensing and solar energy applications. This will show a clear demand for more flexibility in the assessment if an observation is "cloudy". These examples will serve as the baseline motivation for the probabilistic approach which then will be described along the lines of these requirements. The description of the evolution of the cloud probability throughout the

APOLLO_NG processing will then serve as an answer to the question of its advantage in practice, especially in combination with the description of application needs. We will furthermore include a section presenting an overview over current cloud detection and cloud retrieval schemes and how they compare to the APOLLO methodology.

We agree with the reviewer that the manuscript deserves a thorough reworking of the English language.

Science/technical issues:

4415, 18: As mentioned above we will present a more detailed description of the needs, e.g. from solar energy applications. This will explain what we meant here.

4415, 27: We agree with the reviewer. Together with the detailed description of applications where the traditional APOLLO scheme showed limitations, it will become clear that the updates indeed are necessary, for example in order to allow more flexibility in the assessment of cloud presence.

4416, 04: We thank the referee for this comment. We will list the required wavelengths. Of course only one of of the 1.6 μm and 3.7 μm channels is necessary, because both channels are never switched on together at the same time. We will describe the AVHRR channels in more detail in the revised manuscript.

4419, 05: Indeed x_cld = x_bg must be avoided; otherwise the whole calculation of the probabilities will get instable. The test descriptions in Section 2 show that x_cld = x_bg is efficiently ruled out, but we will add a sentence on this constraint in the description of eq. (1).

4429, 03: We agree with the referee that the use of the two-stream approximation is problematic. Of course the argument that channel noise outweighs inadequate treatment of radiative transfer is inadequate for well calibrated narrow-band instruments (like AATSR, MODIS, etc.). Then we do not consider these assumptions. We will point out that this is a severe limitation. But on the other hand we will add a more detailed description of reasons for nevertheless using the two-stream approach. One is following the APOLLO heritage and makes it possible to compare results obtained with the traditional APOLLO scheme and with the new scheme. The application examples mentioned above will help to justify this argument, as the traditional APOLLO scheme has shown to be useful for example in solar energy applications. Moreover we do want to provide at least algorithmic consistence between different sensors including AVHRR. That goal means, that the products obtained from e.g. AVHRR and AATSR will not be consistent as the sensors differ, but that at least they are obtained with the same methodology and no additional inconsistencies are introduced by the use of different radiative transfer schemes. The most important reason for using this version of the two-stream approximation is that it is fast enough for being calculated on-line. This means that the necessary calculations are performed within APOLLO_NG and do not require extensive look-up tables to be kept in the computer memory. We will address especially this latter advantage in much more detail in the revised manuscript. We agree that the method becomes potentially inadequate at large optical depths. From the applications point of view APOLLO has been used for so far, the optically moderately thick or thin clouds are of much more interest than the question, if the optical depth is, for example, 50 or 60 (which in terms of solar energy applications is effectively opaque). We will provide a description of the discrepancy between the usefulness of the method under conditions of high optical depth and the reasons for nevertheless using in APOLLO_NG along with the description in the revised manuscript.

4429, 05: We thank the referee for this comment. The surface is indeed assumed to be Lambertian and with surface albedo estimated from the surrounding (presumably cloud-free) background, which is determined in the cloud detection part. We will add this missing description in the revised manuscript.

4430, 26: We will add a description of the assumption about the size distribution.

4433, 02: We fully agree with the referee. We will accordingly exchange Q_e=2.

4436, 19: We will reformulate this claim along the arguments presented above.

Grammatical/wording issues:

We thank the referee for making us aware of these issues. Each one will be corrected according to the referee's suggestion.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 4413, 2015.