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Atmospheric Measurement Techniques
Discussions

Interactive comment on "Remote sensing of cloud top pressure/height from SEVIRI: analysis of ten current retrieval algorithms" *by* U. Hamann et al.

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Dear referee,

We would like to thank you for your interesting comments.

You wrote: Sect.2 "Datasets and methods". Here the instrumentation and the cloud retrieval methods are introduced. Since we are discussing a quite fine-grained instrument, whose imagery is mainly centered on the african continent, where dust and biomass particles are present, I think that a couple of paragraphs must be added about discrimination of aerosols from clouds. It's clear that for the validation exercise the cloud/aerosol mask of CALIOP can be used (is it really used for discrimination?) but this problematic is only hastily mentioned twice in

the paper (p.416 l.17 and p.436 l.1) without any further consideration.

The distinction of dust and aerosols and clouds is for certain an important topic in particular for the evaluation of the cloud mask which is worth a separate publication using the CREW data set. For the particular focus of the paper on cloud top heights we add a general description of the aerosol cloud distinction and suggest to add another paragraph to Section 2:

The distinction of aerosols and clouds is critically important for aerosol retrievals. Different techniques of detection and aerosol property remote sensing have been successfully applied to SEVIRI measurements (Brindley and Russel, 2006, Brindley et al., 2012; De Pape and Dewitte, 2008; Li et al, 2007, Parajuli et al., 2013; Romano et al., 2013; Sannazzaro et al. 2014). The algorithms have been validated and intercompared (Banks and Brindley, 2013; Brean et al., 2011; Schepanski et al., 2012). Due to the high occurrence of optically thick clouds dominating the radiative properties of the atmosphere this distinction is less important for cloud retrievals, but nevertheless relevant. At the moment none of algorithms described in this paper has an explicit aerosol cloud distinction test. However, most of them consider the radiative effect of aerosols. AWG, EUM, GSF, LAR, MPF, OCA and UKM implicitly consider aerosols by using clear sky reflectance product influenced by the aerosol radiative effect. DLR, CMS and MFR algorithm take care of the effects of aerosols by considering climatologic aerosol loading in their radiative transfer simulations. DLR includes rural aerosol types for continental areas (Shettle, 1989) within the lowest 2 km of the atmosphere and aerosols with a visibility of 50km above. The CMS and MFR algorithms use maritime or continental aerosols of 30km or 70km horizontal visibility for sea and land respectively (Derrien and Le Gleau, 2013).

You wrote: p.412, l.18: Is it still true that the emissivity among the SEVIRI channels (10.8 micron throughout 13.4 micron) is constant/similar? And if not, could you provide quantification?

It is only save to assume constant optical properties for clouds (and for earth's atmosphere and surface) if the two considered wavelength are close together. This is not the case for SEVIRI channel combinations. Hence we replace add some lines to clarify this issue.

The clear sky radiance can be simulated with a radiative transfer model or estimated by locating clear sky measurements in the vicinity of the observation (Smith and Frey, 1990). For radiance ratioing, Eq. (12) for a wavenumber nu1 is divided by the same equation for a second wavenumber nu2. Hence, the formulation becomes independent of the cloud fraction eta. Channel combinations for radiance ratioing are preferably chosen in that way that the gaseous absorption is different, but the cloud emissivities for nu1 and nu2 are similar. For hyper spectral sounders like e.g. AIRS commonly used channel combinations are around 15 μm using the absorption feature of CO2, hence this technique is called CO2 slicing. But beside slight dependencies on the temperature and trace gas profile (Holz et al., 2006; Smith and Frey, 1990), the spectral change of the cloud emissivity still remains an uncertainty. The explicit simulation of the ratio of the cloud emissivities improves the accuracy of the CTP retrievals (Zhang and Menzel, 2002). For the SEVIRI instrument the 10.8 μm channel is commonly used in combination with the 12.0 or 13.4 μm channel. For these combinations an explicit simulation of the cloud emissivity is performed by using longwave radiative properties of clouds (e.g., Hu and Stamnes, 1993; Baum et al., 2005a,b, 2007).

You wrote: p.417 l.22: in Fig.3a it is difficult to distinguish which line belongs to the respective algorithm. This is a common problem for all ensuing Figures. I coudn't come up myself with a smarter visualization, so perhaps it's better not to redo any Figure at all but to insert here a new plot instead. This plot shall cluster the algorithms after the approach for the solution of the forward problem (radiance fitting, optimal estimation and radiance ratioing). This is informative, because the authors state that "It is also written that differences among the algorithms can be traced back to different algorithm characteristics."

We will try to improve the figures in a way, that the algorithms can be better distinguished.

You wrote: p.425 l.6 and 7: "The high occurrence of optically thin clouds in the boundary layers detected by SEVIRI can partly be caused by interpretation of broken clouds as thin clouds." Is this true for all algorithms?

Yes, as all datasets submitted to the CREW database describe the average cloud properties of a satellite pixel, all datasets are affected by this issue.

You wrote: p.430 l.10: As stated by the authors, "many algorithms" are affected by little sensitivity to thin clouds. This means that some (but not all) algorithms may perform differently than others. Could you please be more specific on this issue and expand the discussion, with a similar fashion and depth you devote to the misfits arising from assumed temperature inversions of Sect.4.2.4?

The effect that the SEVIRI algorithm struggle to reproduce the cloud top height of thin cirrus is shown in Fig. 6, 10 and 12. Fig. 6 and 10 show that none of the algorithms can reproduce the occurrence maxima of high thin cirrus cloud in around 16km. In Fig. 12 the dependence on the optical depth is illustrated. For the SEVIRI instrument is important to realize that the algorithms operate near the detection limit for optically thin clouds. In contrast to the temperature inversion problem of low clouds, the reasons for the underestimation of thin cirrus clouds can be various and include uncertainty of the surface emissivity and surface temperature, trace gas profiles, temperature profile, radiative parameterization of the ice crystals, aerosol concentration and composition and more. The reasons for the underestimation of thin cirrus can be different for each of the examined algorithms and would require an in depth analysis of each algorithm separately. Due to the number of algorithms and the estimated workload of this task, this answer unfortunately cannot be given within this publication.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 401, 2014.