

# ***Interactive comment on “Diurnal evolution of cloud base heights in convective cloud fields from MSG/SEVIRI data” by R. Meerkötter and L. Bugliaro***

**R. Meerkötter and L. Bugliaro**

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Response to referee M. Lawrence:

1. The second anonymous referee has also focused on remote sensing aspects and the retrieval algorithm.
2. Yes, it is in principle possible to determine the cloud base height from relative humidities (RH) measured by radiosondes. But, as the referee suspected, values of RH=100% are not measured in all cases of our broken cloud fields most probably due to cloud free regions or horizontal drifting of the sondes into sides of the clouds at higher levels. Nevertheless we add the available height information where radiosondes measure RH  $\geq 99\%$  and recognize good agreement or at least explainable deviations.

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Corresponding text has been added to the manuscript in Sect. 4.2: "In order to present a further independent information from radiosonde measurements we also analyse relative humidity profiles and assume the CBH where the relative humidity first reaches at least 99%. Under conditions of broken clouds this may not provide data everywhere, but where appropriate data are available we add them to our results presented and discussed in Sect. 5."

And in Sect. 5 it has been added: "Looking into the profiles of the relative humidity reveals that the radiosondes enter a cloud during ascent not in all our cases of broken cloud fields. Nevertheless we add to Figs. 5a, c, e, and 6b those heights at which the relative humidity first reaches 99% and regard this as a further information about the cloud base height. Except for Area O on 23 May 2007 (Fig. 5c) where the height assigned to RH=99% is about 350m higher than the LCL all other cases give an agreement in the order of 100m. In Area O on 23 May 2007 the radiosonde probably enters the cloud horizontally from the side at a higher level. The better agreements in Figs. 5a, 5e, and Fig. 6b should be interpreted in view of the fact that the radiosonde measurements have a height resolution of about 150m at condensation level."

p. 18943, l20: The influence of the meteorological parameters (temperature, humidity) and the cloud top heights in the boundary layer on the measured reflectivity in the MSG/SEVIRI solar channels is weak, i.e. mainly in the order of 1% (maximum 2-3%) when using standard atmospheres instead of the local radiosonde data. This uncertainty is also valid for derived optical thicknesses and effective radii. A rough indication of the error is given now on page 18943.

3. Green symbols representing radiosonde measurements have been added to Figure 9 and the caption has been changed accordingly. Furthermore, the legends in all panels of Figs. 5-7 and the related figure captions have been changed according to the recommendation of the referee.

4. p. 18950, l 16-17: Yes, description was reversed and has been changed accordingly.

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5. All recommended corrections have been done

Response to anonymous referee #1:

- p.18938, l 20: Text has been changed accordingly.

- p18939, l 9: "Cloud geometrical thicknesses" has been mentioned in conjunction with the quotations.

- p 18939 l 29: The following sentence is added: "For example, cloud top and base heights determine the projection of cloud shadows on the surface and are therefore especially important for the calculation of the direct solar flux."

- p 18943, l 7: Effects of varied atmospheric temperature profiles or varied cloud tops on the procedure for correcting cloud top temperatures are now described: "Related sensitivity studies reveal that an uncertainty in the atmospheric temperature of  $\pm 3$ K above the cloud results in an uncertainty of about 0.16K for the temperature correction. A cloud top height of 2000m instead of 3000m implies a corresponding uncertainty of 0.33K. To give a benchmark, temperature changes of  $\pm 0.3$ K correspond to base height changes of  $\pm 50$ m in case of a temperature gradient with 0.6K / 100m"

- p 18945, l 9: Information about the selection of the COT ranges is now given in the manuscript: "From empirical studies we found that a COT range from 8 to 12 is adequate. Further increasing the upper COT limit would additionally select clouds with larger geometrical thicknesses which in turn implies an application of the method to clouds for which the adiabatic assumption (Sect. 2) would no longer be valid. As a consequence calculated CGT values become increasingly too small and the CBH is lifted. Shifting the interval center to smaller COT values, e.g. to 5-7 as for the NOAA/AVHRR method, still works in a number of cases but simultaneously it increases the probability of semitransparent cloud fractions occurring in the sub-pixel scale. As a result retrieved cloud top temperatures increase and CTHs as well as CBHs decrease. A reduction of the interval width, for example to a range from 9 to 10, would reduce the

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population of analysable cloud pixels in a scene."

- p 18947, l 19: Typing error is corrected.

- p 18948 l 13: Fig. 5 now exemplarily shows the typical temporal behaviour of the average cloud top height, CTHav, in relation to the CTHmax. The manuscript as well as the Figure captions have been complemented accordingly: "Typical examples for the temporal behaviour of spatially averaged cloud top heights (CTHav) are shown in Fig. 5. In analogy to CTHmax and CBH the differences between CTHav and CBH represent the temporal evolution of average cloud geometrical thicknesses. The curves for CTHav and CBH show that average thicknesses can vary strongly during daytime from 100m to 1km (Fig. 5e, 5f) or remain relatively constant over the day (Figs. 5a, 5b). Although CTHav values are mainly found at levels in the lower half of the maximum cloud thickness, the temporal evolution of average geometrical thicknesses follow qualitatively the diurnal course of maximum geometrical thicknesses."

- p 18950, l 11: Typing error is corrected.

- p 18950, l 14: Typing error is corrected.

- p 18952, l 16: Typing error is corrected.

- p 18952, l 27: Typing error is corrected.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 18937, 2008.

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