

Interactive comment on “The benefit of limb cloud imaging for tropospheric infrared limb sounding” by S. Adams et al.

S. Adams

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We thank the reviewer for his comments. They will help to clarify the discussion of several points. We have taken all points into account and we will give a point-to-point response below.

General: We change the title to “The benefit of limb cloud imaging for infrared limb sounding of tropospheric trace gases”.

Specific:

p1: We change the sentence to: “A proposed limb cloud imager (LCI) mode will detect clouds with a spatial resolution unprecedented for limb sounding.”

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p5: We change the sentence to: “Unlike the first method, COSMO-EU provides the 3 D structure of the clouds in a way which is sufficient for estimating the cloud fraction along a LOS.”

p6: In order to clarify how exactly the radiative transfer calculations performed we add three references and give a more detailed explanation about the retrieval of the IWC threshold in the text.

Fischer, H., M. Birk., C. Blom, B. Carli, M. Carlotti, T. von Clarmann, L. Delbouille, A. Dudhia, D. Ehhalt, M. Endemann, J. M. Flaud, R. Gessner, A. Kleinert, R. Koopman, J. Langen, M. López-Puertas, P. Mosner, H. Nett, H. Oelhaf, G. Perron, J. Remedios, M. Ridolfi, G. Stiller, and R. Zander: MIPAS: an instrument for atmospheric and climate research, *Atmos. Chem. Phys.*, 8, 2151–2188, 2008.

Höpfner, M.: Study on the impact of polar stratospheric clouds on high resolution mid-IR limb emission spectra, *J. Quant. Spectrosc. Radiat. Transfer*, 83, 1, 93–107, 2004.

Spang, R. et al. ESA Technical Note: Retrieval of MIPAS cloud parameter, Contract No.:20601/07/I-OL, ESA-ESRIN, 2008.

“In addition, for the COSMO-EU IWC data (where minimum/maximum IWC values of around 10–11 kg/kg respectively can be found) the LOS is considered to be “cloudy” if the integrated IWC along the entire LOS path exceeds at least $5 \cdot 10^{-2}$ g m⁻². This threshold is based on radiative transfer calculations for large database of modelled cloud spectra with the KOPRA radiative transport model including single scattering effects (Höpfner, 2005) together with measurements of MIPAS instrument (Fischer et al., 2008). Results for the ESA study on MIPAS cloud parameter retrieval [Spang et al., 2008] can be interpreted, that a limb ice water path of $5 \cdot 10^{-2}$ g/m² could be detectable in the IR spectra under certain conditions (e.g. in the tropopause region with its current extremely low background aerosol load). This threshold results in an effective IWC of 10⁻⁶ for a 50 km limb cloud path. Therefore only those ice-water path values are included which show clouds with sufficient optical thickness.”

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p11: We show now a figure (Figure 3) which compares SAGE cloud distributions with the cloud distribution of BT data measured with the simulated LCI. The figure shows that the cloud distribution is similar in general, but the cloud occurrences simulated with the LCI for winter 2005/06 show an underestimation of about 20 % with respect to the cloud occurrences measured with SAGE.

Figure 3: (a) Zonal mean cumulative opaque cloud distribution for the 1997/1998 El Niño 1997/1998 and the DJFMA climatology (1985-1991) (Wang et al. 2003), (b) zonal mean cumulative opaque cloud distribution for Dec. 2005 to April 2006 from BT method, measured with simulated LCI ($4 \times 0.5 \times 8 \text{ km}^3$).

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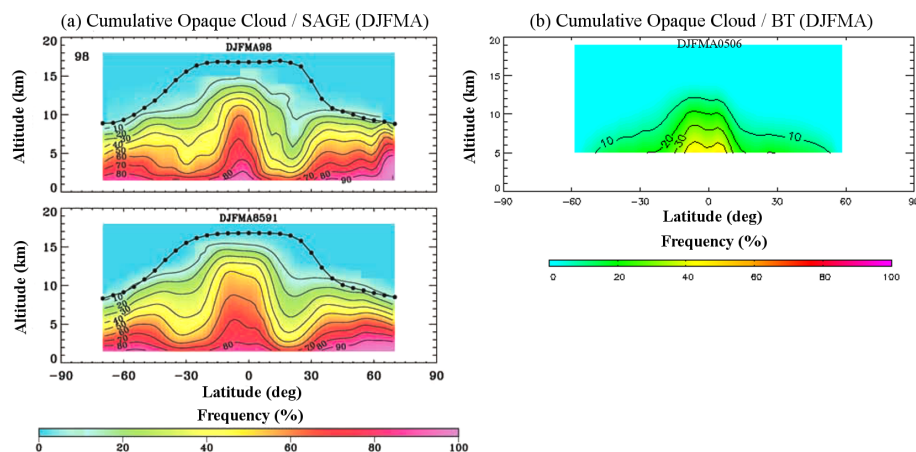


Fig. 1. Figure 3

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