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Atmospheric Measurement Techniques Discussions

Interactive comment on "Potential of airborne lidar measurements for cirrus cloud studies" *by* S. Groß et al.

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Interactive comment on "Potential of airborne lidar measurements for cirrus cloud studies" by S. Groß et al. – Anonymous Referee #2 Received and published: 14 May 2014

We thank this Reviewer for his careful reading of the manuscript and for his suggestions to help us improve the paper.

The answers are given in a direct response.

General comments: This work presents an interesting study using two aircrafts simultaneously to retrieve water vapor mixing ratio in cirrus clouds. The HALO aircraft was

situated above the cirrus using a lidar to retrieve water vapor mixing ratio using remote-sensing while Falcon flew below through the lower parts of the cirrus cloud while measuring in-situ water vapor mixing ratio. This enables a validation of the values retrieved by the lidar. ECMWF-data is used to analyze the RHi-fields inside and outside of cirrus as well. The authors find that the fluctuations in RHi is caused by fluctuations in water vapor mixing ratio rather than variations in temperature. This paper is well-written and suitable for publication in AMT. There are merely some minor issues to be clarified before publication.

Specific comments: Page 3, line 11: You write here that HALO cruises at an altitude of 14 km, about one kilometer above the cirrus cloud. On page 2, line 30 you state that an optimal distance to the cirrus cloud is around two kilometers. In the conclusions, on the other hand, you state this value to be 1.5 km. Which statement is true? Why did you choose to fly only one kilometer above it? The technical specifications of HALO (Table 1) indicates a maximum cruise altitude of more than 15 km.

Unfortunately we were not able during the analyzed case study to fly at maximum cruise altitude. Therefore we could not reach a sufficient distance to the cloud top. We added a comment in the text. Furthermore we corrected the different statements about optimal to the cloud top height.

Page 5, line 16-17: Please use repetition rate instead of repetition frequency

We changed that.

Page 7, line 3-4: The Falcon was situated below HALO from 11:25 until 11:54 UTC. Which distance does this correspond to (you mention that HALO covered 910 km from 10:47 until 11:54 UTC)? How many loops from Fig. 2 were flown within this time frame? There seems to be a repetitive pattern in Fig. 3, possibly because you flew through the same location several times. How did the airmasses change in the time needed to fly one loop? Please comment on this.

The time between 11:25 to 11:45 UTC corresponds to a distance of about 220 km which is about 1.2 ovals of the flight track shown in Figure 2b. We added this in the text. For the whole cross-section shown in Figure 3 five consecutive ovals were flown. In our flight planning we attempted to fly alongside the wind drift and we expected low wind speed in the probed cirrus region due to the general weather situation. In Figure 3 a repetitive pattern appears that changes with time. If these changes are due to changes in the cirrus properties, advection or small differences in the flight route cannot be answered from our measurements.

Page 7, line 8-9: The retrieved OD ranges between 0.1 and 1.5. What is the accuracy on these numbers? How is the OD retrieved?

The OD is retrieved with the high spectral resolution lidar method. We added information about the method, the uncertainties, and the corresponding reference in the text.

Page 8, line 1-4: You have a mean difference in temperature between Falcon and ECMWF of -0.9K. Did you check if this could be improved if you used COSMO-instead of ECMWF-data? COSMO-data data is available in a better resolution.

In the comparison of model and observation we used ECMWF analyses and short term forecasts. We did not used higher resolved data from COSMO. When using boundaries of global NWP analyses e.g. ECMWF IFS to drive COSMO we would not expect significant differences. However, using the COSMO analysis with an own data assimilation running, might cause differences that result from different assimilation techniques or the higher resolution. In this study we focus on ECMWF analyses being one of the most sophisticated global NWP model and used the highest available resolution.

Page 9, line 5-6: Could you comment on the vertical resolution of ECMWF at cirrus altitude? How representative is this resolution as compared to the cloud thickness?

The resolution of the ECMWF model data at cirrus altitude is about 400 m. We added

this in the text.

Page 11, line 21: Please change “Figure 11” to “Figure 10” as there is no Figure 11.

We corrected that.

Page 11, line 24-25: Could you please comment on the occurrence of regions within the cirrus clouds having values of RHi exceeding 130%?

Those high values were measured outside the cirrus cloud. We discuss these values in the discussion section.

Page 12, line 20 showes -> shows

We changed that.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 4033, 2014.