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Interactive comment on "Identification of the cloud base height over the central Himalayan region: Intercomparison of Ceilometer and Doppler Lidar" *by* K. K. Shukla et al.

K. K. Shukla et al.

astrophani@gmail.com

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The paper deals mainly with the potential of a Doppler Lidar (DL) to determine the cloud base height (CBH). The retrieval from a ceilometer (CM) is used as reference. There is already one review (anonymous reviewer #1) available so I only want to add a few very brief comments that were not already covered by him/her:

Response: We appreciate Dr Mathias Weigner for the suggestions in the form of short comments on the manuscript.

âĂć A very well elaborated study comparing DL and CM has been published by Schween et al. (2014). This paper should be considered in the framework of this

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manuscript.

Response: “Schween et al., (2014) studied the mixing layer height (MLH) by using Doppler Lidar vertical velocity standard deviation and ceilometer aerosols backscatter as it is play an important role in the atmospheric dynamics. They have proved that ceilometer is a potential instrument for the estimation of MLH by using aerosols as proxy and also cloud base height (CBH)”. We have somehow missed out and now we have included (Page-2, Lines: 17-20) the reference at the appropriate place in the revised manuscript

âĂć The specific properties of the used ceilometer must be taken into account, e.g. overlap, calibration, water vapor absorption etc.; in particular, the overlap might influence the retrieval of the CBH. Note, that the CT25k provides ’backscatter’ but not ’aerosol backscatter’ in a quantitative way. Moreover, there are several methodologies to retrieve the CBH developed by the manufacturer and/or the scientific community. Depending on the methodology the results might be different. Consequently, the applied algorithm should be briefly outlined or characterized by a (easy to access) publication. Response: We have now included two references related to specific properties of CT25K ceilometers which are relevant in the modified (Page-6, Lines: 2-6) version of draft. We have also outlined the methodology used for estimating CBH with ceilometers in the manuscript.

1. Münkel, C., Eresmaa, N., Räsänen, J., and Karppinen, A.: Retrieval of mixing height and dust concentration with lidar ceilometer, Bound. Lay. Meteorol., 124, 117–128, doi: 10.1007/s10546-006-9103-3, 2007. 2. Münkel, C., Schäfer, K., and Emeis, S.: Adding confidence levels and error bars to mixing layer heights detected by ceilometer, Proc. SPIE 8177, 817708–1 – 817708–9, 2011. 3. Schween, J. H., Hirsikko, A., Löhnert, U., and Crewell, S.: Mixing-layer height retrieval with ceilometer and Doppler lidar: from case studies to long-term assessment, Atmos. Meas. Tech., 7, 3685-3704, doi: 10.5194/amt-7-3685-2014, 2014.

âĂć Are problems of multi-layer clouds encountered when retrieving the cloud coverage of opaque and thin clouds from the TSI? How often are several cloud layers observed by the CM? Is this an issue? Response: No, we have not encountered this type of multi layer clouds issue during retrieval of thin and opaque clouds for all the examples chosen for the present study. Singh et al., (2016) observed by using Ceilometer the dominance of single layer clouds is more and only ∼10 % are multilayer clouds.

Singh, Narendra, Solanki, Raman, Ojha, N., Naja, M., Dumka, U. C., Phanikumar, D. V. Sagar, Ram, Satheesh, S. K., Moorthy, K. Krishna, Kotamarthi, V. R. and Dhaka, S. K.: Variations in the cloud-base height over the central Himalayas during GVAX: association with the monsoon rainfall. Current Science, 111, 109-116, 2016.

âĂć The good agreement between the time-height cross sections from DL and CM as shown in Fig. 4 is not surprising ('It is interesting to note that the temporal...'), the authors should rather focus on a discussion of the differences. A comment how they distinguish opaque and thin clouds from Fig. 4 would be welcome (from the DL/CM or from the TSI?). What is 'Backscatter' meaning (right color code): 0.004 km-1 sr-1 seems to be quite low for a thick cloud?

Response: We have now mentioned those lines in the context of Doppler Lidar where there was reasonably good matching between the instruments. However, some differences are evident as the backscattering are slight different. In some cases, (November 02 and March 11) we observe some differences may be because of different wavelength of the Doppler Lidar and Ceilometer. We have modified the above mentioned discussion part as per the suggestions. The thin and opaque cloud classification is done from the TSI only. For Thick cloud, it is order of 0.01 km-1 sr-1 and it is also here (Page-11, Lines:6-9).

âĂć When comparing the CBHs from MODIS and DL/CM (Fig. 9) differences are likely due to the different sampling (i.e., point measurement vs. spatial average over 1X1 degree, different temporal averaging). At least an estimate of the accuracy of MODIS-

algorithm for the CBH should be added (Sec. 3.3). UT should be changed to LT (as used in the rest of the paper).

Response: We have changed UT to LT in caption of figure 9 in the revised version of the draft (See Page:30, Line: 13). We have also added a reference on the accuracy of MODIS algorithm for the CBH in the revised manuscript.

âĂć When comparing CBHs at different sites the authors switch from height 'above ground level' to height 'above mean sea level' and found agreement with their own site (Tab. 1). Is the 'amsl' more reasonable from a meteorological point of view? Is there a 'need' that the CBH at Nainital is similar to that at, say, Lindenberg? Nobody will in principle doubt the CBHs retrieved from the CM in this paper, thus no justification is required.

Response: Our main motive behind giving the values of other locations was to give a comprehensive picture about the CBH's estimation around the globe. For comparison, we have added our location altitude (from above mean sea level) and CBH altitude. No, it will never same for the Lindenberg or any location because the topography also plays an important role in the cloud formation over any site (Page-20, Line1: Table2).

âĂć page 10, line 23: 'The observations from all the instruments...'. There is something wrong with this sentence. Response: We have modified the above sentence in revised version of manuscript (Page-12, Lines:14-15).

âĂć There are several redundancies, e.g. lines 12/13 on page 11 already appear in the previous paragraph.

Response: We have now removed redundancies from the text in the revised manuscript..

Suggested references:

Schween, J. H., Hirsikko, A., Löhnert, U., and Crewell, S.: Mixing-layer height retrieval with ceilometer and Doppler lidar: from case studies to long-term assessment, Atmos.

Meas. Tech., 7, 3685-3704, doi: 10.5194/amt-7-3685-2014, 2014.

Wiegner, M., Madonna, F., Binietoglou, I., Forkel, R., Gasteiger, J., Geiß, A., Pappalardo, G., Schäfer, K., and Thomas, W.: What is the benefit of ceilometers for aerosol remote sensing? An answer from EARLINET, Atmos. Meas. Tech., 7, 1979-1997, doi: 10.5194/amt-7-1979-2014, 2014.

Haeffelin, M., F. Angelini, Y. Morille, G. Martucci, S. Frey, G. P. Gobbi, S. Lolli, C. D. O'Dowd, L. Sauvage, I. Xueref-Remy, B. Wastine, and D. G. Feist: Evaluation of Mixing-Height Retrievals from Automatic Profiling Lidars and Ceilometers in View of Future Integrated Networks in Europe, Boundary-Layer Meteorol (2012) 143:49–75, DOI 10.1007/s10546-011-9643-z.

Münkel, C., Schäfer, K., and Emeis, S.: Adding confidence levels and error bars to mixing layer heights detected by ceilometer, Proc. SPIE 8177, 817708–1 – 817708–9, 2011 [this is a paper on a more recent Vaisala-ceilometer.

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