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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relation between ice and liquid water mass in mixed-phase cloud layers measured with Cloudnet" *by* Johannes Bühl et al.

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Overall summary: This manuscript used measurements collected by Leipzig Aerosol and Cloud Remote Observations System (LACROS), which includes Raman lidar, ceilometer, cloud radar and microwave radiometer, and then were analyzed with Cloudnet algorithms to take a detailed insight into the microphysics of mixed-phase cloud layers. Authors found that shallow mixed-phase cloud layers mainly produce pristine ice and spaceborne cloud radar might miss a large part of ice formation. This work presents valuable information to understanding of ice formation and to accuracy of satellite measurements. Some minor questions/suggestions need to be solved are listed in the following: Comment and Question: 1. Line 64, 97 and 115: Authors should define the acronyms (TROPOS, LDR, COSMO-EU) when it firstly appeared in the article. 2. A suggestion: the paragraph 2 in page 2 (Line 39-line56) is better moved to the ending of the introduction. 3. As we know, multilayered cloud systems very fre-

quently occur in the atmosphere (Huang, J., P. Minnis, B. Lin, Y. Yi, S. Sun-Mack, T. Fan, and J. Ayers, Determination of ice water path in ice-over-water cloud systems using combined MODIS and AMSR-E measurements, Geophysical Research Letters, 33 (21) (2006), L21801, doi:10.1029/2006GL027038 ; Huang, J., P. Minnis, B. Lin, Y. Yi, M. Khaiyer, R. Arduini, A. Fan, and G. Mace, Advanced retrievals of multilayered cloud properties using multispectral measurements, Journal of Geophysical Research, 110 (D15) (2005), D15S18, doi:10.1029/2004JD005101.). For this study, all lidar or Radar profiles were used? How did you considered the attenuation of lidar power when signal penetrate the lower cloud layer in the multilayered cloud system? 4. For figure1: 'On top the predominantly liquid water top is detected by lidar'. As we know that lidar signal is hard to penetrate mix-phase cloud layer, how could it detects the liquid water top? And the schemes of mixed-phase cloud layer are not well described. If there is mixed-phase cloud, why IWP is only below cloud layer? 5. Line 325: 'a minimum cloud layer lifetime of 3 hours around -25âĎČ', how could authors get this value herein. 6. For the retrieval of LWC, the adiabatic model was used in this study. However, the entrainment of cloud top should be considered, thus this process may reduce the LWC. A better method possible is based on the depolarization ratio measurement from lidar (See paper: Hu, Y., S. Rodier, K. Xu, W. Sun, J. Huang, B. Lin, P. Zhai, and D. Josset, Occurrence, liquid water content, and fraction of supercooled water clouds from combined CALIOP/IIR/MODIS measurements, Journal of Geophysical Research, 115 (2010), D00H34, doi:10.1029/2009JD012384. Hu, Y., M. Vaughan, C. McClain, M. Behrenfeld, S. Sun-Mack, D. Flittner, J. Huang, B. Wielicki, P. Minnis, C. Trepte, and R. Kuehn, 2007: Global statistics of liquid water content and effective number density of water clouds over ocean derived from combined CALIPSO and MODIS measurements, Atmos. Chem. Phys., 7, 4065-4083.)

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