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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Reconciling aerosol light extinction measurements from spaceborne lidar observations and in-situ measurements in the Arctic" *by* M. Tesche et al.

Anonymous Referee #3

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Overview:

This study presents a comparison of extinction coefficients as determined from spaceborne lidar measurements and from ground-based in-situ measurements at Zeppelin station during the year 2008. For this, the authors present here a complex procedure to match CALIPSO and ground-based observations based on HYSPLIT back trajectories to ensure the comparison of the same air mass. This procedure leads to only 57 overpasses during 2008 (from over 2000 overpasses in that year). The results obtained by the authors show how difficult is to obtain good results in such comparison.

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I would recommend the authors to focus more on the screening and matching of the CALIOP data, analyzing further the associated uncertainties (averaging height range, intervals along the CALIPSO ground track, time, etc.). Although the number of cases analyzed is very low, it can be presented as the first attempt to compare extinction coefficients from spaceborne lidar and ground-based measurements using this approach. However, the authors need to analyze in depth the uncertainty of their approach and the results obtained.

General comments:

Page 5695, lines 4 – 8: This paragraph repeats the information on Page 5691, lines 28 – 29 and Page 5692, lines 1 – 4. The Zieger et al. (2013) reference is missing here though.

Page 5696, lines 6 – 13: The hygroscopicity model was validated with data from the period July – October 2008. Can the authors explain further how this is valid for the whole year 2008? How would the annual variation of the aerosol concentration and properties affect this?

Page 5696, lines 14 – 15: "Values of f(RH) = 4.30 $\pm$ 2.26 with a range from 1.5 to 12.5 were found for the year 2008." To get these values, the hygroscopicity model by Rastak et al. (2014) was used with measurements of dry aerosol size distribution and aerosol composition. How frequent were these measurements? What is the uncertainty of this model? How would this affect the aerosol extinction coefficient for ambient conditions? And the comparison with CALIPSO?

Pages 5700 – 5702: "Comparison approach" The authors should include information about the uncertainties associated to this approach, e.g.,

"We believe that time rather than distance is a better parameter to assess changes in the aerosol properties in the atmosphere." Why?

"A change in the along-track average of the CALIOP extinction profile (i.e., 10 from a

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range related to crossing trajectories with different starting time at the location of the ground site to a fixed interval) can result in large differences of the resulting mean extinction profile." By how much?

"Better agreement with the in-situ observation may be obtained for an average over a smaller height range. However, we chose a conservative range that is likely to be suitable for most cases." Please provide level of uncertainty.

Page 5704, lines 1 – 2: "Using the in-situ measurements at the time of the satellite overpass decreases the agreement of the observations." How much?

Page 5704, lines 26 – 28: "There is no indication that a closer distance between satellite ground track and in-situ ground site (or a smaller time lag, not shown) would give a better agreement." Please specify or provide examples, references, etc.

Page 5705, lines 20 – 21: "These aerosol types are rather uncommon at 78N and suggest misclassification in the CALIPSO retrieval." Has this been proved? What is CALIPSO's ratio of misclassifications/classifications?

Page 5705, lines 25 – 26: "It remains unclear, why half of the clean marine cases are within the set of outliers." Why the authors not consider this as misclassifications?

Page 5706, lines 14 – 16: "The RH at the location of the CALIOP observation is taken from the meteorological data provided with the trajectory analysis and thus highly uncertain." Please quantify.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 5687, 2014.