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Atmospheric Chemistry and Physics Discussions
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Interactive comment on "Investigating emission sources and transport of aerosols in Siberia using airborne and spaceborne LIDAR measurements" *by* Antonin Zabukovec et al.

Anonymous Referee #2

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This paper aims contributing to improve the scientific knowledge about aerosol particles over Siberia, a region where some aerosol types (such as pollutants) are still understudied. Because aerosol profiling measurements are scarce in this part of the Earth, this study proposes a combination of in-situ, lidar airborne and satellite-based measurement in the framework of two campaigns to reduce the lack of atmospheric information.

In general, this paper contributes to improve the scientific knowledge but its scientific sound would increase much more if the database were enlarged in the future, with a dataset capable of being statistically analyzed. Anyway, I consider this work (with

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Discussion paper

limited impact) might be published in Atmospheric Chemistry and Physics after major revisions.

Specific comments:

Line 57: This statement is far from truth. Surface measurements are very valuable from a local point of view (with high vertical and temporal resolution). It is not fair to say that they are limited to a few case studies when there are lidar networks that have been working for up to 20 years in some cases. A comment on the main lidar monitoring networks (EARLINET, MPLNET, LALINET, Cislinet, ADnet, NDACC) should be included.

Lines 99-100: Which method was used to perform the polarization calibration? Polarization calibration seems to be not enough for aerosol typing. Can you explain in more detail this? If so, taking into account that co and cross-polarized signal are separately detected, is the optical combination of both signals quality assured?

Lines 101-102: This threshold seems to be somehow ambiguous. Can you provide some references? Is this value cloud type dependent?

Lines 115-116: The correction factor applied for deriving the black carbon mass concentration hugely ranges from 0.5 to 1, depending on the blackening. Because of the impact that this correction (up to 100%) has on the final product, this issue should be explain more in detail.

Line 126: Which is the corresponding accuracy for wind vector?

Line 134-135: For overlap characterization, a method based on the ratio between PR2 and molecular backscatter profile is employed. The latter is computed from the ERA Interim ECWF meteorological analysis, which can differ slightly from the actual atmospheric temperature and pressure values. Is this uncertainty account for the calculations? Which is the impact of using ERA Interim in the overlap derivation? How much does the overlap change from flight to flight?

Line 139-142: The constraining of lidar ratio must be carefully performed. One limitation is the spatial distribution because of the highly aerosol variability. How can the authors justify that an area of +-70 km2 does not disturb the actual AOD value? Another limitation is the temporal distribution. Considering a time slot of +5 around the aircraft observation implies roughly 50% of daytime in June/July for your locations. How can you justify steady AOD values for such huge time slot? In addition, MODIS and airborne lidar work at different wavelengths. How do you deal with this?

Line 186: In the different subsections of section 4, I miss a more complete comparison/discussion of the lidar ratio values obtained here respect to those in the previous literature. There are tens of papers in the framework of EARLINET reporting lidar ratio values for many aerosol types. Your discussion would enrich reviewing the main studies.

Lines 323-330: Again, this comparison will enrich including some works performed in the framework of EARLINET. For instance, regarding biomass burning might consider these articles (and references herein):

Baars, H., Ansmann, A., Ohneiser, K., Haarig, M., Engelmann, R., Althausen, D., Hanssen, I., Gausa, M., Pietruczuk, A., Szkop, A., Stachlewska, I.S., Wang, D., Reichardt, J., Skupin, A., Mattis, I., Trickl, T., Vogelmann, H., Navas-Guzmán, F., Haefele, A., Acheson, K., Ruth, A.A., Tatarov, B., Müller, D., Hu, Q., Podvin, T., Goloub, P., Veselovskii, I., Pietras, C., Haeffelin, M., Fréville, P., Sicard, M., Comerón, A., García, A.J.F., Menéndez, F.M., Córdoba-Jabonero, C., Guerrero-Rascado, J.L., Alados-Arboledas, L., Bortoli, D., Costa, M.J., Dionisi, D., Liberti, G.L., Wang, X., Sannino, A., Papagiannopoulos, N., Boselli, A., Mona, L., D'Amico, G., Romano, S., Perrone, M.R., Belegante, L., Nicolae, D., Grigorov, I., Gialitaki, A., Amiridis, V., Soupiona, O., Papayannis, A., Mamouri, R.-E., Nisantzi, A., Heese, B., Hofer, J., Schechner, Y.Y., Wandinger, U., Pappalardo, G. The unprecedented 2017-2018 stratospheric smoke event: Decay phase and aerosol properties observed with the EARLINET (2019) Atmospheric Chemistry and Physics, 19 (23), pp. 15183-15198. DOI: 10.5194/acp-19-

15183-2019

Ortiz-Amezcua, P., Luis Guerrero-Rascado, J., Granados-Munõz, M.J., Benavent-Oltra, J.A., Böckmann, C., Samaras, S., Stachlewska, I.S., Janicka, L., Baars, H., Bohlmann, S., Alados-Arboledas, L. Microphysical characterization of long-range transported biomass burning particles from North America at three EARLINET stations (2017) Atmospheric Chemistry and Physics, 17 (9), pp. 5931-5946. DOI: 10.5194/acp-17-5931-2017

Sicard, M., Granados-Muñoz, M.J., Alados-Arboledas, L., Barragán, R., Bedoya-Velásquez, A.E., Benavent-Oltra, J.A., Bortoli, D., Comerón, A., Córdoba-Jabonero, C., Costa, M.J., del Águila, A., Fernández, A.J., Guerrero-Rascado, J.L., Jorba, O., Molero, F., Muñoz-Porcar, C., Ortiz-Amezcua, P., Papagiannopoulos, N., Potes, M., Pujadas, M., Rocadenbosch, F., Rodríguez-Gómez, A., Román, R., Salgado, R., Salgueiro, V., Sola, Y., Yela, M. Ground/space, passive/active remote sensing observations coupled with particle dispersion modelling to understand the inter-continental transport of wild-fire smoke plumes (2019) Remote Sensing of Environment, 232, art. no. 111294, DOI: 10.1016/j.rse.2019.111294

Lines 344-345: Specify that this is only valid for this aerosol type. For others, such as mineral dust this affirmation is not correct.

Line 355 (section 5): Here is my main concern. I do not agree with the scope of this section. Taking into account the datasets you are comparing, this does not make sense at all (huge distance/time for comparison). What might be interesting is the use of CALIOP for complementing the profiling done by the flights and check coherence among datasets, but not comparison. Therefore, please reorganize section 5 in this sense.

Technical comments:

General technical comment: Due AOD is a spectral quantity, it is mandatory to always identify the wavelength.

Line 32: Paris et al., 2009b should be Paris et al., 2009a.

Line 45: replace ‘angstrom’ by ‘Angström’.

Lines 84-85: insert comma before (ii) and (iii).

Figure 1: include ‘Altitude (km asl)’ in panels (b) and (c).

Line 95: replace ‘mrd’ by ‘mrad’.

Line 103: replace ‘clearing’ by ‘screening’.

Figure 3, Figure 6, Figure 9, Figure 11, Figure 14 and Figure 17: It is advisable to show the same altitude scale in (a), (b) and (c). In addition, the meaning of the horizontal line in panels (b) and (c) should be included.

Figure 4, Figure 7, Figure 10, Figure 12, Figure 15, Figure 18: Lines for selected CALIOP overpasses and high PES area are somehow difficult to see. I recommend another type of visualization to increase contrast (i.e. white color). Similarly for pink lines in panel (b).

Figure 5, Figure 8: Specify that this is particle linear depolarization ratio, and altitude is in km asl. Line 295: replace ’40 sec’ by ’40 s’.

Table 1: wavelength for AOD and units for lidar ratio are missing.

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