

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-740

Anonymous Referee #1

Referee comment on "Zonal variations in the vertical distribution of atmospheric aerosols over the Indian region and the consequent radiative effects" by Nair K. Kala et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-740-RC1>, 2022

The paper is well written and appropriate for ACP. It provides a good overview of the aerosol conditions over the Indian Subcontinent. The CALIPSO data set is the basis for this and was carefully analyzed.

Minor revision are requested.

Abstract: The text is quite lengthy. I would appreciate a compact abstract, just 10-15 lines on methods and data, and a few key results. Many details are given in unnecessarily large detail. Such a detail description can be given in the summary section.

P2, line 54: Without these field campaigns, one would not know much about, e.g., lidar ratios, used in the CALIPSO data analysis. Such snapshot-like field campaigns are required to get a deep insight in aerosol properties. Without them, nobody would trust the 'larger picture' provided by the CALIPSO data sets.

P4, line 103-104: Are these lidar ratios from 23 to 70 sr in agreement with the lidar ratio observations realized during field campaigns such as INDOEX?

P4, lines 1105-1110: When using CALIPSO backscatter observations and MODIS AOT values one has the chance to get the column lidar ratios (AOD divided by the column backscatter). These values should be in harmony with the CALIPSO lidar ratios used in your data analysis.

Such studies are just indications that you did a lot in terms of quality assurance.

Page 6 is terrible with all the ASSA, OSSA; deltaSSA, eSSA. I had to write down all the abbreviations to get not lost.

P10, I297: Do you know the papers of Hofer et al. (ACP 2017, 2020) on central Asian dust observations (Dushanbe, Tajikistan), and Hu et al. (ACP, 2021) on western China dust observation (Taklamakan area). These papers could be cited.

Hofer, J., Althausen, D., Abdullaev, S. F., Makhmudov, A. N., Nazarov, B. I., Schettler, G., Engelmann, R., Baars, H., Fomba, K. W., Müller, K., Heinold, B., Kandler, K., and Ansmann, A.: Long-term profiling of mineral dust and pollution aerosol with multiwavelength polarization Raman lidar at the Central Asian site of Dushanbe, Tajikistan: case studies, *Atmos. Chem. Phys.*, 17, 14559–14577, <https://doi.org/10.5194/acp-17-14559-2017>, 2017.

Hofer, J., Ansmann, A., Althausen, D., Engelmann, R., Baars, H., Fomba, K. W., Wandinger, U., Abdullaev, S. F., and Makhmudov, A. N.: Optical properties of Central Asian aerosol relevant for spaceborne lidar applications and aerosol typing at 355 and 532 nm, *Atmos. Chem. Phys.*, 20, 9265–9280, <https://doi.org/10.5194/acp-20-9265-2020>, 2020.

Hu, Q., Wang, H., Goloub, P., Li, Z., Veselovskii, I., Podvin, T., Li, K., and Korenskiy, M.: The characterization of Taklamakan dust properties using a multiwavelength Raman polarization lidar in Kashi, China, *Atmos. Chem. Phys.*, 20, 13817–13834, <https://doi.org/10.5194/acp-20-13817-2020>, 2020.

Fig. 2: I would appreciate if OSSA and cSSA would be explained in the figure caption....

Fig.3: Please state in the caption that these observations are taken by CALIOP. What shows the dashed line in Fig.3c?

Fig.4, the PDR values are derived from the respective VDR values by using the particle backscatter coefficient profiles. So the PDR profiles are uncertain. How trustworthy they are... should be discussed! For example, the red PDR fields (4b, 4c) show values of 30-40% depolarization ratio as THREE MONTH MEAN VALUES. Such high values cannot be explained by pure mineral dust. Desert dust produces 30% (so yellow colors), and at extreme conditions, close to dust sources, 35% may happen, but only in some cases.

Fig.5: cSSA, OSSA should be explained in the caption.

