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Atmospheric Measurement Techniques Discussions

Interactive comment on "CALIPSO Level 3 Stratospheric Aerosol Product: Version 1.00 Algorithm Description and Initial Assessment" *by* Jayanta Kar et al.

Anonymous Referee #4

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The paper "CALIPSO Level 3 Stratospheric Aerosol Product: Version 1.00 Algorithm Description and Initial Assessment" presents and discusses the new science algorithm and data handling techniques that are developed to generate the CALIPSO version 1.00 level 3 stratospheric aerosol profile product. The study falls within the scope of AMT. The authors have done a thorough job, the manuscript is well-written/structured, the presentation clear, the language fluent, the quality of the figures high. The result support the conclusions. Two major deficiencies are the implementation of a constant stratospheric aerosol lidar ratio (50 sr), regardless of an aerosol type classification, and the evaluation of the stratospheric aerosol product against SAGEIII extinction coefficient observations, a product which has not been validated (including issues of

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Discussion paper

SAGEIII such as cloud contamination propagating in the comparison). However the stratospheric aerosol product and all the issues are properly and extensively discussed in the manuscript, thus I recommend publication in AMT, under minor revisions before it can proceed to be published.

Minor comments:

1) P1L17-18: “gridded level 3 product is based on version 4.2 of the CALIOP level 1 and level 2 data products”. According to this sentence CALIOP level 1 V4.2 is used. It is not clear whether the authors refer to Level 1B or Level 1.5 Profile Data. In the case of L1B, please provide a web link to the used data repository. 2) P1L27: “where the average difference between zonal mean extinction profiles is typically less than 25% between 20km and 30km”. Please rephrase to provide also whether the sentence refers to overestimation or underestimation compared to SAGEIII. 3) P3L29-30: “This is a level 3 monthly averaged product gridded in latitude (5o), longitude (20o) and altitude (900m)”. Although the justification of the 900m vertical resolution is sufficient, the authors should provide explanation on the reasons why the spatial resolution of 5ox20o deg2 grids was selected. How much the selected spatial (horizontal), vertical and temporal resolution affect the final dataset (in terms of backscatter and extinction coefficient profiles at 532nm)? 4) P5L26: “Note that the range of altitudes to be covered in the stratosphere at various latitudes is from 8.2 km to 36 km, the latter being the lower limit of the calibration region”. Please mention the applied methodology of decoupling stratospheric and tropospheric layers, since the altitude of 8.2 km frequently lies below Tropopause? Does it rely on MERRA-2 by GMAO? 5) P8L8-9: “Further, all L1B profiles within the South Atlantic Anomaly (SAA) region are also removed”: Why do the authors remove CALIOP observations over the SAA region. Based on Kar et al., 2017 (CALIPSO lidar calibration at 532âĂŁnm: version 4 nighttime algorithm), the new nighttime CALIOP calibration technique compensates for the higher NSR values, resulting in reliable calibration coefficients even over the SAA region. The authors it is suggested to include the justification in the manuscript. 6) P8L25: “. . . leading to

generally lower CAD scores (Liu et al., 252019).". Since CAD ranges between -100 and 100, it is not clear whether the authors refer to more aerosol reliable retrievals (CAD -> -100) or to absolute values of CAD score, therefore, CAD values closer to zero. 7) P9L4-7: Although the authors provide the Vaughan et al., 2009 reference, some information on the noise filter should also be included in the manuscript, even if briefly. 8) Figure 4: Based on the manuscript, Figure 4b and 4c refer to the aerosol mode, however it is not clear neither in the caption nor in the manuscript whether they refer to the background or the aerosol mode. In addition, high stratospheric values are observed at 0o latitude, between 25 and 30 km height. Where do the authors attribute the observed values? 9) P12L5: "Note the high scattering ratio values in the Antarctic latitudes between 15 km and 25 km". The authors are kindly requested to provide a reference for this statement. 10) P12L17-18: "The white grid cells over southeast Asia occur because the tropopause is higher than 16 km in this region". The authors are kindly requested to provide a reference for this statement, including the typical tropopause height over this region. 11) P12L21-22: "This is again likely due to small particles which are in the process forming PSCs". The authors are kindly requested to provide a reference for this statement. 12) P13L13: "For the CALIPSO stratospheric aerosol product, the particulate multiple scattering factor is taken as 1 for all species of stratospheric aerosols". The authors are kindly requested to provide a reference for this statement. Which is quantitative the effect of this assumption on the discussed stratospheric aerosol product? 13) P13 - Stratospheric Aerosol Lidar Ratio of 50 sr is used. Although the authors explain in detail the selection of the specific lidar ratio value and evaluate against SAGEIII observations, it is expected that the uniform value used globally, regardless of the aerosol type, introduces large uncertainties. Which is the effect of this assumption to the stratospheric aerosol product? The authors mention that appropriate LR values for different aerosol subtypes will be introduced in future versions of the stratospheric product, however the assumption of constant LR value highly affects the reliability of the extinction coefficient profiles and should be mentioned in the abstract. 14) Figure 8: The authors should discuss on

the high values of attenuated scattering ratios observed over the equator, including the proper references. 15) P18L1-5: “The persistence of the stratospheric perturbation for several months is consistent with the results of Vernier et al. (2016) who found the presence of ash in the lower stratosphere 3 months after the Kelud eruption from balloon observations”. The observed features are qualitative consistent with the results of Verner et al. (2016). Is it possible to the authors to include a quantitative comparison? 16) P20L3-5: “SAGE III performs solar and lunar occultation measurements as the ISS orbits the Earth and covers the entire global latitude (90oS to 90oN) and longitude range (180oW to 180oE).” ISS orbital characteristics are characterized by 51.6o inclination, therefore the authors it is suggested to check the global latitude coverage (90oS to 90oN). 17) P20L15-17: “The globally averaged value of the Angstrom exponent derived using all 15 months of data is about 1.56”. Please mention between which wavelengths. 18) P20L22: “Δ(z) = 100$\times$(σ(z)CALIPSO–σ(z)SAGE)/σ(z)SAGE”. How are extreme cases treated? Which computational filters are applied? For instance, cases with σ(z)CALIPSO = 0 (Δ(z) = -1), or cases with very low values of σ(z)SAGE are also included? In case of applied filters in the dataset used prior to the results, the authors should mention them in the manuscript. 19) P22L14: “between CALIPSO and SAGE III extinction at all altitudes with CALIPSO having a high bias”. Wherever the manuscript refers to statistical indicators, such as the “high bias” here, the authors should mention the corresponding computed values. 20) P23L8: “calculated using the average extinction coefficient profiles between 20 km and 30 km”. The reason of selecting vertically the region between 20km and 30km and not the region from 20 km up to 34 km, hence including the stratospheric region of V3 calibration, is not clear nor justified in the manuscript, since it is proven in Kar et al. (2017) that this region is not aerosol free. 21) P2314: “though the differences begin to rise substantially in the mid-latitudes of both hemispheres”. Please include explanation on the observed features, including the necessary references.

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