Supporting Information for

Assessment of the multi-wavelength ACE-MAESTRO stratospheric aerosol extinction measurements

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S1. Frequency Distribution of Extinction Measurements

In this section, we analyze the frequency distribution of extinction coefficients (~750 nm) measured by OSIRIS, MAESTRO, and SAGE III during their overlap period. Measurements from every profile for the given altitude, latitude range and time range are included in the histogram plots in Fig. SI1. The top panel shows the measurements at 15.5 km, between 55°N to 65°N over the period when all the instruments were operational. In this case, the distribution of SAGE and OSIRIS agree well with each other – both showing a bimodal distribution. Even though MAESTRO is skewed right like the others, it does not show the bimodal structure. Since we know there is correlation, we can deduce that MAESTRO doesn't give the large values for enhancements and that its value is too tightly constrained.

The middle panel shows the comparison during a volcanically active period corresponding to the Raikoke eruption for a period of one month. This is the first month after the eruption where the plume spreads throughout this latitude range and all three instruments have large enough samples. Like in the first case, the SAGE III and OSIRIS shows an excellent overlap. MAESTRO measurements, despite having a similar shape, is biased low. It shows the measurement regime where MAESTRO has the largest bias for the version 3.13 data considered in this study and links to what is shown in Fig. 2 in the manuscript. Finally, the bottom panel shows the comparison during a volcanically quiescent period over a three-months period. It shows that even when there are a few outliers in the MAESTRO data, the medians are close to each other.
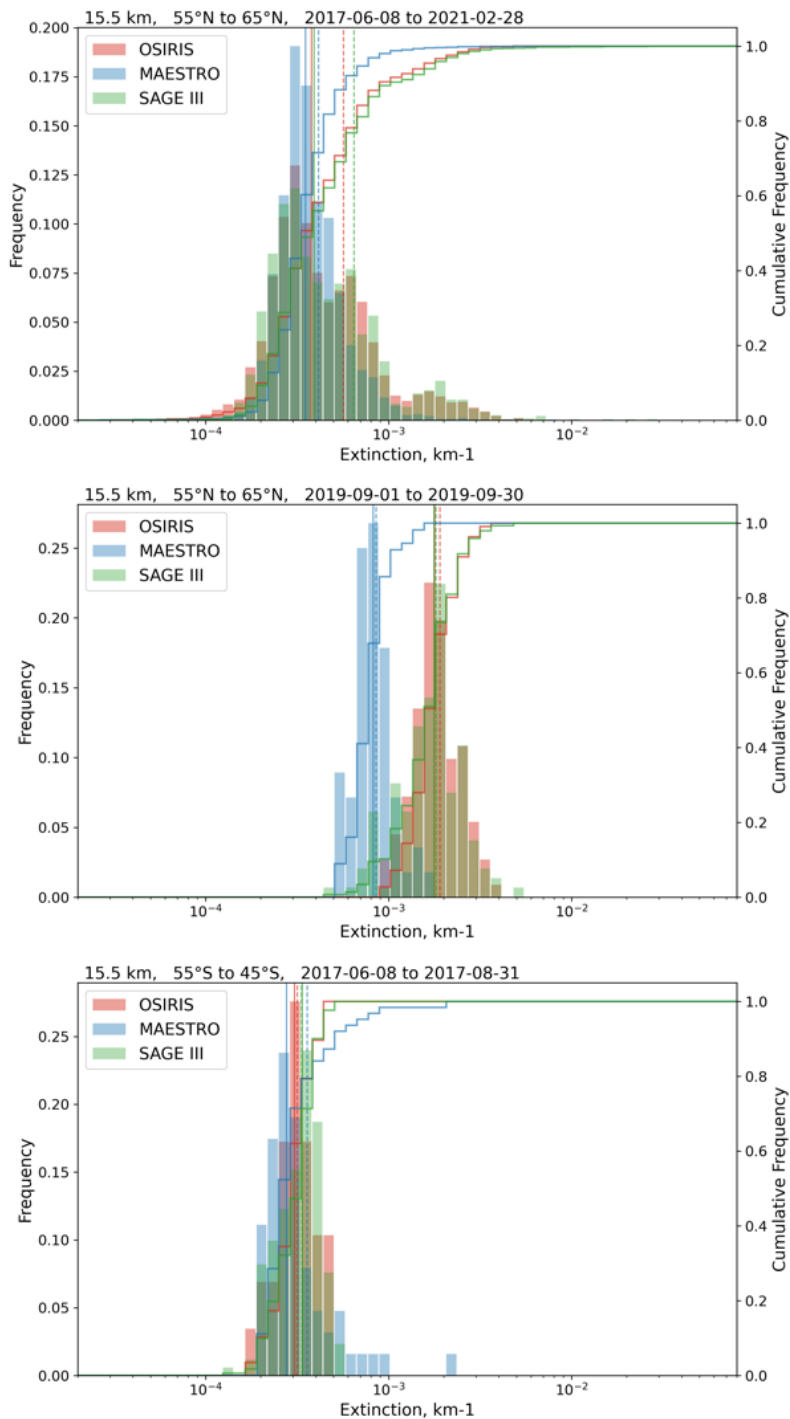
Figure SI1: Frequency distribution of extinction coefficients measured by the OSIRIS (750 nm, red), MAESTRO (779 nm, blue) and SAGE III (756 nm, green). Measurements from each profile at given altitude, latitude range and time range (shown on top of each panel) is included in the histogram. Cumulative frequency distribution is shown with the axis on the right-hand side. Solid vertical lines indicate the median values whereas dashed vertical lines indicate the mean values.

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Supplementary figures referenced in the paper are presented here:
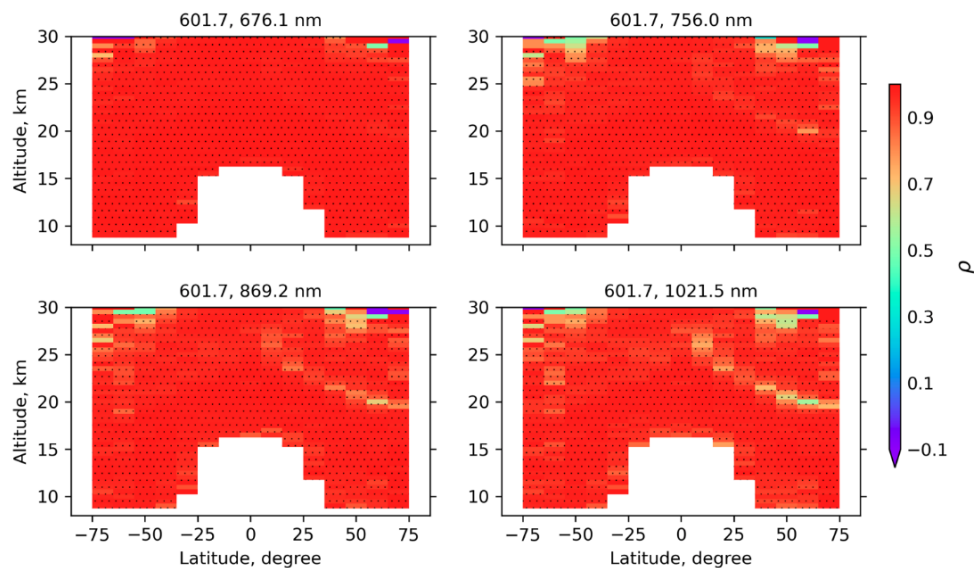
Figure S1: Same as Fig. 5 except with SAGE III extinction coefficients at corresponding wavelengths.

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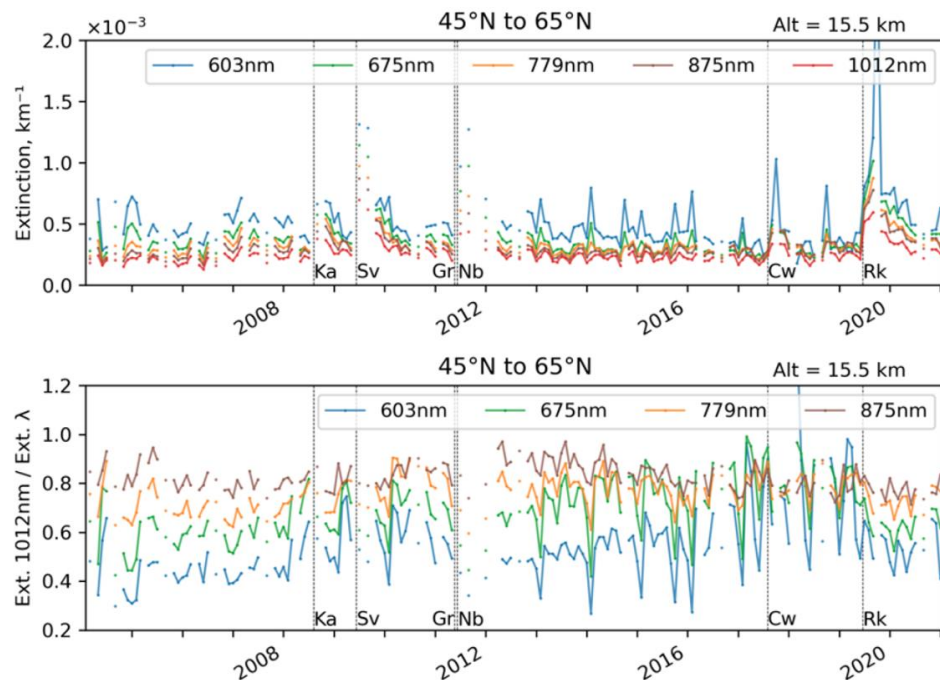
Figure S2: (Top panel) MAESTRO extinction coefficients in the 45-65°N latitude range at five wavelengths shown in different colors. (Bottom panel) Ratio of MAESTRO extinction at 1012 nm to extinctions at four remaining wavelengths shown in corresponding colors. Data in two 10-degree latitude bins are combined to show the timeseries by calculating the number weighted

45   **average of the medians.**
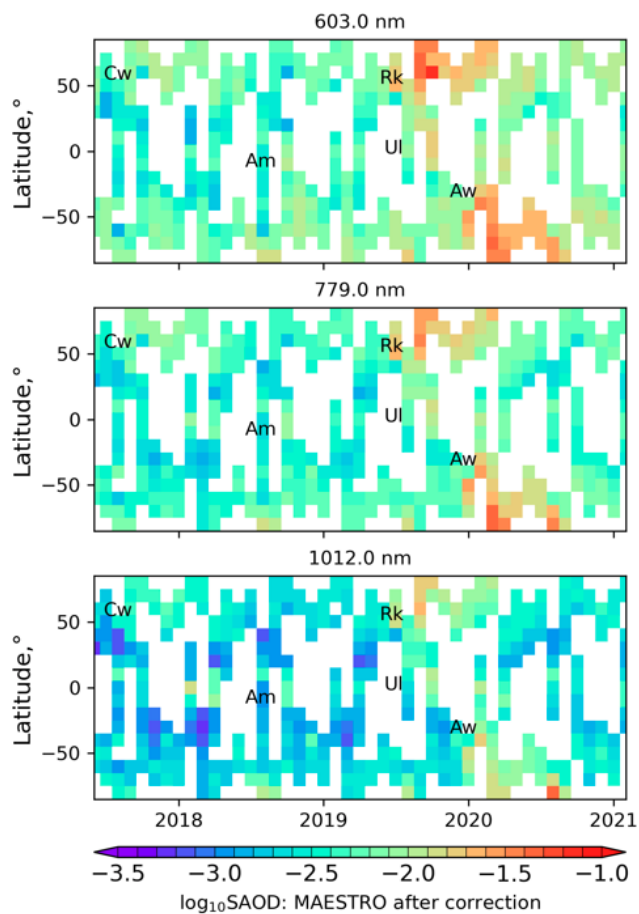
Figure S3: Monthly median SAOD derived from the "tuned" MAESTRO extinctions at three different wavelengths as a function of latitude and time. Labels Cw, Am, Rk, Ul and Aw represent Canadian wildfires, Ambae, Raikoke, Ulawun and Australian wildfires respectively.

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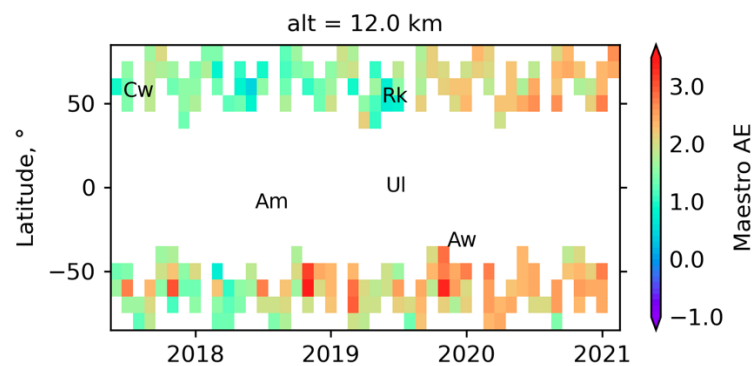
Figure S4: Monthly median AE at an altitude of 12 km derived from the "tuned" MAESTRO extinctions plotted as a function of latitude and time.

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