This supplementary file is supposed to expand the discussion of the method presented in the manuscript by means of an additional figure. The figure (Fig. 1s) is a combined figure of Fig. 3 and 4 of the manuscript and underlies the settings of the radiative modeling described there. In the upper panel of Fig. 1s (a-d) the correction factors are plotted as a function of aerosol optical density (AOD) for different elevation angles for arbitrarily picked scenarios which cover mostly the range of the investigated absorbing wavelength, SZA and PBL height: (a) 360nm, 10° SZA and 0.5km PBL height; (b) 477nm, 30° SZA and 1km PBL height; (c) 577nm, 50° SZA and 1km PBL height; (d) 630nm, 70° SZA and 2km PBL height (case b corresponds to Fig. 3 in the manuscript). It can be seen that the formation of a plateau as described in the manuscript occurs for all 4 wavelengths.

Fig. 1s (lower panels) (e-h) show the mean values of each plateau for different layer heights (0.5km, 1km and 2km) plotted versus the solar zenith angle (SZA) for the 4 wavelengths (thick lines) as it is already shown in Fig. 4 of the manuscript. The green dots in the lower panels (emphasized by green arrows) indicate the corresponding mean values of the plateaus shown in the upper panels directly above. Since the lower panel plots are symmetric towards the SZA there are always two points corresponding to each plateau from above.

In the manuscript only a box profile shape for the trace gas was considered since it can be verified with collapsing trace gas dSCDs. However, if the trace gas profile shape is known this method can also be applied. Then the trace gas dSCDs do not need to collapse and the correction factors of different elevation angles do not necessarily converge or converge with higher AOD. The trace gas VMR value is then an average value up to the height of the differential effective scattering event not resolving vertical gradients. In order to illustrate this, a non-box profile for the trace gas is considered (the aerosol layer was still a box profile of the corresponding height) which is a profile with a linearly decreasing mixing ratio up to top of the PBL where it is zero. Due to the inhomogeneity of the trace gas profile a higher AOD value range was chosen (0.5-0.8) to be able to observe convergence of the correction factors in the lower elevation angles (within the DOAS dSCD uncertainty). The corresponding correction factor mean values are added in Fig 1s (e-h) as thin lines. It can be seen that the correction factor mean values of the linearly decreasing profile are systematically lower than the ones of the box profile. While for 360nm the trace gas VCDs of both scenarios exhibit about the same correction factor for the shown cases this is increasingly not valid for higher wavelengths starting with higher layers.

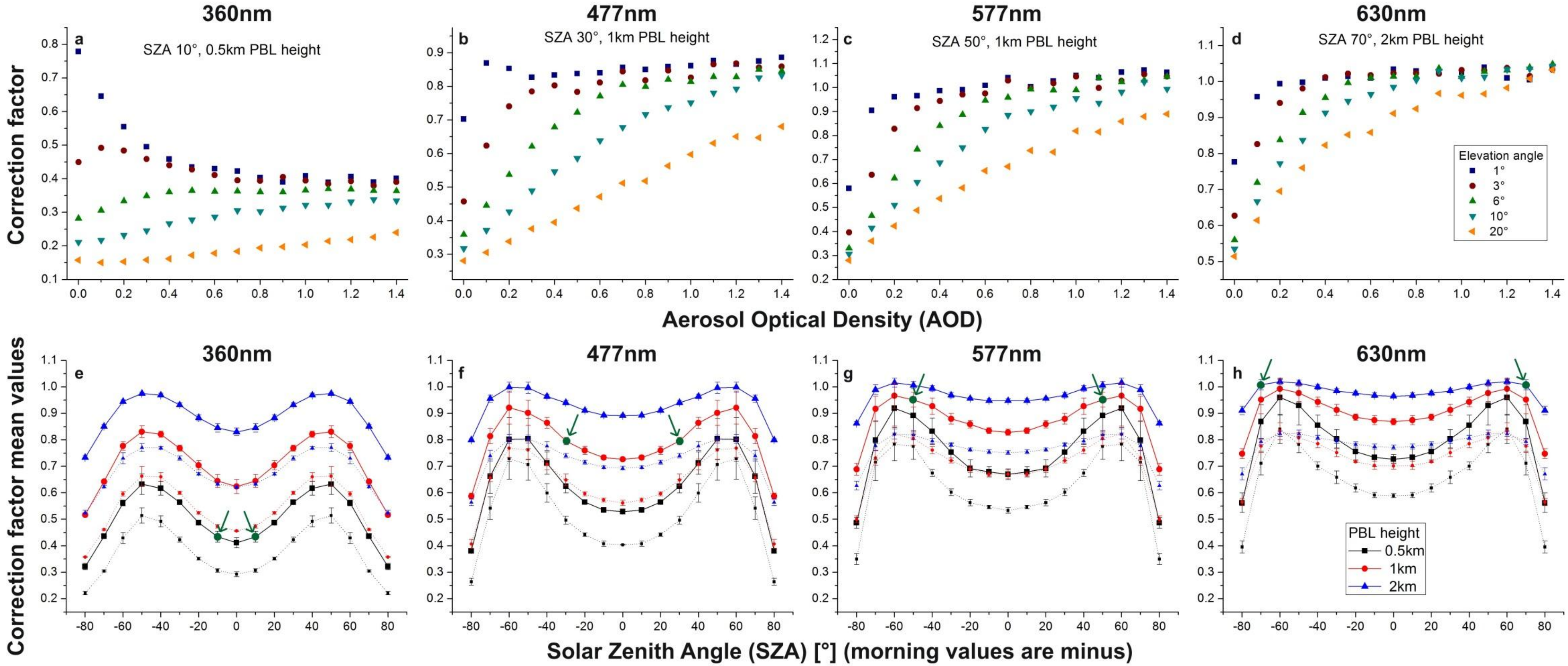

Fig. 1s: a-d: Arbitrarily chosen examples for different PBL heights and SZA of calculated correction factors versus aerosol optical density for 4 different O_4 absorption bands (360nm, 477nm, 577nm, 630nm). The formation of the plateau described in the manuscript can be observed for all four wavelengths. e-h: Correction factor mean value plots for different PBL heights (0.5km, 1km and 2km) versus solar zenith angle. Thick lines indicate constant trace gas mixing ratios up to the corresponding height, thin lines represent linearly decreasing mixing ratios up the corresponding height where it reaches zero. The aerosol profile is always a constant value up to the corresponding height. The green dots in the lower panel (emphasized by green arrows) indicate the corresponding mean values of the plateaus shown in the upper panels directly above.