

Table S1 Box-AMF interpolation fit parameter

Parameter	slope	intercept	R²
Box-AMF			
360 nm to 350 nm	0.9997 ± 0.0001	0.001 ± 0.001	0.9997
477 nm to 447 nm	0.9997 ± 0.0001	0.001 ± 0.002	0.9997
477 nm to 428 nm	0.9992 ± 0.0002	0.003 ± 0.002	0.9992

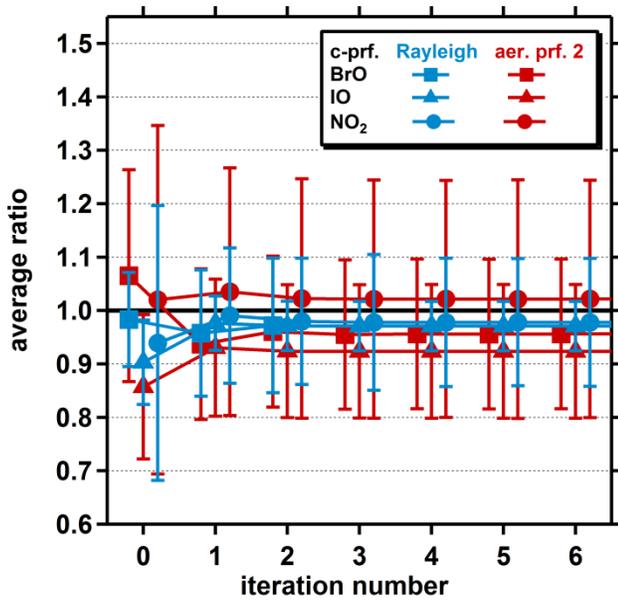


Figure S1 Ratios of retrieved and real VMR averaged over all altitudes for BrO, IO and NO₂ c profiles for Rayleigh and aerosol 2 case studies plotted over iteration number. Averages for different trace gases are offset for better visibility. Error bars are one standard deviation. The most significant change is observed between $i=0$ and $i=1$, due to $dSCD_{trop}^i \neq 0$ after the initial iteration.

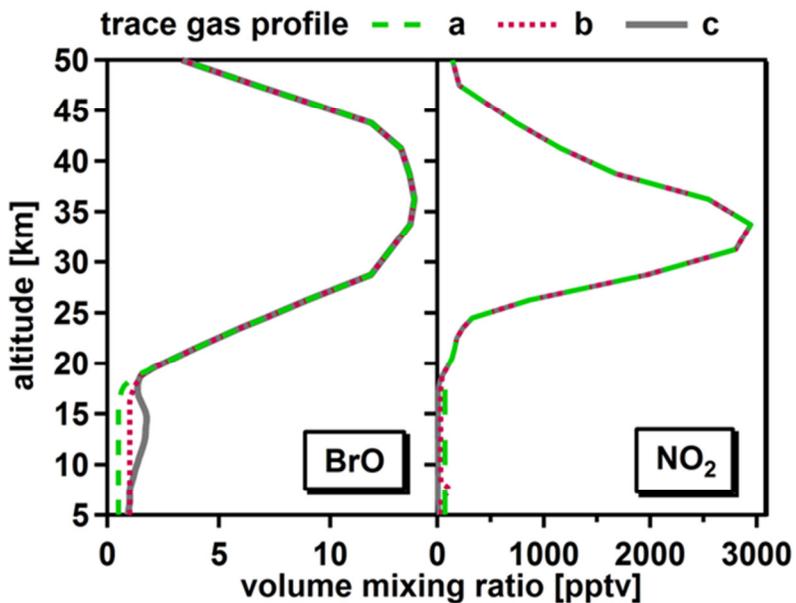


Figure S2 Stratospheric profiles for BrO and NO₂ used for the simulation of dSCD data with $VCD_{strat} = 1.1 \times 10^{13}$ molec cm⁻² and 1.3×10^{15} molec cm⁻² for BrO and NO₂ respectively.

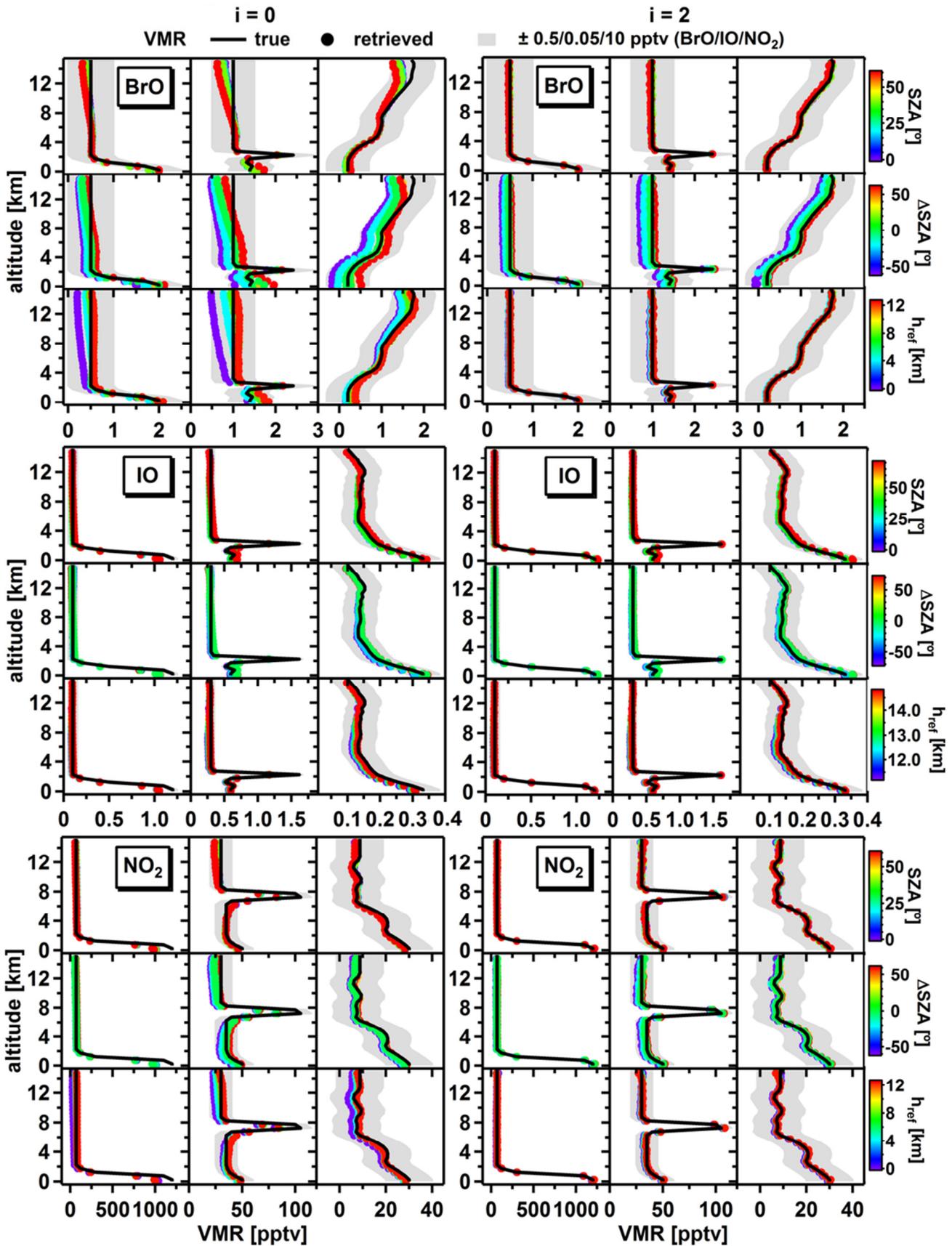


Figure S3. VMR_{para} for BrO (top), IO (middle) and NO_2 (bottom) a-, b-, and c-profiles using dSCD data simulated for a Rayleigh atmosphere for select cases. The left column shows results for $i=0$, while the right column displays the same data after the third iteration ($i=2$). Grey shading denotes ± 0.5 pptv for BrO, ± 0.05 pptv for IO, and ± 10 pptv for NO_2 . True trace gas profiles are included as reference. VMR_{para} are color coded by SZA, ΔSZA , and h_{ref} . For changes in SZA and ΔSZA the reference altitude was fixed at 4.25 km for BrO and NO_2 , and 14.25 km for IO. For changes in SZA and h_{ref} , ΔSZA is 0° , and for changes in h_{ref} SZA is set to 25° and ΔSZA is 0° .

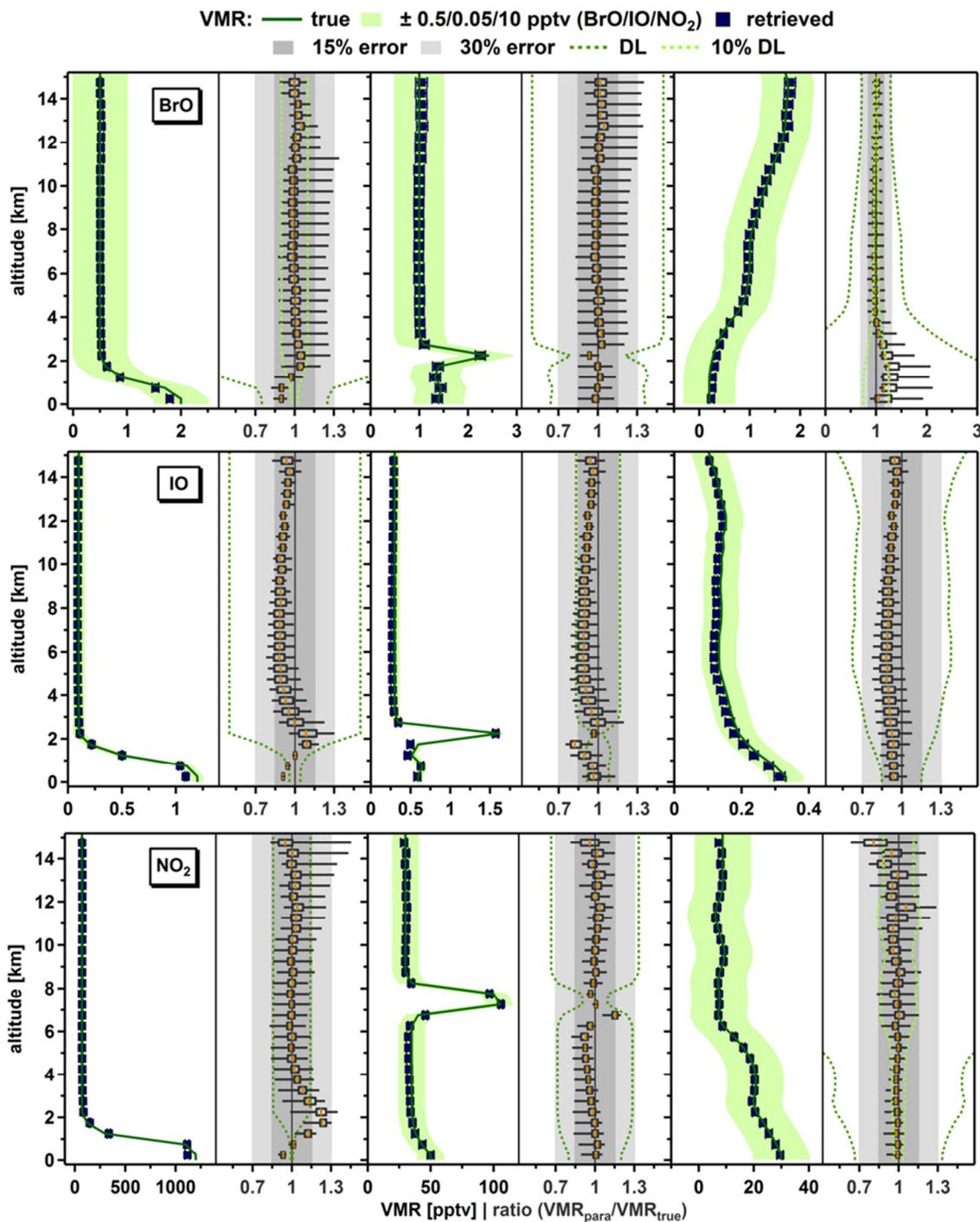


Figure S4. VMR_{para} for BrO (top), IO (middle) and NO_2 (bottom) a-, b-, and c- profiles (left to right), using dSCD data simulated for aerosol 1. Individual left panels show VMR_{para} average and standard deviation. Original trace gas profiles are included as reference and green shading denotes individual trace gas VMR error bounds. Right panels display altitude resolved whisker plots of the ratios of VMR_{para} over VMR_{true} , showing the mean (orange) and 5, 25, 75 and 95 percentiles. Grey shaded areas indicate 15 % and 30 % error; green dashed lines show trace gas detection limits.

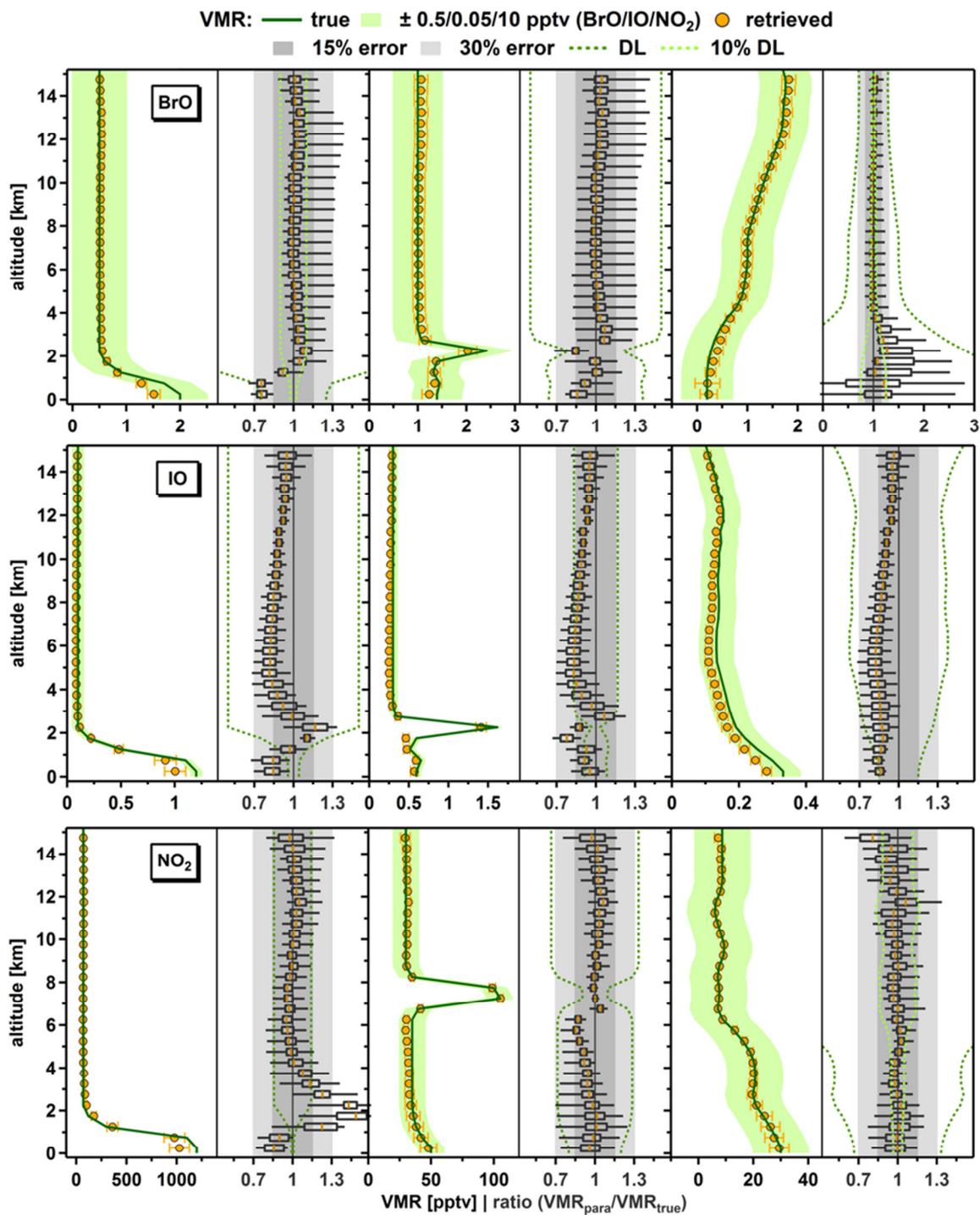


Figure S5. VMR_{para} for BrO (top), IO (middle) and NO_2 (bottom) a-, b-, and c- profiles (left to right), using dSCD data simulated for aerosol 2. Individual left panels show VMR_{para} average and standard deviation. Original trace gas profiles are included as reference and green shading denotes individual trace gas VMR error bounds. Right panels display altitude resolved whisker plots of the ratios of VMR_{para} over VMR_{true} , showing the mean (orange) and 5, 25, 75 and 95 percentiles. Grey shaded areas indicate 15 % and 30 % error; green dashed lines show trace gas detection limits.

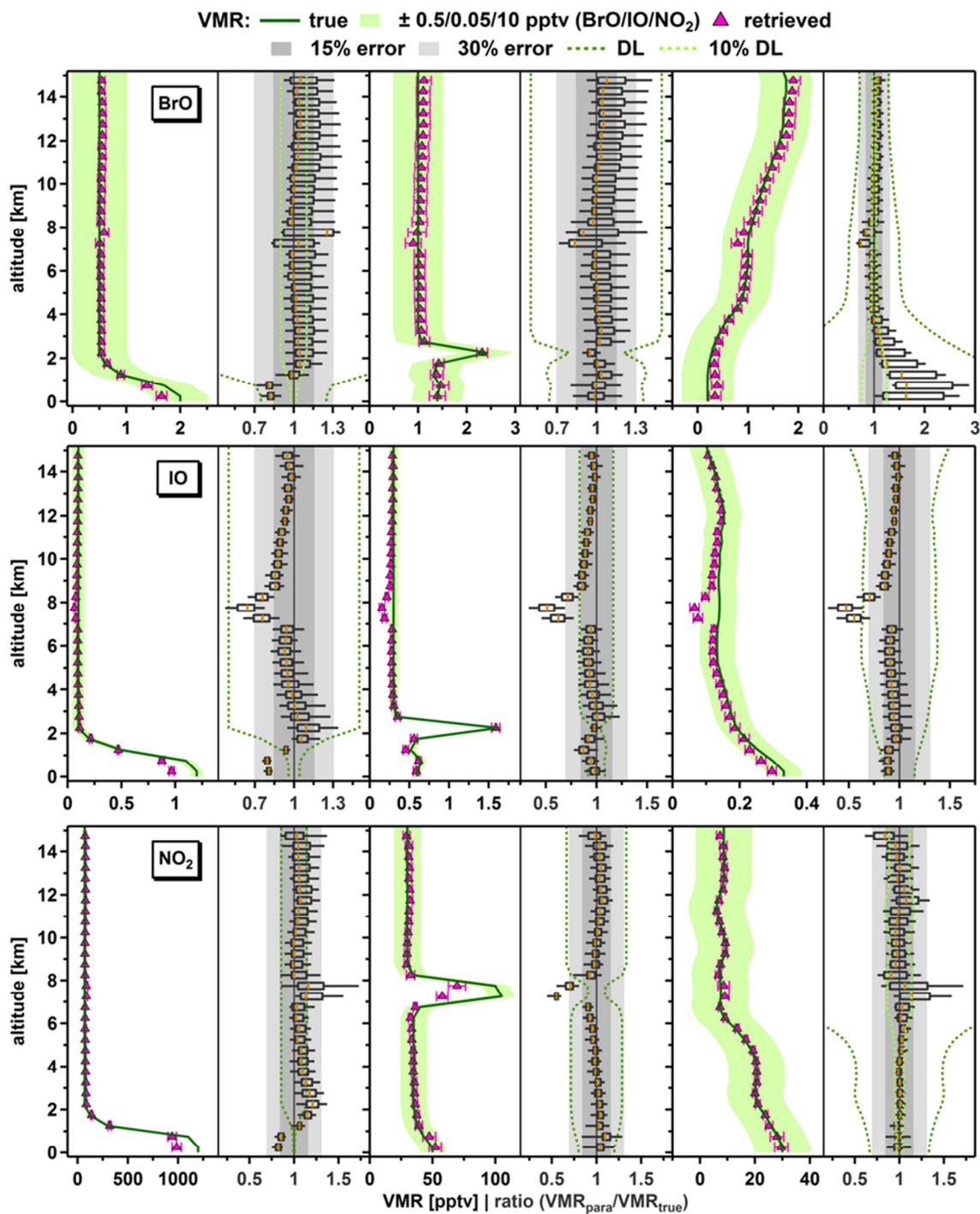


Figure S6. VMR_{para} for BrO (top), IO (middle) and NO₂ (bottom) a-, b-, and c- profiles (left to right), using dSCD data simulated for aerosol 3. Individual left panels show VMR_{para} average and standard deviation. Original trace gas profiles are included as reference and green shading denotes individual trace gas VMR error bounds. Right panels display altitude resolved whisker plots of the ratios of VMR_{para} over VMR_{true} , showing the mean (orange) and 5, 25, 75 and 95 percentiles. Grey shaded areas indicate 15 % and 30 % error; green dashed lines show trace gas detection limits.

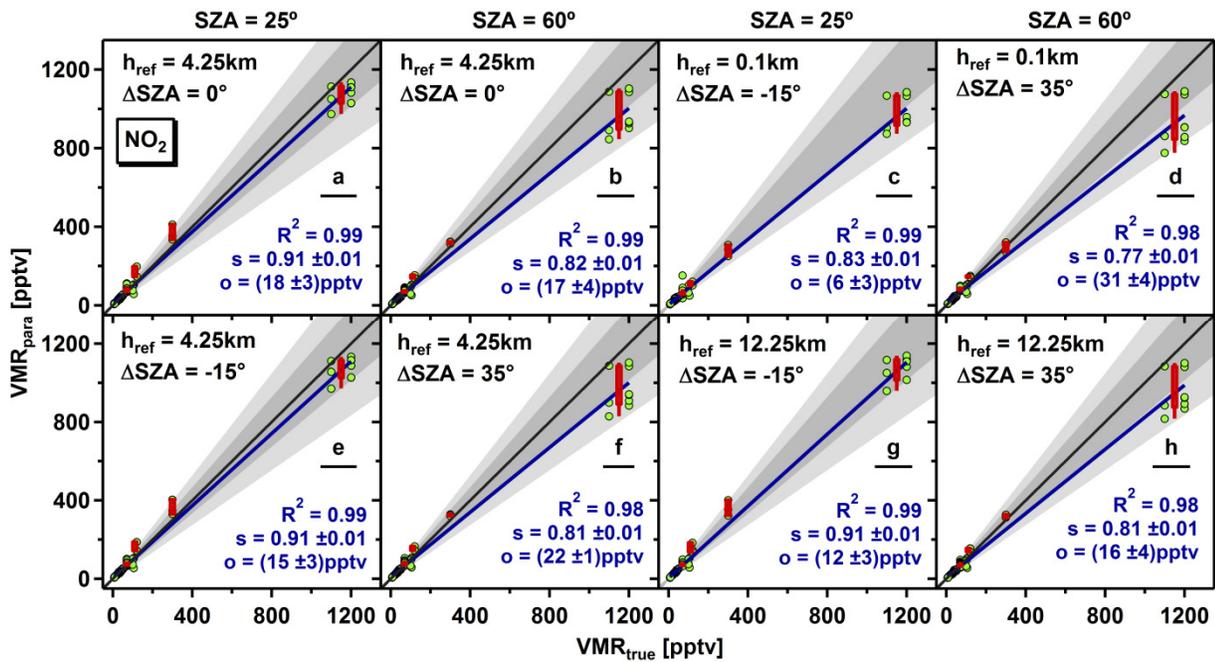


Figure S7. VMR_{para} over VMR_{true} for NO_2 a- profile averaged over all aerosol profiles for select SZA, ΔSZA and h_{ref} . The panel columns alternate between low (SZA = 25°) and high SZA (SZA = 60°). Whisker plots show 5, 25, 75 and 95 percentiles for binned VMR_{para} data. Grey shaded areas indicate 15 % and 30 % error. Linear fits and fit parameter (s : slope, o : offset) are included in each panel.

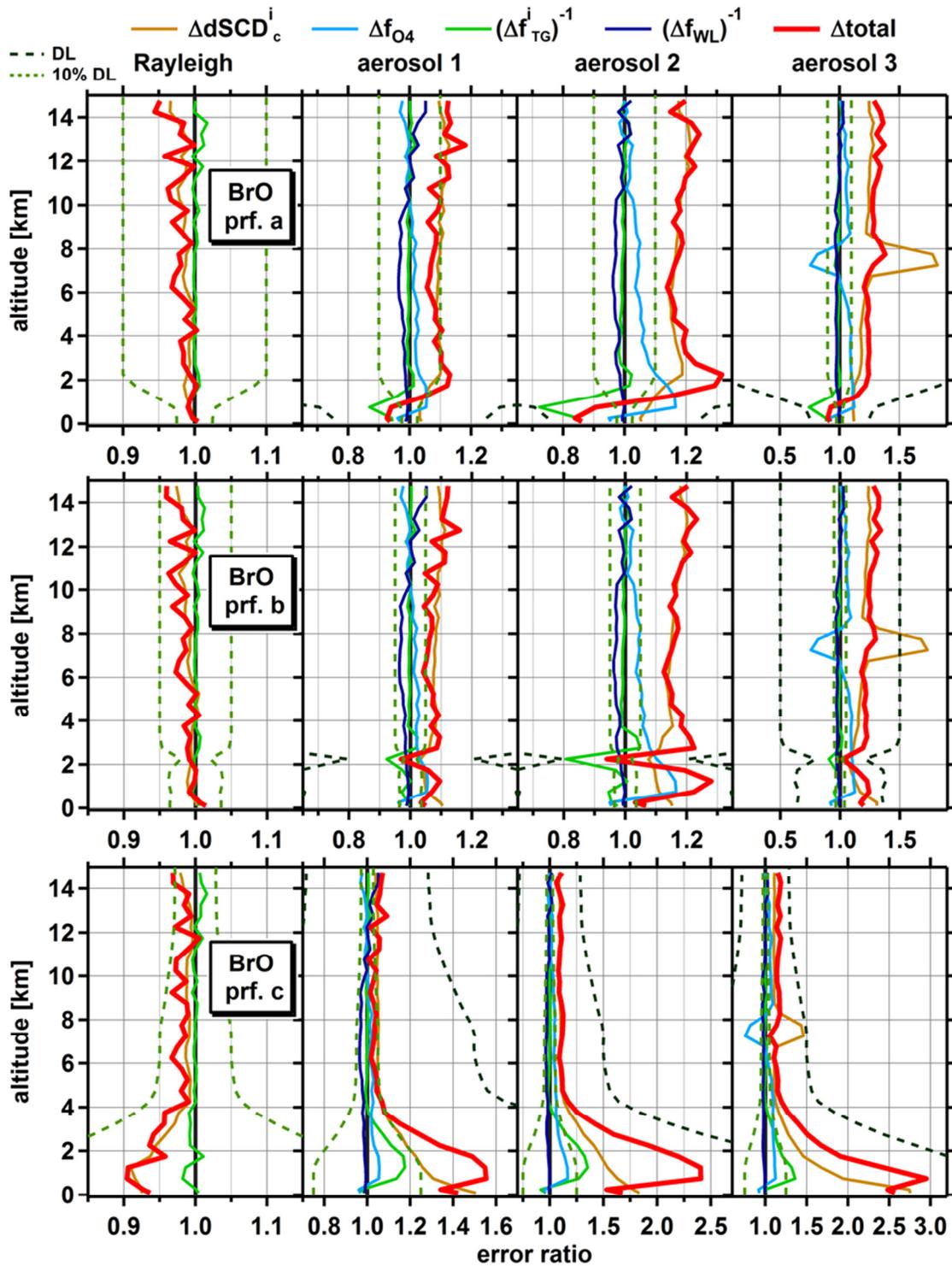


Figure S8. Total error and error ratios of individual components of Eq. (1) for all BrO profiles and atmospheres with $\text{SZA} = 25^\circ$ and $\Delta\text{SZA} = 25^\circ$. Reference altitude for BrO is 4.25 km. Green dashed lines show trace gas detection limits.

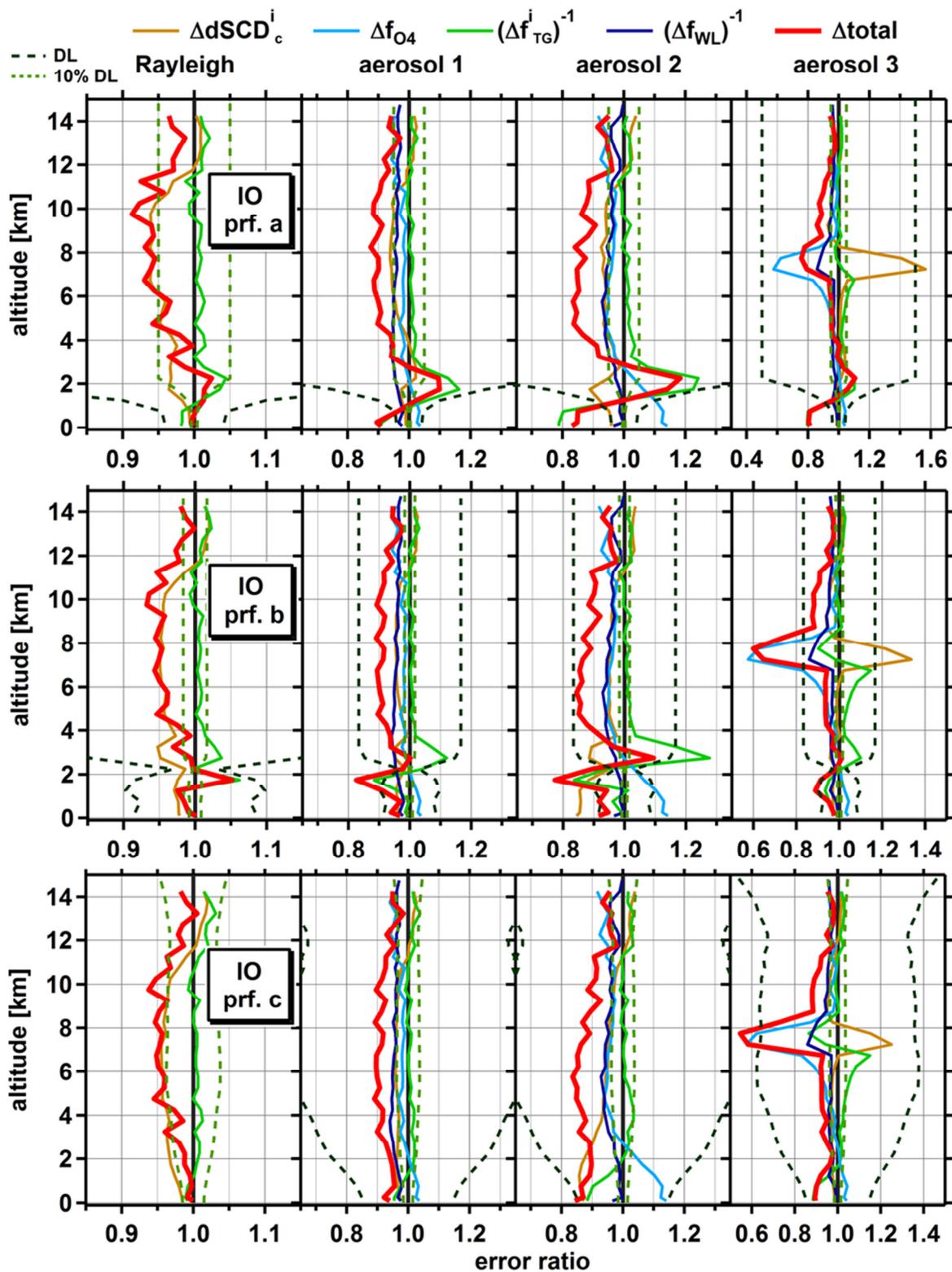


Figure S9. Total error and error ratios of individual components of Eq. (1) for all IO profiles and atmospheres with SZA = 25° and ΔSZA = 25°. Reference altitude for IO is 14.75 km. Green dashed lines show trace gas detection limits.

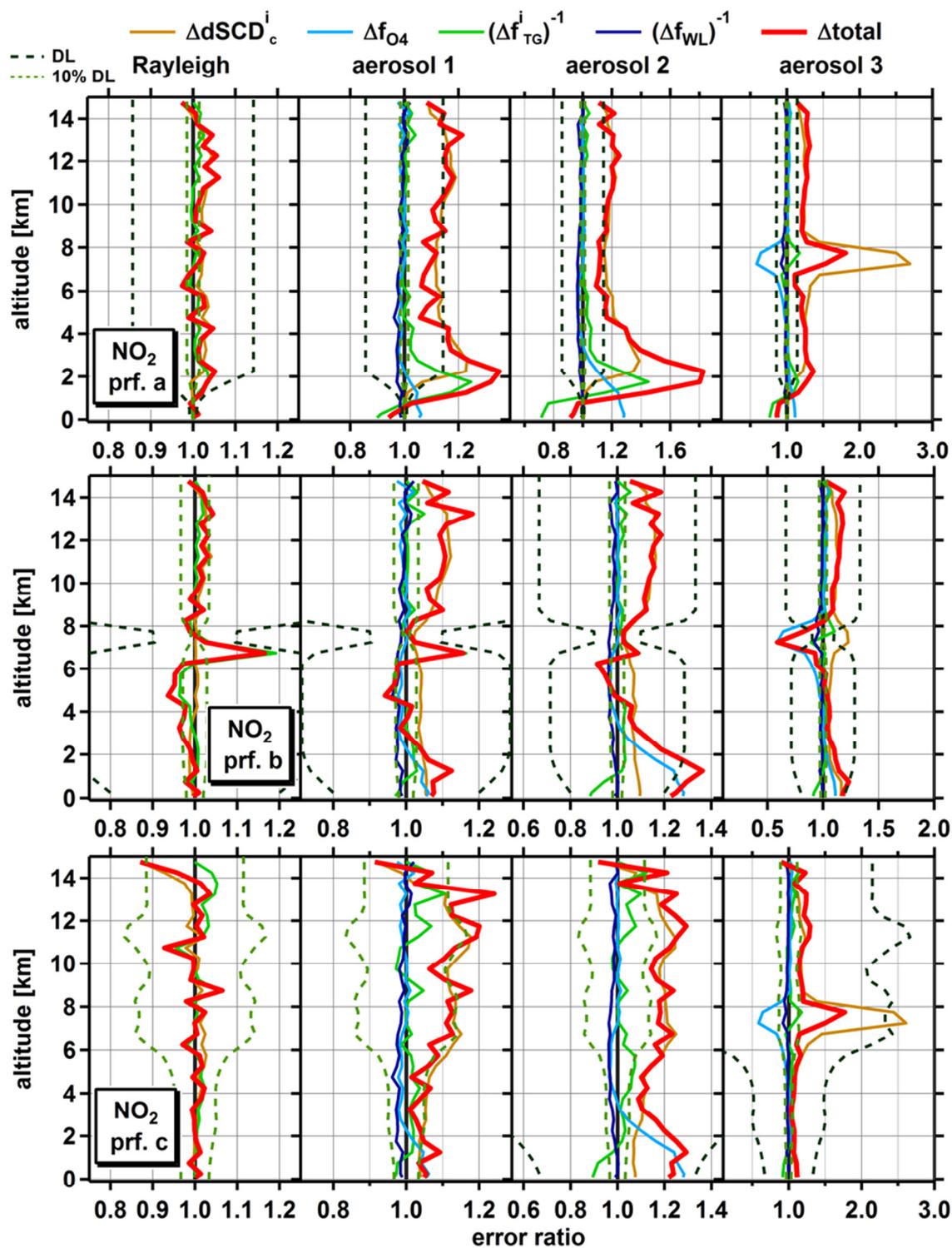


Figure S10. Total error and error ratios of individual components of Eq. (1) for all NO₂ profiles and atmospheres with SZA = 25° and ΔSZA = 25°. Reference altitude for NO₂ is 4.25 km. Green dashed lines show trace gas detection limits.