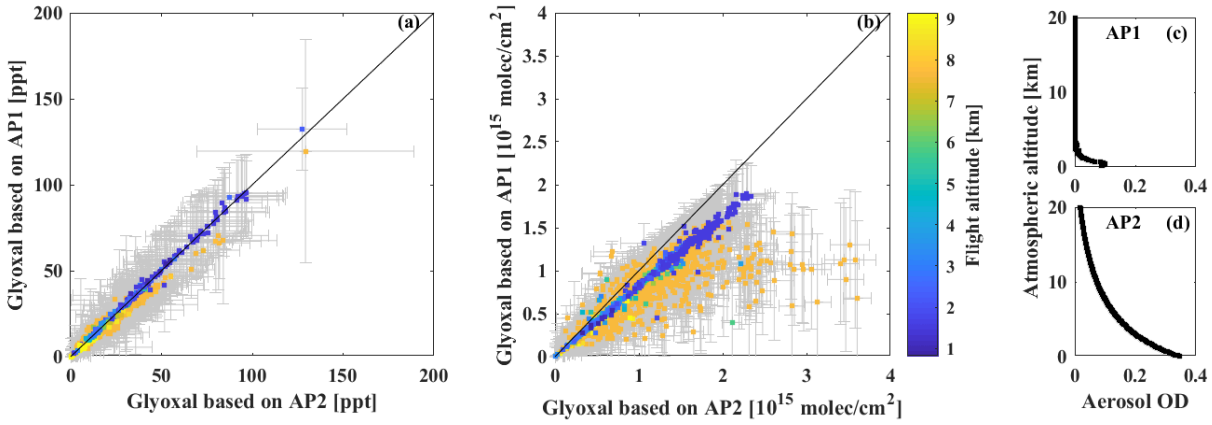

Fig.1: Impact of the assumed aerosols profiles in the RT simulations on the glyoxal retrieval (panels a and b), when using an average (panel c, AP1) and an elevated (panel d, AP2) aerosol optical depth profile for the research flight over Germany and the Upper Silesian Coal Valley on 29 May 2018.

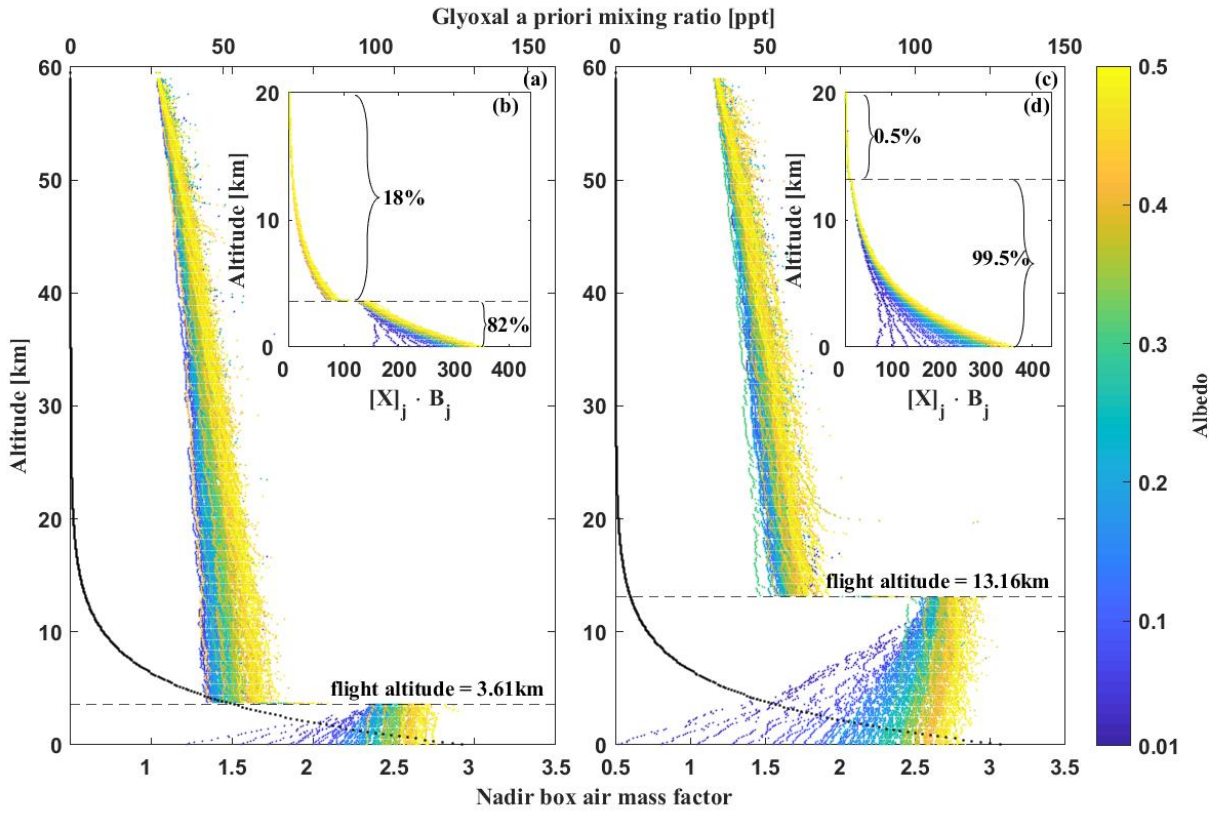

Fig. 2: Box air mass factors (B_j, lower x-axis in panels a and c) of two simulated mini-DOAS Nadir measurements in the lower (panels a and b) and upper (panels c and d) troposphere for different surface albedos between 0.1 and 0.5 (colour-coded). Both simulations are performed for a research flight leading from Oberpfaffenhofen (Germany) to Sal (Cape Verde) on 7 Aug. 2018. The product of B_j with the assumed a priori glyoxal profile $[X]_j$ (upper x-axis of panels a and c, black line) yields the relative contribution of each altitude layer *j* (panels b and d). Evidently, airborne Nadir measurements at lower altitudes predominantly, but not exclusively, probe the atmosphere below the flight altitude (panels a and b), whereas measurements in the upper troposphere are sensitive to almost the whole atmospheric glyoxal column density (see the relative fractions in panel b and d).

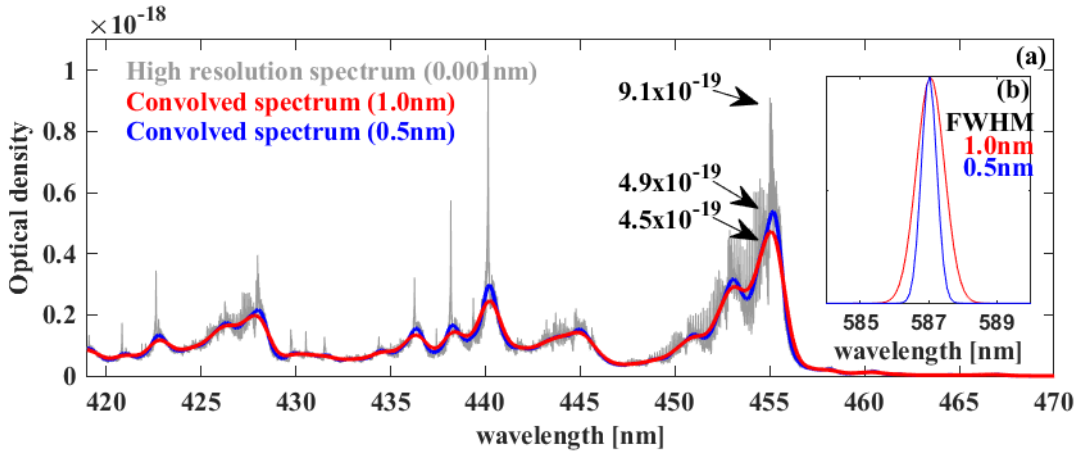

Fig. 3: Effect of different spectral resolutions (panel b) on the differential optical density of glyoxal (panel a).

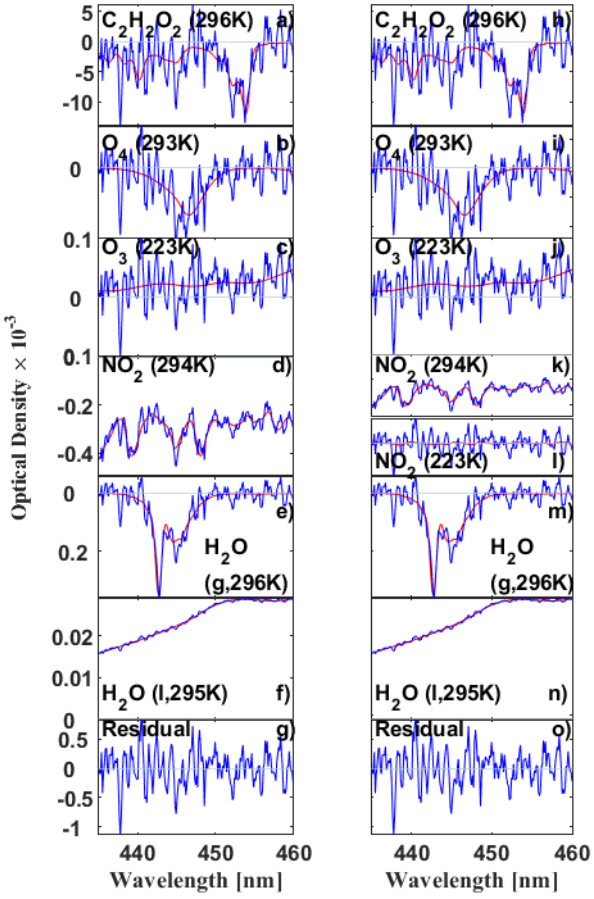

Fig. 4: Glyoxal retrieval in Nadir direction for elevated near surface NO_2, excluding (left column) and including an additional colder NO_2 cross section (at 223K) in the analysis for a measurement over the Munich metropolitan area on 7 Aug. 2018.

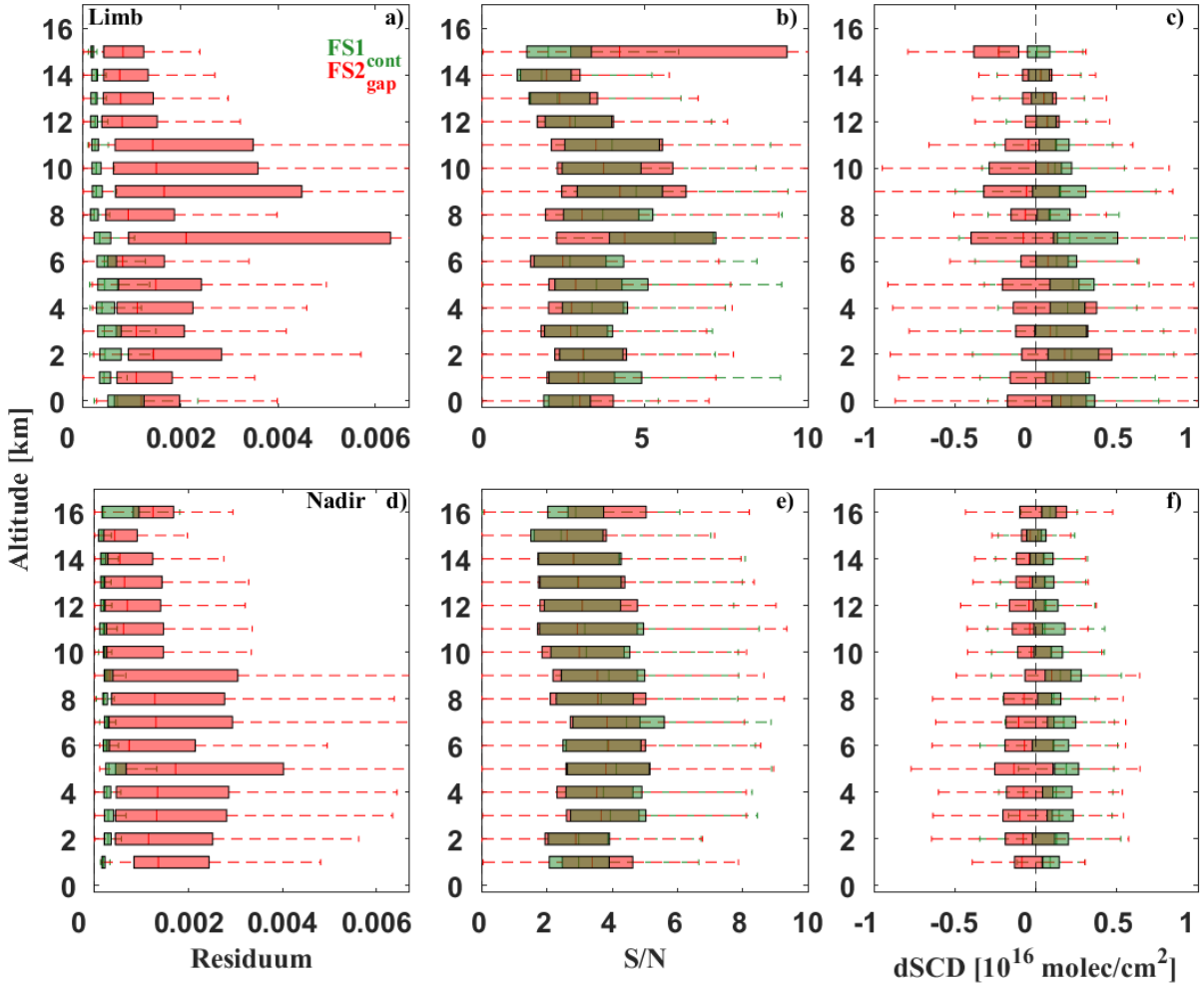

Fig. 5: DOAS retrieval of glyoxal from all 72 research flights in the Limb (upper row) and Nadir (lower row) viewing geometry based on two different spectral ranges avoiding (FS2gap, red) and including (FS1cont, green) the 7*v* absorption band of water, respectively, by using two fitting windows ranging from 430 or 435 nm to 439 nm and 447 to 460 nm, or a continuous spectral range from 430 or 435 to 460 nm, respectively. The data are averaged on a 1 km altitude grid. The different panels show the spectral residuum (a, d), the signal to noise ratio (S/N) of the retrievals (b, e) and the resulting dSCDs (c, f).