Uncertainties in ground based AOD retrievals due to NO_2

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Aerosol Optical Depth (AOD) is the most widely used variable to estimate the load of Aerosols in the atmospheric column and asses their radiative effects. Retrieving AOD from sunphotometric measurements is sensitive to the concentration of atmospheric gases , particulary at bandwidths where the absorption is significant. t the present study, we focus on NO_2 and exploit synchronous and collocated datasets of NO_2 and AOD to assess the errors of widely used approaches for AOD calculation.
PANDORA is a spectrometer that measures direct solar irradiance at spectral range 280-525nm at 0.6nm resolution. Total NO_2 is retrieved by calculating relative NO_2 slant columns using a reference spectrum and the direct sun air mass factor. Accuracy of this retrieval has been estimated at $2.7*10^{14}$ molecules cm^{-2}. Retrievals are freely available from the PANDONIA network(www.pandonia-global-network.org). Aerosol optical properties is monitored globally using sunphotometers (CIMEL, PEDE) by networks like AERONET (Holben et al., 1998) and SKYNET (Nakajima et al., 2007). Operational algorithms for AOD retrieval, utilize climatological NO_2 values. In urban areas, where NO_2 has very high temporal variability, these values diverge from climatological ones, introducing non-negligible errors in spectral ranges with high absorption from the gas.

In order to assess the influence of Total NO_2 on AOD retrievals , we have used data recorded in Rome, Italy. In particular Total NO_2 is derived from PANDORA timeseries in both locations and AOD at 400 and 440nm from AERONET and SKYNET respectively. Using Burrows et al. (1998) NO_2 absorption cross-section, the NO2 Optical Depth at 400 at 440nm has been calculated for all synchronous data. Respectively the same calculations were performed for climatological NO2 values used in AERONET and SKYNET algorithms. Mean relative differences of retrieved AOD between the datasets were in the order of 6.1 and 6.3%, while for low AOD, differences were constantly more than 10%.