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The influence of aerosols and land-use type on NO_2 satellite retrieval over China

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Both aerosols and surface reflectance have a strong influence on the retrieval of NO_2 tropospheric vertical column densities (VCDs), especially over China with its heavy aerosol loading and rapid changes in land-use type. However, satellite retrievals of NO_2 VCDs usually do not explicitly account for aerosol optical effects and surface reflectance anisotropy (BRDF) that varies in space and time. We develop an improved algorithm to derive tropospheric AMFs and VCDs over China from the OMI instrument – POMINO and DOMINO. This method can also be applied to TropOMI NO_2 retrievals in the future. With small pixels of TropOMI and higher probability of encountering clear-sky scenes, the influence of BRDF and aerosol interference becomes more important than for OMI. Daily aerosol information is taken from the GEOS-Chem chemistry transport model and the aerosol optical depth (AOD) is adjusted via MODIS AOD climatology. We take the MODIS MCD43C2 C5 product to account for BRDF effects.

The relative altitude of NO_2 and aerosols is critical factor influencing the NO_2 retrieval. In order to evaluate the aerosol extinction profiles (AEP) of GEOS-Chem improve our algorithm, we compare the GEOS-Chem simulation with CALIOP and develop a CALIOP AEP climatology to regulate the model's AEP. This provides a new way to include aerosol information into the tracer gas retrieval for OMI and TropOMI. Preliminary results indicate that the model performs reasonably well in reproducing the AEP shape. However, it seems to overestimate aerosols under 2km and underestimate above. We find that relative humidity (RH) is an important factor influencing the AEP shape when comparing the model with observations. If we adjust the GEOS-Chem RH to CALIOP's RH, the correlations of their AEPs also improve.

Besides, take advantage of our retrieval method, we executed sensitivity tests to analyze their influences on NO_2 trend and spatiotemporal variations in retrieval. It' the first time to investigate influence from aerosols and surface reflectance in 10-year period (2005-2015) in the real retrieval. We find their influences are largely time and space dependent, but their effects on trend are small, leading relative 7% differences in different areas.