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Retrieval of tropospheric NO2 columns from satellite measurements in presence of cirrus: a theoretical sensitivity study with SCIATRAN and prospect application for the A-Train

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A theoretical sensitivity study of the influence of cirrus cloud properties on tropospheric NO2 columns retrieved by the Ozone Monitoring Instrument (OMI) is performed. It is conducted in the framework of the synergy of A-train sensors to include cloud properties to constrain NO2 vertical column retrievals. The sensitivity study is based on the radiative transfer code SCIATRAN that performs both simulations of TOA reflectances as measured by an OMI-like band and tropospheric NO2 column retrievals based on the DOAS method. The panel of optical, microphysical and geometrical properties of cirrus clouds tested in the sensitivity study stems from aircraft measurements performed during the Cirrus Cloud Experiment (CIRCLE2) campaign. It appears that if cirrus clouds are not included in the retrieval process, the tropospheric NO2 column can be underestimated by up to 60 percent. This underestimation depends on cirrus parameters, surface albedo and NO2 profiles. In order of importance, the cirrus parameters that influence tropospheric NO2 column retrievals are cloud fraction, optical depth, ice crystal phase function, altitude and geometrical depth. The perspective of the synergy between OMI and sub pixel information obtained from cloud-derived products of the A-Train is evaluated using Independent Approximation and 3D radiative transfer modelling.