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Photon path length retrieval from GOSAT observations

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The influence of clouds on the atmospheric radiation budget is investigated, focussing on the photon path length distributions of the scattered sunlight.

Apart from the reflection of incoming solar radiation at the cloud top, clouds can also introduce a large number of additional scattering events causing an enhancement of the photon paths. In certain cloud formations, these scattering events also result in a “ping-pong“ behaviour between different cloud patches and cloud layers. It has been shown from ground based measurements that it is possible to retrieve photon path lengths by analysis of high resolution oxygen A-band spectra (O. Funk et al.). This study uses similar space based measurements of the oxygen A-band for the path length retrieval.

The oxygen A-band spectra are retrieved from the Japanese Greenhouse Gases Observing Satellite (GOSAT) which was successfully launched in 2009. The high spectral resolution of the GOSAT TANSO-FTS instrument allows to almost completely resolve the individual absorption lines. The considered spectral range is particularly suitable for this study because it shows clear absorption structures of different strength. From the analysis of the spectral signatures, cloud properties and the underlying path length distributions can be derived.

The retrieval is done by analysis and comparison of the extracted TANSO-FTS spectra with simulations from the Monte Carlo radiative transfer Model McArtim. The model permits modelling of altitude dependent oxygen absorption cross sections and three-dimensional cloud patterns.

Case studies of clear and cloudy sky scenarios will be presented. Future studies will focus on more complicated cloud structures, especially considering three-dimensional geometries and heterogeneities.