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Effect of both aerosol and cloud to account for atmospheric light scattering in application of PPDF method to space-based observation of green gases

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We present an improved model to describe photon pathlength probability density function (PPDF) that effectively accounts for both aerosol and cloud effect for rapid retrieval of green gases from space-based high spectral resolution measurements (such as provided by the Greenhouse gases Observing Satellite (GOSAT) and the Orbiting Carbon Observatory (OCO)). Reasonable simple PPDF and effective transmittance parameterization permits vertically inhomogeneity of gas absorption and three plane-parallel arbitrary located layers to account for light scattering effects due to aerosol and cloud. The basic assumption to produce the PPDF model refers mainly to present photon pathlength in terms of weekly correlated aerosol and cloud components.
The model was validated using Monte Carlo simulations of photon trajectories and tested for a representative set of atmospheric conditions when both aerosol and cloud modify pathlength significantly.
This study also focuses on the connection of PPDF parameters with atmospheric optical characteristics being usually utilized in the solutions of radiative transfer equation. These characteristics were shown could be converted into PPDF parameters through PPDF retrievals from very limited spectral range of simulated radiance that includes at least one gas absorption line. We have shown that this can be effectively utilized for rapid radiative transfer spectral calculations over a rather wide spectral range of radiance at given atmospheric optical characteristics. Another important application of such conversion is to account for a priori knowledge of atmospheric optical characteristics when retrieving gas amount within PPDF-based approach.