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# Validating the SARTre model — Retrieving properties of subvisible cirrus from MIPAS data

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Though radiative transfer (RT) modeling in spherical atmospheres greatly advanced, the handling of multiple scattering of both solar and terrestrial radiation is still a challenging task. The pseudo-**S**pherical **A**tmospheric **R**adiative **Tr**ansf**e**r model (SARTre) has been developed with emphasis on limb modeling over the whole infrared spectral range and beyond. The model adapts several routines of other RT models, e.g. modules from the MIRART package for Line-by-Line calculation of molecular absorption cross sections and the DISORT package for the solution of the diffuse radiance field. The model was verified by a series of intercomparisons in the solar (McScia) and terrestrial (MIRART, KOPRA, ARTS) spectral region.

Thermal emission limb observations are commonly used for retrieval of atmospheric profiles. They may also serve well for remote sensing of high clouds. Characterized by long paths, infrared limb spectra may allow for the detection and retrieval of properties of subvisible clouds, which are hardly detectable from nadir and slant observations. Nevertheless they are of great interest, since only little is known about their role in the global energy balance and climate. The potential of the SARTre model will be demonstrated by juxtaposing simulated radiances to MIPAS limb spectra, which are contaminated by radiation of cirrus clouds. A limb scan is chosen, showing distinct features caused by high clouds: (i) significantly increased intensity in the continuum regions, (ii) broad absorption lines, e.g. of $H_2O$, where narrow emission lines are expected. With regard to a retrieval of cloud microphysical properties, three microwindows along the ice absorption band in the atmospheric window around $10 \mu m$ are selected. A sensitivity study including varied particle number density/optical depth, particle size and shape is performed. Results are compared to the MIPAS spectra. Simulated spectra are found to be very sensitive to particle size distribution and shape.