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MODELLING POLARIZED MICROWAVE RADIATION IN A 3D SPHERICAL ATMOSPHERE

S. Bühler(1), **C. Emde** (1), P. Eriksson (2), O. Lemke (1), T. R. Sreerekha (1)
(1) University of Bremen, Germany, (2) Chalmers University of Technology, Sweden

A new version of the Atmospheric Radiative Transfer System (ARTS) is currently being developed. The aim is to simulate realistic cloud cases for microwave measurements in limb sounding geometry. Modeling radiative transfer through clouds is a complicated topic for various reasons.

The cloud coverage is vertically and horizontally strongly inhomogeneous which implies that a 3D model is unavoidable for simulating realistic cases. Especially for simulating limb measurements, a 3D geometry is required as the observed region in the atmosphere has a horizontally large extent.

Clouds consist of a variety of particle types. There are liquid water clouds but also cirrus clouds which consist of ice particles of different sizes and shapes. Particle scattering leads to polarization effects, therefore modelling only the first component of the Stokes vector, the scalar intensity, is not sufficient. At least the first two components are required, in some cases, depending on the formation of the cloud, even all four components.

The VRTE (Vector Radiative Transfer Equation) is an inhomogeneous vector differential equation for the Stokes vector. This equation can be solved numerically using an iterative method.
Gaseous absorption is pre-calculated and stored in a lookup table. All particle properties, i.e. extinction, absorption and scattering, can be derived from the amplitude matrix, which is stored for several particle types in a database.
Test calculations demonstrate that the model simulates reasonable results.