ARTS 1.1
Development of a 3D RT model including scattering and polarization

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- Radiative transfer equation:

$$\frac{\mathrm{d}\mathbf{I}}{\mathrm{d}s} = -\mathbf{K}\mathbf{I} + B\mathbf{a} + \int_{\omega} \mathbf{Y}\mathbf{I}\mathrm{d}\omega$$

- The Stokes vector **I** describes the full state of electomagnetic radiation, the intensity and the polarization.
- Extinction: Extinction coefficient matrix **K** contains particle extinction and gaseous extinction.
- Emission: Absorption coefficent vector **a** includes particle and gaseous absorption. B is the Planck function.
- Scattering: Only particle scattering is considered. The scattering matrix **Y** can be calculated using for example the T-matrix method.

Features of ARTS 1.1

- Atmospheric dimensionality can be set to 1D, 2D or 3D.
- Stokes dimension: The model can handle
  - the full vector RTE (all Stokes components are calculated),
  - the scalar case (only intensity is calculated) or
  - the first 2 or 3 components of the Stokes vector (if the radiation is linearly polarized).
- Spherical geometry, scattering calculations are only performed on a limited region, the cloudbox.
- Iterative solution method is used to solve the RTE numerically.

Motivation

- Particle scattering from cirrus clouds has a significant impact on the radiation field.
- Mircowave sensors usually measure only one polarization direction. ($I = I_h + I_v$)
- From polarization measurements information about particle distributions in clouds can be retrieved.
- Atmospheric horizontal inhomogeneities contribute to Limb spectra, therefore a 3D is model much more accurate than a 1D model.