A new IRC Working Group on Polarized / Raman / Advanced Radiative Transfer PRTM? PRRTM? ARTM?

Bernhard Mayer, Claudia Emde

Meteorological Institute (MIM)
Ludwig-Maximilians-University (Munich)

July 22, 2010

Motivation

An increasing number of remote sensing instruments and ESA/NASA phase-A studies use or require

- polarization (GLORY, GOSAT, SCIAMACHY, PARASOL, EarthCARE, CLARREO, AERONET/Cimel ...)
- inelastic scattering (SCIAMACHY, ...)
- spherical Geometry (SCIAMACHY, ACTLIMB, ...)
- ...

in combination with multiple scattering, maybe 3D geometry. To develop retrievals and for end-to-end simulations, highly advanced radiative transfer models are required.

Motivation – Polarization provides information about aerosol and clouds

C. Emde et al.: The impact of aerosols on polarized sky radiance Atmos. Chem. Phys., 10, 383–396, 2010

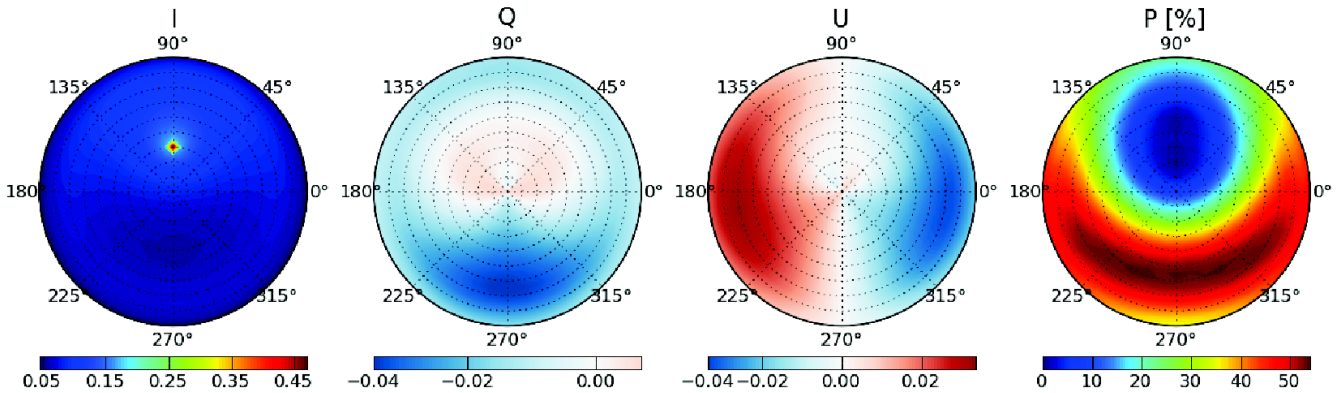

Fig. 6. Stokes components and degree of polarization at 350 nm for a molecular atmosphere with typical aerosol conditions ("continental average" mixture as defined in OPAC with an optical thickness of approximately 0.16).

Status for polarization

- Several (but surprisingly few) radiative transfer models are available which can handle realistic aerosol and cloud scattering phase functions
- Few comparisons have been done, mostly excluding complex scattering phase functions
- Only few benchmark data are available and these are difficult to find (e.g. Coulson et al., 1960: Tables Related to Radiation Emerging from a Planetary Atmosphere with Rayleigh Scattering, University of California Press.)
- For inelastic scattering the situation is worse

Example of a model comparison

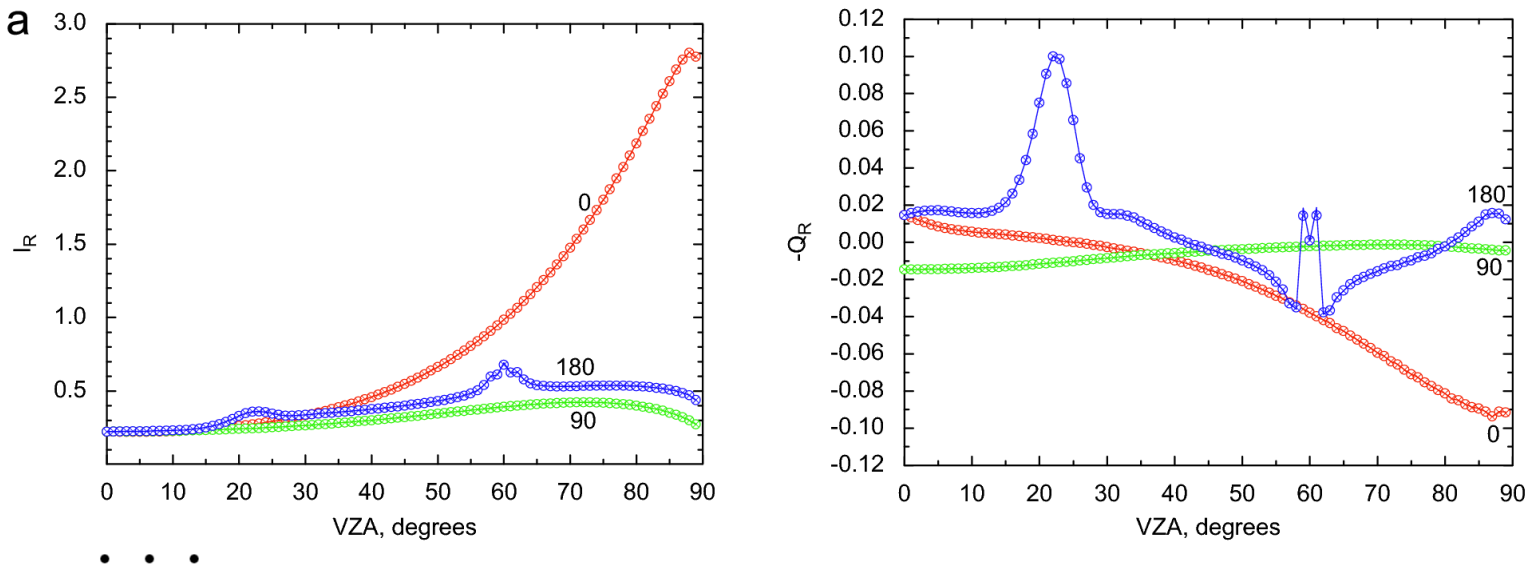

Fig. 4. (a) The normalized Stokes vector elements for the cloud layer scattering case in the reflected light (line—SCIATRAN, circles—*Pstar*, crosses—MYSTIC). The zenith incidence angle is 60° and relative azimuths are 0°, 90°, and 180°. Azimuths counter clock-wise. The third Stokes parameter vanishes at ϕ=0°, 180° and (b) The same as in (a) except for the transmitted light.

Example of a model/measurement comparison

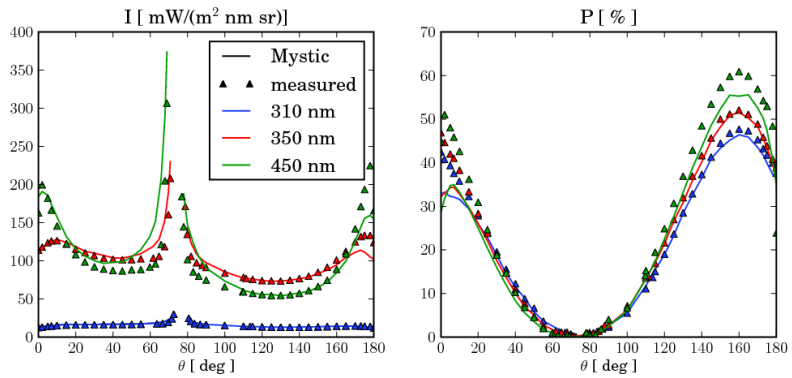

Fig. 12. Normalized intensity and degree of polarization simulated for an aerosol mixture of mineral and water soluble particles (3 June 2005, 12:00 UTC). The aerosol optical thickness was 0.06. Clouds below the measurement site are taken into account using an effective surface albedo of 0.2.

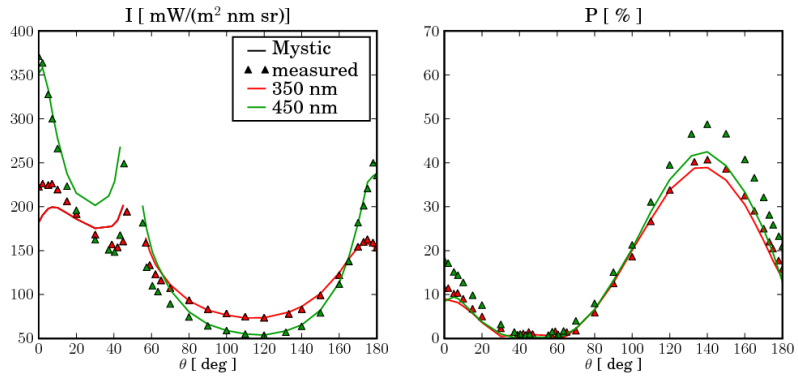

Fig. 13. Intensity and degree of polarization simulated for an aerosol mixture of mineral and water soluble particles (12 June 2005, 10:00 UTC). The aerosol optical thickness was 0.06. Clouds below the measurement site are taken into account using an effective surface albedo of 0.5.

Aims of a potential working group ARTM

Create a forum similar to I3RC and RAMI for polarization (and Raman, spherical geometry, ...?) in order to

- bring the community together
- compare and improve models
- provide information about free codes
- provide benchmark results
- provide input data (scattering matrices, BPDFs – bidirectional polarization distribution functions, ...)