# Scattering from the Microwave up to the vis/UV

The discussion started with the two modelling groups explaining the fundamental equations with which they work. These are the basic radiative transfer equations but suited for the particular frequency region under consideration.

The form of the equation used by STORM is

$$\mu \, d\vec{I}(\theta,\phi) \; / \; d\tau = \vec{I}(\theta,\phi) - \frac{(K_{sca} \; / \; K_{ext})}{4\pi} \int_0^{2\pi} \int_{-1}^{+1} \mathbf{P}(\mu,\phi;\mu',\phi') \vec{\mathbf{I}}(\theta',\phi') \mathbf{d}\,\theta' \mathbf{d}\,\phi' - \frac{(K_{sca} \; / \; K_{ext})}{4\pi} \, \mathbf{P}(\mu,\phi;-\mu_\mathbf{0},-\phi_\mathbf{0}) \; \mathbf{F_0} \; \mathbf{e}^{-\tau/\mu_\mathbf{0}}$$

and that used by ARTS is

$$d\vec{I}(\theta,\phi) \; / \; d\,s = -\mathbf{K_{ext}}(\theta,\phi) \, \vec{I}(\theta,\phi) + \vec{K_{abs}}(\theta,\phi) \, B(T) + \int_0^{2\pi} \int_0^{\pi} \mathbf{Y}(\theta,\phi;\theta'\phi') \, \mathbf{I}(\theta',\phi') d\,\theta' d\,\phi'$$

The extinction terms are denoted by green letters, emission by blue letters and scattering by red letters. STORM used optical depth and ARTS used pathlenght element as FIXME. Both models can handle scattering and computes diffused polarised radiation field at any point of the atmosphere. Refraction is not taken into account in either models. ARTS in the final form will have refraction effect also.

The major differences between the two models can be grouped as follows:

| ARTS | STORM |
|---|---|
| * Source function | |
| thermal emission | solar radiation |
| $\longrightarrow$ microwave region | $\longrightarrow$ UV-vis region |
| * Atmosphere | |
| spherical, 1D, 2D, 3D | plane parallel, 1D |
| * Particle Shape | |
| aspherical and spherical | spherical |
| * Solution Method | |
| Iterative scheme | Matrix Operator method<br>Fourier Decomposition of phase matrix and intensity<br>Interaction principle |
| * Ground | |
| Blackbody grount, no ground reflection | ground reflection |
| * Applications | |
| Cirrus clouds | Clouds, aerosols, wind driven water surfaces,<br>Lambertian surfaces |

There were some suggestions for future work too. One of them was to check whether convergence in the iterative scheme is valid for large optical depths. Another one was to implement other integration methods like Gauss-Lobatto quadrature. Ute gave some information regarding the scattering database prepared by Tom Rother which can be helpful for ARTS.