Passive and Active Microwave Transfer (PAMTRA): a tool to simulate observations from space, air, and ground

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Forward models are a key tool to compare models and observations by converting the output of atmospheric numerical models to synthetic observations. By the capability to create such synthetic observations, these forward models are very beneficial for studies related to future ground based or air- and spaceborne activities, i.e. satellite missions like EarthCare or MetOp-SG with MWI and ICI. Such tools can help to understand the expected observations.

Here, the comprehensive microwave forward model PAMTRA (Passive and Active Microwave TRAnsfer) is introduced, which can simulate passive and active measurements across the microwave spectral region up to 800 GHz. The passive forward model in PAMTRA provides up- and down-welling polarized brightness temperatures and radiances for arbitrary observation angles, while the active forward simulator is capable of simulating the full radar Doppler spectra and its moments. Both can be applied to arbitrary plane-parallel atmospheric scenes, including those with complex hydrometeor assumptions. PAMTRA implements various gas absorption models and methods for the approximation of the scattering properties (Mie, T-matrix, DDA, self-similar Rayleigh-Gans) and uses the same for the passive and active forward simulations. To give an estimate of the surface emmissivity of ocean and land needed for passive microwave applications, several tools are included. The PAMTRA framework includes interfaces to various atmospheric models and considers their respective assumptions in the microphysical schemes with different complexity like one- or two-moment schemes or full bin microphysics. The core module is written in FORTRAN90, whereas the framework and user interface are python based. Therefore, the model is easy to use and extendable.

In this presentation we will introduce the complete PAMTRA framework, which has been selected as a prototype for the integration into ICON model. By various examples, we will demonstrate PAMTRAs capabilities to simulate active and passive observations for space, air, and ground based instruments by making use of cloud resolving model output and measurements from various campaigns.