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Metop SG Ice Cloud Imager data analysis preparations

Patrick Eriksson (1), Jana Mendrok (1), Robin Ekelund (1), Bengt Rydberg (2), Manfred Brath (3), and Stefan A. Buehler (3)

(1) Earth and Space Science, Chalmers University of Technology, Gothenburg, Sweden (jana.mendrok@gmail.com), (2) Molflow, Gothenburg, Sweden, (3) Meteorological Institute, University of Hamburg, Germany

The Ice Cloud Imager (ICI), one the instruments to be onboard the second generation (SG) of Metop satellites, will be the first operational instrument making use of sub-millimeter wavelengths. Increasing the sensitivity of microwave ice hydrometeor measurements with at least two orders of magnitude, its primary aim is to characterize the bulk mass of ice hydrometeors, where the basic retrieval products will be ice water path, mean mass size, and mean mass altitude. With the expected competitive accuracy it can e.g. complement the narrow horizontal coverage of active instruments.

Here we present our activities to develop and improve the data analysis for passive sub-millimeter sensors and ICI in particular, where for the latter we are also developing the froaen hydrometeor retrieval algorithm on behalf of EUMETSAT and its NWC-SAF.

One crucial aspect in the data analysis is the quality of the forward modeling, the ability to produce realistic, statistically representative synthetic measurements and to reproduce the performed observations, which poses challenges regarding representation of hydrometeor microphysical as well as optical properties and of the radiative transfer problem itself (atmospheric dimensionality, polarization, etc.).

One of our core activities is the creation of a consistent database of ice hydrometeor single scattering properties that covers not only ICI applications, but passive and active sensors in the whole microwave region. The database will fill the gaps (spectral, temperature, habits) of and between existing databases (e.g. by Liu, Hong, Ding, Kuo) and will also hold data for oriented particles.
Furthermore, sensitivity to forward modeling assumptions is tested, and the results are validated statistically versus existing (satellite microwave and airborne sub-millimeter) observations. These assumptions include microphysics (e.g. size distributions, habit choices, particle orientation) as well as model complexity (e.g. 3D effects, consideration of polarization). Regarding 3D effects, we e.g. find "shadow effects" of the cloud in the order of several Kelvin in the true 3D versus a slant independent column solution.

Beside the accuracy of the forward model, also its computation time requirements are essential targeting operational processing. Therefore, we also compare the performance (in accuracy and speed) of different scattering radiative transfer solvers we have at hand, which apply different, independent solution approaches (e.g. Monte Carlo, Discrete Ordinate, Doubling-and-adding) with different level of model complexity.