Analysis of the potential of millimeter wave observations for precipitation estimates: use of simulated brightness temperatures derived from a mesoscale cloud model

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Observations from a geostationary satellite could provide the frequent revisiting time necessary to study precipitations. However, from these remote orbits, passive microwave measurements with adequate spatial resolution would require very large antennas. To overcome this problem, the use of millimeter and sub-millimeter wave observations is suggested. The objective of this study is to thoroughly analyze the possible use of these high frequencies for rain estimate and to assess how it complements the existing measurements (lower microwave frequencies and IR).

To analyze the relationship between precipitation and millimeter wave observations, a data set of simulated millimeter wave Tbs is created, using realistic atmospheric profiles derived from a cloud resolving model, and the statistical relationships between the Tbs and the cloud and rain properties are examined.

The atmospheric situations are modeled using Meso-NH, a 3D non-hydrostatic mesoscale code that can simulate a great variety of real meteorological flows. It is currently initialized by ECMWF analyses. Meso-NH has an explicit cloud scheme that calculates the time evolution of several microphysical species: cloud droplets, raindrops, pristine ice crystals, snowflakes and graupels (http://www.aero.obs-mip.fr/mesonh).

Radiative transfer calculations are performed with the Atmospheric Transmission at Microwaves (ATM) model (Pardo et al., JQSRT, 2002; Pardo et al., IEEE TGRS, 2001, Prigent et al., JGR, 2001). It includes atmospheric gaseous absorption, scattering by hydrometeors, and surface emissivity simulations to calculate the expected microwave brightness temperatures corresponding to the conditions simulated by Meso-NH.

In order to evaluate the cloud model outputs and the radiative transfer, the simulations are also performed at AMSU B frequencies and for several atmospheric situations and are compared to real satellite observations.

An assessment of the potential of precipitation retrieval at millimeter and sub-millimeter waves will be presented, based on the statistical analysis of the simulated data set.