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Potential of millimeter wave observations for precipitation estimates: analysis of simulated brightness temperatures derived from a mesoscale cloud model.

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Geostationary satellites provide the adequate revisiting time to study strong precipitation events but passive microwave observations from these high orbits would require very large antennas to obtain the adequate spatial resolution. To overcome this problem, projects involve the use of millimeter and sub-millimeter wave observations for precipitation retrieval from geostationary orbits. The objective of this study is to thoroughly analyze the possible use of these frequencies for rain estimate and its complementarity to the other measurements (lower microwave frequencies and IR).

Outputs from a mesoscale cloud model are used as inputs to a microwave radiative transfer model. A data base is created from the simulated brightness temperature (Tb) 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). Five real situations over Europe are simulated.

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.

This complex dataset is used: (1) to analyze the microphysical structure of the Meso-NH outputs (2) to study the simulated satellite observations to the precipitation signal (3) to investigate the potential of the millimeter observations to retrieve precipitation.