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Ground-Based Multi-Frequency Microwave Radiometry of Rainfall: Model-Based Analysis of Information Content

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Ground-based microwave radiometry has been mainly investigated for estimating temperature, water vapour and cloud liquid profiles in the absence of precipitation. In the last years there has been an increasing interest in investigating its potential for retrieving rainfall from ground (e.g., Marzano et al., 2002; Marzano et al., 2005). One of the main problems of ground-based radiometry for rainfall retrieval is the possible impact of thin water films on the receiving antenna whose measurements can be contaminated. However, both new technological solutions and more robust inversion algorithms can reduce the impact of this aspect. In this respect, previous works have been dedicated to the optimal set up of forward and inverse models for estimating columnar hydrometeor contents and surface rain rate (Marzano et al., 2002; Marzano et al., 2005). This presentation investigates on radiometric frequency configurations for the retrieval of hydrometeors profile. In this work, sample case studies of rainfall at midlatitude with stratiform and convective regime have been chosen to extract 3D grids of hydrometeor fields. The latter have been coupled with a sophisticated pseudo-3D radiative transfer model in order to simulate ground-based radiances at varying elevation angles and for a large set of frequencies between 10 and 90 GHz. The sensitivity of brightness temperature from ground to hydrometeor profile content has been first investigated by means of the evaluation of the profile contribution (weighting) functions at various frequencies. Jacobian matrices have been also computed in order to carry out a systematic information content analysis within the optimal estimation theory. Numerical results showing the source of radiometric information about each component of the cloud profile as function of frequency will be illustrated. Their impact on the performance of an inversion algorithms is also discussed.