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Microwave Remote Sensing of the Atmosphere and Environment III Chair: Christian D. Kummerow

TITLE: Spaceborne Rainfall Doppler radar measurements: Correction of errors induced by pointing uncertainties

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BRIEF BIOGRAPHY: Eastwood Im is the Supervisor of the Atmospheric Radar Science and Engineering Group at JPL, and the Radar Instrument Manager of the NASA's CloudSat Mission. He has extensive experience in spaceborne meteorological radar science and remote sensing, and advanced radar system studies. Dr. Im is the Principal Investigator on several NASA's atmospheric science and technology research tasks.

ABSTRACT TEXT:

Knowledge of the global distribution of the vertical velocity of precipitation is important in estimating latent heat fluxes, and therefore in the general study of energy transportation in the atmosphere. Such knowledge can only be acquired with the use of spaceborne Doppler precipitation radars. Although the high relative speed of the radar with respect to the rainfall particles introduces significant broadening in the Doppler spectrum, recent studies have proven that the average vertical velocity in homogeneous rainfield can be measured to the 1 m/s accuracy level by appropriate selection of radar parameters at 14GHz. Even for inhomogeneous rainfall in which significant non-uniform beam filling (NUBF) takes place, our recently developed Combined Frequency-Time (CFT) processing technique enables the vertical velocity to be measured at a comparable level of accuracy.

Now that the dominant error contributions have been adequately reduced, those other error sources previously being considered as secondary can no longer be ignored. One such source is the uncertainty in radar antenna pointing. In this paper we present a sea surface radar echo spectral analysis technique to correct for the rainfall velocity error caused by radar pointing uncertainty. The correction procedure is quite straightforward when the radar is observing a homogeneous rainfall field. On the other hand, when NUBF occurs and attenuating frequencies are used, additional steps are necessary in order to correctly estimate the antenna pointing direction. The proposed method relies on the application of CFT to correct for uneven attenuation effects on the observed sea surface Doppler spectrum. The algorithm performance was evaluated by Monte Carlo simulation of the Doppler precipitation radar backscatter model, and the high-resolution 3D rain fields generated by a cloud resolving numerical model. Results show that the antenna pointing induced error can be successfully removed by the proposed technique.

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Keywords: Doppler, Spaceborne Radar, Precipitation, Rainfall, Non-Uniform Beam Filling