ABSTRACT TITLE: Rainfall Doppler Velocity Measurements from a Spaceborne Radar

AUTHORS: Simone Tanelli[1], Eastwood Im[2], Stephen L. Durden[2], Luca Facheris[1], Dino Giuli[1]

(1) Dip.Ing.Elettronica, Universita' di Firenze, Firenze, Italy
(2) Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA, USA

ABSTRACT

This paper studies the performance of a spaceborne precipitation radar in measuring vertical Doppler velocity of rainfall. Although the high relative speed of the instrument respect to the rainfall droplets contributes significantly to the spreading of the Doppler spectrum, accurate estimates of the average vertical velocity can be obtained when the rainfall intensity does not varies significantly within the resolution volume of the instrument. Such a result can be inferred through theoretical calculations and it is confirmed here by analyzing the Doppler spectra simulated using data gathered by the NASA/JPL airborne rain radar in TOGA–COARE. As far as a downward pointing precipitation radar is concerned, one of the major problems affecting Doppler measurement at the nadir direction arises from the non uniform beam filling effect (NUBF): when significant variation in rain rate is present within the IFOV in the along track direction, the Doppler shift due to the non uniform weighing of the radial component of the horizontal speed of the satellite dominates any other contribution. Under this condition, shape, average value and width of the Doppler spectrum may not be directly correlated with the vertical velocity of the precipitating particles. However, by using an inversion technique which over–samples the radar measurements in the along track direction, we show that the shift due to NUBF can be identified and evaluated, and that the NUBF induced errors on average fall speed can be reduced.

In this paper we also show that other sources of Doppler spectrum broadening and shifting may be considered as minor problems affecting the vertical velocity estimates.