



Analysis of precipitation in polarimetric images collected by the COSMO SkyMed constellation

Luca Baldini (1), Nicoletta Roberto (1), Eugenio Gorgucci (1), Jason Fritz (2), and Ve Chandrasekar (2)

(1) CNR, Institute of Atmospheric Sciences and Climate, Roma, Italy, (2) Colorado State University, Fort Collins, CO

Synthetic Aperture Radar instruments on board satellite platforms are designed for studying land surface features taking advantage from their high spatial resolution. Effects of rain in SAR images have been noted from early missions. In the presence of precipitation, returns from a ground target are determined by a) surface backscattering attenuated by precipitation between the target and the satellite, and b) backscattering of precipitation, attenuated by the precipitation in the slant range direction. Expressions to describe effects of precipitation on SAR images have been well described in the literature. At X-band, the effect of attenuation induced by precipitation prevails on the backscattering from hydrometeors and therefore, precipitation cells appear as dark blurs. A further effect of precipitation is the degradation of azimuth resolution due to the width of the Doppler spectrum of hydrometeors. However, the achieved resolution is better than that of a satellite borne precipitation radar such as that of TRMM. The quantitative interpretation of precipitation signatures in polarimetric X-SAR images and their utility in atmospheric and precipitation studies is not completely understood. With the launch of the fourth satellite at the end of 2010, the constellation COSMO SkyMed [CSK[®]] of the Italian Space Agency (ASI) has been completed. The orbits of the 4 satellites will be phased by 90 degrees. With three satellites in orbit, the so-called "Tandem Like" interferometric configuration was adopted until 2010. All the satellites are on the same orbital plane and acquisitions of the same scene with the same geometry with a de-correlation time of one day between overpasses of two satellites are possible. Polarimetric modes are implemented using the Ping-pong mode, a strip mode in which the signal polarization is alternated. In the HH-VV mode (the other available mode is the HV-VH), SAR operates in HH for a fraction of the synthetic aperture, and then VV is used for the second half. Correlation among distributed targets in the two polarizations is however reduced and extraction of information on precipitation from co-polar correlation and phase difference is limited.

This study presents preliminary results of specific experiments (some of which are still ongoing) in which SAR measurements collected by the different satellites of the CSK constellation in precipitation using polarimetric modes are analyzed with the aid of coincident measurements collected from ground based radars. By modelling electromagnetic scattering and propagation parameters from the different hydrometeors, it is in fact possible to reconstruct the component of the SAR returns due to the precipitation alone. In the analyzed cases, ground radars are at C- (Piedmont, Italy) and S-band (Florida, USA).