High-resolution spatial analysis of a hurricane structure by means of X-band and Ka-band satellite synthetic aperture radar

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Spaceborne synthetic aperture radars (SARs) allow very high spatial resolution (of the order of hundreds meters in presence of precipitations) and the capability of fully characterize the extinction and scattering properties of the target. Numerous works in the last years have assessed the sensitivity of SARs operating at frequency above C band to atmospheric effects, in particular to precipitations, on both amplitude and phase received signal. The impact of precipitation on SAR slant-view imagery is due to a combination of surface and volumetric backscattering, coupled with path attenuation and with a significant dependence on frequency, polarization and spatial distribution of hydrometeors. Nevertheless several aspects of SARs response interaction with precipitations require a deeper insight. In this respect a valid aid can arise by analysis of simulated scenarios. In this work a sensitivity analysis will be presented, both in amplitude and phase, derived by numerical forward modeling of SAR response. Data have been generated by a revised fully polarimetric model of SAR response, operated at X-Band and Ka-Band, addressing both the actual availability of spaceborne X-Band instruments (i.e. Cosmo-SkyMed constellation and TerraSAR-X/TanDEM-X systems) and the recent research interest towards higher frequency missions. A high-resolution mesoscale atmospheric numerical model is used to extract the three-dimensional distribution of liquid and ice hydrometeors. Different backgrounds are considered, in particular bare soil and marine surface. A validation Cosmo-SkyMed case study, relative to hurricane "Irene" of 2011, will be discussed.