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# COSMO-SkyMed measurements in precipitation over the sea: analysis of Louisiana summer thunderstorms by simultaneous weather radar observations

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Radar signatures of rain cells are investigated using X-band synthetic aperture radar (X-SAR) images acquired from COSMO-SkyMed constellation over oceans off the coast of Louisiana in summer 2010 provided by ASI archive. COSMO-SkyMed (CSK) monitoring of Deepwater Horizon oil spill provided a big amount of data during the period April-September 2010 and in July-August when several thunderstorms occurred in that area. In X-SAR images, radar signatures of rain cells over the sea usually consist of irregularly shaped bright and dark patches. These signatures originate from 1) the scattering and attenuation of radiation by hydrometers in the rain cells and 2) the modification of the sea roughness induced by the impact of raindrops and by wind gusts associated with rain cell. However, the interpretation of precipitation signatures in X-SAR images is not completely straightforward, especially over sea. Coincident measurements from ground based radars and an electromagnetic (EM) model predicting radar returns from the sea surface corrugated by rainfall are used to support the analysis. A dataset consisting of 4 CSK images has been collected over Gulf of Mexico while a WSR-88D NEXRAD S-band Doppler radar (KLIX) located in New Orleans was scanning the nearby portion of ocean. Terrestrial measurements have been used to reconstruct the component of X-SAR returns due to precipitation by modifying the known technique applied on measurements over land (Fritz et al. 2010, Baldini et al. 2011). Results confirm that the attenuation signature in X-SAR images collected over land, particularly pronounced in the presence of heavy precipitation cells, can be related to the S-band radar reflectivity integrated along the same path. The Normalized Radar Cross Section (NRCS) of land is considered to vary usually up to a few dBs in case of rain but with strong dependency on the specific type and conditions of land cover. While the NRCS of sea surface in clear weather condition can be considered as constant, in case of rain, at X-SAR incidence angles, it exhibits a dependence to precipitation event due the combined effects of corrugation due to the impinging raindrops and to the surface wind. Therefore, when retrieving of X-SAR NRCS in precipitation over the sea, this effect must be accounted for and can be quantified based on the precipitation event using a simple NRCS surface model. In this work, an EM model based on Bahar's Full Wave Model is used for evaluating such NRCS depending on polarization, frequency and incidence angle for different values of wind velocity and the root mean square height of the corrugation induced by rainfall. The reconstruction of X-SAR returns in precipitation is finally obtained by joint utilization of volume reflectivity and attenuation estimated from KLIX and the sea NRCS model.

References:

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