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Signatures of extended meterological targets measured with the space-borne synthetic aperature radar TerraSAR-X and their comparison with simultaneous weather radar measurements

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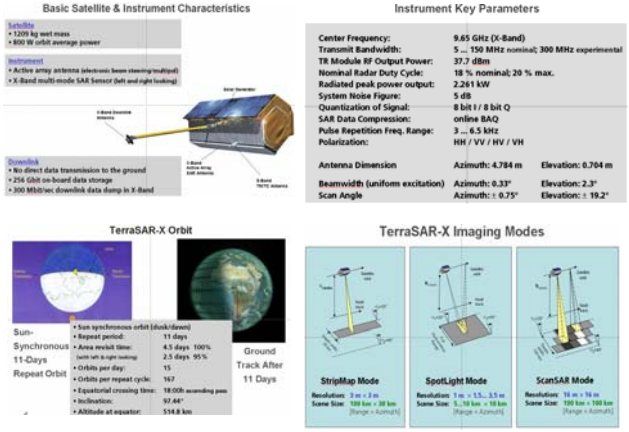
1. Introduction

TerraSAR-X, the first civil German space-borne synthetic aperture radar (SAR) satellite, was successfully launched on 15th of June, 2007. The main purpose of Synthetic aperture radar systems is to map the Earth-surface in high resolution. SAR sensors are often considered as day/night and all-weather imaging systems. Whereas the first argument is true, the second does not hold in every case depending on the operating frequencies. In turn, as shown below some recent examples of images exhibit typical rain-induced signature modification. In Effect, the disadvantage of rain features in SAR imagery may turn out to be a useful source for assessing precipitation intensity over SAR surveyed areas. The main advantage of assessing weather volumes, using the SAR-method presented here, is the high resolution obtained indirectly from the analysis of propagation effects in SAR-pixels.

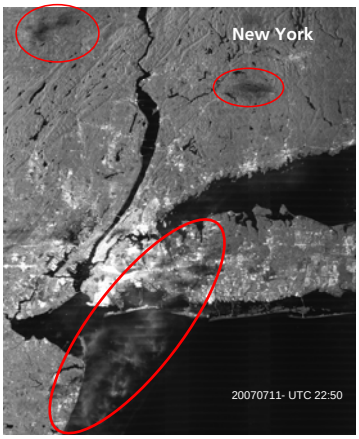
Acquisition parameters	
Date	20070619
Time	15:03:24 – 15:03:31:07
Image dimensions:	
Azimuth	~ 60 km
Range	~ 30 km
Location:	50 km to the west of Volgograd (Russia)
Scene center	Lat: 48.4504 Lon: 43.5542
Imaging Mode	Strip map
Polarization	HH

Sensor and imaging parameters of TS-X

2. TerraSAR-X – Basic sensor information



3. Comparison of rain cell-induced signatures in TerraSAR-X images with ground based weather radar data



A test-case showing a comparison of SAR and Weatherradar data acquired nearly simultaneously (within the same minute) over New York, US. A good agreement between the rain-cell signatures in the SAR – image (top image) and the weatherradar image (bottom) can be observed. The effects are most pronounced for reflectivietes of up to 50 dBZ

Fig. 2(a). SAR image of New York City with rain cell induced signatures.

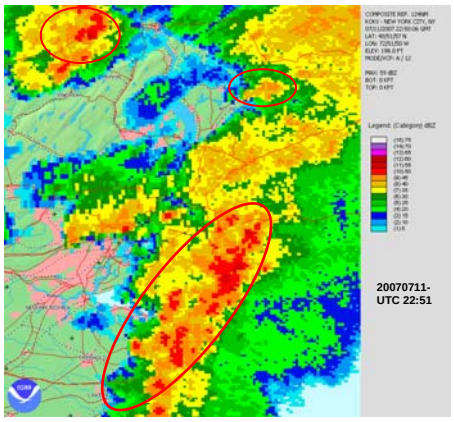


Fig. 2(b): Simultaneously acquired image using a ground based weather radar.

4. Physical Interpretation of rain induced signature in SAR images

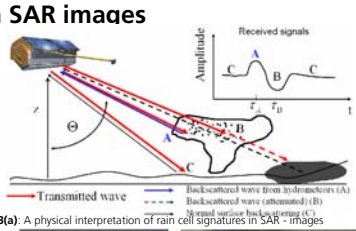


Fig. 3(a): A physical interpretation of rain cell signatures in SAR - images

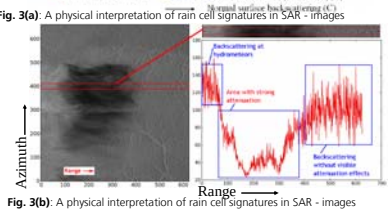
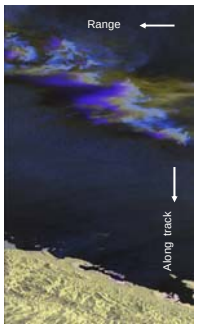


Fig. 3(b): A physical interpretation of rain cell signatures in SAR - images

- The white shading in Fig. 3(b) is due to direct reflections from the rain region (hydrometeors, like larger raindrops and hail) and is shown as volume "A" in Fig. 3(a).
- The dark patches in Fig. 3(b) are due to the attenuation of the transmitted signal through the precipitation medium (shown as volume "B" in Fig. 3(a)).

5. Polarimetric Image example over ocean surface – coast of Panama

Acquisition parameters	
Date	2007-8-11.
Time	9.50. 33.
Image dimensions:	
Azimuth	~ 60 km
Range	~ 30 km
Location:	Panama
Scene center	Lat: -5,50 Lon: -62
Imaging Mode	Strip map
Polarisation	HH/VV
Red	HH
Green	VV
Blue	HH-VV



6. Conclusions

TerraSAR-X offers new possibilities to retrieve the rain rate of SAR surveyed areas.

Simultaneous measurements with weather radars and SAR show good agreement and are now available for further in-depth study and modelling of rain signatures and quantification of rain intensity.