In this study we report the presence of a localised Doppler anomaly occurring during the focusing of a Radarsat-2 dataset acquired on the Merapi volcano (Indonesia) during the devastating 2010 eruption. The Doppler anomaly is manifested as a ~30 km box-like shape. The azimuth shifts between two sub-aperture images. The Doppler anomaly is centered on the summit-south flank of the Merapi volcano. The pixel shifts reaches up to 11.6 meters. Since the Merapi volcano was undergoing a large eruption during the data acquisition, it is possible that there is a volcano-related phenomenon that has delayed the radar sensor so much to create measurable pixel offsets within a single SAR dataset, similar to having more extensive areas in the signal generated by target motions. Small sub-aperture shifts have less extensive areas in the signal generated by atmospheric perturbations. It is known that the SAR signal is delayed as it passes through heterogeneous layers of the atmosphere, but this delay typically affects the SAR signal at a fraction of the phase cycle or few centimeters depending on the radial wavelength employed by the system. We investigate the source of this anomalous pixel signal, we review the theoretical basis of SAR image focusing and we try to provide a consistent physical framework to our observations. Our results are compatible with the SAR signal being perturbed during the actual process of image focusing, the presence of a contrasting medium located approximately between 6 and 12 km altitude, which we propose being associated with the presence volcanic plumes.

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Used softwares: GAMMA (GAMMA-RS), Envi (Exelvis)

References:


3. Meyer et al., 2009, and the work from Meyer et al. (2009) and the previously described geometry, we can propose a set of relationships between the parameters of interest: a) the signal path lengthening, b) the Doppler offset, c) the delay 

Conclusions:

Sub-aperture pixel offsets technique allows to highlight an anomaly on the Doppler parameters estimation of a Radarsat-2 SLC dataset acquired on the 30 of October 2010 (UTC) over Merapi volcano. Sub-aperture pixel offsets reaches 11.6 meters in the azimuth direction (positive towards the platform sense of motion). At that time, Merapi volcano was undergoing an explosive phase. Sub-aperture pixel offsets technique applied to the RADARSAT-2 dataset acquired before the eruption started (28 October 2010) did not reveal any local Doppler anomaly. Therefore, we are inclined to think that there is a volcano-related phenomenon that has consistently delayed the SAR signal during the actual process of image acquisition.

Observations:

Let’s suppose the source of the anomaly is an atmospheric feature:

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Authors affiliation:

1. BRGM France – contact: d.raucoules@brgm.fr
2. Gamma Remote Sensing AG, Switzerland
3. Istituto Nazionale di Geofisica e Vulcanologia, Italy