SAR Remote Sensing of Forest Fires: Gallipoli Forest Fire in 2008

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Mapping forest fire extent and impact from remotely sensed observations had been the subject of much research in the past. Optical observations had been found to be well suited for acquiring information such as fire location, spatial extent, distribution of burned areas, and types of land cover because of their ability to retain sensitivity to the spectral changes of burned and healthy vegetation, changes in temperature during a fire, and their straightforward and intuitive interpretability. Despite the results using optical satellite data for estimation of fire damage were satisfactory, those methodologies still had limited success since the presence of clouds, smoke, haze, and lack of solar radiation could prevent the acquisition of optical data.

Imaging radars may complement traditional optical data in mapping impacts of fire on forest due to high sensitivity to moisture and structural properties of the vegetation, all weather, and day and night observing capability (almost transparent to the atmosphere and clouds, and independent of solar radiation). Extensive archives of spaceborne synthetic aperture radar (SAR) data and planned future SAR missions make it particularly useful to exploit this alternative data set. More than 15 spaceborne SAR sensors are being operated today and 10 new SAR systems will be launched within the next 5 years. It is expected that data acquisition latency from any SAR sensors is reduced to a day in the near future.

In this study, the Gallipoli forest fire, which burned 353 hectares of the pine forest in 2008, is selected to investigate potential capabilities of C-band Synthetic Aperture Radar (SAR) backscatter intensity at VV-polarization in order to infer fire-induced changes in the pine canopy [1]. The backscatter response to the forest fire will be evaluated against burn severity levels estimated by the Landsat dNBR (difference Normalized Burn Ratio) indices. Temporal evaluation of backscatter change with respect to various pre- and post- fire conditions will be investigated using ESA's Envisat ASAR data over the period of 2002-2010. The results indicate that the difference between pre- and post-fire backscatters (ratios in power) increases with the dNBR index, and the forest structure, surface conditions, topography, and local incidence angle play an important role in the SAR signature. Sensitivity on the state of a burned stand and its local fire impact levels will be compared for wet and dry conditions. Possible scattering mechanisms before and after a fire will be briefly explained for single-pol SAR backscatter.

[1] M. Kurum, "C-Band SAR Backscatter Evaluation of 2008 Gallipoli Forest Fire," submitted, IEEE Geoscience and Remote Sensing Letters, 2014.