LOCATION AND CHARACTERIZATION OF MINING ACTIVITY USING INTEFEROMETRIC SYNTHETIC APERTURE RADAR

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Sponsored by the
Institute of Geophysics and Planetary Physics and
Lawrence Livermore National Laboratory
Mini-grant 97-1458

ABSTRACT

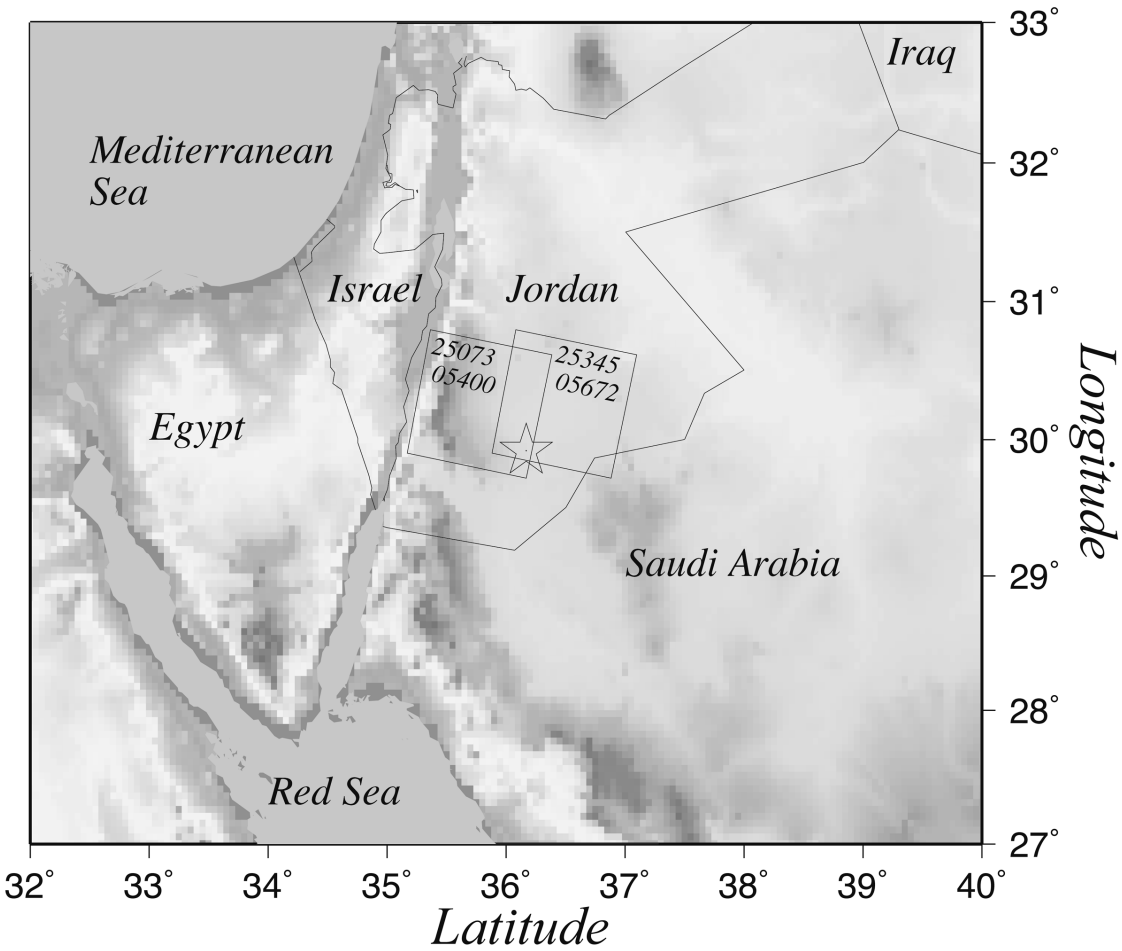
We test the use of satellite-based interferometric synthetic aperture radar (INSAR) to detect, locate, and monitor surface mining at a large phosphate quarry in Jordan. INSAR is a technique that uses radar to create highly accurate digital elevation models (DEM) and can measure small changes in surface deformation. We construct two DEMs of the quarry using two pairs of commercially available tandem images from the ERS-1 and ERS-2 satellites (C band; frame 2997 from May 1 and 2, 1996, and on May 20 and 21, 1996). The region around the quarry is relatively flat and arid, which allows for high coherency between images and high-quality phase information. The quarry is the site of frequent large-scale blasting operations.

The synthetic aperture radar processing uses a range-Doppler algorithm and publicly available orbit information. After aligning and compensating for differences in satellite position, we calculated the correlation and phase difference between the two image pairs. We tested two approaches to phase unwrapping: a least-squares approach and integration. The integration approach produced superior results when converted to topography and compared with ground-truth data. The detailed structure of the quarry is visible on a scale of tens of meters. The quarry's size and location determined from the radar-generated DEMs compare favorably with ground-truth data. Differences observed between the two sets of images may indicate blasting and removal of material during the 19 days between data takes. However, contamination from data artifacts remains a possibility. Currently, we are experimenting with different filters and pixel averaging schemes to determine the robustness of the elevation features.

We also are testing the use of the interferometric phase gradient for detection of subtle features. In addition to the quarry, cultural features such as buildings and power line towers are clearly observed. The quarry is also clearly seen on the correlation images between the different scenes.

We have ordered data and plan to analyze images from the 1998 India and Pakistan tests as well.

Key Words: interferometric synthetic aperture radar, space-borne monitoring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Mediterranean Sea
Israel
Jordan
25073
05400
25345
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Egypt
Saudi Arabia
Red Sea
33°
32°
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Longitude
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Latitude