Surface Deformation and Coherence Measurements of Kilauea Volcano, Hawaii from Six Month Repeat Pass Interferometry with SIR-C

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The Jet Propulsion Laboratory's Shuttle Imaging Radar (SIR-C/X SAR) observed the area of the Kilauea volcano in Hawaii in April 1994 and October 1994. In October the space shuttle was commanded to repeat the April orbit to make repeat pass interferometry possible; an interferometric baseline of approximately 100 m was obtained. L-band (24 cm wavelength) and C-band (5.6 cm wavelength) data have been processed interferometrically to study interferometric coherence and surface deformation over the six month period.

The L-band data maintain good coherence over most of the imaged area despite heavy vegetation in many areas. Lava flows devoid of vegetation have coherence greater than 95%. The C-band data on the other hand lose coherence everywhere there is heavy vegetation.

Surface deformation studies have been carried out using the method of digital elevation model (DEM) elimination [1] to remove topography in the repeat pass interferograms as more passes were not available to apply three pass interferometry methods [2]. The maximum extent of the resulting differential phase signal over the imaged area is less than 1 Cycle! at L-band. This signal consists of surface displacements along the radar line of sight direction, differential tropospheric delays and surface or vegetation changes over the six month interval. The L-C band scaled phase difference shows no significant ionospheric delay. It does however exhibit a phase change entering the vegetated areas prior to losing coherence at C-band. This may indicate a difference in the C-band and L-band scattering centers. There appears to be a significant component of the! L-band differential phase due to the vegetation alone, attributable to coherent shift of dielectric properties or of the effective L-band scattering center between the two observations.

The 100 m relief Pu'u O'o volcanic vent did not mist when the avaliable USGS DEM was made. This topographic error would induce a significant artifact in the deformation map. A small DEM recently acquired by the JPL TOPSAR system was mosaicked into the USGS DEM to correct the error. The L-band surface deformation map shows significant local features in the area of the Pu'u O'o vent, indicating centimeter level displacements. Comparison of the radar derived displacements to *in situ* GPS measurements is in progress.

References

[1] D. Massonet *et al.*, "The displacement field of the Landers earthquake mapped by radar interferometry", *Nature*, **364**, no. 6433, 138 142, 1993.

[2] H. A. Zebker *et al.*, "On the derivation of coseismic displacement fields using differential radar interferometry: the Landers earthquake," submitted to *J. Geophys. Res.*, Dec. 1, 1994