Radar interferometry for measuring regional-scale processes

Andrew Hooper[1], David Bekaert[1], Mahmut Arikan[1]

[1.] Delft Institute of Earth Observation and Space Systems, Delft University of Technology, Delft, Netherlands (a.j.hooper@tudelft.nl)

Satellite radar interferometry (InSAR) is a very effective technique for measuring surface displacements in some instances, but its use remains limited for the measurement of regional scale processes, such as postseismic/interseismic motion. In many instances the signal over much of an image either decorrelates too quickly to be useful, or is swamped by atmospheric signal. Time series InSAR methods address the decorrelation issue by increasing the signal-to-noise ratio through the use of more data. To some extent, atmospheric signal can also be reduced, although on a regional scale the influence can still be significant, especially when the strain rates detected at the surface are low. We have developed a technique to further reduce the tropospheric part of the atmospheric signal, which is the most significant part for the majority of currently orbiting instruments. We use the correlation of the tropospheric signal with topography and account for lateral variation by estimating the relationship locally. We avoid incidental subtraction of any deformation signal by using only the spatial frequencies in the estimation process where the deformation is insignificant. To reduce remaining long wavelength errors, due chiefly to ionospheric signal and orbit errors, we have developed integration strategies that take advantage of other geodetic data acquired in the region of interest, such as GPS. We demonstrate our improved techniques for measuring interseismic motion in western Anatolia and the 2006 subduction slow-slip event in Guerrero, Mexico. For the latter event we model the slip on the subduction interface, and find that incorporation of the InSAR data gives a significantly different slip distribution than using GPS data alone.

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