Radar interferometry for measuring regional-scale processes

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Despite multiple successful applications of InSAR for measuring surface displacements, its use remains limited for the measurement of regional scale processes. In many instances the signal over much of an image either decorrelates too quickly to be useful or is swamped by atmospheric noise. Time series InSAR methods seek to address these issues by increasing the signal-to-noise ratio (SNR) through the use of more data. These techniques are particularly useful for applications where the strain rates detected at the surface are low, such as postseismic/interseismic motion.

Our previous developments in this field have included a persistent scatterer algorithm based on spatial correlation, a full resolution small baseline approach based on the same strategy, and a procedure for combining the two [Hooper, GRL, 2008]. This combined method works well on small areas (up to one frame) at ERS or Envisat strip-map resolution. However, in applying it to larger areas, such as western Anatolia in Turkey and Guerrero region of Mexico, or when processing data at higher resolution, e.g. TerraSAR-X, computer resource problems can arise. We have therefore altered the processing strategy to involve smarter use of computer memory. Further improvement is achieved by the resampling of the selected pixels (whether persistent scatterers or distributed scatterers) to a coarser resolution – usually we do not require a resolution on the scale of individual resolution cells for geophysical applications. Aliasing is avoided by summing the phase of nearby selected pixels, weighted according to their estimated SNR. This is akin to smart multilooking, but note that better results can be achieved than by starting the analysis with low-resolution (multilooked) data.

In order to address long wavelength errors, due to variation in atmospheric refractivity 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 2006/2010 subduction slow-slip events in Guerrero, Mexico.

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