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Crustal deformation studies using synthetic aperture radar (SAR) interferometry

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Abstract

Crustal deformation produces a wide variety of landforms at the surface of the Earth and their size depends on the duration of the process involved in their formation. Co- and post-seismic deformations take place over periods of a few seconds to several days, and produce fault scarps and surface displacement ranging from a few centimeters to several meters in magnitude.
Over longer periods of time (10 Kyr - 1 Myr), the cumulative effect of earthquakes displaces Quaternary surfaces and geomorphic features by tens to hundreds of meters, producing landforms of greater spatial wavelengths. Over millions of years, such processes build mountain ranges. With the advent of spaceborne radar systems (ERS-1/2, JERS-1, SIR-C, RADARSAT), SAR interferometry is becoming a new tool for active tectonics by providing both surface change maps spanning periods of days to years, for measuring co- and inter-seismic deformations, and accurate, high resolution topographic maps for measuring crustal strain accumulated over longer periods of time. The talk will illustrate both applications of this technique with examples taken along seismic faults in the western US and western China.
Co-seismic surface change maps generated for recent earthquakes in the western US revealed details of the displacement field inaccessible to conventional geodetic techniques. Slow deformation processes such as post-seismic deformation subsequent to large earthquakes or creep events along active faults have also been detected using SAR interferometry.
Along the Altyn Tagh fault in western China, radar derived, high resolution topographic maps allowed us to estimate cumulative offsets recorded by displaced geomorphic features over 10,000 to 100,000 years.
Keywords: