Geophysical Research Abstracts
Vol. 19, EGU2017-19256, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

From Geodesy to Tectonics: Observing Earthquake Processes from Space (Augustus Love Medal Lecture)

Barry Parsons
Department of Earth Sciences, University of Oxford, UK

A suite of powerful satellite-based techniques has been developed over the past two decades allowing us to measure and interpret variations in the deformation around active continental faults occurring in earthquakes, before the earthquakes as strain accumulates, and immediately following them. The techniques include radar interferometry and the measurement of vertical and horizontal surface displacements using very high-resolution (VHR) satellite imagery. They provide near-field measurements of earthquake deformation facilitating the association with the corresponding active faults and their topographic expression. The techniques also enable pre- and post-seismic deformation to be determined and hence allow the response of the fault and surrounding medium to changes in stress to be investigated.

The talk illustrates both the techniques and the applications with examples from recent earthquakes. These include the 2013 Balochistan earthquake, a predominantly strike-slip event, that occurred on the arcuate Hoshab fault in the eastern Makran linking an area of mainly left-lateral shear in the east to one of shortening in the west. The difficulty of reconciling predominantly strike-slip motion with this shortening has led to a wide range of unconventional kinematic and dynamic models. Using pre-and post-seismic VHR satellite imagery, we are able to determine a 3-dimensional deformation field for the earthquake; Sentinel-1 interferometry shows an increase in the rate of creep on a creeping section bounding the northern end of the rupture in response to the earthquake. In addition, we will look at the 1978 Tabas earthquake for which no measurements of deformation were possible at the time. By combining pre-seismic 'spy' satellite images with modern imagery, and pre-seismic aerial stereo images with post-seismic satellite stereo images, we can determine vertical and horizontal displacements from the earthquake and subsequent post-seismic deformation. These observations suggest post-seismic slip concentrated on a thrust ramp at the end of the likely earthquake fault and, together with new radar measurements, can be modeled with slip rates declining approximately inversely with time from the earthquake. Measurements such as these examples provide the basis for investigating the dynamic response to the earthquakes to changes in stress occurring in them.