# NEW PERSPECTIVES ON ACTIVE TECTONICS: OBSERVING FAULT MOTION, MAPPING EARTHQUAKE STRAIN FIELDS, AND VISUALIZING SEISMIC EVENTS IN MULTIPLE DIMENSIONS USING SATELLITE IMAGERY AND GEOPHYSICAL DATA BASES

Robert E. Crippen and Ronald G. Blom
Jet Propulsion Laboratory, California Institute of Technology
Pasadena, California 91109 USA
818-354-2475 phone, 818-354-9476 fax, crippen@berlin.jpl.nasa.gov

By rapidly alternating displays of SPOT satellite images acquired on 27 July 1991 and 25 July 1992 we are able to see spatial details of terrain movements along fault breaks associated with the 28 June 1992 Landers, California earthquake that are virtually undetectable by any other means. The SPOT image pixel size is 10m, but tectonically y induced misregistrations between the images perhaps even smaller than one meter can be observed in some areas. The largest fault offsets were up to 6m, thus not only can we detect ground motion, we can also see details of the ground deformation pattern. Specifications for satellite acquisition of the post-quake image were set to match the sun angle and look angle of an existing pre-quake image. This allowed us to avoid detection of shadow elongations and changes in image pattern attributable to viewing perspective. The alternating displays reveal fault locations, patterns of drag and block rotation, and pull-apart zones and allow the geologist to actually see the motions, their relationships to each other, and their relationships to existing topography.

Image Multitemporal Analysis Geodesy ("imageodesy") is a method of quantifying and mapping the subpixel terrain displacements by image correlation (*Episodes, 1992,* v. *15,* p. 56-61). Several horizontal strain vectors can be obtained over each square kilometer in areas where image patterns are strong, The full analysis is computationally demanding (necessitating a supercomputer), and it requires modelling of satellite attitude variations in order to allow comparison of displacement vectors over wide areas of the image. Results thus far along the fault show displacement vectors consistent with field measurements, other field observations, and tectonic geomorphology. Final results should reveal details of the tectonic strain field that would not otherwise be detected.

Additionally, we are producing visualizations of SPOT, Landsat TM, topographic data, and earthquake foci data that reveal patterns in the three spatial dimensions, the time dimension, and the quake magnitude dimension (using several thousand seismic records for the Joshua Tree - Landers - Big Bear earthquake sequence). With three-dimensional viewing and various coding schemes, we are able to observe all dimensions simultaneously. Ultimately, we expect to attain a new understanding of fault break propagation.