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№ 4281

OBSERVATION AND MEASUREMENT OF HORIZONTAL TERRAIN DISPLACEMENTS ASSOCIATE]) WITH THE LANDERS EARTHQUAKE OF 28 JUNE 1992 USING SPOT PANCHROMATIC "IMAGERY

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Previously, we speculated that SPOT satellite imagery could be used to measure terrain displacements associated with earthquakes even though such displacements are smaller than the 10m resolution of the imagery (GSA Abs, 1990, v. 22, no. 3, p. 16). The Landers, California, earthquake provided the first clear opportunity to demonstrate this capability, We acquired an image taken on 27 July 1991, before the earthquake, and had the satellite programmed to acquire a matching scene on 25 July 1992, just 27 days after the quake. These images were taken from the same orbital position and on nearly the same day of year. Thus, problems of differing view and illumination angles were avoided.

initial results have been very positive. By enlarging corresponding small portions of the images and then alternating them on an image display device, we were able to locate the fault breaks and observe the fault motions (EOS, 1992, v, 73, no. 43, p. 364). By recording such displays for several sites, we produced a video which was widely reported in the media as the first visual observation of fault motion from space (e.g. Denver Post, 8 Dec 92, p. 2). The displays allow analysis of the details of deformation patterns that would otherwise go undetected. In addition to terrain shifts, ground breakage is observable in the images. 'J'his results from the darkening of the ground by the internal shadows of numerous cracks over a 10-20 m wide zone, especially as viewed at nadir.

Quantification of the terrain displacements is expected to result in a map of the horizontal strain field of the earthquake at unprecedented levels of spatial detail, The procedure involves computationally demanding statistical image matching performed on a supercomputer (Episodes, 1992, v. 15, no. 1, p. 56-61), Early results arc consistent with known fault locations and offsets and appear to show sharp differences among the fault blocks defined by overlapping fault strands. Results are most reliable for rugged bedrock areas that form distinct image patterns. The precision of measurement appears to be about 50 cm for such areas. This is a full order of magnitude finer than the maximum fault offsets and is therefore adequate for mapping patterns within the strain field.

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