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Application of InSAR measurements and mechanical modeling for natural hazard assessment and mitigation along the Dead Sea Transform

G. Baer (1), M. Abelson (1), Y. Finzi (2), G. J. Funning (3), R. N. Nof (1), G. Shamir (1), T. J. Wright (4)

(1) Geological Survey of Israel, Jerusalem, Israel, (2) Department of Earth and Ocean Sciences, the University of British Columbia, Canada, (3) University of California, Berkeley, USA, (4) School of Earth and Environment, University of Leeds, UK (baer@gsi.gov.il / Fax: +972 2-5380688 / Phone: +972 2-5314231)

InSAR measurements along the Dead Sea Transform (DST) are used to assess and mitigate natural hazards originating from both seismic and non-seismic processes. We are currently focusing on three major topics: (1) the deformation cycle of the November 1995 Gulf of Elat (Aqaba) earthquake, (2) interseismic slip along the DST and secondary faults, and (3) infrastructure collapse.

Ascending and descending track interferograms of the November 22, 1995, Mw=7.2 Gulf of Elat Earthquake were inverted for fault geometry and slip distribution. Using these fault parameters, we calculated the induced stress changes associated with the earthquake and found that major aftershocks and aseismic slip along nearby Gulf-parallel faults were associated with positive Coulomb stress changes. Evidence for accelerated vertical deformation several months prior to the earthquake were observed along the Arava Valley segment north of the main rupture. Continuous vertical deformation in the step zones between these fault segments suggests aseismic creep at a rate of about 30% of the GPS-determined loading rate. This implies an increased expected recurrence time for characteristic major earthquakes along this segment by as much as 40%.

Over the last decade, hundreds of collapse-sinkholes formed along the Dead Sea (DS) coastlines of Israel and Jordan, causing severe damage to the regional infrastructure. The sinkholes cluster along discrete lineaments which, in some places, coincide with

the boundaries of gradual land subsidence features detected by InSAR. Based on similarity in orientation distribution with structural features and earthquake mechanisms, these lineaments were suggested to trace young, possibly active, fault systems, concealed within the fill. This process forms an immediate hazard to the DS coast tourist centers and to the ongoing damming activity of the Dead Sea Works for new salt evaporation ponds. The subsidence zones and their linear boundaries are already incorporated into sinkhole hazard maps used for regional planning.

The Carmel Fault, which splays off the DST further to the north, has been considered as potentially active, threatening the city of Haifa and the nearby petrochemical industry. Recent PSInSAR measurements (processed by TRE Milano) show no relative detectable motion across the fault. This observation is consistent with new seismic and paleoseismic evidence which show lack of seismic energy production along this fault segment, thus questioning its definition as an active fault. The Haifa PSInSAR measurements also show subsidence at rates as high as 7 mm/yr in several locations away from the fault trace, causing significant damage to public buildings. The PSInSAR results will be incorporated in land use maps of the region.