Geophysical Research Abstracts,
Vol. 11, EGU2009-7978, 2009
EGU General Assembly 2009

A SAR-interferometric search for crustal unloading due to the long term water level drop of the Dead Sea

A. Schenk (1), M. Westerhaus (1), O. Dierks (1), Z. Ben-Avraham (2), O. Heidbach (3), and R. Hanssen (4)

(1) Karlsruhe University (TH), Geodetic Institute, Karlsruhe, Germany (westerhaus@gik.uni-karlsruhe.de, ++721 608 6808), (2) Tel Aviv University, Department of Geophysics and Planetary Sciences, Israel (zvi@terra.tau.ac.il), (3) Deutsches GeoForschungsZentrum - GFZ, Germany (heidbach@gfz-potsdam.de), (4) Delft Institute of Earth Observation and Space Systems, Netherlands (R.F.Hanssen@lr.tudelft.nl)

Since the 1950's the Dead Sea declined considerably due to evaporation and insufficient recharge by the Jordan River. During the last decade the water level dropped almost linearly at a rate of about 1m per year. The Earth's crust is supposed to respond to the mass removal by (visco)elastic rebound. Quantification and modelling of the rebound effect will foster new insight into rheological parameters of crust and uppermost mantle along the Dead Sea rift, and potential unloading-induced changes in Coulomb stress along the bounding faults of the Dead Sea pull-apart basin might have an impact on its seismic hazard assessment.

A simplistic a-priori calculation of the expected signals using the Boussinesque solution for a point force pressing on an elastic half-space gives an uplift rate of approx. 1.5 mm/a near the shores of the Dead Sea. In order to get a first impression of the real uplift pattern we use 47 ERS1/2 SLC scenes from descending orbits in a conventional SAR interferometry approach. We calculated 30 interferograms from selected scenes with low coregistration noise and perpendicular base lines less than 300 m in order to reduce the impact of geometrical decorrelation and residual elevation errors. The influence of topography is largely removed using a local digital elevation model with a resolution of 25 m, provided by the Geological Survey of Israel. Contiguous patches in the interferograms with coherency values > 0.7 even for temporal base lines up to 2100 days confirm that the reflection characteristics within a ground resolution cell vary only slowly with time in the semi-arid investigation area. Incoherent parts of the interferograms are masked out prior to unwrapping. Atmospheric path delays are treated stochastically in first instance and are significantly reduced by stacking a large number of short baseline interferograms. Under the premise that the uplift velocity is constant the stack provides a preliminary assessment of the uplift pattern around the Dead Sea.

So far, the interferogram stacks do not reveal a significant crustal unloading signal. What can be clearly recognized are localized zones of increasing LOS-distances; a prominent one is found north-east of the Dead Sea near Wadi Kafrein. We interpret this local signal as subsidence induced by intensive groundwater use. Time averaged subsidence rates in the Kafrein area reach 1.6 cm/year, while the shape of the subsidence bowl is elongated along the mapped eastern boundary fault of the basin. Possible reasons for the asymmetry of the subsiding area and the large rates are (i) structural, i.e. an influence of the boundary between consolidated/unconsolidated sediments, or (ii) tectonical, i.e. a pore pressure induced reactivation of the pre-existing normal fault.