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# Ground motion measurement in the lake Mead area (Nevada, USA), by DInSAR time series : probing the lithosphere rheological structure

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SAR interferometry has proven to be a reliable method for detecting small displacements due to ground subsidence. In this study, we measure ground motion around the lake Mead (Nevada, USA) using InSAR. This artificial lake has been filled with water in 1935. An earlier study, based on leveling measurements, has shown that the load associated with lake impoundement induced a subsidence of 17 centimeters. This relaxation process has been argued as analogous to the postglacial rebound, but at a smaller spatial scale and with a much lower viscous relaxation scale. To quantify the deformation and thus constrain the crust and mantle rheological parameters in the lake area, we analyze multiple interferograms (241) based on 43 ERS images acquired between 1992 and 2001. With baselines smaller than 300 m, all interferograms have a very good coherence due to the desert region. Most of interferograms are affected by strong atmospheric delays that are partly due to the variation of water vapor vertical stratification between two satellite passes. This tropospheric delay is computed for each interferogram and then inverted for each date of SAR images before interferogram correction. These corrections are validated using data from global atmospheric models (ERA40). Corrected interferograms are then inverted to solve for the time series of ground motion in the lake Mead area. The linear inversion treats each pixel independently from its neighbours and uses the data redundancy to reduce errors such as local decorrelations. Additionnal constraints such as temporal smoothing allow to reduce the local atmospheric artefacts. We obtain a time series of the deformation in the lake Mead area with a millimetric accuracy. The deformation is non linear in time and spreads over a large spatial scale. In particular, we observe a subsidence of up to 1.6 cm between 1995 and 1998 due to a 10 meters water level increase, followed by an uplift due to the drop of the water level after 2000. The deformation model allows to

constrain the rheology in the lake Mead area. The model takes into account the loading history of the lake since 1935. We show that a simple elastic response with parameters constrained by seismic experiments in the area does not explain the amplitude and spatial wavelength of the observed motion. To fit the data, a low viscosity (around $10^{18}$ Pa.s) in the lithospheric mantle below a 30 km thick elastic layer is required.