Paper 198 - Session title: Poster Session 2

Thursday-121 - High-resolution InSAR Constraints on Subsidence Mechanisms and Mechanical Properties of Sediments along the Dead Sea Shores

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Sinkholes and sinkhole-related land subsidence constitute a severe geo-hazard along the Dead Sea in Israel and Jordan, affecting both human activities and infrastructure. In order to discriminate between potential subsidence triggers (dissolution, viscoelastic creep, consolidation) and to constrain some of the mechanical properties of the subsurface granular sediments, we examine a 4-year long subsidence record using high-resolution InSAR measurements from the COSMO SkyMed satellites. In particular we study: (a) sinkhole precursory subsidence, which show gradual acceleration before (and in places, also after) sinkhole collapse; (b) Land subsidence in response to surface loading in the mudflats environment, which is characterized by an initial rise and a quasi-exponential decay; and (c) Subsidence following flash-flood events, which is characterized by an abrupt increase immediately after the floods due to enhanced salt dissolution, and a quasi-exponential decay thereafter. Precursory subsidence duration correlates with the sediment properties, in agreement with previous numerical simulations, and can thus be used to constrain sediment viscosity. For the loading experiments in the mudflats, we explore consolidation and viscoelastic creep as possible subsidence mechanisms. Quasi-exponential subsidence decay after flash-floods can be explained by: (a) decay of salt dissolution rate due to an exponential drop of the groundwater hydraulic head after a flash flood; (b) Viscoelastic creep; (c) A combination of dissolution and creep. The Kelvin-Voigt creep model can explain the entire observed subsidence decay pattern, constraining the viscosity and elastic modulus of the consolidated gravel to 10^{15} - 10^{16} Pa s and ~175 MPa, respectively. However, if the elastic moduli are limited to values reported in previous studies (600-4700 MPa), only 10-30% of the subsidence can be explained by viscoelastic creep, implying that more than 70% of the post-flood subsidence decay should be attributed to decreasing dissolution rates due to the observed exponential drop of groundwater head. The viscosity values obtained by our calculations agree well with numerical simulations of sinkhole formation along the Dead Sea, whereas the elastic moduli are generally on the lower end of previous estimates.