DATA ASSIMILATION OF LAND SUBSIDENCE MEASUREMENTS FOR THE ESTIMATION OF RESERVOIR GEOMECHANICAL PARAMETERS

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Geomechanical models are often used as tools to simulate or predict the impact on land surface of fluid withdrawal from deep reservoirs, as well as investigating measures for mitigation. The ability to accurately simulate surface displacements, however, is often impaired by limited information on the geomechanical parameters characterizing the geological formations of interest. In this study, we employ Kalman filter based data assimilation algorithms, to provide improved estimates of reservoir parameters through assimilation of measurements of both horizontal and vertical surface displacement into geomechanical model results. The method leverages about the demonstrated potential of remote sensing techniques developed in the last decade to provide accurate displacement data for large areas of the land surface.

For evaluation purposes, the methodology is applied to the case of a disk-shaped reservoir embedded in a homogeneous, isotropic and linearly elastic half space, subject to a uniform change in fluid pressure. Multiple sources of uncertainty are investigated, including the radius, the thickness and the depth of the reservoir, the pore pressure change, porous medium's vertical uniaxial compressibility (cM) and Poisson's ratio (ν), and the ratio (s) between the medium compressibilities during loading and unloading cycles. Results from all simulations show that the ES has the capability to effectively reduce the uncertainty associated with those parameters that are typically the most uncertain, namely cM and the ratio s. Sensitivity analyses demonstrate that estimation of the these parameters values is dependent on the number of measurements assimilated and the error assigned to the measurement values.