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Retrieving surface deformation by PSInSAR technology: a powerful tool in reservoir monitoring.

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Reservoir monitoring is aimed at measuring, controlling, and predicting the performance of a hydrocarbon reservoir in case of EOR (Enhanced Oil Recovery) and/or CCS (Carbon Dioxide Capture and Storage). Reservoir monitoring is based on an integrated approach involving both reservoir surveying (geophysical investigations, surface deformation measurement, leakage monitoring, etc.) and modeling.
Surface deformation monitoring can provide valuable information about the dynamic behavior of a reservoir, enabling the evaluation of volumetric changes in the reservoir through time. Leveling campaigns, tiltmeters, GPS permanent stations and Permanent Scatterer SAR Interferometry (PSInSAR) are the most used techniques to retrieve surface displacements. Whatever the adopted surveying technique, the detection of millimeter-level surface deformation is generally needed, in order to monitor even small displacement rates which could impact on risk evaluation and mitigation and land use planning. Depending on reservoir depth, volumetric changes in reservoirs due to both fluid extraction or injection can induce either surface subsidence or uplift, which might trigger fault reactivation and threaten well integrity. Mapping the surface effects of fault reactivation due to either fluid extraction or injection necessarily needs the availability of hundreds of points per square km, which can't be obtained with traditional monitoring techniques. PSInSAR represents one of the most promising and cost-effective techniques, capable of providing high precision and high areal density displacement measurements over long periods. Moreover the availability of PS data in both ascending and descending geometries enables the estimation of vertical and E-W horizontal displacement fields in the areas covered by both ascending and descending data.
Selected case histories will be presented, showing the advantages of PSInSAR technology in detecting surface evidences of fault reactivation induced by reservoir exploitation and monitoring their evolution through time, even in case of millimetric differential displacements.