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Modeling the poro-elastic signature of two medium-large earthquakes, tips from GPS and InSAR data

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In this work we focus on the poroelastic effects induced by the two mainshocks (Mw 6.1 and 6.0) of the Emilia-Romagna seismic sequence in May 2012. The poroelastic modeling was performed in a 3D half-space whose elastic and hydraulic parameters are depth dependent, in accordance with the stratification of the crust in the studied area. In particular the model represents time dependent pore-pressure changes and surface displacements due to the subsequent earthquakes under the assumption of locked faults during the postseismic phases. The results of the poroelastic model are compared with postseismic InSAR (SBAS series) and GPS displacement time series. The poroelastic signal is extracted from the GPS time series using a variational Bayesian independent component analysis (vbICA) method. Thanks to this method, we can separate the contribution of afterslip and poroelasticity on the horizontal displacements measured by the GPS stations. Comparing the model results with the poroelastic component present in the data, we infer that the poroelastic effects at the surface are small, but not negligible, especially in near field and they are mainly related to the drainage of the shallowest 3 km of the crust. We also show that both accounting for a 3D fault geometry with a non-uniform slip distribution and modeling the elastic-hydraulic layering of the half-space have an important role in the simulation results. Finally, studying the poro-elastic induced Coulomb Failure Function and the spatial distribution of the seismic sequence, we draw some conclusions about the possible influence of the pore pressure in the triggering of the seismic sequence.