New Thermo-Mechanical Fluid Flow Modeling of Multiscale Deformations in the Levant Basin

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Abstract

The Levant has been repeatedly devastated by numerous earthquakes since prehistorical times. In order to understand the role of the dynamics of the water bodies in triggering the deformations in the Levant basin, a new theoretical thermo-mechanical model is constructed and extended by including a fluid flow component, in COMSOL Multiphysics simulation environment. The latter is modeled on a basis of two-way poroelastic coupling with momentum equation. This coupling is essential to capture the fluid flow evolution induced by dynamic water loading and to resolve porosity changes. All the components of the model, namely elasticity, creep, plasticity, fluid flow, etc., have been extensively verified using and presented in the proposed study. We suggest that dynamic changes in the levels of the water bodies occupying the tectonic depressions in the Dead Sea Transform cause variations in the shallow crustal stress field and on the local fault systems, and trigger earthquakes. This mechanism and its spatial and temporal scales differ from those in tectonically-driven deformation, and once coupled together, they are defined in the current project as multiscale deformation. This coupling has never been explored previously in depth. Then the correlation with historical and contemporary earthquakes in the region will be discussed.

Figures used in the abstract

Figure 1

Figure 2

Figure 3

Figure 4