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New thermo-mechanical fluid flow modeling of multiscale deformations in the Levant basin: formulation, verification, and preliminary analysis

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The Levant has been repeatedly devastated by numerous earthquakes since prehistorical time, as recorded in historical documents, archaeological ruins, and sedimentary archives. 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. 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 and presented. Results of the initial sensitivity analysis addressing the relative importance of each process in earthquakes triggering are discussed. The rich archives of pre-instrumental destructive earthquakes will set constraints for future modeling under the present formulation.