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RECENT ADVANCES IN COMPUTATIONAL GEOMECHANICS

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ABSTRACT

Geomaterials, including soils, rocks, concrete, snow and ice, are porous, heterogeneous and often multiphase media that exhibit nonlinear deformation and failure under natural and engineering conditions. Their behaviour is governed by plasticity, damage, fracture, strain localization and coupled thermal, hydraulic, mechanical and chemical processes, which are central to geohazards, underground energy storage, carbon sequestration, tunnelling, foundations, slopes and resilient geo-infrastructure. Predicting these processes requires advanced computational plasticity frameworks capable of capturing material nonlinearity, multiscale failure, multiphysics coupling and field-scale complexity.

This invited session aims to bring together researchers and practitioners to discuss theoretical, numerical, experimental and data-driven advances in computational plasticity for geomaterials and geosystems, with emphasis on robust constitutive models and computational methods for understanding and predicting deformation and failure across scales. Topics of interest include, but are not limited to: elastoplastic, viscoplastic and hypoplastic constitutive modelling; strain localization, shear banding, compaction banding, damage and fracture in geomaterials; coupled THM and THMC modelling of porous media; multiscale and micromechanical approaches; phase-field, peridynamic, meshfree, particle-based and hybrid numerical methods; model calibration, verification and validation using laboratory and field data; uncertainty quantification, inverse analysis and probabilistic modelling; machine-learning-enhanced constitutive models, surrogate models and model updating; digital twins and computational frameworks for monitoring and field-scale applications. The Mini-Symposium will provide an interdisciplinary platform for exchanging recent advances between computational mechanics, plasticity theory, geomechanics, data science and engineering practice. It aims to advance reliable, predictive and efficient computational tools for safer, more sustainable and resilient interactions with the Earth's subsurface systems.