Stochastic approaches in the optimization of hydro-mechanical models of landslides

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Abstract

Landslides, such as any other geological system, are characterized by an intrinsic heterogeneity of the system proprieties distribution, which take place at any scale. Currently, when dealing with slope stability analysis and modelling of a specific landslide (aimed to slope deformations and/or hazard assessment), mathematical models are used to simulate the hydro-mechanical response of a rock/soil mass subjected to a set of initial and boundary conditions. Since the analytical solution of the governing equations is complex, numerical methods require to discretize the model domain into a finite number of elements/cells associated to a parameter value. However, especially in large scale landslides, most of the time the characterization of parameter distributions inside the model domain is based on few measurements involving a small fraction of the volume of interest. Such lack of knowledge could negatively affect the outcome of a calibration/optimization process, especially when predictions of interest are sensitive to those parameters which are not been directly measured in field. Therefore, results of numerical methods used to reproduce the system behaviour, are affected by uncertainties which should be minimized and, in any case, quantified. This task can be based on one or different uncertainty assessment methods, which span from the sensitivity's analyses to Monte Carlo-based simulations. The results of the uncertainty analyses, if properly accomplished, can give new insights of the landslide's behaviour in his natural or in anthropically modified setting, therefore being a valuable aid in the hazard management framework.