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Uncertainty analysis in a slope hydrology and stability model using probabilistic and imprecise information
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Abstract
In practical geotechnical analysis information may appear in a range of formats, including inexact measurements, probability distributions, linguistic classification and expert judgements. These information formats also appear in the literature, from where modellers may wish to obtain prior information about uncertain soil parameters. Conventional probabilistic uncertainty analysis requires that all uncertain information be expressed as precise probability distributions, regardless of the (often non-probabilistic) format of the original information. The theory of random sets provides a general mechanism for handling information in the form of intervals, sets of intervals or fuzzy sets, as well as (discrete) probability distributions. Relevant theory is developed for constructing random relations describing soil properties, aggregating information from different sources and propagating it through geotechnical models. The theory is applied to the analysis of the stability with respect to rainfall-induced landsliding using a combined slope hydrology and stability model. In the example the soil properties determining slope hydrology are described by joint probability distributions whilst the main geotechnical parameters are represented as sets of intervals. The methodology is readily extended to other combinations of probabilistic and interval-valued information.