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Variance-based sensitivity analysis of the probability of hydrologically induced slope instability
Computers & Geosciences (2006), 32(6), 803-817
doi:10.1016/j.cageo.2005.10.007

Abstract
Analysis of the sensitivity of predictions of slope instability to input data and model uncertainties provides a rationale for targeted site investigation and iterative refinement of geotechnical models. However, sensitivity methods based on local derivatives do not reflect model behaviour over the whole range of input variables, whereas methods based on standardised regression or correlation coefficients cannot detect non-linear and non-monotonic relationships between model input and output. Variance-based sensitivity analysis (VBSA) provides a global, model-independent sensitivity measure. The approach is demonstrated using the Combined Hydrology and Stability Model (CHASM) and is applicable to a wide variety of computer models. The method of Sobol', assuming independence between input variables, was used to identify interactions between model input variables, whilst replicated Latin Hypercube Sampling (LHS) is used to investigate the effects of statistical dependence between the input variables. The SIMLAB software was used, both to generate the input sample and to calculate the sensitivity indices. The analysis provided quantified evidence of well-known sensitivities as well demonstrating how uncertainty in slope failure during rainfall is, for the examples tested here, more attributable to uncertainty in the soil strength than to uncertainty in the rainfall.