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Effects of slope geometry on large slope instabilities

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Slow, sliding and flexural toppling of rock masses commonly creates large-scale mountain slope deformations. Key parameters of the undeformed rock mass may influence failure behaviour and instability initiation and evolution. Numerical modelling, through a parametric study of a large rock slopes, is a powerful tools for understanding the postglacial evolution of the high slopes and for demonstrate the importance of lithological and structural constraints and weathering on sackung triggering and development. Three-dimensional numerical models (Flac3D) have been prepared for various idealized slopes which differ in slope angle, length, orientation respect to the main valley and internal material anisotropy. Models were initially run to evaluate the sensitivity of the models to rock mass property, boundary conditions, including glacial unloading and reloading and groundwater level. Data used in the 3D models include the initial slope geometry, rock mass property and internal anisotropy (pervasive foliation planes). We assumed Mohr-Coulomb behaviour associated with ubiquitous joints to simulate the dipping of foliation in metamorphic rocks. Groundwater conditions were imposed simulating different piezometric levels and varying them during deglaciation stages. The model results indicate that plastic deformation initiates near the highest ridge just after deglaciation commences. A shear zone develops at this time and propagates toward the toe of the slope. The thickness of the failing mass increases from 50 m to more than 100 m during glacier retreat and it depend of geometry of slopes. Different internal shear zones occur into the slopes and indicate different failure behaviour depending on the foliation planes orientations. Numerical modelling show a condition of continuous dynamic equilibrium with slow displacement after an initially accelerated phase and that average slope angles, generally less than those of fresh deglaciated slopes, may represent values for slope that are in this state of “equilibrium”.