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Incorporating GIS and numerical simulations for rock slope stability modelling

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We present a first approach to interlink a GIS (Geographical Information System) with a 2-D numerical simulation scheme (UDEC, Universal Distinct Element Code) for the modelling of rock slope instability phenomena on vertical 2-D cross sections through a GIS-based specification tool. Within the raster-based RSS-GIS (Rock Slope Stability GIS) environment, pixel locations susceptible for slope failure can be delineated with the use of distributed rock slope data sets. Pixel independent, distributed slope stability calculations based on linear (Mohr-Coulomb) strength criteria can be conducted while incorporating geotechnical rock discontinuity parameters and hydrostatic pressures as derived from a steady-state hydrologic model.

Since the GIS-based rock slope stability analysis can be shown to render valid results for static sliding susceptibility analysis of large slope sections under varying hydrological conditions, it is not capable for a mechanical examination of failure processes due to the requirement of much more complex calculation procedures than those that can be performed within GIS-frameworks. For this purpose, we have developed a GIS-based specification tool for interactive setup and parameterization of numerical models with GIS data to be processed with UDEC. 2-D numerical problem geometries can be set up automatically with the GIS-encoded rock slope data base through interactive definition of cross sections through critical slope portions in homogeneous structural domains. The models can be interactively parameterised with GIS-based geotechnical rock slope data as derived e. g. from rock mass rating procedures. Hydrological and mechanical boundary conditions can be defined with GIS-based data up to a certain degree; however, due to the regional modelling approach only simple conditions are

applied.

The presented applications of the technique at two structurally different test locations with different types of rock slope instability phenomena point to the clear advantages of direct coupling of a GIS with a numerical simulation tool with respect to rock slope instability hazard assessments. Our approach will be useful for the future design of GIS-encoded prognostic rock slope hazard, risk and vulnerability assessment tools.