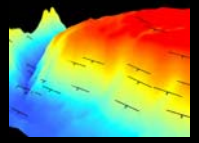
Coupling GIS and field data for landslide hazard predisposition assessment and mapping, using 3D geological modelling

Case study of the Graitery mountain, Canton of Berne, Switzerland

DEM
Geological maps
Boreholes

3D geological model



Interpolating dips

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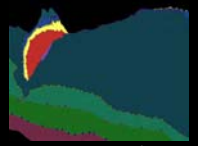

Spreading the geological information using the calculated dips

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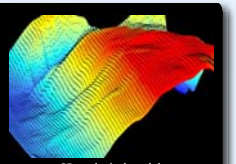

3D geological model in guise of a virtual boreholes grid

Granulometry
Plasticity
Fracturation

3D homogeneous geological units

Merging the geological formations according to the geotypes

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In situ tests (ponctual data)

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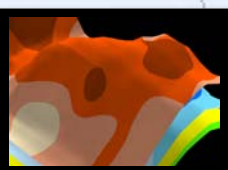
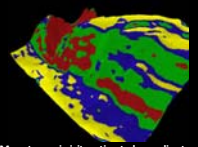


Homogeneous geological units 3D modelling

Measured piezometric level
Hydrographic network map

Simulated piezometric level



Mean transmissivity estimated according to the homogeneous geological units

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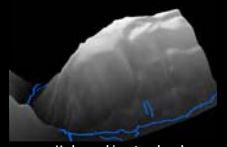

Hydrographic network and measured piezometric levels

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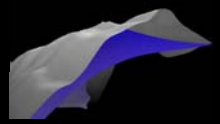


Simulated piezometric level

3D factor of safety

(calculated for each virtual borehole of the model at several depths, keeping the lowest value)

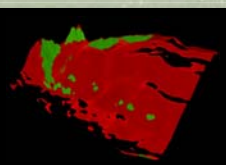
$$FS = \frac{c + \{[(\gamma \cdot \cos\alpha) - u] \cdot \tan\varphi\}}{(\gamma \cdot \sin\alpha) + (\gamma_w \cdot i)}$$

c: cohesion (Pa)
γ : unit weight of the formations ($N.m^{-3}$)
α: slope (°)
u: pore water pressure (Pa)
φ: internal friction angle (°)
γ_w: unit weight of the water ($N.m^{-3}$)
i: hydraulic potential gradient (-)

Situation of the Graitery mountain (BE)

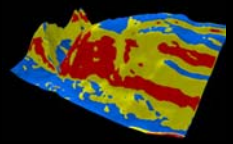
Elevation
Aspect
Vegetation
Pre-existing mitigation work

Stabilizing and destabilizing factors



Summarizing map of the factors with positive or negative effect on stability

Map of slope instability predisposition



ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Contact: Séverine Bilgot
EPFL ENAC IIC GEOLEP
Station 18
1015 Lausanne
Suisse

E-mail: severine.bilgot@epfl.ch
Tel: (+41) 021 693 23 51