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Sloping Local Base Level an insight to the definition of the volume implied in gravitational earth crust movements

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Each mass located above sea level or above a given base level is erodible, but it takes several 100 M years to reach a flat topography (peneplaination). Part of the erosive budget is supplied by gravitational processes such as mountain chain collapse and landslides that imply thrusts, faults, discontinuities or shear zones. Such surfaces can be considered as base levels. The concept of Sloping Local Base Level (SLBL), was developed to characterize the base level applied to mountain chains or to landslides.

At the scale of a mountain chain, the SLBL is a curved surface causing thrusts and ramps in the external part of the chain (Molnar and Lyon-Caen, 1988). At the scale of a valley, the SLBL causes deep-seated landslides affecting especially very steep and deep valleys (Terzaghi, 1962). At the scale of a slope, several orders of SLBL can be found, ranging from the entire slope to small spurs. The time scale of the considered erosional process increases with its volume: typically, it takes several 10 M years for a mountain chain to collapse, but the time scale of slope processes reaches 10,000 years.

Considering slope processes, the SLBL can be defined using invariant points such as rivers incising the bedrock. The surface defined by the rivers makes it possible to define a surface above which rocks are considered to be erodible within a short period of time (i.e. 10,000 years), in other words those volumes are undercut. The erodible volume varies with the order of rivers chosen to define the SLBL. Because river networks follow a fractal law, the erodible volumes also follow fractal or power law distribution rules.

Field observations show different orders of SLBL in many slopes. The same observations can be made in many rockfall scars, such as the 1991 Randa rockfall scar (Switzerland; 30 M m3) or the 1922 Arvel rockfall scar (Switzerland; 0.6 M m3). Moreover, structures like lystric faults or landslides affecting sensitive clays follow also rules that are controlled by the SLBL.

As the SLBL is easy to compute, it appears to be a good tool for landslide hazard assessment.

References:

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