Geophysical Research Abstracts, Vol. 8, 04214, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04214

Topography and Hazards

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Topography and its change through time play a major role in geological and hydrometeorological hazard. The stability of slopes and the likelihood of landslides are controlled by topography, geology, and precipitation. All 3 factors change with time: Uplift increases the slope, soil cohesiveness and friction is modified by wheathering, precipitation patterns shift with regional and global climate change. Topography is critical for the development of floods as for a given flood it controls the area of inundation. Thus changing topography changes flood risk. At the same time topography influences critically the distribution of wind velocities, the main damage parameter, in case of storms.

The occurrence of earthquakes depends on the distribution of stress in a homogeneously and inhomogneously strained lithosphere. It can be demonstrated that the actual distribution of stress in the brittle crust cannot be understood by looking at elastic plate models but is very much influenced by topography in a twofold sense: The surface topography and the Moho topography in an elastic and plastic rheology. We take this as an indication that physical models of seismicity require (a) the present structure of crust and mantle, (b) the recent lateral and vertical deformation, (c) more realistic constitutive relations for deformation on faults that allow to understand the distribution of seismic and aseismic deformation and the episodic or intermittent character of intraplate seismicity.

The talk will provide examples from recent research and attempt to formulate major challenges for TOPO-EUROPE hazard research, such as regional slope stability maps and their potential to change with time and large-scale physical modeling of stress and strain evolution in earthquake-prone zones.