Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10784, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10784
EGU General Assembly 2008

A methodology to derive quantitative, experimentally based, maps of the upper soil layers conductivity in mesoscale alpine catchment

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The vertical hydraulic conductivity K_s at soil saturation is a key soil property affecting a number of surface processes. Otherwise K_s is characterised by high space variability, especially in complex topography areas, and its values frequently span orders of magnitude. Accounting also for the cost of field and laboratory activities, it is often difficult to produce a physically sound quantitative map of K_s over a whole basin at the mesoscale (few hundreds to few thousand square kilometers). Here an experimental methodology, based on a preliminary soil classification and on the use of the single ring infiltrometer and of the falling head permeameter, is proposed. Then, as a result, the data obtained after several field and laboratory campaigns are presented and discussed.
The hypothesis, that the soil response to a rainfall event is largely influenced by its pedogenesis and by its landcover, was introduced as a preliminary classification. Pedogenesis, in fact, affects the soil layering, structure and grain size distribution, and implicitly accounts for other soil forming agents, as climate, ageing and relief. On the other hand landcover can account for most of the organic action on the soil structure. A preliminary qualitative map of the infiltration classes of the investigated basin can be therefore provided by a cross-tabulation of a lithologic and a landcover map. On the basis of this map the experimental points are located, according to the homogeneous areas, on the basis of representativeness criteria. At the experimental sites K_s values are measured for the surface and some subsurface layers, down to the depth of about 50 cm, when possible. A value of the hydraulic conductivity at saturation is finally provided for each infiltration class.

As a result of wide field and laboratory experimental campaigns, this methodology was applied to obtain the surface conductivity maps of three Alpine basins. These are respectively characterised by metamorphic rocks (the Toce River basin at Candoglia, 1532 km^2, in the Eastern Italian Alps; here 146 experimental sites were selected), by significant intrusive formations (the Oglio River basin at Costa Volpino, 1446 km^2, in the Central Italian Alps; 100 sites) and by mainly sedimentary rocks (the Mella River basin at Stocchetta, 312 km^2, Central Italian Alps; 120 sites). The experimental analysis moreover shows an average exponential decay factor of K_s, respectively, of about 0.19 m for the Toce River basin and 0.12 m for the Mella River basin.