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Use of tracers to investigate preferential flow in heterogeneous and unstable media : the case of active mudslides in French Alps.

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Among the difficulties usually encountered in catchment hydrology, the study of local scale hydrological processes comes up against the critical point of scaling up the information to proper scale in term of risk or resources management. In highly heterogeneous media, the major impact of preferential flow makes the question still trickier since the problem of measurements is to be added to the areal extrapolation. One of the most suitable methods to elaborate hydrological conceptual scheme at hillslope or catchment scale is water tracing (both environmental and artificial). In the framework of the GACH2C and ECOUPREF projects, environmental and artificial tracers, both isotopes and solutes, were used to clarify infiltration and groundwater recharge processes on different black marl unstable hillslopes of southern French Alps. The investigation was carried out at different time steps (from event to long term scale) and from local to catchment scale.
Long term isotopic monitoring showed that mean residence time of groundwater was quite short (around a year). However, local isotopic and hydrochemical anomalies suggested that part of groundwater recharge could be due to areas outside the watershed. At local scale, artificial rainfall experiments were carried out in summers 2007 and 2008 and in autumn 2007 using bromide and chloride as tracers. Despite the impervious nature of the marl material, initial results showed how efficient was the role of areal heterogeneity (fissures system, matrix-blocks contacts) on the rapid percolation of water to the water table. Experimental investigations in different soil surface contexts made it possible to propose a first attempt of macropore flow typology and assess the impact of initial and forcing conditions on the preferential flow generation. The analysis of these data provides a description of the main flow mechanisms in the marl material. This advancement in hydrological process understanding helps in better understanding the movement dynamics of the unstable marly slopes that we studied.