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Empirical prediction of the temporal change of hydraulic conductivity in tilled Mediterranean vineyard

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The use of distributed runoff models for the evaluation of hydrological impacts of crop management practices in cultivated catchments (e.g erosion, water pollution) requires recognition of the temporal change of soil hydraulic parameters as influenced by tillage operations and subsequent reconsolidation of the tilled layer under the influence of climatic factors. The more numerous the tillages are during the cultural cycle, the more complicated this recognition is. That is the case of crops with small soil cover like vineyards for which soil tillage is operated several times between the vines rows troughout the vegetative cycle.
The objective of this study was to predict with only few parameters the temporal change of hydraulic conductivity at the plot-scale in a viticultural Mediterranean catchment in southern France.

Hydraulic conductivity was evaluated through 4 classes of soil surface caracteristics (SSC) which differ by different levels of soil crusting, roughness and porosity. A previous experiment showed that each class has a significantly different infiltration property as measured by rainfall simulation. A number of 600 observations of SSC were performed on 59 tilled plots from which 480 from march to july 2007 and 120 from february 2004 to february 2007. The dates of tillages were known thanks to weekly observations and to farmer's declarations. Rainfall was measured by a rain gauge. A discriminant analysis was applied to the observed data in order to derive an empirical equation that predicts the temporal change of SSC.

The results showed that during the vegetative cycle, with regular tillages operations between the vines rows, the temporal change of SSC was well predicted by two parameters : total amount of rainfall and cumulative rainfall kinetic energy since last tillage. Then, each SSC was linked to an hydraulic conductivity, and consequently, the evolution of the soil hydraulic conductivity could be predicted from the evolution of SSC.