Large-scale lateral saturated soil hydraulic conductivity as metric for the connectivity of the subsurface flow paths at hillslope scale

Mario Pirastru[1], Massimo Iovino[2], Hassan Awada[1], Roberto Marrosu[1], Simone Di Prima[1], and F. Giadrossich[1]

[1]University of Sassari
[2]Università degli Studi di Palermo

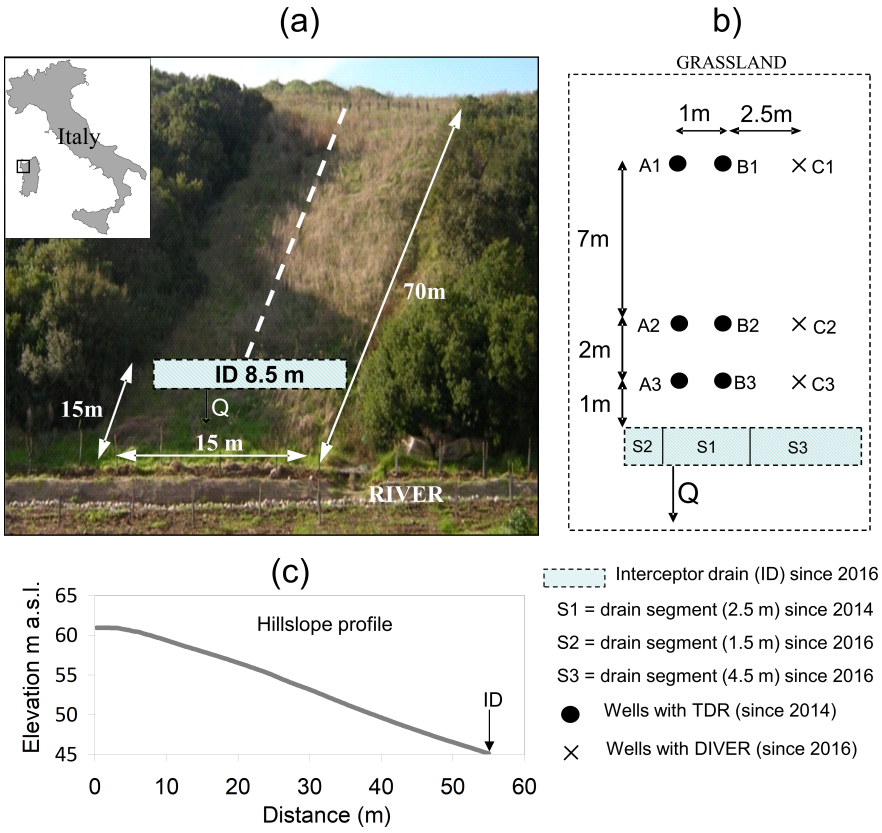
December 8, 2021

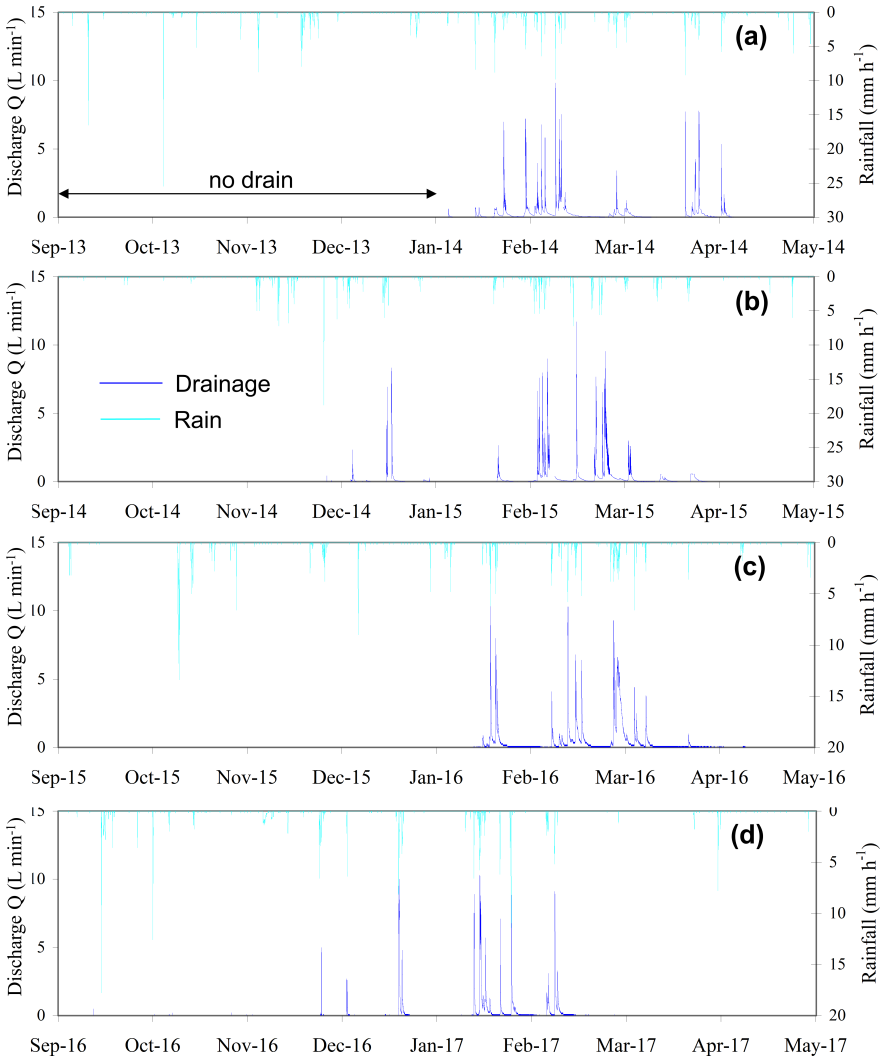
Abstract

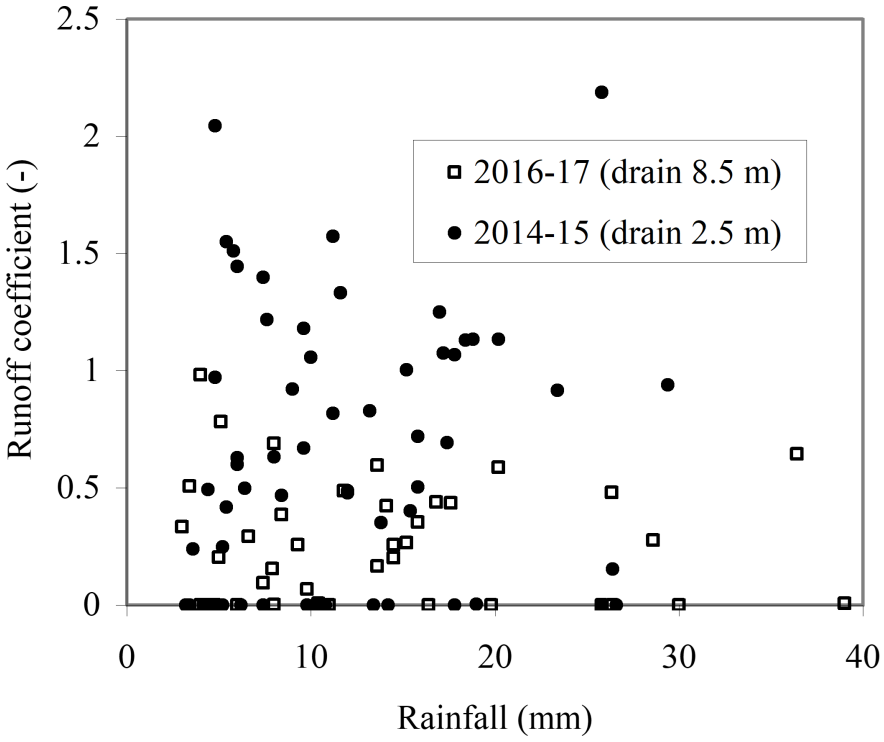
Lateral saturated soil hydraulic conductivity, Ks,l, is the soil property governing subsurface water transfer in hillslopes, and the key parameter in many numerical models simulating hydrological processes both at the hillslope and catchment scales. Likewise, the hydrological connectivity of lateral flow paths plays a significant role in determining the intensity of the subsurface flow at various spatial scales. The objective of the study is to investigate the relationship between Ks,l and hydraulic connectivity at the hillslope spatial scale. Ks,l was determined by the subsurface flow rates intercepted by drains, and by water table depths observed in a well network. Hydraulic connectivity of the lateral flow paths was evaluated by the synchronicity among piezometric peaks, and between the latter and the peaks of drained flow. Soil moisture and precipitation data were used to investigate the influence of the transient hydrological soil condition on connectivity and Ks,l. It was found that the higher was the synchronicity of the water table response between wells, the lower was the time lag between the peaks of water levels and those of the drained subsurface flow. Moreover, the most synchronic water table rises determined the highest drainage rates. The relationships between Ks,l and water table depths were highly non-linear, with a sharp increase of the values for water table levels close to the soil surface. Estimated Ks,l values for the full saturated soil were in the order of thousands of mm h-1, suggesting the activation of macropores in the root zone. The Ks,l values determined at the peak of the drainage events were correlated with the indicators of synchronicity. The sum of the antecedent soil moisture and of the precipitation was correlated with the indicators of connectivity and with Ks,l. We suggest that, for simulating realistic processes at the hillslope scale, the hydraulic connectivity could be implicitly considered in hydrological modelling through an evaluation of Ks,l at the same spatial scale.

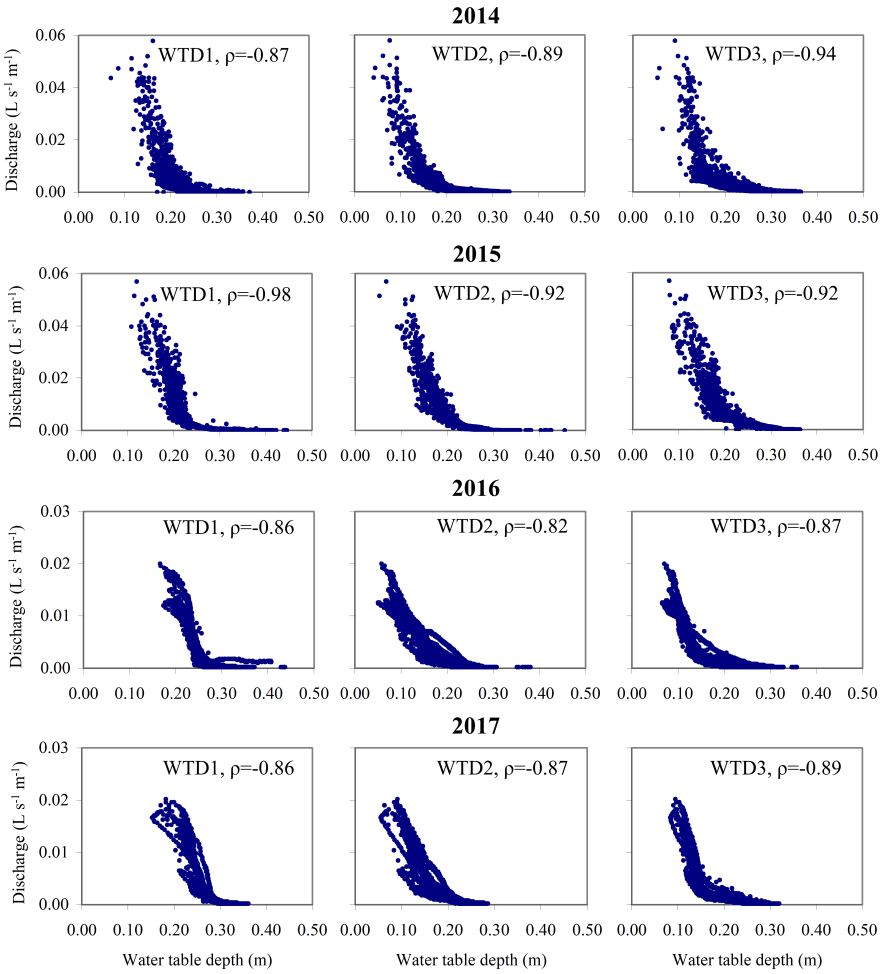
Hosted file

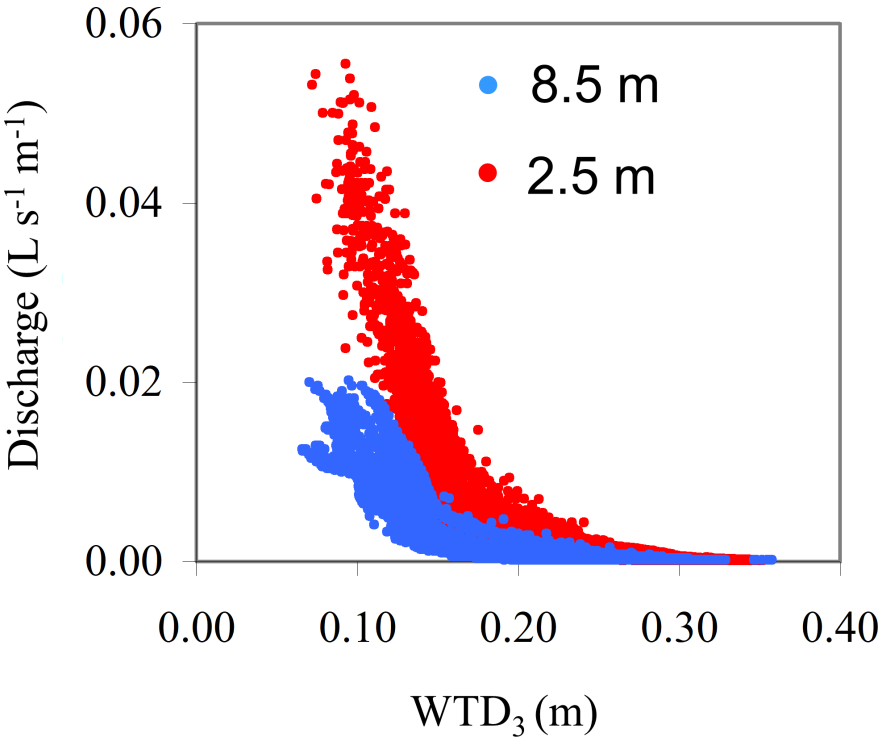
`Pirastru et al. 2021 for submission.DOCX` available at https://authorea.com/users/450202/articles/548576-large-scale-lateral-saturated-soil-hydraulic-conductivity-as-metric-for-the-connectivity-of-the-subsurface-flow-paths-at-hillslope-scale

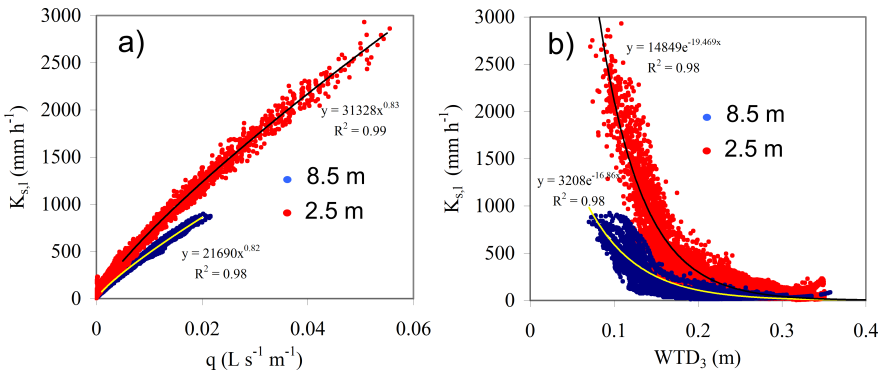


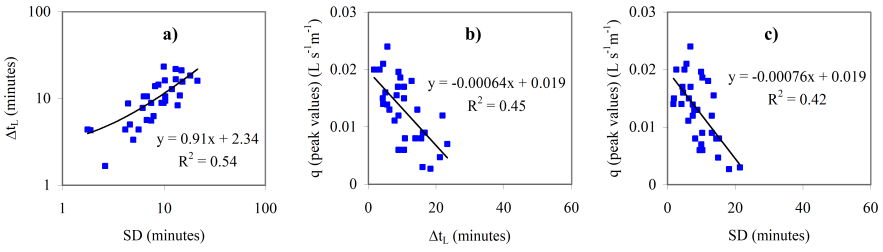


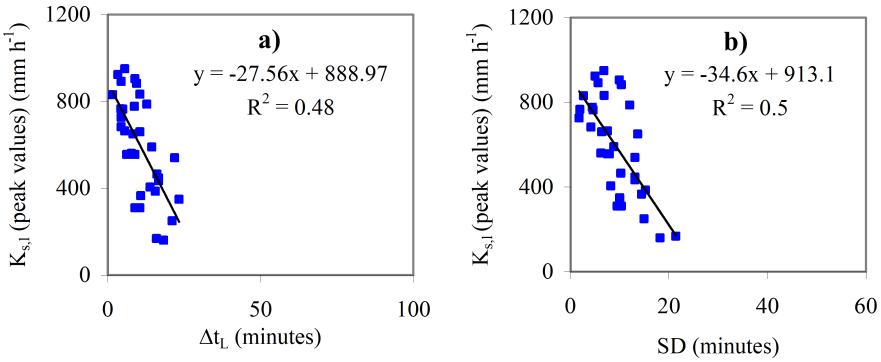


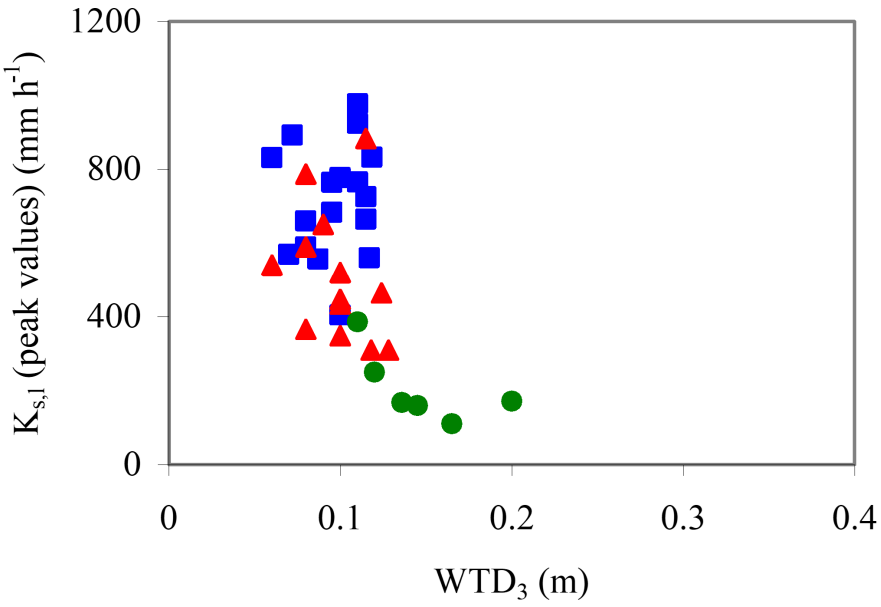


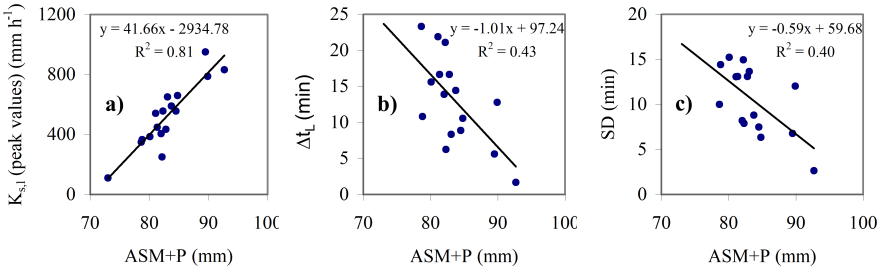


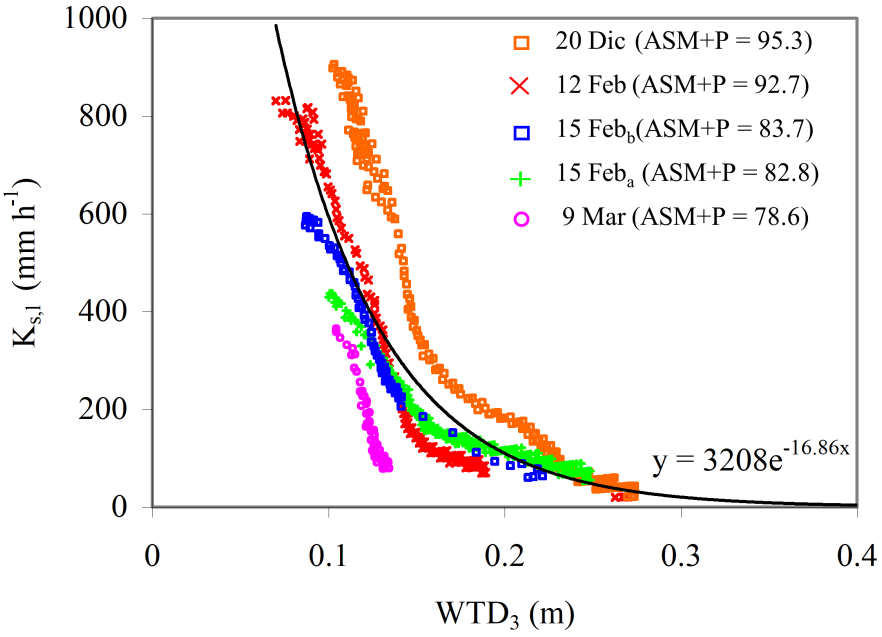












Hosted file

Table 1.docx available at https://authorea.com/users/450202/articles/548576-large-scale-lateral-saturated-soil-hydraulic-conductivity-as-metric-for-the-connectivity-of-the-subsurface-flow-paths-at-hillslope-scale

Hosted file

Table 2.docx available at https://authorea.com/users/450202/articles/548576-large-scale-lateral-saturated-soil-hydraulic-conductivity-as-metric-for-the-connectivity-of-the-subsurface-flow-paths-at-hillslope-scale

Hosted file

Table 3.docx available at https://authorea.com/users/450202/articles/548576-large-scale-lateral-saturated-soil-hydraulic-conductivity-as-metric-for-the-connectivity-of-the-subsurface-flow-paths-at-hillslope-scale

Hosted file

Table 4.docx available at https://authorea.com/users/450202/articles/548576-large-scale-lateral-saturated-soil-hydraulic-conductivity-as-metric-for-the-connectivity-of-the-subsurface-flow-paths-at-hillslope-scale