



Reconciling spatial scales with connectivity?

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Erosion processes may not be continuous within a catchment, and runoff and erosion responses to rainfall events differ in function of the spatial scale of observation. Many of the underlying mechanisms of this scale effect are still unknown and/or not well described. In addition to spatial heterogeneities, erosion processes are also varying depending on the temporal resolution of measurements from the effect of the temporal dynamic of successive rainfall events to more seasonal variations either influenced by climate or anthropogenic land use changes. These spatial and temporal variations interact nonlinearly and are subject to thresholds, underlining the complexity of erosion processes. The objective of this paper is to identify and illustrate these scale effects on runoff and erosion, from the field scale to the river catchment scale in the context of temperate to Mediterranean conditions. The analysis of sediment budgets at different spatial and temporal scales permits to identify some of the dominant processes in the different contexts, and also to distinguish natural from anthropogenic influences. Concerning upland physical soil surface erosion rates, we find that the average travel distance of eroded particles may be limited, implying a strong decrease in physical erosion rates when moving from the local scale (m^2) to the river basin scale ($> 103 km^2$). Chemical erosion rates are less sensitive to scale and can either decrease or increase with increasing area in function of lithology, anthropogenic land management and topography. The results also highlight the predominant role of surface connectivity to characterize the fraction of sediment exported out of river drainage areas by physical soil surface erosion. For the export of dissolved sediment originating from weathering processes, the catchment physiography and connectivity does no longer play the dominant role. A direct link between soil production rates and exported dissolved fluxes tends to show that, contrary to the suspended particles, which are transport-limited, the dissolved matter seems to be supply-limited.