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Soil erosion in time and space

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Detailed soil erosion models generally express rates of sediment transport in terms of flow power or tractive stress in relation to soil strength. Such expressions can conveniently be put in the form of power laws for discharge and gradient, with or without a lower threshold for movement, and parameterised with a soil erodibility. If these expressions are to be used to estimate spatial differences in erosion rate over an area or to estimate long term erosion rates for hillslope evolution, then they must be explicitly or implicitly integrated over the time series of runoff events, which must in turn be linked to climatic data.

Here we explore a number of ways of integrating over the spatial domain to provide an objective distribution map for soil erosion across Europe. The simplest form of this uses daily rainfalls and a linear bucket for runoff in the PESERA model. In this model daily rainfalls are treated as random independent events, with monthly logging of soil moisture to provide seasonal antecedent conditions. Some improvements are proposed, using a simplified Green-Ampt infiltration equation to link with shorter term rainfall data and to provide continuous updating of antecedent conditions during wet periods.

Applying the same approach to long term evolution at a point, integration over the distribution of storms provides an explicit mechanism to incorporate the impact of climate change over time, both externally driven and, with a suitable regional climate model, allowing orographic interactions with the evolving topography.