Geophysical Research Abstracts, Vol. 9, 10645, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10645

Responses of a semi-arid landscape to human disturbance: a simulation study of the interaction between rock fragment cover, soil erosion and land use change

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Landscape responses to human-induced changes cannot always be studied using field monitoring and/or the analysis of

sedimentological archives. Simulation models can provide additional information on the time scale and the way that landscapes respond to human interference. We present an adapted version of the SPEROS model that is subsequently used to study the interaction of water erosion, tillage erosion and rock fragment cover under various land use scenarios on semi-arid hillslopes in southeast Spain. The simulation results show that such a model, based on a relatively simple representation of erosion processes is capable of capturing the essential characteristics of rock fragments patterns in this area, i.e. a semi-logaritmic increase of rock fragment cover with slope gradient on abandoned land and a linear relationship between rock fragment cover and curvature on intensively cultivated land. The model simulations indicate that such patterns develop in a decadal time scale and that the pattern on arable land is the result of the combined action of tillage and water erosion.The model simulations also allow to assess the effects of land use changes on overall sediment production rates due to water erosion. Land abandonment leads to an exponential decline of water erosion rates and hence of sediment export over a time scale of 50–70 years. Conversion of abandoned land to intensively cultivated arable land (e.g. almond groves) will lead to a peak in water erosion, lasting again for several decades after which the water erosion rates decrease again due to the increase of rock fragment cover on the hillslope due to intensive chisel tillage. Only under the traditional system of light mouldboard tillage relatively high

water erosion rates can be sustained for a long time period.The temporal and spatial patterns observed are clearly related to the interaction of water and tillage erosion: this interaction must therefore be accounted for in any long-term impact study.