Geophysical Research Abstracts
Vol. 14, EGU2012-13710-1, 2012
EGU General Assembly 2012

An integrated suspended sediment budgeting of the agricultural Can Revull catchment (Mallorca, Spain)

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The Mediterranean region of Europe has a long history of human settlement and human impacts. The very high spatial and temporal variability of fluvial processes in the region also creates problems for measurement and monitoring and for assessment of effects. Extensive rainfed herbaceous crops are one of the most representative agricultural elements of this region, which should be one of the major factor affecting erosion processes. Although land use is commonly seen as resulting in increased sediment yields, the implementation of soil and water conservation practices can have the reverse effect. Sediment budgets offer a means to assess the sources, storage, rates of transport, yields, and efficiency of delivery of sediment for a range of catchment scales. Field measurements were conducted in Can Revull, a small agricultural catchment (1.03 km2) on the island of Mallorca. This study uses 137Cs measurements, sediment source fingerprinting and continuous turbidity records of four hydrological years (2004-2005 to 2007-2008) to quantify the individual components of the budget. A large proportion of the material mobilized from cultivated fields without conservation practices (gross erosion was 775 t yr^{-1}; 1,270 t $km{-}2\ yr^{-1}$) was, however, subsequently deposited either within the field of origin (112 t yr^{-1}; 180 t $km{-}2\ yr^{-1}$) or at intermediate locations between the source field and the channel network (field-to-channel conveyance loss was 591 t yr^{-1}; 1,090 t $km{-}2\ yr^{-1}$). The estimates of sediment accumulation rates on the floodplain in the lower reaches of the catchment indicate that the mean sedimentation rate was 0.47 g cm-2 yr-1. This value was extrapolated to the total area of the floodplain to estimate a total annual conveyance loss or storage of 150 t yr^{-1}. Monitoring at the catchment outlet over the study period indicated a mean annual suspended sediment yield of 7 t km-2 yr-1. The sum of the estimates of sediment yield and floodplain storage (157 t yr-1) was taken to represent the total annual input of suspended sediment to the channel system. This value was subsequently apportioned using the information provided by the fingerprinting investigation, to estimate the mass of sediment reaching the channel network from cultivated fields and from eroding channel banks. Thus the annual contribution from channel banks was estimated to be 84 t yr-1. In the case of the contributions from cultivated fields, the estimates obtained were, as expected, significantly less than the values of net soil loss from these zones provided by the 137Cs measurements due to conveyance losses associated to field-to-channel conveyance loss. The overall sediment delivery ratios (<1%) indicate that approximately 99% of the sediment mobilized by erosion within the Can Revull catchment is subsequently deposited before reaching the monitoring station. As such, the low sediment outputs from the study catchment should be seen as reflecting the importance of conveyance losses and storage rather than a lack of sediment mobilization from the catchment surface, although part of the catchment headwaters was modified historically by means of terraces and transverse walls to prevent erosion.