Geophysical Research Abstracts
Vol. 14, EGU2012-1363, 2012
EGU General Assembly 2012

Quantifying the effects of human impact on sediment yield for European catchments

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Both from a scientific and environmental management perspective, there is a great need to better assess the magnitude of human impacts on catchment sediment yield (SY, t/km^2/y) and to identify the factors that control this magnitude. Quantification of these impacts is generally impeded by the lack of reliable SY data under "pristine" conditions, i.e. before the catchment was affected by humans in terms of land use or reservoirs. Based on a dataset with SY-measurements from 146 mainly forested catchments in Europe that were not affected by reservoirs, a regression model was developed. This model allows estimating pristine SY, based on the catchment topography, lithology and the degree of seismic activity (as indicated on earthquake hazard maps). Validation of this model indicated that this model is fairly robust, while 95% of the predicted SY-values deviate less than one order of magnitude from their measured SY-value.

Hence, the application of this model to a large (> 400) number of European catchments for which measured actual, i.e. "disturbed", SY-data were available allowed to quantify the effects of human impact on SY and their controlling factors.

It was found that catchment area has a strong control on catchment sensitivity to human impact. Whereas in small (< 1 km^2) disturbed catchments actual SY can be up to 100 times higher than their modeled pristine SY-value, a clear human impact is generally difficult to detect for catchments > 100 km^2. Furthermore, a clear positive relationship between the degree of SY disturbance (i.e. the ratio between the actual and the pristine SY) and the fraction of disturbed land use in the catchment was noted. Catchments with a high fraction of arable land (> 50%) also showed a more distinctive decrease in the degree of disturbance with increasing catchment area. However, the form of this relationship is also controlled by other factors, such as catchment lithology. The relation between the degree of disturbance and the presence of reservoirs, as well as the land use history was also investigated but yielded less clear results. Overall, these findings confirm reported field observations, indicating that hillslopes and small catchments are very sensitive to erosion, but that these impacts may become strongly buffered in larger catchments.