



Suspended sediment/discharge hysteretic loops and solutes as indicators for erosion processes in a headwater catchment in the Central Spanish Pyrenees

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Soil erosion is an important topic in Mediterranean mountain environments as it triggers/causes the loss of natural resources and the sediment load may produce severe off-site damages. Identifying the origin of the sediments in an experimental catchment is fundamental for understanding erosion processes (river bed incision, bank erosion, runoff erosion on slopes). In areas with a homogenous soft rock lithology and where land-use has eroded most of the topsoils, is difficult to differentiate the sediment sources with fingerprinting methods. Therefore, sediment sources have to be deduced from transport characteristics.

Hysteretic loops of the relationship suspended sediment concentration (SSC) / discharge (Q) are suitable for identifying different runoff and erosion types in small catchments, but their interpretation and linkage to different erosion and runoff processes is not easy without additional information.

This work presents the analysis of 100 rainfall-runoff events in a small, intensively disturbed, but now abandoned headwater catchment in the Central Spanish Pyrenees. The events were characterised by a set of variables related to precipitation, discharge, suspended sediment transport and solute load. In addition, they were divided into 3 groups following a classification based on the SSC/Q relationships: (1) clockwise shaped loops, (2) anti-clockwise shaped loops and (3) eight-shaped loops. Similar patterns in the relationships between SSC and solute concentration (EC) and EC and

Q were intended to be identified by analysing several singular events.

A correlation analysis (*Spearman's-Rho*) was performed to identify dependencies between different parameter groups mentioned above. A cluster analysis was carried out to explore whether the dataset of the floods allowed an automatic separation of different event types.

Results show that cluster analysis does not separate events into groups that can be identified as process related: no correlations were found between input and output parameters. On the contrary, significant correlations were found inside the groups separated by hysteretic loop classification. Floods with clockwise shaped hysteretic loop are result of channel erosion, and sediment delivery from the slopes is negligible, whilst events with eight shaped loops are clearly attributable to floods with linkage between sediment sources on the slopes and the river channel. Floods characterised by anti-clockwise hysteretic loop did not show any correlation between the different parameter groups so that they could not be related to any specific runoff and erosion process.

This interpretation is only possible by the introduction of solute transport parameters into the analysis.