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Uncertainty on the evaluation of sediment yield from badland areas: suspended sediment transport estimation in the Araguás catchment (Central Spanish Pyrenees).

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Badland morphologies are well known by its strong geomorphology dynamics, especially in mountain areas with sub-humid climate conditions, which produces very important amounts of sediment yield. Several studies associated to badland erosion and hydrological processes demonstrate that suspended sediment transport is, probably, the main process involved on sediment exportation. The very high suspended sediment concentration (SSC) values, known as hyper-concentrated fluxes, recorded on the gauging stations close to badland areas from Pyrenees (Araguás) and Alps (Draix), suggested that these fluxes should be able to transport very big particles in suspension, especially during extreme floods. It has been confirmed in the Araguás catchment through sediment traps located at different highs, on the middle of the stream bed. After two moderate floods (August 2006 and February 2007), it was observed that the percentage of suspended sediment particles of D > 2 mm was significantly increased within flood with the highest suspended sediment concentration peak (630 g.l-1 on February 2007) and during this event very big particles were found on the sampler tramps (D > 10 mm at 120 mm over the surface and D > 30 mm at 50 mm) with near 20% suspended particles bigger than 2 mm diameter. On the other hand, during the flood with lower SSC peak (145 g.l-1 on August 2006) the percentage of particles bigger than 2 mm reach only about 5%, while the highest particles found on the sediment traps was significantly smaller (D = 10 mm at 50 mm over the surface). The analyses of SSC data recorded in the Araguás catchment shows that around 15% of the SSC peaks reach hyper-concentrate values (> 500 g.l-1) and within the biggest discharge events (2.5%) concentration peaks can reach values higher than 1,000 g.l-1. These extreme values have also been recorded in studies in the badland areas of Draix (Alps), where suspended concentrations over 500 g.l-1 are usual and the highest values estimated reach 800 g.l-1.

These results suggest the importance of suspended sediment transport from mountain badland areas, which are evaluate using turbidity estimation provided by infrared turbidimeter devices and discharge values. It is very important take into account that infrared turbidimeters are unable to detect particles with D > 0.1 mm, while discharge can be evaluate with relative high accuracy. In the Araguás catchment, a statistically and positive lineal relationship between maximum discharge and maximum SSC is observed. The combination of this information suggests the evaluation of sediment yield using turbidity showing a very high range of uncertainty. If we consider that the highest percentage of suspended sediment is transported during the moderate-high floods and within these floods more than 20% of suspended particles shows D > 0.5 mm, we can conclude that estimation of sediment yield from these badland areas should be clearly underestimated. The factor of uncertainty could be calculated through the percentage of the diameter medium of particles not detected by the turbidimeter, and the specific weight of the material, but you can take into account that this uncertainty is not a lineal factor, and the error must be frequently over one order of magnitude. So the main conclusion of this study is to highlight the great difficulty and uncertainty for estimating sediment transport from badland areas using only turbidity data.