Geophysical Research Abstracts
Vol. 13, EGU2011-7857, 2011
EGU General Assembly 2011


# Influence of hydraulic parameters on sediment transport in shallow flows

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Sediment transport is an important component of the soil erosion process. It depends on several hydraulic parameters like flow rate, flow velocity, shear stress, flow depth, and slope gradient. However, the impact of these hydraulic parameters on sediment transport capacity of overland flow is still unclear. Therefore, the main objectives of this research were (1) to examine the influence of flow rate, mean flow velocity, flow depth, and bed slope on the sediment transport capacity, and (2) to investigate the relationship between sediment transport capacity and flow force variables i.e. shear stress, stream power, unit stream power, and effective stream power. Experiments were conducted in a 3.0 m long and 0.5 m wide flume with four well sorted commercially available non-cohesive sands with median grain diameters equal to 0.230, 0.536, 0.719, 1.022 mm. Unit flow rates ranging from 33 to 1033 x 10-6 m2 s-1 were simulated in the flume at slopes ranging from 3o to 10o to analyze the variation of sediment transport rate with grain size. Flow depths were measured by using the point gauge system and mean flow velocities were estimated by using an empirical equation, which was derived from a previous experiments. The measured sediment transport rates after equilibrium was reached were considered equal to the sediment transport capacities. The experimental results depicted that sediment transport capacity increased with both unit flow rate and slope. The effect of slope was more important than the flow rate. Similarly, the combined impact of flow velocity and slope on sediment transport capacity was also analyzed. Flow velocities actually decreased when slope was increased, because more sediment was detached and transported at steep slopes. The resulting high concentration of sediment in the flow retarded the flow velocity. Multiple regression analysis was carried out to determine relationships between sediment transport capacity and slope, unit flow rate, flow velocity and flow depth. The regression analysis between sediment transport capacity and slope and unit flow rate depicted a strong power relationship with a coefficient of determination (R2) equal to 0.92. Replacing unit flow rate with flow velocity gave a slightly better regression (R2 = 0.96), while substitution of flow depth resulted in a poor regression (R2 = 0.62). Hence, flow velocity is more strongly correlated with sediment transport capacity than any other selected hydraulic parameter. Sediment transport capacity was also correlated with composite predictors (shear stress, stream power, unit stream power and effective stream power) by regression analysis. The strongest relationships were obtained between sediment transport capacity and unit stream power (R2 = 0.87) and effective stream power (R2 = 0.85), because both were derived from mean flow velocities.