Measuring and predicting runoff and sediment yield from an unpaved road segment, St. John, U.S. Virgin Islands

Ramos-Scharron, Carlos E.[1], and Lee H. MacDonald
Dept. of Earth Resources-CSU, Fort Collins, CO 80523

Abstract. Previous studies have identified the unpaved road network as the most important source of sediment on the island of St. John, U.S. Virgin Islands. The objective of this study is to develop an empirical model that predicts both runoff response and sediment yields for a partially unpaved road. The 230-m long road segment has an area of 1280 m^2, an average slope of 12.5%, and approximately 25% of its surface area is paved. The segment is regraded about twice a year due to the daily traffic of 100-270 light vehicles and 4-5 heavy trucks.

Runoff data were collected at 5-minute intervals for about 30 storms from August 1999 to May 2000. Precipitation intensities at 5-minute intervals were obtained from a tipping-bucket type rain gauge. Eighty-three suspended sediment samples were collected during 21 precipitation events that generated runoff on the road surface. Maximum 5-minute precipitation intensity exceeded 12 cm hr^{-1}, with an accompanying runoff response of 11.2 cm hr^{-1}. Suspended sediment concentrations varied from 1,270 to 84,700 mg/l. Preliminary analysis of 10 storm events shows that runoff coefficients vary from 0.06 to 0.87, and that sediment yields for the individual events ranged from 4 to 888 kg. Multiple linear regression showed that about 80% of the variation in runoff coefficients can be explained by total precipitation, storm duration, and 24-hr antecedent precipitation. Simple linear regression suggests that sediment yields can be efficiently predicted by total storm precipitation.

The runoff and precipitation data were also analyzed using a unit hydrograph approach. By integrating the unit hydrographs with a sediment rating curve we can model runoff and sediment yield for temporal scales ranging from individual storm events to annual rates. The models developed for this road segment can be used by local engineers and planners to improve road drainage conditions and minimize road erosion. The model will also be compared against measured sediment yields from other road segments as a key step towards determining watershed-scale runoff and sediment yields.

[1] Ph. D. Student
Dept. of Earth Resources-CSU
Fort Collins, CO 80523
Tel. 970/491-2774 Fax. 970-491-6307
Email: cramos@cnr.colostate.edu