ABSTRACT OF DISSERTATION

GIS-BASED UPLAND EROSION MODELING, GEOVISUALIZATION AND GRID SIZE EFFECTS ON EROSION SIMULATIONS WITH CASC2D-SED

The recent developments of two-dimensional models for the simulation of upland erosion and sediment yield from watersheds facilitates the analysis of washload in rives and assists in the planning of soil conservation systems.

The spatial resolution in Digital Elevation Models influences the landscape representation. In runoff models, the change of the physical variables translates into a change on the hydrological model outputs. Process-based upland erosion models are affected by both the change in landscape representation and the change in the hydrological model. The effects of grid cell size on a 2-dimensional, physically-based erosion model have not been investigated yet.

The objectives of this proposed research are to: (1) extend the development of the CASC2D-SED upland erosion model and implement a suitable channel sediment routing algorithm; (2) couple the model time-series output grids with a GIS that will allow the geovisualization of sediment transport dynamics and the spatial erosion and deposition patterns; and (3) investigate the effects of grid resolution on the simulated values of gross erosion, sediment yield, spatial distribution of net erosion and sediment delivery ratios.

The physically-based model CASC2D-SED calculates runoff and upland erosion and simulates spatial erosion rates in a watershed on a grid basis. This two-dimensional model is extended in this study to include interception, revised upland erosion and sediment routing, and a channel sediment routing algorithm. The time-series output grids

from CASC2D-SED are coupled with GIS for their automatic display and creation of a MPEG movie.

The extensively monitored 20.5 km^2 Goodwin Creek watershed, MS, is used to test the new CASC2D-SED model and to study the effects of grid cell size on erosion simulations.

The calibration and validation runs of CASC2D-SED show that the model appropriately predicts hydrographs and sediment graphs at the basin outlet and other internal locations. Washload was simulated to travel through the system by streamflow with very little deposition, carried primarily in suspension while coarser fractions move as bed-material with local deposition. CASC2D-SED predicts sediment graphs by size fraction at the basin outlet. Sediment yields are predicted within ±50% of the observed data. Spatially, CASC2D-SED predicts areas of net erosion on steep slopes, depending on the land use and soil type. Zones of deposition were simulated in valley bottoms or forested areas. Geovisualization and time-series animation of the erosion dynamics and distribution of net erosion represents a form of model validation and facilitates model testing at internal locations.

Goodwin Creek was resampled from a 30-m grid to up to 330-m grid. The input grid cell size affected the CASC2D-SED erosion predictions and at increasingly larger grid cell sizes (x), equilibrium discharge and sediment yield decrease approximately with the inverse of the grid size while gross erosion decreases with $x^{-1.5}$. The sediment delivery ratio increases with grid cell size, and values simulated for the cases of 30-m and 90-m fall within field observations.

It is concluded that a grid cell size smaller that 150-m should be used to identify regions vulnerable to erosion on a watershed for the implementation of a suitable erosion control measure. For the prediction of sediment delivery ratios closer to field observations, a grid size smaller than 90-m is preferable.

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