Modelling Runoff And Erosion In Semi-Arid Areas From The Hillslope To The Catchment Scale

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Biography

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Response of the landscape to intense rainfall events is a complex and poorly understood problem. An understanding of the spatial variability of runoff and soil erosion generated by such storms at the hillslope scale is a necessary goal if patterns of runoff and soil erosion are to be understood at the field and catchment scale also. In recent years, it has been recognised that linking these scales of runoff and erosion may provide an approach by which accurate predictions may be made at all scales from the small hillslope to the large catchment (Wainwright et al., 2001). Furthermore, by studying the way in which patterns of runoff and soil loss vary with spatial scale a better understanding of sediment delivery problems and the dynamic connectivity of systems at a variety of scales can also be made.

To address the issue of scaling within runoff and soil loss prediction, a series of nested experiments was carried out to monitor the flux of runoff after intense, natural rainfall events at a range of scales at the Walnut Gulch Experimental Watershed in the semi-arid south western US. Data from these experiments were used to validate a distributed, dynamic, process-based model, previously shown to perform well at the plot scale on semi-arid shrubland (Parsons et al., 1996). To extend previous work, the model was applied to sites ranging in size from 2 m^2 up to 0.5 km^2 to investigate model response to changes in scale and to provide a means of linking predictions made at the hillslope scale with those made at the catchment scale. Results indicate that given high quality input data accurate predictions can be made at a range of hillslope lengths. Furthermore, hydrographs observed from a series of seven nested catchment areas are reproduced permitting confidence in model upscaling and spatial validation of model output. Limitations focus upon high data requirements, though remote sensing techniques are being developed to reduce time spent on data capture of surface condition parameters. Scaling of erosion and sediment transport is being investigated using a unified approach that uses characteristics of transport distances to provide an inherent scaling factor. Initial results of the combined runoff and erosion modelling will be presented.

References

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