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Issues of upscaling in space and time with soil erosion models

R.E. Brazier (1), A.J. Parsons (2), J Wainwright (2), and C Hutton (1)

(1) University of Exeter, Department of Geography, Exeter, United Kingdom, (2) University of Sheffield, Department of Geography, Sheffield, United Kingdom

Soil erosion - the entrainment, transport and deposition of soil particles – is an important phenomenon to understand; the quantity of soil loss determines the long term on-site sustainability of agricultural production (Pimental et al., 1995), and has potentially important off-site impacts on water quality (Bilotta and Brazier, 2008). The fundamental mechanisms of the soil erosion process have been studied at the laboratory scale, plot scale (Wainwright et al., 2000), the small catchment scale (refs here) and river basin scale through sediment yield and budgeting work. Subsequently, soil erosion models have developed alongside and directly from this empirical work, from data-based models such as the USLE (Wischmeier and Smith, 1978), to 'physics or process-based' models such as EUROSEM (Morgan et al., 1998) and WEPP (Nearing et al., 1989). Model development has helped to structure our understanding of the fundamental factors that control soil erosion process at the plot and field scale. Despite these advances, however, our understanding of and ability to predict erosion and sediment yield at the same plot, field and also larger catchment scales remains poor. Sediment yield has been shown to both increase and decrease as a function of drainage area (de Vente et al., 2006); the lack of a simple relationship demonstrates complex and scale-dependant process domination throughout a catchment, and emphasises our uncertainty and poor conceptual basis for predicting plot to catchment scale erosion rates and sediment yields (Parsons et al., 2006b). Therefore, this paper presents a review of the problems associated with modelling soil erosion across spatial and temporal scales and suggests some potential solutions to address these problems. The transport-distance approach to scaling erosion rates (Wainwright, et al., 2008) is assessed and discussed in light of alternative techniques to predict erosion across spatial and temporal scales.

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