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Cellular modelling of river catchments and reaches: Advantages, limitations and prospects

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The last ten years has witnessed the development of a series of cellular models, which simulate the processes operating within river channels and in turn how this affects their geomorphic evolution.

These models are especially important, as they bridge a gap between large spatial and geological time scale landscape evolution models and high resolution, yet computationally hamstrung, computational fluid dynamics approaches. By using relaxed interpretations of the equations determining fluid flow, they allow rapid solutions of water depths and velocities. These can then be used to drive (usually) conventional sediment transport rules to determine erosion and deposition and alter the channel form. The key advance of using these physically based yet simplified approaches is that they allow us to apply models to spatial areas (1-100km2) and over time periods (1-100 years) that are especially relevant to contemporary management and fluvial studies.

However, these approaches are not without their limitations and technical problems. This paper reviews the findings of nearly 10 years of research into modelling fluvial systems with cellular techniques, principally focusing on improvements in routing water, and how fluvial erosion and deposition (including lateral erosion) is represented. These are illustrated using two case studies relevant to both contemporary river management issues and fluvial geomorphological studies. Firstly modelling braided river dynamics and interactions with vegetation in the Waitaki River, New Zealand and secondly, modelling dynamic flood risk in Welsh river catchments. Finally the problems, prospects and future issues important to the further development and application of

these cellular fluvial models will be outlined.