Geophysical Research Abstracts, Vol. 9, 10491, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10491

Fine sediment dynamics in urban river channels: challenging the first-flush model

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Fifty percent of the world's population is now urbanised, and this is likely to increase to 60 percent within 10 years. Urbanisation is increasingly seen, therefore, as a key environmental change which impacts on river systems. River responses can be more immediately identifiable in fluvial sediment fluxes and water quality signals than in morphological responses. This paper focuses on storm-event suspended sediment and turbidity results from the most urbanised catchment in the UK (River Tame, Birmingham, West Midlands). The study tests first-flush and hysteresis models, and integrates several approaches, including the use of two automatic water quality monitoring stations to detect downstream propagation and transformation of urban impacts, statistical analysis of sediment hysteresis, interdisciplinary conceptual modelling to help inform biogenic impacts on sediment delivery, and anthropogenic tracers to confirm links between urban infrastructure and storm runoff. 'First-flush' effects, common elsewhere, are rare in the Tame: sediment peaks generally follow the flow peak, and lengthy turbidity tails drive *anticlockwise* hysteresis. This suggests limited sediment exhaustion, delayed triggering of sediment supplies and/or distal sources. A new Hysteresis Index allowed event replication to be assessed over longer timescales to assist process inference. Potential biological sediment stabilization effects are conceptualised within a BASS (Biofilm Adhesion of Sediment Supplies) model. Sediment concentration peaks were often associated with ammonia spikes, indicating transient but significant contributions from waste water sources: this has implications for the 'geomorphological' versus 'human' components of urban 'sediment' yield. These newly-

identified prolonged sediment-flux impacts suggest that urban influences on river systems may be more significant than previously thought: this may challenge traditional assessment and mediation measures. Furthermore, small-scale headwater basins can provide early warning systems for sediment and sediment-associated pollution events propagating downstream.