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Special Issue

Water and chemical fluxes through catchments

Preamble

The issue of catchment science has been and remains of major concern in environmental research and management. The recent change in emphasis from measurement to modelling reveals major uncertainties in understanding water and chemcial transport through catchments and the consequential difficulty in translating such complexities into deterministically-based mathematical representation of the diverse processes involved. Further, with issues of fluctuating and changing climate, human endeavours in agriculture and industry plus demographic redistribution, there is often no stable base on which to describe catchment functioning and change. Indeed, the emphasis is now on using science to predict environmental consequences of the changing world, particularly with regard to human-induced impacts. It is considered essential to 'return to the basics' of observing process and change, as noted some years ago. This must take account of the modelling needs that now extend into areas such as fractal processing (Kirchner et al., 2000), the need for more intensive and extensive measurements to study the dynamics of change and, critically, to test and validate models (Kirchner *et al.*, 2004). The aim is to use observation in a much more balanced way to link and develop environmental impact and remediation models. Such models may be used to inform decision-makers of not only of ways forward but also of the consequence of taking no action. On this basis, the need for good and well-funded catchment science has never been greater.

This Special Issue builds on a tradition in HESS to produce stand-alone special issues linked to the theme of catchment science. This volume brings together a spectrum of papers relating to a key area of catchment science — the assessment of water and chemical fluxes through catchments.

The papers range from examining atmospheric inputs to soil, to groundwater, to systems catchment-wide as well as within-river, through to lakes and reservoirs. The first paper deals with atmospheric inputs of chemicals to the Atlantic forest in urban and natural areas of Brazil (Forti *et al.*). The next paper then examines the turbulent sensible and latent heat fluxes simulated in a leading operational weather forecasting model against field data (Johnsen *et al.*). It is followed by three papers on the impacts of broadleaved woodland on water resources in the lowland UK. They concern woodland–grass comparisons in connection to issues of (I) soil water changes (Roberts and Rosier) and (II) evaporation (Roberts *et al.*) at sites at Black Wood and Bridgets Farm in Hampshire, and (III) an extension of the work at these sites to a UK-wide assessment on broadleaved wood land impacts (Roberts and Rosier).

Two papers then deal with water quality at one of the main research catchments for the UK uplands, Plynlimon in mid-Wales. Shand *et al*. examine hydrochemical heterogeneity in relation to spatial, temporal and depth variations in soils, streams and groundwaters in the Hafren forest. Neal then provides an assessment of rare earth elements from rainfall and mist inputs, through to groundwaters and stream outputs; atmospheric pollution can still occur far from industrial sources, even for more unusual/rare components (cerium, in particular, in this case). Laurén *et al*. examine water and chemical transport along typical flow paths in forest clear-cutting and modelling for a first-order stream in Finland. Butterini then explores input–output budgets and the uncertainty in solute flux estimation in small streams, while Jordan *et al*. examine the dynamics of phosphorus transport in a stream draining agricultural land in Northern Ireland using state-of-the-art monitoring technologies.

The final three papers deal with lakes. First, Dai *et al*. examine the role of Lake Dongting in regulating the sediment budget of the Yangtze River in China. Veselý *et al*. then deal with increasing silicon concentrations in Bohemian Forest Lakes of the Czech Republic with decreasing levels of atmospheric pollution. The volume is brought to a close by a paper by Sahlberg and Rahm on light-limiting of primary production in high latitude reservoirs.

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Kirchner, J.W., Feng, X., Neal, C. and Robson, A.J. 2004. The fine structure of water-quality dynamics: the (high-frequency) wave of the future. *Hydrol. Proc.,* **18,** 1353–1359.