Geophysical Research Abstracts
Vol. 17, EGU2015-4264, 2015
EGU General Assembly 2015

Tracer-aided modelling to assess how the interplay of catchment storage and hydrological connectivity controls non-stationary stream water age

Christian Birkel (1,2), Chris Soulsby (2), and Doerthe Tetzlaff (2)

(1) University of Costa Rica, Department of Geography, San Jose, Costa Rica, (2) University of Aberdeen, School of Geosciences, Northern Rivers Institute, Aberdeen, United Kingdom (c.birkel@abdn.ac.uk)

Quantification of how water and solutes move through catchments and the associated transit times remains a key research frontier in hydrology. The storage dynamics of different landscape units (e.g. hillslope vs. riparian zones) regulate both mixing processes and the strength of hydrological connectivity that govern water and solute fluxes to streams determine catchment transit times. This paper integrates 6 years of empirical field observations in a tracer-aided modelling approach to provide fresh insights into the complex interrelationships between catchment storage dynamics, hillslope connectivity and resulting non-stationary water transit times. We show that in a wet Scottish upland catchment dominated by runoff generation from riparian peats (histosols) with high water storage capacity, the frequency and longevity of hydrological connectivity and the associated relative importance of dynamic flow paths control the contribution of younger or older waters to the stream. Water and solute transport is facilitated by overland flow from saturated histosols connected to the stream network even during smaller events. However, during prolonged dry periods near-surface runoff "switches off" and stream water is dominated by older groundwaters. Generally, the saturated riparian soils represent large mixing zones that buffer the time variance of water age and integrate catchment-scale partial mixing processes. Although simulations depend on model performance, which is influenced by stochastic variation in isotope inputs, a longer-term storage analysis of using the model allowed us to examine the sensitivity of the catchment response and transit times to extreme hydroclimatic variability.