Let the data propose the model: Biogeochemical and hydrological processes at Plynlimon

F. Köck (1), G. Lischeid (2), C. Neal (3), and M. Neal (3)

(1) University of Bayreuth, Institute for Ecological Modelling, Bayreuth, Germany (Florian.Koeck@gmx.org), (2) Leibniz Centre for Agricultural Landscape Research, Institute of Landscape Hydrology, Müncheberg, Germany (lischeid@zalf.de, +49-33432-82301), (3) Center for Ecology and Hydrology, Wallingford, United Kingdom (cn@ceh.ac.uk)

Biogeochemical and hydrological processes are often intimately intertwined, especially in shallow soil catchments. As a consequence, a sound understanding of the former is not possible without consideration of the latter. Inversely hydrochemical data can reveal substantial information about hydrological processes.

At Plynlimon, Wales, stream water and groundwater have been monitored since 1984 with many replicates. A tremendous amount of literature dealing with this experimental catchment has been published since then. However, controversies with respect to weighting the effects of single processes do still exist, and competing model strategies have been developed.

This study aimed at identifying the prevailing hydrological and biogeochemical processes in an integrating way, based on a non-linear statistical analysis of the existing water quality data, comprising more than 6000 samples from 15 stream and groundwater sampling sites. To that end, a non-linear principal component analysis (Isometric Feature Mapping) was applied. The statistical components were ascribed to biogeochemical or hydrological processes based on non-linear correlation with single solutes, temperature and discharge. Component scores were interpreted as quantitative measures of the effects of single processes. Consequently, spatial patterns as well as long-term time series of component scores were analysed.

The identified processes were chemical weathering, topsoil runoff, export of DOC, impact of ore deposits, and effects of anthropogenic deposition. The damping behaviour of the catchments with respect to the latter was analysed by spectral analysis of the long-term time series of component scores. Substantial spatial differences were found that are likely due to differing soil depth and bedrock lithology of the investigated subcatchments. These results can be used to constrain hydrological and biogeochemical models that aim to map single processes.