Assessment of Large Scale Hydrological and Hydrochemical Processes by Means of Regional Isotope Patterns in the TERENO Bode Catchment

Christin Müller, Ralf Merz, Ronald Krieg, Kay Knöller

UFZ-Helmholtz Centre for Environmental Research, Department Catchment Hydrology, Halle, Germany

Fig.1

Introduction

Isotope studies conducted over large spatial and/or temporal scales can provide powerful insights into natural hydrological and hydrochemical processes and the effects of anthropogenic influences. The challenge of this projects is to characterize and quantify large (regional) scale dynamics and trends in water and solute fluxes of the TERENO Bode catchment **(Fig.2)**.

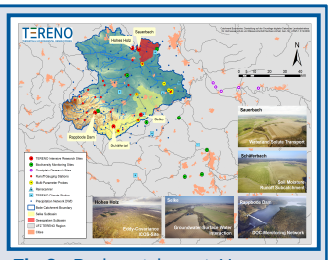


Fig.2 : Bode catchment, Harz Mountains (size: 2500 km², altitude: 80 to 1000 m a.s.l., average precipitation: 500 mm/a)

Changing conditions for example elevated inputs, land use & climate change have to be considered. The development of a statistically refined monitoring-network integrating a multi-isotopic approach is one primary objective of the conducted study.

Monitoring & Laboratory Analysis

Field Monitoring

Surface water sampling of main tributary rivers and detection of on-site parameters (EC, O_2, Redox potential, temperature)
Precipitation water sampling
133 sampling sites and 25 intensive sampling sites **(Fig.1)**

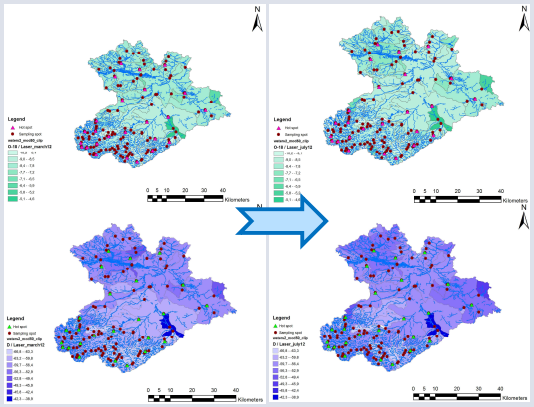
From local point analysis to large scale patterns

Laboratory Analysis

Basic hydrochemical composition (main anions & cations)
Stable isotopes:
$\delta^2H/\delta^{18}O$ of H_2O
$\delta^{15}N$ and $\delta^{18}O$ of nitrate
$\delta^{34}S$, $\delta^{18}O$ of sulfate
$\delta^{13}C$-DIC, $\delta^{13}C$-DOC

Results

The $\delta^2H/\delta^{18}O$-isotopic signature of water provides an ideal conservative tracer of water sources and mixing processes which is useful for quantifying flow contributions from different tributaries and groundwater as well as active evaporation processes **(Fig.3 & 4)**. The detection of $\delta^{13}C_{DIC}$ may help depict the influence of certain soil processes like degradation of organic matter **(Fig.5, right)**.



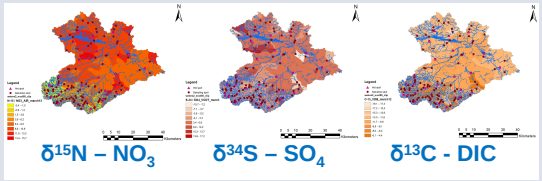


Fig.5: Isotopic patterns of sampling campaign in march 2012

Isotopic signatures of NO_3 **(Fig.6, left)** yield information on nitrogen transformation processes. Isotopes of SO_4 **(Fig.6, middle)** can be used to quantify different input factors and the influence of sulfate reduction & mixing processes.

Outlook

Statistical Analysis

Statistical analyses of temporal and spatial isotope distribution pattern
Combination of isotope pattern **(Fig.6)** with available area data (e.g. soil, vegetation, land use, geology …)

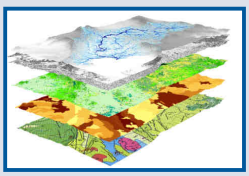


Fig.6: Combined compartment approach

Paired Catchment Study

Erlauf River in the Alpine foothills, Austria
45 surface water sampling sites **(Fig. 7)**

Main differences:
Altitude, precipitation, geology, size etc.

Fig.7: *Left:* River Erlauf, a tributary of the river Donube, Austria; *Right:* Catchment with corresponding sampling sites

Contact:
Ph.D. student Christin Müller, christin.mueller@ufz.de
Prof. Dr. Ralf Merz, ralf.merz@ufz.de
Ronald Krieg, ronald.krieg@ufz.de
Dr. Kay Knöller, kay.knoeller@ufz.de
Theodor-Lieser Str. 4, 06120 Halle
Dep. Catchment Hydrology

TERENO TERRESTRIAL ENVIRONMENTAL OBSERVATORIES
TU WIEN
HIGRADE
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ