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Investigation of catchment scale water and solute fluxes by regional isotope patterns.

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 the presented projects is to characterize and quantify large (regional) scale dynamics and trends in water and solute fluxes from two catchments representing two different climatic zones. While the Gunt catchment in the Pamir Mountains, Central Asia is in a cold-arid climate zone, the Erlauf hydrographic basin in the alpine foothills in Austria is characterized by humid climate. Differences between the two regions in terms of precipitation patterns and altitudes have a major impact on the isotopic signatures of sampled surface waters. The development of a statistically refined monitoring-network integrating a multi-isotopic approach is one primary objective of the conducted study. Laboratory analyses on all stream water samples taken during different sampling campaigns were conducted for stable isotope signatures of water ($\delta^{18}O$, $\delta^{2}H$), of sulfate ($\delta^{34}S$ and $\delta^{18}O$), of dissolved inorganic and organic carbon ($\delta^{13}C$) and of nitrate ($\delta^{15}N$ and $\delta^{18}O$). The D/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. The two dimensional isotope system of sulfate as an important content in soil, wastewater, wetlands, and atmosphere can be used to quantify different input factors and the influence of sulfate reduction and mixing processes. The detection of $\delta^{13}C_{DIC}$ may help depict the influence of certain soil processes like degradation of organic matter. Also, the carbon isotope signature reveals the sources of DIC and the degree of gas exchange with the atmosphere. Isotopic signatures of nitrate yield valuable information on nitrogen transformation processes such as nitrification, denitrification and assimilation and may be used to differentiate between nitrate sources such as fertilizer, wastewater, manure, or atmospheric deposition. Regional isotope patterns of the different isotope systems obtained during the monitoring campaigns are combined with available regional data (e.g. elevation, elevation gradient, slope, vegetation cover, land use, soil, geology etc.). The temporal and spatial isotope distribution patterns (in combination with regional data) undergo a geo-statistical analysis that enables the recognition of dominant processes, of hot spots and hot moments that are subsequently used for model parametrization and validation.