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Regional stable isotope patterns of river waters in an arid catchment in Central Asia

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Central Asia, especially the Aral Sea basin, is one region in the world which is strongly affected by water shortage. The big rivers Amu Darya and Syr Darya are the main contributors to this region. These melt water dominated rivers have their origins in the Pamirs and Tien Shan. One representative catchment for the headwaters of the Aral Sea Basin is the River Gunt Catchment in the Central Pamirs and is located in the transition zone of different wind systems. It covers 14,000 km^2, spanning over altitudes between 2000 and 6700 m a.s.l. and receives precipitation mostly in form of snow from the westerlies, southern cyclones and the Indian Monsoon.

Stable isotopes of water (δ^2H/δ^{18}O) are an ideal tool to identify water sources and mixing processes. With this conservative tracer it is possible to quantify flow contributions of different tributaries and ground water or even to detect active evaporation processes. Isotope patterns can give tremendous insights into natural hydrological processes over large spatial and/or temporal scales.

To delineate water sources and especially precipitation sources we have undertaken a stable isotope study on the water resources in the River Gunt Catchment.

Every month water samples are taken at 30 sampling points for river water and at two meteorological stations monthly integral precipitation is collected. These samples are analyzed for the stable water isotopes. Our first analytical results of the river water show δ^2H values in the range of 131.2 to 94.9 ‰ and δ^{18}O values from 18.0 to 14.0 ‰ while the precipitation data feature a more wide-spreading range (δ^{18}O: -21.1 to -5.9 ‰ and δ^2H: -157.0 to -48.0 ‰). The stable isotope patterns of river water show spatial systematics which can be associated amongst others with a strong altitude effect ($\Delta\delta^2$H $\sim$ -3.6 ‰100m). We also found a seasonal variability in the δ^2H/δ^{18}O-patterns which should been caused in this snow dominated region by melting processes. The high variance in the precipitation data cannot be explained only by changes of the physical state of the precipitation, but by the different precipitation sources.