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Hydrochemistry and land cover in the upper Naryn river basin, Kyrgyzstan

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Economic and social changes at the end of the 20th century affected land use decisions and land management in the Central Asian republics of the former Soviet Union. Amongst others, land tenure changed from mainly collectivized to private land, and in consequence, land management (e.g. soil treatment and fertilization practices) altered. Apart from agricultural pollutants and the impact of irrigation management, water resources are threatened by waste dumps remaining from mining activities. However, recent studies on the effect of land use changes on ecohydrology in Central Asia remain scarce.

In a preliminary study, current land use and hydrochemistry in the upper Naryn Valley (Kyrgyzstan) was analyzed in 2008. Climate is semi-arid, and annual precipitation is approximately 300 mm. Precipitation peak occurs in early summer, while the rest of the year is rather dry. Crop and hay production prevail in the valley bottom. Environmental conditions in the mountains support pastoralism with a shift between summer and winter pastures. Agriculture depends on irrigation to a great deal as precipitation is seasonal and the vegetation period usually is the dry period. Today, production is mainly for subsistence purposes or local markets.

The Naryn river is the headwater of the of the Syrdarya river which is one of the major sources of irrigation water in the Aral Sea basin. Hence, the ecohydrological condition of the contributing rivers is of major importance for the irrigation management downstream. Nevertheless, information on current ecohydrological conditions and land use which may affect the distribution and chemical composition of the rivers is lacking.

In the presented study, basic hydrochemical measurements in the Naryn river and its tributaries were made. In situ measurements comprised electrical conductivity, ammonia and nitrate measurements, among others. While electrical conductivity varies greatly between the Naryn river and its tributaries, ammonia and nitrate concentrations remain below detection limit for the most part. The study shows that tributaries of high electrical conductivity do not affect hydrochemistry of the main river during summer because glacier and snow melt dominates runoff generation. Daily cycles of increased runoff due to snow and ice melt in the afternoon could be observed along the tributaries in the upper parts of the study area. Effects of agricultural production on ecohydrology remain weak as application of fertilizers and pesticides is currently low due to financial constraints. The data will be linked to land use data derived from satellite image products in order to analyse the effect of land cover and land cover changes on ecohydrological processes. Former observation of remote sensing data and related literature showed evidence for a change in land use management in the Naryn Valley. In 2008 training areas of land use classes for a supervised classification of 2008 remote sensing data have been recorded. A land use classification of the Naryn Valley on the base of Landsat ETM+ Data of 2008 and 1993 was done to get information on land use change on a regional scale. The classification uses spectral and spatial data in a hard classifier and object oriented combined approach. Comparing the two datasets with respect to changes in pattern of irrigated area and pasture area, change in cultivated crops and the change of agricultural cell sizes gives further information for hydrological modeling and land use monitoring purposes.