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Quantification of water abstraction in the transboundary Ile Basin (China/Kazakhstan) and changes in future runoff with a physically-based hydrological model

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Understanding runoff changes in the transboundary Ile River basin, Central Asia, is of key importance for preservation of the unique ecosystem of the Balkhash Lake and for sustaining economic activities in Chinese and Kazakh parts of the catchment.
Since late 1980s, rapid population growth and expanding irrigated agriculture in the upstream Chinese part of the Ile basin led to increasing water consumption, which is, however, poorly quantified. This change occurred at the background of ongoing climatic changes affecting natural river runoff and presumably causing discharge increase due to increasing glacier melt. This study quantifies the natural river discharge in the Ile basin since 1960s till today by means of a calibrated hydrological model and contrast it with river flow altered by human activities.
In the period from 1987 to 2014 the average water consumption at the territory of the P.R. China was estimated to 3 km3 per year on average or 20 % from average annual runoff.

Furthermore, we quantified the runoff components at the outlet gauge of the Ile catchment (164 km) for the past period (1971-1986).
Based on the precipitation data from meteorological stations runoff components are as follows: 44 % - of underground runoff, runoff from snow melting - 7 %, runoff from liquid precipitation - 32 %, runoff from glacier component – 17 %. Based on the precipitation data from global climate data APHRODITE: underground runoff – 35 %, snowmelt runoff – 24 %, runoff from precipitated water – 17 %, glacier melt runoff – 24 %. Based on the precipitation data from global climate data WATCH: underground runoff is 44 %, snowmelt runoff – 3 %, runoff from precipitated water – 44 %, glacier melt runoff – 9 %.
Finally, we have analyzed the changes in total runoff and runoff components based on the CMIP5 climate change scenarios, taking into account dynamic changes of the cryosphere.
Annual and seasonal changes in total runoff and the runoff components are discussed against the background of growing water demand for irrigated agriculture in the upstream parts of the Ile basin.