Geophysical Research Abstracts
Vol. 20, EGU2018-17780, 2018
EGU General Assembly 2018

Statistical prediction of seasonal discharge in Central Asia for water resources management with GRACE gravity based water anomaly estimation

Heiko Apel, Ben Gouweleeuw, and Andreas Güntner
GFZ German Research Center for Geoscience, Section 5.4 Hydrology, Potsdam, Germany (hapel@gfz-potsdam.de)

The semi-arid regions of Central Asia crucially depend on the water resources supplied by the mountainous areas of the Tien-Shan and Pamirs. During the summer months the snow and glacier melt dominated river discharge originating in the mountains provides the main water resource available for agricultural production, but also for storage in reservoirs for energy generation during the winter months. Thus a reliable seasonal forecast of the water resources is crucial for a sustainable management and planning of water resources. It has been shown that due to the temporal separation of accumulation and discharge generation the seasonal discharge is well predictable by relatively simple statistical models driven by climate and snow cover data. This motivates the use of satellite based GRACE gravity records, which provide an integral signal of water storage changes, for the prediction of seasonal water availability in Central Asia. This study uses daily GRACE gravity solutions using Kalman smoothing (ITGS-Grace2016_Kalman) produced by the Technical University of Graz, given as global 1 degree grids of water storage anomalies, and tests the predictive power of the water anomalies for two selected catchments in the Tien Shan and Pamir mountains. The catchment areas cover a range between 52,000 and 290,000 square km in order to investigate the effect of spatial resolution of the GRACE data on the prediction. Moreover, different lead times ranging up to 6 months prior to the vegetation period starting in April are tested. Prediction models were derived on the basis of Multiple Linear Regression (MLR) models by an automatic model fitting algorithm, which includes a leave-one-out cross validation. It could be shown that for the larger Amudarya catchment the GRACE data have higher correlations to seasonal discharge than the previously used climatic and snow cover predictors. Moreover, the GRACE water storage anomalies improve the predictions with R2 values reaching 0.98 for MLR models with 4 predictors. GRACE water anomalies are also the most important predictors in the MLR models for Amudarya for lead times up to three months, and for MLR models with 1 to 4 predictors. For the smaller Naryn basin, however, the GRACE water anomalies do not improve the predictions. This leads to the conclusion, that GRACE data can improve the prediction of seasonal water availability in Central Asia, if the catchment size is large enough ($> \sim$150.000 km2). The feasibility of operational use of GRACE products has been tested in the EU H2020 project EGSIEM (European Gravity Service for Improved Emergency Management), showcasing an operational use of GRACE in the seasonal discharge prediction would be possible. However, as the GRACE mission went into decommission phase towards the end of 2017, an operational use of satellite based gravity data for the prediction of seasonal discharge can be resumed with the GRACE Follow-On mission with a planned launch in the early half of 2018 only.