



Spatial and temporal re-distribution of water storage in Central Asia detected by GRACE and remote sensing snow cover data

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Water resources in the Tian Shan and Pamir mountains, Central Asia, are mainly stored as snow and glaciers during winter months and released during spring and summer months delivering water resources for downstream water use. Water resources formed by melting snow and glacier in mountains are used mainly for agricultural production during the growing period, but also for re-filling of reservoirs for energy production in winter months. This leads to temporal and spatial re-distribution of water storage from the mountains along the course of rivers.

In this study, we analyze seasonal re-distribution of water storage in Central Asia using GRACE and satellite based snow cover observations. We investigate to which extent a satellite-based snow cover product explains the variability of Total Water Storage (TWS) signature from GRACE in the mountains of Central Asia. Inter-annual variations of TWS in the headwater regions are well detected by the degree of annual snow accumulation as presented by a Snow Cover Index (SCI) which does not only consider the areal extent of snow cover but also its temporal persistence. In the regions with extensive irrigation practice, a seasonal increase of TWS is, on the one hand, in line with precipitation in spring, and, on the other hand, with replenishing groundwater storage by irrigation for agricultural production in the summer months, when precipitation is negligible. Our analysis further shows that TWS in lowlands is strongly controlled by irrigation activities in dry years with less water being formed in the mountains but extensively used to meet the demand for agricultural production. This study shows the possibility of observing large-scale water re-distribution in the Aral Sea basin with potential applicability in practice for regional scale water resources management and monitoring.