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Water storage changes in the Cuvelai-Etosha Basin and their interrelationship with rainfall characteristics

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Water storage changes and groundwater recharge rates of large river basins are difficult to investigate and quantify, especially in developing countries such as most of Sub-Saharan Africa, where data is generally scarce. Recently developed satellite-based datasets can therefore aid in understanding and quantification of such processes. The aim of this study is to investigate the relationship between rainfall characteristics (i.e. duration of the rainy season, frequency of wet and dry days, frequency of extreme events, length and frequency of wet and dry spells, total rainfall) and total water storage changes.

The study is carried out in the framework of the project SASSCAL (Southern African Science Service Centre for Climate Change and Adaptive Land Management) in the semi-arid Cuvelai-Etosha surface water basin, a trans-boundary catchment, for the time period 2003 - 2012. Rainfall characteristics are derived from *RFE* (Rainfall Estimates) satellite-derived daily rainfall data. Water storage changes were derived from *GRACE* (Gravity Recovery and Climate Experiment) water equivalent depth changes. Finally, the rainfall characteristics showing the highest impact on total water storage changes were identified using a simple regression analysis as well as a multivariate analysis utilizing a Self-Organizing Map (SOM).

Results imply a significant spatiotemporal variability of rainfall characteristics throughout the basin. Seasonal rainfall indicators in regard to both magnitude and timing of the rainy season show noteworthy inconsistency. The analysis of total water storage revealed changes ranging between -54 mm to 91mm of equivalent water depth per year, depending on the overall character of the previous rainy season. Rainfall characteristics affecting water storage changes most are the frequency of wet days, rainy season rainfall amount and, surprisingly, onset of the rainy season with correlation coefficients (R^2) of 0.76, 0.64 and 0.57, respectively. Indicators describing extreme events, duration or number of wet spells reveal lower correlations (R^2 smaller than 0.5). The study enables an understanding of important drivers of water storage changes in large catchments with limited data availability and thus builds a baseline for detailed investigations. It further provides information on rainfall dynamics and their impact on water storage changes. The robustness of the findings is to be examined and validated in future studies, i.e. using ground-penetrating radar or on-site investigations on groundwater recharge (water level fluctuation method, isotopic analysis). Further, the influence of other components of the *GRACE* signal (soil moisture, biomass and surface water storage) will be quantified to verify findings from this research.