What do satellite data say about groundwater storage changes in Morocco?

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Mots-clés : GRACE, Groundwater depletion, rainfall, snow cover, groundwater recharge

Since the early 2000s, the earth's gravity anomalies provided by the GRACE (Gravity Recovery and Climate Experiment) mission have opened new pathways for hydrologists to monitor the changes in terrestrial water storage. They provide valuable information that can be used to complement the in-situ observations. In this work, the relevance of several GRACE solutions was examined to study the changes in TWS (terrestrial total water storage) and GWS (groundwater storage), and their link to snow and rainfall variability. The data were assessed to outline how well the GRACE-based water storage time series follow the piezometer observations. Then, the water storage was tested for trends over Morocco using the Mann-Kendall test and Sen Slope estimator. The results show that the GRACE data can fairly describe the temporal patterns of the GWL (groundwater level), with correlations up to 0.79. Moreover, terrestrial water storage was found to be subject to a strong depletion that was relatively masked by a natural recharge event. We have identified two intermittent depletion episodes (before and after the rechange event) with rates higher than those obtained for the long-term trend lines. Lastly, the TWS appeared to be strongly modulated by snow cover and rainfall distribution.