Estimation and prediction of groundwater storage and depletion using downscaled GRACE data, SWAT model and ANN: Case of the phosphate basin of Meskala.

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Droughts cyclicity due to the climate change effect, population growth and the over pumping of groundwater for irrigation are major factors that affect water resources, especially in arid and semi-arid areas. The rational use of these resources requires the understanding of groundwater storage (GWS) and depletion variations at a high temporal and spatial resolution, which is a challenge in unmonitored watersheds like the Meskala phosphate basin. This work emphasizes the potential benefits of combining a calibrated Soil and Water Assessment Tool (SWAT) model, artificial neural network (ANN) and the data of Gravity Recovery and Climate Experiment (GRACE). The first SWAT model calibration results gave a coefficient of determination (R^2) and the Nash–Sutcliffe efficiency (NSE) equal to 0.52 and 0.5, respectively. The per cent bias (PBIAS) calculated for this model equal was 2.9% < 10%, and a low value of the root mean square error (RMSE). The results can still be improved, especially because we intend to generate future forecasts. To solve this problem, we apply model forcing by GRACE data at a fine scale (1 km × 1 km) by application of a mixed geographically weighted regression (MGWR) and the ANN results on a series of observed data (2000-2010) such as precipitation, temperatures, evapotranspiration, land use, soil texture, NDVI, and soil moisture. The used approach in this work will give the most reliable results for the spatiotemporal variation of GWS and groundwater depletion as well as their future predictions.