

Remote sensing and GIS-based WetSpass model for estimating actual evapotranspiration in Grombalia region, Northeast Tunisia: Comparison with FAO published data

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ABSTRACT

The assessment of actual evapotranspiration and other components of the water balance is an important step for surface and groundwater resources sustainable management. This work aims to i) estimate and map the spatio-temporal distribution of the actual evapotranspiration in Grombalia phreatic aquifer for the 2020/2021 agricultural season using Sentinel 2 images and the WetSpass model and ii) compare the obtained data with the FAO's.

To do so, seven Sentinel images from October 2020 to May 2021 were downloaded and atmospherically corrected. Multi-date supervised classifications were applied to map the land use and land cover (LULC) for the 2020/2021 agricultural season within the limits of Grombalia's shallow aquifer. The LULC classes considered are orchards, agriculture (cultivated land), built-up land, shrubland, and water surfaces. They are defined according to the requirements of the WetSpass water balance model. Two combinations were tested using four images each. The dates of the images for the first combination (C1) are: October 02nd, 2020; December 16th, 2020; March 06th, 2021 and May 10th, 2021 and for the second combination (C2) are: November 01st, 2020; January 20th, 2021; March 26th, 2021; May 10th, 2021. The best resulting LULC map used to run WetSpass model is the one with the highest kappa index (ki). This combination is C2, with ki equal to 0.68.

The LULC map was integrated with seven other raster datasets in the WetSpass model, including three hydro-meteorological datasets (rainfall, temperature, and wind speed) and four biophysical datasets (soil texture, topography, slope, and groundwater depth). The resulting WetSpass simulated parameters are evapotranspiration, surface runoff and diffuse recharge, provided seasonally and yearly. The yearly means of these three simulated parameters are respectively 350, 28 and 36 mm, stating that the water balance is driven mainly by actual evapotranspiration, with 85% of the received precipitation (412 mm). The annual evapotranspiration in the study area varies between 141 and 791 mm. The lowest are located in the building area and the highest are observed in free surface water, especially the Sebkha of Soliman.

The WetSpass simulated evapotranspiration were compared with FAO published data (based on ETlook model). WetSpass gives higher values than FAO under free surface water and building areas and lower values under irrigated agricultural areas, where the highest difference (more than 1000 mm) is observed. The main reason of this difference is that WetSpass model does not consider water irrigation amount as input. This underscores the need of a careful consideration of the input datasets used and a wise interpretation of the results obtained for an appropriate surface and groundwater management and hydrological and hydrogeological assessment.

Key words : GIS, remote sensing, WetSpass model, land use, actual evapotranspiration, groundwater of Grombalia