GC8-Hydro-65, updated on 03 May 2024
https://doi.org/10.5194/egusphere-gc8-hydro-65
A European vision for hydrological observations and experimentation

Integration of remotely sensed and field monitoring data for characterizing the hydrological regime of soils covering karst aquifers and assessing groundwater recharge

Daniele Lepore[1], Christopher Conrad[2], Vincenzo Allocca[1], Delia Cusano[1], Johannes Löw[2], Lèonard El-Hokayem[2], and Pantaleone De Vita[1]
[1]University of Naples Federico II, Department of Earth, Environmental and Resources Sciences, Naples, Italy (daniele.lepore@unina.it)
[2]University of Halle-Wittenberg, Institute of Geosciences and Geography, Department of Geoecology, Halle/Saale, Germany

Remote sensing is recognized as the most feasible means to provide regional information on land surfaces and monitor soil parameters such as soil moisture and evapotranspiration. The use of satellite-derived products can be crucial for groundwater resources in karst aquifers, particularly in regions, such as southern Italy, where groundwater availability drives economic and social development and there is a lack of monitored data. This study aims to expand the classical hydrogeological approach, used for the estimation of groundwater recharge of karst aquifers, to the understanding of the hydrological role of soil coverings by the integration of field monitoring and products derived by remotely sensed data. The research was conducted on the representative Mts. Soprano-Vesole-Chianello karst aquifer (Campania, southern Italy). Copernicus Global Land Services Soil Water Index (SWI) and Moderate Resolution Imaging Spectroradiometer (MODIS) Evapotranspiration products were explored to assess soil water content and evapotranspiration regimes. The analysis included time series gathered by a monitoring network consisting of 5 soil moisture multi-profile probes, working since 2021. The SWI1km provides daily soil water content information at 1 km resolution. Depending on the uncertain calculation, not considering evapotranspiration and soil texture, the SWI1km product provides 8-SWI estimations and the related quality factor values. Instead, the MOD16A2 is based on MODIS data and provides 8-day evapotranspiration estimation at 0.5 km resolution. The product collection is based on the logic of the Penman-Monteith equation, which integrates inputs of daily meteorological re-analysis data along with products derived by (MODIS) including vegetation property dynamics, albedo, and land cover.

Both products showed zones of no-data occurring across the mountain areas of the karst aquifers. This limitation is related to the algorithms that consider several parameters such as topography (slope aspect and angle) and occurrence of clouds for product generation.

The primary outcome of this study was the extraction of SWI values and the calculation of a mean value for the 8-SWI values, weighted by the related quality factor (SWI_w). SWI_w showed a constant difference of about -20% in comparison to the daily average values obtained by field monitoring.

Despite this discrepancy, the annual trend of the SWI_w was found being very consistent with the soil moisture probe measurements (corr. > 0.68) and displaying a good response to rainfall events.

Moreover, the MODIS *ET* data displayed the expected pattern of evapotranspiration with a temporal resolution not achievable in other ways considering the lack of local meteorological data.

In order to cope with missing data across the mountain areas of the karst aquifer, a spatial interpolation of SWI_w and MODIS *ET* was carried out by different geostatistical techniques.

The findings suggest that SWI1km and MODIS16A2 are useful in monitoring soil water content and evapotranspiration of soils covering karst aquifers and controlling groundwater recharge. Although there are limitations due to missing data, both products can be still effectively utilized if properly interpolated. Therefore, they can be considered fundamental for assessing patterns of groundwater recharge in karst aquifers, especially in areas which are not extensively monitored as in the case of southern Italy.