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Drought phenomena and groundwater scarcity in Eastern Romania (Siret-Prut region)

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Droughts are caused essentially by the climatic elements' variability, being the most known recurring phenomena and one of the most frequent natural disasters in many regions of the world. Acting as disturbances of the natural water cycle, the increasing drought frequency and severity has a high impact on water resources having multiple consequences, especially in regions of high population density or scarce water reserves. In this context, the current approach aims to assess the impact of drought phenomena on groundwater, to improve water management in one of the driest regions of Romania.
The study area includes the region between Siret and Prut rivers (about 25,000 km2, in Eastern Romania), being characterized by a hilly and plateau relief, a temperate continental climate with excessive tendencies and a dominant vegetation cover specific to steppe, silvo-steppe and forest domains. Water resources are relatively modest in terms of groundwater or river discharge and characterized by a high time variability. Groundwater reserves and dynamics depend mainly on the climatic conditions, but also on the hydrostatic level depth, the reservoir and drainage conditions. Moreover, the last time, the significant human pressure manifests through a very high density of wells and a continuously increasing consumption, which affect the regenerative capacity of aquifers and perpetuate the water scarcity. In the context of the present climatic changes, the increased frequency and the more accentuated intensity of drought and dryness phenomena significantly affect groundwater reserves.
Processing a consistent database from meteorological stations and 256 hydrogeological drills from the eastern part of Romania allowed highlighting some significant correlation between the hydro-climatic elements, with the purpose of relieving the degree of drought exposure of the phreatic aquifers. According to the typology of phreatic aquifers (floodplain or terrace alluvia, proluvio-coluvial slope-base deposits or accumulated in deluvial or eluvial reservoir deposits), there were identified aspects such as: the variation in depth of the relation hydrostatic level/climatic elements (rainfall, temperature, evapotranspiration), the relation between the standard deviation of the hydrostatic level and the climatic parameters, the depth and variation amplitude of the hydrostatic level, the annual regime of these variations, the relation between the variation indicators of the hydrostatic level and the drought indicators tested and validated for the region of study (Standard Precipitation Index, Rainfall Anomaly Index, Palfai Aridity index etc.). The corrections applied according to the hydrogeological parameters (e.g. depth and grain size distribution of the deposits) increase the accuracy of results. Thus, the statistical computation provides the critical limits of vulnerability to drought within the climatic condition of Eastern Romania (critical groundwater depth, critical discharge, critical wells density etc.), while the spatial analysis allows mapping the different degrees of groundwater exposure to droughts.
Given that each drought has an almost unique combination of duration, spatial extent, intensity and consequences, the current approach offers a tool for a sustainable management of water resources, sufficiently able to satisfy the needs of today and tomorrow population of Eastern Romania.