OPEN ACCESS Freely available online

Journal of Geology & Geophysics

ISSN: 2381-8719

Commentary

Groundwater Variability Characterization Combining Hydrological, Geological, and Climatic Characteristics

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DESCRIPTION

In the foreseeable future, the tropics' dependence on groundwater to supply the rising demands for domestic, industrial, and agricultural water is anticipated to increase significantly. In addition, groundwater becomes a crucial supply of water for residential and agricultural consumption during droughts and dry seasons. Considering the inherent variability of Depth to Groundwater (DTW) and the influencing Hydrological, Geological, and Climatological (HGC) elements is necessary for this. However, it is nearly impossible to provide physical-based models to comprehend the regional-scale variability in extremely heterogeneous geological formations, particularly in countries with a lack of data. In this situation, the data-driven strategy appears to be a reasonable alternative to assess the historical DTW variability's insight and identify the variables dictating the variability observed for the groundwater resource's sustainable management.

The historical trend in DTW over duration suggests important information on the effects of anthropogenic activities, changes in Land Use and Land Cover (LULC), and climate variability. Despite continued reliance on groundwater, there has been very little research on the temporal trend analysis of DTW in the tropical savanna regions of India. This may be because there is insufficient trustworthy and ongoing data monitoring. Additionally, when performing trend analysis on the DTW time series data, previous studies failed to account for the temporal auto-correlation that exists in those data. The temporal auto-correlation included in the time series is taken into account using the modified Mann-Kendall (mMK) test, which increases the accuracy of trend evaluation. Effective resource management requires an understanding of these temporal trends and patterns in the groundwater regime.

This study assesses the regional-scale, multi-aquifer, multi-river basin DTW variability and the degree of dominance the HGC components have in explaining the observed variability. A few studies have looked into how topography affects the spatiotemporal DTW patterns in highland areas. Very few studies have been conducted to determine how various HGC parameters affect groundwater variability. Using a variety of methods, some studies assessed the impact of LULC, soil texture, soil hydraulic characteristics, rainfall, and topography on the spatial distribution and temporal persistence of soil moisture. Instruments that can take into account both category and numerical parameters are the entropy approach.

The marginal entropy values of Shannon's entropy can release information about the geographical variability in the DTW. The aforementioned benefits of Shannon's entropy technique make it more suitable and reliable than other statistical ones. The assessment of previous studies reveals that there have been relatively few attempts to investigate the spatiotemporal variability of DTW at a regional scale and the relevant HGC parameters for groundwater variability. In a country with a dearth of data, it is necessary to look into the main reasons dictating the spatio-temporal variability of DTW.

The study first analysed the variation in DTW of the study region, and then it used Shannon's entropy approach to identify the dominating HGC components for the observed spatio-temporal variability. LULC, geomorphology, Lithological Structure (LS), topography (S, % of slope), and quarterly cumulative rainfall (R) were the HGC system of stratification used in this study. With highly heterogeneous aquifers, the proposed approach is a novel attempt to characterize spatiotemporal variability in DTW in tropical scenarios.

The groundwater variability in the tropical savanna region of India was investigated using Shannon's entropy to determine the spatial variability in DTW and the relative dominance of HGC variables. This method has the advantage of allowing the study to take into account the impact of both categorical and numerically dependent or independent elements. An entropy analysis reveals that a dataset with lower marginal entropy would also have lower variability, and the opposite is indeed true. Similar to how it would be the more prominent HGC factor in terms of affecting DTW variability, the HGC factor on which the lower joint entropy value was predicated.

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Received: 30-Nov-2022; Manuscript No. JGG-22-21123; **Editor assigned:** 02-Dec-2022; PreQC. No. JGG-22-21123 (PQ); **Reviewed:** 16-Dec-2022; QC. No. JGG-22-21123; **Revised:** 23-Dec-2022; Manuscript No. JGG-22-21123 (R); **Published:** 30-Dec-2022, DOI: 10.35248/2381-8719.22.11.1060.

Citation: Gupta V (2022) Groundwater Variability Characterization Combining Hydrological, Geological, and Climatic Characteristics. J Geol Geophys. 11:1060.