Research Paper

Hydrogeomorphology, Vol. 9, No. 30, Spring 2022, pp (13-16)

Received: 2021.11.15
Accepted: 2022.04.17

Spatial Modeling of Geological Formations Based on water Quality Parameters in Parishan Catchment

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1-Introduction

This study is one of the first studies on spatial modeling of water quality parameters with geological formations in the basin. In changing groundwater quality, two factors of type and type of rocks are more important that the main constituents of formations in arid and semi-arid regions of Iran are four groups of lime, gypsum, marl and salt. For this purpose, in this study, by selecting the Parishan basin as an example of semi-closed inland Zagros basins to investigate the relationship between the geological formations and water quality parameters and spatial modeling, geographical weight regression (GWR) model has been used. Therefore, due to the limited water resources in Parishan basin due to its location in the semi-arid and hot zone, the study of factors affecting it, including geological formations and recognition of factors affecting the quality of water resources in basins for protection to reduce the vulnerability of these resources and use a An efficient and powerful model seems essential.

2-Methodology

Parishan Lake catchment with code 2511 is one of the semi-closed cups in Fars province (Kazerun city). From the point of view of geomorphology, this region is part of the southeastern Zagros (Fars region). The area of this basin is 225 square kilometers, of which 40 percent (90 square kilometers) is covered with heights and 60 percent (135 square kilometers) is covered with plains and lakes. The sediments of the fourth period, which include most of the Lake Parishan basin, have formed three types of sediments: slope, alluvial, and lake.

In this study, geographical weight regression (GWR) model has been used to investigate the relationship between geological formations and water quality parameters and spatial modeling. This method is based on the processing of hydrological information of water

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quality and geological data using GIS technique. The required parameters are used as model inputs using a 1: 100000 geological map and for the analysis of qualitative parameters, surface and groundwater resources data from exploitation wells and observations obtained from the Iranian Water Management Organization have been used.

So that the water quality data are related to 25 observation wells in 2019, which among the data of 16 quality parameters, after examining the relationship between the parameters, the ones that have the highest correlation and significant relationship with the hydraulic conductivity (EC) parameter were selected for statistical analysis, and quantification of geological formations, for each well, a polygon was drawn. They were added in to the ARC-GIS environment and analyzed in the following steps;

1. First, to enter the best model for implementation in the GWR method, independent variables related to the trial and error method in the OLS method were analyzed to select the best model with a significant relationship between variables.
2. After selecting the best model, the Moran index was used to evaluate the spatial autocorrelation of OLS model residues. This index measures the degree of clustering or dispersion of standard residues. Residues are used to test the model's reliability in predicting local conditions by spatial correlation testing. GWR records local changes by weighing closer observations than farther observations (Pratt and Chang, 2012: 52).
3. Finally, the relationship between water quality parameters and the geological formation during the time series of years was evaluated by forming the autocorrelation matrix of the Moran index in the spatial analysis of hot spots.

3-Results and Discussion

According to the results of the OLS model) for the Aghajari Formation (MPLa) and alluvial deposits (Qc) of the present era, which mainly includes large layers around Parishan wetland, the sign of beta coefficients in them is negative, indicating their inverse relationship with qualitative parameters. But most of the quality parameters are directly and highly related to the disturbed lake. Also, the amount of EC in disturbed wetlands during the flood period is 2.5 and 2.5 times the salinity (in milligrams per liter), respectively, which in areas with water with saline compounds, TDS is approximately equivalent to salinity; Therefore, there is a relationship between salinity and EC in this area (Rezaei et al., 2021) which indicates surface erosion and leaching of salt and gypsum from the surface by surface currents and their transfer to the low points of the basin, in Parishan wetland. Finally, to better understand the correlation between geological formations and water quality parameters in different parts of the basin, the variables selected from the OLS model were entered into the GWR model.

Therefore, in the study of maps, the highest correlation was related to the parameter and potassium and electrical conductivity and the lowest value was related to the sodium parameter, which indicates salinization of soils located in these areas, while other parameters showed a very high correlation with independent variables. In most qualitative parameters such as potassium, chlorine and electrical conductivity, the highest correlation is related to the west and center of the basin, which indicates the high effect of salt diapir in the Gachsaran Formation located in the basin on water resources and therefore the quality of wells near these points. They are lower than wells in higher and farther points. Also, low resistance and erosion of evaporitic sediments in the Aghajari Formation in the southwestern part of the basin have contributed to this issue.

The GWR model with high spatial variability has shown this and this is exactly the case with the results of research by Hosseinkhah et al., (1995); have also inferred about the high spatial variability of this model. Finally, by forming the autocorrelation matrix of the Moran index in the spatial analysis of hot spots, the relationship between water quality parameters and the geological formation during the time series of 1387-1387 was evaluated. The model with high variability accuracy established a direct relationship between these two parameters and by performing this step, the model validation was confirmed.

4-Conclusions

The results of this study showed that this model with high spatial variability shows the effect of different formations on water resources in different places and critical areas with the most negative effects. Also, the results of this model showed evaporative sediments (gypsum). And salt such as Gachsaran Formation in the basin are among the most important causes of water quality degradation. Also, due to the significant relationship between water quality parameters and low points of the basin such as Parishan Lake, indicate the leaching and transport of these sediments by running water from the salt and calcareous formations of the upstream basins by the Dalaki River and due to low level The bed of the lake, which is negative 11 meters below the level of the open water level and also due to the hydraulic slope, has flowed to this area through underground streams, which is confirmed by the existence of springs with saline water discharge around Parishan Lake. One of the strengths of this model in this research is to show the correct type of correlation (direct and inverse) between the constituents and water quality parameters in the basin.

Keywords: GWR, Modeling, Water quality, Geology, Parishan basin, Fars province.

5-References

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