Geostatistical Method for Compilation of Spatial TDS Variations in Groundwater

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United Nations Sustainable development goal 6 declares Clean Water and Sanitation for the entire globe by 2030. Presently 15% of the Sri Lankan population or ~ 85% of the dry zone people do not have access to safe drinking water, which stems from high salinity (e.g., high total dissolved solids (TDS)), rendering water unpalatable. Presently the hydrogeochemical maps are prepared for the spatial distribution of TDS and other water quality parameters at different scales using the arithmetic averaging method within a pre-defined square lattice method, which does not account for the uneven water distribution, heterogeneous geology, etc. We used a geostatistical spatial method to account for the heterogeneity arisen in groundwater chemical composition. Thirty-six groundwater samples were collected from Nettiyagama Mihintale (36 km^2) to determine major ions by inductively coupled plasma optical emission spectroscopy (ICP-OES) and non-suppressed ion chromatography (IC). Ordinary Kriging (OK) and inverse distance weighting (IDW) analyses were chosen to construct hydrogeochemical spatial maps using ArcGIS. In OK, the variograms were calculated using Spherical, Exponential and Gaussian functions. The sill, nugget and range of the variograms are Spherical (0.0989, 0.0407, 645.5798), Exponential (0.0991, 0.0382, 834.3725) and Gaussian (0.1008, 0.0446, 583.6893), and the best fitted variogram for TDS values was derived from Spherical function. Comparing the lowest root mean square error (RMSE) value of OK (143.8236) and IDW (141.256), the IDW values were used to construct TDS maps and the leave one cross out method was used for data validation. Eighteen locations were used to validate the optimized TDS map constructed by the IDW method. The validated TDS spatial maps can be used as a predictive tool within the area using the experimental values received from the independent sampling program. The observed geological and experimental discrepancies will be further analysed to provide a robust methodology in preparing regional-scale spatial maps for TDS with predictive power. Also NO3- and F- spatial distribution maps were created to classify water based on its suitability for human consumption.

Keywords: Groundwater quality, TDS, Spatial map, Ordinary kriging, IDW

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