Titlul lucrării

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Abstract
Examining pH Variation of groundwater Using Geostatistical Methods , Example Konya Closed Basin.

Keywords: *Groundwater level, Geostatistical Method, Inverse Distance Weighted Interpolation Method (IDW), Kriging Method, , ArcGıs ,Konya Closed Basin*

Introducere

The fact that water, the source of life, cannot be replaced by any other source, has made this resource important since the existence of the world. Water is one of the basic elements of life. In addition to being a nutrient, water plays an incredibly active role in all kinds of biochemical reactions in our body with the minerals and compounds it contains. Starting from maintaining the pH balance of our body, creating a distribution environment for the molecules and organelles in the cells; It takes on many tasks, from transporting nutrients and waste materials to relevant places. Therefore, life without water is unthinkable. This; It has usage areas in agriculture, industry, energy and domestic areas. Water, which is of great importance for societies and ecosystems, also forms the basis of sustainable development. Water is everything to living things and life. Water is also a living environment for living things. Water on the earth is in a constant cycle. Some of the water mixes with the atmosphere as water vapor through evaporation resulting from the energy coming from the Sun and the transpiration of plants. Water vapor falls from the atmosphere back to the earth as precipitation. Some of the precipitation that falls on the land seeps underground and forms groundwater, while some of it passes into surface flow and reaches lakes and seas through streams. This movement of water is called the water cycle. As a result of heating, they evaporate and rise to the sky, and as a result of condensation, they descend to the earth and balance each other. This cycle provides an important ecological balance that affects the sustainability of water on Earth and the management of water resources. It occurs when surface water leaks underground and accumulates in the gaps between layers or in permeable layers. It appears that the largest fresh water resource in the world is ground water. In addition to being used as drinking water, groundwater is also an important resource used in industry and agriculture. pH levels of groundwater are an important factor in determining drinking water quality. pH is a measurement that indicates whether a liquid is acidic, basic or neutral. The human body also operates within a certain pH range and it is important to maintain this balance. The human body generally operates in a slightly alkaline environment (pH 7.35 - 7.45). The pH of drinking water can affect the pH levels of our body fluids. If groundwater is too acidic or too basic, drinking water can affect the body's acidity or alkalinity levels. This can affect cellular functions, enzymatic activities and other biochemical processes. Consuming excessively acidic or excessively basic water can disrupt the acid-base balance in the body and cause various health problems. It is especially important that the pH of drinking water is in a healthy range to protect general health by supporting the digestive system, metabolism and cellular functions. Therefore, drinking water sources are regularly checked and compliance with drinking water standards is ensured. Consuming balanced and healthy drinking water is important to live a healthy life and maintain the acid-base balance in the body. On the other hand ,The pH of groundwater can significantly impact agriculture because the chemical properties of water are crucial for providing suitable conditions for healthy plant growth. Here are the effects of groundwater pH on agriculture: Plant Growth and Nutrient Uptake: The pH of groundwater affects the solubility of nutrients absorbed by plant roots. If the water's pH is not suitable, nutrient uptake by plants can be adversely affected, leading to harmful effects on growth. Impact on Soil pH: The pH of groundwater can influence the pH level of the soil. High-pH water can cause soil to become more alkaline, creating an environment unsuitable for some plants. Salinity and Mineral Solubility: Groundwater pH affects the solubility of minerals in water. High-pH water can increase or decrease the solubility of certain minerals, creating conditions unsuitable for plants. Presence of Toxic Elements: High-pH water sources can increase the solubility of certain toxic metals (e.g., arsenic). This can negatively affect plant health and the safety of produce for human consumption if absorbed by plants. Microbial Activity: The pH of groundwater can influence microbial activity in aquatic environments. Microbial activity is important for soil health and can support nutrient uptake and healthy plant growth. In conclusion, it is evident that the pH of groundwater can have significant effects on agriculture. Therefore, agricultural irrigation projects and water management should include measures to monitor and adjust groundwater pH as necessary. This ensures healthy plant growth and efficient crop production. The World Health Organization (WHO) recommends a pH range of 6.5 to 8.5 for drinking water quality. This range is designed to ensure that drinking water is suitable for human health and preserves the overall health of the community. Water with a pH value within this range is generally considered safe for both drinking and domestic use, reducing the presence of chemical or biological contaminants that may be harmful to human health. Therefore, the pH value of drinking water is an important parameter regularly monitored and controlled by health authorities. The Food and Agriculture Organization (FAO) has established the ideal soil pH value for proper agriculture. Generally, the optimal pH range for most plants is considered to be between 6 to 7.5. Within this range, essential nutrients in the soil are absorbed most efficiently by plants, promoting plant growth. Soils with pH values within this range generally have suitable conditions that support soil structure, microbial activity, and plant health. However, some plants may have different pH requirements, so pH requirements can vary depending on specific plant species. Groundwater constitutes a significant portion of the Earth's freshwater reserves. Groundwater accounts for approximately 30% of surface water, representing a substantial portion of total water reserves and serving as a crucial source for various purposes such as agricultural irrigation, drinking water supply, and industrial usage. The aim of this study is to demonstrate the importance of groundwater, which constitutes 30% of surface water, as a vital source of water that can be utilized for various purposes. During the investigation, I explored whether the pH values of groundwater sources comply with the standards set by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO). Additionally, I employed the Inverse Distance Weighting (IDW) and Kriging methods for analysis. Using ArcGIS software, I generated maps depicting the values measured at the end and beginning of the season. It was observed that the values complied with the standards set by WHO and FAO, and it was also understood that these methods could be used for other studies as well.

Secțiunea preliminară

Material and methods

In this project proposal, two geostatistical methods, namely Inverse Distance Weighting (IDW) and Kriging, will be utilized. The use of the GIS software ARCGIS is planned for the study.

Geoistatistical Methods : Geostatistical methods are commonly used for explaining spatial patterns of natural phenomena, completing missing data, and achieving various objectives.

Inverse Distance Weighting (IDW) Interpolation Method: IDW is one of the most preferred non-geostatistical methods. It is an interpolation technique used to determine cell values for unknown points using the values of known sample points. Since it only generates estimates from neighboring points, it provides a local intermediate value estimate. The method relies on the assumption that neighboring points on the surface where interpolation is to be performed have a greater weight than distant points. The cell value is calculated by observing various points as the distance increases from the relevant cell, and the predicted values are a function of the distance and magnitude of points in the neighboring cell. As the distance increases, the importance and impact on the cell to be estimated decrease. IDW uses a mathematical expression called Shepard's method for interpolation.

$$F(x,y) = \sum_{i=1}^{n} w_i * f_i \qquad (1)$$

$$w_i = h_i^{-p} / \sum_{i=1}^{n} h_i^{-p} \qquad (2)$$

İn the equations ;
p: present the power parameter, which denotes the exponent.
Hi: denotes the spatial distance between sample points and interpolation points.
Wi:the sum of weight values should be 1.
Fi: represent the known elevation values.

Kriking Method: This method was developed by mining engineer Danie Gerhardus Krige. Kriging refers to a group of interpolation methods used to estimate an unobserved value. The location is estimated through a linear combination of values at surrounding locations using weights. One distinctive feature of Kriging compared to other interpolation methods is the ability to compute a variance value for each point being estimated. This contributes to increasing the reliability of the computed values. Kriging provides more accurate results compared to other methods and also determines the lowest variance and standard deviation of the estimation. The variance value obtained through this method is called the Kriging variance. This study was conducted using the Ordinary Kriging method, and Equation (3) belonging to this method was utilized.

$$N_p = \sum_{t=1}^{n} P_i * N_i \qquad (3)$$

İn the equations ;
N: represent the number of points in the model.
Ni: denotes the geoid fluctiation values used in the calculation of Np.
Np: represent the required fluctiation value.
Pi: denotes the weight values for each Ni value used in the calculation of Np.

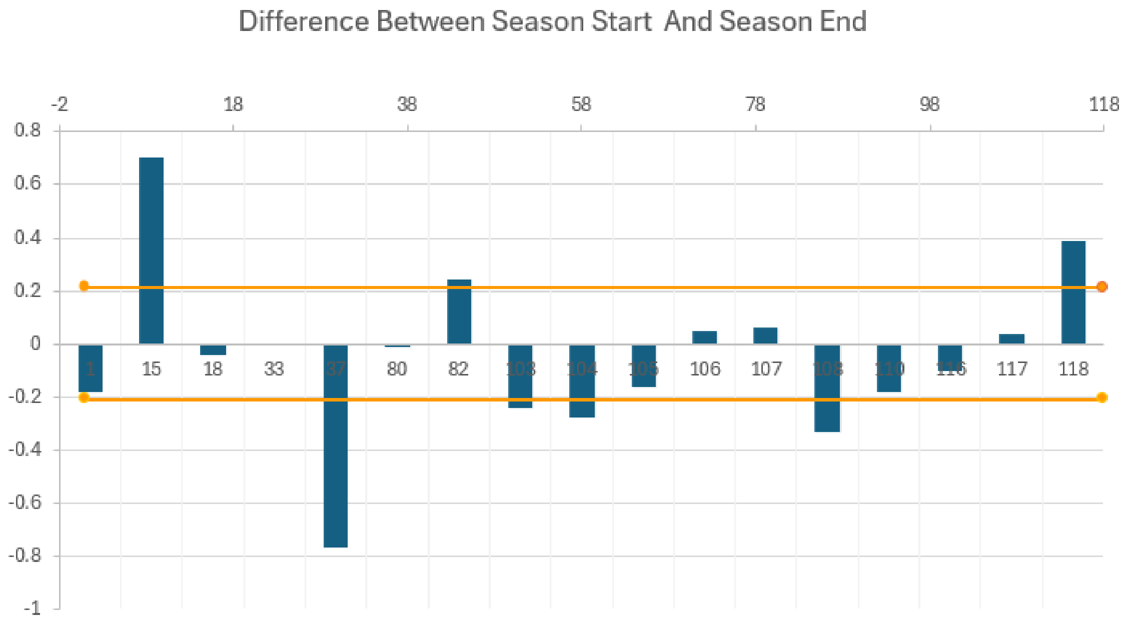


Fig. 1. Imagine : Difference Between Season Start and Season End pH variations. Autor: Kübra Küçük

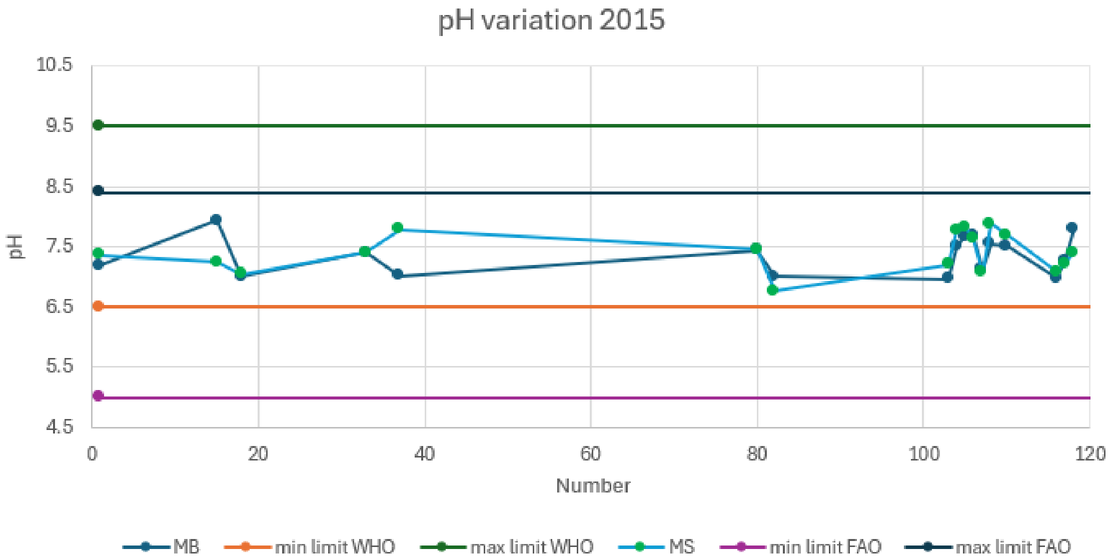


Fig. 2. Imagine : pH Variations between min and max value of WHO and FAO . Autor: Kübra Küçük

Working area

The Konya Closed Basin is one of the closed basins in our country. Located within the boundaries of Turkey's Central Anatolia region, the Konya Closed Basin covers approximately 5 million hectares, constituting 7% of the country's total area. Known as the "granary of Turkey," the Konya Closed Basin is also one of the world's 200 most important ecological regions in terms of biological diversity. Serving as a significant production area both agriculturally and economically, the Konya Closed Basin is home to 15 important plant areas and 6 important bird areas. The Konya Closed Basin is situated between latitudes 36°51' N and 39°29' N, and longitudes 31°36' E and 34°52' E in

Turkey's Central Anatolia region. It is bordered by the Sakarya and Kızılırmak basins to the north, the Kızılırmak and Seyhan basins to the east, the Eastern Mediterranean basin to the south, and the Akarçay and Antalya basins to the west. Within the basin, there are territories of Konya, Isparta, Niğde, Ankara, Aksaray, Nevşehir, and Karaman provinces. Additionally, some uninhabited areas of Antalya and Mersin are also within the basin. The population within the basin boundaries consists of 2,150,514 urban residents, 618,695 rural residents, totaling 2,768,900 individuals. The basin is bounded to the south by the Taurus Mountains in a crescent shape. While the elevations in the inner parts of the plain vary between 850-1000 meters (approximately 65% of the entire basin), they rise up to 3900 meters in the Taurus Mountains. The majority of the water resources feeding the basin originate from rivers and groundwater sources originating from the Taurus Mountains. These waters continue from the Taurus Mountains towards the Salt Lake both on the surface and underground, ultimately ending in the Salt Lake. The Konya Closed Basin harbors vast agricultural lands, and the improper use of these lands could lead to significant potential loss. Due to ineffective utilization of water bodies and incorrect irrigation methods, surface waters in the basin are depleting, and groundwater levels are critically decreasing, especially with the utilization of underground water resources in agriculture. Water flow in the region is directed from the Taurus Mountains towards the Salt Lake; however, with the decrease in groundwater levels, the flow is redirected towards the basin in the Salt Lake. This situation leads to salinization and degradation of fertile lands, particularly due to the utilization of underground water resources in agriculture. Presently, water resources in the Konya Closed Basin are insufficient for agricultural irrigation apart from drinking water needs. Moreover, extensive sinkholes are observed in some areas due to the depletion of underground waters. The decline in surface waters leads to the emergence of large marshlands. Additionally, the planning of migration from rural to urban areas is of great importance for the future of the basin. Quantifying these issues will accelerate future studies and measures to be taken in the coming years.

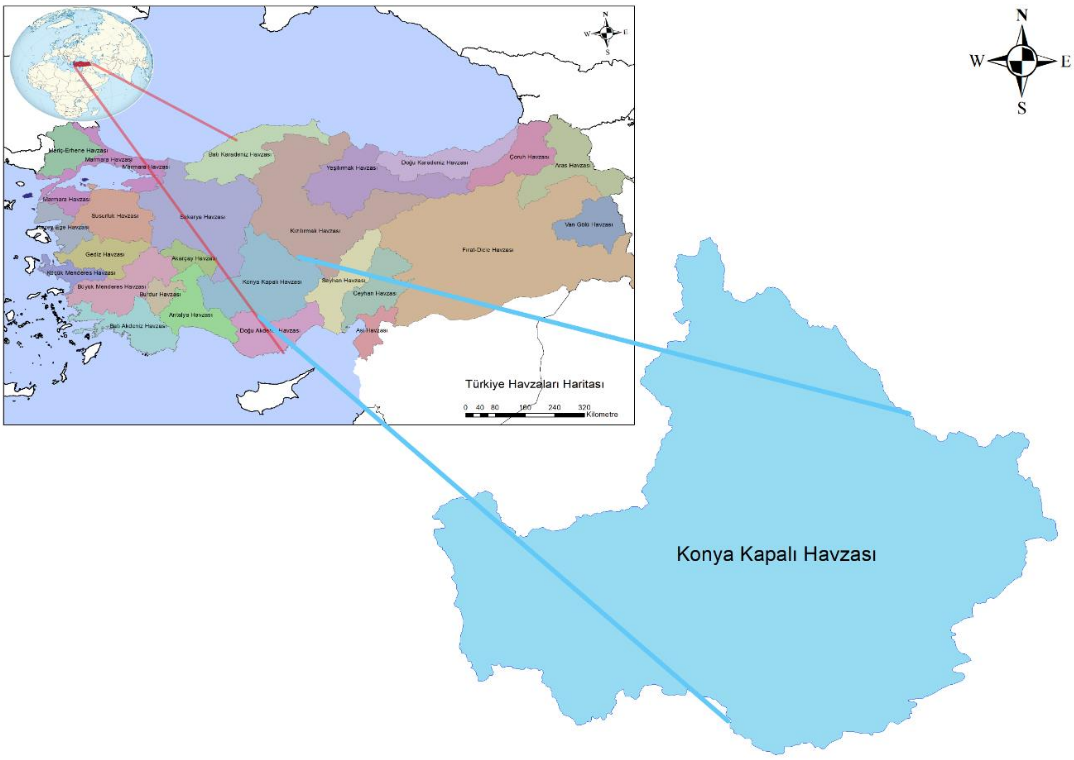


Fig. 3. Imagine : Konya Closed Basin

Concluzii

Interpolation is a mathematical and statistical method used to fill in information derived from incomplete or limited data sets. Determining the pH values of groundwater through interpolation can provide a more comprehensive and detailed view of water quality in a specific region. This information can offer various advantages:

Water Quality Assessment: The groundwater pH map obtained through interpolation provides a general assessment of water quality in a particular region. This can help identify critical areas in terms of water quality and define priority intervention areas.

Environmental Risk Assessment: pH values are important for environmental health and ecosystem integrity. Determining these values through interpolation can aid in identifying and monitoring environmental risks. For example, pH maps can be used to detect or monitor environmental issues arising from acidic waters.

Agricultural and Irrigation Planning: The pH values of groundwater affect the quality of water used in agricultural fields and irrigation systems. This information is crucial for agricultural planning and optimizing irrigation practices.

Water Treatment Strategies: pH data obtained through interpolation can play a significant role in the design of water treatment facilities and systems. This data can be used to determine the acidic or alkaline nature of water and help identify appropriate treatment strategies.

Natural Resource Management: Groundwater pH maps play a vital role in regional natural resource management planning. This information can contribute to sustainable management of water resources and help identify measures to preserve water quality.

Environmental Research and Monitoring: Interpolating groundwater pH values can aid in monitoring environmental changes and conducting environmental research. This is crucial for understanding long-term environmental impacts.

These advantages highlight the importance of using interpolation to determine groundwater pH values for various environmental and water resource management purposes.

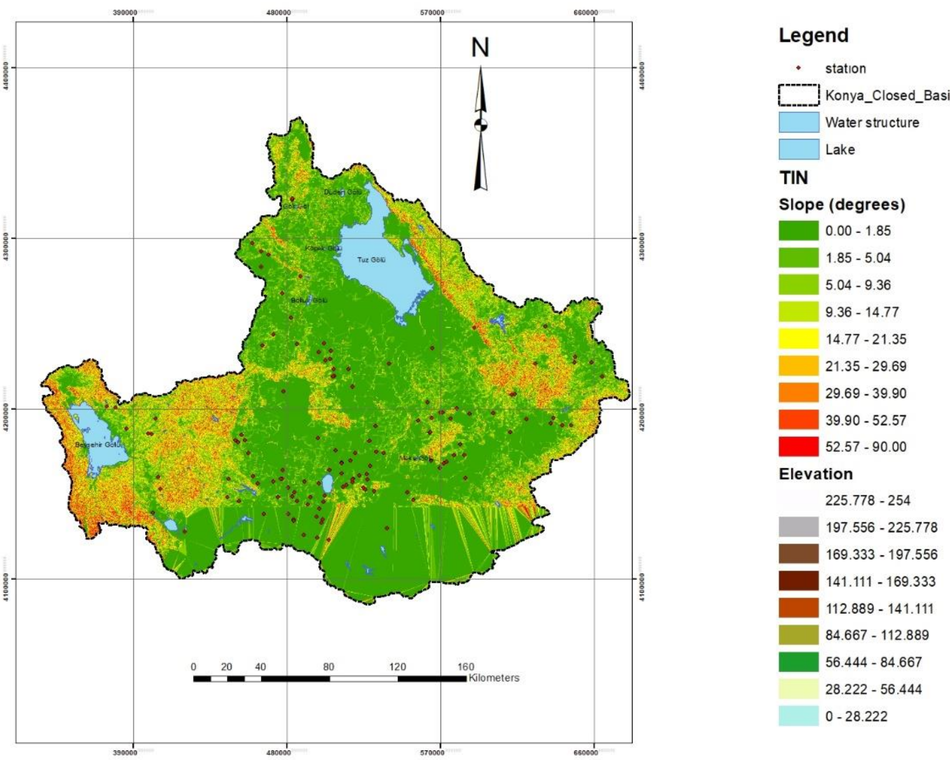


Fig. 4. Imagine:Station Map for Konya Closed Basin. Autor: Kübra Küçük

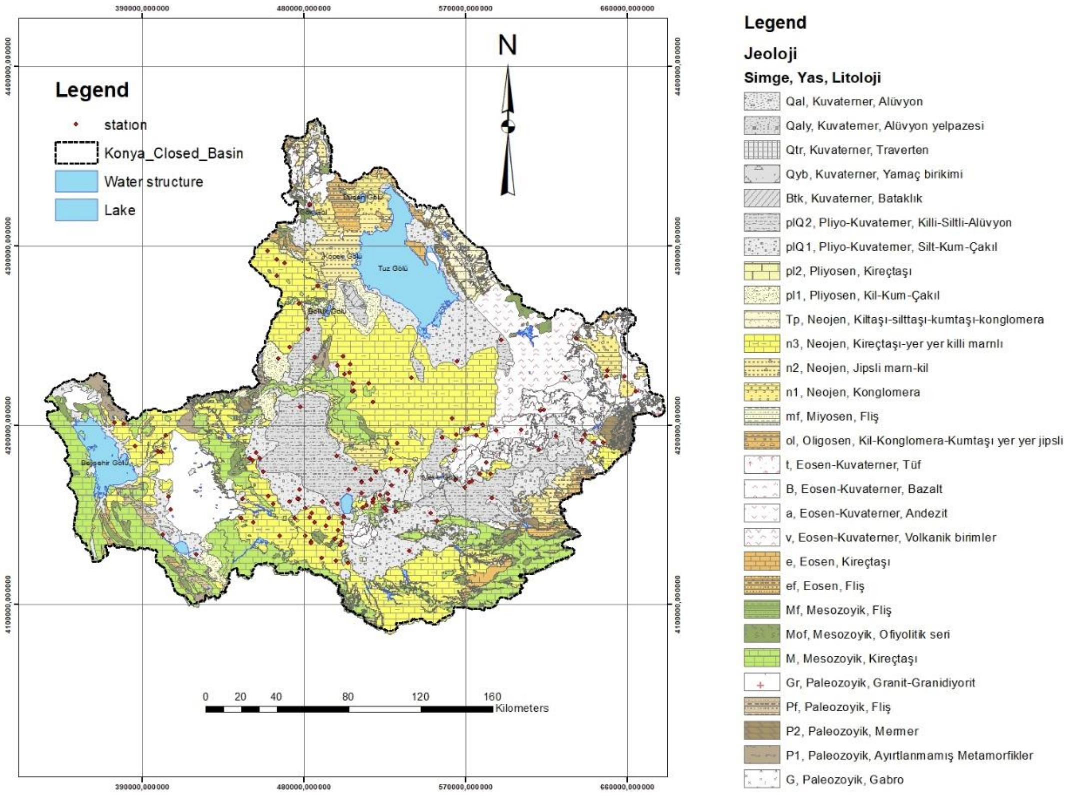
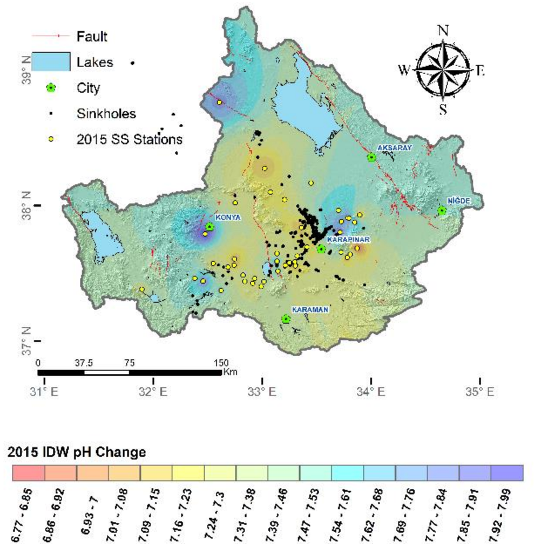


Fig. 5. Imagine:Geological Map for Konya Closed Basin. Autor: Kübra Küçük



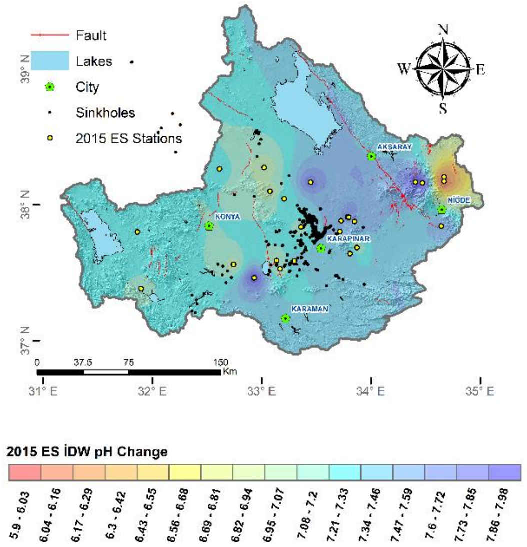
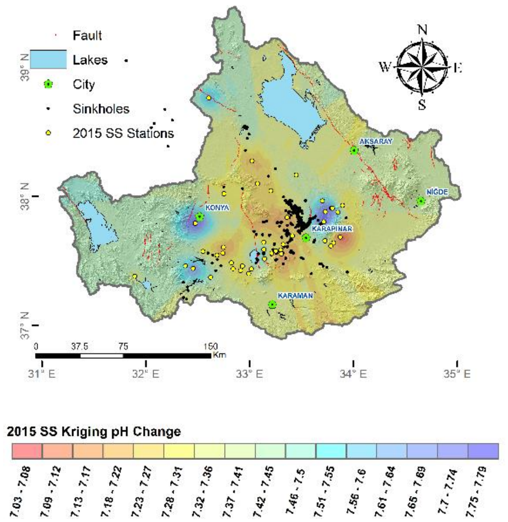


Fig. 6. Imagine: 2015 Start Season pH variation Map. Autor: Kübra KÜÇÜK

Fig. 7. Imagine: 2015 Start Season pH variation Map. Autor: Kübra KÜÇÜK



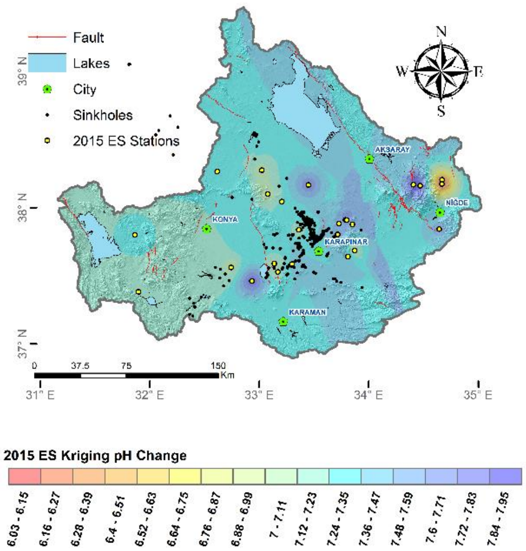


Fig. 8. Imagine: 2015 Start Season pH variation Map. Autor: Kübra KÜÇÜK

Fig. 9. Imagine: 2015 End Season pH variation Map. Autor: Kübra KÜÇÜK

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