The study accuracy of geostatistical methods for determining soil salinity

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Abstract: One of the important problems about soil degradation is a problem of soil salinity. Today salinity of the important problems is considered in the field of the restoration area. Before proceeding to restore an area important issue is to investigate changes in soil salinity features. In this study aimed to assess changes in salinity is using geostatistical methods. This research in Ardekan region to assess soil salinity (electrical conductivity) took place by using geostatistical methods (Kriging and Inverse Distance Weighted methods). Numbers 150 points were collected to determine the amount of electrical conductivity by machine of electromagnetic inductor. Based on the results obtained of the southern part of study area has more salinity and towards the north of the region are closer from salinity decreases. Based on the results method of inverse distance weighting is more accurate compared to method kriging method.

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1. Introduction

In recent years the study of Digital soil mapping from environmental data (representative of the soil factors) with more emphasis on soil properties, are used (Jordan et al, 2004: Moameni, 2011: Daempanah et al, 2011). So that more activities had been Digital mapping on this side, capable of soil properties on the other hand are predict soil characteristics. In this regard, the new devices can be used in operations geology.

For example, in field assessing soil salinity, during the past two decades many of the new techniques such as Wenner array (McKenzie et al. 1997), Electrical conductivity probes of Rhodes (Jordan et al, 2004), reflection survey method of time domain and electromagnetic induction method (Navarro-Pedreno et al, 2007) to measure soil salinity have been used in farm conditions.

One of the methods in which different parts of the world for the management of soil salinity to be used, electromagnetic techniques is that a wide range of users such as researchers and scholars to leading farmers is included. Inductor electromagnetic machine (EM) allows monitor soil salinity without direct contact with it and to spend less time and cost is providing compared to other desert methods (Zolfaghari, 2010).

From electromagnetic induction sensors (especially EM-38) can be used to measure the salinity of the surface layer (30-0 cm) or deeper (90-0 cm). This sensor can be used if combined with global positioning to determine soil salinity map (Walter et al, 2001: Minasny and McBratney, 2006: Daempanah et al, 2011).

Moameni (2011) a study to reduce sampling density to prepare the map soil salinity by using of Kriging, Cokriging and RK methods conducted in China Country. The results showed that the use of auxiliary data in Cokriging and regression kriging method in different sampling density were better than ordinary kriging method. In comparison with Cokriging method is reduced RK method amount square root of 5/41 to 6/23 mm siemens per centimeter; this is because in RK method can be more used auxiliary data.

2. Materials and methods

2.1 The study area

This study was conducted in the city of Ardekan in Yazd province (Figure 1). Expanse of the study area is 62 hectares, that in between longitude 54 ° and one minute to 54 ° and three minutes east and latitude 32 degrees 20 minutes to 32 degrees 22 minutes north is located. Most of soil texture in different parts of this region is sandy loam, clay loam and loam. Irrigation source in this area is a deep well with flow rates about of 25 liters per second, which is located near pistachio gardens. The results chemical properties of irrigation water indicates that the electrical conductivity its 6.12 dS/m and sodium absorption ratio of water is 04/33, which is represents the sodium salt of irrigation water in this region (Ayubi et al, 2007).

2.2 Sampling

For suitable sampling of study area, at first by using electromagnetic induction device, numbers 150

readings were taken. After sample preparation (drying and sifting) was measured electrical conductivity in the saturation extract (Shojaei, 2014).

Kriging: kriging is as one of geostatistical estimation method that based on moving average weighted is firm. This method can be considered the best linear unbiased estimator. From the most important feature is the possibility to achieve the error related to each estimate (Nasiri et al, 2016). This estimator for equation (2) is defined as:

$$Z^*(x_i) = \sum_{i=1}^{n} \lambda_i z(x_i)$$

Where z*(xi): Expression estimated iλ: weight or quantity importance dependent on samples i and z (xi) is a variable amount measured (Tajgardan et al, 2009).

Inverse Distance Weighted method: Inverse distance was interpolation method with average weighting where data via a deflection connection a point of other points are weighted by using of networked nodes. When the network node is estimated, weights assigned points divided to small amounts so that the sum of all weights assigned points equal to 1. When adapted point on the network node, the distance be this point to the node is equal to zero, so in this case weight assigned to mentions points equal to 1 and the weight of other points of around nodes is equal to zero (Shojaei, 1393). This method is based on the assumption that with increasing distance data, impact on each other's data becomes pale. Therefore, weighting coefficient with the distance has reverse proportion. Relevant relationships are as follows:

$$\hat{Z}_J = \frac{\sum_{i=1}^{N} \frac{Z_i}{h_{ij}^{\beta}}}{\sum_{i=1}^{N} \frac{1}{h_{ij}^{\beta}}}$$

$$h_{ij} = \sqrt{d_{ij}^{2} + \sigma^2}$$

Where hij: The difference effective distance between network node (j) and point neighboring node (i), $\hat{Z}_J$: the estimated value parameter Z, Zj: the actual value of the parameter Z in the neighborhood nodes, dij: The distance between network nodes (j) and point neighboring node (i), β: potency weighted, σ: Leveler are coefficient (Zolfaghari et al, 2011).

Evaluation Model

To evaluate the performance of the estimated model dependent variables (soil salinity) from a set of criteria including root mean square error, coefficient of determination and the mean error was used.

3. Results and discussion

Electrical conductivity values obtained from kriging model and inverse distance weighted method shown in Table 1. According to obtained results from electrical conductivity mean value estimate kriging model at a depth of 0-30 cm is equal to 14.44 dS/m. Also mean value electrical conductivity is obtained from inverse Distance Weighted method equal to 16.30 dS m.

Table 1 summarize statistical of electrical conductivity values (dS/m)

Coefficient of variation	SD	mean	depth	method
55.24	4.5	14.44	0-30	**kriging**
43.43	3.6	16.30	**0-30**	**inverse Distance Weighted method**

In this research kriging with spherical model was used. Root Square Error and mean error soil salinity arising from both kriging models and inverse distance weighted method results shown in Table 2.

Table 2 shows the results of the evaluation criteria kriging model to predict the electrical conductivity

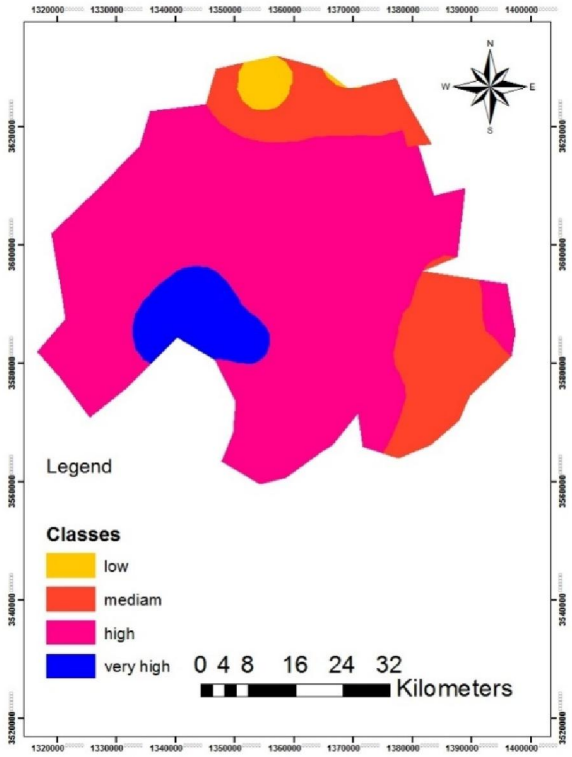
The sum square error	mean error	depth	method
6.7	0.25	30-0	**kriging**
4.3	0.18	30-0	**inverse Distance Weighted method**

Soil salinity map of the study area for 0-30 cm depth was obtained by kriging method (Figure 2). The results showed that salinity is higher in south part and as possible north of this region are closer and is lower salinity. Rainfall less than 60 mm per year, reduction in dry climate and vegetation due to the expansion salinity and release large part of agricultural land from reasons spread of salinity can be expressed in Yazd (Zolfaghari, 2010).

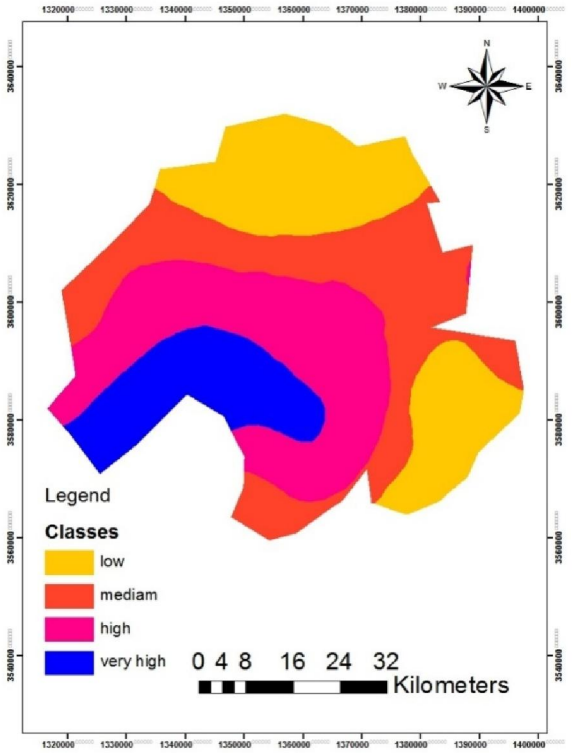
As compared other research (Figueira et al, 1999) results monitoring salinity in two pieces with different humidity soil showed that correlation between electromagnetic navigation device readings in soil with weight moisture 35% more of soil with weight moisture is 20% with increasing soil moisture measurement accuracy of these tools will also increase. After determining the main parameters and neuro-fuzzy model, the remaining amounts of training data is calculated and by using of kriging with

variogram error area was convert to map of continuous variance error. In similar researches paid to Digital zoning of ability electrical conductivity appearance by using of kriging regression and local variogram in Ardekan region.

The results show the high efficiency of regression kriging model with local variogram, so that RK model percentage error predicted in a horizontal position compared to Cokriging and kriging respectively is reduced to 21 and 28 percent.



method inverse distance weighting



Kriging model

Figure 2 maps of ability the electrical conductivity by using of regression kriging model and inverse distance weighting method

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