Comparison of Interpolation Methods in Prediction the Pattern of Basal Stem Rot Diesease in Palm Oil Plantation

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Abstract

Basal Stem Rot is a diseases that caused by Ganoderma Boinense that is the most serious disease for oil palm trees in Malaysia. The analysis of plant disease has been carried extensively with the advancement in computer technology. Particularly, in terms of spatial and temporal, it is very complicated to be processed. Furthermore, the application of GIS in plant disease analysis is becoming more popular, precise and advance. In previous studies, Kriging has been used to predict the pattern of BSR disease. In this study, two commonly used interpolation methods for GIS, Kriging and Inverse Distance Weighting (IDW), are used to interpolate and predict the pattern of Basal Stem Rot disease. Since the IDW method is an exact method and is more accurate one, it was expected to see more accurate results. However, the accuracy results of both methods are the same. Based on the characteristic of both methods and according to advantages and disadvantages, the Inverse Distance Weighted is recommended in this study but, for more informative data, Ordinary Kriging is suggested to be the preferable method to be used as an alternative method.

Keywords: Inverse Distance Weighted, Kriging, Palm Oil

1. INTRODUCTION

About half of the world's palm oil is produced in Malaysia. The oil palm is an important socio-economic crop in Malaysia, with the value of oil palm products estimated at 10.8 million tons in 2000. Concerns about the impact of diseases on future competitiveness and sustainability of the industry have surfaced. Fungal pathogens cause many diseases that strike oil palms. One of these deadly diseases of oil palm in Malaysia is the Basal Stem Rot.There is not enough information on the dynamics of the Basal Stem Rot disease in the system of production of palm oil. The analysis of plant disease has been facilitated to a considerable area (Markom *et al.,* 2008). Although the advancement in computer technology has been substantial, the analysis, particularly in spatial and temporal terms is a very complicated process. Furthermore, using GIS in plant disease analysis is becoming more popular, precise and advanced. GIS can be used in plant disease analysis in many ways. Interpolation is the process of creating estimated values of a phenomenon (such as air temperature) from verified values of the same phenomenon. This

method is commonly used in GIS to create maps depicting phenomena. Two widely used interpolation methods for GIS are Kriging and Inverse Distance Weighting (IDW) which are used to interpolate and predict the pattern of Basal Stem Rot disease in this study.Experiments were conducted on an area of 10.88 ha (108800 m) at the MPOB (Malaysian Palm Oil Board) Teluk Intan Research Station (3.49o N, 101.06o S) in Perak, Malaysia. (Tengku Mohd Azhar Bin Tuan Dir, 2010).

Kriging provides a means of interpolating values for points not physically sampled using knowledge about the underlying spatial relationships in a data set to do so. . Kriging is based on regionalized variable theory, which provides an optimal interpolation estimate for a given coordinate location, as well as a variance estimate for the interpolation value. Inverse distance weighted interpolation is an exact method, using IDW to enforce the condition to influence estimated value more by nearby points rather than farther away. It means that Inverse Distance Weighting (IDW) points in nearest distance to the sample point give more weight when calculating the mean. . Those measured values closest to the prediction location will have more influence on the predicted value than those farther away. Thus, IDW assumes that each measured point has a local influence that diminishes with distance. (Chang, 2010).

2. STUDY AREA

Experiments were conducted on an area of 10.88 ha (108800 m) at the MPOB (Malaysian Palm Oil Board) Teluk Intan Research Station (3.49o N, 101.06o S) in Perak, Malaysia. The study area is mostly flat and lies mostly between 5 to 8 meters above sea level. The site receives a moderately high and uniformly distributed rainfall and has a high soil water table. Between 1990 and 2001, the annual rainfall at the site varied from 1696 to 2404 mm with the driest month being July and the wettest, November. The soil is characterized with very deep (above 3 meters) peat, comprised of a heterogeneous mixture of decomposed plant (humus) material that has accumulated in a water-saturated environment and in the absence of oxygen (Markom et.al, 2009).

2. METHODOLOGY

Kriging involves an interactive investigation of the spatial behavior of the phenomenon before generating the output surface. It is based on the regionalized variable theory, which assumes that the spatial variation in the phenomenon is statistically homogeneous throughout the surface; that is, the same pattern of variation can be observed at all locations on the surface. This hypothesis of spatial homogeneity is fundamental to the regionalized variable theory. Indeed, Inverse Distance Weighting (IDW) is an interpolation technique in which interpolated estimates are made based on values at nearby locations weighted only by distance from the interpolation location. This technique determines cell values using a linearly weighted combination of a set of sample points. The weight is a function of inverse distance. IDW allows the user to control the significance of known points upon the interpolated values, based upon their distance from the output point (Chang, 2010).
The data is divided to training data which include 70% of all data and testing data which is 30% of all data. (Norman, 1975).The output of training (70%) data of using Inverse Distance weighted and Ordinary Kriging is in continuous raster format, while, the selected testing (30%) data is still in two classes (0 and 1) and vector format.

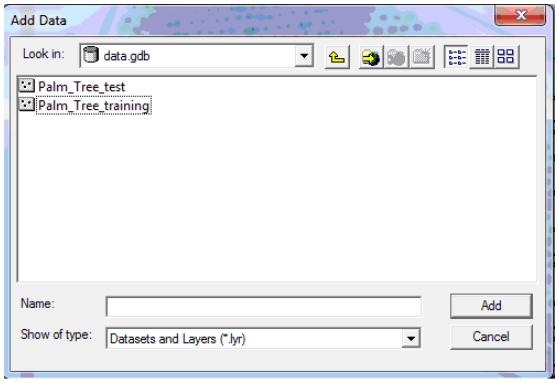

FIGURE 1: Sample testing and training data

In comparing the predicting output and the testing data we need to convert raster output to vector format. Consequently, the raster result is classified into classes: 0-0.5 and 0.5 to 1, and the test value are added into the classified raster output. Then, by comparing the applying selection of attribute in ArcGIS, we can conclude the accuracy of the two applied methods and all other aspects as well.

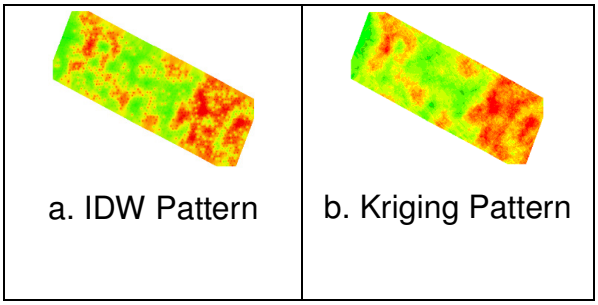

FIGURE 2: The Pattern of BSR Disease in a. IDW and b. Kriging Methods in 2004

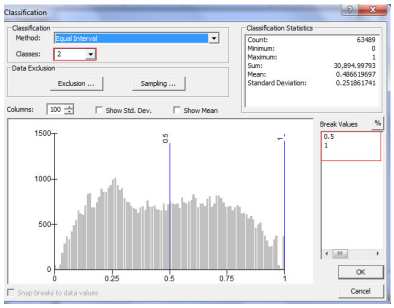

FIGURE 3: The process of classify raster output

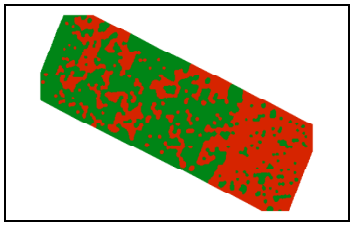

FIGURE 4 : The classified output

Then, the value of the 30% selected testing data is extracted to the classified output. When we extract the value to the result, in fact, we add the value of 30% randomly selected data to the result of 70% ones. This step is exactly the same for the both used methods, and the result is used in the next stages. (Adams *et.al,* 2009).

By extracting the value of selected points to the output, one field (Raster value) is created which contains the infected or non-infected trees in the selected data. This field contains actual data that has not been influenced by prediction patterns and can be used as a reference for testing and measuring the accuracy.

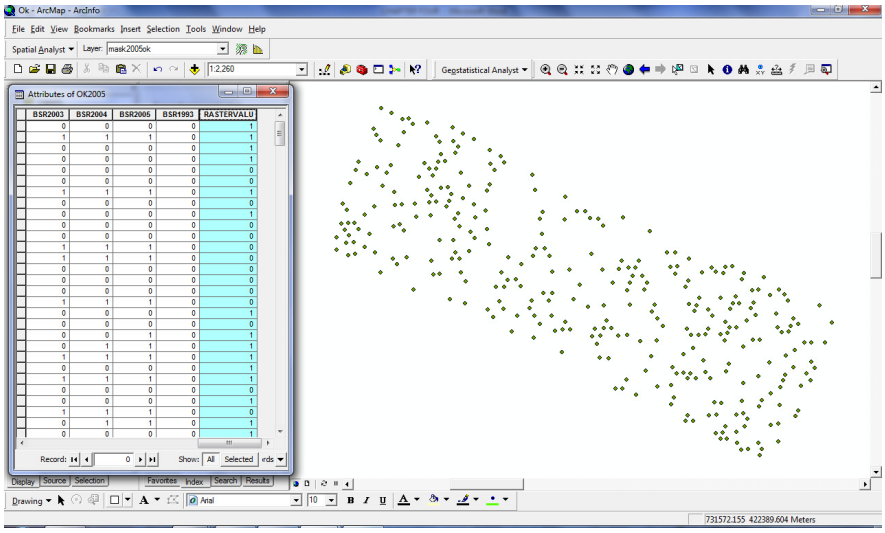

FIGURE 5 : The extracted result of raster map and testing data

Accuracy of the both methods should be compared in ArcGIS by using Selection in the menu and also selection by the attribute. There are four kinds of data in result, the prediction value equal to 1 or 0 and the actual value equal to 1 or 0. Hence, we have agreed values between two predictions filed and actual one and non same values between two predictions field and actual one. Consequently, based on these results we can compare both methods and conclude the more accurate ones.

2.1 Result and Discussion

The accuracy of both Inverse Distance Weighted and Kriging is almost the same. In this study, since nominal data was used to get the result, IDW has more simplicity procedure and fewer steps in comparison Kriging. The advantage of IDW is that it is intuitive and efficient so for this kind of data is recommended. However for more informative data Kriging is more preferable, indeed, Kriging provides a more reliable interpolation because it examines specific sample points to obtain a value for spatial autocorrelation that is only used for estimating around that particular point; rather than assigning a universal distance power value. Furthermore, Kriging allows for interpolated cells to exceed the boundaries of the sample rang. (David w.S Wono, Jay Lee (2005).

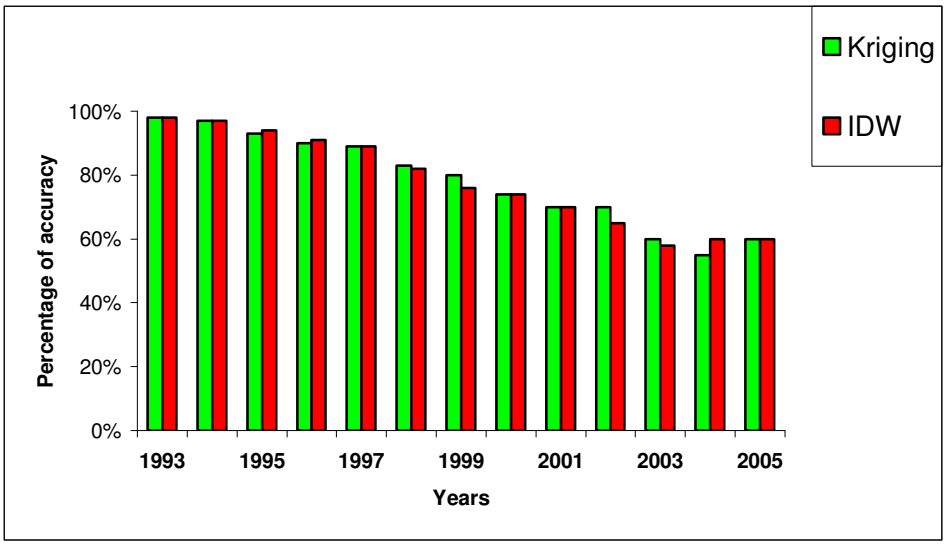

FIGURE 6: Agree values in Kriging and IDW methods (Accuracy of Methods)

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