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Estimating Spatial Variability of Soil Salinity Using Cokriging in Bahariya Oasis, Egypt

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THE MAPPING of saline soils is the first task before any reclamation effort can be conducted. Soil salinity is determined, traditionally, by soil sampling and laboratory analysis. Recently, it became possible to complement these hard data with soft secondary data made available using field sensors like electrode probes or satellite images. Estimating spatial variability of soil salinity is an important issue in precision agriculture.

In this study, geostatistical method of cokriging, were applied to estimate and identify the spatial variability of soil salinity with ECe measurements in 200 km^2 agricultural fields in the north and south Bahariya oasis. In cokriging, more densely sampled secondary data from the ETM satellite image source were incorporated to improve the estimation of the electrical conductivity (ECe). The estimated spatial distributions of ECe using the geostatistical methods with various reduced data sets were compared with the extensive salinity measurements in the large field. The results suggest that sampling cost can be dramatically reduced and estimation can be significantly improved using cokriging. Compared with the kriging results using only primary data set of ECe, cokriging with reduced data sets of ECe improves the estimations greatly by reducing mean squared error and kriging variance up to 70% and increasing correlation of estimates and measurements about 25%. Relative improvements in map accuracy were highest (25% to 38%) in regression colocated cokriging approach, which also performed better than ordinary kriging method that utilized only one ancillary variable. The relative gain from incorporating remote sensing secondary information increased with decreasing sampling density. The results of these models allow to interpolate and classify salinity on a more realistic and continuous scale.

Keywords: Soil salinity, Spatial variability, Cokriging algorithm, Colocated cokriging .

Soil salinity limits food production in many countries of the world. There are mainly two kinds of soil salinity: naturally occurring dryland salinity and human-induced salinity caused by the low quality of water. In both cases the development of plants and soil organisms are limited leading to low yields. In Bahariya oasis, where more than 10% of the land is affected by salt, groundwater and inadequate drainage conditions are the major causes of salinization.

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