Spatial Modeling using Remote Sensing, GIS, and Field Data to Assess Crop Yield and Soil Salinity

Ahmed Eldeiry¹ and Luis A. Garcia²
Integrated Decision Support Group and Associate Professor, Department of Civil Engineering, Colorado State University

Abstract.

A comprehensive salinity monitoring program has been conducted in a portion of the Arkansas Valley in southeastern Colorado from 1999 to the present. This area was selected for study because it provides a good illustration of a salinity-affected area.

The main objective of this presentation is to utilize spatial statistical modeling using information from remote sensing, GIS, GPS, along with field data to develop salinity maps and predict yield. The approach presented in this paper involves integrating remotely sensed data with topographical data (elevation, slope, and aspect) and field data (water table fluctuation, groundwater salinity, soil texture, yield data, and soil salinity) to establish and validate the appropriate spatial techniques to accurately predict crop yield in relation to soil salinity.

The monitoring program is carried out on a large scale and on a field scale. For the large scale, 75 wells were monitored in an area around the Arkansas River in an area covering about 20 miles in length and 10 miles in width. Water table depth, groundwater salinity and soil salinity data are collected for these wells and the lands surrounding them. For the field scale study, five fields were selected to represent different irrigation systems, soil types and crop patterns. In each field 7 to 15 wells were installed. At these fields, water table depth, groundwater salinity, soil salinity, and yield samples are collected regularly during the growing season. In addition to field data collection, two satellite images from IKONOS on July 11, 2001 and on August 1, 2003 and one image from Aster on June 18, 2001 were acquired. The IKONOS image has four bands (blue, green, red, and infrared) with 4 meter of spatial resolution while the ASTER image has 14 bands and has better spectral resolution.

In this study, trend surface models, which describe the large-scale spatial variability, have been developed based on the lowest values of standard errors, modified Akaike’s Information Criterion (AICC) and high R². The test of autocorrelation (whether it is positive, zero or negative) is based mainly on Morani’s value. This study integrates all data to develop a spatial model to predict soil salinity and/or yield.

¹ Ph.D. Candidate, Department of Civil Engineering, Colorado State University
² Director Integrated Decision Support Group and Associate Professor, Department of Civil Engineering, Colorado State University