Application of Geostatistical Inverse Modeling to Satellite Remote Sensing Data

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Abstract

Observational data collected by satellite sensors provide a rich set of information that can be used to parameterize models of the earth's surface. However, the spatial characteristics (orientation, extent, spacing, support) of satellite observations typically do not match the spatial characteristics of these earth surface models. Geostatistical inverse modeling (GIM) can be used to produce integrated estimates on arbitrary grids from multiple overlapping datasets with different spatial characteristics.

Although remote sensing information is typically represented as an image composed of rectangular grid of pixels, optical remote sensors do not gather information uniformly over rectangular areas. Figure 1 illustrates the spatial sensitivity of a typical optical sensor as a function of space. Measurements are typically arranged with significant overlap, so that approximately 50% of a measurement signal originates from outside of the boundaries of an image pixel.

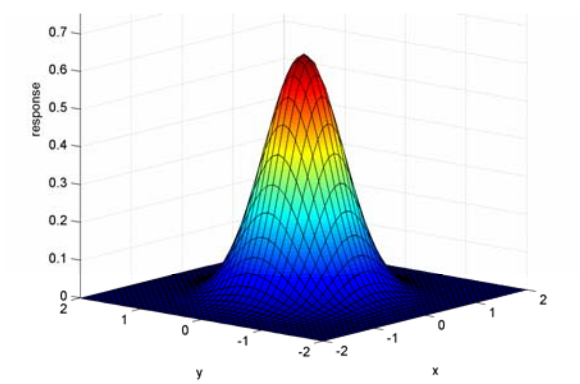

Figure 1 - Model of a two-dimensional point spread function (PSF) of a typical optical sensor, indicating the non-uniform sensor response as a function of space.

This talk will illustrate the application of GIM to multiple datasets of remote sensing observations (Figure 2) in order to produce regularly gridded estimates of ground surface properties (Figure 3), while removing the effect of the non-uniform spatial sensitivity (Figure 1). The effect of the target grid size (upscaling/downscaling) on the best estimate and standard error will also be demonstrated.

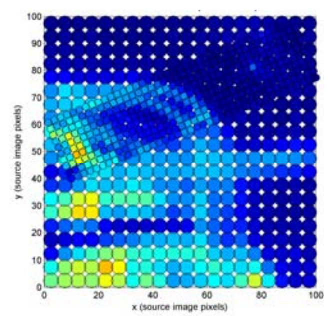

Figure 2 - Remote sensing measurements (simulated) from two sensors with differing spatial characteristics (spacing, grid orientation, support). Circle size is proportional to the width of the sensor PSF.

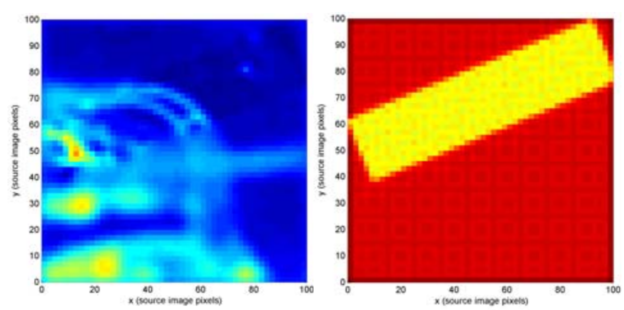

Figure 3 - Best estimate (left) and standard error of estimation (right) obtained from geostatistical inverse modeling.