# On the Change-of-Support Problem for Areal Data: A Geostatistical Inverse Modeling Approach

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A key issue to address in synthesizing complementary geographic information is the change-of-support. Spatial support is the shape, size, and orientation of measurements. This research presents a methodology for solving the change-of-support problem for areal data based on geostatistical inverse modeling that explicitly accounts for differences in spatial support. The restricted maximum likelihood method was used for parameter estimation related to data scaling. We used the geostatistical inverse modeling approach to produce both the best predictions of a target resolution and prediction uncertainties, based on one or more other spatial data with different resolutions, while honoring the original measurements. Second, spatial data covering large geographic areas often exhibit spatial non-stationarity and can lead to computational challenges due to their large sizes. We developed a moving-window geostatistical inverse modeling approach for accommodating spatial non-stationarity and computational burden related to large data size. The geostatistical inverse modeling methodology was demonstrated on both spatially stationary and nonstationary random fields, and synthetic and real data. Synthetic data were first generated and aggregated to different resolutions and downscaled back to the original resolution to analyze the prediction accuracies and the correctness of prediction uncertainties associated with the data scaling process. Similar experiments were demonstrated on real data. Data with different sizes of spatial supports were fused to produce a single resolution data that synthesizes multiple sources of measurements. The effects of variogram parameter misspecification were also explored in the synthetic and real data downscaling process. The modeling results indicated that geostatistical inverse modeling can produce results with high prediction accuracies and correct prediction uncertainties. Therefore, we can conclude that geostatistical inverse modeling is a rigorous solution for dealing with the change-of-support problem of areal data.

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