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Mapping radiation dose with fixed rank filtering

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Spatial statistics provides a powerful tool for spatial data analysis. Spatio-temporal kriging makes it possible for researchers to interpolate data in arbitrary space and time points. However, as the world is entering a ”data rich” age and datasets are more often massive both in space and time, spatio-temporal kriging is not feasible. Recently, a new methodology called fixed rank filtering via spatio-temporal random effects (STRE) model has been proposed to reduce computational complexity for spatio-temporal interpolation. It can handle very large datasets that spatio-temporal kriging cannot. Thus far, however, to the best of our knowledge, only a few researches have been carried out for empirical analysis. Incidentally, various actors including municipalities and residents have been measuring radiation dose after the Tohoku Earthquake struck Eastern Japan in 2011; however, there is no radiation dose distribution map based on an academic methodology.

This study applies the new spatio-temporal interpolation methodology to the radiation dose measurement data of seven municipalities in South Ibaraki, and examines the possibility of creating the radiation dose distribution map. In particular, the study uses three different ranges for radial spatial basis functions and calculates prediction errors to check the sensitivity of the results. The spatial basis function is a key instrument for capturing spatial correlation among the observed data, and therefore, the setting of the range is very crucial. The result shows that the wider the range, the lesser are the prediction errors. This might be due to a sparsity of the radiation dose measurement data in space. If the ranges are narrow, some of the basis functions would have few observed points around them and cannot capture spatial variation.

Keywords: radiation dose, spatio-temporal interpolation, fixed rank filtering