## Map representations of interval estimations for environmental pollutants using WebGIS and R

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When comparing the distributions of environmental pollutants with statistical information such as various geographical information or Government surveys on GIS, the accuracy of estimations will be required. In the case, the interval estimations are required instead of the point estimations. When the spatial distributions are estimated using the Kriging, one of the geostatistics methods, a confidence interval can be obtained from the variance of the estimated values. In this study, a method of expressing this using WebGIS were examined.

The target area in the study was Okayama City, Okayama Prefecture, and the target environmental pollutants were PM2.5 (2015) and Oxidant (2006). The observed concentration data for the pollutants (annual average values) used in this study were published by the National Institute for Environmental Studies (http://www.nies.go.jp/igreen/). The geographic information required for the analysis were JPGIS (Geographical Survey Institute, 2019), which is an open government data system. GNU R (R core team, 2019) was used for geostatistics analysis. The WebGIS that used in this study is jSTAT MAP (Statistics Bureau, Ministry of Internal Affairs and Communications, 2019).

The spatial dependency of the concentration data of environmental pollutants were estimated using variograms, then estimated values of the entire target area and its variance were obtained by the Kriging method. The mesh grid used for the estimation was Japanese 3rd order mesh code (1 km pitch) in consideration of the use in the jSTAT MAP. The code was converted into a rectangular coordinate system during the geostatistics analysis. The obtained concentration estimation data and its variance were imported into the jSTAT MAP and were represented in the concentration map associate with the confidence interval.

The confidence intervals of environmental pollutants expressed by jSTAT MAP were effective in comparing with various geographical and statistical information built-in the jSTAT MAP. In the geostatistics analysis, the number of the observation points and its locations are important. In the determination of a priority of the additional observation points, these maps can be used effectively. In addition, those enable to show the spatial distribution of pollutants with its reliability at one time, it is convenient that using in the public hearings of environmental assessments, etc. Furthermore, since the jSTAT MAP is a WebApp, these procedures can be executed only by the Web browser. In the future, it may be more widely used in the field of Earth and Planetary science research field.

Keywords: WebGIS, jSTAT MAP, Kriging, PM2.5, Oxidant