An analysis of geographical compression effect of PM2.5 by R and GIS applications

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The PM2.5 is a group of suspended particulate matter in the air which aerodynamic radius is about 2.5 micrometers or less. The analysis of the dynamic nature of the distribution of PM2.5 are important information for the consideration on the human health. To use for the purpose, relative high-resolution estimations (about 3 km), and basis on the limited obserbatories numbers, the estimations have been performing by using the time-series analysis and the Kriging method. In this study, a geographic compression effect, one of the dynamic nature of the PM2.5, were attempt to reveal by using the high-resolution estimation of the PM2.5 with R and GIS.

The target area of this study is located at the south part of the Okayama prefecture, Japan. It has a about 40 km length from east to west and about 30 km length from north to south. Observed concentration data of the PM2.5 about the region were obtained from the Okayama prefectural website of the environmental data. The DEM data were acquired from the open data which were distributed by the Japanese government-affiliated research institute. The kriging analysis were performed using the R (R core team, 2016) and its geospatial libraries such as maptools (Bivand and Lewin-Koh, 2014), rgdal (Bivand, Keitt and Rowlingson, 2014) and gstat (Pebesma, 2014). The geographical representations were performed using the QGIS (QGIS Development Team, 2017) and the Google earth (Google, 2016). The rgdal and QGIS are developed under the Open Source Geospatial Foundation and constitute the part of the FOSS4G software.

At first, a geographical subdomain that was expected to occur the geographic compression effect was selected from the research area by the series of the hight-resolution PM2.5 estimations. Then, the compression parameters such as the attack time, ratio and the release time were calculated from the estimations. The slope gradients of the subdomain were calculated by the GIS using with the DEM data. Finally, the correlation of the compression parameters and the slope gradients were analysed by the R. As the result, the degree of a geographical compression showed a relation to the amount of the slope gradients of the subdomain. The consideration of the relationship between the geographical compression and the local meteorology, especially the direction of the wind will be required further analysis.

Keywords: PM2.5, Kriging, Geostatistics, R, GIS, FOSS4G