Data-driven regionalization for analyzing the spatiotemporal characteristic of air quality in China

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Abstract:

With the development of urbanization and industrialization, the degradation of ambient air quality has become a serious issue that impacts human health and the environment; thus, it has attracted more attention from scholars. Usually, the mass concentrations of sulfur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO), ozone (O3) and particulate matter with an aerodynamic diameter less than 10 μm and 2.5 μm (PM10 and PM2.5) are used to evaluate air quality. A commonly used data-driven regionalization framework for studying air quality issues, identifying areas with similar air pollution behavior and locating emission sources involves an incorporation of the principal component analysis (PCA) with cluster analysis (CA) methods. However, the traditional PCA does not consider spatial variations, which is a notable issue in geographic studies. This article focuses on extracting the local principal components (PCs) of air quality indicators based on a geographically weighted principal component analysis (GWPCA), which is superior to the PCA when considering spatial heterogeneity. Then, a spatial cluster analysis (SCA) is used to identify the areas with similar air pollution behavior based on the results of the GWPCA. The results are all visualized and show that the GWPCA has a higher explanatory ability than the traditional PCA. Our modified framework based on the GWPCA and SCA for assessing air quality can effectively guide environmentalists and geographers in evaluating and improving air quality from a new perspective. Furthermore, the visualization results can be used by city planners and the government for monitoring and managing air pollution. Finally, policy suggestions are recommended for mitigating air pollution via regional collaboration.