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Explore the spatio-temporal interrelation of PM2.5 concentration by using the self-organizing maps – a study case in northern Taiwan

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In recent years, fine particulate matter (PM2.5) has become a critical air pollutant in many developed countries. Exposure to high concentrations of PM2.5 can cause serious health problems because PM2.5 contains microscopic particles or liquid droplets that are sufficiently small to reach deep into human lungs. Thus, a precise daily prediction of PM2.5 concentration is notably important to regulatory plans that inform the public and restrain social activities when harmful events are foreseen. PM2.5 has been legislated as an air pollutant in Taiwan since 2012. However, the formation and composition of PM2.5 involves natural and artificial sources, which is very complicated. The mixture of local sources and regional transportation makes the control and accurate prediction of PM2.5 a very challenging work. Analyzing the spatial and temporal characteristics of PM2.5 could help to identify the possible emission sources of PM2.5. The self-organizing map (SOM) can classify high-dimensional datasets to form a meaningful topological map and has advantages of information extraction and visualization. Bearing in mind the clustering capability and visual interpretation, the SOM was used to explore the interrelationships of high-dimensional multivariate air pollutants, where the air quality datasets collected in the northern region of Taiwan at different spatial and temporal scales were used as a study case. The main results of this study showed that :(1) high population density and heavy traffic usually brings high variations in PM2.5 concentration; (2) obviously effects occur when seasons change; (3) the results obtained from the SOM could provide air quality classification and improve air quality forecast accuracy; (4) local air pollution made greater influence on human health than long-range transboundary air pollution; and (5) spatial and temporal variations in air pollution were less likely to be affected by a single event.

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