Estimating Ground-level $PM_{2.5}$ Levels in Taiwan Using Data from Air Quality Monitoring Stations and High Coverage of Microsensors

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Abstract

Particulate matter with an aerodynamic diameter of less than 2.5 μm ($PM_{2.5}$) has been widely studied around the world and has been found to adversely affect human health. In previous epidemiological studies, human exposure to ambient $PM_{2.5}$ was traditionally estimated using the measurements from a small number of central ground monitoring stations; however, it may have introduced exposure misclassification regarding human exposure due to low-resolution spatial variation of pollution levels. In our study, we developed a spatiotemporal model for accurately predicting the ground-level $PM_{2.5}$ concentration in areas without central ground monitoring stations in Taiwan for a long-term period by employing measured $PM_{2.5}$ data from a new widespread monitoring network of microsensors to reduce the estimation bias by lack of spatial variation in monitoring data from central stations. The good model's performance and cross-validation results supported the availability of microsensor data and the feasibility of our models for predicting $PM_{2.5}$ levels, respectively. Our model can provide accurate $PM_{2.5}$ predictions as measures of residential exposure in a long-term period for epidemiological cohort studies.