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Effectiveness of Control Measures for Ambient Fine Particulate Matters Concentration Improvement in Taiwan

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Abstract : Fine particulate matter ($PM_{2.5}$) has become an important issue all over the world over the last decade. Annual mean $PM_{2.5}$ concentration has been over the ambient air quality standard of $PM_{2.5}$ (annual average concentration as 15μg/m³) which adapted by Taiwan Environmental Protection Administration (TEPA). TEPA, therefore, has developed a number of air pollution control measures to improve the ambient concentration by reducing the emissions of primary fine particulate matter and the precursors of secondary $PM_{2.5}$. This study investigated the potential improvement of ambient $PM_{2.5}$ concentration by the TEPA program and the other scenario for further emission reduction on various sources. Four scenarios had been evaluated in this study, including a basic case and three reduction scenarios (A to C). The ambient $PM_{2.5}$ concentration was evaluated by Community Multi-scale Air Quality modelling system (CMAQ) ver. 4.7.1 along with the Weather Research and Forecasting Model (WRF) ver. 3.4.1. The grid resolutions in the modelling work are 81 km × 81 km for domain 1 (covers East Asia), 27 km × 27 km for domain 2 (covers Southeast China and Taiwan), and 9 km × 9 km for domain 3 (covers Taiwan). The result of $PM_{2.5}$ concentration simulation in different regions of Taiwan shows that the annual average concentration of basic case is 24.9 μg/m³, and are 22.6, 18.8, and 11.3 μg/m³, respectively, for scenarios A to C. The annual average concentration of $PM_{2.5}$ would be reduced by 9-55 % for those control scenarios. The result of scenario C (the emissions of precursors reduce to allowance levels) could improve effectively the airborne $PM_{2.5}$ concentration to attain the air quality standard. According to the results of unit precursor reduction contribution, the allowance emissions of $PM_{2.5}$, SO_x, and NO_x are 16.8, 39, and 62 thousand tons per year, respectively. In the Kao-Ping air basin, the priority for reducing precursor emissions is $PM_{2.5} > NO_x > SO_x$, whereas the priority for reducing precursor emissions is $PM_{2.5} > SO_x > NO_x$ in others area. The result indicates that the target pollutants that need to be reduced in different air basin are different, and the control measures need to be adapted to local conditions.

Keywords : airborne $PM_{2.5}$, community multi-scale air quality modelling system, control measures, weather research and forecasting model
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