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Assessing the Cumulative Impact of $PM_{2.5}$ Emissions from Power Plants by Using the Hybrid Air Quality Model and Evaluating the Contributing Salient Factor in South Taiwan

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Abstract : Particles with an aerodynamic diameter of 2.5 meters or less are referred to as "fine particulate matter" ($PM_{2.5}$) are easily inhaled and can go deeper into the lungs than other particles in the atmosphere, where it may have detrimental health consequences. In this study, we use a hybrid model that combined CMAQ and AERMOD as well as initial meteorological fields from the Weather Research and Forecasting (WRF) model to study the impact of power plant $PM_{2.5}$ emissions in South Taiwan since it frequently experiences higher $PM_{2.5}$ levels. A specific date of March 3, 2022, was chosen as a result of a power outage that prompted the bulk of power plants to shut down. In some way, it is not conceivable anywhere in the world to turn off the power for the sole purpose of doing research. Therefore, this catastrophe involving a power outage and the shutdown of power plants offers a great occasion to evaluate the impact of air pollution driven by this power sector. As a result, four numerical experiments were conducted in the study using the Continuous Emission Data System (CEMS), assuming that the power plants continued to function normally after the power outage. The hybrid model results revealed that power plants have a minor impact in the study region. However, we examined the accumulation of $PM_{2.5}$ in the study and discovered that once the vortex at 925hPa was established and moved to the north of Taiwan's coast, the study region experienced higher observed $PM_{2.5}$ concentrations influenced by meteorological factors. This study recommends that decision-makers take into account not only control techniques, specifically emission reductions, but also the atmospheric and meteorological implications for future investigations.

Keywords : $PM_{2.5}$ concentration, powerplants, hybrid air quality model, CEMS, Vorticity
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