Source Tagging Modeling Study of Heavy Haze Episodes under Complex Regional Transport Processes over Wuhan Megacity, Central China

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This study carried on the Nested Air Quality Prediction Modeling System (NAQPMS) coupled with an on-line source-tagging module, aims at delving into the role of regional transport in the occurrence of two strong haze episodes over Wuhan in October 2014 and quantitatively assessing the contributions from potential local and regional sources to $PM_{2.5}$ concentration. Validation of predictions based on observations shows modeling system good skills in reproducing key meteorological and chemical features. Different types of the regional transport were found to play key roles in the formation of the two haze episodes. The first short-time haze episode occurring on 12 October under strong northerly wind, with hourly $PM_{2.5}$ concentration maximum of 180 $\mu g m^{-3}$ is found to be mainly triggered by the long-range transport from the northern regions, contributing to $PM_{2.5}$ concentration by 60.6% versus a total of 32.7% for Wuhan local and nearby sources. For the second episode extending over 15-20 October under stable regional large-scale synoptic condition and weak winds and with hourly $PM_{2.5}$ peak of 231.0 $\mu g m^{-3}$, both the long-range transport from far regions and the short-range transport from Wuhan Megalopolis are the main causes of the haze episode and account for 24.8% and 29.2% of the $PM_{2.5}$ concentration respectively. Therefore, the regional transport acts as a crucial driver of haze pollution over Wuhan through not only long-range transfer of pollutants, but also short-range aerosol movement associated with complex interaction and stagnation under specific meteorological conditions. The present findings incontestably call for enhancing enforcement of strategic environmental assessment with commitment of stakeholders at both local and regional scales.

Keywords: Regional chemical transport, Wuhan, Central China, Haze pollution, Source tagging method

