Evaluation of an Advanced Air Quality Forecasting and Decision Support System for Effective Pollution Management in Delhi.

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Air pollution poses a significant environmental risk to large cities worldwide, including New Delhi, India's capital. From October to March, Delhi and the National Capital Territory (Delhi-NCT) experience frequent episodes of elevated pollution levels, affecting its ~32 million residents annually. Current air quality models struggle to accurately predict severe pollution events in Delhi-NCT, leaving decision-makers challenged in their efforts to protect public health. To address this, a high-resolution Air Quality Early Warning System (AQEWS) was launched in 2018, followed by the integration of a Decision Support System (DSS) in 2021. This enhancement enables dynamic source attribution data and diverse emission reduction scenarios within a single model forecast. The newly developed Air Quality Warning and Integrated Decision Support System for Emissions (AIRWISE) integrates near real-time satellite aerosol optical depth (AOD) retrievals, satellite-based fire information, surface data from 320 air quality monitoring stations, and high-resolution emissions, creating an extensive modeling framework. This framework demonstrates exceptional prediction capabilities, accurately forecasting severe air quality episodes up to three days in advance with an impressive 83% accuracy, even at a street-level resolution of 400 meters. The AQEWS is the world's first operational air quality forecasting system to operate at such a high resolution and incorporate chemical data assimilation. The Commission of Air Quality Management (CAQM) relies on forecast data to enforce the Graded Response Action Plan (GRAP) in Delhi-NCT, which imposes restrictions on pollution sources. This paper outlines the AQEWS and DSS, summarizes modeling experiments, verifies forecasts, and discusses challenges in accurately predicting extreme pollution episodes.

Capsule: Integrated air quality early warning and decision support system for air quality management in India.