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Day-to-day variations in paddy-residue burning and residential heating emissions control aerosol pollution peaks in rural north-west India

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November onwards, the poor air quality over north-west India is blamed on the large-scale paddy residue burning in Punjab and Haryana. However, the emission strength of this source remains poorly constrained due to the lack of ground-based measurements within the rural source regions. In this study, we report the particulate matter (PM) levels at Nadampur, a rural site in the Sangrur district of Punjab that witnesses rampant paddy residue burning, using the Airveda low-cost PM sensors from October to December 2019. The raw PM measurements from the sensor were corrected using the Random Forest machine learning algorithm. The daily average PM_{10} and $PM_{2.5}$ mass concentration at Nadampur correlated well ($r > 0.7$) with the daily sum of VIIRS fire counts. Agricultural activities, including paddy residue burning and harvesting operations, contributed less than 40% to the overall PM loading, even in the peak burning period at Nadampur. We show that the increased residential heating emissions in the winter season have a profound and currently neglected impact on ambient air quality. A dip in the daily average temperature by 1 ºC increased the daily emission of PM_{10} by 6.3 tonnes and that of $PM_{2.5}$ by 5.8 tonnes. Overall, paddy harvest, local and regional paddy residue burning, residential heating emissions, ventilation, and wet scavenging could explain 79% of the variations in PM_{10} and 85% of the variations in $PM_{2.5}$. Day to day variations in PM emissions from residential heating in response to the ambient temperature must be incorporated into emission inventories and models for accurate air quality forecasts.