Measurements of $PM_{2.5}$ During Kharif Rice Crop Residue Burning (2022-2023) By Low-Cost Sensor Network in Punjab, Haryana and Delhi-NCR

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Abstract

Open crop residue burning (CRB) stands as a formidable environmental challenge, particularly for exacerbating air pollution episodes during the harvest seasons (October-November) in northwest India. The Aakash Project at RIHN is aiming to establish a scientific basis to map the effects of CRB on the air quality of the Delhi-National Capital Region (NCR). Uncertainties persist regarding the direct association between CRB practices in Punjab and Haryana and $PM_{2.5}$ levels in Delhi-NCR, hindering effective policymaking for air pollution mitigation in the megacity with a population of over 70 million. We deployed extensive field campaigns using a network of 30 Compact & Useful $PM_{2.5}$ Instrument with Gas sensors (CUPI-Gs) covering Punjab, Haryana and Delhi-NCR in both 2022 (Singh et al., Sci. Rep., 2023) and 2023. Continuous observations revealed a significant decline in fire detection counts (FDCs) by 31-37% in Punjab and Haryana from 2022 to 2023, and thus the $PM_{2.5}$ concentrations, which is in stark contrast to about 20% increase over the Delhi-NCR. A further analysis by combining $PM_{2.5}$ and CO suggested that local incomplete combustion dominated emissions of air pollutants in Delhi-NCR while direct $PM_{2.5}$ emissions from CRB dominated in Punjab and Haryana. Our observations clearly captured the effects of the Graded Response Action Plan (GRAP) and regional meteorological conditions on $PM_{2.5}$ variations in Delhi-NCR due to local emissions in comparison to long-range transport. The 24-hour-backward trajectory using HYSPLIT at three different altitudes revealed a transported $PM_{2.5}$ plume over Delhi-NCR. The unique air quality measurements from a network of sites covering the urban and rural areas of northwest India are providing a holistic view of the origin of air pollution, to aid the policy of effective mitigation. We provide networked observations, meteorological analysis and transport model simulations of $PM_{2.5}$ in near-real time during the CRB campaign 2023 (https://aakash-rihn.org/en/data-set/).

Early Career Scientist

YES, I am an early career scientist.

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