Impact of Autumn Crop Residue Burning Emissions to the $PM_{2.5}$ Concentration Over North-West India using WRF-CHEM with Multiple Emission Scenarios.

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Abstract

The October-November peaks in $PM_{2.5}$ levels across northwest India and around the Delhi National Capital Region (NCR) are closely associated with emissions from crop residue burning (CRB) activities in Punjab and Haryana. However, the precise contribution of CRB emissions from Punjab and Haryana to $PM_{2.5}$ levels in Delhi NCR has been a subject of debate, influenced by both climatic factors and government policies. To quantify the impact of CRB emissions on $PM_{2.5}$ concentrations, a modeling framework utilizing the WRF-CHEM model is employed. This modeling framework incorporated CRB emission scenarios from the FINN biomass fire emissions (FINN v1) and EDGAR anthropogenic emission datasets for the years 2022 and 2023. These FINN emissions scenarios and a case without CRB emissions allowed to assess the varying levels of CRB emissions on $PM_{2.5}$ concentrations at a network of in-situ observation sites established under the AAKASH project at RIHN (https://aakash-rihn.org/en). The analysis conducted using WRF-CHEM model provided a comprehensive understanding of the vertical and horizontal extent of the impact of CRB emissions on $PM_{2.5}$ concentrations across the region. We identified specific CRB emission plumes of airmass transporting towards Delhi for both the years and analyses the factors driving such events. The study calculated the contributions of CRB emissions from Punjab and Haryana separately, facilitating tailored policy implementations at the state level. Moreover, it is important to note that weather parameters, such as humidity, are also influenced by the various emission scenarios (i.e., the level of air pollutants), underscoring their interdependences with the broader environmental variables, and raising new concerns. Our simulations suggest increased humidity when $PM_{2.5}$ emissions increased in WRF-Chem. These findings enable us to quantify the magnitude of these impacts and evaluate the efficacy of various policy interventions targeting administrative hotspots of CRB emissions.

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

CCMi: Chemistry Climate Model Initiative, MAP-AQ: Monitoring, Analysis and Prediction of Air Quality, BBURNED: Biomass Burning Uncertainty: ReactioNs, Emissions and Dynamics

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