

Characteristics of Haze Pollution during Stubble Burning Period over an Upwind Site of Delhi

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Abstract

The National Capital Territory (NCT) of Delhi is one of the most populated and polluted regions in the world. Most existing research over Delhi-NCT have attributed this pollution to the long-range transport of biomass burning aerosols from north-west states of Haryana and Punjab during post-monsoon season. However, there are no observational studies which have investigated these episodes in the pathway of Punjab and Haryana to Delhi. Here, we have used several state-of-the-art instruments installed at an upwind site of Delhi in IIT Delhi's remote atmospheric observatory at Sonipat campus during the biomass burning and Diwali period from 25th October to 15th November, 2023 to capture fine particulate matter (PM_{2.5}), composition based PM_{2.5} (C-PM_{2.5} = non-refractory PM_{2.5} (NR-PM_{2.5}) + Black Carbon (BC)) without the metals, volatile organic compounds (VOCs), green house gases (GHGs), CO, and NO_x. To better comprehend the long-range transport, we investigated the vertical structure of the atmosphere including atmospheric boundary layer (ABL) height using Ceilometer lidar. Results indicate a sudden increase in PM_{2.5}, C-PM_{2.5} species, VOCs, and other pollutants leading to severe haze conditions, followed by rainfall scavenging the concentration to lower levels, and reoccurring of severe haze condition with the onset of Diwali. Based on this, two haze periods (PM_{2.5} > 300 µg/m³) and two non-haze periods were identified and investigated. The chemical composition of C-PM_{2.5} reveals dominance of Organics (65.06%), followed by BC (13.5%), NO₃ (8.22%), NH₄ (6.45%), SO₄ (4.48%), and Cl (2.29%). Higher levels of biomass burning tracers such as levoglucosan, mannosan, potassium (K⁺), CO/CO₂ ratio, and VOCs/CO ratio during the haze episodes suggest that biomass burning activities coupled with shallow ABL (< 300m) and slower winds caused severe stagnated haze conditions. The 24 hours backward trajectory analysis reveals the majority of air masses injecting to Delhi-NCT from North-West states.

Early Career Scientist

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