# Uncertainties in the Estimation of Satellite-based Stubble Fire Detection Affecting Air Quality Management in Delhi

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## Abstract

India, the world's second-largest agriculture-based economy, faces air quality degradation due to biomass burning, notably in Punjab and Haryana. Employing satellite-based methods for estimating emissions from agricultural residue burning brings upon challenges, including uncertainties arising from temporal and spatial resolution limitations, conversion processes, and data reliability. Our study focuses on estimating emissions from agricultural residue burning in Punjab and Haryana during the post-monsoon season from October 10th to November 30th, 2022. We specifically aim to address uncertainties associated with emission estimates derived from VIIRS-based fire detection methods and burnt area assessments using Sentinel-2 satellite products. District-wise surveys and ground observations complement our analysis. Our study finds that, on average, 51% of the total crop area is burnt in Punjab and Haryana. VIIRS underestimates burnt areas compared to Sentinel-2, capturing only about 27% of the area detected by Sentinel-2. The highest emissions of CO2, NH3, and SO2 occur in Sangrur district, Punjab, and Sirsa district, Haryana. In Punjab, PM2.5 emissions from crop residue burning reach 54.28 Gg, while Haryana emits 7.94 Gg. Peak concentrations of CO and NOX are observed in Sangrur and Sirsa districts. District-wise emission estimates highlight variations influenced by agricultural practices and meteorological factors. Notably, PM2.5 emissions exhibit uncertainty, ranging from 6.26 to 54.28 Gg in Punjab and from 7.94 to 24.9 Gg in Haryana. Similarly, CO emissions in Punjab range from 65.22 to 485.62 Gg, while in Haryana, they vary from 2.01 to 226.67 Gg upon employing parameters from different studies. While uncertainties persist, our study provides valuable insights for enhancing emission estimates and developing comprehensive strategies to address crop residue burning in these critical agricultural states. Despite limitations, our results signify a considerable advancement in understanding regional emission dynamics and highlight the need for concerted efforts to mitigate air pollution in the surrounding regions.

## Early Career Scientist

YES, I am an early career scientist.

## IGAC Activities

BBURNED: Biomass Burning Uncertainty: ReactioNs, Emissions and Dynamics, GEIA: Global Emissions Initiative, AMIGO: Analysis of eMIssions usinG Observations

## IGAC Regional Working Groups

Southern Hemisphere Working Group, MANGO: Monsoon Asia and Oceania Networking Group