

# Lightning Induced Emission and its Impact on Air Quality over India

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## Abstract

Lightning alters the composition of trace gases in the middle and upper troposphere by generating nitric oxide (NO) and decomposing O<sub>2</sub> and N<sub>2</sub> at elevated temperatures. NO rapidly converts to NO<sub>2</sub> after formation, collectively known as lightning NO<sub>x</sub> (LNO<sub>x</sub>). Lightning also affects the formation of ozone (O<sub>3</sub>) and hydroxyl (OH) radicals in the upper troposphere, thereby influencing the oxidative capacity of the atmosphere, its composition and hence climate. In the present study, we use the WRF-Chem model along with satellite and ground-based observations to investigate the impact of LNO<sub>x</sub> on the vertical profile of tropospheric NO<sub>x</sub>, O<sub>3</sub>, and OH production over north-western India. Given the increased lightning activity over north-western India during the pre-monsoon (MAM) and monsoon (JJAS) seasons, we selected these two seasons for our study. We identified lightning days over our study region using Lightning imaging sensor high-resolution dataset (10 km x 10 km). Further, we use OMI Level 3 daily gridded data (0.25°x0.25°) of total and tropospheric NO<sub>2</sub> vertical column density to analyze lightning induced variations in atmospheric NO<sub>2</sub>. On days with lightning activity, total NO<sub>x</sub> emissions rise by 10–15% from the surface to the upper troposphere, as indicated by our research. Moreover, the total amount of ozone in the atmosphere rises by 6–8 Dobson Units (DU) during lightning occurrences. Furthermore, lightning significantly alters the OH concentration. Since lightning significantly modifies the atmosphere's oxidative capacity, leading to changes in the lifespan of different air pollutants in the troposphere, it is crucial to consider these effects when developing effective measures to combat air pollution in north-western India. More results from WRF-Chem with greater detail on the impact of LNO<sub>x</sub> on tropospheric chemistry and air pollution will be presented.

## Early Career Scientist

NO, I am not an early career scientist.

## IGAC Activities

CCMi: Chemistry Climate Model Initiative, MAP-AQ: Monitoring, Analysis and Prediction of Air Quality, PACES: Air Pollution in the Arctic: Climate, Environment, and Societies, GEIA: Global Emissions Initiative

## IGAC Regional Working Groups

MANGO: Monsoon Asia and Oceania Networking Group