Impact of emissions and long-range transport on Air Quality in Delhi

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Delhi is the world's most polluted capital city, with annual mean concentrations of PM$_{2.5}$, O$_3$ and NO$_2$ well above the safe legal limits for Europe. Exposure to these pollutants over short and long-time scales is associated with increases in diseases such as heart disease, stroke and lower respiratory tract infections. Local NO$_2$ concentrations vary by month and season and are controlled by both emissions and meteorology. Locally, vehicle pollution contributes to 67% of the total air pollution load and 48% of NO$_x$. The vehicle population has increased substantially in recent years due to an increase in the number of vehicles travelling into Delhi each day from surrounding areas. High pollution episodes, especially in winter, also contribute to the high annual mean observed. This may be due to the trapping of pollutants in a shallow, stable boundary layer or through the long-range transport of pollutants from surrounding regions to Delhi under favourable wind directions. However, the relative contribution of local vs regional emissions has not been quantified previously. This inhibits the introduction of targeted policies to reduce concentrations in the city.

We use observational datasets to quantify the relative contribution of local and regional emissions to local NO$_2$ air quality in Delhi rather than running a computationally expensive atmospheric chemistry transport model (Stirling et al., 2020). We combine satellite data from the TROPOMI instrument on the Sentinel 5 – Precursor (SSP) platform with back-trajectories, from the Reading Offline Trajectory Model (ROTRAJ). This allows us to investigate how different wind directions affect the relative contributions of local and regional NO$_2$ pollution to Delhi NO$_2$. We will then quantify the contribution of different regions and sectors to NO$_2$ in Delhi by combining the back-trajectories with a high resolution emission inventory for India and Delhi. This method also allows us to consider future emission control scenarios and quantify their impacts on air quality in Delhi.