

Nitrogen dioxide (NO₂)

Nitrogen dioxide (NO₂) is an air pollutant, which affects the air quality and actively participates in the atmospheric chemistry. NO₂ is an essential precursor for the formation of ozone in the troposphere, which is another air pollutant at the ground level. Surface NO₂ is of substantial concern for the air quality in the urban as well as rural environments.

Tropospheric NO₂ also influences the concentration of hydroxyl radical and thereby lifetime of methane, which is a greenhouse gas. It also contributes to the formation of nitrate aerosols and thus it indirectly affects the climate.

Fossil fuel combustion in automobiles, industries and power plants are the major sources of NO₂. In addition, the biomass-burning emissions also contribute to the NO₂ budget significantly. The emission is mostly in the form of NO (nitric oxide), which gets converted in to NO₂ quickly, on a timescale of minutes, mainly through reaction with ozone or peroxy radicals.

Due to reaction with hydroxyl radical, lifetime of NO₂ in the lower troposphere is less than a day. Therefore, NO₂ remains in the close vicinity of its source and hence sources are well identifiable from space-based observations. Higher levels of tropospheric NO₂ over cities, power plants, and industries are obvious due to fossil fuel burning, and corresponding hot-spots are clearly visible in the satellite-derived spatial maps of tropospheric column NO₂.

Tropospheric column of nitrogen dioxide (NO₂) from TROPOMI

TROPOMI (TROPOspheric Monitoring instrument) is a nadir-viewing spectrometer (ultraviolet, visible and shortwave infrared) onboard polar-orbiting ESA's Sentinel-5 Precursor satellite with high-spatial resolution of 3.5 km × 5.5 km (across x along track for visible band), swath of ~2600 km and equator crossing time ~13:30 local time. DOAS (Differential Optical Absorption Spectroscopy) method is employed to estimate NO₂ column using spectral measurements in the window of 405–465 nm. Stratospheric contribution is removed from the total column to achieve the tropospheric NO₂. Level-2 near-real time (NRTI) tropospheric column of NO₂ (molecules cm⁻²) is spatially averaged to uniform 10 km × 10 km grids for quality assurance of 0.5 and 0.75. Spatial averaging is carried out by $\sum (a_i \times y_i) / \sum a_i$; where a_i =area of ith pixel and y_i = tropospheric column of NO₂ over ith pixel. Negative or zero values are omitted for daily map over the Indian region.