Sulfur dioxide (SO_2)

Sulfur dioxide (SO_2) is an air pollutant, affects the air quality, tropospheric chemistry and climate. Oxidation of SO_2 forms sulfuric acid, which plays important role in new particle formation (aerosols). Besides being the major precursor of sulfate aerosols, SO_2 contributes to the acid rain and impacts the ecosystem adversely. Large amounts of SO_2 get injected into stratosphere during volcanic eruptions, which get converted into sulfate aerosols. Enhanced scattering of incoming solar radiation by these aerosols results in lower air temperature near Earth's surface.

Due to shorter life time (hours to days), SO_2 hotspots are typically confined close to the emission sources. Major sinks of SO_2 are its reaction with aqueous hydrogen peroxide, wet deposition, etc.

Interestingly, one third of global SO_2 emissions is from the natural sources: volcanic eruption and conversion from biogenic dimethyl sulphide. Anthropogenic emissions particularly from fossil-fuel burning is a major source of SO_2. Coal-fired power plants besides industries (metal smelting and refining) are major sources of SO_2 in India. These hot-spots are clearly visible in the satellite-derived spatial distributions of total column SO_2.

Total column of Sulfur dioxide (SO_2) 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 ultraviolet band), swath of ~2600 km and equator crossing time ~13:30 local time. Spectral measurements in the 312–326 nm window are used to estimate SO_2 concentration using DOAS (Differential Optical Absorption Spectroscopy) technique. Level-2 near-real time (NRTI) total column of SO_2 (Dobson Unit (DU) $=2.69\times10^{16}$ 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 i^{th} pixel and y_i= column of SO_2 over i^{th} pixel. Negative or zero values are omitted for daily map over the Indian region.