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# Towards an improved understanding of nitrogen dioxide emissions from forest fires

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Smoke from wildfires are a significant source of air pollution, which can adversely impact ecosystems and the air quality in downwind populated areas. With increasing severity of wildfires over the years, these are a significant threat to air quality in densely populated areas. Emissions from wildfires are most commonly estimated by a bottom-up approach, using proxies such fuel type, burn area, and emission factors. Emissions are also commonly derived with a top-down approach, using satellite observed Fire Radiative Power. Furthermore, wildfire emissions can also be estimated directly from satellite-borne measurements.

Here, we present advancements and improvements of direct emission estimates of forest fire $NO_x$ emissions by using TROPOMI (Tropospheric Monitoring Instrument) high-resolution satellite datasets, including $NO_2$ vertical column densities (VCDs) and information on plume height and aerosol scattering. The effect of smoke aerosols on the sensitivity of TROPOMI to $NO_2$ (via air mass factors) is estimated with recalculated VCDs, and validated with aircraft observations. Different top-down emission estimation methods are tested on synthetic data to determine the accuracy, and the sensitivity to parameters, such as wind fields, satellite sampling, instrument noise, $NO_2$:$NO_x$ conversion ratio, species atmosphere lifetime and plume spread. Lastly, the top-down, bottom-up and direct emission estimates of fire emissions are quantitatively compared.