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Estimating landfill methane emissions in Indian megacities with Sentinel 5p TROPOMI

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Methane (CH_4) is a greenhouse gas emitted from natural emissions that pre-dominantly come from wetland sources, and from a wide range of anthropogenic sources including livestock, oil–gas systems, landfills, coalmines, wastewater management, and rice cultivation. Since the global warming potential of CH_4 far outweighs that of carbon dioxide (CO_2), this means that policies aimed at reducing CH_4 emissions are key to combating climate change on shorter timescales. Significant gains can be achieved by avoiding accidental or uncontrolled CH_4 emissions from industrial or waste-treatment sites and methods for active monitoring of such sites will play an important role to support this.

For many localised emitters such as landfill sites, it is often difficult to ascertain the level of compliance and effectiveness of waste management protocols used by local authorities, particularly in emerging and developing countries. Some landfill sites are so poorly regulated that there is little handle on the scale and intensity of CH_4 emissions and pollution originating from these sites. Furthermore, in uncontrolled landfill sites, waste can spontaneously combust and lead to the emission of flammable CH_4 gas from decomposition of biological material further aggravating pollution in densely populated cities. For example, in the case of Indian megacities such as Delhi, some landfill sites exceeded their full capacity well over a decade ago and authorities are making important efforts to implement alternative measures to manage and reduce the waste in these landfill sites.

Satellite sensors can map CH_4 emission plumes from strong point sources that can be undetected by sparse ground-based networks and they provide us with a powerful new tool to characterize and quantify the rate and intensity of landfill CH_4 emissions. The recently launched satellite missions such as the Sentinel 5p (carrying onboard the TROPOMI spectrometer) offers the potential to observe such CH_4 plumes on a global scale but with relatively coarse spatial resolution (7km). This is complemented by high-resolution sensors such as the GHGSat imager that offer much improved pixel sizes (tens of m) that can map CH_4 sources at a much finer scale but with

very limited coverage.

Here we present an evaluation of landfill CH_4 emission rates for landfill sites located across Indian megacities using a combination of TROPOMI and space-borne imager observations. We will show an analysis of CH_4 observations over India using the University of Bremen TROPOMI/WFMD CH4 product to identify CH_4 enhancements across Indian landfill sites. We focus on the Ghazipur landfill site in the megacity of Delhi as well as sites in Mumbai and West Bengal and use the cross-sectional flux method to determine the largescale CH_4 emissions originating from these sites. We will discuss the challenges in estimating CH_4 source rates from point sources and present the approach used to detect and quantify CH_4 from Indian landfills from TROPOMI. We will present an evaluation of our estimates against in-country Indian municipal solid waste emission inventories as verification and demonstrate the value of satellite observations in supporting authorities implement corrective actions to better manage landfill emissions.