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Latest on Mobile Methane Measurements with Fast Open-Path Technology: Experiences, Opportunities & Perspectives

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Methane plays a critical role in the radiation balance, chemistry of the atmosphere, and air quality. The major sources of methane include agricultural and natural production, landfill emissions, oil and gas development sites, and natural gas distribution networks in rural and urban environments.

The majority of agricultural and natural methane production occurs in areas with little infrastructure or easily available grid power (e.g., rice fields, arctic and boreal wetlands, tropical mangroves, etc.) Past approaches for direct measurements of methane fluxes relied on fast closed-path analyzers, which typically require powerful pumps and grid power. Power and labor demands may be among the key reasons why such methane fluxes were often measured at locations with good infrastructure and grid power, and not necessarily with high methane production.

Landfill methane emissions were traditionally assessed via point-in-time measurements taken at monthly or longer time intervals using techniques such as the trace plume method, the mass balance method, etc. These are subject to large uncertainties because of the snapshot nature of the measurements, while the changes in emission rates are continuous due to ongoing landfill development, changes in management practices, and the barometric pumping phenomenon. Installing a continuously operating flux station in the middle of an active landfill requires a low-power approach with no cables stretching across the landfill.

The majority of oil and gas and urban methane emission happens via variable-rate point sources or diffused spots in topographically challenging terrains, such as street tunnels, elevated locations at water treatment plants, vents, etc. Locating and measuring methane emissions from such sources is challenging when using traditional micrometeorological techniques, and requires development of novel approaches.

In 2010, a new lightweight high-speed high-resolution open-path technology was developed with the goal of allowing eddy covariance measurements of methane flux with power consumption 30-150 times below other available technologies. The instrumentation was designed to run on solar panels or a small generator, and could be placed in the middle of the methane-producing ecosystem without a need for grid power. This significantly expanded the methane flux measurement coverage in permafrost regions, wetlands, rice fields and landfills.

In the past few years, this instrumentation has been utilized increasingly more frequently outside of the traditional use at stationary flux towers. The novel approaches included measurements from various moving platforms, such as cars, aircraft, and ships. Projects included mapping of concentrations and vertical profiles, leak detection and quantification, mobile emission detection from natural gas cars, soil methane flux surveys, etc.

This presentation will describe key developmental steps in the lightweight low-power high-resolution open-path technology, the instrument principles and key elements of the design, and will highlight several novel approaches where such instrumentation was used in mobile deployments in urban and natural environments.