NCAR | ATMOSPHERIC CHEMISTRY OBSERVATIONS & MODELING

ACOM Seminar

Constraining greenhouse gas emissions across spatial scales using long open-path measurements

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Link: https://operations.ucar.edu/live-acom

ABSTRACT

Rapidly reducing methane emissions is critical to meeting the goals set out in the Paris agreement. Policy makers typically rely on inventories to developing emissions reduction strategies and to track progress towards emissions reduction goals; validating and improving these inventories requires accurate atmospheric observations. Open-path measurements of atmospheric gas species well suited to quantify emissions from distributed area sources like oil and gas production, agricultural facilities, and urban areas. Our group at NIST has developed open-path dual frequency comb spectroscopy (DCS) as a tool to provide accurate simultaneous measurements of multiple trace gas species; the coherent light sources used allow a wide range of path lengths (100 m to >10 km) which can be tailored to the specific spatial scales of the targeted sources. Here, I'll show how these measurements can be used to constrain methane emissions in several field campaigns.

In the first campaign, we used a DCS system to measure CH4 and NH3 emissions from a beef cattle stocker site with around 300 cattle over several months. While the diurnal average emissions agree with IPCC recommended values, significant diurnal variation was observed. We are now extending this to measurements in a grazing system. In another measurement, we deployed to the Platteville Atmospheric Observatory in north-eastern Colorado for 3 months. This site is located in the Denver-Julesburg oil and gas basin and in an area with a large number of confined animal feeding operations, leading to a complex mixture of trace gas emissions. By using measurements of ethane and NH3, we can attribute the observed CH4 to the oil and gas and agricultural sectors. We then use a Bayesian inversion to optimize energy and agriculture methane fluxes using the sector-apportioned methane observations and show that energy emissions are relatively consistent with the 2012 gridded EPA inventory despite a ~350% increase in energy production, indicating that emissions factors have decreased. In contrast to the energy sector, optimized agricultural emissions in the region were 1.5× larger than inventory estimates. Finally, we demonstrate measurements over a 14-km-long path in Boulder and use these to estimate emissions in the Boulder-Longmont area.

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