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Title: GC13F-1076 Quantifying Methane Leak Emissions by Fused Airborne Imaging Spectroscopy with *in situ* Surface Mobile and Airborne Observations of a California Producing Oil Field

Abstract:
Methane (CH_4) emission budgets remain uncertain and are projected to grow as oil and gas production from short-lived wells increases and their subsequent transport through aging gas distribution networks. Orders-of-magnitude variations in temporal, spatial, and emission scales present a key challenge to leak detection and quantification. Also, the probability distributions for large and stochastic, leaky systems such as geological reservoirs (by natural migration-seeps) and petroleum production from those reservoirs remain largely unknown, needed to address current approach limitations.
The scale of many petroleum systems favors remote sensing, but the sensitivity of such systems often precludes detection of weak emissions. Consequently, an accurate evaluation requires that the relative contribution from the emission "tails" of small leaks also be quantified, which is best carried out using high-sensitivity in situ methods. Fusion of remote sensing and in situ approaches leverages complementary capabilities to address these limitations.
We show results from mobile surface (AMOG) and airborne in situ (AJAX) and thermal-infrared (TIR) hyperspectral imaging spectroscopy (Mako) data applied to a producing oil field in the California Central Valley near Bakersfield. AMOG is an automobile-based mobile lab that measures 13 trace gases, aerosol size distributions and vertical profiles, 3D winds and other meteorology, and atmospheric column measurements by solar spectroscopy at highway speeds. AJAX measures 5 trace gases and 3D winds at ~140 $m\ s^{-1}$. Mako is a broad-area TIR imaging spectrometer that can discriminate multiple gases present in each pixel acquired.
In situ-derived, total field emissions were 31±16 $Gg\ yr^{-1}$ CH_4. This was compared with Mako-derived emissions from all plumes identified across the study site. We found that super-emitters were not the dominant emissions mode and the spatial pattern of plume locations from production infrastructure was correlated to geological structures.

Key Words: Methane, Emissions, Airborne, Imaging, Spectroscopy, In Situ, Airborne, California, Oil Field