The Cal Poly Research Dairy, is located on the California Polytechnic State University campus in San Luis Obispo, California, with 300 head during the campaign. It is well-isolated from other dairies and other significant CH₄ sources. Feed barns are flushed four times a day into a waste lagoon with an overflow lagoon to the east.

The strongest NH₃ was observed near the milking station by AMOG, and RamVan, where high methane values also were observed. The difficulty of in situ NH₃ measurements is highlighted by the "latency" of the NH₃ signal on the arrival/departure transits due to its molecular "stickiness."

AlphaJet captures airborne in situ measurements the dynamics of the methane plume, several kilometers downwind (onboard measure) of the Cal Poly Dairy, also mapping the boundary layer at ~900 m height. Surface winds were from Northwest.

Findings

In Situ CH₄ and NH₃ plumes were successfully mapped by AMOG and were spatially segregated on a sub-dairy scale.

The waste lagoon was a major emission source with its strongest emissions focused on the aerator.

In Situ NH₃ and CH₄ strong plumes correlated with strong mobile NH₃ column measurements from RamVan.

The CH₄ plume from the Cal Poly Dairy was mapped by the AlphaJet (NASA ARC) during multiple transects ~5-km downwind.

A very strong column CH₄ plume was observed by the Mini-LHR (NASA GSFC) ~250 m downwind from the dairy feed barns and waste lagoon.

COWGAS demonstrated that the controlled, accessible, and well-described environment of a research dairy can greatly aid in the interpretation of commercial dairy CH₄ and NH₃ emission data, linking dairy operations and emissions, enabling smarter dairy operations.

Experimental Methods

In situ surface data were collected by the AMOG (Automobile Greenhouse Gas) Surveyor Vehicle (BRI) with several Off-Axis Integrated Cavity Output Spectroscopy instruments (LGR) that measured CH₄, CO₂, H₂O, NH₃, and NOₓ. A CO₂ isotope instrument (LGR) was installed in the MCLab Recreational Vehicle. Airborne in situ data were collected by the the AlphaJet aircraft (ARC) with a Cavity Ring Down Spectrometer (Picarro) for CH₄, CO₂, and H₂O. Column measurements were made by the Aerospace Corp. RamVan Mobile Laboratory with a zenith viewing FTIR Spectrometer for CH₄ and NH₃. Additional CH₄ column measurements were made by the Miniaturized-Laser Heterodyne Radiometer (Mini-LHR) (developed by GSFC).

Preliminary (Cloud Uncorrected, uncalibrated) mini-LHR CH₄ column during COWGAS showing a steady decrease in emission strength consistent with decreasing emissions after a noted mid-day waste flushing.