Separation of Methane Emissions from Biogenic Sources and Natural Gas Based on CH₄, C₂H₆ and NH₃ Column Observations in the Colorado Front Range

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Methane (CH₄) in the Northern Colorado Front Range is emitted from biogenic sources such as concentrated animal feeding operations (CAFOs) and natural gas production and storage. In March 2015 we deployed a network of five Fourier Transform Spectrometers (FTS) to characterize the regional-scale CH₄ dome in the Colorado Front Range based on vertical column measurements. Three EM27sun FTS measured CH₄, oxygen (O₂) and water vapor columns at Eaton, CO, inside the dome and at two boundary sites; University of Colorado mobile Solar Occultation Flux measured ethane (C₂H₆), ammonia (NH₃), and H₂O at Eaton, CO, and a NCAR high-resolution FTS measured all gases at Boulder, CO. The column averaged dry air mole fractions XCH₄, XC₂H₆, and XNH₃ were determined using O₂ columns for air mass factor normalization, and background column was subtracted to derive column enhancements over background, dXCH₄, dXC₂H₆, dXNH₃ at Eaton, CO. Eaton is located both near CAFOs and at the northern edge of oil and natural gas production wells of the Denver-Julesburg Basin. Our approach for source apportioning methane employs a linear regression analysis that explains dXCH₄ in terms of dXC₂H₆ as tracer for natural gas sources, and dXNH₃ as tracer for CAFO emissions.

Figure 1. Map showing the measurement sites Eaton, Boulder, and Westminster, as well as CAFO and fracking locations.