Characterization of a Quantum Cascade-Tunable Infrared Laser Differential Absorption Spectrometer (QC-TILDAS) for Atmospheric Ethane and Methane Field Measurements

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Ethane, the second most abundant hydrocarbon in the atmosphere and a tropospheric ozone precursor, has the potential to influence regional air quality. Ethane can also help to inform the understanding of climate forcing, as measurements of ethane are of interest for use as a constraint on methane emissions attribution. The emission ratios of ethane and methane from oil and natural gas operations, a major source of both compounds, can be used to constrain methane emissions in large-scale modeling and for methane source attribution on smaller scales, such as in oil and natural gas basins. Here we characterize a tunable infrared laser differential absorption spectrometer (TILDAS), a mini laser trace gas monitor manufactured by Aerodyne Research, Inc. The quantum cascade laser at 2990 cm^{-1} allows for measurement of both ethane and methane mole fractions, eliminating the need for additional instruments, calibration of multiple instruments, and post-deployment time alignment. The fast response (1 Hz or less) of the instrument permits deployment on various mobile platforms. We present results from tests conducted in the laboratory and aboard ground-based and airborne platforms. Configuration and parameters needed to optimize deployment on these mobile platforms are discussed. Characterization of instrument response time, noise, calibration drift, and potential interferences will be presented. Complete characterization of this instrument will allow for its use for various applications, including for the purpose of long-term monitoring or in intensive field campaigns.

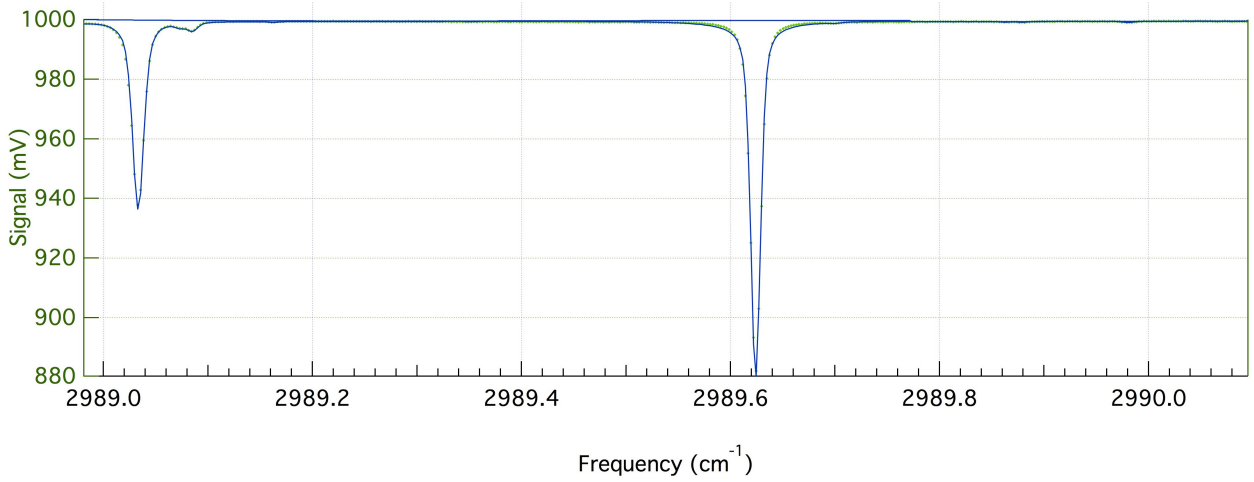

Figure 1. The 2990 cm^{-1} laser in the Aerodyne TILDAS can be used to measure methane, ethane, and water vapor.