FY 2016 PHASE I AWARD WINNER

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AWARD: $119,810.00

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PRINCIPAL INVESTIGATOR: Dr. Scott Herndon

TITLE OF PROJECT: A Direct Absorption Spectrometer for Low Drift and High Accuracy Measurements of Methane Isotopes in Flight

SUBTOPIC NUMBER: 8.3.3D

TECHNICAL ABSTRACT:

Atmospheric methane (CH4) is a potent greenhouse gas and ozone precursor that is increasingly important in our understanding and modeling of climate change. Identifying and differentiating methane sources are crucial to any strategies aimed at reducing CH4 emissions. Isotopic composition and ethane content are both dependent upon methane origin, making them valuable diagnostics for source attribution. Instrumentation capable of fast, high precision quantification of CH4 isotopes and ethane aboard an aircraft platform will advance scientifically backed methane mitigation strategies.

This proposal aims to develop a flight-capable laser-based monitor for 12CH4, 13CH4, CH3D, and C2H6. The 1 Hz standard deviation performance targets of d-13CH4 precision of 0.5 per mil and d-CH3D precision of 10 per mil delta units, and C2H6 mixing ratio precision of 10 parts per trillion will be achieved in this work. These performance goals will be met using direct absorption infrared spectrometry, which has been demonstrated to achieve the desired precision under laboratory conditions. As outlined in the proposal, the technical challenges are: i) identifying and eliminating sources of measurement drift due to aircraft motion, temperature and pressure changes, ii) developing innovative zeroing and calibration methods amenable to these high precision measurements, and iii) designing a flight-ready instrumentation package.

SUMMARY OF ANTICIPATED RESULTS:

The outcome of the Phase I work will first be demonstration of measurement precision and accuracy under controlled laboratory conditions. Second, we will identify and quantify optical (and electronic) noise sources as a result of testing the measurement platform (a dual-laser infrared spectrometer) in simulated turbulence and under high acceleration in all three dimensions. Third, we will demonstrate zeroing and calibration capability that allows for high accuracy and precision isotope ratios and ethane quantification referenced to a standard. Finally, these results from first three parts will lead to the design of the final measurement package, which we plan build and test during Phase II.