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Eddy Covariance Measurements of Methane Flux at Remote Sites with New Low-Power Lightweight Fast Gas Analyzer

Liukang Xu (1), George Burba (1), Jessica Schedlbauer (2), Donatella Zona (3), Dayle K. McDermitt (1), Tyler Anderson (1), Steven Oberbauer (2), Walter Oechel (3), Anatoly Komissarov (1), and Brad Riensche (1)

(1) LI-COR Biosciences, Lincoln, Nebraska, USA, (2) Florida International University, Miami, Florida, USA, (3) University of Antwerp, Antwerp, Belgium, (4) San Diego State University, San Diego, California, USA

Majority of natural methane production happens at remote unpopulated areas in ecosystems with little or no infrastructure or easily available grid power, such as arctic and boreal wetlands, tropical mangroves, etc. Present approaches for direct measurements of CH4 fluxes rely on fast closed-path analyzers, which have to work under significantly reduced pressures, and require powerful pumps and grid power. Power and labor demands may be reasons why CH4 flux is often measured at locations with good infrastructure and grid power, and not with high CH4 production.

An instrument was developed to allow Eddy Covariance measurements of CH4 flux with power consumption 30-150 times below presently available technologies. This instrument, LI-7700, uses <10W of power, and can easily be run on solar panel, or with small portable generator, while present technologies require 300-1500 Watts of the grid power.

The proposed extremely low-power technology would allows placing methane Eddy Covariance stations in the middle of the source (wetland, rice paddy, forest, etc.) in the absence of the grid power. This could significantly expand the Eddy Covariance CH4 flux measurements coverage, and possibly, significantly improve the budget estimates of world CH4 emissions and budget.

Various prototypes of the LI-7700 were field-tested for three seasons at the remote site in middle of Everglades National Park (Florida, USA) using solar panels, at three stationary and several mobile sites during three seasons at remote Arctic wetlands near Barrow (Alaska, USA), in the tropical mangroves near La Paz (Mexico) using portable generator, and in bare agricultural field near Mead (Nebraska, USA) during 2005 through 2010.

Latest data on CH4 concentration, co-spectra and fluxes, and latest details of instrumental design are examined in this presentation. Overall, hourly methane fluxes ranged from near-zero at night to about 4 mg m-2 h-1 in midday in arctic tundra. Observed fluxes were within the ranges reported in the literature for a number of wetlands in North America, including the Everglades wetlands. Diurnal patterns were similar to those measured by closed-path sensors.

The LI-7700 open-path analyzer is a valuable tool for measuring long-term eddy fluxes of methane due to the good frequency response and undisturbed in-situ sampling. It enables long-term deployment of permanent, portable or mobile CH4 flux stations at remote locations with high CH4 production, because it can be powered by a solar panels or a small generator.

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