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Development of a Field-Deployable Methane Carbon Isotope Analyzer

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Methane is a potent greenhouse gas, whose atmospheric surface mixing ratio has almost doubled compared with preindustrial values. Methane can be produced by biogenic processes, thermogenic processes or biomass, with different isotopic signatures. As a key molecule involved in the radiative forcing in the atmosphere, methane is thus one of the most important molecules linking the biosphere and atmosphere. Therefore precise measurements of mixing ratios and isotopic compositions will help scientists to better understand methane sources and sinks. To date, high precision isotope measurements have been exclusively performed with conventional isotope ratio mass spectrometry, which involves intensive labor and is not readily field deployable. Optical studies using infrared laser spectroscopy have also been reported to measure the isotopic ratios. However, the precision of optical-based analyses, to date, is typically unsatisfactory without pre-concentration procedures. We present characterization of the performance of a portable Methane Carbon Isotope Analyzer (MCIA), based on cavity enhanced laser absorption spectroscopy technique, that provides in-situ measurements of the carbon isotope ratio (13C/12C or del_13C) and methane mixing ratio (CH4). The sample is introduced to the analyzer directly without any requirement for pre-treatment or preconcentration. A typical precision of less than 1 per mill (< 0.1%) with a 10-ppm methane sample can be achieved in a measurement time of less than 100 seconds. The MCIA can report carbon isotope ratio and concentration measurements over a very wide range of methane concentrations. Results of laboratory tests and field measurements will be presented.