World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:14, No:05, 2020

Forest Soil Greenhouse Gas Real-Time Analysis Using Quadrupole Mass Spectrometry

Authors : Timothy L. Porter, T. Randy Dillingham

Abstract : Vegetation growth and decomposition, along with soil microbial activity play a complex role in the production of greenhouse gases originating in forest soils. The absorption or emission (respiration) of these gases is a function of many factors relating to the soils themselves, the plants, and the environment in which the plants are growing. For this study, we have constructed a battery-powered, portable field mass spectrometer for use in analyzing gases in the soils surrounding trees, plants, and other areas. We have used the instrument to sample in real-time the greenhouse gases carbon dioxide and methane in soils where plant life may be contributing to the production of gases such as methane. Gases such as isoprene, which may help correlate gas respiration to microbial activity have also been measured. The instrument is composed of a quadrupole mass spectrometer with part per billion or better sensitivity, coupled to battery-powered turbo and diaphragm pumps. A unique ambient air pressure differentially pumped intake apparatus allows for the real-time sampling of gases in the soils from the surface to several inches below the surface. Results show that this instrument is capable of instant, part-per-billion sensitivity measurement of carbon dioxide and methane in the near surface region of various forest soils. We have measured differences in soil respiration resulting from forest thinning, forest burning, and forest logging as compared to pristine, untouched forests. Further studies will include measurements of greenhouse gas respiration as a function of temperature, microbial activity as measured by isoprene production, and forest restoration after fire.

Keywords : forest, soil, greenhouse, quadrupole
Conference Title : ICES 2020 : International Conference on Environmental Sciences
Conference Location : Montreal, Canada
Conference Dates : May 18-19, 2020