Estimation of Enteric Methane Emissions in Ruminants Using CO_2:CH_4 Ratio Obtained with a Wavelength-scanned Cavity Ring-down Spectrometer

L.P. Gamage[1] and W. Gichuhi[2]

[1]School of Environmental Studies, Tennessee Technological University, Cookeville, TN 38505; 931-539-2363, E-mail: lpgamage42@students.tntech.edu
[2]Department of Chemistry, Tennessee Tech University, Cookeville, TN 38505

Experimental measurements of enteric methane (CH_4) involving either individual animals or a group of animals are usually complex and expensive. As a result, models are heavily relied upon when it comes to predicting enteric CH_4 emissions at global, regional, or even local levels. In this work, results on enteric methane measurements based on a direct experiment strategy that uses carbon dioxide (CO_2) as a tracer gas are presented. A calibrated, wavelength-scanned cavity ring down spectrometer (Picarro G2401) is utilized to make simultaneous measurements of dry mole fractions of CH_4 and CO_2 from a beef cattle feedlot located at the Hyder-Burks Agricultural Pavilion farm in Cookeville, Tennessee (36°11'53" N, 85°32'19" W). Heat production unit (HPU) is determined using the animal body weights, milk production, and days of pregnancy to yield CO_2 production (L/day) from ruminants. The value for the total CO_2 production is then combined with the experimentally calculated CH_4:CO_2 ratio to estimate CH_4 emission factors in Putnam County and Tennessee. Using a CH_4:CO_2 ratio of 52.90 ± 3.00 ppb/ppm and the respective livestock populations, we estimate an annual enteric CH_4 emission of 117 ± 7 Gg yr^{-1} and 1.43 ± 0.08 Gg yr^{-1} for Tennessee and Putnam county, respectively. The values obtained from this study are in close agreement to the ones reported by the Environmental Protection Agency's inventory on enteric methane in the United States obtained using the metabolizable energy intake data of nutrients fed to ruminants.

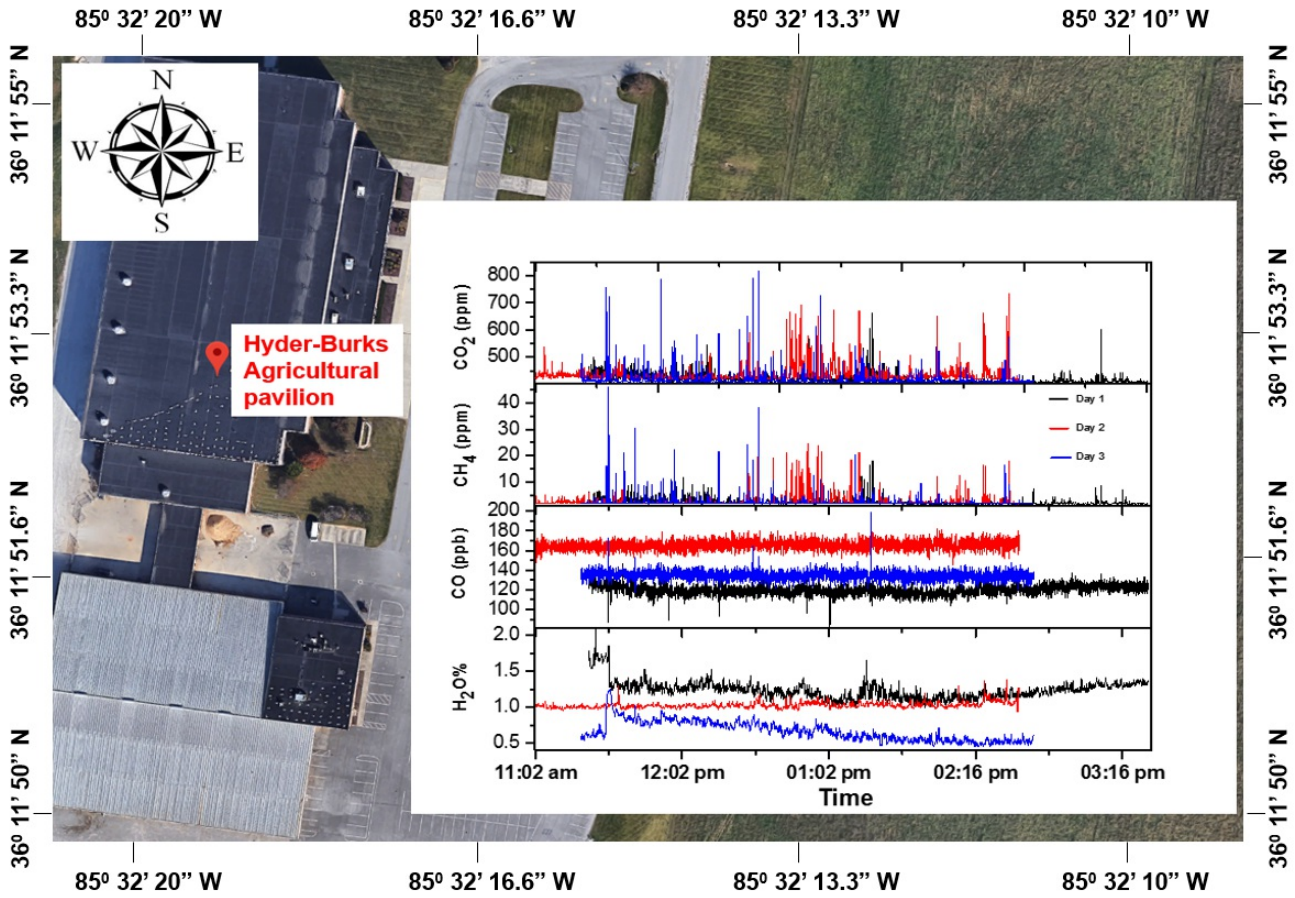

Figure 1. Location of the Hyder-Burks Agricultural Pavilion farm in Cookeville, TN (36° 11' 53" N, 85° 32' 19" W) where concentration measurements from the breath of animals were taken using a Picarro G2401 cavity ring down spectrometer. A daily average CH_4: CO_2 ratio of 0.053 ± 0.003 was obtained on 03/30/2017, 03/31/2017, and 04/07/2017.