A Study of Diurnal and Seasonal Variations of Carbon Dioxide and Methane in the Eastern Highland Rim Region of Tennessee

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Located on the eastern side of the geographically-diverse Highland Rim in Tennessee, the city of Cookeville (36.1628° N, 85.5016° W) has a slightly higher elevation than the surrounding major towns of Nashville and Knoxville, presenting an ideal location for ground-based atmospheric measurements carbon dioxide (CO_2) and methane (CH_4). In this study measurements of CO_2 and CH_4 are made using a Picarro Cavity Ring-Down Spectrometer (CRDS) to gain insights into the atmospheric dynamics contributing to the local and regional methane and carbon cycle within the Eastern Highland Rim region, using Cookeville as a study site. Beginning the summer of 2016 through March 2017, measurements reveal a remarkable seasonal and diurnal variation of CH_4 and CO_2. In a period of one week during the summer of 2016, the respective atmospheric dry molar fractions of CO_2 and CH_4 as measured by the CRDS analyzer were: 400.85 ± 1.67 ppm, and 1.908 ± 0.030 ppb. An increase in the dry mole fractions of the two greenhouse gases was observed during the winter of 2017 where 414.29 ± 1.68 ppm and 2.049 ± 0.026 ppm of CO_2 and CH_4 were recorded in January 2017, respectively. A typical 24-hour continuous monitoring of CO_2 and CH_4 at a height of ~45 m above the ground indicates that the concentration levels increase during night times compared to day times. During the warm, sunny summer months, the presence of sunlight typically decreases the levels of CO_2 as photosynthesis removes CO_2 from the air. At night, the CO_2 levels rises as the plants give off CO_2 during respiration. In the winter months, this daily CO_2 cycle is not as eminent because of the decreased green vegetation in the Cookeville area.

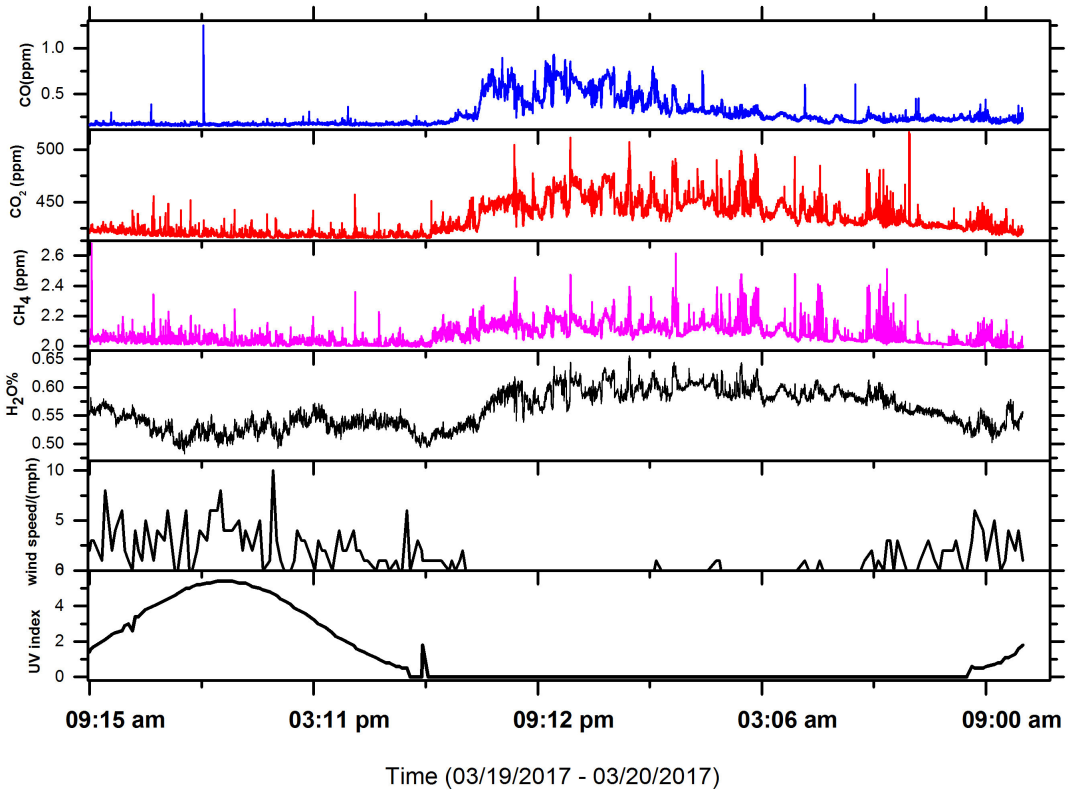

Figure 1. Typical daytime and nighttime CO, CO_2, CH_4,and water vapor dry air mixing ratios in Cookeville, Tennessee during the month of March 2017 as measured using Picarro Cavity-Ring-down Spectrometer accompanied by the corresponding wind speed and UV index.