Trace Gas Fluxes From Through-Canopy Measurements in an Upland Forest of the Eastern Brazilian Amazon

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Methane (CH_4) is a radiatively active trace gas whose atmospheric budget has been perturbed by humans. Wetlands have been recognized as the main natural source of CH_4 for the past 30 years. Current inverse models indicate that tropical sources account for the bulk of CH_4 emissions. The largest sources are likely wetlands, agriculture and burning and that these sources may be underestimated. As part of the LBA experiment, we automatically sampled CH_4 and carbon dioxide (CO_2) mixing ratios in profiles through two forest canopies at sites 67 and 83 km south of Santarém, Pará. CH_4 and CO_2 can have a strong diurnal signal. CH_4 mixing ratios correlated well with CO_2. Both gases had column maxima in the early morning near dawn because of stable nocturnal conditions. However there were differences in the profiles. Highest CO_2 mixing ratios tended to occur near the surface due to the strong respiration source of CO_2. Often the lowest mixing ratios of CH_4 were found near the surface which is consistent with a weak soil sink. Calculations of the CH_4 flux of example periods from different seasons were made by correlating height weighted averages of the half hourly ambient mixing ratios of CH_4 and CO_2 and relating this correlation to the ratio of coincident nocturnal NEE CO_2 eddy correlation fluxes made during windy nights at two towers at the same sites and automated chamber flux measurements made at the km67 site. Fluxes were calculated to be between 2.2 and 23.3 mg CH_4 m^{-2} d^{-1}. If the area of the upland forest area of the Amazon basin is 5 x 10^6 km^2, we then estimate a CH_4 source strength of 4 to 43 Tg y^{-1}. This estimate is consistent with a flux of 4 to 38 Tg y^{-1} calculated from a survey of profile and flux measurements made during the dry and wet seasons at three other sites across the Amazon basin.

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