Towards a better understanding of soil- and tree stem-atmosphere exchanges of greenhouse gases, i.e. CO2, CH4, N2O, in a tropical rainforest

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The importance of greenhouse gas (GHG) emissions in global climate change is undisputed, but our understanding of the daily and seasonal variations of the GHG fluxes is far from complete and detailed flux estimates are unequally distributed among ecosystems worldwide. Carbon dioxide (77%; CO2), methane (14%; CH4) and nitrous oxide (8%; N2O) are the three main GHGs that trap infrared radiations and contribute to climate change. While CO2 has been largely studied, a considerable effort is still required to quantify the magnitude and drivers of CH4 and N2O, which have radiative effects 25 and 298 times greater than CO2, respectively. Tropical forests play a pivotal role in global carbon (C) balance and climate change mitigation, accounting for 68% of global C stock and representing up to 30% of total forest soil C sink. In the tropics, soils are main contributors to the ecosystem GHG fluxes. In fact, tropical forest soils are the largest natural source of soil CO2 and N2O and are overwhelmingly reported as important sink of CH4. More recently, studies reported that tree stems can also emit CO2, CH4 and N2O and act, via passive transport through the soil xylem stream, as a pathway for these gas emissions to the atmosphere.

Although accurate estimates of GHG sources and sinks are of great importance for reducing the uncertainties of C cycle - climate feedbacks, we are only just beginning to understand the role of tropical tree stems as producers and / or conduits of soil-produced GHG.

I present first results of soil and tree stem GHG fluxes estimated over a six-month period, including a dry and a wet season, of continuous high frequency measurements with automated GHG flux systems in a tropical rainforest, in French Guiana. We adapted and extended an existing soil GHG flux system, combining a commercial automated soil CO2 flux chamber system (LI-8100A) and CH4 and N2O analyser (Picarro G2308), to include tree stem chambers. Different closure times were applied to ensure reliable flux estimates, especially for low CH4 and N2O fluxes. I show that the new automated system operated successfully, allowing for robust long-term measurements to examine temporal variations and ultimately calculate budgets of CO2, CH4 and N2O fluxes at soil and tree stem levels. Our results indicated that soils and tree stems acted exclusively as source for CO2, whereas soils and tree stems exhibited distinct patterns for both CH4 and N2O, which
highlights the importance of partitioning GHG fluxes to better determine environmental controls regulating ecosystem GHG exchanges.