THE AMAZON AND THE MODERN CARBON CYCLE

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ABSTRACT

Is the massive Amazon forest a CO_2 sink, a source or is it in equilibrium?

There is a large uncertainty in carbon fluxes estimates for the tropics as a whole and in particular for the Amazon region in South America, bringing the attention to the lack of information to call the region a carbon source or sink. The production of scientific consistent and long term data series for the region is a process that has to advance step by step.

Over the last 7 years the Large Scale Biosphere Atmosphere Experiment in Amazonia (LBA) has produced abundant information regarding the role of the Amazon region in the global carbon, water and energy balances. We reviewed the contribution of this magnificent biome for the global NPP/NEE and the feedbacks of climate change on its dynamics.

The complex sink/source duality of Amazonia has been discussed extensively in the literature and during several scientific meetings of the LBA project. The valuable data emerging from the pioneering network of flux towers and forest plots in Amazonia bring, for the first time, the unique chance to compare and understand diverse and contrasting ecophysiological processes. Process models have yet to capture this immense complexity in a sensible manner. Certainly it is an important and vital question for Brazil and for the world from many perspectives. However, by paying too much attention to the issue of a uniqueness of a sink or source character and finding its magnitude, we may loose a great opportunity to discuss the basic functioning and the complexities of the ecosystems in Amazonia.

The carbon emissions studies related to land use changes for the tropical regions of the world has shown numbers from 0.96 to 2.4 Pg C y^{-1}, while atmospheric CO_2 inversion models have recently indicated a net exchange of 0.62 ± 1.15 Pg C y^{-1} from tropical lands in the Americas with the atmosphere. The difference calculated from these two approaches would imply a local sink of approximately 1.7 Pg C y^{-1}, or a source of 0.85 Pg C ha^{-1} y^{-1}. Considering the area of the Brazilian Amazon forest (5 million km^2) a simple extrapolation would produce a range for the C flux from -3.0 to 0.75 Pg C y^{-1} .

The figure bellow compares several estimates of carbon fluxes, from regional to the global scale, enhancing the importance of Amazonia in these scenarios. For that several different techniques are compared, with different carbon residence time considered in the data set. Yet, the region heterogeneity enhances local peculiarities and the response to carbon exchange. Additionally, it is clear that local process (i.e. nutrient availability, biodiversity, precipitation rate, photosynthetic capacity, and so forth) are crucial to be taken in account when extrapolating carbon fluxes from towers or parcels to regional and global estimates.

The future of the carbon balance, especially in the Brazilian Amazonia, is closely related to the economy. As the Brazilian economy grows, deforestation rates may increase if the government does not provide environmentally sustainable regulation to timber exploitation and agricultural practices in the region. Increasing deforestation rates might overwhelm a potential carbon sink by primary and regrowth forests.

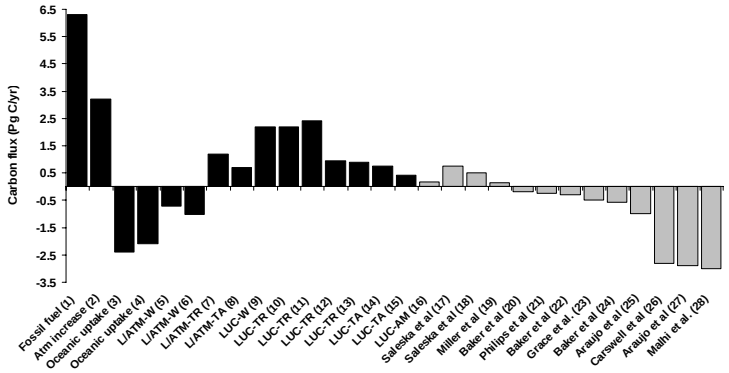

Fig. 1. Carbon flux from several sources. Positive numbers denote sources of carbon to the atmosphere and negative numbers denote an uptake of carbon from the atmosphere. L/ATM denotes a flux from the land to the atmosphere; LUC denotes a flux due to land use changes. W is an abbreviation for World, TR for Tropics, TA for Tropical America and AM for Amazonia. Data (1) through (16) from *Schimel et al*. 2001, *House et al.* 2003, *Houghton et al*. 2003, *Gurney et al*. 2002, *Fearnside* 2000, *Achard et al*. 2002, *DeFries et al.* 2002.

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