CO_2 budget for Amazon Basin using Inverse modeling

D'AMELIO, M.T.S.[1]*; MILLER, J.B.;, ROCHA, H.R.[1]; ALVIM, D.S.[3]; GUTIERREZ, E.R.[3]; GLOOR M.[4]

*[1] University of São Paulo – USP, São Paulo, SP, Brazil, *e-mail: moni.felippe@gmail.com*

[2] National Organization Atmospheric Administration – NOAA, Colorado, USA.

[3] National Institute for Space Research - INPE, Cachoeira Paulista, SP, Brasil.

[4] University of Leeds - UK.

Introduction

Great efforts on researches and international partnerships have been expended to estimate the carbon budget on the Amazon Basin, this basin stores about 150-200 PgC, and any disturbance could promote an important global impact.

Measurements of carbon flux and carbon concentration to estimates carbon flux have been performed in order to answers questions as what the role of Amazon is: source or sink of carbon? How Amazon Basin answers to climate change? This study promote the knowledge about the biosphere carbon fluxes and pools, it also contributes to simulations of potential anthropogenic influence on global climate.

Methods of Analyses

Sampled Sites: ALF: Alta Floresta, Mato Grosso State (09ºS, 56ºW); RBA: Rio Branco, Acre State (9ºS, 56ºW); SAN: Tapajós National Forest, Pará State (02ºS, 54ºW); TAB: Tabatinga (0º, 64ºW)

Period: 2010 (12:00 – 14:00 local time)

Samples in descending spiral vertical profile from 4420 m to 460 m (ALF), 4420 m to 305 m (RBA, TAB) or 4270 m to 305 m (SAN) using small aircraft. 58 Profiles.

Analyses: MAGICC – Multiple Analisys of Greenhouse gases Influence on Climate Change

Modelling

➢Transport Model - Lagrangian particle dispersion model FLEXPART

Footprint units: ppm/(μmol/m²/s)

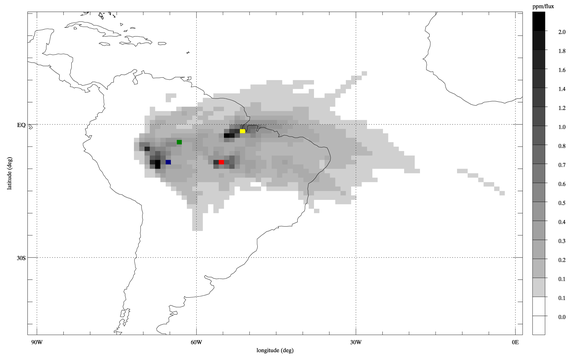

Figure 1. Identification of studied sites and the accumulated footprint for 2010. The color squares represent the centroids calculated from the footprint influence on continent. Red – ALF, Blue - RBA, Yellow - SAN and Green – TAB.

➢ Bayesian Inversion

$$s' = s_p + QH^T(R + HQH^T)^{-1}(z - Hs_p)$$

$$Q' = Q - QH^T(R + HQH^T)^{-1}HQ$$

s': the a posteriori CO_2 flux vector (dimension m);
s_p vector of a priori fluxes to be optimized (dimension m);
z is the vector of CO_2 observations (dimension n);
H is the atmospheric transport sensitivity matrix (dimension n x m), i.e., footprints;
R (dimension n x n) is the model-data mismatch error covariance matrix;
Q (dimension m x m) is the a priori covariance matrix specified for deviations from the prior flux estimates.

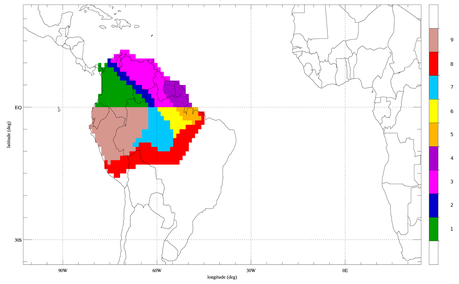

Figure 2. Eco-regions drawn for the Bayesian Inversion for Amazon area, considering climate conditions and North and South hemisphere

CO_2 Vertical Profiles

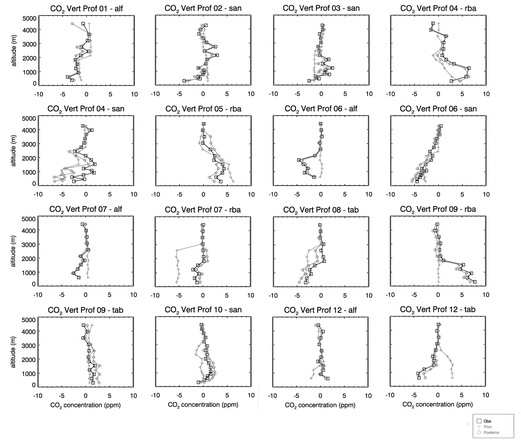

Figure 3. Comparison between CO_2 vertical profiles sampled (square), modeled with CO_2 prior flux - no corrections (plus) and CO_2 modeled flux using Bayesian Inversion (diamond).

CO_2 Flux

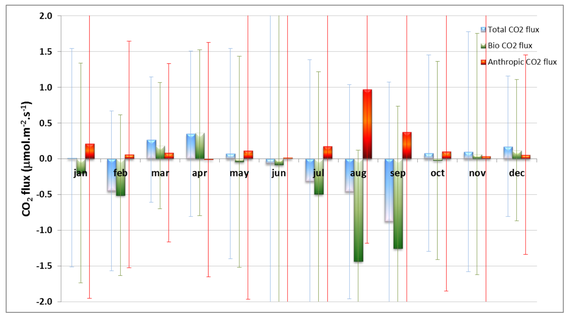

Figure 4. Total, biologic and anthropic CO_2 flux for Amazon Basin in 2010.

Conclusion

➢The accumulated annual CO_2 flux for the Amazon Basin for 2010 was an uptake of 0.3 tonC.ha^{-1}.

➢The anthropic regions contributed with source while the preserved ones with uptake of CO_2.

➢The CO_2 biologic flux (NEE)is predominant to anthropic CO_2 flux. The NEE mean for 2010 was an small uptake of -0.3 ± 1.3 μmolCO_2.m^{-2}.s^{-1}. The anthropic CO_2 flux, the annual mean was 0.2 ± 1.5 μmolCO_2.m^{-2}.s^{-1}.

➢The Bayesian Inverse and Flexpart model presented satisfactory results and the CO_2 modeled flux con be consider good real representation.

References

D' Amelio, M.T.S., Miller, J.B., Rocha, H.R., Gatti, L.V., Gloor, M. CO_2 flux calculation for Amazon using the Inversion Lagrangian Model FLEXPART. Special Issue Global Biogeochemical Cycles – to be submitted, 2014.

Acknowlegements