ROLE OF REMOTE SENSING IN LARGE FIELD EXPERIMENTS IN AMAZÔNIA

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The Amazon Basin has an important role in the global climate due to its dimension. Change in forest cover impacts the hydrological and the biogeochemical cycles of the region. Deforestation with subsequent biomass burning and decomposition causes CO_2 to be released to the atmosphere contributing to the greenhouse effect.

Deforested areas when abandoned, normally regenerate becoming sinks of CO_2 through photosynthesis, counteracting the deforestation process. Aerial extent and rates of CO_2 fixation are unknown for the Basin.

There is a missing sink of the order of 1-2 GtC/year in the global carbon budget (total emissions from fossil fuel burning was 6.0 +/- 0.5 GtC for 1990 and 1.6 +/- 1.0 GtC from deforestation during the 80's). Forest regeneration and fertilization due to CO_2 concentration contribute as CO_2 sinks in terrestrial biosphere. Such processes have not been quantified (IPCC, 1992).

IPCC methodology allows estimation of the carbon balance for the Basin in synoptic scale. However, there is a need for the understanding of the physical processes at the ecosystem level to validate and refine IPCC methodology. Thus, the FOREST-BGC, an ecosystem based model (Running and Coughlan, 1988) with parameters derived from Remote Sensing is proposed for the ecosystem modeling. This model allow estimation of Net Primary Production and simulation of the effect of climate change in the Amazon ecosystem regarding the hydrological and biogeochemical cycles. Due to logistical difficulties, Remote Sensing (RS) becomes an essential tool for sampling schemes and extrapolation of results. However, RS is limited to the superficial view of the multidimensional ecosystems, requiring field measurements of the physical processes involving water, energy and gas exchange between the atmosphere and the biosphere. Models, including the FOREST-BGC, are important tools for the optimization of field work and integration of data for the understanding of physical processes.

Amazon Basin with low lands and with 1/5 of the total fresh water of the planet is also important on global CH_4 emissions. New sensors such as SAR on board of Japanese and European satellites make it possible to map lakes, reservoirs and flooding and floating vegetation. Each of these ecosystems has different methane emission potential. Revisit capability of satellite remote sensing will allow the monitoring of the seasonal dynamics of these ecosystems.

In a vast, diverse, and changing region such as the Amazon, RS plays a unique role in establishing the framework for sampling sites' selection, ecosystem characterization, and extrapolation of site specific results. The complex scaling-up process can benefit from the use of RS. It can be used directly by providing the inter-relationship among the several ecosystems or by providing key parameters for ecosystem's based models. As the different vegetation covers and conversions from one type to another may alter the climate borings, atmosphere chemistry and biogeochemistry, RS plays a significant role in monitoring the basin. Specially in the carbon cycle, RS is essential to provide annual rates of deforestation, ecosystem phenology and dynamics, improve information on carbon density, estimation of carbon sequestration by secondary growth forests and estimation of net primary production of forest ecosystems through modeling.

INPE has been responsible for the estimation of annual rates of deforestation (from 1975-1992) establishing a digital data basis fundamental for carbon cycle studies. Also INPE has been one of the leading institutions on research regarding "Amazônia", in the field of Remote Sensing, in cooperation with national and international partners (EOS). The Amazon is then to be seen as one of the main focus of INPE, because of the synoptic view RS techniques give, in particular, INPE is engaged in the Global

Change program in response to the international effort in this direction. In this context we are carrying out our research within the Earth Observing System (EOS), in collaboration with the University of Washington. Our contribution to the program is to monitor both the Carbon and the Hydrologic cycles of the Amazon Basin.

THE EARTH OBSERVING SYSTEM

The NASA EOS mission is a large-scale, long-term program dedicated to observing and determining the biophysical basis for human-induced global change. Within the overall structure of EOS, there is a series of so-called interdisciplinary programs, each of which addresses a particular problem of the overall Earth system. The EOSRAM (EOS Regional Amazon Model) project is one of these. The project represents a collaboration between the University of Washington and the Instituto Nacional de Pesquisas Espaciais (INPE). The overall goal of the research to be conducted by the EOSRAM team is to determine, how extensive land use change in the Amazon would modify the routing of water and its chemical load from precipitation, through the drainage system, and back to the atmosphere and to the ocean and to determine how these changes affect the carbon cycle. There are fou main research elements of the project; hydrology, phytogeography, biogeochemical cycling (carbon budget), and land use; emphasizing horizontal (across landscape) questions. As such, the research focuses on how the hydrologic cycle and its interactions with biogeochemical cycles function at the land surface on scales of tens to hundreds of kilometers in the last decade of the twentieth century and the first decades of the twenty-first century.

INPE's science goal of the EOS investigation:

To evaluate the role of the Amazon basin relative to the Carbon balance, in three of its main aspects: emissions of deforested areas, re-absorption of carbon in regrowth areas and emissions of methane in aquatic ecosystems.

Specific goals are:

To estimate annual emissions of carbon as a function of deforestation and carbon density;

To estimate the extension, carbon density and assimilation of regenerating areas;

To estimate net exchange of CO_2/H_2O at the interface of terra firme forest (preserved & altered) and the atmosphere;

To estimate the extension and dynamics of aquatic ecosystem (natural methane emissions) of Amazon flood plains.

It is expected that a large future field experiment be built on existing on going research and in summary, RS based on high resolution satellite optical data such as Landsat TM, SPOT HRV, microwave data from European and Japanese ERS-1 and in the near future the Canadian RADARSAT, together with high revisit capability of NOAA AVHRR full resolution data is an integral part of a large field experiment in Amazônia.

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