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TERRESTRIAL ECOLOGY INTERESTS IN A BRAZILIAN STUDY

D. Wickland

NASA- Headquarters, Washington, DC

Changes in land use and land management practices are responsible for some of the more significant global change impacts that humans have effected world-wide. Conversion of tropical forest to various agricultural uses reflects a current significant set of land use changes that may have pronounced regional and global impacts. Of particular concern are the effects of land conversion on trace gas fluxes and the carbon dynamics of tropical ecosystems. The NASA Terrestrial Ecology Program would like to focus its contribution to a future research program in the Brazilian Amazon on the following question.

What are the consequences of tropical forest conversion, agricultural practice and secondary succession on trace gas fluxes and ecosystem carbon dynamics?

Subsidiary questions include, but are not limited to, the following:

Are tropical forest regions net sources or sinks for carbon, and what is the size of the flux?

Are land conversion/management practices in tropical systems a significant cause of increases in atmospheric N_2O?

In such a study we hope to address important uncertainties concerning the ecological processes controlling carbon and trace gas dynamics in converted ecosystems. We need to know more about the role of secondary vegetation in the region's carbon balance. We must obtain better information on the regrowth rate, the controls on carbon accumulation, the spatial extent and distribution of various age classes of regrowth, and the species involved and their recruitment rates. We need better measures or estimates of above and below ground biomass for these ecosystems.

A number of specific, testable hypotheses have been proposed:

Secondary vegetation in tropical systems is sequestering carbon in globally significant amounts.

Soil carbon reservoirs play an important role in the region's carbon dynamics.

Land (i.e., pasture) management practices and style affect the rate of carbon sequestration.

Agricultural use of cleared lands leads to a major enhancement of N_2O release.

Clearly, there are other related hypotheses that could be posed. These merely represent the focus of our thinking to date. It will be important to determine the roles of soil nitrogen, phosphorus, and water as well as the timing of burning, fertilization, abandonment, re-clearing, and other agricultural practices.

There also is a unique opportunity to collaborate with the atmospheric chemistry community in

this study so that regional measurements of trace gas fluxes may be obtained for comparison with the results of ecological models and to enable scaling of process understanding from the local to regional and sub-continental scales. Knowledge of the trace gases in the atmosphere will be of value for assessing the ultimate impacts of land conversion on global biogeochemical cycles.

Study Design

The field study design should capture a range of forest conversion intensities, the primary land management practices in the study areas, the main soil types, and a moisture gradient within the closed forest region of the Amazon. Two transects have been discussed in preliminary planning exercises. Both would focus on the southern Amazon Basin because most of the forest clearing and land conversion is concentrated along its southern fringe. One transect might run northwest to southeast through Rondonia. Relatively undisturbed forest would be studied near the northeast end; forest undergoing rapid, recent conversion in the middle, and agricultural practices in (or near) the cerrado at the southeastern end. In each area, a number of ecological process study sites would be established to examine the processes controlling trace gas fluxes and carbon dynamics for a range of land management practices and age classes typical of that immediate area. At one to three sites, continuous measurements of carbon dioxide fluxes would be made from eddy correlation flux towers. These towers would be located to sample undisturbed forest, pasture, and secondary regrowth. A second transect in the eastern portion of the southern Amazon Basin in Para would capture older age classes of land conversion and another major soil type within the region.

It seems clear that we will be limited in where we will be able to conduct such intensive and extensive field studies. It is very likely that already existing research programs and infrastructure will dictate where we can study these land conversion issues. Early collaboration with Brazilian ecologists seems critical to the development of a viable, feasible, study design. The particular land management practices investigated, therefore, will very likely be determined by the study area(s) selected. The primary requirement is that we choose land management practices that are well represented in the region and, as much as is possible, we exploit existing, on-going land conversion/agricultural practices and not try to conduct our own manipulations.

Scientific Returns

This study will lead to a better understanding of the global carbon and nitrogen cycles. It should provide valuable information for future international assessments of climate change and global change. Better understanding of the contribution of greenhouse gases from tropical ecosystems to the atmosphere (and the role of biomass burning) could lead to better international policy formulations with regard to controlling these emissions. In addition, it may be possible to address the question of the sustainability of various tropical ecosystems under differing land use practices. Finally, the data and information on the long-term effects of/response to land conversion could be useful in developing a more general understanding of how ecosystems respond to such changes. For example, comparisons with ecosystems in the U.S. that have undergone historical conversion to agriculture and then regrowth back to mature forest might yield interesting contrasts.

OPENING TALK ON THE OBJECTIVES FOR THE WORKSHOP

The main goal of the workshop was to discuss the scientific ideas behind an Amazon Biogeochemistry Study involving complementary ecological and atmospheric chemistry investigations and to explore

common U.S. and Brazilian interests for such a study. The overall goal proposed was:

To study the consequences of forest conversion, agricultural practice, and secondary succession on regional and global biogeochemistry.

The workshop was planned jointly by INPE and NASA as a first step in defining a collaboration that could involve other U.S. and Brazilian interests as well as those of international programs. It was recognized that IGBP through GCTE and IGAC and ISLSCP through LAMBADA/BATERISTA have proposed similar or complementary studies and that there are on-going U.S. and Brazilian programs (i.e., EOS) that are currently addressing aspects of this problem.

Other objectives were:

To make progress in defining a research study – or set of complementary, interactive studies – that would be both scientifically important and compatible with the scope and resources of its potential sponsors.

To propose – and, if possible – agree upon a process by which the scientific and programmatic planning for the study could proceed.

To discuss how such a Brazil-U.S. proposed program would be coordinated with the other research activities proposed for the Amazon Basin and how other U.S. and Brazilian agencies might become involved.

U.S. and Brazilian scientists have collaborated in recent years on a number of field studies and aircraft campaigns, including the NASA-INPE GTE-ABLE and TRACE-A campaigns and a number of individual field process studies under NASA's interdisciplinary carbon cycling program. It was proposed that future atmospheric chemistry - ecology studies in the Amazon be built upon this foundation of collaborations and past successes. In the U.S., meetings to plan future campaigns for the NASA Tropospheric Chemistry and Terrestrial Ecology Programs in March and August, 1993, respectively, identified the Brazilian Amazon as a high priority for future work and for a cross-discipline collaboration. A draft white paper describing the ideas proposed was developed and has been brought to this meeting for discussion. Those meetings directly led to this workshop in Brasilia.

An incomplete list of potential sponsors and/or programs interested in the study was offered for discussion. Those groups are listed below:

U.S. Agencies

NASA Terrestrial Ecology Program
NASA Tropospheric Chemistry Program
NASA Physical Climate Program
NASA SCAR Project
NASA EOS Project
NASA TRMM Project

USFS
EPA
DOE

Universities

Programs

IGBP - IGAC
GCTE
BAHC
WCRP/ISLSCP
LAMBADA/BATERISTA/AMBIACE

Brazilian Agencies

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