REPORT ON THE PROGRESS OF PROJECT RLA/92/G34 – IAI/UNDP/GEF/WMO

ACTIVITIES INVOLVING REGIONAL COOPERATION IN SUPPORT OF THE INVESTIGATION INTO GLOBAL CHANGE IN THE IAI COUNTRIES

1.-INTRODUCTION

The activities undertaken since the last meeting of the IAI Executive Council in Panama are described below

2.-ACTIVITIES

2.1-TRAINING.

2.1.1-National training courses in the version of SIG SPRING 2.0 for UNIX

a) A training course was held in the Dominican Republic, attended by 19 specialists from national institutions.

b) We have yet to fix the dates for the courses in Argentina and Chile which will be held during 1998

c)Courses held outside the project countries

c1)A course was held last December in Washington DC, in coordination with the National Science Foundation, which included as students specialists from the United States, and teachers from INPE; all the costs for this course were paid for by NSF and INPE.

c2)A presentation of the GIS-SPRING system was given by specialists from INPE at the headquarters of the National Science Foundation, with senior staff from INPE, NSF and the Open Gis Consortium taking part.

c3)Two further courses will take place, one in South West Asia and the other in Africa, the dates to be agreed with the START authorities. For these courses the costs will be shared between START and by the IAI project. We will only provide the material, the software licences authorized by INPE and the teachers paid for by the IAI/GEF project.

c3)We are examining the possibility of organising during 1998 a training course in the Spring system for specialists from other projects of the United Nations who work with geographical information systems.

d) Case Studies

a)The case study selected relates to an intensive training course for current university teachers in 10 selected countries of the region, who will participate in the Iowa State University course in "Climate and Agents of Global Change".

b)One of the main conditions that will be stipulated for participants is that they must confirm to the IAI their status as current university teachers. They must also send in advance the agreement of the university where they teach so that they can teach the course in their own university.

2.1.2-Regional courses for the training, installation and application of the meteorological data processing system -METVIEW;

a)Currently we have handed over the copies of the Metview system to each country.

2.2.-FELLOWSHIPS

2.2.1-Fourth call for fellowships

a)We have made the fourth and last call for fellowships for the project, which can be given for up to a maximum of 2 months in any institution on the American continent. Preference will be given to those candidates who are already working in research projects that are being financed by the IAI.

2.3-EQUIPMENT

2.3.1-Equipment

a) Upgrades have been carried out on the operating systems from AIX 3.2 to AIX 4.2 for the IBM RISC 6000/250 work stations for: Argentina, Chile, Mexico, Paraguay, Peru, Dominican Republic, Uruguay and Brasil; it is worth pointing out that Venezuela, Colombia, Ecuador and Bolivia being the latest countries to receive the Work Stations, already have the new operating system. Costa Rica updated their operating system more than a year ago. Cuba is a special case and we have not yet succeeded in getting autorization to update their system. Panama does not currently have the update but this will be installed in the near future.

2.4-INTERNET AND EXPERIMENTAL NODES OF THE IAI DIS/PROJECT

2.4.1-Support to countries for direct Internet connection to the IBM RISC 6000/250 work station, functioning as a network server;

a)With the aim of ensuring the connectivity of the countries to the IAI, and as part of the strategy in the use of work stations bought by the project, it was suggested that these should be used as the Internet server for each of the national counterparts of the project, if the counterpart does not already possess equipment of better quality.

2.4.2-Development of the experimental nodes of the IAI DIS system, (San José-Costa Rica y Montevideo-Uruguay).

a)Work is in progress for the installation of the experimental nodes that will be installed to control the central node of the IAI.

b)The personnel who will administer the nodes in Uruguay and Costa Rica will receive training for one and a half months at the IAI headquarters, together with the IAI Node Administrator. The training will be carried out by specialists from CIESIN, which is the firm contracted to carry out the installation and testing of the IAI central node.

2.5-SCIENTIFIC PUBLICATIONS

2.5.1-Purchase of scientific publications;

a)The countries which requested publications are: Bolivia, Dominican Republic, Venezuela, Colombia y Panama.

2.6-SATELLITE IMAGES

2.6.1-Survey of the availability and quality parameters of the images requested by the participating countries.

a)The corresponding requests for this information were sent to the countries. As soon as it is available it will be sent to the WMO to begin the process to purchase this material.

b) The countries which have still not received this material are: Chile, Ecuador, Panama, Paraguay, Dominican Republic and Venezuela

2.7-INCORPORATION OF NEW COUNTRIES IN THE PROJECT

a)After having completed all the relevant legal formalities as a member of the IAI, the Government of Jamaica (through its counterpart The University of The West Indies-Department of Physics), requested UNDP to participate in the IAI/GEF Project. This was discussed at the Second Tripartite Meeting and incorporation was approved, thanks the important financial donation to be made by NSF. An evaluation was made and it was established that this country has the technical capacity to be able to rapidly incorporate itself into the IAI activities.

3-PROJECT EVALUATION.

a)In May the SubDirector of the UNDP/GEF Unit in New York, Emma Tores, visited the project.

b)The visitor emphasized the role that the project was fulfilling within the region.

4-RECOMENDATIONS FOR A POSSIBLE PHASE II OF THE PROJECT, OR A NEW PROJECT.

a)The project is now going through one of its best periods since it started as the majority of the counterparts have now fully understood among themselves the achievements and importance of the project.

b)The establishment by IAI of the "Research Consortia" is an essential process within the research structure of the American continent. This process will probably begin to develop during 1998 and will continue for a period of 3 years.

c)Based on this enormous efforts of the Governments of the American countries the IAI has started to organise the "Research Consortia" at the hughest scientific level in each member country. At the same time the IAI/GEF Project is beginning to give some tools to help this process, but from the other direction.

d)The chances of being successful in this complex process depend both on the efforts of many participants, and on international collaboration and cooperation. The resources supplied by GEF and the countries play a very important role.

f)We must bear in mind that the level of scientific and technological development within the American continent is quite variable, and that countries do not give the same priority to these subjects. Therefore, the effort that must be made to bring everyone together within the same initiative of a regional project such as this one which brings together 16 countries (from South America, Central America and the Caribbean), is truly difficult.

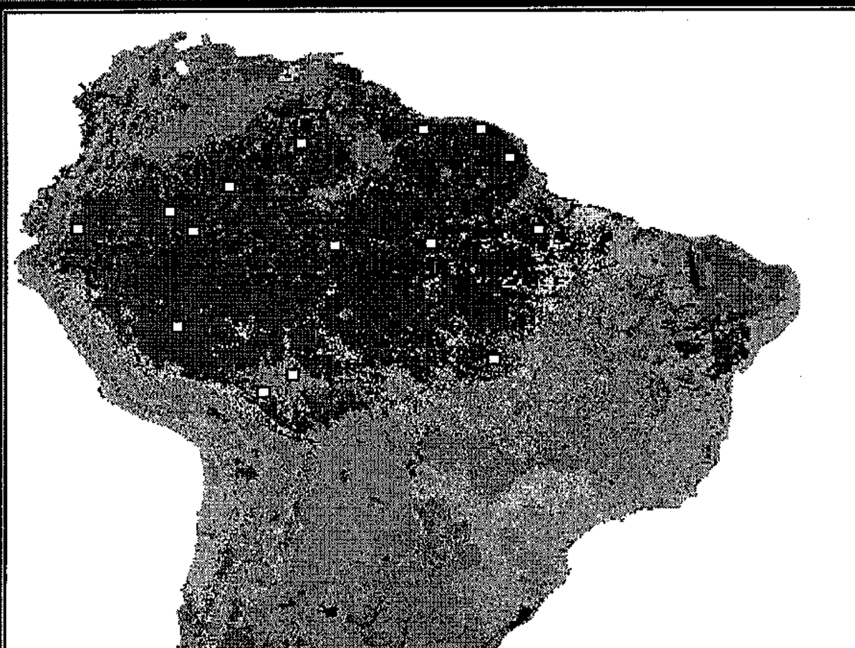
g)Nevertheless, the impact of the IAI within the American Region is considerable, such that its working and its design is being used as an example in other parts of the world for example, as well as by many international organisations who hope to be able to use the results obtained from the research sponsored by the IAI.

h)The possibility of presenting a Phase II of the current project, or a new project which makes use of what has already been established by the existing project, is an important step which will determine the success not only of the IAI initiative but which will give the countries a strong base to set in motion the Research Consortia, whose results will be of use to specialists in biodeiversity, in climate change and in global change.

i)The international obligations generated by the Agreements on Climate Change, Biodiversity, Desrtification etc., will be hugely reinforced because the ability to research, understand and study the problems will be backed up by important research groups throughout the Continent. These groups will include researchers from developed countries such as Canada and the United States, as well as from the other developing countries in the rest of America.

ANEXO I

A PROPOSAL FOR A CO_2 OBSERVATIONAL NETWORK IN THE AMAZON BASIN



Cachoeira Paulista/SP - Brazil
June 1997

A Proposal for a CO_2 Observational Network in the Amazon Basin

Participating Countries: **Brazil, Venezuela, Colombia, Ecuador, Peru and Bolivia.**

Duration: **3 years.**

Total Budget: **U$S5.230.00.=**

1. Introduction

The Amazon basin constitutes a large global store of carbon, which may exchange with the atmosphere through (i) changes in land use brought about by fire, clearing, logging, planting and regrowth and (ii) changes in the balance between photosynthesis and respiration occurring as a result of variations in climate and atmospheric chemistry. Both of types of change introduce uncertainties in the global carbon balance (Tans et al., 1990; Ciais et al., 1995) and both may influence the carbon dioxide of the atmosphere and thus interact with the climate system (Enting et al., 1995). Moreover, information on carbon stocks and fluxes is required by all countries under the terms of the Climate Convention, and is likely to influence national policy on land use, with implications for conservation and biodiversity. A major challenge and opportunity for this monitoring iniatitive is to provide a field data base to determine both the antropogenic components and the climate-induced components of the net flux of carbon.

The need to increase agriculture lands combined with an occupation policy which facilitated the establishment of large cattle ranches in the Amazon, particulary in Brazil, caused a sharp increased in deforestation rate in the 80s (Fig. 1).

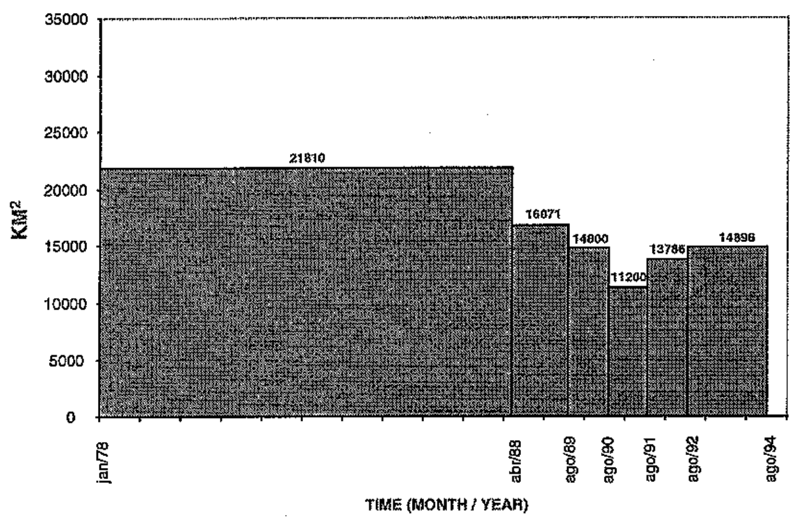


Figure 1 Mean annual deforestation rate estimated using high resolution Landsat imagery (Produced by the Instituto Nacional de Pesquisas Espaciais, São José dos Campos - Brazil)

The conversion of forest to agriculture in Amazonia is still a major source of carbon to the atmosphere. On the other hand, recent Net Ecosystem Exchange (NEE) measurements indicate that undisturbed forest systems in Amazonia may be a net carbon sink (Grace et al., 1995; Fig. 2). This conclusion was also corroborate by Malhi et al. (1997) based on 10 year field measurements (Fig. 3). Notwithstanding the shortness of observational record and spatial representativeness (only two forest sites are represented in fig. 3: Rondônia and Manaus), it is striking that they show a consistent significant carbon accumulation rate (5.8 t ha^{-1} yr^{-1}). If these rates are extrapolated to the whole area covered by the Amazon Forest, it can be concluded that the region could be an important carbon sink to account for the already unbalanced global carbon budget.

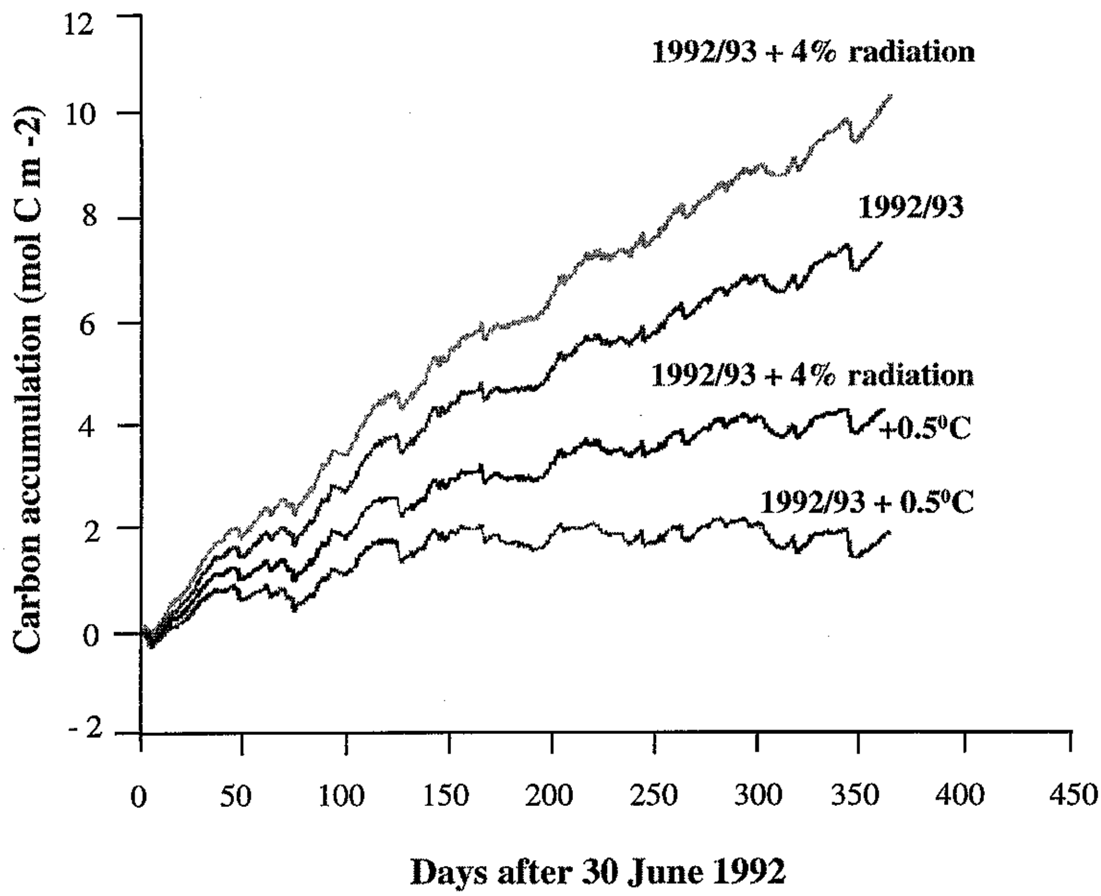


Figure 2 Sensitivity analysis of a carbon model run with 1992/3 climatological data and with modified input, to explore the effect of increasing radiation and temperature on carbon accumulation. Model results suggest that the undisturbed forest systems act as a net carbon sink, which is corroborated by field measurements in Rondônia during 1992/3 and in Manaus 1995/6 (Source: Grace et al., 1995; © by Science).

Moreover, abandoned farmland which is being colonised by trees constitutes a further carbon sink, although the extent of this sink (its area and intensity) is uncertain. Similarly, logged-over-forest and disturbed areas associated with logging have not been evaluated. Studies are required to determine both the areal extent of different land uses and the associated changes in carbon.

Concern about global greenhouse warming has increased in the last decades. According to the IPCC 1995 report, the temperature rise in the last century cannot be explained only by natural variability of the Earth Climate System. In addition to the increase of temperature due to greenhouse effect, drastic changes in the land cover may lead to changes in the energy balance and consequently modify the surface temperature. Changes in the land use also alter the CO_2 storage and exchanges, exacerbating or minimizing greenhouse effects. Recente studies (Victoria et al., 1997) show positive significant trends in surface temperature in Amazonia. As can be seen in Fig. 4, the increase trend in temperature in Amazonia since 50's is sharper than in the Southern Hemisphere. It is interesting to note that studies carried out in Rondônia (fig. 2) show a large sensitivity of the net carbon flux with temperature. Model calculation show that a small increase in temperature can change the forest from a net sink to a net source due to increase in soil respiration.

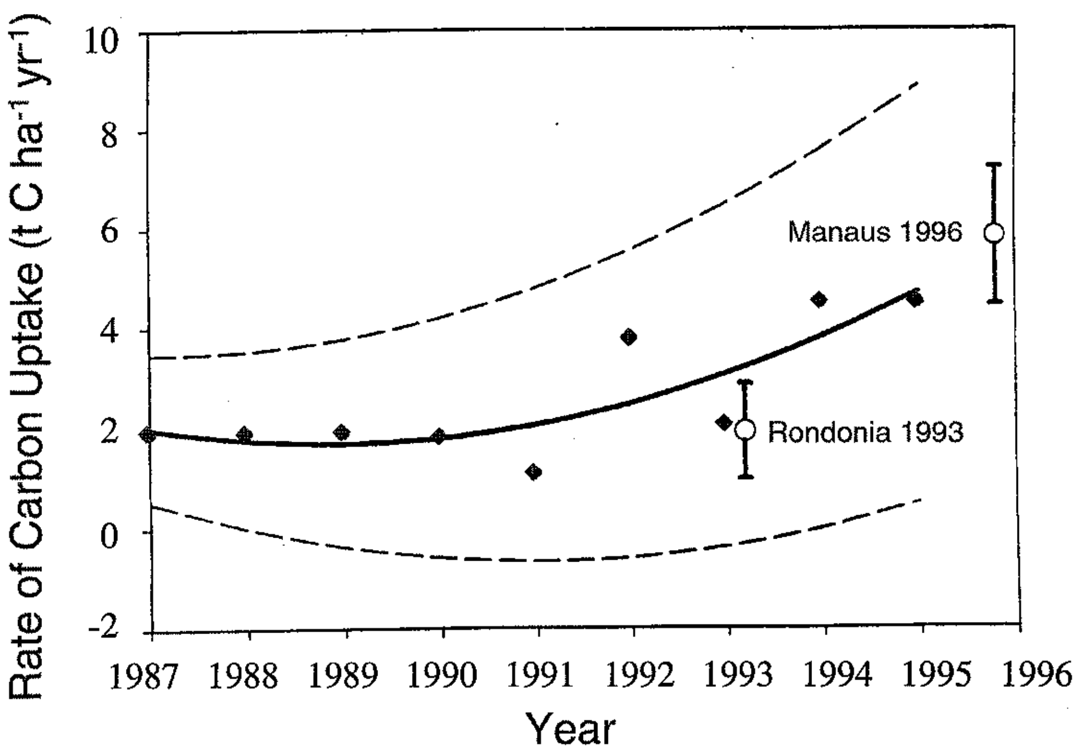


Figure 3 Estimated rates of carbon accumulation in biomass since 1986, as determined from the mean of sample plot data. The solid line is a third order polynomial, the dashes line are the 95 % confidence limits indicating the uncertinty due to spatial varibility between the sample plots. (Malhi et al., 1997).

One approach to the regional carbon balance emphasises the natural carbon cycle, including net primary production (NPP) and respiration. Fluxes in the natural vegetation will reflect two processes. The first of these involves metabolic processes of photosynthesis, growth, and decay, affecting individual trees, and very short time and spatial scales. The second process, over somewhat larger scales, is succession, which affects the number, age and species composition of stems, as well as the amount, nature and turnover rate of soil organic matter. At scales of 0.1-1 km^2, eddy-covariance measurement of CO_2 flux above canopy will integrate both of these processes (metabolic and successional), while repeated measurements of carbon accumulation in living biomass, distribution and decomposition of dead biomass, and the nature and turnover of soil organic matter will allow for partitioning of net flux. Metabolic models based on fundamental physiological parameters may be used to predict regional carbon balance on seasonal to decadeal timescales.

There are major uncertainties in our understanding of the carbon dynamics of re-growing forests in Amazonia. It has been suggested that secondary forest re-growth following pasture or crop land abandonment may be responsible for much more carbon accumulation in Amazonia than previously estimated. This suggestion needs to be investigated. Thus, better information on the ages of secondary forests and the rates of carbon accumulation at various ages is desired.

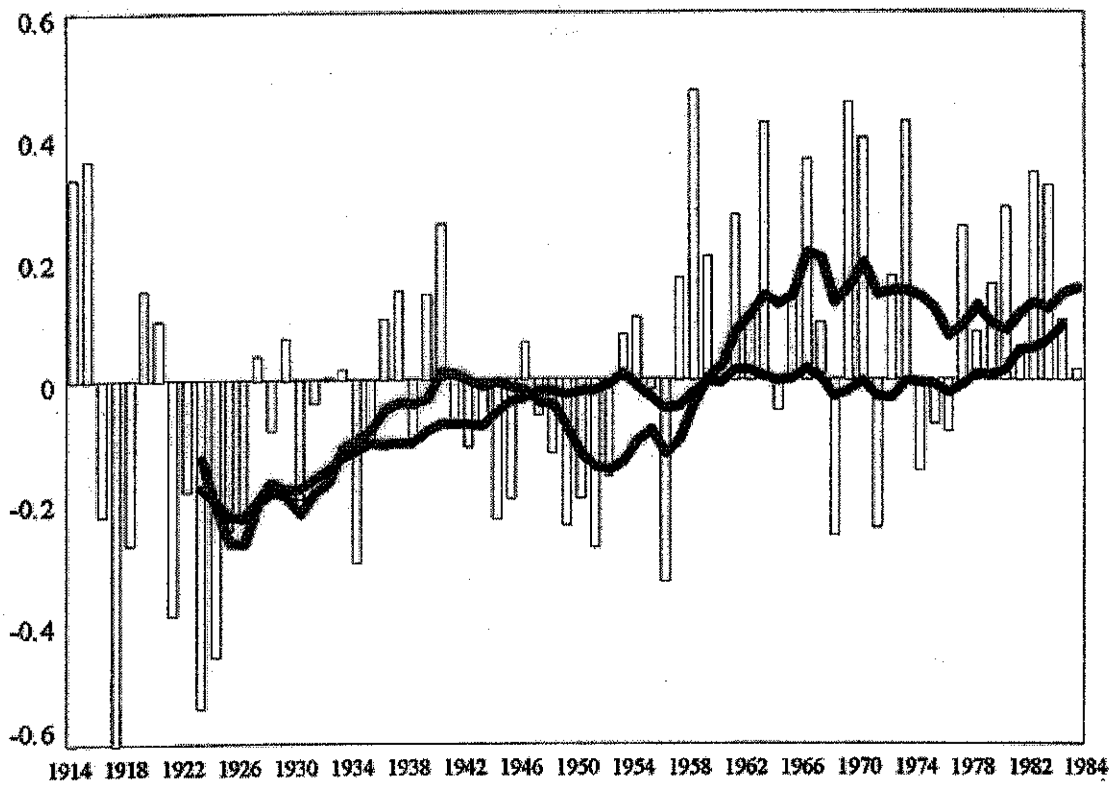


Figure 4 Temporal trend in the air temperature anomalies (bars). The red line is a 10-term gaussian filter of the temperature anomalies in the Amazon region, whilst the green line is the same filter applied to the South hemisphere (Victoria et al., 1997)

2. *Justification*

A new CO_2 monitoring network covering the whole Amazon Basin will provide a unique opportunity to determine both the human management-induced and the climate-induced components of the net flux of carbon, to define the current overall carbon balance of the region, and to estimate the future carbon balance under scenarios of land-use and climatic change.

The resulting data-set from the proposed network will pave the way for an understanding of the overall biogeochemistry of the region, and will assess carbon pools and fluxes in a variety of land-cover and land-use types. It will provide a new insight regarding the seasonal and interannual variability of the CO_2 flux between the atmosphere and different land-cover/land-use types and from the Amazon region as a whole.

In addition, field data will help to determine to what degree do natural sinks and sequestration of carbon in regrowing forests balance/offset sources associated with forest conversion. It will help to answer questions related to the influence of selective logging on carbon cycle. This includes influences on microclimate, decomposition, ecosystem structure, and probability of future disturbances (i.e., fire) that will further influence carbon dynamics. Recent data on timber harvest intensity and wood production indicate that selective logging of otherwise intact stands of forest contributes significantly to the area of forests altered in Amazonia. Selective logging may result in decreased carbon storage in living biomass and increased emissions of carbon through decomposition processes for the region affected. The removal of stemwood to long-term storage pools together with regrowth following harvest may lead to a net carbon sink. The net flux of carbon from forest end-products needs investigation. There is evidence that logged forests may become more prone to fire because of the large fine fuel loads left behind and a drier microclimate near the litter layer. It is difficult to estimate the total area subject to selective logging in Amazonia, and it is even more difficult to quantify the changes in carbon storage and emissions.

Some management practices include fire as a way of concentrating nutrients in available soil pools. Other practices, such as selective logging, may increase the flammability of forests and affect fire frequency. Considerable work on fire is already in hand, both for humid forest and cerrado, but there are a number of unanswered questions about the decomposition of uncombusted organic matter remaining in the soil over months and years following the burn, and also on the rate of carbon accumulation of the regrowth.

The data-set collected by the proposed observational network will provide aditional field data and substantial support to ongoing scientific activities such as the Large Scale Biosphere Atmosphere Experiment in The Amazon (LBA), which is designed to answer various scientific questions across temporal and spatial scales of the carbon cycle in the Amazon. The LBA is an internation research initiative, lead by Brazil, designed to create the new knowledge to understand the climatological, ecological biogeochemical and hydrological functioning of Amazonia, the impact of land use change on thse functions, and the interaction between Amazonia and other components of the Earth System.

3. Observational network design

Carbon storage and exchange should be measured along gradients of climate and land use intensity. Sites are selected in order to cover a wide range of conditions. Choice of sites is not made in order to derive the best representation of the mean condition, but to capture the processes as they are expressed over a wide geographical range, to enable modelling, scaling-up and synthesis. Baldocchi et al. (1996) suggested a minimum set of site measurements required to support flux data.

Sites will serve to compare carbon exchange on a variety of land uses including old-growth forest, secondary forest, pasture/agriculture, and selectively logged forest. The measurement of carbon exchange will require eddy covariance sensors (fig. 5) mounted on micrometeorological towers (fig. 6). The goal is to acquire data continuosly and simultaneously at all towers.

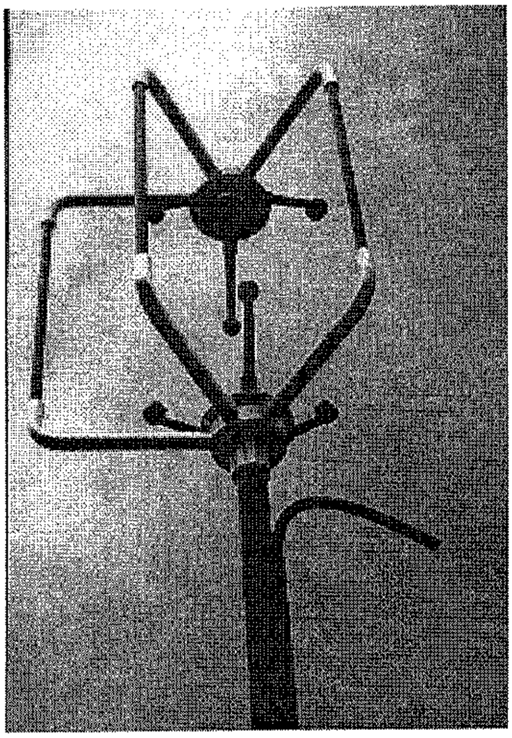
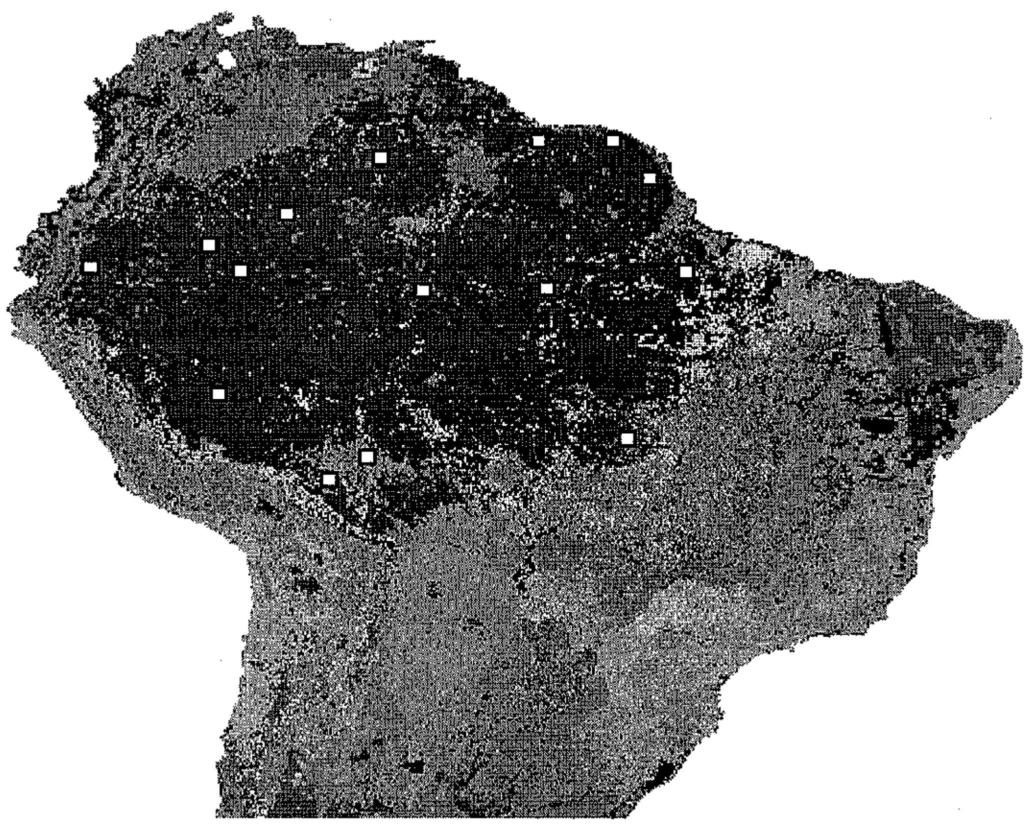


Figure 5 Eddy-covariance measurements of CO_2 will quantify fluxes in natural vegetation due to metabolic and successional processes

Sites will be located along the transects to expand the range of variability in climate, soils, and vegetation. Some of the flux towers will represent extremes of climate and natural vegetation such as wet forest in the northwest Amazon and *cerrado* and possibly other variations such as transitional forest (semi-deciduous) and flooded forest in the central basin. Mobile towers could be used on a campaign basis to measure carbon exchange along variations in the cerrado vegetation and as well as in agriculture and pasture sites in the forest region.

Figure 7 shows a vegetation map (based on AVHRR analysis) and the proposed obsevational network in schematic form. The exact number of stations and their precise location will be defined depending on availability of resources, local facilities and logistics. it is proposed that a minimum number of monitoring stations for the Amazon is 15.

Figure 6 Micrometeorological towers will be used to measure the carbon exchange for a variety of land-uses. In the picture, the tower installed at Reserva Jaru-Rondônia during the ABRACOS experiment is shown.



◻ CO_2 flux measurement station

Figure 7 Preliminar location of station of the proposed observational network. The design takes into account local facilities (near city, national parks, etc) and sample the overall eco-climate variability of the Amazon Basin. (Courtesy of Thomas Stone, WHRC)

4. *Expected Products*

Measurements of carbon storage and exchange will provide crucial data to answer various questions.

4.1 Understanding the causes of seasonal and inter-annual variability in natural systems

To elucidate seasonal and interannual variability, and sensitivity of carbon exchange to climatological variables, eddy covariance sensors will be operated on towers (Fan et al., 1990; Grace et al., 1995; Miranda et al., 1997). The towers will be sited in natural vegetation and in disturbed sites. Supporting measurements of canopy structure, in-canopy concentrations and fluxes, and soil respiration will be required. Flux data will be related to climate and vegetational structure through the use of models incorporating biochemical, stomatal, and micrometeorological components (Mellilo et al., 1993; Lloyd et al., 1995).

4.2 Regional estimates of net carbon storage and exchange.

Field measurements from the proposed network, combined with aircraft profiles and satellite measurements, provide a data-base for testing and validating ecosytem models. The models will be placed in a regional GIS framework of climate and edaphic driving variables to predict carbon exchange for the region. Models that focus on surface atmosphere exchange may be linked to the regional Four Dimensional Data Assimilation - 4DDA model (Fig. 8) which will be able to treat carbon dioxide as a tracer that will interact with the land surface. Predicted fields of carbon dioxide concentration may be compared to measurements from ground based and aircraft borne instrumentation.

5 *Budget*

The cost of a full flux tower installed in the field is about $200 thousand per site. Operating costs (no salaries included) are about US$20 thousand per year. In conjunction with LBA project, technical personnal can be trained to operate, mantain the flux tower sites, and to coleect and pre-process the data. The cost of training is about US$ 10 thousand per person. Each tower site requires a minimum of two technicians for operation/maintance.

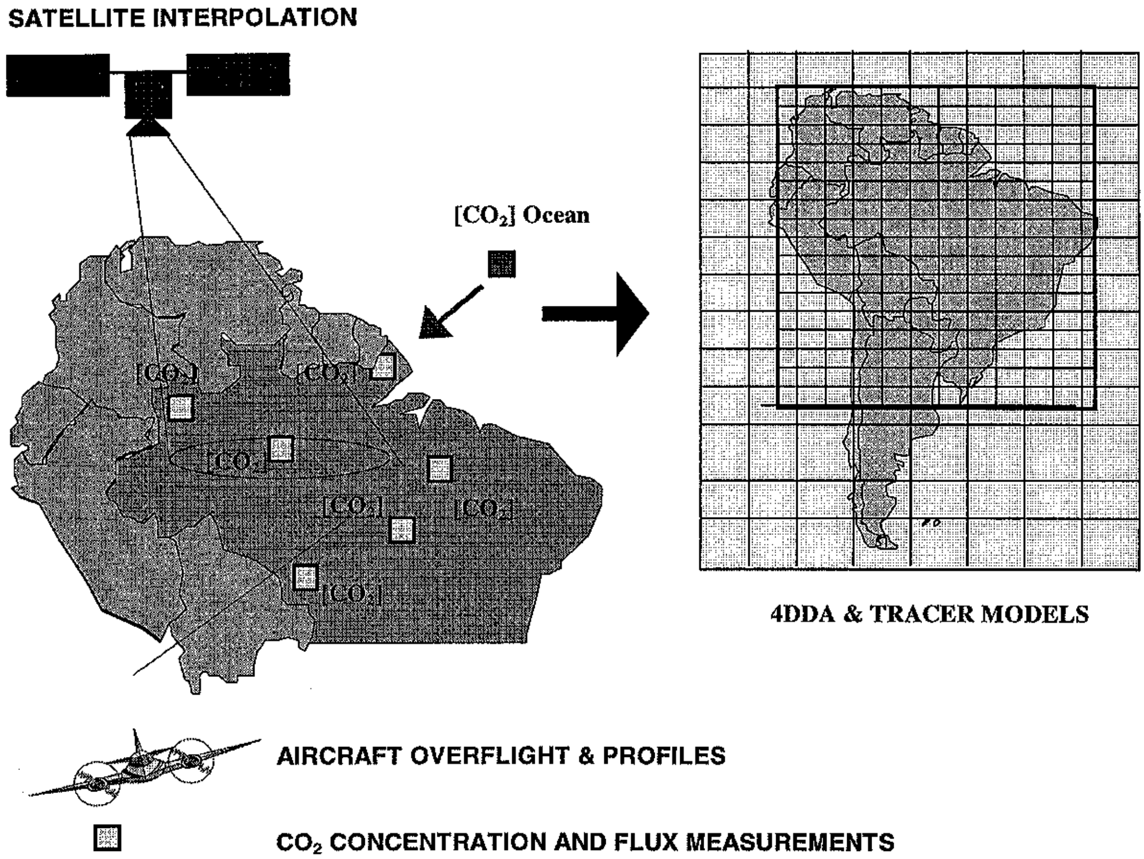


Figure 8 CO2 flux and concentration measurements will feed a Four Dimensional Data Assimilatation (4DDA) atmospheric model, used to estimate carbon budgets over Amazonia.

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