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A Final Report to the National Aeronautics and Space Administration

Land-use in Amazonia and the Cerrado of Brazil: State of knowledge and GIS database

Summary of Research

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Period Covered:
NAGW-5084: April 1, 1996 – September 30, 1997
NAG5-5164: July 15, 1997 – July 14, 1998 (budget augmentation)

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With support from NASA (Grant Number NAGW-5084, and a supplemental award [redacted], NAG5-5164), The Woods Hole Research Center (WHRC), in collaboration with the Amazon Institute of Environmental Research (Instituto de Pesquisas Ambientais da Amazonia-IPAM), The Pennsylvania State University (PSU), the Amazon Institute of Man and the Environment (Insituto Amazonico do Homen e do Meio Ambiente-IMAZON), the University of Brasilia (Universidade de Brasilia-UnB) and the Agricultural Research Center of the Cerrado (Centro de Pesquisas Agropecuarias do Cerrado—Embrapa/CPAC), have assembled datasets to strengthen the Large-Scale Biosphere Atmosphere Experiment in Amazonia (LBA). These datasets can now be accessed through the Woods Hole Research Center homepage (www.whrc.org), and will soon be linked to the Pre-LBA homepages of the Brazilian Space Research Institute's Center for Weather and Climate Prediction (Instituto de Pesquisas Espaciais, Centro de Previsão de Tempo e Estudos Climáticos, INPE/CPTEC) and through the Oak Ridge National Laboratory, Distributed Active Archive Center (ORNL/DAAC).

Some of the datasets that we are making available involved new field research and/or the digitization of data available in Brazilian government agencies. For example, during the grant period we conducted interviews at 1,100 sawmills across Amazonia to determine their production of sawn timber, and their harvest intensities. These data provide the basis for the first quantitative assessment of the area of forest affected each year by selective logging (Nepstad et al, submitted to Nature). We digitized the locations of all of the rural households in the State of Pará that have been mapped by the Brazilian malaria combat agency (SUCAM). We also mapped and digitized areas of deforestation in the state of Tocantins, which is comprised largely of savanna (cerrado), an ecosystem that has been routinely excluded from deforestation mapping exercises.

This grant also allowed us to strengthen the research capacity of two Amazonian institutions: IPAM and IMAZON. Two computers, a digitizing table, and printer were purchased and installed at the IPAM remote sensing laboratory, located at the Federal University of Pará (Universidade Federal do Pará-UFPa) in Belém. Elza Gomes Silva was hired through this grant, trained in remote sensing and GIS (ArcInfo), and is now on the permanent staff of IPAM. One computer was purchased for the IMAZON remote sensing laboratory in Belém, and one recent graduate from Belém was trained in GIS/ArcInfo with grant support.

Some of the datasets originally proposed as part of this grant have already been acquired by INPE/CPTEC, or are in the process of being acquired. These include:

1. IBGE census data and municipality boundaries
2. Precipitation, watersheds, river discharge.
3. Rainfall anomalies for Amazonia during ENSO.

Some of the datasets originally proposed as part of this grant will be added to the homepage upon publication. These include:

1. Minimum rooting depth of Brazilian Amazon forests
2. Interpolated map of soil wilting point and field capacity for Brazilian Amazonian soils.

For each dataset, we have assembled supporting documentation following guidelines provided by the ORNL DAAC program, to the extent possible.

We have included here, as an appendix a printed copy of our Pre-LBA homepage, which provides further information about the datasets that we have assembled.

Publications:

This grant has led to the publication of the following article:

Nepstad, D.C., C. Kink, C. Uhl, I.C. Vieira, P. Lefebvre, IF Brown, M. Pedlowski, E. Amaral, E. Matricardi, G. Negreiros. 1997. Land-use in Amazonia and the cerrado of Brazil. Ciencia e Cultura 49: 73-86.

Another article has been submitted for publication, which presents data from the sawmill survey and from a regional survey of forest ground fires:

Nepstad, D. C., A. Verissimo, A. Alencar, E. Lima and T. Stone. The hidden impoverishment of Amazonian forests. Under review at Nature.

Datasets for Amazonia and the Cerrado

Peter Schlesinger, Daniel Nepstad and Paul Lefebvre - The Woods Hole Research Center

We are pleased to release this collection of Amazonian datasets assembled with funding from the National Aeronautics and Space Agency (NASA). This project was conducted in anticipation of the Large-Scale Biosphere Atmosphere Experiment (LBA), an international research effort led by Brazil . The LBA home page is maintained by the Brazilian weather and climate agency CPTEC (Centro de Previsão de Tempo e Estudos Climáticos) with a US LBA mirror site maintained at Oak Ridge National Laboratory (ORNL).

The science questions to be addressed by LBA are:

> "How does Amazonia currently function as a regional entity?"
>
> "How will changes in land use and climate affect the biological, chemical, and physical functions of Amazonia, including the sustainability of development in the region and the influence of Amazonia on global climate?"

An ecologically focused portion of the LBA effort will be funded by NASA, and this project has as its science question, the following:

> "How do tropical forest conversion, re-growth, and selective logging influence carbon storage, nutrient dynamics, trace gas fluxes, and the prospect for sustainable land use in Amazonia?"

It is our hope that the datasets that can be accessed through this website, and those which will be added over the coming months, will facilitate both the research that will be carried out through the LBA and other studies that require spatially-explicit datasets for this very important tropical forest formation.

The datasets presented here were assembled by The Woods Hole Research Center in collaboration with the following institutions:*Instituto de Pesquisa Ambiental da Amazônia* (Amazonian Institute for Environmental Research, IPAM), Pennsylvania State University, *Instituto de Homen e do Meio Ambiente da Amazônia* (The Amazonian Institute for Man and the Environment, IMAZON), *Empresa Brasileira de Pesquisa Agropecuária/Centro de Pesquisa Agropecuária do Cerrado* (Brazilian Agricultural Research Agency/Center for Agricultural Research of the Cerrado), *Instituto Nacional de Pesquisas Espaciais* (National Institute of Space Research, INPE), and *Universidade de Brasilia* (University of Brasilia).

Additional information on land-use in Amazonia and the Cerrado can be found in:

D.C. Nepstad, C.A. Klink, C. Uhl, I.C. Vieira, P. Lefebvre, M. Pedlowski, E. Matricardi, G. Negreiros, I.F. Brown, E. Amaral, A. Homma and R. Walker. 1997. *Land-use in Amazonia and the Cerrado of Brazil.* Ciéncia e Cultura 49(1/2): 73-86

Funding for this project was provided by NASA through grant HPUSP#884, MTPE Number 5303-TE/95-0059 to The Woods Hole Research Center.

Datasets Acquired from Non-Brazilian Sources

1. Composited Normalized Difference Vegetation Index, including:

   16 km NDVI data from the NOAA AVHRR satellites in weekly time steps from the period 1982-1994 (Source: Dataset ID: GNV28, UNEP/GRID, Geneva). metadata / data

   8 km NDVI data from the NOAA AVHRR satellites in weekly time steps from the period 1982-1994 (Source: Landsat AVHRR Pathfinder, NASA/GSFC website). metadata / data

   1 km NDVI data from the NOAA AVHRR satellites in monthly time steps from the period April 1992-March 1993 (Source: Global Land Cover Characterization, USGS/EROS Data Center website). metadata / data

2. Soil Map of Brazil (IBGE, 1981) (Source: Dataset from UNEP/GRID, Sioux Falls ftp site. metadata / data

3. Vegetation Map of Brazil (IBGE, 1988) (Source: Dataset from UNEP/GRID, Sioux Falls ftp site. metadata / data

4. A Map of the Vegetation of South America Based on Satellite Imagery (1992) (source: Stone et al., The Woods Hole Research Center, Woods Hole, MA). metadata / data

Datasets Acquired from Brazilian Sources

5. Fire Count Images (Source: A. Setzer, INPE, Brazil).
   These data contain weekly cumulative fire counts from analyses of AVHRR data from NOAA 12 and 14 in grid cells of 0.5 degrees of latitude by 0.5 degrees of longitude arranged in a matrix covering from 7 deg N to 40 deg S and from 75 deg W to 34.5 deg W for 1994-1997. metadata / data

6. Land Cover Evaluation of the State of Tocantins, Brazil (Source: EMBRAPA-CPAC/UnB, Brazil)
   Eduardo Assad (EMBRAPA-CPAC) and Carlos Klink (UnB) have completed Landsat TM-based mapping of areas of native cerrado vegetation conversion for southern Maranha State and Tocantins. The digitized maps of cerrado conversion are available here for the State of Tocantins. Assad has also done conversion/deforestation mapping for Mata Grosso, Goias, and Southern Pará. Some of these maps may also be available for LBA. metadata / data

7. Spatial Distribution of Saw Mills in Brazilian Amazonia (Source: IMAZON, Brazil)
   Amazonia contains the world's largest reserve of tropical timber. More than 2000 mills are harvesting this timber, and in the process they are altering large areas of forest, constructing roads into remote forest regions, and providing employment and revenue to rural Amazonian economies. An understanding of the spatial distribution of these saw mills, the volumes of wood that they are harvesting, and the area of forest that they are harvesting, is needed if we are to understand the impact of human activities upon carbon, water and nutrient cycles of Amazonian ecosystems.

   The Instituto Amazonico do Homen e do Meio Ambiente (Amazon Institute of Man and the Environment, IMAZON) has completed a survey of 1190 saw mills operating in Brazilian Amazonia, which is almost half of the total number of mills operating in this region (~2500). The mills that were interviewed are distributed among 76 wood processing centers ("polos madeireiros") which are responsible for more than 95% of all of the wood production in Brazilian Amazonia.metadata / data

8. Rural Households of Para, Brazil (Source: IMAZON, Brazil)
   Future land-use patterns in Amazonia will depend, to a large extent, on the geographical distribution of the rural human population. Maps of deforestation show the cumulative effects of this rural population on forest cover, but do not provide information about the distribution and concentrations of rural households. The Rural Households Dataset provides a digital map of rural households for the state of Para', located in eastern Amazonia. metadata / data

9. Industrial Mining (Source: IPAM, Brazil/WHRC, USA)
   One of the most important human activities in Amazonia is industrial mining. The areal extent of active mine sites in the region is quite small, totalling less than 50,000 hectares, the size of a single large ranch. However, the influence of industrial mines on land-use in Amazonia goes far beyond the area of direct impact, for they can exert a strong influence on the construction of roads, the development of electricity networks, and the migration patterns of the Amazon labor. Knowledge of the current distribution of mines, and the plans that are being made for new mines, is needed to predict the course of frontier expansion in Amazonia.

   The Woods Hole Research Center, in collaboration with the Amazon Institute of Environmental Research (Instituto de Pesquisa Ambiental da Amazonia, IPAM), has assembled data from the Brazilian National Department of Mineral Production (Departamento Nacional de Producao Mineral, DNPM) on the requests for mineral exploration and for mine construction in the following states of the Brazilian Amazon: Acre, Amapa, Amazonas, Para, Rondonia, and Roraima. Data were not available for the states of Tocantins, Mato Grosso and Maranhao. metadata / data

10. Soil Profiles of Amazonia (Source: IPAM, Brazil/WHRC, USA)
    We are releasing soil profile descriptions for 1168 locations throughout Brazilian Amazonia. These data are primarily based on RADAMBRASIL surveys metadata / data

11. Links to Precipitation Data for the Amazon Basin Links

For more information, please write or call us at:
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