

Final Report for NASA Cooperative Agreement NCC5-691

Investigation Group: LC-07

Title: Linking vegetative cover and inundation in Amazon wetlands with regional analyses of carbon dynamics (15 Jan 03 to 30 April 07)

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### 1. Narrative of activities:

Three major accomplishments:

1. Synthetic aperture radar imagery (L-band SAR acquired by the Japanese Earth Resources Satellite-1) was used to map inundation extent and wetland vegetative cover types under low and high water conditions at 100 m resolution (with thematic accuracy assessed using high-resolution digital videography) for a 18° x 8° area in the central Amazon basin. (Hess et al. 2003). A floodplain mask was generated using the same technique for the whole lowland Amazon basin (wetlands below 500 m above sea level) (Melack and Hess 2004).

These remote sensing results in combination with field measurements provided the basis for two important biogeochemical calculations highly relevant to the carbon dynamics of the Amazon basin:

2. Outgassing (evasion) of carbon dioxide from rivers and wetlands of the central Amazon basin constitutes an important carbon loss, and, if extrapolated across the whole lowland Amazon basin, the flux (approximately 0.5 Pg C y<sup>-1</sup>) is an order of magnitude greater than the fluvial export of organic carbon and comparable to upland net productivity (Richey et al. 2002).
3. Methane emission extrapolated from the central Amazon basin to the whole lowland basin is approximately 22 Tg C y<sup>-1</sup>, with a greenhouse warming equivalence of about 0.2 Pg of CO<sub>2</sub> (Melack et al. 2004).

Our LBA team produced 32 reviewed publications, 5 theses and 19 articles in published proceedings(see section 4), conducted field studies in Lago Curuai, Lago Grande de Monte Alegre, Balbina Reservoir and interfluvial wetlands in the upper Negro, and furthered analyses of remote sensing data. Continued work on the JERS-1 basin-wide wetlands mask focused on improved geocoding of the co-registered JERS-1 mosaics using the GeoCover Landsat TM mosaic and the SRTM digital elevation model as

references, estimation of open water area and on validation using our extensive digital videography archive. We applied our processing stream of resampling, coregistration, and mosaicking to multi-date Radarsat images, and conducted an analysis of a time series of Radarsat images centered near the Bananal tower and near Barcelos in interfluvial wetlands bordering the Negro River were completed.

Spatially comprehensive sampling of limnological conditions and bathymetry were conducted in Lago Curuai and were complemented by an *in situ* monitoring system. These data have been combined with analyses of Landsat images to examine spatial heterogeneity with geostatistical methods as part of the PhD thesis of Claudio Barbosa.

Phenological changes in aquatic macrophyte biomass over a full hydrological cycle were measured monthly in Lago Grande de Monte Alegre near Santarem and in Lago Marchantaria near Manaus as a basis for calibrating Radarsat and Envisat images acquired concurrently with the field sampling. A consistent protocol for analysis of the Radarsat and Envisat imagery was developed. These data are being incorporated into a PhD thesis by Thiago Silva. An agreement between the Alaska SAR Facilities/University of Alaska Fairbanks and the University of Victoria (Costa) was established, thus allowing us to use the ASF SAR user tools for calibration of Radarsat 1 imagery.

Field studies of methane and carbon dioxide concentrations and evasion at Balbina Reservoir and in interfluvial wetlands in the upper Negro basin augmented earlier studies along the central Amazon floodplain. Regular, spatially distributed measurements in the reservoir and downstream of the dam were made. Stage and rain gauges were installed in interfluvial wetlands upstream of Barcelos and periodic sampling of gas evasion was done. These studies were part of the PhD theses of Alex Kemenes (Balbina) and Lauren Belger (Negro wetlands).

A method for determining sediment and chlorophyll concentrations from the MODIS data was developed. Generally, 20-30 quality images are available per year for the major tributaries and mainstem Amazon, thus allowing development of time series yielding information on annual variations.

Melack continued to serve on the LBA Science Steering Committee. Members of our team have attended all LBA meeting and presented posters or talks.

## 2. Description of training activities, including lectures, public outreach, and short courses:

Training activities have been focused on graduate student and technician training. Two Ph.D., two M.Sc. and several undergraduate students were associated with our project at INPA. One Ph.D., three M.Sc., two postdocs, several undergraduates and technicians were associated with our project at INPE. One Brazilian Ph.D student is associated with our project from the University of Victoria, Canada. One undergraduate

student is associated with our project at Universidade do Para, Santarem.

Hess's work continued as Wetlands Coordinator of the ALOS Kyoto & Carbon Initiative. Work focused on refining the PALSAR acquisition plan and on writing and revising the ALOS Science Plan. As part of our outreach to conservation planning efforts in the Amazon, Hess attended the "Amazon River and floodplain ecoregion conservation planning workshop" in Manaus; the meeting was sponsored by WWF-Brazil and ProVarzea\_IBAMA.

### 3. Data base status

We have actively worked with Marilyn Gentry to register data and link data to publications. Our files are up-to-date.

### 4. Publications (reviewed)

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5. Participants (over course of project):

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<a href="#">Lauren Belger</a>	Participant	INPA - Instituto Nacional de Pesquisas na Amazonia
<a href="#">Joao Carlos Carvalho</a>	Participant	IAI - Inter-American Institute for Global Change Research
<a href="#">Sueli Pissarra Castellari</a>	Participant	INPE - Instituto Nacional de Pesquisas Espaciais
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