

## 9.0 Remote Sensing

The information presented in this section is based upon a survey of requirements solicited during the first Science Team meeting held in Miami in December 1997. Additional information has been gathered from the investigator proposals, later Science Team Meetings, the draft Science Plan, and correspondence with the investigators. Science team members were asked to specify data source, frequency, spatial resolution, location, and other similar information. The LBA Regional Integration Group (LBARIG), led by Leland Pierce of the University of Michigan, gathered much of this information.

### 9.1 Satellite

#### 9.1.1 Needs of Investigators

LBA–Ecology’s objectives for regional synthesis and integration require remote sensing data. This section of the Experiment Plan has been organized by satellite, with notes addressing spatial and temporal interests, the investigators expecting to use the data, sources, and other issues, if applicable.

#### **Historical Thematic Mapper (TM) and Multi–Spectral Scanner (MSS)**

*Spatial:* Study sites only

*Site Priority:* Manaus, Rondonia, Marabá, Ji–Paraná

*Temporal needs:* For each site, need one image per year for at least the last 10 years. The last 20 years would be even better.

*Investigators:* Skole, Chadwick/Roberts (have most of data they need), Brown (just Acre), Gascon (just Manaus)

*Sources:*

Landsat Pathfinder (<http://www.pathfinder.sr.unh.edu/pathfinder/browser>); over 600 scenes from 1983 (MSS) and 1993 (TM)

Jeff Richey MSS only (‘73–‘86)

More recent (1991) data may be available from the INPE PRODES project.

*Issues:* Distribution (this may include copyright issues and/or limited resources).

#### **Current/Future Landsat**

*Spatial:* Study sites only

*Temporal needs:* *Now:* need images over sites before, during, and after ground campaigns.

*Investigators:* Frohn, Moran, Huete, Walsh, Brown

*Sources:*

**INPE/NASA**–The implementation agreement between the US and Brazil states that NASA is required to “ensure the provision of data from NASA satellites” and that INPE is required to “provide satellite data from Brazilian ground receiving stations and Brazilian satellites.”

**Skole ESIP**

*Issues:* Landsat–7 dependent upon successful launch, 1999. Landsat–7 calibration Processing of L0 data.

*Spatial:* Entire Amazon Basin

*Temporal needs:* *Now,* and once per season (wet/dry), for project duration

*Investigators:* Melack/Novo, Foley, Skole

**INPE/NASA**–The implementation agreement between the US and Brazil states that NASA is required to “ensure the provision of data from NASA satellites” and that INPE is required to “provide satellite data from Brazilian ground receiving stations and Brazilian satellites.”

*Issues:* Landsat–7 calibration? Processing of Level 0 data.

## **AVHRR–GAC**

*Spatial:* Entire Amazon Basin

*Temporal needs:* Once per year or two, since 1988. Once per season (wet/dry) for project duration.

*Investigators:* Foley, Moore

*Sources:*

**AVHRR Pathfinder**

**Moore ESIP UNH** (<http://www.esip.sr.unh.edu/>)

## **AVHRR–LAC**

*Spatial:* Entire Amazon Basin

*Temporal needs:* Once per year or two, since 1988. Once per season (wet/dry) for project duration.

*Investigators:* Brown (needs historical data), Foley

*Sources:* INPE

## **SeaWiFS**

*Spatial:* Entire Amazon Basin

*Temporal needs:* Once per season (wet/dry) for project duration.

*Investigators:* Huete, Frohn

*Sources:* Publicly available from GSFC (<http://seawifs.gsfc.nasa.gov/SEAWIFS.html>)

*Issues:* Preprocessing necessary.

## **MODIS**

*Spatial:* LBA transects (not just test sties)

*Temporal needs:* unknown frequency, project duration

*Investigators:* Huete, Frohn, Foley, Melack/Novo, Moore

*Sources:*

Huete

Moore ESIP

DAAC?

*Issues:* MODIS dependent upon successful launch of EOS–AM1, 1999. Limited use by MODLAND team for 6 months postlaunch.

Information about MODIS products can be found at: <http://modarch.gsfc.nasa.gov/MODIS/MODIS.html>

## **ERS–1**

*Spatial:* Entire Amazon Basin

*Temporal needs:* Once per season (wet/dry) before project starts. Once per season (wet/dry) again before project ends.

*Investigators:* Dobson/Soares, Melack/Novo

*Sources:* ?

**Note:** only ERS–1 or RADARSAT is needed, not both.

## **RADARSAT**

*Spatial:* Entire Amazon Basin

*Temporal needs:* Once per season (wet/dry) before project starts. Once per season (wet/dry) again before project ends.

*Investigators:* Dobson/Soares, Melack/Novo

*Sources:*

Threetek/Radarsat

## **JERS–1**

*Spatial:* Entire Amazon Basin

*Temporal needs:* Once per season (wet/dry) before project starts. Once per season (wet/dry) again before project ends.

**Investigators:** Dobson/Soares, Melack/Novo, Chadwick/Roberts

**Sources:** Data exists already for one season, almost done with other season. Get from JPL.

### **SIR-C/X-SAR**

**Spatial:** Fixed spatial coverage

**Temporal:** Historical

**Investigators:** Dobson/Soares, Melack/Novo, Chadwick/Roberts

**Sources:** EROS Data Center.

### **SPOT**

**Spatial:** Ecuador, details?

**Temporal needs:** Have historical, need recent acquisition

**Investigators:** Walsh

**Sources:** CNES/INPE

**Issues:** Satellite has to be programmed to obtain coverage.

### **SSMR/SSMI**

**Spatial:** Entire Amazon Basin

**Temporal needs:** Monthly during project duration

**Investigators:** Melack/Novo

**Sources:** Evlyn Novo/INPE

### **GOES**

**Spatial:** Entire Amazon Basin

**Temporal needs:** duration of project

**Investigators:** Smith

**Sources:** Smith (FSU), also for a fee from INPE

**Issues:** Distribution, parameters, temporal resolution

### **Space Imaging (or other high resolution imagery)**

**Spatial:** Study sites (~30 samples)

**Temporal needs:** one time?

**Investigators:** Skole

**Sources:** Space Imaging

**Issues:** Programming involved, costs?

## **9.1.2 Strategies for Data Acquisition**

Specific strategies for data acquisition have not yet been finalized. When they are, perhaps soon after the first meeting of the OIC, information about who will be providing which data will become clearer. In some cases, the planning and acquisition of data will require advanced scheduling to ensure acquisition of data for specific areas of interest.

For some data sets there are also distribution and copyright issues that will have to be addressed. These will be addressed on a per data set basis, depending upon the amount of data and the number of investigations requiring raw data.

## **9.1.3 Summary of Existing Data Sets**

Potential sources of existing data:

Landsat Pathfinder

<http://www.pathfinder.sr.unh.edu/pathfinder/browser>  
Over 600 scenes from 1983 (MSS) and 1993 (TM)

Jeff Richey (University of Washington)  
MSS only ('73-'86)

Historical AVHRR Composites  
<http://edcwww.cr.usgs.gov/landdaac/1KM/1kmhomepage.html>

INPE AVHRR  
<http://www.cptec.inpe.br>

INPE PRODES  
Recent TM

JERS-1 SAR of Amazon  
<http://southport.jpl.nasa.gov/GRFM>

Fire Count Images  
<http://www.whrc.org/Tropfor/Humanimpacts/WHRChotpix03.htm>

Land Cover Evaluation of the State of Tocantins, Brazil from Landsat TM  
(Source: EMBRAPA-CPAC/UnB, Brazil)  
<http://www.whrc.org/Tropfor/Humanimpacts/WHRCLBA.htm>

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)  
<http://www.whrc.org/Tropfor/Humanimpacts/WHRCLBA.htm>

## **9.2 Airborne Remote Sensing**

This section deals specifically with applicable results of the NASA-sponsored Light Aircraft Remote Sensing Workshop held in October 1997, rather than the large question of the role of aircraft remote sensing within LBA-Ecology. The workshop was designed to explore the current state of the art in operational small aircraft remote sensing instrumentation and to recommend instrument packages to meet the projected remote sensing needs of NASA's LBA-Ecology Project in the Amazon area.

Three packages developed from off-the-shelf products for airborne remote sensing were considered. It will be essential for the LBA-Ecology Science community to identify clearly the remote sensing parameters and products needed in order to make a final selection of sensor components to be included in the instrument package to be developed. The Project Office is working with the Science Team to determine the requirements for LBA-Ecology remote sensing.

Measured parameters that were deemed to be important to a remote sensing effort included:

- Downwelling spectral irradiance
- Upwelling Spectral Radiance Image
- Atmospheric H<sub>2</sub>O (for atmospheric correction of VIS–NIR imagery)
- Split Window in Thermal Infrared 10.5–11µm, 11.5–12µm
- Surface Humidity
- Surface Temperature
- Canopy Temperature
- Canopy/Surface Topography (transmit energy limits altitude to <3000ft AGL)
- All–Sky Camera (for cloud cover and smoke mapping)

Interfaces and features that were considered important to conduct research included:

- GPS
- INS
- Color video for visual documentation and bore sighting
- Data acquisition storage and system control