LCLUC year 2 task report – November 2002

Title : The Development of a Fine Resolution, Continental Scale Forest Monitoring System Using SAR imagery

Principle Investigator : Dr. Bruce Chapman
Institution : Jet Propulsion Laboratory
Address : 4800 Oak Grove M/S 300-227, Pasadena, CA 91109
E-mail : bruce.chapman@jpl.nasa.gov

Co-Investigator : Dr. Sasan Saatchi
Institution : JPL
Address : 4800 Oak Grove M/S 300-227, Pasadena, CA 91109
E-mail : saatchi@congo.jpl.nasa.gov

Collaborators :
Dr. Masanobu Shimada NASDA/EORC

Dr. Stephen Prince University of Maryland

Dr. Luciano Dutra INPE

Dr. Frank Degrandi EC Joint Research Centre

Dr. Ake Rosenqvist NASDA/EORC

Dr. Laura Hess University of California

Dr. Reiner Zimmermann Max Planck Institute

Abstract

A variety of sensors and international partnerships are required to globally monitor forest cover and forest cover change. While Synthetic Aperture Radar (SAR) has a well defined role in the global observing strategy (providing coverage over persistently cloudy areas), there are many integration issues that have never been executed in an operational environment; for instance, reconciling SAR/AVHRR/Landsat classification schemes. In addition, prior SAR land cover mapping projects, such as the Global Rain Forest Mapping Project (GRFM), have been research activities rather than operational systems. In the summer of 2004, the NASDA Advanced Land Observing System will be launched. The ALOS Kyoto and Carbon Initiative (ALOS K&C) has been established to monitor forest cover in a systematic fashion for most of the Earth's entire land area. This activity is therefore a prototype for what will be possible when that mission launches. During several meetings of the ALOS K&C Science Advisory Panel, new methods to estimate forest structure (such as tree height) using interferometric data has been proposed, and will likely form the foundation of the observation strategy for the ALOS K&C. Systematic mosaicking of the imagery is also planned.

In order to prototype what will be required, we have ported the JPL Multimosaic software to a 128 Node SGI origin 2000, which is capable of 77 Teraflops, and can enable much larger and faster mosaicking of imagery.
Six million sq. kilometers of imagery have so far been processed, but there are still gaps and further processing required to image the forested areas of South America and Africa that were not covered by the GRFM project. The calibration of the mosaics is still underway.

This prototype data set will allow an unprecedented snapshot of the state of forest cover currently unobtainable over perpetually cloudy regions in African and South American sub-tropical areas. The key technology this task incorporates demonstrates inexpensive but efficient processing architectures for continental scale mapping activities.

Keywords:

1) Research Fields : land cover classification, image processing
2) Geographic Area/Biome : South America, Humid tropical forest, wetlands
3) Remote Sensing : SAR, radars
4) Methods/scales : regional scale, data info systems

Questions, Goals, Approaches

The primary deliverable of this task is a baseline land cover map for forested areas South of the Global Rain Forest Mapping (GRFM) Project coverage areas in South America and Africa. Changes in land cover are occurring in these areas, but some areas in particular are difficult to monitor due to cloud cover. The proportion of social science used in this study is 0.0%. Our activity is concentrated on the development of operational forest monitoring techniques, rather than the causes and consequences of land cover and land use change. The GOFC theme is 100% of this task. The scientific question that we are trying to answer through this task is "what are the changes in land cover and/or land use (monitoring/mapping activities)?"

Our approach is to develop a prototype operational processing system that produces mosaicked imagery and classifications of forested areas south of the GRFM coverage in South America and Africa. After the data is mosaicked and a classification performed, it will be possible to compare with data from other complementary sensors

This year, we produced 5000 copies of a cdrom containing the mosaicked pantanal imagery. Copies of this cdrom were sent to the INPE, the Joint Research Center in Italy, NASDA, UC Santa Barbara, the Alaska SAR Facility, the GRFM science team, and other interested users of these data sets. Currently, we are investigating using DVD to distribute future data sets. We have submitted two papers for publication. One of these papers describes the utility of classification of the data based upon the probable scattering mechanism as an intermediate product. This classification technique will be more relevant when ALOS is launched, as the polarimetric L-band SAR data will have more information for determining the probable scattering mechanism that the single channel JERS data.

The Calibration of the data has required a fresh look, as the data comes through a new processing system in which the data is processed into long strips of imagery (which in the past would have been up to 30 individual scenes. This new processing architecture will also be used for ALOS PALSAR, and is more efficient for mosaicking, for which the extended along track projection of the data can be accommodated.

The goals for this upcoming period are to complete the processing of the JERS SAR data. Due to the extraordinary support that NASDA has been willing to provide, we hope to extend the processing to the entire land mass, rather than just forested areas. This will entail careful analysis of the archived imagery to fill in gaps most efficiently. We will also complete calibration of the imagery so that the mosaicked may be interpreted and classified.

Narrative statement of progress in study

A major activity during the past year was the processing of over 6 million sq km of JERS imagery. In addition, the JPL mosaicking software was ported to a 128 node SGI Origin 2000 computer capable of 77 Teraflops, which will enable significantly larger mosaicking efforts.
This year, we produced 5000 copies of a cdrom containing the mosaicked pantanal and central America imagery. We have submitted two papers for publication. One of these papers describes the utility of classification of the data based upon the probable scattering mechanism as an intermediate product. This classification technique will be more relevant when ALOS is launched, as the polarimetric L-band SAR data will have more information for determining the probable scattering mechanism that the single channel JERS data.
We have examined methodologies for classification of the data, and compared with other results (submitted for publication).
The Calibration of the data has required a fresh look, as the data comes through a new processing system in which the data is processed into long strips of imagery (which in the past would have been up to 30 individual scenes. This new processing architecture will also be used for ALOS PALSAR, and is more efficient for mosaicking, for which the extended along track projection of the data can be accommodated.
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New findings: -

New potential:

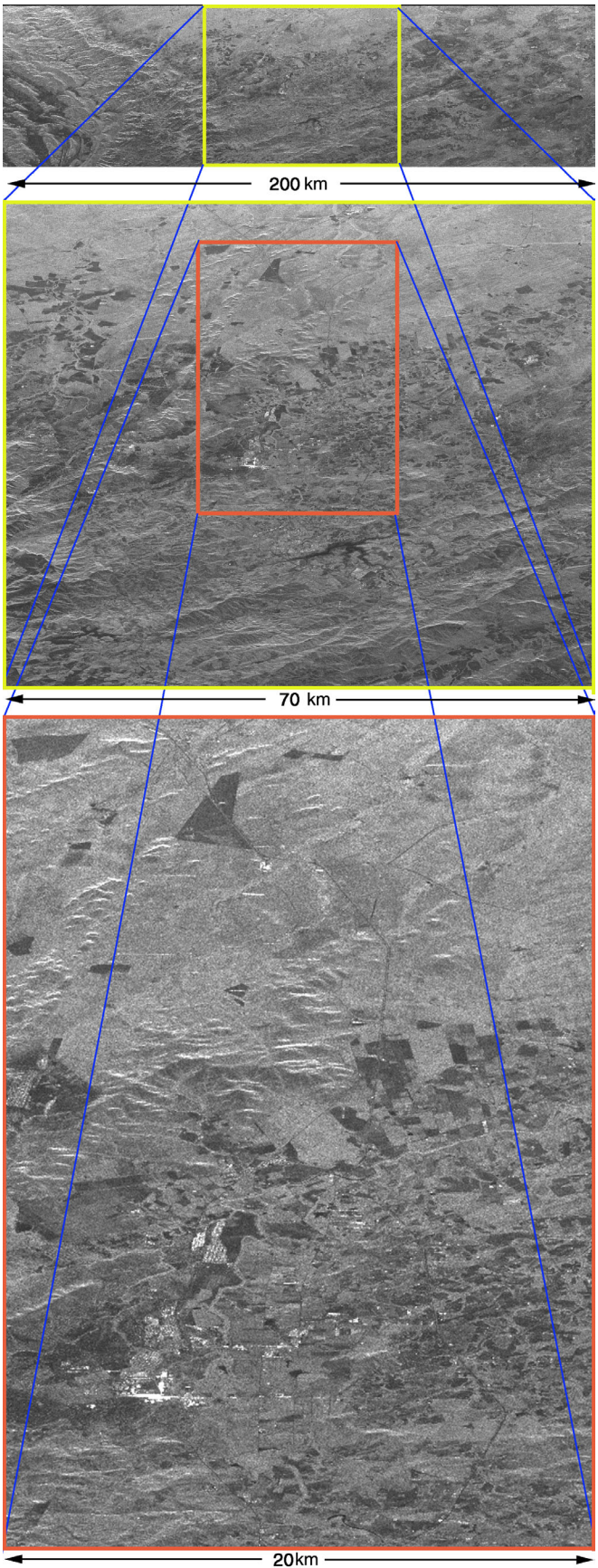
- The ALOS Kyoto and Carbon Initiative has been approved by NASDA as a high priority objective for the ALOS program. This initiative will provide for repeated systematic measurements of forest cover for most of the Earth's land mass.
- It has become clear in the past year that using SAR interferometry to measure forest structure such as tree height (see the work by Treuhaft, Hensley, and Siqueira) is feasible. Through the ALOS K&C science advisory panel, we are encouraging NASDA to adopt a "Vegetation" baseline (in addition to a "Deformation" baseline) for the ALOS orbit during portions of the mission. The addition of a vegetation baseline will enable the ALOS K&C initiative to provide a valuable dataset.

New products:

- CDROM of pantanal imagery (as well as central America) was produced (5000 copies), and distributed worldwide.

Conclusions

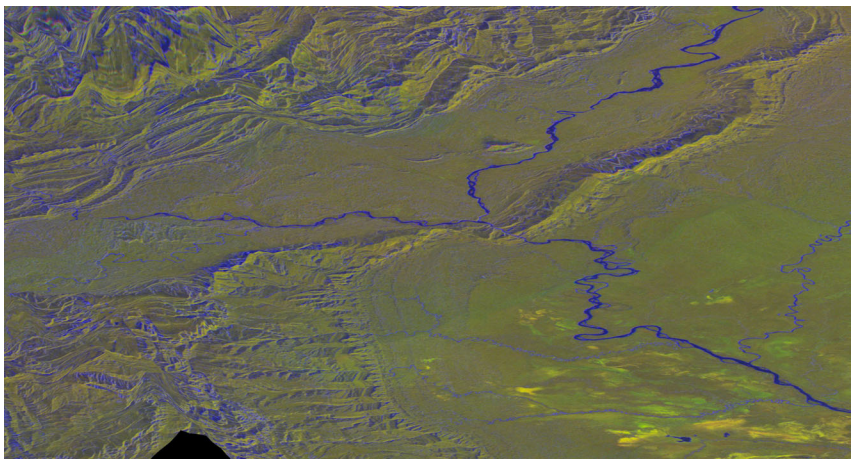
Now that a significant fraction of the data has been processed, we are now estimating coregistration and calibration errors in anticipation of the mosaicking of the data. We have submitted for publication two papers related to these activities, as well as some conference presentations. We expect to collaborate again with NASDA in producing a cdrom or dvd of these data once mosaicked and calibrated, and to publish our classification results.



Submitted Journal Papers:

"The Co-registration, Calibration, and Interpretation of Multiseason JERS-1 SAR Data over South America", P. Siqueira, B. Chapman, and G. McGarragh, submitted to RSE.

"The use of JERS-1 imagery for delineating seasonally inundated humid tropical forest in a GIS",



V. Datadin, B. Chapman, and E. Helmer, submitted to Geocarto International.

Figure 2: Visualization of ra
GTOPO30 DEM.

Figure 1: One quarter of one JERS-1 SAR track over southern Africa