Generation of Global High-Resolution Mosaic Dataset & Forest/Non-Forest Map using ALOS PALSAR Data

Takuya ITOH\textsuperscript{1}, Shinichi Sekioka\textsuperscript{1}, Hayato Okumura\textsuperscript{1}, Yutaka Wada\textsuperscript{1}, Tsutomu Yamanokuchi\textsuperscript{1}, Akira Mukaida\textsuperscript{1}, Nicolas Longépé\textsuperscript{2}, Preesan Rakwatin\textsuperscript{2}, Osamu Isoguchi\textsuperscript{2} and Masanobu Shimada\textsuperscript{2}

\textsuperscript{1} Remote Sensing Technology Center of Japan (RESTEC)
\textsuperscript{2} Japan Aerospace eXploration Agency (JAXA)

Table of Contents

• Background and Motivation
• Generation of Global Mosaic Dataset Using ALOS PALSAR Data
• Forest/Non-Forest Classification Using Global Mosaic Dataset
• Future Plan for ALOS PALSAR Dataset
• Summary
Background and Motivation

Strong requirements for monitoring of...
- Environmental conventions
- Carbon cycle science
- Conservation of the environment
  <Kyoto protocol and REDD+>

Forest monitoring is necessary.
- Deforestation
- Quantification of carbon stocks and biomass

Advantage of satellite remote sensing in forest monitoring.
- Globally covered
- Equal quantity
- Repeat observation

Satellite is very useful for forest monitoring.
ALOS PALSAR

ALOS: Japanese Earth Observation Satellite
- Launch date: Jan 24th 2006
- Orbit: Sun-Synchronous
- Repeat Cycle: 46 days
- Altitude: 691.65 km (at Equator)

PALSAR: L-band SAR sensor
- L-band (1,270MHz)
- Approximately 10m resolution
- Polarization: HH, HV, VH, VV

SAR is less affected by weather condition. L-band long length microwave penetrate forest canopy and backscatter tree trunk. Thus, it’s able to observe tree trunk related to biomass.
= Useful for forest monitoring

Generation of Global Mosaic Dataset Using ALOS PALSAR Data
10m Resolution Mosaic Image of ALOS PALSAR

R: HH, G: HV, B: HH/HV

10m Resolution Global Mosaic Dataset of ALOS PALSAR

- In 2007 & 2009
- The Data acquired between Jun. & Sep.
- 10m High-Resolution
- Ortho-rectification applied
- Slope correction applied using SRTM-3 (GTOPO30 for above 60 deg.)
- Polarization: FBD HH, HV
Slope Correction

Radiometrically corrected for local incidence angle to suppress the distortion due to the topographic undulation.

Forest/Non-Forest Classification Using Global Mosaic Dataset
Forest/Non-Forest Classification

• Using 10m high-resolution Global Mosaic dataset.
• FBD, HH + HV
• Object-based classification method by eCognition software (Trimble, Germany)

Object-Based Classification

Amazon, Forest and Deforestation area

High-resolution SAR image contains speckle noise.

Difficult to apply pixel-based classification

Need to apply object-based classification method

PALSAR Color image (R:HH, G:HV, B:HH)

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Object-Based Classification

Image was devide into objects which have similar feature.

Each object have following statistics.

• Average value of pixels
• Standard deviation of pixels
• Number of pixels
↓
Use these information for classification
Object-Based Classification

Each object was classified Forest/Non-Forest using statistics.

Object-Based Classification

Classification Rule using Gamma-Naught of PALSAR HH and HV
- Above -14dB: Forest
- Below -14dB: Non-Forest

Classify each object applied this rule.
Object-Based Classification

Classified Forest
Non-Forest using object-based classification method

Monitoring of deforestation and forest degradation

Global Forest/Non-Forest Map

- Tropical Rain Forest: Amazon, Central Africa, South East Asia
- Temperate Forest: Monsoon Asia, North America, Europe
- Boreal Forest: North America, Siberia, North Europe
Classification Accuracy

We used DCP as a validation point for this product.

- DCP: Degree Confluence Project
  
  - Ground truth data at each of the latitude and longitude integer degree intersections in the world. (Take pictures at each location.)

(Reference: http://confluence.org/)

Classification accuracy compared with DCP was 84% higher than conventional satellite-based land cover classification map*.

However...

Most validation point of DCP is in non-forest area.

- Forest area: 124 points
- Non-Forest area: 385 points

We need more validation points in Forest area.

Future Plan for ALOS PALSAR Dataset

Time Series Dataset

- Also create 1990’s dataset using JERS-1 SAR data.

↓

Monitoring of Deforestation and Forest Degradation in long terms.
Monitoring Deforestation
Rondonia, Amazon
Ex: long term deforestation monitoring

Comparison between ALOS PALSAR and JERS-1 SAR

Possible to quantify deforestation
Future Plan to Estimate Biomass & Carbon Stocks

• Estimate Global Biomass and Carbon Stocks using Forest/Non-Forest map.
• Improve classification accuracy of Forest/Non-Forest area.
• Increase category of classification

Summary

• Global 10m-resolution Mosaic Dataset has been created using ALOS PALSAR data.
• Global Forest/Non-Forest Map: accuracy of 84%.
• Plan to create time series dataset using PALSAR and JERS-1 SAR.
• Plan to estimate Carbon Stocks & Biomass using classification results.

* This study was done by RESTEC under the contract with JAXA
Thank you