The Gambia and Boreal Forest

Multi-purpose use of ALOS PALSAR-1 data
Objective

The objective is to demonstrate, at country-level, the multi-purpose use of ALOS PALSAR-1 data, particularly of multi-year ALOS PALSAR-1 Intensity data and their synergetic use with other spaceborne SAR data, conditio sine qua non for the provision of accurate and complementary products. In this framework, following products are targeted:

• Digital Elevation Model
• Forest map
• Forest biomass map (to be completed)
• Cultivated area map
Malawi, refer to K&C 18
Malawi, Forest map

Multi-year PALSAR-1 HH-HV during dry season
Cultivated Area product - PALSAR-1 HH-HV + ASAR HH-HV

Multi-year PALSAR-1 HH-HV during dry season

ASAR HH PALSAR HV ASAR HH
ASAR data acquired during wet (crop) season

Cultivated Area (15m)
## Validation

<table>
<thead>
<tr>
<th></th>
<th>forest</th>
<th>sparse veg</th>
<th>other</th>
<th>Total</th>
<th>Omission error (%)</th>
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<td>9</td>
<td>overall accuracy 87%</td>
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**ALOS PALSAR-1 HH-HV, dry season**

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<tr>
<th></th>
<th>forest</th>
<th>sparse veg</th>
<th>other</th>
<th>Total</th>
<th>Omission error (%)</th>
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<tr>
<td><strong>Total</strong></td>
<td>390</td>
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<tr>
<td><strong>Commission error (%)</strong></td>
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<td>9</td>
<td>overall accuracy 91%</td>
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**ALOS PALSAR-1 HH-HV, dry season**

+ **ASAR HH-HV, wet season**
Coherence vs. Intensity

PALSAR-1 HH coherence during dry season

PALSAR-1 HV coherence during dry season

Multi-year PALSAR-1 HH-HV intensity during dry season
The Gambia
Multi-year, Multi-sensor Approach

multi-year ALOS PALSAR-1

- grouping of the data according to:
  - pre-crop (or dry) season
  - crop (or wet) season
  - whole season

- computation of temporal features for:
  - pre-crop (or dry) season
  - crop (or wet) season
  - whole season

knowledge based classification

Land Cover Map

multi-year ENVISAT ASAR

- grouping of the data according to:
  - pre-crop (or dry) season
  - crop (or wet) season
  - whole season

- computation of temporal features for:
  - pre-crop (or dry) season
  - crop (or wet) season
  - whole season
Multi-year, Multi-sensor mosaic at 1 hectare

ALOS PALSAR-1 ScanSAR HH pre-crop
ENVI SAT ASAR Wide Swath HH pre-crop
ENVI SAT ASAR Wide Swath HH span
Agricultural Extent at 1 hectare
Multi-year, Multi-sensor mosaic at 15 meter

- ALOS PALSAR-1 mean HV pre-crop season
- ENVISAT ASAR mean HH pre-crop season
- ENVISAT ASAR HH difference crop and pre-crop season
Land Cover Map at 15 meter

Agricultural area
Mangrove - Sandbanks
Water
Bare soil-weak vegetation (low biomass)
Medium vegetation (medium biomass)
Strong vegetation (high biomass)
Cultivated Area at 3 meter (Cosmo-SkyMed StripMap)
2002-12 Vegetation Productivity Index for agricultural area at 250 m

- The VPI has been derived from Aqua and Terra MODIS 250m every 8 days from 2002 to 2012
- It is relative to Mid September (approximately peak of season) of each year
Ionospheric Effects at L-band 1/3

Fine Beam Single

Fine Beam Dual (HH)
Ionospheric Effects at L-band 2/3

Fine Beam Single

Fine Beam Dual (HH)
## Ionospheric Effects at L-band 3/3

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* mission until April 2011

Nights acquisitions: ionospheric effects should be reduced!
Boreal forest
TSX-Tandem $\sigma^o$
TSX-Tandem coherence

$\gamma > 0.9$
TSX-Tandem - InSAR data characteristics

- Spatial resolution: 5 m
- \( 2\pi \) phase ambiguity: 125 m
- Average coherence forest: > 0.9
- Theoretical height std dev at 1 look: 6.7 m
- Theoretical height std dev after processing: 4 m
- Acquisition time: February 2012
TSX-Tandem - Estimated forest height, February 2012
ALOS PALSAR-1 FBS - InSAR data characteristics

- Spatial resolution: 10 m
- $2\pi$ phase ambiguity: 25 m
- Average coherence forest: > 0.7
- Theoretical height std dev at 1 look: 4 m
- Theoretical height std dev after processing: 2.5 m
- Acquisition time: August-October 2006
ALOS PALSAR-1 FBS - Estimated forest height, Aug-Oct 2006
TSX-Tandem - InSAR data characteristics

- Spatial resolution 5 m
- $2\pi$ phase ambiguity 285 m
- Average coherence forest > 0.85
- Theoretical height std dev at 1 look 15 m
- Theoretical height std dev after processing 12 m
- Acquisition time May 2012
TSX-Tandem - Estimated forest height, May 2012
Estimated forest height - Comparison

in situ  TSX May 12  TSX February 12  PALSAR-1 Aug-Oct
TSX-Tandem - InSAR data characteristics

- Spatial resolution: 5 m
- $2\pi$ phase ambiguity: 26 m
- Average coherence forest: $> 0.85$
- Theoretical height std dev at 1 look: 2 m
- Theoretical height std dev after processing: $> 1$ m
- Acquisition time: May 2013
TSX-Tandem - Estimated forest height, May 2013
Estimated forest height - Comparison

in situ  TSX May 2013
Estimated forest height - Consideration

- A final consideration is on the accuracy of the terrestrial measurements: these are unknown. It is, however, well known that:

  - In forestry, in particular in dense close canopy, the GPS X-Y location is typically inaccurate (several tens of meters): this depends upon the foliage coverage, device, amount of available GPS, atmosphere, and processing software. All this information is not available. Moreover, human errors may occur as shown in the next slide (note that this location is where the inferred TSX height is higher than the GCP one!).

  - In (simple) dense close canopy in deciduous forest conditions (as in this case), terrestrial forest height estimations are typically overestimated by 10 to 20%.
Conclusions - Malawi and The Gambia

• The use of multi-year ALOS PALSAR-1 intensity data provide a high data quality (in terms geometry and radiometry) if compared to single-date intensity or interferometric SAR data.

• Multi-year ALOS PALSAR-1 intensity data are doubtless valuable for forest and environmental applications. However:
  o depending on the geographical area, environmental conditions, and period of the year, data must be selected, processed, and used accordingly;
  o SAR data synergy is conditio sine qua non to enhance the product quality.
Conclusions - Forest height estimation - preliminary considerations

• Baseline and particularly acquisition date (winter acquisitions) play a key role, especially if the forest consists of deciduous and coniferous trees.

• A final consideration is on the accuracy of the terrestrial measurements: these are still unknown. It is, however, well known that:

  • In forestry, in particular in dense close canopy, the GPS X-Y location is typically inaccurate (several tens of meters): this depends upon the foliage coverage, device, amount of available GPS, atmosphere, and processing software. All this information is not available. Moreover, human errors may occur as shown in the next slide (note that this location is where the inferred TSX height is higher than the GCP one!).

  • In (simple) dense close canopy in deciduous forest conditions (as in this case), terrestrial forest height estimations are typically overestimated by 10 to 20%.
Acknowledgments

• The **Japanese Aerospace Exploration Agency** is acknowledged for the provision of ALOS PALSAR-1 data.

• The **European Space Agency** is acknowledged for the provision of ENVISAT ASAR data and to financially support the work performed in The Gambia.

• The **Italian Space Agency** is acknowledged for the provision of Cosmo-SkyMed data.

• The **German Space Agency** is acknowledged for the provision of TerraSAR-X Tandem data.

AN OPERATIONAL REMOTE SENSING BASED SERVICE FOR RICE PRODUCTION ESTIMATION AT NATIONAL SCALE

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Mirco Boschetti², Giacinto Manfoni³, Pietro Alessandro Brivio³
Eduardo Jimmy Quilang⁴, Mary Rose Obico⁴, Vo Quang Minh⁵, Diem Phan Kieu⁵, Quyen Nguyen Huu⁶
Touch Veesa⁷, Amornat Intran⁷, Pak Wahyunto⁸, Sellapenumal Pazhanivelan⁹

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Abstract — One goal of the Remote Sensing based Information and Insurance for Crops in emerging Economies (RIICE) project is to estimate, on an operational basis, rice production at national scale in primis targeted to food security and crop insurance purposes. There are two unique elements to this proposed service:

1. Multi-year, annual, and seasonal SAR data are acquired from all existing operational spaceborne systems are used and complemented by MODIS 250/500 m 16/8-days composite data. This solution:
   - overcomes the spatial-temporal problem, hence assuring an appropriate temporal repetition at an adequate scale (i.e. spatial resolution) even over large areas;
   - provides sensor independent operational monitoring with sufficient data redundancy to ensure information delivery.

2. A crop growth simulation model estimates yield and hence production using dedicated remote sensing products in farms. Rice has been cultivated for over 10,000 years, mostly in Asia but with increasing importance in Africa and Latin America as well as pockets of production in Europe, Australia and the US. The development of short duration varieties for irrigated conditions means that rice can be grown continuously in the humid and sub humid tropics with up to three harvests a year —on the same plot of land. 75% of the world’s rice is cultivated under irrigated conditions on some 93 m ha. Rice is also cultivated in rainfed lowland, upland, mangrove, and deepwater environments albeit with lower productivity.

2. Rice systems are characterized by seasonally-dependent spatio-temporal variations. After field preparation (plowing, harrowing and leveling) the field will usually be irrigated, and later rice will be transplanted (as young
Satellite images map rice damage from typhoon

Satellite images showing flooded rice farms and buildings that were damaged by Typhoon Haiyan (local name Yolanda) in the northwest part of Luzon Province have been released as part of ongoing work to track rice production in the Philippines.

The rapid-release Sentinel-1A images, developed by the International Rice Research Institute in collaboration with the Department of Agriculture, Philippine Rice Research Institute (DA-PhilRice), were released to provide a quick assessment of the extent of the damage and to support a damage assessment mission, led by Dr. Mario de Serpa, the Special Adviser on Operations and National Rice Program Coordinator of the Centre for International Rice Research.

"The release of these images will also validate the DA's rice production monitoring and assessment in the country, which will be greatly enhanced with this ongoing project between DA and JAXA," said Dr. Mario de Serpa, the Special Adviser on Operations and National Rice Program Coordinator of the Centre for International Rice Research.

One map that showed rice fields that were flooded also showed which fields were harvested before the typhoon struck. A second map revealed soft soils and damage to buildings and other infrastructure, suggesting that harvesters that was in storage was also likely damaged from wind, rain, and storm surges.

"The availability of data collected just before the typhoon will help farmers to make informed decisions about what to plant next season," said Dr. Mario de Serpa. The maps are based on synthetic aperture radar (SAR) images processed by sarmap in the days after the typhoon. The data were provided by ALOS-2/GEOSS from COOOGI (Spain) and by Infoterra GmbH from the TerraSAR-X satellite.

"This technology is essential to provide all available SAR platforms to monitor development," said Dr. Mario de Serpa. "A close cooperation with the various space agencies and their data providers is crucial to plan and acquire SAR data in the best possible way. Future satellite missions, such as Sentinel-1A, will significantly contribute to rice crop monitoring."

Leyte is one study area within the Remote Sensing-based Information and Insurance for Crops in Emerging Economies (RICE) project, where IIRR, IRRI, and CGIAR-CSI work with the German Development Cooperation (GIZ), Alliance, and the Asia Development Agency (ADAO) to develop technologies that monitor rice growing areas for food security and crop insurance applications. The consortium was able to map not just the flood-affected areas, but also the status of the rice crop when the typhoon struck.

IIRR's Dr. Mario de Serpa noted that the maps underpin what the consortium's work.

"With the satellite maps, we are able to understand the extent of Typhoon Yolanda's damage to rice production and, hopefully, improve our response to the situation," said Dr. Mario de Serpa.

IRRI and sarmap are also doing larger-term research to monitor rainfall and land use in the Philippines.

The research behind these data was supported by the DA's Flood Staple Sufficiency Program (FSSP), the TDC-funded RICE, and the Global Rice Science Partnership through the CGIAR Research Program on Rice.
Satellite Maps Show Extent of Typhoon’s Wrath on Philippine Rice

By YSI Staff

As part of efforts to help the Philippines recover from the massive damage wrought by Typhoon Haiyan, several of the country’s research institutes have jointly released satellite images showing rice farms flooded by the storm.

The maps, based on radar images provided by the European Space Agency, show the most affected part of the country’s rice belt in the central Luzon region. According to the National Disaster Risk Reduction and Management Council, the typhoon caused massive damage to rice, corn and sugar cane. As it works to rebuild, the government has declared the rehabilitation of the agricultural sector its top priority.

In addition to the huge loss of life and property caused by Typhoon Haiyan, the Philippines witnessed severe damage to agricultural crops such as corn, sugar cane, and coconut. As it works to rebuild from the disaster, it will face equally daunting challenges in bringing the agricultural sector back to life — something that is quickly needed if the country is to feed the estimated 2.5 million people in need of food assistance.