The Gambia and Boreal Forest

Multi-purpose use of ALOS PALSAR-1 data

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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

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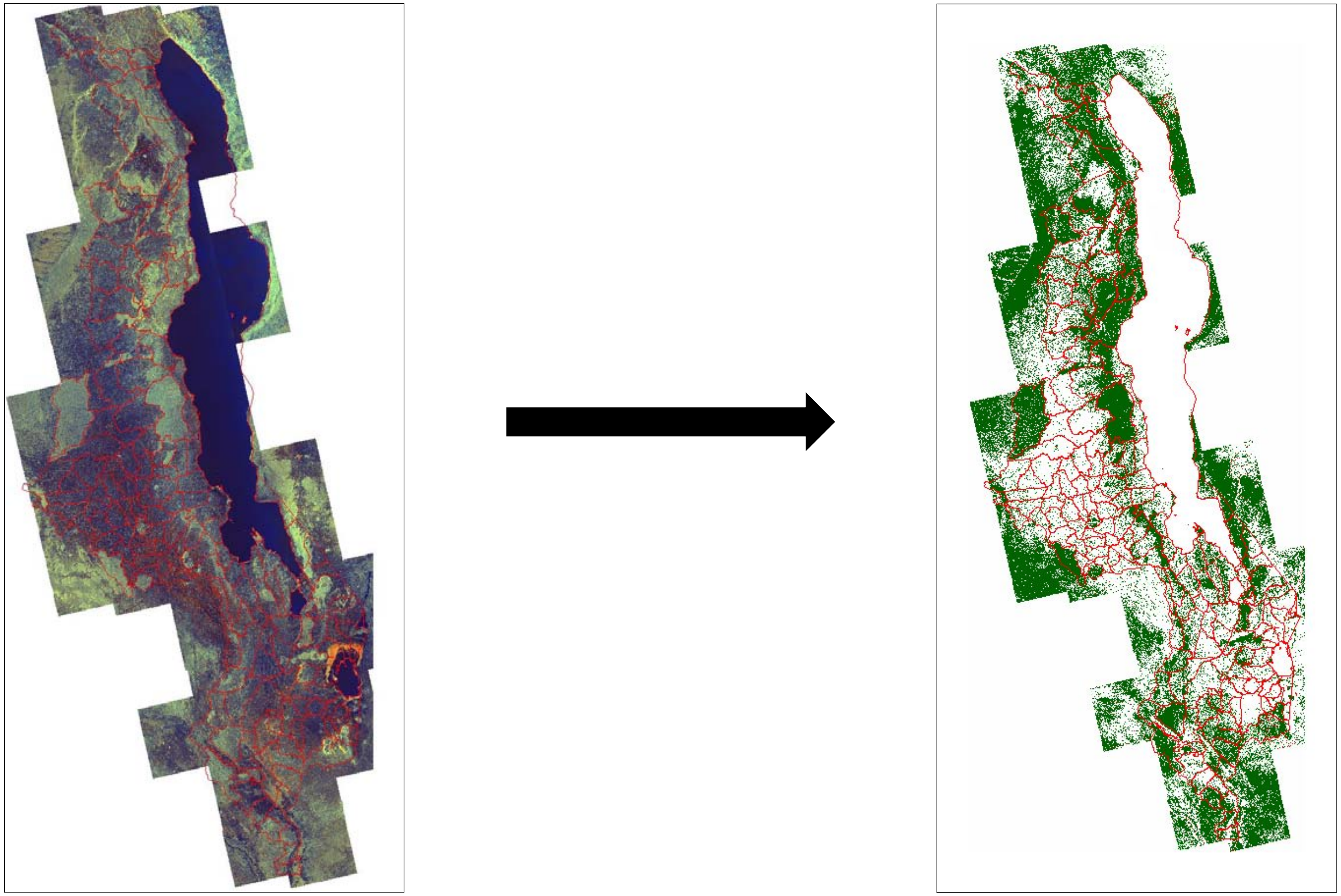
Malawi, Forest map



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

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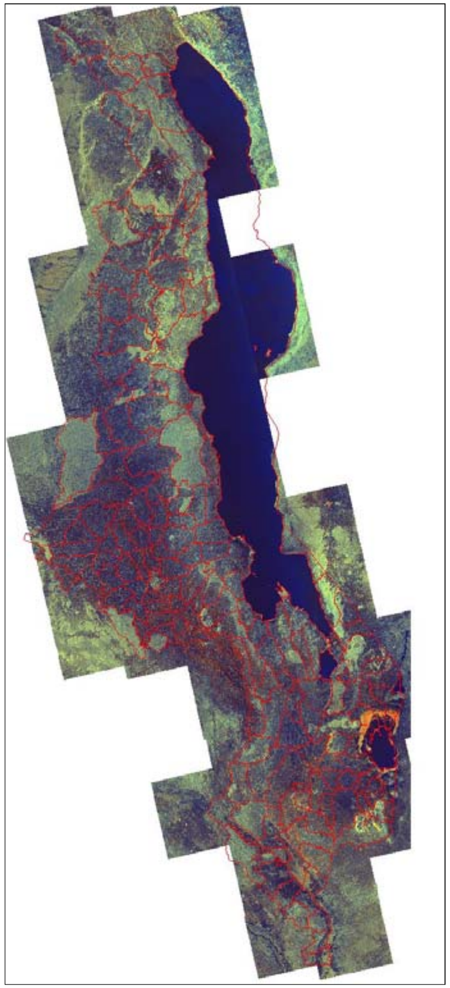
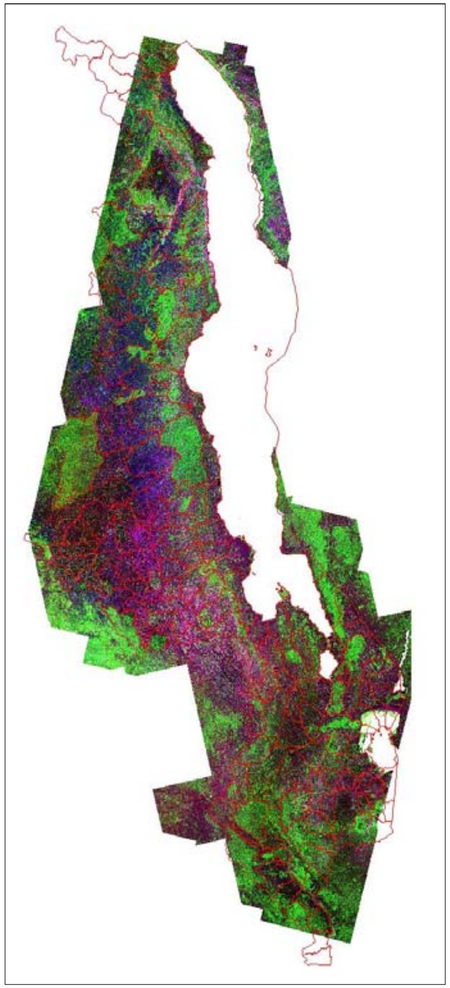
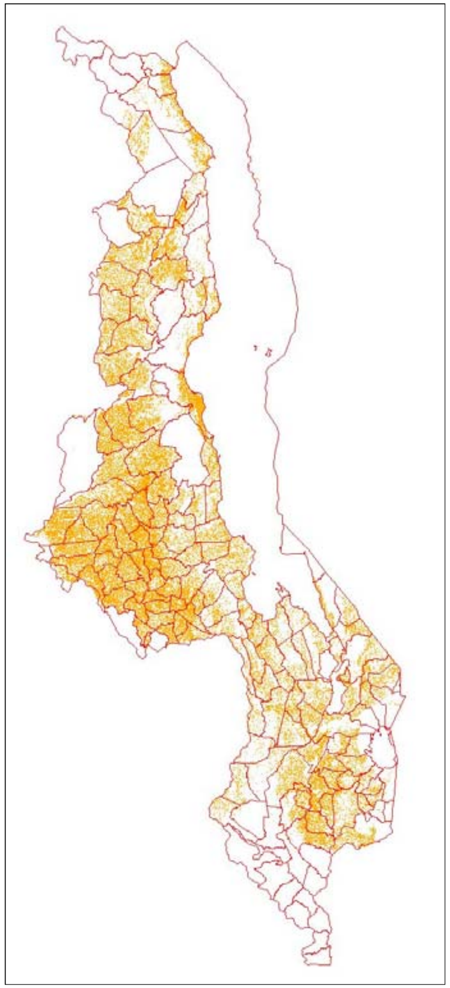
Cultivated Area product – PALSAR-1 HH-HV + ASAR HH-HV



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

	forest	sparse veg	other	Total	Omission error (%)
Urban	10	0	10	20	50
Sugarcane	19	3	7	29	76
Crop	42	0	347	389	11
Forest	365	0	37	402	9
Other	1	0	27	28	4
Total	437	3	428	868	**K-coeff 0.75**
Commission error (%)	16	0	9	**overall accuracy 87%**	

ALOS PALSAR-1 HH-HV, dry season

	forest	sparse veg	other	Total	Omission error (%)
Urban	10	0	10	20	50
Sugarcane	10	3	16	29	45
Crop	12	0	377	389	3
Forest	357	0	45	402	11
Other	1	0	27	28	4
Total	390	3	475	868	**K-coeff 0.82**
Commission error (%)	8	0	9	**overall accuracy 91%**	

ALOS PALSAR-1 HH-HV, dry season

+

ASAR HH-HV, wet season

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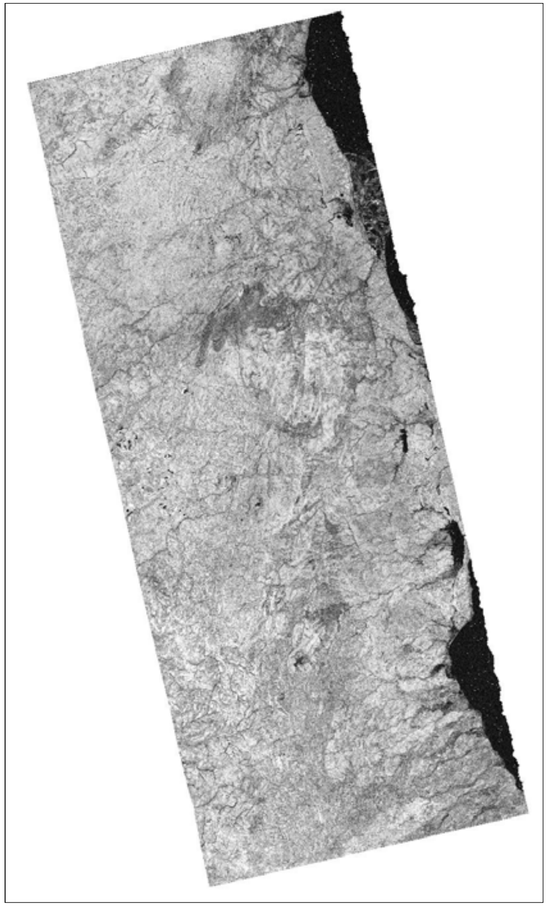
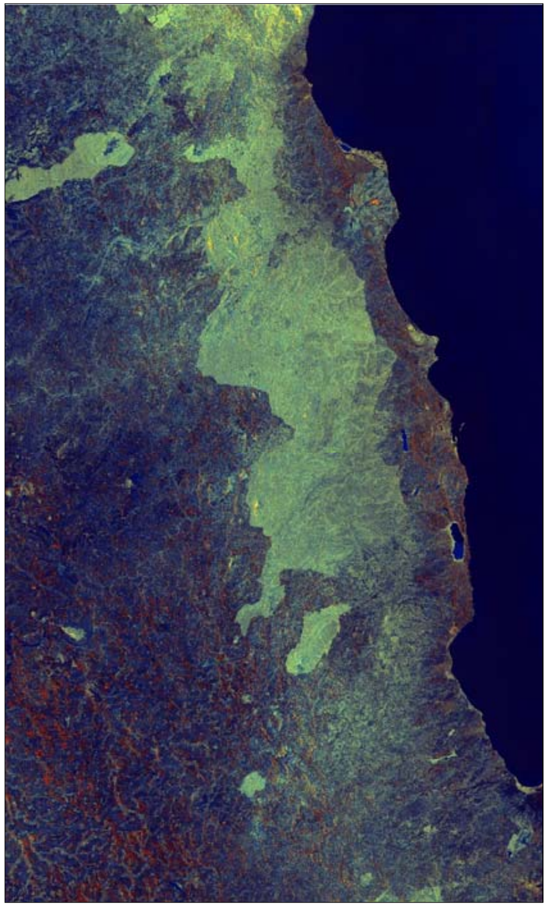
Coherence vs. Intensity



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

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

knowledge based classification

Land Cover Map

data

processing

products

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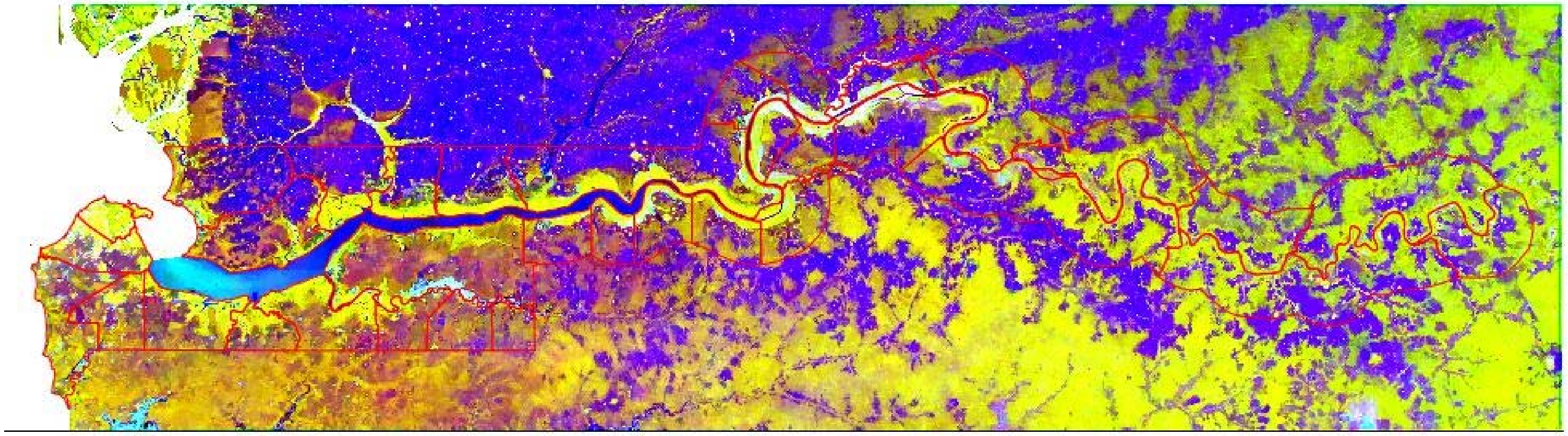
Multi-year, Multi-sensor mosaic at 1 hectare



ALOS PALSAR-1 ScanSAR HH pre-crop

ENVISAT ASAR Wide Swath HH pre-crop

ENVISAT ASAR Wide Swath HH span

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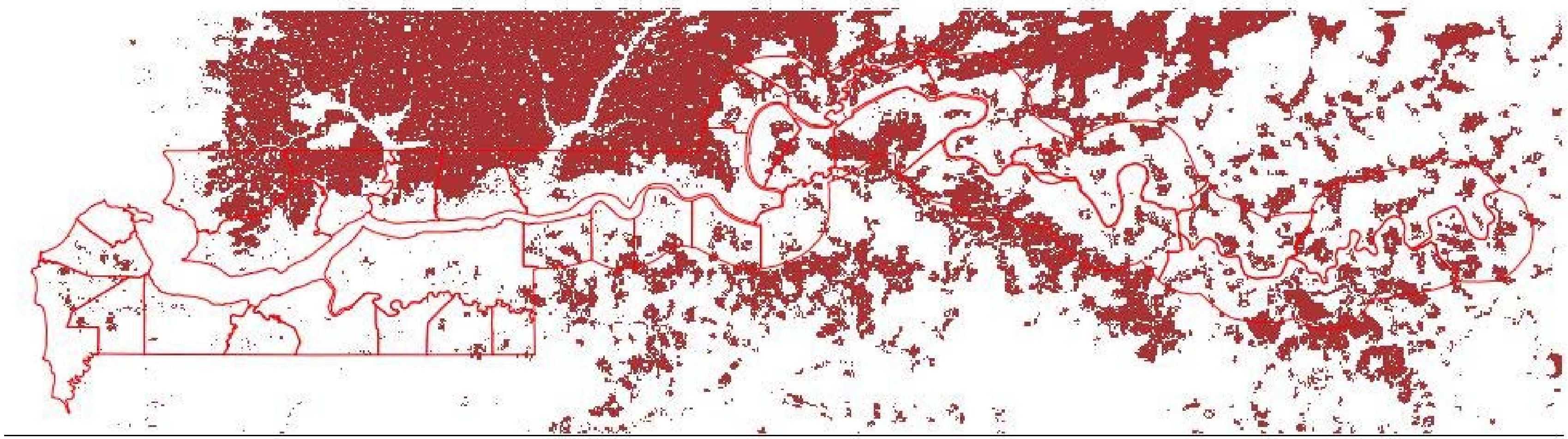
Agricultural Extent at 1 hectare



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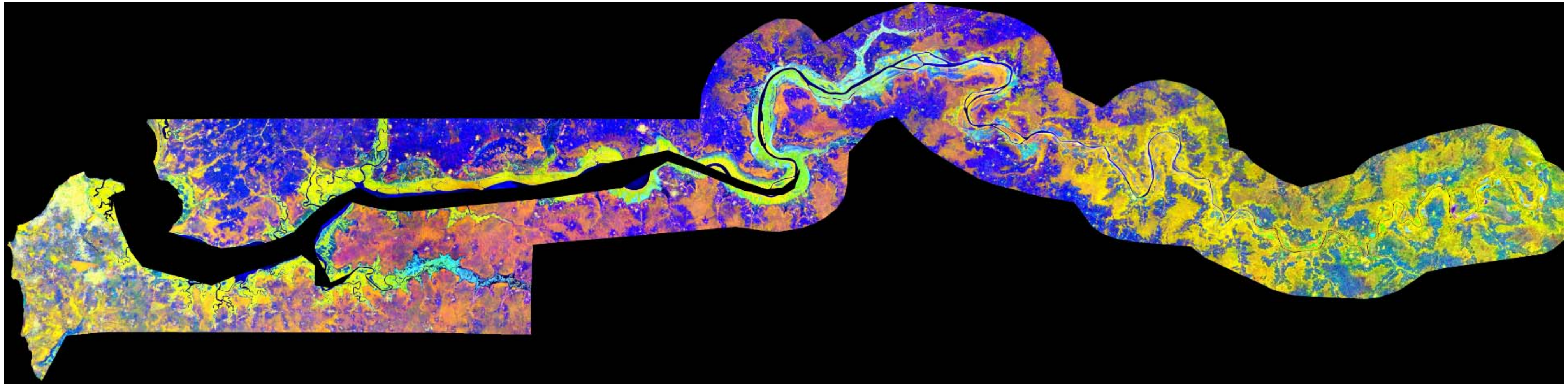
Multi-year, Multi-sensor mosaic at 15 meter

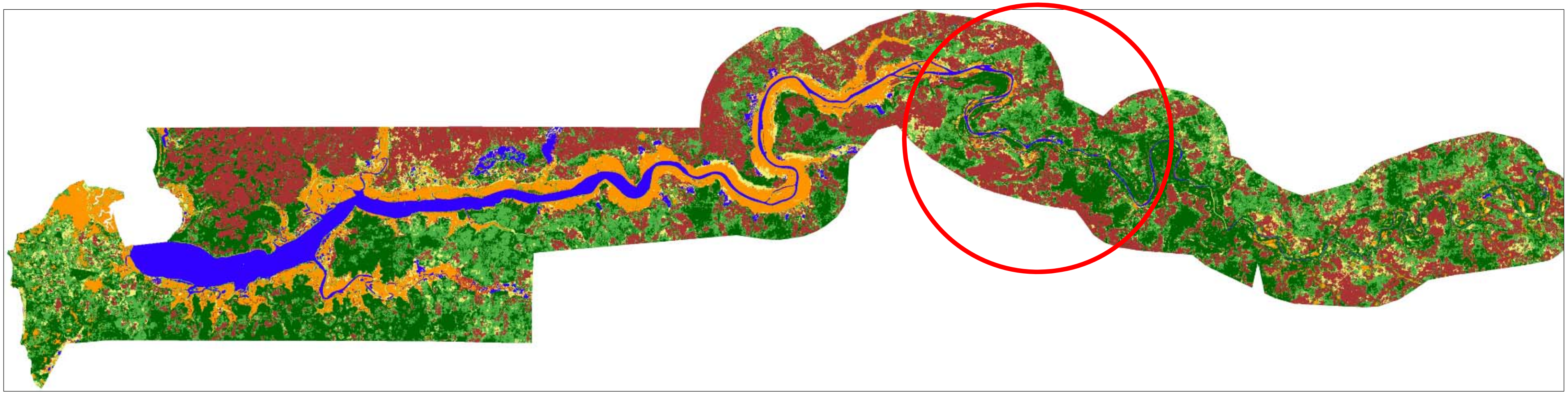


ALOS PALSAR-1 mean HV pre-crop season

ENVISAT ASAR mean HH pre-crop season

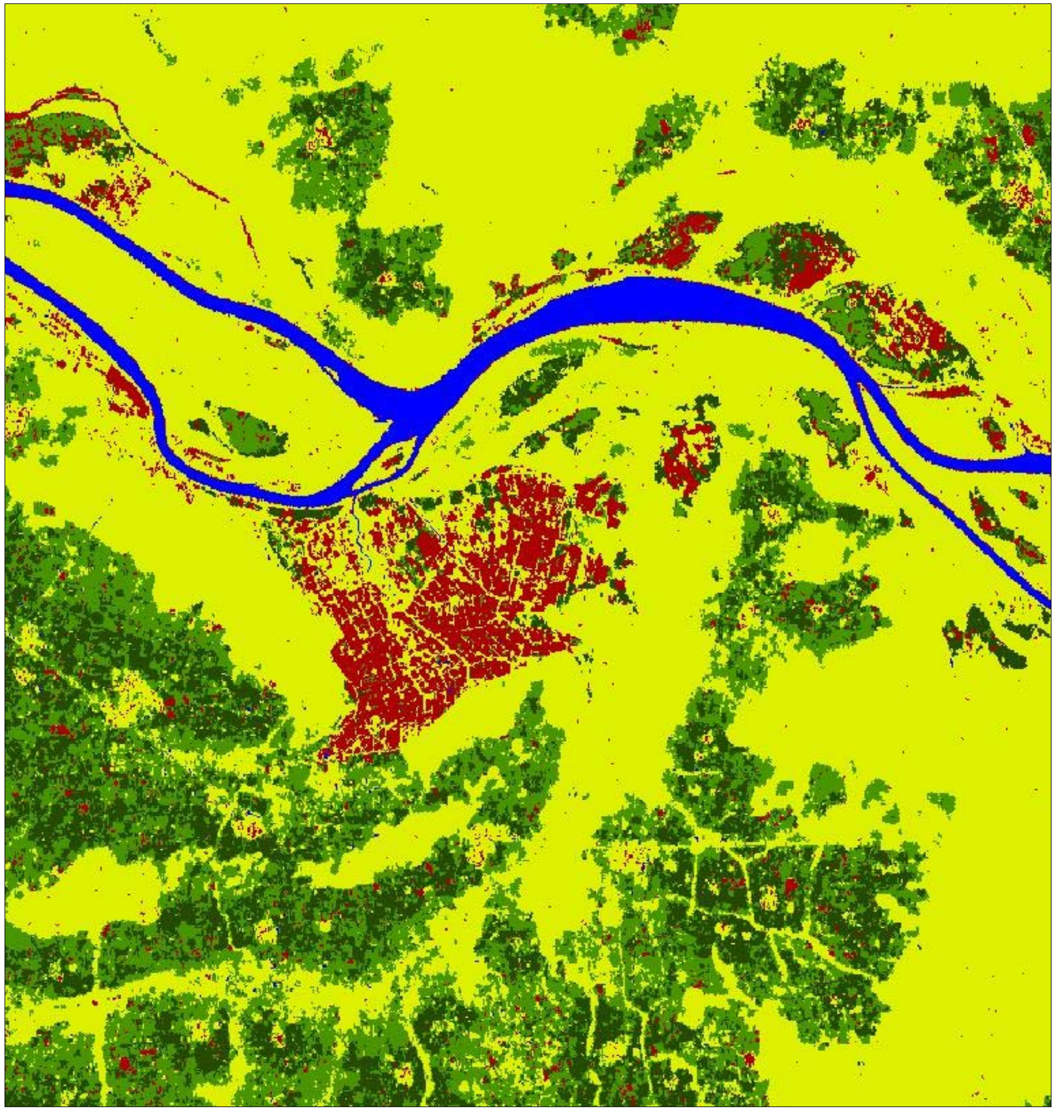
ENVISAT ASAR HH difference crop and pre-crop season

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)



Rice
Crop 1
Crop 2
Water
Forest

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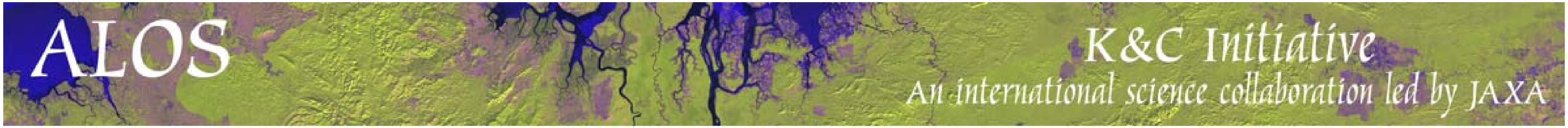
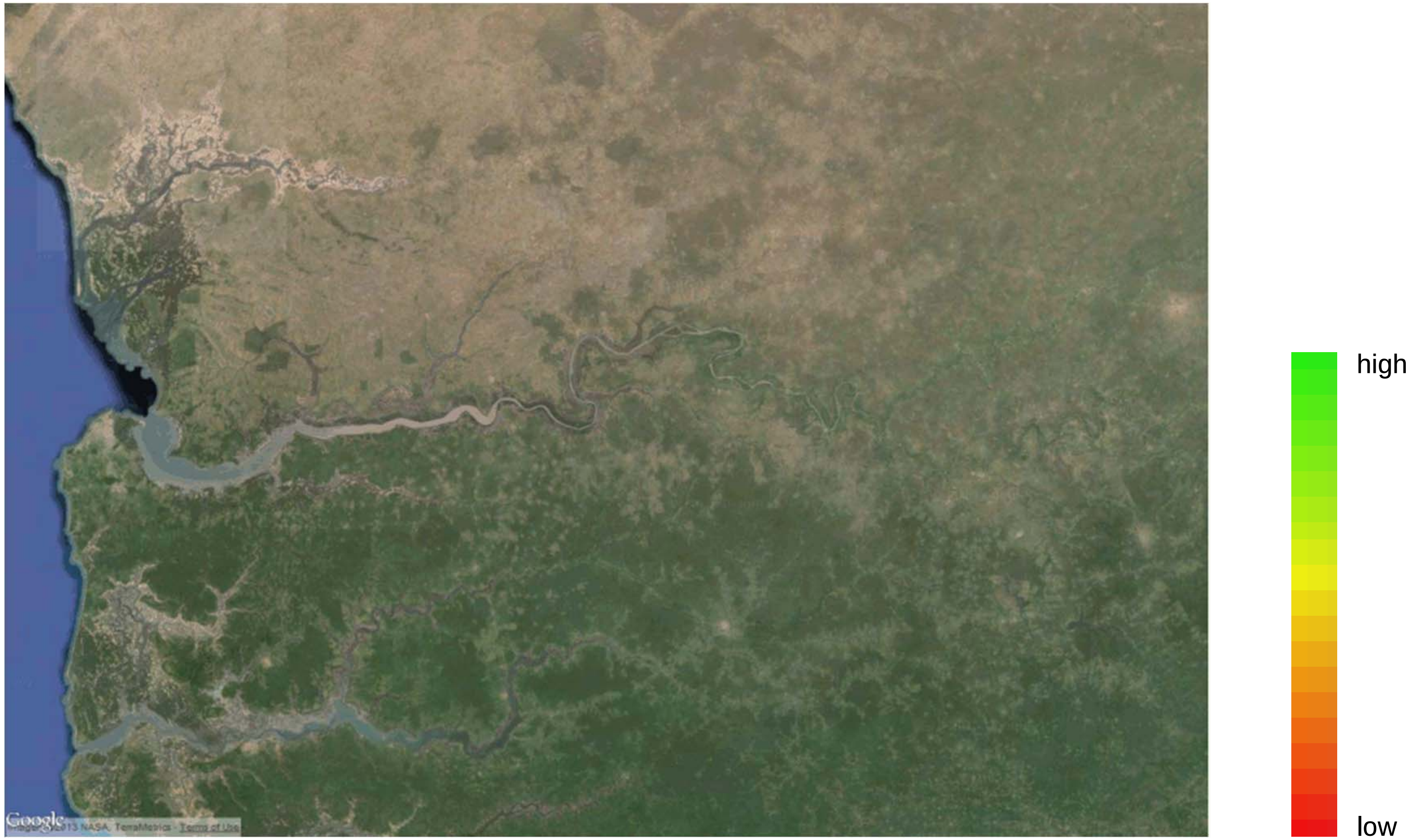
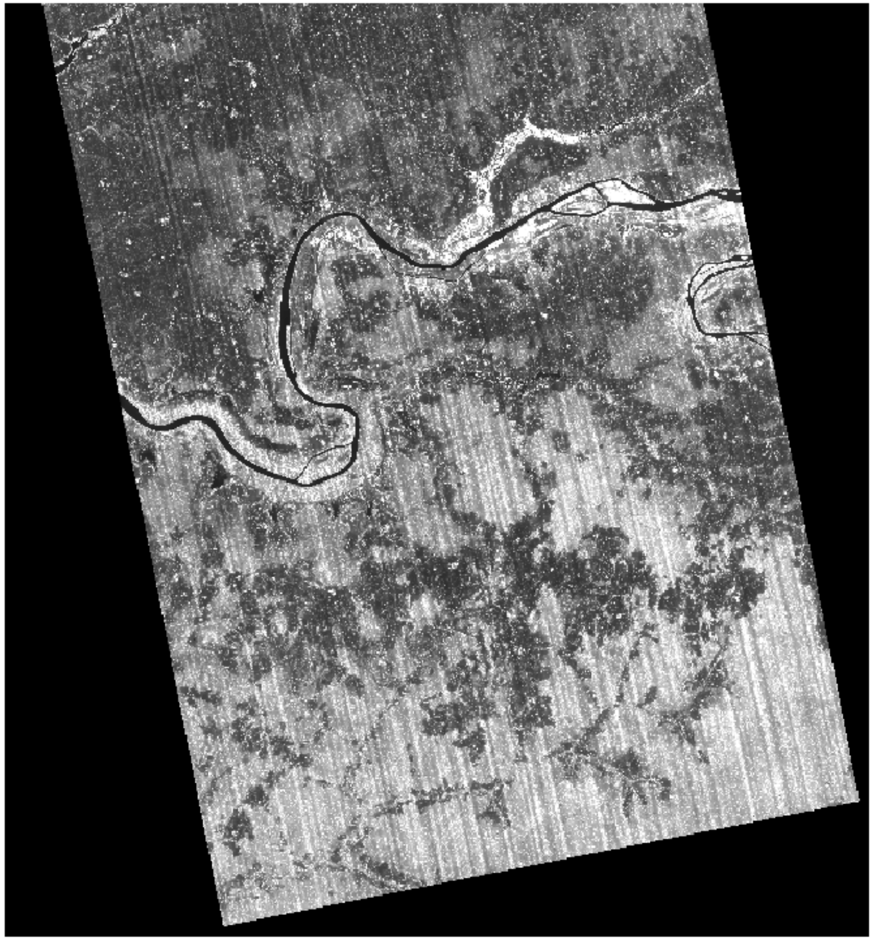


2002-12 Vegetation Productivity Index for agricultural area at 250 m

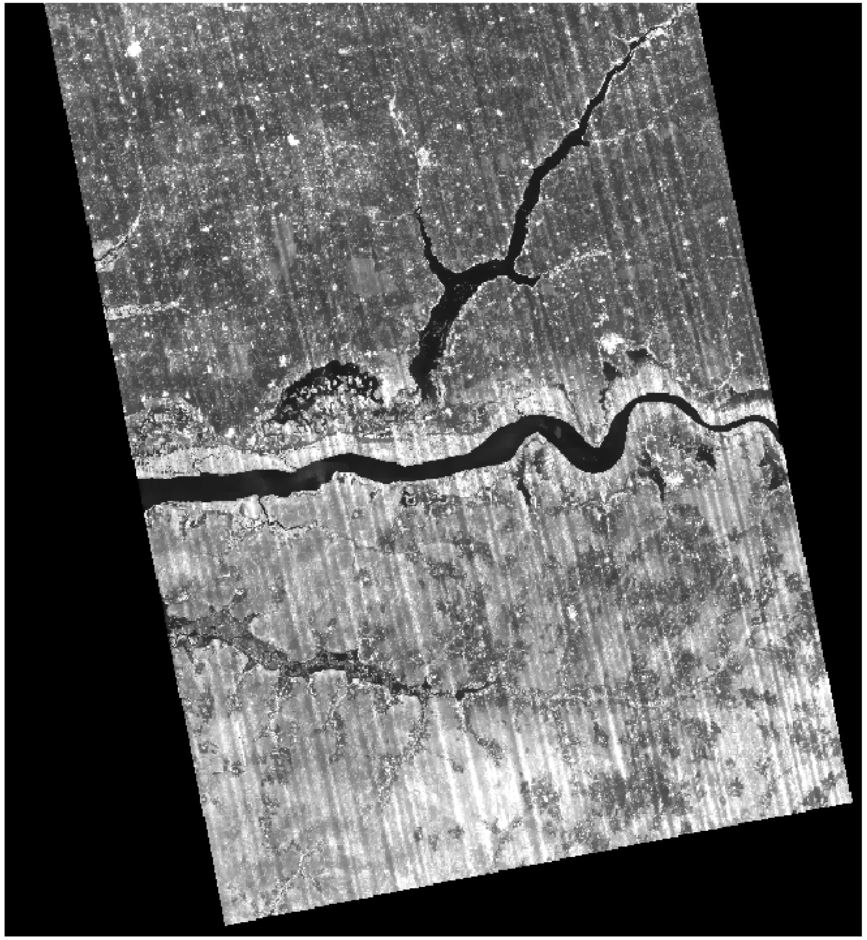


- The VPI has been derived from Aqua and Terra MODIS 250m every 8 days from 2002 to 2012
- It is relative to Mid September (approximately peak of season) of each year

Ionospheric Effects at L-band 1/3



Fine Beam Single

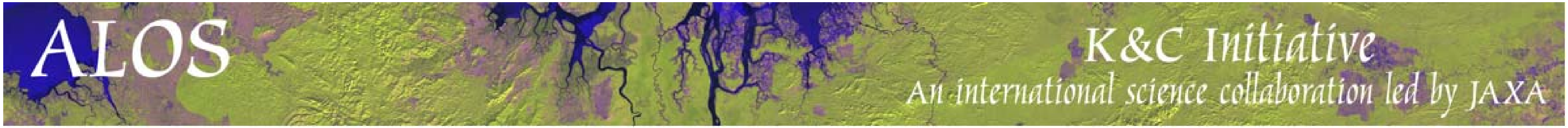


Fine Beam Dual (HH)

Ionospheric Effects at L-band 2/3

Fine Beam Single

Fine Beam Dual (HH)



Ionospheric Effects at L-band 3/3

Month \ Year	2007		2008		2009		2010		2011		Total		
	n	not OK	n	not OK	n	not OK	n	not OK	n	not OK	n	not OK	%
Jan	6	2	8	0	6	2	6	4	6	6	32	14	43.75
Feb	6	2	6	2	6	0	6	2	4	2	28	8	28.57
Mar	2	2	6	6	4	2	6	2	4	0	22	12	54.55
Apr	0	0	6	2	0	0	6	0	0	0	12	2	16.67
May	0	0	6	2	0	0	8	0	0	0	14	2	14.29
Jun	2	0	10	0	4	0	8	0	0	0	24	0	0.00
Jul	10	0	6	0	8	0	6	0	0	0	30	0	0.00
Aug	8	0	6	0	8	0	8	2	0	0	30	2	6.67
Sep	6	0	6	4	8	4	6	4	0	0	26	12	46.15
Oct	8	6	4	2	8	4	6	4	0	0	26	16	61.54
Nov	2	0	0	0	0	0	4	4	0	0	6	4	66.67
Dec	2	0	2	0	4	0	8	2	0	0	16	2	12.50
Total	52	12	66	18	56	12	78	24	14	8	266	74	27.82
not ok (%)	23.08		27.27		21.43		30.77		57.14 *				

* mission until April 2011

Nights acquisitions: ionospheric effects should be reduced!

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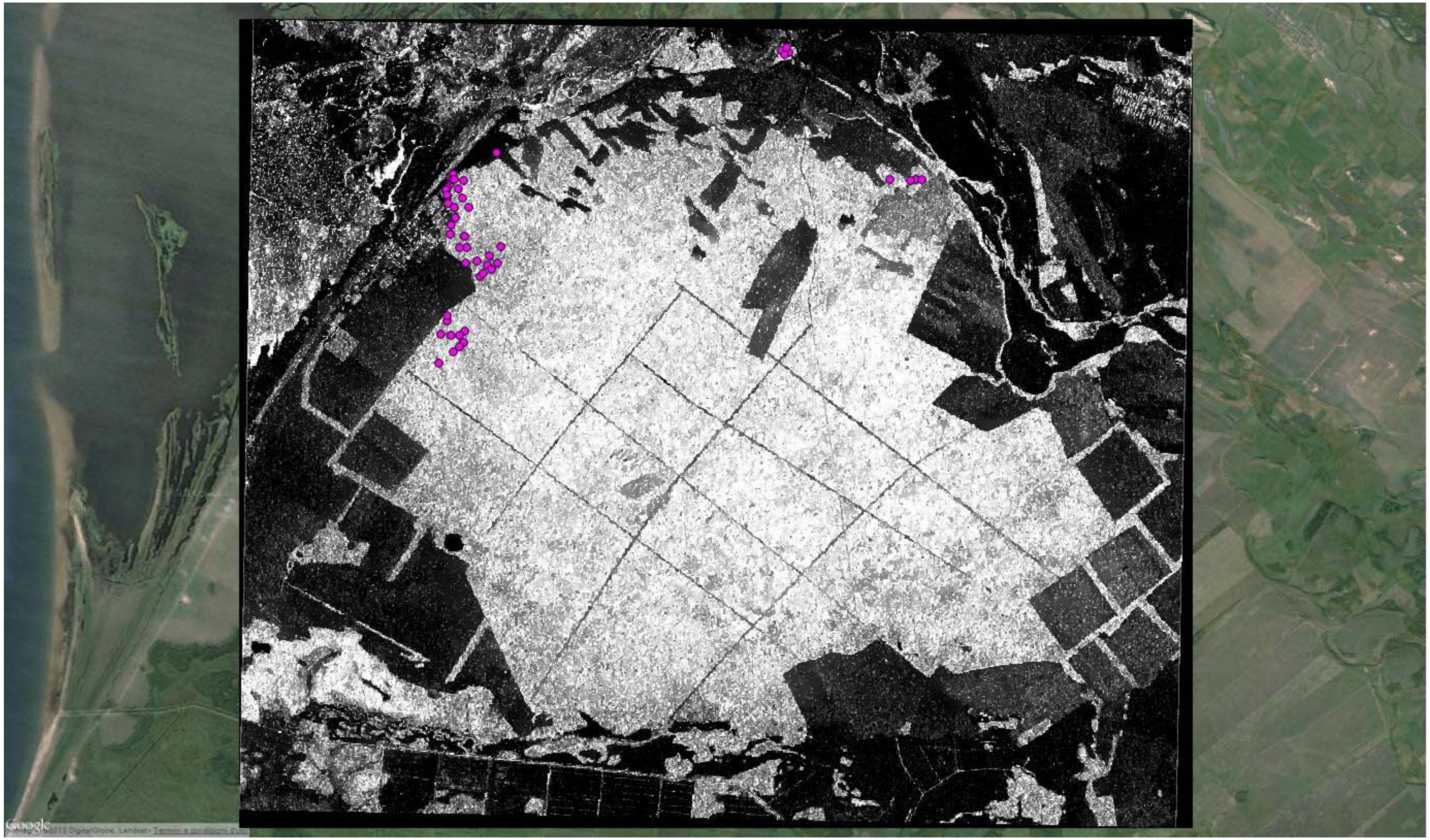
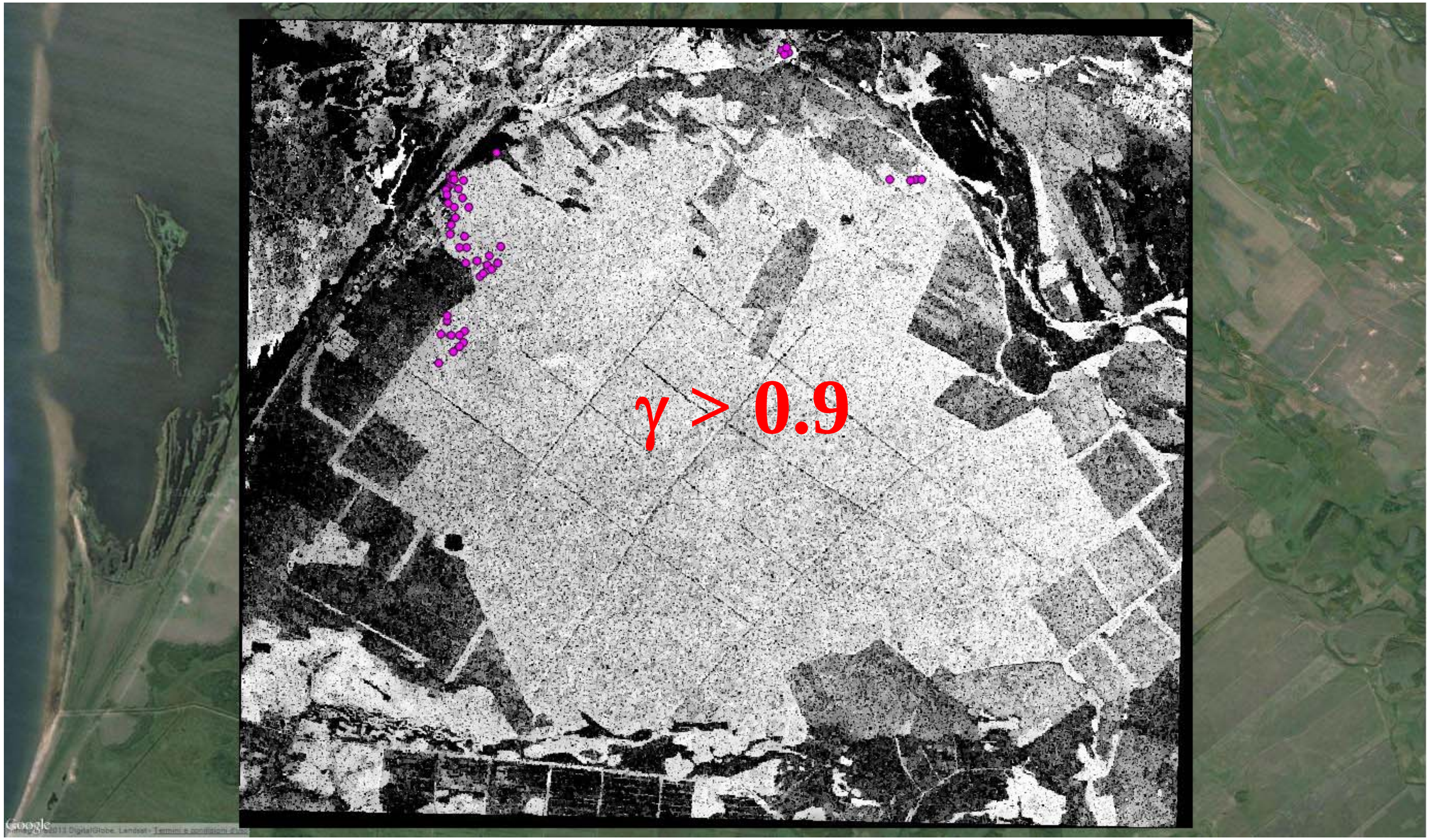
Boreal forest

TSX-Tandem σ^o



TSX-Tandem coherence



TSX-Tandem – InSAR data characteristics

• Spatial resolution	5 m
• 2π 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

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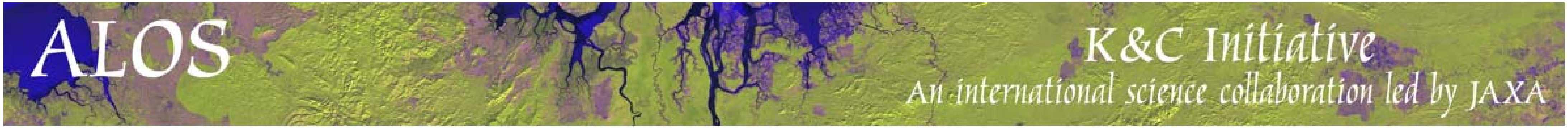
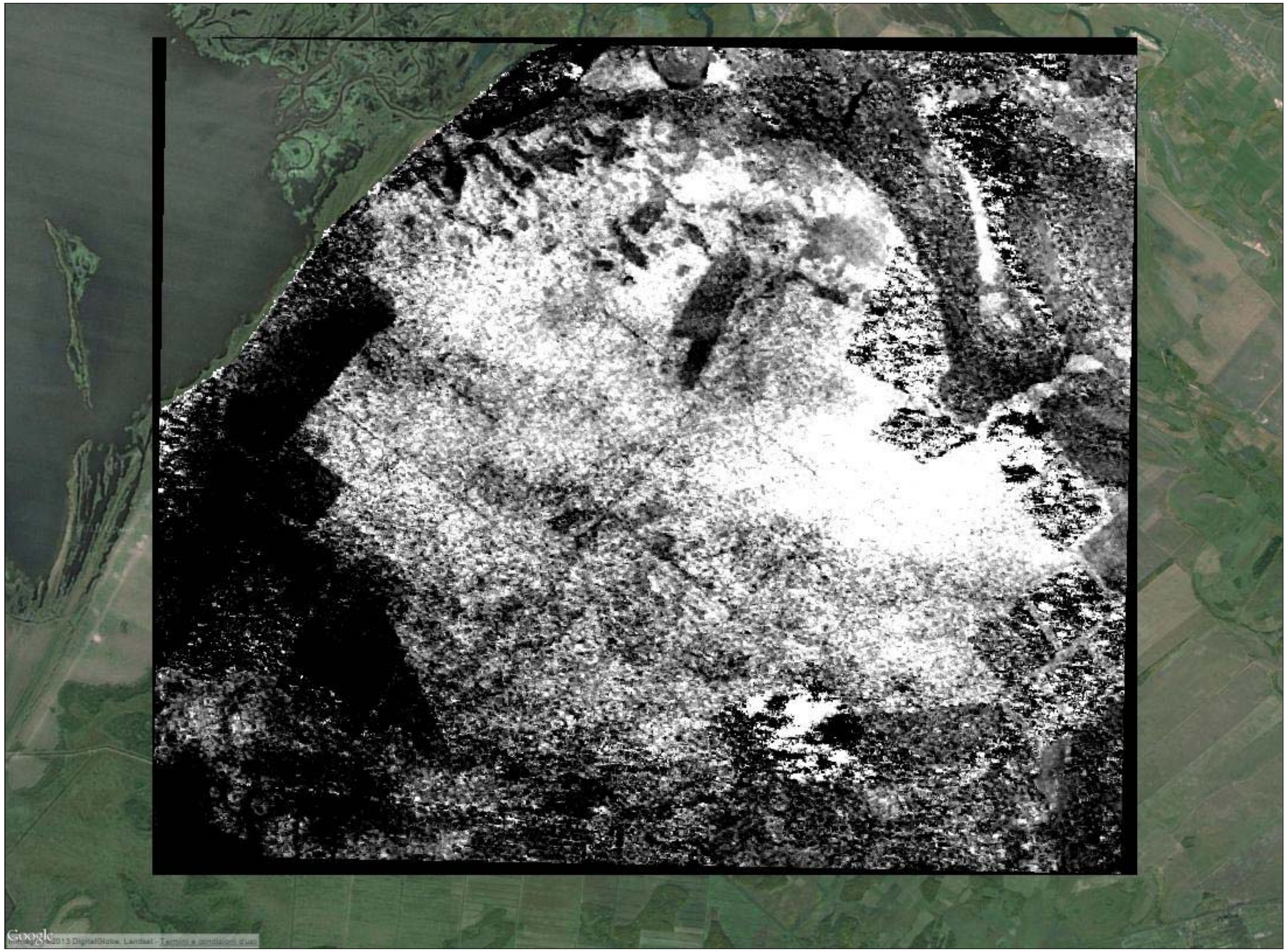


ALOS PALSAR-1 FBS – InSAR data characteristics

• Spatial resolution	10 m
• 2π 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



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TSX-Tandem – InSAR data characteristics

• Spatial resolution	5 m
• 2π 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

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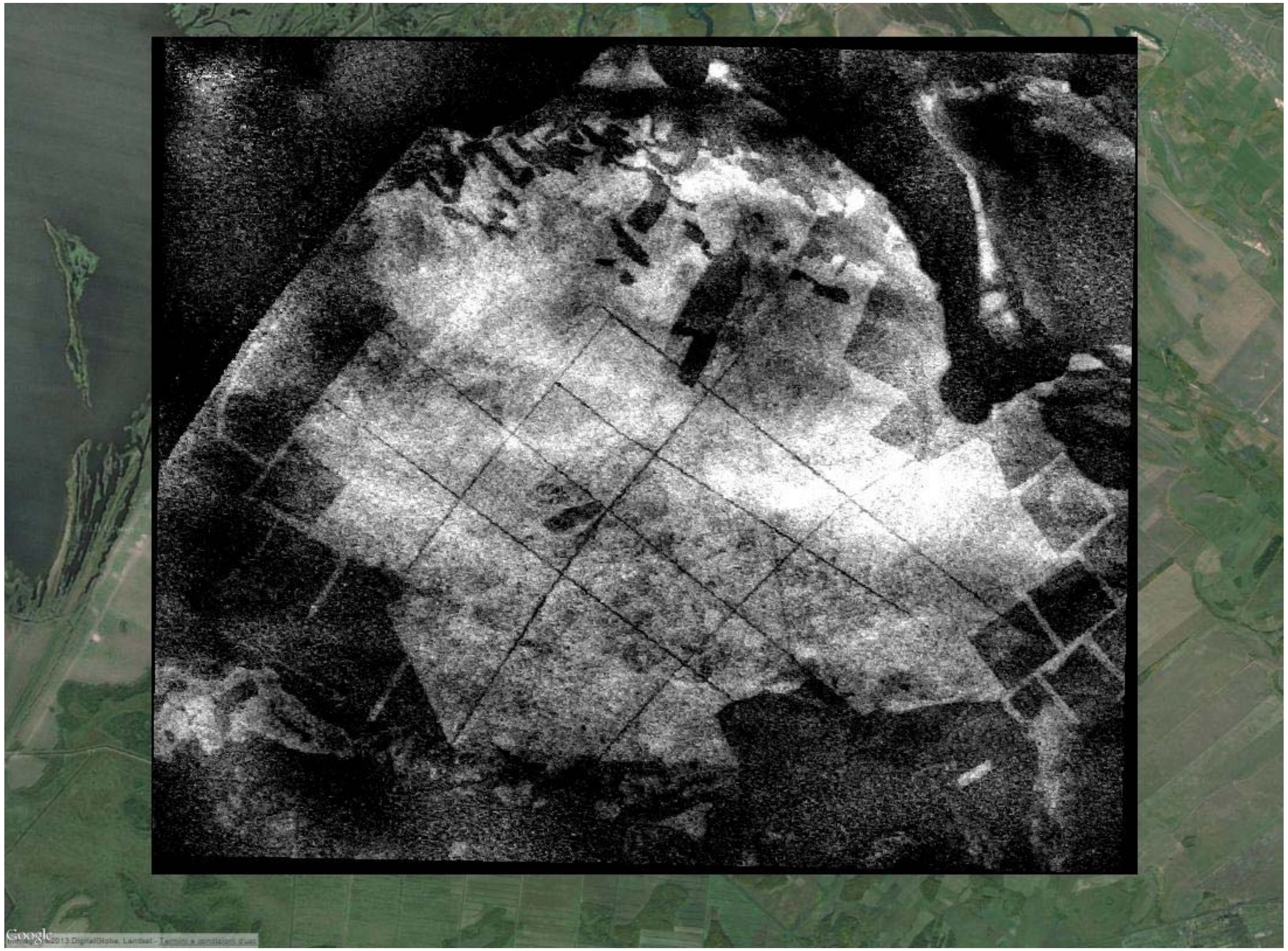
TSX-Tandem – Estimated forest height, May 2012



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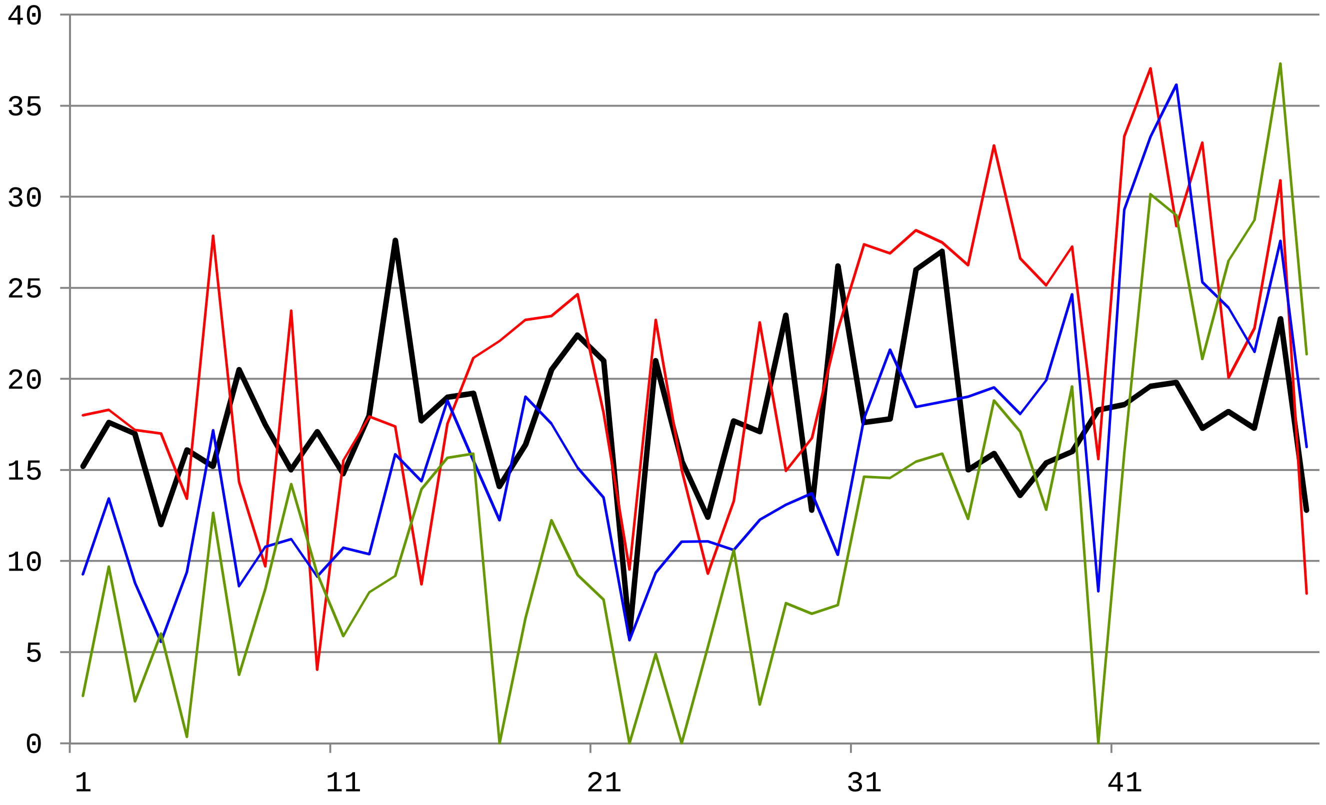
Estimated forest height – Comparison



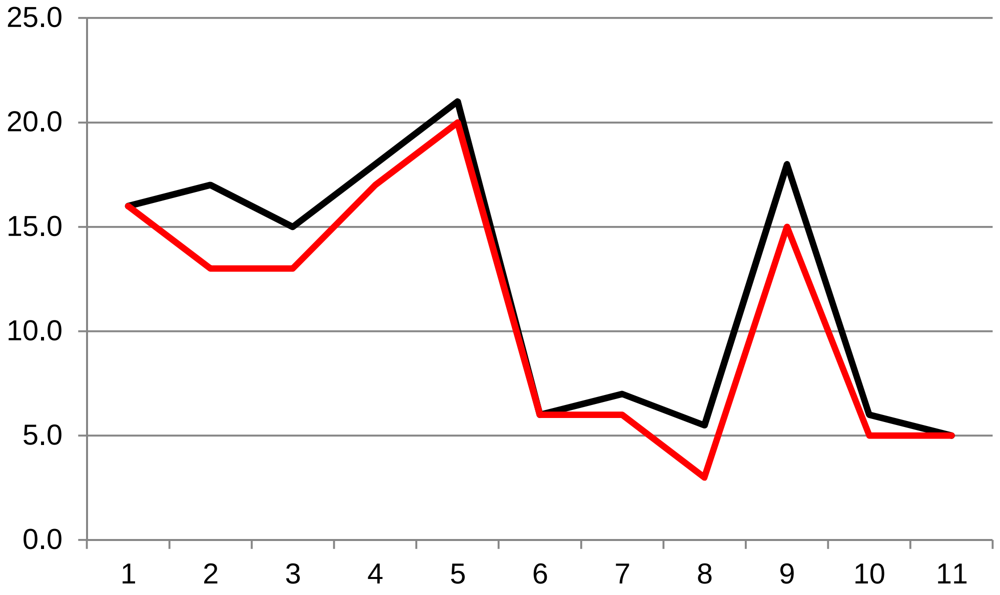
in situ **TSX May 12** **TSX February 12** **PALSAR-1 Aug-Oct**

TSX-Tandem – InSAR data characteristics

• Spatial resolution	5 m
• 2π 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**

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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.
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- 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.

Remote Sensing based Information and Insurance for Crops in Emerging Countries (RIICE) – ESA Living Planet Conference, 2013

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

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Mirco Boschetti[3], Giacinto Manfron[3], Pietro Alessandro Brivio[3]
Eduardo Jimmy Quilang[4], Mary Rose Obico[4], Vo Quang Minh[5], Diem Phan Kieu[5], Quyen Nguyen Huu[6],
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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 93m 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

http://irri.org/ Media Releases

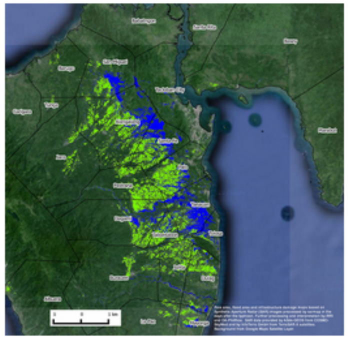
Satellite images map rice damage from typhoon

font size | Print | Email

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

The satellite-generated maps, developed by the International Rice Research Institute in collaboration with sarmap and the Department of Agriculture- Philippine Rice Research Institute (DA-PhilRice), show that flooding has affected about 1,800 hectares of standing rice crop across 15 municipalities and that the typhoon badly damaged buildings where harvested rice may have been stored.

"The Department of Agriculture appreciates the timely release of satellite maps on rice areas affected by Typhoon Yolanda. We will refer to these as we firm up assessment of the effect of this calamity and as we craft our rehabilitation interventions," said DA Undersecretary for Operations and National Rice Program Coordinator Dante Delima. "The release of these maps also boosts our confidence that the current system of rice production monitoring and assessment in the country shall soon be greatly enhanced with this ongoing project between DA and IRRI."



IRRI and partners hope that these maps will aid the Philippine government in recovery and rehabilitation efforts post-Typhoon Haiyan.

(Click on image for more maps)

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

Additional data released last week by DA-PhilRice and IRRI showed that harvesting in the region is usually done from September to October and, this year, was done just before the typhoon hit on 8 November 2013. Extensive damage to infrastructure, however, will have affected rice in storage, irrigation facilities, farm equipment and, likely, planning and preparation for the next rice-growing season.

"Geographic information on the location and seasonality of rice can help in quantifying rice production and evaluate losses following extreme weather events, but it can also be used to plan proactively," said geographer Andy Nelson, who heads IRRI's Geographic Information Systems Laboratory.

Dr. Nelson said that the maps could aid policymakers in making decisions and setting priorities among research and extension activities meant to help rice farmers.

The maps are based on synthetic aperture radar (SAR) images processed by sarmap in the days after the typhoon. The data were provided by ASI/e-GEOS from COSMO-SkyMed and by InfoTerra GmbH from the TerraSAR-X satellites.

"In situations like this, it is essential to use all available SAR platforms to monitor developments," said Francesco Holecz, chief executive officer of sarmap. "A close cooperation with the various space agencies and data providers is crucial to plan and acquire SAR data in the best possible way. Future satellites, such as Sentinel-1A/B, will significantly contribute to rice crop monitoring."

Leyte is one study site within the Remote Sensing-based Information and Insurance for Crops in Emerging Economies (RIICE) project where IRRI, sarmap, and DA-PhilRice work with the German Development Cooperation (GIZ), Allianz, and the Swiss Agency for Development and Cooperation (SDC) 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.

PhilRice Deputy Executive Director for Development Eduardo Jimmy Quilang said that the maps underscore the value of the consortium's work.

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

IRRI and its partners are also doing longer term research to monitor when and where rice is grown in the Philippines.

The research behind these data sets was supported by the DA's Food Staples Sufficiency Program (FSSP), the SDC-funded RIICE project, and the Global Rice Science Partnership that is the CGIAR Research Program on Rice.

Subscribe now

Leyte flood maps in relation to rice-growing areas

(click on photos for larger images)

Overview map of the Philippines

Flooded areas post-Typhoon Haiyan (in blue)

Rice areas (in green)

Flooded areas and rice areas

Infrastructure damage (in red)

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Wall Street Journal, November 29th

Friday, November 29, 2013 8:0:53 GMT

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Satellite Maps Show Extent of Typhoon's Wrath on Philippine Rice

Article | Comments

SOUTHEAST ASIA REAL TIME HOME PAGE »

By WSJ 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 processed by software company sarmap in the days after the typhoon, show the northeast part of hard-hit Leyte province. According to the Manila-based International Rice Research Institute, which partnered with the government's Department of Agriculture, they are an effort to track rice production to allow farmers and the government to better calculate the losses from extreme weather and help plan harvests.

IRRI

Overview map of Philippines. Leyte Province is in green.

In addition to the huge loss of life and property caused by Typhoon Haiyan, the Philippines witnessed severe damage to important crops, such as coconuts, sugar and rice. 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.

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