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Rice crop monitoring using EO data in the Mekong Delta, Vietnam

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2. Previous research results
3. Ongoing research works
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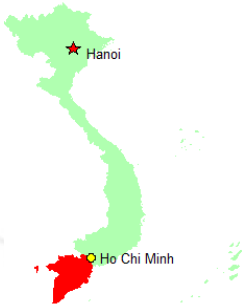
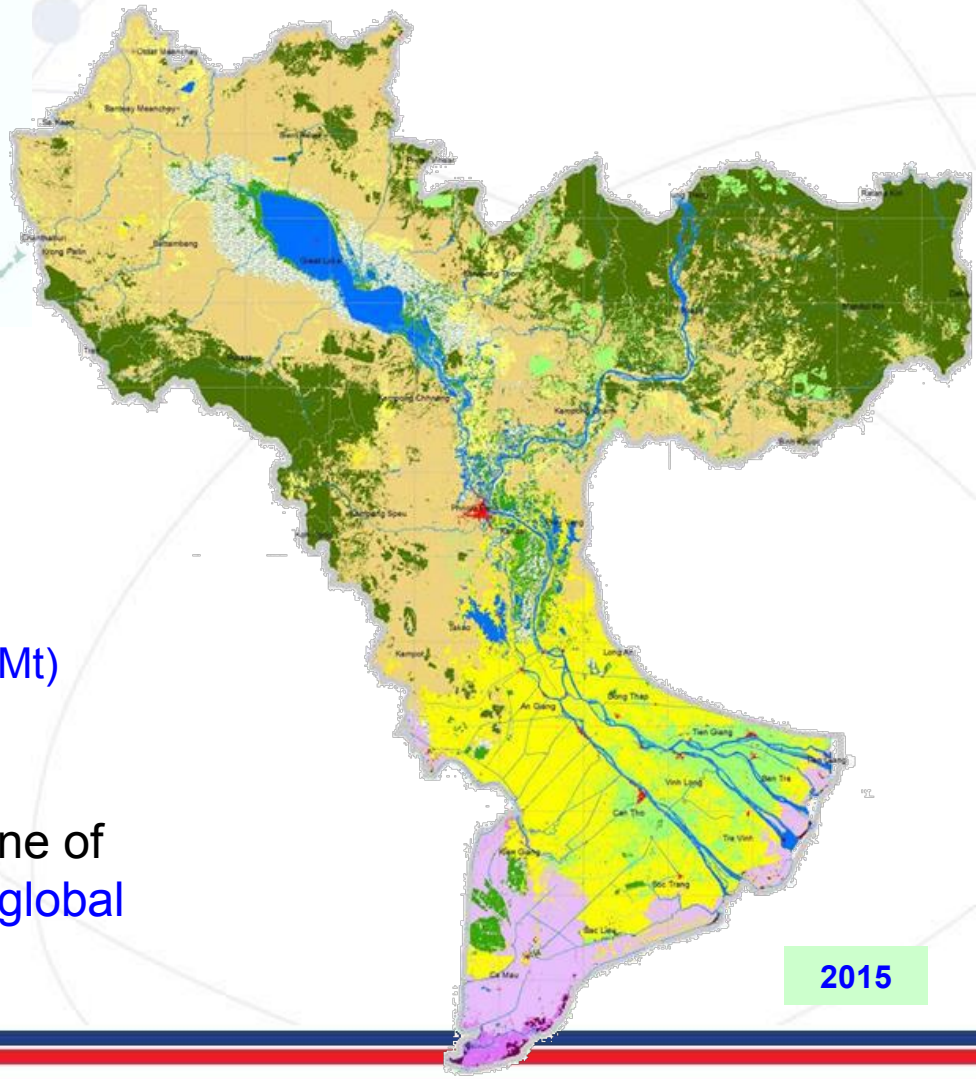
Introduction

Source: Parry, M.L. et al., 2007





Mekong Delta (Source: GSO, 2015):

- Area: 40,576 Km^2 (1/8)
- Population: 17.590 M (~1/5)
- MD accounts for more than half (25.7 / 45.2 Mt) of the country's rice production (>1/2)

The Mekong Delta, South of Vietnam is one of the most affected regions in the world by global warming.

Introduction

Rice cropping system	Rice season
Single rice crop	Traditional rice (rain-fed)
Double rice crop	SA – AW (rain-fed)
	WS – SA (irrigated)
Triple rice crop	WS – SA - AW

Main rice-based cropping systems in the MD

Sowing-transplanting period

Vegetative stage

Reproductive stage

Ripening stage

Pictures of rice growing stages

Rice crop		Planting	Harvesting
English name	Local name		
Winter Spring (WS)	Dong Xuan	Nov./Dec.	Mar./Apr.
Summer Autumn (SA)	He Thu	Apr./May	Jul./Aug.
Rainy season	Thu Dong (Autumn Winter-AW)	Jul./Sep.	Oct./Dec.
	Mua (Traditional rice)	Jul./Sep.	Nov./Jan.

Main rice seasons in An Giang province, Mekong Delta

Introduction

Previous projects

1. Rice & Mangrove monitoring in Southern Vietnam - RICEMAN

- TerraSAR-X & ENVISAT-ASAR data, **2010-2011**
- Rice mapping: Single-date mapping algorithm
- Yield estimation model: Statistical model.

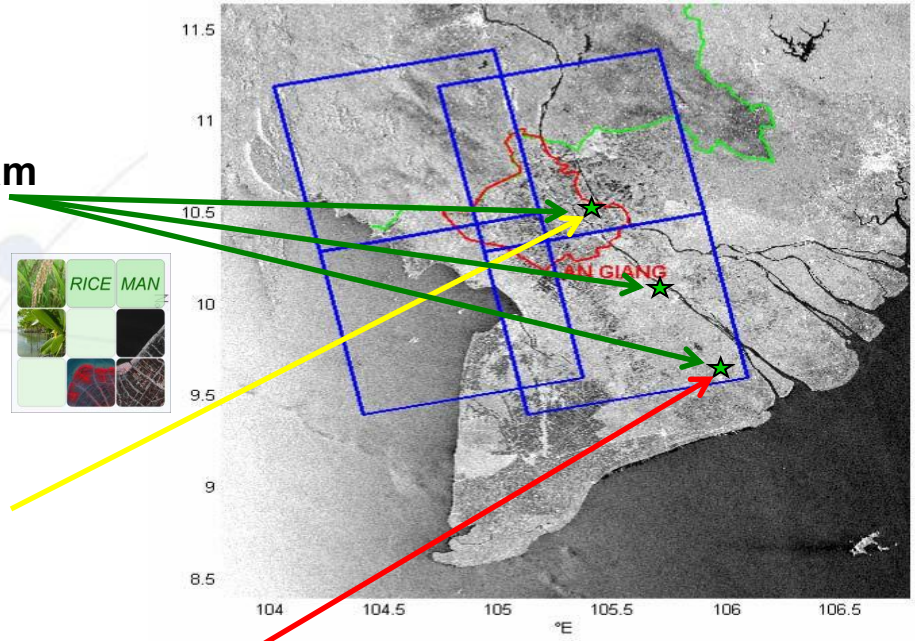
2. Rice crop monitoring using new generation synthetic aperture radar (SAR) imagery

- ENVISAT-ASAR data, **2007-2008**
- Rice mapping: Single-date mapping algorithm
- Yield estimation model: Statistical model.

3. Utilisation of SAR data for rice crop monitoring

- ERS2-SAR data, **1997-1998**
- Rice mapping: Temporal change measurement
- Yield estimation model: Agro-meteorological model (AMM).

4. Other projects in the Mekong and Red River Delta



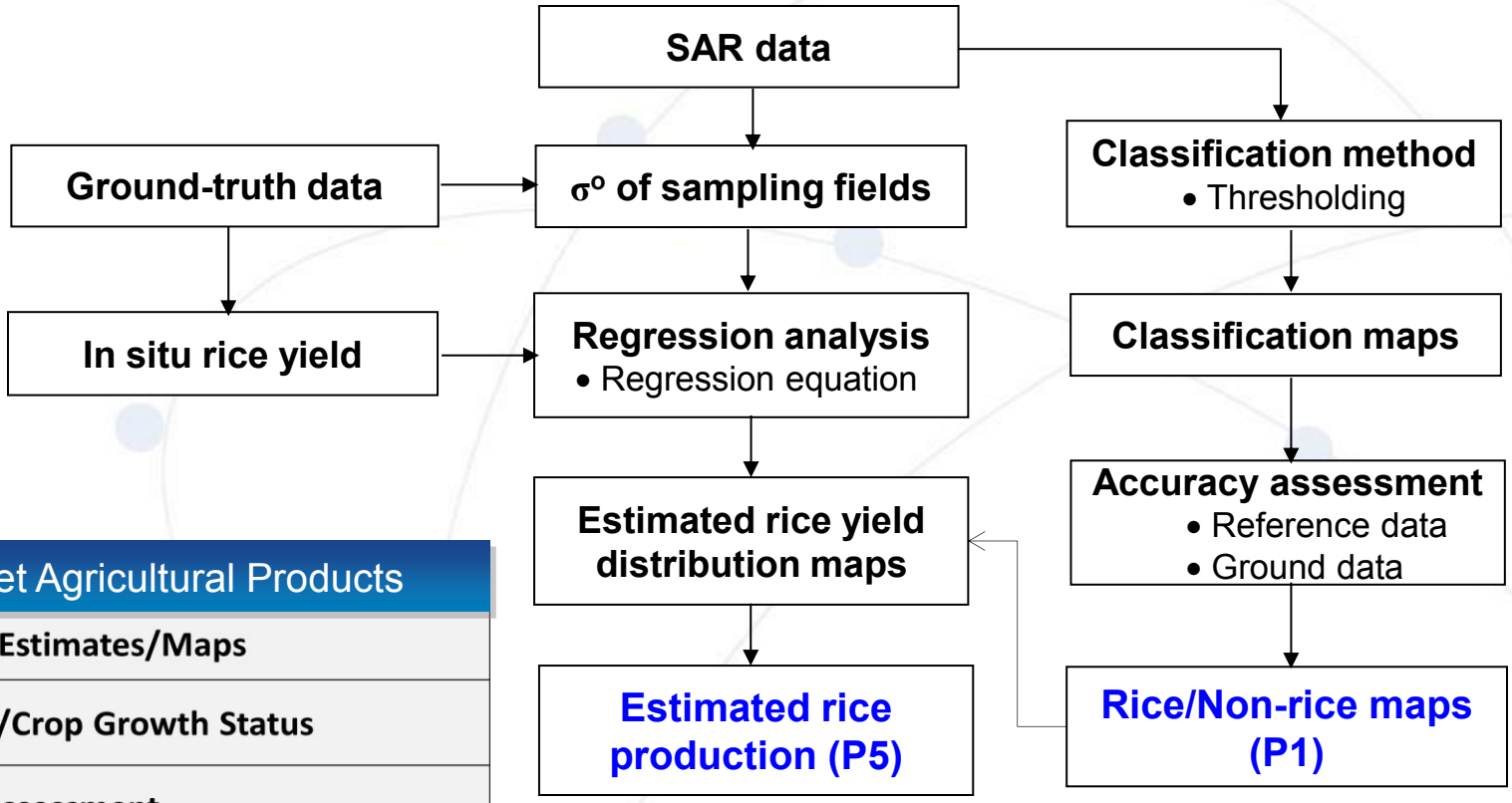
Ongoing projects

1. SAFE/APRSAF (2013-2017) &Asia-RiCE

2. GeoRice (2015-2017)

- Data used: COSMO-SkyMed, RADARSAT-2, ALOS-2, Sentinel-1.

Methods



Asia-RiCE Target Agricultural Products	
P1	Rice Crop Area Estimates/Maps
P2	Crop Calendars/Crop Growth Status
P3	Crop Damage Assessment
P4	Agro-meteorological Information Products
P5	Production Estimation and Forecasting

Data set

SAR data received:

COSMO-SkyMed: Aug 2013 – Feb 2014

RADARSAT-2: Aug 2013 – Now

Sentinel-1: Aug 2014 – Now

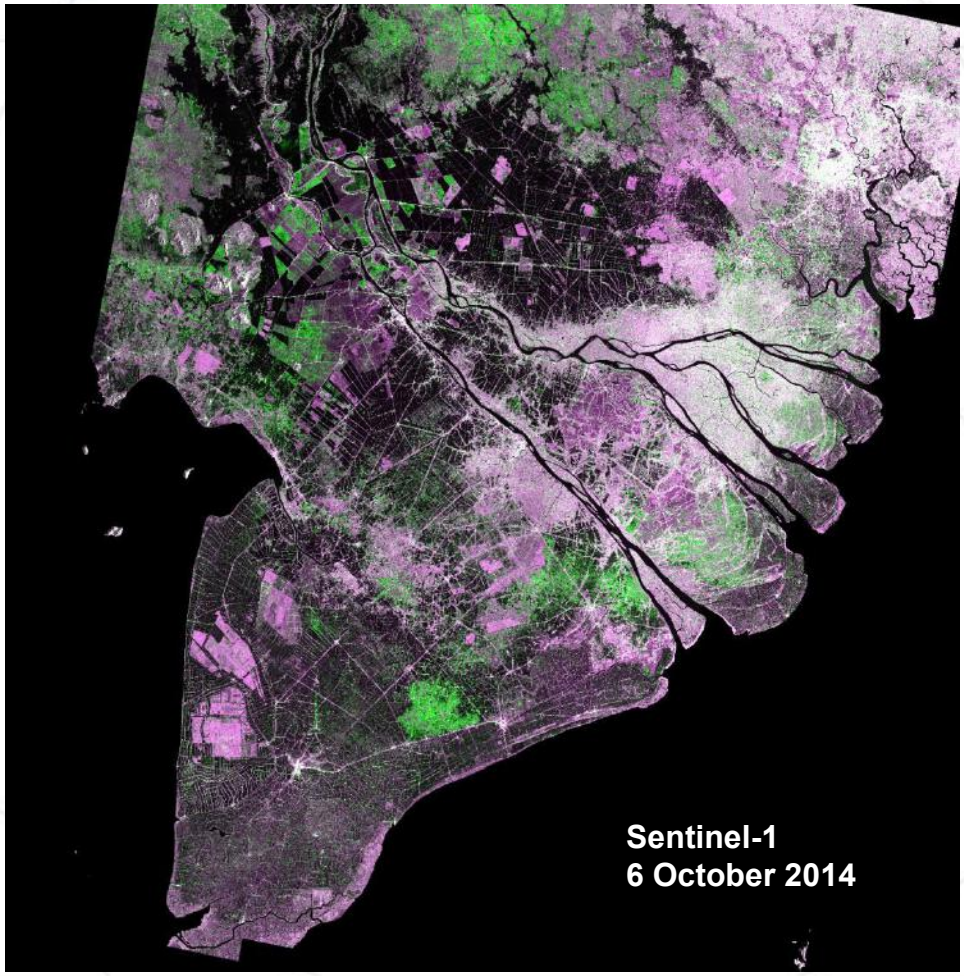
ALOS-2: Nov 2014 – Now

COSMO-SkyMed data:
- Band: X
- Polarisation: HH&VV
- Resolution: 20 m (StripMap PINGPONG)

RADARSAT-2 data:
- Band: C
- Polarisation: VV&VH
- Resolution: 10 m (Wide Fine)

Sentinel-1 data:
- Band: C
- Polarisation: VV&VH
- Resolution: 20 m (SW)

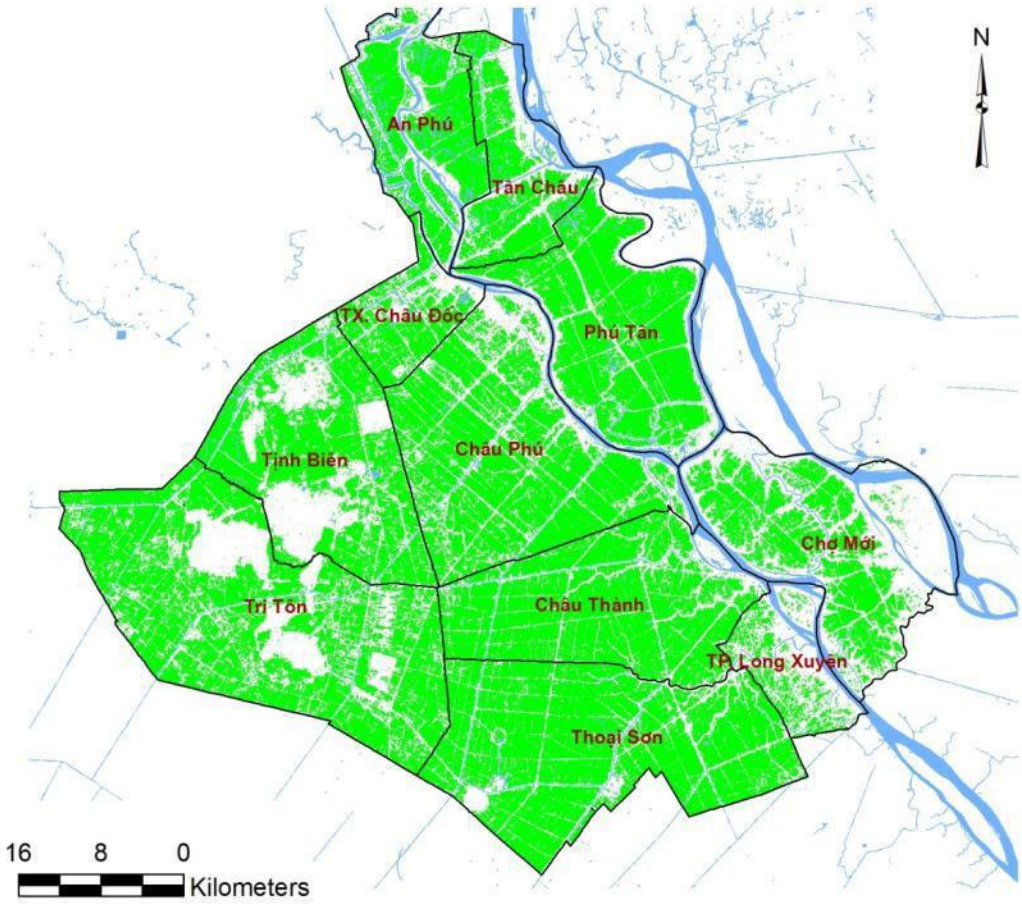
ALOS-2 data:
- Band: L
- Polarisation: HH&HV
- Resolution: 50 m (WS) & 12.5 m (Fine)



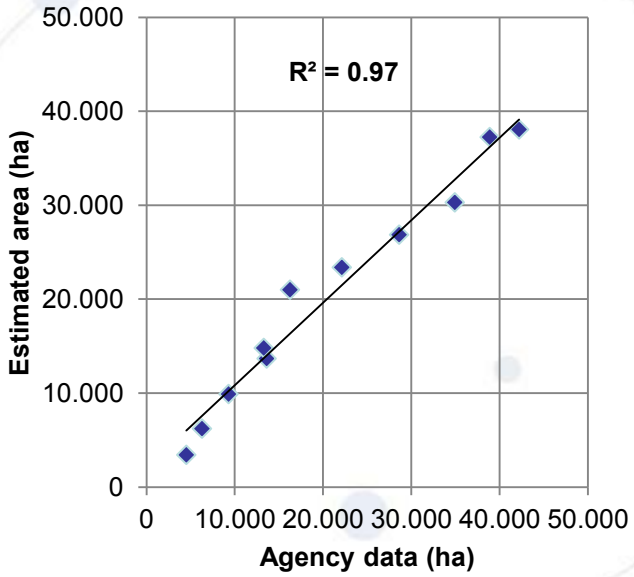
Rice parameters		Description	Equipment
Guidelines for ground data collection for rice monitoring experiments using radar data (Thuy Le Toan)	Paddy variety	Ex.: IR 64	
	Method of planting	direct sowing/ transplanting	
	Sowing date	date of direct sowing or number of days after sowing	
	Transplanting date (if transplanting)	date of transplantation or the number of days after transplantation	
	Date of harvesting	if the rice has been harvested	
General parameters	Yield (kg/m^2)	if the rice have been harvested	
	Plant phenological stage	Seeding, transplanting, tillering, heading, flowering, ripening, ready to harvest	
	Water layer height (cm)	if fields are flooded	stick
	Plant height (cm)	above water layer	tape
	Wet weight per m^2(g)	above water biomass (moist weight by m^2)	cut all plants from defined areas (min 50 x 50 cm)
	Dry weight per m^2 (g)	objective is to measure the dry biomass per m^2	Oven dry (105° during 24 hours)
Leaf parameters (optional)	Number of leaves per stem	Few samples for each sortie	
	Leaf length (cm) Leaf width (cm)		-Photo -Xerox copy of leaves
Panicle parameters	Moist and dry biomass of panicles per m^2		

Data set: RADARSAT-2, 2016, An Giang

District	Agency data (ha)	Estimated area (ha)	Difference percentage (%)
An Phu	13,640	13,679	0.3
Cho Moi	13,304	14,784	11.1
Chau Phu	34,940	30,274	-13.4
Chau Thanh	28,630	26,857	-6.2
Phu Tan	22,151	23,382	5.6
Tinh Bien	16,288	21,000	28.9
Chau Doc	6,315	6,218	-1.5
Long Xuyen	4,518	3,427	-24.1
Thoai Son	38,882	37,236	-4.2
Tri Ton	42,210	38,042	-9.9
Tan Chau	9,321	9,874	5.9
Total	**230,199**	**224,774**	**-2.4**

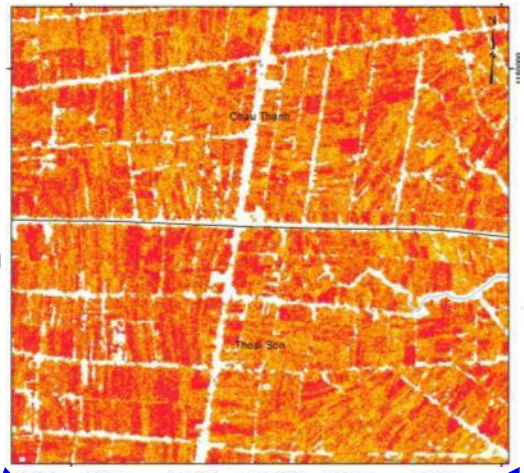


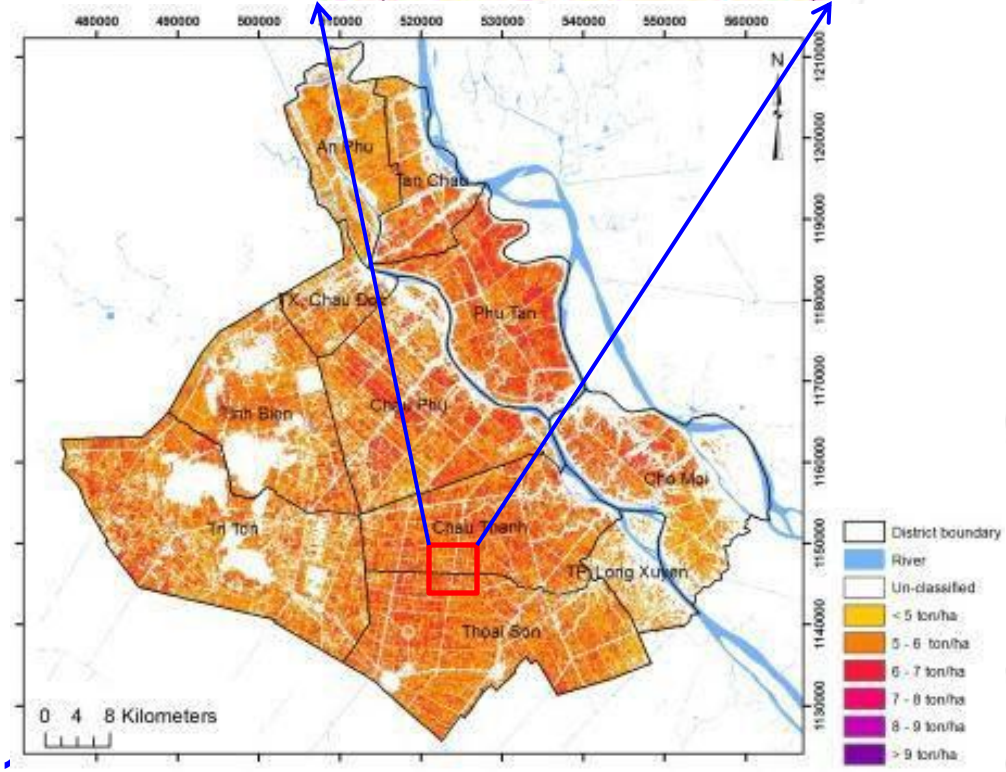
SA 2016 crop (using RADARSAT-2 images
(15 Apr, 09 May, 02 Jun, 26Jun, 20 Jul & 13 Aug)

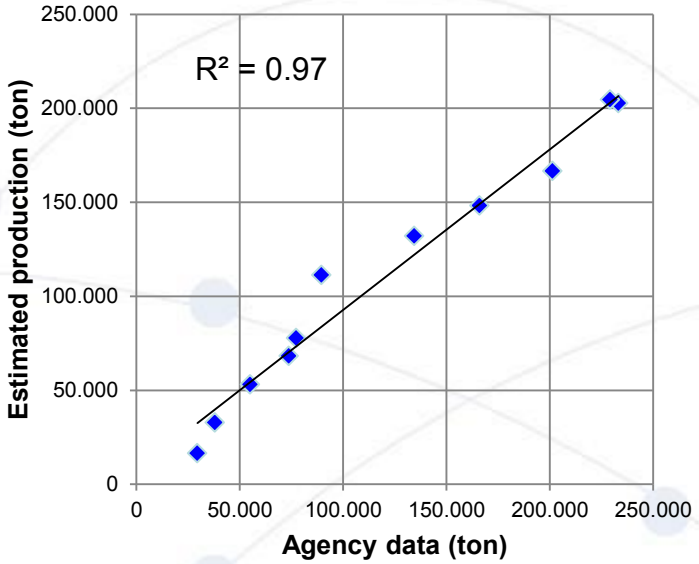


Data set: RADARSAT-2, 2016, An Giang

A distribution map of estimated rice yield of An Giang in SA 2016 crop using RADARSAT-2 data



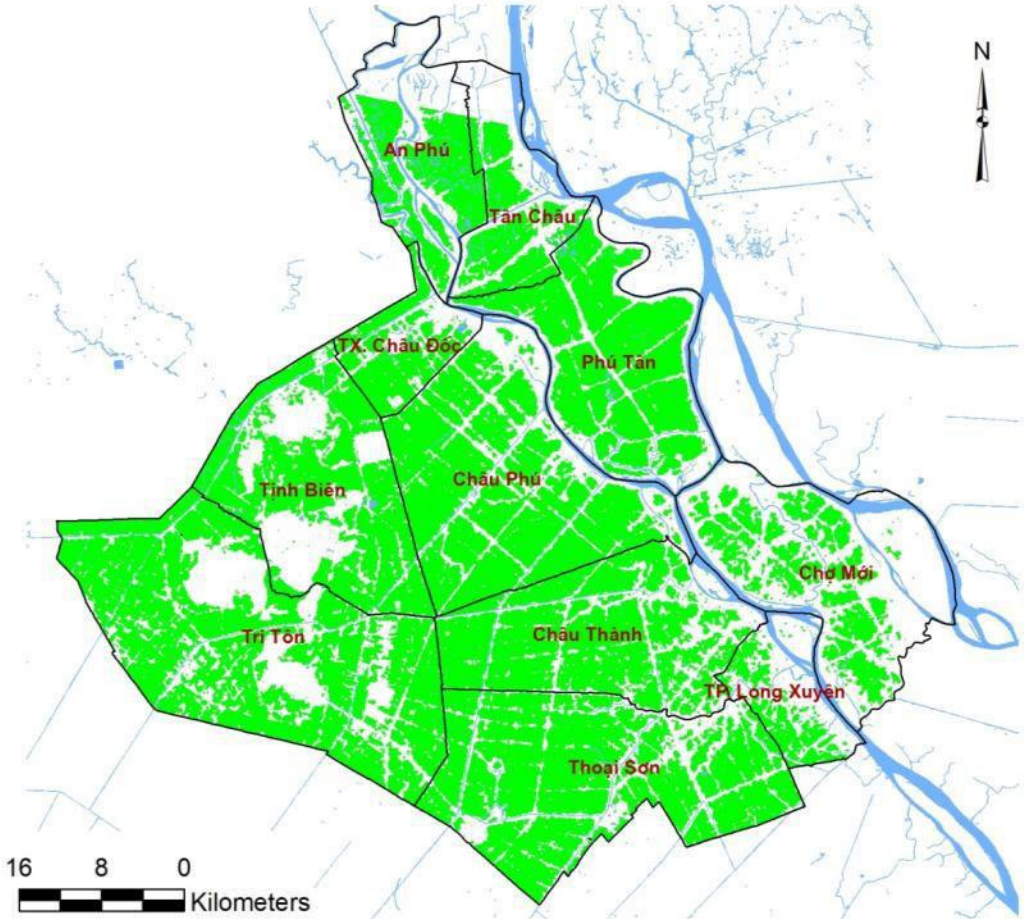




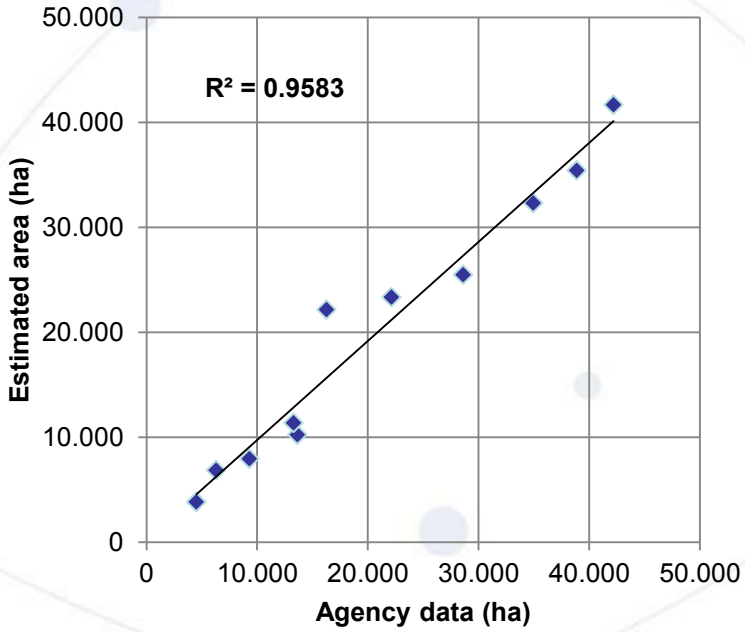
District	Agency data (ton)	Estimated production (ton)	Difference percentage (%)
An Phú	73,656	68,296	-7.3
Chợ Mới	77,296	77,720	0.5
Châu Phú	201,254	166,581	-17.2
Châu Thành	166,054	148,199	-10.8
Phú Tân	134,457	132,012	-1.8
Tịnh Biên	89,584	111,364	24.3
Châu Đốc	37,890	32,798	-13.4
Long Xuyên	29,503	16,456	-44.2
Thoại Sơn	233,292	202,704	-13.1
Tri Tôn	229,200	204,518	-10.8
Tân Châu	54,994	53,099	-3.4
Total	**1,325,946**	**1,213,746**	**-8.5**

Data set: Sentinel-1, 2016, An Giang

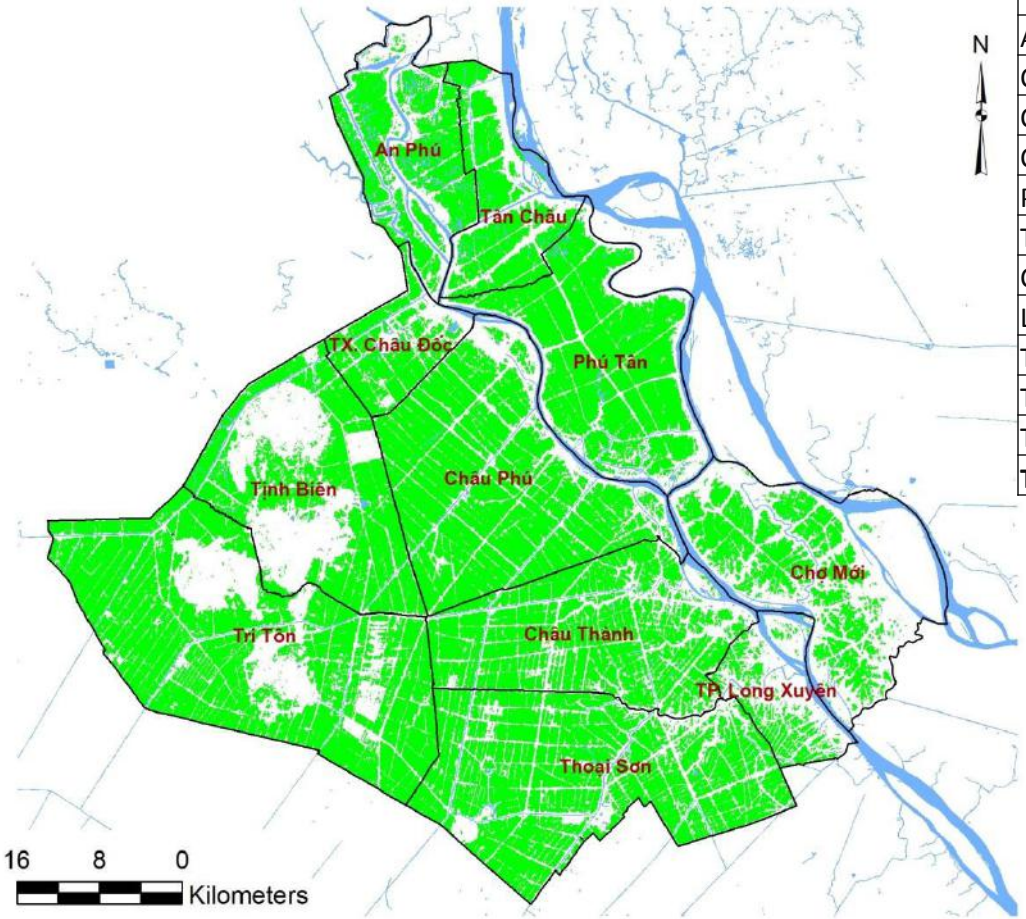
District	Agency data (ha)	Estimated area (ha)	Difference percentage (%)
An Phu	13,640	10,208	-25.2
Cho Moi	13,304	11,351	-14.7
Chau Phu	34,940	32,294	-7.6
Chau Thanh	28,630	25,465	-11.1
Phu Tan	22,151	23,329	5.3
Tinh Bien	16,288	22,137	35.9
Chau Doc	6,315	6,834	8.2
Long Xuyen	4,518	3,819	-15.5
Thoai Son	38,882	35,387	-9.0
Tri Ton	42,210	41,661	-1.3
Tan Chau	9,321	7,937	-14.9
Total	**230,199**	**224,774**	**-2.4**



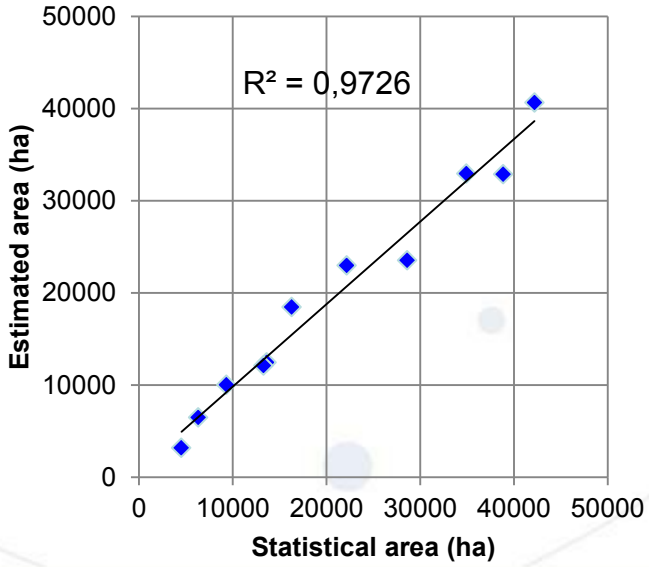
SA 2016 crop (using S-1 images)



Data set: ALOS-2, 2016

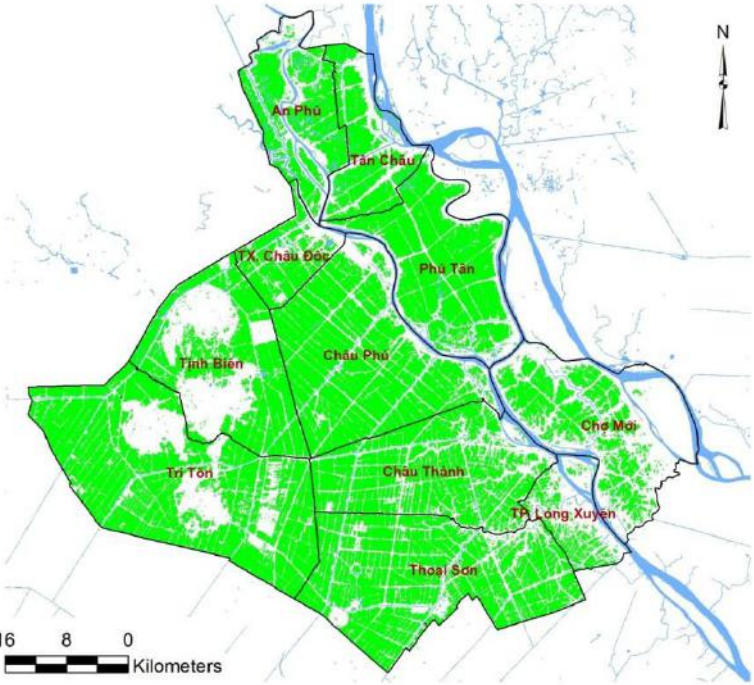


District	Agency data (ha)	Estimated area (ha)	Percentage error (%)
An Phu	13640	12431	-8.9
Cho Moi	13304	12080	-9.2
Chau Phu	34940	32921	-5.8
Chau Thanh	28630	23507	-17.9
Phu Tan	22151	22962	3.7
Tinh Bien	16288	18441	13.2
Chau Doc	6315	6445	2.1
Long Xuyen	4518	3153	-30.2
Thoai Son	38882	32846	-15.5
Tri Ton	42210	40625	-3.8
Tan Chau	9321	10007	7.4
Total	**230199**	**215418**	**-6.4**

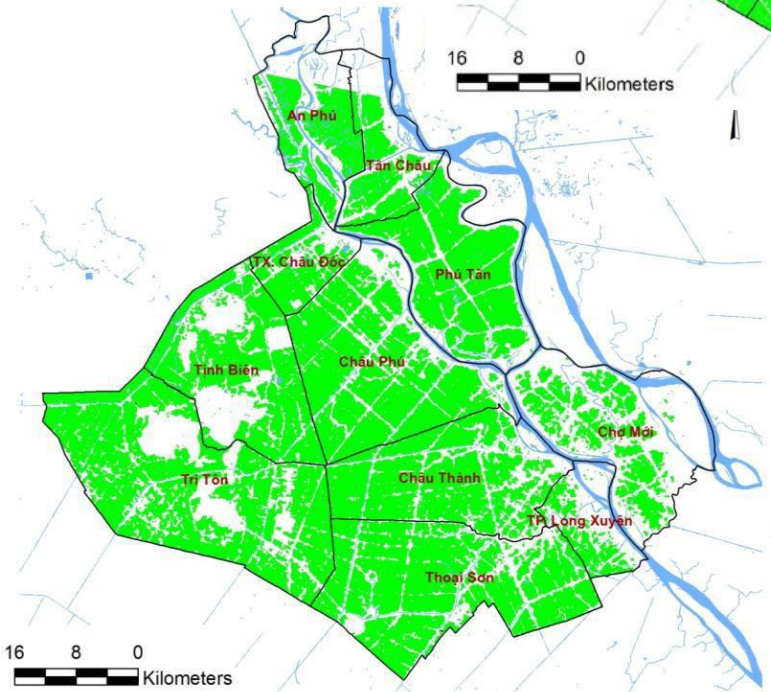


SA 2016 crop (using ALOS-2 images, 08 Apr, 20 May, 01Jul, 29Jul, 09 Sep)

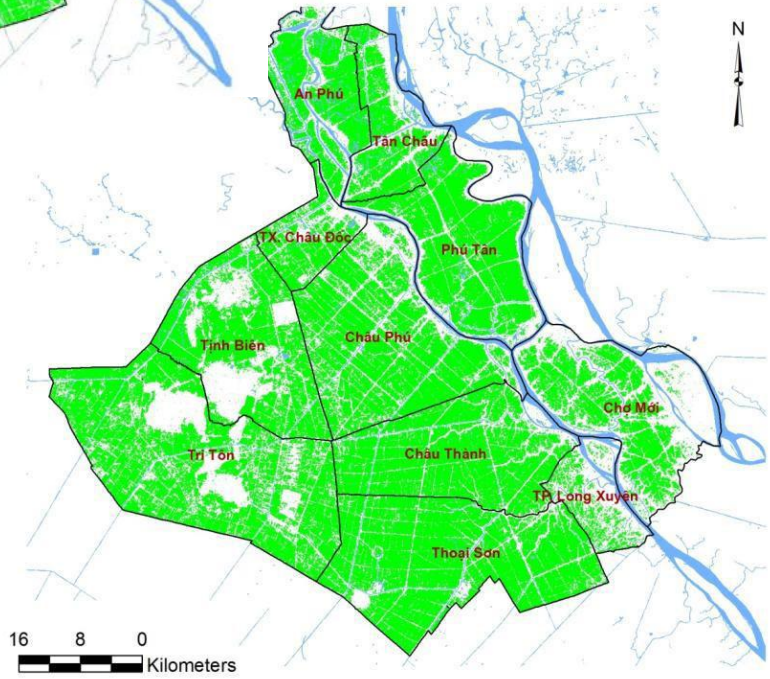
2016



SA 2016 crop
(using ALOS-2 images)



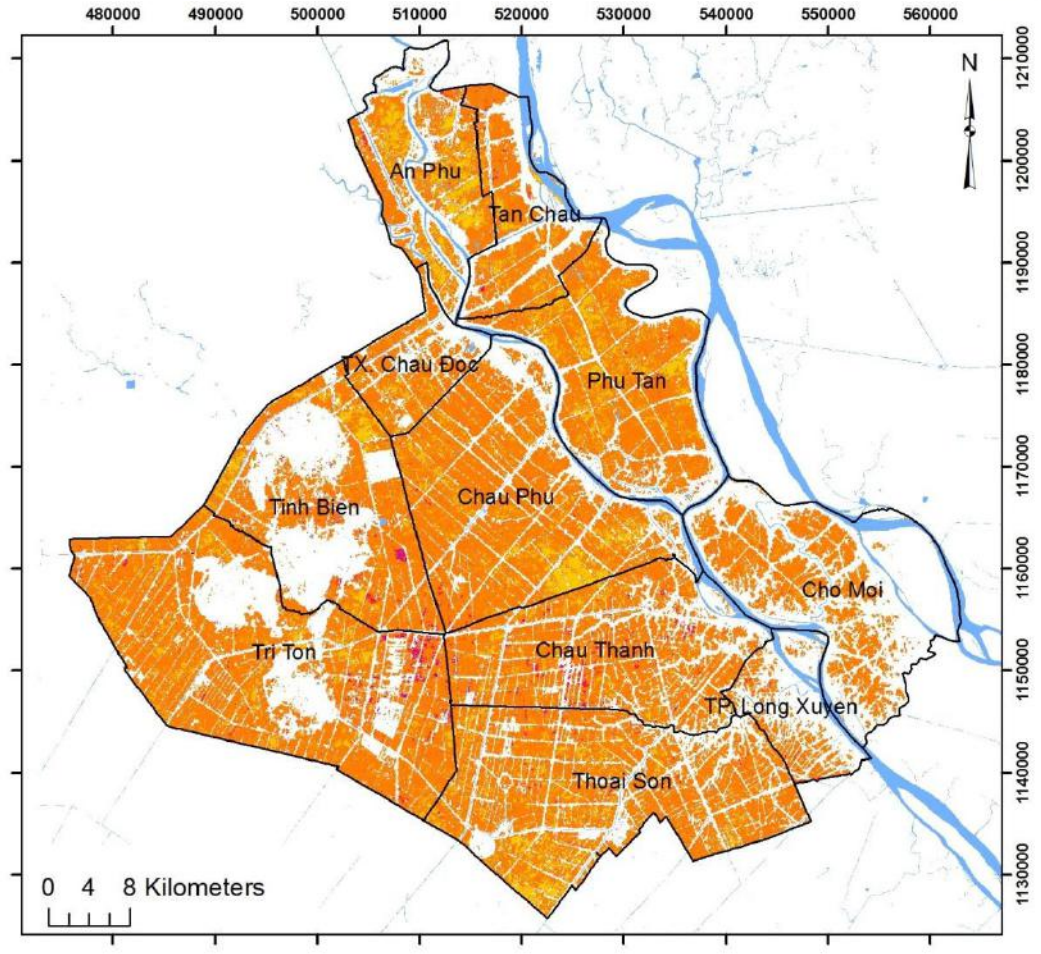
SA 2016 crop (using S-1 images)



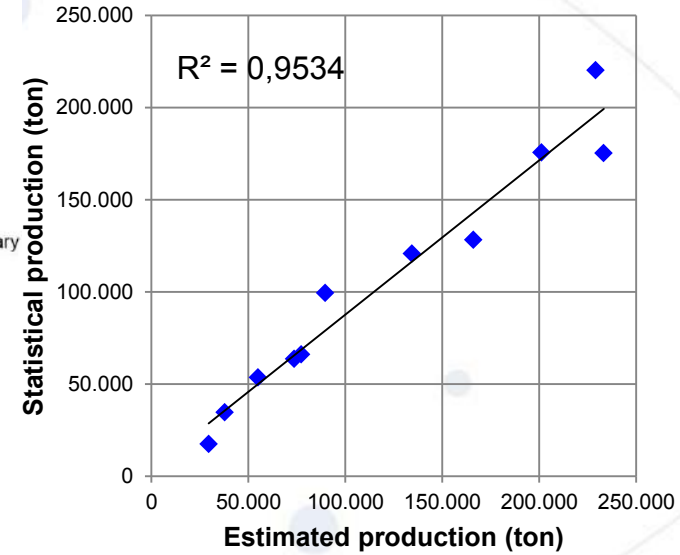
SA 2016 crop (using R-2 images)

Data set: ALOS-2, 2016

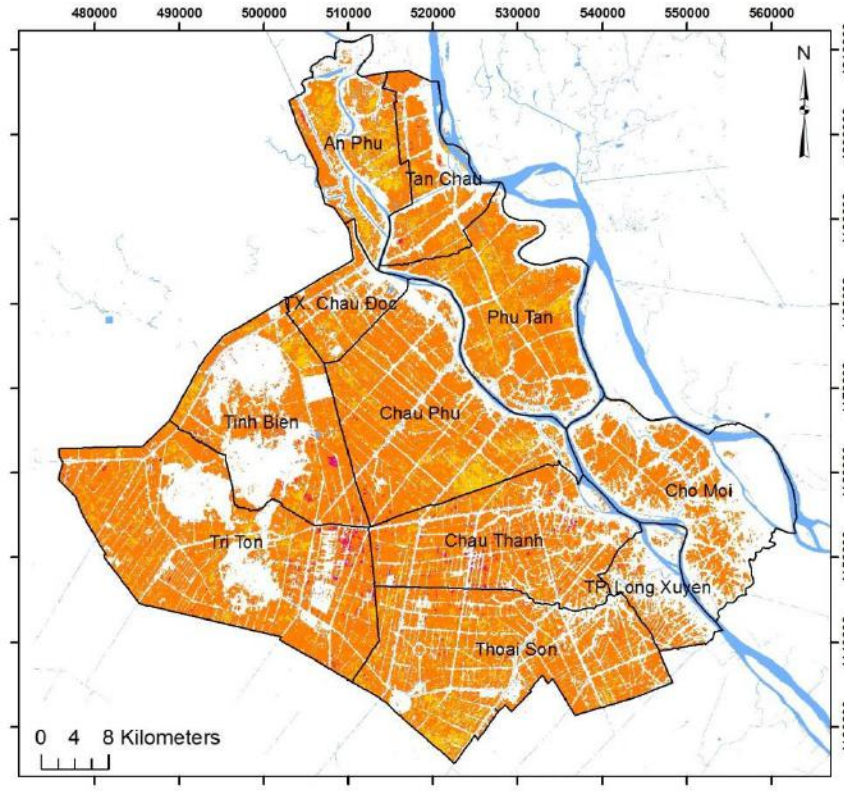
A distribution map of estimated rice yield of An Giang in SA 2016 crop using ALOS-2 data



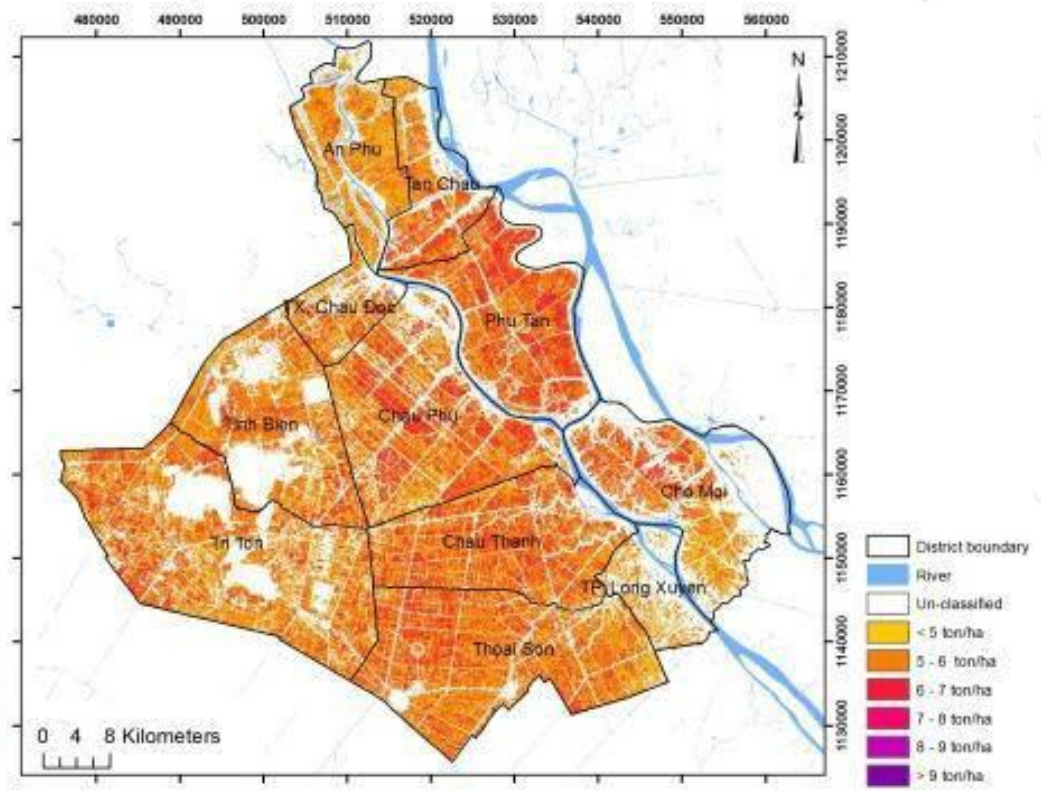
District	Agency data (ton)	Estimated production (ton)	Percentage error (%)
An Phú	73,656	63,717	-13.5
Chợ Mới	77,296	66,103	-14.5
Châu Phú	201,254	175,556	-12.8
Châu Thành	166,054	128,187	-22.8
Phú Tân	134,457	120,703	-10.2
Tịnh Biên	89,584	99,328	10.9
Châu Đốc	37,890	34,638	-8.6
Long Xuyên	29,503	17,422	-40.9
Thoại Sơn	233,292	175,277	-24.9
Tri Tôn	229,200	220,147	-3.9
Tân Châu	54,994	53,576	-2.6
Total	**1,325,946**	**1,154,655**	**-12.9**



Data set: ALOS-2, 2016

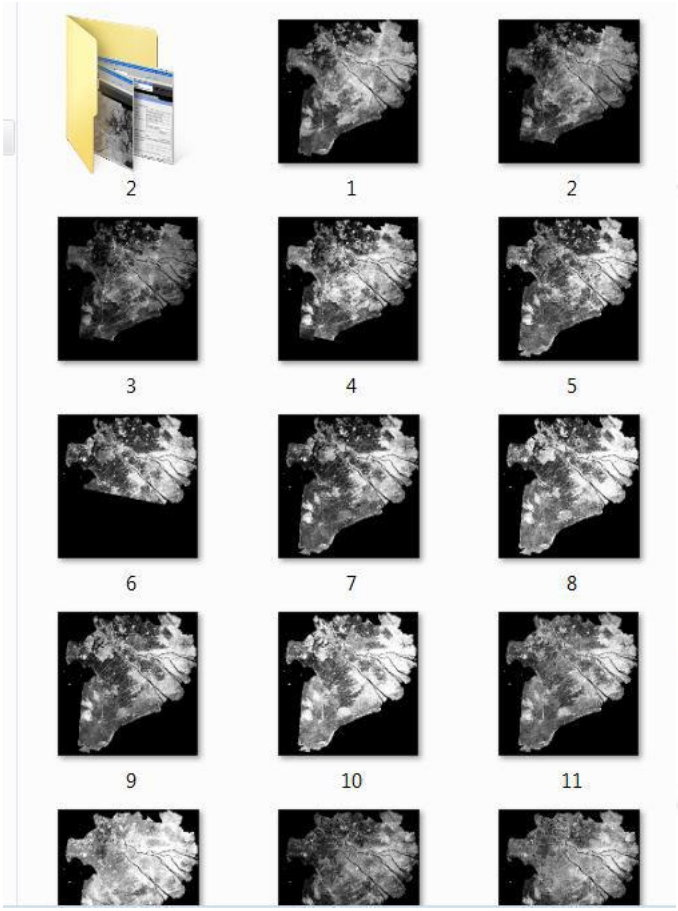


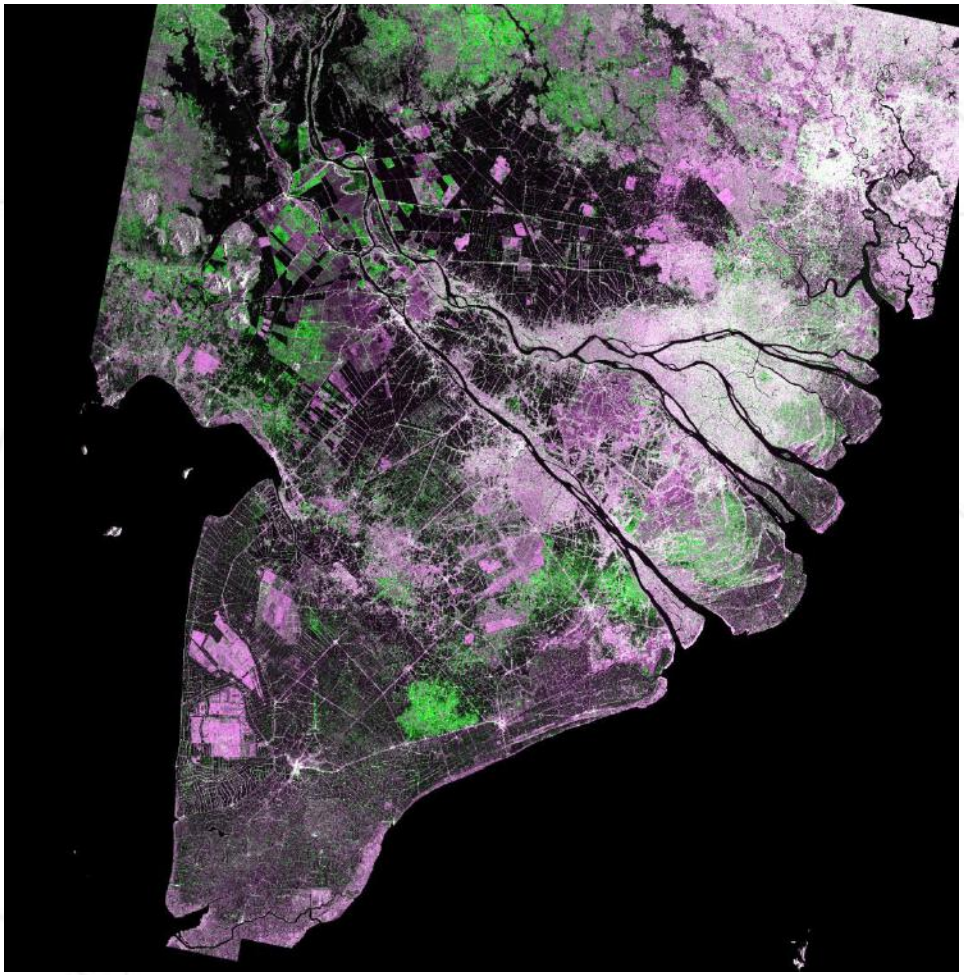
A distribution map of estimated rice yield in SA 2016 crop (using ALOS-2 images)



A distribution map of estimated rice yield in SA 2016 crop (using RADARSAT-2 images)

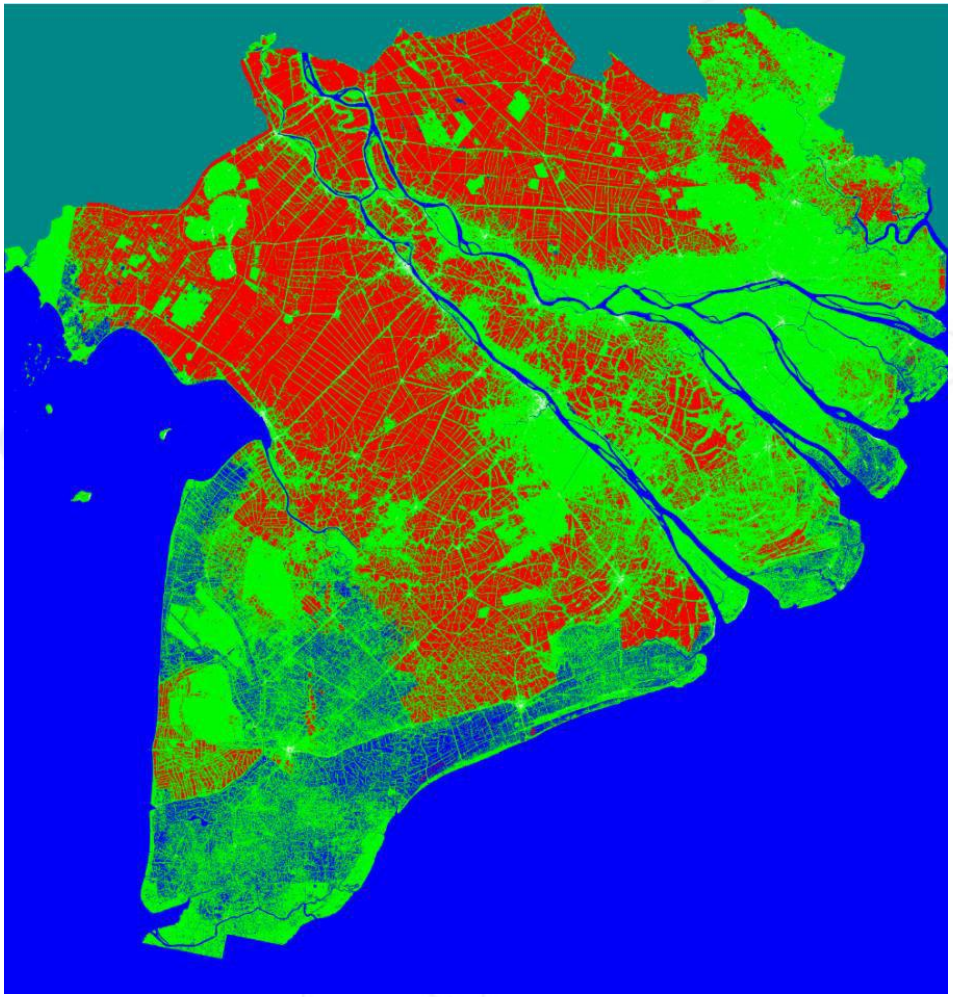
Sentinel-1 data over the Mekong Delta





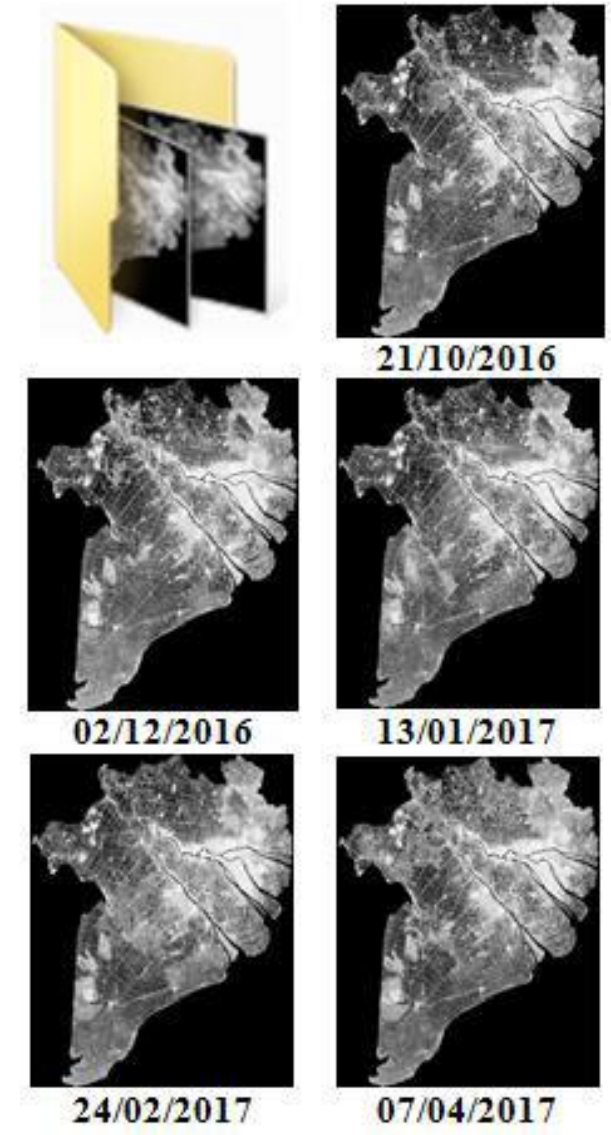
Every 12 days except few gaps

Data set: Sentinel-1, 2016, Mekong Delta

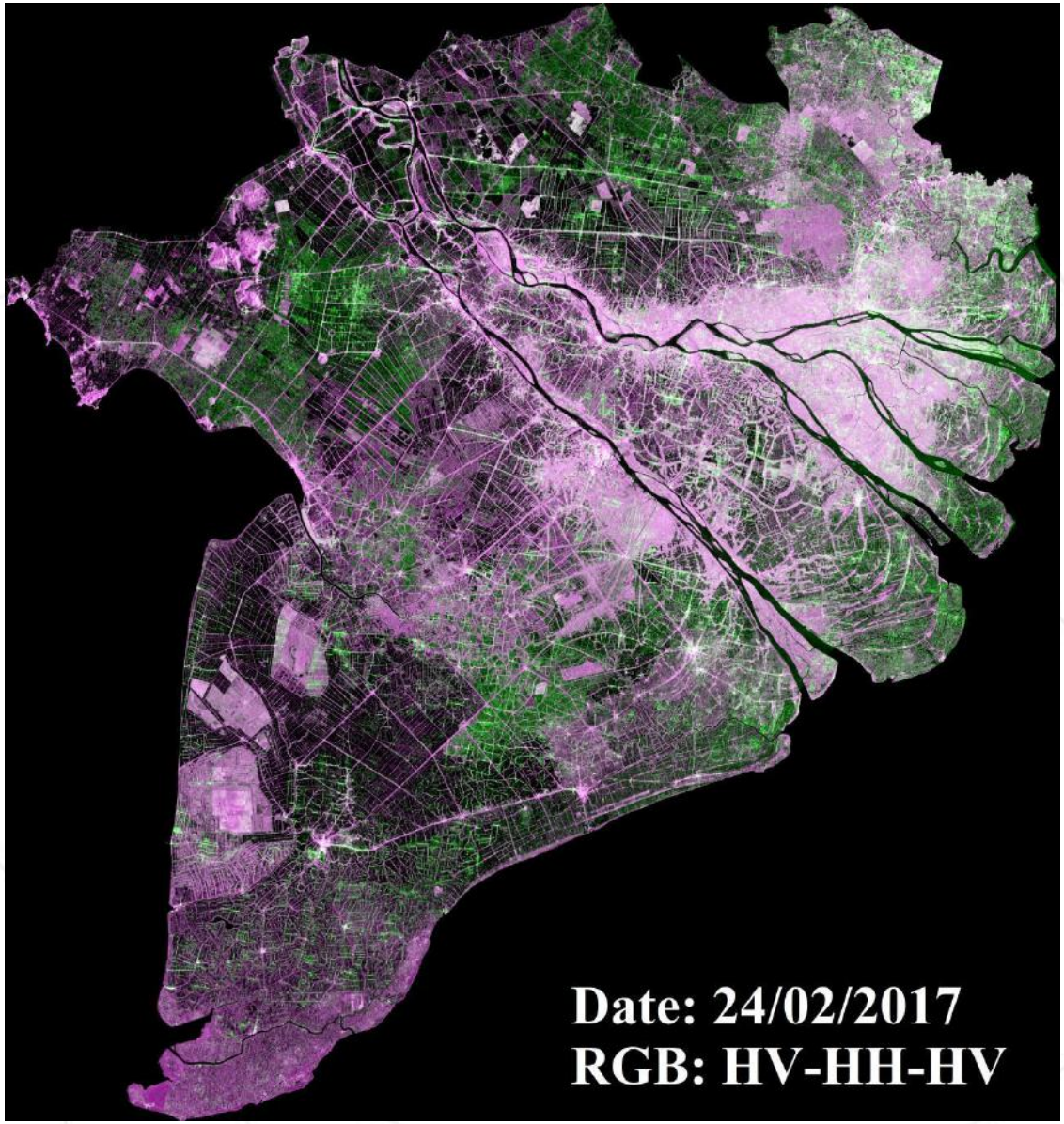


Rice map of WS 2016 (using S-1 images)

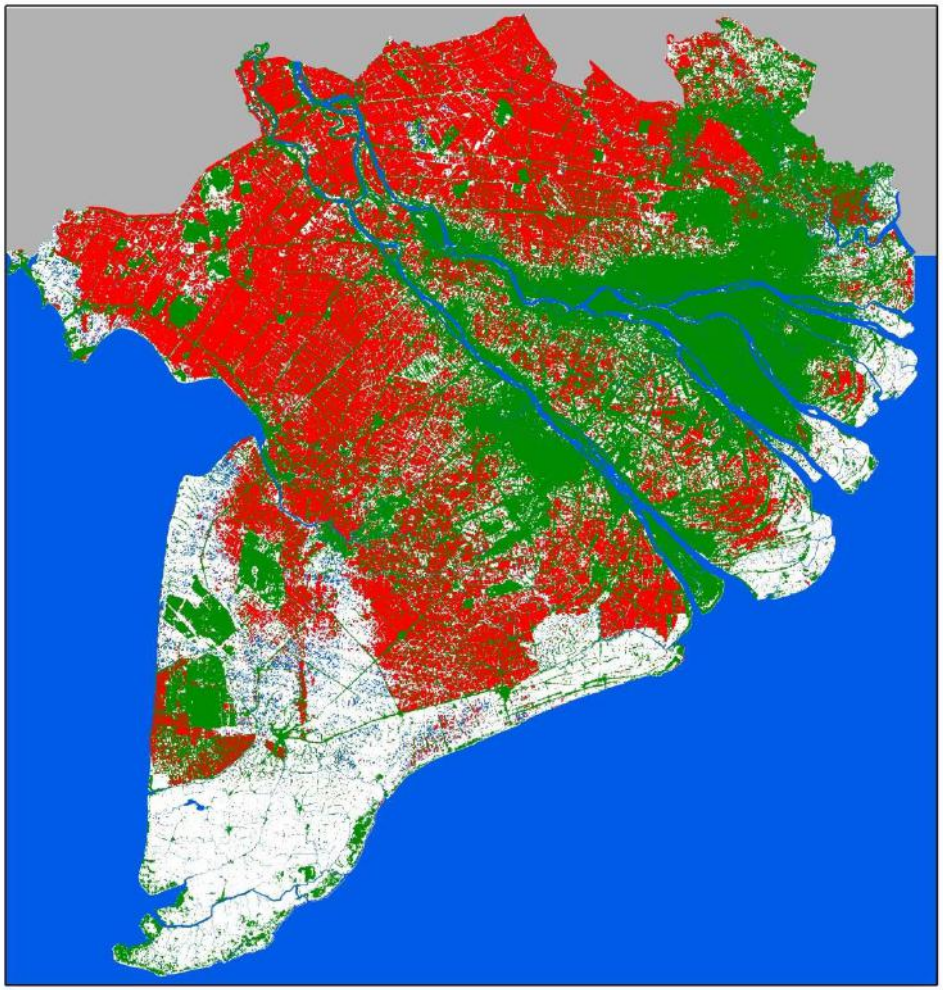
Data set: ALOS-2, 2016-2017, Mekong Delta



Data acquired every 42 days

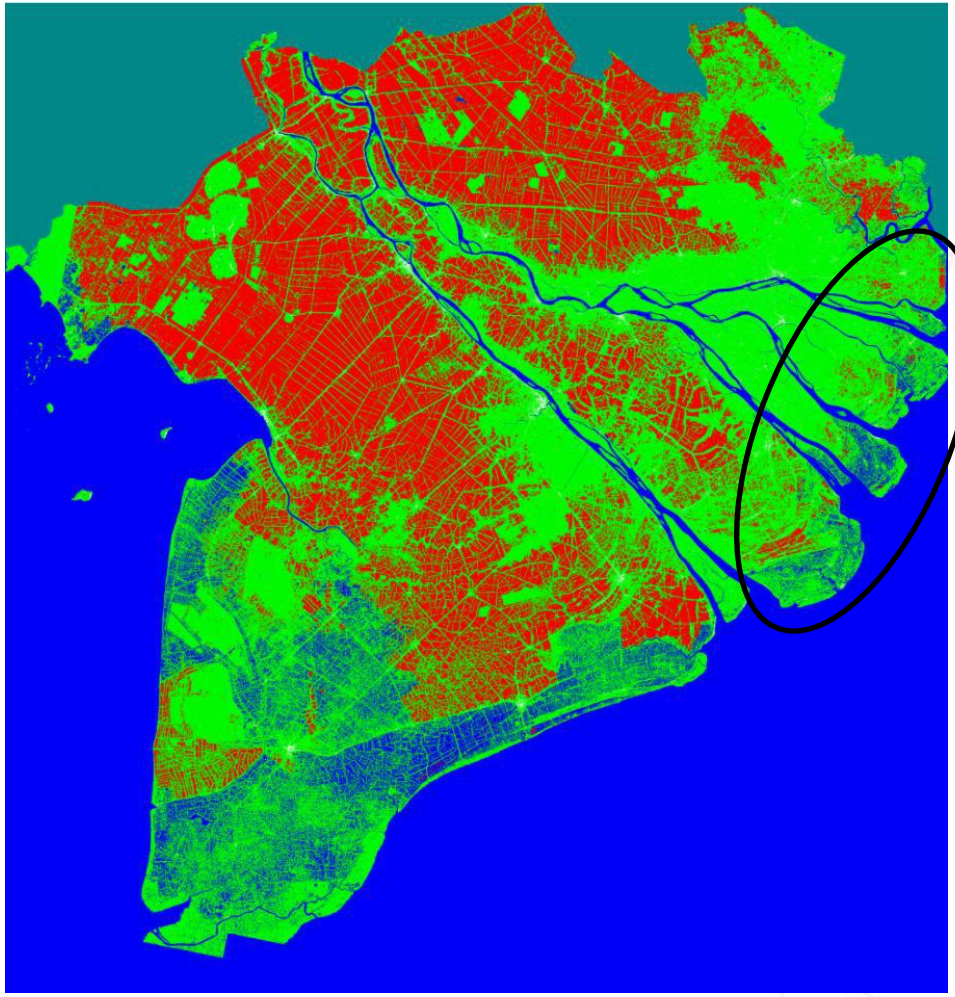


Data set: ALOS-2, 2016-2017, Mekong Delta

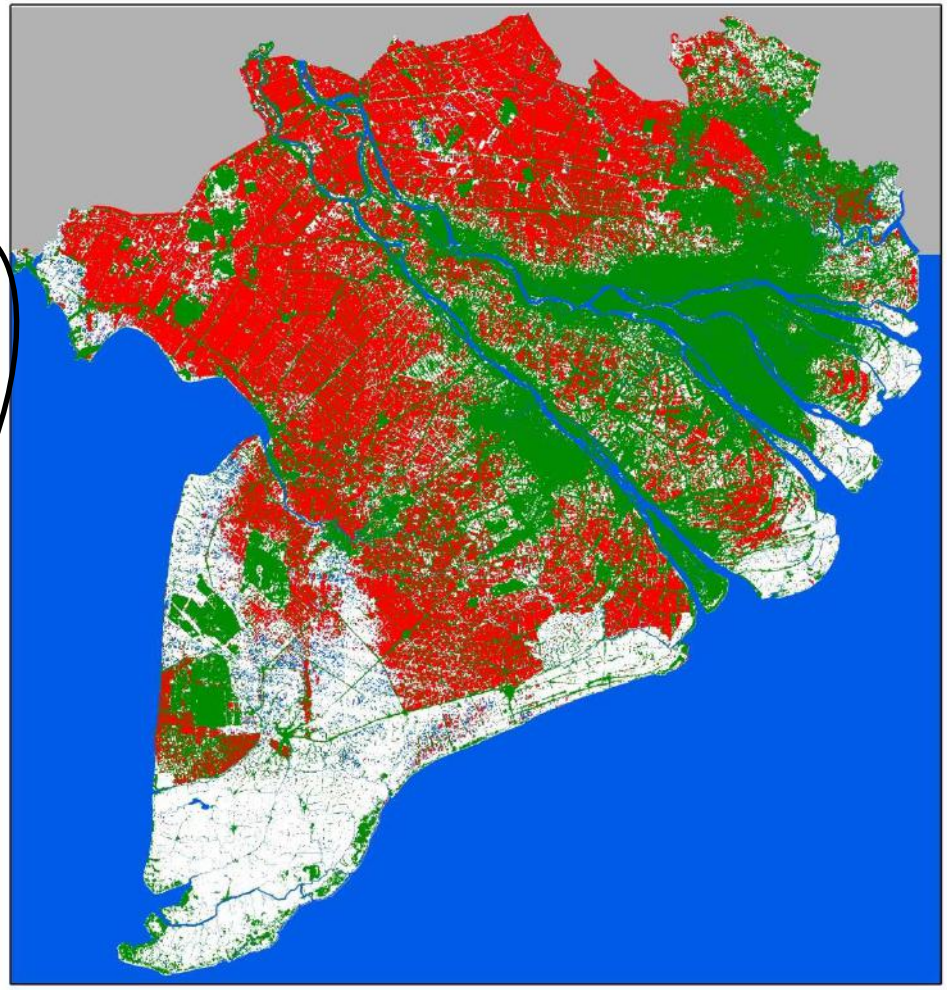


Rice Map of WS 2017 (using ALOS-2 images)

Data set: ALOS-2, 2016-2017, Mekong Delta



Rice map of WS 2016 (using S-1 images)
Reduced area caused by shortage of water and saline water intrusion



Rice map of WS 2017 (using ALOS-2 images)

Ongoing research works

- VNRice (Applied research on the multi-temporal, multi-resolution optical and radar remote sensing data for rice planted area monitoring and rice yield, production estimation in the Mekong Delta and Red River Delta)

  2017-2019 (30 months), State level project

  Rice crop area maps; yield & production estimation; crop calendars/ crop growth status

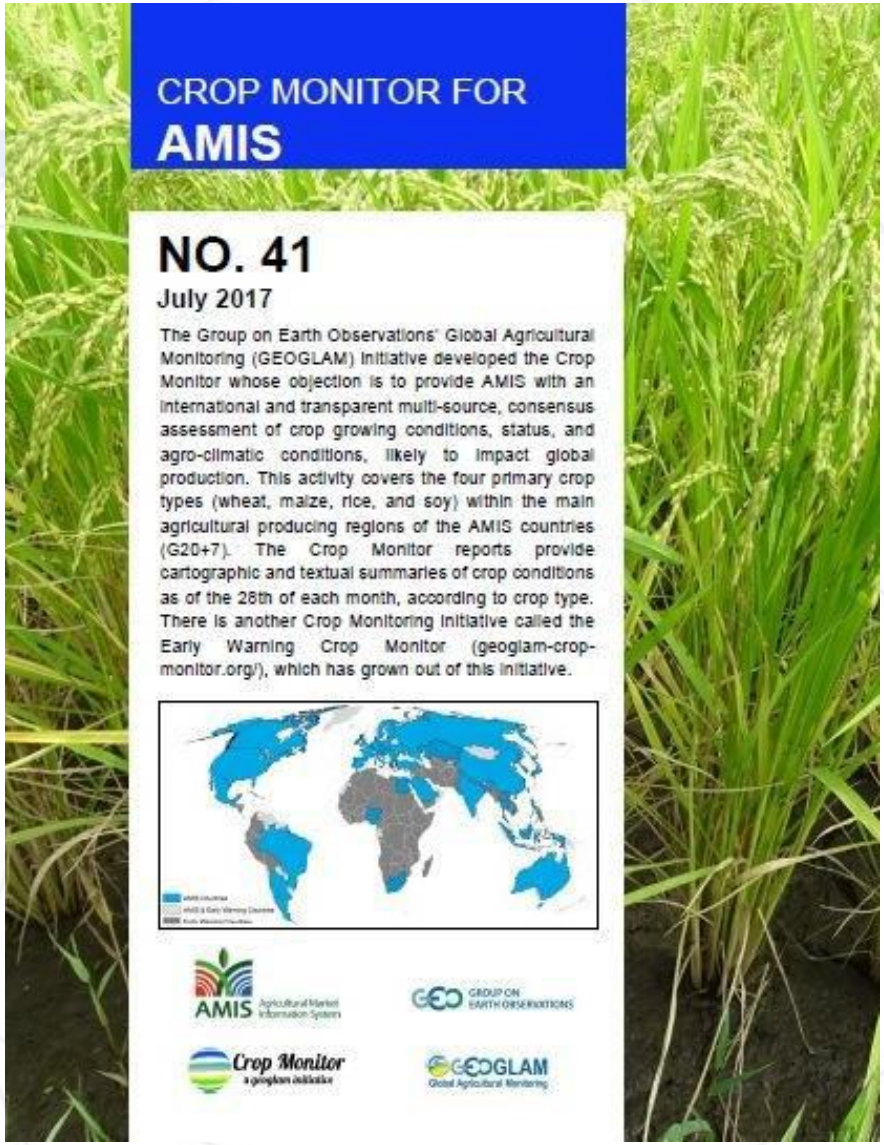
- Catch Mekong (Eco-environmental Changes in Vietnamese Mekong Delta & Impact Assessment of Uncontrolled Economic Activities from Mekong Basin)

  2017-2020 (36 months), State level project

Catch • Mekong

Discussion

- Extend the target area and increase the observation frequency;
- Validation activities for the rice crop estimation;
- Capacity building activities for end user.
- Information dissemination: crop monitor for Vietnam

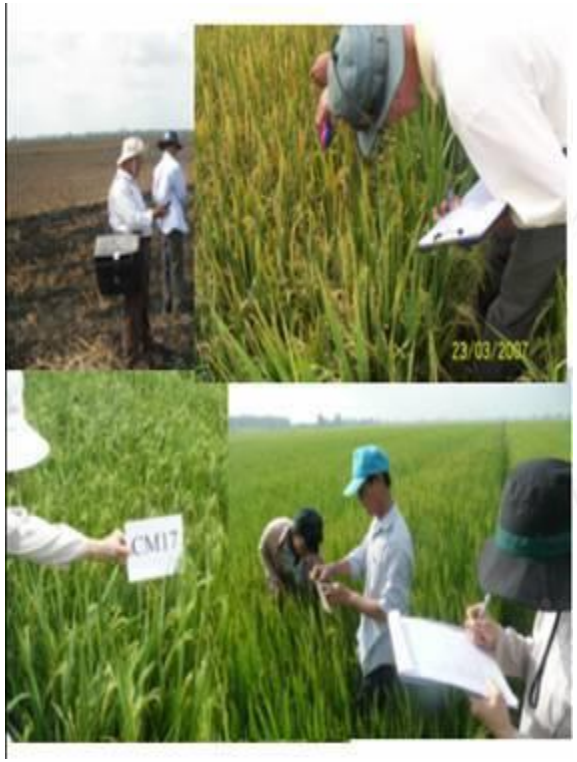


VNSC Data Cube plan

- Place: Hanoi Head quarter office
- Applications:
  - Rice monitoring
  - Forest monitoring
  - Water quality
- Infrastructure: by help of ISMG (I. M. Systems Group, Inc.)
- Satellite Data:
  - Landsats from USGS
  - ALOS from JAXA
  - Sentinel-1&-2 from ESA
- Software:
  - Supports from CSIRO/CEOS

- Pilot setup – 6-7 April 2017
- New Computer system by June, 2017
- Data developer training: July-Aus., 2017
- Technical development: Aus.-Oct., 2017
- Testing: Nov. 2017
- System working and workshop: Dec. 2017

Mekong Data cube: pilot cube of Vietnam Data cube: Landsat, Sentinel-1&-2, ALOS-2



Thank you

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