

Quantifying Changes in Agricultural Intensification, Expansion and Loss in Monsoon Asia in 2000-2010



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Vietnam: **Vietnam Academy of Sciences and Technology: Lam Dao Nguyen, Nguyen
Dinh Duong**



National Science Foundation
WHERE DISCOVERIES BEGIN



Japan Aerospace Exploration Agency

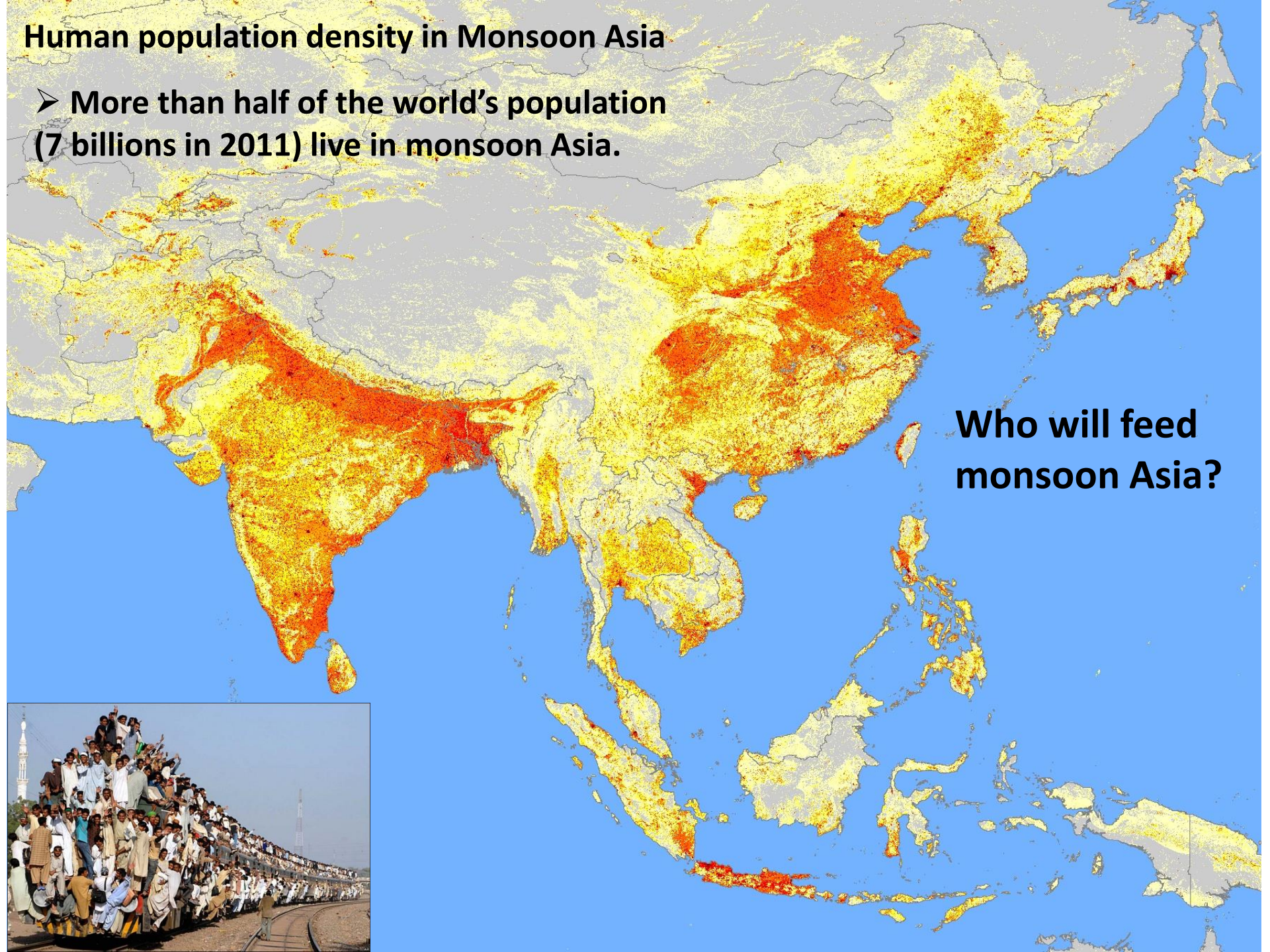


National Institutes of Health

The Nation's Medical Research Agency

Human population density in Monsoon Asia

- More than half of the world's population (7 billions in 2011) live in monsoon Asia.



Who will feed monsoon Asia?



Cropland area

Cropping intensity

number of crops per year in a farm field

Single, double and triple

Crop calendar and phenology

planting date, green-up date, harvest date

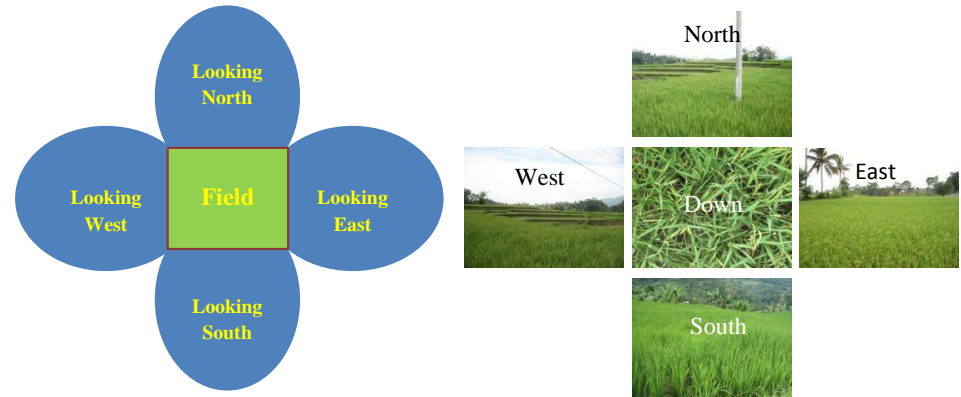
Crop management

irrigation, inundation, fertilization, no-tillage

Crop type

**paddy rice, winter wheat, spring wheat, maize,
soybean**

Protocol for taking photos in the field



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Global Geo-Referenced Field Photo Library

Welcome, you are not logged in
[Home](#) | [Browse](#) | [Map](#) | [Log in](#) | [Register](#)

Search by coordinates: Search by date: Search by metadata: Search by region:

Longitude min: Longitude max: From: Categories: Countries:

Latitude min: Latitude max: To: Users: Geographical:

Search by keywords:

19698 photos

India, Bangladesh, Myanmar (Burma), Thailand, Cambodia

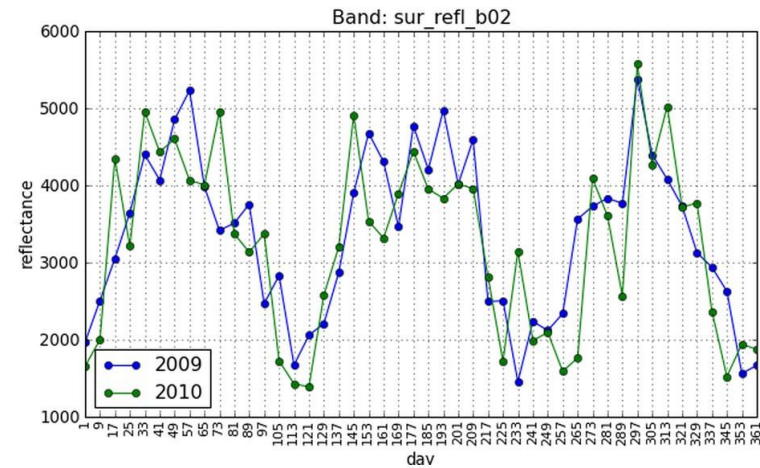
Date: 2010-07-28
91.5169 °E, 22.9336 °N
Category: Cropland/Natural Vegetation Mosaic
[View MODIS time series data](#)

Date: 2010-07-28
91.5342 °E, 22.8967 °N
Category: Urban and Built-Up
Field notes: Rice-paddy
[View MODIS time series data](#)

Date: 2010-07-28
91.5402 °E, 22.8766 °N
Category: Croplands
Field notes: Rice-paddy
[View MODIS time series data](#)

Date: 2010-07-28
91.5509 °E, 22.8291 °N
Category: Croplands
Field notes: Rice-paddy
[View MODIS time series data](#)

Individual photos are linked with time series MODIS data (2000-present)



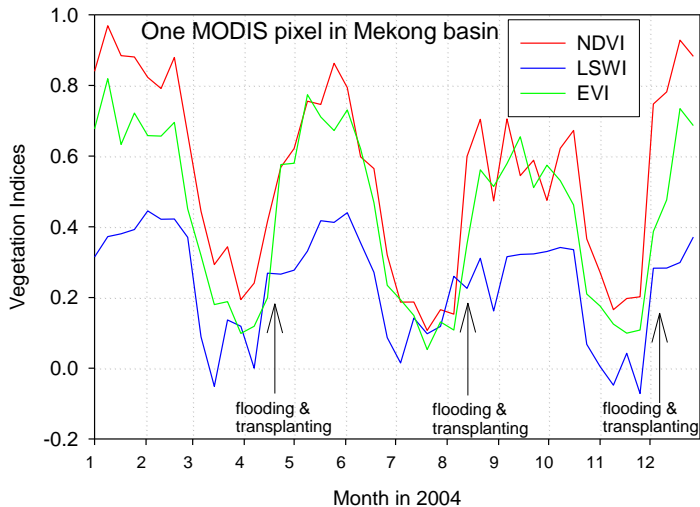
Time series MODIS imagery

Surface reflectance data

250m (2 bands), 500-m (7-bands)

Land surface temperature data

1000-m



Julian day 145-152 (upper panel)
and 185-192 (lower panel) 2000

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Multi-pane MODIS Browser

Click within any map window in order to synchronize map windows views to the same center position.
To change map view independently drag the map or use select tool.
To zoom all maps to the same altitude click the 'Synch Zoom' button.

[Add map](#) | [View MODIS time series data](#)

EVI

- No Data
- 1.00 - -0.20
- 0.20 - -0.10
- 0.10 - 0.00
- 0.00 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.40
- 0.40 - 0.50
- 0.50 - 0.60
- 0.60 - 0.70
- 0.70 - 0.80
- 0.80 - 0.90
- 0.90 - 1.00

EVI 145 2000 Update Modis Map Synch Zoom

EVI 185 2000 Update Modis Map Synch Zoom

FlightReservation.pdf Show All

MODIS-based automated algorithm

MODIS land surface reflectance

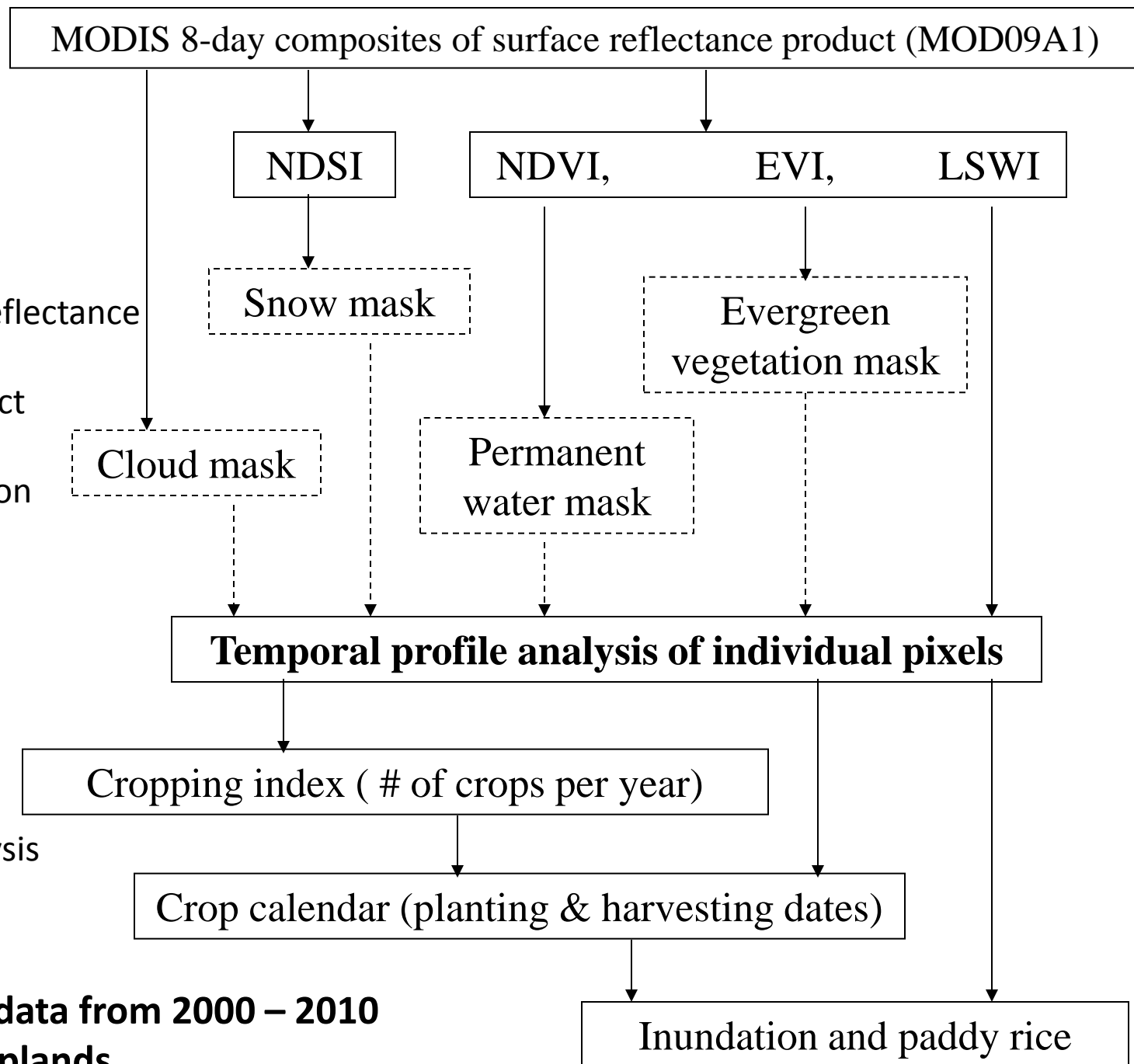
MOD09A1 data product
8-day composite
500-m spatial resolution

Vegetation indices

NDVI
EVI
LSWI

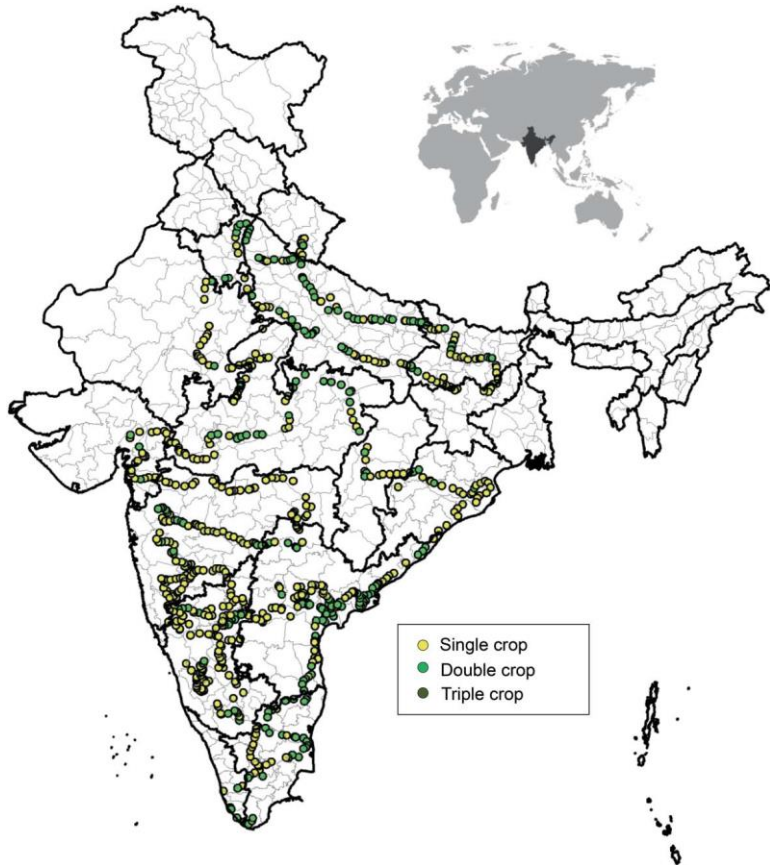
Temporal profile analysis

MODIS time series data from 2000 – 2010
Annual maps of croplands



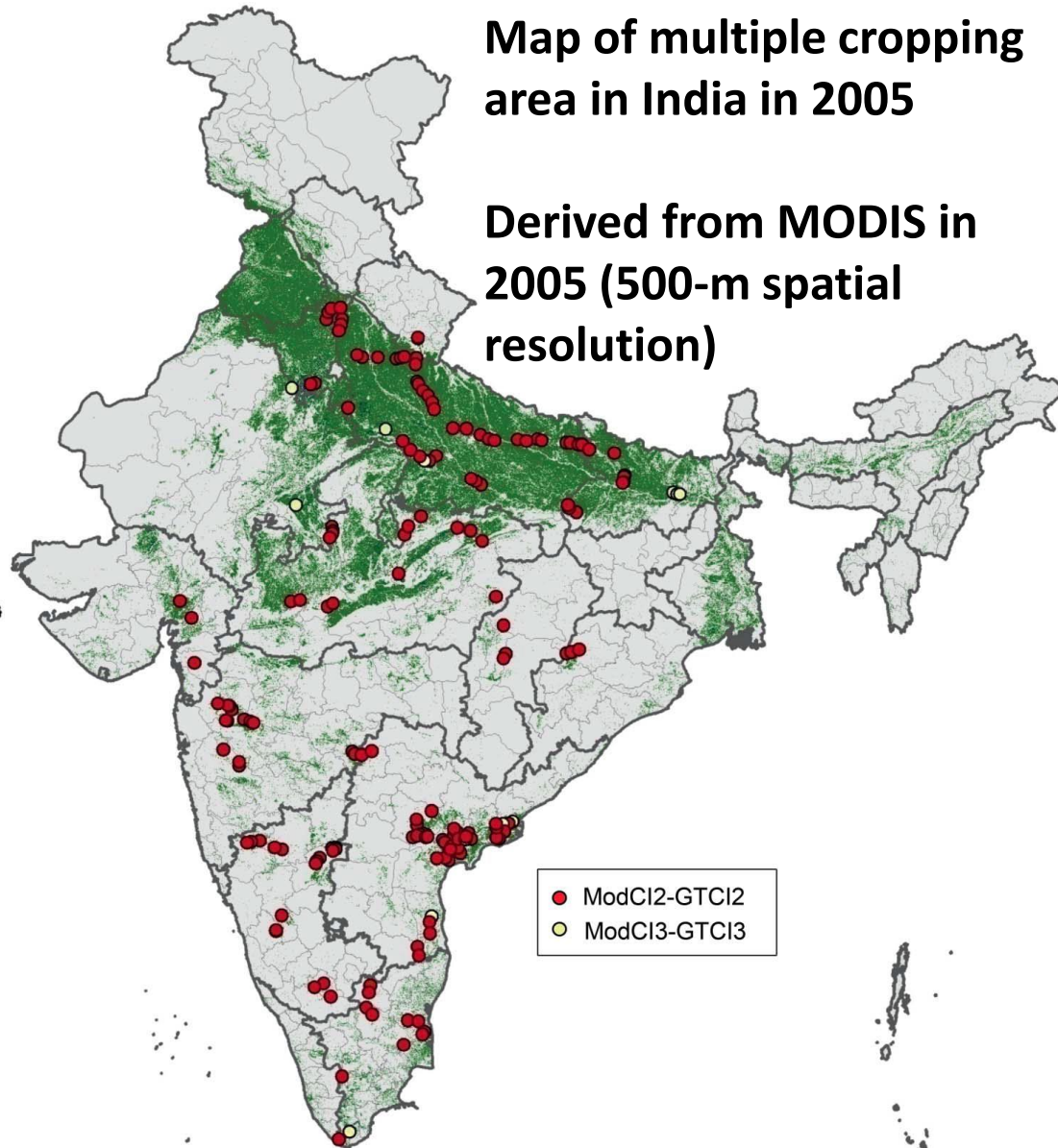
Cropping intensity

Geo-referenced field photos for CAL/VAL

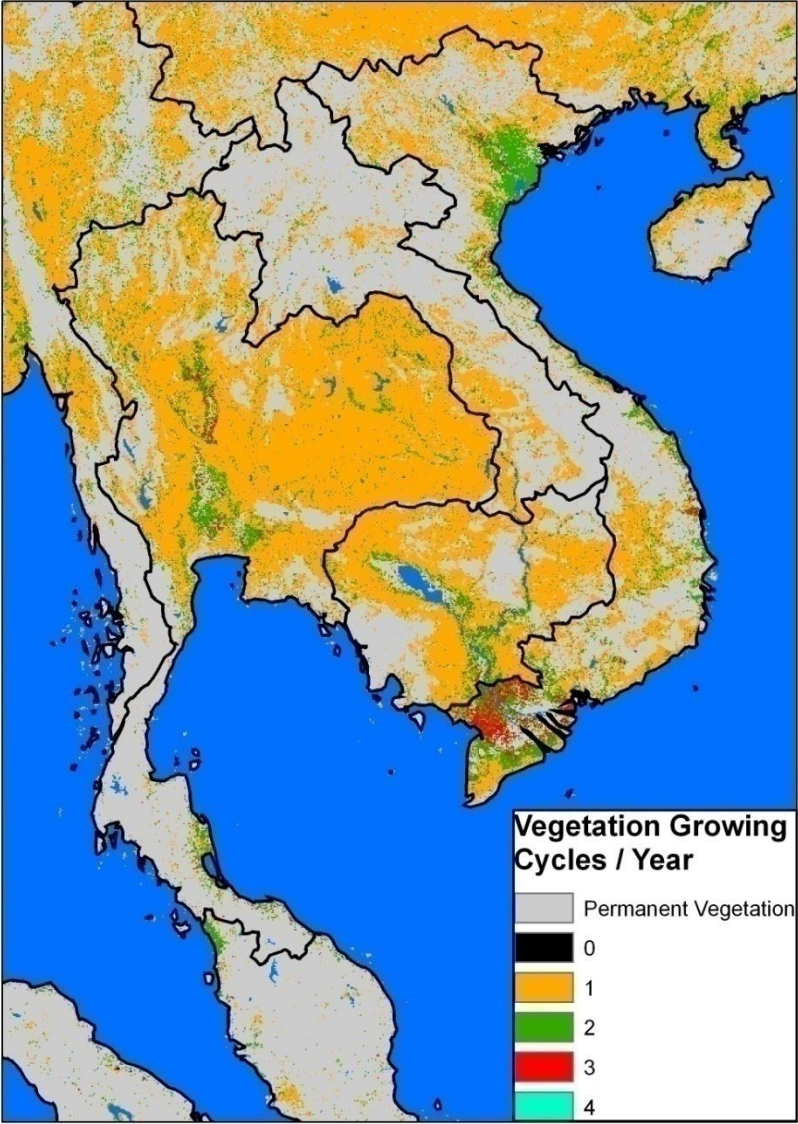


Map of multiple cropping area in India in 2005

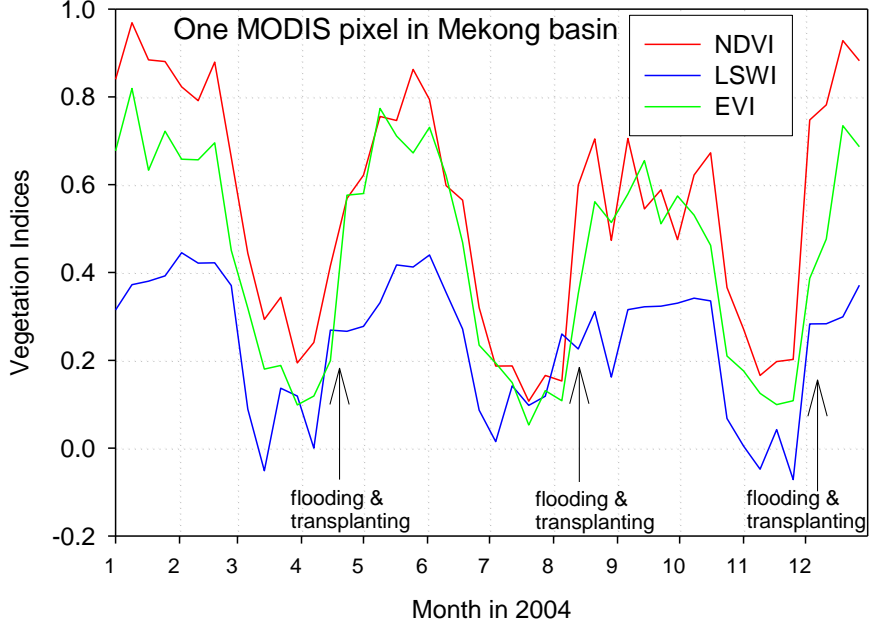
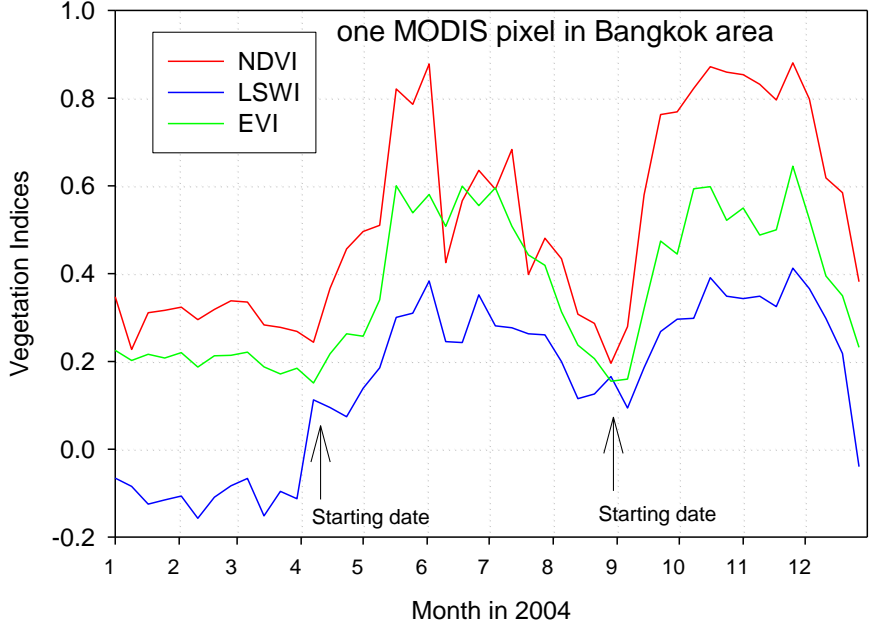
Derived from MODIS in 2005 (500-m spatial resolution)

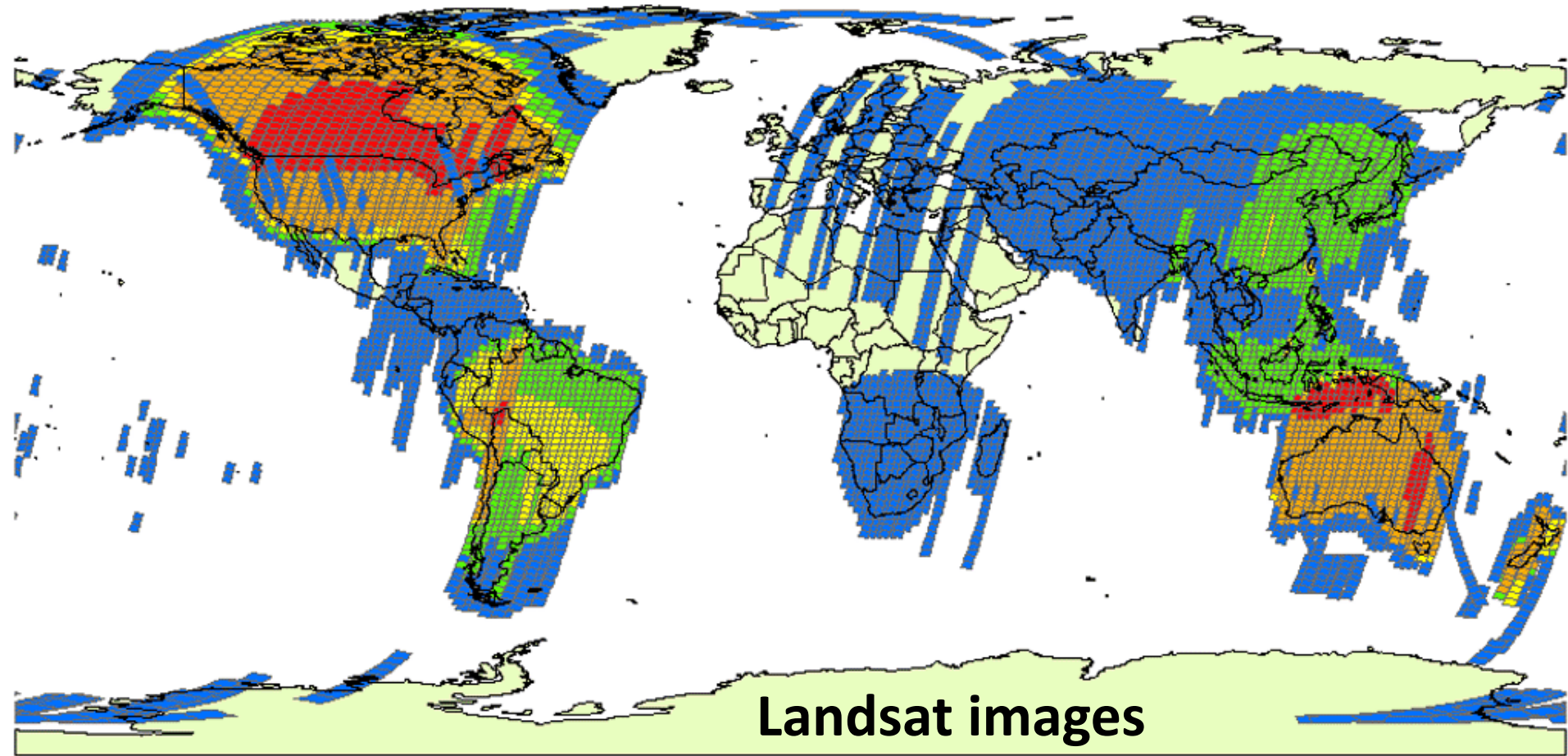


Maps of croplands from MODIS



Cropping intensity map in 2004





Landsat images

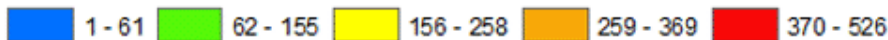
LGAC WRS2 Scenes

Status as of July 31, 2012

Acquisition Date Range: August 22, 1982 through July 30, 2012

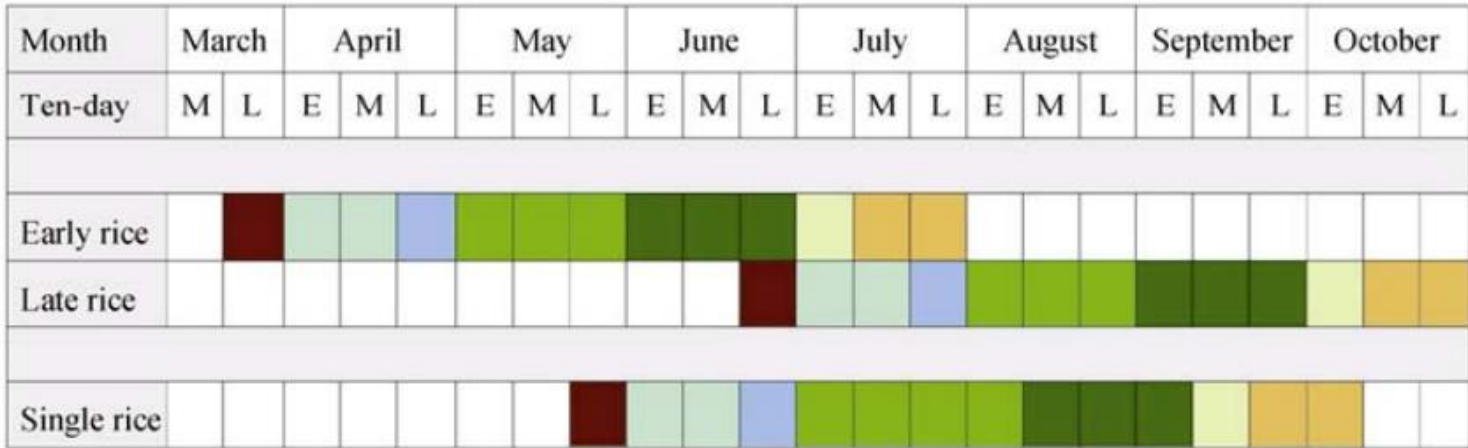
1,051,226 Total Scenes Acquired

8,580 Unique Path/Rows



Objective: -- Use Landsat time series data to map paddy rice at 30-m spatial resolution

Algorithm development



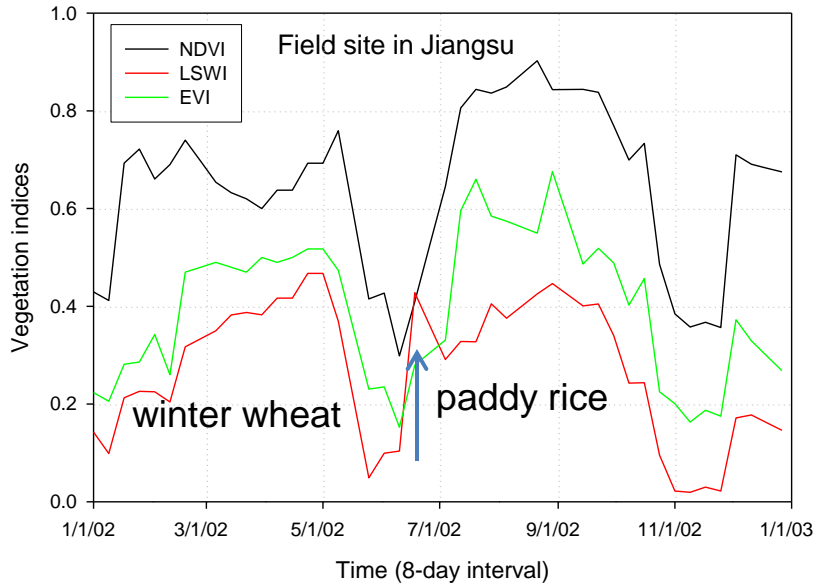
Growth stages



Crop calendar and phenology in Poyang lake, China

Local knowledge from farmers

Dynamics of winter wheat and paddy rice fields in Nanjing, Jiangsu, China



(c) 7/3/99 2-weeks after rice transplanting



(b) 6/11/99 rice field preparation

(d) 9/6/99 rice plant heading



Algorithm development

Transplanting/flooded phase

Canopy closure phase



Will Landsat images acquired in the time windows of these two phases be sufficient to identify and map paddy rice at 30-m spatial resolution?

Algorithm development

Case study --- Bangladesh

9 Landsat images during January – April, 2009 – 2010 (p138/r043)

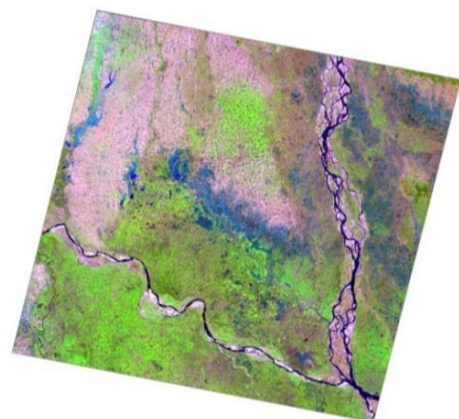
Field surveys were carried out in May 2010. 58 paddy rice ground truth points (with geo-referenced field photos) were collected and located with the Landsat scene.

Fields were flooded in February and paddy rice mature in late April/early May.

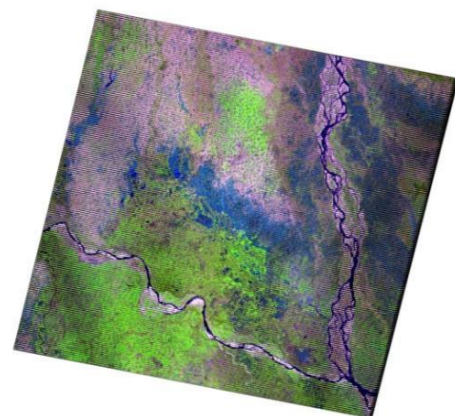
The screenshot shows the 'Earth Observation and Modeling' website interface. At the top, there is a navigation menu with links: Home, About Us, Dataset, Photo, Visualization, Models, iCarbon, GeoHealth, GIS Day, Workshop, and Account. Below the navigation is the 'Global Geo-Referenced Field Photo Library' section. A welcome message says 'Welcome, you are jin5134'. There are links for Home, Browse, Map, My Photos, Upload, Log out, and Admin Site. The search interface includes four main categories: Search by coordinates, Search by date, Search by metadata, and Search by region. Each category has input fields for various parameters like longitude, latitude, date, categories, and countries. A search by keywords field contains the word 'rice'. A 'Submit' button is located below the search fields. Below the search interface, it says '71 photos' and displays a map of Bangladesh with numerous red dots indicating the locations of the field photos. The map shows major cities and regions across Bangladesh, with the word 'Bangladesh' prominently displayed in the center.

Landsat 5 and 7 images in Bangladesh

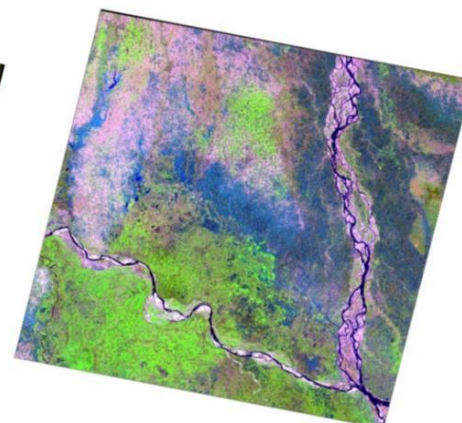
P138r043, RGB=5/4//3



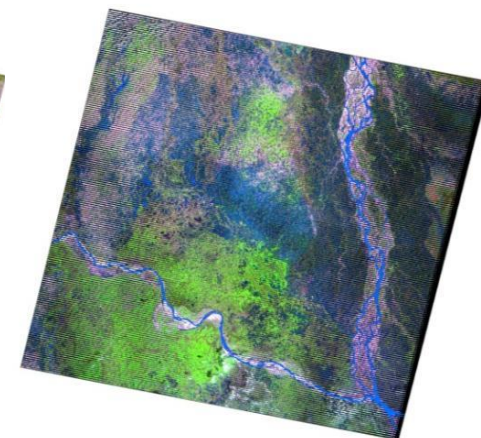
01-21-2010



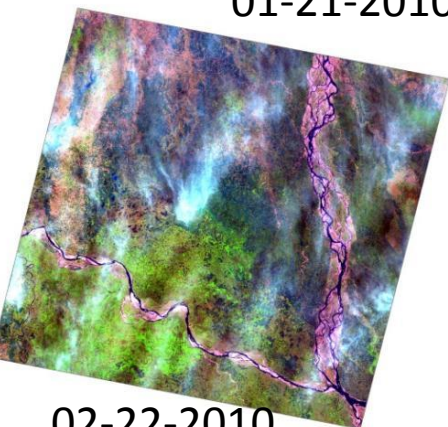
01-29-2010



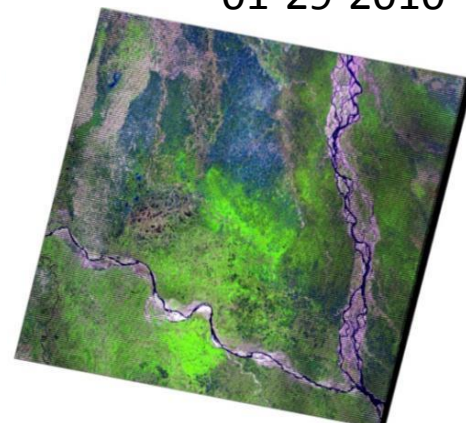
02-06-2010



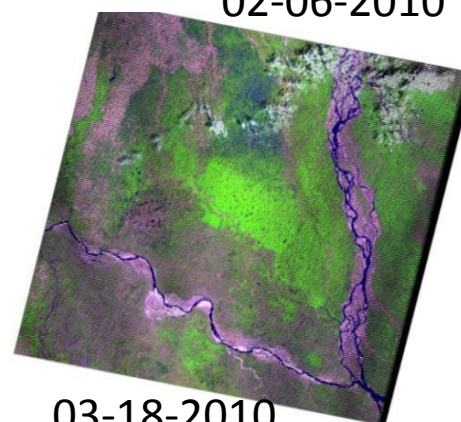
02-14-2010



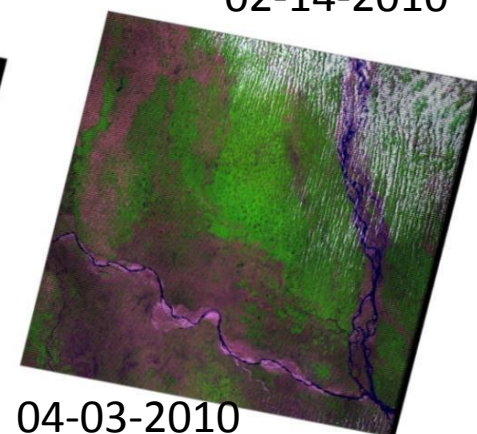
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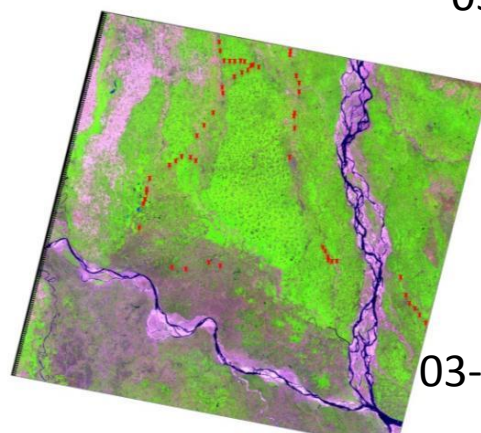
03-02-2010



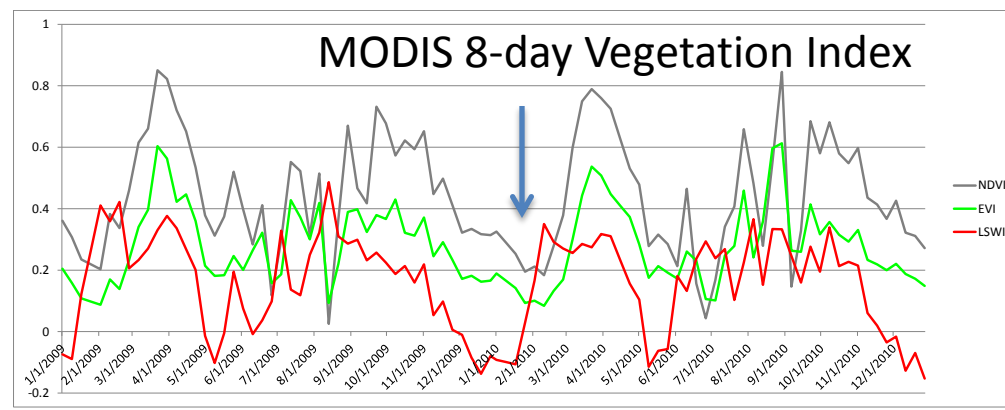
03-18-2010



04-03-2010

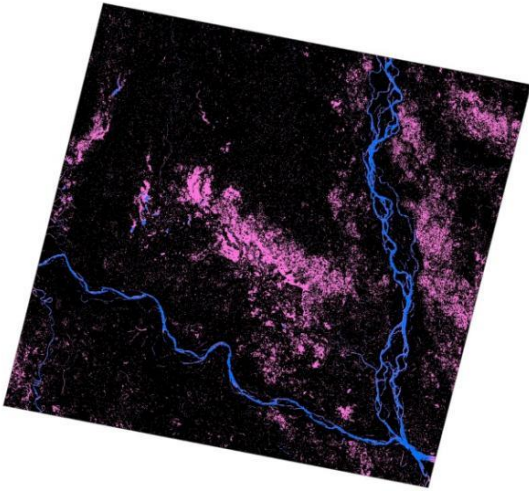


03-23-2009

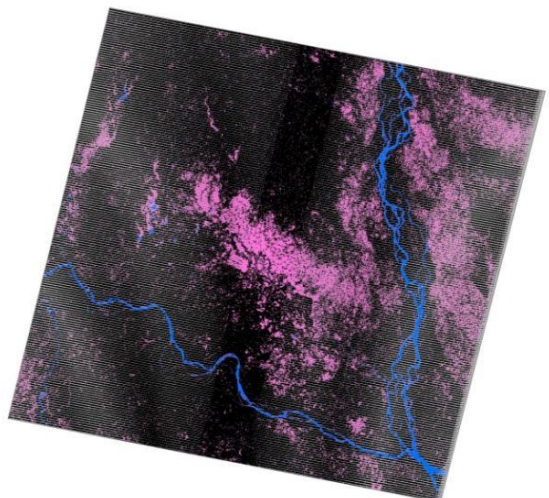


Dynamic maps of transplanting/flooded areas at various dates

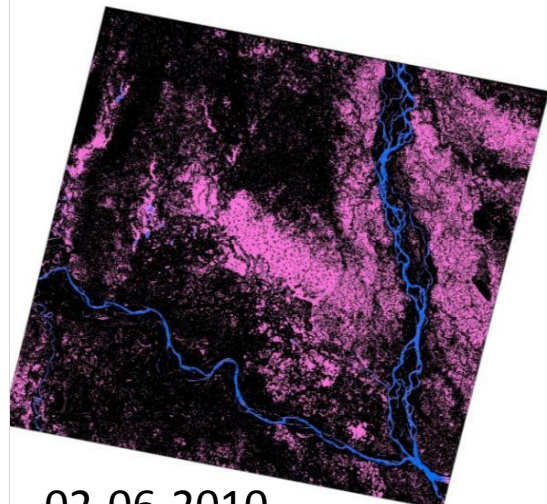
Case study --- Bangladesh



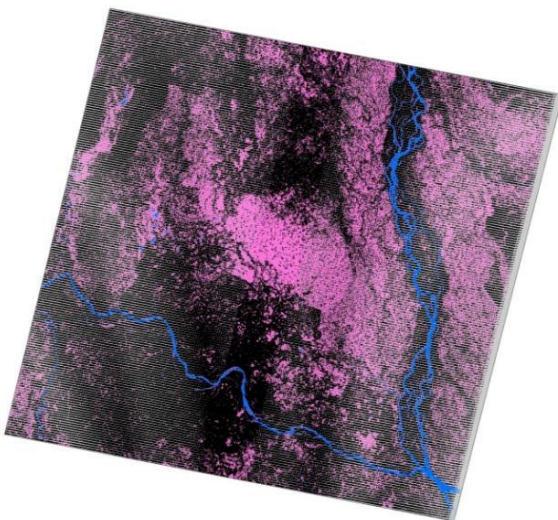
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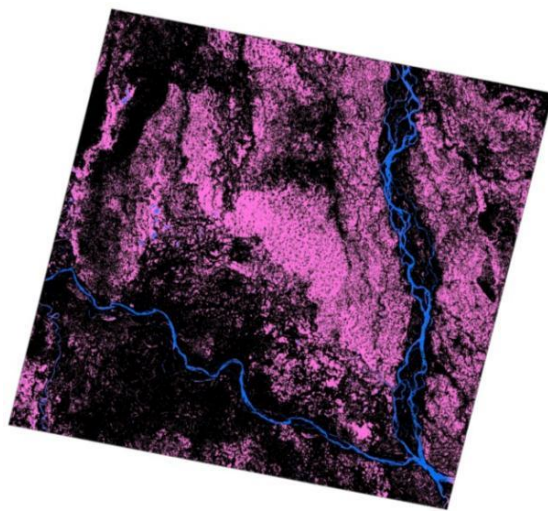
01-29-2010



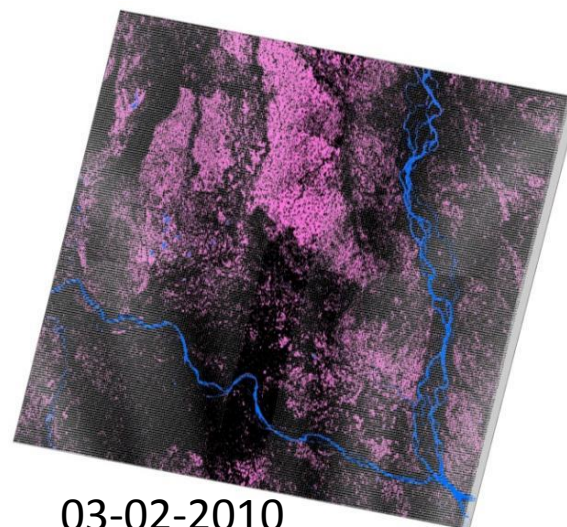
02-06-2010



02-14-2010



02-22-2010

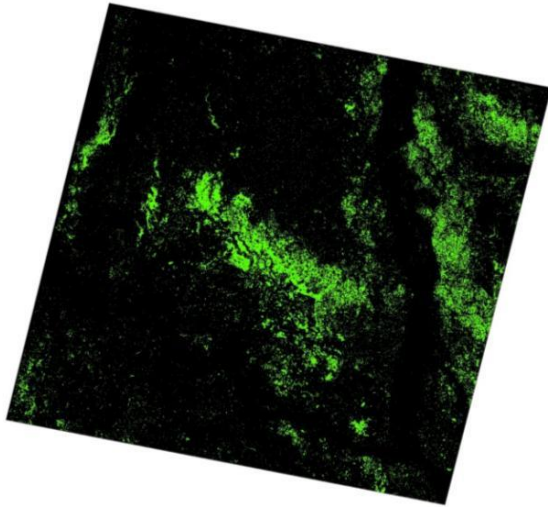


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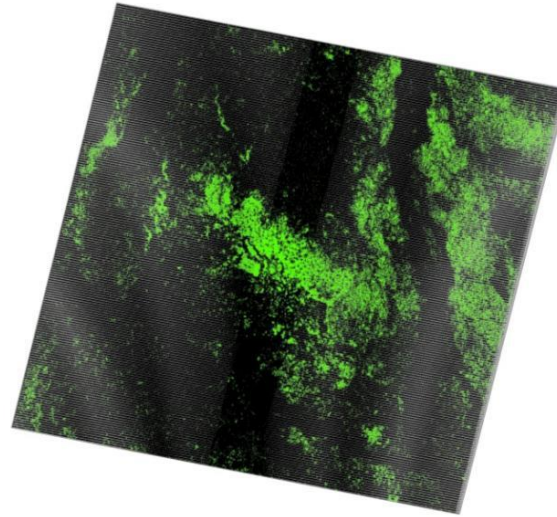


Dynamic maps of paddy rice fields at various dates

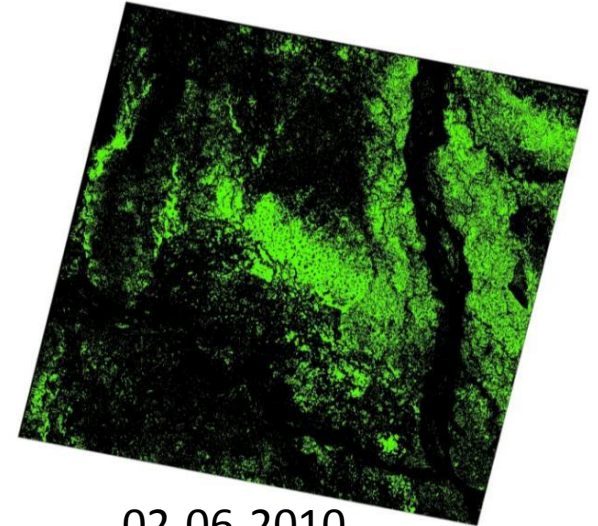
Case study --- Bangladesh



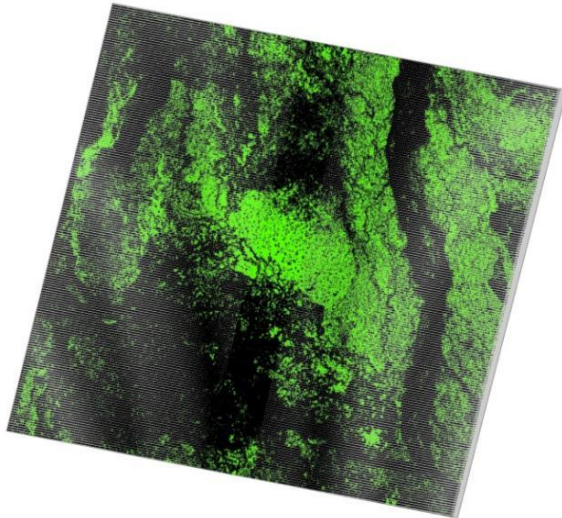
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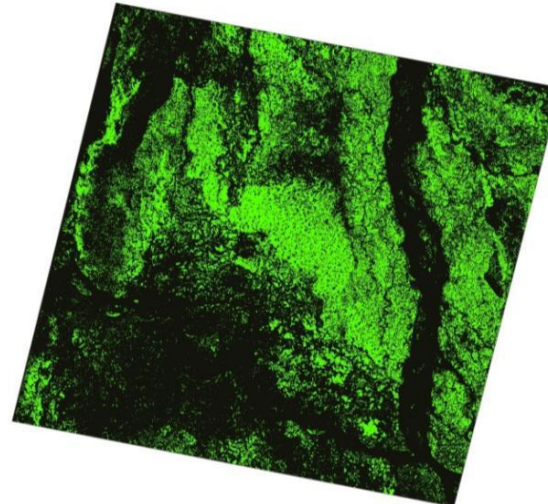
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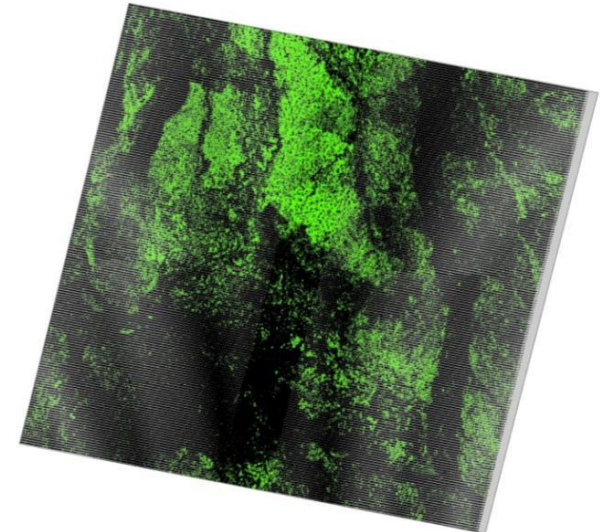
02-06-2010



02-14-2010



02-22-2010

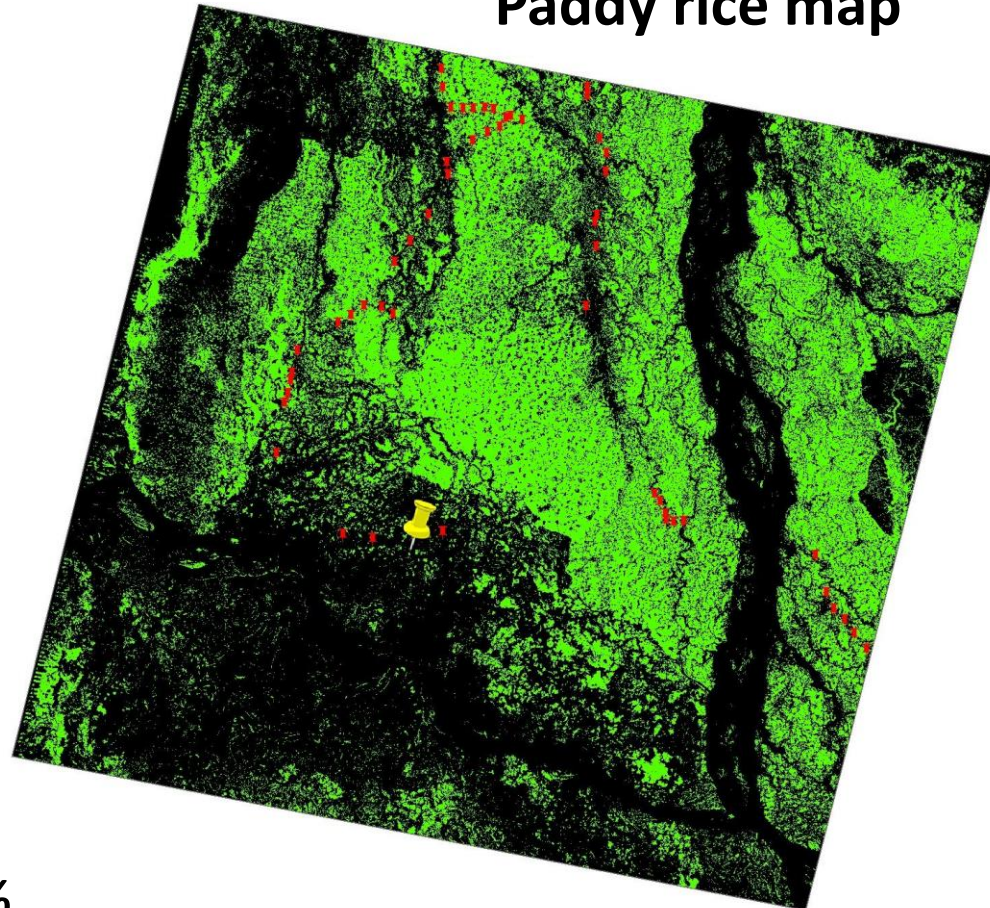
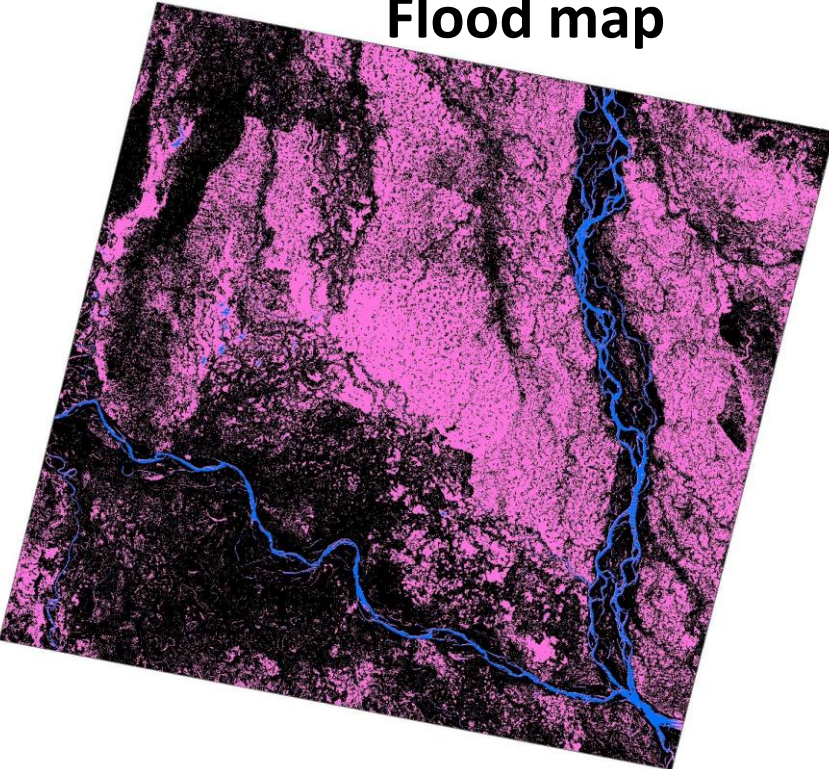


03-02-2010

Flood map

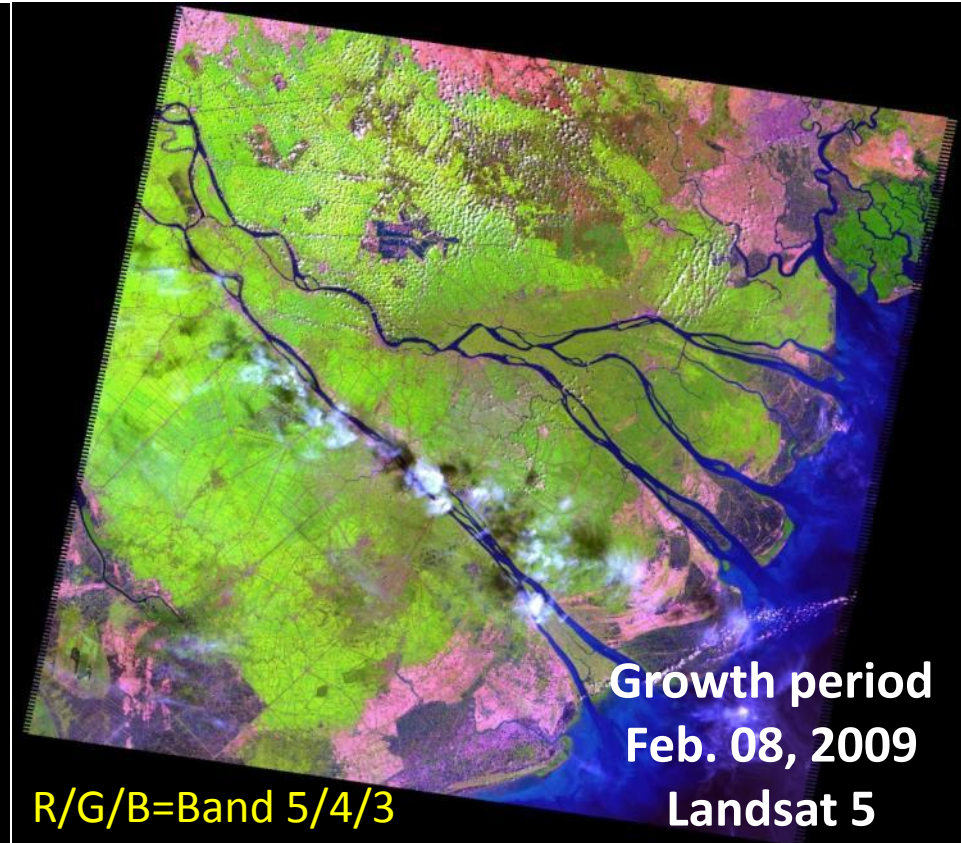
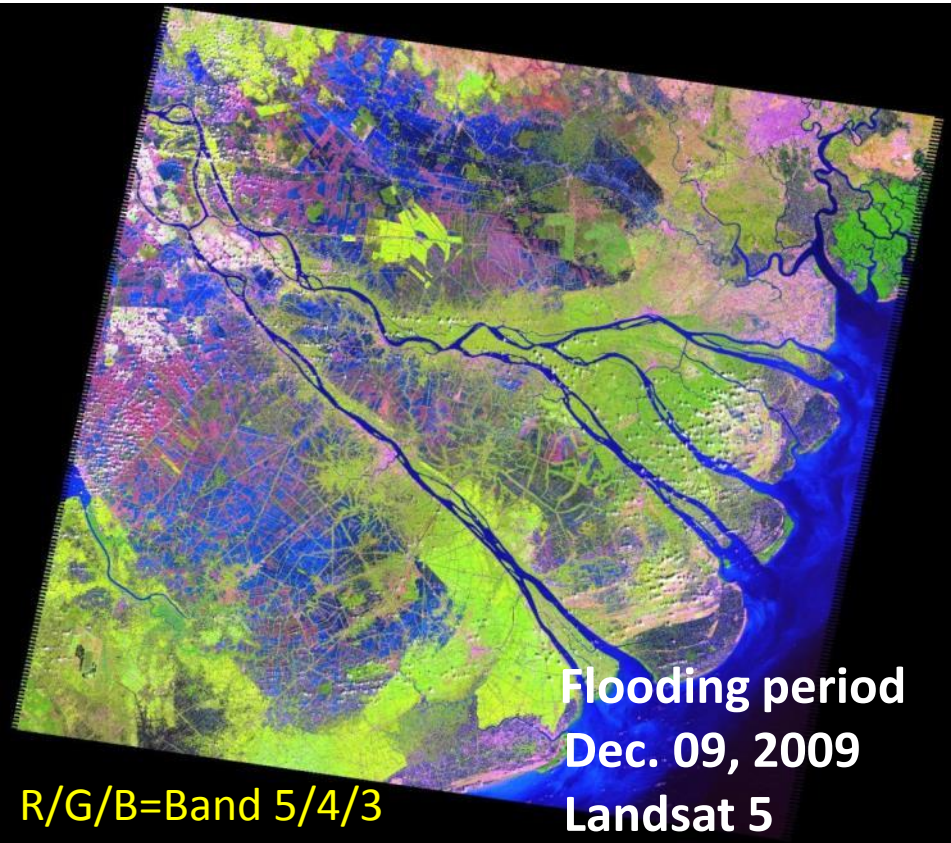
Case study --- Bangladesh

Paddy rice map



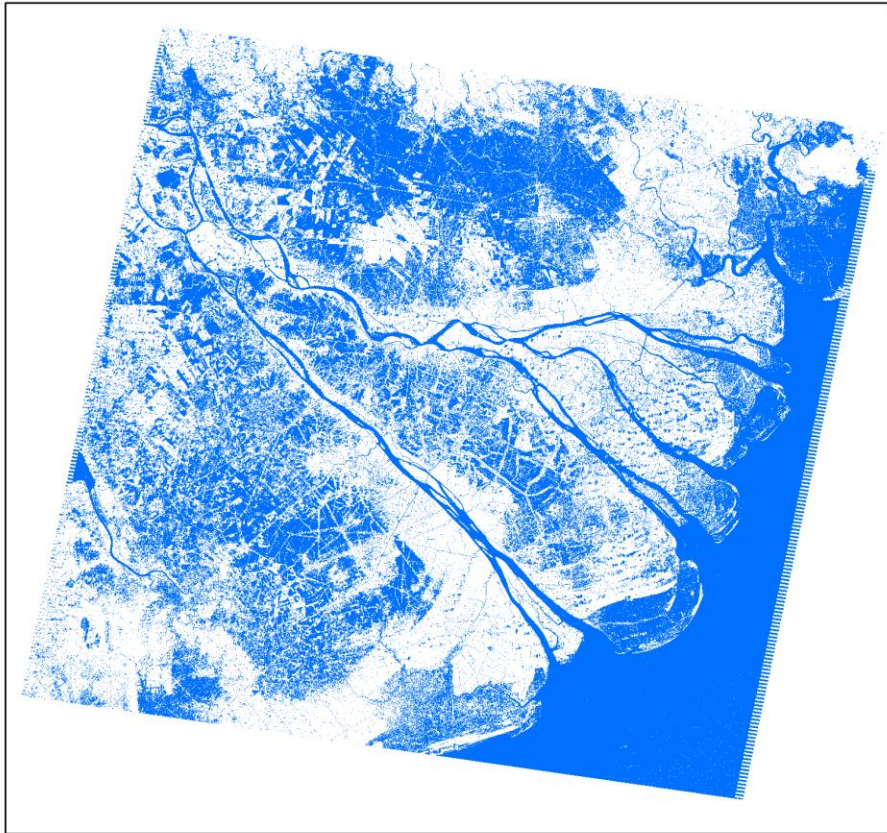
There were 57 ground truth data points, 56 out of 57 points were correctly identified as paddy rice. Accuracy=98.2%

Case study – Mekong River Delta in southern Vietnam

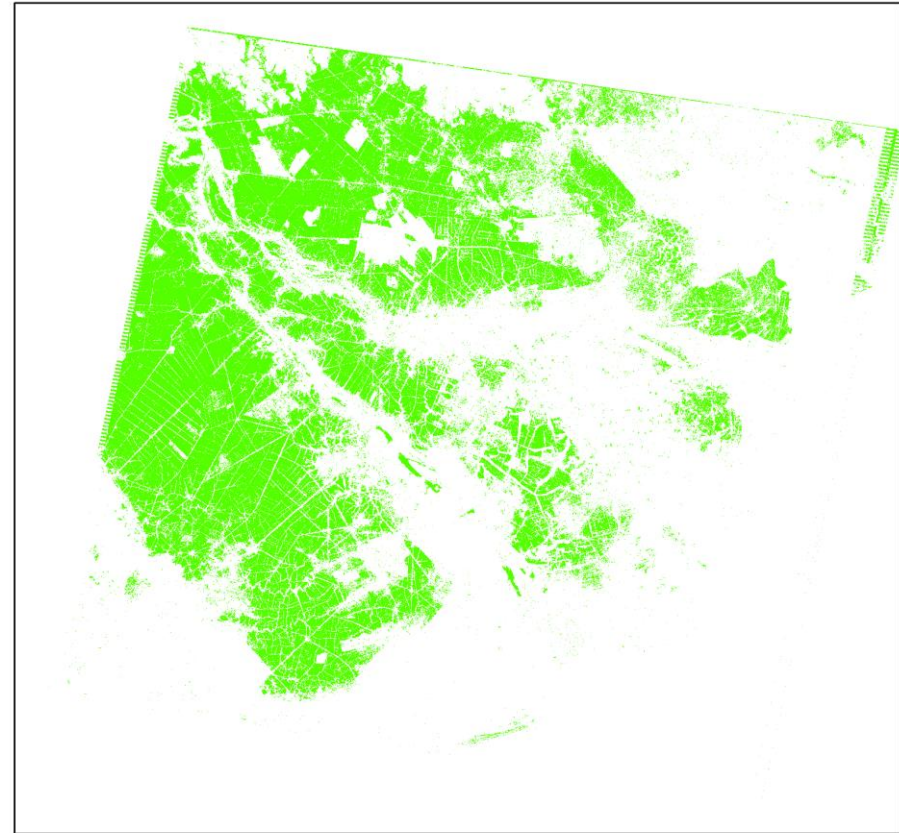


Case study –Mekong River Delta in southern Vietnam

Map of transplanting/flooded field

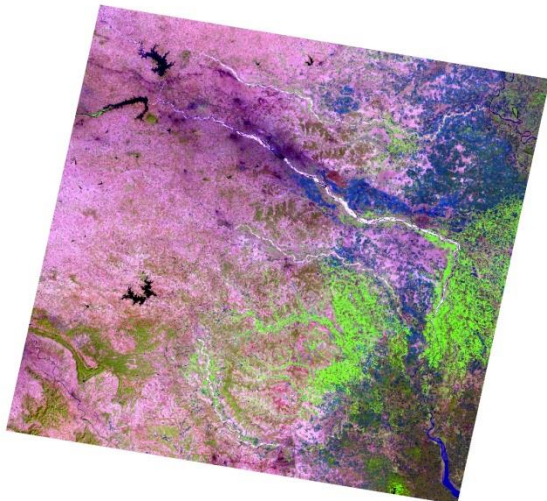


Map of paddy rice field

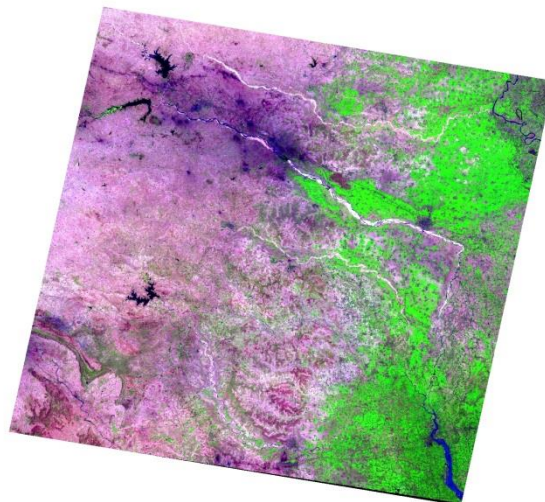


Case study -- India

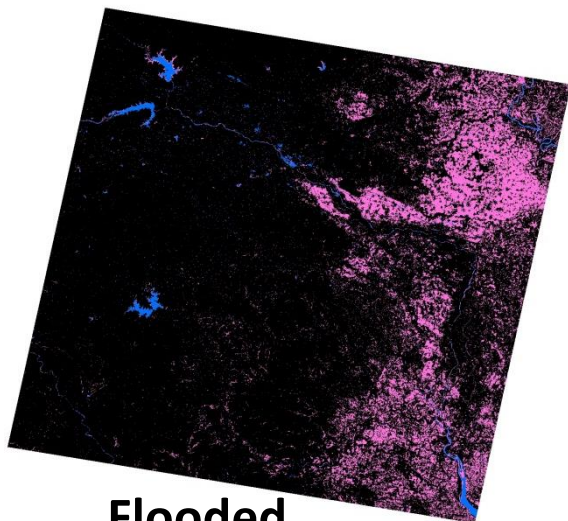
Landsat 5 p139r044



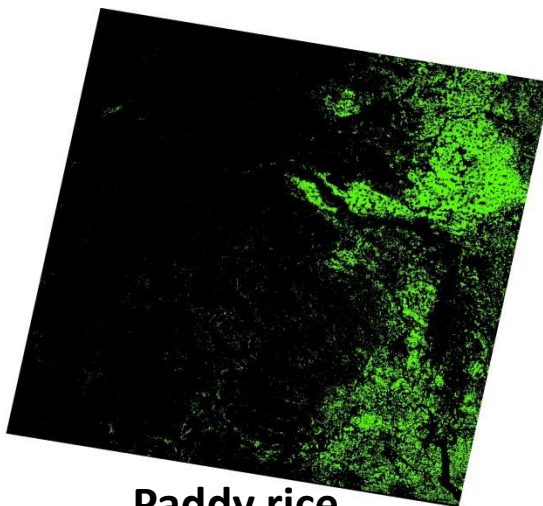
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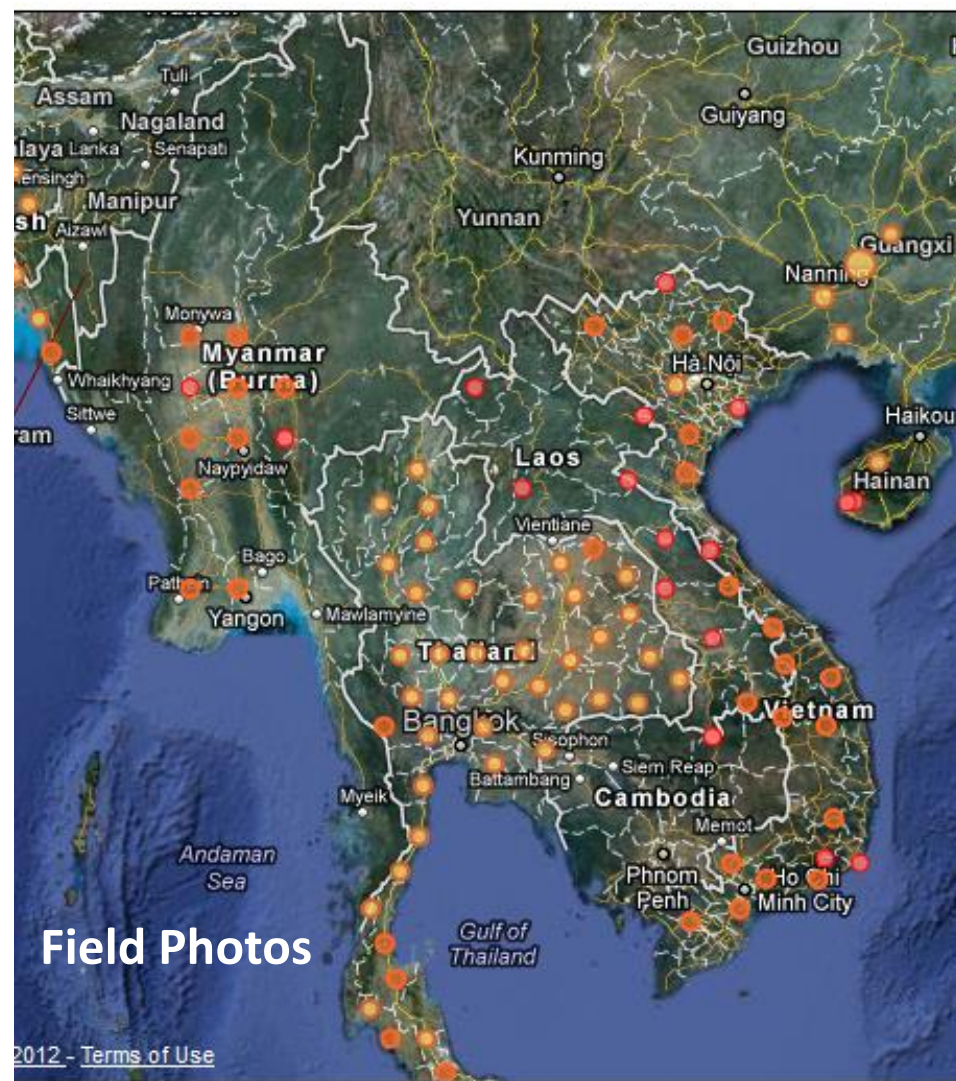
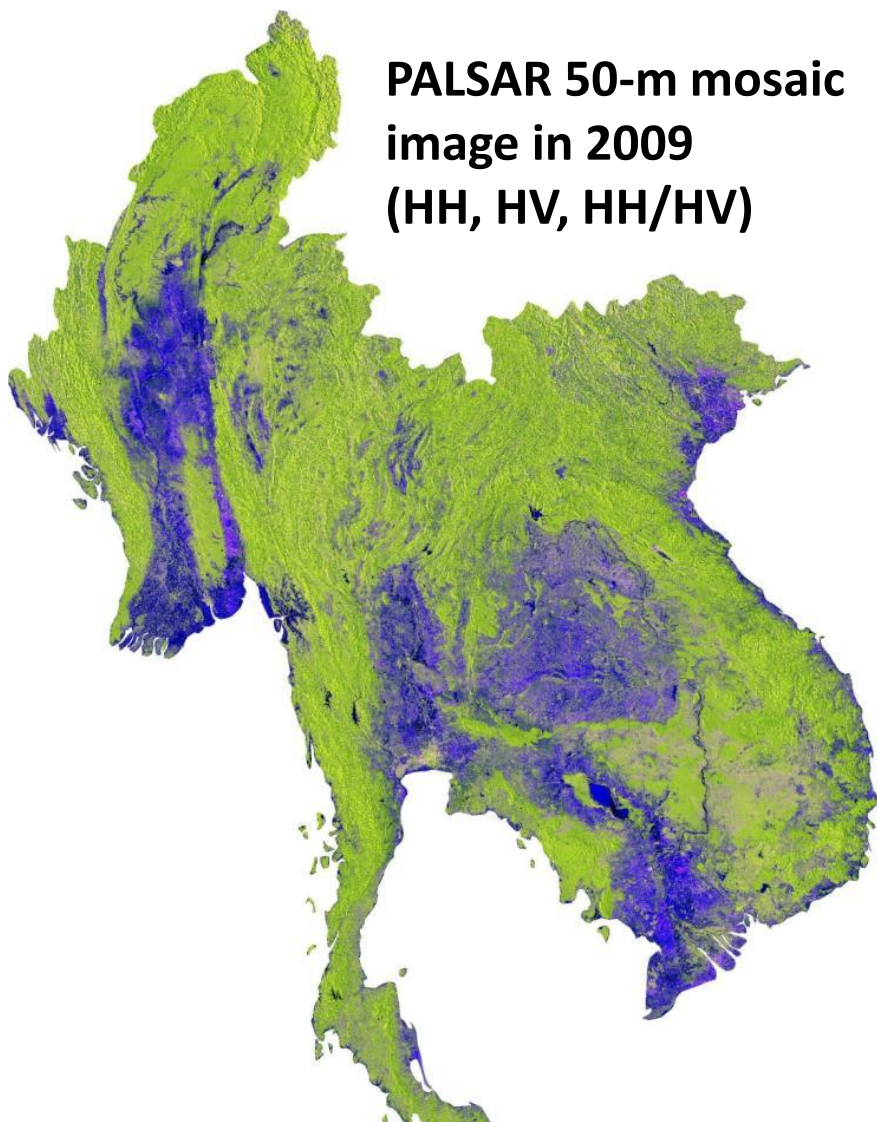
Flooded



Paddy rice

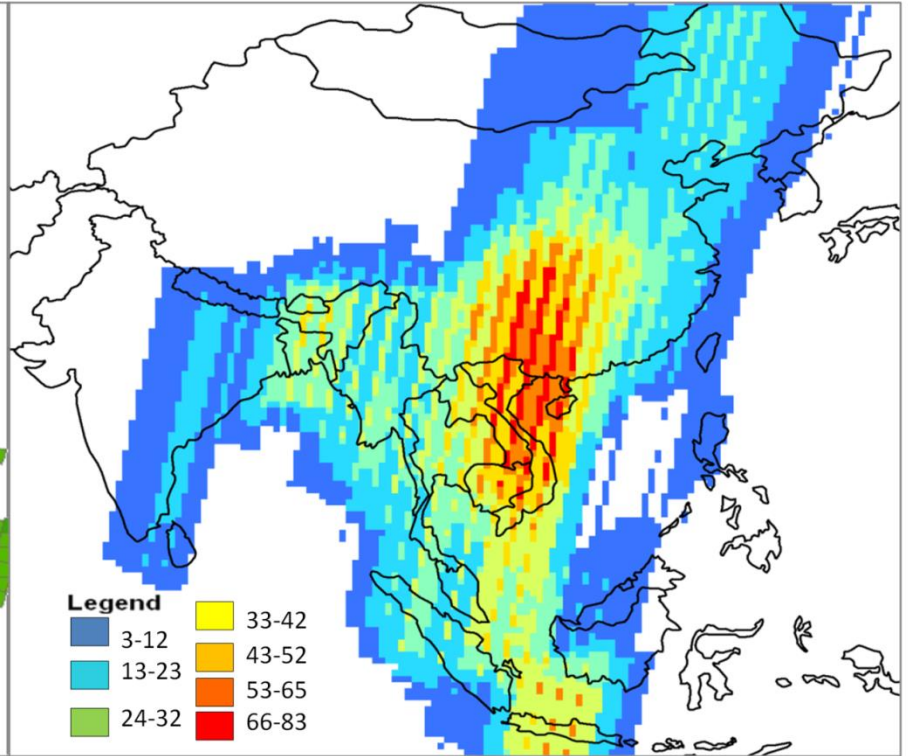
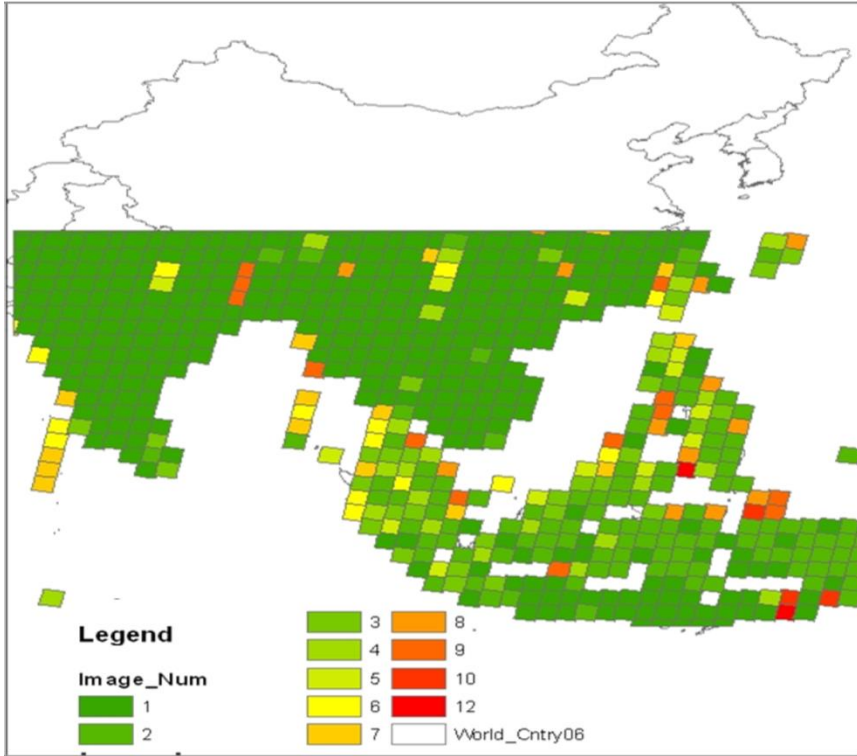


Mapping land cover in Southeast Asia at 50-m resolution



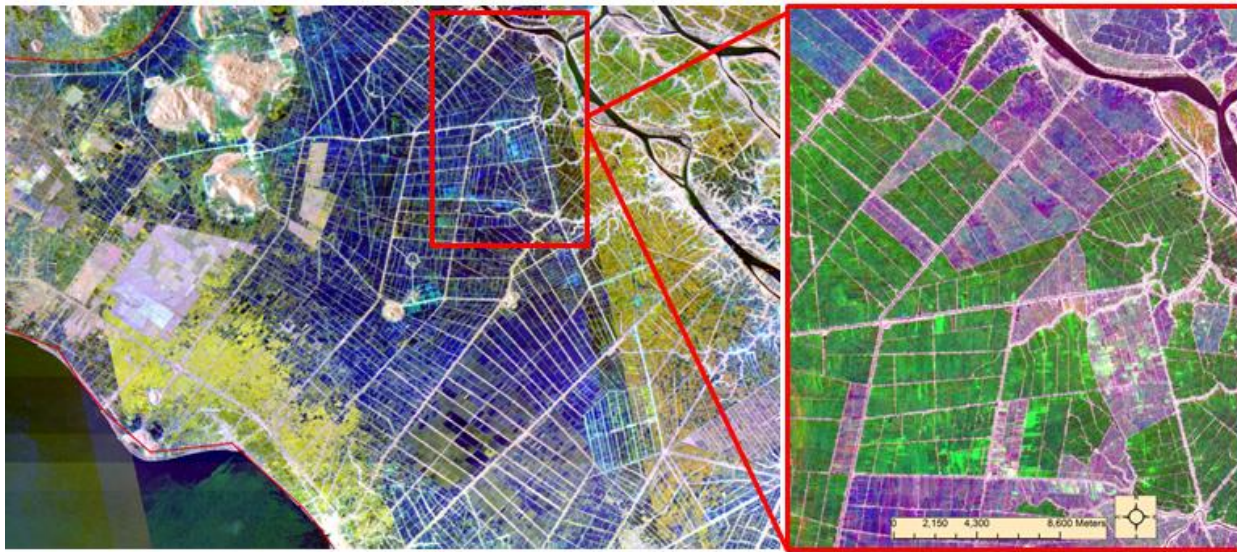
GLS-2005 Landsat

PALSAR ScanSAR imagery



South East Asia GLS2005 Landsat TM/ETM+

South East Asia K&C ScanSAR strips 2007-2009 ORT/SLT



PALSAR HH
images

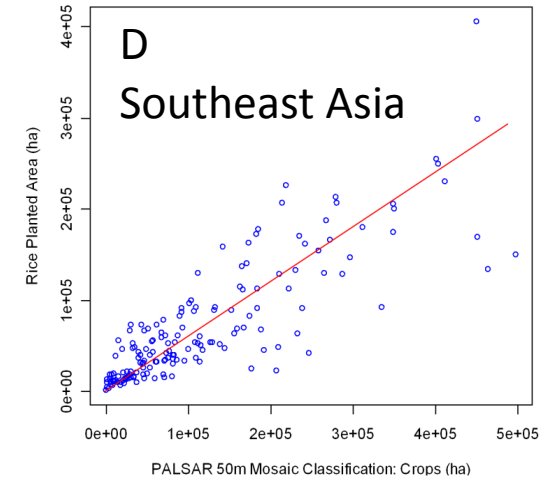
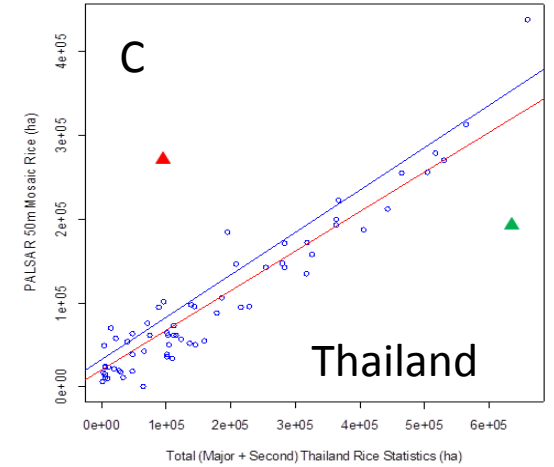
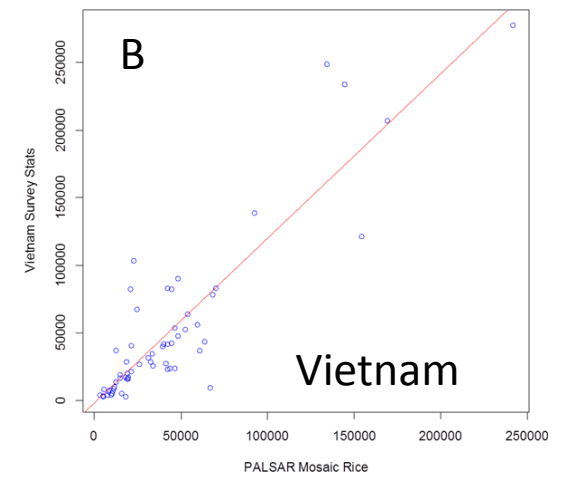
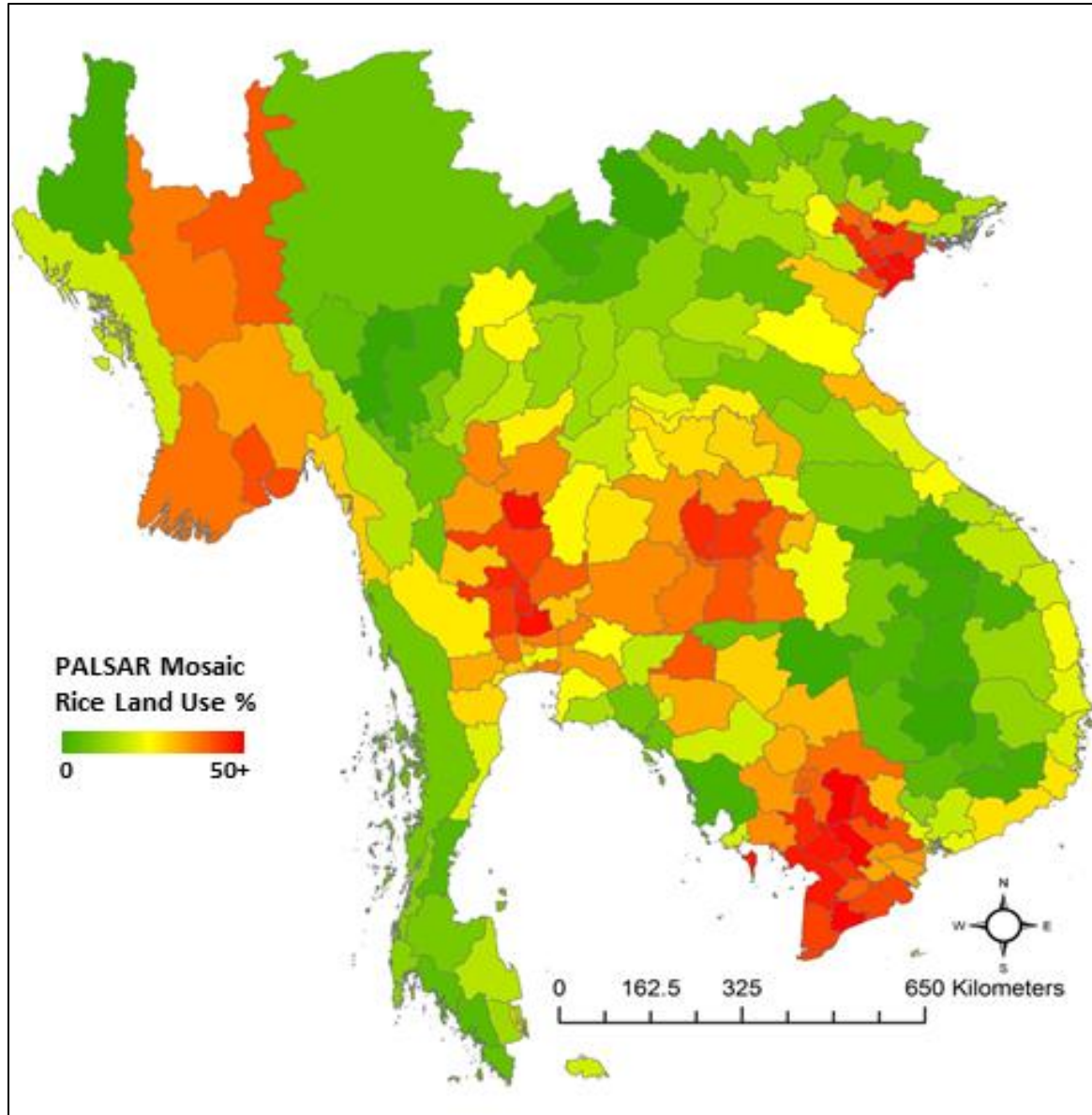
R: 9/21/2011

G: 2/3/2011

B: 11/6/2011

PALSAR-based map of paddy rice in 2009 at 50-m spatial resolution

A



- Completed MODIS-based algorithms and map cropping intensity, crop calendar, inundation and paddy rice in tropical monsoon Asia from 2000 - 2010
- Evaluated PALSAR-based algorithms and map cropping intensity, inundation, paddy rice and forests in southeast Asia in 2009/2010
- Now evaluate Landsat-based algorithms for mapping inundation and paddy rice in tropical monsoon Asia

Publications relevant to the project

Biradar et al., 2011, IJRS; Dong et al., 2012, JPRS; Dong et al., 2012, RSE; Dong et al., 2013, RSE (in press); Dong et al., 2013, RSE (in revision); Fuller et al., 2013, EID; Jin et al., 2013, RSE (in press) ; Xiao et al., 2011, AGU EOS; Zhang et al., 2013, PNAS

Future work

1. Write papers for the Landsat/PALSAR/MODIS algorithms, decadal changes in cropping intensity and paddy rice.
2. Streamline the algorithms and procedure and then implement them in NASA NEX computing facility , where global Landsat images are available.

To generate two data products at 30-m spatial resolution in tropical monsoon Asia

1. Maps of transplanting/flooded croplands
2. Maps of paddy rice field

Questions?

