



Developing land cover data products in Monsoon Asia over the period of 2004-2007 through integration of Landsat and multi-temporal L-band PALSAR/ALOS imagery

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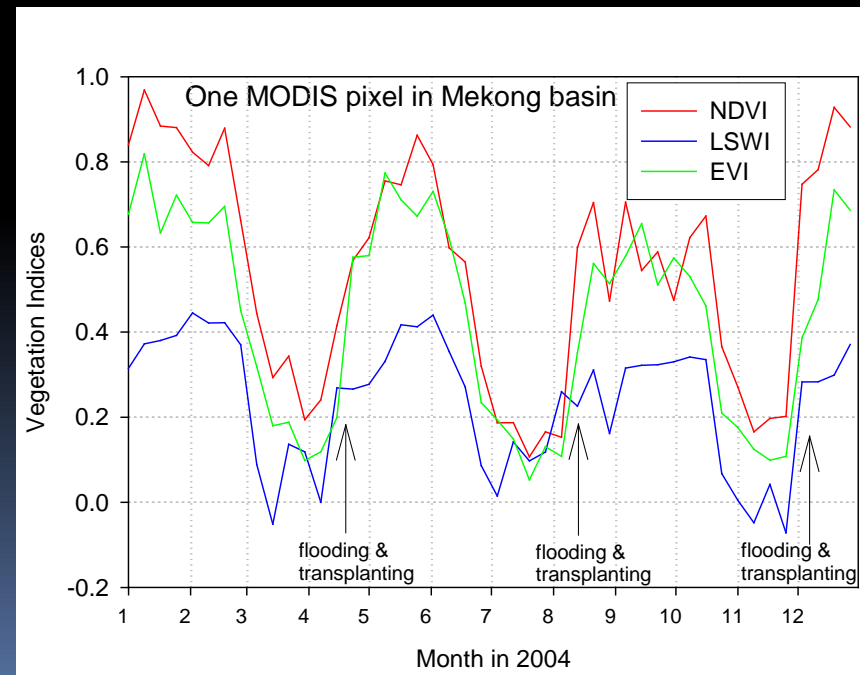
Norman, OK 73019, USA

<http://www.eomf.ou.edu>

**NASA LCLUC Science Team Meeting
January 12 - 17, 2009, Khon Kaen, Thailand**

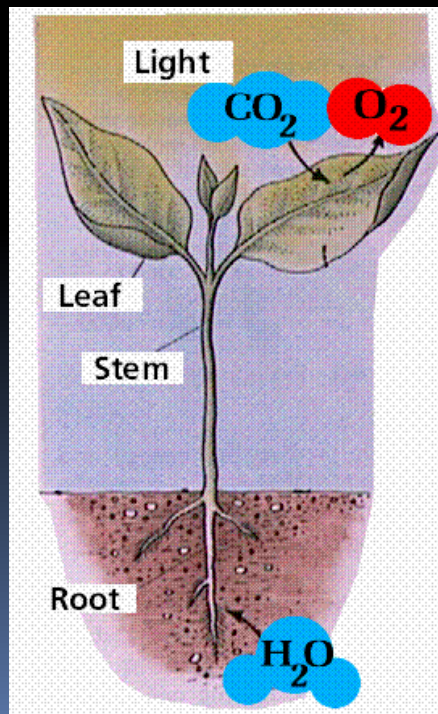
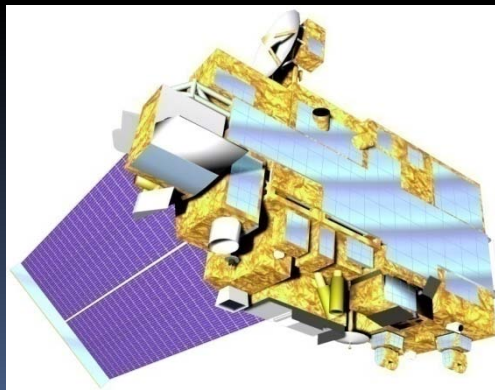
Scientific background

- More than half of the world's population live in monsoon Asia.
- Land use and land cover change occurs extensively and dynamically because of demands for food, water, fibre, and human settlement.
- Intensification of agriculture through multiple cropping, irrigation, fertilizer application.



Scientific background

- Land use and land cover change affects carbon and water fluxes.
- Land use and land cover change affects climate.
- Land use and land cover change affects biodiversity.
- Intensification of agriculture is related to infectious diseases (e.g., H5N1 avian influenza).



On-going projects for land use and land cover change in Asia

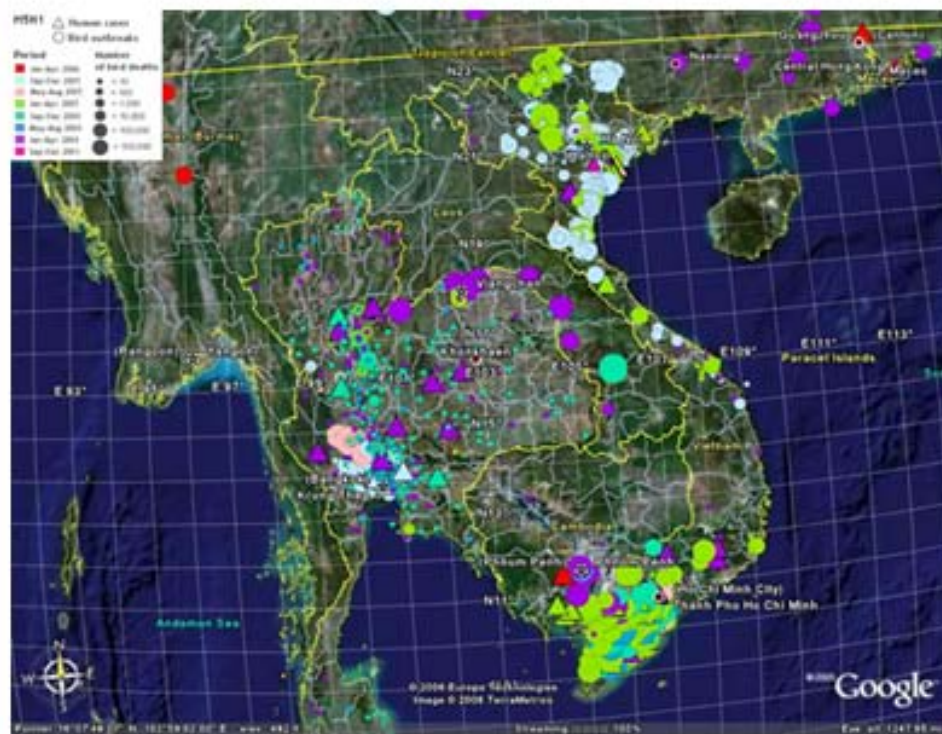
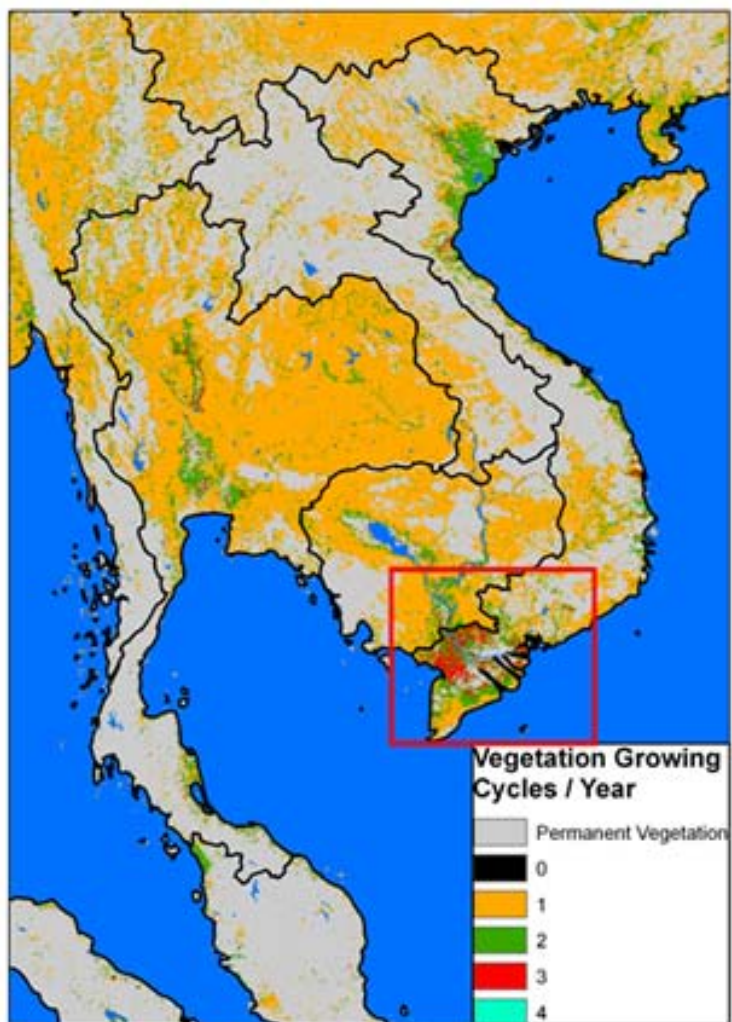
- Ecology-based risk assessment and early warning of highly pathogenic avian influenza in Asia

US National Institutes of Health (2006 – 2010)



Land use and infectious diseases

Multiple-cropping paddy rice agriculture and associated duck production is correlated with spatial distribution of H5N1 highly pathogenic avian influenza (bird flu).



Screenshot taken in Google Earth(TM)

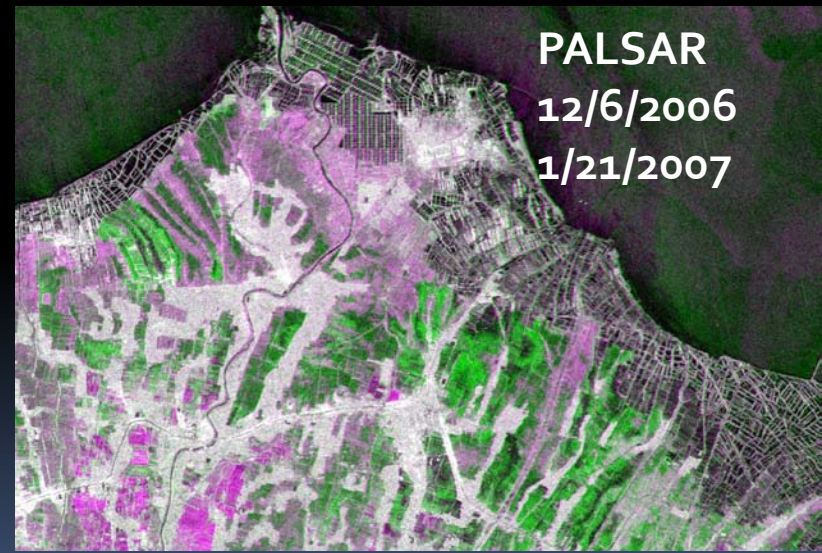
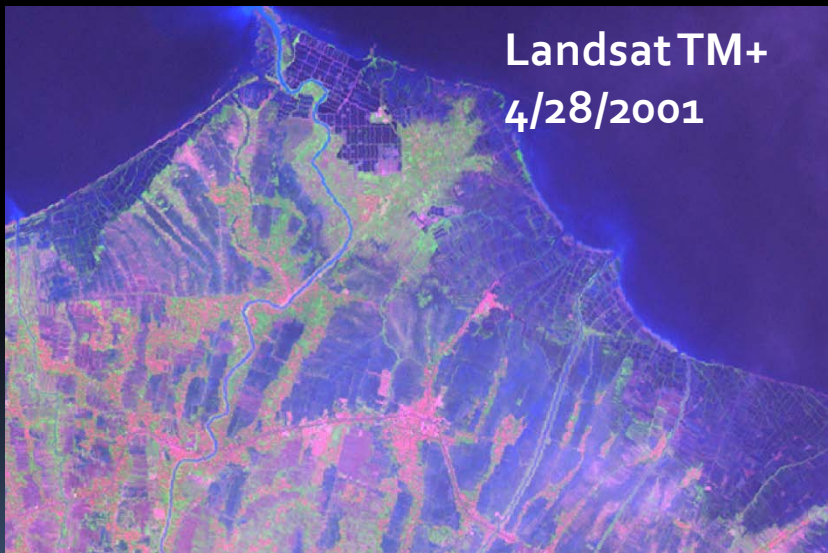
Agriculture – bird flu

These figures show that H5N1 outbreaks in Thailand and Vietnam were concentrated in those area with multiple cropping systems, in particular, multiple paddy rice system.

On-going projects for land use and land cover change in Asia

- **Developing land cover data products in Monsoon Asia over the period of 2004-2007 through integration of Landsat and multi-temporal L-band PALSAR/ALOS imagery**

NASA Land Use and Land Cover Program (2008 – 2010)



Project Objectives

- (1). Develop prototypes of land cover data products (adopting the FAO/UNEP Land Cover Classification System) at 30-m spatial resolution for monsoon Asia, using algorithms and procedures that integrate Landsat and PALSAR ScanSAR images;**
- (2). Evaluate the resultant land cover data products using field data, available regional geospatial datasets, and a large sample of high-resolution images (e.g., IKONOS, PALSAR data); refine the mapping algorithms as needed;**
- (3). Develop biophysical data products from analysis of multi-temporal ScanSAR, and single/dual/polarimetric PALSAR images;**
- (4). Support ongoing projects by the team members (e.g., the global irrigation area mapping, the risk assessment of highly pathogenic avian influenza) and the international scientific projects (e.g., MAIRS) and evaluate scientific uses of these data products.**



Research Team

University of Oklahoma

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International Water Management Institute, Sri Lanka

Prasad Thenkabail

Study area and satellite image data

Spatial domain of the project

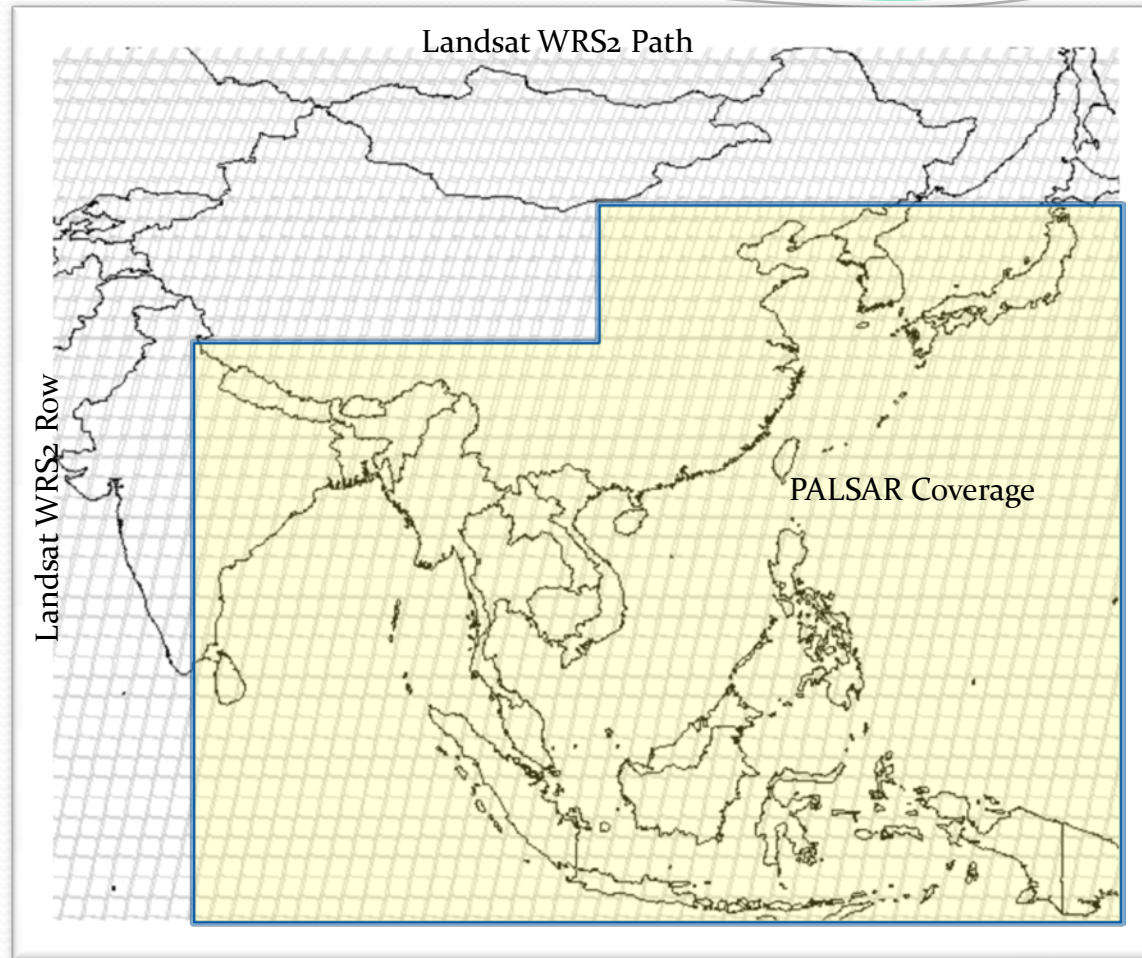


Figure 2. The spatial domain of the study area in this proposal, where multi-temporal PALSAR data are available. Roughly there are a total of 616 ETM+ image tiles for this study: India (193), Southern China (225) and Southeast Asia (198).

Both Landsat ETM+ and L-band PALSAR images are used in this project

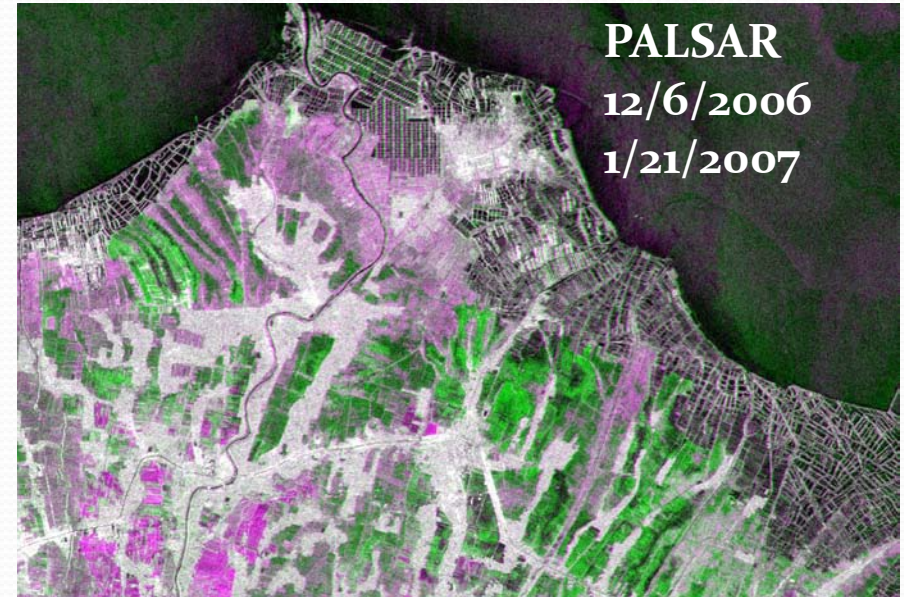
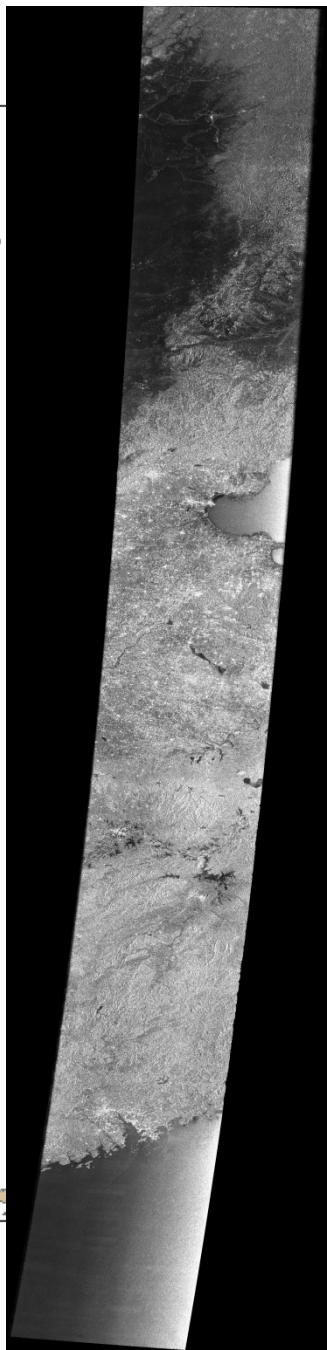
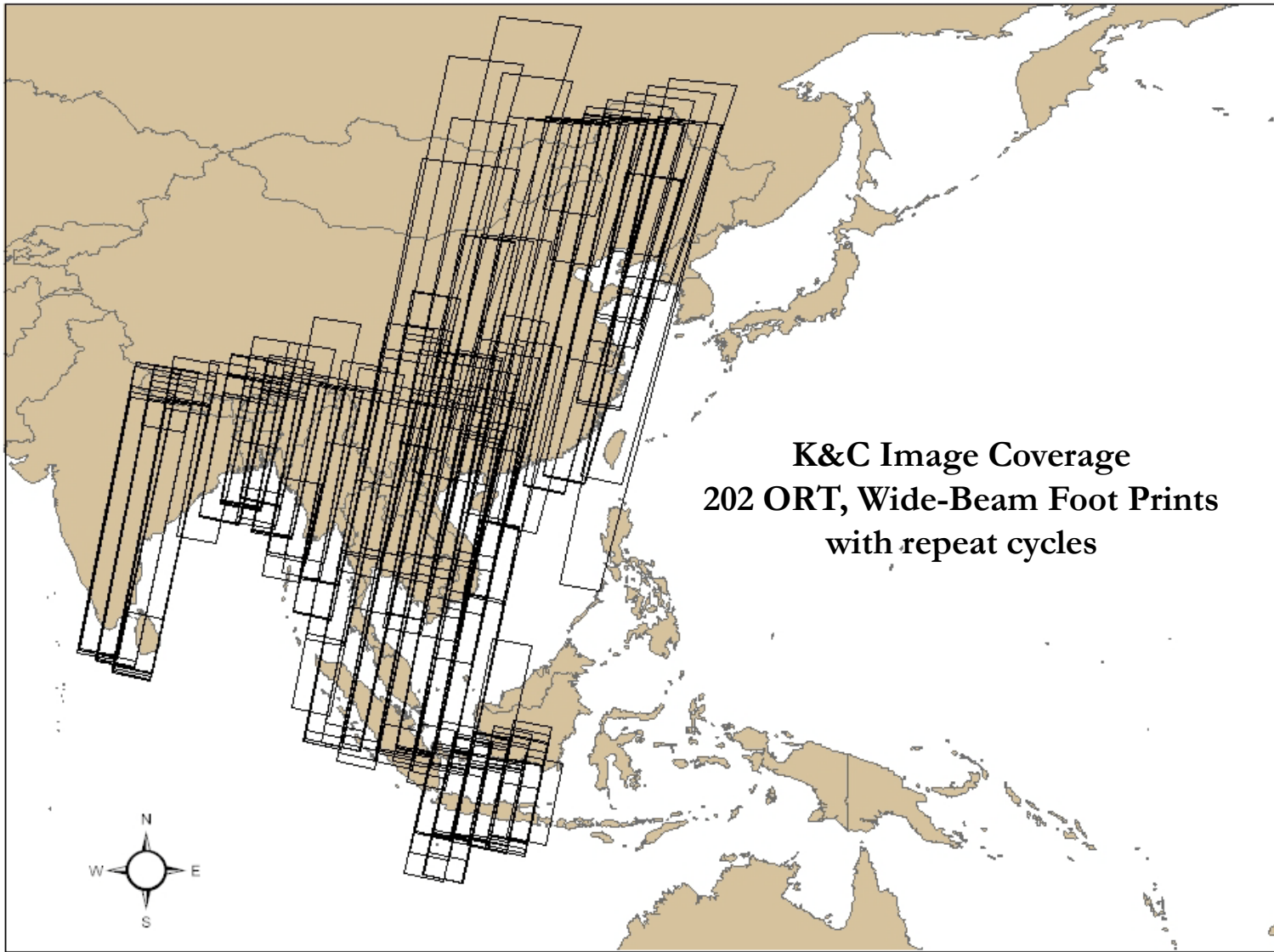


Figure 1. Landscape in Kendal, Java, Indonesia. The left scene is the phase-color combination of Landsat ETM+ image was acquired on April 28, 2001, Red: Band 7, Green: Band 4 and Blue: Band 3. The right mosaiced from two fine-resolution PALSAR images acquired on 6 December, 2006 and 21 January, 2007, respectively. Open water (dark color), fish ponds and rice paddies (green and pink color) could be visually detected easily from this two-date composite image. Green color indicates crop fields flooded in December 2006 but planted in January 2007; Purple color indicates crop fields planted in December 2006 but harvested in January 2007.

The image is approximately ~20km width.



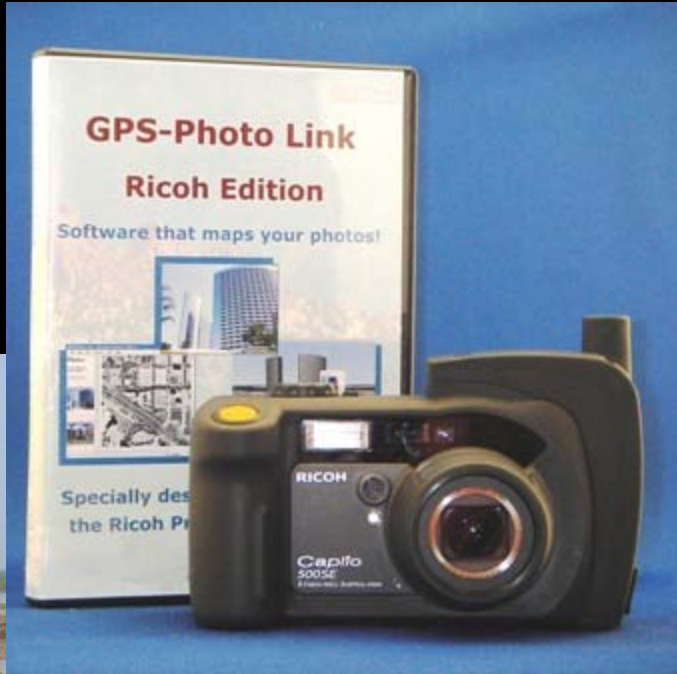
**ALOS PALSAR K&C Image over eastern Asia (China)
November 11, 2007, ORT, Cycle 15, Path 103; S-N Extent: 16 to 53 N**

Ground truth data -- Calibration and validation strategy

Ground Truth Data and Cal/Val Strategy

- (1) Citizen-based field data collection
 - (a) Ground-based Photo Mapping System
 - (b) web-enabled field photo library

2007-05-25
116.7588 °E
28.9062 °N
15m altitude.



Ground Truth Data and Cal/Val Strategy

(1) Citizen-based field data collection

(b) web-enabled field photo library <http://www/eomf.ou.edu>

Global Geo-Referenced Field Photo Library - Query - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://remotesensing.unh.edu/photo-browser/query.php?longmin=&longmax=&latmin=&latmax=ε

Global Geo-Referenced Field Photo Library

Welcome, you are **Guest**

[\[Main\]](#) [\[Log in\]](#) [\[Register\]](#) [\[Query\]](#) [\[Map Query\]](#)

Search by coordinates:
Longitude min: Longitude max:
Latitude min: Latitude max:





Search by date:
From: Jan 1 1990
To: Oct 27 2008

Categories: All
Users: All

Search by keywords:

Public: (74) Private: (0) Deleted: (2)

[Check All](#) | [Uncheck All](#)

| | | | |
|---|---|--|---|
|  |  |  |  |
| Date taken: 2006-07-07 68.857 °E 40.3854 °N | Date taken: 2005-05-07 68.8595 °E 40.3838 °N | Date taken: 2006-08-03 68.8574 °E 40.3904 °N | Date taken: 2006-08-03 68.8563 °E 40.3896 °N |

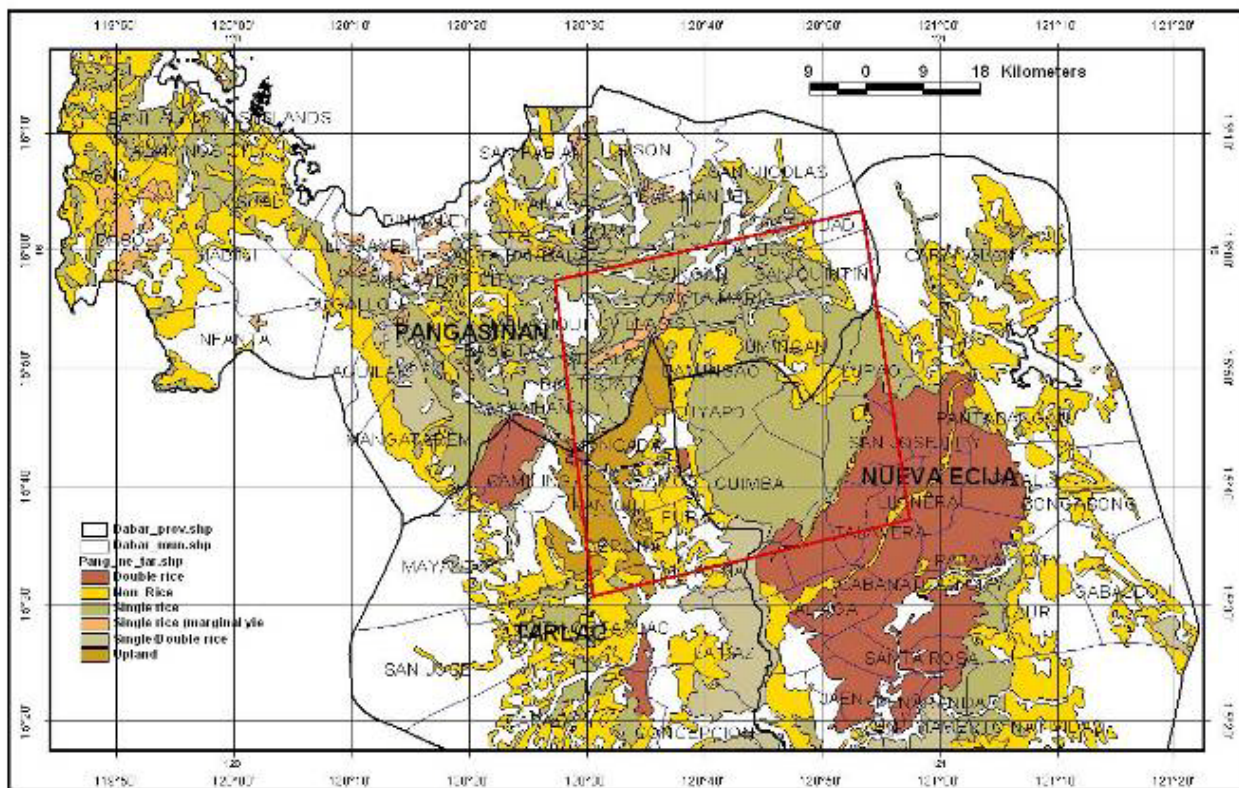
Done

2 M... 2 M... 2 W... Glob... Micr... EN 100% 2:10 PM

Ground Truth Data and Cal/Val Strategy

(2) Collecting available fine resolution land cover maps from the community through collaboration (e.g., AIT, IWMI, others)

Philippines: Pangasinan and Nueva Ecija



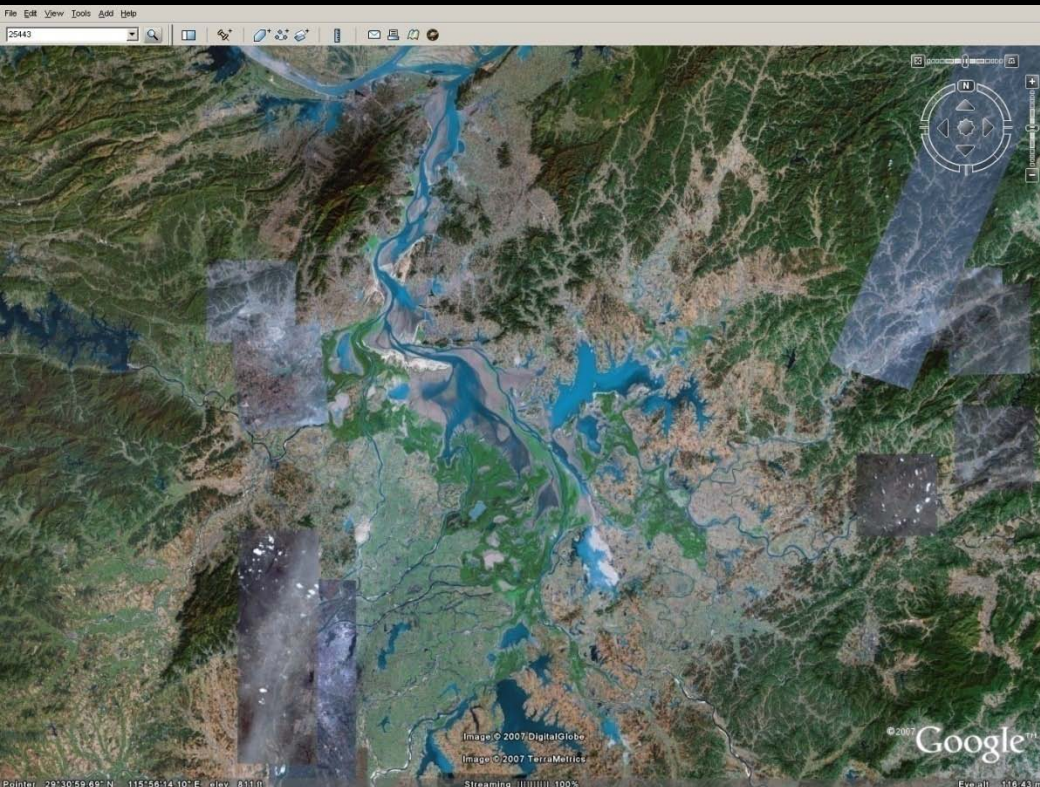
Ground Truth Data and Cal/Val Strategy

(3) Intensive field study

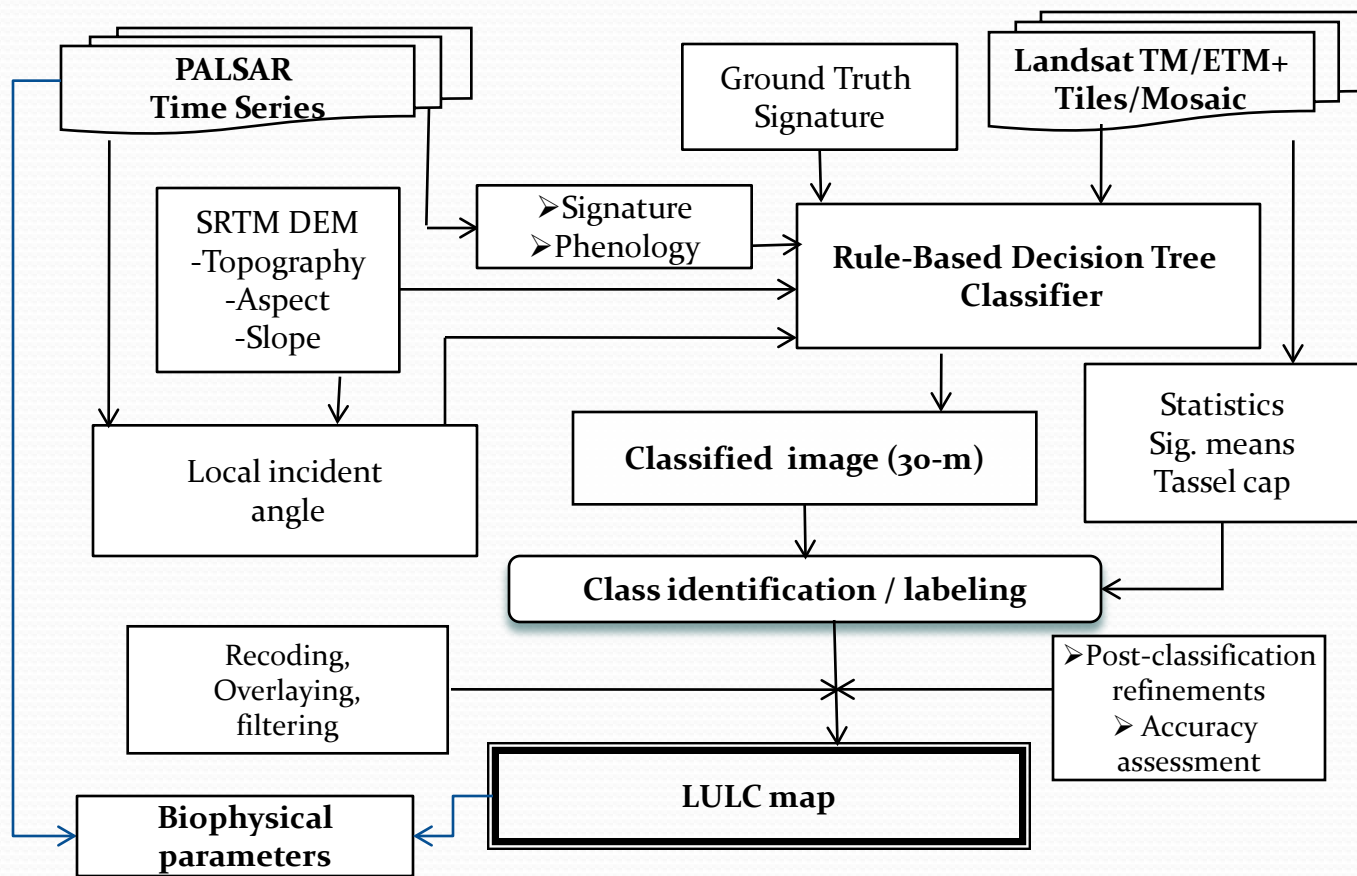
Poyang Lake in Jiangxi Province, China

Land cover survey over seasons in 2007 - 2008

Biophysical parameter measurements of paddy rice at 8-day interval
rice plant height, aboveground biomass, leaf area index

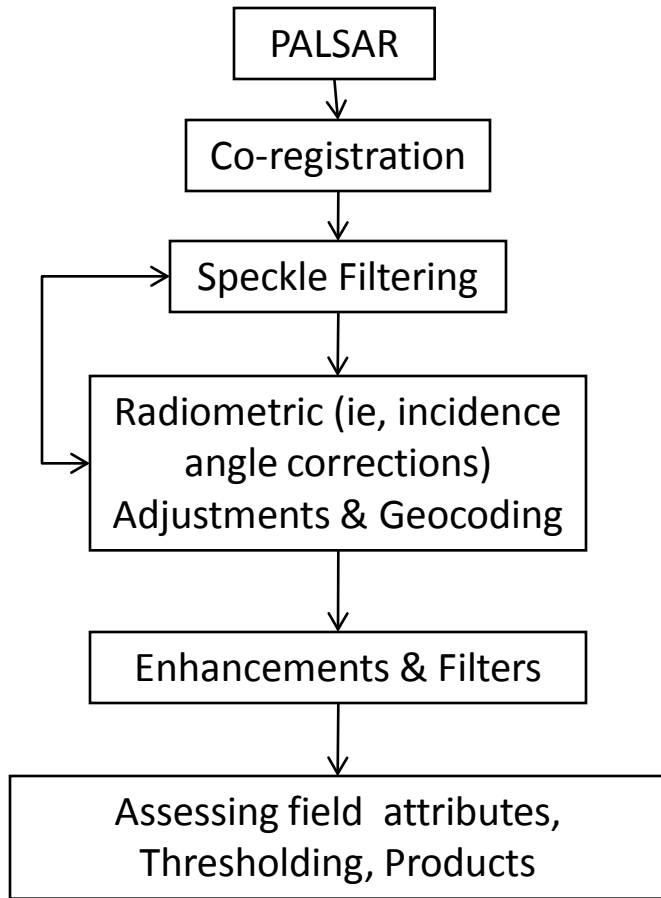


Algorithm development and preliminary result



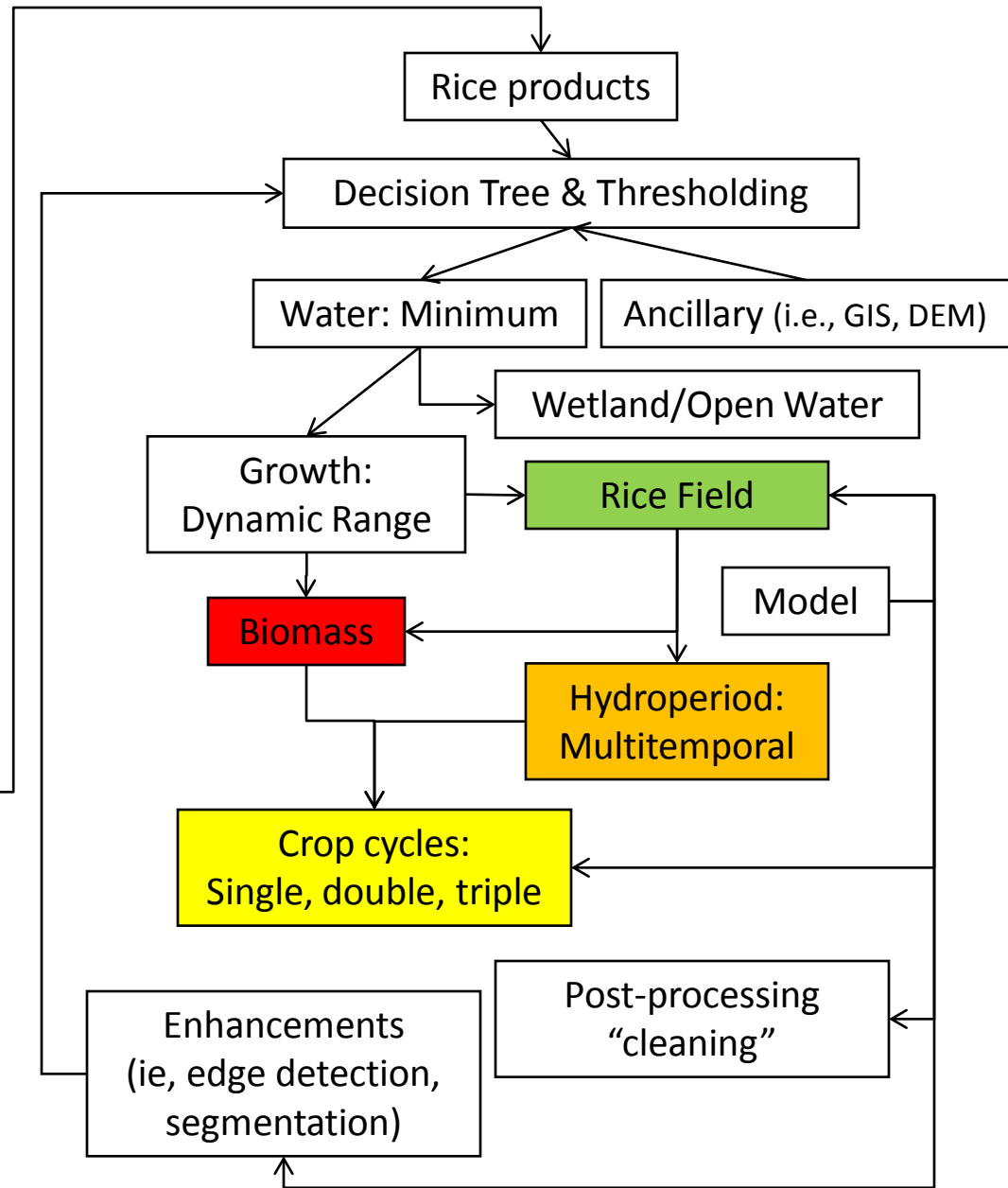
Overall scheme of the Land use / land classification system in the project

Example pre-processing stream



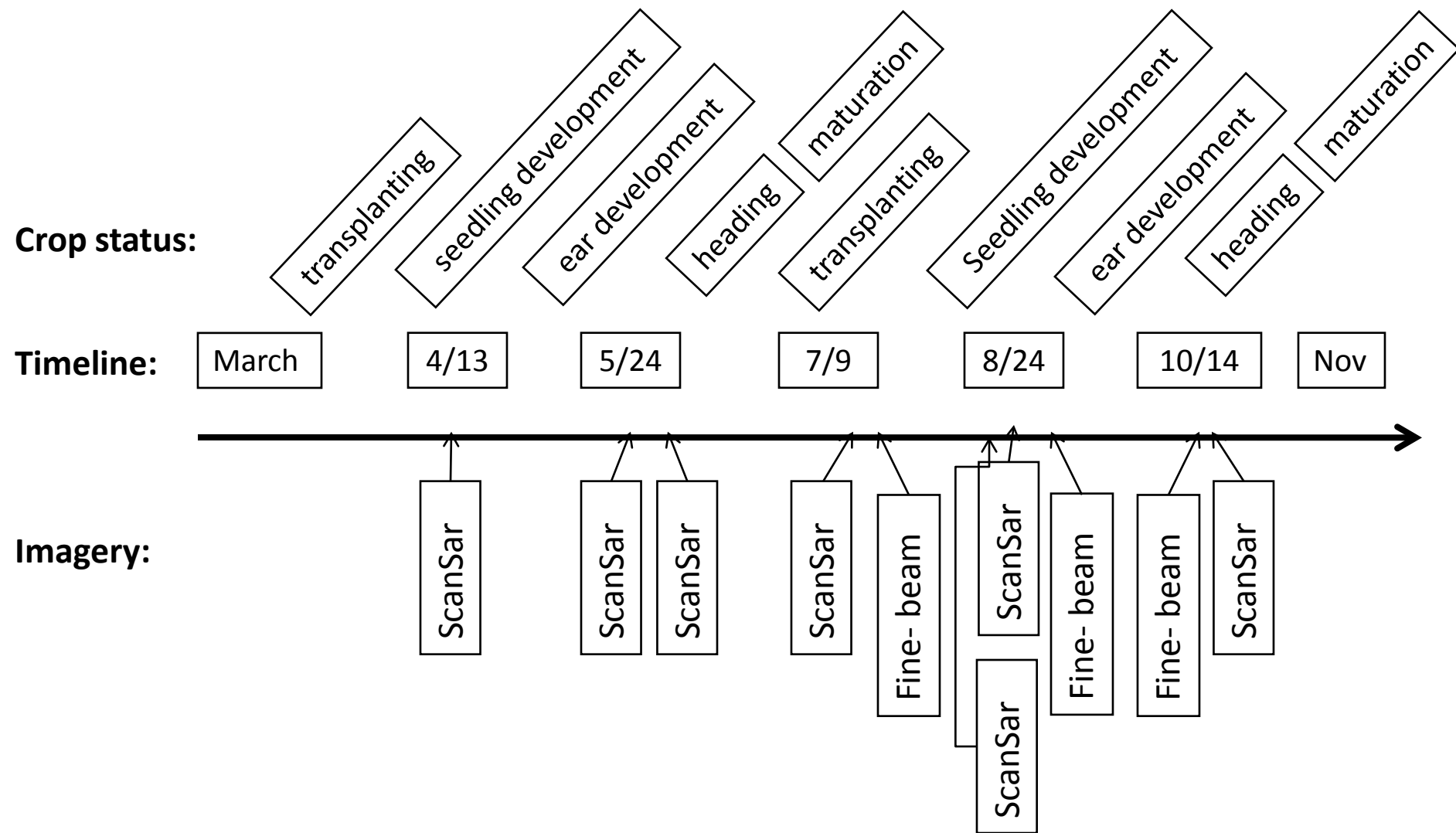
Colors highlight primary operational products

Example rice product stream



Mapping rice paddies & crop cycles

➤ Double rice crop calendar and PALSAR acquisition for Poyang Lake, Jiangxi Province, China, (algorithm development site)



Operational mapping of crop cycles

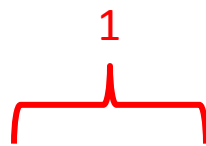
- characterize number of peaks and temporal windows
- rules to utilize PALSAR overpasses and temporal windows of rice growth (i.e., example crop 90-120 days)

single crop

Rice: threshold

rice phenology

time



double crop

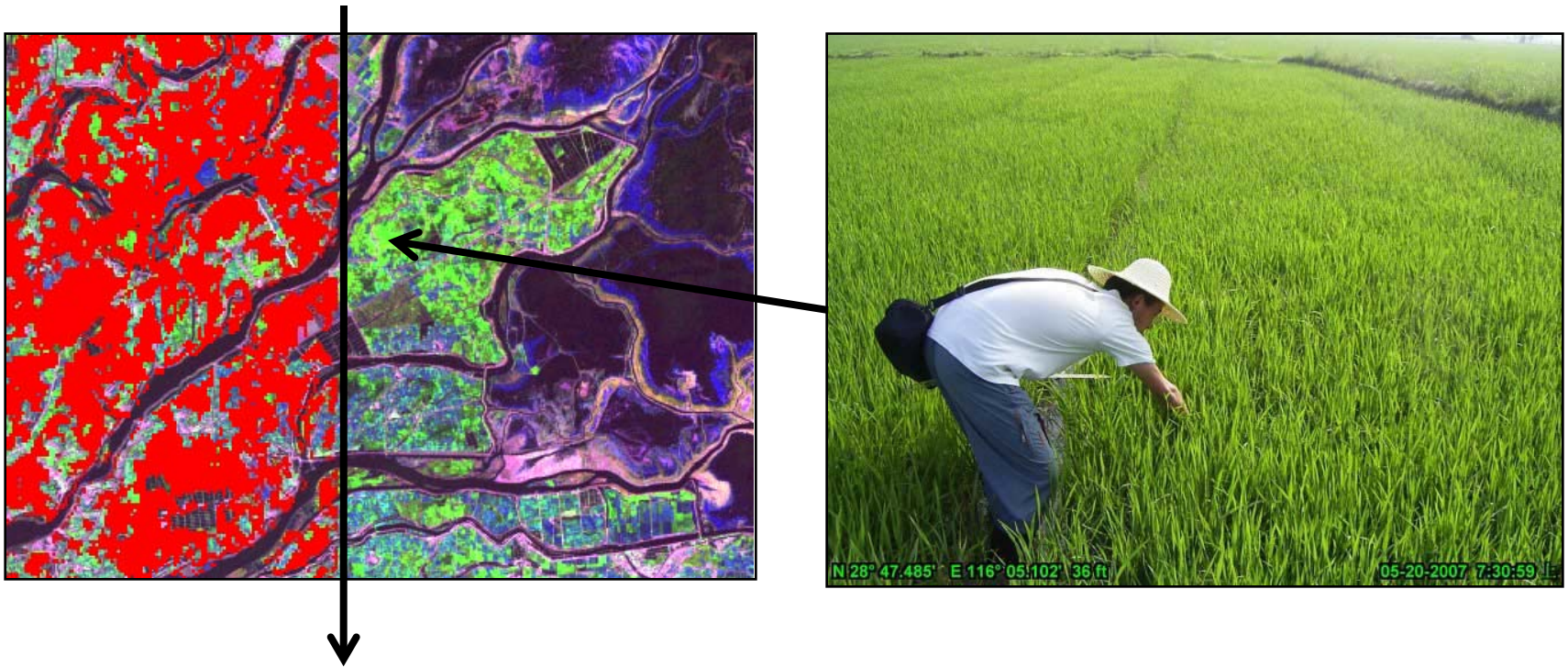
Rice: threshold

rice phenology

time



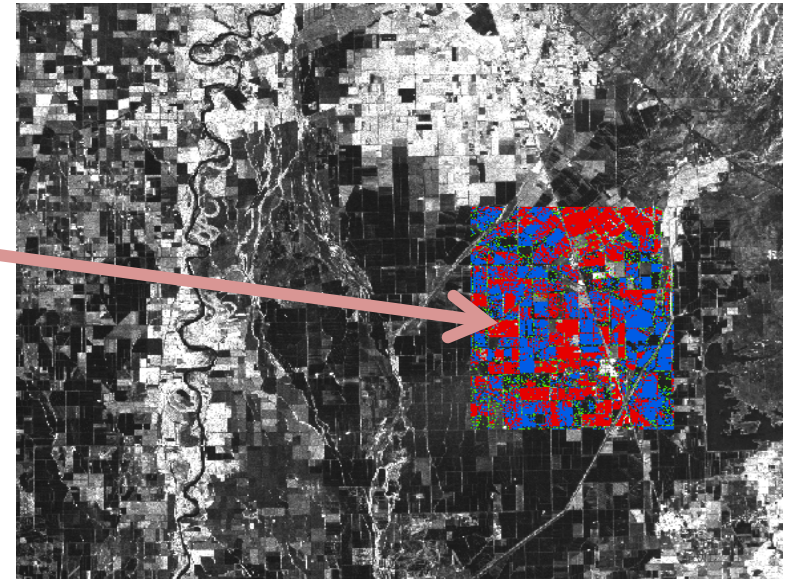
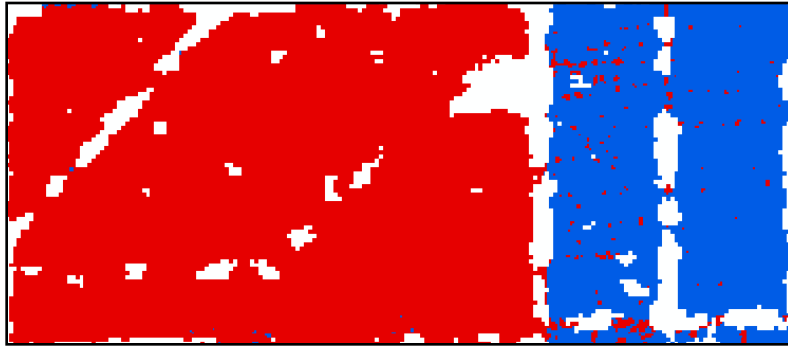
Product: Rice Maps - Poyang Lake, Jiangxi Province, China



AUIG ScanSAR binary map of rice (red); stacked (hh/hv/difference) fine-beam underneath (8/28/07). Automated binary rice maps threshold minimum HH backscatter values (flooded) and dynamic range (rice growth) to isolate rice paddy locations. AUIG ScanSAR products compared against China NLCD “Rice Layers” (made from Landsat) show moderately strong ($R^2=.65$) fractional cover agreement for Poyang Lake development site (~200x200km).

Product: Hydroperiod & Inundation Status

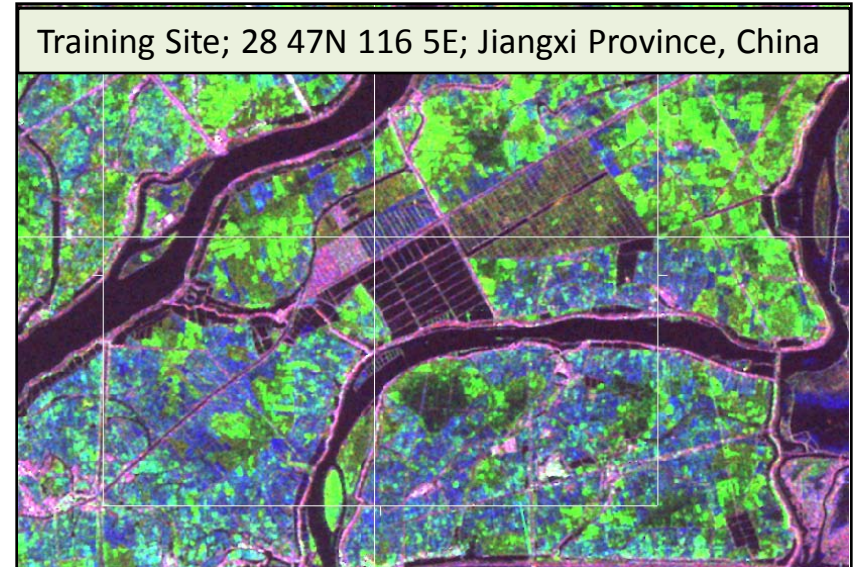
- Characterizing hydroperiod for models of biogeochemistry
- Maps of rice paddies & multi-temporal flood status



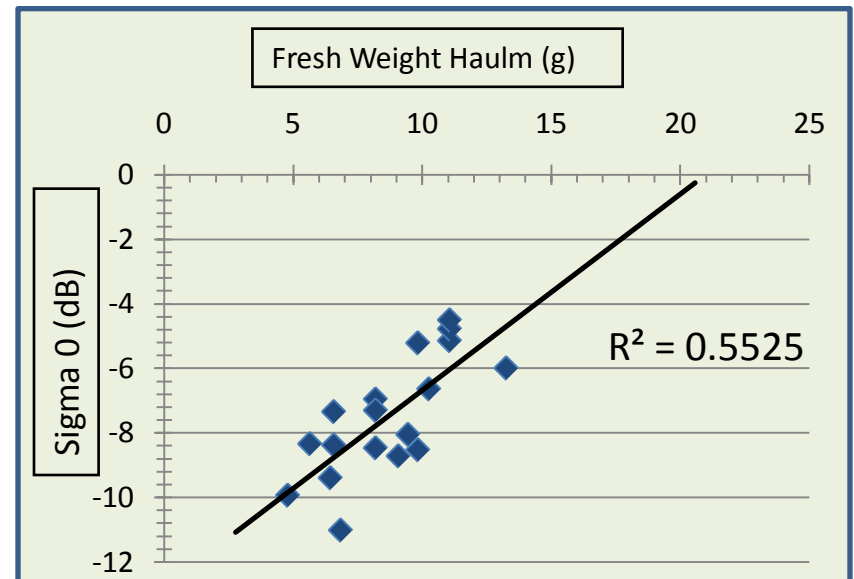
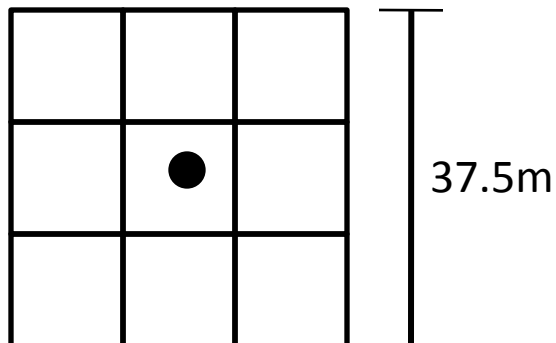
| <u>Categories</u> | hectares | % of SA |
|---------------------------|----------|---------|
| Summer rice | 9645 | 68% |
| Summer rice, winter flood | 4665 | 36% |
| Difference | 4980 | 51% |

Product: Biomass & Yield Estimation

- Utilize established relationships between rice growth characteristics and PALSAR



HH fine-beam vs. GPS field sampling



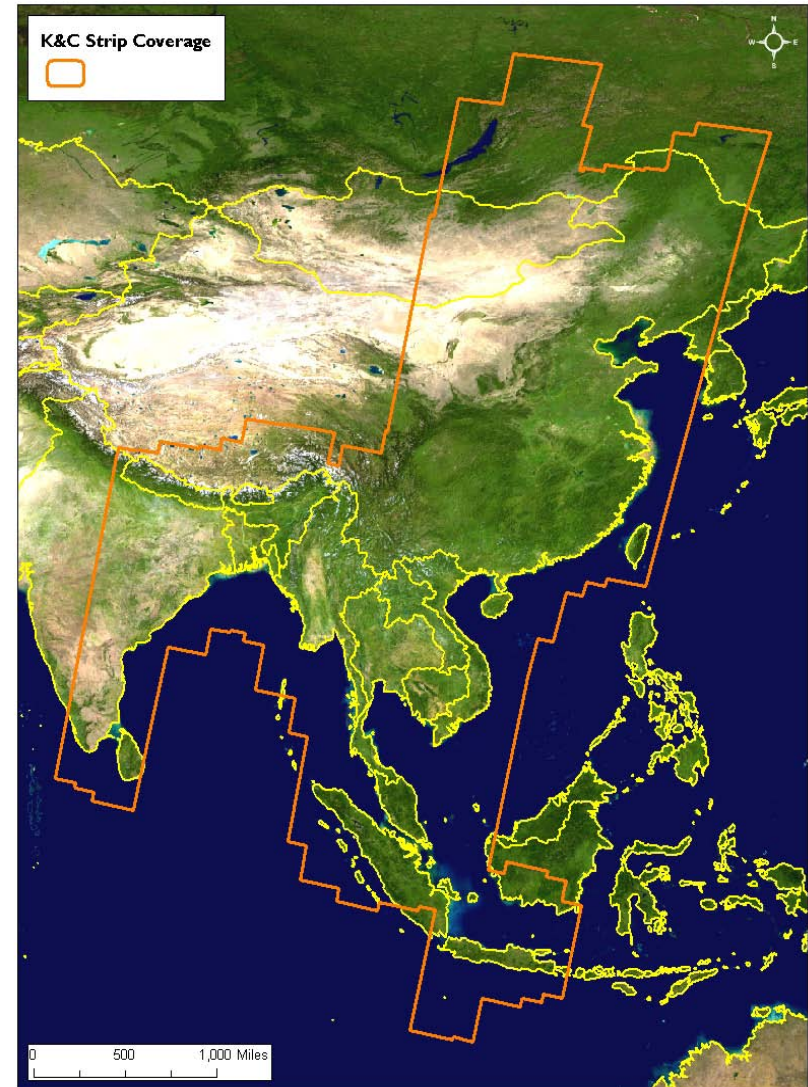
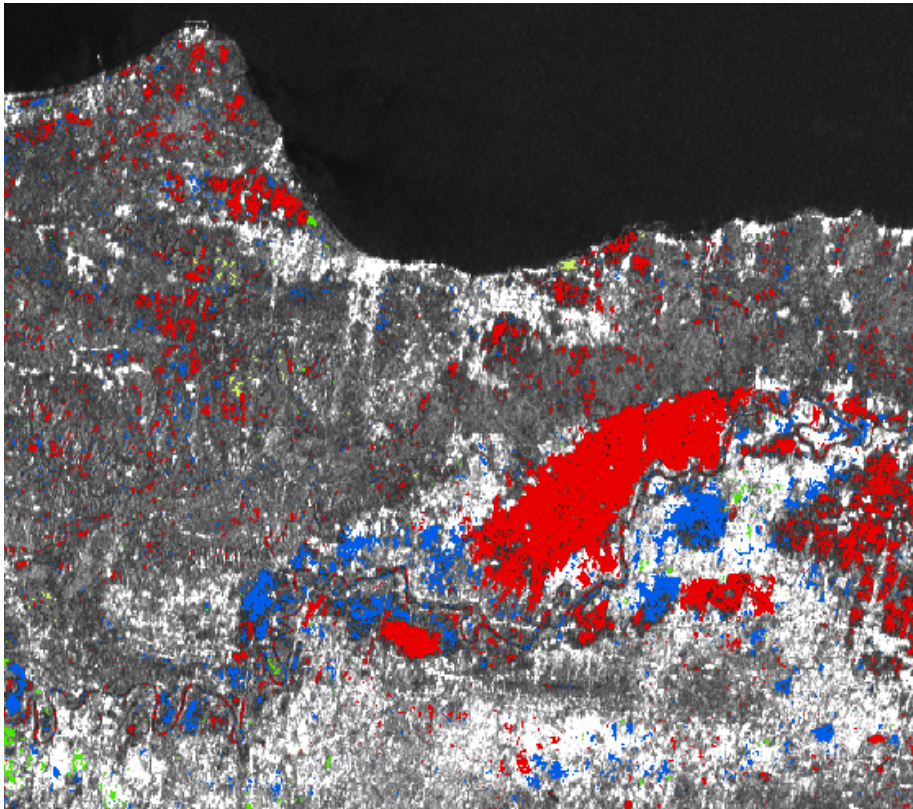
Mapping paddy rice in Java, Indonesia

Example K&C Crop System Map

Java, Indonesia K&C 094/097

Red: Single rice

Blue: Double rice



Project deliverables

- 1. Geospatial datasets of land cover data products in Monsoon Asia from Landsat images in 2004-2007 (30-m spatial resolution);**
- 2. Geospatial datasets of biophysical products (forests, water body, natural wetlands, and paddy rice, hydroperiod)) from PALSAR ScanSAR images (50m by 70-m resolution), which are iteratively used as training and validation datasets for Landsat-based classification;**
- 3. Prototype for algorithms integrating SAR (PALSAR) and optical (Landsat) images for enhanced accuracy and efficiency of land cover classification;**
- 4. An interactive, web-based geo-informatics system for distributed mapping and dissemination of land cover and biophysical datasets for the public and decision makers.**

Earth Observation and Modeling

University of Oklahoma



Thank you for your attention!

and

Welcome to visit Oklahoma, USA!

