

Crop Monitoring and Forecasting:

*Satellite based technology for rice crop monitoring,
yield forecasting and crop damage assessment*

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IRRI and partners are using

remote sensing, crop modeling, smartphone-based surveys, and cloud computing to map and estimate

- Planting dates
- Rice area and yield
- Flood/drought / pest damages

Timely, detailed and accurate information in the hands of stakeholders.



IRRI Integrated Application

Integrated remote sensing, crop modeling, smartphone-based surveys, and cloud computing allowing us answering three basic questions related with rice production

- Where
- When
- How much

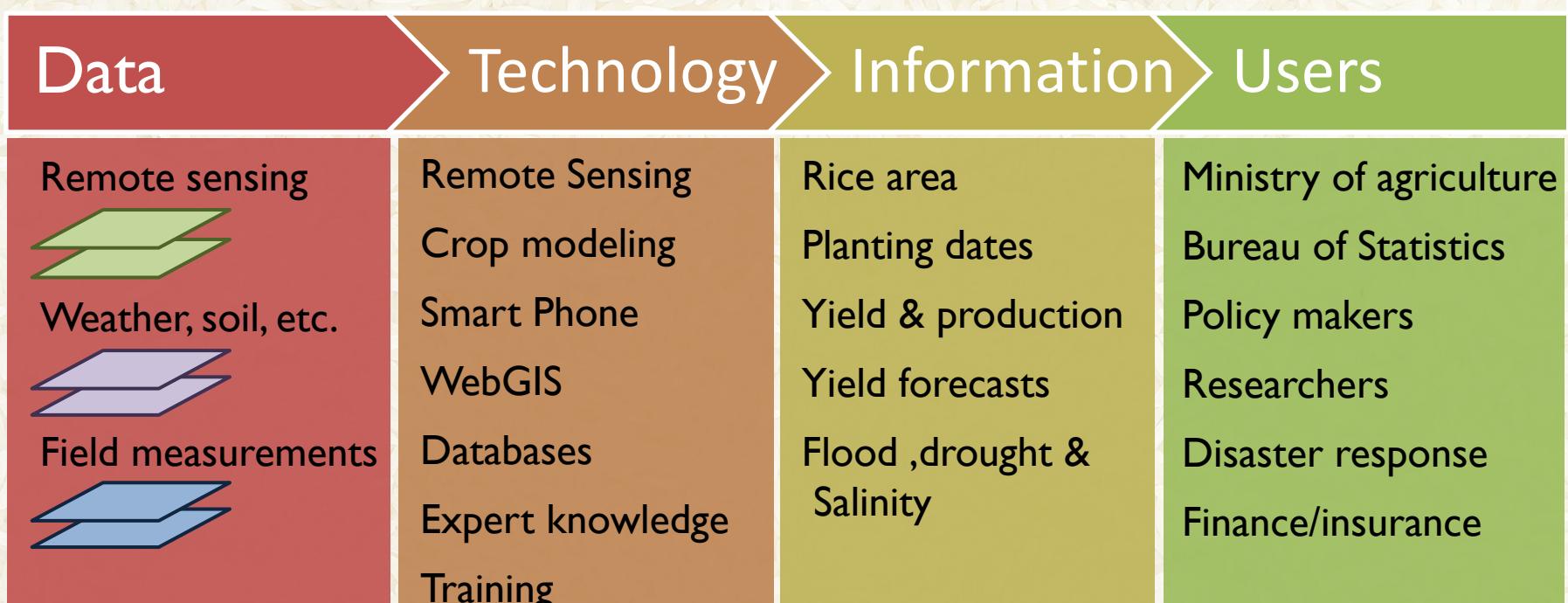
countries where field sizes are < 1 ha, with diverse management, varieties and climate.

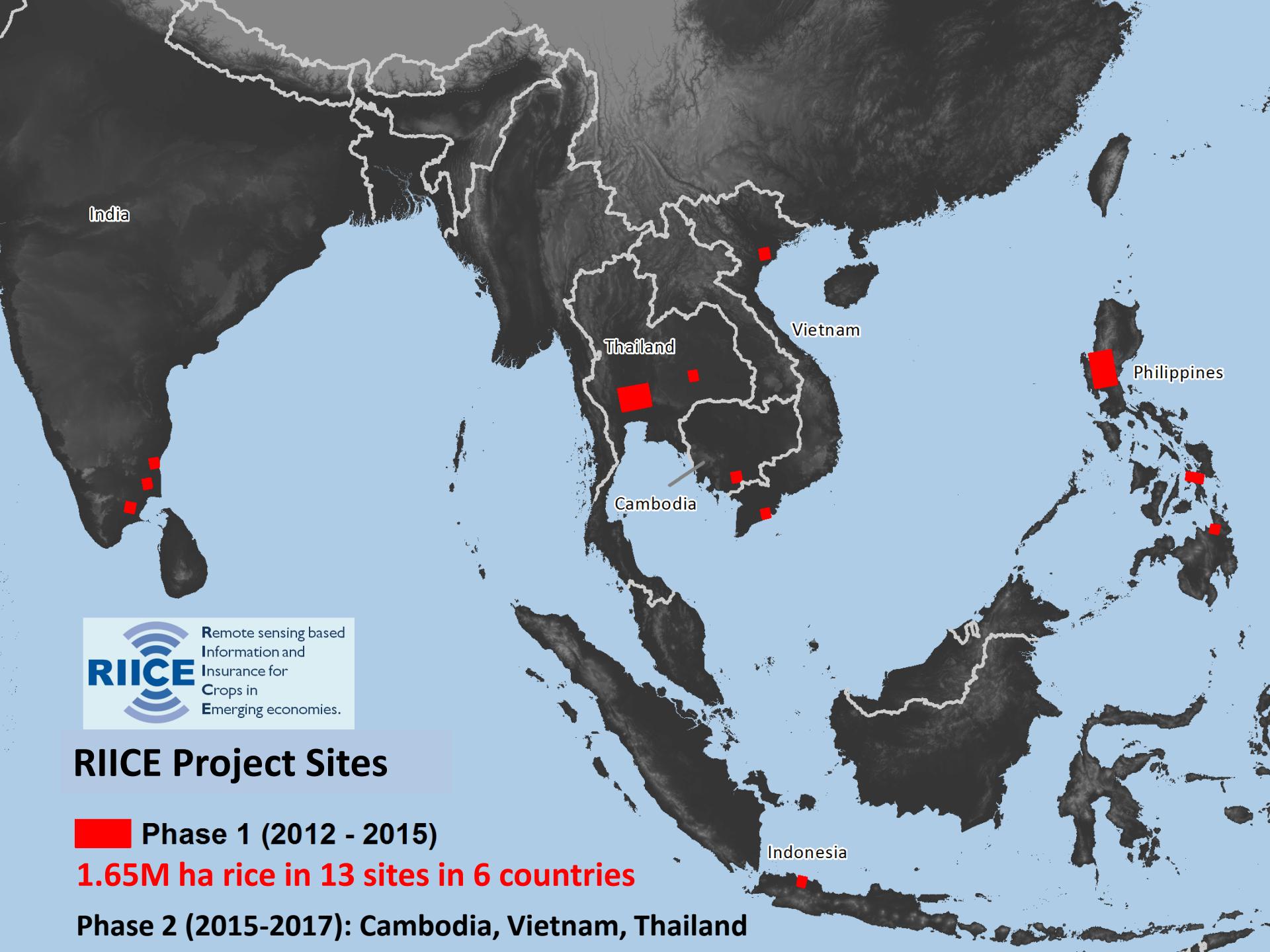
Provide assessment and estimates at higher spatial and temporal resolutions.



RIICE: Remote sensing based Information and Insurance for Crops in emerging Economies

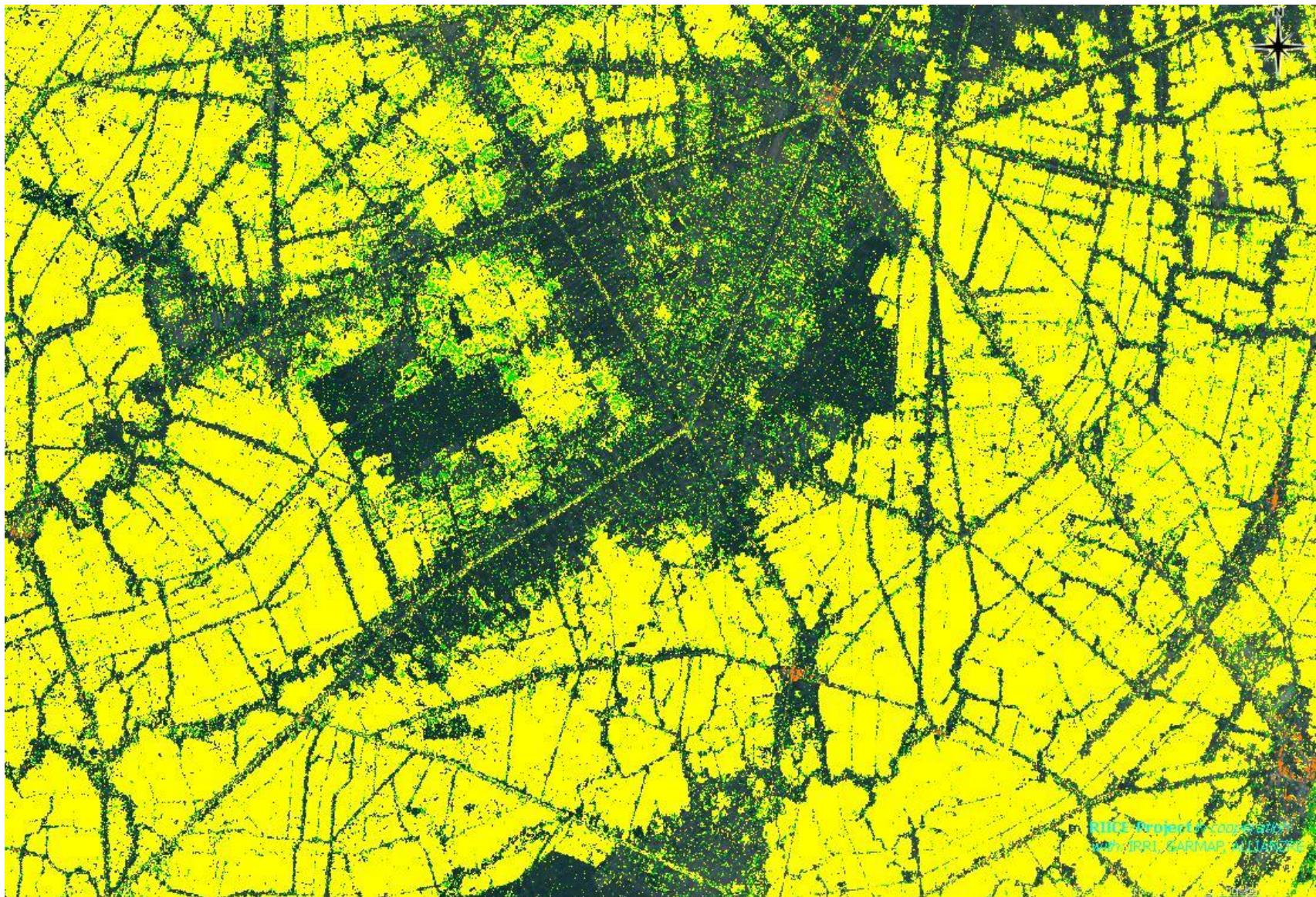
The RIICE project provides **accurate and timely information on rice** using satellite remote-sensing, crop modeling, and other technology.



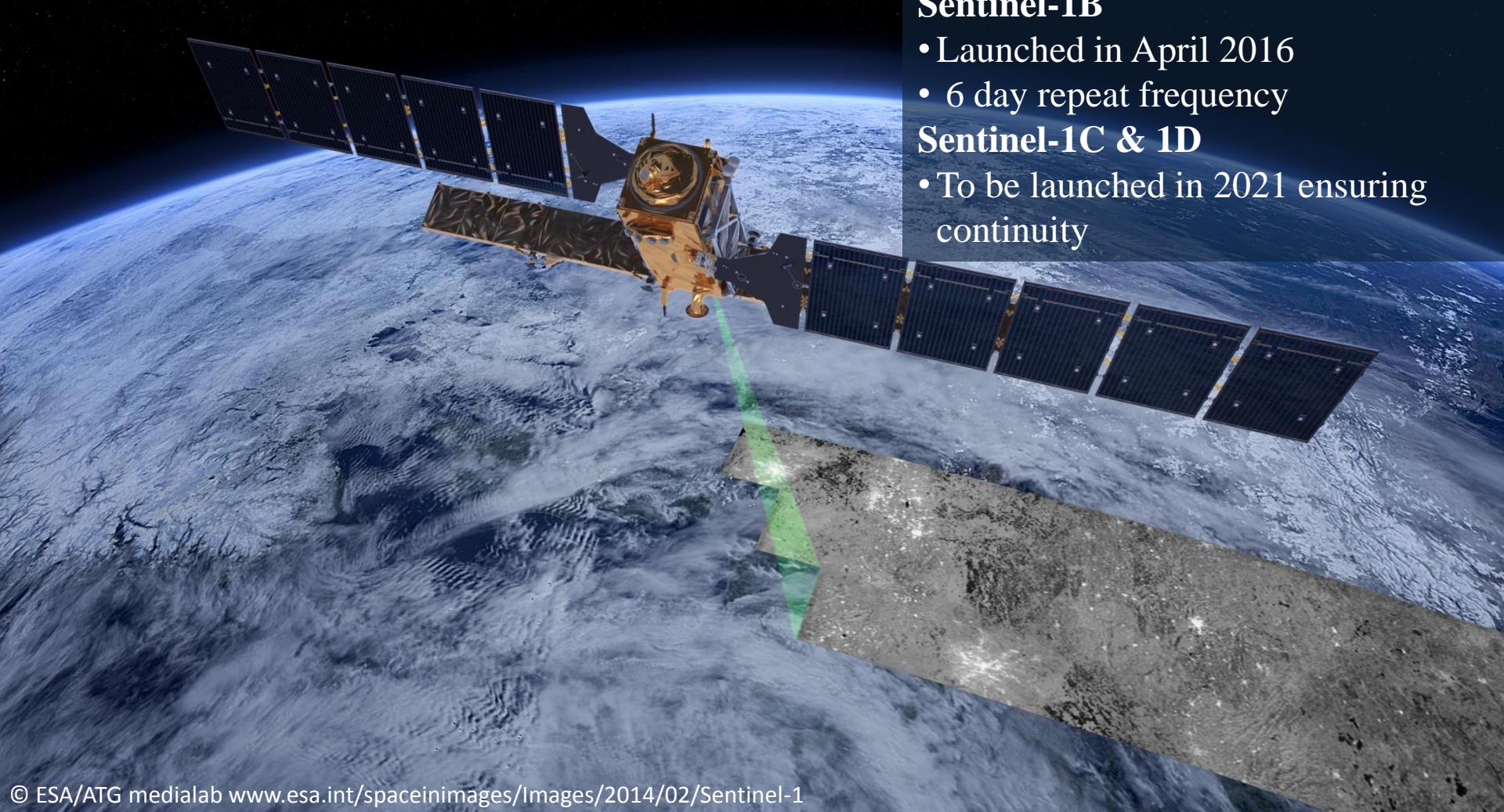


- The RIICE project has demonstrated that rice can be mapped with high accuracy across different seasons, different crop and water management practices and different maturities.
- Rice area accurately mapped at sub hectare resolution in over 1.6m ha across 13 sites in Thailand, India, Vietnam, Cambodia, Indonesia and the Philippines.
- Potential to replicate in other rice growing countries.

Radar (SAR) images vs. optical images



Scaling up...



Sentinel-1A

- Launched April 2014 by ESA
- 12 day repeat frequency
- 20m resolution
- Free and open access
- SAR sensor – perfect for rice

Sentinel-1B

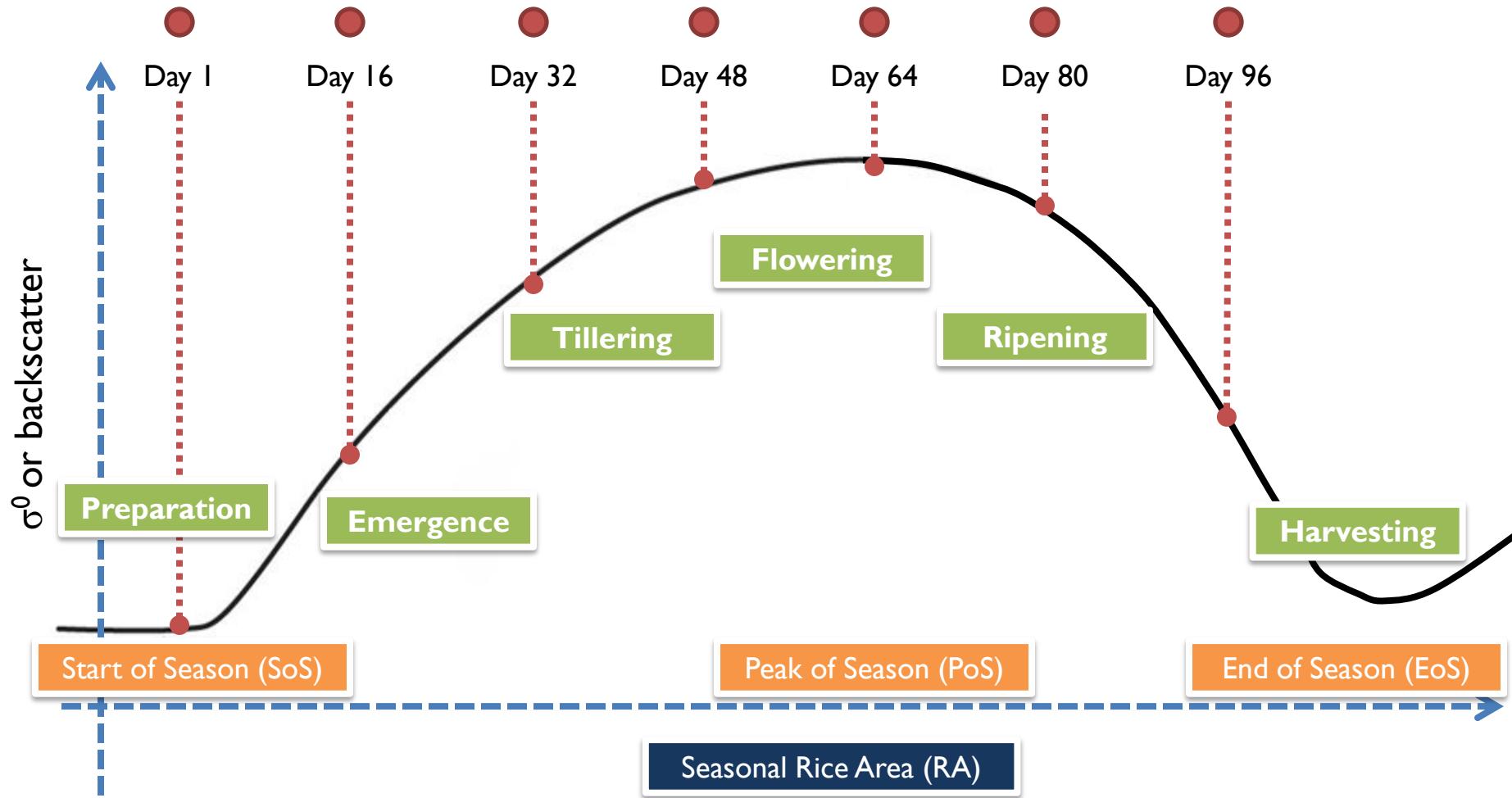
- Launched in April 2016
- 6 day repeat frequency

Sentinel-1C & 1D

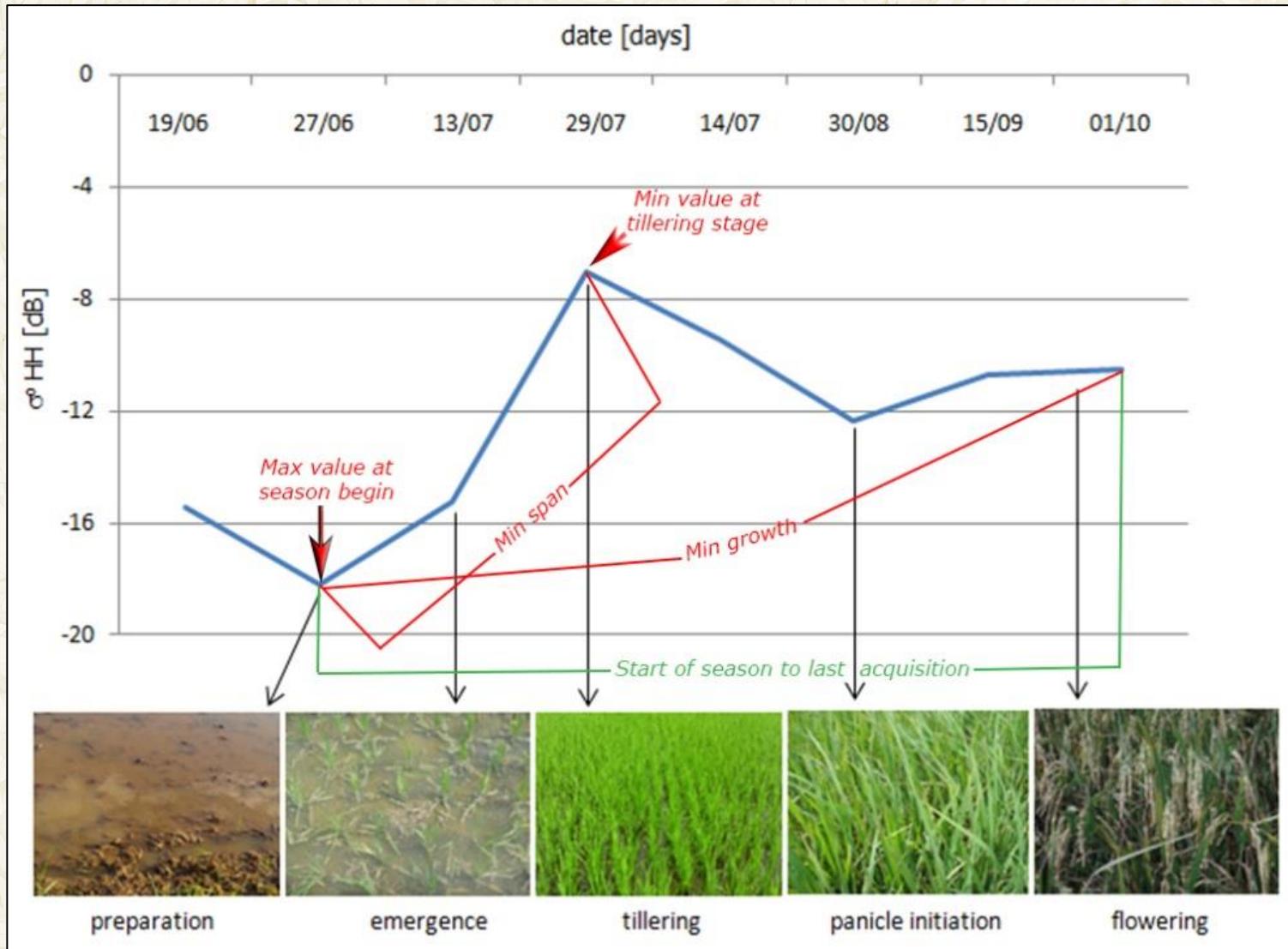
- To be launched in 2021 ensuring continuity

Continuous Monitoring Through Season

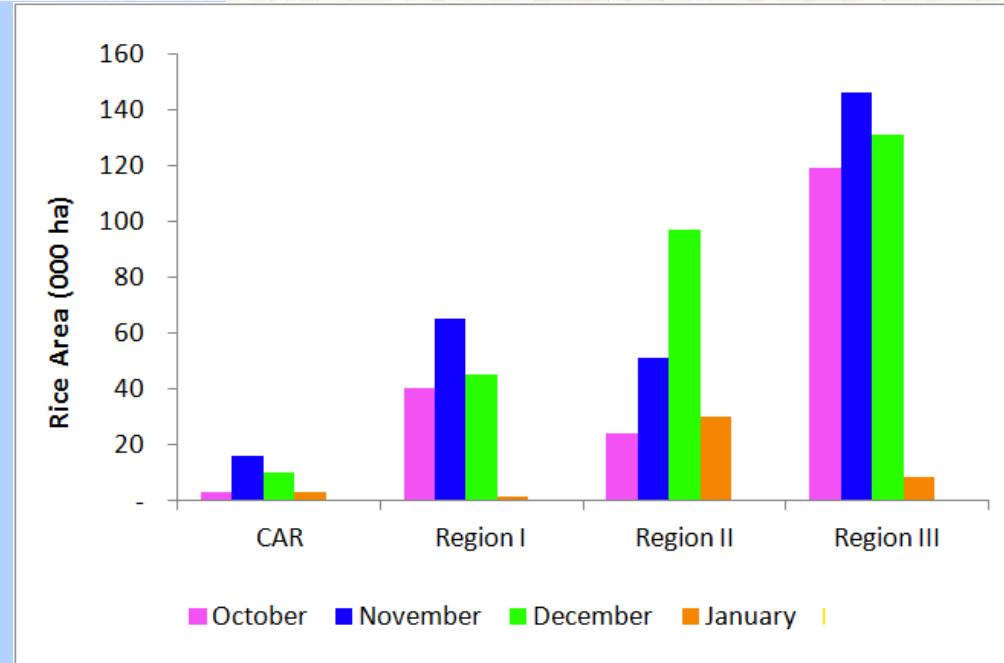
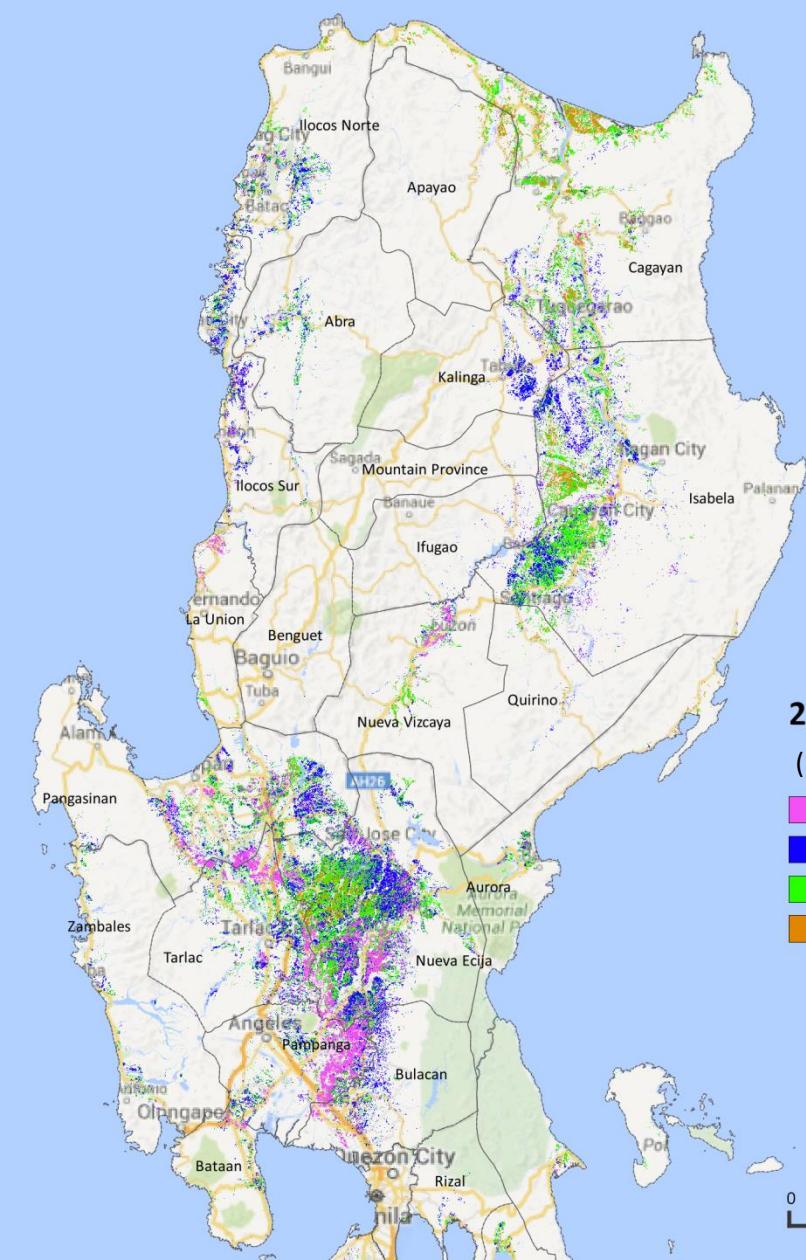
Changes in these images over time are used to map **where** rice is grown, **when** it is grown and **how much rice** is harvested



Rice Has Distinctive Temporal Features

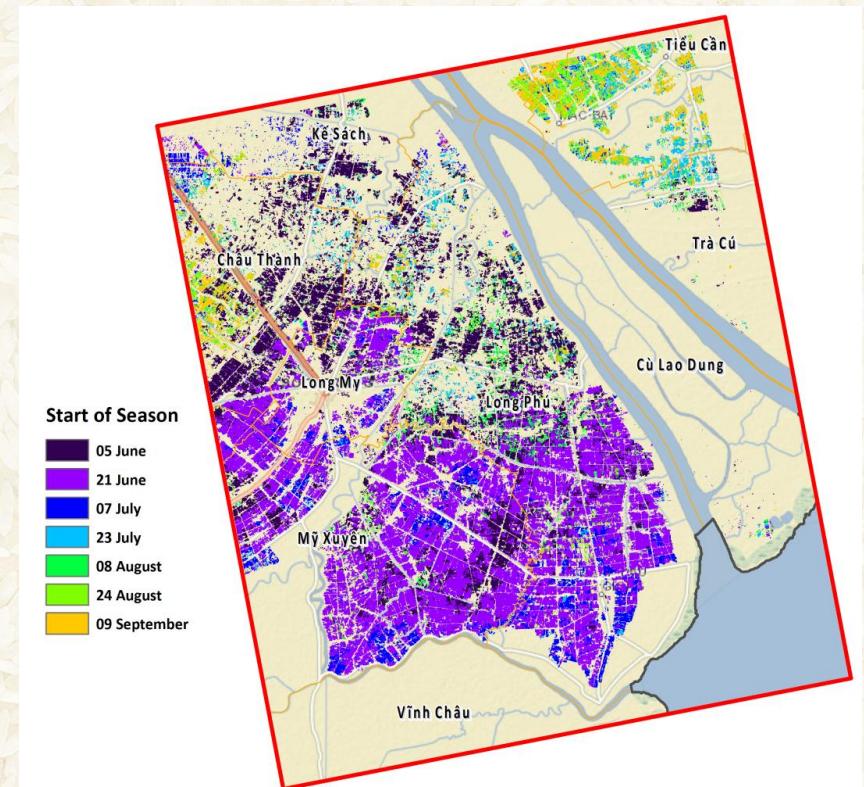
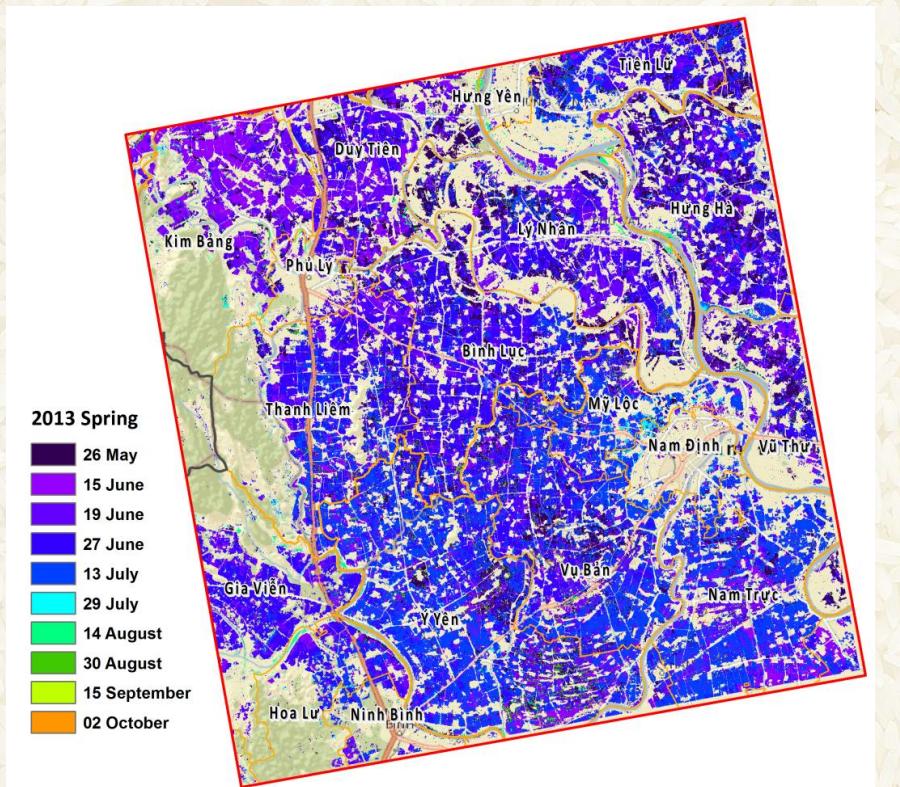


Planting Dates and Seasonality



- reveals heterogeneity in planting
- showing season is early or delayed
- may reveal areas where there are constraints

Red River and Mekong River Delta, Vietnam 2013

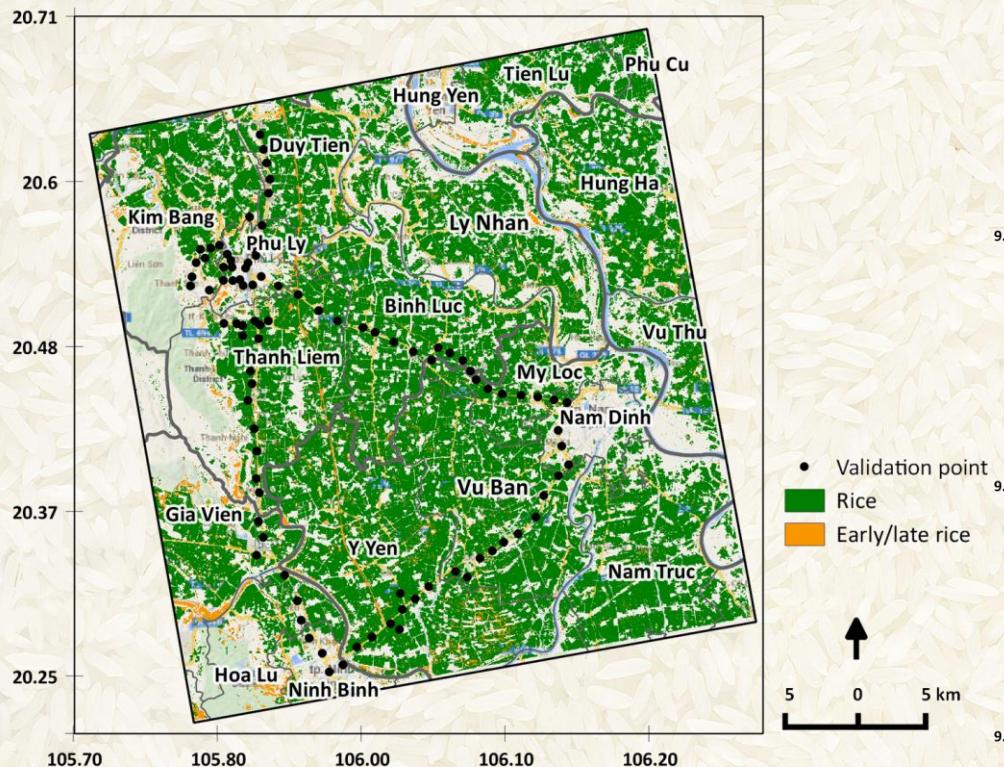


Accuracy \pm 11 days

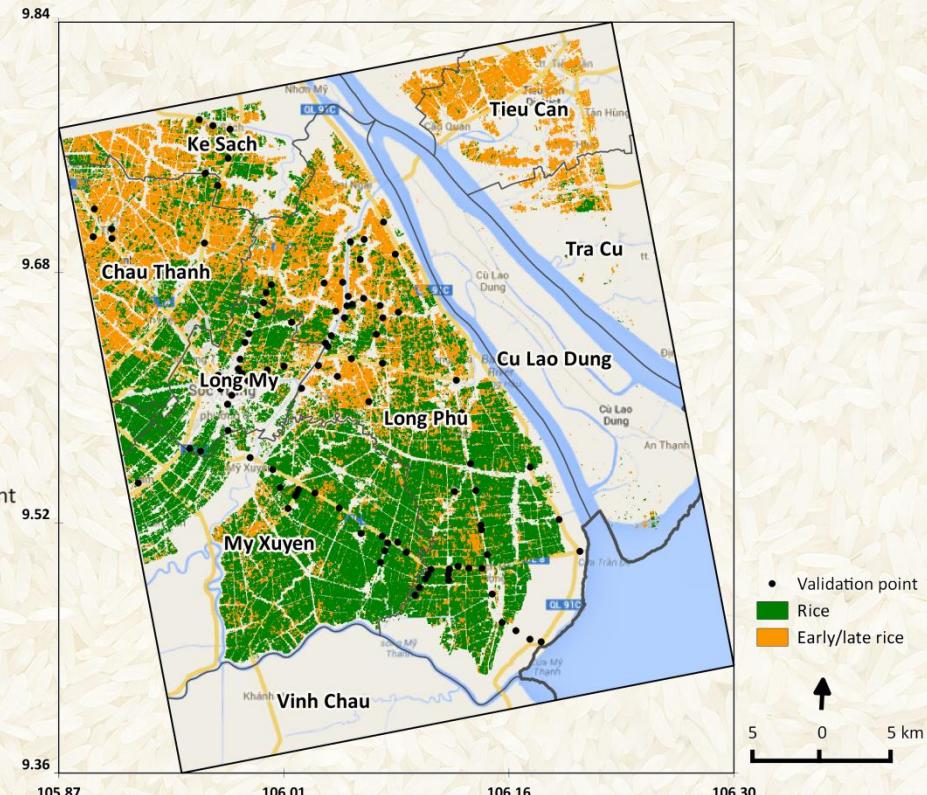
Accuracy \pm 15 days

Rice Area Estimates

Nam Dinh in the Red River Delta



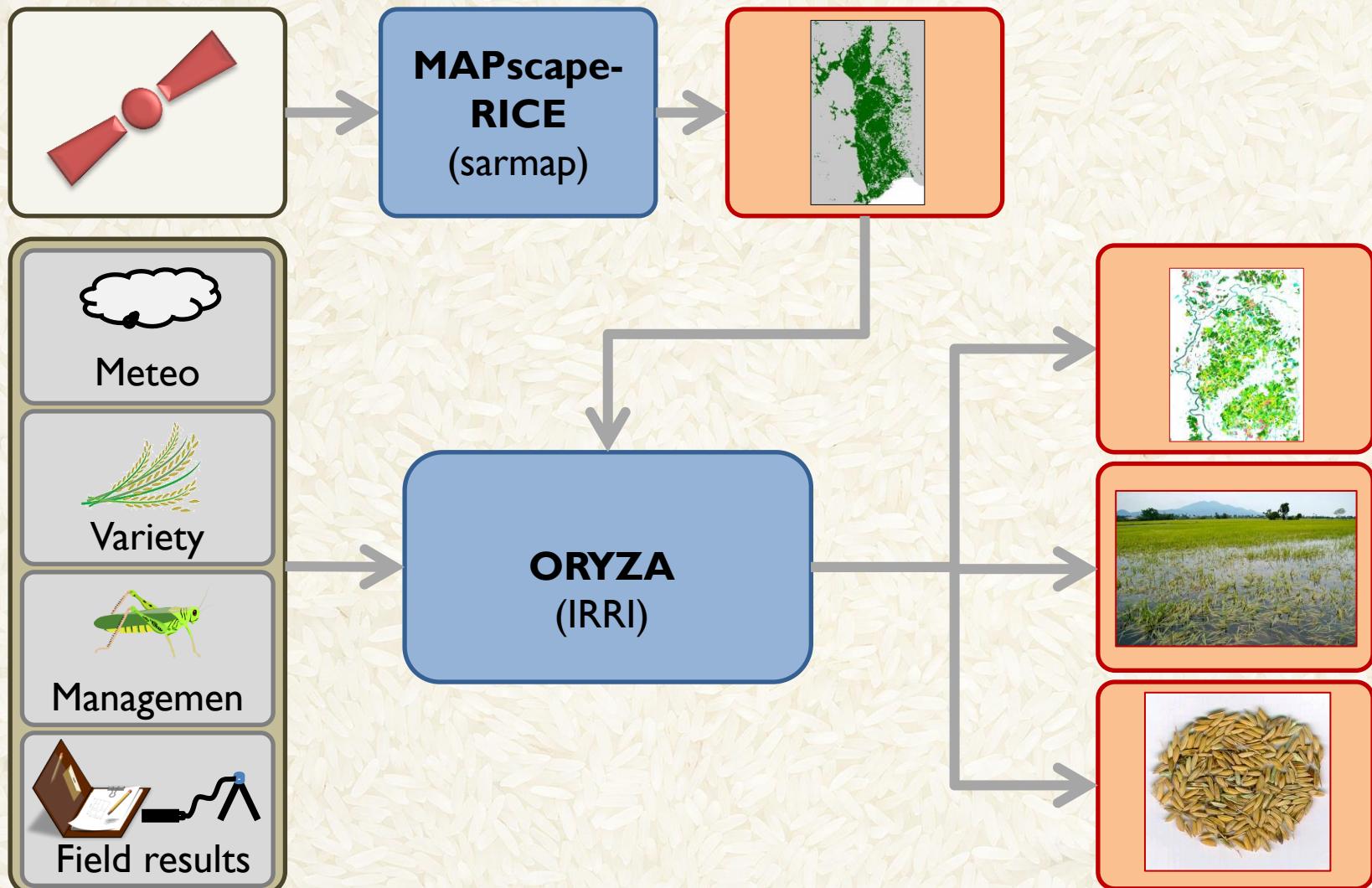
Soc Trang in the Mekong River Delta



Rice map classification accuracy (%) is based on comparison against 100 ground truth points per footprint. Consistently above 85% in all 13 RIICE sites.

Yield Estimation Process

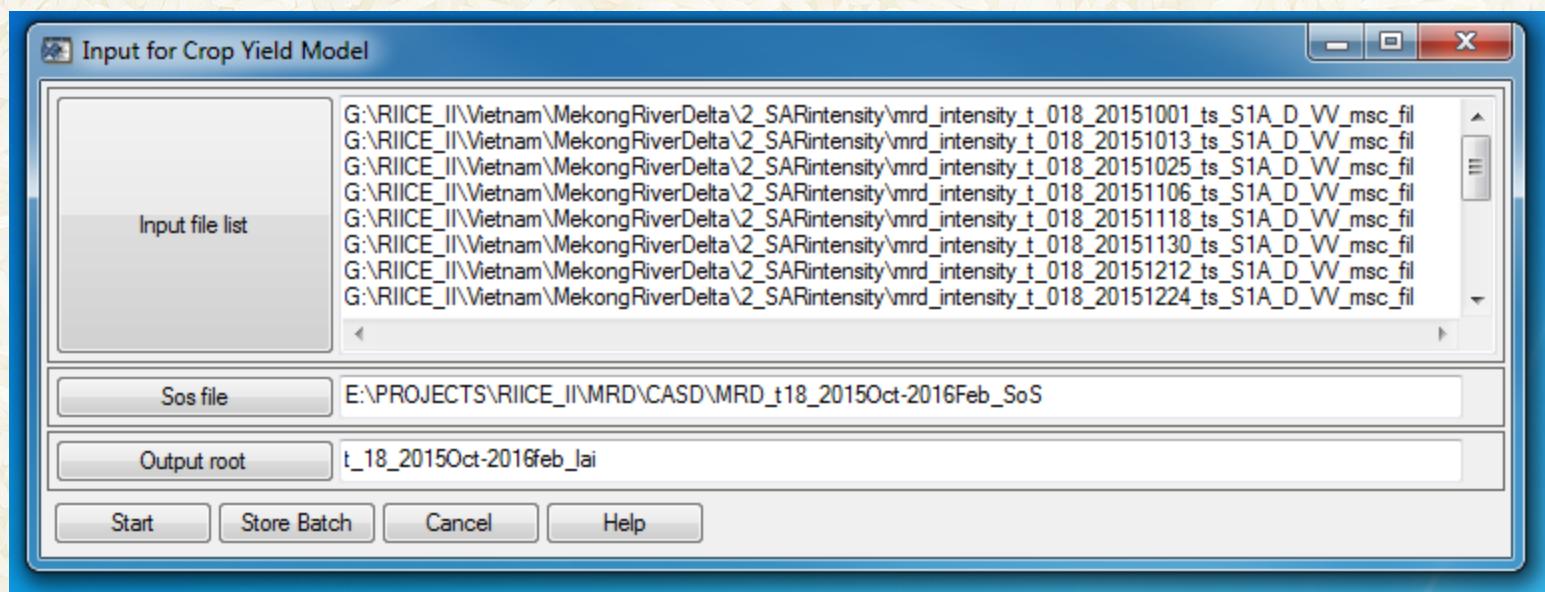
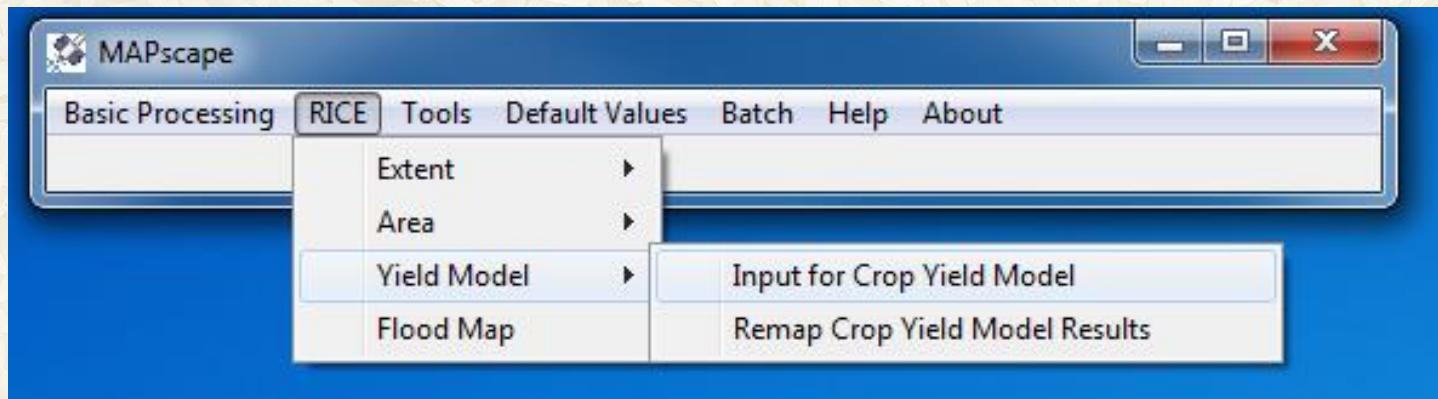
Using remote sensing and crop modeling



MAPScape-Rice

Raw SAR data -> Rice SAR Products

Rice Area Map
Planting Dates Map
LAI Maps



Rice Yield Estimation System (Rice-YES)

SAR products -> Yield Maps

Rice YES 3.1

Yield Simulation Weather Configuration and Settings Tools Help About

- Assimilate Ctrl+A
- Forecast Ctrl+F
- Graph Analysis Ctrl+G

Rice YES 3.1

Yield Simulation Weather Configuration and Settings Tools Help About

Mid-Season Forecast

File Run

Process

Input CYM: E:\Projects\Rice YES New Version\Win64\Debug\SAR\MRD_t18_2015Oct01-2016Oct01.DAT

Variety: E:\Projects\Rice YES New Version\Win64\Debug\VARIETY\MTR110.DAT

Soil: E:\Projects\Rice YES New Version\Win64\Debug\SOIL\WISEPD472B.DAT

Management: E:\Projects\Rice YES New Version\Win64\Debug\MANAGEMENT\YASTNDRD.DAT

Weather: E:\Projects\Rice YES New Version\Win64\Debug\WEATHER

Workspace: E:\Projects\Rice YES New Version\Win64\Debug\OUTPUT

Weather Chart

Main

TChart

Legend:

- srad
- tmin
- tmax
- vp
- wind
- prec

Properties

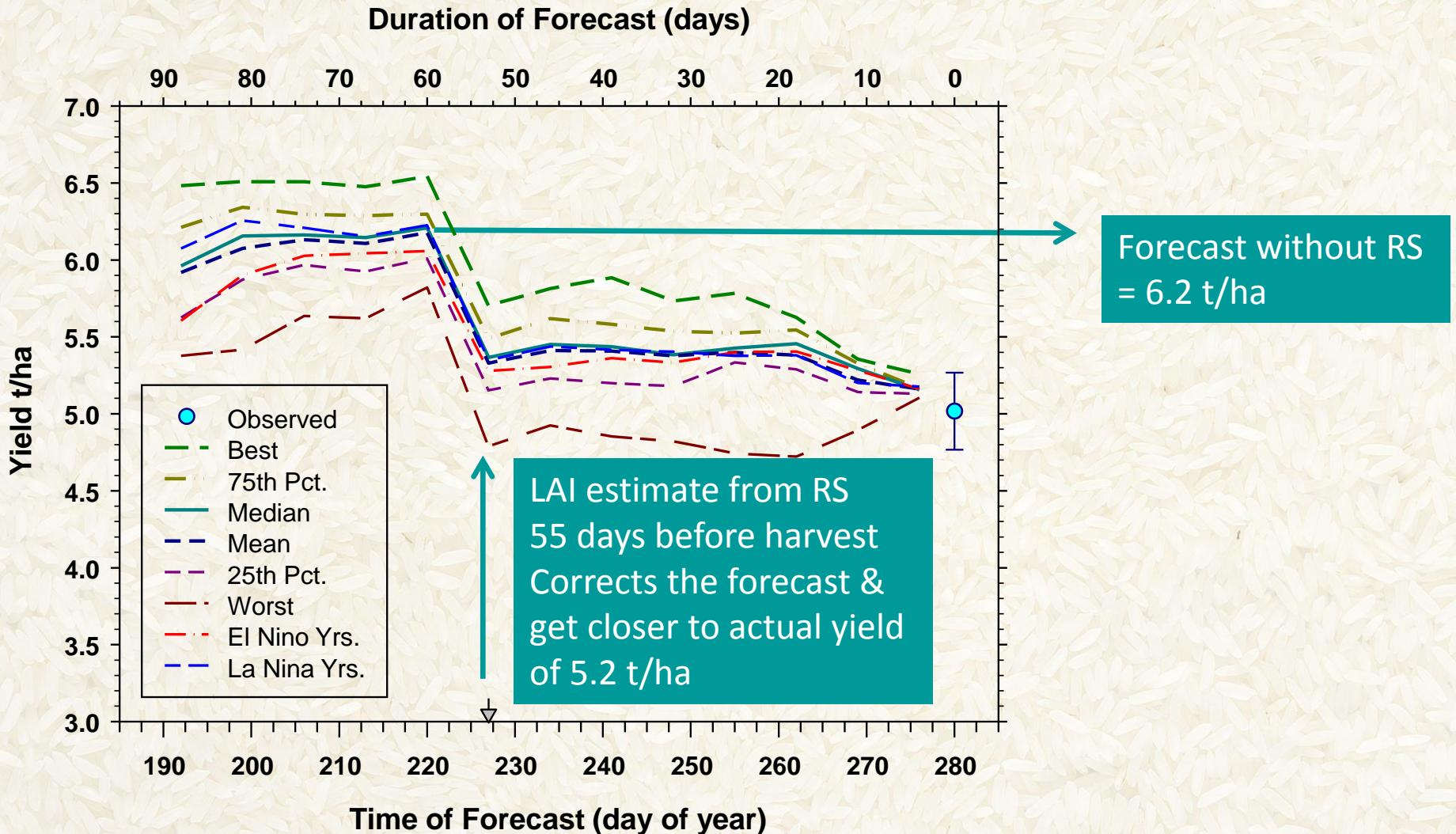
Cell	Year	Day of the year
476417	2015 <input type="button" value="▼"/> 2016 <input type="button" value="▼"/>	Start 220 <input type="button" value="▼"/> End 50 <input type="button" value="▼"/>

Summary

Duration: 2015 220 - 2016 50
 Average tmin: 22.98
 Average tmax: 31.48
 Sum prec: 732.9

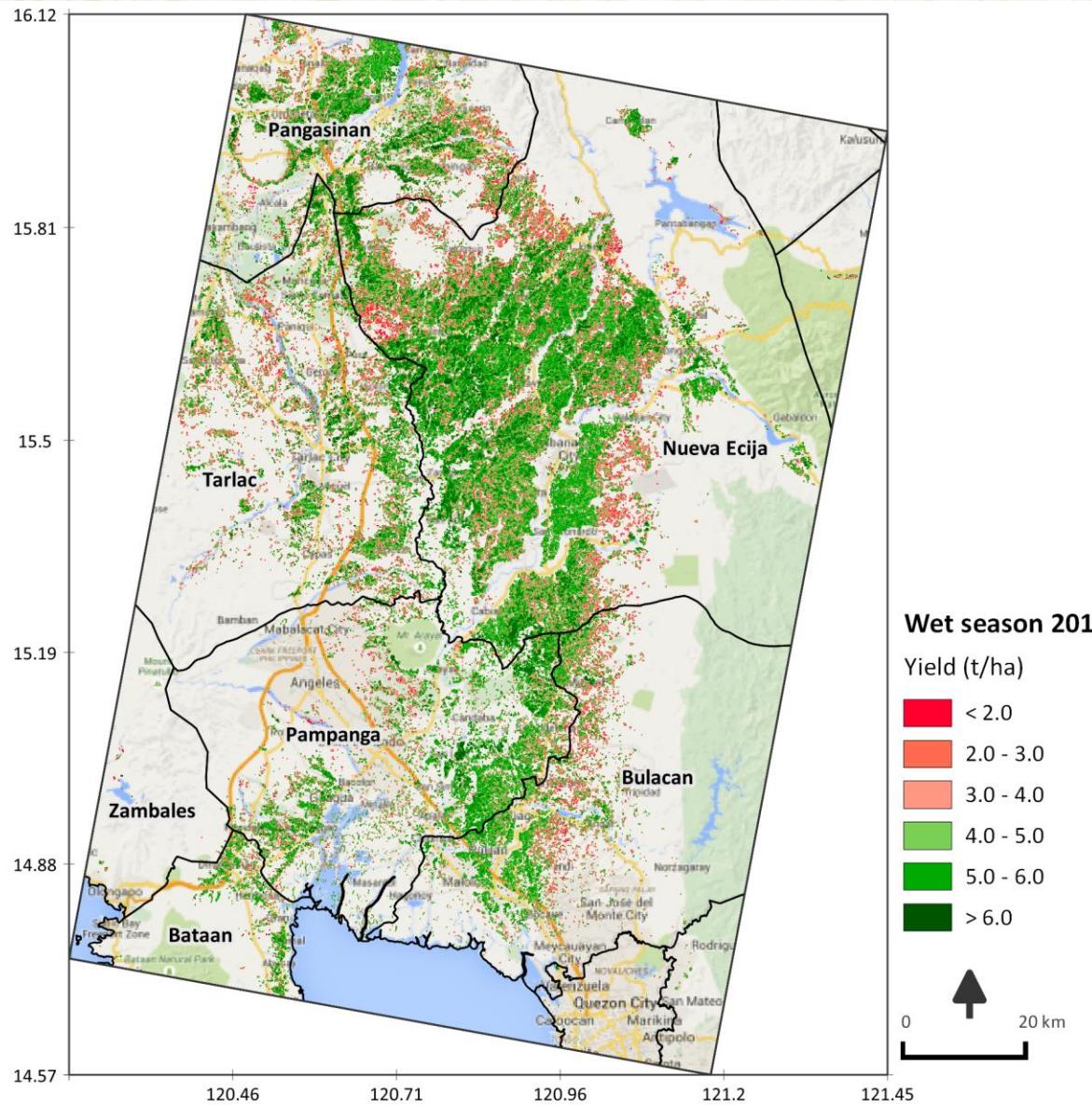
In-Season Rice Yield Forecasting

Linking SAR-based remote sensing data (CSK-LAI) with ORYZA Crop Growth Model



Yield Forecasts and Estimates

Nueva Ecija, Philippines



1st forecast:

Sep 2014 = **5.60 t/ha**

2nd forecast:

Oct 2014 = **5.40 t/ha**

PSA-BAS forecast:

Oct 2014 = **5.48 t/ha**

End-of-season estimate:

Nov 2014 = **5.30 t/ha**

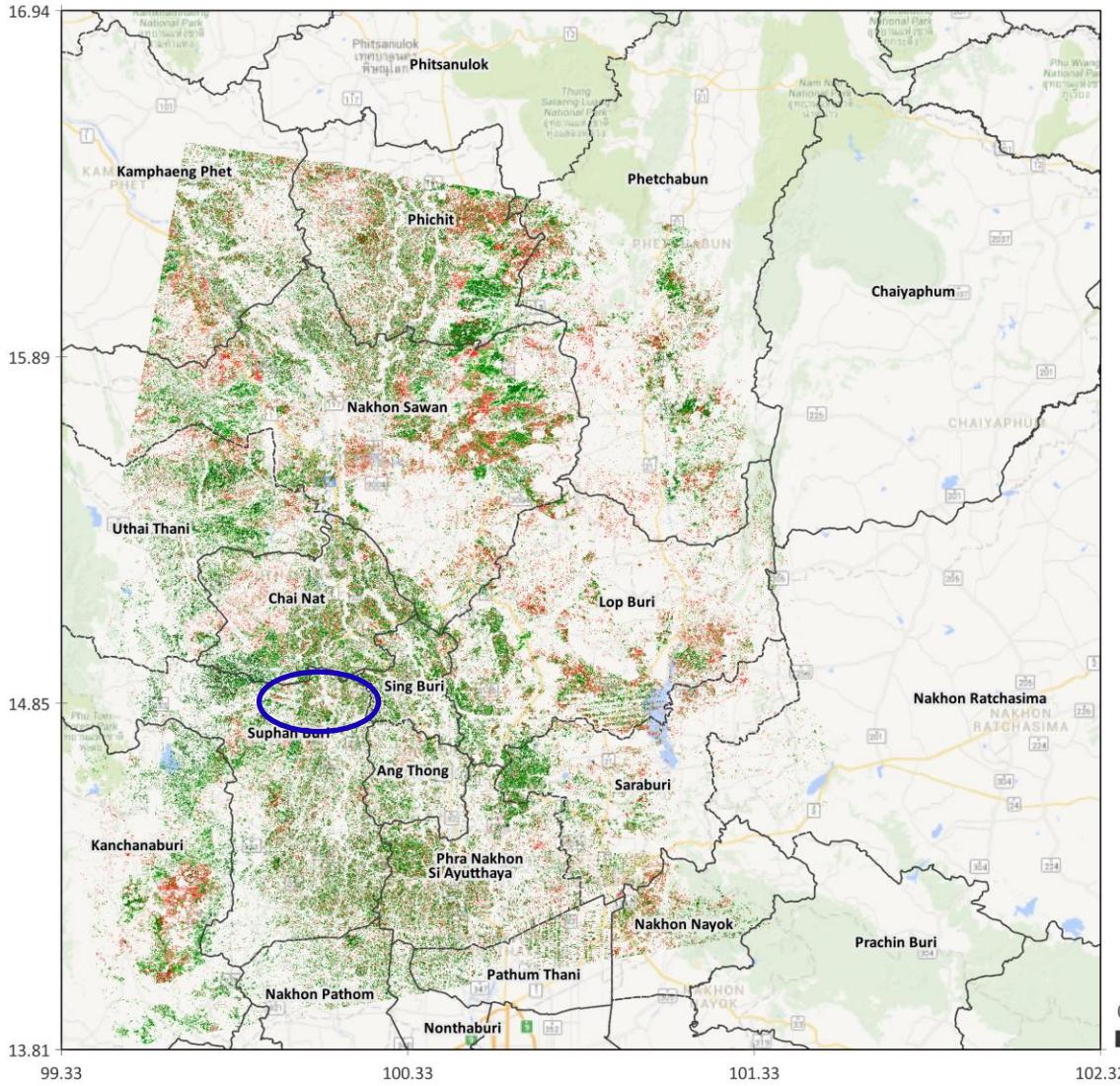
PSA-BAS estimate

(by province):

Mar 2015 = **5.31 t/ha**

Accuracy = 86%

(based on crop cuts)



Yield 2015 Wet Season Central Plain Thailand

Forecast Yield Data
Available: Sep 2015
Agreement: 82%*

End of Season Data
Available: Dec 2015
Agreement: 85%*

OAE Preliminary Data
Available: Mar 2016

Wet season, 2015

Yield (kg/ha)

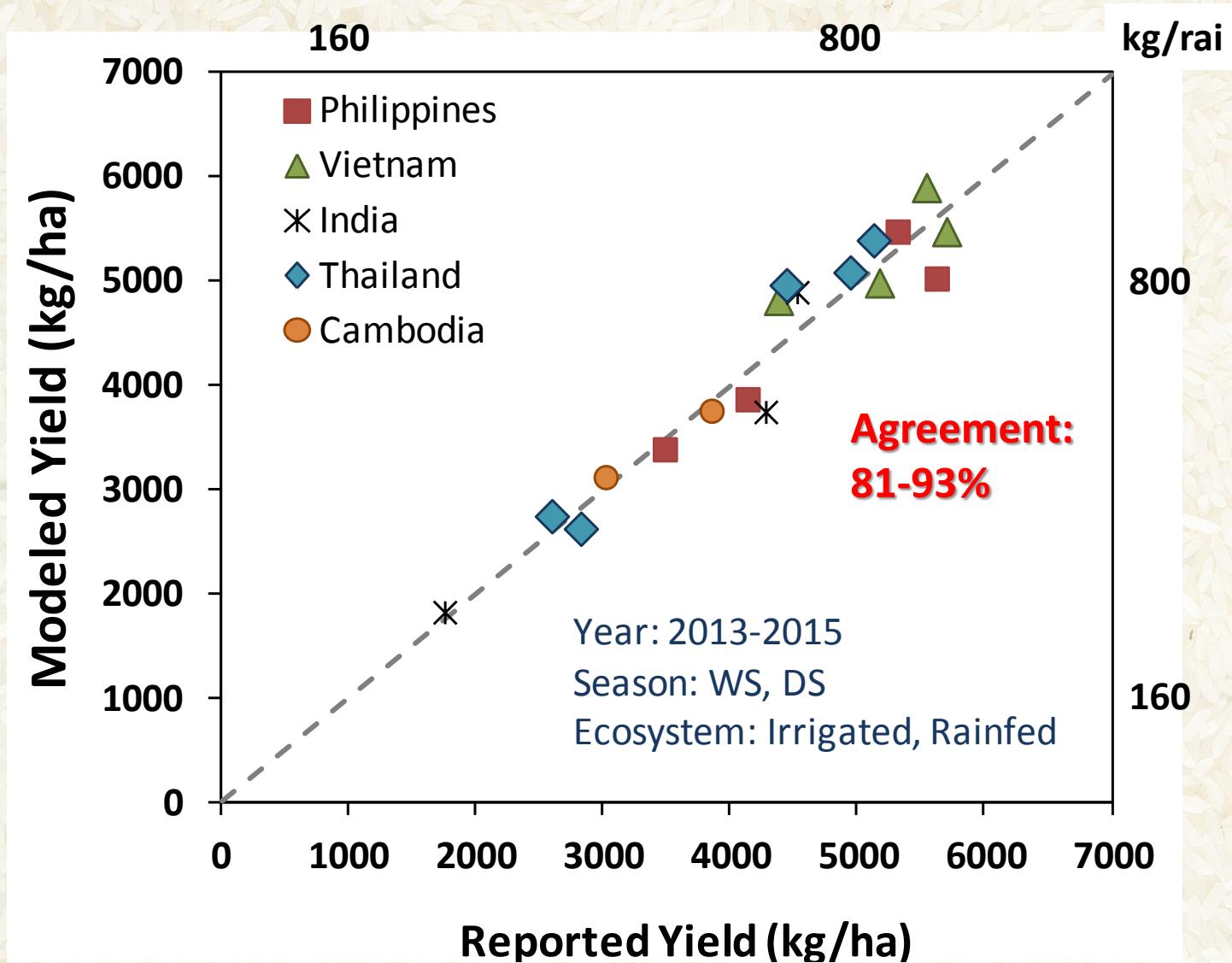
kg/rai
< 320
320 - 480
480 - 640
640 - 800
800 - 960
> 960

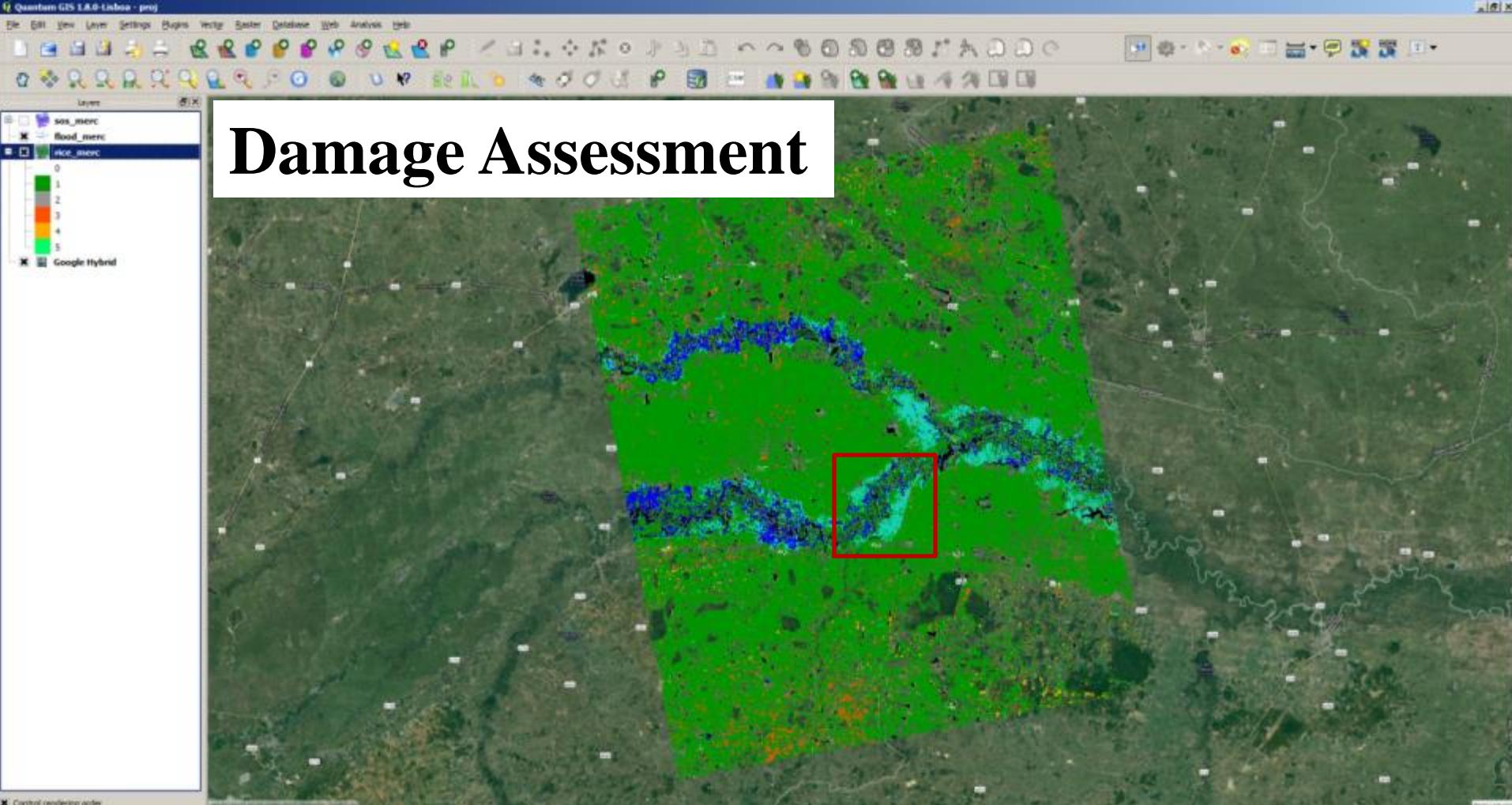


0 25 50 km

*Accessed based on initial data from DOAE for Suphanburi province

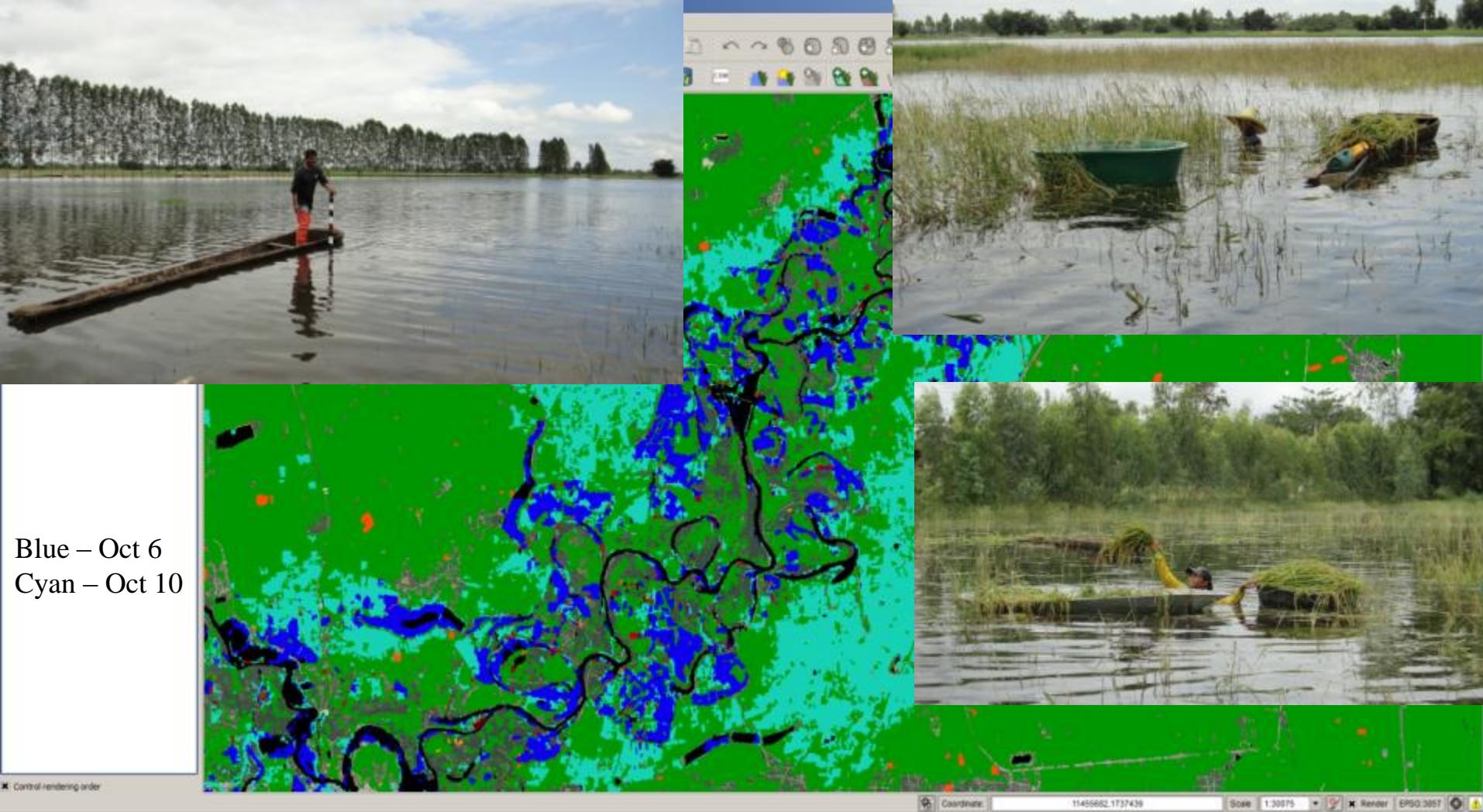
Multi-Country Model Yield Validation





Damage Assessment

Oct 2013 – severe flooding in Nakhon Ratchasima and Buri Ram was captured in our SAR imagery and provided within days to DOAE.
9,103 ha on Oct 6th, of which 7,138 ha were rice
1,576 ha on Oct 10th, of which 1,423 ha were rice



Detailed maps of flood affected rice areas can show which fields were flooded, when and for how long.

Incorporation of remote sensing products (SAR) into crop model improves yield estimation:

- Captures the response of rice plants to environmental conditions over large areas
- Includes rice phenology to initialize the model
- Tested in 6 countries with at least 85% accuracies for end of season yield estimates

Involvement of national partners is crucial:

- The only way to sustain, promote and validate an operational crop monitoring system
- Data collection for calibration and validation & provision of knowledge on rice types and practices that are essential for product generation



www.riice.org

Allianz



Tamil Nadu Agricultural University



Agricultural Insurance Company of India

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



Philippine Rice Research Institute



Philippine Crop Insurance corporation

IRRI INTERNATIONAL RICE RESEARCH INSTITUTE



Thailand Rice Department



Geo-Informatics and Space Technology Development Agency

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC



Indonesian Center for Agricultural Land Resources Research and Development



Cambodia Agricultural Research and Development Institute

sarmap your information gateway



Can Tho University



Institute of Meteorology, Hydrology & Environment

Thank You

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