Experiences from the RIICE and PRiSM projects for rice crop monitoring in Thailand and the Philippines

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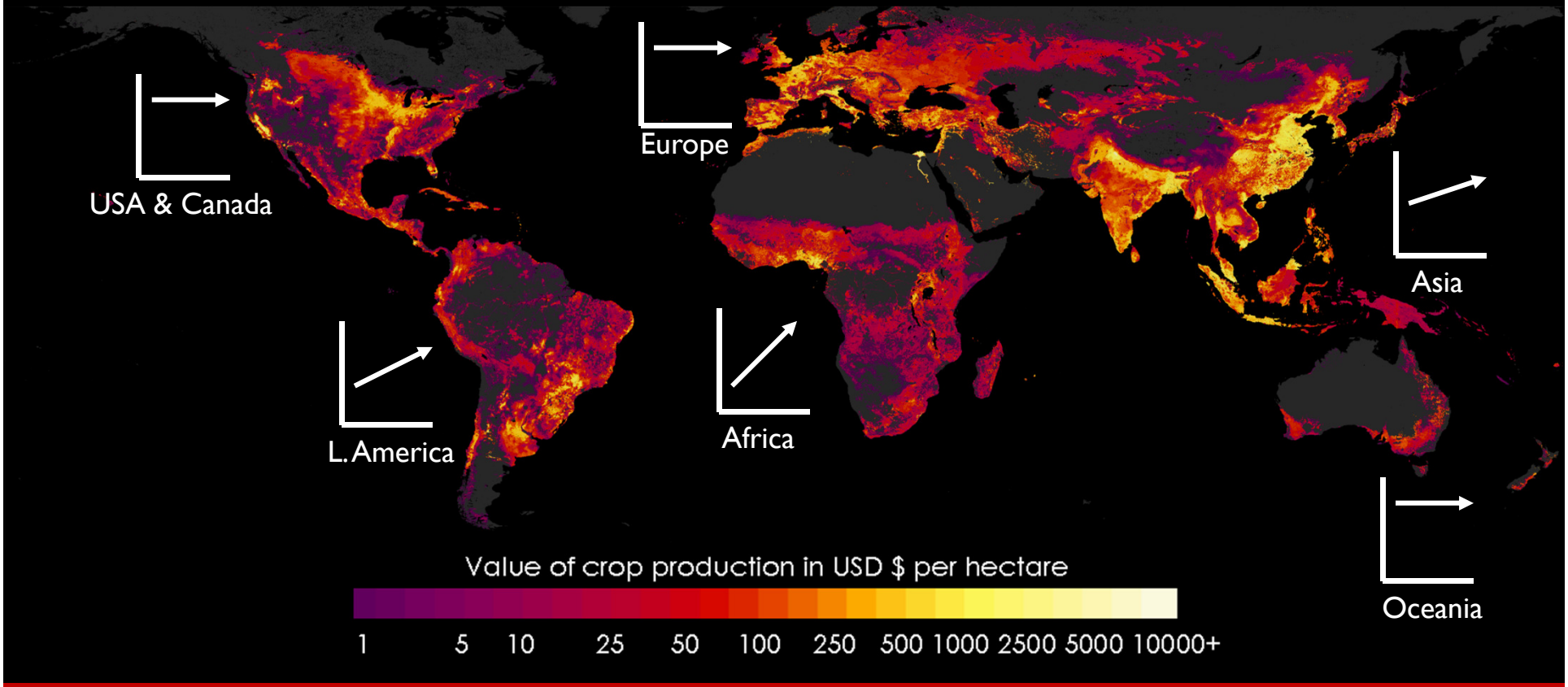
IRRI

CGIAR Research Program on Rice Global Rice Science Partnership

How will we feed 9 billion people in 2050?



Food production must increase sustainably to meet future demands. The regions that must contribute most to future food security are home to 1.3 billion poor people and face rapid demographic, economic, technological and climate change [1]. **What do we know about production trends?**

1 Food Security: The Challenge of Feeding 9 Billion People (2010) Godfray et al. Science Vol 327 812-8.

Information gaps in policy & research

Statistics on productivity and agriculture in emerging economies and low income countries cannot meet our increasing need for data/information [2]. But these are exactly the places where good data/information are most needed.

Poor decisions on food security issues, partly based on poor data, lead to unintended and generally negative consequences, especially for the most vulnerable in society.

There is high demand for alternative and better sources of information to support research and decision making for food security and economic development [3].

2 Poor Numbers, Marten Jerven, 2013, especially chapter 3 on the "calamitous state of affairs" of agricultural production figures in the South.
3 Deaton, Angus, and Alan Heston. 2010. "Understanding PPPs and PPP-Based National Accounts." American Economic Journal: Macroeconomics 2(4): 1–35

The need for *Actionable Information*

"I asked the Department of Science and Technology (DOST) - a month, two months ago, some time back - if we can use satellite imagery to actually determine arable lands that are planted to rice" he said so the government would have an accurate picture of the country's rice situation [4].

- President Benigno Aquino III, 25/06/14

Despite being the most important crop in Asia - economically, nutritionally, politically and culturally - there are major impediments to sustainable production and food security caused by the lack of accurate, detailed and timely information. Spatial science is not everything, but **smart, integrated spatial science does have a role to play.**

4 http://newsinfo.inquirer.net/614287/aquino-downplays-price-hike-says-not-everyone-buys-well-milled-rice

The need for *Actionable Information*

The UN Secretary General's Independent Expert Advisory Group on a **Data Revolution for Sustainable Development**

"To know what we need to know involves a deliberate and systematic effort of finding out. **It means seeking out high quality information that can be compared over time, between and within countries, and continuing to do so, year after year.** It means careful planning, spending money on technical expertise, robust systems, and ever changing technologies. It means building public trust in the data, and expanding people's ability to use it." [5]

5 http://www.undatarevolution.org/

Demand driven – what is needed?

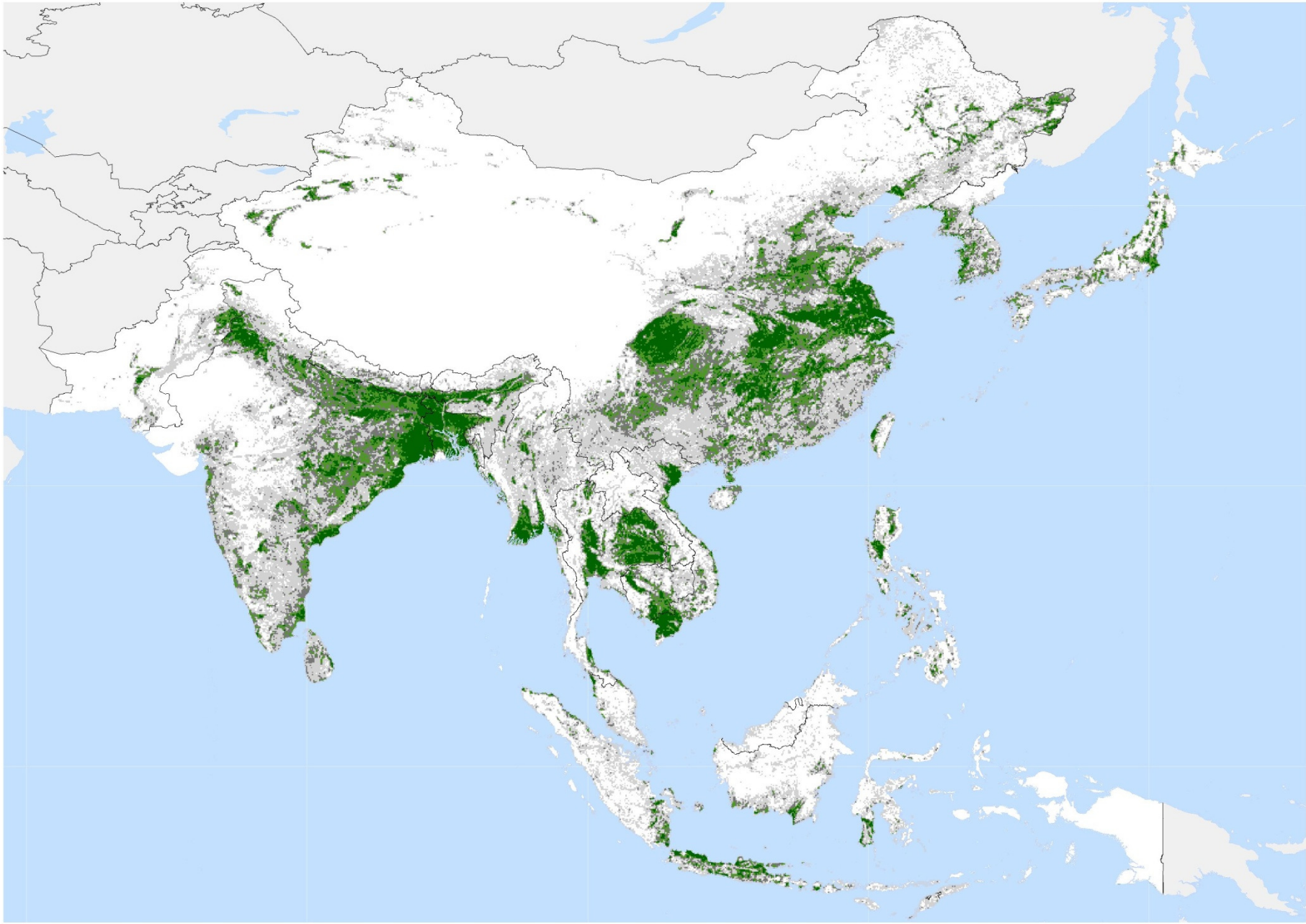
Crop area – ***where*** – is the obvious candidate. The most basic application of remote sensing technology.

Planting and harvesting – ***when*** **-** is just as critical. Sufficient quantity at the wrong time (i.e. a delayed season) can still lead to greater imports and higher prices.

There are other applications too.

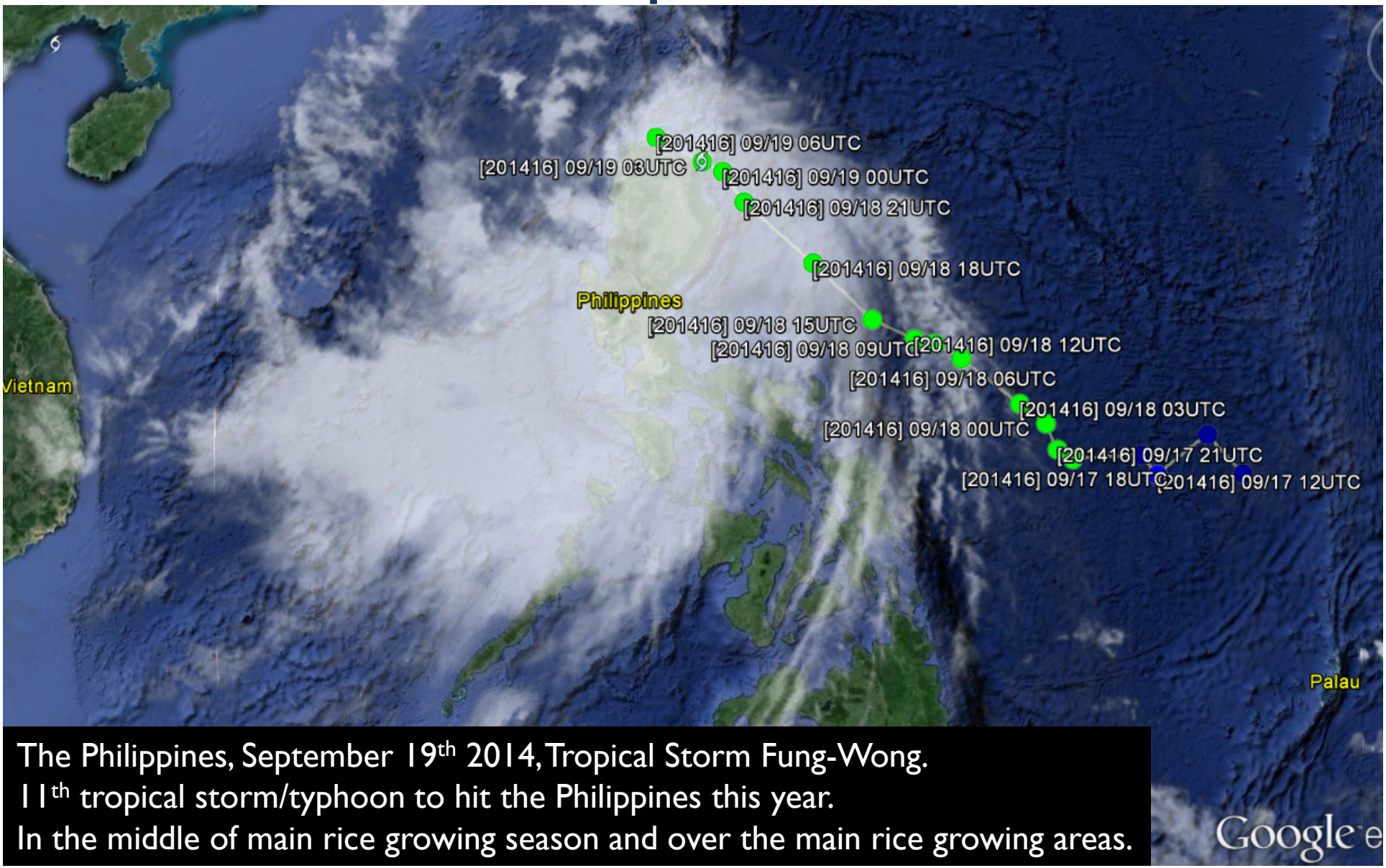
Loss estimates in the event of a calamity **-** disaster response, insurance and other safety nets.

Rice growing areas of Asia. Green areas are the most intensely cultivated regions.



Rice is cultivated in every part of Asia, in diverse environments and seasons

When is as important as where

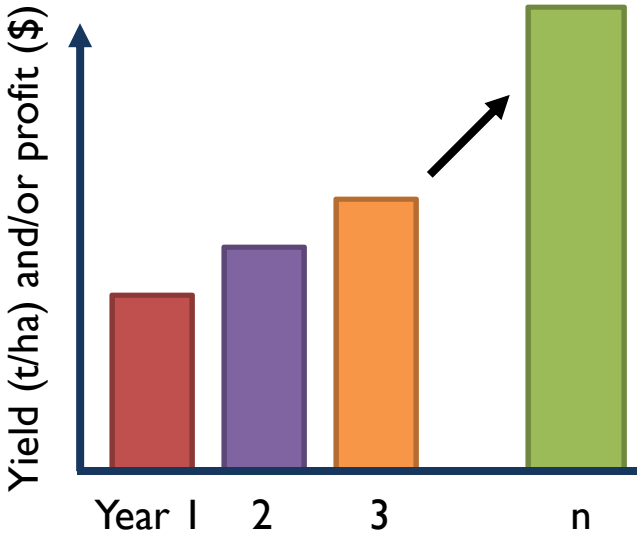


The Philippines, September 19th 2014, Tropical Storm Fung-Wong.
11th tropical storm/typhoon to hit the Philippines this year.
In the middle of main rice growing season and over the main rice growing areas.

Demand driven – what is needed?

How much (yield & production) and **how much more?**

- What is the yield?
- Where are the yield gaps?
- How big are the gaps they?
- What causes them?
- What can be done about them?



Can we support statistical agencies and other stakeholders with alternative sources of complementary information on the rice crop?

1 Seasonal rice area **2 Planting and harvesting dates**

3 Losses from calamities **4 Yield forecasts and estimates**

The role of research and development?

1. Remote sensing algorithms for robust crop measurements
2. Development of low cost field sampling protocols
3. Development of smartphone apps for field collection
4. Outreach and capacity building in all of the above
5. To go from pilot sites (research) to national scale (operation)

Here are some examples from IRRI/GRiSP projects on rice in Asia

Leveraging new technologies

IRRI and partners are demonstrating how technologies like remote sensing, crop modeling, smartphones and web platforms can revolutionize information on the **when**, **where** and **how much** of rice as well as **crop health assessments** and **flood/drought damage**.

RIICE
Remote sensing based
Information and
Insurance for
Crops in
Emerging economies.

www.riice.org

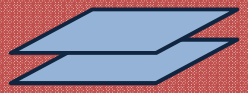
PRiSM
Philippine Rice
Information System

philippinericeinfo.ph

Remote sensing based information and insurance for crops in emerging economies - RIICE

The RIICE project demonstrates that remote sensing and other technologies can provide accurate and timely information on rice and builds capacity in-country to sustain the technology.

RIICE is supported by SDC (Switzerland) 2012-18

Data	Technology	Information	Users
Remote sensing 	Image processing	Rice area	Statistical agencies
Crop modeling	Planting dates	Policy makers
Weather, soil, etc. 	GIS & WebGIS	Yield & production	Researchers
Databases	Yield forecasts	Disaster response
Field measurements 	Expert knowledge	Flood & drought	Crop insurance
Training	Yield gaps	Traders/Markets

Remote sensing based information and insurance for crops in emerging economies - RIICE

RIICE

Allianz

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

IRRI
International Rice Research Institute

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

sarmap
your information gateway

Tamil Nadu Agricultural University

Agricultural Insurance Company of India

Philippine Rice Research Institute

Philippine Crop Insurance corporation

Thailand Rice Department

Geo-Informatics and Space Technology Development Agency

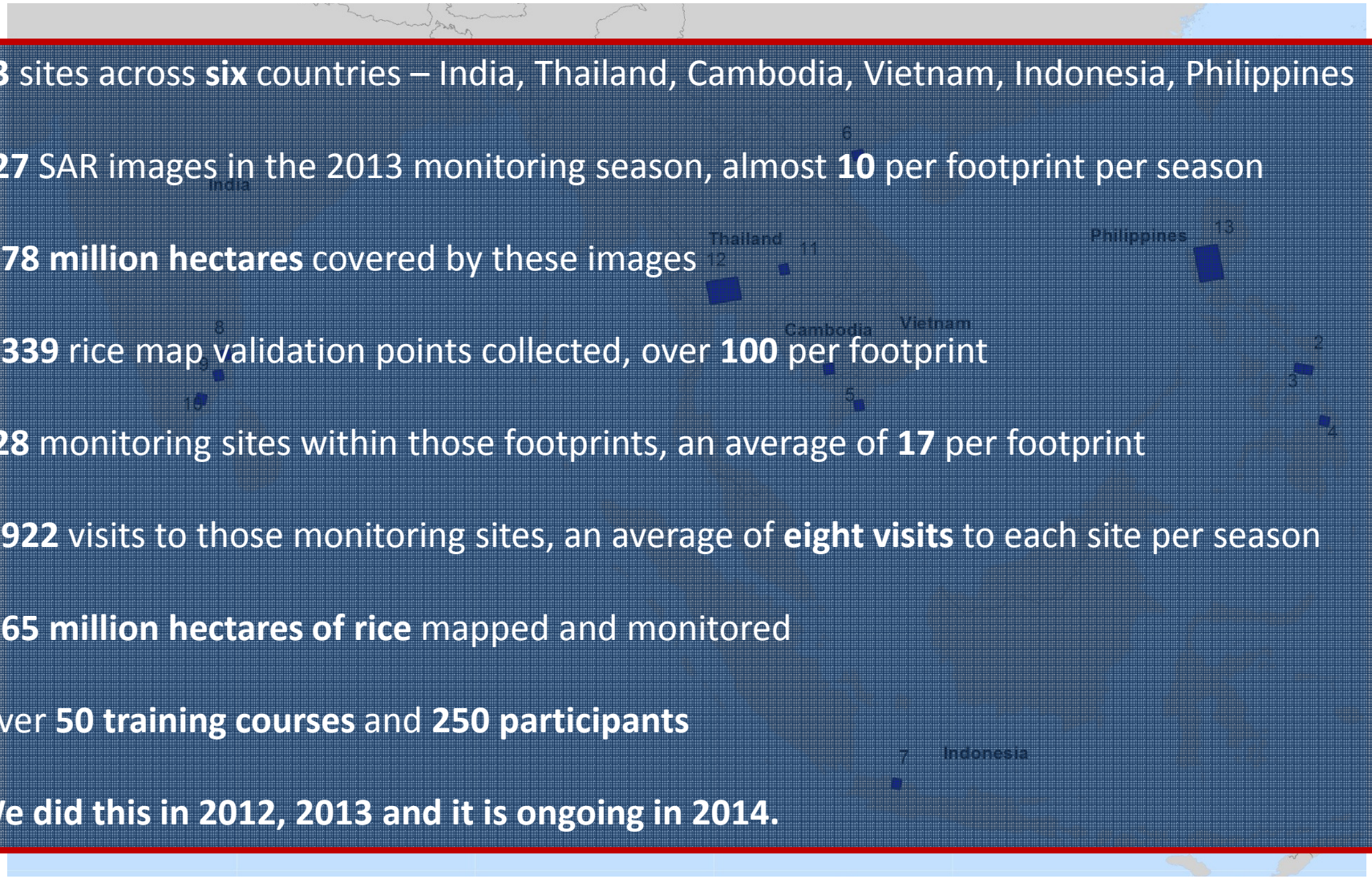
Indonesian Center for Agricultural Land Resources Research and Development

Cambodia Agricultural Research and Development Institute

Can Tho University

Institute of Meteorology. Hydrology & Environment

RIICE demonstration sites in Asia



13 sites across **six** countries – India, Thailand, Cambodia, Vietnam, Indonesia, Philippines

127 SAR images in the 2013 monitoring season, almost **10** per footprint per season

4.78 million hectares covered by these images

1,339 rice map validation points collected, over **100** per footprint

228 monitoring sites within those footprints, an average of **17** per footprint

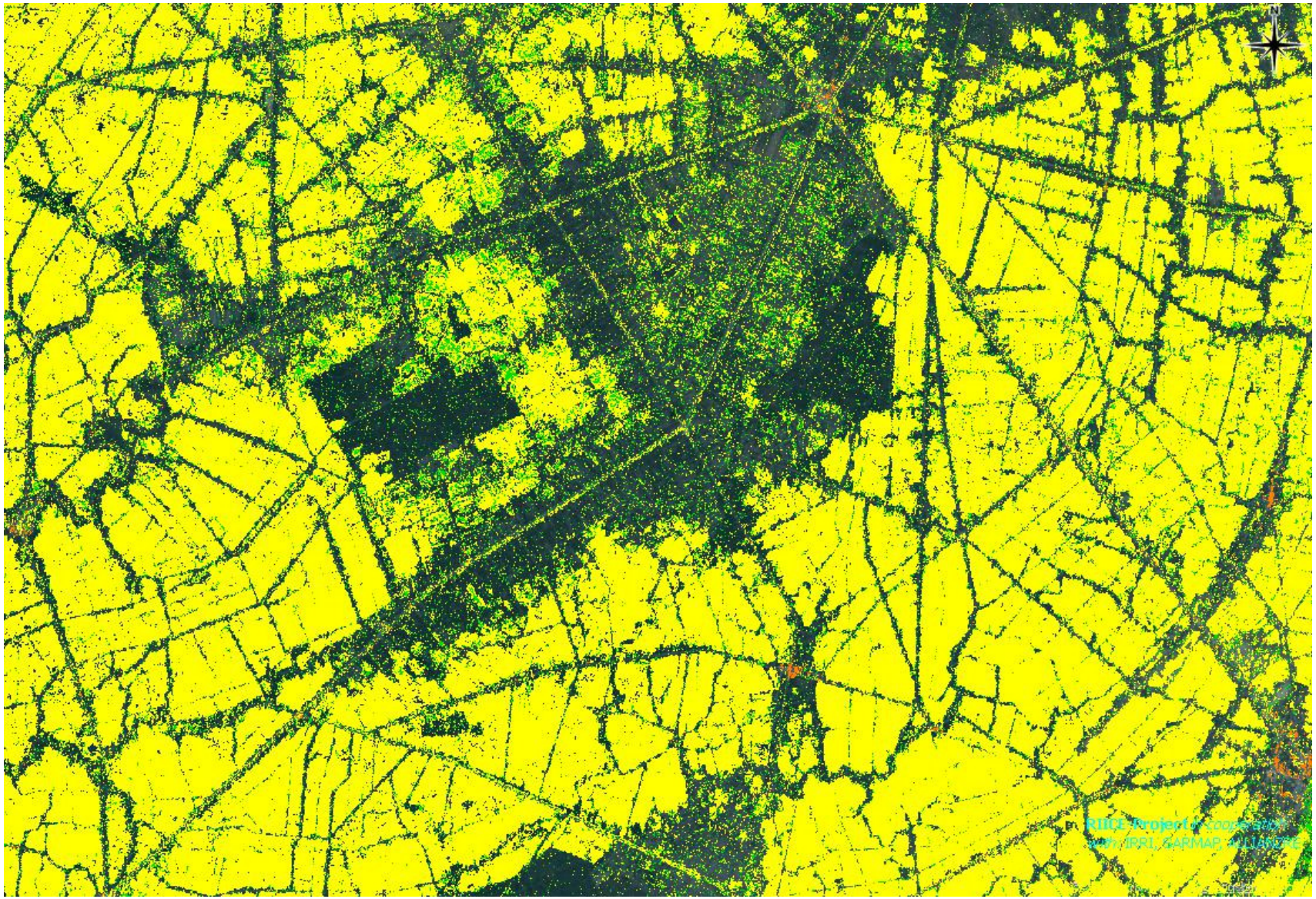
1,922 visits to those monitoring sites, an average of **eight visits** to each site per season

1.65 million hectares of rice mapped and monitored

Over **50 training courses** and **250 participants**

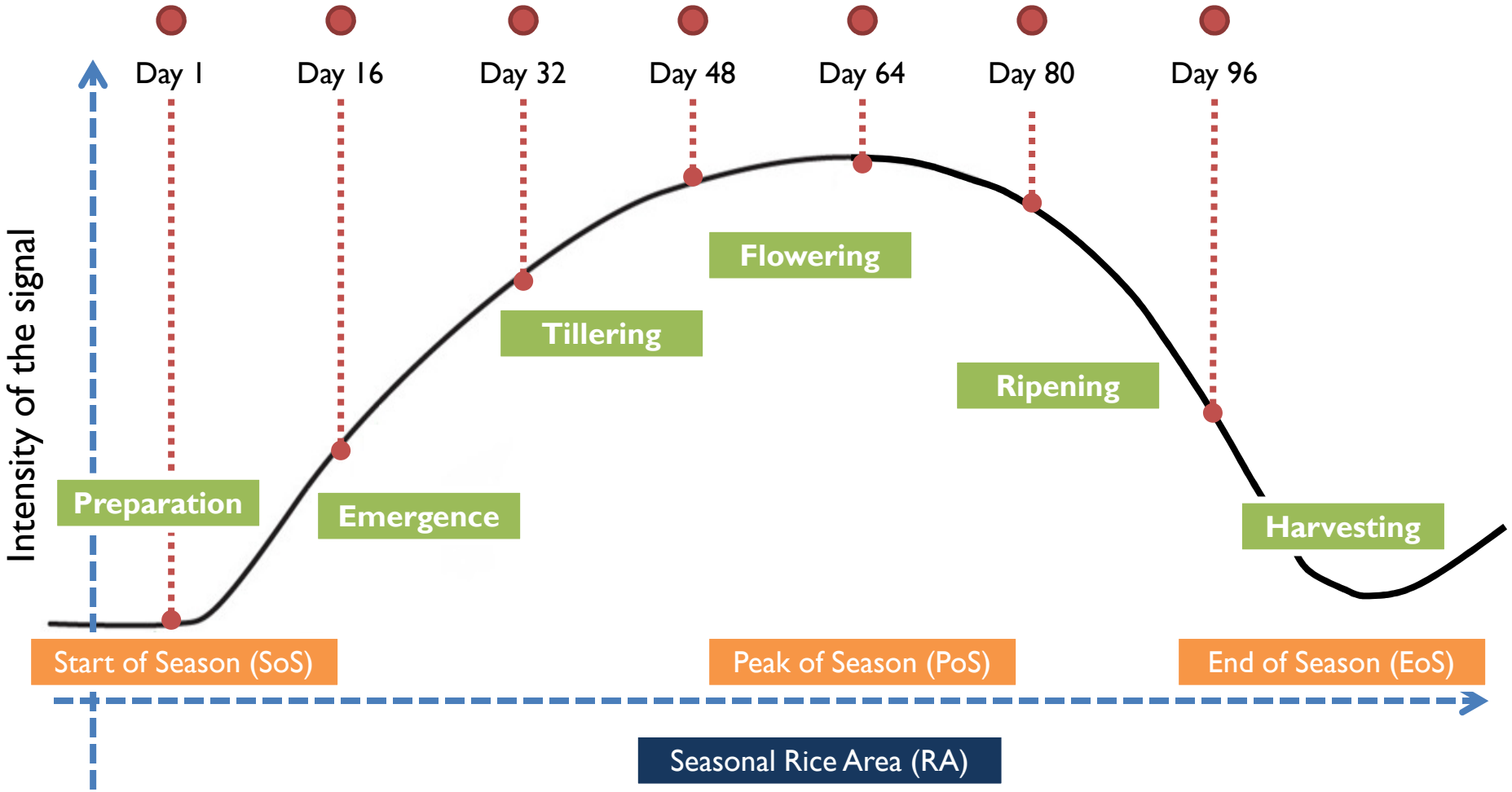
We did this in 2012, 2013 and it is ongoing in 2014.

Radar (SAR) images vs. optical images



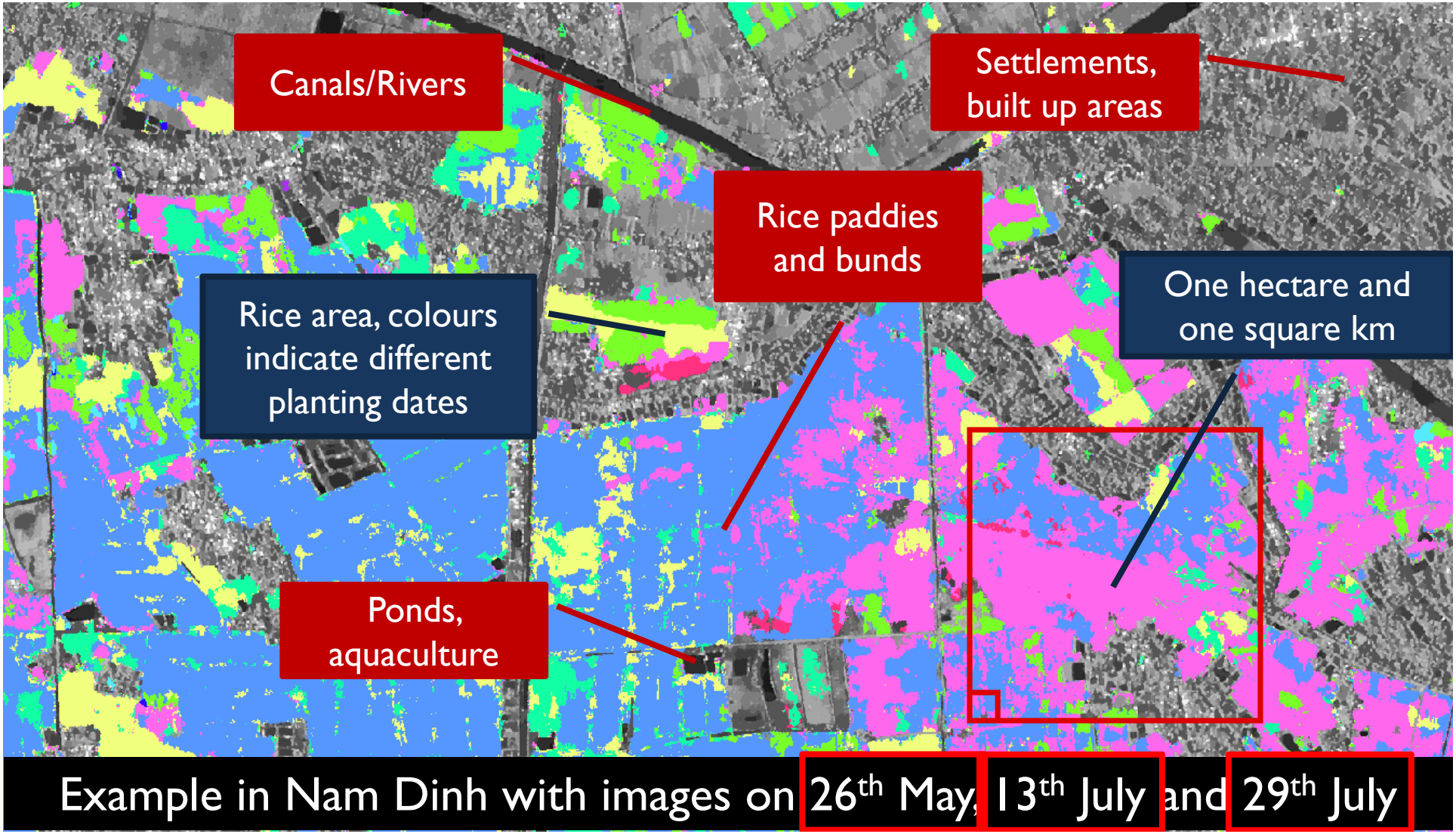
Continuous monitoring through the season

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

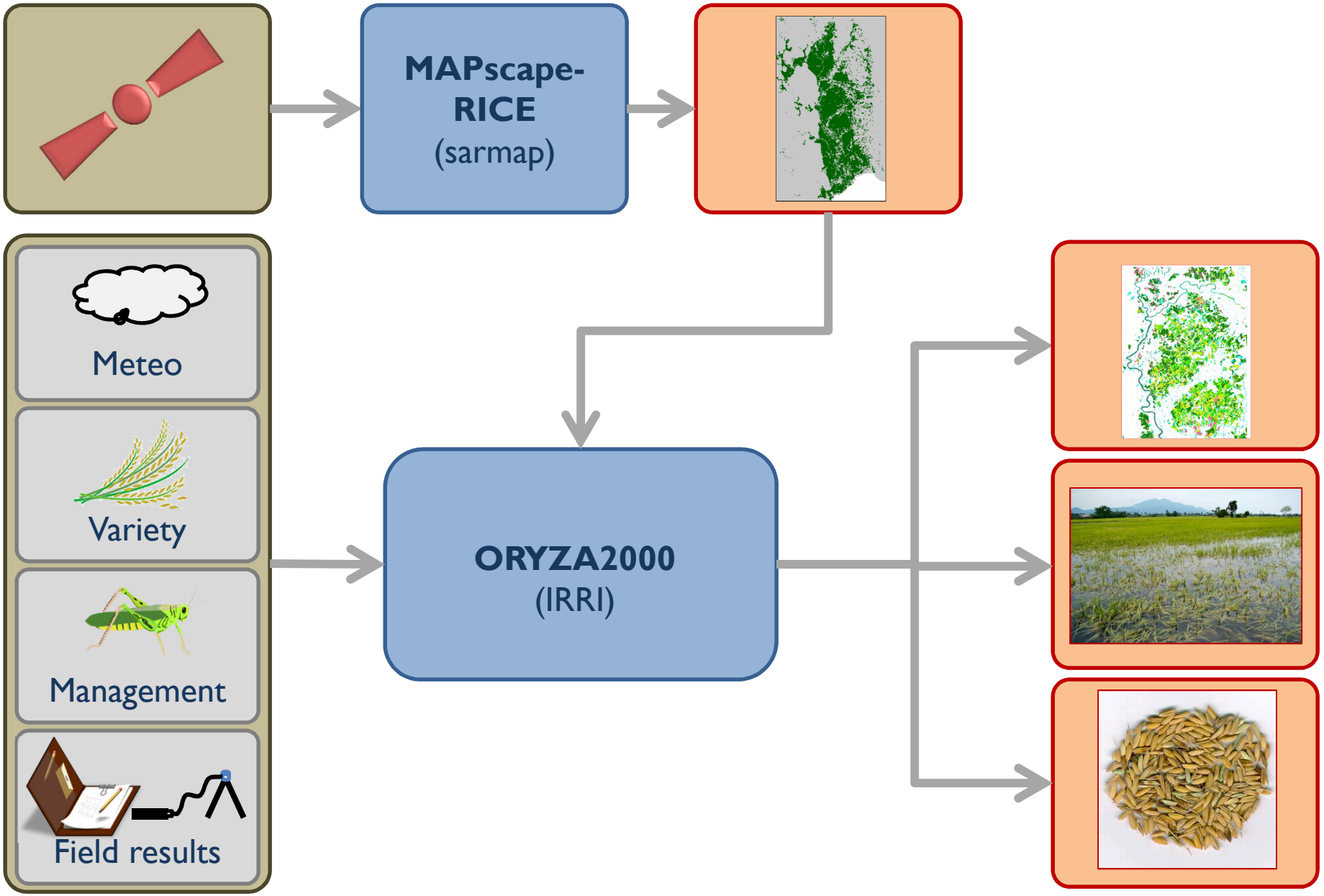


What do we see in the images?

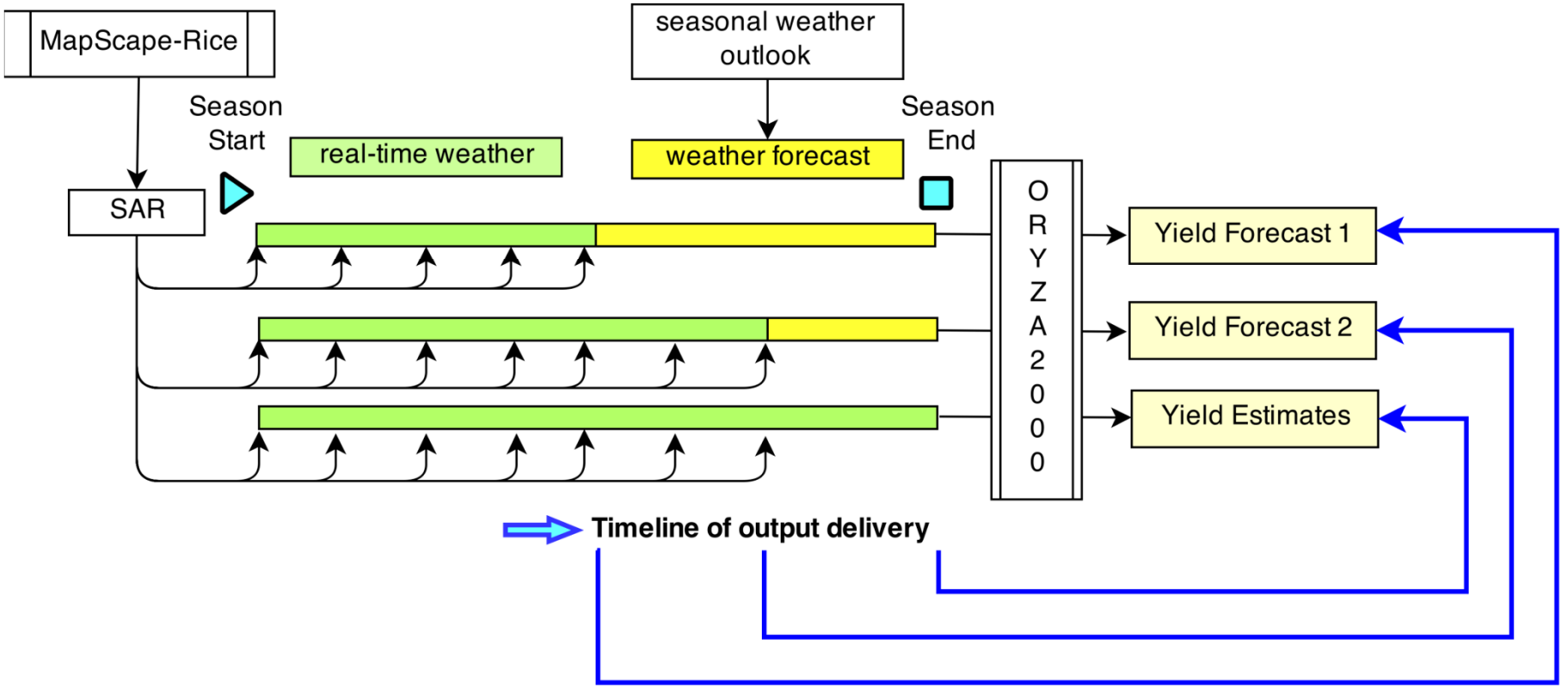
SAR data in RIICE are provided by ASI/e-GEOS and GISTDA from COSMO-SkyMed and by InfoTerra GmbH from TerraSAR-X.



Yield estimation process

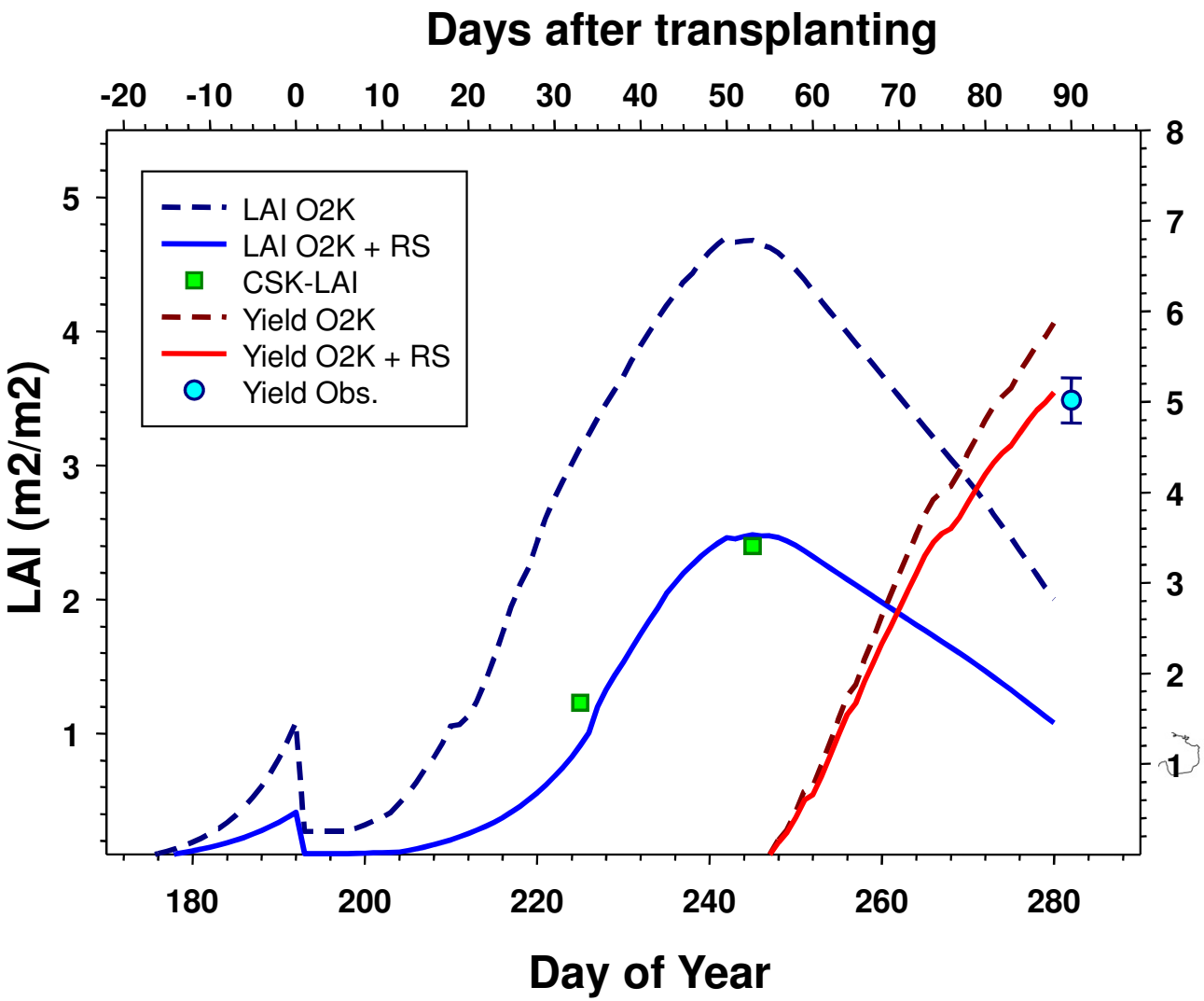


ORYZA2000+SAR Yield Estimate & Forecast Timeline

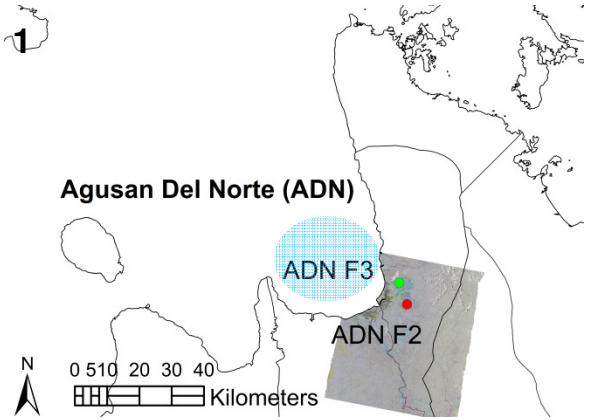


Yield forecast products uses weather forecast information in addition to real-time weather data. Two times of yield forecast is planned in RIICE, the first one in the middle of the season and the second about 2/3 toward the end of season. The second forecast and end of yield estimates are facilitated with more real-time weather data and additional SAR time series data as compared to the 1st forecast.

Linking remote sensing data to crop model for actual yield simulation



LAI = leaf area index
O2K = ORYZA2000
RS = SAR
CSK-LAI = LAI from SAR
Obs. = Observed



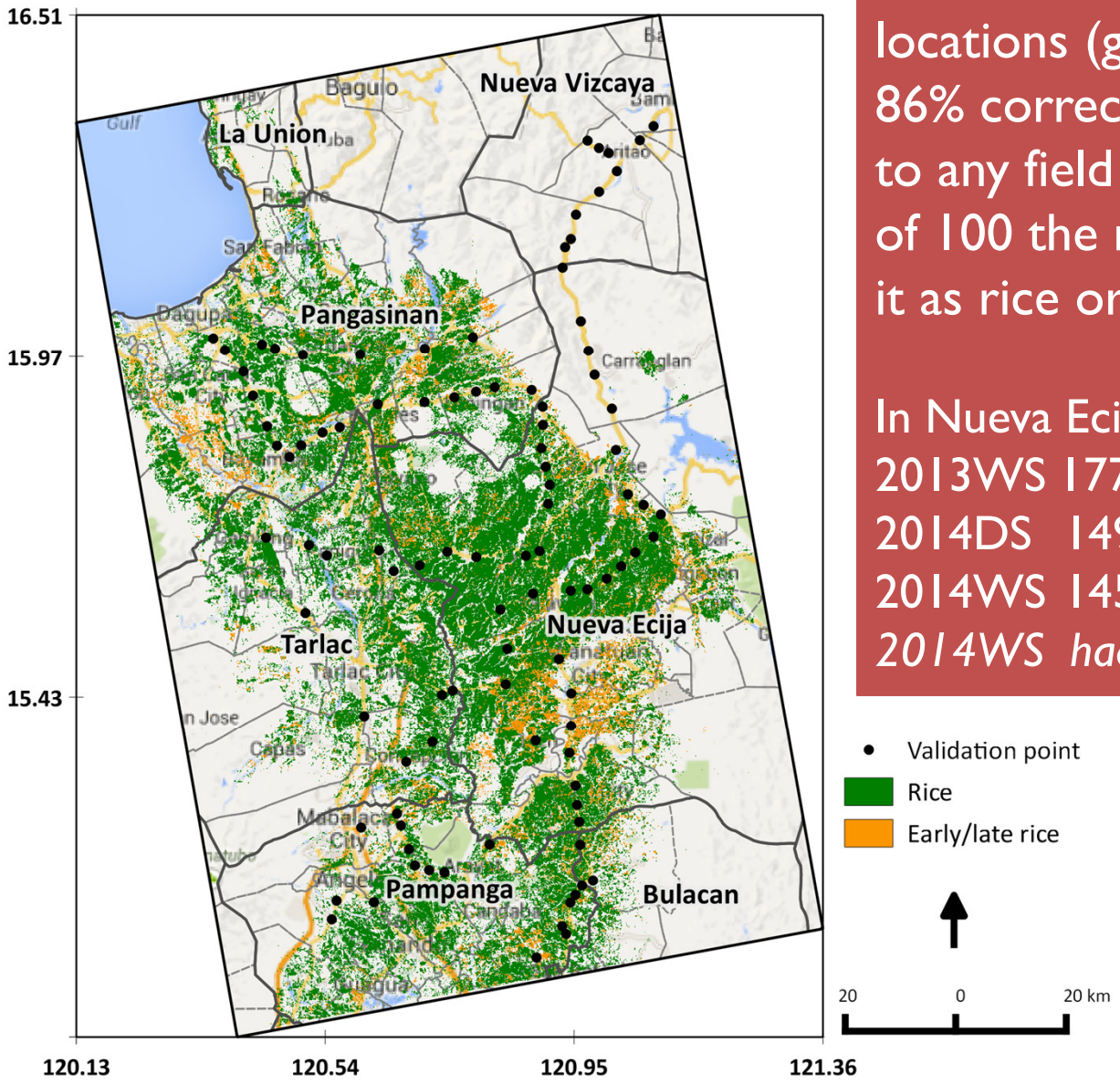
Example outputs

Rice area estimates in Philippines (Nueva Ecija) and Thailand (Muang Yang)

Rice start of season detection

Yield maps and municipal forecasts/estimates

Flood damage maps



Rice area.

Map accuracy for rice area is estimated based on 100 spot check locations (ground truth).

86% correct at field level. If you go to any field in the area, 86 times out of 100 the map will correctly identify it as rice or not rice.

In Nueva Ecija

2013WS 177,000 ha vs 181,000 ha

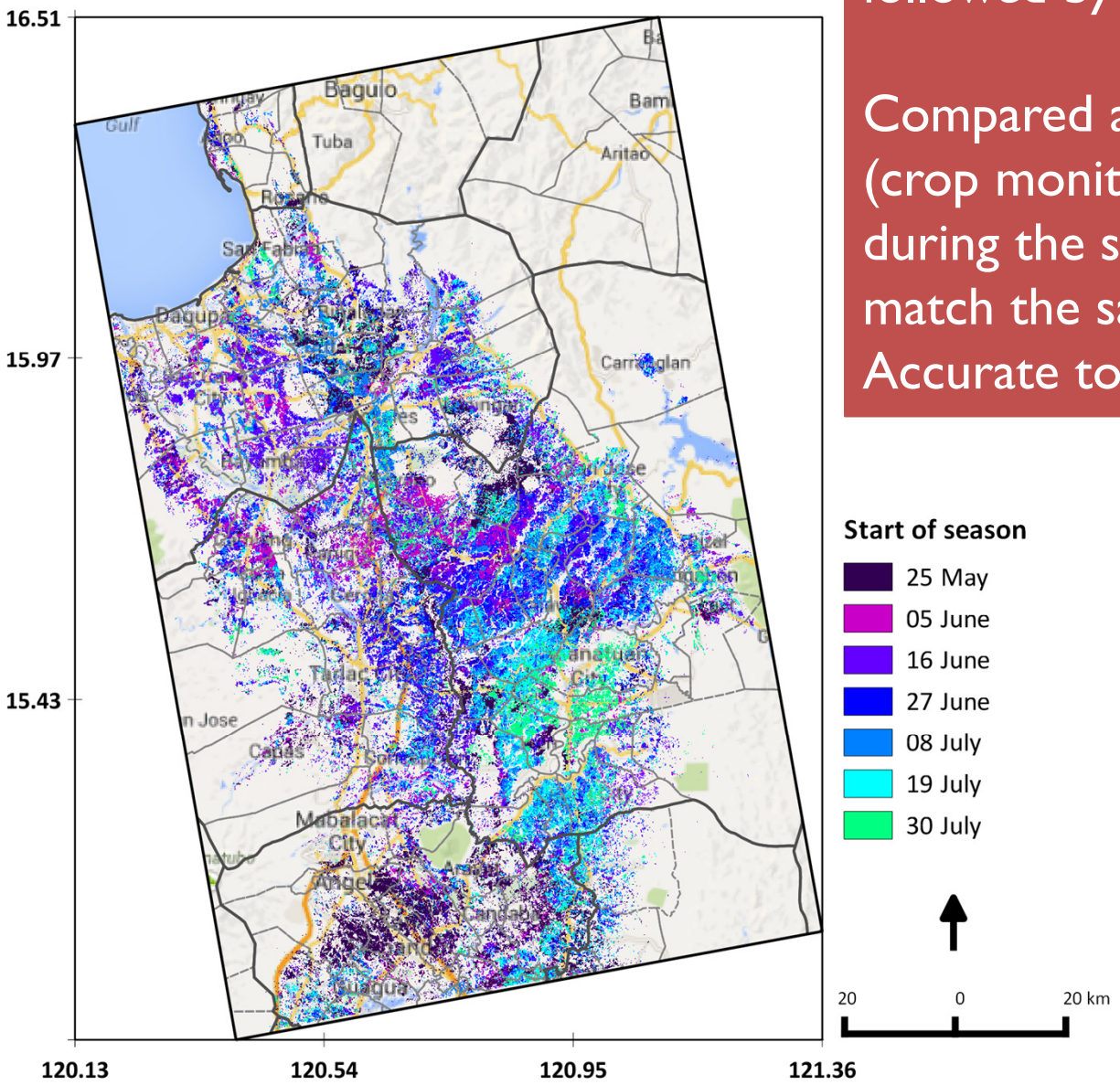
2014DS 149,000 ha vs 137,000 ha

2014WS 145,000 ha vs 167,000 ha

2014WS had RS image problems

Rice start of season date.
Detection of agronomic flooding followed by crop growth.

Compared against field information (crop monitoring sites) collected during the season on dates that match the satellite observation. Accurate to within +/- 11 days.



Rice yield

Estimated on a 1 hectare basis using remote sensing information on the crop growth and crop yield simulation modelling. Compared against crop cuts and municipal statistics.