K&C Phase 3 – Brief project essentials

Application of PALSAR for regional assessments of forest disturbance, rice agriculture and wetland habitats.

William Salas
Applied GeoSolutions, LLC (AGS)
Durham, NH USA, wsalas@agsemail.com

Team includes:

- Nathan Torbick, Steve Hagen and Rob Braswell (AGS)
- Sandra Brown and Nancy Harriss (Winrock International)
- Jiaguo Qi (MSU)
- Xiangming Xiao (OU)

Project objectives and schedule:

Phase 3: Move to GHG decision support

- Map rice agricultural intensification across Monsoon Asia (6/11-12/14)
- Develop rice GHG MRV prototype for two Provinces in Vietnam (10/12-12/13)
- Implement a first-of-its-kind greenhouse gas (GHG) emission reduction offset demonstration initiative with rice producers in the USA (2012-2014)
- Evaluate remote sensing tools (PALSAR and optical) for mapping forest degradation in Guyana (6/13 – 6/14)
- Provide geofield photo database to support JAXA cal / val

K&C Phase 3 – Brief project essentials

Ongoing

- Quantifying changes in agricultural intensification and expansion in monsoon Asia during 2000-2010 (NASA)
- Implementing GHG offset projects in USA rice (USDA)
- Prototyping MRV tools for Vietnam at the regional scale (USAID)
- India REDD / Guyana Forest Degradation / Mapping mangroves Camau Peninsula, Vietnam and Sunderbans, India (USAID and Winrock/GFC)

Recent/Previous

- Developing land cover classification products in monsoon Asia over the period of 2004-2007 through integration of Landsat and ALOS/PALSAR images
- Mapping rice and modeling HPAI in Java

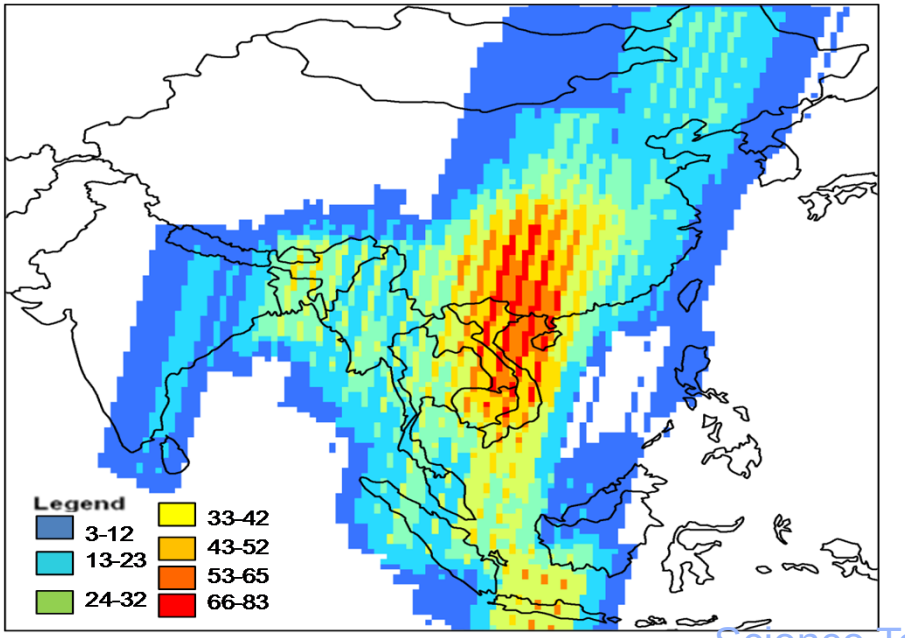
Rice Project areas: Monsoon Asia and USA

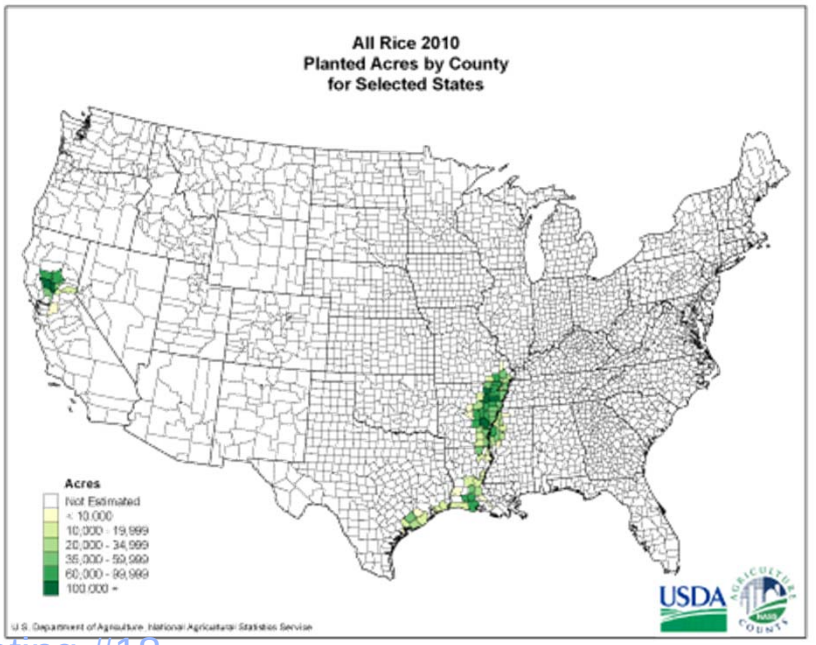
Multi-scale approach

Broad scale: Monsoon Asia

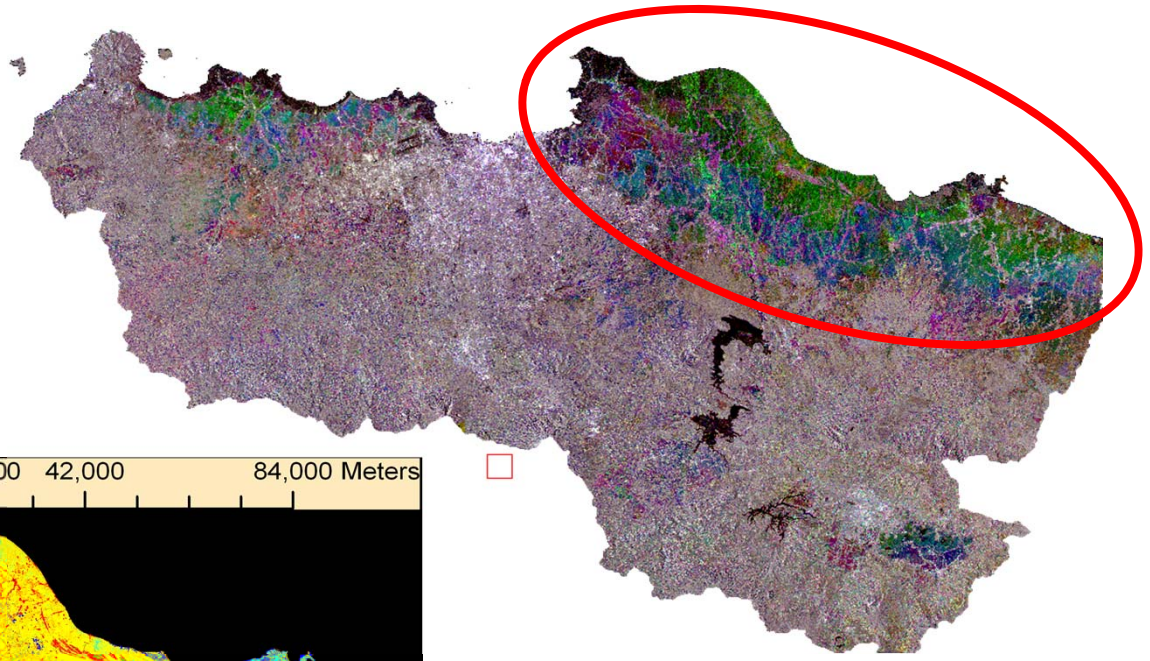
Local scale: cal / val sites in
Bangladesh, China, India, Indonesia,
Thailand, Vietnam

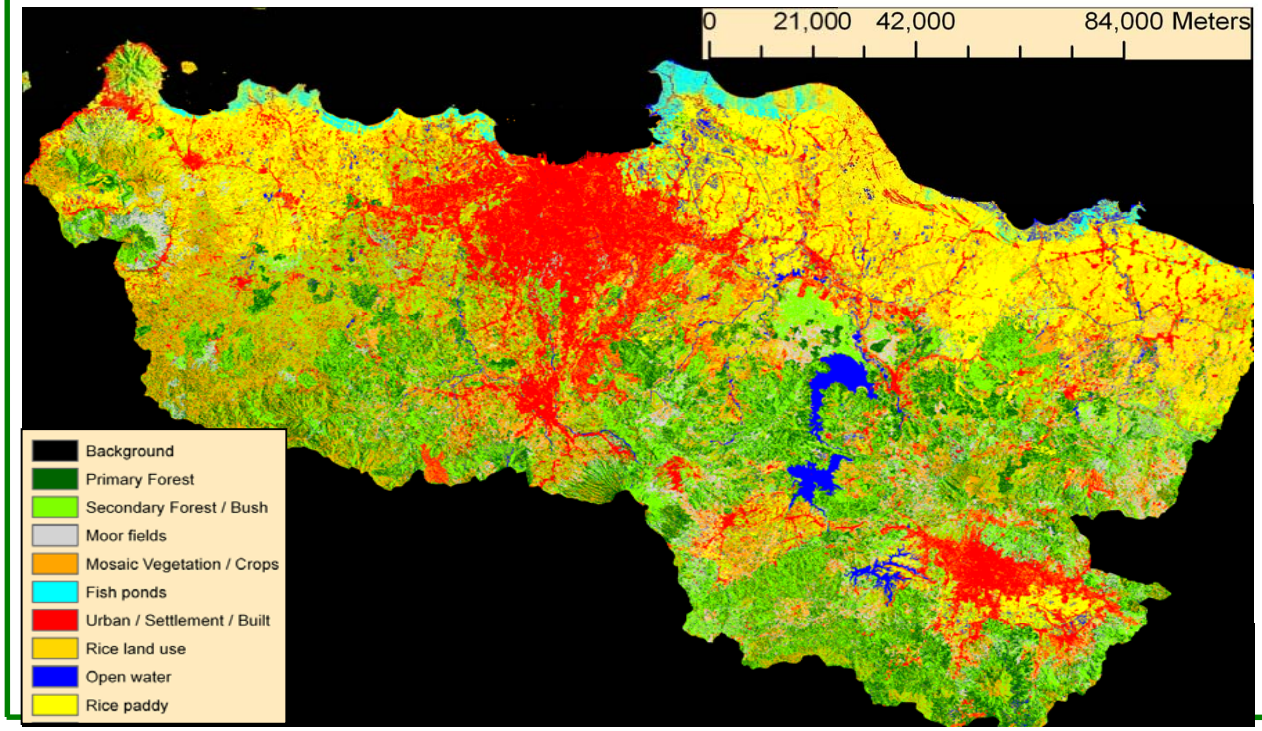
Sacramento Valley & Midsouth





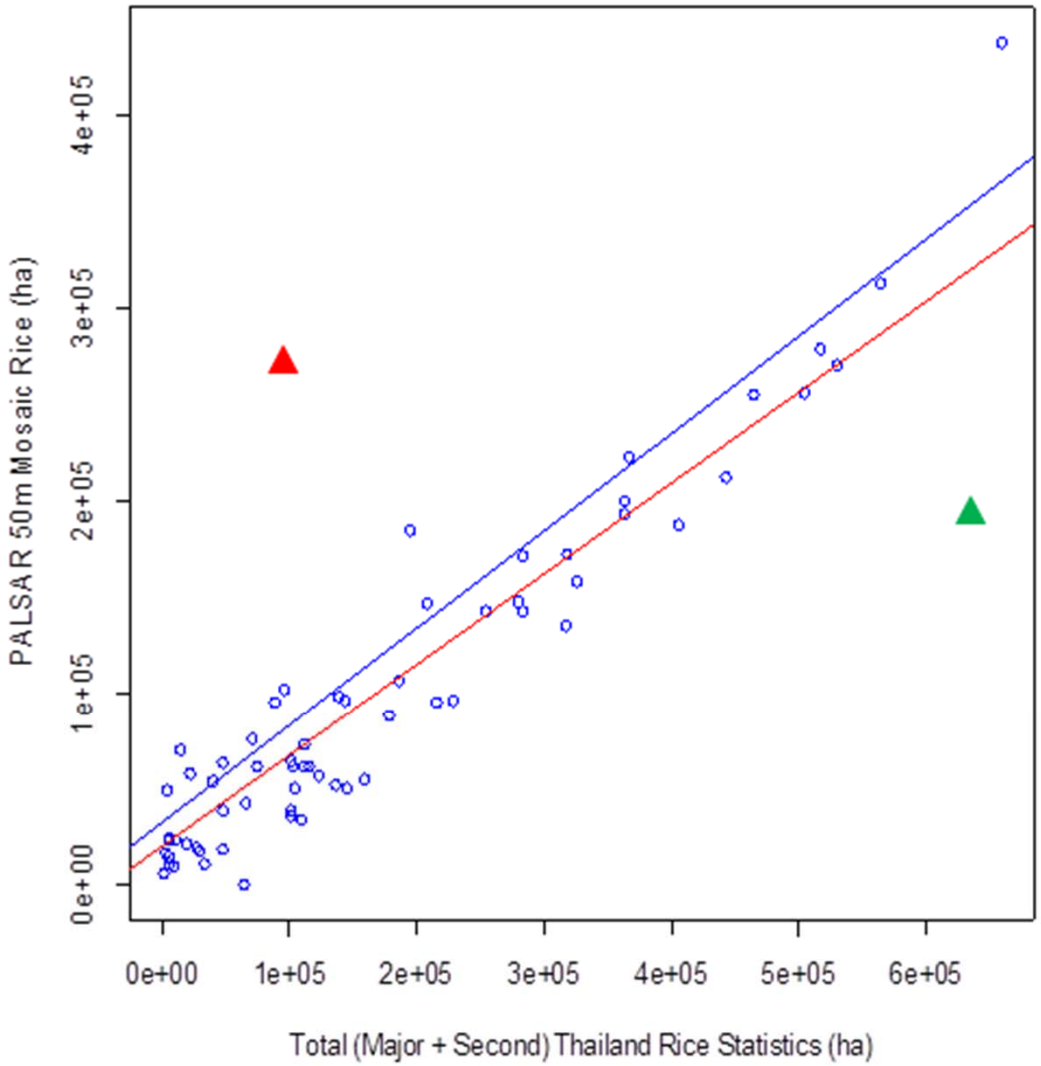
Phase 2 Example rice products to drive GHG Modeling:
Mapping Rice Extent
Mapping Hydroperiod
Mapping Intensity

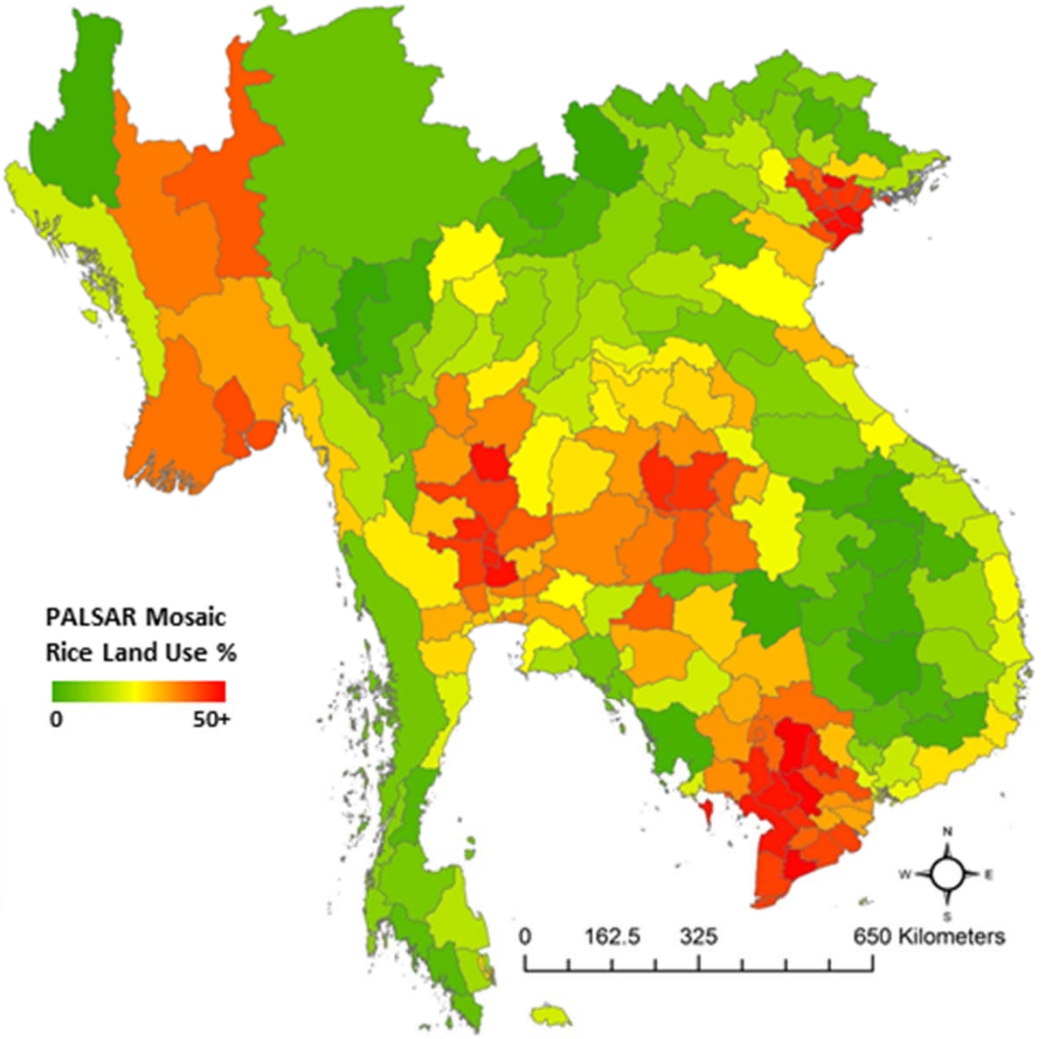




- Watershed scale: Multitemporal FBS/D used to distinguish rice paddy hydroperiod, cropping intensity, calendar, biomass
- Illustrated with HH (Nov, Aug, Feb), 12.5m ground pixel spacing

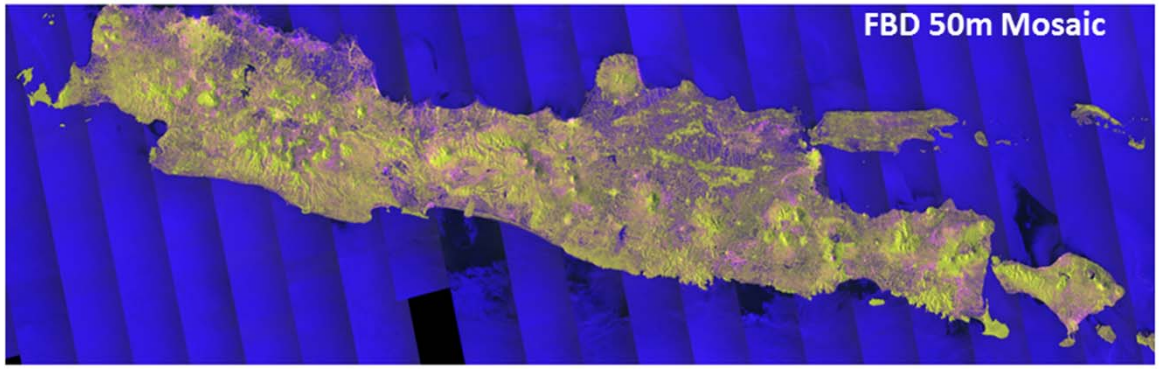
Phase 2 Example rice products: Regional Mapping

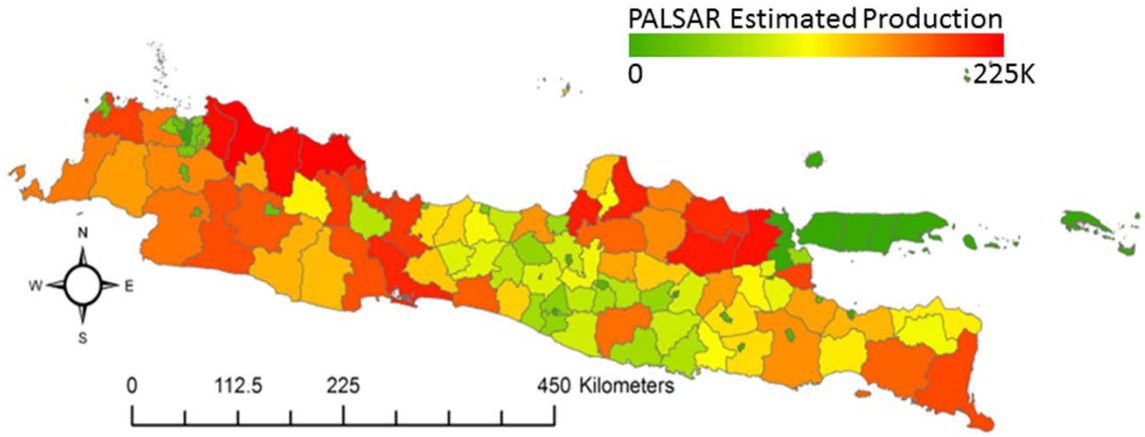


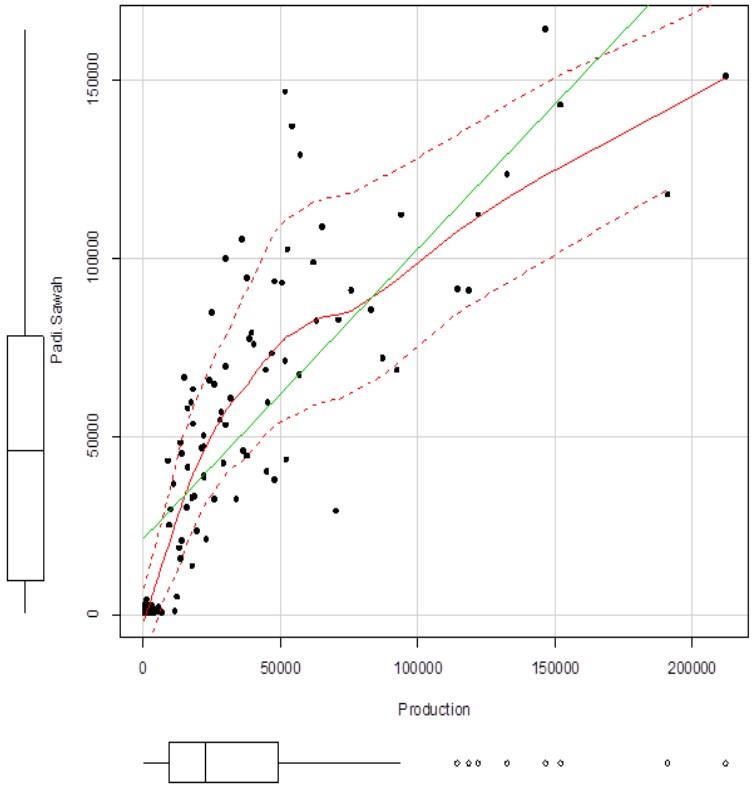


Care comparing census estimate with PALSAR maps

Phase 2 Example rice products: Estimating Production







- Coupling 50 mosaics with ScanSAR improved area estimation
- Generating maps of rice extent, hydroperiod, and cropping intensity with multitemporal dual pol 50m Mosaics and SLT ScanSAR strips to estimate production
- Java, Indonesia shown with assessment using BPS govt statistics (R:0.89)

Phase 3 Deliverables

- Maps of rice agroecological attributes (extent, hydroperiod, cropping intensity, production) across Monsoon Asia
- Maps of rice intensification between 1997 – 2010 in Monsoon Asia
- Maps of irrigation patterns, habitat, rice management and GHG emissions for USA rice
- MRV / Rice maps and GHG emissions for USA
- MRV prototype system for strategic regions in Vietnam
- Map of cerrado biomass in 1996, 2007, and 2012 for the state of Goiás with associated uncertainty (Hagen)
- Degradation assessment: Guyana Logging
- Maps of carbon and (wetland) forest patterns for India sites (TBD)

Support to JAXA's global forest mapping effort

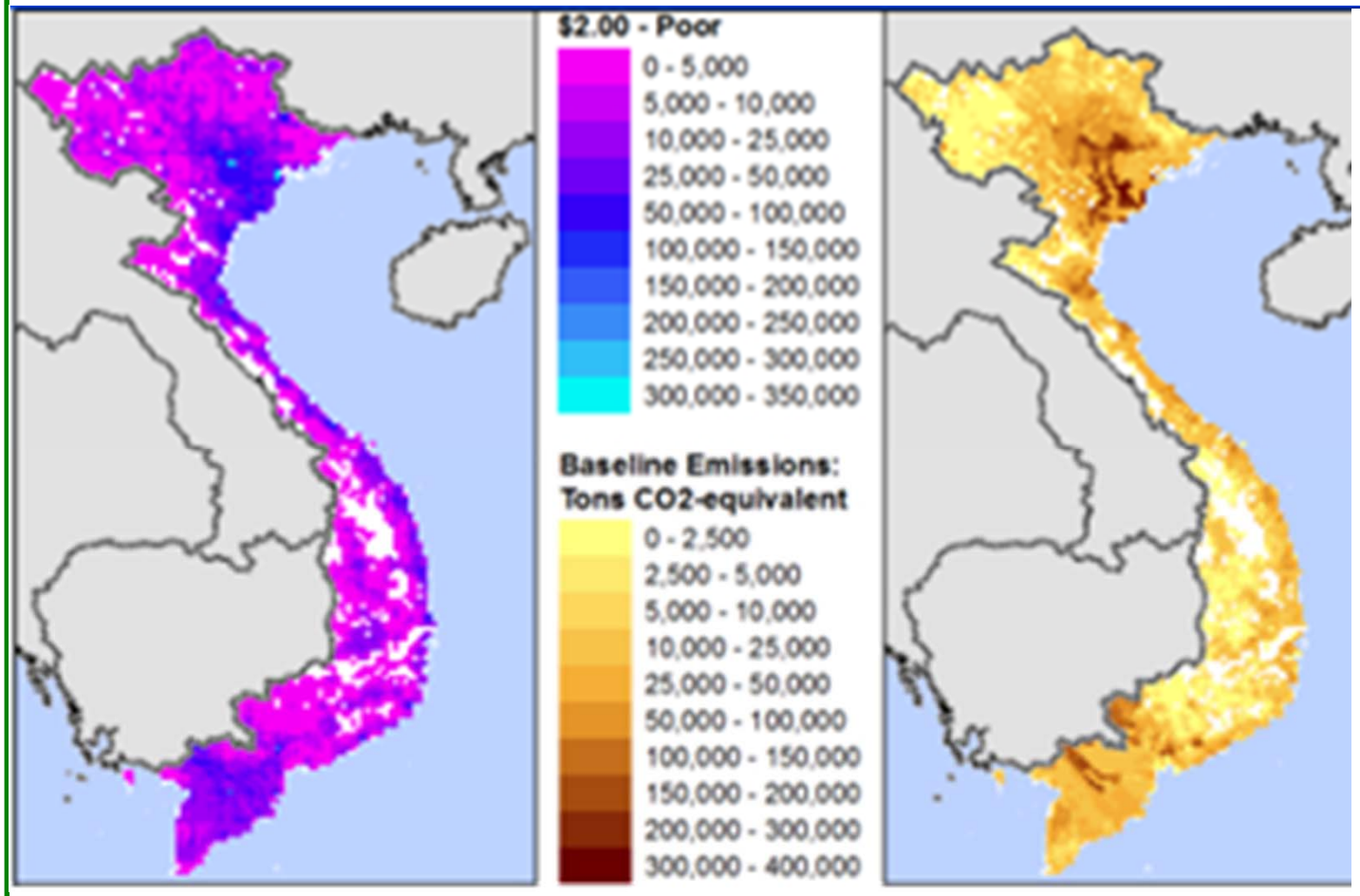
- Help cal /val with geofield photos and survey attributes
- Compare with MODIS & Landsat forest map products (evergreen, deciduous, rubber, etc…) (products developed by Xiao et al.)

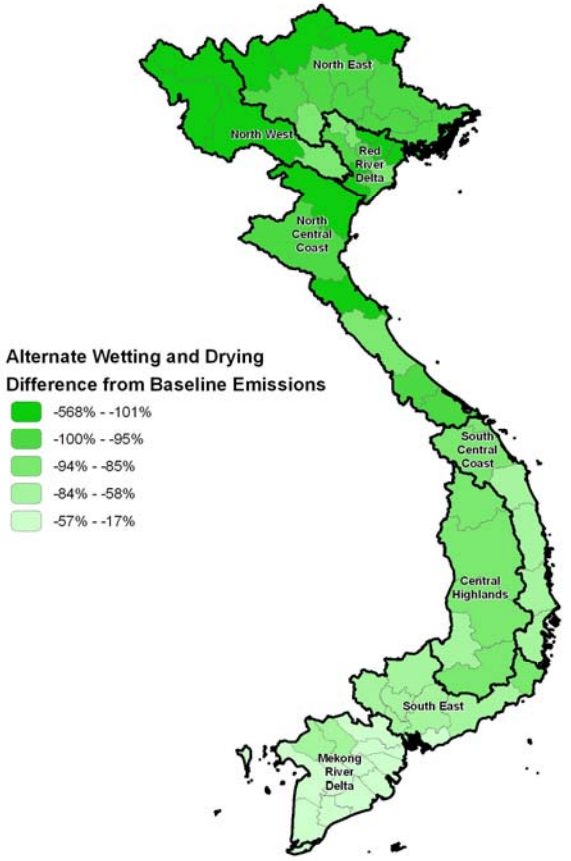
List ground truth data that will be shared with JAXA

- Global Geofield photos (>57,000 GPS points, most with land cover information from field survey. Collaboration with Xiangming Xiao at University of Oklahoma)
- Forest biometric data from northeast USA and Cerrado (Brazil).

.

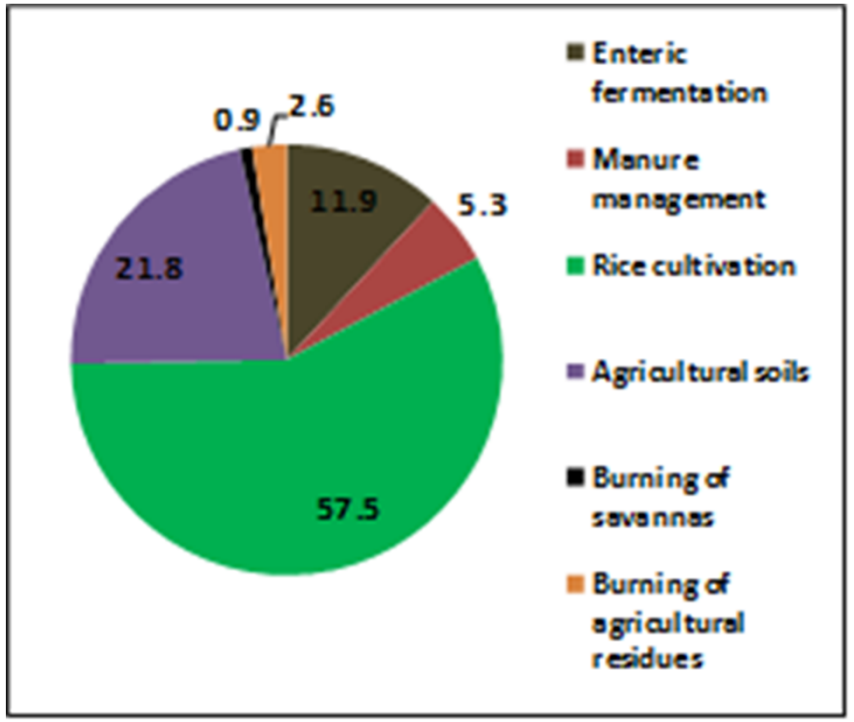
IFPRI GHG Mitigation and Pro-poor Program





Vietnam Rice GHG MRV

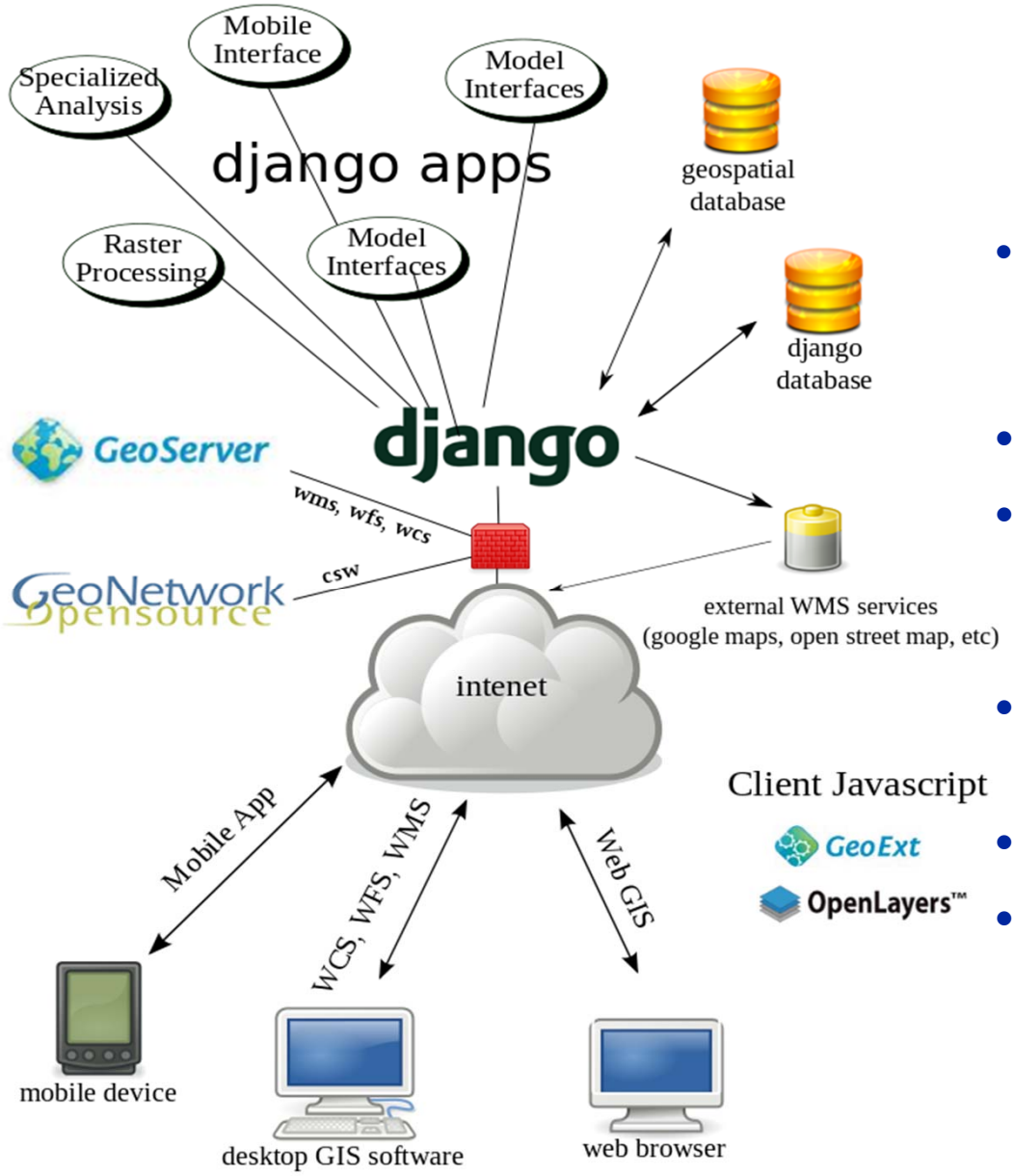
- Goals: Pilot Rice GHG MRV system for 2 Provinces: An Giang and Hanoi.
- Background: National strategy for Low Emissions Development
- Funding USAID AILEG program
- Collaborators:
  - MARD IAE Vietnam
  - Can Tho University in Vietnam
  - EDF
  - Abt Associates in US
  - IFPRI.



Source: Vietnam 2nd National Communication to the UNFCCC

Vietnam Rice GHG MRV

- Components of Rice GHG MRV
  - Rice observatory (multi-sensor, including PALSAR)
    - Spatial information on extent, cropping cycles, development to drive DNDC
  - Field sites for measurement of rice GHG (CH4 and N2O): benchmark sites for baseline and mitigation assessment
  - GIS data server (data on soils, weather, topography)
  - Field survey system on rice management and reference data for validation of RS products (gps mobile device apps)
  - Modeling system: DNDC model cal/val, includes uncertainty system.
  - WebGIS Decision Support Tool: data dissemination & visualization
- Longer term implementation goal: scale up to national and regional scales

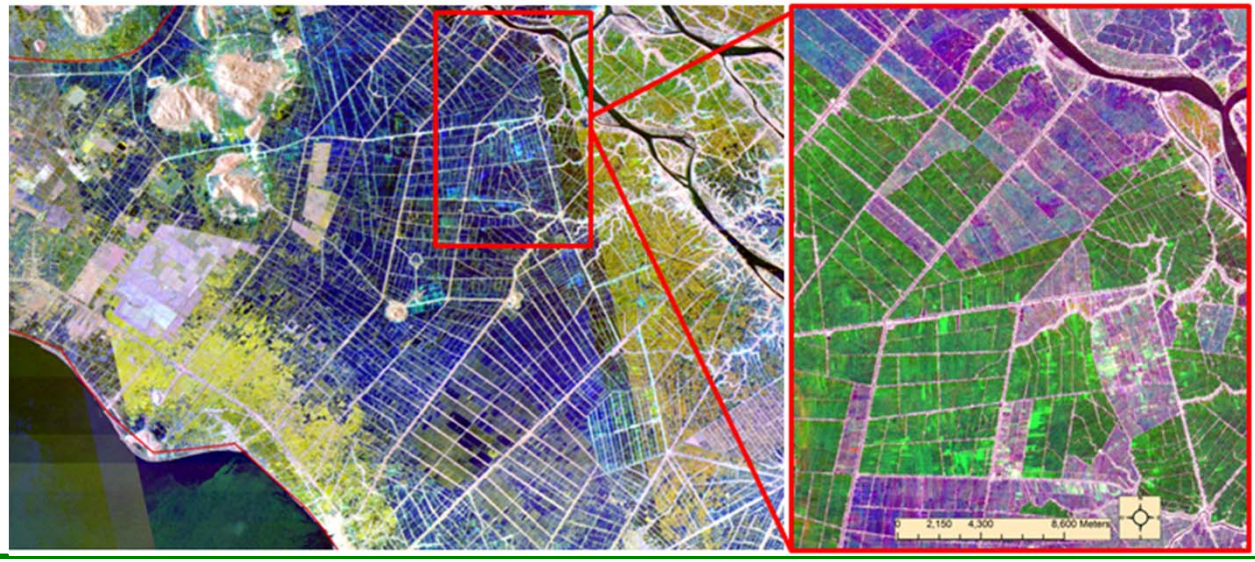


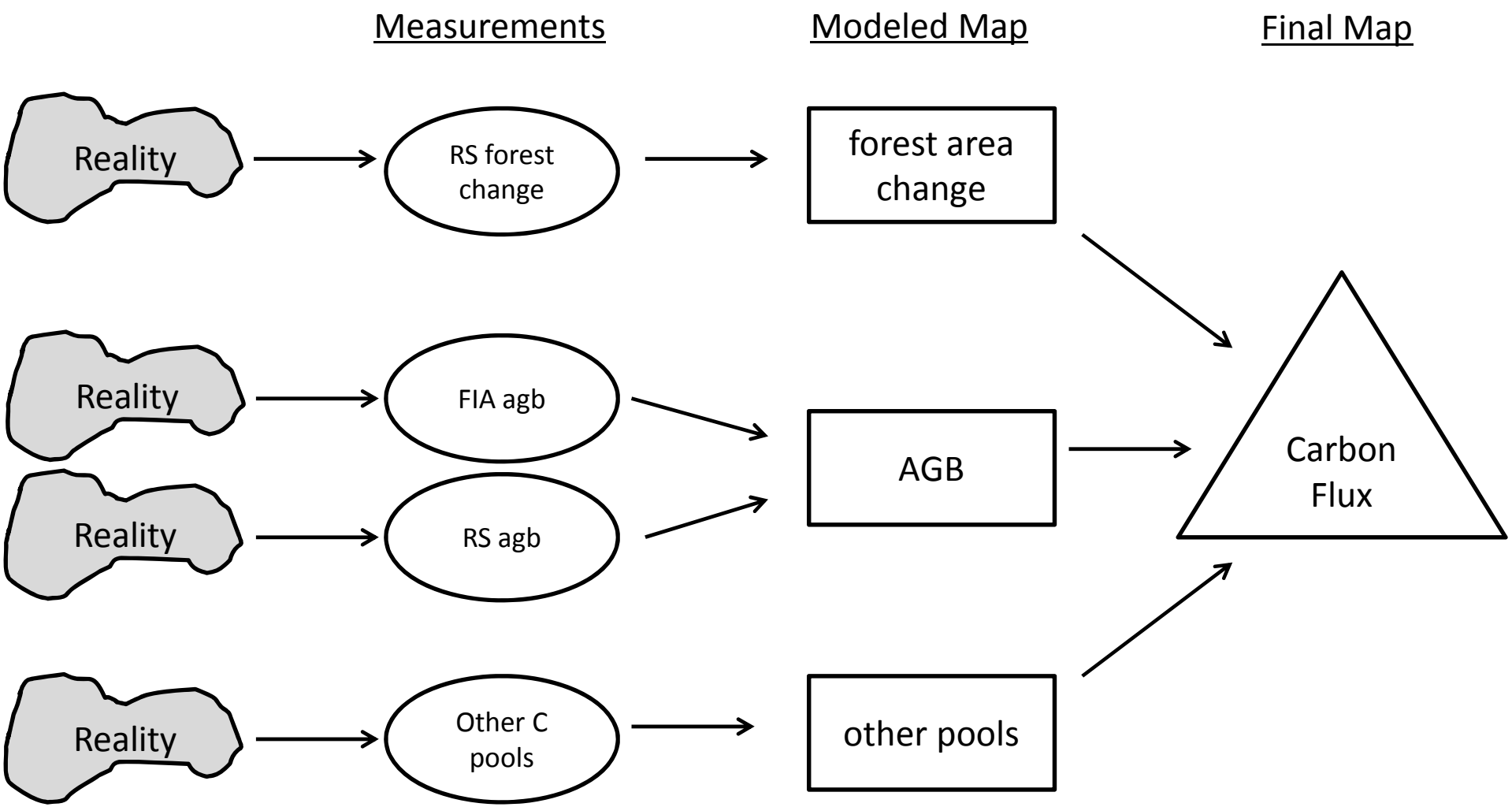
MRV System Framework (open source tools)

- GeoNode - A spatial data infrastructure combining several technologies:
- PostGIS - GeoSpatial Database
- Django - web framework for building website and applications
- GeoServer - Map rendering service
- GeoNetwork – Metadata catalog
- GeoExt / OpenLayers / Leaflet
  - Client javascript tools for visualization and analysis
  - Full-screen web-GIS

MRV Pilot Provinces: An Giang and Hanoi

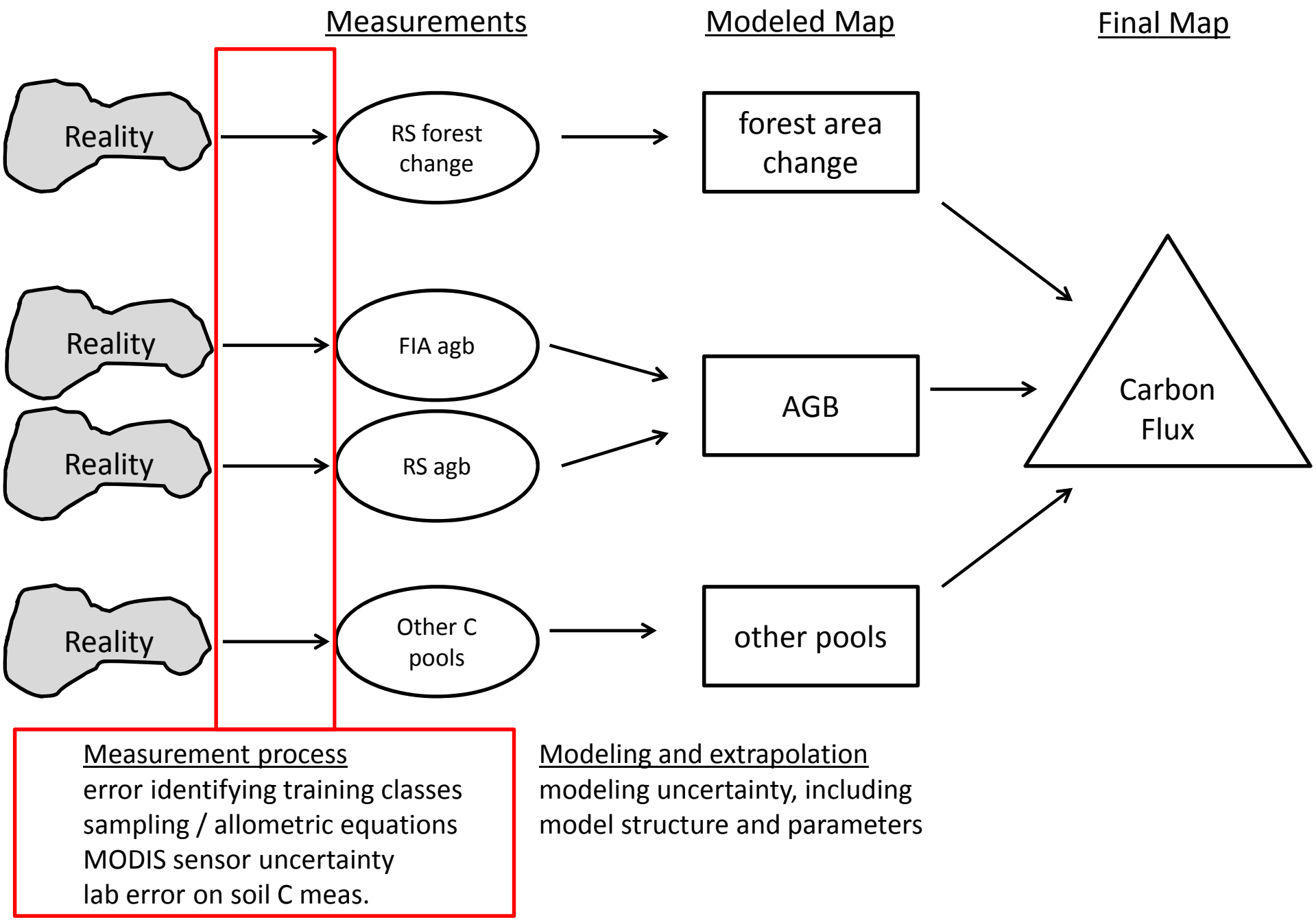
- On-going field studies measuring GHG emissions (CH4 and N2O) with IAE, Can Tho Unversity and EDF VLCRP
  - Assessing water management (MD, AWD)
  - Residue management, biochar amendments
  - Province wide survey of rice management practices
  - 2-3 years of continuous GHG measurement
- Outcomes:
  - DNDC validation
  - Stats on mgmt
  - Mitigation potential
  - Development of uncertainty metrics using MC framework

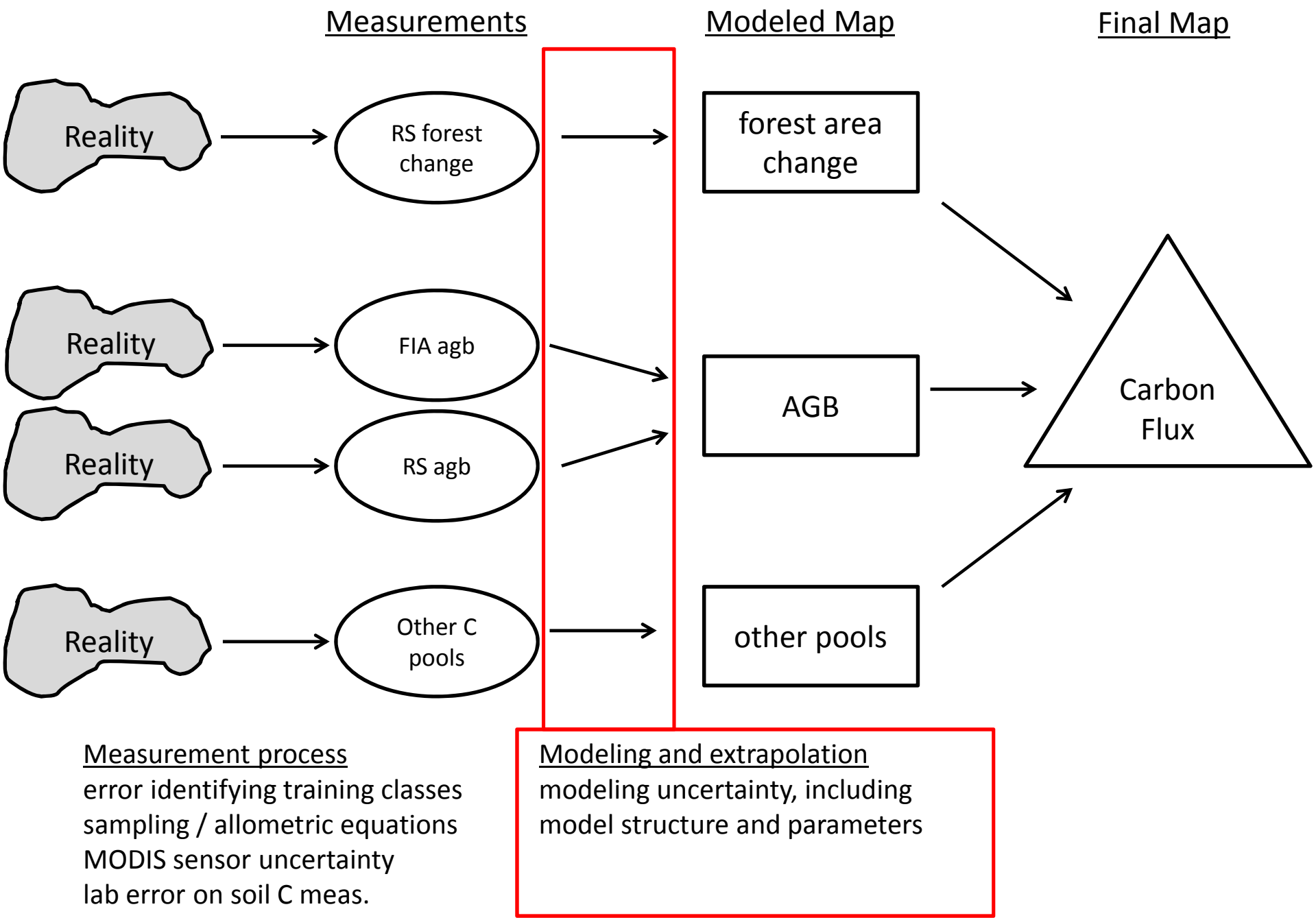




Measurement process
error identifying training classes
sampling / allometric equations
MODIS sensor uncertainty
lab error on soil C meas.

Modeling and extrapolation
modeling uncertainty, including
model structure and parameters


Measurements
Modeled Map
Final Map
Reality
Reality
Reality
Reality
RS forest change
FIA agb
RS agb
Other C pools
forest area change
AGB
other pools
Carbon Flux
Measurement process
error identifying training classes
sampling / allometric equations
MODIS sensor uncertainty
lab error on soil C meas.
Modeling and extrapolation
modeling uncertainty, including
model structure and parameters


Measurements
Modeled Map
Final Map
Reality
RS forest change
forest area change
Reality
FIA agb
Reality
RS agb
AGB
Carbon Flux
Reality
Other C pools
other pools
Measurement process
error identifying training classes
sampling / allometric equations
MODIS sensor uncertainty
lab error on soil C meas.
Modeling and extrapolation
modeling uncertainty, including
model structure and parameters

To propagate uncertainty, why MC framework and not quadrature?

- With Monte Carlo framework, we make fewer assumptions about data distributions
- M.C. allows us to preserve full data distributions (or pdfs) instead of estimating
- Link uncertainty from different sources
- Downsides: data and computational intensive.

300 million ha of forest x 1 ha pixels x 2 bytes ~ 600 MB / layer

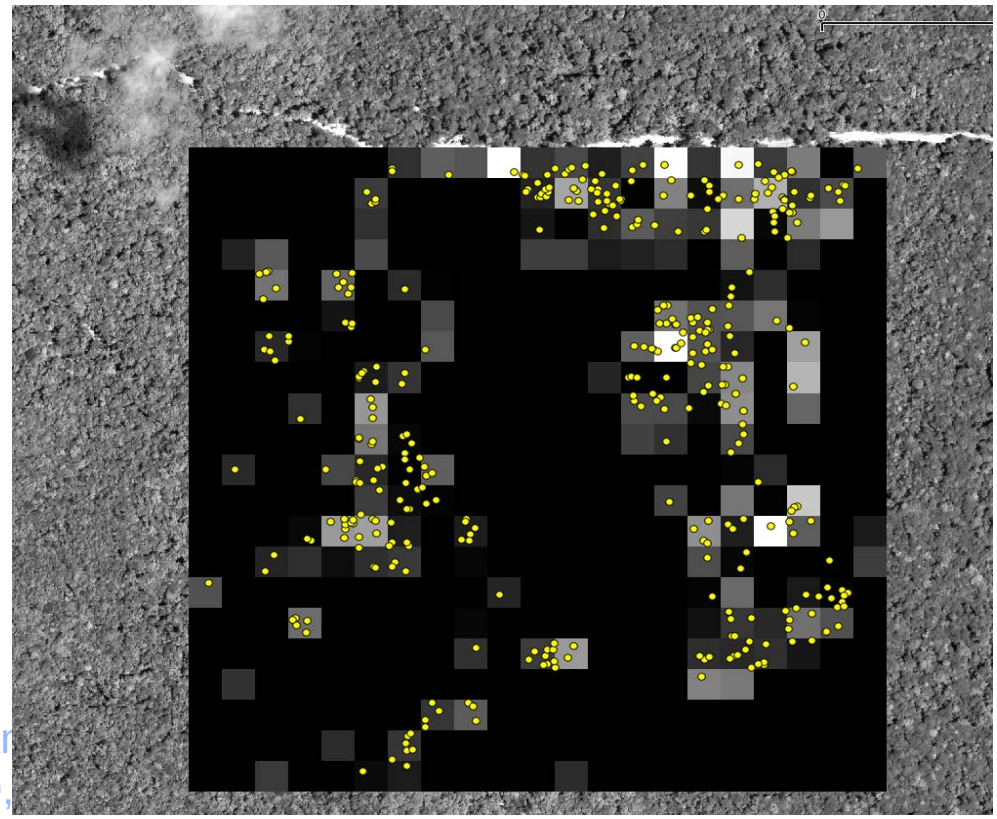
n ~ 600 to 1000 layers -> 360 to 600 GB per data product

Rice GHG Protocol and Verification System

- CAR and ACR rice protocols based on DNDC model with detailed uncertainty quantification
- CDM has DNDC based rice methodology
- Working with CA ARB on development of rice protocol (first compliance protocol).
- Transparency is key, need to keep project development and verification costs down for a successful ag offsets program (transaction costs must be low otherwise there will not be a market).
- Google project: Landsat, MODIS, PALSAR, other data
  - RS based rice extent, wet versus dry seeded system, winter flooding
  - Reduce costs for project developers (eligibility) and validators (100% coverage of fields with know uncertainties)

Guyana Degradation

- **Current agreement with Norway call for a 500 meter buffer, with 50% loss of carbon due to degradation.**
- **Focus: can RS be used to identify degradation, coupled with field surveys (Winrock, GFC)**



RS Approaches

- Crown tracing
- Gap fraction unmixing
- VIs
- Will add PALSAR