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

William Salas
Applied GeoSolutions (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)

Forest Disturbance Project area(s)

- India USAID Forest-PLUS: 4 Pilot Sites
  - Shimla- Himachal Pradesh ; Sub-tropical and temperate forest type
  - Shimoga, Karnataka State Forest Department in Bangalore, Karnataka; evergreen and semi-evergreen forests
  - Madhya Pradesh State Forest Department in Bhopal, Madhya Pradesh; Tropical Moist, Tropical Dry, Subtropical broadleaved Hill forests.
  - Sikim, Himalayia, NE India
- Guyana
  - Central Guyana – area with significant logging.
- Conversion to Plantations: new NASA project: SE Asia
- Kalimantan – new NASA CMS project

ALOS

K&C Initiative

An international science collaboration led by JAXA

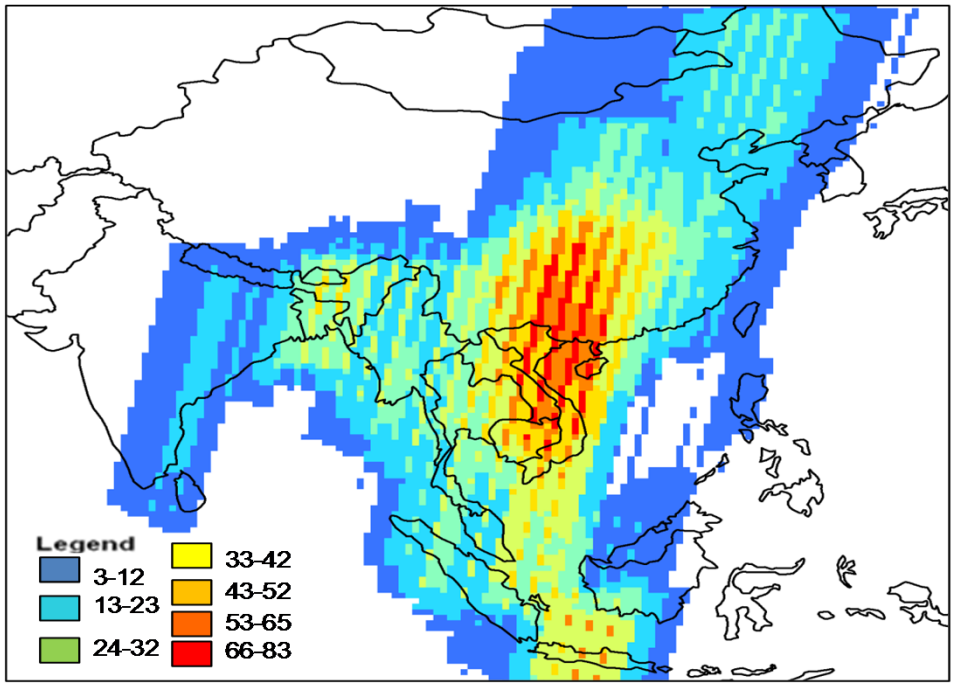
Rice Project areas: Monsoon Asia and USA

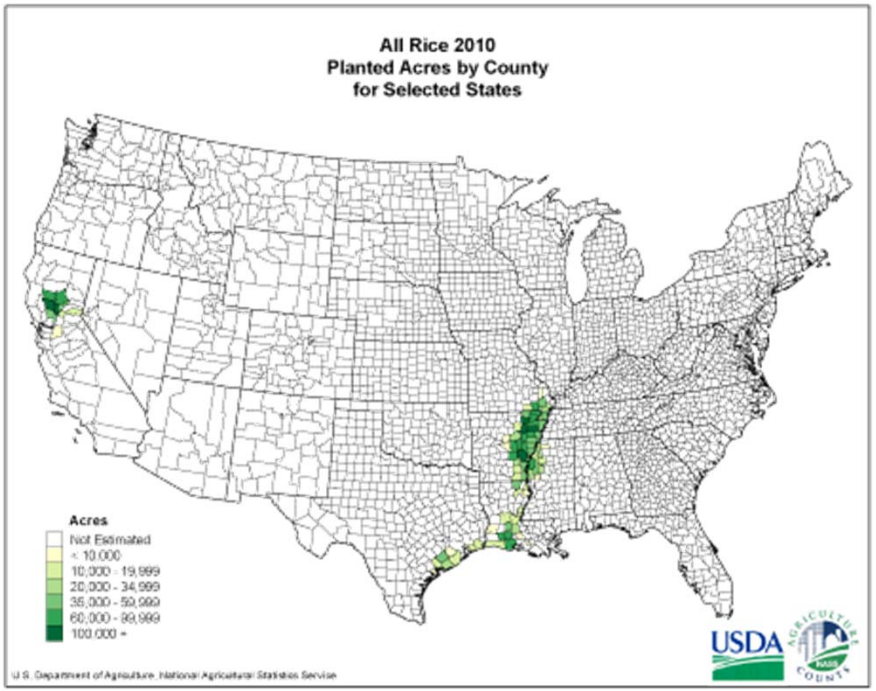
Multi-scale approach

Broad scale: Monsoon Asia

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

Sacramento Valley & Midsouth





Phase 3 Objective: Move to GHG MRV & Decision Support Applications

- Map rice agricultural intensification across Monsoon Asia
- Evaluate remote sensing tools (PALSAR and optical) for mapping forest structure and degradation in India, Guyana and SE Asia
- Develop rice GHG MRV prototype for in Vietnam
- Implement greenhouse gas (GHG) emission reduction offset verification system rice offset protocols
- Provide geofield photo database to support JAXA cal / val

Phase 3 Objective: Move to GHG MRV & Decision Support Applications

- Map rice agricultural intensification across Monsoon Asia
- Evaluate remote sensing tools (PALSAR and optical) for mapping forest structure and degradation in India, Guyana and SE Asia
- Develop rice GHG MRV prototype for in Vietnam
- Implement greenhouse gas (GHG) emission reduction offset verification system rice offset protocols
- Provide geofield photo database to support JAXA cal / val

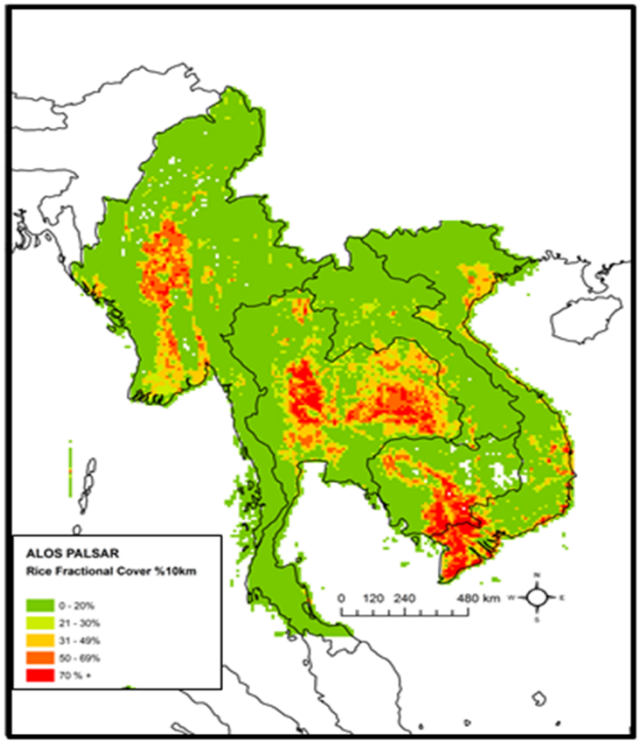
Quantifying changes in agricultural intensification and expansion in monsoon Asia during 2000-2010

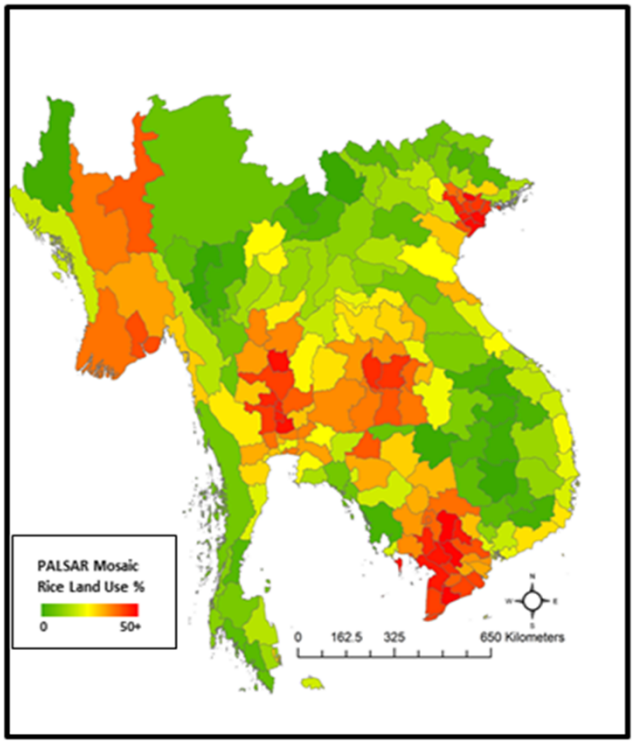
- NASA Land Cover and Land Use Change (2011-2014)
- Final year of project and product production
- Maps of rice extent, cropping intensity, and production
- Pilot products and early publications completed
  - Poyang Lake, Java, Thai Binh, Bagerhat, Karnal, etc…

Deliverables

Planned output of the project.

- Maps of rice extent and now integrating recently provided ScanSAR mosaics for updated maps of extent, cropping intensity, and production planned by end of Phase 3
- Change products for hot spot production regions across SE Asia

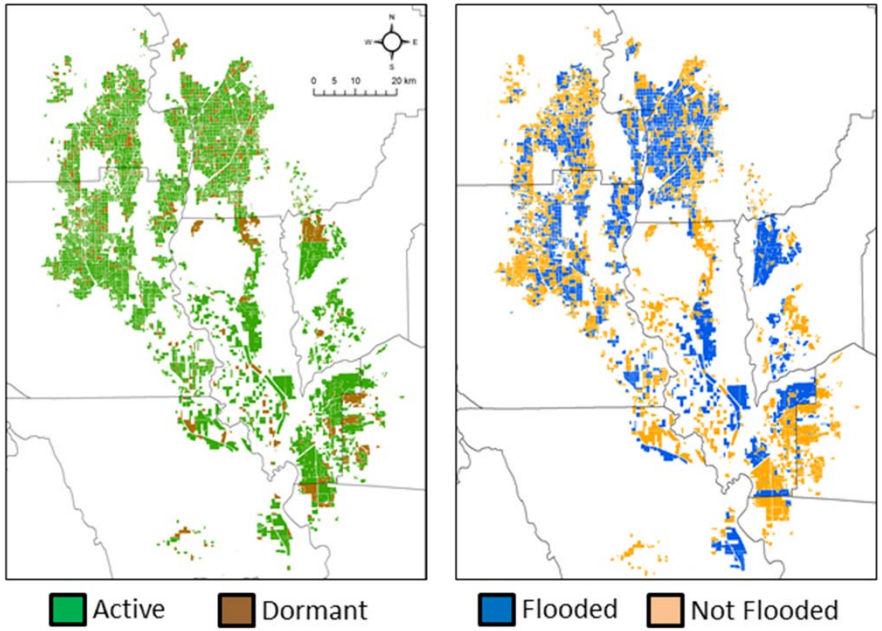


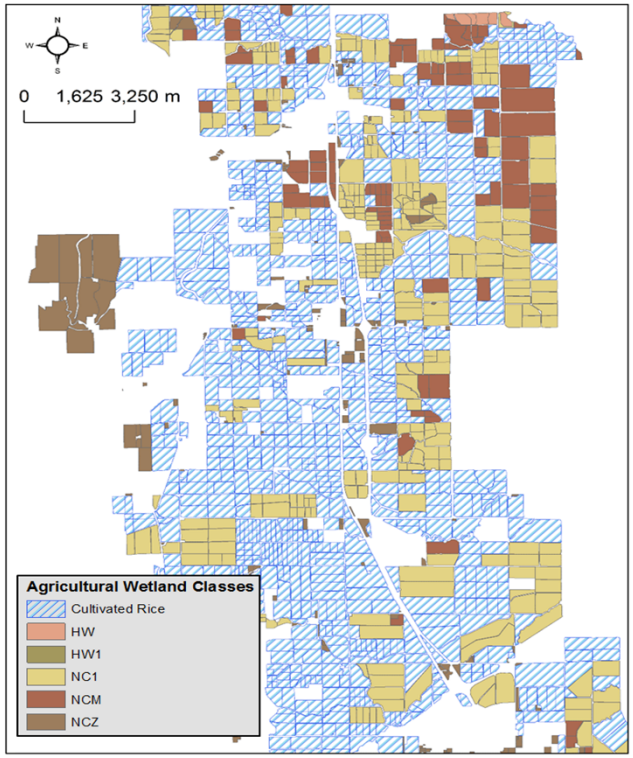


Deliverables

Describe the planned output of your project.

- Maps of rice and wetland habitat in California using PALSAR strips and Landsat
- Manuscript to Wetlands, Ecology, and Management

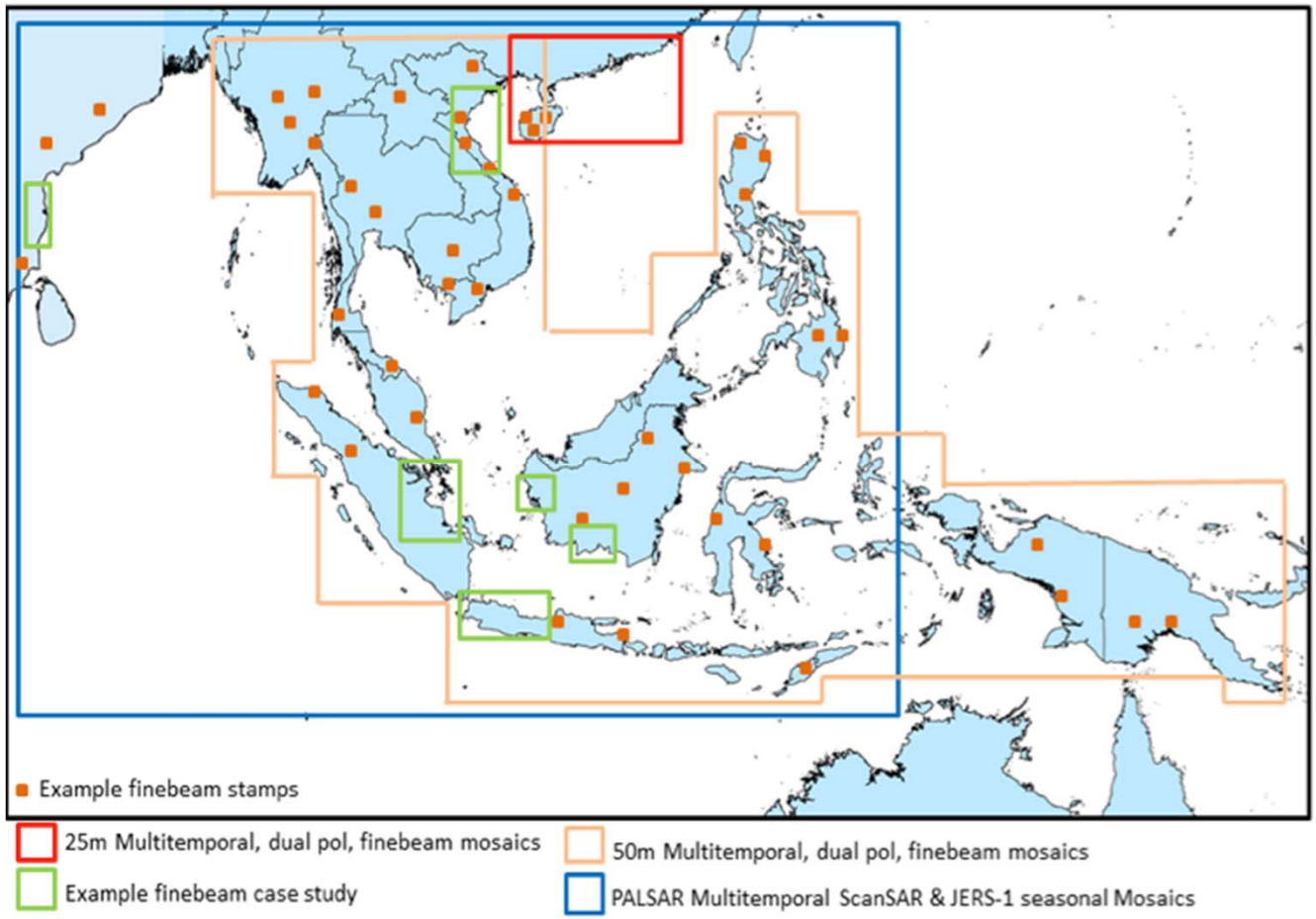




Mapping industrial forest plantations in tropical monsoon Asia through Landsat, MODIS, PALSAR & JERS-1

- NASA Land Cover and land Use Change (2014-2016)
- Team members
  - Xiao Xiangming & Jinwei Dong, University of Oklahoma
  - William Salas & Nathan Torbick, Applied Geosolutions
  - International Collaborators from China, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, and Vietnam

Plantation project area: Monsoon Asia



Project objectives and schedule

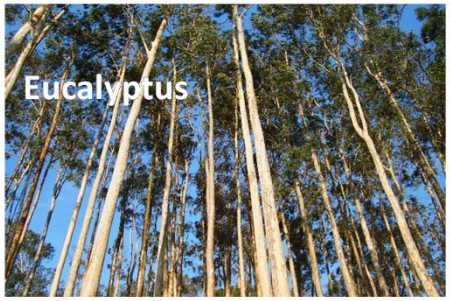
- **1**. Develop in-situ data of forest plantations, including geo-referenced field photos and build citizen scientists across regions
- **2**. Map the area and spatial distribution of industrial forest plantations in tropical monsoon Asia
  - 2015 Landsat 8 (OLI) and ALOS-2 PALSAR
  - 2010 Landsat 5/7 (TM/ETM+) and ALOS-1 PALSAR
  - 2005 Landsat 5/7 (TM/ETM+) images
  - 2000 Landsat 5/7 (TM/ETM+) and JERS-1 images in 1996-2000

List the project milestones from now to March 2014 (the end of project)

- Project kick off and year 1 workshop for Fall 2014
- Pilot site field data collection and image processing

Support to JAXA's global forest mapping effort

- Mapping industrial forests / plantations across SE Asia using PALSAR
- Help assess / support forest layers such as masks, forest type, change maps
- Provide thousands of field photos for cal / val and support algorithm development
- Provide forest biometrics at subset of regions for supporting JAXA product development



Deliverables

Describe the planned output of your project.

- Time series maps of forest plantations at 5 year intervals 2000 – 2015
- Forest masks and data layers with PALSAR based algorithms
- Geofield photos & assessment of JAXA forest maps at strategic locations
- Dong, J., Xiao, X., Chen, B., Torbick, N., Jin, C., Zhang, G., Biradar, C., 2013. Mapping deciduous rubber plantation through integration of PALSAR and time-series Landsat imagery. Remote Sens Environ 134, 392-402.

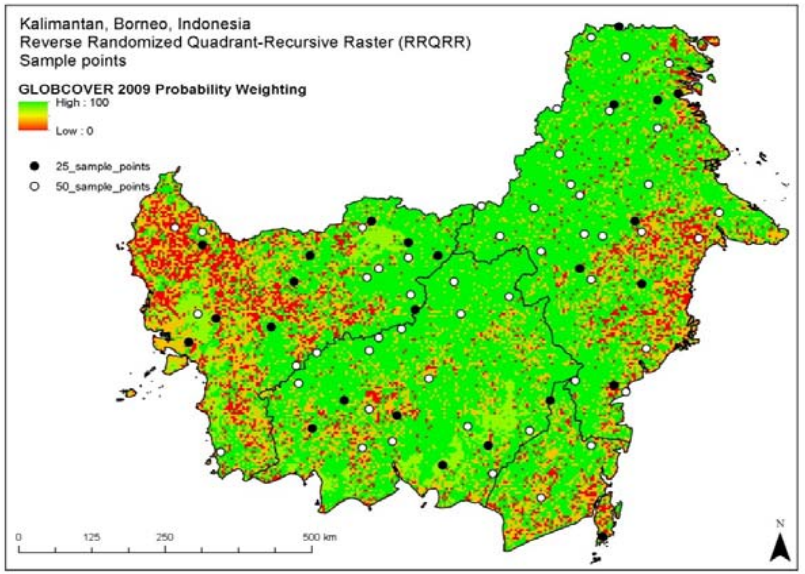
.

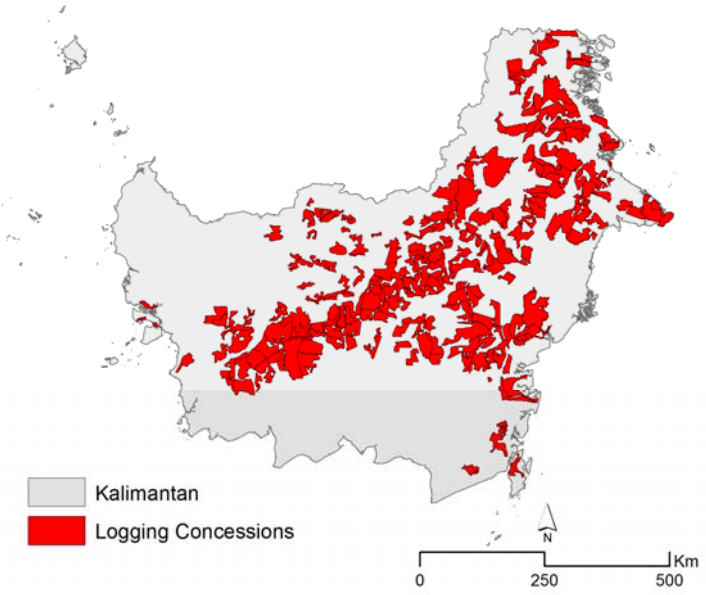
Operational multi-sensor design for national scale forest carbon monitoring to support REDD+ MRV

- NASA-funded Carbon Monitoring System project (2013-2016)
- Team members:
  - Stephen Hagen (PI), William Salas, & Rob Braswell at Applied GeoSolutions
  - Nancy Harris and Sandra Brown at Winrock International
  - Sassan Saatchi at the Jet Propulsion Laboratory
  - Michael Palace at the University of New Hampshire
  - Dirk Hoekman at Wageningen University in the Netherlands
  - Deborah Lawrence at the University of Virginia
  - Orbita Roswintiarti, LAPAN in Jakarta
- Project region: Kalimantan, Indonesia
- Project objectives:
  - Develop an uncertainty tracking system for NFMS
  - Map carbon emissions associated with degradation using LiDAR and radar
  - Produce improved wall-to-wall forest carbon stock maps using LiDAR, radar, & optical

Our CMS Project Goals

- Assist REDD+ stakeholders in Indonesia by contributing data products & improved forest monitoring methods
- Develop improved methods (e.g. mapping biomass, activity, and carbon loss from degradation; tracking uncertainty) that are useful across regions.
- Evaluate commercially available RS data sources (focus of CMS NRA)



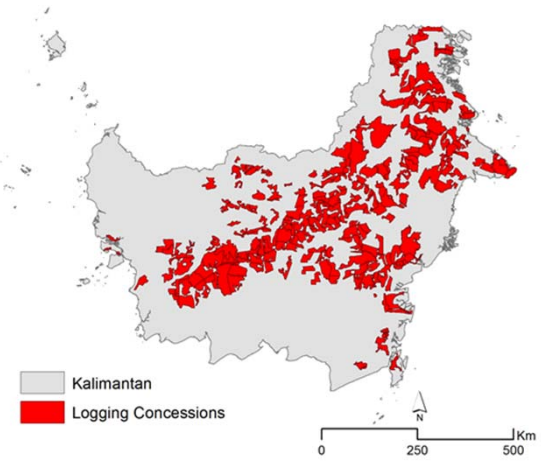


Our CMS Project Details

- Collect commercial airborne LiDAR data from 30 randomly selected transects across Kalimantan.
- Measure forest structure and biomass in the field (~5 regions) and measure forest carbon flux associated with logging in the field (~3 regions).
- Relate LiDAR to forest carbon in multiple types of forests, including degraded areas.
- Calibrate radar and optical data to the field and LiDAR observations to map forest carbon stocks across Kalimantan and estimate carbon associated with logging.
- Create software tools to track uncertainty from the field sampling and measurements through final wall-to-wall maps.
- Essentially, we are building & refining the components of an MRV (NFMS) system for Kalimantan.

Our CMS Project Field Data Collection

- Collecting two types of field data across Kalimantan:
  - Forest structure for above ground biomass estimation
    - dbh
    - tree height
    - canopy dimensions
  - Estimate of carbon loss due to logging
    - size of tree stumps
    - maps of skid trails and logging decks
    - coordinates and size of other downed trees



- The data will be collected from four regions (2 biomass and 2 degradation focused). Each region will have between 10 and 50 samples measured.

India Forest Plus

- Partnership for Land Use Science (FOREST-PLUS)
- USAID funded (~15 million USD, 5 year project)
- Team: TetraTech ARD, Applied Geosolutions and MSU
- AGS/MSU Goals: Develop MRV system; demonstration of RS, GIS and field sampling at 4 landscape sites; and training
- Stakeholders in India: MOEF, FSI and SFD

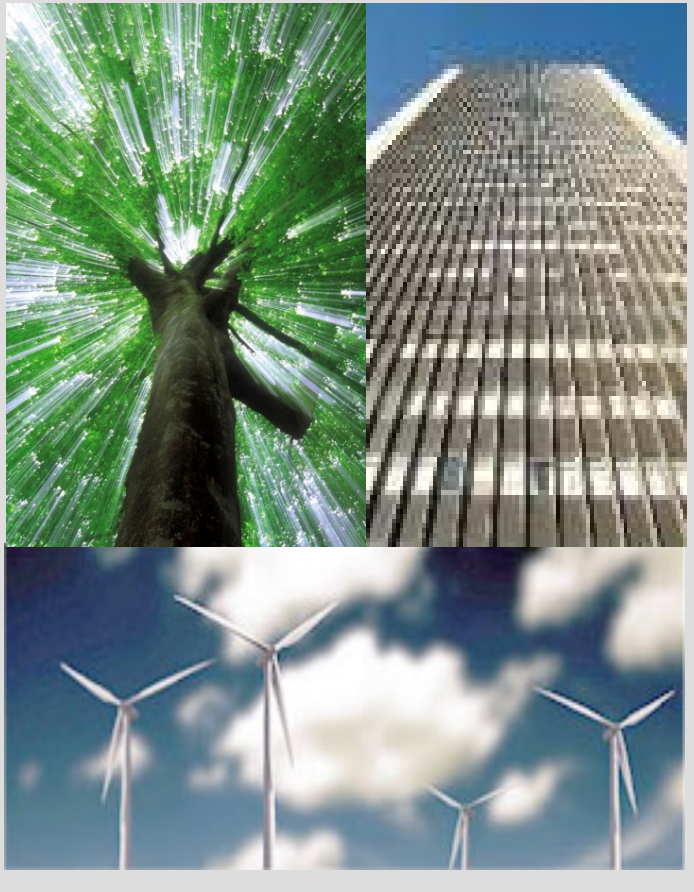
India Forest Plus: Initial Scoping Indicates

- FSI desire for SAR capabilities to:
  - support forest carbon,
  - forest loss and degradation mapping and
  - design of field sample plot stratification.
- Opportunity for 4 new landscape sites: different forest types (gradient S to N), FSI field plots
  - Additional field data for validation of JAXA FNF products.
  - Additional field data on forest structure and biomass
  - Demonstration sites for application of PALSAR for REDD+
  - Integration of PALSAR into the MRV system for GOI/FSI
- Focus of Phase 4 proposal
  - Additional mosaics to cover 4 landscape demonstration sites India

USAID
FROM THE AMERICAN PEOPLE

Pilot Rice Measurement, Reporting and Verification System

Analysis and Investment in Low Emissions Growth (AILEG): Vietnam Pilot



AILEG

Rice MRV System: Motivation

The Challenge

- A monitoring, reporting and verification (MRV) system for GHG emissions in the agriculture sector does not exist in Vietnam, nor do robust country-specific emission factors for rice cultivation.

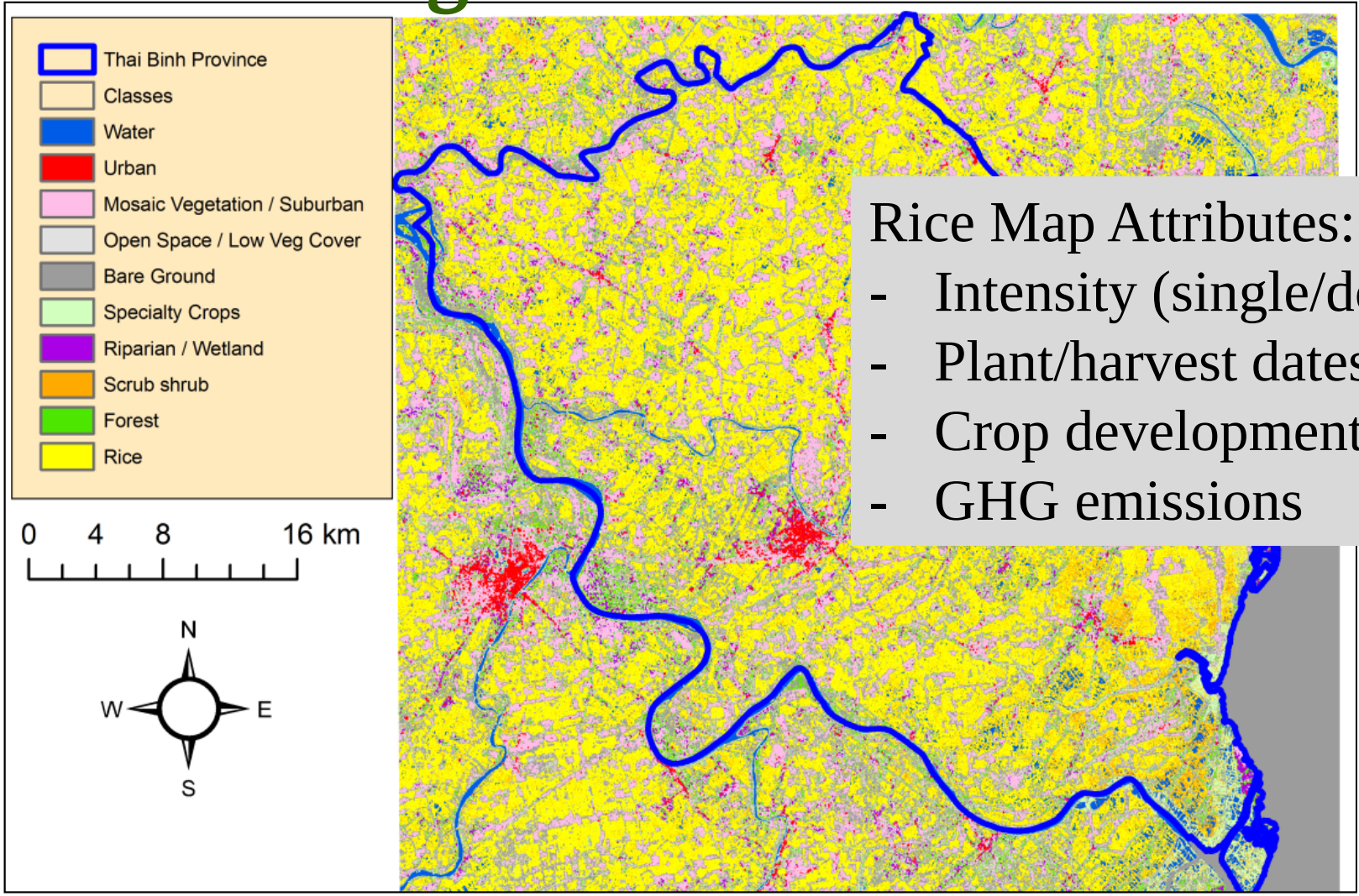
The Solution

- A MRV tool for the rice cultivation in Vietnam could help with national reporting on GHG emissions and explore emissions trajectories for policymaking

Rice MRV System: Components

- Field data collection tools: Mobile apps
- Remote sensing algorithms/tools for mapping and monitoring rice production.
  - Mapping rice acreage by growing season
- Spatial Data Infrastructure: GIS databases
  - Spatial data for regional modeling
- GHG modeling tool: DNDC model
  - Used to scale up site emissions to provincial scale
  - Could include a TIER 2 system for rice
- Open source web GIS system
  - For data dissemination, tracking and visualization.

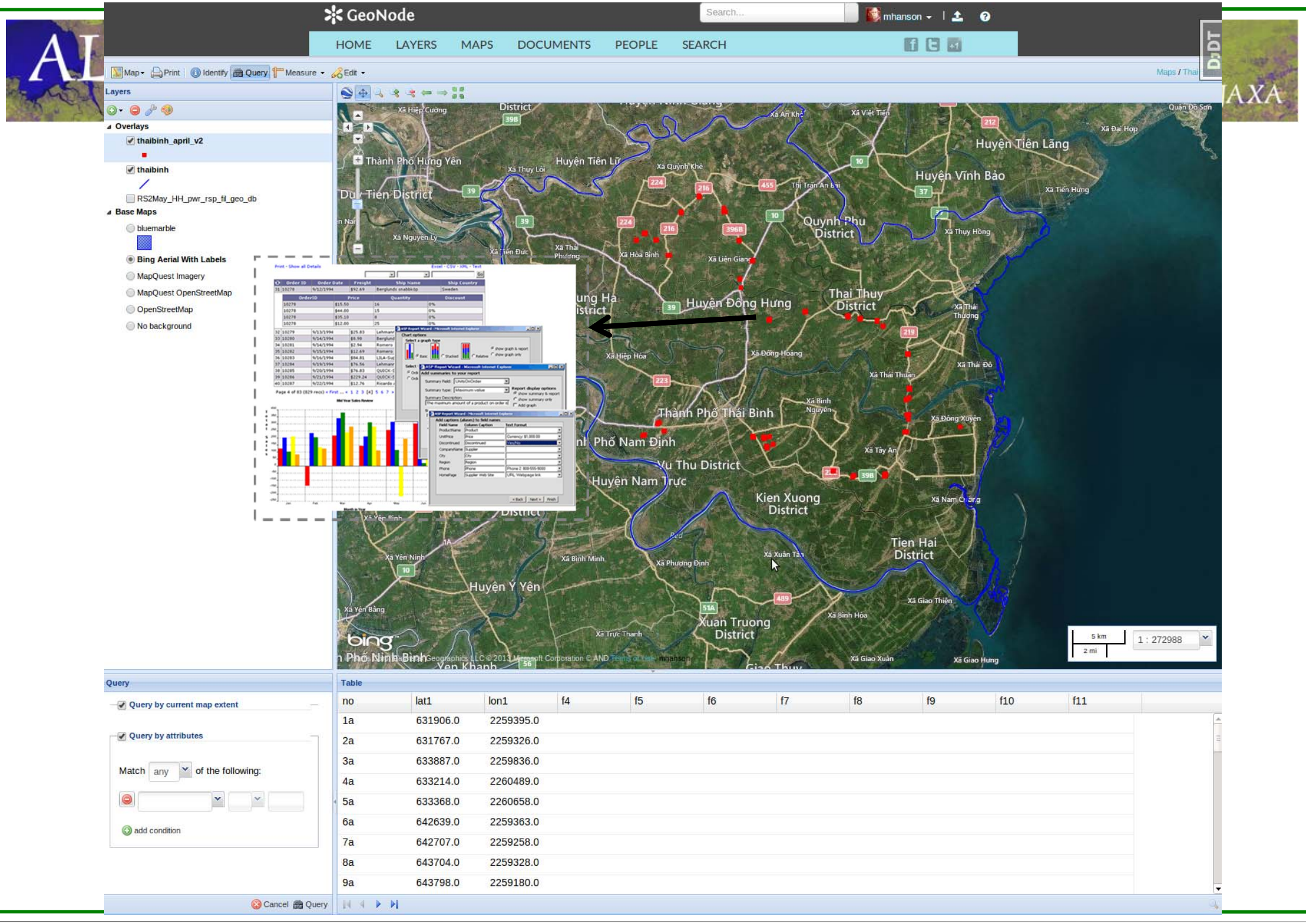
Remote Sensing Product: Thai Binh Land Cover



Rice Map Attributes:

- Intensity (single/double)
- Plant/harvest dates
- Crop development
- GHG emissions

- Mapping LULC, rice, inundation, cropping intensity, calendar
- Parameterizing model, scaling, and monitoring activities


GeoNode
Search...
mhanson
HOME
LAYERS
MAPS
DOCUMENTS
PEOPLE
SEARCH
Map
Print
Identify
Query
Measure
Edit
Maps / Thai
Layers
Overlays
thaibinh_april_v2
thaibinh
RS2May_HH_pwr_rsp_fil_geo_db
Base Maps
bluemarble
Bing Aerial With Labels
MapQuest Imagery
MapQuest OpenStreetMap
OpenStreetMap
No background
Huyện Đông Hưng
Thai Thuy District
Quynh Phu District
Huyện Tiên Lữ
Thành Phố Hưng Yên
Huyện Tiên Lãng
Huyện Vĩnh Bảo
Thành Phố Thái Bình
Vu Thu District
Huyện Nam Trực
Kien Xuong District
Tien Hai District
Huyện Ý Yên
Xuan Truong District
Query
Query by current map extent
Query by attributes
Match any of the following:
add condition
Cancel
Query
Table
no
lat1
lon1
f4
f5
f6
f7
f8
f9
f10
f11
1a 631906.0 2259395.0
2a 631767.0 2259326.0
3a 633887.0 2259836.0
4a 633214.0 2260489.0
5a 633368.0 2260658.0
6a 642639.0 2259363.0
7a 642707.0 2259258.0
8a 643704.0 2259328.0
9a 643798.0 2259180.0
1 : 272988

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).**
- **Vietnam: Thanh Hoa and Nghe An provinces (700 field photos with gps and land cover descriptions - 2013**
- Forest biometric data from northeast USA and Cerrado (Brazil).
- New field data from India Forest-PLUS, NASA Indonesia CMS and NASA SE Asia Plantations projects.

Thank you.

Questions?