Developing a Rice Monitoring System for Asia: Completion of work from Phase 1

- **Summary**
  - Objectives
    - Map the extent of rice paddies in Pan Asian region
    - Map rice cropping systems in Pan Asian region
    - Map inundation period of rice agriculture in Pan Asian region
    - Map and monitor rice biophysical characteristics (biomass, LAI, age, height) in Pan Asian region.
    - Use PALSAR derived products to drive a biogeochemical model to estimate net GHG emissions.

  - Phase 1: Methods for operational mapping developed and tested
  - Phase 1: Products for development sites created
  - Phase 1: Validation underway

William Salas

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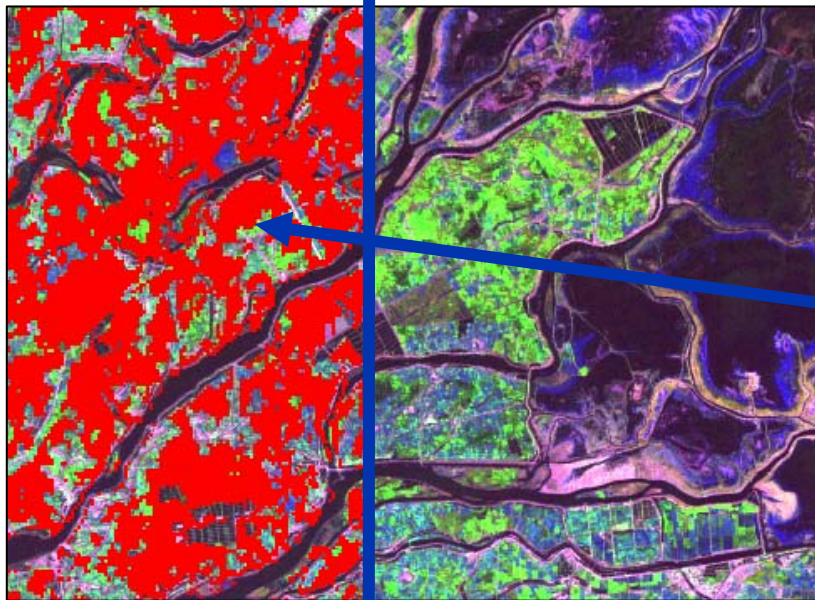
Completion of work from Phase 1

- **Task: Algorithm Development**
  - Algorithms & methodology for rice products (i.e., subtask 1.1.1)
  - Completed using fine-beam, AUIG ScanSAR, & K&C Strips
 - Deliverable report available

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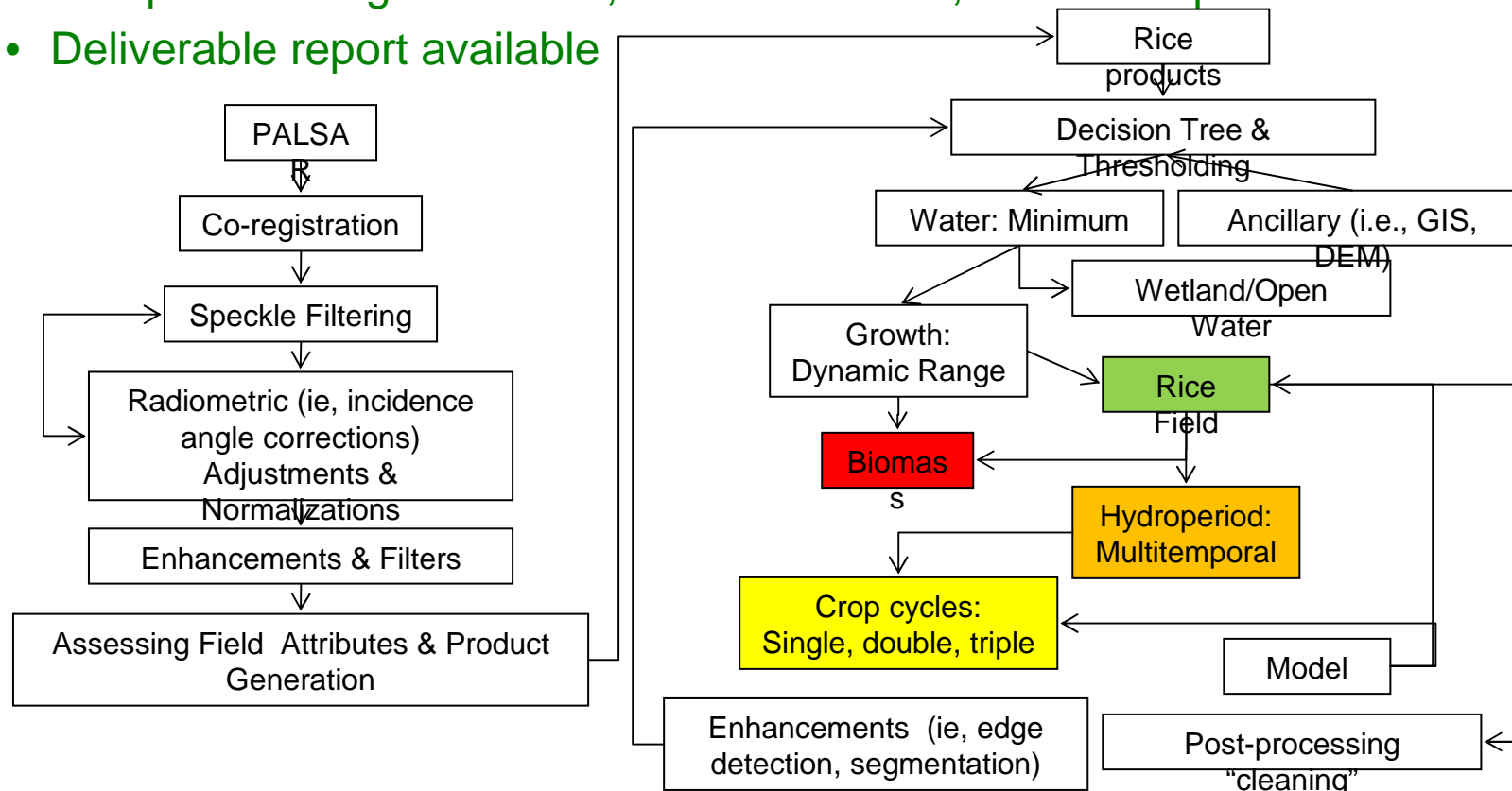
Completion of work from Phase 1

- **Task: Applications and Rice Mapping**
    - Classify rice paddy extent (subtasks 1.1.3 & 1.1.4)
    - Completed for development sites using FBS/D, AUIG ScanSAR & K&C Strips
    - Completed Phase 1 Rice products for Southeast China & Java, Indonesia
    - Deliverables complete for Poyang lake, Java, & California, USA
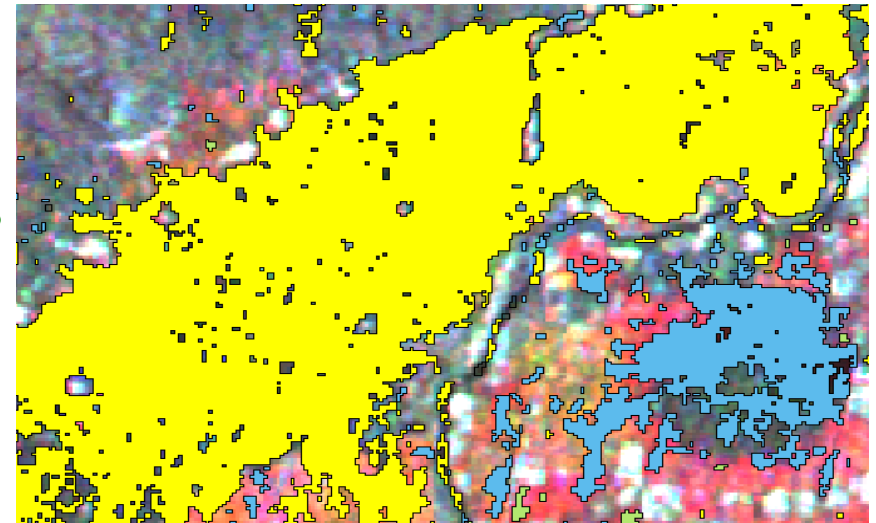
Completion of work from Phase 1

- **Poyang Lake example**
    - Region has variability in paddy size, wetlands with variety of aquatic vegetation,
    - Preliminary validation underway;
   - Deliverables and accuracy available May 2009
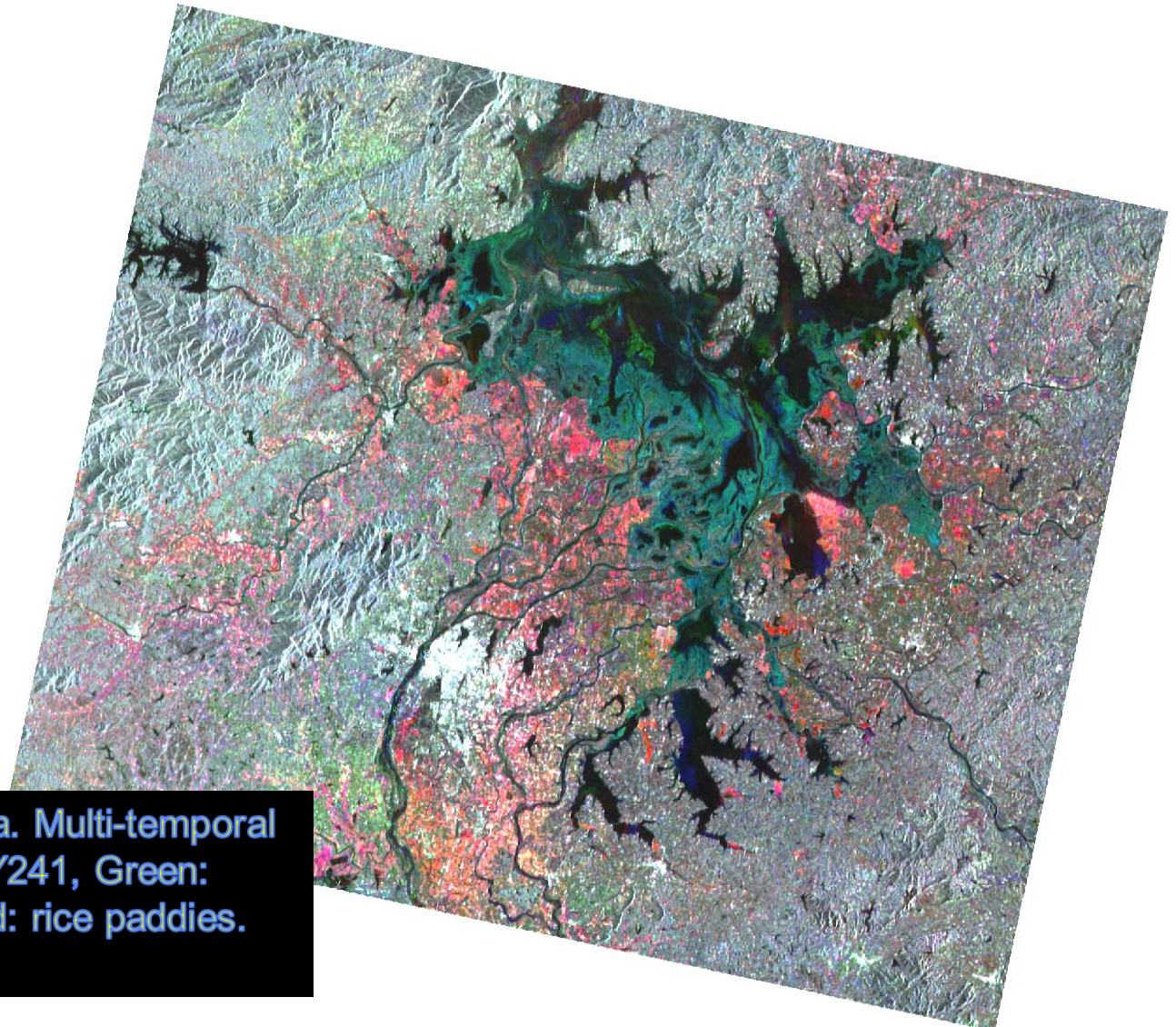
Poyang Lake, Jiangxi Province, China. Multi-temporal (HH: 100m) ScanSAR (Red: DOY241, Green: DOY149, Blue: DOY103). Bright red: rice paddies.

Completion of work from Phase 1

- **Crop cycles using multi-temporal strips**
  - Subtasks 2; Completed Phase 1 rice products (crop cycles) for Java, Indonesia
  - Southeast Asia K&C strip products in progress
  - Characterize number of peaks and temporal windows
  - Complete for Java, Indonesia
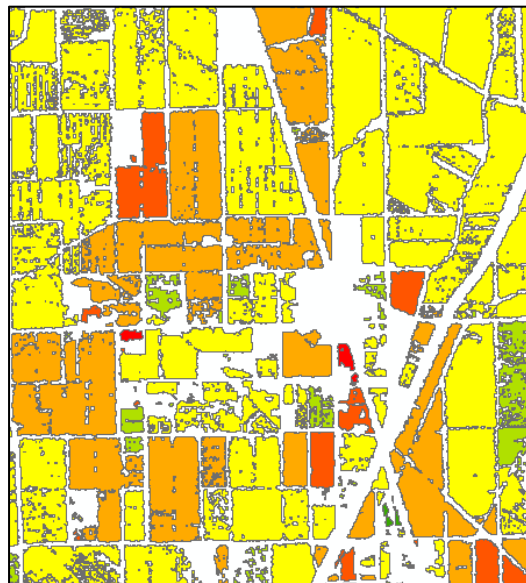 - Pan-Asian Product 2.2 underway 2009

Single Rice Crop   Double Rice Crop

double crop

Rice: threshold

rice phenology
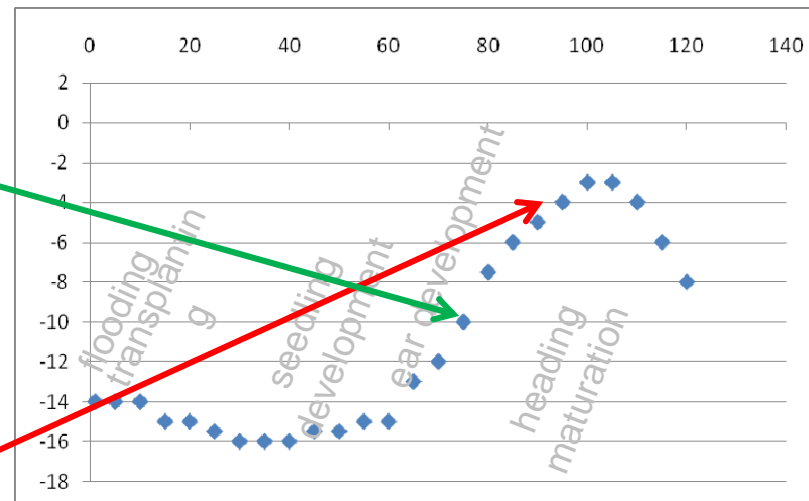
time
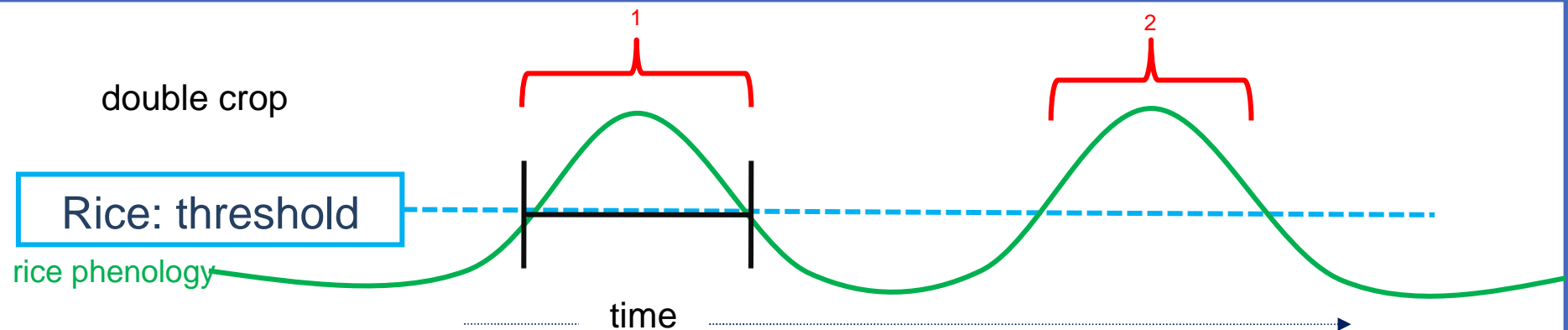
Completion of work from Phase 1

- **Task: Monitoring rice characteristics**
- Attributes include age, planting/harvest dates, biomass
- Completed methodology for development site
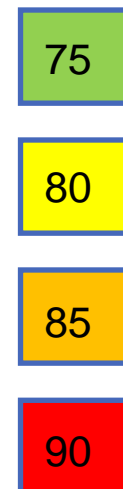- Pan-Asian products scheduled for Phase 2

BS-rice status "example model"

Field-averaged biomass (HH)

~Growth Status (days)

L35HH: Backscatter and rice growth

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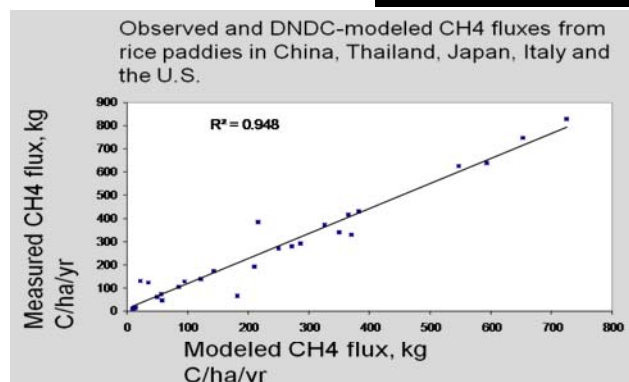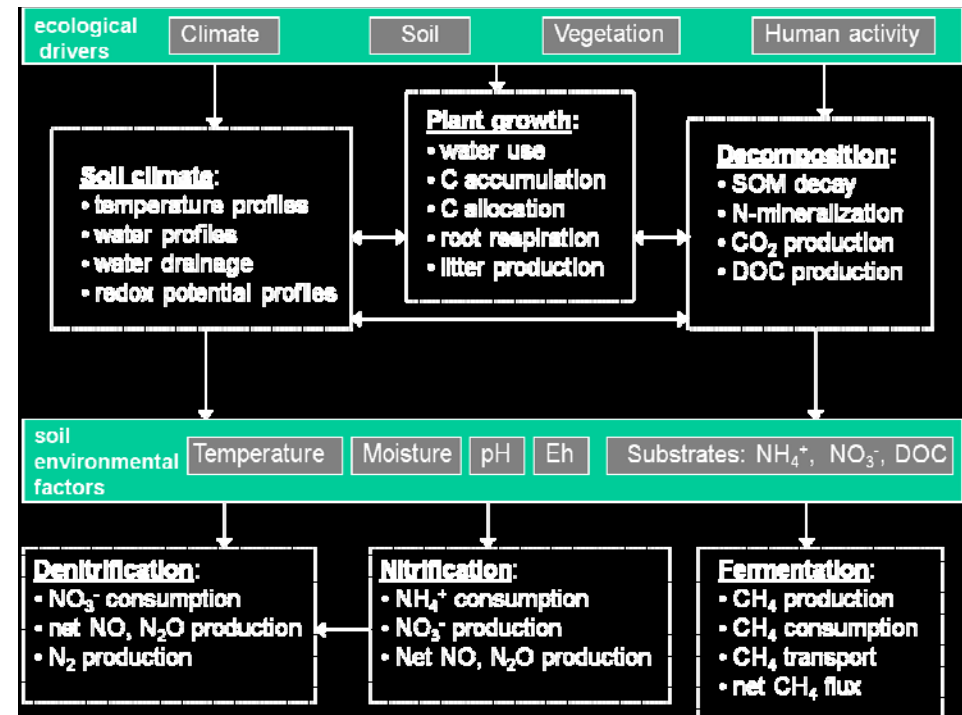
Completion of work from Phase 1

GHG Emissions Modelling

➢ Using DNDC biogeochemical model

  ➢ Provides full GHG accounting (SOC, CH4 and N2O)

  ➢ Well validated across range of rice systems

  ➢ Has management levers.

  ➢ Linked with GIS databases (RS and field data)

Observed and DNDC-modeled CH4 fluxes from rice paddies in China, Thailand, Japan, Italy and the U.S.

Completion of work from Phase 1

Mapping Hydroperiod using multi-temporal PALSAR data

- Need for improved spatial estimates of rice inundation dynamics will improve our model estimates of GHG emissions (Methane and Nitrous Oxide are controlled by redox dynamics.
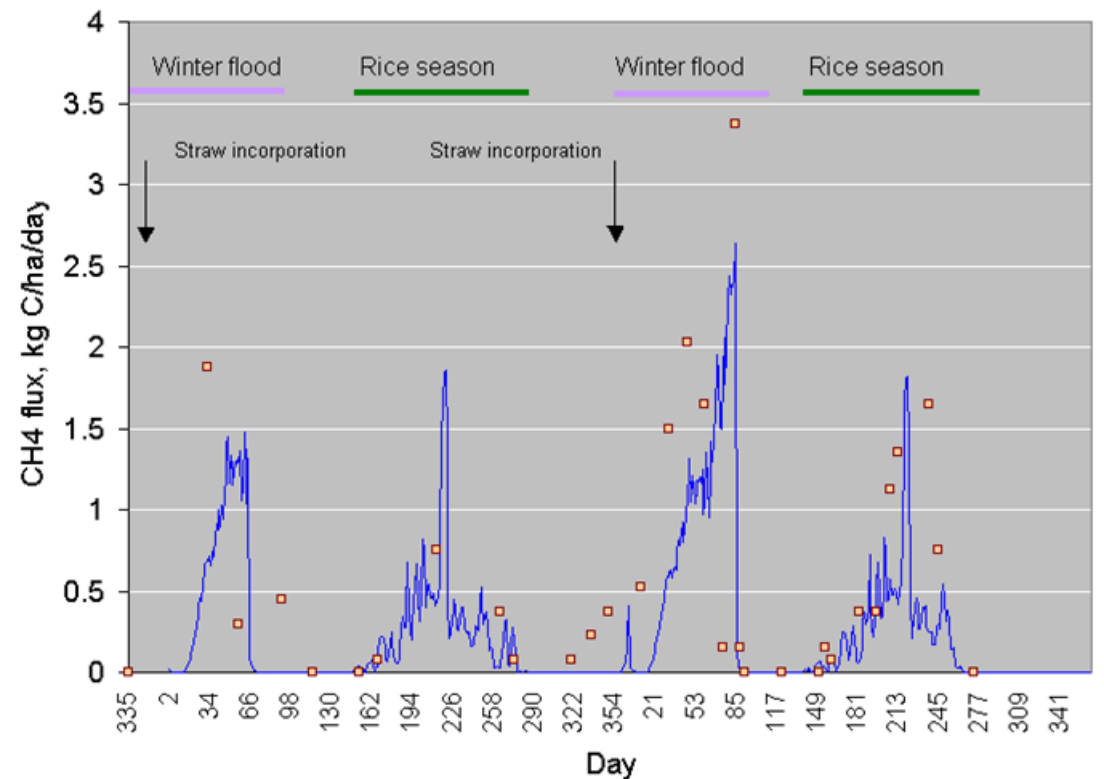
Completion of work from Phase 1

Mapping Hydroperiod using multi-temporal PALSAR data

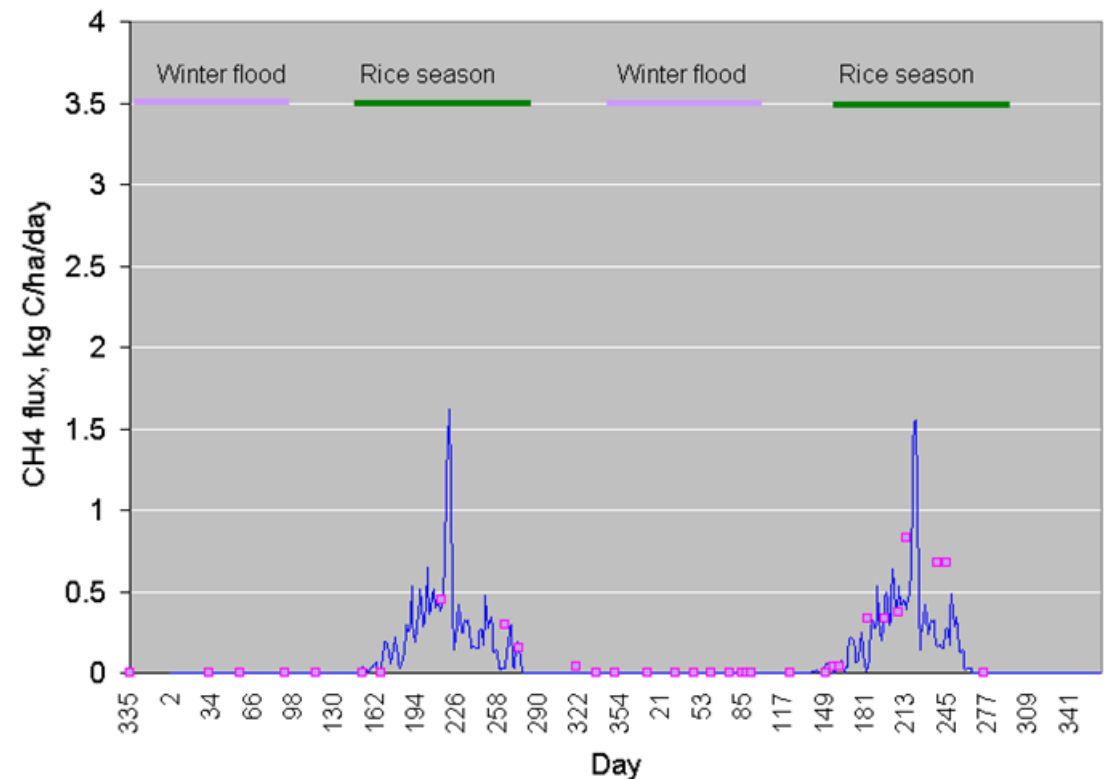- Need for improved spatial estimates of rice inundation dynamics will improve our model estimates of GHG emissions (Methane and Nitrous Oxide are controlled by redox dynamics.
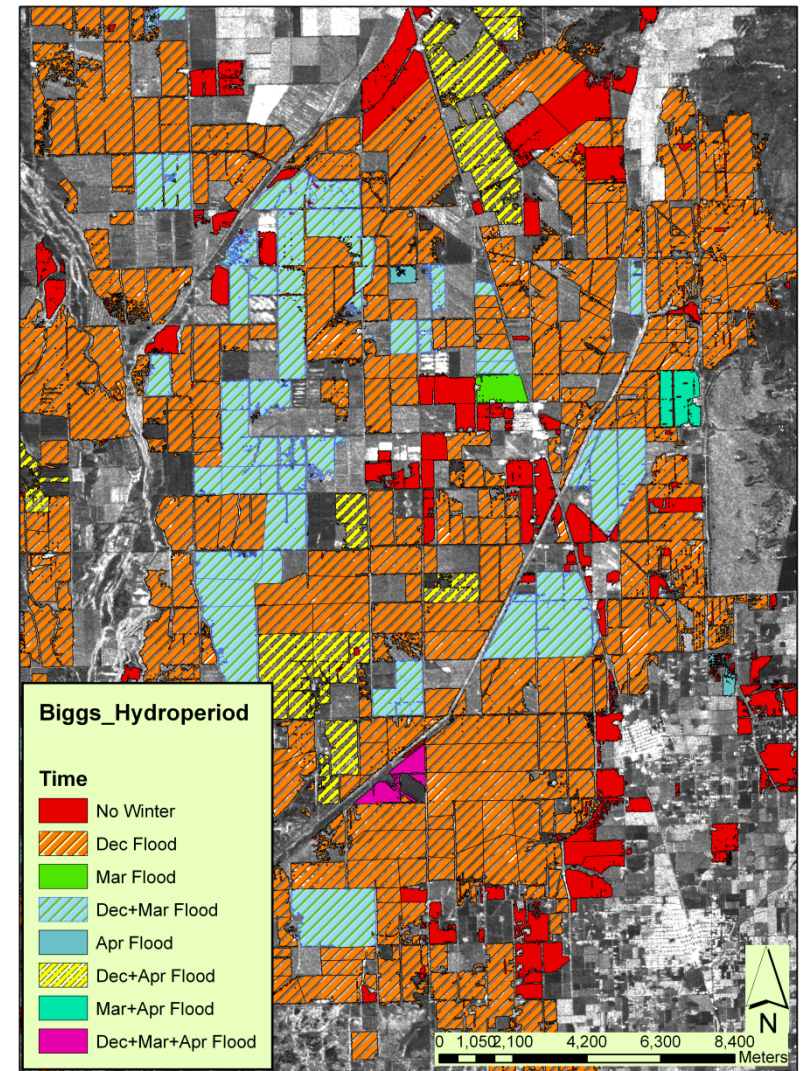
Completion of work from Phase 1

- **Mapping Hydroperiod using multi-temporal data**

  - Subasks 3: Mapping hydroperiod methodology complete

  - Products available for analysis in CA, USA

  - Biggs GHG modeling using rice products

  - Pan-Asian hydroperiod products in progress

Example Application

Biggs hydroperiod assessment:

➢ Rice map using fine-beam PALSAR; 95% overall

accuracy

➢ PALSAR HH 100m ScanSAR monitors hydroperiod
  ▪ 12/5/2006, 3/7/2007, 4/17/2007

➢ Approximately half of paddies (47%) flooded during December (74,292 hectares), 75% flooded one time

➢ 25% of rice paddies not winter flooded

Biggs_Hydroperiod

Time
- No Winter
- Dec Flood
- Mar Flood
- Dec+Mar Flood
- Apr Flood
- Dec+Apr Flood
- Mar+Apr Flood
- Dec+Mar+Apr Flood

0 1,050 2,100 4,200 6,300 8,400
Meters

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Completion of work from Phase 1

GHG Emissions Modelling

➢ Using PALSAR to parameterize DNDC biogeochemical model

➢ Accurate characterization of land surface attributes and captures spatial variability

➢ Estimates of regional emissions and impacts of various managements

GHG Emissions
Net GWP: MTCO2eq/ha

|	
🟥	0.70 - 1.40
🟧	1.40 - 5.10
🟧	5.10 - 6.70
🟨	6.70 - 8.10
🟩	8.10 - 8.20
🟩	8.20 - 10.30
🟦	10.30 - 12.50
🟦	12.50 - 14.00
🟦	14.00 - 17.40
🟦	17.40 - 23.15
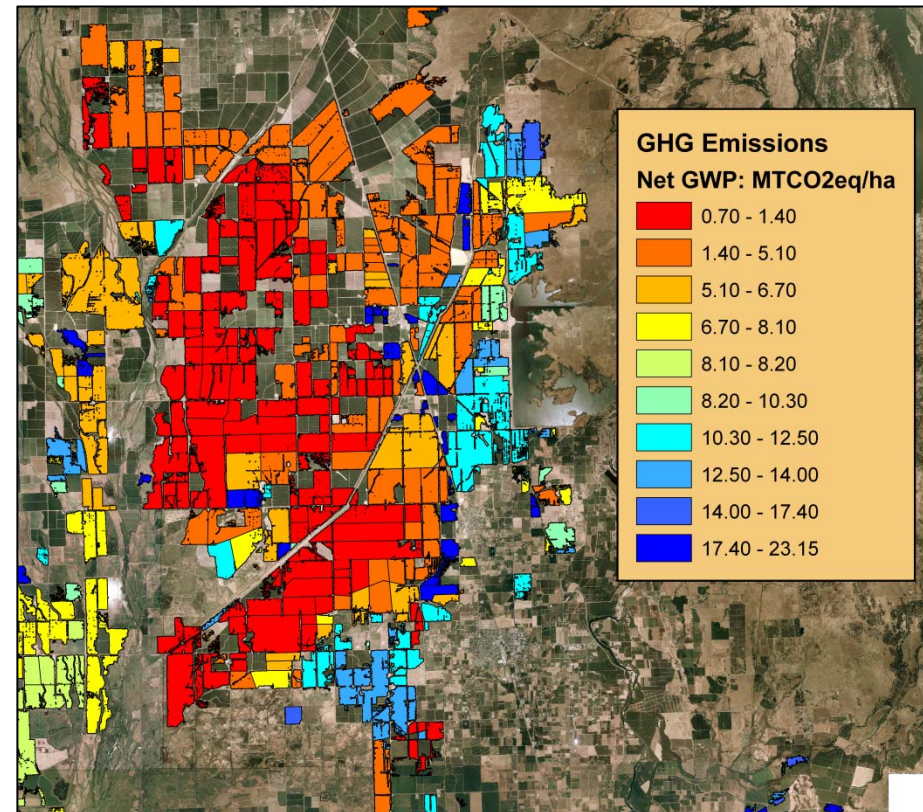
Phase 1 Conclusions

- **Multi-temporal FBS/FBD and ScanSAR are promising for routine mapping and monitoring of rice at regional scale.**

- **Decision tree classification and segmentation can be implemented in an automated system.**

- **ScanSAR radiometry is suitable for mapping and monitoring, but issues of scale in regions with smaller rice paddies.**

- **Ideal system combines FBD/FBS mapping of rice extent with ScanSAR monitoring for refining cropping intensity, cropping dates and inundation dynamics.**

- **Phase 2:**
  - **Systematic validation (sites in China, Java and California)**
  - **Application to all of SE Asia, India and China.**

Completion of work from Phase 1: Papers

- **Wang, C, Wu, J, Zhang, Y., Pan, G., Qi, J., and W. Salas, 2008, Characterizing L-band scattering of paddy rice in southeast China with radiative transfer model and multi-temporal ALOS/PALSAR imagery, *accepted, IEEE Transactions on Geoscience and Remote Sensing..*

- **Zhang, Y., Wang, C., Wu, J., Qi, J., and W. Salas, 2008, Mapping Paddy Rice with Multi-temporal ALOS PALSAR Imagery in Southeast China, *accepted*, International Journal of Remote Sensing.**

- **Beach, R., DeAngelo, B, Rose, S., Li, C., Salas, W., and S., DeGrosso, 2008, Mitigation potential and costs for global agricultural greenhouse gas emissions, *Agricultural Economics,* 38, 109-115.**

- **Salas, W., Boles, S., Li, C., Yeluripati, J., Xiao, X., Frolking, S., and Green, P., 2007, Role of satellite radar observations and biogeochemical models for regional mapping and modeling of greenhouse gas emissions from rice paddies, *Journal of Aquatic Conservation,* Marine and Freshwater Ecosystems 17, 319-329.**
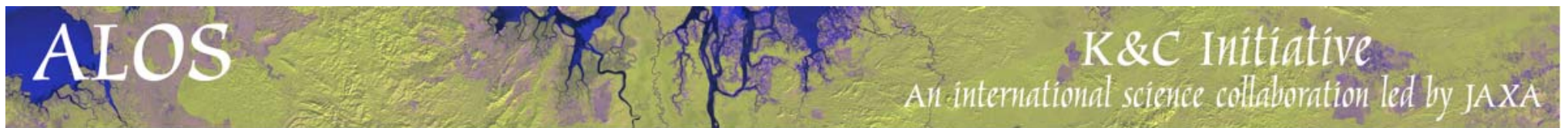
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and

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William Salas

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