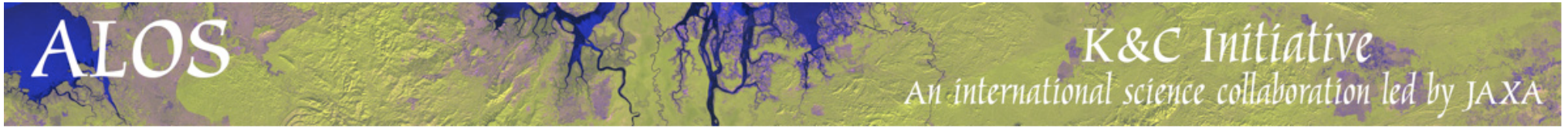


Product Delivery Report for K&C Phase 2

William Salas
Applied Geosolutions, LLC

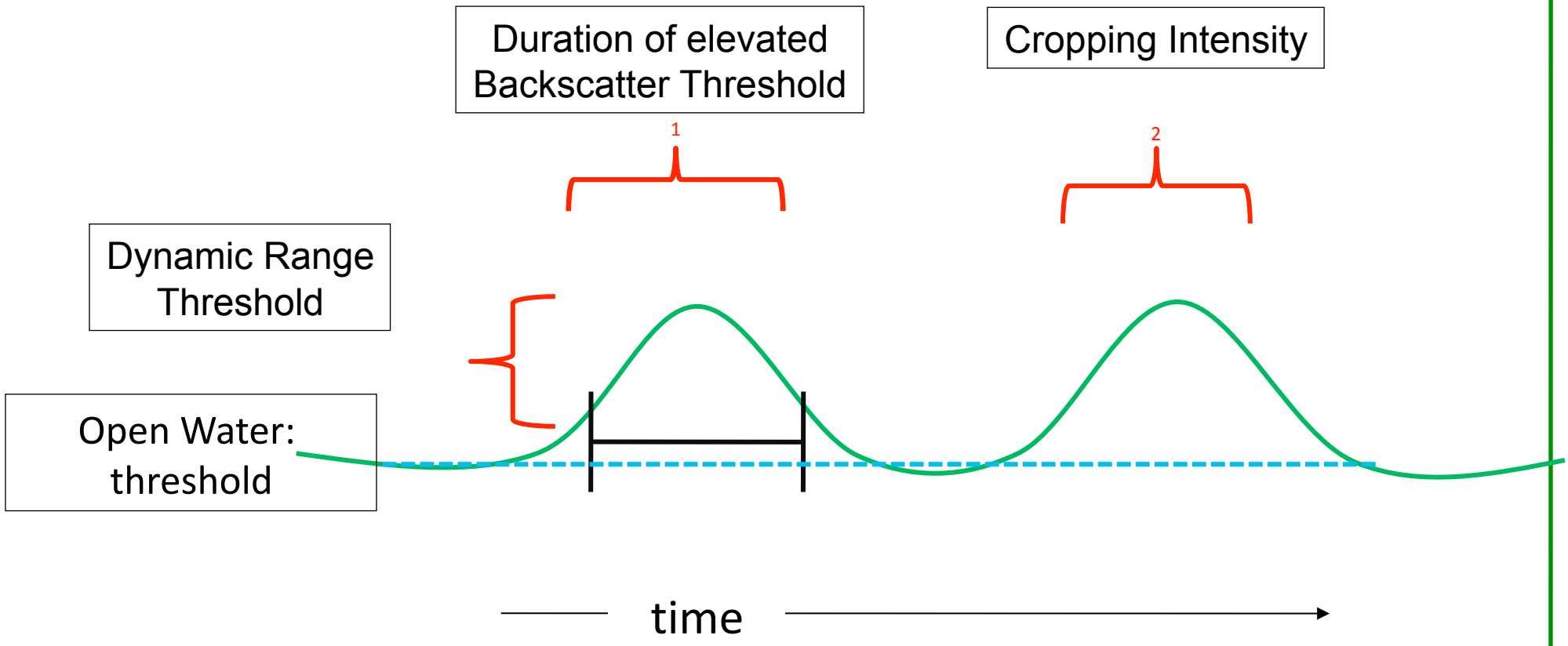
Science Team meeting #15
JAXA TKSC/RESTEC HQ, Tsukuba/Tokyo, January 24-28, 2011

Project Goal

Build an integrated system for mapping and monitoring rice agriculture and quantification of greenhouse gas (CH4, N2O and soil carbon) emissions.

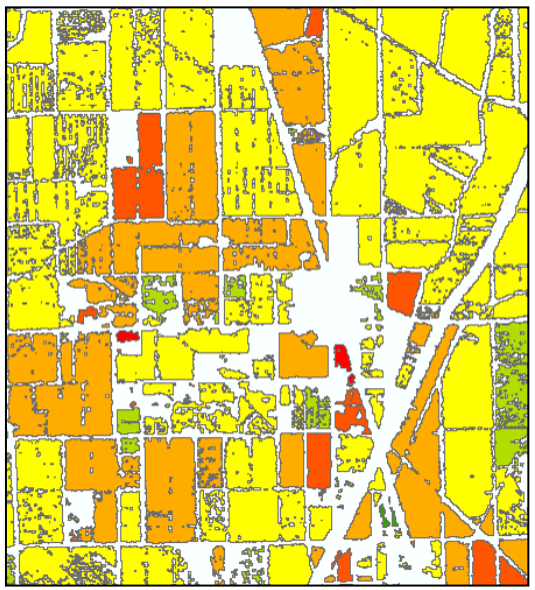
- **System components:**
  - **PALSAR: mapping rice extent, water management and estimate cropping intensity and cycles.**
  - **MODIS: Augment PALSAR water management with finer temporal resolution hydroperiod information.**
  - **Spatially explicit biogeochemical modeling: DNDC**

PALSAR Processing

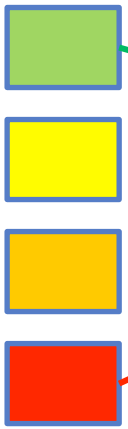


rice phenology

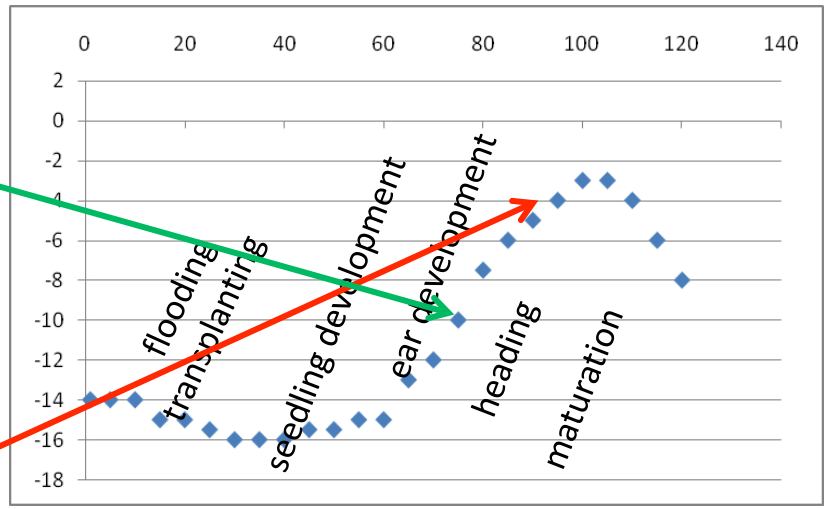
Inverting Temporal Backscatter information for mapping management attributes including age and crop planting/ harvest dates



Field-averaged biomass (HH)



BS-rice status "example model"



~Growth Status (days)

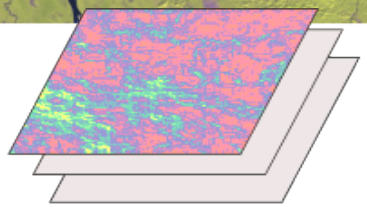
L35HH: Backscatter and rice growth

William Salas

ALOS

K&C Initiative

An international science collaboration led by JAXA

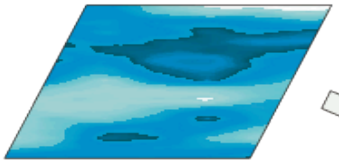


Multi-temporal SAR Imagery

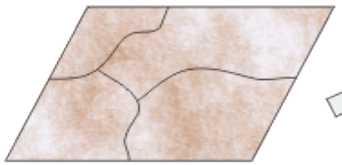
Rice Extent

Rice Cropping Systems

Climate



Soils



DNDC Model

User Defined Management

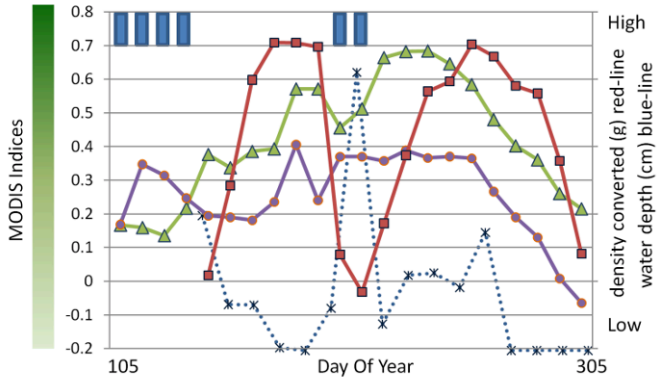
Water Regime
Fertilizer use
Tillage...

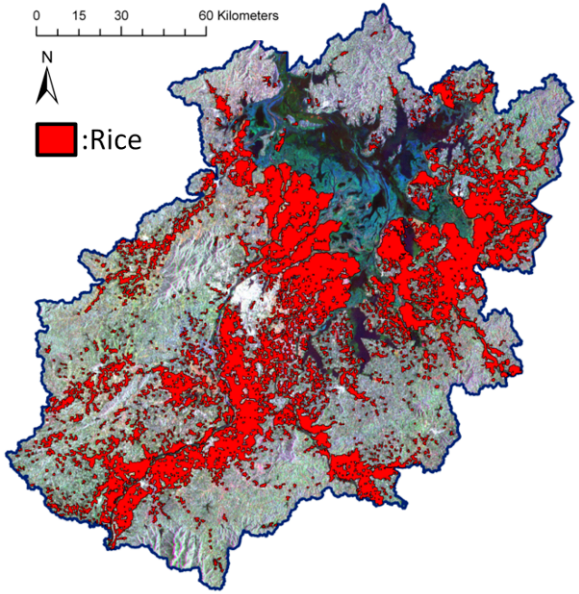
GHG

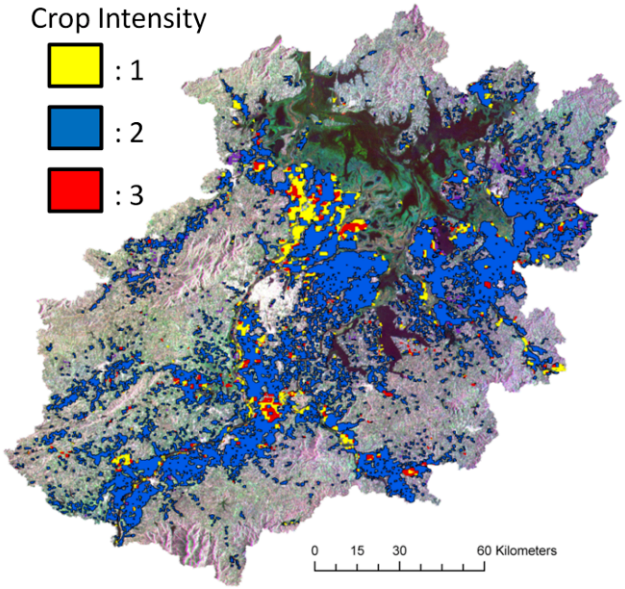
Water Use

Yield

Tested operational mapping for watershed scale studies (Jiangxi Province, China illustrated)





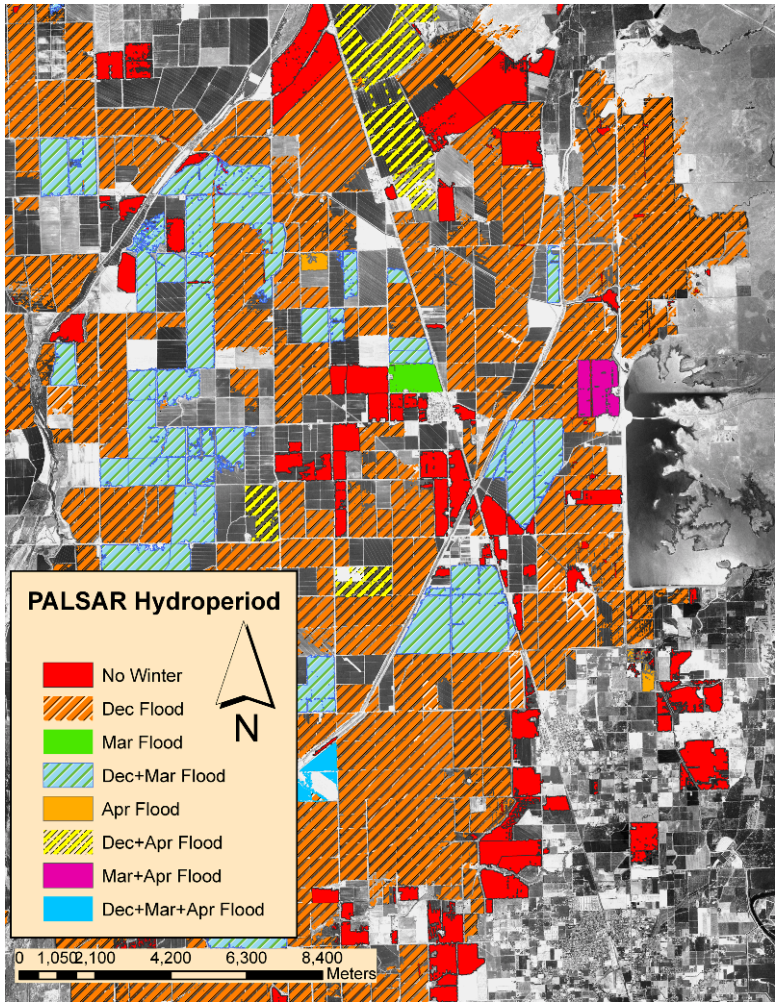


William Salas

Tested operational mapping for State scale studies (California Rice)

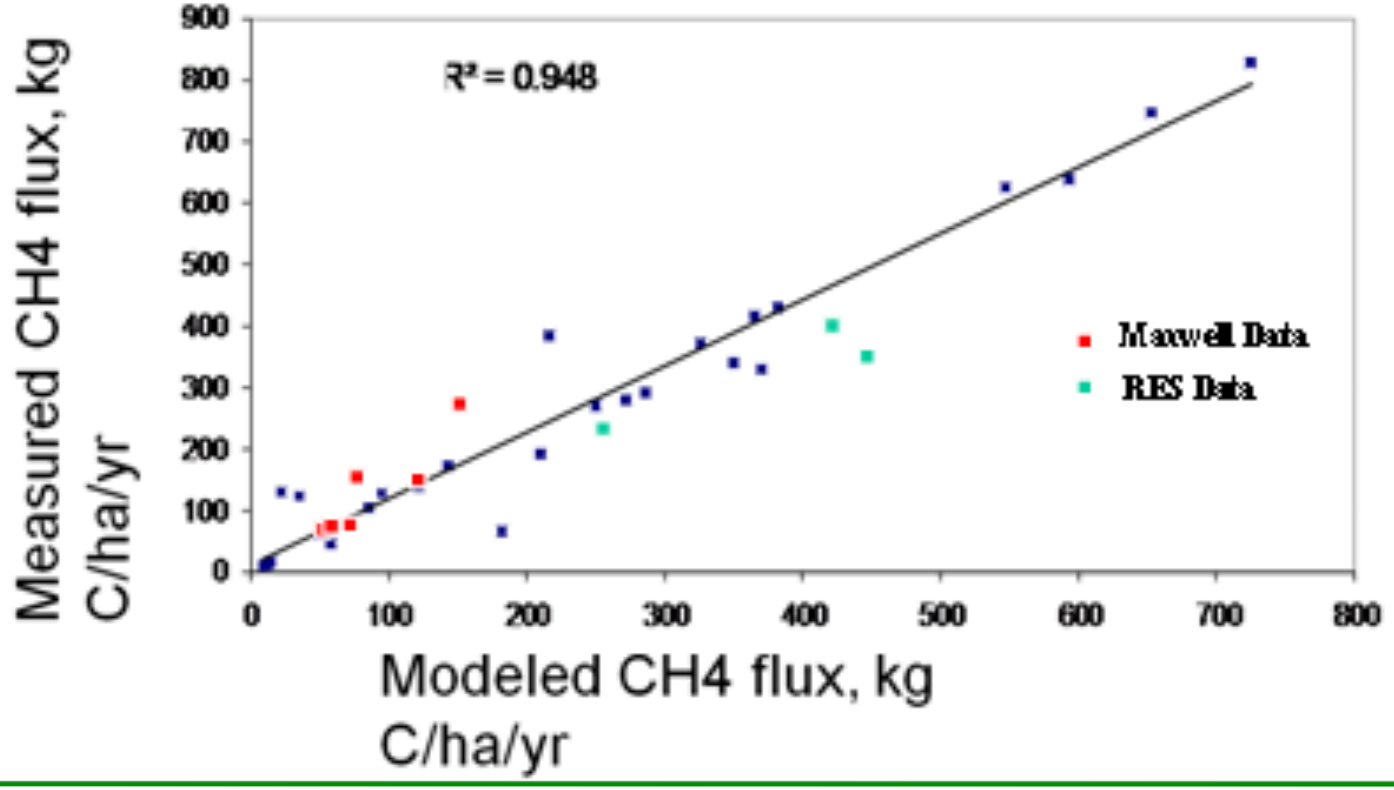
Achieved high accuracies:

- Mapping rice extent
- Mapping winter flooding
- Estimating plant/harvest dates



Independent Validation of DNDC CH4 Estimates (California Rice)

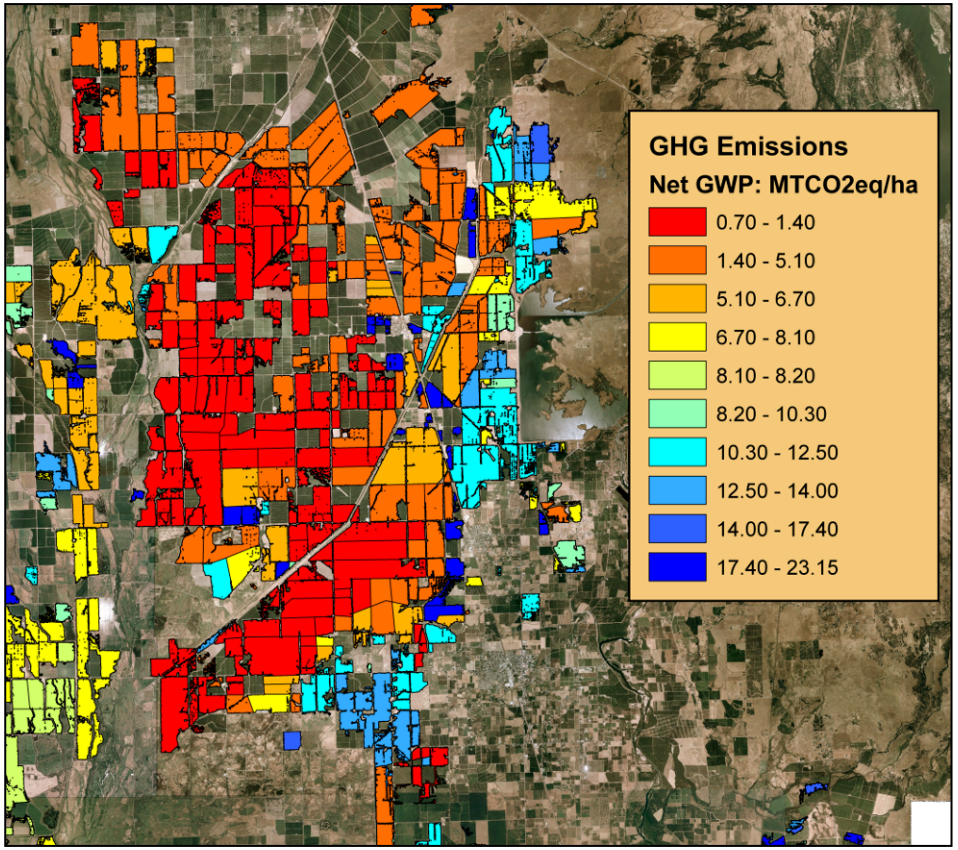
Observed and DNDC-modeled CH4 fluxes from rice paddies in China, Thailand, Japan, Italy and the U.S.



Finished rice GHG assessment using PALSAR products as parameterization

GHG Emissions Modelling

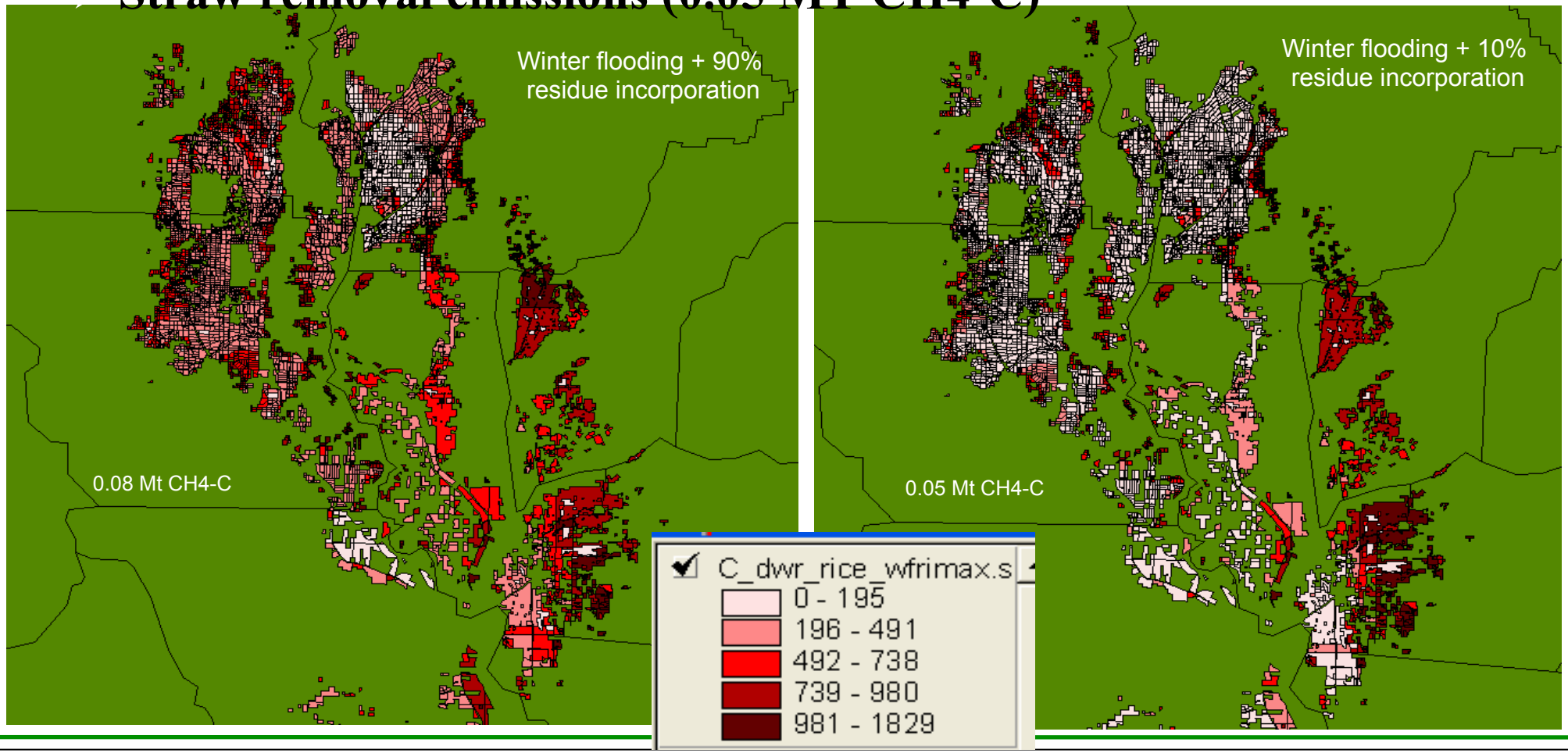
- Rice extent, hydroperiod, crop calendar to parameterize DNDC biogeochemical model
- Accurate characterization of land surface attributes and captures spatial variability
- Estimates of regional emissions and impacts of various managements



Extended Modeling to examine spatially explicit methane mitigation opportunities:

Baseline emissions (0.08 MT CH4-C)

Straw removal emissions (0.05 MT CH4-C)



Modeling approach with SAR/Optical RS monitoring and verification is being integrated in 3 rice carbon offset protocols:

- CAR, ACR and VCS

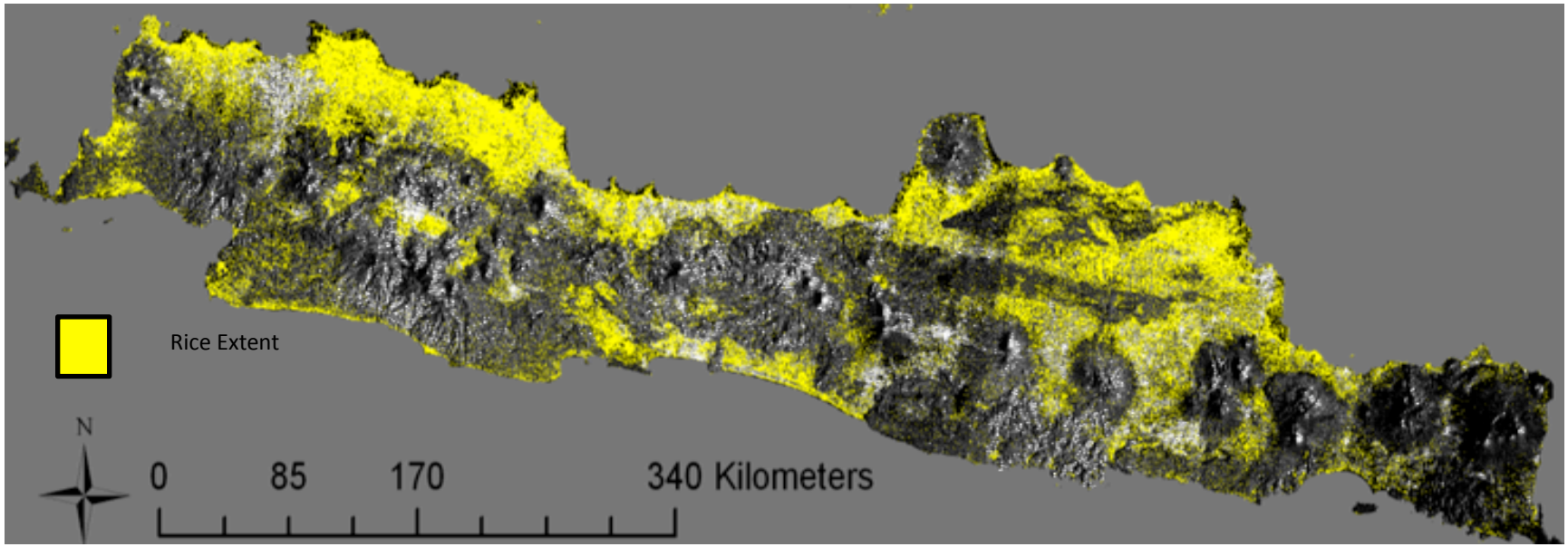
Discussions with CARB for compliance protocol under AB32.

Plans to extend internationally…

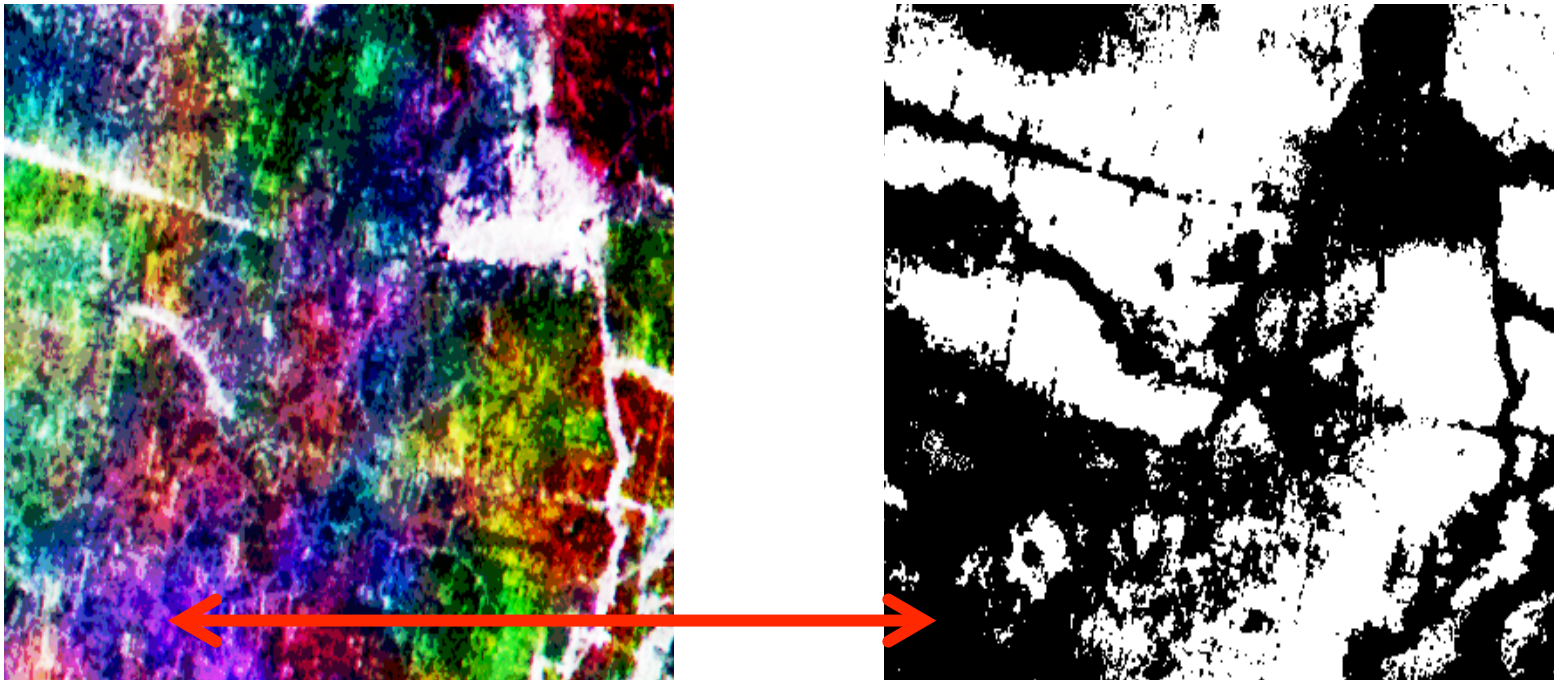
Transitioned to ScanSAR strips…

….relatively small to moderate areas worked ok (e.g. Java)

Larger areas did not!

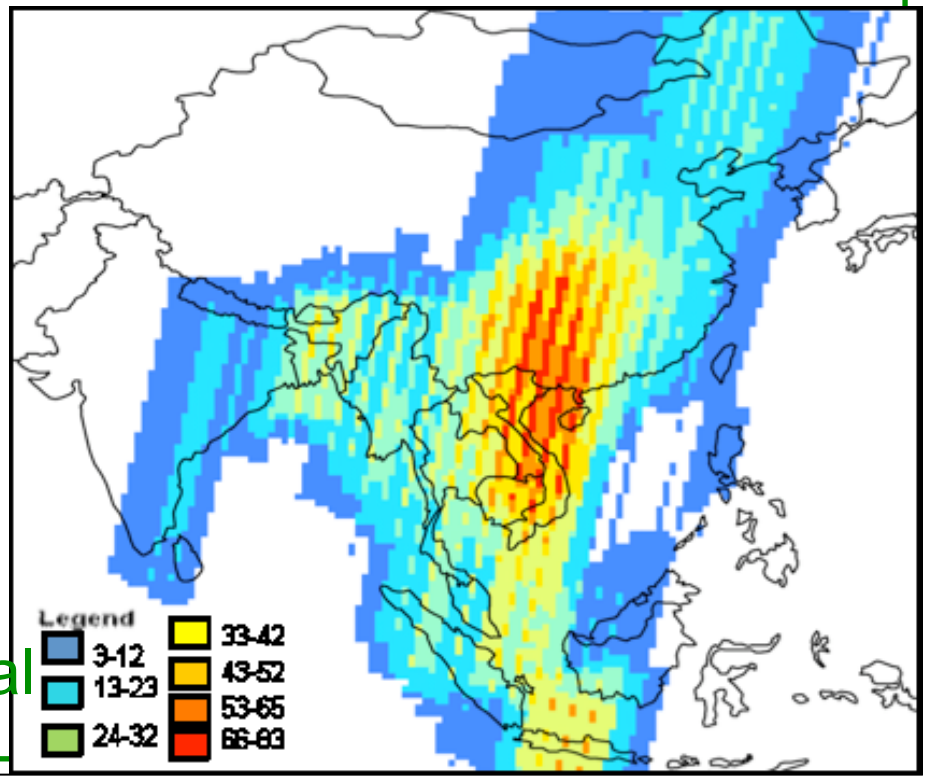


Impact of heterogeneous rice crop phenology… significant errors of omission



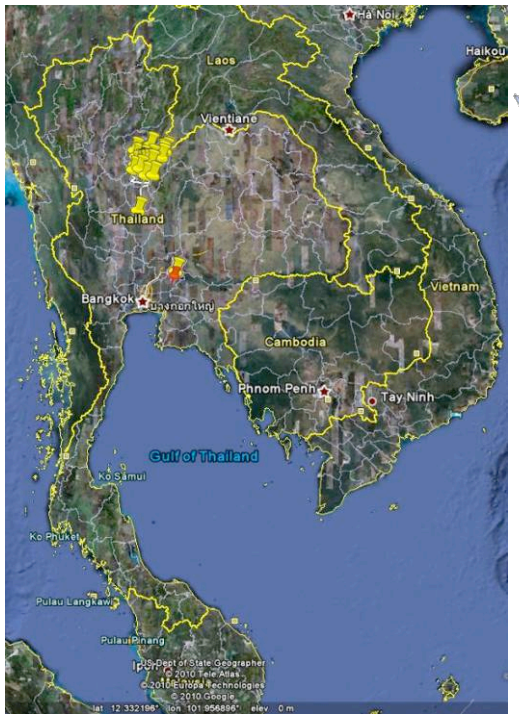
Transitioning of operational approach to ScanSAR strips has been slow

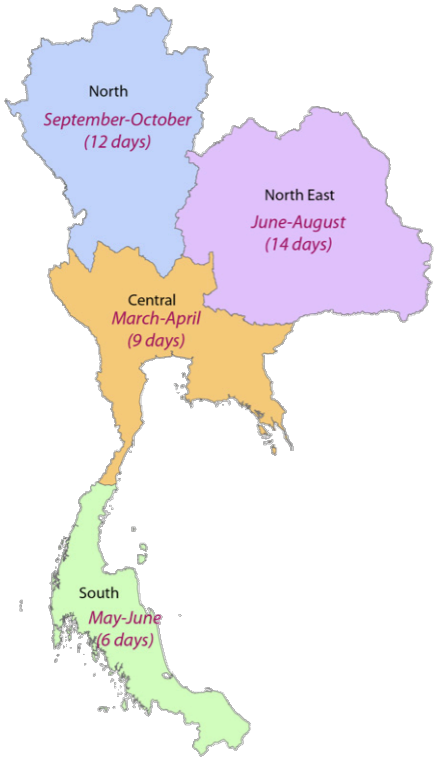
- Operational mapping efforts success is limited!
  - 2+ TB of data for one year of SLT ScanSAR (rsp 94-139)
  - Pre-processing time consuming, data intensive: completed
- Incident angle and adjacent rsp calibration needs to be addressed
- ~75-100m too coarse for smaller/isolated and heterogeneous paddy areas
- Rainfed has mixed signal?
- Mixed calendars add to mixed signal



Additional Outcome: Recent Phase II field work completed in:

- Bangladesh, China, India, Indonesia, Thailand, USA
- Geofield photos available to K&C team (http://www.eomf.ou.edu/)





K&C deliverables
Papers and Reports

1. Conferences (during K&CI Phase II)

- NASA LCLUC Science Team Meetings (Washington DC, USA)
  - Monitoring rice paddies with multitemporal PALSAR
  - Developing land cover data products in Monsoon Asia over the period of 2004-2007 through integration of Landsat and multitemporal L-band PALSAR/ALOS imagery
- International GEO Workshop on Synthetic Aperture Radar (SAR) to Support Agricultural Monitoring (Kananaskis, Alberta, Canada)
  - *Mapping and Monitoring of Rice with Multi-temporal PALSAR: Developing Spatially and Temporally Explicit Products for Modeling Methane Emissions at Regional to National Scales*
- IEEE 2008 International Workshop on Education Technology and Training & 2008 International Workshop on Geoscience and Remote Sensing
- Several smaller scale Science Team conferences via NASA, USDA, AAG, & NIH

K&C deliverables
Papers and Reports

2. Published (during K&CI Phase II)

- K&C Phase-1 and Phase 2 reports
- K&C Booklet contributions
  - W-12: Mapping Rice Agro-Ecological Conditions to Track Avian Influenza
  - W-13: Mapping and Monitoring Rice Agriculture with ALOS ScanSAR Imagery
  - W-14: Assessing climate change and greenhouse gas emissions from rice crops. _

- Zhang Y., C. Wang, J. Wu, J. Qi and W. A. Salas, 2009, Mapping Paddy Rice with Multi-temporal ALOS PALSAR Imagery in Southeast China. *International Journal of Remote Sensing*. 23 (10): 6301-6315
- Wang, C., J. Wu, Y. Zhang, G. Pan, J. Qi and W. A. Salas, 2009. Characterizing L-band scattering of paddy rice in southeast China with Radiative Transfer Model and multitemporal ALOS/PALSAR imagery. *IEEE Transactions on Geoscience and Remote Sensing*. 47 (4): 988-998.
- Zhang et al. 2009. Support Vector Machine Approach to Identifying Buildings Using Multi-temporal ALOS/ PALSAR Data. *International Journal of Remote Sensing. 1-26*
- Torbick, N., Salas, W., Hagen, S., Xiao, X. 2010. Mapping rice agriculture in the Sacramento Valley, USA with multitemporal PALSAR and MODIS imagery. IEEE J. Selected Topics in Remote Sensing. DOI 10.1109/JSTARS. 2010.2091493.
- Zhang et al. 2010. identifying paddy fields with dual polarization ALOS PALSAR data. Canadian Journal of Remote Sensing. 3-28
- Torbick, N. et al 2011. Integrating SAR and optical imagery for regional mapping of paddy rice attributes in the Poyang Lake Watershed, China. Canadian Journal of Remote Sensing (accepted).

K&C deliverables
Papers and Reports

2. Submitted/in preparation (during Phase II)

- *Assessing HPAI risk factors in Java Indonesia using ALOS PALSAR (2011)*
- *Methane emissions from California Rice: Integrating PALSAR and MODIS products with biogeochemical modelling (2011)*
- *Mapping aquatic land use changes in Java with PALSAR (2011)*
- *Regional rice mapping in China and Southeast Asia with multi-temporal SLT PALSAR (TBD)*

K&C deliverables

Data sets and Thematic products (mosaics, classification maps etc.)

1. Completed and Delivered to JAXA during Phase 2

- *Maps of rice, hydroperiod, cropping intensity in Jiangxi Province, China*
- *Java / Indonesia maps of rice & multitemporal mosaics*
- *Maps of rice paddies in Zhejiang Province, China*
- *Maps of rice paddies in Yantze River Delta, East China*
- *Maps of rice, hydroperiod, GHG emissions in California, USA*

K&C deliverables

Data sets and Thematic products (mosaics, classification maps etc.)

2. Completed, but not yet delivered (please deliver ASAP)

- *New 2010 Java Maps of paddy hydroperiod & cropping intensity*
- *Continental SE Asia maps of rice & hydroperiod*
- *SE China maps of rice extent*

Results are too poor…not worth delivering to JAXA at this point… working to improve regional operational algorithm.

Special Thanks to

JAXA

and

Shimada-san and his K&C team!