ALOS

K&C Initiative

An international science collaboration led by JAXA

Assessing Rice Paddy Greenhouse Gas Emissions with ALOS PALSAR Products

Overview

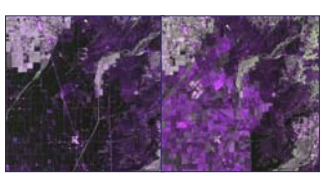
As part of JAXA's Kyoto and Carbon Initiative our team is developing decision support tools that utilize regional PALSAR acquisitions for monitoring rice agriculture and paddy hydroperiod to assess greenhouse gas emissions. Rice agriculture generates upwards of 25% of global methane emissions and the rice industry needs improved operational monitoring tools to systematically assess the role of rice paddy irrigation management on GHG emissions.

Project Objectives

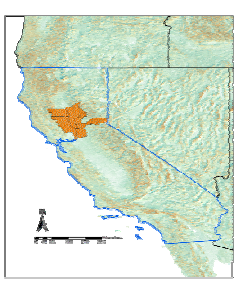
- Map rice paddy extent for California, USA using FBS/D
- Map paddy hydroperiod with ScanSAR & MODIS
- Develop regional estimates of methane and nitrous oxide emissions from rice agriculture using PALSAR derived rice products and DNDC biogeochemical modelling

Approach & Study Area

- Decision-tree, threshold models of fine-beam dynamic range and paddy flooding allow large-area rice mapping with little to no *a priori* data
- ScanSAR & 8-day MODIS used to monitor hydroperiod
- Important rice region in the northern Sacramento Valley, California, USA (centered ~121.825W, 39.20N).
- 95% of rice produced in California cultivated in this region and generates half a billion dollars annually
- Intensive irrigation and agricultural management



Study Area



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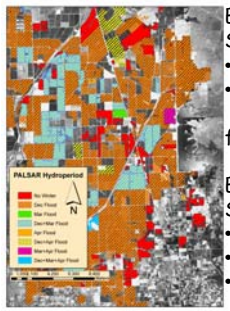
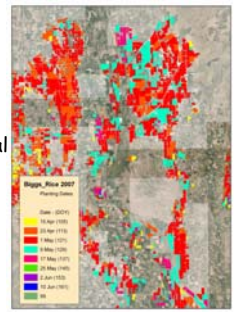
Product Examples



Example Product #1: ScanSAR hydroperiod
Sacramento Valley, CA, USA
- 74,292 hectares flooded in December
- 95% overall product accuracy
- 84-94% MODIS-ScanSAR agreement for flood

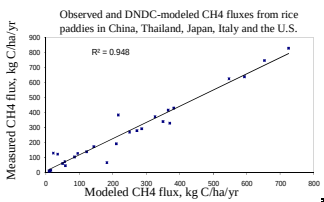
Example Product #2: Fine-beam rice map
Sacramento Valley, CA, USA
- hh:hv/12.5m dual pole rice map
- 96% accuracy for fine-beam rice map
- 155,000 hectares in cultivation in 2007

Example Product #3: Crop calendar
Sacramento Valley, CA, USA
- Planting dates keyed off hydroperiod products
- PALSAR & MODIS integrated for optical spatial and temporal resolution
- Flood status products found 70% of paddies were flooded during winter
- Identifies DOY within +/- four days
- Approach provides "ag-time" info

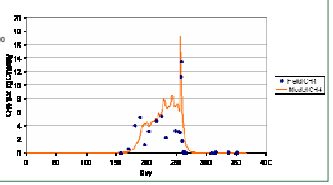


Emissions Modelling

- DNDC is a process-based, soil biogeochemical model that simulates biogeochemistry in agro-ecosystems.
- Use PALSAR products (maps of planting date and winter flooding time period) to parameterize and drive DNDC model.



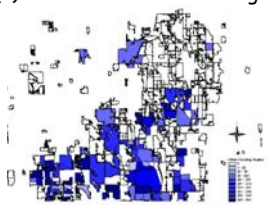
- DNDC has been validated across a wide range of rice paddy systems and performed well (see figure to the left)



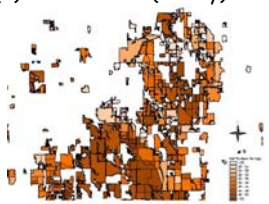
- Additional validation for California rice indicates DNDC is also performing well there (see figure to the right).

Modeling Results

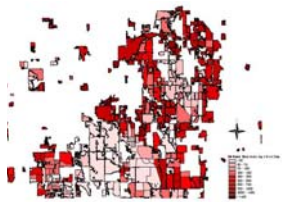
(a) PALSAR Winter Flooding



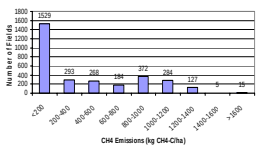
(b) Soil Texture (% Clay)



(c) Modeled CH4 Emissions



(d) Modeled CH4 Emissions



- Individual field level analysis has been compiled for the entire rice growing region:

(a) spatial variability in water management,
(b) soil texture (% Clay)
(c) DNDC modelled CH_4 fluxes
(d) Histogram of CH4 flux rates

- Spatial variability in CH4 fluxes due to soils (texture and organic matter) and flooding regime.
- Remote sensing, GIS soils and climate databases and process modelling system for regional, spatially explicit CH4 inventories.

Summary

- FBS/FBD derived rice map: 95% overall accuracy using field-based georeferenced ground truth data and photos.
- ScanSAR flood product: 95% accuracy with georeferenced field photos; ScanSAR – MODIS flood products 84-94% agreement.
- PALSAR can provide accurate and critical information on rice paddy production systems at field to regional scales.
- An operational mapping, monitoring and verification system for rice methane offsets has been developed.
- Integration in an carbon offset protocol underway.

APPLIED GEOSOLUTIONS, LLC