Mapping Land Cover and Land Use in Monsoon Asia through MODIS, PALSAR and Landsat imagery

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NASA Land-Cover and Land-Use Change Program

JAXA Japan Aerospace Exploration Agency

National Institutes of Health

United States Department of Agriculture

NRCS Natural Resources Conservation Service

K&C Initiative
More than half of the world’s population (7 billions in 2011) live in monsoon Asia.
Community Remote Sensing

To engage citizens & socialize pixels

GPS-camera

Geo-tagged field photos

GT points

GPS Tracks
Support of the Geo-Photo Library to the LCLUC community and citizens

1. Algorithm development

2. Data product validation

A collaboration between EOMF and the IIASA Geo-Wiki project

IIASA Global Land Cover Data Production validation initiative

Cloud-sourcing to label and classify geo-referenced field photos

10546 photos in public at EOMF (available to the community)
Land cover mapping from multi-sensor imagery at multiple resolutions

1. MODIS time series data for cropland and forests (500-m, 250-m)

2. PALSAR multiple temporal ScanSAR data for paddy rice agriculture (100-m)

3. PALSAR 50-m mosaic data for cropland and forests (50-m)

4. Landsat, PALSAR and MODIS data for cropland and forest (30-m)

- National land cover dataset
- Fused PALSAR/Optical data
- Automated algorithms
- Support ongoing projects
  - MAIRS
  - Disease ecology
  - Global Irrigation Maps
  - GHG assessments
Land cover and land use change: MODIS time series imagery data

MODIS 8-day composites of surface reflectance product (MOD09A1)

Automated algorithm

Vegetation indices
  NDVI
  EVI
  LSWI

Temporal profile analysis

MODIS land surface reflectance

MOD09A1 data product
  8-day composite
  500-m spatial resolution

Vegetation indices
  NDSI

Snow mask

Cloud mask

Permanent water mask

Evergreen vegetation mask

Temporal profile analysis of individual pixels

Cropping index ( # of crops per year)

Crop calendar (planting & harvesting dates)

Inundation and paddy rice
Cropland dynamics and maps: from MODIS

Cropping index map in 2004
MODIS-based map of cropland and evergreen forest in monsoon Asia in 2004
PALSAR ScanSAR image acquisition in JAXA/ALOS K&C Initiative

ALOS PALSAR K&C Image over eastern Asia (China)
November 11, 2007, ORT, Cycle 15, Path 103; S-N Extent: 16 to 53 N
Regional / Local & Large area / Continental Mapping

- Complications from Landsat phenology and Alos viewing geometry for large areas
- Strategically fusing Landsat and PALSAR at multiple scales
- We use regional local scale analysis to scale up to Monsoon Asia. We have focused on five local scales in China, India, Indonesia, Japan, Thailand
Two mapping approaches for integrating PALSAR and optical imagery

- **Operational rice monitoring**
  - Using sigma nought/gamma threshold approach
  - Optical data used as masks/phenology descriptors

- Uses multitemporal JAXA ALOS PALSAR K&C Strips (~75m; HH mode)

- Products include:
  - Rice paddy extent
  - Hydropeiod
  - Cropping Intensity
  - Crop calendar

- **Decision Tree LULC maps**

- LCCS hierarchical framework using CART algorithm
  - Ranging scales from fine-beam to continental
  - FBS/D/Q @ ~12-15m spatial resolution
  - PALSAR Mosaics (HH:HV) twice a year @ 50m res
  - Integrate Landsat GLS2005 mosaics with PALSAR @ variety of scales
  - K&C Strips & MODIS used for phenology/attributes
Rice field from multi-temporal PALSAR ScanSAR -- to distinguish rice paddy attributes (4-7 obs / rsp @ 42 day cycles + 45% overlap)

- HH, RSP91-103, ~75m for SE China with Poyang Lake area highlights
Land cover from PALSAR ScanSAR and MODIS imagery
• Integrated Landsat & multi-temporal (FBS) PALSAR ScanSAR products
• CART algorithm; 90% overall accuracy for Level 1
• Open scrub (drier) vs. closed scrub (higher biomass) most confused
• Now integrating climate & DEM to improve descriptors
• Multi-temporal ScanSAR showed 2 crop intensity dominated region
Land cover from PALSAR 50m mosaic and Landsat imagery

2008 PALSAR FBD 50m Orthorectified Mosaics

GLS-2005 Landsat TOA 30m Mosaic in Java, Indonesia

Rice (yellow)
Urban (red)
Vegetation (green)

Integrated CART LULC Classification (8 land cover classes: rice, crop/veg mosaic, water, aquaculture, forest, open scrub/shrub, closed canopy shrub/low-biomass woodland/forest)
Traditionally, free-grazing duck system is closely coupled with multiple paddy rice cultivation, which provides foods and water year-around for ducks. The paddy rice – duck system dominate much of Southeast Asia countries.
Relative risk of an Emerging Infectious Disease (EID) event caused by zoonotic pathogens from wildlife; ~60-76% of recent EID affecting human were zoonoses. 
Jones et al., 2008, Nature

Land cover and land use change (transformation and intensification)
Thank you
and
Welcome to visit Oklahoma, USA