

# LCLUC and its Effects on Carbon & Nitrogen Dynamics in Monsoon Asia Region

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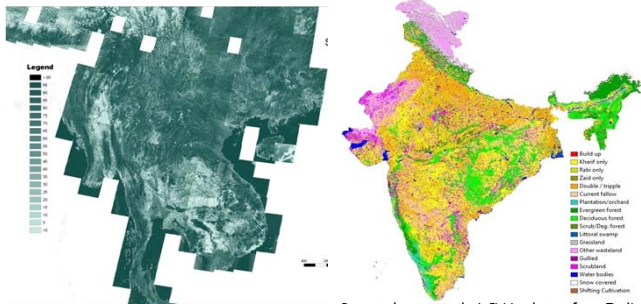
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## Objectives

Use data-modeling framework to pursue three principal objectives:

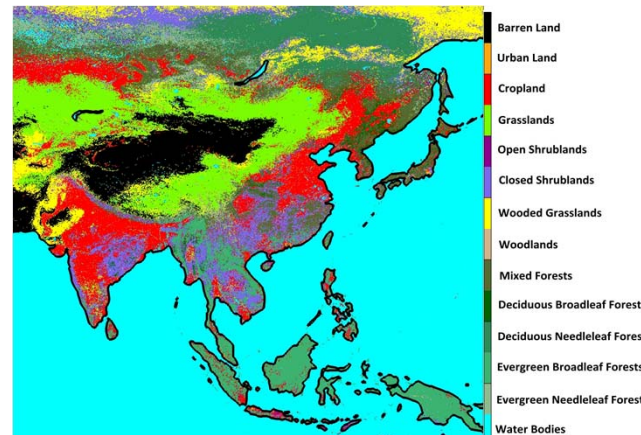
- Improve our understanding of the historical effects of land cover and land use change (LCLUC) dynamics on the quantities and pathways of biogeochemical carbon and nitrogen fluxes
  - achieve by linking the satellite-based historical rates of LCLUCs with the biophysical model
- Project future LCLUC in the study region in the next 50 years
  - achieve by linking the biophysical and socio-economic models
- Quantify the impacts of current and future LCLUC on carbon and nitrogen dynamics in the study region
  - achieve by applying an improved version of the biophysical model

## Satellite-Based LCLUC Data



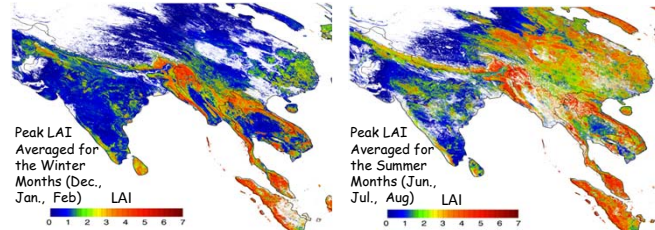
Remotely sensed forest fraction data for South East Asia at 30 m resolution (2005) based on Indian satellite IRS-P6 (AWIFS)

Remotely sensed LCLU data for India region at 56 m resolution (2004-2005) based on Indian satellite IRS-P6 (AWIFS) (Courtesy: P.S. Roy, ISRO).



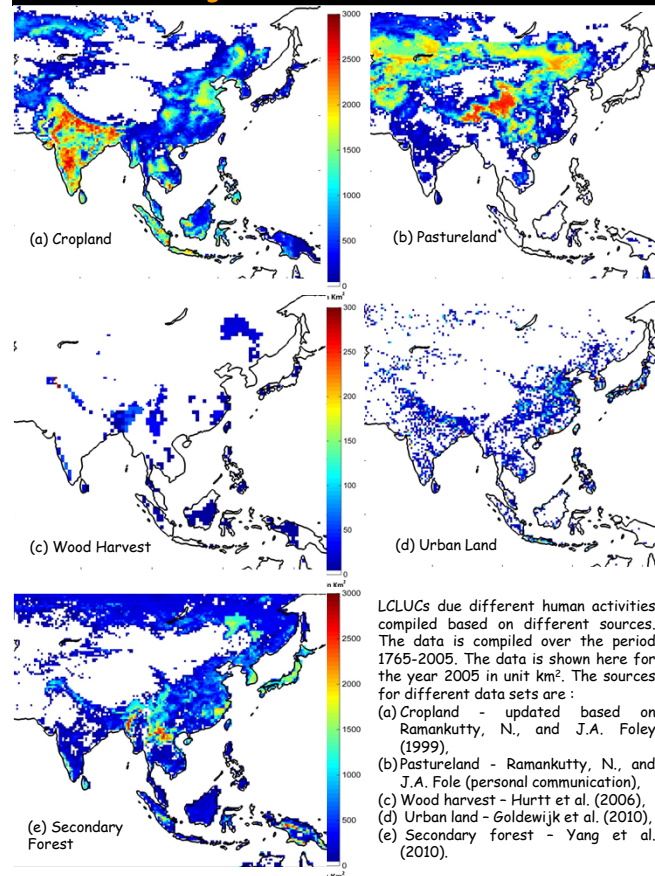
MODIS LCLU data resampled at 250 meter resolution for the year 2005. The land classifications are based on University of Maryland scheme.

## Satellite-Based LAI Data



Monthly climatological (2003-2008) LAI values for monsoon Asia region are estimated using a radiative transfer model. The input to the model are 250 m MODIS surface reflectance data, 250 m MODIS resampled LC data. All the data and modeling simulations are performed using the TOPS modeling framework on NASA's Earth Exchange (NEX) platform.

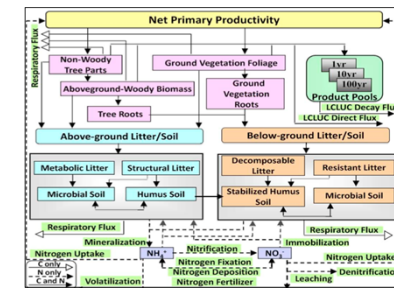
## Land Use Change Due to Different Human Activities



LCLUCs due different human activities compiled based on different sources. The data is compiled over the period 1765-2005. The data is shown here for the year 2005 in unit km<sup>2</sup>. The sources for different data sets are: (a) Cropland - updated based on Ramankutty, N., and J.A. Foley (1999), (b) Pastureland - Ramankutty, N., and J.A. Fole (personal communication), (c) Wood harvest - Hurtt et al. (2006), (d) Urban land - Goldewijk et al. (2010), (e) Secondary forest - Yang et al. (2010).

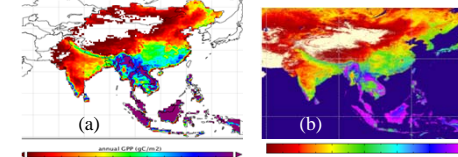
## ISAM Land Surface Model and Results

### ISAM Land Surface Model



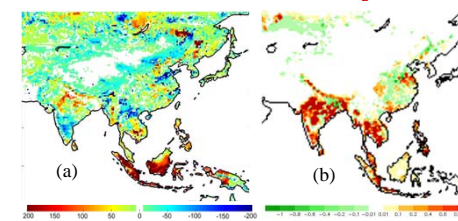
- Calculate fluxes of carbon, nitrogen, energy, water, and the dynamical processes that alter these fluxes
  - 21 Biome types
  - 0.5 x 0.5 degree resolution
  - 30 minutes temporal scale
  - Season-to-interannual variability (penology)
- References:  
Jain and Yang (2005, GBC)  
Jain et al. (2005, GRL)  
Jain et al. (2006, JGR)  
Jain et al. (2009, GBC)  
Yang et al (2009, GBC)  
Yang et al. (2010, Biogeoscience)

### ISAM Model Estimated GPP vs. MODIS Data



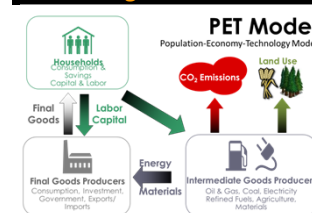
Comparison of (a) ISAM estimated annual GPP averaged for the time period 2000-2006 with (b) MODIS GPP. MODIS GPP figure (b) is directly downloaded from the MODIS data website

### ISAM Model Estimated C & N<sub>2</sub>O Emissions due to LCLUC



ISAM estimated (a) C emissions (Unit: gC/m<sup>2</sup>/yr), (b) N<sub>2</sub>O emissions (Unit: kg N/ha/yr) from LCLUCs in the 2005. Positive values represent net C/N release to the atmosphere and negative values represent net C/N storage in the terrestrial biosphere

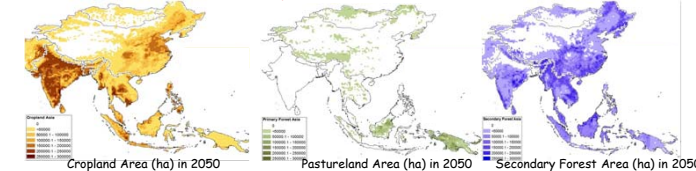
## Linking Socio-Economic and Biophysical Systems



### PET Model IPCC A2 LU Scenario Development:

- Computable General Equilibrium model
- 9 world regions
- 5 economic sectors
- Input
  - A2 ; and use input assumptions - IIASA
  - Economic & land data - GTAP
  - Energy data - IEA

### PET-ISAM IPCC A2 Scenario Results



## Acknowledgements

