

## NASA's Land-Cover/Land Use Change Program

- **Status of the LCLUC program**
  - **Introduction**
  - **LCLUC ST Team**
  - **Internal, Interagency and International Links**
  - **Activities and reporting**
  - **Data and Landsat issues**
  - **Major regional projects**
  - **LCLUC-related projects and NRA's**



# NASA Land Cover and Land Use Change



- LCLUC is an interdisciplinary scientific theme within NASA's Earth Science Program of the Science Mission Directorate (SMD).

The ultimate vision of this program is to:

- *develop the capability to perform repeated global inventories of land-use and land-cover from space, to develop the scientific understanding and models necessary to simulate the processes taking place, and evaluate the consequences of observed and predicted changes.*
  - **further our understanding of the consequences of land-use and land-cover changes on environmental goods and services, the carbon and water cycles and providing the science underpinning for improved management of natural resources**
  - **improve understanding of human interaction with the environment, and thus provide a scientific foundation for sustainability, vulnerability and resilience of land systems and their use.**
- <http://lcluc.hq.nasa.gov/>



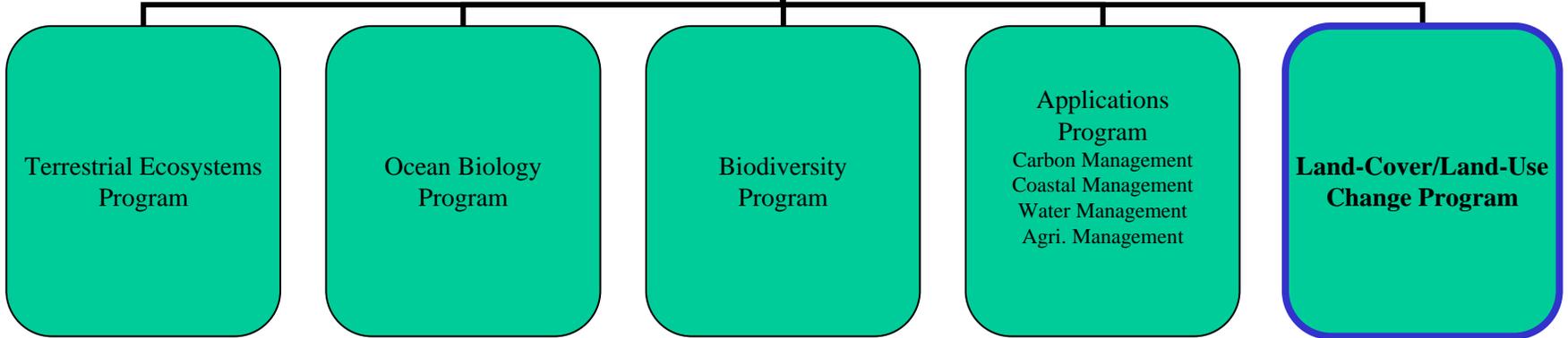
# NASA LCLUC Program - Building Blocks

<ul style="list-style-type: none"><li>• <b>Forcing Factors (Processes)</b><ul style="list-style-type: none"><li>– <b>Climate and Ecological Drivers</b></li><li>– <b>Socioeconomic Drivers</b></li></ul></li></ul>	<ul style="list-style-type: none"><li>• <b>Technique Development</b><ul style="list-style-type: none"><li>– <b>Remote Sensing R and D</b></li><li>– <b>In-situ data collection - surveys / validation / process studies</b></li><li>– <b>Data Management</b></li></ul></li></ul>
<ul style="list-style-type: none"><li>• <b>Responses and Consequences</b><ul style="list-style-type: none"><li>– <b>Land cover conversion, abandonment</b></li><li>– <b>Land use intensification</b></li><li>– <b>Land degradation</b></li><li>– <b>Landscape fragmentation</b></li></ul></li></ul>	<ul style="list-style-type: none"><li>• <b>Satellite Observations</b><ul style="list-style-type: none"><li>– <b>Long -term measurements</b><ul style="list-style-type: none"><li>• Landsat series L7&gt;LDCM</li><li>• AVHRR.&gt;MODIS&gt;NPP (VIIRS)</li></ul></li><li>– <b>Experimental missions</b><ul style="list-style-type: none"><li>• EO-1 - hyperspectral</li></ul></li><li>– <b>Commercial Data Buy</b><ul style="list-style-type: none"><li>• Ikonos - hyperspatial</li><li>• Geocorrected Global Landsat Database</li></ul></li></ul></li></ul>
<ul style="list-style-type: none"><li>• <b>Modeling and Implications</b><ul style="list-style-type: none"><li>– <b>LCLUC modeling &amp; projections</b></li><li>– <b>Coupled modeling of LCLUC with biogeochemical and water cycles</b></li><li>– <b>Modeling land-atmosphere interactions</b></li><li>– <b>Climate impacts on land use</b></li></ul></li></ul>	

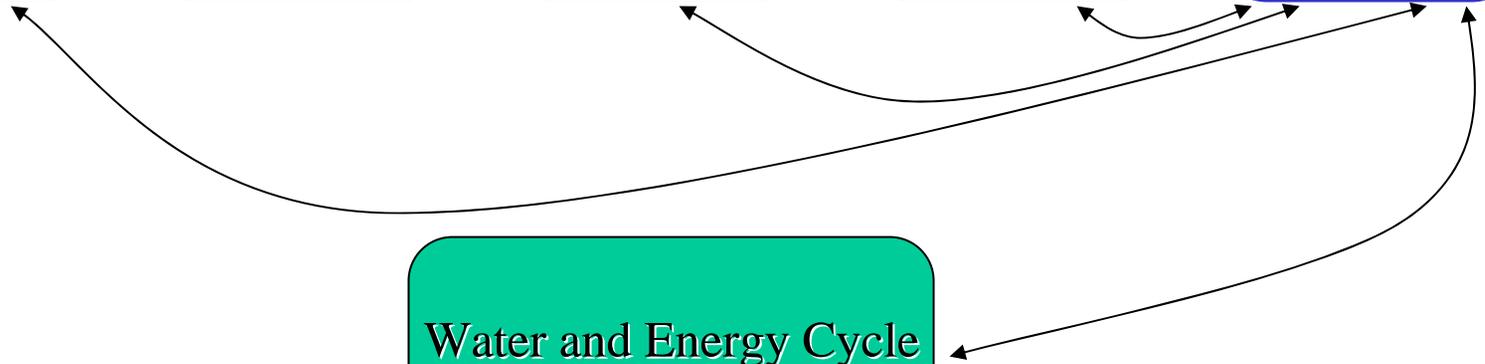


# Internal NASA Programmatic Linkages

Carbon Cycle  
and Ecosystems  
Focus Research  
Area



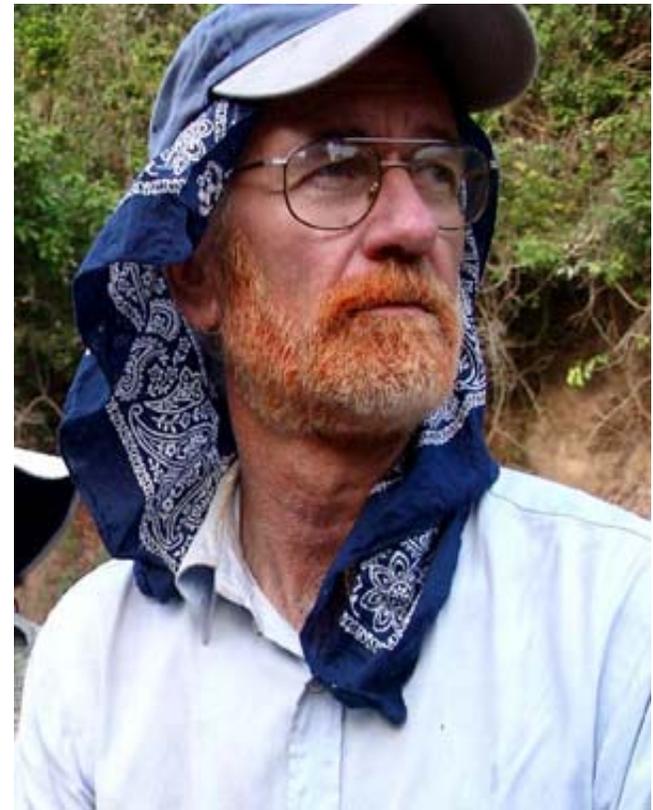
Water and Energy Cycle  
Focus Research Area



# Interagency Activities

## US Climate Change Science Program (CCSP)

- Focus on short-term deliverables
- Providing decision-making/management resources
- Land-Use/Land-Cover Change element (LULCC)
  - LULCC interagency working group (LUIWG) (consisting of representatives from Federal Agencies)
  - **Compton J. Tucker (NASA) & Nancy Cavallaro (USDA)**
  - The high-priority item: high-resolution data to science community
  - Land-use modeling review (National Academy of Sciences)
  - LCLUC-Carbon workshop
  - LCLUC-Water Science workshop



**Compton J. Tucker (NASA)**

# LULCC Interagency Working Group (LUIWG) and LULCC Steering Group (LSG)

- **Purpose of LUIWG**
  - **Interagency coordination**
  - **Securing resources**
  - **Joint solicitations**
- **LUIWG activities**
  - **Monthly housekeeping meetings**
  - **LULCC representation at CCSP meetings**
  - **Inventory of projects by agencies**
  - **Preparation of Implementation Plans**
  - **Preparation of workshops**
  - **Linkages to other CCSP elements**
- **LULCC Steering Group (LSG) had its second meeting in March 2007**
  - **The purpose of the Steering Group is to provide broad-based science and application input to the LUIWG in developing the research program**



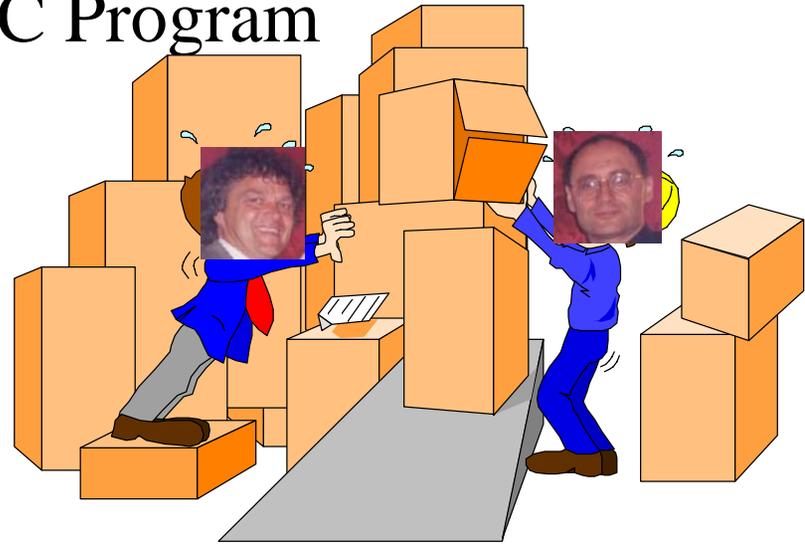
# External International Linkages

- GTOS/Global Observations of Forest Cover and Land-cover Dynamics (GOFC-GOLD)
- IGBP-IHDP/Global Land Project (GLP)
- Northern Eurasia Earth Science Partnership Initiative (NEESPI)
- Monsoon Asia Integrated Regional Study (MAIRS)

# Assembling the LCLUC Team

Science Team consists of LCLUC research funded through various elements in NASA programs but administered under LCLUC Program

- LCLUC Program
- EOS Program
- IDS Program
- Carbon Cycle Program



# LCLUC Program Make-up



- Total ~60 projects
  - LCLUC/Carbon Cycle
  - LCLUC/Water Cycle
  - LCLUC/Climate, Environment, Biodiversity
  - LCLUC Monitoring/Modeling

# LCLUC Science Team Meetings

Washington, DC

March/April

2007: Climate/Carbon

2008: Joint CC&E Focus  
Area meeting

International

September/October

2007: Drylands (NEESPI)

Urumqi, China

2008: TBD (MAIRS)

TBD



# Science Team Meetings

- program status
- feedback from the PI's
- reporting, exchanging ideas
- identifying programmatic gaps, discussing new directions
- New format: less oral talks (mostly joint topical reviews), more discussions
- International: enhancing linkages with international programs and regional networks

# Activities

- Outreach: brochure, web site, PR, acknowledgments, videos, GLP
- Science: books, peer-reviewed publications, special issues, presentations at workshops, conferences, and symposia sessions
- Education

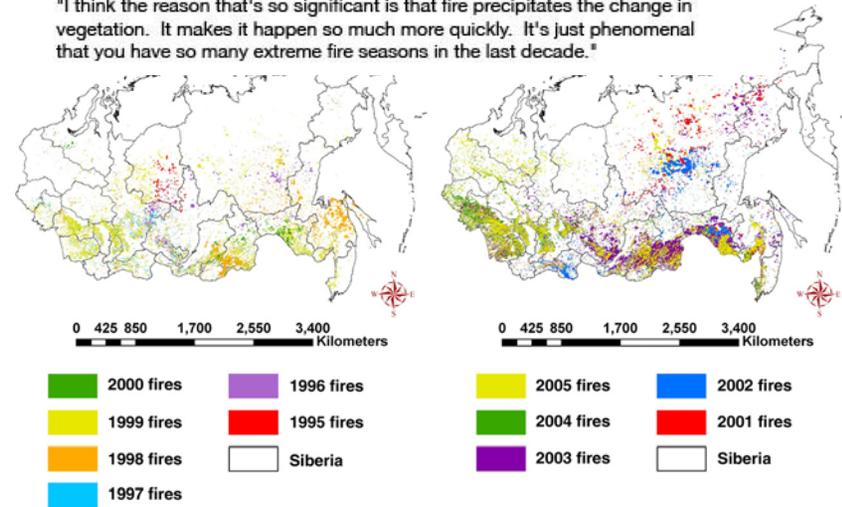
# A PR Example:

## Experts Say: North Forests Affected by Warming

- Earth's warming climate is noticeably changing the forests of the far north - according to Amber Soja, a research scientist with the National Institute of Aerospace. Soja is part of an international team that went to the forests of Alaska, Siberia, and Canada. They were looking for evidence of climate-driven change. What Soja found surprised her.
- *Amber Soja:* I think that what's significant is that it's happening so fast. I don't think that anyone predicted that we would see clear indications of change this early, as large as they are. And examples of that are the white spruce die-back that's happening in Alaska. That was predicted by some models that were run in the 1980s. And now it's happening.
- Amber Soja of the National Institute of Aerospace was interviewed for NPR's Earth and Sky program.



"Fires increased, both in terms of area burned and the number of severe fire seasons," said research scientist Amber Soja of the National Institute of Aerospace. "That's happening in Alaska, Canada, and Siberia." Soja added, "I think the reason that's so significant is that fire precipitates the change in vegetation. It makes it happen so much more quickly. It's just phenomenal that you have so many extreme fire seasons in the last decade."



# Reporting



- The Web site: <http://lcluc.hq.nasa.gov>
  - Project Abstracts
  - Progress reports
  - Presentations
  - **Project update: 1 slide (bullets + visual)**
  - **Posters as ppt presentations!**
  - Lists of publications and references
  - Project metadata and data set links
- Sensitive info - to me by separate e-mail
- Submit these materials to Kelly on an ongoing basis to ensure accurate reflection of all the great work you are doing
- PI's are encouraged to host their own websites to showcase their results in more detail and to make their data sets available- provide links.
- Announcements, events, job ops, news
- Forthcoming meetings
- Outreach (discoveries, journal covers, LCLUCers in the news, etc.)

LCLUC Web Page - Microsoft Internet Explorer

File Edit View Favorites Tools Help

## LCLUC NASA's Land Cover Land Use Change Program

Home Introduction Strategy Implementation Products Resources Search

LCLUC is an interdisciplinary scientific theme within NASA's Earth Science Enterprise (ESE).

**LCLUC Goals:**

- To develop the capability to perform repeated global inventories of land-use and land-cover from space,
- To develop the scientific understanding and models necessary to simulate the processes taking place
- Evaluate the consequences of observed and predicted changes
- Further the understanding of the consequences of land-use and land-cover changes on environmental goods and services, the carbon and water cycles and the management of natural resources
- To improve understanding of human interaction with the environment, and thus provide a scientific foundation for sustainability, vulnerability and resilience of land systems and their use.

**LCLUC Key Science Questions:**

- Where are land cover and land use changing, what is the extent and over what time scale?
- What are the causes and what are the consequences of LCLUC?
- What are the projected changes of LCLUC and their potential impacts?
- What are the impacts of climate variability and changes on LCLUC and what is the potential feedback?

**LCLUC Announcements and Events**

- **New Publication**  
 *Global and Regional Vegetation Fire Monitoring from Space: Planning a Coordinated International Effort*  
For details, click [here](#).
- **ALL LCLUC Announcements**
- **LCLUC ST Tropical and Subtropical Workshop Draft Agenda**  
11/19/2001 - 11/21/2001 College Park, MD  
Download Agenda as [PDF](#) OR [MS Word](#) Format  
Download Logistics as [PDF](#) OR [MS Word](#) Format
- **LCLUC ST Temperate and Boreal Workshop Draft Agenda**  
10/29/2001 - 10/31/2001 College Park, MD  
Download Agenda as [PDF](#) OR [MS Word](#) Format  
Download Logistics as [PDF](#) OR [MS Word](#) Format
- **ALL LCLUC Events**

**LCLUC Related Announcements and Events**

- **Related Announcements:**
  - **Call for papers**  
For International Symposium: LUCC Contribution to Asian Environmental Problems (12/2001, Tokyo). Details at <http://shiba.iis.u-tokyo.ac.jp/LUCC/symp>.
  - **ALL LCLUC Related Announcements**
- **Related Events:**
  - **3rd International Symposium: Remote Sensing of Urban Areas**  
6/11/2002 - 6/13/2002 Istanbul, Turkey
  - **ALL LCLUC Related Events**

**Job Announcements**

Browse Job Opportunities

**Contact Information**

- Project Management
- Principal Investigators

**Products and Data**

- Project Abstracts
- Annual Progress Reports
- Significant Project Results
- Data Access
- Strategy and Planning Documents

**References and Resources**

- Resources
- Funding
- Related Sites
- Transparent World Initiative Document Description in PDF Format
- LCLUC NRA 2000 [Selectees](#)

**Proposal Review**

Join our team of proposal reviewers

# Title: Example of 1-pager:

The team (PI, affiliation, contact), CO-I's, affiliations  
Non-US Collaborators (with affiliations)

- Project's goals
  - Short description of the objectives
- Geographic area
  - Region of the globe or global
- Data
  - Data sources
- Methods
  - A reference to methodology described somewhere else
- Results
  - Updated results
- Next steps
  - Perspective for the coming year
- Reference to the web site with detailed information, list of publications, etc.



**Figure caption:**  
**Secret Agent 008 - Tishka**

# RELATIONSHIP BETWEEN LCLUC AND SURFACE HYDROLOGY OVER SEMIARID REGIONS

PI: Xubin Zeng (Univ of Arizona)

Goals: Combine NASA data and models to better understand LCLUC and surface hydrology over arid and semiarid regions

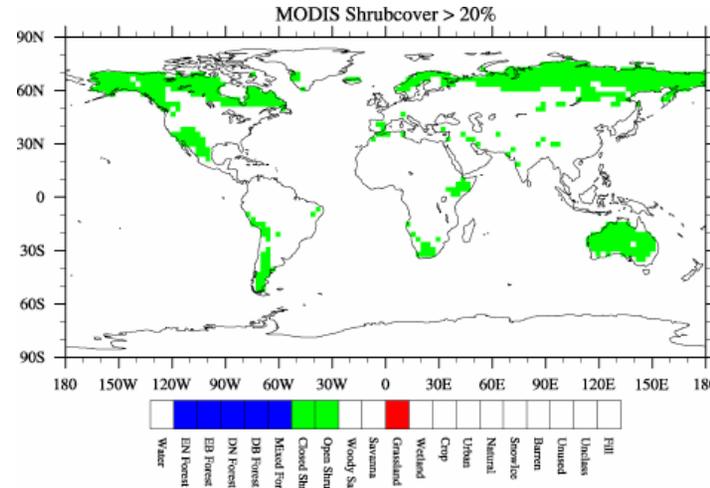
Geographic areas: Global arid and semiarid regions

Data: MODIS, AVHRR, Landsat

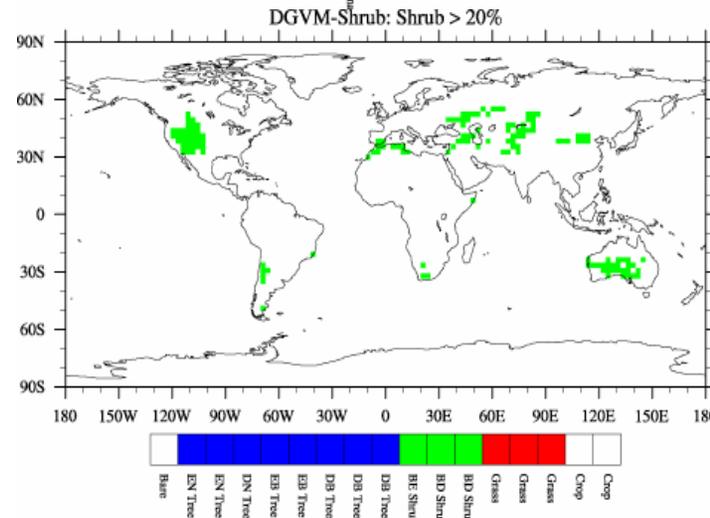
Methods: Model-data integration

Collaborators: Chinese CAS/IAP, Lanzhou University

Results: Grow shrubs in DGVM; model bifurcation and spatial patterns in semiarid regions



MODIS boreal and temperate shrubs



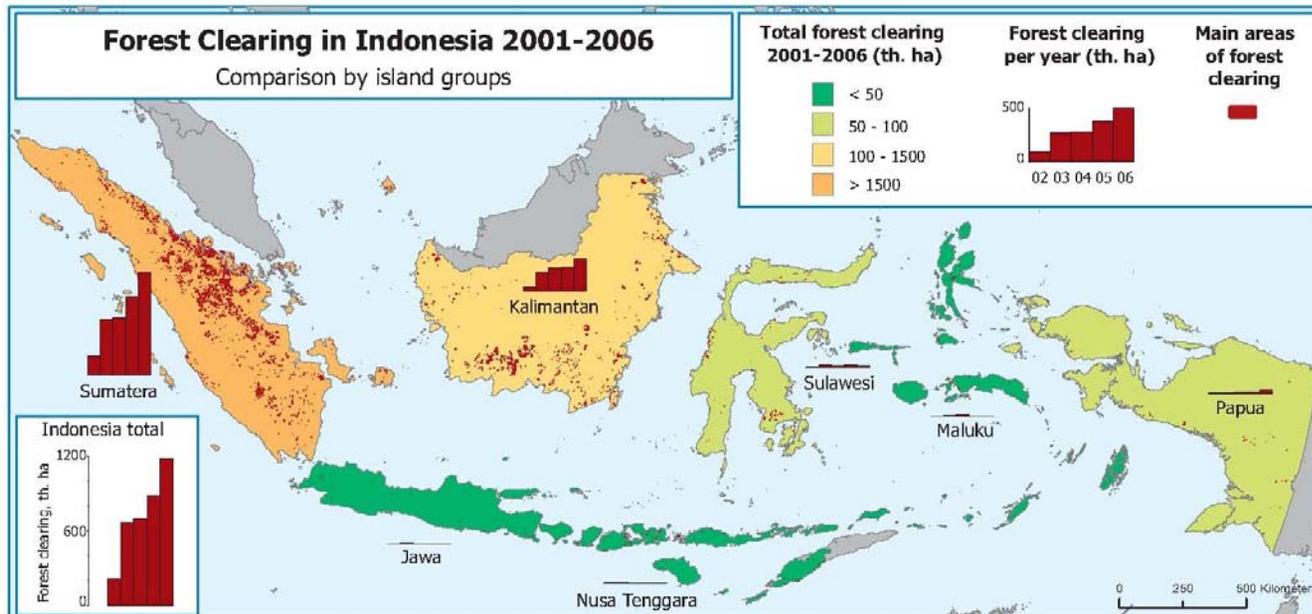
New DGVM temperate shrubs

Note: Original NCAR DGVM does NOT grow shrubs

# Establishing a global forest monitoring capability using multi-resolution and multi-temporal remotely sensed data sets

Matthew Hansen – South Dakota State University, Steve Stehman – SUNY-ESF, Tom Loveland – USGS/EROS,  
Jim Vogelmann – USGS/EROS, Mark Cochrane – South Dakota State University

- Project's goals - Quantify rates and describe patterns of global forest cover change at the biome level
- Geographic area - Global per 5 biomes
- Data - MODIS 2000 to present, Landsat samples from March ~2000 and ~2005
- Methods – Generate 500m MODIS change indicator maps to stratify the land surface into regions of varying change likelihood. A probability-based sampling design is then employed using Landsat imagery to estimate change area
- Results – 1) Prototyped method for Indonesia to product country-wide forest cover loss estimates from 2000 to 2005, 2) Initial humid tropics change results obtained, 3) MODIS change indicator maps created for boreal biome
- Next steps – 1) Refine sampling procedure, 2) implement 250m MODIS change indicator product, 3) Complete humid tropical, boreal and dry tropical biomes
- Two papers in development on establishing rates of forest cover loss in the humid tropical and boreal biomes



# LCLUC Education

- Each PI should provide
  - information on MS and Ph.D. students graduating during and after the project
  - Thesis title, dates
- Statistics on LCLUC educational “products” will be collected
- Students achievements (awards, discoveries)
- All this info together with recent selections from NASA Student Fellowship solicitation will be listed on the LCLUC web site
- GLOBE progress

# LCLUC and Data Issues

- *NASA promotes the free and open sharing of data*
- **LCLUC expects its PI's to make their data and products available to the broader community**
- Data systems and services are currently one of the biggest challenges to earth observation systems
- LCLUCers use established Land Cover data distribution centers
  - GLCF
  - TRFC
- Data sharing is encouraged, some available through the Land Cover Project Office at GSFC
- Metadata page on the LCLUC web site - coming soon to theaters near you

# Landsat Brief Update

- Developing the capability for periodic inventories of land cover from space is critical to the LCLUC Program objectives
- Landsat-7 data are only partially useful - there are gaps. Analysis shows that composites of cloud-free image pairs produce about 60% global coverage. Additionally, mechanical problems may affect satellite longevity.
- Landsat-5 is old and will be out of fuel in 2 years
- A dataset based on L-5 and -7 data is being developed
- The next Landsat (LDCM) ~ 2011-2012
- Landsat Data Gap Study Team considers other sources of Landsat-like observations to mitigate the potential data gap during Landsat-less period in about 2-3 years.

# Mid-Decadal Global Land Survey

- Develop a global orthorectified dataset from Landsat or Landsat-like observations based on measurements during 2004-2006
- Use Landsat-7 composites as primary source, Landsat-5 ground stations data to complement, ASTER to fill the remaining gaps, EO-1/ALI over islands
- *Probably* no need to fill the gaps with foreign data
- USGS leads Phase I – data compilation (completed)
- NASA leads Phase II – data processing at USGS (started)
- Phase III – development of LCLUC products
  - Workshop in February in Annapolis
  - ROSES-2007 LCLUC solicitation

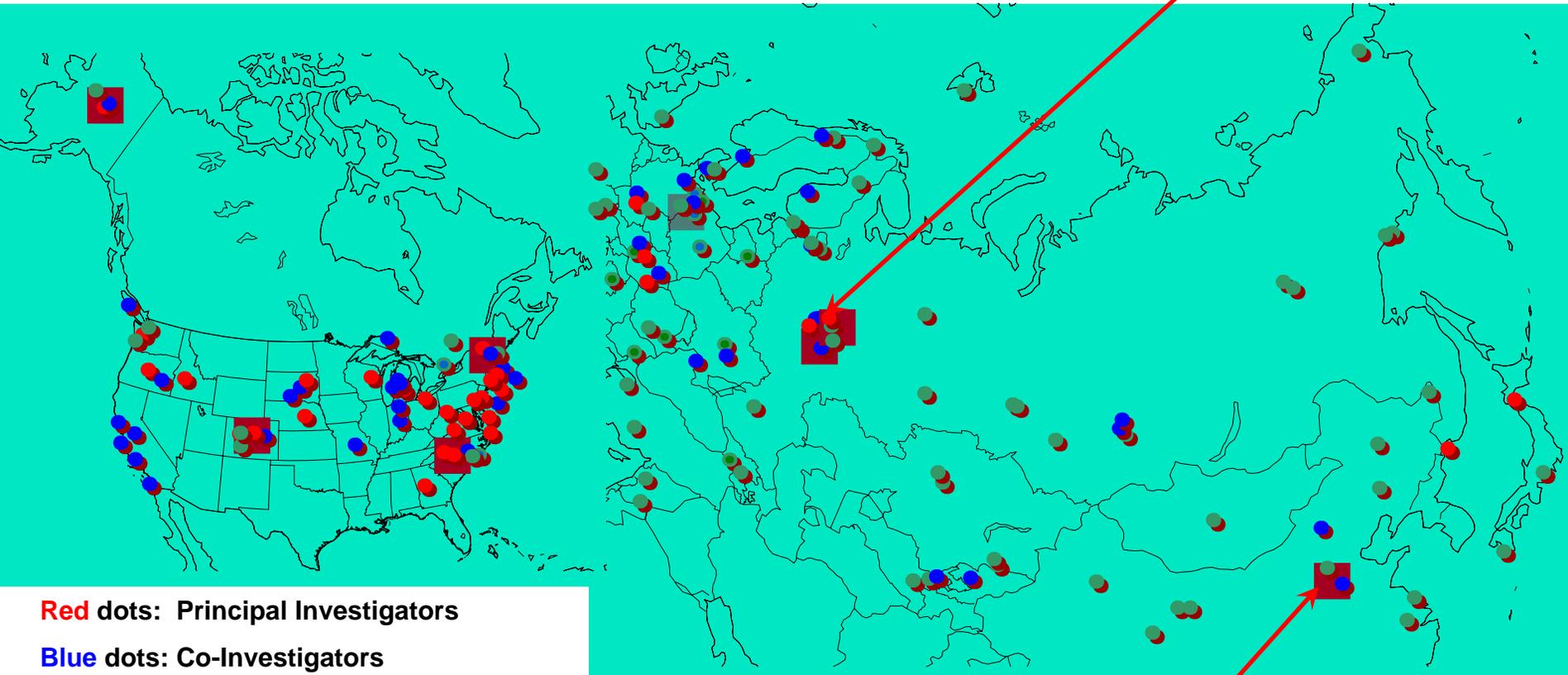
# Major Regional Initiatives With LCLUC Elements

- NACP: North American Carbon Project
- LBA: Field Campaign in Amazon – Phase 3  
(synthesis and data analysis)
- CARPE: Central African Regional Project on the  
Environment in Congo Basin (with US AID)
- NEESPI: Northern Eurasia Earth Science  
Partnership Initiative (with NOAA, EU, RAS,  
CAS, and other organizations)
- MAIRS: Monsoon Asia Integrated Regional Study



# NEESPI Participation

18 institutions in Moscow participate in 21 projects



**Red dots:** Principal Investigators

**Blue dots:** Co-Investigators

**Green dots:** Collaborators

**Squares:** Focus Research Centers and  
Science Data Support Centers

6 institutions in Beijing participate in 5 projects



NEESPI-MAIRS Overlap

# Monsoon Asia Integrated Regional Study (MAIRS)



- South, Southeast and East Asia
  - major features of landscape, such as vegetation, soil and water system developed in a monsoon climate,
  - monsoon rainfall is the main water resource of the region
  - disasters, such as the floods, drought and heat waves often bring about great damage to the region.
  - the most active human development with a history of more than 5000 years civilization.
  - highest population density of the world
  - the most rapid development in last decades and is expected to continue rapid development in the incoming century.
  - human activities of the monsoon Asia region have and will have significant impacts on the environmental conditions, not only regionally but also globally

# MAIRS Vision and Objectives

- Vision
  - To significantly advance understanding of the interactions between the human and natural components of the overall environment in the monsoon Asia region and implication of global earth system, in order to support the strategies for sustainable development
- Objectives
  - To better understand how human activities in regions are interacting with and altering natural regional variability of the atmospheric, terrestrial, and marine components of the environment
  - To contribute to the provision of a sound scientific basis for sustainable regional development
  - To develop a predictive capability of estimating changes in global-regional linkages in the Earth System and to recognize on a sound scientific basis the future consequences of such changes

# Monsoon Asia LCLUC Projects

- **South East Asia:**
  - **Darla Munroe, Ohio State University: LCLUC and Regional Aerosol Composition and Concentration in SE Asia**
- **Jeff Fox, University of Hawaii**
  - **LCLUC in Montane Mainland SE Asia and Hydrological Processes under Changing Climate**
- **Lisa Curran, Yale University**
  - **Effects of Logging, Plantation Conversion, Biomass Burning and Regrowth on Carbon Dynamics in Borneo**
- **Ruth DeFries, University of Maryland**
  - **Carbon emissions from land use-related fires with MODIS data**
- **China:**
  - **Dan Brown, University of Michigan: Changing Responses of Land Dynamics and Vulnerability to Flooding Under Policy and Environmental Change near Poyang Lake, China**
  - **Juaguo Qi, Michigan State University: LCLUC Dynamics of China**

On my trip to China in September I will stop by MAIRS office and hope to establish stronger links with LCLUC program

# Ongoing Projects and Research Announcements

- **IDS, EOS, ACCESS new rounds**
- **Carbon Cycle/LCLUC projects in their 3<sup>d</sup> year**
- **Water Cycle and LBA projects in their 2<sup>nd</sup> year**
- **LCLUC projects (ROSES-2005) in their 2<sup>nd</sup> year**
- **ROSES-2007:**
  - **LCLUC – 2-step reviewing**
    - June 11 and Oct 1 for two steps<sup>2</sup>; two components:
      - “Land change projections”
      - “Landsat”
  - **Carbon Cycle**
- **ROSES-2008: additional LCLUC call**

# Forthcoming Events

- Next Fall LCLUC ST meeting: LCLUC-Monitoring and Modeling in Drylands
- Next Spring LCLUC ST meeting: Joint Carbon Cycle and Ecosystems. Will include a side LCLUC meeting (focus on IPY)
- An ISPRS-sponsored remote sensing meeting on applications in Moscow, December 4-6 hosted by ScanEx. I need a few brave people for a session, which I am organizing. For more info see: <http://www.transparentworld.ru/conference>  
Brochures are available.

# Personal Notes

- Fewer surprises – keep me informed
- I appreciate advance knowledge on any submission, request, etc.
- Calling me is OK but is less efficient than e-mails
- Communication preference: e-mail

**I DO READ THEM!**



"Didn't you get my e-mail?"



谢谢

спасибо

Thank you!