

Evolution and Future Directions for the NASA LCLUC Program

Advancing Land Use Change Science and Understanding through the use of NASA Satellite Assets

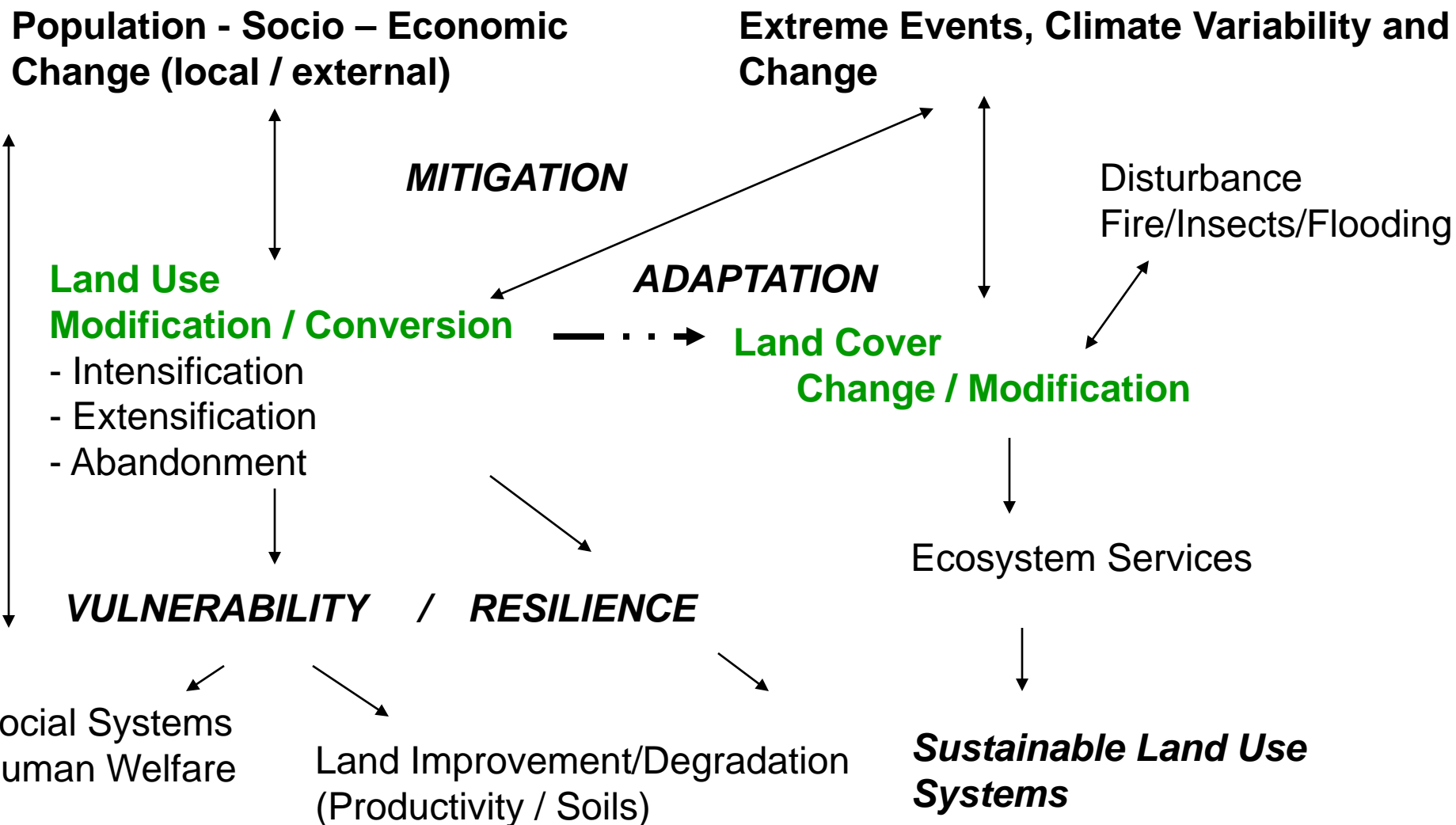
- Local Changes of Regional to Global Scale Significance
- Land Use Requires Combining Physical and Social Science
 - Land Use is implicitly of 'societal relevance'

Land Cover and Land Use Change and Global Change

- **LCLUC is the most immediate and visible form of environmental change**
- **LCLUC will continue to be important, driven by world population growth and socio economic forces (changing demographics and patterns of consumption), the increased demand for land and the increasing need for food and water supply and wood products**
- **Land Use is closely linked to livelihoods and social and economic well being**
- **Science Issues**
 - **LCLUC plays an important role in the global carbon and water cycles**
 - **LCLUC contributes to climate change e.g. source of greenhouse gases and aerosols**
 - **Land Use is a means for climate change mitigation (e.g. REDD)**
 - **LC and LU are being impacted by climate change - effects of extreme events, interannual, decadal and centennial climate variability.**
 - **Land Use systems are starting to adapt autonomously to climate change**
 - **Planned land use adaptation will be needed**
 - **How to establish sustainable Land Use Systems under multiple stressors**
- **We are developing the underpinning science of LCLUC, understanding the processes, the impacts of LCLUC and predicting LCLUC**

LCLUC Science

Developing conceptual frameworks for LCLUC Research



LCLUC Program Evolution

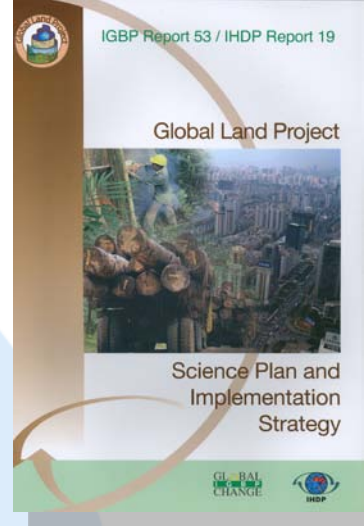
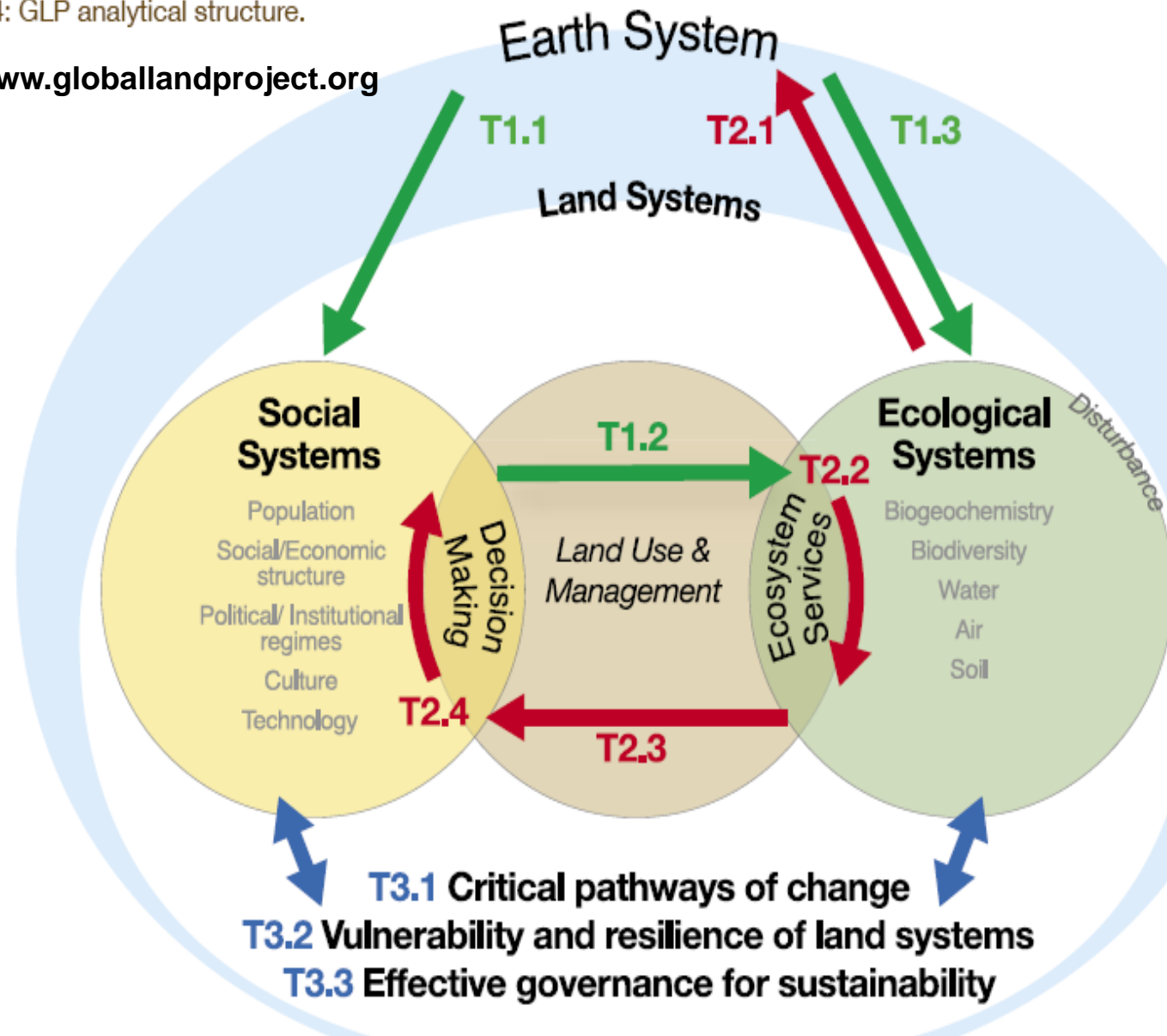
- Roots of the Program in the IGBP/IHDP LUCC
- Initial Emphasis on Regional case studies to understand LUC processes > Synthesis studies
- Integrative Impact Studies (cross-discipline)
 - Biogeochemistry, Hydrology, Atmosphere, Biodiversity
- Land Use Change Modeling Studies > projections
- LC Data Initiatives > emphasis on multi-scale observations to quantify change
 - active international cooperation through GOFCC/GOLD
 - Importance of Landsat class observations for LCLUC
- Remote Sensing R and D encouraged as part of implementing the LCLUC science

NASA LCLUC Program Context

- Promoting interdisciplinary research within NASA Earth Science – shared NRA's with other program elements
 - The human dimensions research part of NASA ES
- Major contributor to US CCSP LULCC
 - Constraints as to how much interagency cooperation could be developed
- In step with emphasis of UN FCCC, IPCC - LULUCF, REDD, Adaptation
- Contributing to International IGOL, GTOS GOFC/GOLD and GEO (Observation Focus)
- Contributing to IGBP/IHDP Global Land Project (Science Focus)

Figure 4: GLP analytical structure.

www.globallandproject.org



T3.1-3: Sustainable Land Architecture

Program Goals

LCLUC will use NASA remote sensing technology to improve our understanding of human interaction with the environment, and thus provide a foundation for sustainable use and management of our natural resources.

The goal of the ESE LCLUC Program is to further the understanding of the consequences of land-cover and land-use change for continued provision of ecosystem goods and services.

The ultimate objective of the LCLUC program is to develop the capability to perform repeated global inventories of land-cover from space, and to develop the scientific understanding and models necessary to simulate the processes taking place, and evaluate the consequences of observed and predicted changes.

Program Approach

- Program implementation through Peer Reviewed Research (ROSES) – 3 year cycle
 - Aligned with national and international science priorities
- An informed and engaged Science Team
 - Regular Team Meetings combination of science results, programmatic context and feedback on program direction (Washington Area (HQ participation) / Regional)
 - Team Web Site and Land Data Portal
 - Science Team sub-group initiatives - LCLUC Books



Previous NRA's (Program Context)

- **Past Topical Emphases**

- LCLUC Process Studies (Drivers)
- LCLUC and Carbon Cycle (Impacts)
- LCLUC and Water Cycle (Impacts)
 - LCLUC and Urban Environments (Impacts)
 - LCLUC and Biodiversity (Impacts)
 - LCLUC and Atmosphere (Impacts)
 - LCLUC and Coastal Zone (Impacts)
- LCLUC Modeling (Projections)
- LCLUC Impacts on Climate (Forcing)
- Climate Impacts on LCLUC (Adaptation)

Previous NRA's (Program Context)

- **Regional Emphasis**

- Tropical Regions – C/S America, Amazon (LBA), C/S Africa, SEA (MAIRS)
- Temperate Regions – US (inc. NACP)
- Northern Eurasia (NEESPI / IPY) – Boreal Forests, Drylands

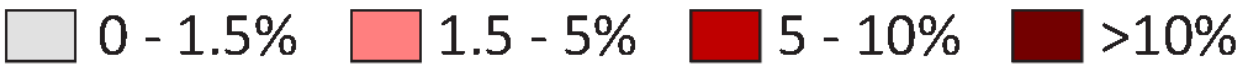
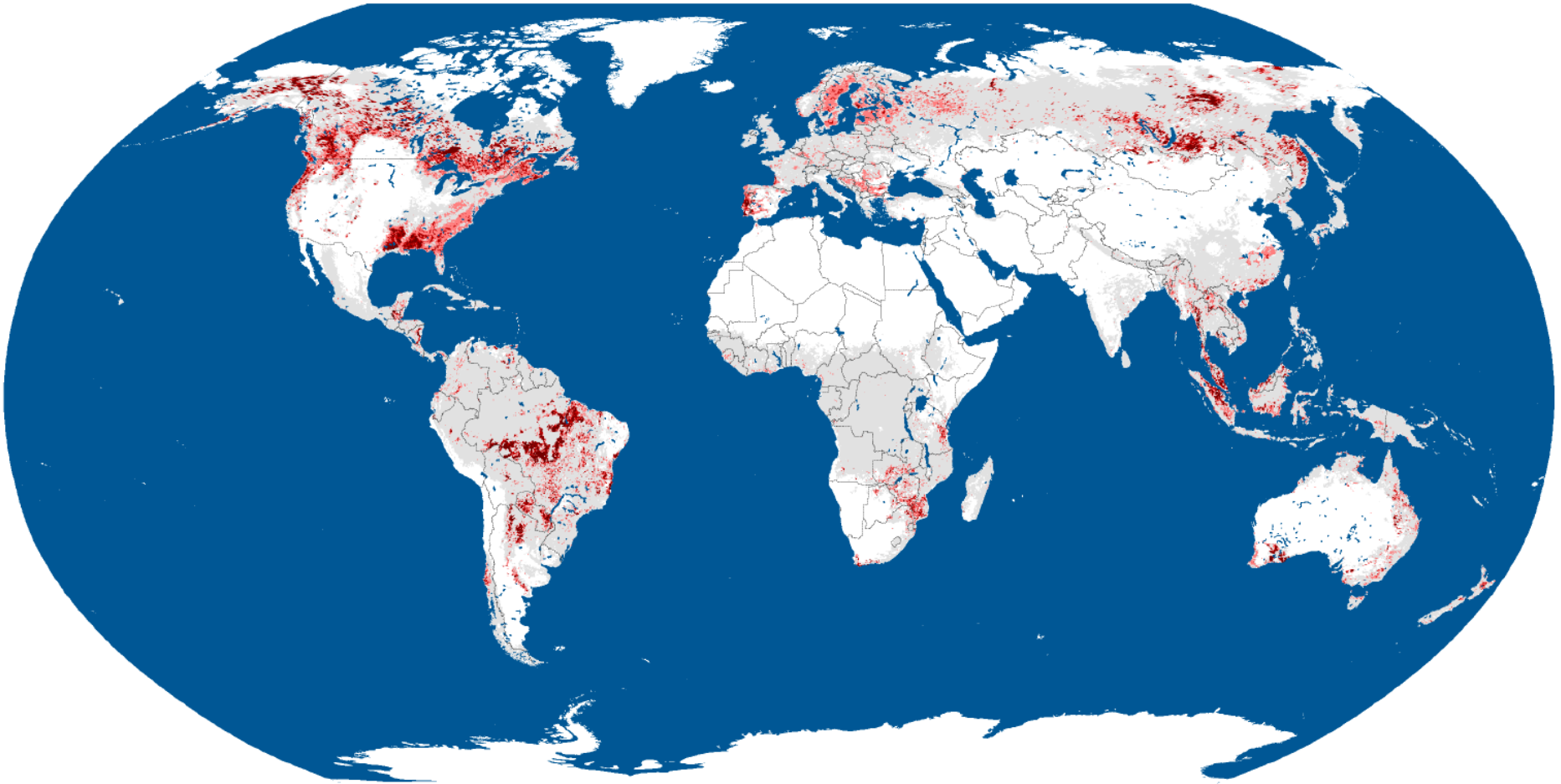
- **LCLUC Data Initiatives**

- Global and Regional LC Change Studies
- Global Land Surveys 2000, 2005, 2010 (GOFC/GOLD, GEO)

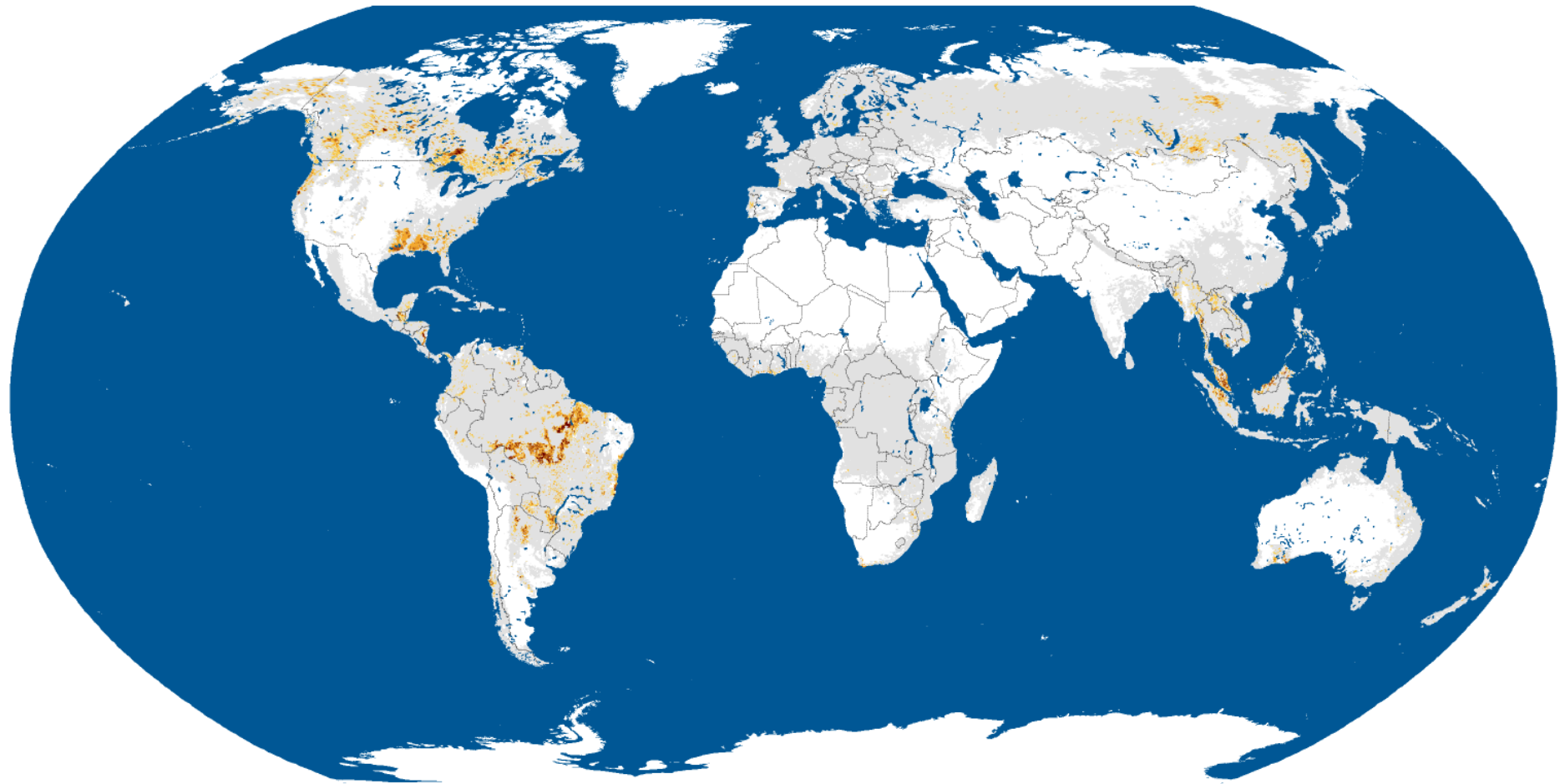
**NASA LCLUC Science Team
MAIRS/GOFC-GOLD/START
January 2009 Workshop on
LCLUC and Monsoon Processes**



Percent forest cover loss, 2000 to 2005



Above-ground carbon release, 2000 to 2005



0 - 2.5 2.5 - 5 5 - 10 10 - 25 20 - 65 tons*ha⁻¹

Matt Hansen et al SDSU

Results

National-scale forest area, forest cover loss and carbon release

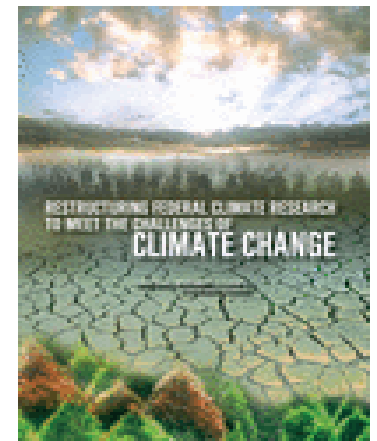
Country	2000 forest cover (Mha)	2000-2005 gross forest cover loss (Mha)	% loss of 2000 forest cover	% of loss of global total	Carbon Storage (Gt)	Carbon release (Gt)	% carbon release of storage	% of release of global total
Brazil	460.1	16.5	3.6	16.3	36.8	1.27	3.4	23.3
Canada	304.5	16.0	5.2	15.8	14.6	0.80	5.5	14.6
China	120.9	2.8	2.8	2.8	3.0	0.07	2.4	1.3
DRC	167.3	1.0	0.6	1.0	24.1	0.13	0.6	2.5
Indonesia	108.5	3.5	3.3	3.5	5.3	0.17	3.2	3.1
Russia	512.2	14.4	2.8	14.2	17.4	0.48	2.8	8.9
USA	199.2	12.0	6.0	11.8	11.2	0.66	5.9	12.2
Total	1872.7	66.2	3.5	65.4	112.4	3.58	3.2	65.9

Current Program Concerns to be discussed at this workshop

- Decline in US Observing Systems for LCLUC
 - Landsat Data Continuity (NASA's role)
 - L7 SLC-Off 2003 - LDCM + Thermal December 2012? (J.Irons)
 - Landsat beyond LDCM (B. Cramer)
 - NASA MODIS Land Product Continuity w. VIIRS
 - MODIS and VIIRS Updates (Justice/ Wolfe)
 - Better access needed to International Assets (CEOS)
 - GLS 2010 (J. Masek, M. Maiden)
- A decreasing Human Dimensions component to the program (B. Turner, E. Moran et al)
- Strengthening LCLUC Reporting/Outreach

Future Directions for LCLUC 1

- Staying aligned with an evolving US CCSP
 - Land Use Mitigation and Adaptation
 - Regional and Decadal Scale modeling
 - Science Societal Issues e.g. Climate Change Water and Food Supply
 - Multiple Stressors – Integrated Modeling – coupling LU and Climate models
 - Increasing the Human Dimension
 - A National Assessment



Future Directions for LCLUC 2

- Science (to be discussed at this meeting)
 - Continuing focus on Forest Cover Change, Carbon and REDD – the emerging bioeconomy
 - Addressing important land cover changes e.g. boreal wetland systems, fire regime changes, urban expansion, protected areas
 - Expanded focus on LU Adaptation to Climate Change
 - including Agriculture
 - LU Change under multiple stressors – integrated modeling
 - Potential New Topics
 - LCLUC in Mountain Systems
 - Hot Spots of LCLUC and human vulnerability (initial data initiative)
 - Societal impacts of Land Use Change

Future Directions for LCLUC 3

- Observations and Data
 - Roadmap for Landsat Continuity
 - Attention to MODIS/ VIIRS Continuity
 - Long Term Data Records (Coarse / Moderate Resn) – mining the archives
 - Complete GLS 2005 (Masek)
 - Implement GLS 2010 – international component – US Help with Ground Segments (Masek)
 - LCLUC science opportunities from the Decadal Survey Missions (Wickland presentation)
 - Need a new data buy for Fine Resolution Data (ALOS - Japan?)
- Increased international cooperation needed on
 - Acquisition strategies
 - Standard data products
 - Product validation – protocols and standards – shared data
 - Securing the archives
 - Data exchange

Agenda for this Workshop

- **Tuesday March 31**
 - Program Overview
 - Research Review Presentations
 - LCLUC Impacts on Environment and Climate
 - LBA LCLUC Research Results
 - Strategic Presentation and Discussion on the Human Dimensions of NASA LCLUC
 - Poster Session and Reception (5.00-7.30pm)

Agenda for this Workshop

- **Wed April 1 – no fooling**
 - Programmatic Presentations
 - International Programs
 - Instrument and Product presentations
 - Landsat
 - EO1
 - MODIS/VIIRS
 - Decadal Survey Session
 - Discussion on Observation Priorities and Recommendations

Agenda for this Workshop

- **Thursday April 2**
 - Research Review Presentations Contd.
 - Summary of Meeting
 - Discussion on Future Program Directions and Next Steps
 - Close of Workshop 12.30pm