

20 Years and Counting.....

The Foundation, Current Status and Possible Future Directions for the LCLUC Program

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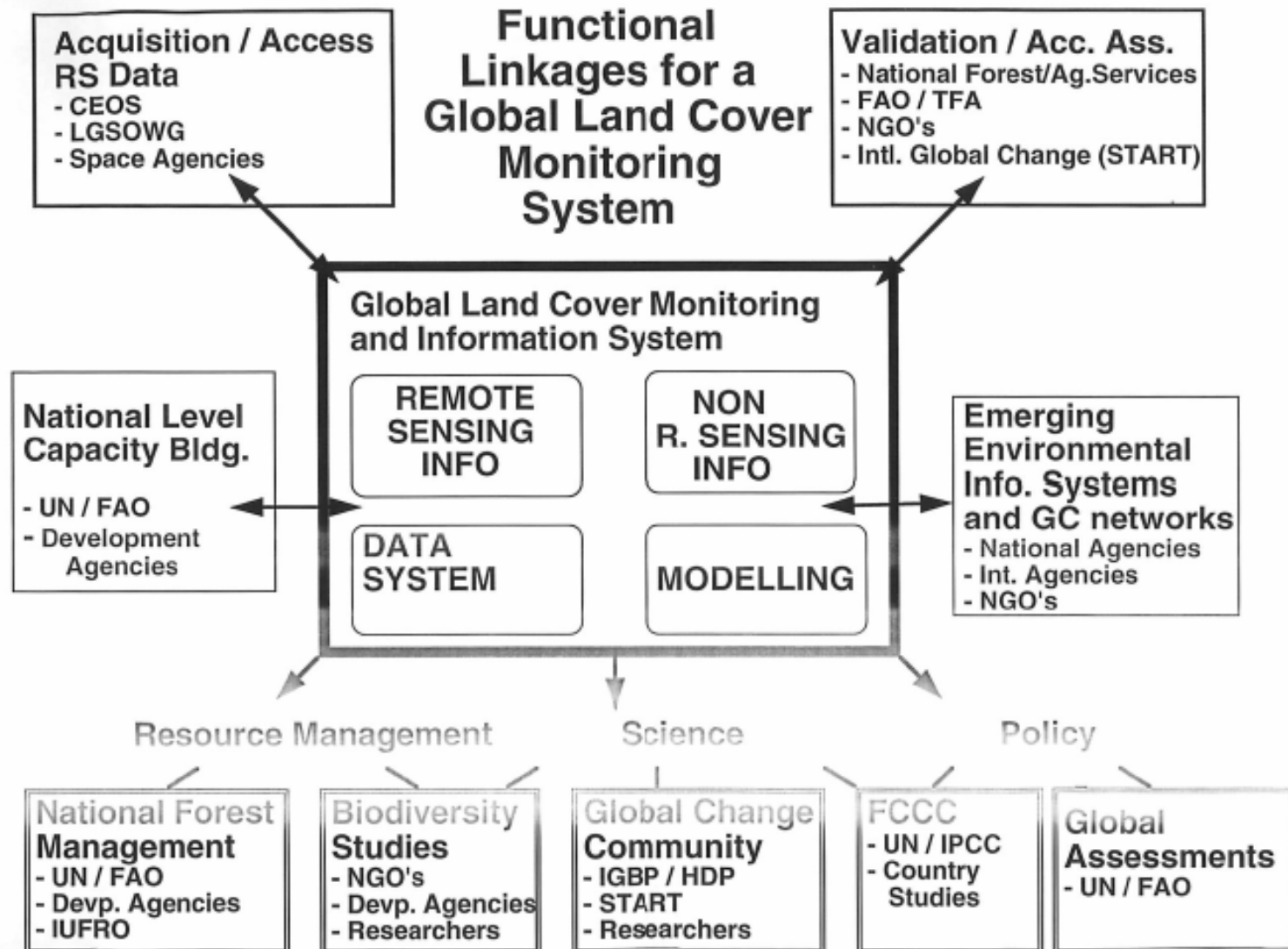
Foundations of LCLUC

- 1990 NASA Landsat Pathfinder initiated (UNH, UMD)
- 1990 IGBP-DIS – global data sets (inc. 1km Land Cover)
- 1994 IGBP/IHDP LUCC officially launched (Skole, Chair)
- 1994 Global Land Cover Monitoring Proposal

For LCLUC Program Evolution see –

http://lcluc.umd.edu/Documents/ScienceTeamMtg/2011_03/Monday/Justice.pdf

Skole and Justice 1994



MTPE Land Use Change Program (white paper)

Tony Janetos, 1995

“Underlying philosophy... further the understanding of the consequences of land use change for continued provision of ecological goods and services” - Sustainable management, human influences, expanding human population

“Ultimate vision ...develop the capability to perform repeated inventories of LU LC from space and develop the scientific understanding and models necessary to evaluate the consequences of observed changes”

Proposed Program Elements

- **Forcing Factors** – socioeconomic, climate and ecological drivers
- **Immediate Changes** – land cover conversion, land use intensification
- **Modeling and Implications** – LUC into existing models, links to ES Modeling
- **Infusing New Technologies** -Landsat Pathfinder as a major data source > w. Landsat 7 and EOS coming (*L7 17 years old last week*)
- **Links to Field Campaigns** – Lambada-Baterista-Ambiace
- **Links to US Agencies and International Programs**
- **Implementation Options** – Amazon, Southeast Asia, Southern Africa, Russia and FSU

“The program will not investigate the human dimension processes directly but will be linked to other research on HD of LUC” ...“The program will rely on other programs for historical LU data sets”

MTPE and the Land Use Change Program

- **Assessments**

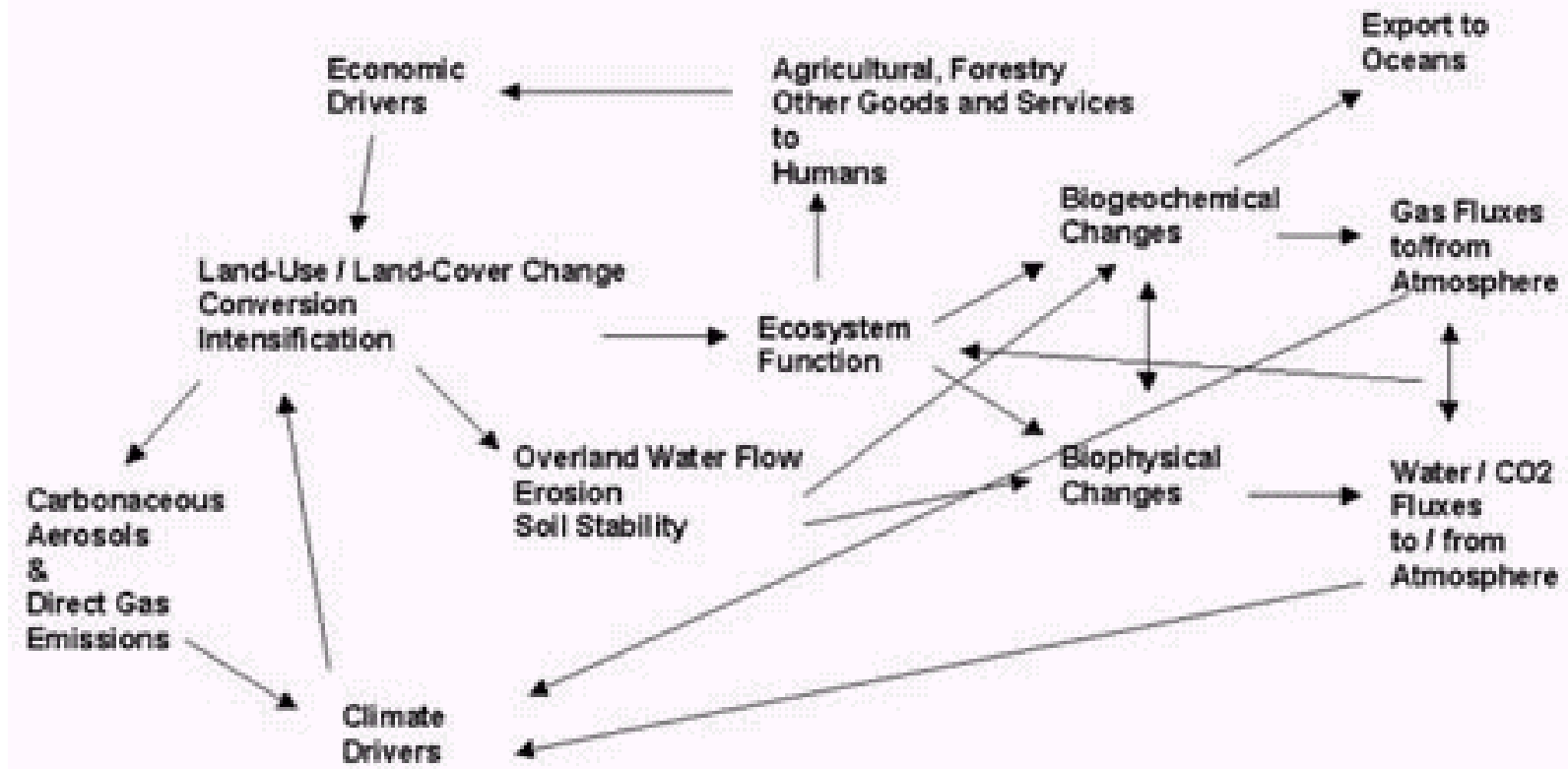
- *The LUC Program will develop a series of reports that identify the consequences of land use change in globally important areas of rapid change, and these reports will provide the scientific foundation for a new NASA series of reports on human influences on the biosphere*

- **The LCLUC Naissance**

- Discussions with Bob Harris (NASA ES Director and CENR)
- May 1995 ESSAC review at NASA HQ
- First funded LCLUC Budget Cycle and RFP 2016
- First LCLUC Science Team Meeting 1997 Airlie House, Warrenton Va.

Early Program Construct - emphasis on BioGeochemical Cycles and Ecosystems Goods and Services

Interactions of Land-Use/Land-Cover Change

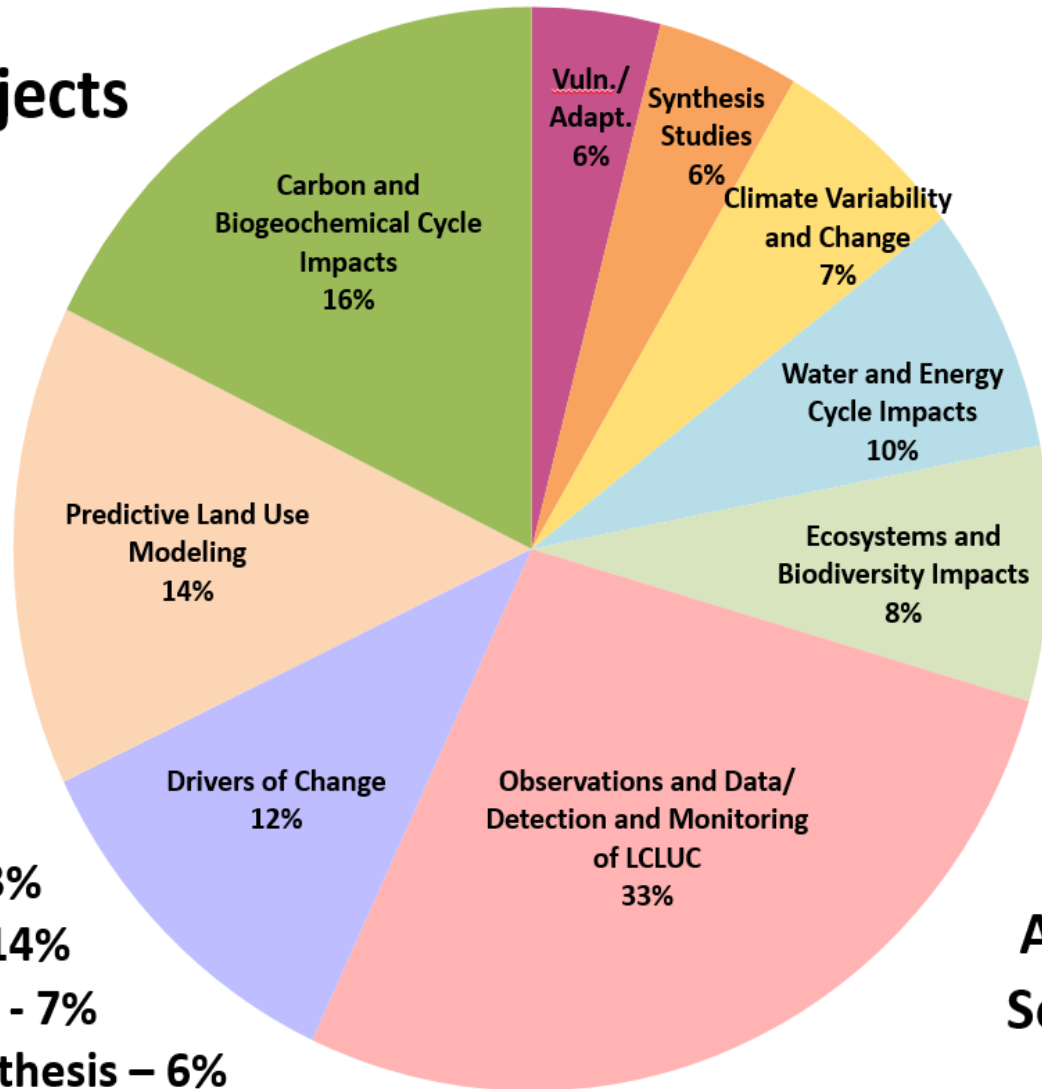


Program Emphases to Date

- **Impacts** of LCLUC on **ecosystem goods and services**
- Case studies on **the process of change** – bringing in the social science
- Regional Forest Cover **mapping** Studies > **detection and monitoring change (epochs)**
- **Modeling**
 - **Better LC parameterization** in Hydrological, Biogeochemical, Ecosystem, Regional Climate, Aerosol Dust Models
 - **LU Modeling** – process driven projections
- **Land use-climate interactions**
 - **Land Use Change impacts on Regional Climate**
 - **Climate change impacts on land use (adaptation)**

LCLUC Program Emphasis 1997- 2016

250 PI projects



Impacts - 34%
Monitoring - 33%
LU Modeling - 14%
LU and Climate - 7%
Case Study Synthesis - 6%
Vulnerability/Adaptation - 6%

**20th
Anniversary
Science Team
Meeting**

Recent Thematic and Regional Emphases

- Forests (tropical and boreal)
- Urban
- Agriculture
- Coastal Zone
- Mountain Systems
- Industrial Forestry
- North America (US)
- Amazon (LBA)
- Northern Eurasia (NEESPI)
- Monsoon Asia (MAIRS)
- Southeast and Southern Asia (SARI)
- Caucasus

Observations on the Recent Program

- Increasingly nuanced characterization of LU e.g. industrial forestry, field size,
- Adaptation – the program was ahead of the community - but now more observable
- Focusing on areas of rapid LU change and large impacts – South and Southeast Asia
- Decreased emphasis on biogeochemical impacts - carbon cycle and carbon monitoring addressed by other NASA programs, but still largely land use
- Expanded Urban theme - through IDS Calls
- Synthesis - much needed but ROSES calls not resonating well with the community

Strengthening International Partnerships

- **GOFC/GOLD Land Cover, Fire, Biomass**
 - Increasing role in AFOLU (presentations to follow)
- **GOFC GOLD Regional Science Networks** focus on use of observations and strengthening regional science and EO use
 - w. START and SERVIR (NASA/USAID) Training (presentation to follow)
- **Global Earth Observing (System of Systems)**
 - Agriculture (GEOGLAM), Land Cover, Fire, Forest Cover (GFOI)
- **Global Land Project** (current topics)
 - *Managing trade-offs and synergies for sustainable land systems*
 - *The water, food, energy nexus*
 - *An urbanizing and telecoupled world*
 - *Governance systems to manage natural resources*
- **Future Earth** (presentation to follow)

Consistent Science Questions

- How and where are Land Cover and Land Use Changing?
- What is driving Land Use Change?
 - Land Tenure - who owns and who manages the land?
 - Economic Development
 - Global Markets, Trade and teleconnections
 - Population Growth and Dynamics
 - Urban Growth – Rural Depopulation
 - Land speculation
 - Subsistence issues (e.g. slash and burn agriculture)
 - Land use policies and institutions
 - Climate variability and change
- Magnitude of the impacts of Land Use Change?
 - carbon cycle, water resources, livelihoods, biodiversity
 - Sustainable land use

2011 Possible Future Emphases

- **Land Use Scenarios and Climate Adaptation**
 - Post Paris Implementation (AFOLU) and IPCC
- **Land Use, Food and Water Supply**
 - The FEW Nexus
- **Social Impacts of LCLUC – vulnerability**
 - UN Sustainable Development Goals (SDG's)
- **LCLUC Product Development**
 - Global Landsat Products and 30yr Landsat Data Stacks
 - SDSU Global WELD, UMD GLAD, etc
 - Fine Resolution data for land use studies - Data from NASA CAD NextView
 - ?????
 - Landsat constellation prototyping – LDCM/Sentinel 2
 - MUSLI (NASA/ESA)
 - Automated Change Detection
 - GLAD Alert w. GFW, ?????
 - Land Use Data Sets – crop calendars, rotation, irrigation, no-till, etc
 - GEOGLAM baseline

2016 Possible Future Program Emphases

- **EO**

- Advocacy for L9 and Continuity and a public good fine resolution system! (Decadal Survey Process)
- Co-use of international missions – MUSLI extended, Sentinels, CBERS, NISAR, Biomass, China/Belgium
- Utilizing upcoming missions – Ecostress, GEDI, JPSS, NISAR, Biomass, China/Belgium
- SLI ?

- **Regional**

- SARI - South/Southeast Asia to achieve critical mass
 - New regional science partners
 - Ongoing Training
- South America ?

- **Thematic**

- AF (and) OLU (2006 IPCC) Post Paris Implementation
 - Land Use and INDC Emissions – Implementation
 - Climate Smart Agriculture
- Agriculture and Food Security
- LU Climate Adaptation Revisited ?????? – now observable

Program Accomplishments

- We have Placed Earth Observations firmly in the discipline of Land Use Science
- Provided the primary NASA science rationale for the Landsat Mission and Moderate Res'n Data Continuity
- Created the means to undertake both periodic and continuous global assessments of Land Use Change
- Provided the basis for monitoring, reporting and verification of forest cover change in the context of the implementation of Carbon Treaties / Intended Nationally Determined Contributions (166 submitted for 188 countries many LULUCF and Ag)
- Developed a community of interdisciplinary scientists capable of utilizing remote sensing to address pressing science questions on land use change

Program Accomplishments

- Scientific analysis of areas of the globe where rapid land cover and land use change is taking place (e.g. Northern Eurasia, Amazon Basin, Southeast Asia, Asia) and provided insight into the various impacts of these changes
- Examined the underlying drivers of land use change including socio- economic, political, institutional aspects in diverse regions of the World
- Quantified rapid changes in the urban built environment around the World
- Evaluated the role of satellite data in initiating projections of future land use change
- Built broad networks of international scientists that routinely utilize NASA data to monitor land use change (in part through a shared program of training with partner programs).

Land Use remains a Priority Research Topic with direct societal benefit

- Land Use is integral to sustainability and livelihoods
 - Critical to national food security
 - Critical to good resource management
 - Critical to viable conservation
 - Critical to the distribution of wealth
 - Critical to local culture
- Land Use Science (monitoring, modeling and analysis) to inform Land Use Policy e.g.
 - To manage natural resources to benefit the nation
 - To promote sustainable livelihoods
 - To protect environmental quality (land, air and water)
- Land Use Change contributing to and impacted by Climate Change

Recognizing Leadership

I would like to also recognize and celebrate the outstanding contribution of John Townshend who:

- Led and established IGBP-DIS
- Led and established the GOFC-GOLD Program
- Did much of the pioneering satellite Land Cover work
- Led and established the Global Land Cover Facility (GLCF), which help build the case for the Open Landsat Archive
- Mentored so many individuals who have been PI's and Co.I's in the LCLUC Program over the last 20 years

Thank you John !

