

# **3rd LCLUC Science Team Meeting**

**Airlie House, Warrenton, Va**

**May 18-21 1999**

# Objectives of the Science Team Meeting

- **Program Updates**
  - current status of NASA LCLUC
  - the first years: a retrospective
  - status of LCLUC across USGCRP - US Carbon / HD / National Assessment
  - status of IHDP / IGBP LUCC
  - LCLUC related meeting reports - community updates
- **Presentation of Early Results from Round 1 Funding**
  - research findings and identification of mid-course corrections
  - new methods, emerging theories and conceptual advances, policy and resource management implications
- **Planning for Packaging of Round 1 and LBA LCLUC early results**
  - identification of significant results, major achievements
  - An LCLUC Book - plans and potential contributions
  - LCLUC Web site update and LCLUC outreach initiatives
  - assess role of LCLUC in regional assessments
- **LCLUC data initiatives**
  - regional CD's, LC ESIPS, Fire Web
  - Landsat 7 status, follow-on rationale and data needs
- **Science Team input to future directions of NASA - LCLUC**
- **Future NASA missions and LCLUC - post Easton**

**May 18<sup>th</sup> Day 1, 9.00 am**

**Plenary Session - The Jefferson Room**

Welcome and Objectives of the Meeting – C. Justice / J. Ranson

Programmatic - LCLUC the first years: a programmatic retrospective – A. Janetos

Programmatic - Current Status of the LCLUC program – C. Justice

**Concurrent Session 1A – The Jefferson Room**

10 – 10.45 Early Results - The dynamics of a semi-arid region in response to climate and water use policy – J. Mustard

10.45- 11.30 Early Results – Assessing future stability of US High Plains landcover integration of process modeling with Landsat, in-situ, modern and paleoclimate data - J. Overpeck

11.30 – 12.30 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: A. Janetos / D. Brown

**Concurrent Session 1B – The Audubon Room (located in auxiliary building)**

10 – 10.45 Early Results - Land Cover Change in the Great Plains: predicting impacts of regional forest expansion on biogeochemical processes – L. Johnson

10.45- 11.30 Early Results – Quantifying Grassland to Woodland Transitions and the implications for carbon and nitrogen dynamics in the Southwest United States – S. Archer

11.30 – 12.30 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: P. Matson / T. Fisher

**LUNCH 12.30 – 1.30 The Airlie Room**

**May 18<sup>th</sup> Day 1, 1.30pm**

**Plenary Session - The Jefferson Room**

1.30 – 1.50 pm Programmatic - Land use change and policy implications – A. Janetos

1.50 – 2.10 pm Programmatic – The IPCC Report Structure and the Land Cover Chapter – R. Houghton

2.10 – 2.30 pm Programmatic – The USGCRP Carbon Cycle Initiative and Land Use Change – L. Dilling /E.Spiker

**Concurrent Session 2A – The Jefferson Room**

2.30 – 3.15 Early Results –Modeling carbon dynamics and their economic implications in two forest regions: pacific northwestern USA and northwestern Russia – J. Kerkvliet

3.15 – 4.00 Early Results – Effects of the development of the Baikal Amur mainline railroad on patterns of boreal forest cover and carbon fluxes in southern Siberia – E. Kasischke

**4.00 – 4.45 Early Results – The role of land-cover change in high latitude ecosystems: implications for the global carbon cycle – D. McGuire - MOVE to Thursday am - Concurrent Session 5B-10.45am**

**4.00 – 5.30** Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: R. Houghton / D. Kicklighter

**Concurrent Session 2B – The Audubon Room**

2.30 – 3.15 Early Results – Modeling and forecasting effects of land use change in China based on socioeconomic drivers – R. Kaufmann

3.15 – 4.00 Early Results –Time series forest change, land cover/land use conversion and socio-economic driving forces in the Northern Peten District, Guatemala – D. Hayes

4.00 – 5.30 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: R. DeFries / S. Archer

**DINNER 6.30pm – The Airlie Room**

**7.30 – 8.15 After Dinner Speaker (The Jefferson Room) – NSF and Land Cover and Land Use Change: status and future directions - Tom Baerwald**

## **Day 2. May 19, 9.00 am**

### **Plenary Session – The Jefferson Room**

9.00 – 9.20 Meeting Report - Integrating social, ecological and remote sensing information on secondary growth – R. Walker

9.20 – 9.40 Meeting Report – Amazon LCLUC Pattern to Process – C. Wood

9.40 – 10.00 Programmatic – New developments in the IGBP/IHDP Lucc program – E. Moran

10.00 - 10.10 Programmatic - Upcoming Amazon LCLU meeting announcement - Foster Brown

### **Concurrent Session 3A - The Jefferson Room**

10.00 - 10.45. Early Results – Land cover and land use change in southern Yucatan Peninsular Region – B. Turner

10.45 – 11.30 Land Use and Land Cover Change in Sonora, Mexico: trajectories of agricultural intensification and consequences for non-agricultural systems – P. Matson

11.30 – 12.30 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: R. Walker / T. Stone

### **Concurrent Session 3B – The Studio**

10.00 – 10.45 Early Results – Deforestation and degradation in Southern and Central Africa Savannas – S. Prince

10.45 – 11.30 Early Results – Coupling land use and land cover change and ecosystem processes in Miombo Woodlands – P. Desanker

11.30 – 12.30 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: R. Rindfuss / L. Johnson

**LUNCH 12.30 – 1.30 The Airlie Room**

## **Day 2. May 19, 2.00pm**

### **Plenary Session – The Jefferson Room 2.00 – 3.00pm**

Meeting Report – Fire Management in African Savannas – P. Frost

Research Presentation – Deforestation Dynamics on the Bolivian Frontier – S. Hecht

### **Concurrent Session 4A – The Jefferson Room**

3.00 – 3.45 Early Results – The Process of Land Cover and Land Use Change in Central Africa – D. Wilkie

3.45 – 4.30 Early Results – Study of land use and deforestation in Central African Tropical Forests using high resolution SAR satellite imagery – S. Saatchi

4.30 – 5.30 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: R. Bilsborrow / C. Dobson

### **Concurrent Session 4B – The Studio**

3.00– 3.45 Early Results – Case studies and diagnostic models of the interannual dynamics of deforestation in Southeast Asia – D. Skole

3.45 – 4.30 Early Results – Soils, water, people and pixels: a study of Nang Rong – R. Rindfuss

4.30 – 5.30 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: R. Kaufmann / C. Wood

**DINNER 6.30pm – The Airlie Room**

**7.30pm After Dinner Presentation - OSTP**

## **Day 3, May 20<sup>th</sup>**

### **Plenary Session – The Jefferson Room**

9.00 – 9.30 Programmatic – The GOFCC Project and the role of LCLUC – J. Townshend

9.30 – 10.00 Programmatic – An assessment of the availability and utility of microwave data for the study of land use and land cover change: a review – G. Sun

### **Concurrent Session 5A – The Jefferson Room**

10.00 – 10.45 Early Results – Hierarchical investigation of socioeconomic drivers of decadal scale land cover changes in the upper Midwest – D. Brown.

10.45 – 11.15 Early Results – Causes and Consequences of land cover in a Greater Ecosystem: trend assessment, monitoring and outreach – A. Hansen

11.15 – 12.00 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: ???????? / J. Kerkvliet

### **Concurrent Session 5B – The Studio**

10.00 – 10.45 - Early Results - Characterizing land cover heterogeneity and land cover change from multi-sensor satellite data – R. DeFries

10.45 – 11.15 - Early Results – The role of land-cover change in high latitude ecosystems: implications for the global carbon cycle – D. McGuire

11.15 – 12.00 Identifying the significant results, new and improved methods, emerging theories and policy implications from the case studies: discussion. Co Chairs: C. Woodcock /P. Desanker

**LUNCH 12.00 - 1.00 – The Airlie Room**

## **Plenary Session – The Jefferson Room**

1.00 – 1.30 Programmatic – The direction of NASA ESE and the role of LCLUC - J. Kaye

1.30 – 2.00 Research Presentation – Climate sensitivity of the Middle East landscape - R. Smith

2.00 - 2.15 Packaging early results for the NASA LCLUC program – C. Justice

**2.15 – 4.00 Co Chairs summary reporting of the significant results, new and improved methods, emerging theories and policy implications from the case studies from the concurrent sessions – Presentation and Discussion**

### **Concurrent Session 4.00 - 5.30**

**5A Synthesis Group** (The Jefferson Room) - developing a synthesis of program findings - Co Chairs – B. Turner / D. Skole

**5B Packaging Group** (The Studio) –packaging of program results – Co Chairs – J. Ranson / S. Archer

DINNER 6.30 – The Airlie Room

7.30 – 8.15 Possible after dinner speaker (The Jefferson Room) -



## **Day 4, May 21<sup>st</sup>**

### **Plenary Presentation 9.00 – 12.00 – The Jefferson Room**

9.00 – 9.30 Programmatic - The Landsat 7 Program: status report – J. Irons

9.30 – 10.00 Programmatic - Future Satellite Missions Relevant for LCLUC – J. Ranson

10.00 – 10.20 Synthesis of Findings – group report back - Skole / Turner

### **COFEE BREAK**

10.30 – 10.40 Packaging the Results – group report back - Ranson / Archer

10.40 – 11.40 Programmatic - Future science directions and priority focus areas for the NASA LCLUC program: towards the next LCLUC NRA: ideas and open discussion – Chris Justice / Jon Ranson

11.40 – 12.00 Programmatic – Next steps for the LCLUC Program and Action Items from the meeting – Chris Justice

### **12.00 Close of Meeting, Lunch and DEPARTURE**

## **Audiences and Approaches**

### **Scientific Community (Primary Audience)**

Peer reviewed papers / Conference presentations / Special Editions  
Project data and products - partner with ESIPS / PI Web Sites / Regional data CD's  
LCLUC Book: case studies, methods, emerging theories, comparisons, synthesis  
Regional / Thematic Scientific Networks (e.g. Miombo / SEASIA)

### **NASA Management**

Summary achievements; keeping it up to date (*Focus for this afternoon*)  
Back up material / LCLUC WEB (format, attribution) - project scientist  
Abstracts - Annual Reporting - Publications list - Web Site  
IWG ?? WG's - presentations - LCLUC results overview presentation

### **Science / Policy 'Brokers' (e.g. OSTP / WRI / etc)-**

cautious translation of hard results into policy context, press release management  
LCLUC areas of emphasis - carbon FCCC / national assessments  
NASA LCLUC and Carbon Workshop 2000 - policy participation  
rapid response mechanism e.g. NASA Fire Web Site, SAFARI, % cover Poster

### **Land Management Community**

targeted topical workshops (funding opportunities ?)  
involvement in national / regional assessments - land use stakeholders  
partner with RESACS - applications program

### **Education / Public Outreach**

Web Site - tutorials - slide show - page links

## **Significant Results Might:**

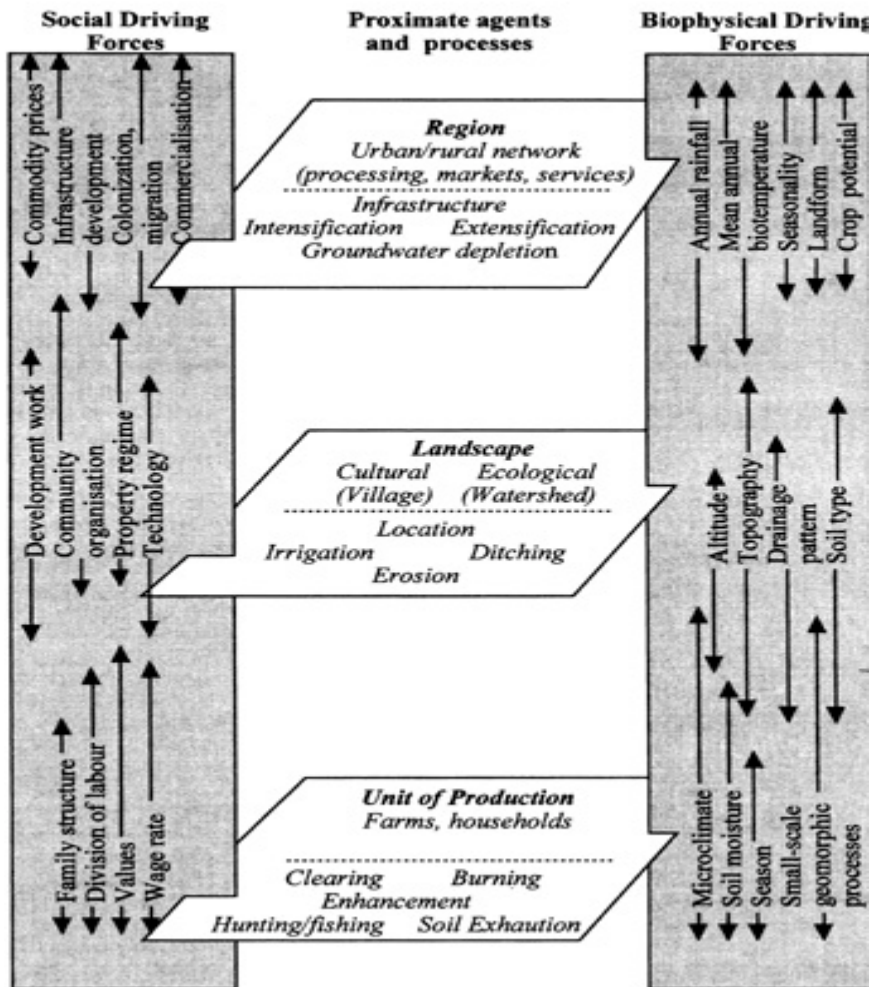
- **Provide a new insight or advance in our understanding of the processes taking place**
- **Contradict or confirm current theory**
- **Answer some outstanding research question**
- **Quantify the drivers or impacts of land cover and land use change**
- **Enable informed decision making concerning resource use**
- **Enable improved land cover or land use management**

## **New or Improved Methods Might:**

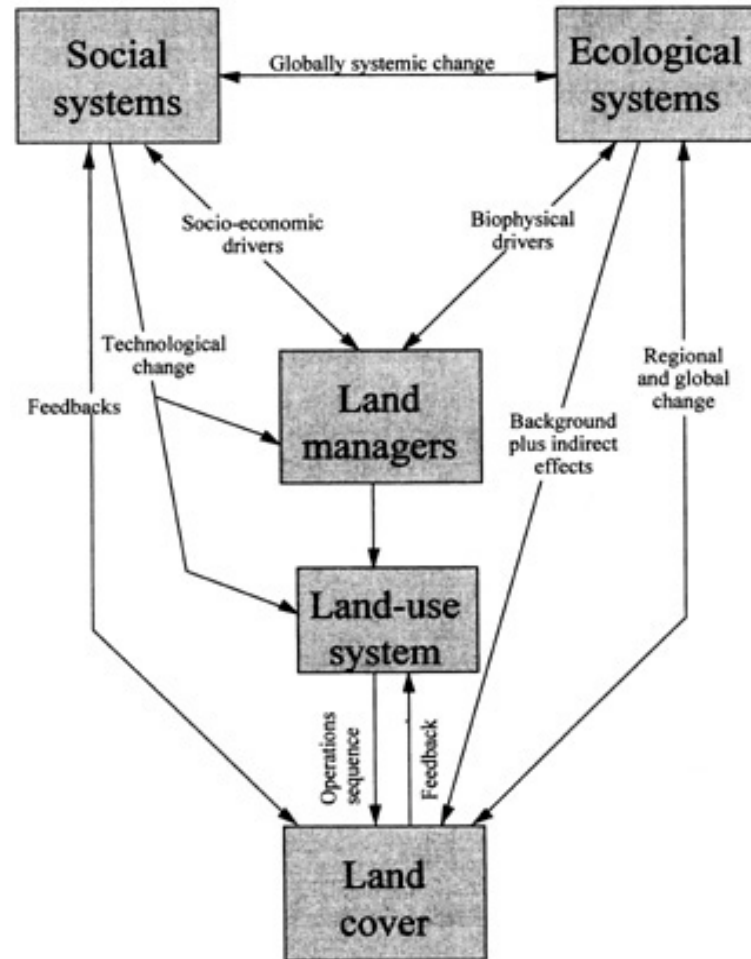
- **Involve new or improved data collection techniques**
- **Involve new or improved data processing and analysis approaches**
- **Provide an independent validation of a model or derived data products**
- **Provide an improved model or predictions capability**
- **Enable improved assessments of land cover or land cover change**
- **Enable remote determination of land use**

# Concept and Theory of LCLUC

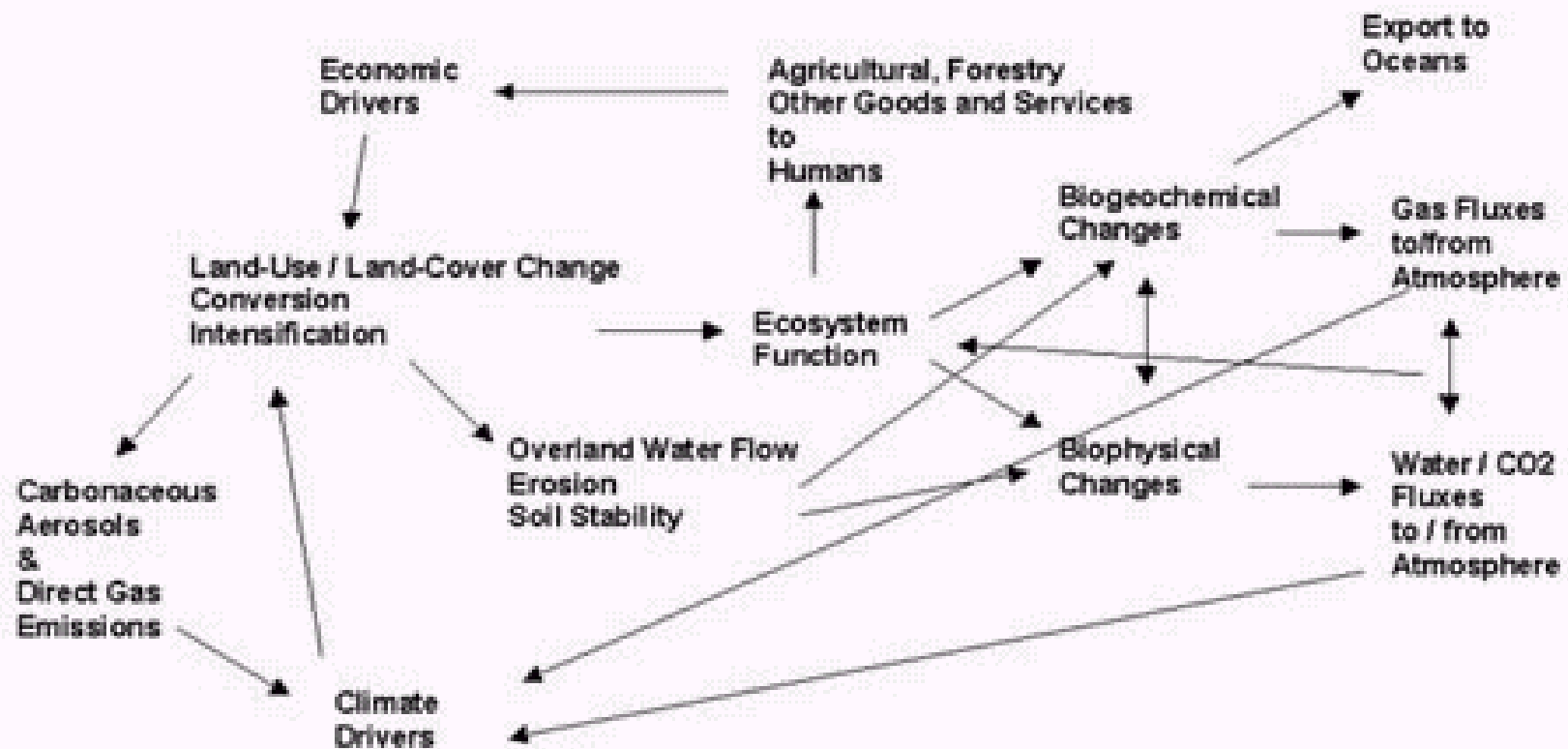
Multiscale Driving Forces in Land Use/Land Cover Change



Framework for Understanding Land-Use/Cover Situations



# Interactions of Land-Use/Land-Cover Change



# **Current Status of the LCLUC Program**

# **Land Cover and Land Use Change and Global Change**

- **LCLUC is the most immediate and visible form of environmental change**
- **Little has been developed in terms of the underpinning science of LCLUC, understanding the impacts of LCLUC and predicting LCLUC**
- **LCLUC will continue to be important for the foreseeable future, driven by the demand for land, world population growth, the need for an increased food supply and wood products**
- **LCLUC contributes to climate change e.g. source of greenhouse gases**
- **LC and LU are impacted by climate change - effect of interannual, decadal and centennial climate variability and trends on land cover and land use**
- **LC and LUC can have an impact on the provision of ecological goods and services e.g. food supply, water quality, biodiversity**

# **Context for NASA's LCLUC Program**

## **USGCRP Overall Goal**

- **Observe, understand, predict, and assess the critical natural and human-induced dynamic states and trends of the Earth's global environmental system across a wide range of time and spatial scales**
- **Address those uncertainties and gaps in scientific knowledge central to the Nation's global environmental change policy interests**
- **Deliver timely information and data products essential to informed decision making that protects the environment, enhances socioeconomic development, and ensures a sustainable future for the Nation and the world**



# USGCRP Program Elements

- Understanding the Earth's Climate System
- **Biology and Biogeochemistry of Ecosystems**
- Composition and Chemistry of the Atmosphere
- Paleoenvironment/Paleoclimate
- Human Dimensions of Global Change
- The Global Water Cycle
- **Carbon Cycle Science**

## **LCLUC and Carbon**

- **Much of the current emphasis on LCLUC has come through attention being given to the carbon cycle - estimation of the sources e.g. rates of tropical deforestation national anthropogenic emissions estimates from land use**
- **Attention is now turning to quantifying sinks - associated with recovery of previous disturbance e.g. tropical regrowth, northern hemisphere 200 yr historical land use, modeling initiatives**
- **The FCCC is giving increased visibility to carbon budgets and trading opportunities, new research initiatives on carbon sequestration are likely - human use of the land will need to be factored in. Increased attention being given to carbon and land management - issues of the Clean Development Mechanism (CDM)**
- **There will ultimately be a need for an independent 'carbon' monitoring system.**
- **Although carbon has dominated the discussion, human alteration of the nitrogen cycle is significant as are other trace gases**
- **Carbon will continue to dominate the 'policy arena' for some time to come**

# USGCRP Phase II Objectives

- The need to broaden and advance the earth sciences research agenda to embrace the whole-system problem of a dynamical **climate system** coupled to a complex and diverse set of large scale **ecological systems**, both interacting on multiple time and space scales with omnipresent human **socioeconomic systems** and their effects.
- The need to study systematically **how these interactions constrain human activity and how a predictive understanding of them creates the opportunity to make economic systems more efficient**, enabling - rather than hindering - development.
- The need to organize in a way which will ensure, nationally and internationally, the capacity of the scientific community to deliver on a continuing basis, beginning now and constantly improving in quality, the information products needed **to enable informed decisions about resource management and economic issues** in a broad spectrum of decision frameworks worldwide, both public and private.

# **USGCRP and Land Cover and Land Use Change (Our Changing Planet - FY 2000)**

- **Biology and Biogeochemistry of Ecosystems: key research challenges**
  - Changing Land Use and Land Cover
    - relationship between LCLUC and weather/climate
    - relationship between climate change and LCLUC
    - the effects of LCLUC on ecosystems, hydrology, species distribution and human social systems
  - Changes in Global Nitrogen Cycle
  - *Multiple stresses of ecosystems*
- **The new USGCRP Carbon Cycle Initiative includes:**
  - Effect of past and current land use change on carbon storage
  - Inventory and long term monitoring of carbon stocks

# US/GCRP Carbon Cycle Science Initiative

## Long Term Goals:

### QUANTIFY

Partitioning of CO<sub>2</sub> between ocean and terrestrial sinks

Spatial and temporal distribution of sources and sinks on a regional scale

### UNDERSTAND

Processes that control source and sink distribution

Factors that regulate net sequestration of anthropogenic CO<sub>2</sub>

### PREDICT

Lifetime, sustainability and variability of sources and sinks of CO<sub>2</sub>



# NASA LCLUC Components

- **Forcing Factors**
  - Climate and Ecological Drivers
  - Socioeconomic Drivers
- **Responses and Consequences**
  - Land cover conversion, abandonment
  - Land use intensification
  - Land degradation
  - Landscape fragmentation
- **Modeling and Implications**
  - LCLUC modeling
  - coupled modeling of biogeochemistry e.g. carbon/nitrogen/trace gases
  - modeling land atmosphere interactions
- **Technique Development**
  - Remote Sensing R and D
  - Data Management
  - In-situ data collection - surveys / validation / process studies

# **NASA LCLUC: current situation**

- **Tony Janetos and Bob Harriss have left NASA**
- **Jon Ranson 6 month secondment from GSFC as Project Manager - Justice remains Project Scientist**
- **New NASA science management less familiar with LCLUC concepts**
- **Janetos replacement in process**
- **LCLUC NRA due any day now**
- **CEOS Global Observation of Forest Cover emerging**
- **LBA and SAFARI 2000 campaigns underway - GCIP in progress**
- **NASA Strategic Planning document drafted**
- **Planned Missions - Landsat 7, Terra, EO1, EOS PM, VCL**
- **New missions pending - Landsat follow on, NPP, Recovery, NPOESS, LightSAR**
- **EOS DIS/ DAACS, PI processing, ESIPS and New DIS**
- **Relationship with other NASA elements e.g.**
  - **Instrument teams**
  - **R and A Ecol/Biogeo, Hydrology**
  - **Data systems, Commercial Data Buy,**
  - **Applications Program**

- **Why should NASA have a LCLUC element ?**
  - **NASA sensing systems provide data essential to the inventory and monitoring of land cover. Remote sensing is the only way to provide some of the necessary data sets**
  - **There are compelling GC research questions of LCLUC that can in part be addressed by remote sensing. LCLUC is highly relevant to society**
  - **The study of LCLUC at regional to global scales provides a data management challenge. NASA is investing in advances in data management and distribution**
- **Do we need and can we create an LCLUC funding wedge ?**
  - **As a new activity for NASA need to justify the existing investment and make the case for continued or increased funding**
  - **Need a continued clearly articulated rationale for LCLUC**
  - **Need to package the program results and future directions for the research in an easily understandable and compelling way**
- **How do we secure the LCLUC mission needs ?**
  - **Landsat 7 / Terra / PM**
  - **The rationale and specifications for future missions**



# **Strategic Questions**

**(1) What is the current distribution of global land cover and how is this changing?**

**(2) What are the interrelationships of interannual climate variability and land cover change?**

**(3) What are the driving forces behind land cover and land use change and how do past land cover distribution and land use changes affect the current distribution of land cover and land use?**

**(4) What are the consequences of land cover and land use change on biogeochemical cycling, biophysical processes, and biodiversity of ecosystems?**

**(5) What are the implications of natural and anthropogenic disturbances on the carbon cycle?**

# **The Role of the LCLUC Science Team**

- **Generate high quality individual or collaborative research - peer reviewed articles**
- **Teamwork is needed to make the program goals - interdisciplinary skill mix / broad experience base / regional expertise**
- **The program needs highly visible results and contributions:**
  - responsive program e,g, OSTP
  - up to date LCLUC WEB site
  - regional CD's
  - IPCC contributions
- **The Science Team needs to help justify the existing investment and make the case for continued or increased funding for the study of LCLUC**
  - up to date summary presentation material
- **Need to package the program results and articulate future directions for the research in an easily understandable and compelling way**
- **Need to contribute to the advance of the LCLUC 'discipline'**



# LCLUC and Global Observation of Forest Cover

- **The CEOS GOF C Pilot Project**
  - provides an opportunity to secure long-term ‘operational’ systems to support the study of land cover change - focus on global change / carbon cycle data needs
  - operational pilot for the Integrated Global Observing System
- **Forest Cover and Cover Change**
  - Combines global coverage at moderate resolution (1km-250m) with targeted regional coverage at high resolution (30-10m) and sample hyperspatial resolution data (<10m)
  - Wall-to-wall high resolution coverage of forests every 5 years;
- **Forest Fire Mapping and Monitoring**
  - Active fire detection, burn scar mapping, multi-source satellite data
  - Web based data delivery systems
- **Forest Biophysical Functioning**
  - Methods and algorithms for LAI/ fPAR/ NPP, above ground biomass, vegetation composition and structure
  - Creation and validation of regional/global data fields



## LCLUC - Landsat 7



- Landsat 7 is a critical component of the LCLUC program
- Permitting periodic assessments of land cover and land cover change
- Continuing the long- term high resolution record - mid 80's
- LCLUC will contribute to the science rationale for a Landsat follow-on
- Issues
  - Need an effective global acquisition strategy - repeated coverage
  - Need for data processing and distribution capability
  - Landsat Pathfinder Humid Tropical Forest Project
  - Need methods for large area mapping
  - Need relationships with foreign ground stations
  - Need to explore cost efficient ways for providing data

# EOS and LCLUC

- **EOS Terra ( July launch ?? ) - new sensors for the study of LCLUC**
- **MODIS - AM/PM (2330 km swath)**
  - **Land Cover Parameterization (UMd) - Townshend and DeFries**
  - **Land cover change (UMd) - Townshend and DeFries**
  - **Fire and Burned Area (UVA/UMd ) Justice/Roy**
  - **Land Cover and Interannual Variability (BU) - Strahler**
  - **BRDF (BU/UCL) - Strahler / Muller et al.**
- **ASTER (60km swath)**
  - **Spectral range: VNIR 0.5-0.9  $\mu\text{m}$ , SWIR 1.6-2.5  $\mu\text{m}$ , TIR 8-12  $\mu\text{m}$**
  - **Spatial resolution: 15 m (VNIR: 3 bands), 30 m (SWIR: 6 bands), 90 m (TIR: 5 bands)**
- **MISR (360km swath)**
  - **Spectral bands 446, 558, 672, 866 nm**
  - **BRDF / Vegetation Structure**