20 YEARS OF LCLUC PROGRAM: A RETROSPECTIVE AND UPDATE

Garik Gutman,
NASA Headquarters
Manager, LCLUC Program

20th Anniversary Celebration

April 2016
LCLUC Program Content

250 projects since Program’s inception
Each year ~40 3-yr projects
Total in the Program >260 researchers

Impacts - 34%
(Carbon+Water+Eco)
Monitoring – 33%
LU Modeling – 14%
LCLUC- Climate interactions - 7%
Synthesis – 6%
Vulnerability/Adaptation – 6%

http://lcluc.hq.nasa.gov
NUMBER OF PUBLICATIONS

Publication Summary

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• About the same as 20 years ago

• Inflation, sequestration, harvesting – “I will get by/I will survive…”

• Growing demand, community

• Balancing processes and geography

Base LCLUC funds: last 10 years
GROWING BY “COALESCEENCE”

- Carbon Cycle program
- Interdisciplinary program (IDS)
- USPI (participation in non-US missions)
- Landsat
- TERRA/AQUA
- NPP
- MuSLI
- ACCESS/MEASURES
LCLUC Science Team Meetings

**Washington:** Spring Blossom
- 2007: Climate/Carbon
- 2008: Joint CC&E Focus Area meeting
- 2009: LCLUC impacts on climate
- 2010: GLS LCLUC products
- 2011: 15th Anniversary (review/update)
- 2011/9: Agriculture (Joint CC&E FA)
- 2012: Urban
- 2013: Wetlands
- 2014: Urban
- 2015: Early Career Scientists (Joint CC&E FA)
- 2016: 20th Anniversary/Industrial Forests
- 2017: Mountains

**International:** Fall-Winter
- 2007/9: NEESPI/MAIRS Urumqi, China
- 2009/1: MAIRS Kohn Kaen, Thailand
- 2009/9: MAIRS/NEESPI Almaty, Kazakhstan
- 2010/8: NEESPI Tartu, Estonia
- 2011/11: MAIRS Hanoi, Vietnam
- 2013/1: MAIRS Coimbatore, India
- 2013/11: NEESPI/MAIRS Tashkent, Uzbekistan
- 2014/10: NEESPI: Sopron, Hungary
- 2016/1: SARI: Yangon, Burma/Myanmar
- 2017: TBD
In Memoriam

Jack Estes: 2001

Don Deering: 2010

Greg Leptoukh: 2012
Carbon Cycle and Ecosystems Focus Research Area

Terrestrial Ecosystems Program
Ocean Biology Program
Biodiversity Program
Applications Program
Carbon Management
Coastal Management
Water Management
Agri. Management

Land-Cover/Land-Use Change Program

Water and Energy Cycle Focus Research Area
Terrestrial Hydrology

Atmospheric Composition Focus Area
Radiation Science
EXTERNAL LINKAGES: NATIONAL

• With U.S. Global Climate Research Program
  • Participated in and supported the LULCC Interagency Working Group
  • Contributed to USGCRP’s annual issues of Our Changing Planet
  • NRC review of land use models - NASA LCLUC co-sponsored with USGS

• With USGS
  • Contributed to Landsat program
  • Led and sponsored Global Land Surveys initiative and projects
  • Supported USGS science projects
  • Contributed to “data buys”

• With USAID
  • Supported SERVIR (acronym standing for Mesoamerican Regional Visualization and Monitoring System in Spanish) - coordination with South/Southeast Asia Initiative
  • Participated in PEER (Partnerships for Enhanced Engagement in Research)
EXTERNAL LINKAGES: INTERNATIONAL

- **GOFC-GOLD**
  - Fire Implementation Team office at UMD funded by LCLUC
  - Regional Information Networks (RINs): CARIN (C. Asia), SCERIN (C. Europe), SEARRIN (SE Asia), SARIN (S. Asia), etc.

- **CEOS/GEO**
  - International Working Group on Calibration and Validation
  - Land Surface Imaging (LSI) Constellation Working Group
  - Global Landcover Datasets (SB-02 C1)
  - Working Group Land Cover Africa

- **IGBP/IHDP (transitioning to Future Earth)**
  - Global Land Project (GLP)
  - NEESPI (Northern Eurasia Earth Science Partnership Initiative)
  - MAIRS (Monsoon Asia Integrated Regional Study)

- **EARSeL LULC Special Interest Group**
  - Joint biennial workshops (2nd one in Prague, 6-7 May)

- **ESA and CNES/CESBIO**
  - Sentinel-2 products
GOFC-GOLD COMPONENTS AND LINKAGES
BACK IN TIME: GOFC EARLY YEARS

• Need to focus on our key objectives and provide ways for us to assess progress
  • Making observation systems operational
  • Making products more available
  • Ensuring use of products

• Need to raise profile of GOFC/GOLD

• Need to strengthen the regional networks

• Need to involve more people

• Need to raise more resources

John Townshend, U.MD, former GOFC-GOLD Chair
BACK IN TIME: LCLUC MAJOR ISSUES 20 YEARS AGO

- Food Production and Distribution
- Carbon Sources and Land Use
- Carbon Sinks and Land Use
- Management of Ecosystems for Goods & Services
- Preservation of Unique Places

Tony Janetos (1999)
LCLUC Program Manager 1996-1999
Current GOFC-GOLD Chair
TOWARDS LCLUC SYNTHESIS: THE EARLY YEARS

- Case studies in various areas of the world
- Patterns to processes
- Disturbances and feedbacks
- Trajectories and projections

The major milestone
Early Synthesis by LCLUC Veterans

Undisturbed Wildlands

Frontier Resource Extraction

Agricultural Expansion

Industrialization and Urbanization

Trajectories of Economic and Land Use Development

Mustard
Fisher
Defries
Moran
Hansen
Turner
• Humans play an important role in LCLUC

• Social and economic science research includes
  • impacts of changes in human behavior on LCLUC
  • impacts of LCLUC on society
  • adaption to climate change of land-use systems

• During the last 8 years, the Social/Economics Science component has been a mandatory part of all LCLUC proposals, unless otherwise stated in the solicitation
Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA)
Science Question: How do tropical forest conversion, re-growth, and selective logging, influence carbon storage, nutrient dynamics, trace gas fluxes, and the prospect for sustainable land use in Amazonia?

- *Amazonia and Global Change* synthesizes the results of the LBA research


- Translated to Portuguese
International Regional Initiatives

- Northern Eurasia Earth Science Partnership Initiative (NEESPI)
- Monsoon Asia Integrated Regional Study (MAIRS)
- Both moving to Future Earth – NEFI and Future Asia
- South Asia Regional Initiative (SARI) is getting momentum
  - LCLUC-2015 and -2016
  - Endorsement by Future Earth under consideration

Project Scientists:
- Jiaguo Qi, MSU (NASA-NEESPI)
- Pasha Groisman, NOAA/UCAR (NASA-MAIRS)
- Krishna Vadrevu, UMD (NASA-SARI)
NASA-RAS Interactions in Early 90’s

Gen. Korovin, (Inter. Forest Inst.)
Deputy Dir.
Specialists on Fires

Acad. Aleks. Isaev
(Inter. Forest Inst.)
Led RAS-NASA interactions before & during NEESPI era

Bob Murphy (NASA HQ)
Facilitated installation of AVHRR Receiving Stations
Prior to NEESPI in mid-90’s
19 institutions in Moscow and 22 projects

- **Red** dots indicate locations of Principal Investigators
- **Blue** dots – locations of Co-Investigators
- **Green** dots - locations of Collaborators
- **Squares** show Focus Research and Science Support Centers.

6 institutions in Beijing and 5 projects
Red dots indicate locations of Principal Investigators
Blue dots – locations of Co-Investigators
Green dots – locations of Collaborators
Squares show Focus Research and Science Support Centers.

20 institutions in Moscow and 40 projects
6 institutions in Beijing and 14 projects
NEESPI: 10 YEARS OF SCIENCE

>750 scientists
>200 institutions
>170 projects
30 countries

>80 Ph.D. students

~1500 papers and 40 books
LCLUC in Eastern Europe to be published in 2016
LCLUC in Central Asia to be published in 2017
NEESPI SYNTHESIS
ONGOING NEESPI SYNTHESIS

LCLUC-2012

- Qianlai Zhuang, Purdue U.
  - Regional and Global Climate and Societal Impacts of Land-Use and Land-Cover Change in Northern Eurasia: A Synthesis Study

- Jiquan Chen, Michigan State U.
  - LCLUC Synthesis: Ecosystem-Society Interactions on a Changing Mongolian Plateau

- Irina Sokolik, Georgia Tech.
  - Multiscale synthesis of land cover and land use, climatic and societal changes in drylands of Central Asia

- Yamal LCLUC Synthesis

- Skip Walker, U. Alaska, Fairbanks
  - Urbanization and Sustainability Under Global Change and Transitional Economies: Synthesis from Southeast, East and North Asia

LCLUC-2013

- Peilei Fan, Michigan State U.
  - Urbanization and Sustainability Under Global Change and Transitional Economies: Synthesis from Southeast, East and North Asia
2-Program Synergy

NEESPI

MAIRS
The Incredible Shrinking of NASA NEESPI: 2014

- Balto-Arctic
- Eastern Europe
- Caucasus
- Central Asia
SARI

South/Southeast Asia
PRE-SARI SYNTHESIS PROJECTS

LCLUC-2012
• Atul Jain/U. of Illinois
  • Land Cover and Land Use Changes and Their Effects on Carbon Dynamics in South and South East Asia: A Synthesis Study

• Jeff Fox, East-West Center, Hawaii
  • Forest, Agricultural, and Urban Transitions in Mainland Southeast Asia: Synthesizing Knowledge and Developing Theory

LCLUC-2013
• Peilei Fan, Michigan State U.
  • Urbanization and Sustainability Under Global Change and Transitional Economies: Synthesis from Southeast, East and North Asia

• Seto, Karen, Yale U.
  • Synthesis of LCLUC studies on Urbanization: State of the Art, Gaps in Knowledge, and New Directions for Remote Sensing Science
WHAT WE HAVE LEARNED BY NOW FOR THE SARI REGION

- Population growth => rapid urban expansion on rural and agricultural lands => further deforestation

- Prevalent commodity crops (rubber and palm) prices increase => reduced food production and increased food costs

- Large-scale land-cover conversion for agriculture => changes in carbon cycle and air quality degradation (biomass burning)

- Economic development initiatives => regional landscape fragmentation
Will be based on the pre-SARI projects and new projects from

- LCLUC-2015 selections for South Asia
- LCLUC-2016 selections for Southeast Asia
- Potentially Carbon Cycle-2016 and IDS-2016
The program has

- **advanced scientific analysis** to areas of the globe where LCLUC is taking place 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 globe
- **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 regional land-use change
DATA PRODUCTS THROUGHOUT THE YEARS

- NASA promotes the free and open sharing of data
- USGS - Landsat data for free distribution
- LCLUC expects its PI’s to make their data and products available to the broader community
- Data sharing is strongly encouraged
- Global maps of change in forests and mangroves
- Landsat GLS-75, -90, 2000, 2005, 2010 and WELD mosaics
- Metadata page on the LCLUC web site - too few projects
Dataset Creator: Matthew Hansen
Dataset: Global Forest Change

Overview
The Global Forest Change Product provides results from time-series analysis of 654,178 Landsat images in characterizing forest extent and change product. For definitions of Forest extent and change refer to Hansen et al., 2013.

Products Details
- Spatial Coverage: Global
- Temporal Coverage: 2000-2013
- Resolution: 1 arc-second per pixel (approx. 30m per pixel at the Equator)
- Projection: GCS WGS84 datum
- Data Type: 8-bit unsigned integer
- Data Format: GeoTIFF

Download
http://earthenginepartners.appspot.com/science-2013-global-forest

Citation
Forest Cover: 2013 percent tree cover
Tree Cover Extent and Forest Loss and Gain: 2000-2014
Mangrove forest cover change 1990-2005
Global cloud-free, geocorrected Landsat-based datasets centered on 1975, 1990, 2000, 2005, and 2010. EO-1 ALI data were used for mosaics over small islands.
- 1 scene per epoch at the peak of vegetation
- 30-m global mosaic
- For global assessments of land-cover change
- Paper describing GLS-2005 published in P&RS Journal with a cover image
- GLS datasets are complete and available for download via GLOVIS/EarthExplorer at USGS free of charge
- GLS-2015 ??

Progression of fires scars in central Canada
GLS (1990-2005) frames w/ > 1% closed canopy forest: MEASURES
LANDSAT-BASED GLOBAL IMPERVIOUS SURFACES
Prototype of Global Composite Using Landsat-5 and -7
The program has

- provided the basis for monitoring, reporting and verification of forest-cover change in the context of the implementation of Carbon Treaties
- created the means to undertake periodic, continuous global assessments of Land-Cover and Land-Use Change
- quantified rapid changes in the urban built environment, forest cover and agriculture around the globe
- provided the primary science rationale for the Landsat Mission and, more general, Sustainable Land Imaging
Ongoing projects:

More on the new and improved LCLUC website tomorrow afternoon
EDUCATION AND OUTREACH

- LCLUC site and Facebook page
  - One month ago we hit 1000 “likes”

- Quarterly e-Newsletter
  - The 2nd issue is out

- One-pagers

- Statistics:
  - Info on grad students needed
  - Info on publications needed

LCLUC Webinars series
- 16 projects have been showcased during 2014-15
- Urban and Urban-Ag transitions were covered
- The Spring 2016 webinar is on Ag monitoring
Educational Component: NASA-MSU IALE
Educational Component: Trans-Atlantic Training (TAT)

LCLUC Training in Latvia - 2010: Czech trainees

More on the new and improved LCLUC website tomorrow afternoon

Agreeing on the TAT: Prague, Dec 2011

NASA-ESA regular training sessions in Eastern Europe for students +3 years
June 2013 in Prague, Czech Rep.
June 2014 in Krakow, Poland
April 2015 in Prague, Czech Rep.
July 2016 in Zvolen, Slovakia
Hands-on Training
IT WOULDN'T HAVE BEEN POSSIBLE WITHOUT THEM DURING THE PAST 20 YEARS
Thank you,
Enjoy
Spring Blossoms

Happy 20th, LCLUC!