LCLUC PROGRAM: UPDATE

Garik Gutman,
NASA Headquarters
Manager, LCLUC Program

April 2018
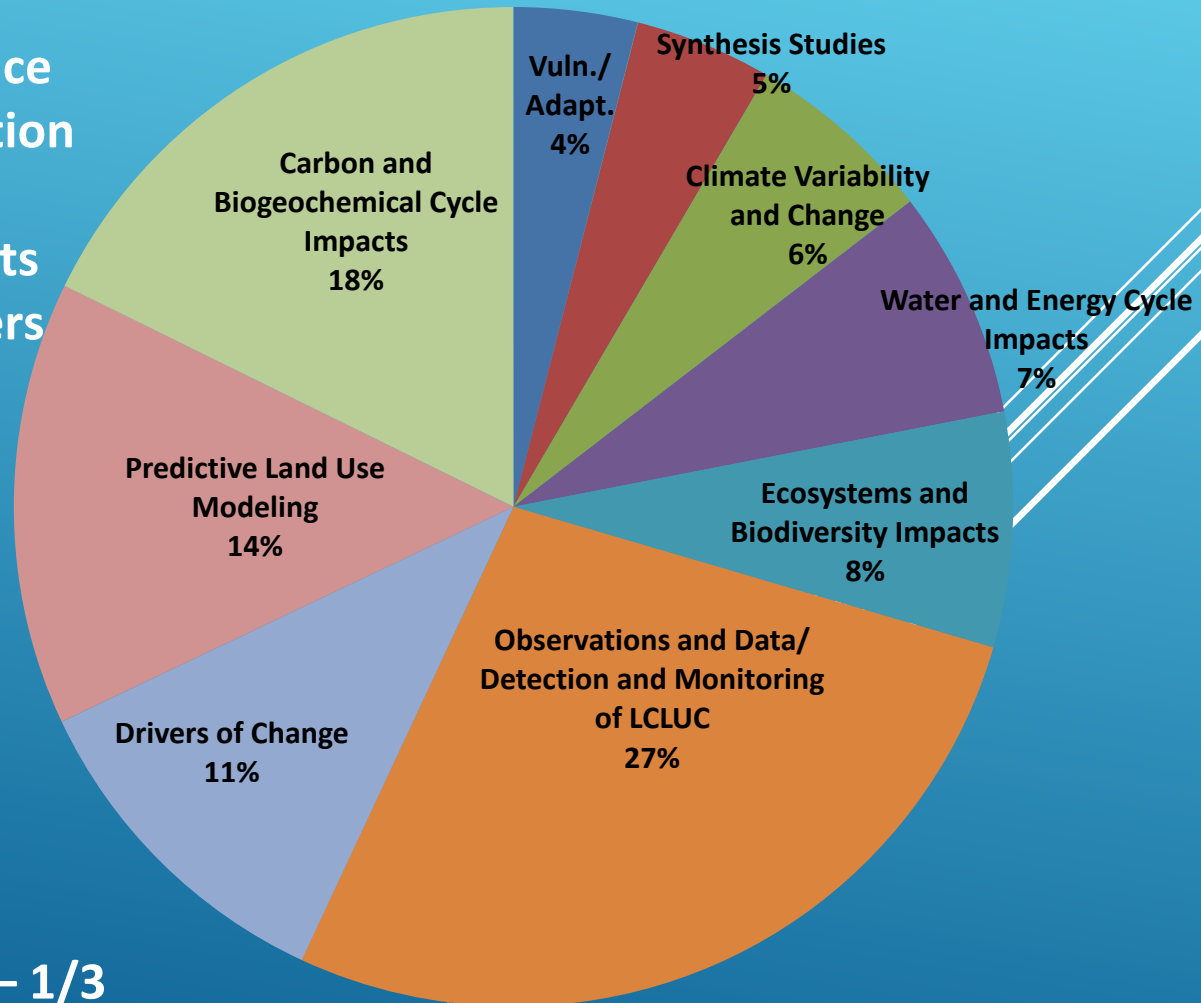
LCLUC Program Content

>300 projects since
Program's inception
Each year:
* ~40 3-yr projects
* ~300 researchers

Impacts - 1/3
Monitoring 1/3
Synthesis, other – 1/3

Vuln./ Adapt.
4%

Synthesis Studies
5%

Carbon and Biogeochemical Cycle Impacts
18%

Climate Variability and Change
6%

Water and Energy Cycle Impacts
7%

Predictive Land Use Modeling
14%

Ecosystems and Biodiversity Impacts
8%

Observations and Data/ Detection and Monitoring of LCLUC
27%

Drivers of Change
11%

http://lcluc.hq.nasa.gov

LCLUC GLOBAL SCIENCE PROGRAM

▸ Socio-economic component as an integral part of projects

▸ Remote sensing component

  ▸ MuSLI (Multi-Source Land Imaging) component

    ▸ Social science is not required

    ▸ Multiple sensor 10-30m resolution data are to be used

    ▸ Merging with Landsat Science Team activities

▸ Regional Initiatives, geographic focus

▸ Capacity Building/Education component

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 & MuSLI

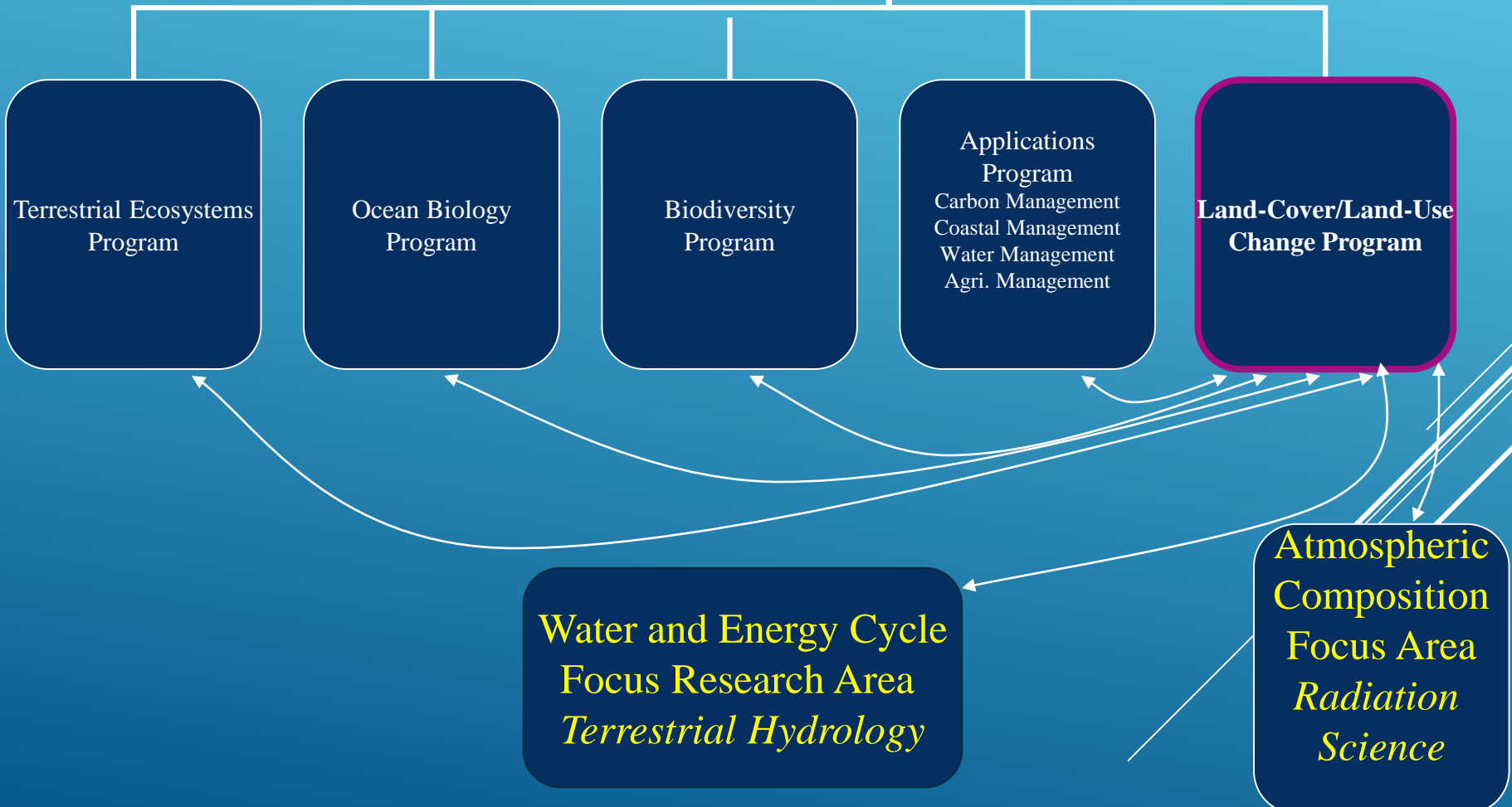2018: SARI-1: South Asia & MuSLI

2019: SARI-2: SE Asia & Caucasus

International Regional

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/MAIRS: Yangon, Burma/Myanmar

2017/7: SARI/MAIRS: Chiang Mai, Thailand

2018/5: SARI: Manila, Philippines

2019: TBD

INTERNAL LINKAGES @ NASA

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

- **USGS**
  - Merge of the newly selected Landsat & MuSLI Science Teams
- **USAID**
  - SERVIR (acronym standing for Mesoamerican Regional Visualization and Monitoring System in Spanish)
  - PEER (Partnerships for Enhanced Engagement in Research)
- **USFS**
  - Global Forest Observations Initiative (GFOI)

EXTERNAL LINKAGES: INTERNATIONAL

- **GOFC-GOLD**

  - •Fire IT office at UMD
  - • START Inc. activities
  - •Regional Information Networks

- **CEOS/GEO**

  - • CEOS on Cal/Val WG
  - • CEOS LSI Constellation WG
  - • GEO Tasks (SB-02 C1) on Global Landcover
  - • GEO WG on Land Cover Africa
  - • GFOI
  - • GEOGLAM

- **Future Earth**

  - • Global Land Program (GLP)
  - • NEFI
  - •Future Asia

- **SERVIR**

  - • SARI (Himalaya and Mekong hubs)

- **EARSeL LULC Special Interest Group**

  - • Joint biennial workshop

- **ESA and EU institutions**

  - • Landsat-Sentinel products under MuSLI

THE ROLE OF SOCIAL SCIENCE IN LCLUC PROGRAM

- **Social and economic science research includes**
  - **impacts of changes in human behavior on LCLUC**
  - **impacts of LCLUC on society**
  - **adaption to climate/environmental change of land-use systems**
- **During the last 12 years, the Social/Economics Science component has been a mandatory part of all LCLUC proposals, unless otherwise stated in the solicitation**

Land Use Science: Relevance to Resource Management
often with an applied focus and regional implementation

International Satellites
Satellite Data, Products, Services

NASA
Satellite Data, Products, Services

EO Requirements

LCLUC Science Research

Applied Sciences

Science Questions
- Remote Sensing Observations
- Physical and Social Science
- Method Development
- Scientific Results Publications
- Data Sets

Research to Operations
(Scientists and End Users)
- Operational R and D
- User Requirements
- Tools / Products
- Decision Support Systems

Enhancing End User uptake of EO in Operational Systems

- Operational End Users
- Decision Support Systems
- Value of EO

Science Capacity Building / Training ↔ **User Capacity Building / Training**

Coordination

SERVIR
(developing country focus)

International and Regional LU Science
- GLP
- GOFC-GOLD Regional Networks
- EARSEL LUCC

- Env. Decision Making using EO
- Geospatial Technologies
- Tools/ information

INTERNATIONAL REGIONAL INITIATIVES

- **Northern Eurasia's Future Initiative (NEFI)**
  - ▸ **LCLUC-2016: Caucasus element**

- **MAIRS under Future Asia**
  - ▸ **Coordinated with SARI**

- **South/Southeast Asia Research Initiative (SARI)**
  - ▸ **Pre-SARI Projects**
  - ▸ **LCLUC-2015: South Asia**
  - ▸ **LCLUC-2016: Southeast Asia**

Project Scientst
NEFI
Pasha Groisman,
NOAA/UCAR

Project Scientist
MAIRS
Jiaguo Qi, MSU

Project Scientist
SARI
Krishna Vadrevu,
NASA MSFC

NEESPI: 12 YEARS OF SCIENCE
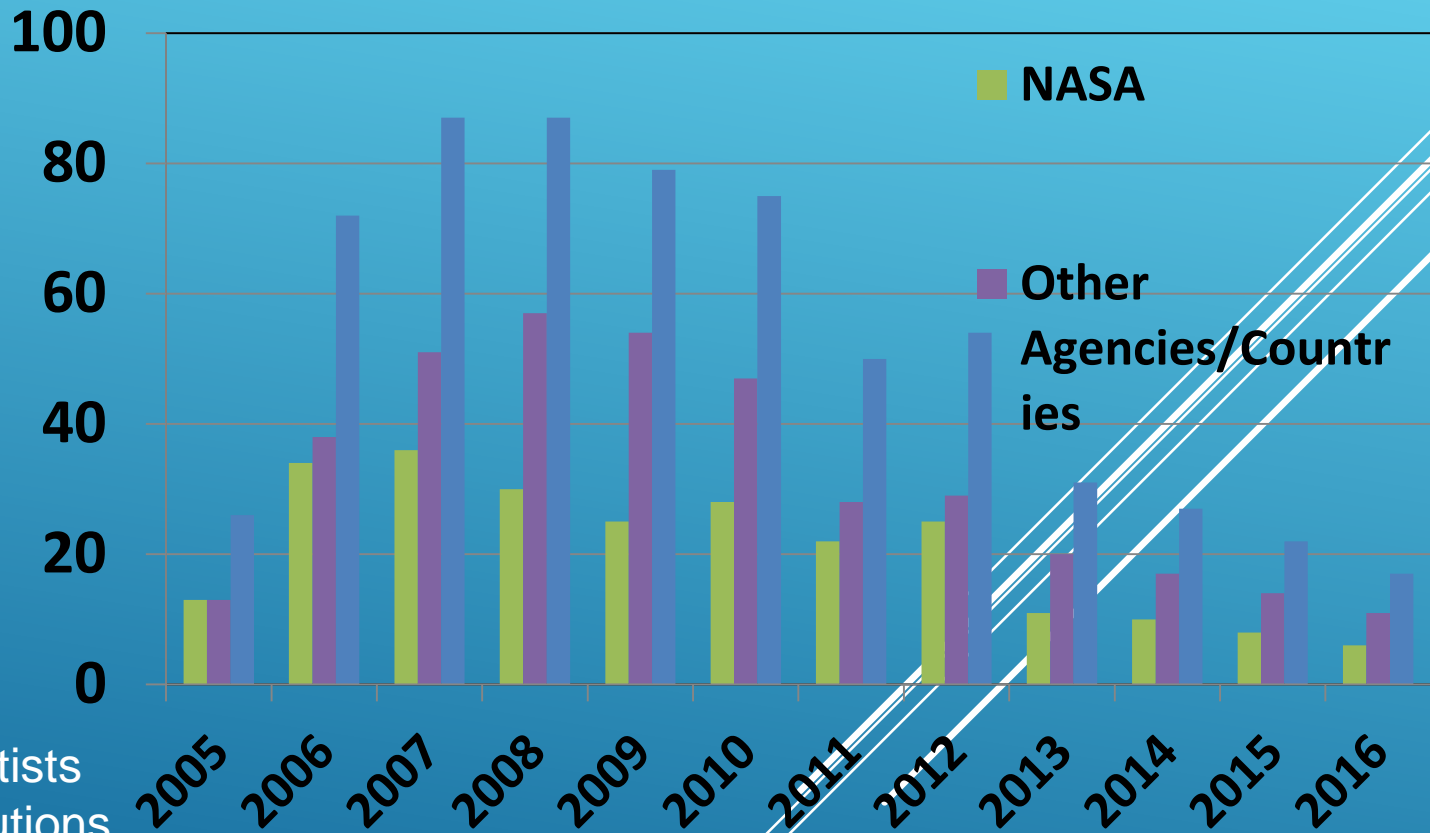
over 1500 papers and 40 books

>750 scientists
>200 institutions
>170 projects
30 countries

>80 Ph.D. students

NEESPI → NEFI

LCLUC-2016 selected 3 projects (on Caucasus)

Synthesis by Peilei Fan for Siberia (urbanization)

NEESPI-LCLUC BOOKS

Eurasian Arctic Land Cover and Land Use in a Changing Climate
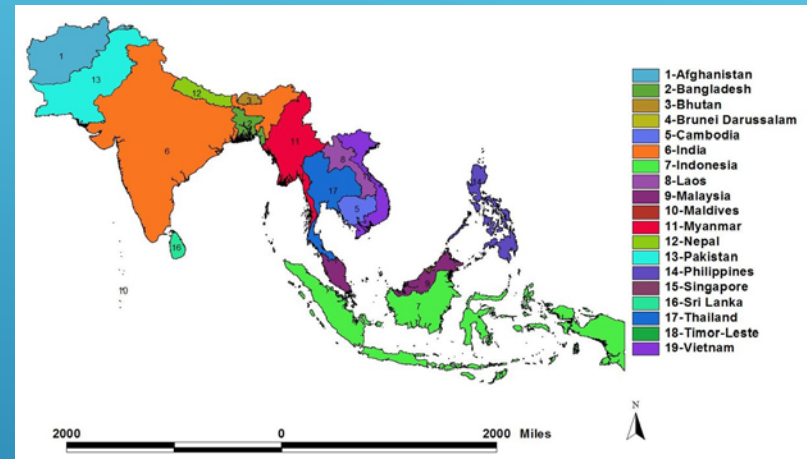
Springer 2010

Regional Environmental Changes in Siberia and Their Global Consequences

Springer 2012

DRYLAND EAST ASIA: LAND DYNAMICS AMID SOCIAL AND CLIMATE CHANGE

Springer 2013

Land-Cover and Land-Use Changes in Eastern Europe after the Collapse of the Soviet Union in 1991
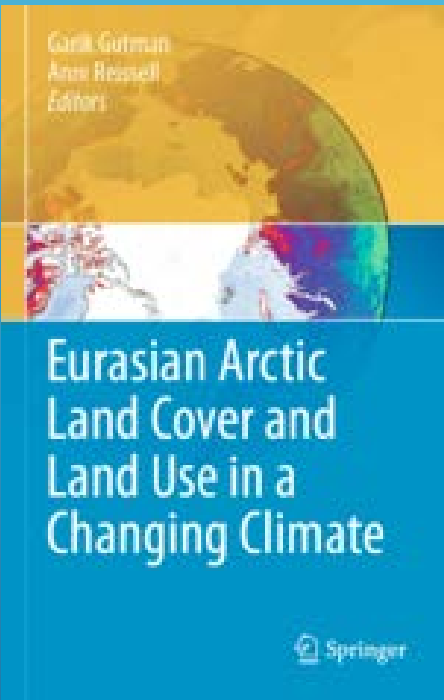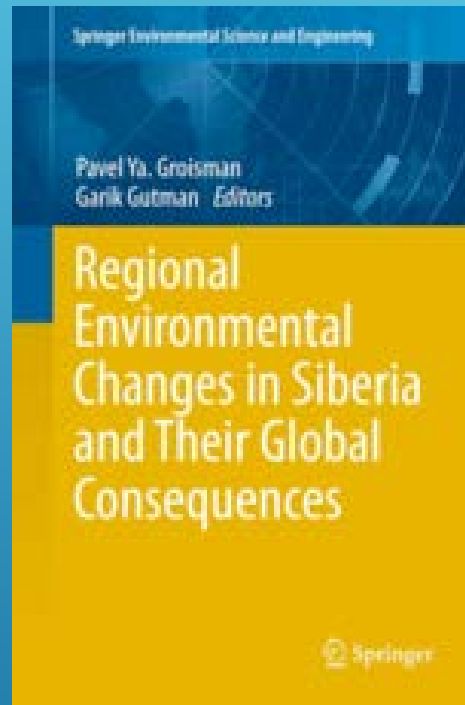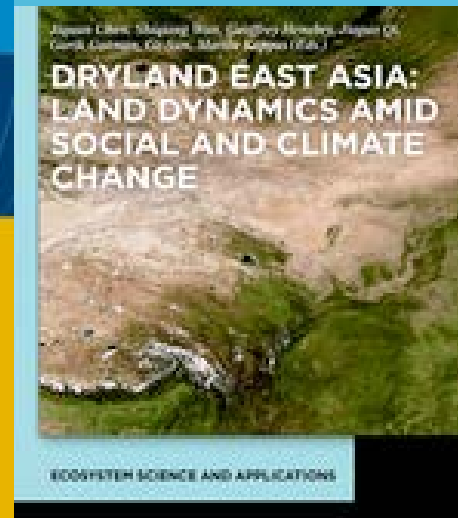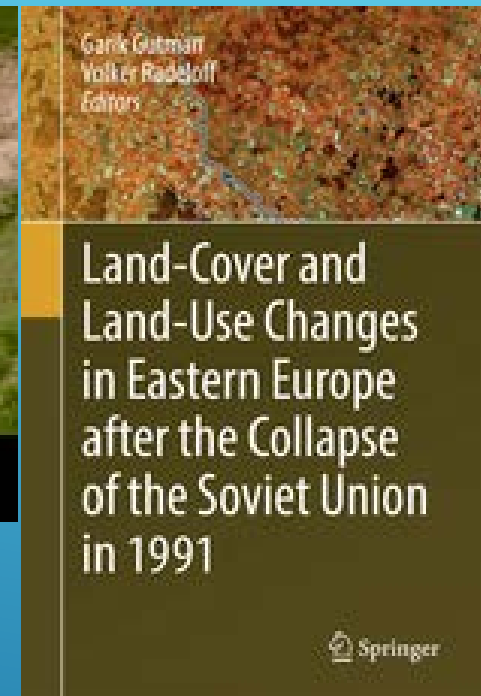
Springer 2017

LCLUC in Central Asia to be published in 2018

THE SOUTH/SOUTHEAST ASIA RESEARCH INITIATIVE (SARI)

▶ Develop an innovative regional research, education, and capacity building program involving state-of-the-art remote sensing, natural sciences, engineering and social sciences to enrich Land Cover/Land Use Change (LCLUC) science in South/Southeast Asia

▶ Adaptive capacity of humans is low and vulnerability is high

▶ About 20 ongoing projects on SARI region from 2 solicitations (2015-2017)

▶ Interactions with two SERVIR hubs: Mekong and Himalaya

▶ Several regional SARI workshops and trainings have been conducted to address SARI science questions including the following:

  ▶ How regional LCLUC interact with climate, water resources, biodiversity, and atmosphere?

  ▶ What are the vulnerability and impacts related to LCLUC, and how systems adapt to changes?

  ▶ What are the nature, magnitude, drivers and impacts of regional LCLUC?

1-Afghanistan
2-Bangladesh
3-Bhutan
4-Brunei Darussalam
5-Cambodia
6-India
7-Indonesia
8-Laos
9-Malaysia
10-Maldives
11-Myanmar
12-Nepal
13-Pakistan
14-Philippines
15-Singapore
16-Sri Lanka
17-Thailand
18-Timor-Leste
19-Vietnam

• Advantageous features of the SARI region
  • Easy to communicate in English with researchers, students, and stakeholders
  • Dedicated student support from Universities
  • High computer literacy

• It is expected that the program will
  • advance LCLUC science in the region
  • strengthen existing and build new collaborations between US and South/Southeast Asia researchers
  • help develop regional scale LCLUC models useful for decision support

NASA-MAIRS PRE-SARI STUDIES
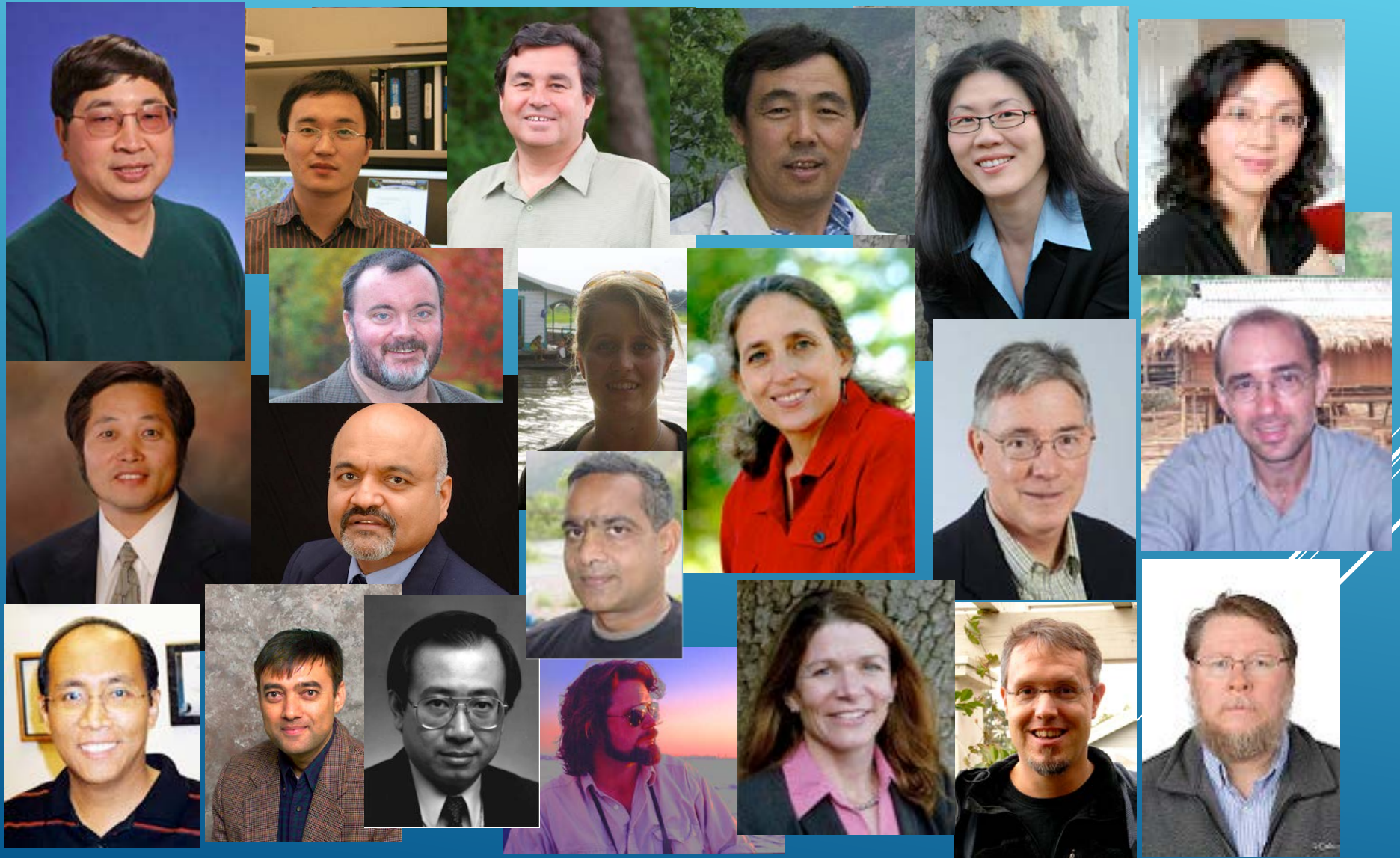
PRE-SARI SYNTHESIS PROJECTS

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

15

LAND COVER AND LAND USE CHANGES AND THEIR EFFECTS ON CARBON DYNAMICS IN SOUTH AND SOUTHEAST ASIA
PI: ATUL JAIN (U. ILLINOIS)

- Data: ESA CCI land cove data to reveal the dynamics of forest and agricultural land from 1992 to 2015

- Hot Spot Analysis technique; principle component analysis; Geographically Weighted Regression model

- The hotspot regions conversions between forest and agricultural land are in Kalimantan, Sumatra, East India, and the Hindu Kush, Himalayan region

- Relative importance of biophysical and socioeconomic drivers varied in different countries

- Roughly equal contributions from biophysical and socioeconomic drivers were observed in Bhutan, Philippines, Sri Lanka, Thailand and Vietnam

- Major drivers of deforestation vary

  - drivers in Bhutan - terrain, soil, water conditions, population and urbanization

  - drivers in Philippines - terrain, soil, water and economy
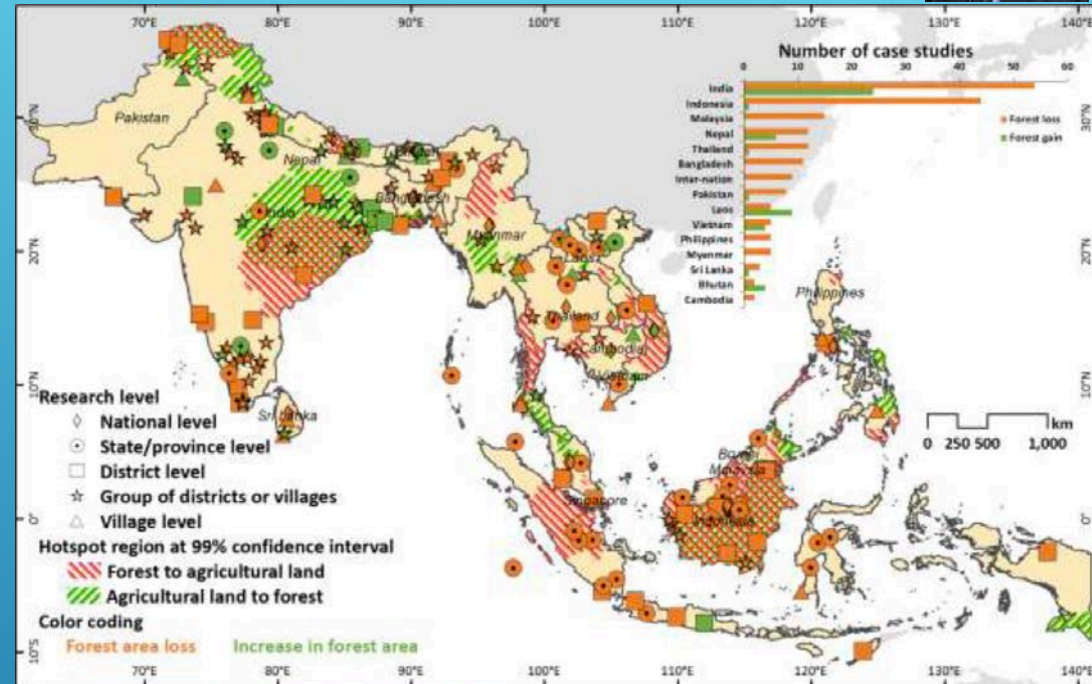
Spatial distribution of LULCC driver case studies and hotspot regions for LULCCs

Field data from Thenkabail et al. (2017) for validation of products

FOREST, AGRICULTURAL, AND URBAN TRANSITIONS IN MAINLAND SOUTHEAST ASIA: SYNTHESIZING KNOWLEDGE AND DEVELOPING THEORY
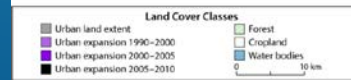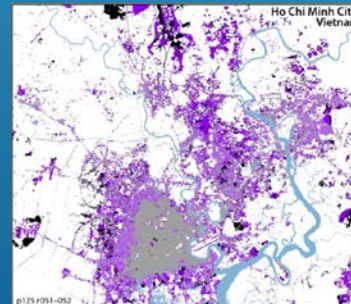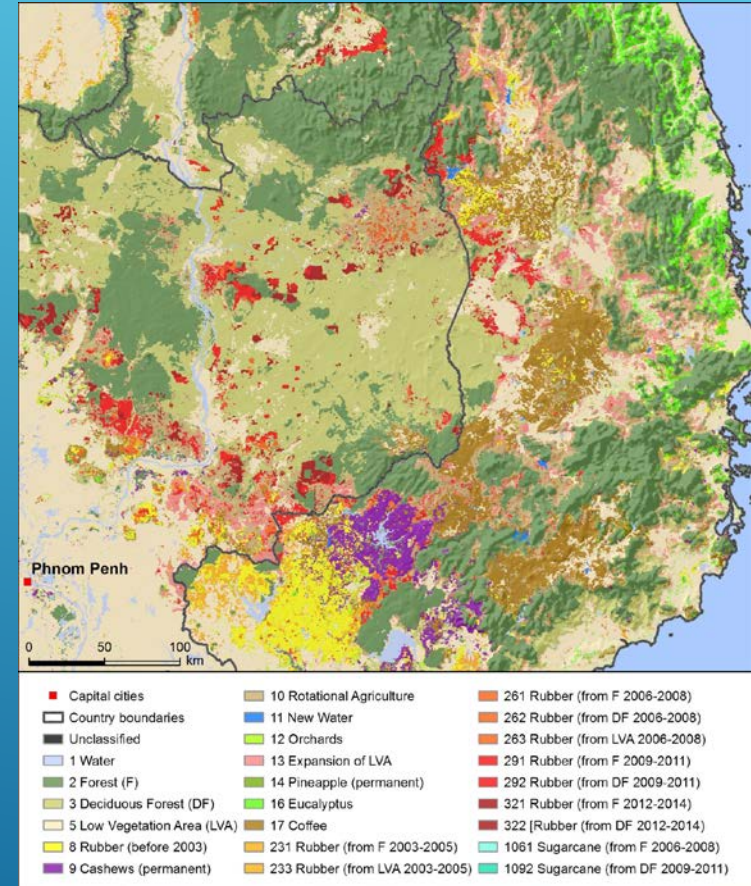
PI: JEFFERSON FOX (EAST WEST CENTER, HAWAII)

Objectives:
- Synthesize existing approaches for mapping the expansion of upland-boom crops and the growth of urban areas throughout Mainland SE Asia.
- Enhance the conceptual underpinnings of land-change science by linking land changes to local, national, and international drivers.

Methods:
- Map the expansion of urban areas and upland-tree plantations using time-series Landsat data and Google Earth images. Use MODIS EVI time-series data and training areas derived from Landsat classifications to map change at regional scales.
- Conduct focus group discussions and household interviews for a sample of forests, tree plantations, and periurban areas in Cambodia, Laos, and Vietnam to produce an integrated understanding of LCLUC

land-cover change classification

Land cover change classification legend:
- Capital cities
- Country boundaries
- Unclassified
- 1 Water
- 2 Forest (F)
- 3 Deciduous Forest (DF)
- 5 Low Vegetation Area (LVA)
- 8 Rubber (before 2003)
- 9 Cashews (permanent)
- 10 Rotational Agriculture
- 11 New Water
- 12 Orchards
- 13 Expansion of LVA
- 14 Pineapple (permanent)
- 16 Eucalyptus
- 17 Coffee
- 231 Rubber (from F 2003-2005)
- 233 Rubber (from LVA 2003-2005)
- 261 Rubber (from F 2006-2008)
- 262 Rubber (from DF 2006-2008)
- 263 Rubber (from LVA 2006-2008)
- 291 Rubber (from F 2009-2011)
- 292 Rubber (from DF 2009-2011)
- 321 Rubber (from F 2012-2014)
- 322 Rubber (from DF 2012-2014)
- 1061 Sugarcane (from F 2006-2008)
- 1092 Sugarcane (from DF 2009-2011)

Ho Chi Minh City, Vietnam

Land Cover Classes
- Urban land extent
- Urban expansion 1990~2000
- Urban expansion 2000~2005
- Urban expansion 2005~2010
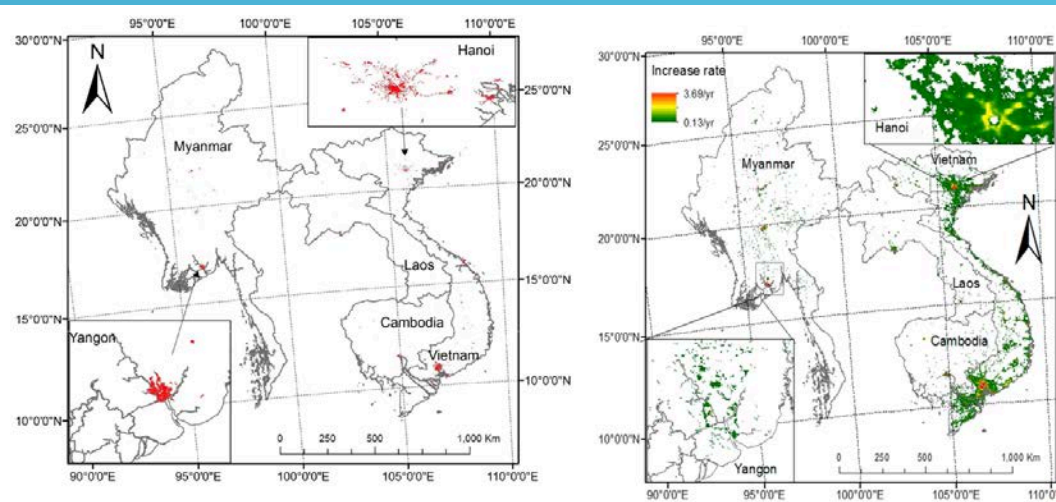- Forest
- Cropland
- Water bodies

- Cambodia and Laos: mainly new rubber
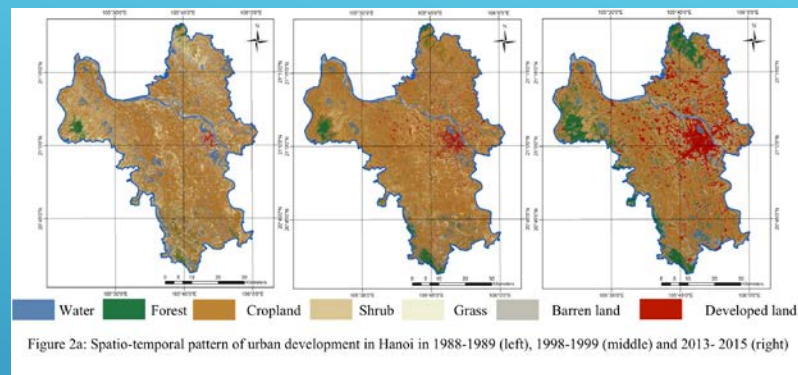- Vietnam: old and new rubber as well as cashew, coffee, and new eucalyptus plantations

URBANIZATION AND SUSTAINABILITY UNDER GLOBAL CHANGE AND TRANSITIONAL ECONOMIES
PI: PEILEI FAN (MICHIGAN STATE UNIVERSITY)
webpage: senacgc.org

Left: Urban built-up land in Vietnam, Cambodia, Laos, and Myanmar in 2010 with a spatial resolution of 30 m
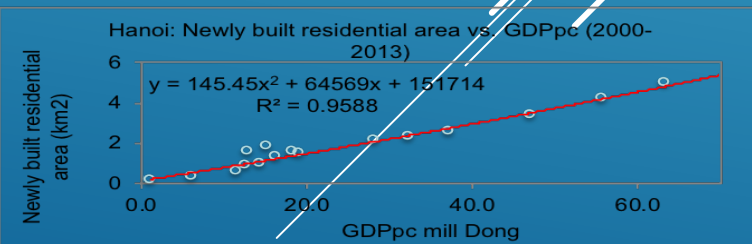Right: The increasing trends of DMSP/OLS NTL brightness in 1992-2010

- Data: Landsat, DMSP/OLS night time light, MODIS NDVI data, and other ancillary spatial data
- Goal: Develop a 30-m resolution urban built-up map of 2010 for transitional economies in Southeast Asia
- Conclusions
  - Vietnam had the highest proportion of urban built-up area, followed by Myanmar, Cambodia and Laos.
  - Vietnam was also the fastest in new built-up development (increased ~8.8-times during the 18-year study period)


Figure 2a: Spatio-temporal pattern of urban development in Hanoi in 1988-1989 (left), 1998-1999 (middle) and 2013- 2015 (right)

Legend: Water — Forest — Cropland — Shrub — Grass — Barren land — Developed land

Hanoi as an example
- Developed land of Hanoi enlarged by 4 times from 32.1 km^2 in 1988-1989 to 129.9 km^2 in 1998-1999, and by 11 times to 361.7 km^2 in 2013-2015
- Both the surface fine particulate matter (PM$_{2.5}$) and NO$_2$ have shown an overall increasing trend. In recent years, PM$_{2.5}$ reached unhealthy level (> 35.5ug/m^3) for sensitive groups
- Economic development is the major driver for urbanization in Hanoi

Hanoi: Newly built residential area vs. GDPpc (2000-2013)

$y = 145.45x^2 + 64569x + 151714$
$R^2 = 0.9588$

Newly built residential area (km2) vs GDPpc mill Dong

Synthesis of LCLUC studies on Urbanization: State of the Art, Gaps in Knowledge, and New Directions for Remote Sensing Science

Karen Seto, Yale University

- What are the patterns of urban LCLUC globally?
- What are the drivers of urban LCLUC globally?
- How do change detection algorithms characterize urban LCLUC?
- What are best practices for applying urban change detection algorithms?
- What are the effects of urban LCLUC on other LCLU?
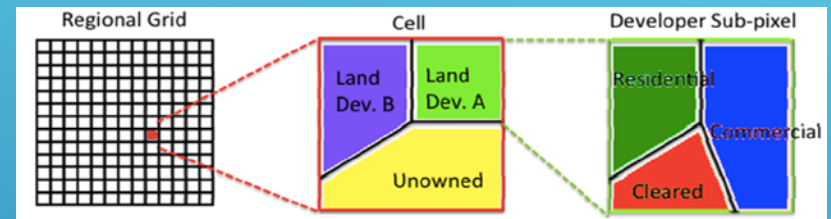
- Method: multi-level modeling approach to examine how socio-economic and policy factors—represented here by fiscal transfers—at different administrative levels affect growth in "urban hotspot counties" across three time periods (1995-2000, 2000-2005, and 2005-2008)

Results
- counties that are more dependent on fiscal transfers from the central government convert less cultivated land to urban use
- local governments are becoming more powerful in shaping urban land development as a result of local economic, fiscal, and political incentives and through the practical management and control of capital, land, and human resources
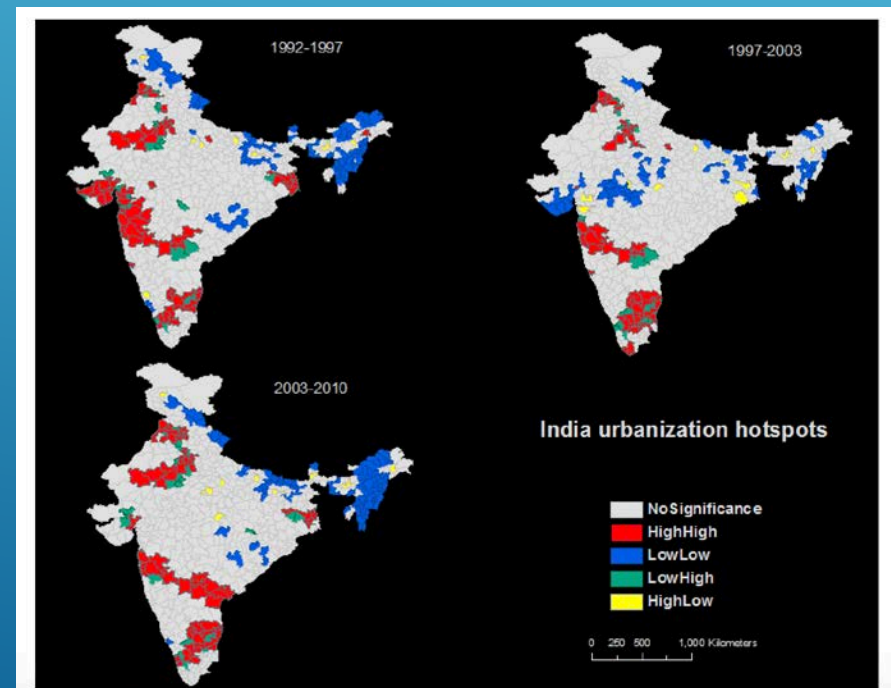
WHAT WE HAVE LEARNED FROM PRE-SARI SYNTHESIS

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

- Prevalent commodity crops (rubber and palm) prices ↑ => food production ↓ and food costs ↑

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

- The hotspot of forest ←→agriculture: Kalimantan, Sumatra, East India, and the Hindu Kush, Himalayan region

- Economic development initiatives => regional landscape fragmentation

- Vietnam has the highest proportion of urban built-up area and is the fastest in new built-up development

- **Counties in India that are more dependent on fiscal transfers from the central government convert less cultivated land to urban use**

ADDITIONAL PRE-SARI NASA LCLUC PROJECTS (MUSLI AND IND. FORESTS)

▸ William Salas, Applied Geosolutions

  ▸ Operational Algorithms and Products for Near Real Time Maps of Rice Extent and Rice Crop Growth Stage Using Multi - Source Remote Sensing

Tonle Sap, Cambodia Sentinel-1A Rice Inundation Dynamics Time Series

▸ Jinwei Dong, U. Oklahoma

  ▸ Mapping Industrial Forest Plantations in Tropical Monsoon Asia Through Integration of Landsat and PALSAR

● David Skole, Michigan State U.

  ● Monitoring and Mapping the Area, Extent and Shifting Geographies of Industrial Forests in the Tropics
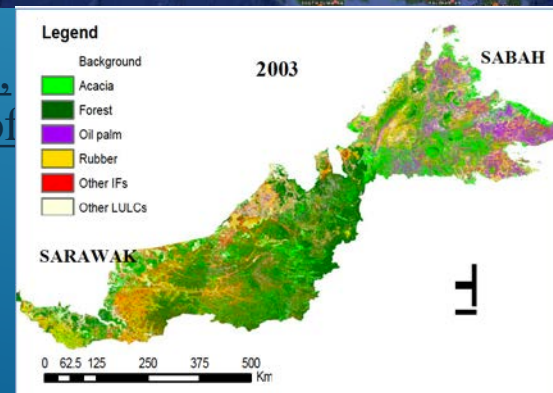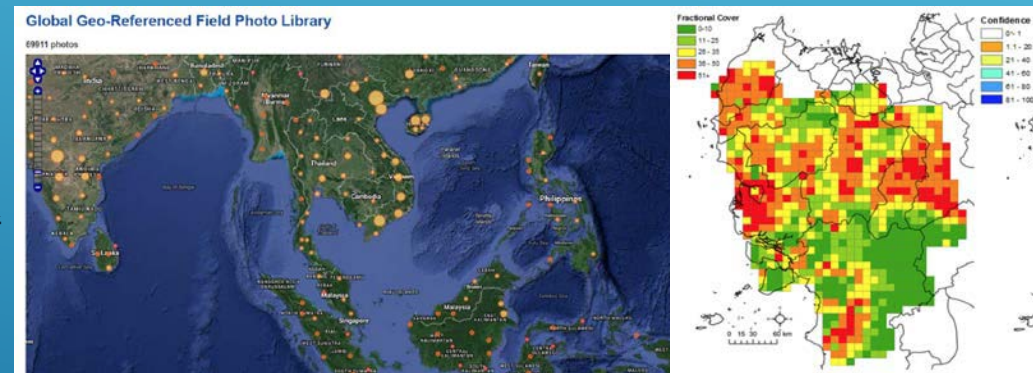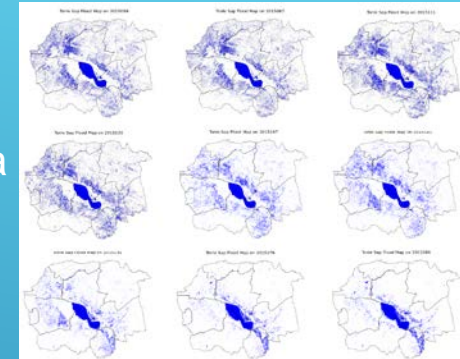
Plantation fractional cover for western West Kalimantan, Indonesia

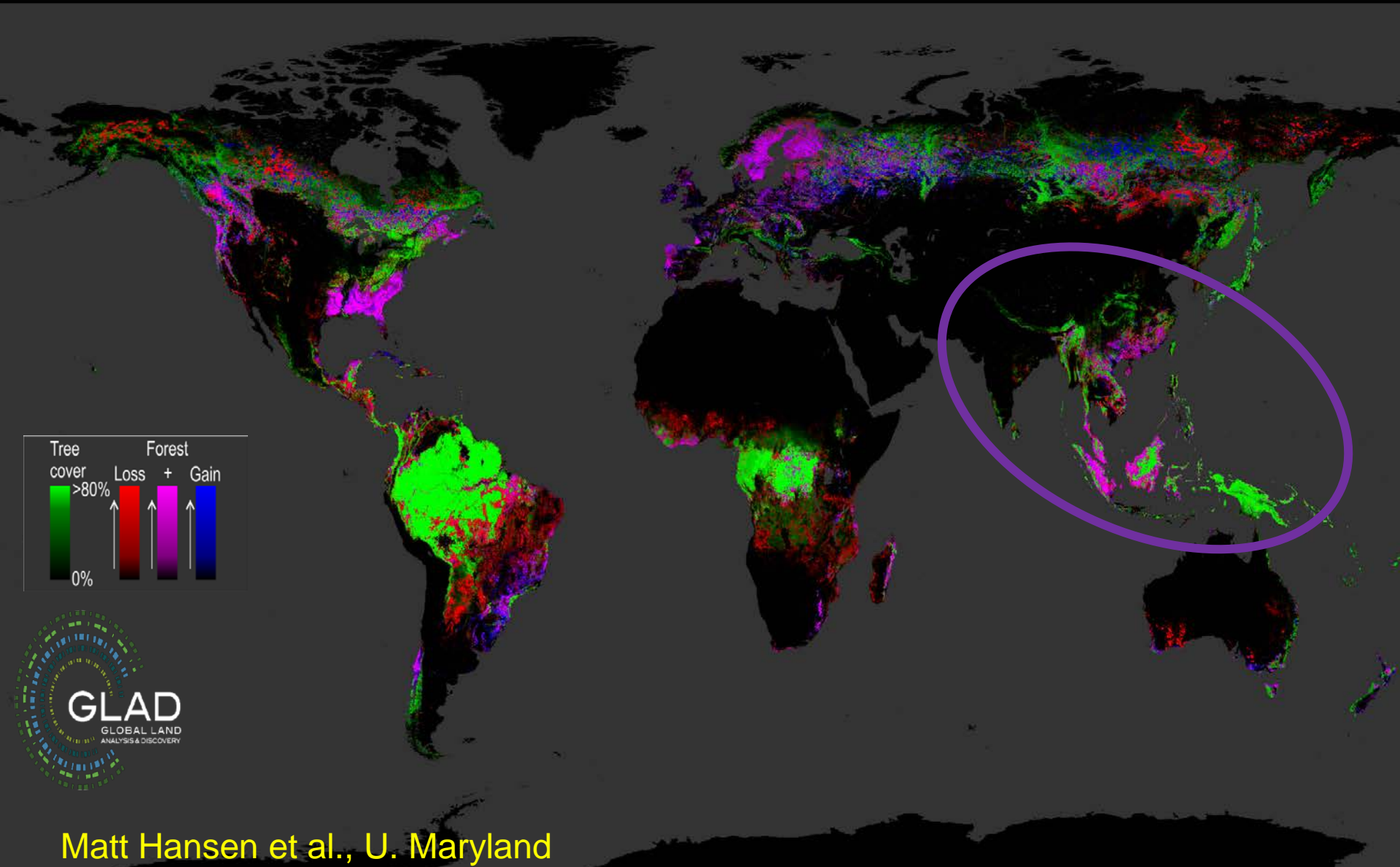The spectral analysis-based land use/land cover map based the *fC* dataset in Sabah and Sarawak, 2003.

Mangrove forest cover change 1990-2005

Chandra Giri, USGS-> EPA

© 2007 National Geographic Magazine
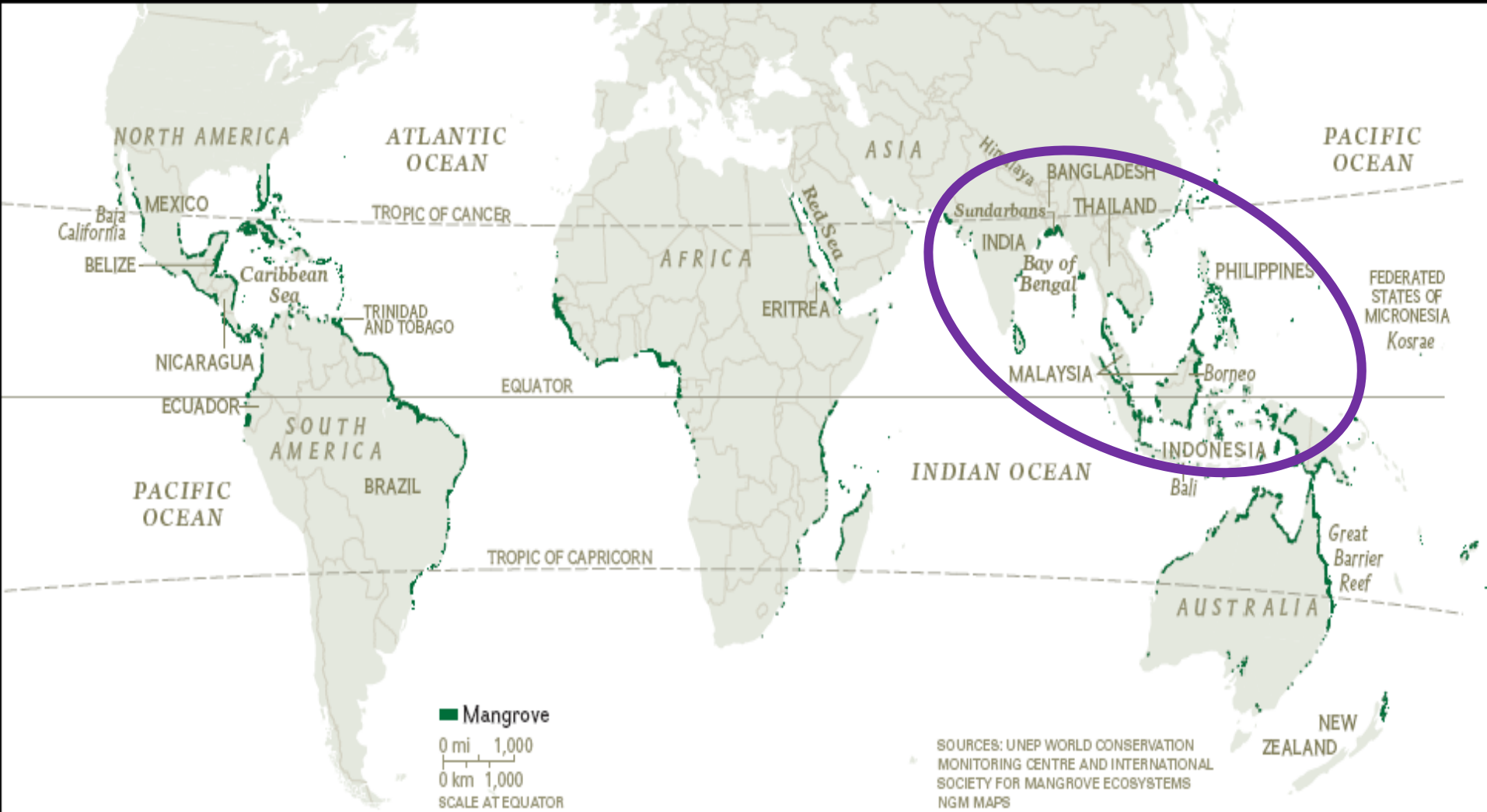
Tree Cover Extent and Forest Loss and Gain: 2000-2014

Matt Hansen et al., U. Maryland

NASA-SARI SCIENCE

Will be based on the pre-SARI projects and ongoing projects from

- ▶ LCLUC-2015 selections for South Asia

- ▶ LCLUC-2016 selections for Southeast Asia

- ▶ LCLUC-2018 forthcoming selections on Asia

A PASSAGE TO INDIA:

- The 5th anniversary of SARI's birth on the bus traveling in the Ooty National Park in Tamil Nadu

- Mid-term for LCLUC projects on South Asia, mostly India

- 15th anniversary of Indian Resourcesat-1 this year

THE BEATLES IN INDIA

- The 50th anniversary of the Beatles' visit to India

Maharishi Mahesh Yogi and participants of a meditation course pose for a photograph, in February 1968.

LCLUC-2015: Ongoing SARI South Asia Projects

DeFries, Ruth **Urban impact on forests** **(India)**	**Columbia U.**	**Tropical Deciduous Forests of South Asia: Monitoring Degradation and Assessing Impacts of Urbanization**
Wynne, Randy **Plantations** **(India)**	**Virginia Tech**	**Spatiotemporal Drivers of Fine-Scale Forest Plantation Establishment in Village-Based Economies of Andhra Pradesh**
Fleischman, Forrest **Afforestation** **(India)**	**U. Minnesota**	**Impacts of afforestation on sustainable livelihoods in rural communities in India.**
Jain, Meha **Agriculture** **(India)**	**U. Michigan**	**The Future of Food Security in India: Can Farmers Adapt to Environmental Change?**
Aditya Singh **Agricuture** **(India)**	**U. Florida**	**Landscapes in flux: The influence of demographic change and institutional mechanisms on land cover change, climate adaptability and food security in rural India**
Di, Liping **Agriculture** **(India)**	**George Mason U.**	**Understanding changes in agricultural land use and land cover in the breadbasket area of the Ganges Basin 2000-2015: A socioeconomic-ecological analysis**

LCLUC-2015: Ongoing SARI South Asia Projects (cont.)

Vincent, Jeff/Giri, Chandra Mangroves (South Asia)	Duke U./EPA	Consequences of changing mangrove forests in South Asia on the provision of global ecosystem goods and services
Seto, Karen Urban growth (South Asia)	Yale U.	Urban growth, land-use change, and growing vulnerability in the Greater Himalaya mountain range across India, Nepal, and Bhutan
Loboda, Tatyana Malaria (Myanmar)	U. Maryland	Understanding the role of land cover / land use nexus in malaria transmission under changing socio-economic climate in Myanmar
Leimgruber, Peter Deforestation (Myanmar)	Smithsonian Institution	Complex Forest Landscapes and Sociopolitical Drivers of Deforestation - The Interplay of Land-use Policies, Armed Conflict, and Human Displacement in Myanmar

LCLUC-2016: New SARI SE Asia Starts

Qi, Jiago SEA: Mekong Region	Michigan State U.		Assessing the impacts of dams on the dynamic interactions among distant wetlands, land use, and rural communities in the Lower Mekong River Basin
Hansen, Matt SEA: Indonesia	U. Maryland		Quantifying the impact of perverse incentives from Indonesia deforestation moratorium, 2011 to 2016
Fox, Jeff SEA: Mainland SE Asia	East-West Center, Hawaii		The agrarian transition in Mainland Southeast Asia: Changes in rice farming 1995 to 2018
McCarty, Jessica SEA: Vietnam	Miami U., Ohio		Land-cover/land-use change in southern Vietnam through the lenses of conflict, religion, and politics, 1980s to present
Nghiem, Son SEA: Mekong Region	JPL		Land Use Status, Change and Impacts in Vietnam, Cambodia and Laos
Bandaru, Varaprasad SEA: Thailand	U. Maryland		Agricultural Land Use Change in Central and Northeast Thailand: Effects on Biomass Emissions, Soil Quality, and Rural Livelihoods

LCLUC-2016: New Starts for NEFI (formerly NEESPI)

Radeloff, Volker Caucasus	U. Wisconsin		Long-term land degradation in the Caucasus
Olofsson, Pontus Caucasus	Boston U.		Comprehensive analysis of thirty years of land change in Georgia: patterns, carbon dynamics and drivers
de Beurs, Kirsten Caucasus	U. Oklahoma		Land Use Patterns and Political Instability as Predictors for the Re-emergence of Malaria in the Caucasus.

DATA PRODUCTS

- *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
- NASA-USGS Landsat Global Land Surveys: GLS-75, -90, 2000, 2005, 2010
- WELD mosaics
- Global
  - Forest/Change
  - Mangroves/Change
  - Impervious Surfaces/Urban/Change
  - Agriculture/Change
- Metadata page on the LCLUC web site – 22 projects represented

Metadata Page on LCLUC website

Data and Information

Data Initiatives	Satellite Sensing Systems	Metadata

Dataset Creator Matthew Hansen
Dataset Global Forest Change
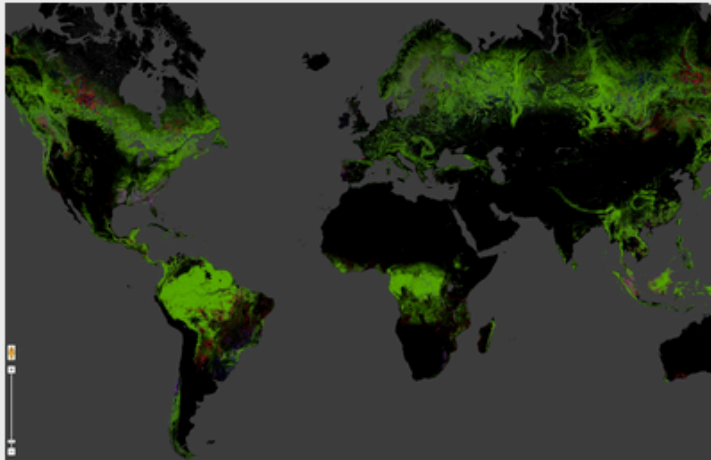
Overview

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.

Project Details

PI Details

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

Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." Science 342 (15 November): 850-53. Data available on-line from: http://earthenginepartners.appspot.com/science-2013-global-forest.

Multi-sensor Fusion to Determine Climate Sensitivity of Agricultural Intensification in South Asia

India Annual Winter Cropped Area, 2016
India Data Collection

1 - PUNJAB

2 - GUJARAT

3 - MADHYA PRADESH

India Annual Winter Cropped Area, 2001–2016, part of the India Data Collection, is a compilation of the extents of annual winter cropped area across India (except the Northeastern states) from 2001 to 2016. This data set utilizes NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) Enhanced Vegetation Index (EVI) time-series for winter growing season (October–March) to produce percent estimates per grid cell for winter cropped area. This map displays percent winter cropped area at a spatial resolution of 1 km for the year 2016.

Winter Cropped Area (%)
0 20 40 60 80 100
No Data

- India Annual Winter Cropped Area, 2001 – 2016
- consists of annual winter cropped areas for most of India (except the Northeastern states)
- from 2000-2001 to 2015-2016.
- NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) Enhanced Vegetation Index (EVI; spatial resolution: 250m) for the winter growing season (October-March).
- Automated algorithm identifies the EVI peak in each pixel for each year and linearly scales the EVI value between 0% and 100% cropped area within that particular pixel.
- Maps were then resampled to 1 km and were validated using high-resolution QuickBird, RapidEye, SkySat, and WorldView-2 images spanning 2008 to 2016 across 11 different agricultural regions of India.
- The spatial resolution of the data set is 1 km, resampled from 250m.
- The data are distributed as GeoTIFF and NetCDF files and are in WGS 84 projection.

Meha Jain
Pinki Mondal
Gillian
Galford
Ruth DeFries

Download Link:
http://sedac.ciesin.columbia.edu/data/set/india-india-annual-winter-crop...

Annually-available dataset in Geotiff or netCDF format with 1km spatial resolution in WGS84 projection. For more details please view the product documentation

Earth Observations from Private Sector Small Satellite Constellations Pilot

- Pilot data buys in 2018 of existing data products related to ECVs derived from private sector-funded small-satellite constellations (at least 3-sats)

- Evaluation by NASA-affiliated researchers to determine value for advancing NASA research and applications activities and objectives

- Researchers will be supported to assess the value of the basic quality geophysical information(stability, characterization, etc.) in the products

- 1 year evaluation period

  - Participants primarily chosen from existing LCLUC projects

  - Written reports to NASA

MULTI-SOURCE LAND IMAGING (MUSLI)

- Sentinel-1a: launched Apr 2014
- Sentinel-1b: launched Apr 2016
- Sentinel-2a: launched Jun 2015
- Sentinel-2b: launched Mar 2017

- Landsat-7 & - 8 – nominal operations

MuSLI ESA Project Scientist
Benjamin Koetz, ESA
Earth Observations Engineer

MuSLI NASA Project Scientist
Jeff Masek, NASA
Landsat-9 Project Scientist

•Prior efforts to synergistically use Sentinel data along with Landsat-8
    •Joint NASA-UMD-CNES/CESBIO project
    •Sentinel-2 NASA Data Use Preparation team
    •Cross-Calibration (GSFC)

LCLUC-2014 MUSLI SCIENCE TEAM

PI and CO-Is

Salas , Applied Geosolutions
Torbick, AG

Lang, U Maryland
Jones, USGS
Huang, UMD

Small, Columbia U.
Nghiem, JPL
Greg Yetman, Columbia U.

Friedl, Boston U.
Gray, BU
Melaas, BU

Roy, South Dakota State U.
Kovalskyy, SDSU
Boschetti, U. Idaho

Hansen, U. Maryland
Potapov, UMD

Townshend, U. Maryland
Sexton, UMD
Feng, UMD
Channan, UMD

Int. Collaborators

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Tansey, UK

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Koetz, ESA,
Sentinel-2 Projects
Coordinator

Dedieu & Hagolle,
CESBIO

Landcover Project Science Office

Masek, NASA, MSLI Project
Scientist

Markham, NASA, calibration team
Helder, SDSU
Czapla-Myers (U. Az)

Schott, RIT
DIRSIG model, LST

Vermote, NASA GSFC
Atm. Corr. Team Claverie, U. MD

Woodcock, Boston U.,
clouds/cloud shadows

Dungan, NASA Ames, NEX
Ganguly, NASA Ames, NEX

LCLUC-2017 MuSLI Recent Selections

Roy, David **Type 1**	**South Dakota State U.**	**Africa burned area product generation, quality assessment and validation – demonstrating a Multi-Source Land Imaging (MuSLI) Landsat-8 Sentinel-2 capability**
Shaaf, Chrystal **Type 1**	**U. Massachusetts**	**Circumpolar Albedo of Northern Lands from Landsat-8 and Sentinel-2**
Friedl, Marc **Type 1**	**Boston U.**	**An Operational Multisource Land Surface Phenology Product from Landsat and Sentinel 2**
Anderson, Martha **Type 2**	**USDA**	**Characterizing Field-Scale Water Use, Phenology and Productivity in Agricultural Landscapes using Multi-Sensor Data Fusion**
Campbell, Petya **Type 2**	**UMBC/NASA**	**Prototyping MuSLI canopy chlorophyll content for assessment of vegetation function and productivity**
Skakun, Sergi **Type 2**	**UMD**	**Crop yield assessment and mapping by a combined use of Landsat-8, Sentinel-2 and Sentinel-1 images**
Radeloff, Volker **Type 2**	**U. Wisconsin**	**Monitoring abandoned agriculture, fallow fields, and grasslands with Landsat and Sentinel-2**
Hulley **Type 2** **Thermal IR**	**NASA/JPL**	**A high spatio-temporal resolution Land Surface Temperature (LST) product for urban environments**

SENTINEL-2 - LANDSAT FUSION

Merging Sentinel-2 and Landsat data streams could provide < 5-day coverage required for Ag monitoring
- Both sensors have 10-30m coverage in VNIR-SWIR
- Satellite orbits complementary
    - Landsat-7 & -8 8 days out of phase
    - Sentinel-2a & 2b 5 days out of phase
    - Landsat and Sentinel sun synch orbits precess relative to each other

Landsat-7
Landsat-8
Sentinel-2a
Sentinel-2b

2013 2014 2015 2016 2017 2018

Global ~5 day coverage

Global ~2-3 day
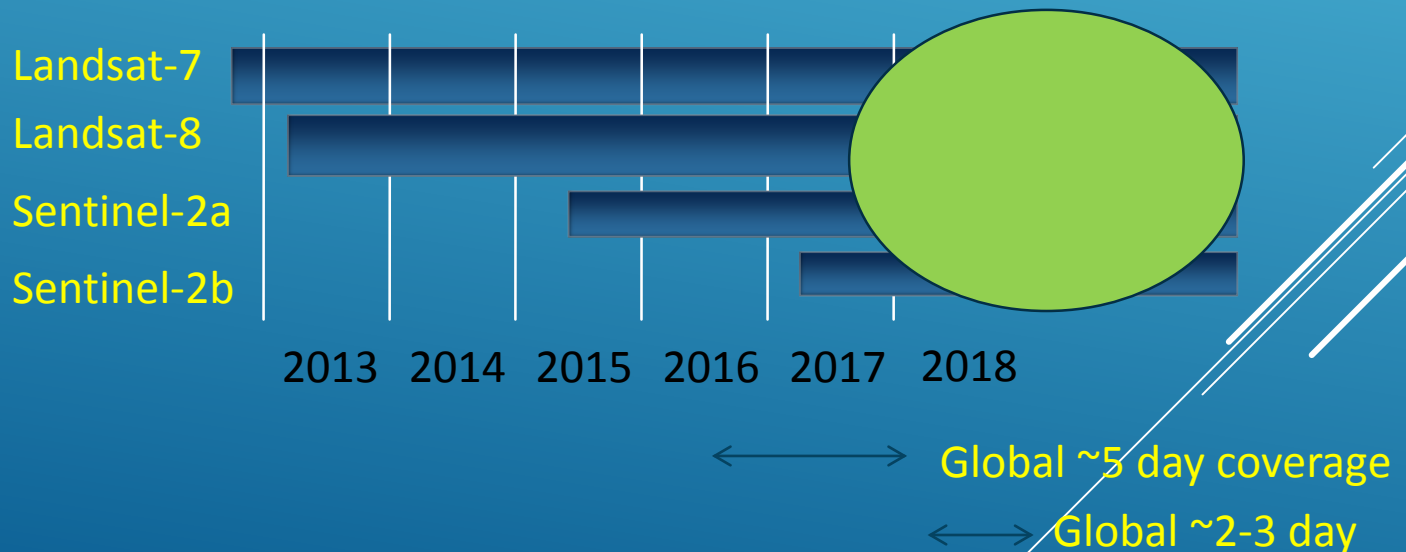
HLS: Harmonized Landsat/Sentinel-2 Products
https://hls.gsfc.nasa.gov — Laramie County, WY
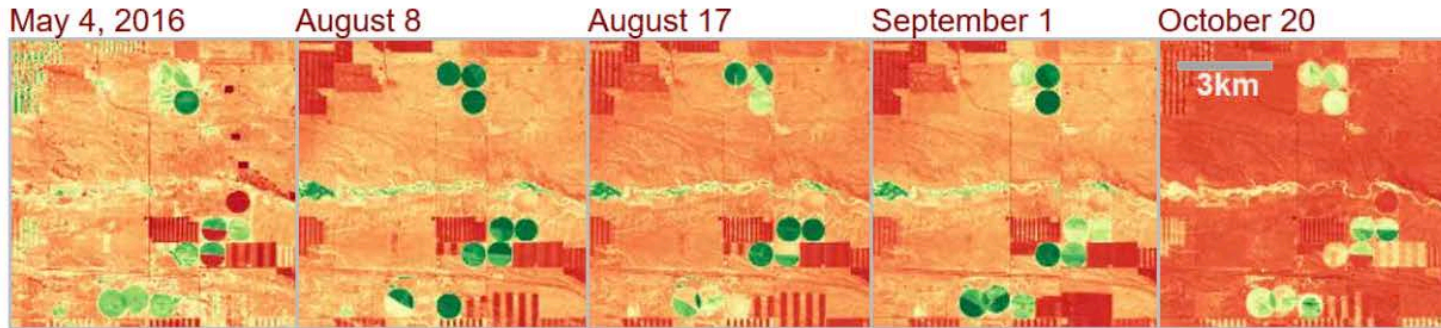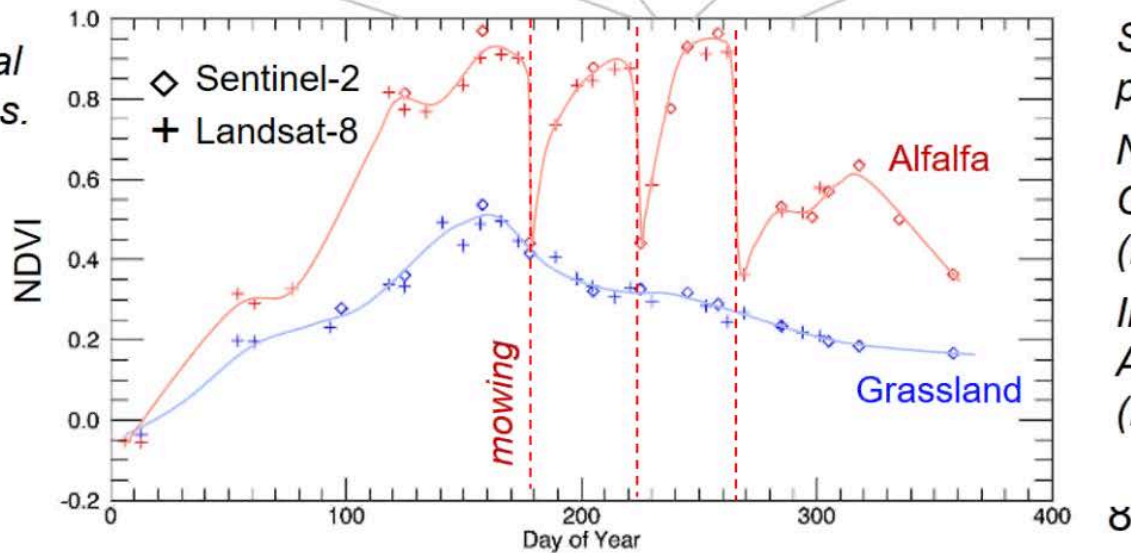
Courtesy: Jeff Masek, NASA GSFC

LCLUC-2018

- Theme: Land-use transitions in Asia (all of it)

- Transitions in smallholder agricultural systems

- Growth in urban areas and urban teleconnections

- Land use transitions in dryland systems

- Expect: resubmissions of the 2015, 2016 rejects + new SARI + new regions (e.g. Central Asia)

- Due date (note difference from previous years!)

  - step-1 Aug 1, 2018

  - step-2 Mar 1, 2019

EDUCATION AND OUTREACH

▸ **E-Newsletters**

▸ **Webinars**

▸ **One-pagers**

▸ **Statistics: Information on students graduating in LCLUC is needed**

▸ **LCLUC website and Facebook page**

LCLUC Webinars series
- Projects have been presented during 2014-17 (Urban, Urban-Ag transitions, Ag)

GOFC-GOLD Regional Networks
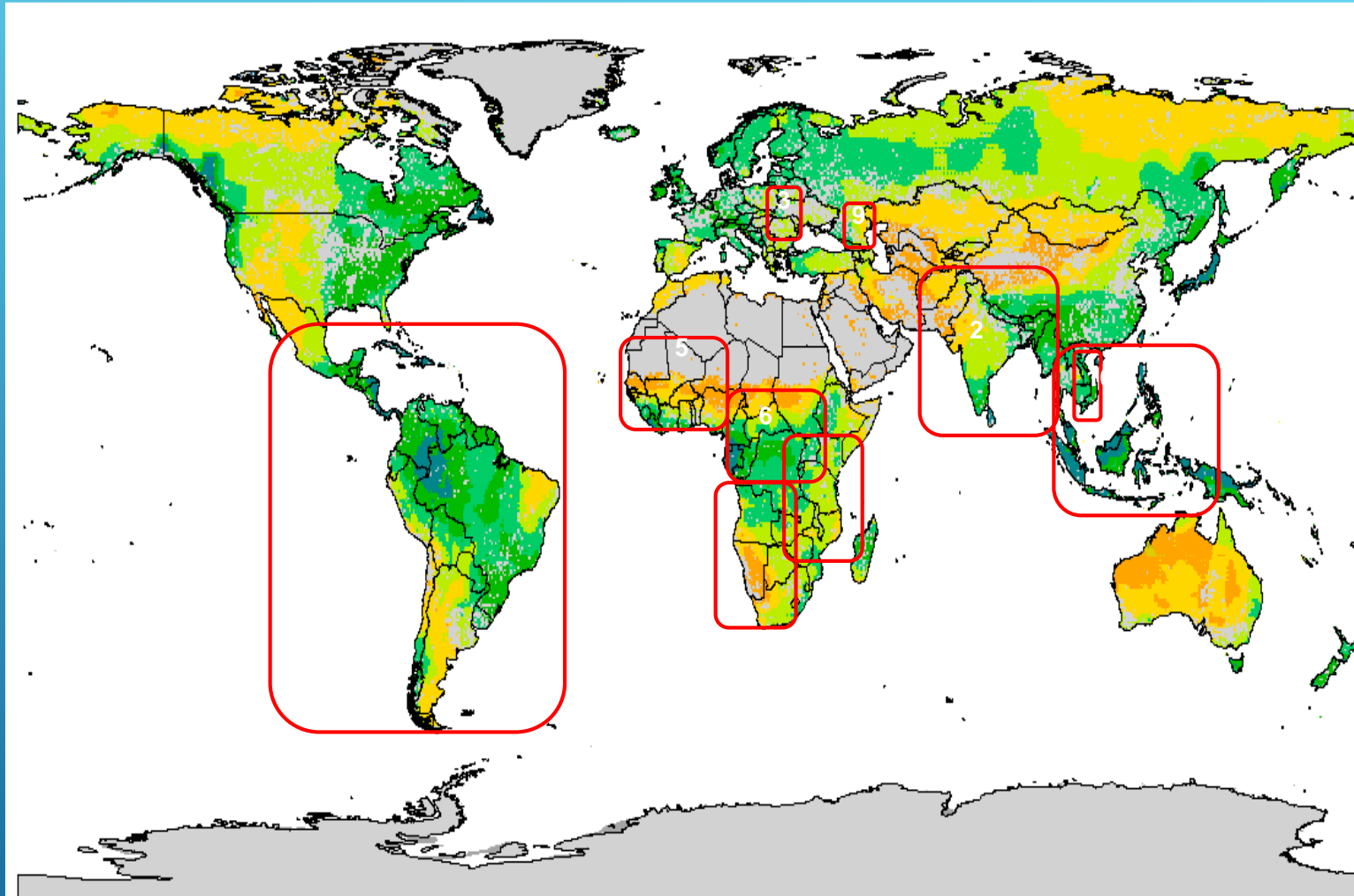
1.Southeast Asia Regional Research and Information Network (SEARRIN); 2. South Asia Regional Information Network (SARIN); 3. South Central European Regional International Network (SCERIN); 4. Red Latinoamerica de Teledeteccion e Incendios Forestales (RedLaTIF); 5. West African Regional Network (WARN); 6. Observatoire Satellital des Forets d'Afrique Central (OSFAC); 7. Miombo Network (MIOMBO); 8. Southern Africa Fire Network (SAFNET); 9.Caucasus Regional Information Network (CaucRIN); 10.Mekong Regional Information Network (MekRIN)

TRANS-ATLANTIC TRAINING (TAT) INITIATIVE

NASA-ESA regular training sessions in Eastern Europe for students and post-docs, open for any satellite data users and stakeholders

- ▶ Five TAT sessions by now
    - ▶ June 2013 in Prague, Czech Rep.
    - ▶ June 2014 in Krakow, Poland
    - ▶ April 2015 in Prague, Czech Rep.
    - ▶ July 2016 in Zvolen, Slovakia
    - ▶ June 2017 in Pecs, Hungary
- ▶ The 6th is planned for June 2018 in Zagreb, Croatia
- ▶ As a rule, conducted in conjunction with the GOFC-GOLD SCERIN network workshops
- ▶ Co-funded by NASA and ESA

TAT-2015 in Prague: Introductory lecture by G. Gutman on the current NASA space assets for studying land surface processes

- • Various, state-of-the-art land remote sensing methods and applications: Forestry, Agriculture, Urban

- • Lectures and hands-on practical exercises from NASA and ESA optical and microwave experts

SARI Capacity Building Activities

- SERVIR
- GISTDA
- SilvaCarbon
- LCLUC
  - after/before each regional meeting

THANKS GO TO

- Organizers: C. J. and Co.

- Mary, Jack, Kris, Catherine, Indu

- Sponsors: SGT, Inc.

STINGER GHAFFARIAN TECHNOLOGIES

To All LCLUCers:
Enjoy
Spring Blossoms