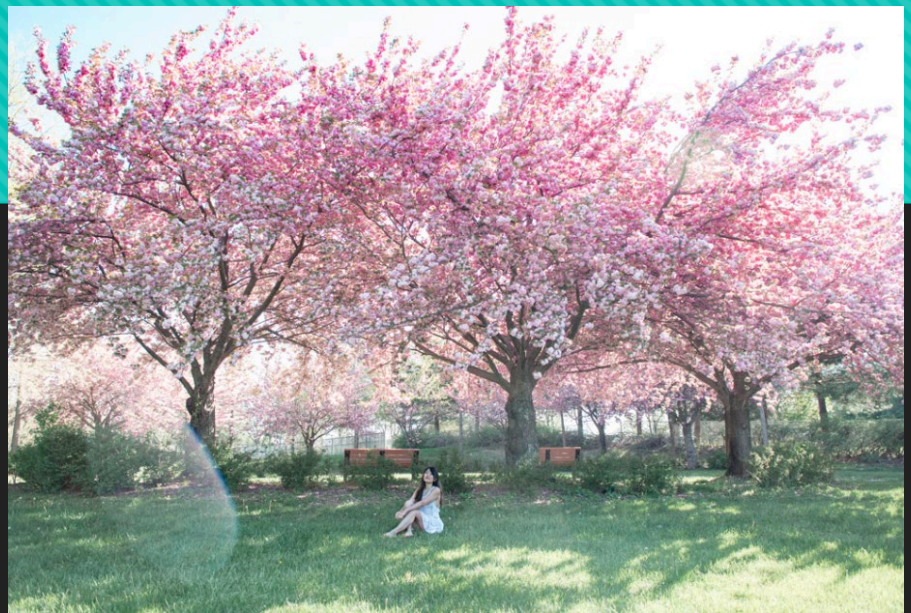
Land-Cover and
Land-Use Change Program

LCLUC Program: An Update

Garik Gutman,
NASA Headquarters
Manager, LCLUC Program

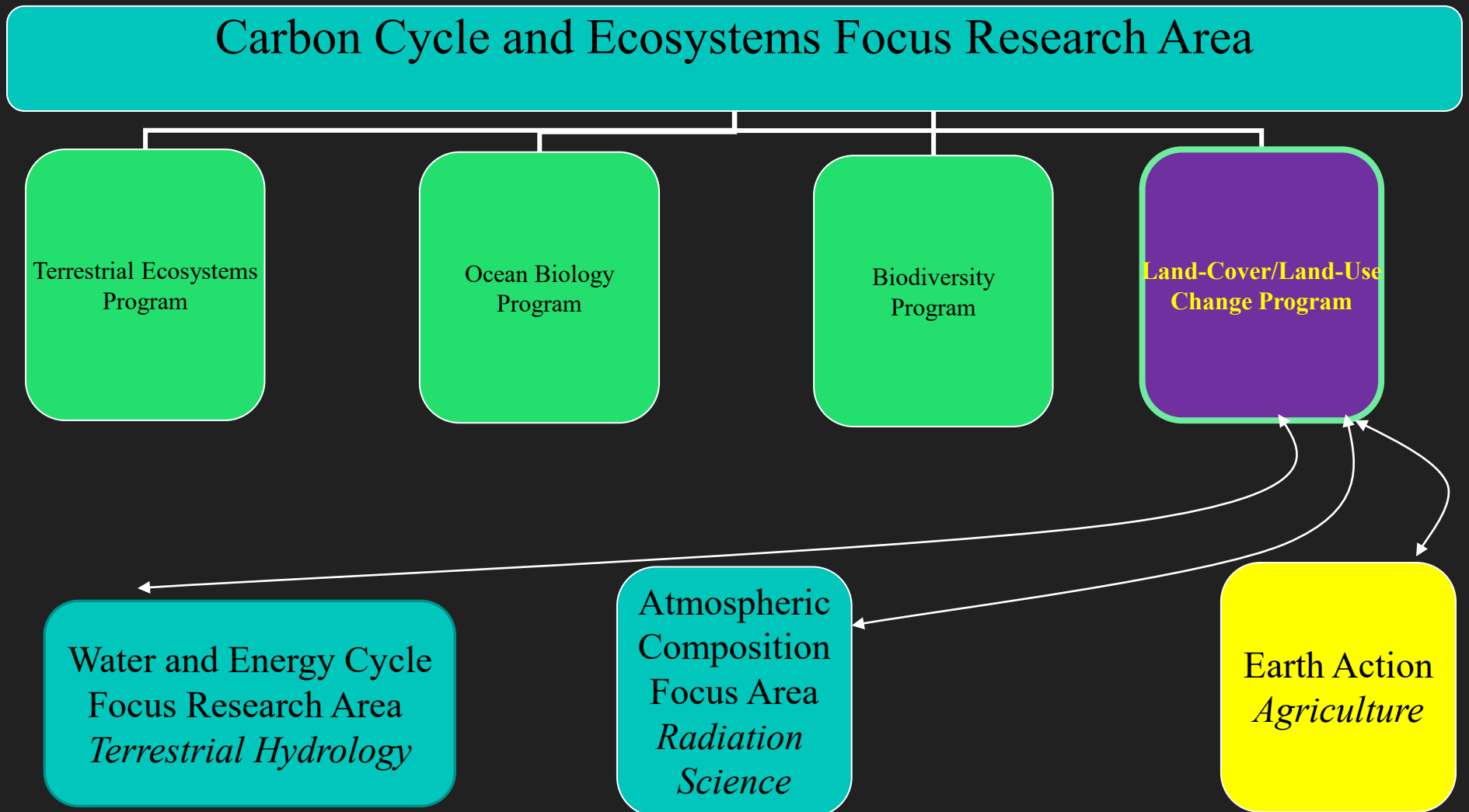
April 2024



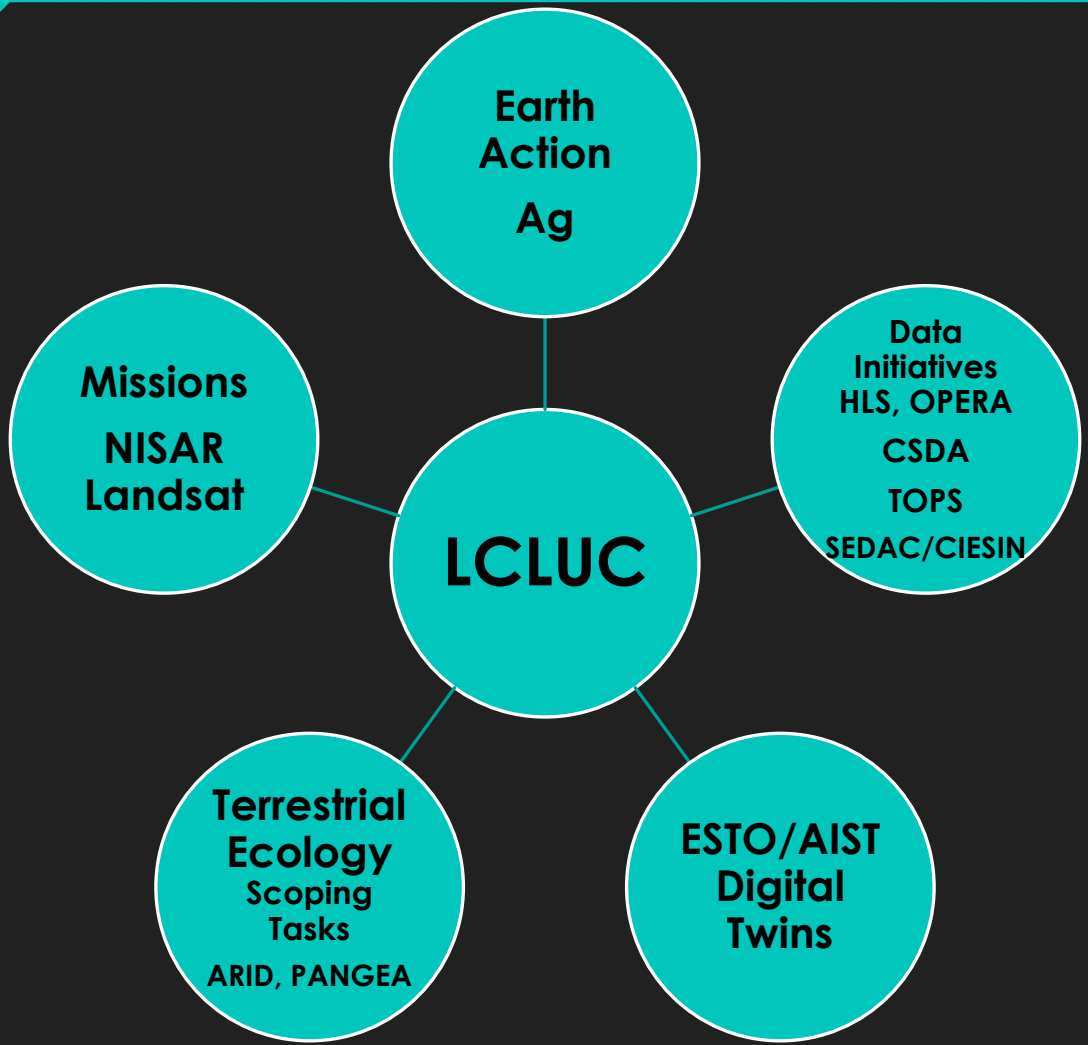
Gaithersburg, MD

- 1765 - a small agricultural settlement known as Log Town.
- 1802 - Benjamin Gaither built a house on the property where the famous Forest Oak tree used to grow
- 1878 - officially became "Gaithersburg".
- 1968 - city status.
- 1997: the 300 year-old famed Forest Oak was felled by a wind storm.
- **2024 -** Gaithersburg is the most ethnically diverse city in the U.S. (according to **WalletHub)**
- Cherry blossoms: **Green Park,** Gaithersburg

INTERNAL EARTH SCIENCE LINKAGES



NASA Programs Interconnections



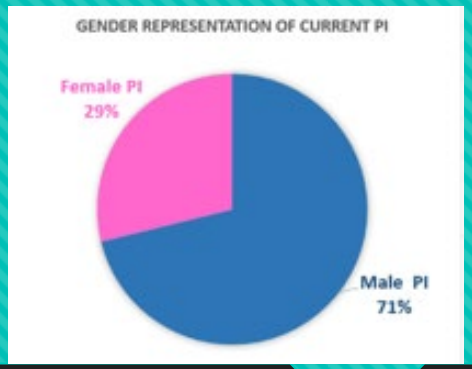
External Interactions:

- National
  - U.S. Global Climate Research Program (USGCRP)
  - U.S. Geological Survey (USGS)
  - U.S. Department of Ag (USDA)
  - U.S. Forest Service (USFS)
  - U.S. Agency for International Development (USAID)
- International
  - Global Observations of Forest Cover and Land-use Dynamics (GOFC-GOLD)
  - CEOS/GEO (e.g. GEOGLAM)
  - Global Land Program (GLP)/Future Earth
  - Regional Initiatives, e.g., SARI
  - Space agencies (e.g., ESA, JAXA, GISTDA, VNSC, ISRO)

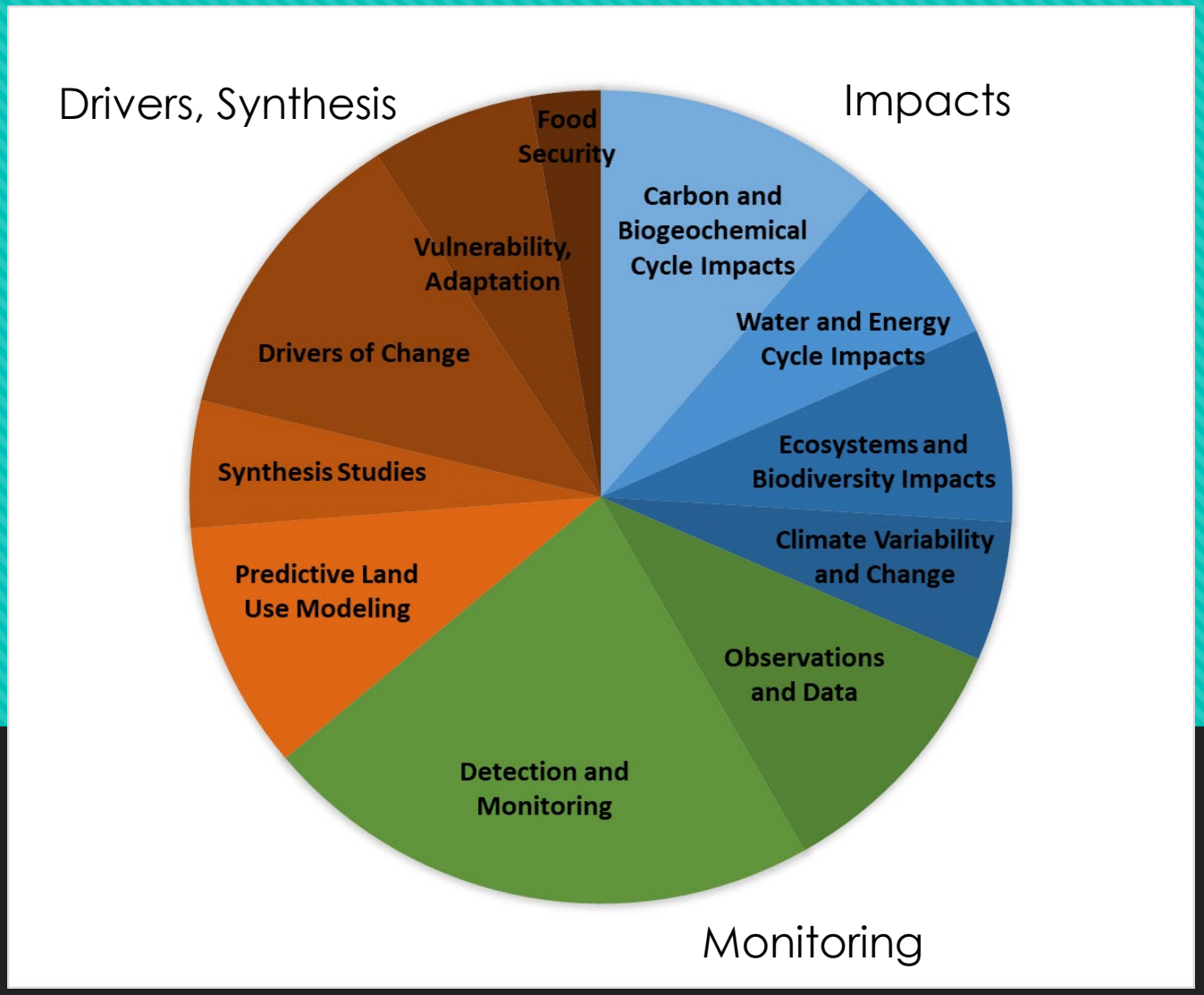
- Private sector, e.g., Planet Lab, Maxar, Google
- NGO, e.g., World Resources Institute (WRI)

Program Stats and Components To Date

Program stats since its inception:
>350 projects
~40 ongoing
>940 researchers
>40 post-docs
>80 grads
>1100 publications



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



http://lcluc.umd.edu

Uniqueness of the LCLUC Global Science Program

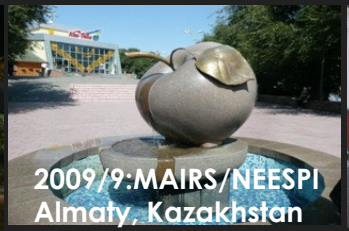
- Socio-economic component: an integral part of the projects
  - impacts of changes in human behavior and economy on LCLUC
  - impacts of LCLUC on society
  - adaption to climate change of land-use systems
  - a mandatory part of all LCLUC proposals, except MuSLI
- Remote sensing component: Multi-Source Land Imaging (MuSLI) component with medium or higher resolution
- Regional Initiatives: focus on Hotspots
- Capacity Building/Education component

LCLUC Science Team Meetings in DC Area

2007: Climate/Carbon
2008: Joint CC&E Focus Area/Arctic
2009: LCLUC impacts on climate
2010: GLS LCLUC products
2011: 15th Anniversary (review)
2011/9: Joint CC&E Focus Area/Ag
2012: Urban
2013: Wetlands
2014: Urban
2015: Joint CC&E FA/LCLU Modeling
2016: 20th Anniversary/Industr. Forests
2017: Mountains & MuSLI
2018: SARI-1: South Asia/MuSLI
2019: SARI-2: SE Asia/Caucasus
2020: MuSLI (virtual)
2022: 25th (Silver) Anniversary/AFOLU
2023: Joint CC&E FA/Hot spots
2024: Hot spots (cont.)

Spring Blossom <-> Fall Colors

International Regional Science Team Meetings (2007-2024)



Windows of Opportunity

Russia: 1997-2014

China: 1997-2011

Myanmar: 2015-2020

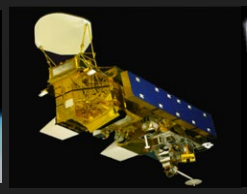
Enough is enough!

Windows is shutting down...

NASA Land Surface-Relevant Missions

Systematic Missions – Passive Optical Observations

coarse resolution

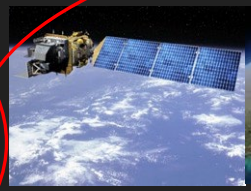


Terra
12/18/99
ASTER ***MODIS***

Aqua
5/3/02

Suomi-NPP
10/28/11
VIIRS

moderate-→ high resolution

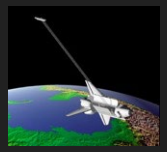


Landsat 8
2/11/13

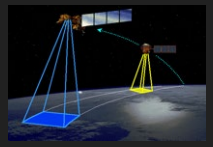
Landsat 9
9/27/21

Landsat Next
Nov 2030

Exploratory Missions –
Exploration of Specific Earth System Processes and Demonstration of Technologies



ShuttleRadar Topography Mission SRTM
2/11/02-2/22/02
Space Shuttle Endeavour



Earth Observing EO-1
11/21/00-3/30/2017
ALI (predecessor of Landsat-8)
Hyperion – first hyperspectral in space

International Space Station (ISS)

ECOSTRESS (thermal IR) 2018
GEDI (**Lidar**) 2018
EMIT (Hyperspectral) 2022

Radar Missions

NASA-CNES

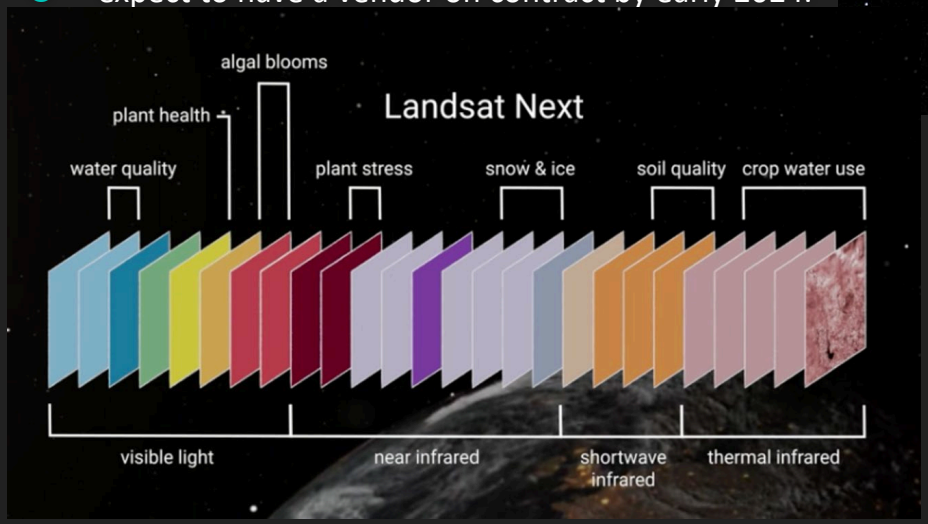
NASA-ISRO

SWOT **2022**

NISAR **2024**

Landsat Next

- Constellation of 3 small satellites
- 26 wavelengths bands
- More frequent and finer resolution
- Launch: planned for Nov **2030**
- Mission Architecture concept definition is complete
- Landsat Next is officially in Phase A
- expect to have a vendor on contract by early 2024.



Landsat Next constellation of three spacecraft will provide finer spatial resolution (10-20m) and expanded spectral (26 band) imaging capabilities every six days (at the equator), i.e. 2-3 d revisit at higher latitudes.

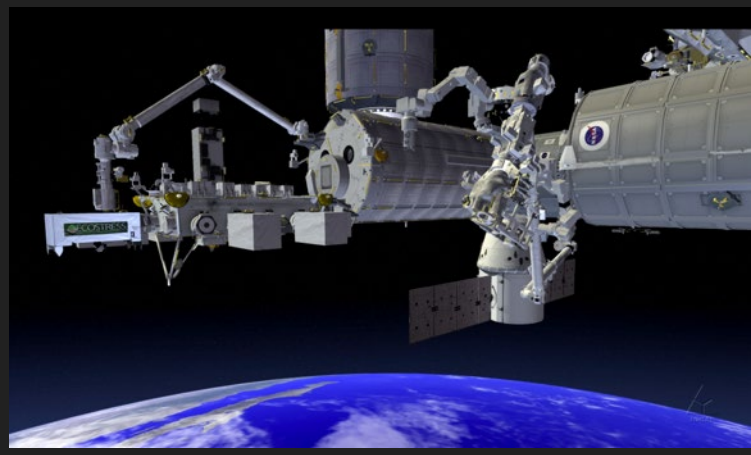
ECOSTRESS: NASA Instrument on ISS

ECOsystem Spaceborne Thermal Radiometer Experiment on the International Space Station (ISS)

- Prototype HyspIRI **Thermal Infrared** Radiometer

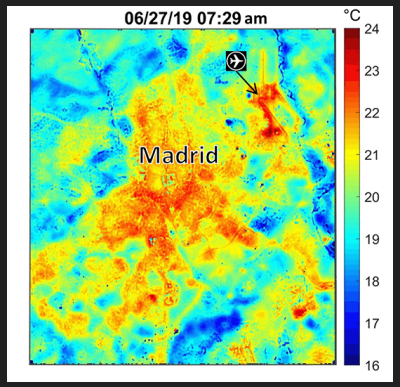
  5 spectral bands in the 8-12.5 μm range +1.6 μm

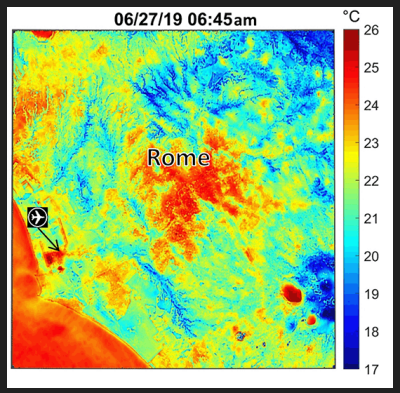
  - Spatial resolution ~70 m
  - **Advantage** over ASTER (on TERRA) – more frequent revisiit
- Science objectives
  - Identify critical thresholds of water use and water stress in key biomes (e.g., tropical/dry transition forests, boreal forests)
  - Detect the timing, location, and predictive factors leading to plant water uptake decline and cessation over the diurnal cycle
  - Measure agricultural water consumptive use over CONUS at spatiotemporal scales applicable to improving drought estimation accuracy

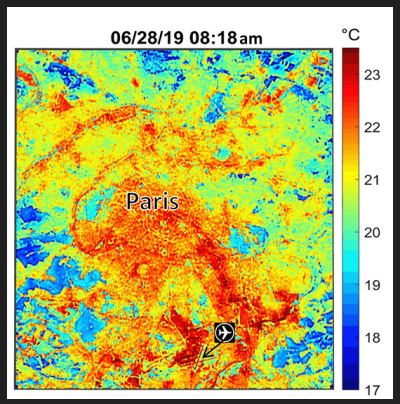


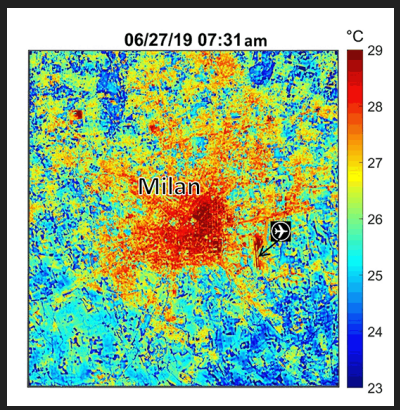
Credit: NASA/JPL-Caltech

Heatwave over Europe: June 2019









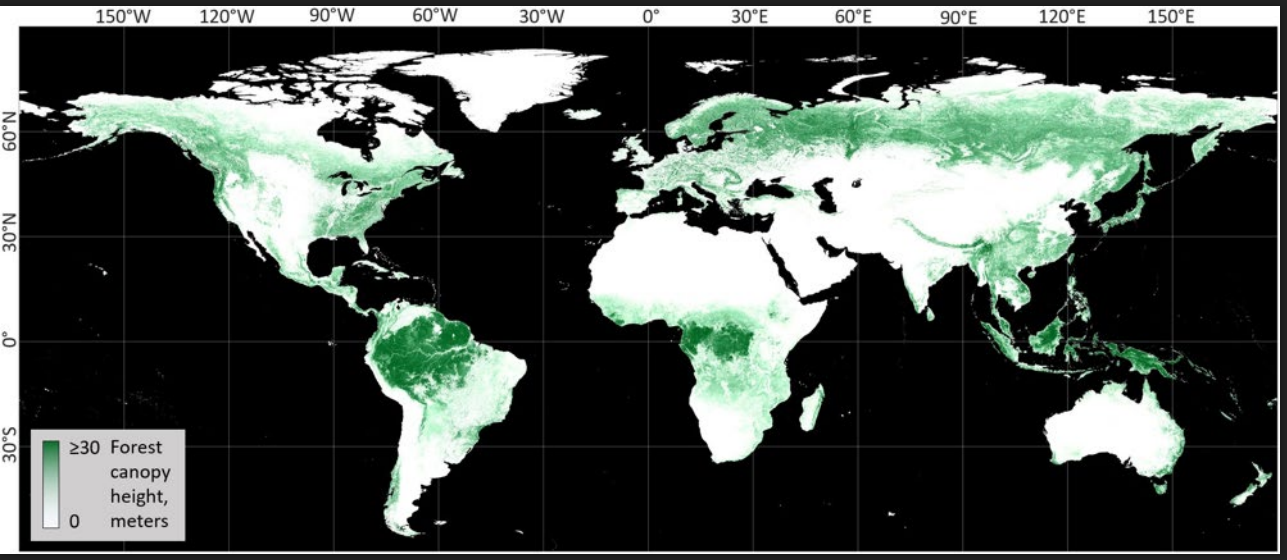
Global Ecosystem Dynamics Investigation
NASA GEDI mission

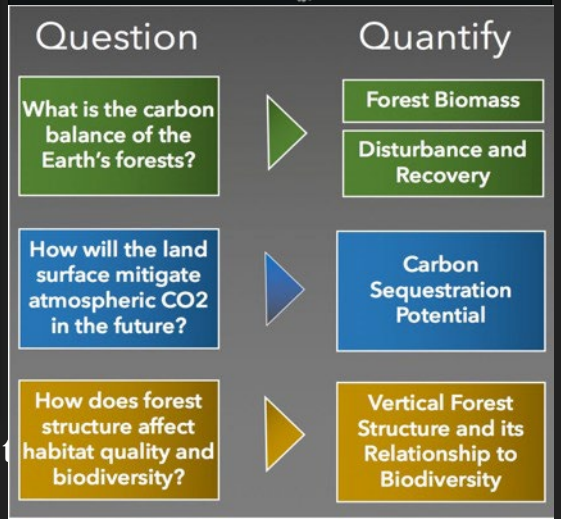
High resolution laser ranging observations

- three lasers produce eight parallel tracks of observations
- each laser fires 242 times per second and illuminates a 25 m spot (a footprint) on the surface

Global Land Analysis & Discovery

Global Forest Canopy Height: 2019

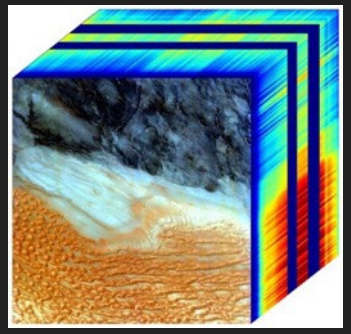




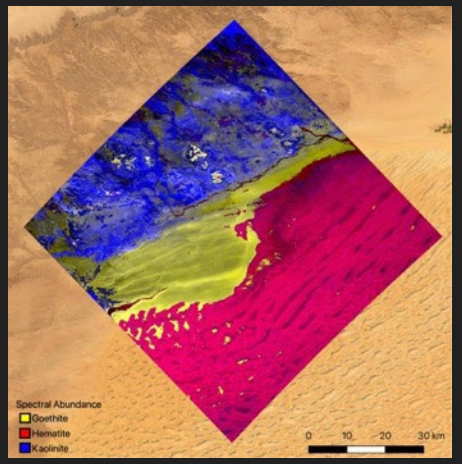
Integration of the GEDI lidar forest structure measurements and Landsat analysis-ready data time-series Potapov et al. 2020, RSE

EMIT on ISS
Earth Surface Mineral Dust Source Investigation

- Launched in July 2022
- Advanced imaging spectrometer with spectral range: 380-2500 nm
- **Primary applications: mineral dust, its heating and cooling effects in the atmosphere**
- **Potential applications**
  - **natural hazards (** flood extent, ecosystem impacts, and surface water sediment load)
  - **environmental pollution (**oil spills, ocean plastics, acid mine drainage, etc.)
  - **coastal waters and harmful algal blooms (**ocean phytoplankton, harmful algal bloom biomass and composition, coral presence and bleaching events, and the health of coastal ecosystems)



the true-color view over southwestern Libya



EMIT first light: The mineral map in southwestern Libya in the Sahara Desert

Credit: JPL

NASA-CNES Surface Water and Ocean Topography (**SWOT**)

- SWOT's 120-km-wide swath with overlaps over most of the globe with an average revisit time of 11 days
- Launched Dec 16, 2022
- On land, it will collect data on lakes and reservoirs larger than 62,500 m^2 and rivers wider 100 m with 50-m spatial and 10-cm height resolutions
- All weather - penetrate cloud cover and the dark of night

SWOT will survey nearly all water on Earth's surface for the first time with **Ka-band Radar** Interferometer (KaRIn, frequency between 26.5 and 40 GHz)

NASA-ISRO SAR (NISAR)

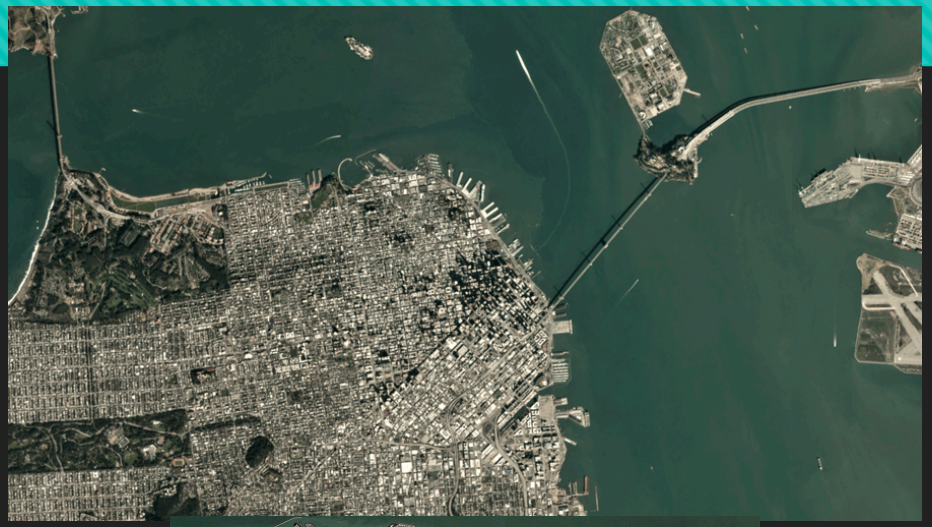
- Will observe Earth's land and ice-covered surfaces globally with 12-day repeat cycle
- Swath of 242 km
- Resolution 3–48 m for L-band
- Resolution of 3-24 m for S-band
- Planned Launch Date: **2024**
- Will observe the distribution of vegetation and biomass to better understand ecosystems' responses to disturbance and recovery
- Will map above-ground woody biomass density for estimating carbon emissions from land-use change with much more accuracy

L-band (24 cm) and S-band (12 cm) **polarimetric SAR**

Zooming-in: Using Very High Resolution Data

Commercial satellites offer images at fine spatial scale and high temporal resolution

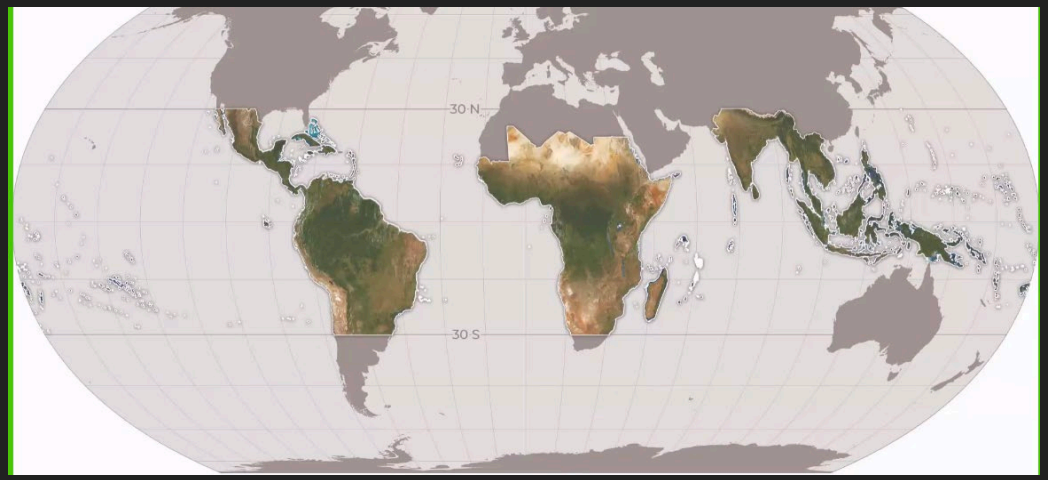
- The first NASA Data Buy 2003 – Ikonos
- **Planet Labs** constellation (>200 sats) acquire daily images of the Earth with 3-m resolution
- **Maxar (Digital Globe, WorldView)** with 1m resolution



- **NASA Commercial Smallsat Data Acquisition (CSDA)**
  - Limited Planet datasets are available for free at Universities
  - Wall-to-wall VHR data over tropics purchased by the government of Norway (to tackle tropical deforestation)
  - Special Issue in Remote Sensing (2020) on applications of VHR data in LCLUC studies

VHR Data Availability: the Good News

- Norway's International Climate and Forest Initiative (NICFI) 30°N-30°S mosaics (<5m) based on Planet data
  - Monthly mosaics: Sep 2000- end of 2024
  - Bi-annual mosaics: Dec 2015 – Aug 2020
- Access: www.planet.com/nicfi
- Bezos Earth Fund announced a new partnership with NICFI to continue providing the world with free access to high-resolution satellite data to support efforts to stop the destruction of the world's rainforests.



The partnership adds to the USD 43 million previously granted by NICFI to establish the NICFI Satellite Data programme and complements the Bezos Earth Fund's investments in protecting tropical forests and enhancing data, monitoring and accountability.

Global Forest Watch Project https://www.globalforestwatch.org

Data Aspects

LCLUC PIs must provide metadata on data products generated under NASA-funded projects

- NASA LCLUC program expects its PIs to make their data and products available to the community for free and open access
- LCLUC metadata page
- Very High-Resolution (VHR) data for NASA-affiliated scientists

Metadata

Displaying 1 - 35 of 35

Search by Keywords

Apply Reset

Metadata Title	Project name	Team	Institution	Project Start Date	Project End Date
Land-Use Status, Change and Impacts in Vietnam/Cambodia/Laos	Land Use Status, Change and Impacts in Vietnam, Cambodia and Laos	Son Nghiem, Andrea Gaughan Forrest Stevens	Jet Propulsion Laboratory	05/01/2018	12/31/2021
Understanding the Role of Land Cover/Land Use Nexus in Malaria Transmission Under Changing Socio-Economic Climate in Myanmar	Understanding the Role of Land Cover/Land Use Nexus in Malaria Transmission Under Changing Socio-Economic Climate in Myanmar	Tatiana Loboda, Mark Carroll Julie Silva Myaing Nyunt Christopher Plowe Kathleen Stewart	University of Maryland	05/01/2017	03/01/2020
Complex Forest Landscapes and Sociopolitical Drivers of Deforestation - The Interplay of Land-use Policies, Armed Conflict, and Human Displacement in Myanmar	Complex Forest Landscapes and Sociopolitical Drivers of Deforestation - The Interplay of Land-use Policies, Armed Conflict, and Human Displacement in Myanmar	Peter Leimgruber, Qiongyu Huang Melissa Songer Joseph Sexton Min Feng Saurabh Channan Enze Han Kevin Woods	Smithsonian Institution	05/01/2017	05/01/2020

Commercial Smallsat Data Acquisition (CSDA) Program Update

The commercial data currently distributed by NASA are available under different scientific use licenses and various access portals. The Commercial Smallsat Data Acquisition (CSDA) program evaluates and procures data from commercial vendors that advance NASA's Earth science research and applications activities. Currently, data acquired during the evaluations of Planet, Maxar (formerly DigitalGlobe, Inc.), and Spire Global are available. Data from the Teledyne Brown Engineering, Inc., DLR Earth Sensing Imaging Spectrometer (DESIS) also are available through a separate collaboration with the International Space Station (ISS).

More Info: https://earthdata.nasa.gov/esds/csdap/commercial-datasets

PDF file:

CSDA_ROSES_data_access_overview[1].pdf

Open Science

- The White House Office of Science and Technology Policy (OSTP) declared 2023 as the Year of Open Science
- Open Science is the principle and practice of making research products and processes available to all, while respecting diverse cultures, maintaining security and privacy, and fostering collaborations, reproducibility, and equity

Open Science @NASA

- The Transform to Open Science (TOPS) mission is a NASA initiative designed to rapidly transform agencies, organizations, and communities to an inclusive culture of open science
- TOPS is part of NASA's Open-Source Science Initiative.
- https://science.nasa.gov/open-science/transform-to-open-science

ROSES Open Science and Data Management Plan

- The requirements regarding archiving of data, software, and publications have been strengthened
  - Publications, data and software developed using ROSES funding in support of a peer-reviewed publication shall be made publicly available at the time of publication
  - Scientifically useful data and software developed during the award that was not already published must be made available by the end of the award
  - LCLUC proposers to ROSES-2024 must provide an "Open Science and Data Management Plan" (formerly called the Data Management Plan) or an explanation of why one is not necessary given the nature of the work proposed
    - https://science.nasa.gov/researchers/sara/faqs/OSDMP

LCLUC-23-MuSLI Selectees

Michael Keller,
US Forest Service

Sergii Skakun,
U. Maryland

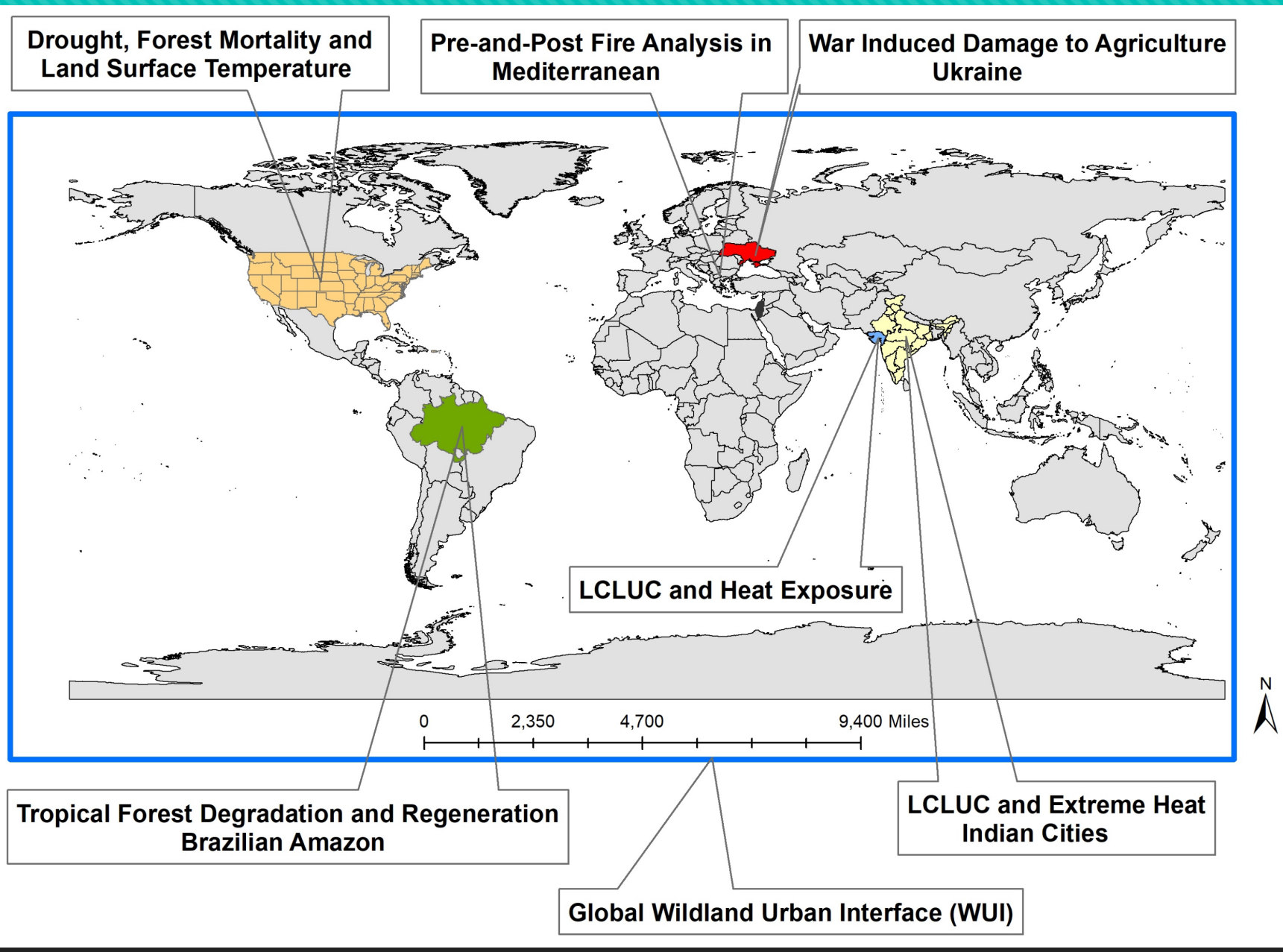
Nimrod Carmon,
JPL

Glynn Hulley,
JPL

Karen Seto,
Yale U.

Jonathan Wang,
U. Utah

Michael Wimberly,
U. Oklahoma


Drought, Forest Mortality and Land Surface Temperature
Pre-and-Post Fire Analysis in Mediterranean
War Induced Damage to Agriculture Ukraine
LCLUC and Heat Exposure
0
2,350
4,700
9,400 Miles
N
Tropical Forest Degradation and Regeneration Brazilian Amazon
Global Wildland Urban Interface (WUI)
LCLUC and Extreme Heat Indian Cities

Open LCLUC-Relevant Solicitations

Solicitation Title	Solicitation #	Released	NOI Due	Proposal Due
A.2 Land Cover/Land Use Change	NNH24ZDA001N-LCLUC	02/14/2024	--	03/28/2024 step-1
A.42 Earth Action: Disaster Risk Reduction, Recovery, and Resilience	NNH24ZDA001N-DISASTER	02/14/2024	03/28/2024	06/14/2024
A.26 Rapid Response and Novel Research in Earth Science *	NNH24ZDA001N-RRNES	02/14/2024	--	03/28/2025
F.8 Supplements for Open-Source Science *	NNH24ZDA001N-SOSS	02/14/2024	--	03/28/2025
F.14 High Priority Open-Source Science *	NNH24ZDA001N-HPOSS	02/14/2024	--	03/28/2025
TWSC-24 Topical Workshops, Symposiums, and Conferences *	NNH24ZDA002N	10/ 13/ 2023	--	11/30/2026

* This program element does not have a proposal due date. Proposals may be submitted at any time.

F.14 High Priority Open-Source Science (HPOSS)

Funding innovative work to make science more accessible, inclusive, and reproducible

- Proposals for new technology that would support open-source science, including new data formats, software, frameworks, or libraries
- Awards of ~$100k to support work for one year
- Proposals for ROSES-24 will be accepted until **March 28, 2025**
- Will be evaluated using a dual-anonymous peer review (DAPR) process

F.8 Supplement for Open Source Science (SOSS)

Supplemental award to add an open science component to an existing "parent" award

- Proposals that increase the accessibility, inclusivity, and reproducibility of the science from the parent award and/or to contribute back to the open science communities relevant to the parent award
- Specific support for credits to support Cloud Computing
- Must have an existing NASA proposal selected for funding
- Awards of ~$50k to support work for one year (~$10K for cloud computing)
- Proposals for ROSES-24 will be accepted until **March 28, 2025**

Dual-Anonymous Peer- Review (DAPR)

- Proposers are unaware of the identity of the reviewers
- Reviewers are not told the identity of the proposers until after the evaluation of the aspects of the proposal that don't include the identity of the proposers
- The objective of dual-anonymous peer review is to minimize bias in the evaluation of the merit of a proposal
- Proposers must follow the instructions in the "Guidelines for Anonymous Proposals" document under "Other Documents" on the NSPIRES page for this program element that explains how to properly prepare the proposal for dual-anonymous peer review

ROSES-24 LCLUC Element: Two Sub-elements

- Land Use for Digital Twins (LCLUC)
  - incorporation of land-use datasets as boundary conditions in regional short-range weather forecast models and evaluation of the impact on the quality of forecasts
  - incorporation of land-use datasets as boundary conditions as a function of time, e.g. on annual basis, in multiannual climate model runs for the last decade or longer and comparison of the hindcast results with the observed climate variables
- Technology Innovations for Land Digital Twins (ESTO/AIST)
  - developing software and information systems technology that will contribute to the development of the future L-ESDT
  - taking advantage of advanced Artificial Intelligence (AI)/ Machine Learning-based methods, Big Data Analytics, and powerful computational and visualization capabilities

DIGITAL TWINS

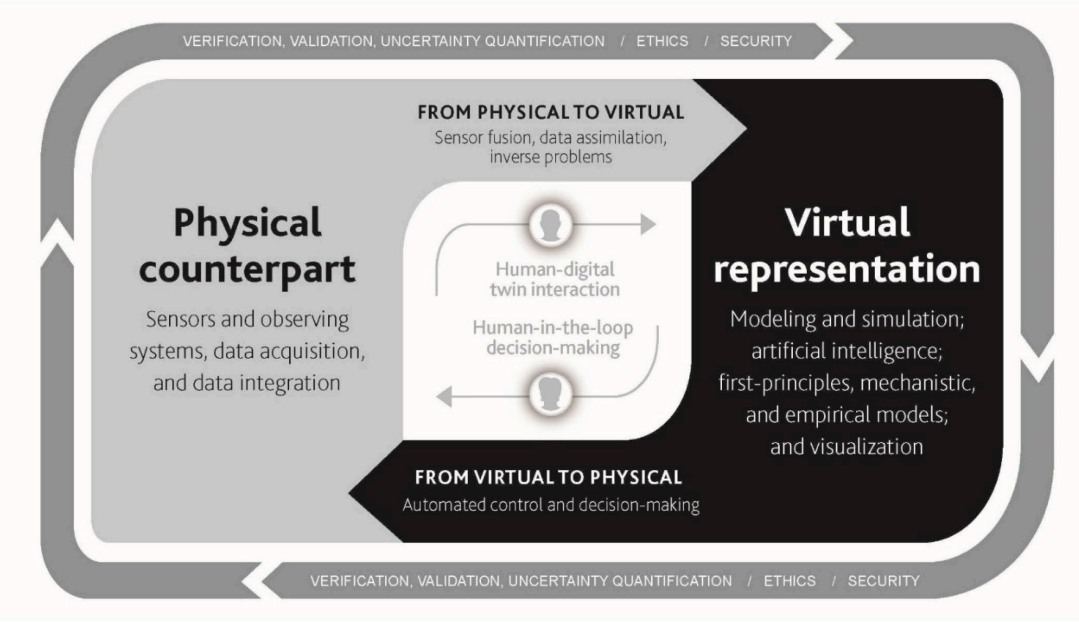
- A digital twin is a set of virtual information constructs that mimics the structure, context, and behavior of a natural, engineered, or social system (or system-of-systems), is dynamically updated with data from its physical twin, has a predictive capability, and informs decisions that realize value.
- The bidirectional interaction between the virtual and the physical is central to the digital twin.
  - feedback flows of information from the physical system to the virtual representation and from the virtual back to the physical system to enable decision making either automatic or with humans in the loop
- Digital twins can be a critical tool for decision-making based on a synergistic combination of models and data.

From National Academies of Sciences, Engineering, and Medicine. 2024. Foundational Research Gaps and Future Directions for Digital Twins. Washington, DC: The National Academies Press. http://nap.nationalacademies.org/26894

More Than Just Simulation and Modeling

The key elements that comprising DT

- modeling and simulation to create a virtual representation of a physical counterpart
- a bidirectional interaction between the virtual and the physical
  - comprising dynamic data-driven model updating (e.g., sensor fusion, inversion, data assimilation) and optimal decision-making (e.g., control, sensor steering).



"fit for purpose," meaning that the virtual representation—model types, fidelity, resolution, parameterization, and quantities of interest—be chosen, and in many cases dynamically adapted, to fit the particular decision task and computational constraints

The NASA LCLUC Program Contribution to the Development of Earth System Digital Twins

Objective

- To contribute to Earth System Digital Twins' development by providing near real-time data on human land uses at the highest spatio-temporal resolution, useful in simulations of the ongoing interactive processes in the Earth's System, that would help operational decision making, mitigate the negative impacts on the system and improve its sustainability

Three basic components

- ***Digital Replica*** of Global Land-Cover/Use Change (continuously updated), powered by Data Assimilation and Fusion, and which incorporates continuous and targeted multi-source, multi-resolution observations
- ***Forecasting Capabilities,*** including Seasonal to Annual Agricultural Land Use, and Annual to Decadal yearly projections of Land-Use Change driven by Changes in Climate and Socio-Economics
- ***Impact Assessment*** uses the *Digital Replica* and *Forecasting Capabilities* with associated societal impacts with ML, causality, uncertainty quantification and advanced computation and visualization capabilities for running large amounts of simulated predictions quickly and at various spatial and temporal scales

DT Example:
Virtual Copy of the Earth's Water Cycle

DTE Hydrology project funded by ESA

Front. Sci., 04 March 2024, V. 1 – 2023, https://doi.org/10.3389/fsci.2023.1190191

Education and Outreach

- **LCLUC website**
- **Facebook page**
- **E-Newsletters**
- **Webinars**

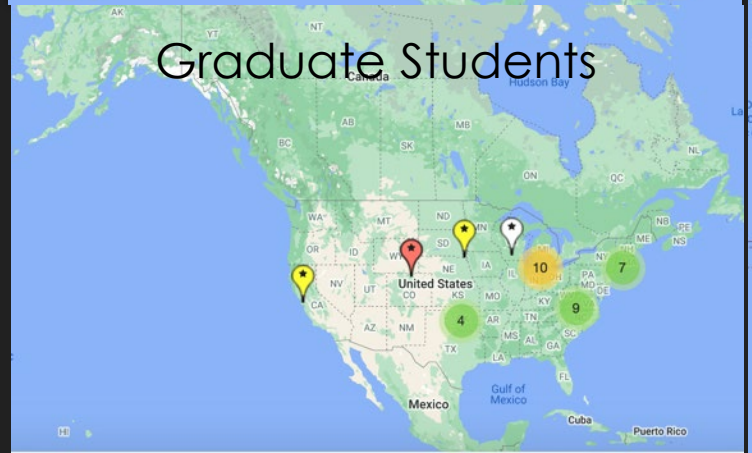
The Program needs

- **One-pagers showcasing the project**
- **Statistics on grad. students**
- **Publications**
- **Media**
- **Project info for the Mapper**

Meghavi is the POC for all the info
(cc Chris, Krishna and me)

LCLUC Mapper

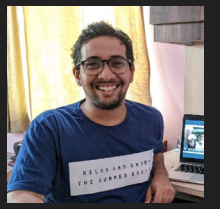
Indrani Kommareddy
LCLUC Program



Hotspots of Land Use

Indrani Kommareddy
Formerly
LCLUC Program

Meghavi Prashnani
LCLUC Program



Rohan Purekar
LCLUC Program

LCLUC Webinars Series 2023

Moderator: Melanie Anne Reynolds

Ag hotspots

Christopher Neigh (NASA Goddard)

The Impact of Investment on Irrigated Rice, Dryland Agriculture and Afforestation in Senegal using SAR and Optical Time-Series Imagery in Data Fusion Approaches

17th February 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Nicholas Cuba (Auburn University)

Evaluating the drivers of international migration from the Northern Triangle of Central America and its implications for land systems in the region

3rd March 2023 11:00 AM to 12:00 PM EST

Register Here

Robert Heilmayr (University of California, Santa Barbara)

Mapping property values to understand land-use change in South America

17th March 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Xiao-Peng Song (University of Maryland)

Soybean Expansion in South America: Quantifying Historical Land-Use Change, Modeling Socioeconomic Drivers and Projecting Future Trajectories

31st March 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Zhenong Jin (University of Minnesota)

Evaluating land use change and livelihood responses to large investments for high-value agriculture: managing risks in the era of the Green Morocco Plan

14th April 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Meha Jain (University of Michigan)

Policy, Market, and Climate Change Impacts on Maize Production in Mexico

28th April 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Urban hotspots

Volker Radeloff (University of Wisconsin-Madison)

Global Hotspots of the Wildland Urban Interface

3rd November 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Yufang Jin (University of California Davis)

Multi-source Wildland Urban Interface Characteri Hazard Assessment

1st December 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Jody Vogeler (Colorado State University)

The Last Urban Frontier: Assessing Drivers of Urbanization and Tradeoffs among Social and Ecosystem Services Associated with LCLUC in Africa

8th December 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Fire hotspots

David Roy (Michigan State University)

Where are the Missing Burned Areas? Global Hotspots of Burned Areas- a Multiresolution Analysis

13th October 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

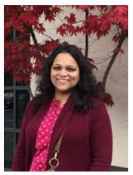
Nimrod Carmon (NASA JPL)

Early Estimation of Fire-Risk in the Eastern Mediterranean and Socioeconomic Informed Communications of Actionable Strategies

20th October 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Mining hotspots



Latha Baskaran (Jet Propulsion Laboratory)

Analyzing the Land-Use Change Impacts of Oil and Gas Related Exploration Infrastructure Changes on Arctic Communities

27th October 11:00 AM to 12:00 PM EST

View Webinar Recording

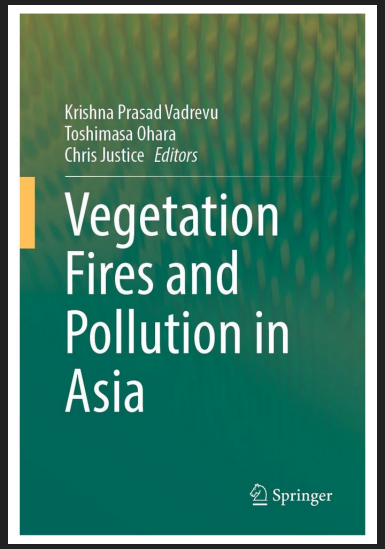
David Lutz (Dartmouth College)

Rapid Change from Alluvial Mining and Development in Madre de Dios, Peru: A Multi-Sensor Fusion Approach to Quantify Terrestrial and Aquatic Impacts and Test Policy Effectiveness

17th November 2023 11:00 AM to 12:00 PM EST

View Webinar Recording

Books on SARI Science: 2023-2024



Springer 2023

CRC Press forthcoming, summer 2024

Special Issues

- **Land Cover/Land Use Changes in South/Southeast Asia and Synthesis**

Guest Editors: Krishna Vadrevu (NASA MSFC), Son Nghiem (JPL), Peilei Fan (Tufts U.), Chris Justice (UMD), Garik Gutman (NASA HQ)

  - past due February 28th, 2024

- **Land Cover and Land Use Change in Conflicted Societies**

Science of Remote Sensing **Guest Editors:** H. Yin (Kent State U.), X. Song (UMD)

  - **due date May 31, 2024**

- Greenhouse Gas Emissions and Air Pollution in Asia – Measurements, Mapping, and Monitoring

Environmental Pollution journal ; Guest editors: K. Vadrevu (NASA MSFC), T. Ohara (NIES, Japan), C. Justice (UMD)

  - **due date May 31, 2024**

New Journal:
Recent Advances in Remote Sensing

- Editor-in-Chief José A. Sobrino (U. Valencia)
- Special Issue: "Advanced remote sensing methods for monitoring natural hazards affecting land cover", including fires, floods, landslides, hurricanes, tsunami, extreme droughts
- Guest Editors: G. Gutman (NASA HQ), Chris Justice (UMD), Krishna Vadrevu (NASA MSFC)
- Submission Deadline: 31 December 2024

Earth Action: Program outputs

"that impact people including policy"

Existing links to Earth Action:

- NASA Harvest
  - the cropland and crop type mapping
  - the Ukraine analysis
- NASA ACRES
  - the field size work

Land-Cover and Land-Use Change Program

Land Use in Action

June 2023

Fates of climate change mitigation and biodiversity conservation in Central America are inextricably linked to U.S. drug policy

DIFFERENT APPROACH TO U.S. DRUG POLICY NEEDED TO MEET CONSERVATION GOALS

- **Counterdrug interdiction** pushes cocaine trafficking into biodiverse landscapes.
- **Analyses integrating remote sensing and socioeconomic data** can identify and quantify land use/cover-change caused by illicit economies.
- **Urgent need for such analyses to inform action** to mitigate climate change and biodiversity loss in Central America.
- **NASA's role in Earth observation is essential** for evaluating long-running U.S. policies.
- **Long-term effects of U.S. drug policy undermine** international conservation efforts.

How is land use/cover being changed?

Accelerated forest loss throughout the Mesoamerican Biological Corridor (MBC) has coincided in space and time with a shift to Central America as the primary 'transit zone' for cocaine trafficking [1]. Counterdrug interdiction of cocaine shipments moving northward from South America have had the unintended consequence of pushing cocaine traffickers into protected areas and indigenous territories [2], [3]. The result has been rapid and widespread loss of forest cover, biodiversity and carbon sinks. Cocaine trafficking has accounted for an estimated 15% to 30% of annual national forest loss in Guatemala, Honduras, and Nicaragua over the past decade, and 30% to 60% of that loss occurred within nationally and internationally designated protected areas [1].

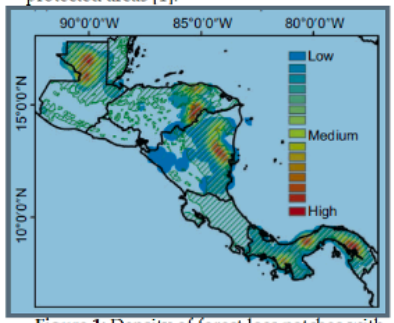


Figure 1: Density of forest loss patches with unusually large and rapid change (i.e., 'anomalous) correlated in space and time with cocaine shipments [1].

Why is this Important?

Illicit economic activities are relatively low risk and highly lucrative generating US$91 to $259 billion per year in global value [4-6]. In response to law enforcement pressure, new cocaine smuggling routes disproportionately target protected areas and indigenous territories that are critical for achieving climate change mitigation and biodiversity conservation goals [2]. Full accounting of such collateral damages should be considered when assessing the current counterdrug strategy and potential drug policy reforms.

How are satellite data being used to inform decision making and Earth Action?

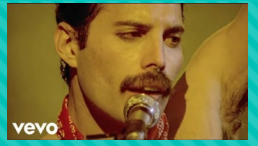
Innovative remote sensing data and methods are being leveraged to corroborate novel socioeconomic data sources (e.g., media reports, court records, field ethnographies) to isolate specific locations and times of cocaine trafficking's influence on LCLUC. Quantifying the LCLUC caused by cocaine trafficking highlights the long-term implications of current counterdrug interdiction practices.

References

[1] Sesnie et al., (2017). *Environ. Res. Lett.*, 12(5), 054015. [2] Magliocca et al. (2019). *PNAS*, 116(16), 7784-7792. [3] Magliocca et al. (2022). *Land. Urban Plan.*, 221, 104359. [4] Gore et al. (2019). *Nat. Sustain.*, 1–3. [5] Nellemann et al. (2016). *UNEP*. [6] Tellman et al. (2020). *Nat. Sustain.*, 3(3), 175–181.

Project Investigator: Nicholas Magliocca, University of Alabama, AL, USA; Email: nrmagliocca@ua.edu

The opinions expressed herein are purely by the PI and do not necessarily reflect the official views of the NASA.



LCLUCers in Media and Awards: 2023

Exceptional Public Achievement Medal

Inbal Becker Reshef

Exceptional Service Medal

Garik Gutman

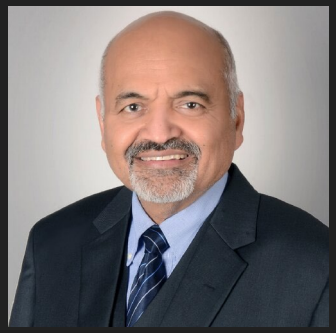
Chris Justice, interviewed by AGU Third pod from the Sun – AGU's podcast. Jan 2023

Peilei Fan elected President of International Association of Landscape Ecology

Kuno Award for Applied Sciences

Eleanor Stokes, contributed to the story on the recent earthquake in Turkey and Syria highlighted in the Washington Post, 2023

Son Nghiem, IEEE Life Fellow *and 2023 Voyager Award*



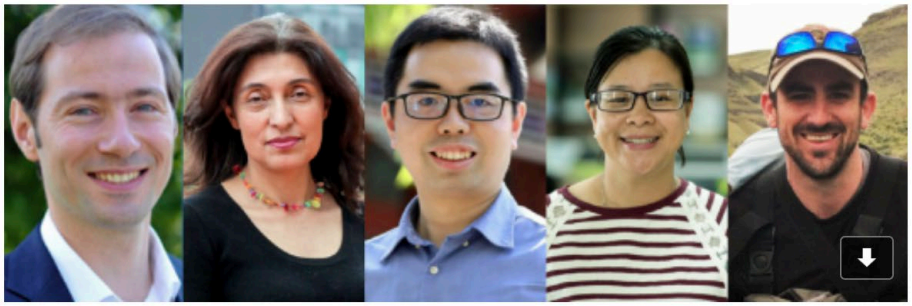
Atul Jain, 2023 AGU Fellow

Lucy Hutyra, 2023 MacArthur Fellow

Meghavi Prashnani 2023 Recipient of the Award for 10+ years dedication to Earth Observation

Global Land Program (GLP)

From the SSC



GLP SSC to welcome 5 new members in June

The GLP Scientific Steering Committee (SSC) will welcome 5 new members at its June 2023 annual meeting. The new members are (from left to right): Dr. Alexander Prishchepov, Dr. Ximena Rueda, Dr. Le You, Dr. Pham Thu Thuy, and Dr. Nicholas Magliocca.

November 4-8, 2024, Oaxaca, Mexico

Abstracts due March 15th, 2024

Submit without paying registration fees

Ariane de Bremond
GLP Executive Director

in conjunction with GLPOSM5

LCLUC international regional meeting

on Nov 3 (Monday) – regional international LCLUC meeting

Ongoing Latin America Projects

Principal Investigator	Project Name	Start Date	End Date
Grant Connette	Can Improved Stakeholder Representation Prevent Human-Caused Mangrove Loss in the Mesoamerican Reef Ecoregion?	04/01/2023	03/31/2026
Nicholas Magliocca	Making the Hidden Visible: Accelerated Land-Use Change and Degradation Caused by Narco-Trafficking In and Around Central America's Protected Areas	01/01/2021	12/31/2024
Nicholas Cuba	Evaluating the drivers of international migration from the Northern Triangle of Central America and	01/01/2021	12/31/2024
Michael Keller	Tropical Forest Degradation and Regeneration in the Brazilian Amazon: Thermal Remote Sensing Integrated into a Multi-Source Land Imaging Approach	01/01/2024	12/31/2027
Robert Gilmore Pontius Jr	Irrigation as climate-change adaptation in the Cerrado biome of Brazil evaluated with new quantitative methods, socio-economic analysis, and scenario models	05/15/2023	05/14/2026
Gillian Galford	Land-cover and Land-use Change at the Frontier: Socioeconomic and Environmental Factors Influencing Land-Use Transitions in the Cerrado Biome	02/01/2023	01/31/2026
McKenzie F. Johnson	Land Cover Land Use Change, Conflict, and Peacebuilding in Colombia	02/01/2022	01/31/2025
Carlos Munoz Brenes	Impacts of Global Markets and National Policies on Forest Carbon Trajectories and Social Outcomes in the Guiana Shield Ecoregion	06/01/2021	05/31/2024
Robert Heilmayr	Mapping property values to understand land-use change in South America	01/01/2021	12/31/2024
Christoph Nolte	Comparing the effectiveness of conservation instruments in the Colombian Andes biodiversity hotspot	01/01/2021	12/31/2024
David A. Lutz	Rapid Change from Alluvial Mining and Development in Madre de Dios, Peru: A Multi-Sensor Fusion Approach to Quantify Terrestrial and Aquatic Impacts and Test Policy Effectiveness	01/01/2021	12/31/2024
Juan Torres-Perez	Watersheds, Water Quality, and Coastal Communities in Puerto Rico (Water2Coasts): An interdisciplinary island landscape to coastal ocean assessment with socioeconomic implications		

Forthcoming Meetings in 2024

Thanks to our loyal supporter for meetings and trainings: START Inc.!

- LCLUC Synthesis in South Asia – early **April**, Haryana, India
- GOFC-GOLD SCERIN-MedRIN joint workshop and TAT training – mid-**July**, Chania (Crete), Greece (right after IGARSS in Athens)
- Space Week Nordeste - mid-**September**, São Luís-Maranhão , NE Brazil.

- **Global Land Program Open Science Meeting GLPOSM) in collaboration with LCLUC (regional international workshop) – early November, Oaxaca, Mexico**

- **ISPRS symposium – early November, Belem, Brazil**

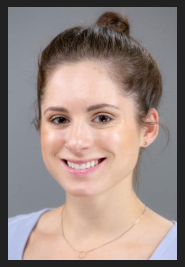
EXACT OVERLAP WITH GLPOSM https://selperbrasil.org.br/events/belem-2024-tc3-symposium/

Thanks go to

JUSTICE at WORK

DEPARTMENT OF JUSTICE — QUI PRO DOMINA JUSTITIA SEQUITUR

- Organizers: C. J. and Co.
- Krishna, Mary, Meghavi



- Our major, loyal sponsor!

KBR

JUSTICE MATTERS

Cherry Blossoms Festival in DC

Enjoy!

https://nationalcherryblossomfestival.org/event/tidal-basin/

Red Reyne

Thu Apr 4th 4:05pm - 5:00pm

// Rock // Red Reyne is an All American Rock and Roll band, with musical styles that can be traced back to 50s

Tap51

Thu Apr 4th 5:15pm - 6:00pm

// Tap Dance // Tap51 is a new tap dance collective based in Washington, DC. Through their exhilarating performances of

Virginia Kenkonkai

Fri Apr 5th 12:00pm - 12:30pm

// Martial Arts // The Virginia Kenkonkai trains in the Japanese martial art of Nakamura Ryu Battodo which grew

deTournai

Fri Apr 5th 12:50pm - 1:50pm

// Progressive Rock // deTournai, DC's "progressive rock brother duo" (Washingtonian), is a group of brothers born

Danny & Jimmy

Fri Apr 5th 2:10pm - 2:55pm

// Latin Pop etc. // Danny & Jimmy a roller coaster of energy. Fusing different genres to connect with everyone.

Sour Station

Fri Apr 5th 3:15pm - 4:00pm

Alternative Indie Sour Station is an indie pop fusion band out of the Philly-metro area, and consists of Natalie Buechel

RAYMI

Fri Apr 5th 4:20pm - 5:05pm

// Andean Music // RAYMI is an Andean folk group formed by a group of young musicians in 1996. The group's purpose

Kuchipudi Dance Academy

Fri Apr 5th 5:30pm - 6:00pm

// Indian Classical Dance // Kuchipudi Dance Academy, founded in 1996 by Lakshmi Babu, is a beacon of classical

Rasha Jay

Sat Apr 6th 12:55pm - 1:55pm

// Alt/Rock and Soul // Rasha Jay is a proud southern Maryland born and raised songwriter who fuses her love for

The Continental Jazz Congress

Sat Apr 6th 2:15pm - 3:15pm

// Jazz // The Continental Jazz Congress is a NoVA-based jazz quintet blending the sounds of swing, bop, blues, latin,

The City Limit

Sat Apr 6th 3:35pm - 4:20pm

// Alternative // Thecitylimit.music@facebook.com

PatriceLIVE

Sat Apr 6th 4:40pm - 5:10pm

// R&B and Pop // PatriceLIVE is a singer, songwriter, marketing professional, entrepreneur, and philanthropist

Fairfax Chinese Dance Troupe

Sat Apr 6th 5:30pm - 6:00pm

// Chinese Dance // Fairfax Chinese Dance Troupe is a non-profit amateur group, dedicated to sharing art and culture