

National Aeronautics and  
Space Administration



# EXPLORE EARTH

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# NASA Applied Sciences Program

The Applied Sciences Program supports innovative and practical uses of Earth observations and scientific knowledge by private and public sectors to inform their planning, decisions, and actions.

- ASP pursues:
  - ▶ Partnerships with public and private organizations
  - ▶ Discovery of innovative NASA Earth science applications
  - ▶ Support of environmental decision-making activities
  - ▶ Demonstration of practical benefits of NASA Earth science
  - ▶ Help to improve the quality of life and strengthen the economy
- Three lines of business:



Mission  
Planning

Capacity Building  
Program

Thematically-organized  
Applications

# Capacity Building Program

## 2018 Reach



8,600  
Individuals



2,944  
Institutions



146  
Countries

- Engages current and future decision makers
- Improves skills and capabilities to access and apply NASA Earth science
- Pursues different approaches to building capacity: trainings, feasibility projects, and product co-development
- Participates in both domestic and international capacity building groups, such as the Group on Earth Observations (GEO) and the Committee on Earth Observation Satellites (CEOS)
- Supports three elements:
  - ▶ ARSET: <https://arset.gsfc.nasa.gov>
  - ▶ DEVELOP: <https://develop.larc.nasa.gov>
  - ▶ SERVIR: <https://www.servirglobal.net/>



# Capacity Building Methods



## Trainings

In-person, webinar, and on-demand virtual module trainings through the ARSET Program and the SERVIR hub network that teach end-users how to access, visualize, and apply NASA Earth Science data



## Feasibility Studies

Rapid 10-week long projects conducted by DEVELOP that serve as a dual capacity building venue with project participants gaining hands-on experience in the use of EO and project partners gaining results and methods



## Service Co-Production

Multi-year, co-development projects that advance the use of space-based observations to inform policy and decision makers in the developing world through the SERVIR Applied Sciences Team

### *Spectrum of Expected Outcomes*

*Improved Awareness of EO Resources*

*Enhanced Access to EO Resources*

*Strengthened Capacity to Use EO Resources*

*Increased Use of EO in Decision-Making*

# CBP Activities in Asia

## Individuals Engaged in SARI Countries

Country	2016	2017	2018
Afghanistan	1	31	38
Pakistan	69	63	83
Bangladesh	46	49	56
Bhutan	0	3	4
India	362	511	859
Nepal	39	113	84
Sri Lanka	4	4	10
Thailand	56	92	89
Myanmar	14	18	51
Vietnam	40	42	83
Cambodia	10	32	10
Laos	2	6	16
Indonesia	34	33	104

## 2016-2018 Activities

- 8 Feasibility Studies
- 4 in-person ARSET trainings
- 31 online ARSET trainings
- 13 SERVIR AST projects
- 74 SERVIR trainings
- 14 SERVIR workshops

# CEOS & GEO CB and Land Activities

## CEOS Working Group for Capacity Building & Data Democracy (WGCapD)

<http://ceos.org/ourwork/workinggroups/wgcapd/>

**Mission:** Increase the capacity of institutions in less developed countries for effective use of Earth Observation data for the benefit of society and to achieve sustainable development.

### Objectives:

1. Establishing effective coordination and partnerships among CEOS Agencies offering Earth observation education/training
2. Working with CEOS entities to address data accessibility

**Recent WGCapD annual meeting** (Mar 2019) – Archive of presentations: <http://ceos.org/meetings/wgcapd-8/>

## GEO Land Degradation Neutrality

<https://www.earthobservations.org/activity.php?id=149>

The GEO Initiative on LDN assists countries, regions, and others interested in addressing land degradation with monitoring and reporting necessary to implement and achieve SDG 15, “Life on Land”.

## GEO Land Cover and Land Cover Change community activity

<https://www.earthobservations.org/activity.php?id=100>

### Goals (broad primary outcomes):

1. Operational systems that provide LC products that meet the varied needs of different users at various levels.
2. Informing policy initiatives, including those from UN Conventions such as the SDGs, and at the national level.
3. Easy access to existing LC and LCC information, including making it easier for users to find the data that best meets their needs.

# SERVIR

- Joint development initiative of NASA & USAID
- Works in partnership with leading regional organizations world-wide to host five hubs:
  - Eastern & Southern Africa – Nairobi, Kenya
  - West Africa – Niamey, Niger
  - Hindu-Kush Himalayas – Kathmandu, Nepal
  - Mekong – Bangkok, Thailand
  - Amazonia – Valle del Cauca, Colombia (opening in 2019)
- Helps developing countries use information provided by Earth observing satellites and geospatial technologies for managing climate risks and land use
- Empowers decision-makers with tools, products, and services to act locally on climate-sensitive issues



<https://www.servirglobal.net/>



# SERVIR

## Current SERVIR-Mekong Services

	Land Cover/Land Use and Ecosystems	Agriculture and Food Security	Water and Disasters	Weather and Climate
Regional		Supporting MRC's regional drought early warning system		Supporting better flood forecasting for MRC
Myanmar	Supporting climate adaptation and mitigation through land use/land cover mapping in Myanmar		Supporting early flood preparedness in Myanmar Improving near-real-time flood monitoring in Myanmar Mitigating impacts and increasing benefits from changing river courses in Myanmar	
Cambodia				Supporting better flood forecasting for Cambodia
Vietnam		Enhancing drought resilience and crop yield security in Vietnam Supporting agricultural planning in Vietnam	Supporting water resource planning and management in Vietnam	





# Supporting GHG Reporting and Forest Monitoring of Myanmar

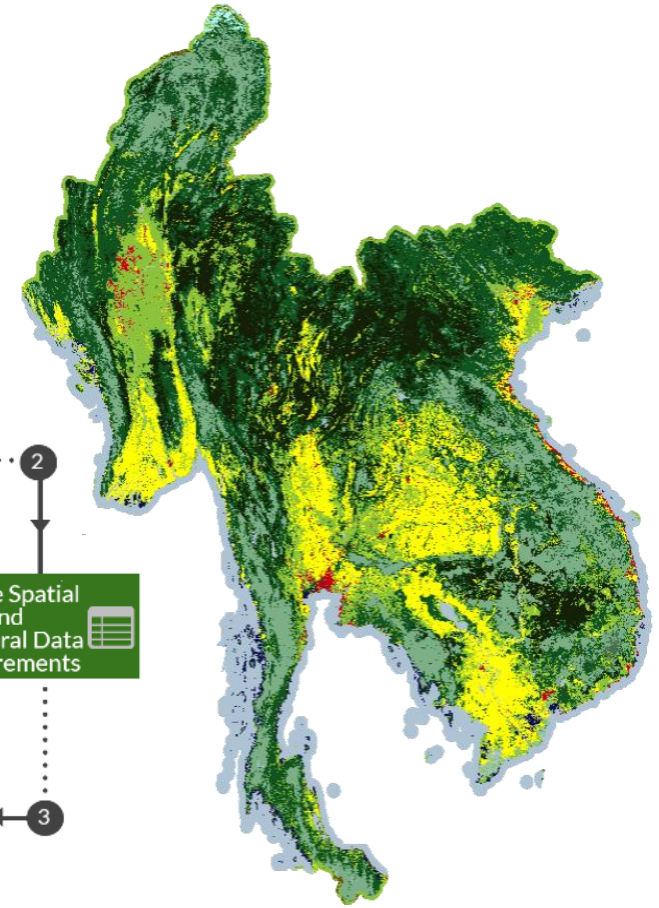
Transparent, consistent reporting with open source methodology is the basis of accountability on climate change reporting to meet targets set by the governments. Myanmar is keen to put in place systems which are able to produce the wall-to-wall maps annually with consistent methodology for the Forest Resources Assessment (FRA) and the United Nations Framework Convention on Climate Change (UNFCCC) reporting.



SERVIR-Mekong, in collaboration with SERVIR-HKH, OneMap-Myanmar, and the U.S. Forest Service, works closely with the Myanmar's Forest Department to develop an approach to customizing the **Regional Land Cover Mapping System (RLCMS)** towards meeting reporting requirements.

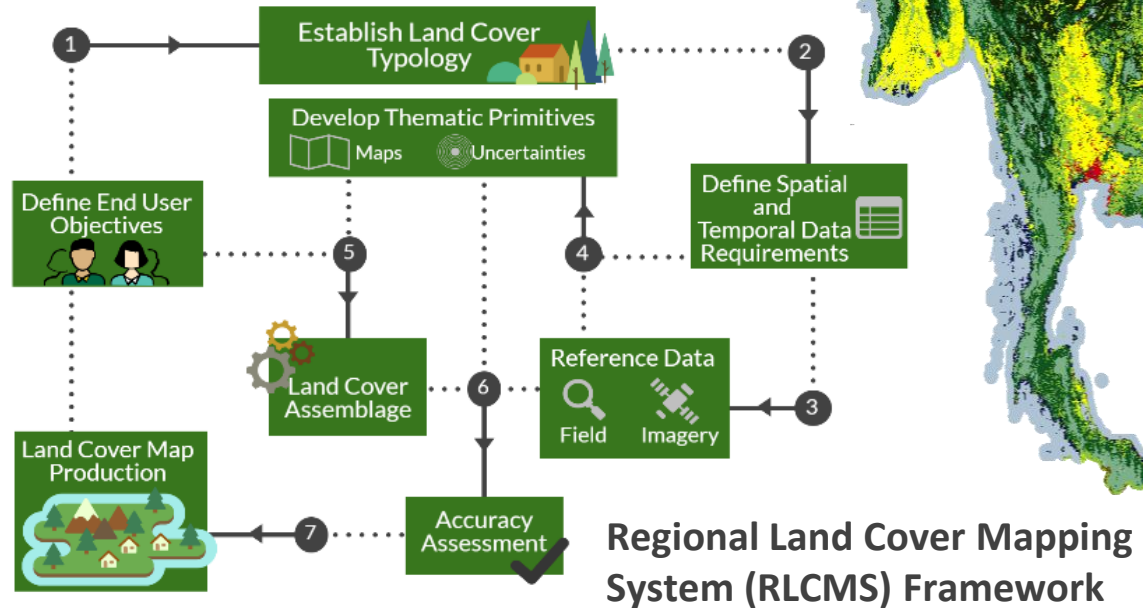


# Supporting GHG Reporting and Forest Monitoring of Myanmar



Regional Land Cover Mapping System (RLCMS) is important for an array of services including land resource planning and for ecosystem services in particular biodiversity conservation and resilience to climate change.

Within RLCMS framework, highlighting the Reference Field Data which was obtained with the Collect Earth Online (CEO) System





# Supporting GHG Reporting and Forest Monitoring of Myanmar



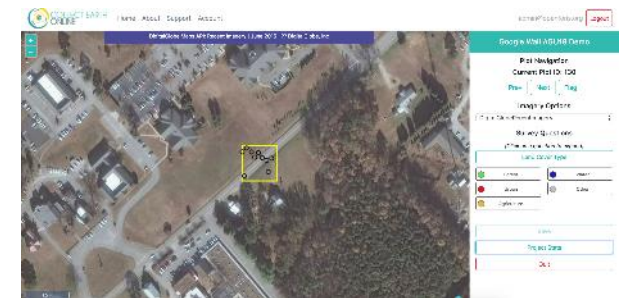
## Example Use Cases and Applications

- Myanmar Forestry Department: FRA and UNFCCC GHG reporting
- National Institute of Agricultural Planning and Projection, Viet Nam: rice monitoring for agriculture insurance
- Ministry of Agriculture, Irrigation and Livestock (MAIL), Afghanistan
- Lower Mekong Basin State of Lands Report



## Immediate Next Steps

- Forest Resources Assessment and Greenhouse Gas Reporting products (June '19 delivery)
- Organize Training of Trainers for Forest Department in Myanmar using the RLCMS platform



## Looking forward

- Myanmar Ministry of Natural Resource and Environmental Conservation can publish the regulation on land cover monitoring using RLCMS process and methods.
- The RLCMS is being fully integrated into the Food and Agricultural Organization (FAO) developed system SEPAL product for land cover and forest monitoring system. This is aimed for Monitoring Reporting Verification (MRV) of various countries for their national reporting purposes.

# Collect Earth Online



(<http://collect.earth>) is a custom built, open-source, satellite image viewing and interpretation system developed by SERVIR and the FAO as a tool for use in projects that require land cover and/or land use reference data.

Originally started in the Mekong region, and has since expanded globally

**CEO** promotes consistency in locating, interpreting, and labeling reference data plots for use in classifying and monitoring land cover / land use change.

The **CEO** codebase is shared through the Open Foris Initiative of the Food And Agriculture Organization of the United Nations.

The screenshot shows the Collect Earth Online web application interface. At the top, there is a navigation bar with the logo, "Home About Support", and a "Login/Register" button. Below the navigation bar is a sidebar menu titled "Institutions" with a search box "Enter text to filter" and a list of institutions: FAO-FRA, US Forest Service, Forest Department (Myanmar), Spatial Informatics Group (SIG), Forest Research and Training Center, Nepal, GLOBE Observer, SERVIR-Mekong Training, Demo, Cambodia Change Detection, and Ecuador Ministerio del Ambiente. The main content area displays a satellite map of the world with several blue circular markers numbered 1 through 17. Below the map, there is a smaller inset showing a detailed satellite image of a specific area with a black outline, and a sidebar with various tool options like "Map", "Layers", "Tools", and "Help".

The system architecture diagram on the right illustrates the data flow. It shows a "USER" interacting with the "CEO Web" (Front End and Back End). The "CEO Web" is connected to the "GeoDash" interface, which in turn connects to the "GeoDash Database". The "GeoDash Database" is linked to the "GEE- Gateway REST server", which connects to "GEE Image Collections". The "FAO Collect Database" is also connected to the "GeoDash Database".



# ARSET

- Applied Remote Sensing Training program
- Increases the use of NASA Earth Science models and data for environmental applications
- Team of 15 NASA scientists, students and support staff at four NASA Centers
- Provides basic, intermediate, and advanced online and in-person training
- Trainings offered on air quality-, disasters-, land-, and water-related applications
- Target audience: decision-makers and other environmental professionals in the public and private sectors
- Since 2009: 19,400+ participants from 5,000+ organizations in 160+ countries



<https://arset.gsfc.nasa.gov>



# ARSET LCLUC-Related Trainings



## Upcoming Trainings

- **Investigating Time Series of Satellite Imagery:** This training will focus on two tools, AppEEARS from the LPDAAC and LandTrendr via Google Earth Engine (GEE). April 15-17, 2019. Online. More information: <https://arset.gsfc.nasa.gov/land/webinars/time-series-19>.
- **ARSET Land Management Training Page:** Hosts information about upcoming land trainings, FAQ for working with NASA data, and information about requesting a training: <https://arset.gsfc.nasa.gov/land>.

## Training Archive

- **Feb 2019:** Earth Observations for Indigenous-Led Land Management: <https://arset.gsfc.nasa.gov/land/webinars/GEO-EO4IM>.
- **Jan 2019:** Remote Sensing for Conservation & Biodiversity: <https://arset.gsfc.nasa.gov/land/webinars/conservation-biodiversity-2018>.
- **Sept 2018:** Change Detection for Land Cover Mapping: <https://arset.gsfc.nasa.gov/land/webinars/adv-change18>.
- **Aug 2018:** Radar Remote Sensing for Land, Water, & Disasters Applications: <https://arset.gsfc.nasa.gov/disasters/webinars/advanced-SAR-18>.
- **Feb 2018:** Accuracy Assessment of a Land Cover Classification: <https://arset.gsfc.nasa.gov/land/webinars/18adv-land-classification>.
- **Sept 2017:** Introduction to Remote Sensing for Scenario-Based EcoForecasting: <https://arset.gsfc.nasa.gov/land/webinars/scenario-based-ecoforecasting-17>.

# ARSET SARI Country Trainings

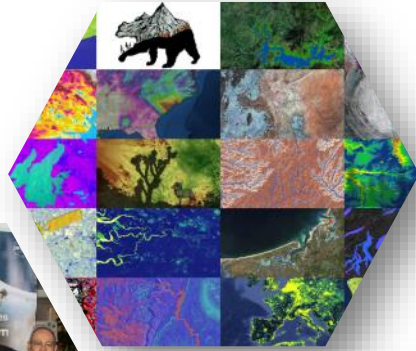
- **March 2018:** ARSET provided an Air Quality training in Jakarta, conducted in partnership with the Indonesian Agency for Meteorological, Climatological, and geophysics, and the U.S. Embassy, Jakarta.
- **Nov 2018:** ARSET conducted two trainings in Dehradun, India, one on satellite remote sensing of Air Quality and another on flood monitoring and management. These were conducted in collaboration with IIRS Dehradun and ISPRS.
- **May 2017:** Satellite Remote Sensing of Air Quality (data, tools, and applications) training in Pune, India. Hosted by the Indian Institute of Tropical Meteorology, Ministry of Earth Sciences.





# DEVELOP

- Bridges the gap between NASA Earth Science and society
- Addresses environmental decision making and public policy issues
- Conducts 10-week long interdisciplinary feasibility studies during 3 terms per year
- Builds capacity to use Earth observations in both participants (students, recent grads & transitioning career professionals) and partner organizations
- Projects are conducted at 12 nodes throughout the US, but project study areas focus on issues around the globe



<https://develop.larc.nasa.gov>





# LCLUC-Related Feasibility Studies

## SARI Land Studies

- **Chao Phraya Water Resources:** Assessing Water Quality in Thailand's Chao Phraya Watershed through Modeling Sediment Concentration and Urban Footprint (2018 Summer)
- **Eastern India Ecological Forecasting:** A Multi-Sensor Approach to Enhance the Prediction of Mangrove Biophysical Characteristics in Chilika Lagoon and Bhitarkanika Wildlife Sanctuary, Odisha, India (2017 Summer)

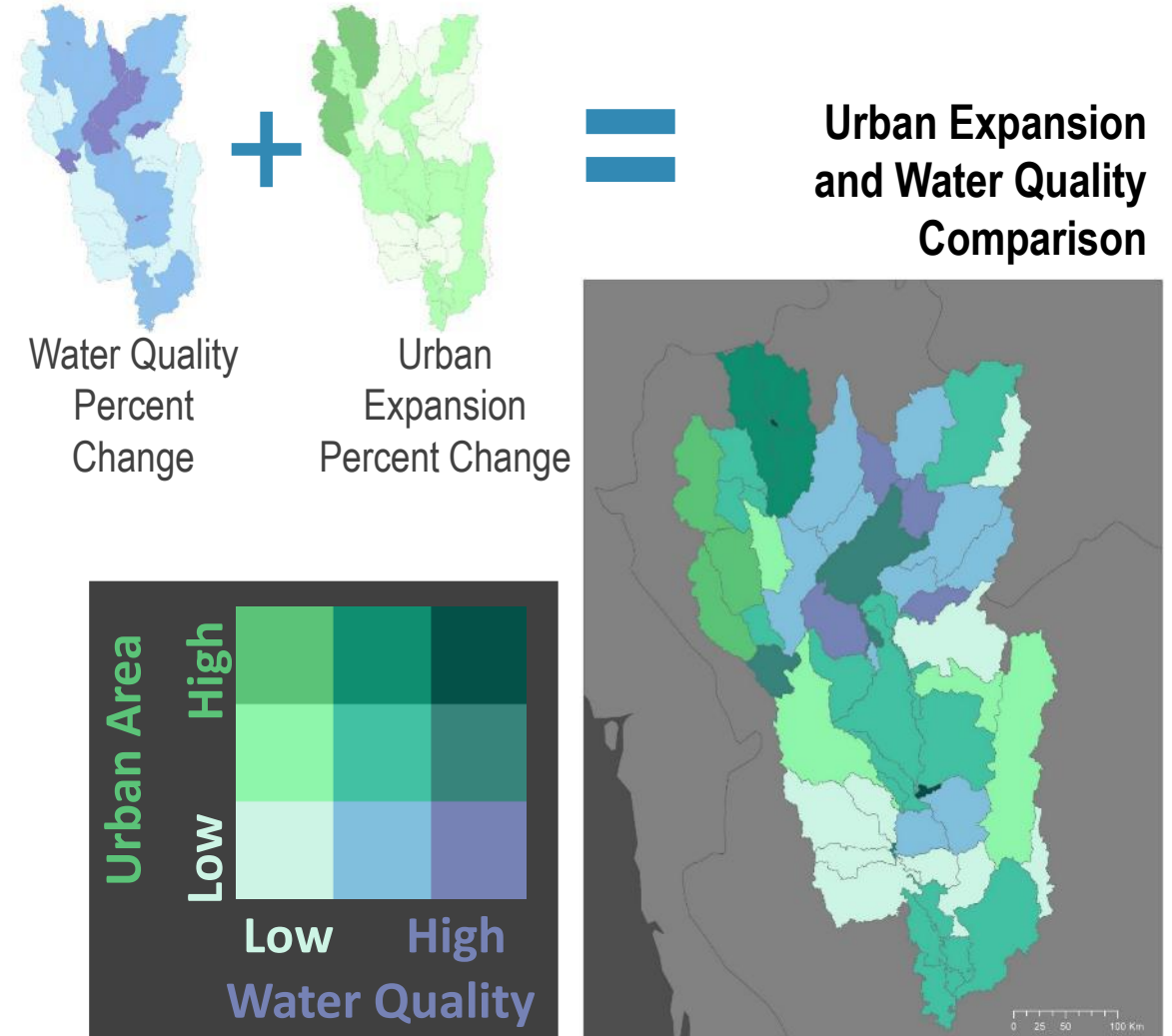
## LCLUC-Related Studies

- 57 out of 228 projects (Jan 2016 to present) related to LCLUC
- Archive: <https://develop.larc.nasa.gov/>

# Assessing Water Quality in Thailand's Chao Phraya Watershed through Modeling Sediment Concentration and Urban Footprint

In response to partners' needs for enhanced watershed management during dry seasons, this project explored the use of TRMM and SRTM data and the SWAT model to identify areas contributing to high sediment concentrations, understand historical changes in WQ throughout the entire watershed, and analyze the relationship between urbanization and sediment concentration.

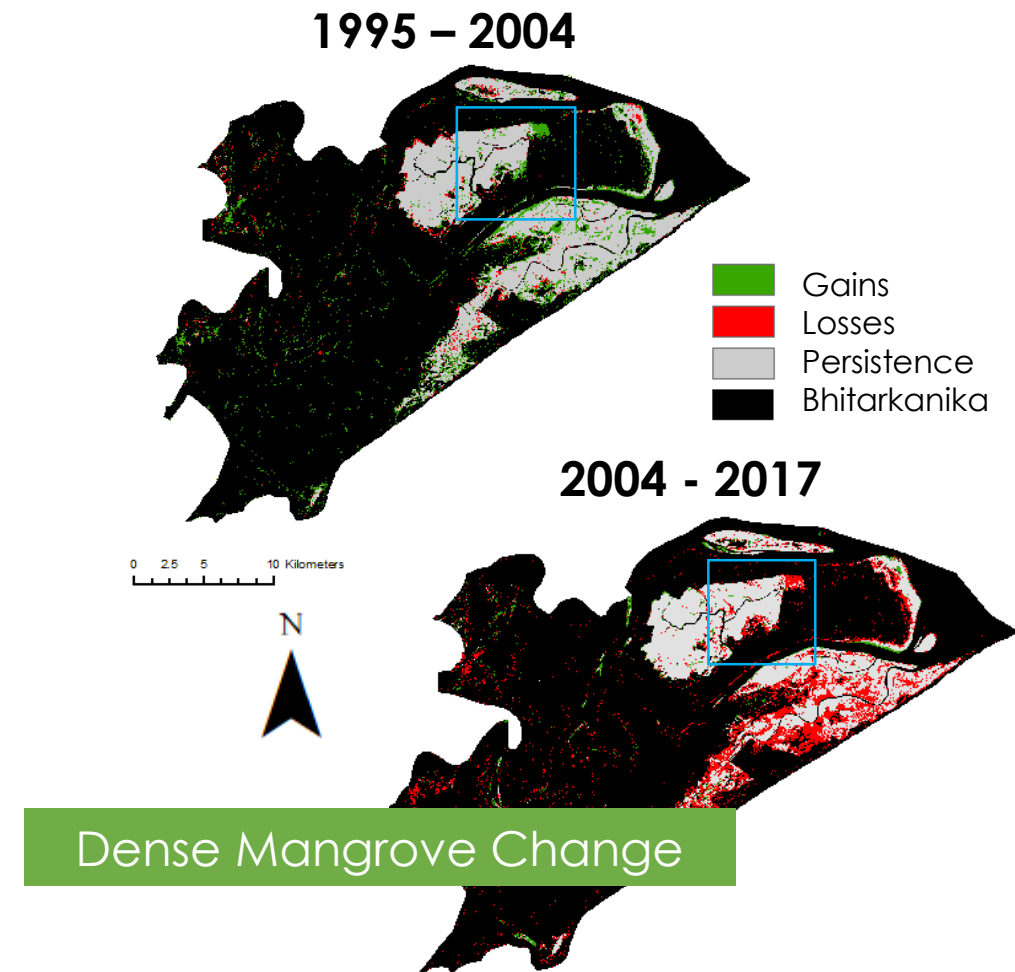
The feasibility study found that upper sub-basins consistently contributed more to sediment concentrations than lower sub-basins, suggesting that these sub-basins could be a good place to further research and remediation efforts. No correlation between percent change in urban area and percent change in water quality was found, however the results and methodology set a foundation for partners to continue a basin-wide assessment of the watershed using EO.



# A Multi-Sensor Approach to Enhance the Prediction of Mangrove Biophysical Characteristics in Chilika Lagoon and Bhitarkanika Wildlife Sanctuary, Odisha, India

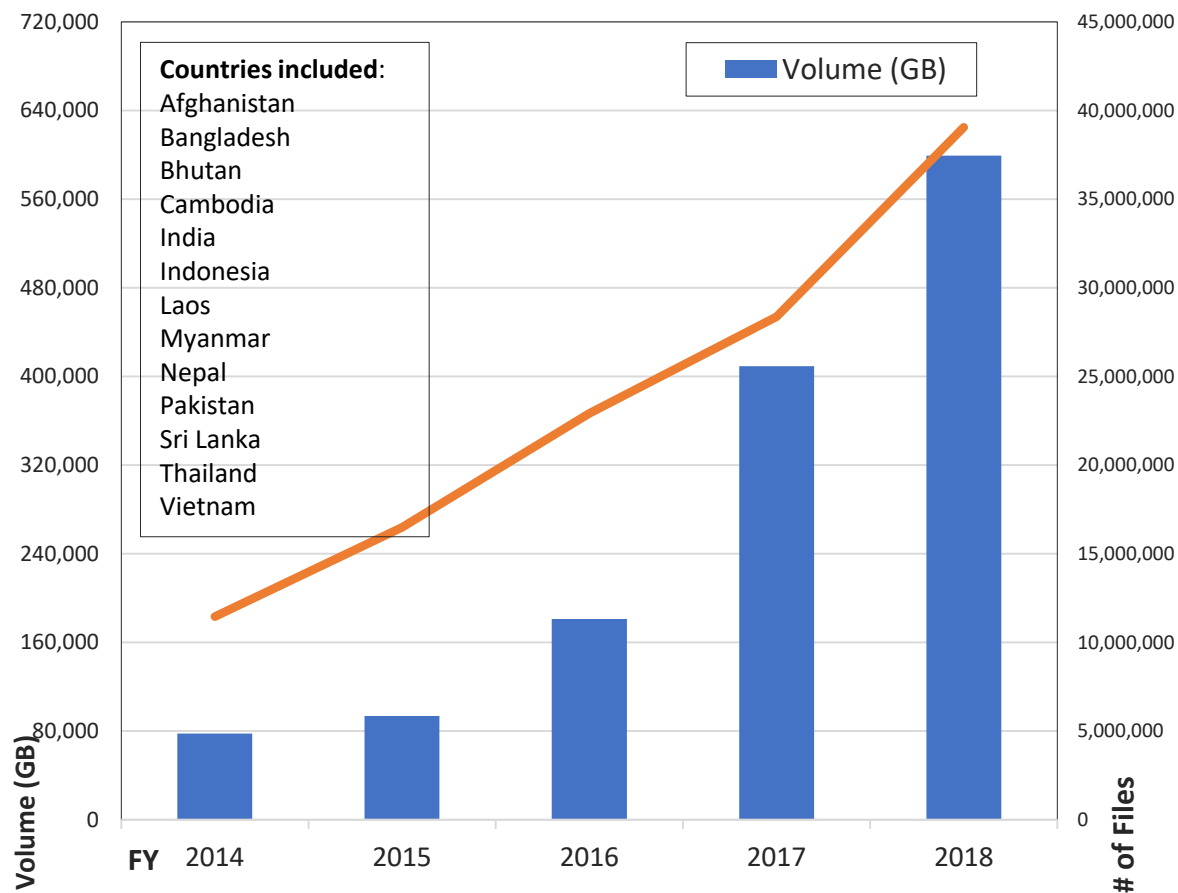
Mangroves provide valuable ecosystem services, yet encroachment by unauthorized aquaculture practices and discharge of effluent place pressure on mangrove forests and biodiversity. This project produced maps illustrating long-term phenology, analyzed spatio-temporal variability of biophysical parameters (GPP, LAI, CHL) using MODIS (2000-2017), and assessed mangrove extent & change over time. It also created a mangrove extent forecasting tool using Landsat 5 TM and Landsat 8 OLI data.

The feasibility found that despite conservation efforts, the current extent of dense mangrove in Bhitarkanika Wildlife Sanctuary is projected to decrease up to 10% by the year 2050. Comparisons between classifications for 1995, 2004, and 2017 indicated that dense mangrove extent decreased while open mangrove and agriculture extents increased. This work supports enhanced management and restoration efforts by the Department of Forest and Environment in Odisha, India.

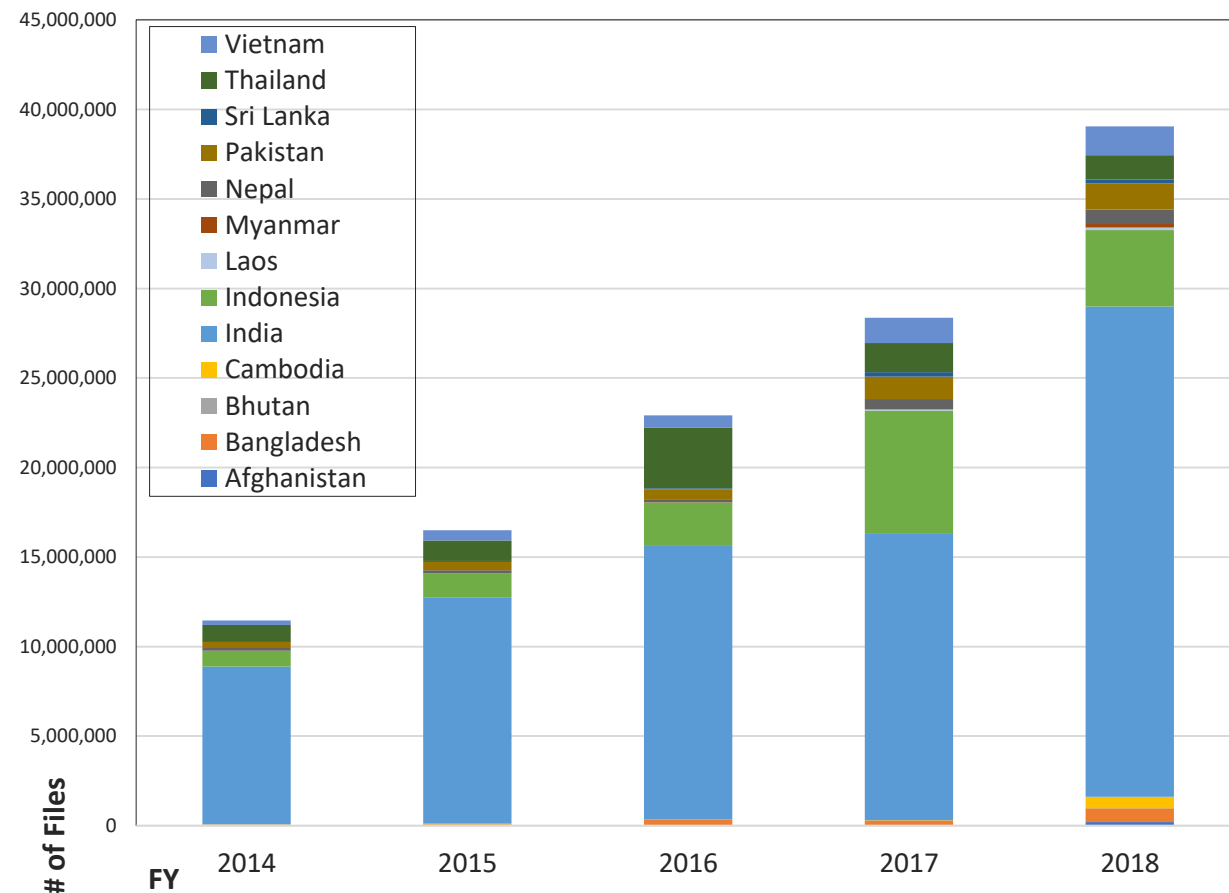


# NASA Data Acquisition in SARI Countries

EOSDIS Yearly Total Data Volume (GB) and Number of Products Distributed to SARI



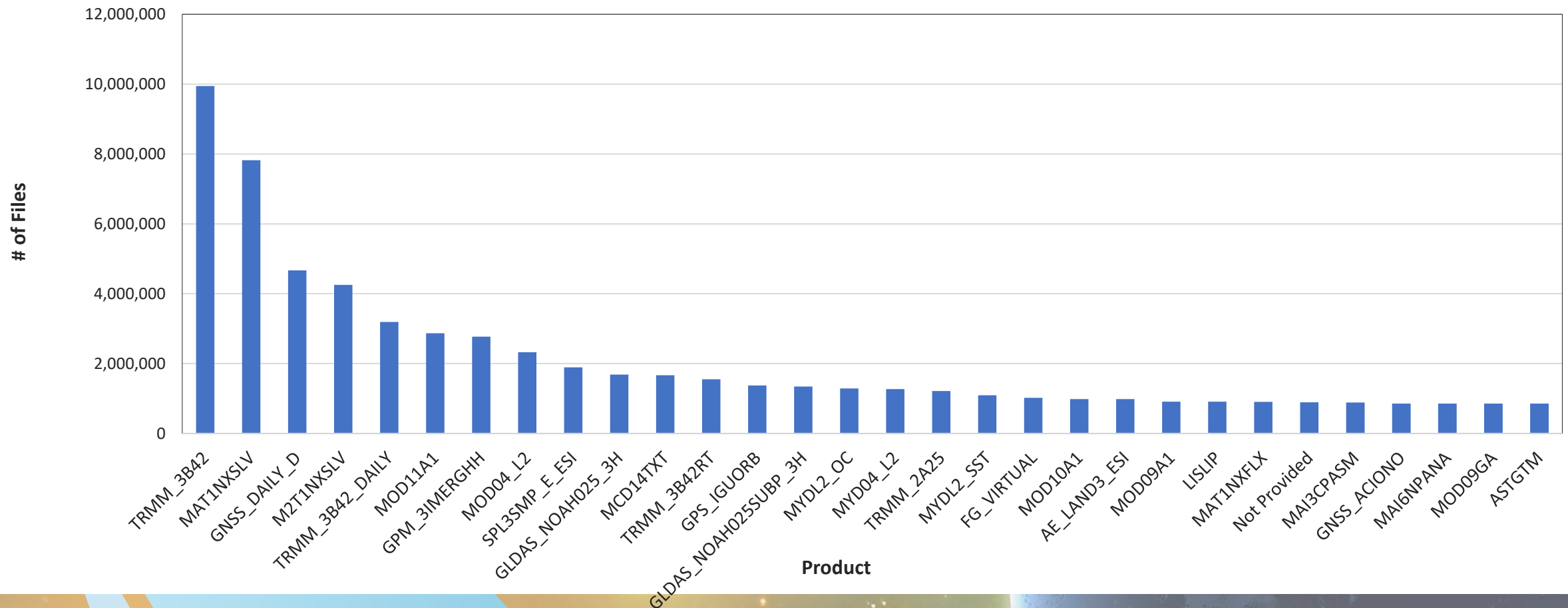
EOSDIS Yearly Number of Distributed Products by Country





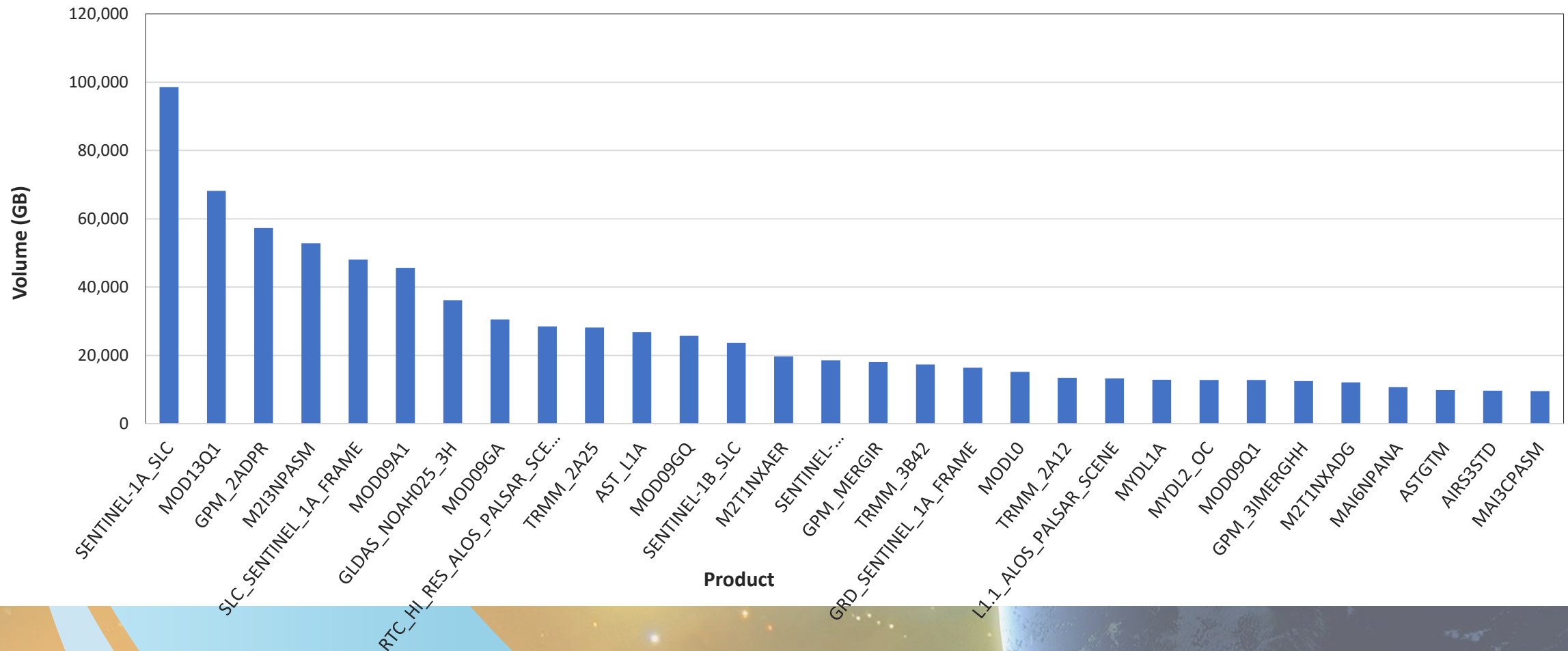
# NASA Data Acquisition in SARI

EOSDIS Total Number of Files Distributed to 13 Countries by Product (FY15-FY18)



# NASA Data Acquisition in SARI

EOSDIS Total Distributed Volume Distributed to 13 Countries by Product (FY15-FY18)



# CBP Best Practices

To increase the capabilities of individuals and institutions to use and apply NASA Earth observations, CBP continues efforts to identify lessons learned and best practices. These best practices are shared through the elements and CEOS:

- **SERVIR's service planning toolkit**, comprised of four tools: 1) consultation and needs assessment, 2) service design, 3) stakeholder mapping, and 4) monitoring, evaluation, and learning: [https://www.servirglobal.net/Portals/0/Documents/ServicePlanningToolkit\\_2017-09-19.pdf](https://www.servirglobal.net/Portals/0/Documents/ServicePlanningToolkit_2017-09-19.pdf)
- **ARSET's "Remote Sensing Training: Methods and Best Practices" training**, provides guidance on how to develop, promote, schedule, and assess a training: <https://arset.gsfc.nasa.gov/all/webinars/best-practices-2016>
- **DEVELOP's dual-capacity assessment approach**: <https://earthzine.org/assessing-the-impacts-of-building-capacity-in-the-use-of-earth-observations-through-the-nasa-develop-program/>
- CBP contributed to the development of a best practices document for conducting trainings through the **Committee on Earth Observing Satellites' Working Group for Capacity Building and Data Democracy. Training Best Practices**: [http://ceos.org/document\\_management/Working\\_Groups/WGCapD/WGCapD-Best-Practices\\_V2.0.pdf](http://ceos.org/document_management/Working_Groups/WGCapD/WGCapD-Best-Practices_V2.0.pdf)



# Resources


- SERVIR's Global Product Catalogue: <http://catalogue.servirglobal.net/>
- DEVELOP's code repository: <https://github.com/NASA-DEVELOP>
- DEVELOP's archive of past projects (2014 to the present): <https://develop.larc.nasa.gov/project-archive.php>.
- ARSET archive of past training materials: <https://arset.gsfc.nasa.gov/webinars>
- NASA's Distributed Active Archive Centers (DAACs): <https://earthdata.nasa.gov/about/daacs>.
- NASA Earth observing satellites: <https://eosps.nasa.gov/content/all-missions>.
- CEOS WGCapD training and other info: <http://ceos.org/ourwork/workinggroups/wgcapd/>





# Opportunities to Engage

- Share ARSET trainings with colleagues: visit <https://arset.gsfc.nasa.gov/> for more information about upcoming trainings list and access the archive of past trainings.
- Connect a decision making organization to DEVELOP to serve as a feasibility project end-user – project request form, found at <https://develop.larc.nasa.gov/projects.php>. Email to [NASA-DL-DEVELOP@mail.nasa.gov](mailto:NASA-DL-DEVELOP@mail.nasa.gov).
- Serve as a volunteer advisor for a DEVELOP feasibility project: email DEVELOP at [NASA-DL-DEVELOP@mail.nasa.gov](mailto:NASA-DL-DEVELOP@mail.nasa.gov) to learn about projects within your area of expertise.
- Consider engaging with WGCapD as a trainer. Email [Nancy.D.Searby@nasa.gov](mailto:Nancy.D.Searby@nasa.gov) and [Lauren.M.Childs@nasa.gov](mailto:Lauren.M.Childs@nasa.gov) for more information.
- Participate in GEO community activities: Land Degradation Neutrality (<https://www.earthobservations.org/activity.php?id=149>) and Land Cover and Land Cover Change (<https://www.earthobservations.org/activity.php?id=100>)



**Thank You!**  
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