



EARTH SCIENCE
APPLIED SCIENCES

2020 ANNUAL SUMMARY

NASA EARTH SCIENCE APPLIED SCIENCES PROGRAM

CAPACITY BUILDING
PROGRAM



On October 22, 2020, the Operational Land Imager (OLI) on Landsat 8 captured this false-color image of the Colorado East Troublesome fire. The image shows active fires (bright red), scarred land consumed by fire (darker red), and intact vegetation (green).

WELCOME

We welcome you to the Capacity Building Program's 2020 Annual Report. The year has brought many challenges yet the program's agility & the team's dedication and creativity have helped us to shift these challenges into opportunities.

As a program, we set new records in 2020 for the number of individuals & institutions engaged & countries reached. ARSET continued its online training offerings, which reached a broader/larger audience breaking its participation record, offered new training topics, e.g. urban heat islands, and increased private sector participation. The Indigenous Peoples Pilot offered its first virtual trainings, including an introductory course on remote sensing for indigenous lands through a partnership with United Tribes Technical College. DEVELOP successfully transitioned its in-person experiential learning to a virtual platform, including a program-wide software skills-building training. SERVIR found new ways to work virtually with the global network, and continues to work with users on improved services, e.g. with the Thailand Pollution Control Department on a system to visualize historical, near real-time, & forecasted air quality and impacts of fires in the Mekong.

I am proud of and grateful for our team and its continued achievements in 2020 despite many difficulties. On behalf of the entire Capacity Building Program, I'd like to thank our many stakeholders that help us impact so many across the globe. We invite you to read on to learn about our 2020 highlights and accomplishments.

Dr. Nancy D. Searby

Capacity Building Program Manager



I. PROGRAM INTRODUCTION



Part of NASA's Earth Science Division's [Applied Sciences](#), the Capacity Building Program (CBP) builds capacity around the globe to **expand the Earth observations user base & increase awareness** within non-traditional audiences of NASA Earth observations data & products. CBP works through both program and element activities. Program activities include participating in domestic and international capacity building groups, such as the Group on Earth Observations (GEO) and the Committee on Earth Observation Satellites (CEOS), as well as identifying partnership opportunities to reach new end-users like the Indigenous Peoples Pilot. CBP includes three elements: the Applied Remote Sensing Training Program (ARSET), DEVELOP, and SERVIR.



[Capacity Building](#) is led by **Dr. Nancy Searby** at NASA Headquarters and supported by **Lauren Childs-Gleason, Christine Mataya,** and **Yasha Moz**. Each element and pilot is led by management teams at NASA Centers:

ARSET – **Dr. Ana Prados**, UMD at GSFC

DEVELOP – **Michael Ruiz**, NASA LaRC

SERVIR – **Dan Irwin**, NASA MSFC

Indigenous Peoples Initiative – **Dr. Cindy Schmidt**, BAERI at ARC

ARSET



empowers the global **community** through remote sensing trainings.

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

Through its trainings, participants learn how to access and use NASA Earth science data, applications, and models for environmental management and decision support.

DEVELOP



addresses environmental issues & public policy through applying the lens of NASA Earth observations to **community concerns**.

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

These interdisciplinary feasibility projects provide experiential learning & workforce development for both participants & partner organizations to utilize NASA data and resources in their decision making processes.

SERVIR



supports developing countries apply geospatial technology to environmental **decision making**.

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

A joint development initiative between NASA and the U.S. Agency for International Development (USAID), works in partnership with a global network of leading regional organizations to support developing countries' use of Earth-observing satellites & geospatial technologies.

TEAMWORK

The program elements work independently, yet engage in many collaborative activities. These include a joint initiative to strengthen foundations of science, technology, engineering, and mathematics in Bhutan, collaboration on trainings and feasibility projects, joint relationship building with external organizations, and participation in each other's events.



Another key collaboration for the CBP team was the collective effort to lead the coordination of the first ever, virtual Applied Sciences Week 2020 which took place in August 2020.

APPLIED SCIENCES WEEK

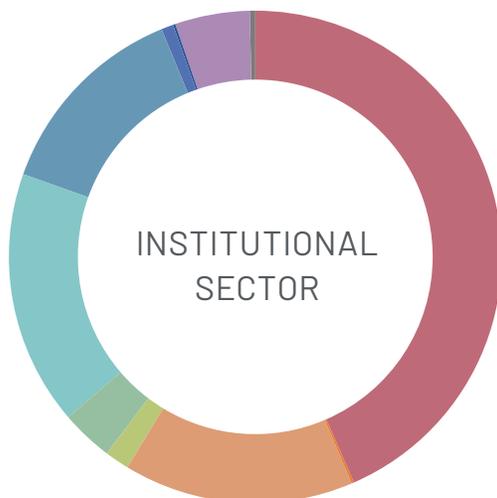
CELEBRATING REAL-WORLD APPLICATIONS OF EARTH SCIENCE

II. 2020 REACH & ACCOMPLISHMENTS

CBP had a dynamic year with an increased focus on virtual capacity building & efforts to creatively collaborate & engage with partners & the user community. The program conducted 93 trainings, 69 co-development projects, and 43 feasibility studies, which reached broadly across sectors, thematic areas, & geographies leading to a 103% increase over 2019 in individuals engaged, a 42% increase in unique organizations engaged, and 4% increase in countries reached.



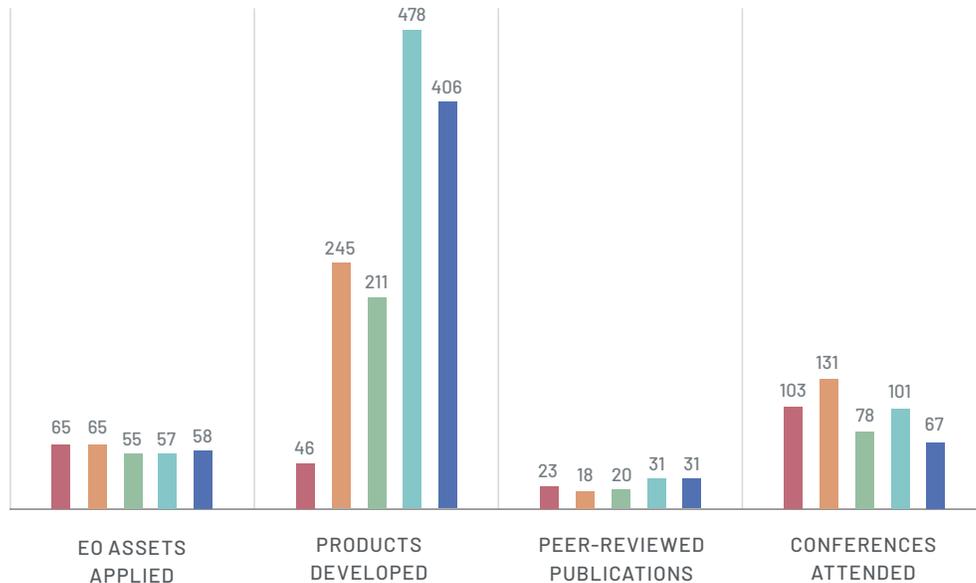
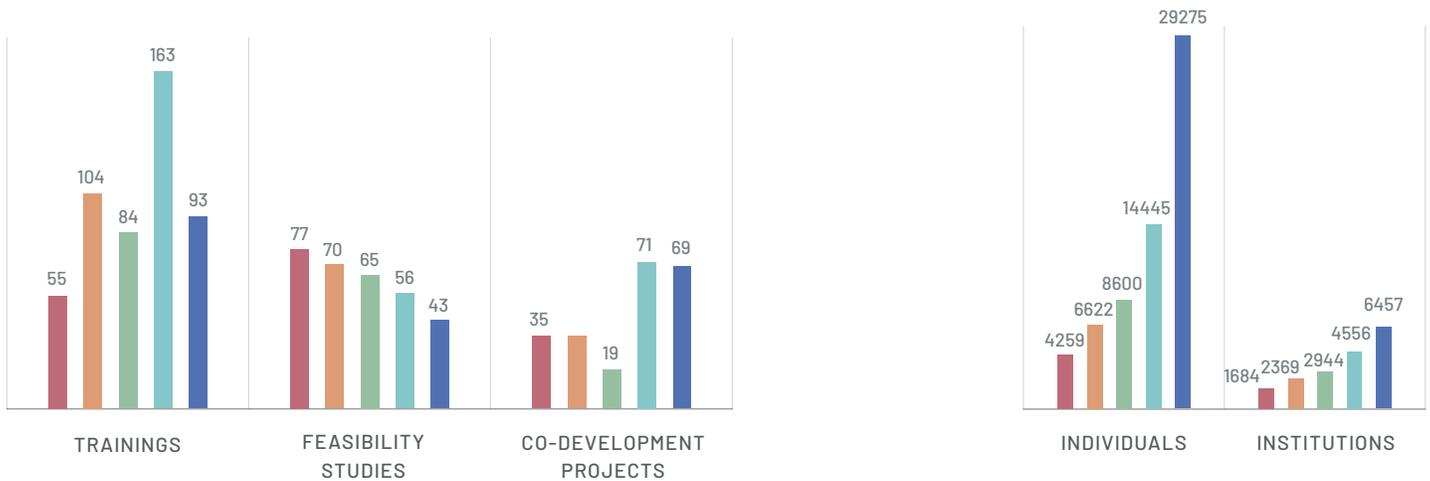
SECTORAL ENGAGEMENT



- Academic Institution (43%)
- Consortium (<1%)
- Federal/Central Government (15%)
- Intergovernmental Organization (2%)
- Local Government (3%)
- Private Sector (For-Profit) (17%)
- Private Sector (Non-Profit)/Voluntary or NGO (13%)
- Regional or Multi-State Agency (1%)
- Research Institution (<1%)
- State/Provincial Government (5%)
- Tribal/Indigenous Organization (<1%)

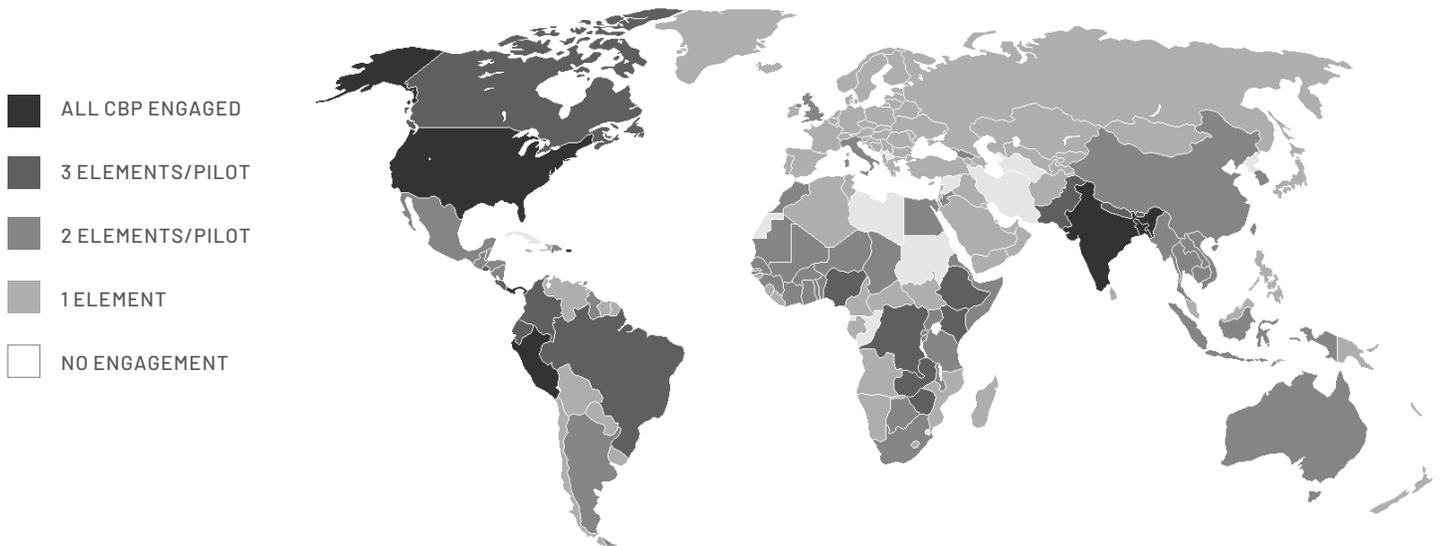
PROGRAMMATIC STATISTICS

The program reached participants from all sectors of society. Compared to 2019, 2020 saw increases in academic institutions (5% increase) & the for-profit private sector (1% increase), while a decrease in federal government (6% decrease).

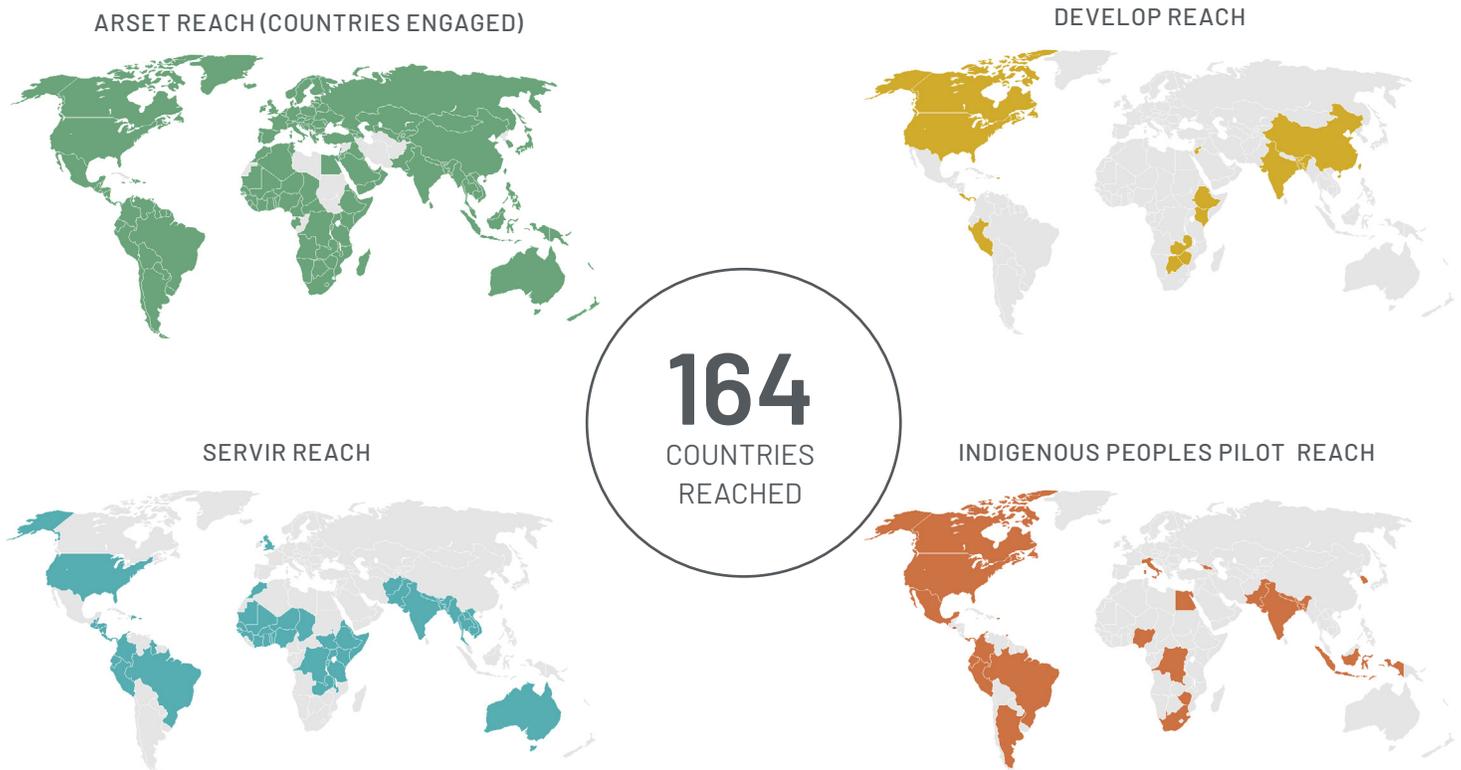


GEOGRAPHIC REACH

While the numbers of feasibility studies, trainings and conferences decreased this year partly due to the impacts of pandemic, the Capacity Building Program still had a combined reach of 164 countries, up from 158 in 2019. The map below shows the extent of the program's reach:



Each element has different geographical targets & focus. ARSET has global reach whereas DEVELOP focuses more domestically & SERVIR focuses in the 50 countries served by five hubs in Africa, Asia, & the Amazon. The Indigenous Peoples Pilot is focused on the US but is engaging virtual trainees globally. The virtualization of capacity building activities in 2020 allowed for more people to participate from around the world, which can be seen in the following maps:



COVID-19 RESPONSE: VIRTUALIZATION

A major accomplishment was the program's response to the COVID-19 pandemic, including transitioning in-person activities to virtual and addressing new needs through **new trainings**:

ARSET

AN INSIDE LOOK AT HOW NASA MEASURES AIR POLLUTION

LANGUAGES: ENGLISH & SPANISH

REACH: 2000+ PARTICIPANTS

96 COUNTRIES

46 STATES

DEVELOP

VIRTUAL SOFTWARE CARPENTRY TRAINING

DEVELOP successfully transitioned its in-person experiential learning opportunities to virtual by using collaborative software tools/virtual machines that provided access to software & processing for project work.



SERVIR

APPLIED SCIENCES TEAM (AST)

International travel restrictions affected projects & hubs by limiting in-person trainings, consultation workshops, and events, yet the network found ways to effectively get their work done virtually.

VIRTUAL AMAZONIA SUBJECT MATTER EXPERT TRAINING

To conduct this training virtually, SERVIR used Amazon Web Services (AWS) cloud-computing resources, a time-saving alternative for working with big data & complex software remotely.

INDIGENOUS PEOPLES PILOT

1ST VIRTUAL REMOTE SENSING TRAINING

Through collaboration with the United Tribes Technical College, a virtual course, "Introduction to Remote Sensing on Indigenous Lands" strengthened the skills of 151 participants from 135 unique organizations (42% academic, 25% Indigenous, 12% Govt., 11% NGO, and 10% Private), from 24 countries and 24 U.S. states. Sessions/materials can be freely accessed at the course [website](#).

INDIGENOUS MAPPING WORKSHOP

The pilot conducted a series of training sessions for the [Indigenous Mapping Workshop](#) focused on Earth observations, web tools, & various land analyses. They also presented at multiple conferences, & continued to foster relationships with indigenous groups through meetings/activities.

STAKEHOLDER & COMMUNITY ENGAGEMENT

67

NATIONAL CONFERENCES,
INTERAGENCY MEETINGS, &
INTERNATIONAL EVENTS

7

NASA SCIENCE TEAM
MEETINGS

To engage with stakeholders and the broader user community, Capacity Building participated in 67 national conferences, interagency meetings, and international events and seven NASA Science Team meetings – 60 of these events were virtual.

The CBP Program Manager, Dr. Nancy Searby, served as Chair for the [CEOS Working Group on Capacity Building and Data Democracy](#) (WGCapD), Co-Chair for the [GEO Capacity Development Working Group](#) (CD-WG), and Program Scientist for [NASA's Socio-economic Data Center](#) (SEDAC). She also supported the interagency U.S. Group on Earth Observations (USGEO)'s International Activities Working Group, Co-Chaired USGEO's Americas Group, and led **AmeriGEO's** capacity building activities.

CBP leadership chaired over a dozen sessions at the 2020 **AGU Fall Meeting**, contributed to a multiple day side-event during the European Space Agency's (ESA) **Earth Observation Phi Week**, and hosted a virtual synthetic aperture radar (SAR)

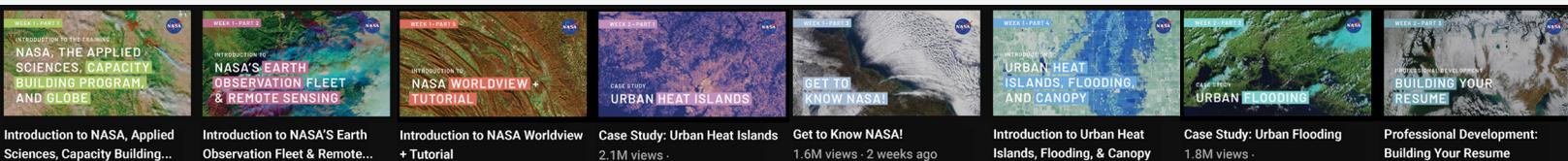
Townhall at the **European Geosciences Union (EGU) General Assembly 2020**. The CBP team served as panelists at events such as the [United Nations High-level Political Forum on Sustainable Development Indigenous side event](#), and the [GEO Indigenous Summit](#) and presented at dozens of virtual conferences and meetings such as the [GEO Virtual Symposium 2020](#), the [Geo For Good Summit 2020](#), and the [2020 Virtual Annual Water Resources Conference](#).

DIVERSITY, EQUITY, & INCLUSION

Supporting a renewed focus on enhancing diversity, equity, and inclusion activities, CBP pursued multiple efforts to increase outreach to underserved communities, expand its offerings of informational webinars, review demographic trends and tracking processes, as well as hosted a series of dialogues and events.

The Indigenous Peoples Pilot continued its focus on social inclusion and worked to increase indigenous representation in the Earth observations community, and built skills of indigenous decision makers and their staff to use satellite data.

In a train the trainer approach, the overall program engaged a team of interns that researched best practices for conducting trainings, then built their own training to introduce marginalized youth in the **Groundwork USA** network to remote sensing and urban applications of Earth observations.



VIRTUAL WiSci STEAM CAMPS

SERVIR

SERVIR GENDER EXCHANGE

ORGANIZERS: International Union for Conservation of Nature (IUCN), Advancing Gender in the Environment (AGENT) Program

REACH: 100+ PARTICIPANTS

PURPOSE: CBP exploring how better to incorporate gender in service design

WHITE HOUSE WOMEN'S GLOBAL DEVELOPMENT AND PROSPERITY INITIATIVE (W-GDP)

PARTICIPANTS: SERVIR /YouthMappers networks

PARTNERSHIP: Arizona State University

PURPOSE: A series of trainings to empower early career women

DEVELOP + SERVIR

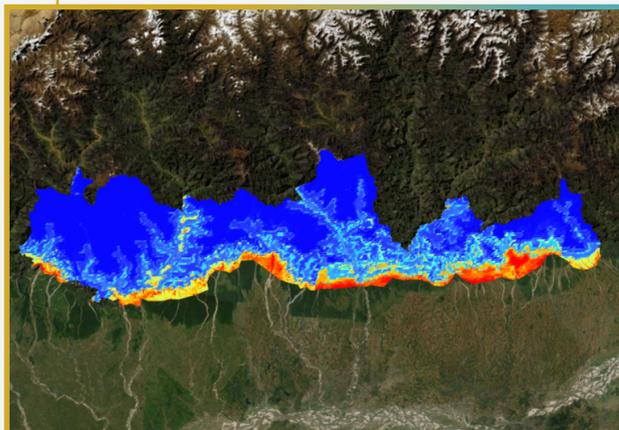
SOUTHERN BHUTAN ECOLOGICAL FORECASTING + BHUTAN WATER RESOURCES FEASIBILITY STUDIES

PARTNERSHIP: Interagency Agreement - U.S. Department of State

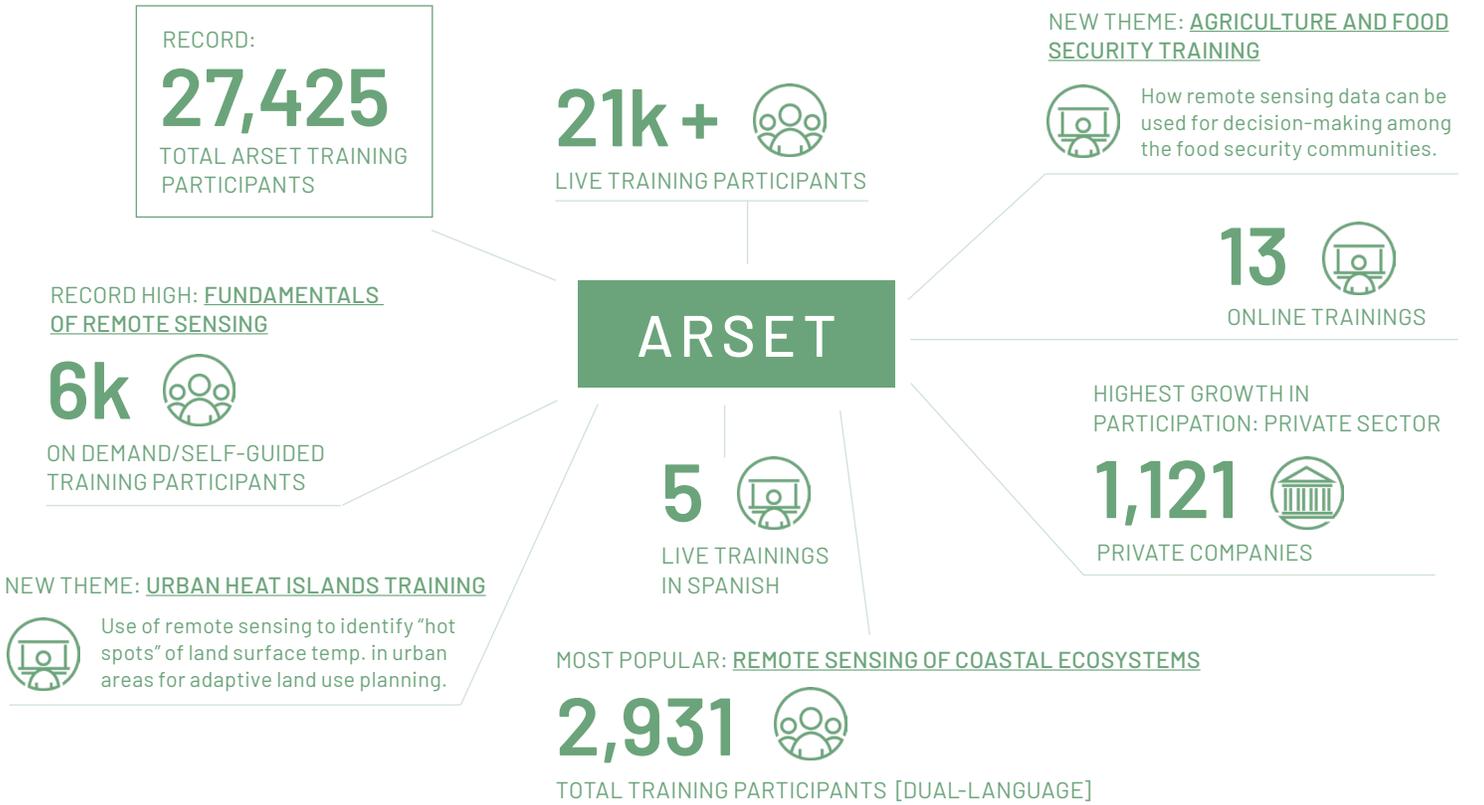
PARTICIPANTS: 9 Bhutanese scholars

LOCATIONS: Maryland-Goddard DEVELOP, Alabama-Marshall DEVELOP

PURPOSE: DEVELOP assembled two teams of participants with backgrounds ranging from psychology to civil engineering, global supply chain management, and international business. The participants used their diverse backgrounds, along with guidance from SERVIR, NASA, and partner advisors, to apply remote sensing and GIS to evaluate elephant habitat suitability in southern Bhutan & compare precipitation, temperature, & phenology data trends in Bhutan to assist the Himalayan Environmental Rhythm Observation and Evaluation System project.



III. 2020 ELEMENT ACCOMPLISHMENTS



2020 ELEMENT ACCOMPLISHMENTS

ENGAGEMENT FROM : TOOLS, TECHNOLOGIES, DATA, & METHODOLOGIES



IMPACT:



USING DATA FROM:



SERVIR

5 REGIONAL HUBS: Science Coordination Office, Applied Sciences Team, SERVIR Support Team

ARL - 4

APPLICATION READINESS LEVEL AVG. FOR AST PROJECTS



AIR QUALITY EXPLORER

In partnership with Thailand's Pollution Control Department (PCD) & Geo-Informatics & Space Technology Development Agency (GISTDA), SERVIR-Mekong developed a new [Air Quality Explorer tool](#) for Thailand, in response to chronic seasonal air pollution. The tool allows users to intercompare historic, near real-time satellite observations, ground-based air quality observations, and forecasted conditions.

COLLECT EARTH ONLINE

The [Global Forest Resource Assessment 2020 Report](#) cited SERVIR's [Collect Earth Online](#) (CEO), as enabling countries in "the collection of data for FRA's remote sensing survey" and many countries continue to use SERVIR's CEO to support Greenhouse Emissions reports.

HYDRA FLOODS

The UN World Food Programme (WFP) is integrating SERVIR services & data into their [PRISM interactive platform](#), ingesting information from SERVIR's near real-time flood monitoring system, [HYDrologic Remote Sensing Analysis for Floods](#) and drought monitoring tool, R DCYIS.

UTTTC TRAINING ENGAGEMENT:



INDIGENOUS PEOPLES PILOT

GEO

IPP supported the creation of the GEO Indigenous Alliance & the first [GEO Indigenous Summit](#)

UTTTC TRAINING REACH:

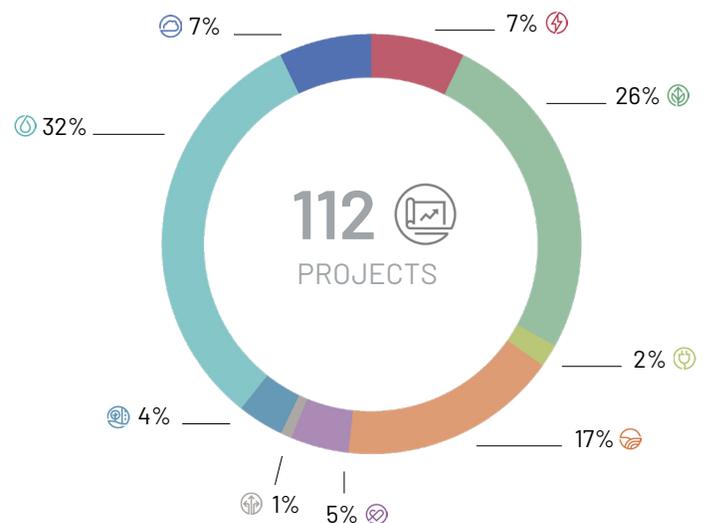
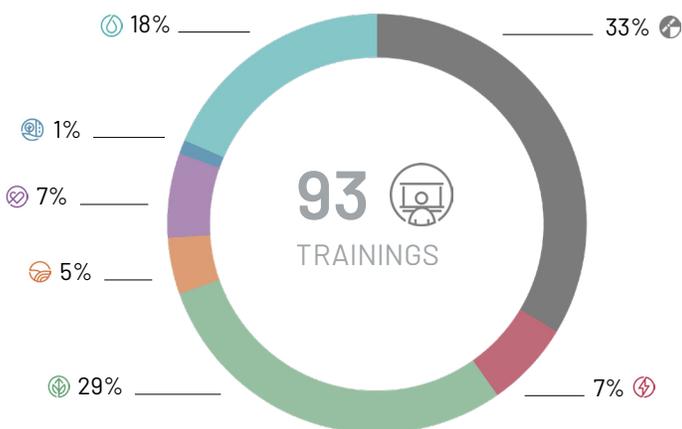
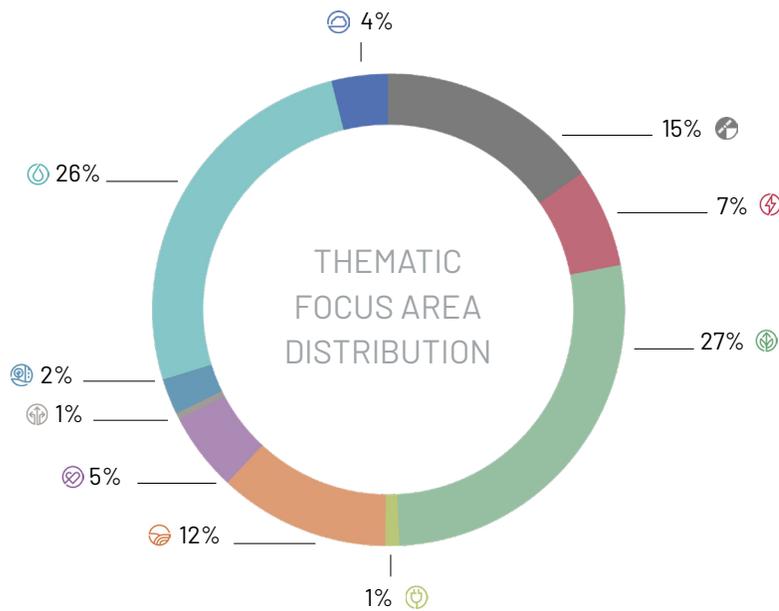


IV. THEMATIC & REGIONAL PORTFOLIO

-  WATER RESOURCES
-  ECOLOGICAL FORECASTING
-  URBAN DEVELOPMENT
-  HEALTH & AIR QUALITY
-  TRANSPORTATION & INFRASTRUCTURE
-  ENERGY
-  AGRICULTURE & FOOD SECURITY
-  DISASTERS
-  CROSS-CUTTING/OTHER
-  WEATHER/CLIMATE

The Capacity Building Program engages individuals & institutions through a variety of capacity building approaches: trainings, collaborative feasibility studies, and co-development projects. In 2020, the program conducted 93 trainings, 43 feasibility studies, & 69 projects. For more information about the full portfolio of individual projects and trainings, visit the ARSET, DEVELOP, and SERVIR websites and Appendix D below.

CBP activities addressed eight thematic topics in alignment with the Applied Sciences' Application Areas: **Agriculture and Food Security, Disasters, Ecological Forecasting, Energy, Health & Air Quality, Transportation & Infrastructure, Urban Development, and Water Resources**, as well as other cross-cutting topics such as remote sensing/GIS fundamentals, coding, and climate/weather applications.



REGIONAL STATISTICS

CBP organizes international activities by GEO Regional Caucus (**Americas, Asia & Oceania, Europe, Africa, and CIS**) to assess progress and identify regions that have benefited most from the Program's capacity building.

AMERICAS

INDIVIDUALS



10,480

ARSET

166

DEVELOP

566

SERVIR

115

IPP

ACTIVITIES



10

SERVIR AST/
HUB PROJECTS

38

DEVELOP
PROJECTS



10

SERVIR
TRAININGS

ASIA & OCEANIA

INDIVIDUALS



6,124

ARSET

15

DEVELOP

553

SERVIR

22

IPP

ACTIVITIES



25

SERVIR AST/
HUB PROJECTS

2

DEVELOP
PROJECTS



18

SERVIR
TRAININGS

EUROPE

INDIVIDUALS



2,918

ARSET

2

IPP

AFRICA

INDIVIDUALS



1,898

ARSET

347

SERVIR

11

IPP

ACTIVITIES



24

SERVIR AST/
HUB PROJECTS

3

DEVELOP
PROJECTS



12

SERVIR
TRAININGS

CIS

INDIVIDUALS



149

ARSET

1

IPP

V. ASSESSMENT

67

NATIONAL CONFERENCES,
INTERAGENCY MEETINGS, &
INTERNATIONAL EVENTS

7

NASA SCIENCE TEAM
MEETINGS

The program collects outcomes through success stories, highlights, ARSET surveys, and DEVELOP participant surveys. Indicators are used to track intermediate results. Strategic targets are assessed annually, along with Application Readiness Level (ARL) and Project Strength Index (PSI) scores to track yearly progress. The programmatic performance tracking system was initiated in 2016 based on results frameworks that identify unique indicators for each program element, with a refined number of program-wide indicators collected across all elements. The collection process and indicators collected were refined at the end of 2018 with enhanced definitions of inputs feeding each indicator from each element and a new submission system and documentation.

Some targets, actuals, and indicators' increased, while others decreased from 2019 to 2020 and were driven primarily by the COVID-19 pandemic and its restrictions and impacts to onsite work, travel, and equitable resources (see Appendix B).



INDIVIDUALS

CBP saw a **103% increase** from 2019, which was driven by ARSET's increase in participants & a thirst from the global community for online trainings fueled by the pandemic.



PROJECTS

CBP saw a **15% decrease** in the number of projects conducted in 2020. This decrease was driven by the completion of the SERVIR 2015 Applied Sciences Team projects and DEVELOP conducting fewer feasibility studies.



INSTITUTIONS

CBP saw a **42% increase** in unique institutions engaged, which was driven by ARSET's growth in individuals trained.



TRAININGS

CBP saw a **43% decrease** in the number of trainings in 2020, which was driven by pandemic limitations on travel ending all in-person trainings.

COUNTRIES

CBP saw a **4% increase** in countries reached through its activities, primarily through ARSET's online trainings. A gap analysis shows that in 2020, 13 new countries were impacted but 7 reached in 2019 were not impacted, meaning 6 more countries were impacted than the year before. There were 26 countries not impacted by CBP in the past two years. In 2021, CBP will explore options for engaging those countries, where possible.

FRONT-END ACTIVITIES

In 2020, CBP engaged in 46,385 front-end activities, a **29% increase** from 2019. This continued the collection process used in 2019 (35,944 front-end activities), which includes all early engagements of individuals & institutions conducted by CBP elements (e.g. needs assessments, training and project request forms, training registrations, participant applications, pre-training growth assessments, and partnering forms).

Looking ahead to 2021, the program will continue its monitoring and evaluation efforts with a focus on learning from these activities and how to better conduct these analyses. Updates to indicators will be discussed and course correction taken as appropriate.

PROJECT PROGRESS & STRENGTH

ARL - 4

AVERAGE FOR SERVIR
AST PROJECTS

SERVIR

SERVIR's Applied Sciences Team was selected through NASA's Research Opportunities in Space and Earth Science (ROSES) in fall 2019, resulting in **20 new AST projects** beginning in early 2020. The in-person kickoff for the new teams was held at the 2020 SERVIR Annual Global Exchange (SAGE), held February in Siem Reap, Cambodia. Sessions on the first day of SAGE allowed participants from the new AST team to engage with SCO and hub scientists, and the networking opportunities provided by SAGE were of particular value this year, allowing for in-person interactions and side discussions of regional activities throughout the week. In terms of performance, out of the 2018 AST projects, 15 of 20 projects advanced one or more ARLs. Three projects advanced by two ARLs. The initial mean ARL for these projects was 3.1, and the current mean is 4.

43 

FEASIBILITY PROJECTS

PSI - 3.0

AVERAGE FOR 8 STUDIES

DEVELOP

In 2020, DEVELOP conducted 43 feasibility projects, 32 were first term projects, eight were second term projects, and three third term projects. The program updated its Project Strength Index (PSI) to incorporate partner feedback directly into the score to depict project strength more accurately. The PSI is now calculated two terms after the project's completion. As such, the number of projects that have a complete PSI score within a single calendar year is lower than in previous years. The PSI takes into consideration both the scientific merit of the work and the project's applicability to decision-making and partner capacity building. It tracks project progress across a 5-point scale of 1) Basic Research, 2) Application Concept Complete, 3) Application Demonstration Successful, 4) Application Verified/End User Engaged, and 5) Transition to End User/Decision Enhanced. For the eight feasibility studies completed & fully assessed during 2020, the average PSI score was a 3.0. More 2020 scores will be calculated as more post-project partner forms are received.

PROJECT STRENGTH INDEX

- 1) BASIC RESEARCH
- 2) APPLICATION CONCEPT COMPLETE
- 3) APPLICATION DEMONSTRATION SUCCESSFUL
- 4) APPLICATION VERIFIED/END USER ENGAGED
- 5) TRANSITION TO END USER/DECISION ENHANCED

VI. LOOKING AHEAD

As the world moves on from the COVID-19 pandemic, Capacity Building will continue its pursuit of expanding the networks of individuals and institutions to be aware of, able to access, and use Earth observations in their decision making. Through its elements and initiatives, the program will engage with interagency and international consortiums, boundary organizations, and the broader NASA Earth Sciences community to further increase the number of individuals and institutions benefiting from NASA's investment in Earth science. We look forward to contributing to the strategic priorities of Applied Sciences and the Earth Sciences Division.

2021 ELEMENT PLANS

ARSET

plans to explore new thematic application areas (i.e. energy resilience) and novel datasets (e.g. hyperspectral data, population grids, LIDAR, and solar induced fluorescence) for its trainings, as well as a multi-thematic training series drawing on relevant Earth observations for water resources, land management, and air quality for wildfire management.

INDIGENOUS PEOPLES PILOT

will pursue workshops, trainings, & engagement sessions in support of the GEO Indigenous Alliance, US GEO, CEOS AmeriGEO, and continue to engage with indigenous communities & partners to strengthen relationships, as well as develop an engagement strategy for working with US tribes and support Indigenous youth opportunities at NASA.

DEVELOP

will continue to engage the future workforce virtually & offer Software Carpentry trainings across the program, refining virtual workshop curriculum, and expanding participation of external groups. It is exploring opportunities to engage participants through an in-person/virtual hybrid model toward the end of 2021 and plans to expand its outreach and recruiting efforts to underrepresented applicants & geographic areas, while leveraging ongoing efforts across AppSci and NASA.

SERVIR

will continue to strengthen the network through co-development of services across multiple hubs and partners. The SERVIR Annual Global Exchange (SAGE) 2021 will be held virtually and the network will work to integrate the new SERVIR Strategic Plan for 2020 to 2025 into SERVIR services. SERVIR hopes to explore additional phases for SERVIR hubs, creation of a geospatial infrastructure strategy, multi-donor support of new hubs, and cross-hub collaborations on joint services and exchanges.

We also look forward to the day our team can reunite in-person, renew in-person interactions with our partners, and physically attend conferences!

VII. APPENDIX A. ACRONYMS

AmeriGEO: Americas Group on Earth Observations	MINAM: Ministerio del Ambiente
AGENT: Advancing Gender in the Environment	MOU: Memorandum of Understanding
AppSci: Applied Sciences Program	MSFC: Marshall Space Flight Center
ARC: Ames Research Center	NASA: National Aeronautics & Space Administration
ARL: Application Readiness Level	NGO: Non-Governmental Organization
ARSET: Applied Remote Sensing Training	PCD: Pollution Control Department
AST: Applied Sciences Team	PI: Principal Investigator
AWS: Amazon Web Services	PSI: Project Strength Index
BAERI: Bay Area Environmental Research Institute	PRISM: Platform for Real-time Impact & Situation Monitoring
CBP: Capacity Building Program	RAPID: Routing Application for Parallel computation of Discharge
CD-WG: Capacity Development Working Group	RDCYIS: Regional Drought & Crop Yield Information System
CEMADEN: Centro Nacional de Monitoramento e Alerta de Desastres Naturais	ROSES: Research Opportunities in Space & Earth Science
CEO: Collect Earth Online	SAGE: SERVIR Annual Global Exchange
CEOS: Committee on Earth Observation Satellites	SAR: Synthetic Aperture Radar
CEUs: Continuing Education Units	SCO: Science Coordination Office
CIS: Commonwealth of Independent States	SEDAC: Socioeconomic Data Center
COVID-19: Coronavirus Disease 2019	SENAMHI: Servicio Nacional de Meteorología e Hidrología
CY: Calendar Year	SERFOR: Servicio Nacional Forestal y de Fauna Silvestre
EGU: European Geosciences Union	SME: Subject Matter Expert
EO: Earth Observations	SSAI: Science Systems and Applications, Inc.
ESA: European Space Agency	STEAM: Science, Technology, Engineering, Arts, Mathematics
GEO: Group on Earth Observations	UN: United Nations
GIS: Geographic Information Systems	USAID: United States Agency for International Development
GISTDA: Geo-Informatics and Space Technology Development Agency	USGEO: U.S. Group on Earth Observations
GSFC: Goddard Space Flight Center	UTEC: Universidad de Ingeniería y Tecnología
HYDRAFloods: Hydrologic Remote Sensing Analysis for Floods	UTTC: United Tribes Technical College
IBAMA: Brazilian Institute of the Environment & Renewable Natural Resources	WFP: World Food Programme
IDEAM: Institute of Hydrology, Meteorology & Environmental Studies	WGCapD: Working Group on Capacity Building & Data Democracy
INDECI: Instituto Nacional de Defensa Civil	W-GDP: Women's Global Development & Prosperity Initiative
INPE: Instituto Nacional de Pesquisas	WiSci: Women in Science
IPP: Indigenous Peoples Pilot	
IUCN: International Union for Conservation of Nature	
LaRC: Langley Research Center	
LIDAR: Light Detection & Ranging	

VIII. APPENDIX B.

STRATEGIC TARGETS & INDICATORS

ARSET

ACTIVITY	TARGET	2014	2015	2016	2017	2018	2019	2020
U.S. States Impacted	40+	44	50	50	50	50	50	50
Countries Impacted	90+	109	123	130	132	138	151	161
Total # of Individuals	1,500+	1,014	2,877	3,277	4,864	6,362	12,370	27,425
Total # of Institutions	500+	650	1,032	1,392	2,030	2,570	4,273	6,245
Application Areas	4	4	4	7	4	4	4	6
Trainings	Varies	11	11	15	18	17	16	13

DEVELOP

ACTIVITY	TARGET	2014	2015	2016	2017	2018	2019	2020
U.S. States Impacted	35+	46	50	42	49	46	48	43
U.S.: International	<1:4	N/A	1:4	1:4	1:6	1:5	2:7	2:7
Total # of Individuals	200+	379	393	359	342	308	269	217
Total # of Institutions	75+	160	157	125	128	121	135	94
Application Areas	All	All (9/9)	All (9/9)	8/9	All (9/9)	All (8/8)	All (8/8)	All (8/8)
Feasibility Studies	60	83	93	77	70	65	56	43

SERVIR

ACTIVITY	TARGET	2014	2015	2016	2017	2018	2019	2020
Countries Impacted	38	44	43	40	40	41	52	48
Custom Services	42	N/A	47	38	37	42	36	39
Total # of PI Leads	16	N/A	11	27	25	16	36	28
Total # of Individuals	283	425	834	623	1202	1,907	1,771	1,465
Total # of Institutions	27	159	128	143	150	249	195	199

INDIGENOUS PEOPLES PILOT

ACTIVITY	2017	2018	2019	2020
US States Impacted	9	3	7	24
Total # of Participants	39	23	35	151
Total # of Organizations	19	12	11	135
Application Areas Covered	3	2	3	3

INDICATORS

IR-1: Improved Awareness of – and Access to – Earth Observation Data, Products, and Tools		
<i>Sub-IR 1.1: Awareness Increased in New Geographic Regions & Different Sectors</i>		
1.1.1 The Number of States & Countries Reached through CBP Trainings & Projects	2019: 50 states; 158 countries	2020: 50 states; 162 countries
1.1.2 The number of Institutions (by type) Reached through Trainings & Projects	2019: Total: 4,556 – Academic Institution (38%); Consortium (<1%); Federal/ Central Government (19%); Intergovernmental Organization (2%); Local Government (3%); Private Sector (For-Profit)(16%); Private Sector (Non-Profit)/Voluntary or NGO (13%); Regional Agency (<1%); Research Institute (<1%); State/ Provincial Government (5%); Tribal Entity (1%)	2020: Total: 6,457 – Academic Institution (43%); Consortium (<1%); Federal/ Central Government (15%); Intergovernmental Organization (2%); Local Government (3%); Private Sector (For-Profit)(17%); Private Sector (Non-Profit)/Voluntary or NGO (13%); Regional Agency (1%); Research Institute (<1%); State/ Provincial Government (5%); Tribal Entity (<1%)
<i>Sub-IR 1.2: Individual & Institution Needs Identified</i>		
1.2.1 The number of front end engagement activities	2019: 35,944	2020: 46,385
<i>Sub IR-1.3: Access to Data, Products, Tools & Trainings Enhanced</i>		
1.3.1 The number of CBP trainings & projects by AppSci National Application Area	2019: Projects – 127 Total: Agriculture (26); Disasters (8); Ecological Forecasting (32); Energy (3); Health & Air Quality (3); Transportation & Infrastructure (2); Urban Development (8); Water Resources (36) Trainings – 163 Total: Agriculture (23); Disasters (18); Ecological Forecasting (47); Energy (0); Health & Air Quality (8); Transportation & Infrastructure (0); Urban Development (0); Water Resources (14)	2020: Projects – 112 Total: Agriculture (19); Disasters (8); Ecological Forecasting (29); Energy (2); Health & Air Quality (5); Transportation & Infrastructure (1); Urban Development (4); Water Resources (36); Weather & Climate (8) Trainings – 93 Total: Agriculture (5); Disasters (6); Ecological Forecasting (27); Energy (0); Health & Air Quality (6); Transportation & Infrastructure (0); Urban Development (1); Water Resources (17); Cross-Cutting (31)
1.3.2 The number of CBP products posted online	2019: 384	2020: 371
1.3.3 The number of NASA Earth observation platforms & sensors utilized in projects & highlighted in trainings	2019: 57	2020: 58
IR-2: Strengthened Capacity to Use Earth Observation Data, Products & Tools		
<i>Sub-IR 2.1: Individuals Engaged & Trainings Delivered</i>		
2.1.1 The number of trainings & workshops given or facilitated by CBP Elements	2019: 163	2020: 93
2.1.2 The number of individuals engaged in CBP activities	2019: 14,445	2020: 29,275

INDICATORS

2.1.3 The number of policy & science conferences attended	2019: 101	2020: 67
<i>Sub-IR 2.2: Tailored Products & Tools Co-developed</i>		
2.2.1 The number of products developed by/with support from CBP	2019: 478	2020: 406
<i>Sub-IR 2.3: Number of Organizations Using NASA Earth Observations in Their Decision-Making Process</i>		
2.3.1 The number of individuals and/or institutions integrating Earth observations in their decision-making process (stories collected)	2019: 40	2020: 23
IR-3: Improved Capacity Building Practices & feedback to Earth Science Community		
<i>Sub-IR 3.1: Best Practices & Lessons Learned Collected & Shared</i>		
3.1.1 The number of best practice documents produced and/or presented by CBP	2019: 3	2020: 6
3.1.2 The number of outreach events for CBP activities	2019: 24	2020: 3
<i>Sub-IR 3.2: Increased Capability to Monitor & Evaluate Impact of CBP Activities and Collect Feedback</i>		
3.2.1 The percent of individuals who completed pre-training/ project surveys & assessments	2019: ARSET (100%); DEVELOP (Participants – 99%; Partners – 50%) SERVIR (N/A); IP (N/A)	2020: ARSET (100%); DEVELOP (Participants – 99.5%; Partners – 67%) SERVIR (N/A); IP (N/A)
3.2.2 The percent of individuals who completed post-training/ project surveys & assessments	2019: ARSET (33%); DEVELOP (Partners – 22%; Participants – 97%); SERVIR (N/A); IP (N/A)	2020: ARSET (42%); DEVELOP (Partners – 20%; Participants – 99%); SERVIR (N/A); IP (38%)
3.2.3 The number of projects that achieved yearly ARL goal	2019: 8 out of 16	2020: 9 out of 20
3.2.4 The annual average PSI score for feasibility projects	2019: 3.1	2020: 3.0
<i>Sub-IR 3.3: Feedback to Earth Science Community Delivered</i>		
3.3.1 The number of participation in Science Team Meetings	2019: 6	2020: 7
3.3.2 The number of DAAC engagement and feedback activities	2019: 7	2020: 9

IX. APPENDIX C. PUBLICATIONS

1. Aekakkararungroj, A., Chishtie, F., Poortinga, A., Mehmood, H., Anderson, E., Munroe, T., Cutter, P., Loketkawee, N., Tondapu, G., Towashiraporna, P., Saah, D. (2020) A publicly available GIS-based web platform for reservoir inundation mapping in the Lower Mekong region. *Environmental Modelling and Software*. Volume 123, January 2020; <https://doi.org/10.1016/j.envsoft.2019.104552> [SERVIR]
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APPENDIX C. PUBLICATIONS

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APPENDIX C. PUBLICATIONS

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IX. APPENDIX D.

SERVIR CO-DEVELOPMENT PROJECT SUMMARIES

ROSES 2018 - SERVIR AST:



AMERICAS: ECOLOGICAL FORECASTING [LAND COVER/LAND USE CHANGE & ECOSYSTEMS]

FORECASTING SEASONAL TO SUB-SEASONAL FIRE & AGRICULTURAL RISK FROM DROUGHT IN AMAZONIA

PRINCIPAL INVESTIGATOR: Douglas Morton, NASA Goddard Space Flight Center

DESCRIPTION: This project will extend a seasonal fire forecast model to the entire SERVIR-Amazonia domain, develop regional fire products for enhanced situational awareness, & support regional interests in modeling fire progression/spread. Products will include near-real time classification of fire type & estimates of fire spread & CO₂ emissions & a seasonal forecast of **Fire Season Severity**.



YEAR 1 HIGHLIGHTS: The team released the **Amazon Dashboard** & new individual fire data product (to classify fires in near-real time for science & situational awareness), in August 2020 (on [GlobalFireData.org](https://globalfiredata.org)). Earth Observatory posted a story on the new Amazon Dashboard data product, which served as key resources for press interest in fires in the Amazon & surrounding biomes.

START ARL: 3
CURRENT ARL: 4
GOAL ARL: 6

END USERS/STAKEHOLDERS:

IBAMA, CEMADEN, Embrapa, MINAM, SERFOR, INPE, INDECI, SENAMHI, PNN



UNLOCKING THE POWER OF ACTIVE REMOTE SENSING FOR ECOSYSTEM SERVICES MODELING IN THE AMAZON'S FOREST-AGRICULTURE INTERFACE

PRINCIPAL INVESTIGATOR: Naiara Pinto, NASA Jet Propulsion Laboratory

DESCRIPTION: This project proposes to infuse active remote sensing observations into existing monitoring pipelines to improve land cover characterization in the Amazon, with a focus on forest-agriculture interfaces. The stakeholders are farmers enrolled in sustainable landscapes initiatives & decision makers in NGOs/government that support sustainable agriculture practices. The team plans to leverage subnational initiatives in Ucayali, Peru, & Pará, Brazil.

END USERS/STAKEHOLDERS:

PNCBMCC, SERNANP (Peru), Embrapa (Brazil), Alianza Cacao (Peru), Centro de Conservacion, Investigacion, y Manejo de areas Naturales (CIMA, Peru)



YEAR 1 HIGHLIGHTS: The team obtained initial field points from Alianza Cacao & Embrapa to initialize draft maps for Ucayali & Para. Oil palm & cacao maps have been produced by the target sites using manual delineation by agencies in Peru & Brazil. The availability of in situ data & co-developers' willingness to participate in validation gives confidence that the application is feasible.

START ARL: 1
CURRENT ARL: 3
GOAL ARL: 6

APPENDIX C. PUBLICATIONS



AMERICAS: ECOLOGICAL FORECASTING [LAND COVER/LAND USE CHANGE & ECOSYSTEMS] QUANTIFYING THE EFFECTS OF FOREST COVER CHANGES ON PROVISIONING & REGULATING ECOSYSTEM SERVICES IN THE SOUTHWESTERN AMAZON

PRINCIPAL INVESTIGATOR: Stephanie Spera, University of Richmond

DESCRIPTION: This project will characterize changes in forest cover in transboundary region (degradation & deforestation), attribute change to localized changes in hydrologic ecosystem services, generate maps that highlight areas that have undergone changes in micro-climatology & land use, and disseminate the information through trainings, workshops and conferences.

YEAR 1 HIGHLIGHTS: LandTrendR (NDFI added) CODED & Machine Learning algorithms have been implemented in GEE. Once the team holds an initial mini-training on implementing the algorithm and gets a planned manuscript together, they expect that will get the project to ARL 4.



END USERS/STAKEHOLDERS: Amazon Conservation Association, Borderland Indigenous Communities/Federations, The Upper Amazon Conservancy, Regional Environmental Authority in Ucayali, SEMA, Acre Environmental Secretariat, Geospatial Transboundary Group of the Southwestern Amazon, Director of National Parks in Peru, Ucayali Regional Economic Development Unit, CPI-ACRE, OARU, ProPURUS, SOS Amazonia

START ARL: 1
CURRENT ARL: 3
GOAL ARL: 7



AMERICAS: WATER + DISASTERS [WATER & WATER-RELATED DISASTERS] IMPROVING RESILIENCY & REDUCING RISK OF EXTREME HYDROLOGIC EVENTS THROUGH APPLICATION OF EARTH OBSERVATIONS & IN SITU MONITORING INFO

PRINCIPAL INVESTIGATOR: Jim Nelson, Brigham Young University

DESCRIPTION: This project will extend the team's global streamflow forecasting techniques and tools to flood delineation & impact, & will focus on the goal of reducing loss of life & property due to flood damage. They will partner with developers across the SERVIR-Amazonia hub to apply these applications in the region.

START ARL: 3
CURRENT ARL: 5
GOAL ARL: 8



END USERS/STAKEHOLDERS: Senamhi (Peru), IDEAM (Colombia), CEMADEN (Brazil), Red Cross/Cruz Roja

YEAR 1 HIGHLIGHTS: The team has held a number of virtual engagements with national stakeholder agencies, signed a MOU w/ Senamhi in Peru and are making progress towards MOUs with IDEAM in Colombia & CEMADEN in Brazil. An MOU was also signed with UTEC in Peru. The team helped Senamhi use RAPID and the same watershed and river network used by GEOGloWS to create their national hydrologic forecast, & have been working on methods for validation and bias correction that should allow comparisons w/their new model formulation. During 2020, the project team held ongoing discussion with IDEAM to integrate the forecasts in their national system, & expect to make progress there before the next rainy season.

APPENDIX C. PUBLICATIONS



ASIA & OCEANIA: WEATHER & CLIMATE

ADVANCING AIR QUALITY MONITORING AND PREDICTION CAPABILITIES IN THE HINDU-KUSH HIMALAYAN (HKH) REGION

PRINCIPAL INVESTIGATOR: Emily Berndt, NASA Marshall Space Flight Center. Science PI: Aaron Naeger

DESCRIPTION: This project will fuse information from state-of-the-art satellite sensors for developing comprehensive aerosol and trace gas products that advance real time monitoring capabilities over the HKH region; assimilate satellite products into a unique modeling framework for providing accurate AQ, fog and smog, and temperature and stability forecasts; will utilize the data-assimilated model analysis fields for initializing a lagrangian trajectory model to aid in rapid response to extreme aerosol and AQ events. The team will implement aerosol and AQ satellite datasets & model forecasts into applicable DSS for the region, and develop customized end-user training.



YEAR 1 HIGHLIGHTS: Components of the Air Quality system have been developed with the data of interest and preliminary validation is underway. The team produced the AMI nighttime microphysics RGB product, conducted initial validation work and user guide development, completed development of baseline WRF-Chem configuration (no data assimilation), and test runs with a March 2020 dust event.

START ARL: 2

CURRENT ARL: 3

GOAL ARL: 7

END USERS/STAKEHOLDERS:

Nepal Department of Environment, India's Central Pollution Control Agency, National Environment Commission of Bhutan, Pakistan Environment Protection Agency



A CLOUD COMPUTING TOOLBOX FOR SAR-BASED MONITORING OF THE HYDROLOGIC CYCLE IN THE SERVIR HINDU-KUSH HIMALAYAN REGION

PRINCIPAL INVESTIGATOR: Franz Meyer, University of Alaska, Fairbanks

DESCRIPTION: This project will build a cloud-based HydroSAR system, featuring automatic processing of SAR data from Sentinel-1 & NISAR; will implement hydrology relevant Level-3 products (RTC30, HYDRO30, FD30, AG100, AG100-IN); conduct performance assessments, & transition HydroSAR to in-region partners.

END USERS/STAKEHOLDERS:

Department of Hydrology and Meteorology (DHM), Nepal; Ministry of Home Affairs (MOHA), Nepal; Flood Forecasting and Warning Centre (FFWC), Bangladesh; National Center for Hydrology & Meteorology (NCHM), Bhutan



YEAR 1 HIGHLIGHTS: A full end-to-end Surface Water Mapping chain was implemented and validated. Flood Mapping supported the 2020 South Asia Monsoon event. The team has integrated prototype versions of all intended products into the same platform so that they can be exercised and tested together. A prototype version of the flood depth product is also implemented and first validations were performed for areas in Bangladesh. The flood extent product was used to support responses in Alaska (2020 Spring breakup flooding) and Bangladesh (Cyclone Amphan).

START ARL: 3

CURRENT ARL: 4

GOAL ARL: 7

APPENDIX C. PUBLICATIONS



ASIA & OCEANIA: FOOD SECURITY & AGRICULTURE

REMOTE SENSING & AGRO-GEOINFORMATICS BASED PRODUCTS AND SERVICES FOR SUPPORTING AGRO-DECISION MAKING IN HINDU-KUSH-HIMALAYAN REGION

PRINCIPAL INVESTIGATOR: Liping Di, CSISS, George Mason University

DESCRIPTION: The goal of the project is to transfer agro-geoinformatic technologies/service systems to the SERVIR-HKH hub, to enhance the capacity in agricultural & food security decision-making at national /regional levels in the HKH region, specifically Bangladesh, Nepal and Pakistan. The project is achieving its goal by adapting & migrating USDA operational products/services to the hub, improving accuracies in crop mapping, condition monitoring, & acreage/yield estimation with remote sensing data.

END USERS/STAKEHOLDERS:

Department of Agriculture, Nepal; Ministry of Agriculture (Bangladesh and Pakistan); CIMMYT, Individual Farmers.



YEAR 1 HIGHLIGHTS: The project's GeoFairy app has been beta-tested/published in Apple & Google Play stores. The app has demonstrated significant improvement for obtaining useful EO information & for product validation & ground truth collection by users. It has been validated & ready to be used in the field, and other products/services have been prototyped for Nepal.

START ARL: 3

CURRENT ARL: 3

GOAL ARL: 9



ENHANCEMENT OF THE RHEAS CAPABILITIES FOR MONITORING/FORECASTING OF SEASONAL RICE CROP PRODUCTIVITY FOR THE LOWER MEKONG BASIN COUNTRIES

PRINCIPAL INVESTIGATOR: Narendra Das, NASA Jet Propulsion Laboratory, now at Michigan State University

DESCRIPTION: This project is being implemented in the SERVIR-Mekong hub at the Asian Disaster Preparedness Center (ADPC). There are six specific tasks: 1) Increasing spatial resolution of the RHEAS framework from 25 km to 5 km; 2) Inclusion of the latest high-resolution GlobalSoil Grid250m data, 3) Calibration tool for the RHEAS M-DSSAT model; 4) GUI to ingest important farm management practice data, 5) Tool to determine the rice planting date; 6) Tool to generate customized reports for stakeholders, and prepare training materials.

END USERS/STAKEHOLDERS:

Mekong River Commission, Vietnam Academy of Water Resources, Institute for Agricultural Environment (IAE), and the Institute of Water Resource Planning



YEAR 1 HIGHLIGHTS: All planned tasks are on schedule. Soil, vegetation, landcover, DEM, and snowband files were created at 5 km resolution, & a Python GUI was developed to create RHEAS Ancillary files, for the entire world. Testing was conducted successfully on the 5 km RHEAS Setup installed at ADPC, and this is being integrated with the ADPC website.

START ARL: 7

CURRENT ARL: 7

GOAL ARL: 9

APPENDIX C. PUBLICATIONS



ASIA & OCEANIA: ECOLOGICAL FORECASTING [LAND COVER/LAND USE CHANGE & ECOSYSTEMS] SUPPORTING OPERATIONAL REGIONAL LAND COVER MONITORING AT HIGH SPATIAL AND TEMPORAL RESOLUTION FOR THE HINDU-KUSH-HIMALAYAN REGION

PRINCIPAL INVESTIGATOR: Peter Potapov, University of Maryland, College Park

YEAR 1 HIGHLIGHTS: Landsat ARD data processing (1997-2019) was completed. Annual surface water, tree canopy cover, tree height, & forest change models/products, 2000-2019 were completed, & the data delivered to SERVIR-HKH. The forest height map calibrated with GEDI data, and GLAD ARD Tools V1.1, were published.

END USERS/STAKEHOLDERS: Nepal Forest Research/ Training Center (FRTC); Afghanistan Ministry of Agriculture Irrigation and Livestock; Bangladesh Forest Department (BFD/RIMS); Myanmar Forest Department (FD); National Universities in Bangladesh and Pakistan.

DESCRIPTION: The Regional Land Cover Monitoring System (RLCMS) developed by SERVIR-HKH provides critically timely information for land management, forest monitoring, & crop area analysis. The project's goal is to support the development and operational updates of the regional land cover information used, building on the established operational forest monitoring capabilities of SERVIR-Mekong & national applications supported by SilvaCarbon.

START ARL: 3

CURRENT ARL: 3

GOAL ARL: 9



LEVERAGING CLOUD-COMPUTING & AN INTEGRATED DISTURBANCE/VEGETATION MAPPING FRAMEWORK FOR PROTECTED AREAS MONITORING IN THE LOWER MEKONG

PRINCIPAL INVESTIGATOR: Robert Kennedy, Oregon State University

DESCRIPTION: The project goal is to build services that help local land managers and the Cambodian government to better monitor forest loss, and to better understand how to manage forests to protect wildlife habitat and carbon. Objectives include translation of the change detection framework to Lower Mekong Basin (LMB) countries, with initial focus on protected areas in Cambodia, & translation of an integrated change and land cover mapping to LMB, adapting to image constraints and availability of reference data. Products/tools will include the Google Earth Engine based LandTrendr algorithms for temporal segmentation of the Landsat archive.

YEAR 1 HIGHLIGHTS: The project has made significant progress towards implementation, and developed country-wide fitted imagery for Cambodia, which the hub is now evaluating. They have begun prototyping a disturbance alert system requested by the stakeholder (Greening Prey Lang, GPL), using deep-learning techniques to build disturbance detection maps from Sentinel 1 radar imagery. Through interactions with the hub and USAID and GPL personnel, a baseline understanding of forest alert and monitoring system has been established.

START ARL: 2

CURRENT ARL: 3

GOAL ARL: 8

END USERS/STAKEHOLDERS: Greening Prey Lang – USAID and Cambodian Ministry of Environment Project



APPENDIX C. PUBLICATIONS



ASIA & OCEANIA: WATER + DISASTERS [WATER & WATER-RELATED DISASTERS]

A LANDSLIDE HAZARD AND RISK ASSESSMENT SYSTEM FOR SERVIR-MEKONG

PRINCIPAL INVESTIGATOR: Dalia Kirschbaum, NASA Goddard Space Flight Center

DESCRIPTION: This project aims to enable informed decision making on landslide hazard/risk, leveraging EO data, & will build the capacity of regional/national agencies & other stakeholders to increase situational awareness & support preparedness activities. The project will create a suite of products/services that will inform comprehensive landslide characterization/awareness in the region.

END USERS/STAKEHOLDERS:

Asian Disaster Preparedness Center (ADPC), Department of Mineral Resources (DMR), Thailand, Vietnam Institute of Geosciences and Mineral Resources (VIGMR), Regional Capacity Enhancement for Landslide Impact Mitigation (RECLAIM) Network.



YEAR 1 HIGHLIGHTS: The project has made progress on the prototype of the LHASA-Mekong model and have two prototypes developed, and are working with the hub to demonstrate the potential options. The team will be implementing the model in a Google Cloud environment as well as a version accessible for training purposes through GEE. The landslide inventories continue to be an important part of model evaluation. The team has identified new landslide mapping sites in Northern Vietnam, & produced four new landslide inventories of the Mekong region—in total there are now five inventories.

START ARL: 3

CURRENT ARL: 4

GOAL ARL: 8



OPERATIONAL SERVICES FOR WATER, DISASTERS & HYDROPOWER APPLICATIONS FOR LOWER MEKONG POPULATIONS USING NASA EARTH OBSERVATIONS & MODELS

PRINCIPAL INVESTIGATOR: Hyongki Lee, University of Houston

DESCRIPTION: This project will continue building new & improved services to be co-developed with the SERVIR Mekong hub (based on identified stakeholders' urgent & real needs), in order to provide missing pieces of info on the real-time availability of water for the entire Lower Mekong & its inhabitants. Objectives include operational hindcast/forecast of inundation extents in the Lower Mekong, operational Real-time Reservoir Monitoring System for All Dams in Mekong, and updating the operational Virtual Stream Gauge Data Service.

END USERS/STAKEHOLDERS:

RFDMC (MRC), Ministry of Water Resources & Meteorology (MOWRAM) of Cambodia, Vietnam Meteorological Hydrological Administration (VMHA)



YEAR 1 HIGHLIGHTS: The project started discussions with MRC toward potential implementation of Forecasting Inundation Extents using REOF analysis (FIER) in the Lower Mekong, conducted a SWOT Early Adopter virtual hackathon at the University of Washington, & implemented FIER over TSL through the Tethys Hackathon. Preliminary FIER results obtained over the entire Lower Mekong were presented at AGU Fall Meeting 2020.

START ARL: 5

CURRENT ARL: 6

GOAL ARL: 8

APPENDIX C. PUBLICATIONS



AFRICA: WATER + DISASTERS [WATER & WATER-RELATED DISASTERS]

GEOSPATIAL INFORMATION TOOLS THAT USE MACHINE-LEARNING TO ENABLE SUSTAINABLE GROUNDWATER MANAGEMENT IN WEST AFRICA

PRINCIPAL INVESTIGATOR: Norm Jones, Brigham Young University

DESCRIPTION: Proper management of groundwater resources is essential for regions like West Africa that are susceptible to drought. This project will assist local users in characterizing their groundwater resources & planning how to develop them sustainably going forward.

END USERS/STAKEHOLDERS:

Directorate General of Water Resources (DGRE): Ministry of Water Resources/Sanitation; Niger Basin Authority; National Water Partnership; rural communities, cooperatives, farmers' organizations.



YEAR 1 HIGHLIGHTS: Significant progress was made in Q2 2020. The water level mapper & GRACE subsetting apps are relatively mature. Modifications are being made to the water level mapping app to broaden its capabilities and customize it for users in West Africa, but have a strong foundation to build on.

START ARL: 3

CURRENT ARL: 3

GOAL ARL: 8



IN-SITU DATA COLLECTION WITH REMOTE SENSING FOR MACHINE LEARNING PARAMETER ESTIMATES AND IMPROVED HYDROLOGIC MODELS FOR FLOOD, DROUGHT AND AGRICULTURAL YIELD FORECASTING

PRINCIPAL INVESTIGATOR: Evan Thomas, University Of Colorado, Boulder

DESCRIPTION: Millions of people living in the Horn of Africa face water insecurity as droughts are more severe and frequent. Drought-driven humanitarian emergencies can be prevented if groundwater is reliably made available at strategic locations during cycles of water stress. DRIP - The Drought Resilience Impact Platform, combines early detection and planning with proactive groundwater management.



YEAR 1 HIGHLIGHTS: The groundwater pumping data is presently being used by decision makers in Kenya & Ethiopia to allocate resources for groundwater system management. FEWS Net predictor, visualization of preliminary groundwater maps in Tethys were implemented. A prototype groundwater demand system has been demonstrated and integrated with remote sensing and sensor data with statistical cross validation.

END USERS/STAKEHOLDERS:

Kenya National Drought Management Authority; Millennium Water Alliance; Ethiopia Ministry of Water, Irrigation and Energy; Intergovernmental Authority on Development Climate Prediction & Applications Center (ICPAC); Famine Early Warning Systems Network (FEWS NET)

START ARL: 3

CURRENT ARL: 4

GOAL ARL: 6

APPENDIX C. PUBLICATIONS



AFRICA: ECOLOGICAL FORECASTING [LAND COVER/LAND USE CHANGE & ECOSYSTEMS]

LINKING DEFORESTATION, URBANIZATION, & AGRICULTURAL EXPANSION FOR LAND USE DECISIONS IN GHANA

PRINCIPAL INVESTIGATOR: Jasmeet Judge, University of Florida, Gainesville

YEAR 1 HIGHLIGHTS: The project now has two good test cases/districts, with preliminary land cover classification maps for the two Districts using Google Pro for ground truth, an inventory of existing remote sensing data is completed, with continued inventory of the existing District level data/processing & has completed the initial round of developing customized Processing Algorithms, which are essential for creating land use suitability models in QGIS.

END USERS/STAKEHOLDERS: Land use and spatial planning authority (LUSPA); National Development and Planning Agency; Atiwa District Assembly; Twifo-Hemang Lower Denkyira Assembly; Ashanti Akim Central District

DESCRIPTION: Ghana consists of 18% of the remaining Upper Guinean forest, that continue to be vulnerable to deforestation. The specific objectives of the project are to: (i) investigate linkages among deforestation, urbanization, and agricultural expansion in Eastern and Ashanti Regions, (ii) integrate these trends & linkages with a GIS-based, open source land use planning framework (LUPMISPlus) in the two regions; & (iii) build local capacity in the use of remote sensing, GIS tools, and the land use planning framework for sustaining these efforts beyond the lifetime of this project.

START ARL: 2

CURRENT ARL: 3

GOAL ARL: 7



SUPPORTING CONTINUOUS MONITORING & SAMPLE-BASED ESTIMATION OF LAND CHANGE & FOREST DEGRADATION IN WEST AFRICA

PRINCIPAL INVESTIGATOR: Pontus Olofsson, Boston University

DESCRIPTION: The objective of this project is to enhance the capacity in West African countries to address obstacles to sustainability and effective decision-making by providing direct access to tools & datasets for consistent monitoring of deforestation, forest degradation, land cover and land change. The project will provide access to a global dataset of land cover & land change (NASA MEaSUREs/GLanCE) that is hierarchical and customizable via a set of tools in Google Earth Engine.

YEAR 1 HIGHLIGHTS: Version 1 of the NASA MEASURES (GLANCE) dataset of land cover and land cover change has been completed for the whole continent of Africa. Tools running in Google Earth Engine that allow users to extract maps & examine time series have been implemented and shared with the hub. In June, PI Olofsson gave a webinar on the GLanCe datasets and data access tools.

END USERS/STAKEHOLDERS:

Permanent Inter-State Committee for Drought Control in the Sahel (CILSS); the Agriculture, Hydrology & Meteorology (AGRHYMET) Regional Center; hub consortium partners, with support from Tetra Tech, Inc.; and governments of SERVIR-West Africa countries.

START ARL: 4

CURRENT ARL: 4

GOAL ARL: 9



APPENDIX C. PUBLICATIONS

AFRICA: FOOD SECURITY & AGRICULTURE



EARTH OBSERVATION FOR NATIONAL AGRICULTURAL MONITORING

PRINCIPAL INVESTIGATOR: Catherine Nakalembe, Department of Geographical Sciences, University of Maryland, College Park

DESCRIPTION: This project will document the status of existing national agricultural monitoring systems and improve baseline datasets for in-season crop monitoring. Yield modeling using coarse resolution data sets will be complimentary to on-going work with RHEAS, and the team will coordinate with other Agriculture & Food Security ASTs to broaden impact. The team will develop a scalable field-data collection strategy for smallholder agriculture in E&SA, and establish a Joint Experiment for Crop Assessment and Monitoring (JECAM) site.

END USERS/STAKEHOLDERS:

Kenya Ministry of Agriculture; Kenya Agricultural & Livestock Research Organization (KALRO); Office of the Prime Minister, Uganda Ministry of Agriculture; Tanzania Ministry of Agriculture; East Africa Grain Council; East Africa Community; IGAD Climate Predictions and Applications Center (ICPAC).



YEAR 1 HIGHLIGHTS: Operational National Crop Monitors in Kenya, Uganda and Tanzania, as well as one in development in Rwanda, were implemented after clear characterization of the decision-making process. A manuscript on the status of current systems is also in preparation, and the Kenya Cropland 2019 Map was completed. GEOCIF outputs have been implemented in the crop monitor for early warning and used for monthly monitoring and are now accessible for Kenya, Uganda, and Tanzania at the province level. There is strong support from the Kenya Ministry of Agriculture and Agricultural organizations for project products to support Food Balance Sheet calculations, yield modeling, and crop insurance programs. Continued collaboration with AST PI Davenport on yield model evaluation.

START ARL: 3

CURRENT ARL: 3

GOAL ARL: 7



USING EARTH OBSERVATIONS AND STATISTICAL MODELS TO ENHANCE DROUGHT, FOOD SECURITY, & AGRICULTURAL OUTLOOKS IN EASTERN & SOUTHERN AFRICA

PRINCIPAL INVESTIGATOR: Frank Davenport, University of California, Santa Barbara

DESCRIPTION: Project objectives are to develop Decision Support Tools that translate Earth Observation Products into improved drought, agricultural mapping, and agricultural monitoring services; enable regional analysts to bridge the gap between EO products and grain production outcomes; & implement the tools and capacity building infrastructure within the regional hub.



YEAR 1 HIGHLIGHTS: A prototype yield forecasting report was developed and shared with RCMRD and some select stakeholders (FEWS NET field scientists). Additional prototype elements are still being developed. The team began development of an interactive interface (modified RHEAS viewer), which is continuing & has expanded to new countries. The project began development of Somalia forecasts, and team members met with Catherine Nakalembe and her team to plan coordinated forecasts.

START ARL: 3

CURRENT ARL: 4

GOAL ARL: 8

END USERS/STAKEHOLDERS:

RCMRD, ICPAC, FEWS NET

APPENDIX C. PUBLICATIONS



RANGE MONITORING FOR DECISION SUPPORT, PASTORAL LIVELIHOODS & FOOD SECURITY IN ARID & SEMI-ARID EAST AND SOUTHERN AFRICA

PRINCIPAL INVESTIGATOR: Niall Hanan, New Mexico State University

YEAR 1 HIGHLIGHTS: A virtual stakeholder workshop provided feedback on the alpha-version of a Sentinel-1 and -2 canopy cover mapping tool for Kenyan rangelands, using GEE and CEO derived plot data. The team developed a GEE tool and updated analysis using MODIS Collection 6 for LAI partitioning for improved wet season forage monitoring. A new workflow for efficient processing of large samples of VHR imagery, that provides critical calibration and validation data, has been developed. The dry season forage monitoring application, also being implemented in GEE, will inform dry season forage progression from green, to dry biomass and eventually to low biomass/bare soil—critical for livestock survival in the dry season.



DESCRIPTION: The team is mapping woody canopy cover in East and Southern Africa (E&SA) at medium-high (sub-100m) resolution. Objectives include wet season woody and herbaceous forage production and anomalies in E&SA rangelands, based on LAI partitioning algorithm; dry season dry forage dynamics and anomalies in E&SA rangelands, based on weekly green and dry (senescent) biomass monitoring; and forage forecasting, based on short-term weather forecasts, growth / senescence models.

START ARL: 3

CURRENT ARL: 4

GOAL ARL: 8

END USERS/STAKEHOLDERS:

RCMRD, ILRI, Northern Rangelands Trust (NRT), Livestock/range sectors.



AFRICA: WEATHER & CLIMATE

CONNECTING WEST AFRICA USERS TO CUTTING EDGE RESOURCES: INTEGRATING EO & CLIMATE FORECASTS TO ENHANCE AGRICULTURAL/PASTORAL WATER-MANAGEMENT DECISION-MAKING USING AGRO-PASTORAL WATER DEFICIT PREDICTIONS

PRINCIPAL INVESTIGATOR: Shraddhanand Shukla, University of California, Santa Barbara

DESCRIPTION: The objective of the project is to improve West African climate information services by co-developing a 21st century Agro-pastoral Water Deficit Prediction System (21cAWDPS) to improve: 1) agricultural and rangeland productivity, 2) agro-pastoral water usage, and 3) transhumant movement management in West Africa.

END USERS/STAKEHOLDERS:

AGRHYMET, ACMAD, CILSS, National Meteorological agencies, Niger Basin Authority, ECOWAS; Ministries of Agricultural and/or Animal Husbandry and Water resources ministries; WA-WASH Project and Action Against Hunger; ICRAF, AfDB, UNECA, WFP, UNHCR, USAID and UNICEF.



YEAR 1 HIGHLIGHTS: In collaboration with the hub, the project is conducting an analysis to examine the relationship between subseasonal climate and food insecurity in West Africa. Results were presented at the AGU Fall Meeting 2020. The project team has implemented climatology-based subseasonal forecasts as a benchmark and developed a prototype product for crop water stress forecasting, and are currently working on determining the potential of some of these products.

START ARL: 3

CURRENT ARL: 4

GOAL ARL: 9

For more Earth Observation Imagery, visit:
<https://earthobservatory.nasa.gov/>

CAPACITY BUILDING PROGRAM

