ARSET

Applied Remote Sensing Training Program

2024

Annual Report

2024 Annual Report

Welcome to ARSET's 2024 Annual Report. This report provides an overview of our activities throughout the 2024 calendar year. In short, you will find summary statistics for all trainings conducted in 2024, US and global participation maps, specifics from each training, and feedback from some of our participants. You'll also read about our new Learning Management System, launched in early 2024.

ARSET delivered a total of 18 trainings in 2024, twelve online, instructor-led, five in-person, and one online, self-paced training with three modules. In addition, we hosted two live online Q&A sessions. We saw a significant jump in US participation, from 18% of total participation in 2023, to 27% in 2024.

We would like to begin and end by thanking all those within NASA, especially within the NASA Earth Action Capacity Building Program, who support the work of ARSET. We would also like to thank all of our participants who make this program possible.

ARSET Trainer Juan Torres-Pérez gives a lecture in South Africa. Photo Credit: ARSET

ARSET Trainers Amita Mehta, Sean McCartney, and Erika Podest in Bhutan. Photo Credit: Tony Kim

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ARSET Trainer Sean McCartney gives a lecture in Bhutan. Photo Credit: Tony Kim

Front page image captured by the OCI instrument aboard PACE on March 9th, 2024. Photo Credit: NASA Ocean Color

ARSET 2024 By The Numbers

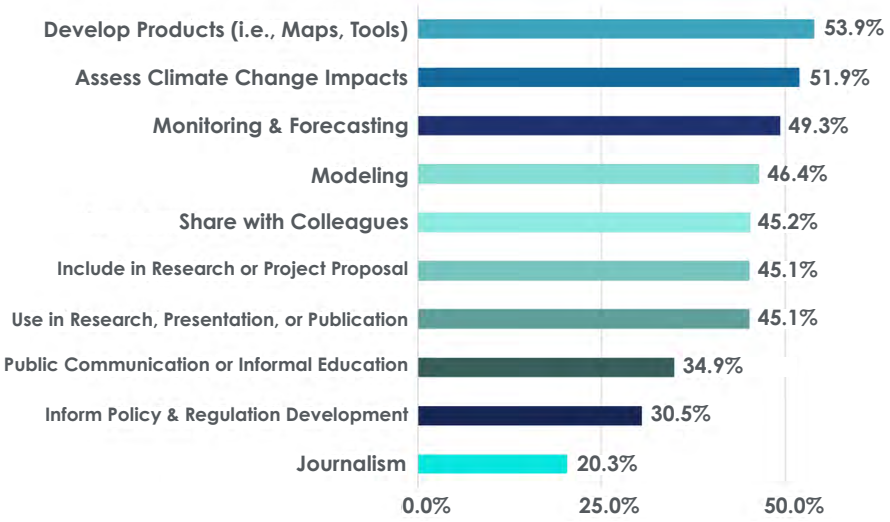
15,784 Total Participants	**4,927** On-Demand Training Participants	**10,857** Live Training Participants	**27%** US Participation	**56** Guest Instructors
158 Countries Reached	**52** US States & Territories Reached	**5,023** Unique Orgs Reached	**73%** International Participation	**15** Collaborating Organizations

An average of **97%** of participants from all trainings in 2024 reported that our trainings **met or exceeded their expectations**.

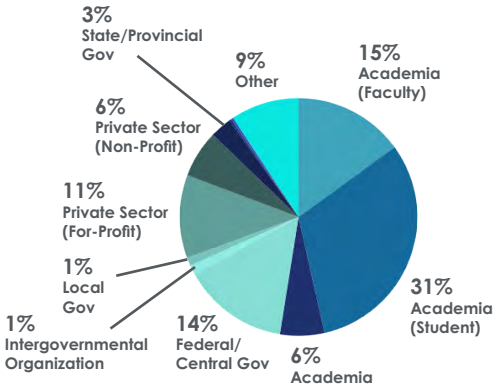
The majority of participants came into our trainings with a **moderate or high degree of prior knowledge** in remote sensing (**50.4%** and **26.5%** respectively).

Requests from Participants: **More Training (49%), Analysis & Data Processing (27%), Hands-On Time (16%) and Applications & Case Studies (13%)**

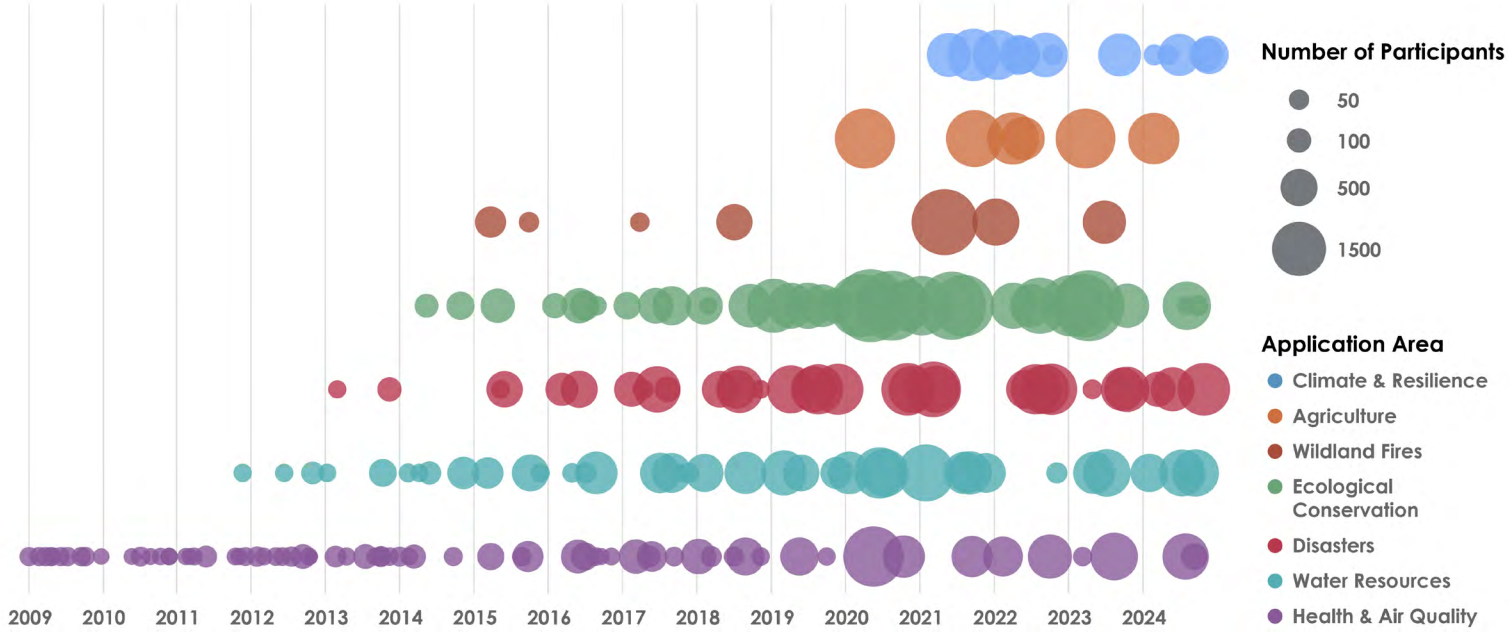
How Participants Intend to Use the Skills Learned



ARSET Participation by Sector



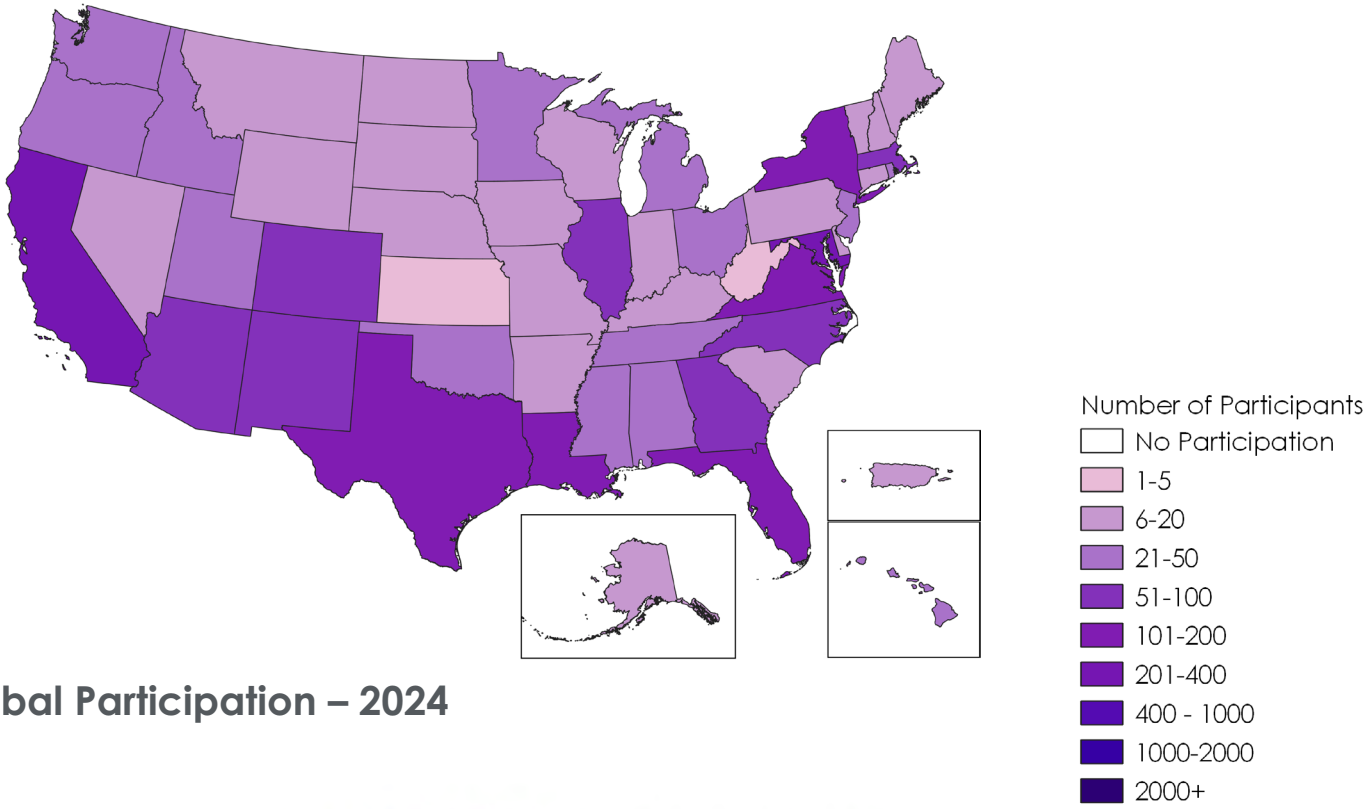
ARSET Participation by Theme, 2009-2024



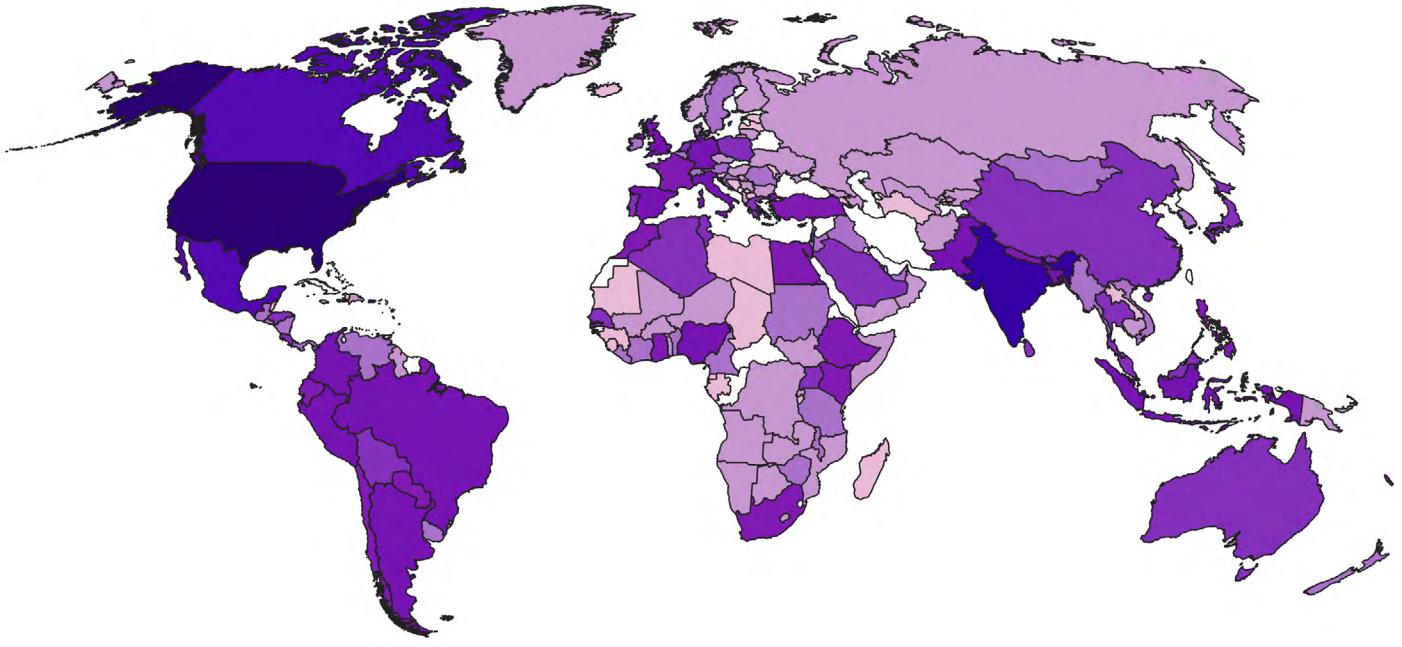
2024 Participation Maps

Consistent with previous years, the majority of 2024 participants came from the United States, India, Canada, and Mexico. There is also notable participation from South America, Europe, and Australia. Within the United States, the highest numbers of participants came from the East Coast, the Southern States, and California, and a notable increase in participation in the State of Illinois.

US Participation – 2024



Global Participation – 2024



New Learning Management System

In early 2024, we were excited to launch our new learning management system (LMS). The ARSET LMS enables us to provide asynchronous self-paced training opportunities that participants can access and earn completion certificates at any time. Our first self-paced training, Developing Sustainable Earth Science Applications, is designed for scientists and partners who want to increase the impact of their Earth science-based applications.

[Link to Training Webpage]

Developing Sustainable Earth Science Applications

This training helps scientists and partners working on Earth science-based applications increase the usability and relevance of their products, datasets, and tools - described here as "applications." Based on the NASA Earth Science Applications Guidebook, the training uses a narrative approach to introduce the Applications Pathway and critical non-science success factors necessary to building sustainable Earth Science applications, including project management and team collaboration, partner engagement, communications, and monitoring and evaluation. Participants can choose between three characters: early career researcher, Ana, community partner, Kyle, and experienced researcher new to applied science, Dinesh.

2024 Trainings (Following Pages)

ARSET delivered a total of 18 trainings and 2 live Q&A sessions in 2024. In the following pages you will find a page with the following information for each training offered:

- Training description and summary statistics
- A list of ARSET instructors and guest instructors who created and delivered the training
- Some general training statistics including overall attendance and countries reached
- Notable quotes from training participants taken from survey responses

Developing Sustainable Earth Science Applications

ARSET Support

Melanie Follette-Cook
NASA Goddard Space Flight Center

Brock Blevins
NASA Goddard Space Flight Center/Science Systems and Applications Inc.

Natasha Johnson-Griffin
NASA Goddard Space Flight Center/GST

Suzanne Monthie
NASA Goddard Space Flight Center/GST

Course Authors

Erin Martin

Sterling Riber

Project Advisors

Sarah Brennan
NASA Headquarters/Booz Allen Hamilton

Lauren Childs-Gleason
NASA Langley Research Center

Cindy Schmidt
NASA Ames Research Center/Bay Area Env. Research Institute

Tony Kim
NASA Marshall Space Flight Center

Launch Date: January 2, 2024

Level: Introductory

Type: Online, Self-Paced

Language(s): English

Reach

686 Participants

513 Organizations

91 Countries

32 US States

This training helps scientists and partners working on Earth science-based applications increase the usability and relevance of their products, datasets, and tools – described here as "applications." Based on the NASA Earth Science Applications Guidebook, the training uses a narrative approach to introduce the Applications Pathway and critical non-science success factors necessary to building sustainable Earth Science applications, including project management and team collaboration, partner engagement, communications, and monitoring and evaluation. Participants can choose between three characters: early career researcher, Ana, community partner, Kyle, and experienced researcher new to applied science, Dinesh.

As a result of this training...

84%
Regarded the information learned as being useful in the next year.

74%
Improved their ability to identify the 5 steps in the Applications Pathway for developing EO applications moderately or greatly.

93%
Reported overall satisfaction with the training.

75%
Improved their ability to design and implement a plan for leading effective communication with end users and other partners moderately or greatly.

Participant Feedback:

I think this course was very informative and I wish I took it sooner! I think it's an amazing resource that all students interested in learning earth science or a career in research should take as soon as possible to best prepare them for the future ahead. (Federal Government Employee, United States)

This is really useful for proposal writing. I am trying to secure funding for sustainability research projects, and this will be immediately useful. (Private Sector Employee, United States)

Link to Training Webpage

Overview of SeaDAS 8.4.1 for the Processing, Analysis, and Visualization of Optical Remote Sensing Data for Water Quality Monitoring

ARSET Instructors

Amita Mehta
NASA Goddard Space Flight Center/University of MD, Baltimore County

Guest Instructors

Daniel Knowles Jr.
NASA Ocean Biology Distributed Active Archive Center (OB.DAAC)

Aynur Abdurazik
NASA Ocean Ecology Lab/ SAIC SeaDAS Applications Lead

Bing Yang
NASA OB.DAAC/SAIC

Date(s): February 13, 2024

Level: Advanced

Type: Online, Instructor-Led

Language(s): English

Satellites/Sensors: Landsat OLI, Aqua/ Terra MODIS, SNPP/JPSS VIIRS, Sentinel-3A/3B OLCI, PACE-OCI

Reach

555	275	83	27
Participants	Organizations	Countries	US States

SeaDAS software, developed by the NASA Ocean Biology Processing Group (OBPG), is used in the processing, analysis, and visualization of satellite images. SeaDAS uses OBPG algorithms to produce water quality data and can be used to obtain water quality parameters from current optical sensors such as OLI (Operational Land Imager), MSI (MultiSpectral Instrument), OLCI (Ocean and Land Colour Instrument), VIIRS (Visible Infrared Imaging Radiometer Suite), and MODIS (MODerate resolution Imaging Spectroradiometer). SeaDAS can also be used to apply atmospheric correction and obtain remote sensing reflectance at the water surface level from these sensors. This two-hour training provided an overview and demonstration of the latest version of SeaDAS 8.4.1, which is useful for remote sensing of water quality monitoring. This training will also serve as a prerequisite for future ARSET trainings on remote sensing of water quality.

As a result of this training...

97%
Improved their ability to use **SeaDAS** tools to analyze and visualize WQ parameters.

88%
Found **SeaDAS** to be moderately or very useful.

96%
Improved their awareness of **PACE** data processing capability in SeaDAS.

82%
Found **NASA Ocean Color Web** to be moderately or very useful.

Participant Feedback:

In general, users have found SeaDAS to be a comprehensive tool for analyzing ocean color data on Windows operating systems. The software's interface is user-friendly, making it relatively easy to navigate and perform various analyses. However, some users have reported challenges with installation and configuration, particularly when setting up the software to correctly interact with satellite data files. Additionally, troubleshooting technical issues can sometimes be complex due to the software's dependencies and system requirements. Overall, while SeaDAS offers powerful capabilities, users may encounter some initial hurdles during setup and usage. (Survey Comment, March, 2024; Student, India)

I truly appreciate the ARSET program. I am so energized by learning these new skills! Your team makes remote sensing skills easy and accessible. I can't wait to participate in future trainings and incorporate these skills into my work! Thank you! (Survey Comment, March, 2024; Local Government Employee, United States)

Link to Training Webpage

Large Scale Applications of Machine Learning using Remote Sensing for Building Agriculture Solutions

ARSET Instructors

Sean McCartney
NASA Goddard Space Flight Center/Science Systems and Applications Inc.

Guest Instructors

John Just
Deere & Company

Erik Sorensen
Deere & Company

Date(s): March 5–19, 2024

Level: Advanced

Type: Online, Instructor-Led

Language(s): English

Satellites/Sensors: Sentinel-2 MSI

Reach

1,319	650	103	41
Participants	Organizations	Countries	US States

Remote sensing data is becoming crucial to solve some of the most important environmental problems, especially pertaining to agricultural applications and food security. Effectively working with this large data source requires different tools and processing, such as cloud computing and infrastructure. Participants of this training became familiar with data format and quality considerations, tools, and techniques to process remote sensing imagery at large scale from publicly available satellite sources, using cloud tools such as AWS S3, Databricks, and Parquet. Additionally, participants learned how to analyze and train machine learning models for classification using this large source of data to solve environmental problems with a focus on agriculture. Participants were also given a basic understanding of tools such as Pyspark and TensorFlow.

As a result of this training...

97%
Improved their ability to download and process data at large scale with cloud tools.

74%
Found **Amazon Simple Storage Service (AWS S3)** to be moderately or very useful.

76%
Found **Databricks Community Edition** to be moderately or very useful.

76%
Found **Parquet** to be moderately or very useful.

Participant Feedback:

Next step is to create end to end production level pipeline to test it out on other countries. This session has been my favorite from ARSET I attended and watched online and the reasons are (1) it uses all free data and programming code instead of some tools that not everyone can use it in their work for the scale of work they are doing and open-source code is a key; (2) it shows you not just one simple example image how it works but a series of images as if we are building a production grade application. This is important to make ARSET training practical. Personally I found many training is too theory and utilize too much close-off tools (e.g., some NASA tools, QGIS, ArcGIS, etc.) that have lots of limitations that participants can't go production (e.g,. no access, can't call API). Would be really great if ARSET can focus on real world practicality more. Overall, I really enjoy ARSET and thank you! (Survey Comment, April, 2024; Private Sector Employee, Canada)

This session is the most practical one (in the general sense) that I have seen from ARSET. Remote sensing data is large and showing just a sample using some black box tool isn't as helpful as this one using cloud computing and open data and code. The amount of theory is right balanced with more emphasis on practical application. Hope ARSET takes this as the standard for all future trainings. Thank you so much for this great training! (Survey Comment, April, 2024; Private Sector Employee, Canada)

Link to Training Webpage

Satellite Data for Beginners: A NASA Training

ARSET Instructors

Melanie Follette-Cook
NASA Goddard Space Flight Center

Brock Blevins
NASA Goddard Space Flight Center/Science Systems and Applications Inc.

Sean McCartney
NASA Goddard Space Flight Center/Science Systems and Applications Inc.

Suzanne Monthie
NASA Goddard Space Flight Center/GST

Date(s): March 7, 2024

Level: Introductory

Type: In-Person

Language(s): English

Satellites/Sensors: Entire Fleet

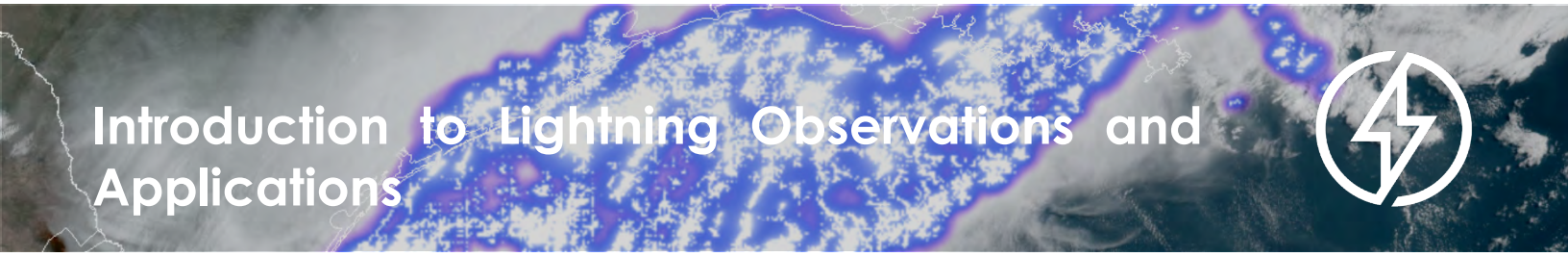
Reach

50
Participants

NASA has 30+ satellites pointed at Earth collecting data that is free to the public, and you don't have to be an expert to use it! NASA conducts free trainings to use this data. And for the first time, we brought that directly to SXSW EDU! NASA's Applied Remote Sensing Training Program gave participants an introduction to accessing, interpreting, and applying NASA data on local and global scales, with real-life case studies and opportunities to bring it into the classroom. No experience was required.

Top Left: Brock Blevins and **Bottom Left:** Melanie Follette-Cook speak at the SXSW EDU Conference in Austin, TX. **Below Right:** ARSET's Sean McCartney, Melanie Follette-Cook, Sue Monthie, and Brock Blevins pose for a picture. Photo Credits: ARSET

[Link to Training Webpage]



Introduction to Lightning Observations and Applications

ARSET Instructors

Amita Mehta
NASA Goddard Space Flight Center/University of MD, Baltimore County

Guest Instructors

Steven Goodman
Thunderbolt Global Analytics/NASA GSFC

Timothy Lang
NASA MSFC

Scott Rudlosky
NOAA

Christopher Schultz
NASA MSFC

Date(s): March 26 – April 2, 2024

Level: Introductory

Type: Online, Instructor-Led

Language(s): English

Satellites/Sensors: OTD, TRMM-LIS, ISS-LIS, GLM, Lightning Mapping Array, Lightning Imaging Package

Reach

420 Participants

200 Organizations

84 Countries

26 US States

It is well-documented that there are approximately 24,000 worldwide fatalities from lightning each year, with about 10 times more being injured from lightning (NIH-NCBI). In addition, lightning strikes are one of the leading causes of wildfire ignition. During storms, lightning strikes on trees, utility poles, and infrastructure, can damage power lines resulting in power outages. Lightning flashes also generate electromagnetic fields (Sferics) that interfere with electrical devices on ground. As the intensity and frequency of extreme weather events are likely to increase due to climate change impacts, lightning activity will likely increase as well, causing more power outages, increased risks of wildfire ignition, and increased numbers of injuries and fatalities. Therefore, information about lightning activity is critical for better preparedness against these disasters. This three-part, introductory training focused on global and regional lightning data products that can be applied to disaster risk preparedness.

As a result of this training...

97%

Improved their ability to access appropriate data to monitor lightning activity.

77%

Found the **Lightning Visualization Dashboard** to be moderately or very useful.

74%

Found **GHRC DAAC Lightning Data Access** to be moderately or very useful.

79%

Found the **NESDIS/STAR GOES Viewer** to be moderately or very useful.

Participant Feedback:

To enhance the use of remote sensing data for monitoring and assessing lightning impacts, additional information and skills that would be beneficial include a solid understanding of weather and electromagnetics, advanced data analysis and statistical skills, proficiency in working with multiple datasets, familiarity with numerical models used in lightning analysis, and technical competencies in programming and geospatial data analysis. Suggestions for improving future ARSET trainings include providing hands-on practical exercises, comprehensive educational resources, and technical support channels for participants. (Survey Comment, April, 2024; Faculty, Egypt)

The lightning training was fantastic! Really appreciated the presentations by the scientists who are actually working on the sensors and analysis. (Survey Comment, April, 2024; Academic Researcher, United States)

Link to Training Webpage

Building Capacity to Use Earth Observations in Addressing Environmental Challenges in Bhutan

ARSET Instructors

Sean McCartney
NASA Goddard Space Flight Center/Science Systems and Applications Inc.

Amita Mehta
NASA Goddard Space Flight Center/University of MD, Baltimore County

Erika Podest
NASA Jet Propulsion Laboratory/Caltech

Guest Instructors

Aparna Phalke
NASA SERVIR

Sarah Cox
NASA SERVIR

Date(s): May 13 – May 16, 2024

Level: Intermediate

Type: In-Person

Language(s): English

Satellites/Sensors: Landsat 8 OLI/TIRS, Sentinel-2 MSI, Sentinel-1 C-Band SAR, Terra/Aqua MODIS, SNPP-JPSS VIIRS, GPM IMERG, SMAP, SRTM/TanDEM, NEX-GDDP, GLDAS/MERRA-2

Reach

46 Participants

10 Organizations

This in-person training was in collaboration with Druk Holdings and Investments (Bhutan) and the SERVIR program. It covered data acquisition of satellite and modeled data; methodologies on how to generate land-, water-, and disaster-related products from satellite data; and accessing relevant existing products for assessing land use change, natural resource management, and climate mitigation. This training was tailored to case studies in Bhutan with the goal of improving capacity to use remote sensing data to better manage natural resources, improve land use planning, and monitor disasters experienced in the Kingdom of Bhutan.

As a result of this training...

100%
Improved their ability acquire and analyze time series of remote sensing data.

100%
Improved their ability to utilize satellite and modeled data for monitoring disasters.

97%
Improved their ability to monitor and quantify changes in land use and land cover.

100%
Improved their ability to use **Global Climate Model** data to analyze regional climate change projections.

Participant Feedback:

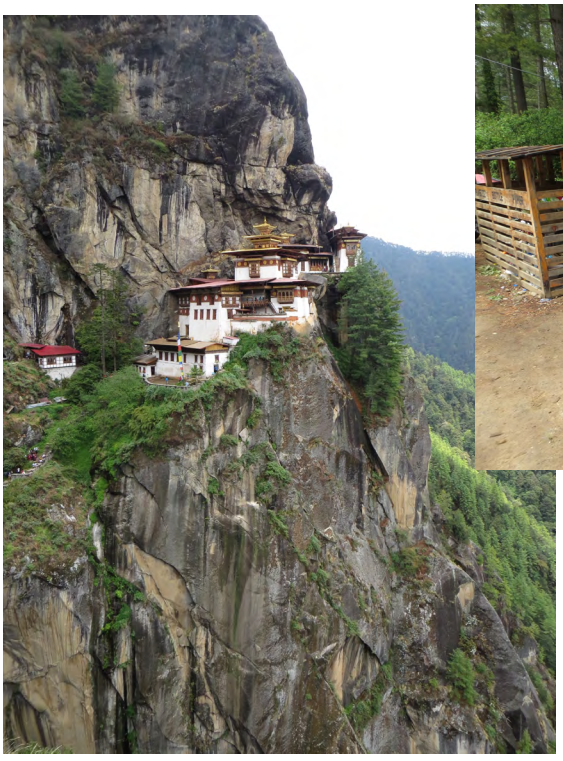
It was a great training program with rigorous theory and practical input. So I could gain a lot of new ideas in remote sensing mainly how to use Google Earth Engine for analyzing RS data. The trainers were very expert and friendly to help for any doubts. Hoping for further support in future from ARSET team. Thank you so much for the knowledge that you all imparted. (Bhutan Training Participant, May, 2024, Faculty)

I am planning to join [the] Division of Telecom and Space (DoTS), GovTech Agency wherein I will be more involved on remote sensing program. DoTS is planning to [implement] high resolution satellites in the future which could be used for disaster management, urban planning, and environmental conservation and monitoring. We would require definite assistance from ARSET to realize the remote sensing objectives of DoTS. (Bhutan Training Participant, May 2024, Federal Government Employee)

Link to Training Webpage

Building Capacity to Use Earth Observations in Addressing Environmental Challenges in Bhutan

Above: Group photo taken at in-person remote sensing training in Bhutan in 2024. Photo Credit: ARSET



Left: Cliffside buildings in Bhutan.
Top: ARSET Trainer Erika Podest poses with training participants.
Right: ARSET Trainer Amita Mehta gives a lecture.
Photo Credits: ARSET

Earth Observations for Humanitarian Applications

ARSET Instructors

Sean McCartney
NASA Goddard Space Flight Center/Science Systems and Applications Inc.

Guest Instructors

Mark Bernhofen
University of Oxford

Mark Trigg
University of Leeds

Ruby Paterson
Oxfam

Luckson Katsi
UNHCR

Andrew Zimmer
Montana State University

Sitian Xiong
Clark University

Jamon Van Den Hoek
Oregon State University

Lyndon Estes
Clark University

Date(s): June 6 – June 20, 2024

Level: Intermediate

Type: Online, Instructor-Led

Language(s): English

Satellites/Sensors: Landsat 8 OLI, Landsat 9 OLI2, Sentinel-1 C-band SAR, Sentinel-2 MSI, TRMM, Aqua/Terra MODIS

Reach

844	425	107	31
Participants	Organizations	Countries	US States

This three-part training presented concrete strategies for mapping localized climate conditions with risks faced by refugee and IDP communities around the world, and was a follow-on to our 2022 Introductory training, Humanitarian Applications Using NASA Earth Observations. This training focused on flood risk assessments and specific challenges for assessing flood risk in refugee and IDP camps; gauging long-term heat stress in refugee camps and the challenges with decision making surrounding heat risk; and monitoring drought effects on agricultural landscapes in refugee settings using Earth observations (EO) to explore the correlations between anomalies in crop productivity and weather-based factors. By the end of the training, participants were able to integrate EO, building footprint and infrastructure data, and population data to quantify climate risk and development trends in specific humanitarian settings, and recognize the value and limitations of specific EO and geospatial datasets.

As a result of this training...

97%
Improved their ability to identify localized climate risk in refugee settings.

91%
Found **Google Earth Engine** to be moderately or very useful.

88%
Found **QGIS** to be moderately or very useful.

81%
Found **Google Colab** to be moderately or very useful.

Participant Feedback:

To enhance the use of remote sensing data for climate risk and development indicators in humanitarian settings, additional training should focus on advanced data processing, integration, and analysis skills, particularly using GIS, Python, and cloud-based platforms like Google Earth Engine. Training should also cover machine learning applications for predictive modeling, climate risk assessment, and understanding the specific impacts of climate risks on vulnerable populations. Practical applications through case studies, hands-on workshops, and interactive sessions would be beneficial. Future ARSET trainings could improve by tailoring content to regional needs, enhancing interactivity, involving experts from both remote sensing and humanitarian fields, and providing follow-up support to ensure ongoing learning and application. (Survey Comment, June, 2024; Private Sector Employee, Nepal)

Link to Training Webpage

Applications of Carbon Dioxide Measurements for Climate-Related Studies

ARSET Instructors

Erika Podest
NASA Jet Propulsion Laboratory/Caltech

Guest Instructors

Vivienne Payne
NASA Jet Propulsion Laboratory/Caltech

Junjie Liu
NASA Jet Propulsion Laboratory/Caltech

Karen Yuen
NASA Jet Propulsion Laboratory/Caltech

David Moroni
NASA Jet Propulsion Laboratory/Caltech

Abhishek Chatterjee
NASA Jet Propulsion Laboratory/Caltech

Date(s): July 9 – July 16, 2024

Level: Intermediate

Type: Online, Instructor-Led

Language(s): English and Spanish

Satellites/Sensors: OCO-2, OCO-3

Reach

738	365	87	31
Participants	Organizations	Countries	US States

Space-based CO2 measurements have become an important capability in support of climate studies and to inform policy decisions. This intermediate, three-part webinar series built on the previous CO2 training from 2022, providing a more in-depth review of OCO-2 and OCO-3 measurements along with demonstrations of case-studies. The latter focused on how to read, visualize, and interpret the data, how to account for quality flags in an analysis, how to use the data from the OCO missions to analyze impacts of an El Niño event on atmospheric CO2 and carbon sources and sinks, and how to examine spatial variations of CO2 over a metropolitan area. The demonstration was conducted using Jupyter Notebooks.

As a result of this training...

96%
Improved their ability to access and download data through **GES DISC**.

97%
Improved their ability to interpret **OCO-2/OCO-3** XCO2 data for global, regional, and local scales.

96%
Improved their ability to open and visualize XCO2 data from **OCO-2/OCO-3**.

96%
Improved their ability to assess the level of confidence in XCO2 measurements using quality flags.

Participant Feedback:

Working with OCO data is challenging due to its complexity, large volumes requiring significant storage and processing power, ensuring data quality and calibration, and the need for integration with other datasets. To regularly use it, we need more training and education resources, user-friendly software tools, access to computational resources, and community support for knowledge sharing and problem-solving. (Survey Comment, July, 2024; Student, India)

I consider all the training and capacity building that the organization you lead to be of utmost importance. Some time ago I had the opportunity to attend a training outside of Venezuela, it was held in Brazil, where two instructors from the agency, Erika Podest and Amita Mehta, were excellent. The work that you do to improve management and life on the planet is very enriching. (Survey Comment, July, 2024; Faculty, Venezuela)

Link to Training Webpage

Aplicaciones de Mediciones de Dióxido de Carbono para Estudios Relacionados con el Clima

Instructores de ARSET

Erika Podest
NASA Jet Propulsion Laboratory/Caltech

Instructores Invitados

Vivienne Payne
NASA Jet Propulsion Laboratory/Caltech

Junjie Liu
NASA Jet Propulsion Laboratory/Caltech

Karen Yuen
NASA Jet Propulsion Laboratory/Caltech

David Moroni
NASA Jet Propulsion Laboratory/Caltech

Abhishek Chatterjee
NASA Jet Propulsion Laboratory/Caltech

Fecha(s): El 9 al 16 de julio de 2024

Nivel: Intermedio

Tipo: Virtual

Idioma(s): Inglés y Español

Satélites/Sensores: OCO-2, OCO-3

Alcanzó

738 Participantes

365 Organizaciones

87 Países

31 Estados de EE.UU.

Las mediciones de dióxido de carbono desde el espacio son valiosas para apoyar estudios climáticos y para informar en la toma de decisiones políticas. En esta capacitación en línea de nivel intermedio y de tres partes, se profundizará en el material que se presentó en una capacitación sobre CO2 en el 2022. Se repasará en más detalle las mediciones de OCO-2 y OCO-3 y se harán demostraciones de estudios de caso. Las demostraciones se centrarán en cómo leer, visualizar e interpretar los datos de CO2, cómo tomar en cuenta los indicadores de calidad en un análisis y cómo utilizar los datos de OCO para analizar los impactos de El Niño en el CO2 atmosférico y en las fuentes y sumideros de carbono. También se analizarán las variaciones de CO2 sobre una zona metropolitana. La demostración se realizará usando Jupyter Notebook.

Como resultado de esta capacitación...

96%

Se mejoró su capacidad para acceder y descargar datos a través de **GES DISC**.

97%

Mejoró su capacidad para interpretar datos de **OCO-2/OCO-3** XCO2 a escalas global, regional y local.

96%

Se mejoró su capacidad para abrir y visualizar datos de XCO2 de **OCO-2/OCO-3**.

96%

Mejoró su capacidad para evaluar el nivel de confianza en las mediciones de XCO2 utilizando indicadores de calidad.

Participant Feedback:

Como siempre con el Programa ARSET, me encanta la calidad con que diseñan y comparten todos los conocimientos que involucran estos eventos. Aprendo mucho, se siente y se ve la alta calidad de lo que hacen, y estoy muy contento siempre por los conocimientos que adquiero con ustedes. Son una fortuna para la ciencia. Me encantó, y me encanta todo lo que hacen, la alta calidad de lo que nos comparten, y lo mucho que logro aprender cada vez con ustedes. [As always with the ARSET Program, I love the quality with which you design and share all the knowledge involved in these events. I learn a lot, you can feel and see the high quality of what you do, and I am always very happy with the knowledge I acquire with you. You are a fortune for science. I loved it, and I still love everything you do, the high quality of what you share with us, and how much I manage to learn every time with you.] (Survey Comment, July, 2024; Faculty, Colombia)

Link to Training Webpage

Drought Monitoring, Prediction, and Projection using NASA Earth System Data

ARSET Instructors

Amita Mehta
NASA Goddard Space Flight Center/University of MD, Baltimore County

Sean McCartney
NASA Goddard Space Flight Center/Science Systems and Applications Inc.

Guest Instructors

Kelsey Satalino
CIRES/NOAA/NIDIS

Steve Ansari
NOAA

Brad Pugh
NOAA/NWS

Compton Tucker
NASA Goddard Space Flight Center

Andrea Molod
NASA GMAO

Date(s): July 23 – August 1, 2024

Level: Advanced

Type: Online, Instructor-Led

Language(s): English

Satellites/Sensors: GPM, SMAP, Landsat 8/9, Sentinel-2, Terra/Aqua MODIS, Sentinel-1 SAR

Reach

1,014	500	108	34
Participants	Organizations	Countries	US States

The United Nations has documented that drought frequency and duration have increased globally since 2000. According to this report 2.3 billion people around the world are currently facing water stress. Although droughts only represent 15% of natural disasters, they killed 650,000 people between 1970 and 2019. Also, it is predicted that by 2050, drought could affect more than 75% of the world's population. Droughts affect drinking water availability, ecosystems, and crop production – critical for quality and sustainability of plant, animal and human lives. For better water and agricultural management it is crucial to monitor and forecast drought conditions. This four-part advanced training will build upon previous ARSET trainings and provide hands-on data analysis exercises for monitoring different types of drought (meteorological, hydrological, and agricultural). Moreover, the training will include drought prediction analysis on sub-seasonal to seasonal (S2S) time scales and climate change projection analysis of drought conditions.

As a result of this training...

99%
Improved their ability to identify relevant drought portals and geophysical parameters.

78%
Found the **National Integrated Drought Information System** to be moderately or very useful.

73%
Found **US Drought Monitor** to be moderately or very useful.

93%
Found **Google Earth Engine** to be moderately or very useful.

Participant Feedback:

I work a lot on land use change and detection of areas for reforestation. The information from the NEX-GDDP will allow me to develop scenarios for the areas I develop, which will allow me to know the risks to be faced by Climate Change for these activities, in arid and semiarid areas of Mexico. (Survey Comment, August, 2024; Federal Government Employee, Mexico)

I come from Liberia, a country that lacks some basic social services for its citizens. Data availability and accessibility are very scarce. ARSET training is essential for students, academics, and professionals from my country and other underdeveloped countries. Being in Thailand as a student, I have realized that my country needs a lot of support in capacity building and knowledge sharing. (Survey Comment, September, 2024; Student, Thailand)

Thank you very much for these courses, they are essential in my courses at the university. (Survey Comment, August, 2024; Faculty, Nicaragua)

Link to Training Webpage

NASA Atmospheric Composition Ground Networks Supporting Air Quality and Climate Applications

ARSET Instructors

Carl Malings
NASA Goddard Space Flight Center/Morgan State University

Melanie Follette-Cook
NASA Goddard Space Flight Center

Guest Instructors

Pawan Gupta
NASA Goddard Space Flight Center

Petar Grigorov
Science Systems and Applications, Inc.

Tom Hanisco
NASA Goddard Space Flight Center

Apoorva Pandey
University of Maryland, Baltimore County (UMBC)

Bryan Place
SciGlob

John Sullivan
NASA Goddard Space Flight Center

Judd Welton
NASA Goddard Space Flight Center

Date(s): August 8 – August 22, 2024

Level: Intermediate

Type: Online, Instructor-Led

Language(s): English

Satellites/Sensors: AERONET, Pandora, TOLNet, MPLNET

Reach

979	475	105	39
Participants	Organizations	Countries	US States

In this five-part, online, intermediate-level training, multiple NASA networks participated and provided training on their atmospheric composition ground networks. These networks provide data relevant to aerosol and trace gas column concentrations and vertical structure, supporting applications in air quality and climate. This online training provided a basic understanding of aerosol and trace gas measurements using both active and passive techniques for ground-based remote sensing. It also taught users how to select, access, and incorporate relevant data from these ground networks into their work. Finally, it demonstrated an application comparing ground-based and satellite remote sensing products.

As a result of this training...

91%
Found the **AERONET website** to be moderately or very useful.

82%
Found the **TOLNet website** to be moderately or very useful.

84%
Found the **Pandora website** to be moderately or very useful.

81%
Found the **MPLNET website** to be moderately or very useful.

Participant Feedback:

To incorporate ground-based atmospheric composition networks into my work on air quality and climate, I'd start by combining their data with satellite observations to get a fuller picture. I'd also look to work closely with those running these networks to make sure the data is accurate and reliable. ARSET could really help by offering guidance on how to effectively integrate these different data sources, providing access to useful datasets, and connecting me with experts in the field. (Survey Comment, August, 2024; NGO Employee, Nigeria)

For next steps, I am incorporating the ground-based atmospheric composition networks APIs into the Atmospheric Community Toolkit (ACT), which is supported by DOE's Atmospheric Radiation Measurement (ARM) program. This will allow DOE ARM/ASR researchers the ability to sync ARM and ARSET datasets in near real time to create science ready datasets for the general public. This will also provide support for ARM instrument mentors to provide context for our surface in-situ observations. (Survey Comment, September, 2024; Federal Government Employee, United States)

Link to Training Webpage

Invasive Species Monitoring with Remote Sensing

ARSET Instructors

Sativa Cruz
NASA Ames Research Center/Bay Area Env. Research Institute

Juan L. Torres-Pérez
NASA Ames Research Center

Justin Fain
NASA Ames Research Center/Bay Area Env. Research Institute

Guest Instructors

Erin Hestir
UC Merced

Hamed Gholizadeh
Oklahoma State University

Date(s): August 14 – August 28, 2024

Level: Introductory

Type: Online, Instructor-Led

Language(s): English

Satellites/Sensors: Landsat, Sentinel-2, MODIS, VIIRS, AVIRIS-NG, GEDI, HyMap, SBG, GLIMR, PACE

Reach

1,120 Participants
550 Organizations
97 Countries
49 US States

Invasive species costs the U.S. economy billions of dollars a year and can cause declines in ecosystem health. NASA data can be used to identify the impacts of invasive species including the extent, potential distribution, and impacts to affected ecosystems. With improvements to the temporal, spatial, and spectral resolution of data alongside cloud-based computing there are new opportunities to apply NASA data, products, and tools to landscape management. This training provided participants with an overview of typical NASA satellites and sensors used to map invasive plants such as Landsat, MODIS, and VIIRS, as well as innovative or upcoming data and missions such as the Global Ecosystem Dynamics Investigation (GEDI), HyMap, the Surface Biology and Geology (SBG) mission, and the Geosynchronous Littoral Imaging and Monitoring Radiometer (GLIMR). This training highlighted project-based applications of remote sensing for plant species of interest especially those affecting grasslands and aquatic inland lakes and water bodies, and more with a lens towards innovative uses of hyperspectral data for additional invasive species detection.

As a result of this training...

100%
Improved their ability to identify types of remote sensing data that can be used for invasive species mapping.

78%
Found **AppEEARS** to be moderately or very useful.

90%
Found **Earthdata** to be moderately or very useful.

84%
Found **Worldview** to be moderately or very useful.

Participant Feedback:

Additional training on using machine learning and deep learning algorithms for more accurate classification of invasive species from remote sensing data would be very helpful. Also, more detailed instruction on the use of multi-spectral and hyperspectral data to detect subtle differences in plant species would improve my ability to identify invasive species. Future ARSET trainings could include more real-world case studies and practical applications of remote sensing for invasive species monitoring in different ecosystems. This would provide participants with a clearer understanding of how to adapt methodologies to their specific regional contexts. (Survey Comment, September, 2024; Federal Government Employee, Tunisia)

Link to Training Webpage

Enabling Earth Observations for Land Applications with NASA's Applied Remote Sensing Training Program (ARSET)

ARSET Instructors

Juan L. Torres-Pérez
NASA Ames Research Center

Sativa Cruz
NASA Ames Research Center/Bay Area Env. Research Institute

Date(s): August 9, 2024

Level: Introductory

Type: In-Person

Language(s): English

Satellites/Sensors: Aqua/Terra MODIS, SNPP/JPSS VIIRS

Reach

20
Participants

NASA's Applied Remote Sensing Training Program (ARSET) exists to introduce and build skills of individuals and institutions in the use and application of remote sensing information and datasets. ARSET offers online and in-person training to develop technical skills and empower users to utilize NASA Earth Science resources in the decision making process. Since 2008 the program has reached over 100,000 participants. In this training members of our ARSET Ecological Conservation team provided an overview of NASA Earth Observation data and some available tools for land, climate, and wildfire applications.

Top Left: ARSET Trainer Juan Torres-Pérez gives a lecture. **Top Right:** A room full of participants listens intently. **Bottom Left:** ARSET Trainers Sativa Cruz and Juan Torres-Pérez. **Bottom Right:** Juan and Sativa engage with participants after the training. Photo Credits: ARSET

[Link to Training Webpage]

Ask NASA ARSET: Radar Remote Sensing for Flood Monitoring

ARSET Instructors

Erika Podest
NASA Jet Propulsion Laboratory/Caltech

Translator

David Barbato
NASA GSFC/University of Maryland Baltimore County

Date(s): September 5, 2024

Level: Introductory

Type: Online, Instructor-Led

Language(s): English and Spanish

Satellites/Sensors: NISAR, PALSAR, Sentinel-1, SMAP, SWOT

Reach

202	100	58	11
Participants	Organizations	Countries	US States

Synthetic Aperture Radar (SAR) signals can "see" the surface of the Earth during the day or night, and under nearly all weather conditions. In addition, the signal can penetrate through the vegetation canopy and detect inundation. These capabilities are unique to radar and make it an ideal sensor for flood detection and monitoring. In association with AmeriGEO Week 2024 (26-30 August 2024), we conducted a live Question & Answer (Q&A) Session on the use of radar remote sensing observations for flood monitoring. The goal of this live, one-hour Q&A was to provide participants with the opportunity to ask questions to a panel of experts. We had a translator available for our Spanish-speaking audience.

Link to Training Webpage

Ask NASA ARSET: Remote Sensing Observations for Air Quality Applications

ARSET Instructors

Melanie Follette-Cook
NASA Goddard Space Flight Center

Carl Malings
NASA Goddard Space Flight Center/Morgan State University

Erika Podest
NASA Jet Propulsion Laboratory/Caltech

Guest Instructors

Didier Davignon
CCMEP/ECCC

Translator

David Barbato
NASA GSFC/University of Maryland Baltimore County

Date(s): September 19, 2024

Level: Introductory

Type: Online, Instructor-Led

Language(s): English and Spanish

Satellites/Sensors: AERONET, GEMS, GOES, Aqua/Terra MODIS, OMI, TEMPO, TROPOMI, SNPP/JPSS VIIRS

Reach

153	75	47	10
Participants	Organizations	Countries	US States

Previous ARSET Air Quality (AQ) online webinar series have covered the basics of remote sensing, descriptions of available satellite data and model products, how to access and visualize data and manage different data formats, and how to use satellite observations for applications like smoke monitoring, air quality modeling and forecasting, and for environmental justice applications. In association with AmeriGEO Week 2024 (26-30 August 2024), and to supplement the Air Quality Workshop conducted on 29 August by the GEOHealth Community of Practice, we conducted a live Question & Answer (Q&A) Session on September 19, 2022. The goal of this live, one-hour Q&A was to provide participants with the opportunity to ask questions to a panel of experts. We had a translator available for our Spanish-speaking audience.

Link to Training Webpage

Introduction to Plankton, Aerosol, Cloud, Ocean Ecosystem (PACE) Hyperspectral Observations for Water Quality Monitoring

ARSET Instructors

Amita Mehta
NASA Goddard Space Flight Center/University of MD, Baltimore County

Guest Instructors

Antonio Mannino
NASA Goddard Space Flight Center

Morgaine McKibben
NASA Goddard Space Flight Center

Carina Poulin
NASA Goddard Space Flight Center/Science Systems and Applications, Inc.

Anna Windle
NASA Goddard Space Flight Center/Science Systems and Applications, Inc.

Date(s): September 25 – October 9, 2024

Level: Introductory

Type: Online, Instructor-Led

Language(s): English and Spanish

Satellites/Sensors: PACE

Reach

1,037	500	92	43
Participants	Organizations	Countries	US States

Plankton, Aerosol, Cloud, ocean, Ecosystem (PACE), a new NASA mission, was launched on 8 February 2024. PACE – Ocean Color Instrument (OCI) collects global, hyperspectral observations for water quality monitoring. This three-part, introductory training provided an overview of past and current hyperspectral sensors. Specifically, this training provides information on NASA's PACE mission, its sensors and data products, webtools to access data, and software for processing hyperspectral data and water quality parameters derived from PACE/OCI. The training also highlighted some advantages and limitations of PACE data. This was the first ARSET training focusing on the use of hyperspectral data for water quality applications.

As a result of this training...

99%
Improved their ability to access and analyze **PACE Level-2 & -3** data to detect and visualize chlorophyll-a concentration.

87%
Found **OB.DAAC Level-3 & -4 Browser** to be moderately or very useful.

91%
Found **Earthdata Search** to be moderately or very useful.

90%
Found **Worldview** to be moderately or very useful.

Participant Feedback:

One potential barrier I foresee in accessing or applying PACE data is the format in which the data is presented. If the data is not standardized or user-friendly, it may require additional effort to convert or analyze, especially for those without advanced technical skills. Another challenge could be the location of the data—if the data is dispersed across multiple platforms or requires complex navigation to access, it could slow down the process. Additionally, the availability of specific software or code to efficiently analyze the data could be limited, particularly if the tools required are expensive or have a steep learning curve. Ensuring open-source, user-friendly tools and a centralized, easily navigable platform would greatly help in addressing these issues. (Survey Comment, October, 2024; Student, Nepal)

Water quality as we've discussed gives more information of the state of water system. So through the training I have been thinking of applying what I have learned in Ghana's marine water system in the Exclusive Economic Zone. There is an increase illegal mining in various water bodies in Ghana bringing a lot sediment to marine water system. Thus, I want to assess its impact on the water quality of the sea. (Survey Comment, October, 2024; Student, Ghana)

Link to Training Webpage

Introducción a los Datos Hiperespectrales de la misión "Plankton, Aerosol, Cloud, Ocean Ecosystem" (PACE) para el Monitoreo de la Calidad del Agua

Instructores de ARSET

Amita Mehta
NASA Goddard Space Flight Center/University of MD, Baltimore County

Instructores Invitados

Antonio Mannino
NASA Goddard Space Flight Center

Morgaine McKibben
NASA Goddard Space Flight Center

Carina Poulin
NASA Goddard Space Flight Center/Science Systems and Applications, Inc.

Anna Windle
NASA Goddard Space Flight Center/Science Systems and Applications, Inc.

Fecha(s): El 25 de septiembre al 9 de octubre de 2024

Nivel: Introductorio

Tipo: Virtual

Idioma(s): Inglés y Español

Satélites/Sensores: PACE

Alcanzó

1,037 Participantes
500 Organizaciones
92 Países
43 Estados de EE.UU.

La misión Plankton, Aerosol, Cloud, Ocean, Ecosystem (PACE) es una nueva misión de la NASA y fue lanzada al espacio el 8 de febrero de 2024. PACE – Ocean Color Instrument (OCI) recopila observaciones hiperespectrales a nivel mundial para el monitoreo de la calidad del agua. Esta capacitación introductoria de tres partes presentará un resumen de los sensores hiperespectrales. Específicamente, la capacitación cubrirá información sobre la misión PACE, sus sensores y datos, herramientas y software en línea para acceder y procesar estos datos. Además cubrirá como acceder datos de la calidad del agua derivados de PACE/OCI. La capacitación también resaltará algunas ventajas y limitaciones de los datos de PACE. Esta será la primera capacitación de ARSET enfocada en el uso de datos hiperespectrales para aplicaciones de la calidad del agua.

Como resultado de esta capacitación...

99%
Mejoró su capacidad para acceder y analizar datos de **PACE Nivel-2 y -3** para detectar y visualizar la concentración de clorofila-a.

87%
Encontré que el **navegador OB.DAAC Nivel-3 y -4** es moderadamente o muy útil.

91%
Encontré que **Earthdata Search** es moderada o muy útil.

90%
Encontré que **Worldview** es moderada o muy útil.

Comentarios de los Participantes:

Me gustaría ver como trabajar con r las imágenes de PACE e incluso más sobre el tema como trabajar desde la nube y los resultados de estos estén disponibles al público así como poder compartir la información y algoritmos o correcciones con otros grupos de investigación [I would like to see how to work with PACE images and even more on the subject of working from the cloud and the results of these being available to the public as well as being able to share the information and algorithms or corrections with other research groups.] (Survey Comment, October, 2024; Student, Mexico)

Mi institución trabaja en asuntos oceanográficos y marino costeros del Ecuador, sería muy interesante contar con datos satelitales que nos permitan caracterizar la contaminación de los ríos debida a aguas negras, residuos industriales, actividades mineras. [My institution works on oceanographic and coastal marine issues in Ecuador. It would be very interesting to have satellite data that would allow us to characterize the contamination of rivers due to sewage, industrial waste, and mining activities.] (Survey Comment, October, 2024; Federal Government Employee, Ecuador)

Link to Training Webpage

Field Spectroscopy Hands-On Training for Airborne Image Validation

ARSET Instructors

Juan L. Torres-Pérez
NASA Ames Research Center

Sativa Cruz
NASA Ames Research Center/Bay Area Env. Research Institute

Justin Fain
NASA Ames Research Center/Bay Area Env. Research Institute

Date(s): October 7 – October 11, 2024

Level: Intermediate

Type: In-Person

Language(s): English

Satellites/Sensors: AVIRIS-NG, PRISM

Reach

47 Participants

21 Organizations

This joint, 5-day, in-person workshop was done in collaboration with ORNL DAAC, and the BioSCape campaign and held in Cape Town, South Africa. The first two days of the training were led by ARSET and provided hands-on experiences on the use of hyperspectral in-situ field spectroradiometers for land and water targets as well as a first-view of some of the hyperspectral imagery collected during the BioSCape campaign. Participants were taught to use in-situ spectral data as a means for validation of airborne imagery. We also explored aspects for consideration when working with airborne data such as sun glint, sun angle, aircraft (pitch, row, yaw) factors, among others and how these impact the image analysis. Participants also explored differences between in-situ and image spectral signatures and how these differences are affected by image spatial resolution.

As a result of this training...

100%

Improved their ability to explain similarities and differences of spectral signatures from diverse aquatic systems.

100%

Improved their ability to analyze field spectral data with traditional (e.g., Excel) and more advanced methods (e.g., Python, R).

100%

Improved their ability to account for factors that may affect the collection of field spectroscopy data.

81%

Feel confident that they can use **Python** or **R** for data analysis for their work needs.

Participant Feedback:

For me this was incredibly informative, I haven't been active in the scientific community for a few years and am eternally grateful to have been included in this workshop, loved the group of participants, representing various facets of the conservation, governmental, scientific communities in one room. Thank you! (Survey Comment, October, 2024; Local Government Employee, South Africa)

It would've been helpful to process datasets from the same sites that were multispectral (e.g., Sentinel) vs. hyperspectral (BioSCape) so that we could see the differences and discuss the pros and cons in relation to applications for biod[iversity] conservation and natural resource management. (Survey Comment, October, 2024; Independent Contractor, South Africa)

This was my first ARSET workshop experience, the course is well designed, every aspect fed well into the next, as the intro, field work, notebooks and multiple question tests. It was very interactive and the staff was great! (Survey Comment, October, 2024; Student, South Africa)

The workshop was run by enthusiastic, knowledgeable, and humble instructors. That made it comfortable to the participants and more interactive than other workshops I've been to where participants were intimidated by the instructors. (Survey Comment, April, 2024; Federal Government Employee, South Africa)

Link to Training Webpage

Field Spectroscopy Hands-On Training for Airborne Image Validation

Above: ARSET Trainer Juan Torres-Pérez gives a lecture in Cape Town, South Africa. Photo Credit: ARSET
Below: Group photo taken at in-person training in Cape Town, South Africa. Photo Credit: ARSET

Overview of Earth Observations for Societal Benefit

ARSET Instructors

Sean McCartney
NASA Goddard Space Flight Center/Science Systems and Applications Inc.

Amita Mehta
NASA Goddard Space Flight Center/University of MD, Baltimore County

Erika Podest
NASA Jet Propulsion Laboratory/Caltech

Date(s): October 28, 2024

Level: Introductory

Type: In-Person

Language(s): English

Satellites/Sensors: Entire Fleet

Reach

19 Participants

19 UN Entities

This training session was jointly organized by the United Nations (UN) Inter-Agency Meeting on Outer Space Activities (UN-Space) and the Committee on Earth Observation Satellites Working Group on Capacity Development (CEOS WGCapD), with support provided by the Capacity Development and Operational Training Service (CDOTS) of the Department of Operational Support. It aimed to empower UN entities with the latest tools and knowledge in the realm of Earth observation and satellite data utilization in support of their agendas. The training featured sessions led by the NASA Applied Remote Sensing Training Program (ARSET) and Earth Science Data Systems (ESDS) program highlighting Earth observations and satellite data analysis and providing a hands-on experience.

Above: Group photo taken at the in-person ARSET training at the United Nations in New York City. Photo Credit: ARSET

Participant Feedback:

As a Military planner for peace keeping missions we need various of latest maps to ascertain the ground situation before executing the tasks. The kind of data and maps which I can use through ARSET will be very useful for my work. (Survey Comment, November 2024; Intergovernmental Organization Employee, United States)

I currently work in the Evaluation Division of the Office of Internal Oversight Services, we do programme/ thematic evaluation to assess the effectiveness and impact of the UN agencies. The remote sensing data could help us obtain additional data and triangulate them with the survey, interview data that we collect to gain a better understanding of the programme (such as peacekeeping missions) work and performance. (Survey Comment, November 2024; Intergovernmental Organization Employee, United States)

Link to Training Webpage

An Introduction to Synthetic Aperture Radar (SAR) and Its Applications

ARSET Instructors

Erika Podest
NASA Jet Propulsion Laboratory/Caltech

Guest Instructors

Eric Fielding
NASA Jet Propulsion Laboratory

Franz Meyer
Alaska Satellite Facility/ University of Alaska, Fairbanks

Heidi Kristenson
Alaska Satellite Facility

Date(s): November 6 – November 20, 2024

Level: Introductory

Type: Online, Instructor-Led

Language(s): English and Spanish

Satellites/Sensors: NISAR, PALSAR, Sentinel-1

Reach

1,395	700	108	45
Participants	Organizations	Countries	US States

Historical and operational SAR data have been used to support numerous science and applications questions and needs. However, upcoming SAR satellite sensors, such as NISAR and BIOMASS, will enhance these capabilities with their unique observing frequencies and spatial and temporal resolutions. This online webinar provided an introduction to SAR, including interferometric SAR (InSAR), as well as a review of the characteristics of historical, current and upcoming openly available SAR satellite data. It also explored the type of applications that each sensor can best address. Additionally, this webinar discussed online sources of openly available SAR data, along with tools, software, and other resources to understand, explore, and facilitate the analysis of SAR data.

As a result of this training...

98%
Improved their ability to access & visualize SAR data for a given study area.

84%
Found **ASF DAAC** to be moderately or very useful.

99%
Improved their ability to interpret the content in SAR images to distinguish different features.

83%
Found **Jupyter Notebook** to be moderately or very useful.

Participant Feedback:

Coming into this training I had only completed the fundamentals of remote sensing course online. I have no remote sensing background but am very interested in learning and this training has changed the trajectory of my academic career as I plan to take remote sensing and GIS coursework in my future. As a beginner, some topics were beyond my knowledge, however with the transcriptions I was able to research topics on my own time and learn some of the content I was not familiar with. It was such an honor to partake in this training. It was thorough, organized and visually appealing. Thank you so much. (Survey Comment, December, 2024; Student, United States)

Improving Future ARSET Trainings Suggestions: Include sector-specific modules that provide tailored approaches for various industries. Offer more hands-on exercises, including real-world case studies and collaborative projects. Expand content on cutting-edge developments, such as AI-based SAR analysis or advanced polarimetric SAR applications. Provide online labs or workbooks that participants can use for independent learning after the training. Facilitate community interaction, such as forums or regular Q&A sessions with SAR experts. By addressing these areas, future ARSET trainings could better prepare participants to effectively utilize SAR data in their respective fields. (Survey Comment, December, 2024; Student, India)

Link to Training Webpage

Introducción al Radar de Apertura Sintética (SAR) y sus Aplicaciones

Instructores de ARSET

Erika Podest
NASA Jet Propulsion Laboratory/Caltech

Instructores Invitados

Eric Fielding
NASA Jet Propulsion Laboratory

Franz Meyer
Alaska Satellite Facility/ University of Alaska, Fairbanks

Heidi Kristenson
Alaska Satellite Facility

Fecha(s): El 6 al 20 de noviembre de 2024

Nivel: Introductorio

Tipo: Virtual

Idioma(s): Inglés y Español

Satélites/Sensores: NISAR, PALSAR, Sentinel-1

Alcanzó

1,395 Participantes

700 Organizaciones

108 Países

45 Estados de EE.UU.

Los datos históricos y operativos de SAR han apoyado numerosas investigaciones científicas y aplicaciones. Sin embargo, los próximos sensores satelitales SAR, como NISAR y BIOMASS, mejorarán aún más estas capacidades con sus frecuencias de observación, así como sus resoluciones espaciales y temporales. Este webinar en línea presentará una introducción a SAR, incluyendo SAR interferométrico (InSAR), así como un repaso de las características de los datos de SAR históricos, actuales y futuros. También explorará el tipo de aplicaciones que cada sensor puede abordar más efectivamente. Además, este webinar repasará las fuentes en línea de datos SAR de acceso abierto, junto con herramientas, software y otros recursos para ayudar a entender, explorar y analizar datos SAR.

Como resultado de esta capacitación...

98%
Mejoró su capacidad para acceder y visualizar datos SAR para un área de estudio determinada.

84%
Encontró que **ASF DAAC** es moderado o muy útil.

99%
Mejoró su capacidad para interpretar el contenido de las imágenes SAR para distinguir diferentes características.

83%
Encontró que **Jupyter Notebook** es moderado o muy útil.

Comentarios de los Participantes:

Trabajo para la administración pública en Gestión del dominio Público Hidráulico, en concreto en concesiones de aguas para uso privativo, todas las formaciones acerca de masas de agua, superficiales o subterráneas me es de utilidad en mi trabajo, que luego repercuten en la mejor gestión de la cuenca y los recursos hídricos. [I work for the public administration in Public Water Management, specifically in water concessions for private use. All training on bodies of water, whether surface or underground, is useful to me in my work, which then has an impact on better management of the basin and water resources.] (Survey Comment, November, 2024; Federal Government Employee, Spain)

En futuro sería conveniente tener un grupo temporal de colaboración por vía RRSS de forma que puedan compartirse ideas o realizar colaboración. [In the future, it would be convenient to have a temporary collaboration group via social networks so that ideas can be shared or collaboration can be carried out.] (Survey Comment, December, 2024; Non-Governmental Organization Employee, Chile)

Link to Training Webpage

Methane Observations for Large Emission Event Detection and Monitoring

ARSET Instructors

Melanie Follette-Cook
NASA Goddard Space Flight Center

Guest Instructors

Lesley Ott
NASA Goddard Space Flight Center

Andrew Thorpe
NASA Jet Propulsion Laboratory

Dana Chadwick
NASA Jet Propulsion Laboratory

Phillip Broderick
NASA Jet Propulsion Laboratory

Date(s): November 19 – November 21, 2024

Level: Introductory

Type: Online, Instructor-Led

Language(s): English and Spanish

Satellites/Sensors: EMIT, AVIRIS-NG, AVIRIS-3

Reach

363	180	67	35
Participants	Organizations	Countries	US States

Many activities can lead to the release of large concentrations of methane during the course of normal industrial operations or as accidental releases. These are often referred to as 'super emitter' events, which can be identified from modern satellites. This introductory, two-part training began with an introduction to the U.S. Greenhouse Gas Center and provided participants with an overview of how methane observations from the Earth surface Mineral dust Source Investigation (EMIT) mission can be used to identify and monitor areas of high methane enhancement. This course also demonstrated how to navigate the U.S. Greenhouse Gas center portal to access data products as well as highlighted tools for visualizing methane observations.

As a result of this training...

98%
Improved their ability to articulate the goals and objectives of the US Greenhouse Gas Center.

99%
Improved their recognition of the strengths and limitations of satellite observations used to measure methane for large emission event tracking.

99%
Greatly improved their ability to identify the sensors used to measure methane.

98%
Improved their ability to navigate the **US Greenhouse Gas Center Portal** and **EMIT VISIONS** portal.

Participant Feedback:

I want to express my sincere gratitude for the opportunity to participate in the ARSET Training. The sessions were not only informative but also incredibly engaging. The accessible approach to complex topics made learning a delightful experience. I'm excited to apply the newfound knowledge and skills to my ongoing project. I believe this training will significantly enhance the quality and impact of my work. Thank you once again for organizing such a valuable learning experience. (Survey Comment, December, 2025; Private Sector Employee, India)

To improve my use of remote sensing data for understanding methane emissions and informing mitigation strategies, I would benefit from advanced training in data analysis techniques, integration of multi-source data, effective visualization tools, and practical experience with remote sensing platforms, along with more interactive workshops and expert panels in future ARSET trainings. (Survey Comment, December, 2024; Federal Government Employee, Tunisia)

Link to Training Webpage

Earth Observations of Blue Carbon Ecosystems

Guest Instructors

Lola Fatoyinbo
NASA Goddard Space Flight Center/Biospheric Sciences Lab

Adia Bey
NASA Goddard Space Flight Center/University of Maryland, Baltimore County

Anthony Campbell
NASA Goddard Space Flight Center/University of Maryland, Baltimore County

Cheryl Doughty
NASA Goddard Space Flight Center/University of Maryland, Baltimore County

Kelly Luis
NASA Jet Propulsion Laboratory/Caltech

Siti Maryam Yaakub
Conservation International

María Claudia Díazgranados Cadelo
Conservation International

Date(s): December 3 – December 5, 2024

Level: Intermediate

Type: Online, Instructor-Led

Language(s): English and French

Satellites/Sensors: Landsat, Sentinel-1, Sentinel-2

Reach

1,395 Participants

700 Organizations

108 Countries

45 US States

Blue carbon ecosystems, such as mangroves, salt marshes, and sea grasses, are a key aspect of nature-based climate solutions because of high carbon sequestration rates, long-term burial of carbon in sediments, potential for restoration, and connections to many additional ecosystem services. This training builds from a series of previous trainings on Remote Sensing of Coastal Ecosystems, Remote Sensing of Mangroves, Remote Sensing of Greenhouse Gases, and Remote Sensing of Carbon Monitoring for Terrestrial Ecosystems to provide a comprehensive overview of blue carbon ecosystem remote sensing. The course guided participants through mapping extent and quantifying the carbon stocks of blue carbon ecosystems using earth observations to support assessment, monitoring, and restoration goals of these ecosystems.

As a result of this training...

96%
Improved their ability to map the extent of blue carbon ecosystems using satellite observations.

93%
Found **Google Earth Engine** to be moderately or very useful.

95%
Improved their ability to measure the carbon stock of mapped blue carbon ecosystems.

89%
Found the **Mangrove Dataset Comparison Tool** to be moderately or very useful.

Participant Feedback:

I am living in northern Cyprus, which is not a recognized country. My institution is not supported directly/efficiently for research by international donors because of administrative/political issues. RS data, I believe, will improve research and decision-making in the community. (Survey Comment, December, 2024; Faculty, Cyprus)

To improve my use of remote sensing data in quantifying and mapping carbon stocks in blue carbon ecosystems, I would consider the following improvements in information and skills: Advanced integration of multiple data sources. Combine remote sensing data from different sensors (optical, radar, LiDAR) to obtain a more precise characterization of the structure and composition of ecosystems such as mangroves, seagrasses and salt marshes. (Survey Comment, December, 2024; NGO Employee, Ecuador)

Link to Training Webpage

La Télédétection des Écosystèmes de Carbone Bleu

Instructeurs Invitées

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Siti Maryam Yaakub
Conservation International

María Claudia Díazgranados Cadelo
Conservation International

Date(s): 3 à 5 décembre 2024

Niveau: Intermédiaire

Type: Virtuel

Langue(s): Anglais et Français

Satellites/Capteurs: Landsat, Sentinel-1, Sentinel-2

Atteindre

1,395 Participants

700 Organisations

108 Pays

45 États Américains

Les écosystèmes de carbone bleu, tels que les mangroves, les marais salants et les herbiers marins, sont un aspect clé des solutions climatiques fondées sur la nature en raison des taux élevés de séquestration du carbone, de l'enfouissement à long terme du carbone dans les sédiments, du potentiel de restauration et des connexions à de nombreux autres services écosystémiques. Cette formation s'appuie sur une série de formations précédentes sur la télédétection des écosystèmes côtiers, la télédétection des mangroves, la télédétection des gaz à effet de serre, et la télédétection du suivi du carbone des écosystèmes terrestres, afin de fournir un aperçu complet de la télédétection des écosystèmes de carbone bleu. Le cours guidera les participants dans la cartographie de l'étendue et la quantification des stocks de carbone des écosystèmes de carbone bleu en utilisant la télédétection pour soutenir l'évaluation, le suivi et la restauration de ces écosystèmes.

Suite à cette formation...

96%
Amélioration de leur capacité à cartographier l'étendue des écosystèmes de carbone bleu à l'aide d'observations satellite.

93%
J'ai trouvé que **Google Earth Engine** était moyennement ou très utile.

95%
Amélioration de leur capacité à mesurer le stock de carbone des écosystèmes de carbone bleu cartographiés.

89%
J'ai trouvé que **l'outil de comparaison des ensembles de données sur les mangroves** était modérément ou très utile.

Commentaires de Participants:

En tant qu'étudiant en géomatique et climatologie, je travaille avec une communauté mal desservie qui rencontre de nombreux défis. Nous manquons d'accès à des informations essentielles, car les données sensibles sont souvent réservées à l'État, et nous n'avons pas les moyens d'acheter des images de faible résolution spatiale. Pour améliorer notre situation, il serait crucial d'avoir accès à des données de télédétection gratuites ou à coût réduit, notamment des images multispectrales et des données sur l'utilisation des terres, afin de mieux comprendre les enjeux environnementaux et de soutenir des initiatives de développement durable. [As a student of geomatics and climatology, I work with an underserved community that faces many challenges. We lack access to critical information, as sensitive data is often reserved for the state, and we cannot afford to purchase low-resolution imagery. To improve our situation, access to free or low-cost remote sensing data, including multispectral imagery and land use data, would be crucial to better understand environmental issues and support sustainable development initiatives.] (Survey Comment, December 2024; Student, Senegal)

Link to Training Webpage

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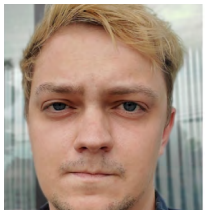

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APPLIED REMOTE SENSING TRAINING PROGRAM
TRAIN - EMPOWER - ADVANCE

Thank You!