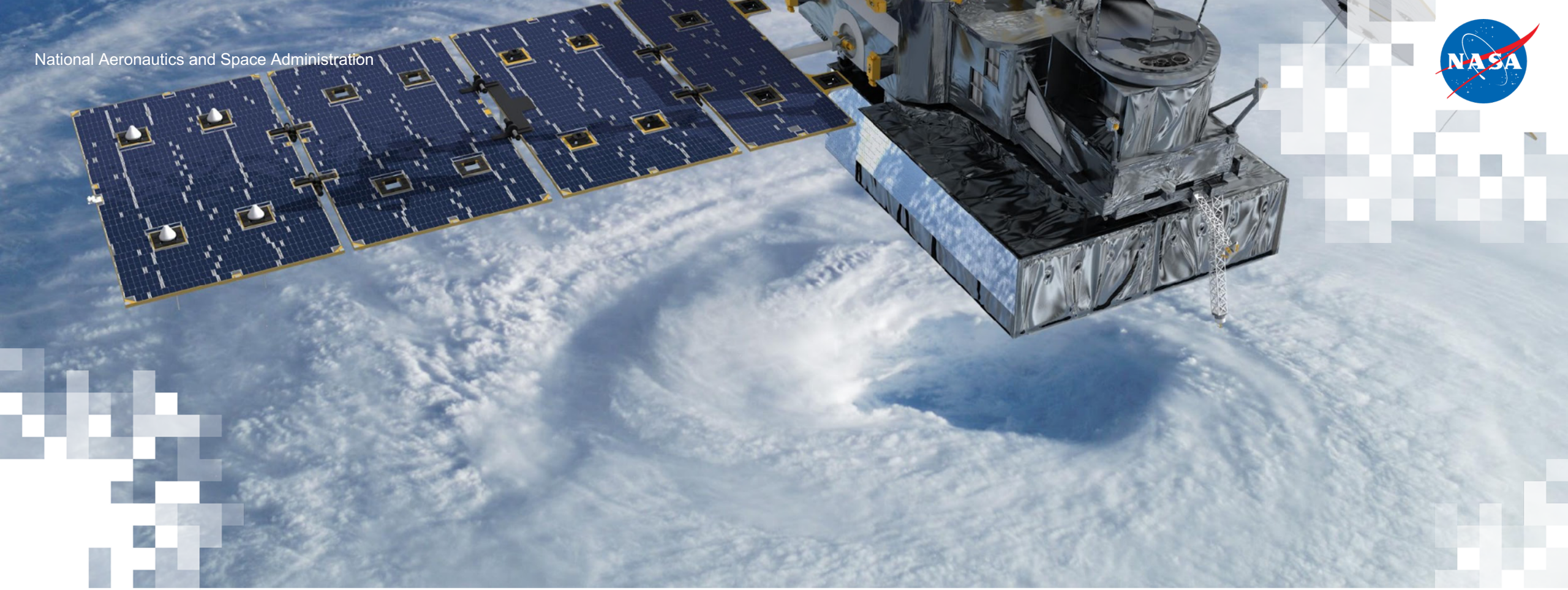


Applications of GPM IMERG[1] Reanalysis for Assessing Extreme Dry and Wet Periods

Amita Mehta and Sean McCartney

January 28, 2020

[1]IMERG: Integrated Multi-satellitE Retrievals for Global Precipitation Measurements (GPM)

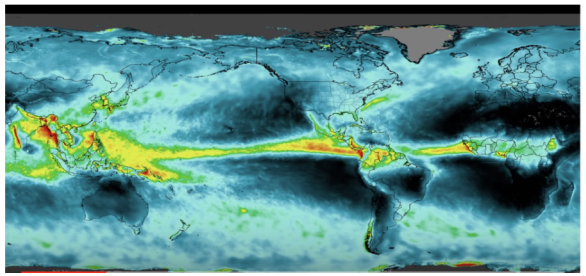
Objectives

- Learn to access IMERG data and derive regional precipitation statistics (mean, standard deviation, anomalies, percentile values)

- Learn to calculate and interpret the Standardized Precipitation Index (SPI) using IMERG for assessing extreme dry and wet periods

Training Outline

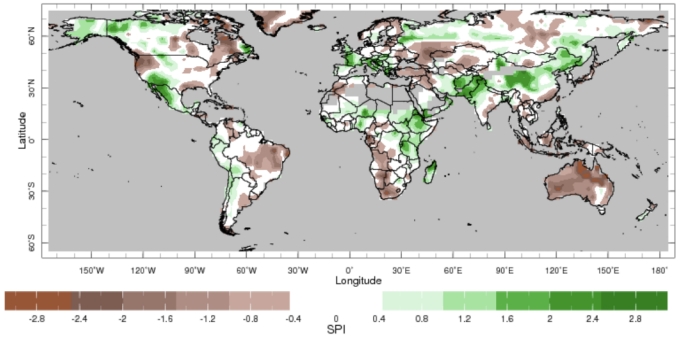
January 28, 2020



Calculation of Precipitation Statistics Using IMERG

https://www.youtube.com/watch?time_continue=9&v=qNlRQgACTFg&feature=emb_title

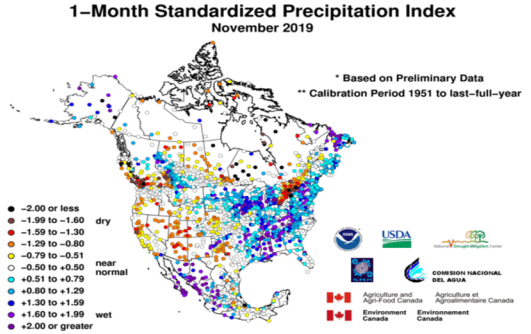
January 30, 2020



Calculation of SPI based on IMERG to Monitor Wet and Dry Conditions

https://iridl.ldeo.columbia.edu/maproom/Global/Precipitation/SPI.html

February 4, 2020



Flood and Drought Risk Assessment Based on IMERG Statistics and SPI

https://www.ncdc.noaa.gov/monitoring-content/temp-and-precip/drought/nadm/indices/spi/maps/ghcnd-na-1mon-spi-dot-pg.gif

Prerequisites

Attendees that do not complete the required prerequisites may not be adequately prepared for the pace of the training.

Fundamentals of Remote Sensing

Overview and Applications of Integrated Multi-Satellite Retrievals for GPM (IMERG) Long-term Precipitation Data Products

Register on NASA Earthdata

- https://earthdata.nasa.gov/

Install QGIS version 3.x

- https://qgis.org/en/site/

Install Panoply

- https://www.giss.nasa.gov/tools/panoply/

Install Anaconda Python version 3.7

- https://www.anaconda.com/

Windows users only, install Git Bash

- https://gitforwindows.org/

Training Format and Certification

- Three 2-hour sessions, each with:
  - Part-1: Presentations and demonstrations of data access, calculations, and analysis
  - Part-2: Lab time with hands-on, computer-based exercises

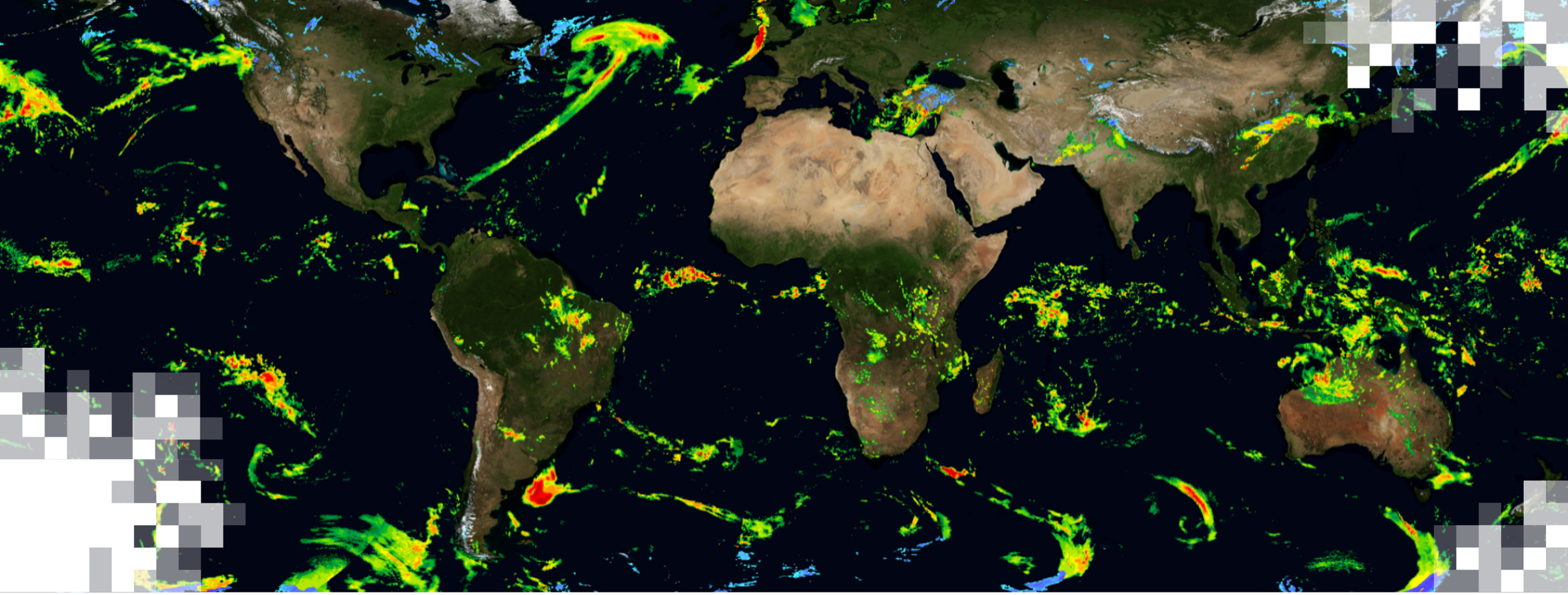
- Homework Assignments will be available after all three sessions from: https://arset.gsfc.nasa.gov
  - Answers must be submitted via Google Form
  - Due dates: 11, 18, and February 25

- Certificate of Completion will be awarded to those who:
  - Attend all webinars
  - Complete all homework assignments

- You will receive a certificate approximately two months after the completion of the course from: marines.martins@ssaihq.com

Part-1 Outline

- About ARSET
- IMERG: Data and Access Information
- Demonstration: Calculation of Precipitation Statistics
  - Case study: Texas → Houston
  - Long-term mean map
  - Time series of precipitation, percentile value
  - Precipitation anomalies (departure from mean)
- Exercise: Calculation of Precipitation Statistics as above
  - Case study: Mozambique → Maputo



About ARSET

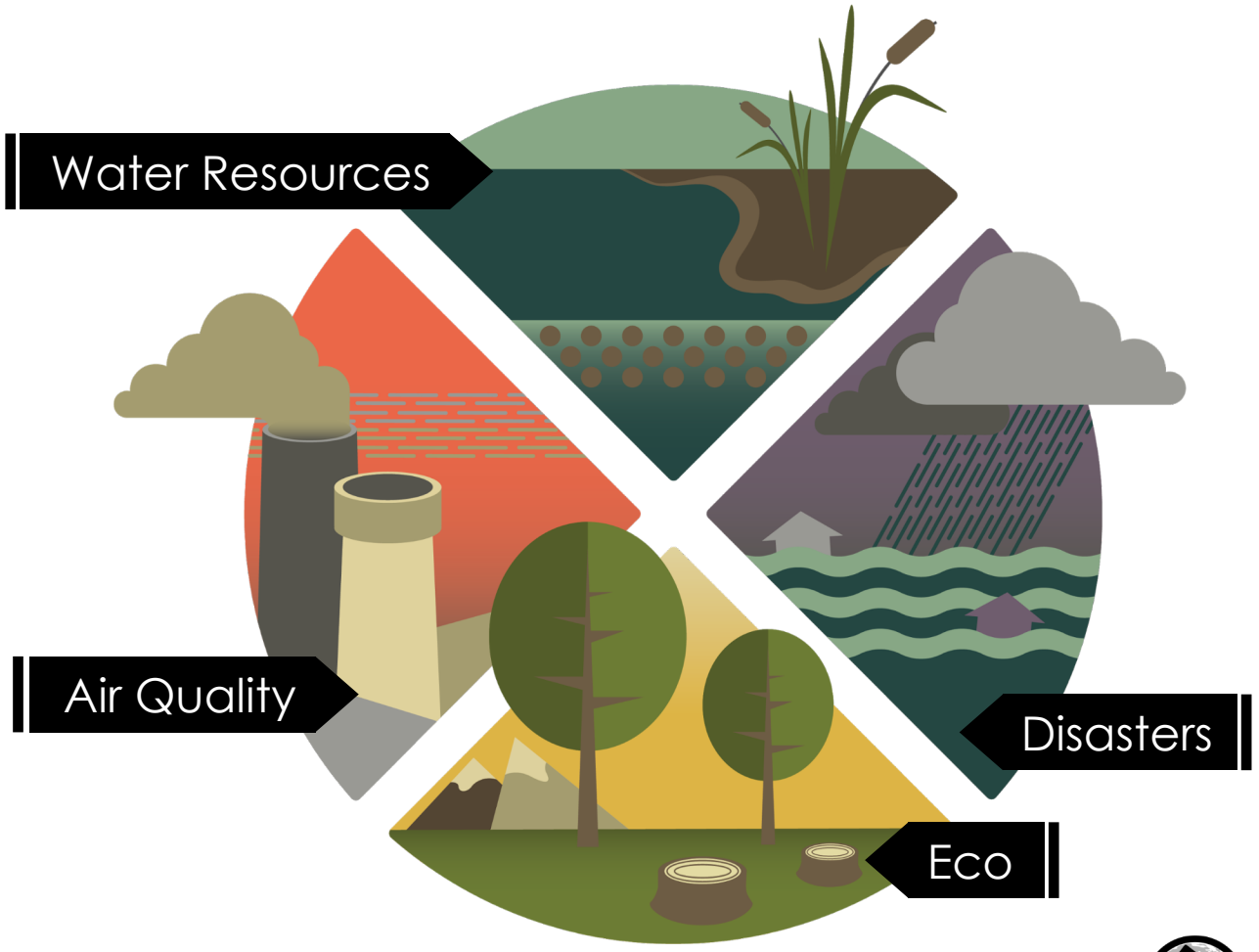
NASA's Applied Remote Sensing Training Program (ARSET)

http://arset.gsfc.nasa.gov/

- Part of NASA's Applied Sciences Capacity Building Program
- Empowering the global community through remote sensing training
- Our goal is to increase the use of Earth science in decision-making through training for:
  - policy makers
  - environmental managers
  - other professionals in the public and private sector

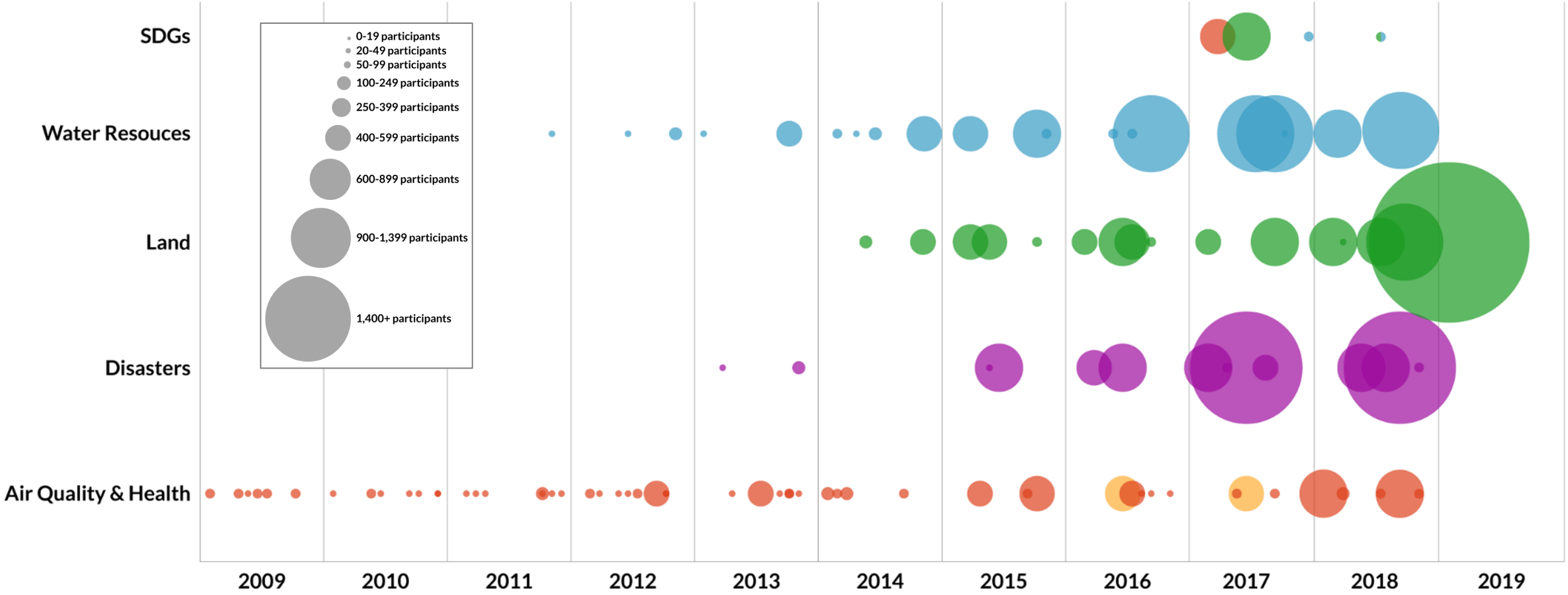
If you use the methods and data presented in ARSET trainings, please acknowledge the NASA Applied Remote Sensing Training (ARSET) Program.

Topics for trainings include:



ARSET Trainings

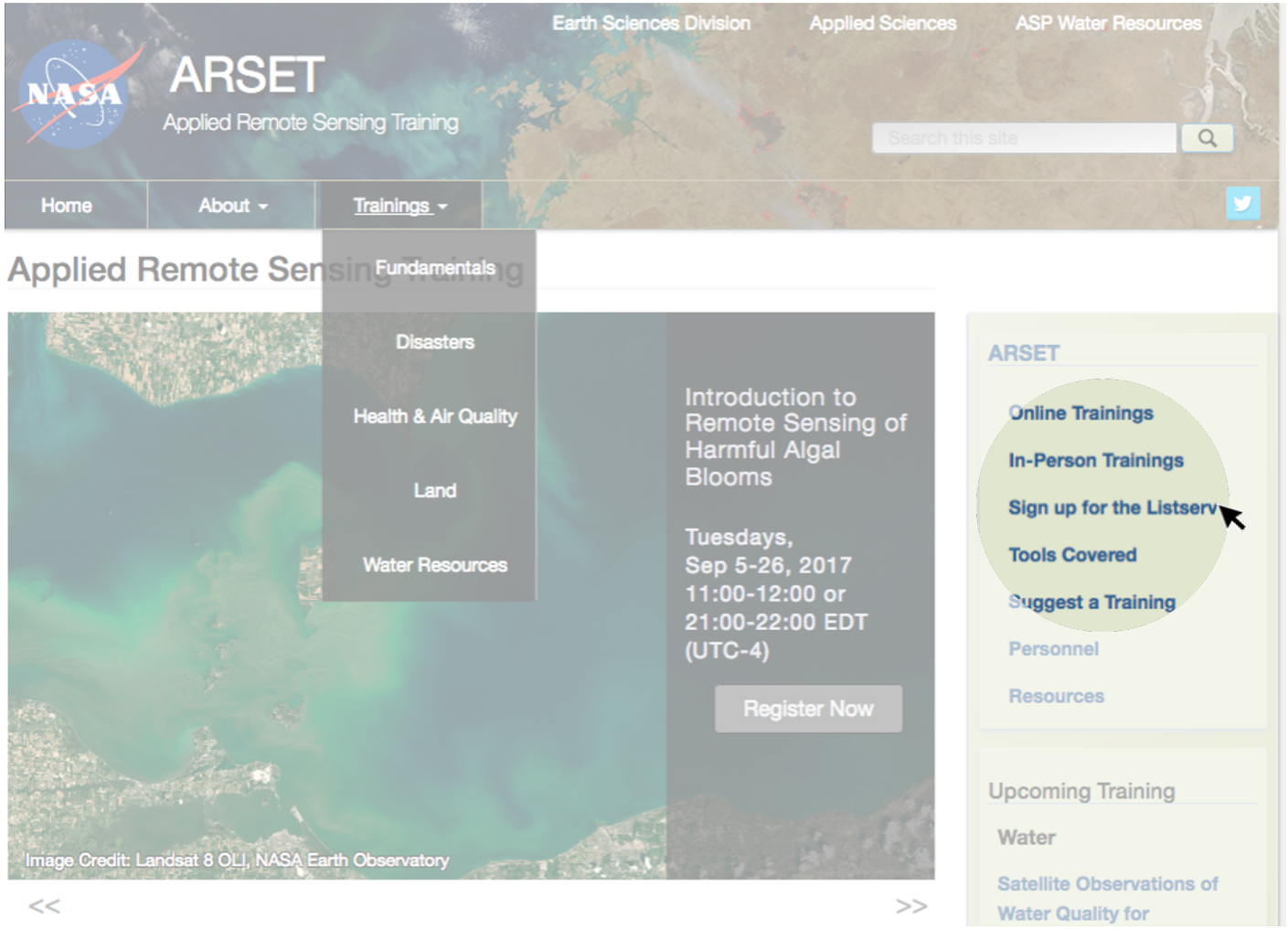
130+ trainings | 30,000+ participants | 165+ countries | 8,200+ organizations

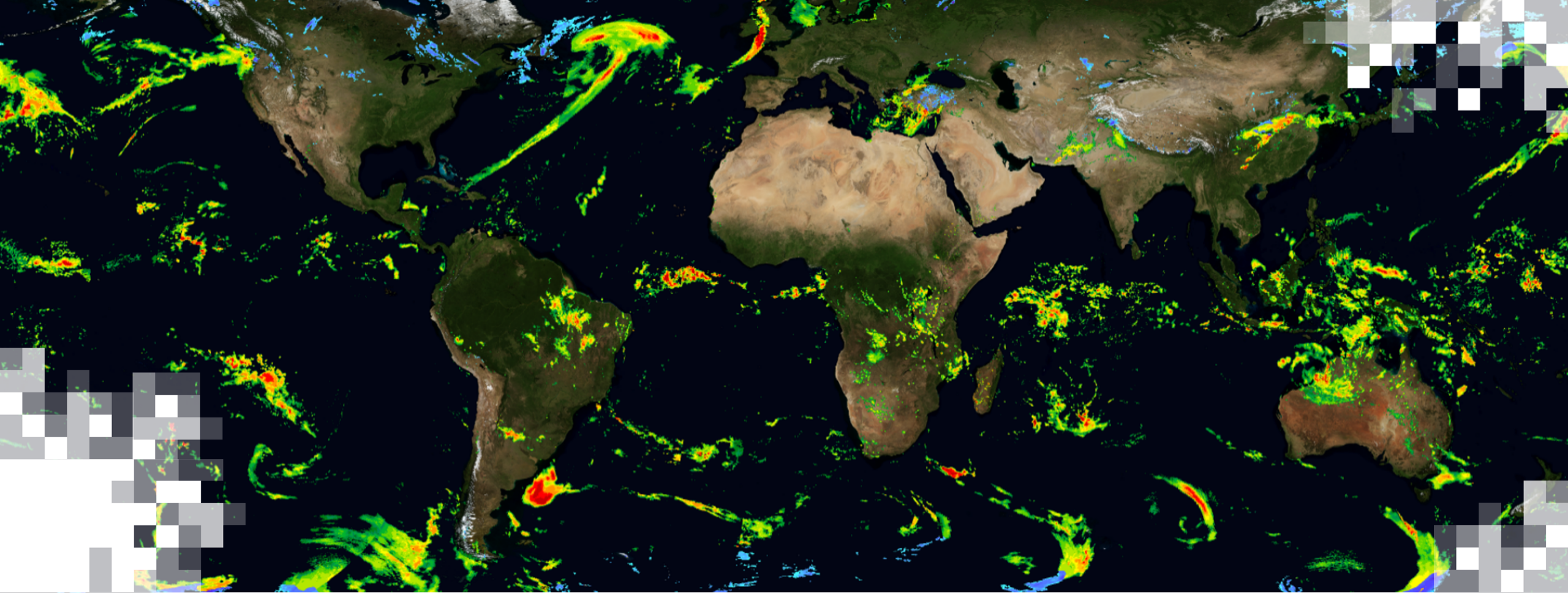


* Bubble size corresponds to number of attendees

Learn More About ARSET

http://arset.gsfc.nasa.gov/



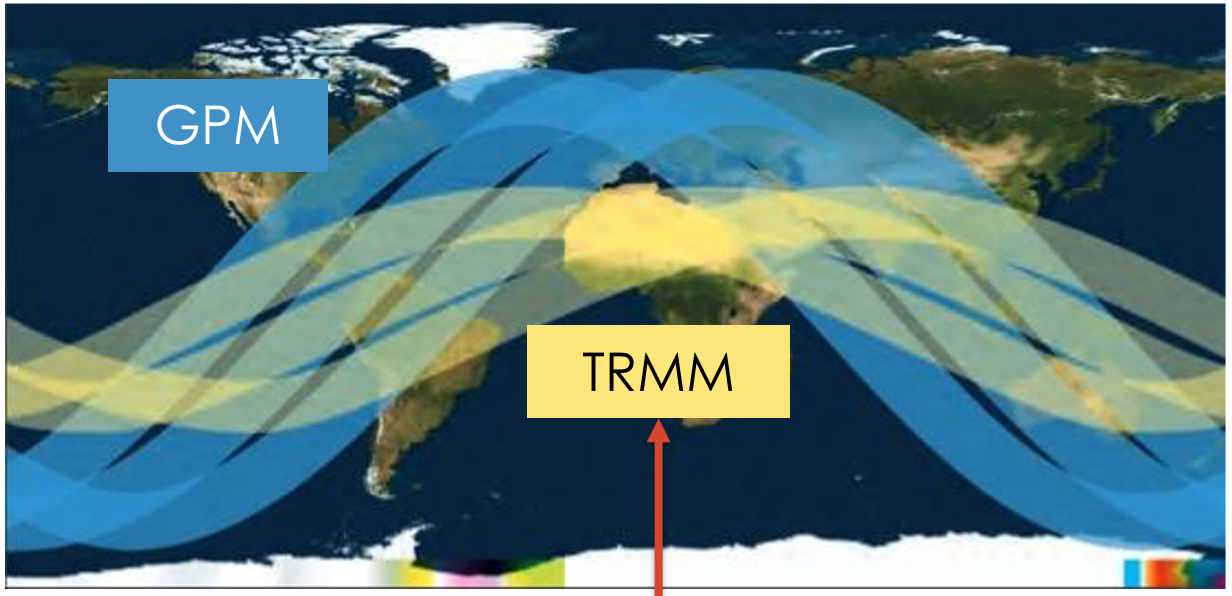


IMERG: Data and Access Information

Global Precipitation Measurement (GPM) Mission

http://pmm.nasa.gov/GPM/

- Core satellite launched Feb 27, 2014
  - Non-polar, low-inclination orbit
    - Altitude: 407 km
- Spatial Coverage:
  - 16 orbits a day, covering global area between 65°S – 65°N
- Along with a constellation of satellites, GPM has a revisit time of 2-4 hrs. over land
- Sensors:
  - GMI (GPM Microwave Imager)
  - DPR (Dual Precipitation Radar)

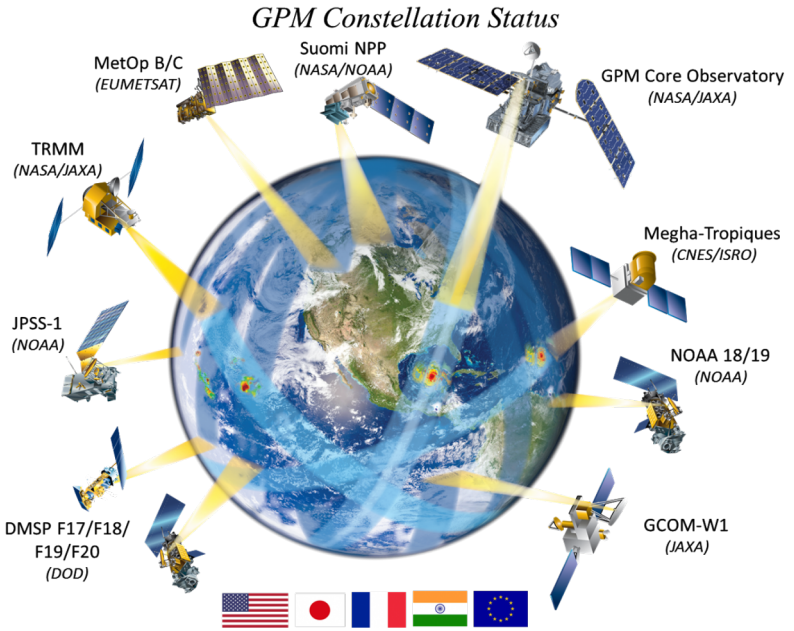


Tropical Rainfall Measurement Mission

IMERG Constellation

https://pmm.nasa.gov/sites/default/files/document_files/IMERG_ATBD_V4.6.pdf

- The current GPM constellation includes:
  - 5 polar-orbit passive microwave imagers
  - 5 polar-orbit passive microwave sounders



- Input precipitation estimates include:
  - GPM Profiling Algorithm (GPROF) [Passive Microwave]
  - Precipitation Retrievals and Profiling Scheme (PRPS) for Sondeur Atmosphérique du Profil d'Humidité Intertropicale par Radiométrie (SAPHIR)
  - Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks Cloud Classification Scheme (PERSIANN-CCS) [Geostationary Infrared]
  - Combined Radar-Radiometer Algorithm (CORRA) [combined Passive Microwave-Ku radar]
  - Global Precipitation Climatology Project - monthly satellite-gauge (PCP-SG)

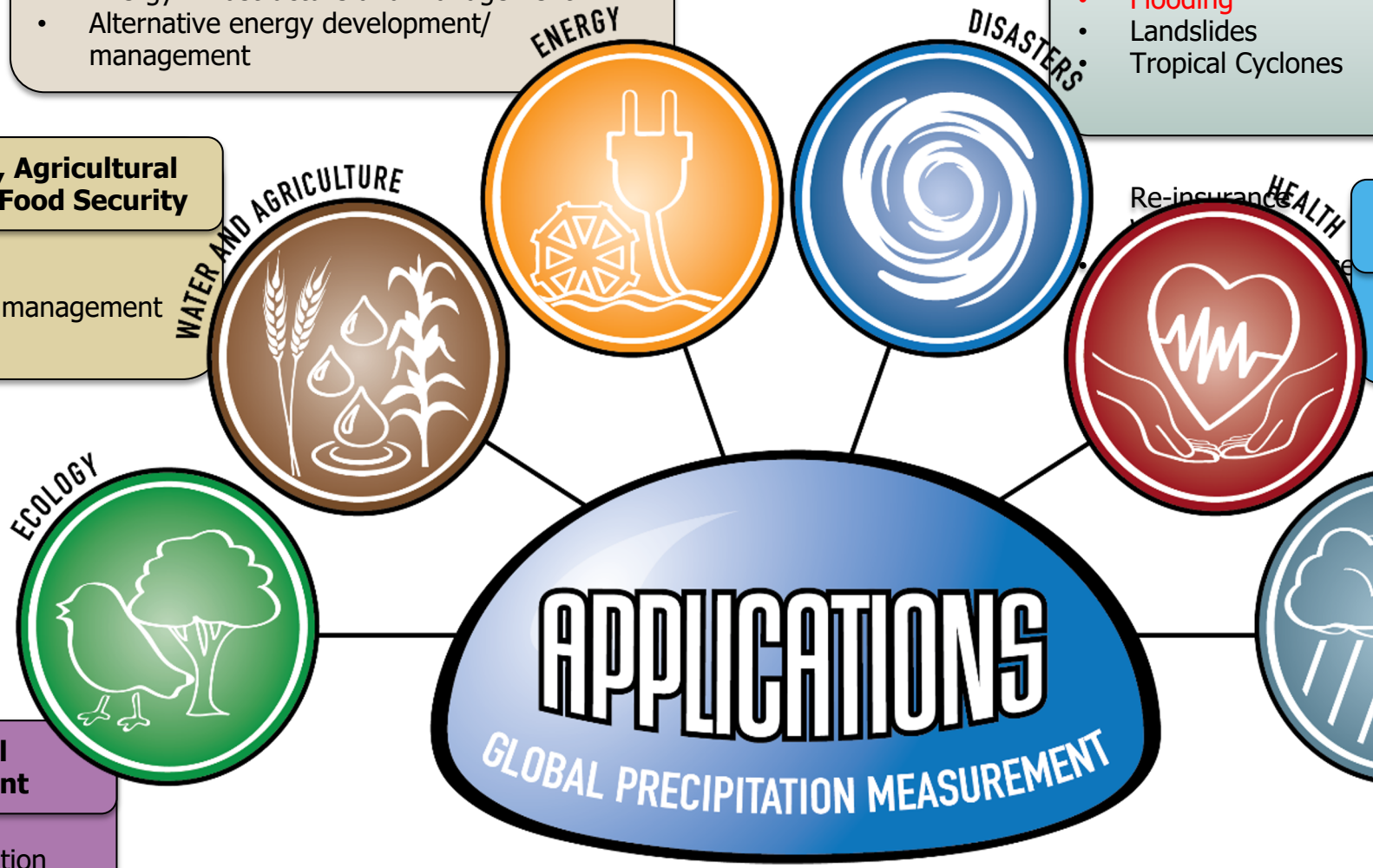
Based On: Huffman (https://www.youtube.com/watch?v=OyPUp7SuEy4&feature=youtu.be)

IMERG Version 06 Data

- IMERG is a single integrated code system for near-real and post-real time
- Multiple runs for different user requirements for latency and accuracy
  - "Early" – 4 hr. (flash flooding)
  - "Late" – 14 hr. (crop forecasting)
  - "Final" – 3 months (research)
- Time intervals are half-hourly and monthly (final only)
- 0.1° global grid
- Morphing of precipitation based on numerical models poleward of 60° N/S
- Overall calibration is provided by TRMM and GPM Combined Radar-Radiometer Algorithm. TRMM June 2000-May 2014, GPM thereafter.
- IMERG is adjusted to GPCP monthly climatology zonally to achieve a bias profile that is considered reasonable

Based On: Huffman (https://www.youtube.com/watch?v=OyPUp7SuEy4&feature=youtu.be)

IMERG Applications: Societal Benefit Areas



Energy Infrastructure and Management

- Energy infrastructure and management
- Alternative energy development/ management

Disasters and Risk Management

- Flooding
- Landslides
- Tropical Cyclones

Water resources, Agricultural Forecasting, and Food Security

- Drought
- Water resource management
- Food security

Development and Public Health

- Disease Tracking
- Transportation

Ecological Management

- Animal Migration
- Ecological Management and Sustainability

Weather, Climate, and Land Surface Modeling

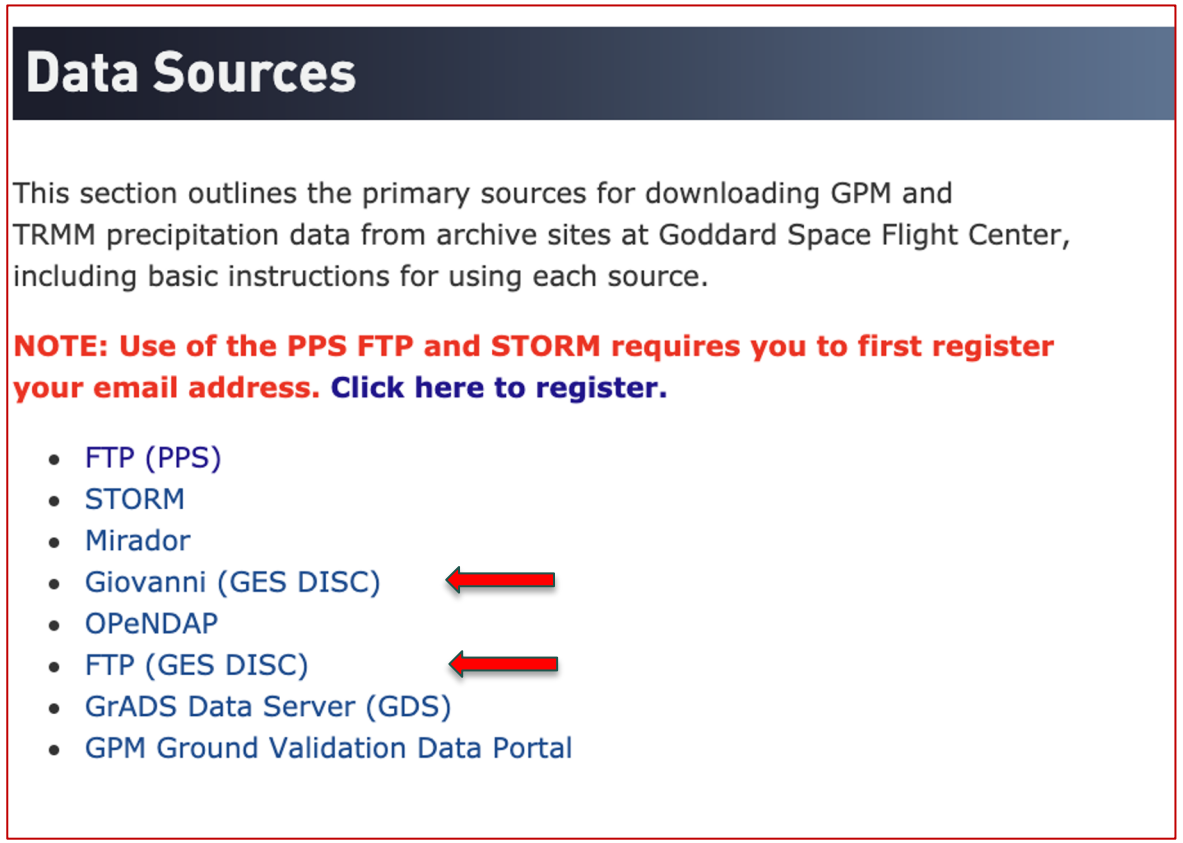
- Numerical Weather Prediction
- Climate variability and change
- Land Surface Modeling

Courtesy: Andrea Portier andrea.m.portier@nasa.gov

IMERG Data Access

https://pmm.nasa.gov/data-access

- Multiple Data Access sources for IMERG (https://pmm.nasa.gov/data-access/data-sources)



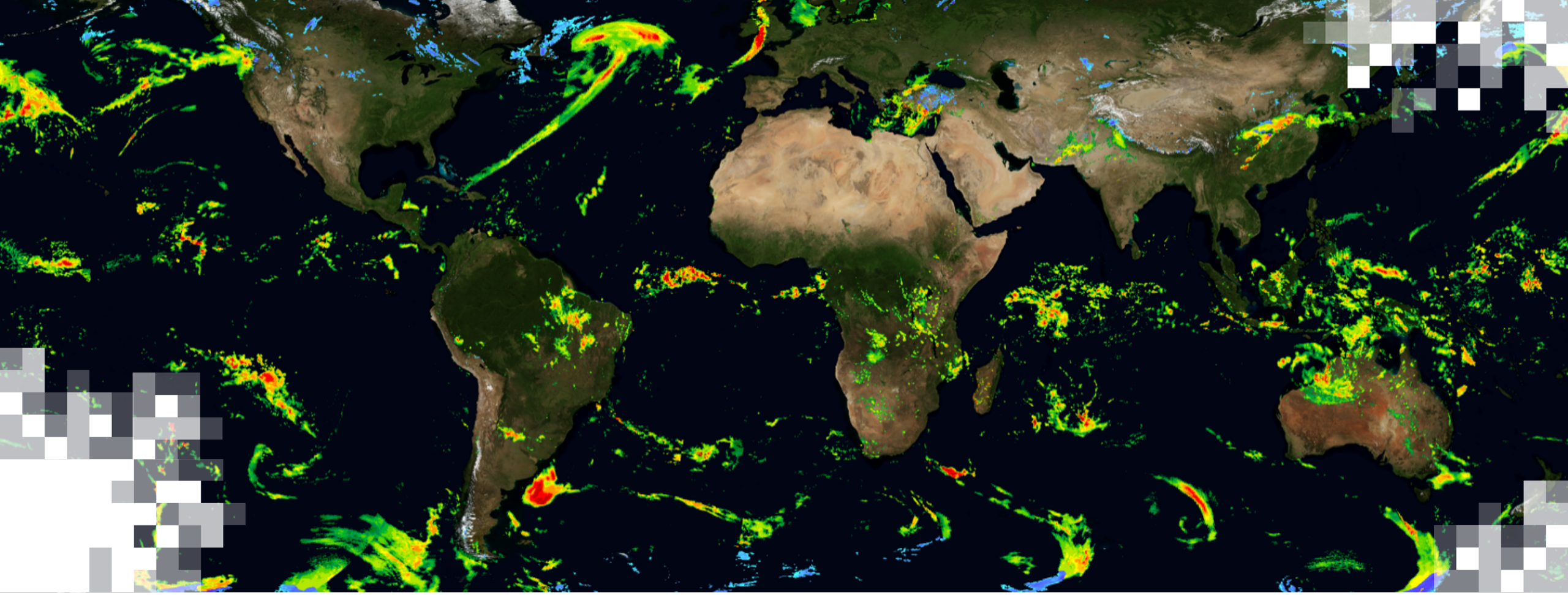
Data Sources

This section outlines the primary sources for downloading GPM and TRMM precipitation data from archive sites at Goddard Space Flight Center, including basic instructions for using each source.

NOTE: Use of the PPS FTP and STORM requires you to first register your email address. Click here to register.

- FTP (PPS)
- STORM
- Mirador
- Giovanni (GES DISC)
- OPeNDAP
- FTP (GES DISC)
- GrADS Data Server (GDS)
- GPM Ground Validation Data Portal

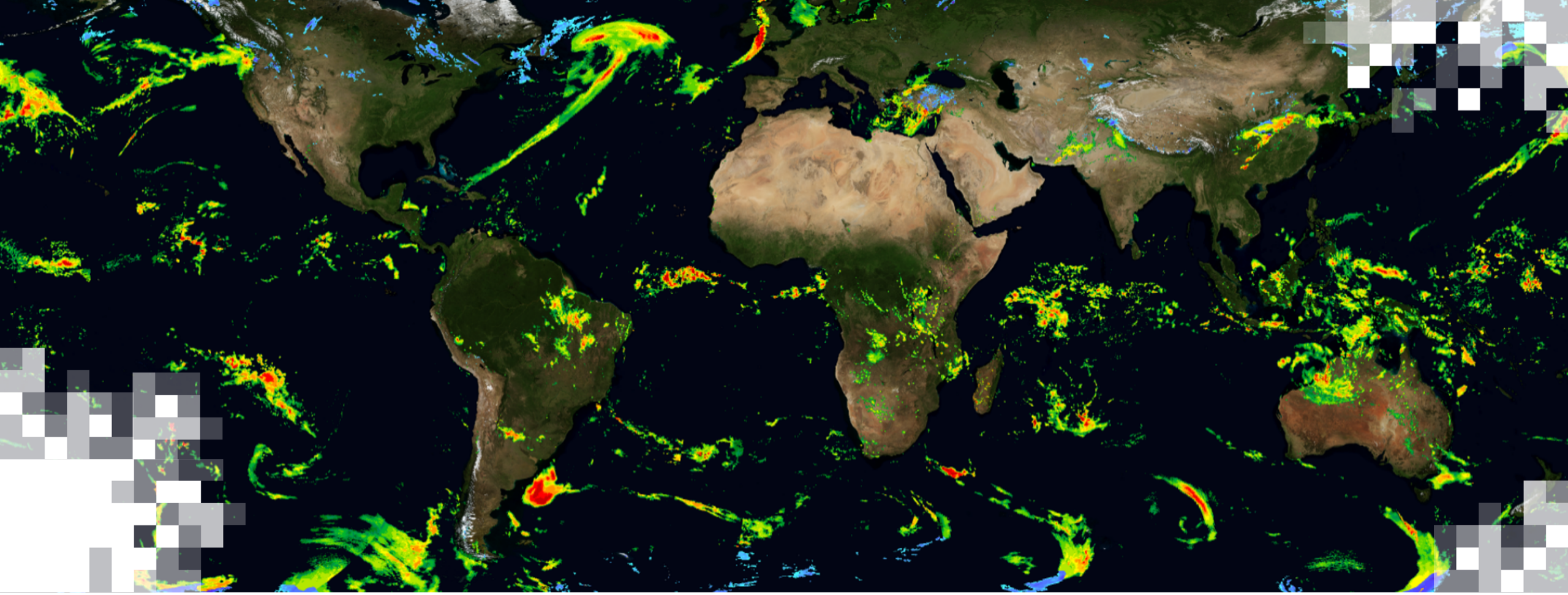
For detailed information and tutorials visit https://pmm.nasa.gov/training



Demonstration: **Calculation of Precipitation Statistics**
Case Study: Texas → Houston

IMERG Regional and Local Statistics

- Using Giovanni (https://giovanni.gsfc.nasa.gov/giovanni/)
  - Calculate and download long-term mean precipitation maps for Texas
  - Calculate area-averaged, monthly precipitation time series for Houston
- Using QGIS
  - Calculate precipitation anomaly maps to detect dry and wet areas
- Using Excel
  - Calculate mean, standard deviation, anomalies, and percentile precipitation value for Houston



Exercise: **Calculation of Precipitation Statistics**

Case Study: Mozambique → Maputo

Next Week

- Background and Calculation of Standardized Precipitation Index (SPI) using Python
- Before next week:
  - Register on NASA Earthdata
    - https://earthdata.nasa.gov/
  - Install QGIS version 3.x
    - https://qgis.org/en/site/
  - Install Panoply
    - https://www.giss.nasa.gov/tools/panoply/
  - Install Anaconda Python version 3.7
    - https://www.anaconda.com/
  - ***Windows users only***, install Git Bash
    - https://gitforwindows.org/

Contact information

Amita Mehta: amita.v.mehta@nasa.gov

Sean McCartney: sean.mccartney@nasa.gov

Thank You!