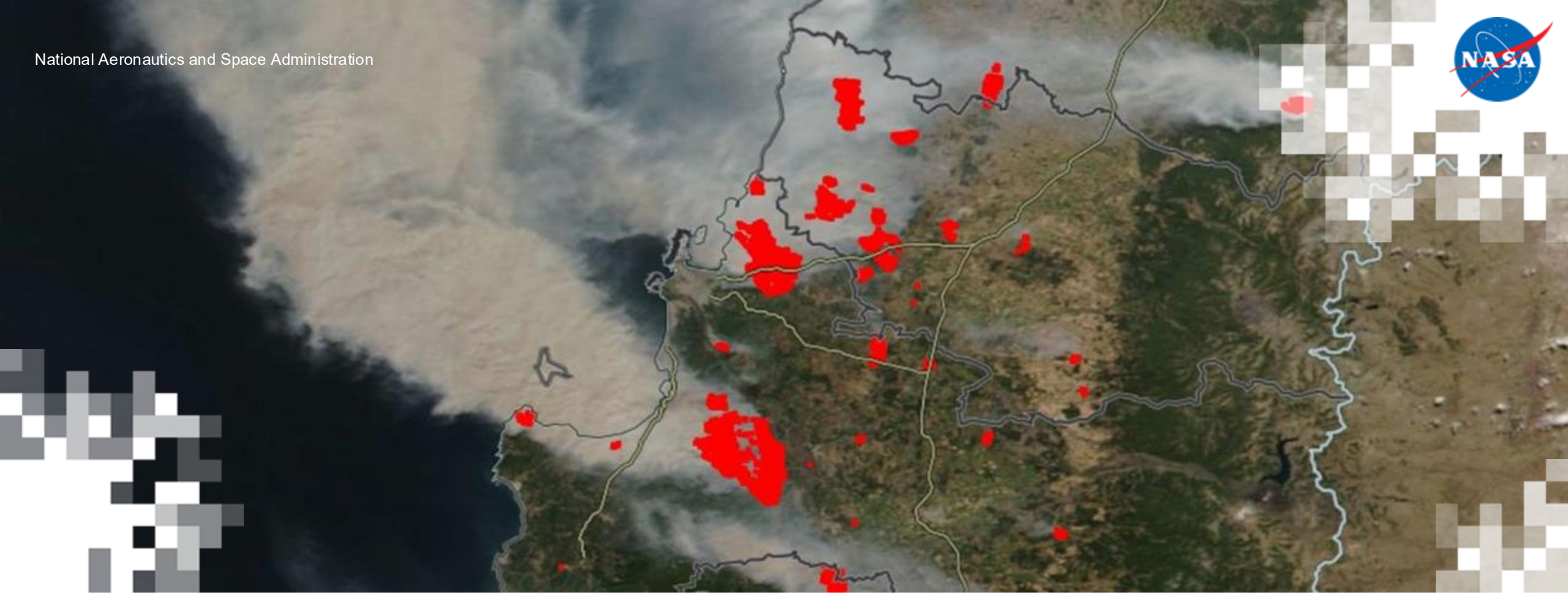
National Aeronautics and Space Administration



Introduction to NASA Earth Observations and Tools for Wildfire Monitoring and Management

Part 2: Wildfire Monitoring and Evaluation Using FIRMS

Brad Quayle (USDA USFS), Jenny Hewson (SSAI), Diane Davies (SSAI/Trigg-Davies Consulting Ltd.), & Melanie Follette-Cook (NASA GSFC)

April 23, 2025

Training Outline

Part 1

Introduction to Satellite-Based Active Fire Detection using FIRMS

April 16, 2025

Part 2

Wildfire Monitoring and Evaluation

April 23, 2025

Part 3

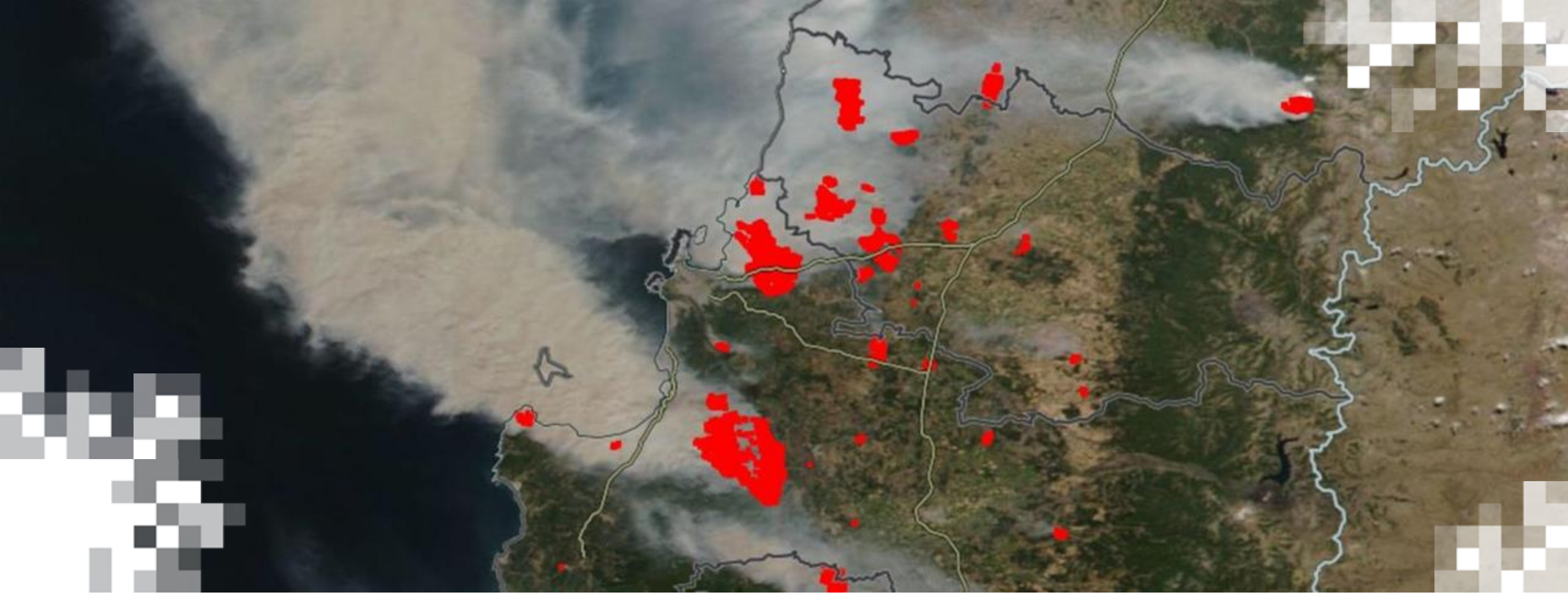
Data Access and Visualization

April 30, 2025

Homework

Opens April 30– Due May 14– Posted on Training Webpage

A certificate of completion will be awarded to those who attend all live sessions and complete the homework assignment(s) before the given due date.



Introduction to NASA Earth Observations and Tools for Wildfire Monitoring and Management

Part 2: Wildfire Monitoring and Evaluation Using FIRMS

Part 2 – Trainers

Jenny Hewson

Lance Outreach & Implementation Manager
SSAI

Brad Quayle

Disturbance Assessment and Services Program
USDA USFS

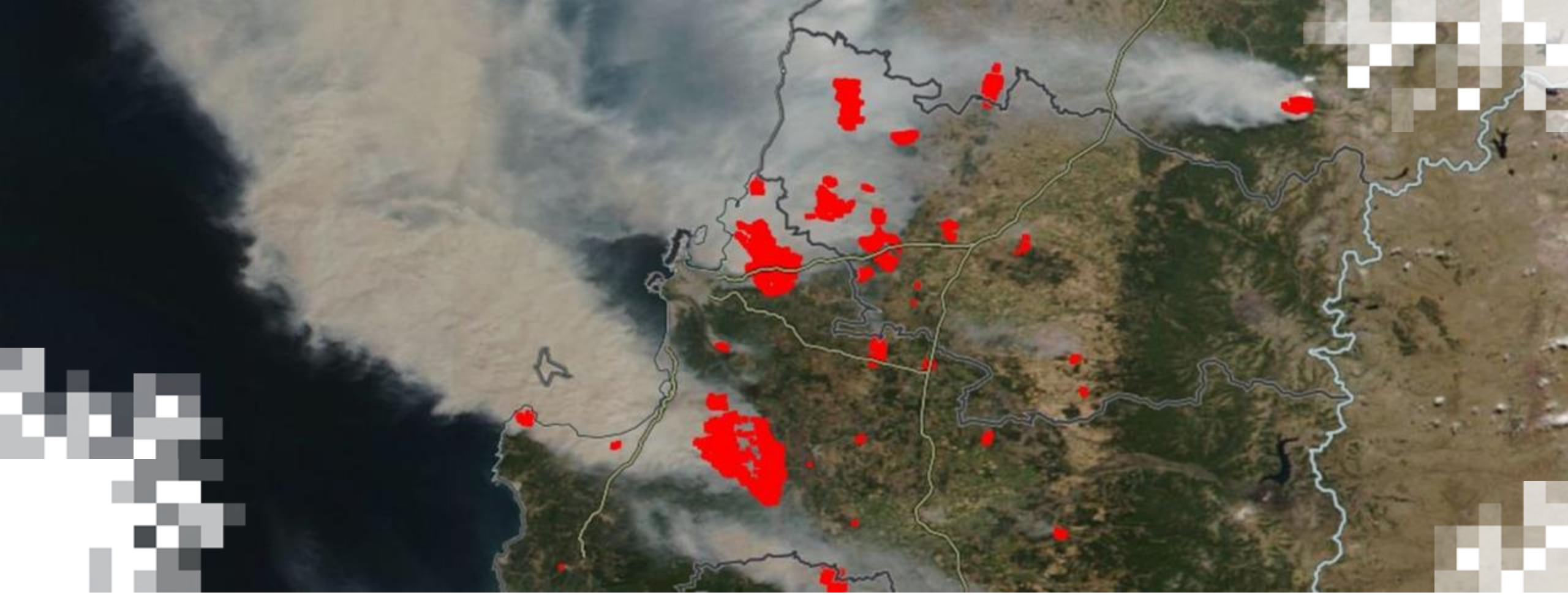
Part 2 Objectives

By the end of Part 2, participants will be able to:

- Identify the latencies of different sources of active fire information available in FIRMS
- Use FIRMS to monitor the evolution and growth of wildfires
- Identify factors that can impact wildfire detection

How to Ask Questions

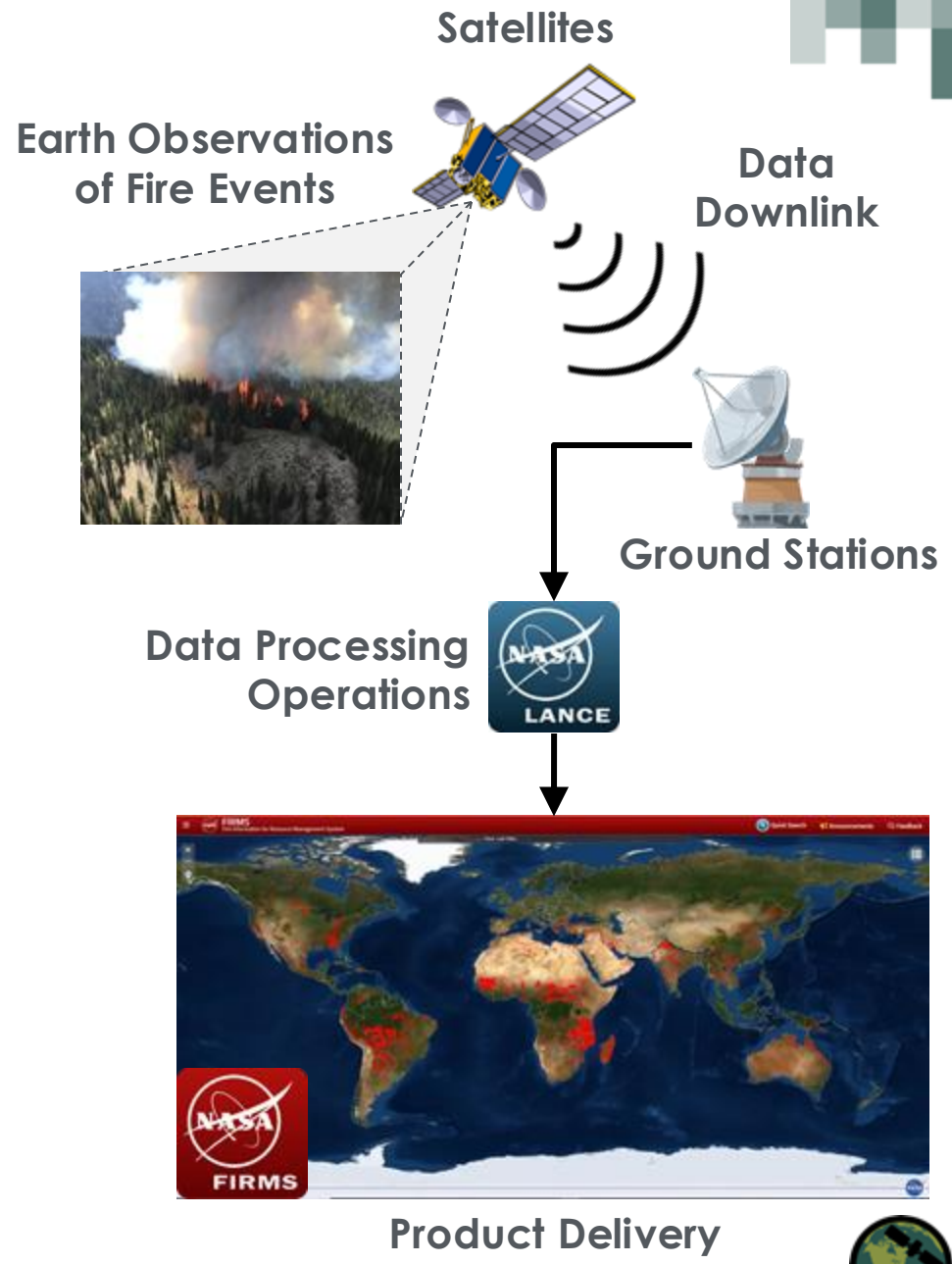
- Please put your questions in the Questions box and we will address them at the end of the webinar.
- Feel free to enter your questions as we go. We will try to get to all of the questions during the Q&A session after the webinar.
- The remainder of the questions will be answered in the Q&A document, which will be posted to the training website about a week after the training.



Data Latency

Data Latency and Fire Management

- **Latency** – Total time elapsed between satellite observation and when the data are made available
- Wildfire events are highly dynamic and can change rapidly based on weather, fuel conditions, terrain, etc.
- Value of remote sensing observations/data is inversely related to latency
  - Delivery is desired at or immediately after the time of observation
  - Increases situational awareness and enables decision support functions



Data Latency Terminology/Classification

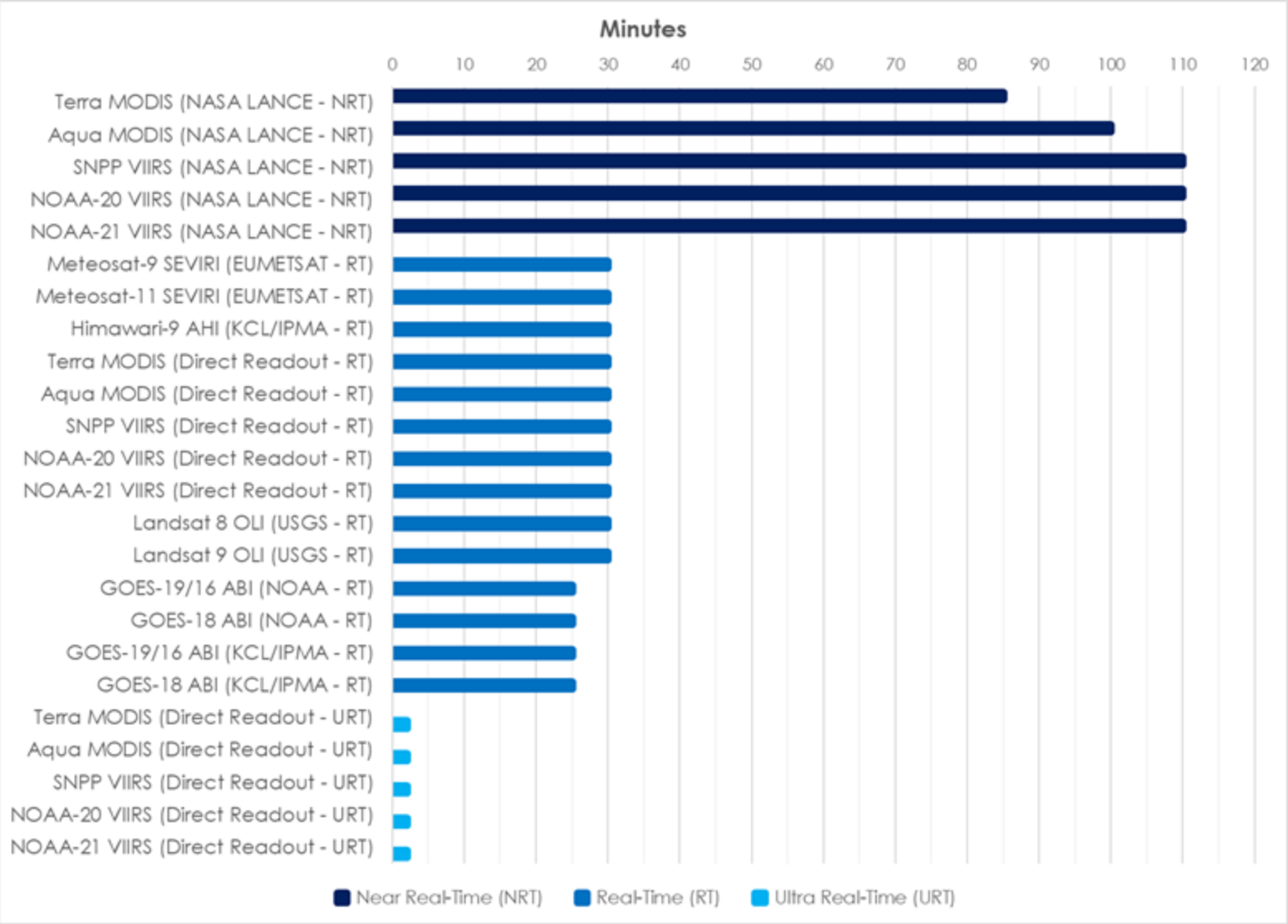
- Products provided by FIRMS are classified by latency – NRT, RT, or URT.
- Several factors affect the speed at which data are processed and made available.

NASA Data Latency Terminology	
Term	**Latency**
Ultra Real-Time (URT)	Less than 5 minutes
Real-Time (RT)	Less than 1 hour
Near Real-Time (NRT)	1-3 hours
Low Latency	3-24 hours
Expedited	1-4 days
Standard Routine Processing	Generally, 8–40 hours, but up to 2 months for some higher-level products

https://www.earthdata.nasa.gov/learn/backgrounders/data-latency

Active Fire Detection Data Latency in FIRMS

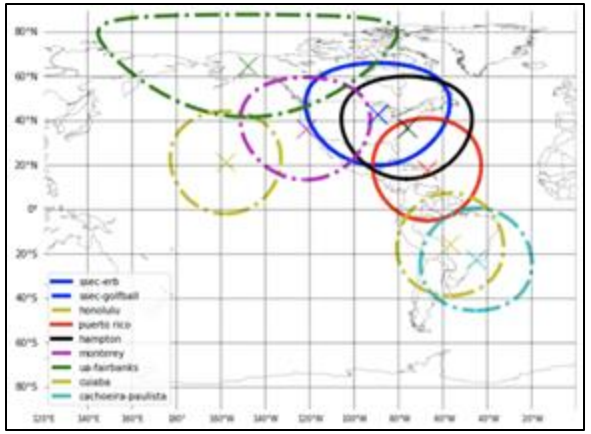
From satellite acquisition to FIRMS…



Ultra Real-Time (URT) MODIS and VIIRS Active Fire Data in FIRMS

URT MODIS and VIIRS data is posted in FIRMS within a few minutes of satellite observation

- 5-10 second "micro granules" from each ground station are streamed to University of Wisconsin-SSEC and merged
- URT data generated using NASA algorithms
- URT data eventually replaced by NASA LANCE NRT data in FIRMS



Network of MODIS/VIIRS X-Band Ground Stations

L2 URT Active Fire Data for North America (~2-Minute Latency)

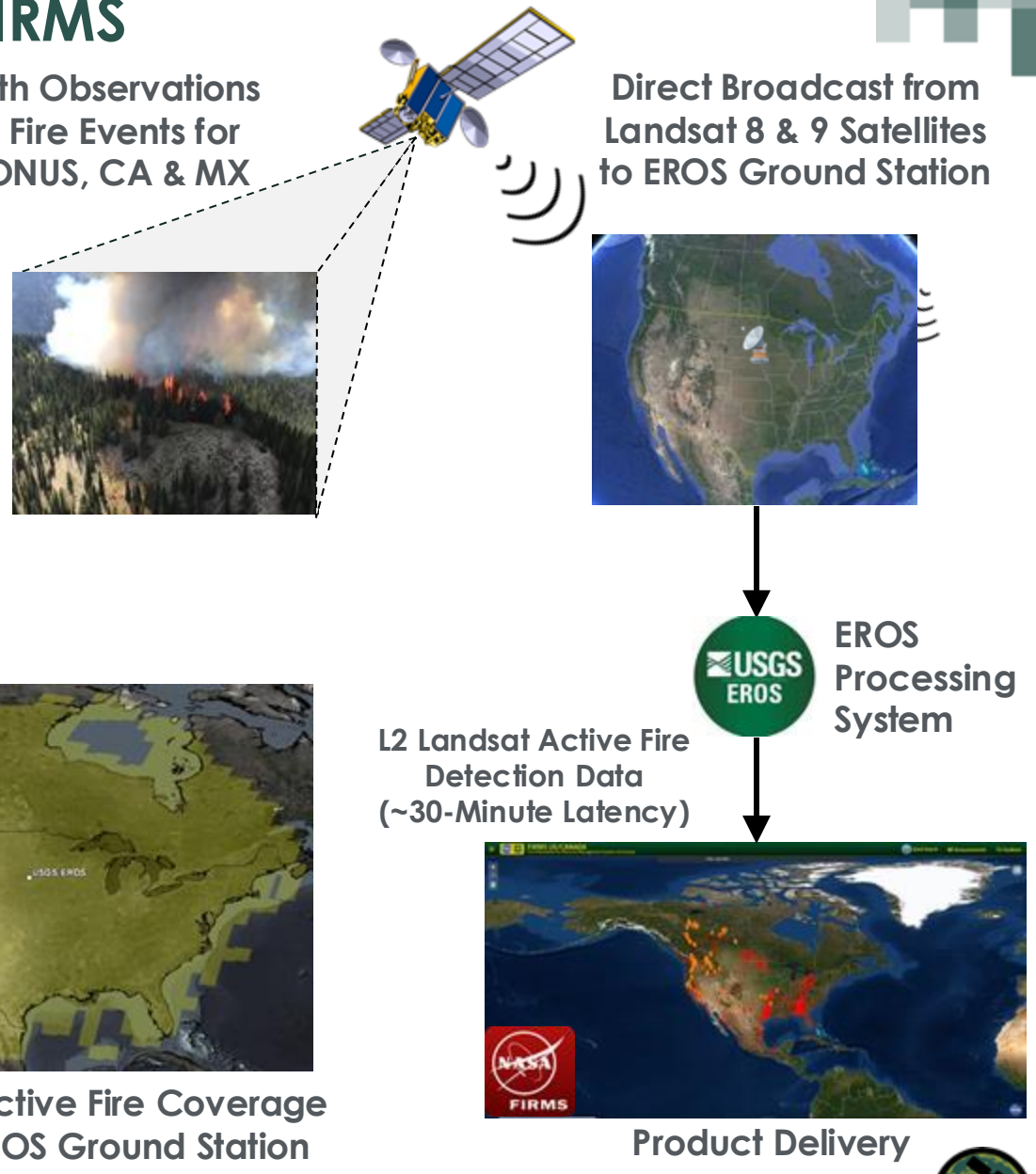
SSEC Processing

Product Delivery

Real-Time (RT) Landsat Active Fire Data in FIRMS

30m active fire data posted in FIRMS within 30 minutes of satellite observation

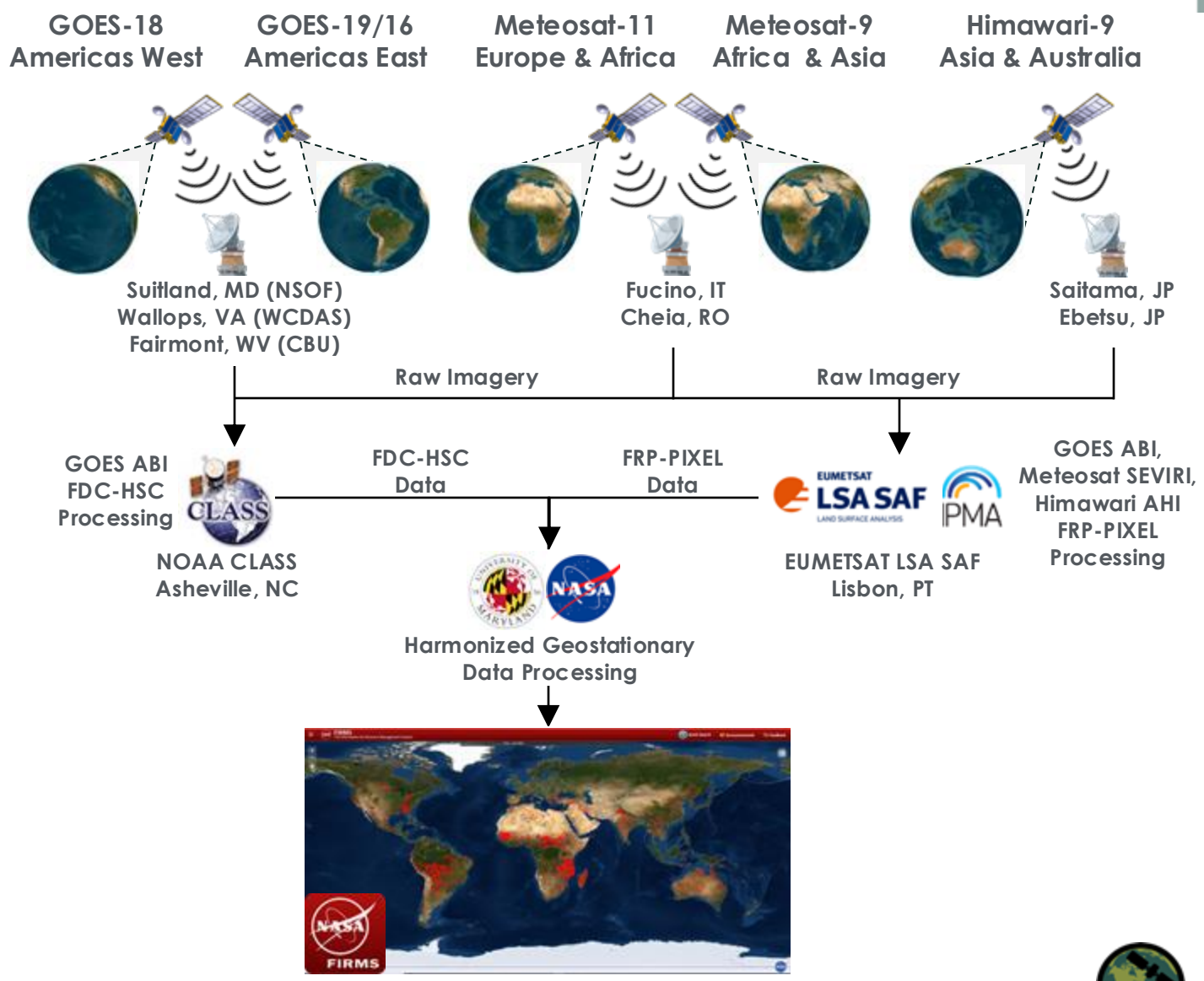
- Data generated using NASA/University of Maryland algorithm
- Active fire data exclusively available to NASA FIRMS and Forest Service

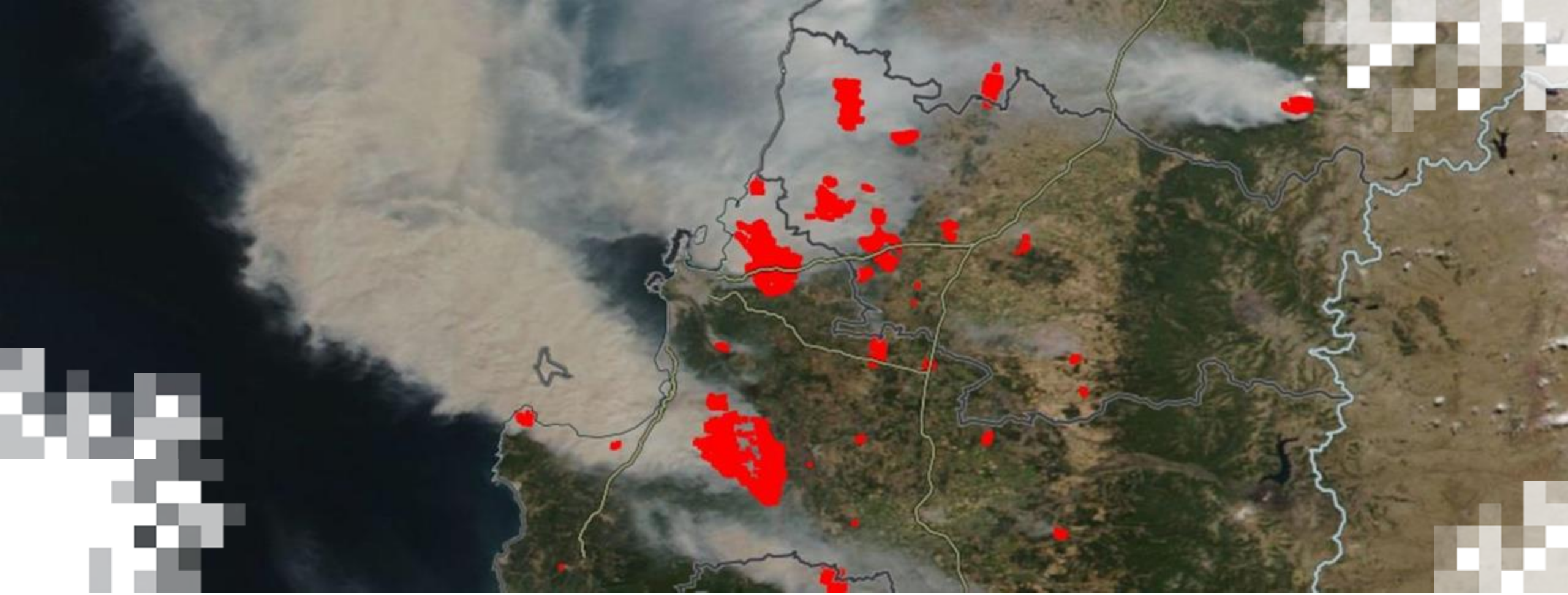


Real-Time (RT) Geostationary Active Fire Data in FIRMS

Active fire data available in FIRMS within 30 minutes of satellite observation

- Geostationary satellite observations every 10-15 minutes
- NOAA, EUMETSAT and IPMA generate active fire detection data
  - FDC-HSC Product
  - FRP-PIXEL Product
- Harmonized global data provided by NASA/UMD





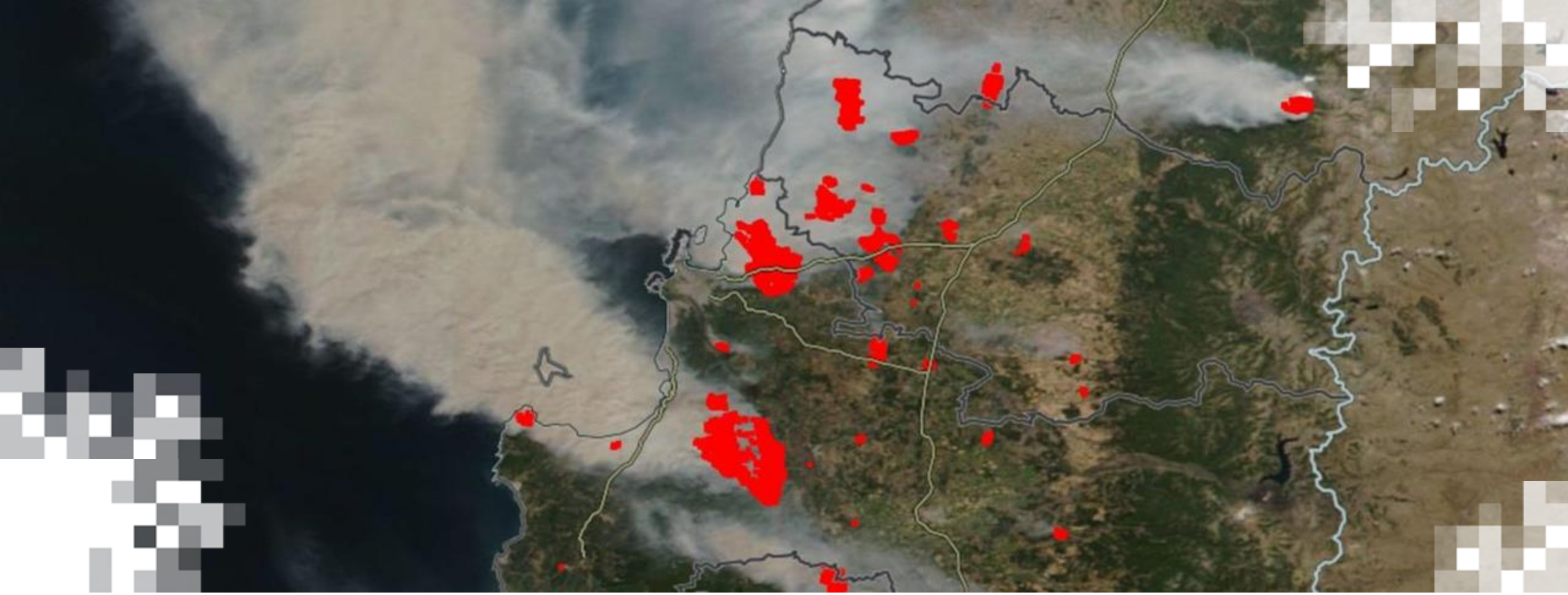
Demo

Monitoring Wildfires

Monitoring Wildfires

Demo Outline

- Use and sources of data of different latency
- Identifying time/location of fire ignitions
- Tools to visualize and track fires over time
- Identifying areas that have burned



Identifying Factors that can Impact Wildfire Detection

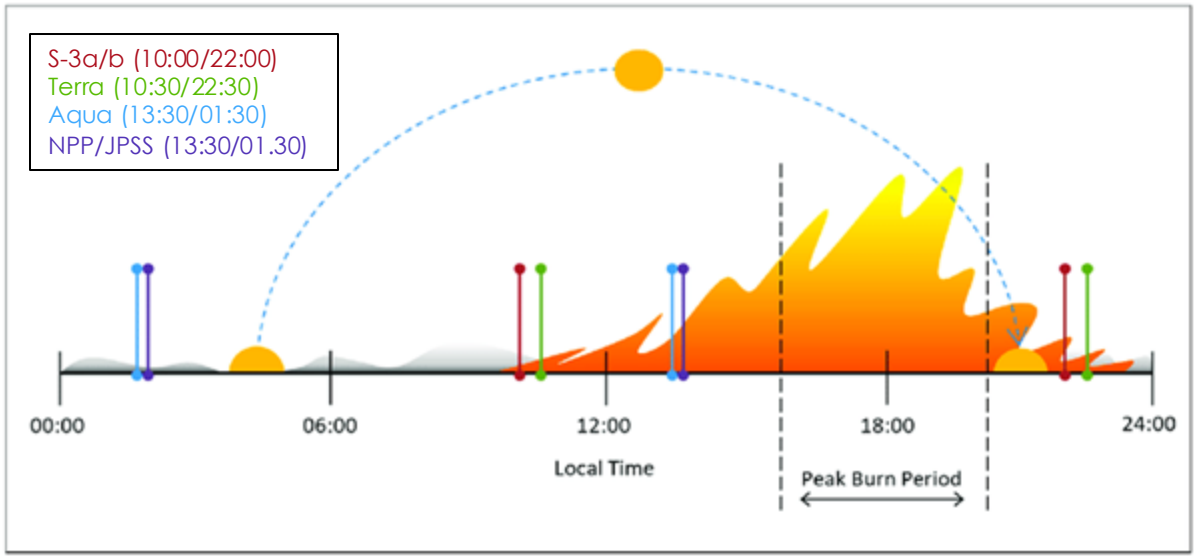
Factors Affecting Satellite Ability to Detect/Monitor Fire Activity

- Sensor Spatial Resolution
- Fire Size/Intensity
  - MODIS (1000m)
    - ~1,000m^2 smoldering to flaming fires in good conditions (day)
    - ~100m^2 flaming fire in good conditions (day)
  - VIIRS I-Band (375m)
    - ~100m^2 smoldering to flaming fires in good conditions (day)
    - ~20m^2 flaming fire in good conditions (day)
    - ~2m^2 flaming fire in good conditions (night)
  - Landsat OLI (30m)
    - ~10-20m^2 smoldering to flaming fires in good conditions (day)
    - ~4m^2 flaming fire in good conditions (day)
    - ~1m^2 flaming fire in good conditions (night)
- Algorithms (Typically Global in Scope; Not Calibrated for Regional Conditions)
- Fire Location on the Swath/Field of View (View Angle)

Factors Affecting Satellite Ability to Detect/Monitor Fire Activity

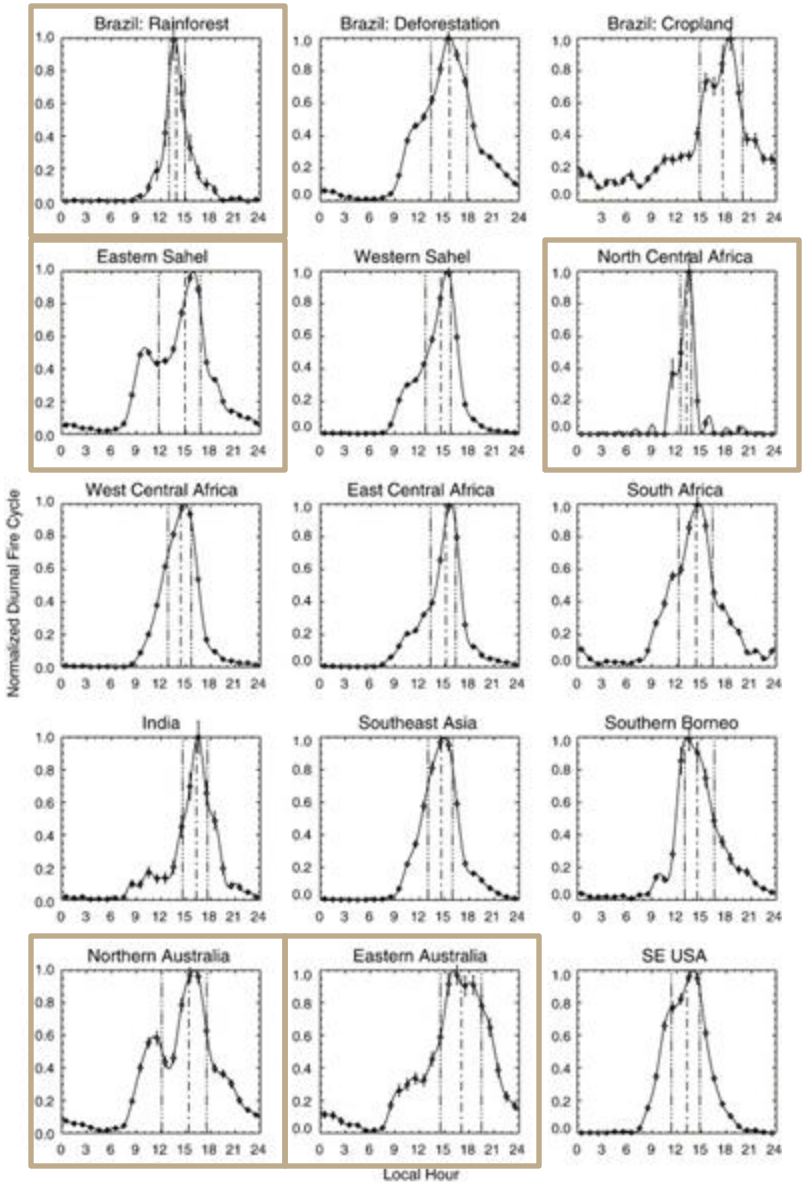
- Sensor Temporal Resolution
- Sensor Overpass Time

Diurnal Wildfire Activity Cycle



Credit: Johnson et al., 2020
https://doi.org/10.3390/s20185081

Diurnal Fire Cycle: Tropics & Sub-Tropics

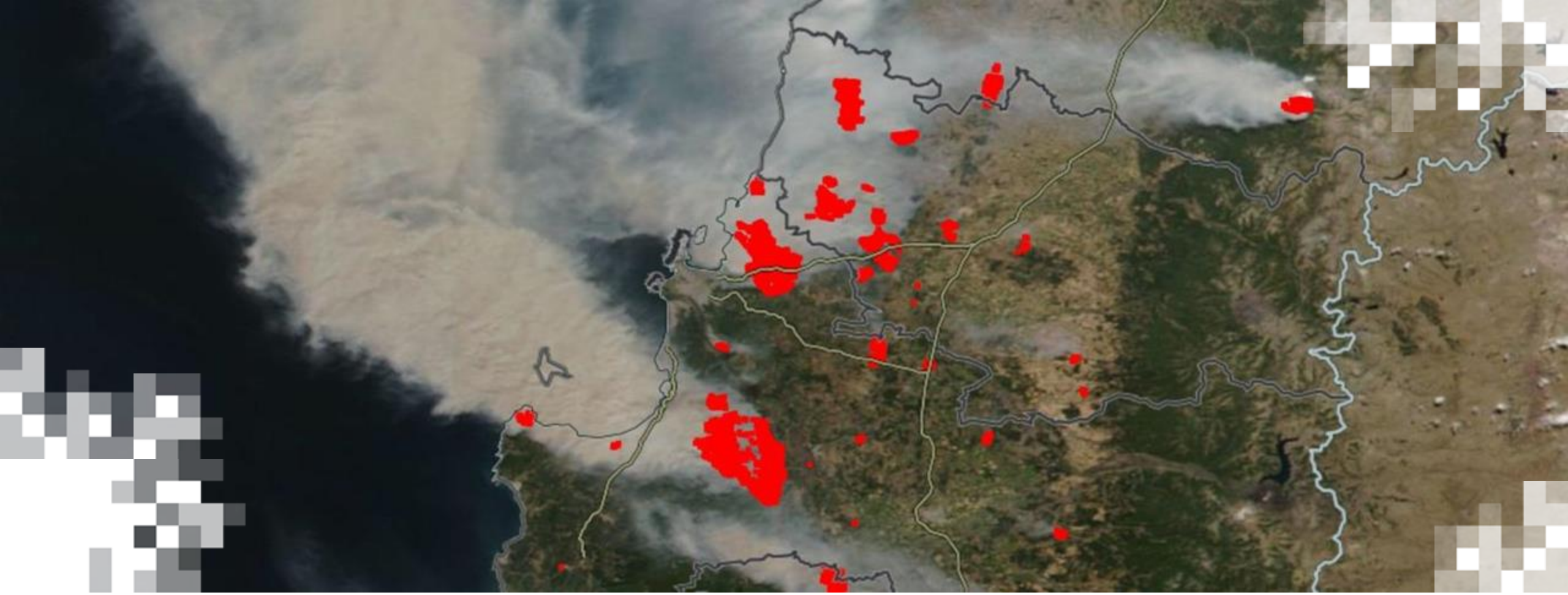


Credit: Giglio, 2007:
https://doi.org/10.1016/j.rse.2006.11.018

Factors Affecting Satellite Ability to Detect/Monitor Fire Activity

- Atmospheric Obscurations
  - Cloud Cover
  - Dense Smoke
  - Fog

- Biophysical Setting
  - Forest Canopy
  - Less Forested Areas
  - Terrain



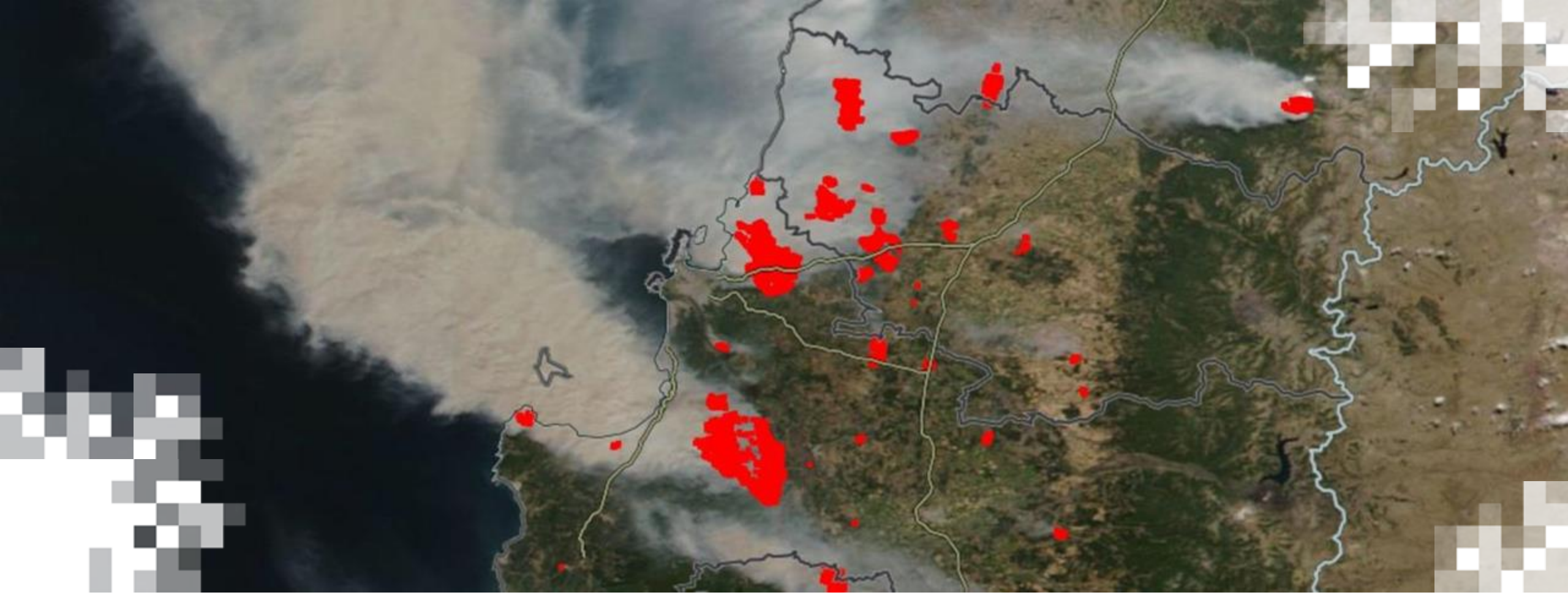
Demo

Identifying Factors that can Impact Wildfire Detection

Identifying Factors That Can Impact Wildfire Detection

Demo Outline

- Examples of biophysical and atmospheric effects on active fire detection:
  - Clouds
  - Fog
  - Smoke Terrain/Sensor Geometry
- Techniques and tools available to mitigate these factors:
  - Nighttime Products
  - *Day-Of* and Planning Satellite Overpass Tools



Part 2:

Summary

Summary

- Data Latency – time between observation and when the data are available
  - Low latency observations are important for time-sensitive decisions
  - Data in FIRMS is available in a range of latencies depending on characteristics like resolution processing requirements
  - Active fire detections are available with URT, RT, and NRT latencies, depending on the sensor
- Demo - identify and time and locations of fire ignitions, monitor and track fires over time, identify areas that have been burned
- Factors that can impact wildfire detection
  - Sensor spatial resolution, view angle, diurnal cycle of fire activity, atmospheric and biophysical factors (e.g., clouds, smoke, fog, dense forest canopy, terrain)
- Demo – Use FIRMS to examine factors that can impact detection (true and false color imagery, observations at different times of day, topographic layer), and mitigate impact (nighttime observations, future observations)

Looking Ahead to Part 3

- Explore Web Services available through FIRMS
- Options for ingesting active fire data and information into a GIS platform

Homework and Certificates

- **Homework:**
  - One homework assignment
  - Opens on 04/30/2025
  - Access from the training webpage
  - Answers must be submitted via Google Forms
  - **Due by 05/14/2025**

- **Certificate of Completion:**
  - Attend all three live webinars (attendance is recorded automatically)
  - Complete the homework assignment by the deadline
  - You will receive a certificate via email approximately two months after completion of the course.

Contact Information

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Resources

- FIRMS Adds Ultra Real-Time Data from MODIS and VIIRS
- Ultra Low Latency MODIS and VIIRS Data for FIRMS US/Canada – And Beyond
- Landsat Fire and Thermal Anomaly Data Added to FIRMS
- Active Fire Detection using Landsat-8/OLI Data
- GOES ABI Fire/Hotspot Characterization Product
- EUMETSAT FRP-PIXEL Product
- Validation of GOES-16 ABI and MSG SEVIRI Active Fire Products
- Geostationary Satellite Ground Segment Information
  - GOES
  - Meteosat
  - Himawari
- Diurnal Wildfire Activity Cycle
- Diurnal Wildfire Activity Cycle – Tropics and Subtropics
- OB.DAAC Overpass Prediction Tool


APPLIED REMOTE SENSING TRAINING PROGRAM
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Thank You!