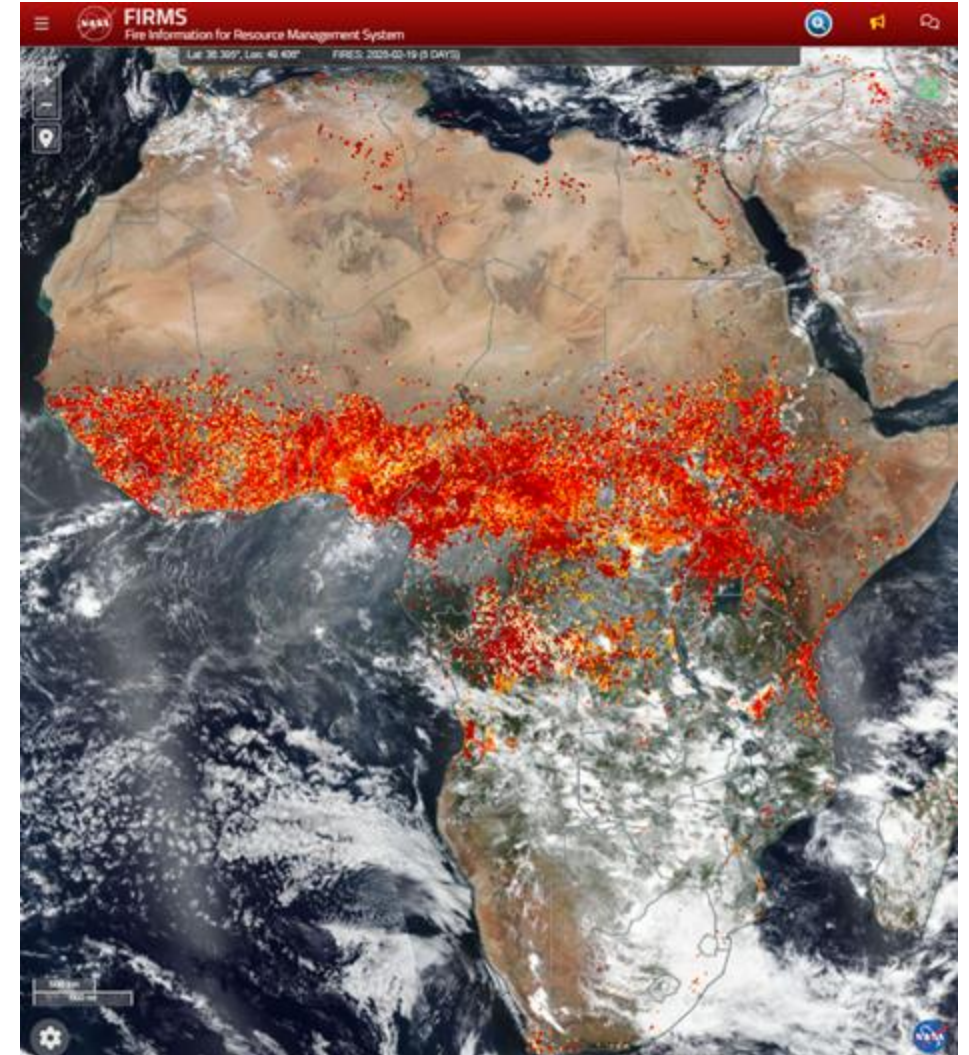




Fire Information for Resource Management System (FIRMS)

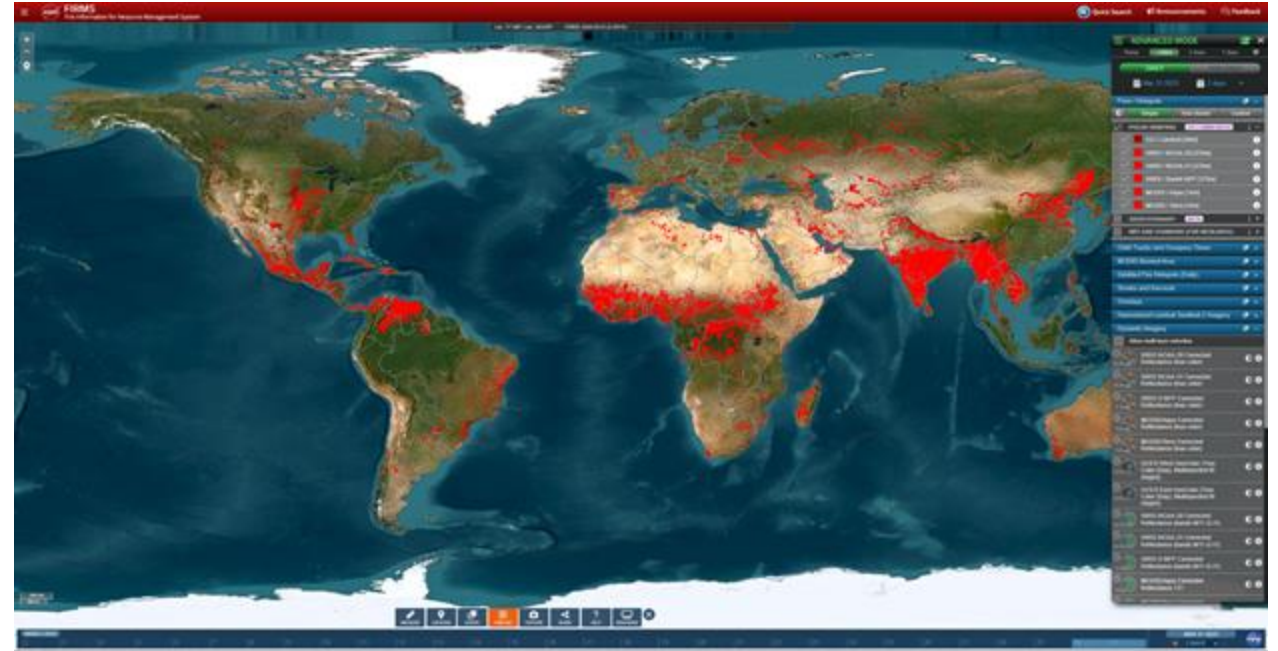
Fire Information for Resource Management System (FIRMS)

- [FIRMS Website](#)
- Provides multiple sources of time sensitive derived active fire detection data products and satellite imagery.
- Objectives:
 - Provide global, low-latency satellite imagery and active fire products from multiple missions.
 - Monitor fire location, extent, intensity, environmental effects, and support emergency response.
 - Support science-based decisions through standardized interfaces for operational users and researchers.



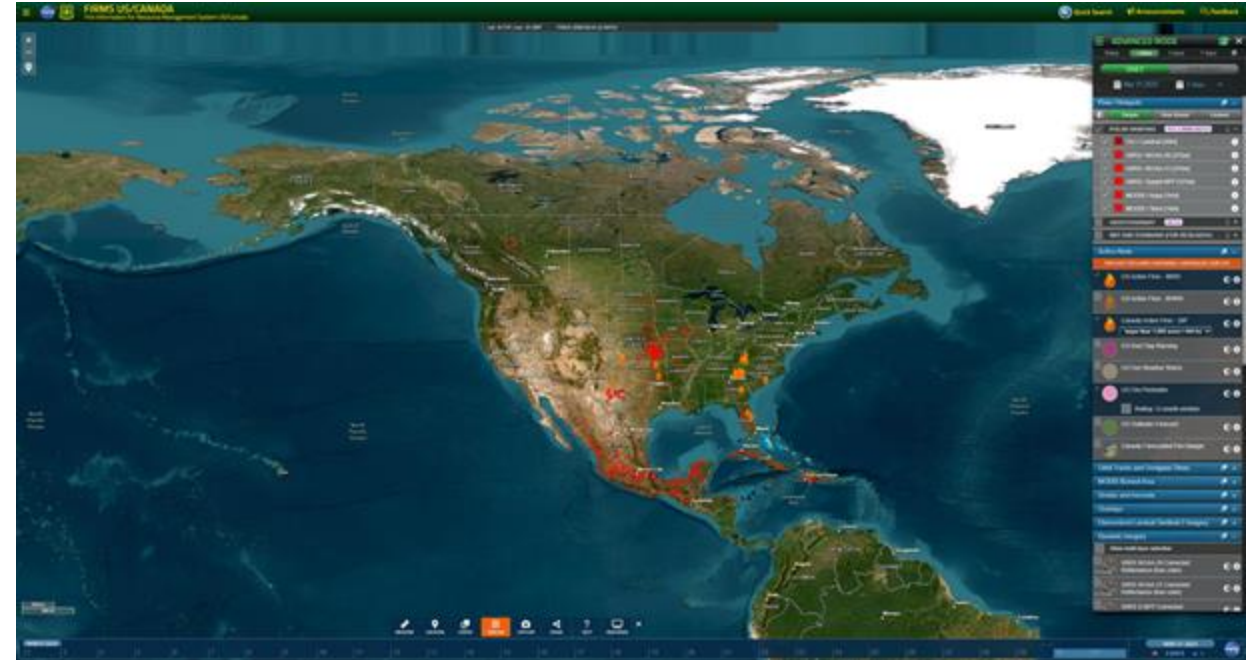
FIRMS – Global

- [FIRMS Global](#)
- Low-latency imagery and active fire detection products for the world
- Developed by University of Maryland in early 2000s and used data from MODIS
- Transitioned to NASA's Land, Atmosphere Near real-time Capability for Earth observation (LANCE) in 2012



FIRMS – US/Canada

- [FIRMS US/Canada](#)
- Low-latency imagery and active fire detection products for the US & Canada
- Developed in partnership with USDA Forest Service
- Extension of the Forest Service's Active Fire Mapping Program developed in 2001 that used data from MODIS and direct broadcast/direct readout
- Integrated with FIRMS Global within NASA LANCE in 2021

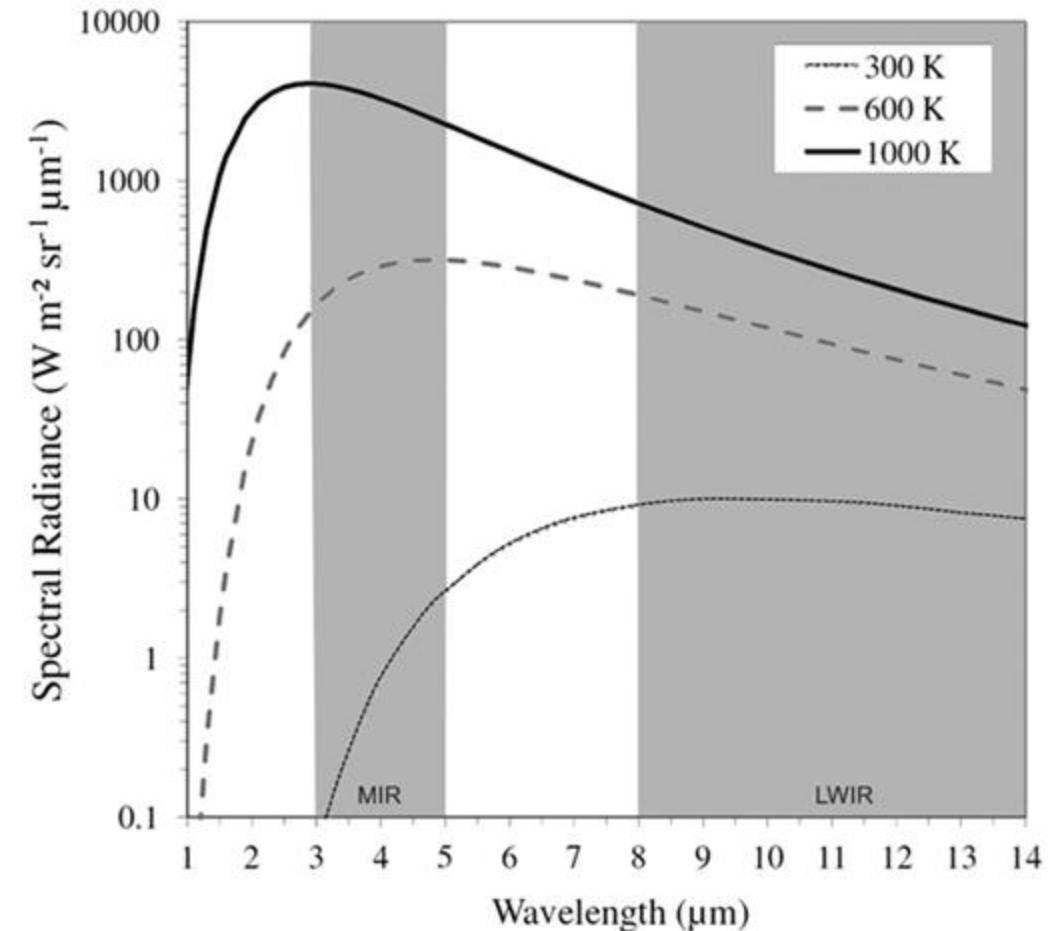




Satellite-Based Detection of Fires

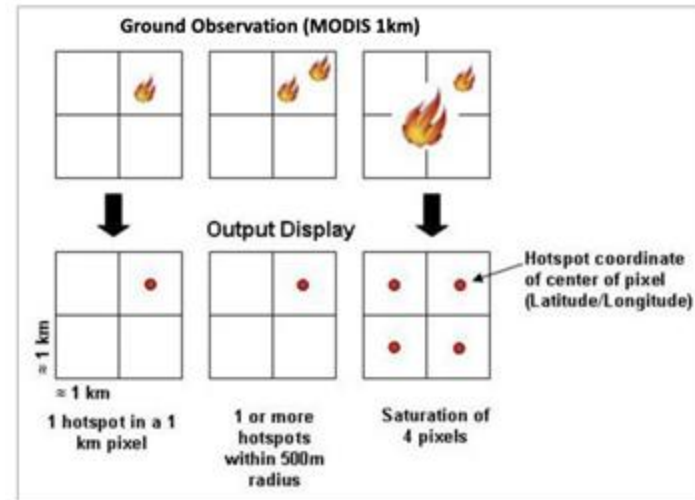
How is a fire detected by satellite?

- Satellites detect fires at the time of observation or overpass.
- Specific reflective and emissive bands located on the satellite sensor are used to detect fires.
 - Leverage response from fires in Mid-Wave InfraRed (MWIR) and Long-Wave (LWIR) bands
 - Other bands used for masking, rejection of false positives, etc.
- Typical Temperatures:
 - Earth's Surface: ~300K
 - Smoldering Fires: 600K to 800K
 - Flaming Fires: ~1000K and Higher



What does a detection mean on the ground?

- Driven by the characteristics of the fire.
- Detected fire activity is often less than the pixel size.
 - Small or large, intense fire(s)
 - Less intense fire burning over a broader area
- Pixel size for fire detection data is determined by sensor spatial resolution.
- Detection coordinates are the center of a pixel containing fire activity.



What sizes/types of fires can be detected by satellite?

- Sensor Spatial Resolution
- Fire Size/Intensity
 - MODIS (1000m)
 - ~1,000m² smoldering to flaming fires in good conditions (day)
 - ~100m² flaming fire in good conditions (day)
 - VIIRS I-Band (375m)
 - ~100m² smoldering to flaming fires in good conditions (day)
 - ~20m² flaming fire in good conditions (day)
 - ~2m² flaming fire in good conditions (night)
 - Landsat OLI (30m)
 - ~10-20m² smoldering to flaming fires in good conditions (day)
 - ~4m² flaming fire in good conditions (day)
 - ~1m² flaming fire in good conditions (night)
- Algorithms and products are not perfect!



Landsat (30m)
VIIRS (375m)
MODIS (1km)

Schroeder et al., 2016

Schroeder et al., 2014

Schroeder & Giglio, 2017



Summary of Satellite Data Product Availability in FIRMS

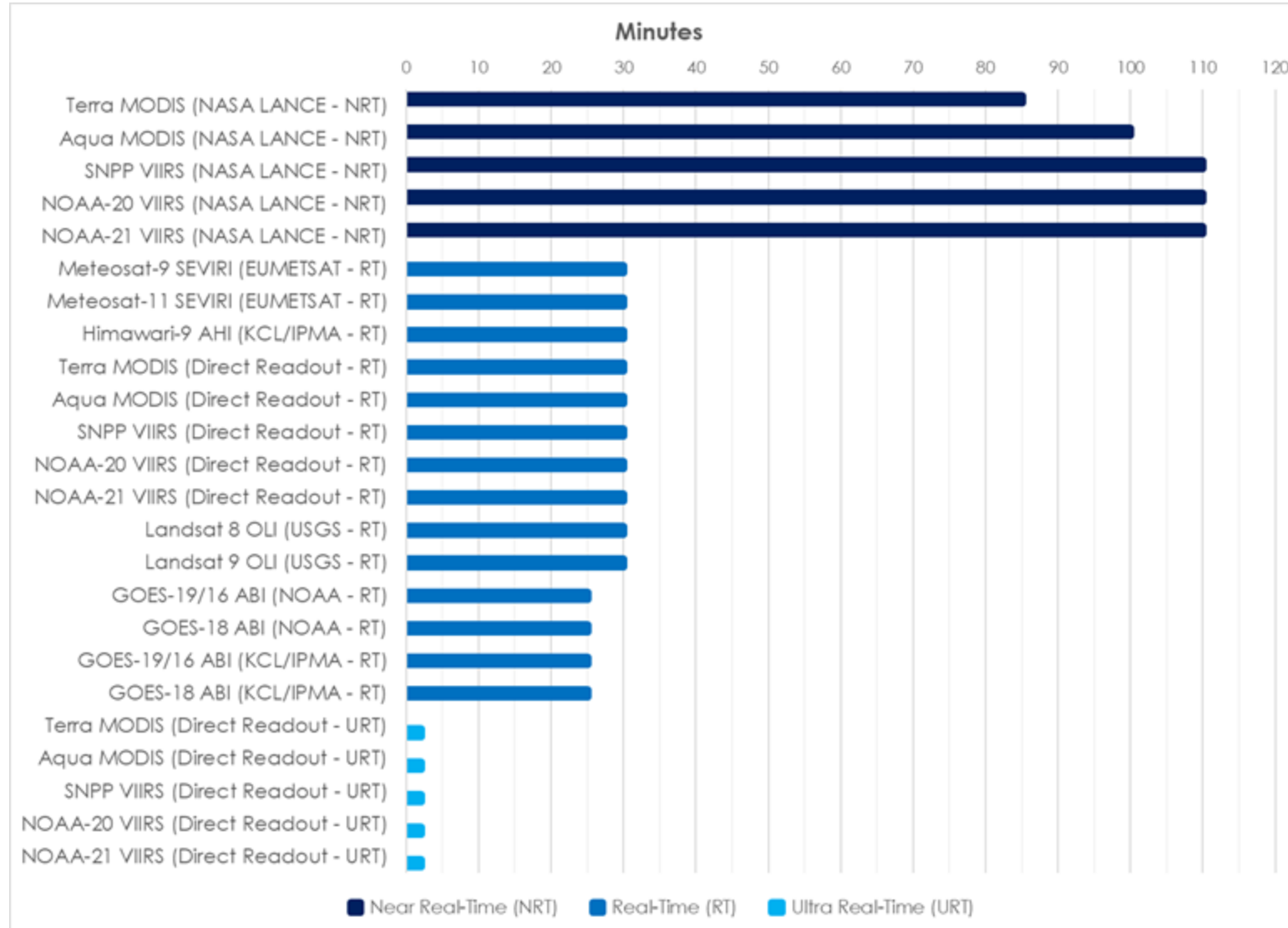
Satellite - Sensor	Active Fire	True Color Composite Imagery	False Color Composite Imagery	DNB Imagery	DNB/IR Composite Imagery	Burned Area	Vegetation Indices	Aerosol Indices	Snow Cover
GOES-16 ABI									
GOES-18 ABI									
Meteosat-9 SEVIRI									
Meteosat-11 SEVIRI									
Himawari-9 AHI									
Terra MODIS									
Aqua MODIS									
S-NPP VIIRS									
NOAA-20 VIIRS									
NOAA-21 VIIRS									
Sentinel-3A SLSTR									
Sentinel-3B SLSTR									
Landsat 8 OLI									
Landsat 9 OLI									
Sentinel 2A MSI									
Sentinel 2B MSI									

Available – Provided in FIRMS	Available – Planned to Include in FIRMS	Available – Not Planned to Include in FIRMS	Available – Not Provided in FIRMS	Not Available
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Active Fire Detection Data Latency in FIRMS

From satellite acquisition to FIRMS...

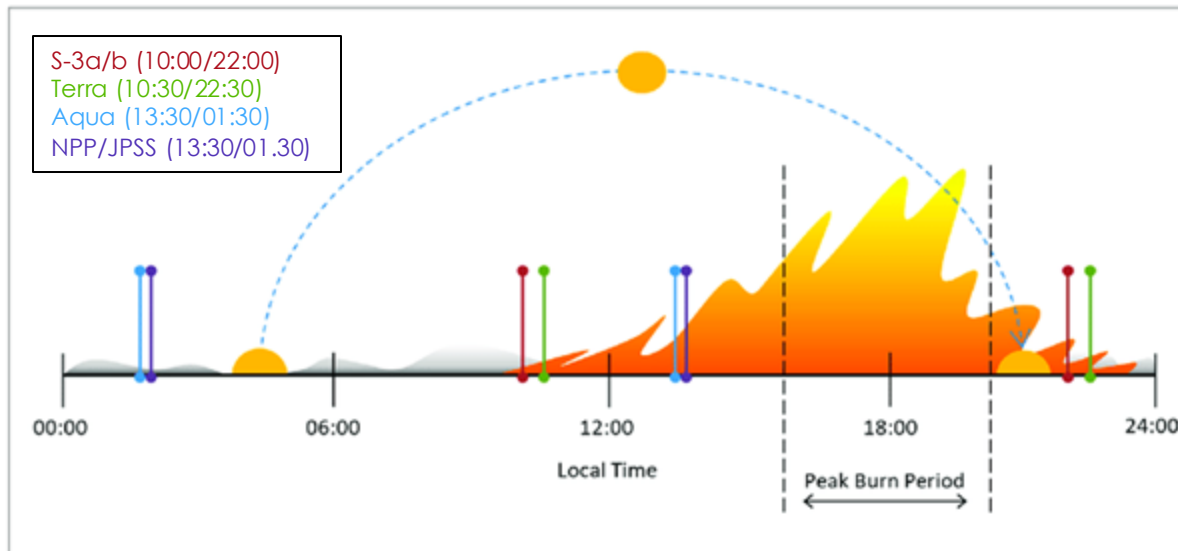


Factors Affecting Satellite Ability to Detect/Monitor Fire Activity

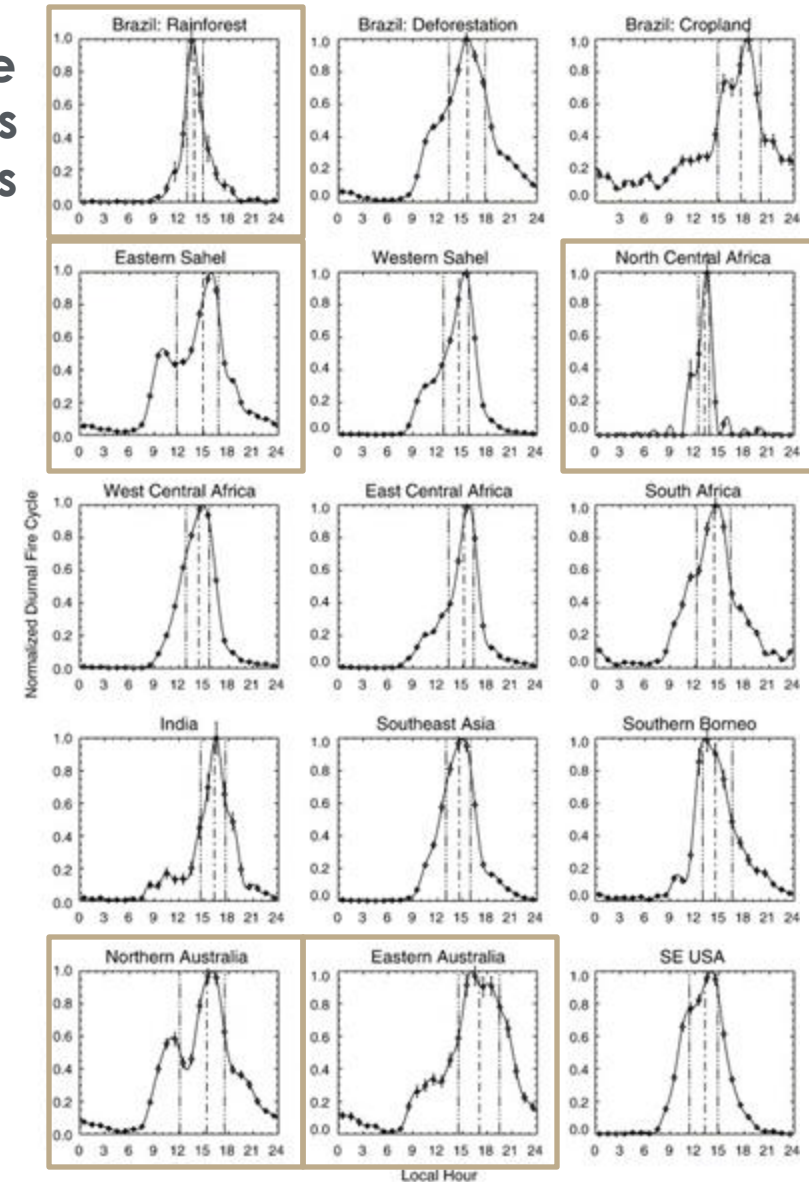
- Sensor Temporal Resolution
- Sensor Overpass Time

Diurnal Fire Cycle: Tropics & Sub-Tropics

Diurnal Wildfire Activity Cycle



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

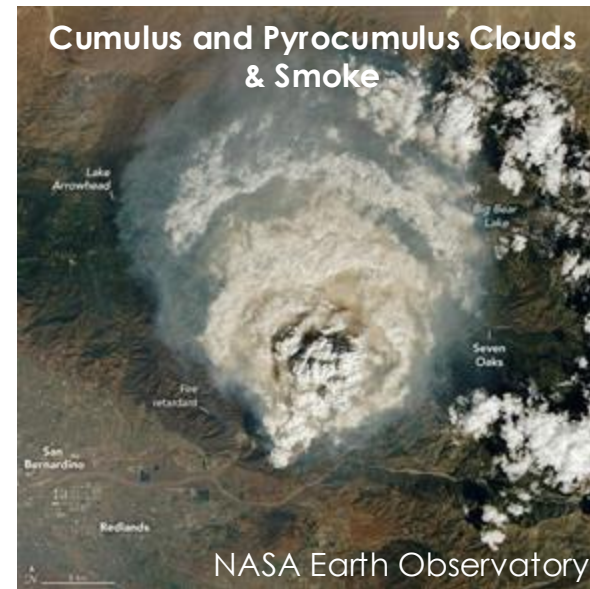


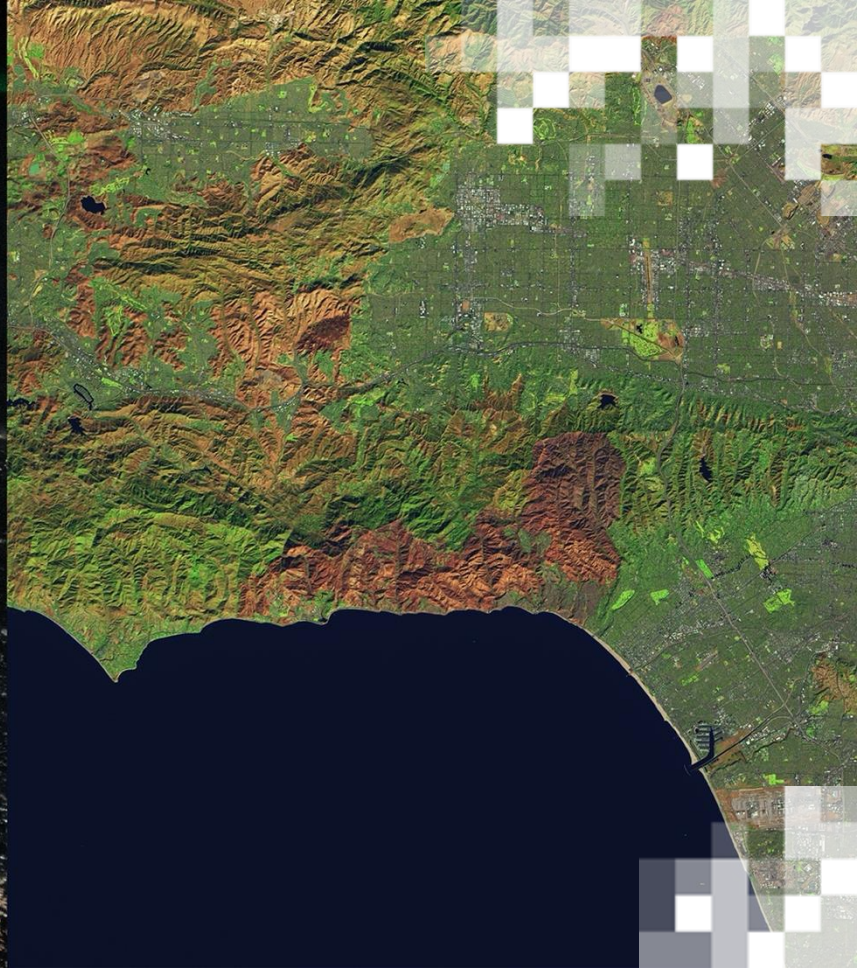
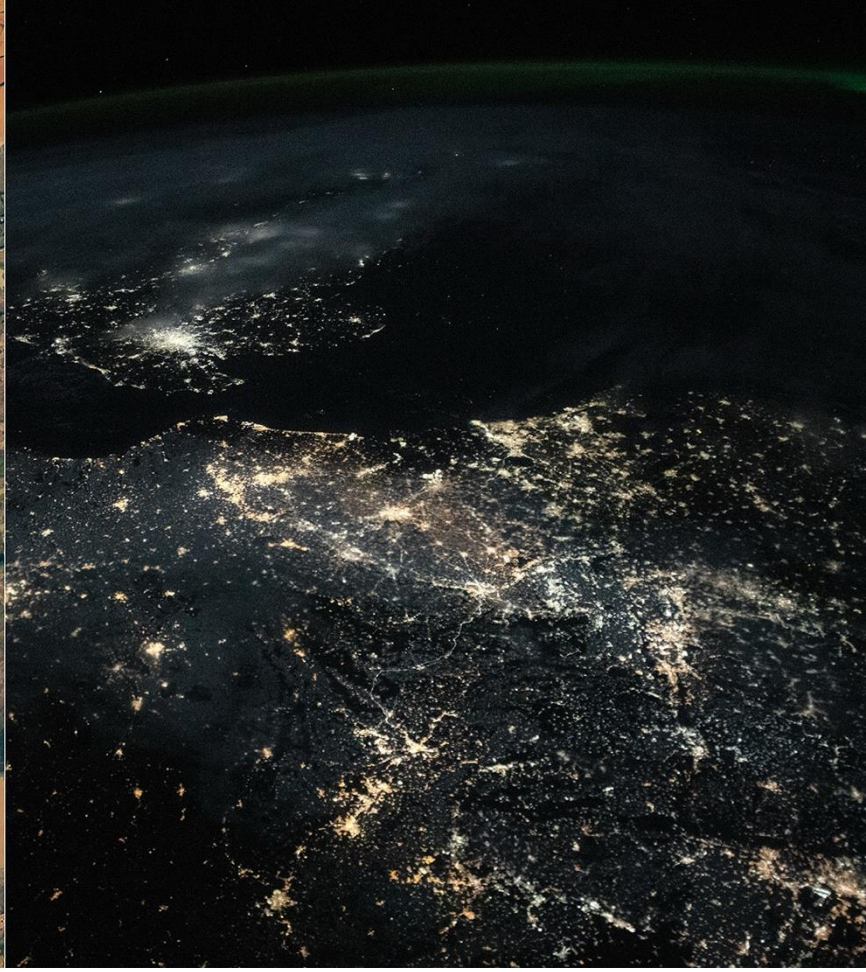
Credit: Giglio, 2007:
<https://doi.org/10.1016/j.rse.2006.11.018>



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 – FIRMS



NASA Worldview

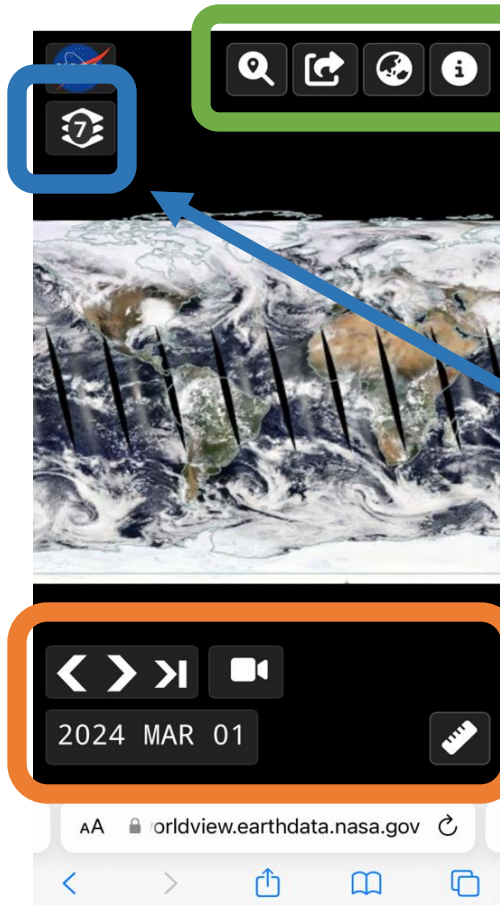
NASA Worldview

- [Website](#)
- Access Earth satellite remote sensing data easily
 - 1000+ global, full-resolution satellite imagery layers
 - Some imagery available in near real time (NRT)
 - Choose date or date range
 - Browse, search, save, share & download imagery layers
 - Worldview is built by the NASA/GSFC [Earth Science Data and Information System \(ESDIS\) Project](#)



Worldview Controls

Mobile Browser



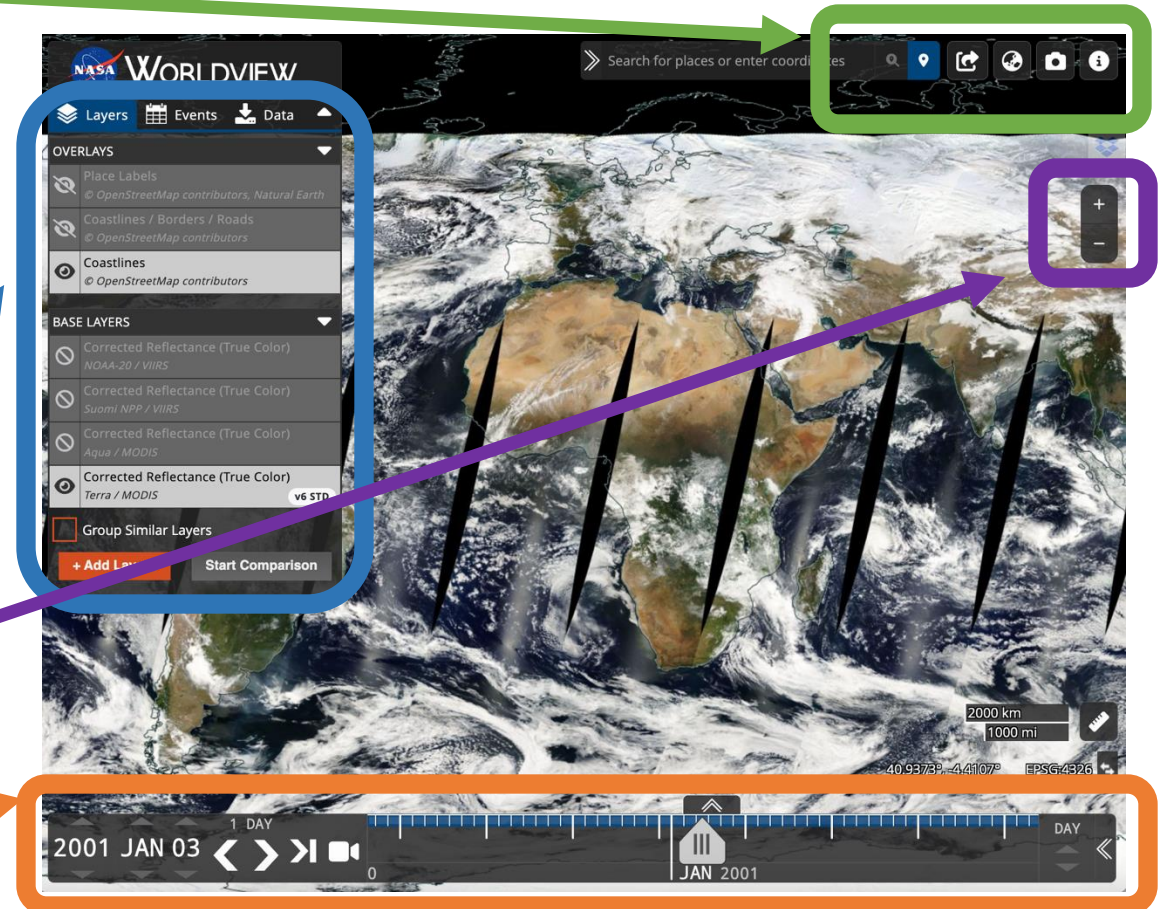
- Search by location
- Share image
- Change projection
- Help/info

- View layers, events
- Add image layers
- Download data

- Zoom via buttons or mobile device pinch

- Choose date & time
- Create an animation

Desktop Browser



Explore Imagery Layers

Organized by application area and science discipline

The screenshot displays the NASA WorldView web application interface. The top navigation bar includes the NASA logo, the text "WORLDVIEW", and tabs for "Layers", "Events", and "Data". Below this, a search bar is present. The main content area is organized into a grid of categories, each with a representative image and a list of available layers:

- Hazards And Disasters**
 - All
 - Aboveground Biomass
 - Absolute Dynamic Topography
 - Aerosol Index
 - Aerosol Optical Depth
 - Aerosol Albedo
 - Aerosol Type
 - ...
 - Drought
 - Corrected Reflectance
 - Dams
 - Drought Hazard
 - Human Built-up And Settlement Extent
 - Land Surface Reflectance
 - Land Surface Temperature
 - ...
 - Floods
 - Flood
- Science Disciplines**
 - Air Quality
 - Aerosol Index
 - Aerosol Optical Depth
 - Aerosol Type
 - Carbon Monoxide
 - Corrected Reflectance
 - Dust
 - ...
 - Dust Storms
 - Aerosol Index
 - Aerosol Optical Depth
 - Aerosol Type
 - Dust
 - Corrected Reflectance
 - Human Built-up And Settlement Extent
 - ...
 - Severe Storms
 - Corrected Reflectance
- Featured**
 - Ash Plumes
 - Aerosol Index
 - Aerosol Optical Depth
 - Corrected Reflectance
 - Fires and Thermal Anomalies
 - Human Built-up And Settlement Extent
 - Land Surface Reflectance
 - ...
 - Fires
 - Aerosol Index
 - Aerosol Optical Depth
 - Aerosol Type
 - Fires and Thermal Anomalies
 - Carbon Monoxide
 - Corrected Reflectance
 - ...
 - Shipping
 - Corrected Reflectance
- Recent**

On the left side, there are two sections: "OVERLAYS" and "BASE LAYERS". The "OVERLAYS" section includes "Place Labels", "Coastlines / Borders / Roads", and "Coastlines". The "BASE LAYERS" section includes "Corrected Reflectance (True Color)" from NOAA-20 / VIIRS, Suomi NPP / VIIRS, Aqua / MODIS (v6.1), and Terra / MODIS. There are buttons for "+ Add Layers" and "Start Comparison".

At the bottom, there is a timeline slider showing the date "2024 MAR 01" and navigation controls for "1 DAY", "JAN 2024", "FEB 2024", and "MAR 2024".

On the right side, there is a large satellite image of Earth with a scale bar indicating "2000 km" and "2000 mi".

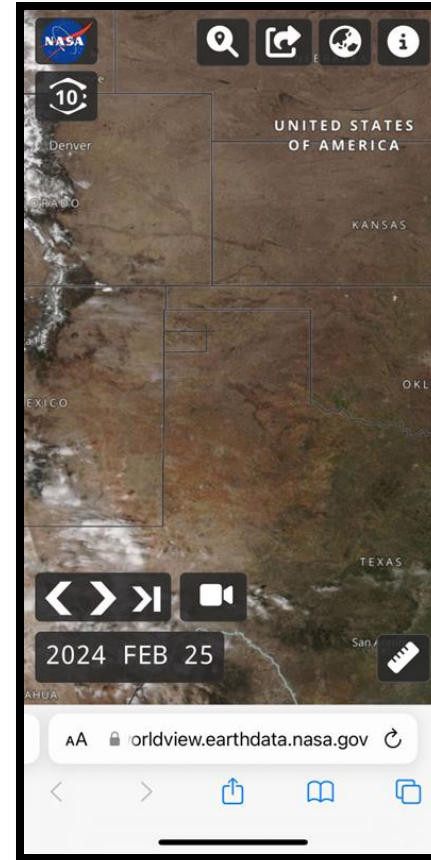


Worldview Exercise – Part 1

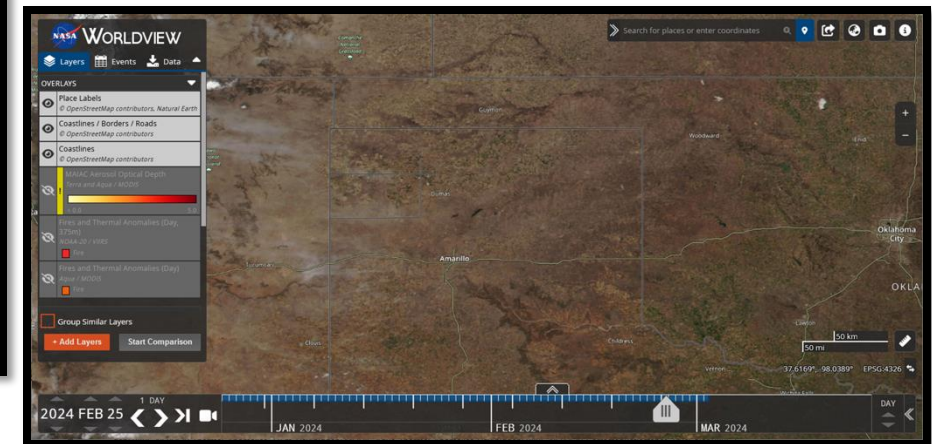
Smokehouse Creek Fire, TX
Feb 26, 2024

Explore Worldview navigation

1. Zoom in and out
2. Change the date and see the event evolve
3. Examine satellite basemap layers
4. Explore available layers
 - Fire detections from MODIS
 - Fire detections from VIIRS
 - Aerosols from MODIS
5. Make an animation

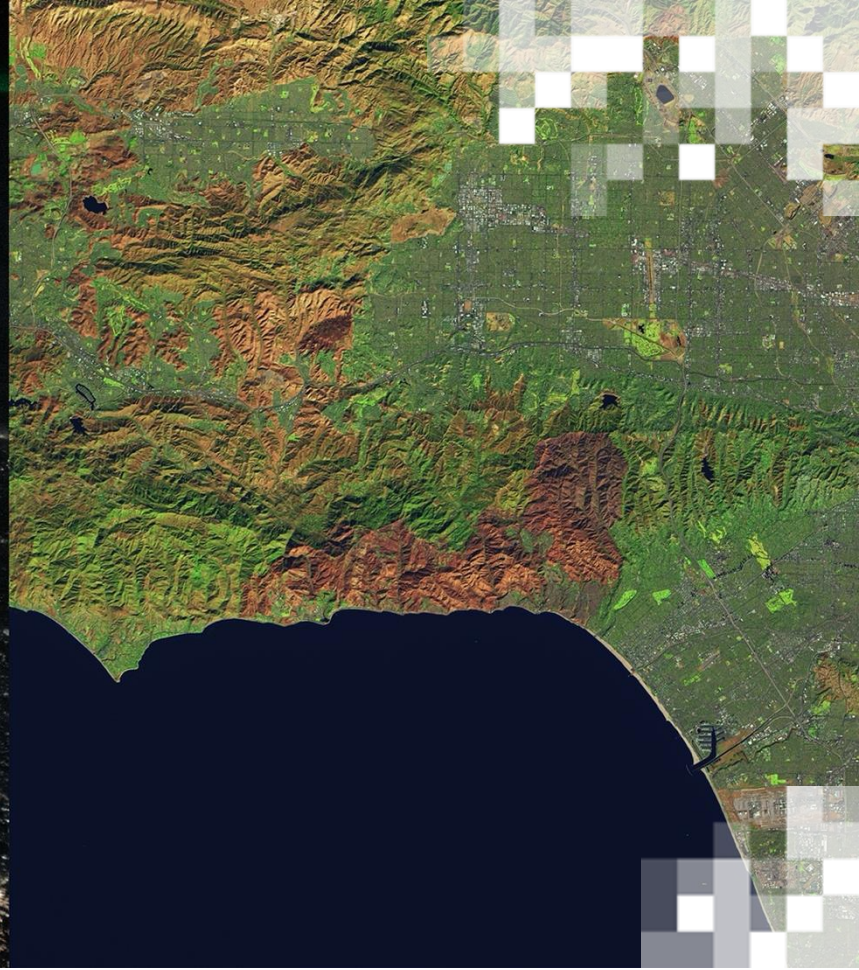
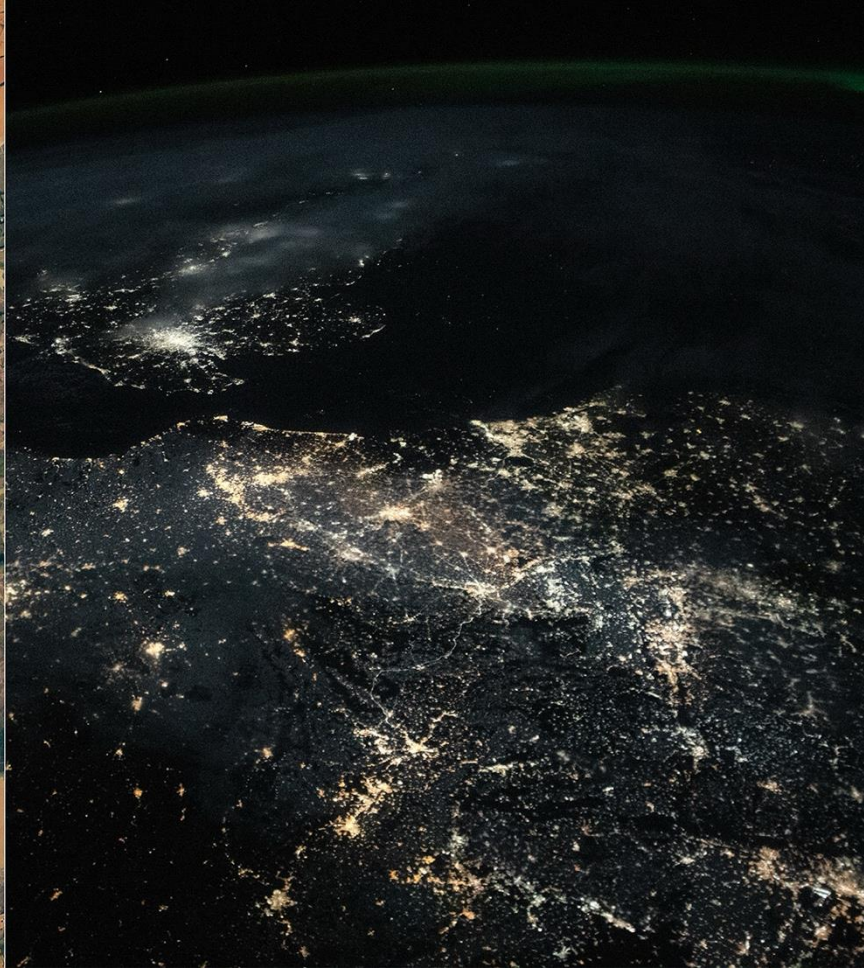


go.nasa.gov/3wON6he





Demo – Worldview



Exercise

Cameron Peak fire

- Wildfire that started near Chambers Lake, Colorado on August 13, 2020
- Fire burned 208,663 acres (326 sq mi.) through the Arapaho and Roosevelt National Forests
- Largest wildfire in Colorado history
- Forced the evacuation of over 6,000 residents
- Exercise:
 - Explore FIRMS & Worldview
 - Adapt GEE code from Eaton Fire (LA) case study
 - Develop your own case study in a domain that aligns with your work experience or personal interests.



Image credit: [U.S. Forest Service](#)



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[ARSET Website](#)

[ARSET YouTube](#)





Thank You!

