



National Aeronautics  
and  
Space Administration

## EARTHDATA

# NASA's Near Real-Time Data System: Bridging the Gap between Research and Time-Sensitive Decision Making

Tuesday, 14<sup>th</sup> January, 14:45 – 15:15 CST

Session: User-Centered Approaches to Applied Research, Innovation, and Developing Capabilities to Support Stakeholder Decision Making



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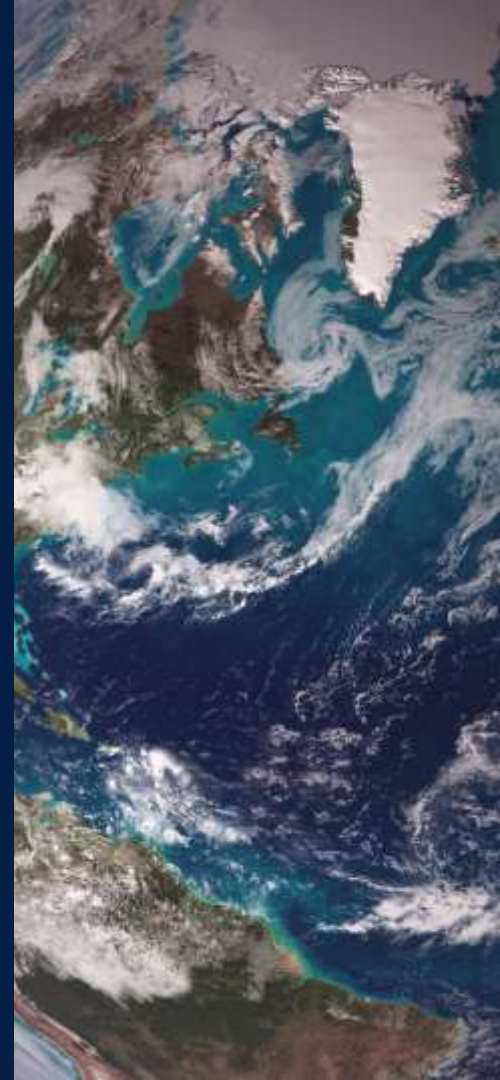
# Contributors

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# Overview

Background

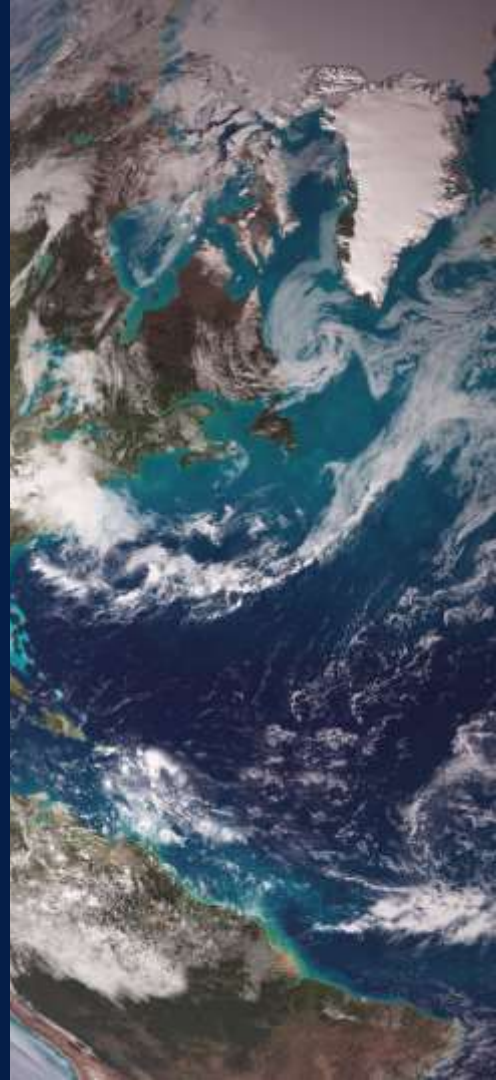
Model of LANCE

Use case examples

User-centered evolution

Partnerships with NASA programs

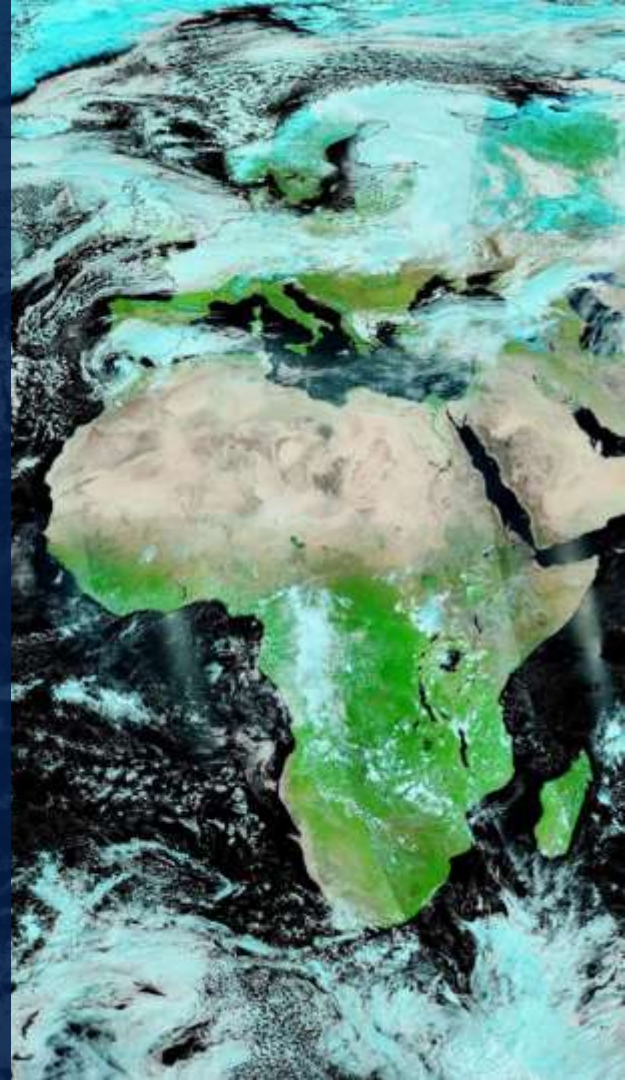
Looking to the future



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# Background

NASA' Land, Atmosphere Near real-time Capability for Earth observation (LANCE)



# Background

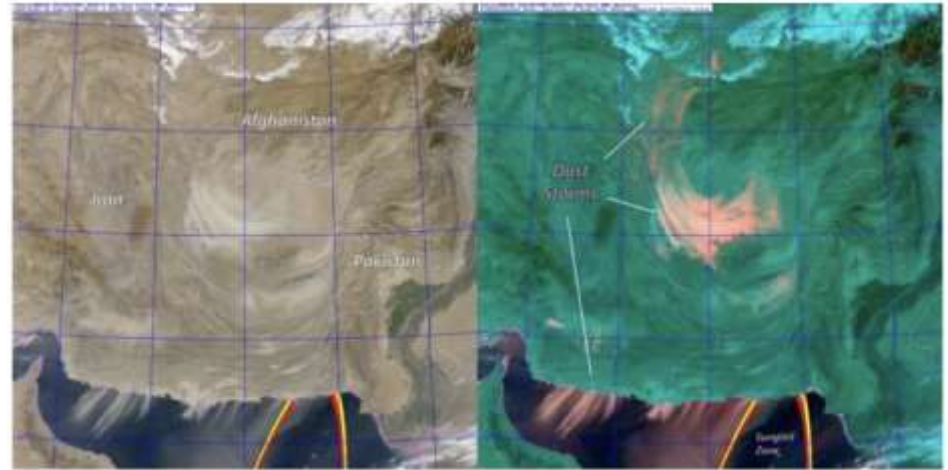
Bridge gap of research to operations:

- Increasing need to support time-sensitive applications
- Agencies outside NASA with different technical needs
- Evolving geopolitical landscape
- Barriers:
  - Available vs accessible
  - Data format & bandwidth limitations
  - Lack of software/infrastructure

# Background

Data and information needs:

- ❑ Data and imagery needed to be available within 3 hours of satellite observation.
- ❑ US Forest Service requested Terra imagery in support of wildfire suppression and response
- ❑ MODIS Rapid Response System:
  - ❑ wildfire management applications
  - ❑ monitoring hurricanes, dust storms as well as crops, floods, ash plumes and oil spills
  - ❑ Facilitated uptake of Earth Science products as trusted, actionable data



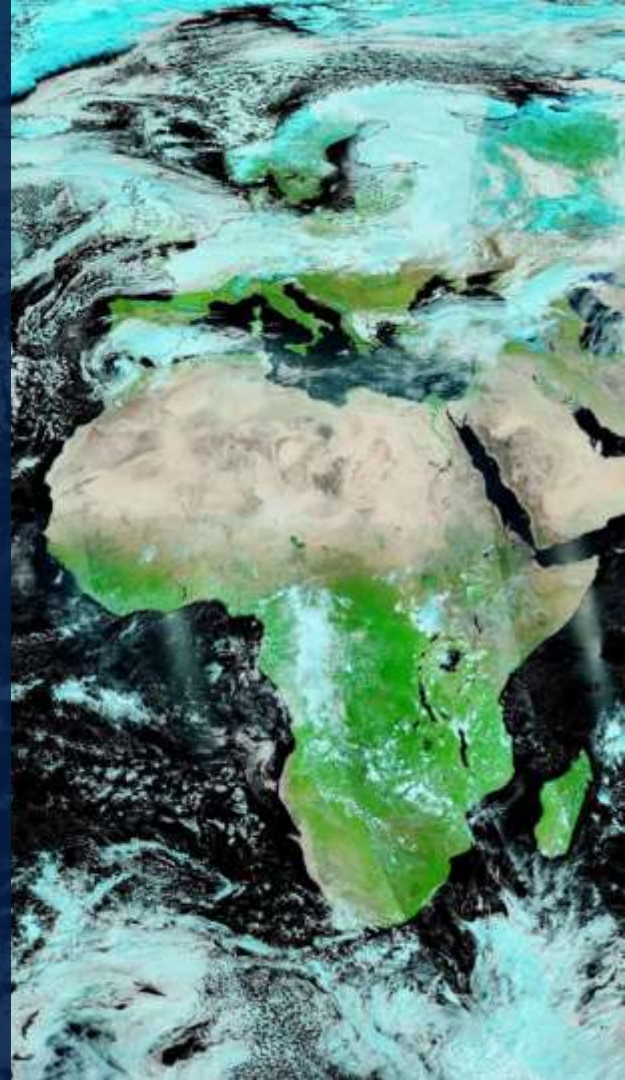
A new technique for enhancing lofted mineral dust storms was developed, enabled by NRT MODIS data, and was used extensively by Coalition Forces in the Middle East



**EARTHDATA**

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# Model of LANCE



# Land, Atmosphere Near Real-time Capability for Earth observation (LANCE)

- ❑ Goal: provide consistent near real-time (NRT) data products for increasingly diverse user base
- ❑ Facilitate NRT science and applications “one-stop shop”
- ❑ Users span operational to applications users (USDA-FAS, USAID FEWS-NET, USFS, US National Ice Center, NRL, FEMA, NASA SPoRT, Global Forest Watch, Conservation International, GEOGLAM, ECMWF)



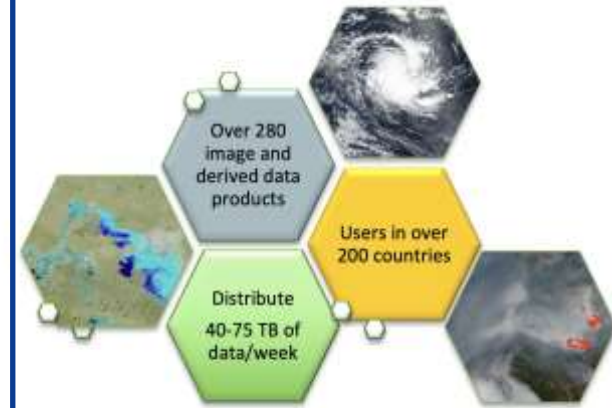
*LANCE supports the following applications Air Quality, Dust storms, Fires, Vegetation changes, floods, ash plumes, drought, smoke plumes, sea ice mapping, and severe storms*

# LANCE

- ❑ Timely data from 10 instruments
- ❑ Data available within 3 hours\* (from satellite overpass to user)

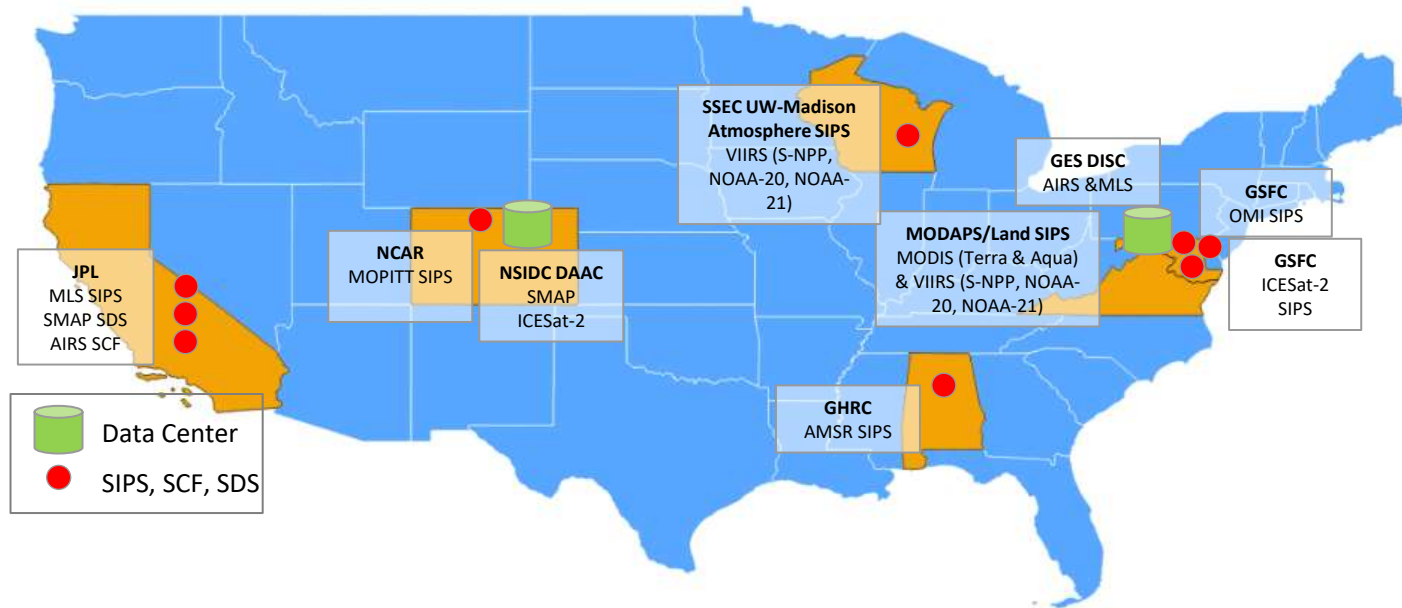
\*ICESat-2 quick looks - within 3 days (in comparison to an average 45-day latency for the standard dataset)

- [AIRS](#) Atmospheric Infrared Sounder
- [AMSR2](#) Advanced Microwave Scanning Radiometer 2
- [ICESat-2](#) Advanced Topographic Altimeter System (ATLAS) on the Ice, Cloud, and land Elevation Satellite-2
- [MLS](#) Microwave Limb Sounder
- [MODIS](#) Moderate Resolution Imaging Spectroradiometer
- [MOPITT](#) Measurement of Pollution in the Troposphere
- [OMI](#) Ozone Monitoring Instrument
- [OMPS](#) Ozone Mapping Profiler Suite
- [SMAP](#) Soil Moisture Active Passive
- [VIIRS](#) Visible Infrared Imaging Radiometer Suite



- Harness NASA capabilities → partner with multiple NASA centers/science processing facilities
- Monthly check-ins to ensure collaboration & consistency

# Current LANCE Facilities

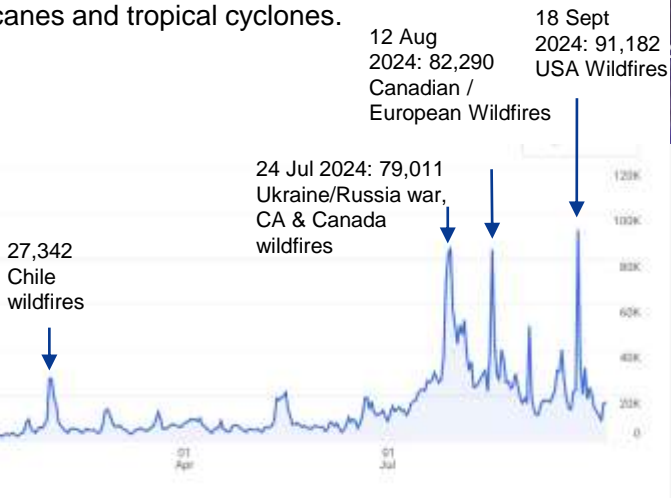


The LANCE elements are located at the following facilities

- **GSFC Earth Sciences Data and Information Services Center (GES DISC)** is providing AIRS with support from the AIRS Science Computing Facility (SCF) at JPL, and MLS data via the MLS SIPS at JPL
- **AMSR Science Investigator-led Processing System (SIPS)** is providing AMSR2 data
- **MODIS Adaptive Processing System (MODAPS) and Land SIPS** are providing MODIS and VIIRS Land data
- **Ozone Science Investigator-led Processing System (SIPS)** is providing OMI and OMPS data
- **MOPITT SIPS (National Center for Atmospheric Research (NCAR))** is providing MOPITT data
- **Atmosphere SIPS (Space Science and Engineering Center (SSEC) University of Wisconsin)** is providing VIIRS Atmosphere data
- **The Jet Propulsion Lab (JPL) Science Data System (SDS)** is providing SMAP data for distribution by the **National Snow and Ice Data Center (NSIDC)**
- **The Ice, Cloud and land Elevation Satellite-2 SIPS** is providing the ICESat-2 data for distribution by the **National Snow and Ice Data Center (NSIDC)**

# Worldview

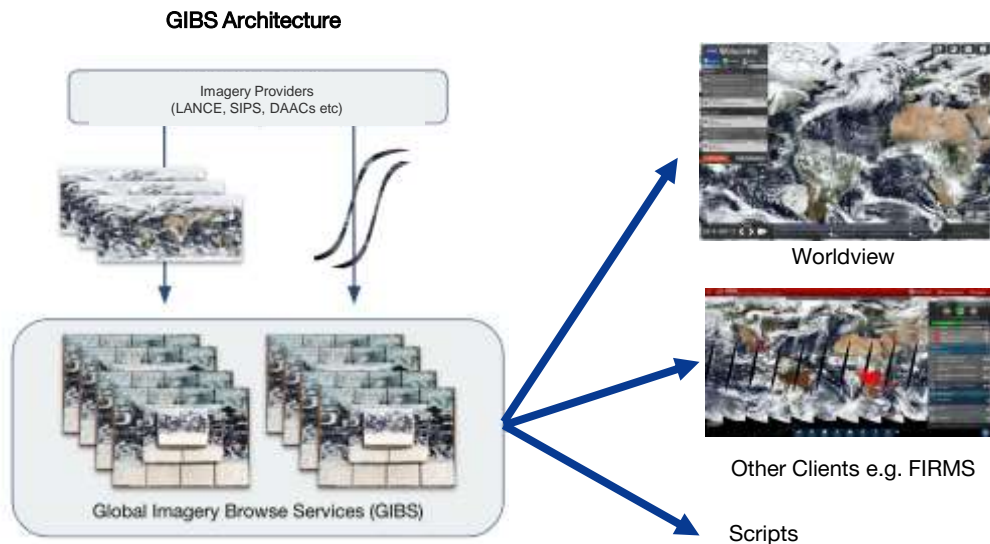
- ❑ Built on the success of the LANCE
- ❑ Expand/broaden user base with visual-first approach
- ❑ open-source web mapping application with interactive browsing of NASA's global satellite imagery
- ❑ 6-10k daily science, applied science, education, media and public users
- ❑ Spikes (natural hazard events - fires, air quality, hurricanes and tropical cyclones).



The Black Marble Nighttime Blue/Yellow Composite (Day/Night Band) false-color image shows Typhoon Koinu over southern Taiwan on October 4, 2023

# GIBS – Global Imagery Browse Services

- ❑ Worldview is powered by GIBS
- ❑ An open visualization API serving >1000 actively maintained products from across EOSDIS
- ❑ >100k daily users across dozens of custom apps and GIS clients via open standards
- ❑ Very fast response time (<50ms) enables highly interactive use over space and time



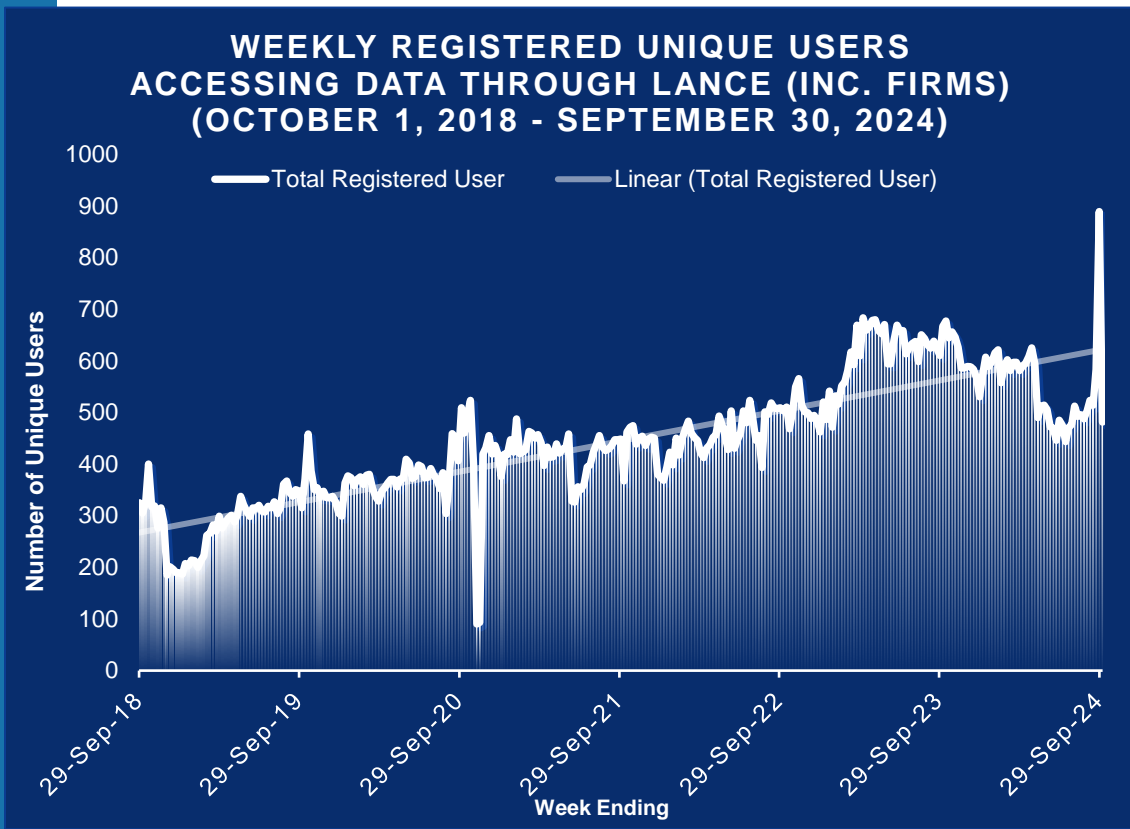
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# Use case examples

Research to Applications



# Increasingly diverse user base



Active users by Country

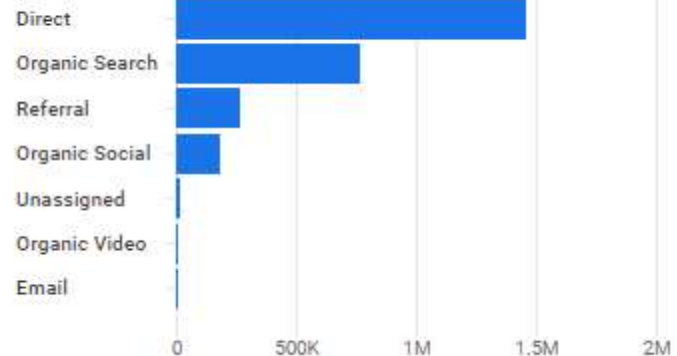
Custom Oct 29, 2023 - Nov 25, 2024



COUNTRY	ACTIVE USERS
United States	1.2M
Canada	307K
Greece	134K
Germany	85K
Russia	82K
Chile	80K
Türkiye	55K
-	-

New users by

First user primary channel group (Default C...)

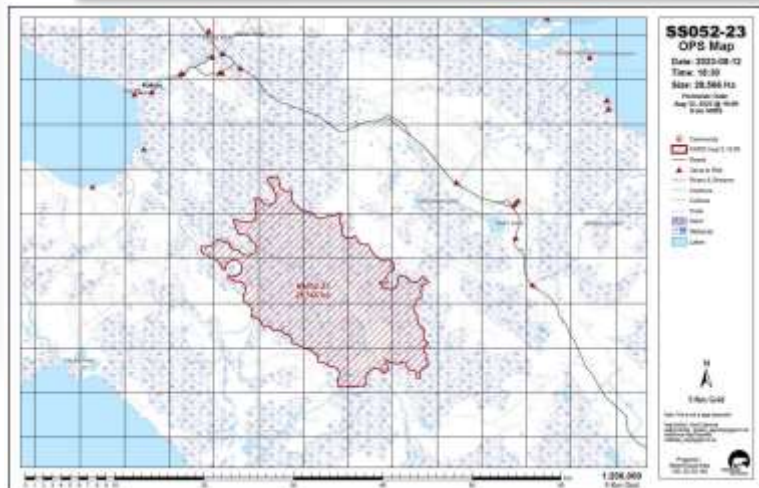
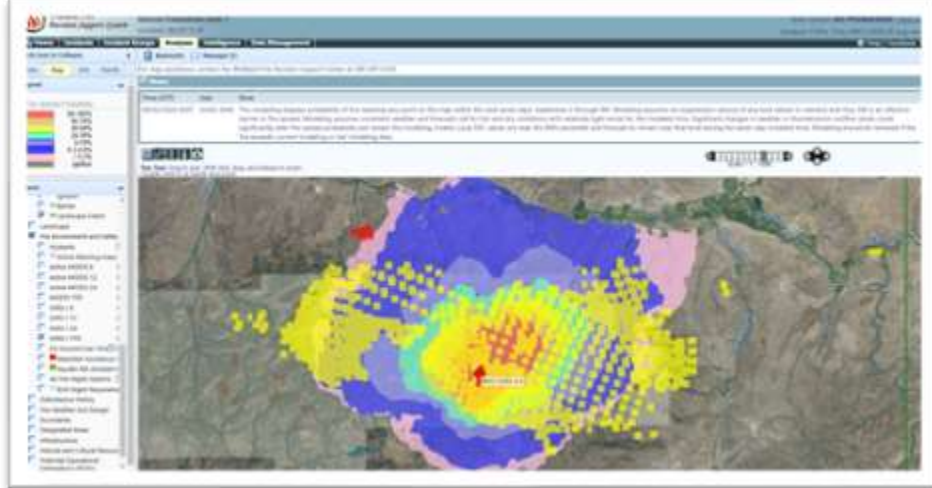
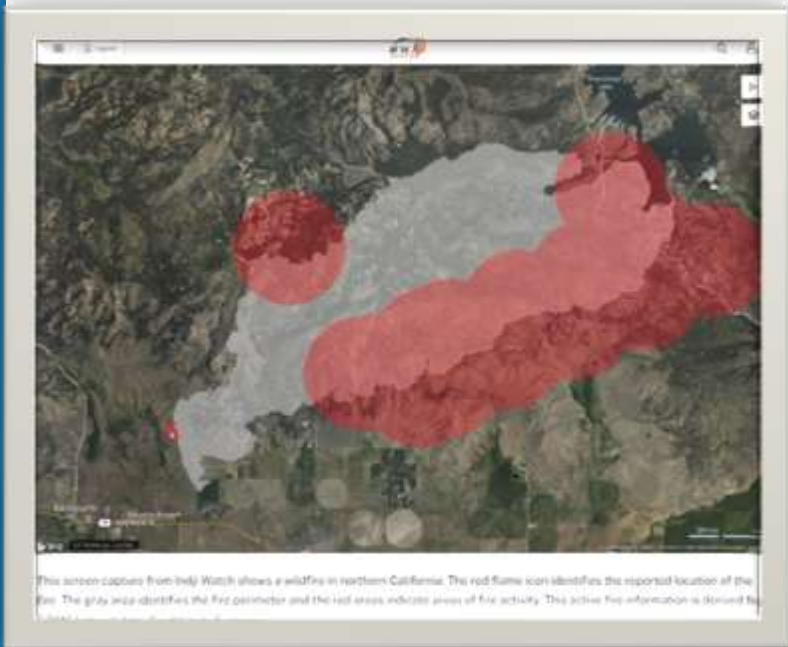


# Use Case Examples

Supporting across scales...individual wildfire event to global forecasting; bridging the gap between research and applications

1. Wildfire modeling, management, monitoring
2. Modeling/Analysis
3. Forecasting
4. Informing Air Quality
5. Highlighting impact of disasters

# Wildfires



Credit: NWT/ECC

# Modeling/Analysis - ECMWF

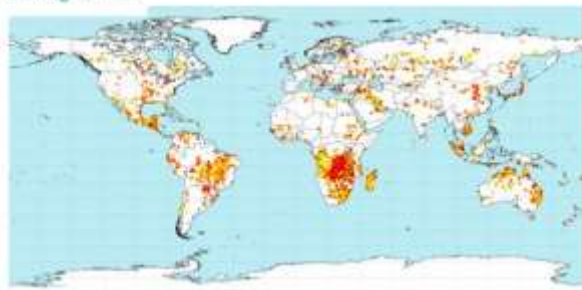
## Continuing to Bridge NRT Data and Users through LANCE

FRP and AOD data are acquired in NRT from LANCE

### For Modeling/Analysis

<https://atmosphere.copernicus.eu/>

Fire activity analyses



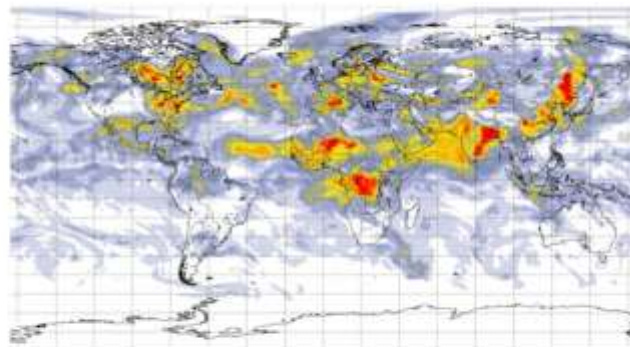
The global year 2014 is presented in LANCE, the Copernicus Atmosphere Monitoring Service (AMS) map.

The CAMS Global Fire Assimilation System (GFAS) assimilates fire radiative power (FRP) observations from satellite-based sensors to produce daily estimates of wildfire and biomass burning emissions.

The CAMS global aerosol system includes assimilation of aerosol optical depth (AOD) from the MODIS sensors (among other datasets) to produce operational aerosol forecasts out to day 5.

### Aerosol forecasts

Baseline: Tue 20 Jun 2023 00:00 UTC (00000000) - Tue 20 Jun 2023 00:00 UTC (00000000) - Global Aerosol Opt. - Total aerosol



Aerosol optical depth at 550 nm (provided by CAMS, the Copernicus Atmosphere Monitoring Service) (global)

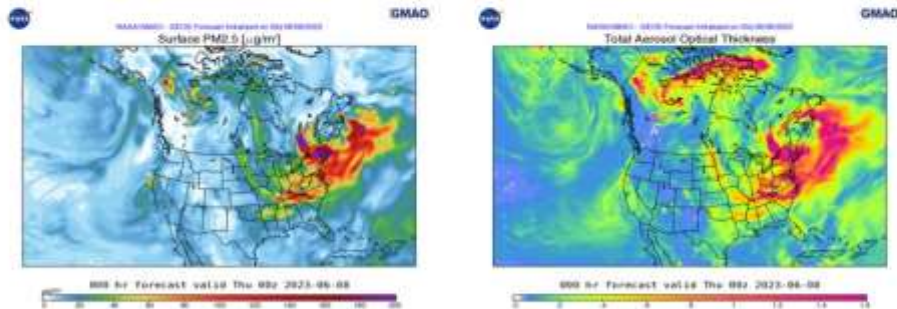
# Forecasting - GMAO

Continuing to Bridge NRT Data and Users through LANCE



## For Modeling

- ❑ Global Modeling and Assimilation Office
- ❑ Ingesting 12 products
  - Aerosols, AOT, albedo, BRDF, fire & thermal anomalies



Courtesy: Global Modeling and Assimilation Office

World / Asia

# Toxic smog in Pakistan is so bad you can see it from space



By [Helen Regan](#) and [Sophia Saifi](#), CNN

🕒 4 minute read · Updated 12:38 PM EST, Mon November 11, 2024



Images from the Pakistani cities of [Lahore](#) and [Multan](#) this weekend show the dark haze engulfing streets and blocking buildings from view.

Pollution in the region [ramps up each winter](#), when an ominous yellow haze blankets the skies due to a combination of farmers burning agricultural waste, coal-fired power plants, traffic and windless days. Air quality worsens in the winter because colder and drier air traps pollution, rather than lifting it away, as warm air does when it rises.



Satellite imagery from NASA Worldview shows heavy smog over Pakistan's Punjab province and parts of northwest India on November 10, 2024, compared to the same region on August 31, 2024. NASA Worldview/CNN

## Informing Air Quality

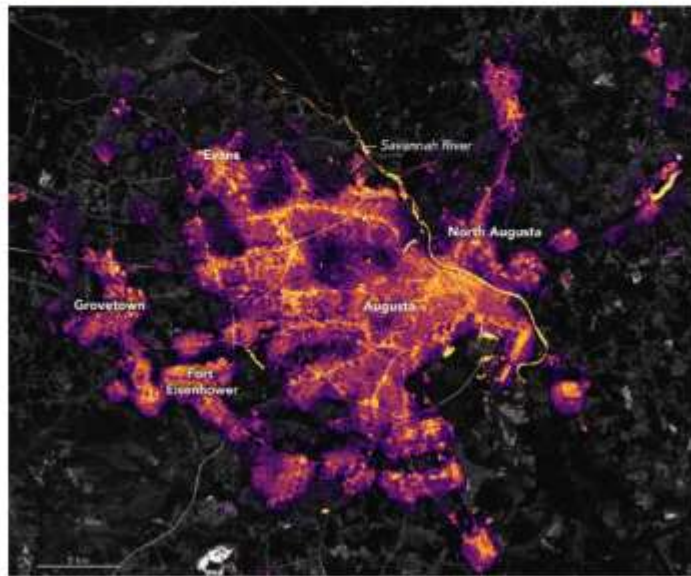


NATIONAL

## The scale of Helene's devastating impact is eye-popping, even from space

OCTOBER 4, 2024 - 2:22 PM ET

By Bill Chappell

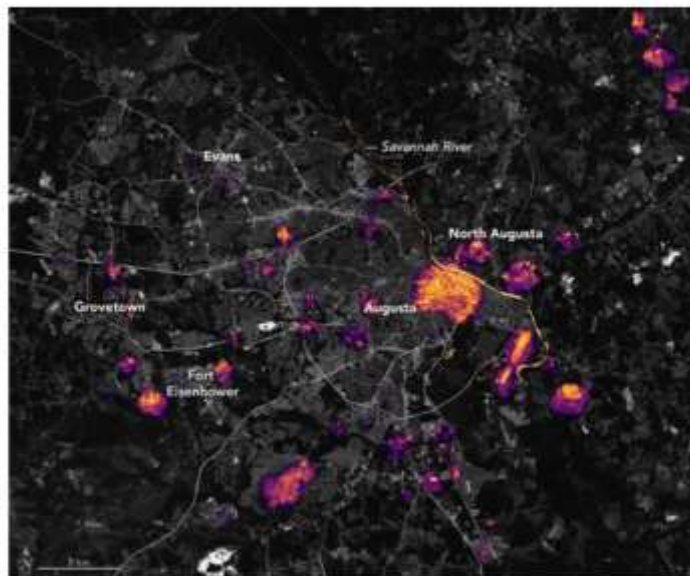


A satellite image shows Augusta, Ga., one month before Helene's arrival plunged it and many other cities into darkness.

NASA Earth Observatory images by Lauren Daughit, using Black Marble data courtesy of Ranjay Shrivastava/NASA Goddard Space Flight Center

Satellite photos shared by NASA and NOAA show the fast-moving hurricane carved a dark corridor into the Southeast as its center roared inland, plunging cities and entire areas into blackouts.

In one striking set of images, Augusta, Ga., is seen going from a glowing metropolis to a largely blacked-out city, with the largest cluster of working lights centered on its downtown along the Savannah River.

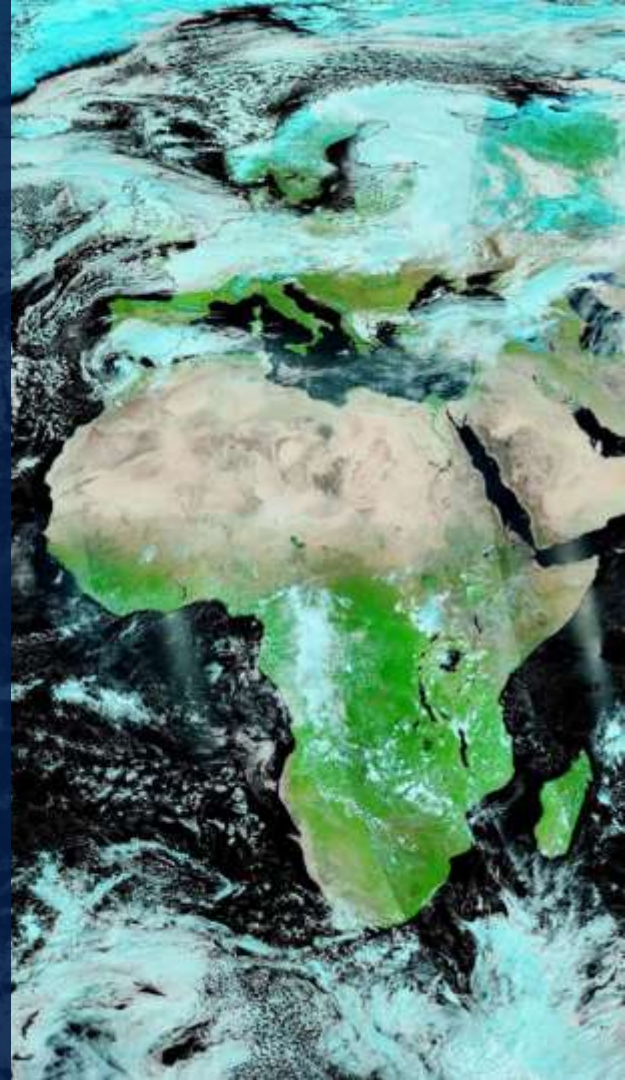


People in Augusta, Ga., have been dealing with electricity and water outages since Helene rampaged through the area in late September.

NASA Earth Observatory images by Lauren Daughit, using Black Marble data courtesy of Ranjay Shrivastava/NASA Goddard Space Flight Center

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# User-centered evolution

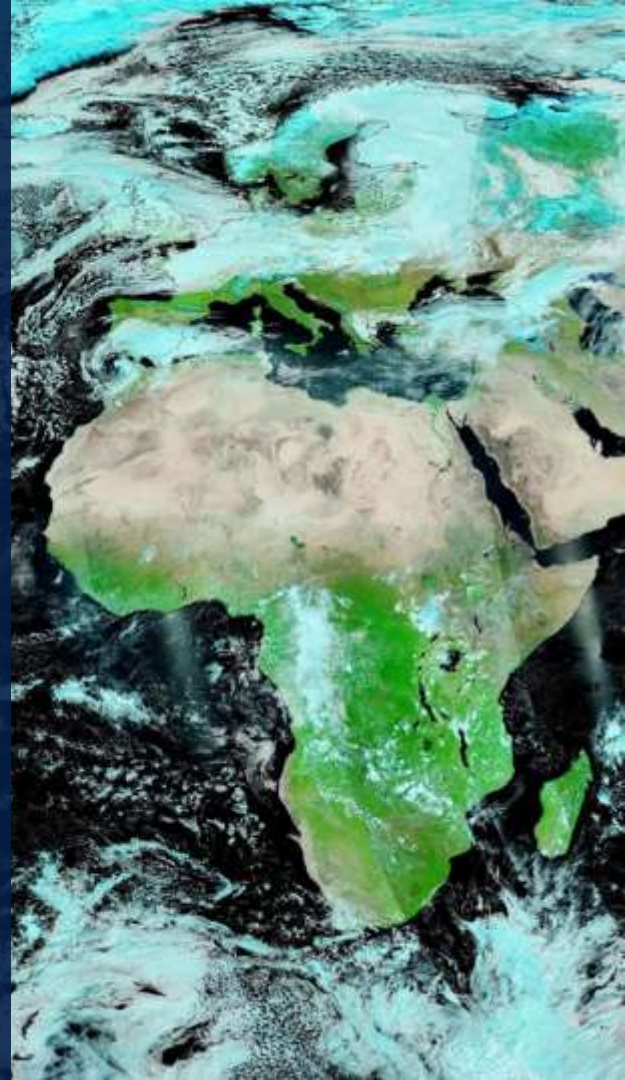


# User-centered evolution

- ❑ Informed by a user working group
- ❑ members represent NRT community
- ❑ Guidance, feedback, suggestions for new products

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# Partnerships with NASA Programs



# Partnerships with NASA programs

- ❑ Sits at intersection of NASA's Earth Science Data Systems (ESDS) and NASA's Earth Action program
- ❑ NASA's Earth Science to Action Strategy
- ❑ Ready conduit for support ES2A

# Partnerships with NASA programs

Expanding needs, expanding missions, concentrated engagement with other programs

2 examples:

NASA Mission Engagement team

NASA's Satellite Needs Working Group (SNWG)

# Partnerships with NASA programs

- NASA Mission Engagement team
- Embed/advocate for NRT in mission design
- Ensure efficient communication
- Identify efficient additions
- Increase awareness of LANCE and needs of NRT community

# Partnerships with NASA programs

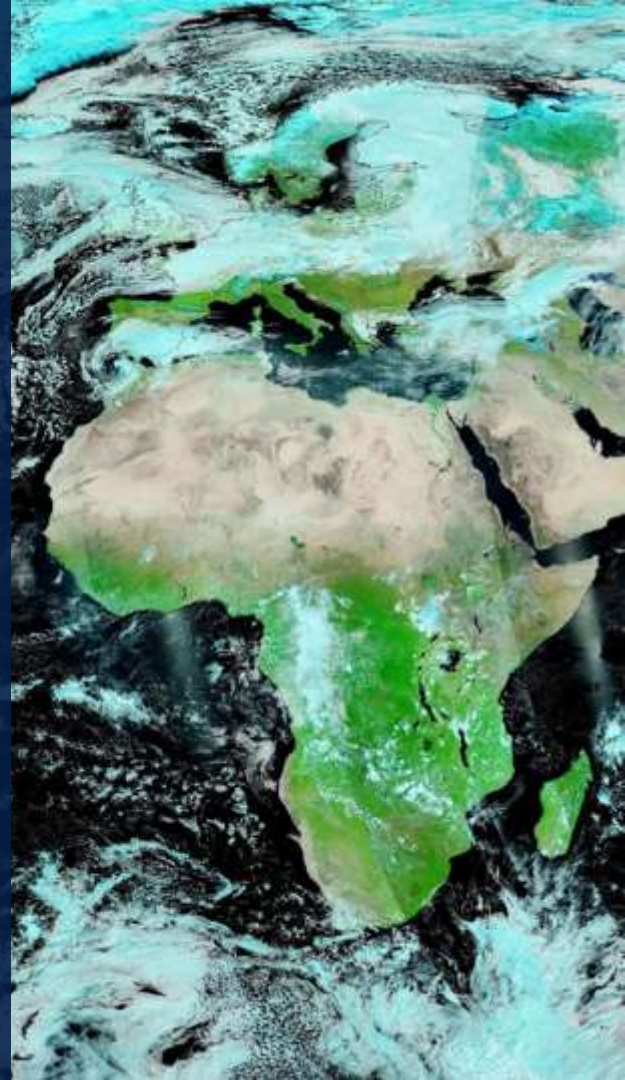
NASA provides support to the ***Satellite Needs Working Group***, including evaluating surveys and formulating solutions to meet US government agency decision-making needs. Many needs relate to NRT data applications.

LANCE hosts several SNWG NRT solutions:

- TEMPO NRT products
- ICESat-2 Quick Look products
- To come: HLS low latency products

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Looking to the future

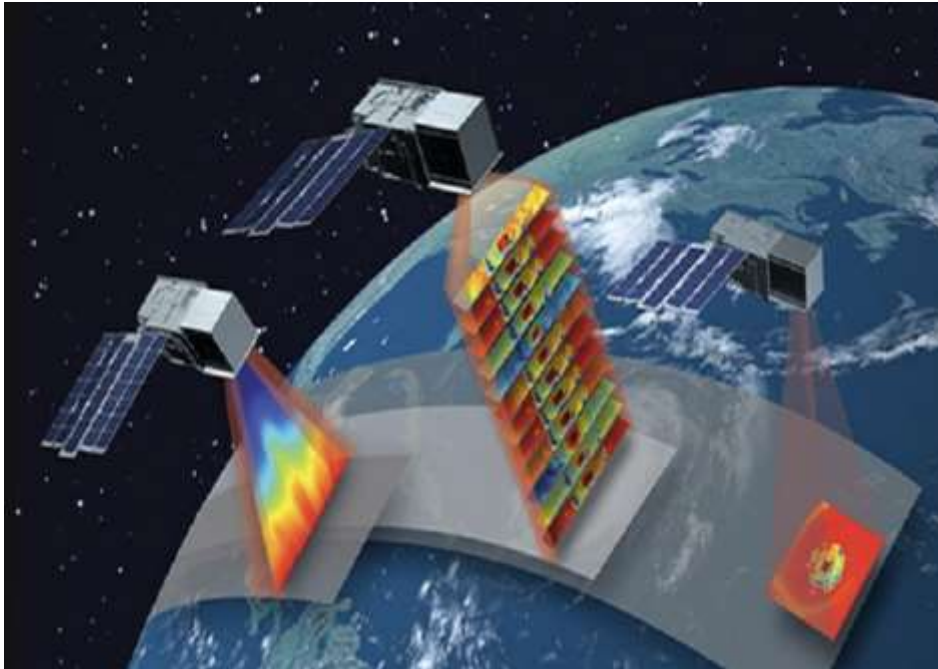


# Looking to the Future

- ❑ TROPICS
- ❑ Tempo
- ❑ PACE
- ❑ Decommissioning of Terra, Aqua, Aura
- ❑ Sentinel-3 project

# TROPICS Update

Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats



## TROPICS Pathfinder Launched June 2021

- Mission ended 12/2023

## TROPICS Constellation Launched May 2023

- TROPICS-03 -05, and -06 are operational with degraded geolocation due to GPS issues
- TROPICS-07 is still not producing science data due to a communication issue between the payload and spacecraft bus since August 2023

# Decommissioning of Terra, Aqua, Aura Impact on LANCE

- [AIRS](#) Atmospheric Infrared Sounder

- [AMSR2](#) Advanced Microwave Scanning Radiometer 2

- [ICESat-2](#) Advanced Topographic Altimeter System (ATLAS) on the Ice, Cloud, and land Elevation Satellite-2

- [MLS](#) Microwave Limb Sounder

- [MODIS](#) Moderate Resolution Imaging Spectroradiometer

- [MOPITT](#) Measurement of Pollution in the Troposphere

- [OMI](#) Ozone Monitoring Instrument

- [OMPS](#) Ozone Mapping Profiler Suite

- [SMAP](#) Soil Moisture Active Passive

- [VIIRS](#) Visible Infrared Imaging Radiometer Suite

 Terra decommission in FY27

 Aqua decommission in FY26

 Aura decommission in FY25

- VIIRS data is available in LANCE for continuity with MODIS Aqua (PM)

- OMPS data is available in LANCE for continuity with OMI

- Sentinel 3: potential for continuity with MODIS (AM); LANCE Pilot Study focus

- Fire product from EUMETSAT for FIRMS;

- Corrected Reflectance and Land Surface Reflectance for Worldview.



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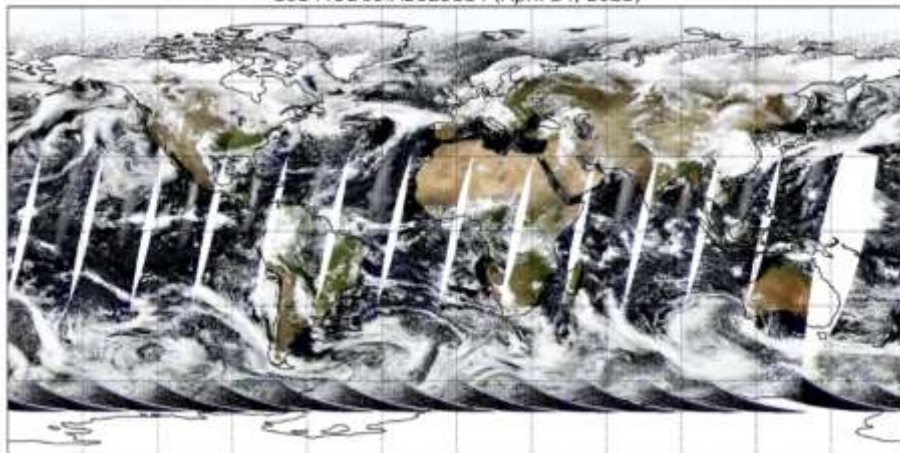
# Sentinel-3 Project

Adapt the MODIS algorithms to provide consistency with the quality and accuracy of the MODIS products.

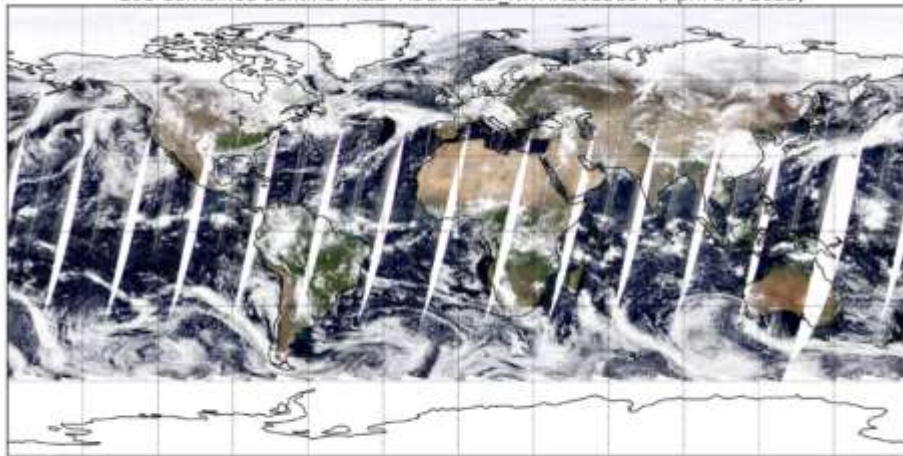
- ❑ **Goal 1/Fire:** Next steps: continue to review and assess the updated product from EUMETSAT and determine if it is suitable for use in FIRMS and Worldview as a replacement for Terra MODIS.  
Develop a fire-appropriate interpolation scheme for combining SLSTR bands F1 and S7 and implement this as a post-swath-reconstruction processing step in the production chain. Develop Level-2, Level-2G, and Level-3 active fire products based on this that will provide consistency with the Terra MODIS Active Fire product suite (MOD14, etc.).
- ❑ **Goal 2/Corrected Reflectance (CR):** Operationalize the CR process evaluated during the pilot study. Imagery from S-3A and S-3B will be fused and delivered to GIBS to provide a continuation from the “morning” MODIS Terra imagery that users rely on in Worldview and FIRMS.
- ❑ **Goal 3/Land Surface Reflectance:** Reconstruct Level 1 swath data. Develop an atmospherically-corrected LSR product from Sentinel-3 (S3) L1 TOA product that will provide continuity to the Terra MODIS LSR suite (MOD09). This will provide the capability for generating additional NASA products from S3, should that be needed.



C61 MOD09.A2023114 (April 24, 2023)



C01 Combined Sentinel A&B A3CREFLO\_NRT.A2023114 (April 24, 2023)



*Fig 2: Fused Corrected Reflectance (True Color, v1, Near Real-Time, OLCI, S3A and B) from 24 April 2023 (top image); the fused corrected reflectance image is comparable with MODIS Terra Corrected Reflectance (True Color) from 24 April 2-23 (bottom image).*



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[earthdata.nasa.gov](http://earthdata.nasa.gov)

## Thank You

For more information on NASA's LANCE (Land, Atmosphere Near real-time Capability for Earth observation)



NASA LANCE