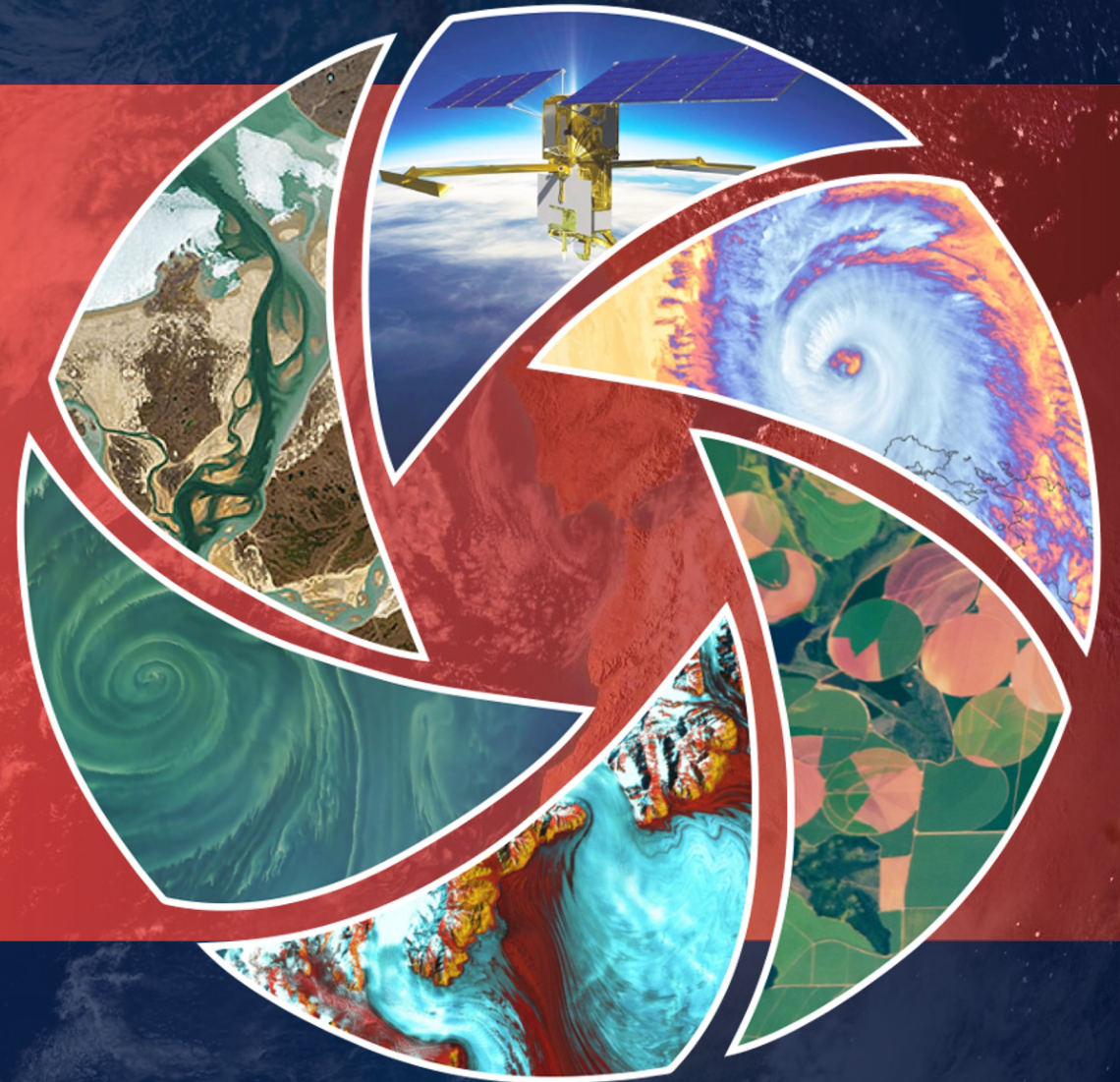


NASA's Land, Atmosphere Near real-time Capability for EOS (LANCE)

Diane Davies, Karen Michael, Jenny Hewson, Dawn Lowe
NASA GSFC

Presentation to ICAP November 9, 2023



EARTHDATA

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LANCE Updates

- Decommissioning of Terra, Aqua, Aura
- TROPICS
- NRT Deep Blue and Dark Target v 2.0
- NRT OMPS Aerosol Index
- Sentinel-3 Pilot Study
- Additional Active Fire data (and functionality) added to FIRMS



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Land, Atmosphere Near Real-time Capability for Earth Observing Systems (LANCE)

- Goal: to provide near real-time (NRT) data products within 3 hours of observations to meet the timely needs of applications users including disasters.
- NRT Imagery is available from GIBS and Worldview.
- LANCE aims to enable NRT science and applications and is used by a broad range of operational and applications users, including USDA-FAS, USAID FEWS-NET, USFS, US National Ice Center, NRL, FEMA, NASA SPoRT, Global Forest Watch, Conservation International, GEOGLAM, ECMWF

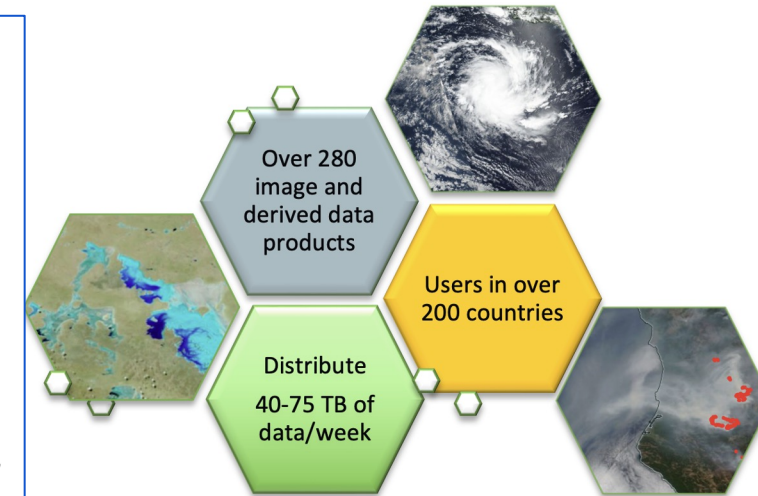


LANCE supports the following applications Air Quality, Dust storms, Fires, Vegetation changes, floods, ash plumes, drought, smoke plumes, sea ice mapping, and severe storms

LANCE

- LANCE provides timely data from 12 instruments
- All data with the exception of ICESat-2 are available within 3 hours of satellite overpass
 - 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
- **LIS ISS** - Lightning Imaging Sensor on the International Space Station
- **ICESat-2** - Advanced Topographic Altimeter System (ATLAS) on the Ice, Cloud, and land Elevation Satellite
- **MISR** - Multi-angle Imaging SpectroRadiometer
- **MLS** - Microwave Limb Sounder
- **MODIS** - Moderate Resolution Imaging Spectroradiometer
- **MOPITT** - Measurements of Pollution in the Troposphere
- **OMI** - Ozone Monitoring Instrument
- **OMPS** - Ozone Mapping and Profiler Suite
- **SMAP** - Soil Moisture Active Passive
- **VIIRS-Atmosphere** - Visible Infrared Imaging Radiometer Suite
- **VIIRS-Land** - Visible Infrared Imaging Radiometer Suite



Decommissioning of Terra, Aqua, Aura Senior Review Outcome

- Terra and Aqua are expected to continue providing MODIS products for at least three more years until FY26.
- After that, the team is directed to initiate mission termination (Phase F) in FY27.
- The drifting orbits will provide valuable diurnal information, and the MODIS Science team is requested to take this into consideration as they plan their algorithm maintenance activities under the Senior Review.
- Program will face the significant challenge of working with constrained budgets
- An exciting opportunity to achieve a 27-year data record.

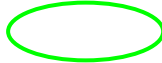


The Aura Project was advised to:

- extend operations through FY25
- initiate mission termination (Phase F) in FY26

Decommissioning of Terra, Aqua, Aura Impact on LANCE

- AIRS - Atmospheric Infrared Sounder
- AMSR2 - Advanced Microwave Scanning Radiometer 2
- LIS ISS - Lightning Imaging Sensor on the International Space Station
- ICESat-2 - Advanced Topographic Altimeter System (ATLAS) on the Ice, Cloud, and land Elevation Satellite
- MISR - Multi-angle Imaging SpectroRadiometer
- MLS - Microwave Limb Sounder

- MODIS - Moderate Resolution Imaging Spectroradiometer
- MOPITT - Measurements of Pollution in the Troposphere
- OMI - Ozone Monitoring Instrument
- OMPS - Ozone Mapping and Profiler Suite
- SMAP - Soil Moisture Active Passive
- VIIRS-Atmosphere - Visible Infrared Imaging Radiometer Suite
- VIIRS-Land - 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
- ATMS and CrIS data: available in NRT to a limited customer base from NOAA
- Sentinel 3: some potential for continuity with MODIS (AM); LANCE pilot study underway (Fire product from EUMETSAT for FIRMS; Corrected Reflectance and Land Surface Reflectance for Worldview).

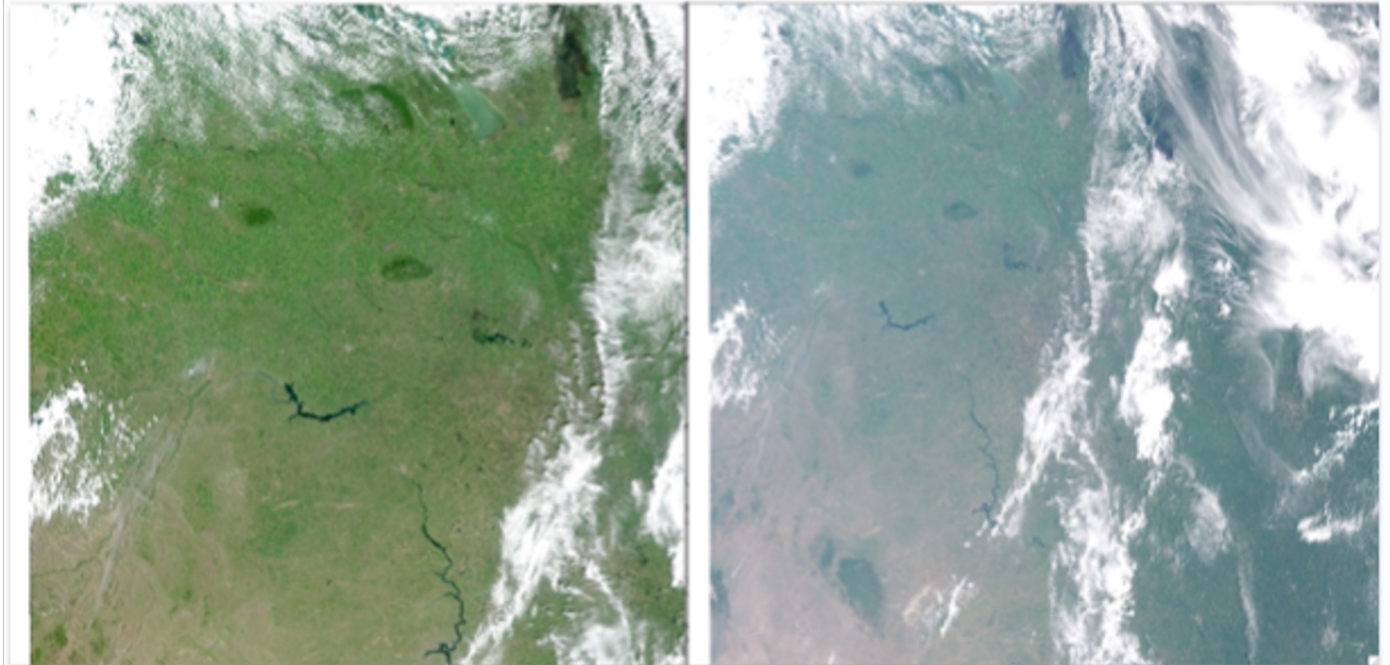
Objective of the Sentinel-3 (S3) Pilot Study

To study and demonstrate feasibility of Sentinel-3 data towards ensuring continuity of Earth System Data Records (ESDRs) from Terra-AM MODIS. Four main goals of this project are:

1. Evaluate Sentinel 3A (S3A) and 3B (S3B) **NRT Fire Products**, and extract and import the active fire data into the FIRMS database for display and distribution in LANCE FIRMS and Worldview
2. Generate S3A and S3B NRT L2 **Corrected Reflectance (CR) Product** and generate Terra-AM MODIS heritage CR imagery from S3 CR for distribution and display on LANCE and GIBS/Worldview.
3. Prototype Sentinel 3 standard product for **Land Surface Reflectance (LSR)** at SIPS.
4. Support, as appropriate, program-wide engagement with CEOS WGCV on ESA/NASA Bilateral Activities.

Preliminary Results from S3 Pilot Study

- NASA (Louis Giglio) is providing feedback to EUMETSAT (Julian Chimot) on the S3 FRP product to enable it to be used in FIRMS and Worldview as a replacement for Terra MODIS.
- NASA (Eric Vermote) has finished code to produce OLCI Corrected Reflectance imagery. Code for OLCI Surface Reflectance should be complete in November 2023.
 - next step will be validation
 - browse imagery in GIBS/Worldview

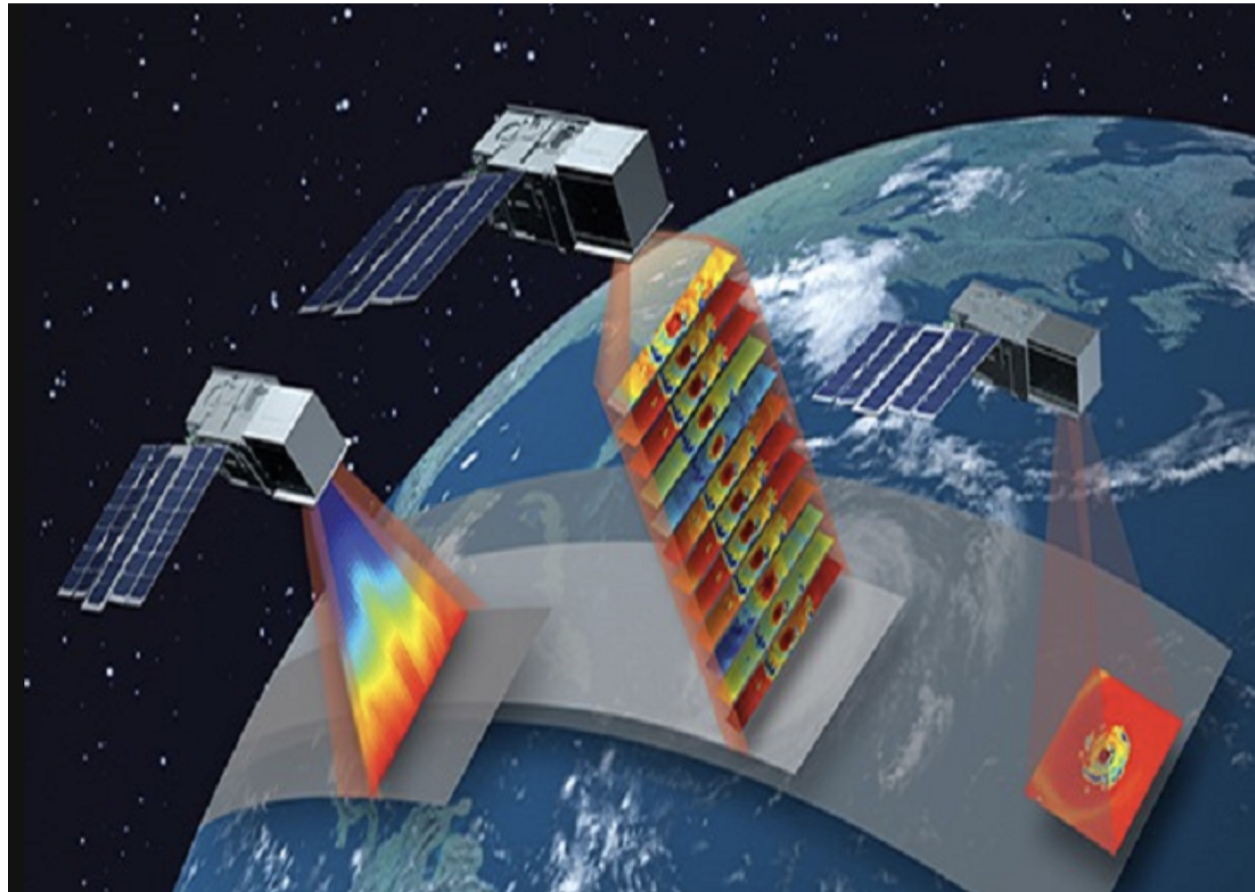


Corrected reflectance's (OLCI)
RGB

Top of the atmosphere reflectance's
(OLCI) RGB

TROPICS Update

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



TROPICS Pathfinder Launched June 2021

- L1b validated products are currently released to Early Adopters and NRT users
- An update to reduce the orbital bias on some channels is underway, and a validated-2 is expected by early 2024 that will be released to the public

TROPICS Constellation Launched May 2023

- Only three of the four satellites are presently producing science data
- All the constellation data is available NRT at beta maturity for imagery purposes only

TROPICS Update



TROPICS Constellation

- TROPICS-03 and TROPICS-06 L1a/L1b is at provisional maturity with the data record starting in June 2023 (available via GES DISC)
- TROPICS-05 provisional maturity is under development and expected within a month
- TROPICS-07 only has data from mid-June to end of July and will be provisional later this year after TROPICS-05
- Data access is currently limited to Early Adopters and public release is expected in early December
- Transfer of the provisional calibration to the NRT processing will be in early 2024

TROPICS project has received funding from several organizations for additional ground contacts for continued NRT processing.

Current plans are to support NRT TROPICS data in LANCE and Worldview when the data becomes public.



Slide courtesy of Jess Braun (Univ of Wisconsin-Madison)
and Vince Leslie (MIT Lincoln Laboratory)

NRT OMPS Aerosol Index

- Work to extend aerosol index availability through LANCE is underway
- Code to generate the AI product from the NOAA 20 and NOAA 21 OMPS sensors has been developed and tested
 - These products will utilize the heritage definition of the AI
 - Will make them compatible with the product from heritage TOMS sensors and with the current TROPOMI sensor
 - Will make comparisons between current and historical events easier, particularly for communities like the pyroCb group
- Plan to have both NOAA 20 and NOAA 21 products available by early next year
 - Current S-NPP OMPS product uses a different formulation for the AI, will be reverted back to the heritage form at this time



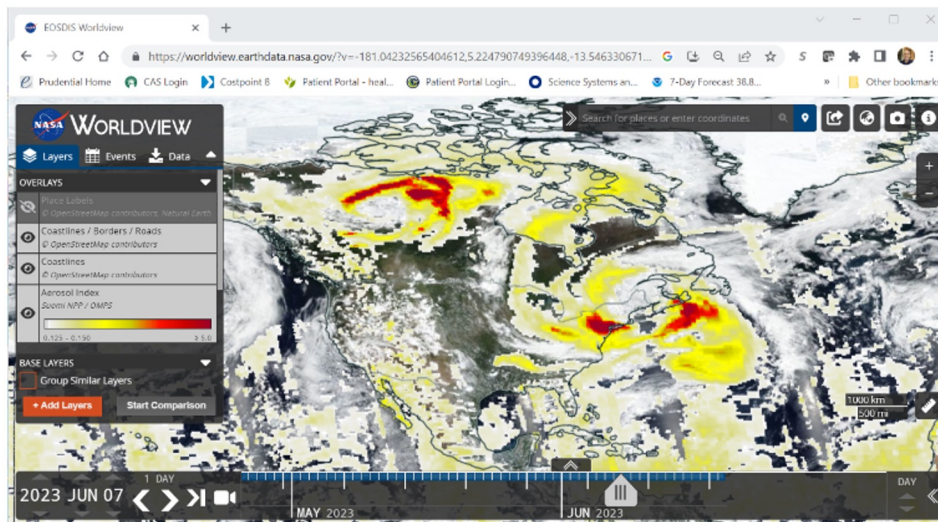
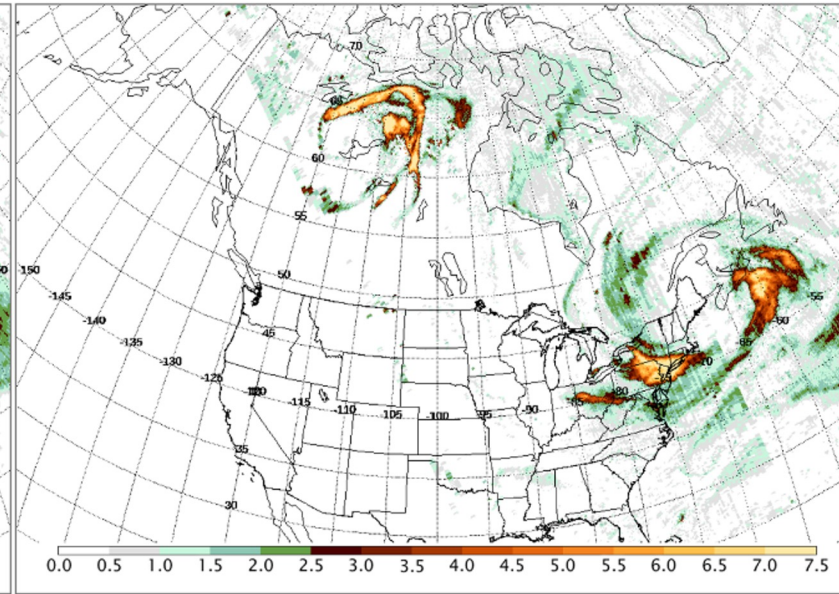
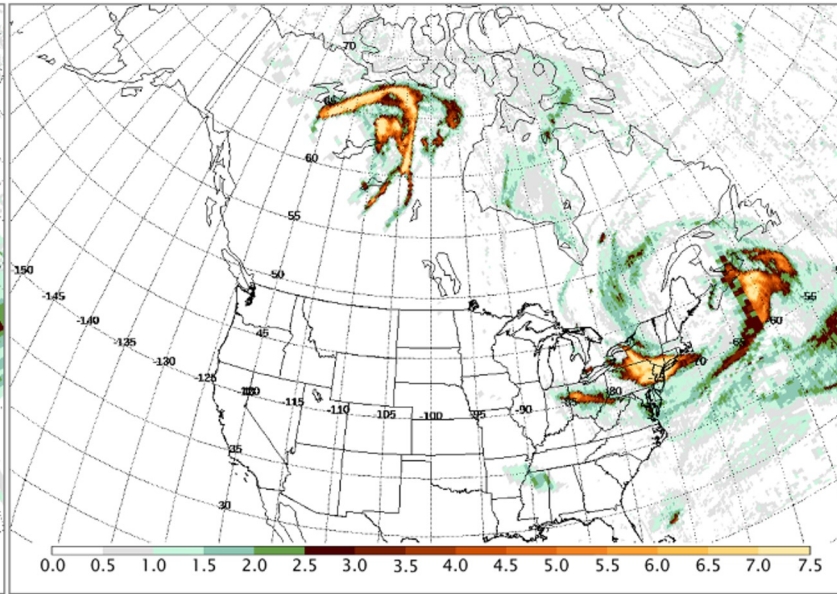
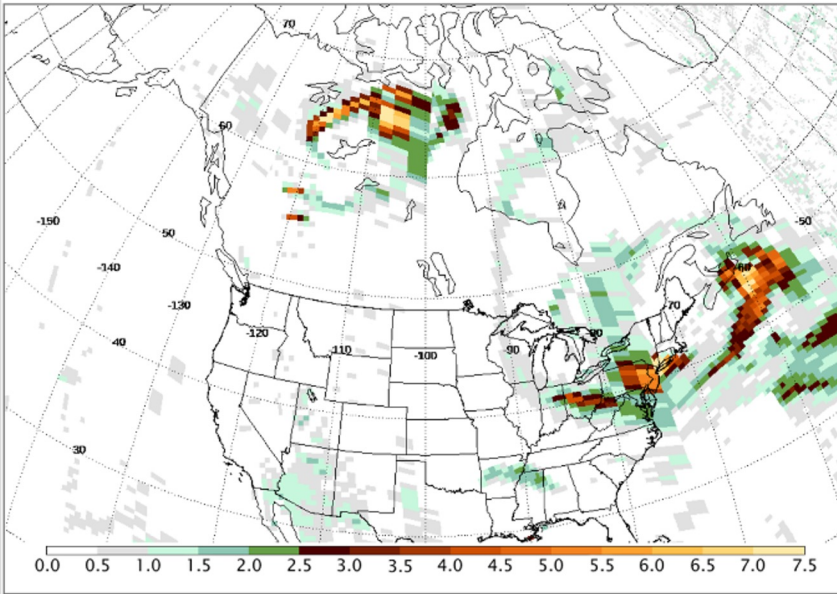
OMPS AI for 7 June 2023 showing increased resolution from S-NPP to N20 to N21



S-NPP

N20

N21



LANCE S-NPP OMPS AI in Worldview on the left

Photo from Greenbelt, MD at ~7 AM EDT on the right



Slide and Photo Courtesy of Colin Seftor, NASA GSFC

Updates from LANCE VIIRS Atmosphere

NRT Deep Blue v 2.0 (includes new NOAA-20)

- product is searchable in Earthdata Search
- imagery is in testing in GIBS/Worldview UAT environment

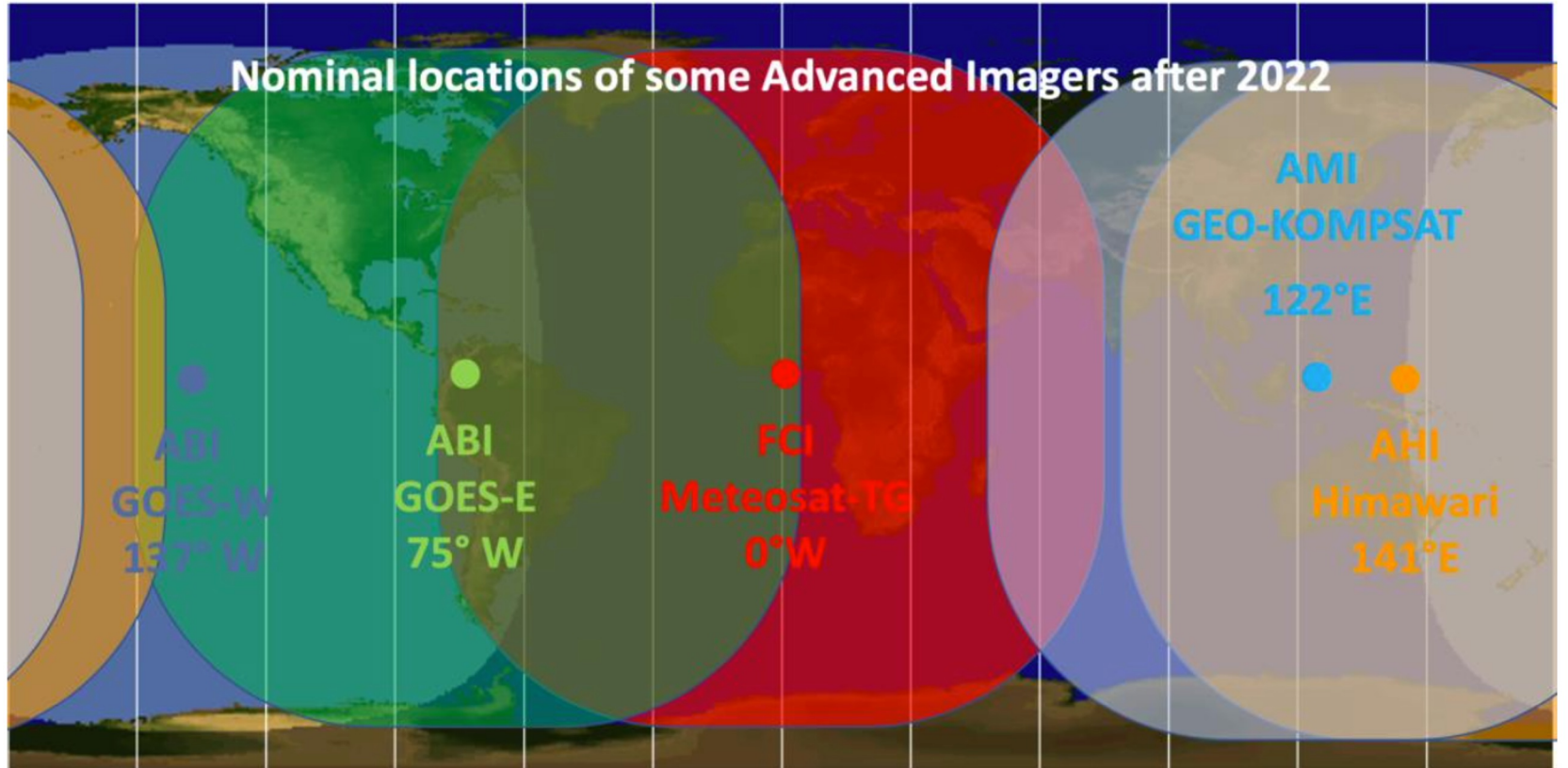
NRT Dark Target v 2.0 (includes new NOAA-20)

- awaiting an update to better support NRT processing latency from the Science Team

Update on LANCE Enhancement Request

Near Real Time
Geostationary
Aerosol Data

Put forward by
Arlindo da Silva (NASA)
Jeffrey Reid (NRL)



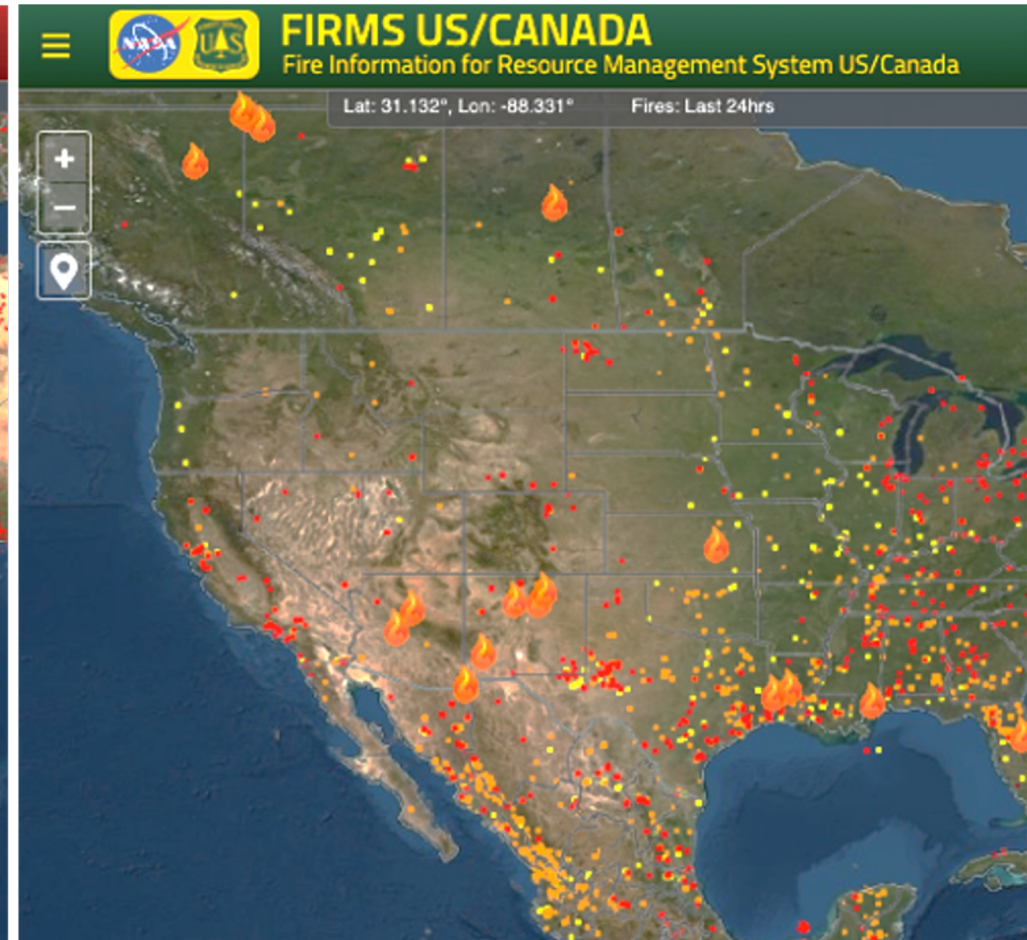
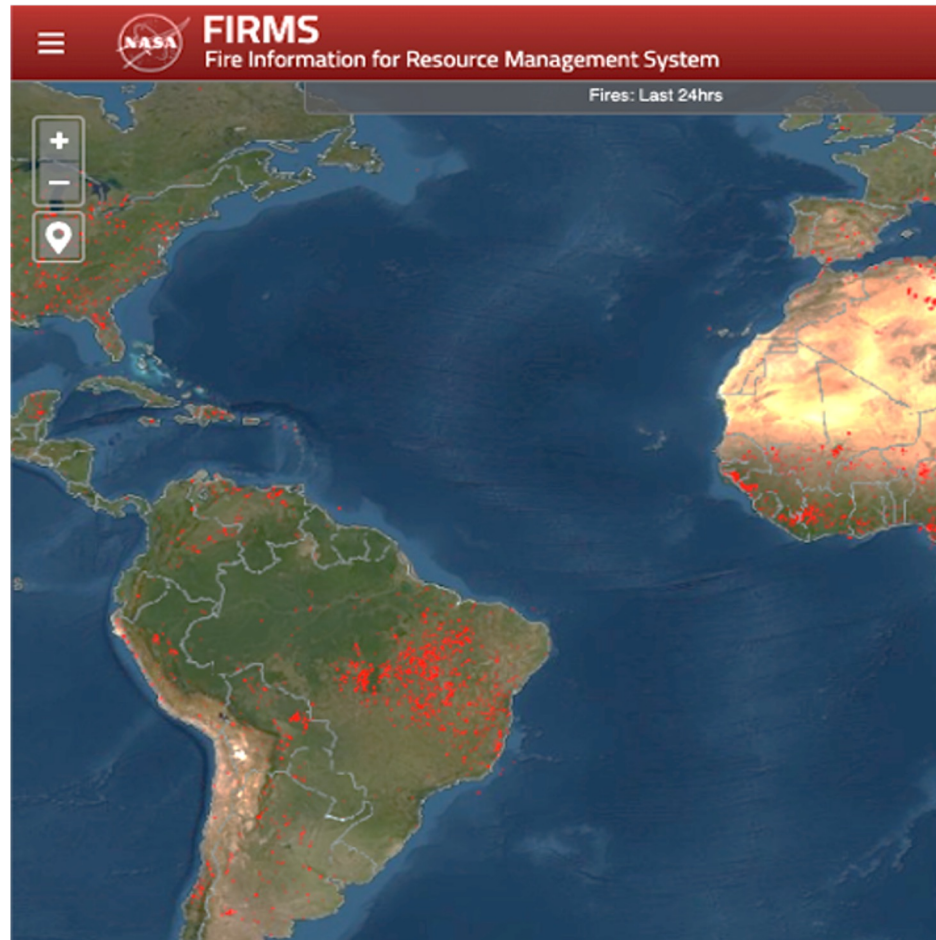
Nominal location of some advanced geostationary imagers after 2022

Other Potential LANCE Products

- AMSR3 is expected to launch between April 2024 and March 2025.
 - JAXA has agreed to provide NRT data to NASA, and a technical approach and budget have been presented to NASA HQ.
- New products may come from the SNWG
 - TEMPO nominally operational.
 - SNWG stakeholder engagement meeting scheduled for November 8, 2023

NASA FIRMS

Fire Information for Resource Management System



Satellite Active Fire Detection Data Used in FIRMS

Active Fire and Thermal Anomalies Data				
Sensor (Platform)	Source	Spatial Resolution	Temporal Resolution	Latency ⁴ (Coverage)
ABI (GOES-16 & 18)	NOAA	2km sub-satellite ¹	Sub-hourly	RT - ~20-30 mins (Americas)
ABI (GOES-16 & 18)	KCL/IPMA	2km sub-satellite ¹	Sub-hourly	RT - ~20-30 mins (Americas)
SEVIRI (Meteosat 9 & 11)	EUMETSAT/LSA SAF	3km sub-satellite ¹	Sub-hourly	RT - ~30 mins (Europe-Africa-India)
AHI (Himawari-8)	KCL/IPMA	2km sub-satellite ¹	Sub-hourly	RT - ~30 mins (Australia-Asia)
MODIS (Terra/Aqua)	NASA LANCE	1km sub-satellite ¹	Twice daily ²	NRT - <3 hours (Global)
VIIRS (Suomi NPP/NOAA-20)	NASA LANCE	375m sub-satellite ¹	Twice daily ²	NRT - <3 hours (Global)
MODIS (Terra/Aqua)	SSEC Univ of Wisconsin	1km sub-satellite ¹	Twice daily ²	RT - <30 mins (US-Canada)
VIIRS (Suomi NPP/NOAA-20)	SSEC Univ of Wisconsin	375m sub-satellite ¹	Twice daily ²	RT - <30 mins (US-Canada)
MODIS (Terra/Aqua)	SSEC Univ of Wisconsin	1km sub-satellite ¹	Twice daily ²	URT - <1 mins (US-Canada)
VIIRS (Suomi NPP/NOAA-20)	SSEC Univ of Wisconsin	375m sub-satellite ¹	Twice daily ²	URT - <1 mins (US-Canada)
OLI (Landsat 8 & 9)	USGS EROS	30m	8 days ³	RT - <30 mins (US-Canada)

¹ The pixel size systematically grows from sub-satellite towards the edge of the disk/swath.

² Thermal data are collected for daytime and nighttime observations ~ 12 hours apart.

³ L8 and L9 orbit cycles each have 16-day orbit cycles and their orbits are 8 days out of phase. This does not include potential nighttime observations.

⁴ Latency refers to the estimated time from satellite observation to availability in FIRMS. Near Real-Time (NRT), Real-Time (RT) & Ultra-Real-Time (URT).

Thank you

earthdata.nasa.gov/lance

questions: diane.k.davies@nasa.gov

Back-up Charts



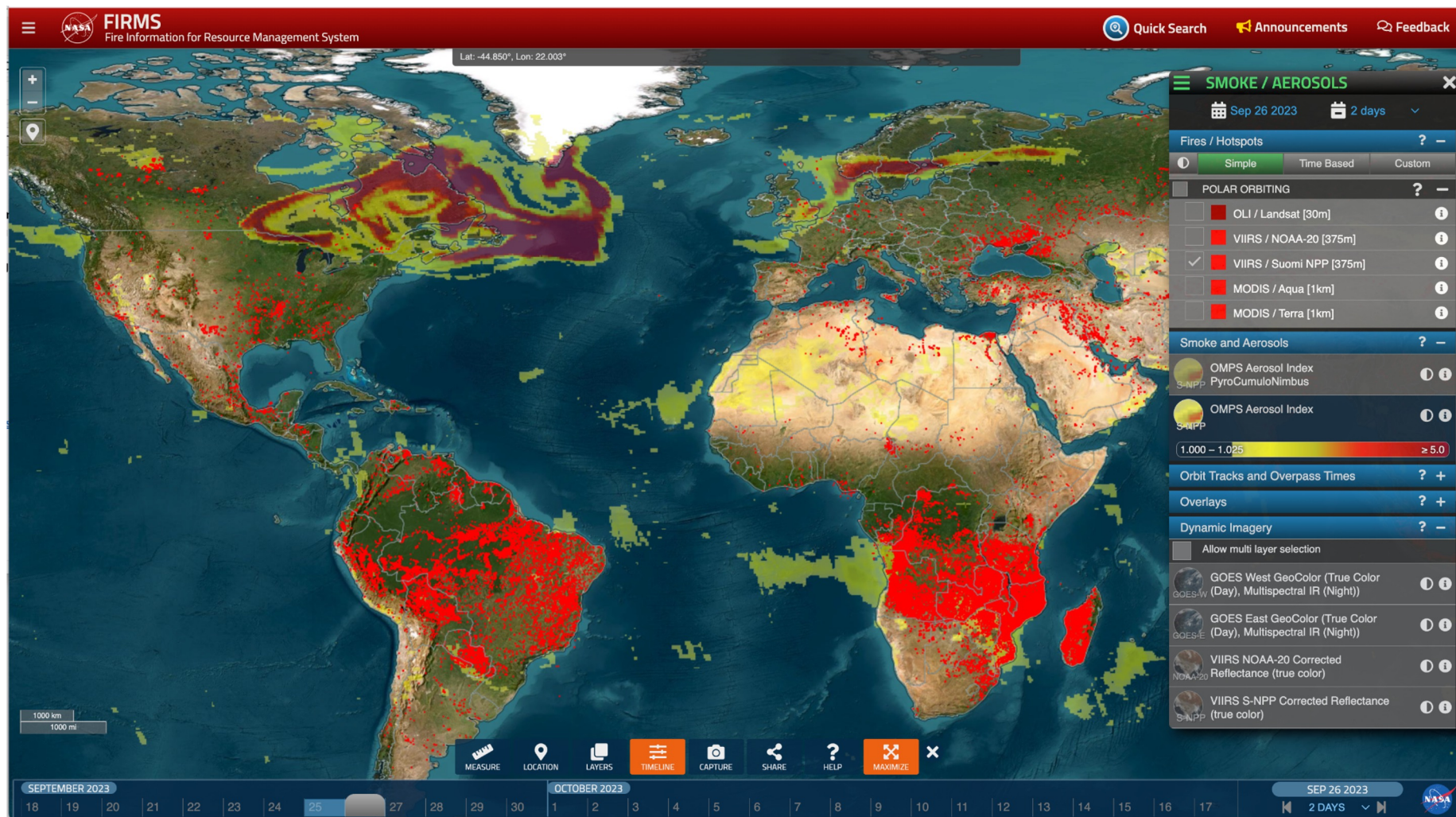
Sentinel-3 Pilot Study - Background

- MODIS Terra (AM Platform) is a mainstay of land science and applications.
- VIIRS instruments are all PM overpass – no US morning overpass.
 - NOAA uses MetOp AVHRR and will use MetOp-SG MetImage.
- Land Discipline recommended that NASA evaluate Sentinel 3 series as a replacement for MODIS Terra and start to consider METimage data from MetOp-SG
 - 2018 MODIS VIIRS Science Team meeting
 - May 2023 NASA TAA Data Continuity Workshop
 - SNWG agencies (USDA, NASA, USFS) had made strong requests for AM continuity (Agriculture and Fire Monitoring)
 - We received several international inputs on the need for AM continuity for fire monitoring.
- NASA HQ agreed to fund a pilot study.

Update FIRMS UI

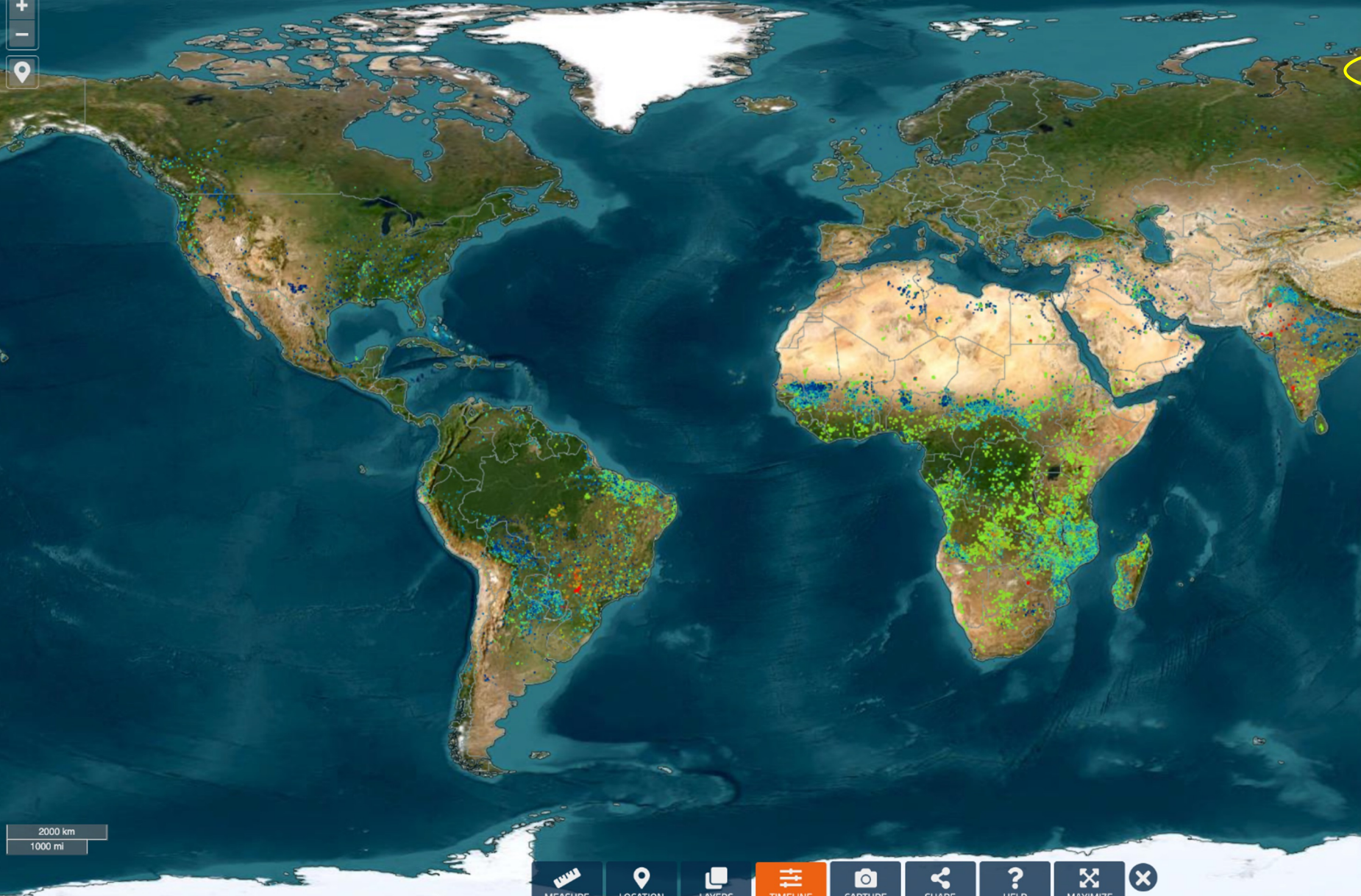
MAIN MAP MENU

BASIC MODE	ADVANCED MODE	BURNED AREA
US/CANADA	SMOKE / AEROSOLS	EXPERIMENTAL IN-PROGRESS
FIRE ALERTS	DOWNLOADS	



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Lat: 30.007°, Lon: 86.834°



ADVANCED MODE [X]

1hr 4hrs Today **24hrs** 7days [i]

DAILY SUB-DAILY

Nov 08 2023 2 days [v]

Fires / Ho [?] -

Pre-select [?] -

- Custom
- Fires
- Confidence
- FRP**
- Time Since Detection (1 Day +)
- Time Since Detection (5 Days +)

VIIRS / NOAA-20 [375m] [?] -

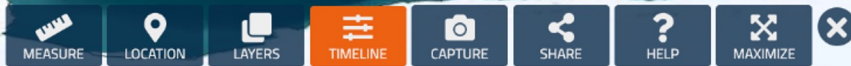
VIIRS / Suomi NPP [375m] [?] -

MODIS / Aqua [1km] [?] -

MODIS / Terra [1km] [?] -

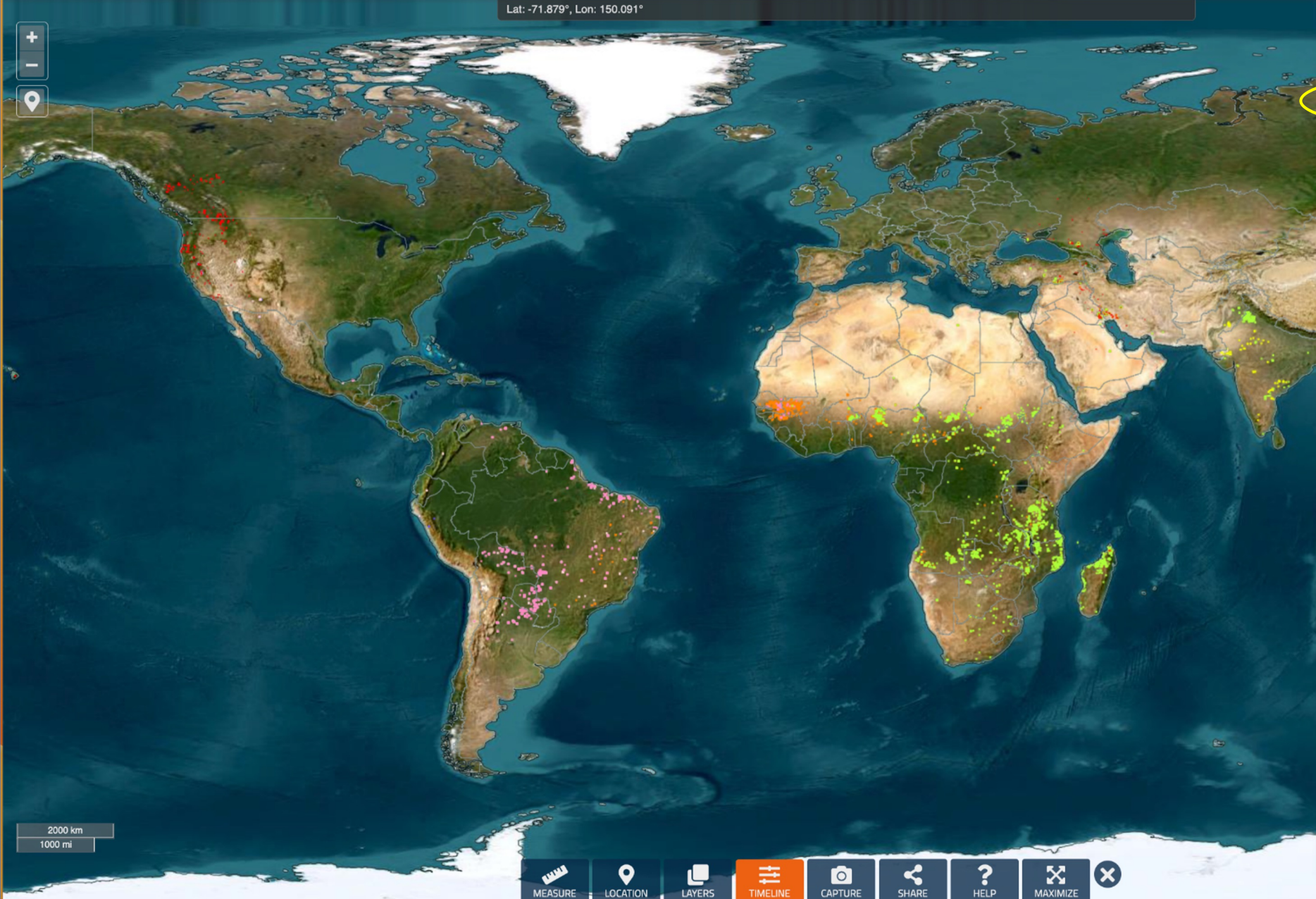
GEOSTATIONARY **BETA** [?] -

- Filtered Geostationary (provisional) [?] -
- GOES-18 NOAA FDC [?] -
- GOES-18 (KCL/IPMA) [?] -
- GOES-16 NOAA FDC [?] -
- GOES-16 (KCL/IPMA) [?] -
- Himawari-8 (KCL/IPMA) [?] -
- Meteosat-9 LSA SAF [?] -
- Meteosat-11 LSA SAF [?] -
- NRT AND STANDARD (FOR RESEARCH) [?] +





Lat: -71.879°, Lon: 150.091°



ADVANCED MODE ✕

1hr **4hrs** Today 24hrs 7days ⓘ

DAILY **SUB-DAILY**

📅 Nov 08 2023 🕒 13:50 UTC

-10 mins 4 hrs +10 mins

Fires / Hotspots ? -

🕒 Simple Time Based **Custom**

Pre-select: **Fires** ▼

POLAR ORBITING **RECOMMENDED** ? -

- OLI / Landsat [30m] + ⓘ
- VIIRS / NOAA-20 [375m] + ⓘ
- VIIRS / Suomi NPP [375m] + ⓘ
- MODIS / Aqua [1km] + ⓘ
- MODIS / Terra [1km] + ⓘ

GEOSTATIONARY **BETA** ? -

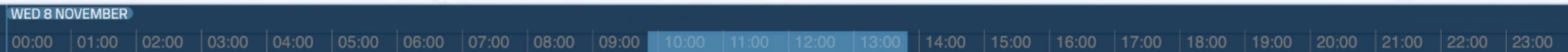
- Filtered Geostationary (provisional) + ⓘ
- GOES-18 NOAA FDC + ⓘ
- GOES-18 (KCL/IPMA) + ⓘ
- GOES-16 NOAA FDC + ⓘ
- GOES-16 (KCL/IPMA) + ⓘ
- Himawari-8 (KCL/IPMA) + ⓘ
- Meteosat-9 LSA SAF + ⓘ
- Meteosat-11 LSA SAF + ⓘ

NRT AND STANDARD (FOR RESEARCH) ? +

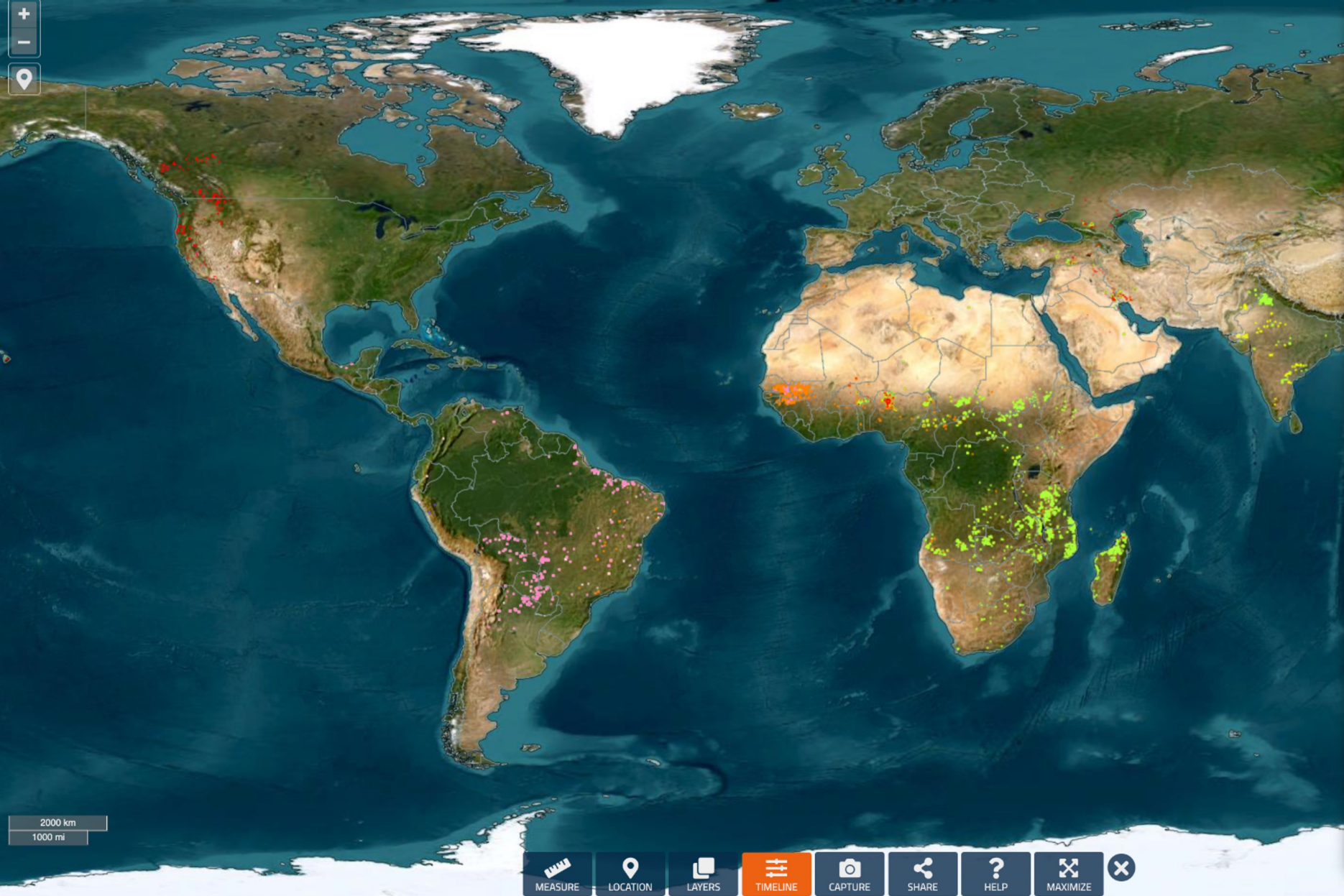
Orbit Tracks and Overpass Times ? +

MODIS Burned Area ? +

Smoke and Aerosols ? +



Lat: -71.879°, Lon: 150.091°

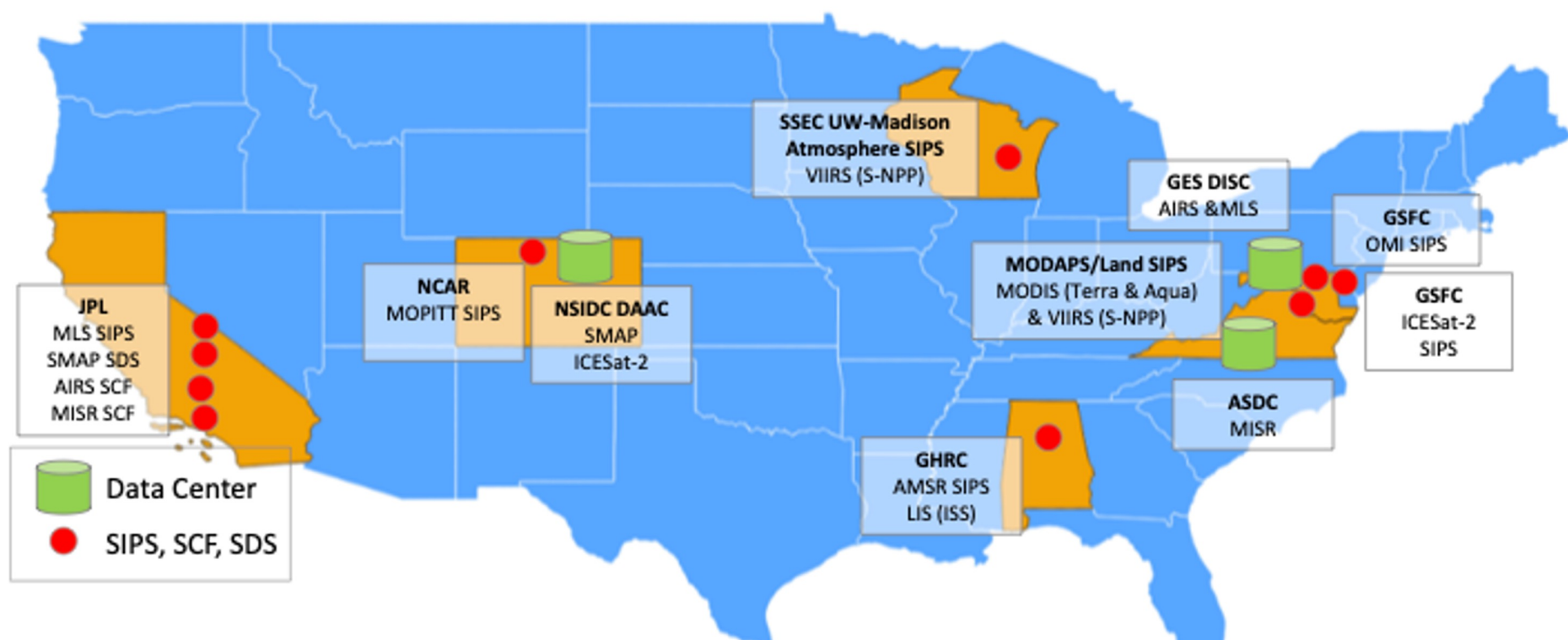


2000 km
1000 mi

MEASURE LOCATION LAYERS TIMELINE CAPTURE SHARE HELP MAXIMIZE

ADVANCED settings menu including time intervals (1hr, 4hrs, 1hr, 2hrs, 3hrs, 4hrs, 6hrs, 8hrs, 10hrs, 12hrs, 18hrs, 24hrs), layer selection (POLAR ORBIT, GEOSTATIONARY), and data sources (OLI, VIIRS, MODIS, GOES, Himawari, etc.).

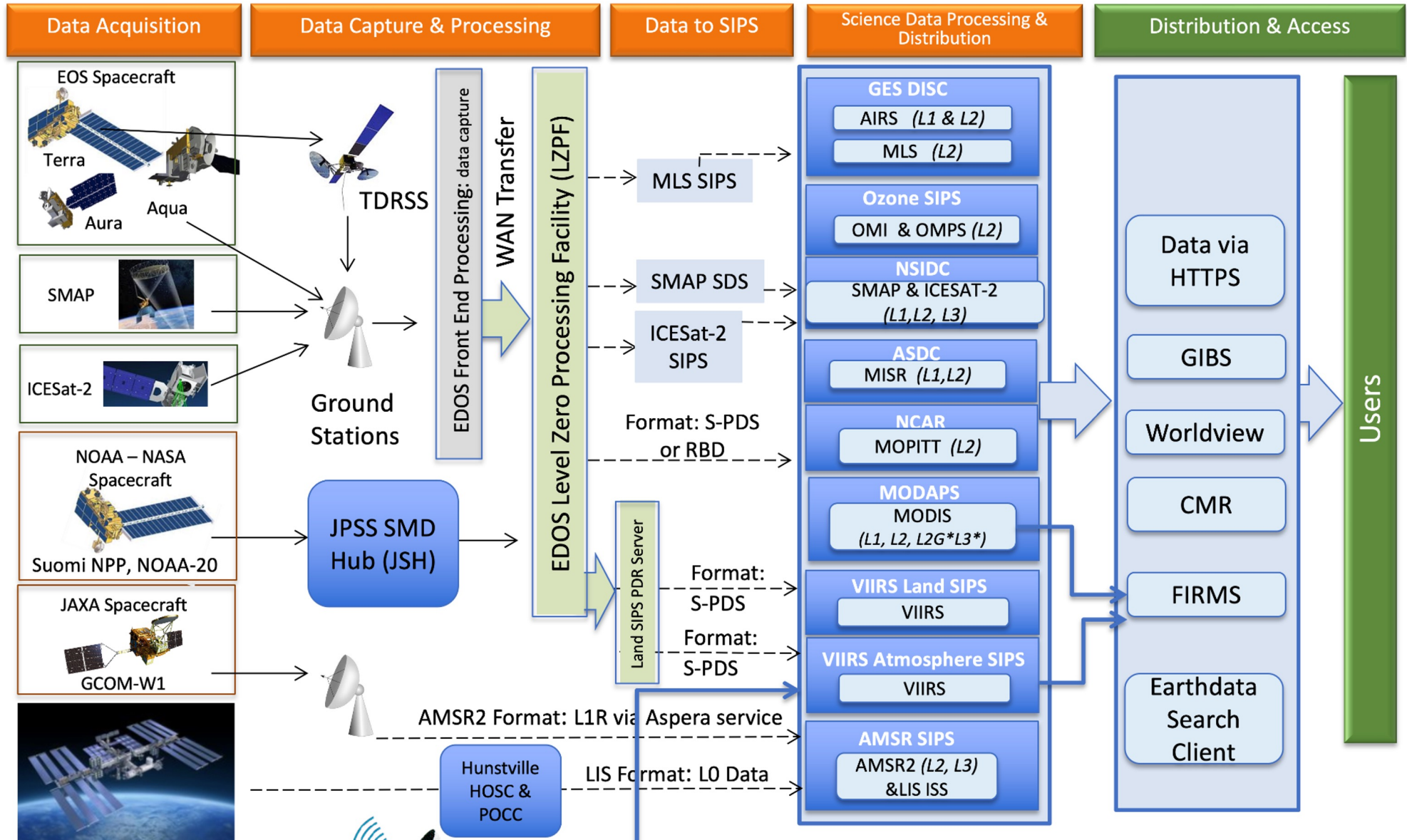
Current LANCE Facilities



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
- **Atmospheric Science Data Center (ASDC)** is providing MISR data with support from the MISR SCF at JPL
- **AMSR Science Investigator-led Processing System (SIPS)** is providing AMSR2 and LIS data
- **MODIS Adaptive Processing System (MODAPS) and Land SIPS** are providing MODIS and VIIRS Land data
- **OMI 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)

LANCE Architecture



International Space Station

Direct Broadcast / Readout Stations

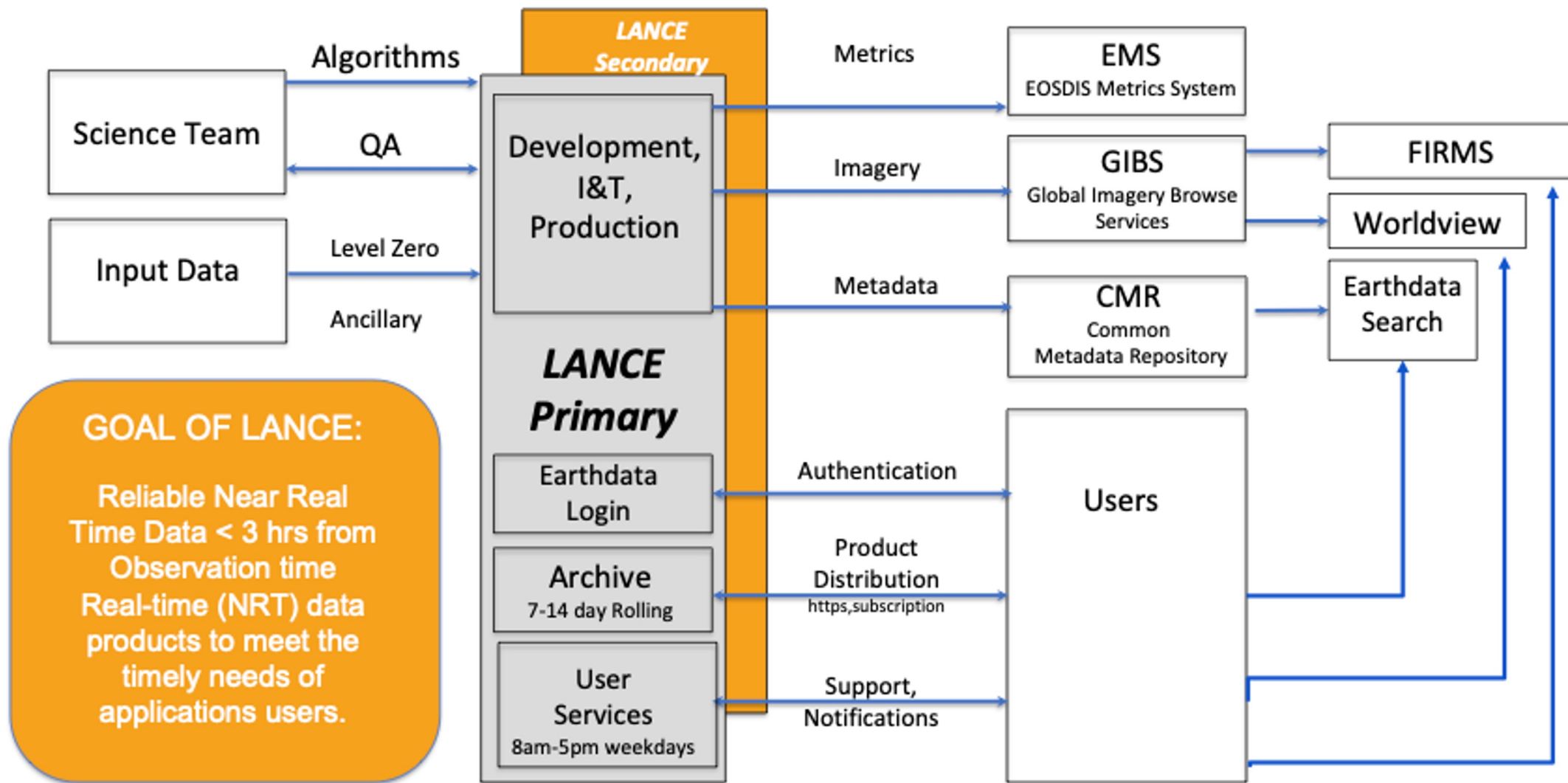


SIPS: Science Investigator-led Processing Systems, TDRSS: Tracking and Data Relay Satellite System, SDS: Science Data System

RBD: Rate Buffered Data, S-PDS: Session Based Production Data Set

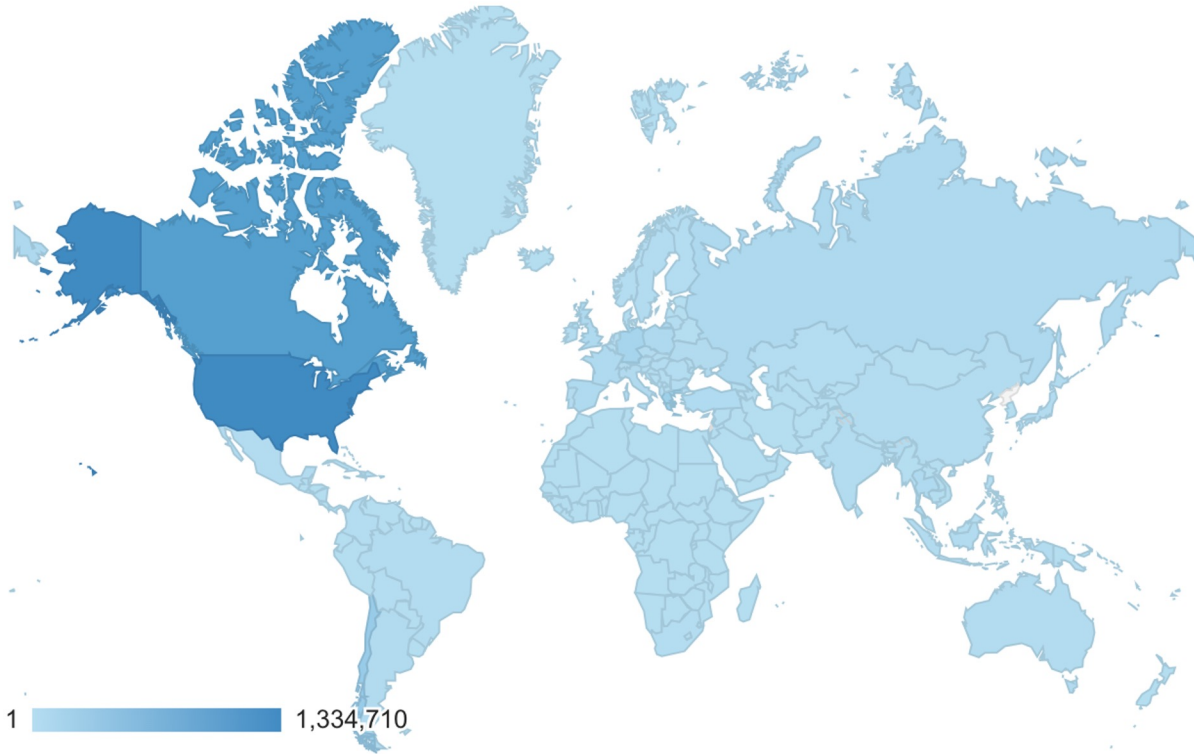
*MODIS & VIIRS L2G and L3 products are 27 – 48 hours, ICESat-2 L3 has a latency of 3 days

LANCE in a Nutshell



LANCE Metrics

20 Oct 2022 - 26 Oct 2023 ▾



Country ?	Acquisition	
	Users ? ↓	New Users ?
	3,777,916 % of Total: 100.00% (3,777,916)	3,750,231 % of Total: 100.10% (3,746,373)
1. 🇺🇸 United States	1,334,710 (35.12%)	1,337,814 (35.67%)
2. 🇨🇦 Canada	992,401 (26.11%)	983,012 (26.21%)
3. 🇨🇱 Chile	269,077 (7.08%)	267,250 (7.13%)
4. 🇬🇷 Greece	202,837 (5.34%)	201,730 (5.38%)
5. 🇩🇪 Germany	128,819 (3.39%)	124,253 (3.31%)
6. 🇵🇱 Poland	66,281 (1.74%)	63,961 (1.71%)
7. 🇷🇺 Russia	58,110 (1.53%)	56,630 (1.51%)
8. 🇬🇧 United Kingdom	53,347 (1.40%)	51,606 (1.38%)
9. 🇪🇸 Spain	48,113 (1.27%)	46,614 (1.24%)
10. 🇹🇭 Thailand	47,887 (1.26%)	47,291 (1.26%)

