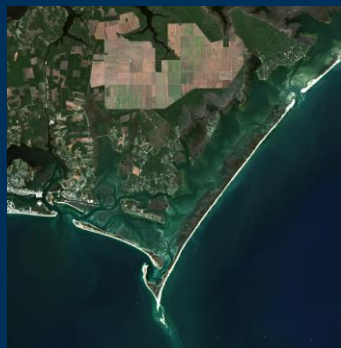
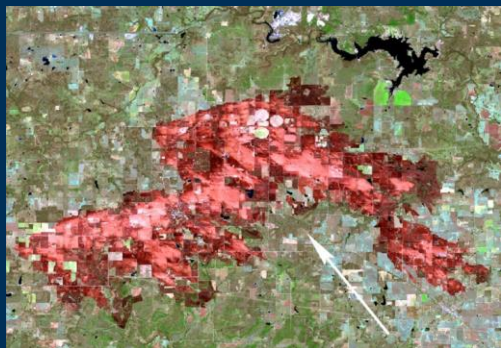




Advancing science capabilities with data harmonization: NASA's Harmonized Landsat Sentinel-2 products



Danielle Golon

C2G, contractor to the U.S. Geological Survey
(USGS) Earth Resources Observation and
Science (EROS) Center
Sioux Falls, South Dakota

Dr. Brian Freitag

Research Physical Scientist, NASA Marshall
Space Flight Center (MSFC)
Huntsville, Alabama

*Work performed under USGS contract [G0121D0001]

U.S. Department of the Interior
U.S. Geological Survey

What is NASA's LP DAAC?

- Land Processes (LP) Distributed Active Archive Center (DAAC)
 - <https://lpdaac.usgs.gov>
- Located at the USGS Earth Resources Observation and Science (EROS) Center in Sioux Falls, SD
- Established in 1990



LP DAAC Data Fast Facts!

- Access to 7.8 Petabytes of land data
- Data available from 1981 to present
- Data provides information about the Earth from 1 millimeter spatial resolution up to 5,600 meters per pixel
- All data, on-premises and in the cloud, and resources available at no cost



ASTER: AST_L1T
Kurnool Ultra Mega Solar Park, India
DOI 10.5067/ASTER/AST_L1T.003:
15 meter



VIIRS: VNP09CMG
Globe
DOI 10.5067/VIIRS/VNP09CMG.001:
5,600 meter

Harmonized Landsat Sentinel-2 (HLS)

- Aims to produce a **consistent, harmonized** surface reflectance product from **Landsat 8** Operational Land Imager (OLI) and **Sentinel-2** Multi-Spectral Instrument (MSI) data. Providing a unique opportunity to observe the earth every **2-3 days** at a **medium** resolution.
- Version 2 Data Products
 - **HL30** – Derived from Landsat 8 OLI data
 - Landsat 9 coming soon!
 - **HS30** – Derived from Sentinel-2 MSI data
- Spatial Extent: **Global**
- Spatial Resolution: **30 m**
- Temporal Extent: Available since **2013-04-11**
 - *Historical processing is ongoing
- File Format: **Cloud Optimized GeoTIFF (COG)**



Harmonized Landsat Sentinel-2 (HLS)

- What is "harmonized"?
 - Using data from two similar instruments and constructing an algorithm so derived products from each instrument can be used interchangeably
- Spectral similarities of Landsat OLI and Sentinel-2 MSI allow for data harmonization of the two instruments
 - Virtual constellation allows for global coverage at 30 meter resolution every 2-4 days



Sentinel-2

photo credit: ESA



Landsat 8

photo credit: NASA

MSI vs. OLI characteristics

Parameter	MSI	OLI
Swath	290 km	185 km
Repeat Cycle	10 (5)	16 (8)
Field of View	20.6	15
Equatorial Crossing	10:30 AM	10:13 AM
Spectral Coverage	440-2300 nm	440-2300 nm
Spectral Bands	13	9
IFOV	4 VNIR Bands @10 m 6 Bands @ 20 m 3 Atmospheric Bands @ 60m	8 Bands @ 30m 1 Pan Band @ 15m
Data Quantization	12 bits	12 bits
Saturation Radiances	~100% diffuse solar	~100% diffuse solar

HLS Coverage Area

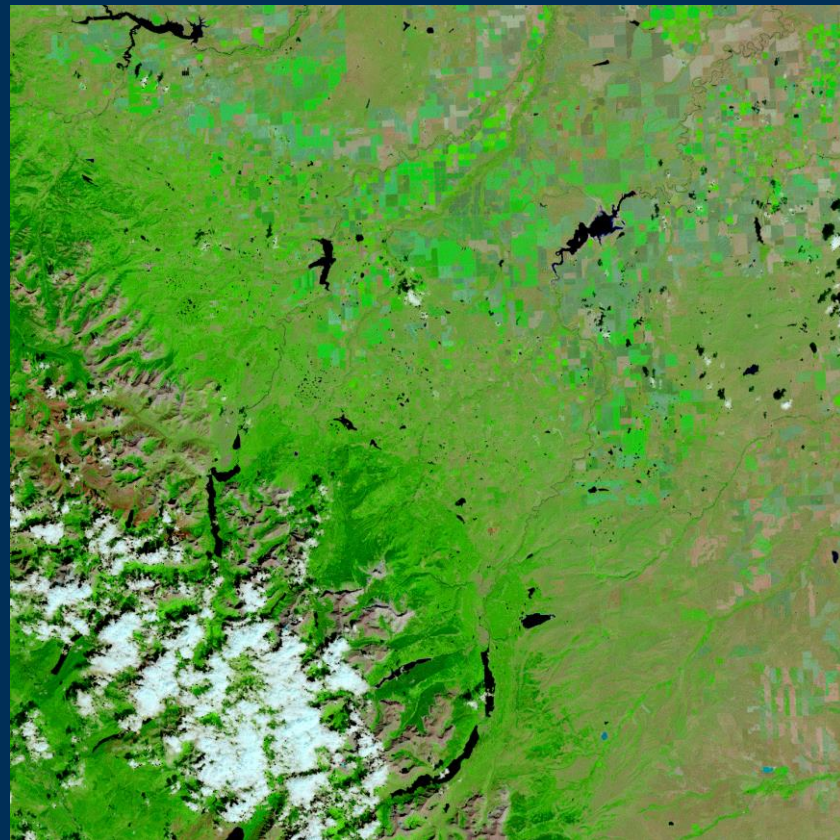


U.S. Geological Survey



HLS Dataset Statistics

	HLSSL30	HLSS30
Current data start date	11-Apr-2013	29-Sep-2020
Number of granules	~7.75M	~3.4M
Average daily files	2350	5860
Average daily volume (TB)	0.75	1.9



HLS Dataset Statistics

- Resolution: 30 m
- Latency: 2-4 days - dependent upon MODIS data for atmospheric correction
- Data Format: Cloud-optimized Geotiff
- Granule Structure:
 - 13 (10) single band data files
 - 4 angle bands
 - 1 QA band, 1 browse image, 1 STAC metadata record



HLSS30 Band Information

Band Name	S30 Band	Wavelength (μm)	Units
Coastal Aerosol	B01	0.43 - 0.45	reflectance
Blue	B02	0.45 - 0.51	reflectance
Green	B03	0.53 - 0.59	reflectance
Red	B04	0.64 - 0.67	reflectance
Red-Edge 1	B05	0.69 - 0.71	reflectance
Red-Edge 2	B06	0.73 - 0.75	reflectance
Red-Edge 3	B07	0.77 - 0.79	reflectance
NIR Broad	B08	0.78 - 0.88	reflectance
NIR Narrow	B8A	0.85 - 0.88	reflectance
Water Vapor	B09	0.93 - 0.95	reflectance
Cirrus	B10	1.36 - 1.38	reflectance
SWIR 1	B11	1.57 - 1.65	reflectance
SWIR 2	B12	2.11 - 2.29	reflectance

HLSL30 Band Information

Band Name	L30 Band	Wavelength (μm)	Units
Coastal Aerosol	B01	0.43 - 0.45	reflectance
Blue	B02	0.45 - 0.51	reflectance
Green	B03	0.53 - 0.59	reflectance
Red	B04	0.64 - 0.67	reflectance
NIR Narrow	B05	0.85 - 0.88	reflectance
SWIR 1	B06	1.57 - 1.65	reflectance
SWIR 2	B07	2.11 - 2.29	reflectance
Cirrus	B09	1.36 - 1.38	reflectance
Thermal IR 1	B10	10.60 - 11.19	degrees (C)
Thermal IR 2	B11	11.50 - 12.51	degrees (C)

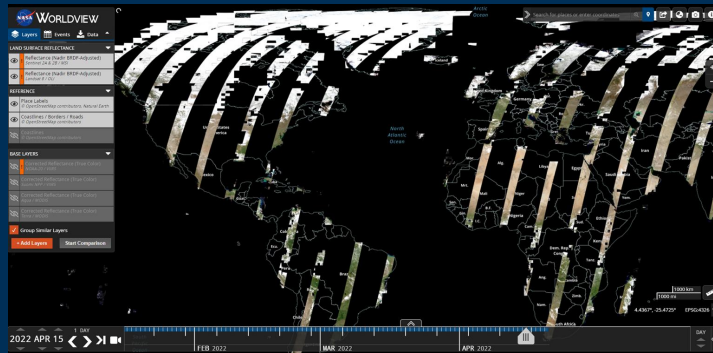
Resources!



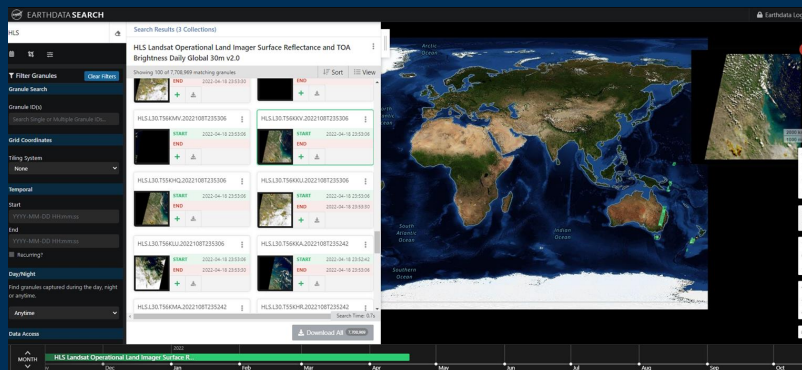
- DOI Landing Pages:
 - <https://doi.org/10.5067/HLS/HL30.002>
 - <https://doi.org/10.5067/HLS/HLSS30.002>
- Data Tutorials and Scripts:
 - [Getting Started with Cloud-Native Harmonized Landsat Sentinel-2 \(HLS\) Data in R](#)
 - [Getting Started with Cloud-Native HLS Data in Python](#)
 - [HLS Subsetting, Processing and Exporting Reformatted \(HLS SuPER\) Script](#)
 - [Harmonized Landsat and Sentinel-2 \(HLS\) Bulk Download Script \(Bash Script\)](#)
- Podcast Episodes:
 - [Eyes on Earth Episode 45 – Harmonized Landsat Sentinel Data](#)
 - [Eyes on Earth Episode 66 – Exotic Annual Grasses](#)
- Publications:
 - [16 articles have cited HLS data products](#)
- Imagery Examples and Videos:
 - [12 examples on the Outreach Materials wall](#)

Data Access?

- Visualizations:
 - <https://worldview.earthdata.nasa.gov/>

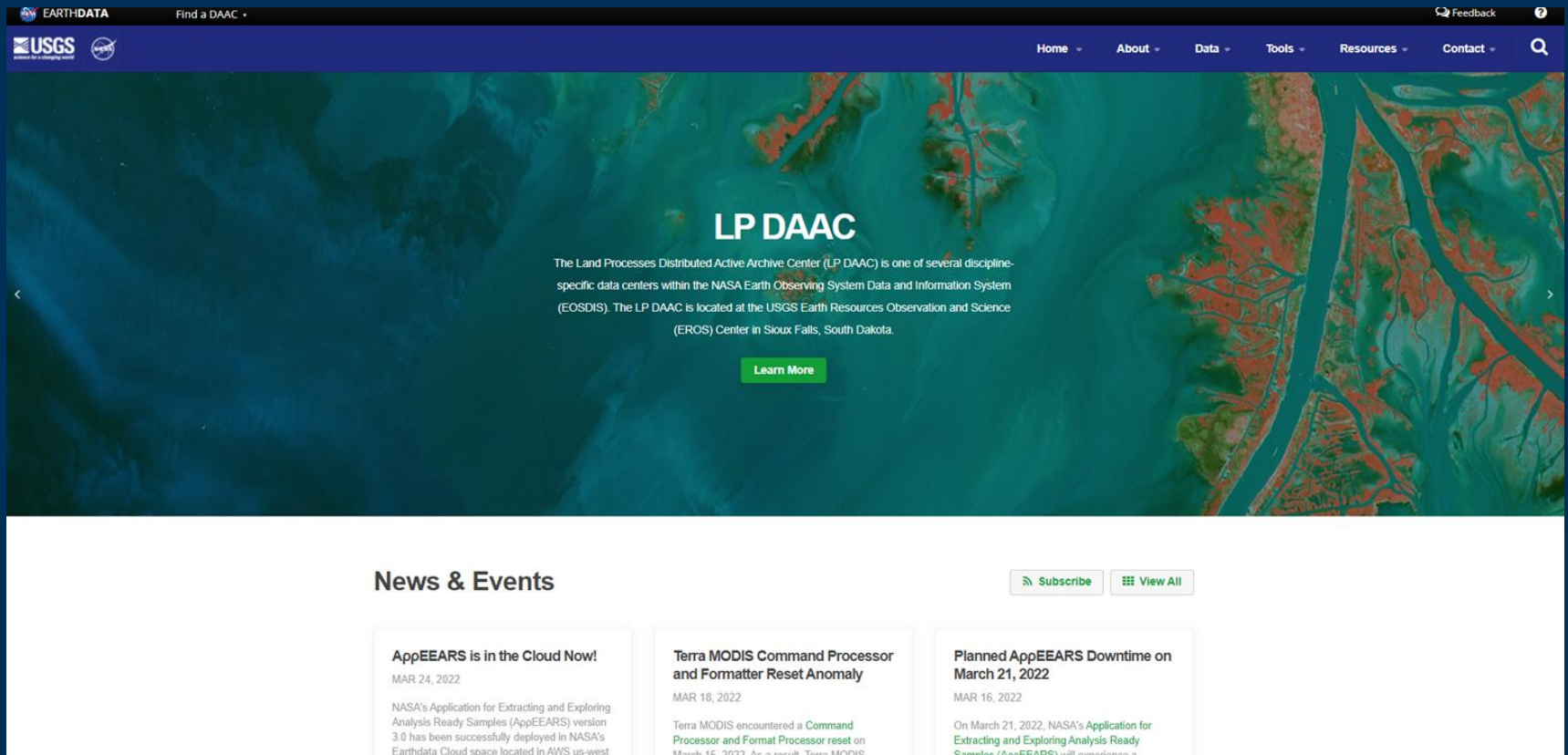


- Searching and Downloading:
 - <https://search.earthdata.nasa.gov/search>



Website Demo!

<https://lpdaac.usgs.gov/>



EARTHDATA Find a DAAC [Feedback](#)

USGS [Home](#) [About](#) [Data](#) [Tools](#) [Resources](#) [Contact](#)

LP DAAC

The Land Processes Distributed Active Archive Center (LP DAAC) is one of several discipline-specific data centers within the NASA Earth Observing System Data and Information System (EOSDIS). The LP DAAC is located at the USGS Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota.

[Learn More](#)

News & Events

[Subscribe](#) [View All](#)

AppEEARS is in the Cloud Now!

MAR 24, 2022

NASA's Application for Extracting and Exploring Analysis Ready Samples (AppEEARS) version 3.0 has been successfully deployed in NASA's Earthdata Cloud space located in AWS us-west

Terra MODIS Command Processor and Formatter Reset Anomaly

MAR 18, 2022

Terra MODIS encountered a Command Processor and Format Processor reset on March 15, 2022. As a result, Terra MODIS

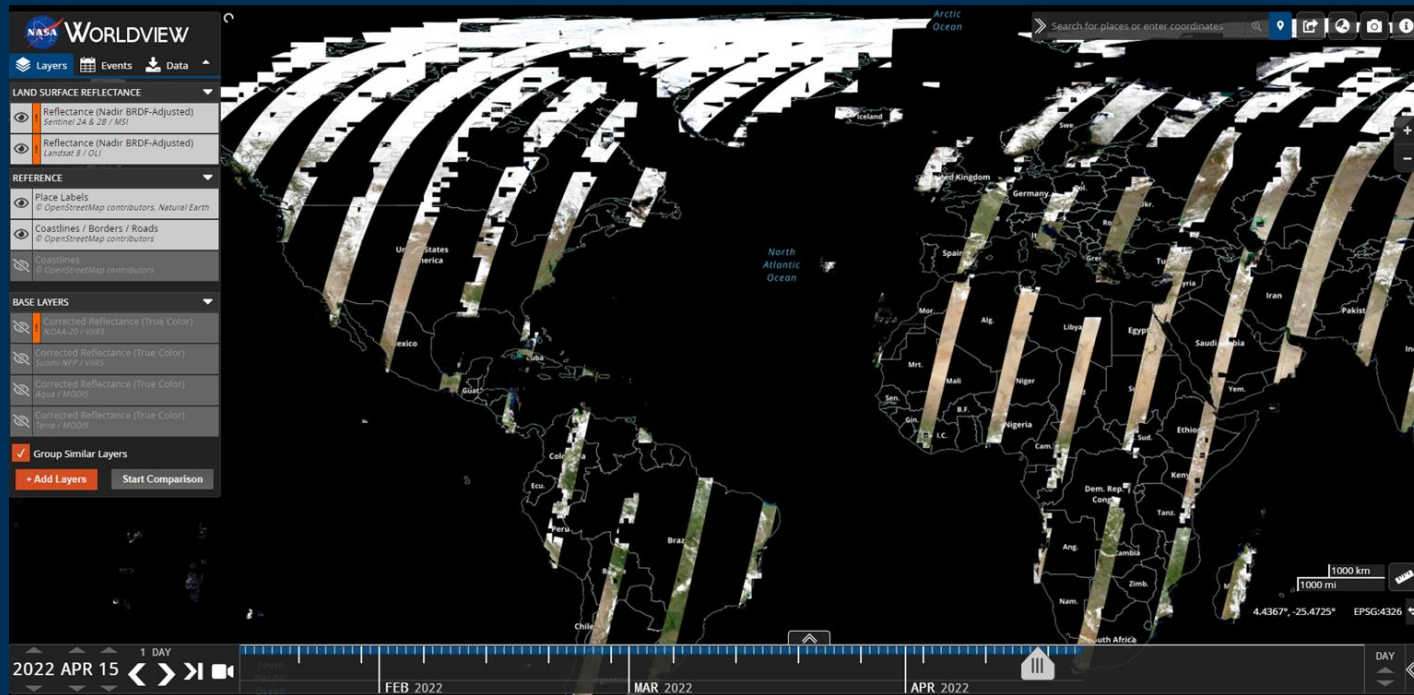
Planned AppEEARS Downtime on March 21, 2022

MAR 16, 2022

On March 21, 2022, NASA's Application for Extracting and Exploring Analysis Ready Samples (AppEEARS) will experience a

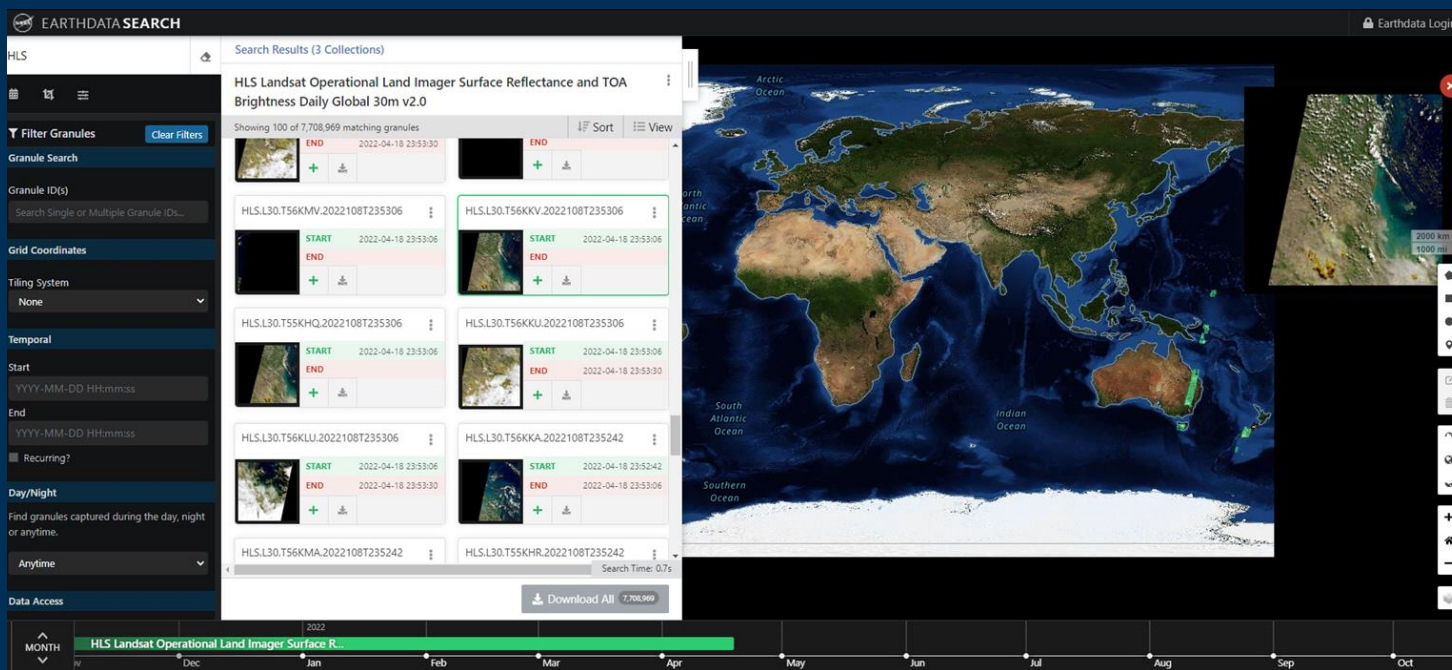
WorldviewDemo!

- <https://worldview.earthdata.nasa.gov/>

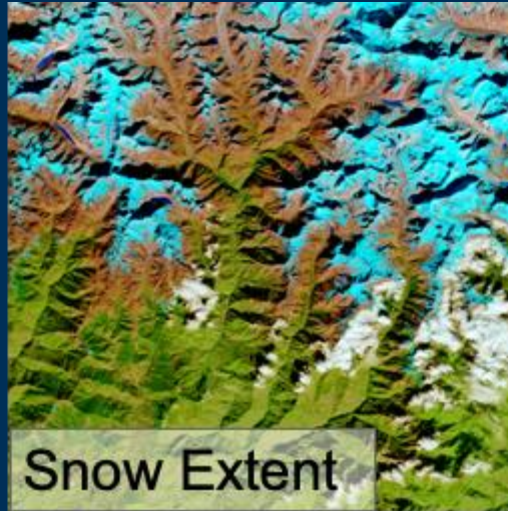


Earthdata Search Demo!

- <https://search.earthdata.nasa.gov/search>



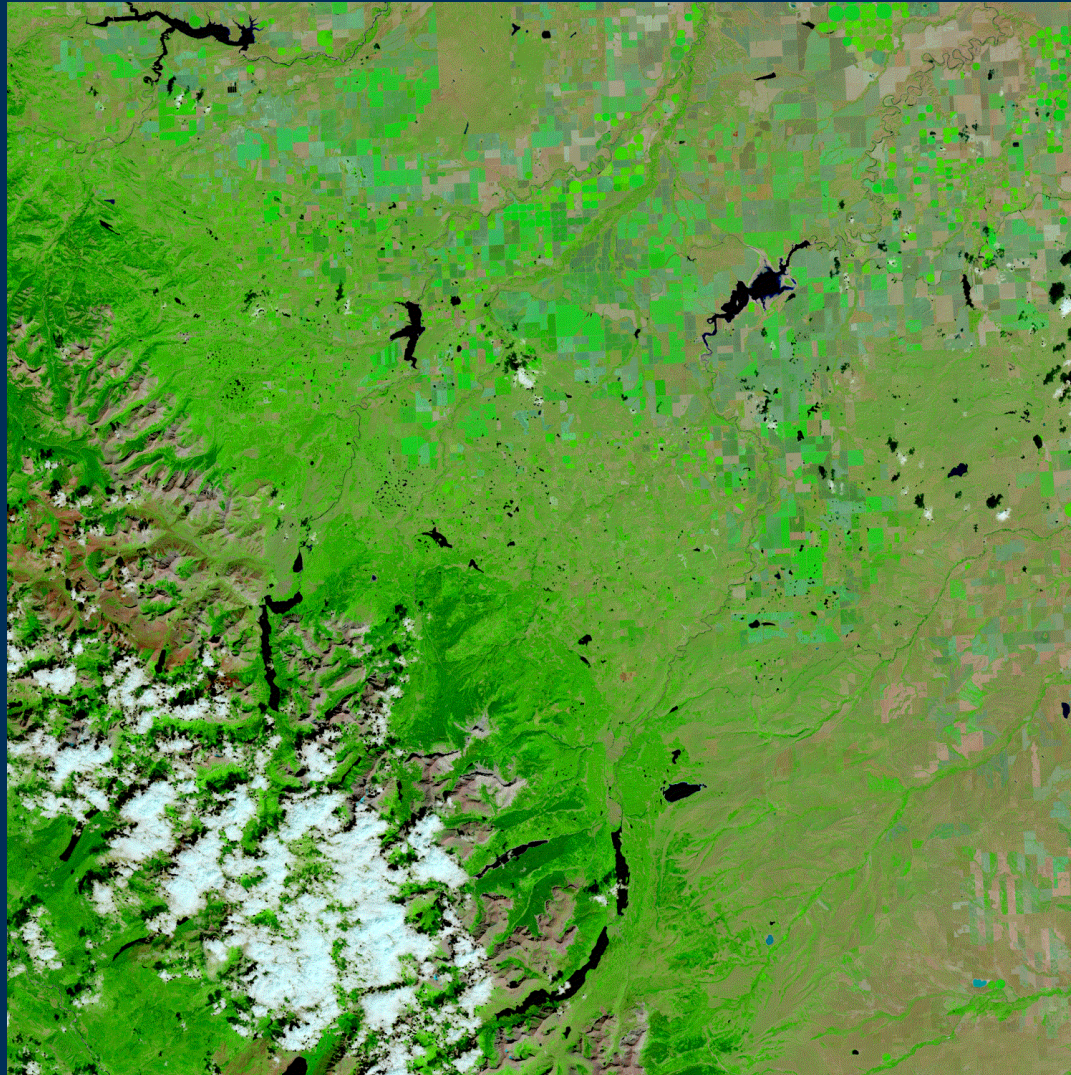
Potential HLS Science Applications



U.S. Geological Survey



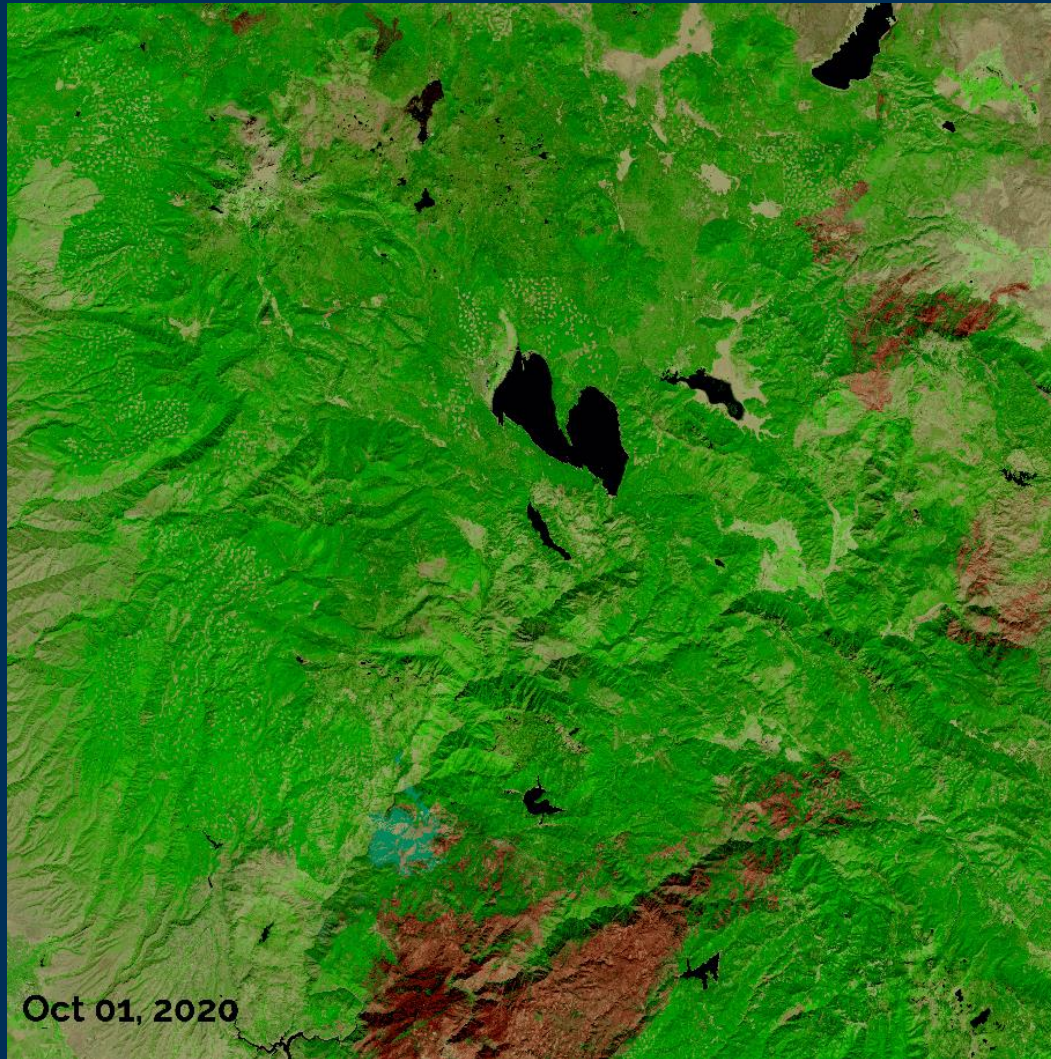
HLS Science Application Use Cases



U.S. Geological Survey



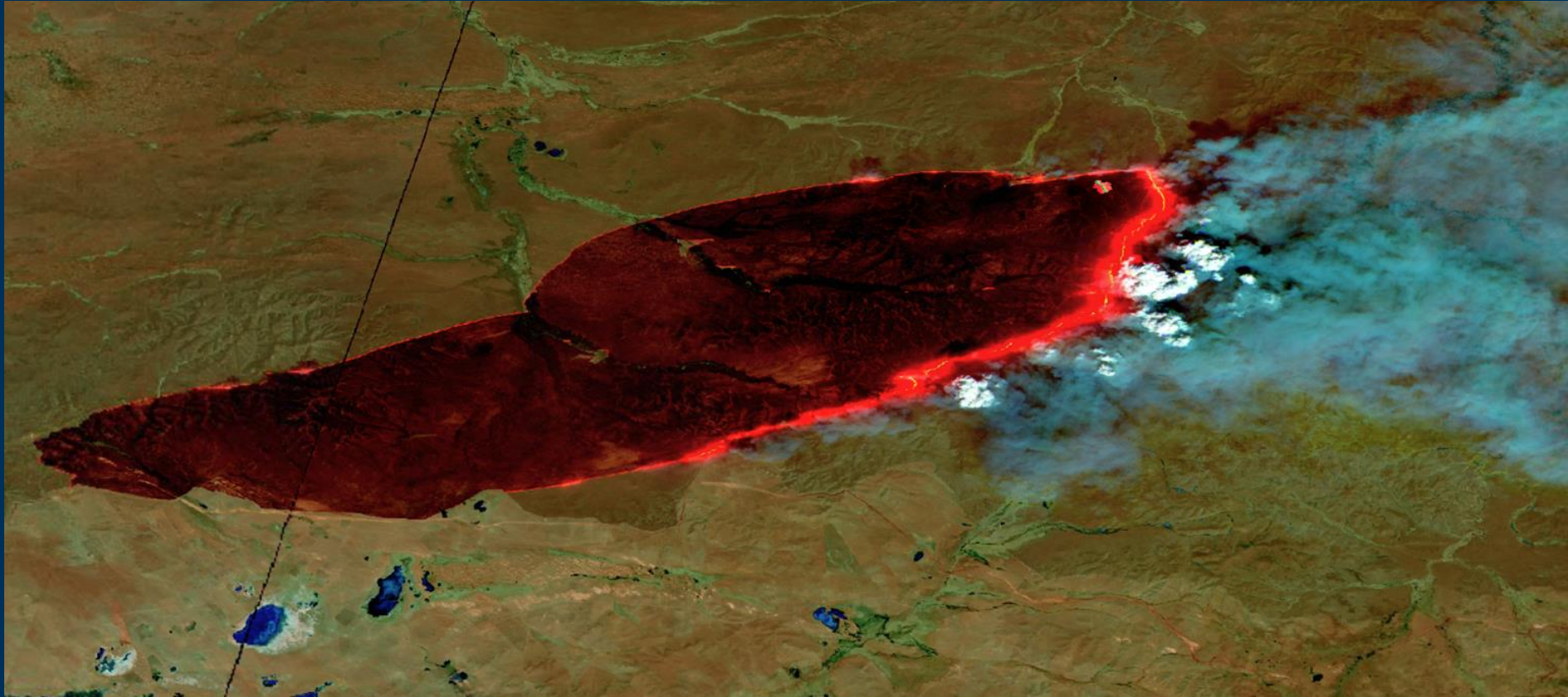
HLS Science Application Use Cases



U.S. Geological Survey



HLS Science Application Use Cases



[FIRMS Landing Page](#)

[HLS Dynamic Tile Layer in FIRMS](#)

U.S. Geological Survey



User Services

- **Contact information:**
 - **Questions about LP DAAC data:**
 - Voice:** 605-594-6116
 - Toll Free:** 866-573-3222 (866-LPE-DAAC)
 - E-mail:** LPDAAC@usgs.gov
 - Web:** <https://lpdaac.usgs.gov/>
 - Earthdata Forum:** <https://forum.earthdata.nasa.gov/>
- **Join our listserv!**
 - Send a blank email to lpdaac-join@lists.nasa.gov