NOAA LOW EARTH ORBIT (LEO) JPSS SATELLITE DATA NODD OFFICE HOURS

April 18, 2024 | 12:00 - 1:15pm EDT | Register HERE

Hosted by NOAA National Environmental Satellite, Data, and Information Service (NESDIS), NOAA Open Data Dissemination (NODD), and NODD's cloud partner Google Cloud. Please join to learn more about NOAA's LEO Joint Polar Satellite System (JPSS) data (SNPP, NOAA 20 & 21), connect with NOAA and cloud subject matter experts, and share your use case.

Adrienne Simonson
NOAA Open Data Dissemination (NODD)

Lihang Zhou
NOAA LEO Joint Polar Satellite System (JPSS)

Tyler Russell
Google Research

Mya Sears
NC Institute for Climate Studies (NCICS)

GoogleMeet Webinar - Recorded

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(Record Meetings and Training Sessions)

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Disclosure: Voluntary; by joining and participating in the meeting consent is being given to the recording.

- Thank you for your registration and interest.
- Webinar is recorded. Anyone with video display has to provide consent. Only hosts and presenters are asked to turn their video on.
- If do not wish to be part of the recording, please feel free to drop off.
- Meeting summary and presentation slides will be available on the NODD website
  - **NOAA.GOV/NODD**

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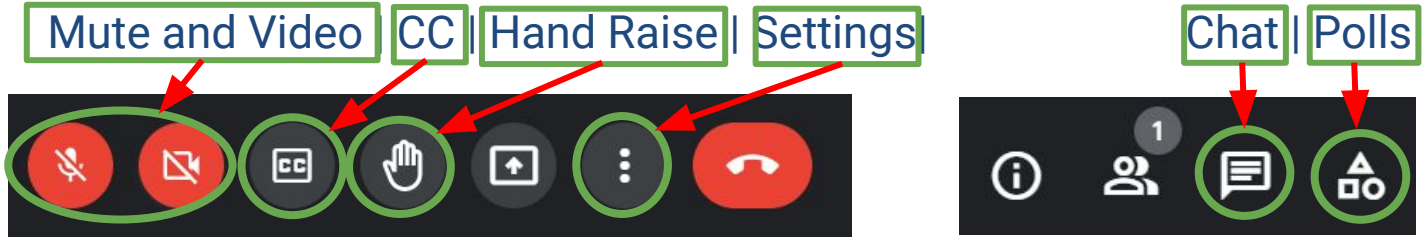
GoogleMeet Webinar Logistics

How to join the discussion!

- Keep yourself muted throughout (for call-in participants: to mute and unmute use *6) and videos off
- Raise your hand if you have a question and we'll respond in the order of the queue
- The following features of Google Meet:



- This webinar will be recorded.
- You can also join by phone line only if you are having connectivity issues.

Guidelines for Discussion

- Keep it brief
- Keep it respectful
- Use the chat function for links, references and/or resources
- Submit questions through the chat function or raise your hand
- Identify who the question is directed to where possible

Quick Google Poll

POLL1

- How do you access JPSS satellite data today?
  - On-prem via NOAA
  - Cloud
  - Both/Either
  - 3rd party/Web-based Viewer
  - None/Other

POLL2

- My primary goal for attending today is:
  - Technical use and access of JPSS data
  - To learn about cloud access to data (e.g. NODD Program)
  - Meet and engage with NOAA staff scientists
  - Learn about Google Cloud access and tools

NODD Disseminates NOAA Line Office Data

Open and Free, with Value to the Public:

- From NOAA Line Offices via NODD to public cloud buckets of three CSPs =
  - ❏ An exponential number of users can access
- Harnesses the scalability of the cloud to improve data access
  - ❏ No egress costs for users or the agency
- No use restrictions or user registration
- Appropriate Metadata included

NOAA Data is Growing Exponentially

TECHNOLOGY MODERNIZATION

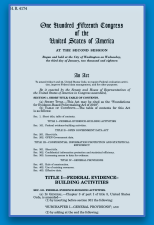
Reduces stress on NOAA's on-premise dissemination systems

Improves services for users

FULL & OPEN PUBLIC ACCESS

Supports Federal Data Strategy & Evidence Act Requirements

No egress costs



ENABLES & ENGAGES USERS

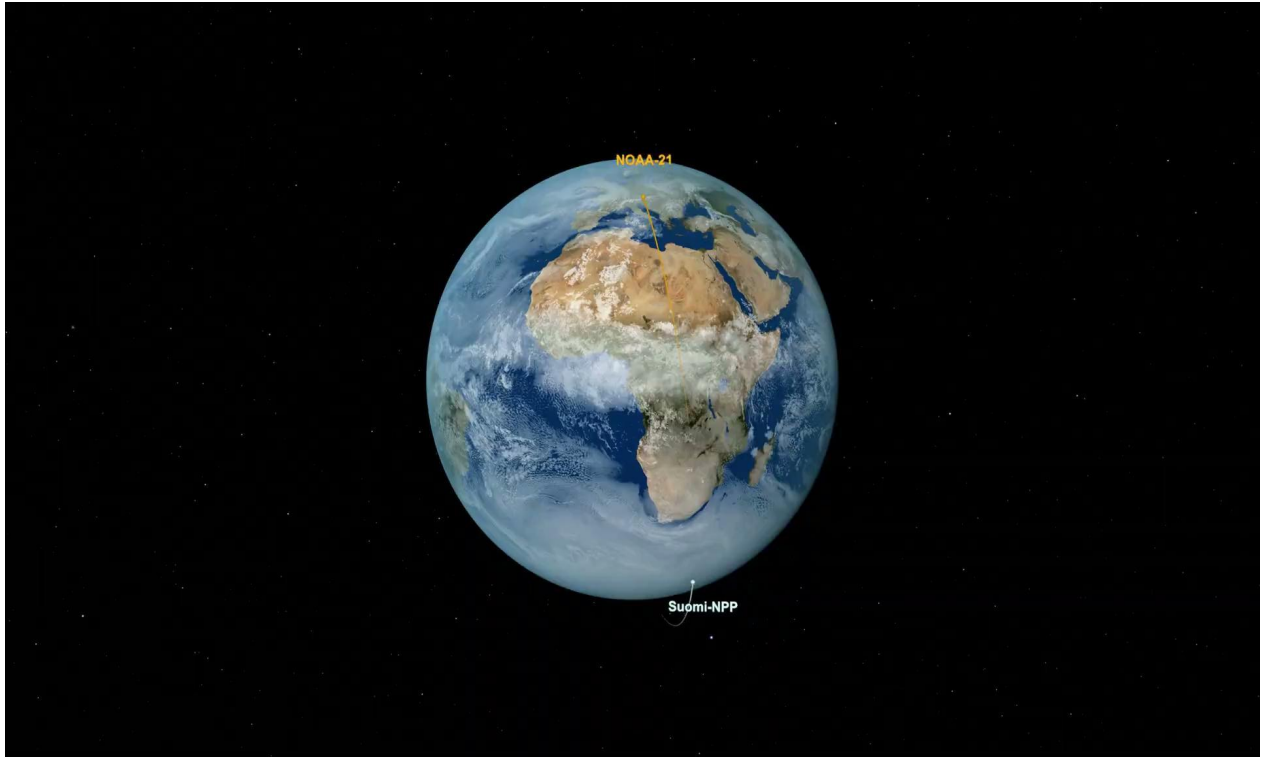
Catalyzes innovation in environmental services

Enables interoperability

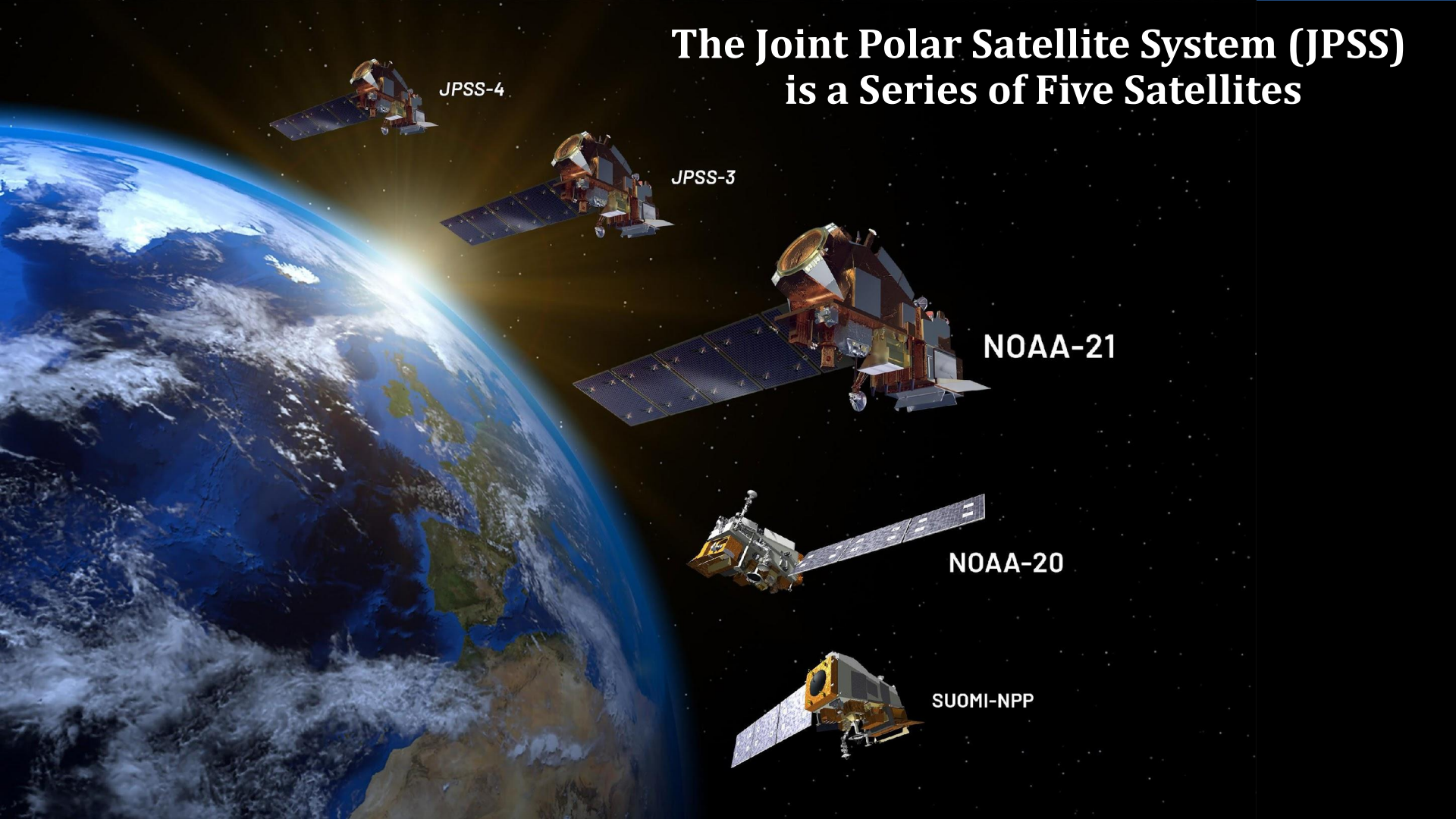
Low Earth Orbit (LEO) Satellites

SNPP, NOAA20, NOAA21: Operational Constellation

- Launched into Low Earth Orbit—512 miles
- **14x** Orbits Earth 14 times pole-to-pole with SNPP
- **2x** Images entire globe twice a day
- State of the art instrumentation to collect data on Earth's atmosphere, lands, and oceans
- Sends more than 2,000 gigabytes of data to Earth every day

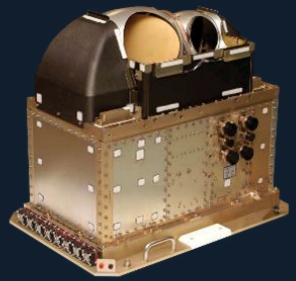


The Joint Polar Satellite System (JPSS) is a Series of Five Satellites



JPSS Instruments

ATMS
Advanced Technology Microwave Sounder



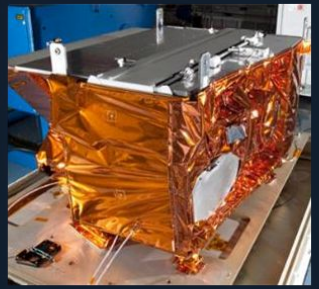
ATMS and CrIS together provide high vertical resolution temperature and water vapor information needed to maintain and improve forecast skill out to 5 to 7 days in advance for extreme weather events, including hurricanes and severe weather outbreaks.

NORTHROP GRUMMAN

CrIS
Cross-track Infrared Sounder

HARRIS

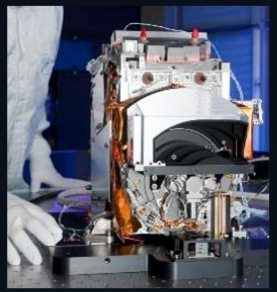
VIIRS
Visible Infrared Imaging Radiometer Suite



VIIRS provides many critical imagery products including snow/ice cover, clouds, fog, aerosols, fire, smoke plumes, vegetation health, phytoplankton and chlorophyll abundance.

Raytheon

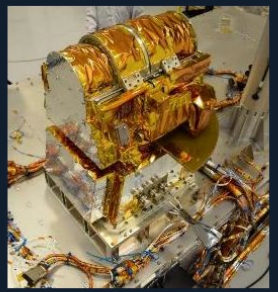
OMPS
Ozone Mapping and Profiler Suite



Ozone spectrometers for monitoring ozone hole and recovery of stratospheric ozone and for UV index forecasts.

Ball

CERES
Clouds and the Earth's Radiant Energy System



Scanning radiometer which supports studies of the Earth Radiation Budget (ERB).

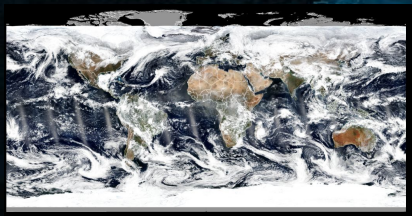
**Discontinued after JPSS-1 (NOAA-20)*

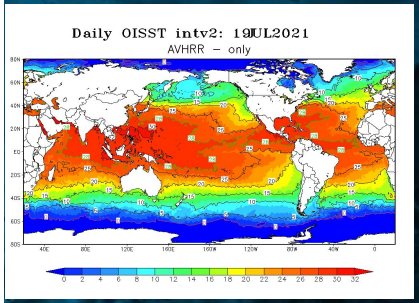
NORTHROP GRUMMAN

LEO Measurements Contribute to All NOAA Mission Service Areas

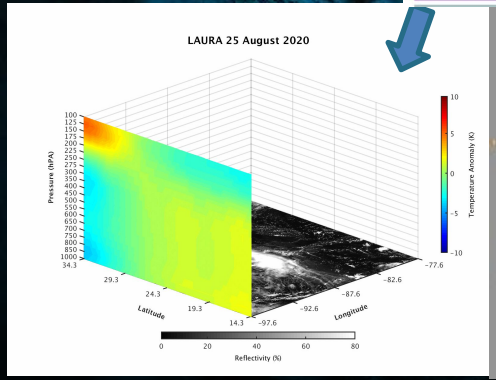
WEATHER READY NATION (WRN)	HEALTHY OCEANS (HO)	RESILIENT COASTS (RC)	CLIMATE (CLI)
National Weather Service	**National Marine Fisheries Service**	**National Ocean Service**	**Office of Oceanic and Atmospheric Research**
1. Aviation Weather & Volcanic Ash (WRN-AWX) 2. Fire Weather (WRN-FWX) 3. Hydrology & Water Resources (WRN-IWF) 4. Marine Weather & Coastal Events (WRN-MWX) 5. Hurricane/Tropical Storms (WRN-HUR) 6. Routine Weather (WRN-RWX) 7. Severe Weather (WRN-SEV) 8. Space Weather (WRN-SWX) 9. Tsunami (WRN-TSU) 10. Winter Weather (WRN-WWX)	1. Ecosystem Monitoring, Assessment & Forecast (HO-ECO) 2. Fisheries Monitoring, Assessment & Forecast (HO-FMA) 3. Habitat Monitoring & Assessment (HO-HAB) 4. Protected Species Monitoring (HO-PSM)	1. Coastal Water Quality (RC-CWQ) 2. Marine Transportation (RC-MTS) 3. Planning & Management (RC-PAM) 4. Resilience to Coastal Hazards & Climate Change (RC-RCC)	1. Assessments of Climate Changes & Its Impacts (CLI-ACC) 2. Climate Mitigation & Adaptation Strategies (CLI-CMA) 3. Climate Science & Improved Understanding (CLI-SIU)
11. Science, Services and Stewardship	**5. Science, Services and Stewardship**	**5. Science, Services and Stewardship**	**4. Climate Prediction and Projections (CLI_CPP)**

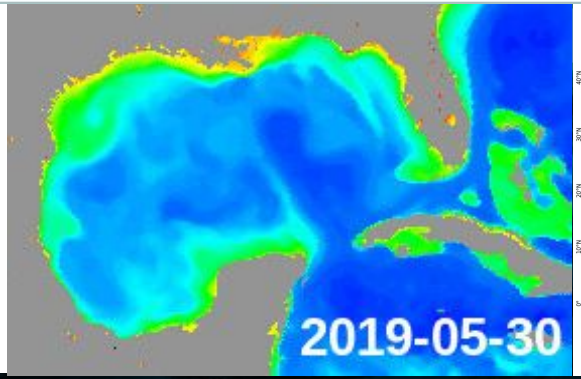
Imagery

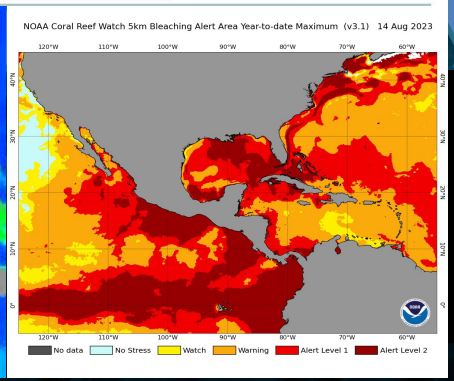




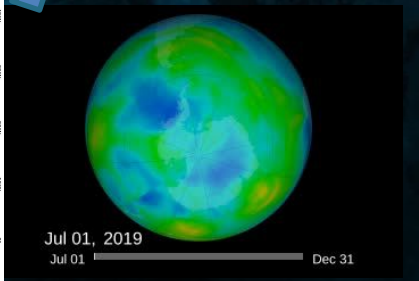
Soundings



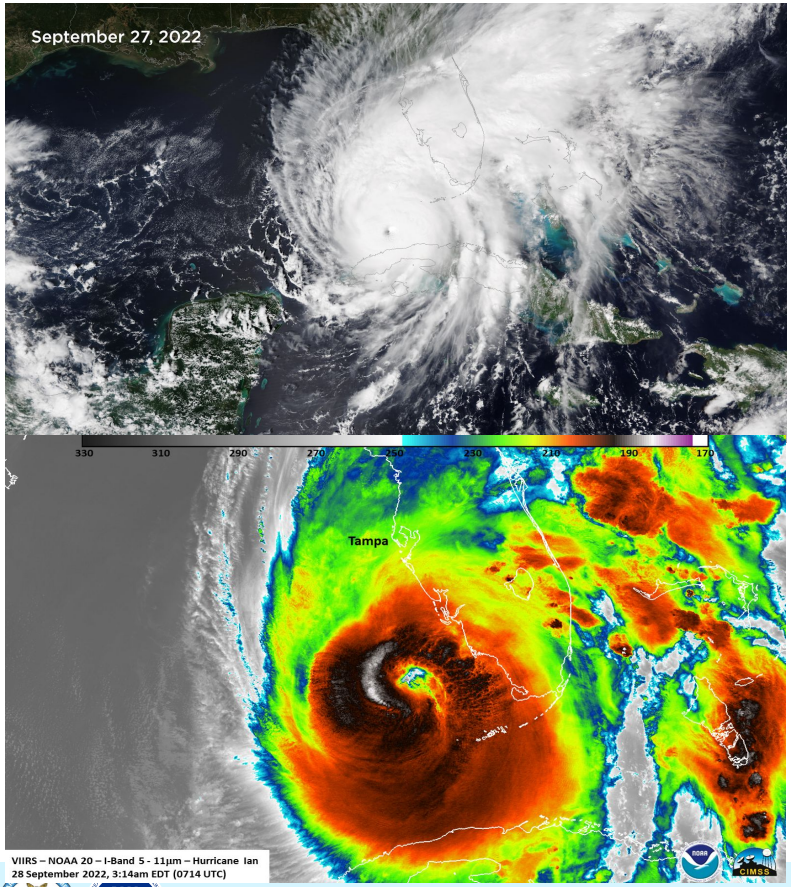




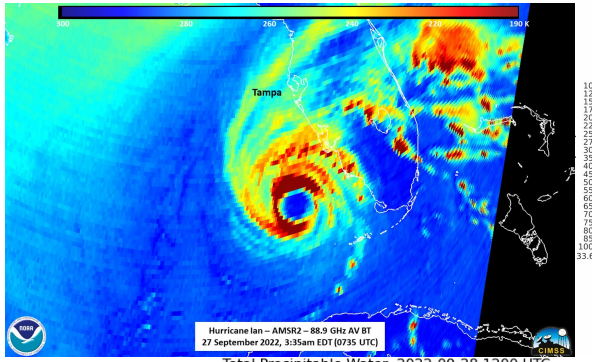
Ozone Mapping

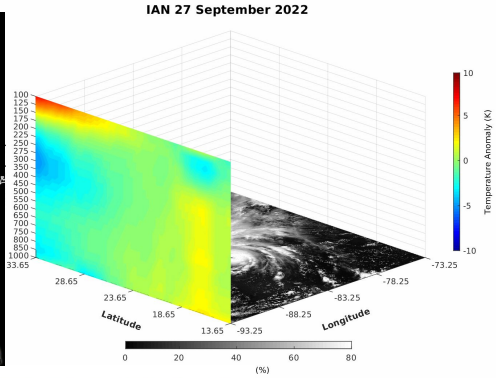


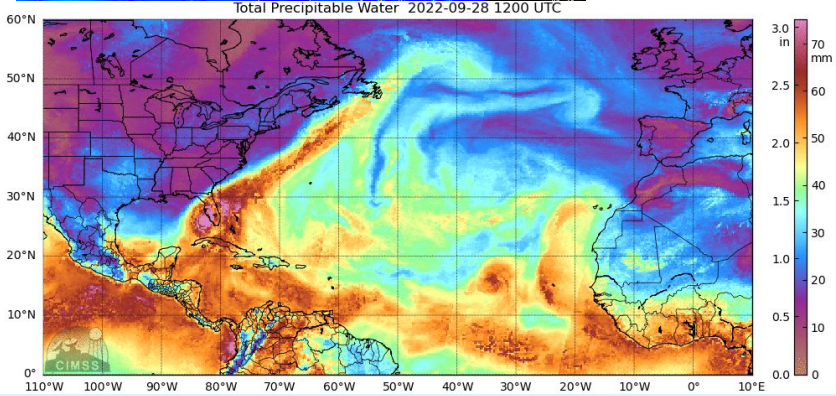
Hurricane Ian (September 27-29, 2022)



Hurricane Ian as observed by JPSS satellites on September 27-29, 2022. Ian had intensified into a dangerous Category 4 storm by 5:00am EDT Wednesday, according to the NOAA NWS National Hurricane Center. Bringing with it heavy winds and rainfall amounts.



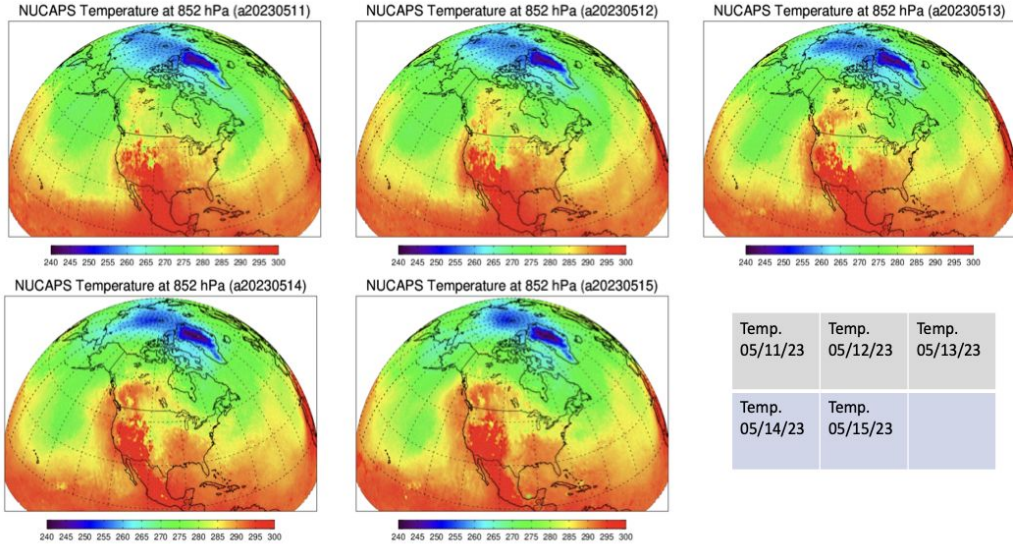




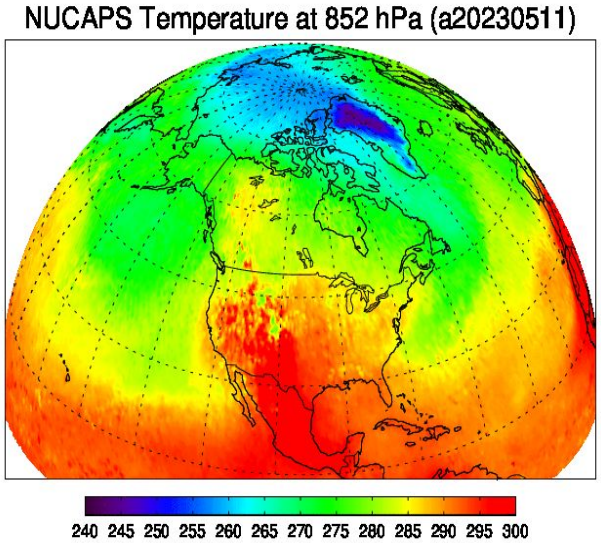
⬆️ ***ATMS 3D View of the Hurricane.***

⬅️ ***TPW (Total Precipitable Water) from ATMS MiRS Retrieval (Sept. 28-29, 2022).***

Heatwave in US Pacific Northwest (May 11 – 15, 2023)

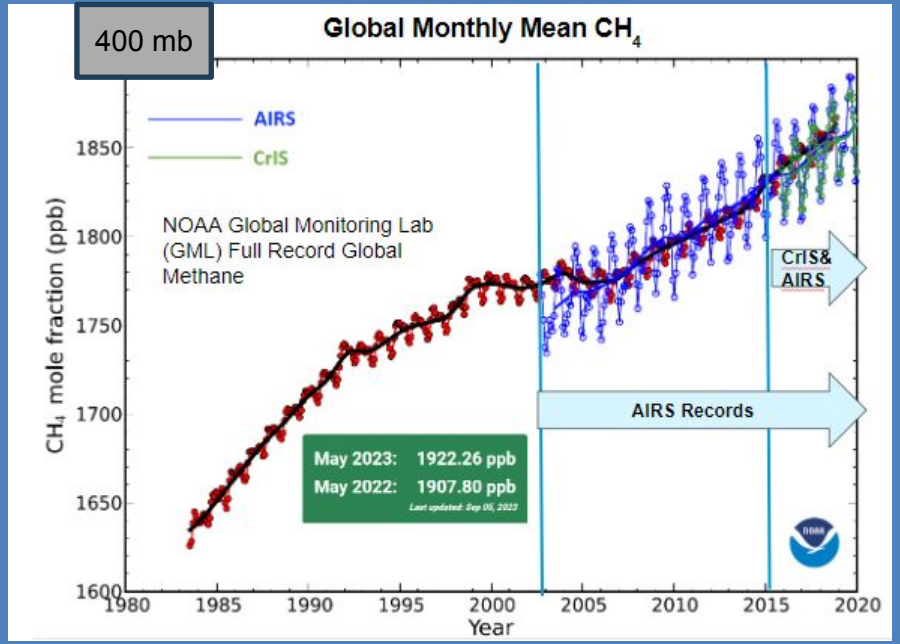


Temp. 05/11/23	Temp. 05/12/23	Temp. 05/13/23
Temp. 05/14/23	Temp. 05/15/23	

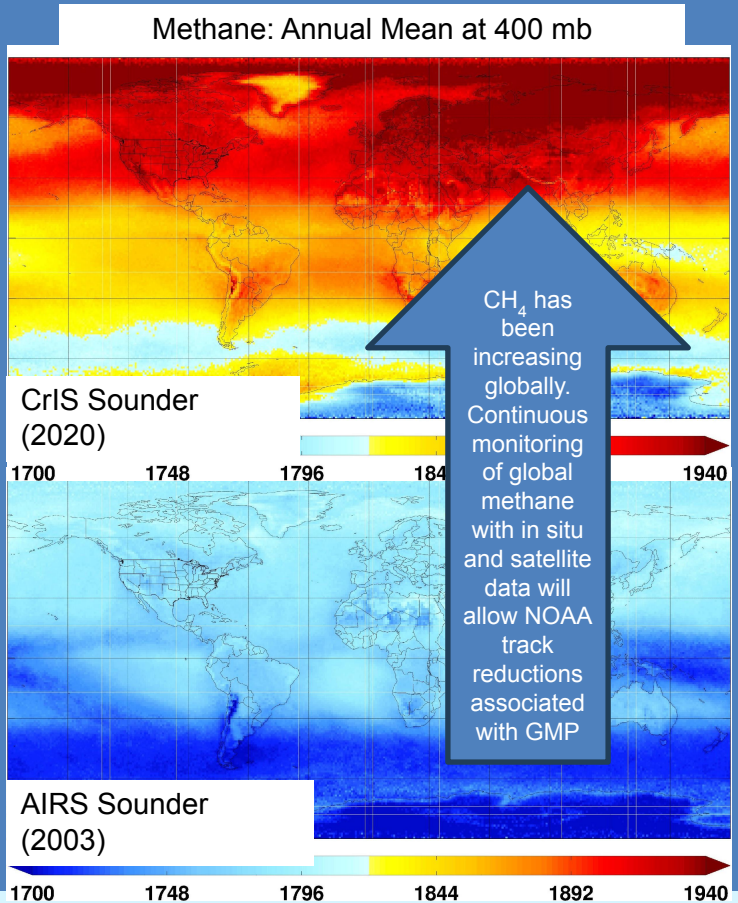


The mid-May western North America heatwave: the 852 hPa temperature retrieval using a moving 3-day composite (max) of NUCAPS data is shown in spherical projection. NOAA/STAR/NUCAPS Team

LEO Satellites' GHG Capabilities - Methane



NASA Aura AIRS: Atmospheric Infrared Sounder
NOAA-NASA Suomi NPP CrIS: Cross-track Infrared Sounder



Zhou, L.; Warner, J.; Nalli, N.R.; Wei, Z.; Oh, Y.; Bruhwiler, L.; Liu, X.; Divakarla, M.; Pryor, K.; Kalluri, S.; et al. Spatiotemporal Variability of Global Atmospheric Methane Observed from Two Decades of Satellite Hyperspectral Infrared Sounders. Remote Sens. ***2023****, 15, 2992. https://doi.org/10.3390/rs15122992*

Canadian Fires (June 2023) Monitored by VIIRS

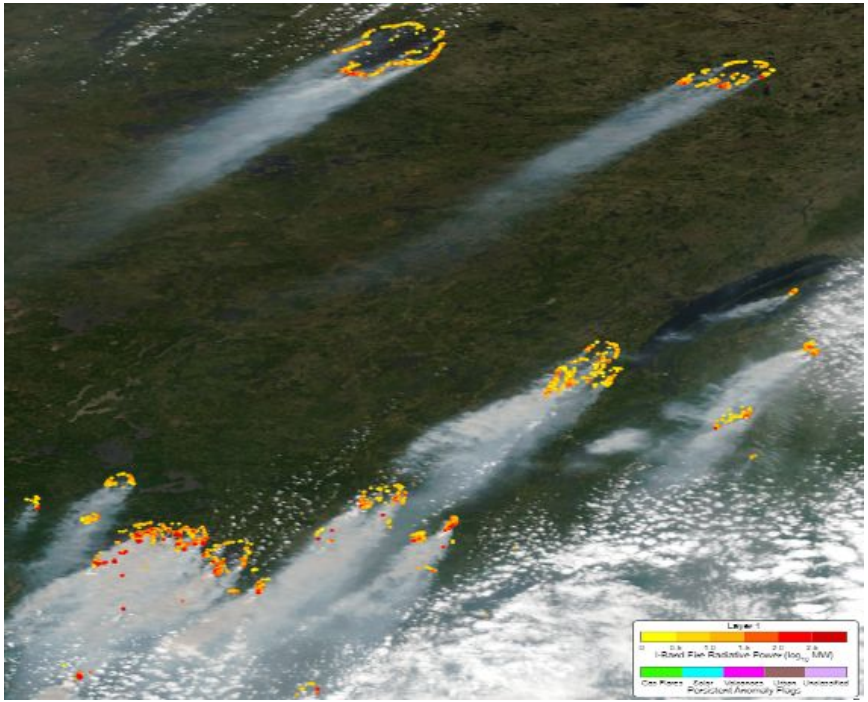
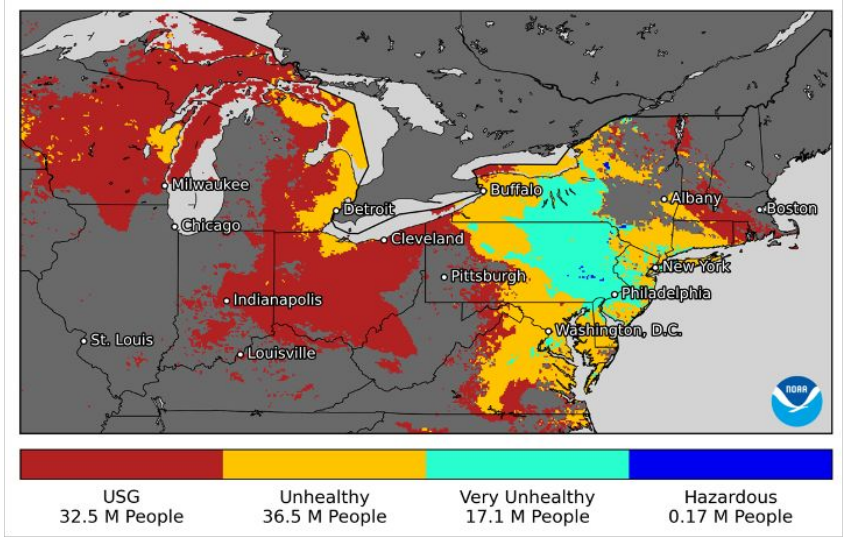


Figure above - SNPP VIIRS 375 m daytime fire radiative power (FRP) image of fire activity in Quebec, on June 6, 2023. (NOAA STAR Fire Team(

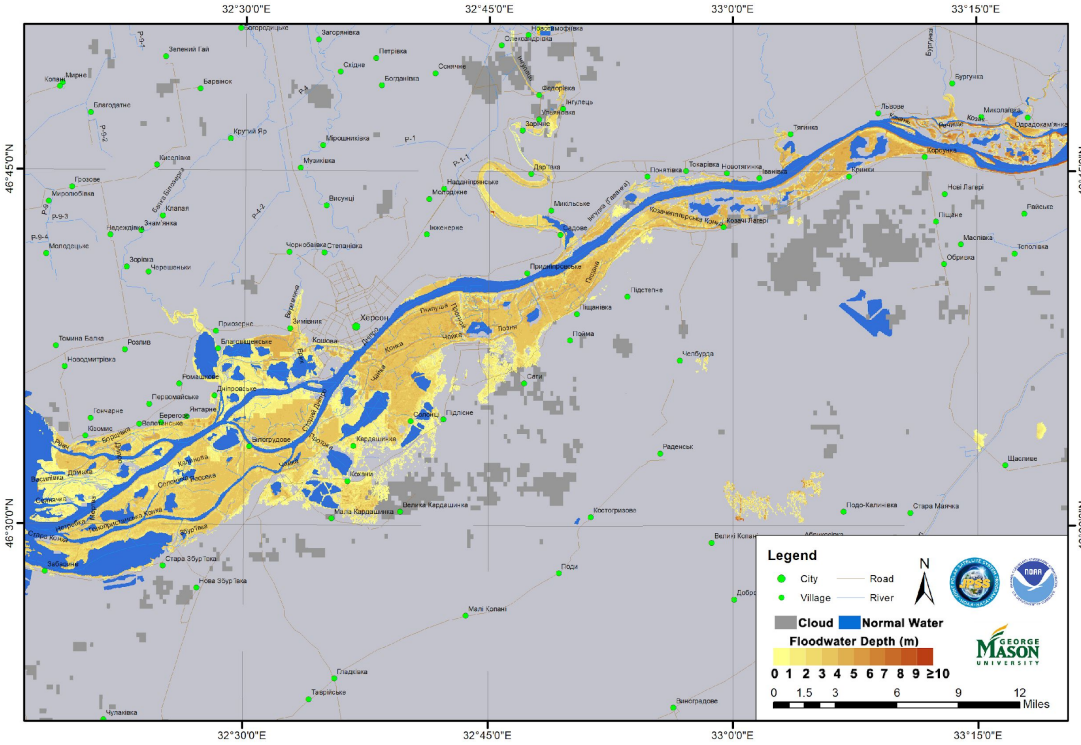
Figure below - Millions (“M”) of people in the U.S. were exposed to harmful particulate pollution (PM2.5) on June 3-10, broken down by Air Quality Index (AQI) level, estimated from measurements of aerosol optical depth made by VIIRS on the NOAA-20 and SNPP; gray indicates regions not impacted or no data. “USG” stands for “Unhealthy for Sensitive Groups”. (NOAA/STAR Aerosol Team)



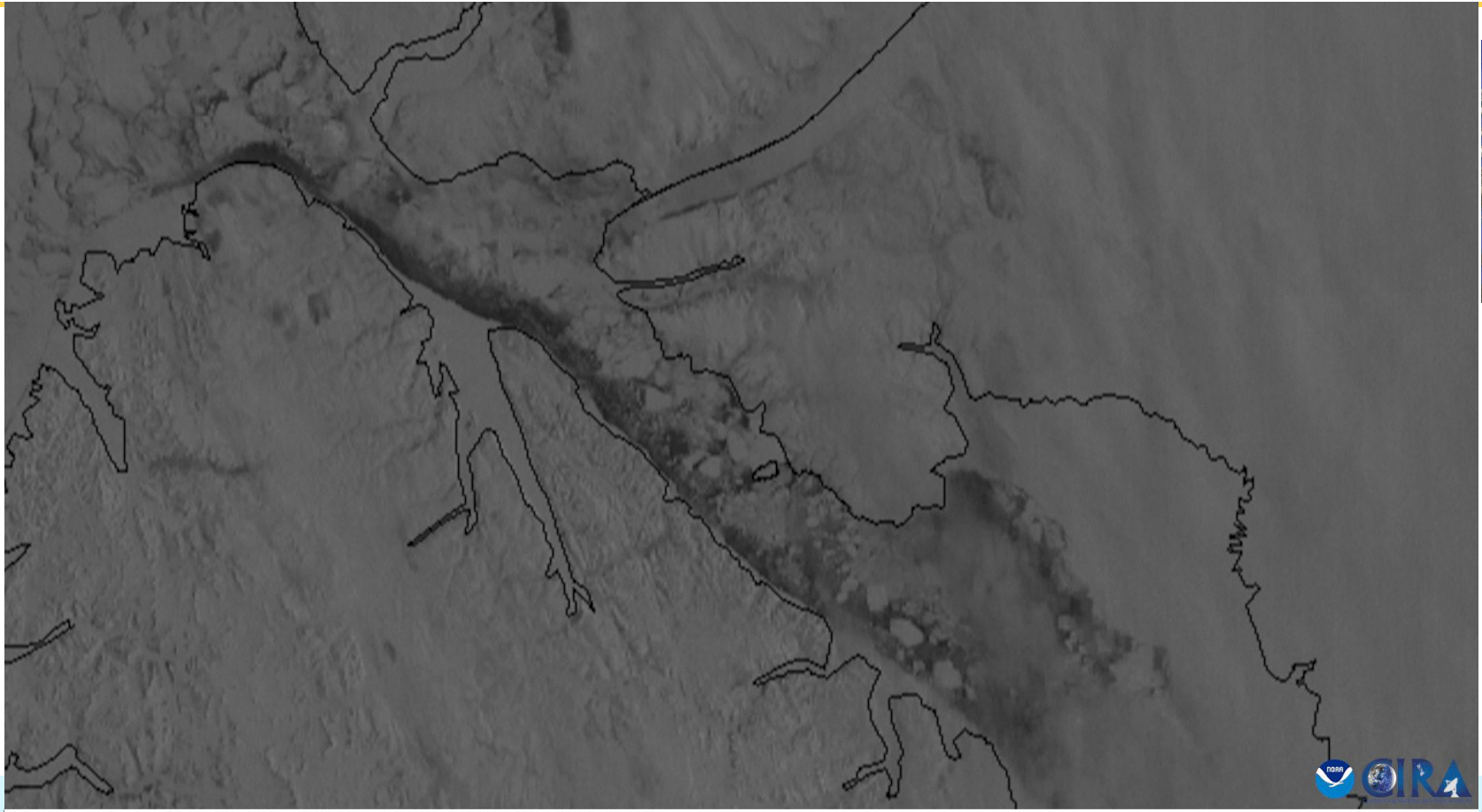
VIIRS Captured Flooding in Ukraine (June 5-9, 2023)

The Kakhovka Dam in Ukraine was breached in the early hours of 6 June 2023, causing extensive flooding along the lower Dnipro river. (GMU Flood Team)

Suomi-NPP&NOAA-20/VIIRS 30m Floodwater Depth Map in Ukraine, Jun. 07th, 2023



Arctic Ice Streaming Down Strait between Greenland and Ellesmere Island



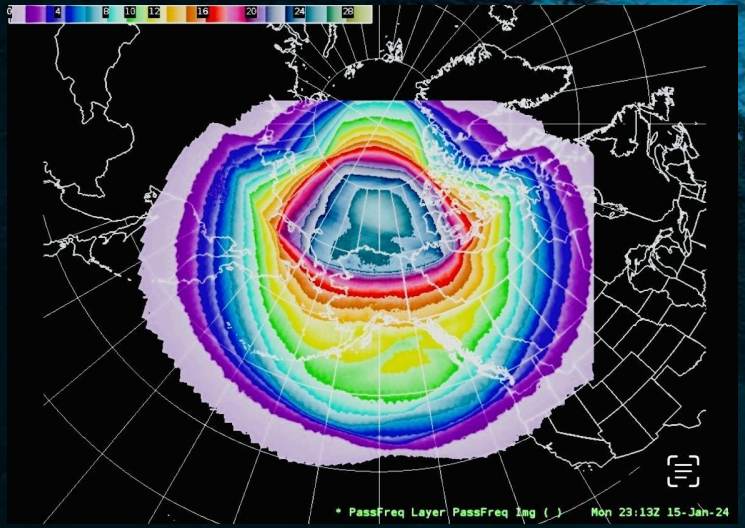
11-29-2023 | 05:35 UTC | NOAA-20/NOAA-21/S-NPP | VIIRS | Day/Night Band

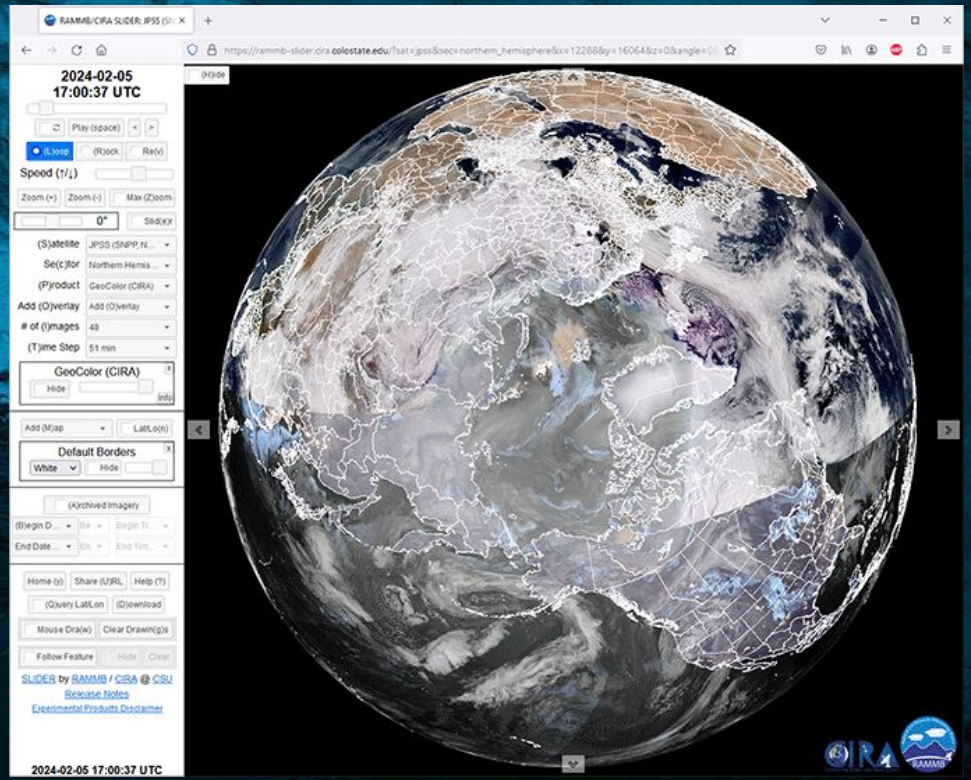
NOAA STAR
Imagery Team

NOAA-21 is Primary - Working together with NOAA-20, SNPP

3 JPSS Satellites VIIRS Sensor Coverage

- 24+ views of the Arctic
- 16+ views of Interior AK



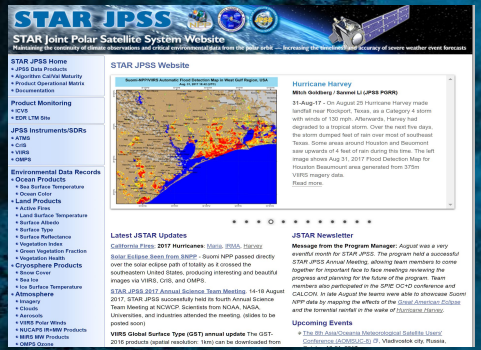


Jennifer Delamere (jsdelamere@alaska.edu) @ University of Alaska Fairbanks Geographic Information Network of Alaska (GINA)

https://rammb-slider.cira.colostate.edu/?sat=jpss

Where to Get the Data: Transparency and Accessibility

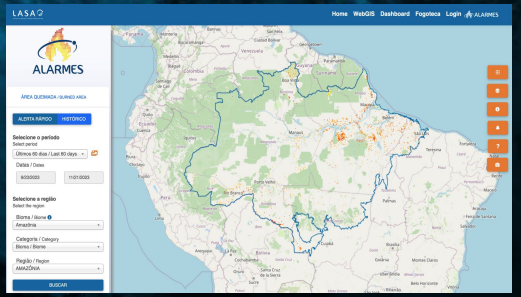
- **Transparency of the Science:** Detailed information on JPSS instruments, Science data products and documents (ATBDs, Cal Val Plans, Data Format, Product maturity status, README files, Requirements), Long term validation and science monitoring of SDR/EDR Products https://www.star.nesdis.noaa.gov/jpss/



- **Open Data**: JPSS Data is available through CLASS (Comprehensive Large Array-data Stewardship System), PDA (Production Distribution and Access), and Direct Readout/GEONETCast. JPSS data is also now available in NODD, for free and easy public access.

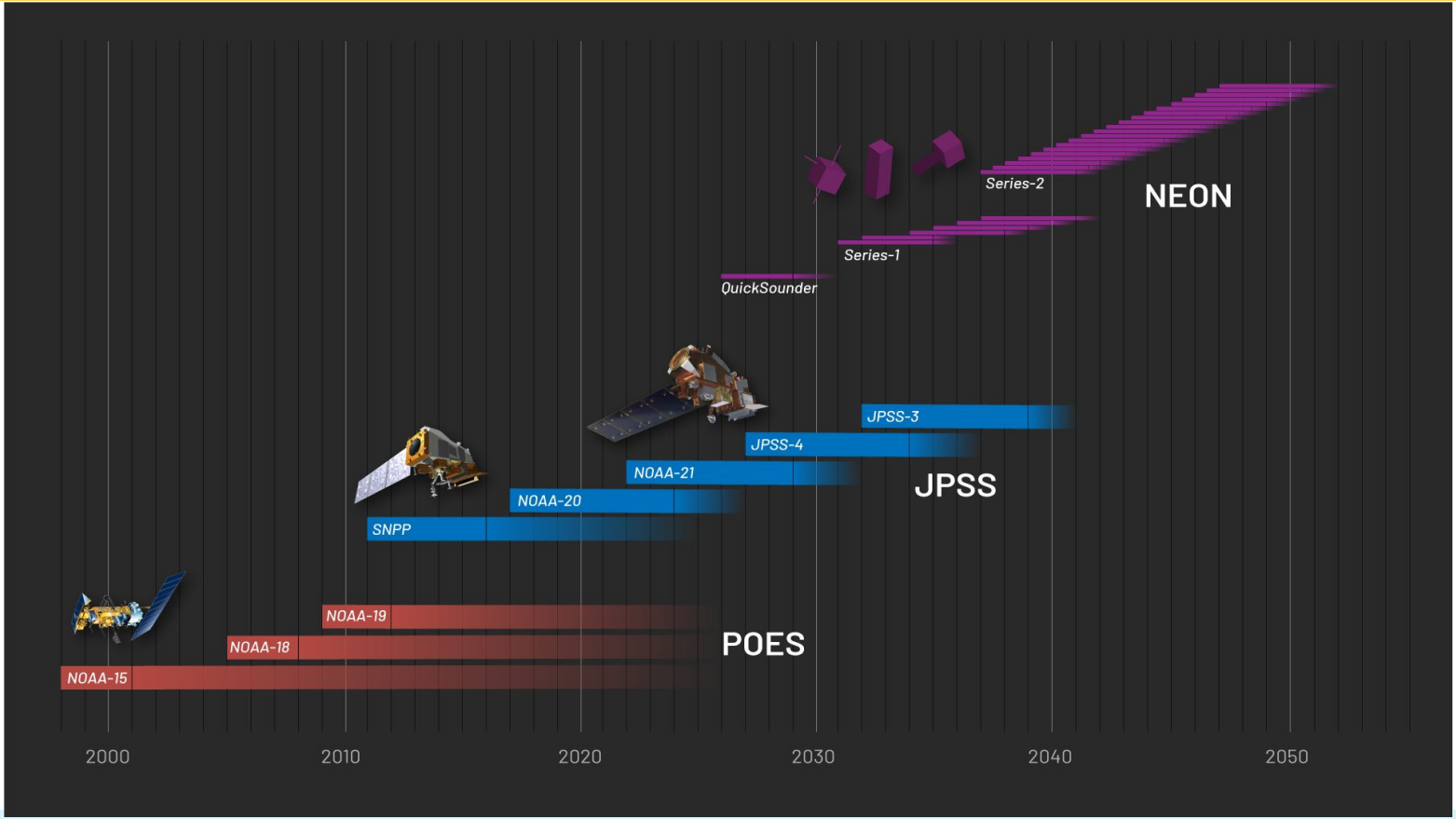
Near Real-Time JPSS Data via NOAA Open Data Dissemination (NODD)

The VIIRS data on the NODD is currently supporting NRT fire-related applications in Brazil and Mexico. https://alarmes.lasa.ufrj.br/platform/webgis (POC: Wilfrid Schroeder/NOAA NESDIS SAB)



NOAA Supports Open Science - Free, easy, and timely access to JPSS Data

LEO and the Near Earth Observation Network (NEON)



2023

JPSS

ANNUAL SCIENCE DIGEST

FROM THE NOAA NESDIS OFFICE OF
LOW EARTH ORBIT (LEO) OBSERVATIONS

EXPLORING THE IMPACT AND APPLICATIONS OF JPSS DATA

Download your copy today!

www.nesdis.noaa.gov/JPSS-digest

Google Cloud

NOAA Public Datasets on Google Cloud - JPSS

04/18/2024

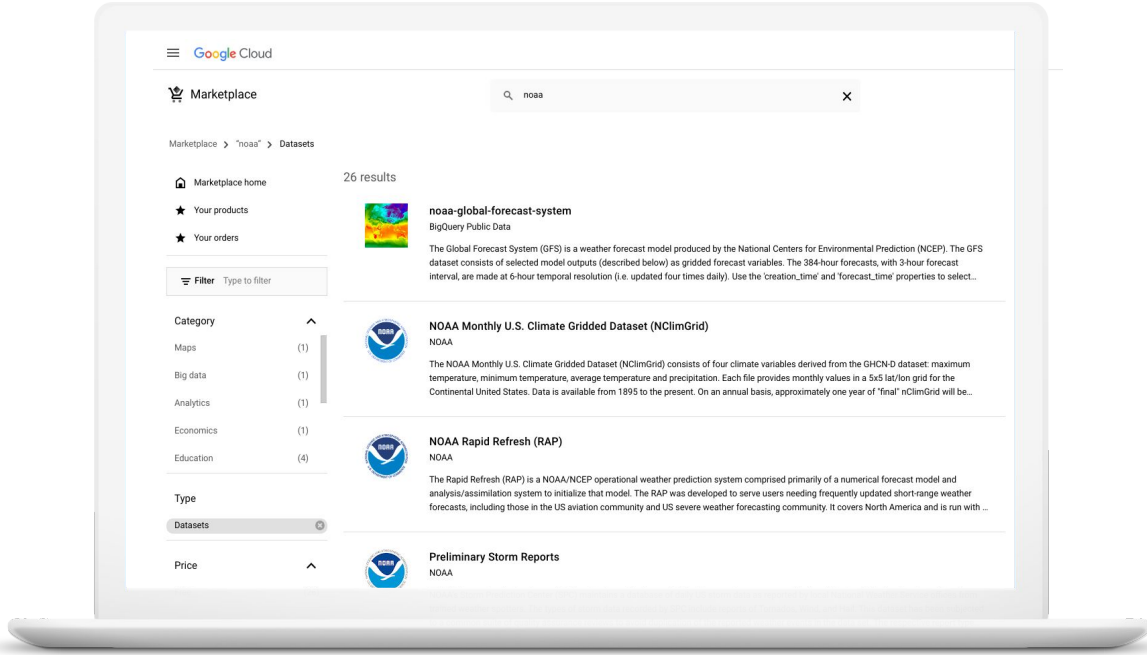
01

Public Datasets on Google Cloud

Google Cloud Public Datasets is a carefully curated and (mostly) Google managed dataset catalog from various sources all around the world, including weather data, shopping data, crypto, and even Google's own Search data.

Datasets in Marketplace

- Google Cloud Marketplace is the source of truth for datasets in GCP
- Can search and filter through what's available
- No login required to browse dataset entries
- All consumption of raw (non-tabular, bucket) data is free
- BigQuery tabular data is charged per query
- JPSS data is available in the Marketplace!



An explosion of satellite data

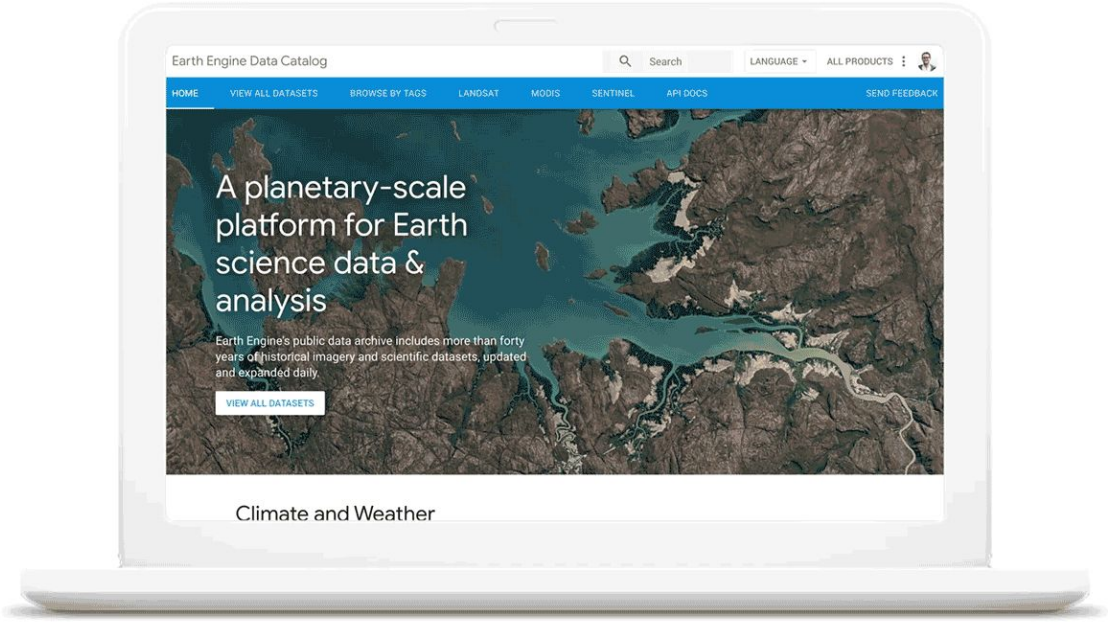
Source: NASA

70+ Petabytes
Growing daily

1 Petabyte
Monthly growth rate

700+
Curated datasets

Continuously updated in near real-time



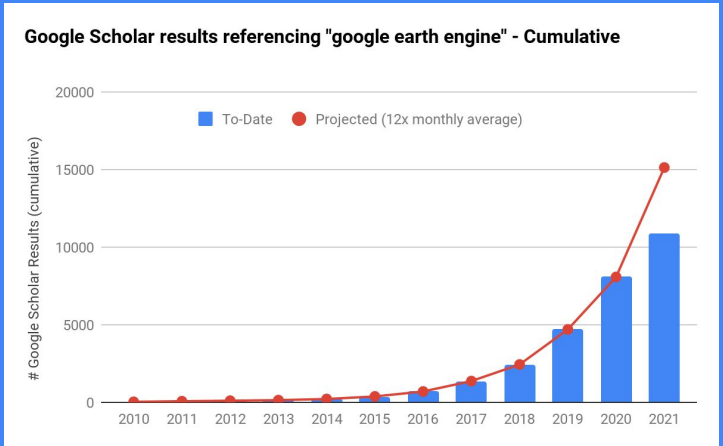
developers.google.com/earth-engine/datasets/

400k+

Scientists around the world

8,000+

Scientific papers



Remote Sensing of Environment
Volume 202, 1 December 2017, Pages 18-27

Google Earth Engine: Planetary-scale geospatial analysis for everyone

Science Home News Journals Topics Careers

High-Resolution Global Maps of 21st-Century Forest Cover Change

M. C. Hansen[1,*], P. V. Potapov[1], R. Moore[2], M. Hancher[2], S. A. Turubanova[1], A. Tyukavina[1], D. Thau[2], S. V. Stehman[3], S. J. ...

nature
International journal of science

High-resolution mapping of global surface water and its long-term changes

Jean-François Pekel, Andrew Cottam, Noel Gorelick & Alan S. Belward

Science Home News Journals Topics Careers

Tracking the global footprint of fisheries

David A. Kroodsma[1,*], Juan Mayorga[2,3], Timothy Hochberg[1], Nathan A. Miller[4], Kristina Boerder[5], Francesco Ferretti[6], Alex ...

Google Earth has helped users find amazing things

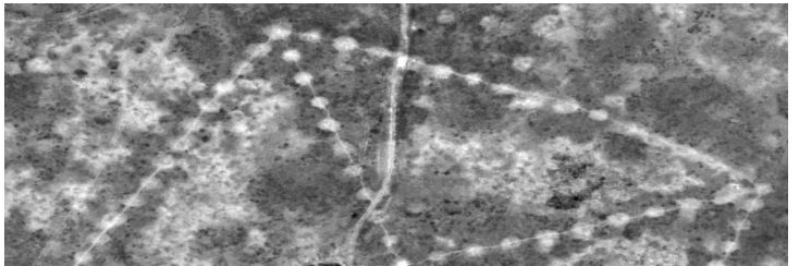
The New York Times

Hundreds of Mysterious Stone 'Gates' Found in Saudi Arabia's Desert

How Google Earth helped find Mozambique's lost forest of Mount Mabu | video

The New York Times

NASA Adds to Evidence of Mysterious Ancient Earthworks

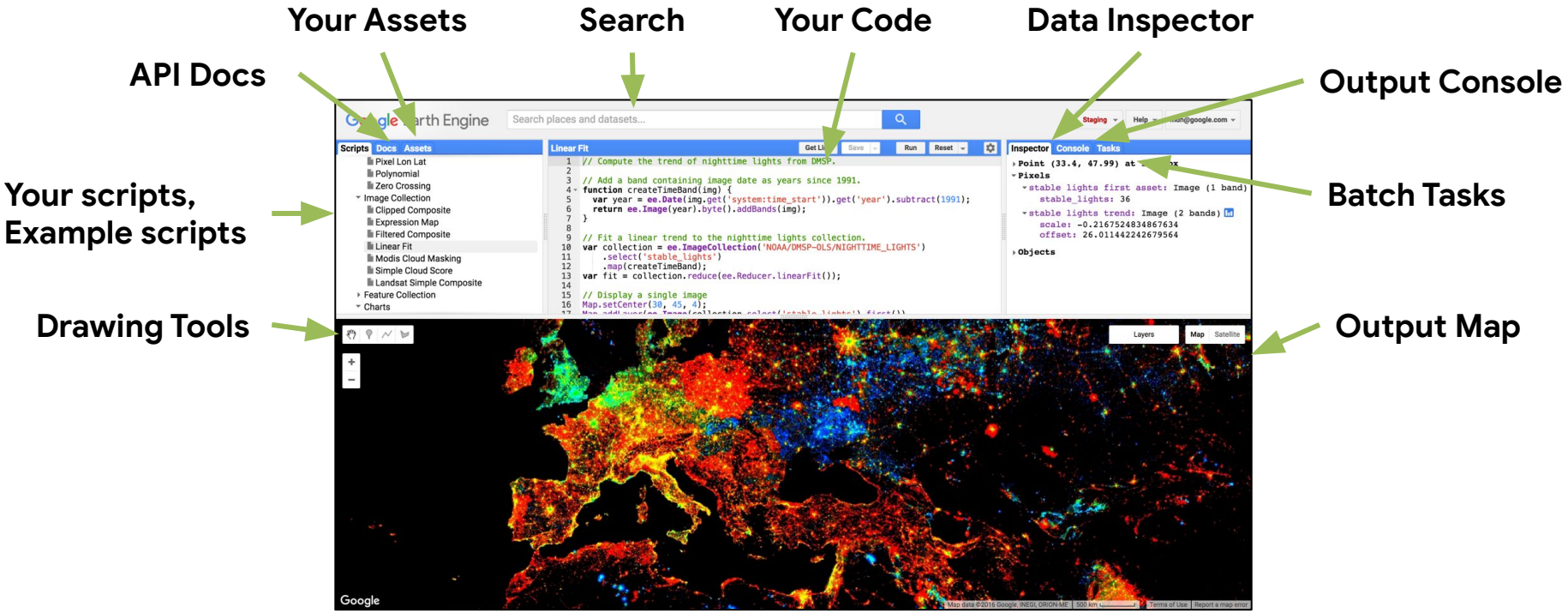


News

Enthusiast uses Google to reveal Roman ruins

Google Earth programme leads to remains of ancient villa.

What is Earth Engine? | Code Editor



code.earthengine.google.com

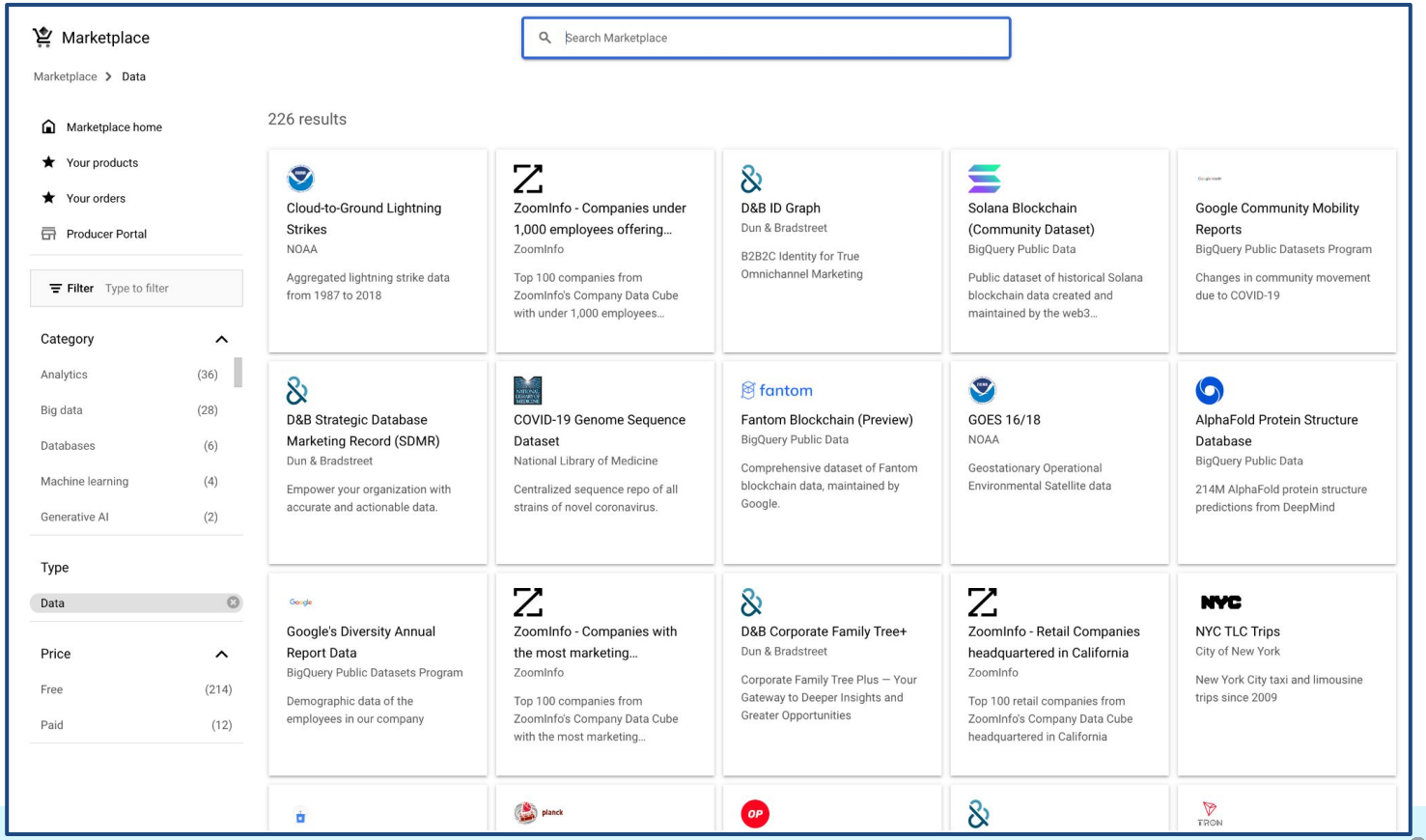
Featured NOAA datasets

	Joint Polar Satellite System (JPSS) NOAA-20/21 and SNPP available from 2023-Present with VIIRS, ATMS, CRiS, and OMPS, etc. sensors with low latency and high resolution.	**Next Generation Radar (NEXRAD)** High-resolution S-band Doppler weather radars operated by the National Weather Service (NWS).
Global Forecast System (GEFS) A weather model created by the National Centers for Environmental Prediction (NCEP) that generates 21 separate forecasts to address underlying uncertainties in the input data.	**High Resolution Rapid Refresh (HRRR)** 3-km resolution hourly updated, cloud-resolving, convection-allowing atmospheric model.	**Global Summary of the Day (GSOD)** A dozen daily averages computed from global hourly station data, covering 1929 to present.

02

Accessing and Using Public Datasets

Google Cloud Datasets Marketplace



Where are public datasets stored?

Google Cloud Storage is a managed service for storing unstructured data.

Buckets contain objects (a.k.a. files and folders) that contain the data and how they're organized.

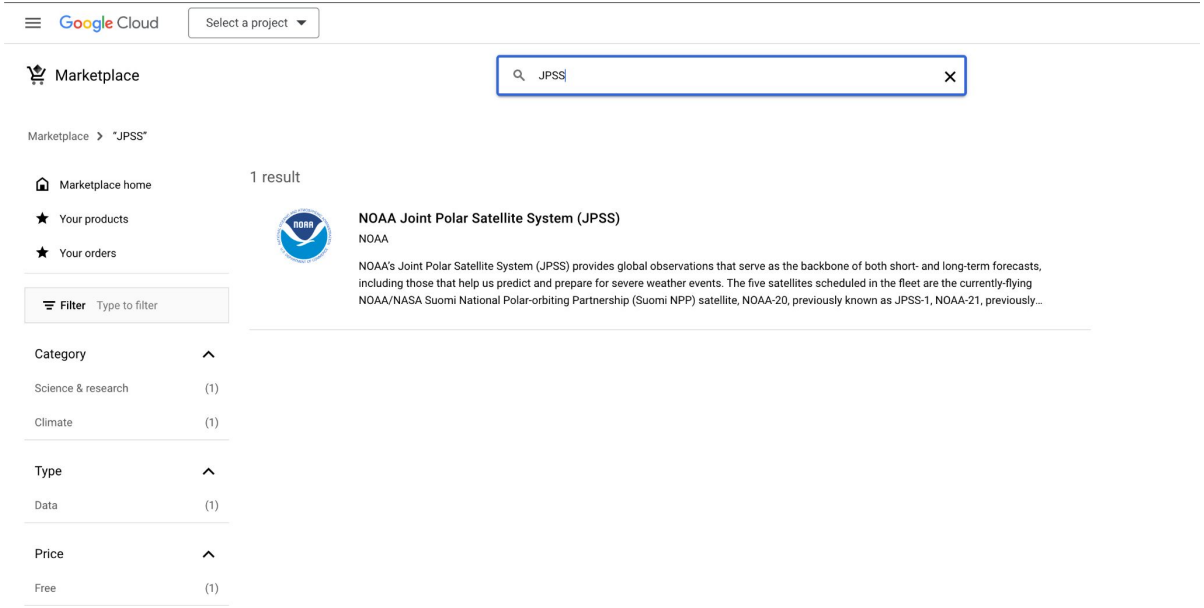
There are more than 80 buckets containing public datasets in various file formats.

BigQuery is Google's fully managed, serverless data warehouse for structured data.

It supports querying using a dialect of SQL.

There are more than 300 public BigQuery datasets spanning thousands of tables.

Access Other NOAA Datasets: GEFS



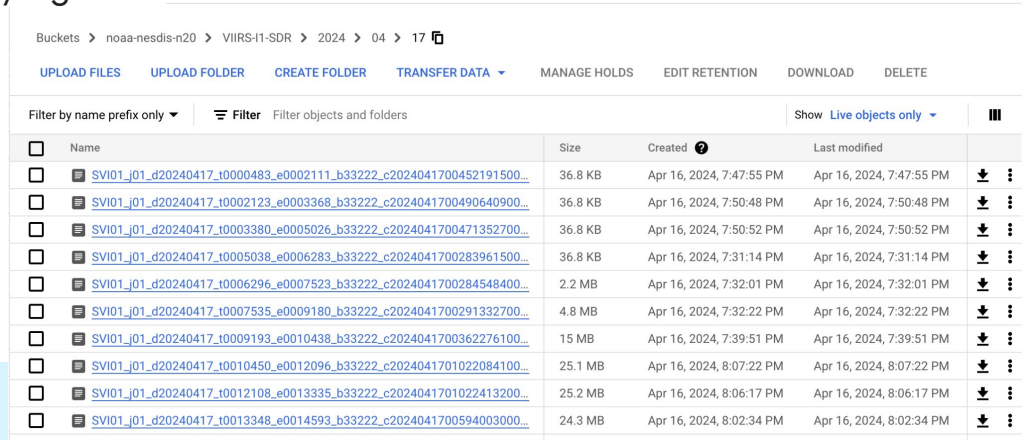
https://console.cloud.google.com/marketplace/product/noaa-public/noaa-jpss

Access JPSS data using a browser

1. The Google Cloud Storage bucket that stores the data is noaa-nesdis-n20 and noaa-nesdis-n21
2. Using a web browser, access the root of the bucket with the following URI*
   https://console.cloud.google.com/storage/browser/noaa-nesdis-n20
3. You can examine multiple levels of the bucket by appending the path to the URI above.

   For example, to access the data from April 17, 2024 in the M3 band, use the URI
   https://console.cloud.google.com/storage/browser/noaa-nesdis-n20/VIIRS-I1-SDR/2024/04/17

*You will be asked to sign in if you are not currently signed in

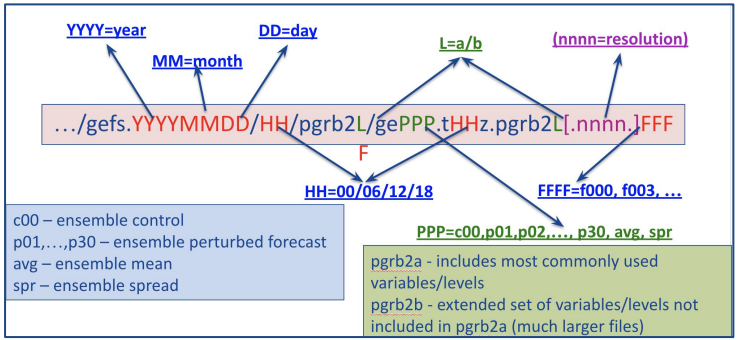


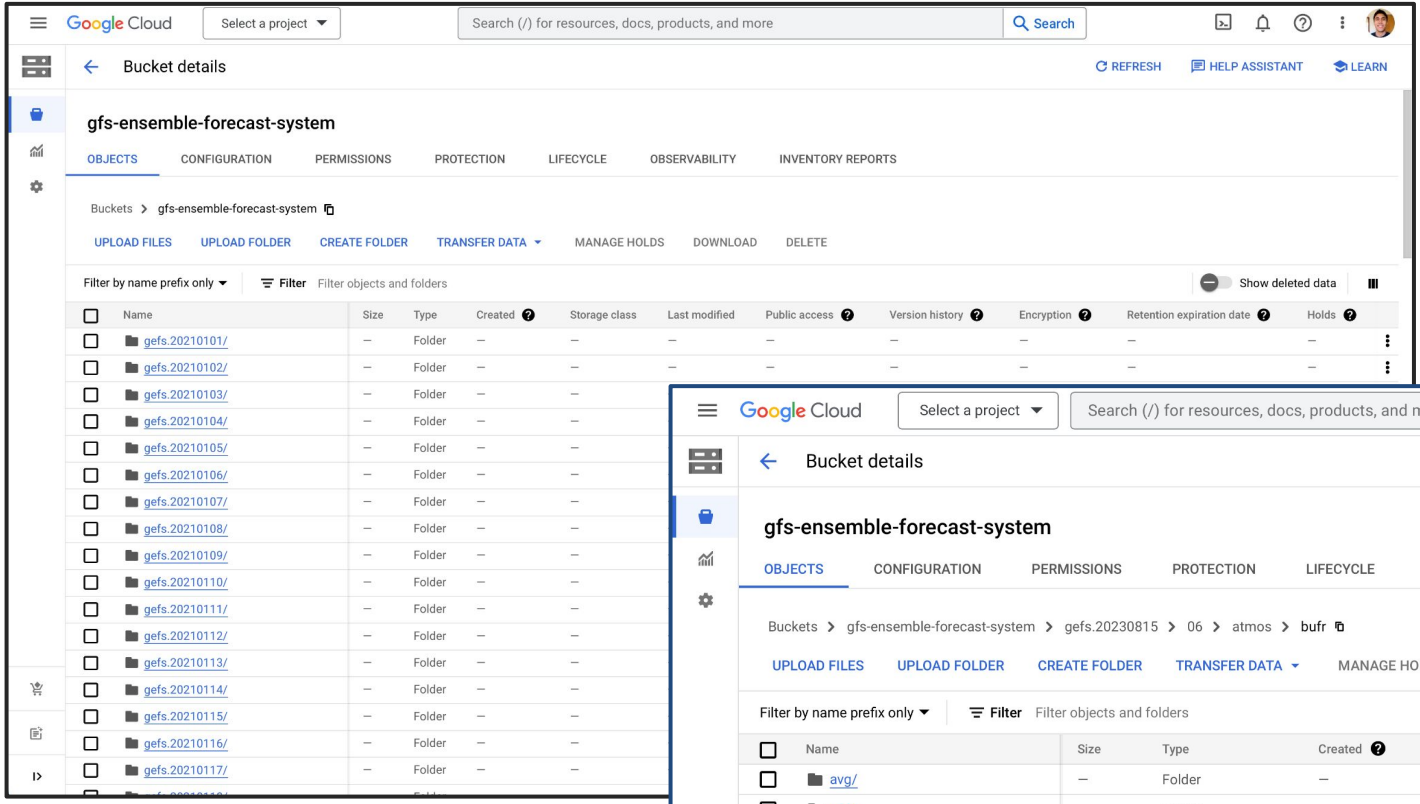
What about model data? Accessing GEFS!

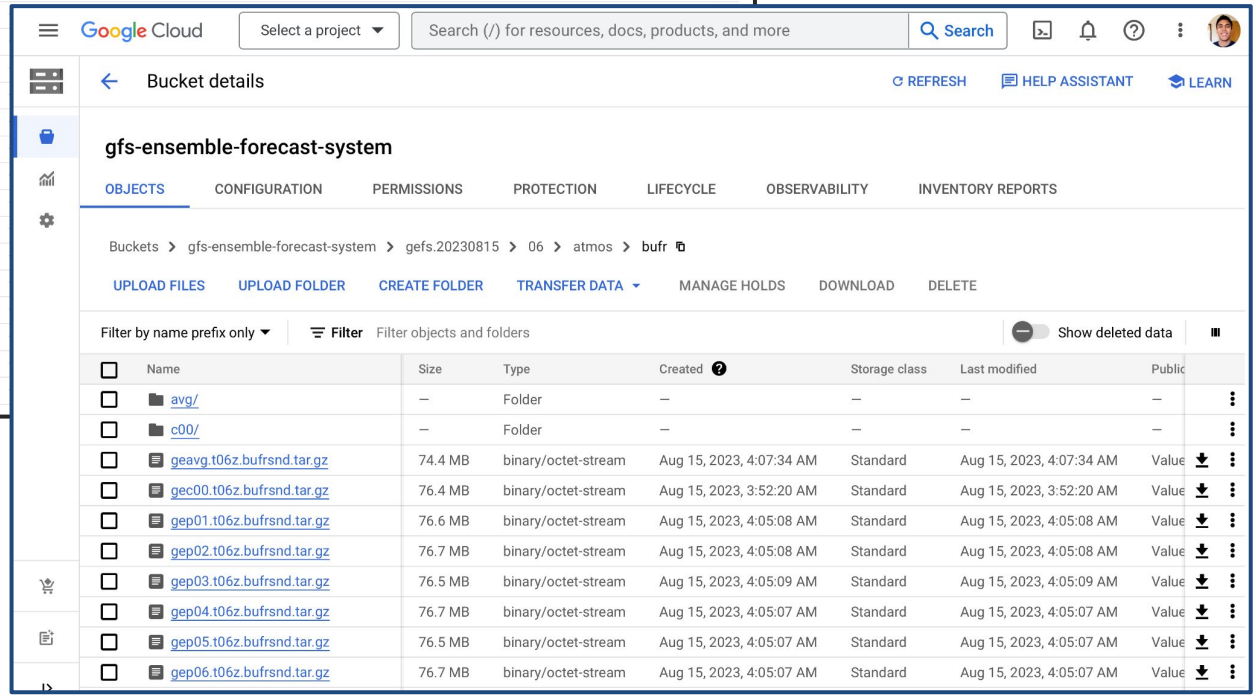
1. The Google Cloud Storage bucket that stores the data is gfs-ensemble-forecast-system
2. Using a web browser, access the root of the bucket with the following URI*
   https://console.cloud.google.com/storage/browser/gfs-ensemble-forecast-system
3. You can examine multiple levels of the bucket by appending the path to the URI above.

   For example, to access the path gefs.20230815/06/atmos/bufr, use the URI
   https://console.cloud.google.com/storage/browser/gfs-ensemble-forecast-system/gefs.20230815/06/atmos/bufr

*You will be asked to sign in if you are not currently signed in







https://console.cloud.google.com/storage/browser/gfs-ensemble-forecast-system

Access JPSS data using the command line

gsutil is a Python application that lets you access Cloud Storage buckets and contents from the command line.

To list objects from the root of the bucket:

```
$ gsutil ls gs://noaa-nesdis-n21

gs://noaa-nesdis-n21/ATMS-SCIENCE-RDR/
gs://noaa-nesdis-n21/ATMS-SDR-GEO/
gs://noaa-nesdis-n21/ATMS-SDR/
gs://noaa-nesdis-n21/ATMS-TDR/
gs://noaa-nesdis-n21/ATMS_BUFR/
gs://noaa-nesdis-n21/CRIS-SCIENCE-RDR/
...
```

Using gcloud storage has a similar effect:

```
$ gcloud storage ls gs://noaa-nesdis-n21
```

Access JPSS data using the command line

To copy an entire prefix (directory tree) and its contents to the current directory*

```
$ gsutil -m cp gs://noaa-nesdis-n21/VIIRS-I1-SDR/2024/04/17 .
```

*The -m flag enables multiprocessing to parallelize object downloads. Note that data for a single date is more than 25 GB in size!

Again, using gcloud storage has a similar effect (without the -m flag):

```
$ gcloud storage cp gs://noaa-nesdis-n21/VIIRS-I1-SDR/2024/04/17 .
```

(For more info, see https://cloud.google.com/sdk/gcloud/reference/storage)

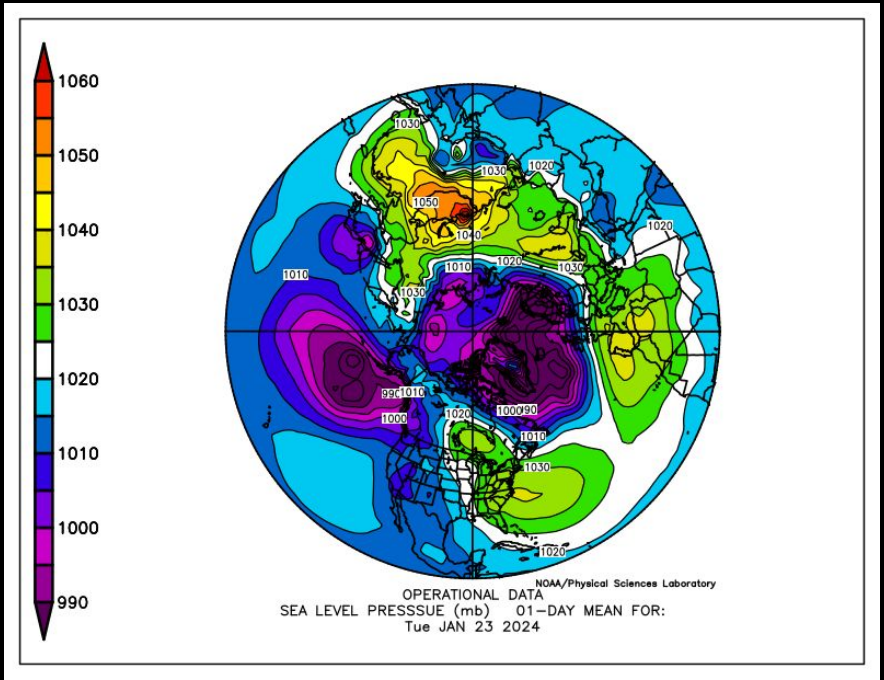
03

Use Cases and Journeys

Weather Satellites: An Invaluable Resource

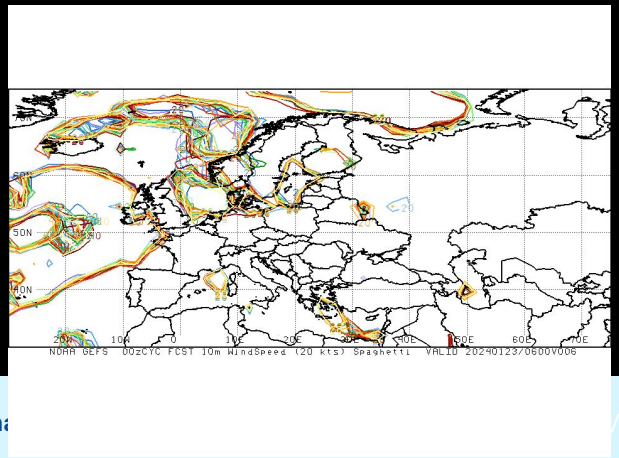
- Nearly unlimited use cases. Weather observations for agriculture, transportation, finance, and energy sectors
- Climate change monitoring
- Disaster/risk management
  - Wildfires
  - Extreme Floods
  - Hurricanes, Tropical Storms, and Extreme Weather

Global Weather Models: Another Invaluable Resource



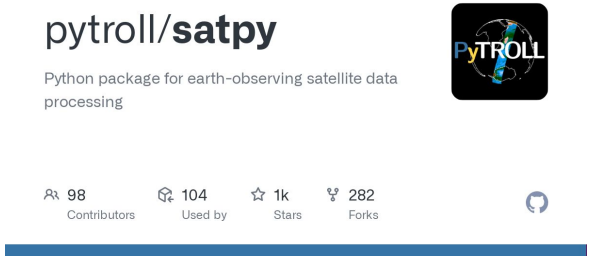
- Global weather models available in high resolution 4x per day for:
  - Business Analytics
  - Operational Forecast Needs
  - ML training and validation

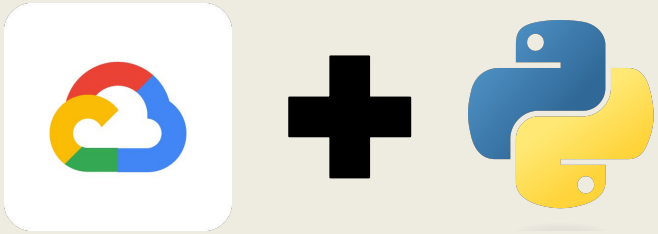
- Global weather model ensembles available
  - Use 30 perturbed + 1 control forecast to increase your certainty in how much uncertainty a model has!



Code example for JPSS VIIRS data on GCP

Try this on your own Colab!





Setup

Setup your environment for all the tools you will need to accomplish the task of visualizing some data.

```
!pip install -q satpy pyspectral

from satpy.scene import Scene
from satpy import find_files_and_readers
import h5py
import gcsfs
from google.colab import auth
from google.cloud import storage
from datetime import datetime
import pandas as pd
import numpy as np
import re


auth.authenticate_user()
```

Instantiate clients and set search limits

For a free Colab, you'll want to make sure you are processing only one true color image at a time using this code.

```
bucket_name = "noaa-nesdis-n21"

year = '2023'
month = '08'
day = '09'
start_hour = '23'
start_minute = '49'
end_hour = '23'
end_minute = '50'

start_limiter = datetime(int(year), int(month), int(day),
int(start_hour), int(start_minute), 0)
end_limiter = datetime(int(year), int(month), int(day), int(end_hour),
int(end_minute), 0)

# Instantiates a client
storage_client = storage.Client()

# Instantiate file system
fs = gcsfs.GCSFileSystem(anon=True)
```

Make some functions!

Let's make functions to help us identify files of interest and to return a list of interesting data.

```
def list_blobs(bucket_name, prefix, delimiter=None):
    """Lists all the blobs in the bucket."""

    storage_client = storage.Client()
    blobs = storage_client.list_blobs(bucket_name, prefix=prefix,
delimiter=delimiter)
    # Note: The call returns a response only when the iterator is
consumed.
    results = []
    for blob in blobs:
        # print(blob.name)
        results.append(blob.name)
    return results

def parse_dates_from_filename(f):
  start =
pd.Timestamp(datetime.strptime("_".join(re.findall(r"_[dt](\d+)",
f.split('/')[-1])), "%Y%m%d_%H%M%S%f"))
  return start
```

Identify the files we want to work with…

Isolate the files you want to work with and add some additional parsed data.

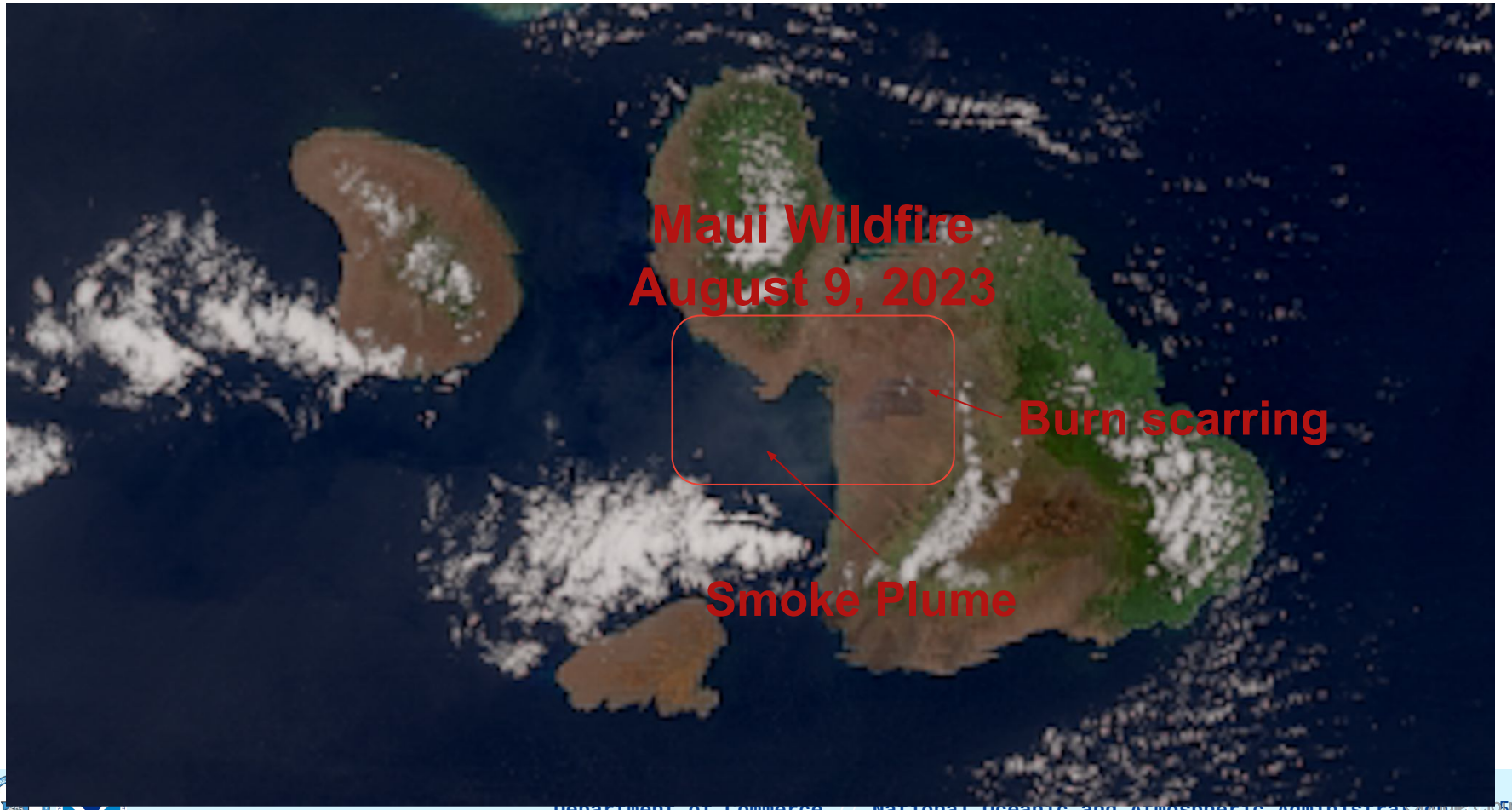
```
# Create a dataframe and add datetime field from filenames
dfr = pd.DataFrame(results, columns=['Files'])
dfr['Date'] = dfr.Files.apply(parse_dates_from_filename)

#Fetch data from an important time
lets_get = dfr[(dfr.Date >= start_limiter) &
               (dfr.Date < end_limiter)]

# Get Filenames
Lets_get = lets_get.Files.to_list()
print('Filtered to:', len(lets_get))

# Show first 5 files
lets_get[0:5]
```

Open and process files

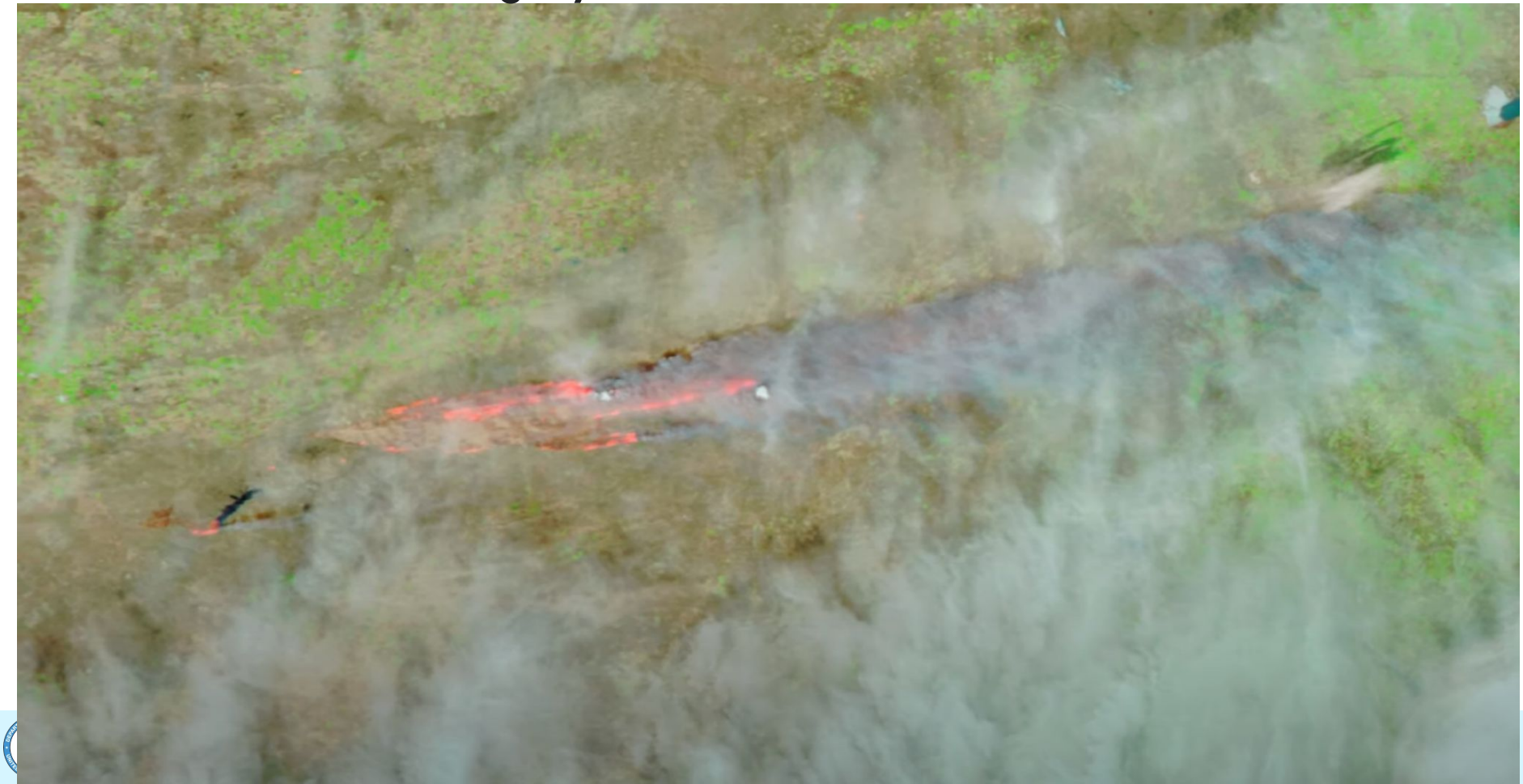
Process data from each of the 6 bands listed to make a true color representation of JPSS data.

```
results = []
target_data = [
                'VIIRS-M3-SDR',
                'VIIRS-M4-SDR',
                'VIIRS-M5-SDR',
                'VIIRS-I1-SDR',
                'VIIRS-MOD-GEO',
                'VIIRS-IMG-GEO',
               ]

for target in target_data:
  stuff = list_blobs(bucket_name, f"{target}/{year}/{month}/{day}/",
None)
  dfr = pd.DataFrame(stuff, columns=['Files'])
  dfr['Date'] = dfr.Files.apply(parse_dates_from_filename)
  dfr.Files = dfr.Files.apply(lambda x: 'gs://' + bucket_name +'/' + x)
  results.extend(dfr[(dfr.Date >= start_limiter) & (dfr.Date <
end_limiter)].Files.to_list())

print(f'Found {int(len(results)/len(target_data))} snapshots to
combine.')
scene = Scene(filenames=results, reader='viirs_sdr')
scene.load(['true_color'])
natscn = scene.resample(resampler='native')
natscn.show('true_color')
```

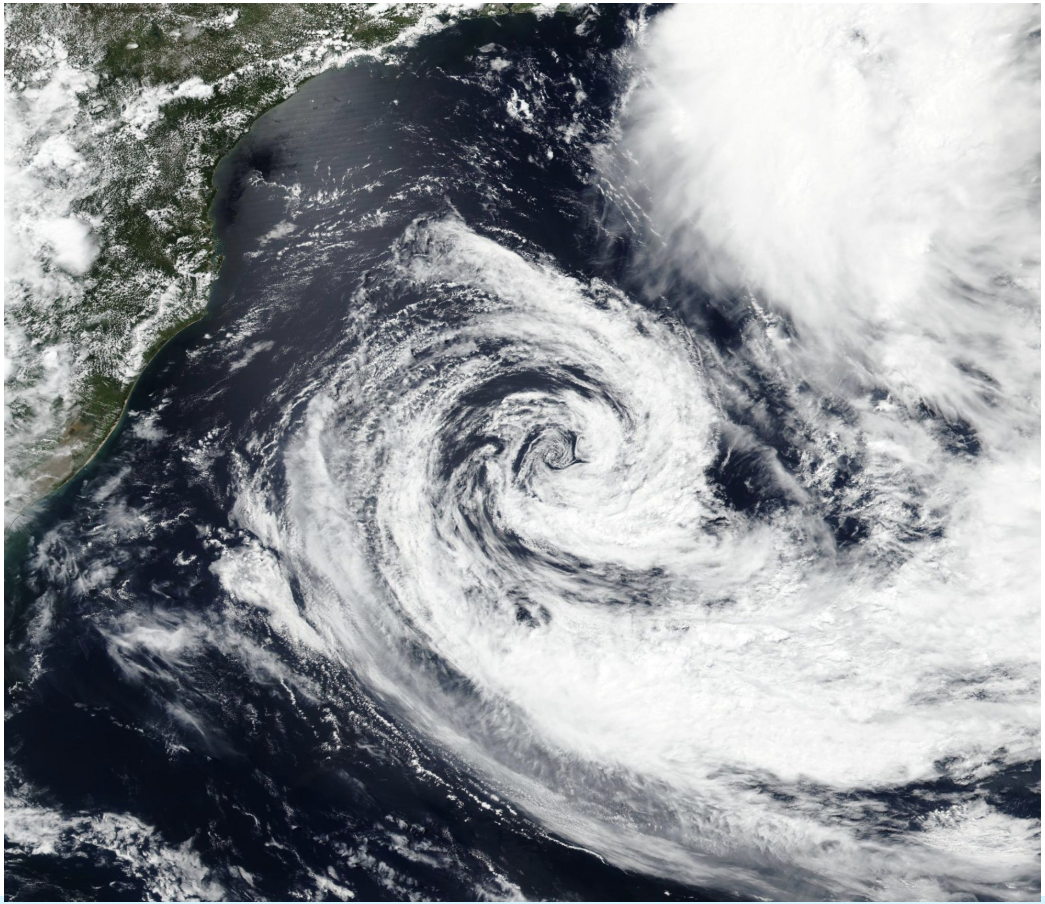
JPSS Imagery from Maui Wildfire Aug 2023



JPSS Imagery from Texas Wildfires Feb 2024



Tropical Storm Ikará Offshore Brazil Feb 2024



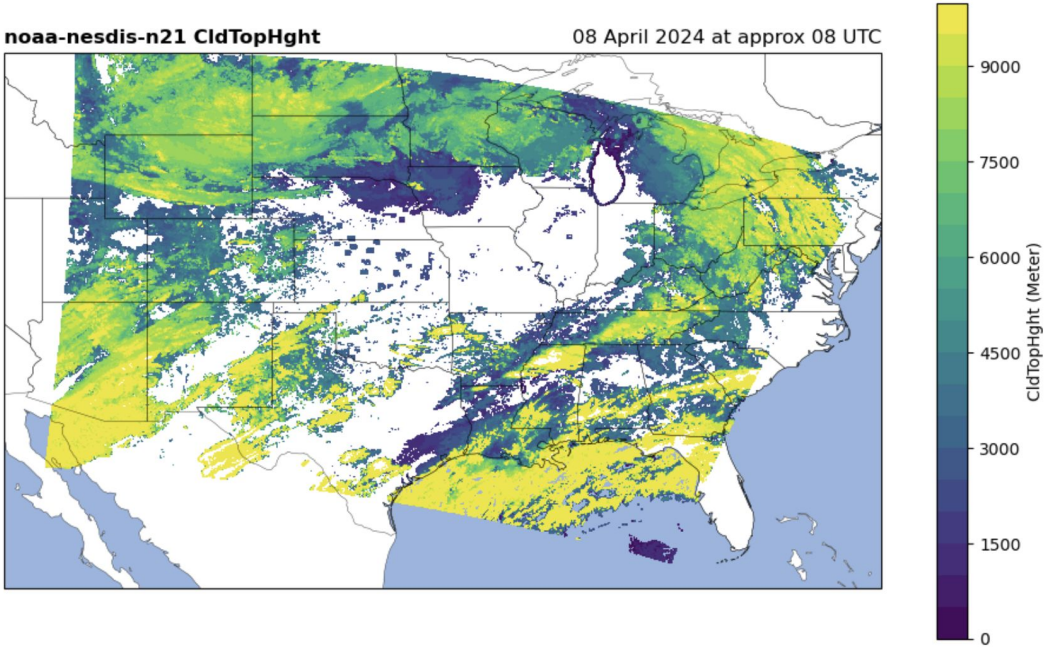
Thank you.

Questions? Email us at:
cloud-public-dataset-conferences@google.com

Google Cloud

Jupyter Notebook Demo

```
# Show the plot
plt.show()
```



Terminal 1 | JPSS_notebook_geolocate | JPSS_notebook_timeselect

Code | git | Python 3

▾ Data variables:

quality_informat...	()	uint8	...
StartRow	()	int32	...
StartColumn	()	int32	...
AchaMode	()	float64	...
NumOfQualityFl...	()	float32	...
Shadow_Mask	(Rows, Columns)	float32	...
Latitude_Pc	(Rows, Columns)	float32	...
Longitude_Pc	(Rows, Columns)	float32	...
CldTopTemp	(Rows, Columns)	float32	...
CldTopTempLow	(Rows, Columns)	float32	...
CldTopPres	(Rows, Columns)	float32	...
CldTopPresLow	(Rows, Columns)	float32	...
CldTopHght	(Rows, Columns)	float32	...
CldTopEmss	(Rows, Columns)	float32	...
CldOptDpth	(Rows, Columns)	float32	...
CloudHgtQF	(Rows, Columns)	float32	...
CldHgtFlag	(Rows, Columns, CldHgtFlgCnst)	float32	...
ProcOrder	(Rows, Columns)	float32	...
Cost	(Rows, Columns)	float32	...
InverFlag	(Rows, Columns)	float32	...
TcError	(Rows, Columns)	float32	...
PcError	(Rows, Columns)	float32	...

Resources

JPSS Product Documentation:

- https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php (Variable explanations)
- https://www.star.nesdis.noaa.gov/jpss/JPSS_products.php (Product description)
- https://www.ospo.noaa.gov/Products/Suites/jpss-rr/count_JRR_product.html?product=aerosol (JRR product visualization)
- https://www.nesdis.noaa.gov/our-satellites/currently-flying/joint-polar-satellite-system/jpss-satellite-and-instruments (About the satellites)
- https://rammb2.cira.colostate.edu/training/visit/jpss-imagery-for-users/ (Data visualization)
- https://weather.ndc.nasa.gov/sport/jpsspg/viirs.html (Real-time product visualization)

Coding Sources:

- https://github.com/jpss-nodd/python-scripts/tree/main
- https://medium.com/the-barometer/plotting-noaa-dnb-nighttime-data-using-python-h5py-cartopy-daefef240b0f
- https://github.com/modern-tools-workshop/AMS-python-workshop-2023
- https://www.meted.ucar.edu/education_training/course/54
- https://www.star.nesdis.noaa.gov/atmospheric-composition-training/python_abi_level2_download.php

Questions and Discussion

- Please be brief in your questions / comments
- Use the chat or raise your hand for questions
- Identify who the question is directed to where possible
    - As questions are answered, we will go to the next in the chat queue and call on you to unmute yourself and ask your question.
    - We appreciate there may be questions that cannot be answered immediately and even those that we won't have an opportunity to get to: please be patient as we build our understanding and summary responses.

Resources

We invite you to stay engaged with NOAA!

- **NOAA JPSS:**
  - https://www.nesdis.noaa.gov/our-satellites/currently-flying/joint-polar-satellite-system
- **NOAA Open Data Dissemination:**
  - noaa.gov/nodd
  - Email: NODD@noaa.gov
- **Google JPSS:**
  - https://console.cloud.google.com/marketplace/product/noaa-public/noaa-jpss?hl=en&project=nmfs-trusted-images