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.
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- 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](NOAA.GOV/NODD)
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 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:
  - Mute and Video
  - CC
  - Hand Raise
  - Settings
  - Chat
  - Polls
- 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

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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
- Orbits Earth 14 times pole-to-pole with SNPP
- 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.

CrIS
Cross-track Infrared Sounder

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.

OMPS
Ozone Mapping and Profiler Suite
Ozone spectrometers for monitoring ozone hole and recovery of stratospheric ozone and for UV index forecasts.

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)
LEO Measurements Contribute to All NOAA Mission Service Areas

WEATHER READY NATION (WRN)
- National Weather Service
  1. Aviation Weather & Volcanic Ash (WRN-AVX)
  2. Fire Weather (WRN-FWX)
  3. Hydrology & Water Resources (WRN-IWV)
  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)

HEALTHY OCEANS (HO)
- National Marine Fisheries Service
  1. Ecosystem Monitoring, Assessment & Forecast (HO-ECD)
  2. Fisheries Monitoring, Assessment & Forecast (HO-FMA)
  3. Habitat Monitoring & Assessment (HO-HAB)
  4. Protected Species Monitoring (HO-PSM)

RESILIENT COASTS (RC)
- National Ocean Service
  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)

CLIMATE (CLI)
- Office of Oceanic and Atmospheric Research
  1. Assessments of Climate Changes & Its Impacts (CLI-ACCI)
  2. Climate Mitigation & Adaptation Strategies (CLI-CMA)
  3. Climate Science & Improved Understanding (CLI-SIU)

- 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.
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

CH₄ has been increasing globally. Continuous monitoring of global methane with in situ and satellite data will allow NOAA to track reductions associated with GMP

CH4

https://doi.org/10.3390/rs15122992

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

NOAA Global Monitoring Lab (GML) Full Record Global Methane

AIRS Sounder (2003)

May 2023: 1922.26 ppb
May 2022: 1907.80 ppb

AIRS Records

CrIS Sounder (2020)
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)
Arctic Ice Streaming Down Strait between Greenland and Ellesmere Island
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/](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)

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

The VIIRS data on the NODD is currently supporting NRT fire-related applications in Brazil and Mexico. [https://alarmes.lasa.ufrj.br/platform/webgis](https://alarmes.lasa.ufrj.br/platform/webgis) (POC: Wilfrid Schroeder/NOAA NESDIS SAB)
LEO and the Near Earth Observation Network (NEON)
EXPLORING THE IMPACT AND APPLICATIONS OF JPSS DATA

Download your copy today!
www.nesdis.noaa.gov/JPSS-digest
NOAA Public Datasets on Google Cloud - JPSS

04/18/2024
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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
Google Earth has helped users find amazing things

**The New York Times**

*Hundreds of Mysterious Stone ‘Gates’ Found in Saudi Arabia’s Desert*

*NASA Adds to Evidence of Mysterious Ancient Earthworks*

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

**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

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<tr>
<th>Dataset</th>
<th>Description</th>
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<tr>
<td><strong>Joint Polar Satellite System (JPSS)</strong></td>
<td>NOAA-20/21 and SNPP available from 2023–Present with VIIRS, ATMS, CRiS, and OMPS, etc. sensors with low latency and high resolution.</td>
</tr>
<tr>
<td><strong>Next Generation Radar (NEXRAD)</strong></td>
<td>High-resolution S-band Doppler weather radars operated by the National Weather Service (NWS).</td>
</tr>
<tr>
<td><strong>Global Forecast System (GEFS)</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>High Resolution Rapid Refresh (HRRR)</strong></td>
<td>3-km resolution hourly updated, cloud-resolving, convection-allowing atmospheric model.</td>
</tr>
<tr>
<td><strong>Global Summary of the Day (GSOD)</strong></td>
<td>A dozen daily averages computed from global hourly station data, covering 1929 to present.</td>
</tr>
</tbody>
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02

Accessing and Using Public Datasets
Google Cloud Datasets Marketplace

226 results

- **D&B Strategic Database Marketing Record (SDMR)**
  - Dun & Bradstreet
  - Empower your organization with accurate and actionable data.

- **COVID-19 Genome Sequence Dataset**
  - National Library of Medicine
  - Centralized sequence repo of all strains of novel coronavirus.

- **D&B Corporate Family Tree**
  - Dun & Bradstreet
  - Corporate Family Tree Plus — Your Gateway to Deeper Insights and Greater Opportunities.

- **ZoomInfo - Companies with the most marketing**
  - ZoomInfo
  - Top 100 companies from ZoomInfo's Company Data Cube with the most marketing.

- **D&B ID Graph**
  - Dun & Bradstreet

- **ZoomInfo - Companies under 1,000 employees offering**
  - ZoomInfo
  - Top 100 companies from ZoomInfo's Company Data Cube with under 1,000 employees.

- **Fantom Blockchain (Preview)**
  - BigQuery Public Data
  - Comprehensive dataset of Fantom blockchain data, maintained by Google.

- **GOES 16/18**
  - NOAA
  - Geostationary Operational Environmental Satellite data.

- **AlphaFold Protein Structure Database**
  - BigQuery Public Data
  - 214M AlphaFold protein structure predictions from DeepMind.

- **ZoomInfo - Retail Companies headquartered in California**
  - ZoomInfo
  - Top 100 retail companies from ZoomInfo's Company Data Cube headquartered in California.

- **Google Community Mobility Reports**
  - BigQuery Public Datasets Program
  - Changes in community movement due to COVID-19.

- **Google's Diversity Annual Report Data**
  - BigQuery Public Datasets Program
  - Demographic data of the employees in our company.
**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

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](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

*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.
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:

```bash
$ 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:

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

Access JPSS data using the command line
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 model ensembles available
  - Use 30 perturbed + 1 control forecast to increase your certainty in how much uncertainty a model has!

- Global weather models available in high resolution 4x per day for:
  - Business Analytics
  - Operational Forecast Needs
  - ML training and validation
Code example for JPSS VIIRS data on GCP

Try this on your own Colab!
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()
```
For a free Colab, you’ll want to make sure you are processing only one true color image at a time using this code.

```python
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)
```
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.

```python
# 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.

```python
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 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
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](https://www.nesdis.noaa.gov/our-satellites/currently-flying/joint-polar-satellite-system)

- **NOAA Open Data Dissemination:**
  - [noaa.gov/nodd](http://noaa.gov/nodd)
  - Email: NODD@noaa.gov

- **Google JPSS:**