



# **Goddard Earth Sciences Data and Information Services Center (GES DISC)**

## **Exploring synergistic tools from NASA satellite data for Air Quality**

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# Outline

- Air Quality vs Earth Observatory AQ data
- **Data Challenge:**
  - **Demand** (community needs) vs. **Supply** (available data) often do not meet
  - Tools & Tips in **Data Discovery**
  - Tools & Tips in **Data Exploration**
- Examples on how you can exploit data through **Worldview** and **Giovanni**



# Air Quality Indicators vs. NASA Data

## Demand

- Ground level ozone
- **Carbon monoxide (CO)**
- **Sulfur dioxide (SO<sub>2</sub>)**
- **Nitrogen dioxide (NO<sub>2</sub>)**
- Airborne particles (PM10, PM2.5) or **aerosols (AOD)**
- Precursors:  
**Formaldehyde(HCHO)**  
**Ammonia (NH<sub>3</sub>)**

## Supply

### *In-Situ*

- AERONET
- Field Campaigns

### Space-borne

- AIRS, SNPP/CrIS, MOPITT**
- OMI, OMPS, S5P/TROPOMI**
- SeaWiFS, MODIS, MISR, VIIRS
- Other Missions (GOES-R, Himawari, TEMPO, MAIA...)

### Model

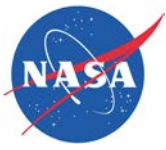
- MERRA-2**
- MAIAC (MCD19A2)**



# Data Challenges in Air Quality

- **Demand (purpose for using data) varies**
  - Monitoring - temporal/spatial, data latency
  - Decision-making - simple, visualization
  - Research - detail and ancillary information
- **Data Type varies**
  - Instrument
    - Platform
    - Data Access
  - Implementation (e.g., algorithm)
  - Data formats
  - Quality (e.g., Real Time, Near-Real-Time, Production)





# Tools & Tips: Discover NASA Air Quality data

- Tools to discover NASA AQ data:

EARTHDATA Find a DAAC

## GES DISC

Atmospheric Composition, Water & Energy Cycles, and Climate Variability

Feedback Help Login



### Explore...

Data Collections - Enter search (e.g., rainfall, GPM, TRMM\_3B42)

- Data Collections
- Data Documentation
- Alerts
- FAQs
- Glossary
- How-To's
- Image Gallery
- News
- Tools

Archive Size: 2,207.224 TB  
Archived Data Files: 115,833,482  
Files Distributed\*: 2,361,344,528  
Data Volume Distributed\*: 22,440.550 TB

### Projects & Missions

#### Cloud Absorption Radiometer (CAR)

The Cloud Absorption Radiometer (CAR) is an airborne multi-wavelength scanning radiometer that can perform several functions including: d...

#### MEASUREs

MEASUREs: Making Earth System Data Records for Use in Research Environments, is a NASA project, solicited through Research Opportunities In ...

#### SSBUV

The Shuttle Solar Backscatter Ultraviolet (SSBUV), nearly identical to Nimbus-7

### Featured Gallery Images



### News



The Giovanni News issue for the 3rd Quarter of 2018 is online  
Nov 14, 2018



The TRMM and GPM precipitation record  
Nov 9, 2018



# Tools & Tips: Exploit NASA Air Quality data

## ● NASA AQ Exploring Tools

- Worldview: <https://worldview.earthdata.nasa.gov>
- Giovanni: <https://giovanni.gsfc.nasa.gov/giovanni/>
- Multi-sensor Aerosol Products Sampling System:
  - [MAPSS](https://giovanni.gsfc.nasa.gov/mapss/): <https://giovanni.gsfc.nasa.gov/mapss/>
  - [MAPSS Explorer](https://giovanni.gsfc.nasa.gov/mapss_explorer/): [https://giovanni.gsfc.nasa.gov/mapss\\_explorer/](https://giovanni.gsfc.nasa.gov/mapss_explorer/)

## ● NASA Applied Sciences AQ Resources:

- [NASA Health and Air Quality \(AQ\)](#)
- [GSFC Air Quality](#)
- [NASA Applied Remote SEnsing Training \(ARSET\)](#)
- [NASA Health and Air Quality Applied Sciences Team \(HAQAST\)](#)
- NASA Earth Observatory: <https://earthobservatory.nasa.gov>

## ● Tips:

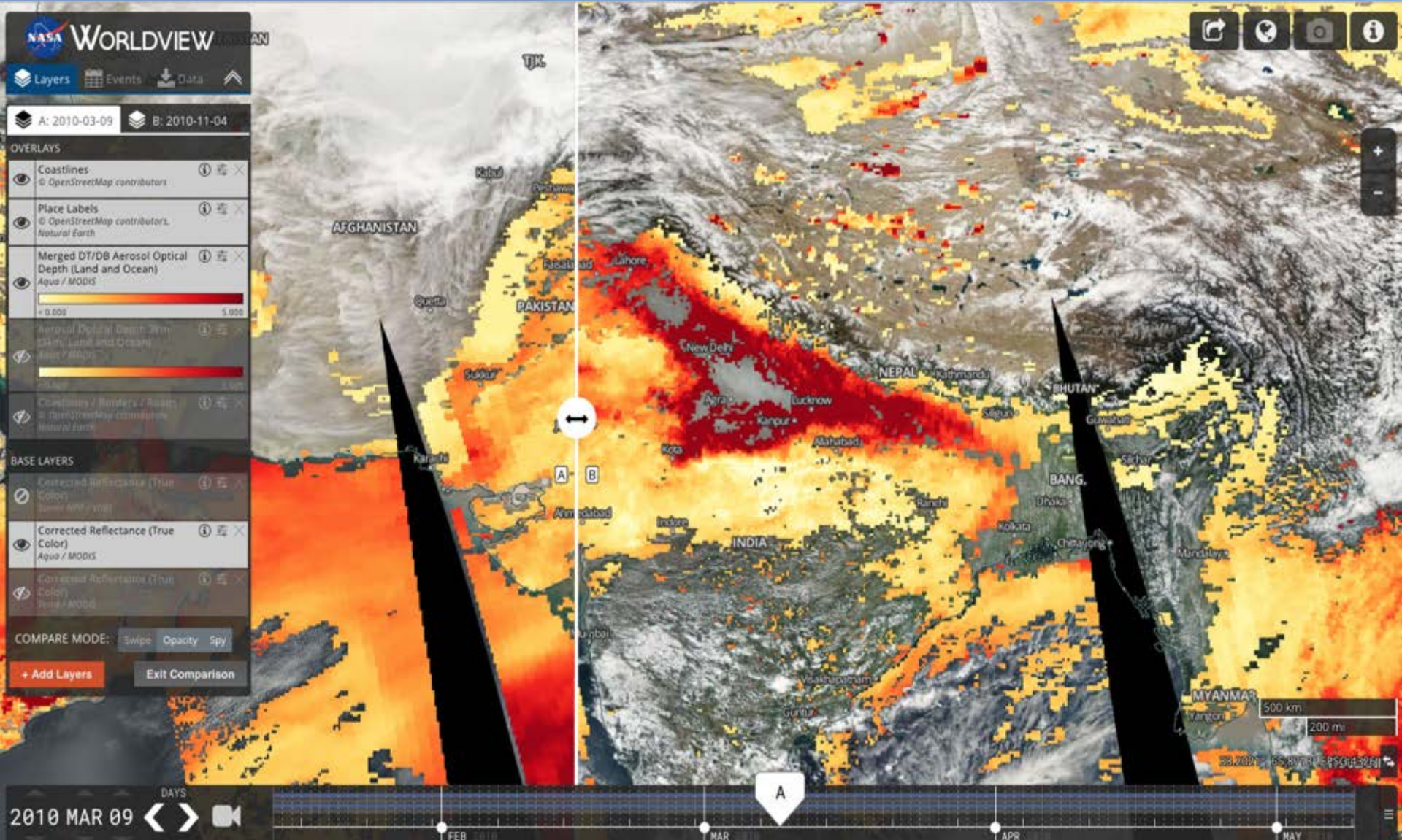
- Use Quick Tour for the tool
- Data Recipe or Data HowTo's
- Webinars
- News articles from NASA EO and GES DISC





# NASA Worldview

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







# NASA GES DISC Giovanni

<https://giovanni.gsfc.nasa.gov/>

EARTHDATA Data Discovery - DAACs - Community - Science Disciplines -

**GIOVANNI** The Bridge Between Data and Science v 4.28

[Feedback](#) [Help](#) [Login](#)

AIRS Project recommends not to use total column CO and CH4 ... [1 of 1 messages] [Read More](#)

### Select Plot

Maps: Time Averaged Map ▾
  Comparisons: Select... ▾
  Vertical: Select... ▾
  Time Series: Select... ▾
  Miscellaneous: Select... ▾

### Select Date Range (UTC)

YYYY-MM-DD HH:mm

-   :  to  -  :

Valid Range: 1948-01-01 to 2018-11-19

### Select Region (Bounding Box or Shape)

Format: West, South, East, North

Please specify a start date.

### Select Variables

#### ▼ Disciplines

- Aerosols (71)
- Atmospheric Chemistry (56)
- Atmospheric Dynamics (24)
- Water and Energy Cycle (8)

#### ▶ Measurements

#### ▶ Platform / Instrument

#### ▶ Spatial Resolutions

#### ▶ Temporal Resolutions

#### ▶ Wavelengths

#### ▶ Special Features

#### ▼ Portal

- Atmospheric Composition Portal (149)
- Basic (421)
- Omnibus (1701)

Number of matching Variables: 149 of 1933 Total Variable(s) included in Plot: 0

Please select at least 1 variable

Keyword:

	Variable	Units	Source	Temp.Res.	Spat.Res.	Begin Date	End Date	Vert. Slice
<input type="checkbox"/>	<a href="#">Aerosol Absorption Optical Depth 388 nm (OMAERUVd v003)</a>	-	OMI	Daily	1°	2004-10-01	2018-11-13	-
<input type="checkbox"/>	<a href="#">Aerosol Absorption Optical Depth 500 nm (OMAERUVd v003)</a>	-	OMI	Daily	1°	2004-10-01	2018-11-13	-
<input type="checkbox"/>	<a href="#">Aerosol Optical Depth 555 nm (MIL3DAE v4)</a>	-	MISR	Daily	0.5°	2000-02-25	2017-05-31	-
<input type="checkbox"/>	<a href="#">Water Vapor Mass Mixing Ratio (Daytime/Ascending) (AIRX3STD v006)</a>	gm/kg	AIRS	Daily	1°	2002-08-31	2016-09-24	1000 hPa
<input type="checkbox"/>	<a href="#">Water Vapor Mass Mixing Ratio (Nighttime/Descending) (AIRX3STD v006)</a>	gm/kg	AIRS	Daily	1°	2002-08-31	2016-09-24	1000 hPa
<input type="checkbox"/>	<a href="#">Water Vapor Mass Mixing Ratio at Surface (Daytime/Ascending) (AIRX3STD v006)</a>	g/kg	AIRS	Daily	1°	2002-08-31	2016-09-24	-
<input type="checkbox"/>	<a href="#">Water Vapor Mass Mixing Ratio at Surface (Nighttime/Descending) (AIRX3STD v006)</a>	g/kg	AIRS	Daily	1°	2002-08-31	2016-09-24	-
<input type="checkbox"/>	<a href="#">Total Column Water Vapor (Daytime/Ascending) (AIRX3STD v006)</a>	kg/m2	AIRS	Daily	1°	2002-08-31	2016-09-24	-





# Multi-Sensors Multi-Measurements Statistical Tools

The Multi-sensor Aerosol Products Sampling System (MAPSS) has been established as a consensus data framework for multi-sensor aerosol validation, intercomparison, and joint analysis. MAPSS provides statistics of spatial and temporal subsets of Level-2 aerosol scientific data sets (SDS) from a range of sensors that currently includes AERONET, MODIS, MISR, OMI, SWDB, VIIRS, POLDER, and CALIOP.

## MAPSS

## MAPSS Explorer

### MAPSS: Multi-sensor Aerosol Products Sampling System

This user interface is used to obtain selected parameter statistics from the MAPSS database for a chosen location and time period. Time Series Plot is the available service. Plot output is rendered as a graph and is also available in ASCII format.

Data Selection Results **NEW** Try out the MAPSS Statistical Explorer

**Plot Data** Reset Clear Send Us Feedback! Help

Select Station  
Click 'Browse' button or type in comma separated names:  Browse

Select Plot  
Satellite Colocated with AERONET  
 Time Series  
 Scatter Plot

Select Measurements  
Click each list below (beginning with the left-most list) to show the set of fully-qualified measurements. Select a measurement and then click 'Add'. Repeat for additional measurements.

Basic  Advanced

Product	Parameter	Layer	Measurement
AERONET aerosols L2, ver. 2			
AERONET deconvolution L2, ver. 41			
AERONET inversions L1.5, ver. 2			
AERONET inversions L2, ver. 2			
CALIPSO column and layer aerosols L2			
More...			

Selected Measurements

Interactive Map Plots Help

Current station	Display stations	Period	Surface	Measurement	Sensor	ARNT ADD range	Season	Outliers	QA	Statistics
GSFC	Only with data from at least one	'06-'	Land	All month	MISR v.22	All ADD	Mar	Excluding out	Pre-filter	R <sup>2</sup>

Key to map symbols

- MODIS (Green)
- MODIS DB (Light Green)
- AMODIS (Blue)
- AMODIS DB (Light Blue)
- OMI (Orange)
- SeaWiFS (Dark Grey)
- MISR (Red)
- POLDER (Yellow)
- CALIOP (Pink)
- NO DATA (Light Grey)
- NO DATA (Dark Grey)

Statistics value (normalized)

- val = 1.0 (Black)
- val = 0.7 (Dark Grey)
- val = 0.3 (Light Grey)
- val = 0.0 (White)

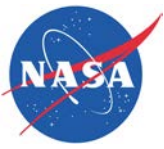
Sample size

- N < 10 (Small Circle)
- 10 <= N < 100 (Medium Circle)
- N > 100 (Large Circle)

All locations

<https://giovanni.gsfc.nasa.gov/mapss/>

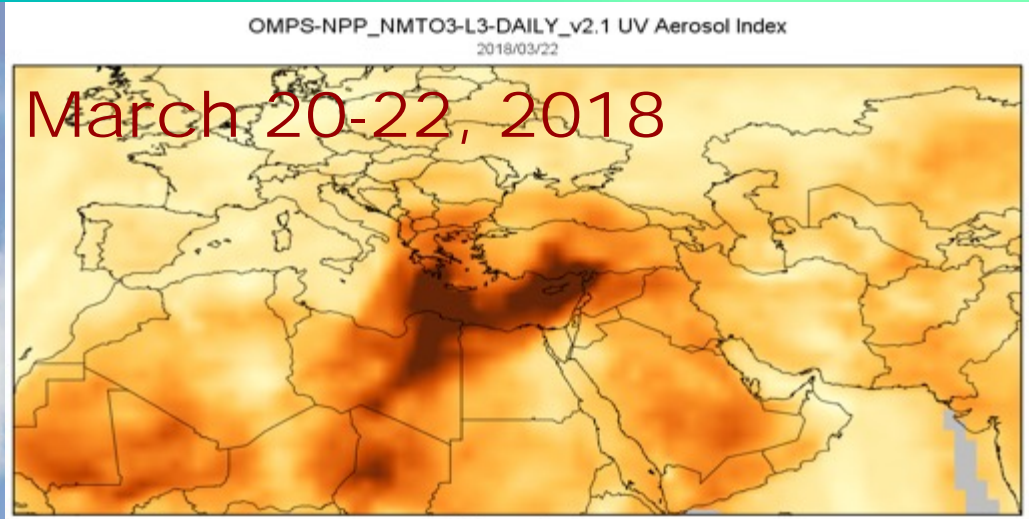
[https://giovanni.gsfc.nasa.gov/mapss\\_explorer/](https://giovanni.gsfc.nasa.gov/mapss_explorer/) **GES-DISC**  
Goddard Earth Sciences  
Data Information Services Center



# Episodic Event - Orange Snow?



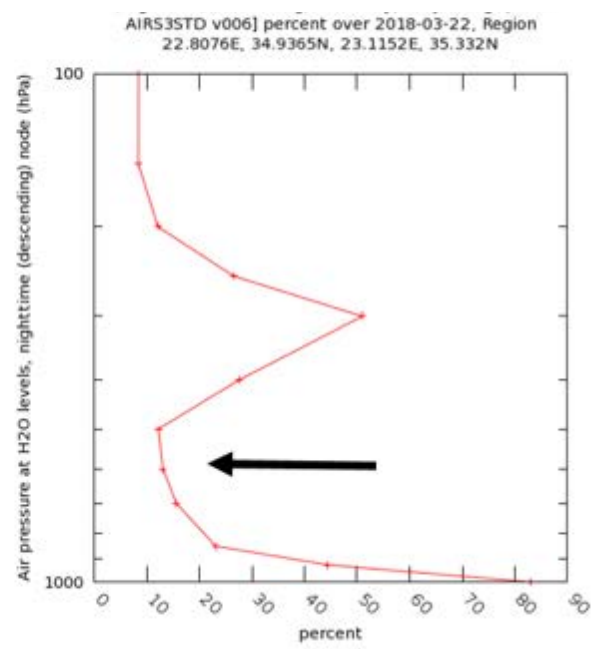
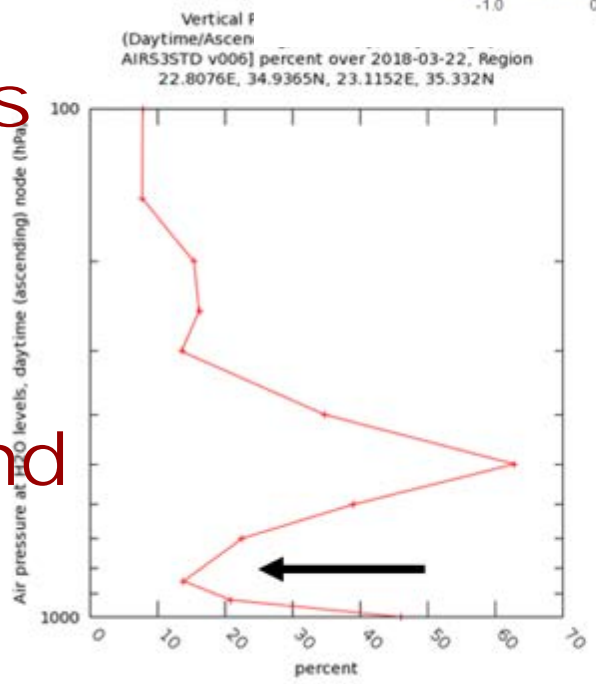
Feb. 4, 2018



March 20-22, 2018



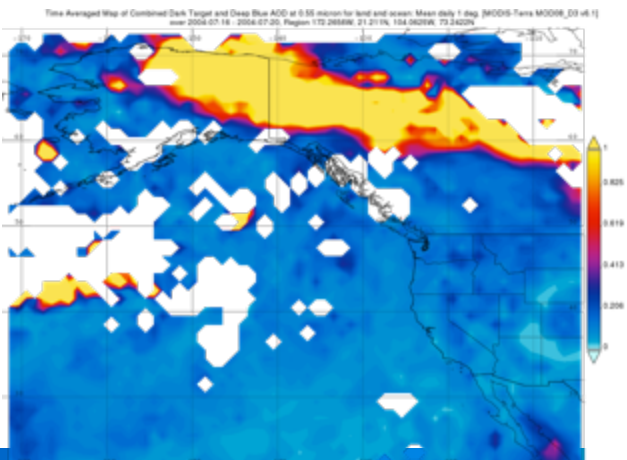
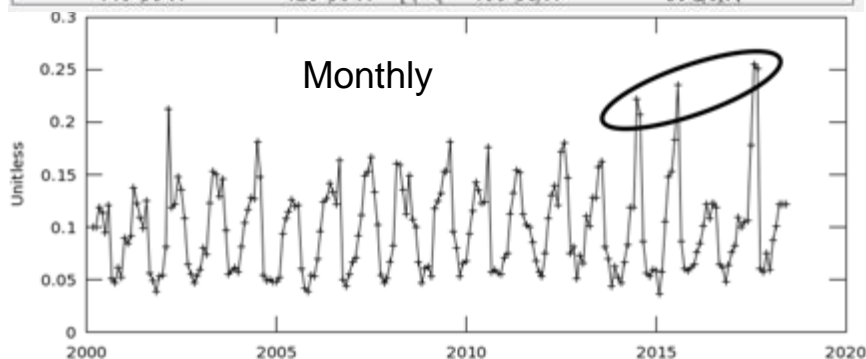
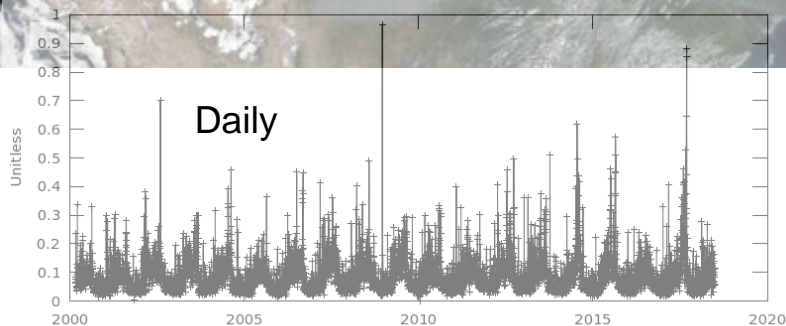
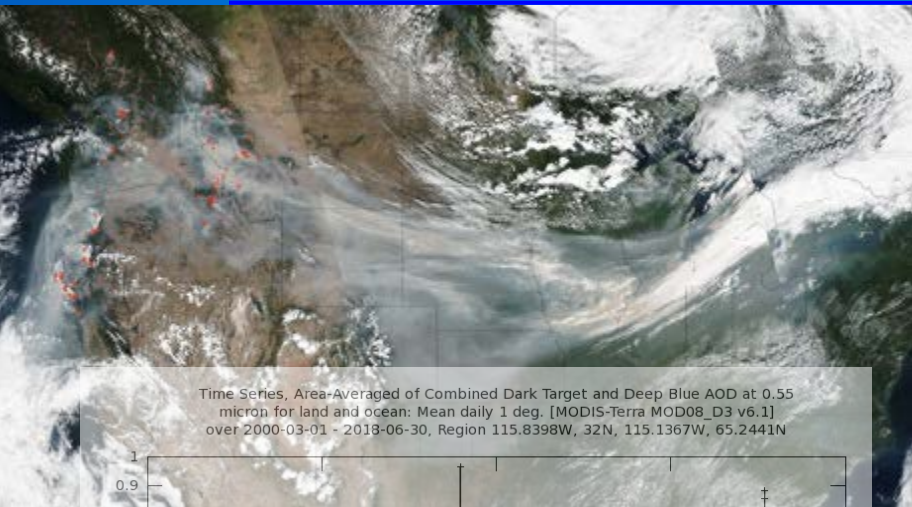
Giovanni allows rapid data analysis over user-specified time periods and region







# Identify Events: Aerosol Optical Depth Across North America - What Can a Giovanni Time Series Indicate?



## Links for Additional Information

- ▶ [Wildfire Smoke Crosses the U.S. on the Jet Stream](#)
- ▶ [A Season of Smoke](#)
- ▶ [Impact of California Fires on Local and Regional Air Quality: The Role of a Low-Cost Sensor Network and Satellite Observations](#) (Gupta et al., GeoHealth, May 2018)

## Related Data Sets for Wildfire Research

- AOD and related data products in Giovanni
- Carbon Monoxide (CO) in Giovanni
- Nitrogen Dioxide (NO<sub>2</sub>) in Giovanni
- AIRS Carbon Monoxide (all listed AIRS data products include the CO variable)
- Nitrogen Dioxide





# Summary

**NASA EOSDIS Data Search** <https://search.earthdata.nasa.gov>

**NASA GES DISC Data Search** <https://disc.gsfc.nasa.gov/>

**Worldview:** <https://worldview.earthdata.nasa.gov/>

**Giovanni:** <https://giovanni.gsfc.nasa.gov/giovanni/>

**GES DISC's HowTos** <https://disc.gsfc.nasa.gov/information/howto>

## Questions?

For Giovanni ⇒ Jennifer.C.Weil@nasa.gov

For Worldview ⇒ Ryan.Boller@nasa.gov

Help Desk ⇒ gsfc-help-disc@lists.nasa.gov