

# Open Source Air Quality Data and User Tools/Tutorials Provided by the NASA TROPESS Project

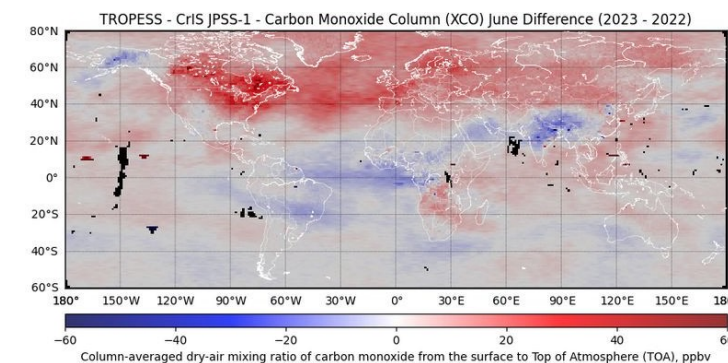
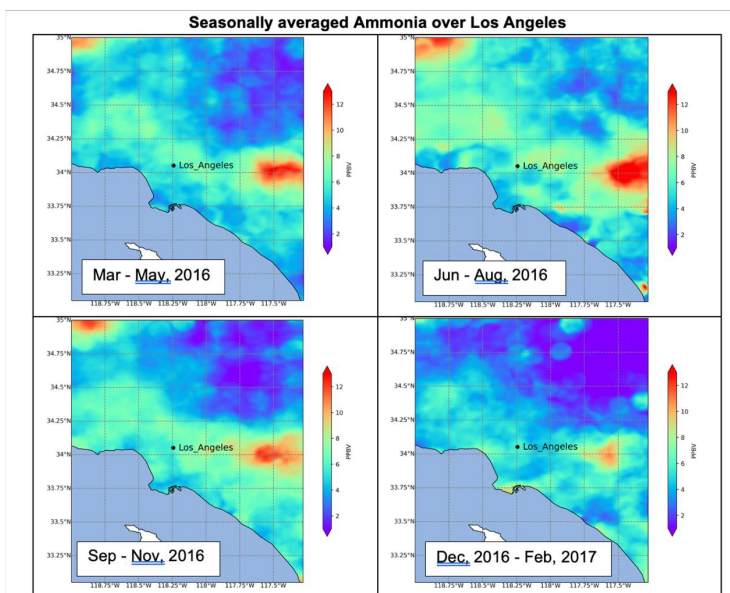


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**Passive Contributions:**  
JPL TROPESS Science Team, PO.DAAC, GES DISC,  
JPL Unity Team, NASA Openscapes





JPL Site->



# Intro to TROPESS

GES DISC->

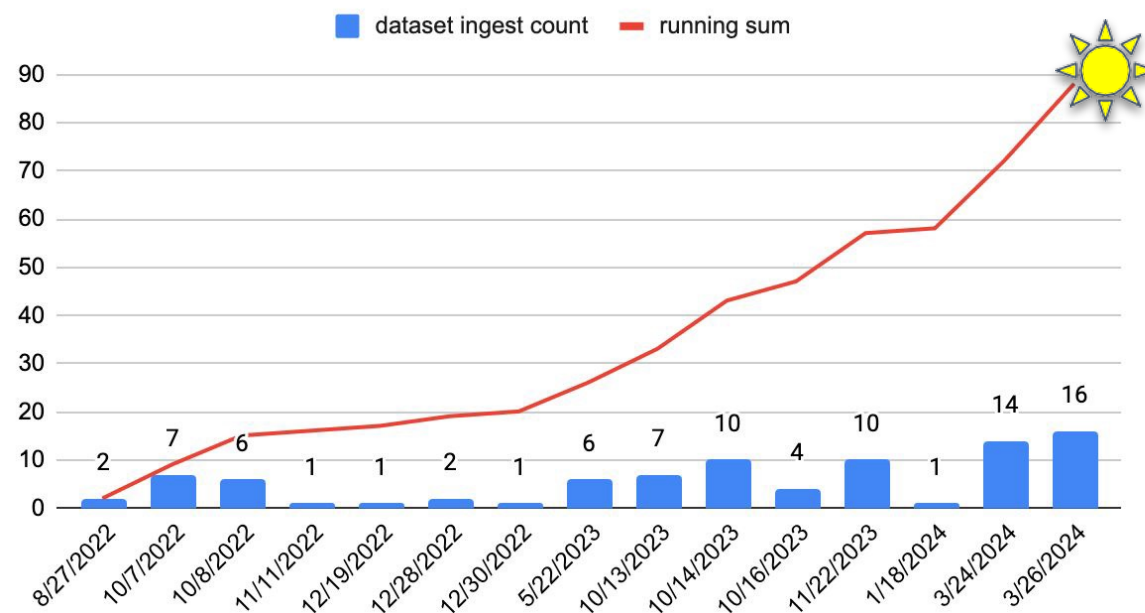


- TROPESS = TRopospheric Ozone and its Precursors from Earth System

Sounding: <https://tes.jpl.nasa.gov/tropess/>

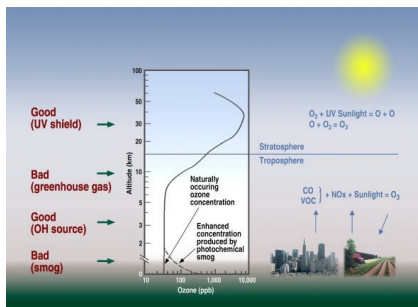
- Estimates of trace gases and atmospheric parameters including CO, CH<sub>4</sub>, Hydrogen-Deuterium Oxide (HDO), PAN, H<sub>2</sub>O, and more...
- 156 Datasets** at GES DISC; **88** on Earthdata Cloud.
- Level 2 (**88**) data from multiple platforms/sensors: AIRS Aura, CrIS-JPSS, and CrIS-SNPP.
- Level 4 (**68**) data from TCR-2 Reanalysis Model.
- All data is netCDF-4.
- Project granted **open-source approval** for public-facing source-code, notebooks, and tutorials: <https://software.nasa.gov/software/NPO-51949-1>

TROPESS Datasets in the Cloud

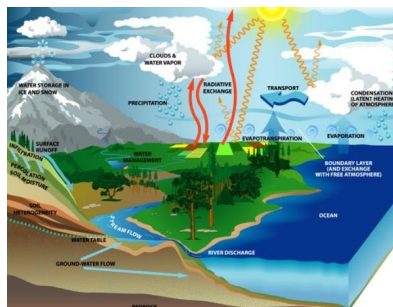


GES DISC will be 100% cloud-native by Nov. 2024

## Chemistry



## Water Cycle

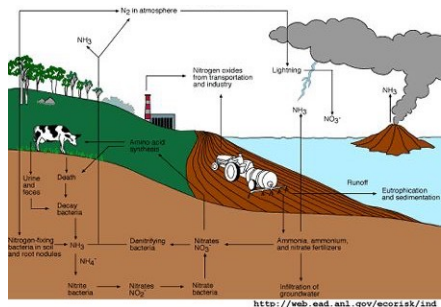


*Tropospheric sounding from satellite observations provides vital information about atmospheric composition and its impact on human health and climate.*

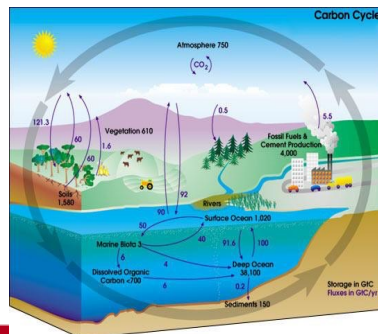
## Objectives

- Generate **consistently calibrated data records** of ozone and other atmospheric constituents by processing data from multiple satellites through a common retrieval algorithm.
- Promote the **availability and utility** of these **data records** to support scientific communities, e.g., **HAQAST**, IGAC, IPCC.
- Support the science of **Decadal Survey** and **CEOS Atmospheric Composition Virtual Constellation (AC-VC)** missions through a dependable forward stream of tropospheric composition data from existing and planned satellites.
- Support NASA activities including **fields campaigns** and **mission formulation**.

## Nitrogen Cycle



## Carbon Cycle







# Recently Released Datasets



## • Feb. 2024 - L4 Chemical Reanalysis (TCR-2) (68) [See Poster!](#)

- Trace gasses:  $O_3$ ,  $CO$ ,  $OH$ ,  $SO_2$ ,  $PAN$ ,  $HNO_3$ ,  $NO$ ,  $NO_2$ ,  $CH_2O$
- Aerosols:  $SO_4$ ,  $NH_4$ , and  $NO_3$
- Emission sources of  $NO_x$ ,  $CO$ , and  $SO_2$
- Global coverage at 2-hourly, 6-hourly, and monthly resolution
- Spatial resolution: 1.125 degrees latitude by 1.125 degrees longitude

## Dec. 2023 - CrIS-SNPP L2 Reanalysis Summary Version 1 (6)

- $CH_4$ ,  $PAN$ ,  $HDO$ ,  $O_3$ ,  $CO$  and  $NH_3$ .
- Global coverage
- Spatial resolution: 14 km at nadir

## Dec. 2023 - AIRS L2 Reanalysis Summary Version 1 (4)

- $CH_4$ ,  $HDO$ ,  $O_3$ , and  $CO$ .
- Global coverage
- Spatial resolution: 13.5 km at nadir

## October 2023 - CrIS-SNPP L2 Megacities Collection (16)

- $CH_4$ ,  $CO$ ,  $H_2O$ ,  $HDO$ ,  $NH_3$ ,  $O_3$ ,  $PAN$ , and temperature.
- Currently 7 megacity regions globally.
- Los Angeles, Mexico City, Tokyo, Beijing, Delhi, Karachi, Lagos, Sao Paulo
- Spatial resolution: 14 km at nadir

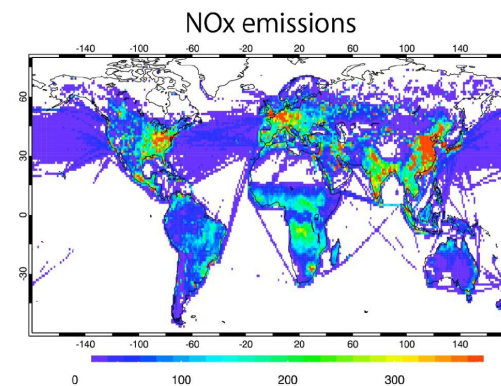


Figure 1: TCR-2 global distributions of surface  $NO_x$  emissions (in  $10^{-13} \text{ kgNm}^{-2}\text{s}^{-1}$ ) averaged over 2005-2018 (credit: Miyazaki et al., 2020b).

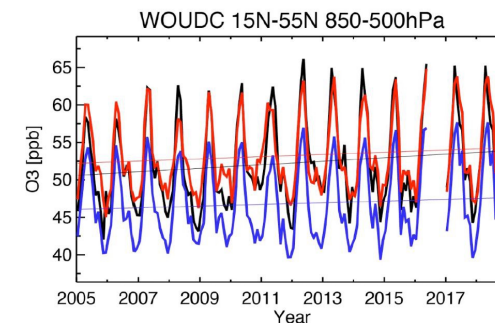
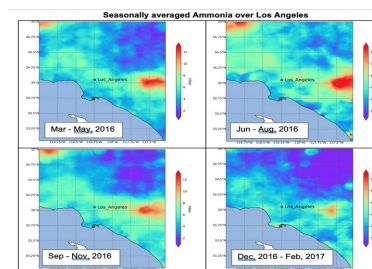
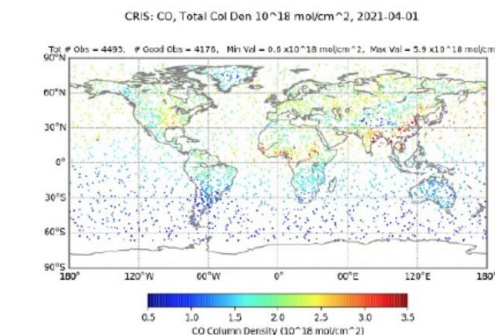
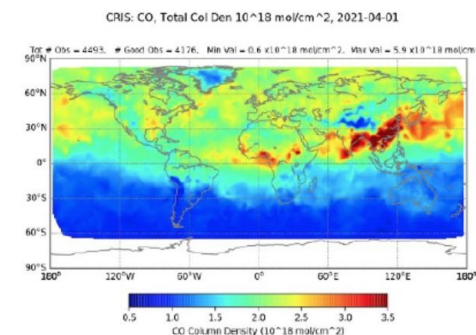
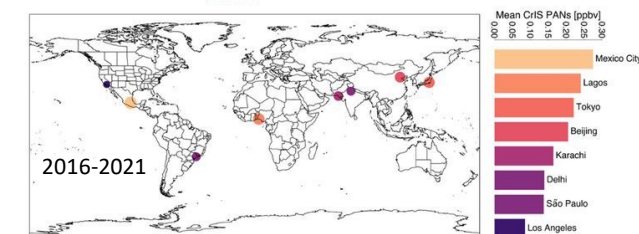


Figure 2: TCR-2 time series of the monthly mean  $O_3$  concentration obtained from ozonesondes (black), the control run (blue), and reanalysis (red) averaged in Northern Hemisphere midlatitudes ( $15^\circ$ - $55^\circ$  N) at atmosphere pressure levels between 850-500 hPa for 2005-2018 (from Miyazaki et al., 2020b).



TROEPP PANs from SNPP-CrIS show varying levels for megacities around the world.





# Open-Source User Tools and Tutorials



[https://github.com/NASA-TROPESS/tutorials\\_notebooks/](https://github.com/NASA-TROPESS/tutorials_notebooks/)



| Tutorial Title                                                                                                        | Summary                                                                                                                                                                                                                                                                                                             | Link                         | Features/Capabilities                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------|
| Bulk Download of Megacities Data by Species                                                                           | Demonstrates the utilization of the open-source earthaccess Python library which allows users to query the CMR API for data granule metadata that can then be used for targeted download and extraction via a user-defined temporal bounding box and the gas species.                                               | <a href="#">Notebook</a>     | Data search/access /extraction                                                                                 |
| Bulk Data Subscriber and Download Service                                                                             | Demonstrates the utilization of a commandline-based tool known as the podaac-data-subscriber[downloader] which allows users to either subscribe to datasets (for periodic, continuous updating featuring the latest available data) or one-time "bulk" downloading of one or more data files with a single request. | <a href="#">Tutorial</a>     | Data search/access /extraction                                                                                 |
| TROPESS netCDF Primer Notebook                                                                                        | A Jupyter Notebook coded in Python which fully extracts all data and metadata, then produces a 2-D map plot of the CrIS-JPSS1 L2 Total Column Carbon Monoxide                                                                                                                                                       | <a href="#">Notebook</a>     | Data extraction/plotting /visualization                                                                        |
| Study 2023 Canadian Wildfires using TROPESS CrIS JPSS-1 Carbon Monoxide (CO) data products - Integrated Data Download | A Jupyter Notebook coded in Python which reads TROPESS CrIS JPSS-1 CO data products for June 2023 and June 2022 and makes a monthly averaged data product and plots and compare them with fully integrated download of the input data files.                                                                        | <a href="#">Notebook</a><br> | Data access/subset /extraction/plotting/analysis /visualization                                                |
| Study 2023 Canadian Wildfires using TROPESS CrIS JPSS-1 Carbon Monoxide (CO) data products - Direct S3 (Cloud) Access | A Jupyter Notebook coded in Python which reads TROPESS CrIS JPSS-1 CO data products for June 2023 and June 2022 directly from S3 on NASA Earthdata Cloud and makes a monthly averaged data product and plots and compare them.                                                                                      | <a href="#">Notebook</a>     | Data access/subset /extraction/plotting/analysis /visualization/direct s3 (cloud) access/cloud-based operation |

## EarthAccess Python Library: CMR query/subset/extract

```
# Define the start and end date/time (YYYY-MM-DD).
start_time = '2020-01-01'
end_time = '2020-12-31'

# Select Species Type; options include: TATM, CH4, HDO, H2O, NH3, PAN, O3
species = 'NH3'

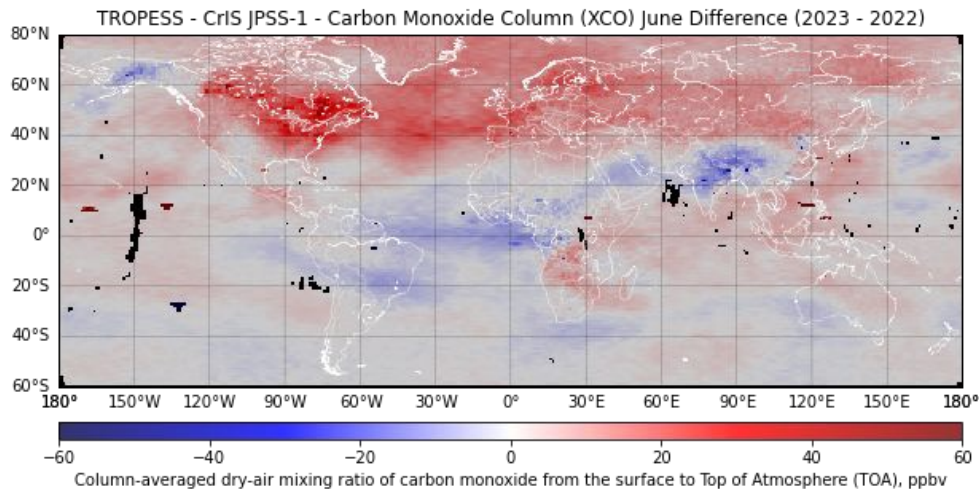
# CMR Query for Data Granules
query = DataGranules().granule_name('*'+species+'*').short_name(shortname).temporal(start_time, end_time)
```

## Command-line Utility for Bulk Download

```
!podaac-data-downloader -c TRPSYL2C0CRS1FS -d data -p GES_DISC -sd 2023-06-01T00:00:00Z -ed 2023-06-30T23:23:59Z
```

Downloaded Locally

Direct via Cloud





# Thank you!



GitHub Repo



Mailing List



Data Access (GES DISC)

