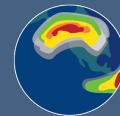




Jet Propulsion Laboratory
California Institute of Technology



tropess

The Tropospheric ozone trends from Tropospheric Ozone from Earth System Sounding (TROPESS) Project: An update on data products, data availability and science results

Greg Osterman for the TROPESS team

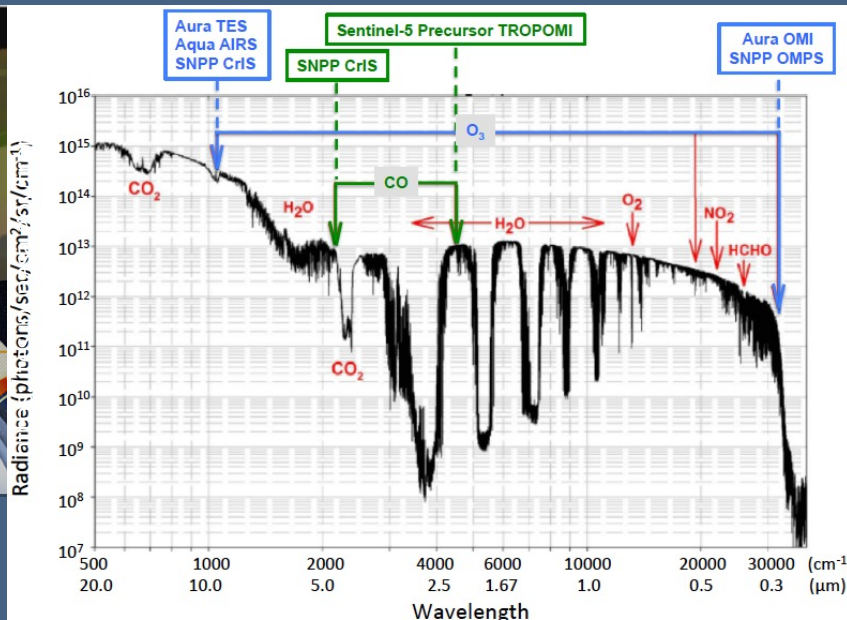
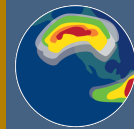
Jet Propulsion Laboratory, California Institute of Technology

NASA Health and Air Quality Applied Sciences Team (HAQAST) Meeting

October 20, 2023

TROPESS takes a panspectral approach, combining radiances from multiple instruments to generate Earth Science Data Records with degrees of freedom superior to a single instrument.

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



Products

- Ozone
- Carbon monoxide
- Ammonia
- Methane
- Peroxyacyl Nitrate (PAN)
- Deuterated water (HDO)
- Ozone Instantaneous Radiative Kernels (IRKs)
- Temperature
- Water vapor

- Panspectral techniques provide better vertical sensitivities than individual bands which is critical for relating concentrations to emissions
- Systematic errors between instruments and spectroscopy must be assessed
- TROPESS has considerable heritage in multi-spectral, multi-instrument retrieval algorithms for UV, IR, NIR, microwave for O₃, CO, CO₂, CH₄
- Kuai et al (2013), Worden et al (2015), Fu et al (2016)

TROPESS Processing Schedule

- TROPESS processing is done on single field of view L1B radiances.
- Datasets are sub-sampled spatially due to constraints on computing resources.
- TROPESS has 3 processing modes:
 - Forward processing: Low latency (<2 week) for AIRS+OMI, JPSS-1 CrIS (5/21-present)
 - Reanalysis: Reprocessing over full record with fixed algorithm version (Start in May 2022)
 - Special Collections: regional processing in support of exceptional events

Instrument(s)	Day/night	Stream	Time Range	Expected Completion
SNPP CrIS Full Spectral Resolution (FSR)	Day+night	Forward Stream	Feb 2021 – May 2021	Complete (Stopped with loss of midwave in May 2021)
JPSS-1 CrIS	Day+night	Forward Stream	April 2021 – present	Ongoing
AIRS	Day	Forward Stream	Feb 2021 – present	Ongoing
AIRS/OMI (Ozone)	Day	Forward Stream	Feb 2021 – present	Ongoing
SNPP CrIS Full Spectral Resolution (FSR)	Day+night	Reanalysis Stream	Dec 2015 – May 2021	Batch 1 of 10: complete
SNPP CrIS Nominal Spectral Resolution (NSR)	Day+night	Reanalysis Stream	Jan 2012 – Dec 2015	Batch 1 of 10: December 2023
AIRS	Day+night	Reanalysis Stream	2004-2009/2015-2020	Batch 1 of 10: December 2023
AIRS/OMI	Day	Reanalysis Stream	2004-2009/2015-2020	Batch 1 of 10: December 2023

Forward Stream Data is Publicly Available

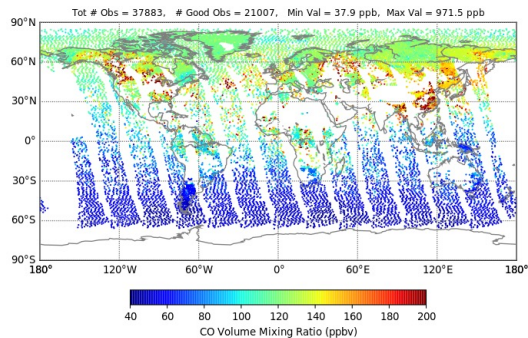
TROPESS Data can be obtained at the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC)

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

Dataset	Source	Version	Time Res.	Spatial Res.	Level	Begin Date	End Date
 TROPESS CrIS-JPSS1 L2 Carbon Monoxide for Forward Stream, Standard Product V1 (TRPSDL2COCRS1FS 1) Subset / Get Data Hover	JPSS-1 CrIS	1	1 day	14 km x 14 km	2	2021-04-01	2023-09-27
 TROPESS CrIS-SNPP L2 Carbon Monoxide for Forward Stream, Standard Product V1 (TRPSDL2COCRSFS 1) Subset / Get Data Hover	Suomi-NPP CrIS	1	1 day	14 km x 14 km	2	2021-02-01	2023-05-18
 TROPESS AIRS-Aqua L2 Carbon Monoxide for Forward Stream, Standard Product V1 (TRPSDL2COAIRSFS 1) Subset / Get Data Hover	Aqua AIRS	1	1 day	13.5 km x 13.5 km	2	2021-02-01	2023-07-31

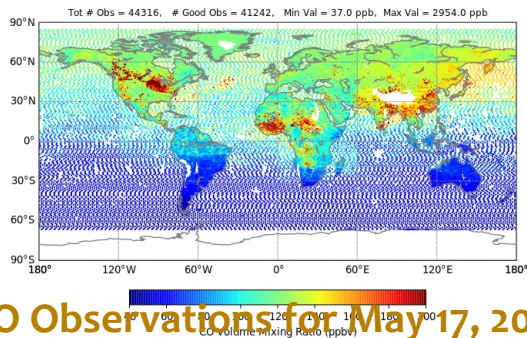
AIRS CO

AIRS: CO, Pres=749.9 hPa, 2023-05-17



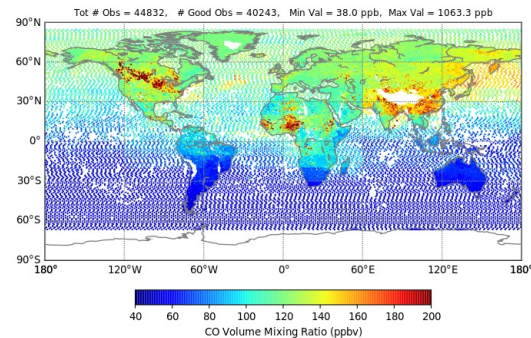
CrIS-SNPP CO

CrIS: CO, Pres=749.9 hPa, 2023-05-17



CrIS-JPSS1 CO

CrIS: CO, Pres=749.9 hPa, 2023-05-17



CO Observations for May 17, 2023

Forward Stream Data is Publicly Available



Hover

TROPESS AIRS-Aqua L2 Ozone for Forward Stream, Summary Product V1 (TRPSYL2O3AIRSFS 1)

[Subset / Get Data](#)



Hover

TROPESS CrIS-SNPP L2 Ozone for Forward Stream, Summary Product V1 (TRPSYL2O3CRSFS 1)

[Subset / Get Data](#)



Hover

TROPESS OMI-Aura L2 Ozone for Forward Stream, Summary Product V1 (TRPSYL2O3OMIFS 1)

[Subset / Get Data](#)



Hover

TROPESS CrIS-JPSS1 L2 Ozone for Forward Stream, Summary Product V1 (TRPSYL2O3CRS1FS 1)

[Subset / Get Data](#)



Hover

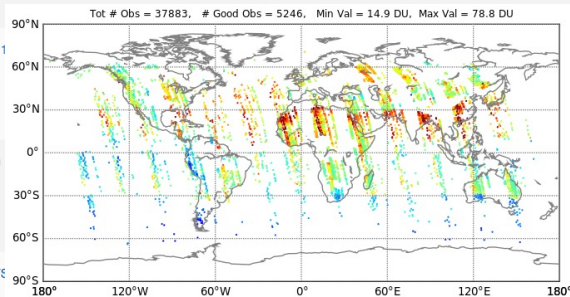
TROPESS AIRS-Aqua and OMI-Aura L2 Ozone for Forward Stream, Summary Product V1 (TRPSYL2O3AIRSOMIFS 1)

[Subset / Get Data](#)

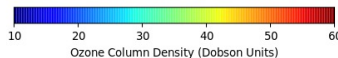
Aqua AIRS

Additional O₃ Products: AIRS-OMI, OMI

9-25

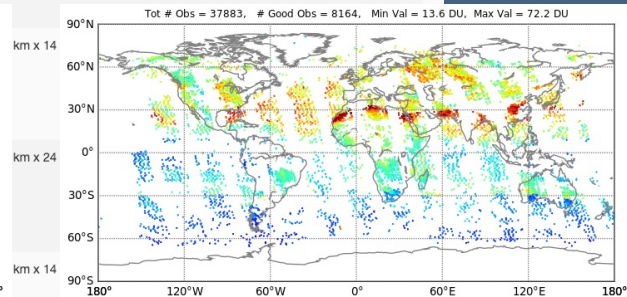


OMI

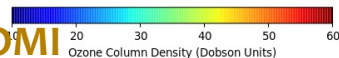


Aqua AIRS, Aura OMI 1

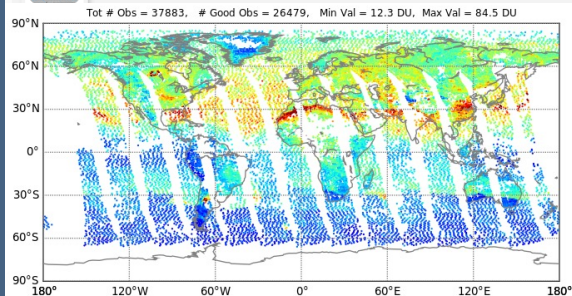
1 day



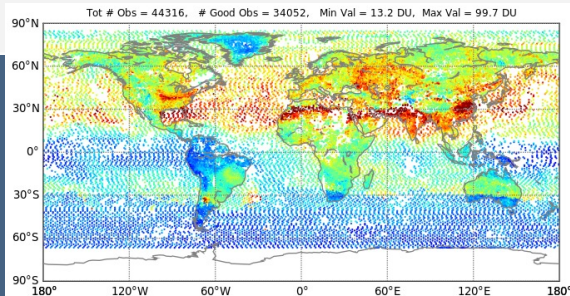
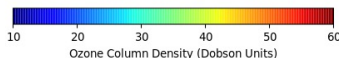
AIRS-OMI



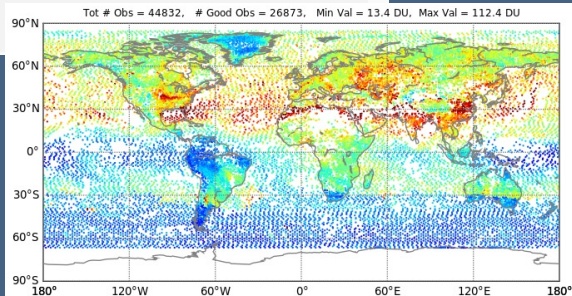
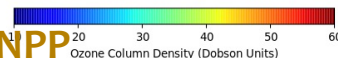
2 2021-02-01 2023-09-25



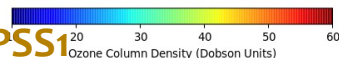
AIRS



CrIS-SNPP



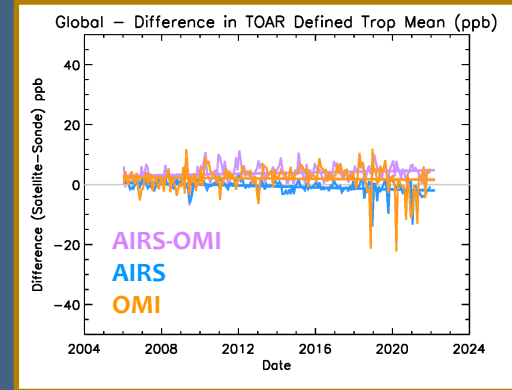
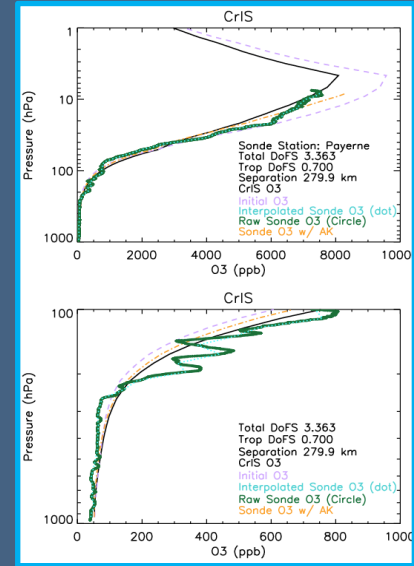
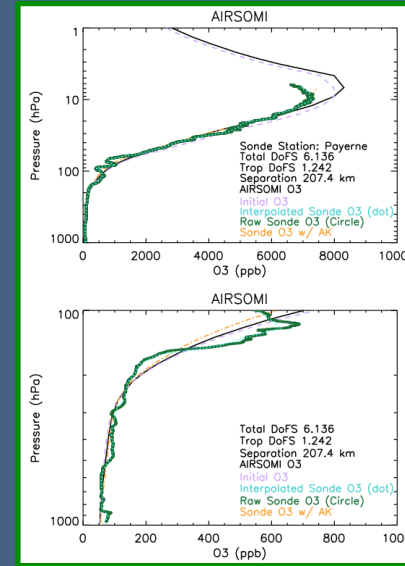
CrIS-JPSS1



O₃ Observations for May 17, 2023

Reanalysis Stream Data is (not yet) Publicly Available

- TROPESS team expects to have the first batch of the reanalysis stream for SNPP-CrIS publicly available by the end of 2023
- Data from the CrIS-SNPP reanalysis stream highlighted in presentations in this session by Madison Shogrin and Mukesh Rai
- Ozone data being used to study trends in tropospheric ozone (TOAR II)
- We are working on validating the different ozone data records

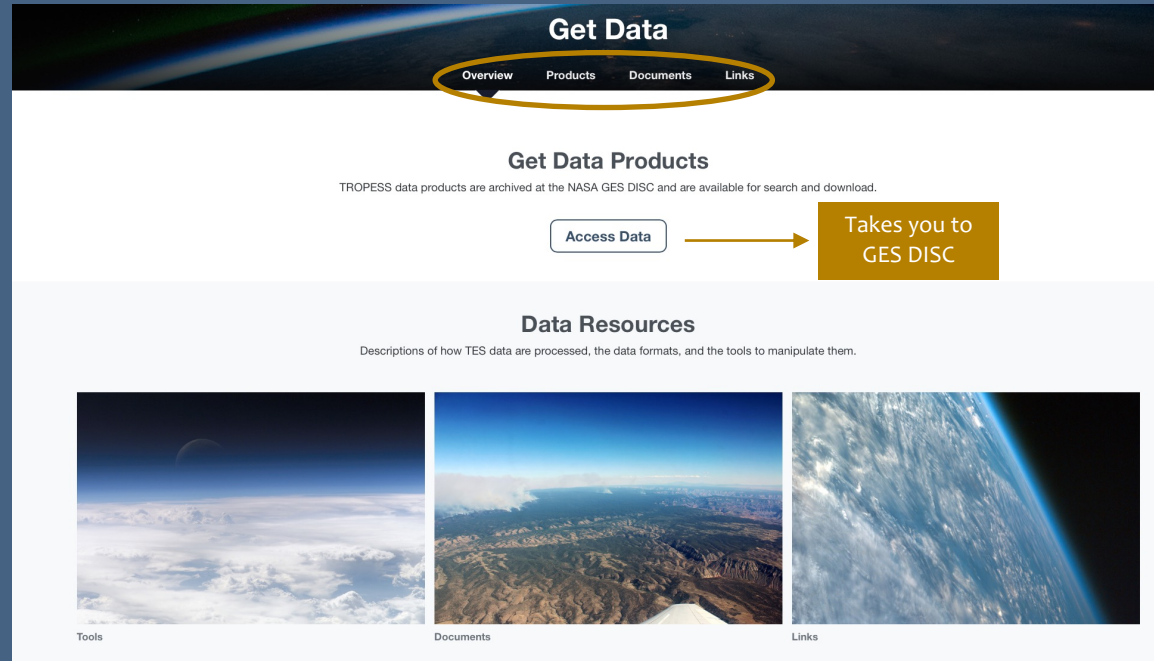


TROPESS Data - Special Collections

<https://tes.jpl.nasa.gov/tropess/get-data/>

Collections at GES DISC:

- Forward Stream (SNPP-CrIS)
- Forward Stream (J1-CrIS)
- Forward Stream (AIRS)
- Forward Stream (AIRS-OMI)
- 2020 West Coast Fires (SNPP-CrIS)
- 2020 Australian Fires (SNPP-CrIS)
- Buchholz 2021 Time Series (SNPP-CrIS CO only)
- Megacities (SNPP-CrIS)
 - Mexico City
 - Los Angeles
 - Karachi
 - Beijing
 - Delhi
 - Tokyo
 - Lagos
 - Sao Paulo
 - Other cities soon....

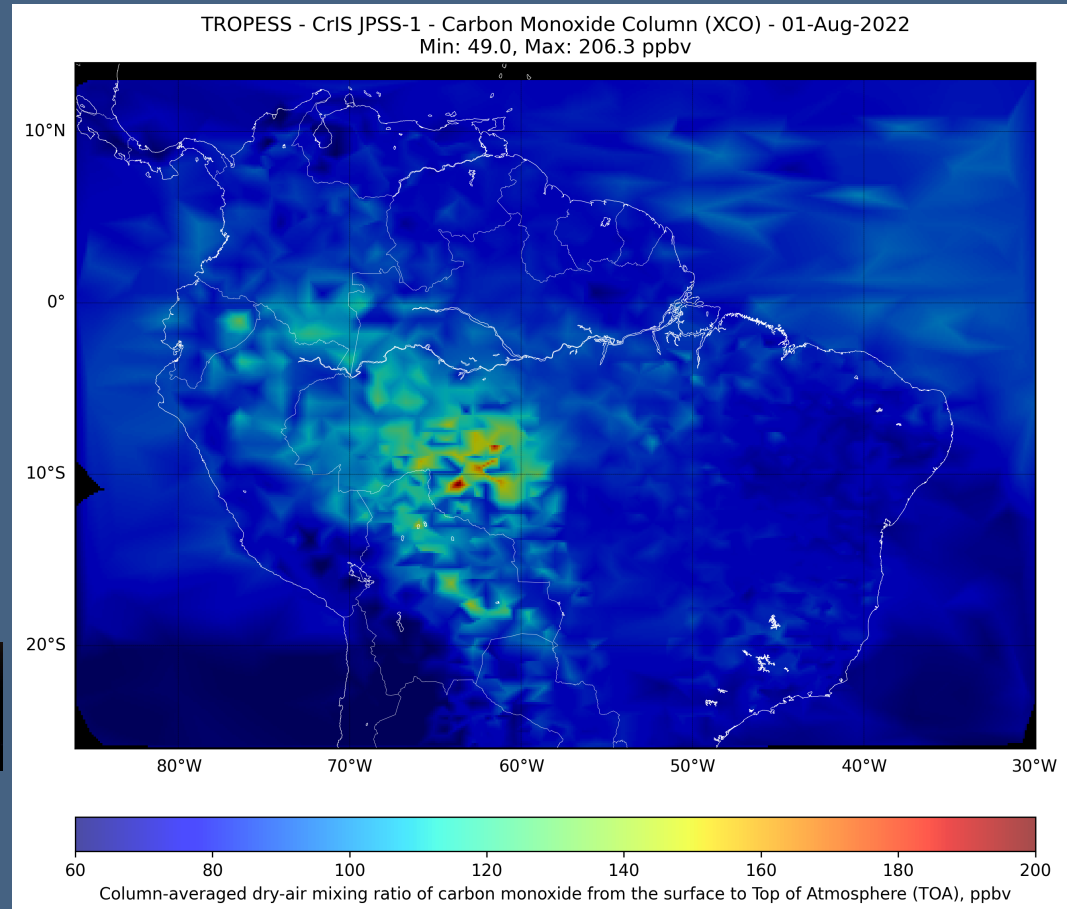


Links

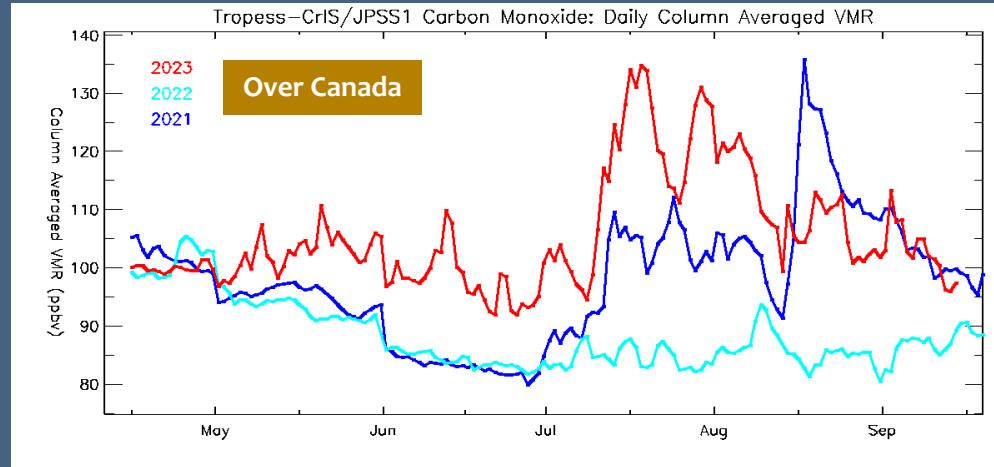
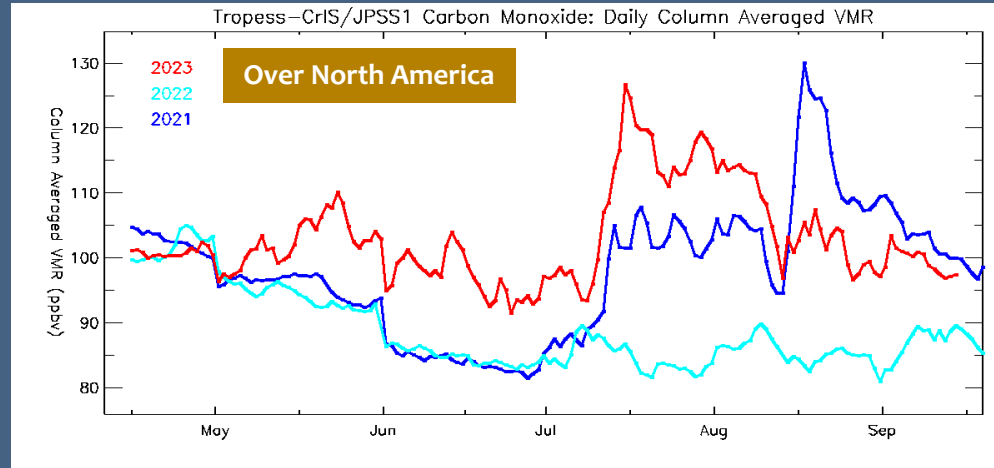
- Information on types of Level 2 Products
- Link to TROPESS documentation
- Links to the home pages for the different satellites used by TROPESS

Jupyter Notebooks

- TROPESS Team is creating Jupyter Notebooks to help interested users download and visualize TROPESS data
- Examples include downloading data, creating scatter plots and maps
- Brazilian fires (2022), Canadian fires (2023)
- Notebooks available:
 - https://github.com/NASA-TROPESS/tutorials_notebooks
 - TROPESS Site “Get Data” dropdown menu

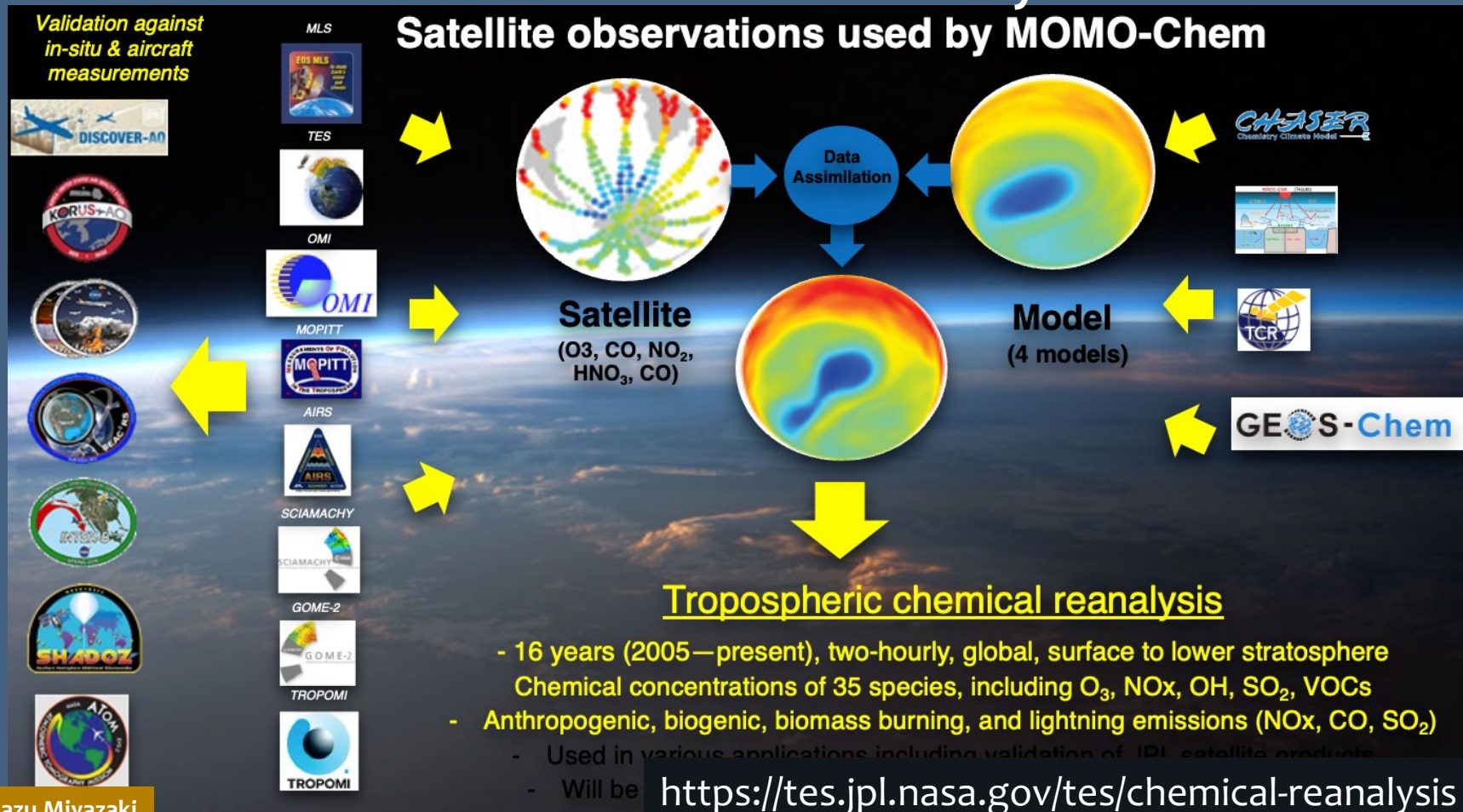


TROPESS Mean JPSS1-CrIS X_{CO} Over Canada and North America



TROPESS: Chemical Reanalysis

Satellite observations used by MOMO-Chem



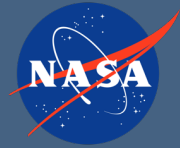
Thank you!

TROPESS Team

- JPL: Kevin Bowman (PI), Ming Luo, Vivienne Payne, David Moroni, Valentin Kantchev, James McDuffie, Josh Laughner, Elva Kuai, Vijay Natraj, Sirvard Akopyan, Jonathan Wang, Thomas Kurosu, John Worden, Frank Werner, Mukesh Rai, Fabiano Oyafuso, Kazu Miyazaki, Jessica Neu, Seungwon Lee, Greg Osterman
- AER: Karen Cady-Pereira
- NASA Ames: Susan Kulawik
- Colorado State University: Emily Fischer, Madison Shogrin, Julieta Juncosa Calahorrano
- NCAR: Helen Worden

Questions?

- Contact – Gregory.B.Osterman@jpl.nasa.gov



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TROPESS Level 2 Data Product Types

File Type	Description
Summary	• The Summary data product is a good first-look data product for a new user to the TROPESS data products. • It contains the retrieved physical parameters of interest with a minimal set of diagnostic parameters
Standard	• Includes more diagnostic information about the retrieved physical parameters
Full Archival	• For users familiar with TROPESS or TES data • Products contains complete and unfiltered retrieval results and detailed diagnostic parameters at the original vertical resolution.

- There are separate Level 2 data files for each species
- Files are in netcdf format

FAQs

Question	Answer
For a given processing stream, you have three types of data products: Summary, Standard, and Archival. Which types of data products should I use?	Among the three types of data products (Summary, Standard, Archival), the Summary data product is a good first-look data product for a new user to the TROPESS data products. It contains the retrieved physical parameters of interest with a minimal set of diagnostic parameters. For a user who is looking for more diagnostic information about the retrieved physical parameters, the next data product to use is the Standard data product. If the user is familiar with the TROPESS data products and would like to have the most extensive information about the data, they should use the Archival data product which contains complete and unfiltered retrieval results and detailed diagnostic parameters at the original vertical resolution.
You have many data collections generated from three types of processing streams: Forward, Reanalysis, and Special Collection. How would I determine which data collection is useful for my research and application?	The data collections generated from the Forward processing stream are useful to study the impacts of recent weather and air quality events and to apply to the data assimilation and forecasting type of work. The Forward-processing data collections are not designed to study a long-term trend since the software used to generate the products is updated regularly. In contrast, the data collections generated from the Reanalysis processing stream are useful to study a long-term trend as they provide a long-time coverage (multiple years) of the retrieved parameters with a fixed retrieval configuration and a fixed software version. The data collections generated from the Special-Collection processing stream are designed with a particular target area and a particular event in mind. For example, the Megacities collections were generated to study the air quality and atmospheric components of global big cities for a longer period (2016-2021). The Australian Fire collections were generated to study the 2019-2020 Australian Bushfire season.

FAQs

Question	Answer
I would like to download multiple years of TROPESS datasets in a single bulk request. What is the best way to do this?	There is a free open-source, commandline-based tool known as the 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 tutorial with instructions on how to install and use this tool is available here: https://github.com/NASA-TROPESS/tutorials_notebooks/blob/main/data_subscriber_downloader.md
I prefer to do my data analysis in Python and/or iPython/Jupyter notebooks, but this is my first time working with TROPESS data. Do you have any Python code and/or notebook examples to help me get started?	There are numerous open-source Jupyter notebooks and tutorials based on Python covering a wide variety of TROPESS datasets. These notebooks provide examples of the following features/capabilities: data search/discovery, data access/subset/extraction, data plotting/analysis/visualization. This is an ongoing, collaborative effort between the JPL TROPESS project and the GES DISC. More info is available here: https://github.com/NASA-TROPESS/tutorials_notebooks

TROPESS JPSS1-CrIS CO Canada and North America

Science

Objectives

Mailing List

Highlights

Publications

<https://tes.jpl.nasa.gov/tropess/science/highlights/wildfire-smoke-transport-from-canada-to-us>

Wildfire Smoke Transport from Canada to US

In the first week of June 2023, wildfires in the Great Lakes region of Canada generated vast smoke plumes that have extended into the eastern U.S.

Measurements of carbon monoxide (CO) made by the NOAA/NASA joint JPSS-1 CrIS satellite from 1-8 June (see plots below) illustrate how pollution generated by these fires is transported to the Great Lakes region of Michigan, Ohio, Pennsylvania and New York and creates localized pollution in these regions. As a tracer of combustion, satellite-based observations of CO act as a proxy for atmospheric smoke transport and provide local air quality forecasters an indication of likely impacts to ground-level air quality.

