



# OCO-3 Version 11 Snapshot Area Mapping (SAM) Mode Observations

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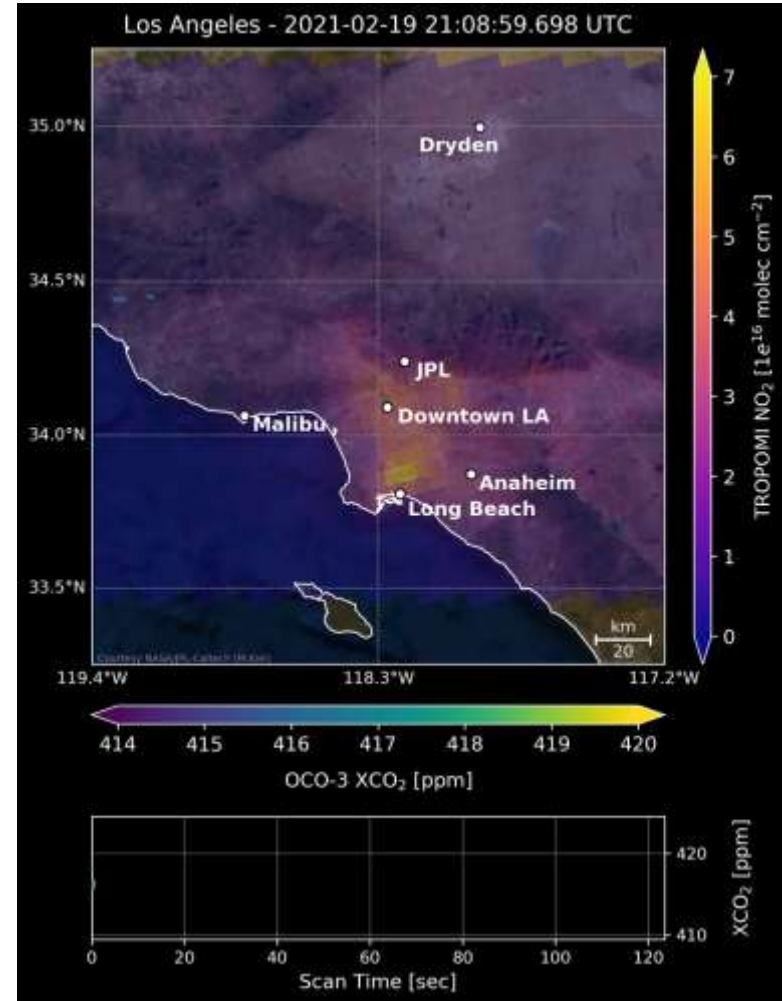
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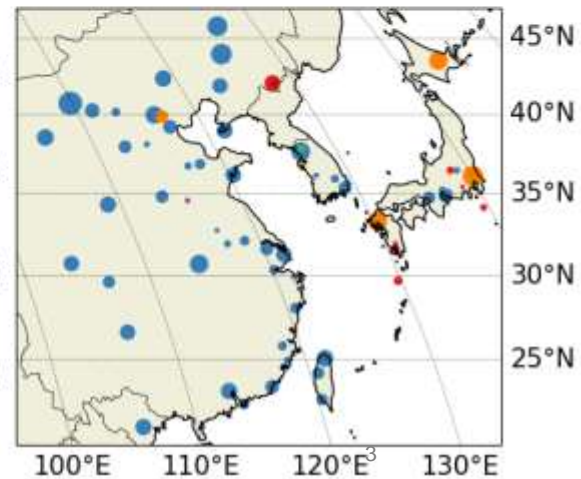
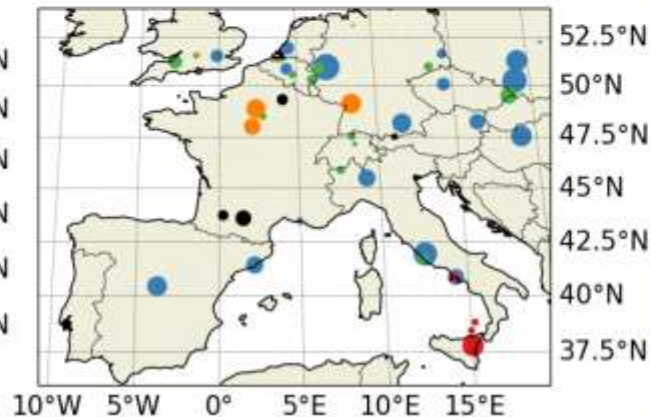
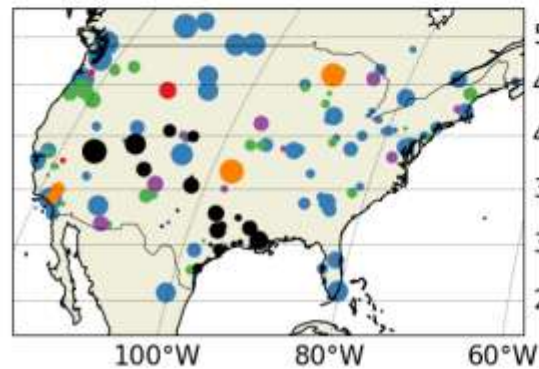
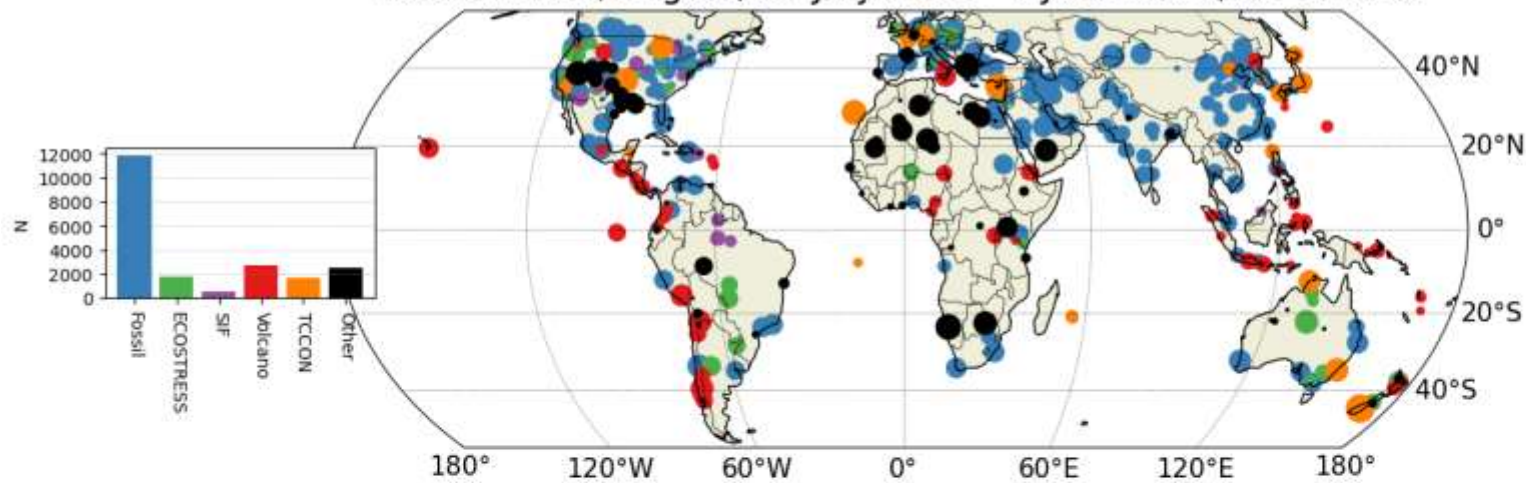
IWGGMS-21, 10 June 2025

# ACOS Version 11 (v11)

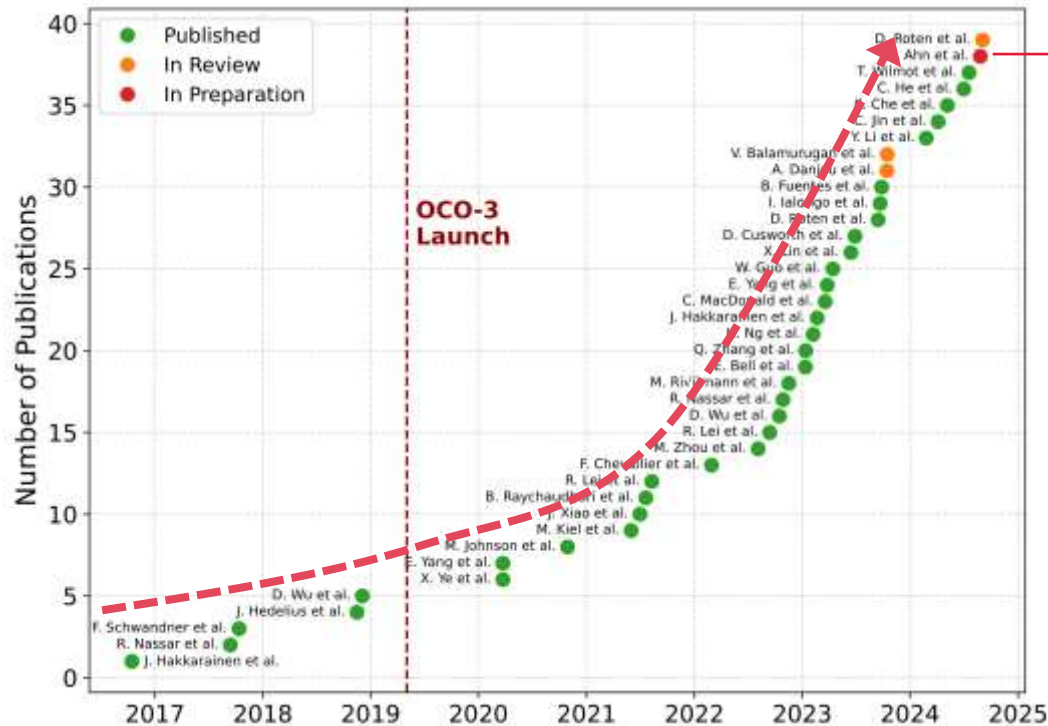
- OCO-3 data record has recently been reprocessed using the latest version (v11) of the Atmospheric Carbon Observations from Space (ACOS) dry-air mole-fraction of carbon dioxide (XCO<sub>2</sub>) retrieval
- Major changes in v11 include:
  - Updated to the Copernicus Digital Elevation Model (DEM)
  - Switched from GEOS FP-IT to GEOS-IT for meteorology and aerosol priors
  - New ocean surface treatment (scaled Cox-Munk)
  - ABSCO updates (v5.2) and geolocation improvements
- OCO-3's Snapshot Area Mapping (SAM) mode: ~80 x 80 km<sup>2</sup> in ~2 min.



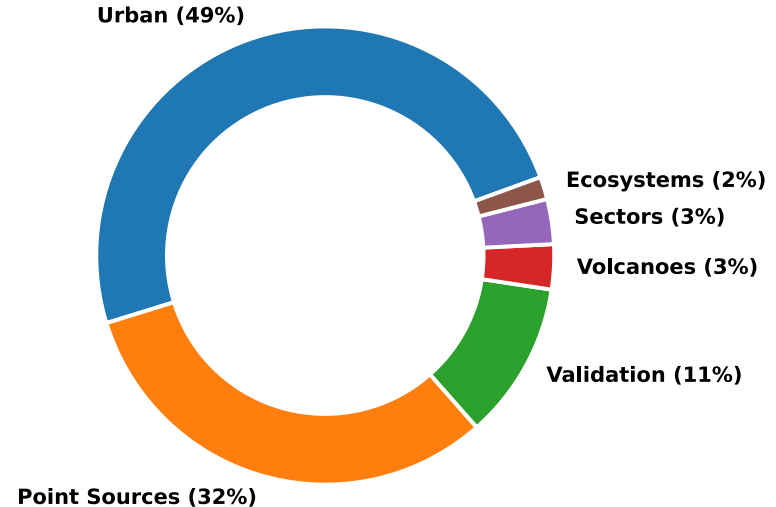
OCO-3 SAMs/Targets, 26 July 2019 - 3 June 2025, N = 21048



# Utilization of SAMs within the scientific community continues to grow



e.g., see Ahn et al. Talk (6.10), Thurs. AM



# Methodology

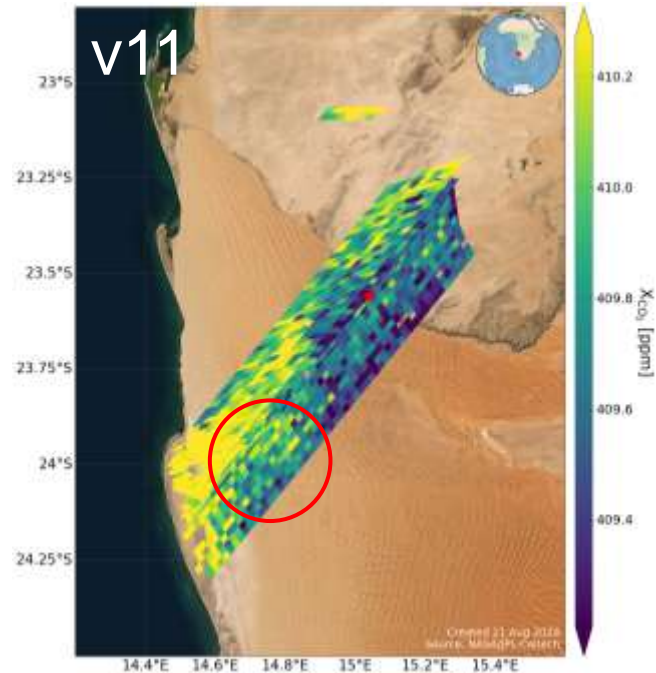
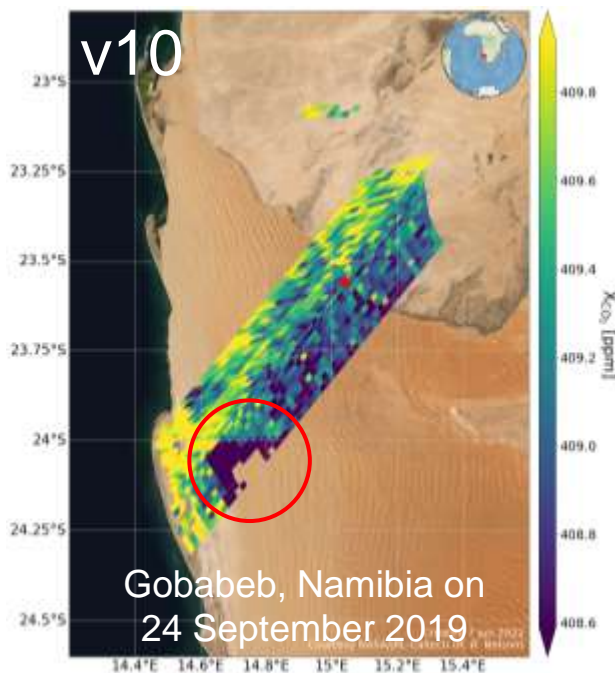
- Compared OCO-3 **v10** to **v11 SAMs** (only XCO<sub>2</sub> fields analyzed)
  - Looked at ~16000 SAMs/Targets from 6 Aug. 2019 – 12 Nov. 2023 (storage)
  - Final XCO<sub>2</sub> quality flag applied
  - Final bias correction applied

# Conclusions

- **Most SAMs appear similar** in v11 versus v10
- For **some SAMs**, v11 represents a **clear improvement** over v10
- Some XCO<sub>2</sub> artifacts remain, which will hopefully be addressed in a future version!

# DEM Improved

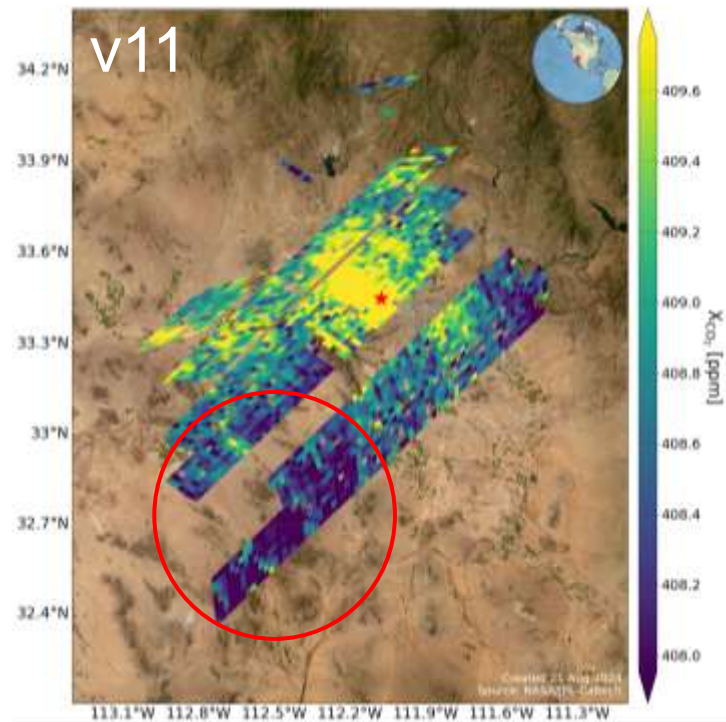
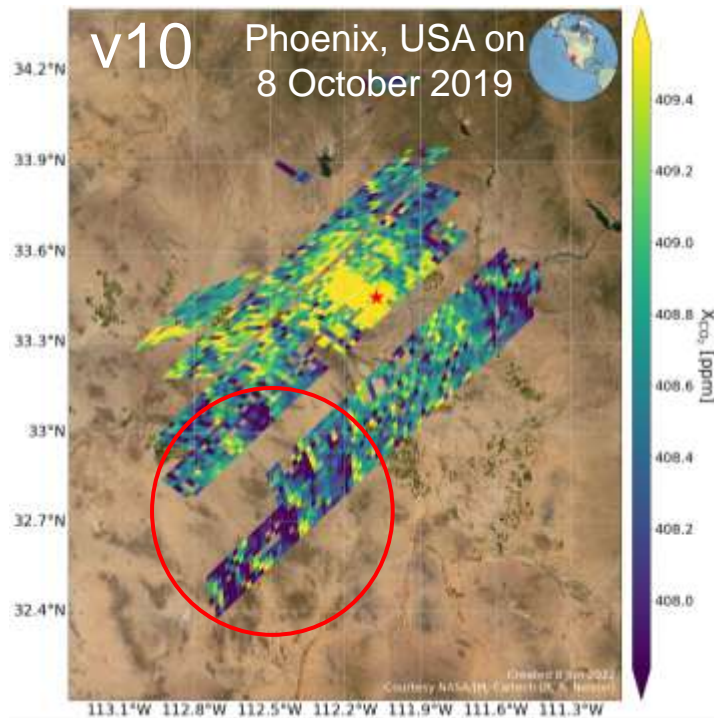
- Fewer topography-induced errors
  - v10 DEM errors were causing the retrieved surface pressure to differ from the prior (“dp”), which propagated into BC XCO<sub>2</sub>





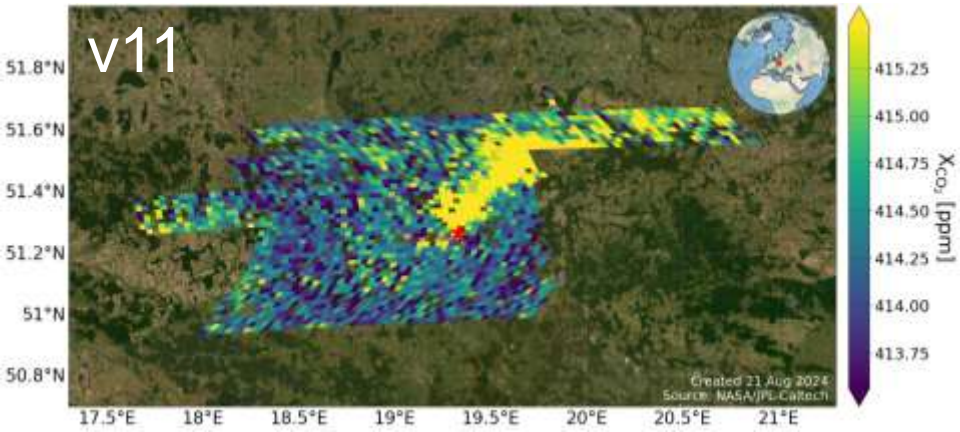
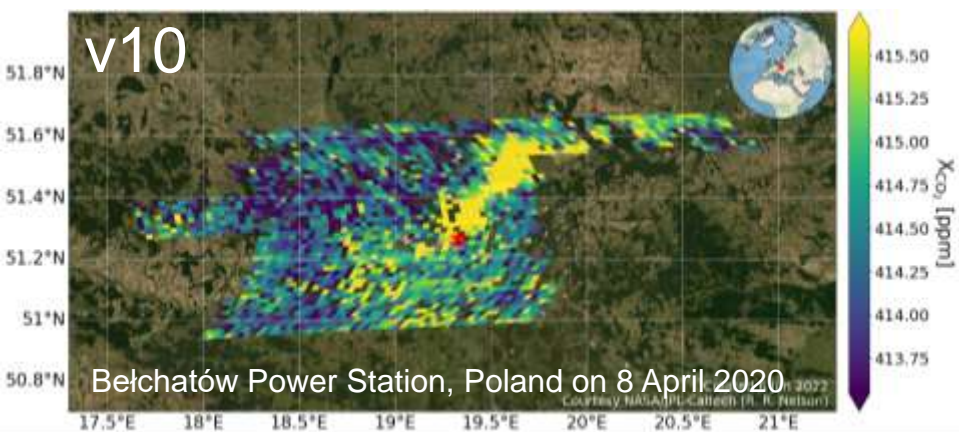
# DEM Improved

- Fewer topography-induced errors enables a more accurate background  $\text{XCO}_2$  estimate for urban  $\text{CO}_2$  emission estimates



# DEM Improved

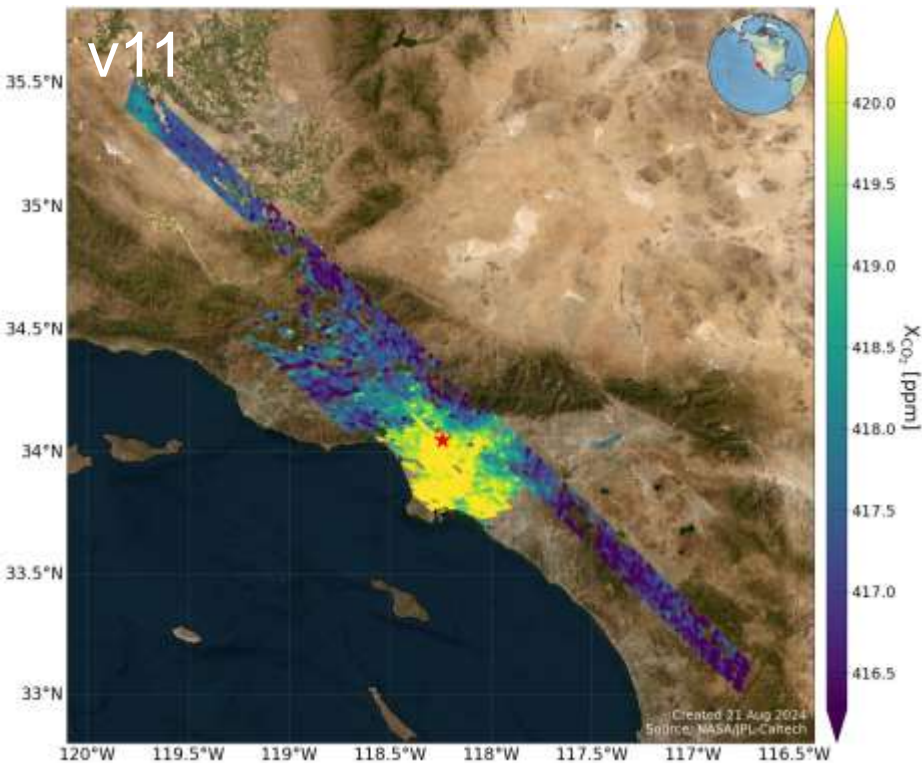
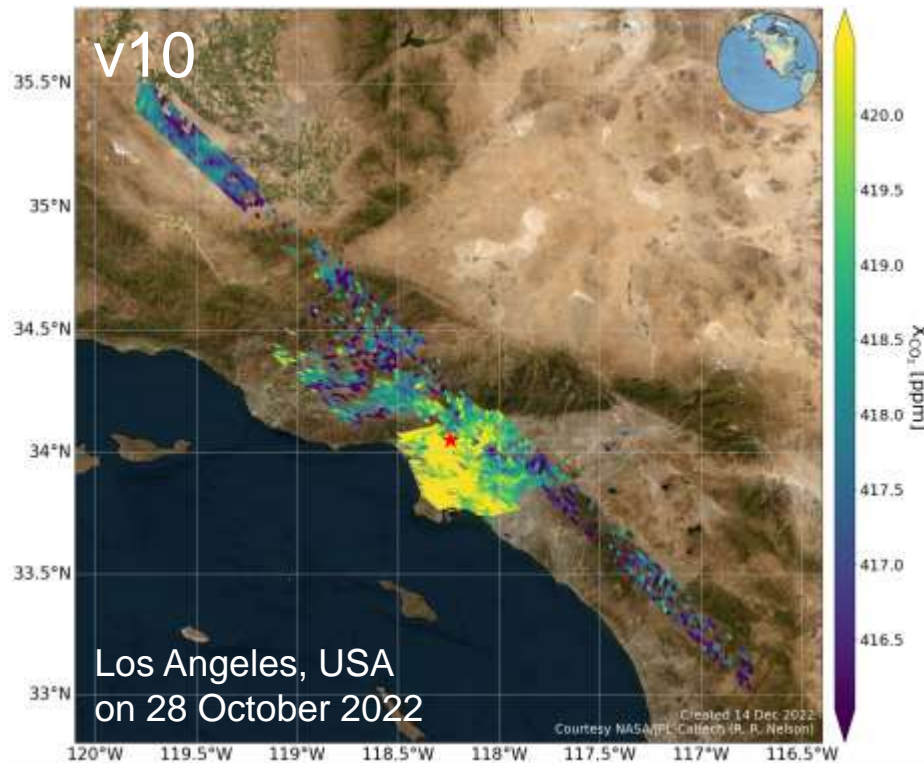
- Some power plant XCO<sub>2</sub> plumes are easier to identify because the background XCO<sub>2</sub> has fewer DEM-driven artifacts





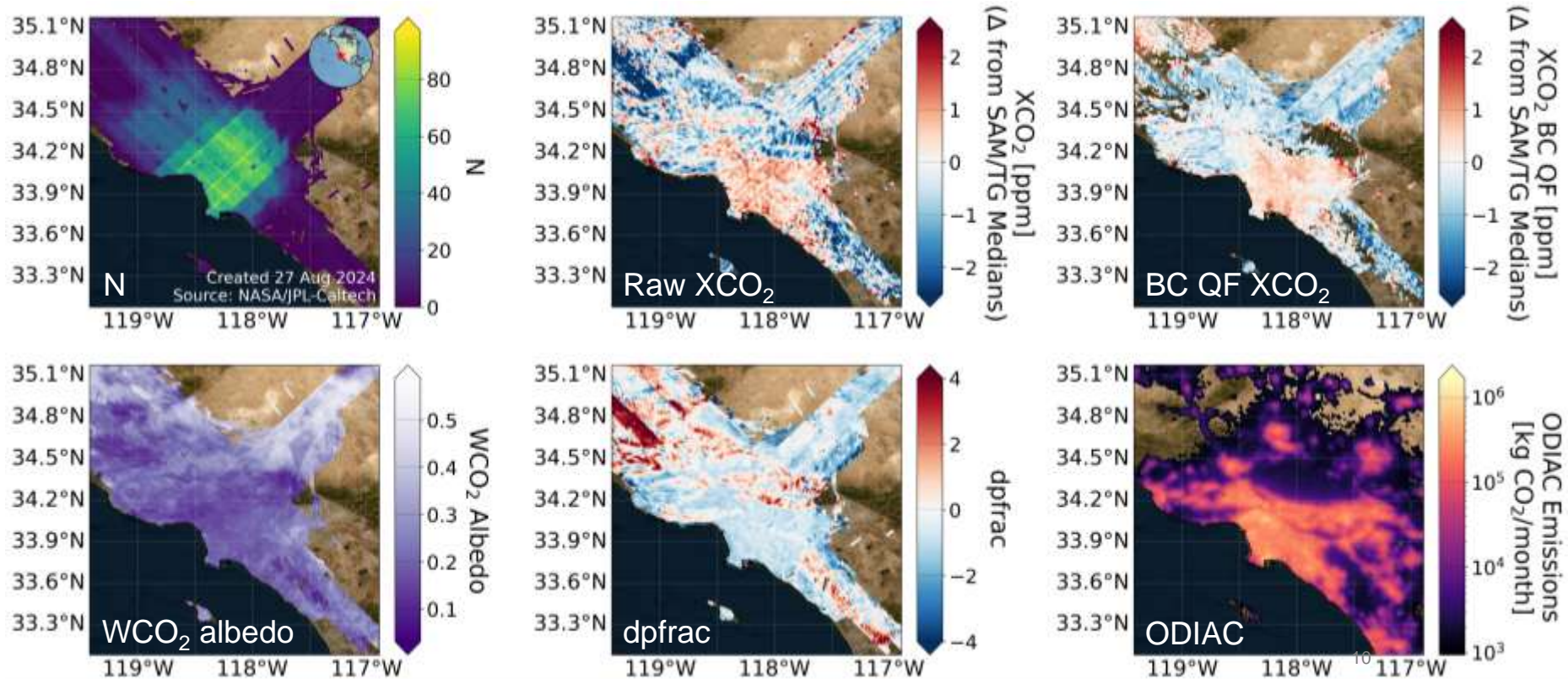
# DEM Improved

- Some urban  $\text{XCO}_2$  plumes are easier to identify in v11 due to improved coverage and fewer artifacts



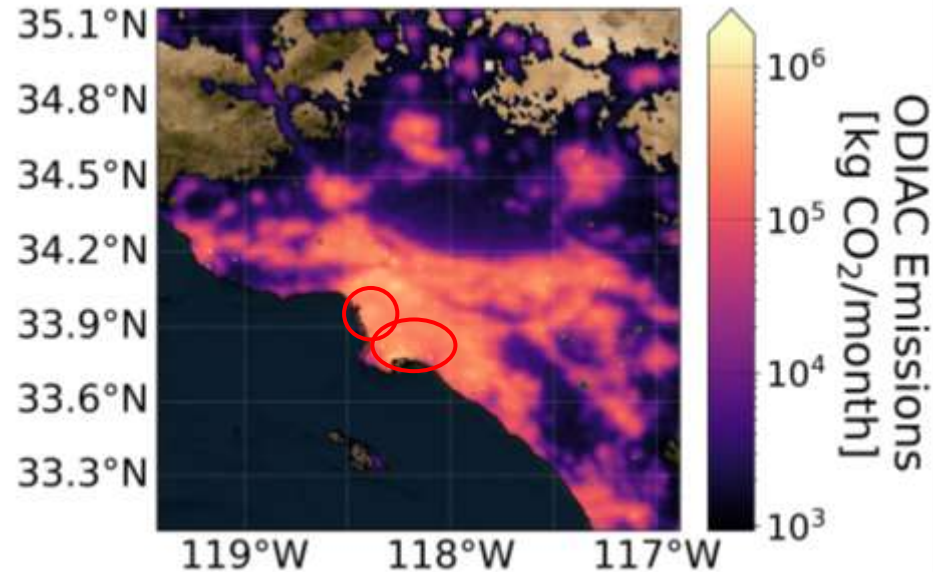
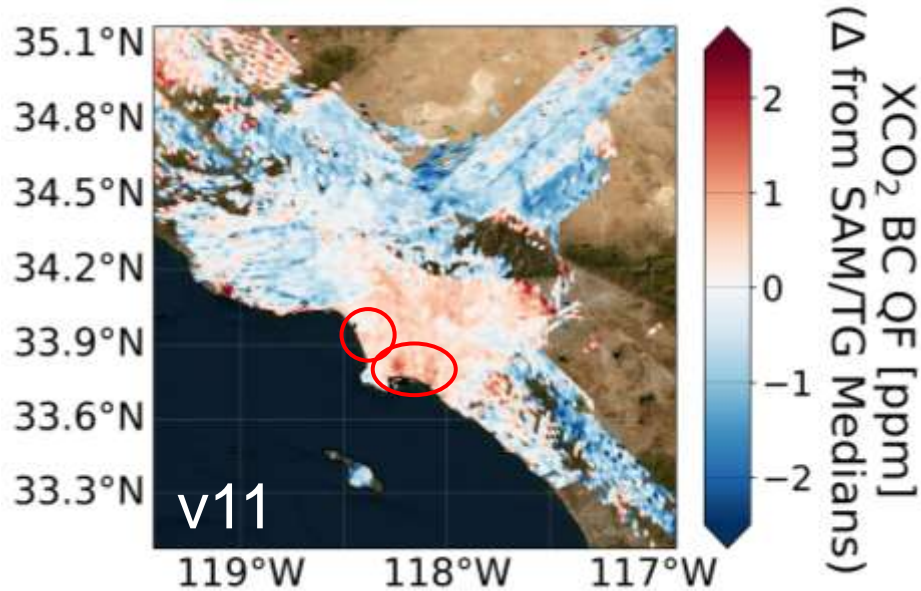
# Site-Average Plots

- All OCO-3 SAMs for a given site averaged onto a  $0.25^\circ \times 0.25^\circ$  lat-lon grid



# Los Angeles (Number of SAMs = 98)

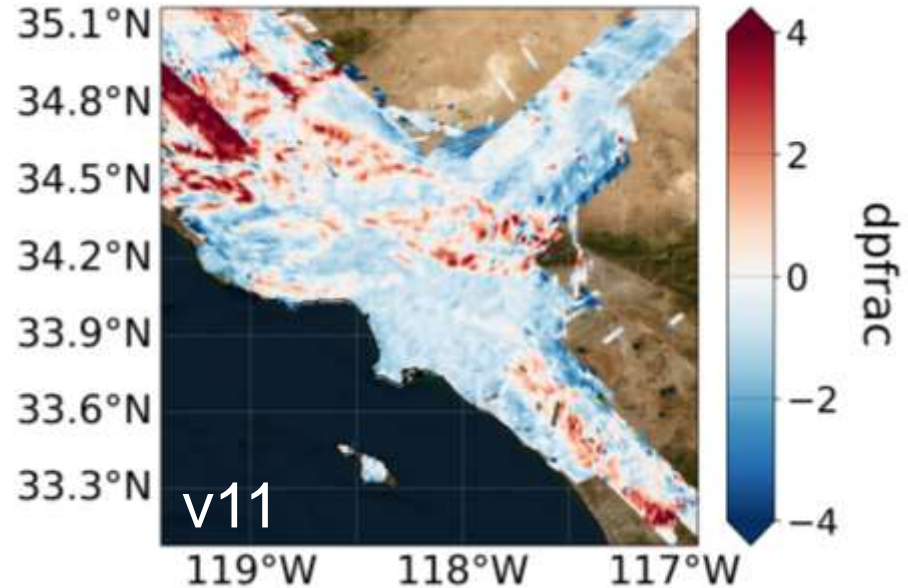
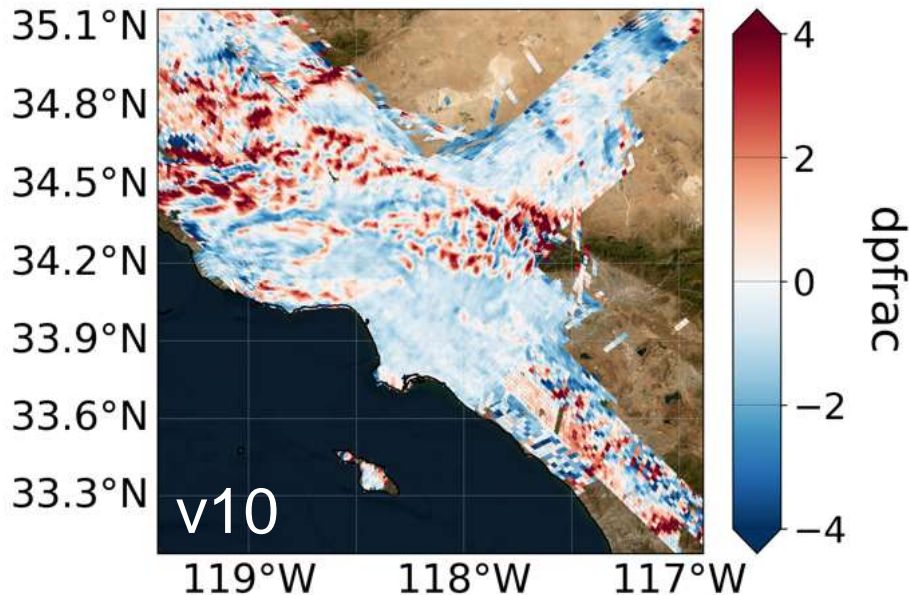
- Higher  $\text{XCO}_2$  values are seen in the LA basin
- $\text{XCO}_2$  patterns visually match ODIAC  $\text{CO}_2$  emissions
  - e.g., the Ports of Los Angeles/Long Beach, Los Angeles International Airport





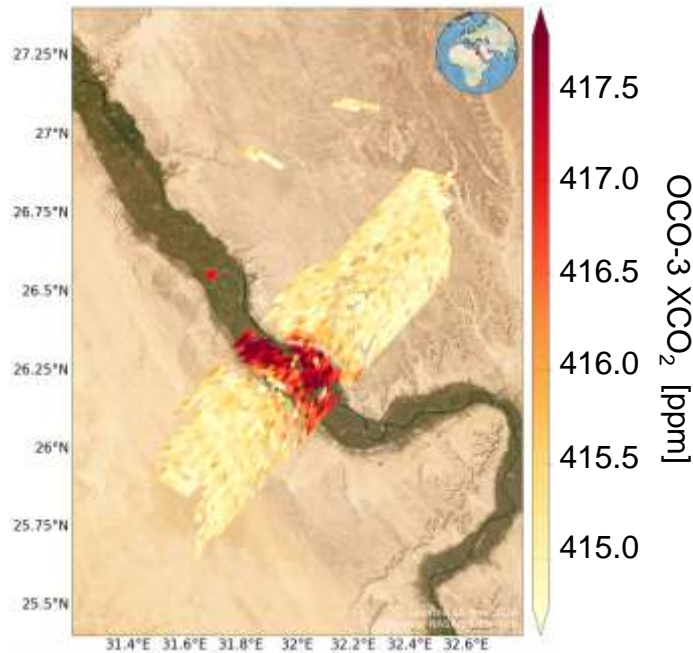
# Los Angeles (Number of SAMs = 98)

- The artifacts in dpfrac (similar to dp) are smaller in v11, a result of using a more accurate DEM

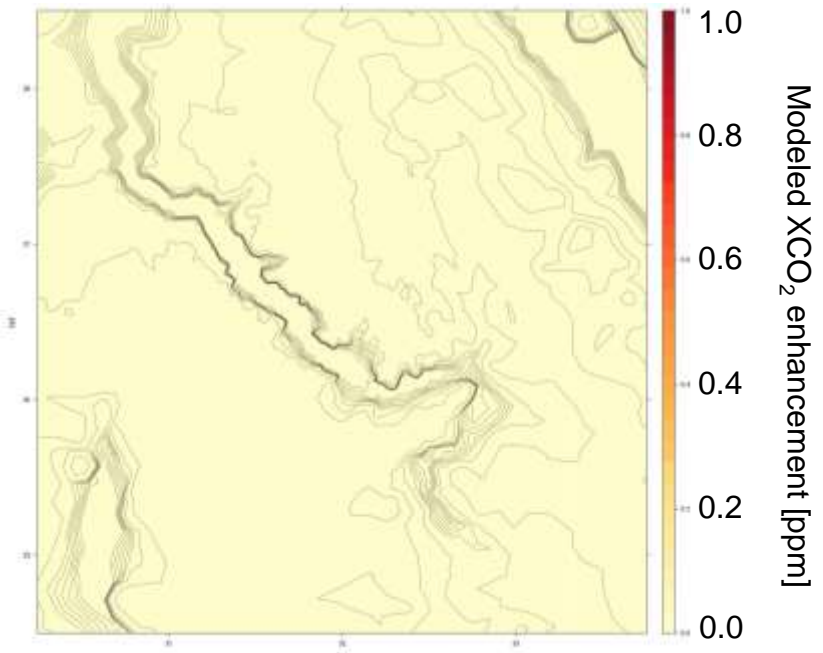


# Artifacts Remain

- The OCO-3 v11 XCO<sub>2</sub> enhancement (left) is large (~1–3.5 ppm) relative to a high-res model (right) in the Nile River Valley, suggesting a potential albedo-induced bias



OCO-3 SAM of Sohag, Egypt  
on 8 Feb. 2021

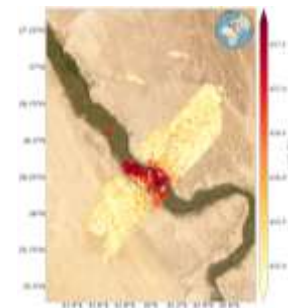
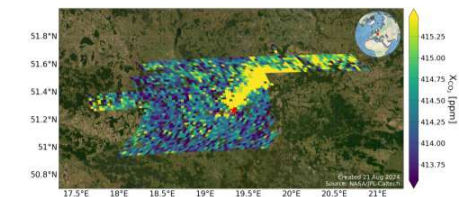
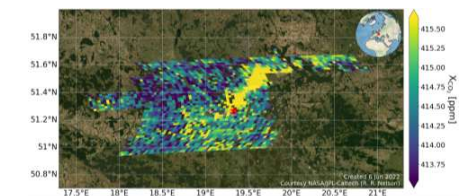
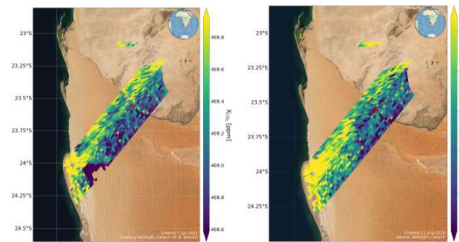


Simulated XCO<sub>2</sub> from the Ocean Land Atmosphere Model  
(OLAM) for 4 Feb. 2020 (from Andrew Schuh)<sup>13</sup> [jpl.nasa.gov](https://jpl.nasa.gov)



# Conclusions

- **Most SAMs appear similar** in v11 versus v10
- For **some SAMs**, v11 represents a **clear improvement** over v10
  - DEM improvement leads to fewer topography-induced  $\text{XCO}_2$  errors
  - Sometimes smoother-looking  $\text{XCO}_2$  fields, which aid in estimating urban backgrounds and identifying point source plumes
- Some  $\text{XCO}_2$  artifacts remain, which will hopefully be addressed in a future version!



## Low latency

- External users are quickly informed of SAMs being collected

## Custom search

- Sub-setting tools to filter and/or select a region with multiple SAMs
- Download subsetting .nc4 files!

Marker colors denote the type of site: validation, desert, SIF\_Low, fossil, SIF\_high, and volcano.



Site Name or Target ID <input type="text"/>	Site Type <input type="text"/>
Start Date <input type="text"/>	End Date <input type="text"/>
SZA <input type="text"/>	+/- degrees <input type="text"/>
# of Soundings <input type="text"/>	
Spatial Region <input type="text"/>	

## Quick-look plots

- XCO<sub>2</sub> (Raw)
- XCO<sub>2</sub> (BC+QF)
- O<sub>2</sub> A-Band Radiance
- SIF
- dp
- TROPOMI NO<sub>2</sub>, CO
- Geostationary imagery (GOES, Himawari)

## Add your site!

- We can support your ground/airborne campaigns or sites of interest!
- “Request a SAM”

# Thank You!

GES DISC  
OCO-3 v11 Lite  
XCO<sub>2</sub> files:



**GES DISC** | EARTH DATA | Find a DAAC +

Atmospheric Composition | Water & Energy Cycles | and Climate Variability

Data Collections: OCO-3 Lite

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Back to search results

Orbiting Carbon Observatory-3  
**OCO-3 Level 2 bias-corrected XCO<sub>2</sub> and other select fields from the full-physics retrieval aggregated as daily files, Retrospective processing V11r (OCO3\_L2\_Lite\_FP)**

Version 11r is the current version of the data set. Older versions will no longer be available and are superseded by Version 11r.

The Orbiting Carbon Observatory -3 (OCO-3) was deployed to the International Space Station in May, 2019. It is technically a single instrument, almost identical to OCO-2.

The Orbiting Carbon Observatory is the first NASA mission designed to collect space-based measurements of atmospheric carbon dioxide with the precision, resolution, and coverage needed to characterize the processes controlling its buildup in the atmosphere.

OCO-3 incorporates three high-resolution spectrometers that make coincident measurements of reflected sunlight in the near-infrared CO<sub>2</sub> near 1.61 and 2.06 micrometers and in molecular oxygen (O<sub>2</sub>) A-Band at 0.76 micrometers. The three spectrometers have different characteristics and are calibrated independently.

Oxygen-A-Band cloud screening algorithm is one of the primary cloud screening tools implemented in the operational OCO proc. ... more

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