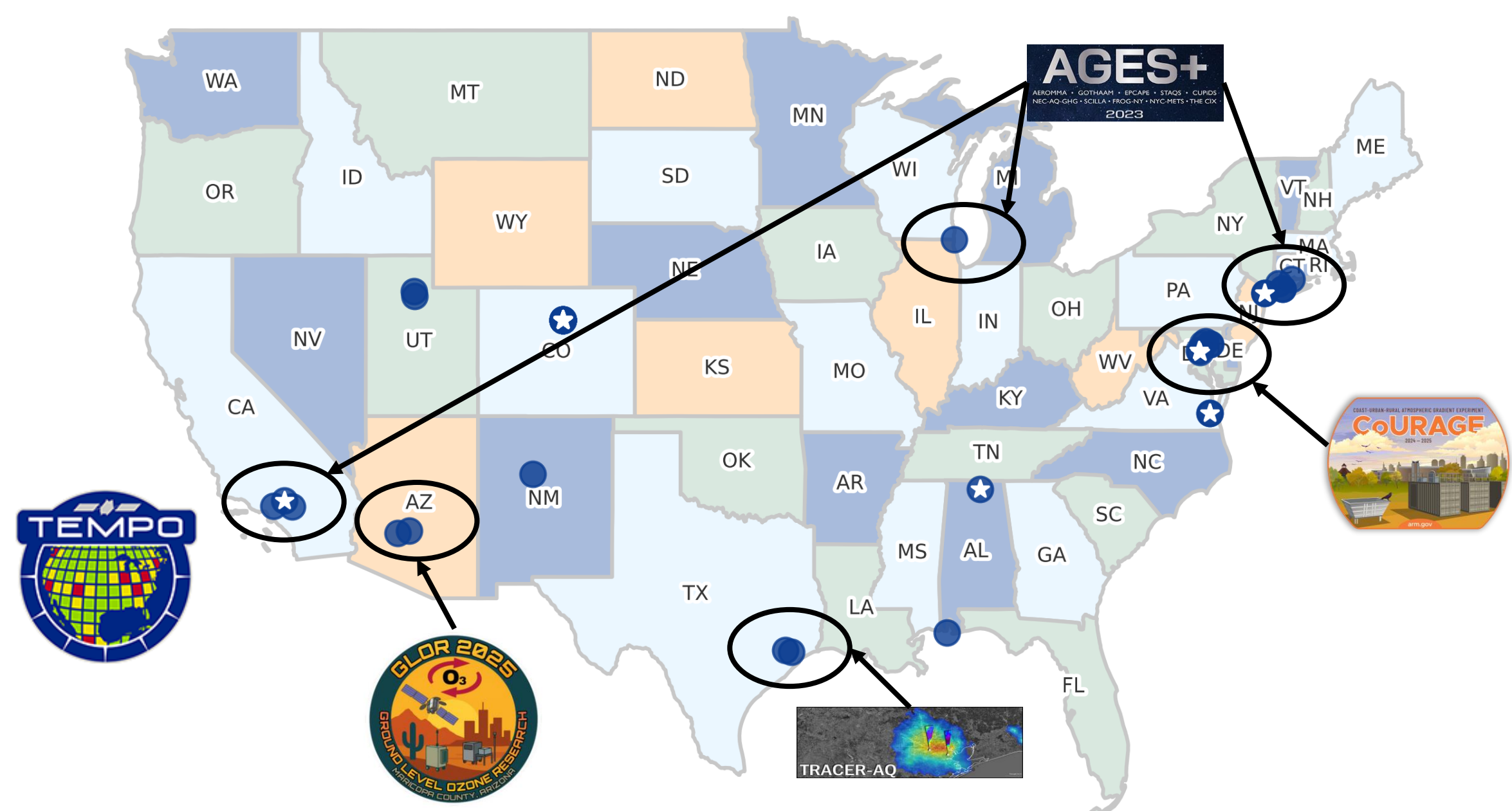


Tropospheric Ozone Lidar Network (TOLNet)



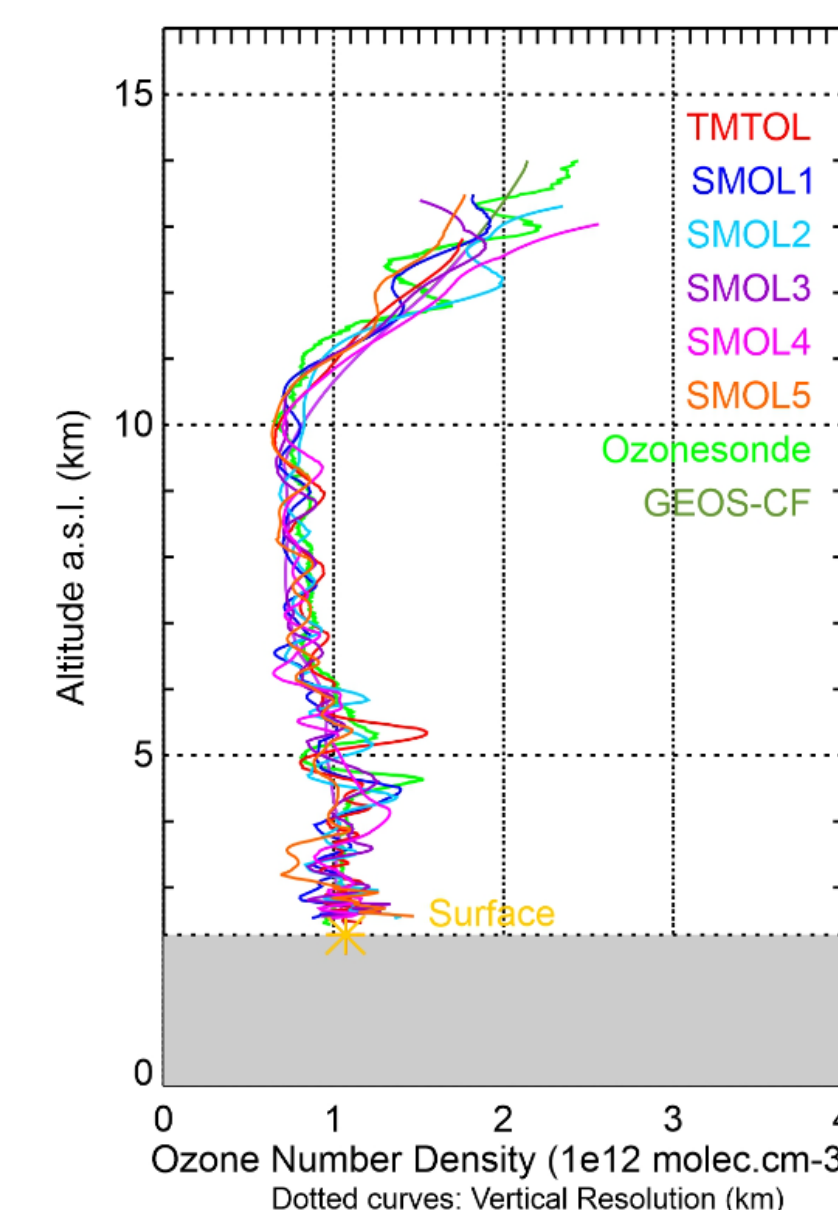
TOLNet Measurement Sites



TOLNet provides measurement of vertically resolved ozone profiles across the United States. **Routine Measurements** are conducted at each instrument group home site (white stars). **Campaign Deployments** (blue circles) are locations from campaigns measurements and extended experiments.

TOLNet is a **collaborative initiative, administered by the NASA**, which provides high-resolution observations of tropospheric ozone to (1) better **understand physical processes driving the ozone budget** in various meteorological and environmental conditions and (2) **validate the tropospheric ozone** measurements from spaceborne missions.

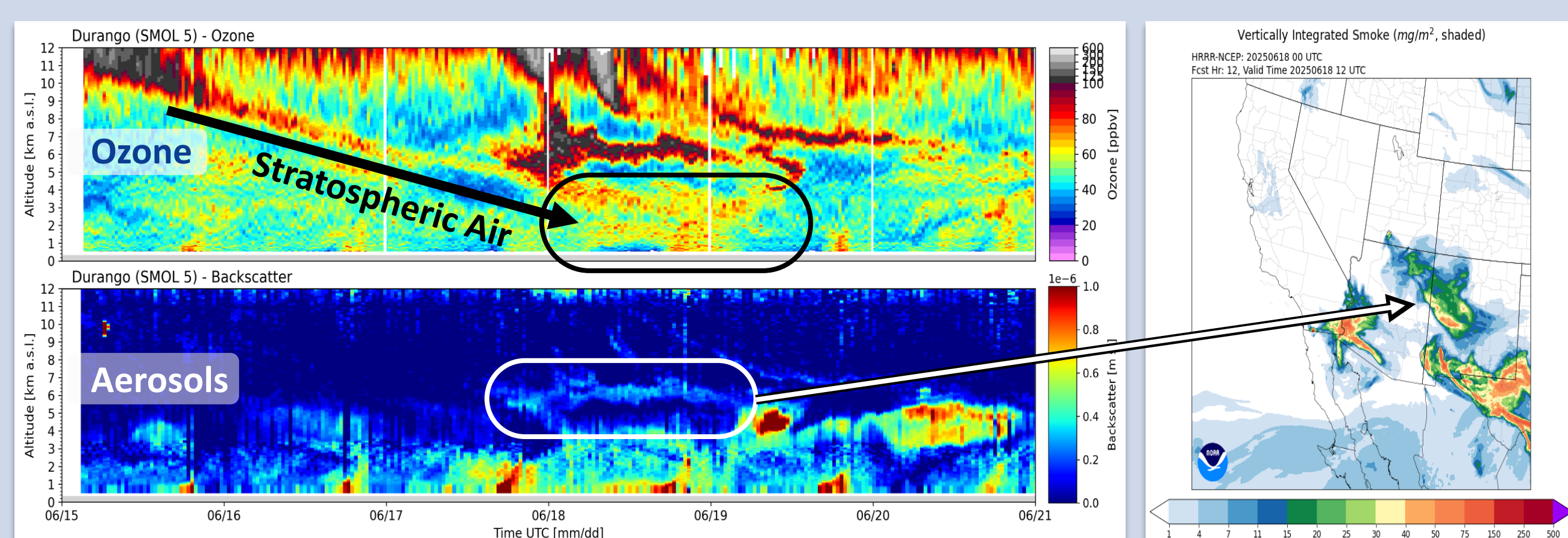
- **Deliver** high-resolution ozone profiles
- **Assess** satellite measurement fidelity
- **Discover** new atmospheric structures
- **Improve** air quality models
- **Leverage** ground network synergy



The Importance of Ozone Profiles

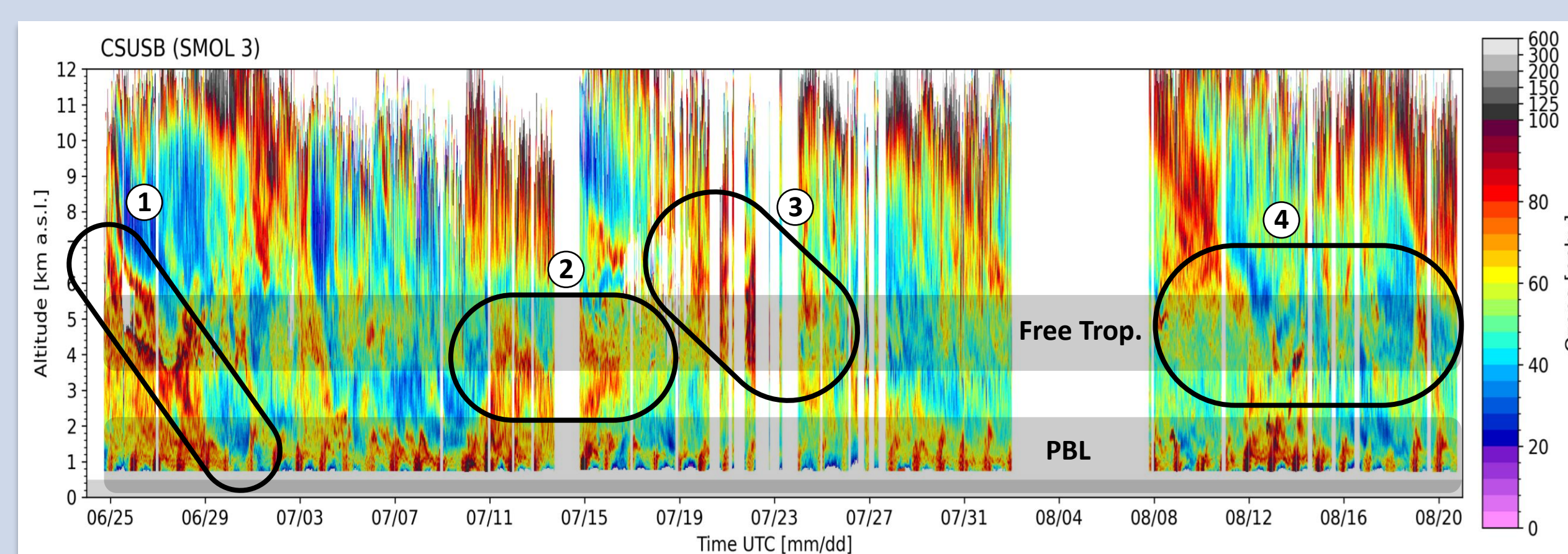
Although vital in the stratosphere, **ozone is a greenhouse gas and an air pollutant that causes health problems for humans and vegetation**. Despite significant regulatory efforts and pollution-control programs developed over the past 30 years, free-troposphere ozone continues to increase, and ozone-exceedances are still routinely observed. **Through Routine Measurements and Joint Field Deployments TOLNet:** Provides high spatio-temporal observations of planetary boundary layer (PBL) and free tropospheric ozone for use by the **satellite, regulatory, and scientific community**; Discovers new structures and transport processes throughout the boundary layer and upper troposphere/lower stratosphere, especially in the **diurnal and vertical variation**; Supports community understanding of the relationship between ozone and aerosols aloft and surface ozone and PM values both during U.S. **wildfire and long-range transport events**; Advances our understanding of processes controlling **regional background atmospheric composition** (including stratospheric contribution and long-range transport) and their effect on surface air quality.

Stratosphere-Troposphere Exchange



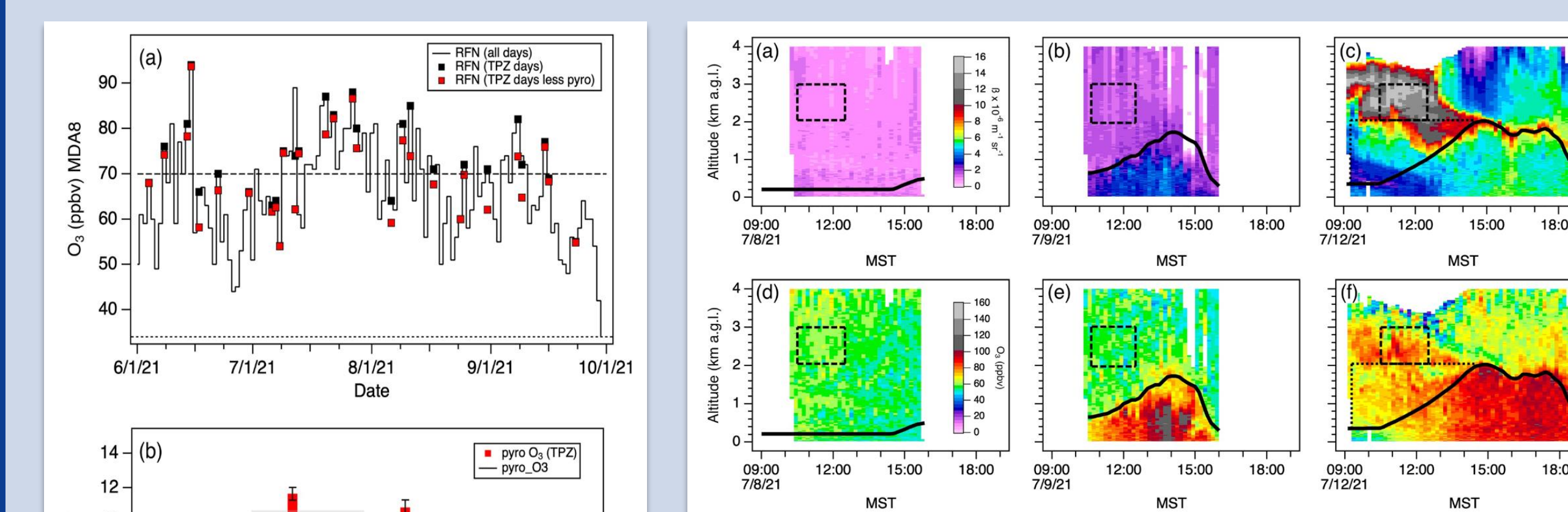
Intrusion of Stratospheric air into the Troposphere, and then into the surface air, can bring with it dry and ozone rich air masses that result in ozone-exceedances. The high vertical-resolution, and high temporal resolution of our datasets is primed for **capturing, and characterizing, these events to help the air quality community**. Simultaneous retrieval of ozone and aerosols allows for the discernment between major ozone sources; wildfire-smoke, stratospheric air, or local production.

Local vs. Long-Range Transport



Continuous routine measurements allows high-temporal coverage of Surface to Upper Troposphere for study of **vertically resolved ozone diurnal cycle**. Boundary layer oscillation, Ozone Transport, and Aloft Ozone Reservoirs can easily be capture. Many of our analyses use technics to **differentiate between local production and long-range transport of ozone**; **characterize interesting ozone structures**; and determine the **ozone background for a region**.

Characterizing Exceedance Events



Backscatter (top) and O3 (bottom): Mean O3 mixing ratios within the dashed boxes. The solid lines show the boundary layer and the dotted lines in (c and f) define the regions used to estimate the smoke entrainment. Estimates of **O3 contribution from wildfire** entrainment are on the left plot. (Langford et al., 2023)

Small Mobile Ozone Lidar

Deployable Systems for Ozone Profiles

- **Uncertainty:** <10%
- **Vertical Extent:** Surf. - 10 km
- **Temporal Resolution:** 30 minutes
- ***Aerosols Backscatter profiles***
- **Fully autonomous 24/7 operation**
- **Live Data** (tolnet.larc.nasa.gov)
- **Centralized Processing** at NASA LaRC



Chouza, F.: The Small Mobile Ozone Lidar (SMOL): Instrument description and first results. Atmos. Photo. Tech., 16, 400-419, <https://doi.org/10.5194/amt-16-400-2023>, 2023.

Complementary Datasets

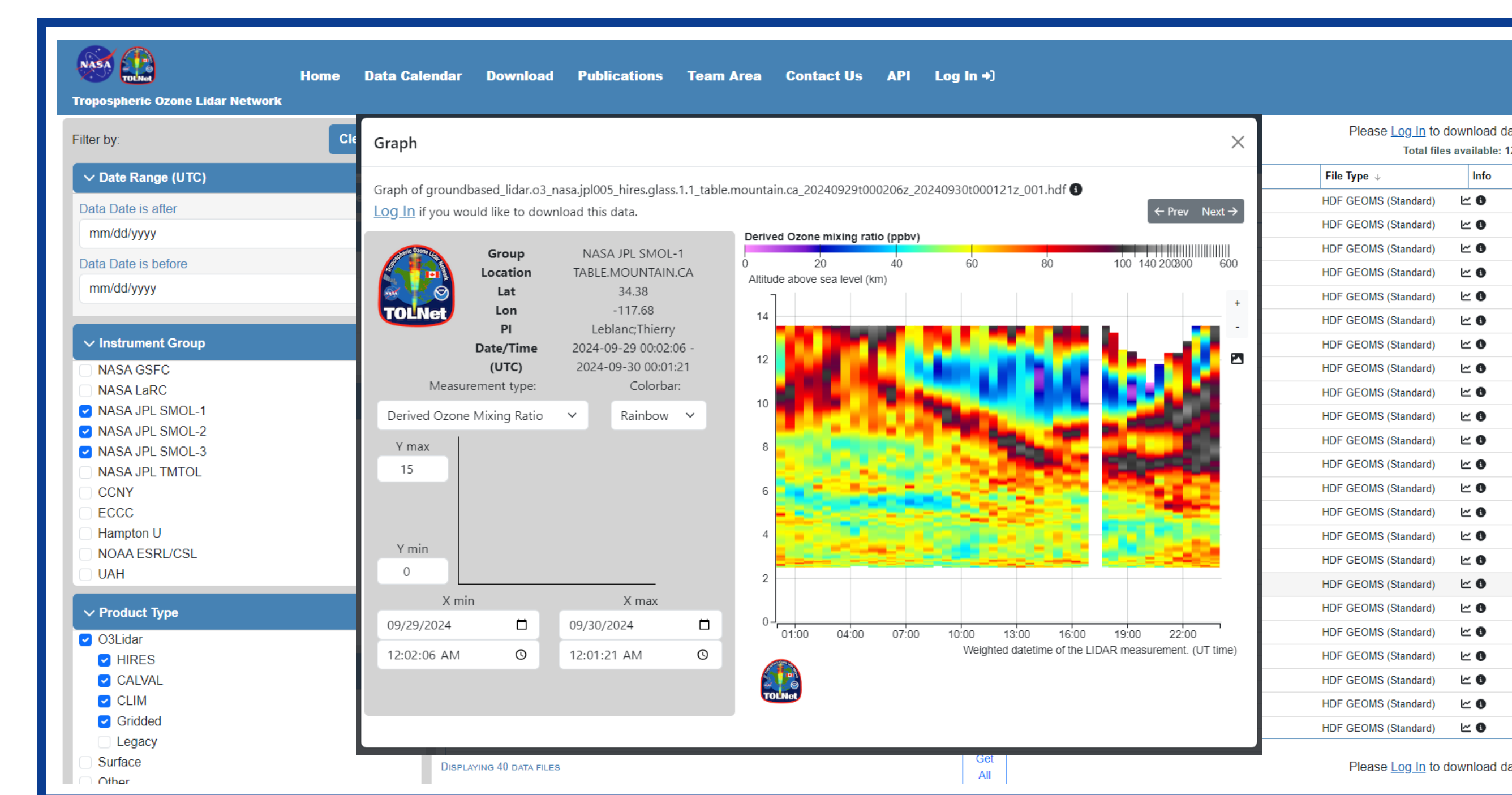
In addition to ozone profiles from ground-based TOLNet lidars, our campaigns collect data from aerosol lidars, wind lidars, ozone-sondes, pandora spectrometers, sun-photometers, and in-situ & remote sensing aircraft observations; while also leveraging the existing ground-networks from NASA, NOAA, and the EPA. This multi-faceted campaign datasets allow for a comprehensive analysis of air quality dynamics.

Data Integration

Combining datasets from different instruments and platforms (e.g., satellite, aircraft, ground-based) provides a comprehensive spatial and temporal view of atmospheric constituents. This integration is key to understanding the interactions between different pollutants and their collective impact on air quality within the complex coastal terrain.

Acknowledgments

We gratefully acknowledge the contributions of the NASA GSFC, NASA JPL, NASA LaRC, CCNY, and NOAA ESRL, and all collaborating institutions for their invaluable support and data during campaigns and routine measurements.

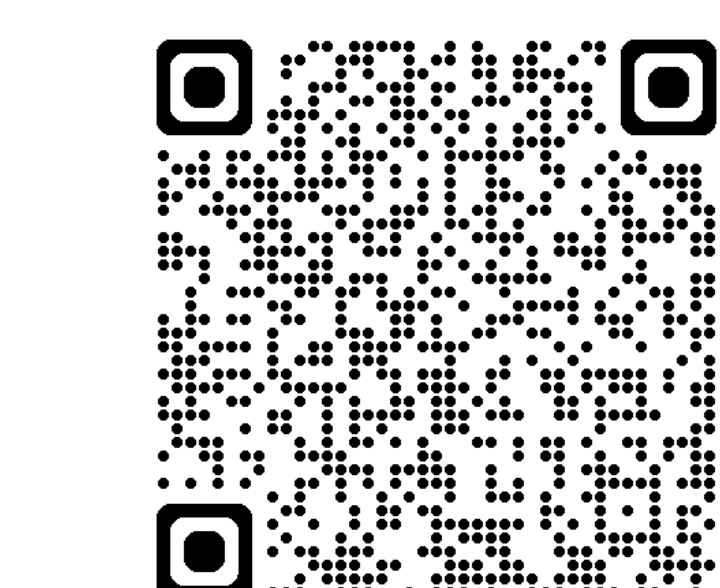


Developing a **TOLNet Toolbox for end-users** to download, visualize, and explore our datasets.

- **API Access** in Python
- **Tutorials** in Jupyter Notebooks (ARSET Training)
- **Integration** with current analysis tools



<https://tolnet.larc.nasa.gov>



<https://forms.gle/9gJeDSF8ms75GAo6>