TOLNet Validation Efforts for TEMPO

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- TOLNet began 11 years ago and now comprises 8 lidar stations in USA and Canada, a modeling group, and a DAAC at LaRC.
- TOLNet measures ozone concentration and aerosol backscatter vertical profiles at 7 stations and NO2 at 1 station.
- 5 stations are currently mobile. 2 more expect to become mobile. At least 1 station can make profile measurement while under way on the road.
- Developing more integrated measurement approach with other ground-based profiling networks.
- - Find us on Twitter @NASA_TOLNET

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Measurement Capabilities

- TEMPO measures with 3 second dwell time per N-S pixel row . TOLNet measures .le. 2-minute dwell in PBL, 10-min dwell in FT.
- TEMPO requests: 1) Clear-sky (CF < 0.2) measurements coordinated during commissioning phase, 2) Both climatological (regular temporal spacing), diurnal, and episodic (high, low, smoky, etc.) observations. TOLNet can accommodate all requests.
- TEMPO would like to assess its ability to characterize spatial and temporal gradients and to assess the effect of ozone and aerosol laminae on its retrievals. TOLNet profiles can contribute to this effort. The precision and accuracy of TOLNet measurements has been very well quantified (it's in the few percent range).
- In addition to home-station measurements, TOLNet lidars have participated in several campaigns with multiple other groups (both measurement and modeling) to characterize air-quality morphology over a variety of environments. These campaigns will contribute to the validation of TEMPO.
- The TOLNet modeling group collaborates with several forecast modeling groups to produce tailored predictions of ozone, aerosol, and cloud distributions at all TOLNet sites (and potentially any other locations). These alerts will provide timely information for TOLNet observations and TEMPO special operations to captured desired conditions.

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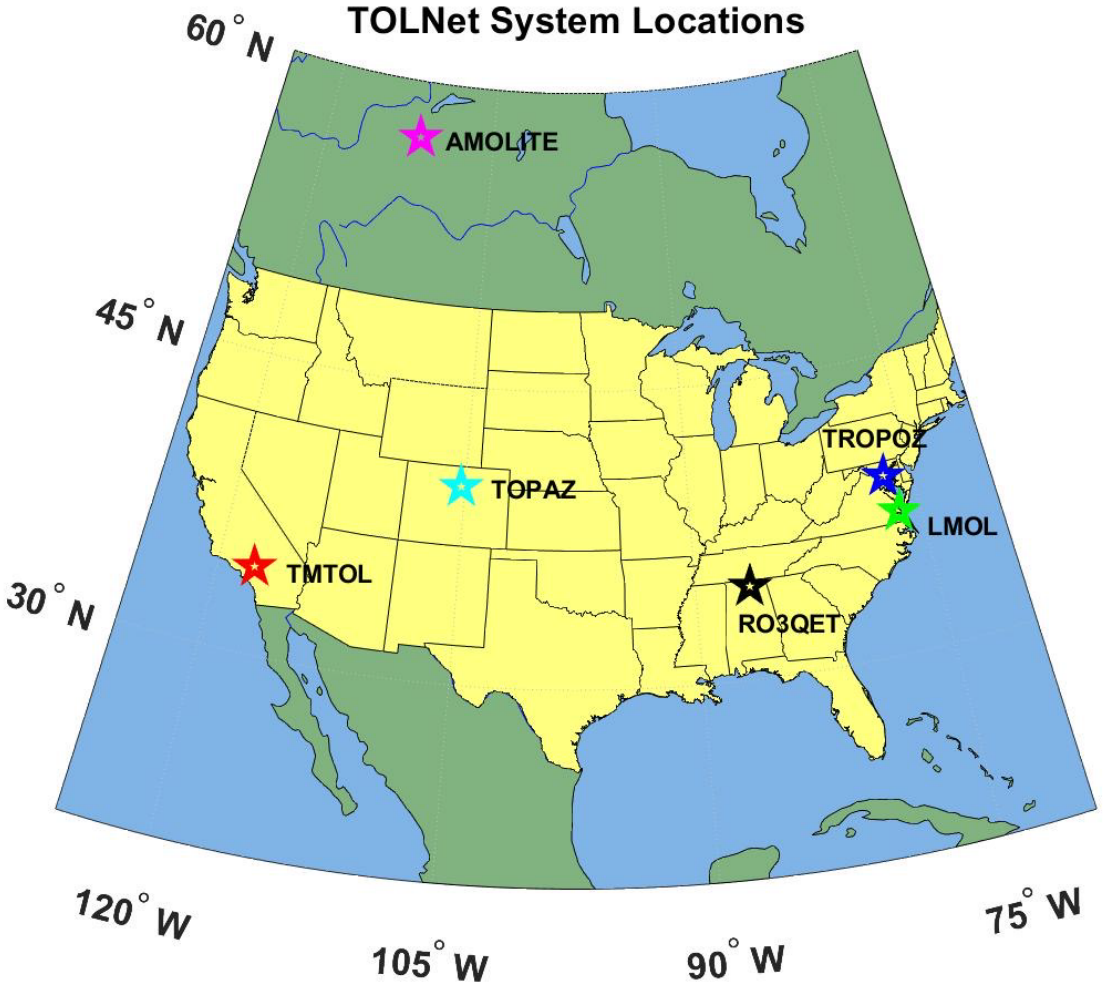
Analysis Techniques

- Applying TEMPO Averaging Kernels (AK's) to TOLNet profiles will result in compatible vertical information for assessing TEMPO accuracies and precisions. Alternatively, retrieving TOLNet profiles within an Optimal-Estimation framework using the TEMPO AK's will also provide TEMPO-compatible information. These AK frameworks provide elegant mathematical domains for validating TEMPO measurements.
- Diurnal measurements of ozone and aerosol profiles allow assessment of the SZA dependence of TEMPO retrievals.
- Including coincident insitu (next slide) and remote-sensing aircraft (GCAS, GeoTASO) measurements of PBL ozone at TEMPO pixel resolution allows analysis of the inter- and intra-pixel accuracies and precisions of TEMPO.

TOLNet Lidar Stations within the TEMPO FoR

TOLNet contributions to TEMPO validation



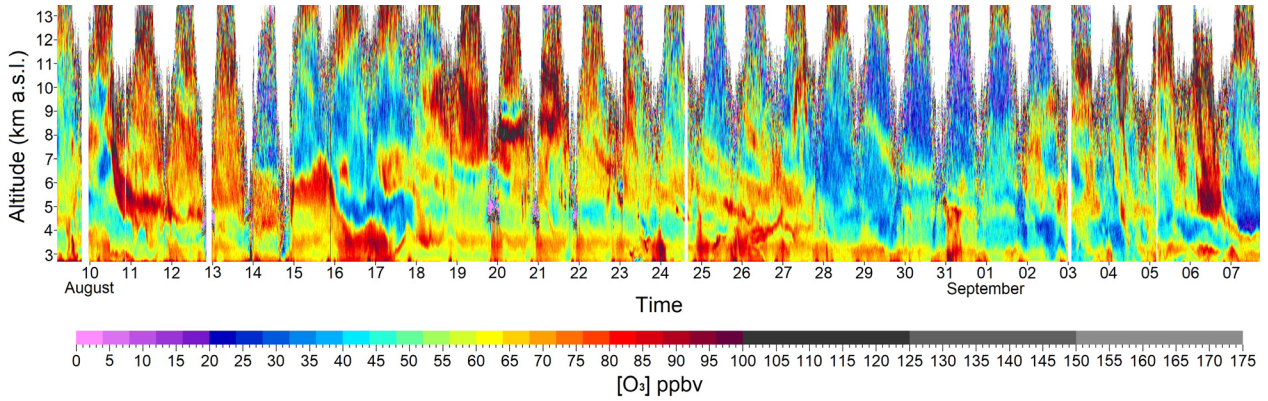
TOLNet measurements are a desirable TEMPO evaluation dataset as the observations:

1. Have high temporal/vertical resolution

2. Are high accuracy observations

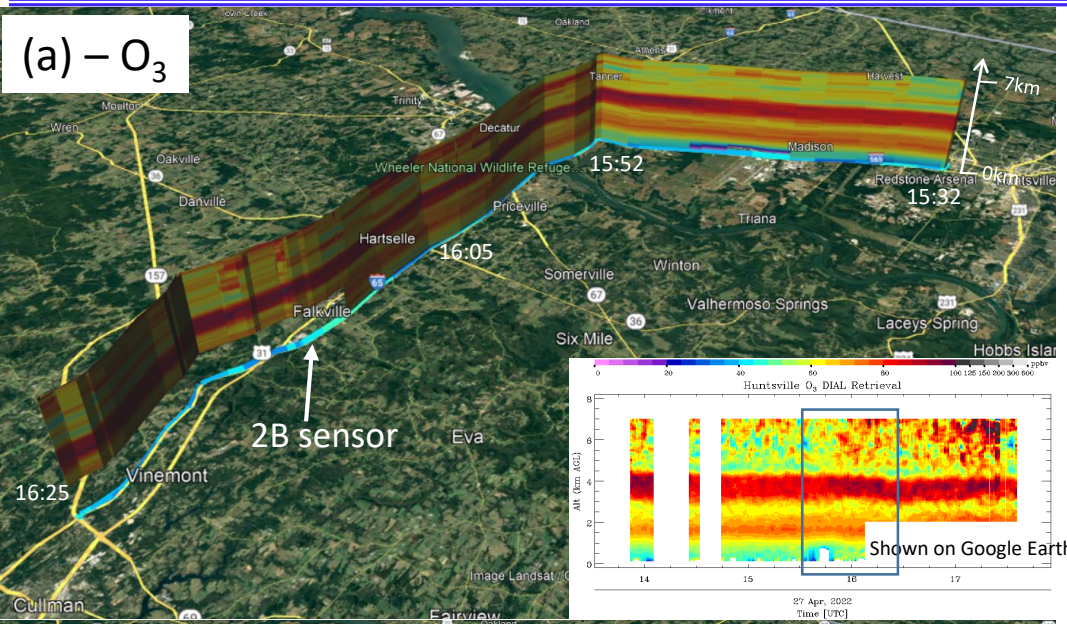
3. Provide "event" observations and routine measurements

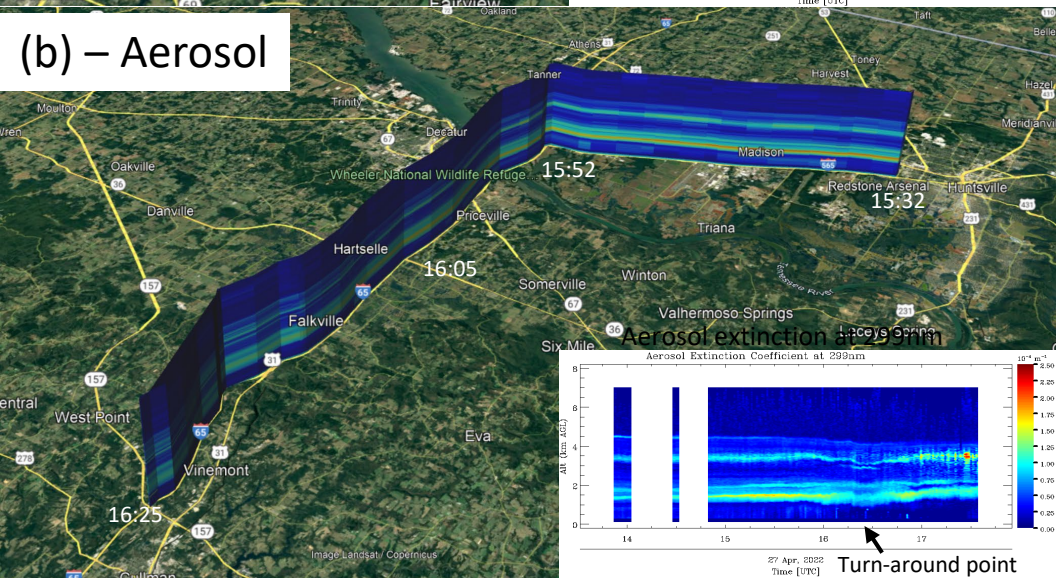
4. Provide multi-hour diurnal ozone and aerosol information about TEMPO performance at all vertical layers of the troposphere (e.g., planetary boundary layer, free troposphere, and the upper troposphere).



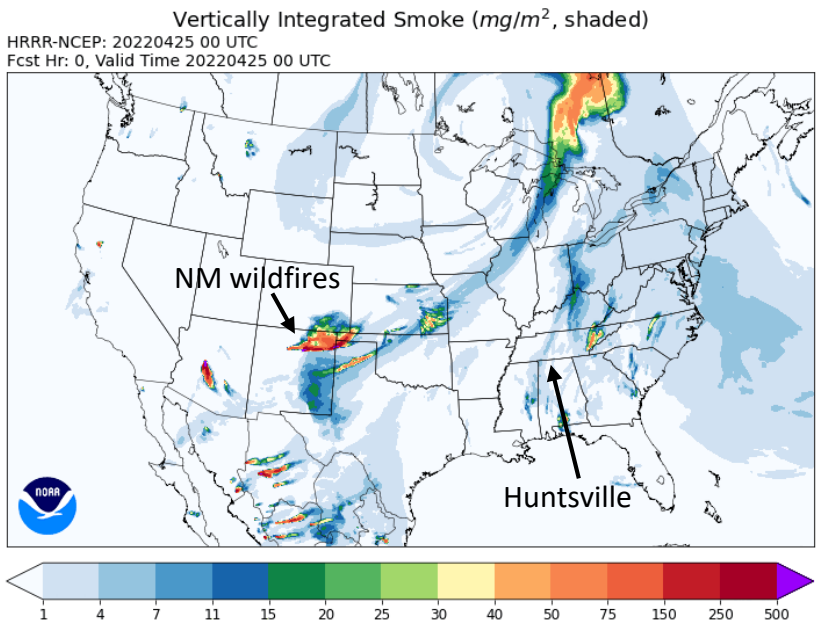
Ozone and Aerosol Profiling on Highway by UAH RO_3QET Mobile Lidar

Shi Kuang, Mike Newchurch, Todd McKinney, Paula Tucker, U. Of Alabama in Huntsville





RO_3QET



NOAA/NCEP High-Resolution Rapid Refresh (HRRR) vertically integrated smoke, 0425 00z – 0427 12z, 2022

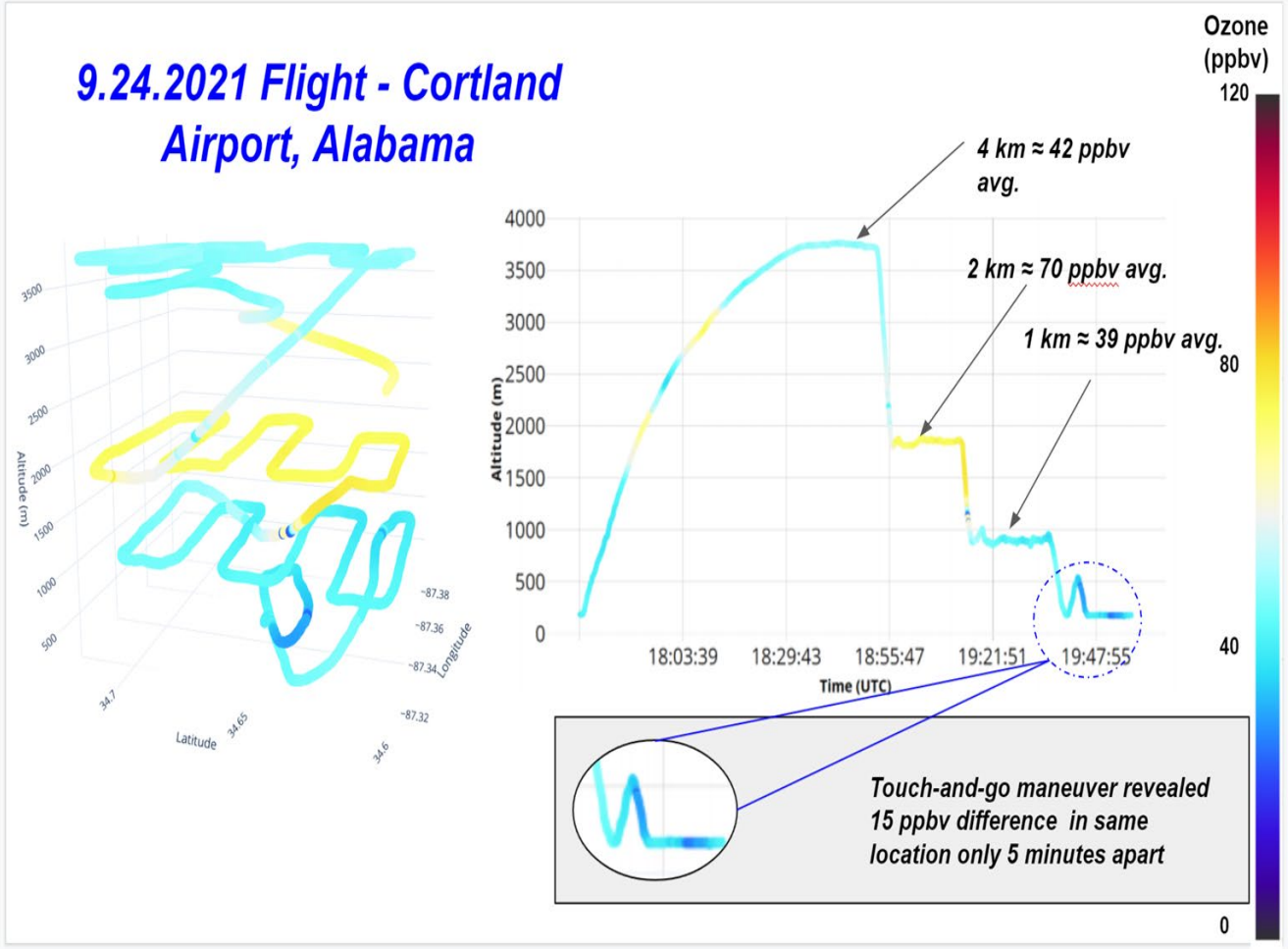
Introduction: The RO_3QET laboratory is a newly developed mobile observation system integrating laser remote sensing, radiosondes, surface observations, and UAV-attached measurements for convenient deployment in a field campaign.

Findings: The left figure presents the measurements made on the Alabama highways on April 27, 2022, with a moving speed of about 60 mph showing multiple FT smoke layers associated with the NM wildfires. The symmetric aerosol structures with the vehicle turn-around time axis at 16:25 UTC suggest different geographic aerosol distributions (lower smoke altitude in the south) due to the smoke transport processes.

Significance: NASA-funded RO_3QET mobile lidar will provide valuable 3-D ozone and aerosol data for various scientific studies with a lower cost than airborne sampling.

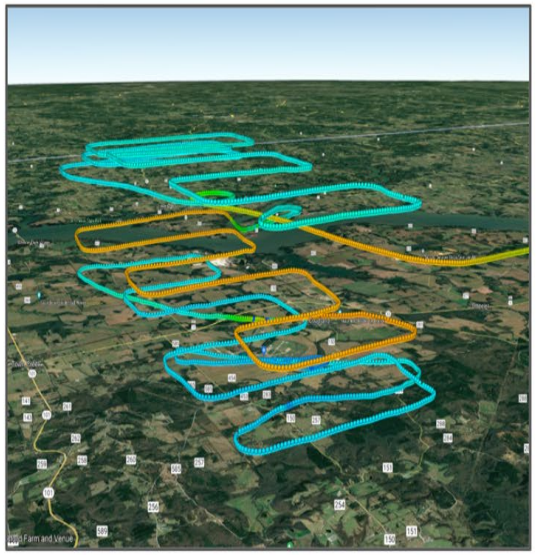
PBL Ozone and Aerosol insitu measurements of TEMPO Pixels

Shi Kuang, Mike Newchurch, Todd McKinney, Paula Tucker, U. Of Alabama in Huntsville



Goals of Study:

1. Validation on TEMPO PBL ozone variations using a fixed-wing aircraft
2. Standardize flight grid patterns for future TEMPO Satelite comparisons
3. Determine linkage between ozone concentrations and HYSPLIT backwards trajectory locations



Example Flight Grid Pattern w/ Ozone Color Scale