

Processes Resulting in Ozone Laminar Evolution Measured in SEAC⁴RS and SENEX

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1. Introduction

This work is motivated by previous studies showing major discrepancies between ozone observations and model simulation at SEUS in summer [Fiore et al., 2009; Parrington et al., 2008]. Incorporation of regional, free-tropospheric ozone laminae in to the growing, convective boundary layer represents the primary connection between regional and local sources and sinks of pollution and precursors. The key scientific questions to answer are: (1) what mechanisms resulted in the observed ozone laminar evolution? (2) When and where can models capture ozone laminae? (3) What are the characteristics of the vertical ozone distribution in 2013 summer related to the general laminar processes?

In the summer of 2013, the UAH ozone Differential Absorption Lidar (DIAL) measured vertical ozone profiles with a 2 or 10 min resolution between 0.1 and ~12 km during both daytime and nighttime whenever weather allowed. Daily ozonesondes complemented the SEAC⁴RS field survey. We also hosted the HSRL from the University of Wisconsin at Madison (from June to September 2013) for obtaining additional aerosol information. We provided coordinated ground-based observations whenever the NASA DC8 airborne measurements were carried out above or close to Huntsville. The dates for the coordinated observations are Aug. 12, 14, 21, and 30, and Sep. 6, 11, and 16.

In this poster, we present these ozone and aerosol data as well as their preliminary analysis. Ozone lidar data can be accessed at http://nsstc.uah.edu/atmchem/lidar/DIAL_data.html. HSRL data is available at <http://hsrl.ssec.wisc.edu/>. Ozonesonde data is achieved at the SEACIONS (led by Anne Thompson) web site

<http://ozone.met.psu.edu/dev/research/seacions/quicklooks.php>.

2. Measurements during SENEX

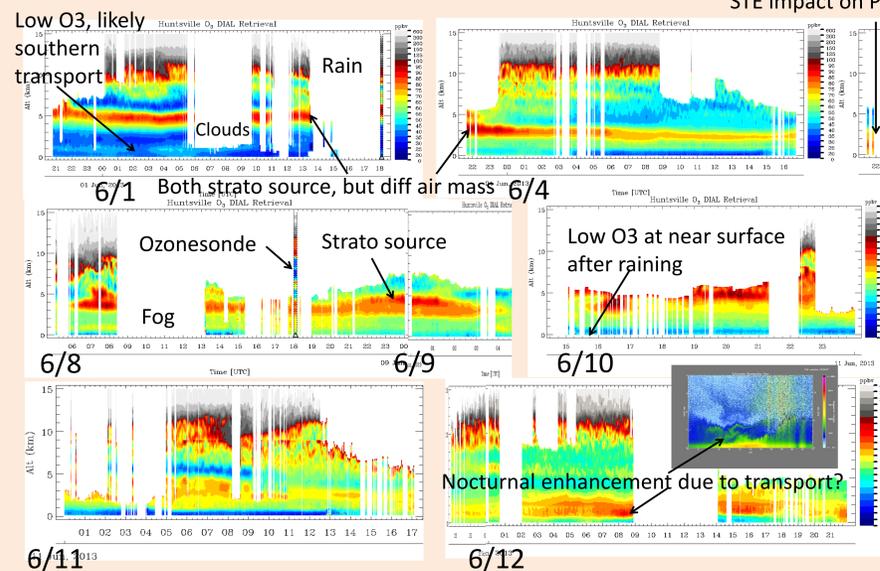


Figure 1. Ozone lidar measurements (in ppbv) in the first half of June 2013 showing a large influence of stratospheric sources on the mid/low tropospheric ozone variations.

3. Measurements during SEAC⁴RS

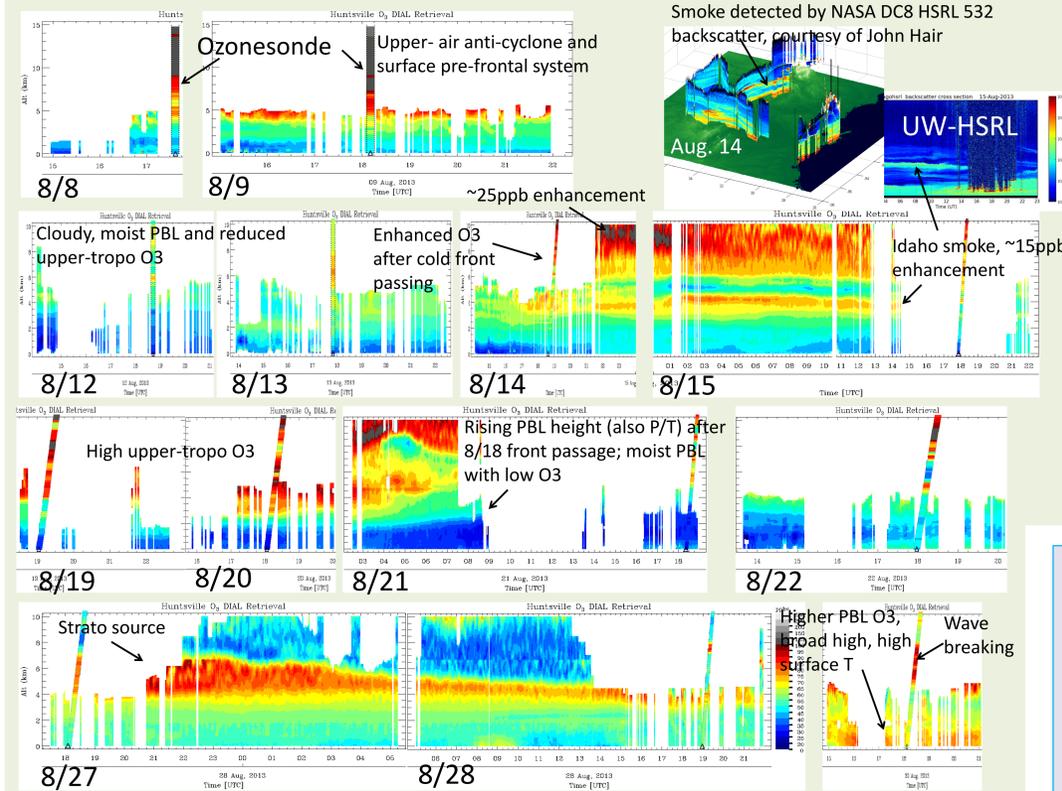


Figure 3. UAH ozone lidar observations in Aug. showing frequent enhanced upper-tropospheric ozone and low PBL ozone associated with upper-air circulations, surface meteorological conditions, convective dynamics, and aerosol transport.

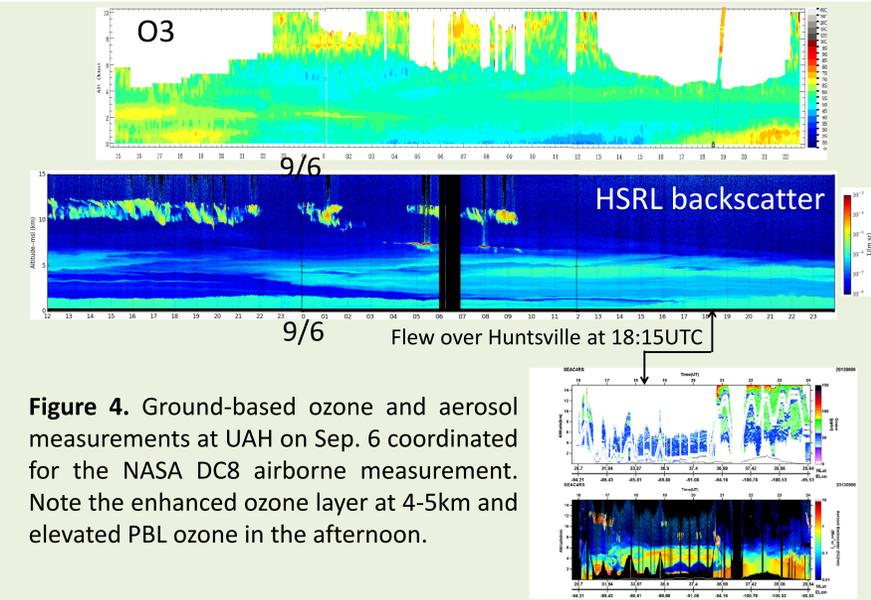


Figure 4. Ground-based ozone and aerosol measurements at UAH on Sep. 6 coordinated for the NASA DC8 airborne measurement. Note the enhanced ozone layer at 4-5km and elevated PBL ozone in the afternoon.

4. Characteristics of the 2013 summertime ozone at Huntsville

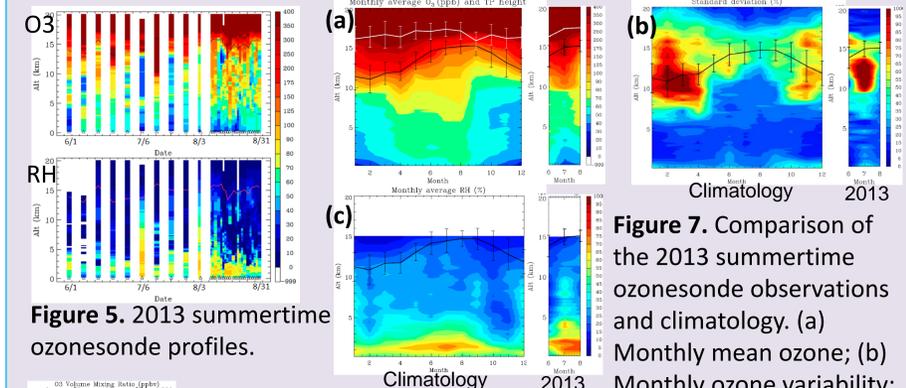


Figure 5. 2013 summertime ozonesonde profiles.

Figure 6. Average showing increasing ozone mixing ratio with altitude in the troposphere.

Figure 7. Comparison of the 2013 summertime ozonesonde observations and climatology. (a) Monthly mean ozone; (b) Monthly ozone variability; (c) Monthly mean RH. Lower PBL ozone associated with high RH. High variability for upper-tropospheric ozone in July.

5. Conclusions and future plan

1. UAH O3 lidar (affiliated with TOLNet and NDACC), ozonesonde, and Wisconsin-deployed HSRL have made extensive collocated observations in 2013 summer. The coincident ground-based and airborne measurements are especially valuable for data analysis and process studies.
2. Ozone DIAL and HSRL obs. show significant biomass burning transport throughout summer. Ozone generally shows a +10ppbv enhancement associated with smoke or pollution layers.
3. The generally low PBL ozone in summer 2013 is likely due to moist weather and relatively low surface T.
4. Enhanced upper-tropospheric ozone has similar pattern as climatology and needs modelling to quantify contributions from different processes.

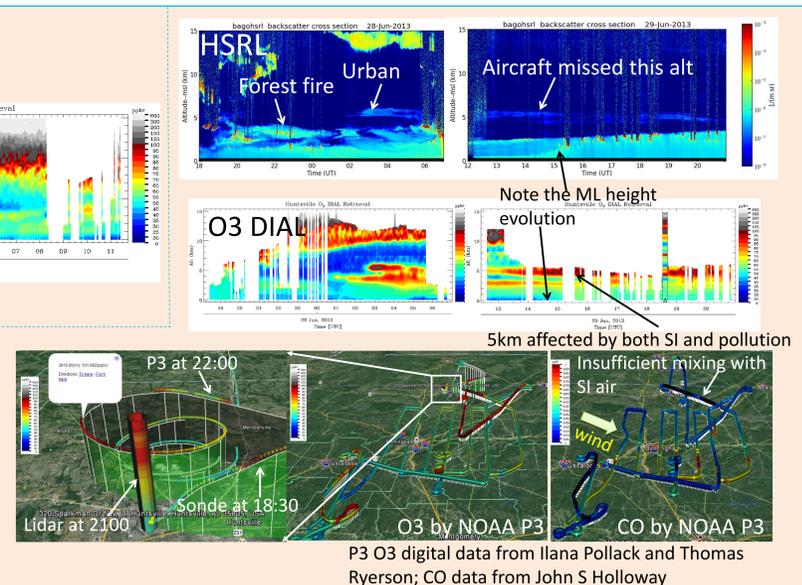


Figure 2. Coincident airborne and ground-based measurements on June 29 suggesting that upper-air ozone at Huntsville were affected by both STE and pollution transport.