Measurement of Glyoxal and Nitrogen Dioxide by Cavity Enhanced Spectroscopy during SENEX 2013

Principal Investigator: Kyung-Eun Min
NOAA ESRL Chemical Sciences Division
kyung-eun.min@noaa.gov

Co-investigator: Rebecca A. Washenfelder
NOAA ESRL Chemical Sciences Division
rebecca.washenfelder@noaa.gov

Co-investigator: Andrew O. Langford
NOAA ESRL Chemical Sciences Division
andrew.o.langford@noaa.gov

Co-investigator: William P. Dubé
NOAA ESRL Chemical Sciences Division
William.p.dube@noaa.gov

Co-investigator: Steven S. Brown
NOAA ESRL Chemical Sciences Division
Steven.s.brown@noaa.gov

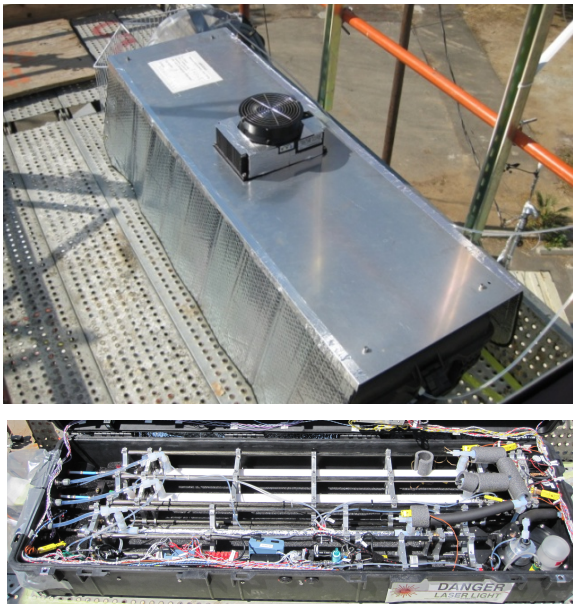

Figure 1. Prototype visible cavity enhanced spectrometer at the Pasadena ground site during CalNex 2010

Glyoxal is one of the key reactive intermediates in the atmospheric oxidation of hydrocarbons, particularly biogenic VOCs and aromatic compounds. It is the simplest α-dicarbonyl species, and it can serve either as a source of radicals through its photolysis or as a source of secondary organic aerosol through its heterogeneous uptake and subsequent oligomerization. It also has strong visible absorption bands that facilitate its detection via spectroscopic methods. Cavity enhanced spectroscopy, CES, is a recently developed technique for high-sensitivity, spectrally resolved measurements. As shown in Figure 2, it employs a broadband light source, such as a light emitting diode (LED), an optical cavity and a grating spectrometer / CCD. The technique can achieve optical path lengths of several tens of kilometers for measurement of atmospheric trace gases at sub part per billion levels.

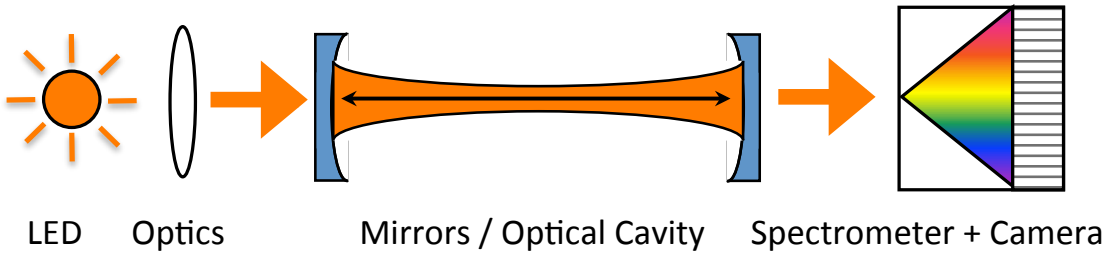

Figure 2. Simplified schematic of a broadband CES instrument

The CES technique has been demonstrated for measurement of glyoxal in both the laboratory [*Washenfelder et al.*, 2008] and in the field during CalNex 2010 [*Washenfelder et al.*, 2011; *Young et al.*, 2012]. Ground based CES measurements during the CalNex 2010 campaign also included nitrogen dioxide (NO_2) and HONO [*Young et al.*, 2012].

For SENEX, a new version of the instrument will be constructed that is aircraft certified and that has sufficient sensitivity for rapid (≤ 10s) measurements of glyoxal at its expected ambient concentrations in the Southeast U.S. The instrument will also provide high sensitivity measurements of nitrogen dioxide. The new instrument will be called "ACES," for "Airborne Cavity Enhanced Spectrometer."

References

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