Lidar measurements of aerosol, ozone, and boundary layer winds on board the Ronald H. Brown during the Texas Air Quality Study, 2006

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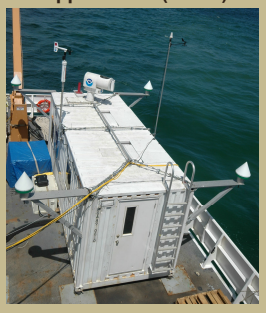
Background

The ship-based portion of the The 2006 Texas Air Quality Study (TexAQS 2006) took place late July through mid-September of 2006. Measurements were concentrated in the Galveston bay and Houston shipping channel area. Objectives for the ship-based study included characterization of pollution sources, study of chemical/pollution transport and transformation processes, study of coastal impacts on air quality, and study of the radiative effects of aerosols. During the campaign, NOAA's High Resolution Doppler Lidar (HRDL) performed continuous measurements of boundary layer winds, velocity variance, and relative 2 micron aerosol backscatter. NOAA's Ozone Profiling Atmospheric Lidar (OPAL) provided high vertical resolution aerosol backscatter and ozone profiles. In addition to their unique remote sensing observations, measurements from both instruments provide context and transport information, including boundary layer mixing and aerosol layer heights, for the in-situ aerosol and gas-phase chemistry measurements.

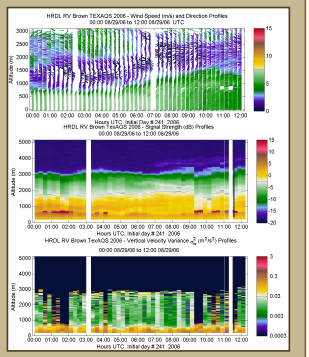
High Resolution Doppler Lidar (HRDL)

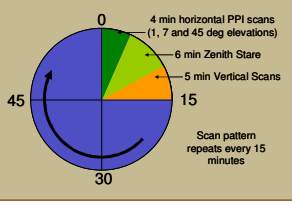


Wavelength	2.02 micron
Pulse Energy	2-3 mJ
PRF	200 Hz
Max Range	4-8 km
Range Res.	30 m
Beam rate	2 Hz
Scanning	Full Hemispheric
Precision	10 cm/s

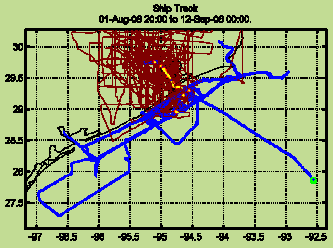
Basic HRDL Products

- Mean wind speed and direction
- Average return signal strength
- Small scale mixing strength

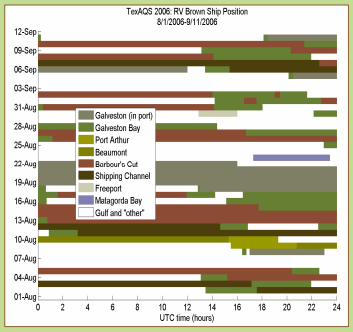




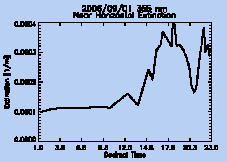
RV Brown



Plot of RV Brown ship track during TexAQS 2006 –with NOAA Twin Otter flight tracks

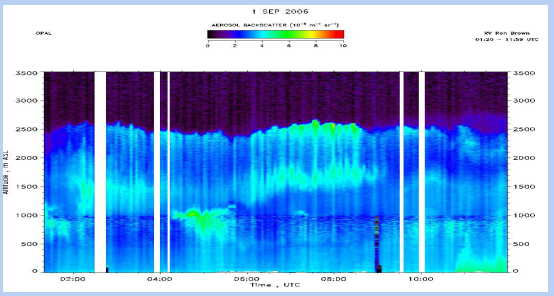


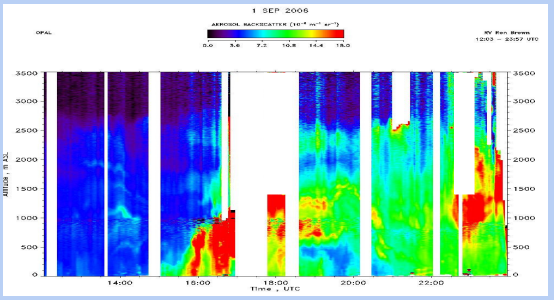
Ozone Profiling Atmospheric Lidar (OPAL)



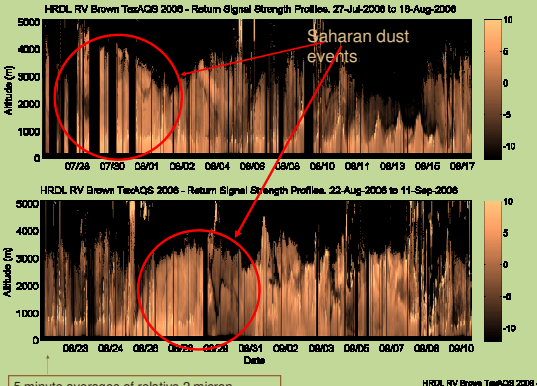
Aerosol Measurements

OPAL aerosol data measured at 355-nm wavelength. Displayed is the natural logarithm backscatter, corrected for range dependence, and calibrated using a clean region of 4500 – 5500 m in the Klett Retrieval Method.



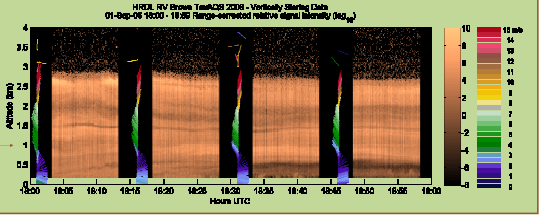


HRDL-TexAQS 2006: Zenith Return Signal Strength



5 minute averages of relative 2 micron aerosol backscatter profiles for leg one (top) and leg two (bottom) of the TexAQS experiment, derived from HRDL vertical return signal strength data.

High temporal resolution (2 Hz) 2 micron relative aerosol backscatter profiles for 1800 to 1900 on September 1, interwoven with HRDL derived mean-wind speed and direction profiles. Note the low-level winds bringing in a clean layer near the surface.



Derived HRDL products

- Speed and directional shear information and statistics
  - Useful in space-based lidar modeling
- Aerosol and mixed layer (i.e. Boundary layer) heights
  - used in many different applications
- Horizontal small-scale mixing strength
- Vertical profiles of relative aerosol strength
  - layering information
  - may lead to backscatter
- Information about boundary layer dynamics such as rolls, surface streaks, gravity waves, etc.
  - improve boundary layer models

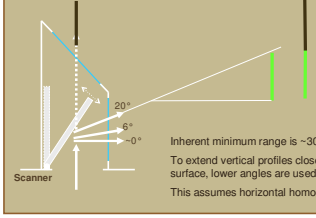
Basic OPAL Products

- Total backscatter (molecular plus particulate)
- Extinction Profiles
- Ozone profiles

The OPAL Laser is a Differential Absorption Lidar (DIAL) which emits pulses at four ultraviolet wavelengths [266, 289, 299 and 355 nm].

The ozone measurements are estimated choosing the wavelength pair 266/355 nm using the DIAL technique.

The scanner and scanning technique is unique to OPAL . Staring at multiple angles extends the ozone and aerosol profiles to near the surface.

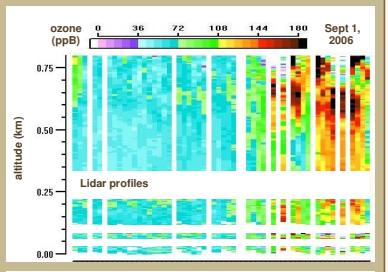


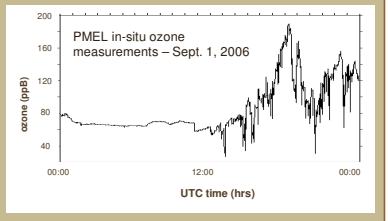
Inherent minimum range is ~300 m.

To extend vertical profiles closer to the surface, lower angles are used.

This assumes horizontal homogeneity.

Ozone Measurements





http://esrl.noaa.gov/csd/ors/data_pages/TexAQS06/opal/

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