Marine boundary Layer dynamics and heights during TexAQS 2006: HRDL measurements from the RV Brown

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High Resolution Doppler Lidar (HRDL)

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

Poster
Ship-Based LIDAR Estimates of Marine Mixed Layer Heights during TexAQS 2006
Motion compensation

Hemispheric beam scanner
- Motion compensation calculations enable the scanner to perform “world frame” scans.
- Tilt axis enables us to do Zenith stares.
- New algorithms allow zenith stare as part of scan pattern.

GPS based inertial navigation
- Estimates orientation, angular rates, position, velocity, and acceleration at 20 Hz.
- Static precision 0.15°
- Dynamic precision < 0.5°
HRDL wind and aerosol products for understanding Marine Boundary Layers

**Composite products**
- Horizontal mean wind profiles
- Profiles of relative aerosol strength and aerosol layering
- Vertical winds and vertical mixing/turbulence statistics
- Horizontal (near surface) mixing/turbulence statistics
- Aerosol and mixed layer (i.e. Boundary layer) heights
- Wind speed and directional shear profiles

**Individual Scan Products**
- Boundary layer dynamic features: rolls, surface streaks, thunderstorm outflows, etc
- Ship/oil-platform plume detection
Basic TexAQS 2006 HRDL Data Products
available at http://esrl.noaa.gov/csd/orrs/data_pages/TexAQS_06/hrdl/

Profiles of:
• Mean wind speed and direction
• Average return signal strength
• Small scale vertical mixing strength
Individual Scans: Zenith/Vertical stare data: Barbour’s Cut and Galveston Bay

Relative aerosol back-scatter: Layering and rolls/waves

Vertical velocity: Mixing, Entrainment & Venting

02-Sep-06 19:00 - 19:59 Motion corrected radial velocity (m/s)

Initial day #245 2006

Lat : 29.659  Lon : -94.981
Ship-Based LIDAR Estimates of Marine Mixed Layer Heights during TexAQS 2006
Mean wind speeds and ozone as measured on the ship
• Diurnal cycle in wind speed observed when the ship is near land
• Nocturnal low-level jets correlate with ozone depletion.

Ongoing Study: What is the relationship between wind speed and ozone min/max values?
Making sense of a single day.

1 Sept 2006 TEXAQS

See Machol et. al. poster for more information on this day.
Additional TexAQS 2006 Observations with HRDL

• NOAA’s High Resolution Doppler Lidar data provide contextual information about local transport and mixing conditions from the surface to the top of the aerosol layer.

• Within the HRDL dataset, nocturnal low-level jets correlate with low ship-measured ozone days.

• HRDL observed strongly capped (at ~500 m) nighttime boundary layers prior to high ozone days – despite ship position.

• Dust events typically correspond to higher aerosol layer heights
Ongoing and Future studies

- Mixed Layer and Boundary Layer Heights
  - Comparison to other lidars
    - OPAL on the RV Brown
    - TOPAZ on the Twin Otter
    - HSRL on the King Air
  - Study of BL heights over the water prior to high ozone days
  - Study of BL heights during nocturnal LLJ – and effects on local chemistry
- MBL dynamics: shear, streaks, rolls – integration into large eddy simulation (LES) models.
- Comparison: 2-micron aerosol backscatter profiles and in-situ measurements
- Satellite comparisons of backscatter
- Dust trajectory studies
- Large (1.5-micron+) aerosol/dust flux estimates
Thank you.