Bay Breeze Impact on Surface Ozone at Edgewood, Maryland

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Introduction
- Ozone ($O_3$) in the troposphere is an EPA criteria pollutant due to its ability to irritate and damage the human respiratory system as well as detrimentally affect plant photosynthesis rates.
- The meteorological conditions necessary to produce widespread ozone pollution also favor formation of a bay or sea breeze depending on proximity to a large body of water. These include:
  - Light or calm synoptic scale winds
  - Intense Solar Radiation (leading to land/water temperature gradients)
- Ozone surface deposition slower over water than land
- Ozone precursors emitted into shallow, stable over-water boundary layer
- Bay breeze creates a convergence zone for pollutants

NATIVE (Penn State)
- Nittany Atmospheric Trailer and Integrated Validation Experiment:
  - Mobile platform with in-situ measurements of trace gases and ground station for balloon launches
- Meteorological measurements of temperature, RH, wind speed and direction and SW radiation from UVMFR-7 Shadowband Radiometer
- Measurements taken at Aberdeen Proving Ground, Edgewood, MD (39.411°N, 76.298°W) as part of NASA's DISCOVER-AQ Campaign

DISCOVER-AQ:
- Multi-year project designed to relate column amounts of trace gases to surface variability
- July 2011: NASA P3-B profiles of trace gases and aerosols over Maryland Dept. Environment sites
- Supplementary Millersville University measurements - 1 km from NATIVE (sodar, tethered balloon trace gases)

Results
- 5 of 31 days (top) met all bay breeze criteria. 4 of those days exceeded the EPA 8 hour average ozone standard of 75 ppbv
- 4 of 31 days (omitted from figures) exhibited bay breeze front passage, but were then inhibited by rain or gust fronts
- Only 2 of 10 July 2011 exceedances at Edgewood, MD occurred on days without bay breeze frontal passage
- Late day advection of high surface ozone mixing ratios leads to exceedances. Bay breeze ozone maximum occurs an average of 3 hours later than non-bay breeze days
- Aerosol Lidar (bottom) shows quick boundary layer growth during morning of bay breeze days, slow gradual growth during non-bay breeze days

Future Work
- (Top) Use hi-res WRF runs to visualize bay breeze and transport of pollutants
- Consistent morning transport to over bay waters, followed by bay breeze initiation?
- (Bottom) Does total column ozone behave differently on bay breeze days?

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