An Analysis of Meteorological Factors That Influence Boundary Layer Ozone Concentrations

Using Ozonesonde Data from Houston, Texas

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Introduction

Three different categories: High, mid and low ozone days
- High = 1 \(\sigma\) above mean sfc. \(<\text{O}_3>\)
- Low = 1 \(\sigma\) below mean sfc. \(<\text{O}_3>\)
- Mid = remaining launches

Results show that meteorology plays an integral role in the variability of surface based ozone

Evolution of the Boundary Layer

• 5 August 2004
• Morning and afternoon launches
• Blue profile = 1200 Z launch
• Green profile = 1900 Z launch
• Mixed layer heights = cyan line

Conclusions for Houston Launches

• Large amount of ozone precursor produced at surface
• Higher mixed layer height \(\rightarrow\) Higher ozone concentration
• Warmer temperatures = more sunlight = higher ML heights
• Although ML heights are larger, increasing volume of BL, more sunlight led to more production
• ML heights cannot be used to explicitly predict \(\text{O}_3\) conc.

Surface Readings and Meteorological Variables

Meteorological Variables that Affect Mixed Layer Heights and \(\text{O}_3\):

• Synoptic Conditions (pressure systems & fronts)
• Cloud Cover (insolation and temperature)
• Soil Moisture and Relative Humidity
• Wind Speed and Direction

Average Mixed Layer Heights

- Low ozone days = 1.193 km
- Mid ozone days = 1.337 km
- High ozone days = 1.713 km

Average mixed layer height determined by ozone concentration, potential temperature, and relative humidity

Exemplary Mixed Layer Heights for Low, Mid and High Ozone Days

Low Ozone Day
- Mean ML Height: 1.193 km
- Mean \(<\text{O}_3>: 22 \text{ ppb}

Mid Ozone Day
- Mean ML Height: 1.337 km
- Mean \(<\text{O}_3>: 46 \text{ ppb}

High Ozone Day
- Mean ML Height: 1.713 km
- Mean \(<\text{O}_3>: 94 \text{ ppb}

Conclusions for Houston Launches

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References


http://www.rice.edu/ozone/