Evaluation of NMM-CMAQ and WRF-Chem during High Ozone Episodes in TexAQS-II

Focus on regional assessment
119 surface ozone stations
11 wind profilers
7 week period 8/12 to 9/30 2004

James Wilczak, Irina Djalalova,
Stu McKeen, Laura Bianco
NOAA/ESRL
What, if any, regional variations in max 8-h ozone existed during TexAQS-2006?
Seven Geographic Clusters

1 Dallas/FW
2 Austin
3 San Antonio
4 Corpus Christi
5 Houston
6 Beaumont /PA
7 Rural/other
8 All sites
Average daily 8-h max ozone by geographic cluster

+++ > 43 ppb  - - - < 35 ppb

- When one cluster has low ozone, all clusters do
- 16 days of “low” ozone in 5 intervals
- When one cluster has high ozone, usually all others also do
- 23 days of “high” ozone in 5 intervals
23 day high ozone composite of 8-hr max ozone
16 day low ozone composite of 8-hr max ozone
Histograms of individual station 8-h max ozone

- Low Ozone Days
- High Ozone Days
- Other Ozone Days
TexAQS 2004 wind profiler network
Automated PBL depth detection algorithm

SNR

Vertical velocity

Spectral width

Site: nbf  Year: 06  Day: 237  LT (%)  Beam index: 5
Diurnal variation of PBL depth at each profiler site
Winds, PBL depths, RASS temperatures averaged from 19-22 UTC (13-16 LST) between 0-1200m.

Low ozone days composite

- Ozone good
- Winds good
- PBL too shallow
High ozone days composite

- Ozone good
- Winds too northerly
- PBL too shallow
Low ozone days composite

- Ozone too high (grad ok)
- Winds too easterly
- Temps too warm (2-3 C)
- PBL too deep
High ozone days composite

- Ozone good
- Winds too northerly
- Temps too warm
- PBL too deep (600m!)
Conclusions-observations

• High and low ozone episodes tend to be regional events

• Composite of 23 high ozone days shows uniform high-zone across Texas; 16 low-ozone day composite shows a north-south gradient, with higher ozone to the north

• High ozone days have weak winds from the east; low ozone days strong winds from the south

• PBL depths show large gradient, increasing inland and to west, not much difference between high/low ozone days

• Surprisingly small differences in solar radiation between high/low ozone days
Conclusions-models

• WRF-Chem and NMM-CMAQ generally replicate the observed meteorology

• Problems:
  – Winds: NMM too easterly, WRF too northerly; NMM does not fully simulate weak winds on high ozone days, strong winds on low ozone days
  
  – PBL: NMM-CMAQ too deep, WRF too shallow
  
  – Temp: NMM too warm
  
  – Solar radiation: both models over-predict, especially on high ozone days
Boundary layer depth estimations. Site: "hve".