

Charlotte-Rock Hill-Gastonia MSA Summertime Ozone Formation



Photos from 2001 Mecklenburg County State of the Environment Report

Arizona's Valley of the Sun "Brown Cloud"



Phoenix photo from <http://phoenix.about.com/library/weekly/uc051601a.htm>, accessed Mar 2004

- **Observed since early 1990's; contains C Particles and NO₂ (brown) gas**
- **From burning fossil fuels: cars, construction equipment, power plants, lawn mowers, leaf blowers contribute to this brown cloud**
- **Weather also a key factor**

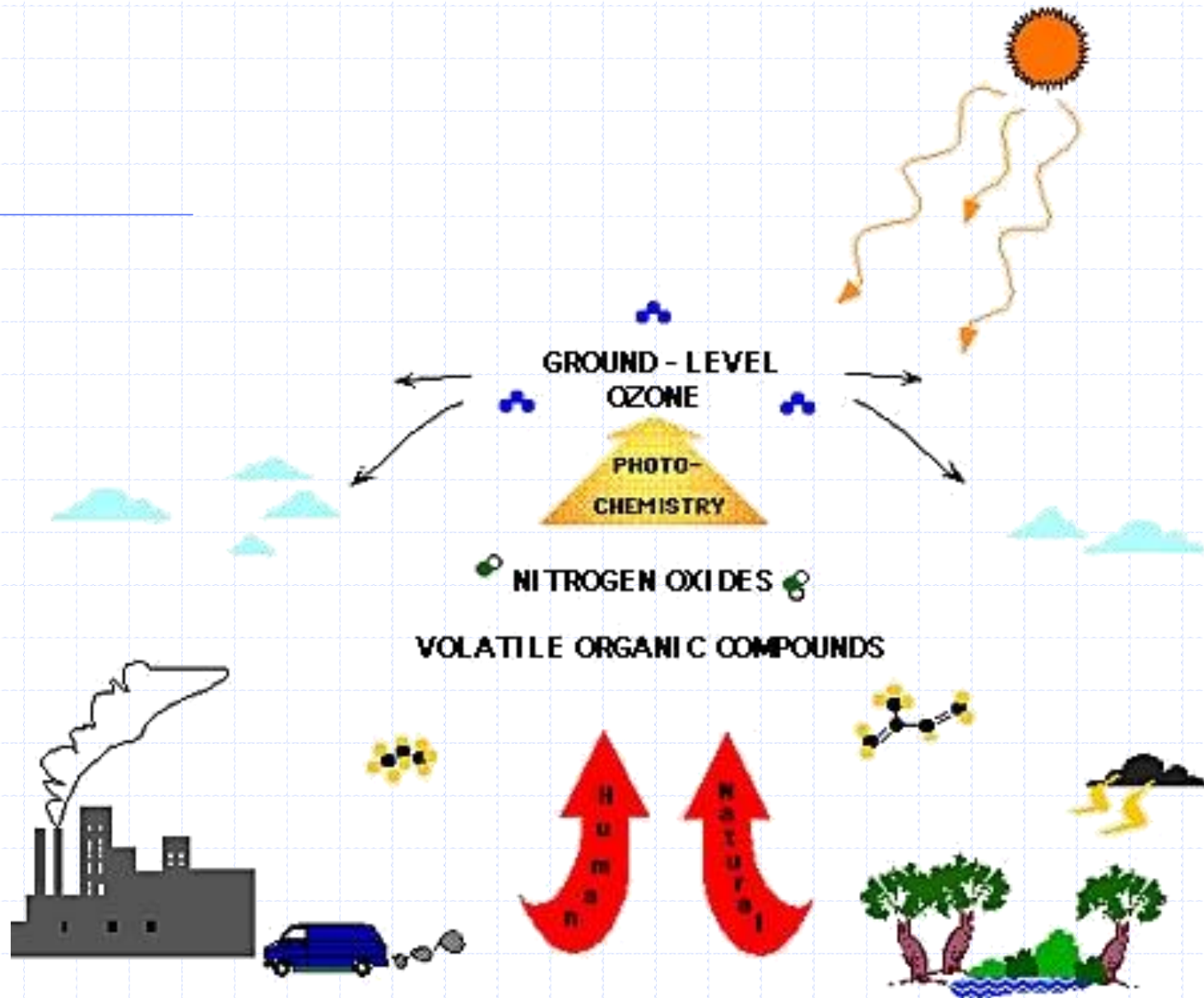
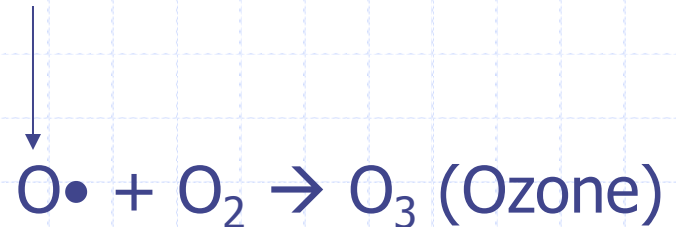


Image take from <http://www.al.noaa.gov/WWWH/D/Doc/TropoRural.html>, accessed Mar 2004

Presence of NO₂ (brown gas) results in inevitable formation of ozone



- ***Control measures to effectively address ground-level ozone must focus on minimizing NO₂ formation***

Ozone precursors

Nitrogen Oxides

- Dry Air is 78% Nitrogen (N_2), 21% Oxygen (O_2)
- Heating air to high temperatures forms NO (motor vehicles, fossil-fuel power plants, lightning)
- NO is an ozone precursor and also reacts directly with ozone to destroy it

Volatile Organic Compounds (VOC's)

- VOC's continuously emitted by fuel spills, motor vehicles, trees, air fresheners, paints, and countless other sources
- OH hydroxyl radical is the atmosphere's "natural detergent" that cleans VOC's from the air by initiating the process that converts them into carbon dioxide and water₅

Volatile Organic Compound (VOC) Removal

Air's natural VOC cleanser produced from ozone and water



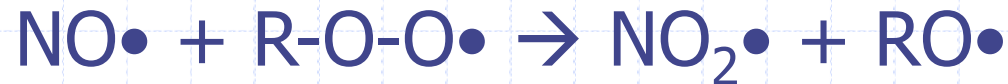
- OH• works by transforming stable VOC molecules (R-H) into reactive radicals (R•)



- Reactive organic radicals immediately combine with oxygen to form peroxide radicals



Formation of Nitrogen Dioxide



Formation of NO_2 (and O_3) driven primarily by:

- Concentration of VOC's (near emission sources)
- Concentration of $\text{NO}\bullet$ (rural & downwind areas)
- Concentrations of both $\text{NO}\bullet$ and VOC's

******Summertime ozone pollution results from an overload in our air of $\text{NO}\bullet$, VOC's, or both***

NO and VOC Effects on Ozone Production

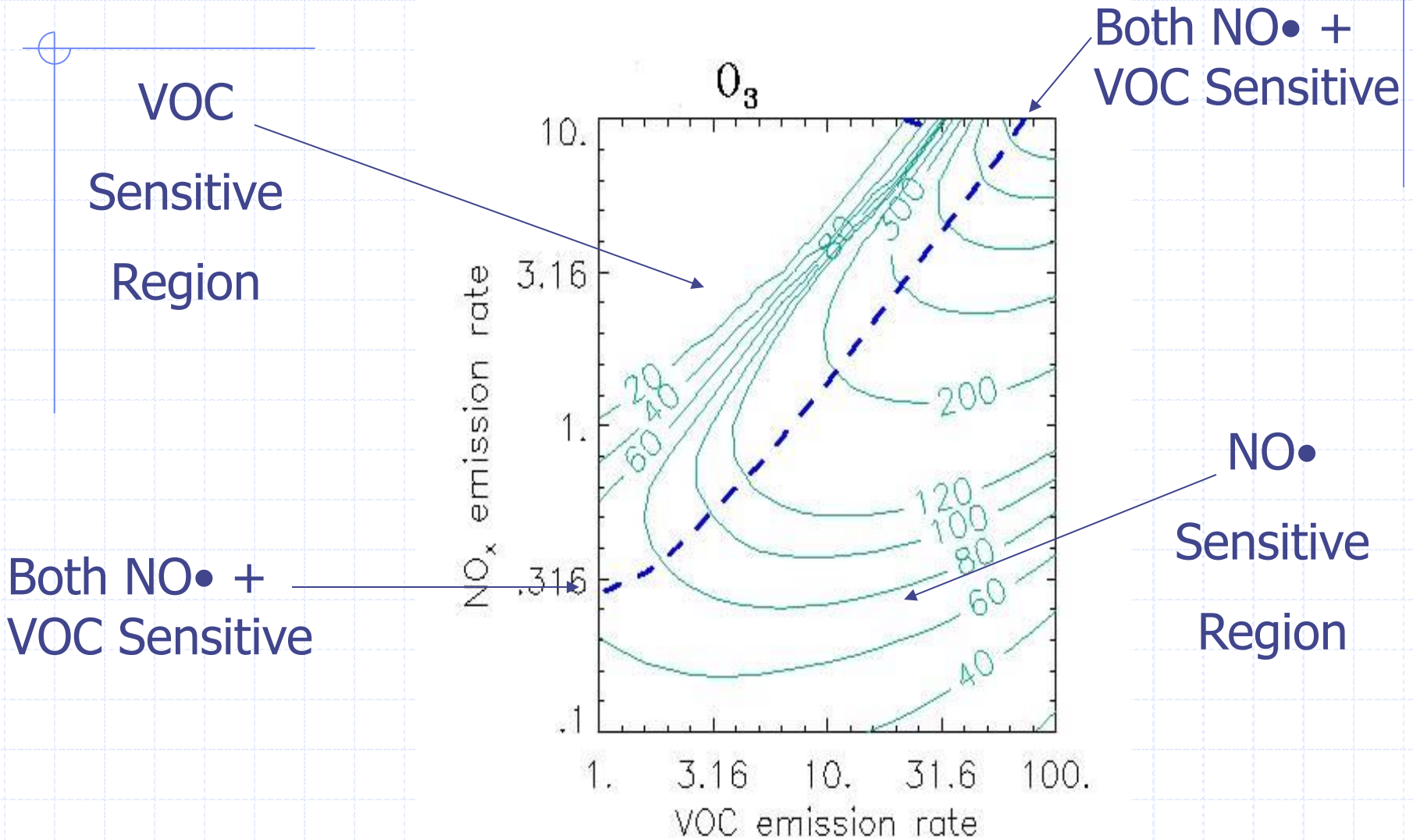
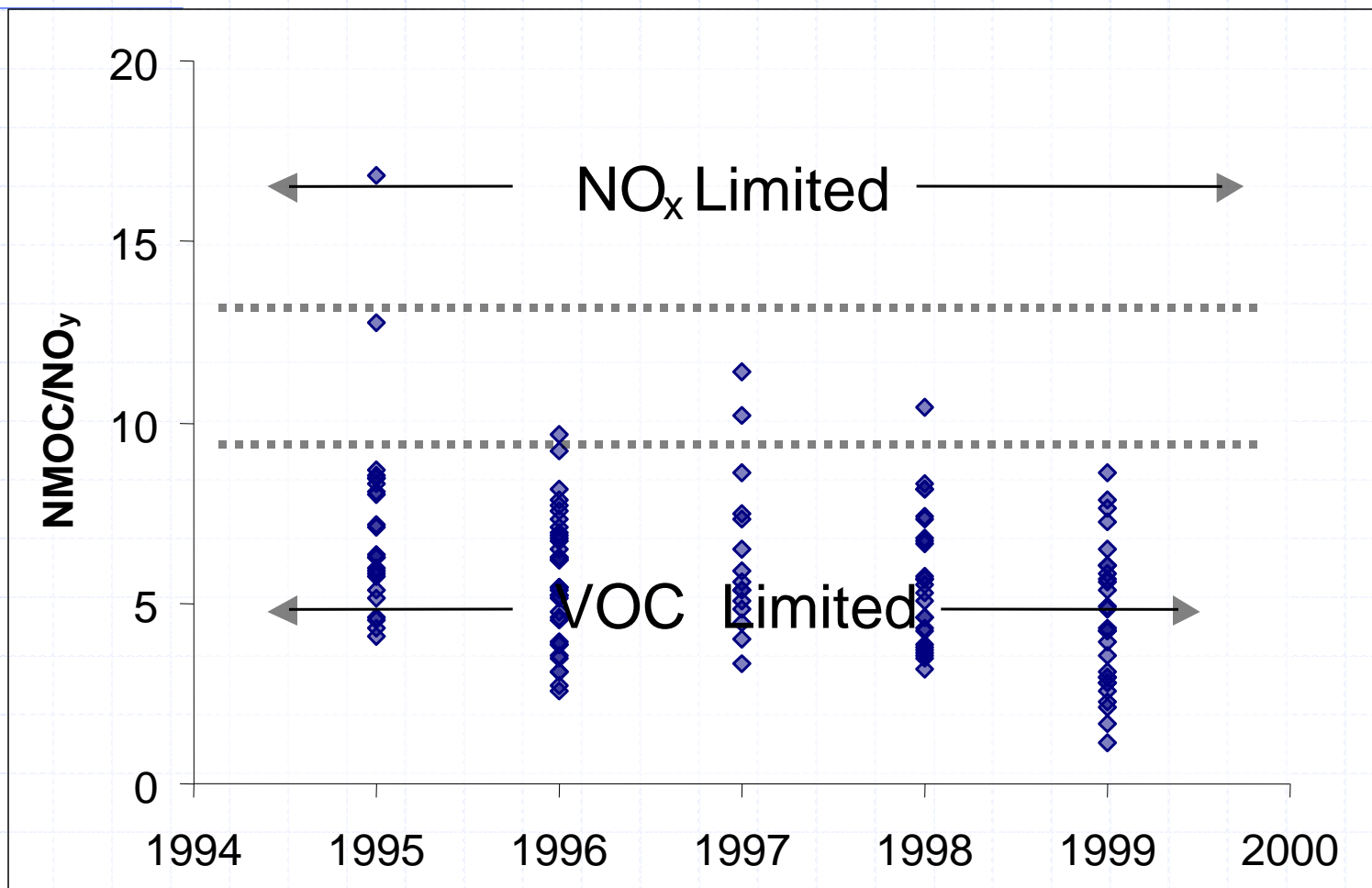


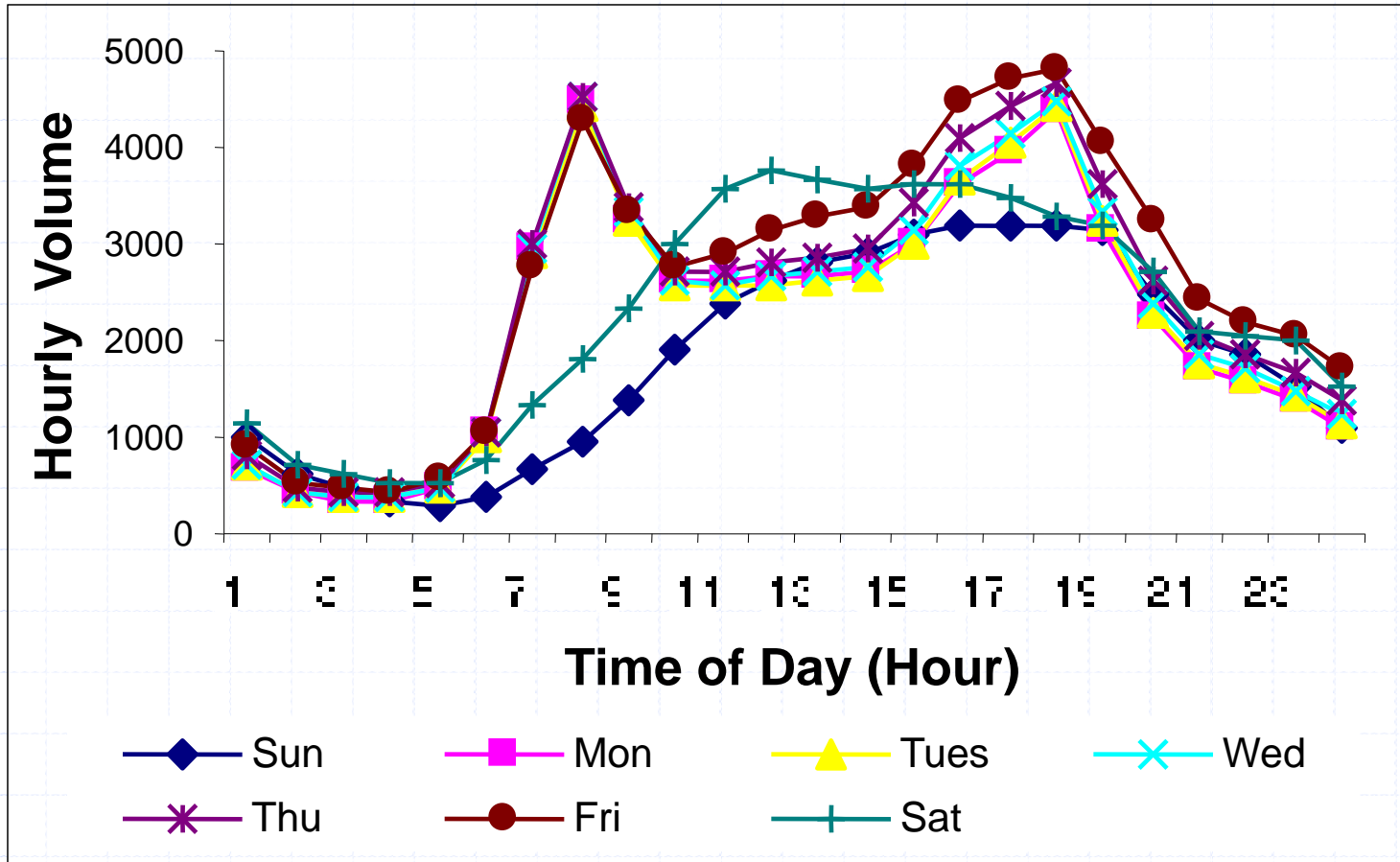
Figure from : <http://www-personal.engin.umich.edu/~sillman/ozone.htm>, accessed Mar 2004

'95-'99 AM NMOC/NO_y Ratios for the Plaza Monitoring Site



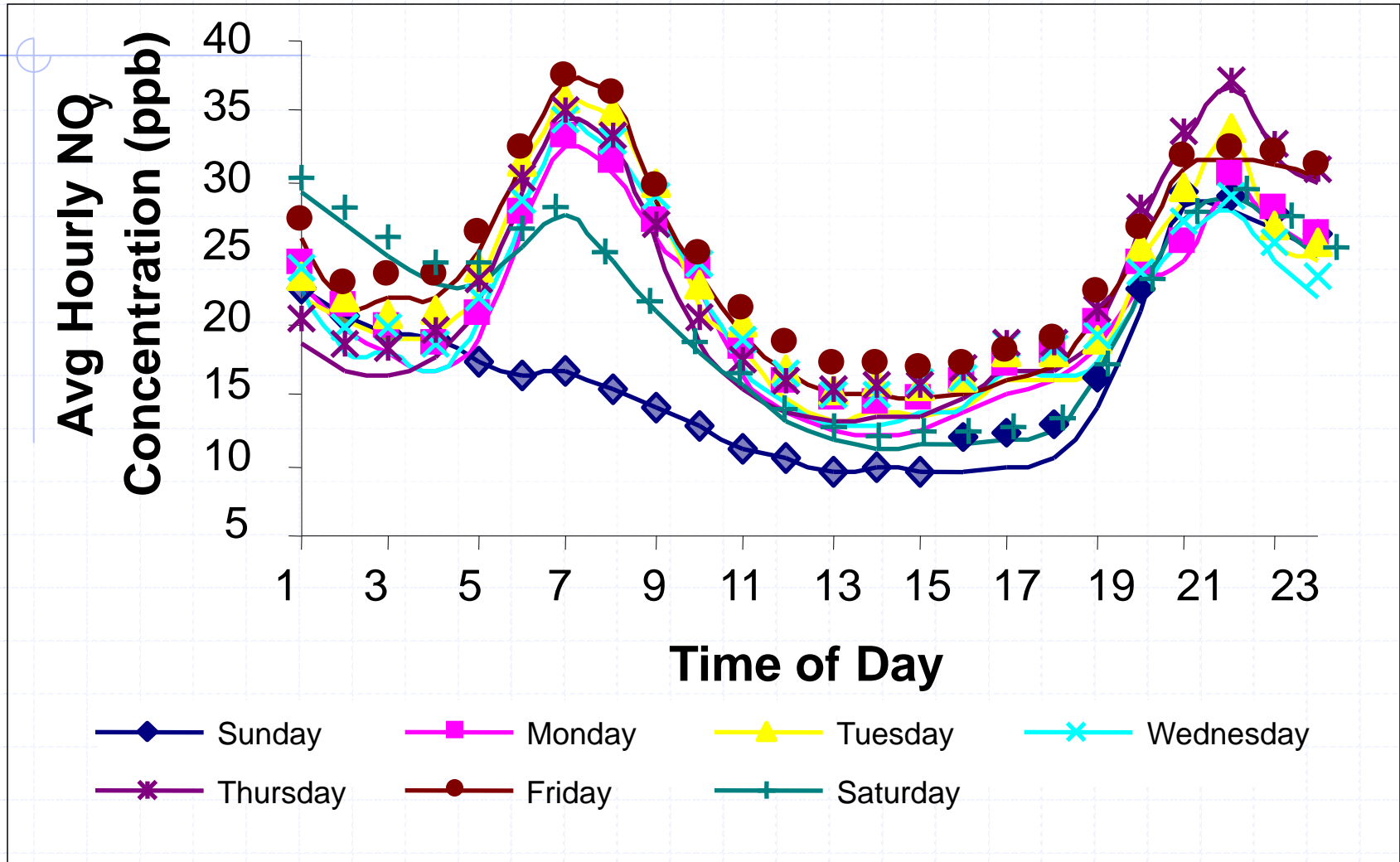
From Perry, JL and Owens, PM, "Weekday/Weekend Variability and Long-Term Trends in Traffic, CO, NO_y and Ozone for the Charlotte Metropolitan Area during the 1990's, AWMA, June 2001

I-77 Traffic Volume vs. Time of Day



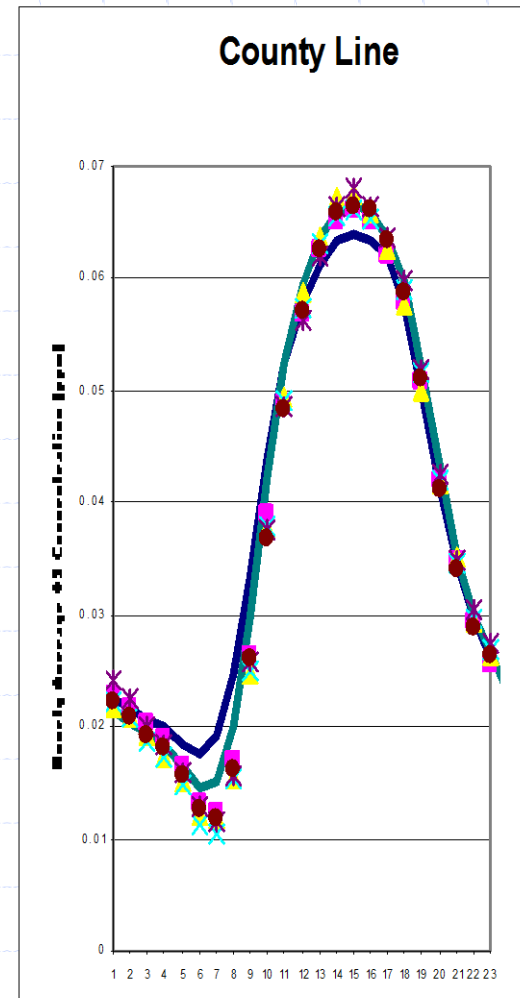
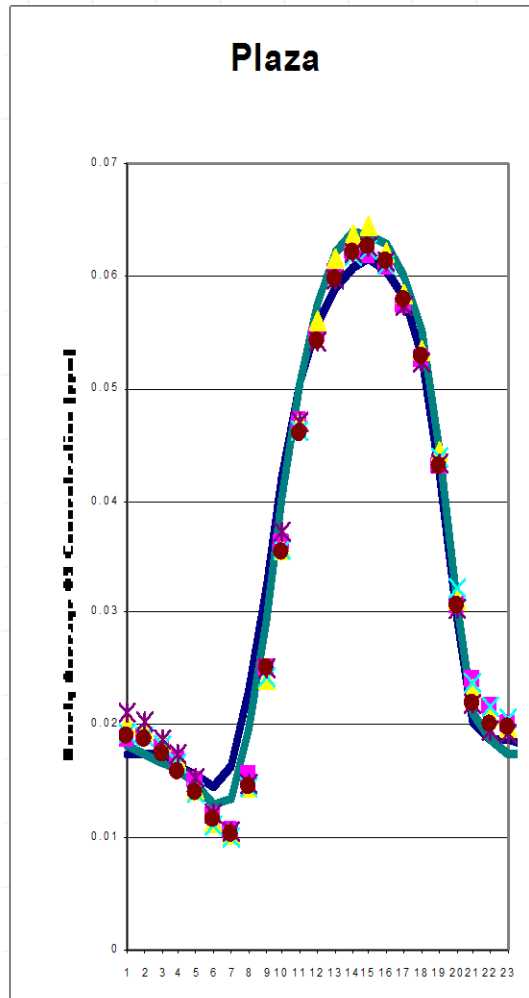
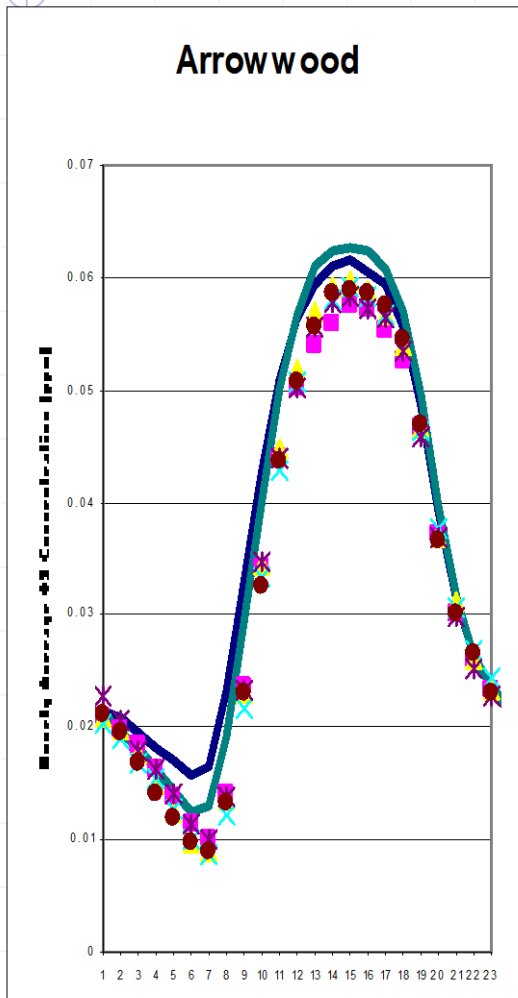
From Perry and Owens, AWMA, 2001

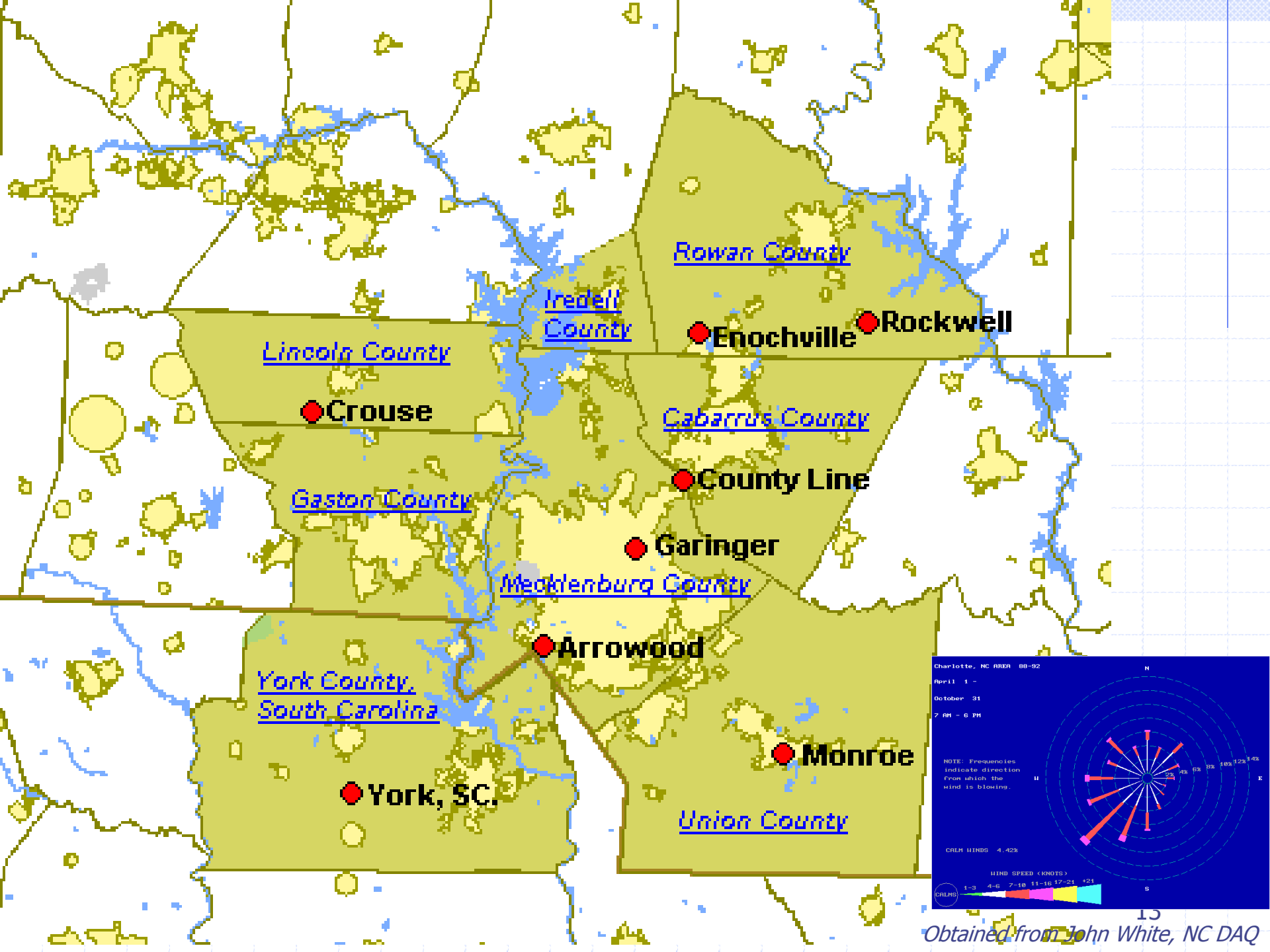
May-Sep '95-'98 Plaza Average Hourly NO_y

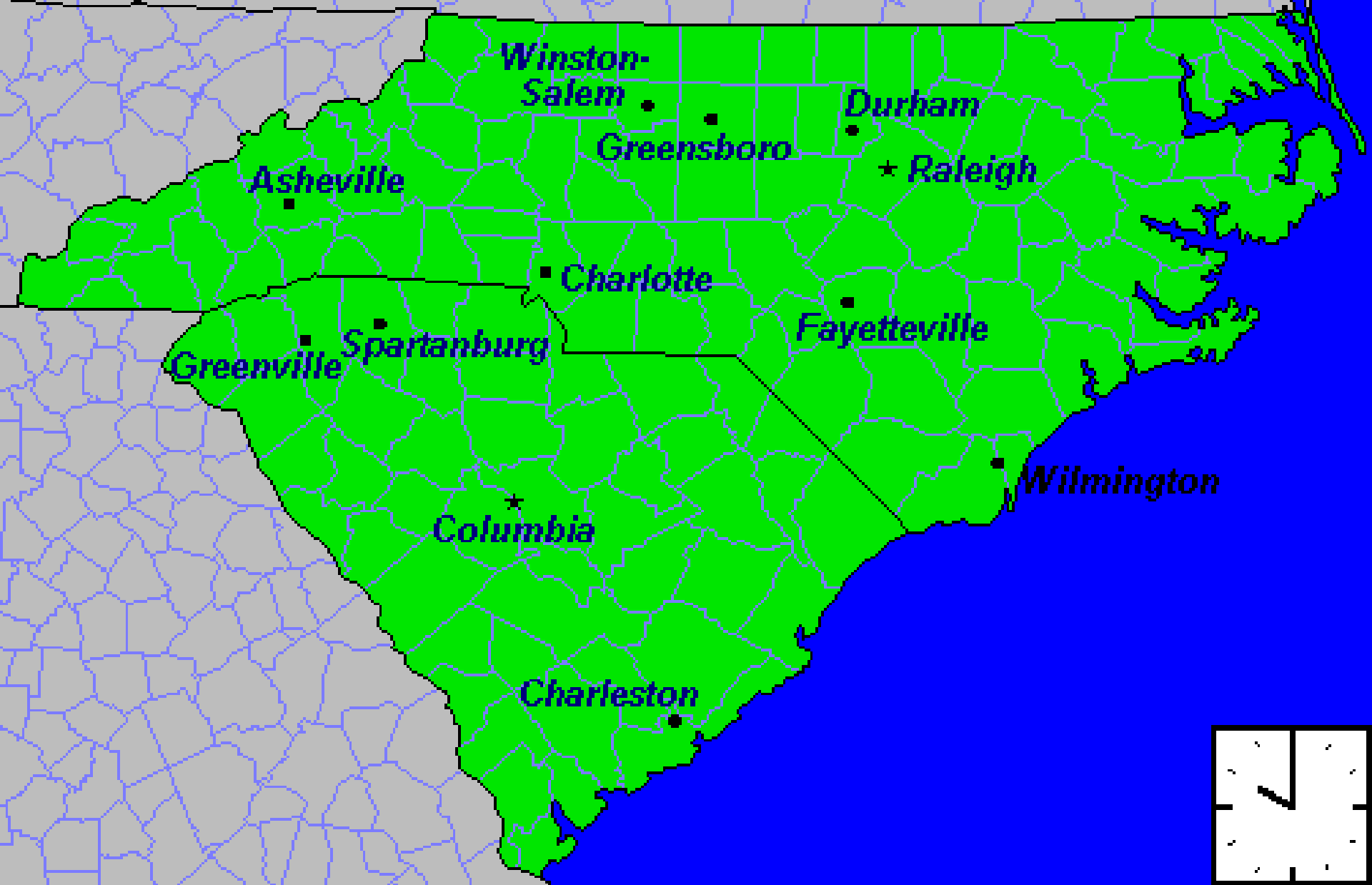


From Perry and Owens, AWMA, 2001

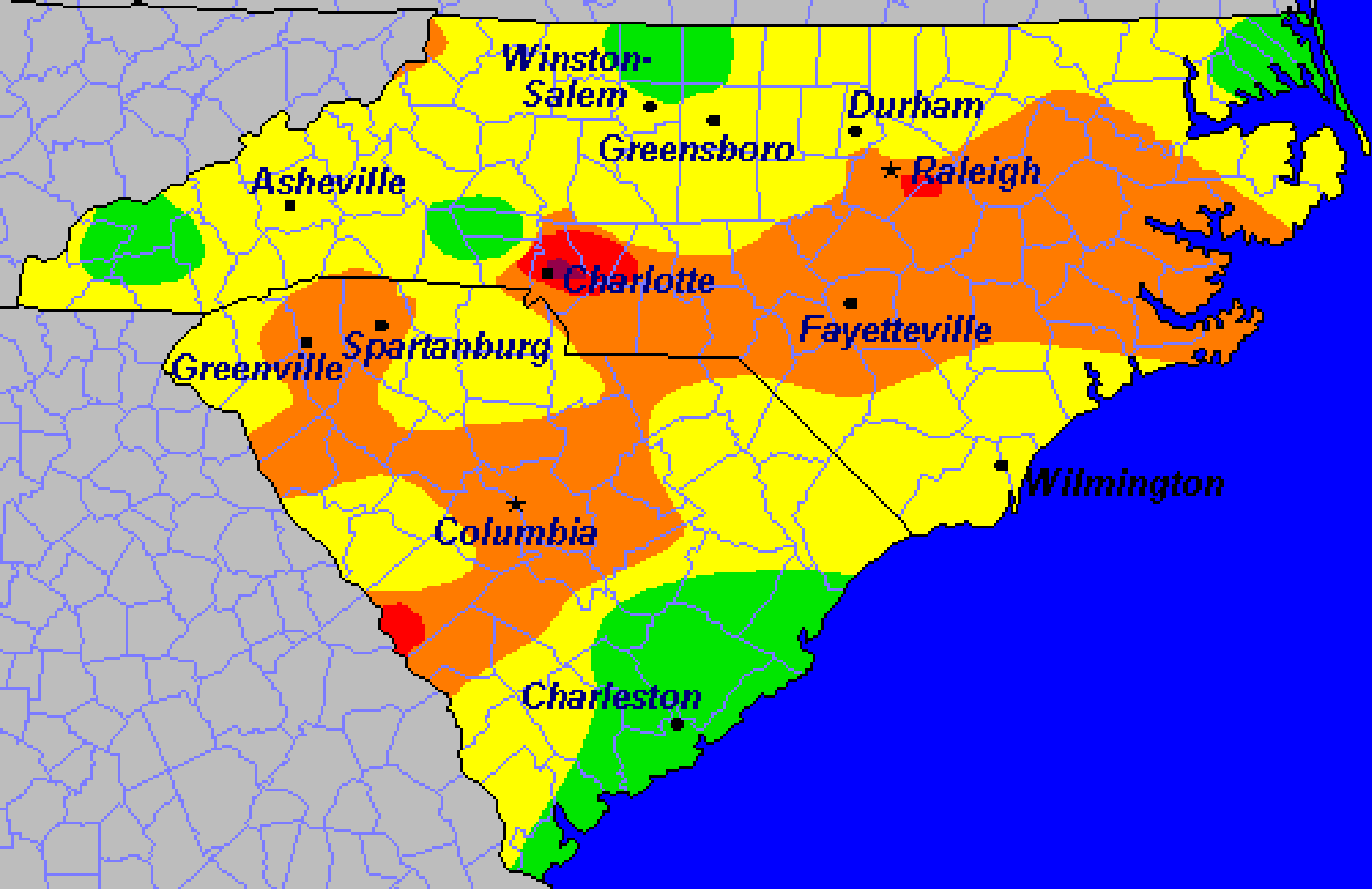
1990-1998 May-Sep Diurnal Charlotte Ozone Averages By Day of Week (*weekend days-lines, weekdays-markers*)







10 am June 1, 2000 EDT



June 1, 2000