City-Level Variations in NOx Emissions Derived from Hourly Monitoring Data in Chicago

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Recent STL AQS Trends

St. Louis Area Monitoring Agencies Meeting

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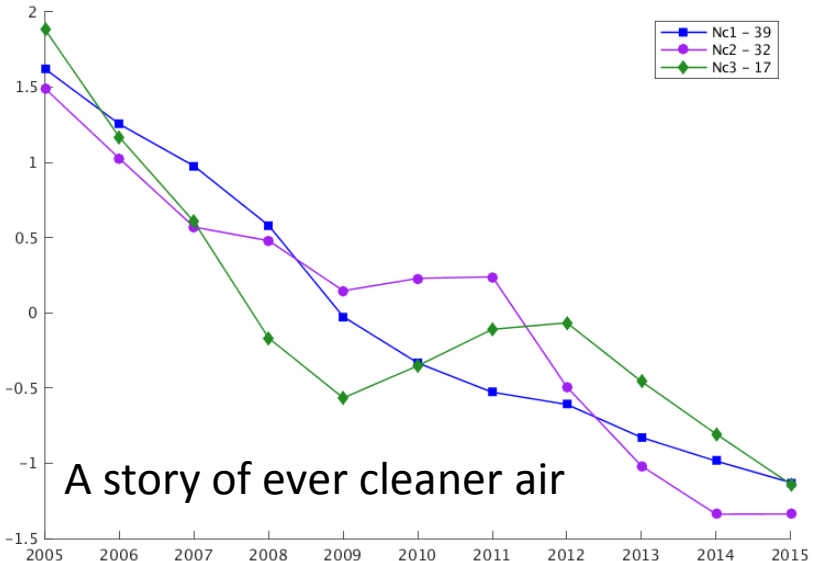
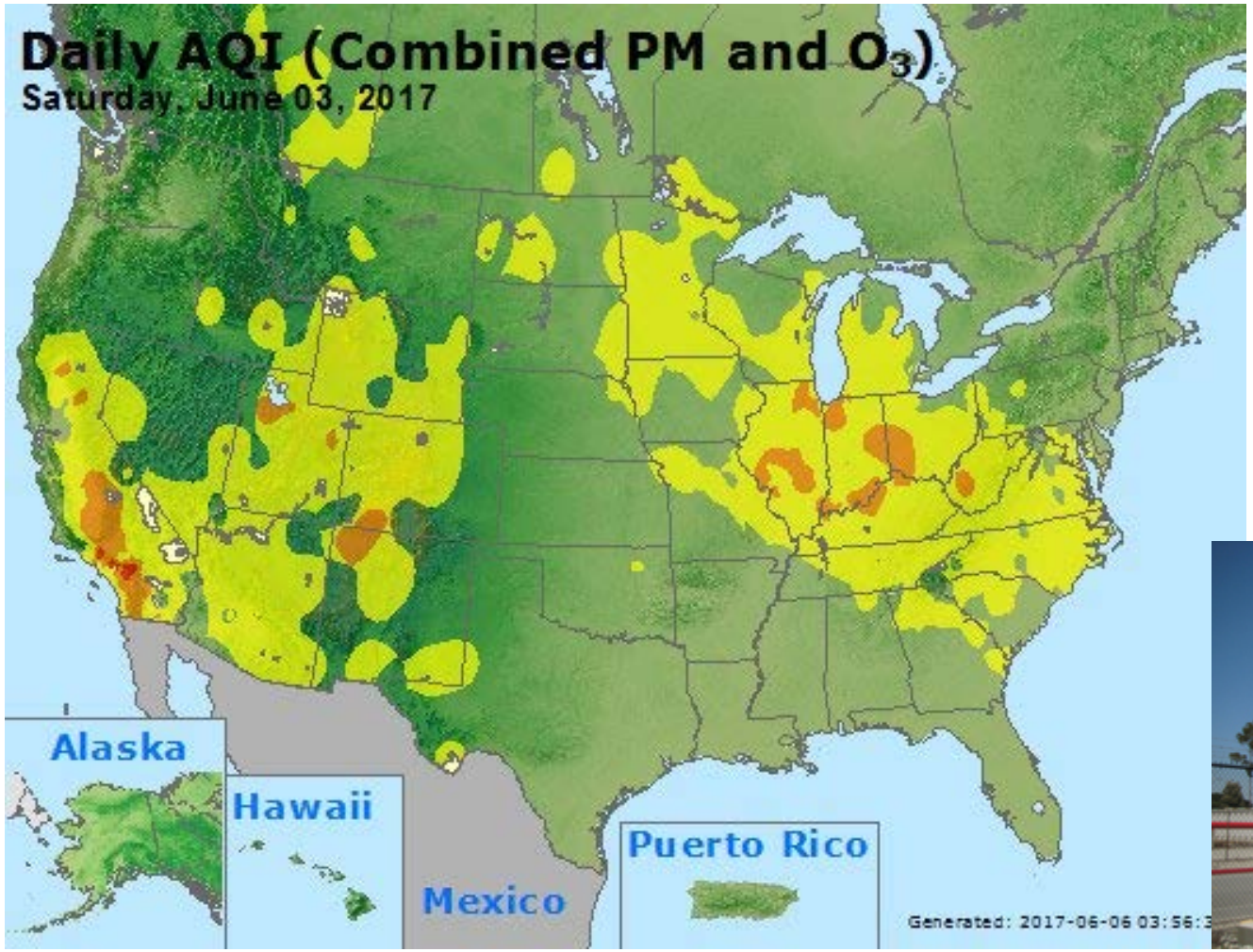
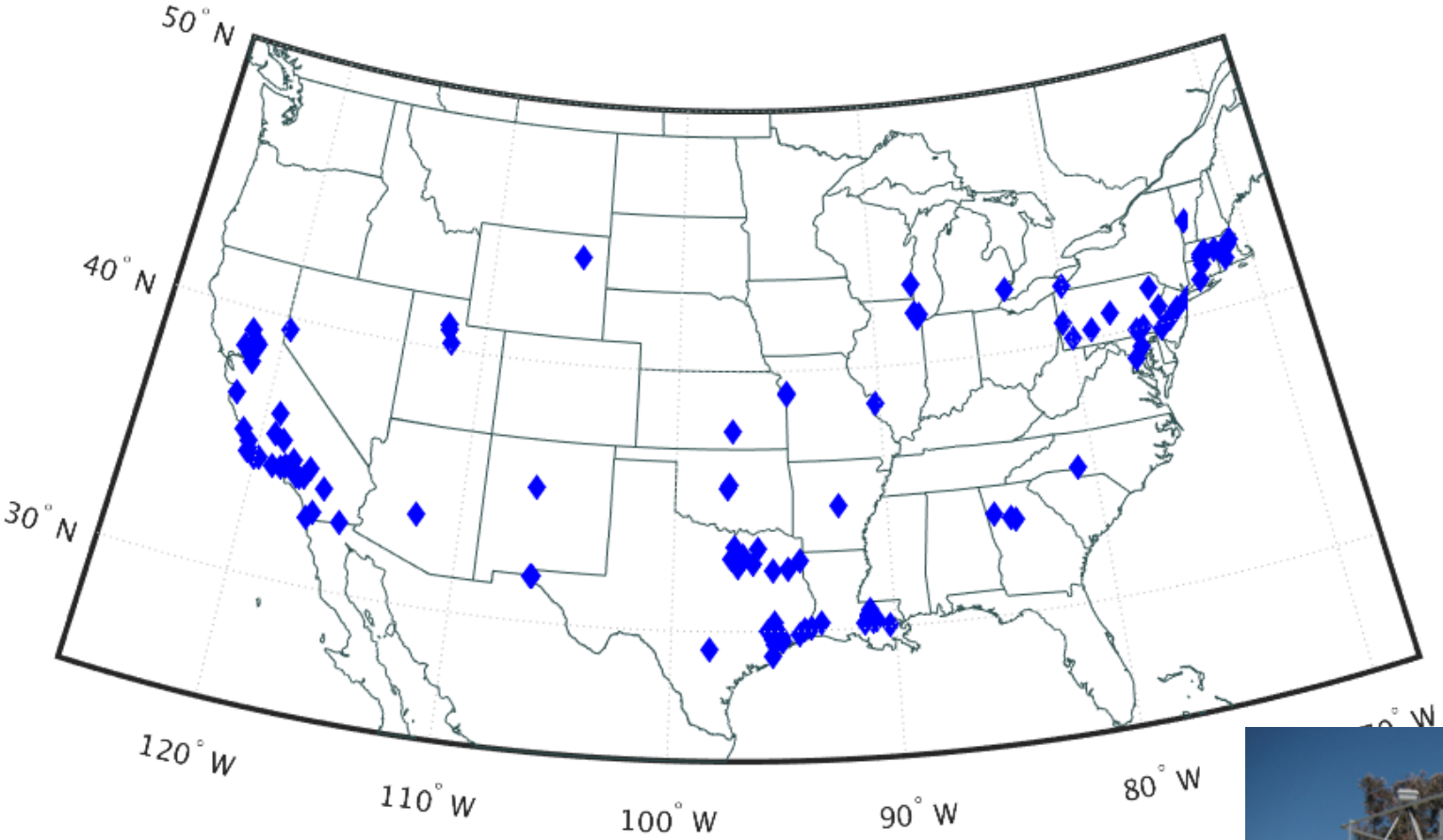


Hourly Air Quality Monitoring at Hundreds of Stations



US-EPA AQS Data Analysis of Hourly NO_x Concentrations



Sites with 90% data for 2005-2015

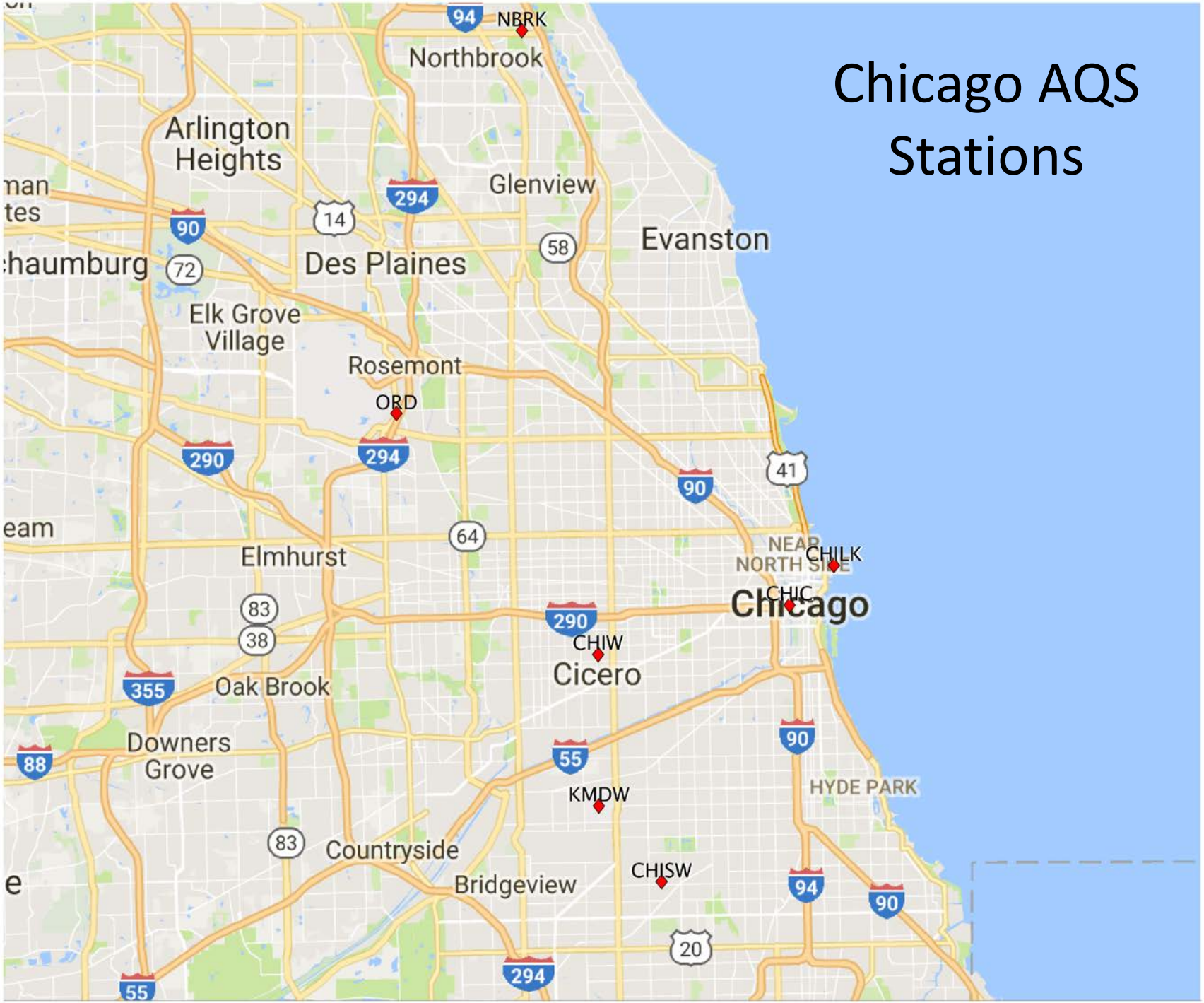
US-EPA AQS Data Analysis: Hourly NO_x Concentrations 2005-2015, 90% data completeness

Factors Contributing to NO_x Surface Concentrations:

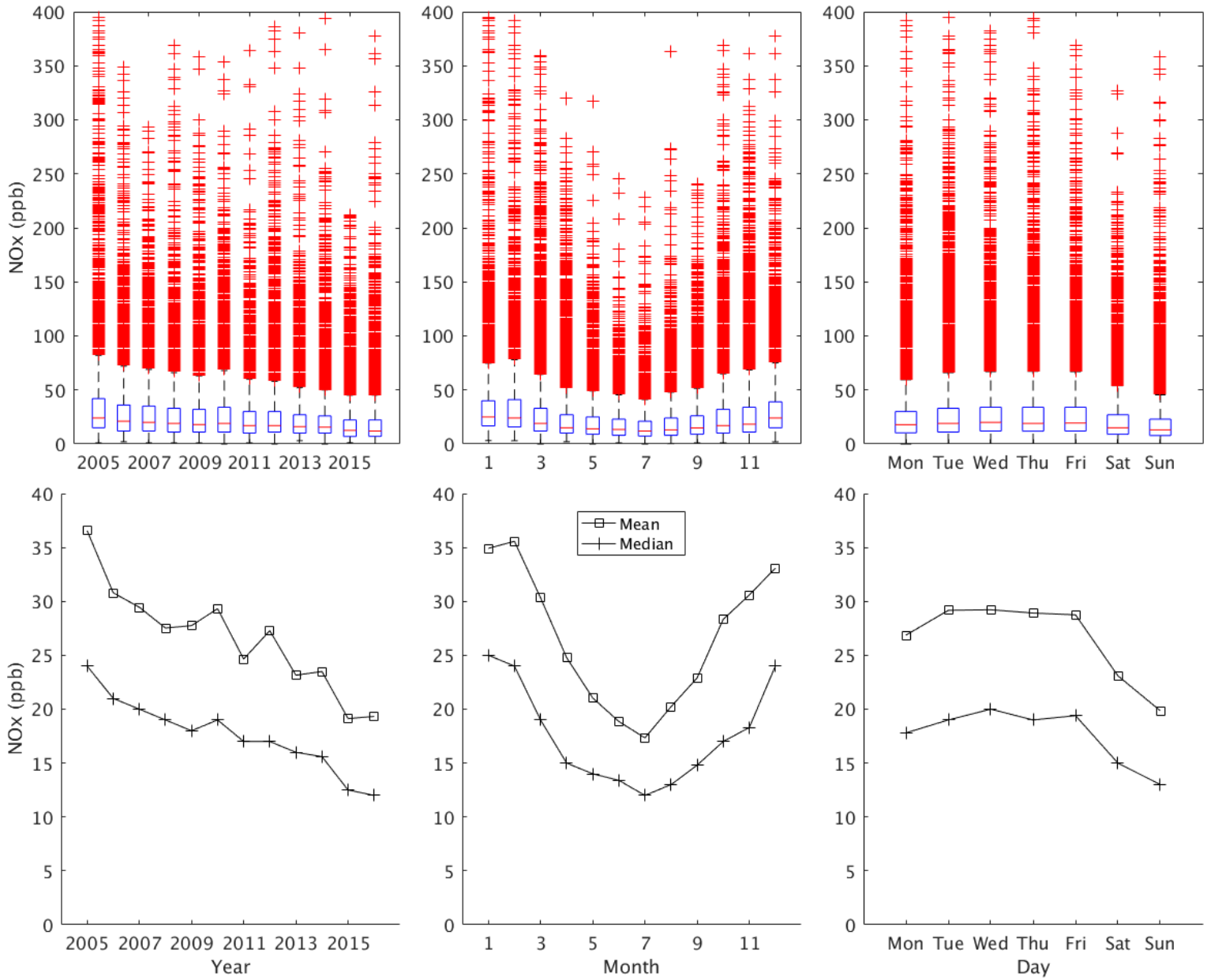
- **Emissions:** diurnal, weekly, seasonal, long-term signals
- **Transport:** wind speed and direction, boundary layer height
- **Chemistry:** NO_x lifetime: rough proxies: ozone, ultraviolet radiation, temperature, humidity

de Foy, B., 2017. City-level variations in NOx emissions derived from hourly monitoring data in Chicago. Atmospheric Environment.

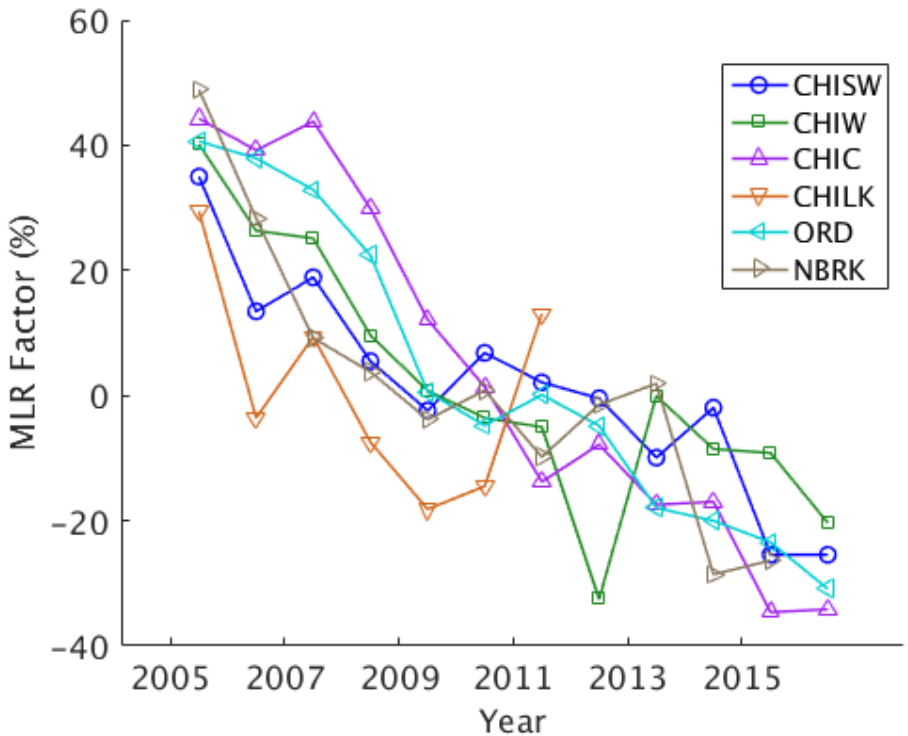
Chicago AQS Stations

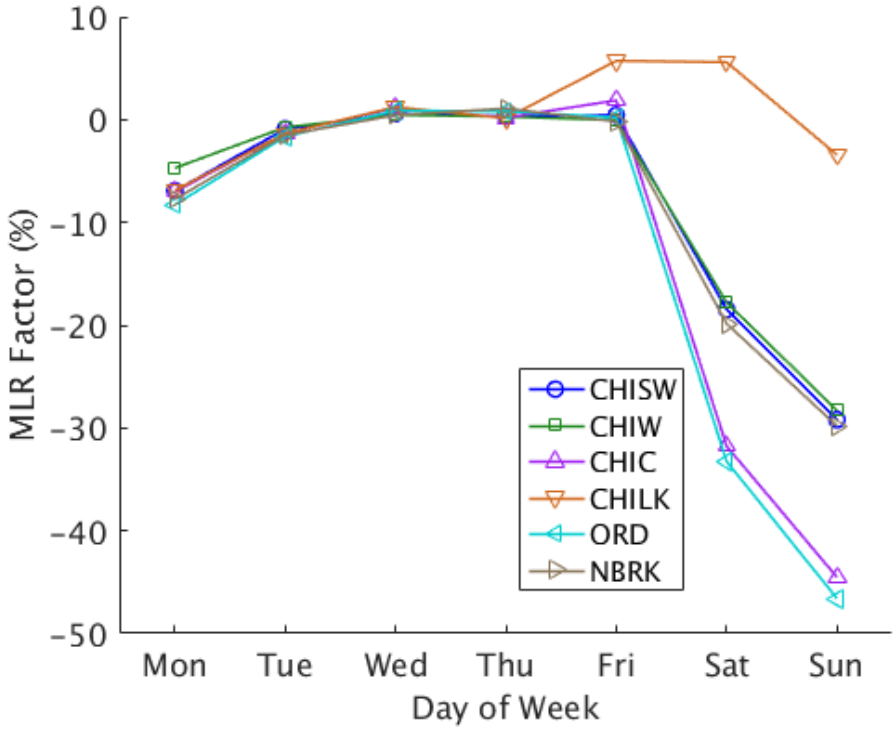


Temporal Variations in Southwest Chicago: Downward Annual Trend, Seasonal Pattern, Weekend Effect

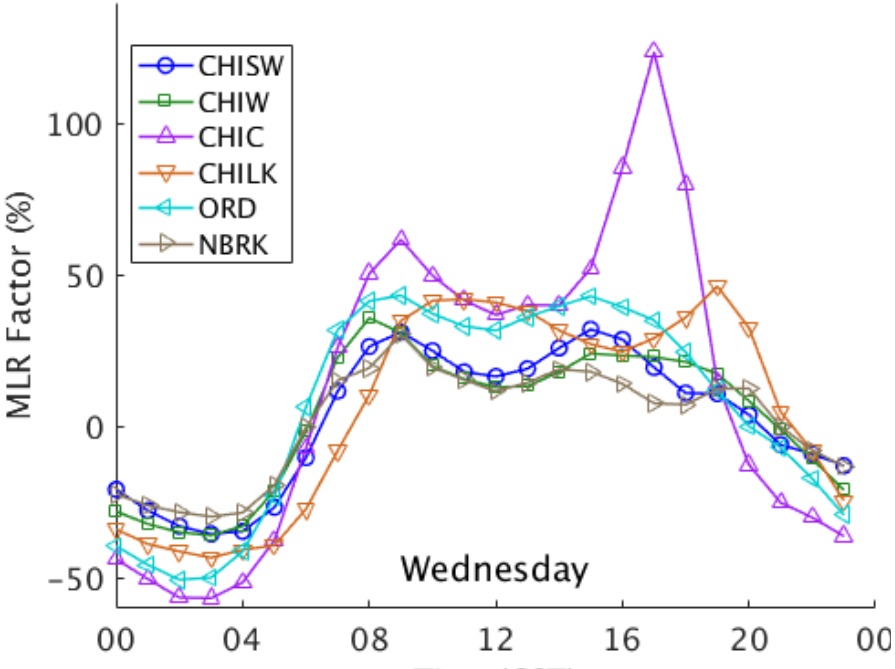


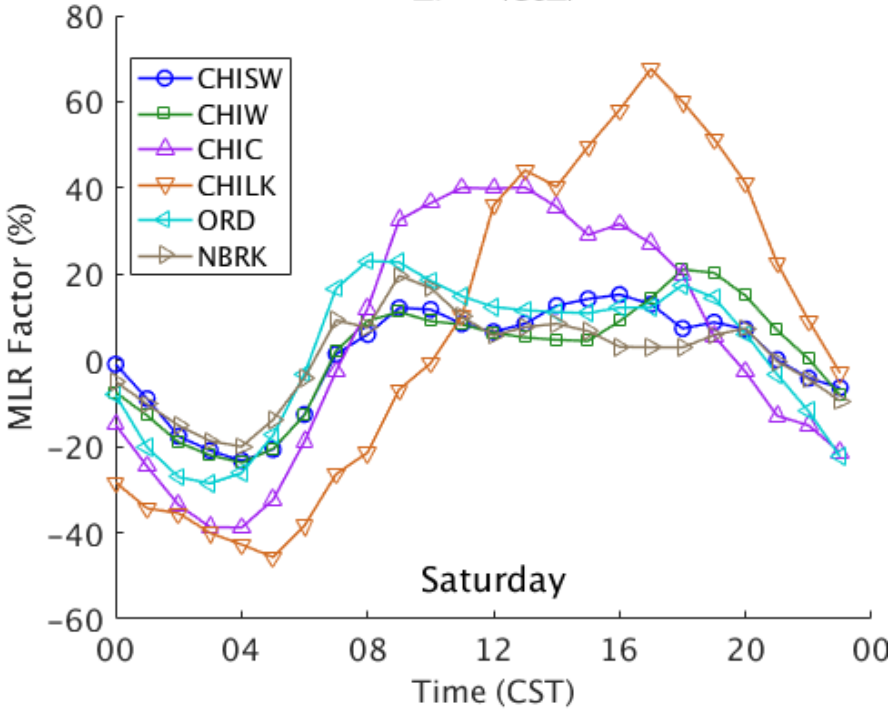
Chicago NOx Regression:
NOx Reductions Everywhere, Weekend Effect Varies with Location

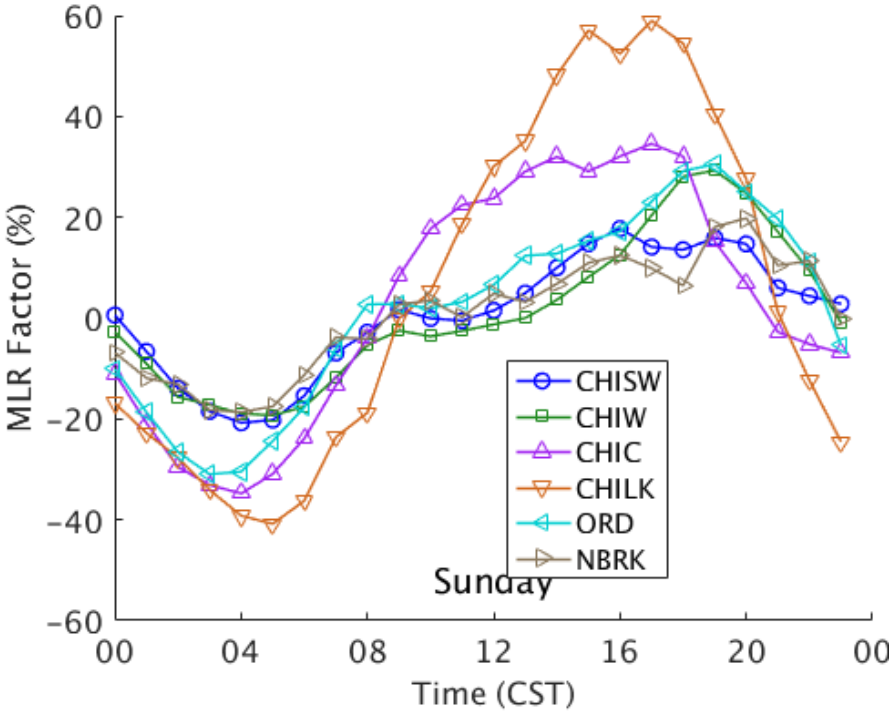




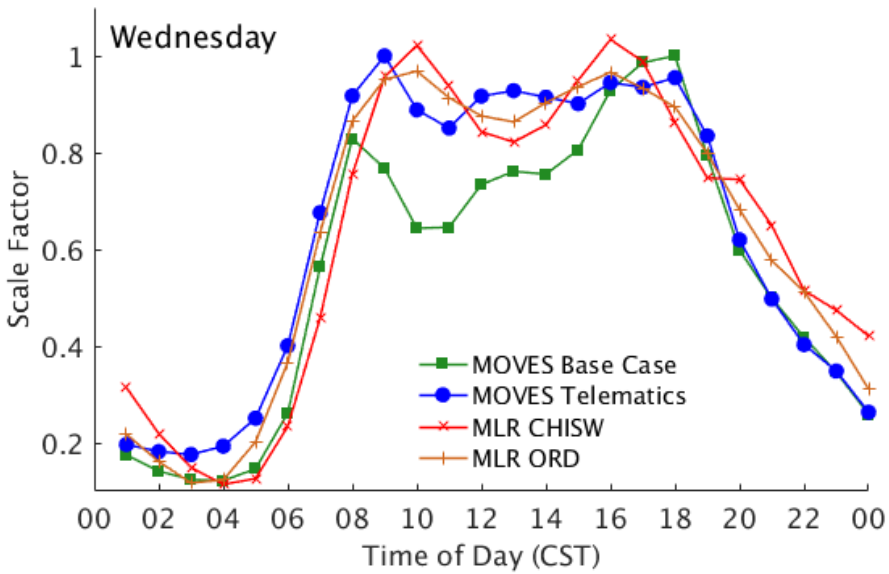
Diurnal Profiles of NOx Scaling Factors Vary by Location and by Weekday

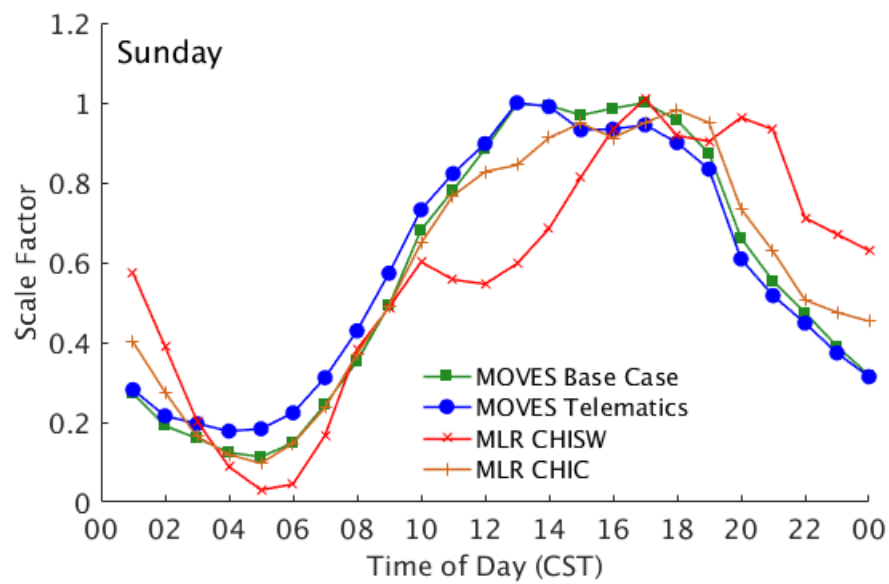






Using both Vehicle Counts and Vehicle Speeds Yields Better Agreement Between NOx Emissions Inventory and Monitoring Data





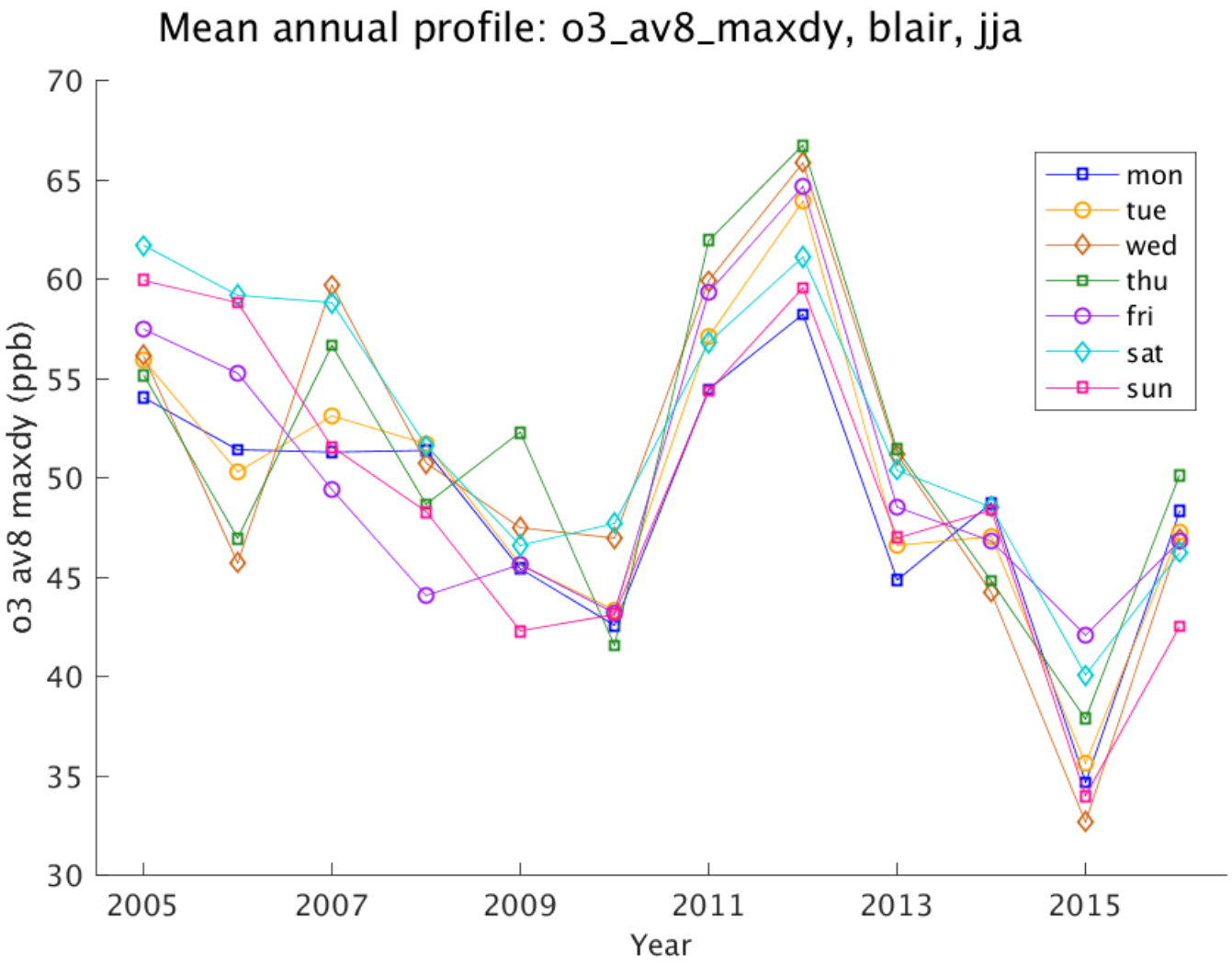
Site Specific Differences Remain, eg. Southwest Chicago (CHISW) and Central Chicago (CHIC)

MOVES Profiles from: Eastern Research Group, Inc, February, 2017. Improvement of Default Inputs for MOVES and SMOKE-MOVES. Tech. Rep. A-100. Coordinating Research Council.

St. Louis AQS Trends and Temporal Profiles

- Ozone Trends and Diurnal Profiles
- PM10 at Branch Street
- PM2.5 at Blair Street and Forest Park

Ozone MDA8 at Blair Street: Downward Trend, but Subject to Weather Patterns



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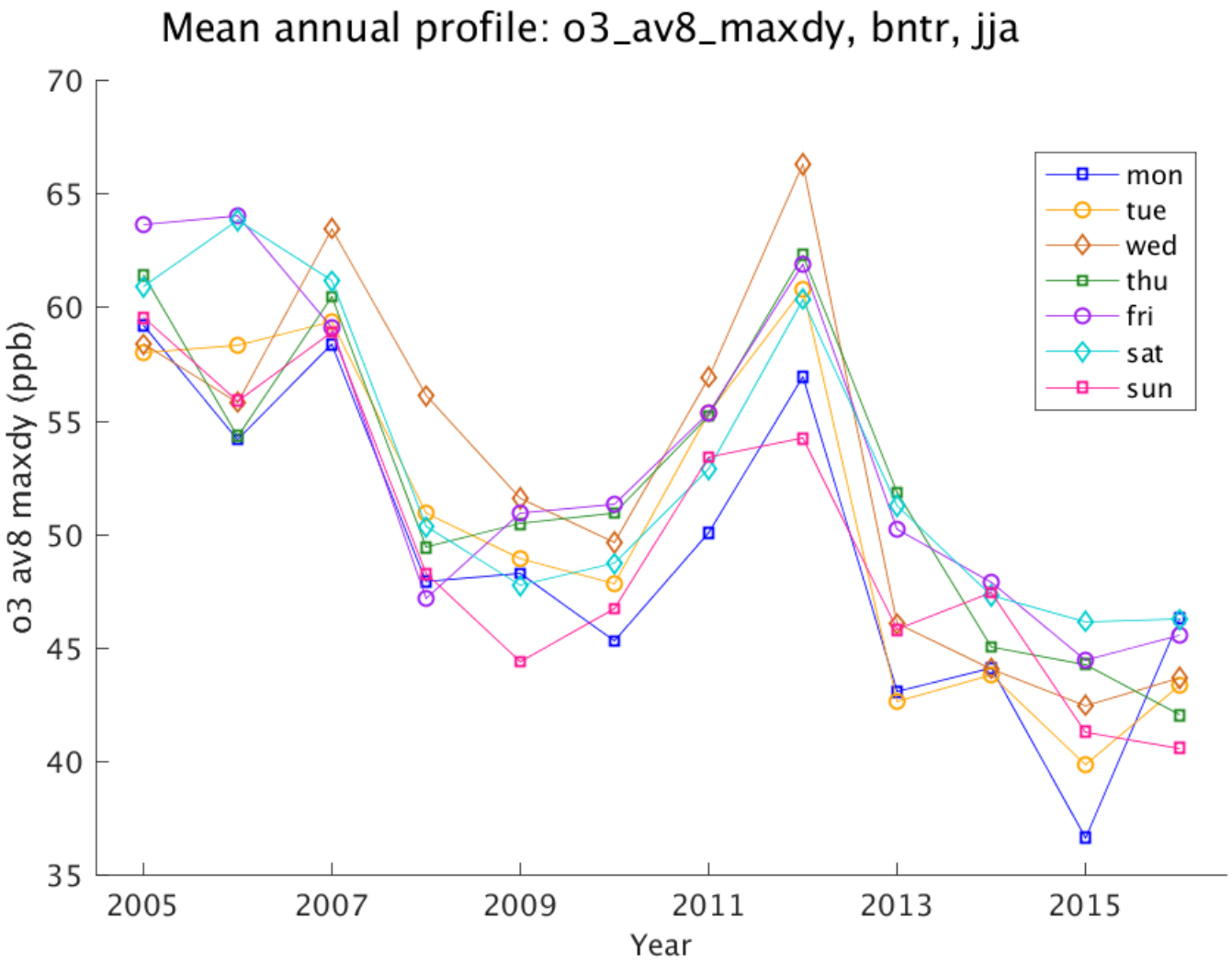
cf_boxplot_weekdays.m:cfbp_blair_o3_av8_maxdy_z0_annual_byweekday_mn060708

O3 MDA8 at Bonneterre: Similar to Blair Street – Regional Air Mass?



Benjamin de Foy, 22-May-2018

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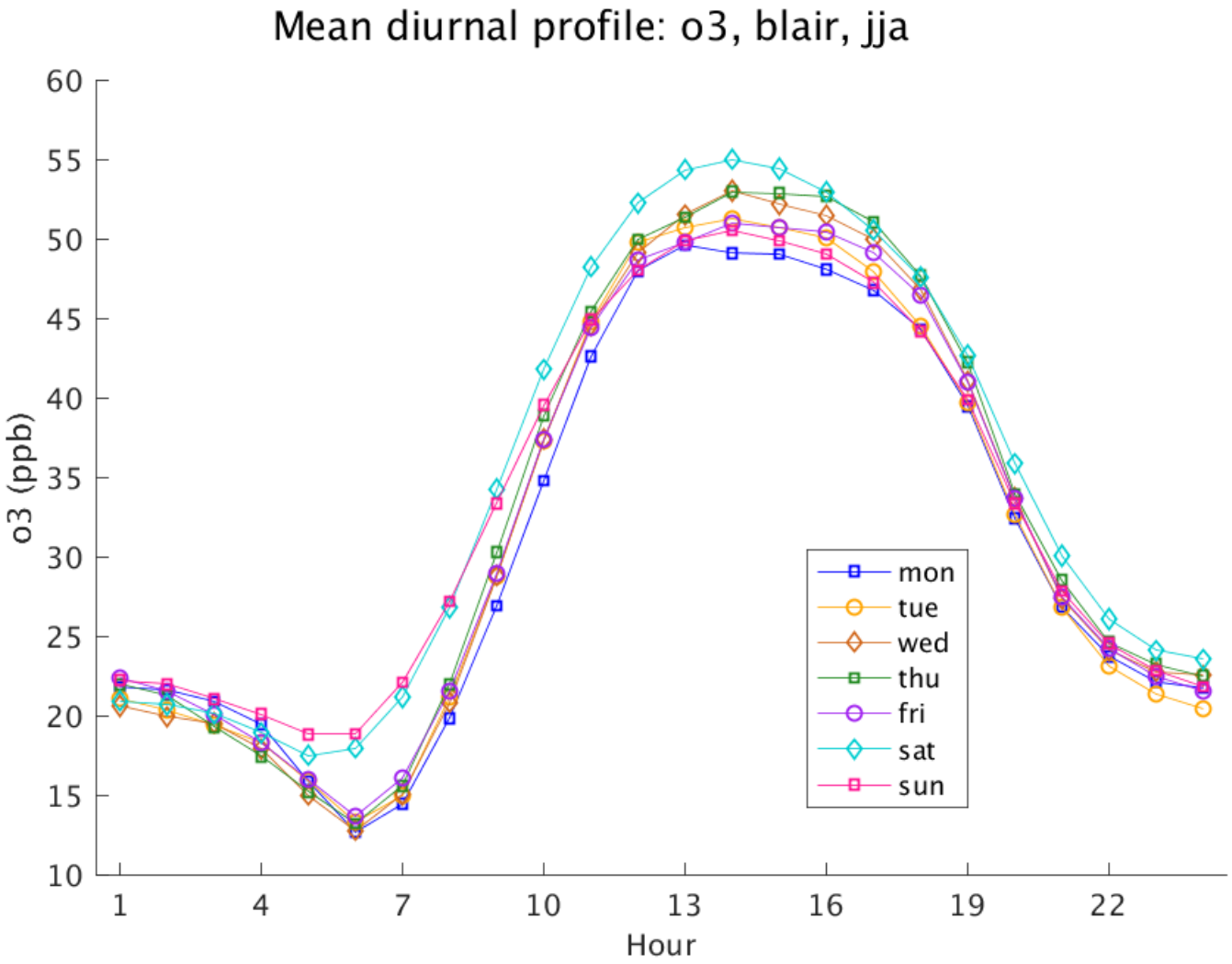
Summer Ozone MDA8 at Blair Street: Max on Saturdays, Min on Sundays and Mondays



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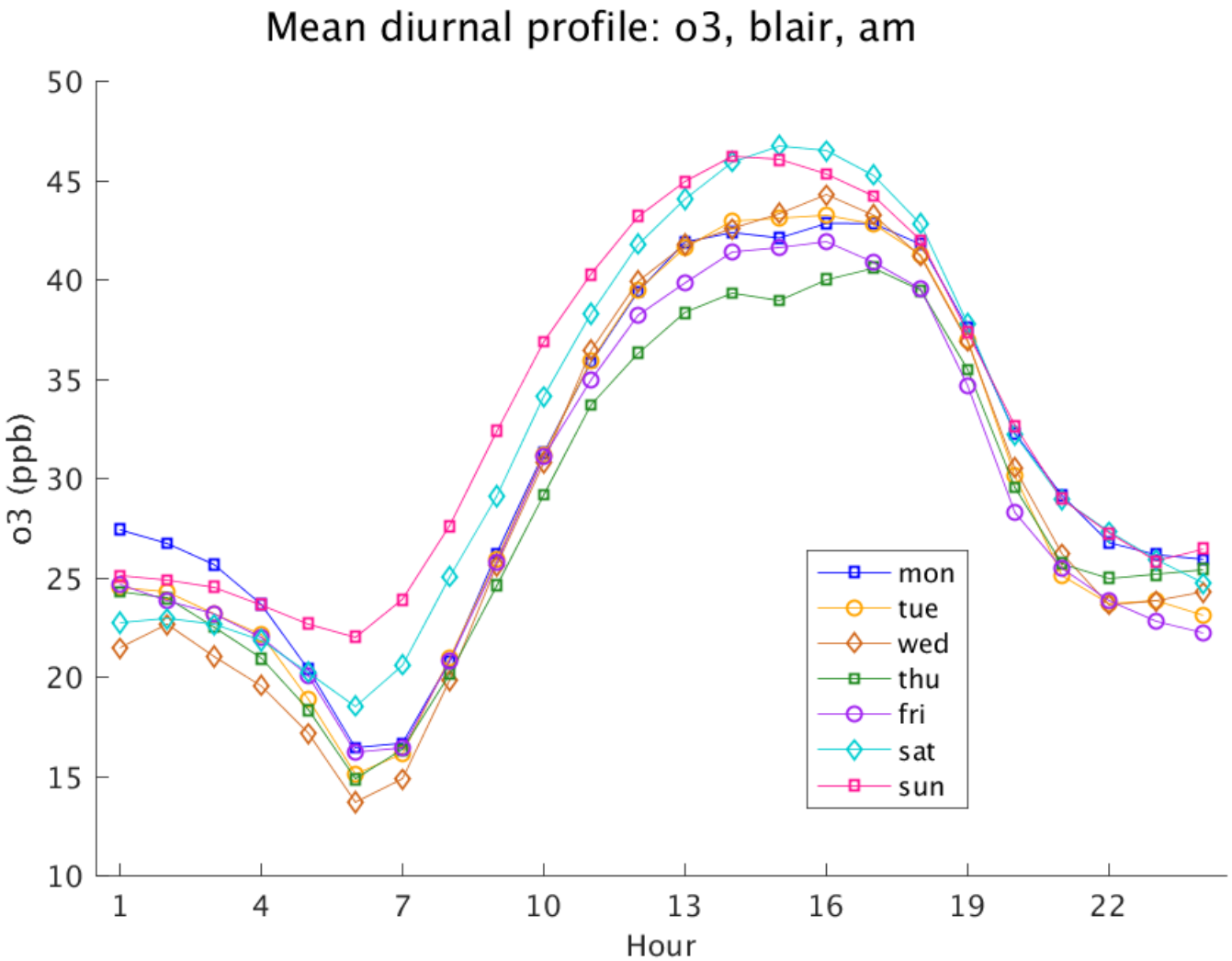
Spring Ozone MDA8 at Blair Street: Max on Saturdays and Sundays



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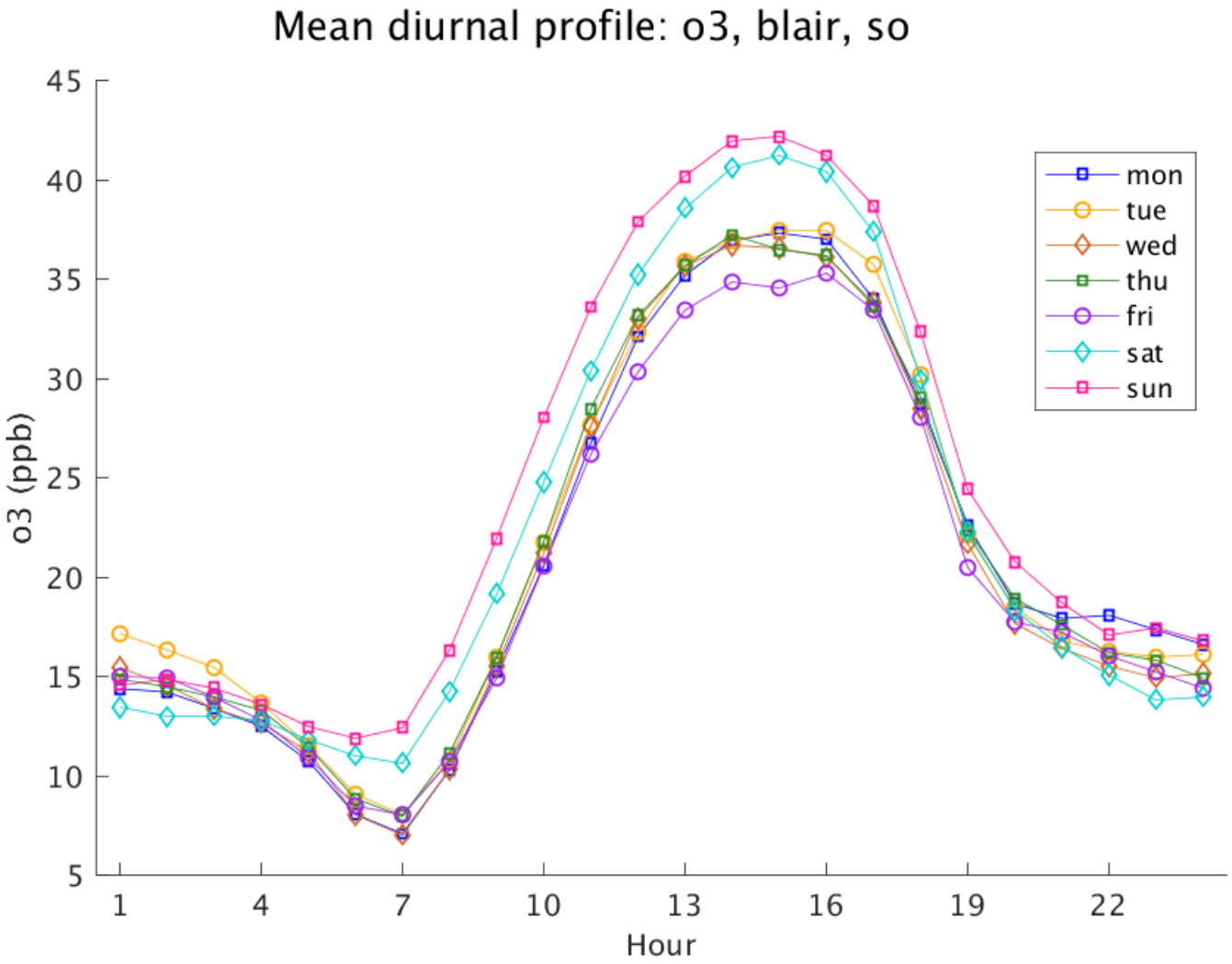
Fall Ozone MDA8 at Blair Street: Max on Sundays, Min on Fridays



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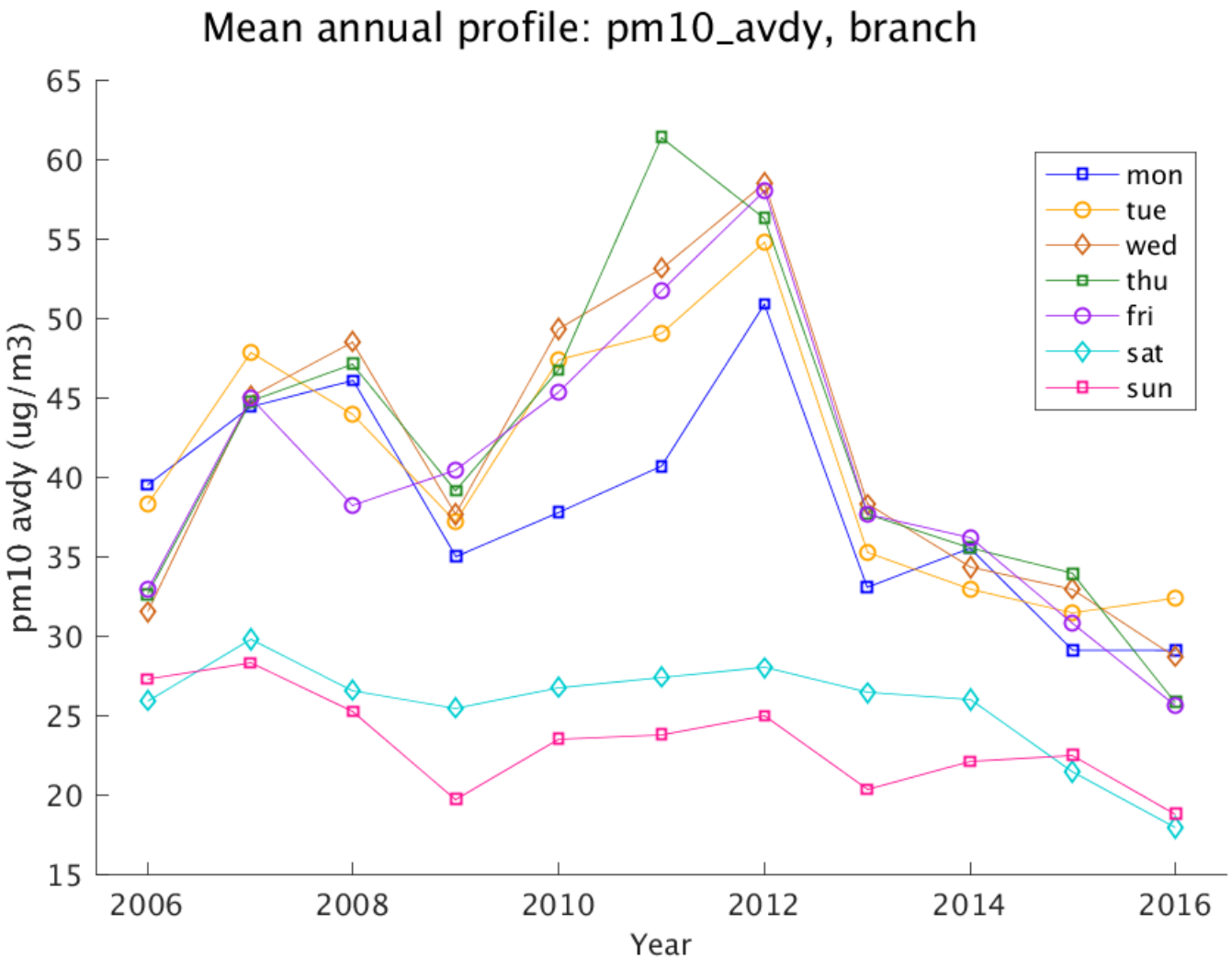
PM10 at Branch Street: Weekday Activity, Downward Trend



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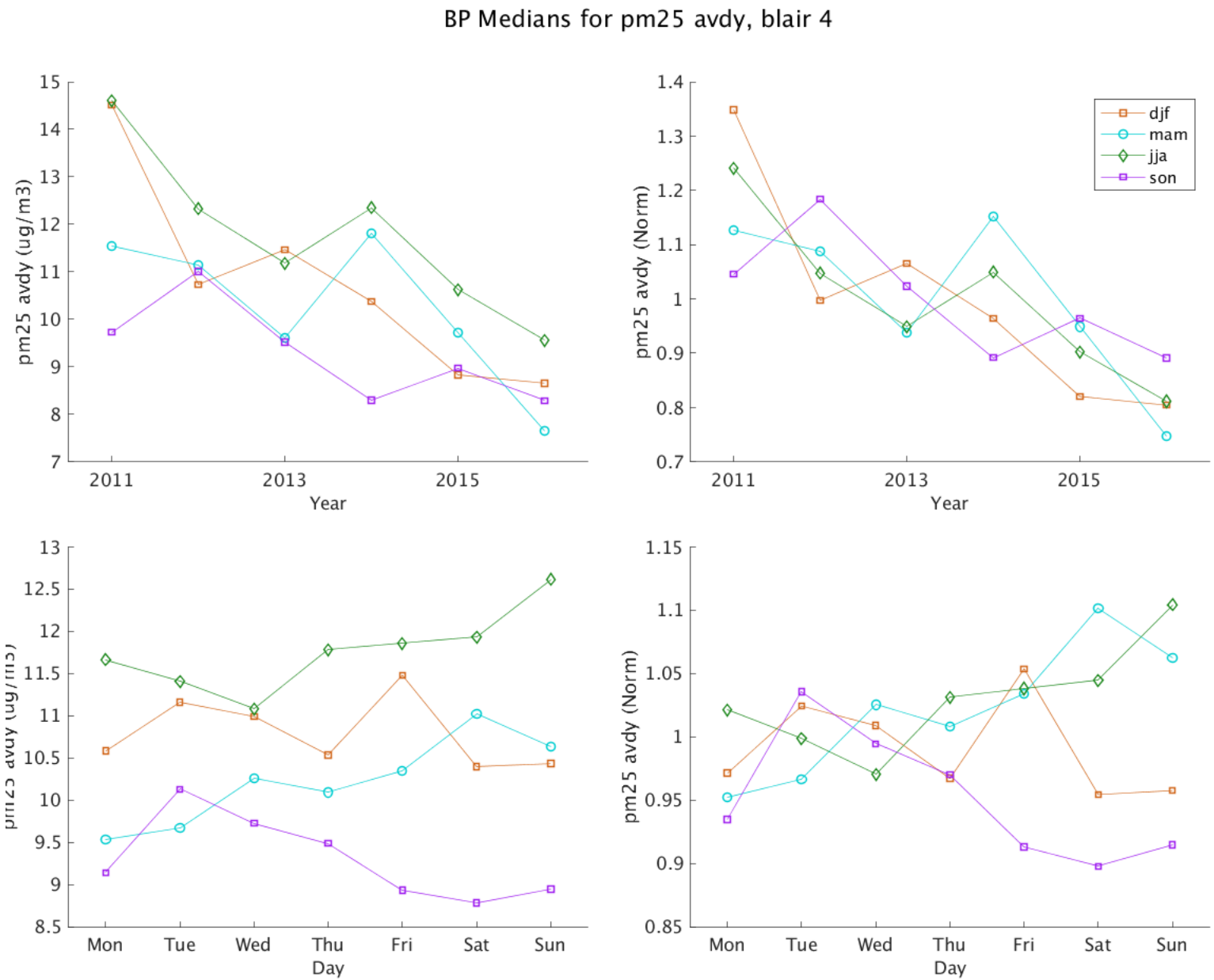
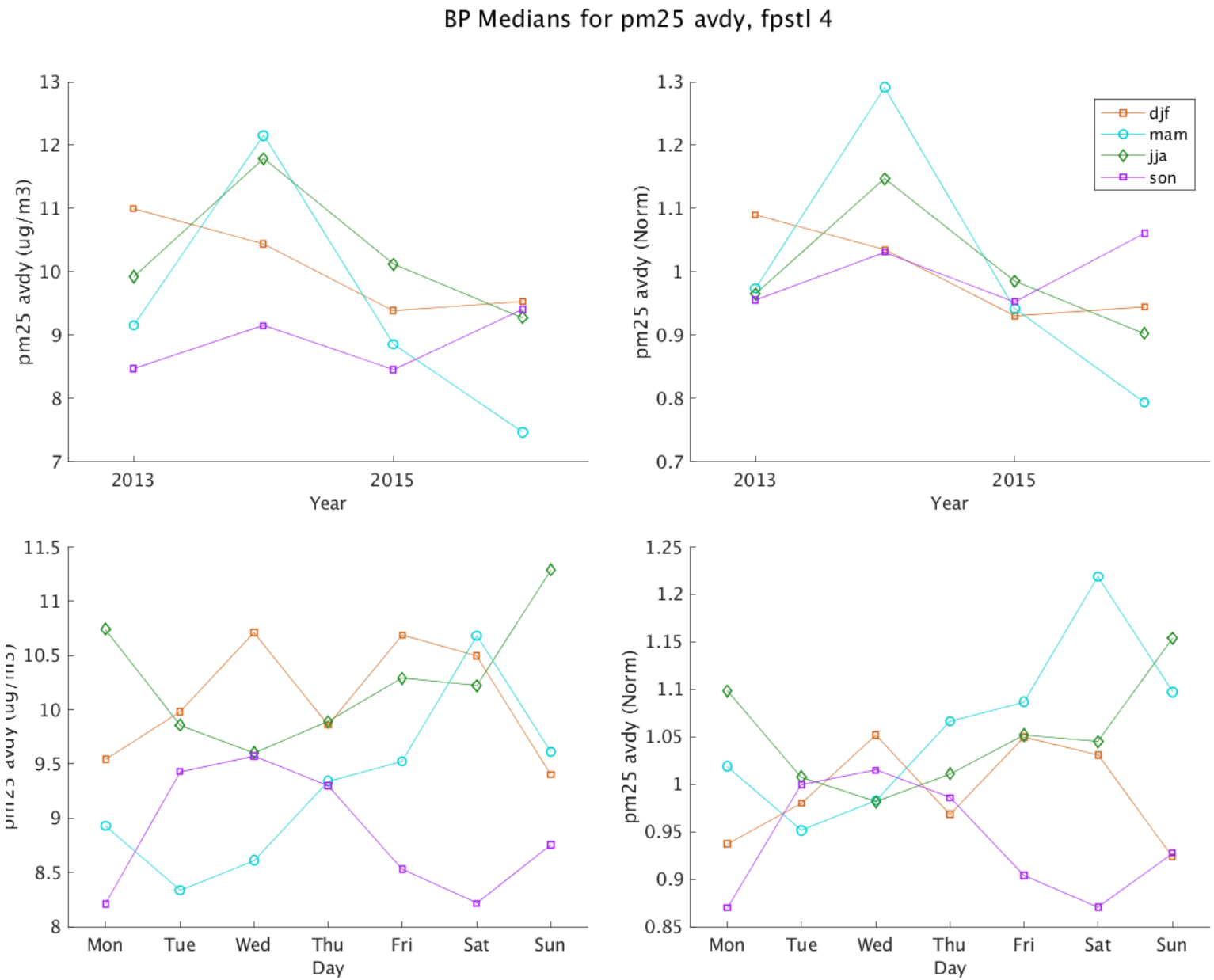
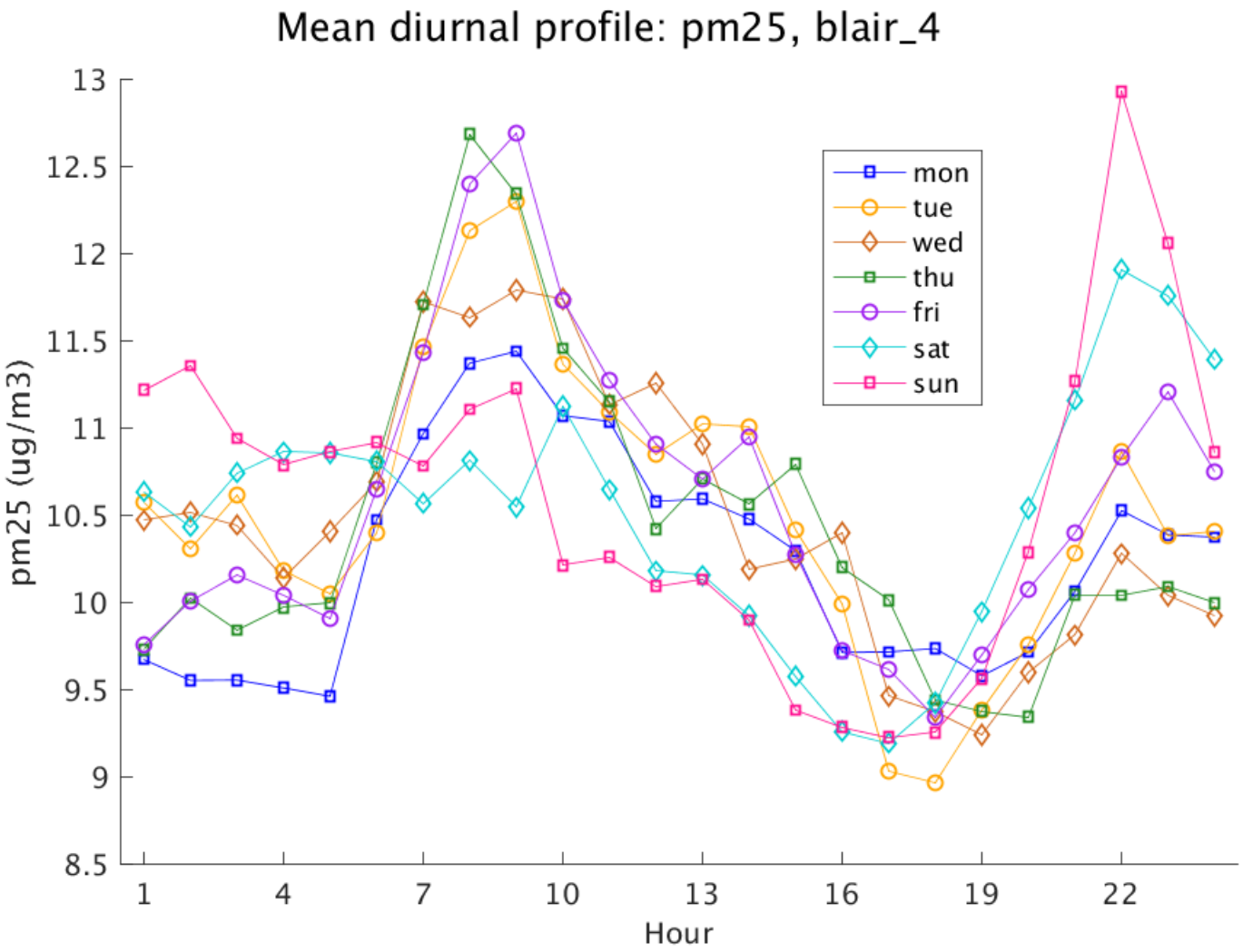
PM2.5 at Blair Street:
Downward Trend, Weekday Effect varies by Season



PM2.5 at Forest Park:
Mixed Trends, Variable Weekday Effects



PM2.5 at Blair Street:
Morning Rush Hour, Evening Accumulation (Party Effect?)



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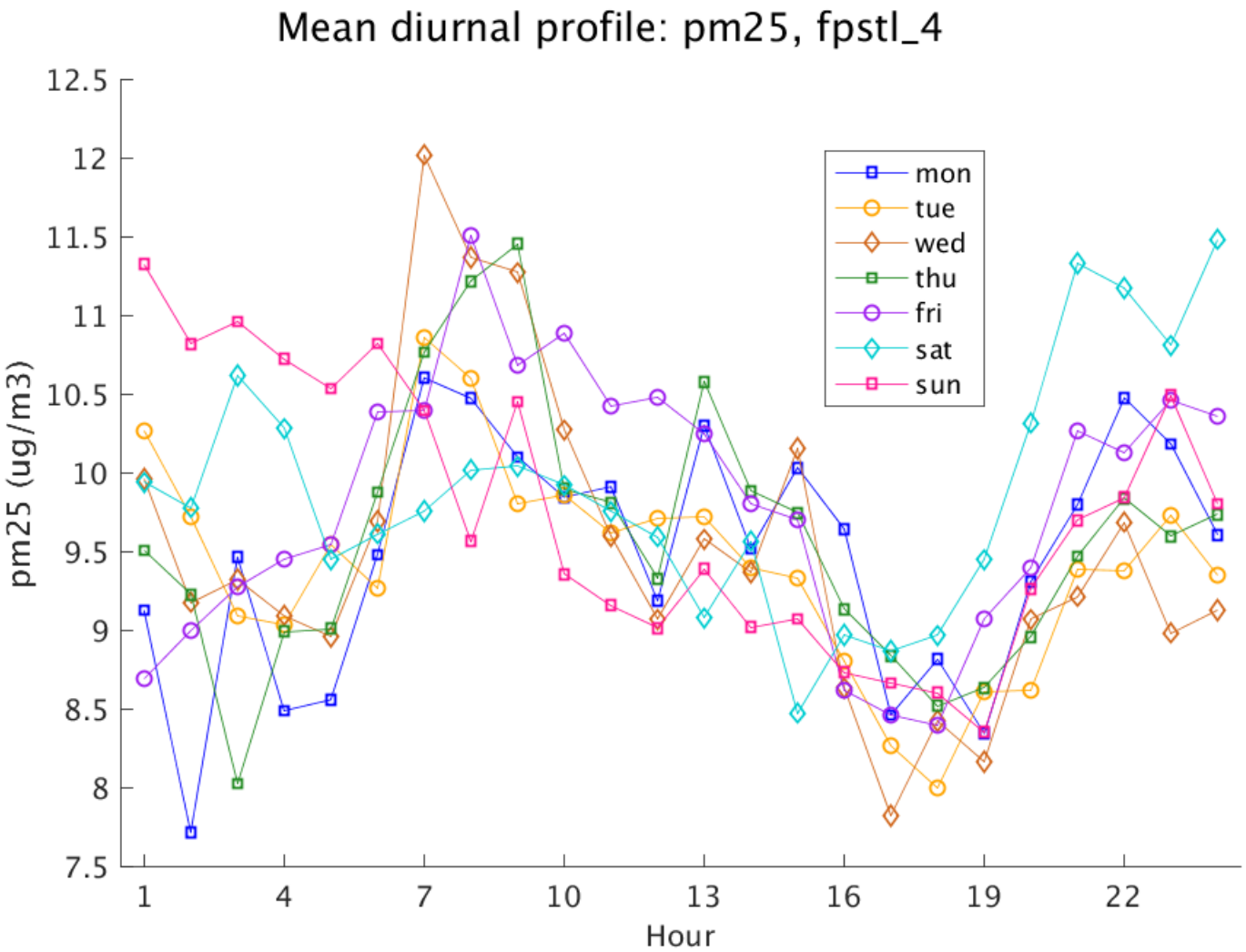
PM2.5 at Forest Park:
Similar to Blair Street – Morning Rush Hour + Evening Traffic?



Benjamin de Foy, 21-May-2018

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Conclusions:

- Need to Account for Traffic Speed (esp. at Rush Hour) to Improve NOx Emissions
- NOx Emissions Vary within Urban Areas

- Ozone in STL going down, large year-to-year variations due to weather
- Minima on Sundays and Mondays suggest impact of day-to-day carry-over
- Weekend effect varies by season: Different dynamics?

- PM2.5 concentrations going down
- PM2.5 in STL due mostly to regional background and primary traffic emissions?

Extras