

US EPA ARCHIVE DOCUMENT

Improving Emission Inventories Using Direct Flux Measurements and Modeling

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Acknowledgements

Houston Yellow Cab

TARC (establishing the site, VOCs)

EPA-STAR (criteria pollutants & VOCs)

NOAA-GCC (carbon fluxes)



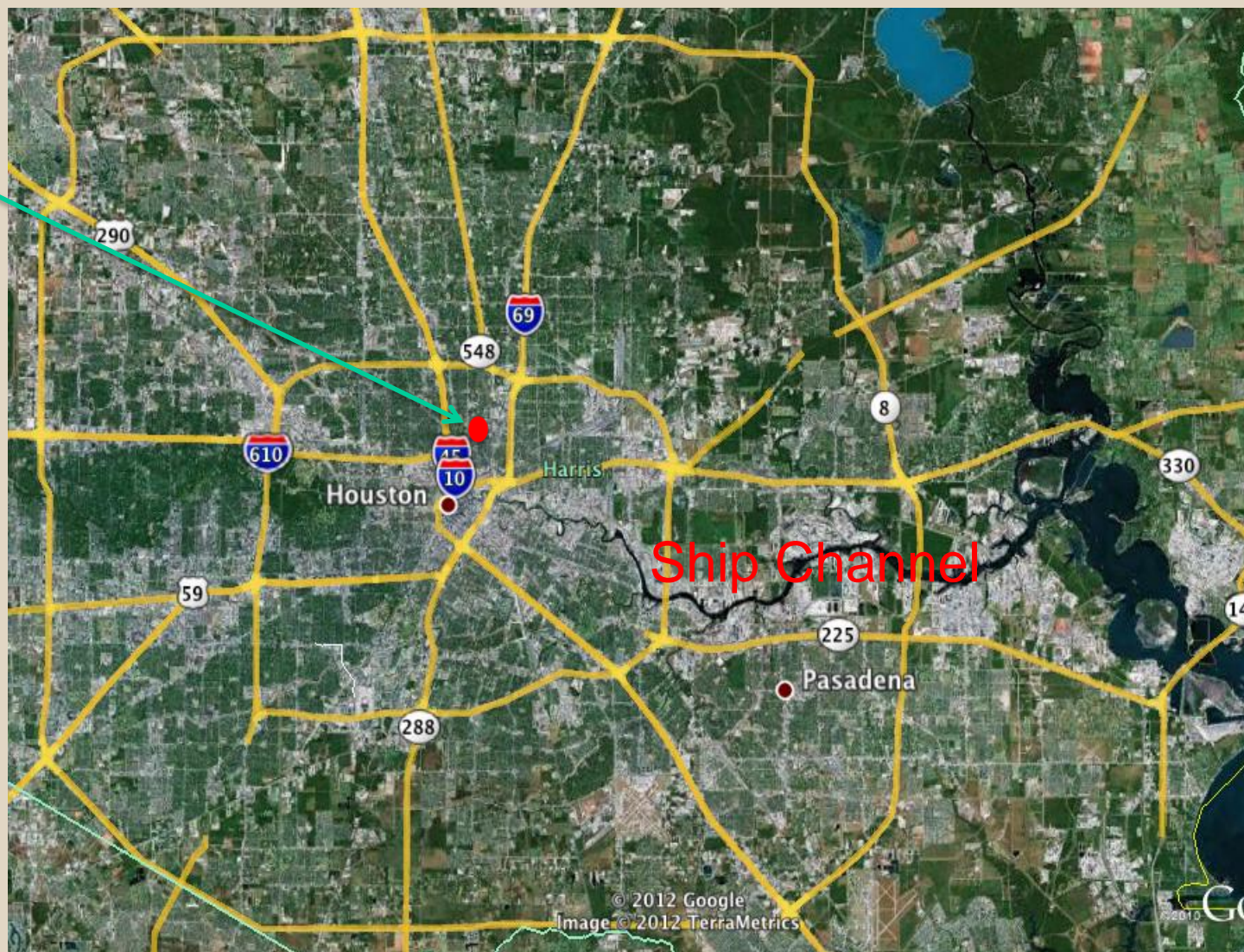
Outline

- Location and measurements
- Site Description
- CO₂ fluxes
 - Traffic Counts
- CO & NO_x fluxes
- VOC fluxes
- Tracer release and testing of footprint model
- Conclusions



Site Description, I

Tower Site



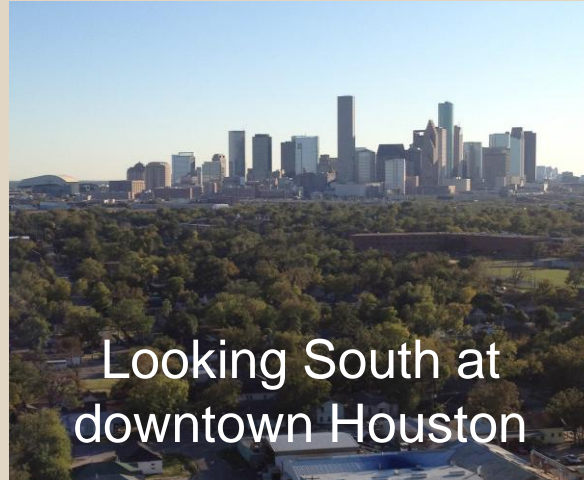
Views From the Sampling Point on the Tower



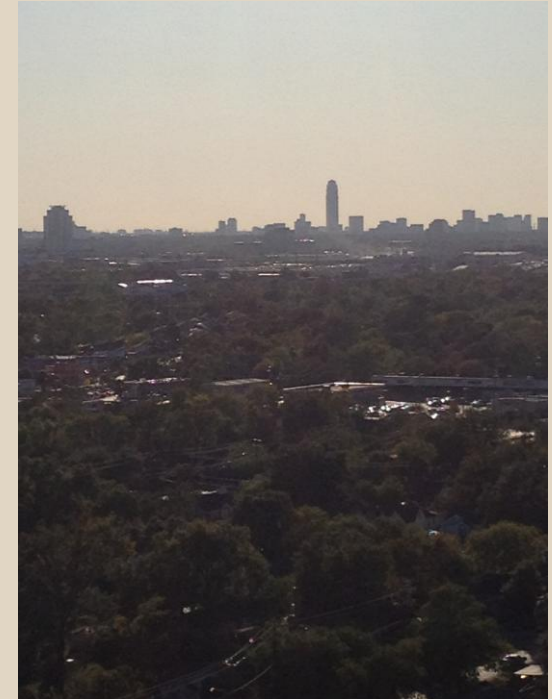
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Looking ESE at the
ship channel
refineries



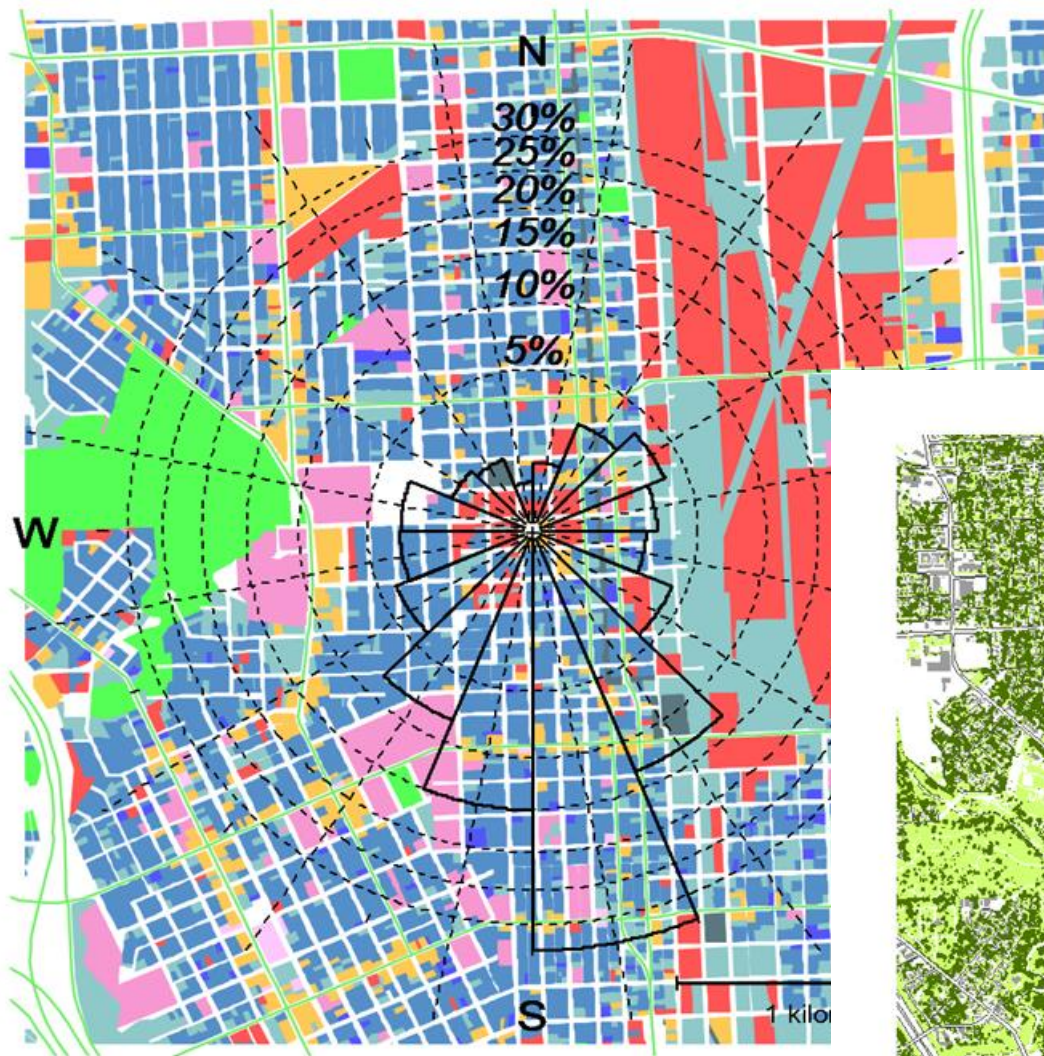
Looking South at
downtown Houston



Looking WSW at
the Galleria area

Site Description, II



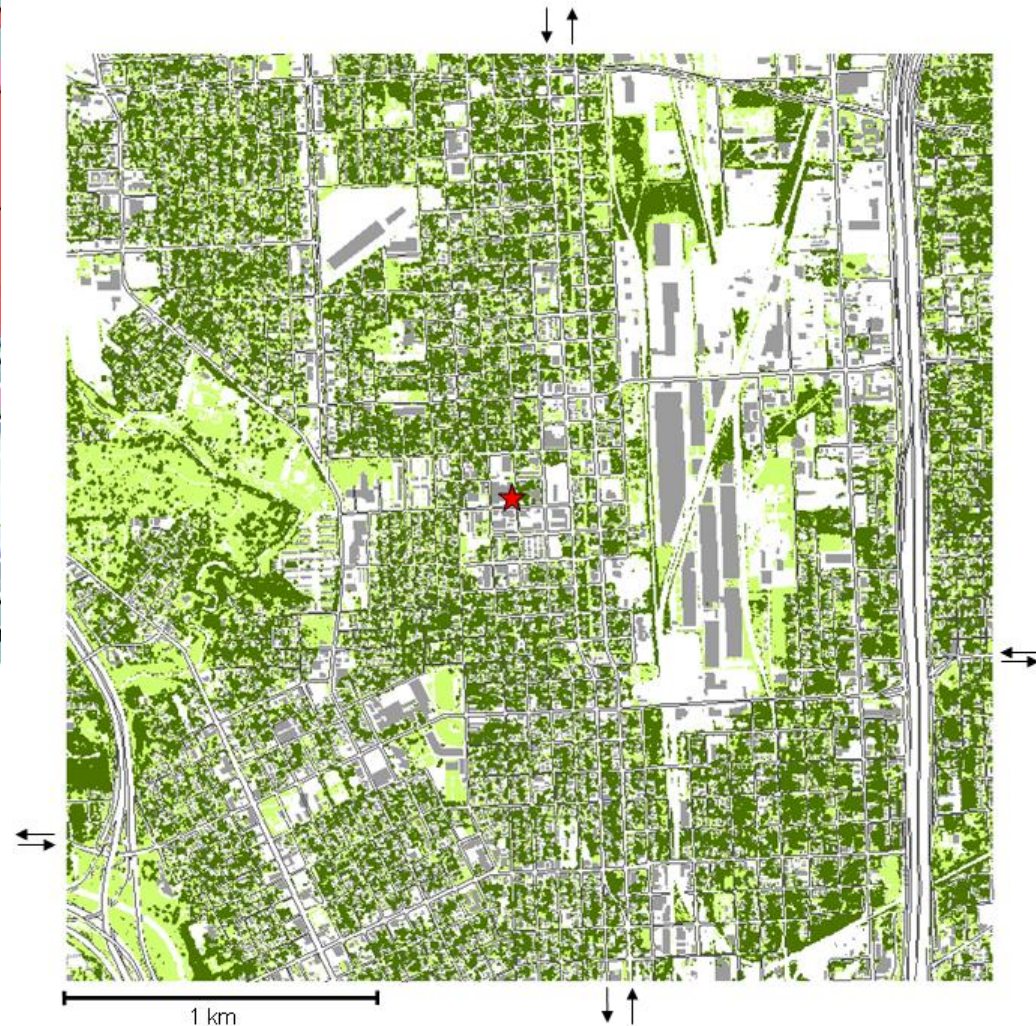


land use

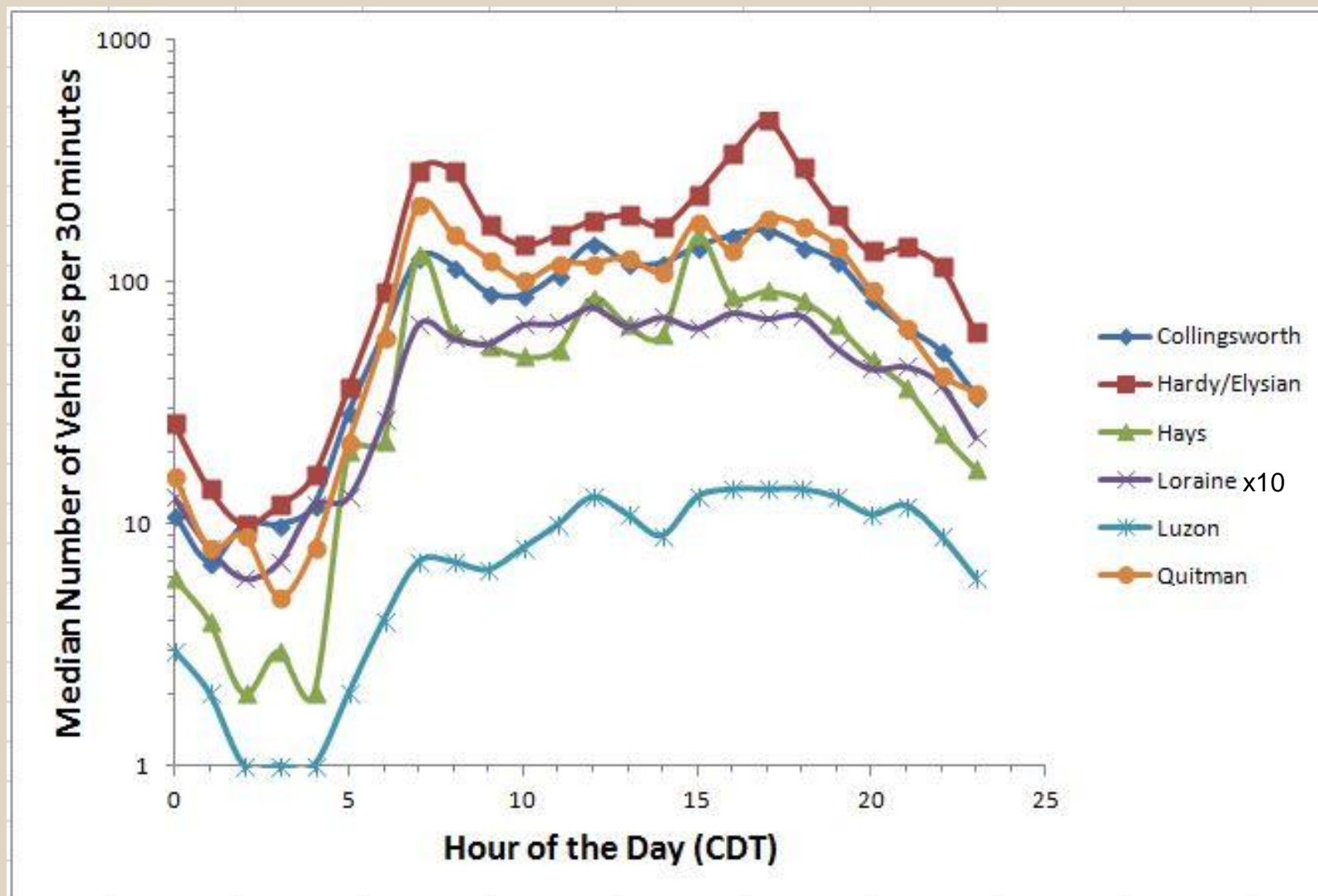


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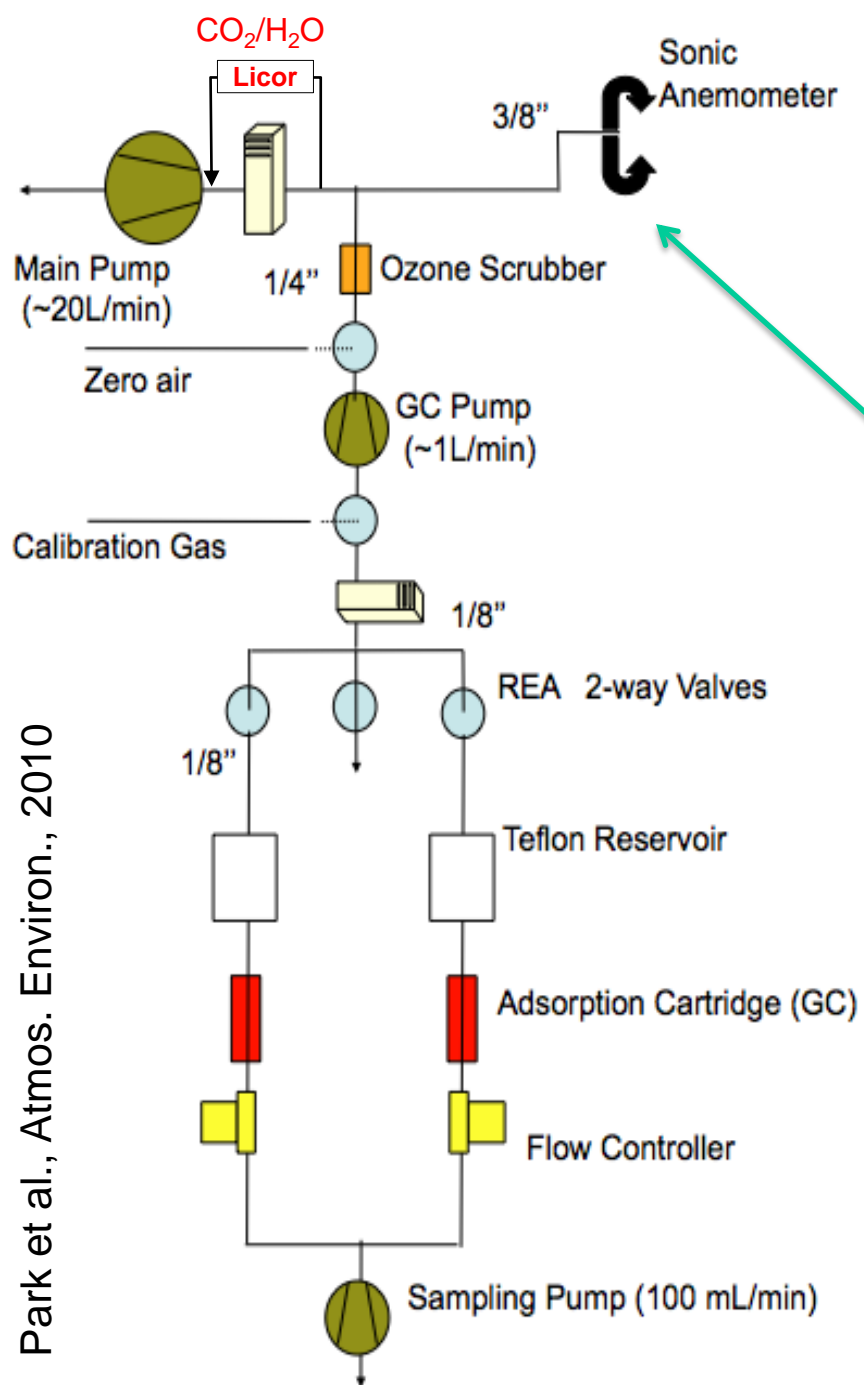
land cover



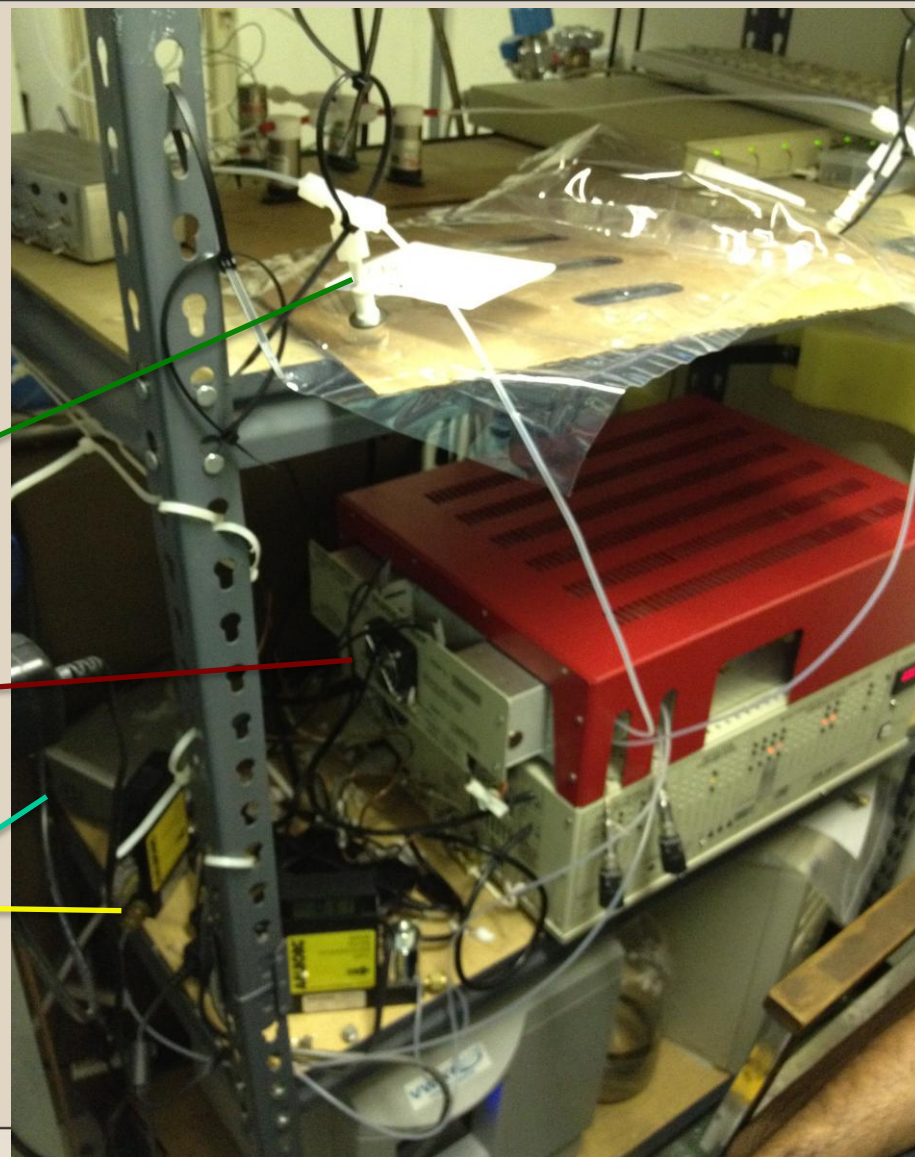
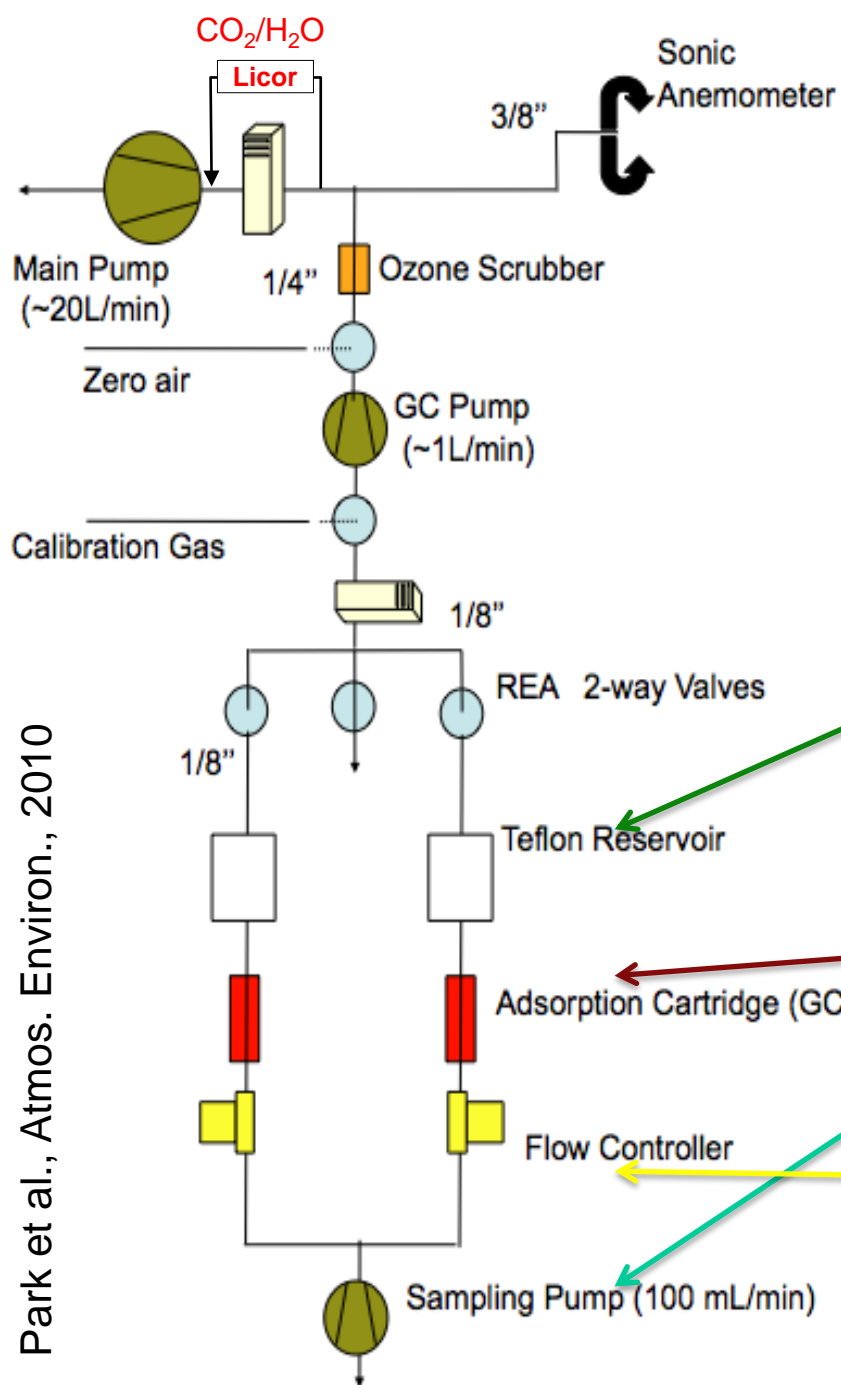
Traffic counts



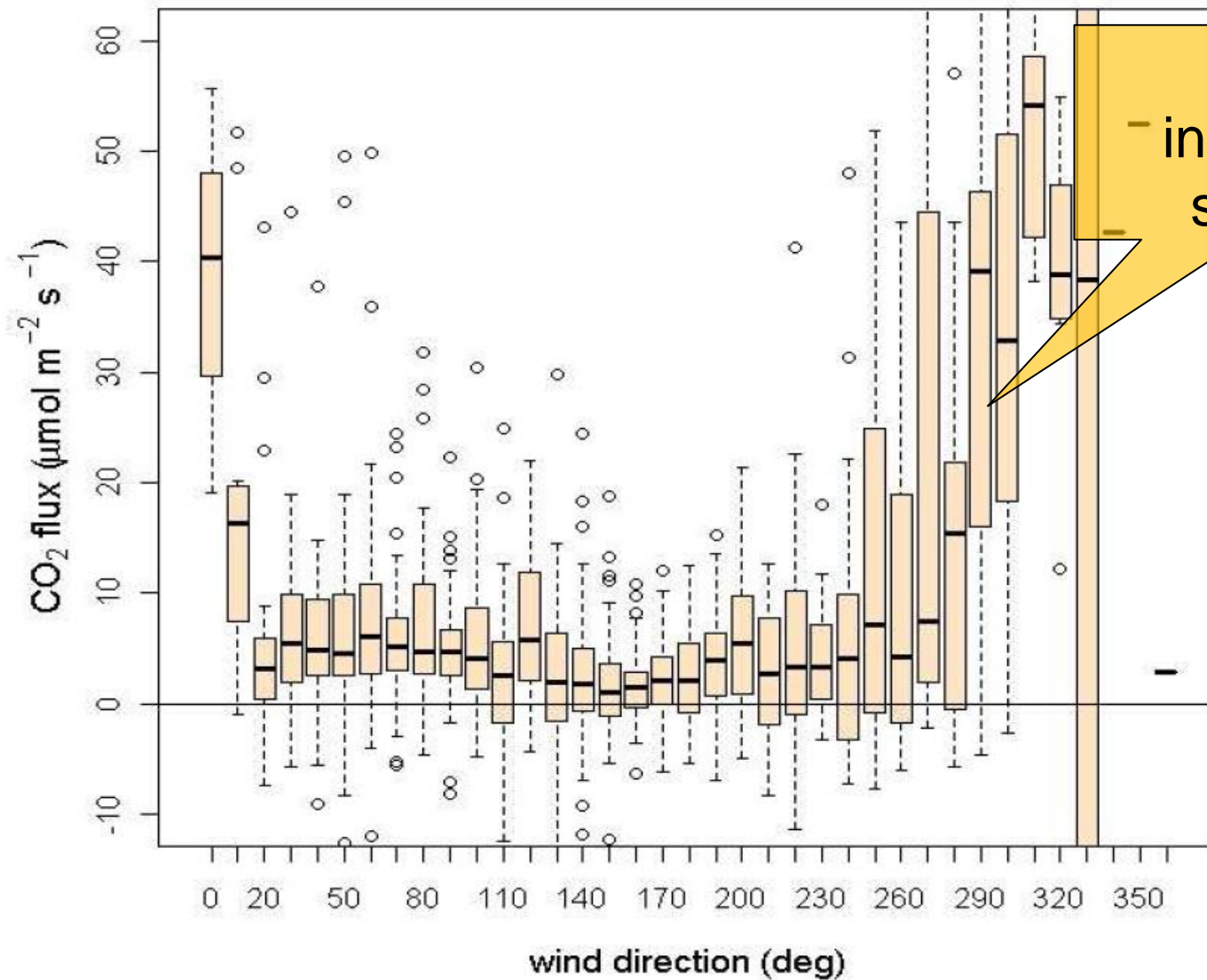
Setup



Setup



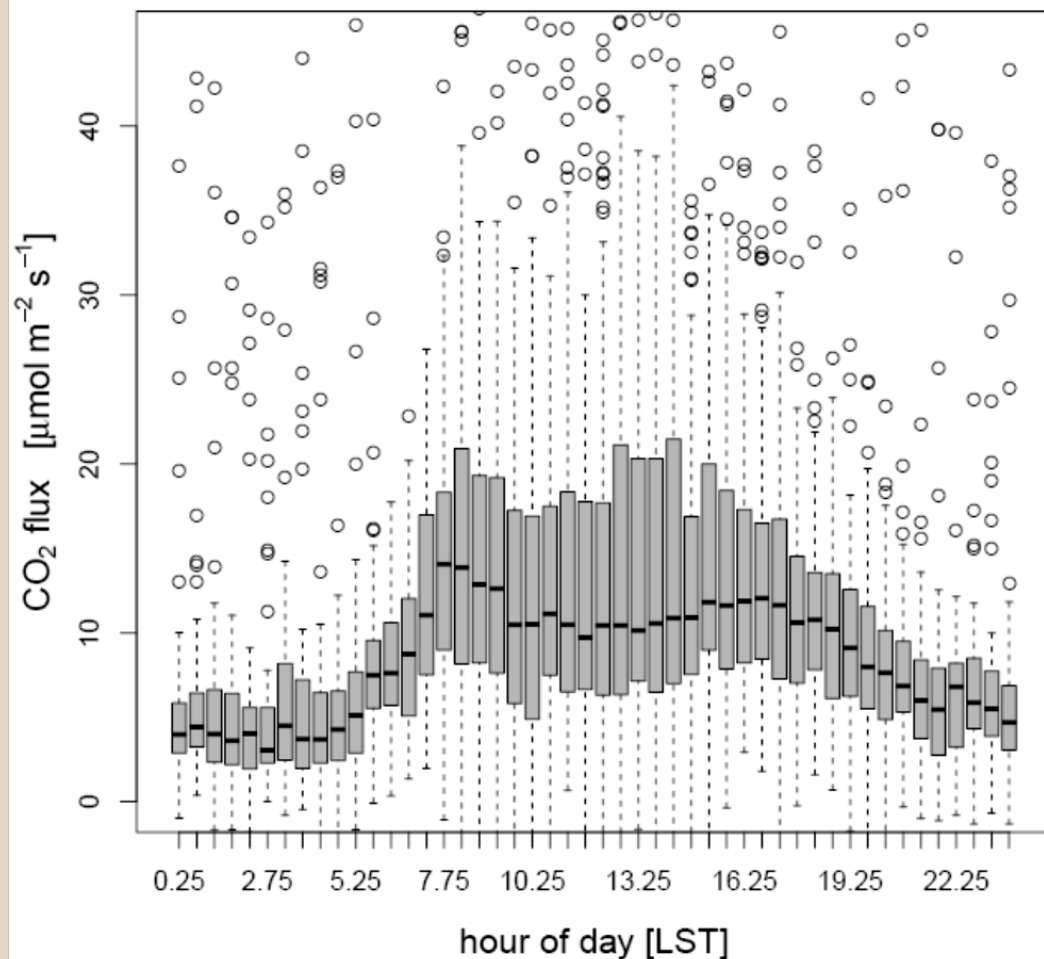
CO₂ fluxes, I



large
industrial
source

CO₂ fluxes, II

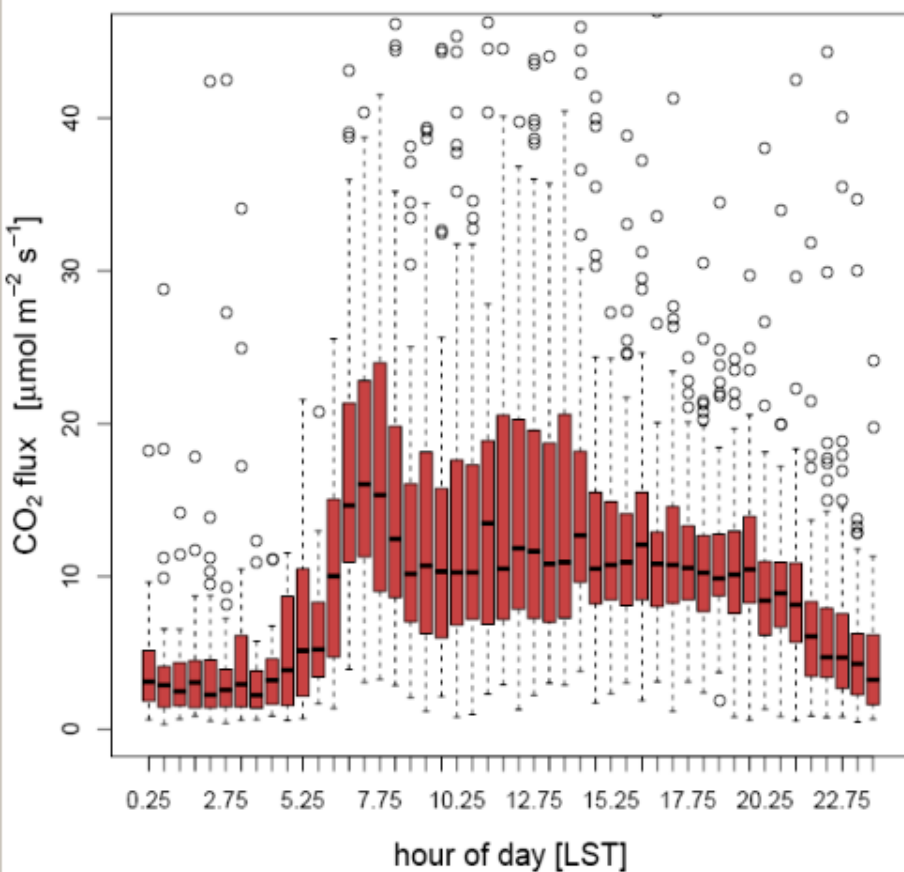
Winter



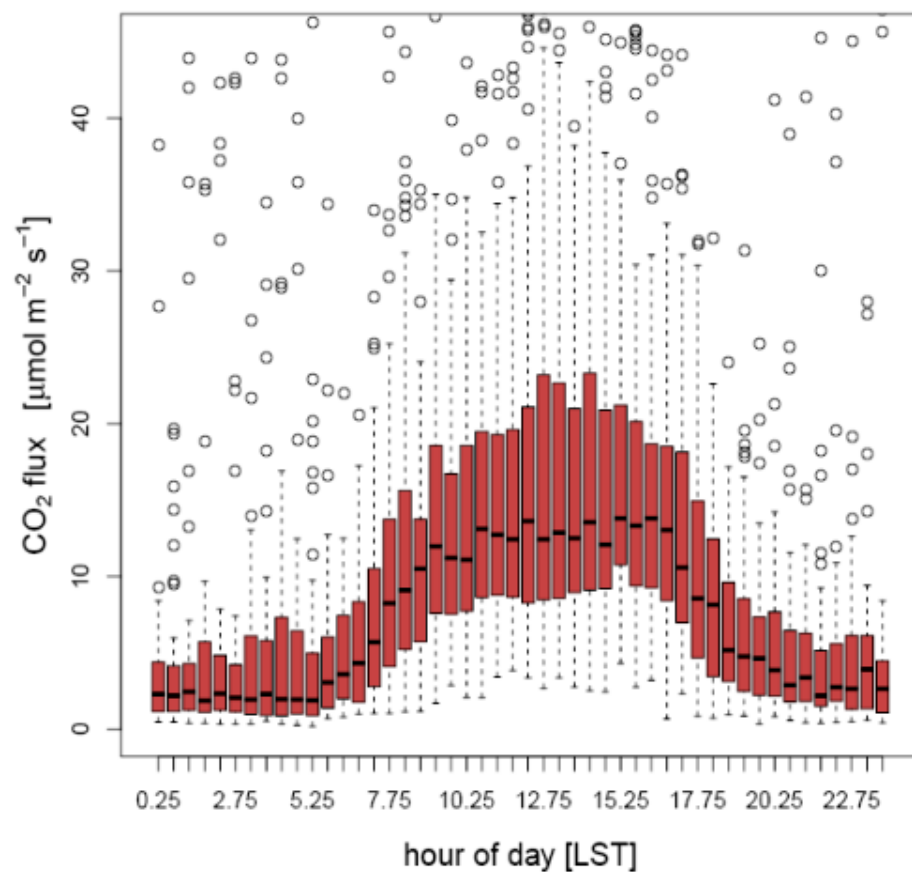
- not as strongly driven by traffic as expected
- net fluxes affected by biogenic uptake

CO₂ fluxes, III

Summer

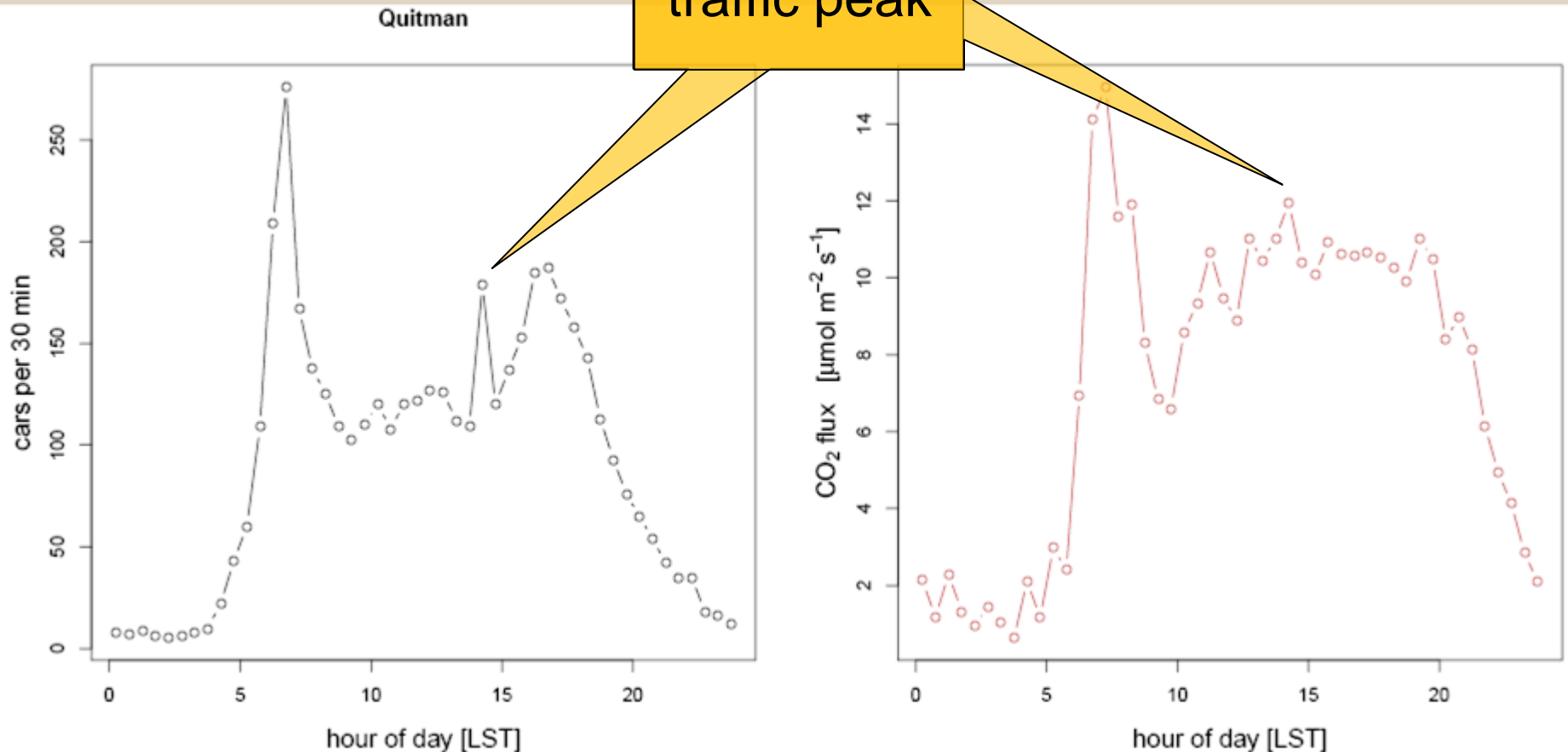


Winter



CO₂ fluxes, IV

School
traffic peak

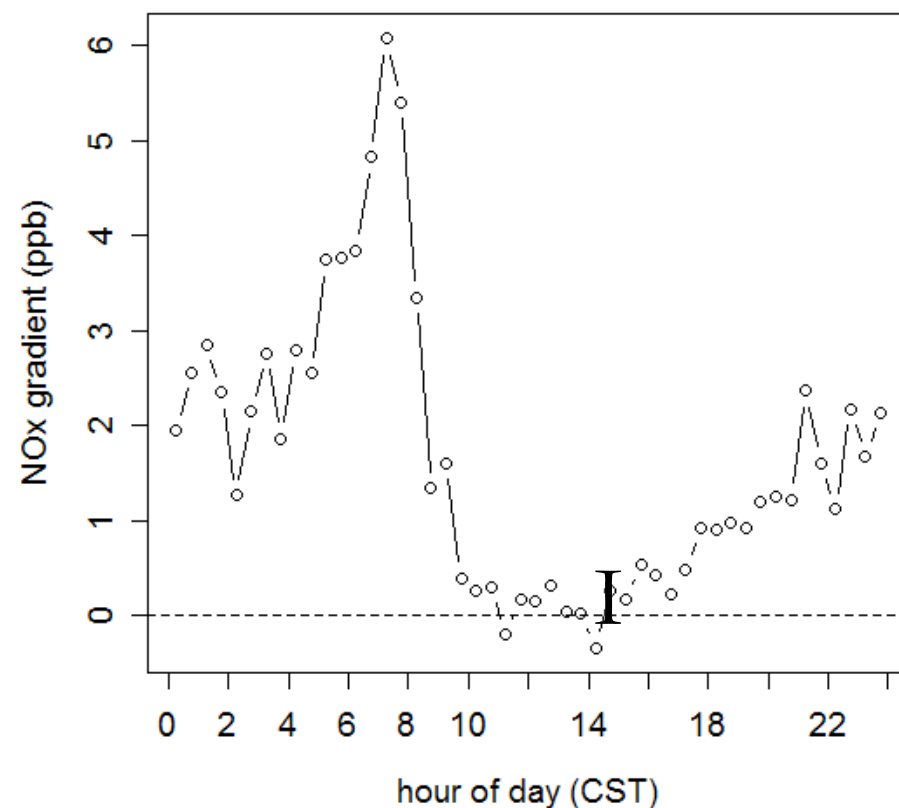
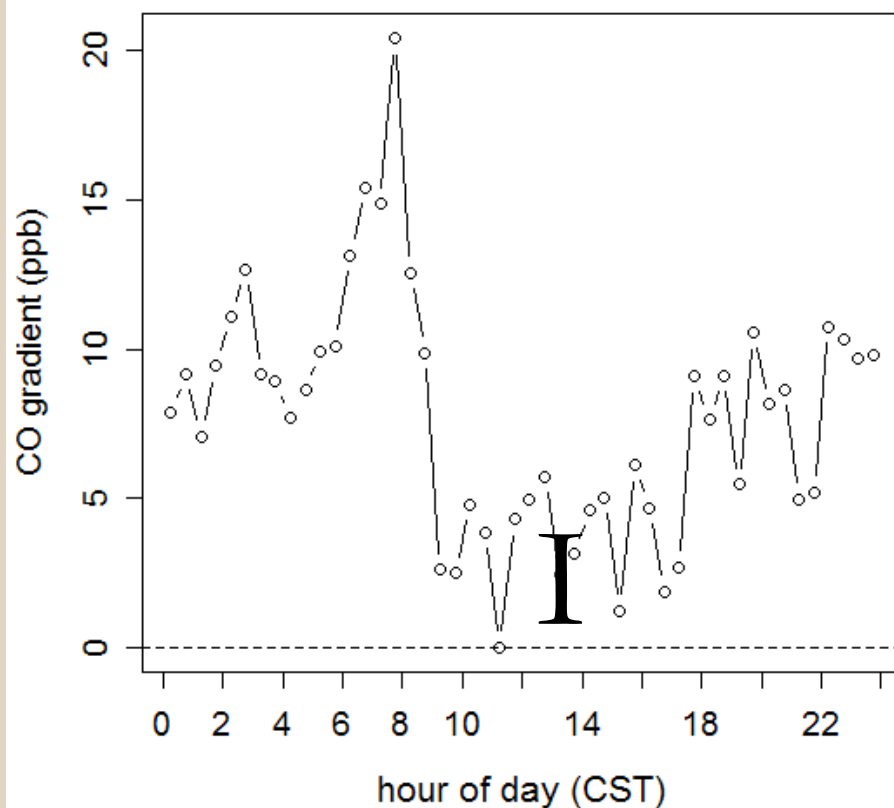


Anthropogenic CO₂-flux = 10 $\mu\text{mol m}^{-2} \text{s}^{-1}$

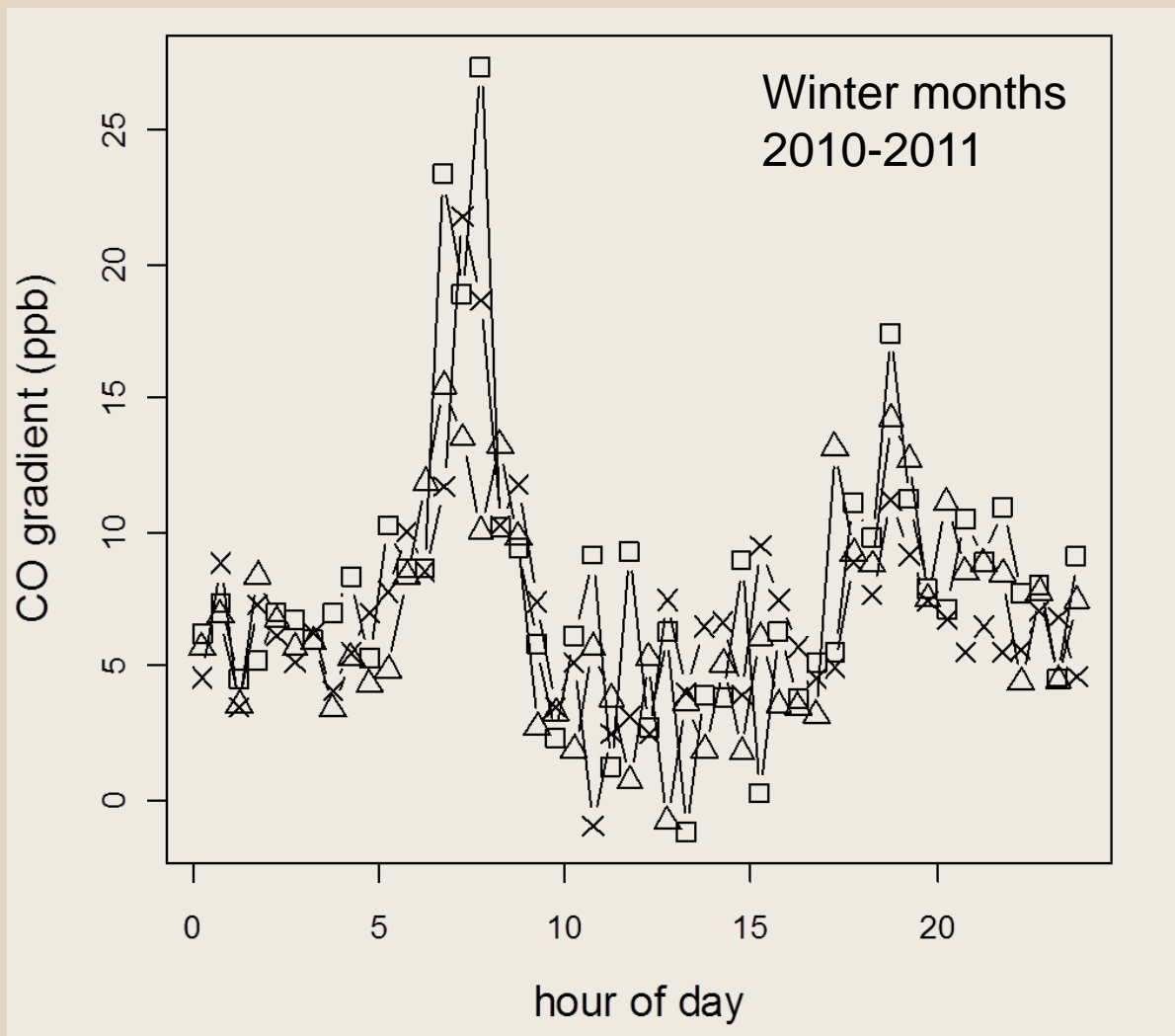
60% car traffic (from CO flux data), 20-30% human respiration (residual),

20-10% soil respiration (uncertain), <10% natural gas use (local data)

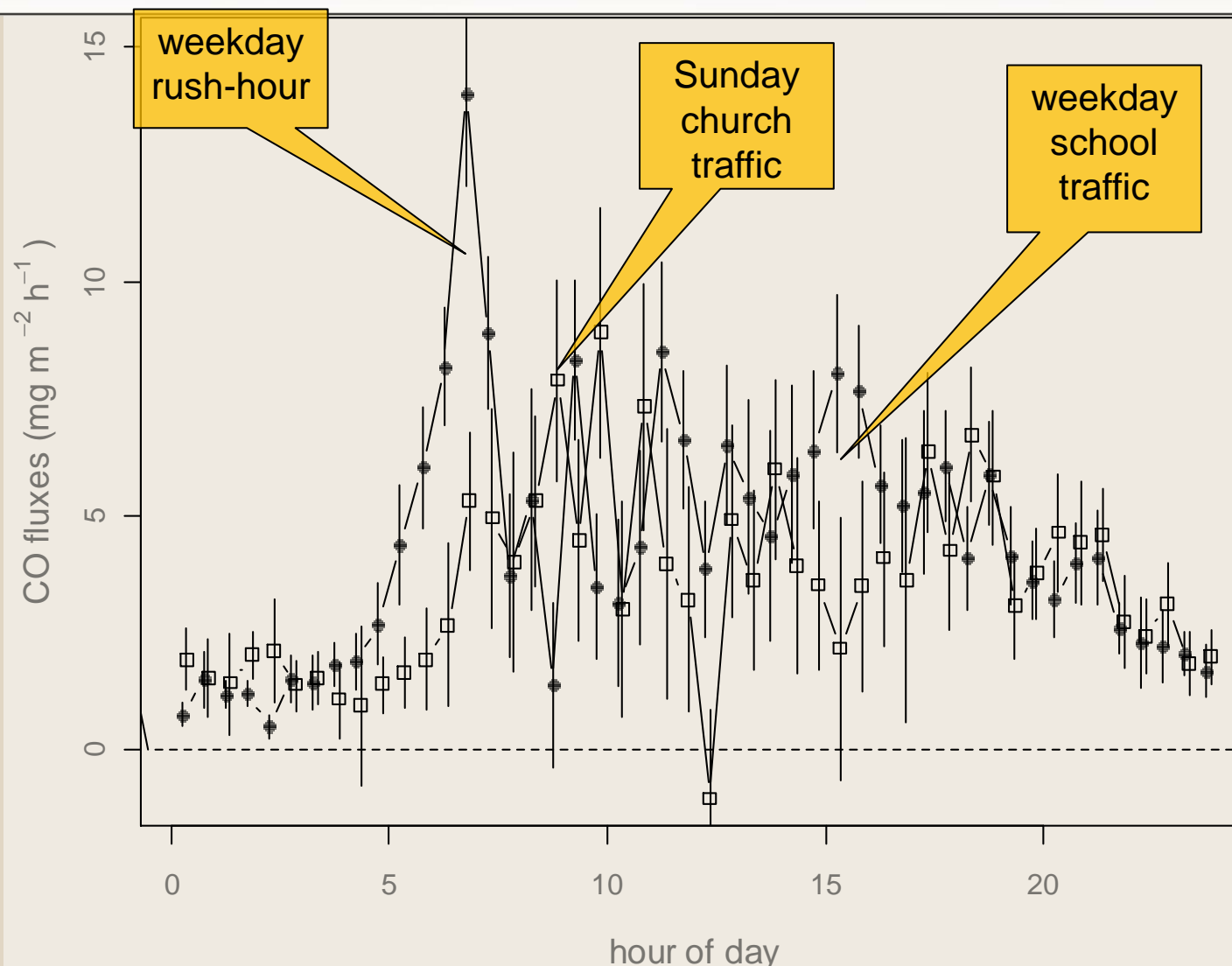
Criteria Pollutant Fluxes, I



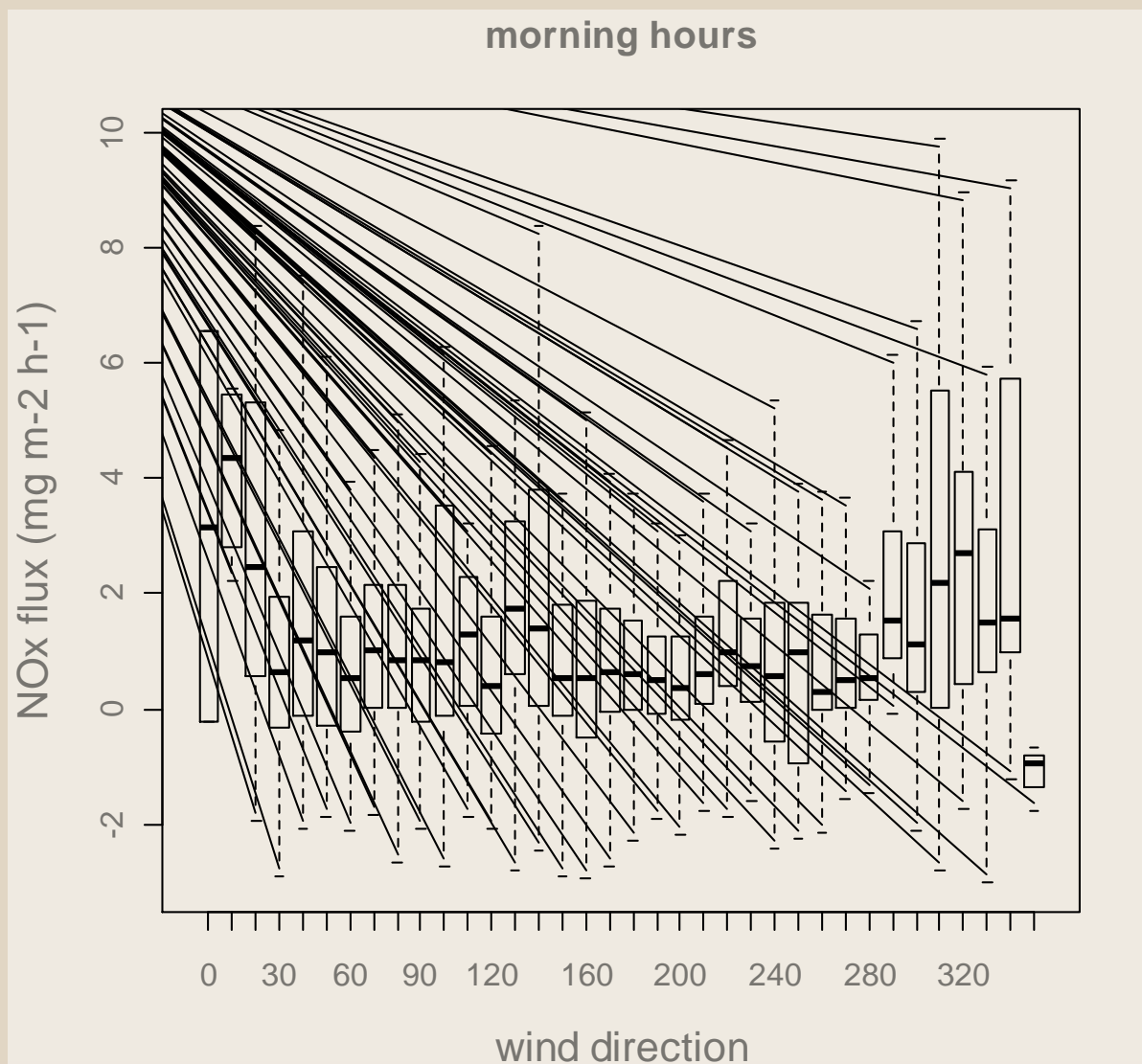
Criteria Pollutant Fluxes, II



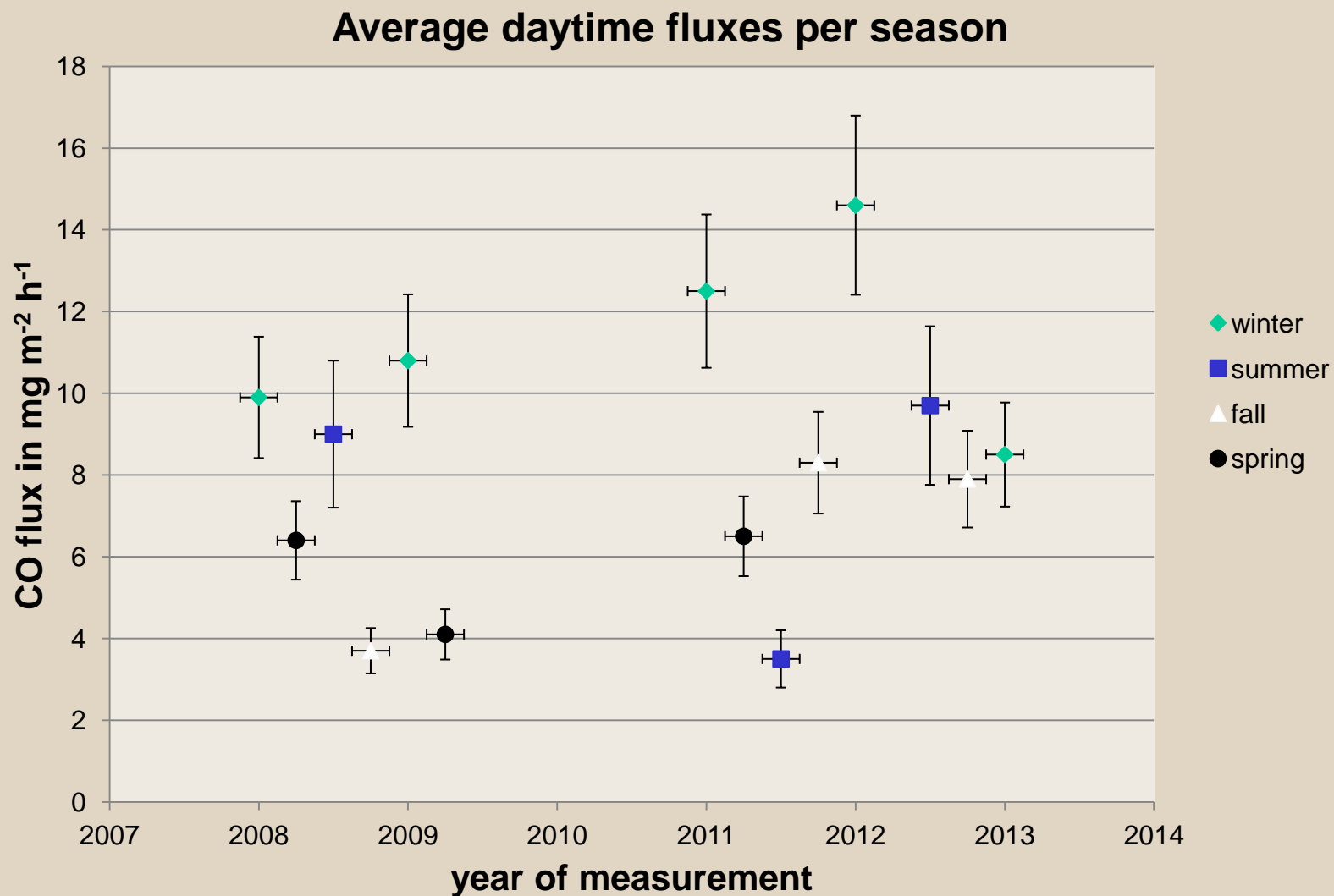
Criteria Pollutant Fluxes, III



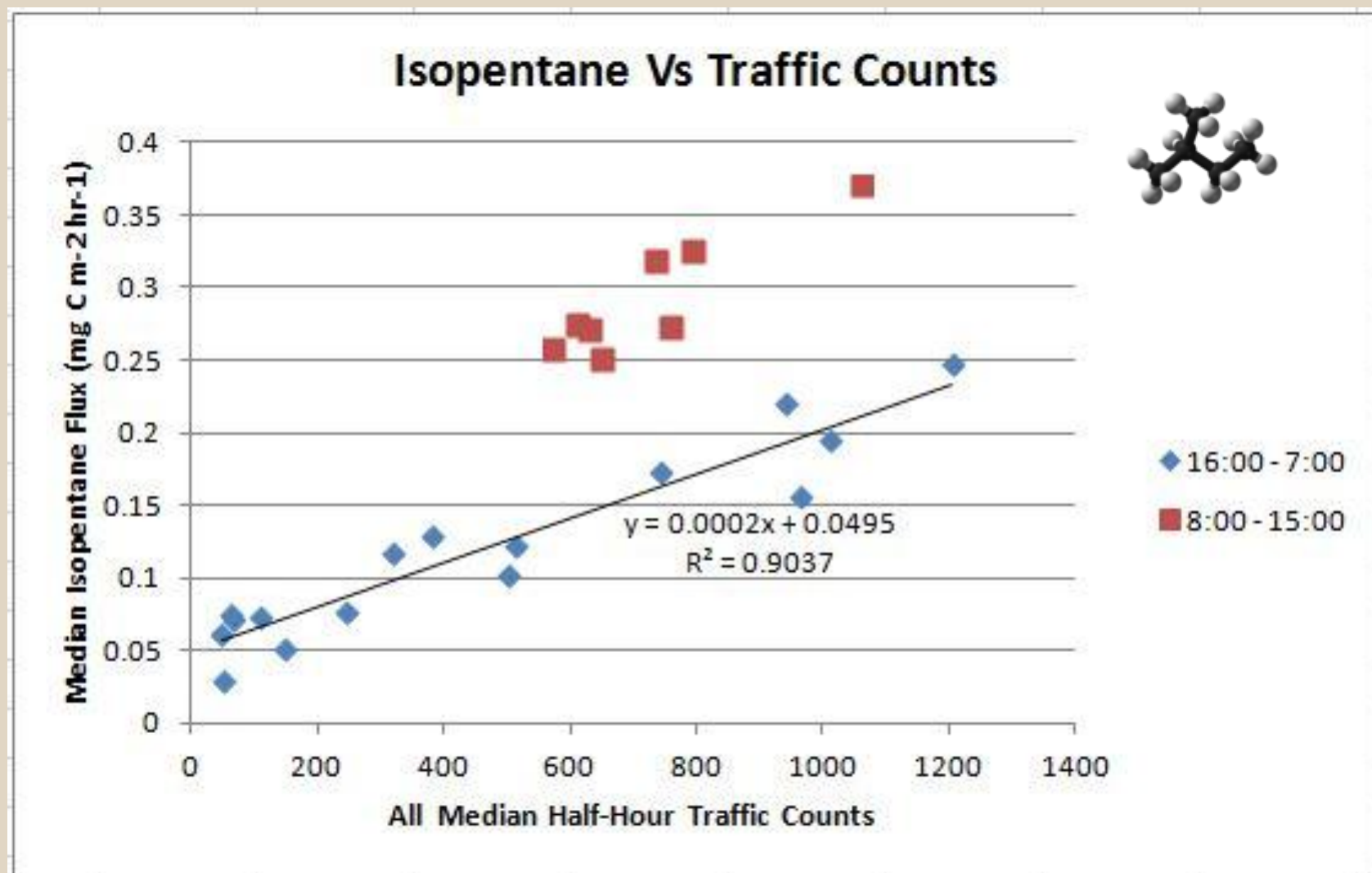
Criteria Pollutant Fluxes, IV



CO fluxes over time

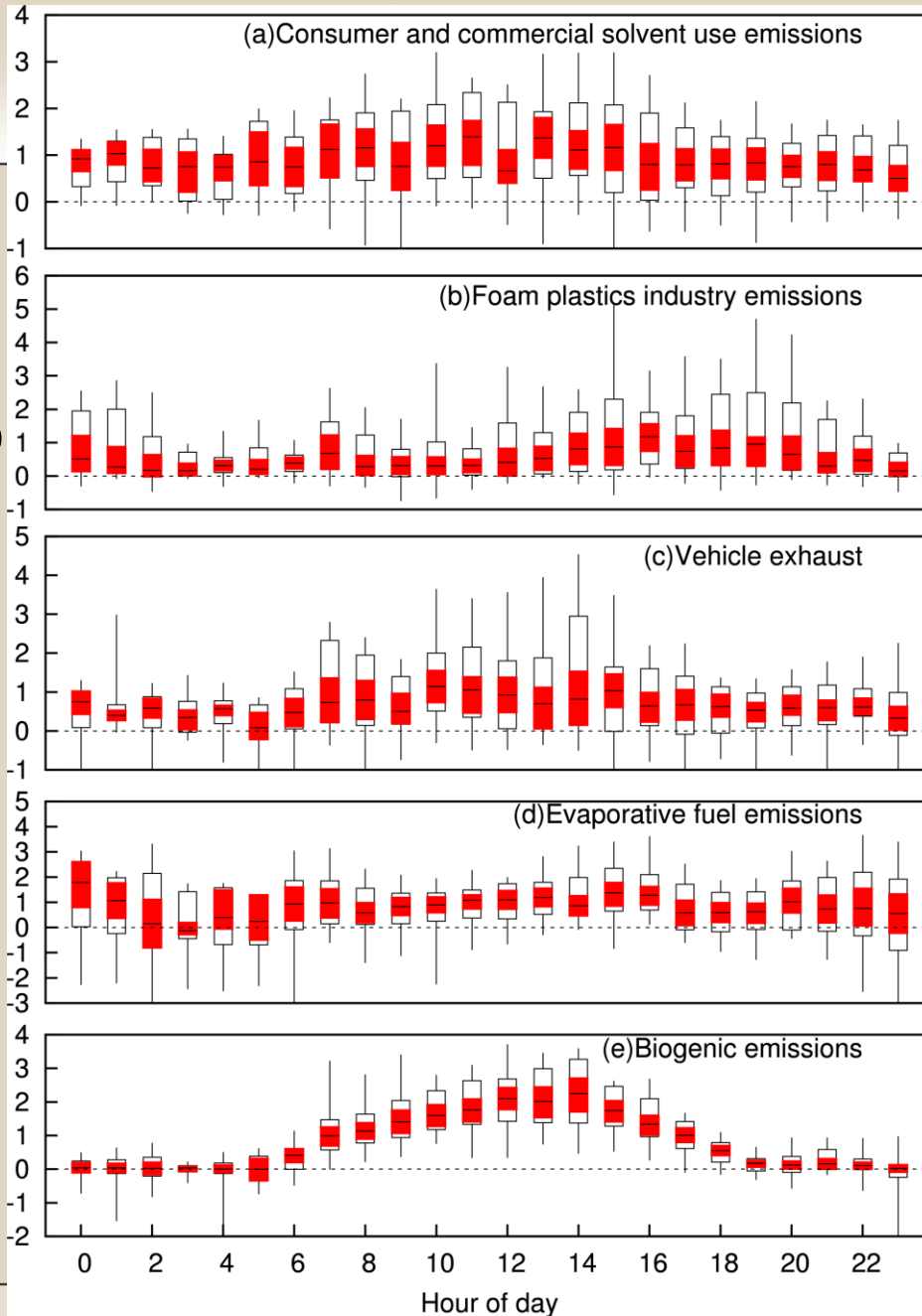


VOC fluxes, I



VOC fluxes, II

VOC emissions in $\text{mg m}^{-2} \text{h}^{-1}$



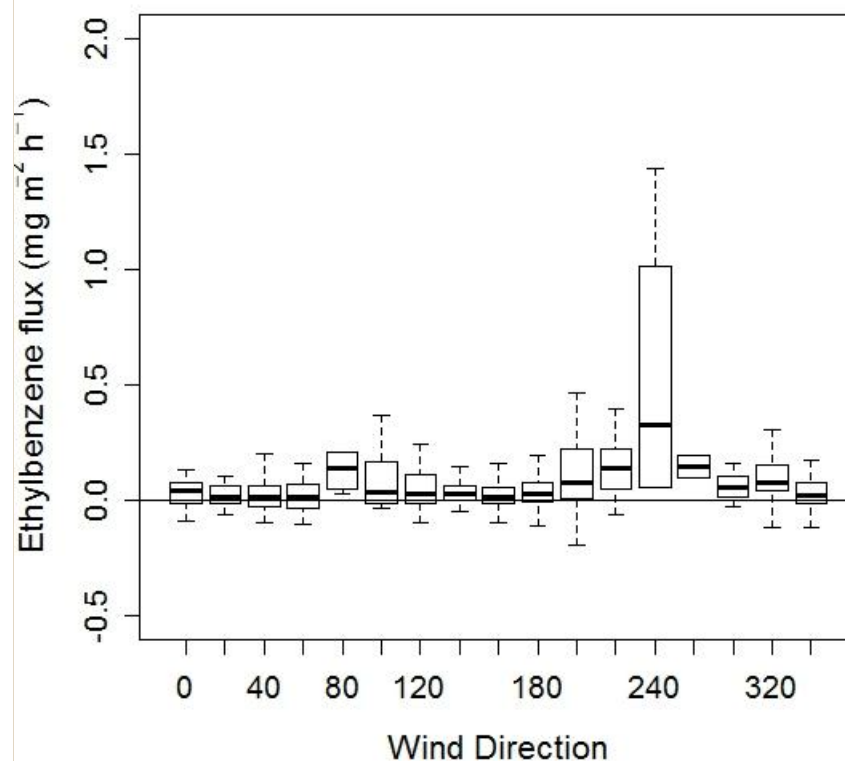
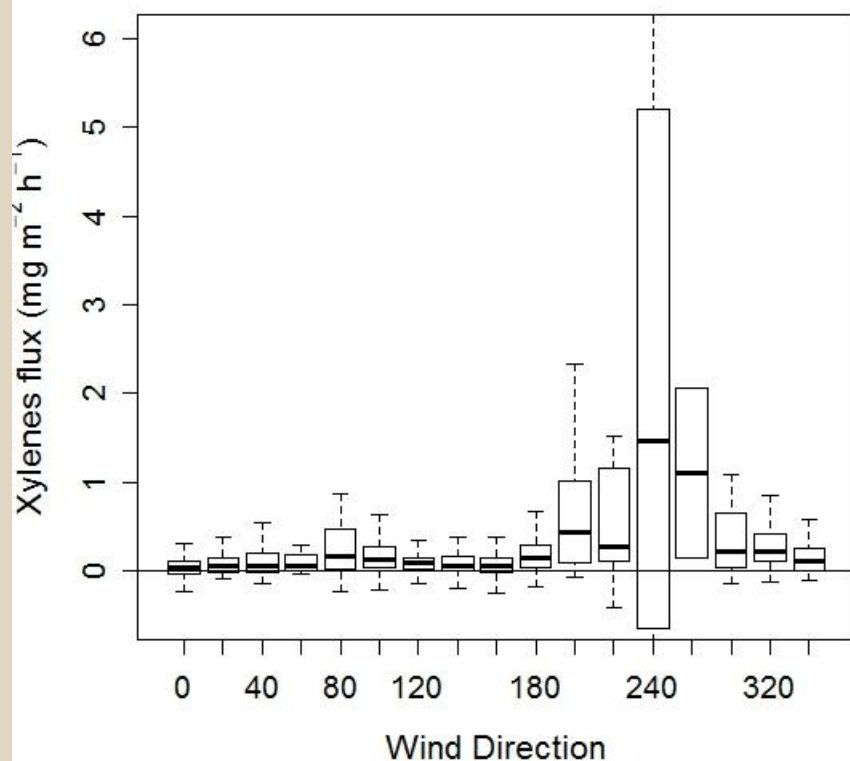
- makeup, paint, etc.
- industry
- your car exhaust
- your (car) fuel leak(s)
- those pesky trees

VOC fluxes over time

	Max.	Mean	Median	SD
Benzene				
Winter 2009	1.52	0.21	0.17	0.23
Winter 2012	1.34	0.07	0.06	
Spring 2013	2.28	0.09	0.08	0.16
4-year % Change	50%	-57%	-53%	
Toluene				
Winter 2009	4.54	0.35	0.24	0.47
Winter 2012	3.40	0.19	0.07	
Spring 2013	7.31	0.26	0.11	0.64
4-year % Change	61%	-26%	-54%	
Ethylbenzene				
Winter 2009	0.86	0.07	0.04	0.09
Winter 2012	0.84	0.03	0.02	0.12
Spring 2013	3.02	0.07	0.03	0.21
4-year % Change	251%	0%	25%	
Xylenes				
Winter 2009	4.33	0.23	0.14	0.35
Winter 2012	3.23	0.14	0.08	0.36
Spring 2013	10.85	0.23	0.10	0.66
4-year % Change	151%	0%	-40%	

VOC fluxes, III

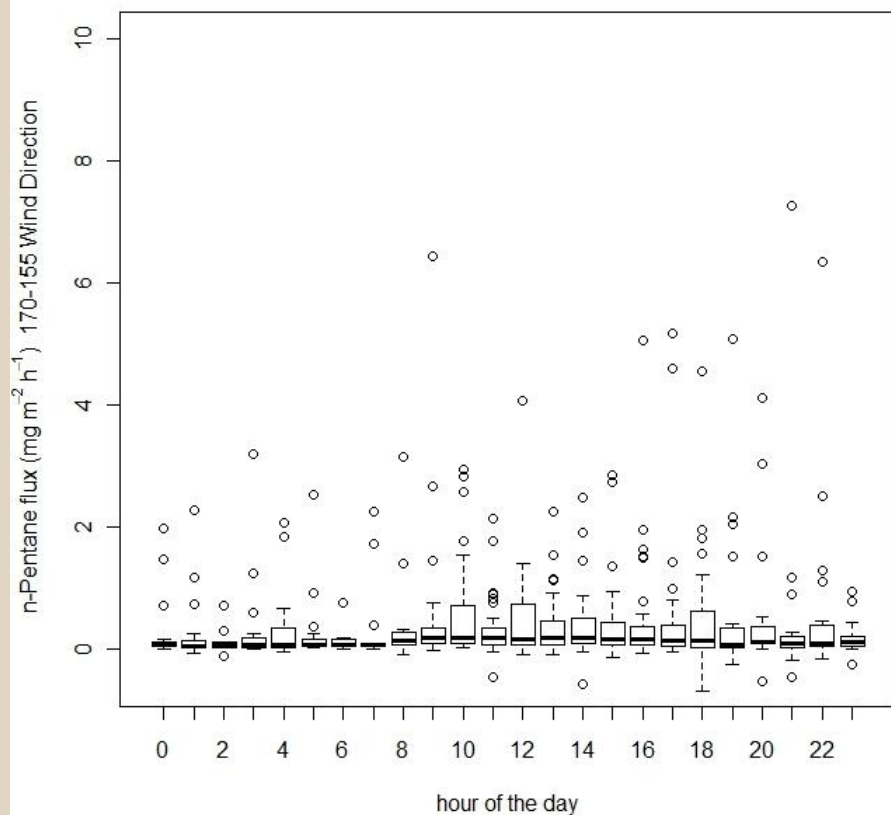
Xylan© coating process facility, 200 m SSW of tower



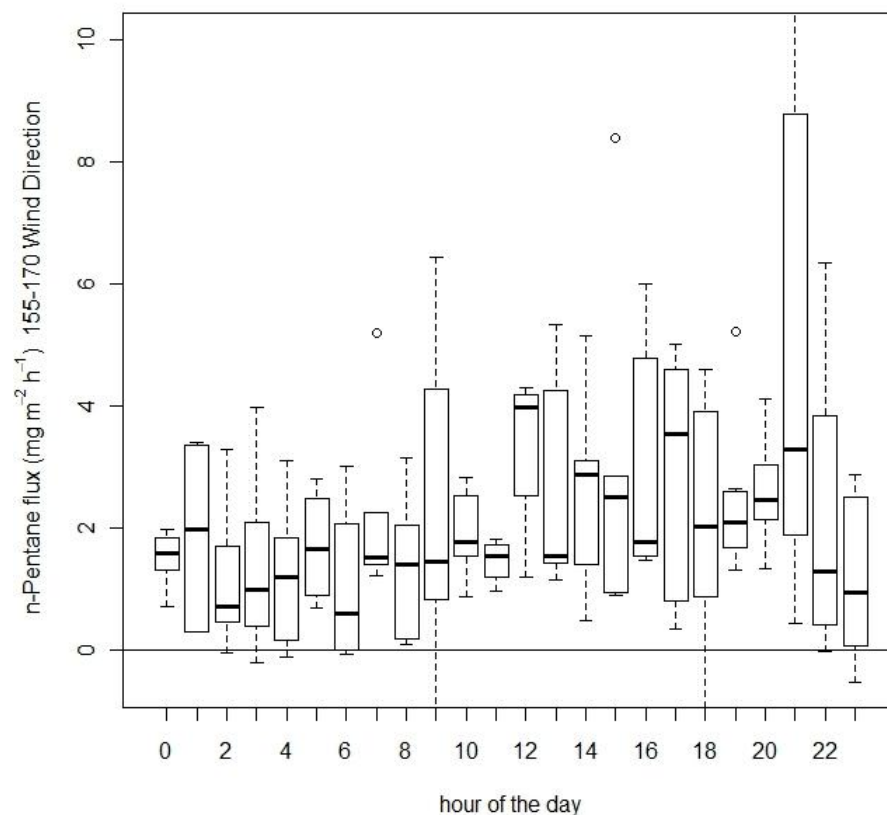
A Large Pentane Source, I

- n-Pentane used as a blowing agent in polystyrene foam production

wind not from source

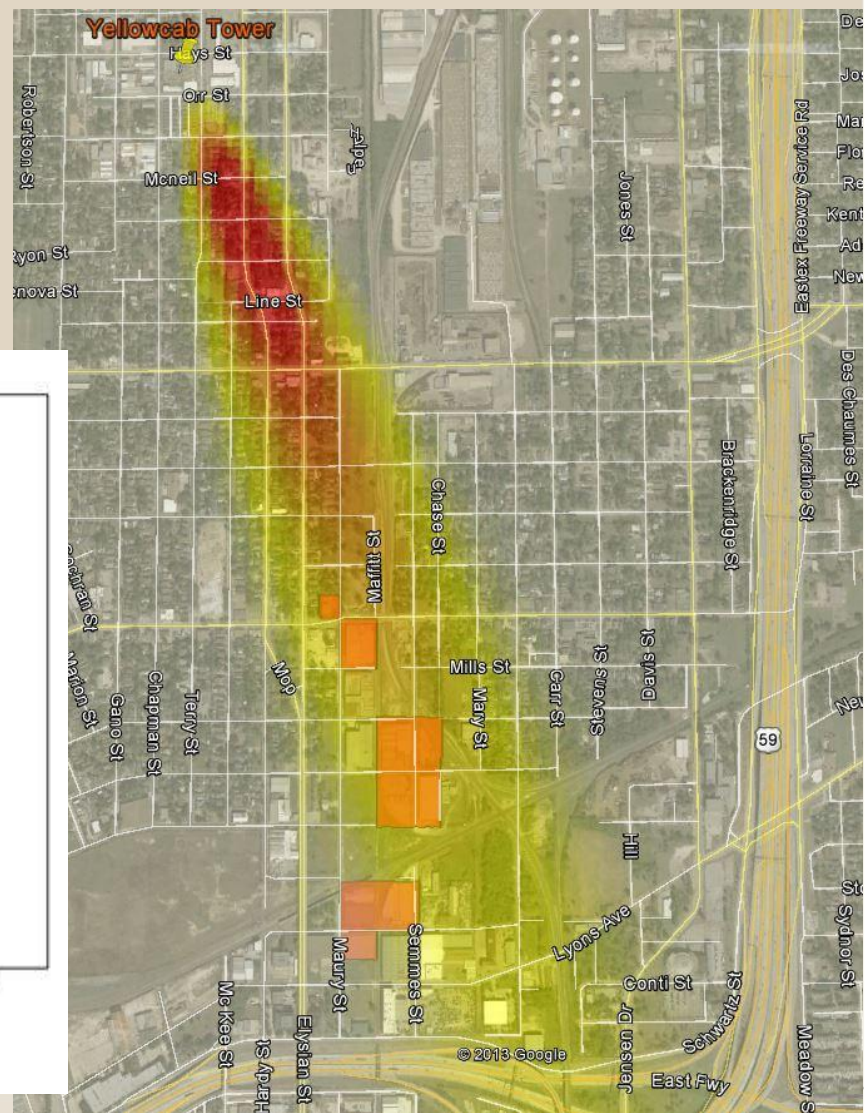
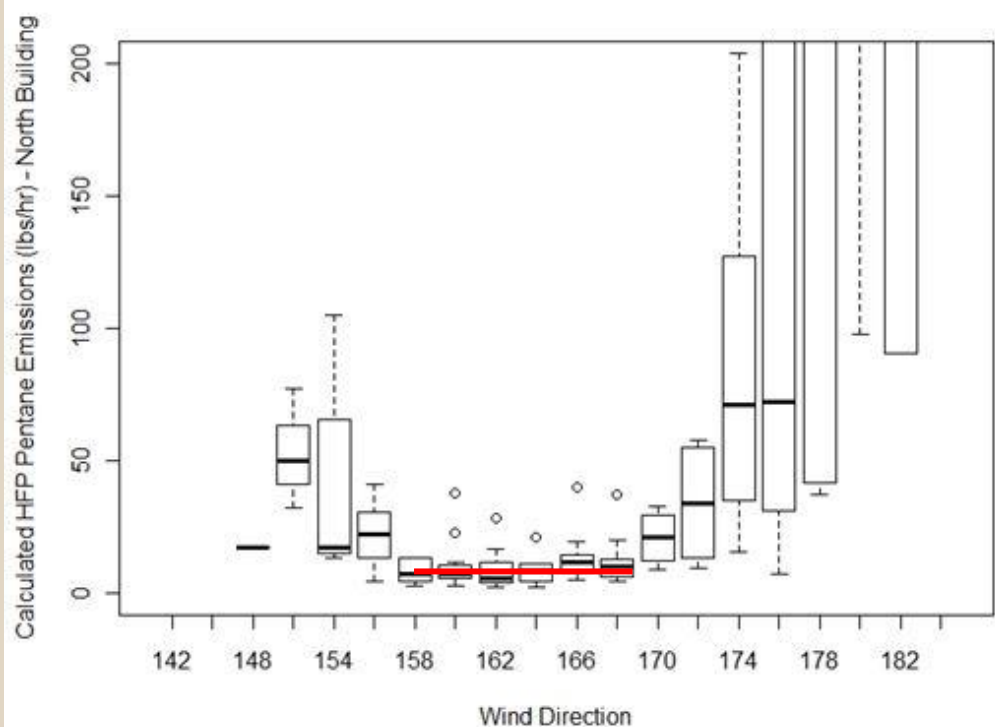


wind from pentane source



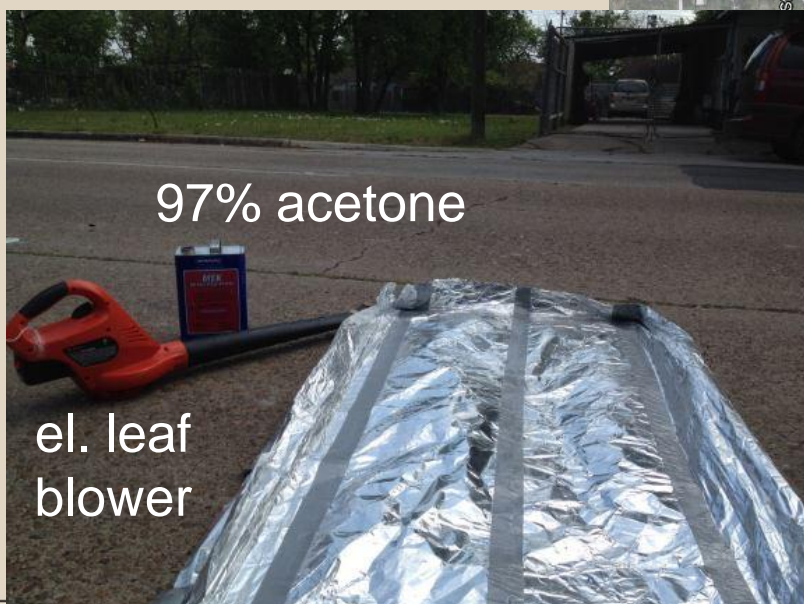
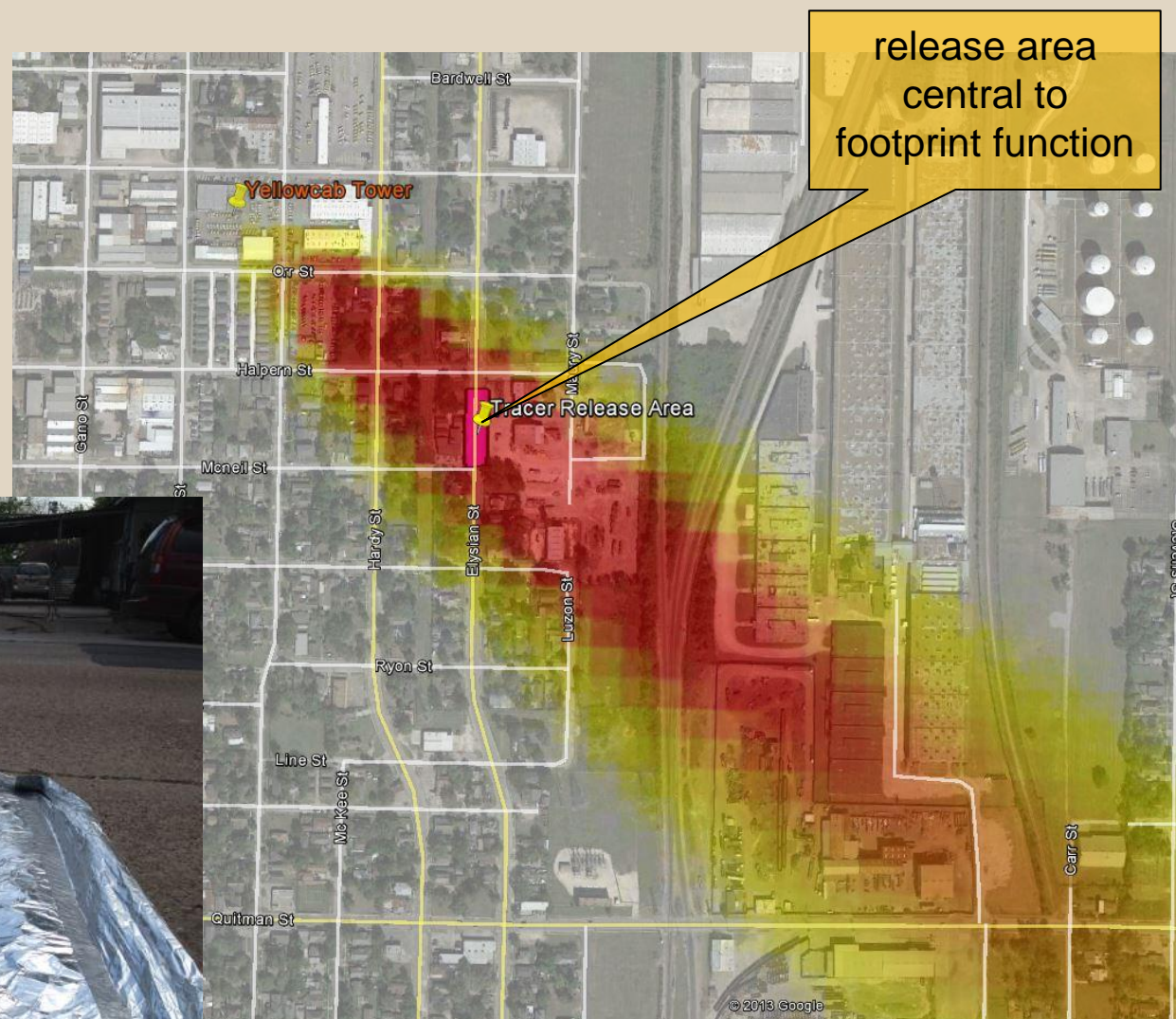
A Large Pentane Source, II

- emissions permit: 10-23 lbs/hr (mean-max)
- using footprint model and net flux corrected for background shows average and median emissions of 15.1 lbs/hr and 12.2 lbs/hr, respectively

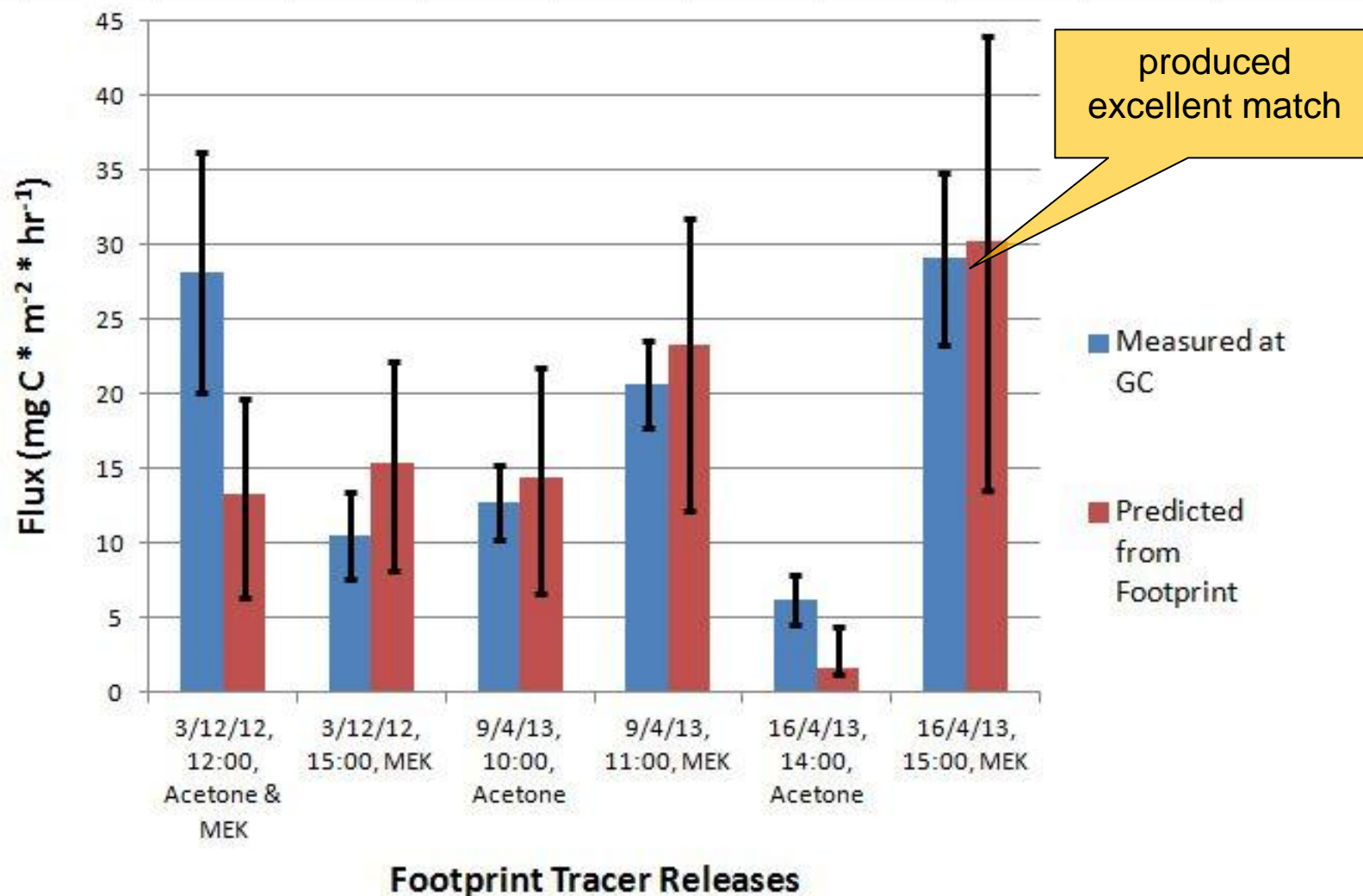


Tracer release study, I

- April 16, 2013 15:00
CDT release of 2
gallons of MEK via
pour and blow dry
evaporation method.



Tracer release study, II



Some Conclusions

- 4-5 years of useful CO₂, CO, and NO_x flux data
 - available for model comparisons
 - 2007/08/09 net CO₂ fluxes in Ameriflux data base
 - CO fluxes used independently to scale traffic contribution
 - no consistent trend in measured CO fluxes though
- unique seasonal VOC flux data
 - clear reductions over 4-yr period
 - used to carry out successful tracer release study
 - can monitor individual sources
 - can distinguish between sources
- bulk flux footprint model reasonably reliable
 - within factor of 2 when overlapping source; many uncertainties
 - biased when edge of footprint function overlaps source