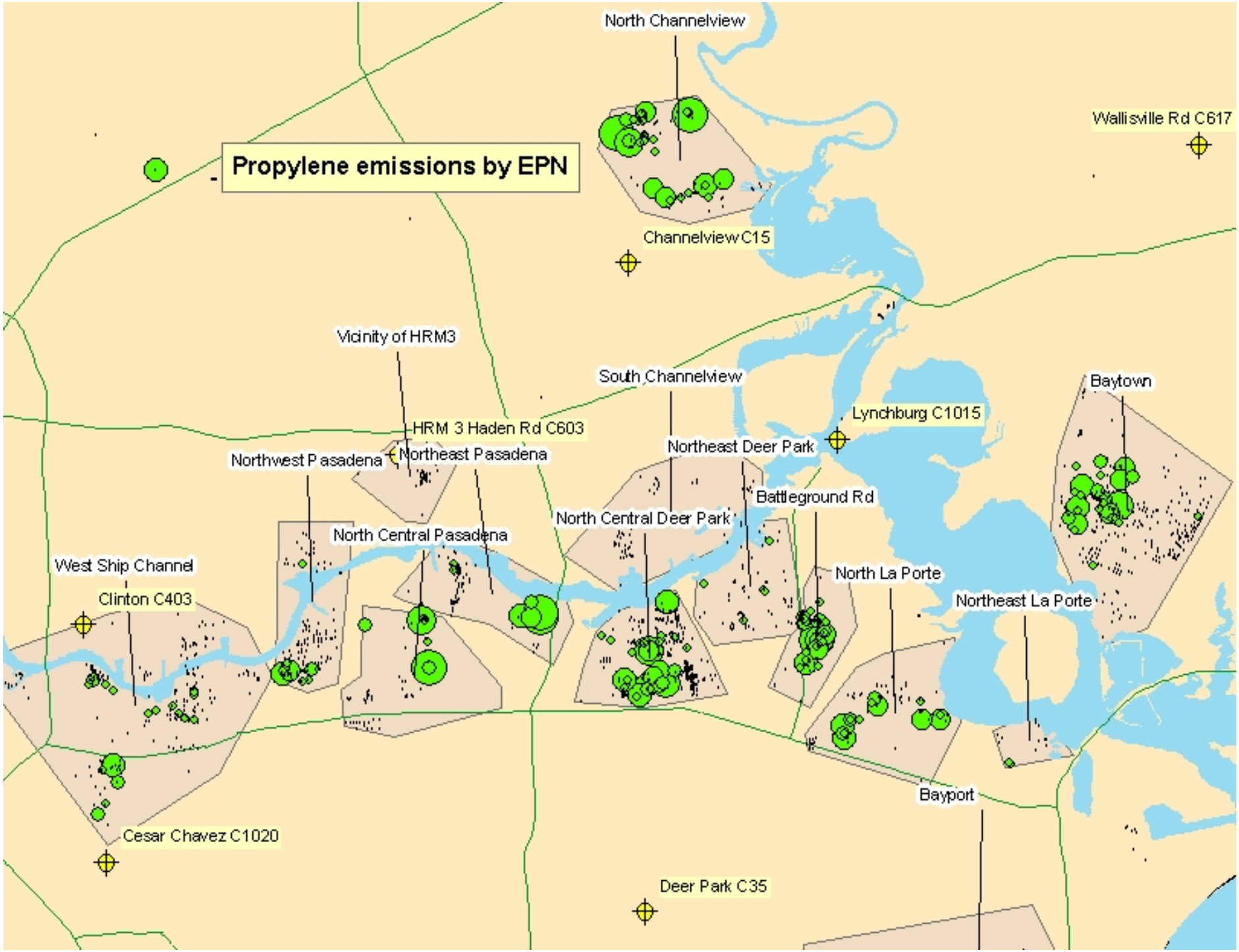
A New Spatial Emission Adjustment for HRVOCs

Mark Estes, Clint Harper, Dick Karp, John Jolly
Air Modeling and Data Analysis Section

The Quest for a Proper Distribution of Emissions

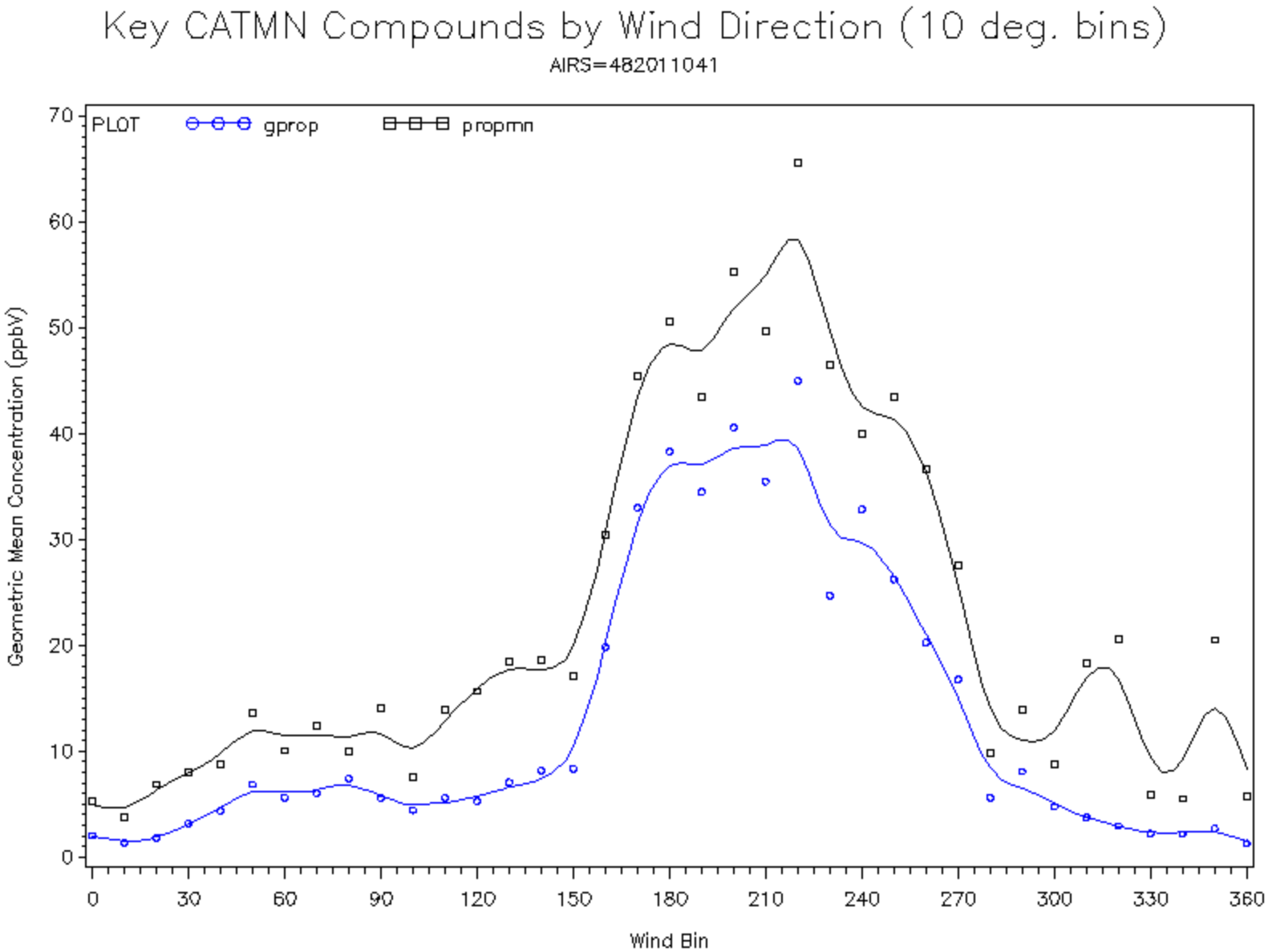
Ever since the TexAQS 2000 study found that the VOC emissions in Houston were underestimated, TCEQ staff has been seeking a method of properly estimating and distributing the point source emissions, especially in the industrial areas.


Propylene emissions by EPN
North Channelview
Wallisville Rd C617
Channelview C15
Vicinity of HRM3
South Channelview
Baytown
Lynchburg C1015
HRM 3 Haden Rd C603
Northeast Deer Park
Northwest Pasadena
Northeast Pasadena
Battleground Rd
North Central Deer Park
North Central Pasadena
West Ship Channel
North La Porte
Clinton C403
Northeast La Porte
Bayport
Cesar Chavez C1020
Deer Park C35

Estimating Emissions from Observations

- When VOC monitors are downwind of certain source clusters (e.g. Battleground Rd), they consistently observe high concentrations.
- In the past, however, we have not had VOC data from enough sites to triangulate upon the emission sources.
- It has been very challenging to estimate emissions from observations.

San Jacinto Monument



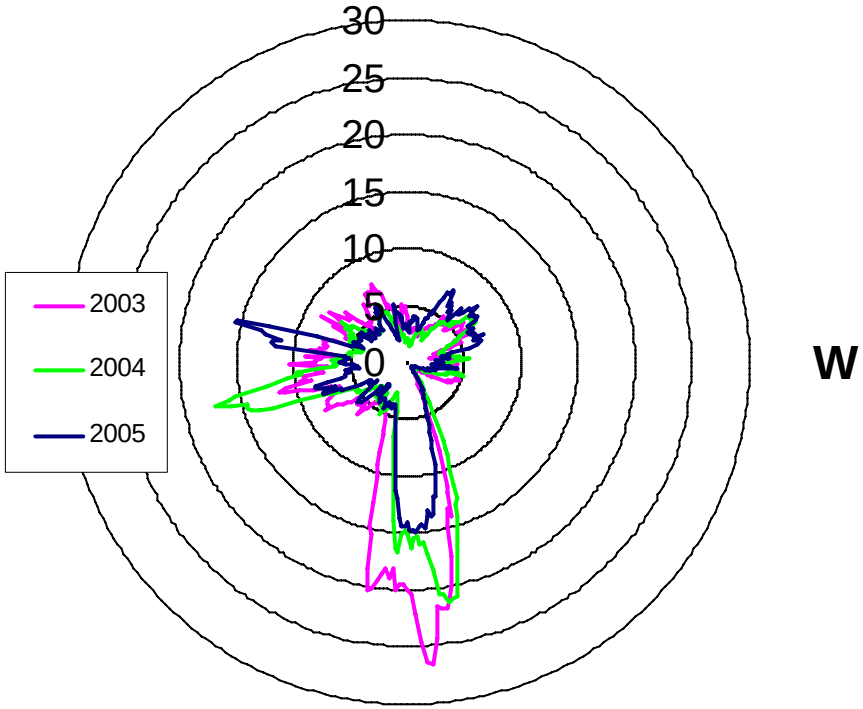
When winds blow from south and south-southwest, high propylene concentrations were consistently observed at the San Jacinto Monument site.

Triangulation Using EISM Data

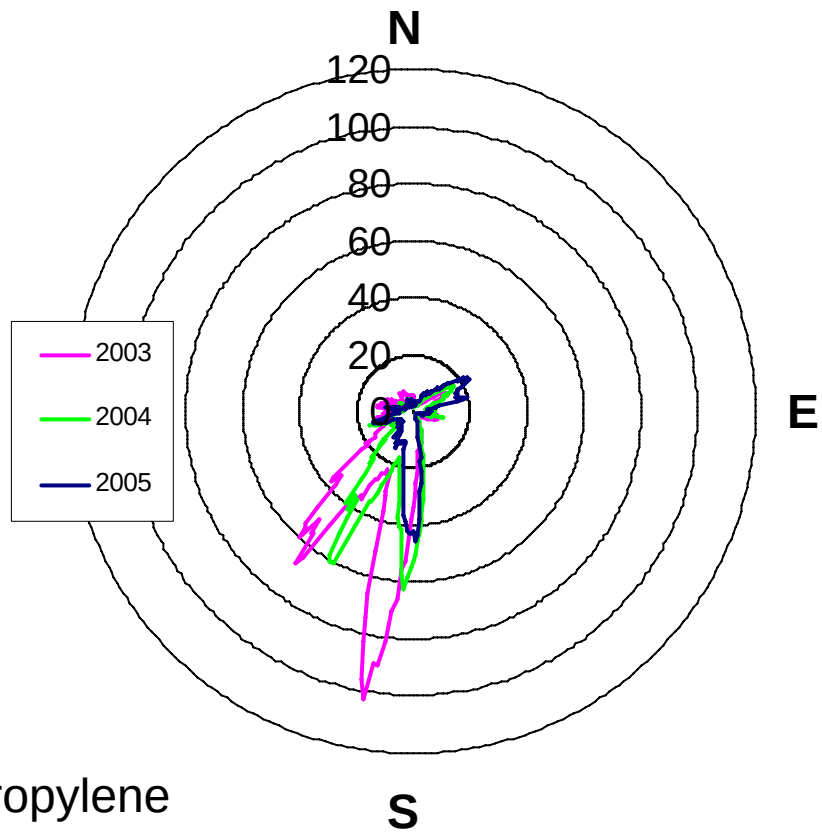
- In 2003, the EISM program added three new auto-GCs in the industrial areas of Houston: Wallisville Rd., Lynchburg Ferry, and Haden Road-HRM3.
- Since 2003, two more auto-GCs have been added: Chavez HS and Milby Park.
- The resulting network is composed of eight auto-GCs, which encompass the industrial areas of southeastern Harris Co.

Geometric Mean Ethylene and Propylene by Wind Direction at Lynchburg 2003 – 2005, June – August only

Ethylene

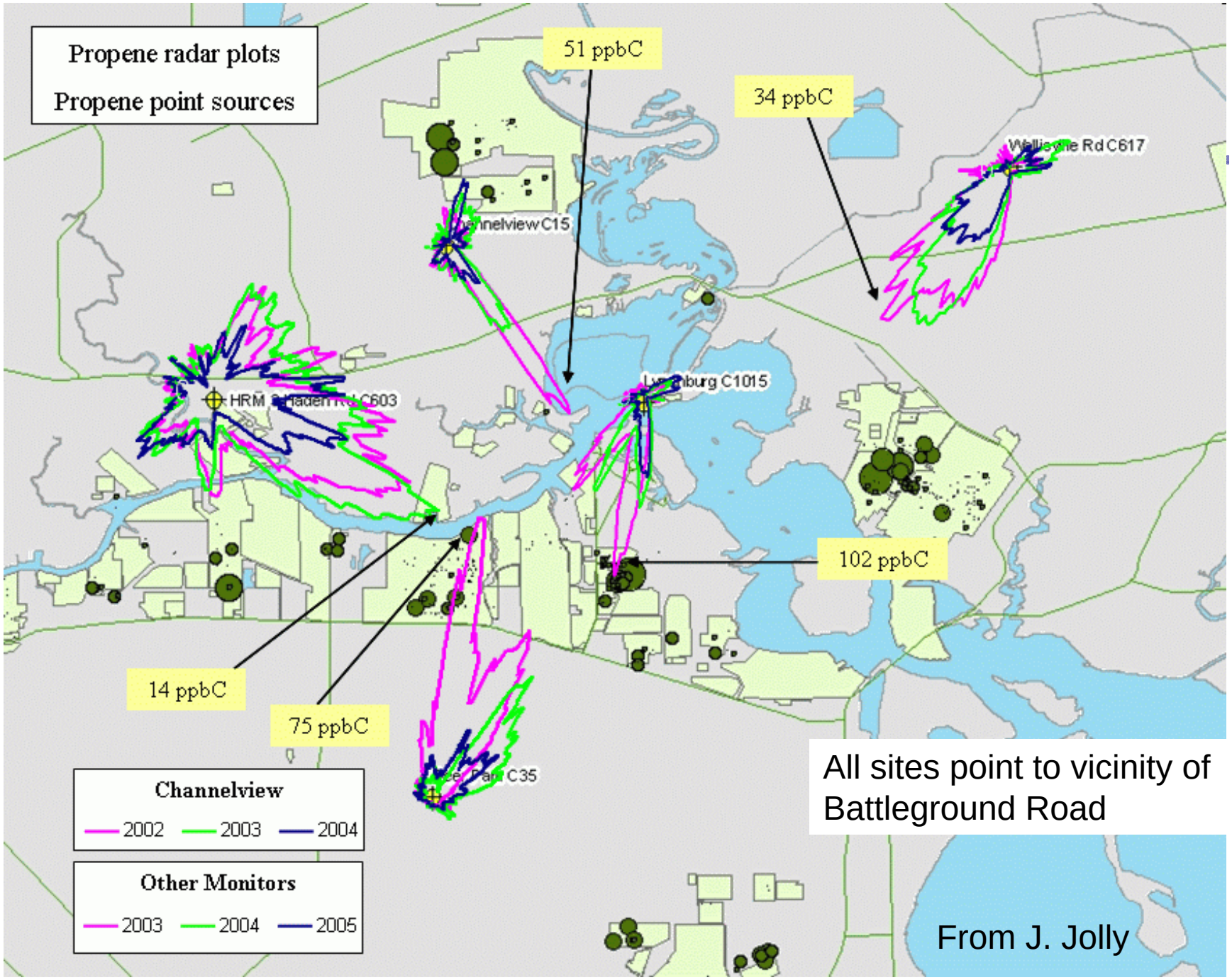


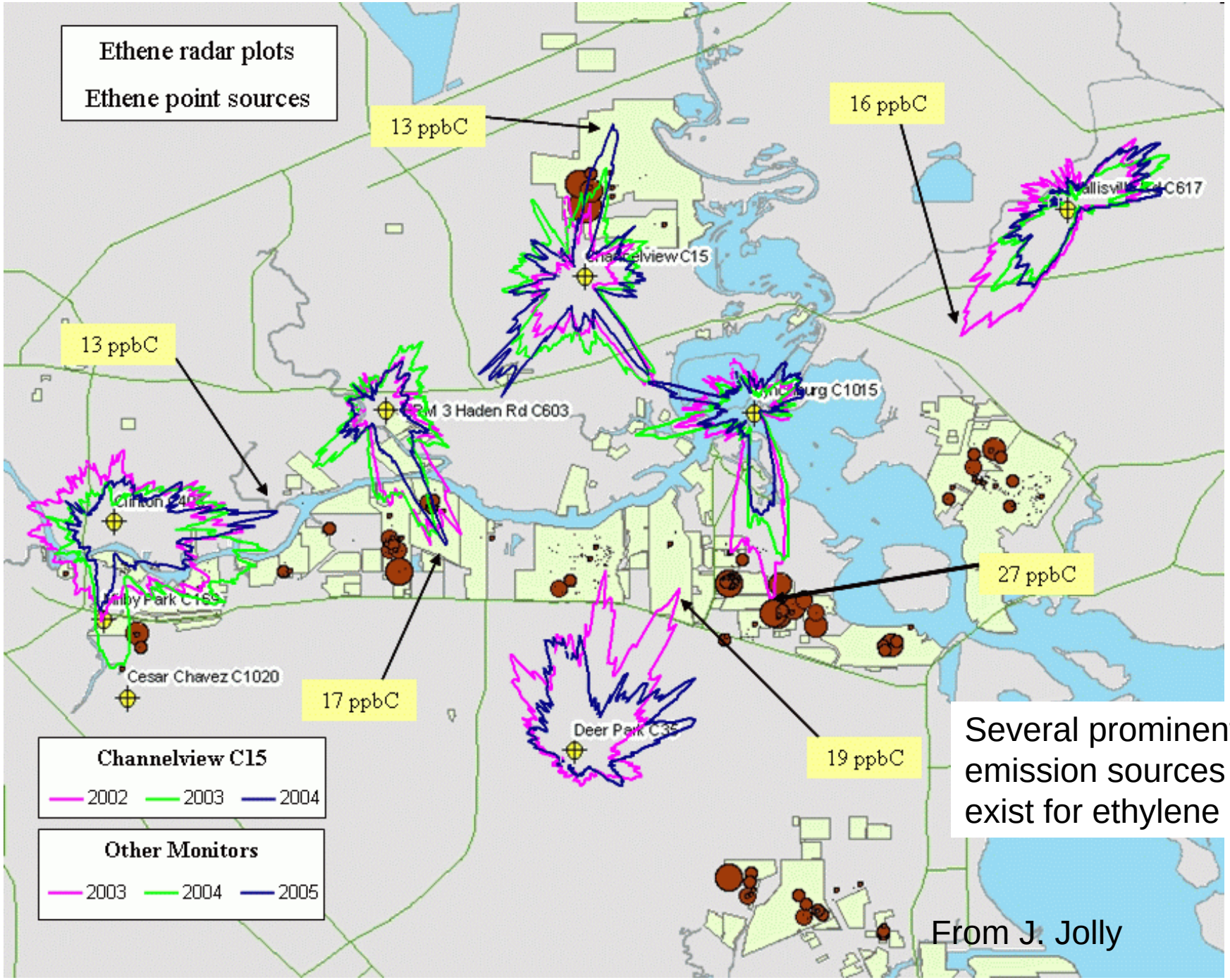
Propylene



Radar plots show that high ethylene and propylene concentrations are consistently observed at Lynchburg Ferry when winds are southerly.

From J. Jolly


Propene radar plots
Propene point sources
51 ppbC
34 ppbC
102 ppbC
14 ppbC
75 ppbC
Channelview
2002
2003
2004
Other Monitors
2003
2004
2005
All sites point to vicinity of Battleground Road
From J. Jolly

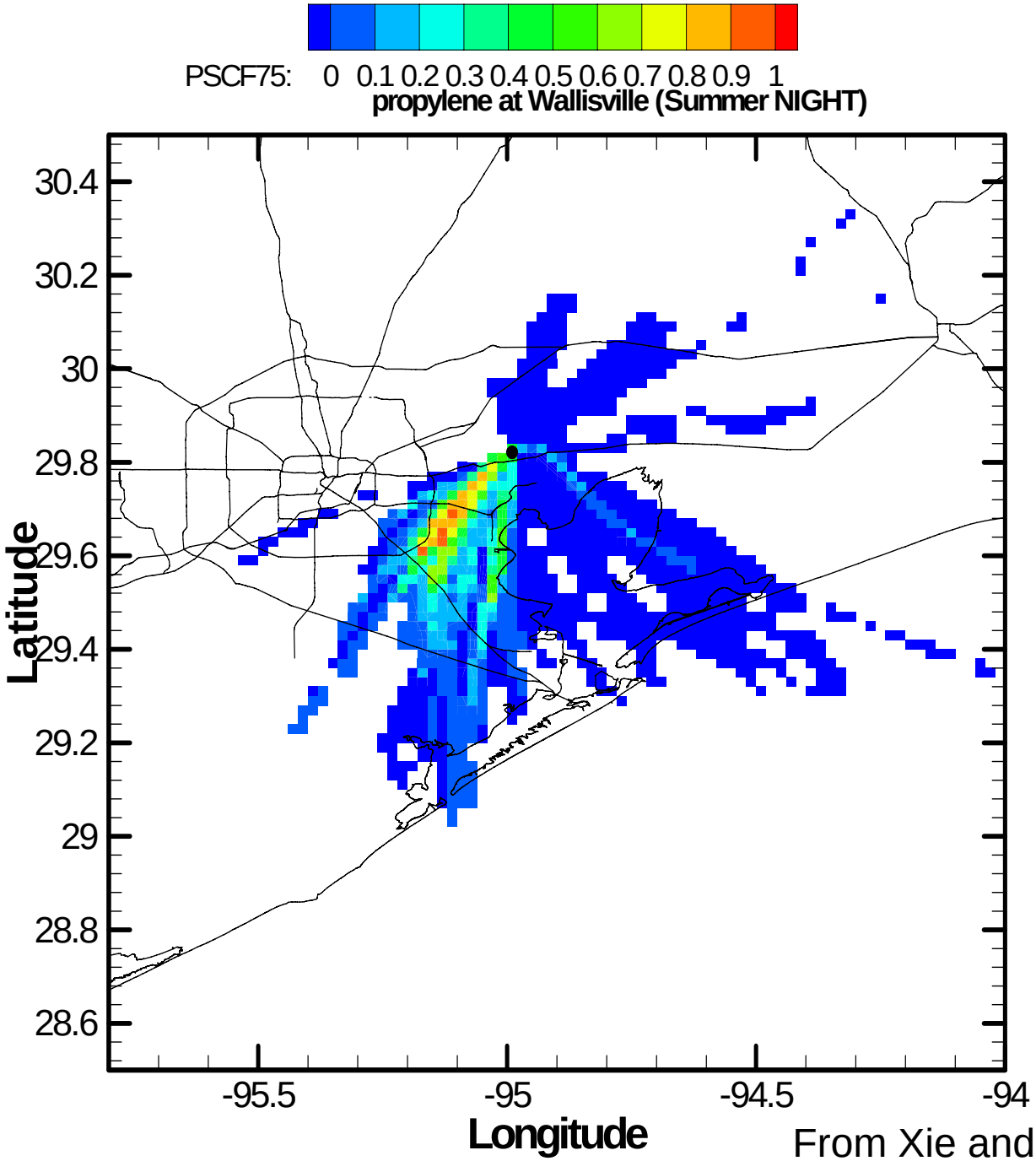


Several prominent emission sources exist for ethylene

From J. Jolly

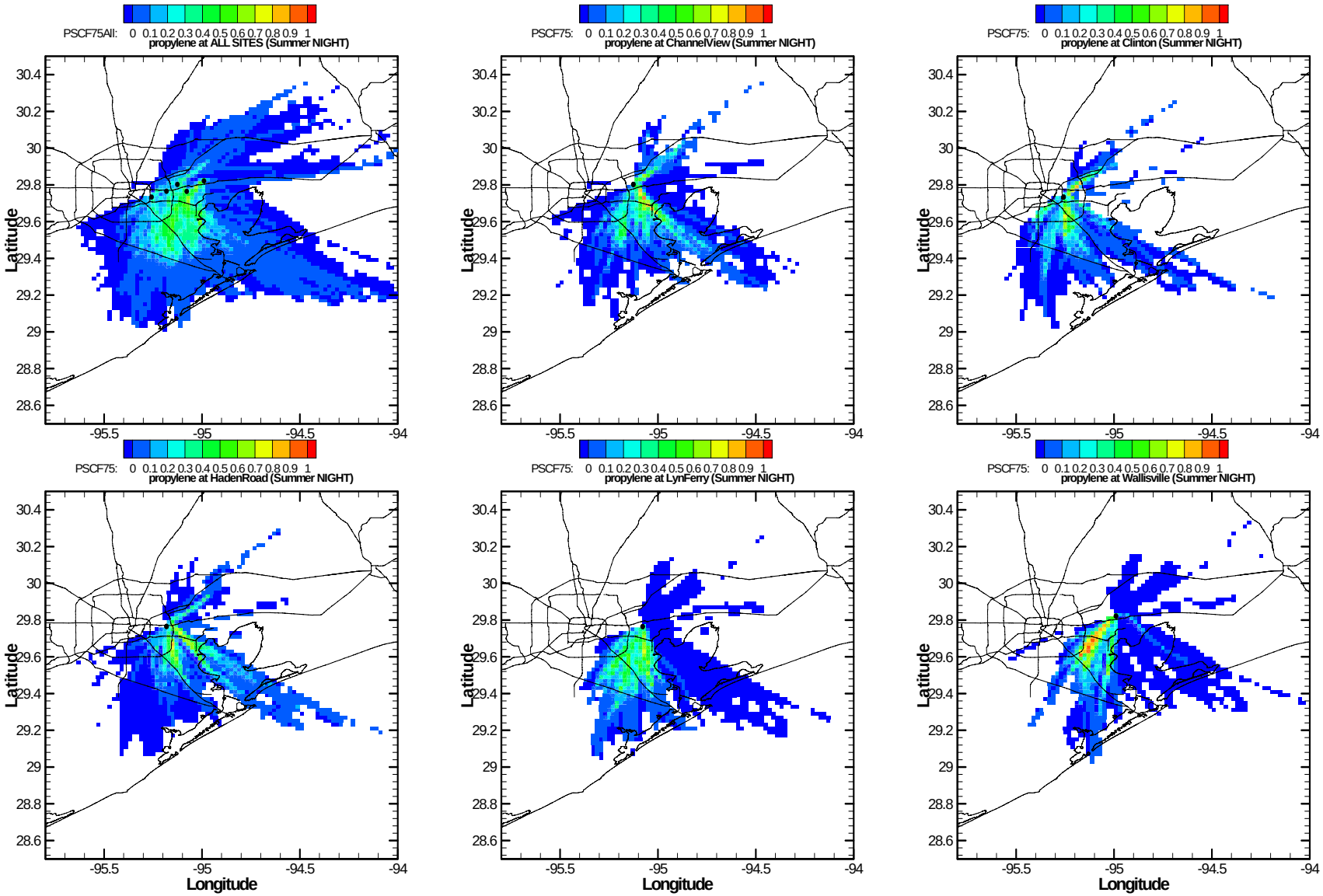
Question

- How often does a monitoring site observe high concentrations of a VOC after the air mass has passed over a particular point in the Houston area?
- Of all the trajectories that pass over a point, how many of them result in concentrations greater than the 75th percentile? If an air parcel passes over a particular point, what is the probability that it will contain high VOC concentrations?
- The maps of probabilities of high concentrations are called the potential source contribution functions (PSCF).



From Xie and Berkowitz, 2005

propene

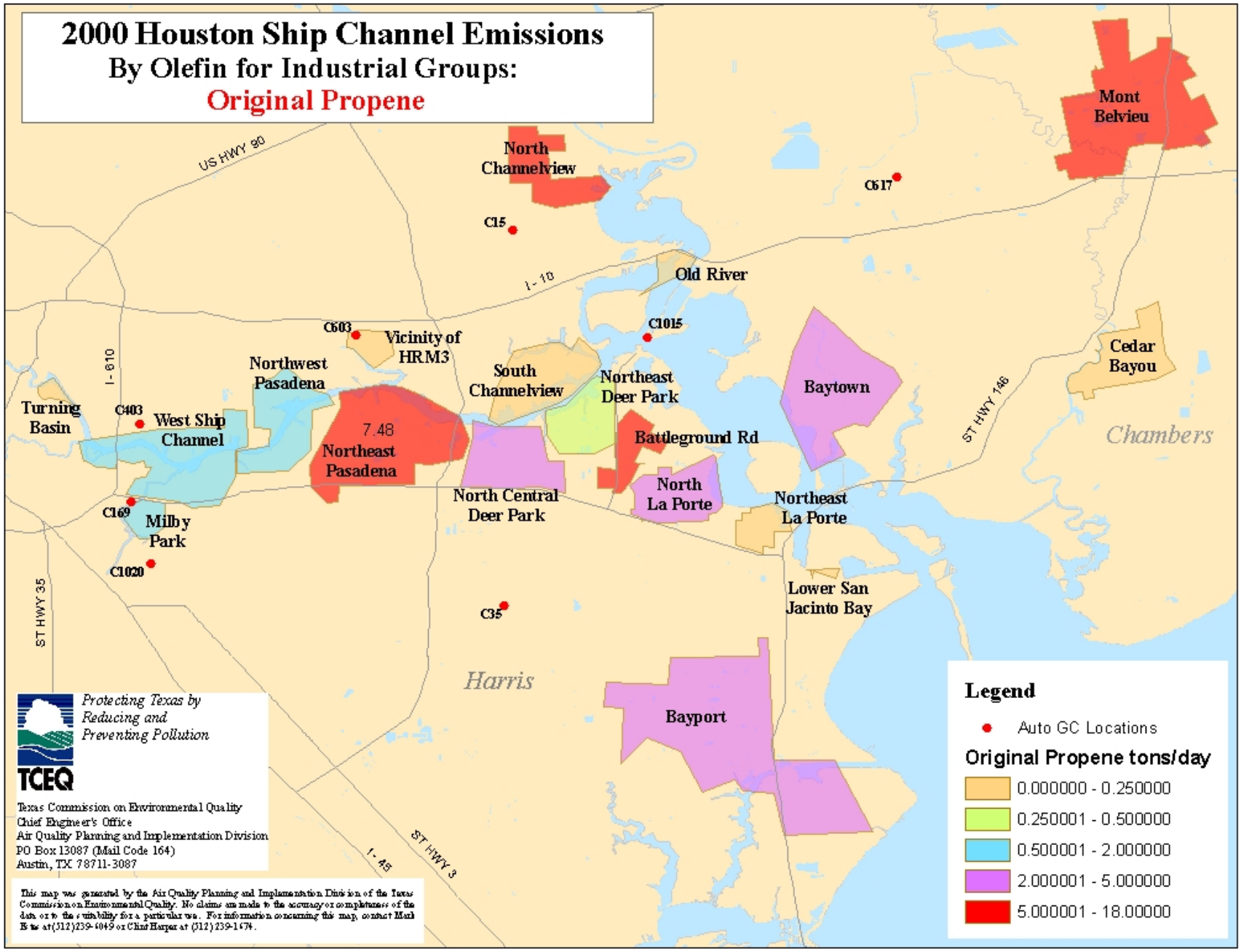


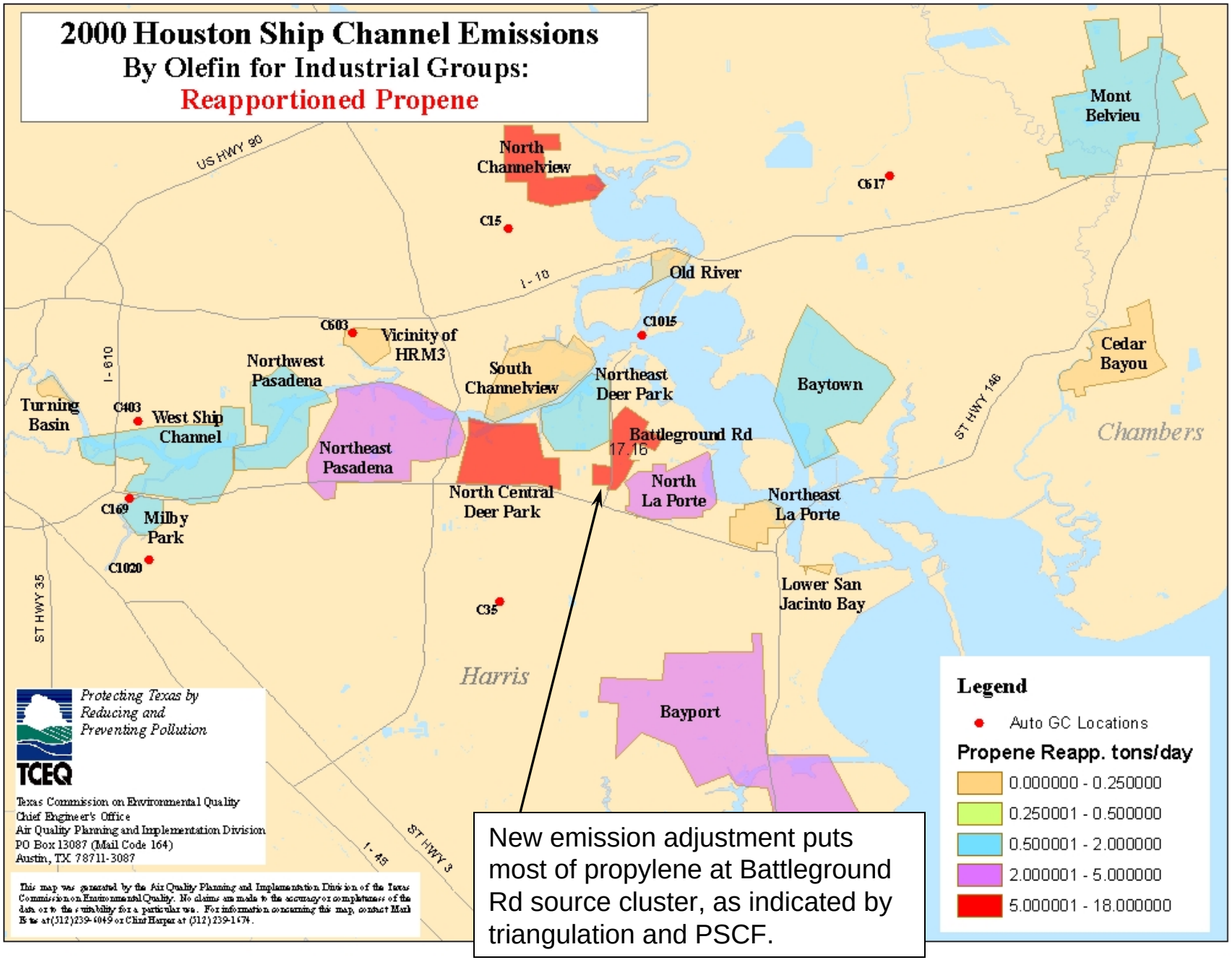
Potential source contributions for each site (Xie and Berkowitz, 2005).

New Emission Adjustment for Modeling

- The same quantity of extra olefins* (i.e., above the reported point source EI) was added to the original reported inventory.
- However, it was redistributed according to the potential source contribution functions (PSCF).

**Light olefins* refer to the class of compounds which include ethylene, propylene, butenes, and butadiene.


2000 Houston Ship Channel Emissions
By Olefin for Industrial Groups:
Original Propene
US HWY 90
North Channelview
C15
C617
Mont Belvieu
I - 10
Old River
C603
Vicinity of HRM3
C1015
Cedar Bayou
I - 610
Northwest Pasadena
South Channelview
Northeast Deer Park
Baytown
ST HWY 146
Turning Basin
C403
West Ship Channel
7.48
Northeast Pasadena
Battleground Rd
Chambers
North Central Deer Park
North La Porte
Northeast La Porte
C169
Milby Park
C1020
ST HWY 35
Lower San Jacinto Bay
C35
Harris
Bayport
Protecting Texas by Reducing and Preventing Pollution
TCEQ
Texas Commission on Environmental Quality
Chief Engineer's Office
Air Quality Planning and Implementation Division
PO Box 13087 (Mail Code 164)
Austin, TX 78711-3087
I - 45
ST HWY 3
This map was generated by the Air Quality Planning and Implementation Division of the Texas Commission on Environmental Quality. No claims are made to the accuracy or completeness of the data or to the suitability for a particular use. For information concerning this map, contact Mark Estes at (512) 239-4049 or Clint Harper at (512) 239-1474.
Legend
Auto GC Locations
Original Propene tons/day
0.000000 - 0.250000
0.250001 - 0.500000
0.500001 - 2.000000
2.000001 - 5.000000
5.000001 - 18.00000

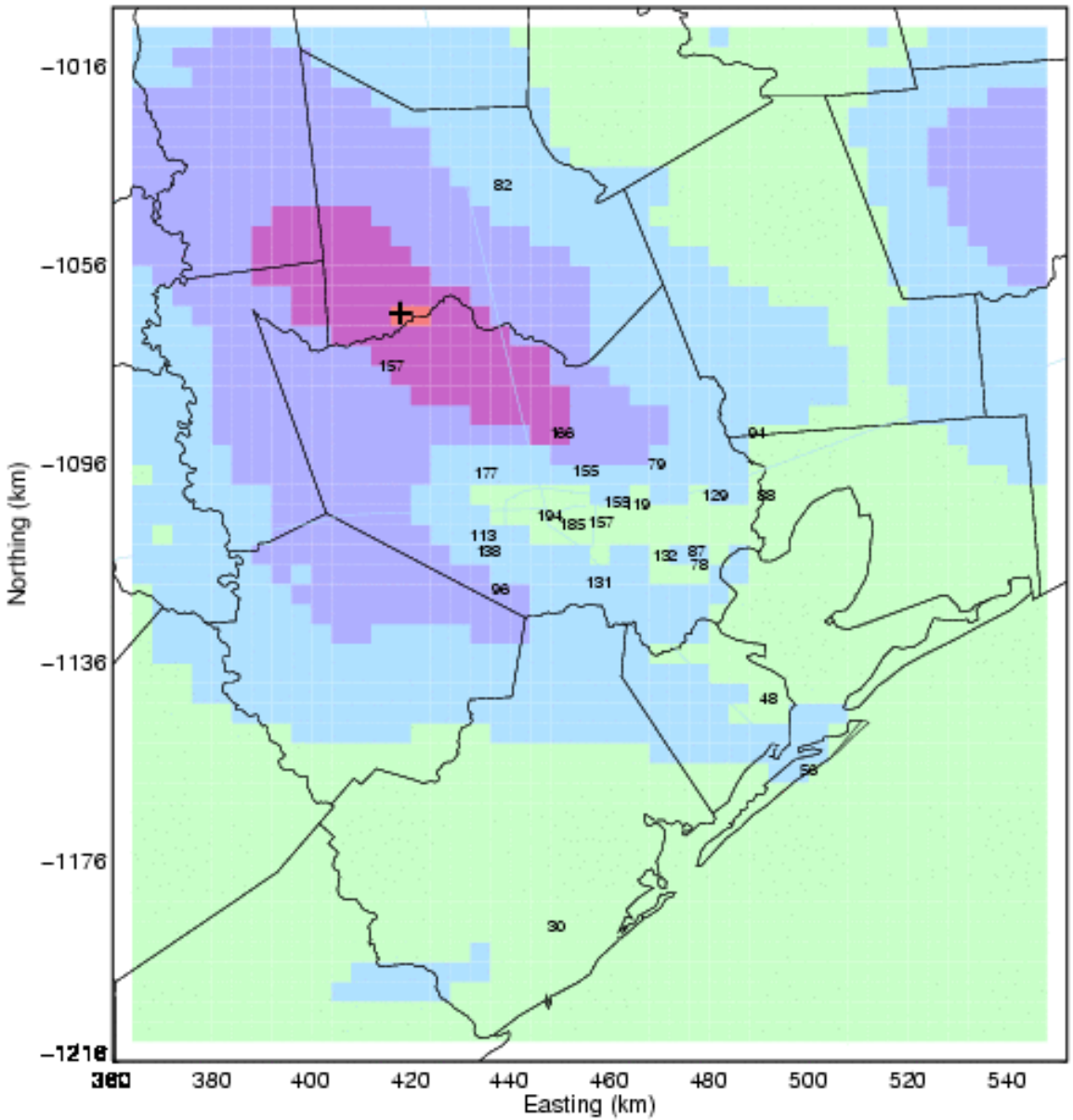


New emission adjustment puts most of propylene at Battleground Rd source cluster, as indicated by triangulation and PSCF.

Daily Maximum Hourly Average O_3 Concentrations (ppb) for **08/25/2000**

camx431_cb4.hgb8h.base1c.regular.TCEQuh1_eta_tke

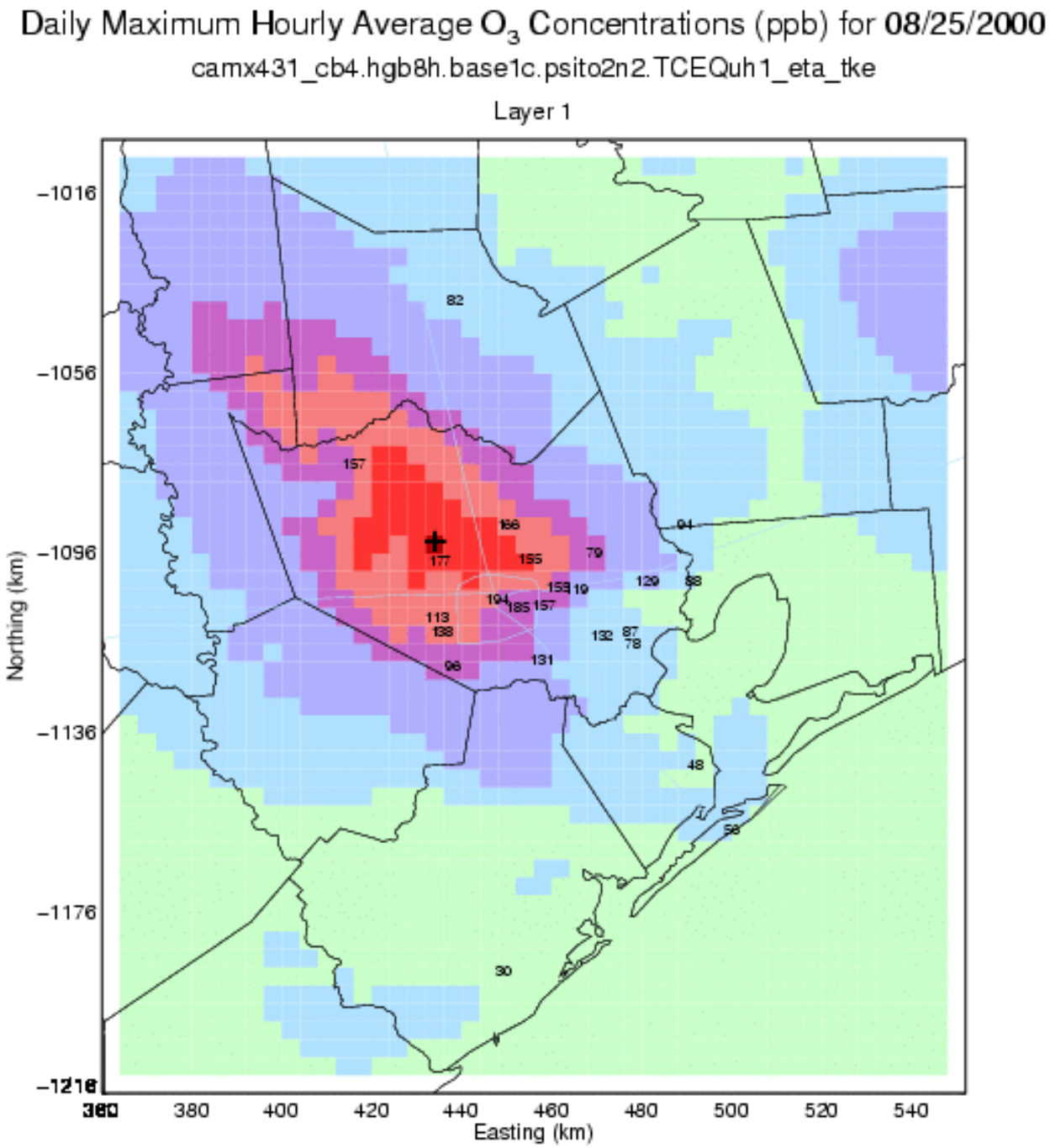
Layer 1



Model results for Aug 25, 2000, with no emission adjustment

Max O_3:
125.7 ppb
at (418,-1066)

Legend
- < 45
- 45 – 65
- 65 – 85
- 85 – 105
- 105 – 125
- 125 – 145
- 145 – 165
- >= 165



Model results for Aug 25, 2000, with old emission adjustment

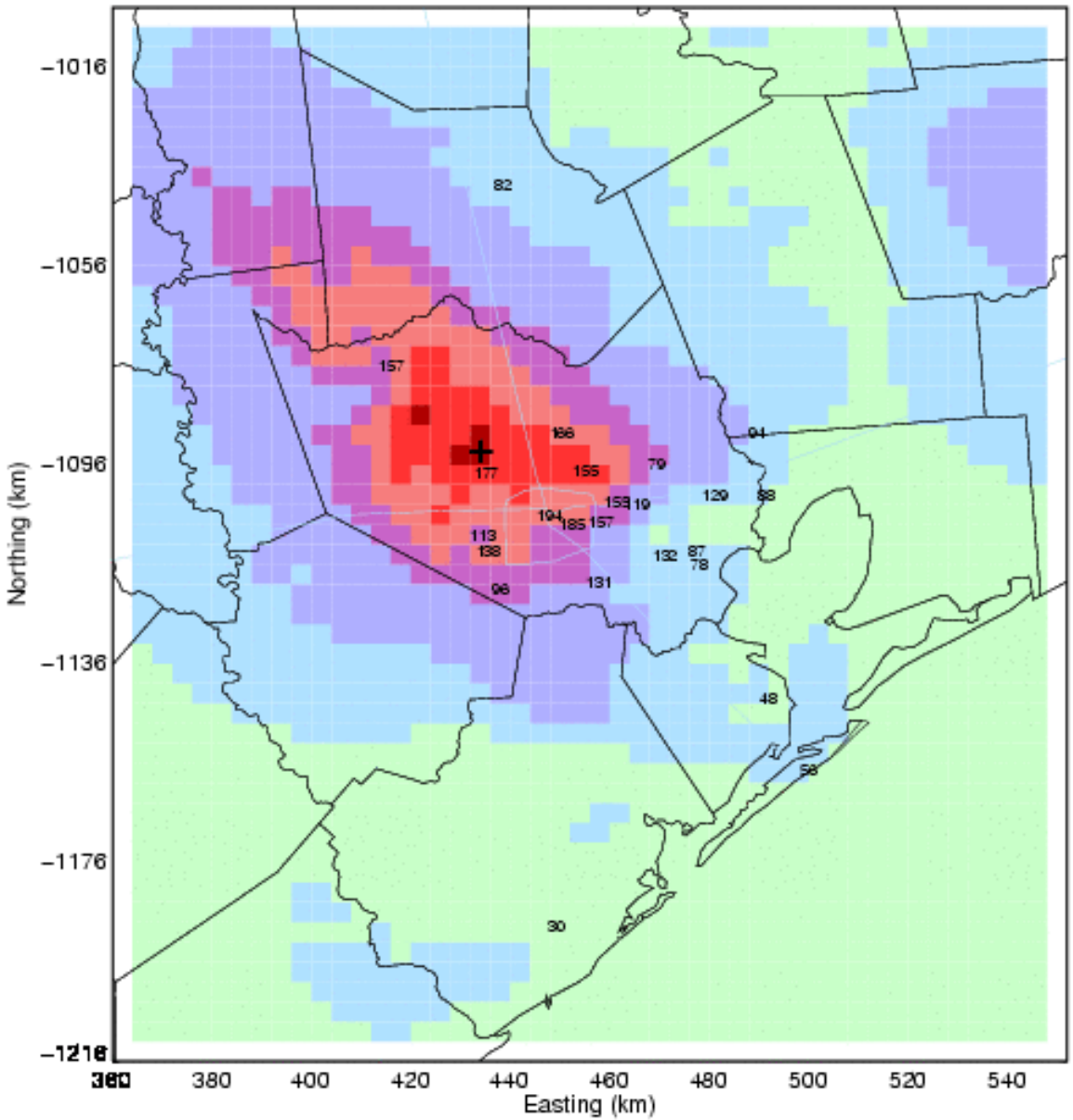
Max O_3:
166.3 ppb
at (434,−1094)

Legend
- < 45
- 45 – 65
- 65 – 85
- 85 – 105
- 105 – 125
- 125 – 145
- 145 – 165
- >= 165

Daily Maximum Hourly Average O_3 Concentrations (ppb) for **08/25/2000**

camx431_cb4.hgb8h.base1c.pscfolev1.TCEQuh1_eta_tke

Layer 1



Model results for Aug 25, 2000, with new emission adjustment

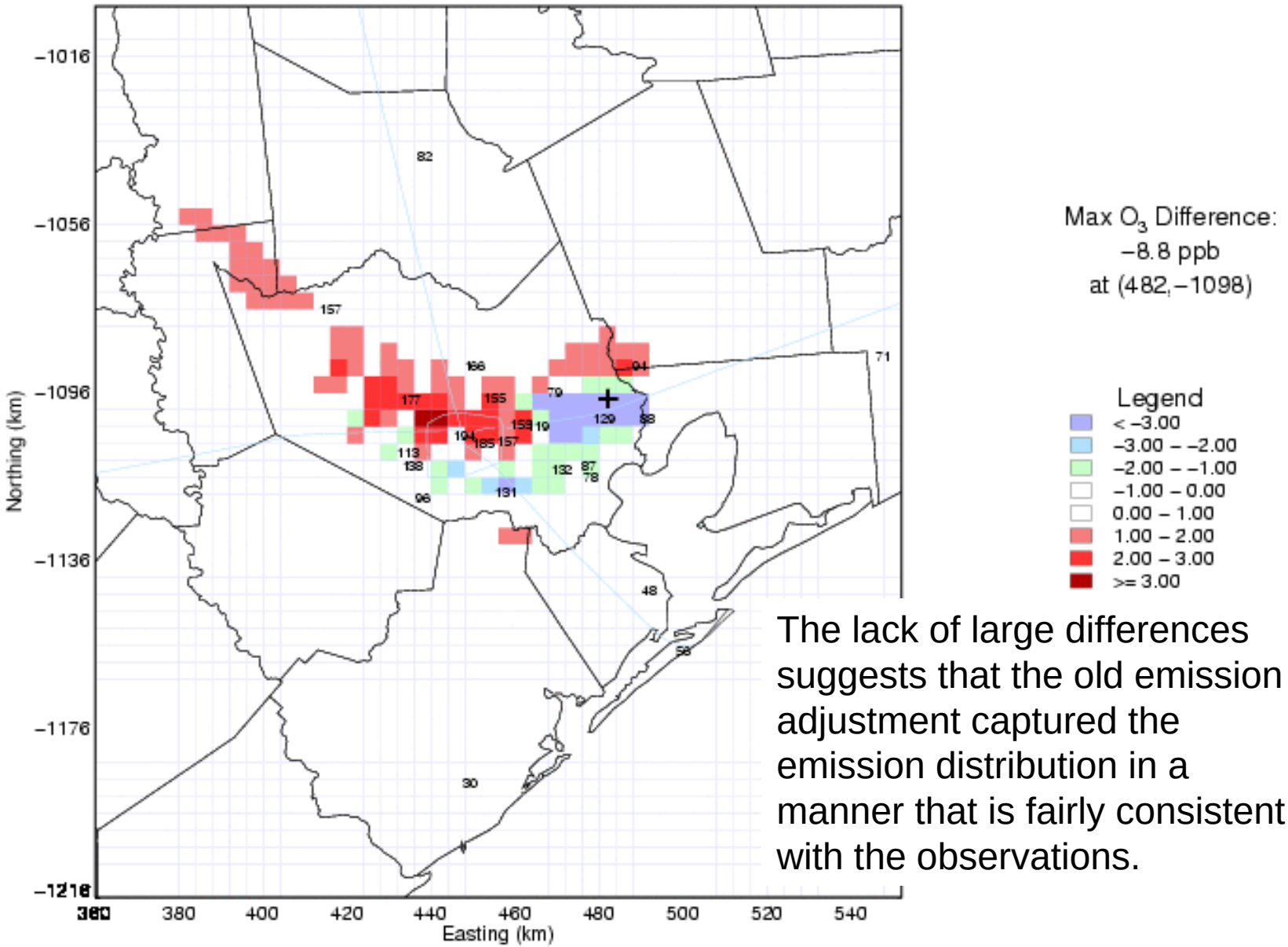
Max O_3:
168.0 ppb
at (434,−1094)

Legend
- < 45
- 45 – 65
- 65 – 85
- 85 – 105
- 105 – 125
- 125 – 145
- 145 – 165
- >= 165

Difference of Daily Maximum Hourly Average O_3 Concentrations (ppb) for **08/25/2000**

x431_cb4.hgb8h.base1c.pscfolev1.TCEQuh1_eta_tke–camx431_cb4.hgb8h.base1c.psito2n2.TCEQuh1_eta_tke

Layer 1



The lack of large differences suggests that the old emission adjustment captured the emission distribution in a manner that is fairly consistent with the observations.

Conclusions

- The new emission adjustment corroborates the old emission adjustment well.
- The new emission adjustment is based solidly upon observational data from the auto-GC network and should be easier to defend.