TCEQ

2014 HGB Ozone Summary

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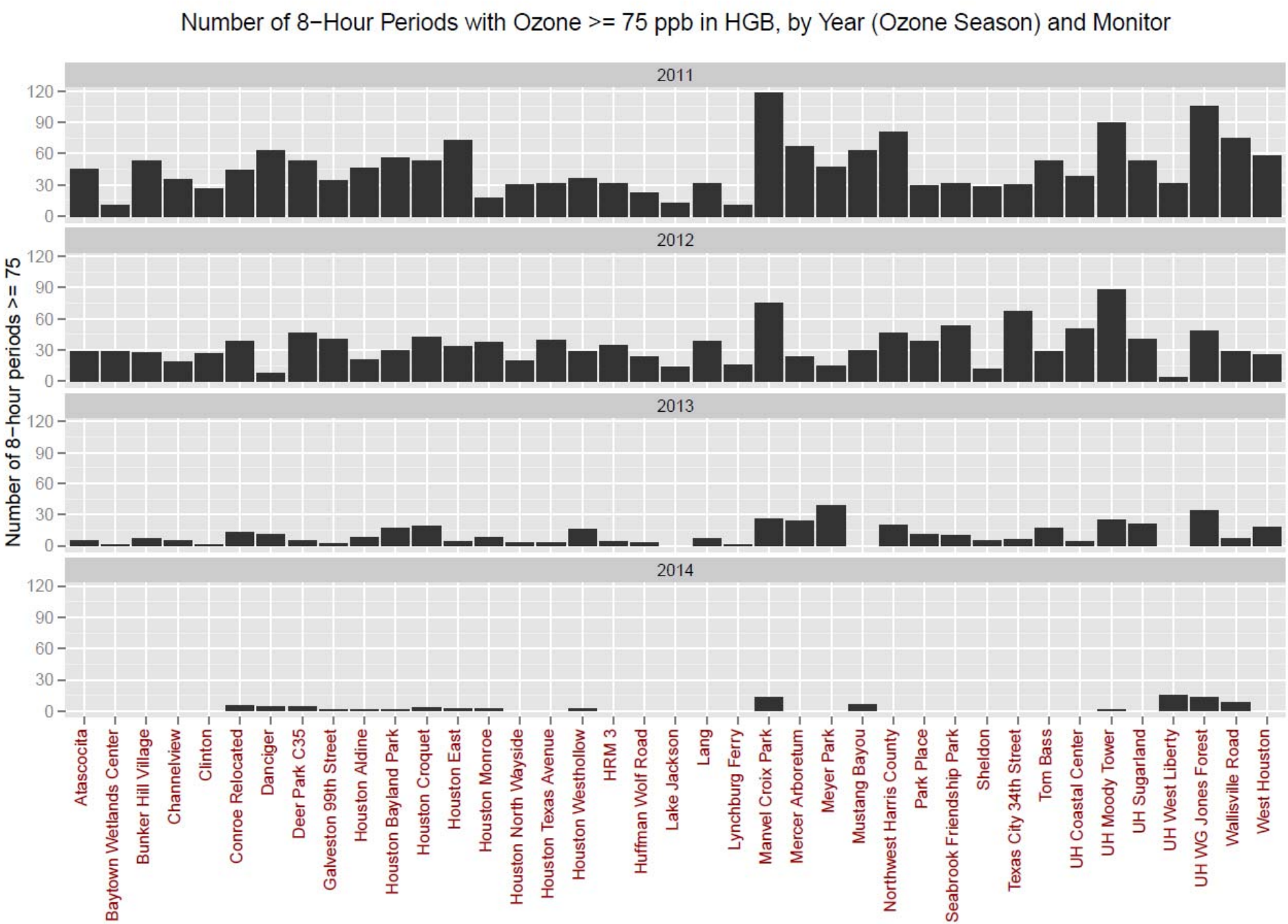
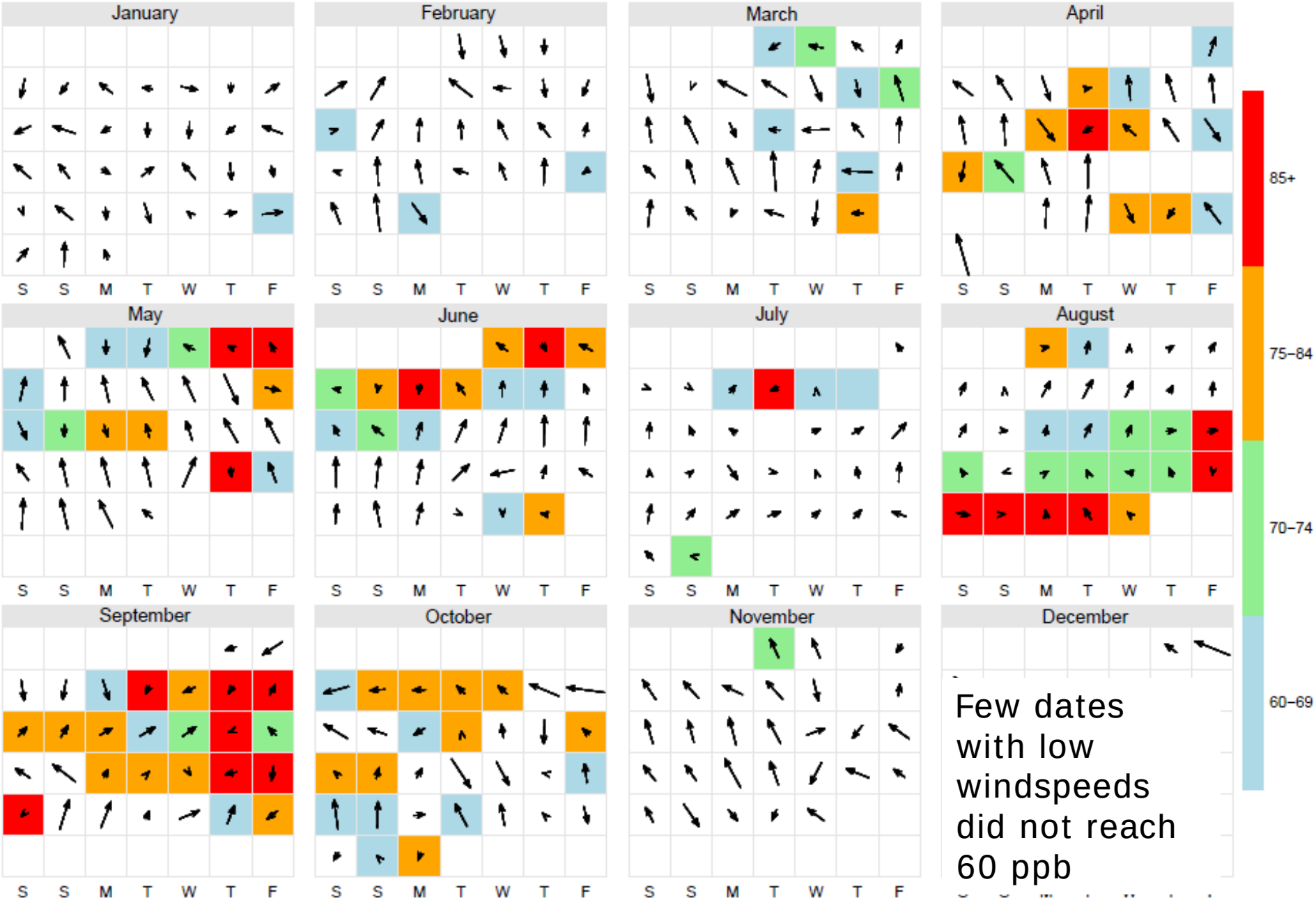
Outline

- Magnitude of decrease in 2014 from previous years
- Evaluation of variables – what might explain the decrease?
- Evaluation of specific 2014 days with peak 8-hour ozone >= 75 ppb
- What are limitations of this analysis?

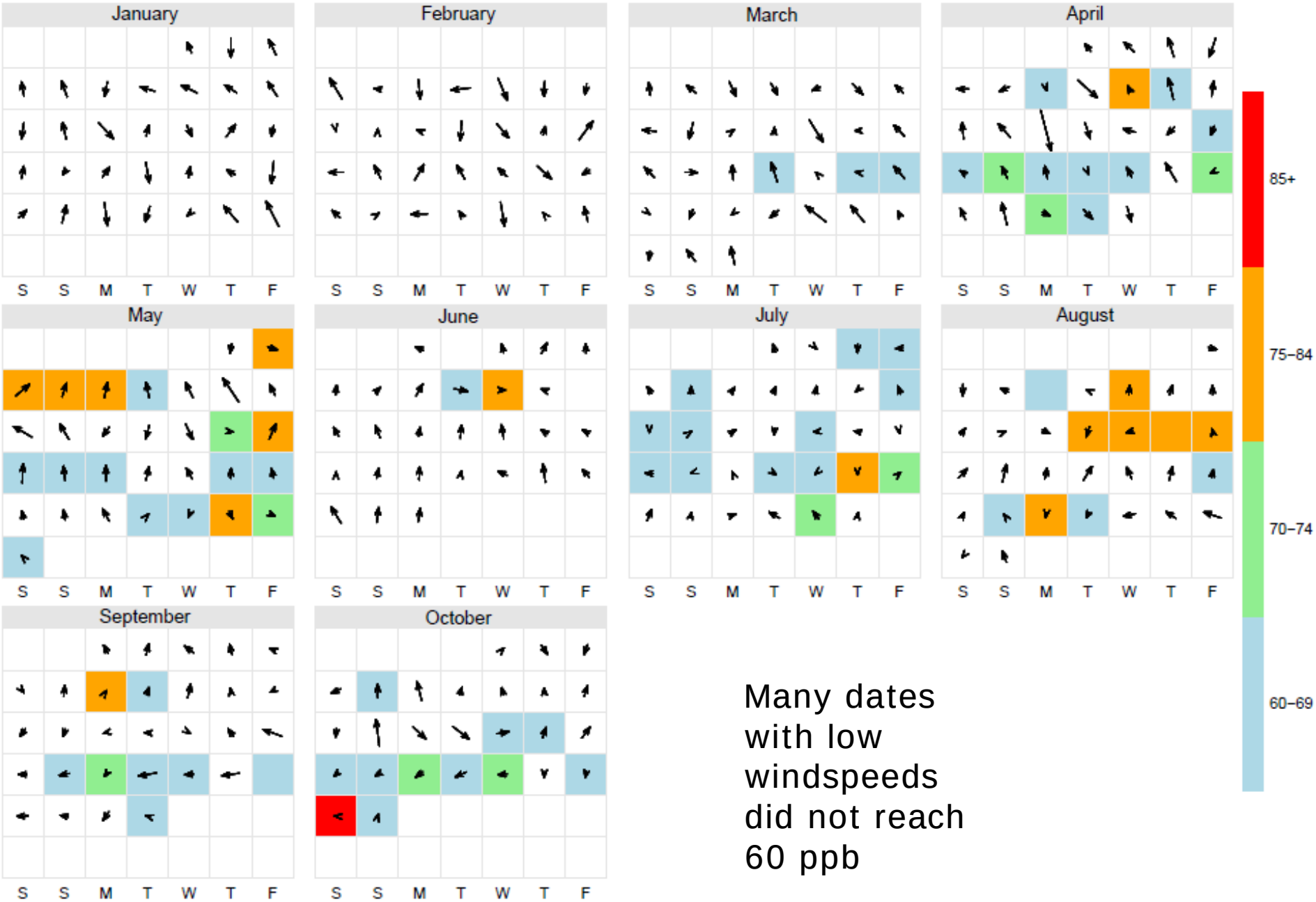

Number of 8−Hour Periods with Ozone >= 75 ppb in HGB, by Year (Ozone Season) and Monitor
Number of 8−hour periods >= 75
2011
2012
2013
2014
0
30
60
90
120
Atascocita
Baytown Wetlands Center
Bunker Hill Village
Channelview
Clinton
Conroe Relocated
Danciger
Deer Park C35
Galveston 99th Street
Houston Aldine
Houston Bayland Park
Houston Croquet
Houston East
Houston Monroe
Houston North Wayside
Houston Texas Avenue
Houston Westhollow
HRM 3
Huffman Wolf Road
Lake Jackson
Lang
Lynchburg Ferry
Manvel Croix Park
Mercer Arboretum
Meyer Park
Mustang Bayou
Northwest Harris County
Park Place
Seabrook Friendship Park
Sheldon
Texas City 34th Street
Tom Bass
UH Coastal Center
UH Moody Tower
UH Sugarland
UH West Liberty
UH WG Jones Forest
Wallisville Road
West Houston

Maximum Daily 8-Hr Ozone in HGB in 2011, with Windspeed/Wind Direction at Time of Max



Few dates with low windspeeds did not reach 60 ppb

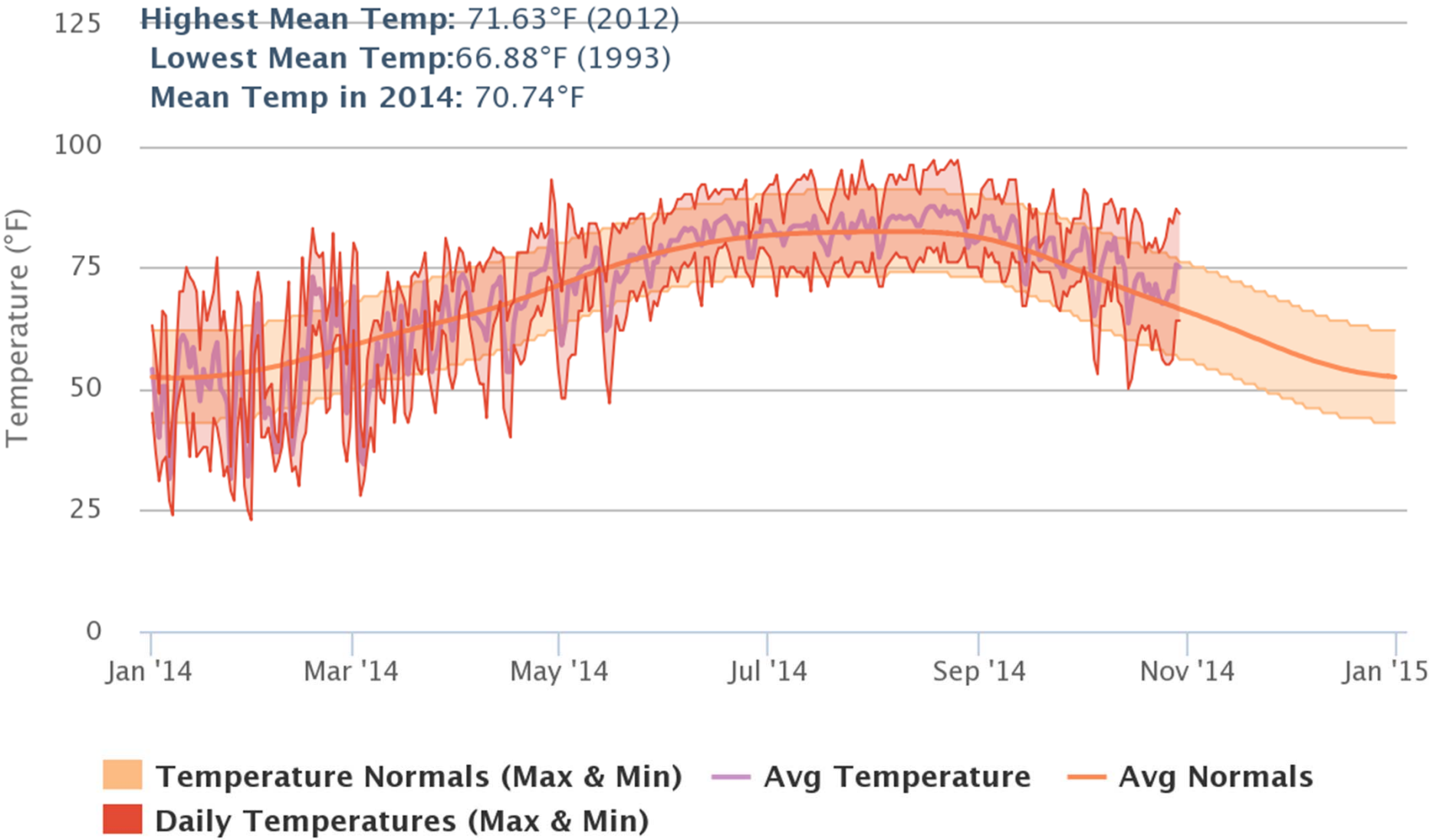
Maximum Daily 8-Hr Ozone in HGB in 2014, with Windspeed/Wind Direction at Time of Max



Many dates with low windspeeds did not reach 60 ppb

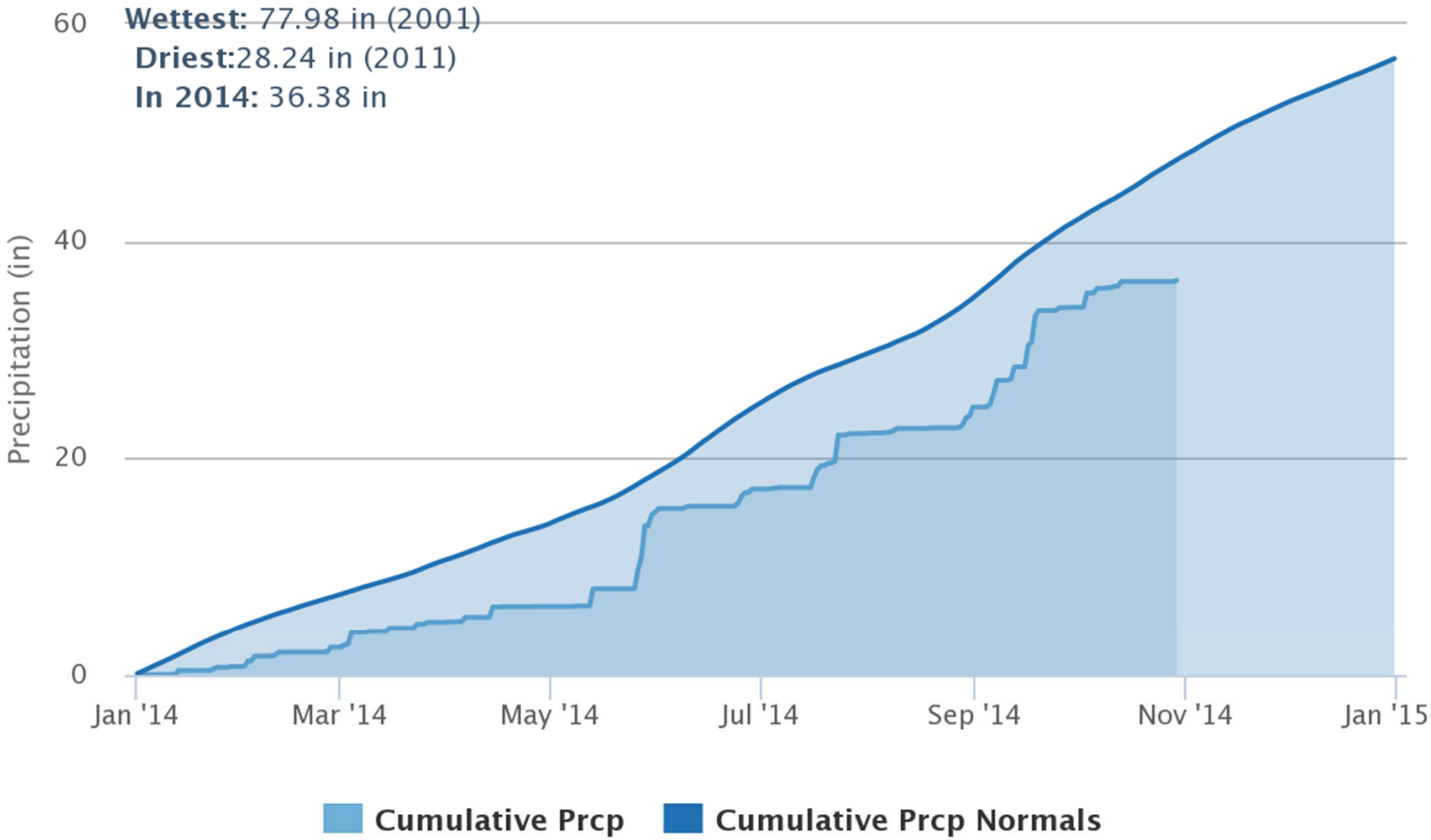
Houston 2014 Temperature vs Long-Term Average

Station: HOUSTON NWSO, TX

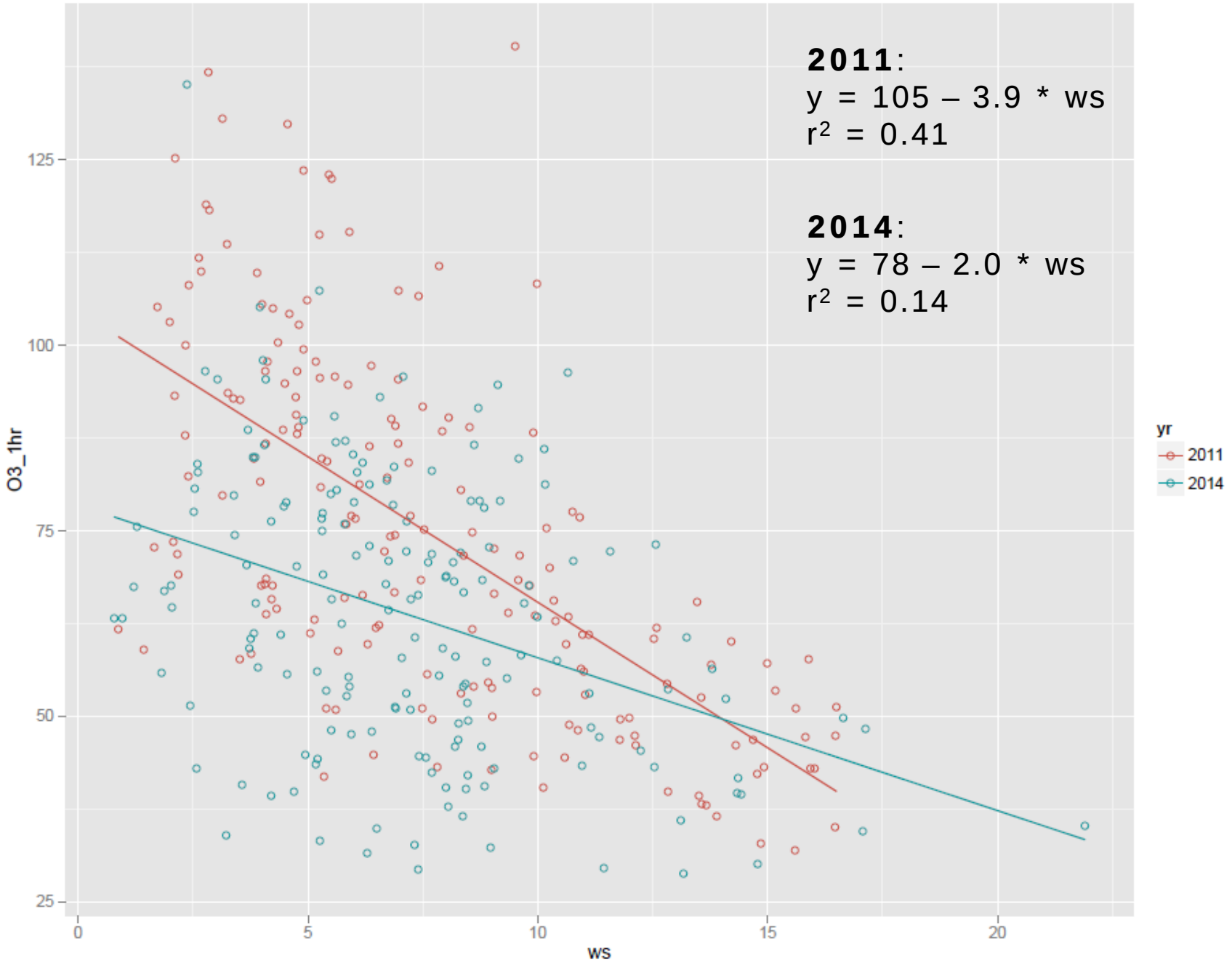


Houston 2014 Precipitation vs Long-Term Average

Station: HOUSTON NWSO, TX

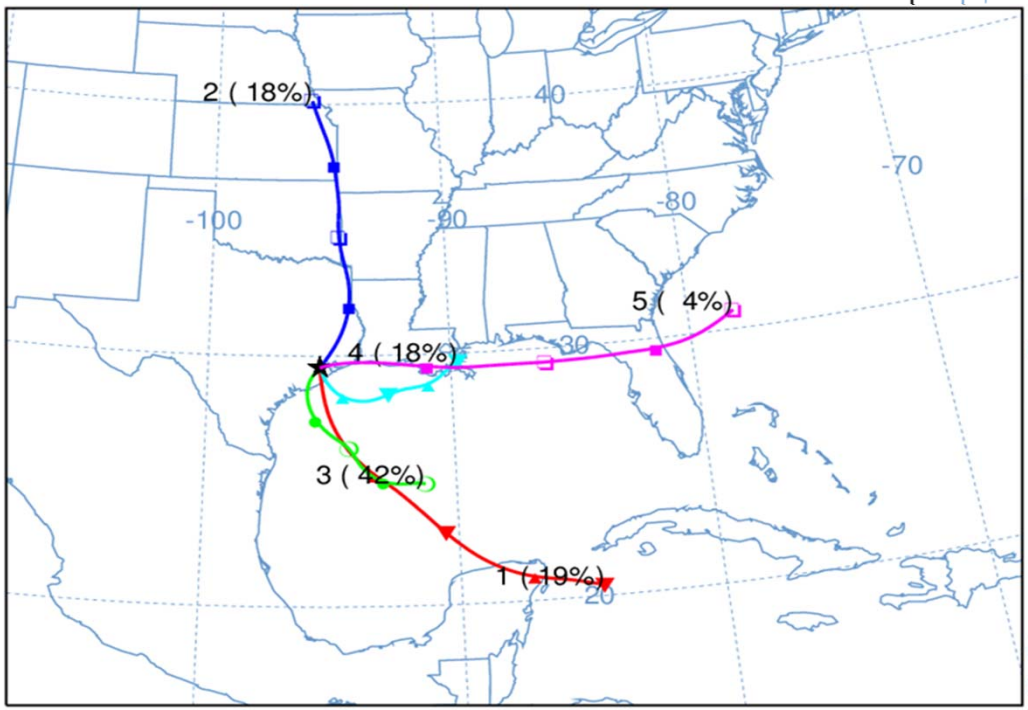


HGB Peak 1–Hour Ozone and Windspeed at Time of Peak, 2011 vs 2014



Back trajectory patterns, 2011 vs 2014

2011



2011

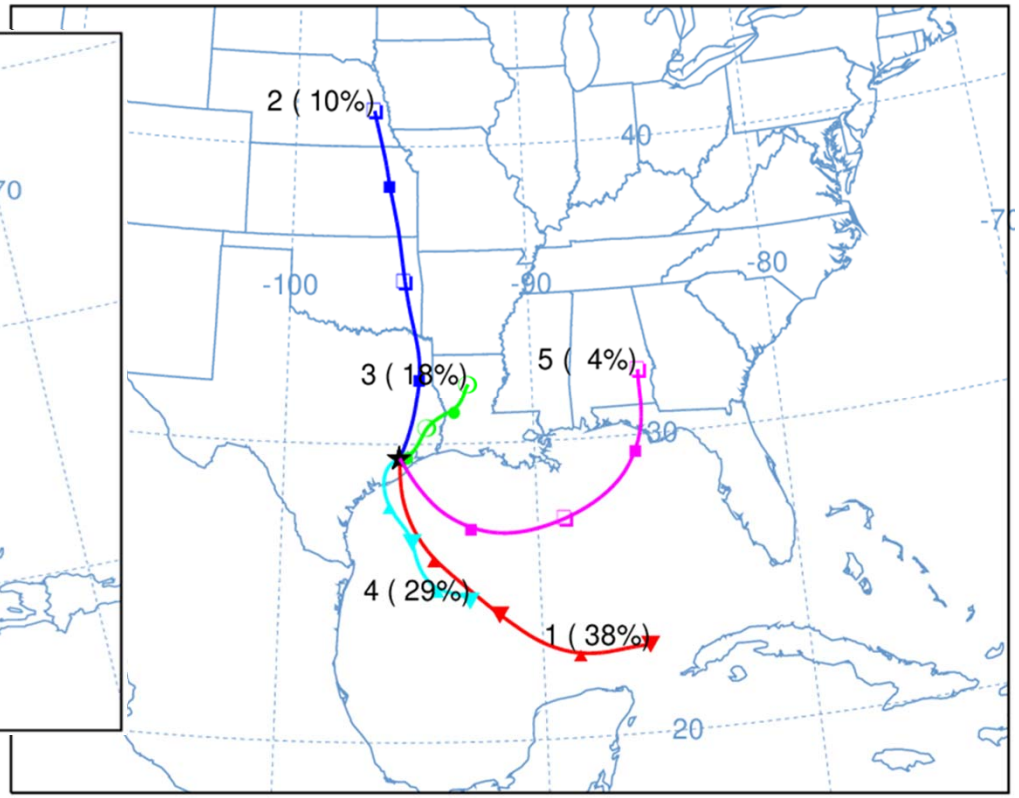
Manvel Croix: 20 Days >= 75 ppb

7 days Trajectory Cluster 2

5 days Trajectory Cluster 3

8 days Trajectory Cluster 4

2014



2014

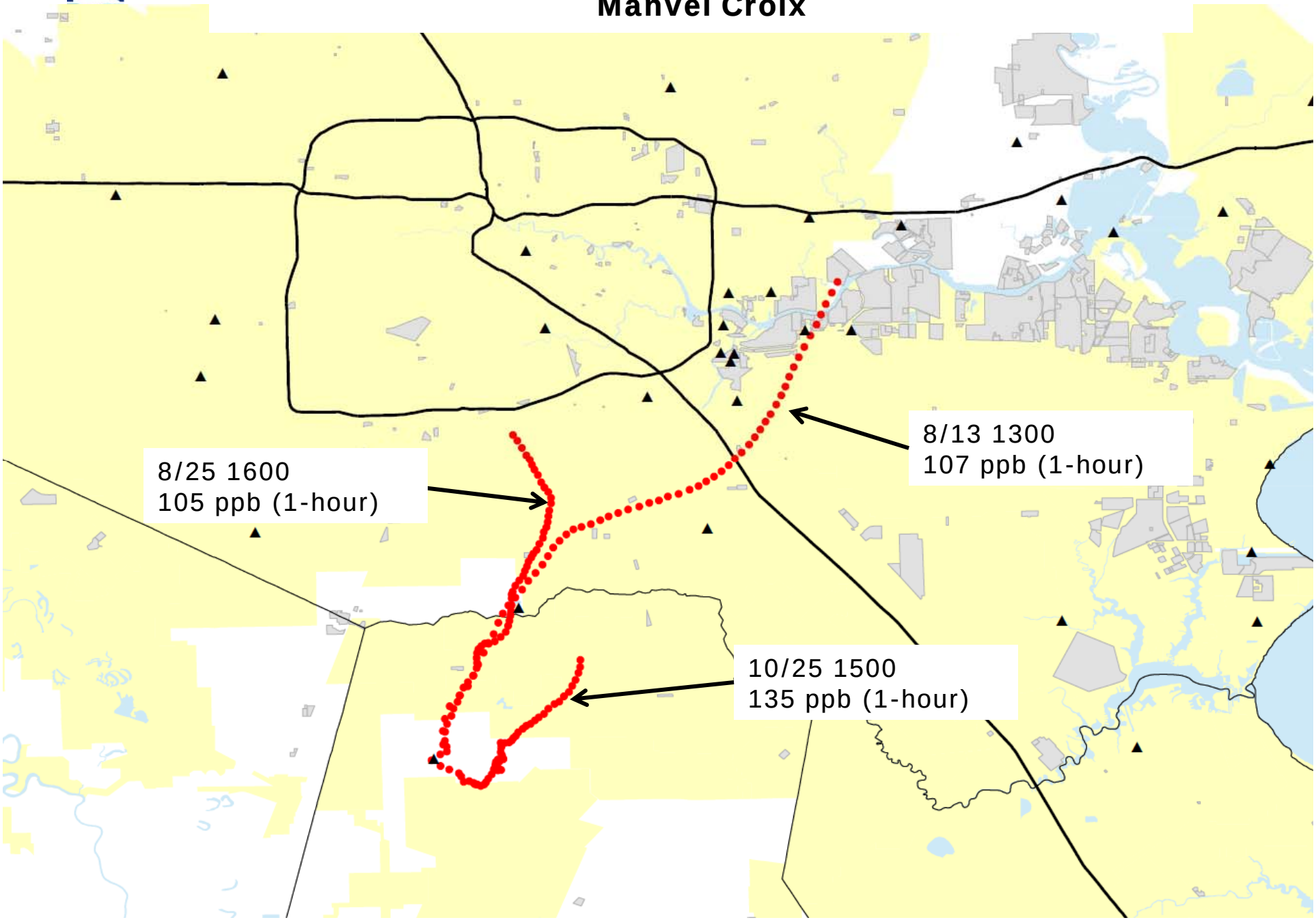
Manvel Croix: 3 Days >= 75 ppb

3 days Trajectory Cluster 3

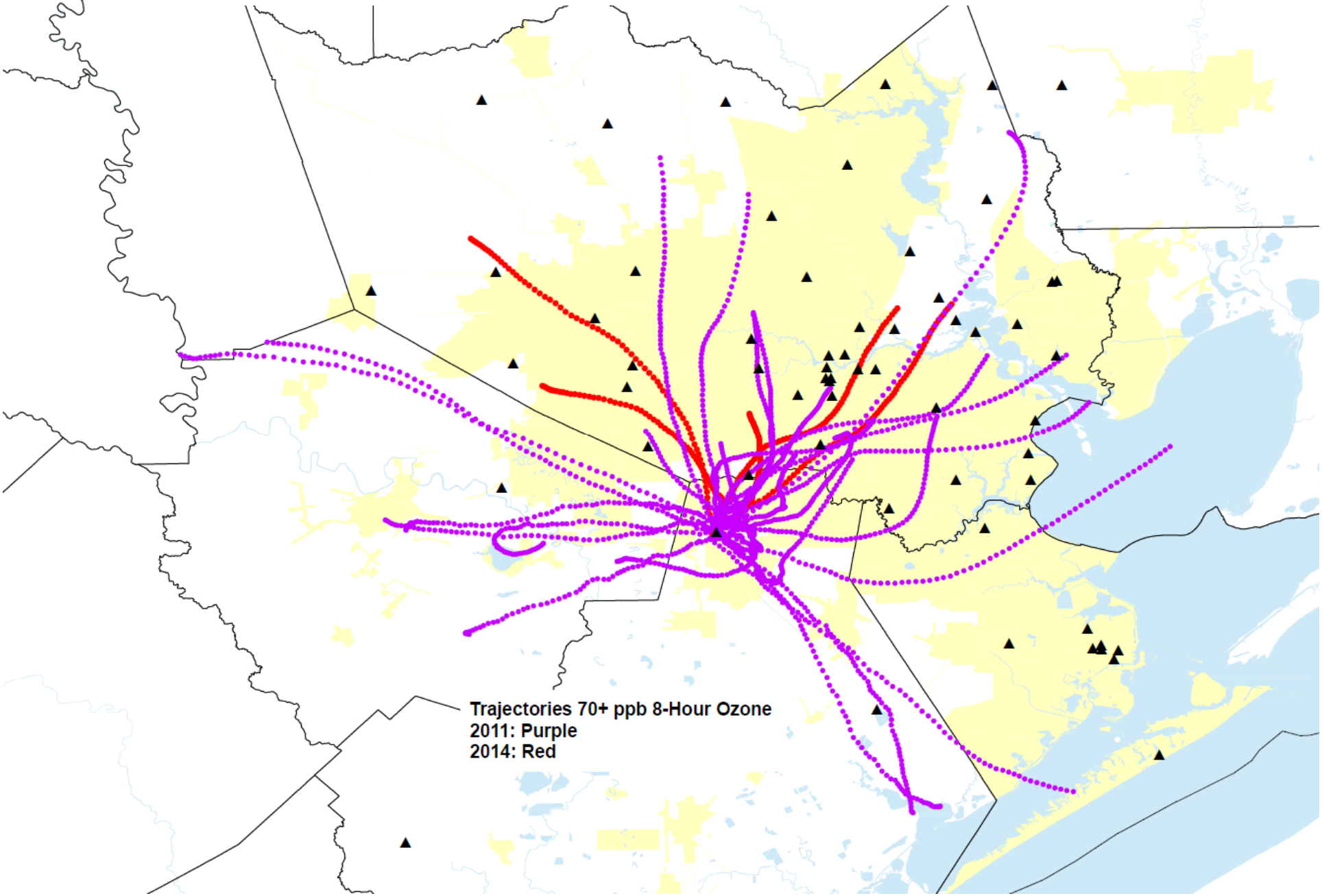
2011 vs 2014 Trajectories

		Count of Trajectories			
		2011		2014	
Direction / Source Area	Length	All	High Ozone	All	High Ozone
North (continental)	Long	44	7	25	0
East/Northeast	Short	44	8	44	3
Gulf Coast / N Gulf of Mexico	Medium/Long	10	0	10	0
Southeast (Gulf of Mexico)	Short	103	5	71	0
Southeast (Gulf of Mexico)	Long	47	0	93	0

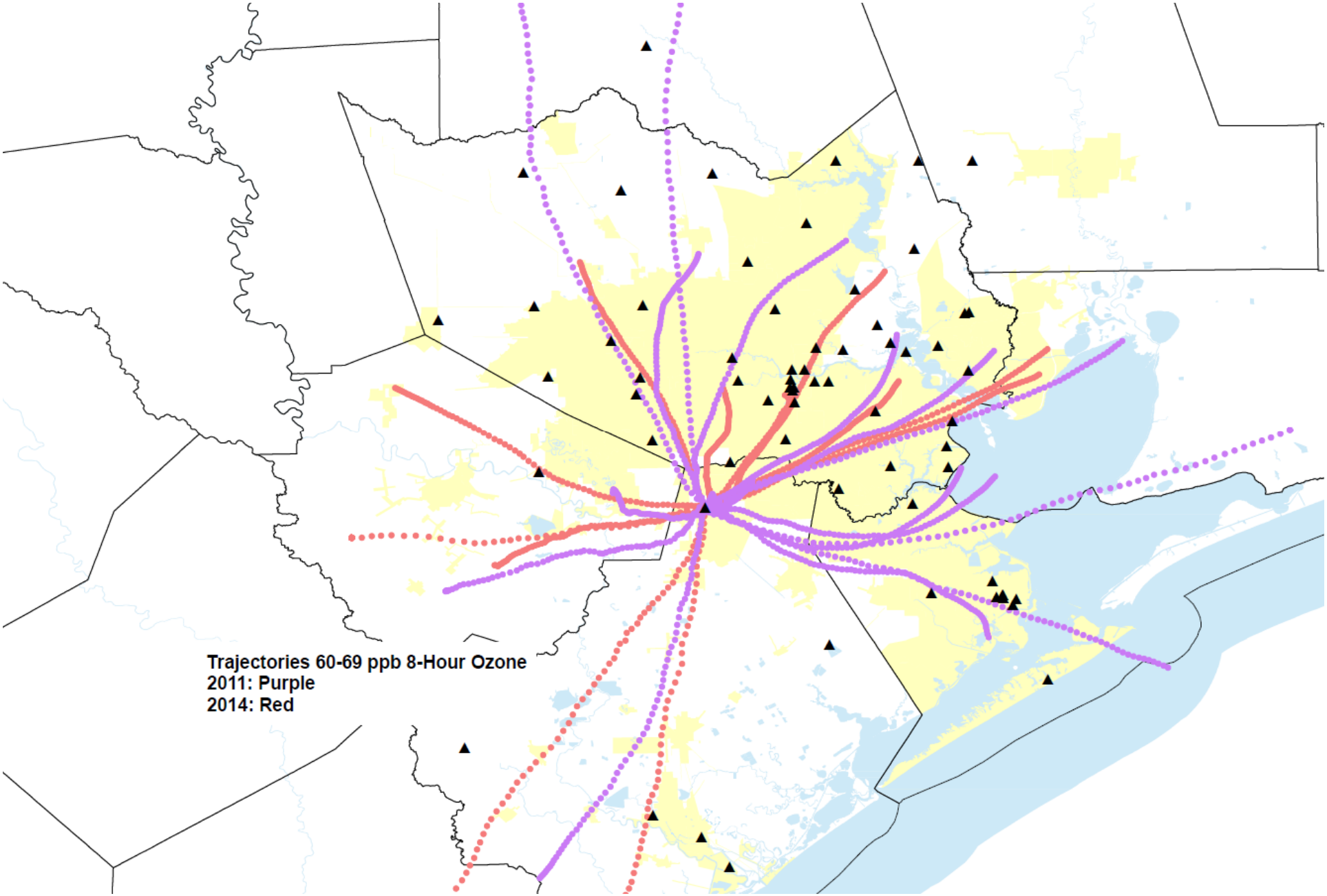
5-hr Back Trajectories for 2014 Days >= 75 ppb at Manvel Croix



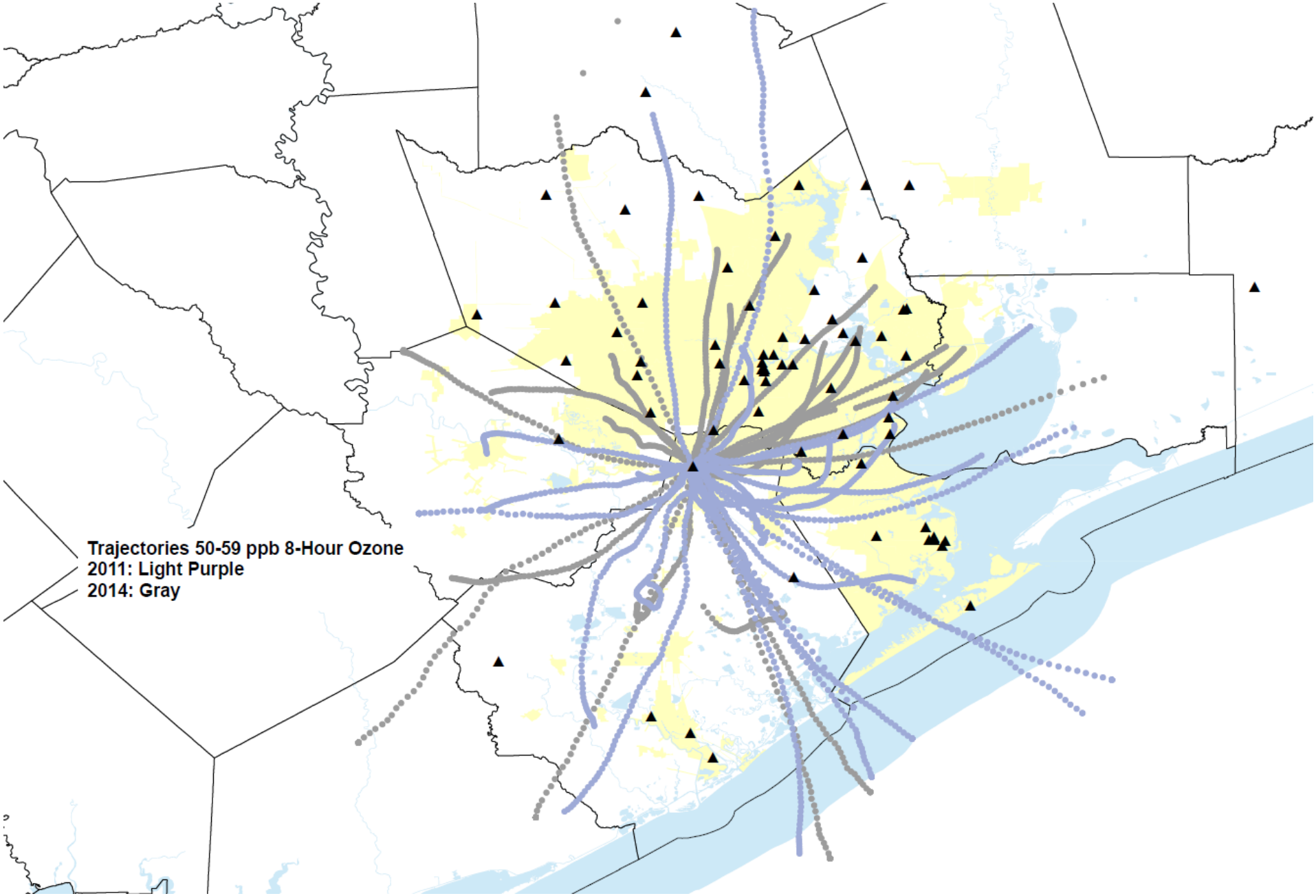
6-hr Back Trajectories, 2011 and 2014, For Days Where Peak 8-Hour Ozone at Manvel Croix >= 70 ppb



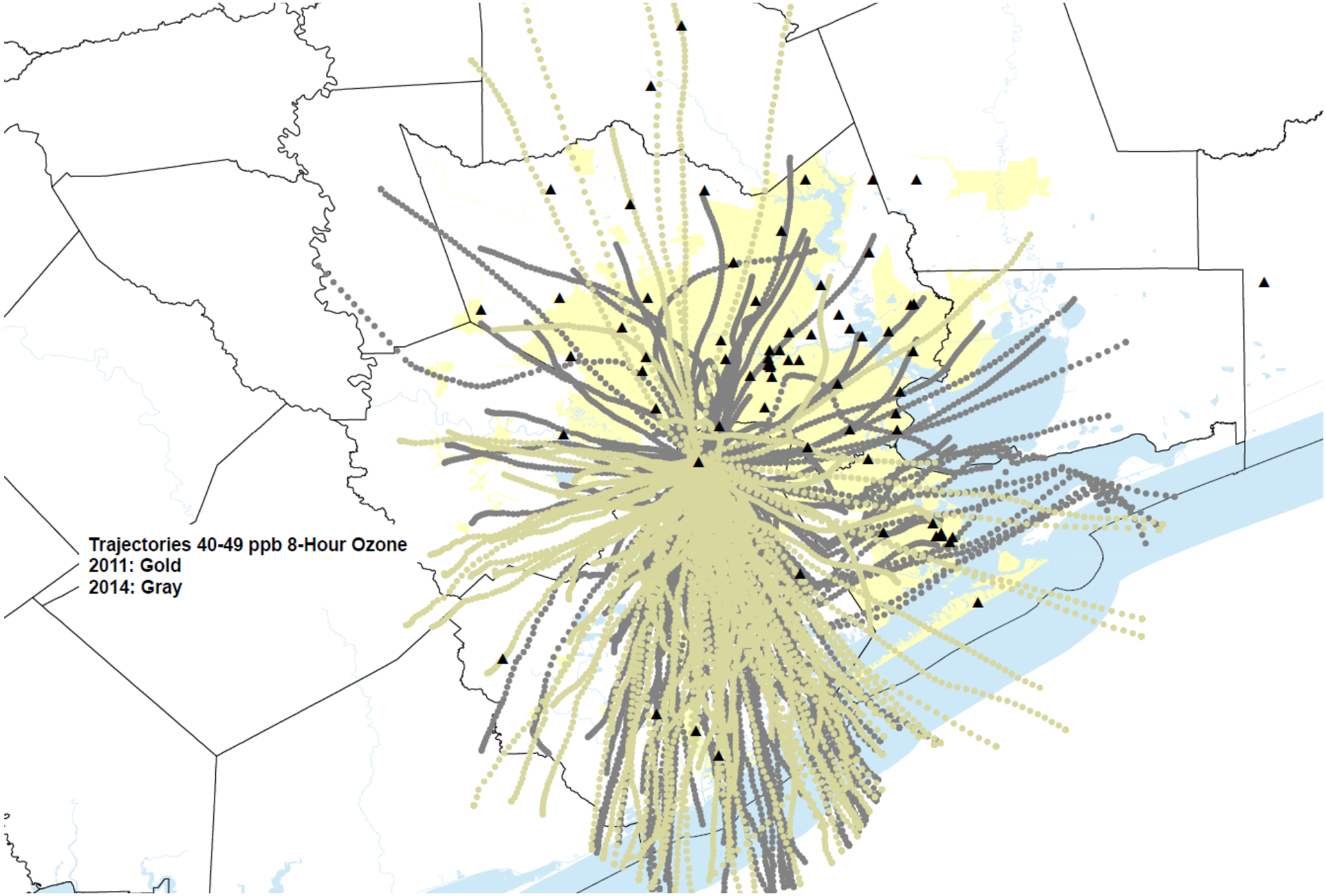
6-hr Back Trajectories, 2011 and 2014, For Days Where Peak 8-Hour Ozone at Manvel Croix 60-69 ppb



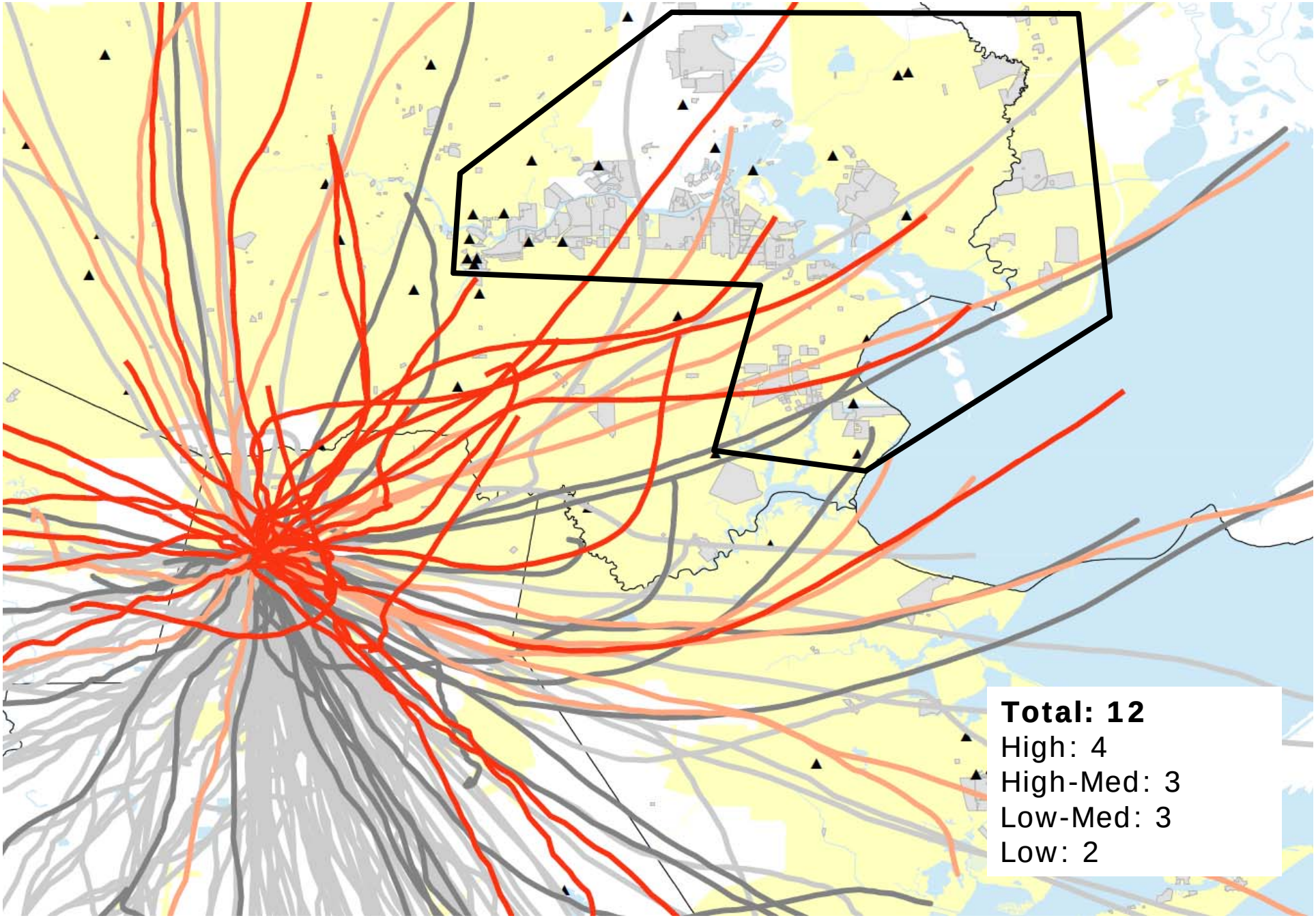
6-hr Back Trajectories, 2011 and 2014, For Days Where Peak 8-Hour Ozone at Manvel Croix 50-59 ppb



6-hr Back Trajectories, 2011 and 2014, For Days Where Peak 8-Hour Ozone at Manvel Croix 40-49 ppb



2011: Trajectories, by Class, Originating / Passing Through Industrial Areas of Eastern Harris County



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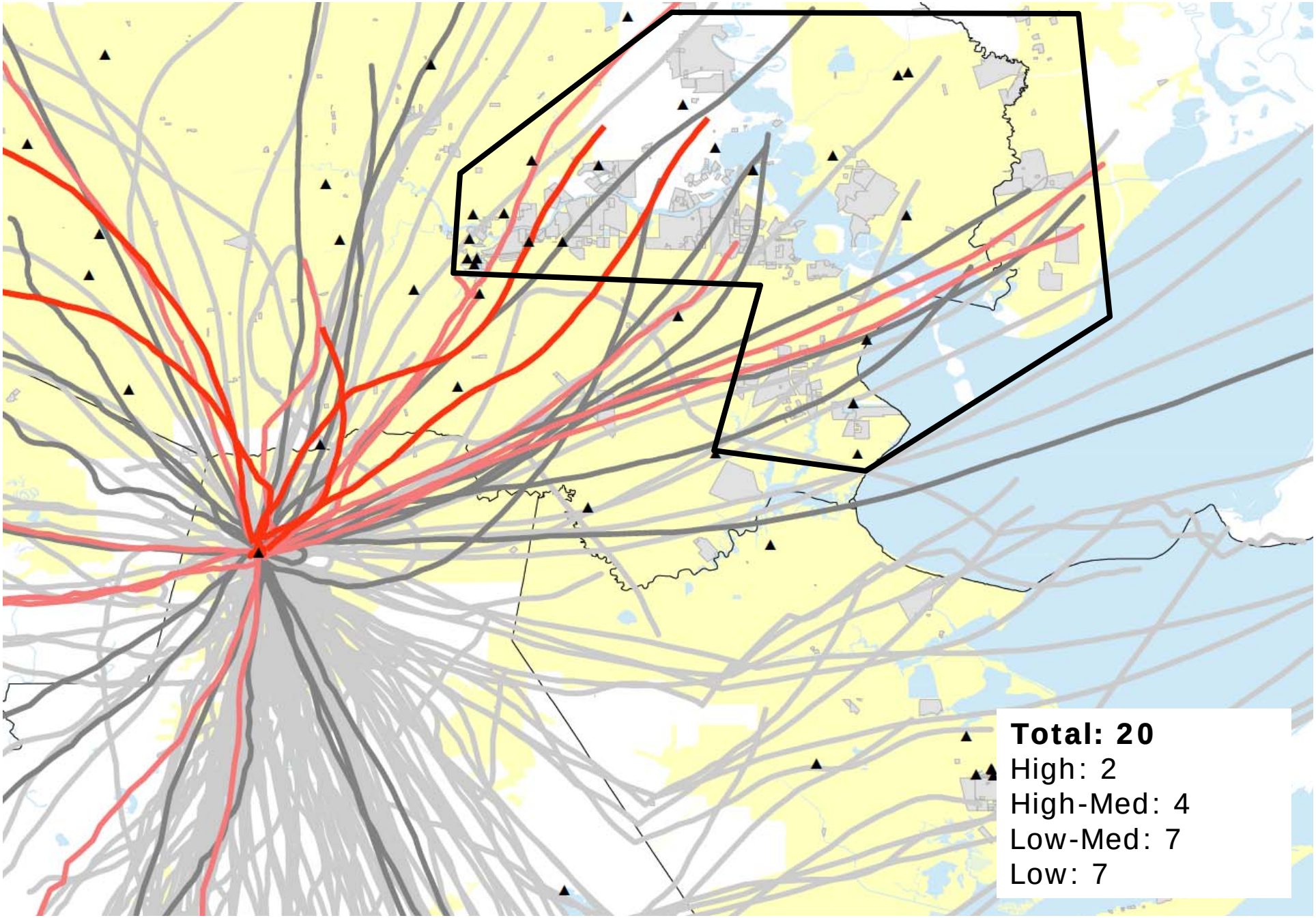
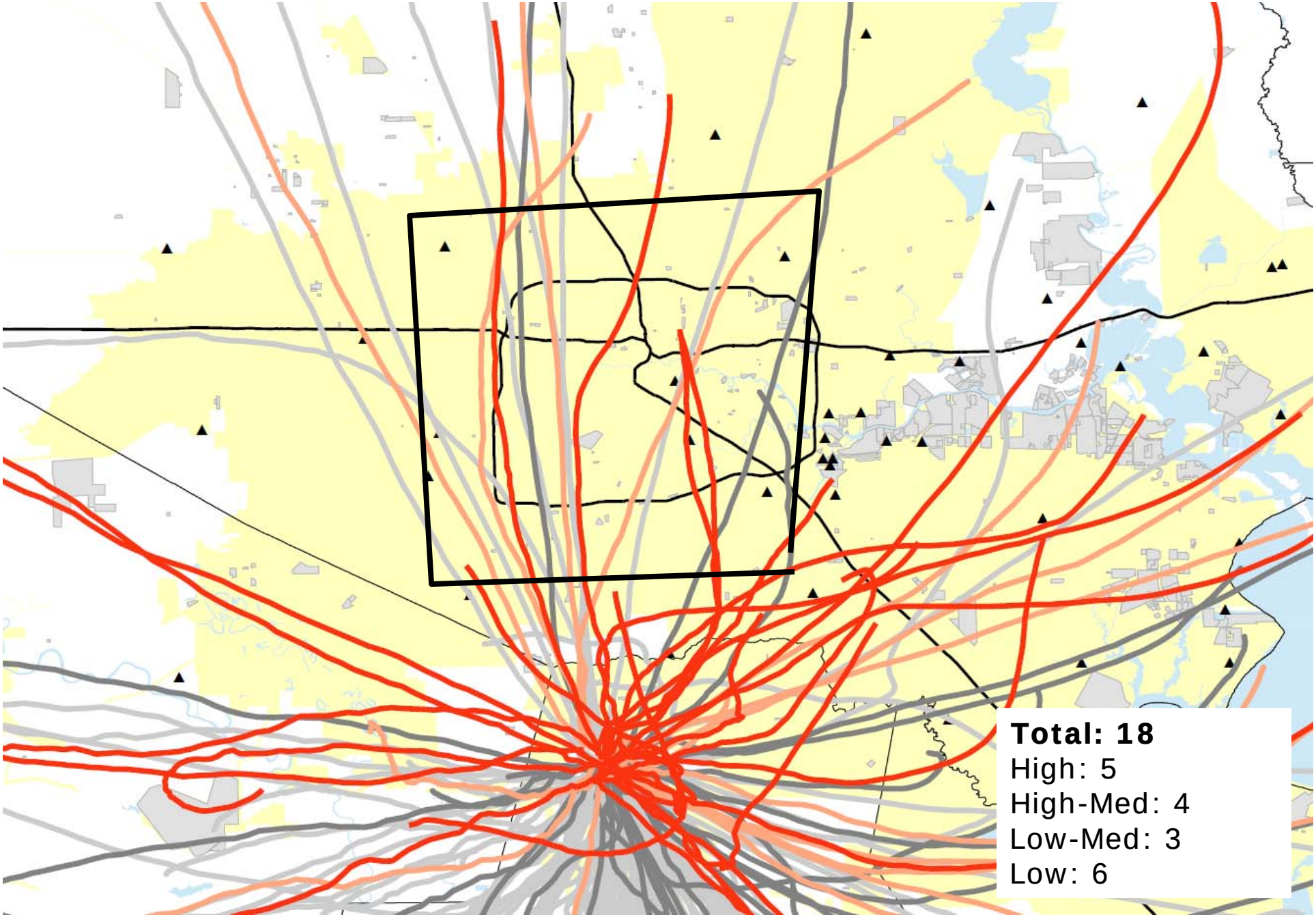


2011: Trajectories, by Class, Originating / Passing Through Houston Urban Core



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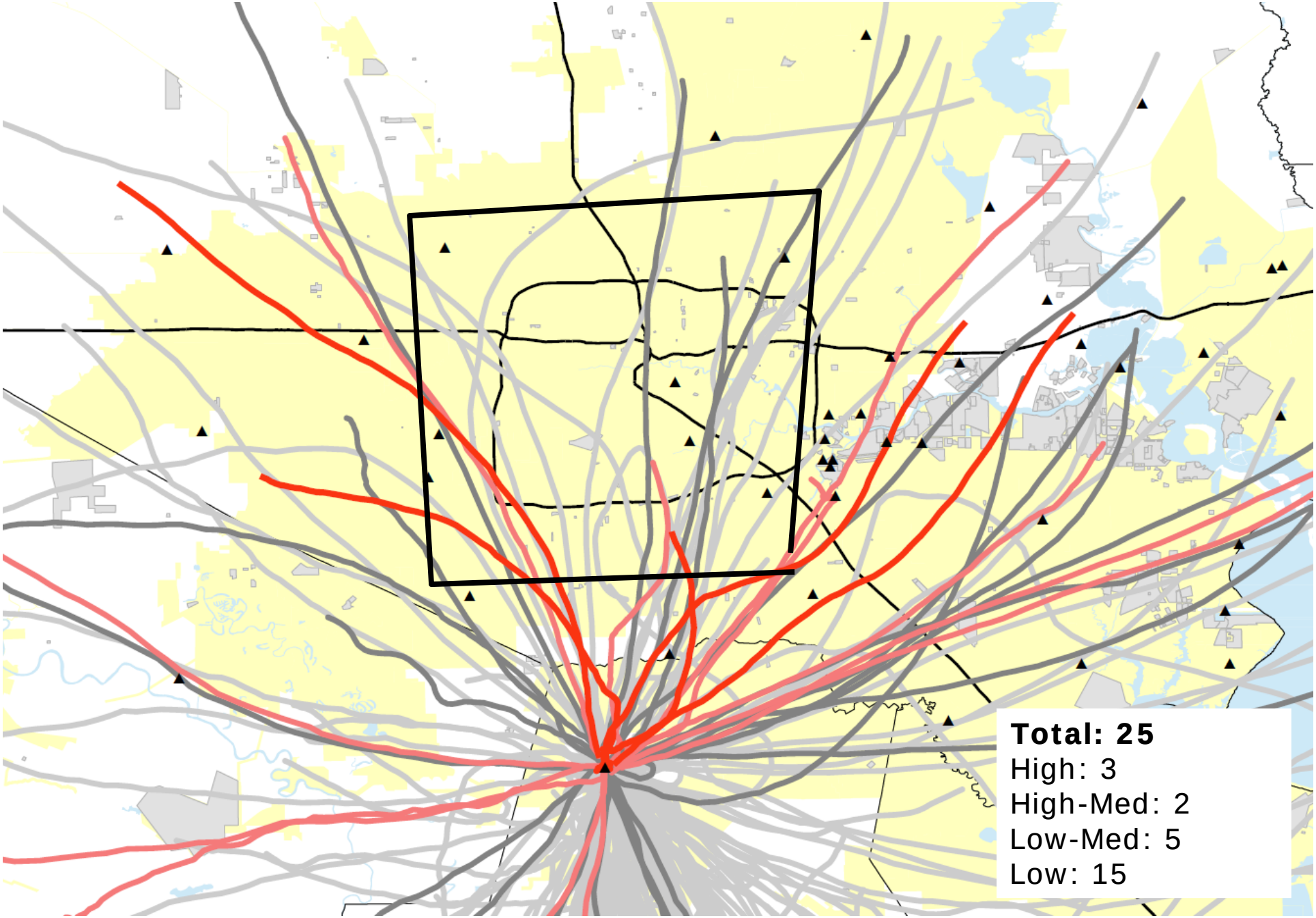
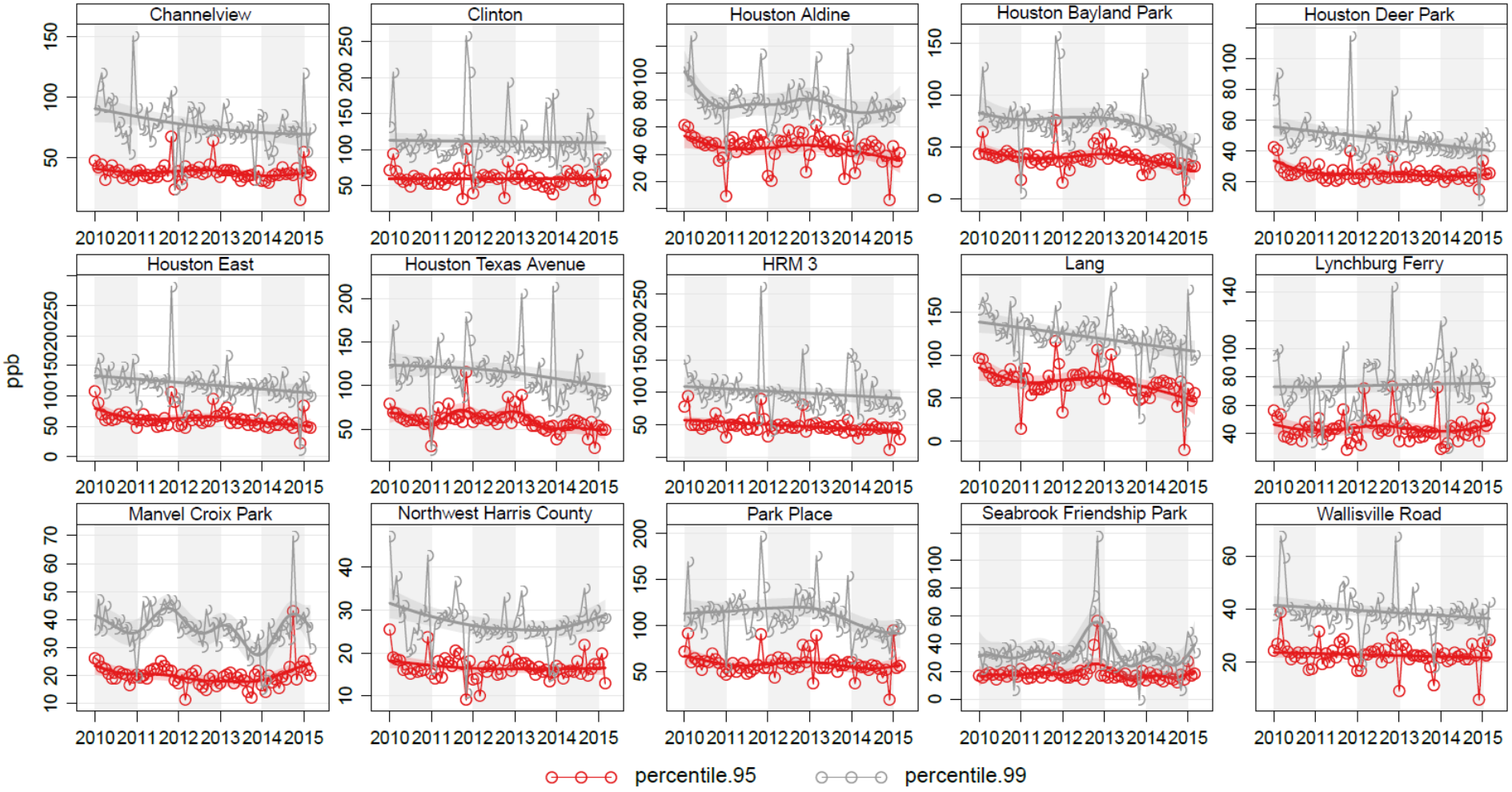
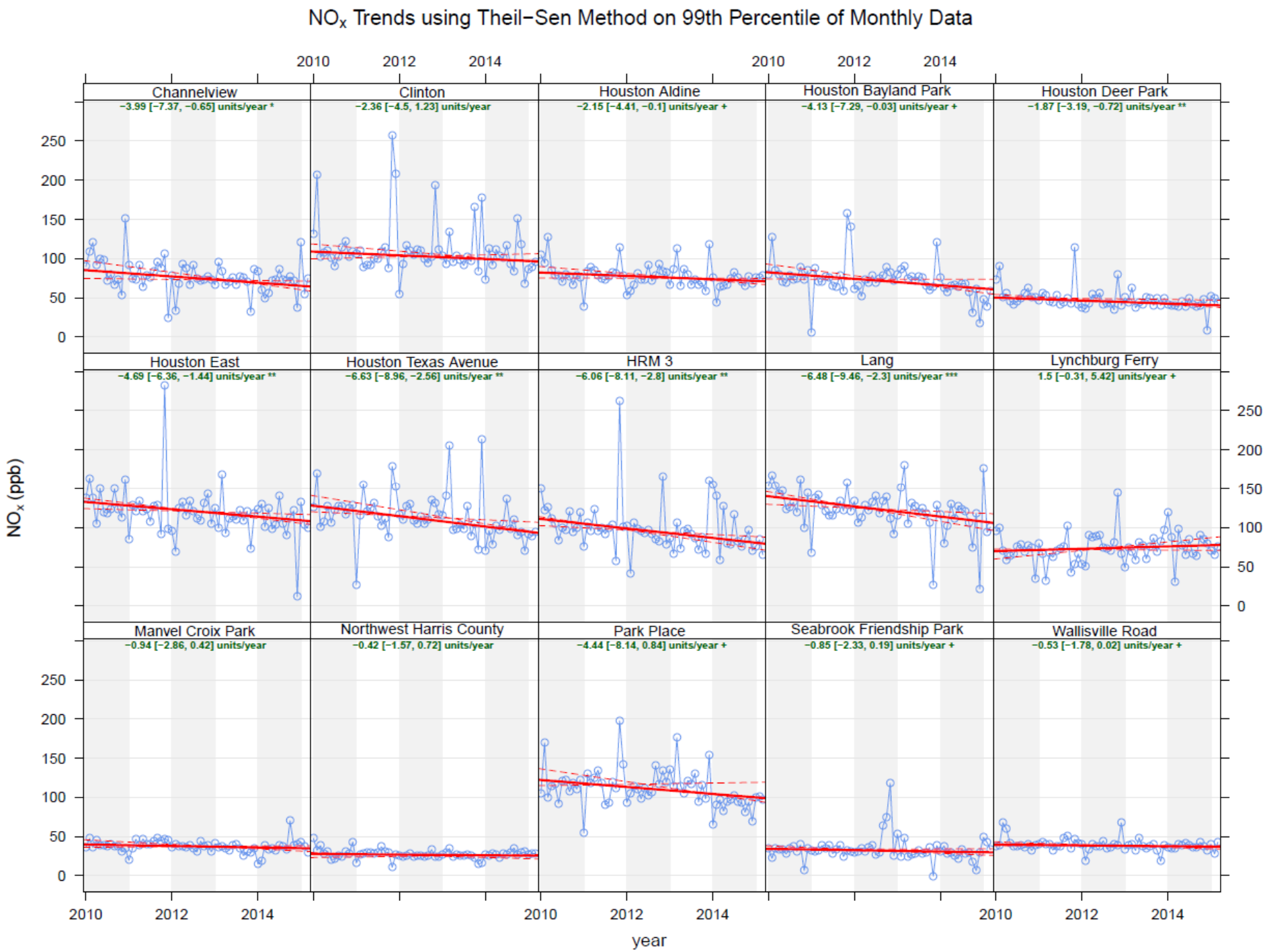
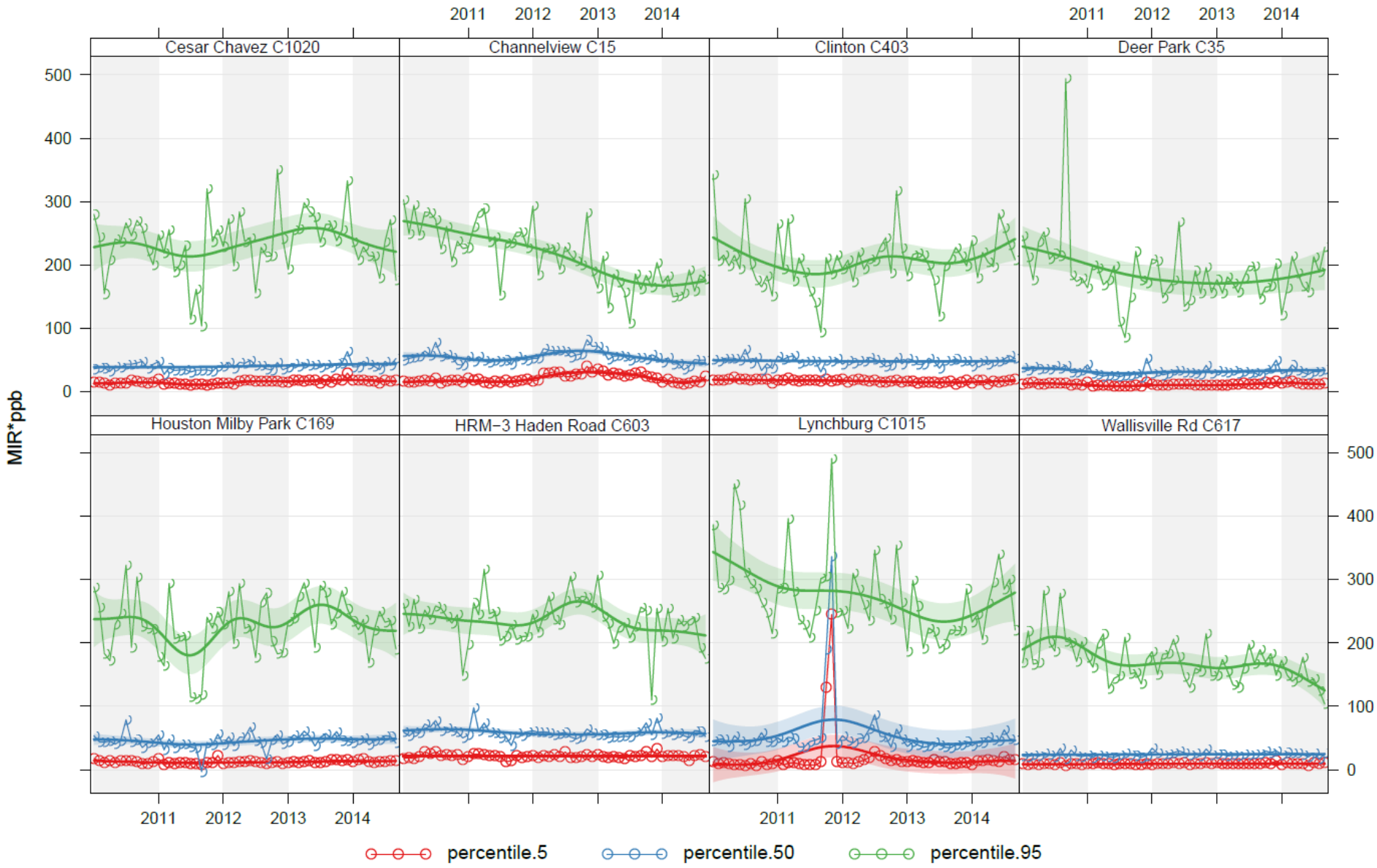


Monthly 95th/99th Deseasonalised NO_x Percentiles with Smoothed Trendline, 2010 – March 2015




NOx Trends using Theil−Sen Method on 99th Percentile of Monthly Data
Channelview
−3.99 [−7.37, −0.65] units/year *
Clinton
−2.36 [−4.5, 1.23] units/year
Houston Aldine
−2.15 [−4.41, −0.1] units/year +
Houston Bayland Park
−4.13 [−7.29, −0.03] units/year +
Houston Deer Park
−1.87 [−3.19, −0.72] units/year **
Houston East
−4.69 [−6.36, −1.44] units/year **
Houston Texas Avenue
−6.63 [−8.96, −2.56] units/year **
HRM 3
−6.06 [−8.11, −2.8] units/year **
Lang
−6.48 [−9.46, −2.3] units/year ***
Lynchburg Ferry
1.5 [−0.31, 5.42] units/year +
Manvel Croix Park
−0.94 [−2.86, 0.42] units/year
Northwest Harris County
−0.42 [−1.57, 0.72] units/year
Park Place
−4.44 [−8.14, 0.84] units/year +
Seabrook Friendship Park
−0.85 [−2.33, 0.19] units/year +
Wallisville Road
−0.53 [−1.78, 0.02] units/year +
NOx (ppb)
year
0
50
100
150
200
250
2010
2012
2014

Monthly 5th/50th/95th Percentile Deseasonalised Reactivity−Weighted VOC with Smoothed Trendline, 2010 − September 2014



HGB 2010 – 2014 Reported Point Source NOx Emissions (TCEQ EI)

CNTY_NAME_TXT	CONTAM_CD	CONTAM_NAME_T	SumOfANN_QTY	YR_CAPT
HARRIS	70400	NITROGEN OXIDES	15886.8563	2010
HARRIS	70400	NITROGEN OXIDES	16120.6009	2011
HARRIS	70400	NITROGEN OXIDES	15733.685	2012
HARRIS	70400	NITROGEN OXIDES	15772.7534	2013

Summary

- Ozone decreases observed from 2011/12 to 2013/14 are pervasive and substantial
  - Number of 8-hr periods decreased considerably
  - Number of days >= 75 ppb at Manvel Croix (design value monitor) decreased from 20 (2011) to 3 (2014)
  - Area design value decreased 19 ppb (monotonically) from 2011 to 2014
  - Ozone at Manvel Croix C84:
    - 2011: 20 days >= 75 ppb
    - 2014: 3 days >= 75 ppb

- Potentially Explanatory Variables
  - NOx
    - 2% decrease in reported point source Nox emissions, 2010 to 2013
    - 6 of 15 monitors show statistically significant decrease in 99th percentile NOx from 2010 to early 2015
  - VOCs
    - Just 2 of 8 Harris County monitors show statistically significant decreases in 99th percentile rx-weighted concentrations between 2010 and 2014
  - Weather: normal year for precipitation/temperature

Summary

- Potentially Explanatory Variables
  - Wind speed
    - This analysis does not suggest that higher windspeeds in 2014 vs 2011 were responsible for lower ozone in 2014
    - PSCF/ Residence Time analysis would help (trajectory length
  - Emissions from source areas
    - Surface Trajectories:
      - In 2014, trajectories that passed through / originated in both Houston urban and Ship Channel industrial areas were associated with lower ozone than those in 2011.
    - HYSPLIT trajectories
      - In both 2011 and 2014, short trajectories to E/NE associated with high ozone in HGB.
      - In 2011, longer north (continental) and short Gulf (marine) trajectories associated with high ozone, but these source areas not associated with high ozone in 2014

Future Work

- Evaluate upwind areas/states' emissions/concentrations in 2014 vs 2011
- Case studies of specific high ozone days – windspeeds, NOx and VOC concentrations, wind curvature
- PSCF – residence time over different parts of HGB