

The Impact of Wind Direction on the Location of High Ozone in the Houston-Galveston-Brazoria Area

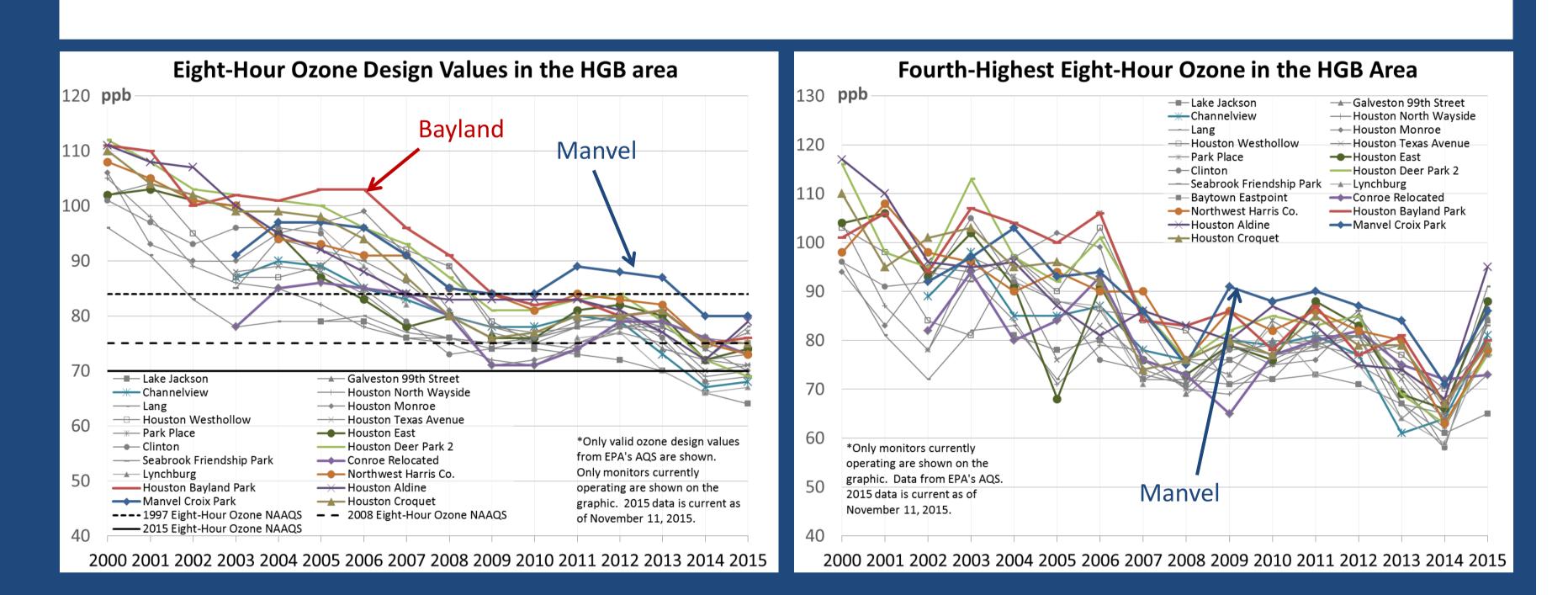
Kasey Savanich, Zhaohua Fang, Philip Leung, Fernando Mercado, and Jonathan Steets

Introduction

- The Houston-Galveston-Brazoria (HGB) area has historically observed some of the highest ozone in the state of Texas.
- For several years, the highest ozone design values in the HGB area were observed at the Bayland Park Monitor, but after 2009, the Manvel Croix Park Monitor had the highest design values.
- Why has the location of high ozone in the HGB area changed?

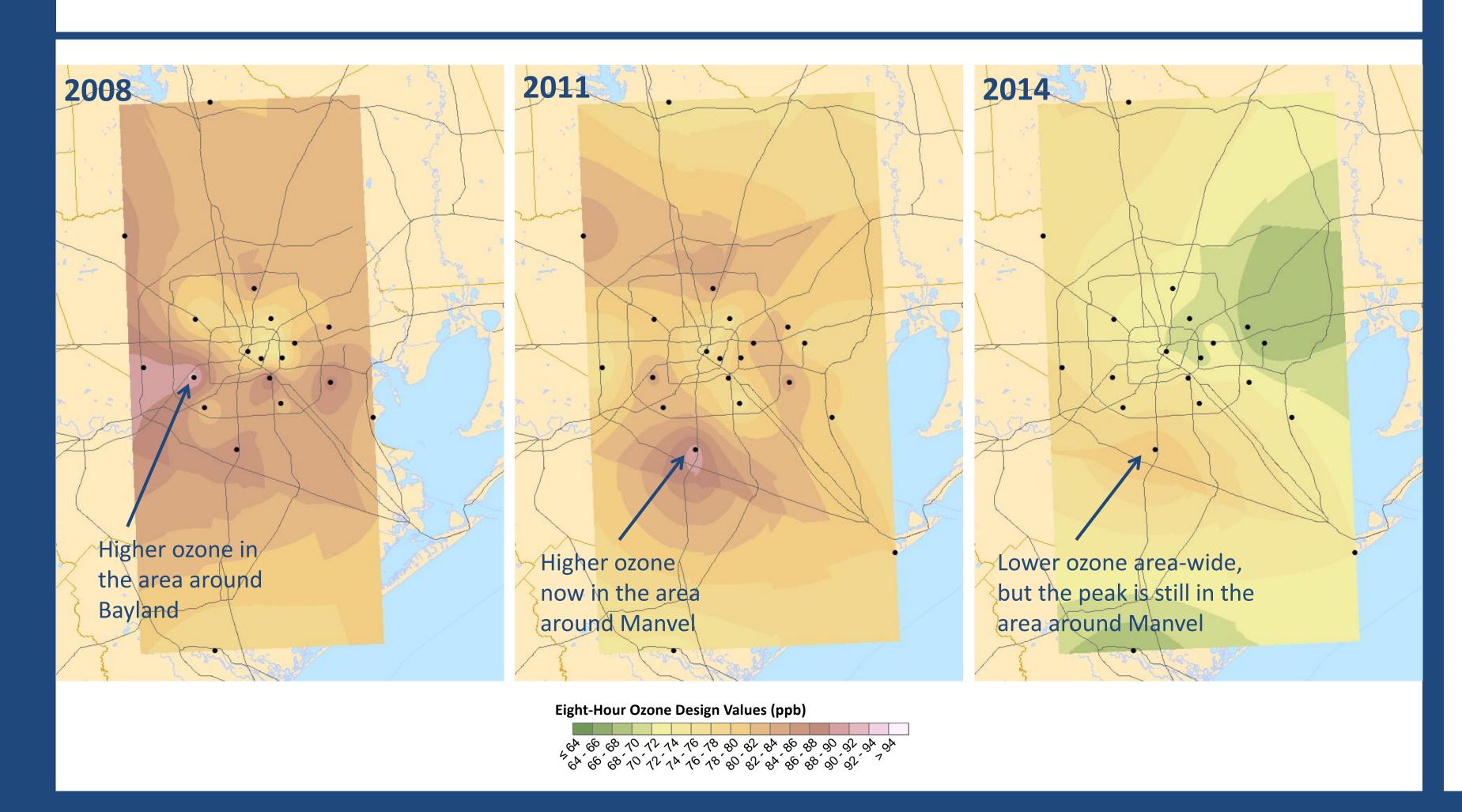
Ozone Design Value Trends

- Ozone design values are the three-year average of the fourth-highest eight-hour ozone values at a monitor.
- They are used to determine compliance with EPA's national Ambient Air Quality Standards (NAAQS).
- The Bayland Park monitor observed the highest eight-hour ozone design values from 2003 through 2009
- After 2009, the highest eight-hour ozone design values were observed at Manvel Croix Park.
- The Manvel Croix Park monitor has also observed some of the highest fourth-highest concentrations from 2009 through 2014.



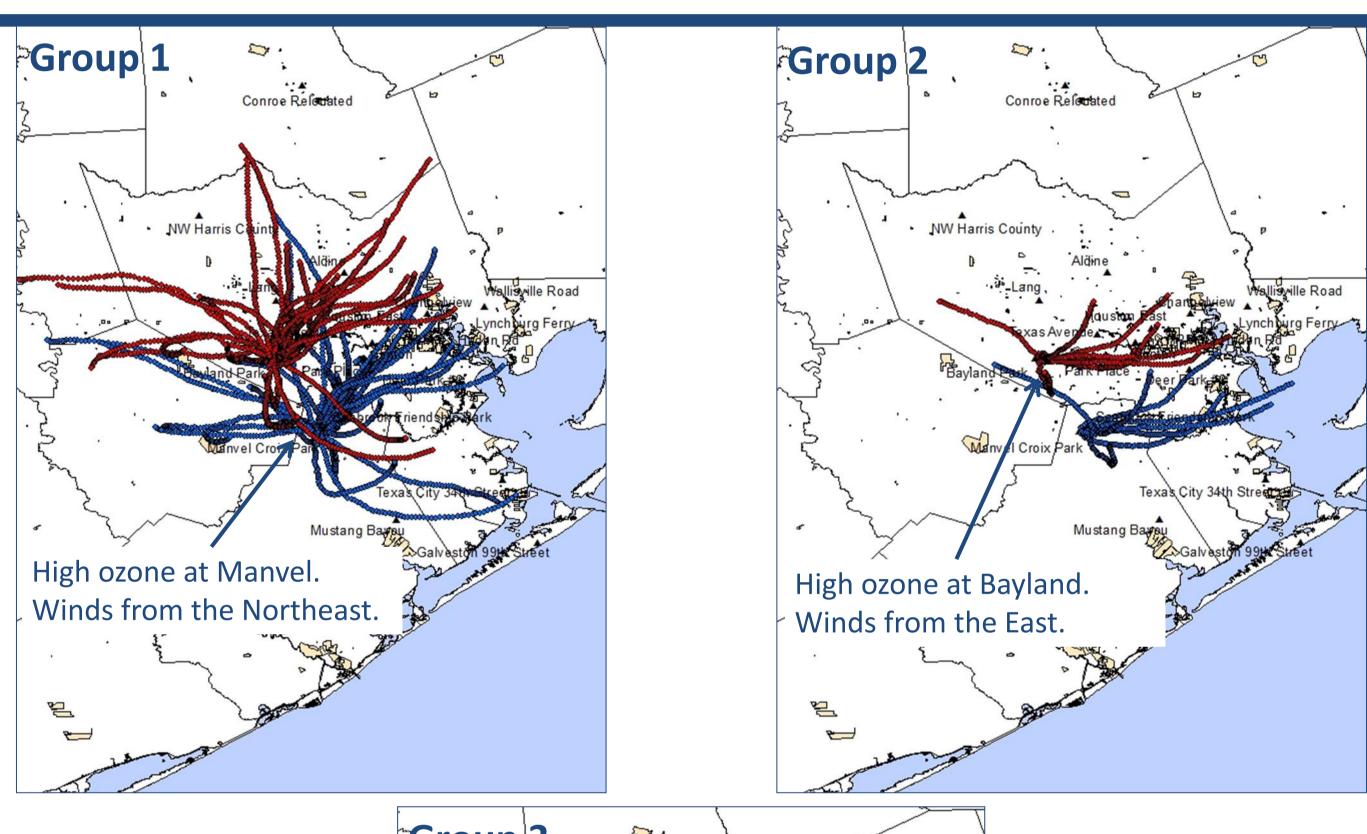
Spatial Trends in Ozone Design Values

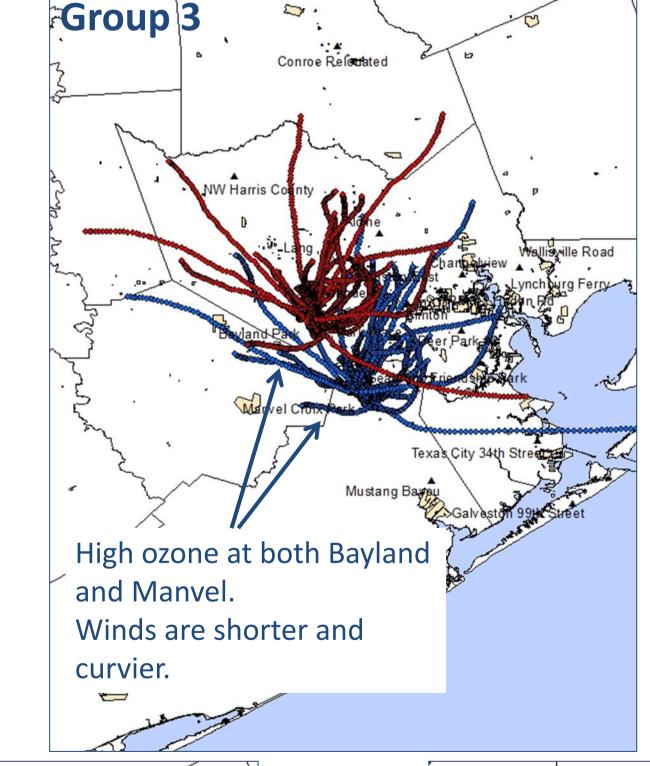
- Spatial examination of ozone design values is a first step in determining the cause of high ozone at different locations.
- In 2008 the highest ozone was on the western edge of the HGB monitoring area at the Bayland Park monitor, but high ozone was also observed in other parts of the area.
- By 2011, ozone decreased in the HGB area, but the highest ozone was observed at the Manvel Croix Park monitor, which is located on the southwestern part of the HGB monitoring area.
- Ozone values were much lower in 2014 but the highest values continued to remain at the Manvel Croix Park monitor.

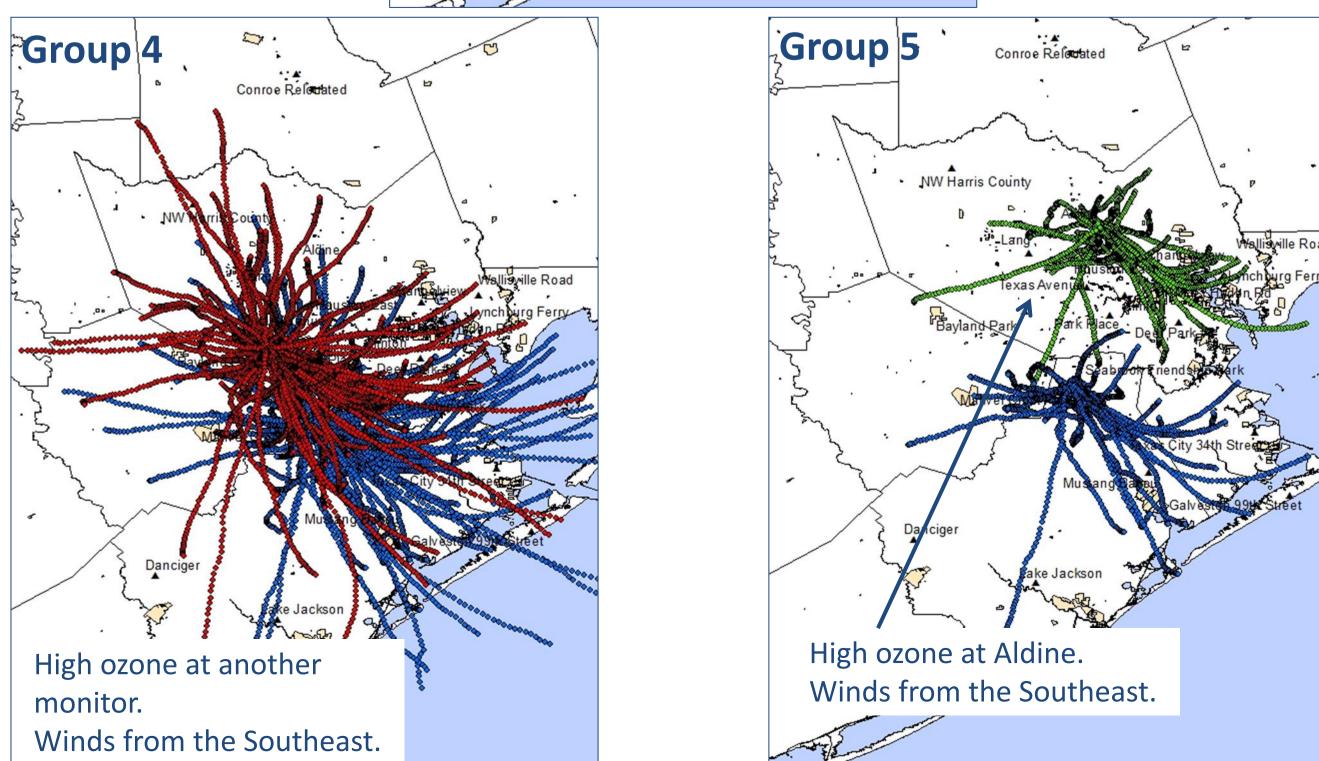


Surface-Level Back Trajectories

- Surface-level back trajectories are another way to investigate the causes for the change in high ozone in the HGB area.
- Surface-level back trajectories were ran for five groups of days from 2008 through 2014:
- 1. Days with eight-hour averaged ozone > 75 ppb at Manvel Croix Park but not at Bayland Park.
- 2. Days with eight-hour averaged ozone > 75 ppb at Bayland Park but not at Manvel Croix Park.
- B. Days with eight-hour averaged ozone > 75 ppb at both Manvel Croix Park and Bayland Park.
- 4. Days with eight-hour averaged ozone > 75 ppb at another HGB monitor but not at Manvel Croix Park or Bayland Park.
- 5. Days with eight-hour averaged ozone > 75 ppb at Aldine but not at Manvel Croix Park or Bayland Park.
- The back trajectories were all ran for 6 hours back starting at 1 PM LST.
- Comparing the different groups shows shifts in the predominant wind directions within each group:
 - Group 1 days are mostly from the northeast.
 - Group 2 days are mostly from the east.
 - Group 3 days are shorter.
 - Group 4 and 5 days are mostly from the southeast.

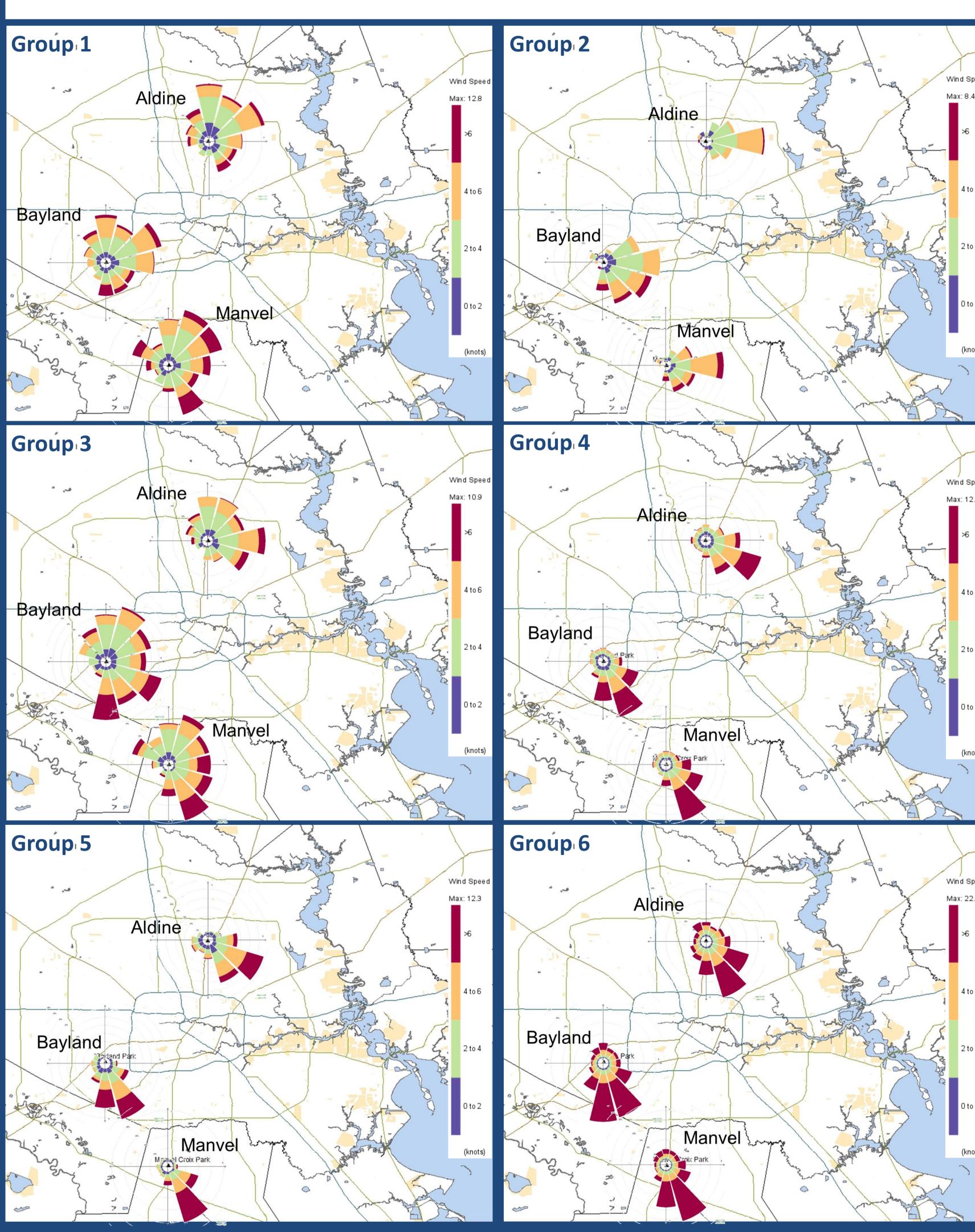






Wind Roses

- Wind roses were created at three monitors in the HGB area for the same 5 groups of days used for the surface trajectories.
- Wind roses were also created for a 6th group of days, which includes all days with eight-hour averaged ozone < 75 ppb.
- The resulting wind roses for each group show patterns similar to those observed in the surface back trajectories.
- The wind roses also show faster wind speeds on days when eight-hour averaged ozone is < 75 ppb.



Conclusions

- In recent years, the highest ozone in the HGB area has shifted locations from Bayland Park to Manvel Croix Park; this appears to be partly due to changes in wind directions.
- Looking at wind directions for different groups of days shows that the location of high ozone in the HGB area is dependent on the wind direction.
 - When ozone is high at Bayland Park, the winds are typically from the east
 - When ozone is high at Manvel Croix Park, the winds are typically from the northeast
 - When ozone is high at Aldine, the winds are typically from the southeast.
- On low ozone days the winds are typically much faster and from the south.