

# Ozone Concentration and Meteorology at Lakeshore and Inland Monitors

## Gail Good

Director, Bureau of Air Management  
Wisconsin Department of Natural Resources

## Analysis by Angela Dickens

Policy Analyst  
Regional Pollutants and Mobile Sources Section  
WDNR Bureau of Air Management



**Question:**

*How quickly do ozone concentrations drop off inland from the Lake Michigan lakeshore?*

**Topics:**

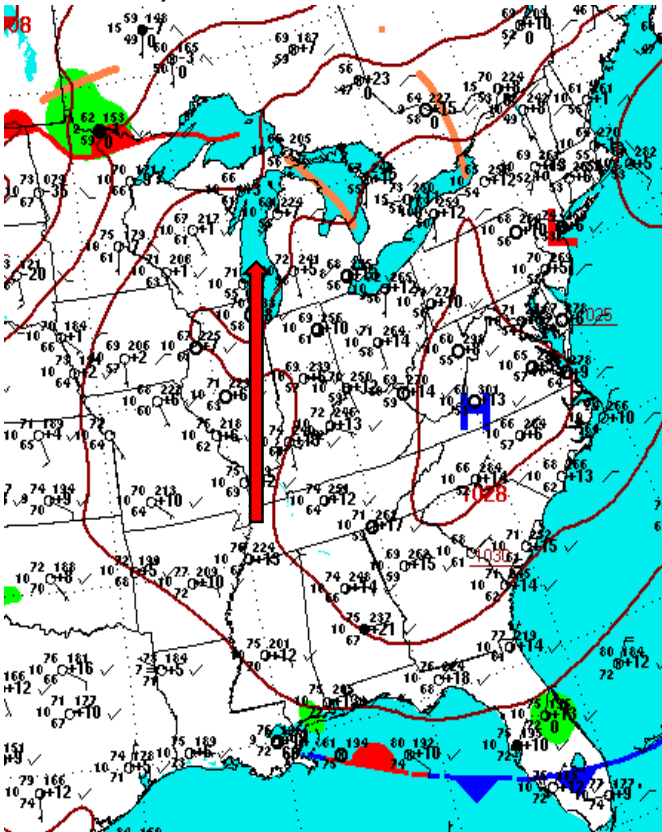
1. Background on ozone in Wisconsin
2. Concentration comparisons at inland and lakeshore monitors
3. The role of meteorology in driving ozone at these monitors
4. Applications to policy

# 1. Background on ozone in Wisconsin

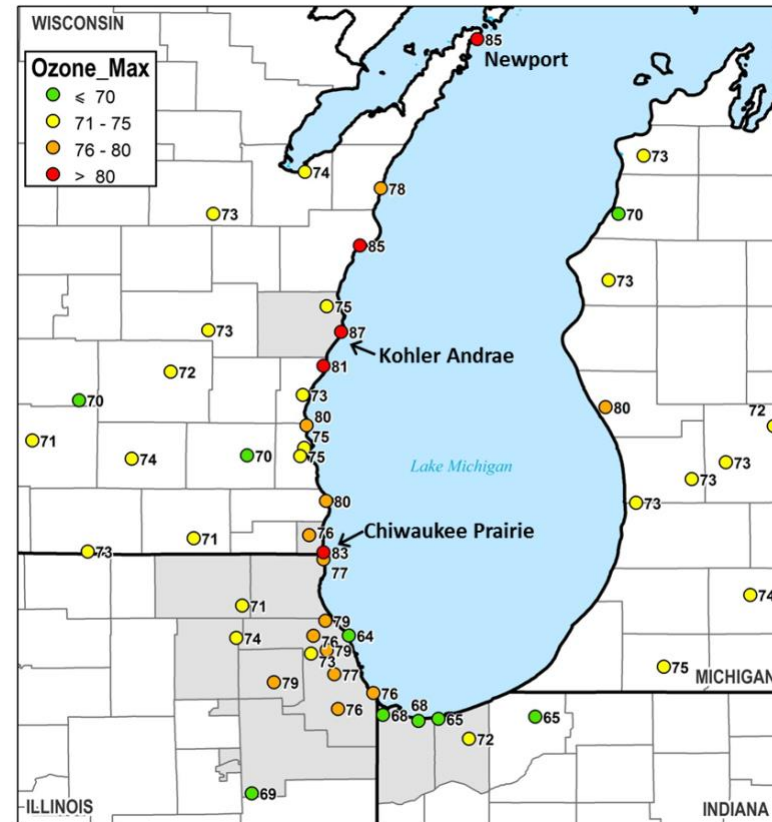
Typical high-ozone day:

- Synoptic transport of ozone/precursors
- Onshore transport via the lake breeze

June 19, 2016



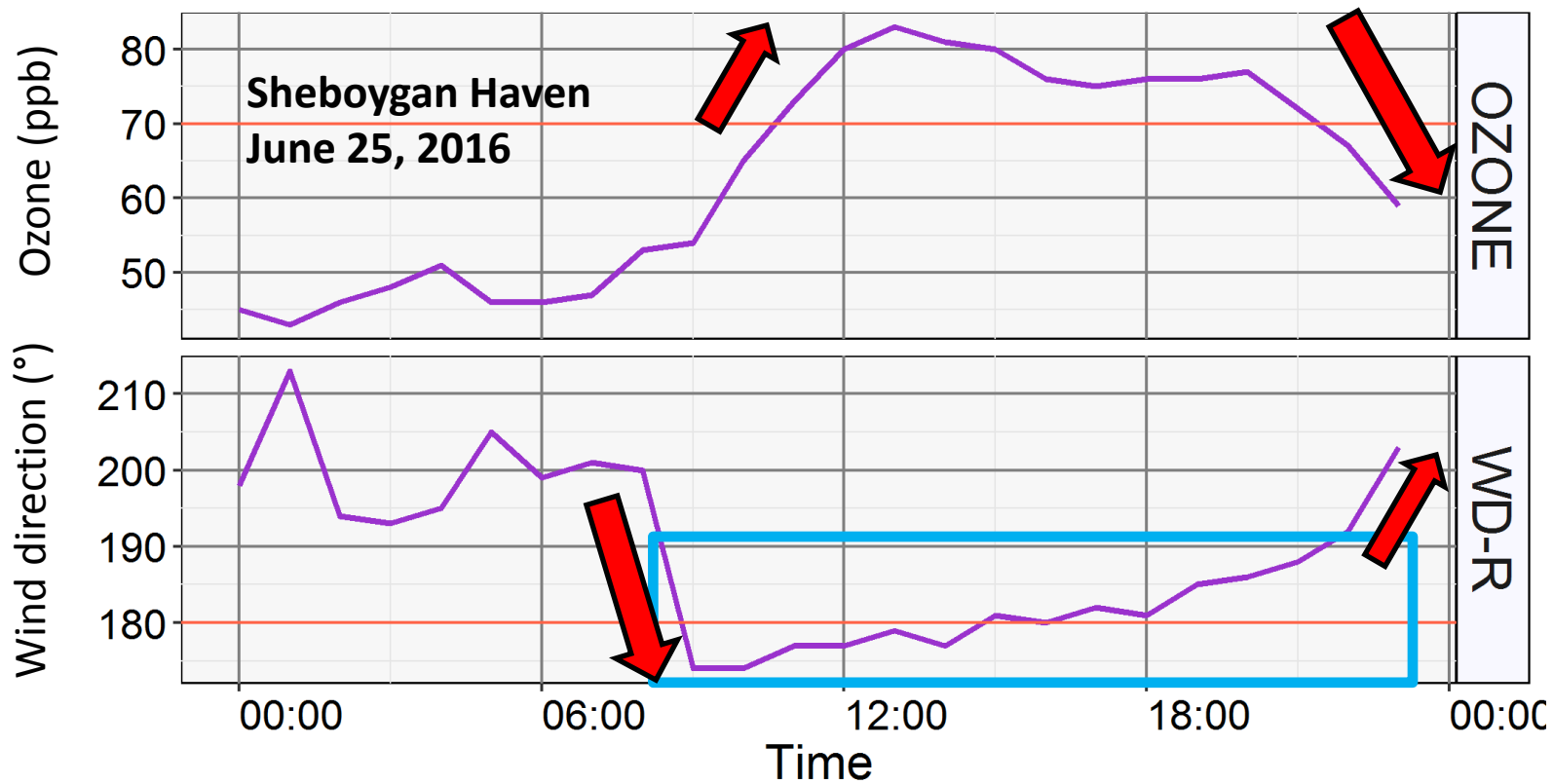
6am surface synoptic weather map



Maximum daily 8-hour average ozone concentrations

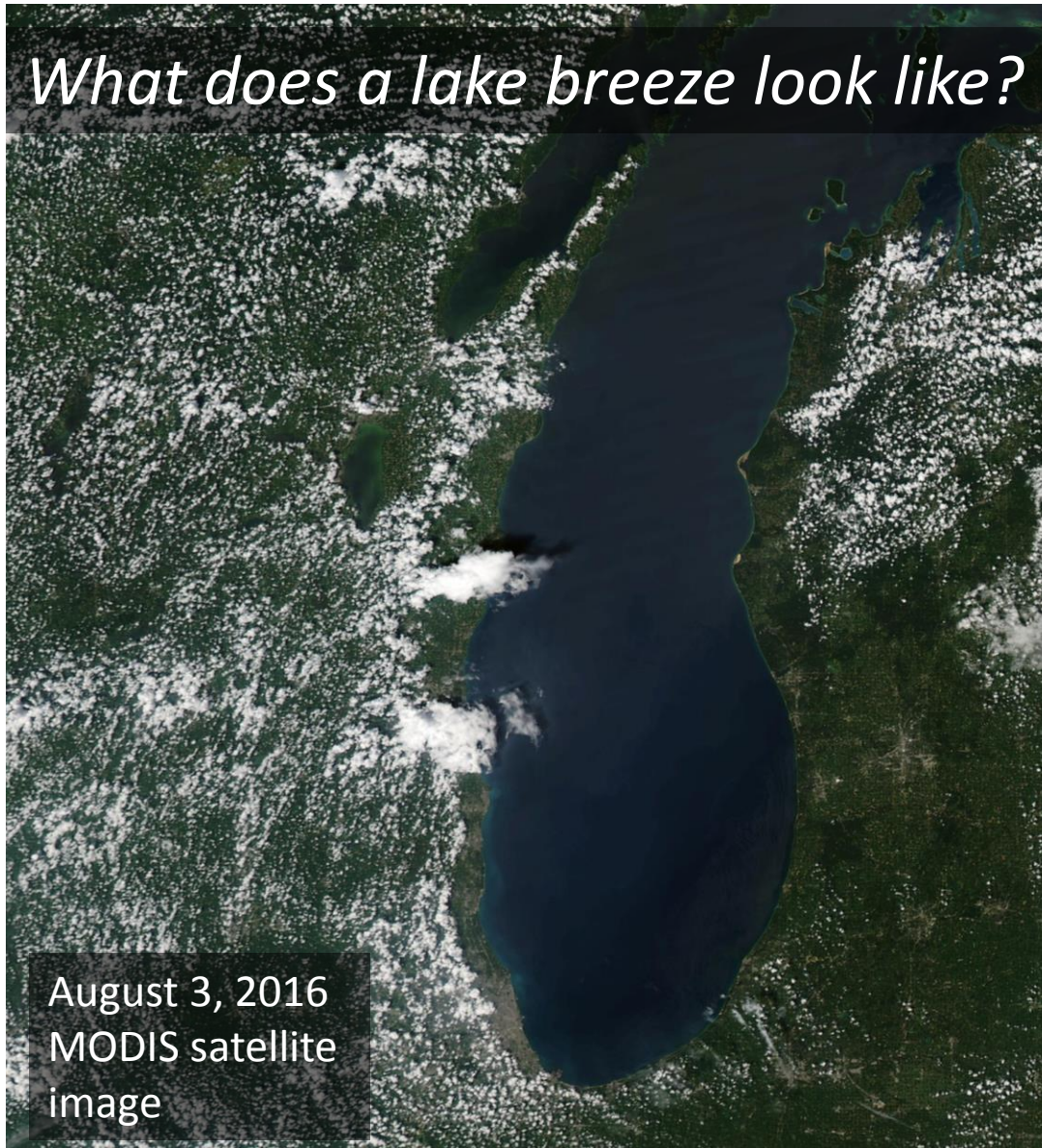
# 1. Background on ozone in Wisconsin

*What does a lake breeze look like?*



## 1. Background on ozone in Wisconsin

*What does a lake breeze look like?*

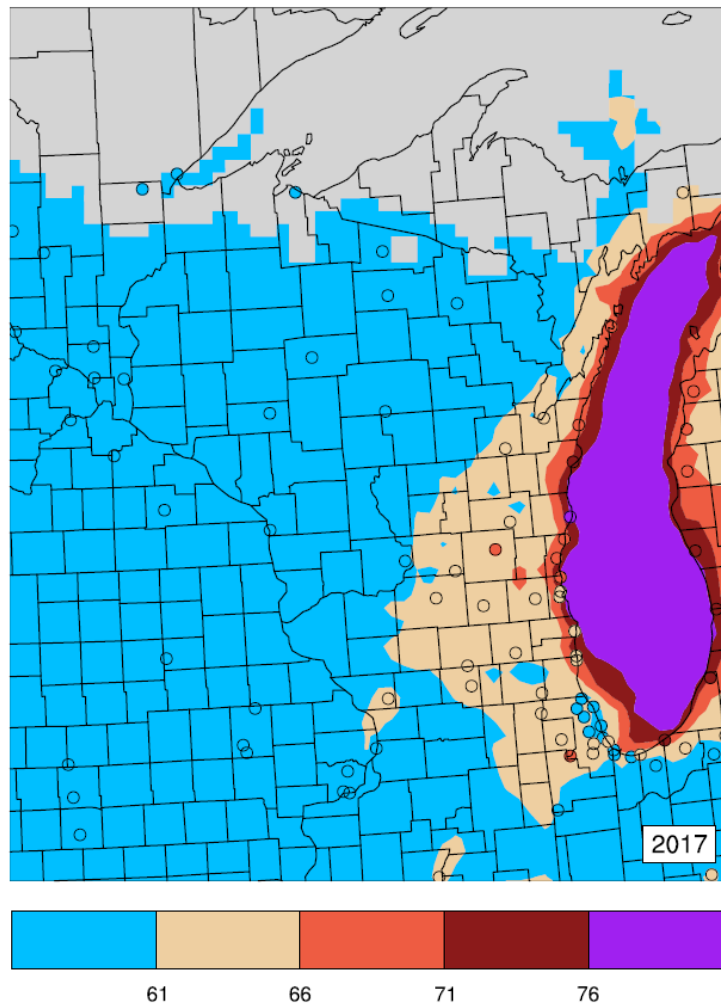


August 3, 2016  
MODIS satellite  
image

# 1. Background on ozone in Wisconsin

## Photochemical modeling suggests high-ozone air stays near shore

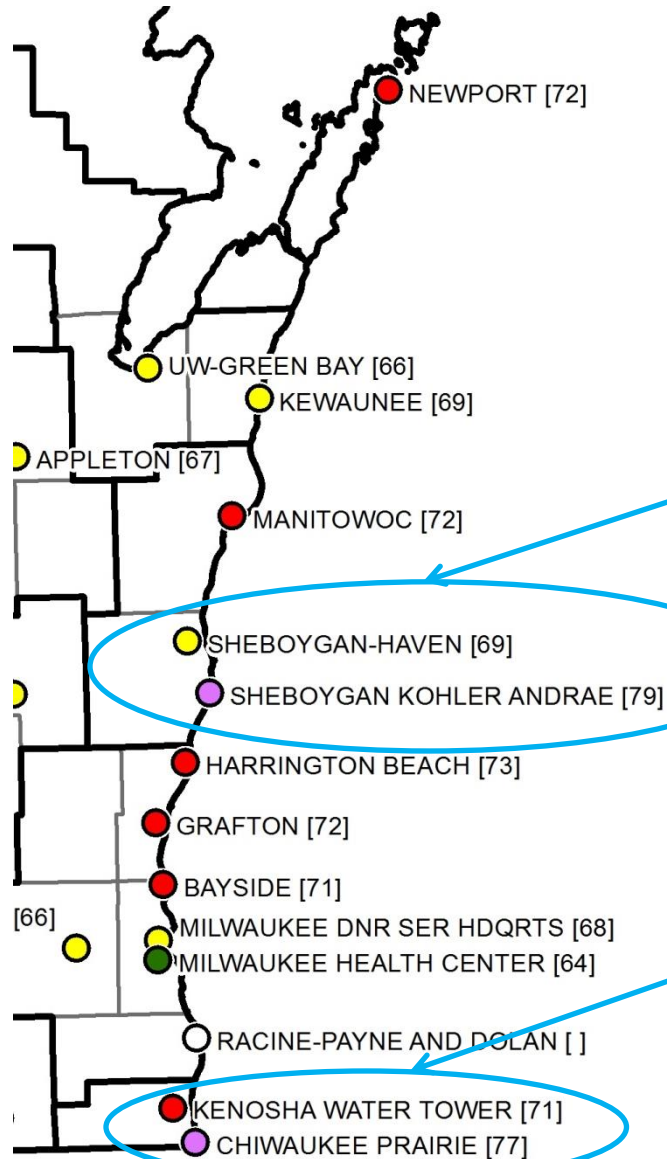
Gradient-Adjusted Fused Surface (ppb)



Modeling by the Lake Michigan Air Directors Consortium (LADCO)

## 2. Concentration comparisons at inland and lakeshore monitors

2014-16 DVs



### Sheboygan County

#### Inland monitor:

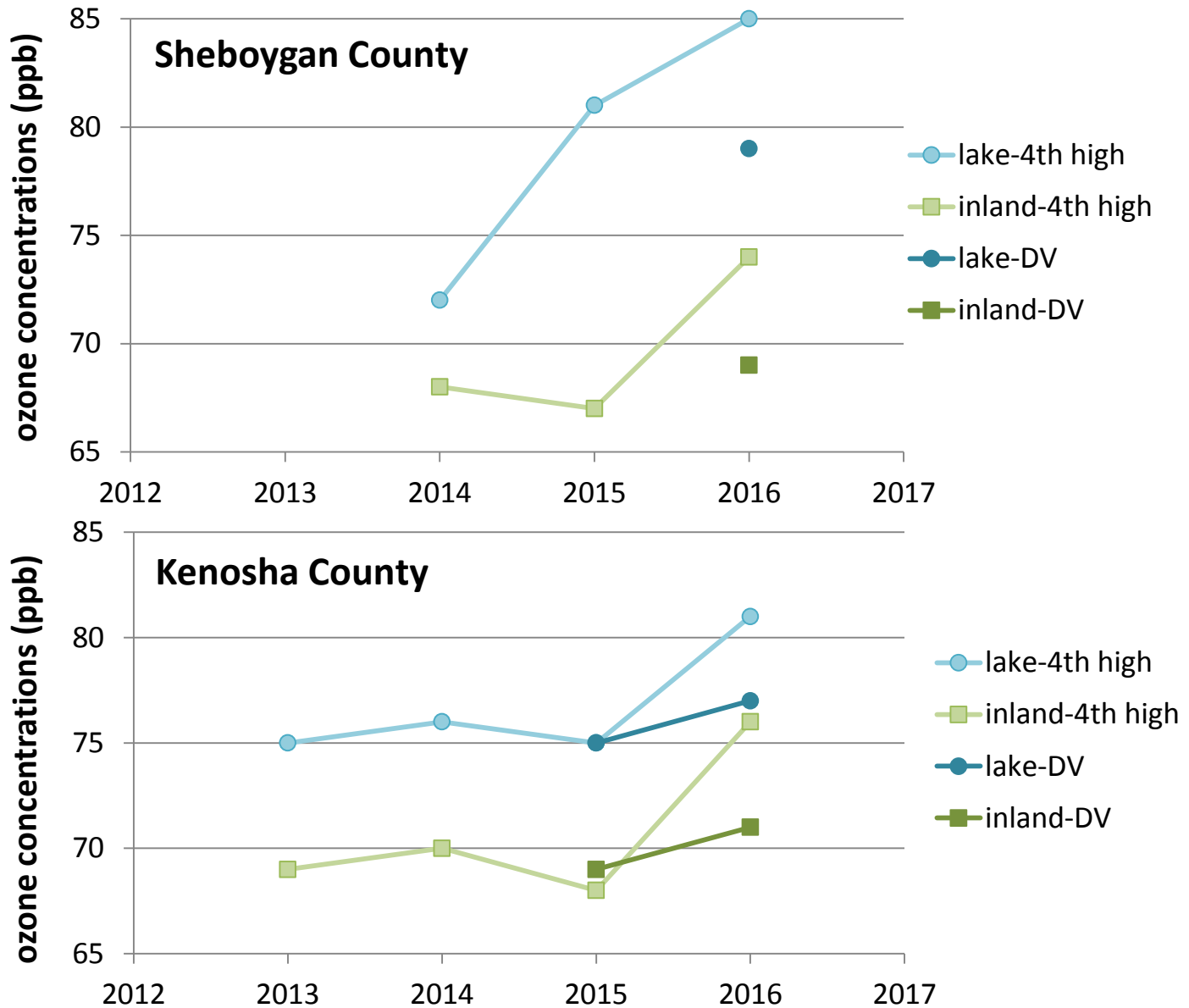
- Ozone & met data from 2014-2016
- 3.2 miles inland

### Kenosha County

#### Inland monitor:

- Ozone data from 2013-2016
- Met data from 2014-2016
- 3.6 miles inland

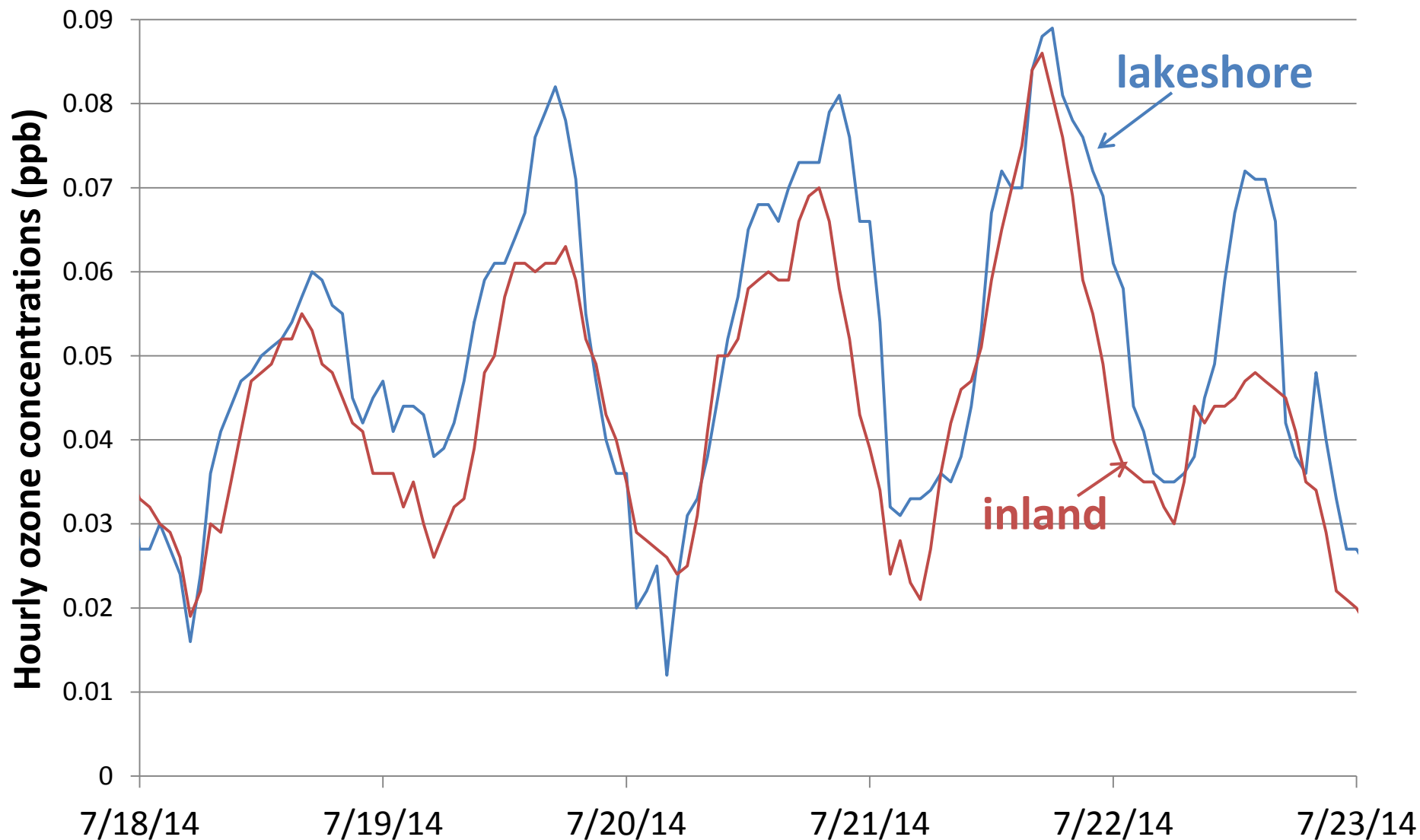
## 2. Concentration comparisons at inland and lakeshore monitors





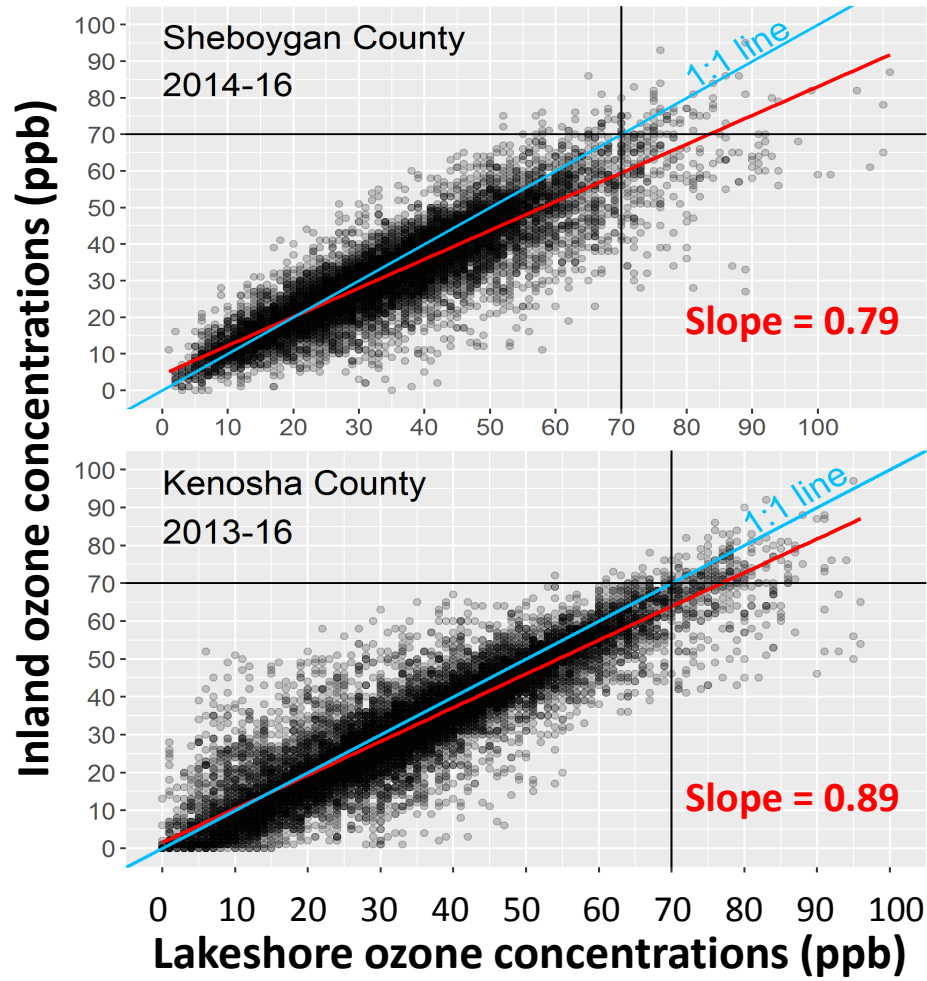
## 2. Concentration comparisons at inland and lakeshore monitors

1-hour concentrations – For a 2014 episode



## 2. Concentration comparisons at inland and lakeshore monitors

1-hour concentrations – All hours



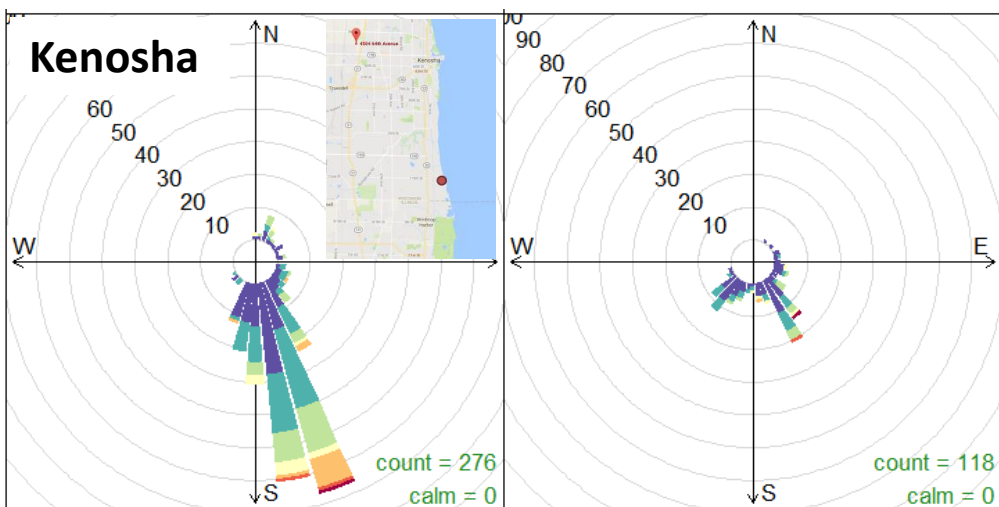
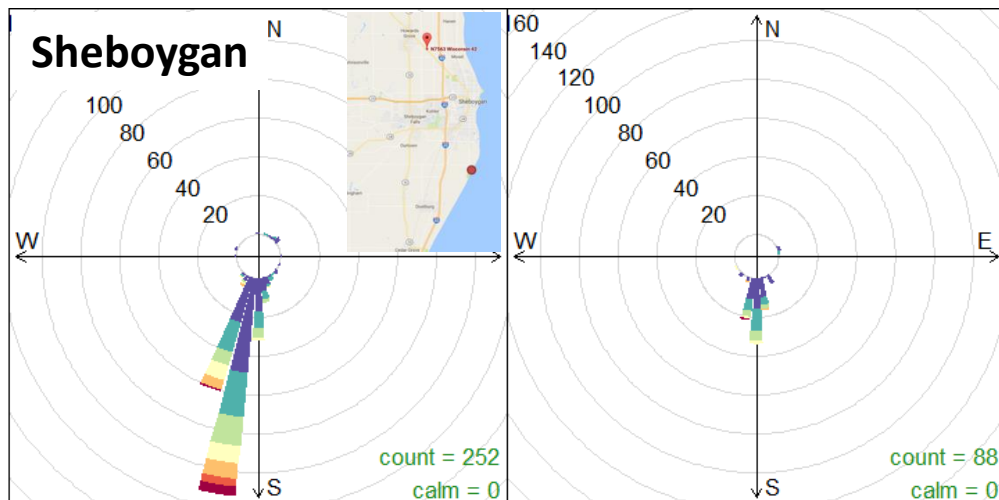
- Inland conc.  $\uparrow$  with  $\uparrow$  lakeshore conc.
- Inland conc. trend lower than lakeshore
  - Sheboygan:  $\approx 79\%$
  - Kenosha:  $\approx 89\%$
- High lakeshore concentrations:
  - Inland conc. don't trend with lakeshore
  - Really high concentrations don't seem to penetrate inland (mostly)
- Higher inland ozone at Kenosha WT versus Sheboygan Haven

### 3. The role of meteorology in driving ozone at these monitors

Only hours with ozone >70 ppb at that site (*different sets of hours at each monitor*)

Lakeshore

Inland



- Ozone-rich winds come from the south over the lake
  - Kenosha monitors also get some ozone from over land
- Many fewer hours with high ozone inland (~1/3)



## Conclusions

- Lakeshore ozone concentrations are consistently higher than inland concentrations.
  - These differences are the greatest at the highest lakeshore concentrations.
  - The highest ozone air rarely reaches the inland monitors.
- Almost all ozone comes from the south over the lake
  - A small amount at Kenosha comes from over land to the south

**Overall: Ozone concentrations drop off sharply within a few miles of the lakeshore.**

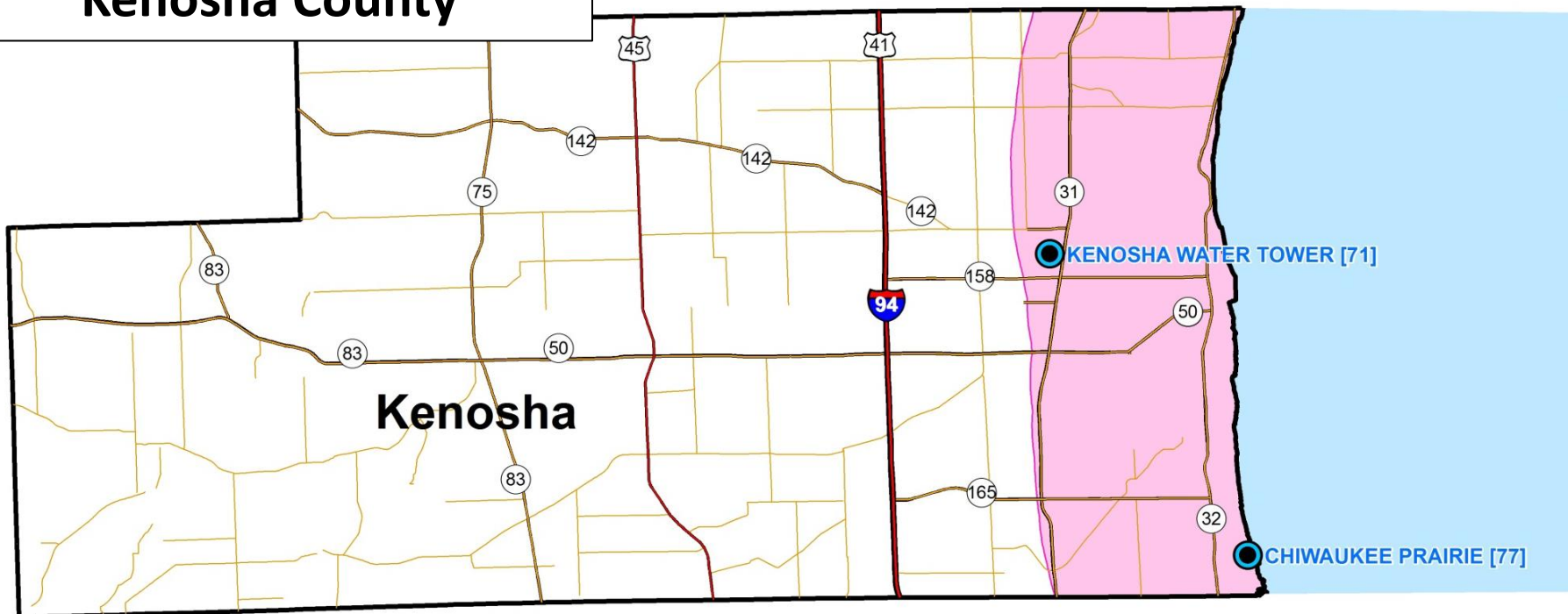


## Applications to Policy


Submitted a Technical Support Document for 2015 ozone NAAQS designations


- Supporting the Governor's recommendation of full attainment for the state
  - Demonstrated the overwhelming role of transport to Wisconsin's monitors
- Using technical data to estimate the extent of design values above 70 ppb
  - Most of the lakeshore: 70 ppb contour is a few miles inland
    - Milwaukee County: most of the county attained the NAAQS
    - Racine County: not enough data
  - Kenosha County: 70 ppb contour is farther inland due to direct overland transport from Chicago
  - Northernmost lakeshore counties:
    - Kewaunee County attained the NAAQS
    - Only a small portion of Door County is estimated to exceed the NAAQS

# Application to policy – Kenosha County



-  Interstate HWY
-  U.S. Route HWY
-  State Route HWY
-  County Route HWY

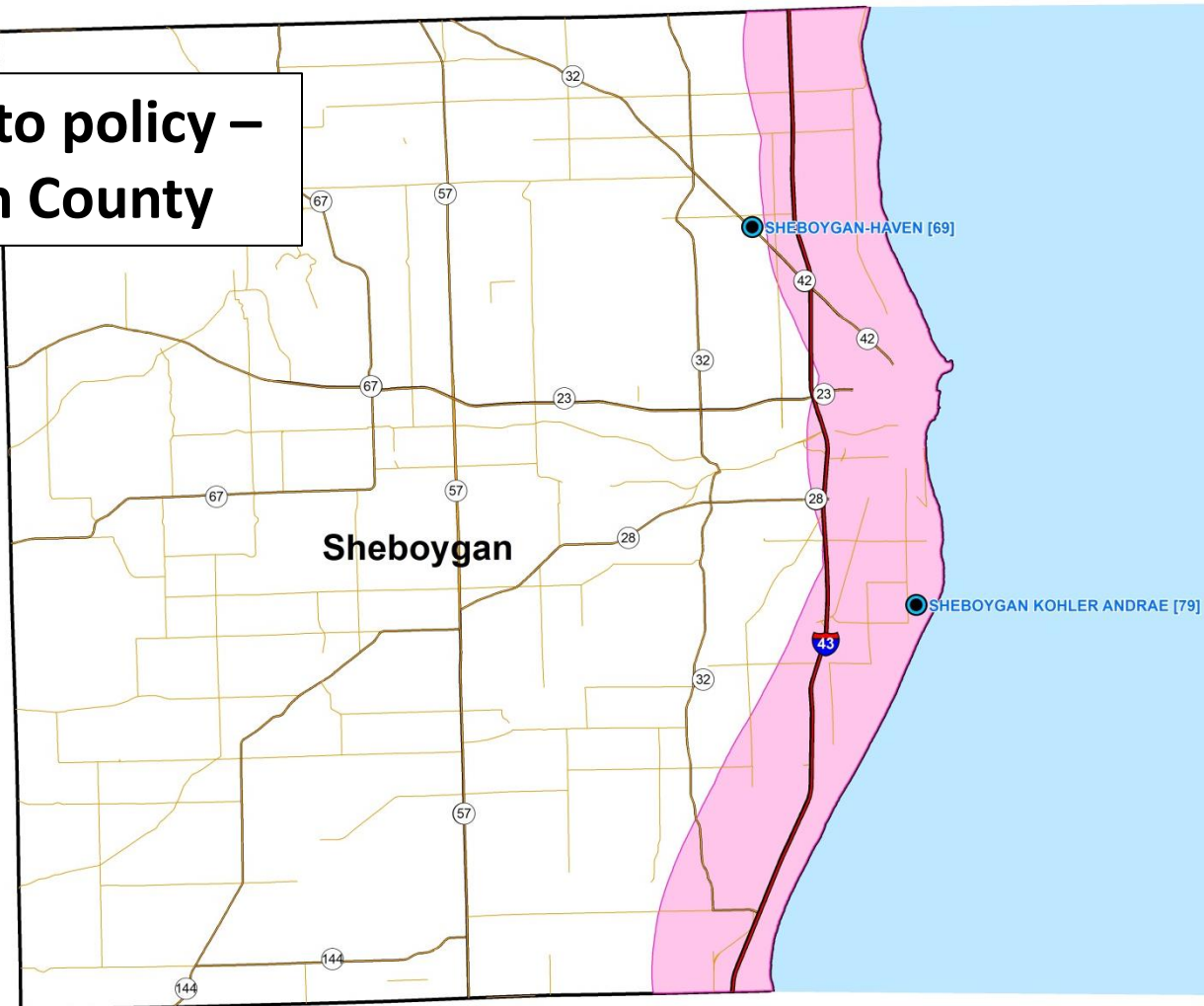
 County boundary

 Ozone Monitor Locations and 2014-2016 DVs



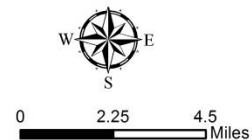
0 2.5 5 Miles

# Application to policy – Sheboygan County



- Interstate HWY
- U.S. Route HWY
- State Route HWY
- County Route HWY

- County boundary
- Ozone Monitor Locations and 2014-2016 DVs



# Application to policy – Wisconsin lakeshore







Thank you! Questions?

[Gail.Good@wisconsin.gov](mailto:Gail.Good@wisconsin.gov)