Uses of Meteorology Data in Air Quality Management

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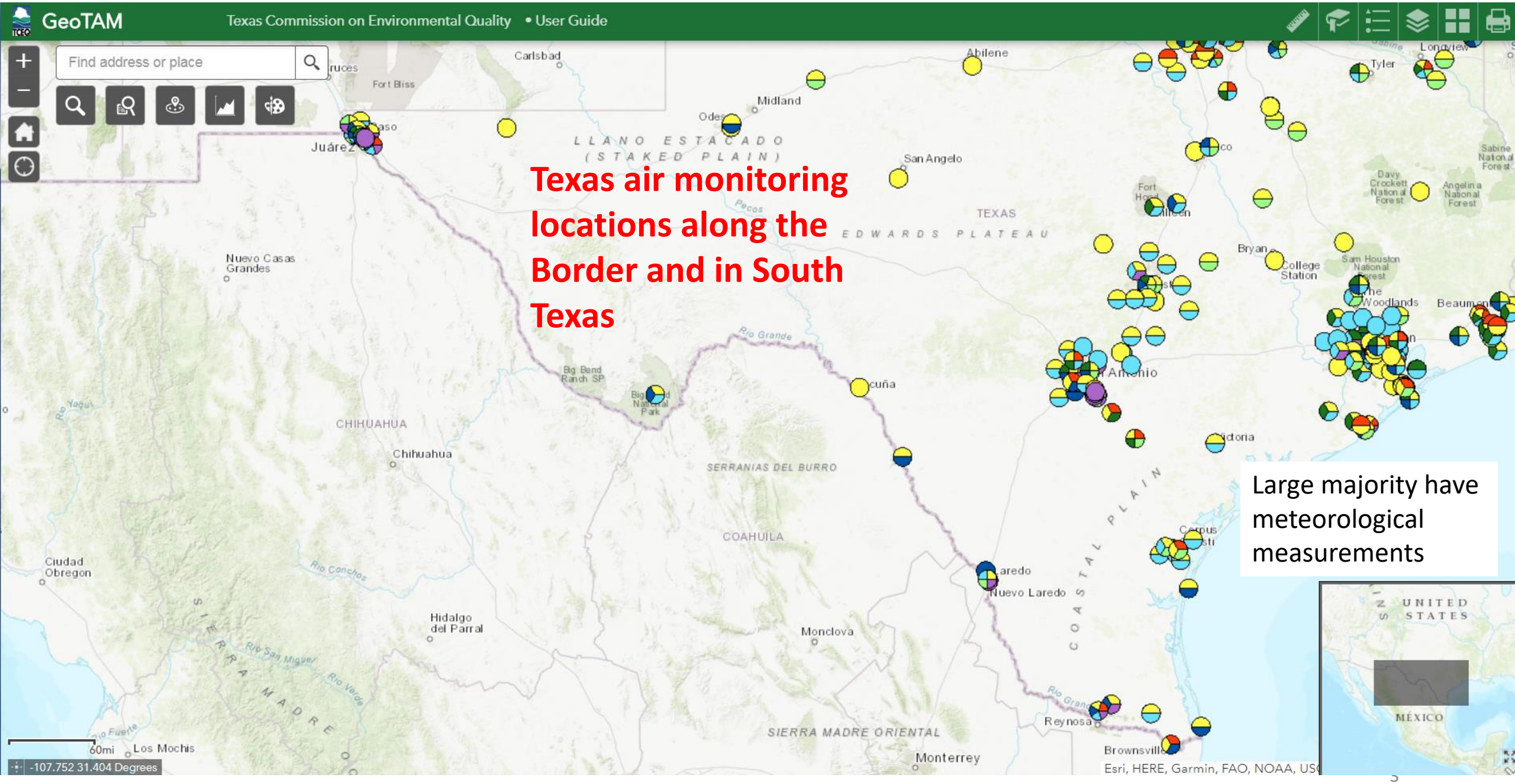
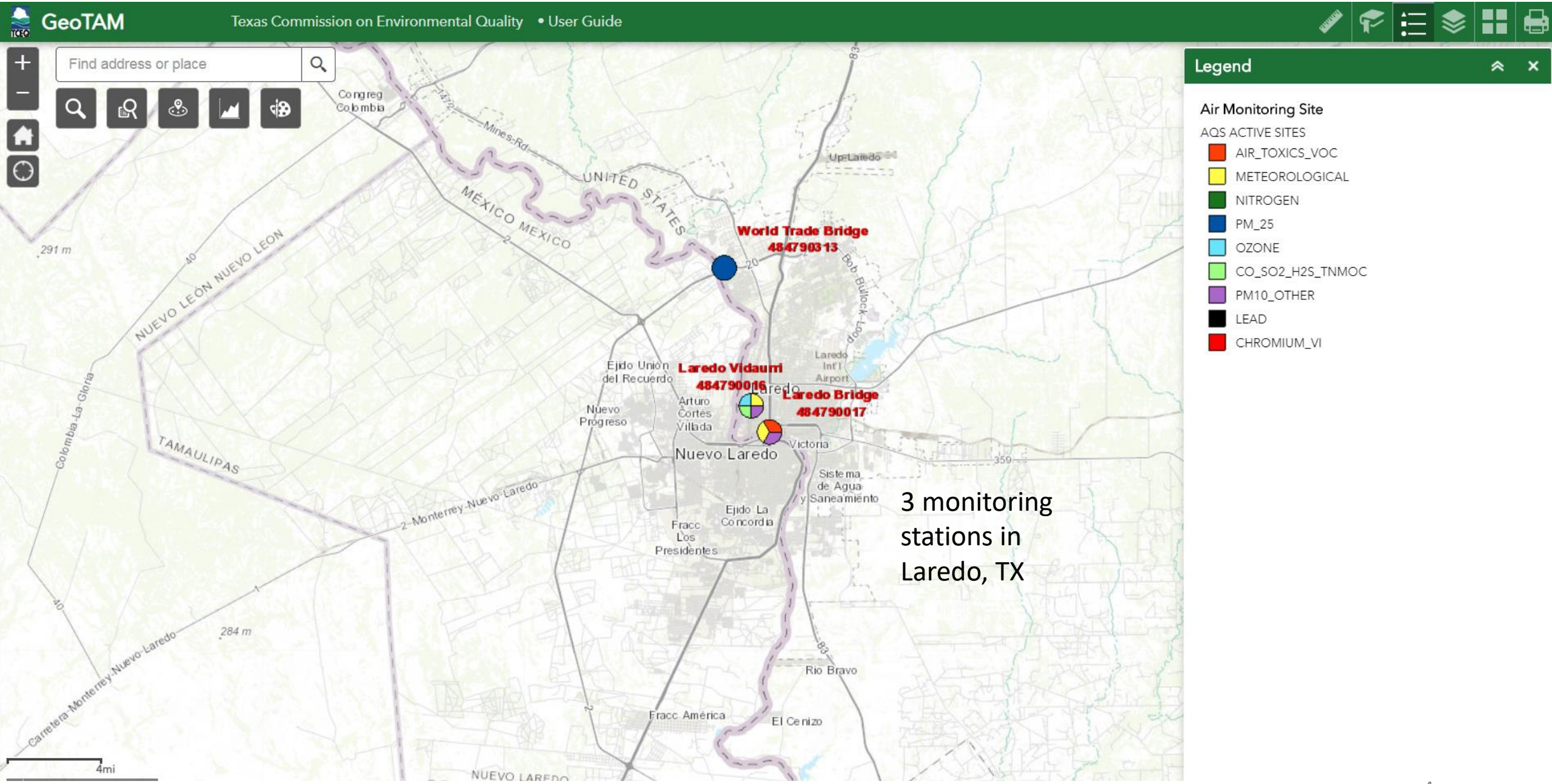
Meteorological data uses

1. Meteorological data provided by existing stations (air quality or national/federal weather service) can be used to select new air monitoring site locations.
2. Meteorological data can be used to forecast air pollution events.
3. Meteorological data collected can be used to explain air pollution events.
4. Meteorological data are used in permit modeling to assess likely impact of new facilities on local/regional air quality.
5. Meteorological data are used in NAAQS compliance modeling such as in developing the State Implementation Plan for ozone (O_3), $PM_{2.5}$, or Sulfur Dioxide (SO_2).

This talk to cover 1, 2, & 3 above….


GeoTAM
Texas Commission on Environmental Quality • User Guide
Find address or place
Texas air monitoring locations along the Border and in South Texas
Large majority have meteorological measurements
Carlsbad
Fort Bliss
Midland
Odessa
Abilene
Tyler
Longview
Juárez
San Angelo
LLANO ESTACADO (STAKED PLAIN)
TEXAS
EDWARDS PLATEAU
Pecos
Nuevo Casas Grandes
Bryan
College Station
The Woodlands
Beaumont
Rio Grande
Big Bend Ranch SP
Big Bend National Park
CHIHUAHUA
Chihuahua
SERRANIAS DEL BURRO
COAHUILA
COASTAL PLAIN
Ciudad Obregon
Rio Conchos
Hidalgo del Parral
Monclova
Laredo
Nuevo Laredo
Corpus Christi
Victoria
Reynosa
Brownsville
Monterrey
SIERRA MADRE ORIENTAL
SIERRA MADRE
Rio San Miguel
Rio Verde
Los Mochis
60mi
-107.752 31.404 Degrees
Esri, HERE, Garmin, FAO, NOAA, US
UNITED STATES
MÉXICO


GeoTAM
Texas Commission on Environmental Quality • User Guide
Find address or place
Legend
Air Monitoring Site
AQS ACTIVE SITES
AIR_TOXICS_VOC
METEOROLOGICAL
NITROGEN
PM_25
OZONE
CO_SO2_H2S_TNMOC
PM10_OTHER
LEAD
CHROMIUM_VI
World Trade Bridge
484790313
Laredo Vidaurri
484790016
Laredo Bridge
484790017
3 monitoring stations in Laredo, TX
UNITED STATES
MÉXICO MEXICO
NUEVO LEON NUEVO LEON
TAMAULIPAS
Nuevo Laredo
Laredo
Ejido Union del Recuerdo
Nuevo Progreso
Arturo Cortés Villada
Laredo Int'l Airport
Victoria
Sistema de Agua y Saneamiento
Ejido La Concordia
Fracc Los Presidentes
Rio Bravo
Fracc América
El Cenizo
Up-Laredo
Congreg Colombia
Mines Rd
Bob Bullock Loop
Colombia-La Gloria
Monterrey-Nuevo Laredo
Carretera Monterrey-Nuevo Laredo
291 m
284 m
4mi

1. Using meteorological data to select a monitoring station location

- A strategic use of meteorological data – in particular wind direction and speed – is in planning where to put monitoring stations.
- Prevailing daytime summer winds suggest where to put O_3 monitors upwind and downwind of urban areas.
- Prevailing winds suggest where to put air toxics monitors downwind of emission sources.

40 CFR Part 58 Table D-1 of Appendix D – Relationship Between Site Types and Scales of Representativeness

Site type	Appropriate siting scales
1. Highest concentration	Micro, middle, neighborhood (sometimes urban or regional for secondary pollutants).
2. Population oriented	Neighborhood, urban.
3. Source impact	Micro, middle, neighborhood.
4. General/background & regional transport	Urban, regional.
5. Welfare-related impacts	Urban, regional.

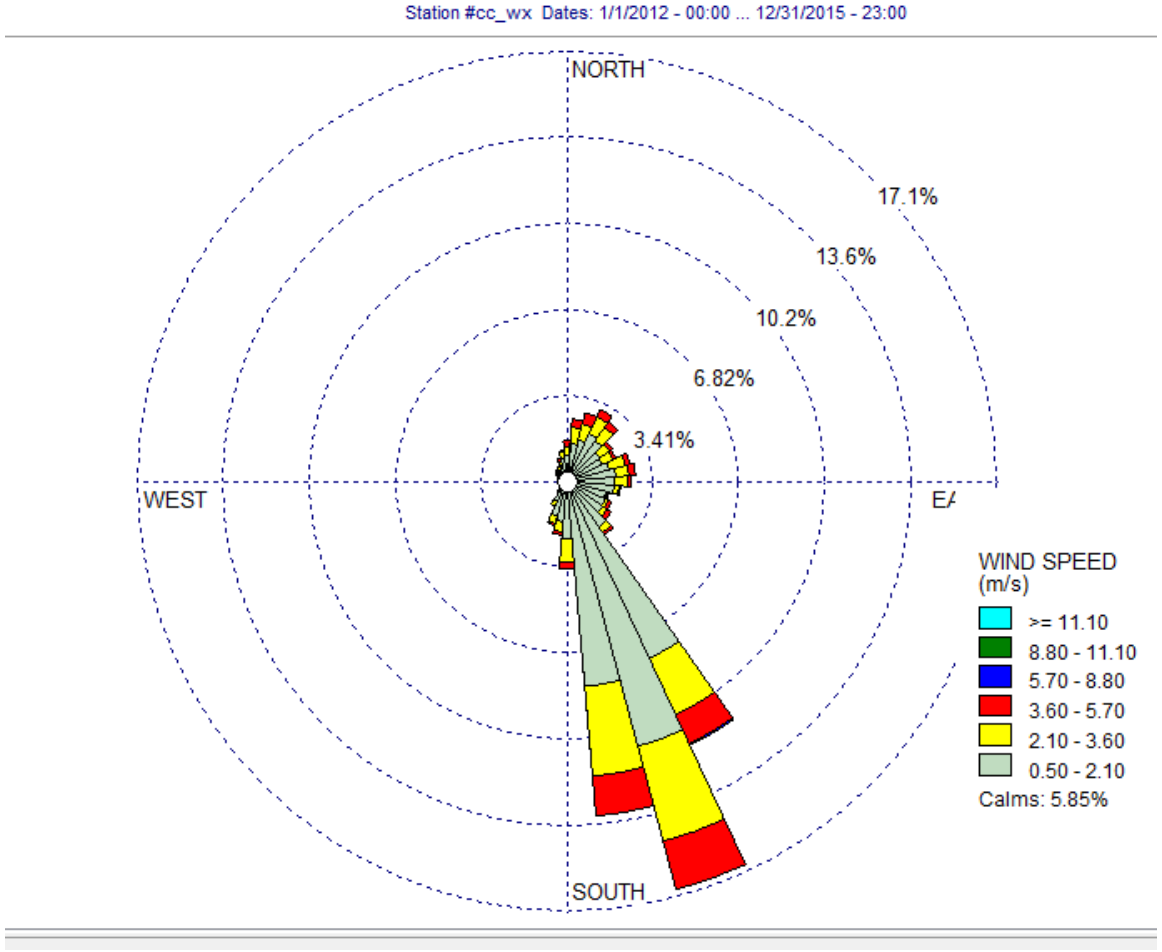
Appendix D to Part 58—Network Design Criteria for Ambient Air Quality Monitoring

- **§** 4(f): After reviewing meteorological & air quality data, max concentration site should be selected in a direction from the city most likely to observe the highest O3 concentrations, more specifically, ***downwind*** during periods of photochemical activity.
- Max concentration O3 sites often 10 to 30 miles or more ***downwind*** from the urban area where max precursor emissions originate.
- The ***downwind*** direction and appropriate distance should be determined from historical meteorological data collected on days which show the potential for producing high O3 levels.

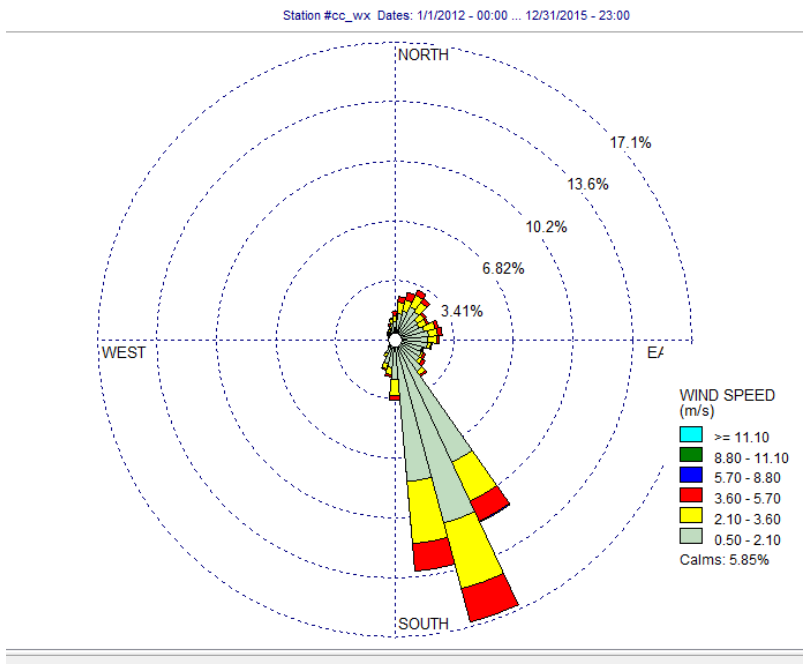
Using meteorological data to select a monitoring station location: **Case Study**

- UT recently contracted to monitor air quality for community exposure assessment and provide public info on air quality.
- Community was seeing growth in industrial facilities.
- One company worked with the local school district to provide community benefits, which included an air monitoring station.
- UT examined wind direction measurements for other monitoring sites in the general area.
- Based on historical observed winds, a site was selected directly downwind of that company's new industrial facility.

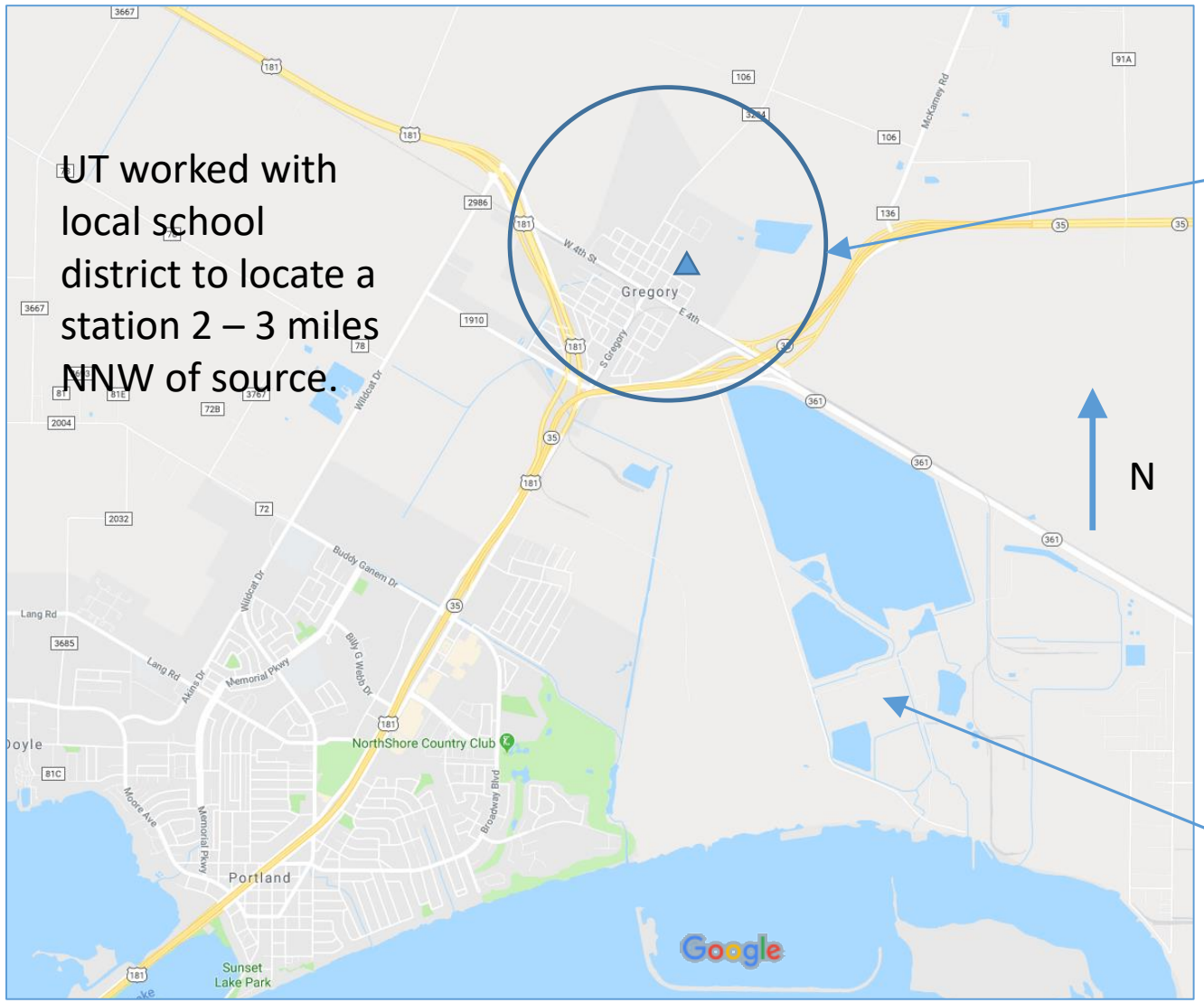
Wind rose compiled from three nearby monitoring sites in San Patricio and Nueces counties using 3 years of hourly data



Location selected 2-3 miles downwind



Area Wind Rose



2. Using meteorological data to forecast air quality

- TCEQ Monitoring Division meteorologists examine National Weather Service and local weather forecasts, along with recent air quality measurements to forecast whether weather (*how often do you get the chance to say "whether weather"?*) conditions and persistence can lead to high concentrations.
- Also use satellite imagery, forecast air mass trajectories, meteorological and photochemical dispersion/air quality models, aerosol analysis data.
- TCEQ send daily forecast e-mail, posts to social media, issues press releases, and updates website with forecast information.

Thu 6/6/2019 10:04 AM

Texas Commission on Environmental Quality <tceq@service.govdelivery.com>

TCEQ Daily Air Quality Forecast Update

To Sullivan, David W

If there are problems with how this message is displayed, click here to view it in a web browser.

Forecast is for Ozone, PM2.5, & PM10, and is based on EPA's Air Quality Index (AQI)

Forecast Region (Click name for AIRNOW version)	Thu 06/06/2019	Fri 06/07/2019	Sat 06/08/2019	Sun 06/09/2019
Amarillo	Ozone	Ozone	Ozone	Ozone
Austin	Good	Ozone	Ozone	Good
Beaumont-Port Arthur	Good	Good	Good	Ozone
Brownsville-McAllen	Good	Good	Good	Good
Corpus Christi	Good	Good	Good	Good
Dallas-Fort Worth	Ozone	Ozone	Ozone	Ozone
El Paso	Ozone*	Ozone	Ozone	Ozone
Houston	Ozone	Ozone	Ozone	Ozone
Laredo	Good	Good	Good	Good
Lubbock	Ozone	Ozone	Ozone	Ozone
Midland-Odessa	Ozone	Ozone	Ozone	Ozone
San Antonio	Good	Ozone	Ozone	Ozone
Tyler-Longview	Good	Good	Good	Good
Victoria	Good	Good	Good	Good
Waco-Killeen	Good	Ozone	Good	Ozone

An asterisk (*) indicates that an Ozone Action Day is or will be in effect for the indicated region.

A caret (^) indicates that levels of PM may exceed the applicable short-term NAAQS. For more information see the following TCEQ websites: Air Pollution from Particulate Matter and Voluntary Tips for Citizens

TCEQ Daily Air Quality Forecast Update: Forecast Discussion

Thursday 06/06/2019

- **An Ozone Action Day is in effect on Thursday for the El Paso area**. Light to moderate winds, warm to hot temperatures, sufficient afternoon sunshine, and elevated incoming background levels could be enough for ozone to reach "Unhealthy for Sensitive Groups" in parts of the El Paso area; "Moderate" or, if there is sufficient sunshine, possibly higher in parts of the Midland-Odessa area; the lower to middle end of the "Moderate" range in parts of the Amarillo, Dallas-Fort Worth, and Lubbock areas; the lower end of the "Moderate" range in parts of the Houston area; and the upper end of the "Good" range in the and Austin, San Antonio, and Waco-Killeen areas, with highest concentrations in the afternoon and early evening.
- Otherwise and elsewhere in the state, moderate winds, heavy cloud cover with precipitation, and/or lower incoming background levels should help keep air quality in the "Good" range in most spots.

TCEQ Daily Air Quality Forecast Update: Forecast Discussion

Friday 06/07/2019

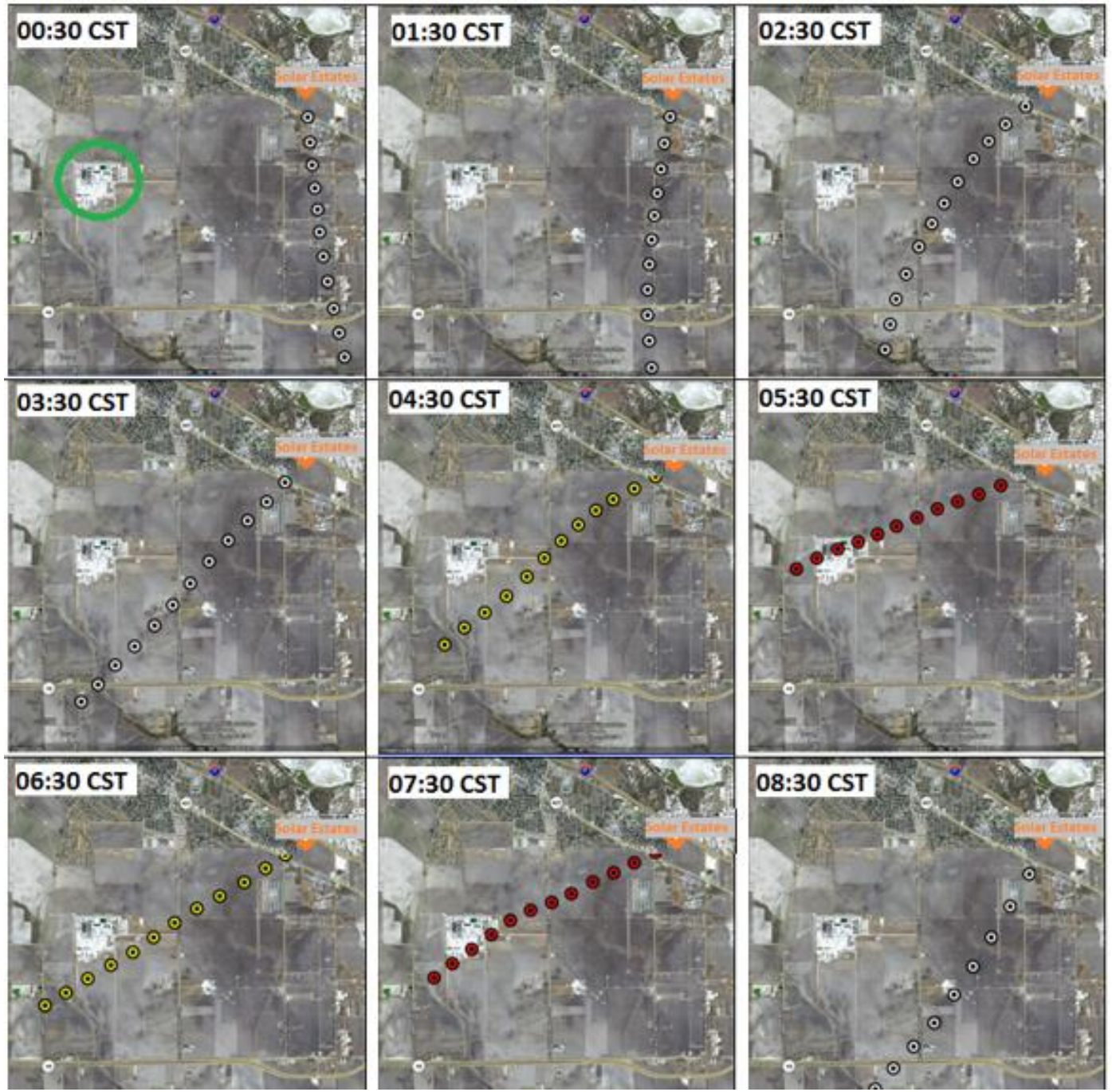
- Light to moderate winds, warm to hot temperatures, sufficient afternoon sunshine, and elevated incoming background levels could be enough for ozone to reach "Unhealthy for Sensitive Groups" in parts of the Midland-Odessa area; the upper end of the "Moderate" range or possibly higher in the El Paso area; the middle to upper end of the "Moderate" range in parts of the Amarillo and Lubbock areas; the lower to middle end of the "Moderate" range in parts of the Dallas-Fort Worth, Houston, and San Antonio areas; the lower end of the "Moderate" range in the Austin and Waco-Killeen areas; and possibly the upper end of the "Good" range in parts of the Beaumont-Port Arthur area, with highest concentrations in the afternoon and early evening.
- Otherwise and elsewhere in the state, moderate winds, lingering cloud cover with precipitation, and/or lower incoming background levels should help keep air quality in the "Good" range in most spots.

3. Using meteorological data to explain air quality measurements

- TCEQ & UT have conducted many, many case studies using combinations of wind speed, wind direction, temperature (or solar radiation), and precipitation to explain elevated concentrations of O_3, $PM_{2.5}$, SO_2, and other pollutants including air toxics.
- In some cases, upper air measurements of wind speed, wind direction, & planetary boundary layer height have been used.
- In some cases, wind & other atmospheric data employed in more complicated use of surface air back trajectories or upper air back trajectories.

Using meteorological data to explain air quality measurements: **Case Study 1**

- From 2005 to 2012, relatively high (e.g., up to 35.8 ppbV) hourly concentrations of **1,3-butadiene** sometimes measured at Corpus Christi Solar Estates monitoring station under southwest winds.
- One chemical plant was located 3 miles (4.8 km) SW of the station.
- UT used a **surface trajectory tool** → users selected locations & start times // tool produced likely air parcel upwind locations at 5-min. steps back in time.
- Data used in trajectories collected automatically from TCEQ data archive of 5-min time resolution wind speed & direction from area monitors.

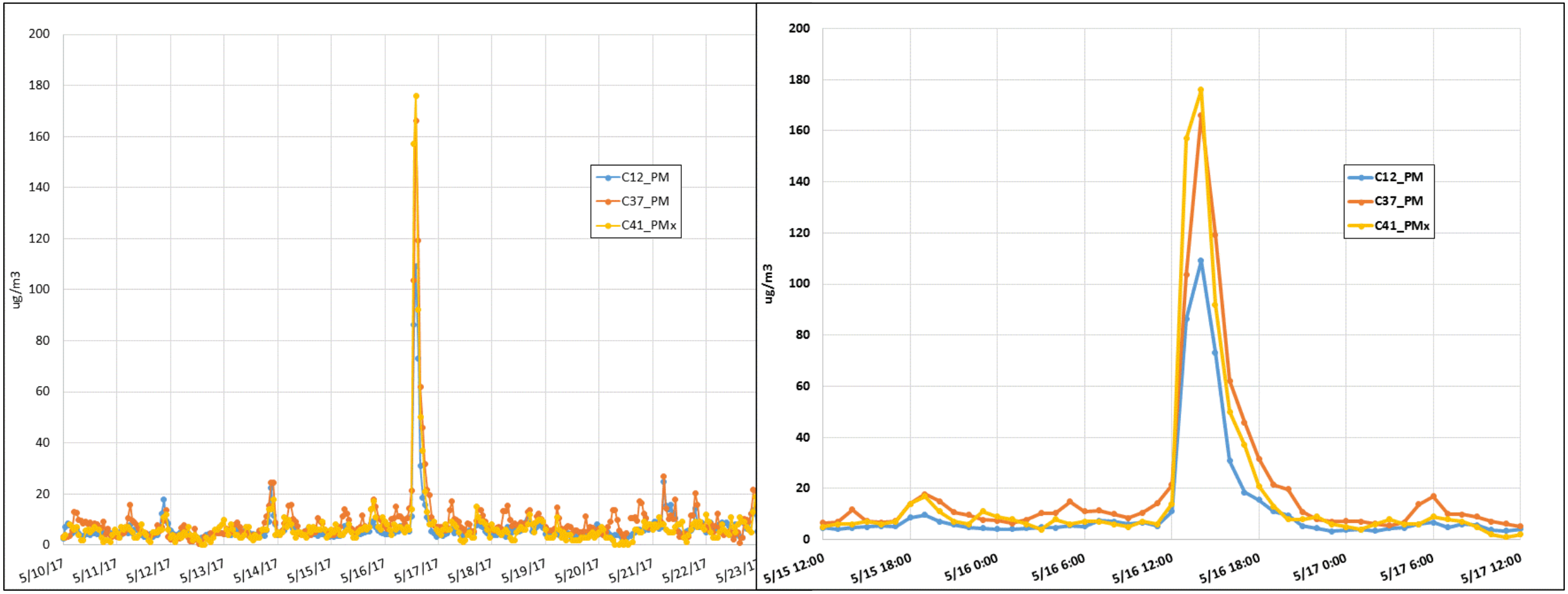


Trajectories for 9/27/2009, color-coded by 1,3-butadiene concentration:
white = 0 ppbV
yellow = 2 to 6 ppbV
red = 35 ppbV.

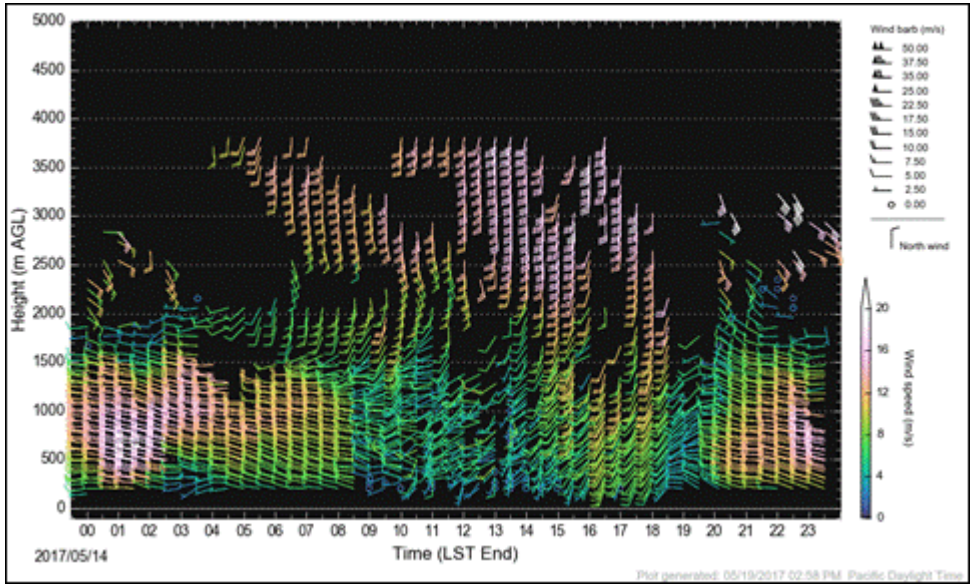
Using meteorological data to explain air quality measurements: **Case Study 2**

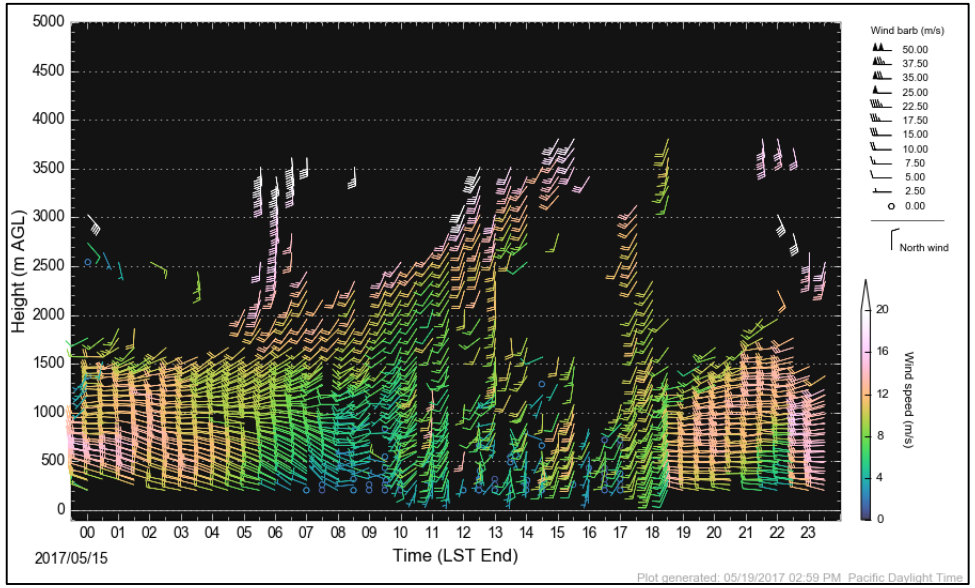
- The TCEQ weather forecast on Tuesday May 16, 2017 for El Paso said:
  - *Strong afternoon winds are expected to generate and transport patchy blowing dust in parts of West Texas and the Panhandle, including in the El Paso area, where the daily PM10 AQI could reach "Moderate" or possibly higher levels, and in the Lubbock and Midland-Odessa areas, where the duration, intensity, and associated precipitation is not expected allow the daily PM10 AQI to rise beyond the "Good" range.*

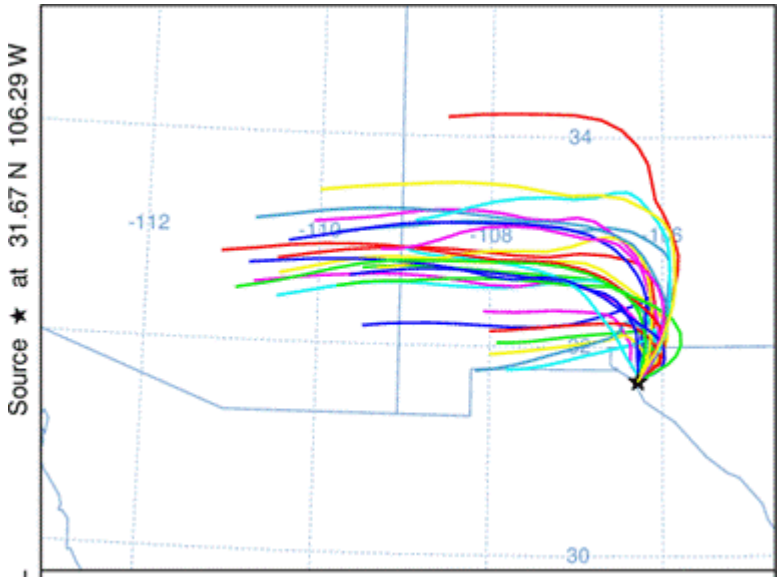
El Paso County $PM_{2.5}$ monitor (TEOM & Beta-gauge) concentrations May 15 – 17, 2017

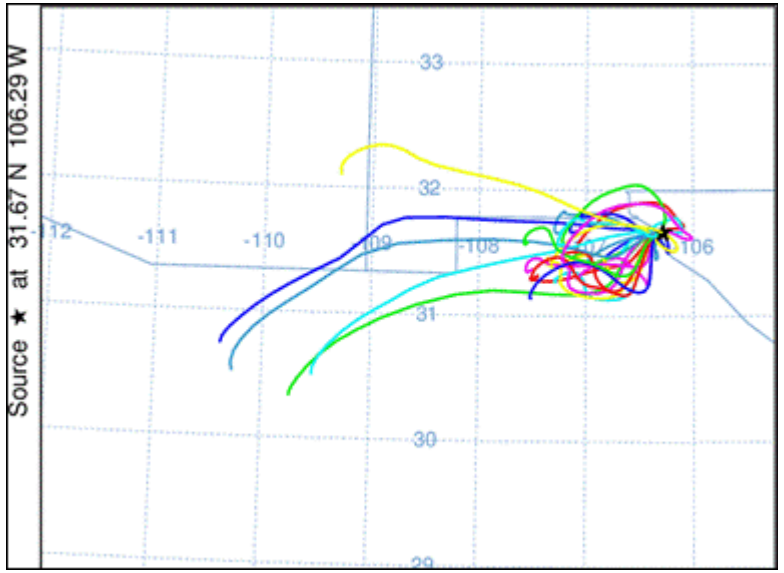


May 14 & 15, 2017 winds in El Paso

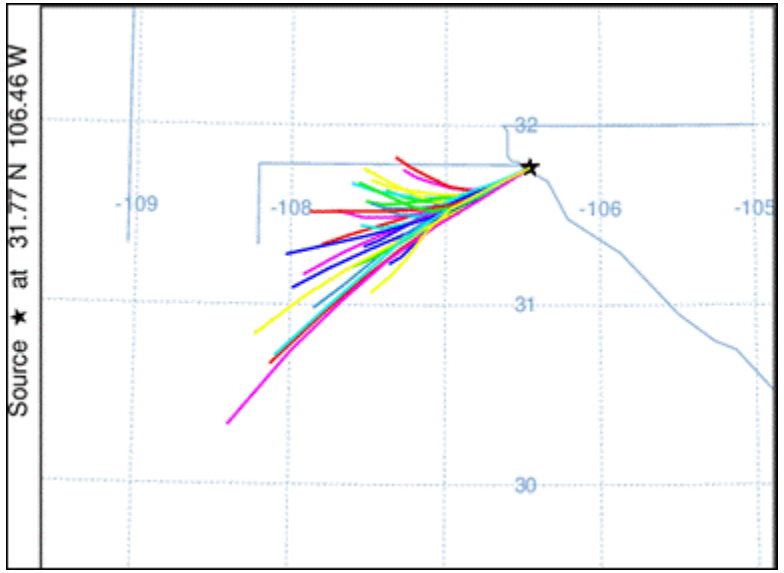


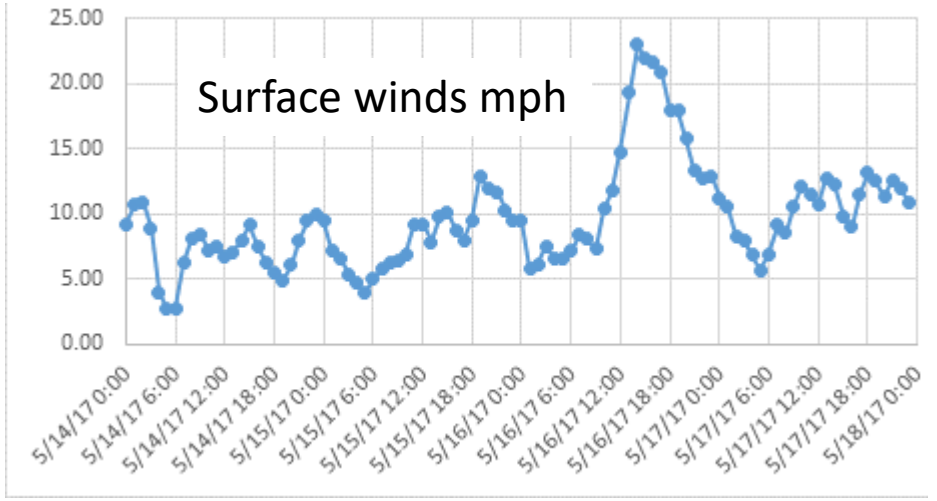


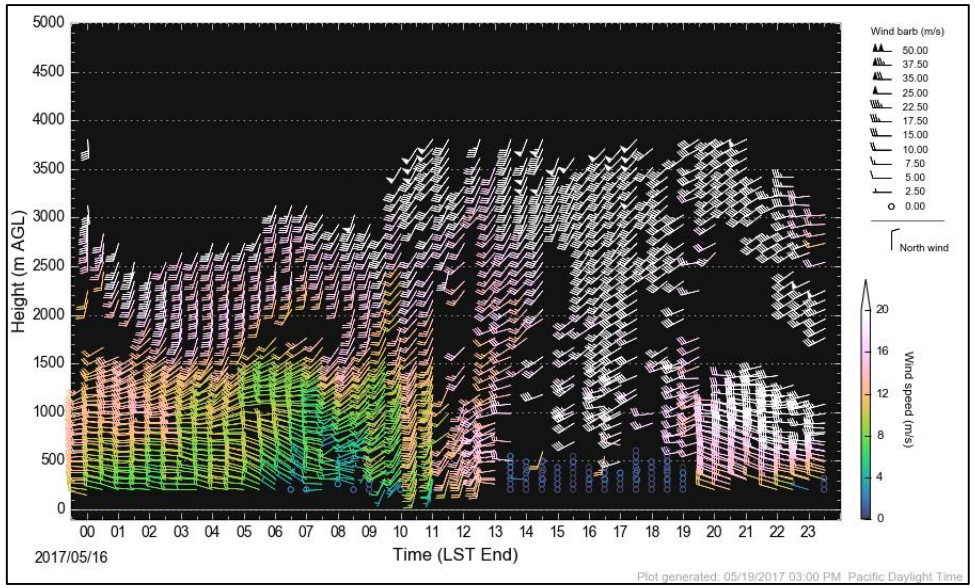




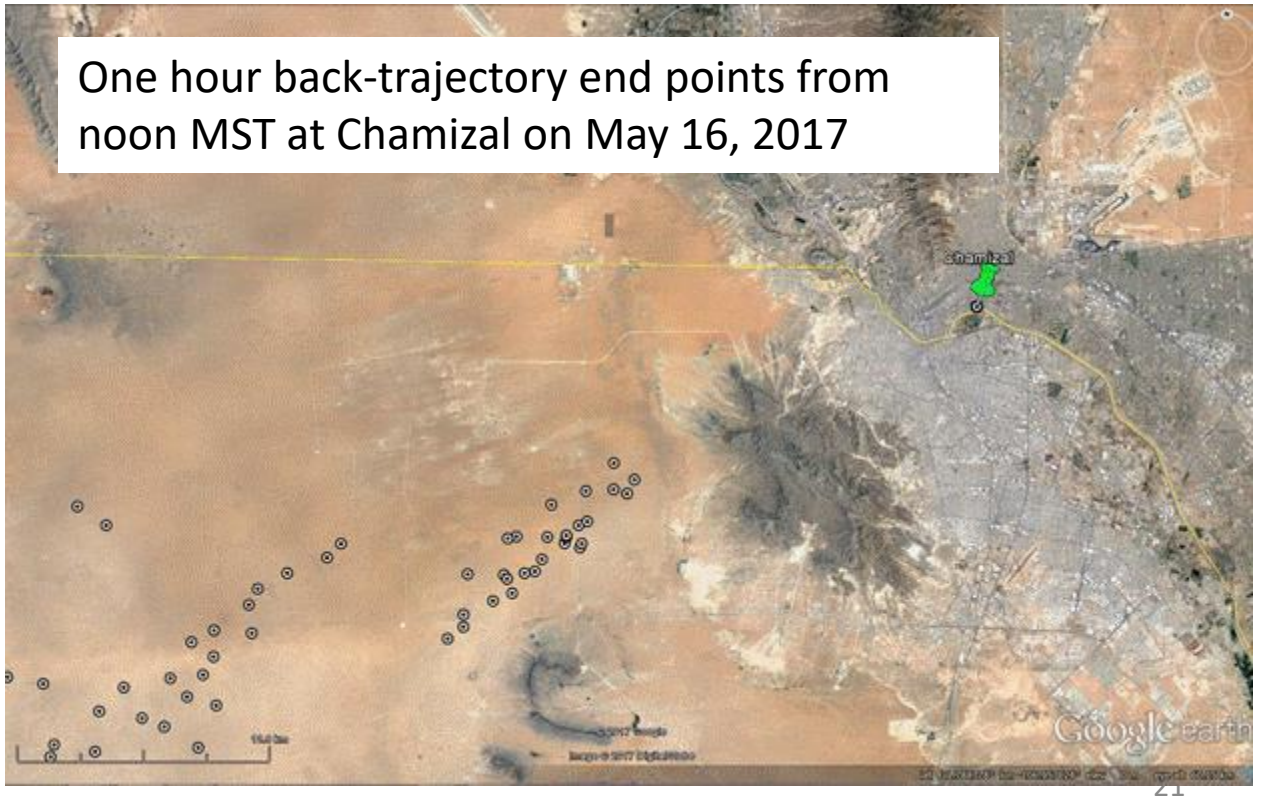
May 16, 2017







One hour back-trajectory end points from noon MST at Chamizal on May 16, 2017



Using meteorological data to explain air quality measurements: **Case Study too** many to cover

- At **Houston Clinton Dr. site**, used precipitation data to show local dust was more a problem there than at other $PM_{2.5}$ sites nearby.
- Used wind speed & direction data to show the upwind direction associated with elevated dust.
- These analyses along with the chemical speciation of the $PM_{2.5}$ samples led to saving Houston from $PM_{2.5}$ nonattainment.

Using meteorological data to explain air quality measurements: **Case Study too** many to cover

- In **Corpus Christi**, combination of graphs of mean SO_2 concentration by wind direction from UT & TCEQ monitoring stations led to triangulating on location of SO_2 sources → ships docked along Ship Channel, burning high-sulfur fuel oil.
- In **Tyler & Longview** in NE TX, a comparison of time series of O_3 concentrations showed that the two sites ~ 35 miles apart affected by regional O_3 as opposed to only local…. Except when wind shifted to northeast (to nearby chemical plant), and O_3 suddenly rose at Longview and not at Tyler.

Using meteorological data to explain air quality measurements: **Case Study too** many to cover

- In 2017, TCEQ sponsored an air quality research project for **San Antonio, TX**.
- UT operated meteorological instruments to measure surface and upper air winds, and boundary layer heights.
- Equipment installed at
  - UTSA campus (acoustic sounder, radar wind profiler, ceilometer) in NW San Antonio and
  - TCEQ Calaveras Lake station in SE Bexar County (Acoustic sounder).
- Data helped explain elevated O_3 episodes.

Using meteorological data to explain air quality measurements: **Case Study too** many to cover

- In studying NOx concentrations at **Midlothian, TX**, discovered changes in the peak mean concentration upwind direction over time.
- In looking at archived aerial photos on Google Earth, found that the heavy-duty digging & hauling equipment at a nearby surface mine advanced around the edge of the mine in agreement with the changing peak NOx wind direction.

Conclusion

- Meteorological data provided by existing stations (air quality or national/federal weather service) can be used to select now air monitoring site locations.
- Meteorological data can be used to forecast air pollution events.
- Meteorological data collected can be used to explain air pollution events.
- Not covered in this talk, but meteorological data play a key role in industrial permit modeling and in State Implementation Planning air quality modeling.

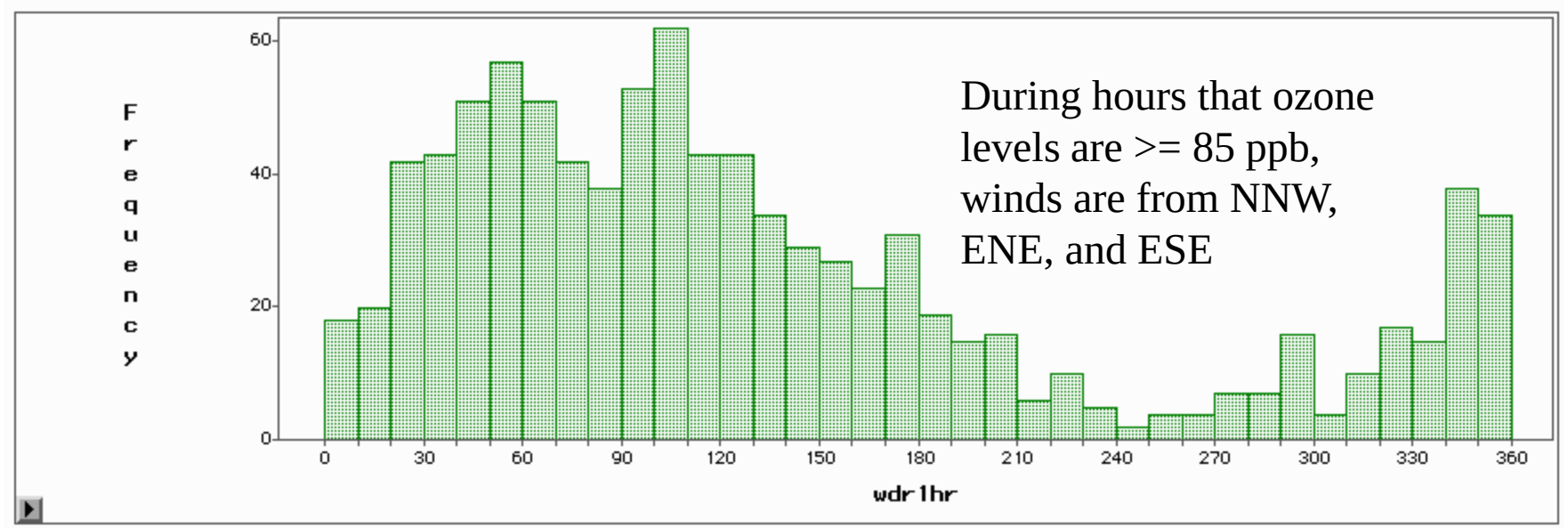
Extra slides if needed….

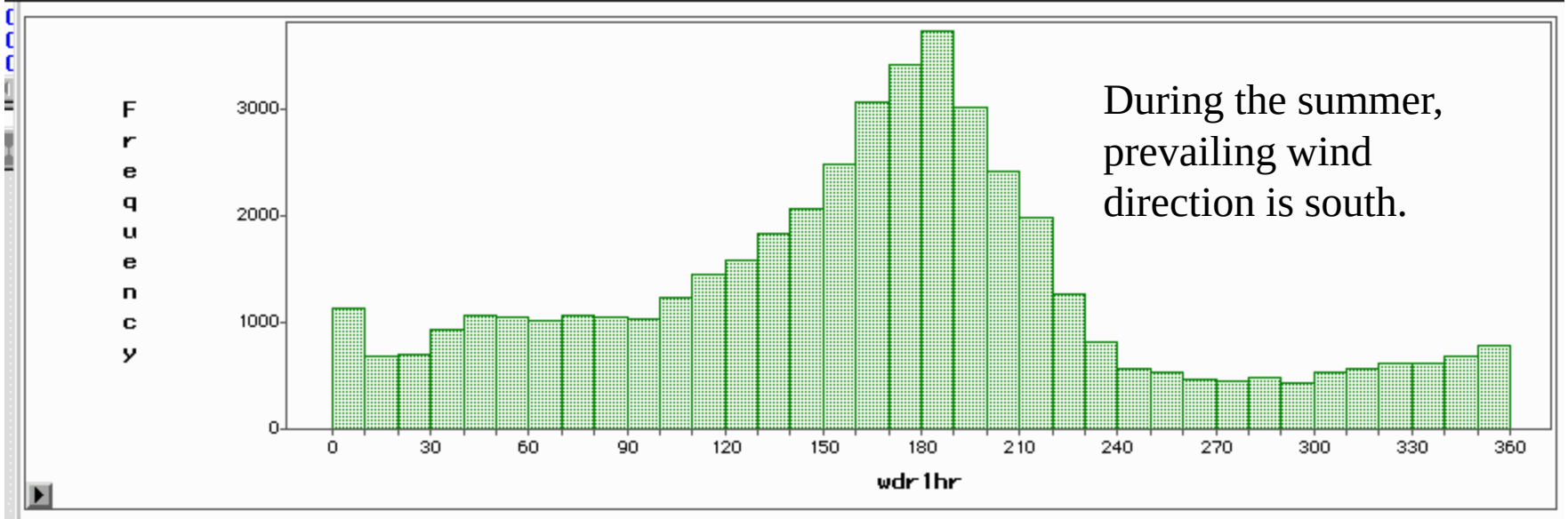
Why monitor air quality?

- **40 CFR Part 58 AMBIENT AIR QUALITY SURVEILLANCE § 58.2 Purpose.**
- **(a)** This part contains requirements for measuring ambient air quality and for reporting ambient air quality data and related information. The monitoring criteria pertain to the following areas:
  - **(1)** Quality assurance procedures for monitor operation and data handling.
  - **(2)** Methodology used in monitoring stations.
  - **(3)** Operating schedule.
  - **(4)** Siting parameters for instruments or instrument probes.
  - **(5)**Minimum ambient air quality monitoring network requirements used to provide support to the State implementation plans (SIP), national air quality assessments, and policy decisions. These minimums are described as part of the network design requirements, including minimum numbers and placement of monitors of each type.
  - **(6)** Air quality data reporting, and requirements for the daily reporting of an index of ambient air quality.
- **(b)** The requirements pertaining to provisions for an air quality surveillance system in the SIP are contained in this part.
- **(c)** This part also acts to establish a national ambient air quality monitoring network for the purpose of providing timely air quality data upon which to base national assessments and policy decisions.

4 monitoring stations in Nuevo Laredo, TM.

Wind direction corresponding to high ozone at the Longview Gregg Co. Airport (481830001/CAMS19), 1993-2002/April-Oct.





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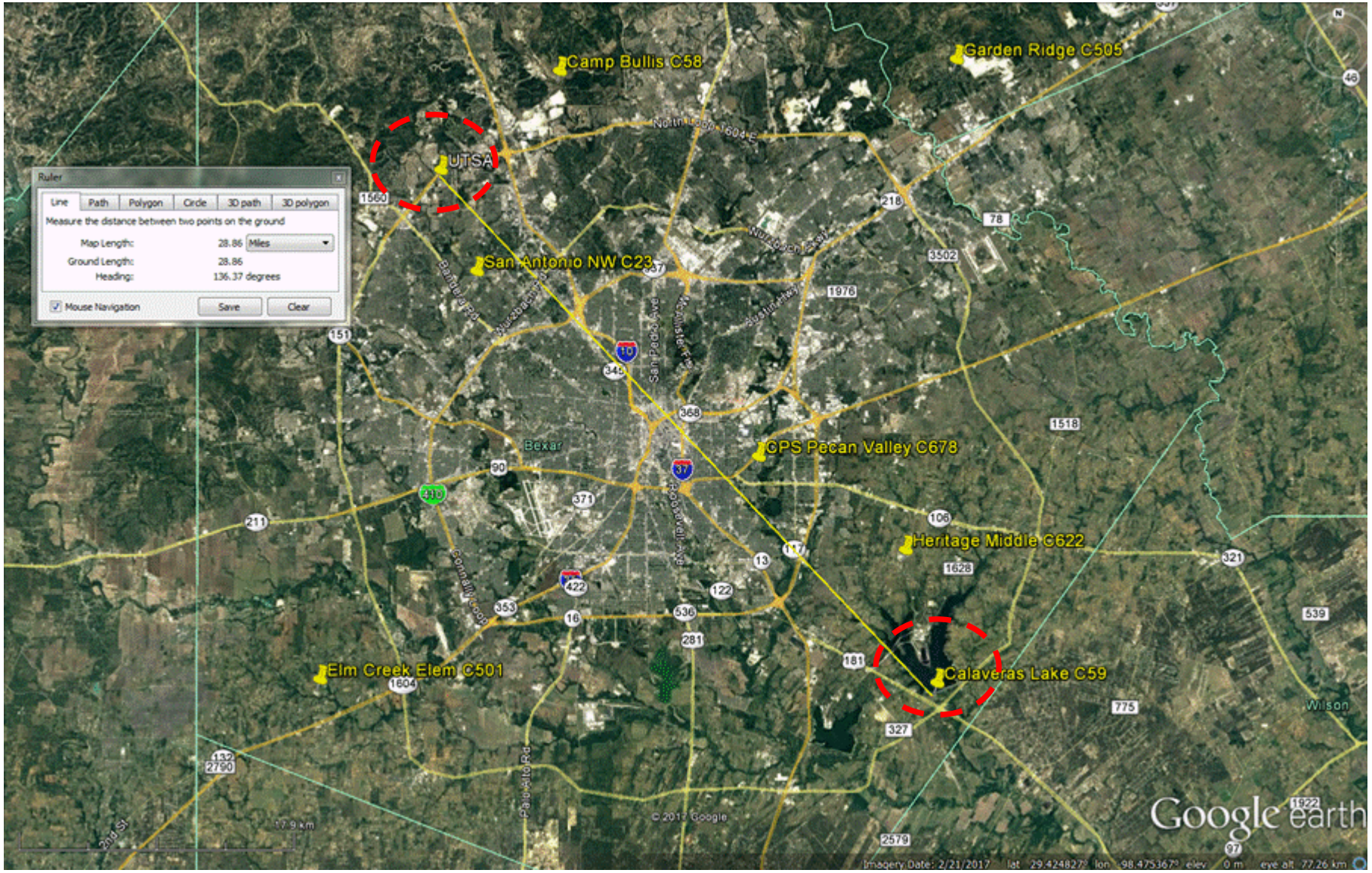
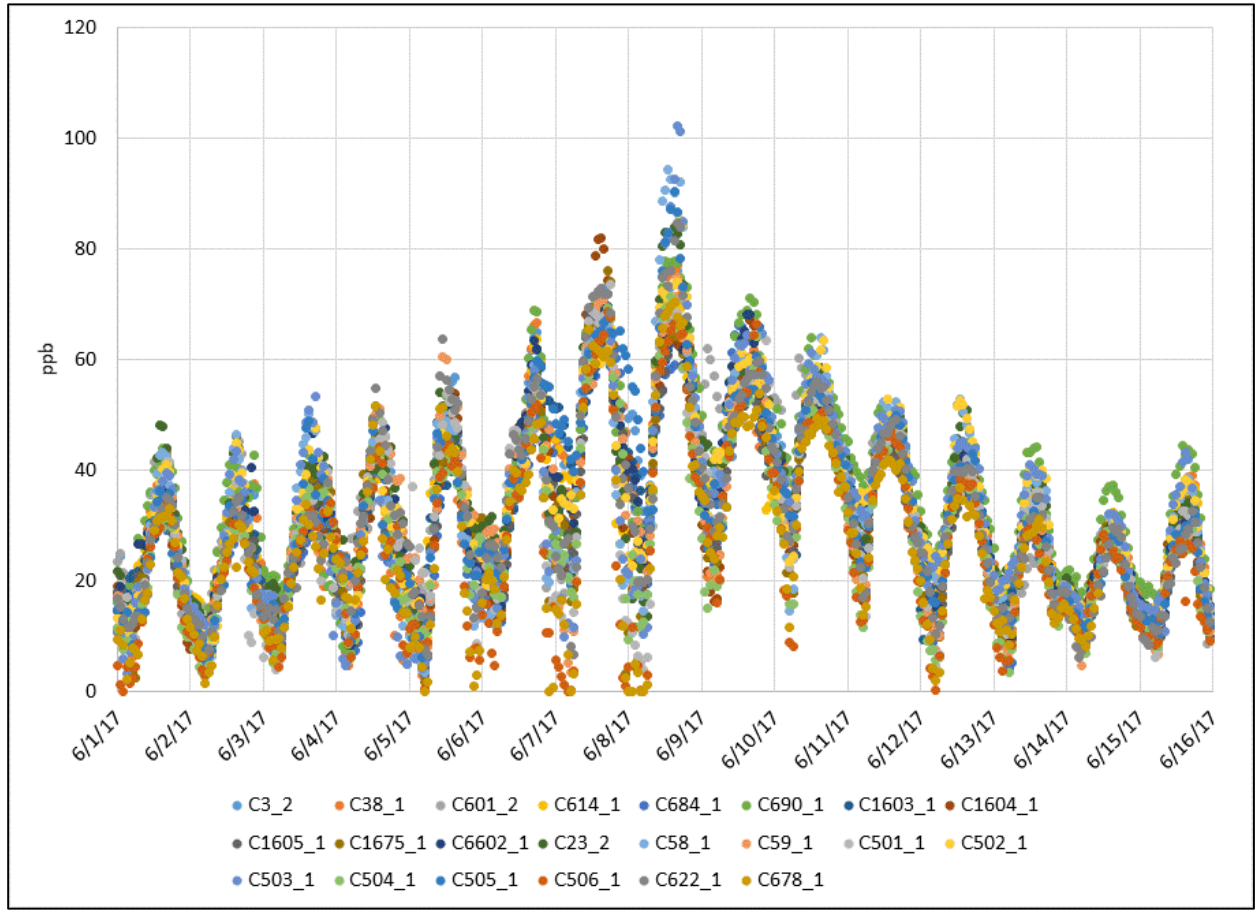
Monitor siting in the San Antonio area, summer 2017

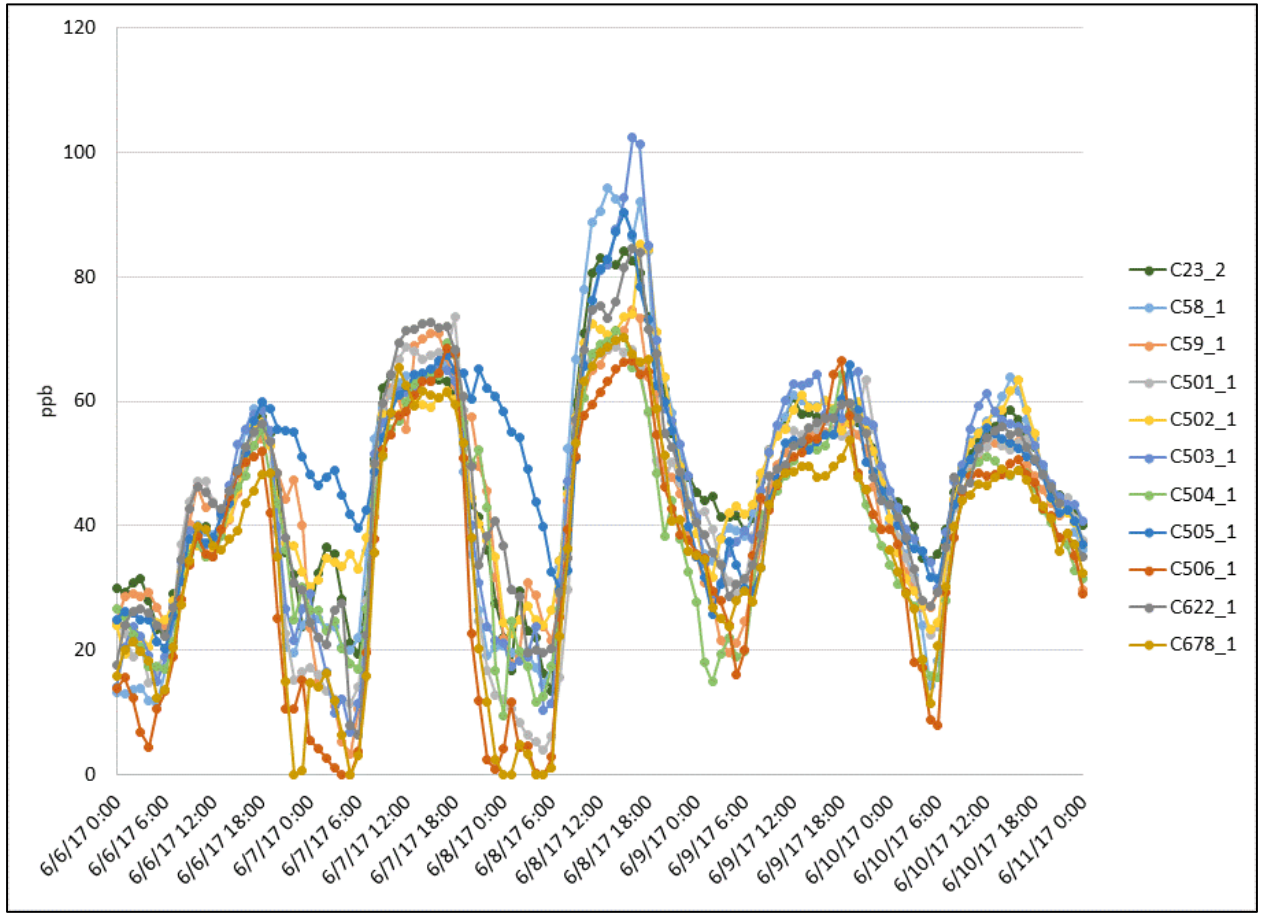


San Antonio high Ozone, Summer 2017

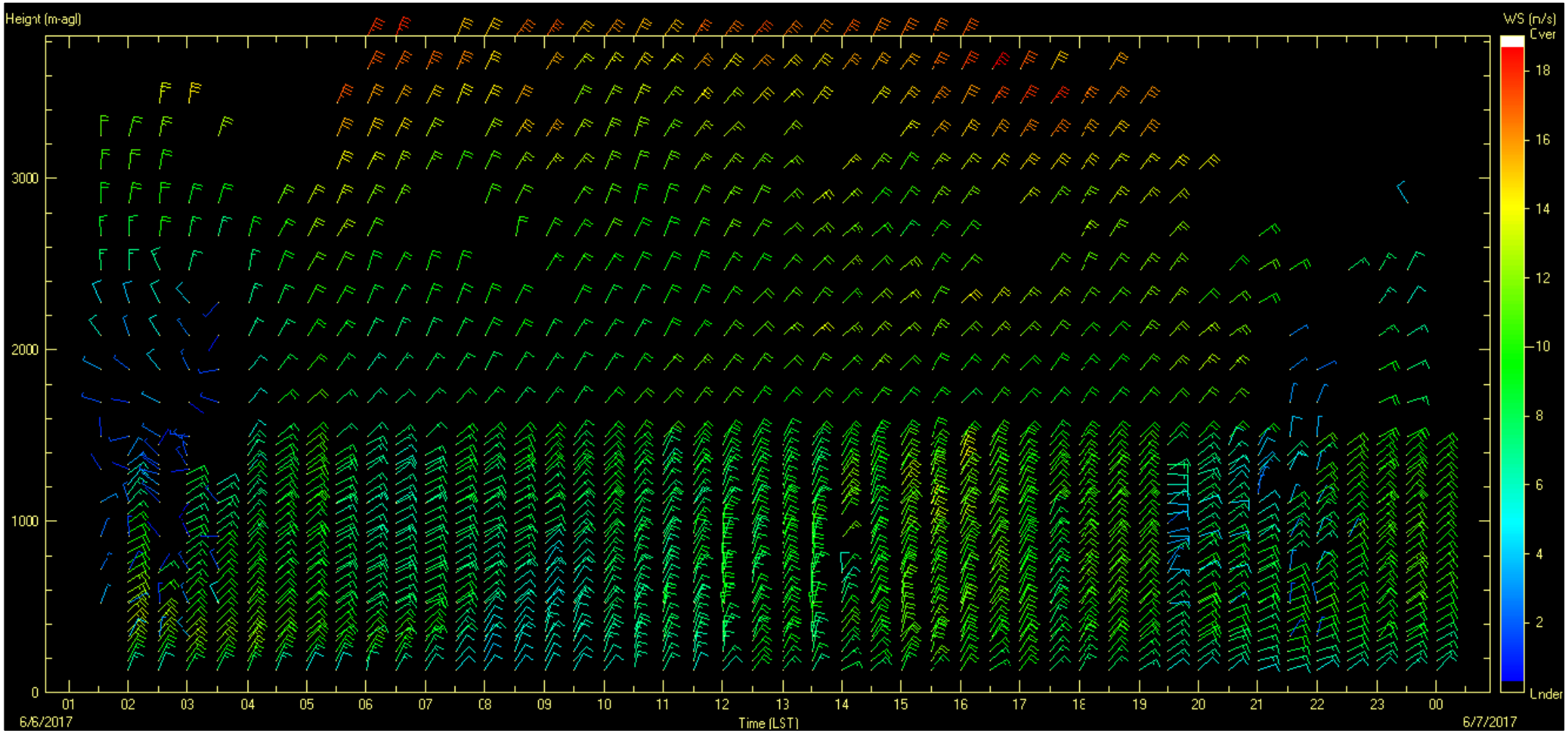
- For 2 of 11 sites, May 6 is in the top four.
- For 9 of 11 sites (including SA NW), May 7 is in the top four.
- For 5 of 11 sites, June 7 is in the top four.
- **For 10 of 11 sites (including SA NW and Camp Bullis), June 8 is in the top four.**
- For 3 of 11 sites (including SA NW and Camp Bullis), August 1 is in the top four.
- For 3 of 11 sites (including SA NW and Camp Bullis), August 4 is in the top four.
- For 1 of 11 sites, September 12 is in the top four.
- For 5 of 11 sites (including Camp Bullis), September 13 is in the top four.

Ozone concentrations around Thurs. June 8, 2017

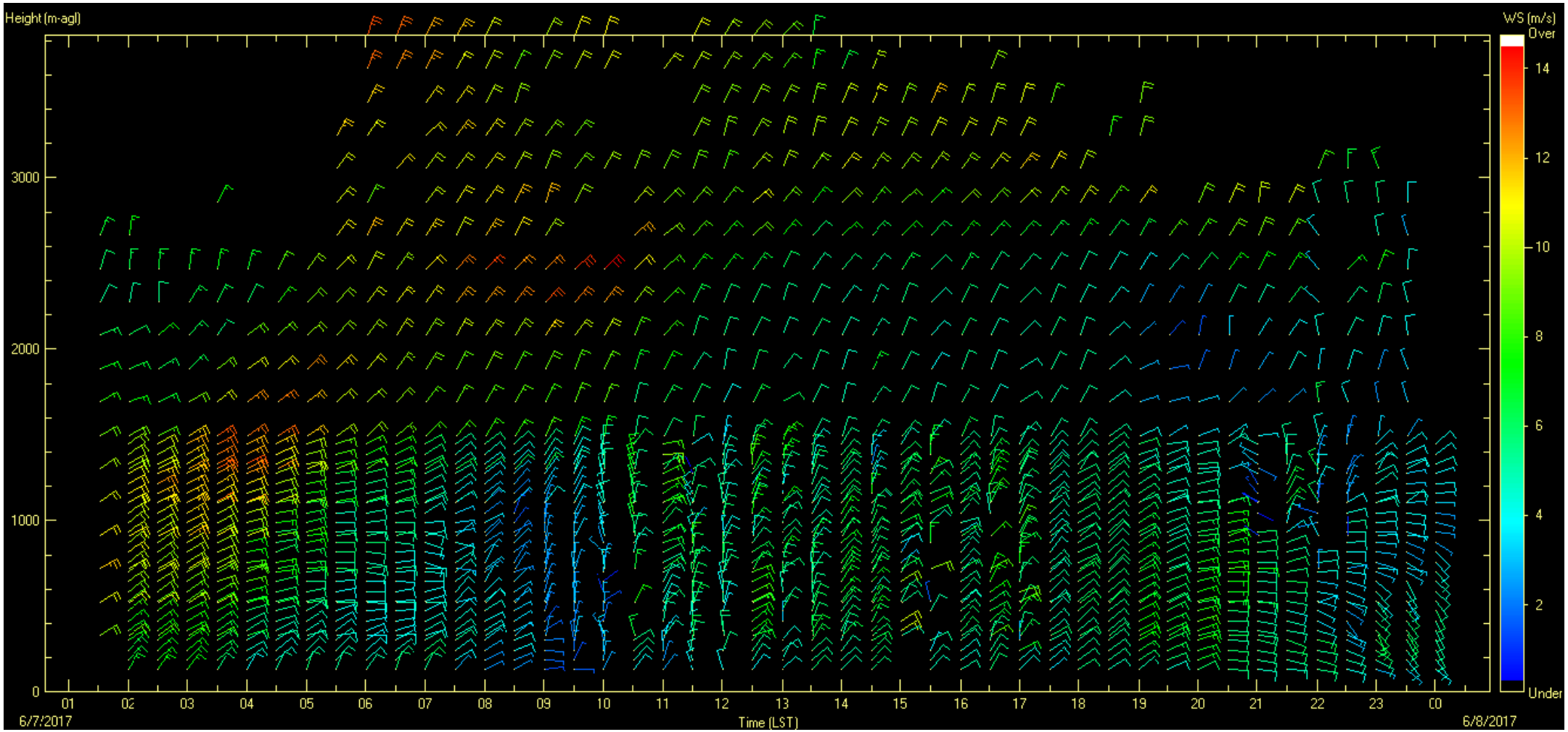




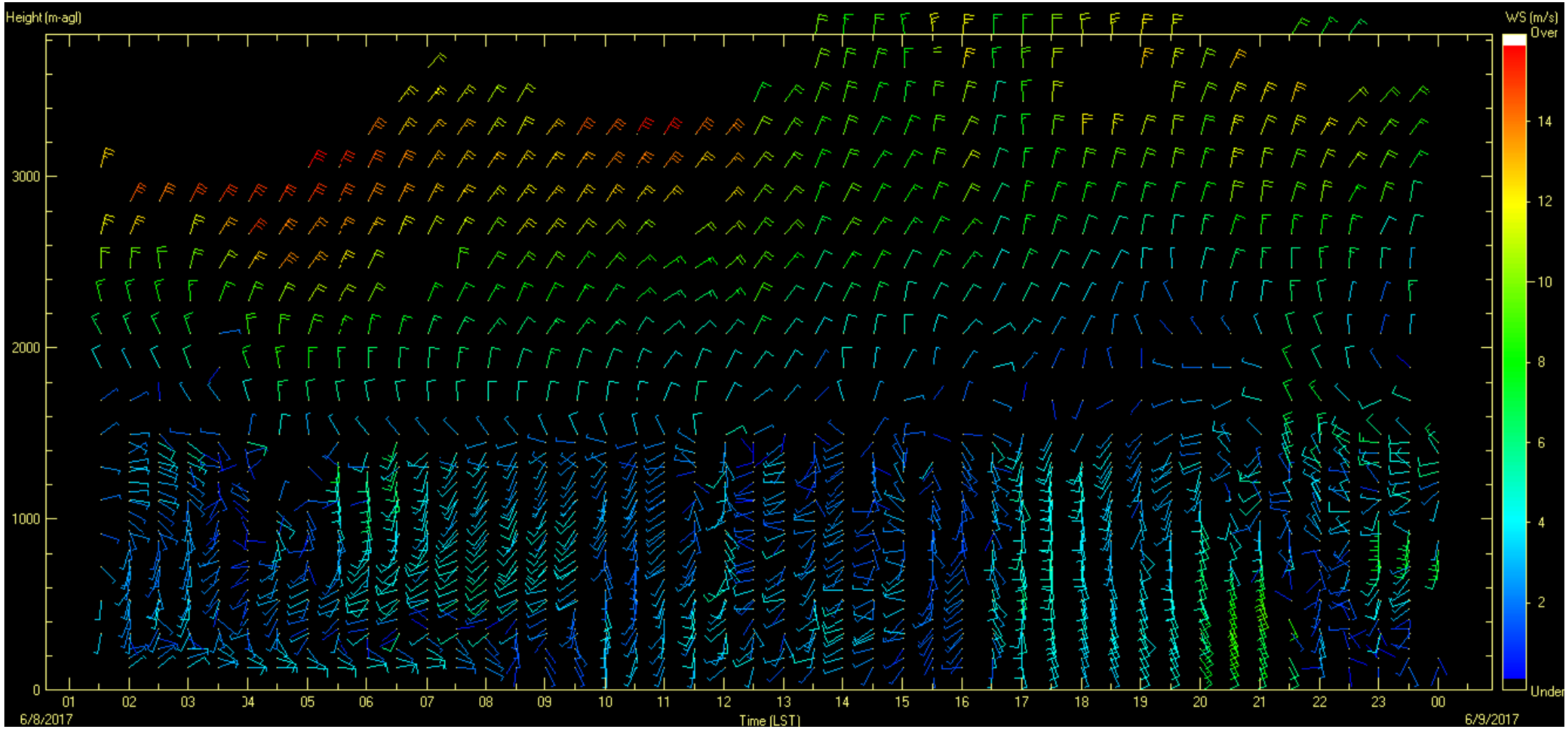
UTSA RWP for June 6, 2017, strong consistent northeast wind to 4km



UTSA RWP for June 7, 2017, weaker wind becoming more variable, O3 concentrations rise



UTSA RWP for June 8, 2017, light and variable winds, O3 concentration peak



UTSA RWP for June 9, 2017, increasing wind shifting to the south, O3 concentration drop