



Forecasting the Impacts of Smoke and Saharan Dust in Texas

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(TCEQ)



Forecasting the Air Quality in Texas

- Monitoring Division meteorologists produce daily air quality forecast.
 - Includes today, tomorrow, and the following 2-3 days.
 - Forecast pollutants include ozone, $PM_{2.5}$, and PM_{10} .
 - Posted to [TCEQ webpage](#), distributed via email, submitted to AirNow, etc.
- Ozone Action Days
 - Forecasts are made daily for each participating metropolitan area during ozone season.
- Forecasts based on Air Quality Index (AQI) scale.

Today's Texas Air Quality Forecast

The latest forecast for air quality conditions in Texas' metropolitan areas.

August 27, 2018

Related Current Data

[Air Quality Index \(AQI\) Report](#)

[Map of Current PM2.5 Levels](#)

[Map of Current Ozone Levels](#)

[Current Satellite Images](#)

[Real-Time Winds Aloft](#)

Related Information

[Ozone: The Facts](#)

[Texas Air Monitoring Data](#)

[EPA AIRNow Air Quality Forecasts](#) [↗](#)

[NOAA/EPA Ozone Model Forecasts](#) [↗](#)

[NRL Aerosol Model Forecasts](#) [↗](#)

Forecast based on EPA's Air Quality Index (AQI)



Forecast Region (Click name for AIRNOW version)	Mon 08/27/2018	Tue 08/28/2018	Wed 08/29/2018	Thu 08/30/2018
Amarillo	Good	Good	Good	Good
Austin	Good	Good	Good	Good
Beaumont-Port Arthur	Good	Good	Good	Good
Brownsville-McAllen	Good	Good	Good	Good
Corpus Christi	Good	Good	Good	Good
Dallas-Fort Worth	Ozone	Ozone	Good	Ozone
El Paso	Good	Good	Ozone	Ozone
Houston	Good	Good	Good	Good
Laredo	Good	Good	Good	Good
Lubbock	Good	Good	Good	Ozone
Midland-Odessa	Good	Good	Good	Ozone
San Antonio	Good	Good	Good	Good
Tyler-Longview	Good	Good	Good	Good
Victoria	Good	Good	Good	Good
Waco-Killeen	Good	Good	Good	Good

Forecast Discussion

Monday 08/27/2018

Winds may be light enough and/or incoming background levels high enough for ozone to reach the lower end of the "Moderate" range in parts of the Dallas-Fort Worth area and the upper end of the "Good" range in parts of the El Paso, Lubbock, and Waco-Killeen areas, with the highest concentrations in the afternoon and early evening.

Very light amounts of smoke from wildfires across the Western United States is expected to continue weakening but may linger in spots across Northeast Texas, though the intensity of the smoke is not expected to be enough to raise the daily PM2.5 AQI beyond the "Good" range in most of the Tyler-Longview area.

Elsewhere in the state, moderate to strong winds, increased cloud cover with precipitation, and/or lower incoming background levels should help keep air quality in the "Good" range in most spots.

Tuesday 08/28/2018

Winds may be light enough and/or incoming background levels high enough for ozone to reach the lower end of the "Moderate" range in parts of the Dallas-Fort Worth area and the upper end of the "Good" range in parts of the El Paso and Lubbock areas, with the highest concentrations in the afternoon and early evening.

Very light amounts of smoke from wildfires across the Western United States is expected to continue weakening but may linger in spots across Northeast Texas, though the intensity of the smoke is not expected to be enough to raise the daily PM2.5 AQI beyond the "Good" range in most of the Tyler-Longview area. Additionally, a slight increase in urban fine particulate background levels in the Rio Grande Valley could result in intermittently elevated PM2.5 at times, though the daily AQI in the Brownsville-McAllen and Laredo areas is expected to remain in the "Good" range overall.

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.

Wednesday 08/29/2018 Outlook

Winds may be light enough and/or incoming background levels high enough for ozone to reach "Moderate" or possibly higher in parts of the El Paso area and the upper end of the "Good" range in parts of the Lubbock area, with highest concentrations in the afternoon and early evening.

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.

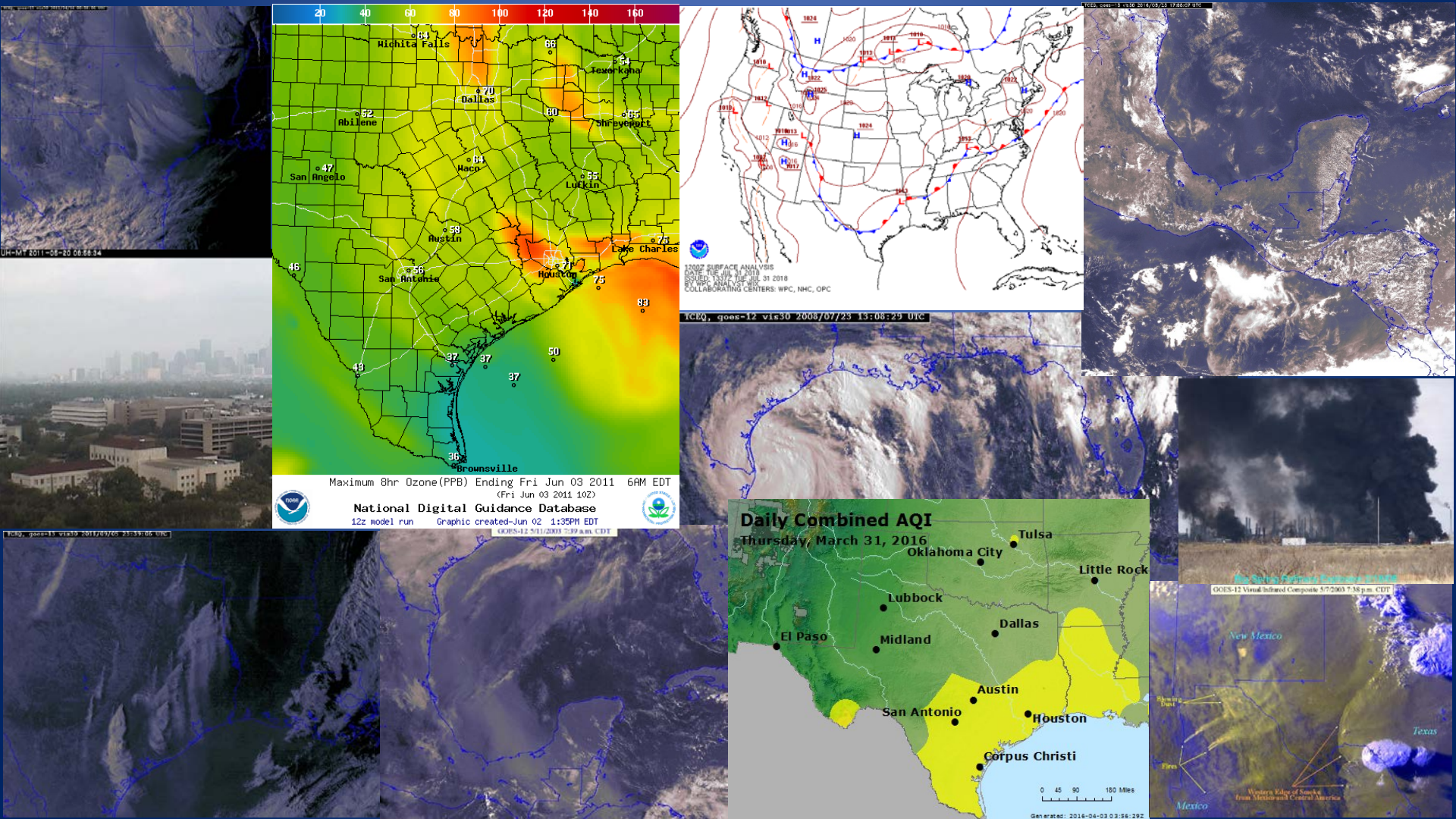
Thursday 08/30/2018 Outlook

Winds may be light enough and/or incoming background levels high enough for ozone to reach "Moderate" or possibly higher in parts of the El Paso area; the middle to upper end of the "Moderate" range in parts of the Dallas-Fort Worth and Lubbock areas; the lower to middle end of the "Moderate" range in parts of the Midland-Odessa area; and the upper end of the "Good" range in parts of the Amarillo and Waco-Killeen areas, with highest concentrations in the afternoon and early evening.

Elsewhere in the state, moderate winds, heavy cloud cover with lingering precipitation, and/or lower incoming background levels should help keep air quality in the "Good" range in most spots.



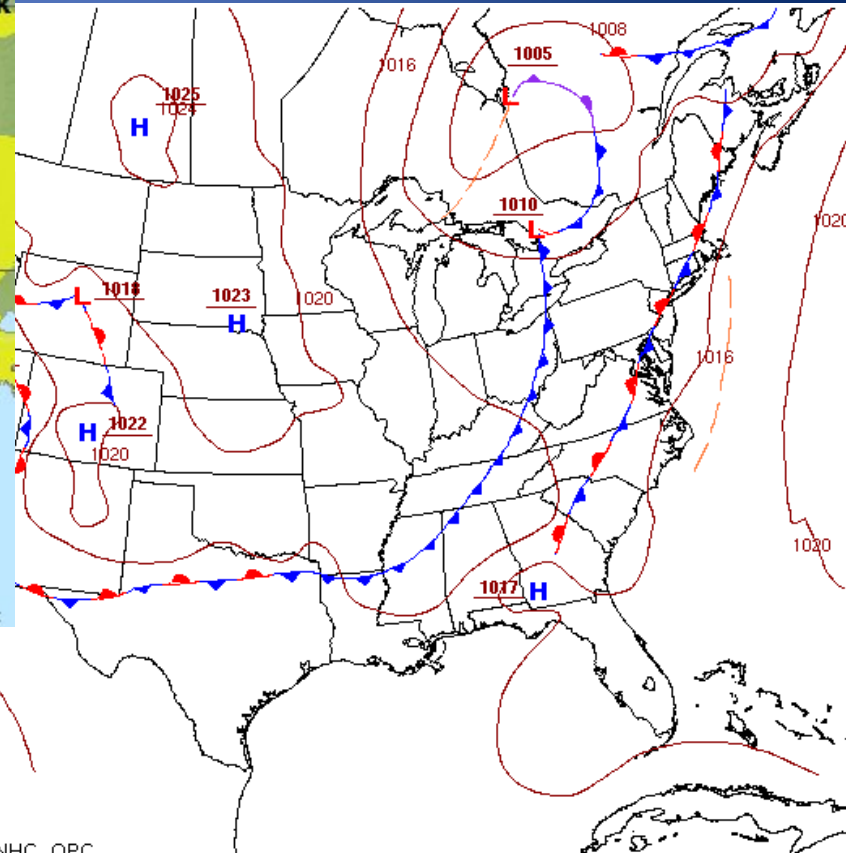
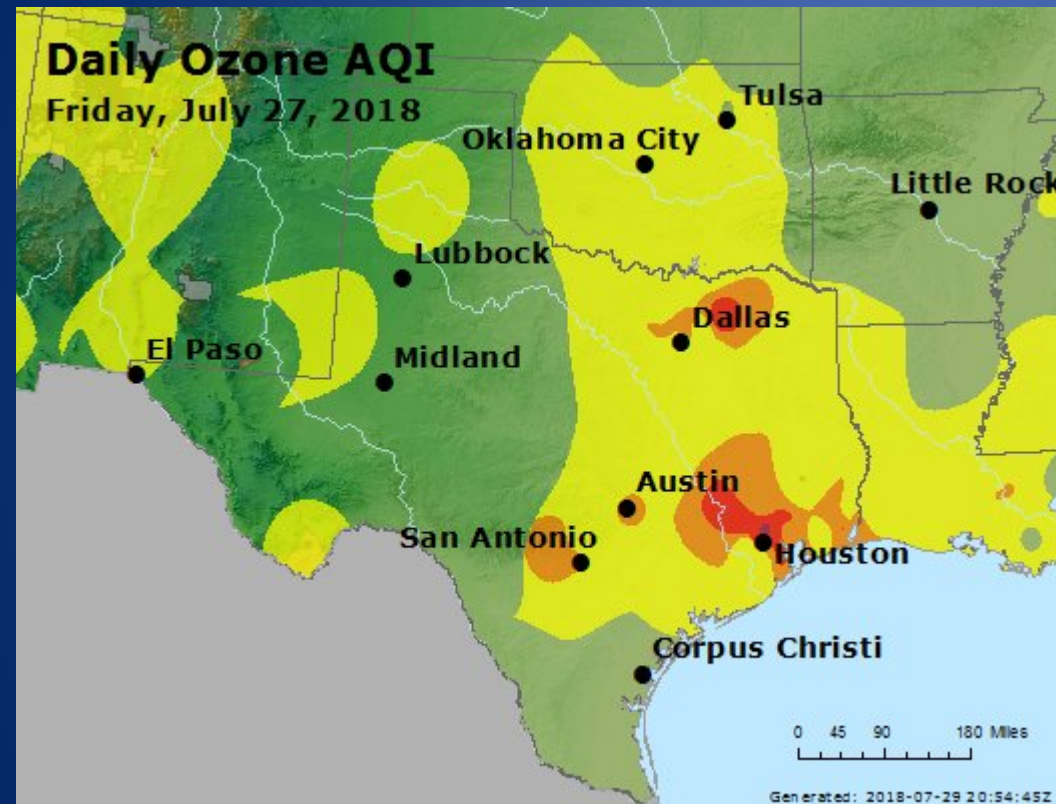
What types of events routinely impact air quality in Texas?





High Ozone

July 27, 2018

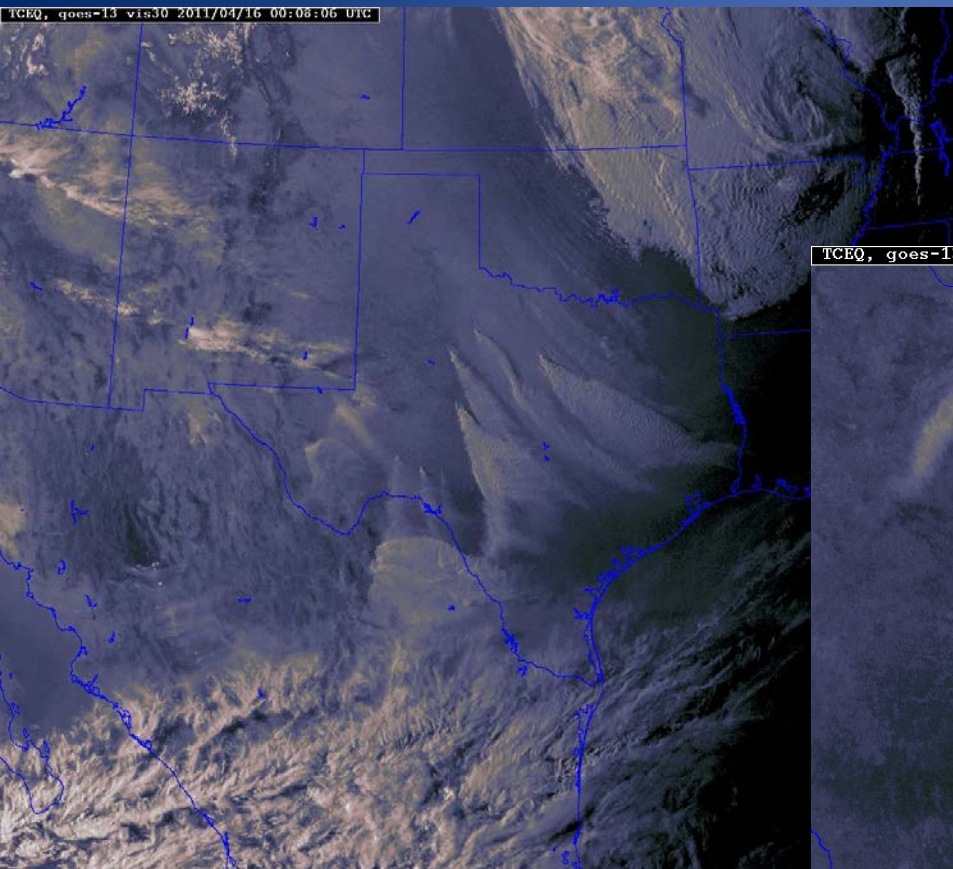




Smoke from Wildfires

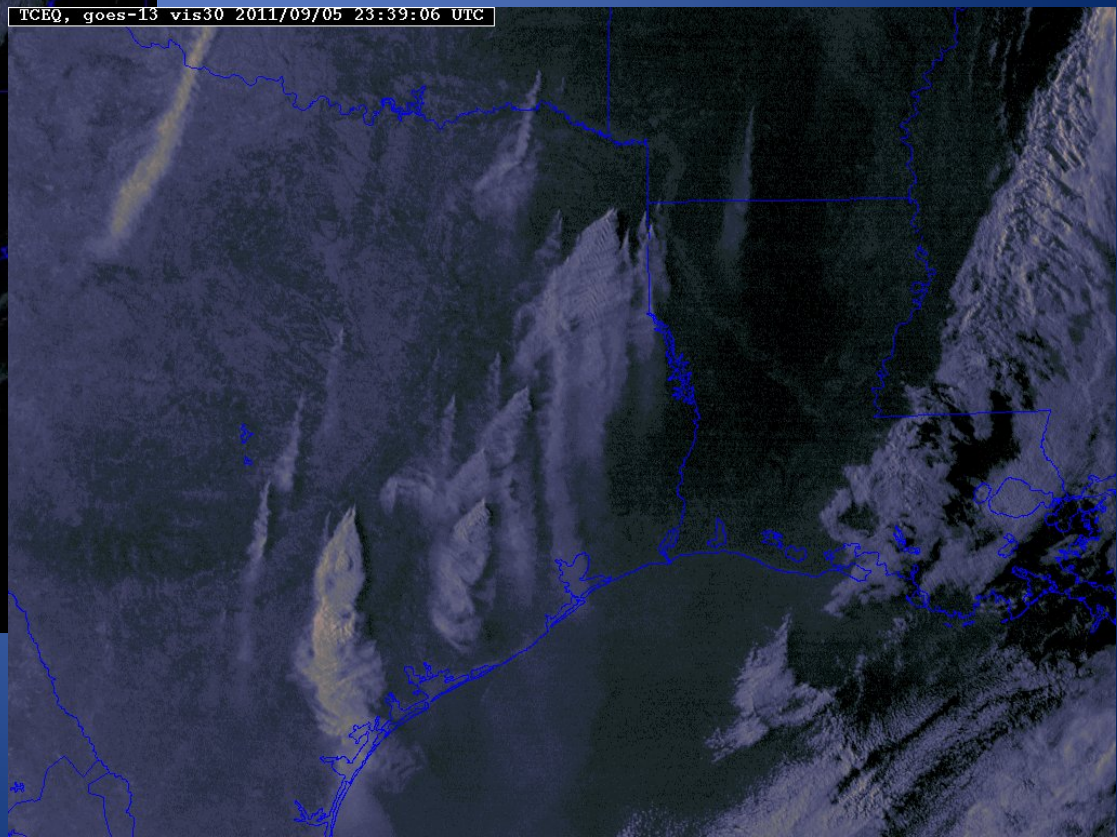
April 16, 2011

TCEQ, goes-13 vis30 2011/04/16 00:08:06 UTC



September 5, 2011

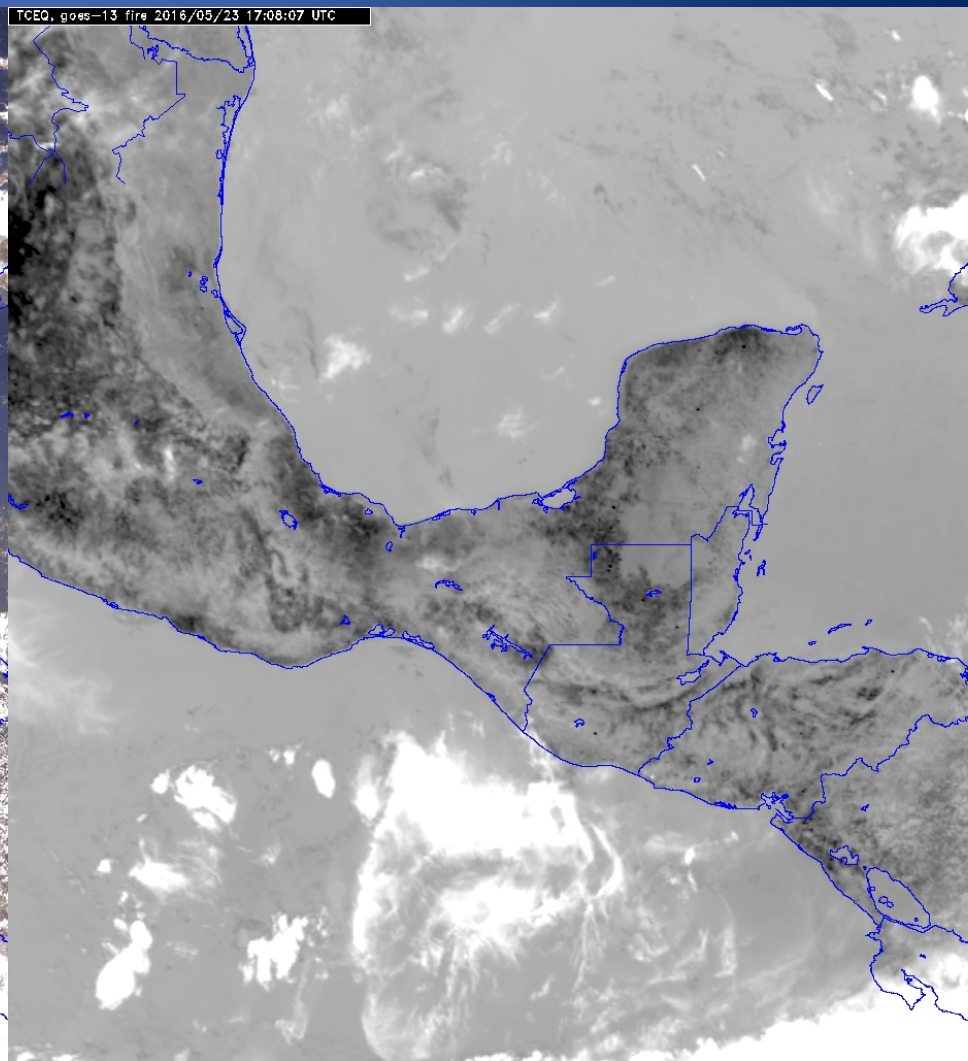
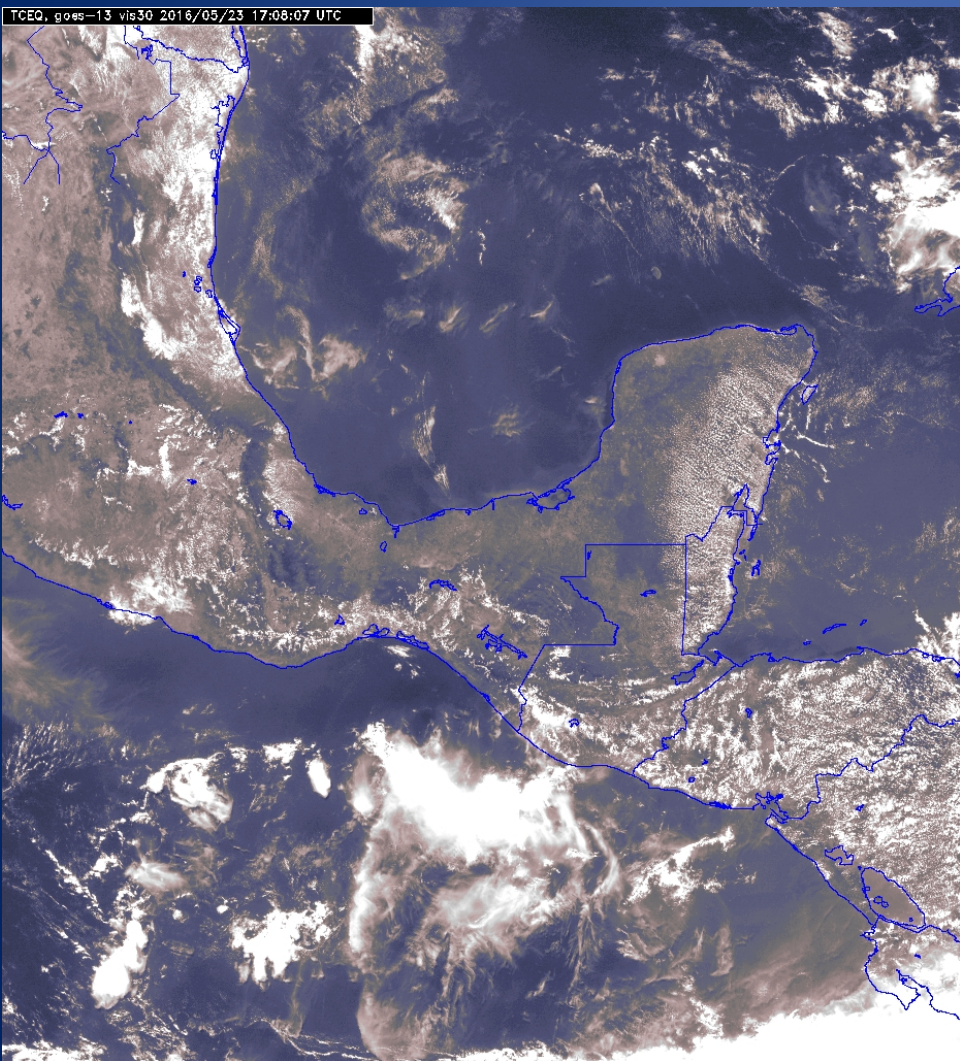
TCEQ, goes-13 vis30 2011/09/05 23:39:06 UTC



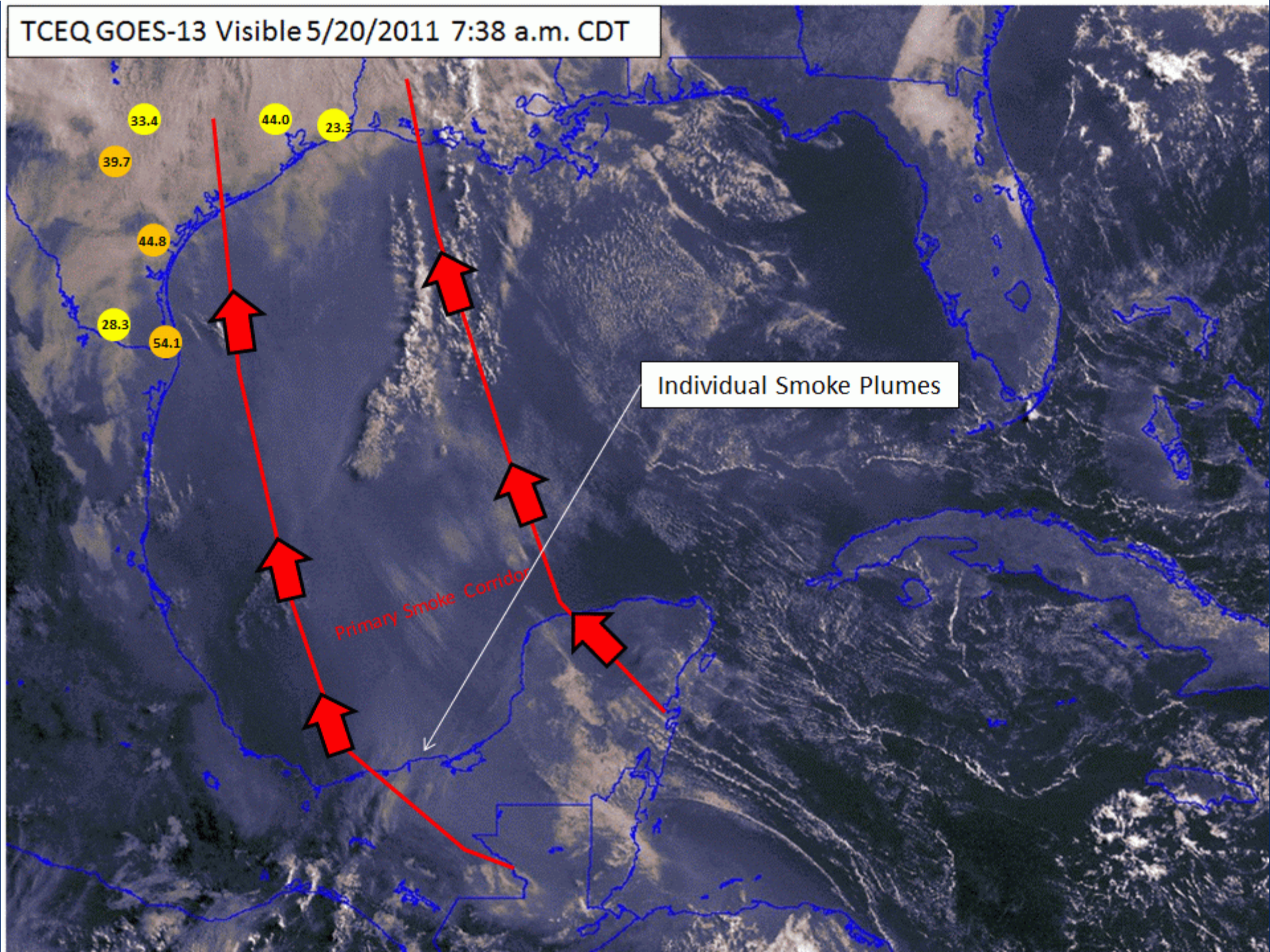


Smoke from Mexico & Central America

Late March through early June



TCEQ GOES-13 Visible 5/20/2011 7:38 a.m. CDT



Individual Smoke Plumes

Primary Smoke Corridor



Blowing Dust

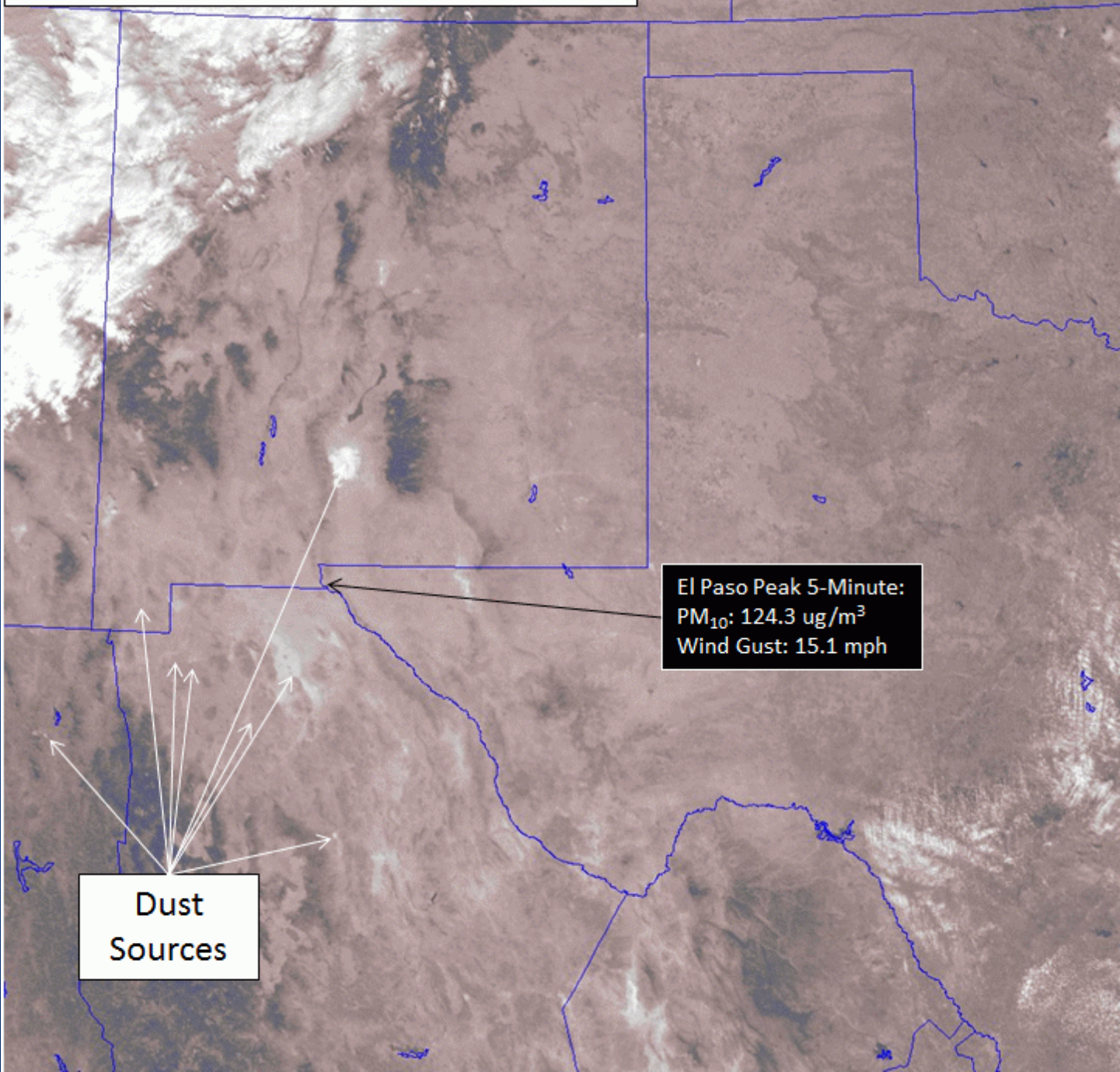
Typically seen in El Paso and the Panhandle

11/28/2010 12:01 PM



11/28/2010 2:31 PM



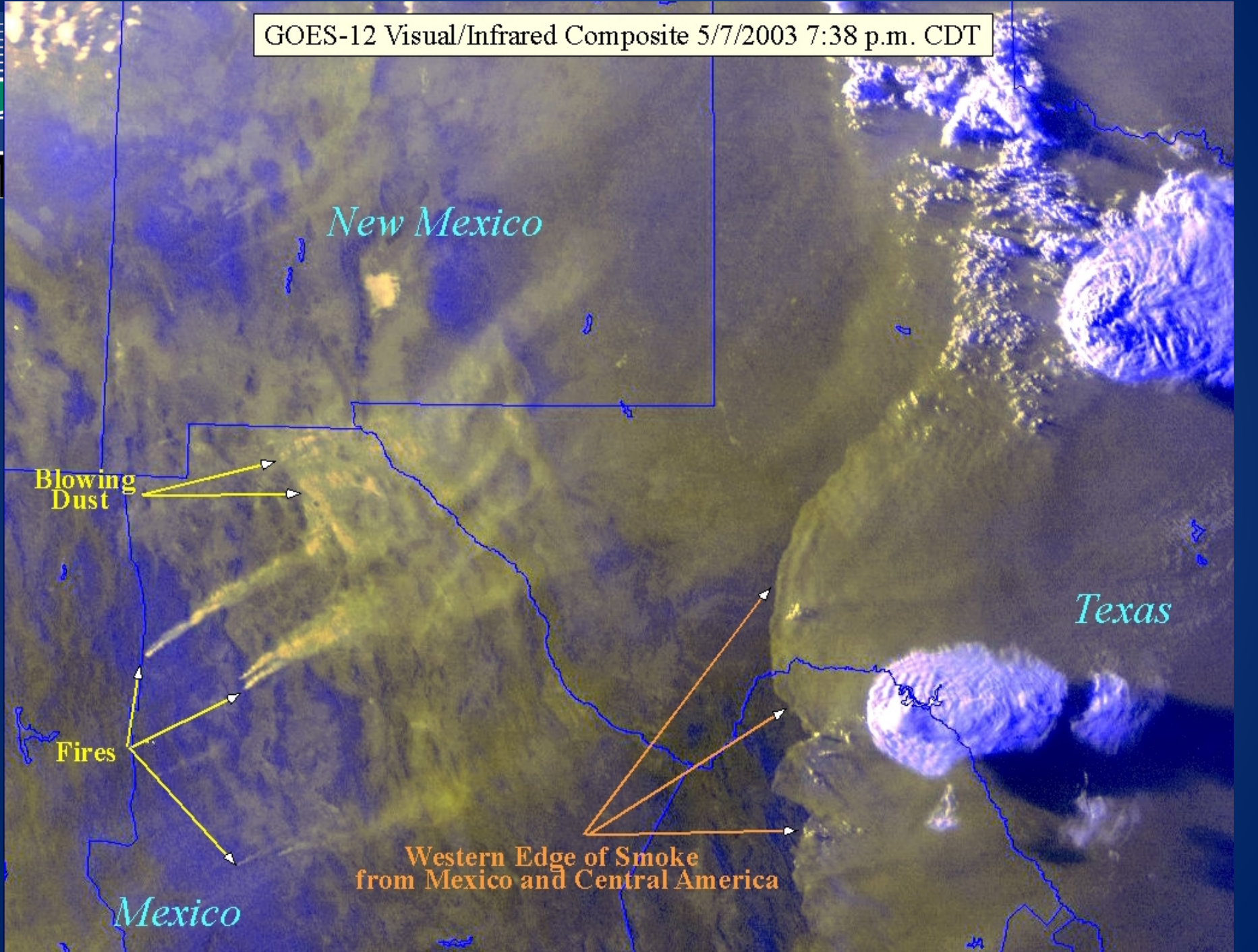


Dust Sources

El Paso Peak 5-Minute:
PM₁₀: 124.3 ug/m³
Wind Gust: 15.1 mph

11/28/2010 06:01 AM





New Mexico

Texas

Mexico

**Blowing
Dust**

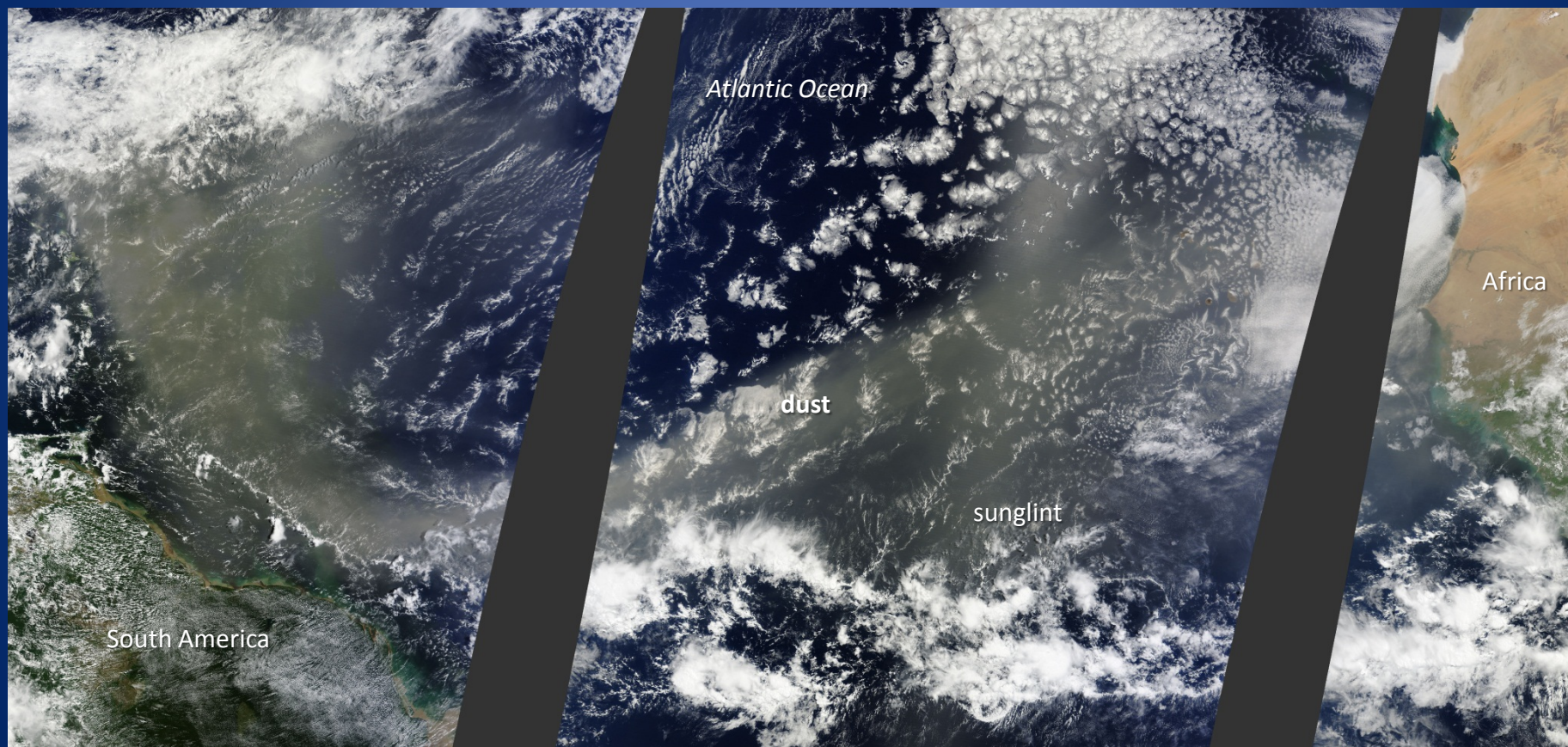
Fires

**Western Edge of Smoke
from Mexico and Central America**



African Dust

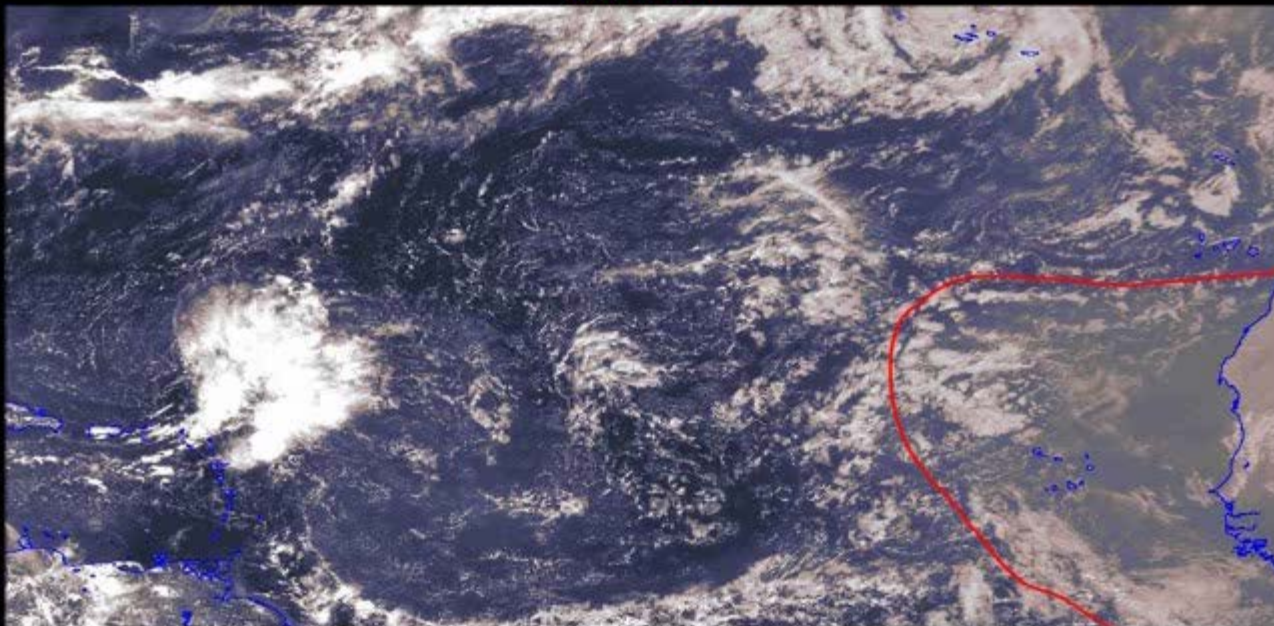
Travels across the Atlantic from June through August





Dust Clouds Moving Over the Atlantic Ocean, July 2010

6/26/2010





Houston webcam comparison: July 4 and July 13

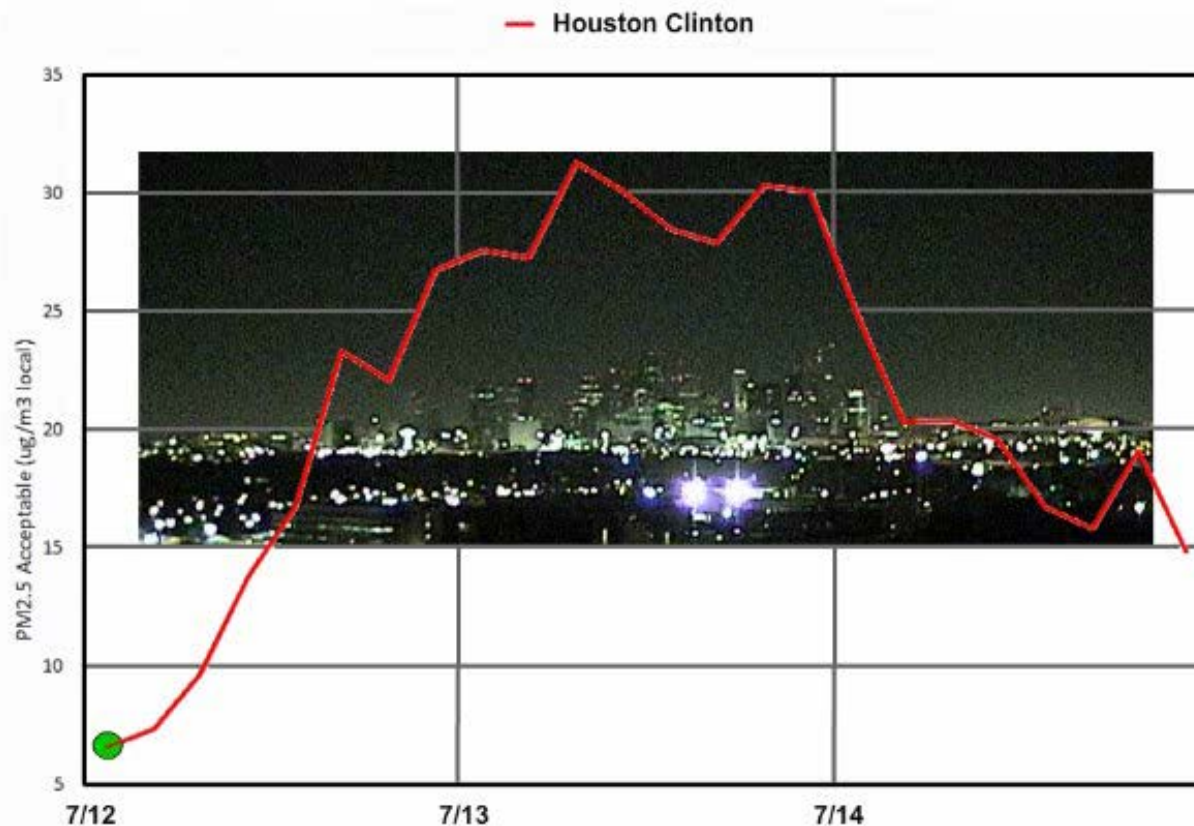
July 4

July 13





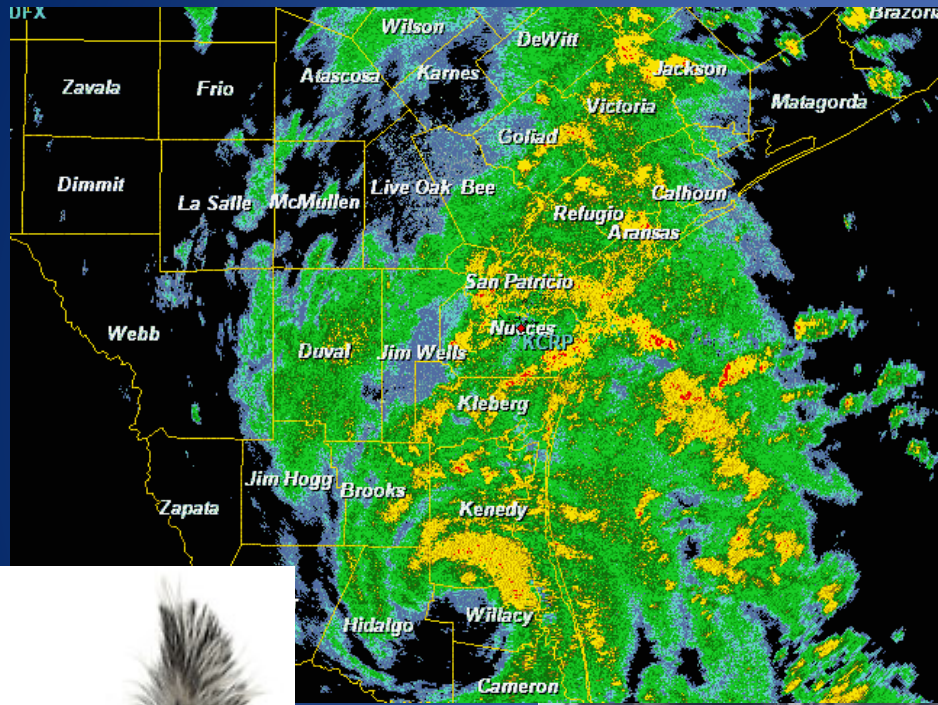
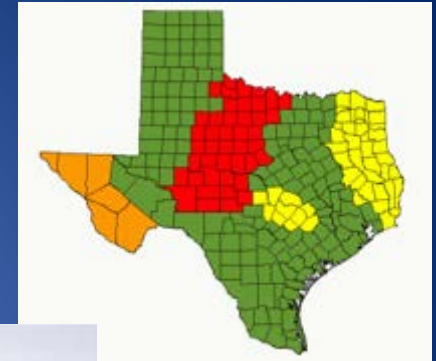
Webcam View of Downtown Houston, July 12-14, 2010





“Other”

Unique events



Big Spring Refinery Explosion 2/18/08





How do we develop each day's forecast?

- “Past, Present, Future” approach
- Past
 - Review previous day's weather and air quality
 - Ask important questions (what happened?, why did it happen? , where did it come from? , was it foreseeable?, etc.)
 - Recognize trends



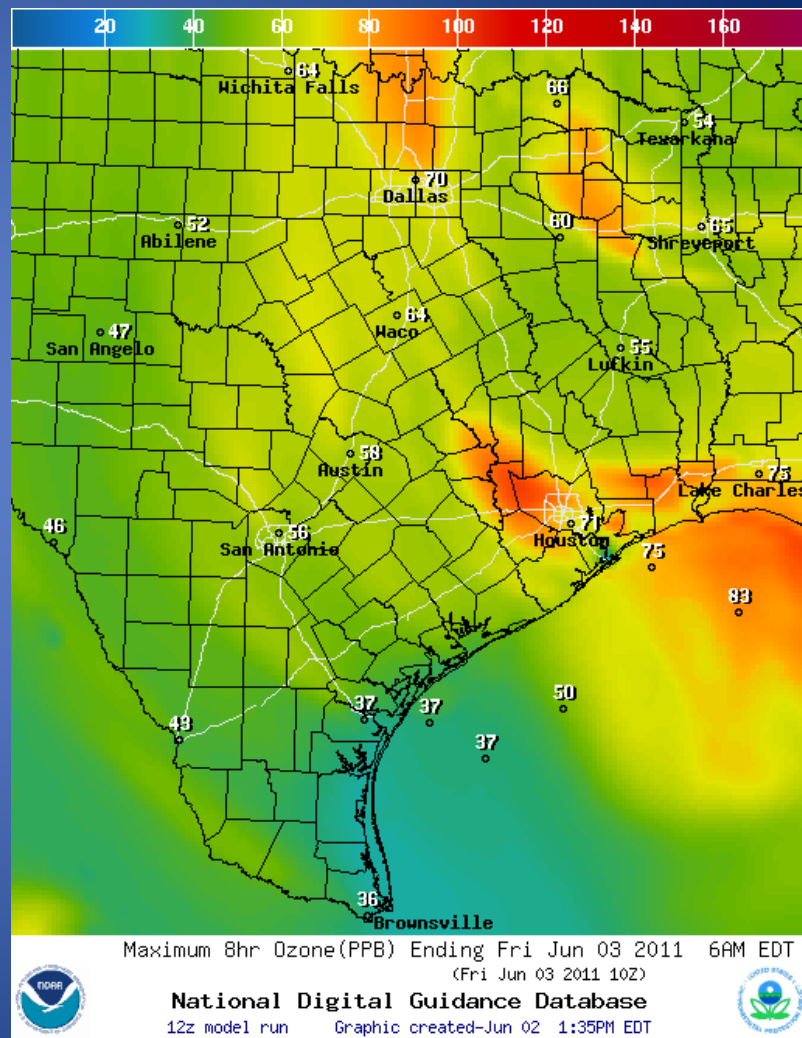
How do we develop each day's forecast? cont'd

- Present
 - What is happening right now?
 - Does it make sense?
 - Can it be explained?
 - Is it supported by multiple products?
- Future
 - What is going to happen?
 - Use of previous event analyses (i.e., “Past”) and current conditions (i.e., “Present) give clues.
 - No two days are the same, though many are similar.
 - Keep it simple
 - Avoid overcorrecting

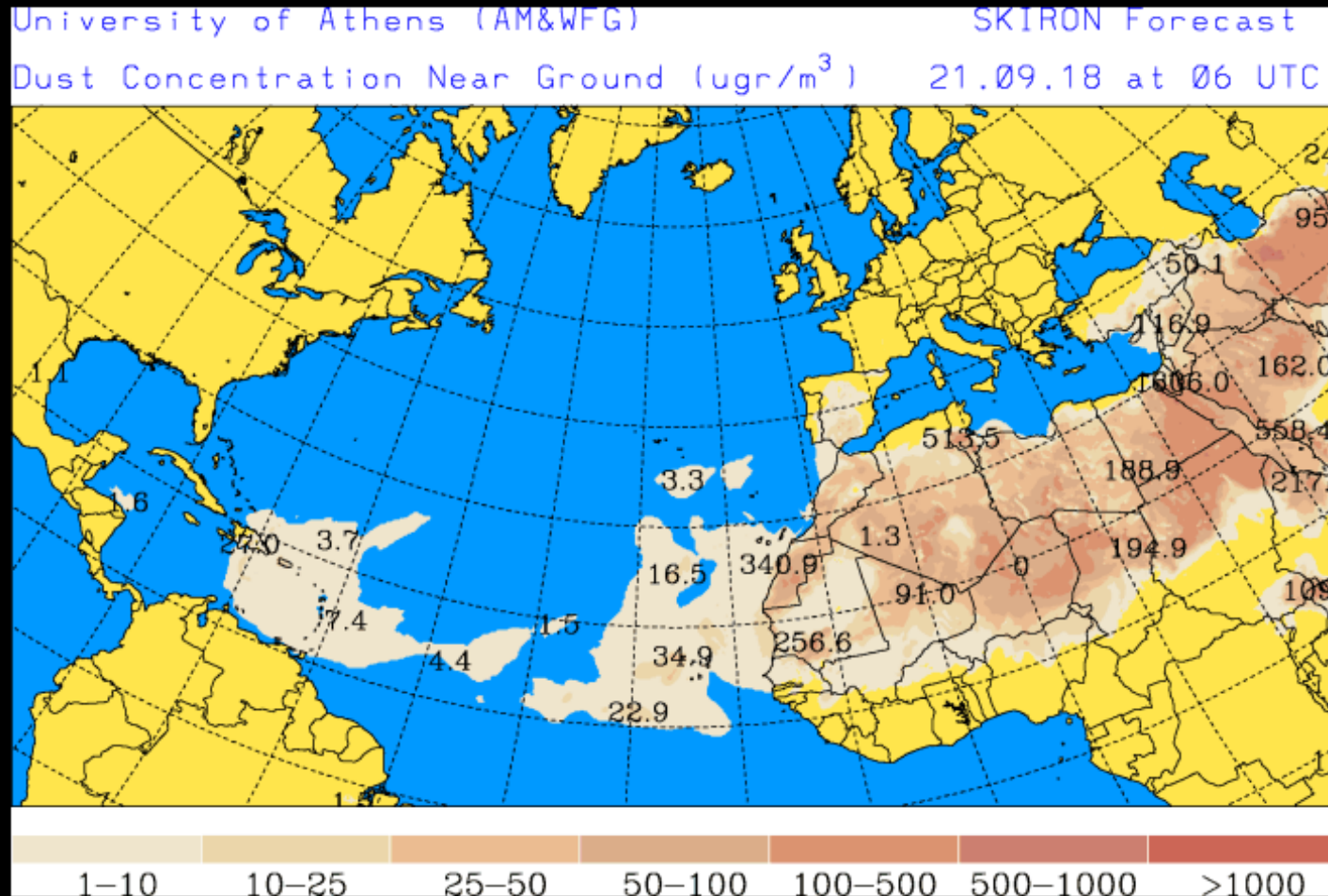


Forecast Tools

- Past
 - [Air Quality Index Report](#) (TCEQ)
 - [AirNow](#) (EPA)
 - [AirNowTech Navigator](#) (EPA)
 - [Hazard Mapping System Fire and Smoke Product](#) (NOAA)
- Present
 - [Satellite Imagery](#) (College of DuPage)
 - [Map of Current Ozone Levels](#) (TCEQ)
 - [Map of Current PM_{2.5} Levels](#) (TCEQ)
 - [Surface Weather Plot](#) (UCAR)
 - [Radar](#) (NOAA)
 - [Surface Analysis](#) (NOAA)
 - [Upper Air](#) (NOAA)
- Future
 - [Weather Models](#) (e.g., GFS, NAM, etc.) (NOAA)
 - [Model Output Statistics](#) (NOAA)
 - [Air Quality Model Forecast Guidance](#) (NOAA/EPA)
 - [NAAPS Aerosol Model](#) (Naval Research Lab)
 - [Saharan Dust Model](#) (University of Athens)

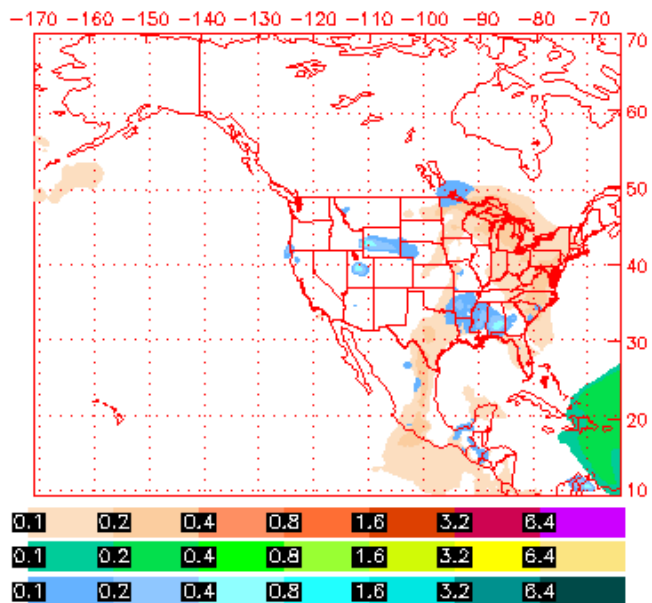


U. of Athens SKIRON Dust Model

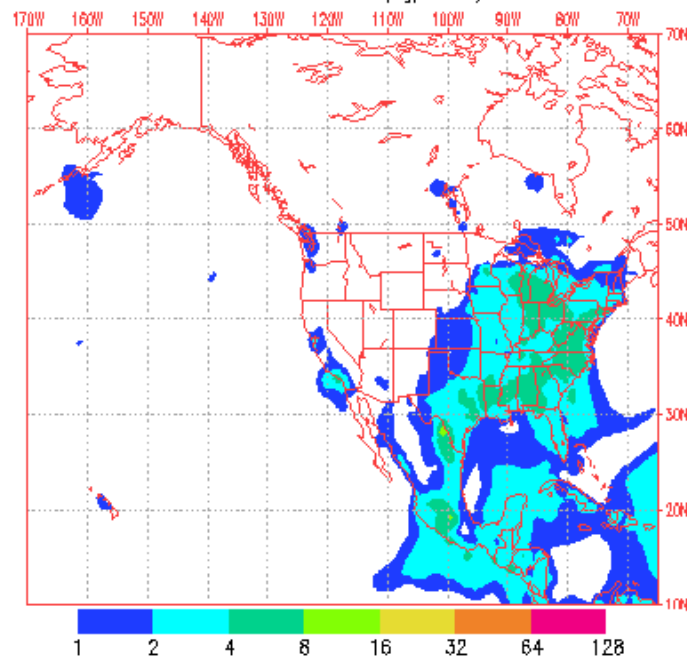




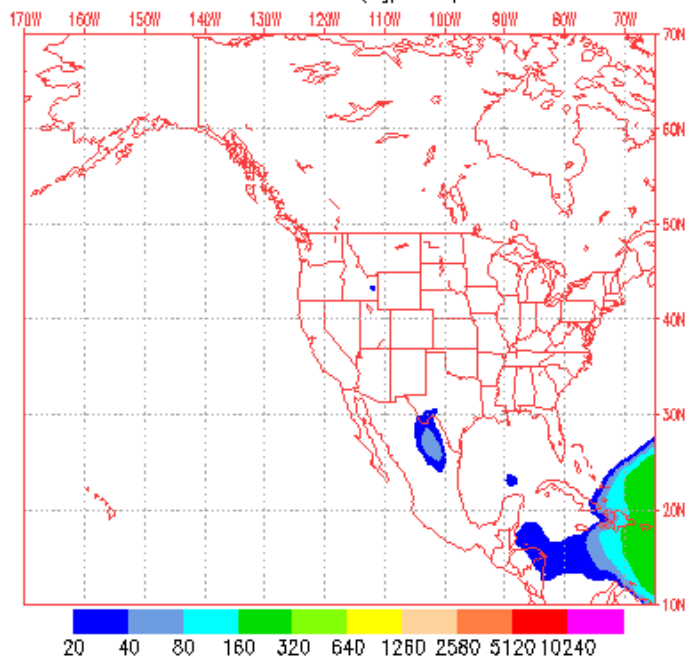
NAAPS Total Optical Depth for 00:00Z 21 Sep 2018
 Sulfate: Orange/Red, Dust: Green/Yellow, Smoke: Blue



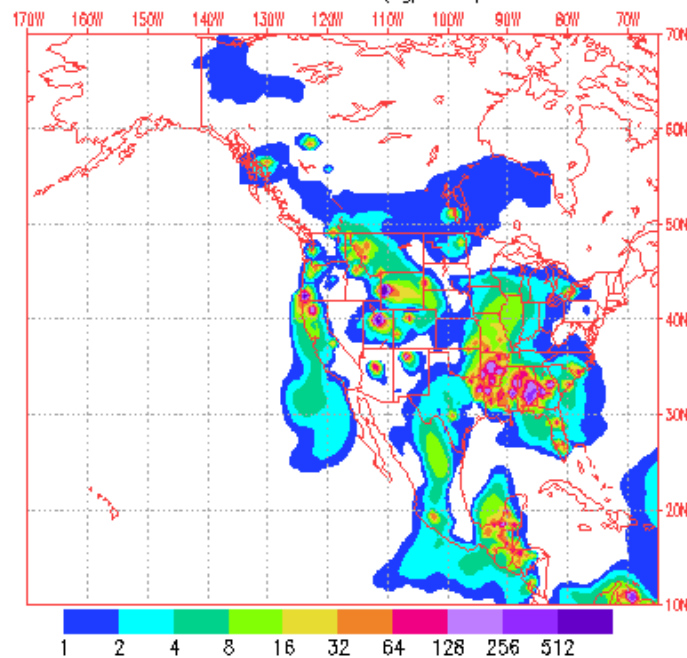
Sulfate Surface Concentration ($\mu\text{g}/\text{m}^3$) for 2018092100



Dust Surface Concentration ($\mu\text{g}/\text{m}^3$) for 2018092100



Smoke Surface Concentration ($\mu\text{g}/\text{m}^3$) for 2018092100





Regression model

- Regression-type statistical air quality forecast model developed in-house
 - Early prototypes from 2011/2012
 - Operational by mid-2015
- Three main inputs
 - Air Monitoring Data
 - Ozone: Max Daily 8-Hour, Background Estimate per Region
 - $PM_{2.5}/PM_{10}$: Average PM per Region
 - GFSX MOS forecasts
 - 00Z Temp, 00Z Dew Point, 12Z-00Z Max Wind Speed, 12Z-00Z Precipitation Probability
 - “Delta Met” – today minus yesterday for Temp, Dew Point, Wind Speed
 - Naval Research Laboratory NAAPS Aerosol Model data
 - Satellite-derived AOD, plus surface concentrations of sulfates, dust, and smoke
- “Recalibrated” daily



Regression Model Example – African Dust

07/16/2018 Austin region model forecast – w/ NAAPS aerosol component

GFSX				ΔGFSX			NRL Aerosol Model							Adj				Date	O3 Ver	PM2.5 Ver			
TMP	DPT	WND	P12	TMP	DPT	WND	AODsf	AODd	AODsm	Sulfate	Dust	Smoke	O3fx	O3bgfx	PM2.5fx	PM10fx	O3fx	O3bgfx	PM2.5fx	PM10fx			
95	64	11	2	2	-4	-1	0.10	0.15	0.00	3.0	80.0	0.0	35	23	43.6	#VALUE!	36	24	45.3	#VALUE!	Mon 7/16	38	35.8
96	63	9	2	1	-1	-2	0.10	0.10	0.00	2.0	40.0	0.0	40	27	22.2	#VALUE!	41	28	23.9	#VALUE!	Tue 7/17	40	23.2
95	63	9	2	-1	0	0	0.05	0.05	0.00	2.0	20.0	0.0	41	29	13.9	#VALUE!	42	30	15.6	#VALUE!	Wed 7/18	49	17.5
97	66	9	9	2	3	0	0.00	0.00	0.00	2.0	30.0	0.0	40	27	9.8	#VALUE!	41	28	11.5	#VALUE!	Thu 7/19	50	14.8
97	67	8	4	0	1	-1							44	29	8.5	#VALUE!	45	30	10.2	#VALUE!	Fri 7/20		
98	66	9	4	1	-1	1							44	30	8.6	#VALUE!	45	31	10.3	#VALUE!	Sat 7/21		
97	68	10	7	-1	2	1							41	28	9.1	#VALUE!	42	29	10.8	#VALUE!	Sun 7/22		
96	67	12	7	-1	-1	2							40	27	10.1	#VALUE!	41	28	11.8	#VALUE!	Mon 7/23		

07/16/2018 Austin region model forecast – w/o NAAPS aerosol component

GFSX				ΔGFSX										Adj				Date	O3 Ver	PM2.5 Ver			
TMP	DPT	WND	P12	TMP	DPT	WND							O3fx	O3bgfx	PM2.5fx	PM10fx	O3fx	O3bgfx	PM2.5fx	PM10fx			
95	64	11	2	2	-4	-1							41	29	10.8	#VALUE!	48	34	12.2	#VALUE!	Mon 7/16	38	35.8
96	63	9	2	1	-1	-2							44	30	10.3	#VALUE!	51	35	11.7	#VALUE!	Tue 7/17	40	23.2
95	63	9	2	-1	0	0							46	32	10.1	#VALUE!	53	37	11.5	#VALUE!	Wed 7/18	49	17.5
97	66	9	9	2	3	0							43	29	9.3	#VALUE!	50	34	10.7	#VALUE!	Thu 7/19	50	14.8
97	67	8	4	0	1	-1							44	29	8.5	#VALUE!	51	34	9.9	#VALUE!	Fri 7/20		
98	66	9	4	1	-1	1							44	30	8.6	#VALUE!	51	35	10.0	#VALUE!	Sat 7/21		
97	68	10	7	-1	2	1							41	28	9.1	#VALUE!	48	33	10.5	#VALUE!	Sun 7/22		
96	67	12	7	-1	-1	2							40	27	10.1	#VALUE!	47	32	11.5	#VALUE!	Mon 7/23		



Forecast Verification

- Strike balance between false alarms and misses.
 - Verification can be limited by:
 - Monitoring network (e.g., “If a tree falls in the forest...”)
 - Regulatory vs. Non-Regulatory monitors
 - Verification approach (e.g., Highest monitor in area? Average concentration of area?)
 - Ozone Action Days work?...!
- Verification statistics can include:
 - Accuracy: Percent of forecasts that correctly predicted the event or non-event.
 - Bias: Indicates if forecasts are underpredicted (false negatives) or overpredicted (false positives)
 - False Alarm Rate (FAR): The percent of times a forecast event did not actually occur.
 - Critical Success Index (CSI): Same as accuracy, but removes large number of correctly predicted non-events.
 - Probability of Detection (POD): Ability to accurately predict event.



Forecast Verification Statistics Trends

Area	Accuracy	Bias	FAR	CSI	CSI+	POD
2018 TCEQ OAD, w/ Non-Reg	94%	0.88	28%	50%	68%	63%
2018 TCEQ OAD, w/o Reg only	96%	1.10	37%	49%	?	69%
2018 NOAA Ozone Model	95%	0.38	26%	26%	?	28%
2016-2017 TCEQ OAD, w/o Non-Reg	98%	0.94	58%	25%	?	39%
Regression Model, w/ aerosol data	?	?	?	?	?	?
Regression Model, w/o aerosol data	?	?	?	?	?	?
2016-2018 TCEQ PM2.5 "Mod" Fx	83%	0.86	37%	41%	?	54%
Summer 2018 TCEQ PM2.5 "Mod" Fx	75%	0.95	25%	58%	?	72%



How are we improving?

- Erring toward “False Alarms” over “Misses”
- Greater emphasis on event analysis (concurrent and post-event)
- Learning about, evaluating, and implementing new satellite-derived aerosol products
- Incorporating upper air data



GOES-12 5/11/2003 7:39 a.m. CDT

Thank you!

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