



# ***August 26, 2011: Evidence of an Exceptional Event?***

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Air Modeling and Data Analysis Section

Presented to: Southeast Texas Photochemical Modeling  
Technical Committee  
July 21, 2014



# Outline

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- August 26, 2011
  - Ozone
  - Meteorological Parameters
  - Smoke/Fire Emissions
- A Clear Causal Relationship Exists
  - Timing
  - Louisiana Monitors
  - Other HGB Monitors
  - Wildfires in US
  - Trajectory
  - GOES



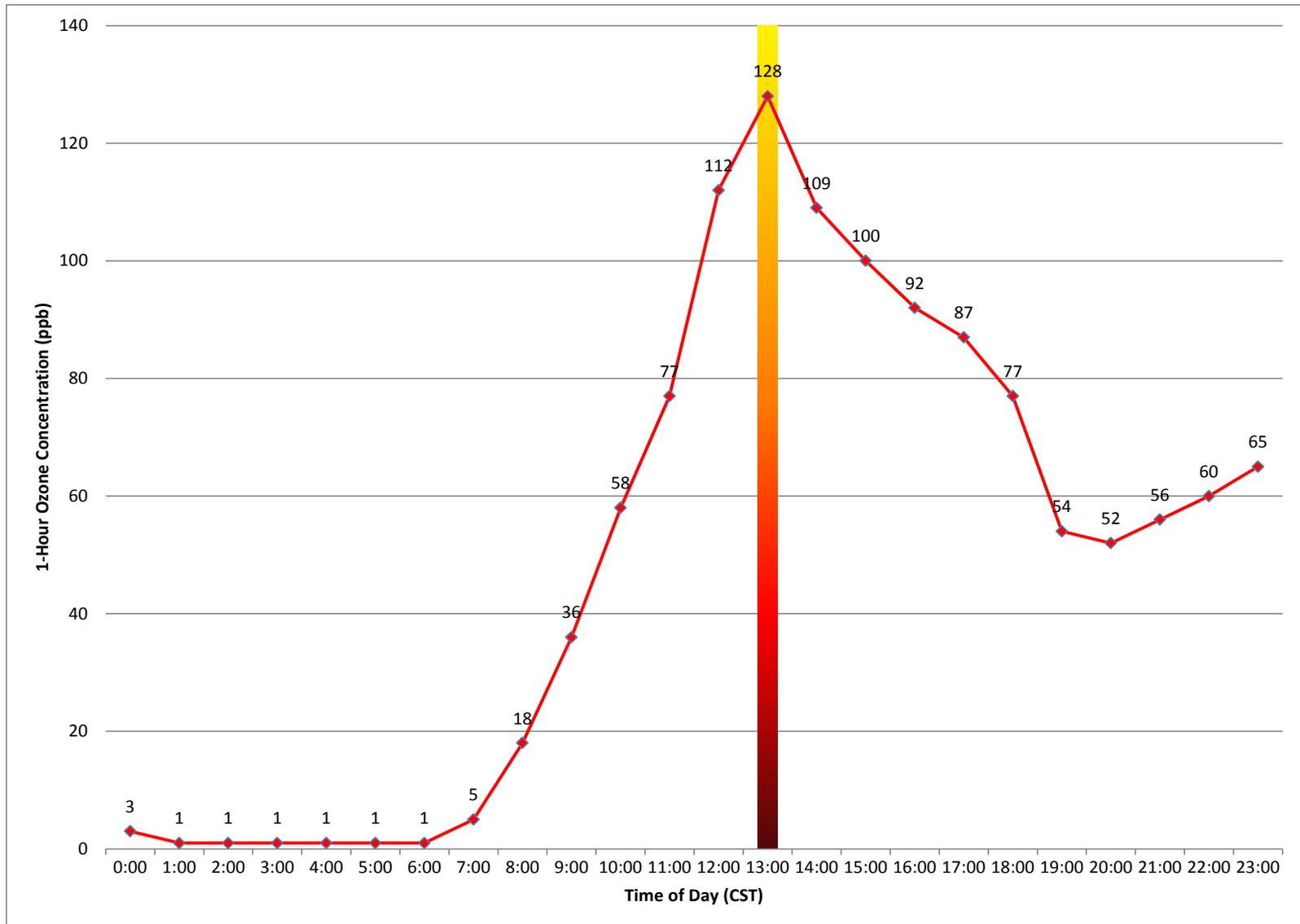
# Outline (cont.)

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- Calipso
- No Exceedance but for the Event
  - Background Ozone
  - Surrogate Day Analysis



# Houston East (CAMS 1) August 26, 2011





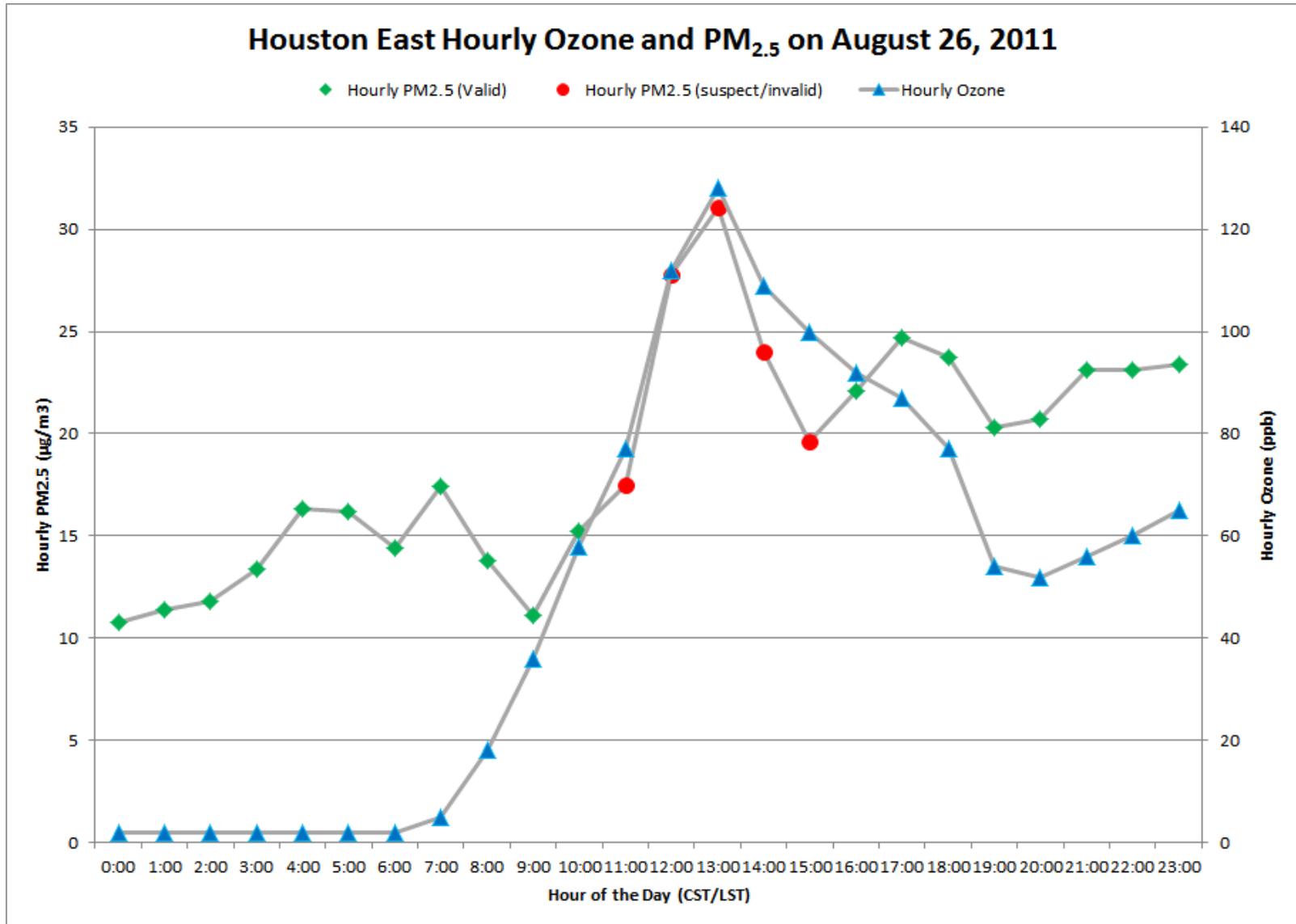
# A Clear Causal Relationship Exists



# Unique Timing of Hourly PM<sub>2.5</sub> and Ozone at Houston East on August 26, 2011



# Houston East PM2.5 and Ozone on August 26, 2011

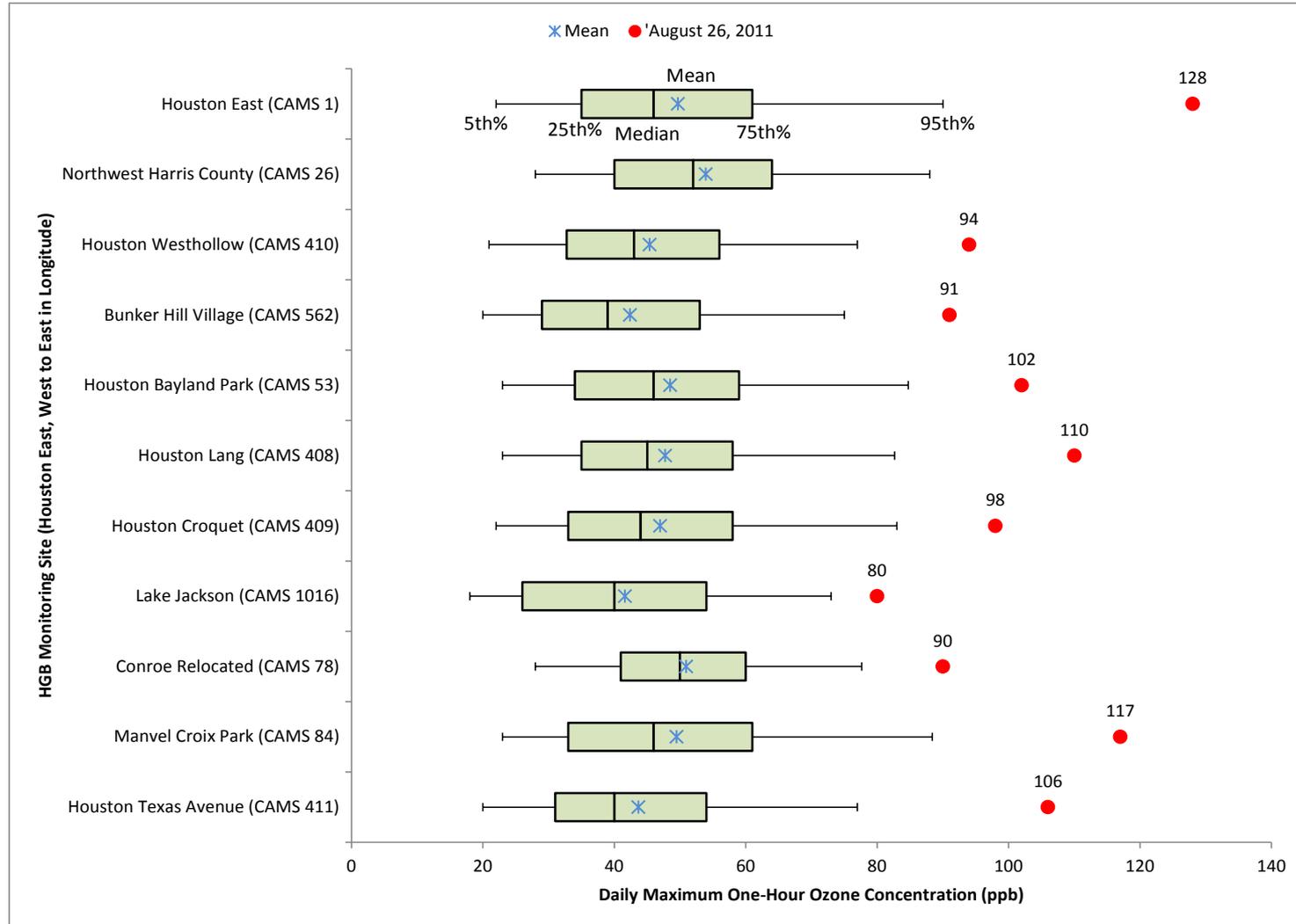




# Houston/Galveston/Brazoria Monitor Values for August 26, 2011

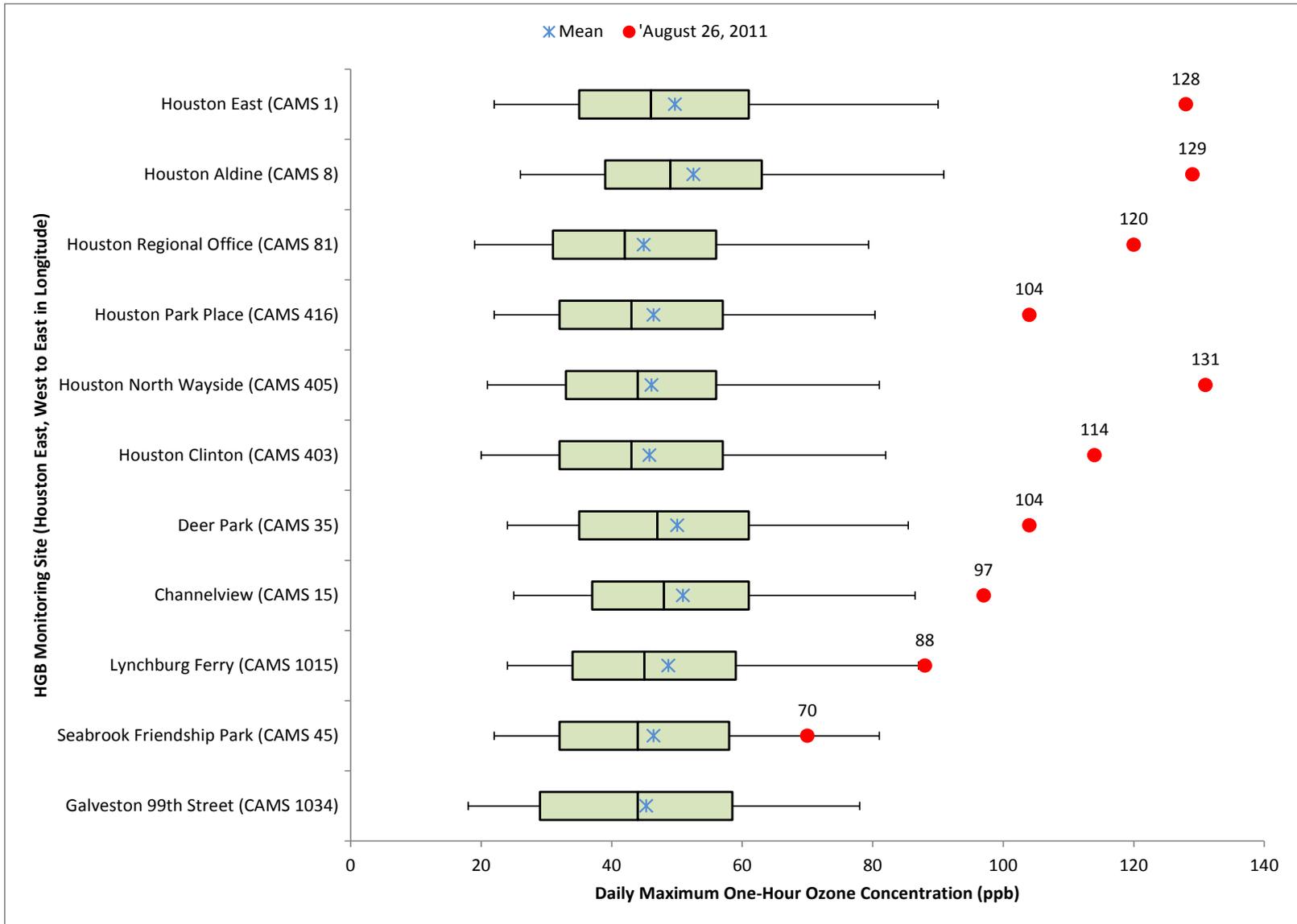


# Western HGB Ozone Sites





# Eastern HGB Ozone Sites



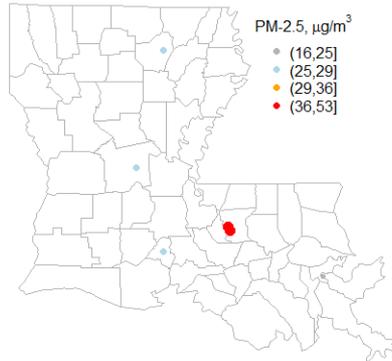


# Regional Monitor Values



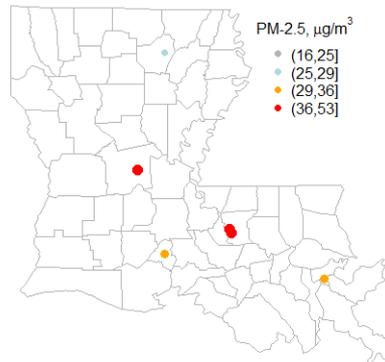
# PM<sub>2.5</sub> Values in Louisiana

PM-2.5 Daily Max 2011-08-24



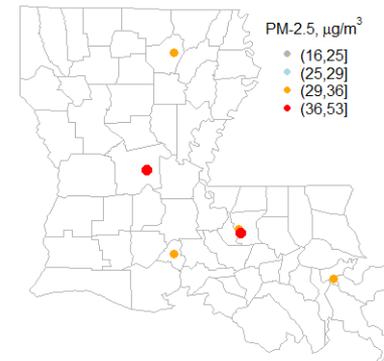
August 24, 2011

PM-2.5 Daily Max 2011-08-25



August 25, 2011

PM-2.5 Daily Max 2011-08-26



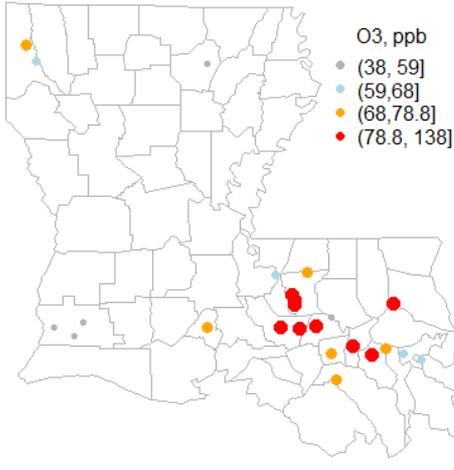
August 26, 2011

PM<sub>2.5</sub> Daily Maximums at monitors in Louisiana show a trend towards increasing monitor values over August 24<sup>th</sup> and August 25<sup>th</sup> going into August 26<sup>th</sup>.



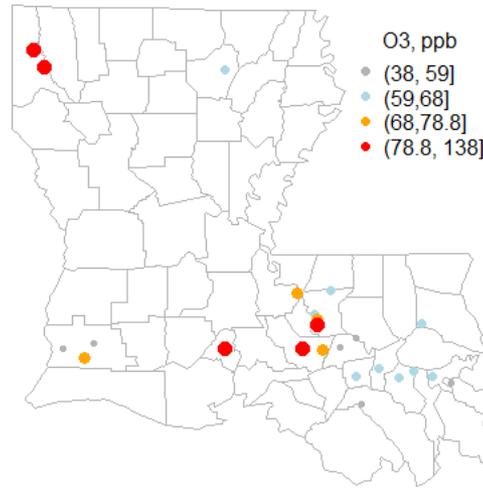
# Trending Ozone Values in Louisiana

Ozone Daily Max 2011-08-24



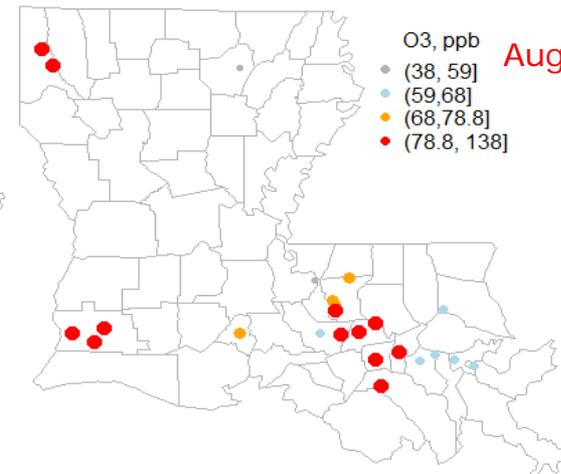
August 24, 2011

Ozone Daily Max 2011-08-25



August 25, 2011

Ozone Daily Max 2011-08-26



August 26, 2011

Maximum daily ozone values at Louisiana monitors in the Baton Rouge and Lake Charles areas show clear evidence of a westward trend of increasing ozone values on August 24-26.



# Fires



# Fire Locations



August 20



August 21



August 22



August 23



August 24



August 25



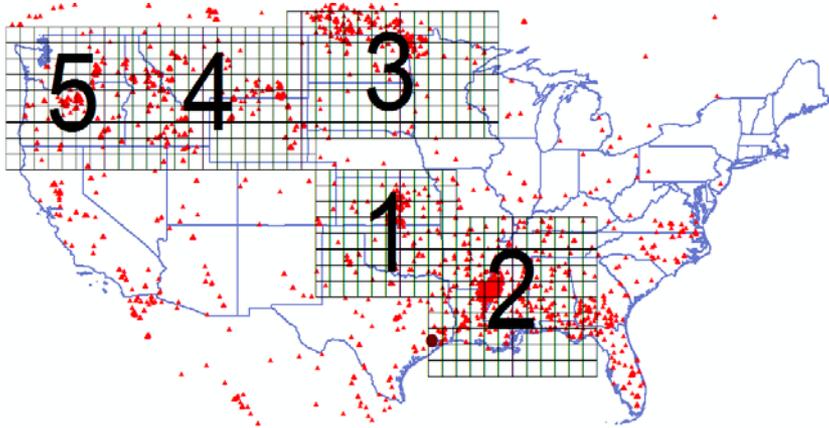
August 26



# Trajectory Evidence



# Trajectory Source Areas



Matrix	Description	Duration (hrs)	Southwest Corner of Matrix		Northeast Corner of Matrix		Total Trajectories in Grid
			Lat (deg)	Lon (deg)	Lat (deg)	Lon (deg)	
1	OK/KS/TX	84	33°	-103°	40°	-94°	80
2	AR/LA/MS	84	28°	-95°	37°	-84°	120
2b	AR/LA/MS	48	28°	-95°	37°	-84°	120
3	MN/ND/S	84	43°	-105°	50°	-91°	120
4	ID/MT/WY	84	41°	-118°	49°	-104°	135
5	OR/WA	84	41°	-125°	49°	-117°	81

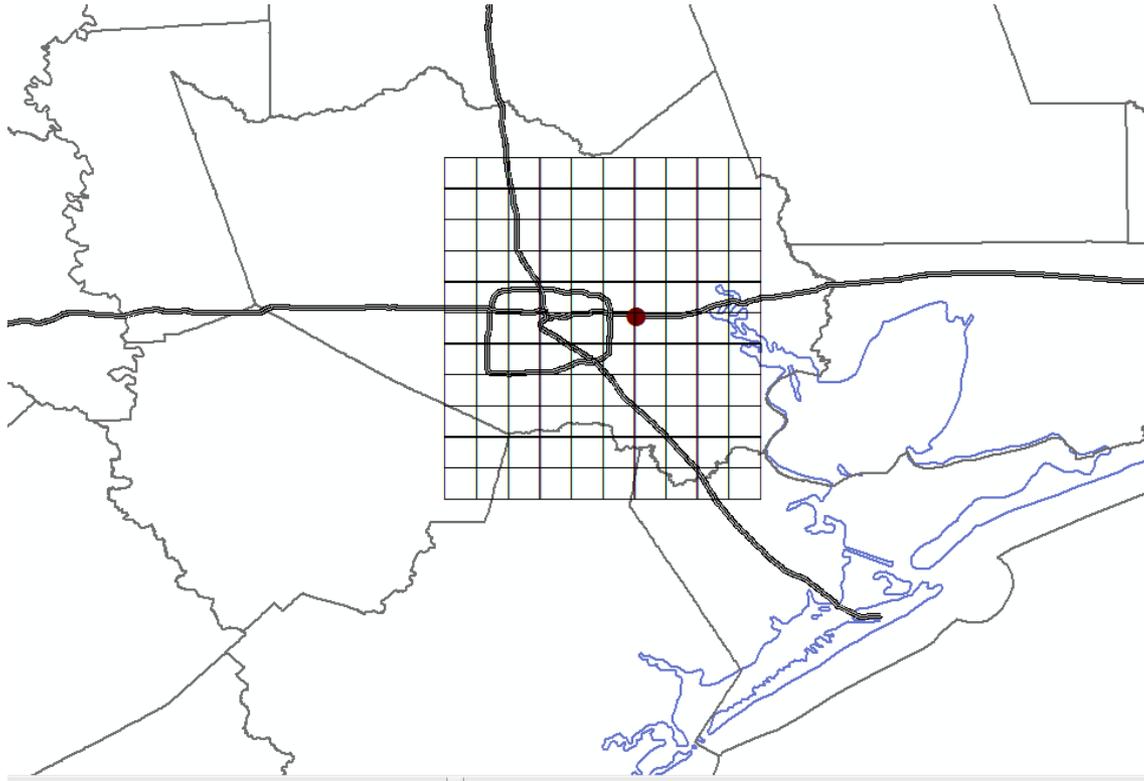


# Incoming Trajectory Height



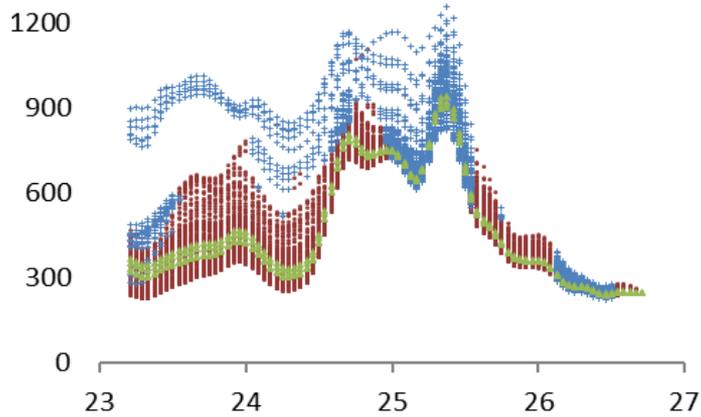
# Matrix 6 for Incoming Trajectories

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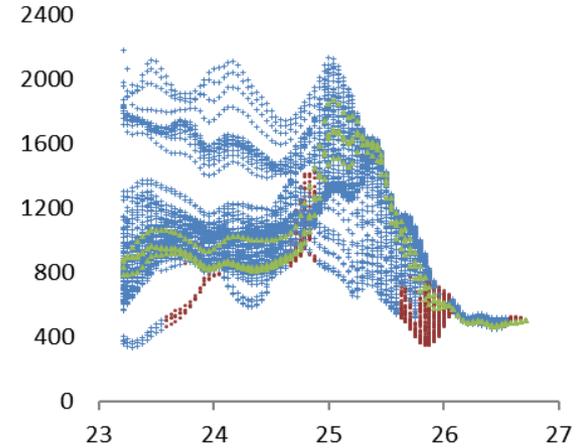




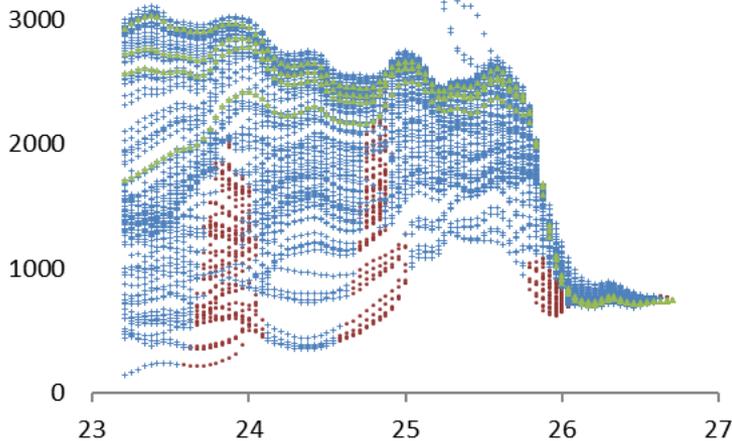
# Trajectory Termination in Houston East Area



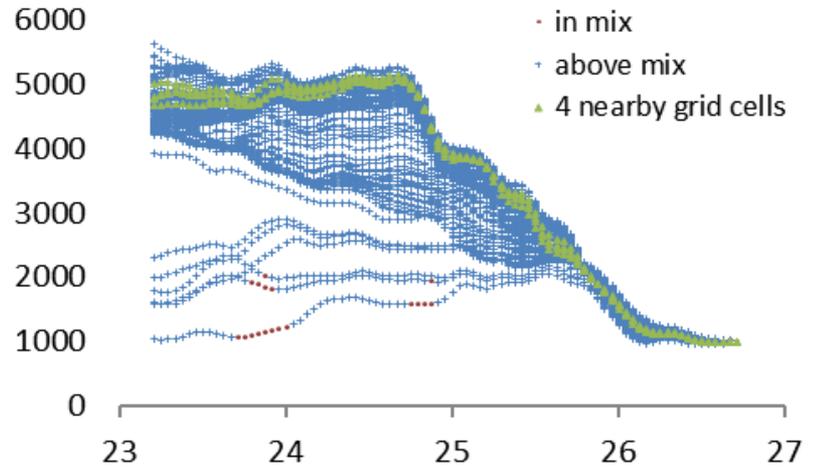
250 meters



500 meters



750 meters



1000 meters





# GOES Satellite Imagery



# NOAA Satellite Interpretation on August 26, 2011

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DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY  
THROUGH 1515Z August 26, 2011

<http://www.ssd.noaa.gov/PS/FIRE/DATA/SMOKE/2011/2011H261537.html>

"Southcentral US:

A ridge of high pressure over NE **TX** continues to hold smoke from emissions earlier this week from the fires in ID/MT and WY. This smoke is thin with small linear shaped pockets/strands of moderate smoke covering all of KS, OK, **TX**, LA and NM with portions of smoke affecting SW AR, and SW MS and the coastal Gulf of Mexico from Brownsville, **TX** over to Mobile, AL. Smoke over SE KS/E OK/SW AR and LA is moving SEward into the Gulf, while influence from the upper level ridge is moving smoke in **TX**, W OK, W KS due south into Old Mexico and southwestward across NM starting to move into SE AZ."



# NOAA Satellite Interpretations on August 26, 2011

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DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY  
THROUGH 0330Z August 26, 2011

<http://www.ssd.noaa.gov/PS/FIRE/DATA/SMOKE/2011/2011H260353.html>

“Oregon/Montana/Wyoming/Idaho:

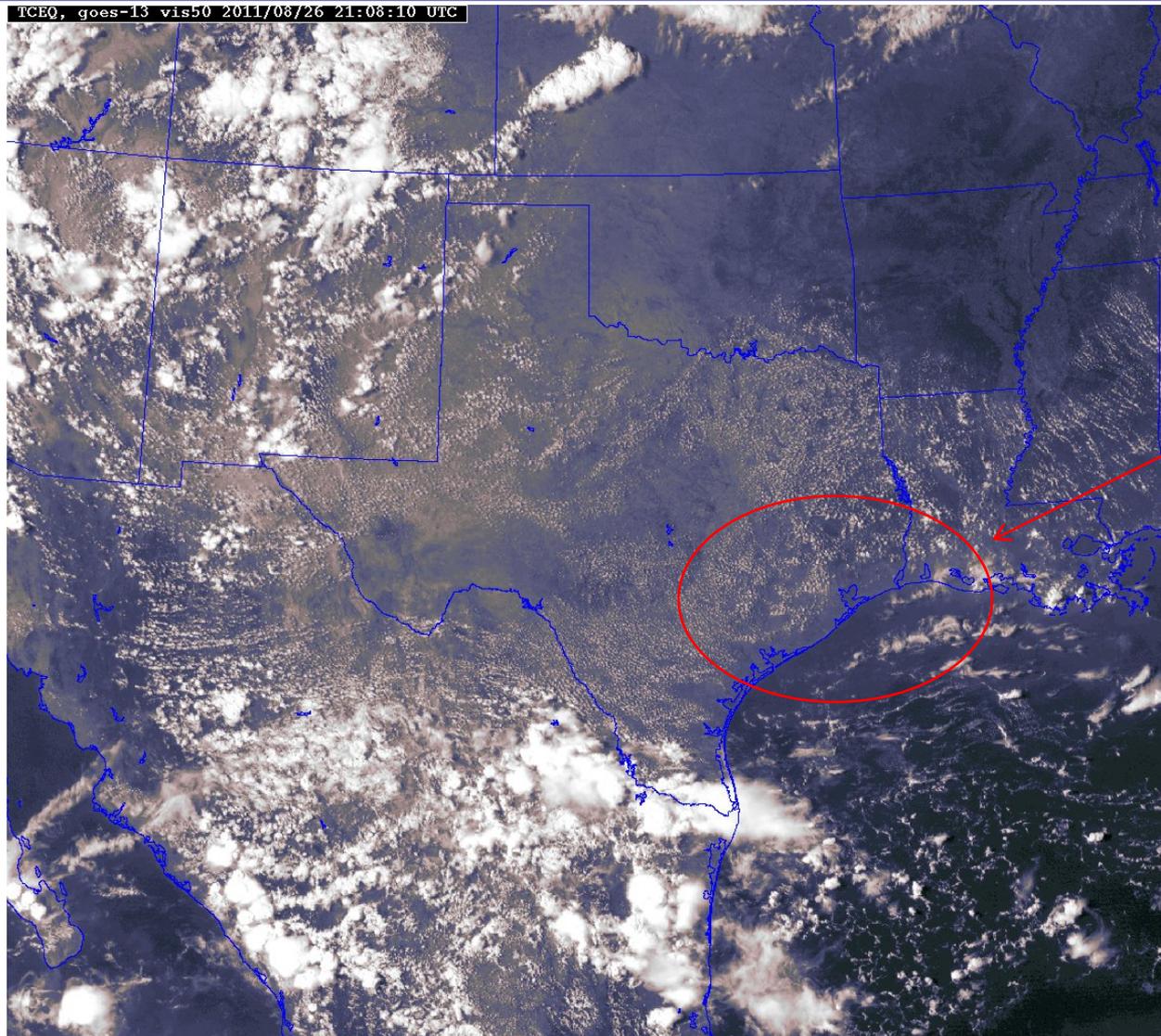
Several wildfires in Oregon, Montana, Wyoming, and Idaho are producing locally dense smoke that is observed moving east as thin density plumes this evening.”

“Central Plains/Mississippi River Valley:

An expansive area of smoke ranging from thin to very dense covers much of the central US. Thin density smoke stretches across the northern, central, and southern plains as well as the entire Mississippi Valley as far south and east as Alabama and Kentucky, respectively. Moderate density smoke mainly covers the upper and middle Mississippi Valley while dense smoke is observed only in the eastern Dakotas, Minnesota, and Iowa. This detached smoke has originated from numerous fires in Idaho, Wyoming, and Montana that have been burning over the past several days.”



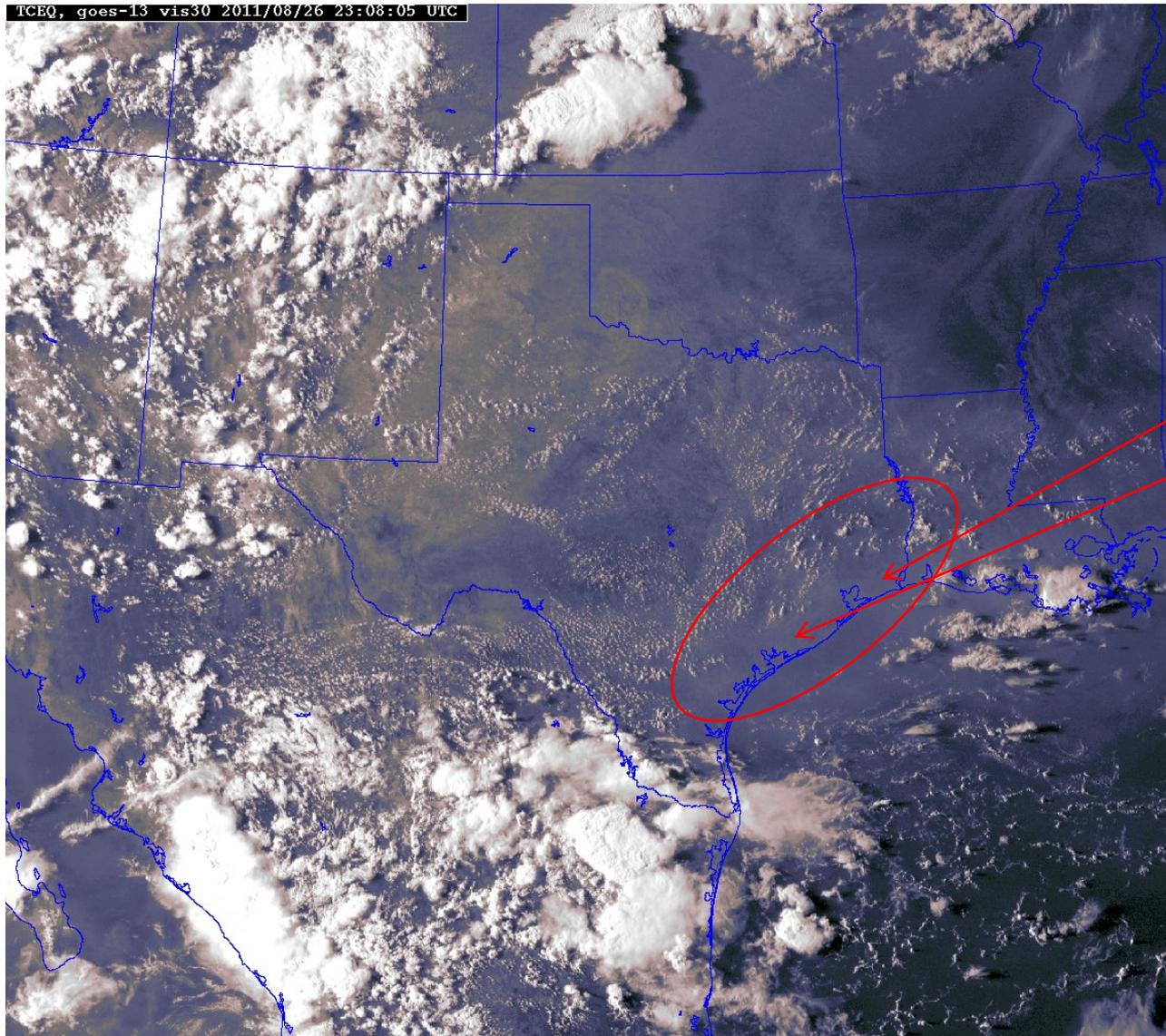
# GOES Image on August 26, 2011



Haze/smoke  
over Houston



# GOES Image on Afternoon of August 26, 2011



Smokey haze covering the upper Texas Gulf Coast



# CALIPSO SATELLITE IMAGERY



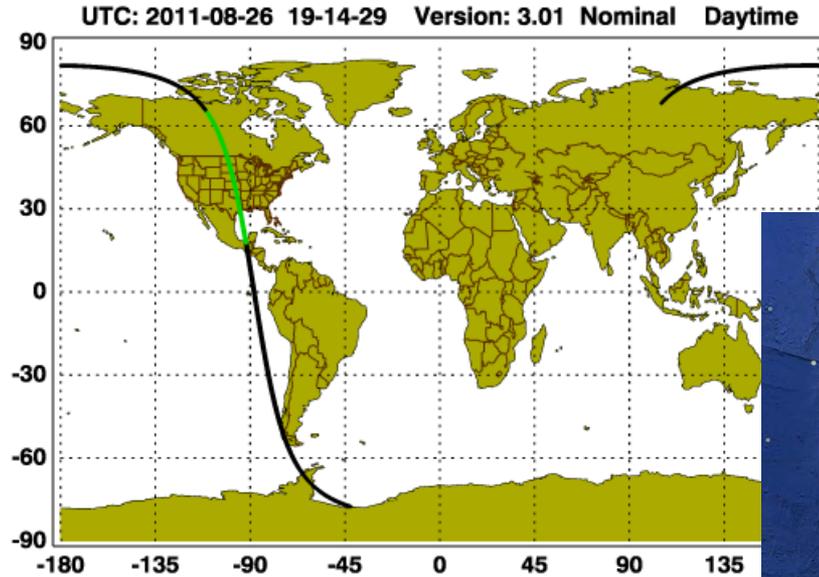
# CALIPSO BACKGROUND

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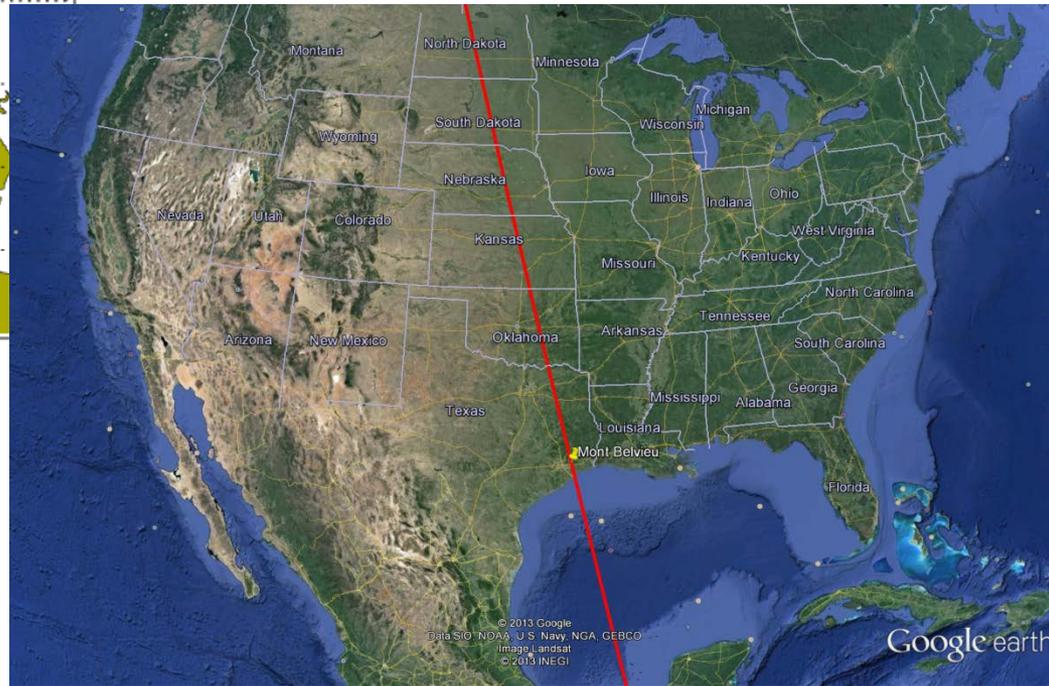
- NASA orbiting instrument/satellite using LIDAR, Imaging Infrared Radiometer, and Wide Field Camera.
- Launched in 2006 with Sun-synchronous orbit.
- LIDAR produces high-resolution vertical profiles of aerosols and clouds.



# CALIPSO Orbital Track on August 26, 2011



CALIPSO is on a North-to-South trajectory on August 26, 2011, between 1:41:26 PM and 1:54:54 PM (CST).



NASA/Langley Research Center

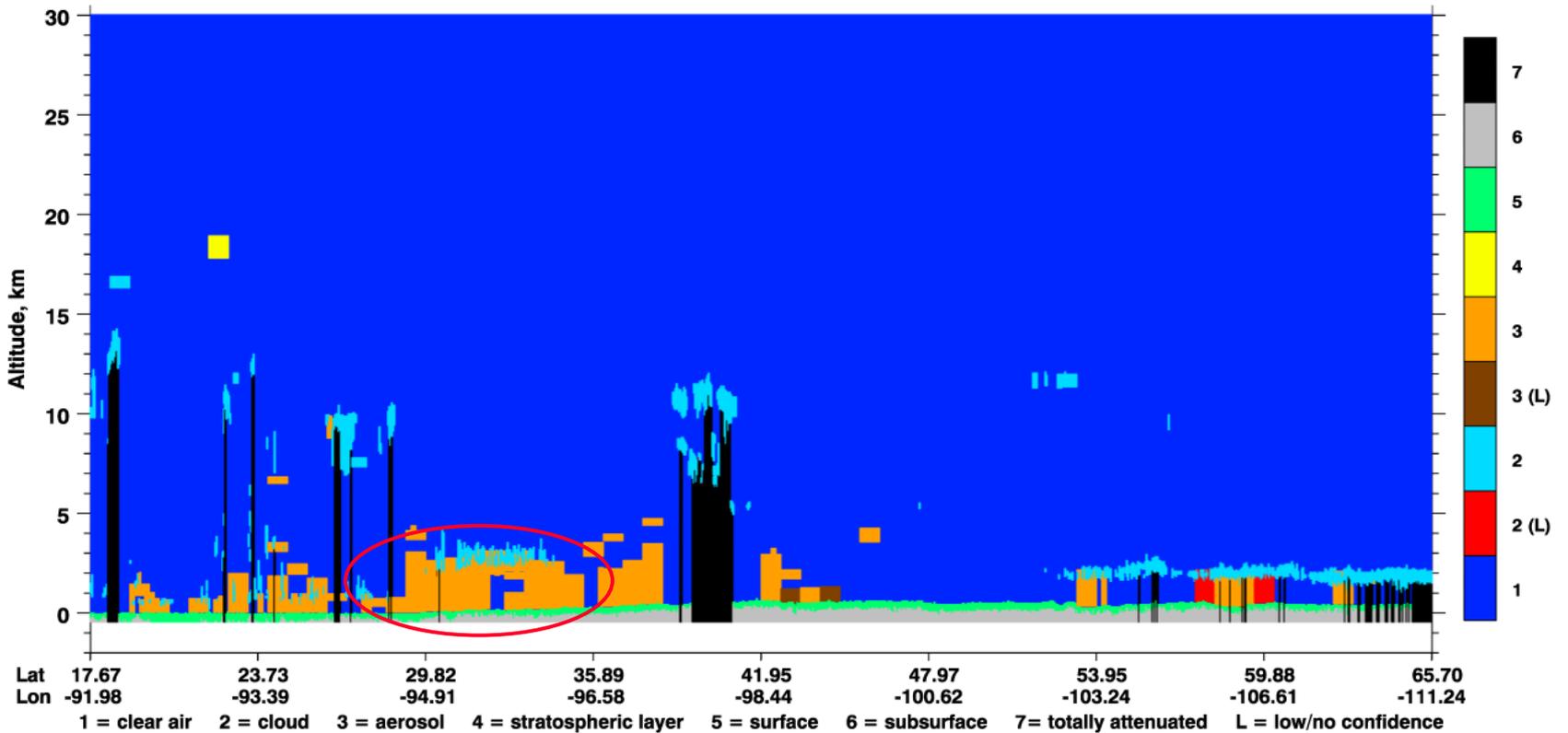
[http://www-calipso.larc.nasa.gov/products/lidar/browse\\_images/show\\_detail.php?s=production&v=V3-01&browse\\_date=2011-08-26&orbit\\_time=19-14-29&page=3&granule\\_name=CAL\\_LID\\_L1-VolStage1-V3-01.2011-08-26T19-14-29ZD.hdf](http://www-calipso.larc.nasa.gov/products/lidar/browse_images/show_detail.php?s=production&v=V3-01&browse_date=2011-08-26&orbit_time=19-14-29&page=3&granule_name=CAL_LID_L1-VolStage1-V3-01.2011-08-26T19-14-29ZD.hdf)





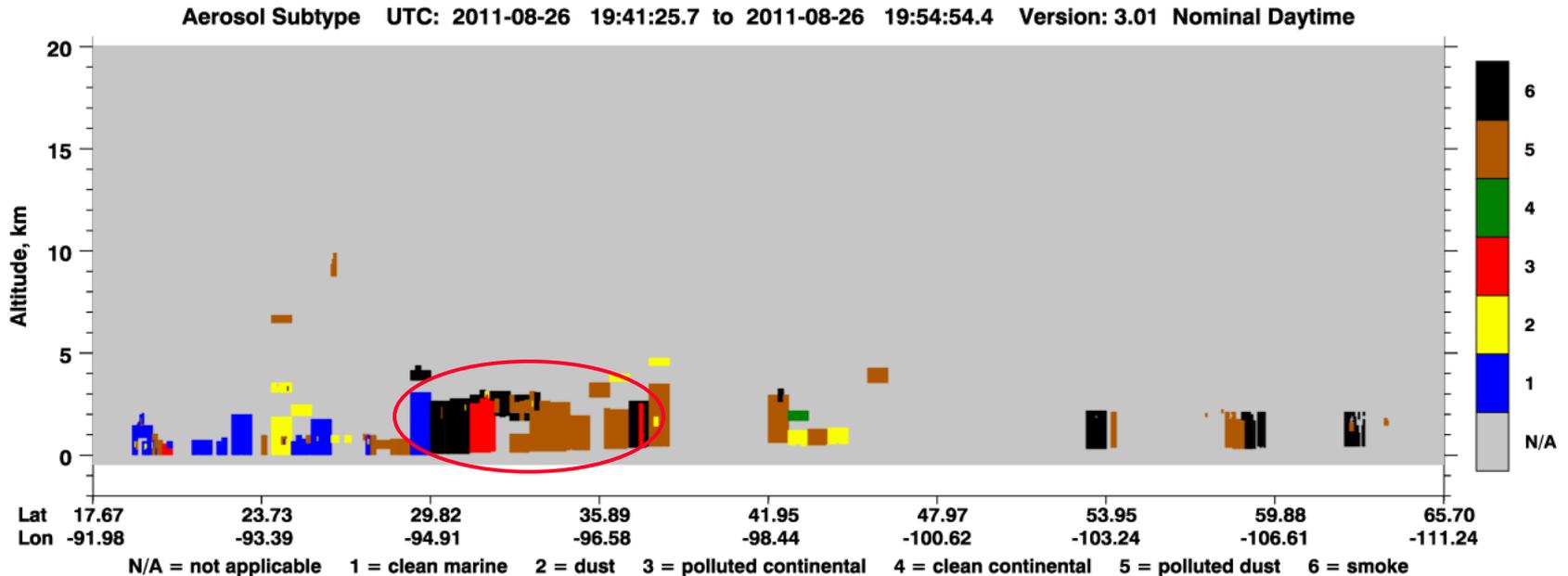
# CALIPSO Feature Mask Plot

Vertical Feature Mask UTC: 2011-08-26 19:41:25.7 to 2011-08-26 19:54:54.4 Version: 3.01 Nominal Daytime



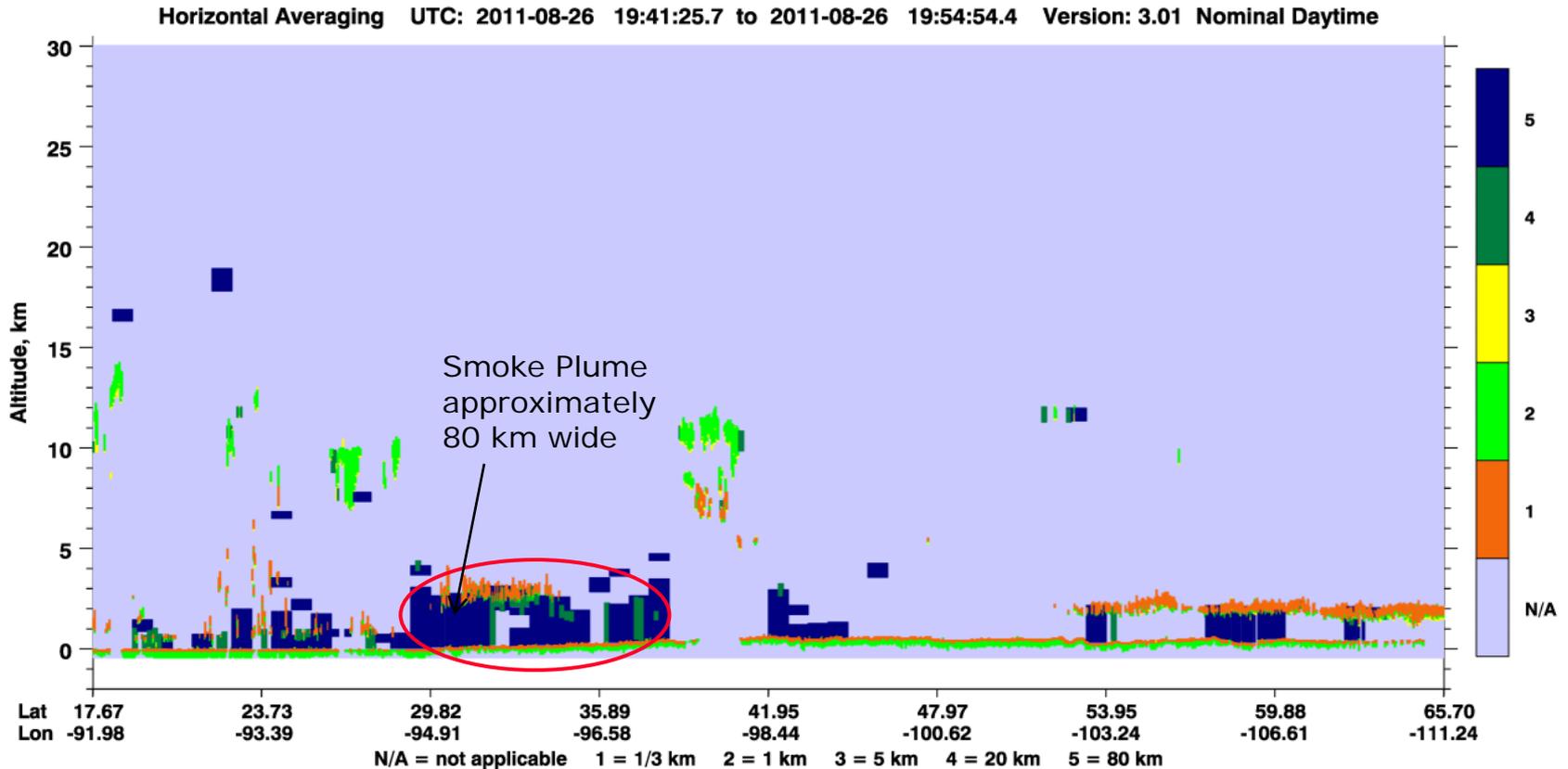


# CALIPSO Aerosol Subtype Plot





# CALIPSO Horizontal Averaging Plot





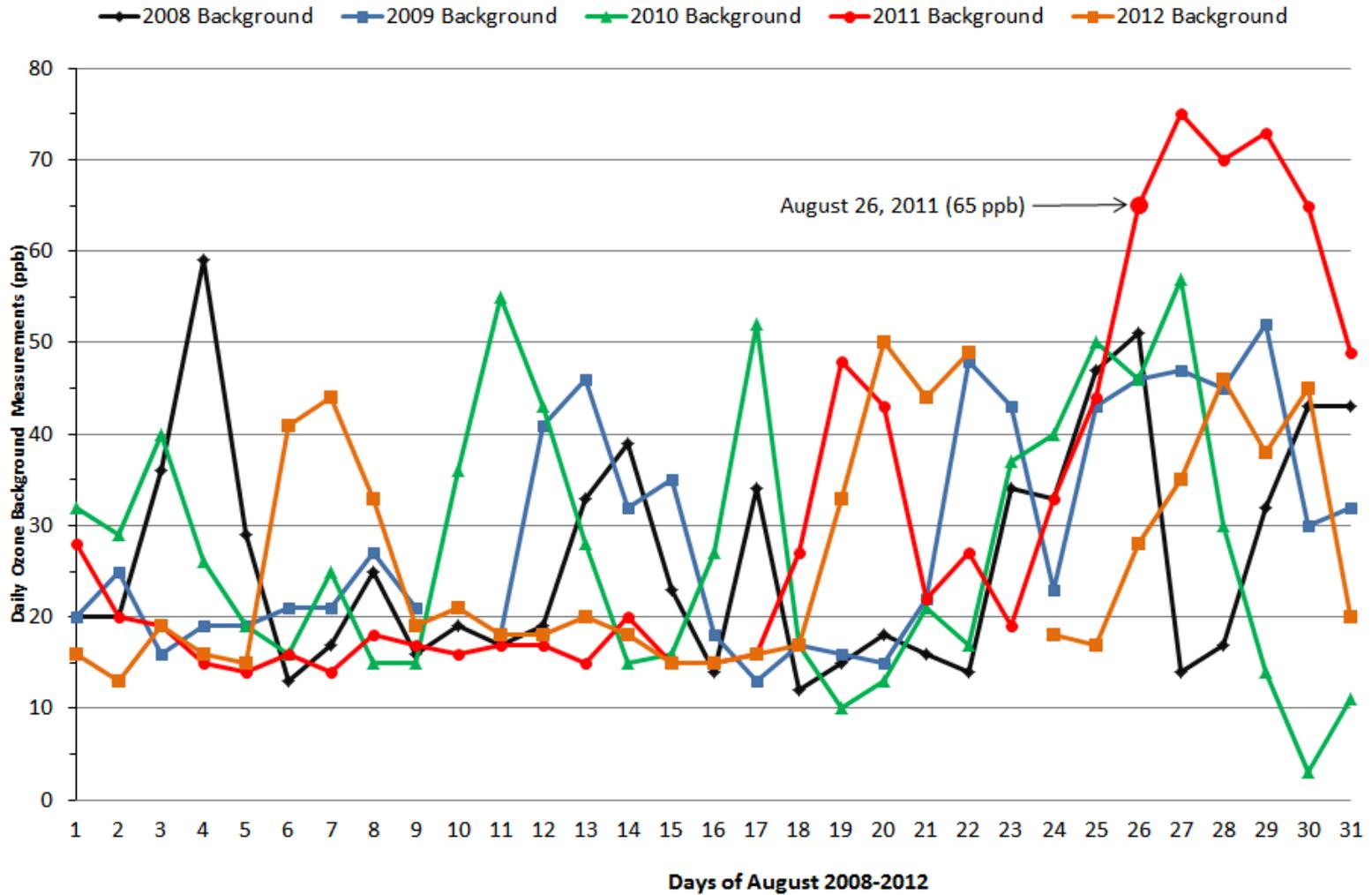
# **No Exceedance but for the Exceptional Event**



# Background Ozone



# Houston Area Background for August, 2008-2012



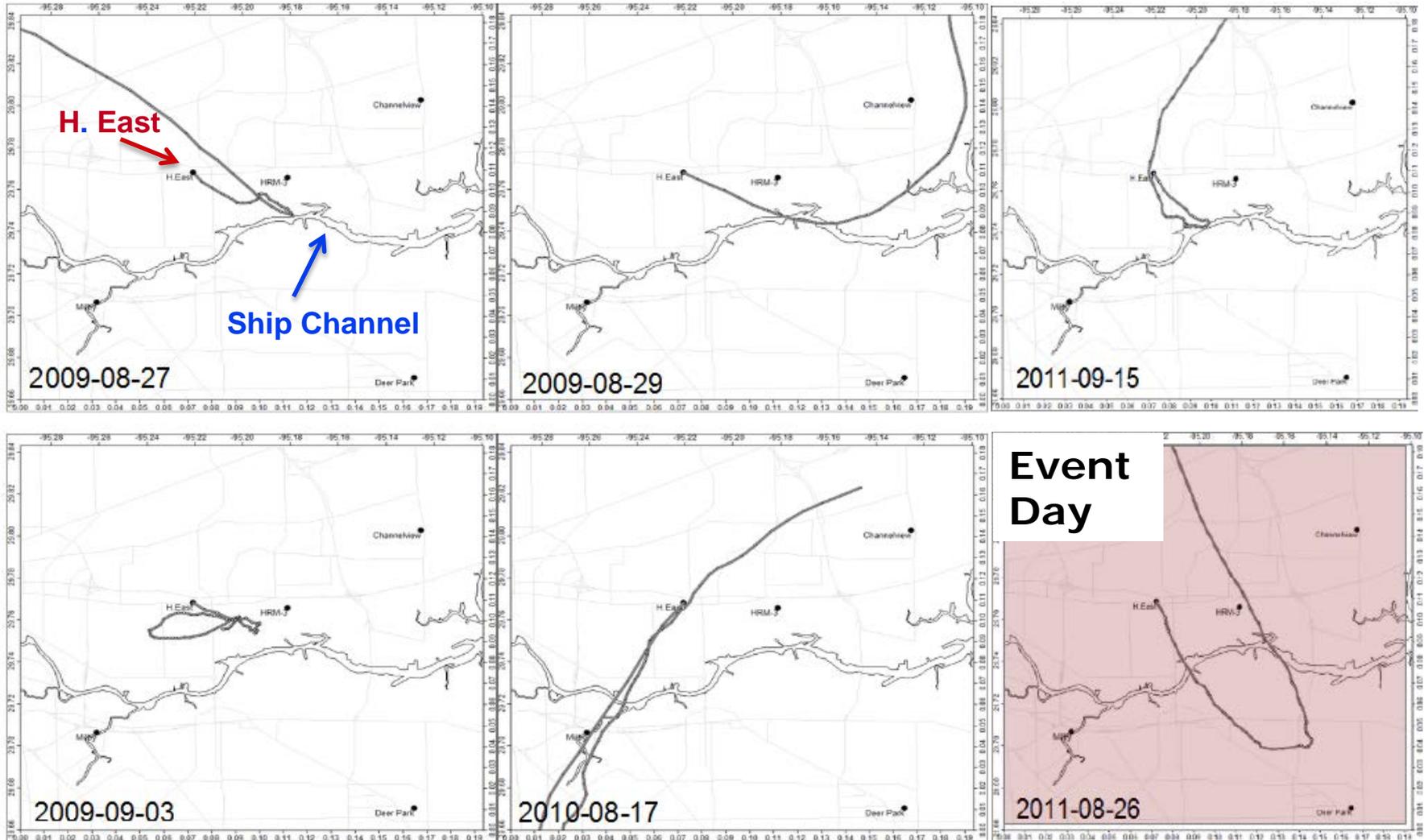
Background is defined as the second lowest ozone measurement in the HGB area at the time of the area's maximum daily peak ozone in the HGB area.



# Surrogate Day Analysis



# Five Surface Back Trajectories Identified Similar to August 26, 2011





# Meteorological Comparison of Candidate days to August 26

Date	Avg Speed Mil/hr	Temp F°		O3 ppb	Solar Rad* Langley/mi n	Flow Reversal	Precip.* in.	RH* %	Surface Pattern	Cloud Cover
		min	max							
8/26/2011	3.6	78	98	128	0.7	Yes	0.0	53	High pressure over Texas	Clear Skies
8/27/2009	2.13	77.5	90.8	111.6	n/a	Yes	0.00	73.8	High pressure with front over north Texas	Mostly Cloudy
8/29/2009	3.92	75.1	89.6	69.4	n/a	Yes	0.03	89	Post frontal passage	Mostly Cloudy
11/3/2009	3.04	55.2	74.7	41.4	1.0	Yes	0.00	88.6	High pressure with front over north Texas	Clear
8/17/2010	2.87	80.2	96.3	73.5	1.3	Yes	0.00	87.0	High pressure with front over north Texas	Mostly Cloudy
8/15/2011	3.39	79.2	97.3	48.4	1.2	Yes	0.00	82.2	High pressure with stationary front over Louisiana	Partly Cloudy

\* Used data from Clinton Dr.; Downloaded on August 5, 2013

- Avg wind speed (6:00-14:00) LST
- Avg solar radiation (6:00-14:00) LST



# HGB Event Emissions Incidents on 8/26/2011 and 8/27/2009

**HGB Event Emissions Incidents, 8/26/11**

date area	event_type	count
8/26/2011 HGB	AIRSHUTDWN	2
8/26/2011 HGB	AIRSTARTUP	9
8/26/2011 HGB	AIR_MAINTENANCE	9
8/26/2011 HGB	AIR_UPSET	28
<b>TOTAL EVENTS</b>		<b>48</b>

**HGB Event Emissions Incidents, 8/27/09**

date area	event_type	count
8/27/2009 HGB	AIRSHUTDWN	2
8/27/2009 HGB	AIRSTARTUP	10
8/27/2009 HGB	AIR_MAINTENANCE	10
8/27/2009 HGB	AIR_UPSET	31
<b>TOTAL EVENTS</b>		<b>53</b>

The surrogate day actually had more active upsets than the exceptional event day. Undertaking a more detailed comparison of emissions incidents would be prohibitive.



# Special Recognition

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- AMDA Data Analysis Team:
  - Dave Westenbarger
  - Jonathan Steets
  - John Jolly
  - Fernando Mercado
- Monitoring Division
  - Bryan Lambeth
  - Lindsey Jones