

CMAQ

Ozone and PM_{2.5} 12Z Predictions: Metro Phoenix, Arizona

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AQ Forecast Program

- ◇ Team of Meteorologists
- ◇ Daily 72-hour AQ Forecast Issuance

- ◇ Phoenix

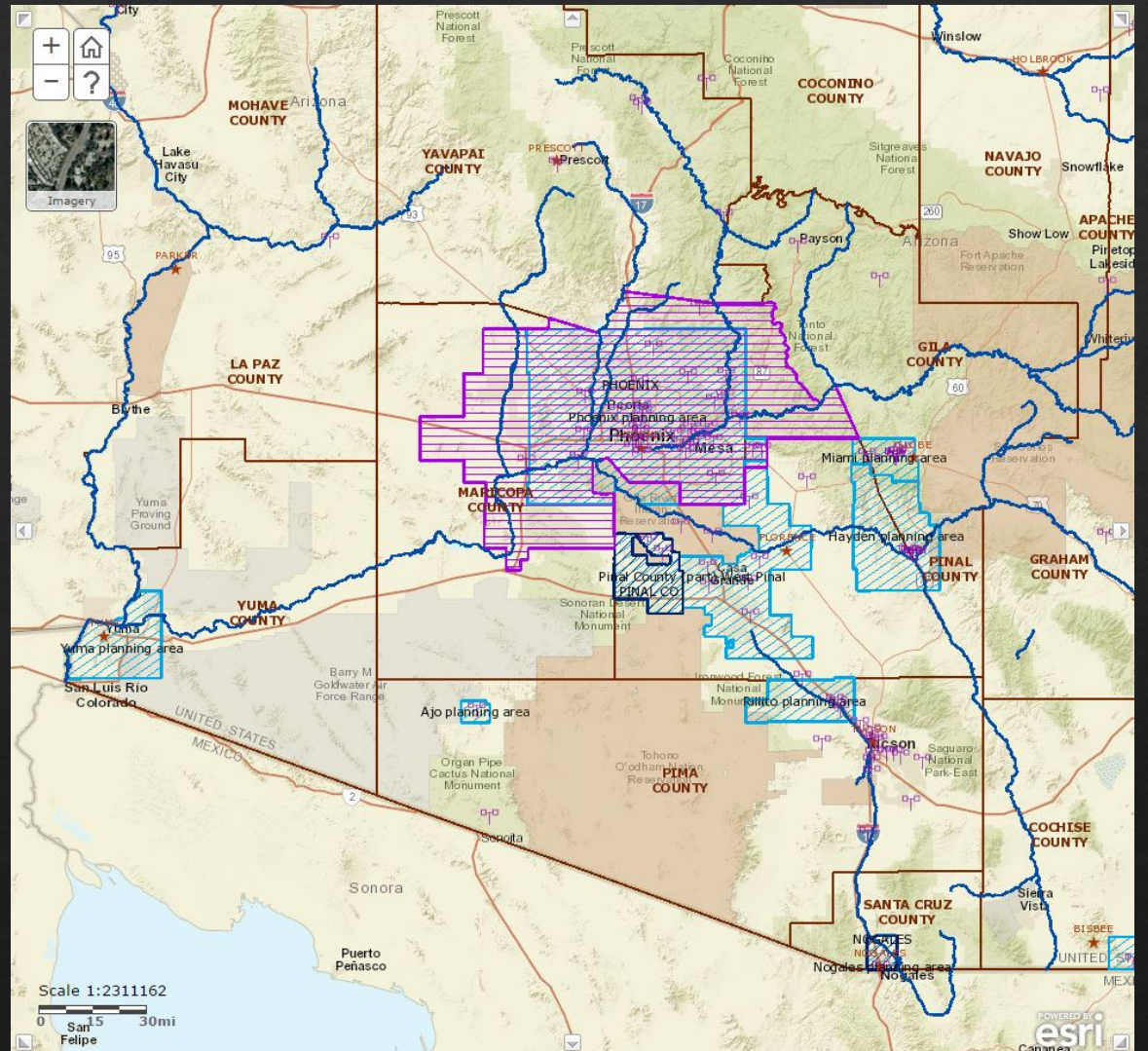
- ◇ Ozone (8-hour Max)
- ◇ PM2.5 (24-hour Mean)
- ◇ PM10 (24-hour Mean)

- ◇ Yuma

- ◇ Ozone (8-hour Max)
- ◇ PM10 (24-hour Mean)

- ◇ Nogales

- ◇ PM2.5 (24-hour Mean)
- ◇ PM10 (24-hour Mean)



- ◇ Goal is to Issue Accurate High Pollution Advisories (>100 AQI)

Arizona AQ Forecasting Challenges for CMAQ

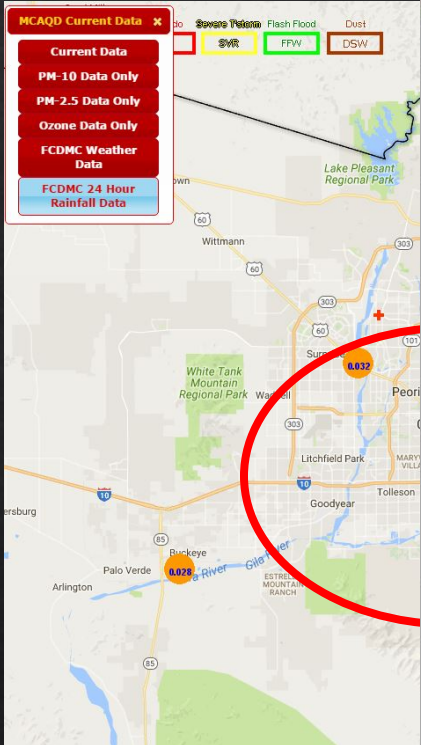
January 1, 2016 11:45 AM

- ◆ Complex Terrain
 - ◆ Confidence in Weather and Air Quality Models is Limited
 - ◆ High Model Resolution Modelling Required
- ◆ Frequent High Energy – Short Temporal – Small Spatial Events (Dust Storms)
- ◆ Local Pollutant Generation versus Long-range Transport
- ◆ Wildfire, Prescribed, and Ag Fires
- ◆ One-offs (Industrial Fires)
- ◆ Public Behavior



Metro Photo

◇ Morning



◇ Dominant

◇ Creates "SI

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Change Variable Type:
 Daily Max CMAQ Forecasts

Change Plot Type:
 Comparison plots

Year: 2016
 Month: Aug
 Day: 15

Select Cycle:
 12Z

Select Region:
 South West U.S.

Select Field:
 Ozone(8h) Daily Max

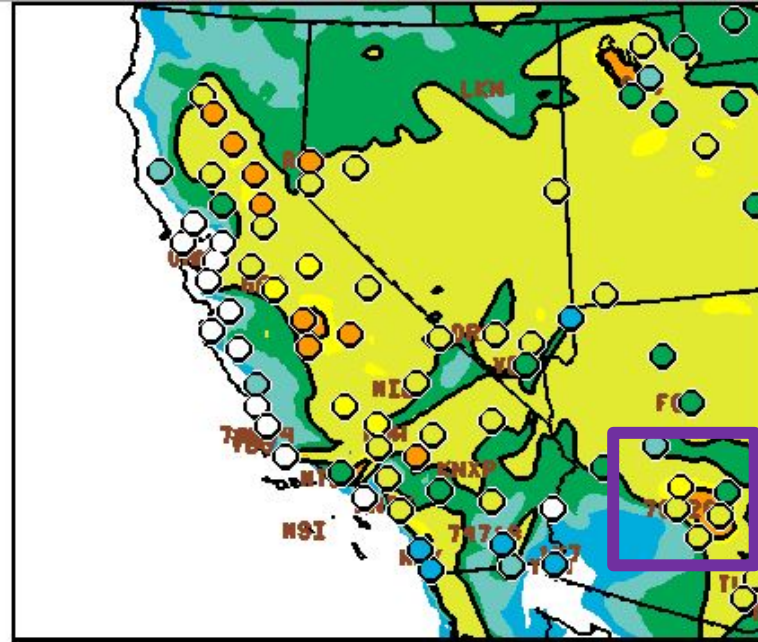
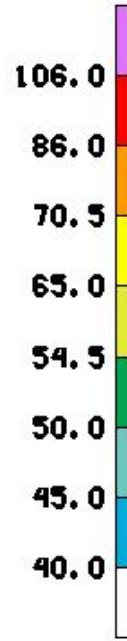
Overlay Type:
 Observations

Select Day:
 Day 1

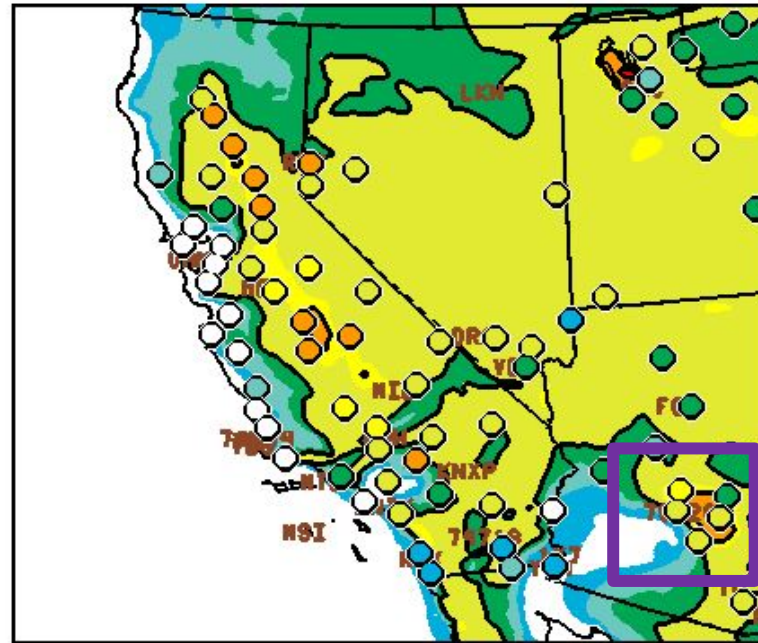
Get map

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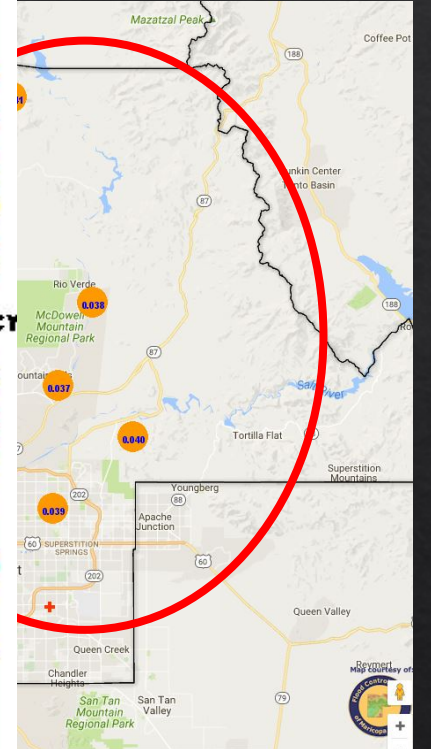
PARA2 CMAQ.V5.O.2 DAY1 OZHX08 20160815 12Z CYC



PROD DAY1 OZHX08 20160815 12Z CYC

Geography

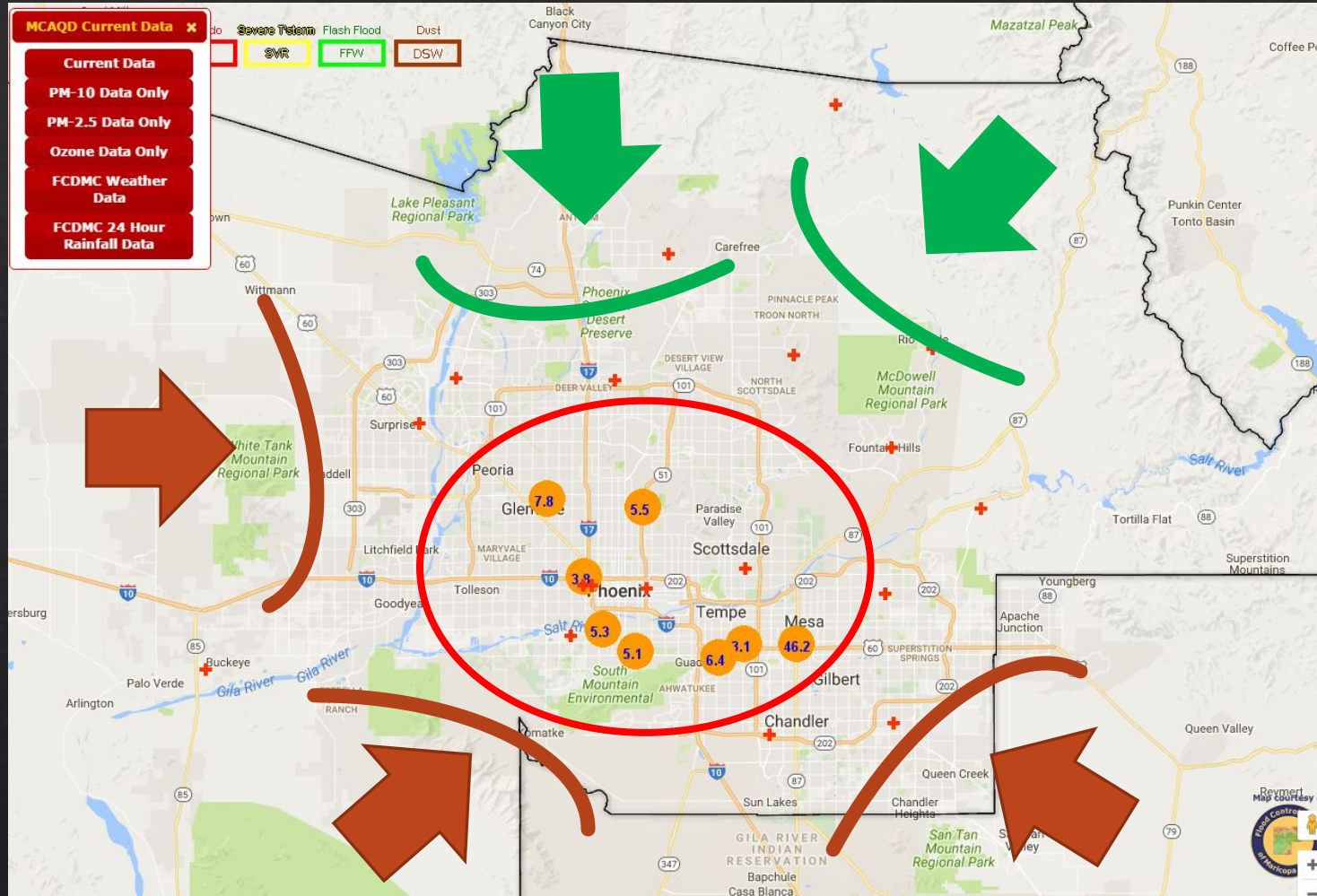
Plume



Southwest PM

n

Metro Phoenix PM2.5 Monitor Placement and Geography



- ◇ Downtown is Natural Collection for Particulates from Surrounding Population
- ◇ Concentrated Industrial Activities near Monitors
- ◇ Local Drainages can Bring Smoke from Nearby Wildfires
- ◇ Major Particulate Sources to West, South, and Southeast (Thunderstorm Outflows or High Wind Events)

CMAQ version 5.0.2 Performance in Metro Phoenix, Arizona
PM2.5 and Missed Blowing Dust

July					August				
Date	µg/m ³	AQI	Cause	CMAQ Forecasted?	Date	µg/m ³	AQI	Cause	CMAQ Forecasted?
7/1/2016	5.7	24			8/1/2016	29.1	87	BLDU	NO
7/2/2016	6	25			8/2/2016	6.9	29		
7/3/2016	7.7	32			8/3/2016	6.4	27		
7/4/2016	11.8	49			8/4/2016	7.5	31		
7/5/2016	9.5	40			8/5/2016	7.1	30		
7/6/2016	7.2	30			8/6/2016	7.4	31		
7/7/2016	7.1	30			8/7/2016	5.9	25		
7/8/2016	5.6	23			8/8/2016	6.5	27		
7/9/2016	5.5	23			8/9/2016	12.6	52	BLDU	NO
7/10/2016	5.2	22			8/10/2016	7	29		
7/11/2016	6.7	28			8/11/2016	7.8	33		
7/12/2016	6.3	26			8/12/2016	6.4	27		
7/13/2016	7.5	31			8/13/2016	8	33		
7/14/2016	6.7	28			8/14/2016	6.9	29		
7/15/2016	7.6	32			8/15/2016	7.6	32		
7/16/2016	7.1	30			8/16/2016	8.4	35		
7/17/2016	6	25			8/17/2016	6.4	27		
7/18/2016	8.5	35			8/18/2016	4.2	18		
7/19/2016	14.7	56	BLDU	NO	8/19/2016	4.4	18		
7/20/2016	6.9	29			8/20/2016	5.7	24		
7/21/2016	6.5	27			8/21/2016	16.5	60	BLDU	NO
7/22/2016	40.8	114	BLDU	NO	8/22/2016	3.5	23		
7/23/2016	8.3	35			8/23/2016	4.9	20		
7/24/2016	5.7	24			8/24/2016	16.6	60	BLDU	NO
7/25/2016	5.5	23			8/25/2016	6.7	29		
7/26/2016	0	0			8/26/2016	6.7	28		
7/27/2016	9.2	38			8/27/2016	6.1	25		
7/28/2016	8.9	37			8/28/2016	4.8	20		
7/29/2016	20.8	69	BLDU	NO	8/29/2016	7.5	31		
7/30/2016	16.5	60	Total	No	8/30/2016	7.1	30		
7/31/2016	8.6	36			8/31/2016	5.9	25		

CMAQ version 5.0.2 Performance in Metro Phoenix, Arizona
Ozone and Thunderstorm Outflow Reductions

July				August					
Date	ppb	AQI	Cause	CMAQ Model-Obs	Date	ppb	AQI	Cause	CMAQ Model-Obs
7/1/2016	57	58			8/1/2016	69	97		
7/2/2016	56	54							
7/3/2016	54	50							
7/4/2016	51	47							
7/5/2016	62	74							
7/6/2016	56	54							
7/7/2016	56	54							
7/8/2016	59	64							
7/9/2016	54	50							
7/10/2016	52	48							
7/11/2016	56	54							
7/12/2016	55	51							
7/13/2016	67	90			8/13/2016	76	119		
7/14/2016	64	80			8/14/2016	68	93		
7/15/2016	68	93			8/15/2016	75	115		
7/16/2016	68	93			8/16/2016	75	115		
7/17/2016	48	44			8/17/2016	67	90		
7/18/2016	68	93		20-40 ppb	8/18/2016	73	108		
7/19/2016	70	100			8/19/2016	68	93		
7/20/2016	76	119			8/20/2016	59	64		10-20 ppb
7/21/2016	79	129			8/21/2016	72	105		
7/22/2016	75	115			8/22/2016	56	54		
7/23/2016	60	67			8/23/2016	62	74		
7/24/2016	56	54			8/24/2016	68	93		20-40 ppb
7/25/2016	72	105			8/25/2016	63	77		
7/26/2016	70	100			8/26/2016	60	67		
7/27/2016	64	80			8/27/2016	53	49		
7/28/2016	78	128			8/28/2016	60	67		
7/29/2016	70	100		20-40 ppb	8/29/2016	59	64		
7/30/2016	76	119			8/30/2016	62	74		
7/31/2016	64	80			8/31/2016	63	77		

92	33.3	73	22.5	63	17.2	38	6	130	28.82			29.93	AA		30.00
95	36.0	73	22.9	63	17.2	36	5	130	28.82			29.94	AA		30.00
96	36.0	72	22.4	61	16.1	32	0	000	28.82			29.93	AA		30.00
101	39.3	74	23.3	61	16.1	27	10	180	28.90			29.91	AA		29.98
100	37.8	73	22.8	60	15.6	27	0	000	28.77			29.89	AA		29.95
101	38.3	73	23.0	60	15.6	26	5	250	28.75			29.88	AA		29.93
103	38.4	73	23.0	59	15.0	23	0	000	28.71			28.82	AA		29.89
104	40.0	74	23.1	59	15.0	23	3	VR	28.69			28.80	AA		29.86
105	40.6	74	23.3	59	15.0	22	10	200	28.66			29.77	AA		29.84
103	39.4	73	23.0	59	15.0	23	6	210	28.66			M	SP		29.84
97	36.0	74	23.2	63	17.0	33	30	220	28.69			M	SP		29.86
92	33.3	74	23.1	65	18.3	41	28	210	28.69			29.80	AA		29.86
86	30.0	73	22.6	67	19.4	53	33	240	28.69			M	SP		29.86
86	30.0	74	23.4	66	20.6	57	46	260	28.69			M	SP		29.87
87	30.6	73	22.6	67	19.4	52	37	200	28.69			M	SP		29.87
88	31.1	73	22.6	65	18.3	47	39	280	28.69			M	SP		29.87
87	31.1	72	22.4	64	17.8	46	39	280	28.69			M	SP		29.88
82	27.8	73	22.6	69	20.6	65	13	200	28.77			M	SP		29.95
81	27.2s	73	22.6	69	20.6	67	9	230	28.77			M	SP		29.95
81	27.2s	72	22.0	67	19.4	63	20	330	28.76			M	SP		29.94
82	27.8s	71	21.6	65	18.3	56	18	340	28.75			M	SP		29.93
86	30.0	71	21.6	63	17.2	46	14	320	28.74			M	SP		29.92
85	29.4s	72	22.0	65	18.3	51	14	340	28.73			M	SP		29.91
87	30.6	72	22.0	64	17.8	46	14	360	28.71			M	SP		29.89
88	31.1	72	22.1	64	17.8	46	14	360	28.71			M	SP		29.89
95	29.4s	74	23.3	69	20.6	59	7	210	28.71			29.83	AA	T	29.89
98	31.1	74	23.4	68	20.0	52	7	140	28.71			29.83	AA		29.89
91	32.8	74	23.2	66	18.9	44	13	080	28.75			29.86	AA		29.93
89	31.7	73	22.9	66	18.9	47	8	160	28.77			29.89	AA		29.95

- Phoenix Sky Harbor Weather Obs. (7-18-2016)
- Strong Gusty Outflow Winds (5-7 PM)
- Overlaps Peak Ozone 8-hour Concentrations
- Typical Arrival of Metro Phoenix Outflows is Late Afternoon/Early Evening

Factors Affecting Phoenix Ozone and PM2.5: July-August North American Monsoon Season

◆ PM2.5

- ◆ Excessive PM10 leading to Excessive PM2.5 (Dust Storms)
 - ◆ Exceedance Missed by CMAQ
 - ◆ Can CMAQ Capture These?
 - ◆ All 7 Moderate Days Linked to Blowing Dust and CMAQ Under Forecasted
- ◆ Early Monsoon Moisture = Quick end to Large Wildfires Season
- ◆ No Major Wildfire Smoke Affected Phoenix

◆ Ozone

- ◆ Four Corners High Blocking Pattern and “Sloshing Effect” (Exceedance Scenario)
- ◆ Spatial and Temporal Variability of Thunderstorms
 - ◆ Will Outflow Boundaries Interrupt Peak Ozone?
- ◆ Variable Cloud Coverage
- ◆ **Convection is key to Phoenix AQ in Monsoon Season**

Suggestions for CMAQ User Interface

- ◆ Have Point Click Option or Pop-up Hover of CMAQ Forecasted Values
 - ◆ Perhaps mimic College of DuPage
- ◆ Additional Map Overlay Options
 - ◆ Cities
 - ◆ County Boundaries
 - ◆ Nonattainment Areas

