Evaluation of NOAA Ozone and PM2.5 Forecast For the South Coast Air Basin

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Overview

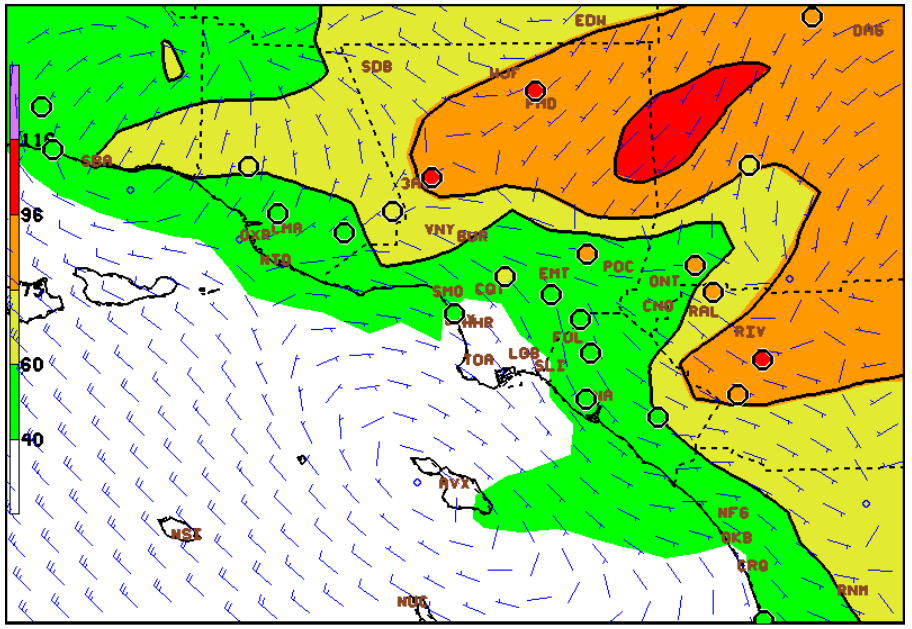
- Compare 3 sets of ozone and PM2.5 model predictions to observations
- Evaluate performance for the Basin maximum concentration and key locations that reflect transport routes and design sites
- Determine if NOAA forecast can be efficiently scaled for local use

Prediction Models Evaluated

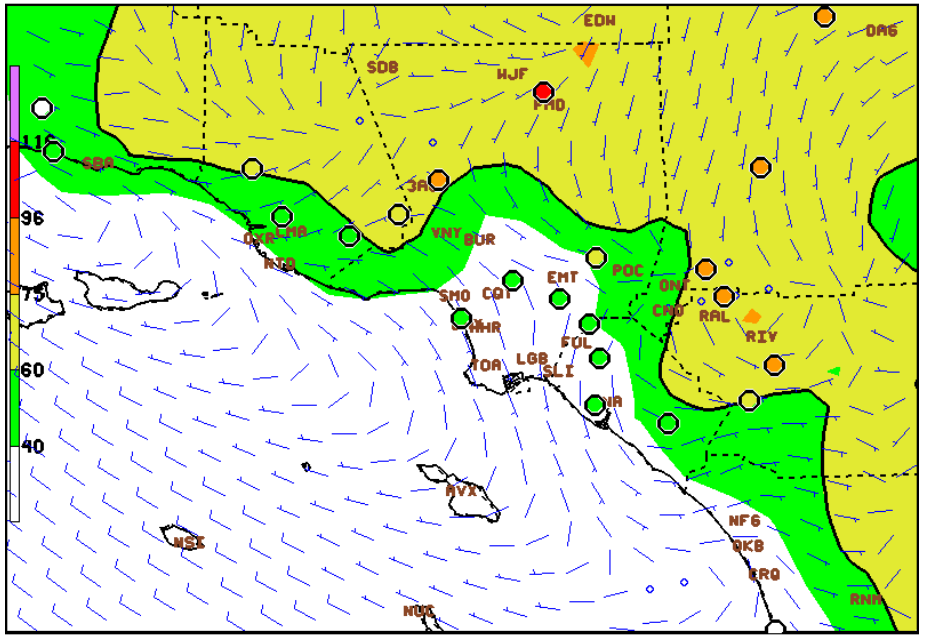
- NOAA forecast (12Z initialization)
  - 12 km grid application
  - Concentrations projected for 30 Basin sites
- AQMD daily air quality forecast
  - Objective empirical forecast model
  - Employs local & synoptic data, ozone and PM persistence, and MOS
  - Forecasted subjective override
- CASS forecast model
  - Objective empirical prediction model
  - Uses NGM projected grid data and persistence
  - No forecaster interaction or override capability

Key Ozone Considerations

- NOAA grid size too coarse
- Local VOC/NOx ratio dampened
- Higher ozone concentrations predicted outside Basin: north and east
- Biogenic emissions may have greater influence
- Overall trend indicates meteorology is well predicted



PROD AQM SFC DAY1 OZM001 20150623 12Z CYCLE -

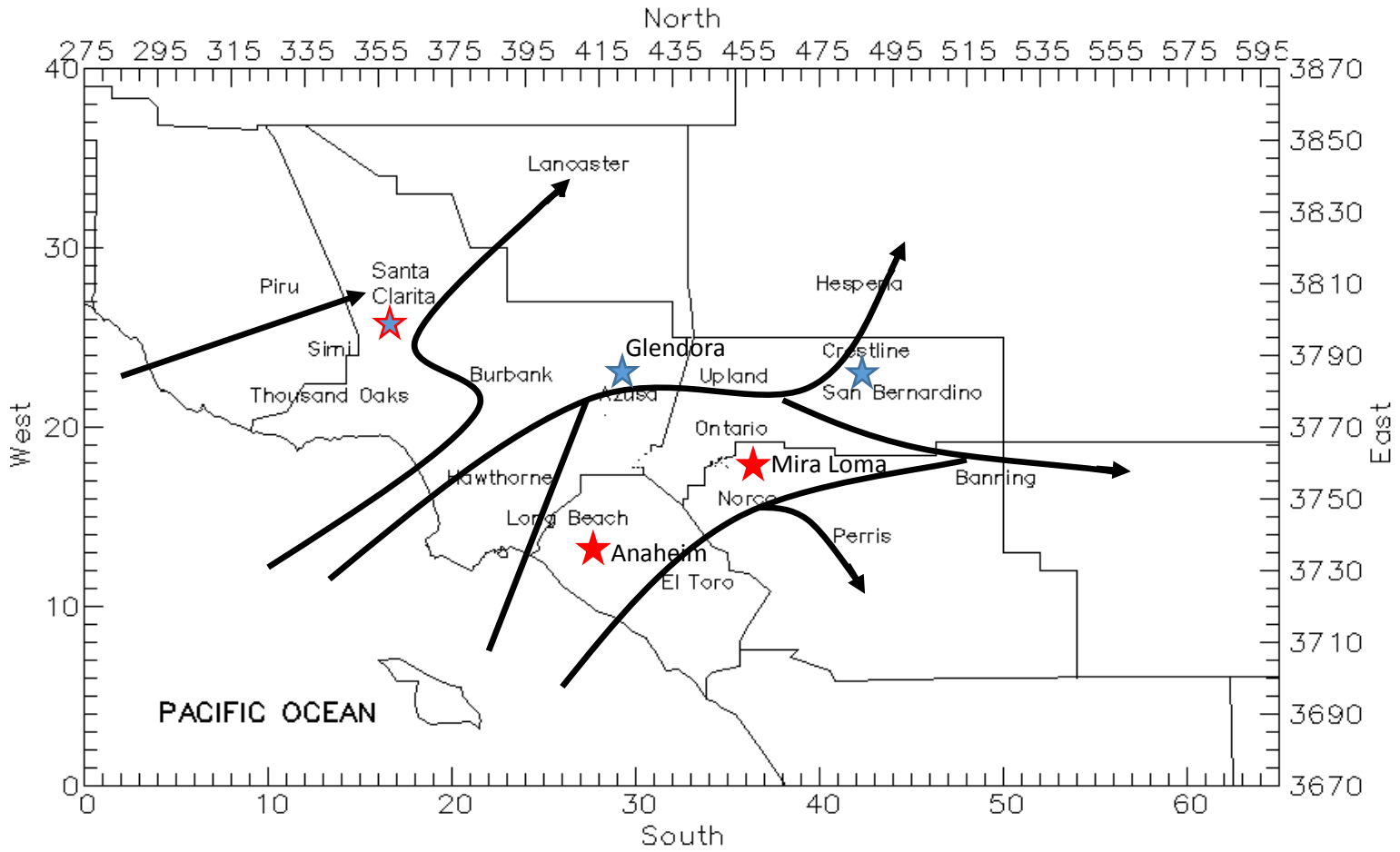


PROD AQM SFC DAY2 OZM008 20150623 12Z CYCLE -

Design Sites and Transport Routes

Ozone: Santa Clarita, Glendora, Crestline

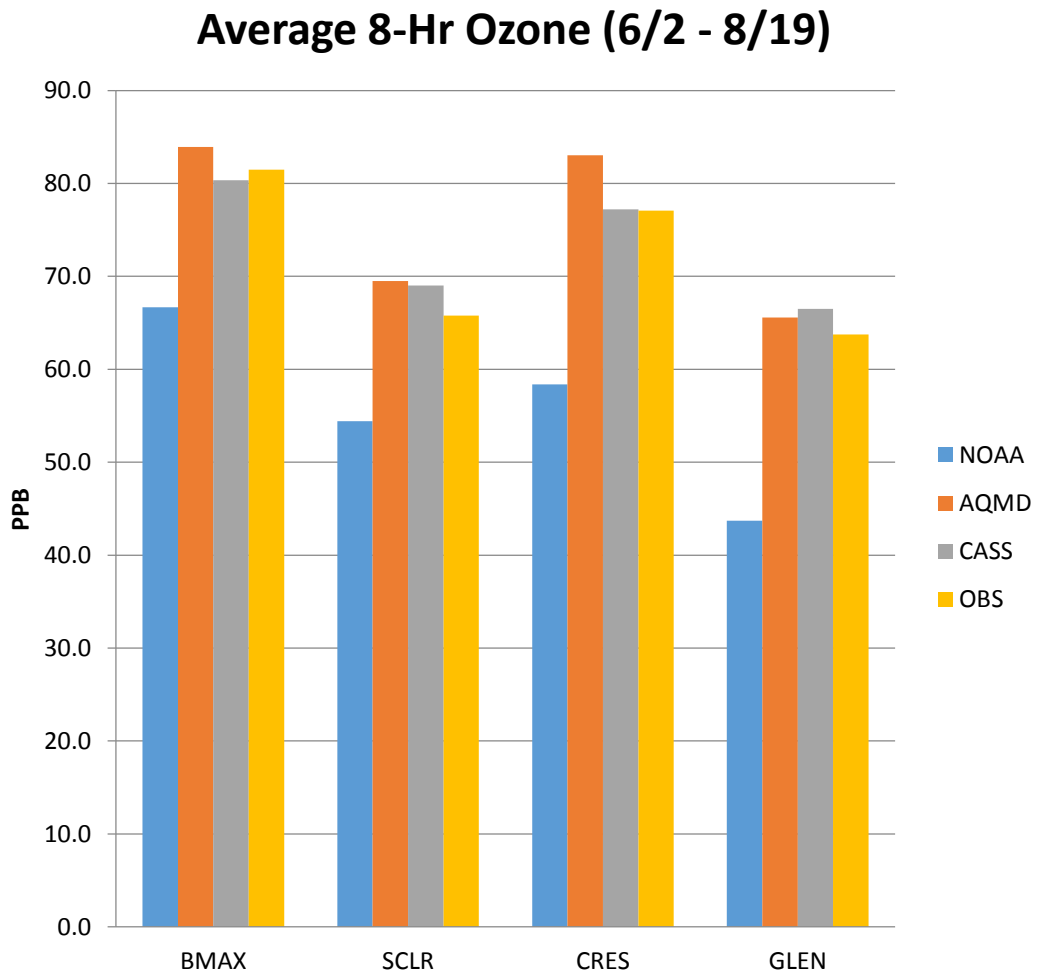
PM2.5: Santa Clarita, Anaheim, Mira Loma

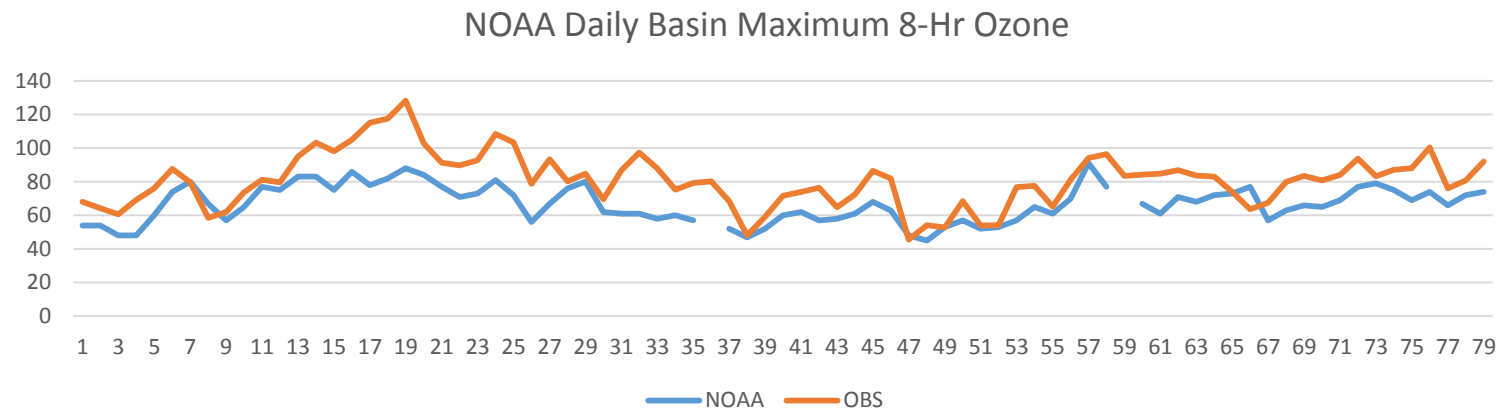


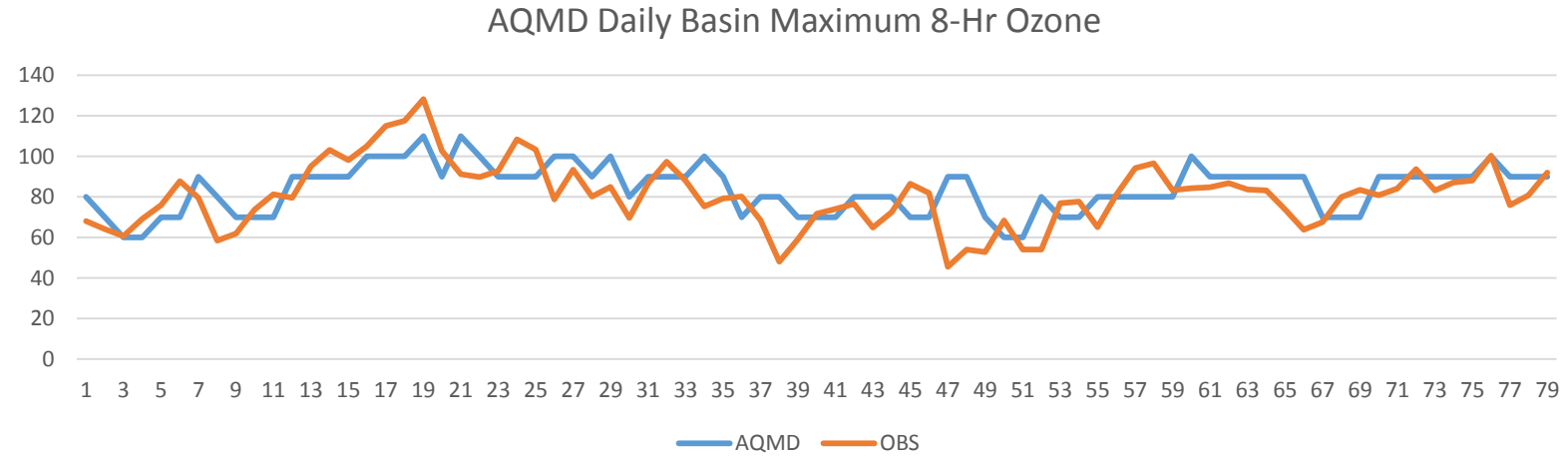
Ozone Summary

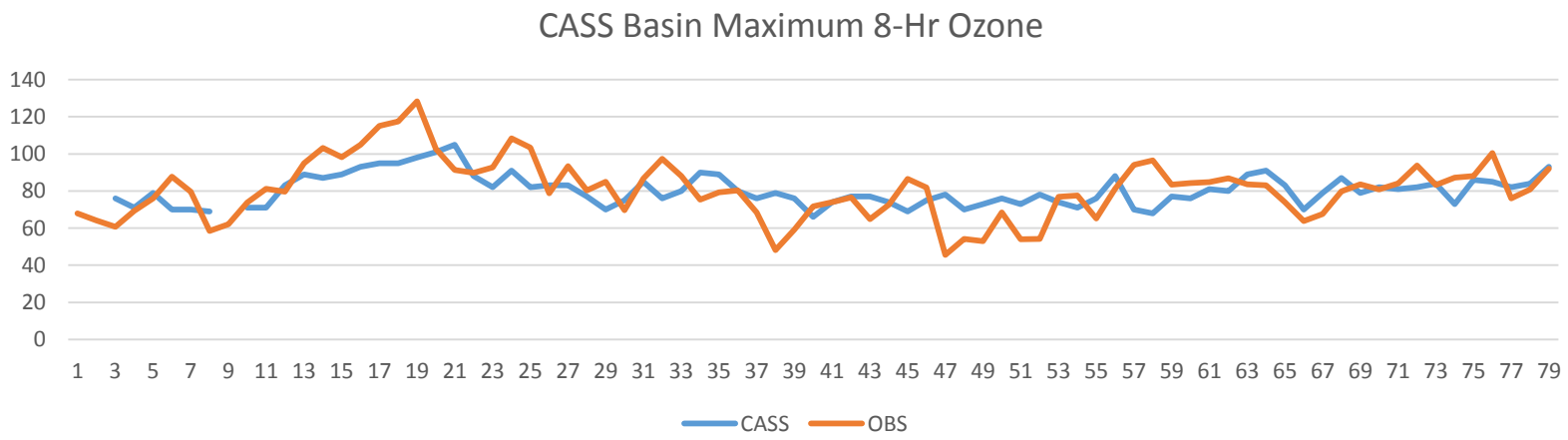
Summary Statistics

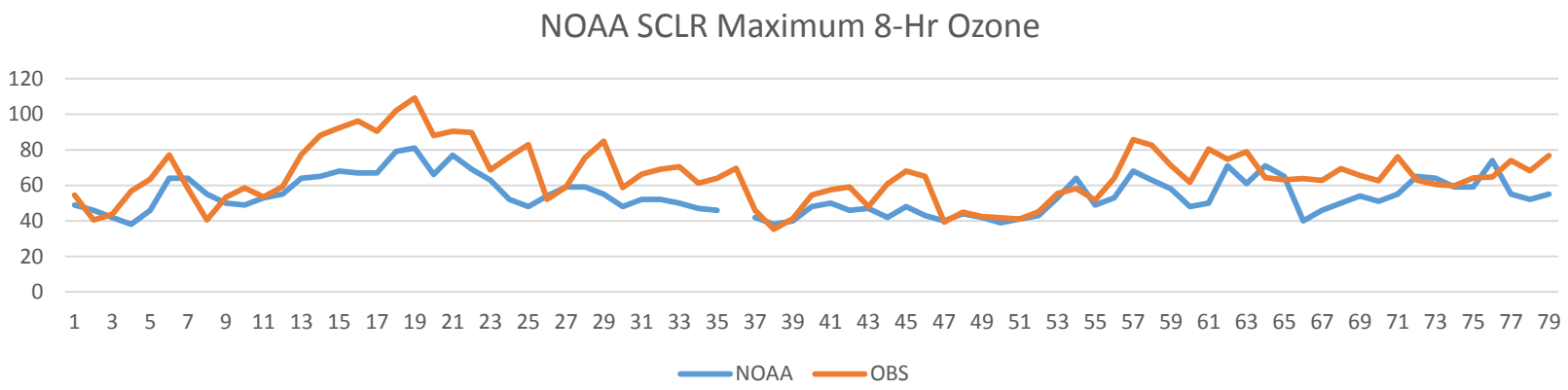
Prediction	BMAX	SCLR	CRES	GLEN
NOAA	66.7	54.4	58.4	43.7
AQMD	83.9	69.5	83.0	65.6
CASS	80.3	69.0	77.2	66.5
OBS	81.5	65.8	77.1	63.8
Bias	BMAX	SCLR	CRES	GLEN
NOAA	-15.9	-11.5	-18.8	-20.1
AQMD	3.0	4.2	6.6	2.3
CASS	-1.2	3.1	0.1	1.3
Abs Error	BMAX	SCLR	CRES	GLEN
NOAA	16.5	13.0	19.8	21.0
AQMD	11.1	11.6	13.4	11.9
CASS	10.3	9.9	10.6	12.0
Goal	12.8	10.9	12.8	10.4

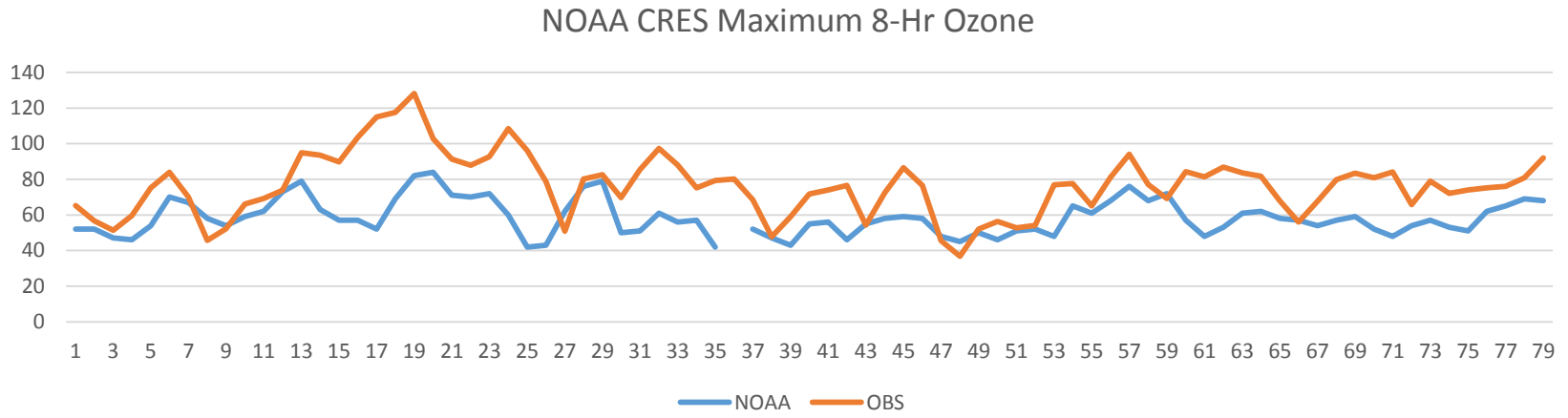


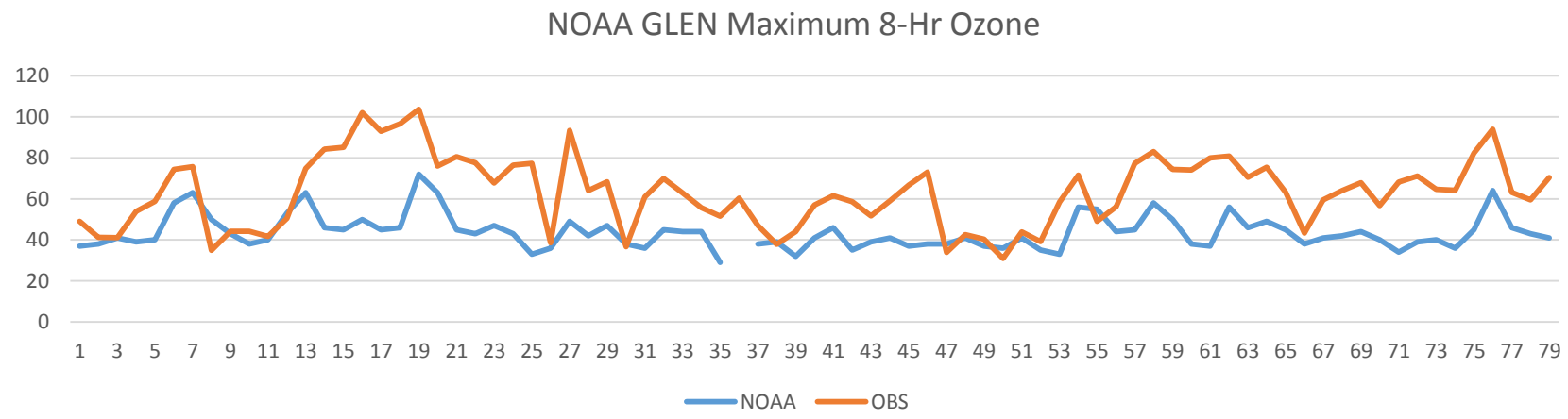

NOAA Daily Basin Maximum 8-Hr Ozone
140
120
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79
NOAA
OBS

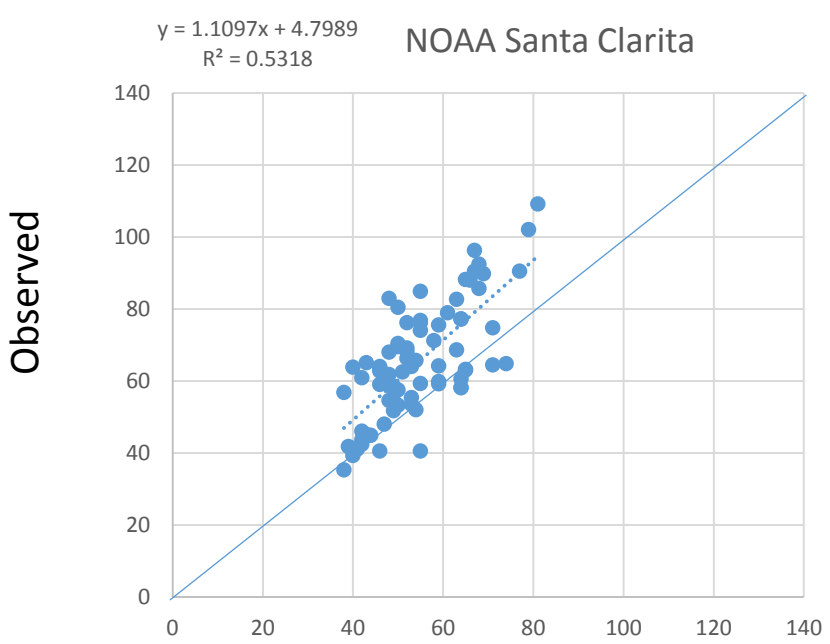

AQMD Daily Basin Maximum 8-Hr Ozone
140
120
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79
AQMD
OBS

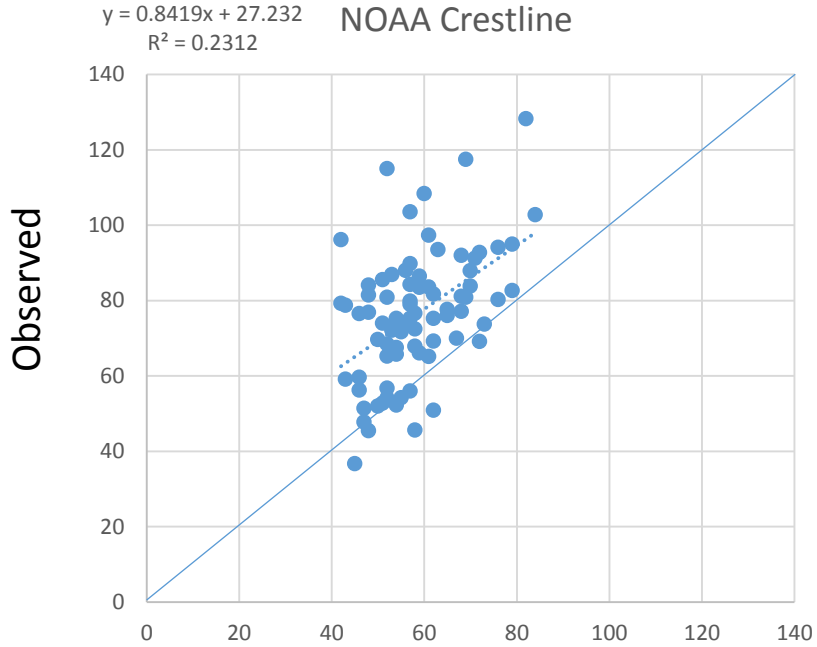

CASS Basin Maximum 8-Hr Ozone
140
120
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79
CASS
OBS

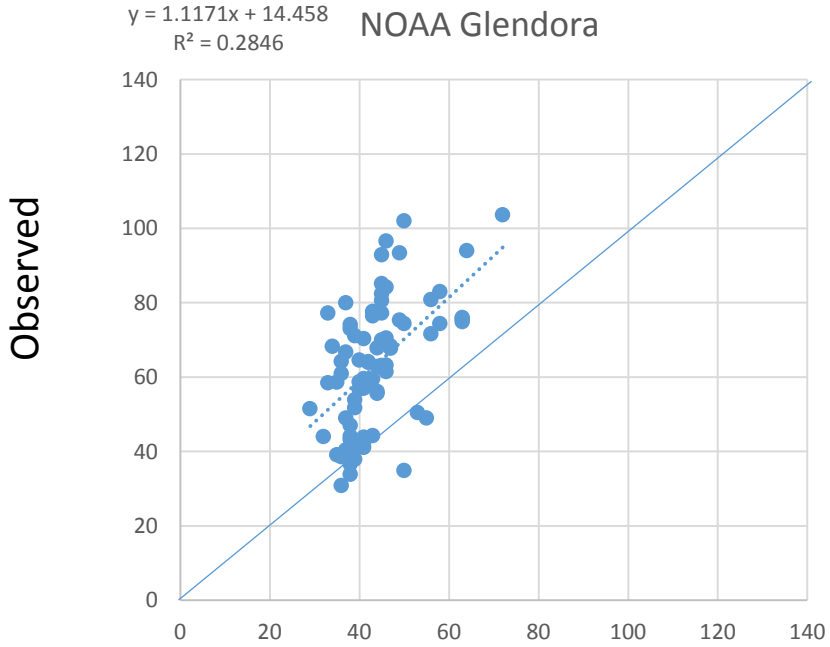

NOAA SCLR Maximum 8-Hr Ozone
120
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79
NOAA
OBS

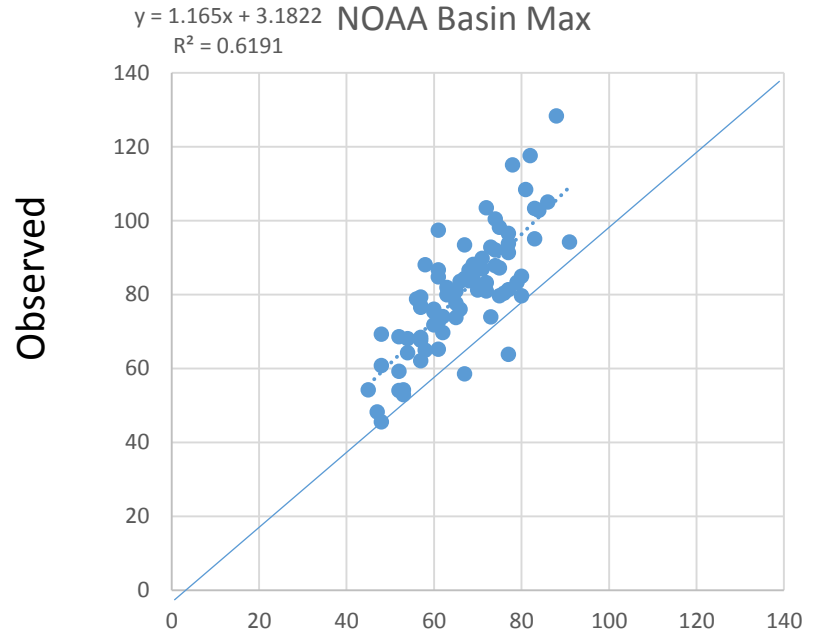

NOAA CRES Maximum 8-Hr Ozone
140
120
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79
NOAA
OBS


NOAA GLEN Maximum 8-Hr Ozone
120
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79
NOAA
OBS


y = 1.1097x + 4.7989
R² = 0.5318
NOAA Santa Clarita
Observed
0
20
40
60
80
100
120
140

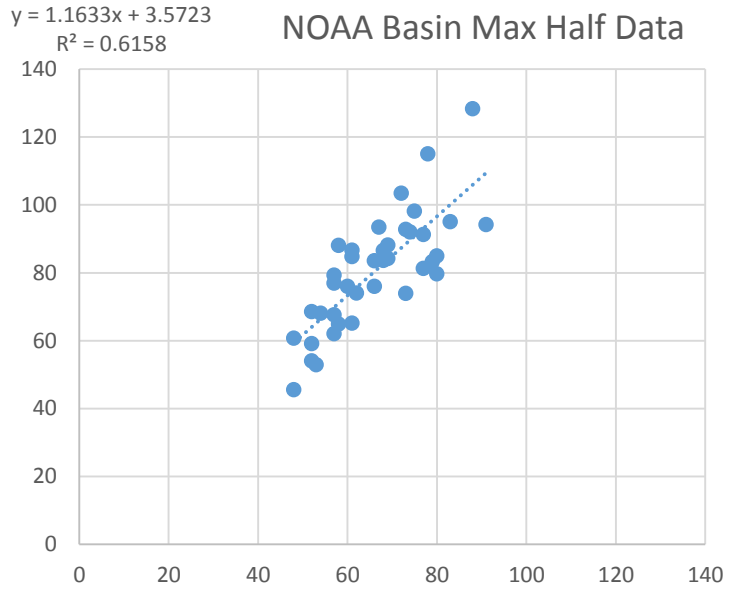

y = 0.8419x + 27.232
R² = 0.2312
NOAA Crestline
Observed
0
20
40
60
80
100
120
140

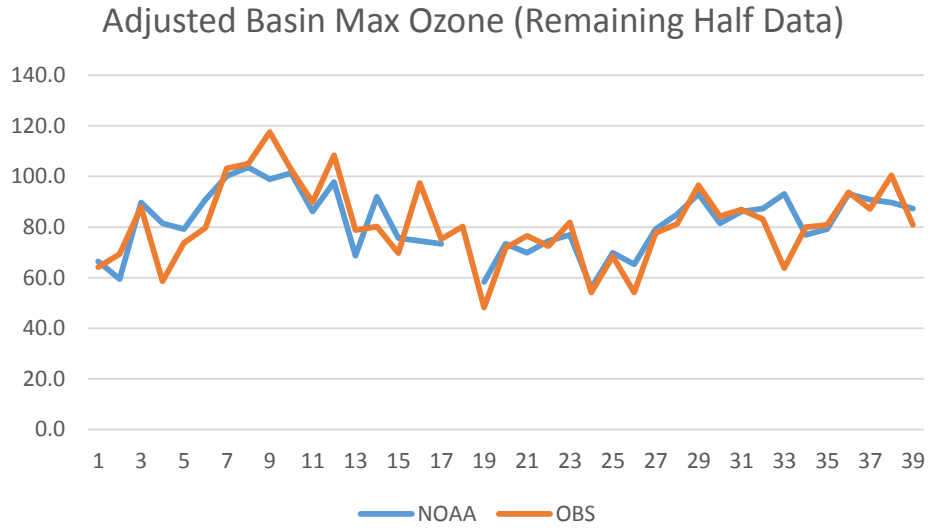

y = 1.1171x + 14.458
R² = 0.2846
NOAA Glendora
Observed
0
20
40
60
80
100
120
140


y = 1.165x + 3.1822
R² = 0.6191
NOAA Basin Max
Observed
0
20
40
60
80
100
120
140

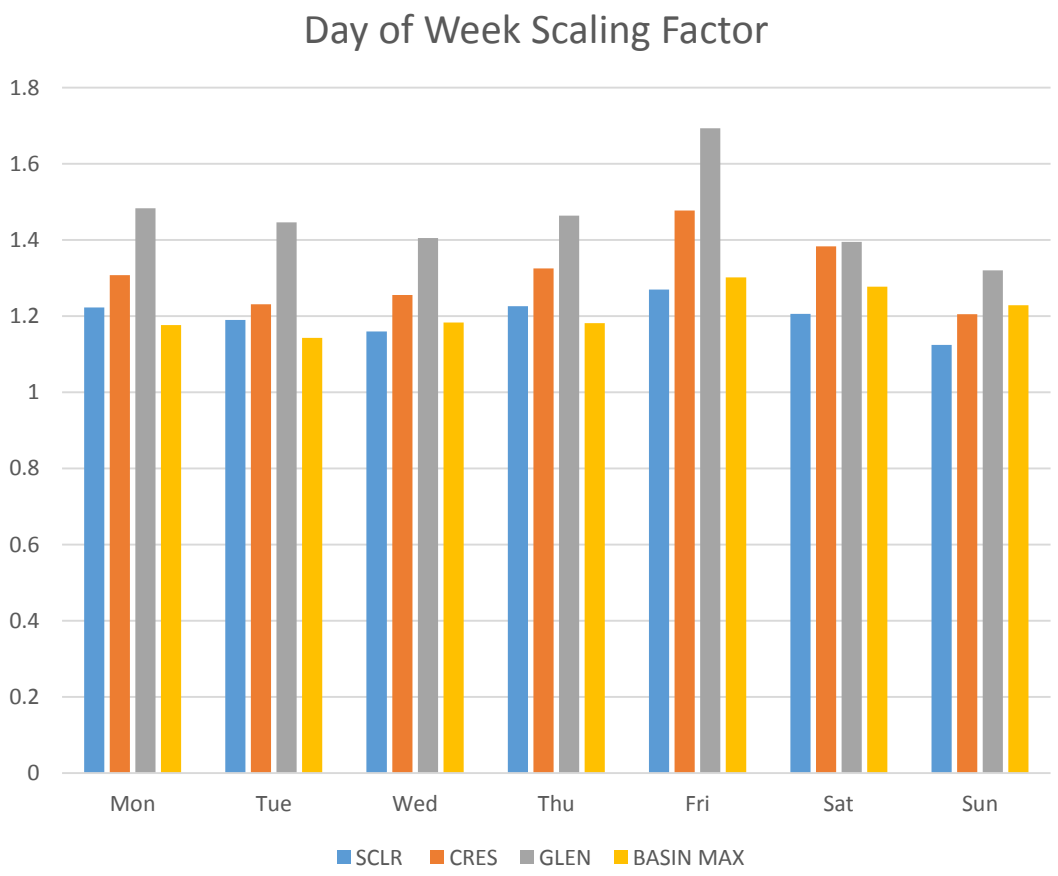
Scaling the NOAA Forecast to Observed 8-Hr Ozone Basin Max

- Use Basin max best fit equation to project daily 8-hr basin maximum ozone
- Quasi MOS application
- Check for Weekday/Weekend bias
- Split data set – every other day and regenerate best fit
- Apply to remainder of data



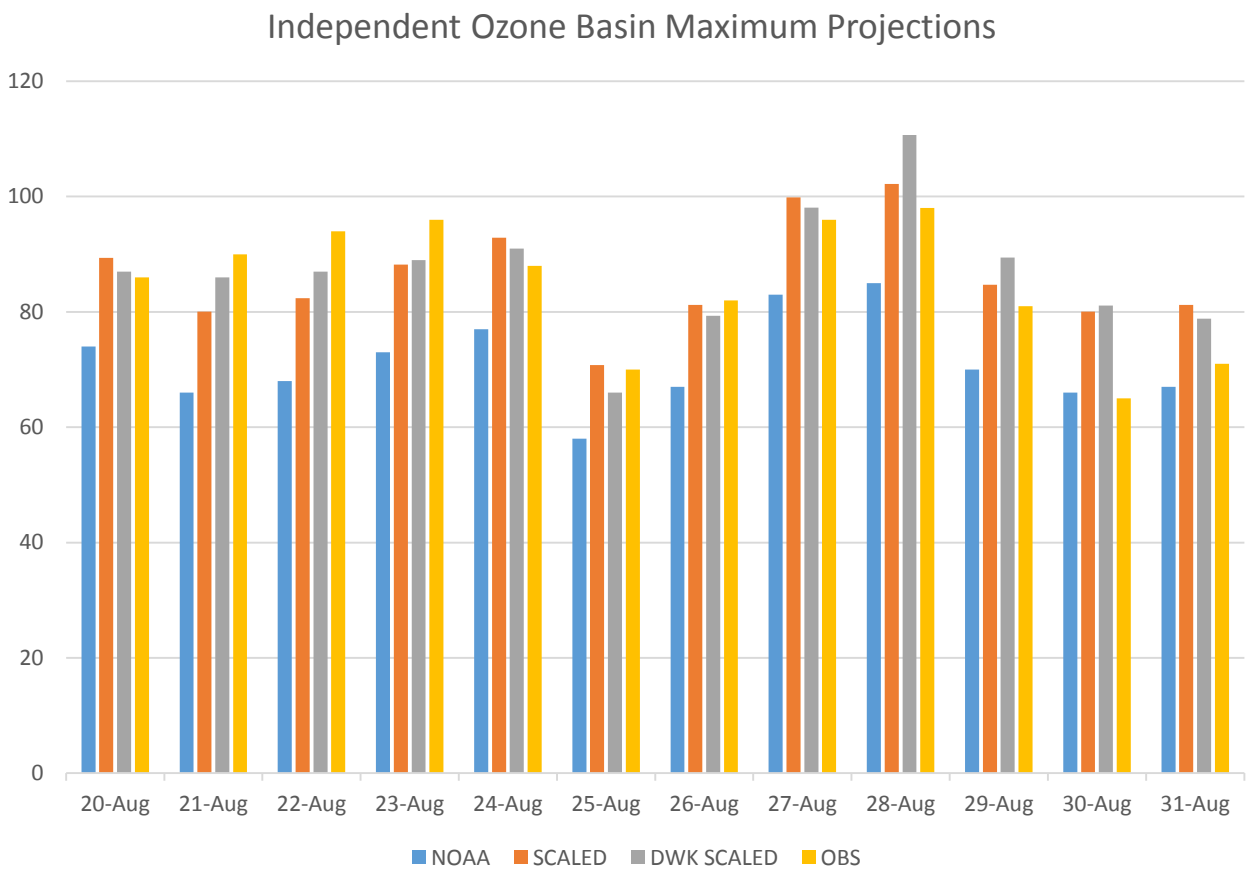


Day of Week Fit of Data and Adjustment Scaling Factor



	SCLR	CRES	GLEN	BASIN MAX
Mon	1.22	1.31	1.48	1.18
Tue	1.19	1.23	1.45	1.14
Wed	1.16	1.26	1.41	1.18
Thu	1.23	1.33	1.46	1.18
Fri	1.27	1.48	1.69	1.30
Sat	1.21	1.38	1.40	1.28
Sun	1.12	1.21	1.32	1.23

Applying Adjustment Scaling Factors To NOAA Basin Maximum Forecast (August 20th –August 31st)

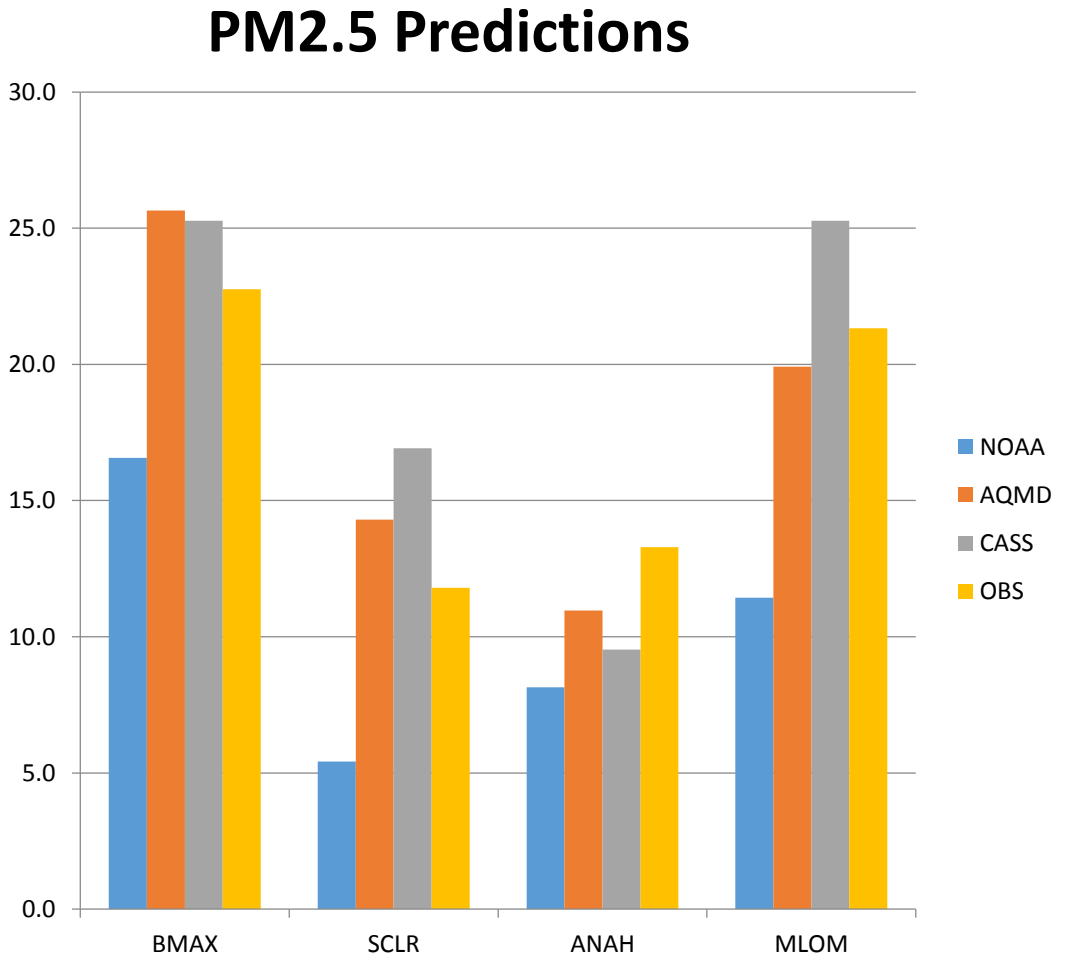


Summary Statistics

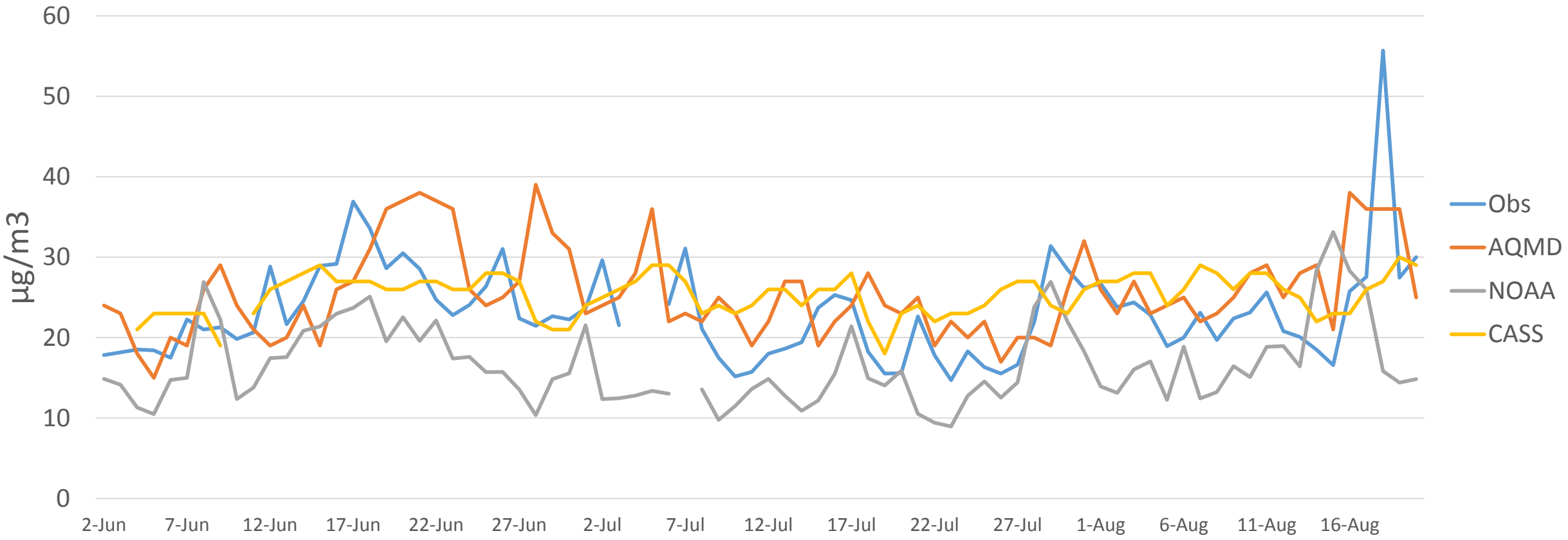
	NOAA	SCALED	DWK SCALED	OBS
Mean	71.2	86.1	87.0	84.8
	NOAA	SCALED	DWK SCALED	
Bias	-13.6	1.3	2.2	
Error	13.8	6.4	6.3	

PM2.5 Summary (µg/m³)

Prediction	BMAX	SCLR	ANAH	MLOM
NOAA	16.6	5.4	8.1	11.4
AQMD	25.6	14.3	11.0	19.9
CASS	25.3	16.9	9.5	25.3
OBS	22.8	11.8	13.3	21.3
Bias	BMAX	SCLR	ANAH	MLOM
NOAA	-5.4	-6.3	-5.2	-9.5
AQMD	3.5	2.5	-2.3	-1.1
CASS	2.3	5.4	-3.6	4.1
Abs Error	BMAX	SCLR	ANAH	MLOM
NOAA	7.0	6.3	5.6	9.8
AQMD	6.0	3.7	3.9	4.5
CASS	4.1	5.5	4.1	5.1
Goal	3.7	2.6	2.8	3.4



Comparison of Basin Maximum PM2.5 Prediction
(June 3rd – August 20th)



Key Considerations

Forecast under predicts

Mid Basin reasonably captured

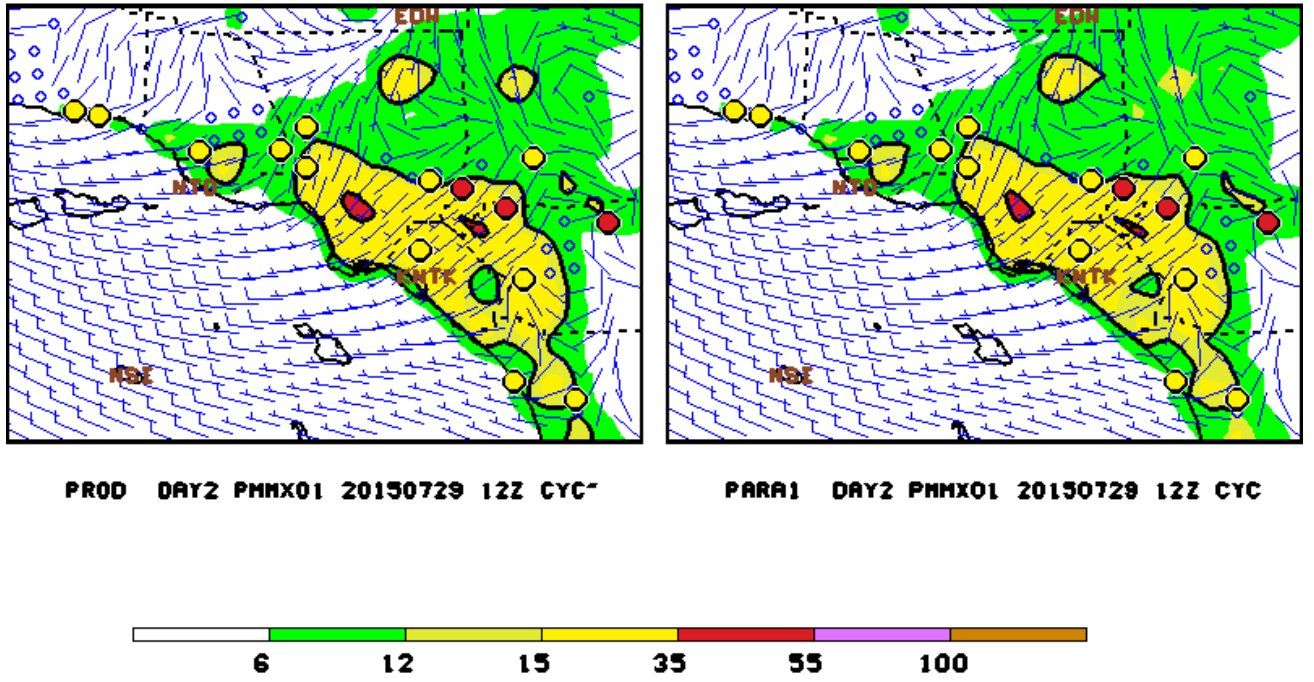
Transport to the north poor

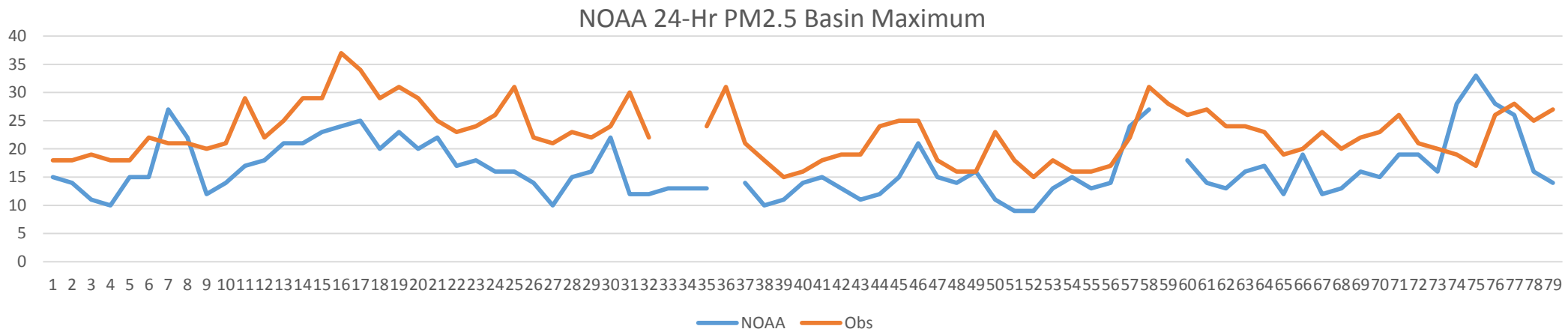
VOC/NOx ratio not as critical

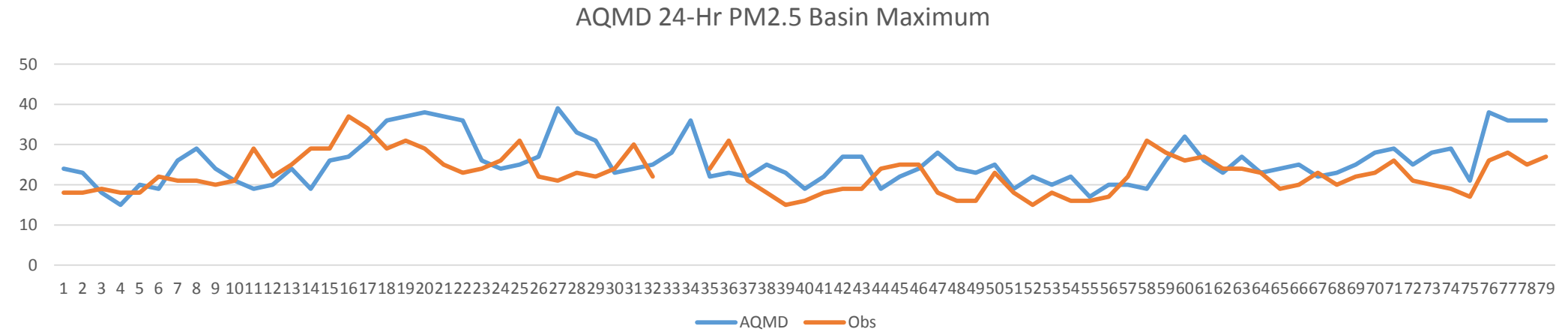
Multiple precursors contributing

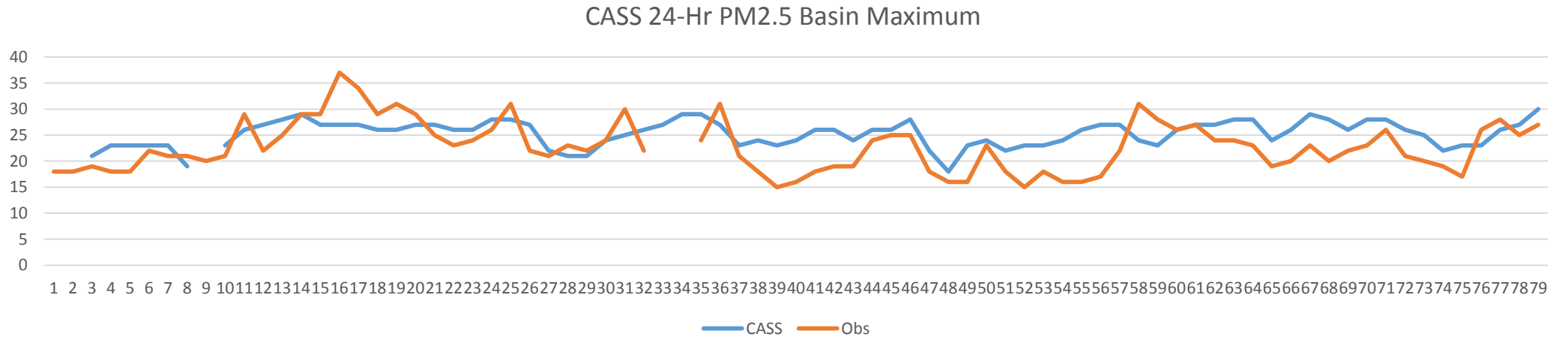
Emissions	Weighting Factor
PM2.5 Direct	15
SOx*	8
NOx*	1
VOC	0.3

* Ammonia included in mass

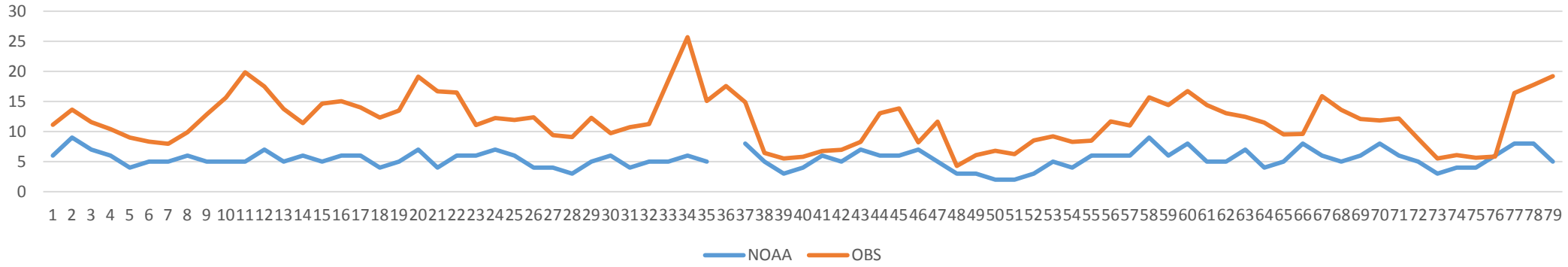



NOAA 24-Hr PM2.5 Basin Maximum
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79
NOAA
Obs

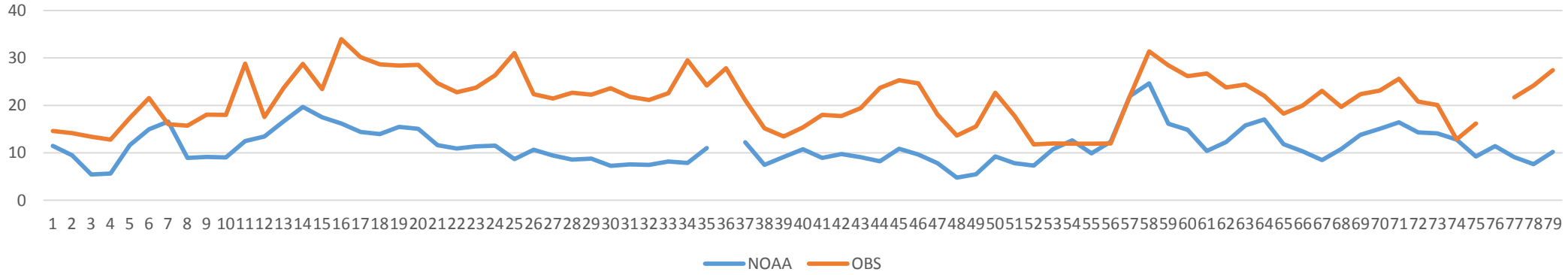

AQMD 24-Hr PM2.5 Basin Maximum
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79
AQMD
Obs


CASS 24-Hr PM2.5 Basin Maximum
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79
CASS
Obs

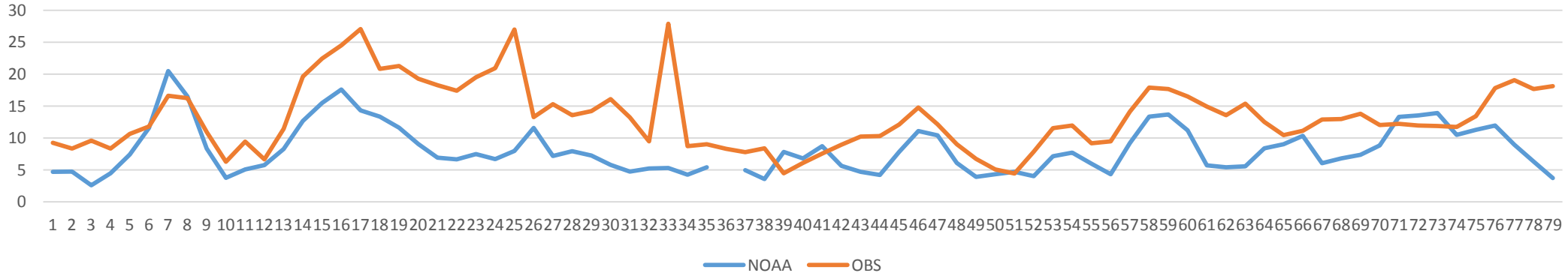
NOAA Santa Clarita

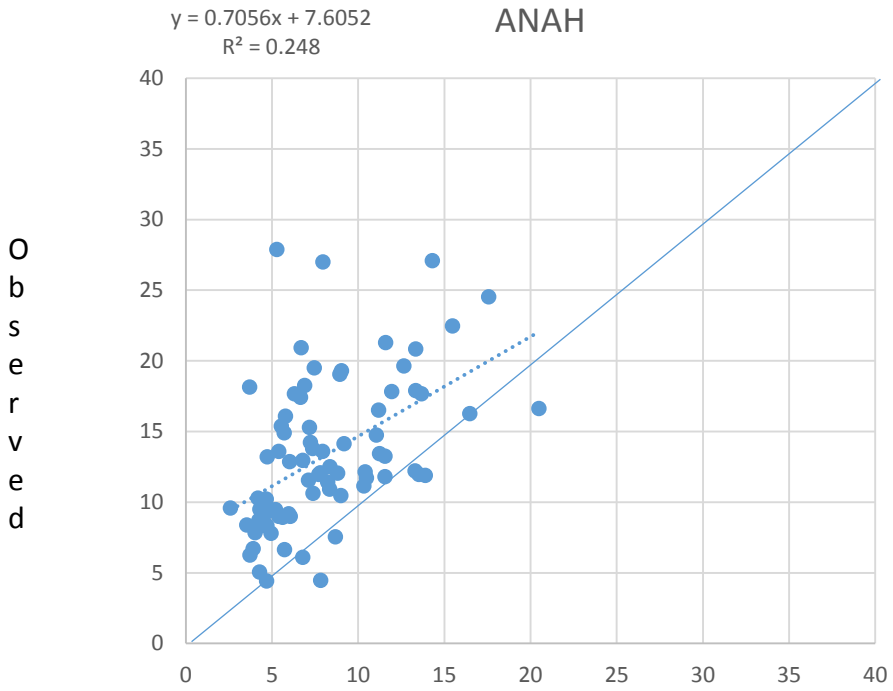


NOAA Mira Loma



NOAA Anaheim

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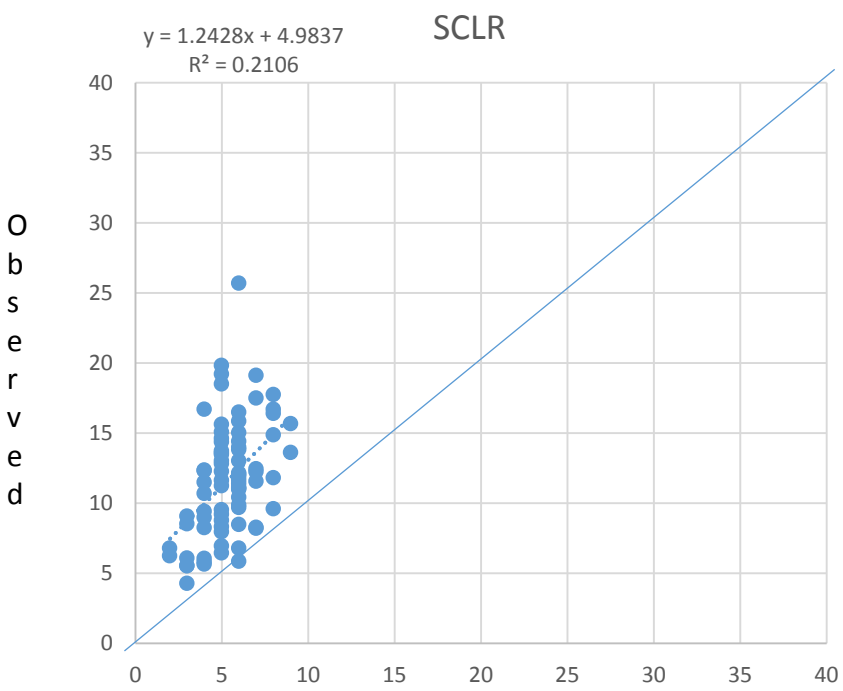
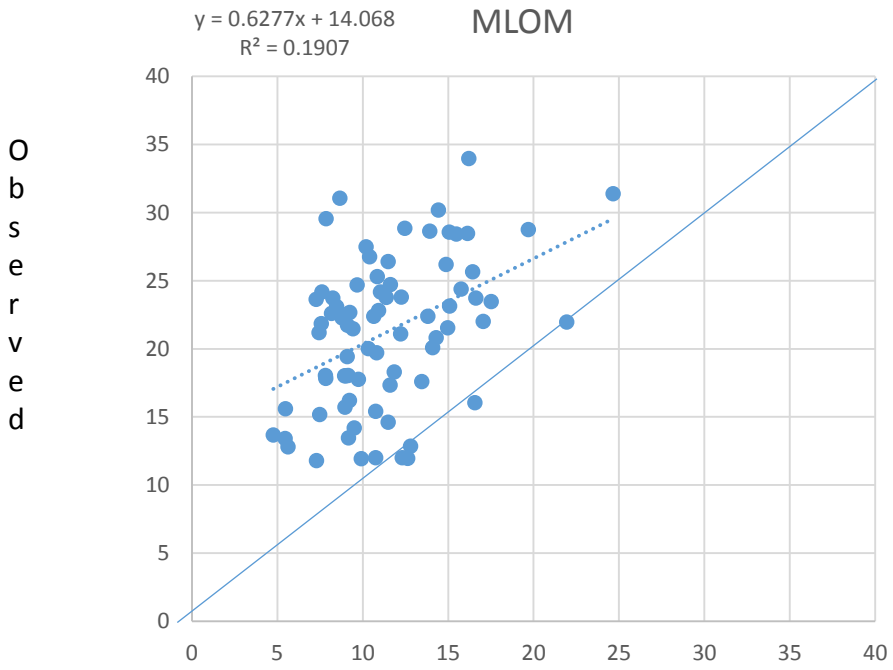
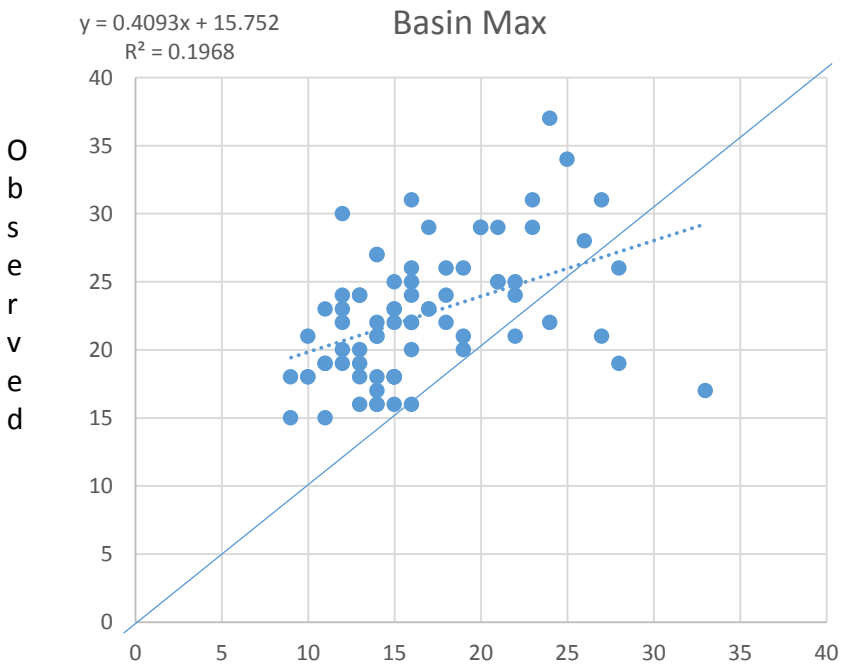
R² = 0.248
ANAH
Observed
0
5
10
15
20
25
30
35
40

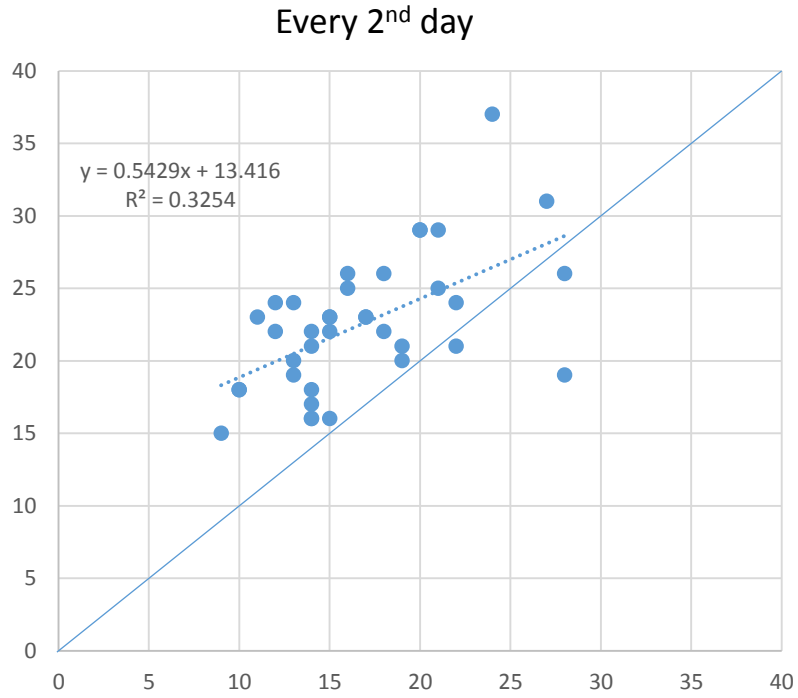

y = 1.2428x + 4.9837
R² = 0.2106
SCLR
Observed
0
5
10
15
20
25
30
35
40

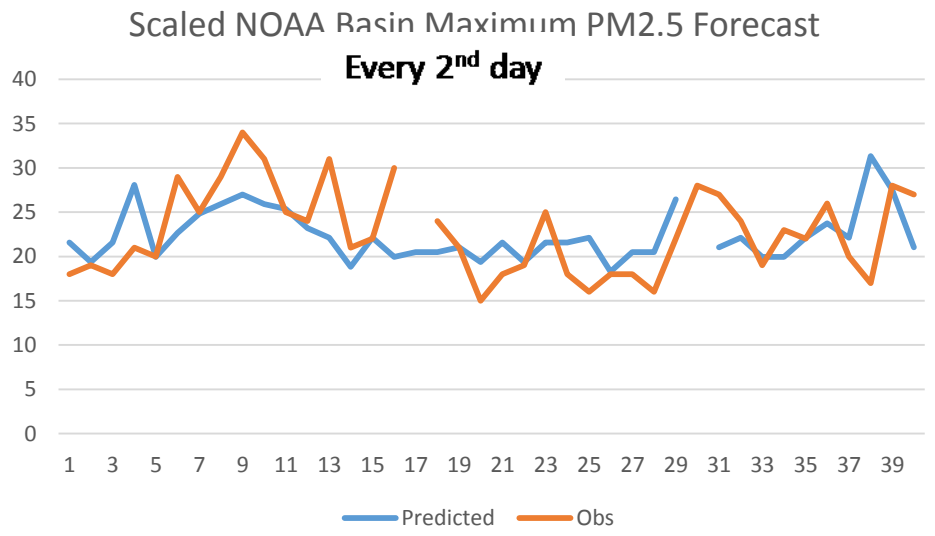

y = 0.6277x + 14.068
R² = 0.1907
MLOM
Observed
0
5
10
15
20
25
30
35
40


y = 0.4093x + 15.752
R² = 0.1968
Basin Max
Observed
0
5
10
15
20
25
30
35
40

Scaling the NOAA Basin Max PM2.5 Forecast

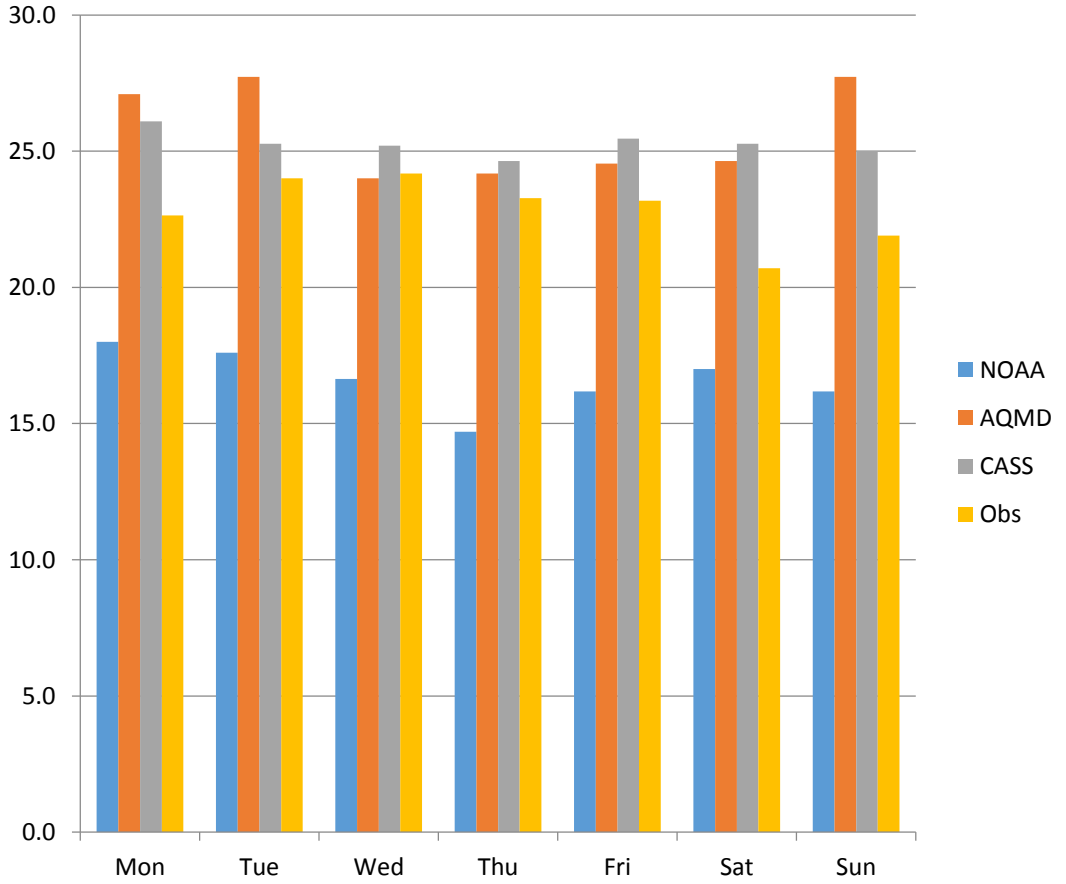
- Use Basin max best fit equation to project daily 24-hr Basin maximum PM2.5
- Quasi MOS application
- Split data set – every other day and regenerate best fit
- Apply to remainder of data



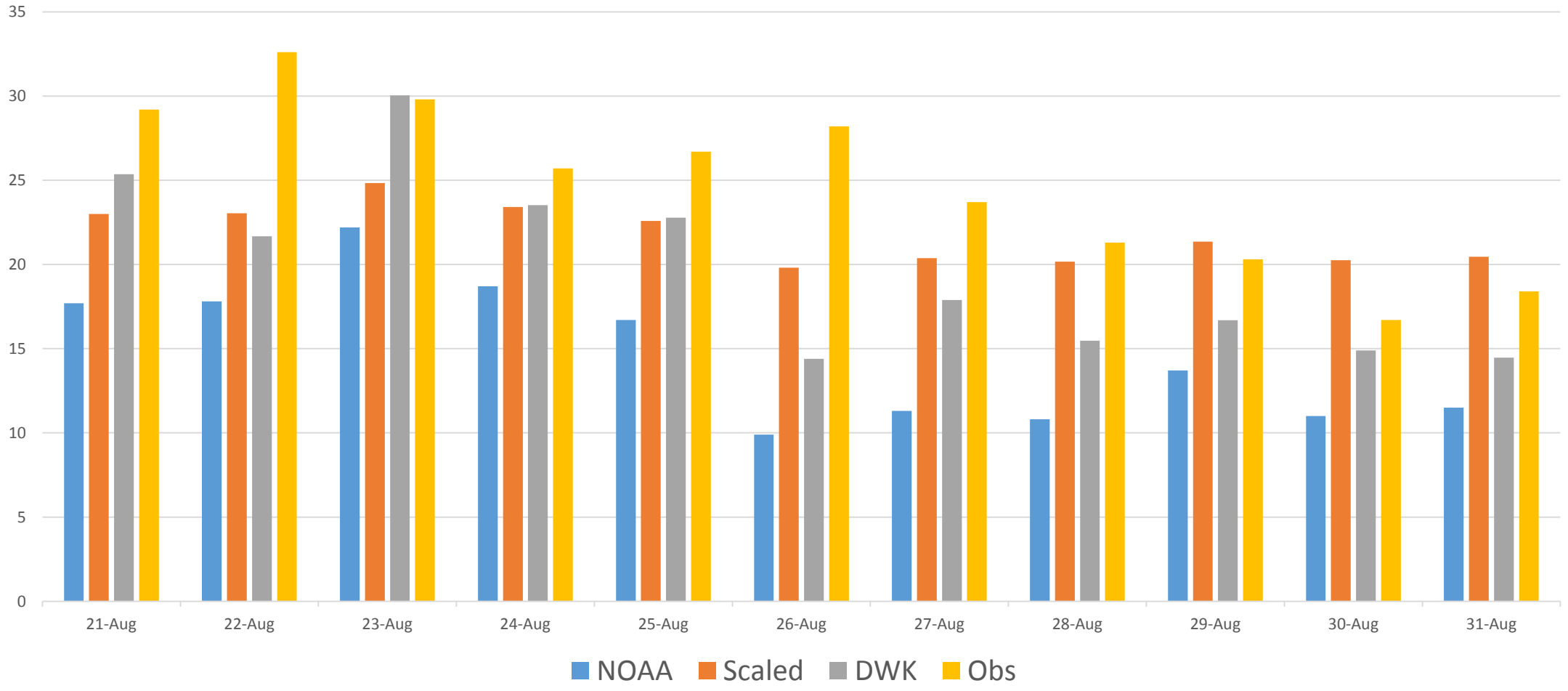


Day of Week Fit of Data

- Weekday/Weekend bias evident with lower concentrations on weekend days -- less heavy duty trucks on the road and construction



Applying Adjustment Scaling Factors To NOAA Basin Maximum PM2.5 Forecast (August 20th –August 31st)



Summary

- NOAA ozone forecast captures the weather influence
- Ozone forecasts under predicted
- Grid scale impacts VOC/NOX ratio and spatial impact
- Scaled Basin maximum ozone predictions recreate trend
- Scaled approach potential for application in less complex terrain
- NOAA PM2.5 less well defined
- PM2.5 forecasts under predicted
- Attempts to scale forecast to observations not as successful as ozone