Maintenance*, Performance Evaluation and Development of the National Air Quality Forecasting Capability (NAQFC)

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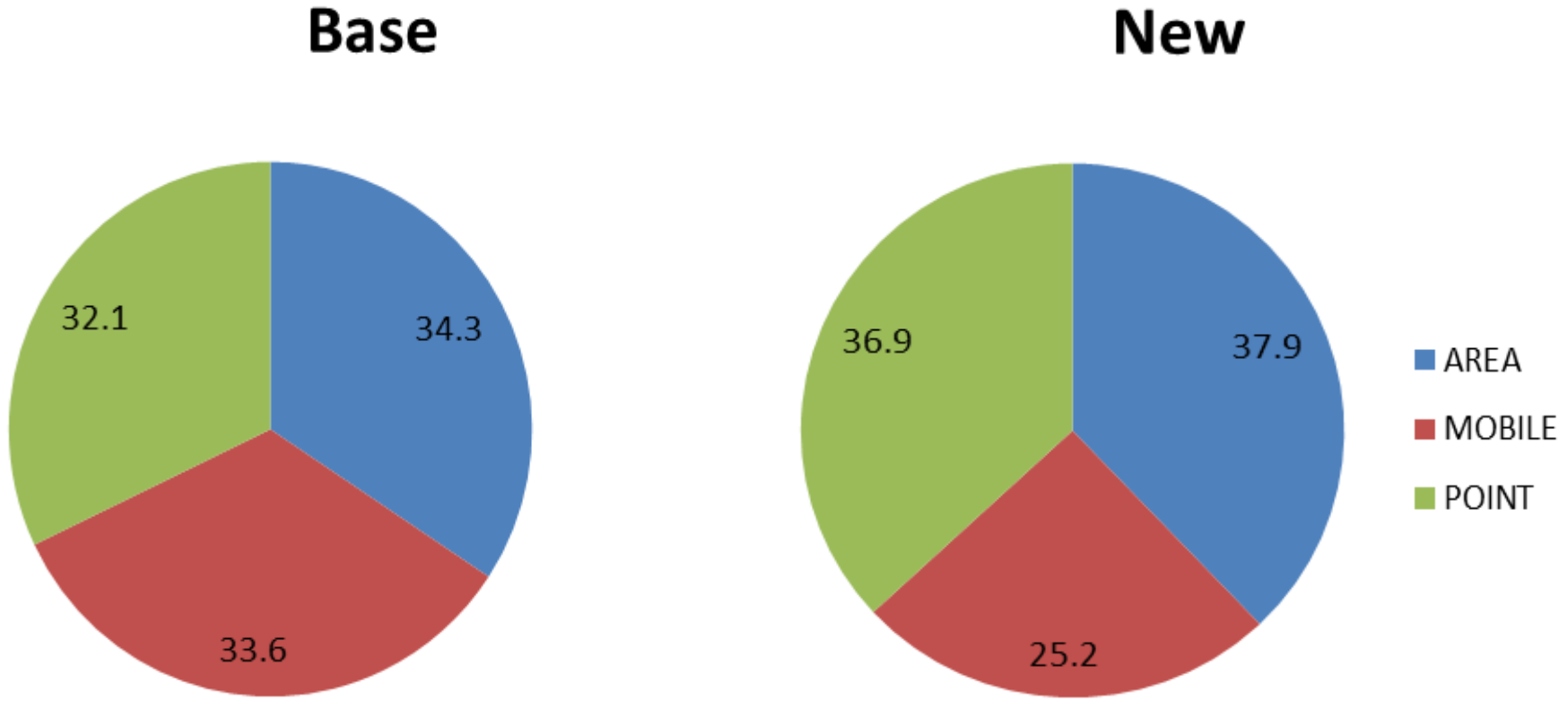
***ARL & EMC ported NAQFC from NCEP's AIX to Linux based super computer**

Emission configurations considered for 2013 emission

Source		Option 1	Option 2	Option 3	Used
Mobile Source		2005 MOVES	2012 MOVES	2005 MOBILE6	**2005 MOBILE6 + '05 to '12 Projections**
Point Sources		2010 CEM + 2012 Energy Outlook			**2010 CEM + 2012 DoE Energy Outlook**
Area Source	**Nonroad**	2005aa	2005cs	2012cs	**2012 Cross-state Rule Projection**
	Other sectors	2005aa	2005cs		**2005 cs**
Biogenic Emissions		BEIS 3.11 (PREMAQ)	BEIS3.13 (CMAQ inline)		**BEIS3.13**
Canadian Emissions (Area, Mobile, and Point)		2000 EI	2006 EI/New Surrogates		**2006 EI**

Recycle 2012 emission by aligning weekdays and weekends

Mobile% NO_x for FY12

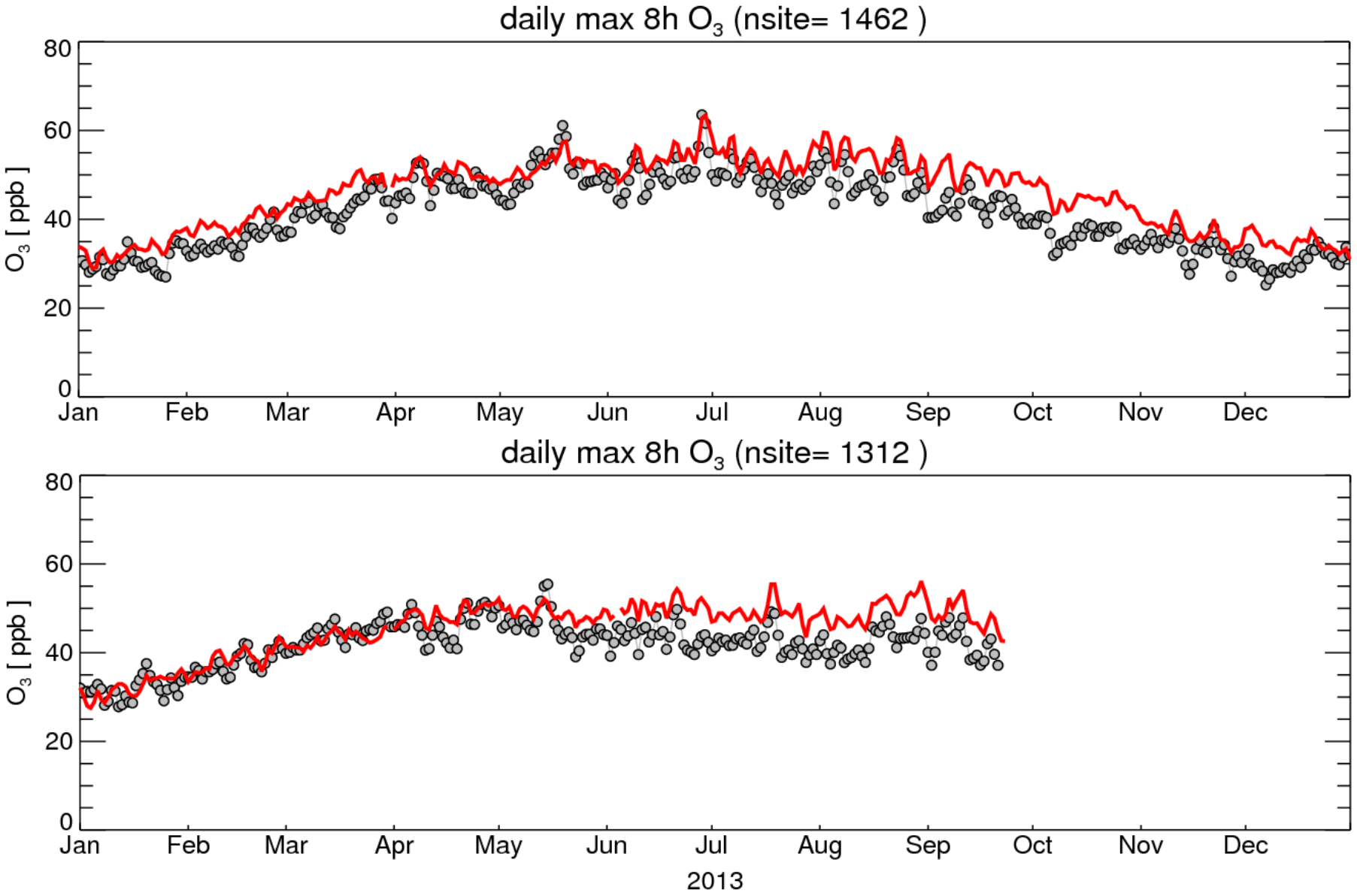


***Use state-wide all hours averaged projection based on 2012 to 2005 NO_x ratio**

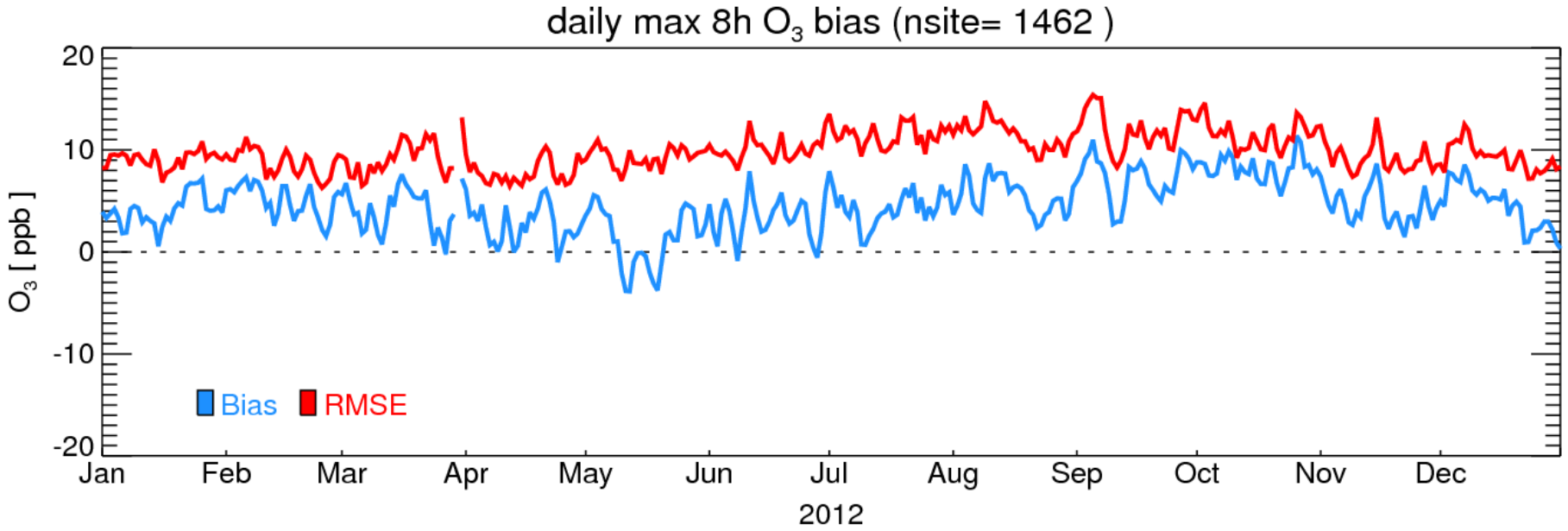
Weekly Changes for NO_x FY12

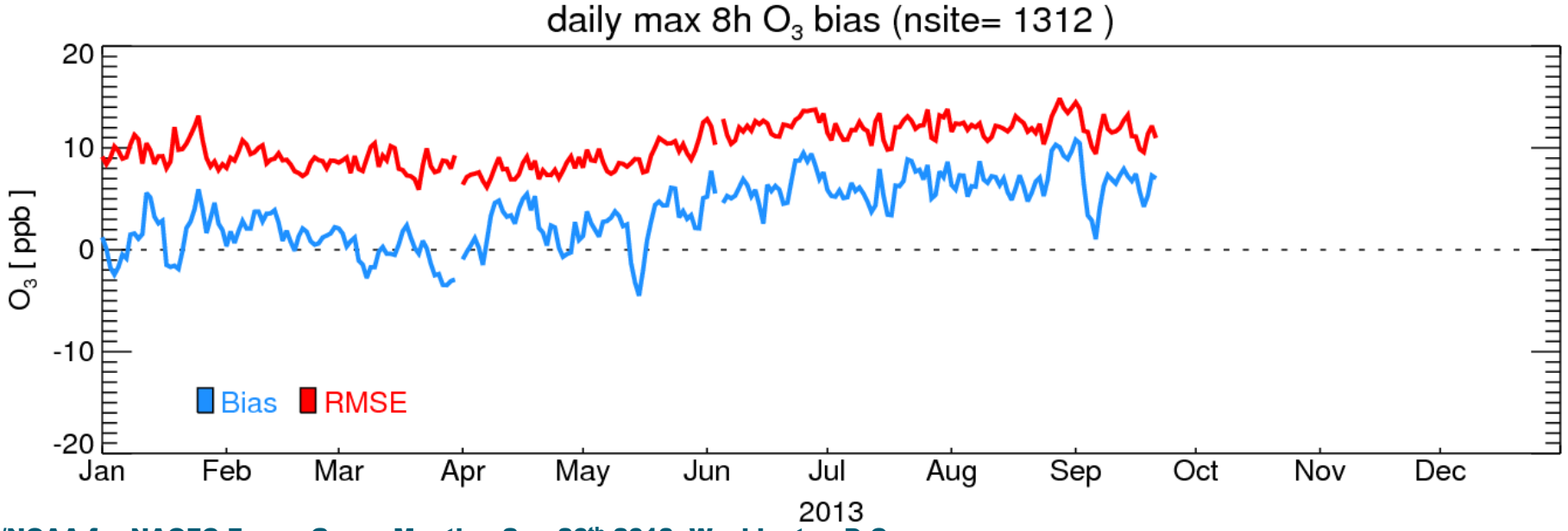
	weekday	weekend	weekly
area	-10.5%	-3.6%	-8.1%
mobile	-37.8%	-37.9%	-37.8%
point	-4.2%	-4.0%	-4.1%
Total	-18.3%	-13.5%	-17.2%
surface	-23.9%	-18.6%	-22.2%

2012 vs. 2013 (O_3)



2012 vs. 2013 (O_3)



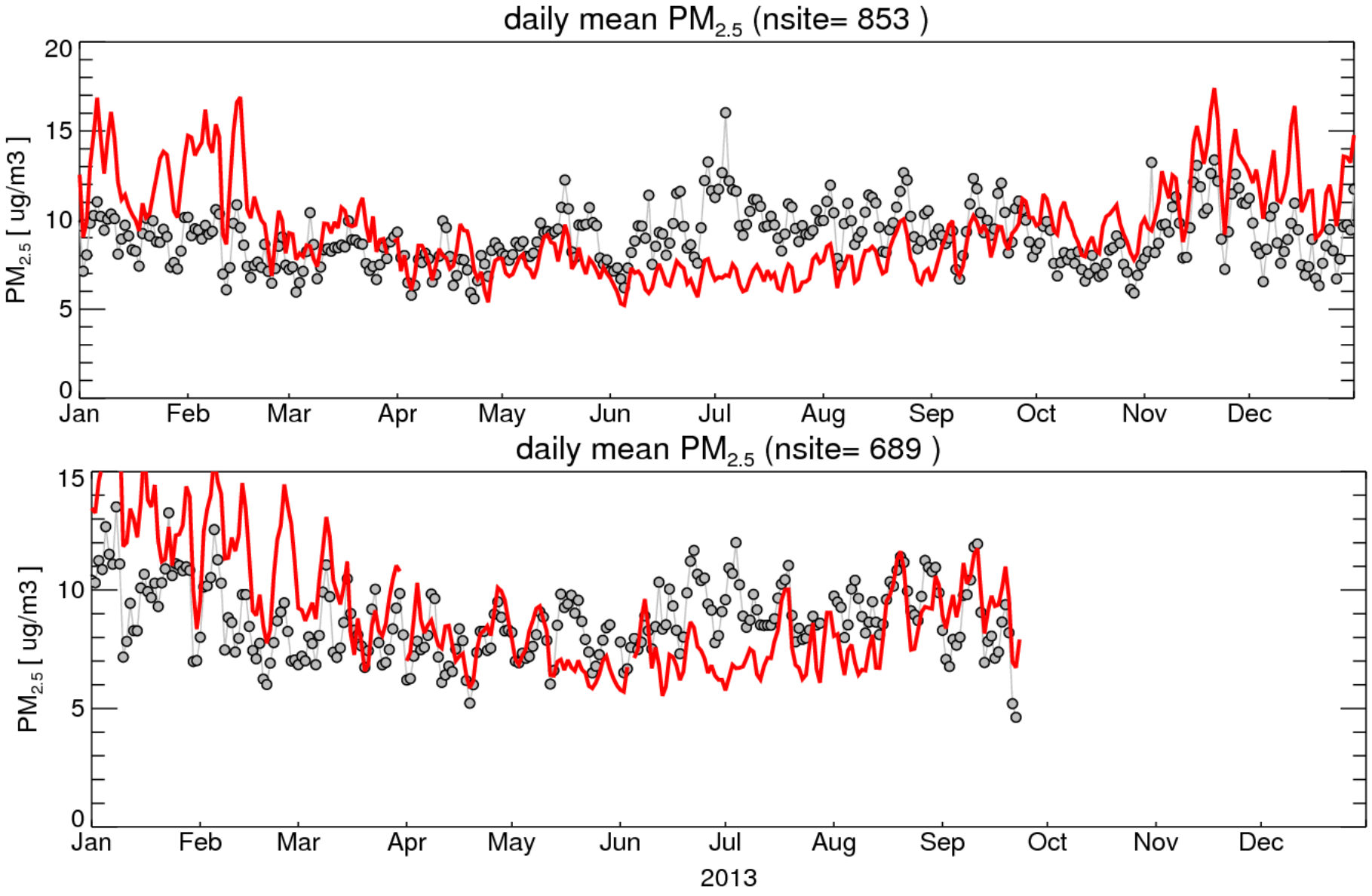


2012 vs. 2013 (O_3)

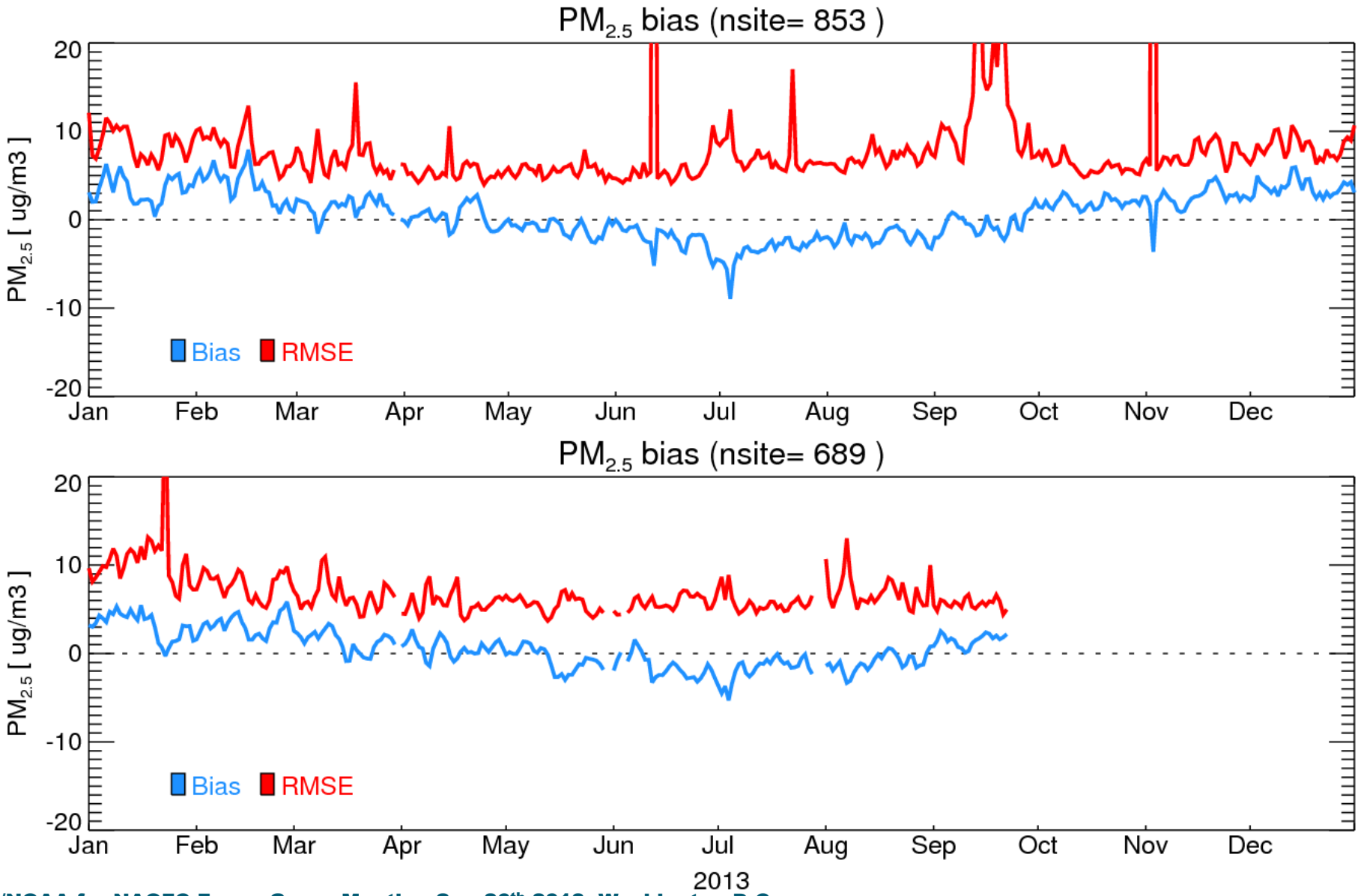
	Obs_Mean	Mod_Mean	Bias	RMSE	R2
2012_O3	34.68	40.73	6.05	17.38	0.64
2013_O3	31.38	37.84	6.49	16.14	0.56
2012_PM25	10.04	8.04	-2.00	11.53	0.17
2013_PM25	9.29	8.29	-1.00	8.98	0.14

	Obs_Mean	Mod_Mean	Bias	RMSE	R2
2012_Urban	33.06	38.40	5.34	18.15	0.68
2012_Sub	33.87	40.17	6.30	17.95	0.64
2012_Rural	35.98	42.06	6.08	16.56	0.60
2013_Urban	30.29	35.99	5.70	16.67	0.55
2013_Sub	30.73	37.44	6.71	16.65	0.58
2013_Rural	32.73	38.85	6.59	15.46	0.54

2012 vs. 2013 ($PM_{2.5}$)



2012 vs. 2013 ($PM_{2.5}$)



2012 vs.2013 $PM_{2.5}$ (Urban, Suburban & Rural)

	Obs_Mean	Mod_Mean	Bias	RMSE	R2
2012_Urban	10.19	8.52	-1.67	11.39	0.19
2012_Sub	10.29	8.78	-1.51	10.15	NA
2012_Rural	9.43	6.35	-3.08	12.26	0.30
2013_Urban	9.46	8.63	-0.83	8.53	0.13
2013_Sub	9.54	8.95	-0.59	8.96	0.15
2013_Rural	8.64	6.85	-1.79	8.84	0.12

CMAQ Experimental Run Results (Spatial Plots)

Pre-defined US regions

Year 2013

Month September

Day 5

Variable Ozone

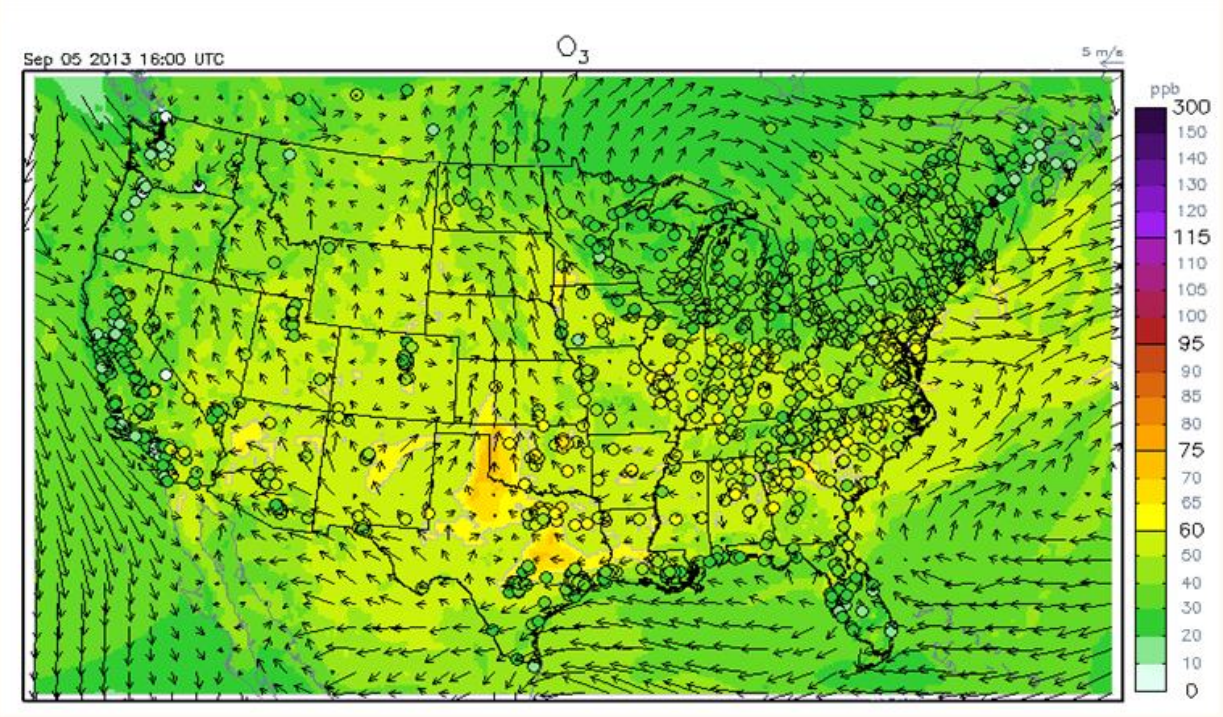
Region Continental US

Submit Parameters

Ozone in Continental US of 09/05/2013 run

Forecast hour: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 | :: Day 1 Max

Forecast hour: 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 | :: Day 2 Max

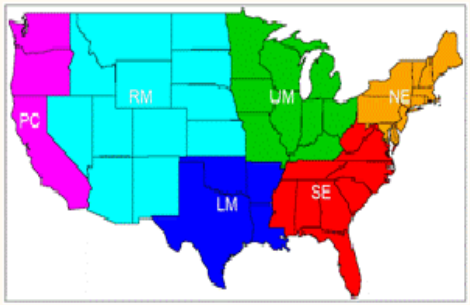


[Hourly ozone animation] [8-hour ozone animation] [Daytime ozone bias] [Nighttime ozone bias]

8-Hour Average at: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 | :: Day 1 Max

8-Hour Average at: 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 | :: Day 2 Max

Pre-defined US regions



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Ozone in Continental US of 09/05/2013 run

Forecast hour: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 | :: Day 1 Max

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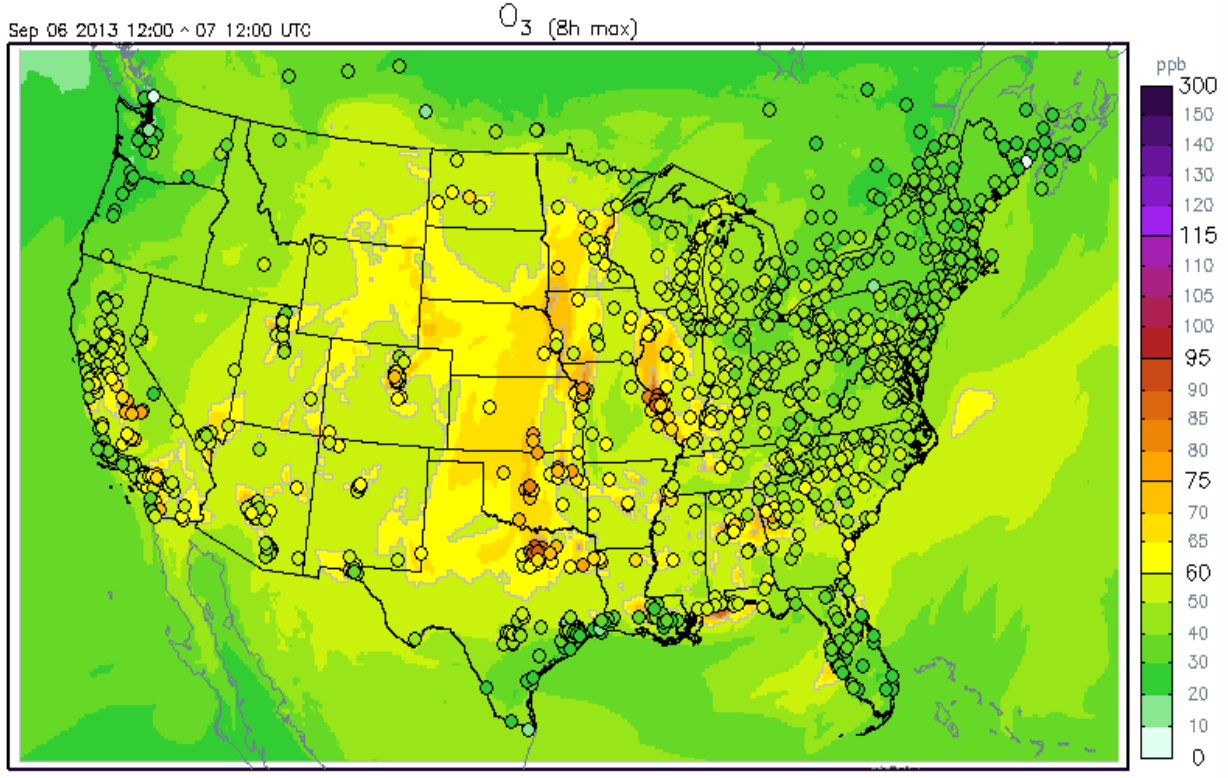

[Hourly ozone animation] [8-hour ozone animation] [Daytime ozone bias] [Nighttime ozone bias]

8-Hour Average at: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 | :: Day 1 Max

8-Hour Average at: 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 | :: Day 2 Max

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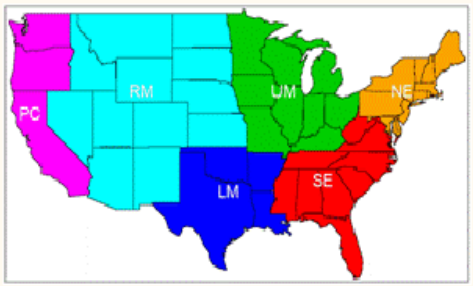
Pre-defined US regions



Year 2013

Month September

Day 5

Variable PM2.5

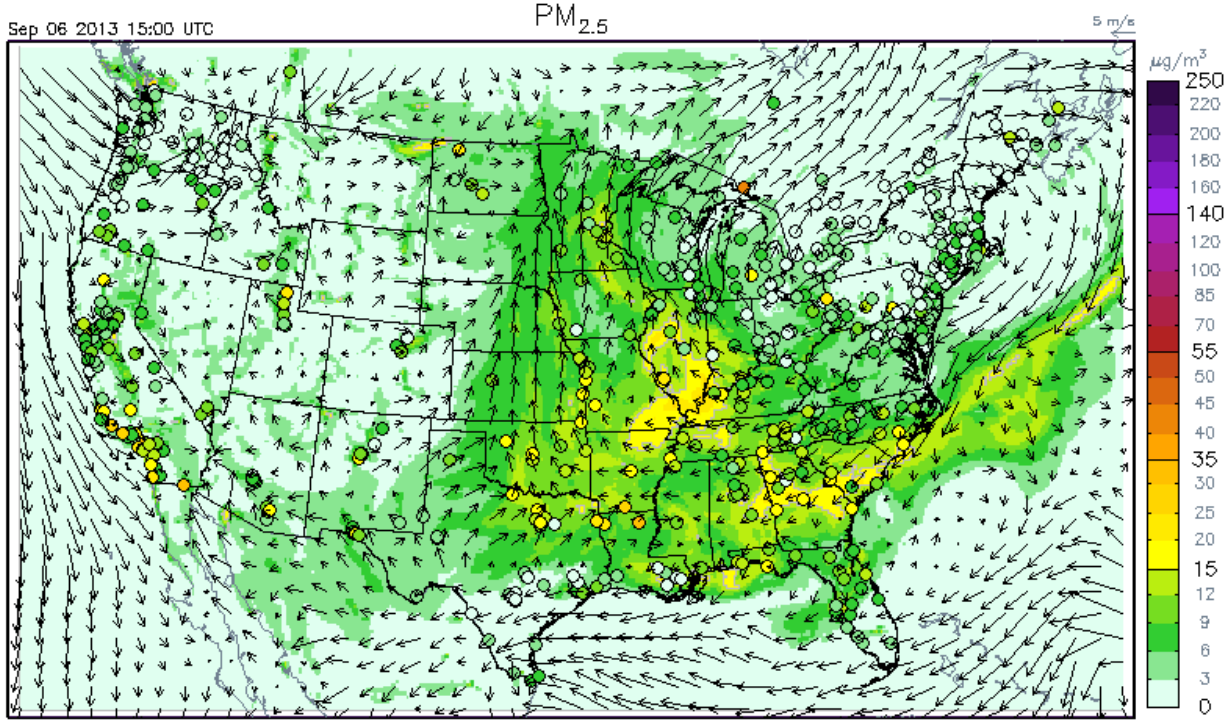
Region Continental US

Submit Parameters

PM2.5 in Continental US of 09/05/2013 run

Forecast hour: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Forecast hour: 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24



Day 1 mean :: PM2.5 :: SO4 :: NO3 :: NH4 :: EC :: POC :: SOC :: A25J

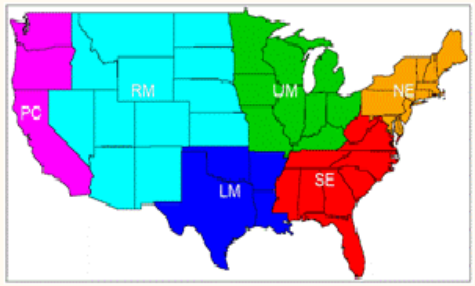
Animation :: PM2.5 :: SO4 :: NO3 :: NH4 :: EC :: POC :: SOC :: A25J

Day 2 mean :: PM2.5 :: SO4 :: NO3 :: NH4 :: EC :: POC :: SOC :: A25J

|| PM2.5 Daytime Bias || PM2.5 Nighttime Bias || Day 1 Dust || Snow Cover || Day 2 Dust

CMAQ Experimental Run Results (Spatial Plots)

Pre-defined US regions



Year 2013

Month September

Day 5

Variable PM2.5

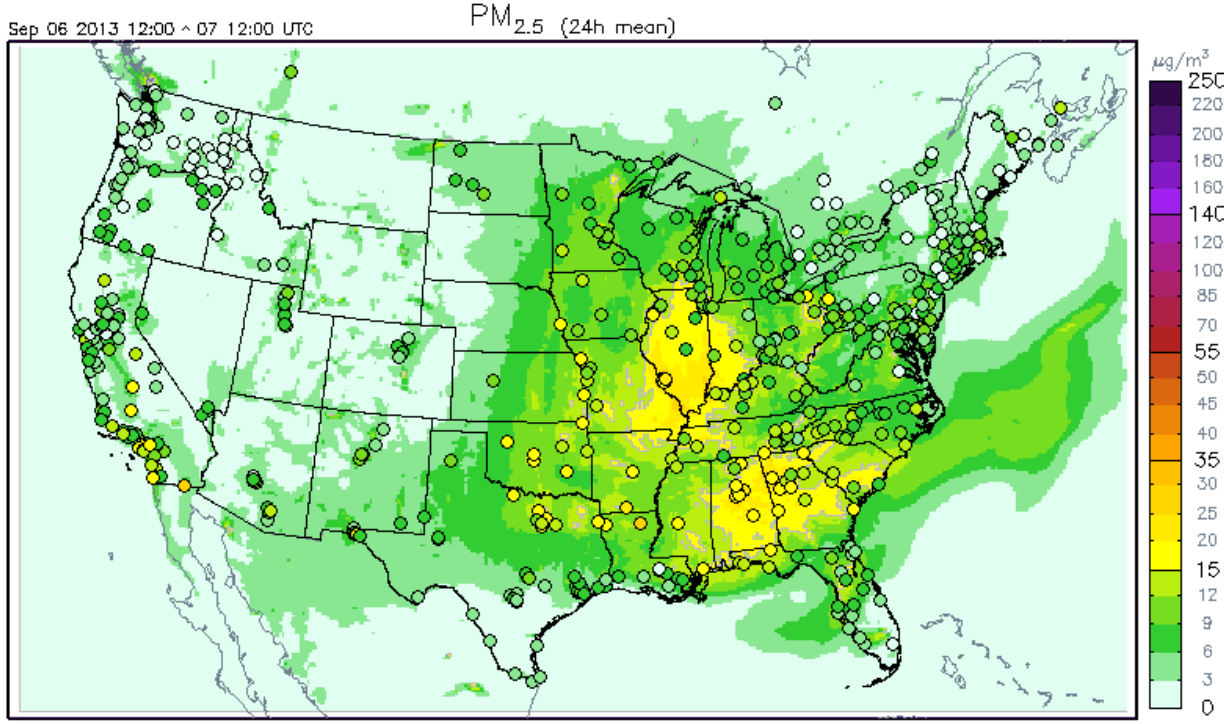
Region Continental US

Submit Parameters

PM2.5 in Continental US of 09/05/2013 run

Forecast hour: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Forecast hour: 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24



Day 1 mean :: PM2.5 :: SO4 :: NO3 :: NH4 :: EC :: POC :: SOC :: A25J || PM2.5 Daytime Bias || Day 1 Dust

Animation :: PM2.5 :: SO4 :: NO3 :: NH4 :: EC :: POC :: SOC :: A25J || || Snow Cover

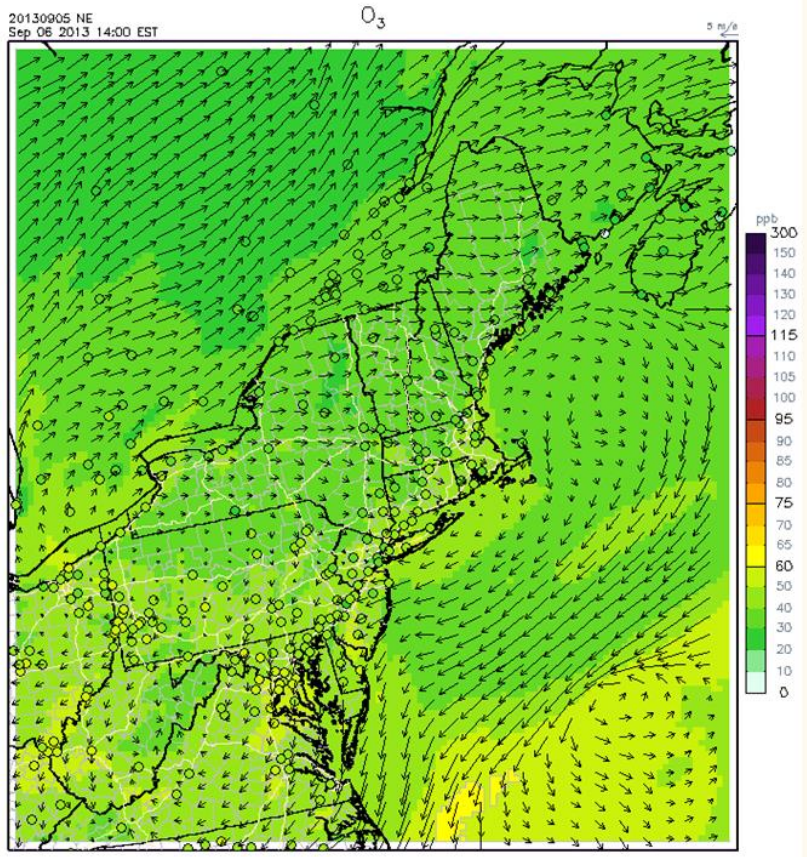
Day 2 mean :: PM2.5 :: SO4 :: NO3 :: NH4 :: EC :: POC :: SOC :: A25J || PM2.5 Nighttime Bias || Day 2 Dust

Forecast hour: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Forecast hour: 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24

Pre-defined US regions

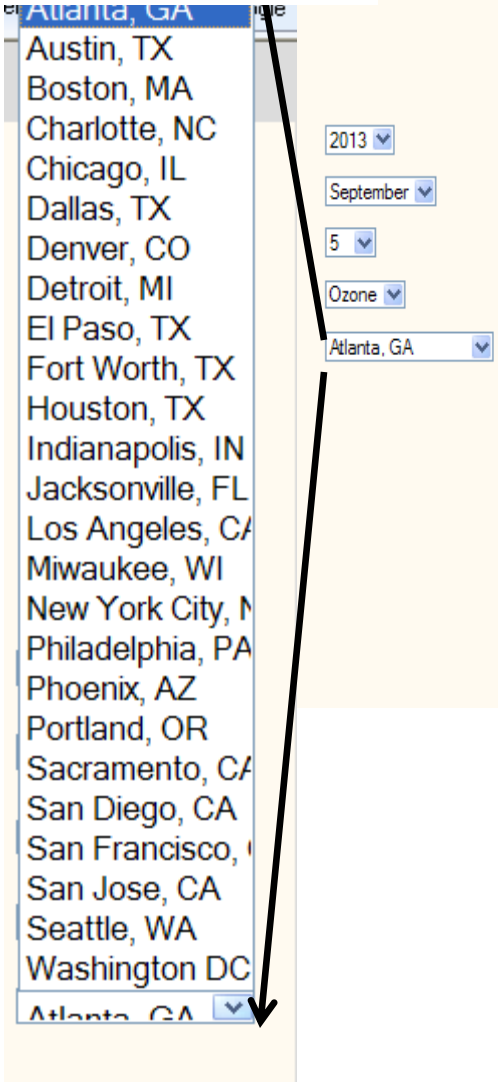
Year 2013
Month September
Day 5
Variable Ozone
Region Northeast US
Submit Parameters

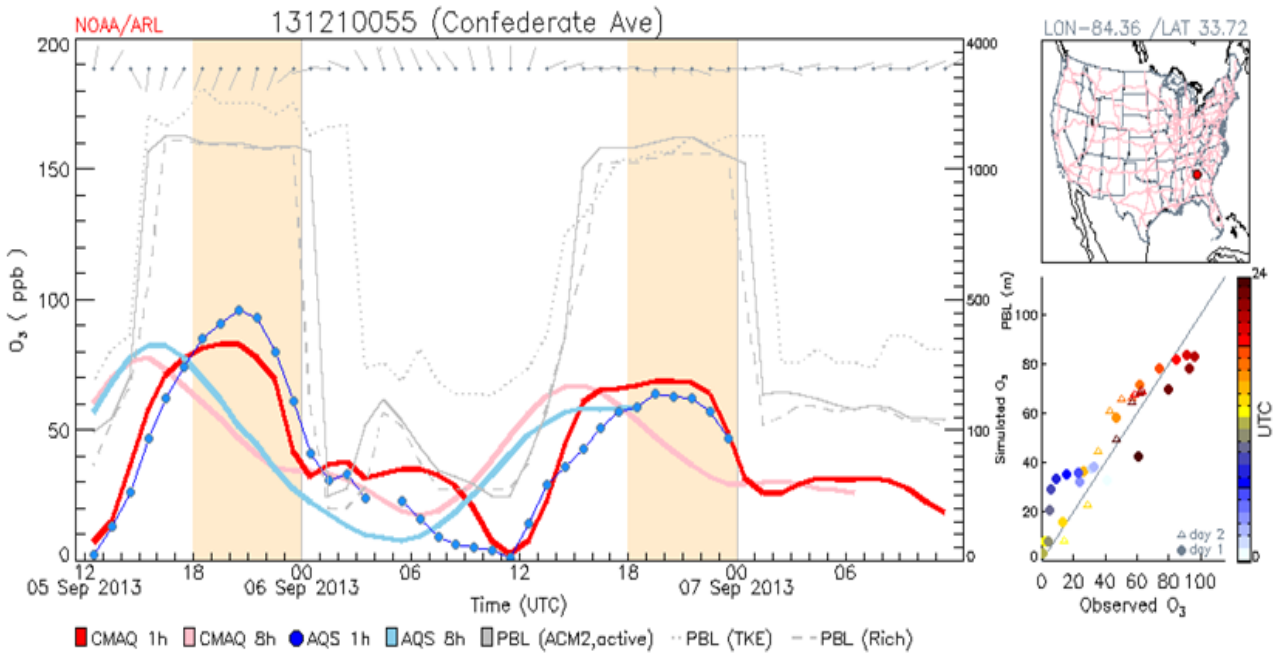
Northeast US
Continental US
-- Six Predined Region
Pacific Coast
Rocky Mountain
Upper Middle
Lower Middle
Northeast US
Southeast US
-- Enlarged Metro Reg
Atlanta
Chicago
Dallas - Fort Worth
Houston
New York City
Los Angeles



CMAQ Experimental Run Results (Time Series)

Time series of O3 at AIRNow site 131210055 in Atlanta, GA, from 09/05/2013 forecast run





Summary:

- Emission recycled from last year

  Different then previous years:
  e.g. Mobile6 for mobile inventory as base data
  but scaled by growth/reduction rate for 2012
  - Non-road area source used Cross State Rule Inventory
  - Canadian Emission used 2006 EI

  Routine CEM updates for point sources

- Ported NAQFC to a new NCEP super-computer: generally 3X speed
  - ➔ can run longer forecast?
  - ➔ longer lead-time?

- Looking ahead:
  - New $PM_{2.5}$ verification web-site under construction
  - CMAQ4.7.1 looked promising
  - Real-time capturing of intra and exo-domain wild fire and dust
  - Finer vertical grid resolution to capture free-trop phenomena
  - NAM is poised to improve its low level wind forecasts

BACKUP SLIDES

NAM_X z0 changes were for these 5 vegetation types:

- Evergreen Needle leaf Forest
- Deciduous Broadleaf Forest
- Mixed Forests
- Croplands
- Cropland/natural vegetation mosaic

Address a high 10-m wind bias primarily in the eastern CONUS.
Changes to the gravity wave drag scheme to reduce a slow 10-m wind bias in the western CONUS

O_3 Forecast Performance

Nomenclature of met-driver subscripts: _1 (NAM); _2 (NAMx) for NAQFC_expr

	Obs	Mod_1	Mod_2	Bias_1	Bias_2	RMSE_1	RMSE_2
CONUS	28.43	35.34	34.63	6.92	6.22	14.86	14.19
Urban	26.56	32.65	31.96	6.08	5.39	15.3	14.53
Suburb	27.88	34.7	34.01	6.81	6.1	15.18	14.53
Rural	29.54	36.86	36.21	7.31	6.65	14.43	13.78
LM	26.71	34.14	33.4	7.42	6.69	16.03	15.05
NE	27.33	32.16	31.68	4.84	4.34	13.29	12.74
PA	31.63	34.94	34.46	3.33	2.84	15.81	15.57
RM	34.31	41.78	41.39	7.44	7.06	14.59	14.05
SE	27.36	37.41	36.7	10.08	9.36	16.03	15.11
UM	25.29	32.51	31.38	7.22	6.09	13.53	12.67