Comparative analysis of MANE-VU 2002 Simulation with EPA NERL CMAQ 2002 Simulation Internal Documentation for Mult-Agency Eastern Critical Loads Project Deposition Estimates

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5/21/2009

All comparisons are made with annual deposition provided in kg/ha.

EPA NERL CMAQ 2002 provided by Robin Dennis and is "precip corrected bias adjusted".

> The bias adjustment for sulfur has one step (first step) and the bias adjustment for nitrate and ammonium has two steps. The first step is to multiply the CMAQ deposition by the ratio of PRISM-to-MM5 precipitation. This would be like adjusting the wet concentration fields from CMAQ. The second step is to compare these precipitation-adjusted data to NADP data across the eastern US, identify the degree of bias, and come up with a single multiplicative factor that will remove this regional bias (on average - there will still be scatter due to errors in emissions, etc.). This second step covers the entire eastern US. It is not specific to the NE.
>
> This is a work in progress and there is as of yet no formal documentation. Kristen can get you the MM5 and PRISM data that we used for you to better understand. I'm having problems with a server and can't get you the bias correction numbers yet for step two. What we found is that the step two bias for sulfate was negligible and not worth bothering about. That is why sulfur only goes through one "correction" step.

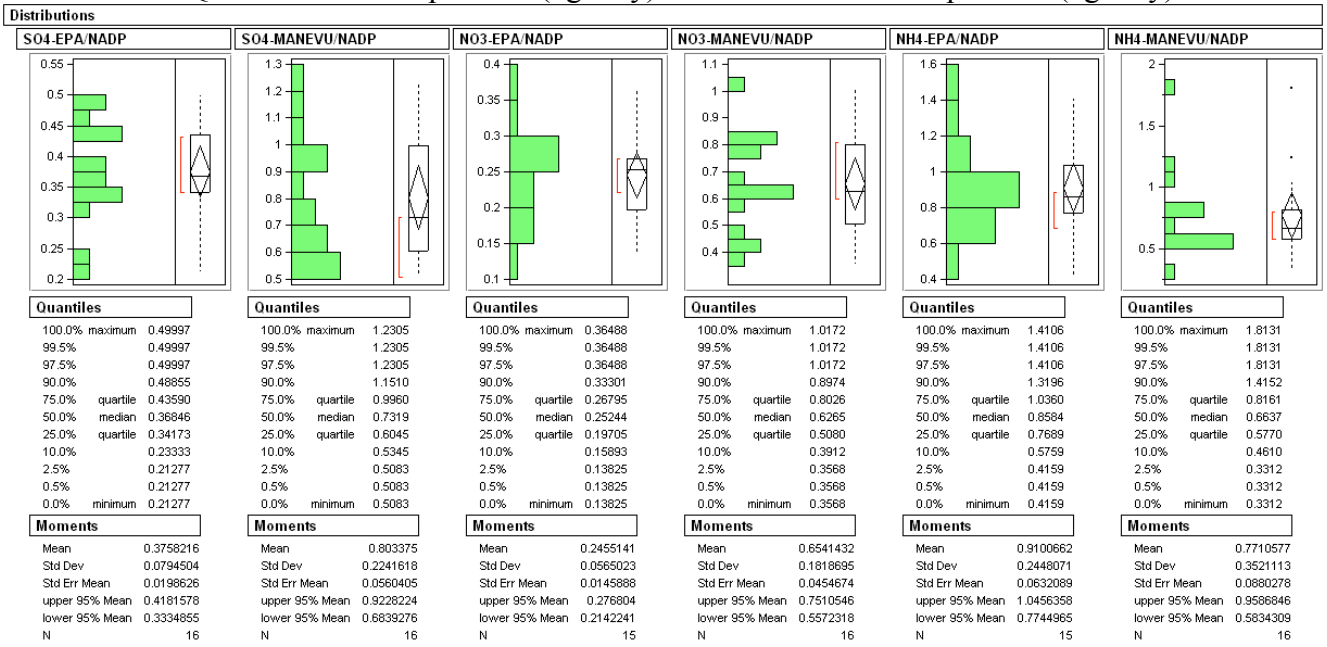
MANE-VU CMAQ 2002 was provided by John Graham at NESCAUM.

The MANE-VU CMAQ run used MM5 data provided by EPA (we think it is the same version as EPA used). However the emissions inventory was different taking into account SIPs. There were no other corrections made to the data.

Comparison of CMAQ results with NADP observations

Ratio of CMAQ run estimated deposition (kg/ha/y) to NADP observed deposition (kg/ha/y)

Distributions



SO4-EPA/NADP

Quantiles		
100.0%	maximum	0.49997
99.5%		0.49997
97.5%		0.49997
90.0%		0.48855
75.0%	quartile	0.43590
50.0%	median	0.36846
25.0%	quartile	0.34173
10.0%		0.23333
2.5%		0.21277
0.5%		0.21277
0.0%	minimum	0.21277

Moments	
Mean	0.3758216
Std Dev	0.0794504
Std Err Mean	0.0198626
upper 95% Mean	0.4181578
lower 95% Mean	0.3334855
N	16

SO4-MANEVU/NADP

Quantiles		
100.0%	maximum	1.2305
99.5%		1.2305
97.5%		1.2305
90.0%		1.1510
75.0%	quartile	0.9960
50.0%	median	0.7319
25.0%	quartile	0.6045
10.0%		0.5345
2.5%		0.5083
0.5%		0.5083
0.0%	minimum	0.5083

Moments	
Mean	0.803375
Std Dev	0.2241618
Std Err Mean	0.0560405
upper 95% Mean	0.9228224
lower 95% Mean	0.6839276
N	16

NO3-EPA/NADP

Quantiles		
100.0%	maximum	0.36488
99.5%		0.36488
97.5%		0.36488
90.0%		0.33301
75.0%	quartile	0.26795
50.0%	median	0.25244
25.0%	quartile	0.19705
10.0%		0.15893
2.5%		0.13825
0.5%		0.13825
0.0%	minimum	0.13825

Moments	
Mean	0.2455141
Std Dev	0.0565023
Std Err Mean	0.0145888
upper 95% Mean	0.276804
lower 95% Mean	0.2142241
N	15

NO3-MANEVU/NADP

Quantiles		
100.0%	maximum	1.0172
99.5%		1.0172
97.5%		1.0172
90.0%		0.8974
75.0%	quartile	0.8026
50.0%	median	0.6265
25.0%	quartile	0.5080
10.0%		0.3912
2.5%		0.3568
0.5%		0.3568
0.0%	minimum	0.3568

Moments	
Mean	0.6541432
Std Dev	0.1818695
Std Err Mean	0.0454674
upper 95% Mean	0.7510546
lower 95% Mean	0.5572318
N	16

NH4-EPA/NADP

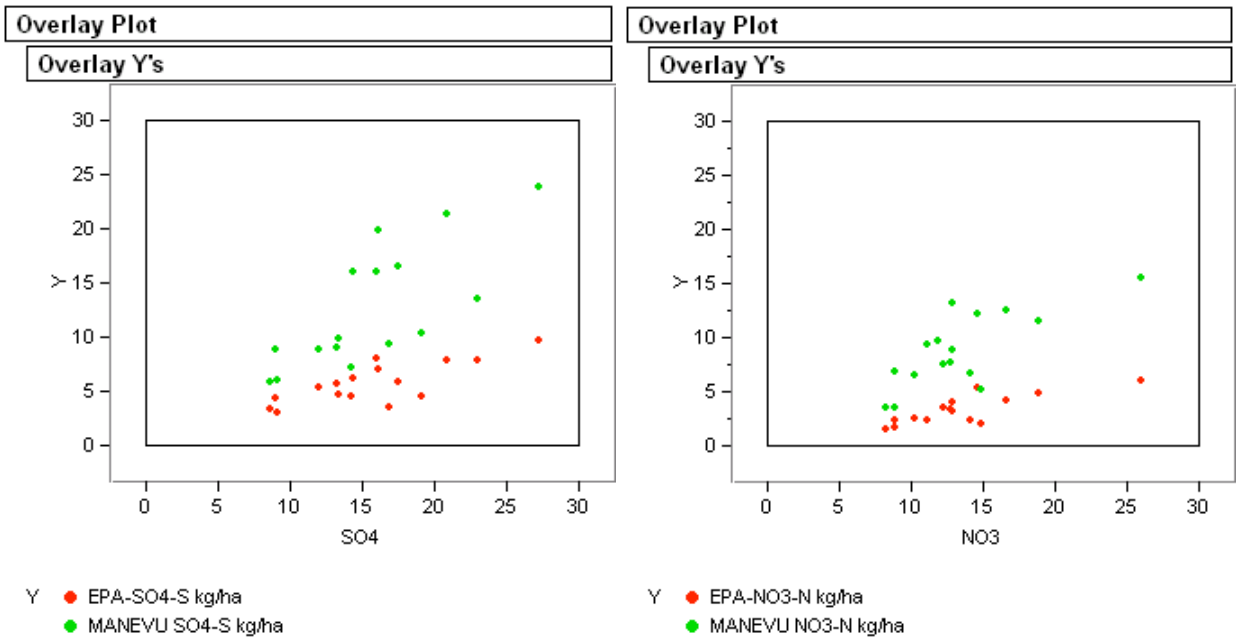
Quantiles		
100.0%	maximum	1.4106
99.5%		1.4106
97.5%		1.4106
90.0%		1.3196
75.0%	quartile	1.0360
50.0%	median	0.8584
25.0%	quartile	0.7689
10.0%		0.5759
2.5%		0.4159
0.5%		0.4159
0.0%	minimum	0.4159

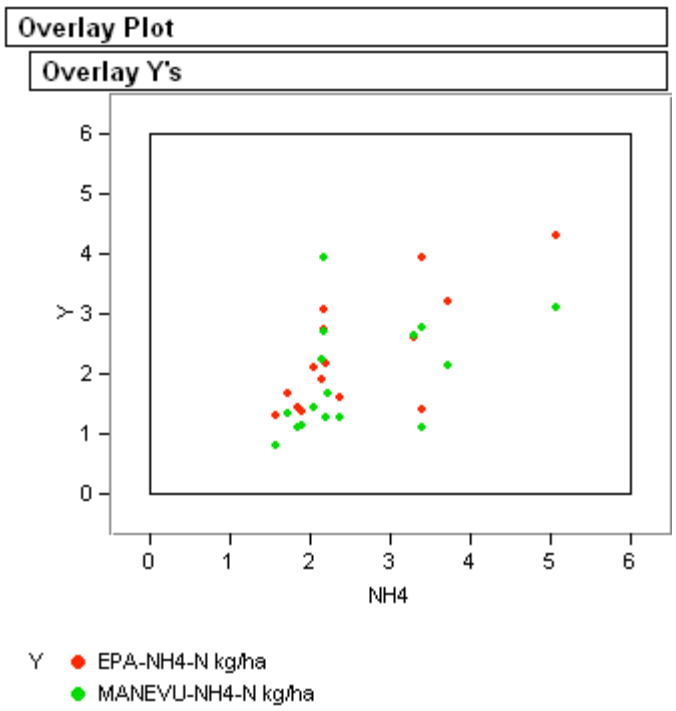
Moments	
Mean	0.9100662
Std Dev	0.2448071
Std Err Mean	0.0632089
upper 95% Mean	1.0456358
lower 95% Mean	0.7744965
N	15

NH4-MANEVU/NADP

Quantiles		
100.0%	maximum	1.8131
99.5%		1.8131
97.5%		1.8131
90.0%		1.4152
75.0%	quartile	0.8161
50.0%	median	0.6637
25.0%	quartile	0.5770
10.0%		0.4610
2.5%		0.3312
0.5%		0.3312
0.0%	minimum	0.3312

Moments	
Mean	0.7710577
Std Dev	0.3521113
Std Err Mean	0.0880278
upper 95% Mean	0.9586846
lower 95% Mean	0.5834309
N	16





Summary of comparison with NADP observations

The MANE-VU simulation is in better agreement with Northeast NADP observations than the EPA simulation.

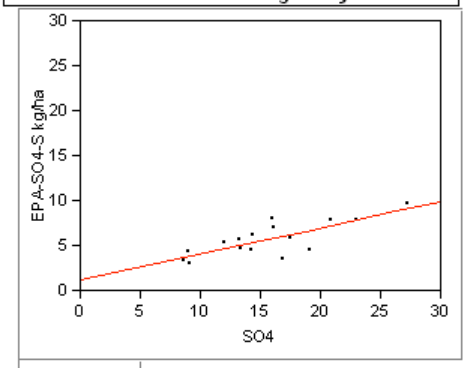
Both simulations were reasonably well correlated with NADP observations.

The simulations were better correlated with each other than with the NADP observations.

There appears to be something about the 12km PRISM/MM5 precipitation amount ratio correction that is skewing the Northeast low for sulfate.

The largest deviations between the two simulations were for NO3 with MANE-VU averaging 2.6X EPA. Still the MANE-VU simulation averaged about 0.65 X the NADP observations.

Bivariate Fit of EPA-SO4-S kg/ha By SO4



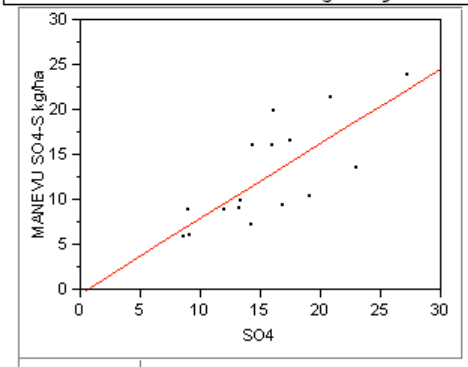
Linear Fit

EPA-SO4-S kg/ha = 1.1927968 + 0.291916 SO4

Summary of Fit

RSquare	0.614623
RSquare Adj	0.587097
Root Mean Square Error	1.231834
Mean of Response	5.790475
Observations (or Sum Wgts)	16

Bivariate Fit of MANEVU SO4-S kg/ha By SO4



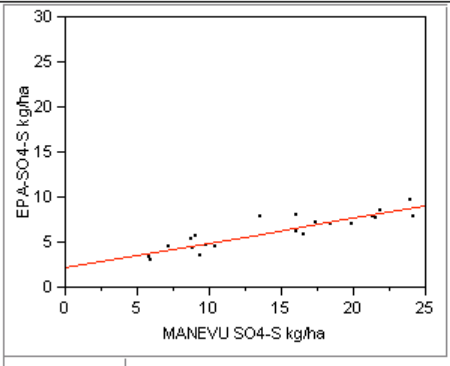
Linear Fit

MANEVU SO4-S kg/ha = -0.418613 + 0.8344332 SO4

Summary of Fit

RSquare	0.574368
RSquare Adj	0.543965
Root Mean Square Error	3.827984
Mean of Response	12.72371
Observations (or Sum Wgts)	16

Bivariate Fit of EPA-SO4-S kg/ha By MANEVU SO4-S kg/ha



Linear Fit

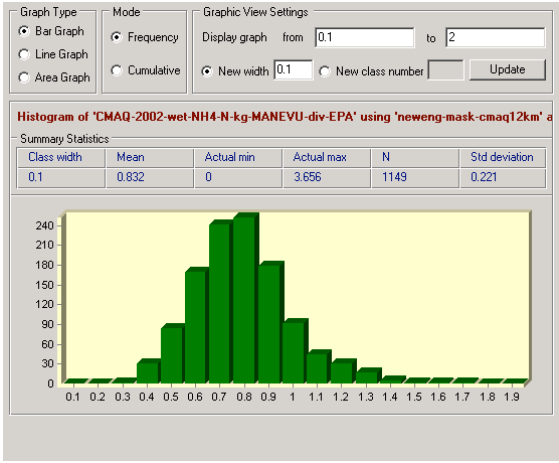
EPA-SO4-S kg/ha = 2.2109171 + 0.2762956 MANEVU SO4-S kg/ha

Summary of Fit

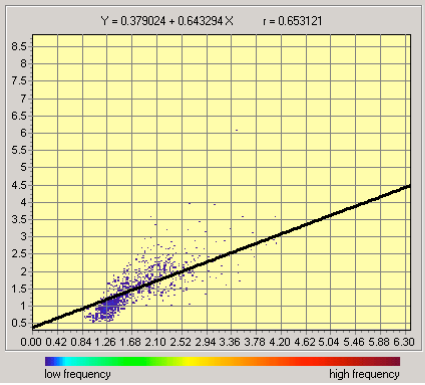
RSquare	0.811134
RSquare Adj	0.801194
Root Mean Square Error	0.8413
Mean of Response	6.25343
Observations (or Sum Wgts)	21

Wet Deposition of Reduced N (NH4)

Ratio of MANE-VU/EPA RUN 2002



Correlation of MANE-VU with EPA RUN 2002

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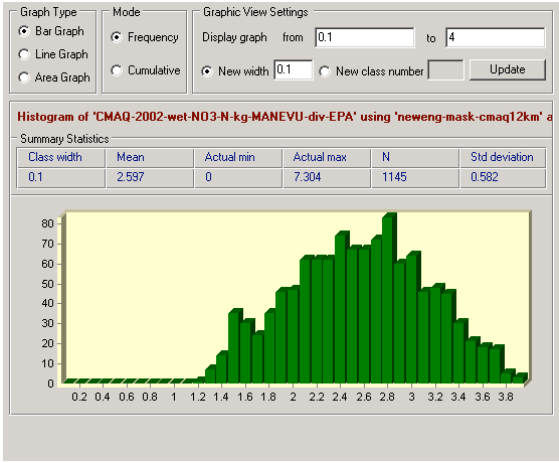
Regression Parameters:

X axis: EPA-CMAQ-2002-wet-NH4-N-kg
Y axis: 2002-total-wet-dep-NH4-wetdep

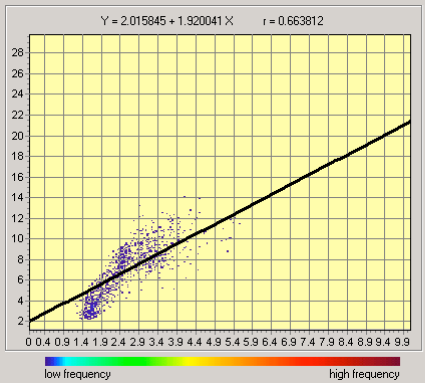
Coeff. of Det.          =      42.66 %
Std. Dev. of X          =     0.603741
Std. Dev. of Y          =     0.594658
S.E. of Estimate        =     0.450307
Std. Error of Beta      =     0.021685
t Stat for r or Beta    =     29.664995
t Stat for Beta <> 1    =    -16.449190
Sample Size (n)         =           1185
Apparent df             =           1183
```

Wet Deposition of Oxidized N (NO3)

Ratio of MANE-VU/EPA RUN 2002



Correlation of MANE-VU with EPA RUN 2002

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Regression Parameters:

X axis: EPA-CMAQ-2002-wet-NO3-N-kg
Y axis: 2002-total-wet-dep-NO3-wetdep

Coeff. of Det.          =      44.06 %
Std. Dev. of X          =     0.905874
Std. Dev. of Y          =     2.620193
S.E. of Estimate        =     1.959641
Std. Error of Beta      =     0.062895
t Stat for r or Beta    =     30.527683
t Stat for Beta <> 1    =     14.628188
Sample Size (n)         =           1185
Apparent df             =           1183
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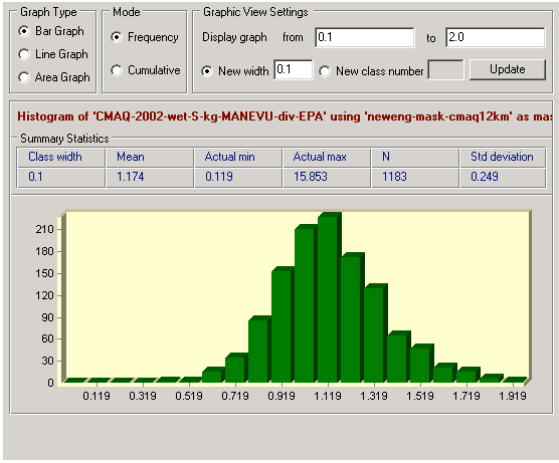
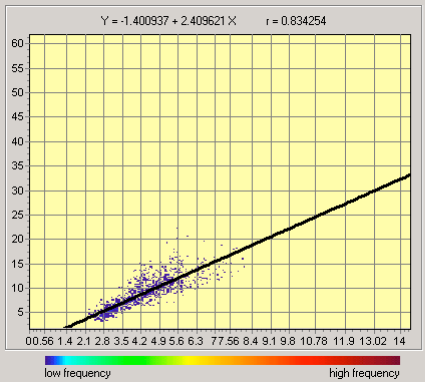
Wet Deposition of S

Ratio of MANE-VU/EPA RUN 2002



Correlation of MANE-VU with EPA RUN 2002

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Regression Parameters:

X axis: EPA-CMAQ-2002-wet-S-kg
Y axis: 2002-total-wet-dep-SO4-wetdep

Coeff. of Det.          =      69.60 %
Std. Dev. of X          =     1.123528
Std. Dev. of Y          =     3.245148
S.E. of Estimate        =     1.789312
Std. Error of Beta      =     0.046303
t Stat for r or Beta    =     52.040211
t Stat for Beta <> 1    =     30.443365
Sample Size (n)         =           1185
Apparent df             =           1183
```