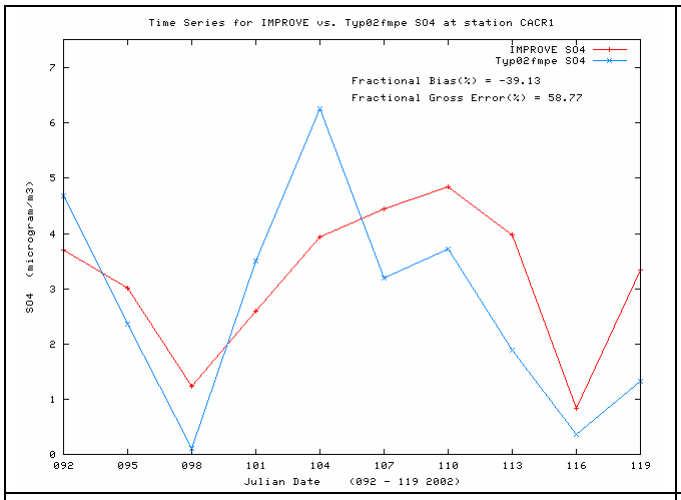
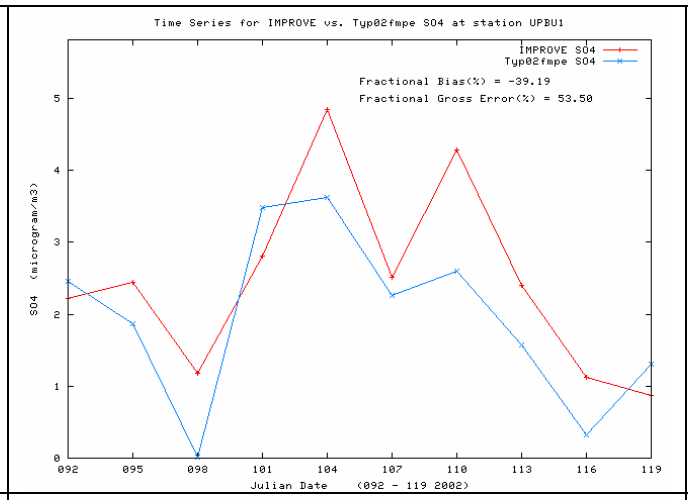
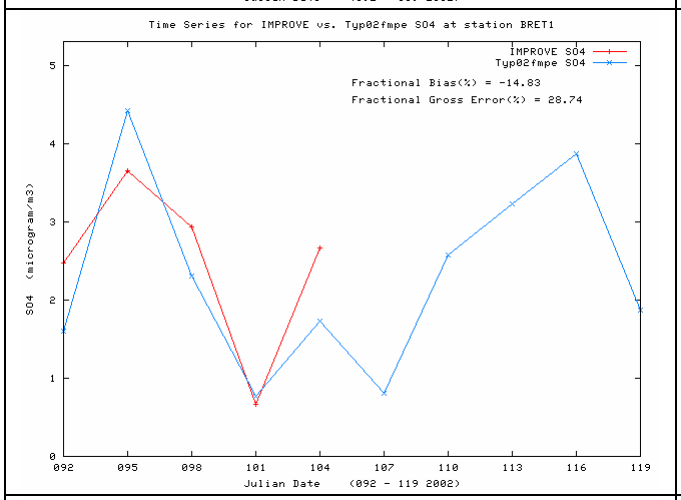
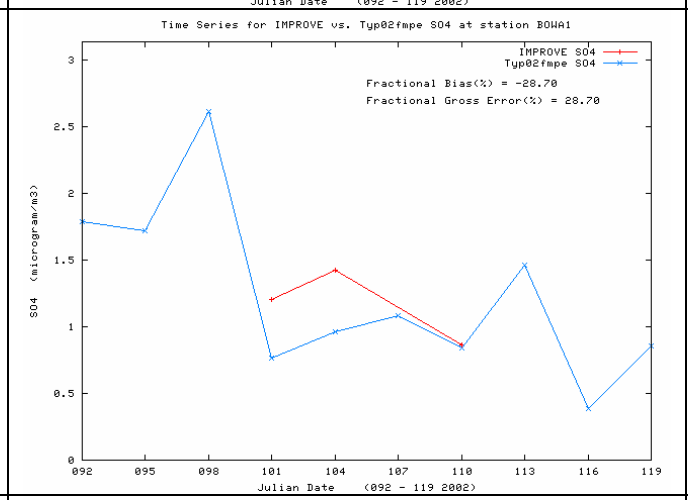
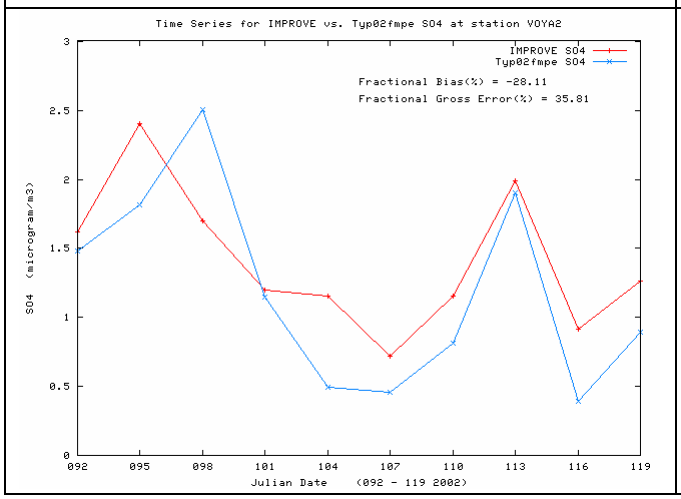
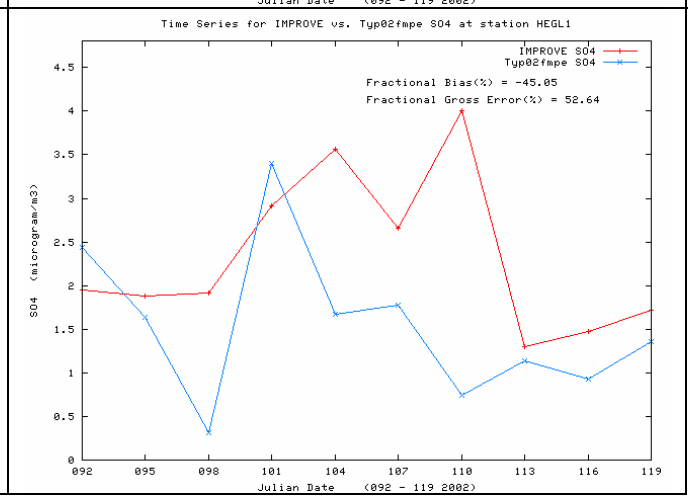

Time Series for IMPROVE vs. Typ02fmpe SO4 at station CACR1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -39.13
Fractional Gross Error(%) = 58.77
SO4 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station UPBU1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -39.19
Fractional Gross Error(%) = 53.50
SO4 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station BRET1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -14.83
Fractional Gross Error(%) = 28.74
SO4 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station BOWA1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -28.70
Fractional Gross Error(%) = 28.70
SO4 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station VOYA2
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -28.11
Fractional Gross Error(%) = 35.81
SO4 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station HEGL1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -45.05
Fractional Gross Error(%) = 52.64
SO4 (microgram/m3)
Julian Date (092 - 119 2002)

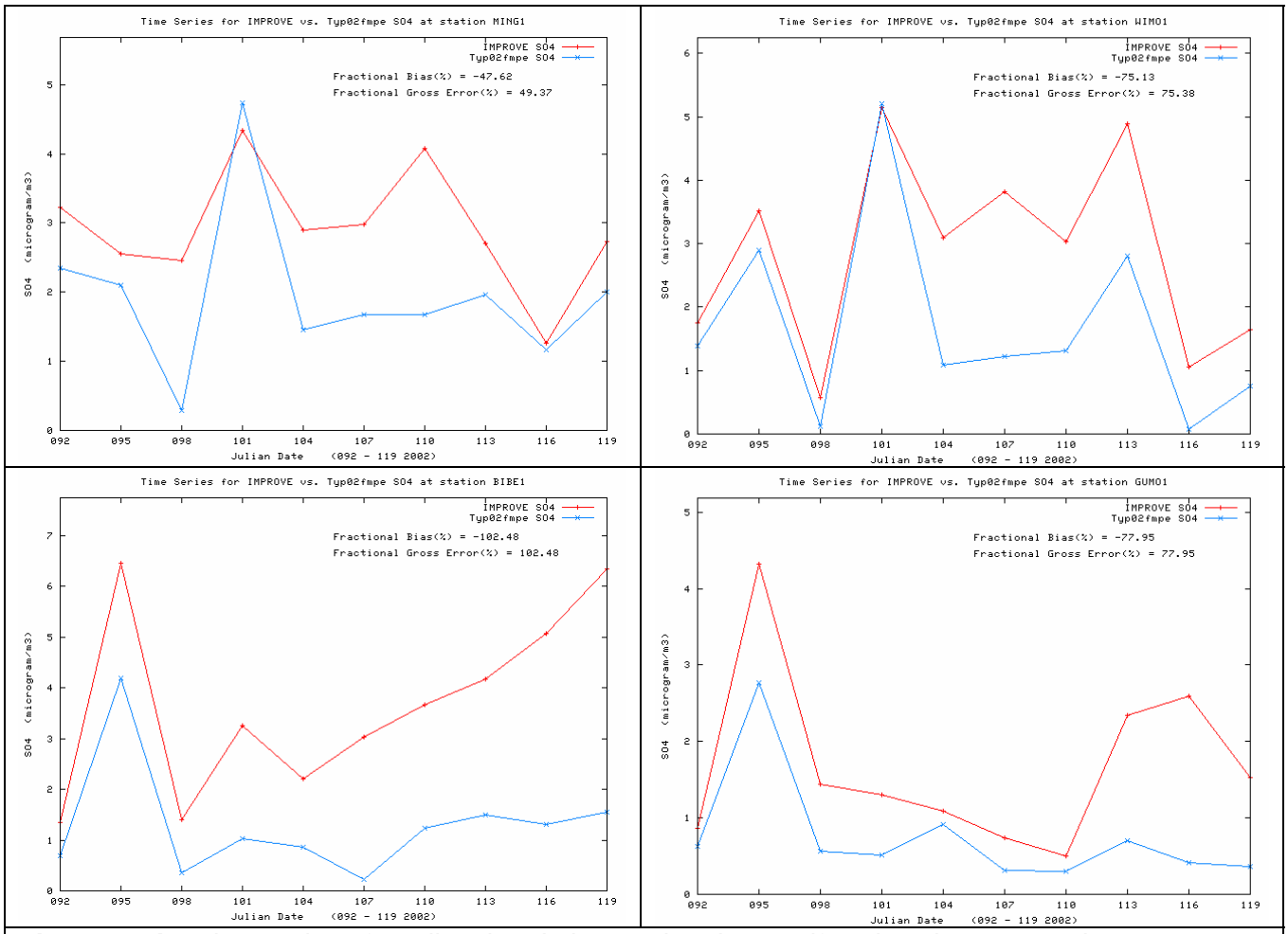


Figure C-5b. Time series of predicted and observed 24-hour sulfate (SO4) concentrations at CENRAP IMPROVE CLASS I AREA sites in April 2002 for CMAQ 2002 36 km Base F base case simulation.

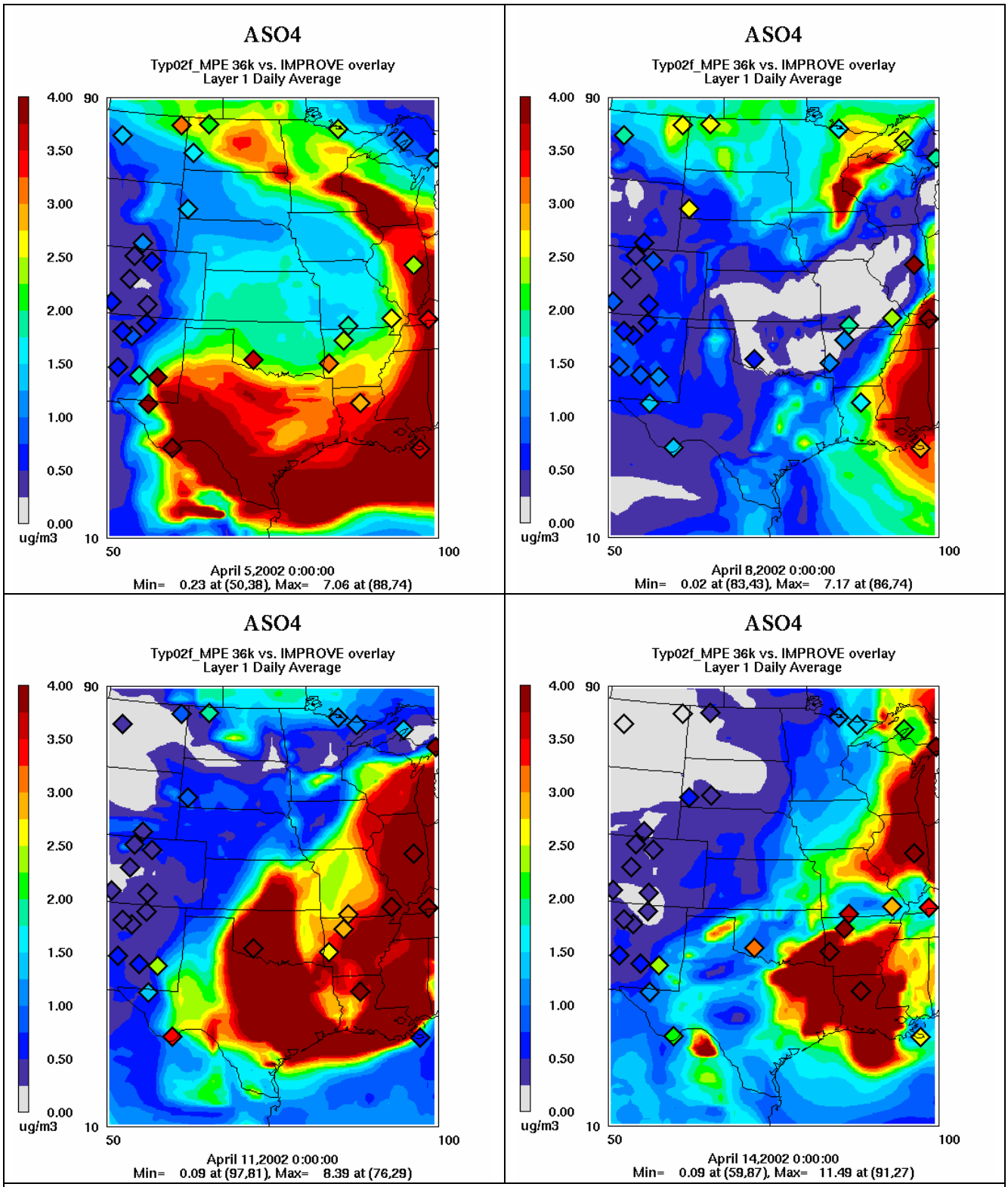


Figure C-5c. Spatial plot comparisons of the predicted and IMPROVE observed 24-hour SO4 concentrations for April 5, 8, 11 and 14, 2002.

C.3.1.3 SO4 in July 2002

SO4 concentrations are also underestimated by CMAQ in July (Figure C-6a) with fractional bias value ranging from -22 to -52%. Wet SO4 deposition is slightly overstated (22%) with a lot of scatter (83% error). The July SO4 under-prediction bias is also reflected in the time series plots (Figure C-6b). Comparisons of the predicted and observed spatial distribution of SO4 in the CENRAP region for July 7, 10, 13 and 16, 2002 are shown in Figure C-6c. In general the model and observations agree on the locations of the elevated SO4, except that the observed extent is somewhat larger so that the modeled elevated SO4 fails to impact some of the sites on the edge of the elevated cloud of SO4 (e.g., Big Bend, Guadalupe Mountains and northwestern Oklahoma).

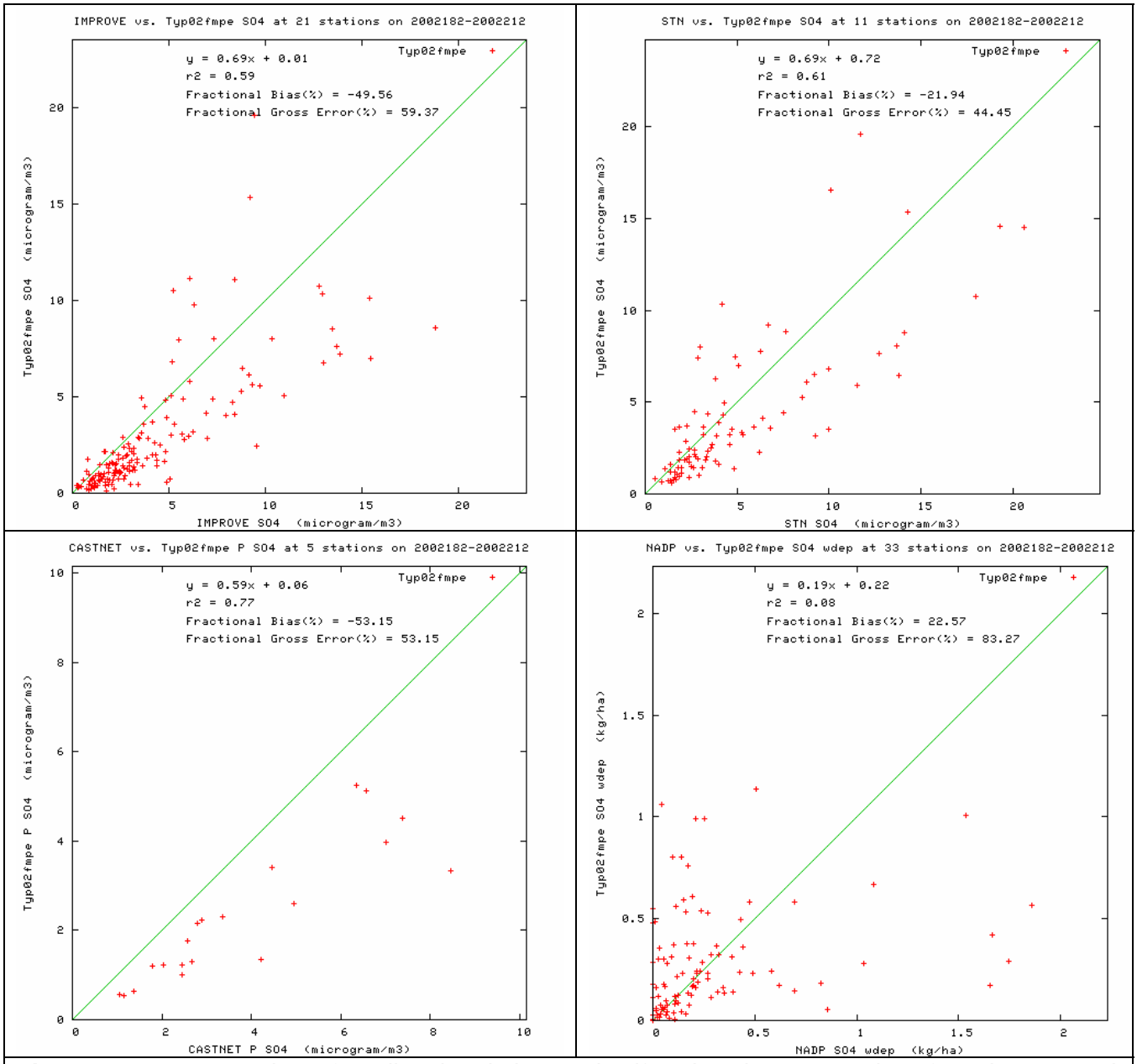
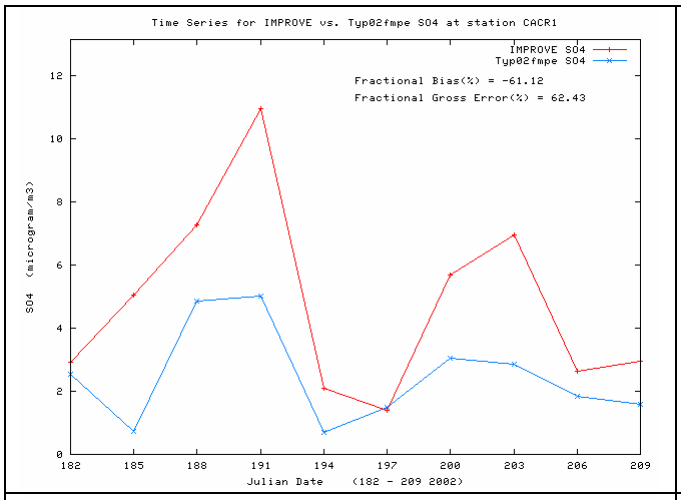
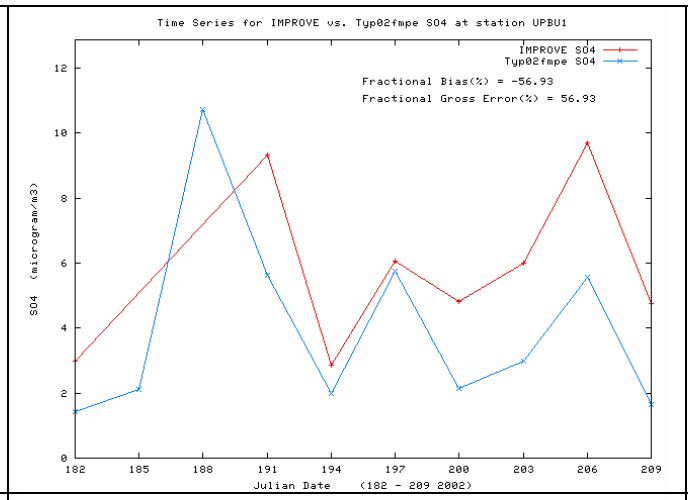
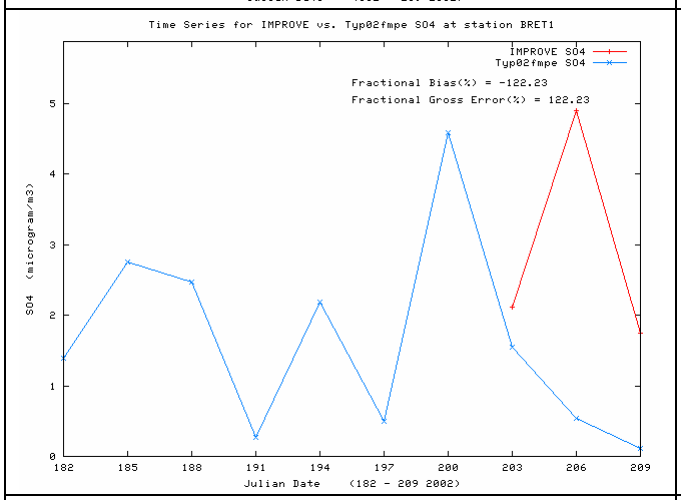
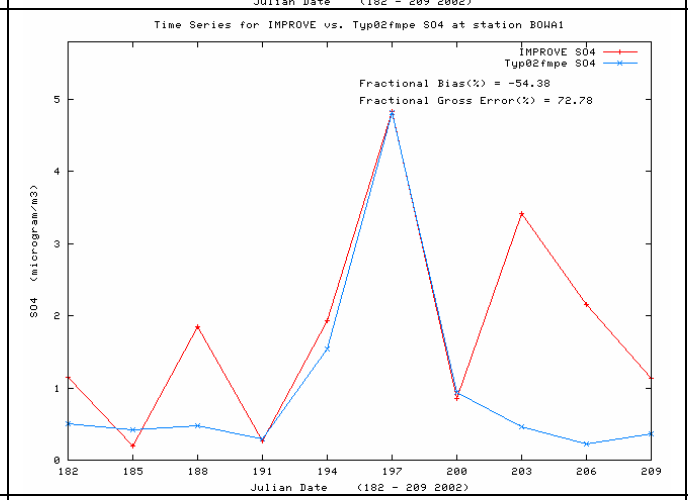


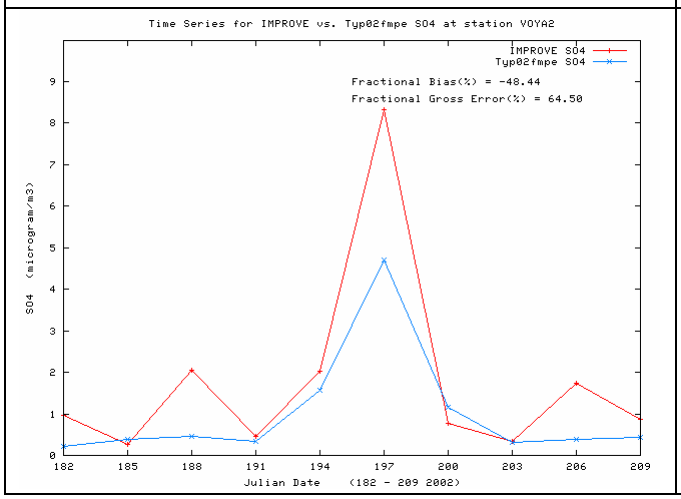
Figure C-6a. Scatter plots of predicted and observed sulfate (SO4) concentrations for July 2002 and sites in the CENRAP region using IMPROVE (top left), STN (top right), CASTNet (bottom left) and NADP monitoring networks using the CMAQ 2002 36 km Base F base case simulation.

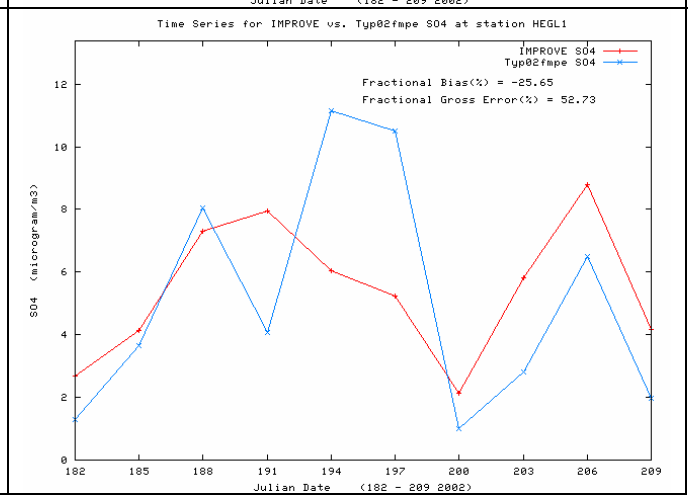

Time Series for IMPROVE vs. Typ02fmpe SO4 at station CACR1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -61.12
Fractional Gross Error(%) = 62.43
SO4 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station UPBU1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -56.93
Fractional Gross Error(%) = 56.93
SO4 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station BRET1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -122.23
Fractional Gross Error(%) = 122.23
SO4 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station BOWA1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -54.38
Fractional Gross Error(%) = 72.78
SO4 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station VOYA2
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -48.44
Fractional Gross Error(%) = 64.50
SO4 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station HEGL1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -25.65
Fractional Gross Error(%) = 52.73
SO4 (microgram/m3)
Julian Date (182 - 209 2002)

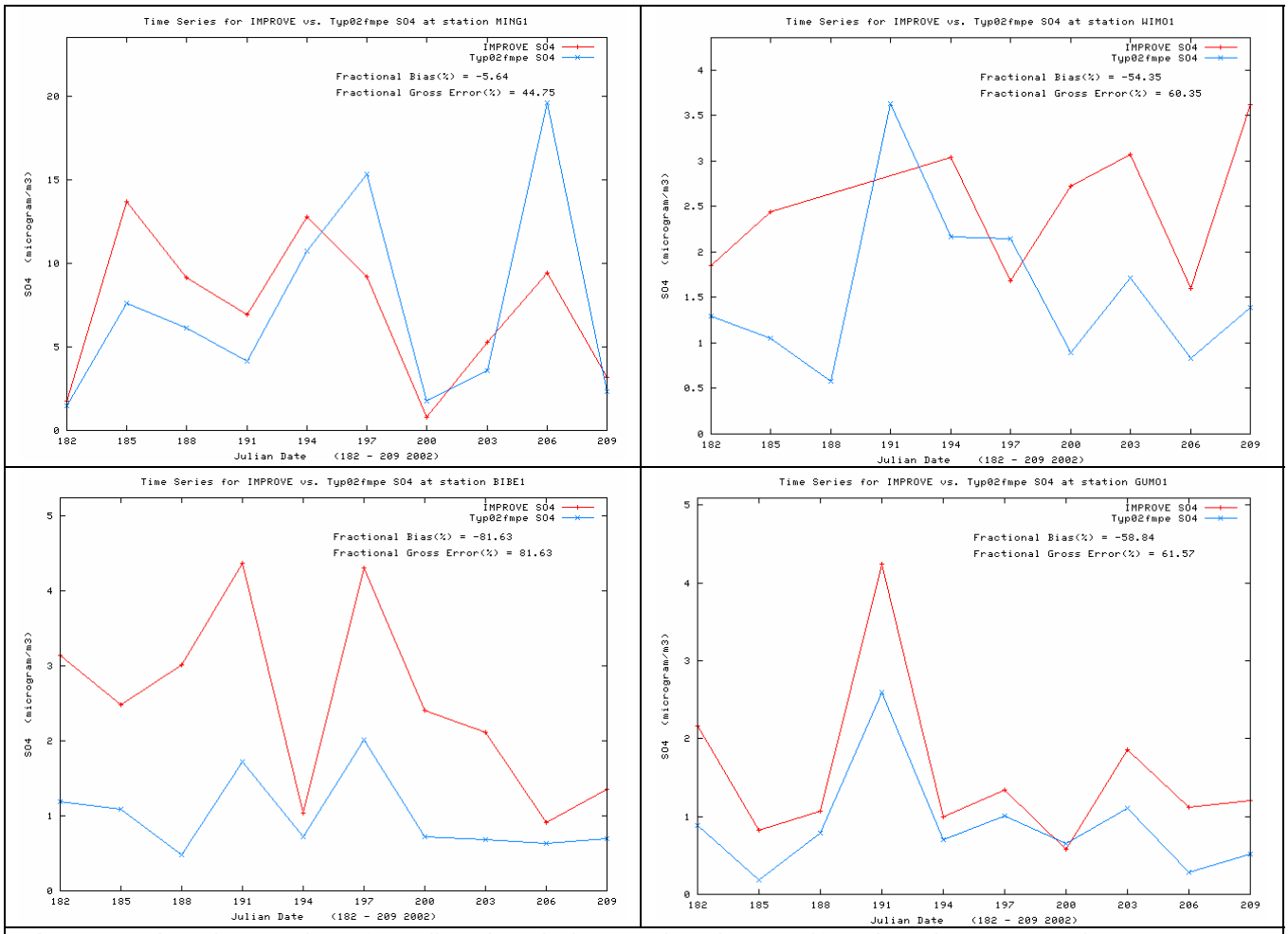


Figure C-6b. Time series of predicted and observed 24-hour sulfate (SO4) concentrations at CENRAP IMPROVE CLASS I AREA sites in July 2002 for CMAQ 2002 36 km Base F base case simulation.

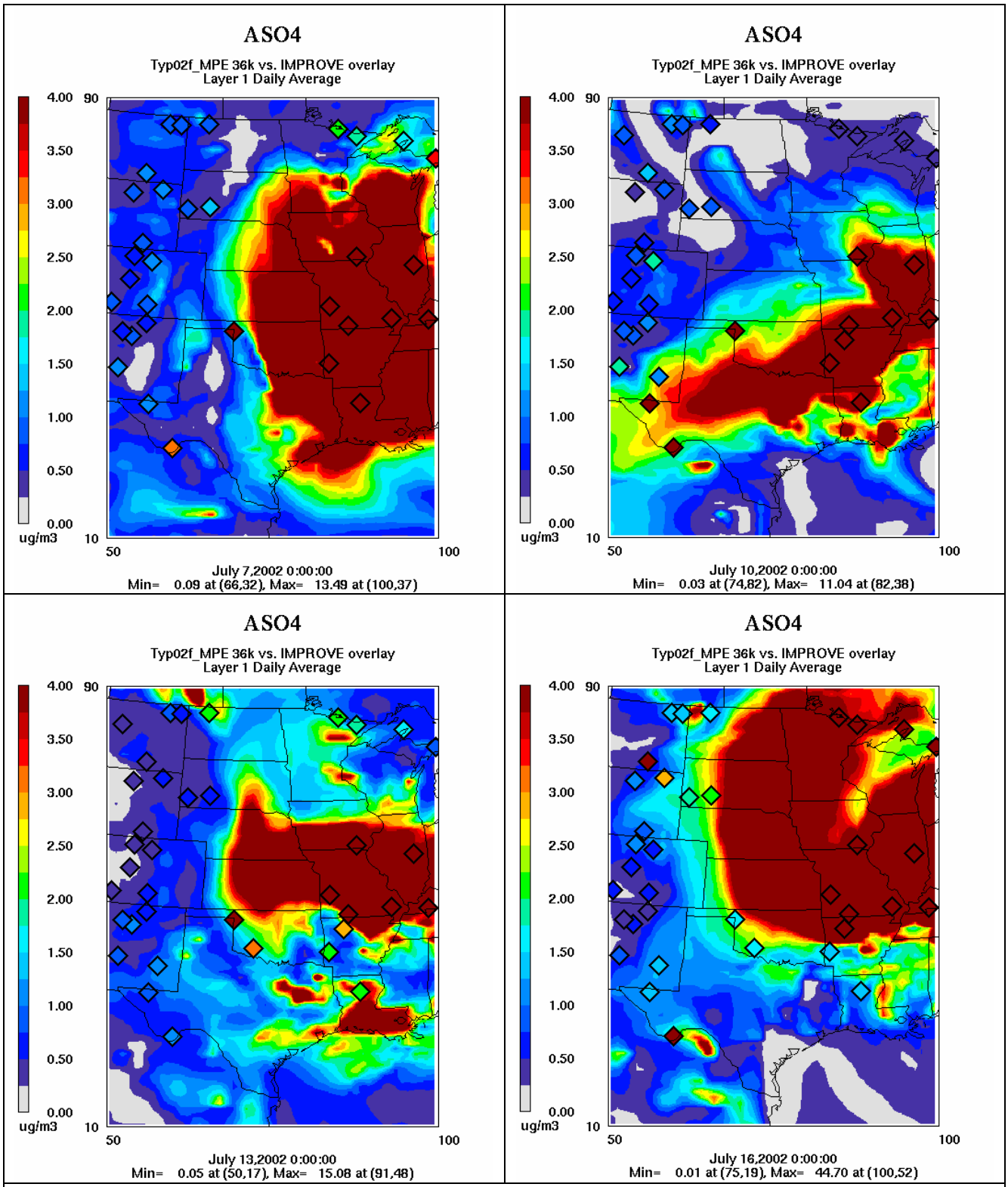


Figure C-6c. Spatial plot comparisons of the predicted and IMPROVE observed 24-hour SO4 concentrations for July 7, 10, 13 and 16, 2002.

C.3.1.4 SO4 in October 2002

In October 2002, CMAQ is doing a better job of reproducing the observed SO4 concentrations with much lower fractional bias values (-6%, 0% and -23%) and fractional errors < 40% (Figure C-7a). The observed SO4 time series are also reproduced well by the model, although an under-prediction bias is clearly evident at Big Bend, Guadalupe Mountains and Wichita Mountains. The model also reproduces the observed spatial distribution of SO4 well in October (Figure C-7c).

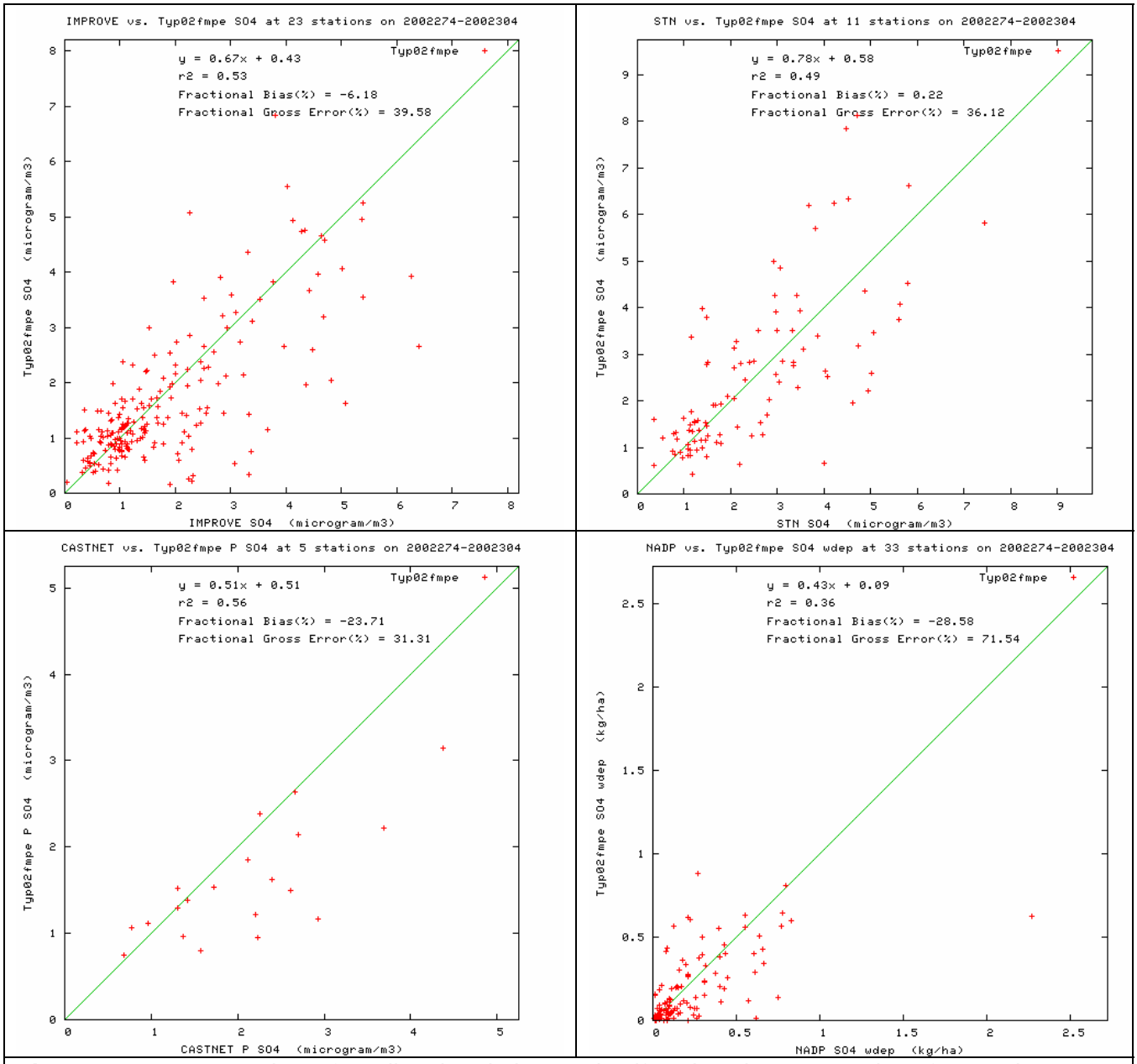
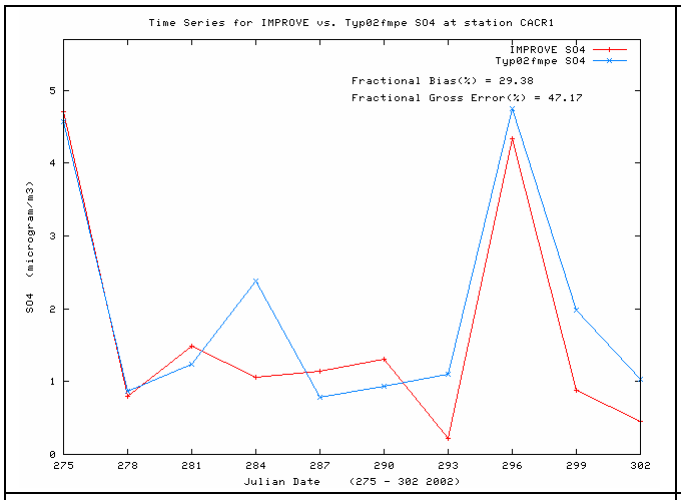
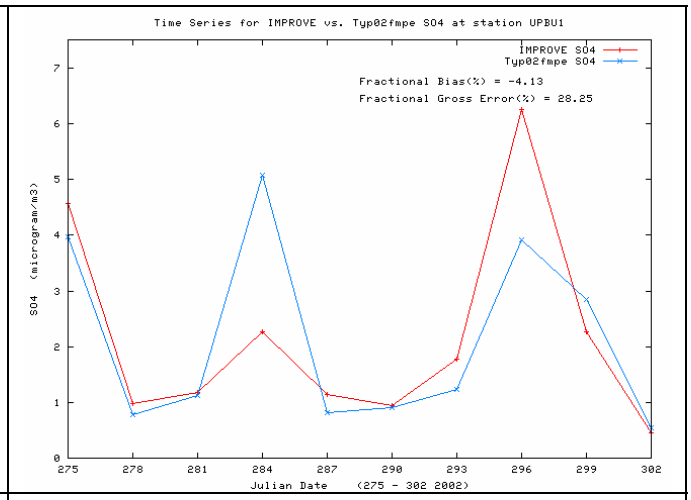
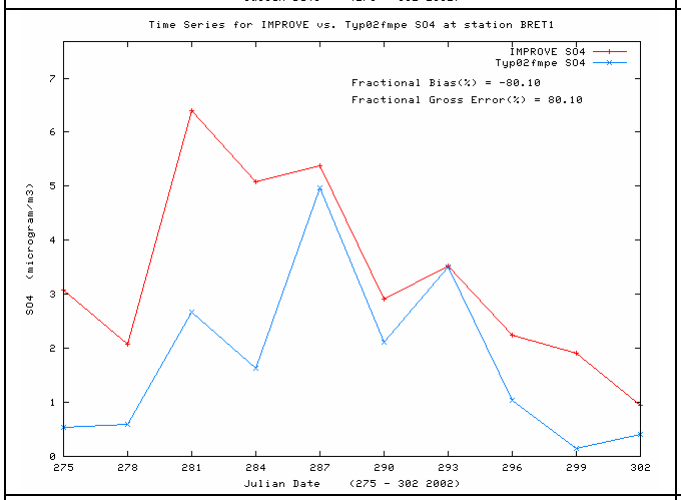
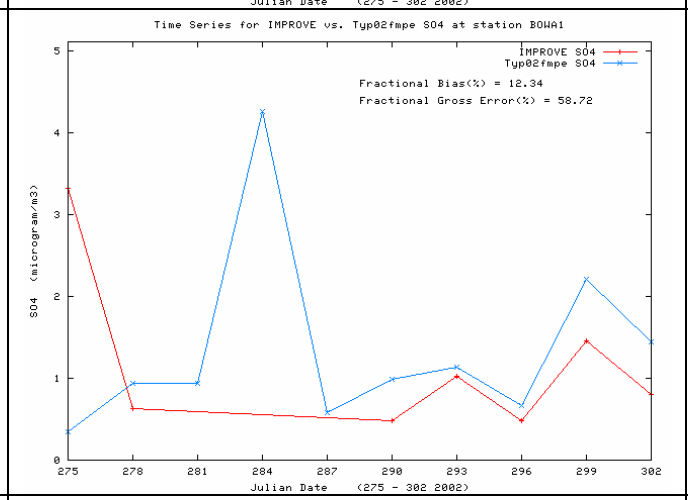


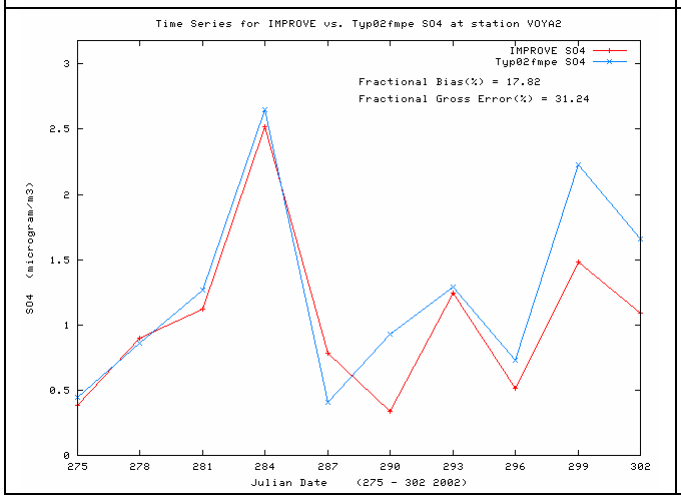
Figure C-7a. Scatter plots of predicted and observed sulfate (SO4) concentrations for October 2002 and sites in the CENRAP region using IMPROVE (top left), STN (top right), CASTNet (bottom left) and NADP monitoring networks using the CMAQ 2002 36 km Base F base case simulation.

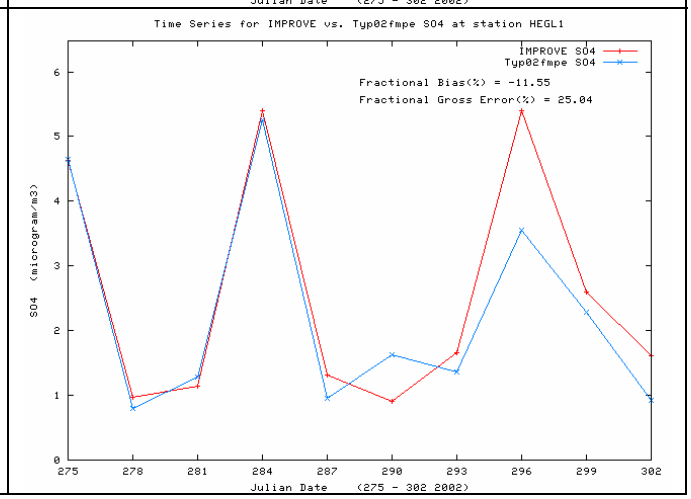

Time Series for IMPROVE vs. Typ02fmpe SO4 at station CACR1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = 29.38
Fractional Gross Error(%) = 47.17
SO4 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station UPBU1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -4.13
Fractional Gross Error(%) = 28.25
SO4 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station BRET1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -80.10
Fractional Gross Error(%) = 80.10
SO4 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station BOWA1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = 12.34
Fractional Gross Error(%) = 58.72
SO4 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station VOYA2
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = 17.82
Fractional Gross Error(%) = 31.24
SO4 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe SO4 at station HEGL1
IMPROVE SO4
Typ02fmpe SO4
Fractional Bias(%) = -11.55
Fractional Gross Error(%) = 25.04
SO4 (microgram/m3)
Julian Date (275 - 302 2002)

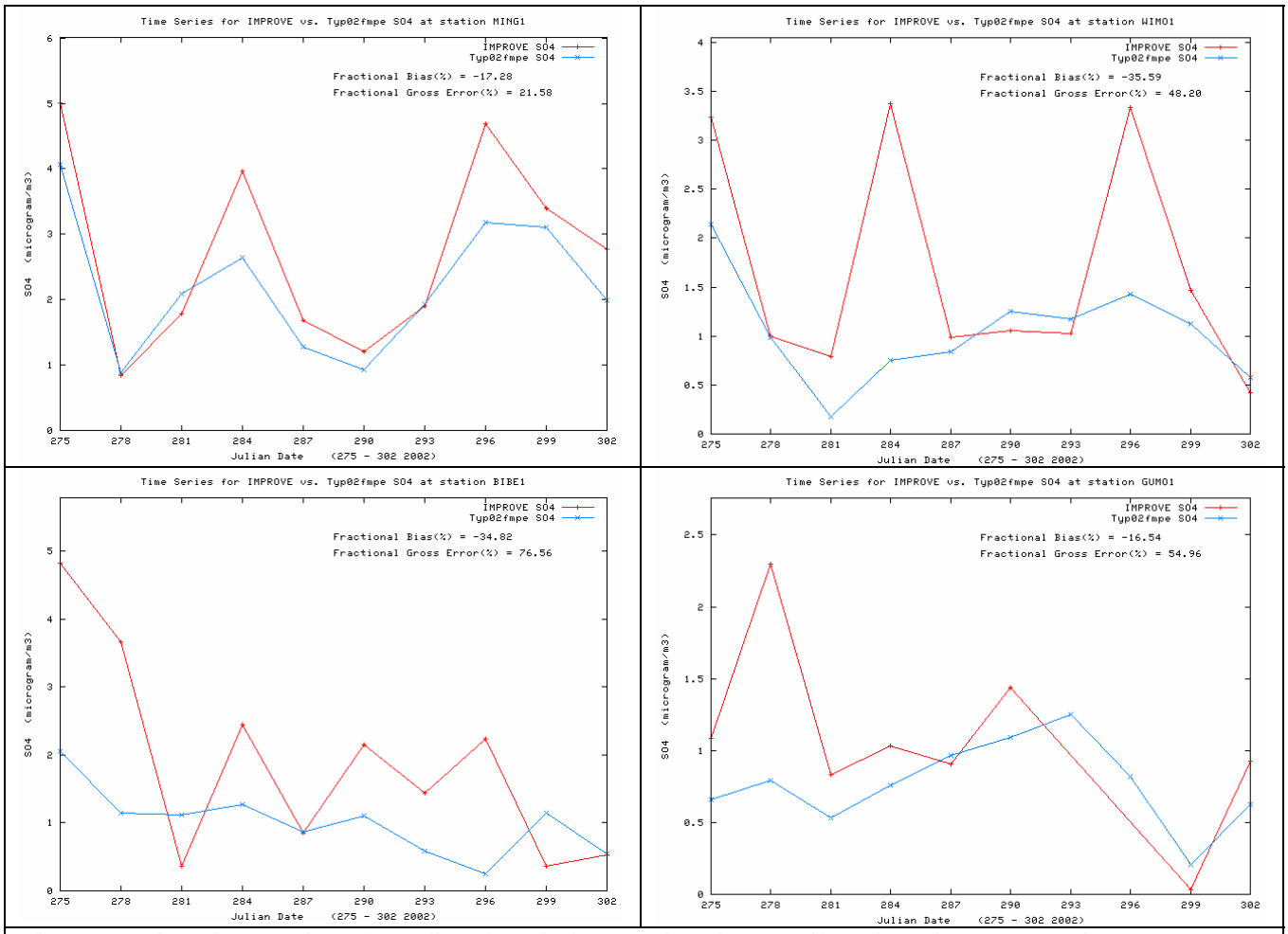


Figure C-7b. Time series of predicted and observed 24-hour sulfate (SO4) concentrations at CENRAP IMPROVE CLASS I AREA sites in October 2002 for CMAQ 2002 36 km Base F base case simulation.

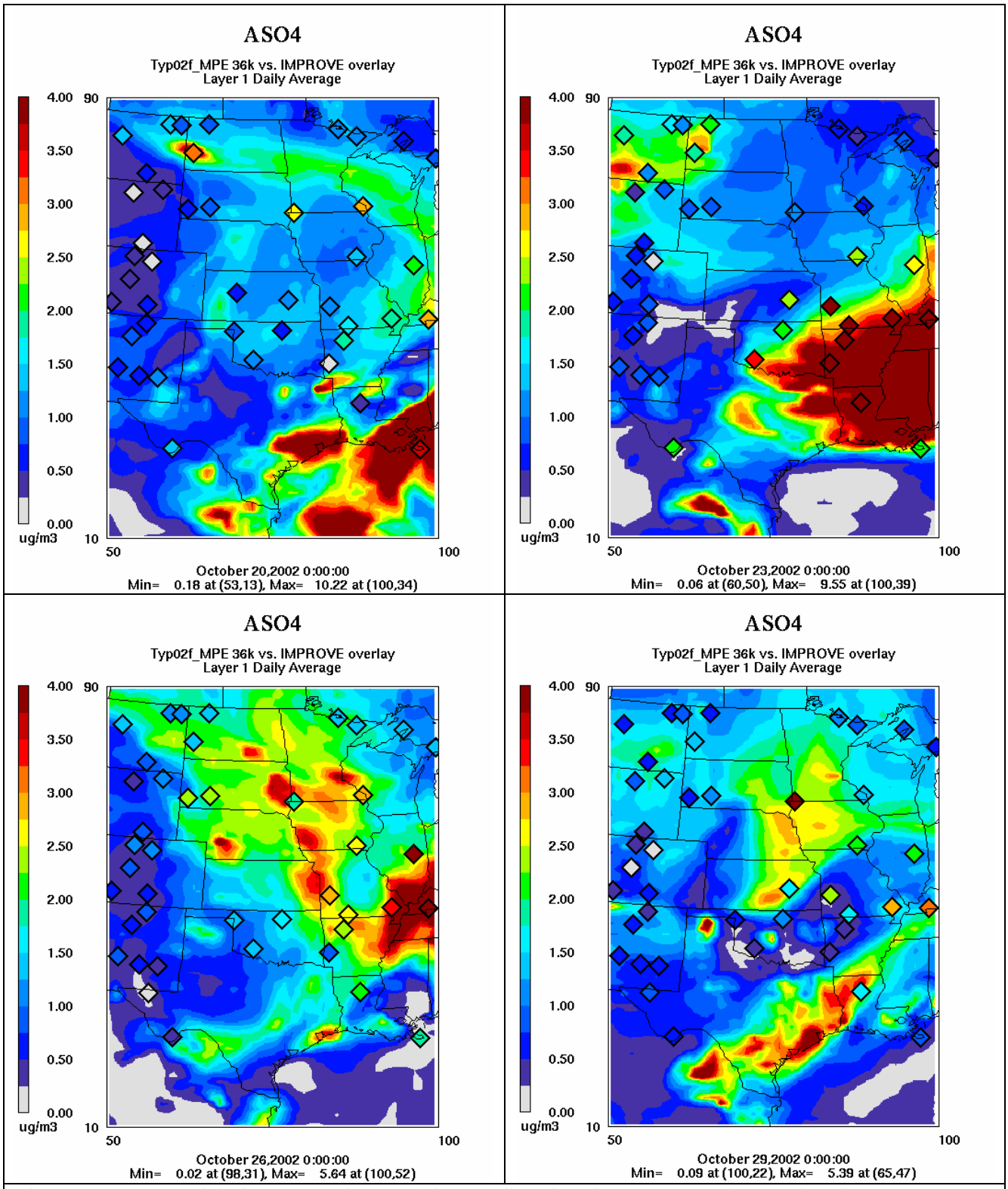


Figure C-7c. Spatial plot comparisons of the predicted and IMPROVE observed 24-hour SO4 concentrations for October 20, 23, 26 and 29, 2002.

C.3.1.5 SO4 Monthly Bias and Error

Figure C-8 compares the monthly SO4 fractional bias and error across the CENRAP region for the three monitoring networks. The under-prediction bias is clearly evident the first 8-10 months of the year. This underestimation bias is greatest across the CASTNet network which persists through out the year and is least for the STN network where it disappears by August-September. The monthly SO4 fractional errors are generally between 30% and 60% and are greatest in the summer when SO4 concentrations are the highest.

Figure C-9 presents a Bugle Plot of monthly So4 fractional bias and error statistics and compares them against the proposed PM model performance goal and criteria (see Table C-3). For the STN network, it appears that SO4 performance for all months achieves the proposed PM model performance goal. For the IMPROVE network, approximately half of the months achieve the proposed PM performance goal with the other half exceed the goal but within the performance criteria. Across the CASTNet network most months exceed the proposed goal and are within the criteria. Although the CASTNet fractional bias for some months is right at the criteria (≤±60%). With the exception of two IMPROVE months, all of the monthly SO4 fractional error performance statistics achieve the proposed PM model performance goal.

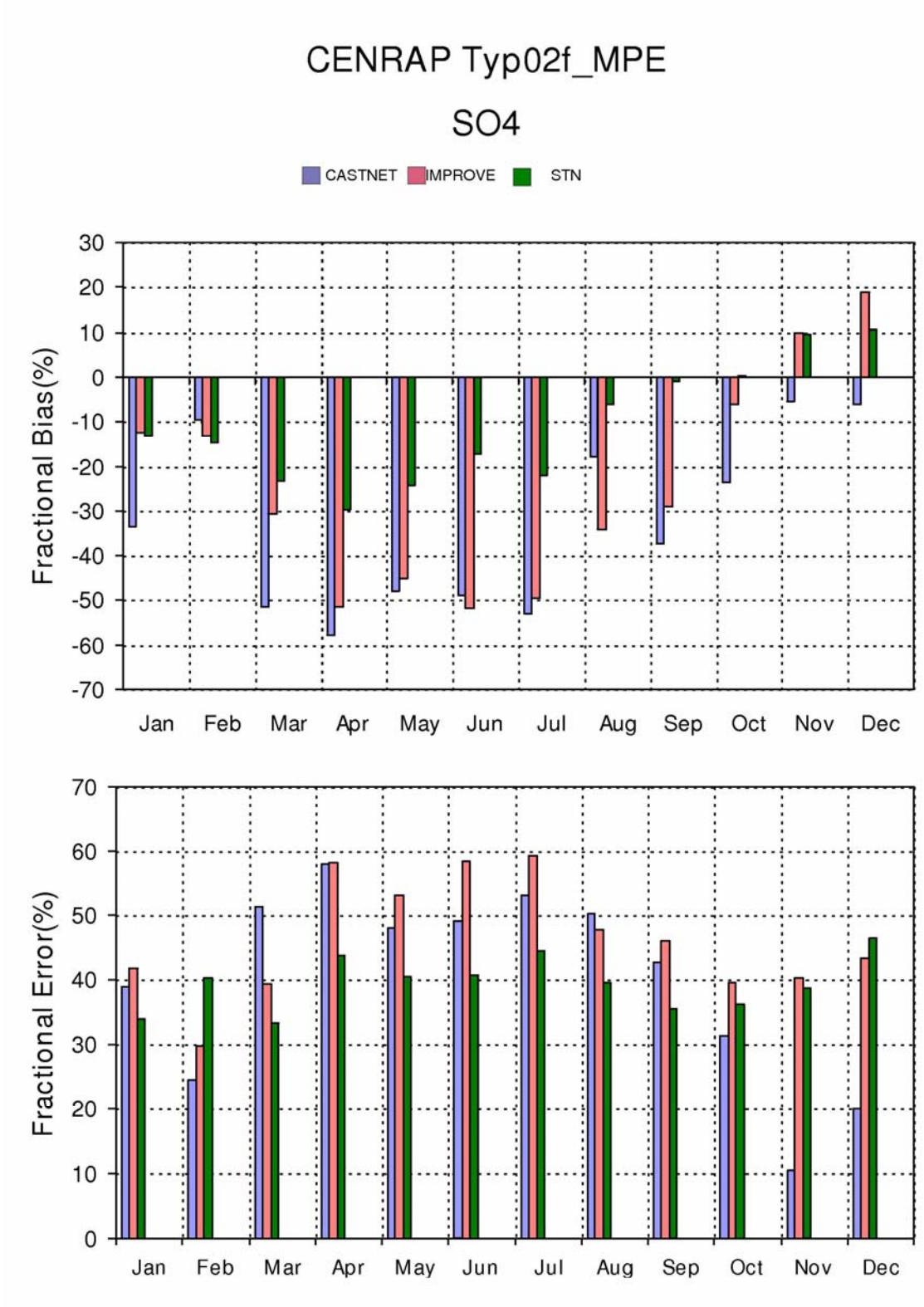


Figure C-8. Monthly SO4 fractional bias (top) and fractional gross error (bottom) statistical measures for IMPROVE, STN and CASTNet monitoring sites in the CENRAP region.

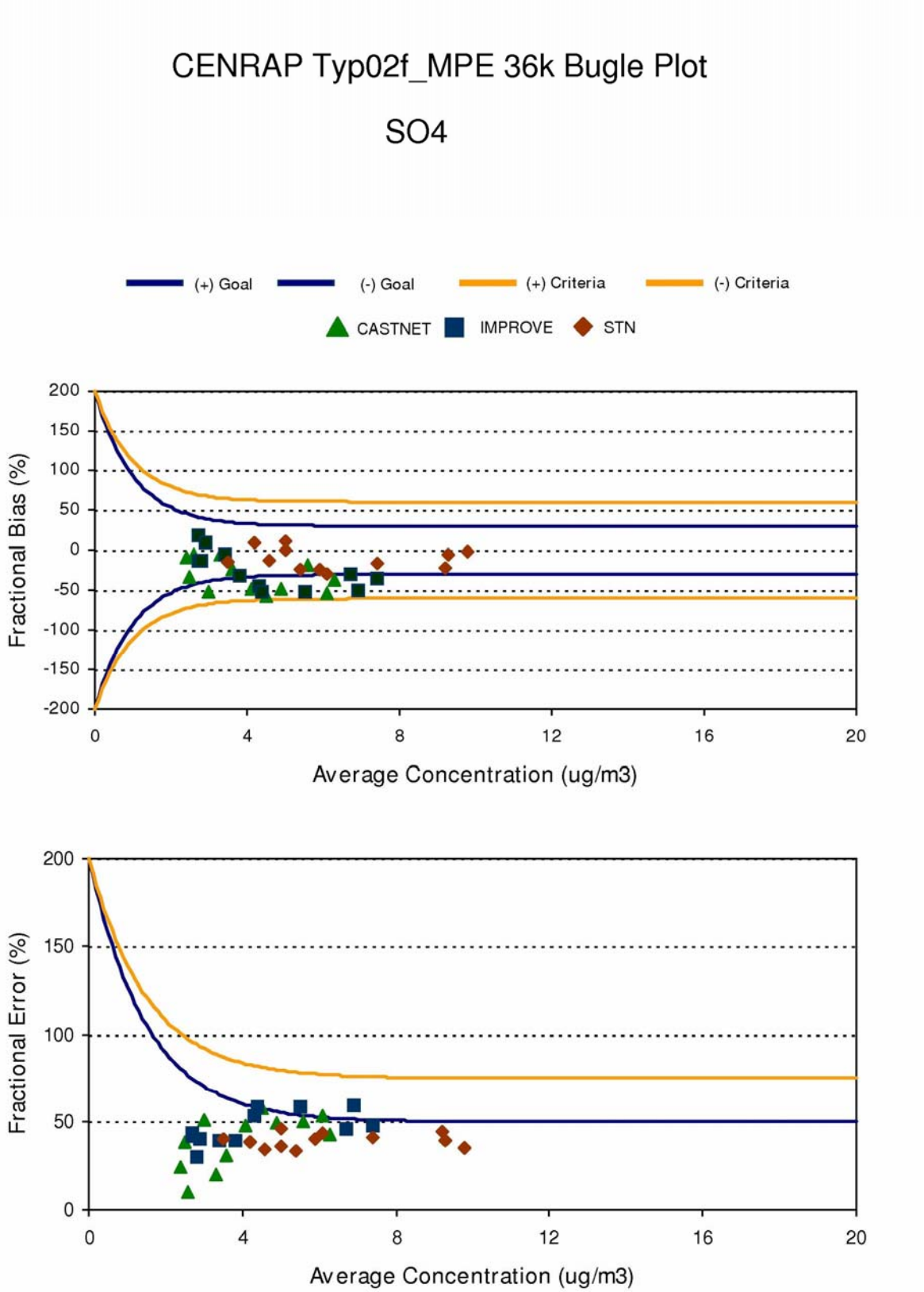


Figure C-9. Bugle Plots of monthly fractional bias (top) and fractional gross error (bottom) and comparisons with model performance goals and criteria for SO4 and IMPROVE, STN and CASTNet monitoring sites in the CENRAP region.

C.3.2 Nitrate (NO3) Monthly Model Performance

The following sections discuss the monthly NO3 model performance across the IMPROVE, STN and CASTNet monitoring networks in the CENRAP region.

C.3.2.1 NO3 in January 2002

January NO3 CMAQ model performance is characterized by an overestimation bias across the CENRAP region (Figure C-10a). The fractional bias values for the IMPROVE, STN and CASTNet networks are 38%, 29% and 61%. Unlike SO4, wet deposition of NO3 is also overstated in January (43%). Fractional errors range from 90%-100% for the IMPROVE and CASTNet networks and are lower (54%) for the STN network and higher (114%) for the NADP network.

With the exception of Breton Island and Big Bend, the model NO3 over-prediction bias occurs at the other 8 CENRAP Class I areas (Figure C-10b). The observed time series is reproduced reasonable well at a couple sites, such as Wichita Mountains and the first half of January for Voyageurs. However, for most sites the observed NO3 time series is not reproduced very well and is extremely poorly reproduced for Breton Island, Big Bend and Guadalupe Mountains.

The model typically estimates a larger area of elevated NO3 concentrations than is observed. This is shown for January 20, 23, 26 and 29 in Figure C-10c. Whereas the model exhibits large areas of brown indicated daily average NO3 concentrations of 4 $\mu g/m^3$ or higher, the observed values of this high rarely occur and are usually limited to the central Illinois site. On January 20 the model estimates the entire eastern half of the CENRAP region should be covered by elevated NO3 concentrations, whereas the observations indicate much lower values. On January 23 the modeled elevated NO3 concentrations lies between the IMPROVE monitoring sites, although the central Illinois site suggests high NO3 did occur in the region. The observations on January 26 also suggest lower NO3 than the model is predicting. On January 29 the model estimates elevated NO3 from the central Illinois site to Wichita Mountains, Oklahoma that is supported by these two observations. In general, the model is estimating more wide-spread elevated NO3 concentrations than observed, whereas the observations suggest that the elevated NO3 occurrences is less frequent and more spotty.

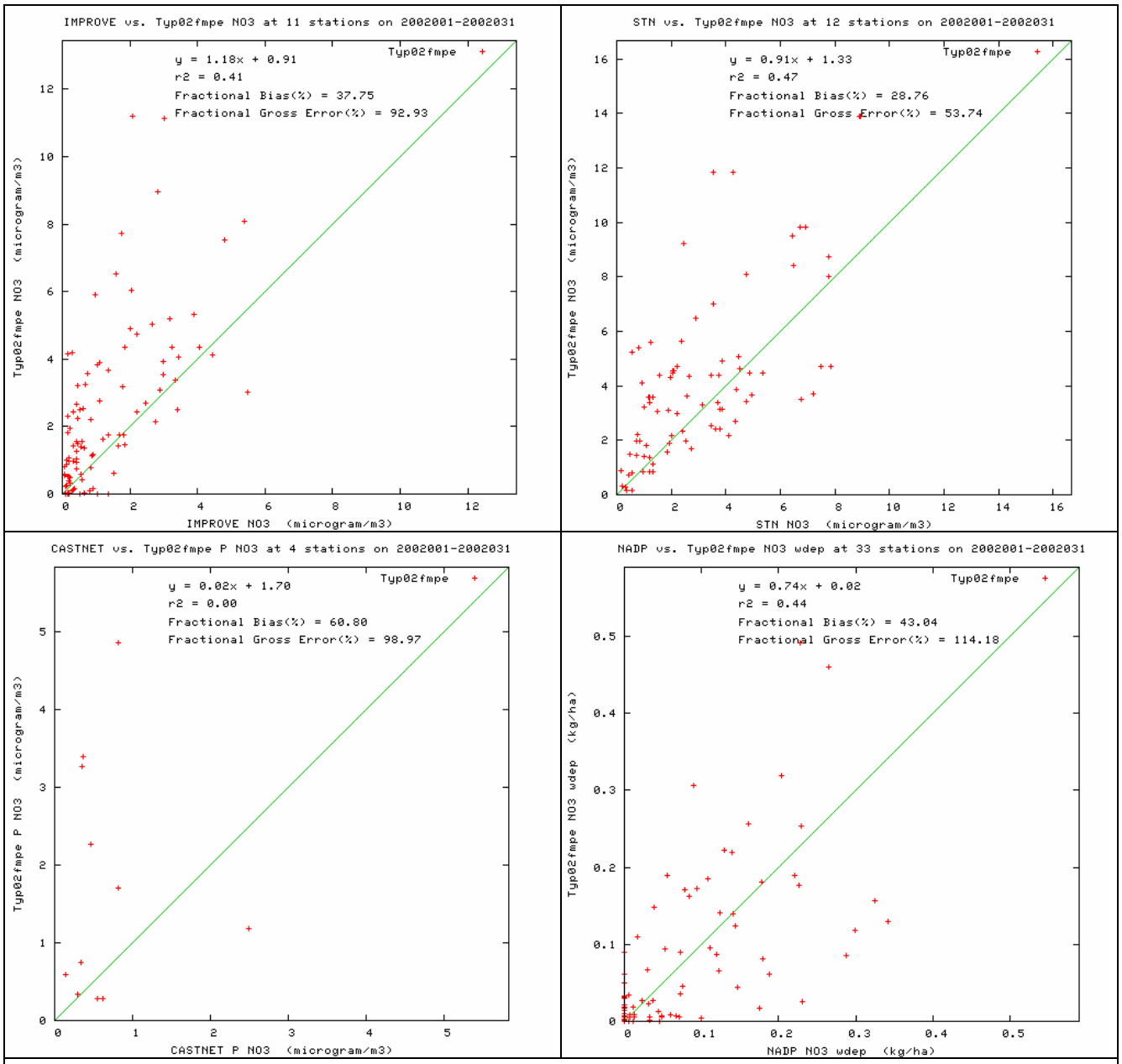
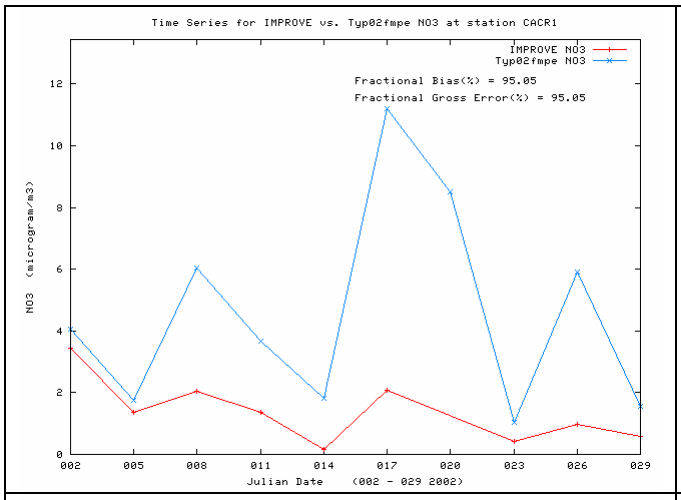
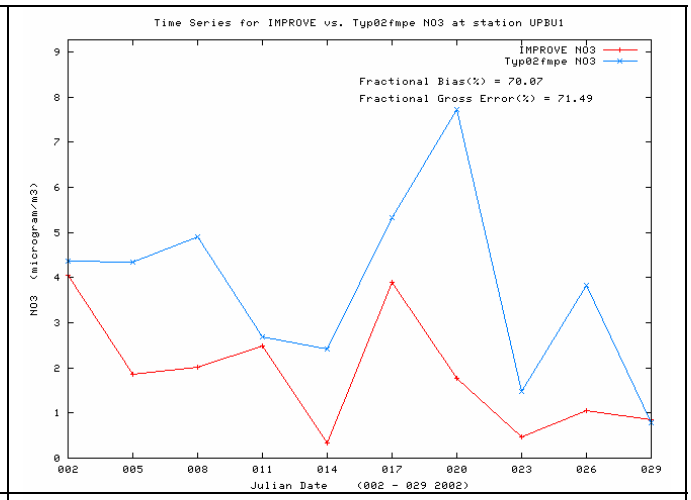
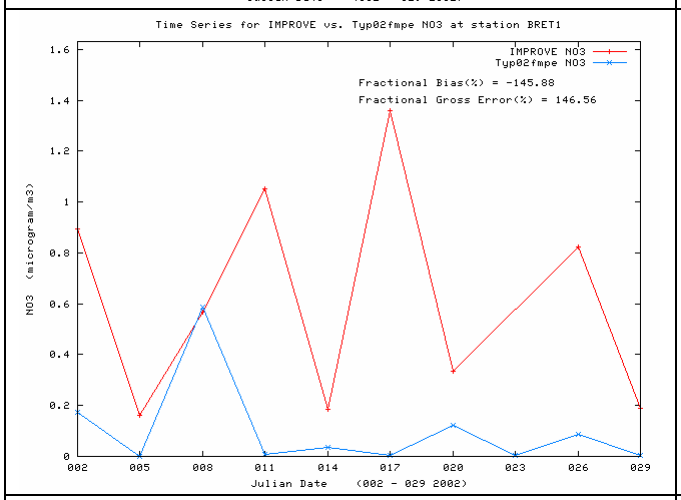
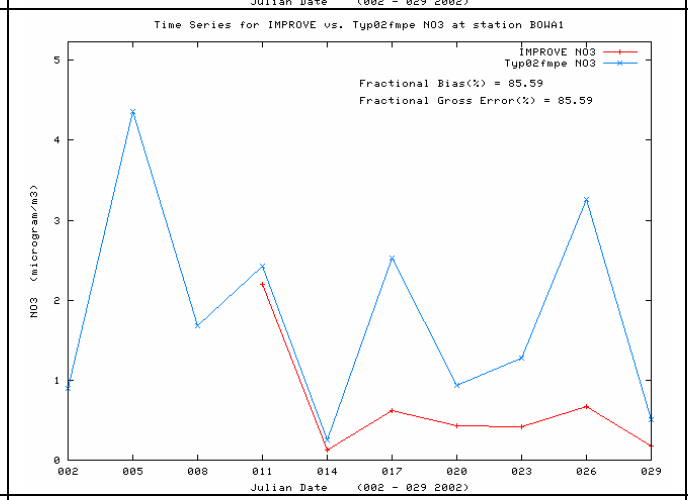


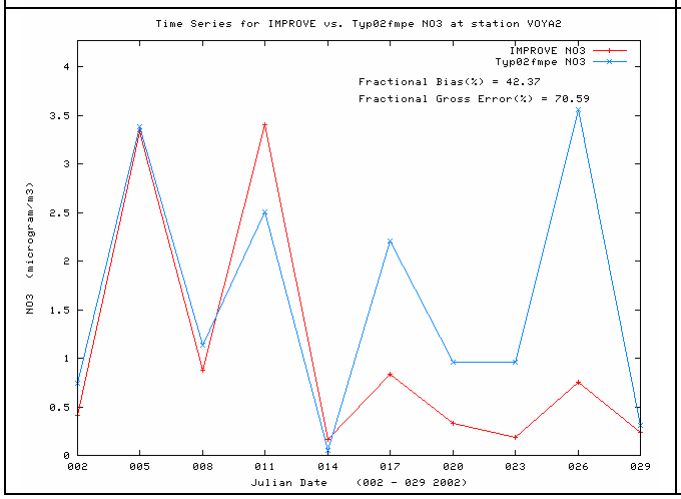
Figure C-10a. Scatter plots of predicted and observed nitrate (NO3) concentrations for January 2002 and sites in the CENRAP region using IMPROVE (top left), STN (top right), CASTNet (bottom left) and NADP monitoring networks using the CMAQ 2002 36 km Base F base case simulation.

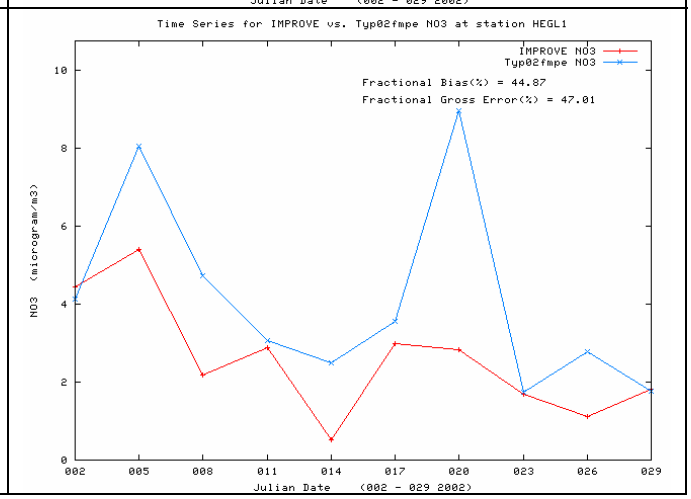

Time Series for IMPROVE vs. Typ02fmpe NO3 at station CACR1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 95.05
Fractional Gross Error(%) = 95.05
NO3 (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station UPBU1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 70.07
Fractional Gross Error(%) = 71.49
NO3 (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station BRET1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -145.88
Fractional Gross Error(%) = 146.56
NO3 (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station BOWA1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 85.59
Fractional Gross Error(%) = 85.59
NO3 (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station VOYA2
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 42.37
Fractional Gross Error(%) = 70.59
NO3 (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station HEGL1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 44.87
Fractional Gross Error(%) = 47.01
NO3 (microgram/m3)
Julian Date (002 - 029 2002)

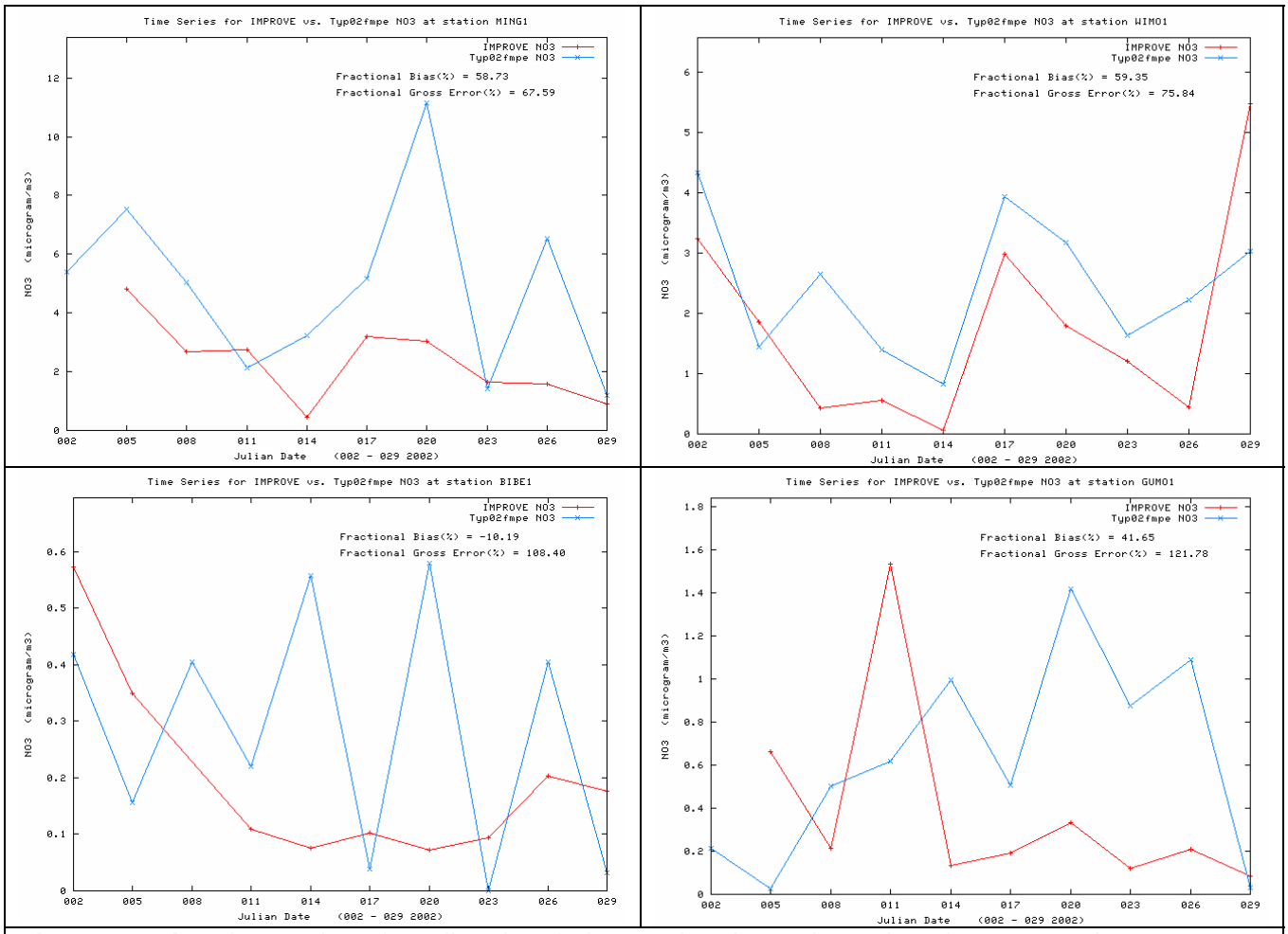


Figure C-10b. Time series of predicted and observed 24-hour nitrate (NO3) concentrations at CENRAP IMPROVE CLASS I AREA sites in January 2002 for CMAQ 2002 36 km Base F base case simulation.

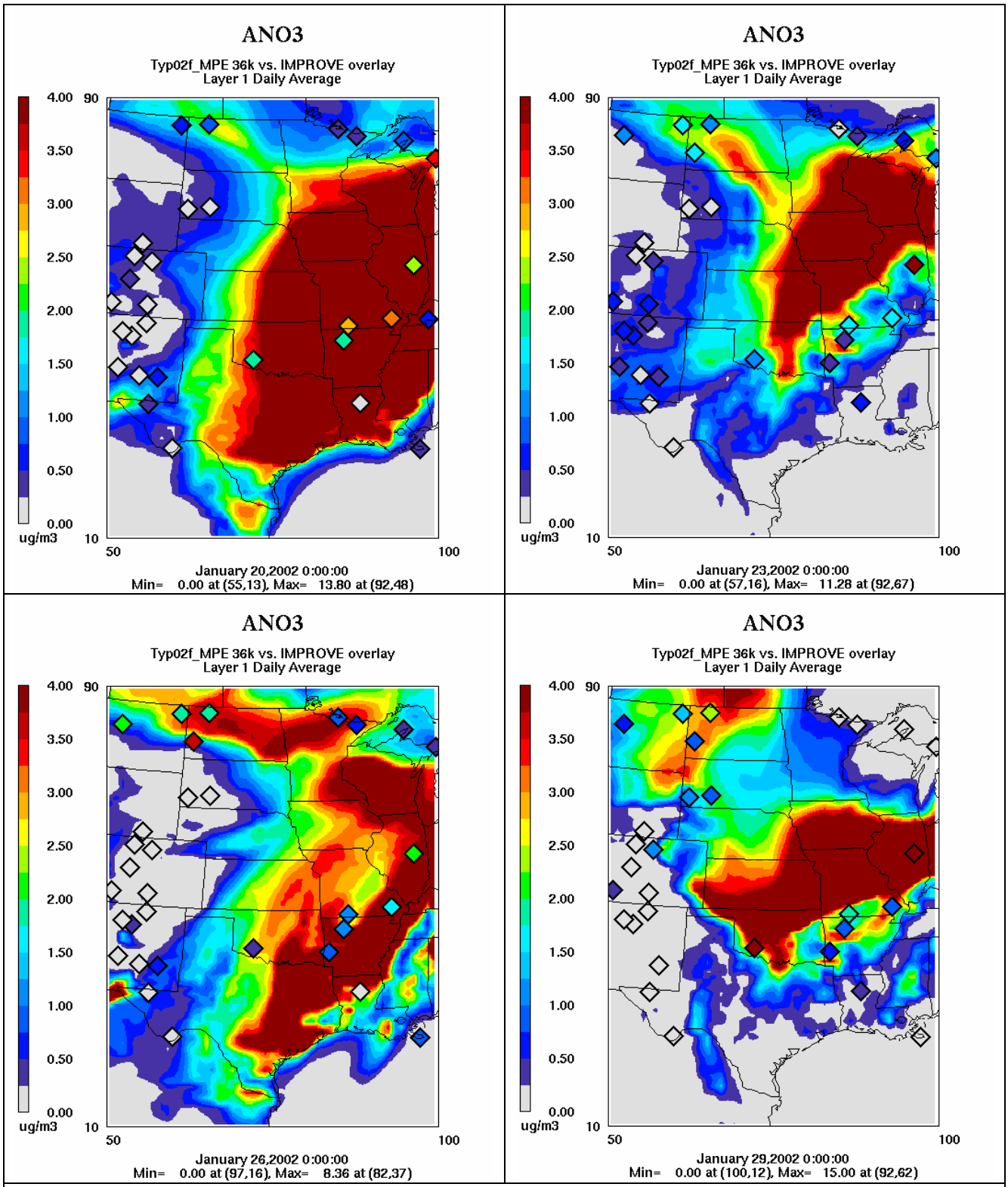


Figure C-10c. Spatial plot comparisons of the predicted and IMPROVE observed 24-hour NO3 concentrations for January 20, 23, 26 and 29, 2002.

C.3.2.2 NO3 in April 2002

Unlike the NO3 overestimation bias of January, the April NO3 performance is characterized by an underestimation bias (Figure C-11a). This under-prediction bias appears to be driven by near zero model predictions when the observed values are small (< 1 $\mu g/m^3$), but positive. This effect is especially noticeable in the NO3 time series (Figure C-11b) where at several sites the modeled NO3 concentrations foes to zero (e.g., BRET, BIBE, GUMO), whereas the observed values has an approximately 0.2 µg/m3 floor. The spatial maps suggest that the large April NO3 under-prediction bias indicated by the performance statistics is not as bad as they suggest (Figure C-11c). Mostly the model is predicting low NO3 values where low values are observed, just that the model approaches zero which results in a large relative difference with the observe values.

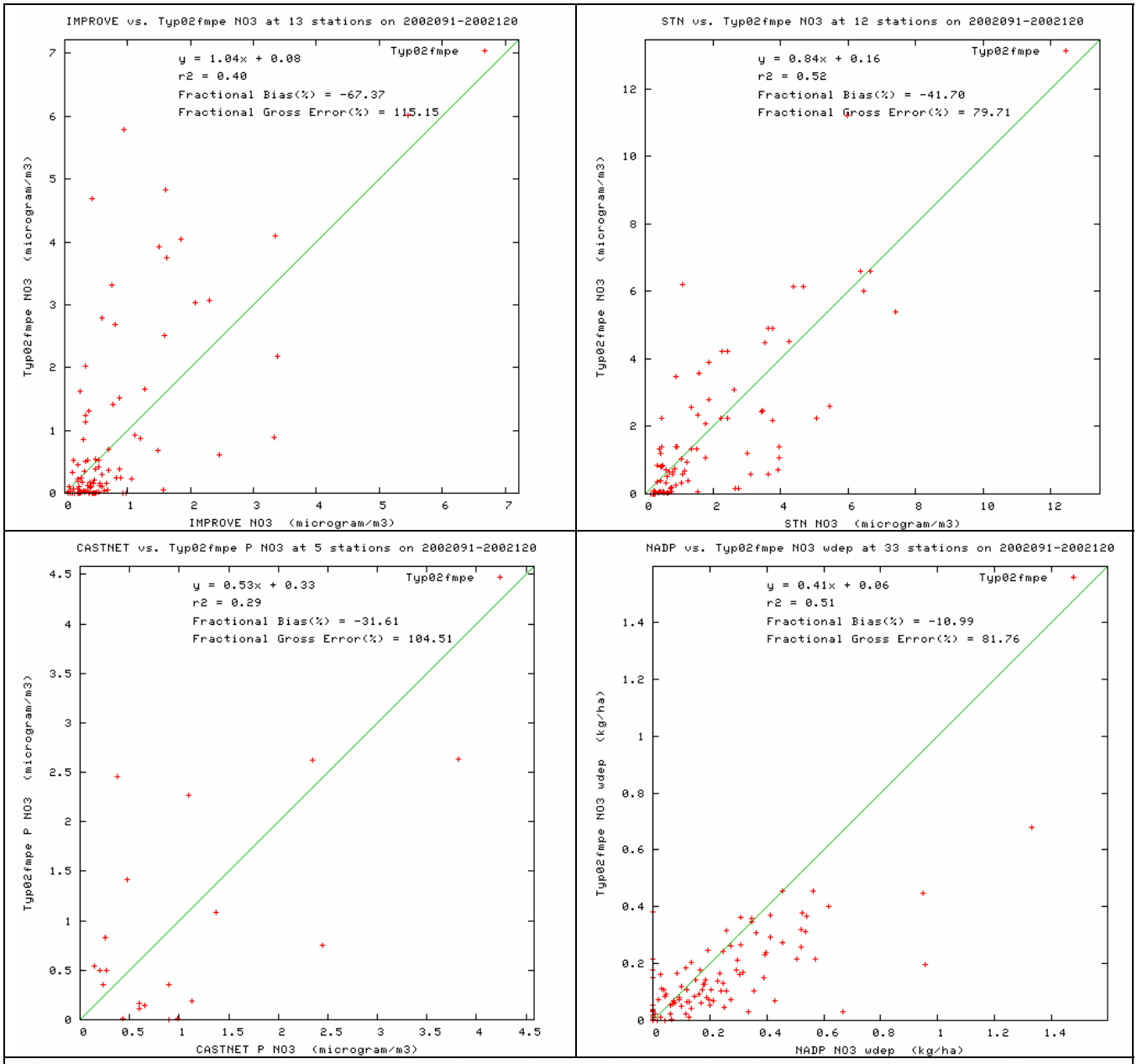
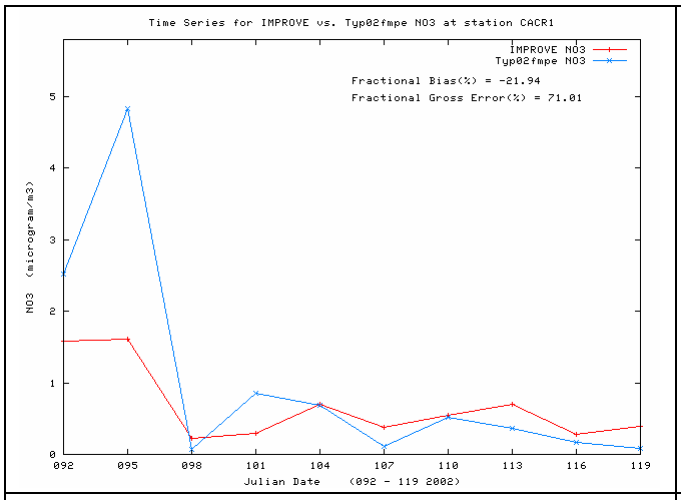
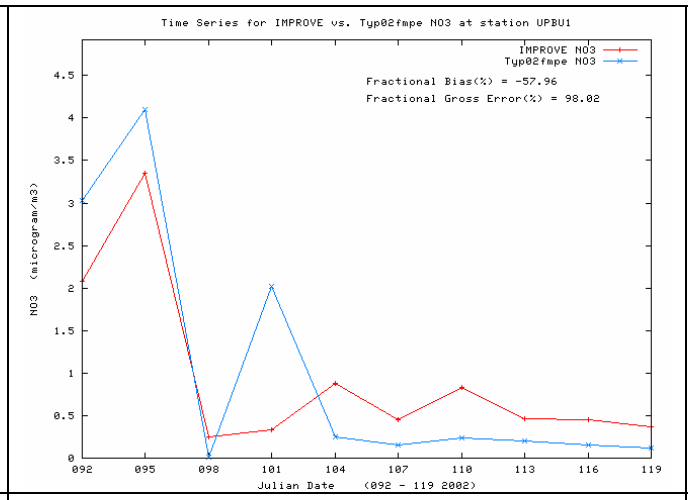
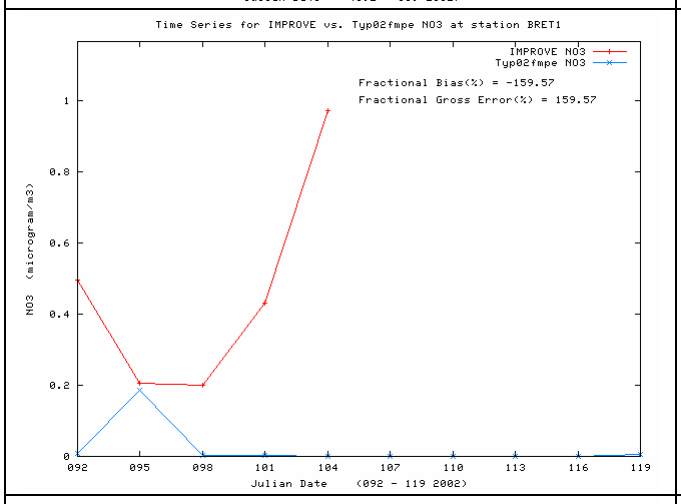
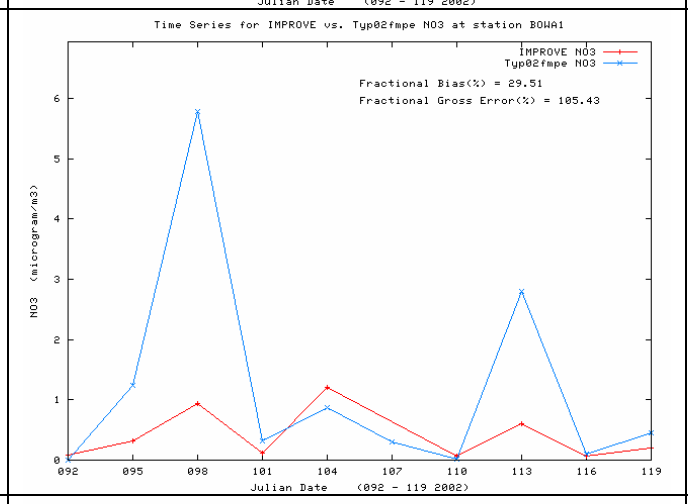


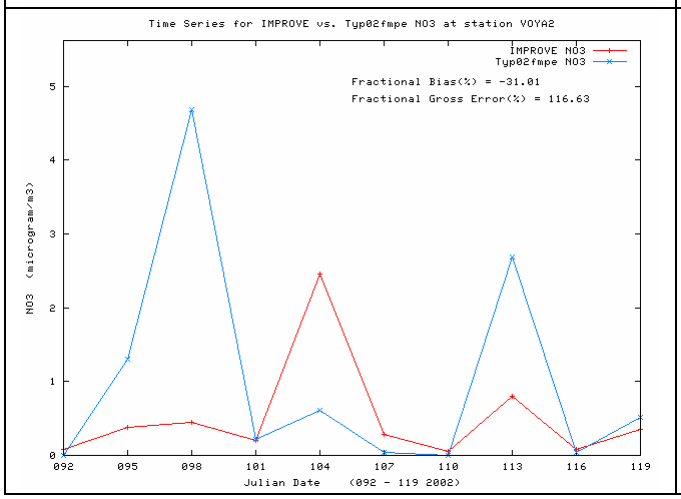
Figure C-11a. Scatter plots of predicted and observed nitrate (NO3) concentrations for April 2002 and sites in the CENRAP region using IMPROVE (top left), STN (top right), CASTNet (bottom left) and NADP monitoring networks using the CMAQ 2002 36 km Base F base case simulation.

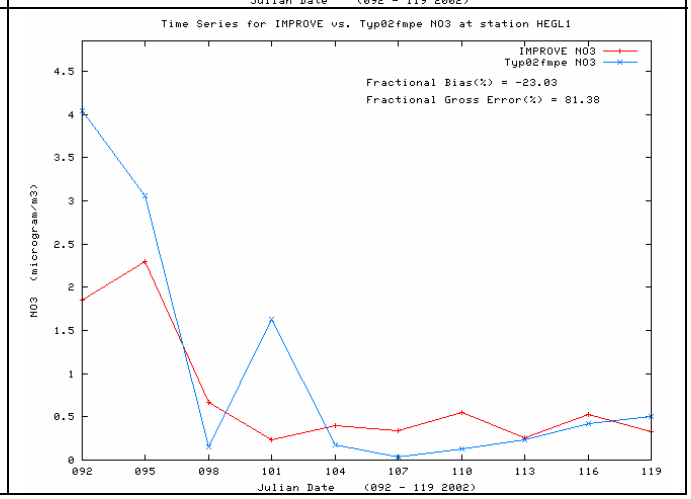

Time Series for IMPROVE vs. Typ02fmpe NO3 at station CACR1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -21.94
Fractional Gross Error(%) = 71.01
NO3 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station UPBU1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -57.96
Fractional Gross Error(%) = 98.02
NO3 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station BRET1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -159.57
Fractional Gross Error(%) = 159.57
NO3 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station BOWA1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 29.51
Fractional Gross Error(%) = 105.43
NO3 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station VOYA2
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -31.01
Fractional Gross Error(%) = 116.63
NO3 (microgram/m3)
Julian Date (092 - 119 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station HEGL1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -23.03
Fractional Gross Error(%) = 81.38
NO3 (microgram/m3)
Julian Date (092 - 119 2002)

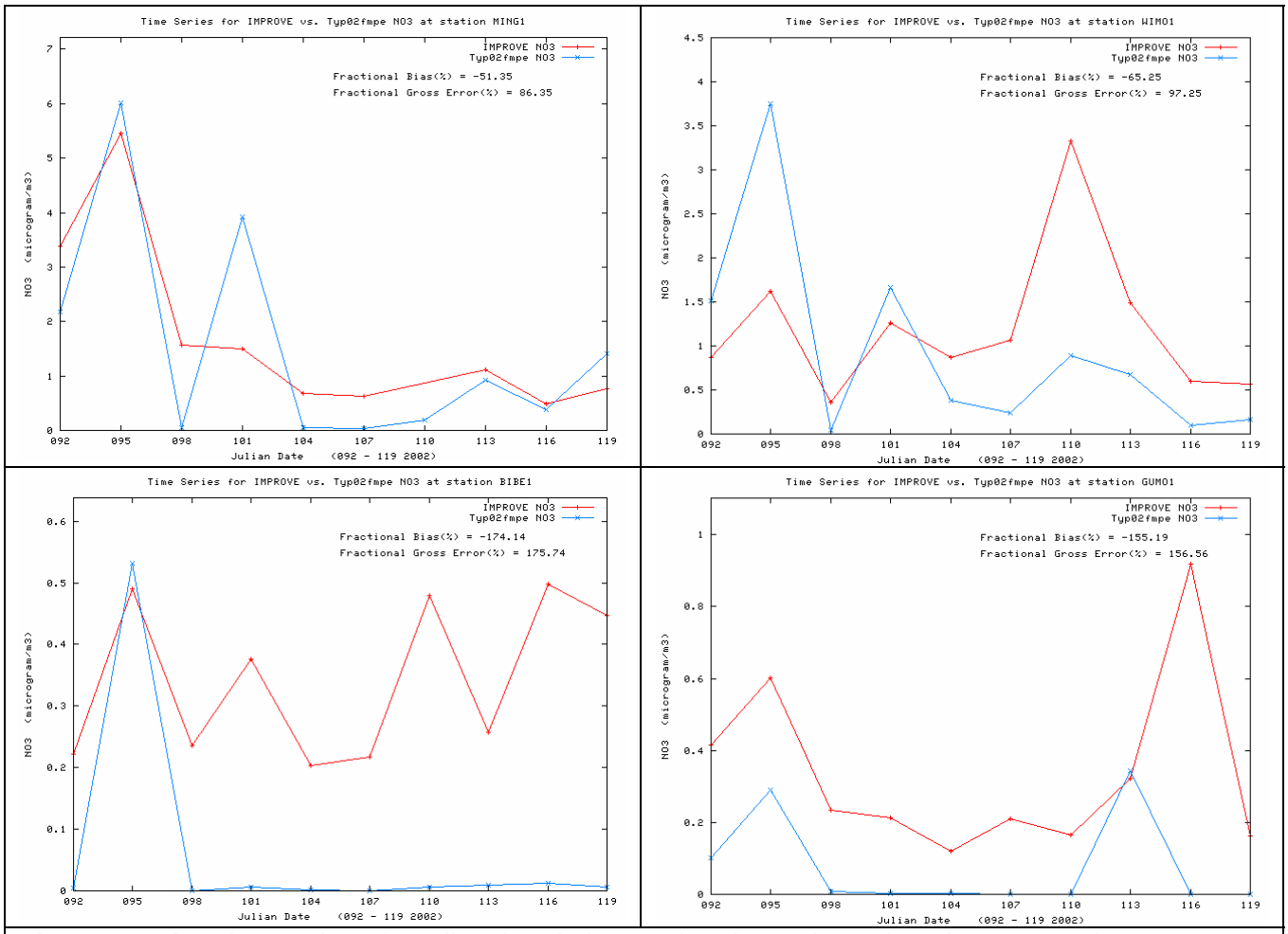


Figure C-11b. Time series of predicted and observed 24-hour nitrate (NO3) concentrations at CENRAP IMPROVE CLASS I AREA sites in April 2002 for CMAQ 2002 36 km Base F base case simulation.

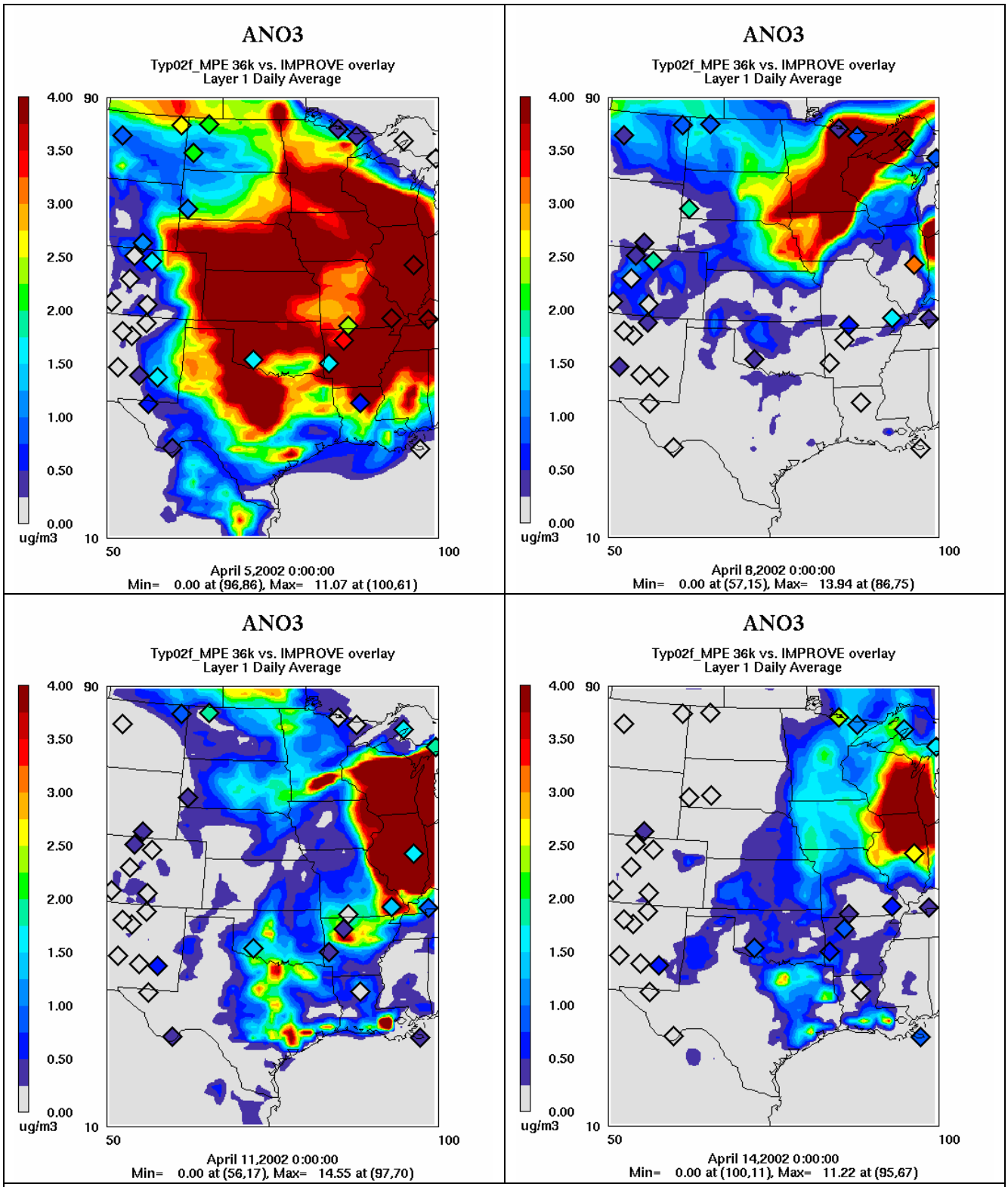


Figure C-11c. Spatial plot comparisons of the predicted and IMPROVE observed 24-hour NO3 concentrations for April 5, 8, 11 and 14, 2002.

C.3.2.3 NO3 in July 2002

NO3 performance in July 2002 is also characterized by a large under-prediction bias that is driven by the frequent occurrence of near zero modeled values (Figure C-12). Both the model and observations agree that NO3 is mostly extremely low in July, just the model produces near zero values and resultant poor performance statistics.

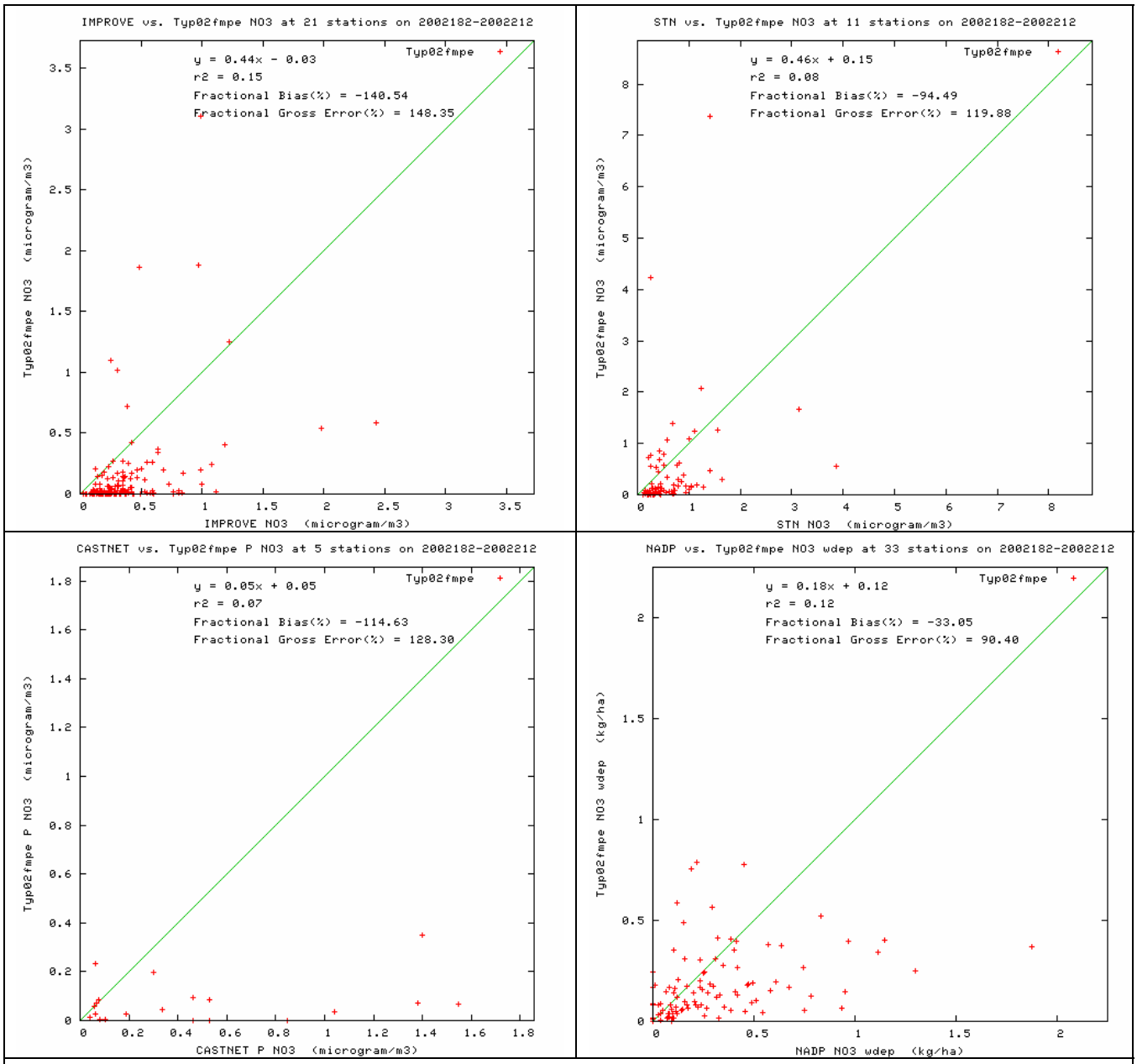
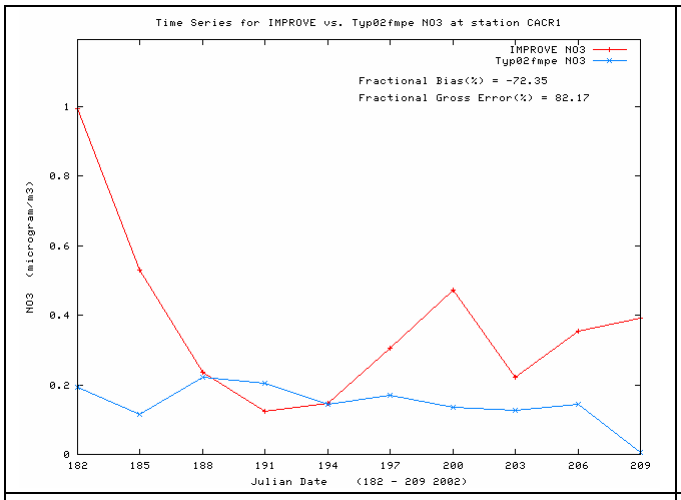
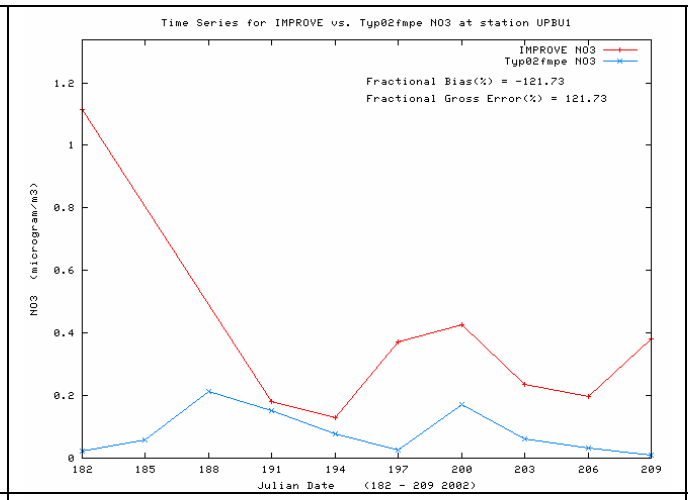
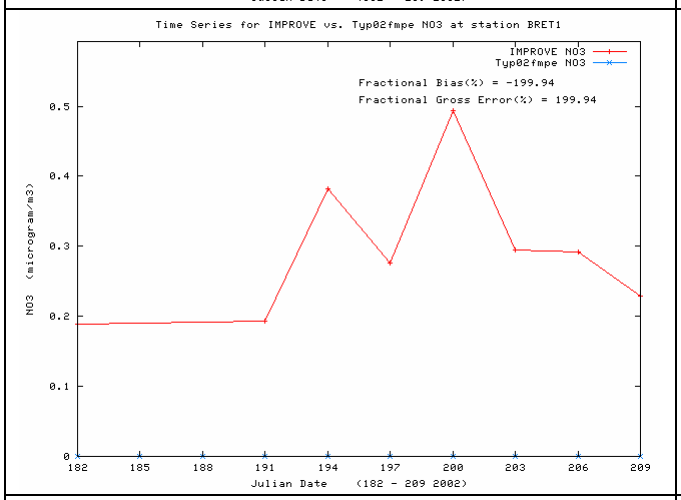
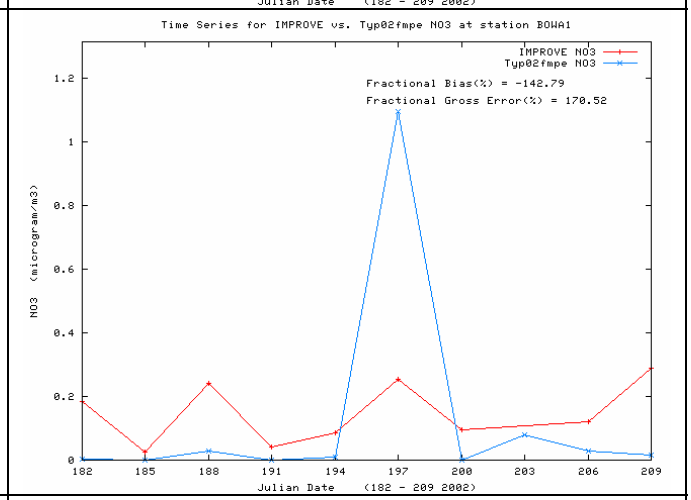


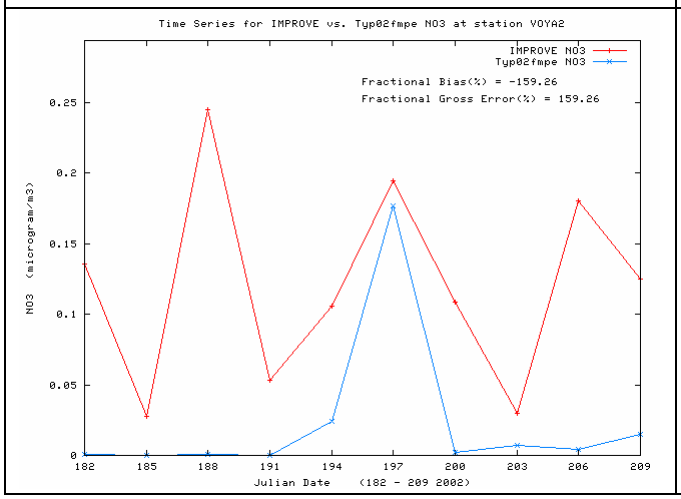
Figure C-12a. Scatter plots of predicted and observed nitrate (NO3) concentrations for July 2002 and sites in the CENRAP region using IMPROVE (top left), STN (top right), CASTNet (bottom left) and NADP monitoring networks using the CMAQ 2002 36 km Base F base case simulation.

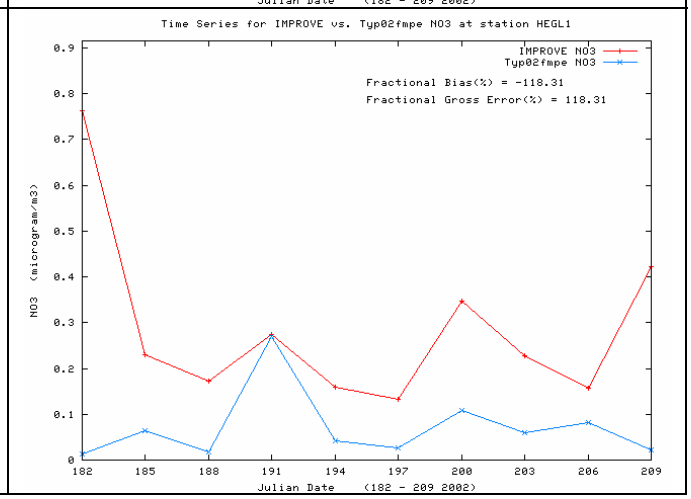

Time Series for IMPROVE vs. Typ02fmpe NO3 at station CACR1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -72.35
Fractional Gross Error(%) = 82.17
NO3 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station UPBU1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -121.73
Fractional Gross Error(%) = 121.73
NO3 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station BRET1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -199.94
Fractional Gross Error(%) = 199.94
NO3 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station BOWA1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -142.79
Fractional Gross Error(%) = 170.52
NO3 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station VOYA2
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -159.26
Fractional Gross Error(%) = 159.26
NO3 (microgram/m3)
Julian Date (182 - 209 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station HEGL1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -118.31
Fractional Gross Error(%) = 118.31
NO3 (microgram/m3)
Julian Date (182 - 209 2002)

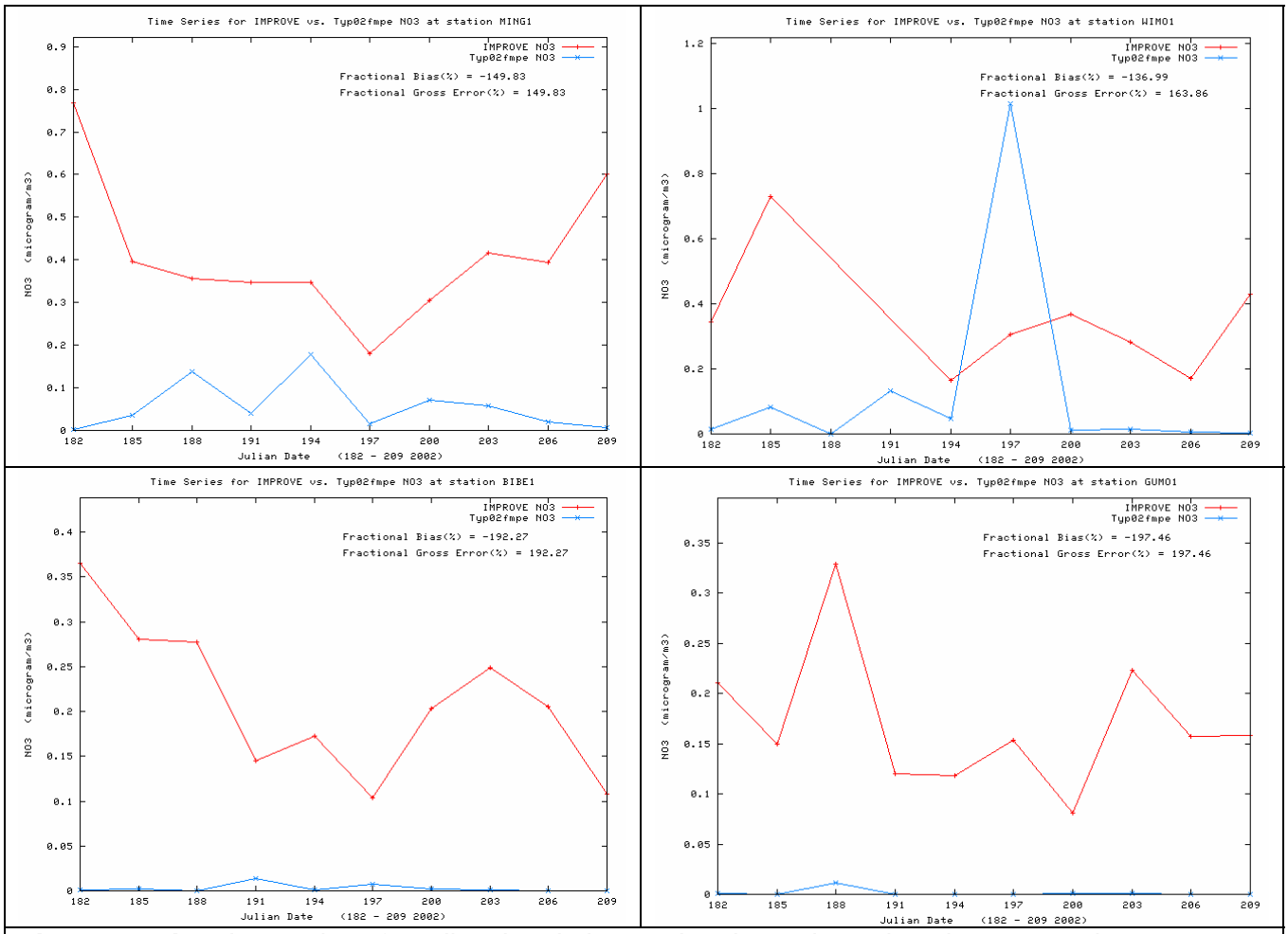


Figure C-12b. Time series of predicted and observed 24-hour nitrate (NO3) concentrations at CENRAP IMPROVE CLASS I AREA sites in July 2002 for CMAQ 2002 36 km Base F base case simulation.

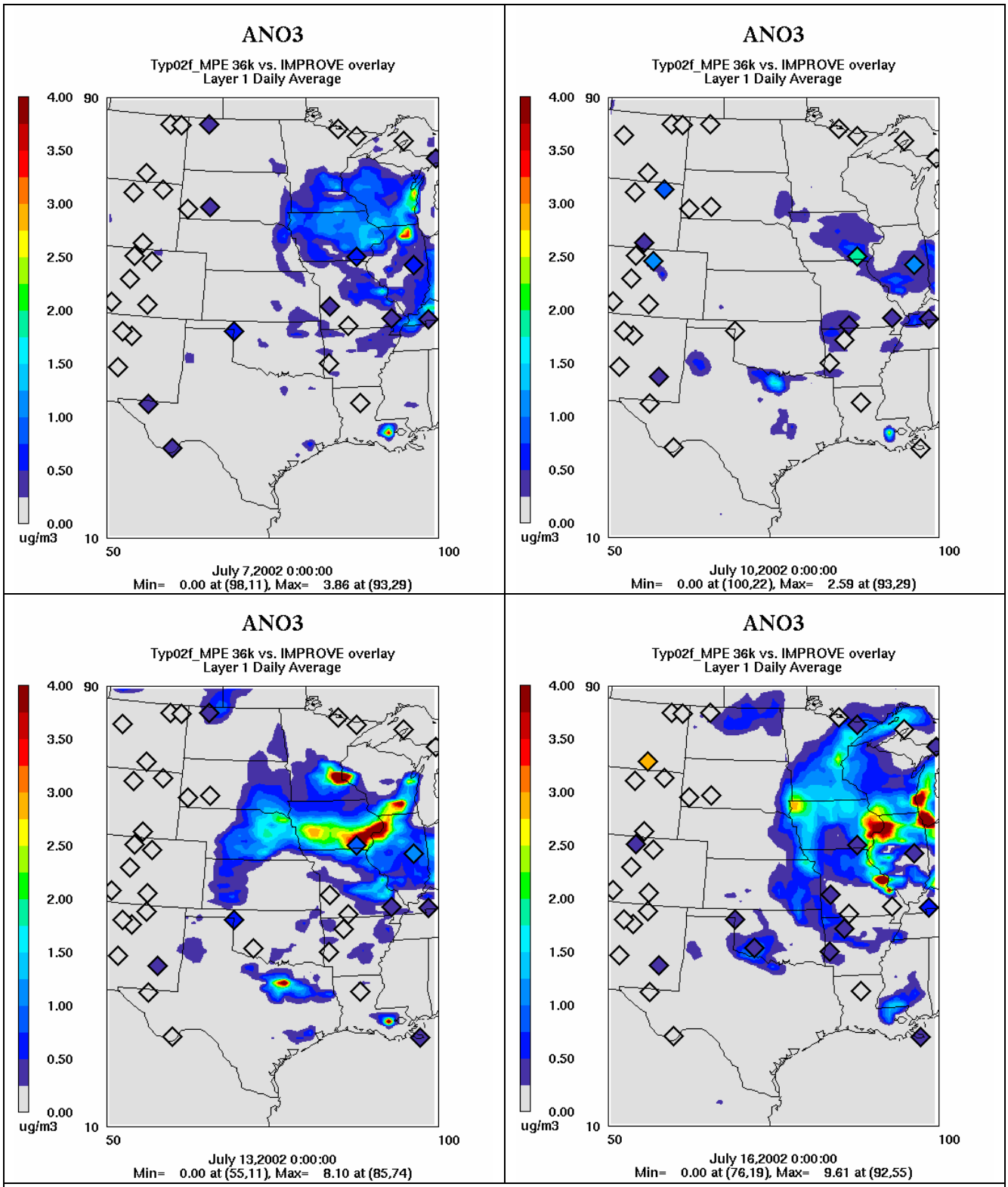


Figure C-12c. Spatial plot comparisons of the predicted and IMPROVE observed 24-hour NO3 concentrations for July 7, 10, 13 and 16, 2002.

C.3.2.4 NO3 in October 2002

Like January and unlike April and July, in October the model has a net NO3 overestimation bias of about 30%-40% (Figure C-13a). This overestimation bias occurs at all sites but BRET, BIBE and GUMO that exhibit a NO3 underestimation bias (Figure C-13b). The spatial maps suggest that the modeled elevated NO3 concentrations are more wide-spread and less spotty than observed.

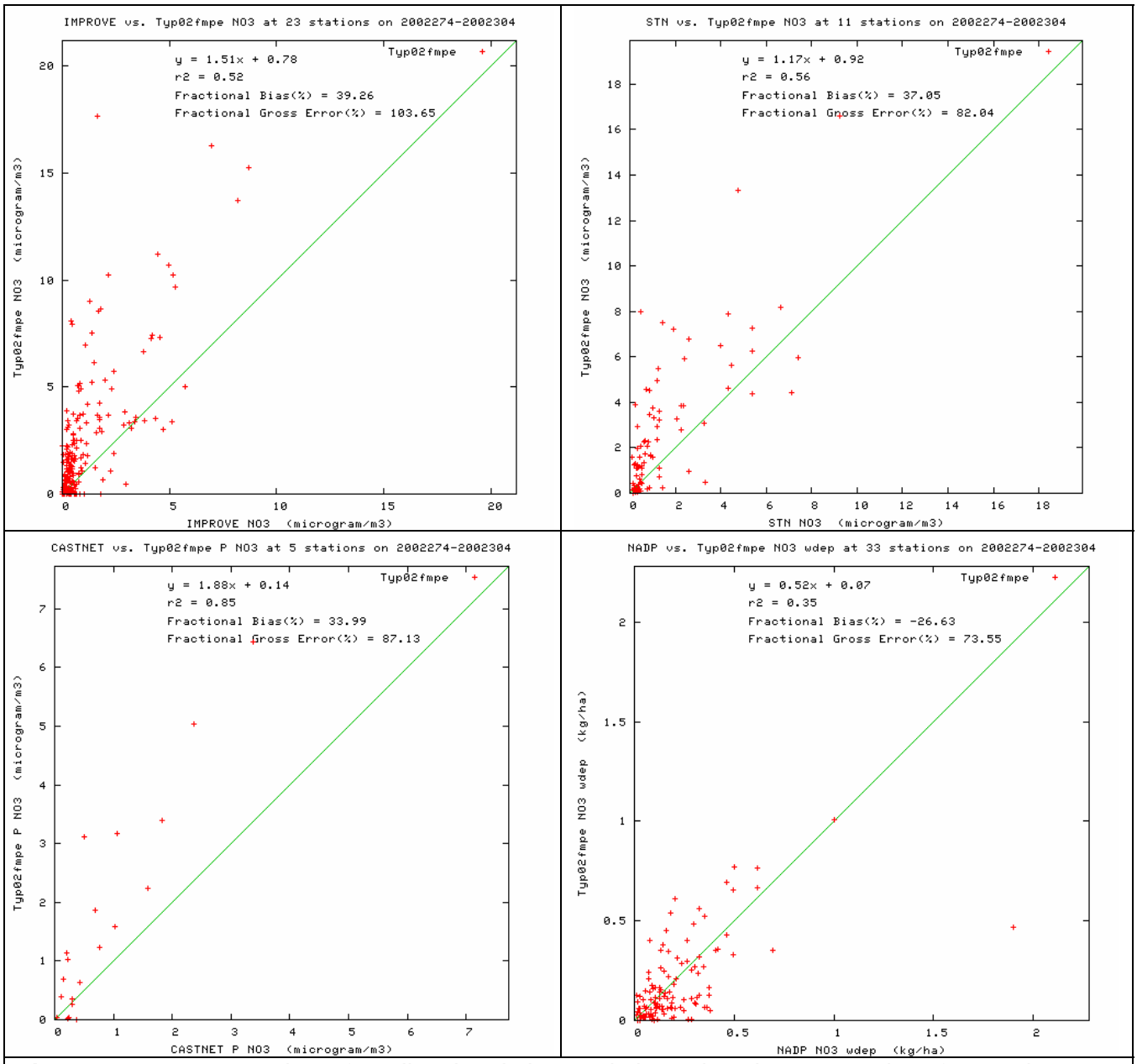
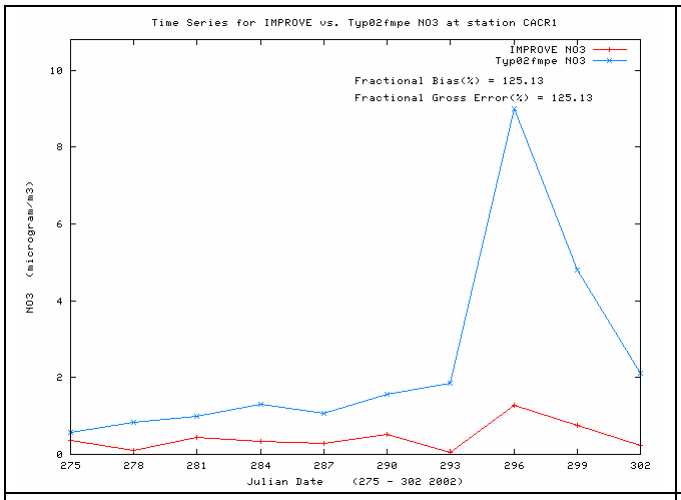
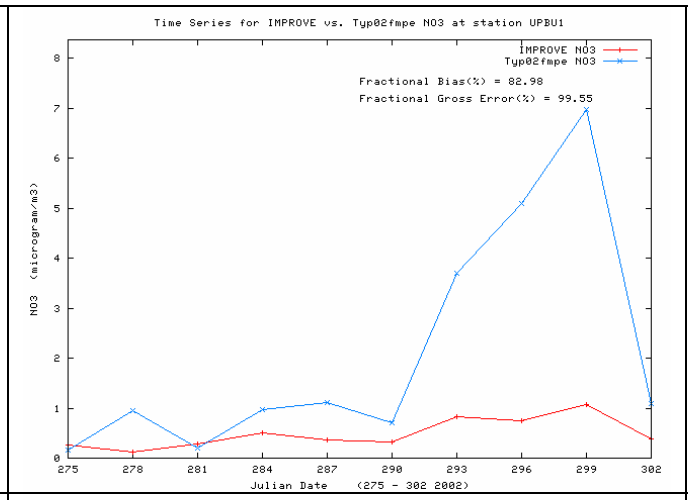
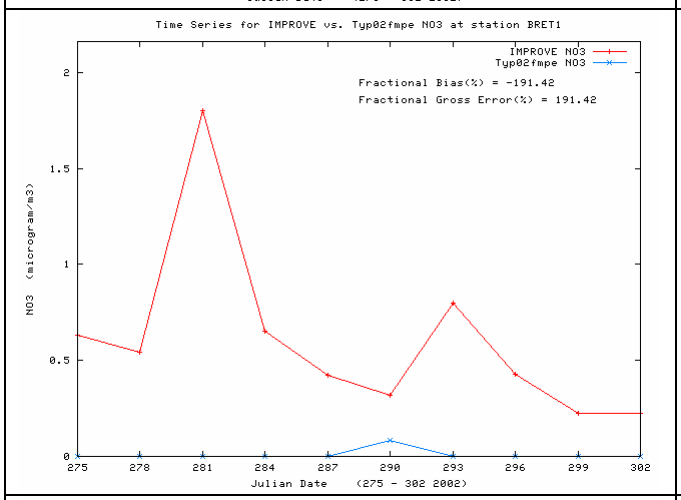
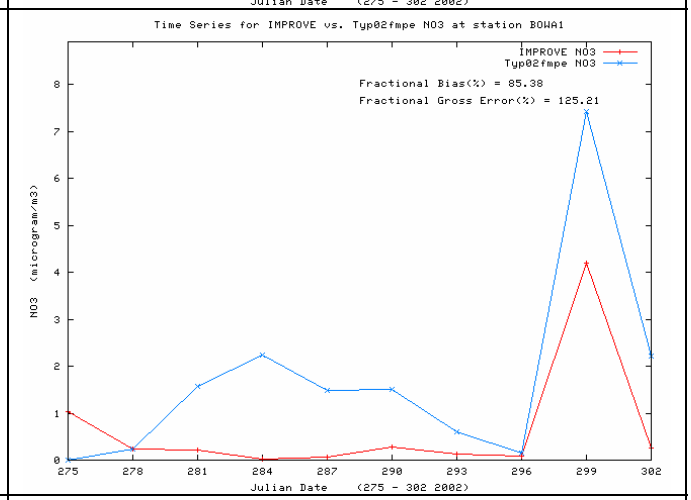


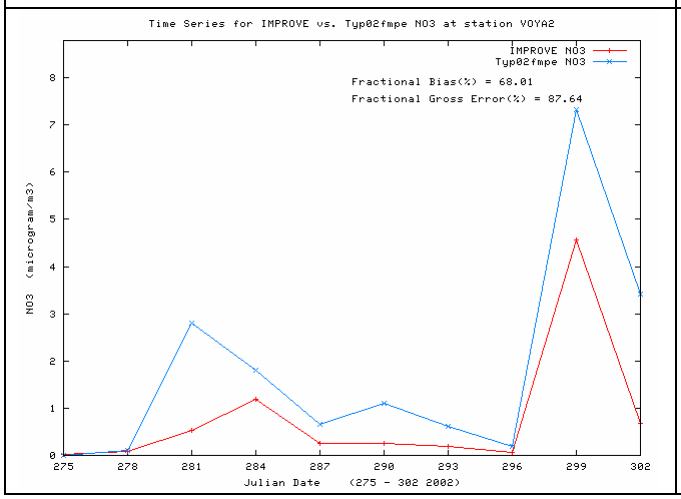
Figure C-13a. Scatter plots of predicted and observed nitrate (NO3) concentrations for October 2002 and sites in the CENRAP region using IMPROVE (top left), STN (top right), CASTNet (bottom left) and NADP monitoring networks using the CMAQ 2002 36 km Base F base case simulation.

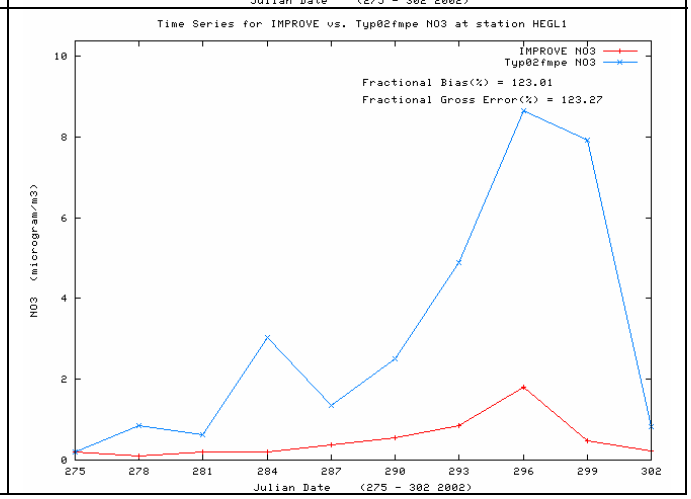

Time Series for IMPROVE vs. Typ02fmpe NO3 at station CACR1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 125.13
Fractional Gross Error(%) = 125.13
NO3 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station UPBU1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 82.98
Fractional Gross Error(%) = 99.55
NO3 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station BRET1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = -191.42
Fractional Gross Error(%) = 191.42
NO3 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station BOWA1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 85.38
Fractional Gross Error(%) = 125.21
NO3 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station VOYA2
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 68.01
Fractional Gross Error(%) = 87.64
NO3 (microgram/m3)
Julian Date (275 - 302 2002)


Time Series for IMPROVE vs. Typ02fmpe NO3 at station HEGL1
IMPROVE NO3
Typ02fmpe NO3
Fractional Bias(%) = 123.01
Fractional Gross Error(%) = 123.27
NO3 (microgram/m3)
Julian Date (275 - 302 2002)

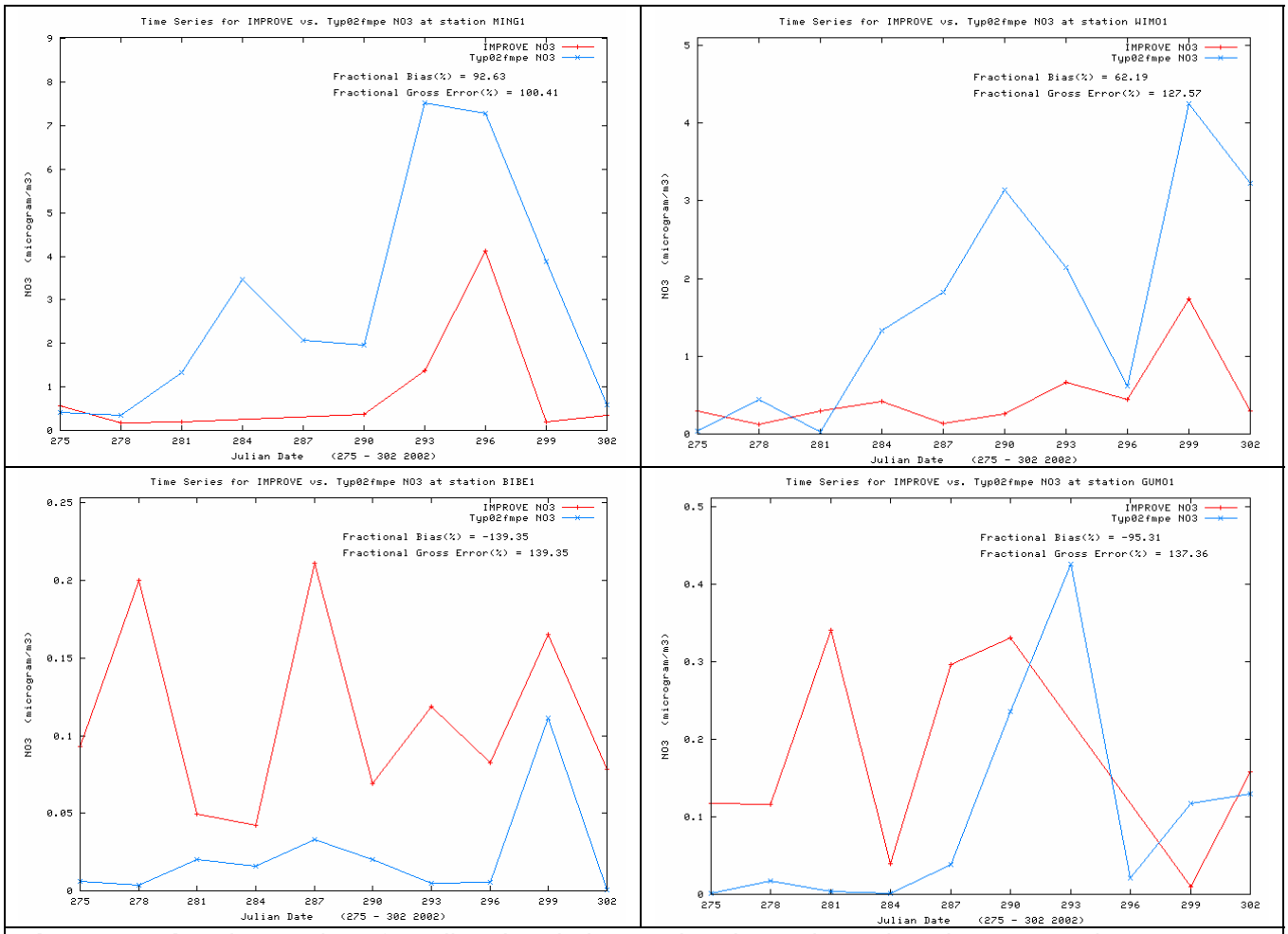


Figure C-13b. Time series of predicted and observed 24-hour nitrate (NO3) concentrations at CENRAP IMPROVE CLASS I AREA sites in October 2002 for CMAQ 2002 36 km Base F base case simulation.

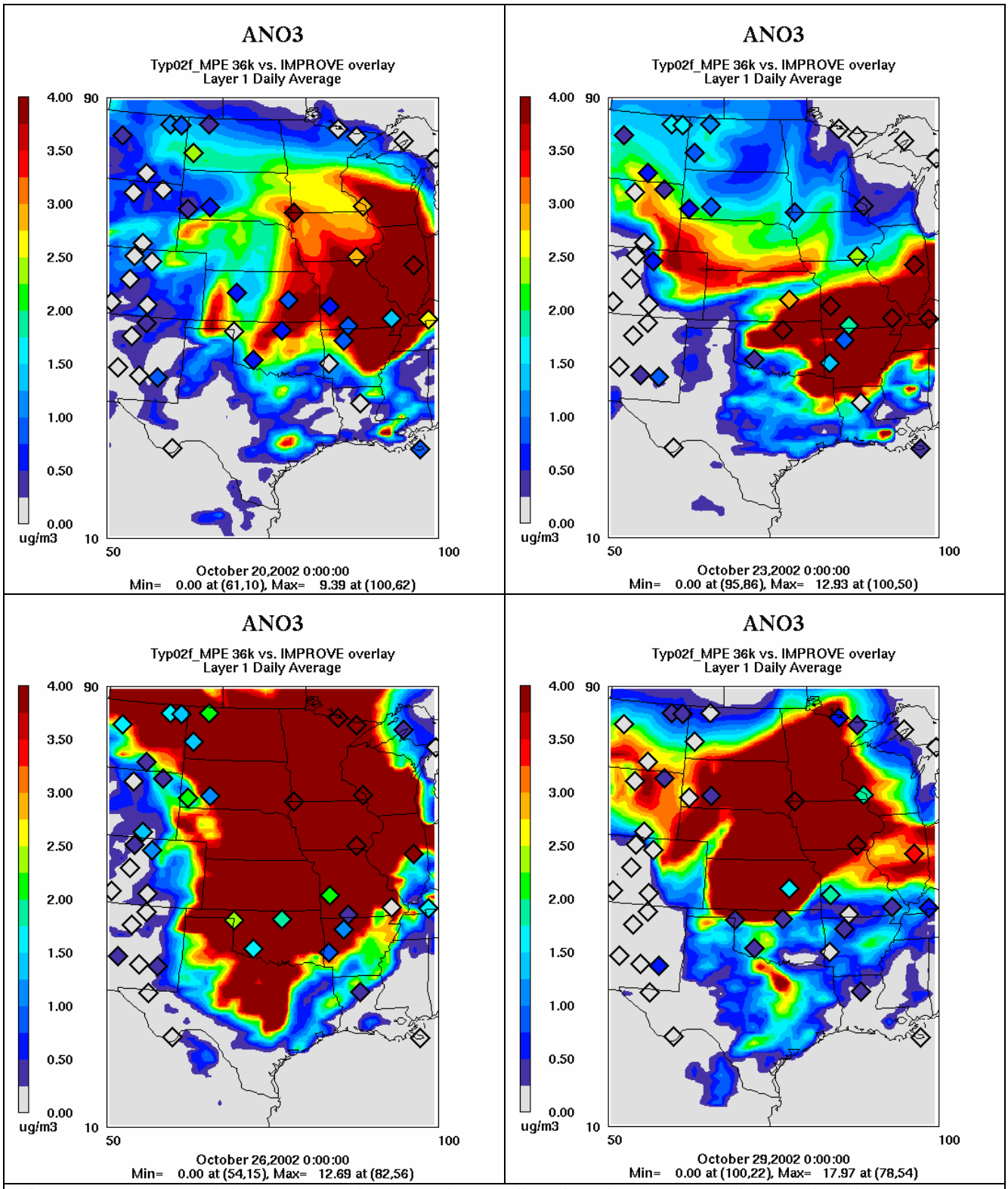


Figure C-13c. Spatial plot comparisons of the predicted and IMPROVE observed 24-hour NO3 concentrations for October 20, 23, 26 and 29, 2002.

C.3.2.5 NO3 Monthly Bias and Error

The monthly fractional bias values for NO3 clearly show the summer underestimation and winter overestimation bias (Figure C-14). The summer underestimation bias is more severe exceeding -100%, whereas the winter overestimation is closer to 50%. The fractional errors in the summer are also greater than in the winter with some values exceeding 100%. So based on statistics alone, it appears the summer underestimation bias is a bigger concern than the winter overestimation bias. However, the Bugle Plots in Figure C-15 paint a different picture entirely. The summer underestimation bias occurred when NO3 is low and is not an important component of PM and visibility impairment. These summer values occur in the flared horn part of the Bugle Plot and in fact the summer NO3 performance mostly achieves the model performance goal and always achieves the performance criteria. Whereas the winter overstated NO3 performance mostly doesn't meet the performance goal and there are even some months/networks that don't meet the performance criteria.

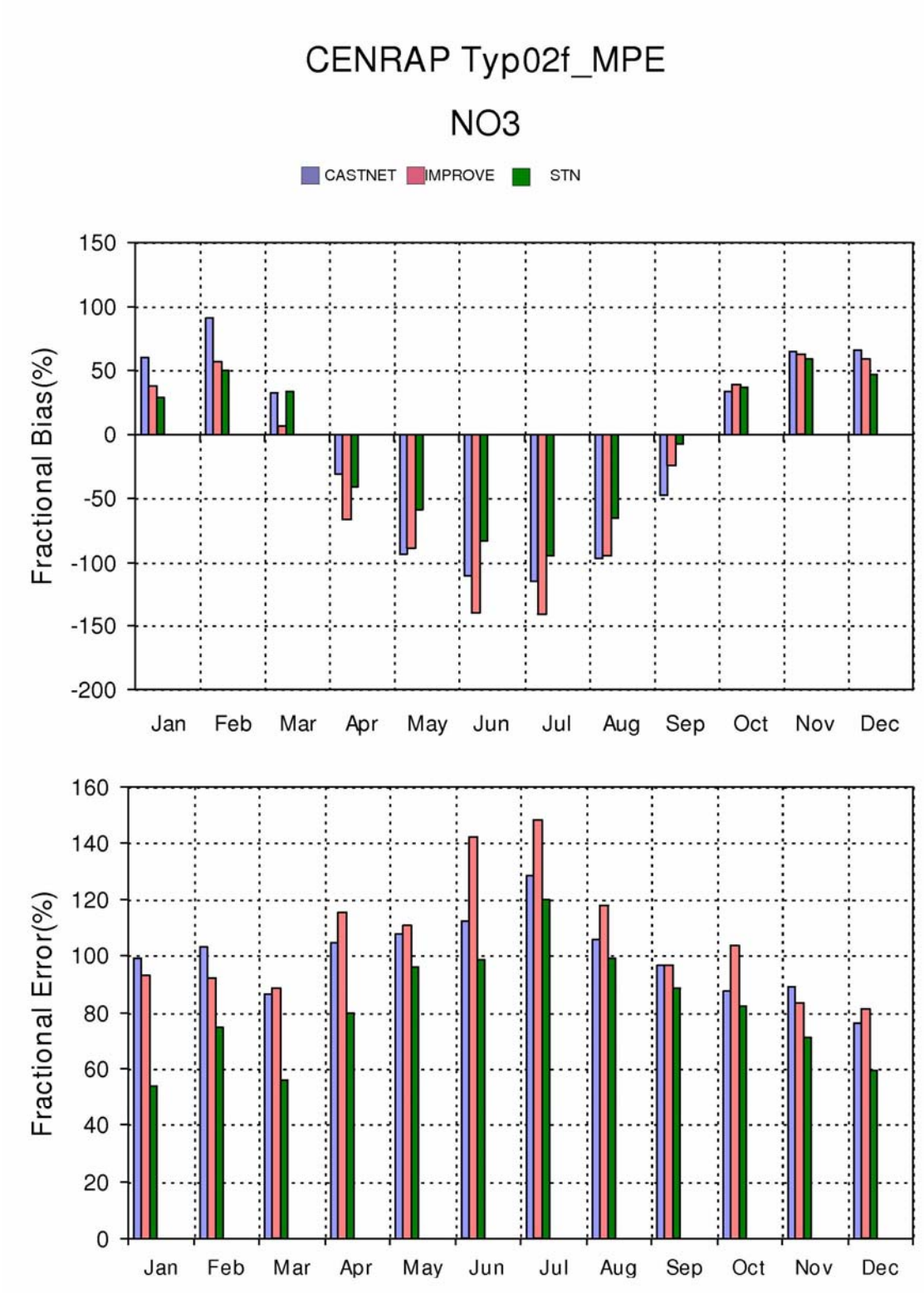


Figure C-14. Monthly NO3 fractional bias (top) and fractional gross error (bottom) statistical measures for IMPROVE, STN and CASTNet monitoring sites in the CENRAP region.

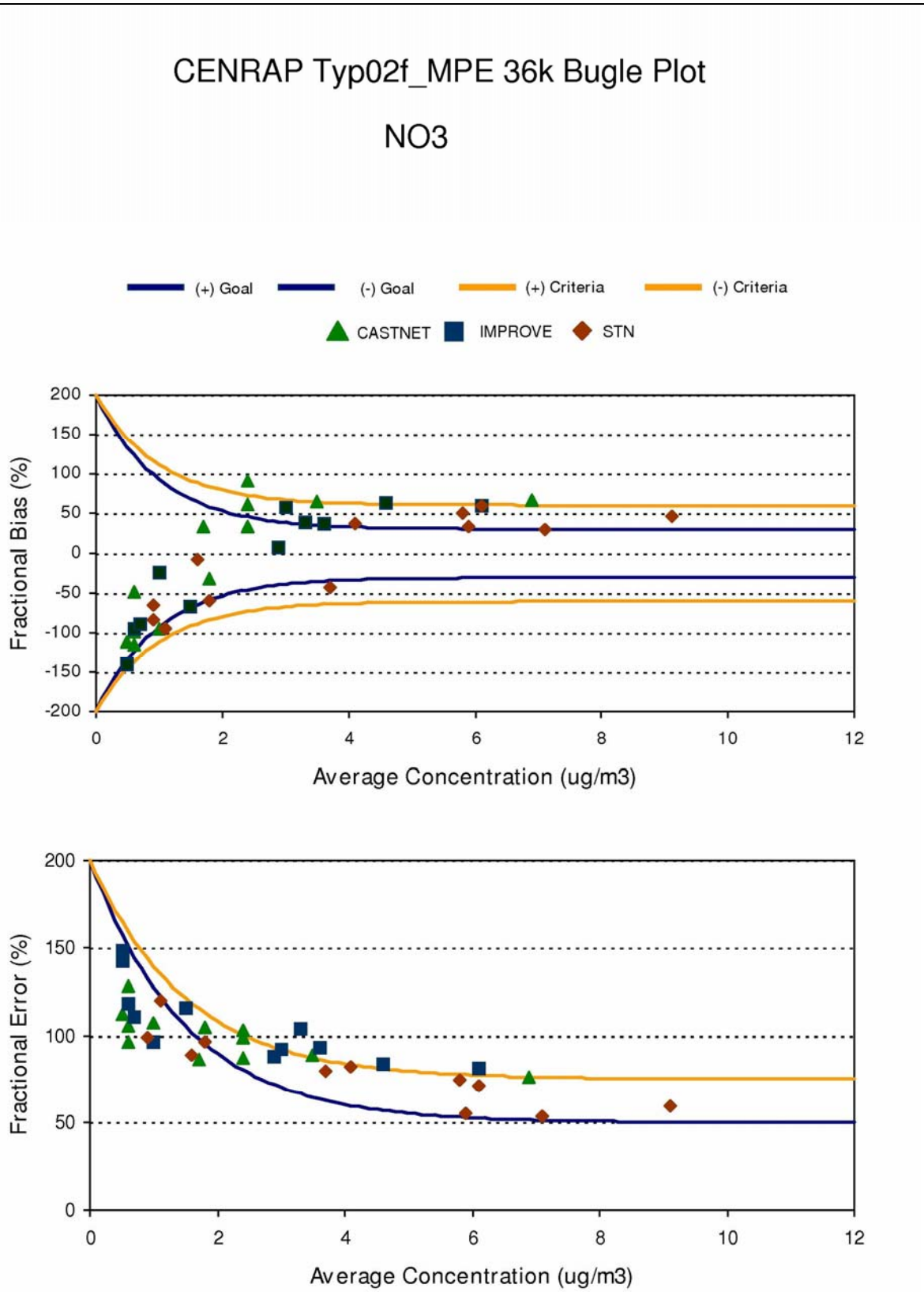


Figure C-15. Bugle Plots of monthly fractional bias (top) and fractional gross error (bottom) and comparisons with model performance goals and criteria for NO3 and IMPROVE, STN and CASTNet monitoring sites in the CENRAP region.

C.3.3 Organic Matter Carbon (OMC) Monthly Model Performance

Organic Matter Carbon (OMC) model performance is presented below. There is incommensurability between the observed and modeled OMC, the model provides estimates of OMC that includes Organic Carbon (OC) as well as other elements attached to the OC (e.g., oxygen), whereas the monitoring networks measure just the carbon component of OMC (i.e., OC). Consequently, the measured OC must be adjusted to OMC for comparison with the model to account for the additional elements attached to the carbon. The OMC/OC ratio is not constant and depends in part on the age of the OMC with fresh OMC having lower OMC/OC ratios than aged OMC. The original IMPROVE equation used an OMC/OC ratio of 1.4 based mainly on urban-oriented measurements. The new IMPROVE equation uses an OMC/OC ratio of 1.8 reflecting the fact that OMC at the more rural IMPROVE monitors is more aged than urban OMC. Thus, selecting a single OMC/OC ratio for adjusting the measured OC to OMC for the model evaluation is somewhat problematic when we have both urban (STN) and rural (IMPPROVE) monitors. In addition, measured OC also has substantial uncertainty with different measurement techniques differing by as much as 50% (Solomon et al., 2005). A 1.4 OMC/OC ratio was used to convert the measured OC to OMC for the model performance evaluation.

C.3.3.1 OMC in January 2002

Figure C-16a displays scatter plots and performance statistics for January OMC model performance across the IMPROVE and STN sites in the CENRAP region. OMC model performance is fairly with near zero bias across the IMPROVE sites, -38% underestimation bias across the STN sites and errors of ~50%. The underestimation of OMC at the urban STN sites is a common occurrence in air quality modeling and may indicate a missing source of urban OMC. With the exception of an underestimation bias at Breton Island and an over-prediction bias at the two Texas IMPORVE sites (BIBE and GUMO), the model reproduces the observed OMC time series in January fairly well. The modeled spatial distribution of OMC is in general agreement with the observations although it sometimes captures the elevated values on some days (e.g., January 29, 2002 in central Illinois) and misses it on others (e.g., January 26, 2002 at Mingo).

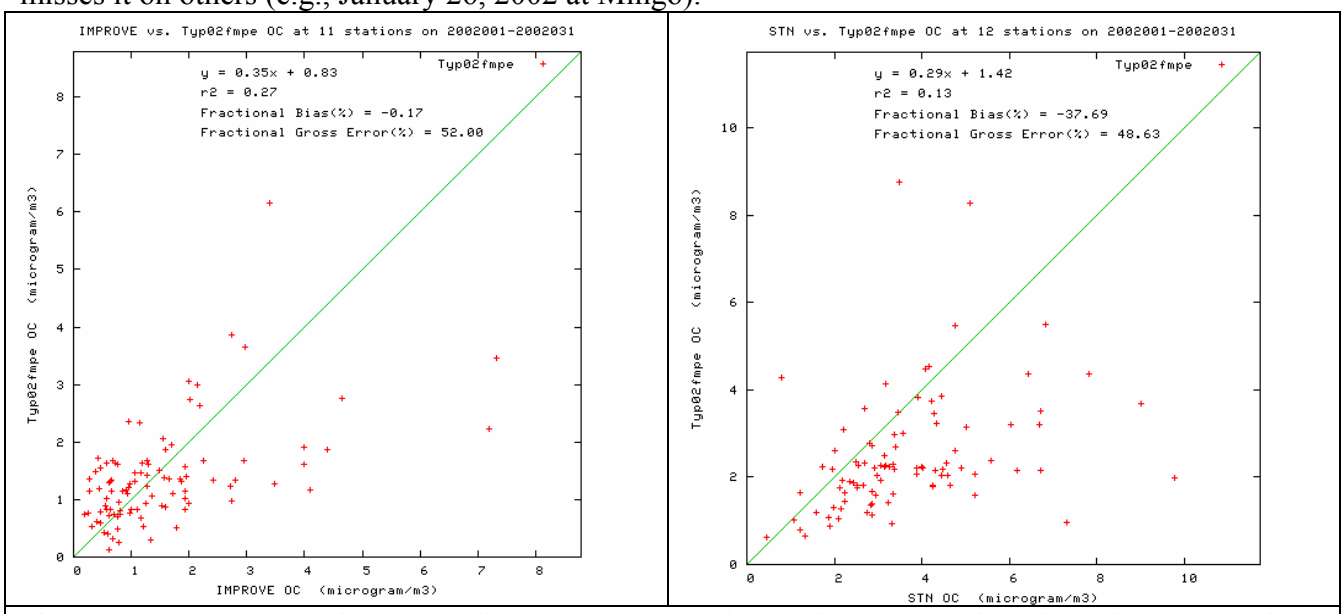
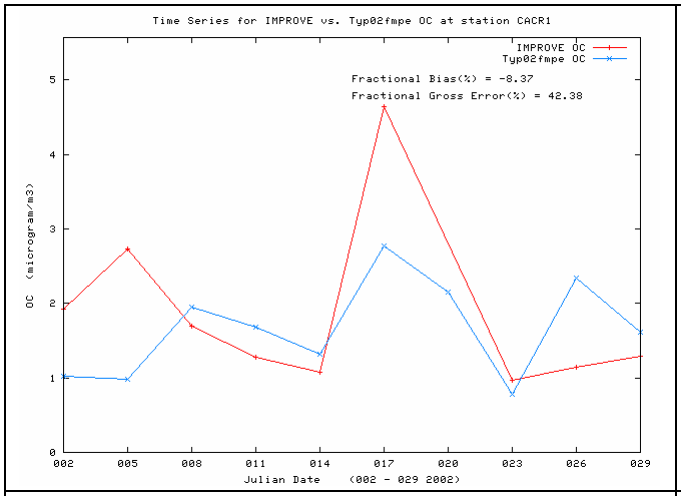
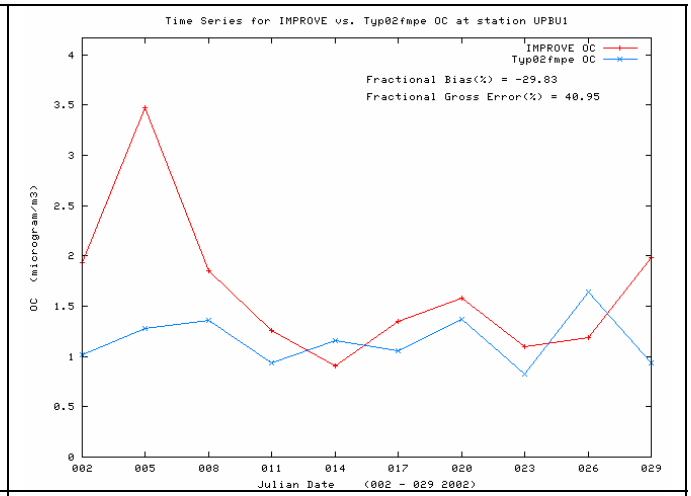
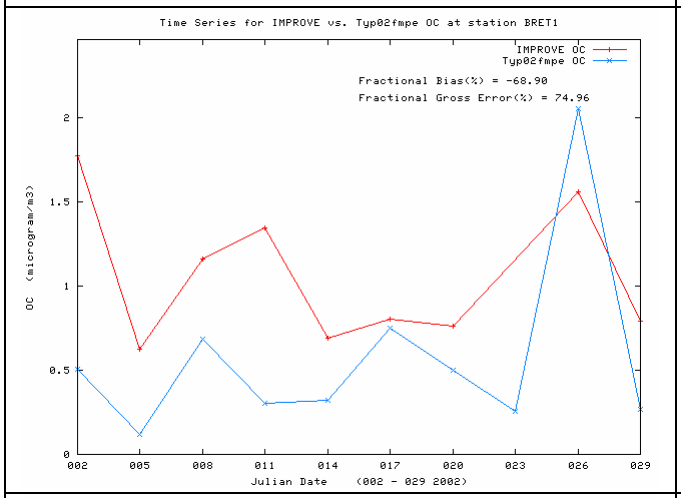
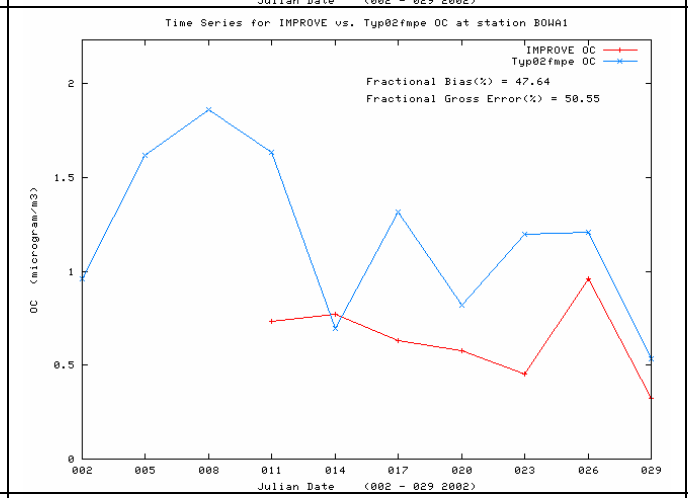


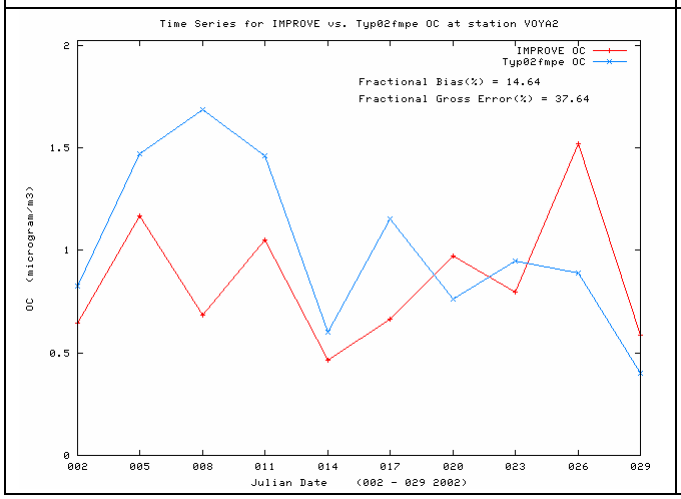
Figure C-16a. Scatter plots of predicted and observed organic matter carbon (OMC) concentrations for January 2002 and sites in the CENRAP region using IMPROVE (left) and STN (right) monitoring networks using the CMAQ 2002 36 km Base F base case simulation.

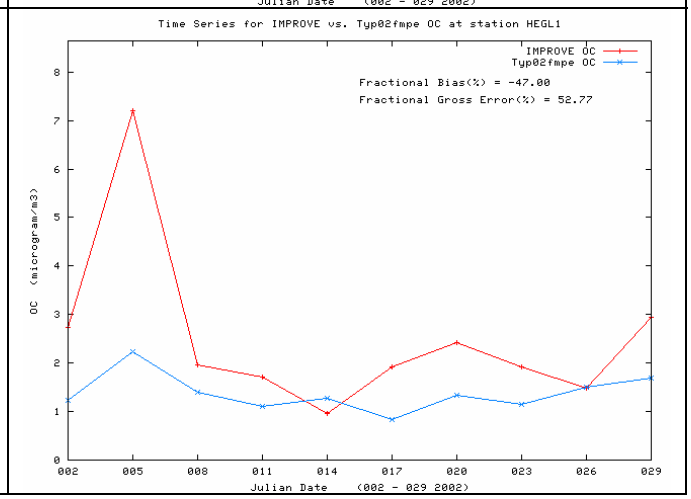

Time Series for IMPROVE vs. Typ02fmpe OC at station CACR1
IMPROVE OC
Typ02fmpe OC
Fractional Bias(%) = -8.37
Fractional Gross Error(%) = 42.38
OC (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe OC at station UPBU1
IMPROVE OC
Typ02fmpe OC
Fractional Bias(%) = -29.83
Fractional Gross Error(%) = 40.95
OC (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe OC at station BRET1
IMPROVE OC
Typ02fmpe OC
Fractional Bias(%) = -68.90
Fractional Gross Error(%) = 74.96
OC (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe OC at station BOWA1
IMPROVE OC
Typ02fmpe OC
Fractional Bias(%) = 47.64
Fractional Gross Error(%) = 50.55
OC (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe OC at station VOYA2
IMPROVE OC
Typ02fmpe OC
Fractional Bias(%) = 14.64
Fractional Gross Error(%) = 37.64
OC (microgram/m3)
Julian Date (002 - 029 2002)


Time Series for IMPROVE vs. Typ02fmpe OC at station HEGL1
IMPROVE OC
Typ02fmpe OC
Fractional Bias(%) = -47.00
Fractional Gross Error(%) = 52.77
OC (microgram/m3)
Julian Date (002 - 029 2002)

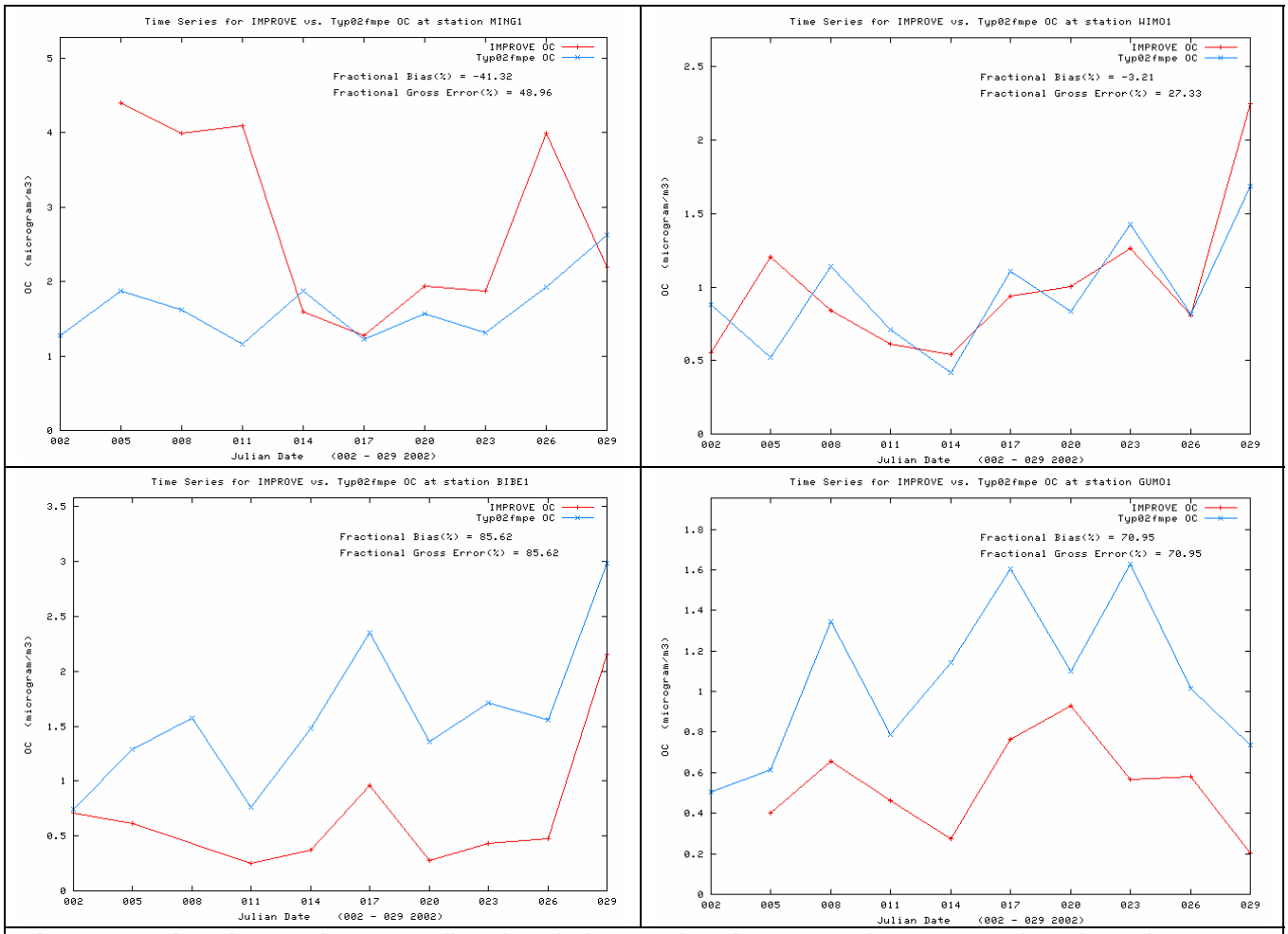


Figure C-16b. Time series of predicted and observed 24-hour organic matter carbon (OMC) concentrations at CENRAP IMPROVE CLASS I AREA sites in January 2002 for CMAQ 2002 36 km Base F base case simulation.

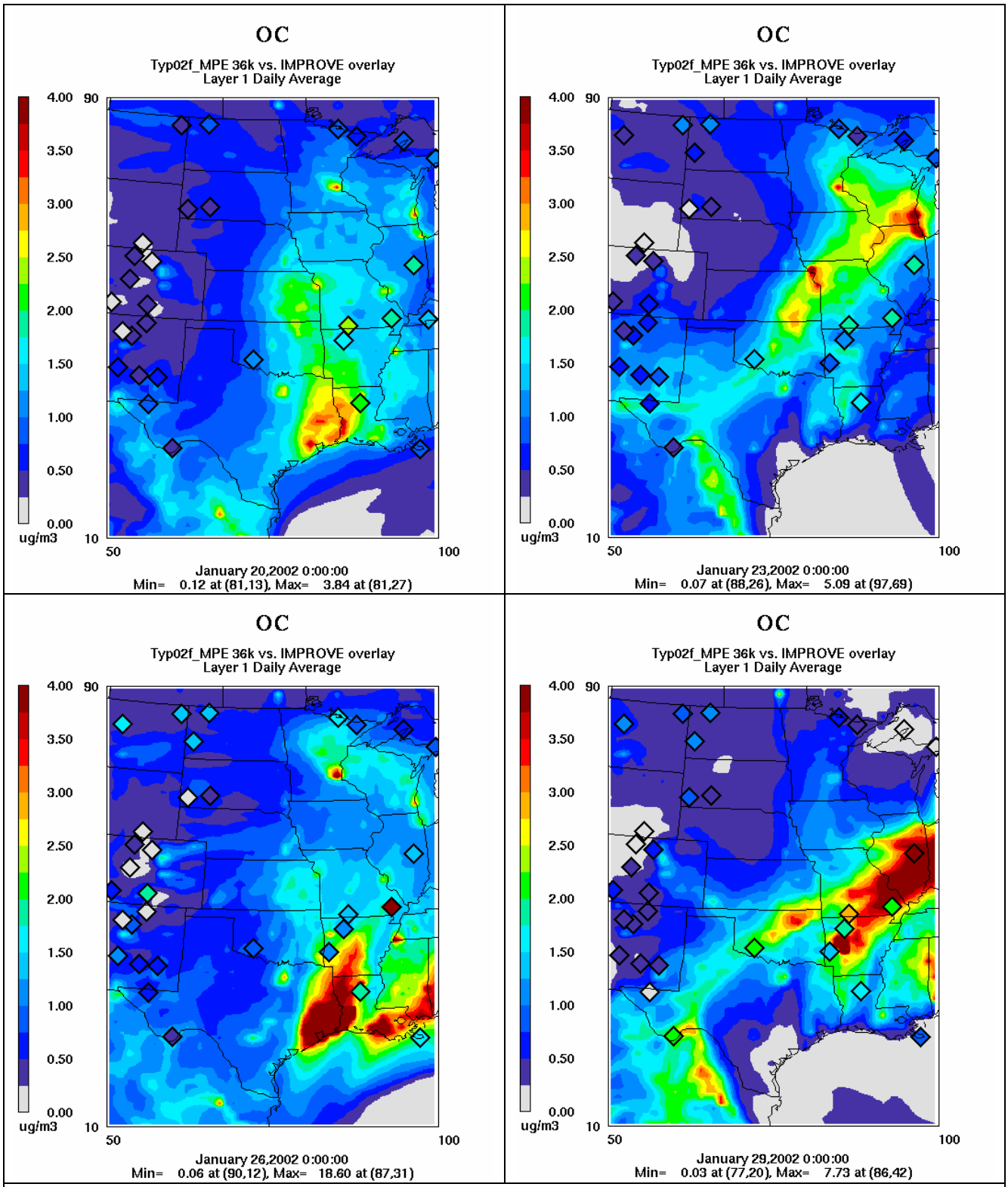


Figure C-16c. Spatial plot comparisons of the predicted and IMPROVE observed 24-hour OMC concentrations for January 20, 23, 26 and 29, 2002.

C.3.3.2 OMC in April 2002

The OMC performance in April is also fairly reasonable, again bias across the IMPROVE monitors is near zero (-7%), an underestimation bias exists across the STN sites (-30%) and errors are near 50% (Figure C-17a). The time series comparisons (Figure C-17b) are also reasonable with the model generally agreeing on the magnitudes of the observed OMC, but with an underestimation bias at several sites (e.g., MING and WIMO). The observed spatial distribution of OMCV appears to be much spottier than predicted (Figure C-17c). Thus, when the model reproduces an elevated observed OMC value like at UPBU on April 5th, it overestimates OMC at neighboring sites that have lower values (e.g., HEGL).

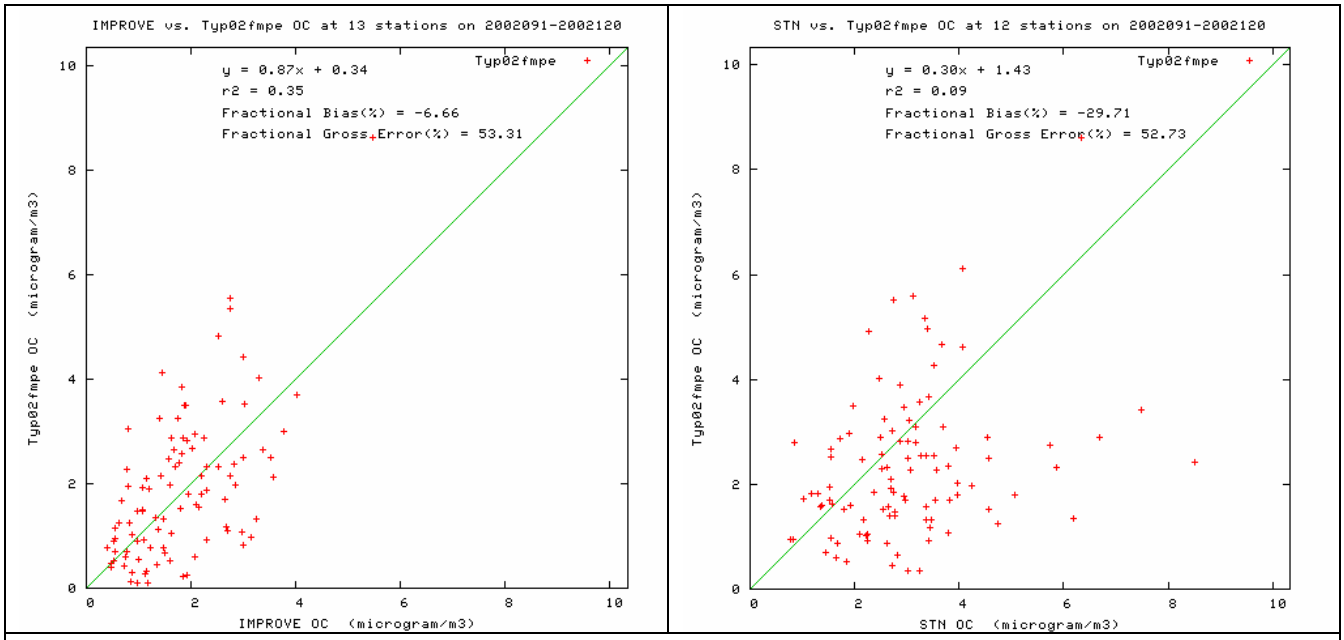


Figure C-17a. Scatter plots of predicted and observed organic matter carbon (OMC) concentrations for April 2002 and sites in the CENRAP region using IMPROVE (left) and STN (right) monitoring networks using the CMAQ 2002 36 km Base F base case simulation.