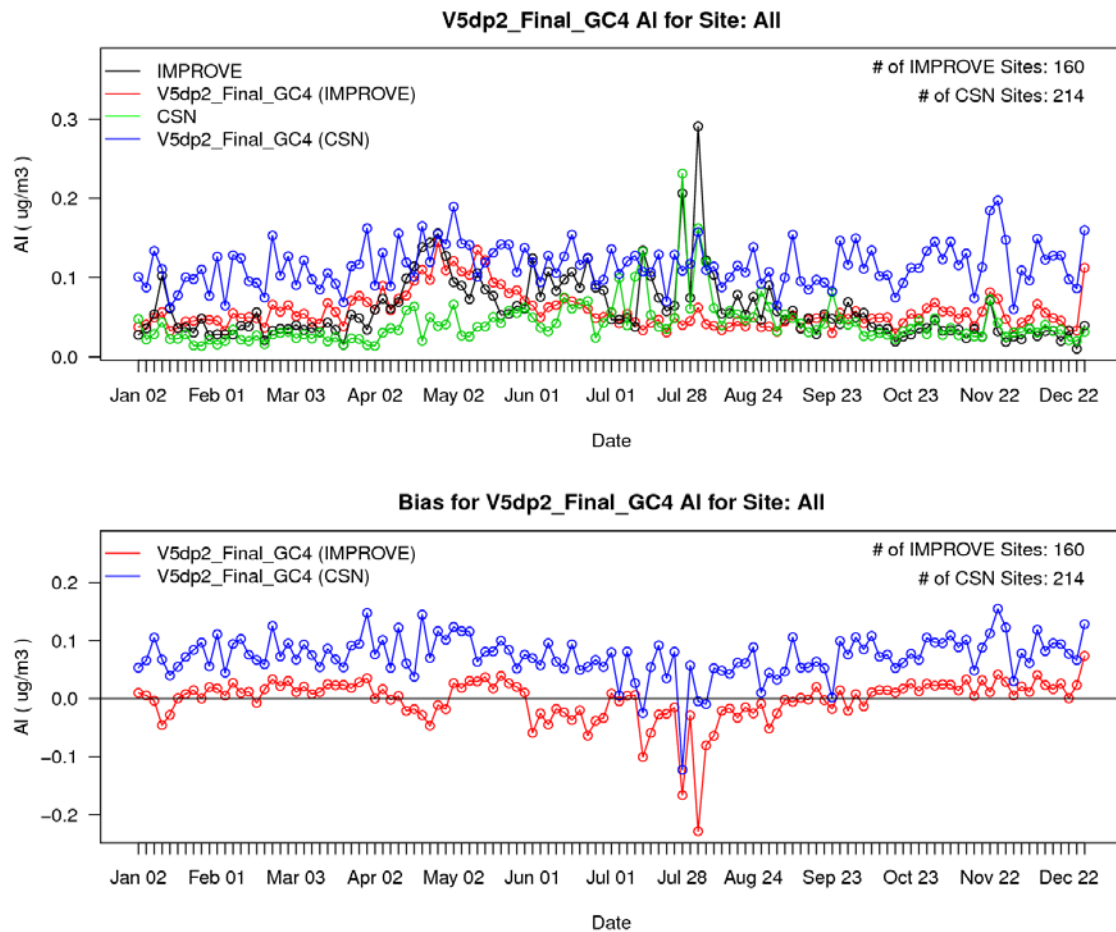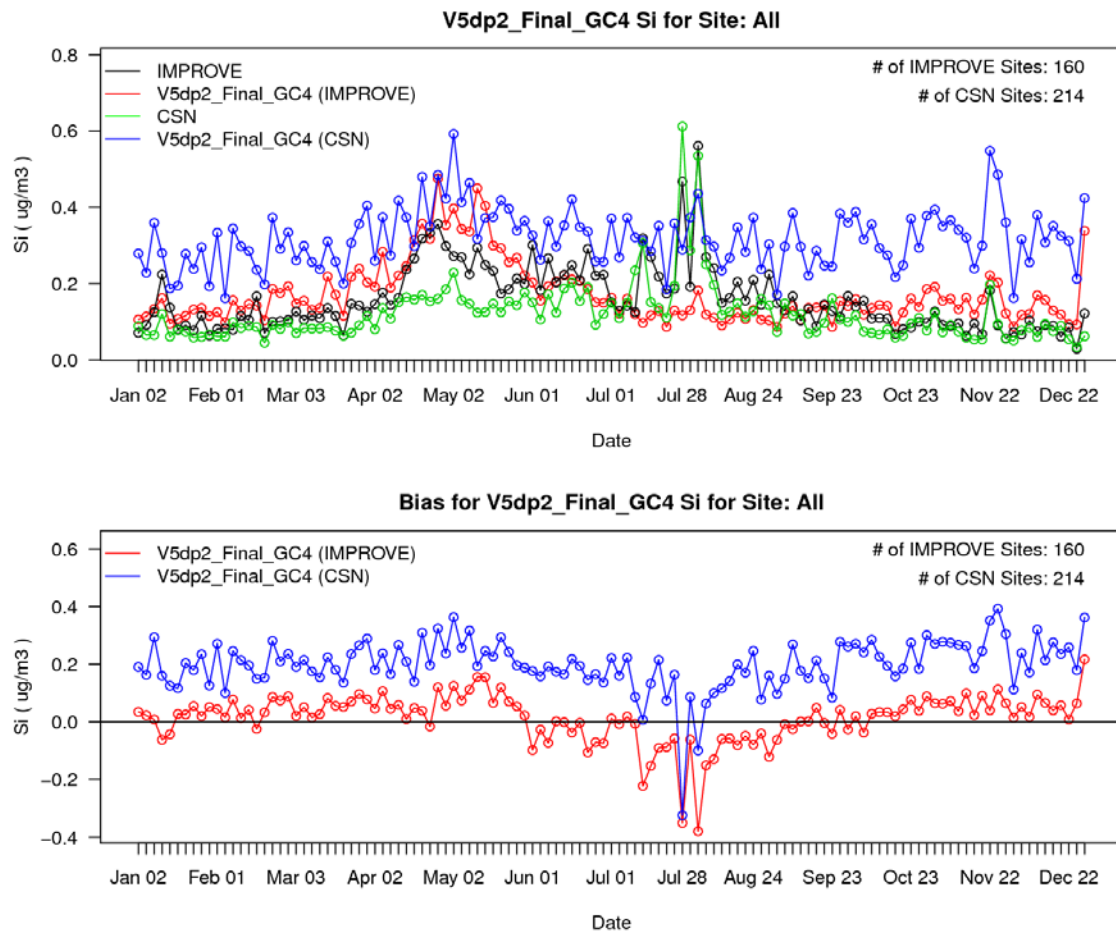1

2 Figure S1. The top time series plot shows the IMPROVE fine particulate Fe observations

3 (black) versus CMAQ estimated Fe (red) and CSN Fe observations (green) versus CMAQ

4 estimated Fe (blue) for 2006 for all CONUS sites. The bottom time series plot shows the

5 CMAQ bias for Fe at the IMPROVE network sites (blue) and CSN sites (red). Both plots are in

6 units of μgm^{-3}.

7

V5dp2_Final_GC4 Al for Site: All

IMPROVE
V5dp2_Final_GC4 (IMPROVE)
CSN
V5dp2_Final_GC4 (CSN)

\# of IMPROVE Sites: 160
\# of CSN Sites: 214

Al (ug/m3)

Jan 02 Feb 01 Mar 03 Apr 02 May 02 Jun 01 Jul 01 Jul 28 Aug 24 Sep 23 Oct 23 Nov 22 Dec 22

Date

Bias for V5dp2_Final_GC4 Al for Site: All

V5dp2_Final_GC4 (IMPROVE)
V5dp2_Final_GC4 (CSN)

\# of IMPROVE Sites: 160
\# of CSN Sites: 214

Al (ug/m3)

Jan 02 Feb 01 Mar 03 Apr 02 May 02 Jun 01 Jul 01 Jul 28 Aug 24 Sep 23 Oct 23 Nov 22 Dec 22

Date

1

2   Figure S2. The top time series plot shows the IMPROVE fine particulate Al observations

3   (black) versus CMAQ estimated Al (red) and CSN Al observations (green) versus CMAQ

4   estimated Al (blue) for 2006 for all CONUS sites. The bottom time series plot shows the

5   CMAQ bias for Al at the IMPROVE network sites (blue) and CSN sites (red). Both plots are in
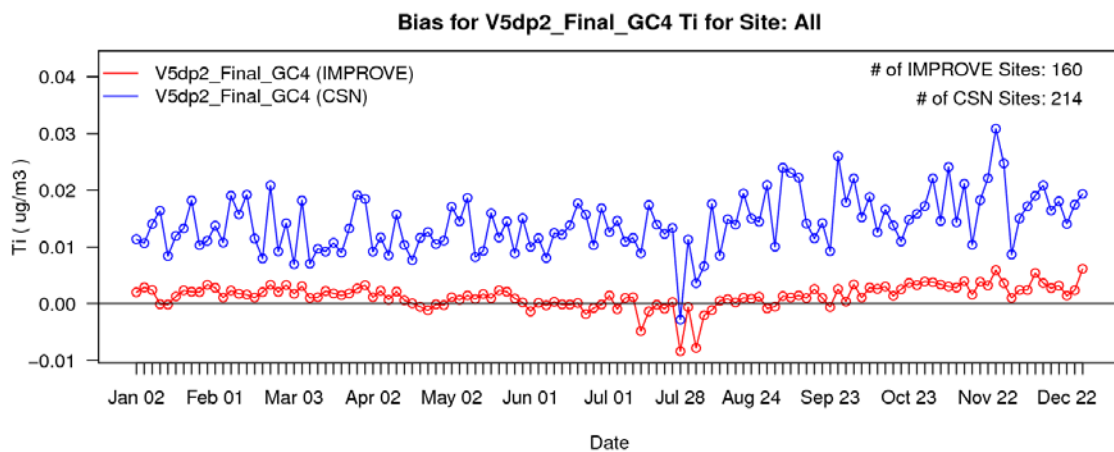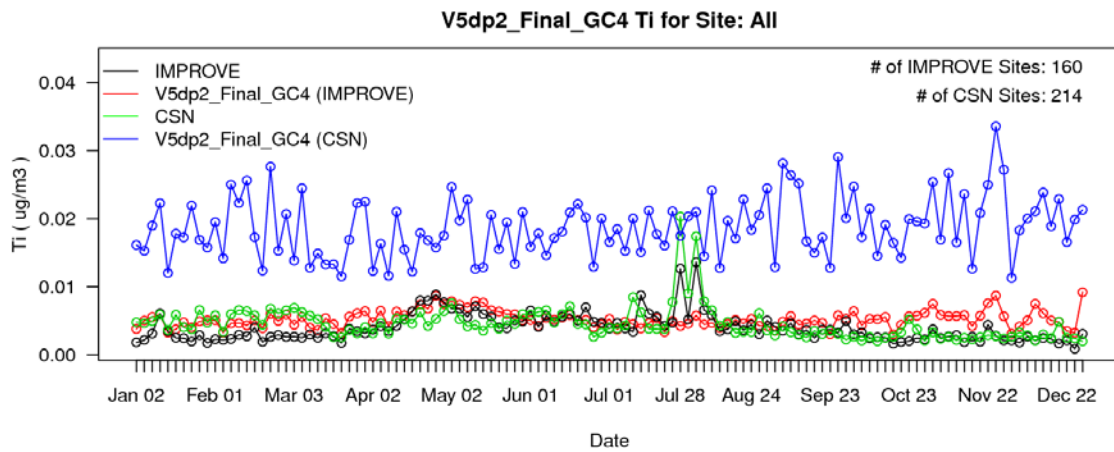
6   units of μgm^{-3}.

7

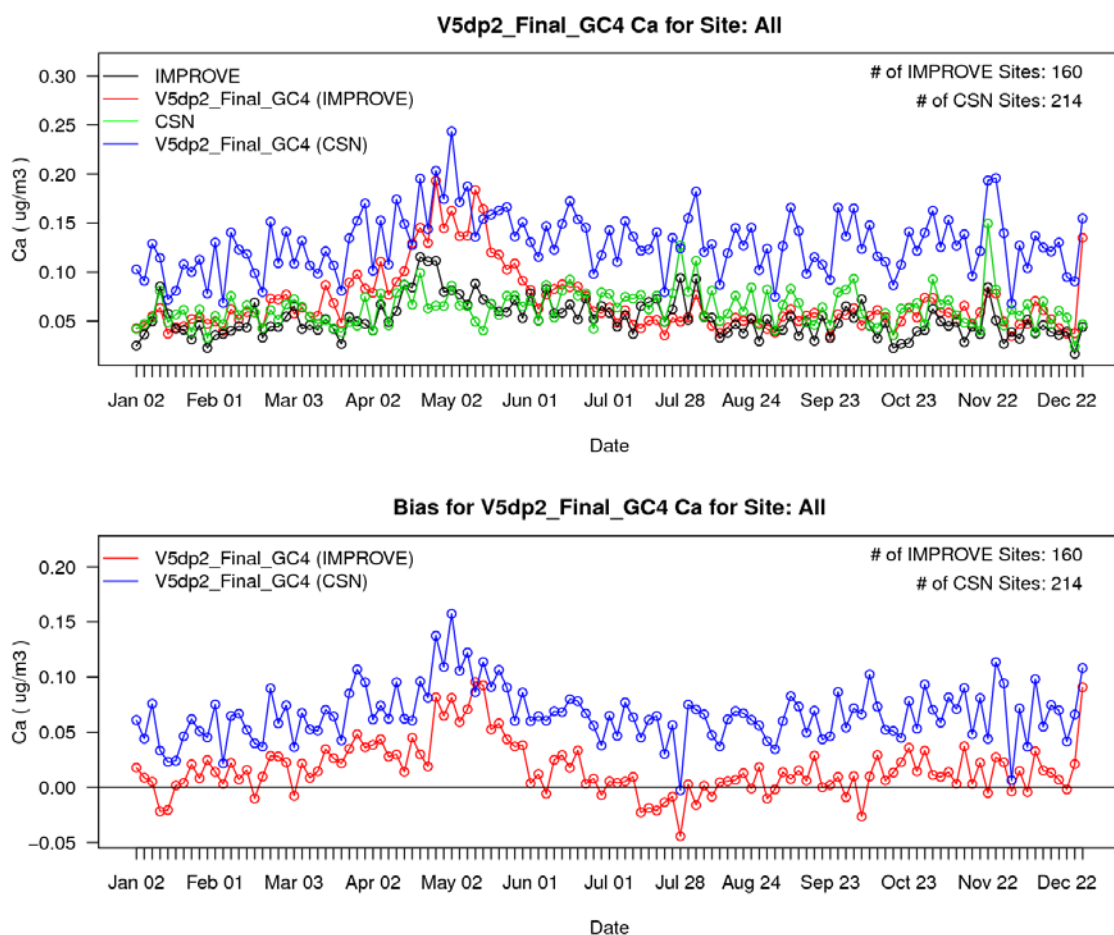Figure S3. The top time series plot shows the IMPROVE fine particulate Si observations (black) versus CMAQ estimated Si (red) and CSN Si observations (green) versus CMAQ estimated Si (blue) for 2006 for all CONUS sites. The bottom time series plot shows the CMAQ bias for Si at the IMPROVE network sites (blue) and CSN sites (red). Both plots are in units of μgm^{-3}.

1

2   Figure S4. The top time series plot shows the IMPROVE fine particulate Ti observations
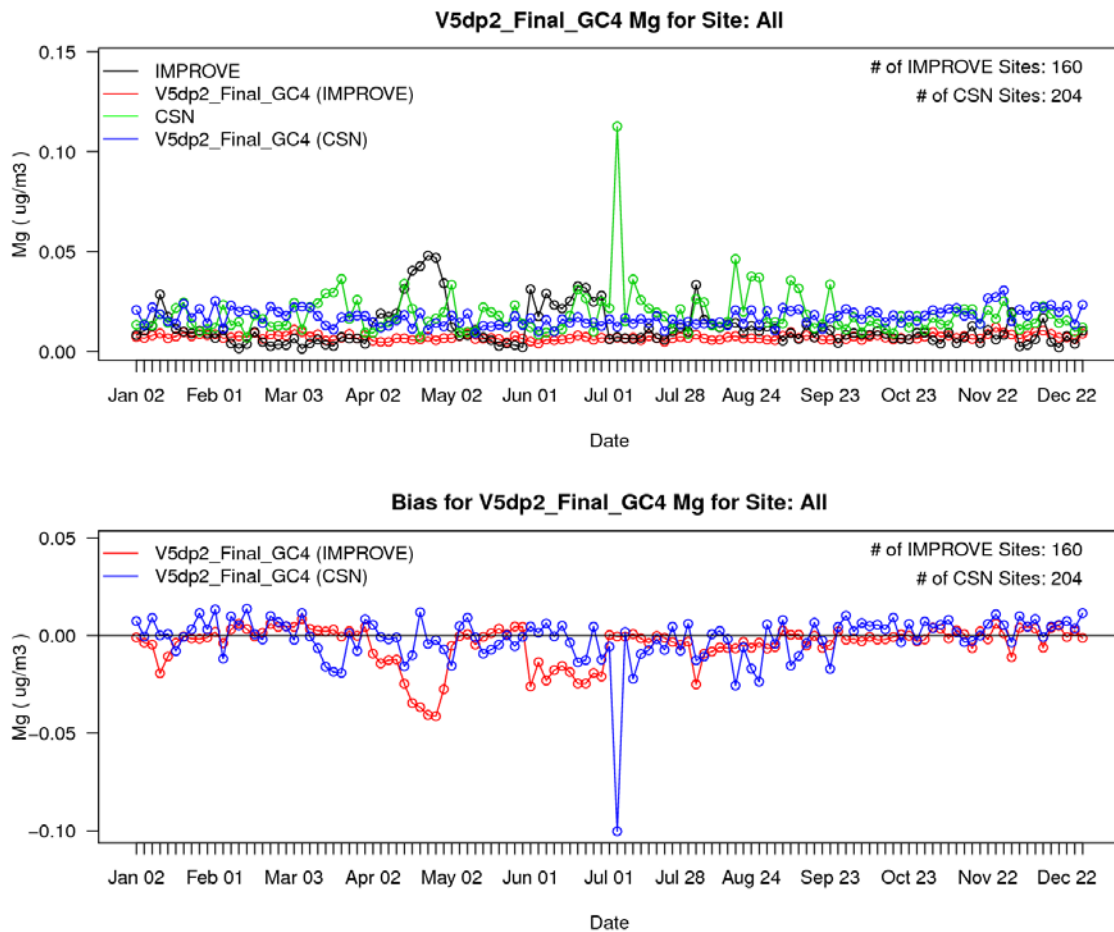
3   (black) versus CMAQ estimated Ti (red) and CSN Ti observations (green) versus CMAQ

4   estimated Ti (blue) for 2006 for all CONUS sites. The bottom time series plot shows the

5   CMAQ bias for Ti at the IMPROVE network sites (blue) and CSN sites (red). Both plots are in
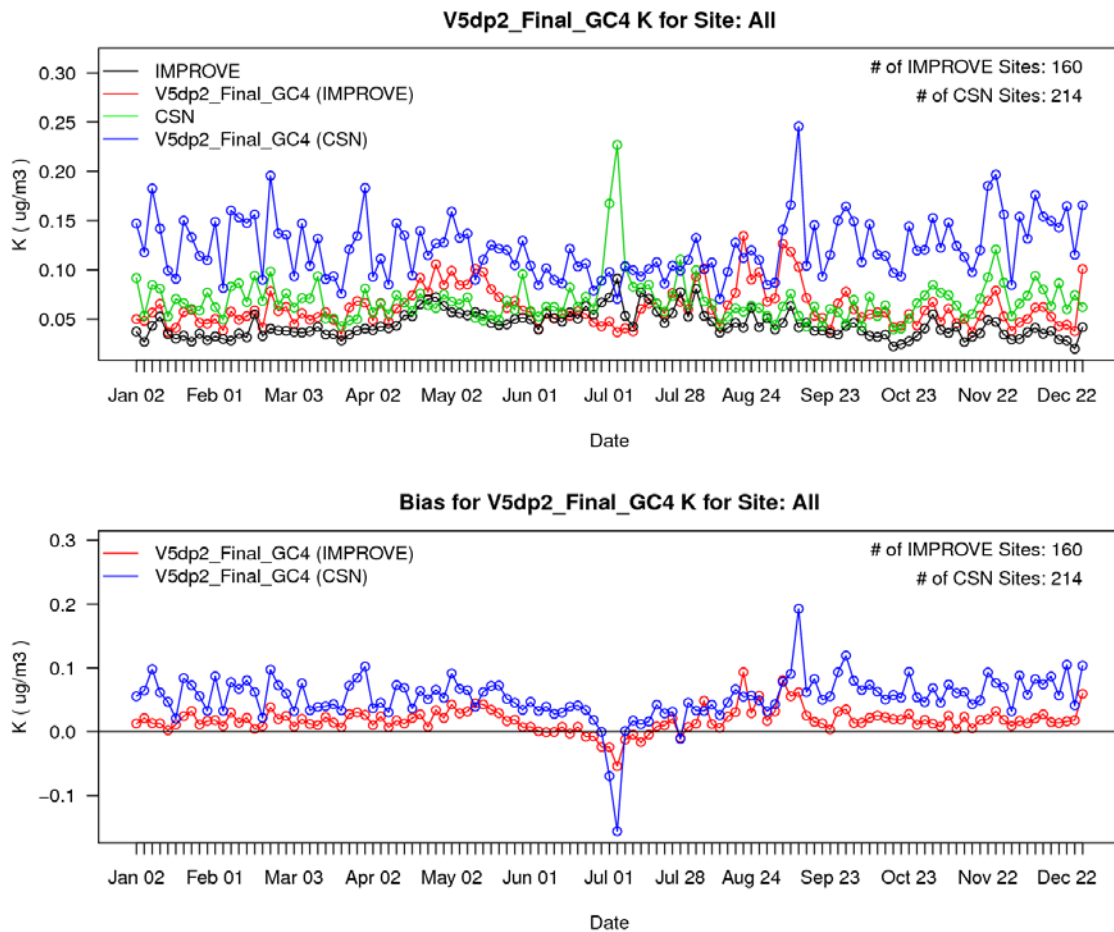
6   units of μgm^{-3}.

7

Figure S5. The top time series plot shows the IMPROVE fine particulate Ca observations (black) versus CMAQ estimated Ca (red) and CSN Ca observations (green) versus CMAQ estimated Ca (blue) for 2006 for all CONUS sites. The bottom time series plot shows the CMAQ bias for Ca at the IMPROVE network sites (blue) and CSN sites (red). Both plots are in units of μgm^{-3}.

Figure S6. The top time series plot shows the IMPROVE fine particulate Mg observations (black) versus CMAQ estimated Mg (red) and CSN Mg observations (green) versus CMAQ estimated Mg (blue) for 2006 for all CONUS sites. The bottom time series plot shows the CMAQ bias for Mg at the IMPROVE network sites (blue) and CSN sites (red). Both plots are in units of μgm^{-3}.
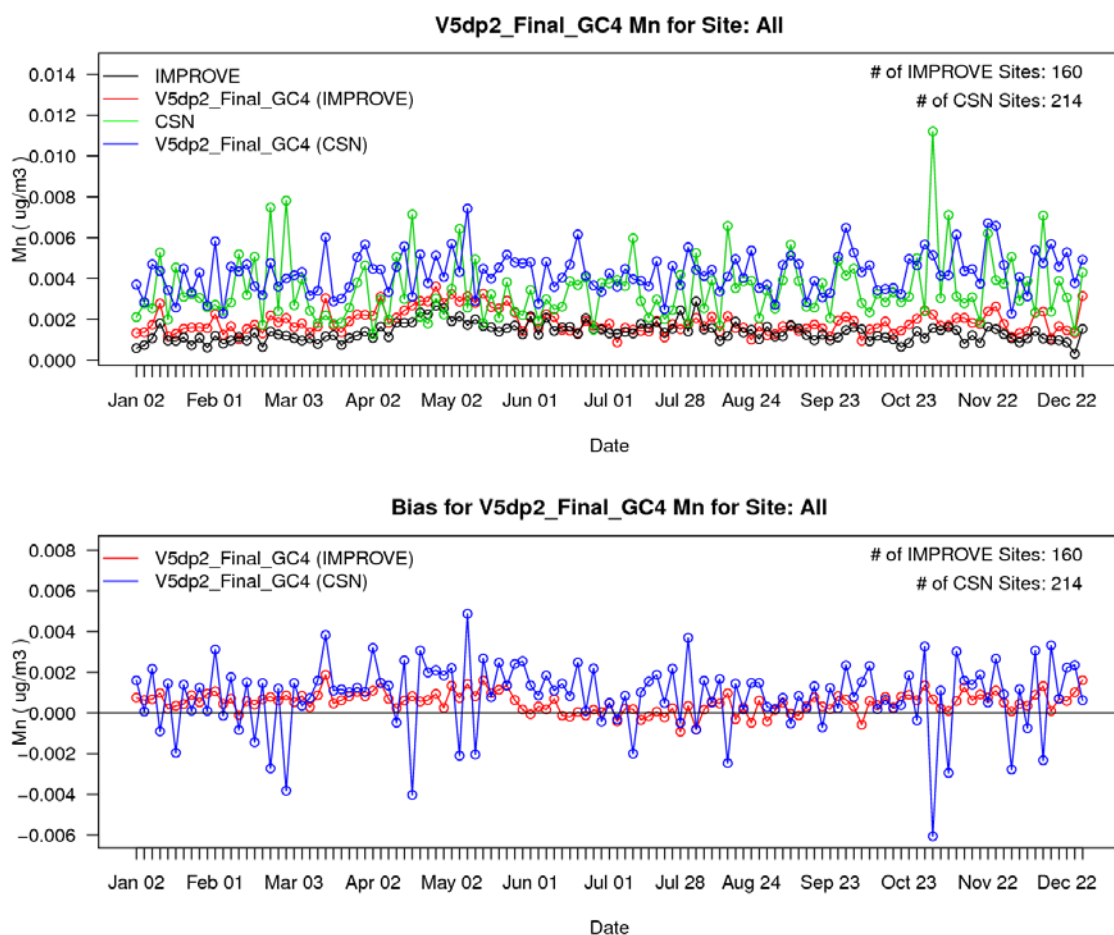
1

2 Figure S7. The top time series plot shows the IMPROVE fine particulate K observations

3 (black) versus CMAQ estimated K (red) and CSN K observations (green) versus CMAQ

4 estimated K (blue) for 2006 for all CONUS sites. The bottom time series plot shows the

5 CMAQ bias for K at the IMPROVE network sites (blue) and CSN sites (red). Both plots are in

6 units of μgm^{-3}.

7

V5dp2_Final_GC4 Mn for Site: All

Bias for V5dp2_Final_GC4 Mn for Site: All

Figure S8. The top time series plot shows the IMPROVE fine particulate Mn observations (black) versus CMAQ estimated Mn (red) and CSN Mn observations (green) versus CMAQ estimated Mn (blue) for 2006 for all CONUS sites. The bottom time series plot shows the CMAQ bias for Mn at the IMPROVE network sites (blue) and CSN sites (red). Both plots are in units of μgm^{-3}.
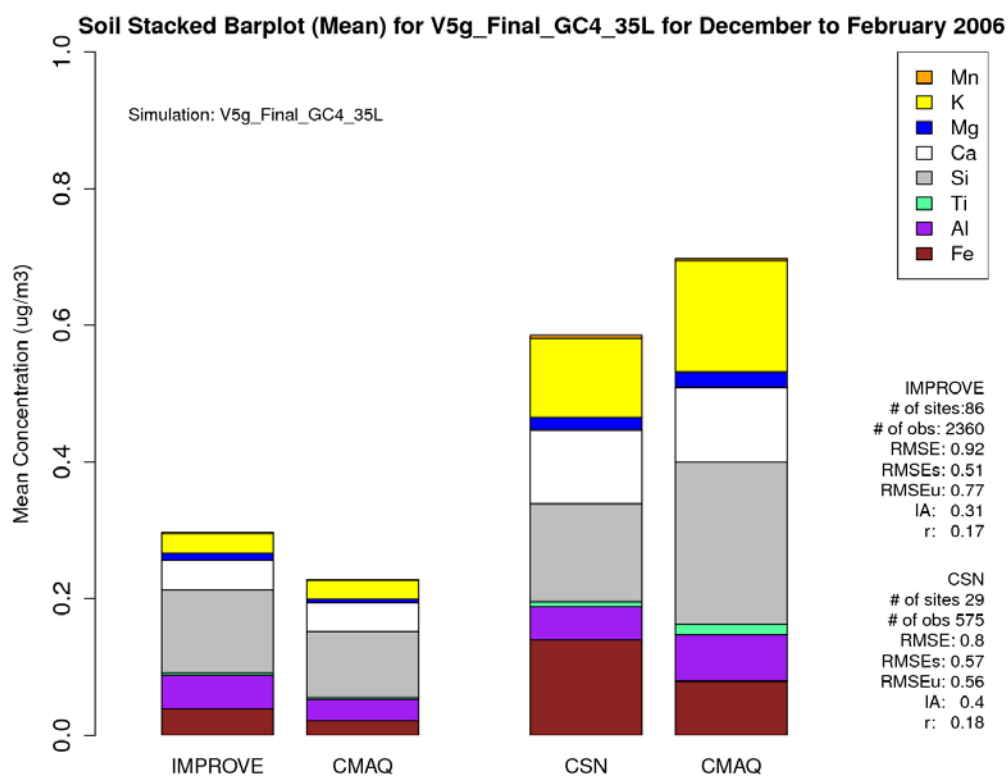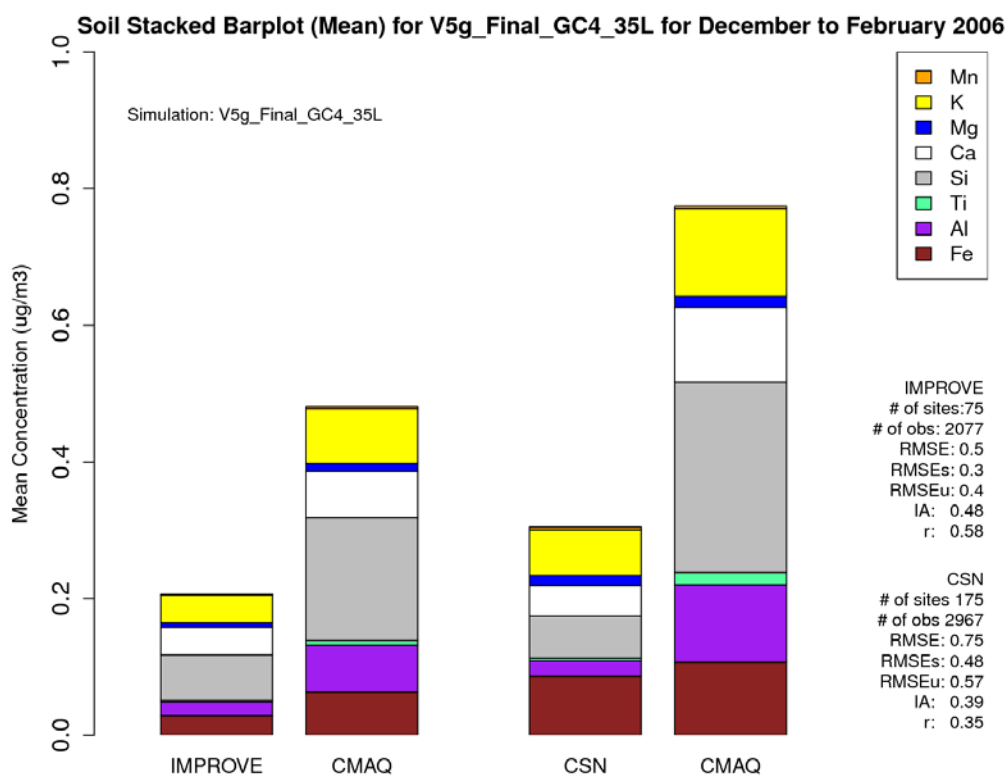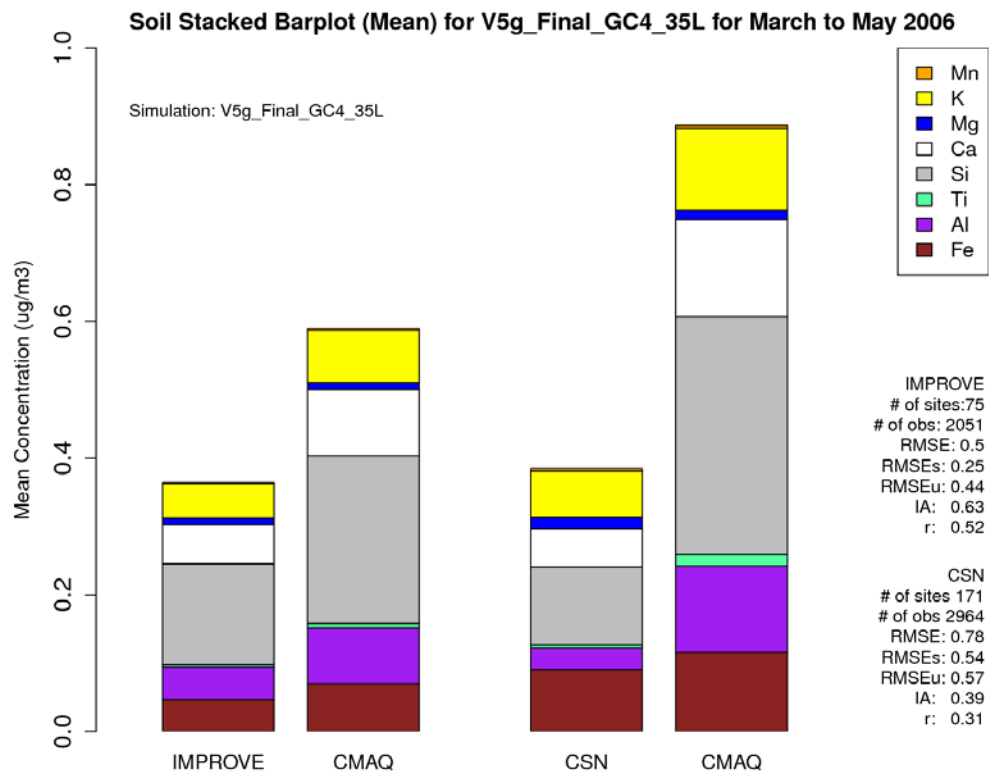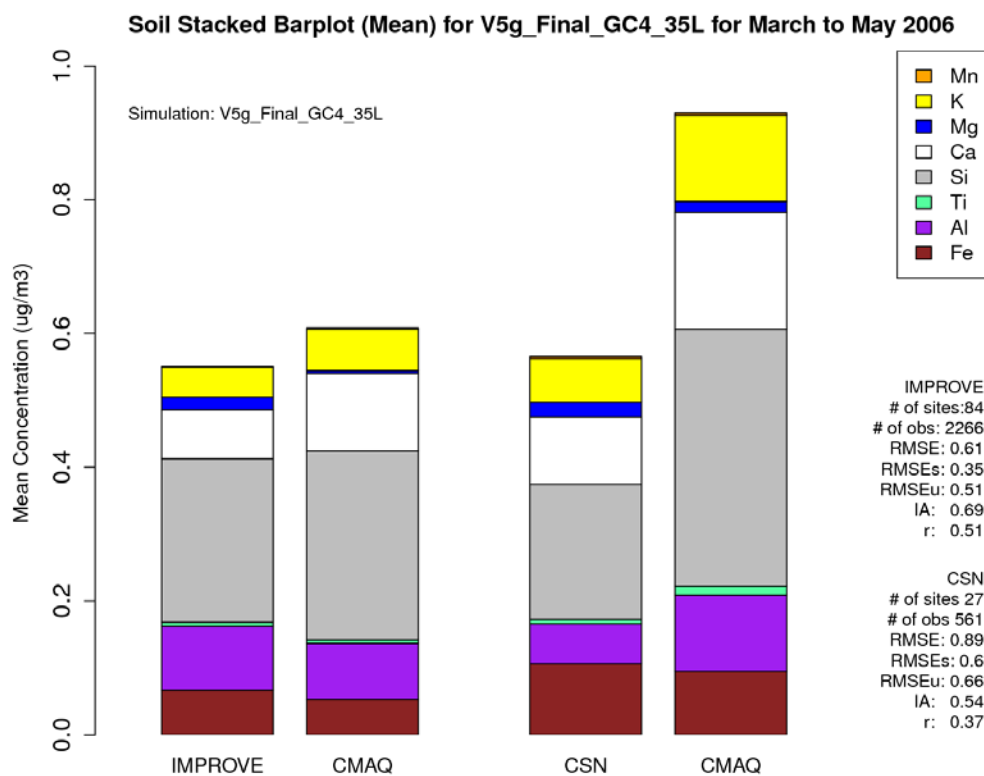
Figure S9. Eastern U.S. (top) and Western U.S. (bottom) trace metal performance for winter.

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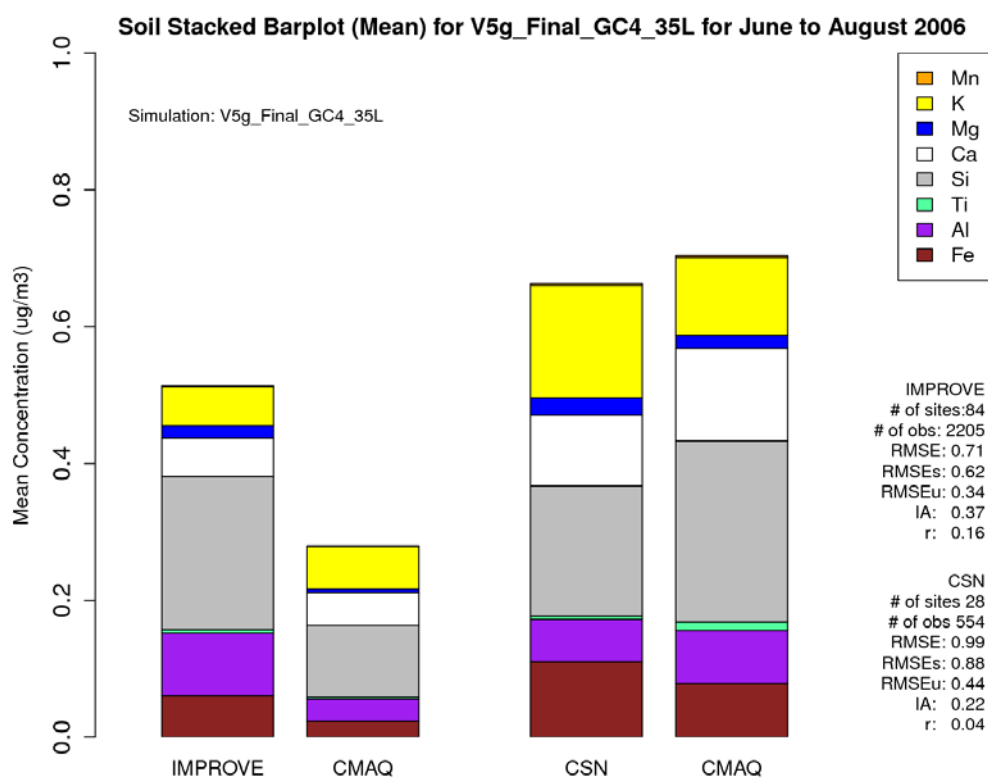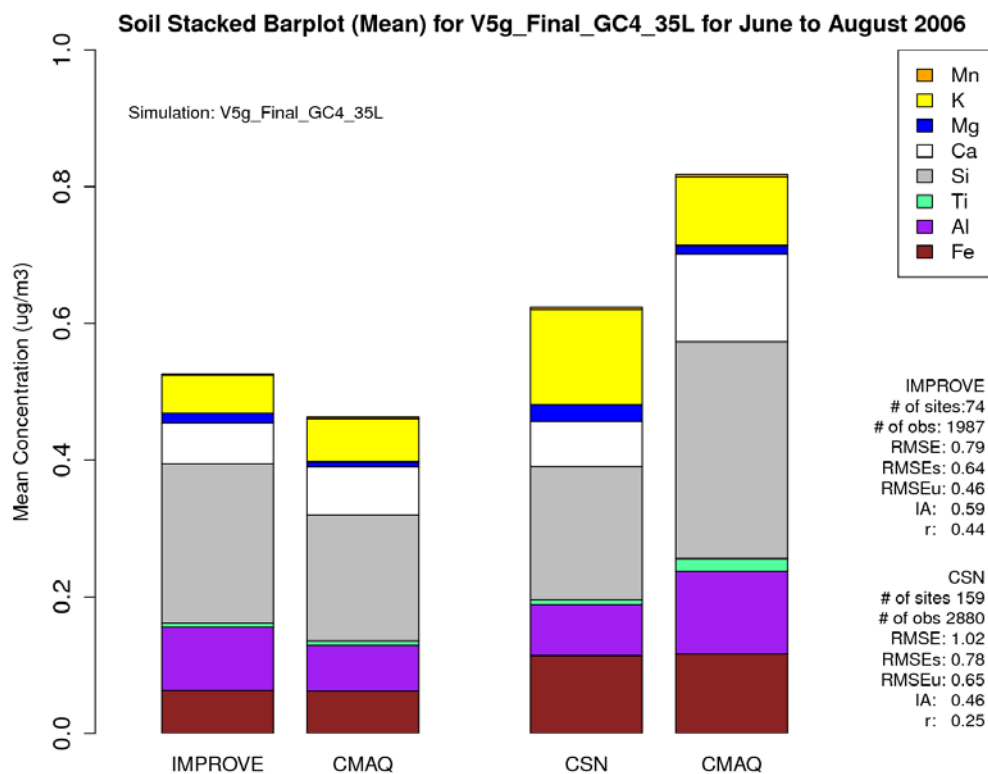Figure S10. Eastern U.S. (top) and Western U.S. (bottom) trace metal performance for spring.

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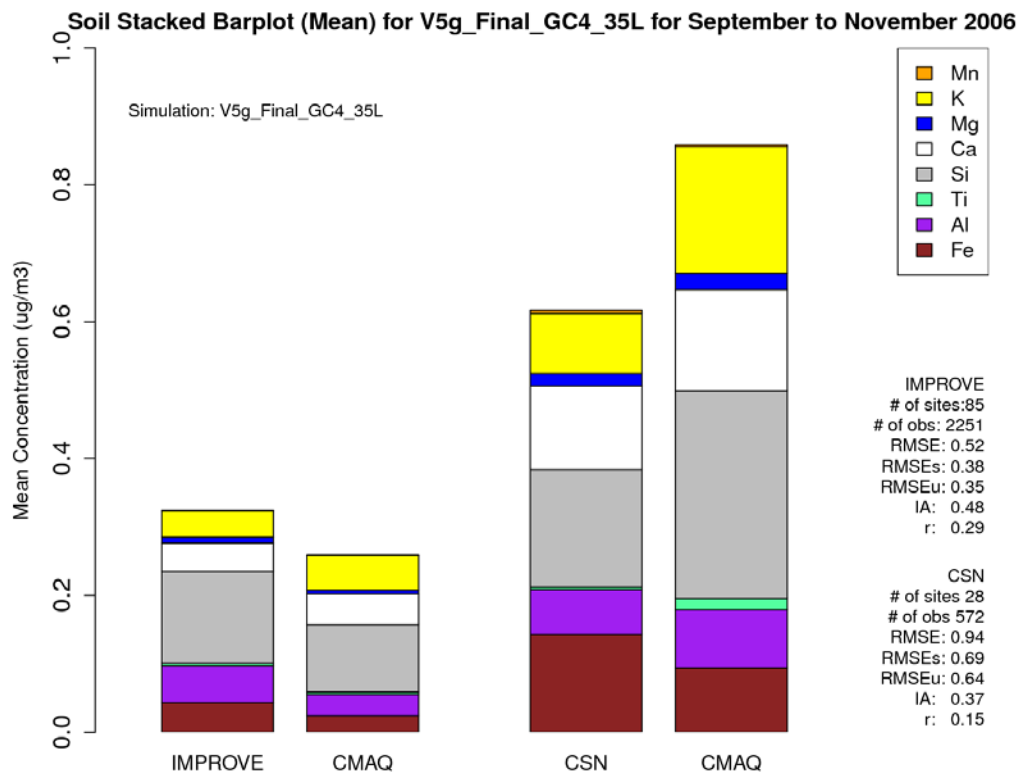3 Figure S11. Eastern U.S. (top) and Western U.S. (bottom) trace metal performance for
4 summer.

Soil Stacked Barplot (Mean) for V5g_Final_GC4_35L for September to November 2006

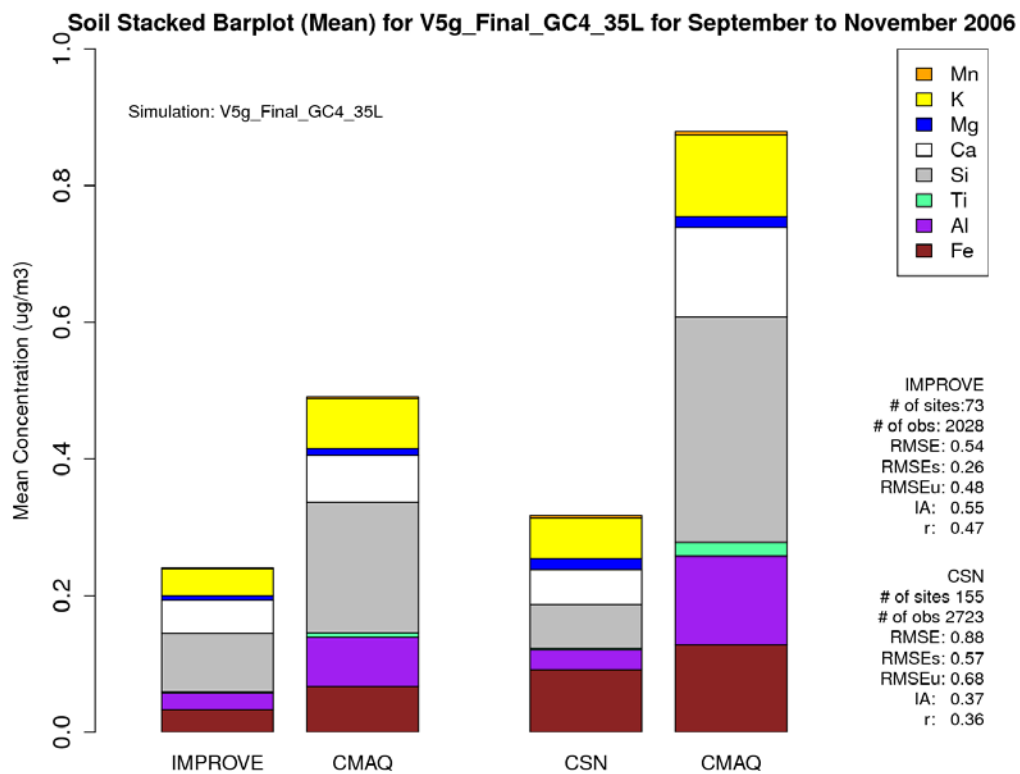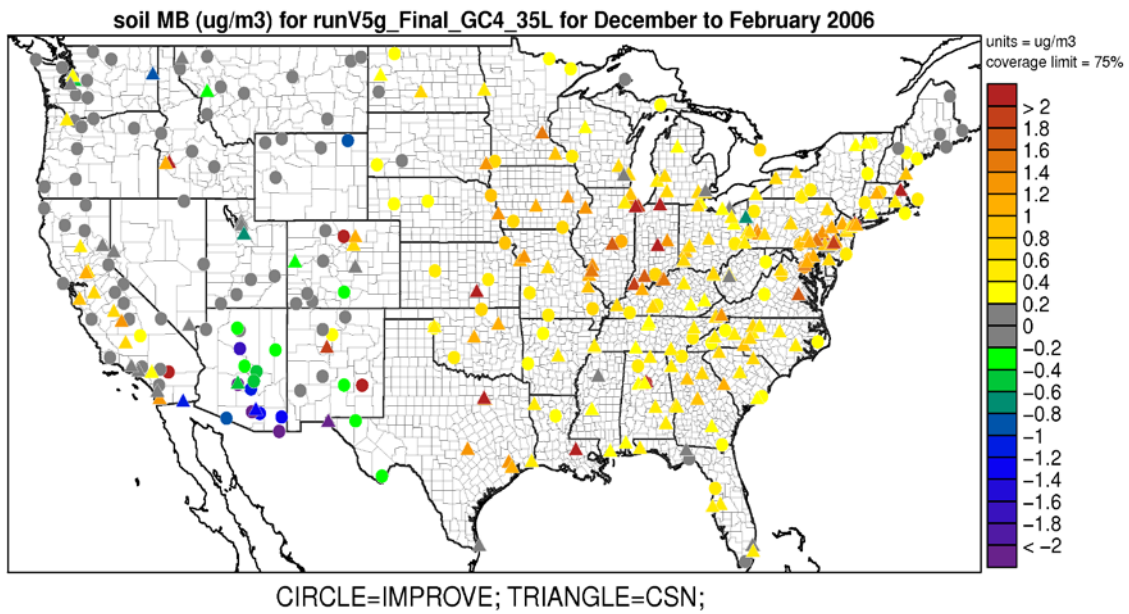Soil Stacked Barplot (Mean) for V5g_Final_GC4_35L for September to November 2006

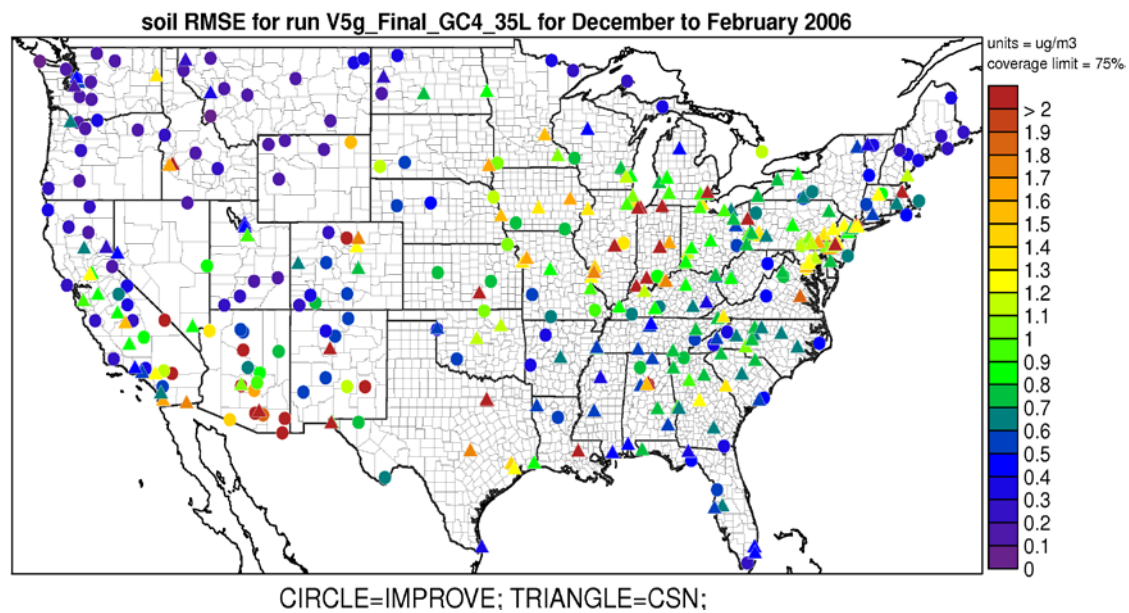Figure S12. Eastern U.S. (top) and Western U.S. (bottom) trace metal performance for fall.

soil MB (ug/m3) for runV5g_Final_GC4_35L for December to February 2006

CIRCLE=IMPROVE; TRIANGLE=CSN;

1

soil RMSE for run V5g_Final_GC4_35L for December to February 2006

CIRCLE=IMPROVE; TRIANGLE=CSN;

2

3   Figure S13. Soil mean bias (top) and (RMSE) performance for winter.

soil MB (ug/m3) for runV5g_Final_GC4_35L for March to May 2006

units = ug/m3
coverage limit = 75%

CIRCLE=IMPROVE; TRIANGLE=CSN;

soil RMSE for run V5g_Final_GC4_35L for March to May 2006

units = ug/m3
coverage limit = 75%

CIRCLE=IMPROVE; TRIANGLE=CSN;

Figure S14. Eastern U.S. (top) and Western U.S. (bottom) trace metal performance for spring.

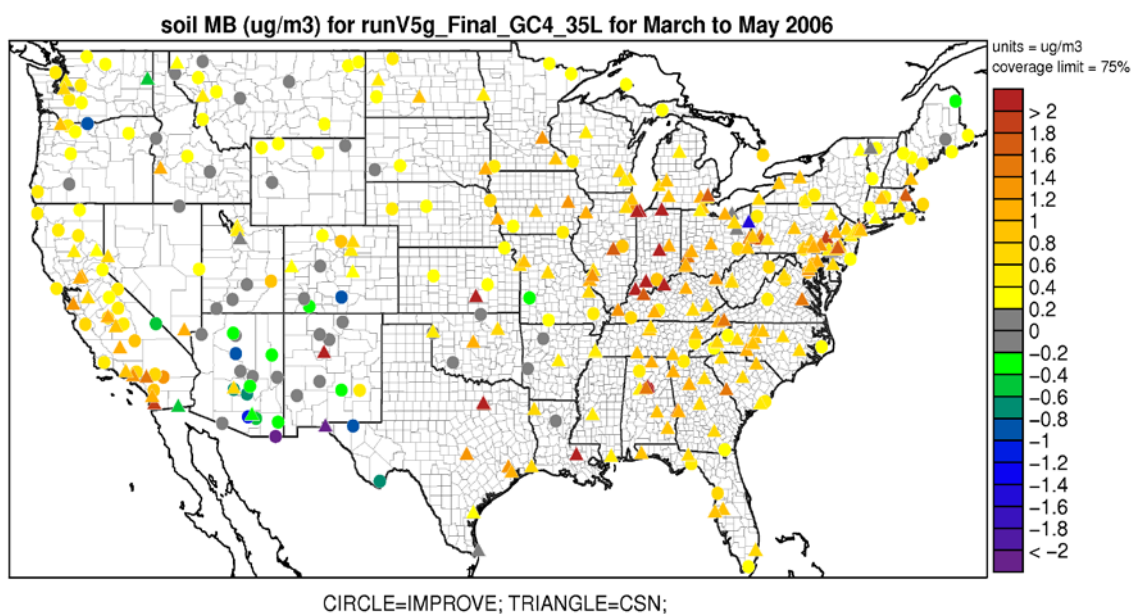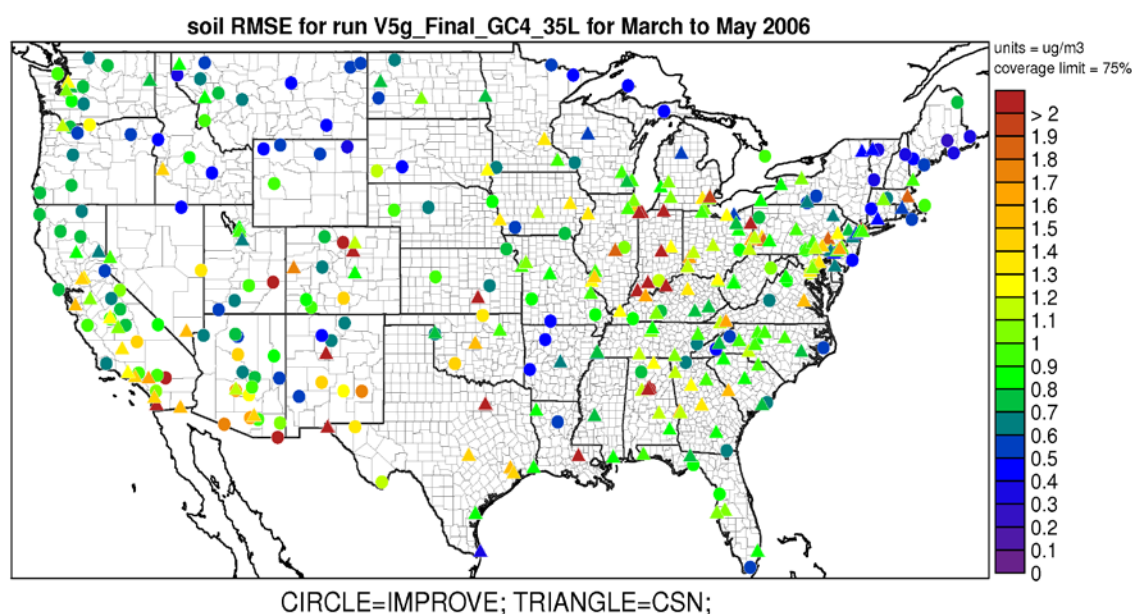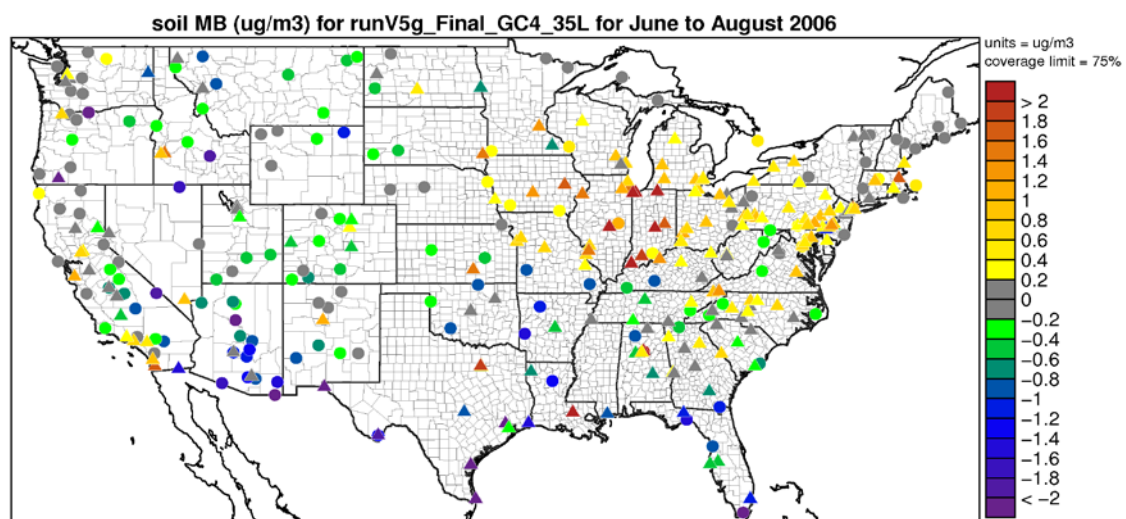**soil MB (ug/m3) for runV5g_Final_GC4_35L for June to August 2006**

units = ug/m3
coverage limit = 75%

CIRCLE=IMPROVE; TRIANGLE=CSN;

1

soil RMSE for run V5g_Final_GC4_35L for June to August 2006

units = ug/m3
coverage limit = 75%
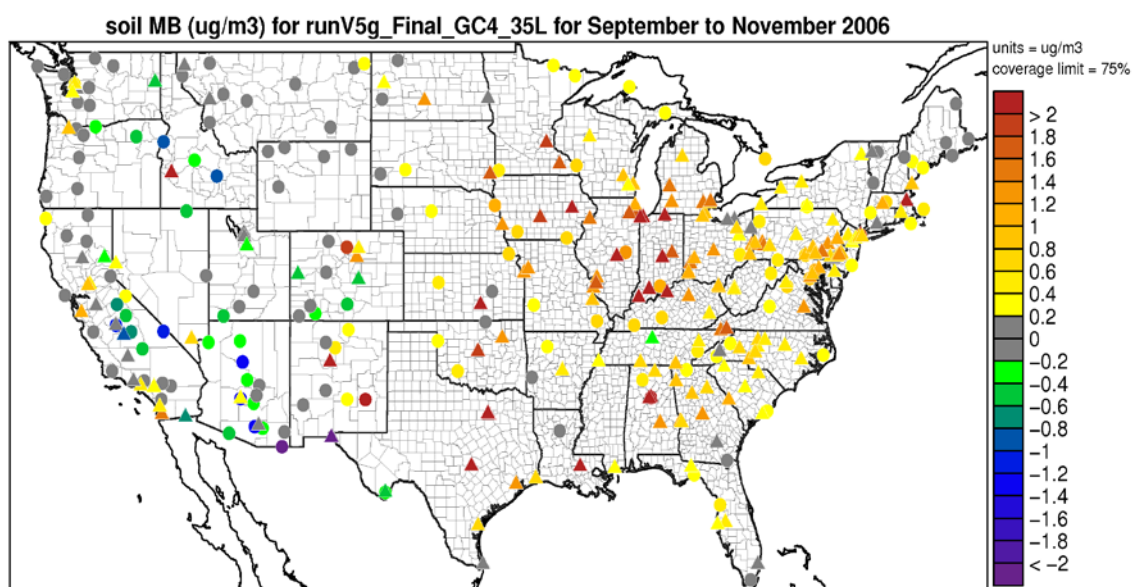
CIRCLE=IMPROVE; TRIANGLE=CSN;

2

3 Figure S15. Eastern U.S. (top) and Western U.S. (bottom) trace metal performance for

4 summer.

soil MB (ug/m3) for runV5g_Final_GC4_35L for September to November 2006

units = ug/m3
coverage limit = 75%

CIRCLE=IMPROVE; TRIANGLE=CSN;

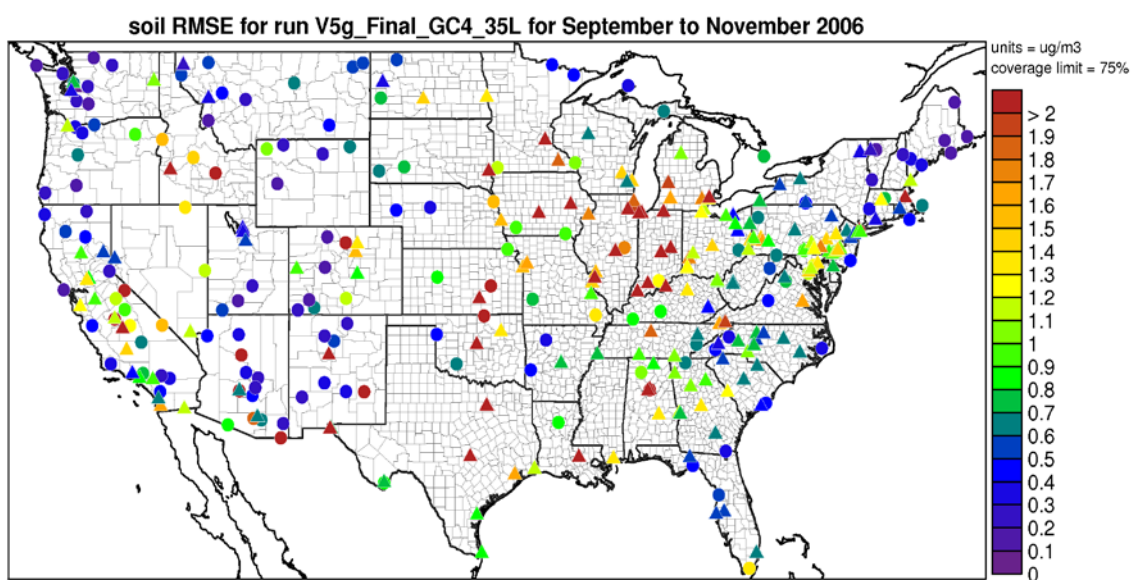**soil RMSE for run V5g_Final_GC4_35L for September to November 2006**

units = ug/m3
coverage limit = 75%

CIRCLE=IMPROVE; TRIANGLE=CSN;

3   Figure S16. Eastern U.S. (top) and Western U.S. (bottom) trace metal performance for fall.