Supplement of

Inverse modeling of SO$_2$ and NO$_x$ emissions over China using multisensor satellite data – Part 2: Downscaling techniques for air quality analysis and forecasts

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Figure S1. The box height of the lowest layer of GEOS-Chem in October 2013.
CGS and MIX-DDC for SO$_2$

Figure S2. It is similar to Fig. 4, but GC adjoint v35m rather than GCv12.0.0 is used.
Figure S3. It is similar to Fig. 5, but GC adjoint v35m rather than GCv12.0.0 is used.
NMSE of surface SO$_2$ and NO$_2$

Figure S4. Normalized mean squared error (NMSE) of surface SO$_2$ (a) and NO$_2$ (b). All surface SO$_2$ and NO$_2$ simulations come from MIX-DDC and NL-DC, respectively. Black dots are posterior simulations from Joint-F-POS. The blue line is prior simulation results with SO$_2$ NMSE from MIX-DDC-PRI and NO$_2$ NMSE from NL-DC-PRI, respectively. The orange line is simulation results with SO$_2$ NMSE from MIX-DDC-POS and NO$_2$ NMSE from NL-DC-POS, respectively. The green line is similar to orange line, but posterior SO$_2$ emission from separate assimilation and prior NO$_x$ emission are used. The red line is similar to orange line, but posterior NO$_x$ emission from separate assimilation and prior SO$_2$ emission are used. In the figure (a), the blue line is covered by the red line, and the orange line is covered by the green line.
O₃ forecasts

Figure S5. (a) is similar to Fig. 14c, but in the posterior forecasts, the prior MIX NOₓ emission inventory and the posterior MIX-DE SO₂ emission inventory is used. (b) is similar to Fig. 14c, but in the posterior forecasts, the prior MIX SO₂ emission inventory and the posterior MIX-DE NOₓ emission inventory is used.

Figure S5 shows that the improvement of O₃ forecasts is caused by using optimized posterior NOₓ emission inventory; the change SO₂ emission inventory has negligible impact.