Supplementary Materials: Evaluation and Bias Correction of the Secondary Inorganic Aerosol Modeling over North China Plain in Autumn and Winter *Atmosphere 2021*

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Table S1. The 28 heterogeneous reactions considered in the NAQPMS

No.	Heterogeneous Reaction	γ(unitless)
R1	N_2O_5 + ASO4 → $2HNO_3$	$\gamma = \alpha \times 10^{\beta}$ $\alpha = 2.79 \times 10^{-4} + 1.3 \times 10^{-4} \times RH - 3.43 \times 10^{-6} \times RH^2 + 7.52 \times 10^{-8} \times RH^3$ $\beta = 4 \times 10^{-2} \times (T - 294)\ (T \geq 282K)$ $\beta = -0.48\ (T < 282K)$
R2	NO_2 + BC → 0.5HONO+0.5HNO_3	3×10^{-3}
R3	NO_3 + ASO4 → HNO_3	3×10^{-3}
R4	HO_2 + ASO4 → 0.5H_2O_2	2.5×10^{-3}
R5	HCHO + ASO4 → PRODUCTS	2.2×10^{-2}
R6	OH + ASO4 → PRODUCTS	2×10^{-1}
R7	O_3 + BC → PRODUCTS	$1.8\times 10^{-4} \times e^{-\frac{1000}{T}}$
R8	NO_2 + BC → HONO	3.3×10^{-4}
R9	HNO_3 + BC → NO_2	2.1×10^{-2}
R10	N_2O_5 + BC → $2HNO_3$	5.0×10^{-3}
R11	O_3 + DUST → PRODUCTS	2.7×10^{-5}
R12	HNO_3 + DUST → ANO3 + PRODUCTS	$\frac{c \times RH}{(1 - RH) \times (1 - 1(1 - c) \times RH)} \times 0.018\ (c = 8)$
R13	NO_2 + DUST → 0.5HONO + 0.5HNO_3	2.1×10^{-6}
R14	NO_3 + DUST → HNO_3	1.0×10^{-3}
R15	N_2O_5 + DUST → $2HNO_3$	3.0×10^{-2}
R16	OH + DUST → PRODUCTS	1.0×10^{-1}
R17	HO_2 + DUST → 0.5H_2O_2	2.0×10^{-1}
R18	H_2O_2 + DUST → PRODUCTS	$12 \times RH^{-2} - 5.95 \times RH + 4.08$
R19	SO_2 + DUST → ASO4	1.0×10^{-4}
R20	CH_3COOH + DUST → PRODUCTS	1.0×10^{-3}
R21	CH_3OH + DUST → PRODUCTS	1.0×10^{-5}
R22	HCHO + DUST → PRODUCTS	1.0×10^{-5}
R23	N_2O_5 + SSA → $2HNO_3$	$5.0 \times 10^{-3}(RH < 62\%)$ $3.0 \times 10^{-2}(RH \geq 62\%)$
R24	NO_3 + SSA → HNO_3	1.0×10^{-3}
R25	HO_2 + SSA → 0.5HONO	2.0×10^{-1}
R26	SO_2 + SSA → ASO4	$5.0 \times 10^{-3}(RH < 50\%)$ $5.0 \times 10^{-2}(RH \geq 50\%)$
R27	NO_3 + SSA → ANO3	1.7×10^{-2}
R28	HNO_3 + SSA → ANO3	5.0×10^{-1}

Table S2. Sensitivity tests of the uptake coefficients of R9.

	Configuration of the uptake coefficients	Purpose
S1	$\gamma_9 = 0.02$	Evaluate the sensitivity of uptake coefficient in R9 to SIA simulations
S2	$\gamma_9 = 0.01$	
S3	$\gamma_9 = 0.005$	
S4	$\gamma_9 = 0.025$	
S5	$\gamma_9 = 0.0$	

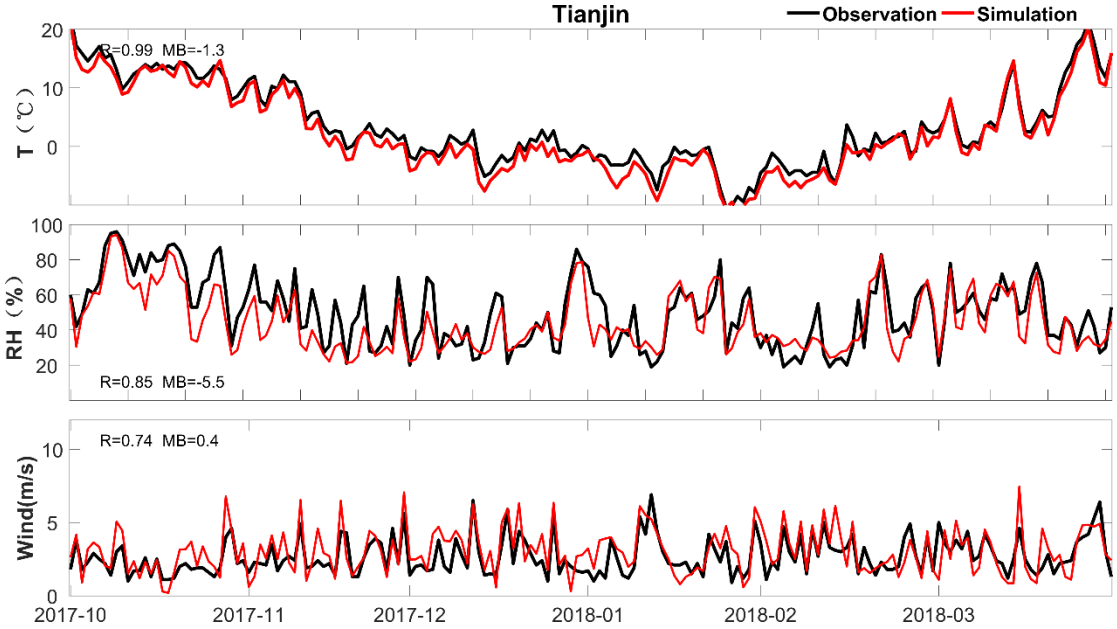

Figure S1. Time series of the simulated (red) and observed (black) daily averaged meteorological parameters at the Tianjin site from 1 October, 2017 to 31 March, 2018.

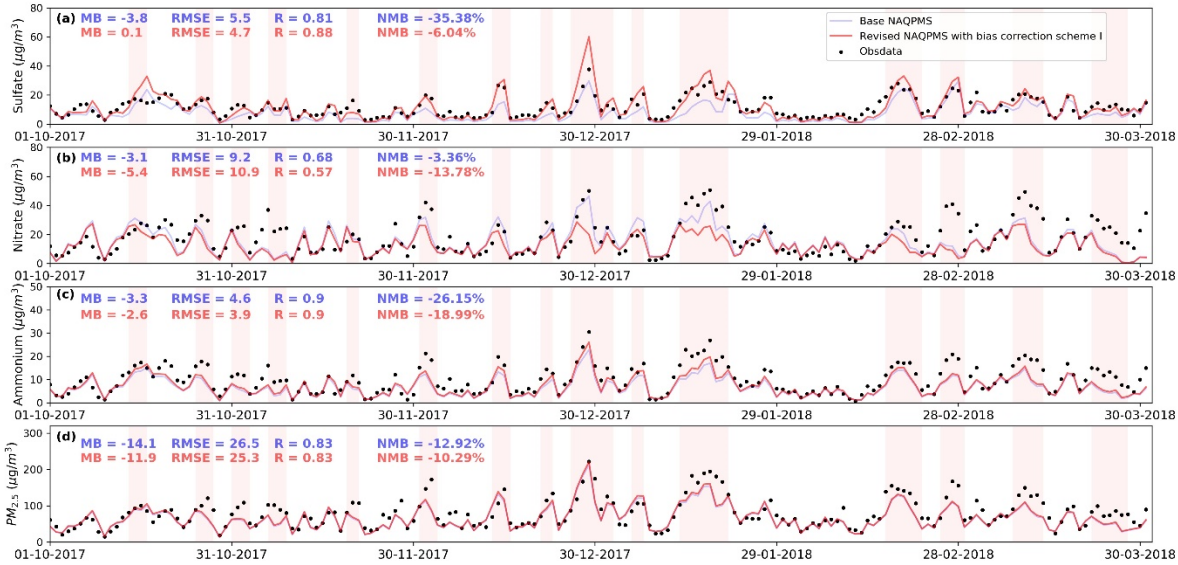

Figure S2. Comparison of the simulated and observed (black solid cycles) daily sulfate (**a**), nitrate (**b**), ammonium (**c**) and $PM_{2.5}$ (**d**) concentrations averaged over the 28 monitoring sites in North China Plain from 1 October 2017 to 31 March 2018. The black dots correspond to the observations, and the red and blue lines indicate the simulations of the base run and the run with bias correction scheme I, respectively.

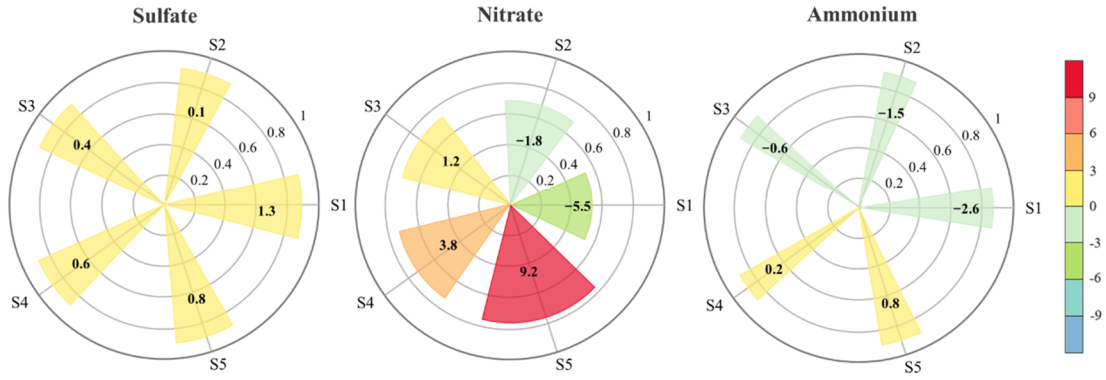

Figure S3. Rose diagram of the statistical indicators for the simulation of sulfate, nitrate and ammonium in the different cases of R9. The radius of each sector represents the degree of correlation between the simulations and observations, the radian indicates the RMSE, the different colours indicate the MB, and the value in the shaded block is the MB value.