

**Supplementary material to:**

**Development of the High-Order Decoupled Direct Method in Three Dimensions for Particulate Matter: Enabling Advanced Sensitivity Analysis in Air Quality Models**

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Table S1 Statistical comparison of brute force and HDDM-PM for first-order sensitivities

		Sensitivity to $E_{SO_2}$	Sensitivity to $E_{NO_x}$	Sensitivity to $E_{NH_3}$
Sulfate	$R^2$	0.92	0.68	0.50
	Slope	1.03±0.01	0.704±0.007	0.338±0.005
	Intercept	-0.005±0.002	-0.0041±0.0008	0.004±0.001
Nitrate	$R^2$	0.94	0.95	0.94
	Slope	0.955±0.003	0.955±0.004	0.918±0.004
	Intercept	-0.005±0.002	-0.005±0.003	-0.0007±0.0019
Ammonium	$R^2$	0.86	0.92	0.96
	Slope	0.624±0.004	0.891±0.004	0.858±0.003
	Intercept	0.0028±0.0004	-0.00065±0.0001	-0.0015±0.0006
PM2.5	$R^2$	0.83	0.92	0.93
	Slope	0.843±0.005	0.946±0.004	0.853±0.003
	Intercept	0.016±0.003	-0.001±0.002	0.007±0.003

Table S2 Statistical comparison of brute force and HDDM-PM for second-order sensitivities

		Sensitivity to $E_{SO_2}$	Sensitivity to $E_{NO_x}$	Sensitivity to $E_{NH_3}$
Sulfate	$R^2$	0.71	0.67	0.18
	Slope	0.649±0.006	0.558±0.006	0.146±0.005
	Intercept	-0.012±0.002	-0.0009±0.0009	0.009±0.001
Nitrate	$R^2$	0.82	0.82	0.43
	Slope	0.513±0.004	0.513±0.004	0.0937±0.0003
	Intercept	-0.022±0.004	-0.022±0.004	-0.012±0.002
Ammonium	$R^2$	0.58	0.77	0.42
	Slope	0.291±0.003	0.459±0.003	0.101±0.002
	Intercept	-0.0027±0.0003	-0.005±0.001	-0.0023±0.0007
PM2.5	$R^2$	0.63	0.79	0.45
	Slope	0.502±0.006	0.531±0.005	0.108±0.002
	Intercept	-0.019±0.002	-0.037±0.004	-0.020±0.002