Supplementary Material

Table S1. Properties of SVOCs used in the model.

Species	Precursor	Production Pathways	Molecular Weight	OM:OC	SVP (298K, atm)
ALK	Alkene	OH	180	1.5625	2.72E-12
BNZ1	Benzene	OH high-NO_x	161	2.0	4.58E-11
BNZ2	Benzene	OH high NO_x	148	2.0	1.83E-08
TOL1	Toluene	OH high NO_x	163	2.0	1.20E-09
TOL2	Toluene	OH high NO_x	175	2.0	1.66E-08
XYL1	Xylene	OH high NO_x	174	2.0	1.12E-09
XYL2	Xylene	OH high NO_x	185	2.0	1.57E-08
ISO1	Isoprene	OH	132	1.6	2.14E-08
ISO2	Isoprene	OH	133	1.6	1.13E-10
TRP1	Monoterpenes	OH/O_3/NO_3	177	1.4	2.04E-09
TRP2	Monoterpenes	OH/O_3/NO_3	198	1.4	1.65E-08
SQT	Sesquiterpenes	OH/O_3/NO_3	273	2.1	2.23E-09

Table S2. Properties of NV-organics used in the model.

Species	Precursor	Production Pathways	Molecular Weight	OM:OC	SVP (298K, atm)
BNZ3	Benzene	OH low NO_x	180	2.0	1.43E-14
TOL3	Toluene	OH low NO_x	194	2.0	5.39E-15
XYL3	Xylene	OH low NO_x	218	2.0	1.17E-13
AIEPOX	Isoprene	Acid-catalyzed	211	2.7	2.32E-15
AIMAE	Isoprene	Acid-catalyzed	211	2.7	2.32E-15
AGLYMGLY	BVOCs and aromatics	Heterogeneous uptake	211	2.0	2.32E-15
OLGA	Anthropogenic VOCs	oligomerization	206	2.1	1.43E-14
OLGB	Biogenic VOCs	oligomerization	248	2.1	7.58E-16

Table S3. Properties of POA used in the model.

POA	Molecular weight	Fraction
tetracosanoic acid	368	0.01
acetonyl syringol	185	0.01
n-alkane	408	0.08
phthalic acid	166	0.1
benzo(ghi)-perylene	276	0.1
2,6-naphthalene-diacid	216	0.1
butanedioic acid	118	0.1
octadecanoic acid	284	0.1
17.alpha.(H)-21.beta.(H)-hopan	412	0.1
unknown compounds	390	0.3

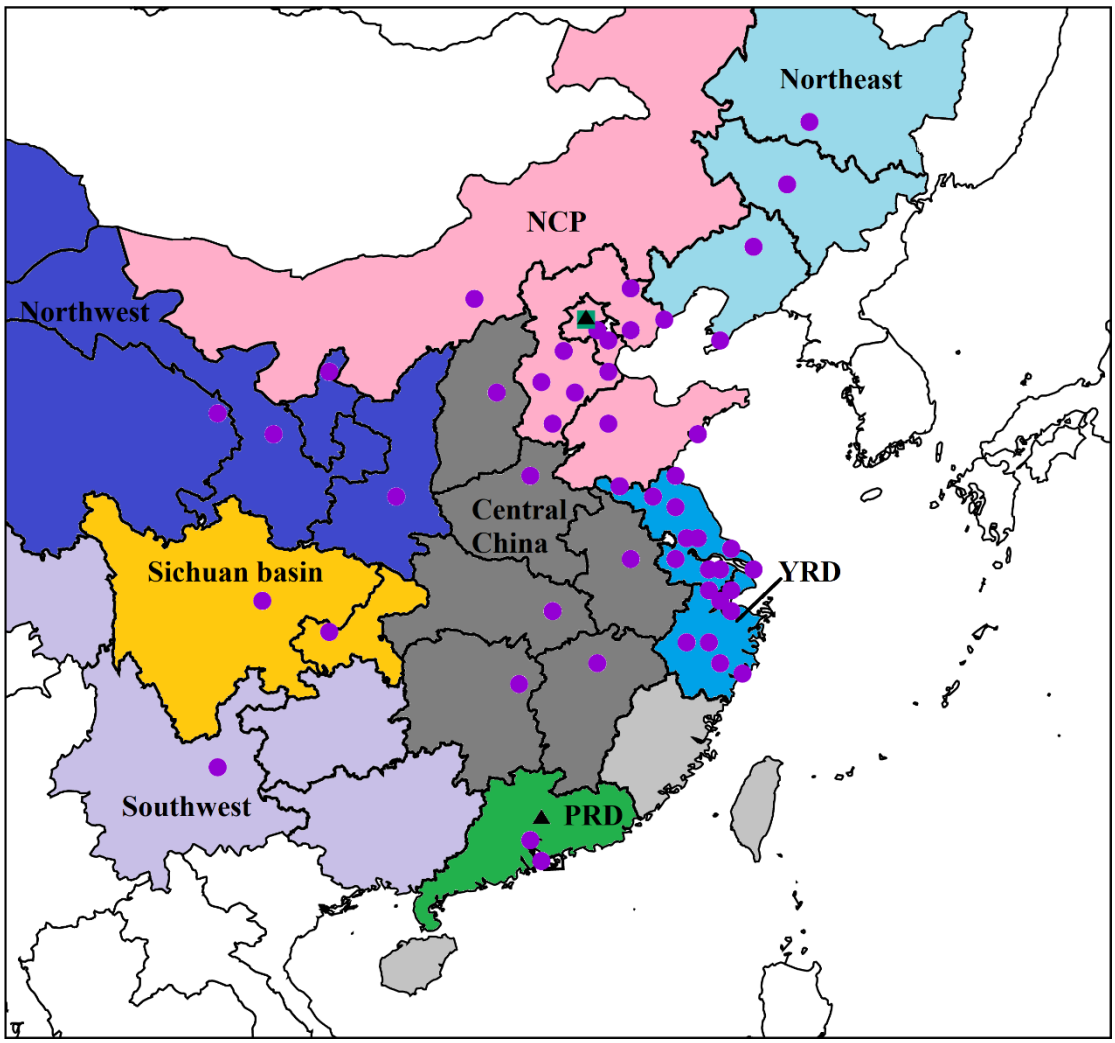

Figure S1. Domain of this study and locations of monitoring sites of $PM_{2.5}$ (dot), OC (triangle) and OA (rectangle). The figure also shows geographical areas in different colors. NCP represents North China Plain, YRD represents Yangtze River Delta, and PRD represents Pearl River Delta.

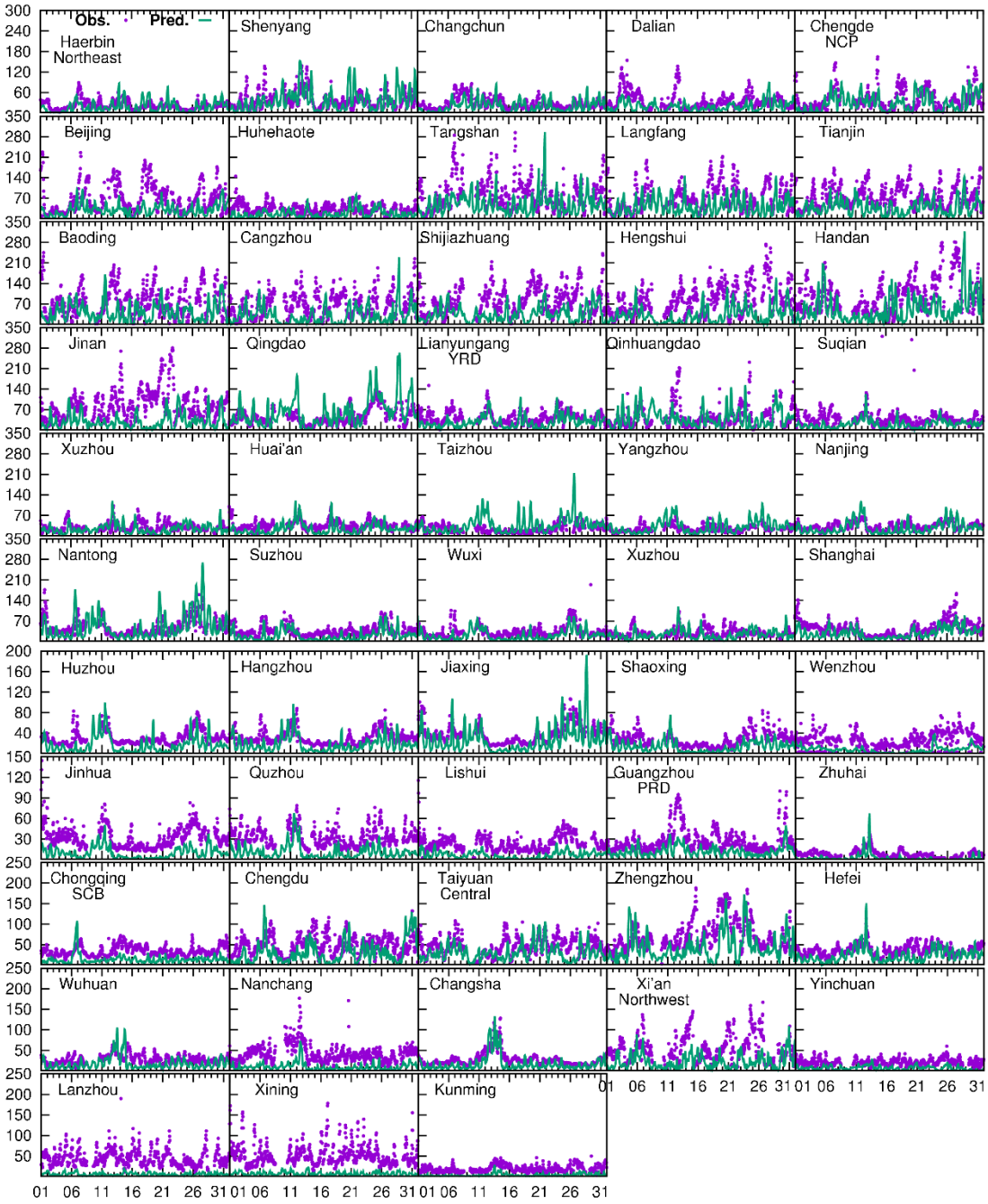

Figure S2. Comparison of observed (dots) and predicted (lines) $PM_{2.5}$ concentration ($\mu g\ m^{-3}$) at monitoring sites shown in Figure S1(a) during July of 2013.

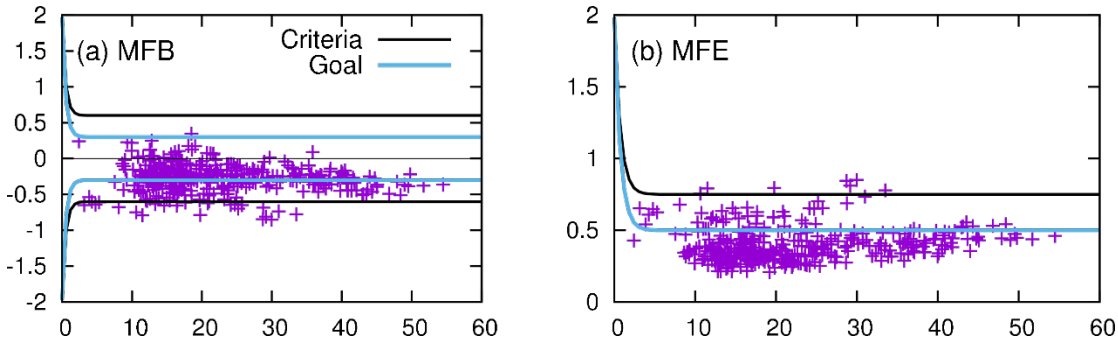

Figure S3. Statistical analysis of modeled $PM_{2.5}$ in July, 2013 at monitoring sites shown in Figure S1.

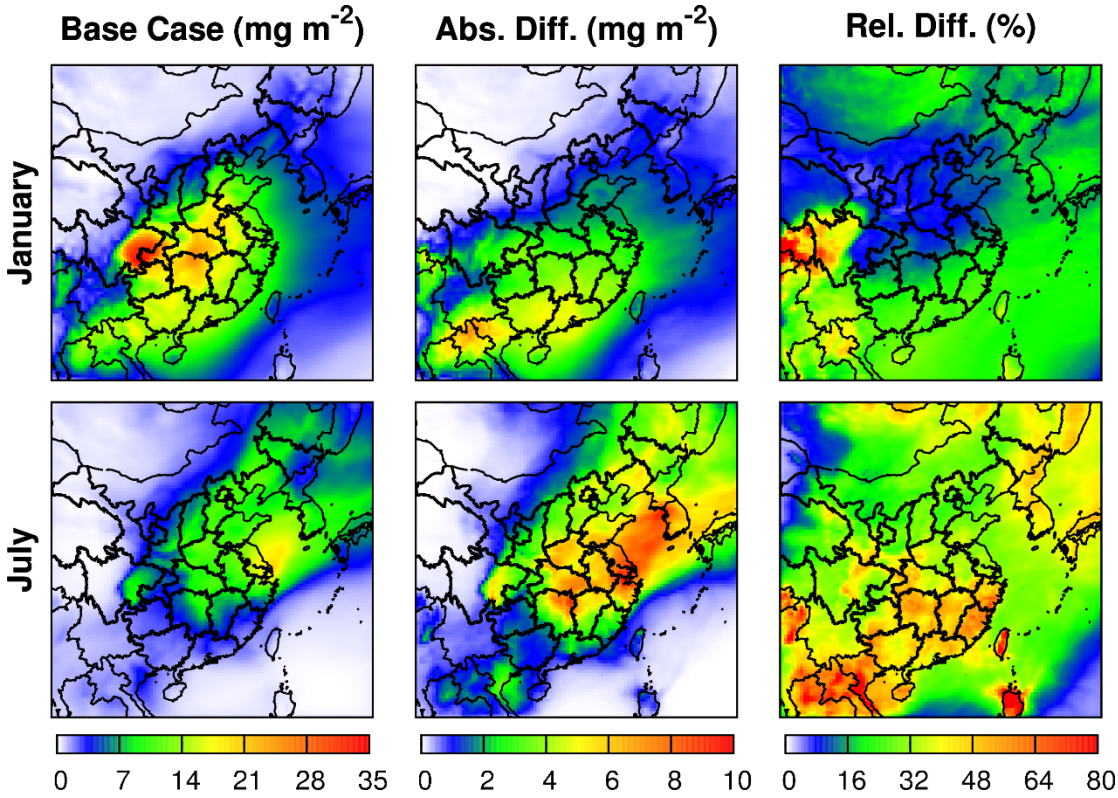

Figure S4. Monthly-averaged SOA column concentration in BS and monthly-averaged daily maximum changes due to water partitioning and non-ideality of organics-water mixture. “Abs. Diff.” represents absolute differences (S3-BS); “Rel. Diff.” represents relative differences ((S3-BS)/BS, %).

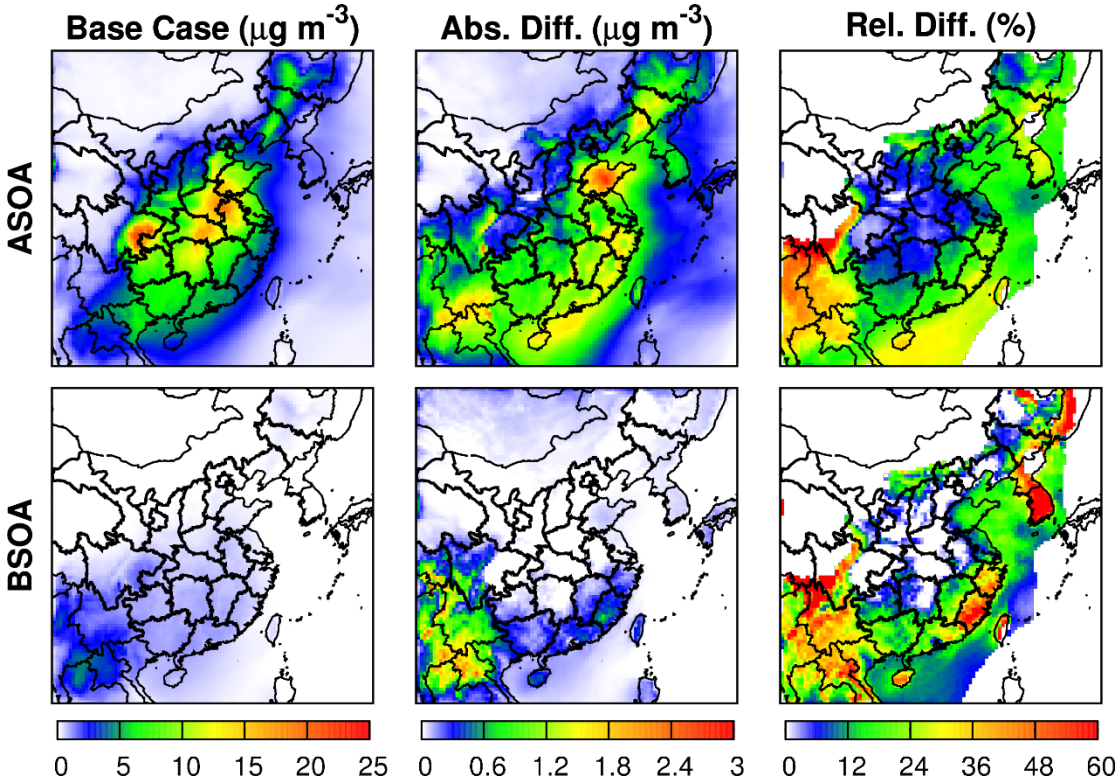

Figure S5. Monthly-averaged surface anthropogenic SOA (ASOA) and biogenic SOA (BSOA) in BS and monthly-averaged daily maximum changes due to water partitioning and non-ideality of organics-water mixture during January, 2013. "Abs. Diff." represents absolute differences (S3-BS); "Rel. Diff." represents relative differences ((S3-BS)/BS, %). Relative differences are shown in areas with monthly-averaged SOA concentration greater than 1 μg m^{-3}.

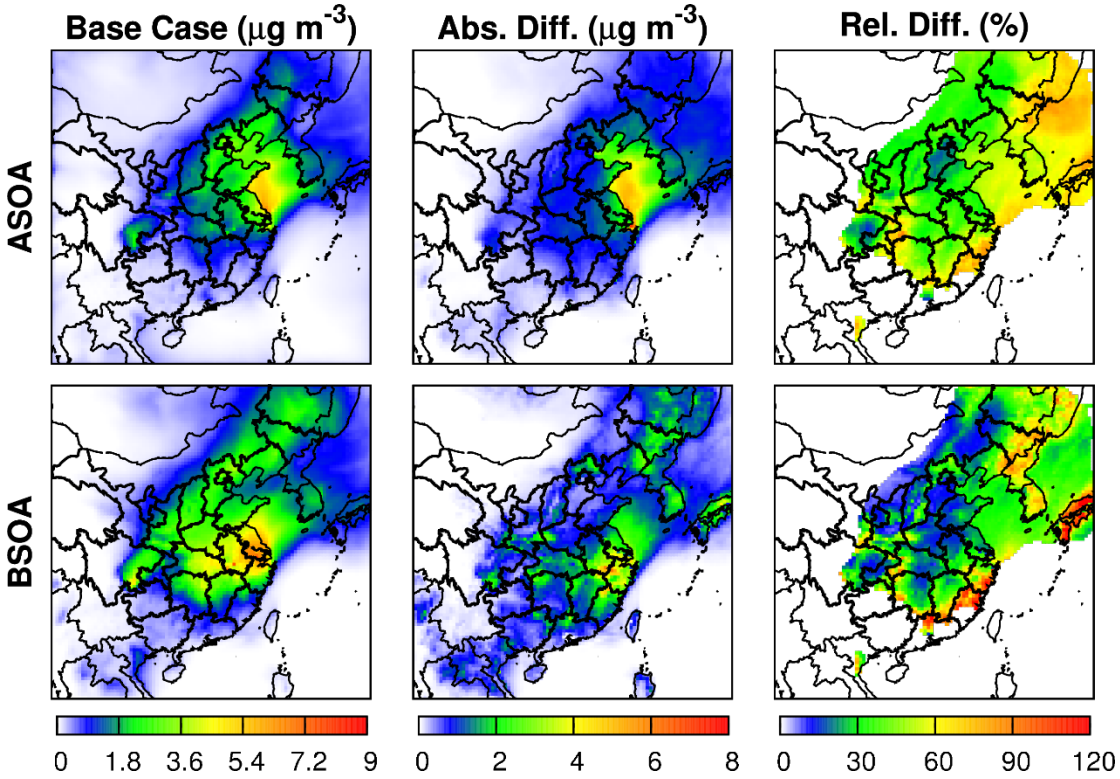

Figure S6. Same as Figure S5 but for July of 2013.

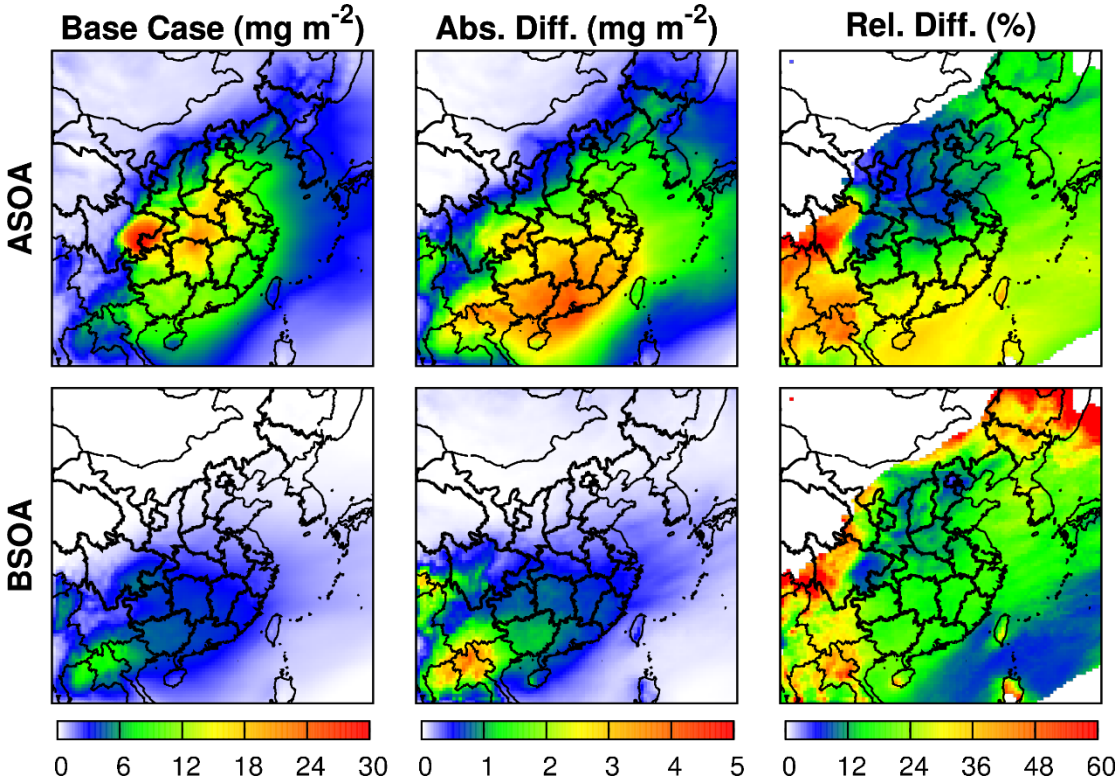

Figure S7. Monthly-averaged column total concentration of anthropogenic SOA (ASOA) and biogenic SOA (BSOA) in BS and monthly-averaged daily maximum changes due to water partitioning and non-ideality of organics-water mixture during January, 2013. "Abs. Diff." represents absolute differences (S3-BS); "Rel. Diff." represents relative differences ((S3-BS)/BS, %). Relative differences are shown in areas with monthly-averaged col-SOA concentration greater than 1 mg m^{-2}.

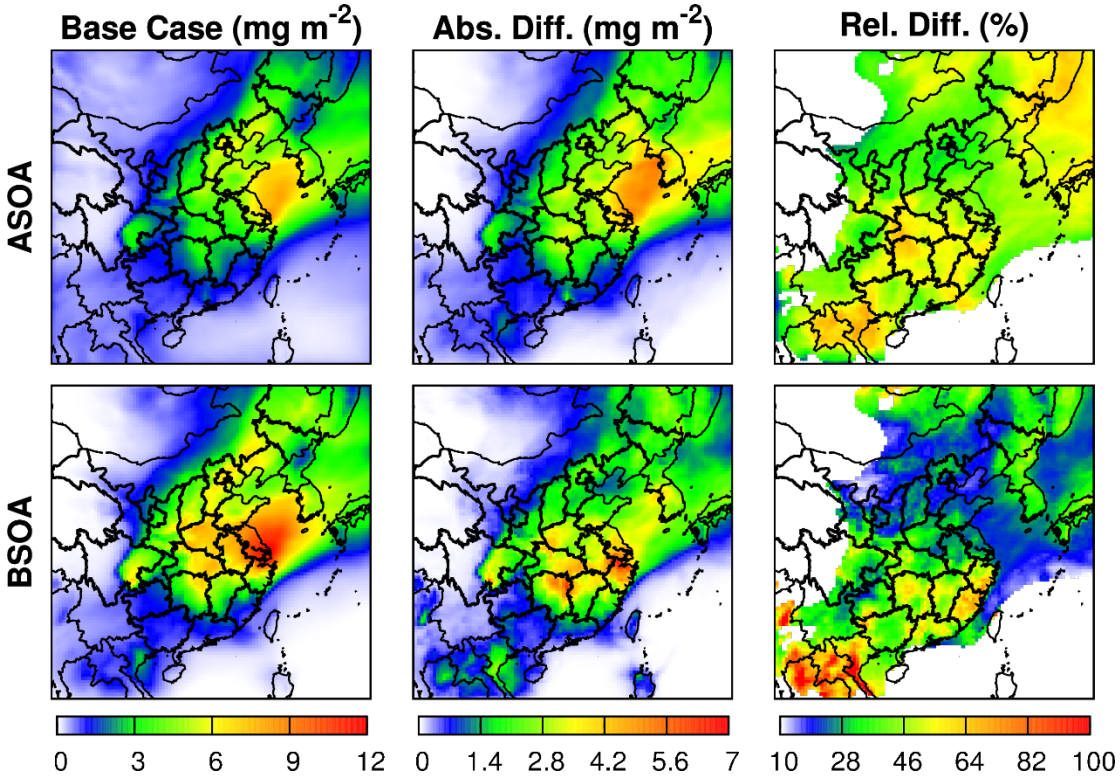

Figure S8. Same as Figure S7 but for July of 2013.

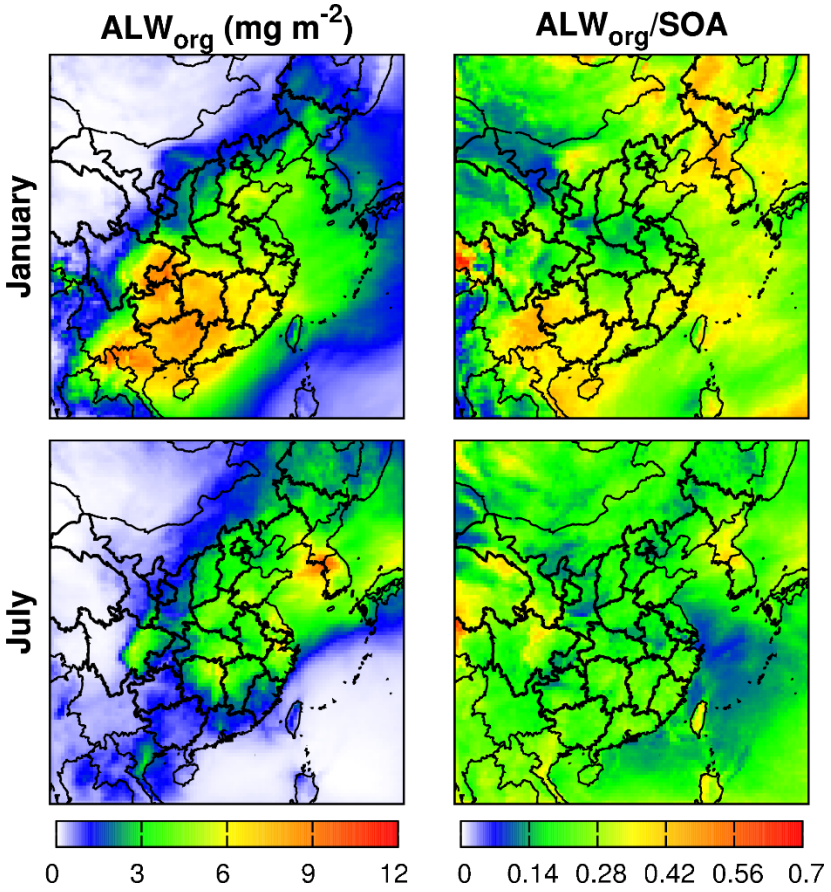

Figure S9. Monthly-averaged daily maximum column concentration of ALW_{org} and the ratio to SOA column concentration in January and July of 2013.

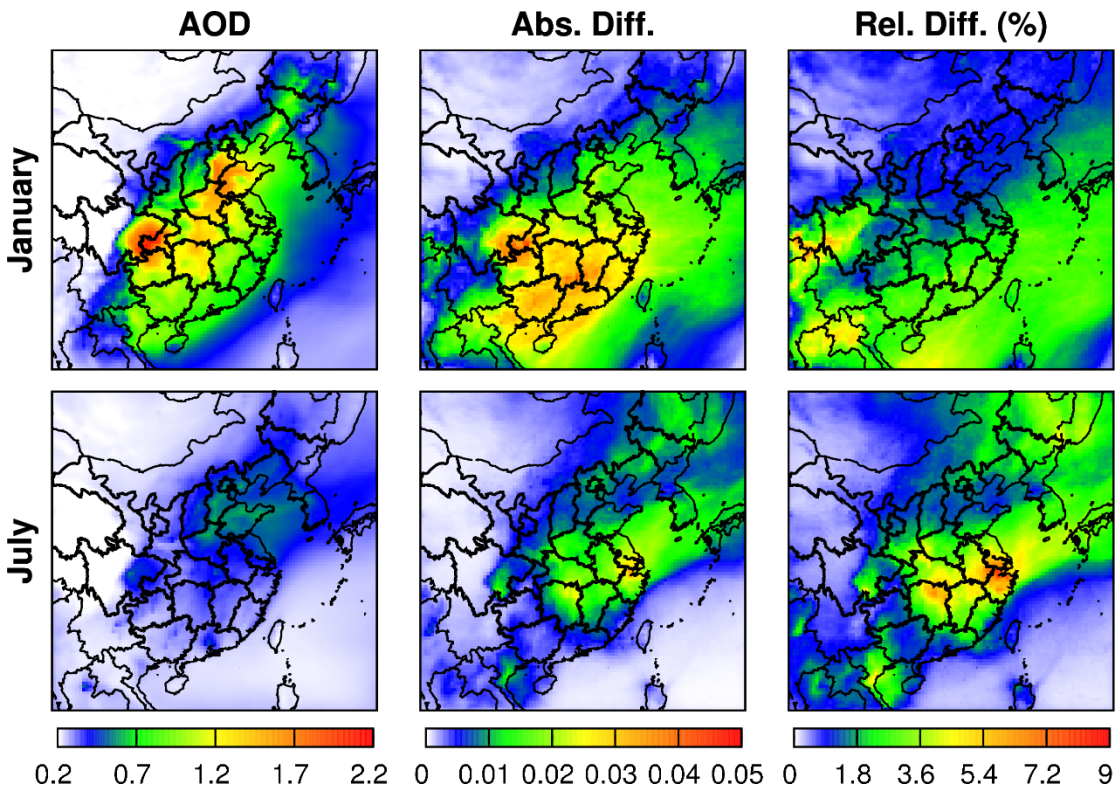

Figure S10. Monthly-averaged AOD at 550nm calculated with fine aerosol extinction coefficient by Mie theory and the monthly-averaged daily maximum impacts due to water partitioning and non-ideality of organics-water mixture during January and July of 2013.

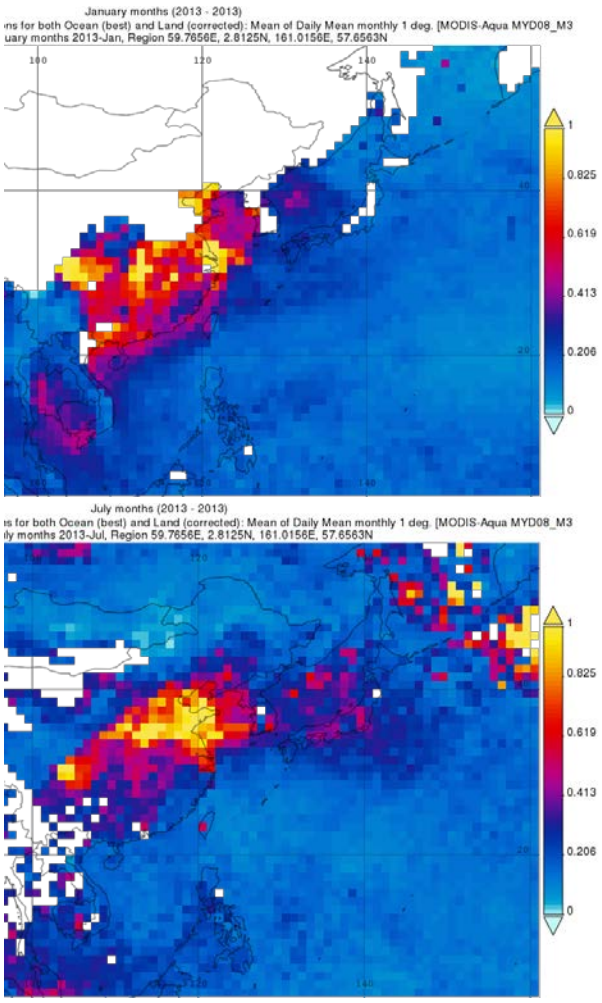

Figure S11. Monthly-averaged AOD at 550nm observed by MODIS AQUA during January and July of 201301.

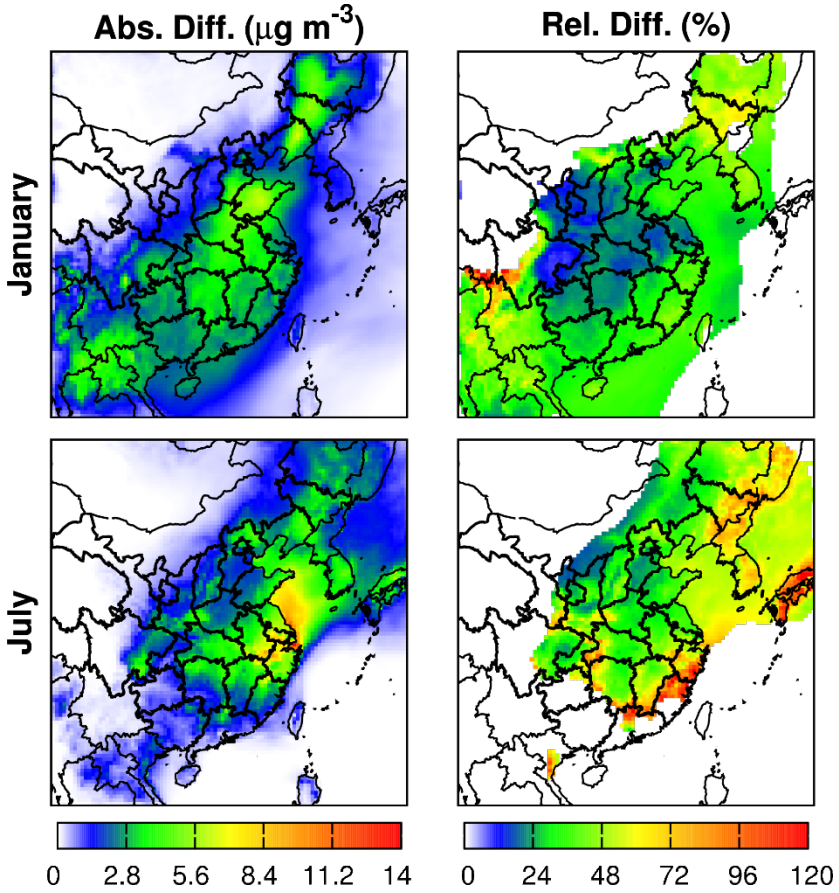

Figure S12. Monthly-averaged daily maximum impacts of water partitioning into OPM on SOA. "Abs. Diff." represents absolute differences (S3-S2); "Rel. Diff." represents relative differences ((S3-S2)/S2, %). Relative differences are shown in areas with monthly-averaged SOA concentration greater than 1 μg m^{-3}.

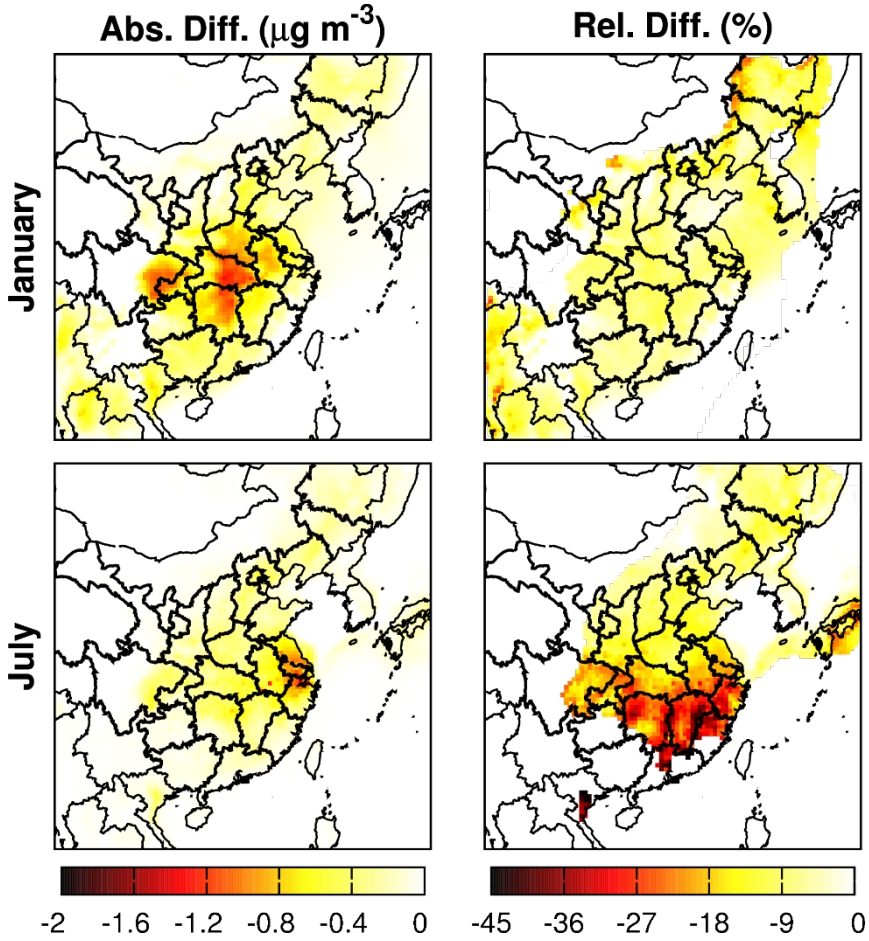

Figure S13. Monthly-averaged daily maximum impacts of non-ideality of organics-water mixture on SOA. "Abs. Diff." represents absolute differences (S3-S1); "Rel. Diff." represents relative differences ((S3-S1)/S1, %). Relative differences are shown in areas with monthly-averaged SOA concentration greater than 1 μg m^{-3}.