Supplementary

Fig. S1

Fig. S1. Regions defined in HTAP phase II and coastal area. Region 1-Global, 2-Ocean (include Arctic), 3-North America, 4-Europe, 5-South Asia, 6-East Asia, 7-Southeast Asia, 8-Australia, 9-North Africa, 10- Sub Saharan Africa, 11-Middle East, 12- Mexico, Central America, Caribbean, Guyanas, Venezuela, Columbia (Central America), 13-South America, 14-Russia, Belarussia, Ukraine (RBU), 15-Central Asia, 17-Antarctic.

Fig. S2
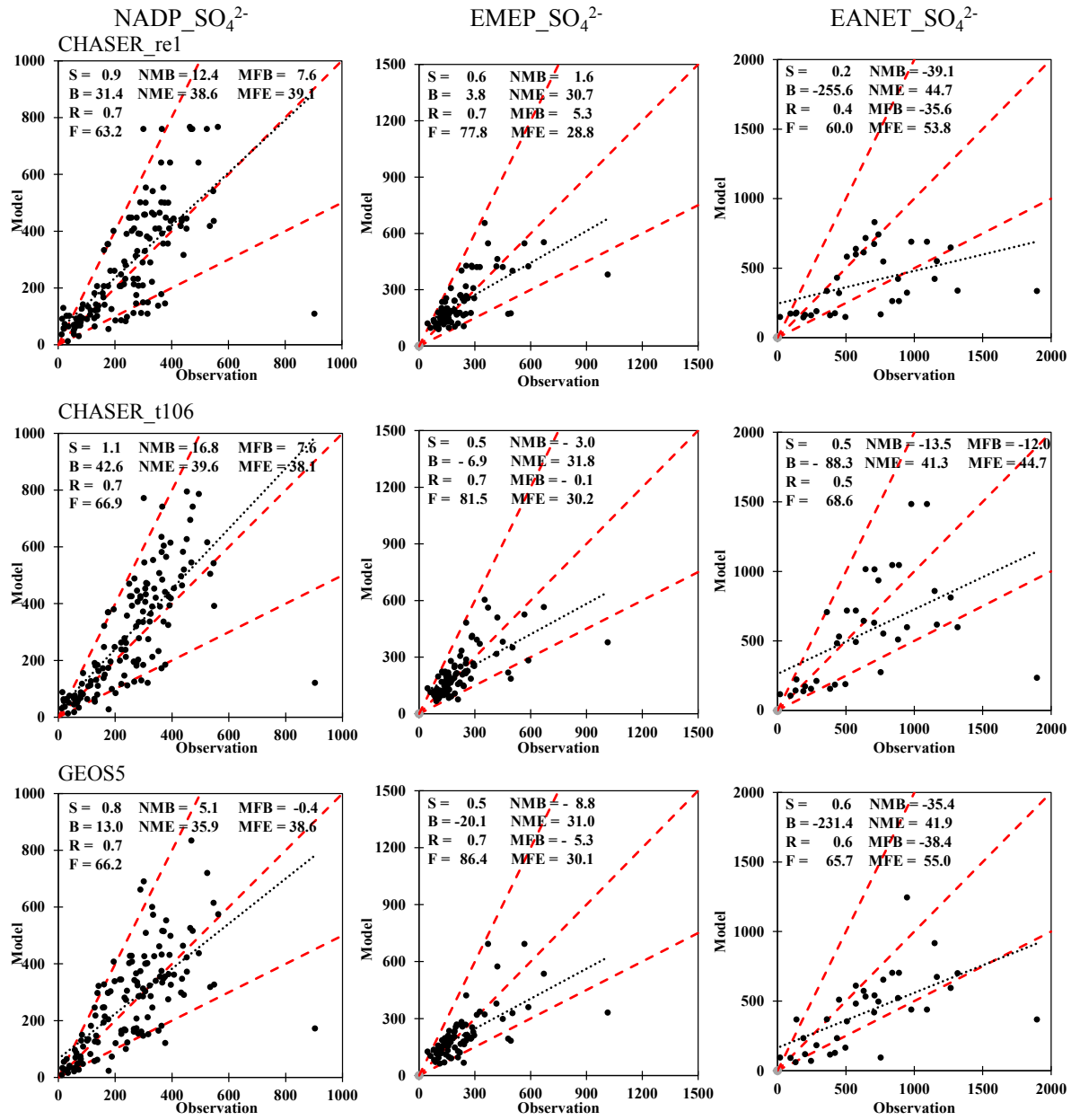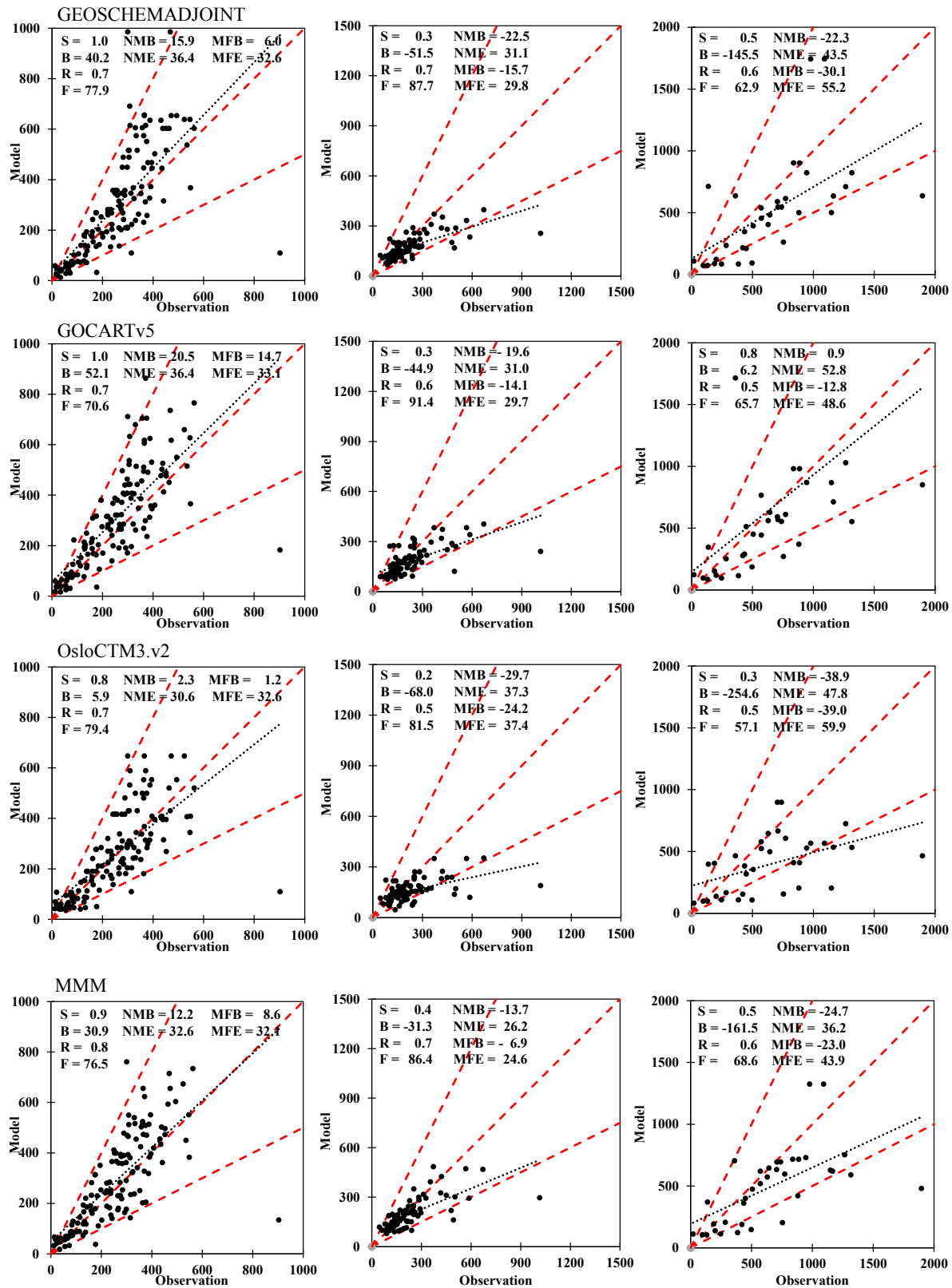
Fig. S2. Individual model performances on SO_4^{2-} wet deposition (mg (S) $m^{-2}yr^{-1}$). The model result is the annual deposition in 2010 and the observation is 3-year average annual data of 2009-2011.

Fig. S3
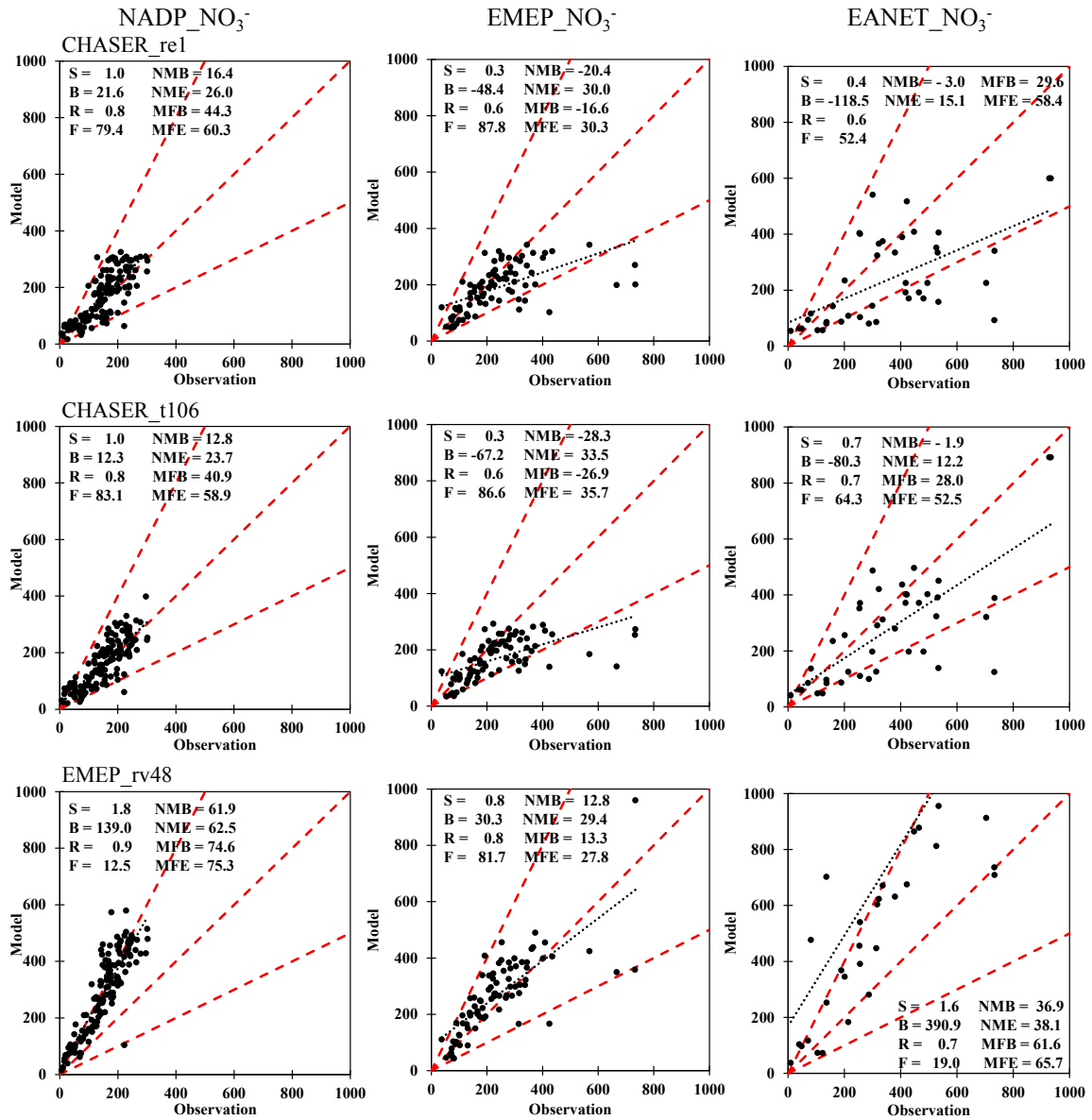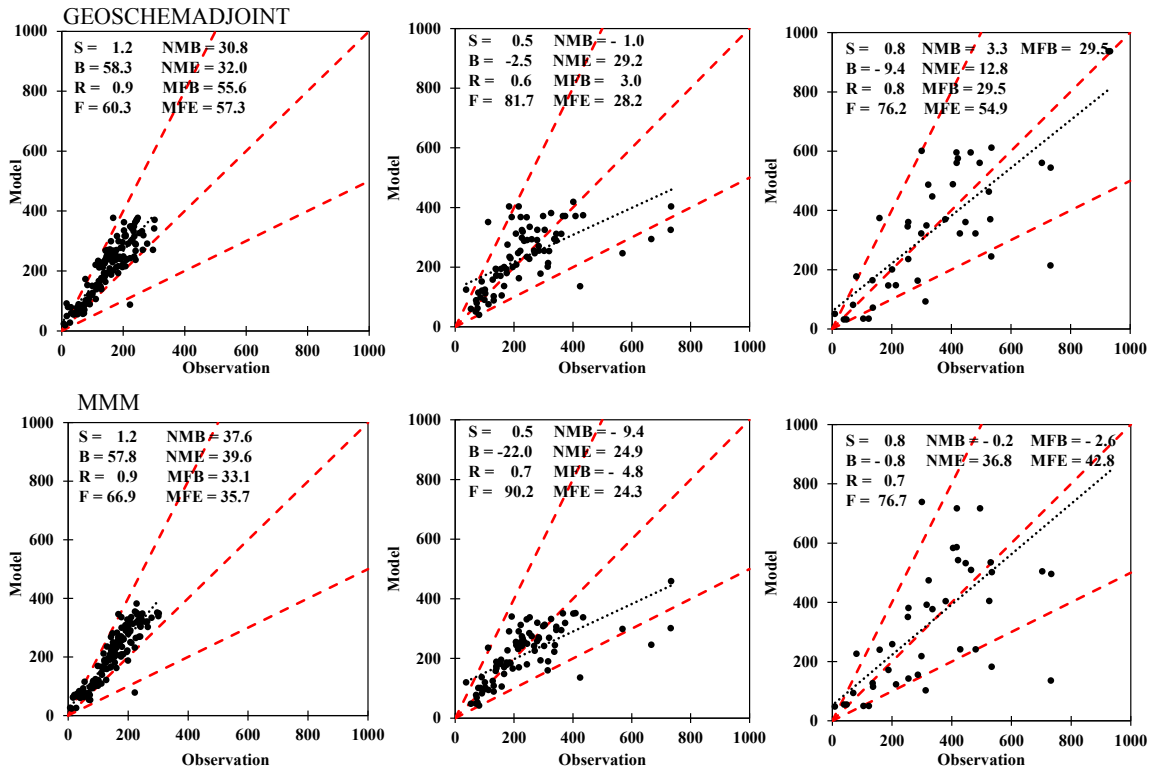
Fig. S3. Same as Fig. S2 but for NO_3^- wet deposition (mg (N) m^{-2}yr^{-1})

Fig. S4
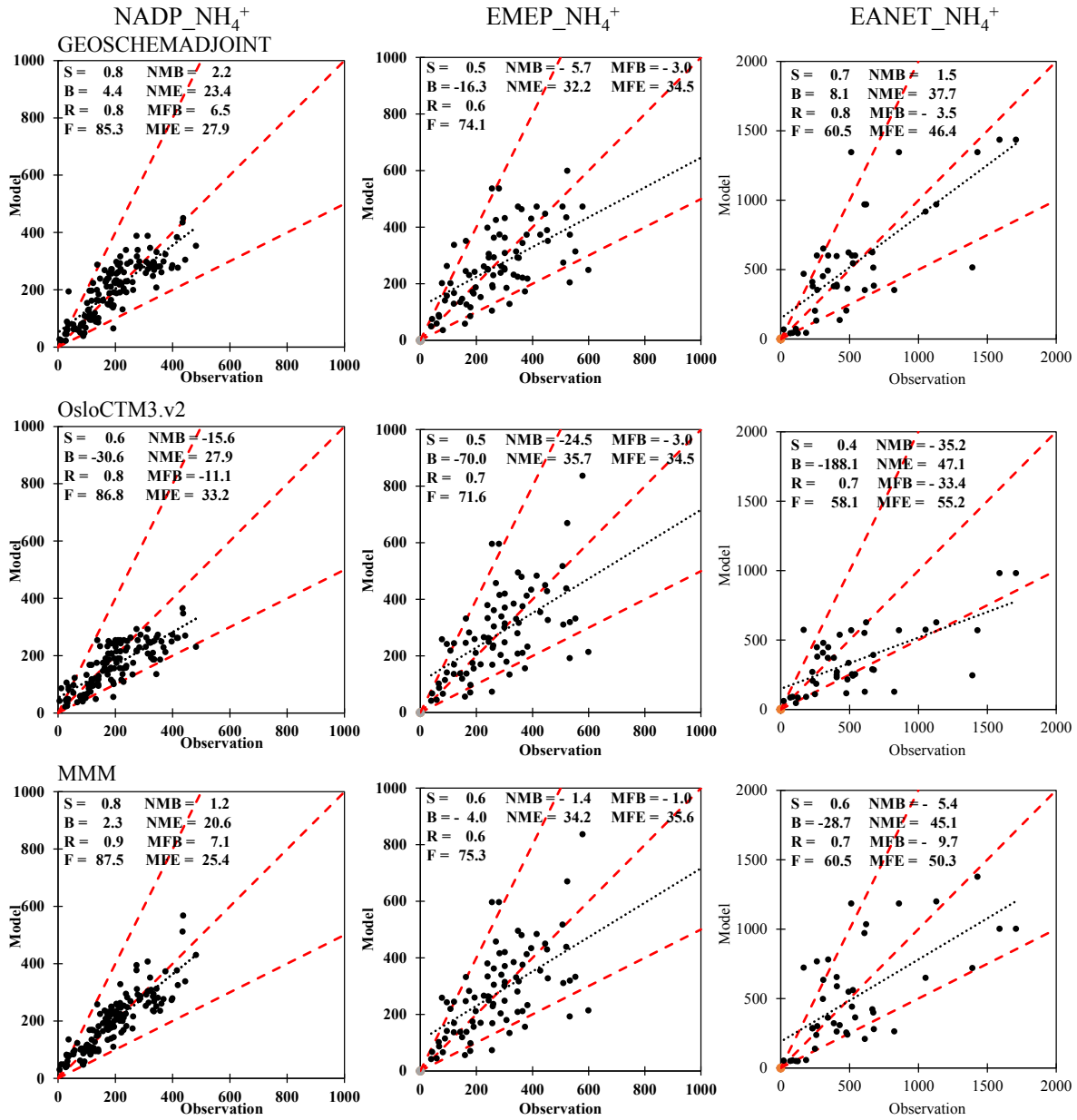
Fig. S4 Same as Fig. S2 but for NH_4^+ wet deposition $(mg\ (N)\ m^{-2}yr^{-1})$

Fig. S5
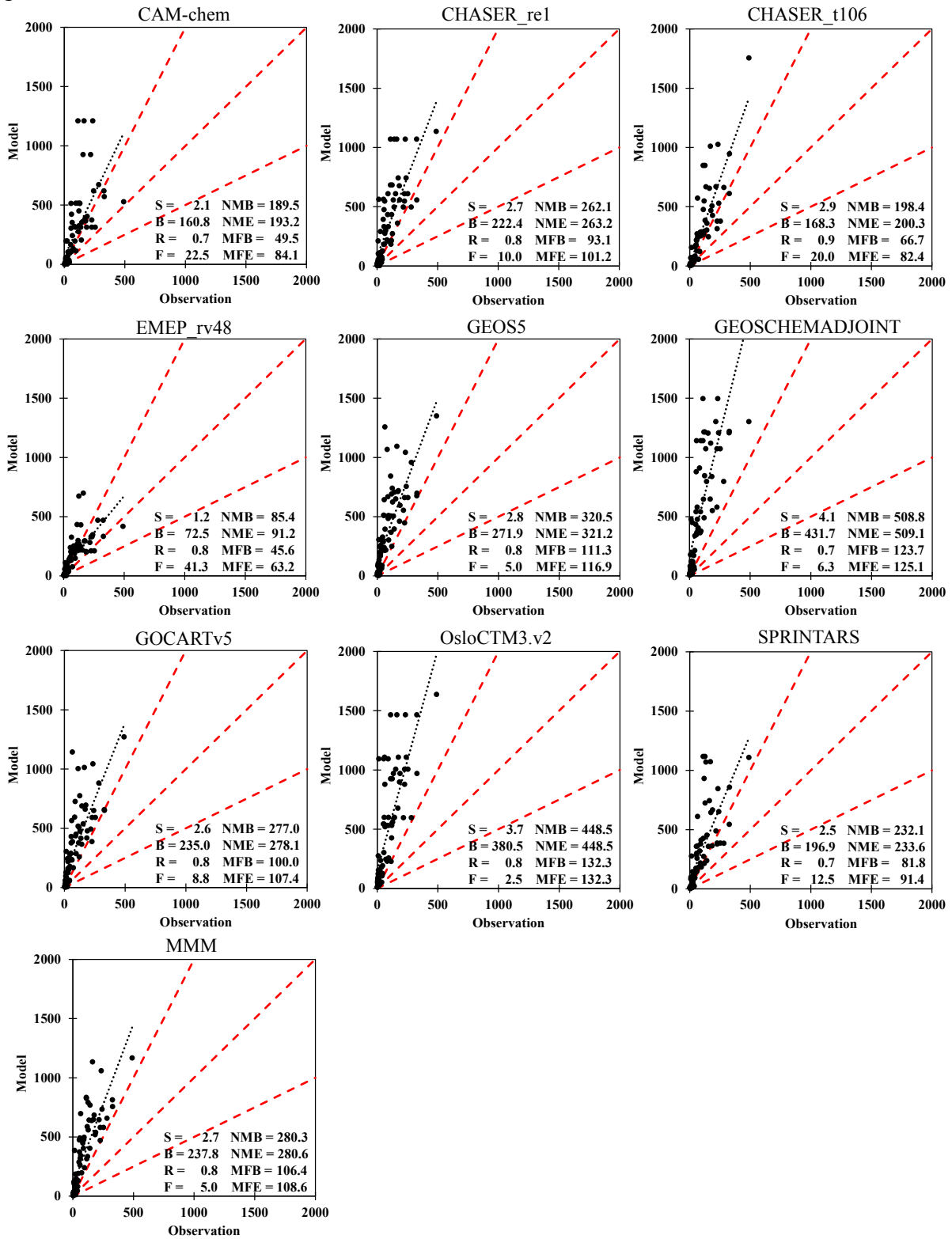
Fig. S5. Individual model performances on SO$_2$ dry deposition (mg (S) m^{-2}yr^{-1}). The model result is the annual deposition in 2010 and the observation is 3-year average annual data of 2009-2011.

Fig. S6
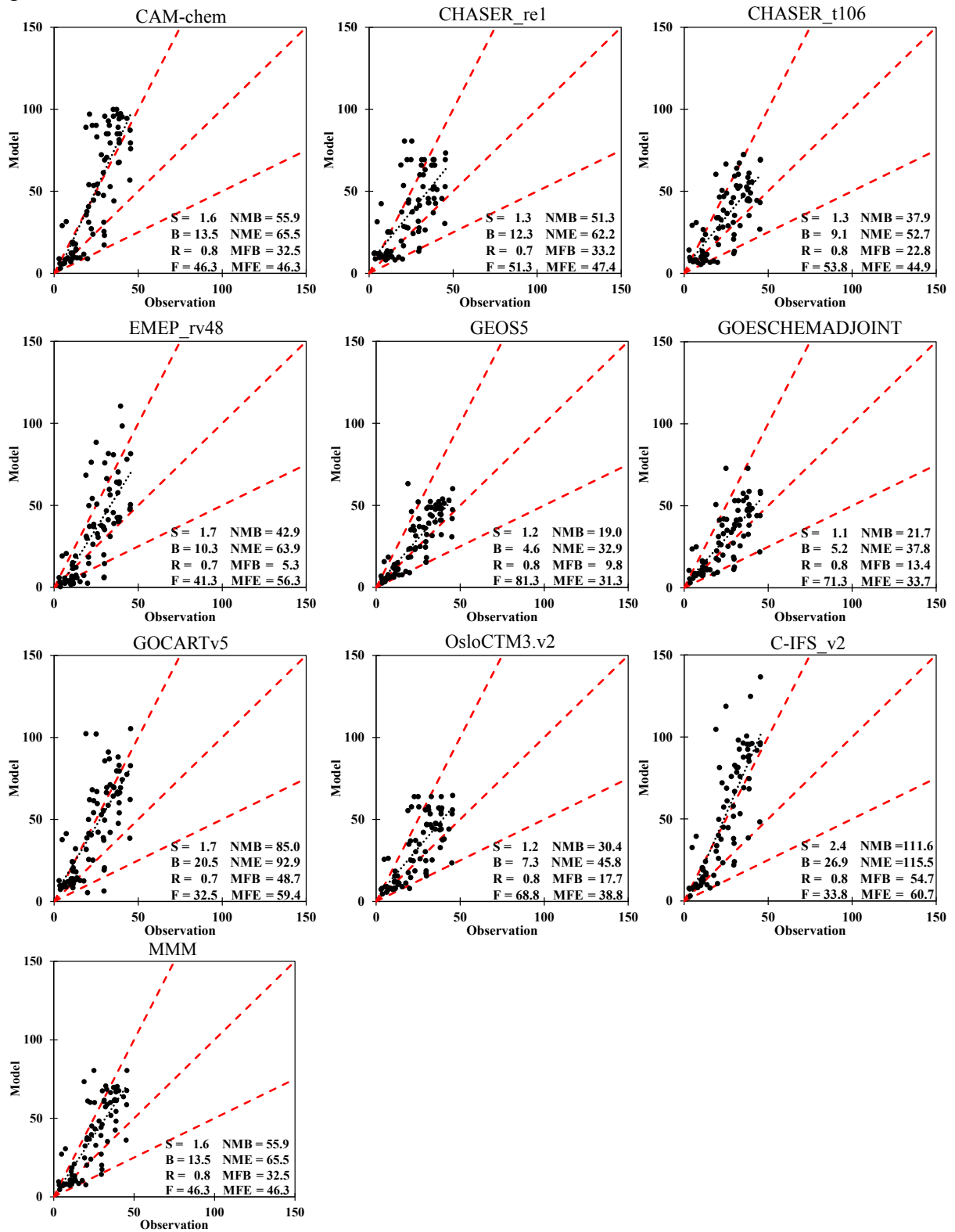
Fig. S6. Same as Fig. S5 but for SO_4^{2-} dry deposition (mg (S) m^{-2}yr^{-1})
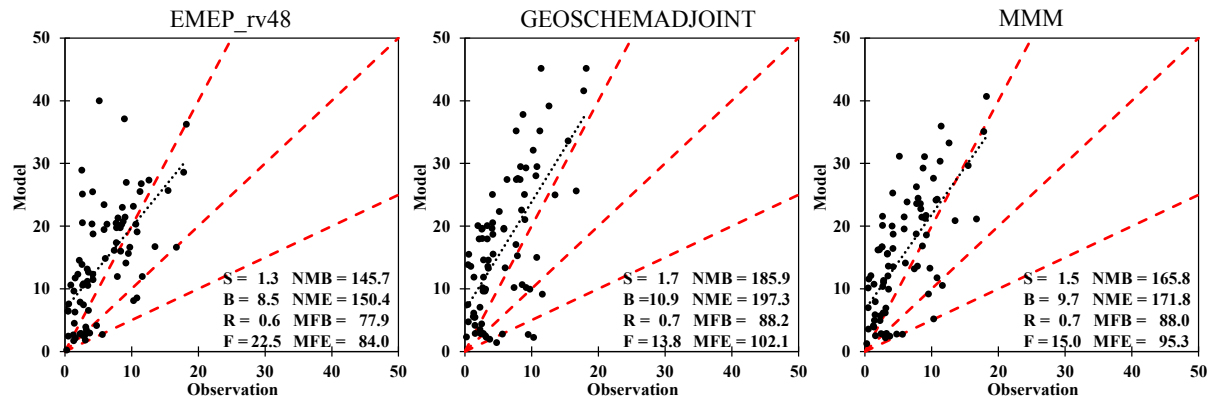
Fig. S7. Same as Fig. S5 but for NO_3^- dry deposition (mg (N) m^{-2}yr^{-1})

Fig. S8
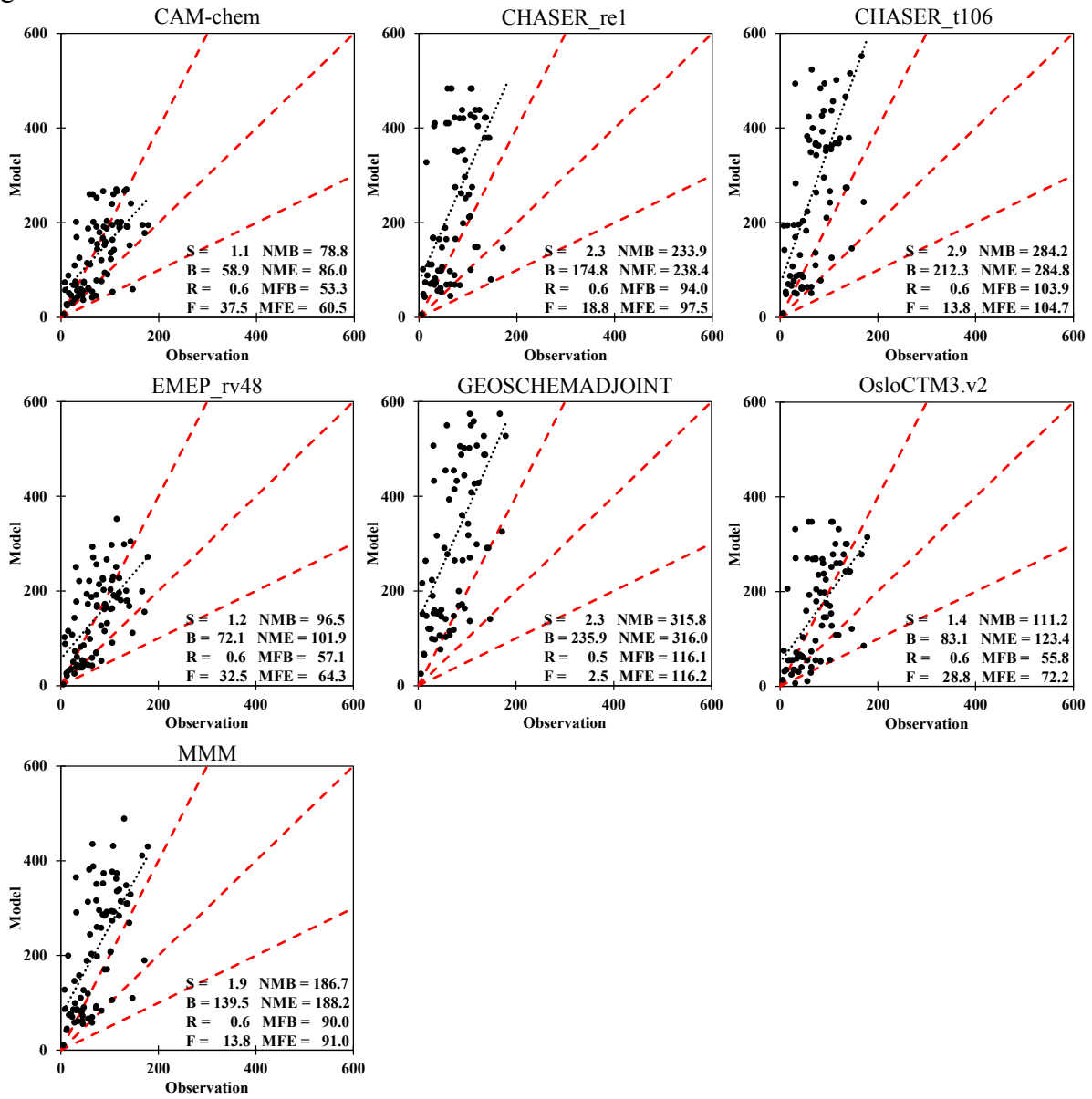
Fig. S8. Same as Fig. S5 but for HNO$_3$ dry deposition (mg (N) m^{-2}yr^{-1})

Fig. S9
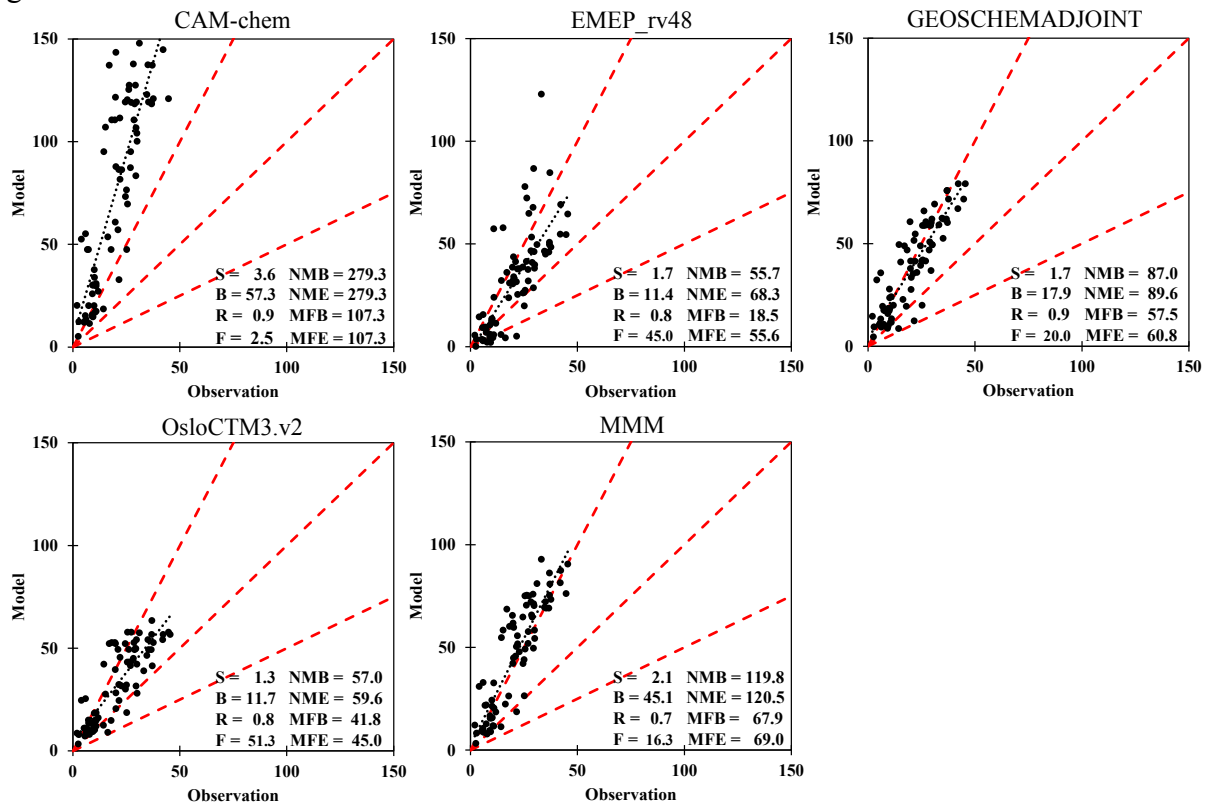
Fig. S9. Same as Fig. S5 but for NH_4^+ dry deposition (mg (N) m^{-2}yr^{-1})

Fig. S10
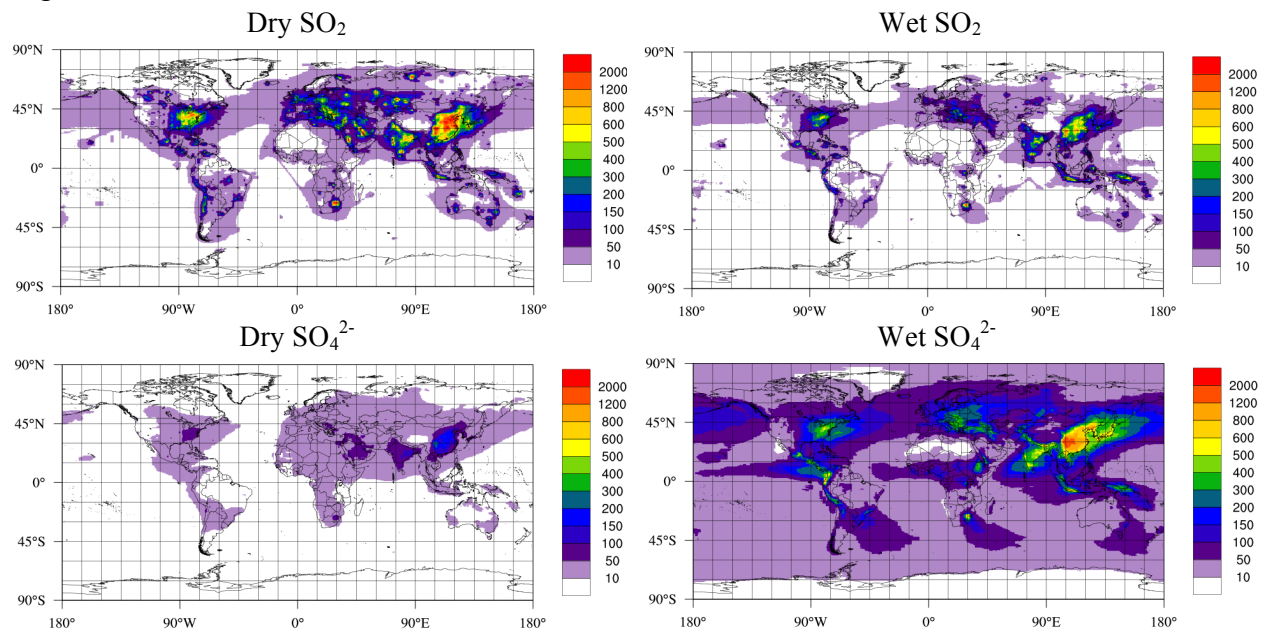
Fig. S10 Spatial distribution of SO_2 and SO_4^{2-} deposition in 2010 from MMM results (mg(S) m^{-2}yr^{-1}).

Fig. S11

(a) HTAP II S emission – HTAP I S emission

(b) HTAP II S deposition – HTAP I S deposition
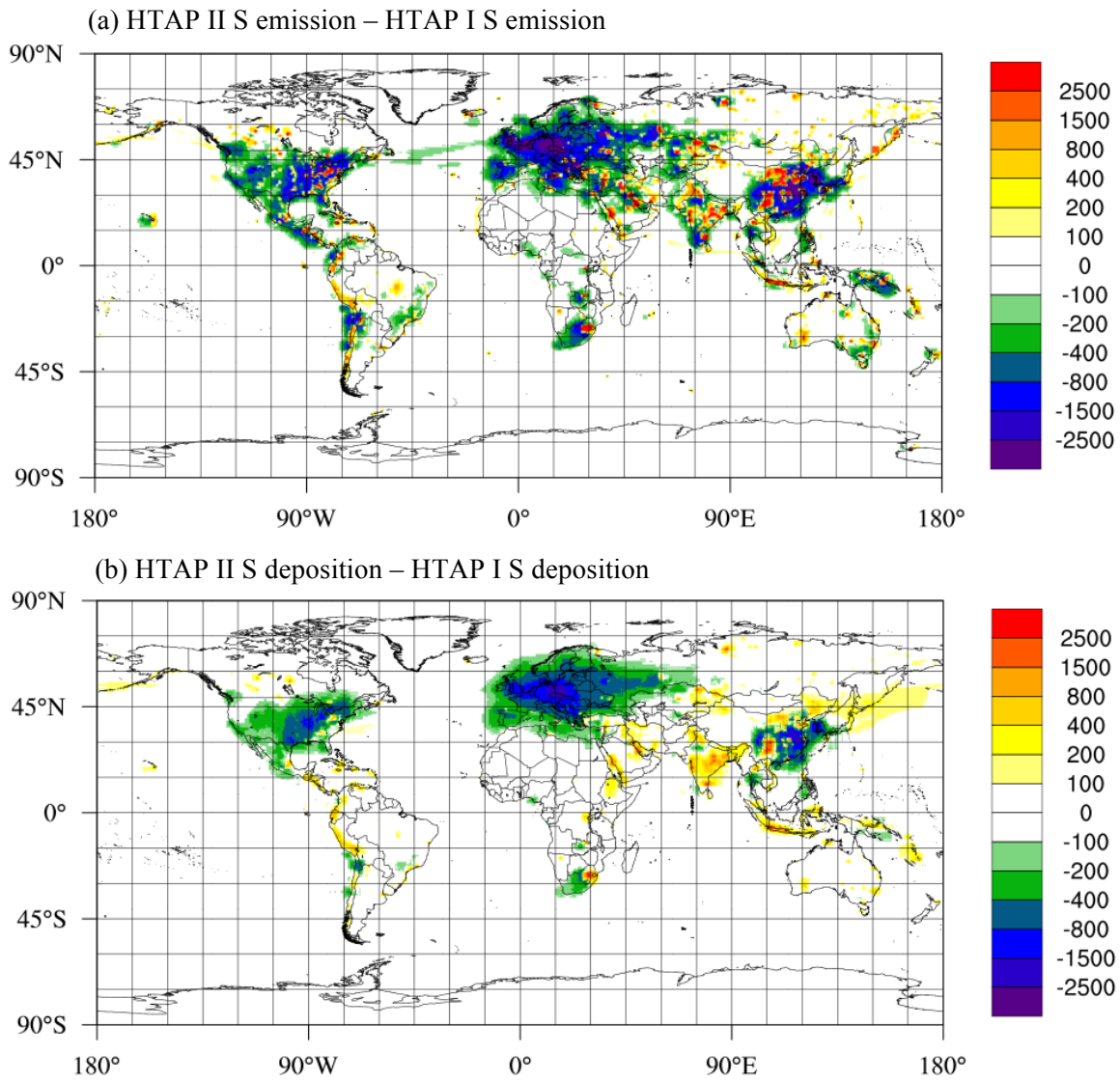
Fig. S11 Difference between MMM of HTAP II and HTAP I for (a) S emission (b) S Deposition. Unit: mg(S) m^{-2} yr^{-1}.

Fig. S12
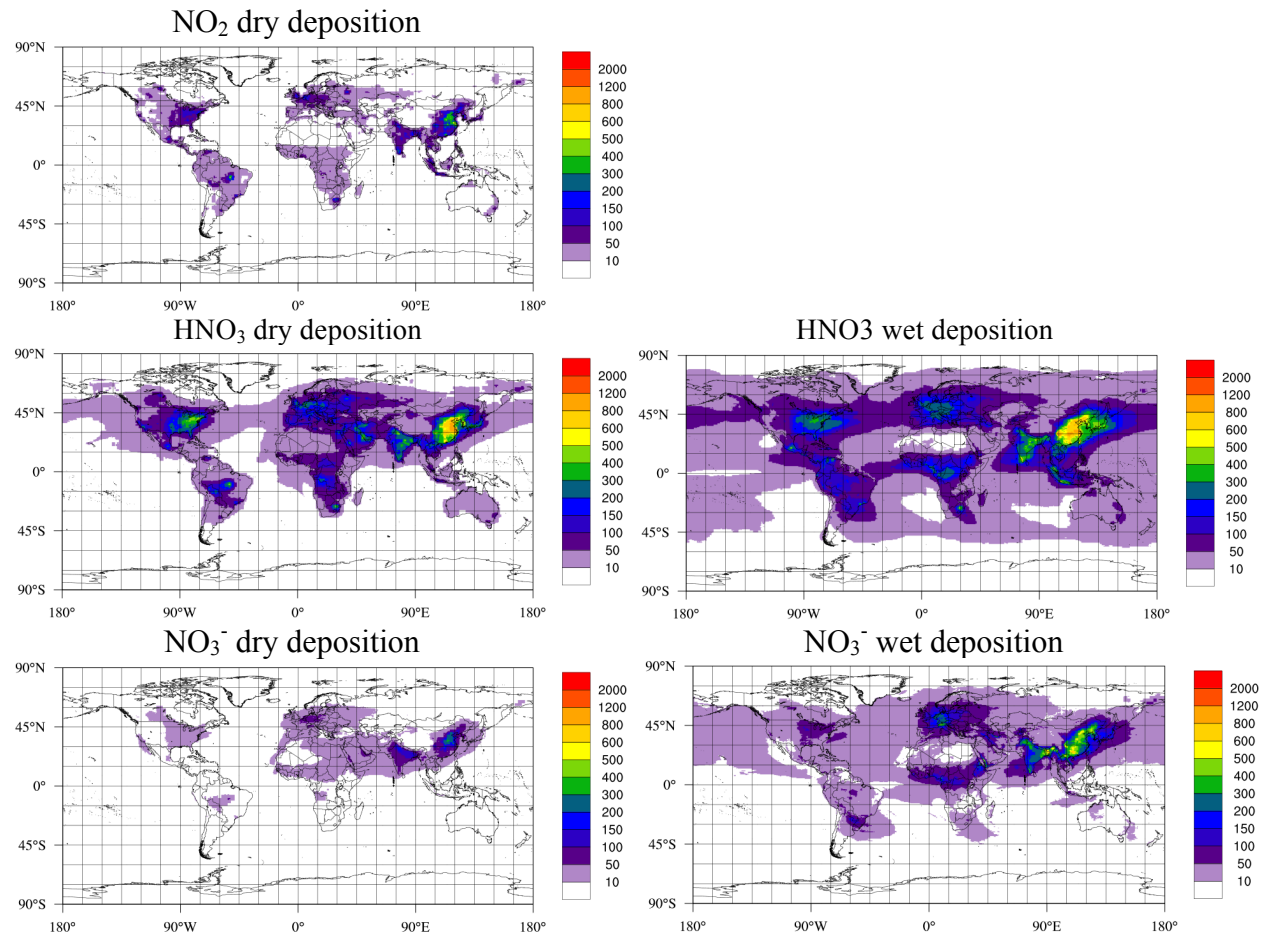
Fig. 12 Spatial distributions of NO₂, HNO₃ and NO₃⁻ deposition in 2010 from MMM results $(mg(N)\ m^{-2}yr^{-1})$.

Fig. S13
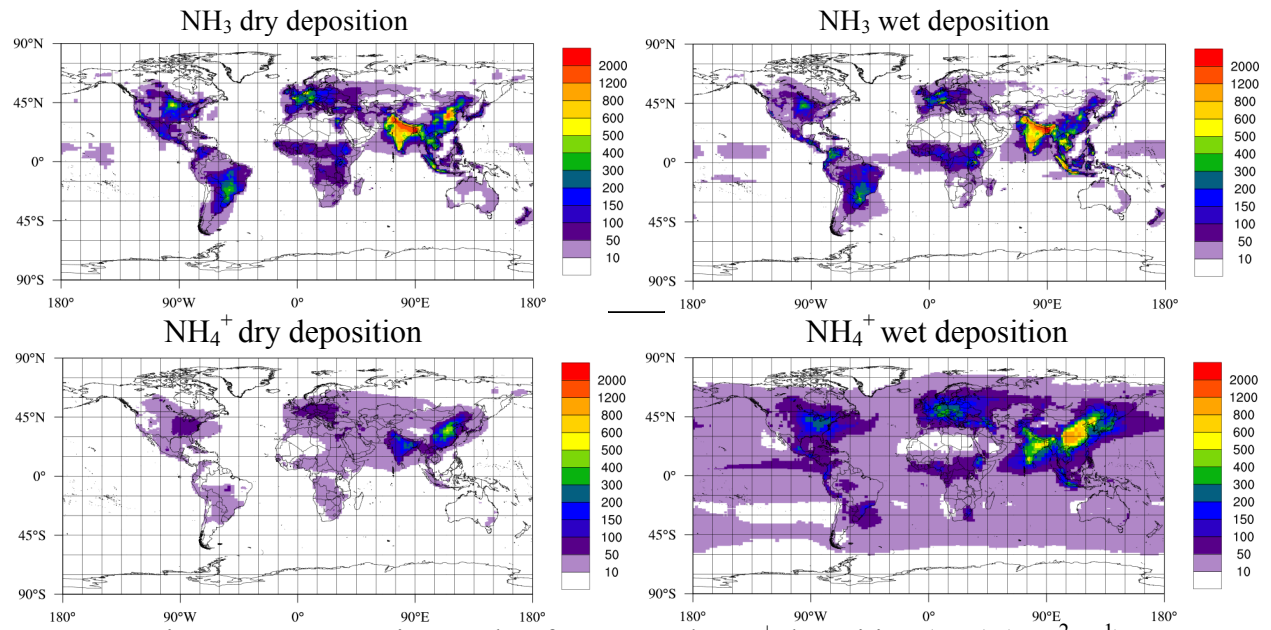
Fig. S13 Same as Fig. S12 but for NH_3 and NH_4^+ deposition $(mg(N)\ m^{-2}yr^{-1})$

Fig. S14
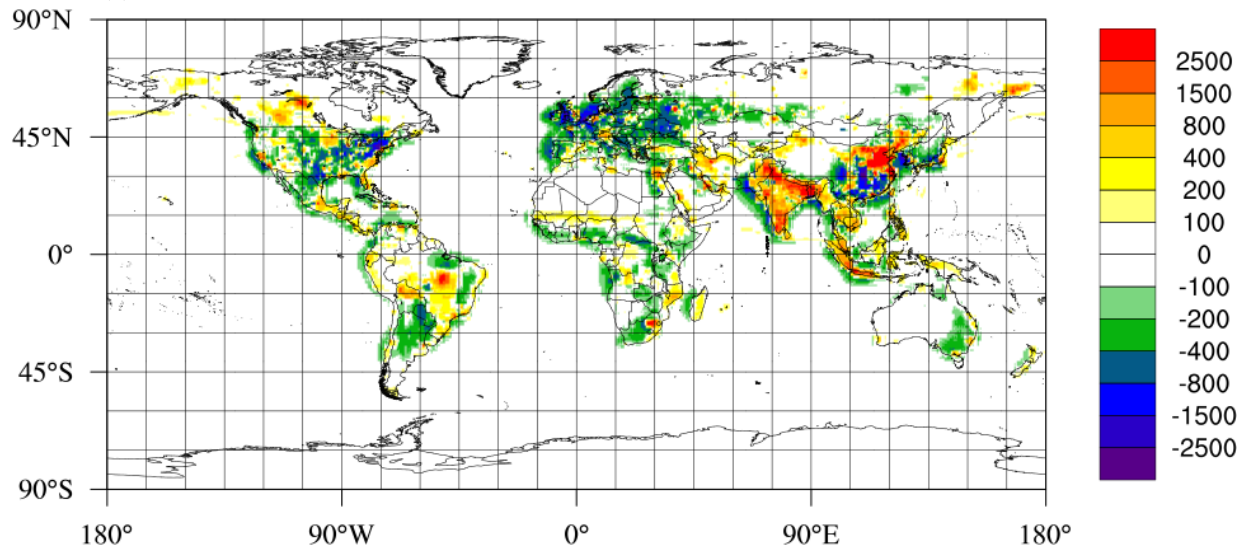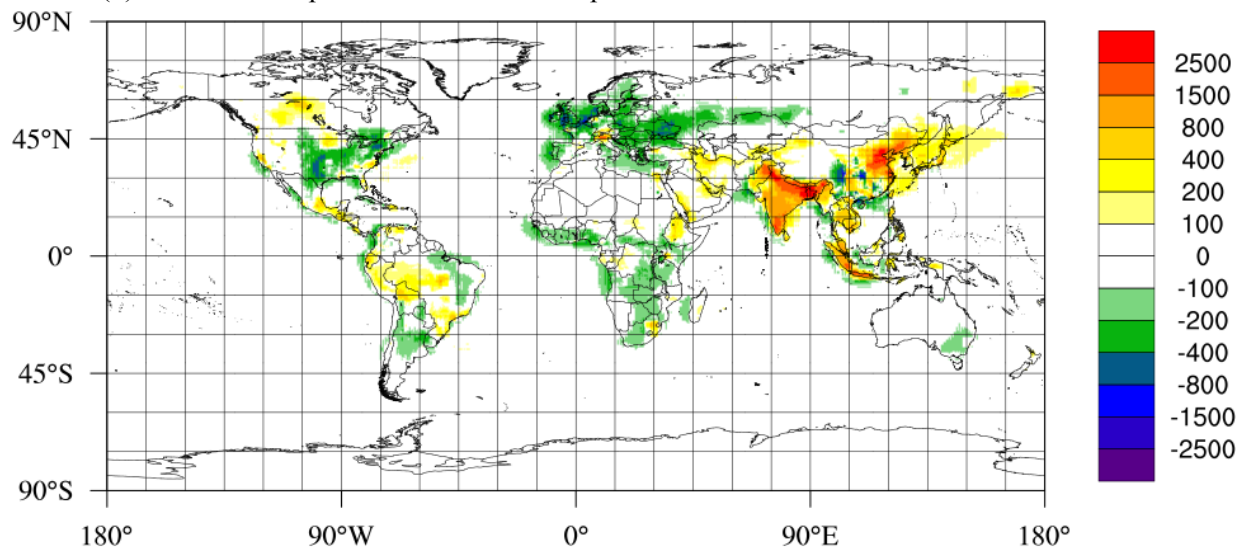
Fig. S14 Difference between MMM of HTAP II and HTAP I for (a) N emission (b) N Deposition. Unit: mg(N) m^{-2} yr^{-1}

Fig. S15
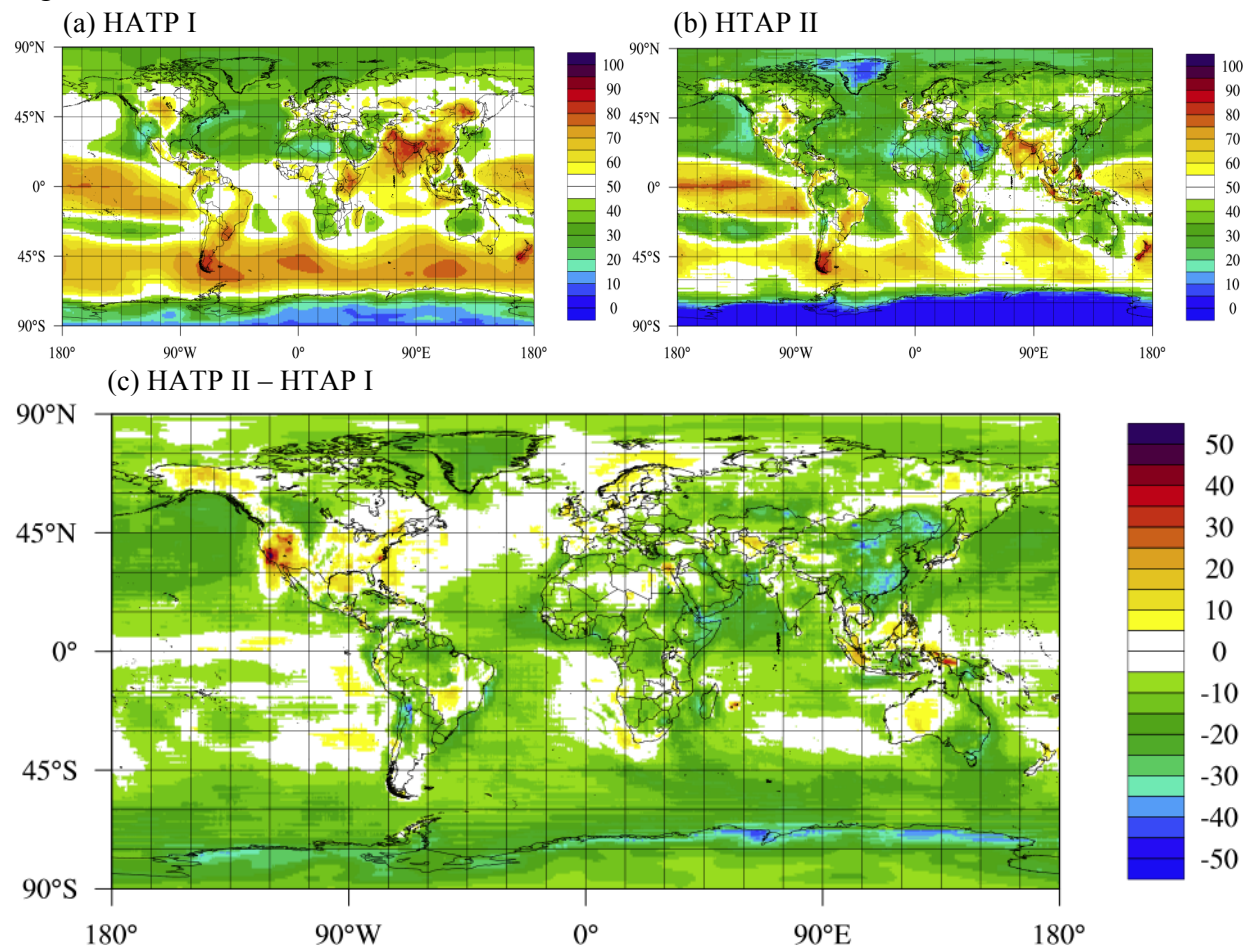
Fig. S15 Ratio of NH$_X$ deposition in N (NO$_y$ + NH$_x$) deposition from MMM results of (a) HTAP 1 (b) HTAP II. (c) HTAP II – HTAP I. Unit: %.

Table S1

Model/Species	Dry deposition	Wet deposition	Total Deposition	Emission surface SO_2	Emission surface SO_4^{2-}	Emission DMS	Total Emission
CAM-chem	18	-	-	55	-	28	83
CHASER_re1	25	54	79	55	-	25	80
CHASER_t106	23	53	77	55	-	23	78
EMEP_rv48	16	42	58	-	-	-	-
GEMMACH	-	-	-	66	-	-	-
GEOS5	34	43	77	53	2	31	85
GEOSCHEMADJOINT	32	52	85	62	1	-	-
OsloCTM3.v2	40	63	103	77	2	-	-
GOCARTv5	29	47	76	66	2	-	-
SPRINTARS	26	-	-	60	1	22	84
C-IFS_v2	-	-	-	77	-		77
Multimodel mean	28	56	84	55	1	27	91

Note: S deposition is the sum of SO_2, SO_4^{2-}, Methanesulfonic acid (MSA) and Dimethyl sulfide (DMS) deposition. S emission is the sum of SO_2, SO_4^{2-} (sulfate dry aerosol particles due to emission) and Dimethyl sulfide (DMS) emission.

Table S2

Table S2. Summary of Global Total Deposition and Emission of NO_y in 2010 (Tg(N) yr^{-1})

Model/Species	Dry deposition	Wet deposition	Total Deposition	Emis NOx	Emis lNO$_X$	Total Emission
CAM-chem	16	-	-	-	4	-
CHASER_re1	23	28	51	57	4	60
CHASER_t106	25	27	52	58	5	63
EMEP_rv48	15	45	59	-	-	-
GEMMACH	-	-	-	44	-	44
GEOSCHEMADJOINT	26	28	54	54	-	54
OsloCTM3.v2	25	-	-	51	-	51
Multimodel mean	22	38	59	57	4	60

Note: NO_y deposition is the sum of all simulated oxidized nitrogen species (expressed as nitrogen) including NO, NO_2, HNO_3, HNO_4, NO_3aerosol, NO_3(radical), N_2O_5, Peroxyacyl nitrates (PAN), other organic nitrates other than PAN, but not N_2O (Orgn) deposition. NO_x emission is sum of anthropogenic NO_X emission, aircraft NO emission, soil NO emission and lightening NOx emission (lNO$_X$).

Table S3

Model/Species	Dry deposition		Wet deposition		Total Deposition	Emission
	NH_3	NH_4^+	NH_3	NH_4^+		
CAM-chem	12	8	-	-	-	54
EMEP_rv48	11	3	13	-	-	-
GEOSCHEMADJOINT	14	4	13	24	55	55
OsloCTM3.v2	19	4	-	21	-	54
Multimodel mean	14	5	13	22	54	54

Note: NH_X deposition is the sum of NH_3 and NH_4^+ deposition. NH_X emission is NH_3 emission.