Supplement of Atmos. Chem. Phys., 18, 10931–10954, 2018
https://doi.org/10.5194/acp-18-10931-2018-supplement

Atmospheric Chemistry and Physics
Open Access
EGU

Supplement of

Spatial–temporal patterns of inorganic nitrogen air concentrations and deposition in eastern China

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Sect. S1. Information on measuring methods, sample replications and collection

The DELTA system comprises contains a sampling train consisted of two potassium carbonate/glycerol-coated denuders in series for trapping acidic trace gases (HNO_3 SO_2 and HCl), followed by two citric acid-coated borosilicate glass denudes for NH_3 and finally by two sets of cellulose filter papers in a 2-stage filter pack at the end of the sampling train. These filters were impregnated with the same alkaline solution as the denuders to capture NH_4^+, and with the same acid solution for the collection of NO_3^-, SO_4^{2-} and Cl^-. The empirically determined effective size cut-off for particle sampling is of the order of 4.5 μm (E. Nemitz, personal communication). The air was drawn through the sampling train at a rate of 0.2-0.4 L min^{-1} and directly into the first denuder with no inlet line to avoid sampling losses. The total sampled air volume of the DELTA system was recorded by the gas meter which was checked every month for data reading, performance and maintenance.

The Gradko passive sampler consists of a 71.0 mm long × 11.0 mm internal diameter acrylic tube with coloured and white thermoplastic rubber caps. Gaseous NO_2 is absorbed into a 20% triethanolamine/deionised-water solution coated onto two stainless steel wire meshes within the coloured cap. A constant gas diffusion coefficient based on an assumption of 25 °C was used for the calculation of NO_2 concentration, in accordance with the Gradko introduction manual and previous studies (Luo et al., 2013; Shen et al., 2013).

The sampling trains and tubes for field measurements were prepared and measured in the analytical laboratory at China Agricultural University (CAU), Beijing. Each batch of new trains and field (travel) blanks was sealed in individual airtight storage bags and sent monthly to monitoring sites to replace the old ones. After sampling, the blank and exposed trains and tubes were sealed in individual airtight storage bags and sent back to the laboratory, being stored at 4 ^{o}C prior to analysis.

Sect. S2. The information on the evaluation of GEOS-Chem model

To evaluate the model simulations, we compared modeled annual wet deposition fluxes of NH_4^+-N and NO_3^--N for the year 2010 with their respective observed fluxes (5-year averages). The comparison results are shown in Fig. S12 in the Supplement. The model can partly capture the spatial variations of measured bulk deposition fluxes of NH_4^+ and NO_3^- with correlation coefficients of 0.6 and 0.4, respectively. Compared with measurements, model results were 23% higher for bulk NH_4^+ deposition, and 23%

lower for bulk NO_3^--N deposition. The model biases were reasonable since simulated N deposition fluxes were for 2010 whereas the observations cover a period from 2000 to 2015. Both NH_3 and NO_x emissions change over the time periods, resulting in difference in subsequence N deposition. Besides emissions, inter-annual variations of meteorological conditions especially precipitation can also affect wet deposition fluxes. So model simulated wet deposition fluxes show larger biases. In addition, the model biases also reflect the incapability of the coarse model resolution (about 50 km) to distinguish different land use types (e.g., the forest, rural and urban sites) at such regional scale. Future work is needed to conduct high resolution simulation using regional models combined with improved N_r emission inventories.

References

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Figure captions

Figure S1. Annual mean concentrations of **(a)** NH_3; **(b)** NO_2; **(c)** HNO_3; **(d)** pNH_4^+; **(e)** pNO_3^-; and **(f)** total N_r: sum of all measured N_r in air at twenty-seven sites. Trend analysis (annual concentration vs. time) was conducted at each site. The slope of the Theil regression and *p* value for each site are labeled in black and yellow. U, R, and B denote urban, rural, and background sites, respectively.

Figure S2. Annual volume-weighted mean concentrations of NH_4^+ **(a)**; NO_3^- **(b)** and total inorganic N (TIN): sum of NH_4^+ and NO_3^- **(c)** in precipitation at twenty-seven sites. Trend analysis (annual concentration vs. time) was conducted at each site. The slope of the Theil regression and *p* value for each site are labeled in black and red. U, R, and B denote urban, rural, and background sites, respectively.

Figure S3. Annual dry deposition fluxes of **(a)** NH_3; **(b)** NO_2; **(c)** HNO_3; **(d)** pNH_4^+; **(e)** pNO_3^-; and **(f)** total N_r: sum of all measured N_r in air at twenty-seven sites. Trend analysis (annual concentration vs. time) was conducted at each site. The slope of the Theil regression and *p* value for each site are labeled in black and green. U, R, and B denote urban, rural, and background sites, respectively.

Figure S4. Annual wet/bulk deposition of NH_4^+ **(a)**; NO_3^- **(b)** and total inorganic N (TIN): sum of NH_4^+ and NO_3^- **(c)** in precipitation at twenty-seven sites. Trend analysis (annual concentration vs. time) was conducted at each site. The slope of the Theil regression and *p* value for each site are labeled in black and red. U, R, and B denote urban, rural, and background sites, respectively.

Figure S5. Total (dry plus wet/bulk) deposition fluxes at the three land use types in eastern China and its northern and southern regions. The number of sixteen selected sites with the same land use type in each region can be found in Figure S6 and Table S1. The error bars are the standard errors of means, and values without same letters on the bars denote significantly difference between the land use types at $p<0.05$.

Figure S6. Annual total (dry plus wet/bulk) deposition fluxes during 2011-2105 period at different observation scales: the annual deposition fluxes at sixteen sites (a), and averaged deposition fluxes during the 2011-2012 and 2013-2015 periods for three land use types (b). The number of sixteen selected sites with the same land use type in each region can be found in Table S1. The error bars are the standard errors of means. Trend analysis (annual concentration vs. time) was conducted at each site. The slope of the Theil regression and *p* value for each site are labeled in black and blue. U, R, and B denote urban, rural, and background sites, respectively.

Figure S7. Correlations between NNDMN_NH_3 concentration and IASI_NH_3 columns at twenty-seven sites. Sites with non-significant correlation were marked in red.

Figure S8. Correlations between NNDMN_NO_2 measurements and OMI_NO_2 columns at twenty-seven sites. Sites with non-significant correlation were marked in green.

Figure S9. HYSPLIT back-trajectories analysis on the path of air parcels (NO_2, particulate NH_4^+ and particulate NO_3^-) prior to arrival at five selected sites (Nanjing, Baiyun, Taojing, Ziyang and Huinong) in southern region of eastern China during different seasons (January-Winter, April-Spring, July-Summer, October-Autumn).

Figure S10. Seasonal mean concentrations of reduced (the sum of NH_3 and pNH_4^+) and oxidized (the sum of HNO_3, NO_2 and pNO_3^-) N in air at different land use types in eastern China and its northern and southern regions. The number of sites with the same land use type in each region can be found in Table S1. The error bars are the standard errors of means, and values without same letters on the bars denote significantly difference between the seasons at $p<0.05$. U, R, and B denote urban, rural, and background sites, respectively.

Figure S11. Seasonal mean precipitation amount at different land use types in eastern China and its northern and southern regions. The number of sites with the same land use type in each region can be found in Table S1. The error bars are the standard errors of means, and values without same letters on the bars denote significantly difference between the seasons at $p<0.05$. U, R, and B denote urban, rural, and background sites, respectively.

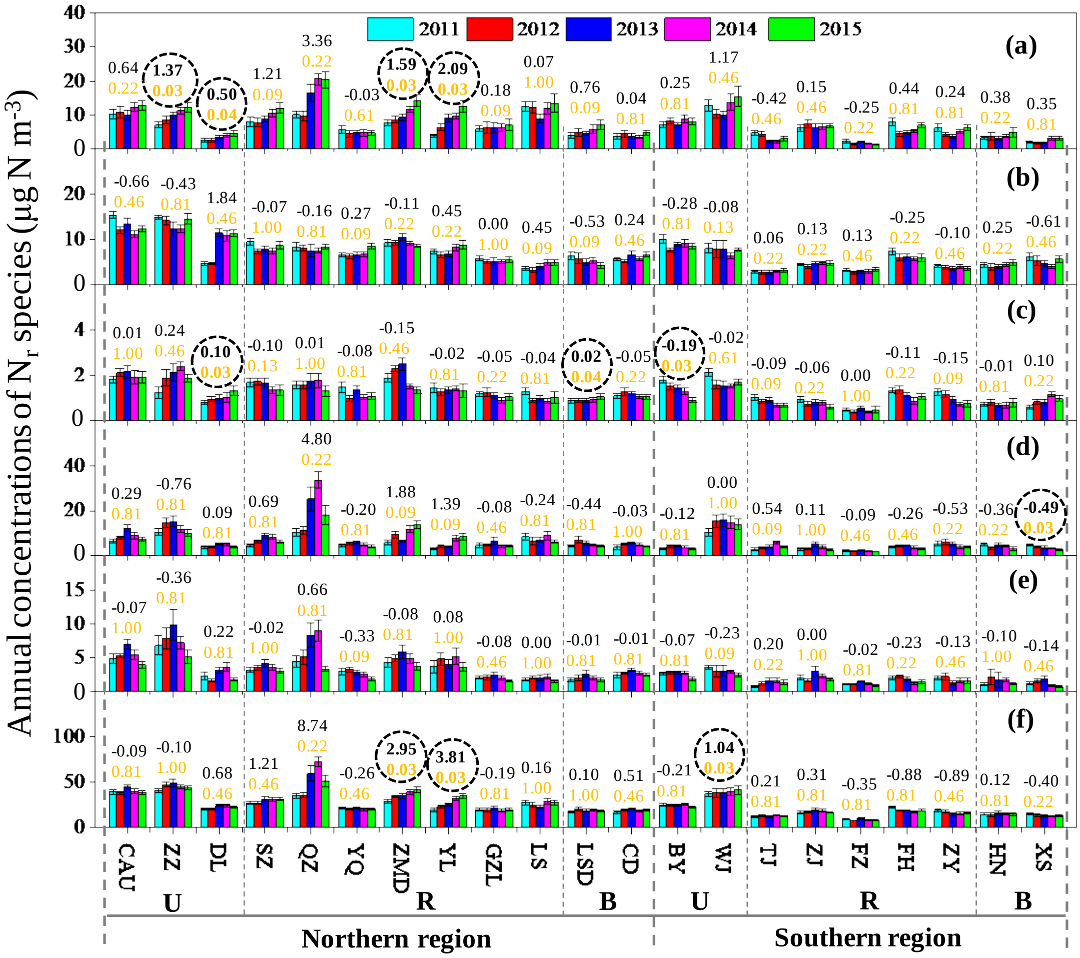
Figure S12. Seasonal dry deposition velocities of NH_3, NO_2, HNO_3, pNH_4^+ and/or pNO_3^- at different land use types in eastern China and its northern and southern regions. The number of sites with the same land use type in each region can be found in Table S1. The error bars are the standard errors of means, and values without same letters on the bars denote significantly difference between the seasons at $p<0.05$. U, R, and B denote urban, rural, and background sites, respectively.

Figure S13. Comparison of model simulated NH_4^+ wet deposition, NO_3^- wet deposition for 2010 with surface observations (5-year averages) at twenty-seven sites.

The background colors show the model results and the overplotted dots show the observations. The correlation coefficients (r) and normalized mean bias (NMB=$\sum_{i=1}^{N}(M_i - O_i) / \sum_{i=1}^{N} O_i$) between N observed and corresponding modeled values are shown inset.

Figure S14. Annual variations in precipitation amounts at sixteen selected sites.

Figure S1



2011 2012 2013 2014 2015
(a)
(b)
(c)
(d)
(e)
(f)
Annual concentrations of N_r species (μg N m^{-3})
CAU ZZ DL SZ QZ YQ ZMD YL GZL LS LSD CD BY WJ TJ ZJ FZ FH ZY HN XS
U R B U R B
Northern region
Southern region

Figure S2

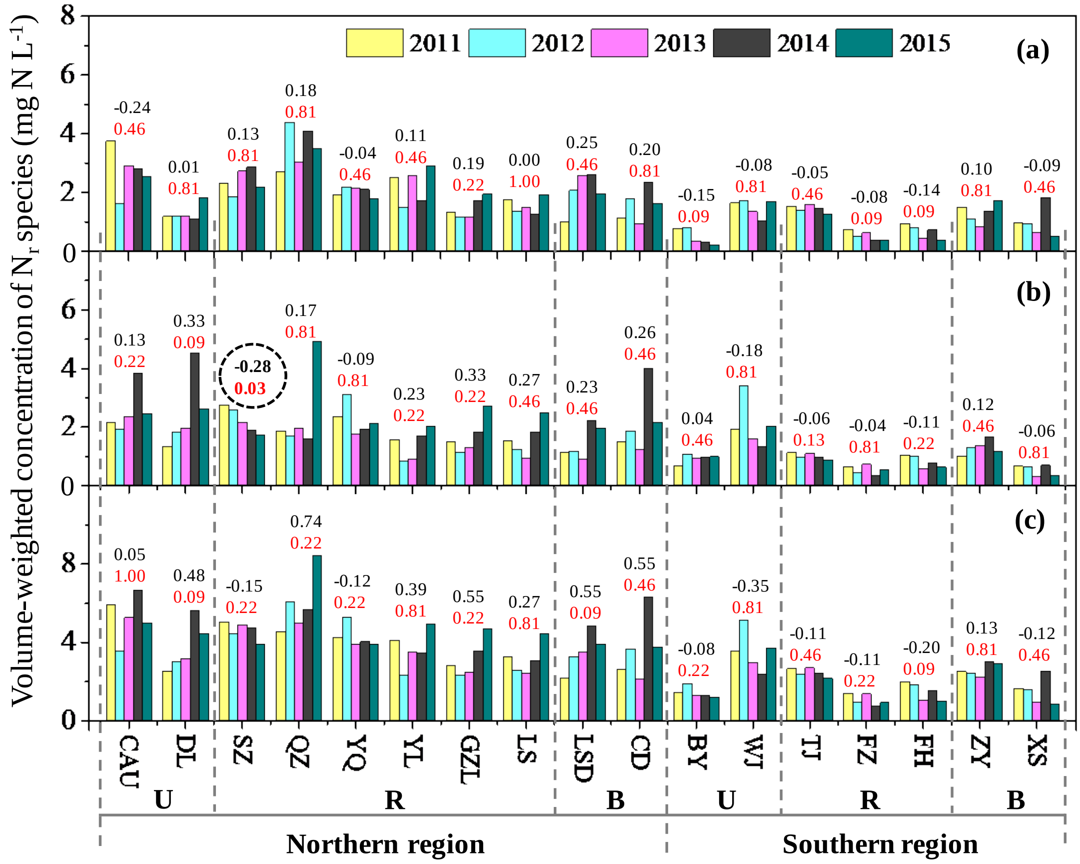
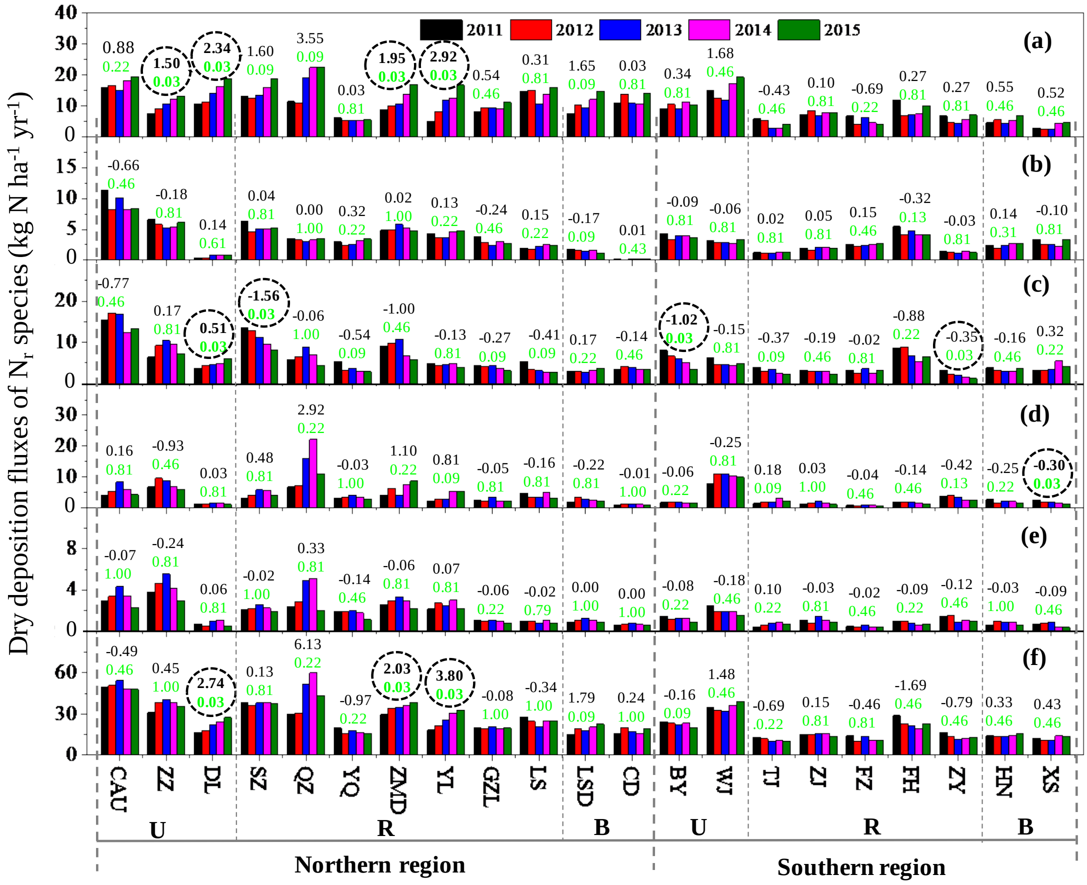
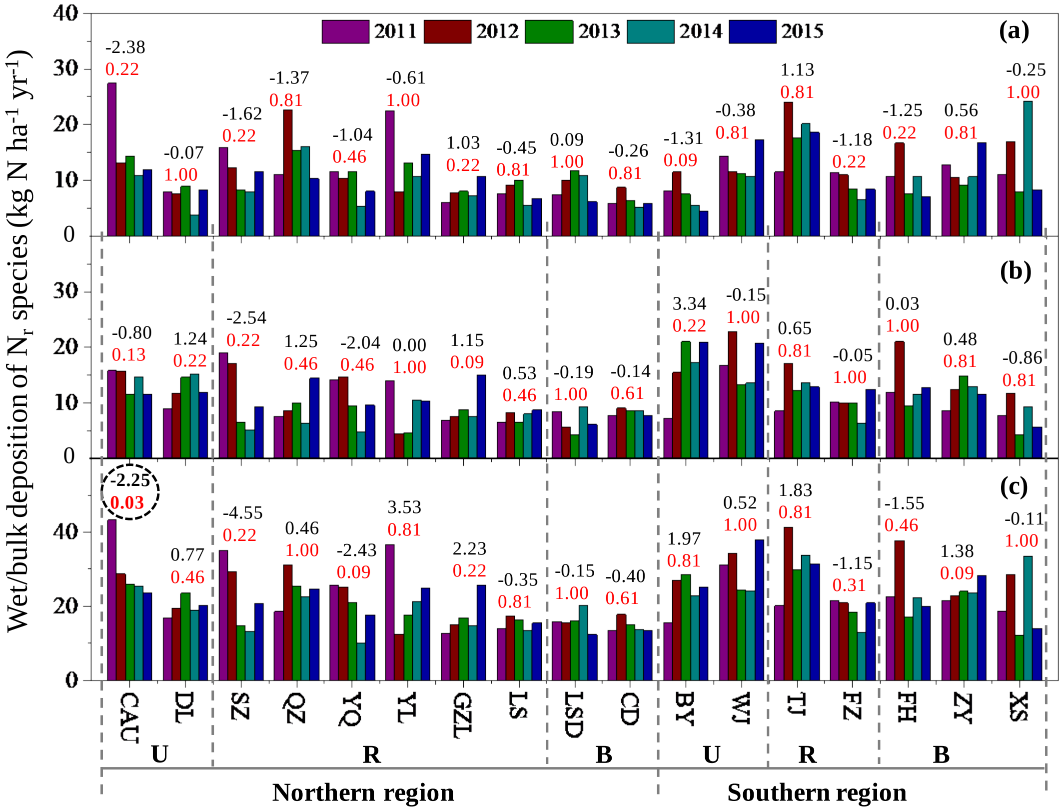

Volume-weighted concentration of N_r species (mg N L^{-1})
2011
2012
2013
2014
2015
(a)
(b)
(c)
CAU
DL
SZ
QZ
YQ
YL
GZL
LS
LSD
CD
BY
WJ
TJ
FZ
FH
ZY
XS
U
R
B
U
R
B
Northern region
Southern region

Figure S3



Dry deposition fluxes of N_r species (kg N ha^{-1} yr^{-1})
2011
2012
2013
2014
2015
(a)
(b)
(c)
(d)
(e)
(f)
CAU
ZZ
DL
SZ
QZ
YQ
ZMD
YL
GZL
LS
LSD
CD
BY
WJ
TJ
ZJ
FZ
FH
ZY
HN
XS
U
R
B
U
R
B
Northern region
Southern region

Figure S4



Wet/bulk deposition of N_r species (kg N ha^{-1} yr^{-1})
2011
2012
2013
2014
2015
(a)
(b)
(c)
CAU
DL
SZ
QZ
YQ
YL
GZL
LS
LSD
CD
BY
WJ
TJ
FZ
FH
ZY
XS
U
R
B
U
R
B
Northern region
Southern region

Figure S5

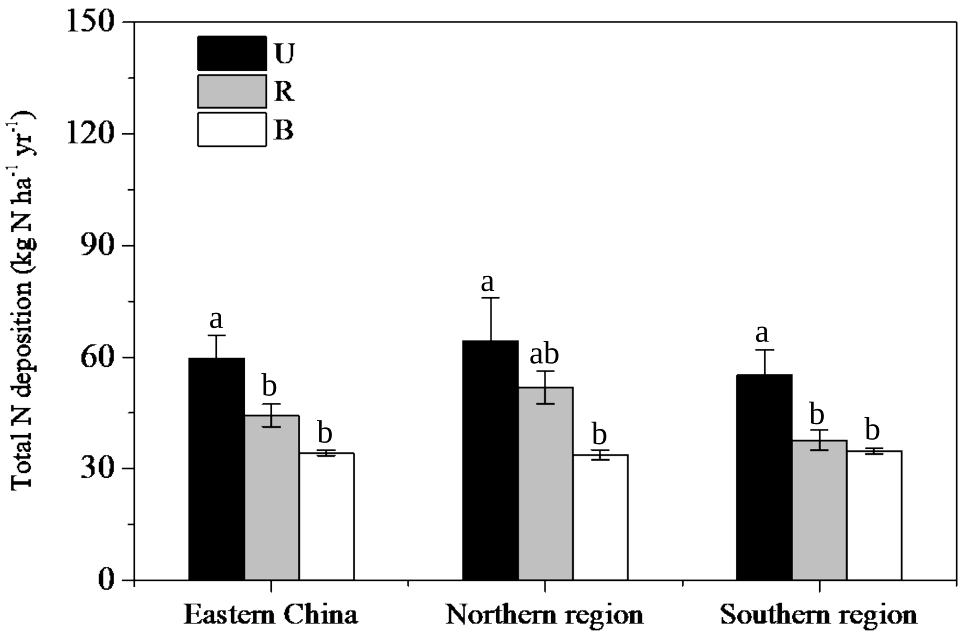
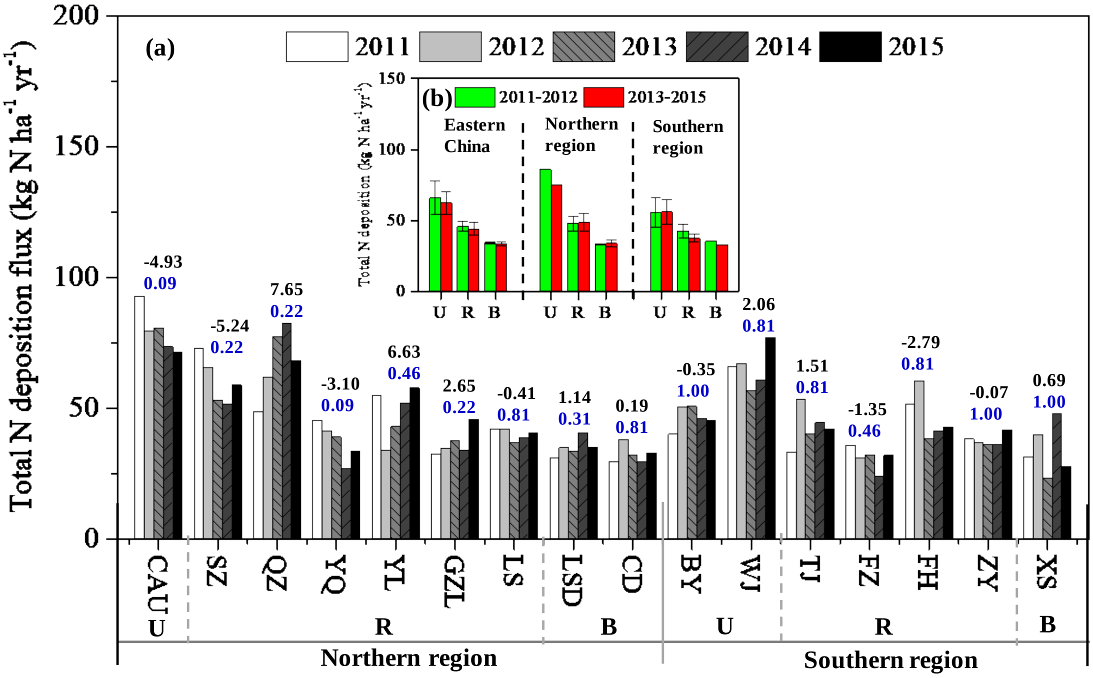
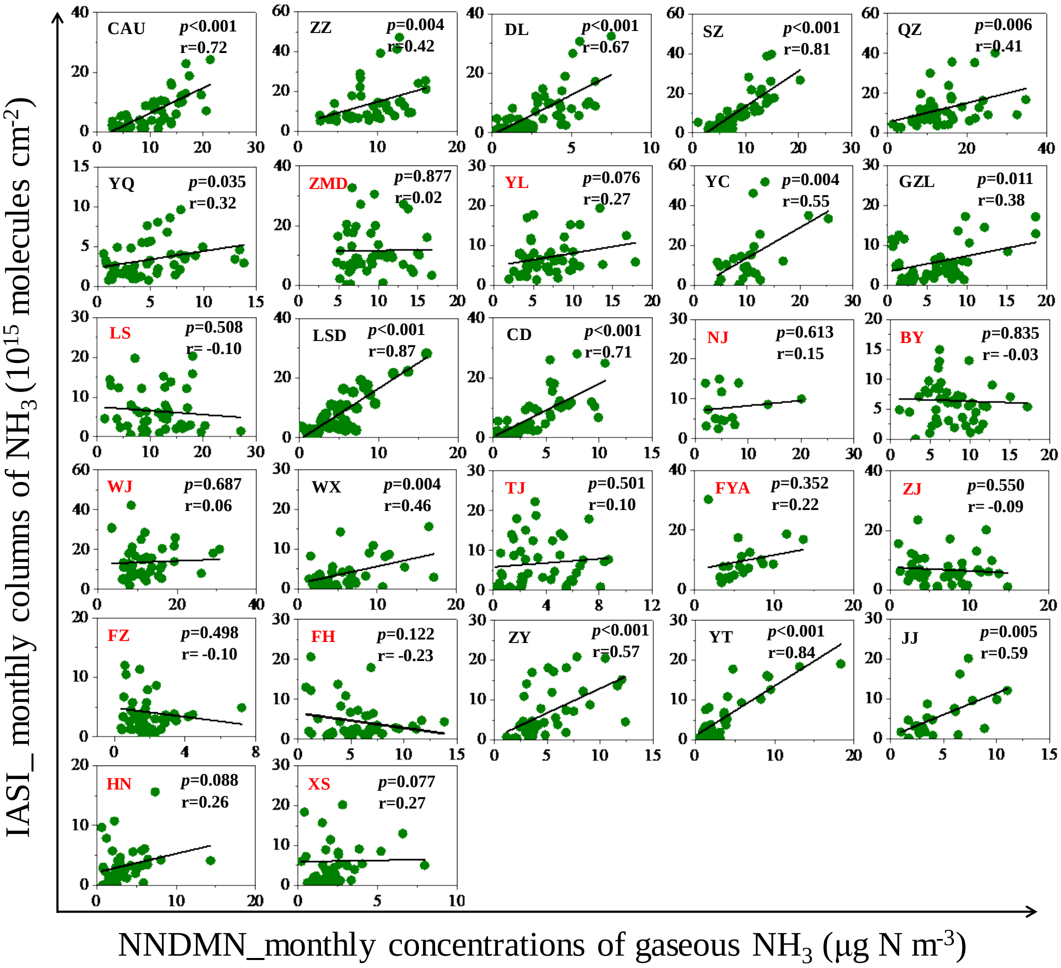

150
120
90
60
30
0
Total N deposition (kg N ha-1 yr-1)
U
R
B
a
b
b
a
ab
b
a
b
b
Eastern China
Northern region
Southern region

Figure S6



(a)
2011
2012
2013
2014
2015
Total N deposition flux (kg N ha-1 yr-1)
200
150
100
50
0
-4.93
0.09
-5.24
0.22
7.65
0.22
-3.10
0.09
6.63
0.46
2.65
0.22
-0.41
0.81
1.14
0.31
0.19
0.81
-0.35
1.00
2.06
0.81
1.51
0.81
-1.35
0.46
-2.79
0.81
-0.07
1.00
0.69
1.00
CAU
SZ
QZ
YQ
YL
GZL
LS
LSD
CD
BY
WJ
TJ
FZ
FH
ZY
XS
U
R
B
U
R
B
Northern region
Southern region
(b)
2011-2012
2013-2015
Total N deposition (kg N ha-1 yr-1)
150
100
50
0
Eastern China
Northern region
Southern region
U R B
U R B
U R B

Figure S7



CAU p<0.001 r=0.72
ZZ p=0.004 r=0.42
DL p<0.001 r=0.67
SZ p<0.001 r=0.81
QZ p=0.006 r=0.41
YQ p=0.035 r=0.32
ZMD p=0.877 r=0.02
YL p=0.076 r=0.27
YC p=0.004 r=0.55
GZL p=0.011 r=0.38
LS p=0.508 r= -0.10
LSD p<0.001 r=0.87
CD p<0.001 r=0.71
NJ p=0.613 r=0.15
BY p=0.835 r= -0.03
WJ p=0.687 r=0.06
WX p=0.004 r=0.46
TJ p=0.501 r=0.10
FYA p=0.352 r=0.22
ZJ p=0.550 r= -0.09
FZ p=0.498 r= -0.10
FH p=0.122 r= -0.23
ZY p<0.001 r=0.57
YT p<0.001 r=0.84
JJ p=0.005 r=0.59
HN p=0.088 r=0.26
XS p=0.077 r=0.27
IASI_monthly columns of NH3 (10^15 molecules cm^-2)
NNDMN_monthly concentrations of gaseous NH3 (μg N m^-3)

Figure S8

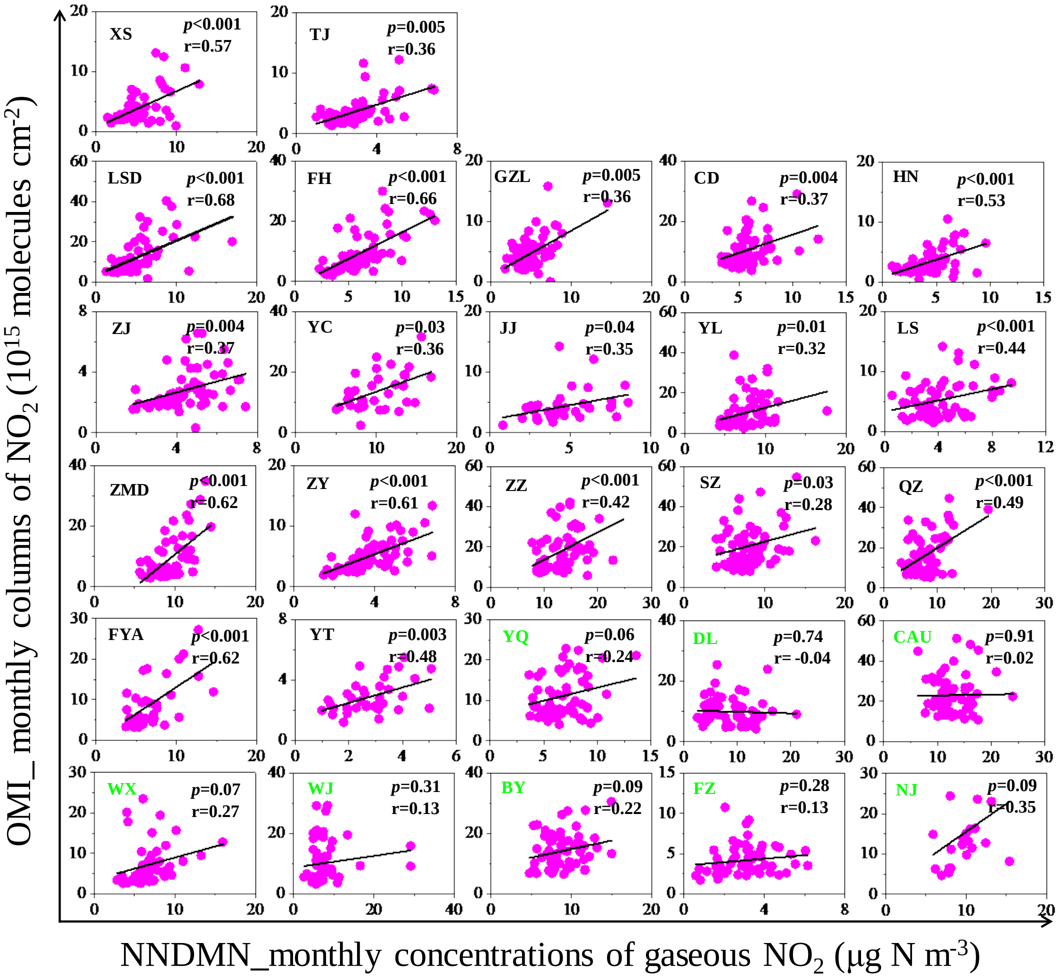

XS p<0.001 r=0.57
TJ p=0.005 r=0.36
LSD p<0.001 r=0.68
FH p<0.001 r=0.66
GZL p=0.005 r=0.36
CD p=0.004 r=0.37
HN p<0.001 r=0.53
ZJ p=0.004 r=0.37
YC p=0.03 r=0.36
JJ p=0.04 r=0.35
YL p=0.01 r=0.32
LS p<0.001 r=0.44
ZMD p<0.001 r=0.62
ZY p<0.001 r=0.61
ZZ p<0.001 r=0.42
SZ p=0.03 r=0.28
QZ p<0.001 r=0.49
FYA p<0.001 r=0.62
YT p=0.003 r=0.48
YQ p=0.06 r=0.24
DL p=0.74 r= -0.04
CAU p=0.91 r=0.02
WX p=0.07 r=0.27
WJ p=0.31 r=0.13
BY p=0.09 r=0.22
FZ p=0.28 r=0.13
NJ p=0.09 r=0.35
OMI_ monthly columns of NO2 (10^15 molecules cm^-2)
NNDMN_monthly concentrations of gaseous NO2 (μg N m^-3)

Figure S9

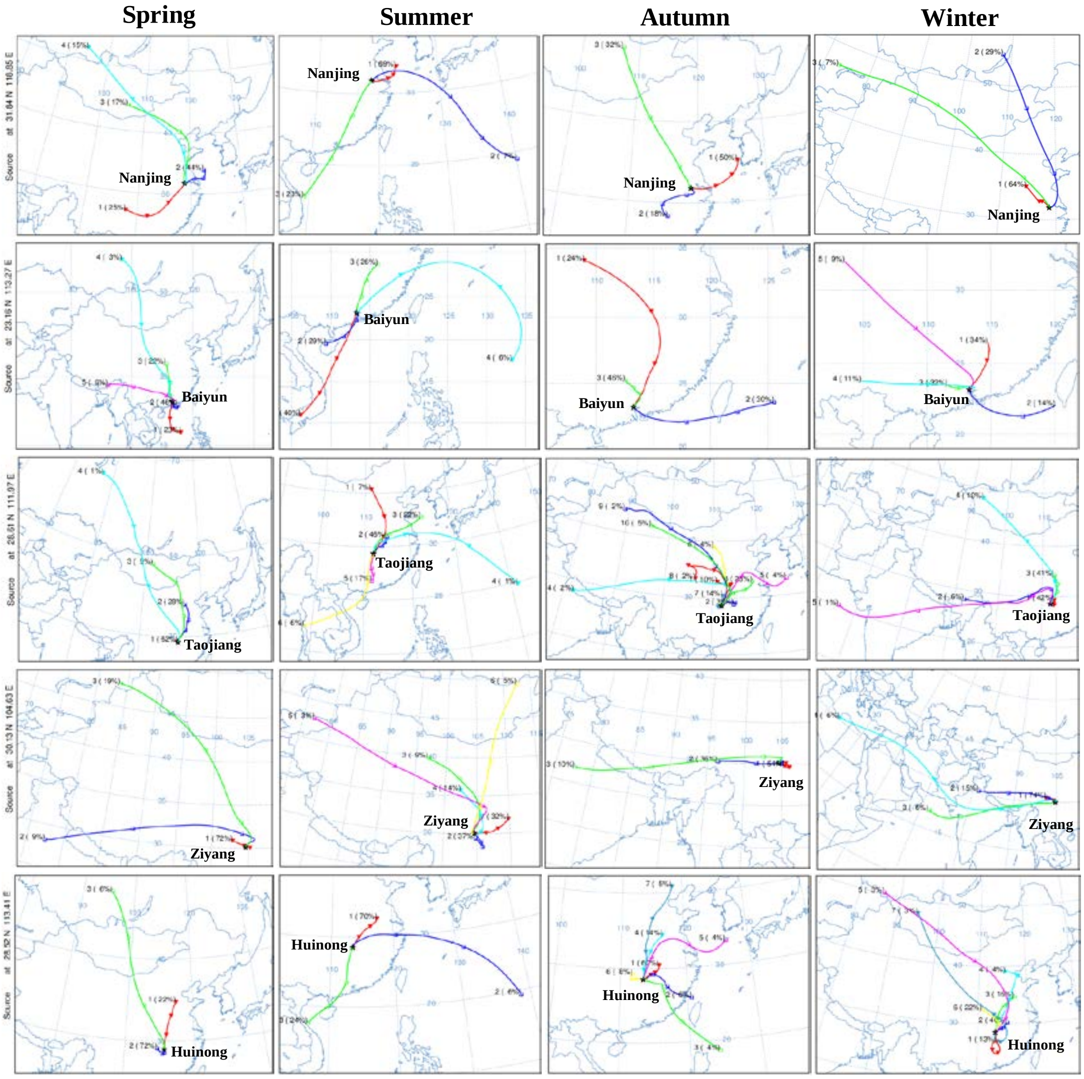

Spring
Summer
Autumn
Winter
Nanjing
Baiyun
Taojiang
Ziyang
Huinong

Figure S10

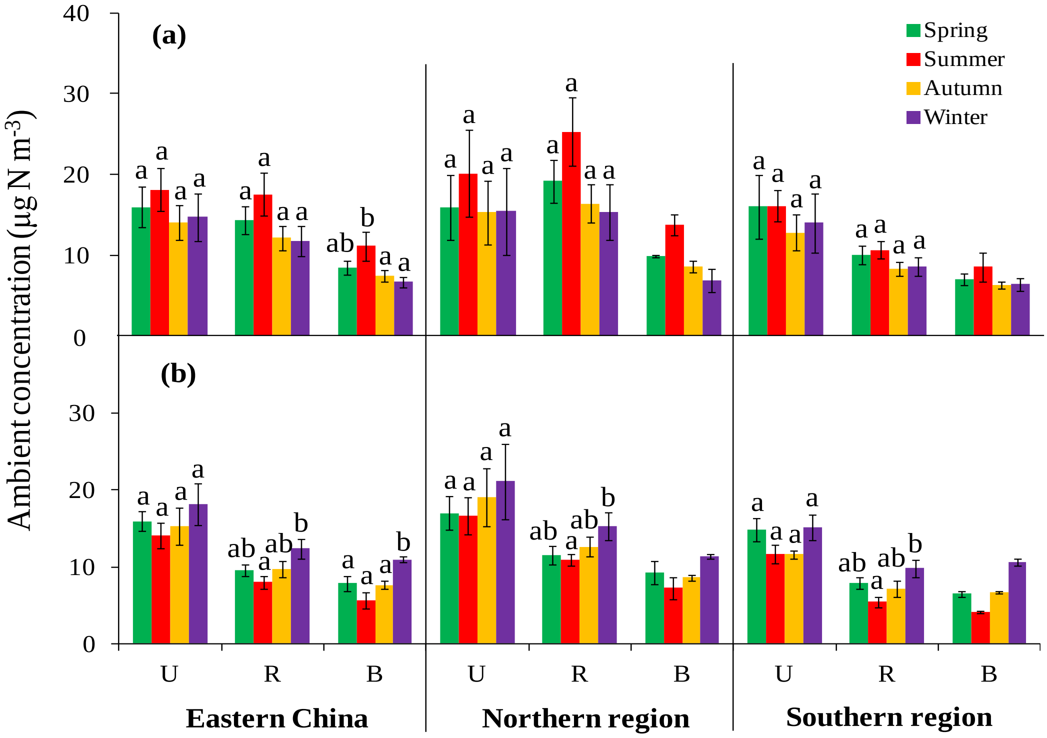
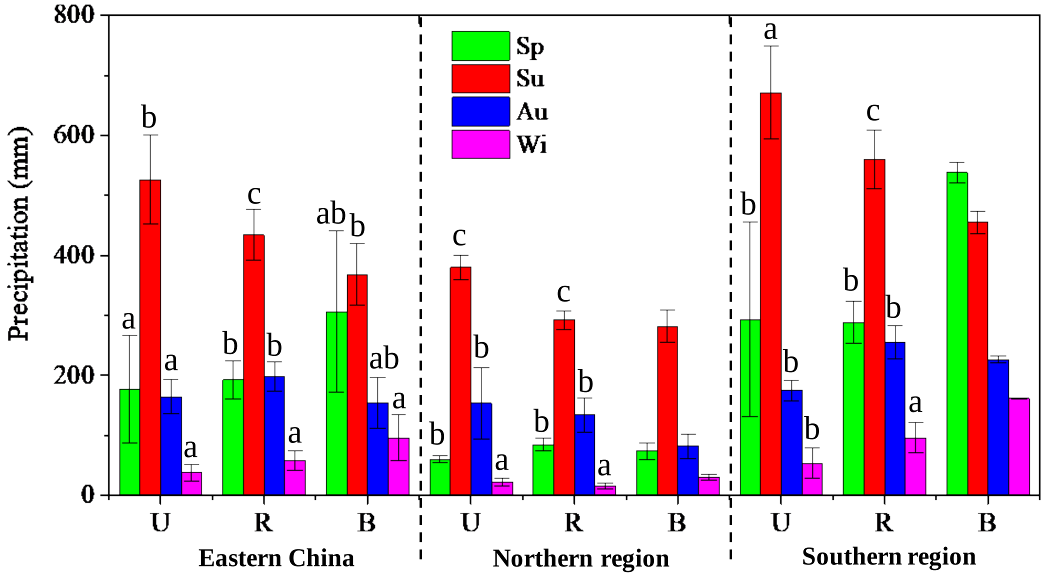
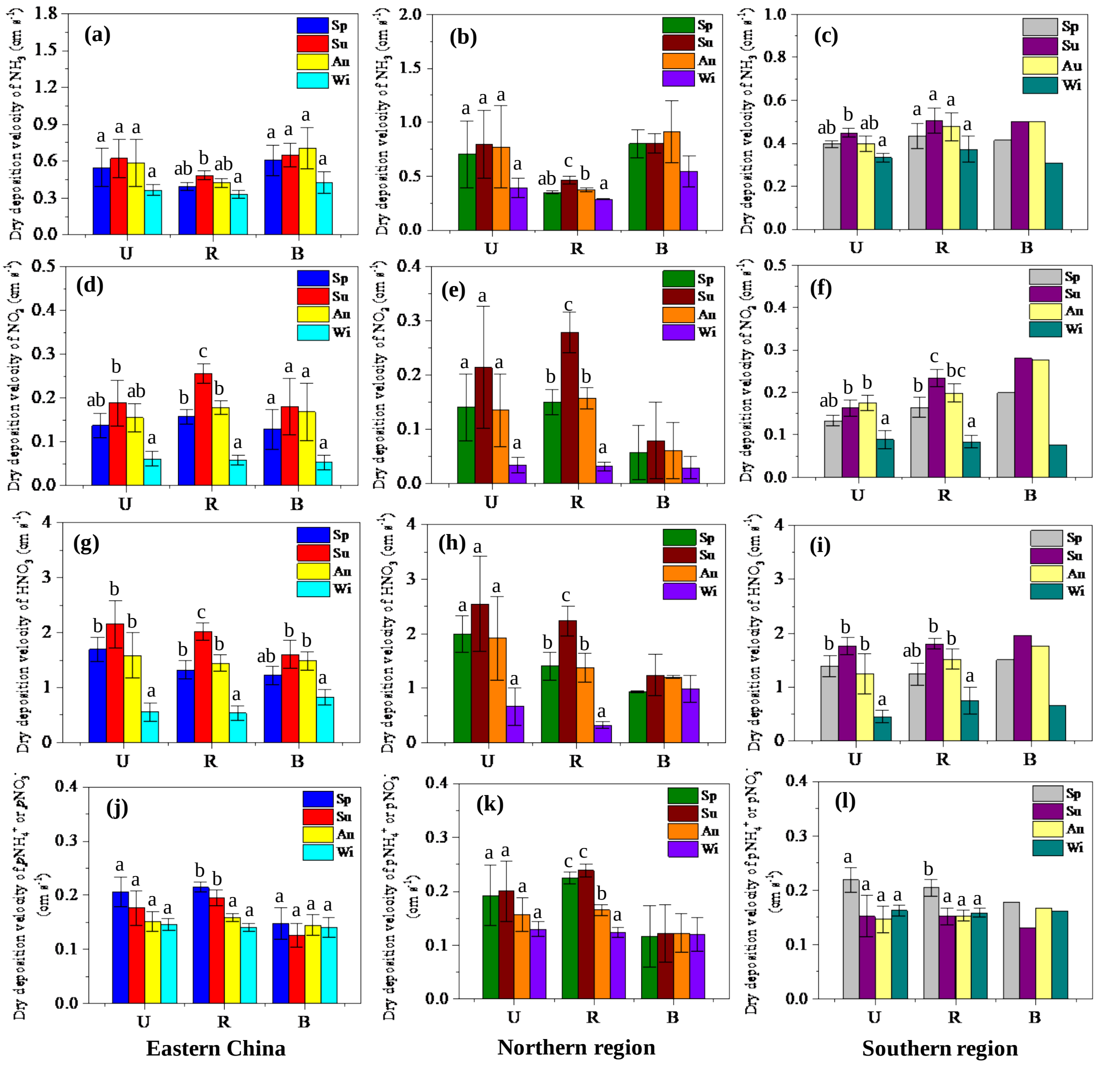

(a)
(b)
Spring
Summer
Autumn
Winter
Ambient concentration (μg N m-3)
0
10
20
30
40
U
R
B
Eastern China
Northern region
Southern region

Figure S11



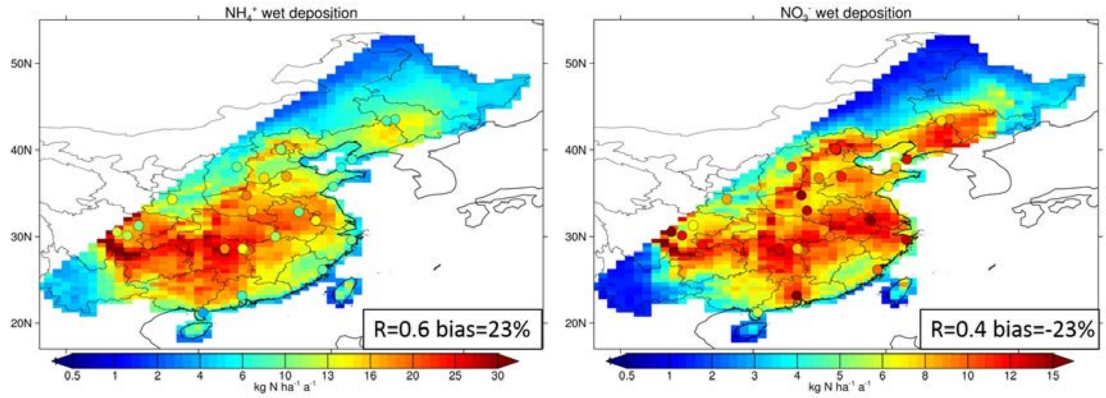
Precipitation (mm)
800
600
400
200
0
Sp
Su
Au
Wi
U
R
B
Eastern China
Northern region
Southern region

Figure S12



(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
(j)
(k)
(l)
Sp
Su
Au
Wi
U
R
B
Dry deposition velocity of NH_3 (cm s^{-1})
Dry deposition velocity of NO_2 (cm s^{-1})
Dry deposition velocity of HNO_3 (cm s^{-1})
Dry deposition velocity of pNH_4^+ or pNO_3^- (cm s^{-1})
Eastern China
Northern region
Southern region

Figure S13



NH4+ wet deposition
NO3- wet deposition
50N
40N
30N
20N
R=0.6 bias=23%
R=0.4 bias=-23%
0.5 1 2 4 6 10 13 16 20 25 30
0.5 1 2 3 4 5 6 8 10 12 15
kg N ha-1 a-1

Figure S14

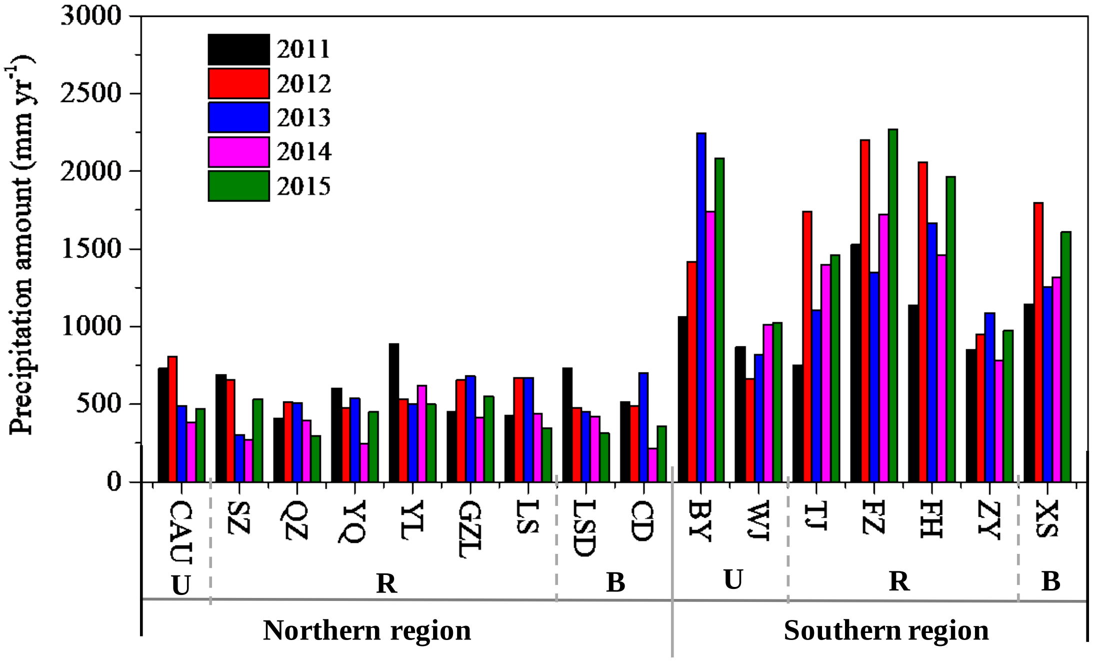

2011
2012
2013
2014
2015
Precipitation amount (mm yr^{-1})
3000
2500
2000
1500
1000
500
0
CAU
SZ
QZ
YQ
YL
GZL
LS
LSD
CD
BY
WJ
TJ
FZ
FH
ZY
XS
U
R
B
U
R
B
Northern region
Southern region

Table S1. Summary of the twenty-seven monitoring sites locations and periods.

Site name	Land use type	Region	Coordinate	Monitoring period	
				Dry deposition	Wet deposition
China Agricultural University (CAU)	Urban	Northern region	116.28 ° E, 40.02 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Zhengzhou (ZZ)	Urban	Northern region	113.63 ° E, 34.75 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2011
Dalian (DL)	Urban	Northern region	121.58 ° E, 38.92 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Shangzhuang (SZ)	Rural	Northern region	116.20 ° E, 40.11 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Quzhou (QZ)	Rural	Northern region	114.94 ° E, 36.78 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Yangqu (YQ)	Rural	Northern region	112.89 ° E, 38.05 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Zhumadian (ZMD)	Rural	Northern region	114.05 ° E, 33.02 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2011 Jan. 2014-Dec. 2015
Yanglin (YL)	Rural	Northern region	108.01 ° E, 34.31 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Yucheng (YC)	Rural	Northern region	116.63 ° E, 36.94 ° N	Jan. 2013-Dec. 2015	Jan. 2013-Dec. 2015
Gongzhuling (GZL)	Rural	Northern region	124.83 ° E, 43.53 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Lishu (LS)	Rural	Northern region	124.17 ° E, 43.36 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Lingshandao (LSD)	Background	Northern region	120.18 ° E, 35.77 ° N	Feb. 2011-Dec. 2015	Feb. 2011-Dec. 2015
Changdao (CD)	Background	Northern region	120.75 ° E, 37.93 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Nanjing (NJ)	Urban	Southern region	118.85 ° E, 31.84 ° N	Jan. 2011-Dec. 2011 Jan. 2015-Dec. 2015	Jan. 2011-Dec. 2011 Jan. 2015-Dec. 2015
Baiyun (BY)	Urban	Southern region	113.27 ° E, 23.16 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Wenjiang (WJ)	Urban	Southern region	103.84 ° E, 30.55 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Wuxue (WX)	Rural	Southern region	115.79 ° E, 30.01 ° N	Jan. 2012-Dec. 2015	Jan. 2012-Dec. 2015
Taojing (TJ)	Rural	Southern region	111.97 ° E, 28.61 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Fengyang (FYA)	Rural	Southern region	117.56 ° E, 32.88 ° N	Feb. 2013-Dec. 2015	Feb. 2014-Dec. 2015

Zhanjiang (ZZ)	Rural	Southern region	110.33 ° E, 21.26 ° N	Jan. 2011-Dec. 2015	Jan. 2013-Dec. 2015
Fuzhou (FZ)	Rural	Southern region	119.36 ° E, 26.17 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Fenghua (FH)	Rural	Southern region	121.53 ° E, 29.61 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Ziyang (ZY)	Rural	Southern region	104.63 ° E, 30.13 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015
Yanting (YT)	Rural	Southern region	105.47 ° E, 31.28 ° N	Jan. 2012-Dec. 2013 Jan. 2015-Dec. 2015	Jan. 2012-Dec. 2013
Jiangjin (JJ)	Rural	Southern region	106.18 ° E, 29.06 ° N	Jan. 2013-Dec. 2015	Jan. 2013-Dec. 2015
Huinong (HN)	Background	Southern region	113.41 ° E, 28.52 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2014
Xishan (XS)	Background	Southern region	113.31 ° E, 28.61 ° N	Jan. 2011-Dec. 2015	Jan. 2011-Dec. 2015

Table S2. Summary of monthly mean N_r concentrations measured during the 2011-2015 period.

Site	NH_3 (μg N m^{-3})				NO_2 (μg N m^{-3})				HNO_3 (μg N m^{-3})				pNH_4^+ (μg N m^{-3})				pNO_3^- (μg N m^{-3})			
	Min	Max	Avg	N	Min	Max	Avg	N[a]	Min	Max	Avg	N	Min	Max	Avg	N	Min	Max	Avg	N
CAU	2.86	22.43	11.21	60	6.35	24.03	12.87	60	0.36	4.93	1.98	60	1.96	19.40	8.72	60	1.01	13.38	5.34	60
ZZ	2.75	18.59	9.76	60	7.74	24.75	13.66	60	0.07	4.30	1.89	60	1.35	33.10	12.53	60	0.44	32.06	7.40	60
DL	0.27	8.53	3.40	60	2.54	21.04	8.60	60	0.10	2.58	1.00	60	0.65	9.54	4.45	60	0.01	7.16	2.53	60
SZ	1.00	21.23	9.44	60	3.96	16.27	8.16	60	0.29	3.50	1.54	60	1.48	15.95	6.95	60	1.00	9.43	3.53	60
QZ	1.36	34.80	15.43	60	3.23	19.48	7.97	60	0.14	4.40	1.59	60	1.89	57.20	19.68	60	0.22	20.78	6.06	60
YQ	0.58	13.81	4.88	60	3.62	13.61	6.98	60	0.04	2.73	1.18	60	0.99	10.69	5.11	60	0.21	7.26	2.72	60
ZMD	4.73	27.30	10.31	60	5.65	14.47	9.36	60	0.22	4.09	1.90	60	0.92	21.87	9.52	60	0.47	14.50	4.75	60
YL	1.91	19.77	8.30	60	4.30	17.64	7.55	60	0.14	3.73	1.35	60	0.59	21.55	5.56	60	1.07	16.22	4.29	60
YC	4.39	25.36	11.88	36	5.02	16.78	9.74	36	0.10	3.82	1.52	36	4.70	46.53	13.66	36	1.00	11.81	4.50	36
GZL	0.48	18.62	6.35	60	1.79	14.52	5.29	60	0.21	2.41	1.09	60	0.40	18.14	4.97	60	0.51	5.52	2.07	60
LS	1.42	38.89	11.79	60	0.55	9.45	4.16	60	0.22	3.27	1.00	60	1.61	26.67	7.51	60	0.29	5.79	1.93	60
LSD	0.30	16.02	5.30	59	1.32	16.97	5.31	59	0.08	1.69	0.92	59	0.39	20.69	5.34	59	0.21	6.15	2.05	59
CD	0.30	10.55	4.04	60	3.40	12.37	5.97	60	0.50	2.92	1.13	60	0.54	12.97	4.91	60	0.97	6.55	2.74	60
NJ	1.57	20.06	6.02	24	5.89	15.38	9.73	24	0.64	3.65	1.80	24	0.56	9.28	5.87	24	1.13	5.64	3.17	24
BY	1.13	17.22	7.86	60	4.75	14.97	8.86	60	0.16	2.58	1.38	60	0.60	8.57	3.81	60	0.73	4.62	2.62	60
WJ	3.53	39.57	12.47	60	2.52	29.06	7.58	60	0.09	3.27	1.70	60	2.00	32.21	14.09	60	1.09	11.50	3.04	60
WX	1.39	17.12	5.91	48	2.82	15.93	6.81	48	0.32	3.24	1.27	48	0.70	12.42	5.22	48	0.10	8.55	1.98	48
TJ	0.16	8.70	3.31	60	1.00	6.85	2.91	60	0.14	1.71	0.82	60	0.24	9.03	4.19	60	0.03	4.41	1.32	60
FYA	1.73	20.25	6.81	35	3.70	14.58	7.01	35	0.18	2.25	1.41	35	0.73	11.85	5.71	35	0.83	9.21	3.01	35
ZJ	1.07	14.80	6.68	60	1.84	7.41	4.52	60	0.09	1.68	0.77	60	0.39	10.23	3.58	60	0.19	9.83	2.23	60
FZ	0.19	7.20	1.77	60	0.57	6.15	3.05	60	0.05	1.62	0.45	60	0.17	3.79	2.22	60	0.22	2.20	1.20	60
FH	0.76	13.83	5.90	60	2.26	13.04	6.24	60	0.29	2.63	1.13	60	0.45	8.01	4.04	60	0.31	3.88	1.81	60

ZY	1.16	12.46	5.12	60	1.45	6.85	3.83	60	0.22	2.24	0.96	60	0.11	16.08	4.99	60	0.11	5.53	1.78	60
YT	0.43	18.31	4.18	36	0.99	5.07	2.75	36	0.08	1.20	0.49	36	0.88	15.80	3.01	36	0.11	2.54	1.01	36
JJ	0.70	12.99	4.48	36	0.82	8.61	4.75	36	0.13	3.09	1.48	36	1.26	16.74	7.85	36	0.34	7.61	3.03	36
HN	0.64	18.86	3.78	60	0.89	9.59	4.31	60	0.12	2.68	0.74	60	0.44	12.58	4.21	60	0.16	14.77	1.62	60
XS	0.21	7.97	2.38	60	1.41	12.81	5.18	60	0.08	1.96	0.87	60	0.43	9.19	3.74	60	0.15	5.27	1.25	60

[a]Multiply by 3 to obtain a total numbers of NO_2 samples.

Table S3. Summary of monthly volume-weighted mean N_r concentrations in precipitation measured during the 2011-2015 period.

Site	NH_4^+-N (mg N L^{-1})				NO_3^--N (mg N L^{-1})				TIN (mg N L^{-1})			
	Min	Max	Avg	N	Min	Max	Avg	N	Min	Max	Avg	N
CAU	0.16	19.15	3.91	47	0.22	15.75	4.20	47	0.46	32.37	8.10	47
ZZ	1.37	10.67	4.11	10	1.01	27.89	5.30	10	2.38	38.56	9.41	10
DL	0.13	15.93	2.94	53	0.70	14.40	4.22	53	1.13	25.57	7.15	53
SZ	0.44	13.08	3.21	42	0.40	8.99	2.86	42	0.84	19.52	6.08	42
QZ	0.16	16.60	3.76	47	0.21	14.40	3.04	47	0.53	29.27	6.80	47
YQ	0.16	17.56	2.79	48	0.22	12.45	3.18	48	0.69	30.01	5.96	48
ZMD	0.03	9.31	2.66	34	0.07	5.81	2.21	34	0.11	12.29	4.87	34
YL	0.46	10.51	3.29	53	0.07	8.32	2.83	53	0.55	17.86	6.12	53
YC	0.97	26.77	6.80	32	0.84	23.52	4.81	32	2.22	50.29	11.61	32
GZL	0.12	7.34	2.37	60	0.53	10.06	2.67	60	0.81	15.05	5.05	60
LS	0.27	12.72	2.22	48	0.28	9.46	2.61	48	0.55	14.73	4.82	48
LSD	0.29	8.44	2.38	45	0.14	11.10	2.41	45	0.54	17.67	4.80	45
CD	0.34	11.27	2.48	54	0.46	19.92	4.00	54	1.06	29.65	6.47	54
NJ	0.33	2.82	1.27	26	0.28	8.31	2.11	26	0.62	10.06	3.38	26
BY	0.01	13.88	0.97	53	0.11	6.23	1.70	53	0.34	19.98	2.67	53
WJ	0.19	13.62	2.65	52	0.10	28.92	4.75	52	0.91	34.64	7.41	52
WX	0.16	2.88	1.01	44	0.10	7.39	1.30	44	0.31	8.75	2.31	44
TJ	0.24	8.36	2.02	59	0.11	7.23	1.53	59	0.35	15.03	3.55	59
FYA	0.24	9.63	2.32	24	0.34	28.77	3.06	24	0.61	38.40	5.38	24
ZJ	0.10	2.04	0.42	29	0.07	3.77	0.79	29	0.23	4.16	1.21	29
FZ	0.04	4.96	0.74	60	0.09	4.93	0.85	60	0.22	8.88	1.59	60
FH	0.12	5.62	1.03	55	0.34	6.61	1.25	55	0.52	12.23	2.27	55
ZY	0.16	5.08	1.79	53	0.47	11.52	2.20	53	1.20	15.74	3.99	53
YT	0.16	3.81	1.31	32	0.16	3.13	1.17	32	0.54	6.27	2.48	32
JJ	0.35	12.73	3.27	36	0.26	10.31	2.63	36	0.61	23.04	5.89	36
HN	0.19	5.26	1.40	48	0.17	3.74	0.91	48	0.36	8.86	2.30	48
XS	0.03	3.78	1.22	60	0.06	3.52	0.81	60	0.09	6.09	2.03	60

Table S4. Seasonal average concentrations and deposition fluxes of gaseous NH_3 at twenty-seven monitoring sites in eastern China.

Sites	Air concentrations				Dry deposition fluxes			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	12.1 ± 1.9b	16.0 ± 2.4a	11.2 ± 1.6b	5.6 ± 1.5c	3.8 ± 0.6b	7.8 ± 1.1a	4.1 ± 0.6b	1.3 ± 0.3c
ZZ	11.7 ± 1.4a	12.2 ± 3.9a	8.9 ± 3.2ab	6.3 ± 1.1b	3.4 ± 0.4a	3.4 ± 1.1a	2.2 ± 0.8ab	1.5 ± 0.3b
DL	3.8 ± 1.0a	5.1 ± 1.2a	3.5 ± 1.3a	1.2 ± 0.4b	4.2 ± 1.1a	5.5 ± 1.3a	4.1 ± 1.5a	0.6 ± 0.2b
SZ	9.7 ± 1.9b	14.9 ± 2.5a	9.0 ± 2.9b	4.2 ± 1.4c	3.1 ± 0.6b	7.3 ± 1.2a	3.4 ± 1.1b	1.0 ± 0.3c
QZ	17.4 ± 5.7a	18.2 ± 4.6a	13.3 ± 3.8a	12.8 ± 8.8a	4.8 ± 1.6a	5.8 ± 1.5a	3.7 ± 1.1a	3.0 ± 2.1a
YQ	7.7 ± 0.8a	6.0 ± 0.6a	3.1 ± 0.7b	2.7 ± 2.1b	2.0 ± 0.2a	2.0 ± 0.2a	0.9 ± 0.2b	0.6 ± 0.5b
ZMD	11.3 ± 4.0a	9.8 ± 4.1a	10.8 ± 2.9a	9.3 ± 0.9a	3.8 ± 1.3a	3.1 ± 1.3a	2.9 ± 0.8a	2.2 ± 0.2a
YL	7.6 ± 2.8a	10.9 ± 6.3a	8.5 ± 3.8a	6.3 ± 2.1a	2.4 ± 0.9ab	4.3 ± 2.5a	2.7 ± 1.3ab	1.5 ± 0.5b
YC	10.9 ± 2.2b	17.0 ± 2.0a	12.2 ± 2.3ab	9.2 ± 2.1b	2.6 ± 0.5b	4.9 ± 0.6a	3.1 ± 0.6b	2.1 ± 0.5b
GZL	7.3 ± 0.6b	11.7 ± 2.4a	5.2 ± 0.3b	1.3 ± 0.6c	1.8 ± 0.2b	5.5 ± 1.2a	1.8 ± 0.1b	0.2 ± 0.1c
LS	17.0 ± 3.5a	13.2 ± 2.5ab	11.9 ± 1.9b	5.1 ± 1.7c	4.0 ± 0.8b	5.5 ± 1.1a	3.6 ± 0.6b	1.0 ± 0.4c
LSD	5.0 ± 0.9b	9.4 ± 2.4a	4.8 ± 2.2bc	1.9 ± 0.4c	2.6 ± 0.5b	5.2 ± 1.4a	2.4 ± 1.1b	0.5 ± 0.1c
CD	4.9 ± 0.7b	6.9 ± 1.2a	3.3 ± 0.9b	1.1 ± 0.5c	3.6 ± 0.5ab	4.8 ± 1.0a	3.0 ± 0.8b	0.6 ± 0.3c
NJ	7.7 ± 1.7	10.2 ± 2.1	3.6 ± 1.1	3.8 ± 0.1	2.6 ± 0.6	3.8 ± 0.8	1.1 ± 0.3	0.9 ± 0.0
BY	7.4 ± 1.2b	9.9 ± 2.0a	9.4 ± 0.8ab	4.7 ± 0.8c	2.2 ± 0.4b	3.1 ± 0.6a	3.3 ± 0.3a	1.4 ± 0.2c
WJ	14.8 ± 3.8a	16.2 ± 6.9a	10.1 ± 3.8a	8.8 ± 1.7a	4.5 ± 1.1ab	5.9 ± 2.5a	2.6 ± 1.0b	2.1 ± 0.4b
WX	6.3 ± 1.9b	9.6 ± 1.7a	5.1 ± 0.9bc	3.2 ± 0.5c	1.9 ± 0.6b	3.3 ± 0.6a	1.8 ± 0.3b	0.8 ± 0.1c
TJ	4.0 ± 2.5ab	5.3 ± 1.4a	2.4 ± 1.2b	1.5 ± 0.8b	1.1 ± 0.7ab	1.8 ± 0.5a	0.9 ± 0.4b	0.4 ± 0.2b
FYA	6.4 ± 1.6ab	11.2 ± 4.9a	5.4 ± 0.2ab	3.8 ± 0.5b	2.1 ± 0.5ab	3.6 ± 1.8a	1.6 ± 0.0ab	0.8 ± 0.3b
ZJ	7.6 ± 1.5a	9.3 ± 1.9a	6.6 ± 1.6a	3.3 ± 1.3b	1.9 ± 0.4a	2.6 ± 0.5a	2.3 ± 0.6a	0.8 ± 0.3b
FZ	1.7 ± 0.5ab	3.0 ± 1.2a	1.4 ± 0.2b	1.0 ± 0.6b	1.2 ± 0.4b	2.2 ± 0.9a	1.1 ± 0.2b	0.7 ± 0.4b
FH	6.9 ± 2.3ab	7.5 ± 2.5a	5.9 ± 1.6ab	3.4 ± 1.5b	2.5 ± 0.9a	3.1 ± 1.0a	2.2 ± 0.6ab	0.8 ± 0.4b
ZY	7.7 ± 1.4a	5.7 ± 2.0ab	4.3 ± 1.2bc	2.9 ± 0.5c	2.0 ± 0.4a	1.9 ± 0.6a	1.1 ± 0.3b	0.7 ± 0.1b

YT	3.3 ± 0.7b	9.3 ± 0.8a	2.6 ± 1.4b	1.5 ± 0.7b	1.0 ± 0.2b	3.4 ± 0.2a	0.8 ± 0.4b	0.4 ± 0.2b
JJ	7.1 ± 1.2a	5.2 ± 2.1ab	3.3 ± 0.8b	2.4 ± 0.4b	2.1 ± 0.4a	1.9 ± 0.8a	1.1 ± 0.3ab	0.6 ± 0.1b
HN	4.1 ± 0.7ab	7.0 ± 2.8a	2.2 ± 0.9b	1.8 ± 0.6b	1.4 ± 0.2b	2.7 ± 1.1a	0.9 ± 0.4b	0.4 ± 0.2b
XS	2.7 ± 1.3ab	3.5 ± 1.3a	1.8 ± 0.7ab	1.5 ± 0.5b	0.9 ± 0.5ab	1.4 ± 0.5a	0.7 ± 0.3ab	0.4 ± 0.1b

The data shown are the seasonal means ± standard deviations of observation periods (sampling period for each site are given in Table S1). Different letters in the columns of “air concentrations” and “dry deposition fluxes” indicate significant difference between the seasons at $p<0.05$. The full names of all the sites are presented in Table S1.

Table S5. Seasonal average concentrations and deposition fluxes of gaseous NO_2 at twenty-seven monitoring sites in eastern China.

Sites	Air concentrations				Dry deposition fluxes			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	12.0 ± 1.7a	12.7 ± 1.7a	14.3 ± 3.3a	12.5 ± 2.1a	1.9 ± 0.2c	4.2 ± 0.6a	2.9 ± 0.8b	0.3 ± 0.0d
ZZ	12.5 ± 1.8a	12.0 ± 2.2a	15.0 ± 2.0a	15.1 ± 2.3a	1.9 ± 0.2a	1.7 ± 0.3ab	1.4 ± 0.2b	0.7 ± 0.1c
DL	9.1 ± 4.2a	8.4 ± 4.4a	8.6 ± 3.7a	8.3 ± 3.8a	0.1 ± 0.1a	0.2 ± 0.1a	0.2 ± 0.1a	0.1 ± 0.0a
SZ	8.8 ± 0.9a	7.4 ± 1.0a	7.4 ± 0.8a	9.0 ± 2.1a	1.4 ± 0.1b	2.4 ± 0.3a	1.3 ± 0.2b	0.2 ± 0.0c
QZ	6.8 ± 1.5b	7.3 ± 1.5ab	8.0 ± 0.9ab	9.7 ± 1.7a	0.9 ± 0.2a	1.2 ± 0.2a	0.9 ± 0.1a	0.3 ± 0.1b
YQ	6.7 ± 1.7a	6.8 ± 1.6a	7.5 ± 0.6a	6.8 ± 1.8a	0.6 ± 0.1b	1.4 ± 0.3a	0.8 ± 0.1b	0.1 ± 0.0c
ZMD	9.3 ± 0.9ab	8.0 ± 0.5b	9.5 ± 1.0ab	10.5 ± 1.6a	1.9 ± 0.2a	1.5 ± 0.1b	1.1 ± 0.1c	0.7 ± 0.1d
YL	7.2 ± 1.9ab	5.9 ± 1.1b	7.8 ± 0.4ab	9.3 ± 1.8a	1.3 ± 0.3a	1.5 ± 0.3a	1.1 ± 0.2a	0.3 ± 0.1b
YC	9.9 ± 2.9a	8.5 ± 2.1a	9.9 ± 2.2a	11.3 ± 3.0a	0.9 ± 0.2ab	1.1 ± 0.3a	0.8 ± 0.2ab	0.3 ± 0.1b
GZL	4.3 ± 1.0a	5.8 ± 1.1a	5.0 ± 0.5a	6.0 ± 1.5a	0.4 ± 0.1b	1.9 ± 0.4a	0.6 ± 0.2b	0.04 ± 0.01c
LS	3.8 ± 1.7a	5.5 ± 0.6a	3.8 ± 0.9a	3.6 ± 1.0a	0.3 ± 0.1b	1.5 ± 0.2a	0.4 ± 0.1b	0.03 ± 0.01c
LSD	4.5 ± 1.4bc	3.4 ± 0.7c	6.0 ± 2.4ab	7.5 ± 0.3a	0.4 ± 0.1a	0.4 ± 0.1a	0.5 ± 0.2a	0.3 ± 0.0a
CD	6.5 ± 0.5ab	5.1 ± 0.5b	5.2 ± 0.7b	7.1 ± 1.6a	0.04 ± 0.00a	0.04 ± 0.00a	0.04 ± 0.00a	0.05 ± 0.01a
NJ	12.0 ± 0.9	7.8 ± 0.7	8.5 ± 1.6	10.9 ± 0.8	1.5 ± 0.2	1.2 ± 0.1	1.1 ± 0.4	0.4 ± 0.0
BY	10.7 ± 2.0a	9.4 ± 2.1ab	7.6 ± 1.0b	7.7 ± 0.7b	1.0 ± 0.2a	1.1 ± 0.2a	1.1 ± 0.1a	0.7 ± 0.1b
WJ	7.4 ± 1.4ab	5.9 ± 1.4b	6.6 ± 0.6b	10.4 ± 3.4a	0.9 ± 0.2a	1.1 ± 0.3a	0.5 ± 0.1b	0.5 ± 0.1b
WX	6.8 ± 0.3a	4.7 ± 0.7a	8.0 ± 2.7a	7.5 ± 1.4a	0.8 ± 0.0ab	0.8 ± 0.1ab	1.2 ± 0.4a	0.4 ± 0.1b
TJ	2.6 ± 0.6bc	1.9 ± 0.2c	2.9 ± 0.3b	4.3 ± 0.4a	0.3 ± 0.1bc	0.3 ± 0.0ab	0.4 ± 0.1a	0.2 ± 0.0c
FYA	6.0 ± 1.3a	5.7 ± 1.0a	8.3 ± 0.8a	8.4 ± 2.4a	0.8 ± 0.2a	0.9 ± 0.1a	0.7 ± 0.2ab	0.3 ± 0.1b
ZJ	5.3 ± 0.4a	3.2 ± 0.8b	4.5 ± 0.8a	5.1 ± 0.6a	0.4 ± 0.0b	0.4 ± 0.1b	0.8 ± 0.1a	0.4 ± 0.0b
FZ	4.1 ± 0.5a	3.4 ± 0.4b	1.7 ± 0.2c	3.0 ± 0.4b	0.9 ± 0.1a	0.8 ± 0.1a	0.4 ± 0.1b	0.4 ± 0.1b
FH	6.7 ± 1.2b	4.4 ± 1.1c	5.5 ± 0.6bc	8.4 ± 0.9a	1.4 ± 0.3a	1.2 ± 0.3ab	1.2 ± 0.2ab	0.8 ± 0.1b
ZY	4.5 ± 0.8ab	2.7 ± 0.4c	3.5 ± 0.6bc	4.6 ± 0.2a	0.4 ± 0.1a	0.4 ± 0.1a	0.3 ± 0.1b	0.2 ± 0.0c

YT	3.2 ± 0.7ab	2.0 ± 0.4b	2.4 ± 0.2ab	3.5 ± 0.4a	0.4 ± 0.1ab	0.4 ± 0.1a	0.3 ± 0.0ab	0.2 ± 0.0b
JJ	5.4 ± 0.7ab	3.5 ± 0.4bc	3.3 ± 0.9c	6.8 ± 0.9a	0.4 ± 0.1ab	0.5 ± 0.1a	0.4 ± 0.1ab	0.2 ± 0.0b
HN	3.8 ± 0.9bc	2.7 ± 0.9c	4.5 ± 0.4b	6.1 ± 0.8a	0.6 ± 0.1bc	0.6 ± 0.2b	0.9 ± 0.1a	0.4 ± 0.0c
XS	4.9 ± 1.2b	2.8 ± 0.9b	4.9 ± 0.8b	8.2 ± 2.1a	0.7 ± 0.2ab	0.6 ± 0.2b	1.0 ± 0.2a	0.5 ± 0.1b

The data shown are the seasonal means ± standard deviations of observation periods (sampling period for each site are given in Table S1). Different letters in the columns of “air concentrations” and “dry deposition fluxes” indicate significant difference between the seasons at $p<0.05$. The full names of all sites are presented in Table S1).

Table S6. Seasonal average concentrations and deposition fluxes of gaseous HNO_3 at twenty-seven monitoring sites in eastern China.

Sites	Air concentrations				Dry deposition fluxes			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	1.9 ± 0.8a	1.9 ± 0.2a	1.8 ± 0.3a	2.3 ± 0.8a	3.5 ± 1.5b	6.3 ± 0.6a	4.6 ± 0.7b	0.6 ± 0.2c
ZZ	2.3 ± 0.5ab	2.8 ± 0.5a	1.5 ± 0.7bc	1.0 ± 0.7c	3.6 ± 0.7a	3.9 ± 0.8a	0.8 ± 0.4b	0.2 ± 0.2b
DL	1.1 ± 0.5a	1.3 ± 0.4a	1.0 ± 0.3a	0.7 ± 0.4a	1.2 ± 0.6a	1.5 ± 0.4a	1.3 ± 0.4a	0.7 ± 0.4a
SZ	1.3 ± 0.3b	1.3 ± 0.5b	1.5 ± 0.3ab	2.0 ± 0.5a	2.7 ± 0.6b	4.3 ± 1.5a	3.5 ± 0.6ab	0.5 ± 0.1c
QZ	1.8 ± 0.3a	1.8 ± 0.8a	1.2 ± 0.4a	1.6 ± 0.6a	2.7 ± 0.6a	2.3 ± 1.0a	1.0 ± 0.3b	0.4 ± 0.2b
YQ	1.3 ± 0.5a	1.0 ± 0.4a	1.0 ± 0.1a	1.3 ± 0.5a	1.0 ± 0.4ab	1.6 ± 0.5a	0.9 ± 0.2b	0.2 ± 0.1c
ZMD	1.6 ± 0.5a	1.8 ± 0.3a	2.0 ± 0.6a	2.2 ± 0.7a	2.9 ± 0.9a	2.9 ± 0.6a	1.5 ± 0.5b	1.2 ± 0.3b
YL	1.1 ± 0.2c	1.2 ± 0.0bc	1.5 ± 0.2ab	1.7 ± 0.3a	1.4 ± 0.2ab	1.6 ± 0.0a	1.1 ± 0.3b	0.4 ± 0.1c
YC	1.2 ± 0.1a	1.9 ± 0.1a	1.9 ± 1.1a	1.3 ± 1.2a	0.4 ± 0.0bc	2.1 ± 0.1a	1.1 ± 0.6b	0.2 ± 0.2c
GZL	0.9 ± 0.0a	0.9 ± 0.1a	1.2 ± 0.4a	1.3 ± 0.4a	0.6 ± 0.1b	1.8 ± 0.1a	1.4 ± 0.5a	0.2 ± 0.0c
LS	0.9 ± 0.2ab	1.0 ± 0.4ab	0.7 ± 0.2b	1.4 ± 0.5a	0.6 ± 0.1b	2.0 ± 0.8a	0.7 ± 0.3b	0.2 ± 0.1b
LSD	1.1 ± 0.1a	0.9 ± 0.3ab	0.7 ± 0.2b	1.0 ± 0.2ab	0.8 ± 0.1ab	1.2 ± 0.4a	0.6 ± 0.2b	0.6 ± 0.2b
CD	1.1 ± 0.2a	1.2 ± 0.2a	1.0 ± 0.2a	1.2 ± 0.2a	0.9 ± 0.2a	0.8 ± 0.1a	1.0 ± 0.2a	1.1 ± 0.2a
NJ	1.6 ± 0.4	1.8 ± 0.5	1.6 ± 0.6	2.2 ± 0.8	2.3 ± 0.3	2.8 ± 0.7	1.3 ± 0.5	0.5 ± 0.2
BY	1.4 ± 0.4a	1.7 ± 0.4a	1.2 ± 0.6a	1.2 ± 0.2a	1.2 ± 0.4bc	2.3 ± 0.6a	1.8 ± 0.8ab	0.6 ± 0.2c
WJ	2.0 ± 0.3a	1.5 ± 0.2b	1.5 ± 0.3ab	1.8 ± 0.3ab	2.0 ± 0.3a	1.7 ± 0.2a	0.7 ± 0.2b	0.6 ± 0.1b
WX	1.3 ± 0.2a	1.3 ± 0.3a	1.1 ± 0.5a	1.4 ± 0.3a	1.0 ± 0.2ab	1.5 ± 0.3a	1.1 ± 0.5a	0.4 ± 0.1b
TJ	0.9 ± 0.3a	0.7 ± 0.1a	0.7 ± 0.2a	0.9 ± 0.1a	0.8 ± 0.4a	1.0 ± 0.2a	0.9 ± 0.3a	0.3 ± 0.0b
FYA	1.3 ± 0.3a	1.4 ± 0.2a	1.4 ± 0.3a	1.5 ± 0.3a	1.9 ± 0.6a	1.7 ± 0.3a	1.0 ± 0.4ab	0.4 ± 0.1b
ZJ	0.8 ± 0.3a	0.4 ± 0.1b	0.9 ± 0.2a	1.0 ± 0.1a	0.5 ± 0.2b	0.5 ± 0.1b	1.4 ± 0.2a	0.6 ± 0.1b
FZ	0.5 ± 0.1ab	0.6 ± 0.2a	0.3 ± 0.2b	0.3 ± 0.1ab	0.8 ± 0.2a	1.0 ± 0.3a	0.6 ± 0.3a	0.6 ± 0.2a

FH	1.1 ± 0.3ab	0.9 ± 0.2b	1.0 ± 0.3b	1.5 ± 0.2a	2.0 ± 0.5a	1.5 ± 0.3a	1.7 ± 0.6a	2.1 ± 0.4a
ZY	1.3 ± 0.5a	0.6 ± 0.2b	0.7 ± 0.3b	1.2 ± 0.2ab	0.7 ± 0.3a	0.8 ± 0.3a	0.5 ± 0.2ab	0.2 ± 0.0b
YT	0.6 ± 0.3a	0.4 ± 0.1a	0.4 ± 0.1a	0.5 ± 0.2a	0.6 ± 0.3a	0.5 ± 0.1a	0.4 ± 0.1a	0.2 ± 0.0a
JJ	1.7 ± 0.7a	1.4 ± 0.8a	1.2 ± 0.6a	1.6 ± 0.4a	0.7 ± 0.3ab	1.9 ± 1.0a	0.9 ± 0.5ab	0.3 ± 0.1b
HN	0.9 ± 0.3a	0.6 ± 0.2a	0.7 ± 0.2a	0.7 ± 0.2a	1.1 ± 0.4a	1.0 ± 0.3a	0.9 ± 0.3a	0.4 ± 0.1b
XS	0.8 ± 0.2a	0.9 ± 0.4a	0.9 ± 0.2a	0.9 ± 0.4a	1.0 ± 0.3ab	1.3 ± 0.5a	1.2 ± 0.3a	0.5 ± 0.2b

The data shown are the seasonal means ± standard deviations of observation periods (sampling period for each site are given in Table S1). Different letters in the columns of “air concentrations” and “dry deposition fluxes” indicate significant difference between the seasons at p<0.05. The full names of all sites are presented in Table S1.

Table S7. Seasonal average concentrations and deposition fluxes of particulate NH_4^+ at twenty-seven monitoring sites in eastern China.

Sites	Air concentrations				Dry deposition fluxes			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	7.9 ± 3.6a	10.4 ± 3.7a	7.8 ± 2.0a	8.8 ± 1.6a	1.5 ± 0.7a	2.0 ± 0.8a	1.2 ± 0.3a	1.0 ± 0.2a
ZZ	8.2 ± 2.1b	12.3 ± 4.5b	10.7 ± 1.7b	18.9 ± 4.6a	1.6 ± 0.4a	2.5 ± 0.9a	1.6 ± 0.3a	2.0 ± 0.5a
DL	3.9 ± 0.8a	4.5 ± 1.6a	3.9 ± 0.3a	5.5 ± 0.9a	0.2 ± 0.1b	0.3 ± 0.1ab	0.3 ± 0.0ab	0.4 ± 0.1a
SZ	6.2 ± 2.2a	8.7 ± 2.1a	6.3 ± 1.9a	6.6 ± 2.0a	1.2 ± 0.4ab	1.7 ± 0.4a	0.9 ± 0.3b	0.7 ± 0.2b
QZ	15.3 ± 10.5a	24.2 ± 12.2a	15.7 ± 9.7a	23.5 ± 12.6a	2.9 ± 1.9a	5.1 ± 2.6a	2.2 ± 1.4a	2.3 ± 1.3a
YQ	4.6 ± 1.4a	5.1 ± 0.6a	5.0 ± 0.6a	5.8 ± 1.4a	0.9 ± 0.3ab	1.2 ± 0.2a	0.7 ± 0.1b	0.6 ± 0.2b
ZMD	11.5 ± 5.4ab	12.7 ± 4.0a	8.8 ± 4.2ab	5.2 ± 0.7b	2.1 ± 1.0a	2.1 ± 0.6a	1.3 ± 0.6ab	0.6 ± 0.1b
YL	4.8 ± 2.7a	6.3 ± 2.4a	4.1 ± 1.8a	7.0 ± 4.2a	0.9 ± 0.5a	1.4 ± 0.6a	0.6 ± 0.3a	0.8 ± 0.5a
YC	8.9 ± 0.8bc	27.9 ± 1.9a	7.3 ± 0.9c	13.1 ± 2.8b	1.6 ± 0.2b	5.0 ± 0.3a	1.0 ± 0.2c	1.3 ± 0.2bc
GZL	4.9 ± 2.3a	6.1 ± 2.6a	3.9 ± 0.8a	5.0 ± 0.5a	0.8 ± 0.3ab	1.0 ± 0.5a	0.4 ± 0.1b	0.4 ± 0.1b
LS	8.3 ± 5.1a	9.8 ± 3.1a	5.9 ± 1.0a	6.0 ± 1.6a	1.3 ± 0.8ab	1.6 ± 0.5a	0.6 ± 0.1b	0.4 ± 0.1b
LSD	4.8 ± 0.7a	5.6 ± 3.3a	4.5 ± 0.8a	6.5 ± 1.4a	0.6 ± 0.1a	0.7 ± 0.4a	0.5 ± 0.1a	0.7 ± 0.2a
CD	5.2 ± 0.8a	5.5 ± 1.0a	4.6 ± 1.5a	4.3 ± 1.4a	0.2 ± 0.0a	0.3 ± 0.0a	0.3 ± 0.1a	0.3 ± 0.1a
NJ	5.6 ± 2.4	4.4 ± 1.8	5.4 ± 0.3	7.8 ± 0.5	0.9 ± 0.3	0.5 ± 0.2	0.5 ± 0.0	0.9 ± 0.1
BY	3.6 ± 0.8a	3.8 ± 0.8a	3.4 ± 1.1a	4.5 ± 0.3a	0.5 ± 0.1a	0.3 ± 0.1b	0.3 ± 0.1b	0.6 ± 0.0a
WJ	8.9 ± 0.5a	3.7 ± 1.5a	6.5 ± 2.7b	12.3 ± 1.3b	4.3 ± 1.0a	3.4 ± 0.6a	1.0 ± 0.2b	1.3 ± 0.5b
WX	4.2 ± 1.3a	4.6 ± 1.7a	5.2 ± 0.6a	6.5 ± 1.0a	0.6 ± 0.2a	0.4 ± 0.2a	0.6 ± 0.1a	0.7 ± 0.1a
TJ	3.6 ± 1.3a	3.3 ± 1.2a	4.5 ± 1.1a	5.4 ± 2.5a	0.5 ± 0.2a	0.4 ± 0.1a	0.6 ± 0.2a	0.7 ± 0.3a
FYA	4.9 ± 1.3b	4.4 ± 0.4b	5.2 ± 1.2b	8.7 ± 1.2a	0.8 ± 0.2a	0.6 ± 0.1a	0.6 ± 0.1a	0.8 ± 0.1a
ZJ	3.6 ± 2.5a	2.0 ± 0.3a	4.1 ± 0.6a	4.6 ± 1.6a	0.5 ± 0.3a	0.1 ± 0.0b	0.4 ± 0.1ab	0.6 ± 0.2a

FZ	2.8 ± 0.7a	1.6 ± 0.3b	2.1 ± 0.5ab	2.4 ± 0.6ab	0.3 ± 0.1a	0.1 ± 0.0b	0.2 ± 0.0ab	0.2 ± 0.1ab
FH	3.6 ± 1.0a	4.2 ± 1.4a	3.9 ± 1.5a	4.5 ± 1.3a	0.5 ± 0.1a	0.4 ± 0.1a	0.4 ± 0.2a	0.5 ± 0.2a
ZY	5.0 ± 2.1ab	3.5 ± 1.3b	4.2 ± 1.4b	7.2 ± 1.4a	1.0 ± 0.4a	0.6 ± 0.2a	0.6 ± 0.2a	1.0 ± 0.2a
YT	2.9 ± 1.1a	2.7 ± 0.8a	2.4 ± 0.9a	2.7 ± 0.6a	0.5 ± 0.2a	0.4 ± 0.1a	0.3 ± 0.1a	0.4 ± 0.1a
JJ	8.9 ± 0.5ab	3.7 ± 1.5c	6.5 ± 2.7bc	12.3 ± 1.3a	1.8 ± 0.1a	0.6 ± 0.2b	0.9 ± 0.4b	1.9 ± 0.2a
HN	3.5 ± 0.6a	3.4 ± 1.4a	4.5 ± 1.2a	5.4 ± 1.3a	0.5 ± 0.1ab	0.3 ± 0.1b	0.6 ± 0.2ab	0.7 ± 0.2a
XS	3.6 ± 0.7a	3.2 ± 0.7a	4.0 ± 1.5a	4.1 ± 1.6a	0.5 ± 0.1a	0.3 ± 0.1a	0.5 ± 0.2a	0.5 ± 0.2a

The data shown are the seasonal means ± standard deviations of observation periods (sampling period for each site are given in Table S1). Different letters in the columns of “air concentrations” and “dry deposition fluxes” indicate significant difference between the seasons at p<0.05. The full names of all sites are presented in Table S1.

Table S8. Seasonal average concentrations and deposition fluxes of particulate NO_3^- at twenty-seven monitoring sites in eastern China.

Sites	Air concentrations				Dry deposition fluxes			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	4.7 ± 1.6ab	4.2 ± 1.2b	5.9 ± 1.1ab	6.5 ± 0.8a	0.9 ± 0.3a	0.8 ± 0.2a	0.9 ± 0.2a	0.7 ± 0.1a
ZZ	4.8 ± 1.1b	4.3 ± 0.5b	7.1 ± 2.2b	13.3 ± 4.5a	0.9 ± 0.2a	0.9 ± 0.1a	1.0 ± 0.3a	1.4 ± 0.5a
DL	2.5 ± 1.3a	2.1 ± 0.8a	1.8 ± 0.9a	3.6 ± 1.7a	0.2 ± 0.1ab	0.2 ± 0.1ab	0.1 ± 0.1b	0.3 ± 0.1a
SZ	3.3 ± 0.7a	2.9 ± 0.9a	3.9 ± 0.6a	4.0 ± 1.4a	0.6 ± 0.1a	0.5 ± 0.2a	0.6 ± 0.1a	0.5 ± 0.1a
QZ	4.5 ± 2.3b	3.7 ± 1.6b	6.2 ± 2.8ab	9.7 ± 4.0a	0.9 ± 0.4a	0.8 ± 0.3a	0.9 ± 0.4a	0.9 ± 0.4a
YQ	2.7 ± 0.9a	2.2 ± 0.6a	2.9 ± 0.8a	3.1 ± 1.3a	0.5 ± 0.2a	0.5 ± 0.2a	0.4 ± 0.1a	0.3 ± 0.1a
ZMD	3.7 ± 0.7bc	3.1 ± 0.6c	5.4 ± 0.8ab	6.8 ± 2.0a	0.7 ± 0.1ab	0.6 ± 0.1b	0.8 ± 0.1a	0.8 ± 0.2a
YL	3.2 ± 0.7b	2.4 ± 0.3b	4.1 ± 0.7b	7.5 ± 2.2a	0.6 ± 0.1ab	0.5 ± 0.1b	0.5 ± 0.1ab	0.8 ± 0.2a
YC	4.1 ± 0.8ab	3.0 ± 0.3b	3.9 ± 1.2ab	6.6 ± 1.5a	0.7 ± 0.1a	0.6 ± 0.1a	0.5 ± 0.2a	0.6 ± 0.1a
GZL	1.7 ± 0.4a	1.7 ± 0.3a	2.3 ± 0.8a	2.5 ± 0.8a	0.3 ± 0.1a	0.3 ± 0.0a	0.2 ± 0.1a	0.2 ± 0.0a
LS	1.6 ± 0.8a	1.7 ± 0.4a	2.0 ± 0.5a	2.4 ± 0.8a	0.3 ± 0.1a	0.3 ± 0.1a	0.2 ± 0.1a	0.2 ± 0.1a
LSD	2.1 ± 0.4ab	1.5 ± 0.3b	1.5 ± 0.7b	3.1 ± 0.9a	0.3 ± 0.1a	0.2 ± 0.0a	0.2 ± 0.1a	0.3 ± 0.1a
CD	3.1 ± 0.4a	2.4 ± 0.3a	2.7 ± 0.5a	2.7 ± 0.7a	0.1 ± 0.0a	0.1 ± 0.0a	0.2 ± 0.0a	0.2 ± 0.1a
NJ	3.5 ± 0.8	2.5 ± 0.2	2.7 ± 0.9	3.8 ± 0.5	0.6 ± 0.0	0.2 ± 0.0	0.3 ± 0.1	0.4 ± 0.1
BY	3.0 ± 0.7a	2.3 ± 0.4a	2.2 ± 0.6a	2.9 ± 0.2a	0.4 ± 0.1a	0.2 ± 0.0b	0.2 ± 0.1b	0.4 ± 0.0a
WJ	2.7 ± 0.8b	2.0 ± 0.7b	2.8 ± 0.7ab	4.6 ± 1.5a	0.5 ± 0.2a	0.4 ± 0.1a	0.4 ± 0.1a	0.6 ± 0.2a
WX	1.7 ± 0.5a	1.3 ± 0.4a	1.9 ± 1.4a	2.9 ± 0.6a	0.2 ± 0.1ab	0.1 ± 0.0b	0.2 ± 0.2ab	0.3 ± 0.1a
TJ	0.9 ± 0.3b	0.5 ± 0.0b	1.3 ± 0.6b	2.5 ± 1.0a	0.1 ± 0.0b	0.1 ± 0.0b	0.2 ± 0.1ab	0.3 ± 0.1a
FYA	2.8 ± 0.4a	2.1 ± 0.1a	3.0 ± 1.4a	4.5 ± 2.3a	0.4 ± 0.1a	0.3 ± 0.0a	0.3 ± 0.2a	0.4 ± 0.1a
ZJ	2.3 ± 0.7ab	1.1 ± 0.2b	2.2 ± 0.4ab	3.4 ± 1.5a	0.3 ± 0.1ab	0.1 ± 0.0c	0.2 ± 0.0bc	0.4 ± 0.2a

FZ	1.4 ± 0.1a	1.1 ± 0.1a	1.1 ± 0.5a	1.2 ± 0.2a	0.2 ± 0.0a	0.1 ± 0.0a	0.1 ± 0.0a	0.1 ± 0.0a
FH	1.9 ± 0.3ab	1.1 ± 0.4c	1.6 ± 0.7bc	2.7 ± 0.4a	0.3 ± 0.0ab	0.1 ± 0.0c	0.2 ± 0.1bc	0.3 ± 0.0a
ZY	1.6 ± 0.4bc	0.7 ± 0.4c	1.9 ± 1.0ab	2.9 ± 0.5a	0.3 ± 0.1a	0.1 ± 0.1b	0.3 ± 0.1ab	0.4 ± 0.1a
YT	1.3 ± 0.4a	0.8 ± 0.1a	0.9 ± 0.6a	1.2 ± 0.3a	0.2 ± 0.1a	0.1 ± 0.0a	0.1 ± 0.1a	0.2 ± 0.0a
JJ	2.9 ± 0.7ab	1.7 ± 0.8b	2.5 ± 1.6ab	4.9 ± 0.8a	0.6 ± 0.1a	0.3 ± 0.1a	0.4 ± 0.2a	0.8 ± 0.1a
HN	1.4 ± 0.3b	0.6 ± 0.2b	1.3 ± 0.5b	3.2 ± 1.9a	0.2 ± 0.0b	0.1 ± 0.0b	0.2 ± 0.1b	0.4 ± 0.2a
XS	1.2 ± 0.6ab	0.7 ± 0.1b	1.2 ± 0.4ab	2.0 ± 1.0a	0.2 ± 0.1a	0.1 ± 0.0a	0.2 ± 0.0a	0.2 ± 0.1a

The data shown are the seasonal means ± standard deviations of observation periods (sampling period for each site are given in Table S1). Different letters in the columns of “air concentrations” and “dry deposition fluxes” indicate significant difference between the seasons at $p<0.05$. The full names of all sites are presented in Table S1.

Table S9. Seasonal average concentrations and deposition fluxes of the total N_r at twenty-seven monitoring sites in eastern China.

Sites	Air concentrations				Dry deposition fluxes			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	38.6 ± 4.5ab	45.3 ± 3.6a	40.9 ± 4.2ab	35.7 ± 3.0b	11.7 ± 2.2b	21.0 ± 0.3a	13.6 ± 1.3b	3.9 ± 0.7c
ZZ	39.6 ± 2.9b	43.6 ± 4.1b	43.2 ± 2.0b	54.6 ± 9.2a	11.4 ± 1.2a	12.5 ± 1.3a	7.0 ± 1.0b	5.9 ± 0.9b
DL	20.5 ± 6.5a	21.3 ± 7.1a	18.9 ± 4.8a	19.3 ± 4.7a	5.9 ± 1.6a	7.7 ± 1.7a	6.0 ± 1.4a	2.1 ± 0.2b
SZ	29.4 ± 3.4ab	35.2 ± 2.1a	28.1 ± 5.2ab	25.9 ± 4.4b	9.0 ± 1.1b	16.3 ± 1.3a	9.6 ± 1.2b	2.9 ± 0.6c
QZ	45.9 ± 18.2a	55.2 ± 16.5a	44.5 ± 14.6a	57.3 ± 22.6a	12.2 ± 4.2ab	15.2 ± 4.3a	8.7 ± 2.6ab	7.0 ± 3.6b
YQ	23.0 ± 1.1a	21.2 ± 2.2ab	19.5 ± 1.1b	19.7 ± 2.4b	5.1 ± 0.5b	6.6 ± 0.8a	3.6 ± 0.2c	1.9 ± 0.4d
ZMD	37.4 ± 8.7a	35.4 ± 7.2a	36.6 ± 6.2a	34.0 ± 3.7a	11.3 ± 1.6a	10.1 ± 1.2a	7.7 ± 0.9b	5.5 ± 0.6c
YL	23.9 ± 6.7a	26.6 ± 8.2a	26.0 ± 4.3a	31.7 ± 7.7a	6.6 ± 1.7ab	9.3 ± 2.9a	6.0 ± 1.2b	3.8 ± 1.0b
YC	34.9 ± 5.2b	58.4 ± 5.0a	35.2 ± 3.1b	41.6 ± 3.1b	6.2 ± 0.7bc	13.8 ± 0.8a	6.5 ± 0.5b	4.6 ± 0.2c
GZL	19.1 ± 2.6b	26.3 ± 3.0a	17.5 ± 2.2b	16.1 ± 1.7b	3.9 ± 0.3b	10.5 ± 1.0a	4.4 ± 0.7b	1.0 ± 0.1c
LS	31.6 ± 8.0a	31.2 ± 4.4a	24.3 ± 2.9ab	18.4 ± 2.3b	6.5 ± 1.2b	10.8 ± 1.7a	5.5 ± 0.8b	1.8 ± 0.3c
LSD	17.5 ± 1.0a	20.8 ± 4.4a	17.5 ± 2.5a	20.1 ± 2.3a	4.7 ± 0.4b	7.7 ± 1.8a	4.2 ± 0.7bc	2.4 ± 0.4c
CD	20.7 ± 1.2ab	21.1 ± 1.8a	16.9 ± 2.6ab	16.4 ± 3.4b	4.9 ± 0.4ab	6.0 ± 1.1a	4.5 ± 0.7b	2.3 ± 0.3c
NJ	30.5 ± 2.0	26.8 ± 1.7	21.7 ± 1.4	28.5 ± 1.0	7.8 ± 0.4	8.6 ± 1.5	4.2 ± 0.8	3.1 ± 0.3
BY	26.2 ± 3.0a	27.1 ± 1.8a	23.8 ± 1.7ab	21.0 ± 0.9b	5.3 ± 0.8b	7.0 ± 0.5a	6.8 ± 0.6a	3.6 ± 0.2c
WJ	48.5 ± 4.1a	44.7 ± 11.2a	27.6 ± 3.9b	34.7 ± 9.0ab	12.2 ± 0.8a	12.5 ± 3.3a	5.2 ± 1.2b	5.1 ± 1.2b
WX	20.3 ± 2.6a	21.4 ± 2.4a	21.2 ± 4.2a	21.6 ± 1.1a	4.5 ± 0.8b	6.2 ± 0.6a	4.9 ± 0.6b	2.6 ± 0.2c
TJ	12.0 ± 2.3a	11.8 ± 1.1a	11.8 ± 2.3a	14.6 ± 2.7a	2.9 ± 0.8ab	3.7 ± 0.4a	3.0 ± 0.8a	1.8 ± 0.3b
FYA	21.5 ± 3.7a	24.8 ± 4.2a	23.3 ± 3.2a	26.9 ± 3.8a	6.0 ± 0.2ab	7.0 ± 1.5a	4.1 ± 0.7bc	2.7 ± 0.4c
ZJ	19.6 ± 4.3a	15.9 ± 1.6a	18.2 ± 2.7a	17.4 ± 3.1a	3.5 ± 0.8b	3.7 ± 0.5b	5.0 ± 0.7a	2.8 ± 0.4b
FZ	10.6 ± 1.3a	9.6 ± 1.3ab	6.7 ± 0.6c	7.9 ± 1.5bc	3.3 ± 0.6ab	4.3 ± 1.0a	2.4 ± 0.3bc	2.0 ± 0.6c
FH	20.2 ± 3.7a	18.0 ± 2.2a	17.9 ± 2.1a	20.5 ± 1.9a	6.6 ± 1.5a	6.2 ± 1.2ab	5.6 ± 0.7ab	4.5 ± 0.4b

ZY	20.1 ± 2.3a	13.2 ± 3.4c	14.6 ± 3.0bc	18.8 ± 1.8ab	4.5 ± 0.6a	3.8 ± 1.1ab	2.8 ± 0.7b	2.6 ± 0.3b
YT	11.2 ± 2.1b	15.2 ± 1.3a	8.6 ± 0.3b	9.6 ± 0.6b	2.7 ± 0.8b	4.9 ± 0.4a	1.9 ± 0.2bc	1.2 ± 0.1c
JJ	25.9 ± 1.4ab	15.5 ± 4.6c	16.8 ± 5.3bc	28.0 ± 1.6a	5.5 ± 0.5a	5.2 ± 1.9a	3.6 ± 1.2a	3.7 ± 0.3a
HN	13.7 ± 1.3b	14.3 ± 2.2ab	13.2 ± 2.1b	17.3 ± 1.5a	3.7 ± 0.5a	4.6 ± 1.0a	3.5 ± 0.9ab	2.2 ± 0.2b
XS	13.2 ± 1.3ab	11.0 ± 2.4b	12.7 ± 1.7ab	16.7 ± 3.6a	3.3 ± 0.7ab	3.7 ± 1.1a	3.6 ± 0.5a	2.1 ± 0.2b

The data shown are the seasonal means ± standard deviations of observation periods (sampling period for each site are given in Table S1). Different letters in the columns of “air concentrations” and “dry deposition fluxes” indicate significant difference between the seasons at p<0.05. The full names of all sites are presented in Table S1.

Table S10. Seasonal volume-weighted mean concentrations and wet/bulk deposition fluxes of NH_4^+-N in precipitation at twenty-seven monitoring sites in eastern China.

Sites	Volume-weighted mean concentrations				Wet/bulk deposition fluxes			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	2.8	2.6	2.9	3.9	1.7 ± 0.9b	10.8 ± 6.8a	2.5 ± 2.0b	0.4 ± 0.3b
ZZ	4.5	3.2	1.6	3.8	2.6	8.0	4.5	1.3
DL	2.5	0.8	1.1	5.2	1.8 ± 0.9ab	3.1 ± 0.7a	1.2 ± 0.4b	1.2 ± 1.1b
SZ	3.2	2.2	1.8	6.1	1.5 ± 1.0b	7.6 ± 3.9a	1.8 ± 1.6b	0.3 ± 0.4b
QZ	3.0	4.0	2.6	3.8	2.2 ± 1.5b	10.5 ± 5.4a	1.9 ± 0.9b	0.5 ± 0.9b
YQ	2.8	2.1	1.5	2.7	2.0 ± 0.6b	5.0 ± 1.6a	2.2 ± 1.4b	0.2 ± 0.1b
ZMD	2.0	2.2	2.1	3.8	2.6 ± 0.2a	5.8 ± 3.8a	5.8 ± 5.9a	1.5 ± 0.9a
YL	2.2	2.3	2.1	6.6	2.8 ± 0.9ab	5.6 ± 3.9a	4.9 ± 3.7ab	0.5 ± 0.4b
YC	4.5	3.3	2.8	10.7	2.5 ± 1.8b	10.4 ± 3.1a	1.5 ± 0.6b	3.2 ± 3.1b
GZL	2.6	1.1	1.1	2.9	2.4 ± 1.3ab	3.7 ± 0.8a	1.1 ± 0.2bc	0.7 ± 0.1c
LS	2.0	1.3	1.9	4.2	1.6 ± 0.5b	4.2 ± 0.9a	1.7 ± 1.4b	0.3 ± 0.2b
LSD	2.1	1.9	1.9	1.6	1.9 ± 2.4b	4.8 ± 0.4a	2.0 ± 1.9b	0.6 ± 0.4b
CD	2.0	1.2	0.9	3.9	1.2 ± 0.3b	3.7 ± 1.3a	0.5 ± 0.3b	1.0 ± 0.8b
NJ	1.1	1.6	0.7	0.9	1.1 ± 0.3	11.0 ± 1.2	1.0 ± 0.2	0.6 ± 0.1
BY	0.6	0.3	0.4	1.0	3.5 ± 1.3a	2.2 ± 0.6ab	0.7 ± 0.4b	1.1 ± 1.0b
WJ	2.0	1.2	1.3	6.7	3.2 ± 1.4b	6.4 ± 2.7a	2.4 ± 0.9b	1.0 ± 0.9b
WX	1.0	1.2	1.0	1.0	3.8 ± 0.8ab	5.1 ± 2.1a	2.0 ± 1.3bc	0.8 ± 0.6c
TJ	2.8	2.6	2.9	3.9	5.7 ± 1.4a	3.7 ± 1.4a	3.7 ± 1.4a	5.3 ± 2.8a
FYA	1.2	0.8	2.0	3.4	2.2 ± 0.2	3.3 ± 0.6	2.5 ± 3.3	1.7 ± 0.6
ZJ	0.3	0.3	0.5	0.3	0.7 ± 0.6ab	1.7 ± 0.3a	1.5 ± 0.6a	0.1 ± 0.1b

FZ	0.7	0.4	0.5	0.5	3.1 ± 1.2a	3.1 ± 1.1a	1.8 ± 2.3a	1.1 ± 0.4a
FH	0.9	0.4	0.4	1.6	2.8 ± 0.8a	2.8 ± 0.6a	1.5 ± 1.0a	3.4 ± 2.2a
ZY	1.9	1.0	1.0	3.3	3.7 ± 2.3ab	5.5 ± 2.0a	1.8 ± 1.0b	1.0 ± 1.0b
YT	1.0	1.0	0.8	1.1	2.2± 0.2	5.8±0.8	2.2±0.1	0.3±0.3
JJ	2.5	1.3	1.5	5.6	6.0 ±1.5a	6.4±2.4a	2.9±1.8a	3.7±3.3a
HN	1.0	0.9	0.9	1.4	5.1±1.3b	3.9±2.3ab	2.1±1.1a	2.4±1.3a
XS	1.1	0.5	1.0	1.6	6.3±4.8b	2.4±1.2a	2.3±1.4a	2.6±0.7ab

The data on wet/bulk deposition fluxes are the seasonal means ± standard deviations of observation periods (sampling periods at all sites are given in Table S1). Different letters in the "wet/bulk deposition fluxes" column indicate significant difference between the seasons at p<0.05. The full names of all sites are presented in Table S1.

Table S11. Seasonal volume-weighted mean concentrations and wet/bulk deposition fluxes of NO_3^--N in precipitation at twenty-seven monitoring sites in eastern China.

Sites	Volume-weighted mean concentrations				Wet/bulk deposition fluxes (Mean ± SD)			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	3.5	2.0	3.5	4.0	2.1 ± 0.6bc	8.3 ± 2.2a	3.1 ± 1.5b	0.4 ± 0.3c
ZZ	4.6	2.1	1.6	2.8	2.7	5.1	4.4	0.9
DL	2.7	1.6	3.3	5.5	1.9 ± 0.7bc	6.0 ± 1.8a	3.3 ± 0.9b	1.3 ± 0.9c
SZ	2.3	2.4	1.8	3.0	1.1 ± 0.6b	8.4 ± 6.1a	1.8 ± 1.4b	0.1 ± 0.2b
QZ	2.7	2.1	2.0	4.5	1.9 ± 2.0b	5.5 ± 1.6a	1.5 ± 1.0b	0.6 ± 1.1b
YQ	2.7	1.9	2.7	3.6	2.0 ± 0.5ab	4.5 ± 1.5a	3.8 ± 2.7a	0.2 ± 0.2b
ZMD	2.2	1.7	1.9	2.6	2.9 ± 1.5a	4.5 ± 1.8a	5.3 ± 6.2a	1.0 ± 0.2a
YL	1.8	1.4	1.3	4.3	2.3 ± 0.9a	3.2 ± 2.7a	3.0 ± 1.7a	0.3 ± 0.3a
YC	4.0	2.0	2.7	4.2	2.3 ± 1.8ab	6.4 ± 3.2a	1.5 ± 0.9ab	1.3 ± 0.8b
GZL	2.6	1.4	1.5	2.8	2.5 ± 1.0ab	4.6 ± 2.5a	1.5 ± 0.5b	0.6 ± 0.1b
LS	2.8	1.1	1.5	6.0	2.3 ± 0.6b	3.6 ± 0.9a	1.4 ± 0.4bc	0.4 ± 0.5c
WW	3.8	1.4	1.6	2.8	0.8 ± 0.8ab	1.0 ± 0.4a	0.3 ± 0.2ab	0.1 ± 0.1b
LSD	1.4	1.2	1.9	1.2	1.2 ± 0.7ab	3.1 ± 1.6a	2.0 ± 1.7ab	0.4 ± 0.2b
CD	3.2	1.3	1.6	6.1	1.9 ± 0.6b	3.9 ± 0.9a	1.0 ± 0.5b	1.6 ± 1.0b
NJ	1.4	1.7	1.2	1.4	1.4 ± 0.7	11.6 ± 2.1	1.7 ± 0.9	1.4 ± 0.2
BY	0.8	0.9	1.5	1.7	4.7 ± 1.8ab	6.9 ± 2.8a	3.0 ± 1.1b	1.7 ± 0.6b
WJ	4.8	1.0	1.8	7.3	7.8 ± 2.2a	5.4 ± 3.2ab	3.2 ± 0.8bc	1.1 ± 0.7c
WX	0.9	1.0	0.8	1.0	3.4 ± 0.7a	4.1 ± 3.9a	1.7 ± 0.5a	0.8 ± 0.6a
TJ	3.5	2.0	3.5	4.0	4.0 ± 1.1a	1.9 ± 0.7a	3.1 ± 1.4a	4.0 ± 2.0a
FYA	1.0	0.9	1.9	2.5	1.8 ± 0.5	3.8 ± 1.7	2.4 ± 2.2	1.3 ± 0.6

ZJ	0.6	0.3	0.7	2.3	1.2 ± 0.9a	1.9 ± 0.3a	2.1 ± 0.6a	0.8 ± 1.0a
FZ	0.8	0.3	0.6	0.6	3.6 ± 2.0a	2.8 ± 1.5a	2.1 ± 1.8a	1.3 ± 0.6a
FH	1.0	0.5	0.7	1.9	3.1 ± 1.2a	3.7 ± 0.7a	2.5 ± 0.4a	4.0 ± 2.9a
ZY	2.0	1.0	1.3	3.5	3.8 ± 1.2ab	5.1 ± 1.8a	2.2 ± 0.6bc	1.0 ± 0.7c
YT	0.7	0.5	0.5	2.2	1.5 ± 0.4	3.0 ± 0.2	1.5 ± 0.6	0.7 ± 0.6
JJ	1.5	0.7	1.0	4.4	3.6 ± 0.3a	3.4 ± 1.4a	2.0 ± 1.2a	3.0 ± 1.2a
HN	0.6	0.4	0.6	1.1	2.9 ± 0.8a	1.6 ± 0.4a	1.5 ± 0.8a	1.9 ± 1.0a
XS	0.5	0.3	0.6	1.2	3.1 ± 1.8a	1.3 ± 0.5a	1.5 ± 0.8a	1.9 ± 0.8a

The data on wet/bulk deposition fluxes are the seasonal means ± standard deviations of observation periods (sampling periods at all sites are given in Table S1). Different letters in the "wet/bulk deposition fluxes" column indicate significant difference between the seasons at $p<0.05$. The full names of all sites are presented in Table S1.

Table S12. Seasonal volume-weighted mean concentrations and wet/bulk deposition fluxes of TIN (the sum of NH_4^+-N and NO_3^--N) in precipitation at twenty-seven monitoring sites in eastern China.

Sites	Volume-weighted mean concentrations				Wet/bulk deposition fluxes (Mean ± SD)			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
CAU	6.3	4.6	6.4	7.9	3.9 ± 1.2b	19.1 ± 8.9a	5.6 ± 2.9b	0.8 ± 0.6b
ZZ	9.1	5.3	3.2	6.6	5.2	13.1	8.9	2.2
DL	5.2	2.4	4.4	10.7	3.7 ± 1.1b	9.2 ± 1.3a	4.5 ± 1.3b	2.4 ± 1.9b
SZ	5.5	4.6	3.6	9.1	2.7 ± 1.5b	16.0 ± 9.8a	3.6 ± 3.0b	0.4 ± 0.6b
QZ	5.7	6.1	4.6	8.3	4.1 ± 3.0b	16.0 ± 6.3a	3.4 ± 1.7b	1.1 ± 2.0b
YQ	5.5	4.0	4.2	6.3	4.0 ± 1.0bc	9.6 ± 2.9a	6.0 ± 3.8ab	0.4 ± 0.3c
ZMD	4.2	3.9	4.0	6.4	5.5 ± 1.3a	10.3 ± 5.3a	11.0 ± 12.0a	2.5 ± 1.1a
YL	4.0	3.7	3.4	10.9	5.0 ± 1.6ab	8.8 ± 6.6a	7.9 ± 5.1ab	0.7 ± 0.7b
YC	8.5	5.3	5.5	14.9	4.8 ± 3.6b	16.8 ± 6.0a	3.0 ± 1.4b	4.4 ± 3.9b
GZL	5.2	2.5	2.6	5.7	4.9 ± 2.3ab	8.3 ± 3.0a	2.6 ± 0.5bc	1.3 ± 0.2c
LS	4.8	2.4	3.4	10.2	3.9 ± 1.0b	7.8 ± 0.6a	3.1 ± 1.7b	0.6 ± 0.8c
WW	8.9	4.9	4.9	7.4	1.8 ± 1.5ab	3.6 ± 1.2a	1.1 ± 0.7b	0.3 ± 0.3b
LSD	3.5	3.1	3.8	2.8	3.1 ± 2.7b	7.9 ± 1.8a	4.0 ± 3.6ab	1.0 ± 0.5b
CD	5.2	2.5	2.5	10.0	3.1 ± 0.9b	7.6 ± 2.0a	1.5 ± 0.7b	2.6 ± 1.8b
NJ	2.5	3.3	1.9	2.3	2.6 ± 1.0	22.6 ± 3.3	2.6 ± 0.7	2.0 ± 0.3
BY	1.4	1.2	1.9	2.7	8.2 ± 2.2a	9.1 ± 2.8a	3.8 ± 1.3b	2.7 ± 0.8b
WJ	6.8	2.2	3.1	14.0	11 ± 2.9a	11.8 ± 4.1a	5.6 ± 1.5b	2.1 ± 1.6b
WX	1.9	2.2	1.8	2.0	7.3 ± 1.5ab	9.1 ± 4.9a	3.7 ± 1.8ab	1.6 ± 1.2b
TJ	6.3	4.6	6.4	7.9	9.7 ± 2.5a	5.6 ± 2.0a	6.8 ± 2.8a	9.2 ± 4.8a
FYA	2.2	1.7	3.9	5.9	4.1 ± 0.6	7.1 ± 2.3	4.9 ± 5.4	3.0 ± 1.2
ZJ	0.9	0.6	1.2	2.6	1.9 ± 0.9ab	3.6 ± 0.3a	3.5 ± 1.0a	0.9 ± 1.1b
FZ	1.5	0.7	1.1	1.1	6.7 ± 3.0a	5.9 ± 2.5a	3.9 ± 4.1a	2.4 ± 0.9a

FH	1.9	0.9	1.1	3.5	5.9 ± 1.8a	6.6 ± 1.1a	4.0 ± 1.0a	7.5 ± 5.0a
ZY	3.9	2.0	2.3	6.8	7.5 ± 2.4ab	10 ± 3.0a	4.3 ± 1.0bc	2.0 ± 1.7c
YT	1.7	1.5	1.3	3.3	3.7 ± 0.6b	8.8 ± 1.0a	3.7 ± 0.7b	1.0 ± 0.9b
JJ	4.0	2.0	2.5	10.0	9.6 ± 1.8a	9.8 ± 3.7a	4.9 ± 3.0a	6.7 ± 3.3a
HN	1.6	1.3	1.5	2.5	8.1 ± 2.0a	5.5 ± 2.7a	3.6 ± 1.8a	4.3 ± 2.2a
XS	1.6	0.8	1.6	2.8	9.4 ± 6.4a	3.7 ± 1.6a	3.8 ± 1.9a	4.5 ± 1.5a

The data on wet/bulk deposition fluxes are the seasonal means ± standard deviations of observation periods (sampling periods at all sites are given in **Table S1**). Different letters in the "wet/bulk deposition fluxes" column indicate significant difference between the seasons at $p<0.05$. The full names of all sites are presented in **Table S1**.

Table S13. Annual NH_3 and NO_x emissions over Eastern China and its contribution to total emissions in China (Tg N a^{-1})

	Source Type	Eastern China	Eastern China/China
NH_3	Fertilizer[a]	7.3	93%
	Livestock	1.8	76%
	Human waste	1.4	93%
	Fuel combustion[b]	0.6	93%
	Natural	0.4	81%
	Total	11.6	90%
NO_x	Industry	3.1	92%
	Power	2.5	88%
	Transportation	2.1	91%
	Residential	0.3	90%
	Natural[c]	0.5	68%
	Total	8.5	89%

[a]Fertilizer NH_3 emissions include both chemical fertilizer and manure fertilizer.

[b]NH_3 emissions from fuel combustion in power plant, industry, transportation and residential.

[c]Natural NO_x emissions from soil, lighting and biomass burning.