Supplement to: Multi-model mean nitrogen and sulfur deposition from the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP): evaluation and historical and projected changes by Lamarque et al.

This supplement contains

Table S1: Model description, adapted from Lamarque et al. (2012a)
Table S2: Regional mean and standard deviation (amongst models) of dry deposition, wet deposition and associated NO_x emissions over the 1850-2000 (Table S2a), 2030 (Table S2b) and 2100 (Table S2c)
Table S3: Regional mean and standard deviation (amongst models) of dry deposition, wet deposition and associated NH_x emissions over the 1850-2000 (Table S3a), 2030 (Table S3b) and 2100 (Table S3c)
Table S4: Regional mean and standard deviation (amongst models) of dry deposition, wet deposition and associated SO_x emissions over the 1850-2000 (Table S4a), 2030 (Table S4b) and 2100 (Table S4c)
Table S5: Geographical information on ice-core locations used in this study

Figure S1a. Change (2000-1980) in anthropogenic emissions of NO over the United States and Europe.

Figure S1b. Change (2000-1980) in anthropogenic emissions of NH_3 over the United States and Europe.

Figure S1c. Change (2000-1980) in anthropogenic emissions of SO_2 over the United States and Europe.

Only the anthropogenic portion of the emissions is shown in Fig.1 since that is the largest contributor to changes over the 1980-2000 period.

Figure S2. Comparison of the precipitation change in the ACCMIP MMM and in the CMAP precipitation dataset (Xie and Arkin, 1997).

Figure S3. Comparison of annual total precipitation in the ACCMIP MMM against the gauge-based precipitation measurements that are available for the period of 1995 to 2004 and cover large areas in the Arctic (Yang et al., 2005), available http://ine.uaf.edu/werc/people/yang/yang_files/MonthlySum/

Figure S4. Inter-model standard deviation (in %) of the NO_y wet deposition. The standard deviation is only shown for regions where deposition is larger the 0.5 kg(N)/ha/year (see Fig. 5a). The number of models used for each time slice is shown in Table S2.

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Model	Modelling Center	Model Contact	Resolution (lat/lon/lev), Top Level	NOy deposition	NHx deposition	SOx deposition	Reference
CESM-CAM-Superfast	LLNL, USA	Dan Bergmann, Philip Cameron-Smith	1.875/2.5/L26, 3.5hPa	X		X	Lamarque et al, 2012b
CMAM	CCCMA, Environment Canada, Canada	David Plummer	3.75/3.75/L71, 0.00081hPa	X			Scinocca et al, 2008
GEOSCCM	NASA GSFC, USA	Sarah Strode	2/2.5/L72, 0.01hPa	X			Oman et al, 2011
GISS-E2-R	NASA-GISS,USA	Drew Shindell, Greg Faluvegi,	2/2.5/L40, 0.14hPa	X	X	X	Koch et al, 2006 ; Shindell et al, 2012
GISS-E2-R-TOMAS	NASA-GISS,USA	Drew Shindell, Greg Faluvegi, Yunha Lee	2/2.5/L40, 0.14hPa	X			Shindell et al, 2012; Lee and Adams, 2011
MOCAGE	GAME/CNRM, MéteoFrance, France	Béatrice Josse	2.0/2.0/L47, 6.9 hpa	X			Josse et al, 2004 Teyssèdre et al, 2007
NCAR-CAM3.5	NCAR ESL, USA	Jean-François Lamarque	1.875/2.5/L26, 3.5hPa	X	X	X	Lamarque et al, 2011 Lamarque et al, 2012b
NCAR-CAM5.1	PNNL, USA	Steve Ghan	1.875/2.5/L30, 3.5hPa			X	Liu et al, 2012
STOC-HadAM3	University of Edinburgh, United Kingdom	Ian McKenzie, David Stevenson, Ruth Doherty	5.0/5.0/L19 50hPa	X	X	X	Stevenson et al, 2004
UM-CAM	NIWA, New Zealand	Guang Zeng	2.5/3.75/L19, 4.6hPa	X			Zeng et al, 2008, 2010

Table S1. Model description summary, adapted from Lamarque et al. (2012a).

	historical					
	1850		1980		2000	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.5	0.2	2.8	0.8	2.9	0.8
Central + South America	0.5	0.3	0.9	0.4	1.0	0.4
Africa	1.2	0.6	2.5	0.7	2.7	0.7
Europe	0.2	0.1	1.6	0.5	1.4	0.4
Former USSR + Middle East	0.4	0.1	2.7	0.9	2.3	0.6
Asia	0.6	0.3	2.1	0.7	3.6	1.2
Oceania	0.2	0.1	0.3	0.1	0.3	0.1
Continents	3.7	1.6	12.9	3.6	14.2	4.0
Ocean	1.4	0.6	5.2	2.0	6.2	2.4
Global	5.1	1.8	18.1	5.2	20.4	5.9
wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.6	0.2	2.7	0.6	2.9	0.6
Central + South America	0.9	0.4	1.3	0.5	1.5	0.6
Africa	1.6	0.4	2.7	0.5	2.8	0.5
Europe	0.2	0.0	1.4	0.4	1.3	0.3
Former USSR + Middle East	0.5	0.1	2.8	0.7	2.4	0.5
Asia	1.0	0.3	2.5	0.6	4.0	0.9
Oceania	0.3	0.1	0.4	0.1	0.4	0.1
Continents	5.1	1.4	13.7	3.0	15.2	3.0
Ocean	5.9	2.5	12.5	3.3	14.7	4.0
Global	11.1	2.9	26.2	4.5	29.9	5.0
emissions	mean	sdev	mean	sdev	mean	sdev
North America	1.6	0.2	7.8	0.2	8.0	0.2
Central + South America	2.6	0.9	3.7	0.8	4.1	0.8
Africa	4.2	1.1	6.6	0.8	6.8	0.8
Europe	0.5	0.1	4.7	0.1	4.1	0.1
Former USSR + Middle East	1.0	0.2	5.9	0.2	4.9	0.2
Asia	2.5	0.7	6.1	0.7	10.1	0.7
Oceania	0.9	0.2	1.1	0.1	1.2	0.1
Continents	13.3	3.2	35.9	2.2	39.1	2.2
Ocean	1.5	0.7	6.1	1.3	8.2	1.8
Global	14.8	3.7	42.0	2.8	47.3	3.0
Number of models	9		9		9	

Table S2a. Regional deposition and emission (Tg(N)/yr) from NO_x emissions for the historical period.

	2030					
	RCP26		RCP45		RCP85	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	1.3	0.4	1.4	0.4	1.8	0.5
Central + South America	0.6	0.3	0.9	0.5	1.0	0.5
Africa	2.4	0.6	3.2	0.9	3.1	0.8
Europe	0.9	0.3	0.9	0.3	1.0	0.3
Former USSR + Middle East	1.7	0.4	2.2	0.7	2.8	0.8
Asia	4.2	1.5	5.4	1.9	6.4	1.9
Oceania	0.2	0.1	0.3	0.1	0.3	0.1
Continents	11.3	3.4	14.3	4.5	16.3	4.6
Ocean	5.7	1.9	6.0	2.1	6.8	2.0
Global	17.0	5.1	20.3	6.3	23.1	6.3
wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	1.4	0.2	1.4	0.3	1.8	0.2
Central + South America	1.0	0.3	1.1	0.4	1.2	0.3
Africa	2.5	0.2	2.7	0.1	2.8	0.3
Europe	0.7	0.2	0.8	0.2	0.8	0.2
Former USSR + Middle East	1.6	0.3	1.9	0.4	2.3	0.4
Asia	4.2	0.8	4.9	0.6	5.6	0.8
Oceania	0.3	0.1	0.3	0.1	0.3	0.1
Continents	11.8	1.3	13.1	1.3	14.9	1.5
Ocean	13.7	4.1	14.5	5.4	15.0	4.4
Global	25.4	5.0	27.6	6.6	29.9	5.4
emissions	mean	sdev	mean	sdev	mean	sdev
North America	3.6	0.5	3.4	0.5	4.3	0.5
Central + South America	3.0	1.1	3.3	1.0	3.6	1.1
Africa	6.5	1.4	6.8	1.2	7.1	1.3
Europe	2.3	0.2	2.1	0.2	2.4	0.3
Former USSR + Middle East	3.3	0.3	4.0	0.3	5.4	0.4
Asia	11.4	1.6	12.2	1.8	15.3	1.3
Oceania	0.8	0.2	0.8	0.3	0.9	0.2
Continents	30.9	5.0	32.6	5.1	39.0	4.9
Ocean	8.2	1.3	8.6	0.6	9.1	1.3
Global	39.1	5.9	41.1	5.3	48.1	5.8
Number of models	6		4		7	

Table S2b. Regional deposition and emission (Tg(N)/yr) from NO_x emissions for 2030.

	2100					
	RCP26		RCP45		RCP85	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.5	0.2	0.8	0.3	1.1	0.4
Central + South America	0.6	0.3	0.7	0.4	0.8	0.4
Africa	2.4	0.7	2.7	1.0	2.9	1.0
Europe	0.3	0.1	0.5	0.2	0.6	0.2
Former USSR + Middle East	1.0	0.3	1.0	0.4	1.6	0.5
Asia	2.0	0.8	1.9	0.8	2.5	0.8
Oceania	0.1	0.1	0.2	0.1	0.2	0.1
Continents	6.8	2.2	7.8	2.9	9.7	3.2
Ocean	2.6	1.0	3.3	1.1	4.7	1.5
Global	9.4	3.2	11.1	3.8	14.4	4.4

wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.7	0.2	1.0	0.2	1.4	0.2
Central + South America	0.9	0.3	0.9	0.3	1.1	0.3
Africa	2.7	0.3	2.5	0.1	3.0	0.4
Europe	0.3	0.1	0.5	0.1	0.5	0.1
Former USSR + Middle East	0.9	0.2	1.1	0.2	1.6	0.3
Asia	2.2	0.5	2.2	0.4	3.0	0.5
Oceania	0.2	0.1	0.3	0.1	0.3	0.1
Continents	7.9	1.0	8.4	1.0	11.0	1.3
Ocean	8.8	3.4	10.2	4.5	12.4	4.1
Global	16.7	4.2	18.6	5.5	23.4	4.9

emissions	mean	sdev	mean	sdev	mean	sdev
North America	1.5	0.4	2.2	0.5	3.0	0.7
Central + South America	2.8	1.1	2.4	1.1	3.0	1.3
Africa	7.3	1.4	6.1	1.4	7.2	1.7
Europe	0.8	0.2	1.2	0.2	1.4	0.3
Former USSR + Middle East	2.1	0.3	1.9	0.4	3.3	0.5
Asia	5.9	1.4	5.0	1.6	6.9	1.6
Oceania	0.6	0.2	0.7	0.3	0.8	0.3
Continents	21.1	4.9	19.5	5.4	25.6	6.1
Ocean	2.9	1.1	5.3	0.6	7.8	1.3
Global	24.0	5.8	24.8	5.8	33.4	7.1
Number of models	6		4		7	

Table S2c. Regional deposition and emission (Tg(N)/yr) from NO_x emissions for 2100.

	historical					
	1850		1980		2000	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	1.1	0.2	1.7	0.4	1.9	0.4
Central + South America	0.6	0.0	2.1	0.2	1.9	0.2
Africa	1.1	0.1	2.6	0.3	2.4	0.2
Europe	0.3	0.1	1.2	0.4	1.6	0.4
Former USSR + Middle East	0.8	0.2	1.9	0.7	2.2	0.6
Asia	1.6	0.3	5.0	1.2	6.1	1.5
Oceania	0.2	0.1	0.4	0.1	0.4	0.1
Continents	5.8	0.9	14.8	3.1	16.4	3.3
Ocean	3.6	1.2	5.4	1.9	5.8	2.1
Global	9.4	1.9	20.3	4.3	22.3	4.7
wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.8	0.3	1.9	0.5	2.0	0.5
Central + South America	0.6	0.1	1.7	0.6	1.6	0.5
Africa	0.8	0.2	1.9	0.6	1.8	0.5
Europe	0.2	0.0	1.2	0.3	1.3	0.1
Former USSR + Middle East	0.6	0.2	2.3	0.9	2.5	0.7
Asia	1.3	0.6	4.3	2.1	5.7	2.5
Oceania	0.2	0.1	0.3	0.1	0.3	0.1
Continents	4.6	1.4	13.7	3.4	15.2	3.8
Ocean	6.1	0.5	10.4	0.8	11.5	1.1
Global	10.7	1.9	24.1	3.8	26.7	4.2
emissions	mean	sdev	mean	sdev	mean	sdev
North America	2.3	0.0	4.0	0.1	4.3	0.1
Central + South America	1.0	0.3	4.4	0.3	4.0	0.3
Africa	2.2	0.3	5.6	0.3	4.8	0.3
Europe	0.6	0.0	3.3	0.1	4.1	0.1
Former USSR + Middle East	1.5	0.1	4.1	0.2	4.5	0.2
Asia	3.5	0.1	12.5	0.3	15.9	0.4
Oceania	0.5	0.0	0.9	0.0	0.8	0.0
Continents	11.5	0.8	34.8	0.8	38.4	1.1
Ocean	8.3	0.9	10.2	1.5	10.7	1.7
Global	19.8	1.2	44.9	1.4	49.1	1.7
Number of models	3		3		3	

Table S3a. Regional deposition and emission (Tg(N)/yr) from NH_x emissions for the historical period.

	2030					
	RCP26		RCP45		RCP85	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	2.7	0.3	2.4	0.0	2.7	0.3
Central + South America	2.6	0.3	2.0	0.2	2.8	0.3
Africa	3.2	0.3	2.5	0.1	3.2	0.3
Europe	1.7	0.4	1.5	0.2	2.2	0.5
Former USSR + Middle East	2.7	0.7	2.0	0.1	3.1	0.8
Asia	8.8	1.9	6.5	0.5	7.7	1.8
Oceania	0.5	0.1	0.3	0.0	0.5	0.1
Continents	22.2	3.6	17.2	0.4	22.1	3.9
Ocean	7.8	3.2	6.0	2.7	7.6	2.9
Global	30.0	5.6	23.1	2.3	29.7	5.6
wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	2.0	0.4	2.2	0.2	2.2	0.3
Central + South America	2.0	0.9	1.9	0.7	2.2	1.0
Africa	2.4	0.9	2.2	0.6	2.4	0.8
Europe	1.0	0.3	1.2	0.3	1.3	0.4
Former USSR + Middle East	2.2	0.5	2.7	0.1	2.8	0.7
Asia	7.3	3.5	7.0	2.5	6.9	2.6
Oceania	0.3	0.1	0.3	0.1	0.3	0.1
Continents	17.3	6.4	17.6	4.5	18.2	5.5
Ocean	12.8	1.4	12.8	0.9	13.2	1.5
Global	30.0	6.3	30.4	3.6	31.4	5.7
emissions	mean	sdev	mean	sdev	mean	sdev
North America	5.1	0.1	5.1	0.1	5.4	0.0
Central + South America	5.3	0.3	4.4	0.3	5.8	0.3
Africa	6.7	0.3	5.2	0.3	6.7	0.3
Europe	3.8	0.1	4.1	0.0	5.0	0.1
Former USSR + Middle East	5.1	0.2	4.7	0.1	6.2	0.2
Asia	22.1	0.6	19.5	0.1	19.9	0.5
Oceania	1.0	0.0	0.9	0.0	1.0	0.0
Continents	49.0	0.9	43.9	0.9	50.0	0.9
Ocean	11.4	2.0	9.7	0.6	11.8	2.0
Global	60.4	1.5	53.6	0.4	61.7	1.5
Number of models	3		2		3	

Table S3b. Regional deposition and emission (Tg(N)/yr) from NH_x emissions for 2030.

	2100					
	RCP26		RCP45		RCP85	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	3.6	0.5	2.8	0.2	4.0	0.4
Central + South America	3.7	0.6	2.1	0.4	3.6	0.6
Africa	4.6	0.6	2.8	0.3	5.1	0.7
Europe	1.8	0.3	1.3	0.1	2.7	0.5
Former USSR + Middle East	3.7	0.7	2.1	0.1	4.4	1.0
Asia	13.5	2.8	6.9	0.5	10.1	1.9
Oceania	0.6	0.1	0.4	0.0	0.7	0.1
Continents	31.4	4.5	18.4	0.3	30.7	4.5
Ocean	11.3	5.8	7.2	4.0	11.0	5.4
Global	42.7	8.4	25.6	4.3	41.6	7.7

wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	2.3	0.9	2.2	0.6	2.7	0.9
Central + South America	2.7	1.6	2.0	0.9	2.7	1.6
Africa	3.1	1.5	2.2	1.0	3.9	2.3
Europe	1.0	0.5	1.0	0.4	1.4	0.8
Former USSR + Middle East	2.3	0.8	2.0	0.3	3.0	0.9
Asia	9.5	7.0	6.6	4.2	7.3	4.4
Oceania	0.4	0.2	0.4	0.1	0.4	0.2
Continents	21.3	12.0	16.4	7.5	21.5	11.0
Ocean	13.7	1.6	11.6	0.7	14.0	1.8
Global	34.9	12.0	28.0	6.9	35.6	11.0

emissions	mean	sdev	mean	sdev	mean	sdev
North America	6.2	0.1	5.3	0.1	7.2	0.1
Central + South America	7.2	0.4	4.4	0.3	7.3	0.3
Africa	9.1	0.2	5.8	0.3	11.4	0.3
Europe	3.3	0.0	3.2	0.0	5.4	0.1
Former USSR + Middle East	6.4	0.2	4.4	0.1	8.0	0.2
Asia	30.6	0.8	18.4	0.0	23.2	0.5
Oceania	1.3	0.0	1.0	0.0	1.4	0.0
Continents	64.0	1.1	42.4	0.8	63.8	1.1
Ocean	12.6	2.5	9.6	0.6	12.7	2.3
Global	76.6	1.7	52.0	0.3	76.5	1.7
Number of models	3		2		3	

Table S3c. Regional deposition and emission (Tg(N)/yr) from NH_x emissions for 2100.

	historical					
	1850		1980		2000	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.4	0.3	6.5	1.0	3.8	1.3
Central + South America	0.3	0.1	1.3	0.4	1.0	0.4
Africa	0.5	0.2	2.6	0.4	1.9	0.7
Europe	0.3	0.2	9.1	1.3	2.4	0.8
Former USSR + Middle East	0.3	0.2	5.4	0.5	3.4	1.1
Asia	0.5	0.2	4.7	1.0	6.4	1.7
Oceania	0.2	0.1	0.5	0.1	0.5	0.2
Continents	2.3	1.2	30.1	4.5	19.4	6.0
Ocean	6.8	3.6	16.5	6.8	13.8	5.5
Global	9.1	4.6	46.6	10.0	33.2	11.0
wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.8	0.3	4.6	0.7	4.2	0.8
Central + South America	1.3	0.4	2.0	0.3	2.2	0.5
Africa	0.7	0.2	2.2	0.2	2.3	0.4
Europe	0.5	0.2	3.3	0.6	1.9	0.5
Former USSR + Middle East	0.7	0.1	5.7	1.5	4.4	1.0
Asia	1.7	0.3	5.2	0.9	8.2	1.8
Oceania	0.4	0.0	0.6	0.1	0.7	0.1
Continents	6.2	0.8	23.6	3.9	23.8	4.6
Ocean	15.9	1.3	25.8	2.2	26.3	1.9
Global	22.1	2.0	49.3	6.0	50.1	6.1
emissions	mean	sdev	mean	sdev	mean	sdev
North America	1.3	1.5	14.4	1.4	10.4	1.3
Central + South America	2.2	1.2	4.3	1.1	4.2	1.2
Africa	0.6	0.3	3.9	0.4	3.4	0.4
Europe	1.4	0.8	19.0	0.6	6.7	0.4
Former USSR + Middle East	0.4	0.3	9.7	0.4	8.2	0.3
Asia	2.0	0.9	10.5	1.0	16.9	0.9
Oceania	0.5	0.2	1.3	0.2	1.6	0.2
Continents	8.3	3.4	63.1	2.6	51.3	2.6
Ocean	22.4	6.0	33.0	5.6	31.4	6.6
Global	30.7	7.7	96.0	7.5	82.8	8.0
Number of models	6		4		6	

Table S4a. Regional deposition and emission (Tg(S)/yr) from SO_x emissions for the historical period.

	2030					
	RCP26		RCP45		RCP85	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	1.0	0.3	1.5	0.4	2.0	0.4
Central + South America	1.1	0.3	1.0	0.4	0.9	0.2
Africa	2.0	0.4	2.7	0.5	2.4	0.4
Europe	0.6	0.2	1.0	0.3	0.8	0.2
Former USSR + Middle East	1.8	0.3	2.7	0.5	3.2	0.5
Asia	6.3	1.2	7.4	1.8	9.0	1.4
Oceania	0.3	0.1	0.5	0.2	0.3	0.1
Continents	13.0	2.6	16.9	4.1	18.6	3.1
Ocean	10.7	5.2	14.5	7.8	12.5	5.7
Global	23.8	7.4	31.3	12.0	31.1	8.1

wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	1.3	0.4	1.9	0.2	2.2	0.4
Central + South America	1.8	0.3	2.0	0.0	1.6	0.2
Africa	1.9	0.2	2.6	0.2	2.2	0.2
Europe	0.6	0.1	1.0	0.1	0.8	0.1
Former USSR + Middle East	1.8	0.1	3.1	0.5	2.9	0.3
Asia	6.7	1.1	8.4	1.3	8.4	1.5
Oceania	0.5	0.1	0.6	0.1	0.5	0.1
Continents	14.6	1.5	19.7	2.3	18.7	2.1
Ocean	21.3	1.2	25.3	1.9	23.6	1.6
Global	36.0	2.7	45.1	4.2	42.3	3.7

emissions	mean	sdev	mean	sdev	mean	sdev
North America	2.7	1.6	3.7	0.0	5.0	1.6
Central + South America	3.8	1.1	4.6	0.4	3.0	1.1
Africa	3.7	0.2	5.5	0.0	4.2	0.2
Europe	1.6	0.6	2.5	0.3	2.1	0.6
Former USSR + Middle East	3.7	0.3	5.9	0.0	6.9	0.3
Asia	15.1	1.0	19.0	0.4	20.4	0.9
Oceania	0.7	0.2	1.5	0.0	0.8	0.2
Continents	31.3	3.1	42.7	0.2	42.5	3.0
Ocean	28.5	5.6	35.2	5.8	30.8	5.6
Global	59.8	7.9	77.9	5.6	73.3	7.6
Number of models	4		2		4	

Table S4b. Regional deposition and emission (Tg(S)/yr) from SO_x emissions for 2030.

	2100					
	RCP26		RCP45		RCP85	
dry deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.4	0.3	0.5	0.2	0.5	0.3
Central + South America	0.4	0.2	0.5	0.3	0.6	0.2
Africa	1.5	0.3	1.5	0.4	1.6	0.3
Europe	0.3	0.1	0.4	0.2	0.3	0.1
Former USSR + Middle East	0.5	0.2	0.7	0.2	1.2	0.2
Asia	1.0	0.3	1.4	0.5	1.8	0.4
Oceania	0.2	0.1	0.4	0.1	0.2	0.1
Continents	4.3	1.3	5.3	1.9	6.4	1.6
Ocean	7.9	4.4	10.3	6.4	9.1	5.2
Global	12.3	5.5	15.7	8.3	15.4	6.5

wet deposition	mean	sdev	mean	sdev	mean	sdev
North America	0.8	0.4	0.9	0.1	1.0	0.4
Central + South America	1.1	0.2	1.5	0.1	1.3	0.2
Africa	1.6	0.2	1.6	0.0	1.8	0.1
Europe	0.4	0.1	0.6	0.0	0.5	0.1
Former USSR + Middle East	0.9	0.1	1.1	0.1	1.4	0.1
Asia	2.4	0.3	2.9	0.3	3.3	0.4
Oceania	0.4	0.1	0.5	0.1	0.4	0.1
Continents	7.7	0.4	9.1	0.4	9.7	0.4
Ocean	16.6	0.6	18.6	0.7	18.6	1.0
Global	24.4	0.9	27.8	1.1	28.3	1.4

emissions	mean	sdev	mean	sdev	mean	sdev
North America	1.4	1.7	1.2	0.0	1.7	1.7
Central + South America	1.9	1.1	3.3	0.4	2.3	1.1
Africa	2.9	0.3	2.9	0.0	3.2	0.3
Europe	0.9	0.6	1.2	0.3	1.0	0.6
Former USSR + Middle East	1.0	0.4	1.3	0.0	2.6	0.4
Asia	3.2	0.9	4.7	0.5	5.2	0.9
Oceania	0.5	0.2	1.1	0.0	0.6	0.2
Continents	11.9	3.5	15.6	0.2	16.6	3.5
Ocean	25.3	5.5	30.1	5.7	27.0	5.6
Global	37.2	7.6	45.8	5.5	43.6	7.7
Number of models	4		2		4	

Table S4c. Regional deposition and emission (Tg(S)/yr) from SO_x emissions for 2100.

Ice Core Site Name	Latitude	Longitude	Elevation (m)
Antarctica			
W10	66° 44 S	112° 50’ E	1390
THW	76° 57’ S	121° 13’ W	2020
DIV	76° 46’ S	101° 44’ W	1329
WD	79° 28’ S	112° 41’ W	1759
PIG	77° 57’ S	95° 57’ W	1593
NUS Site8_7	74° 53 ‘ S	01° 36’ E	2700
NUS Site8_4	82° 49’ S	18° 54’ E	2552
NUS Site8_5	82° 38’ S	17° 52’ E	2554
NUS Site7_7	82° 04’ S	54° 53’ E	3725
NUS Site7_5	78° 39’ S	35° 38’ E	3619
NUS Site7_2	76° 04’ S	22° 28’ E	3582
NUS Site7_1	73° 43’ S	7° 59’ E	3174
Northern hemisphere			
ACT11d	66° 28’ N	46° 18’ W	2296
D4	71° 24’ N	43° 54’ W	2766
Zoe	72° 36’ N	38° 18’ W	3258
NEEMS3	77° 26’ N	51° 03’ W	2454
Tunu	78° 01’ N	33° 59’ W	2213
McCall	69° 18‘ N	143° 48’ W	2400
Akademmi Nauk	80° 31’ N	94° 49’ E	750
Flade Isblink	81° 35’ N	15° 42’ W	618

Table S5. Geographical information on the various ice-cores used in this study.

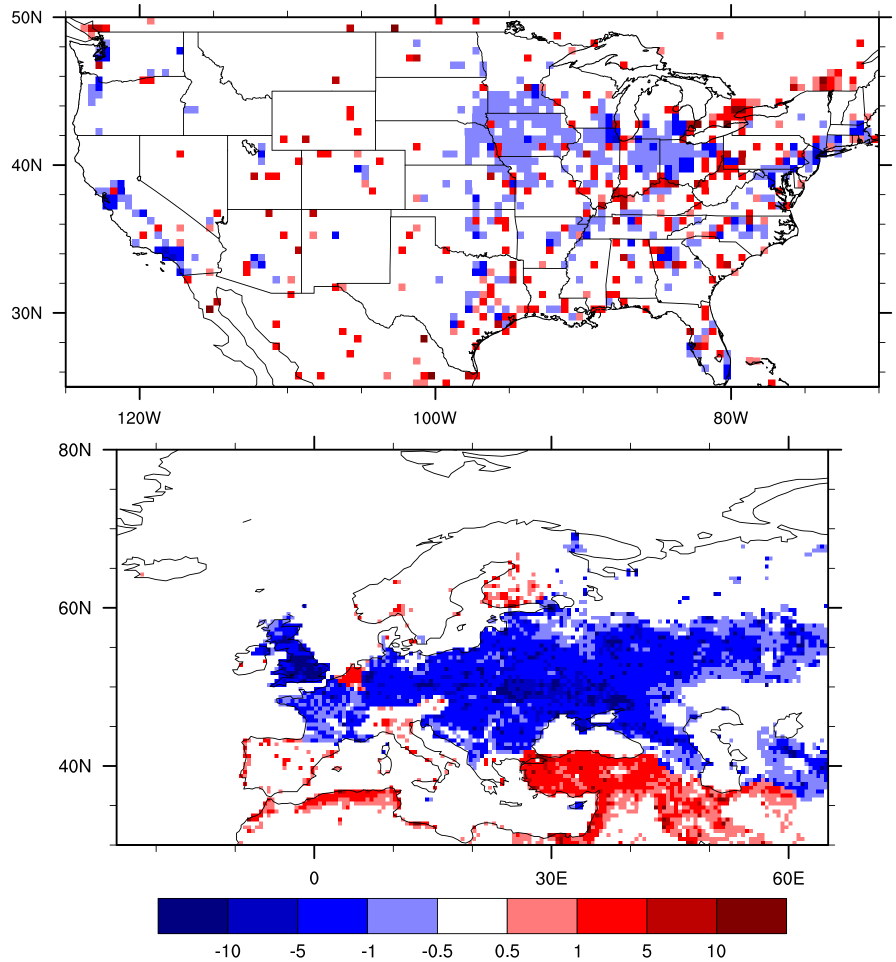

Figure S1a. Change in NO anthropogenic emissions (2000-1980) in kg(N)/ha/year

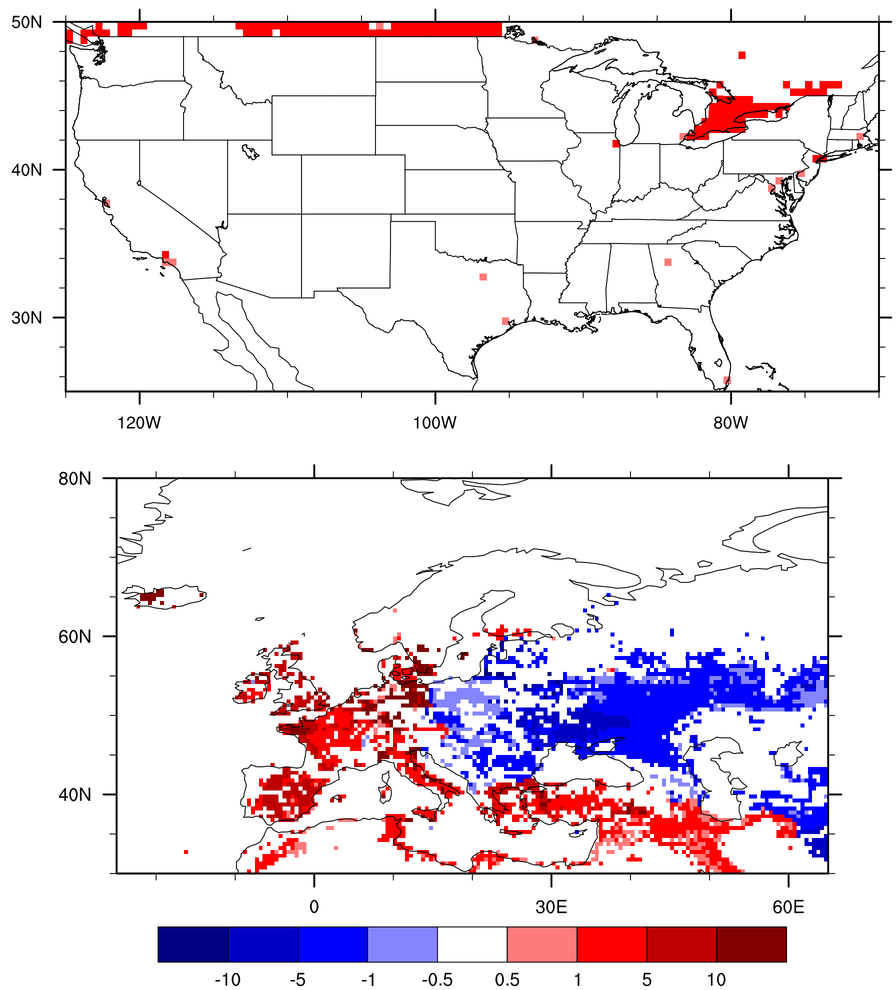

Figure S1b. Change in NH_3 anthropogenic emissions (2000-1980) in kg(N)/ha/year.

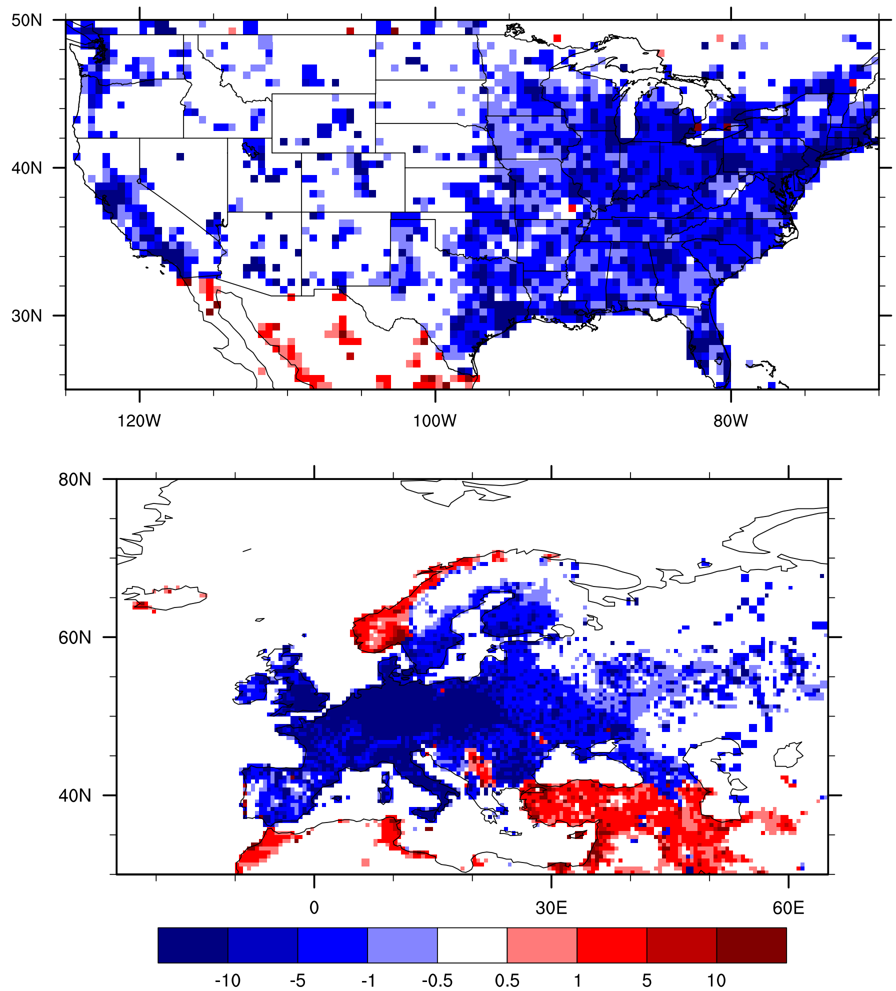

Figure S1c. Change in SO_2 anthropogenic emissions (2000-1980) in kg(S)/ha/year.

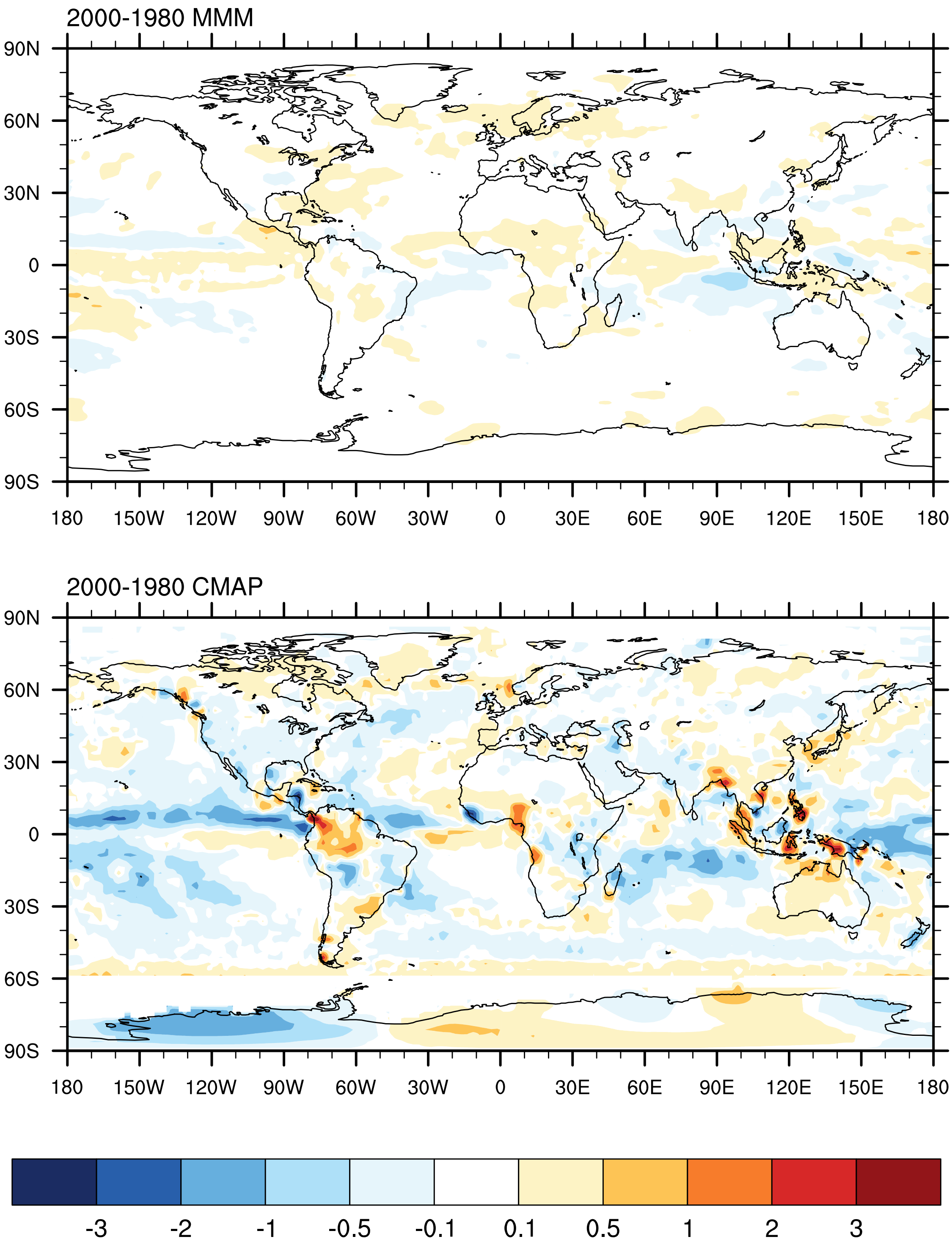

Figure S2. Comparison of annual mean precipitation (mm/day) change (2000-1980) from the ACCMIP MMM (top) and from the CMAP database (bottom; Xie and Arkin, 1997). Note that a 6-year average on the CMAP data is used for both time slices.

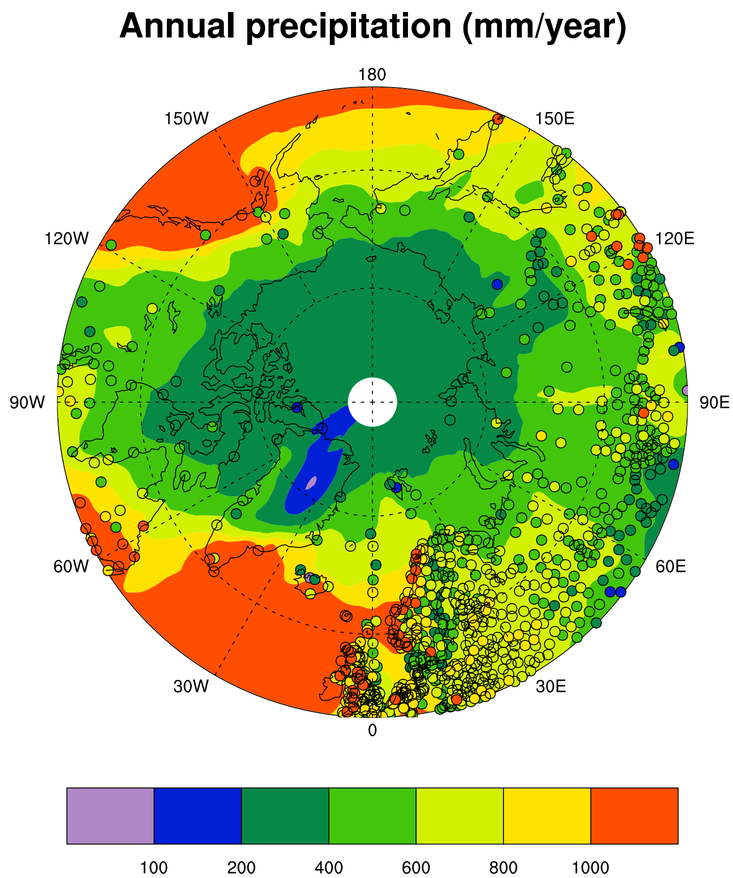

Figure S3. Annual mean precipitation from the ACCMIP MMM (contours) and observations (filled circles) from Yang et al. (2005).

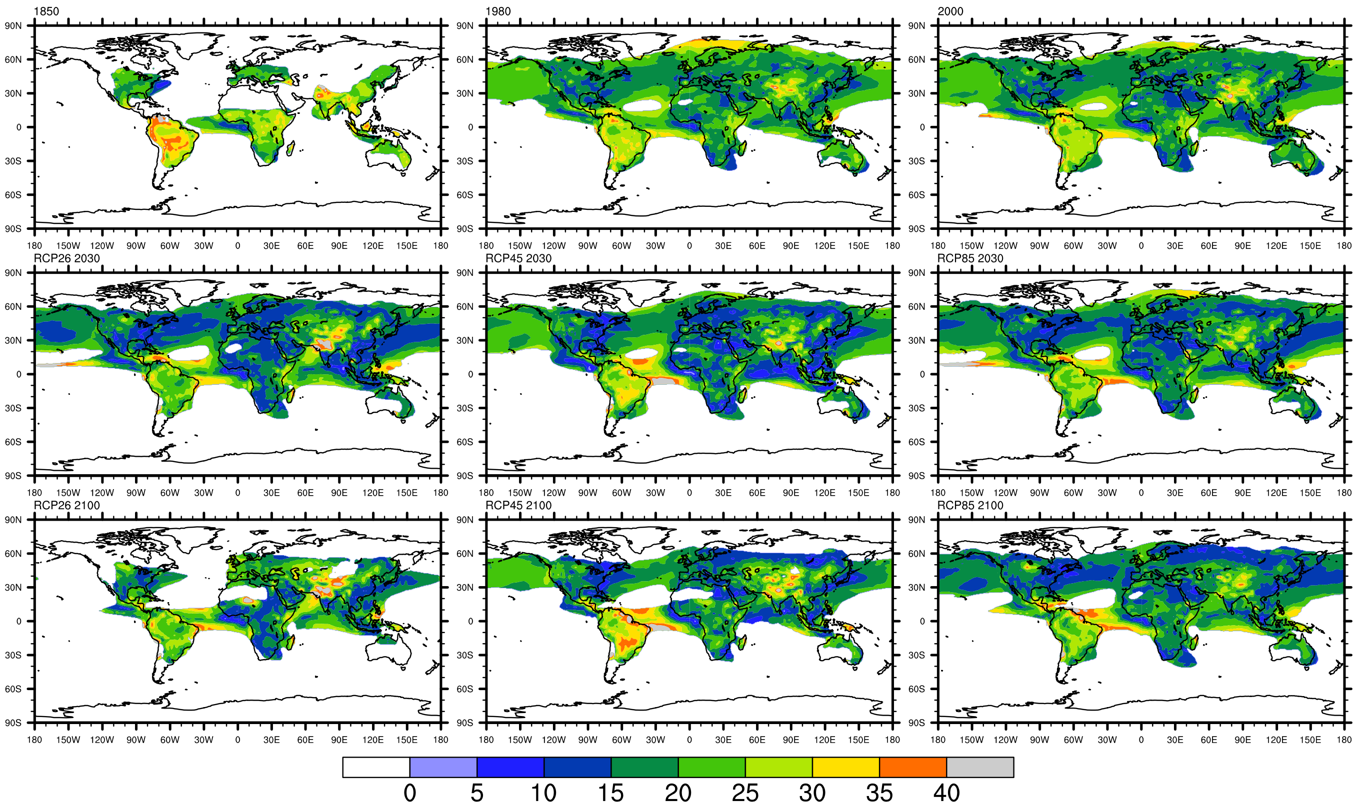

Figure S4. Inter-model standard deviation (in %) of the NO_y wet deposition. The standard deviation is only shown for regions where deposition is larger the 0.5 kg(N)/ha/year (see Fig. 5a). The number of models used for each time slice is shown in Table S2.