Global Maps of Atmospheric Nitrogen Deposition, 1860, 1993, and 2050

Abstract

This data set provides global gridded estimates of atmospheric deposition of total inorganic nitrogen (N), NH_x (NH_3 and NH_4^+), and NO_y (all oxidized forms of nitrogen other than N_2O), in mg N/m^2/year, for the years 1860 and 1993 and projections for the year 2050. The data set was generated using a global three-dimensional chemistry-transport model (TM3) with a spatial resolution of 5 degrees longitude by 3.75 degrees latitude (Jeuken et al., 2001; Lelieveld and Dentener, 2000). Nitrogen emissions estimates (Van Aardenne et al., 2001) and projection scenario data (IPCC, 1996; 2000) were used as input to the model. The model output grids were subdivided into 50 km x 50 km sub-grids to create spatially defined deposition maps. The gridded data were assigned to continental and marine regions using boundaries delineated on a world data coverage from ESRI (1993).

The data set contributes to a global nitrogen budget that was developed to answer questions, such as: (1) How has the global nitrogen budget changed from the late 19th century to the late 20th century? and (2) What is the global nitrogen budget projected to be in the mid-21st century?

Background Information

Investigators:
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Project: International Nitrogen Initiative

Data Set Title: Global Maps of Atmospheric Nitrogen Deposition, 1860, 1993, and 2050

Site: Global (gridded)

Westernmost Longitude: -180 W
Easternmost Longitude: 180 E
Northernmost Latitude: 90 N
Southernmost Latitude: -90 S

Data Set Citation:

Dentener, F. J. 2006. Global Maps of Atmospheric Nitrogen Deposition, 1860, 1993, and 2050. Data set. Available on-line [http://daac.ornl.gov/] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S. A.

Product Description:

This data set can be used to produce maps that illustrate both the temporal and spatial variability of atmospheric deposition of N, NH_x, and NO_y as well as the degree of alteration and regional heterogeneity in deposition through time. Nine data files are provided to produce the following maps:

Global N Deposition (1860, 1993, and 2050)
Global NH_x Deposition (1860, 1993, and 2050)
Global NO_y Deposition (1860, 1993, and 2050)

Also included as data files are GeoTIFF format files (Tagged Image File Format) created from the nine nitrogen deposition data files. A world file of projection information (*.twf) is included for each GeoTIFF file.

Data File Information:

The original data are stored as ASCII text files (.txt), in space delimited format. The data values are model outputs provided as annual means (mg $N/m^2/y$) in arrays of dimension IM x JM, where IM is the number of longitudes (72) and JM is the number of latitudes (48). Each data file contains 10 columns and 346 rows with a spatial resolution of 5 degrees longitude by 3.75 degrees latitude. The data files are organized by nitrogen species by year.

Sample Data Records:

N-deposition	mg N/ m^2/ year	im = 72		jm = 48		year1860			
0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.64	0.75	0.90	1.32	1.42	0.95	0.31	0.16
0.13	0.15	0.18	0.22	0.27	0.32	0.42	0.41	0.31	0.26
0.23	0.23	0.23	0.21	0.35	0.48	0.37	0.17	0.16	0.16
0.18	0.20	0.22	0.22	0.21	0.17	0.14	0.11	0.09	0.10
0.11	0.11	0.11	0.12	0.12	0.12	0.11	0.11	0.10	0.10
Etc...									

Data Users Please Note:

- In all data files, the first data value corresponds to a location centered at 90 S, 180 W.
- In all data files, the last data value corresponds to a location centered at 90 N, 180 E.

Sample Maps:

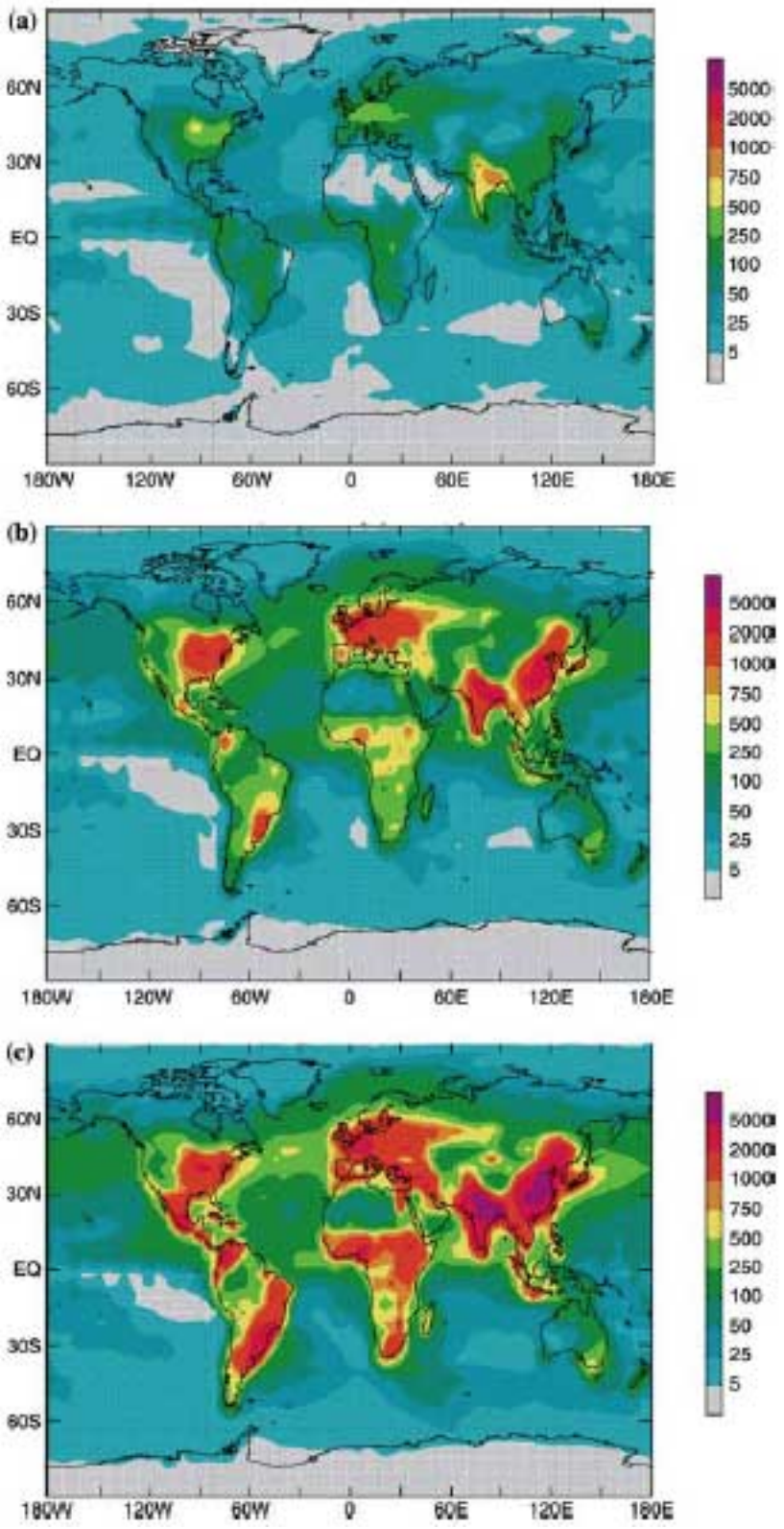

Figure 1. Spatial patterns of total inorganic nitrogen deposition in (a) 1860, (b) early 1990s, and (c) 2050, mg $N/m^2/y$ (Source: Galloway et al., 2004).

Methods and Materials:

Emission scenarios for NO and NH_3 are based on Van Aardenne et al. (2001). These estimates were derived from version 2.0 of the Emission Database for Global Atmospheric Research (EDGAR 2.0) (Olivier et al., 1999). The predictions of NO and NH_3 emissions are based on the IS92a scenario (IPCC, 1996). For this scenario, the projected NO_x emissions compares to the higher (more pessimistic) end of the range seen in recent SRES scenarios (IPCC, 2000) (but still well within that range). Neither IS92a or SRES provide scenarios for NH_3 emissions, so the 2050 scenario used in this work for NH_3 is determined in analogy to N_2O emissions (since these grossly represent the development of agricultural activities). In fact, very recent RIVM/IMAGE scenarios for the year 2030 (based on SRES A2/B2) agree well with the increases that the investigator's IS92a based work would predict for 2050. Overall, the IS92a can be considered among the higher end of current scenarios regarding NO_x emissions, and reflects the current information on NH_3 emissions.

The emissions estimates and projections described above were used as input to the global three-dimensional chemistry-transport model TM3 [described in Jeuken et al. (2001) and Lelieveld and Dentener (2000)] to produce global maps of atmospheric nitrogen deposition for 1860, 1993, and 2050.

Data Usage Guidance:

Error Sources:

See Appendix I in Galloway et al. (2004) for a discussion of uncertainties in the deposition estimates.

Please note that over the ocean negative NH_x fluxes may occur. These particular model simulations were done using an oceanic NH_3 equilibrium concentration approach. This means that negative deposition fluxes represent net emissions from the ocean.

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