The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

The International Union of Geodesy and Geophysics

2339-8

Workshop on Atmospheric Deposition: Processesand Environmental Impacts

21 - 25 May 2012

The National Atmospheric Deposition Program (NADP) Lessons Learned from a Long-Term Continental Scale Network

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The National Atmospheric Deposition Program (NADP)

Lessons Learned from a Long-Term Continental Scale Network

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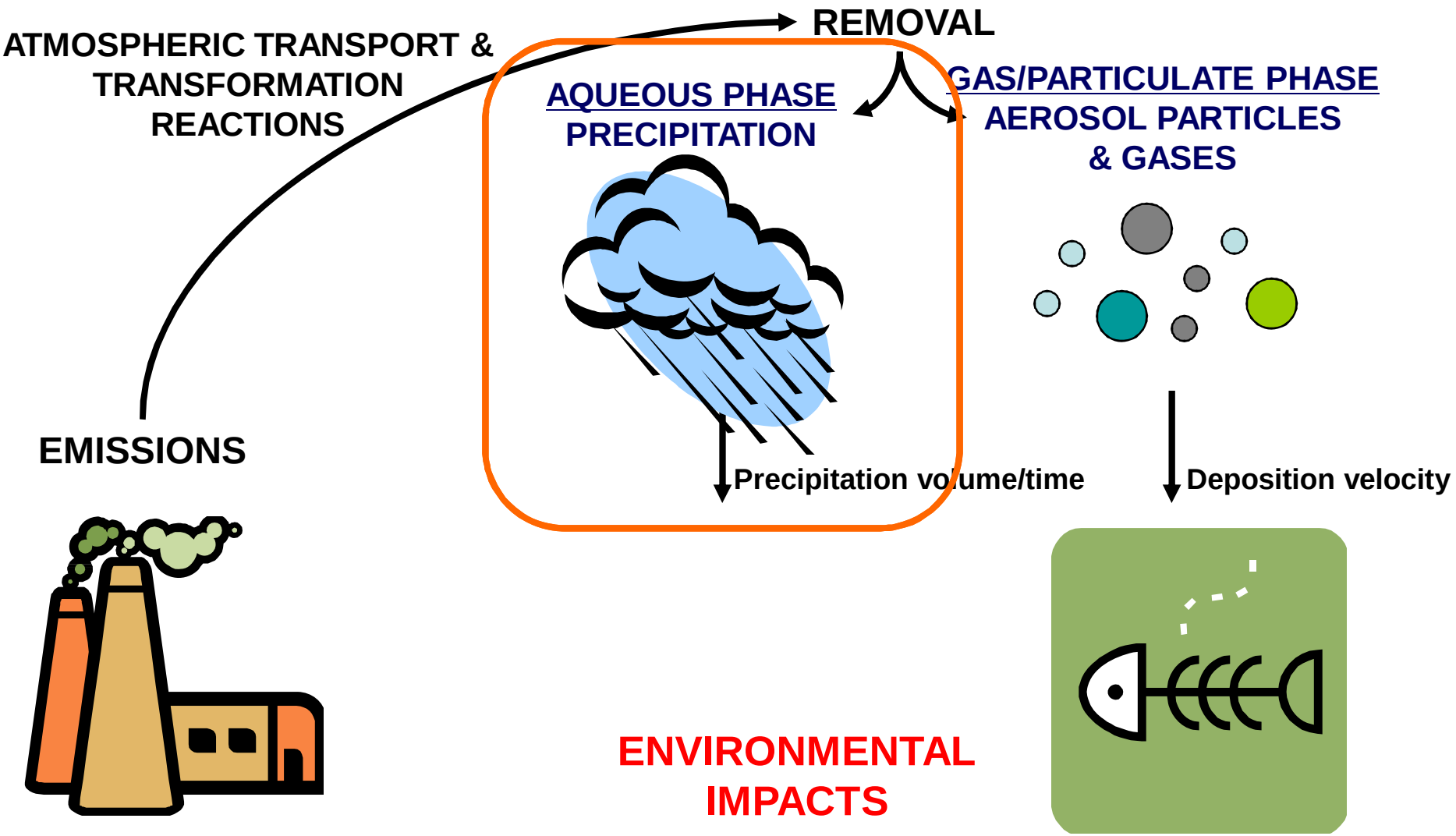
National Atmospheric Deposition Program
Illinois State Water Survey - Prairie Research Institute
University of Illinois, Urbana-Champaign

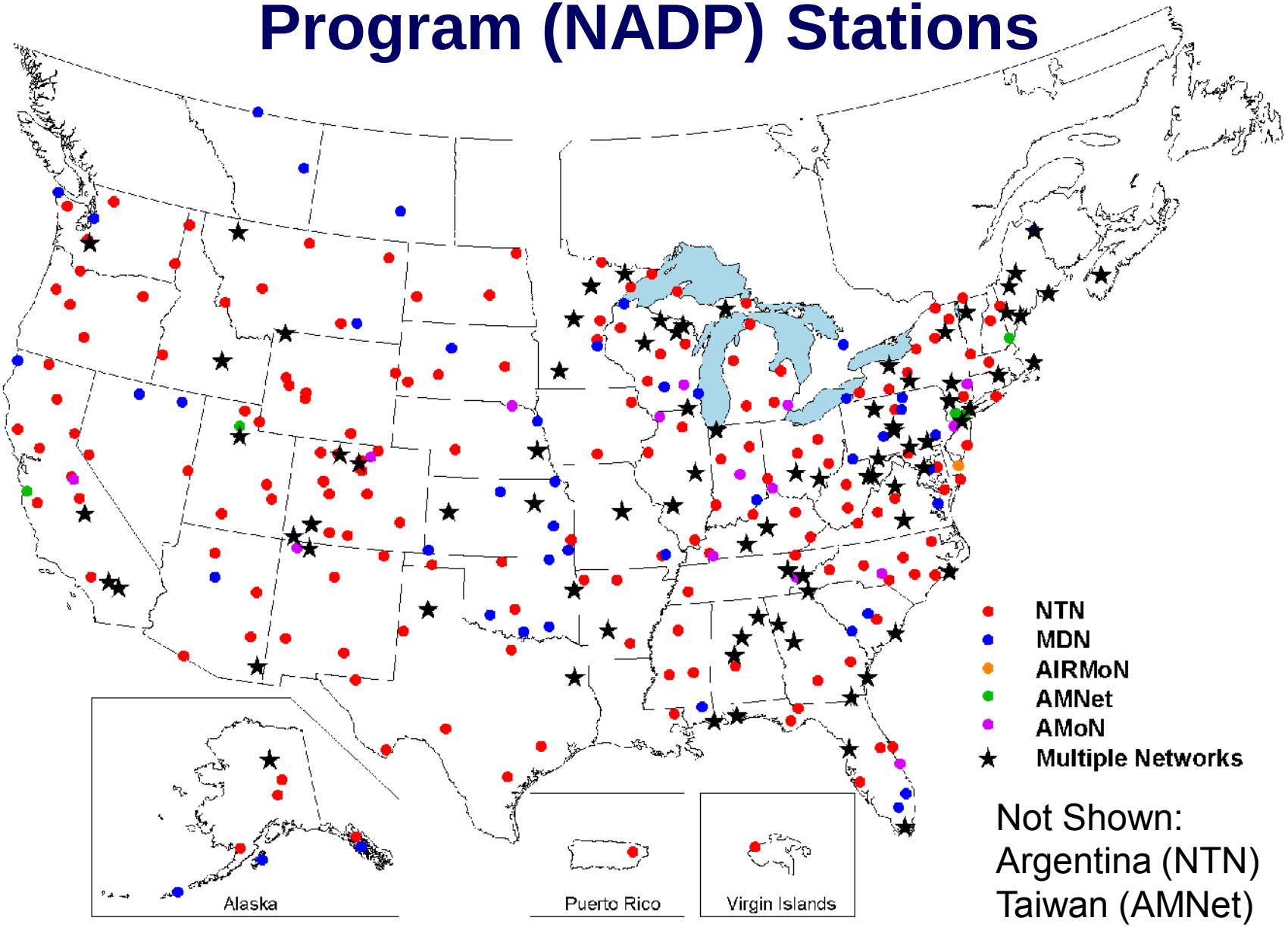
National Atmospheric Deposition Program

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Atmospheric Deposition



National Atmospheric Deposition Program (NADP) Stations



Not Shown:
Argentina (NTN)
Taiwan (AMNet)

Mission of the National Atmospheric Deposition Program (NADP)

- Provide data on the exposure of managed and natural ecosystems and cultural resources to acidic compounds, nutrients, mercury, and base cations in precipitation.
- Remain one of the nation's premier cooperative research support programs, serving science and education and supporting communication and informed decisions on air quality issues affecting ecosystems and human health.

A Cooperative Research Program

All decisions made by scientific consensus of supporting agencies and individuals

(equal vote, regardless of affiliation)

- Field Equipment
- Analytical Procedures
- Data Analysis

National Atmospheric Deposition Program

Some of our Funders

(100+ total agencies)

Federal Agency Members

Tribal Organizations

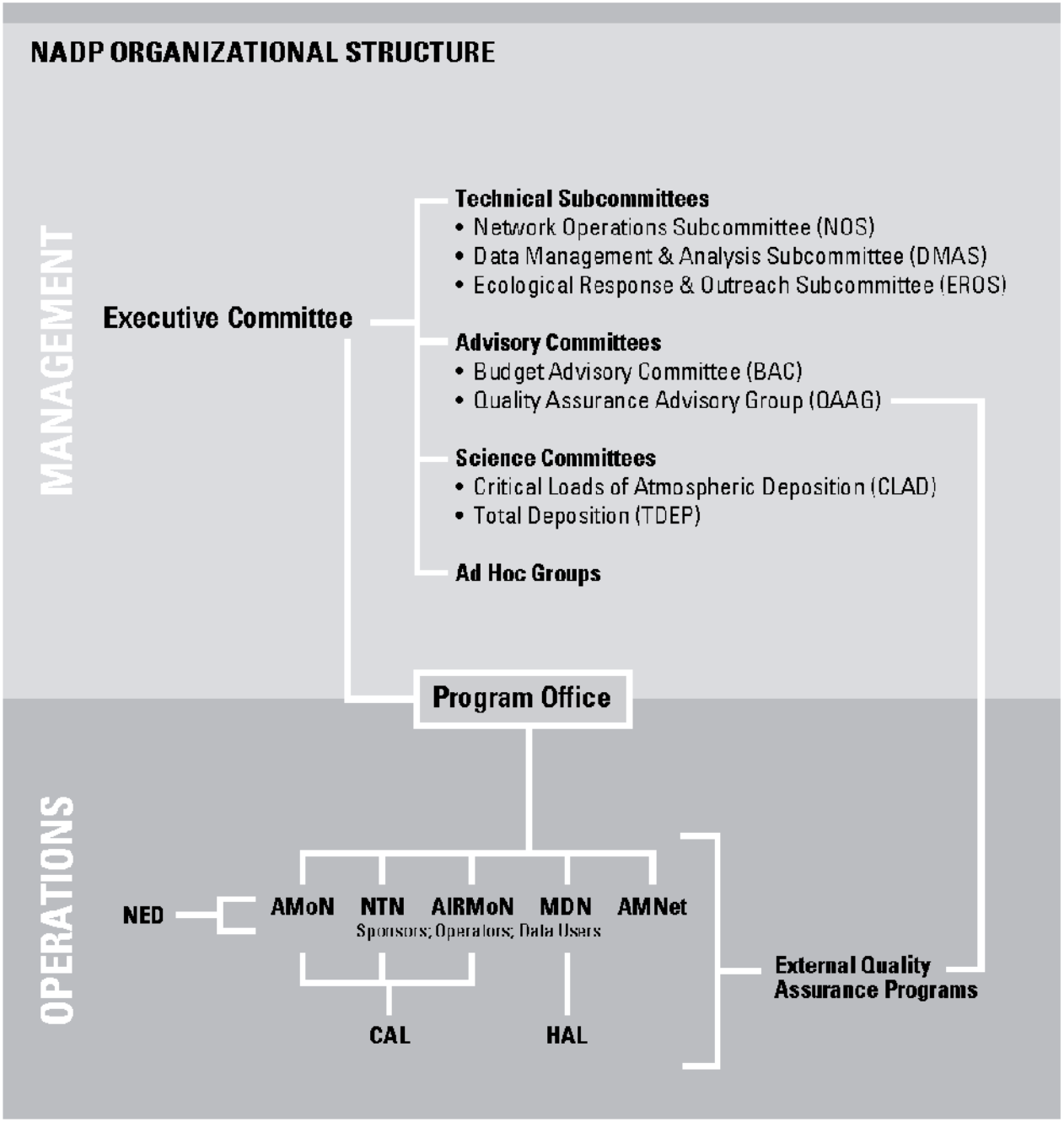
Universities

US States

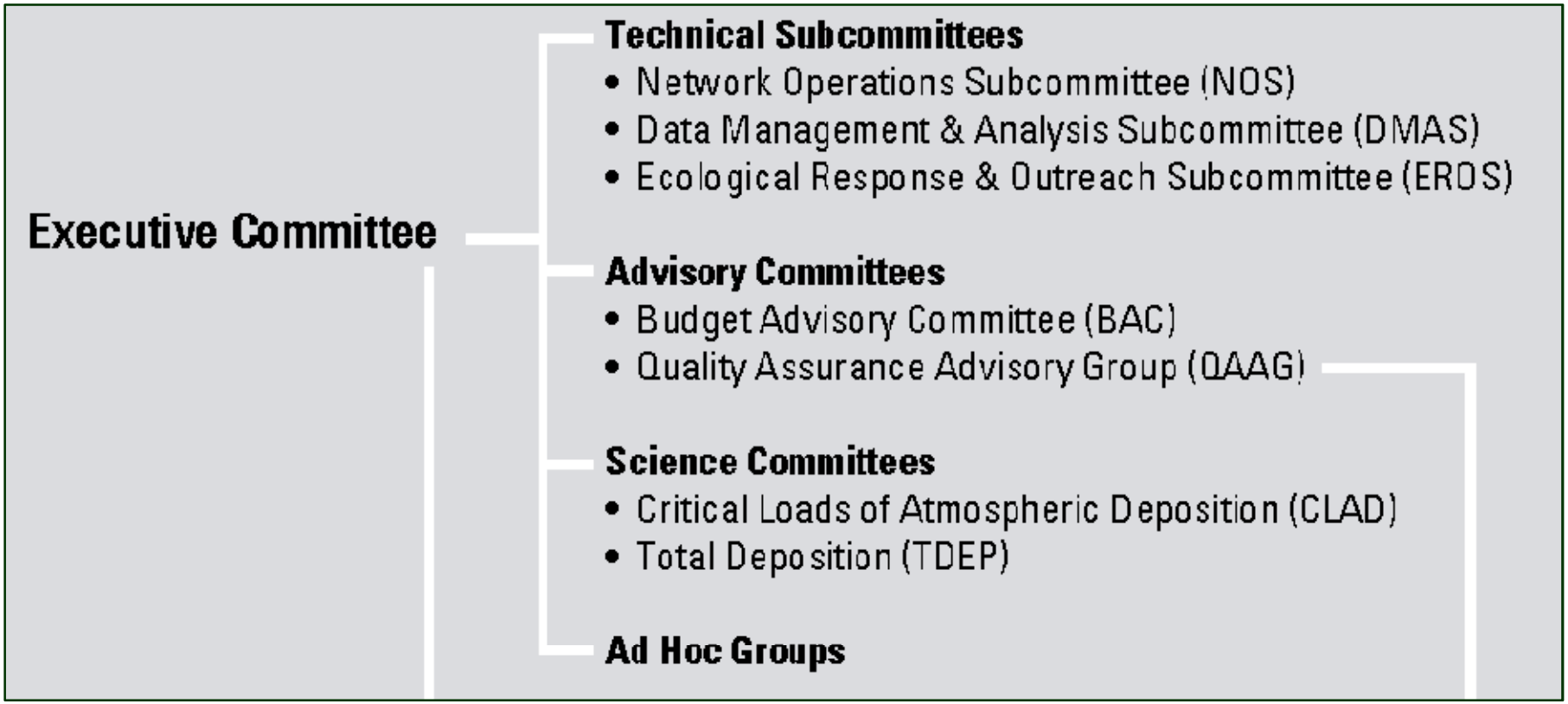
Other Organizations

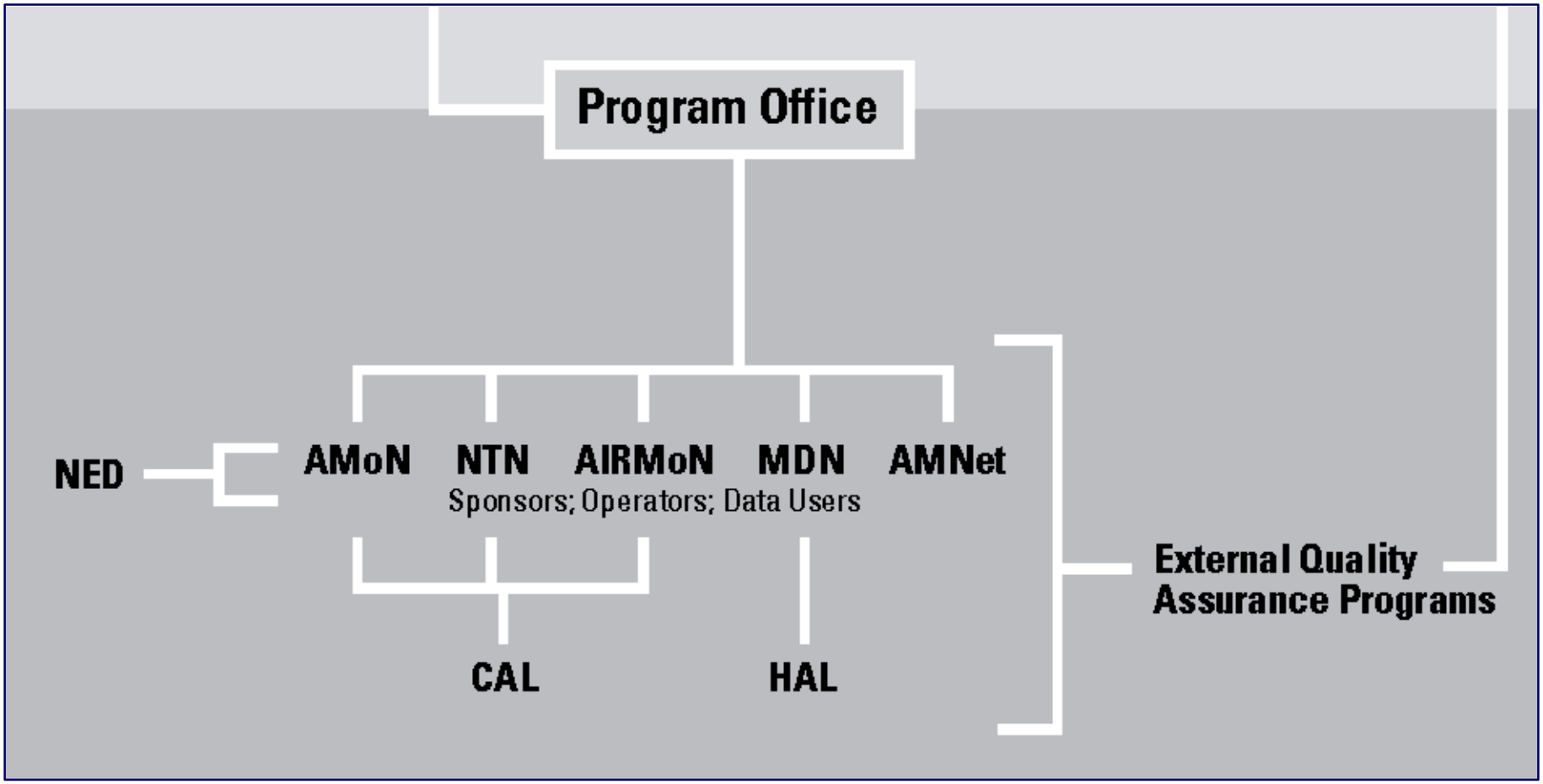
Lessons Learned…

1. Have a diversity of financial support



NADP Governance Handbook, 2012


Executive Committee
Technical Subcommittees
• Network Operations Subcommittee (NOS)
• Data Management & Analysis Subcommittee (DMAS)
• Ecological Response & Outreach Subcommittee (EROS)
Advisory Committees
• Budget Advisory Committee (BAC)
• Quality Assurance Advisory Group (QAAG)
Science Committees
• Critical Loads of Atmospheric Deposition (CLAD)
• Total Deposition (TDEP)
Ad Hoc Groups


Program Office
NED
AMoN
NTN
AIRMoN
MDN
AMNet
Sponsors; Operators; Data Users
CAL
HAL
External Quality Assurance Programs

Lessons Learned…

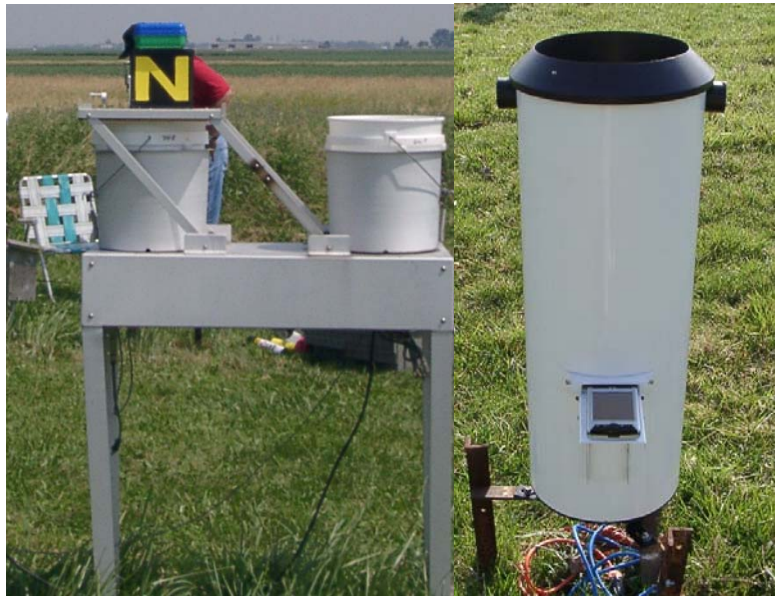
1. Have a diversity of financial support
2. Provide a means for stakeholders to contribute to (but not dominate) decision making

The NADP Networks (I)

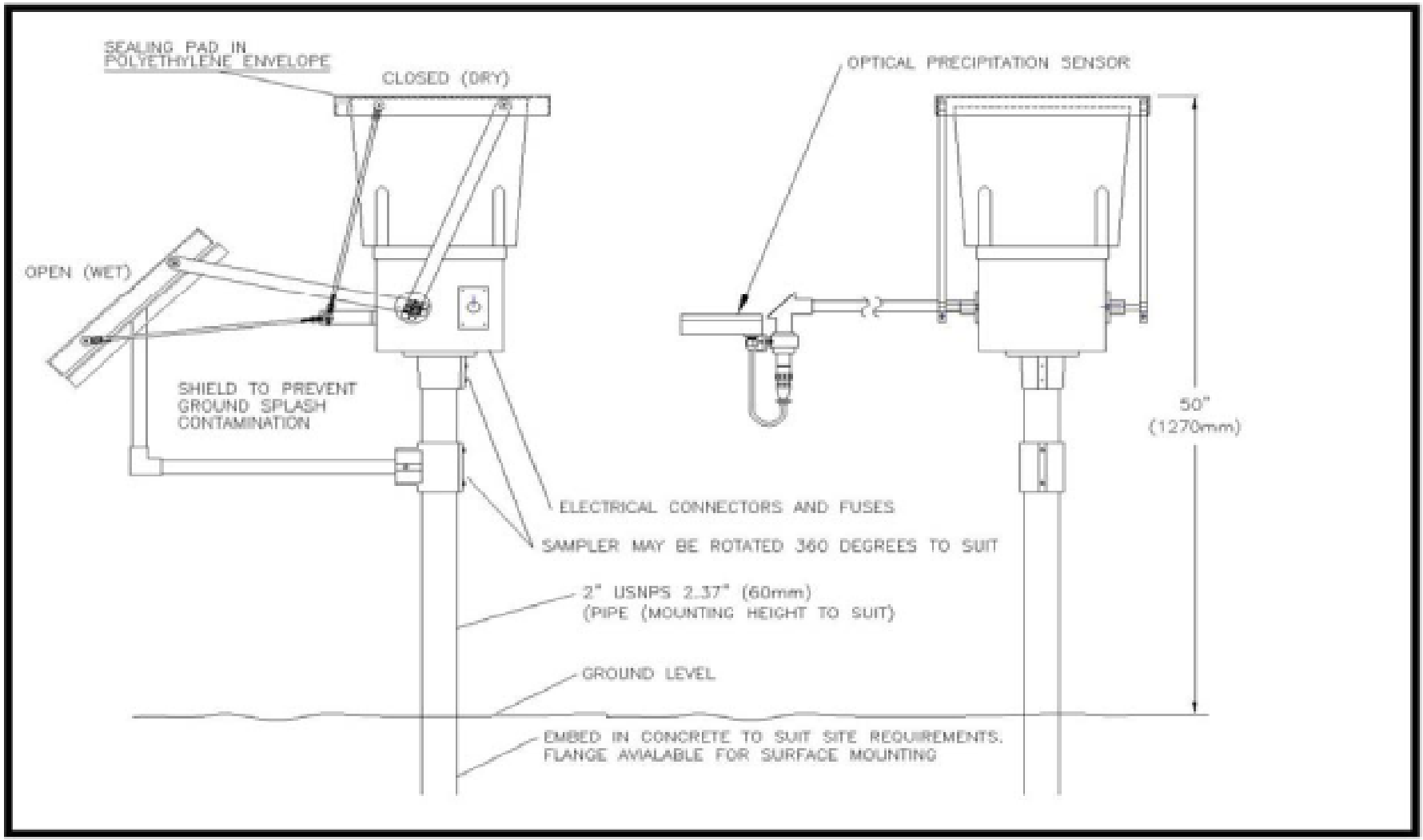
1. National Trends Network (NTN)
   - Major ions (cations, anions, pH, conductivity)
   - 258 sites + 2 QA
   - ~360,000 weekly samples since 1978

National Trends Network (NTN)

- Operators collect weekly wet deposition sample from NADP wet-dry collector
- Continuous precipitation record
- Chemical Analysis
  - Acids (SO_4^{2-}, NO_3^-, Cl^-, Br^-)
  - Bases (Ca^{2+}, Mg^{2+}, K^+, Na^+)
  - Nutrients (NH_4^+, PO_4^{3-})
  - pH
  - Specific Conductivity



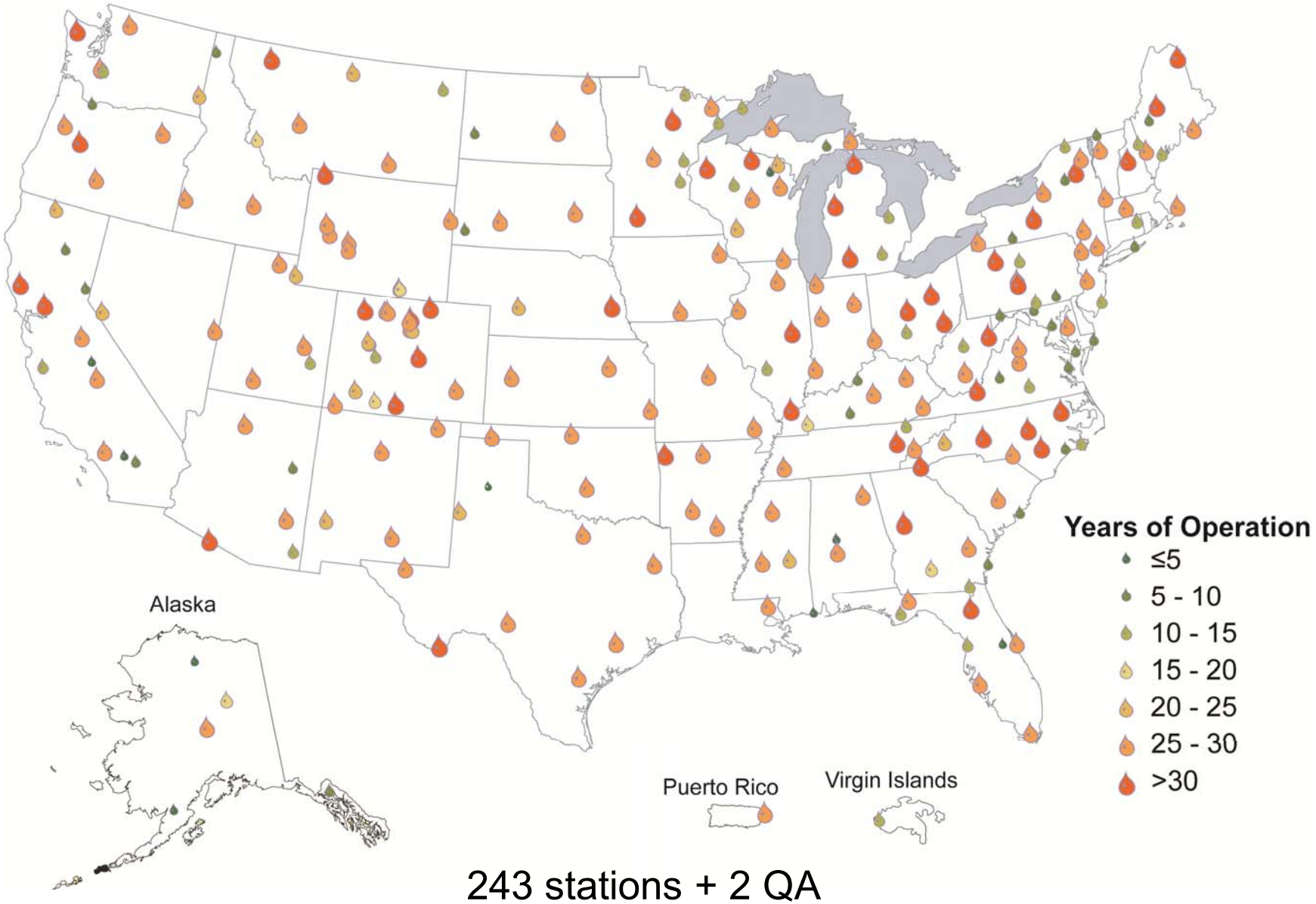
N-CON Systems Wet Deposition Collector


SEALING PAD IN POLYETHYLENE ENVELOPE
CLOSED (DRY)
OPTICAL PRECIPITATION SENSOR
OPEN (WET)
SHIELD TO PREVENT GROUND SPLASH CONTAMINATION
50"
(1270mm)
ELECTRICAL CONNECTORS AND FUSES
SAMPLER MAY BE ROTATED 360 DEGREES TO SUIT
2" USNPS 2.37" (60mm)
(PIPE (MOUNTING HEIGHT TO SUIT)
GROUND LEVEL
EMBED IN CONCRETE TO SUIT SITE REQUIREMENTS.
FLANGE AVIALABLE FOR SURFACE MOUNTING

NTN NV05
Great Basin National Park

NTN IL11
Bondville, IL

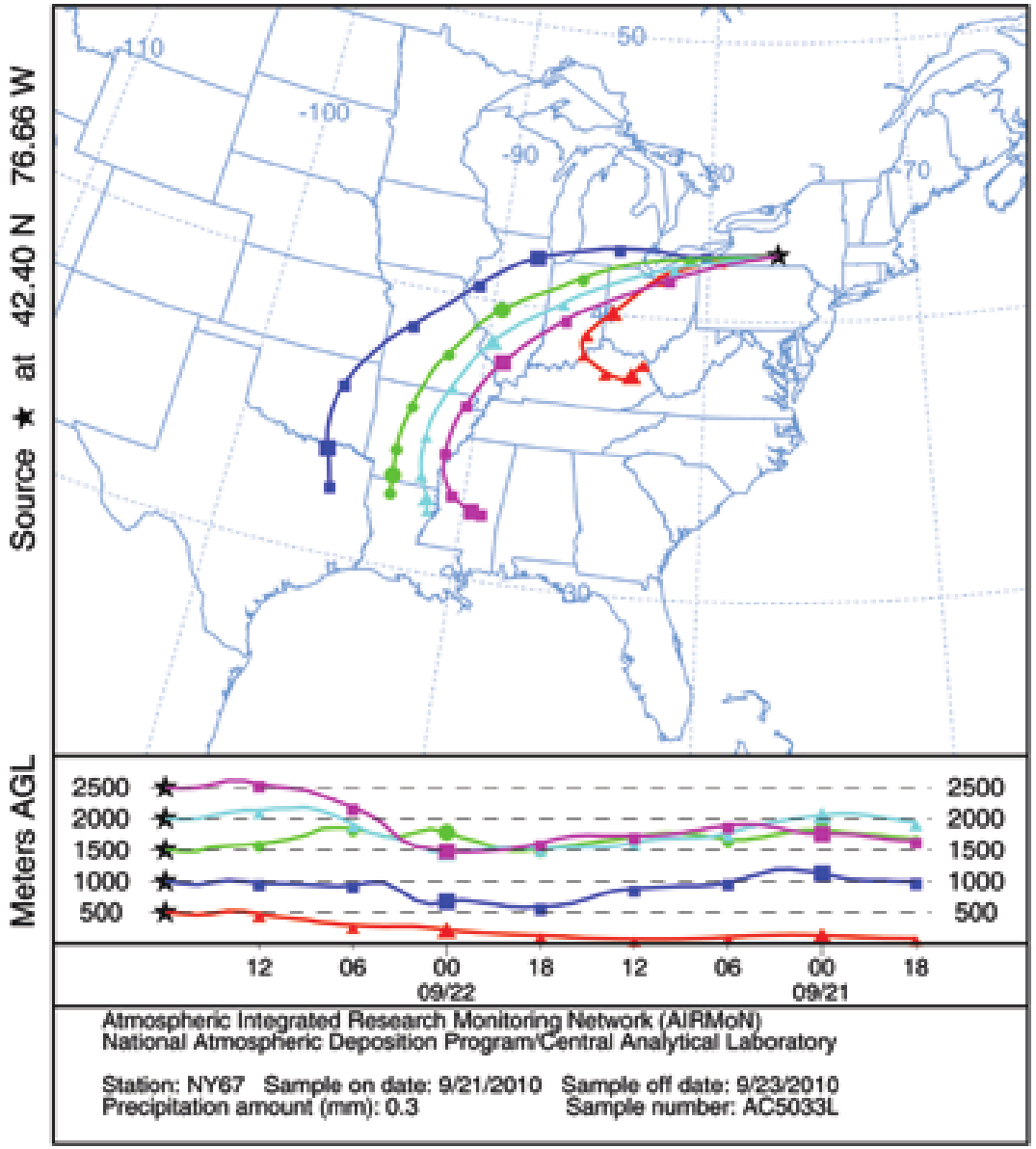
National Trends Network (NTN)



243 stations + 2 QA

The NADP Networks (I)

1. National Trends Network (NTN)
   - Major ions (cations, anions, pH, conductivity)
   - 258 sites + 2 QA
   - ~360,000 weekly samples since 1978
2. Atmospheric Integrated Research Monitoring Network (AIRMoN)
   - Major ions (cations, anions, pH, conductivity)
   - Refrigerated event samples
   - 7 sites; ~25,000 samples since 1992



Example back trajectories from the NOAA/HYSPLIT model.

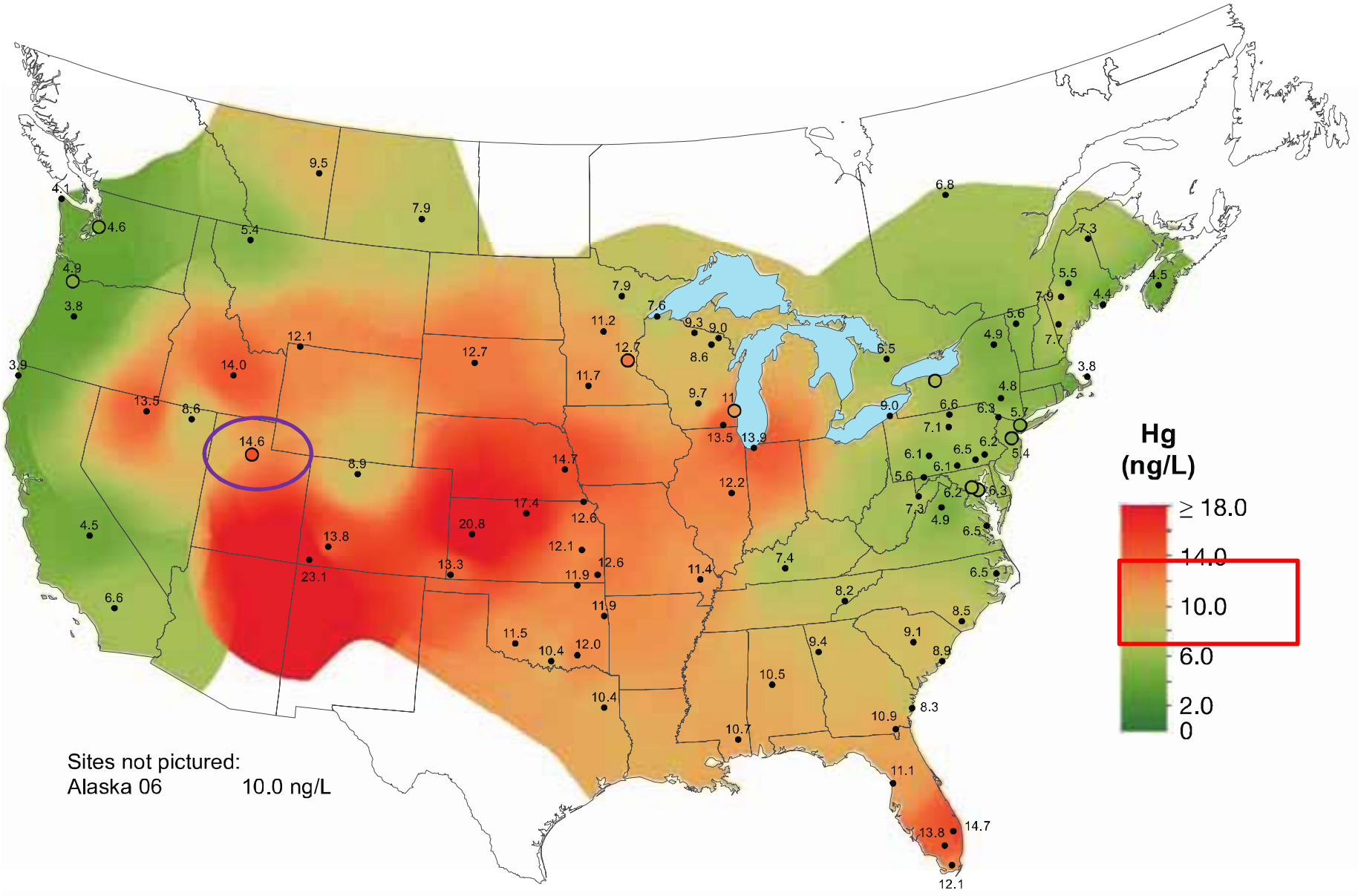
The NADP Networks (II)

3. Mercury Deposition Network (MDN)
   - Mercury, methyl mercury concentrations
   - 106 sites; ~56,000 samples since 1996
4. Atmospheric Mercury Monitoring Network (AMNet)
   - Gas-phase speciated mercury concentrations
   - 23 sites; hourly data since 2006

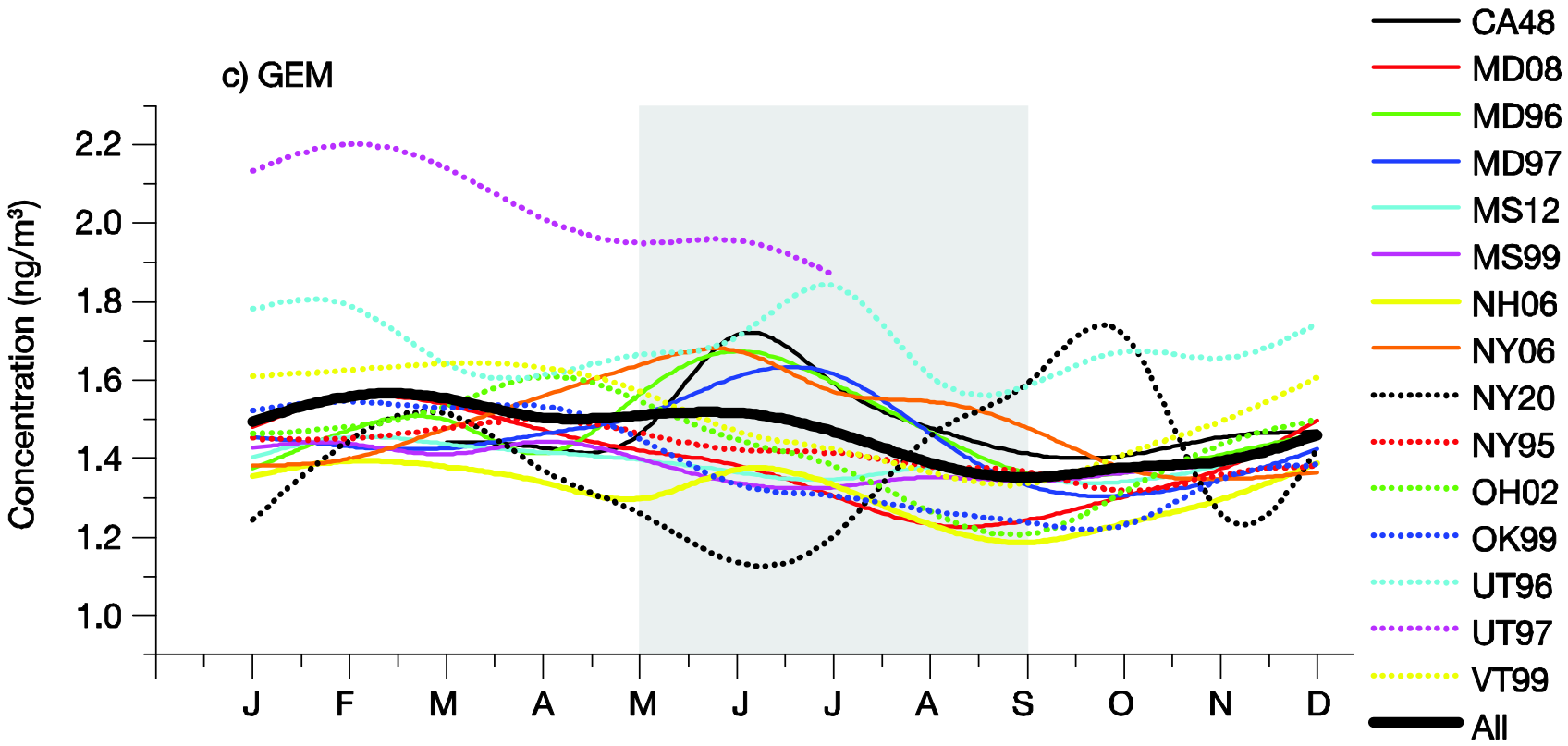

MDN43

Atmospheric Mercury Monitoring Network (AMNet)

Total Mercury Concentration in Precipitation, 2010



Total Mercury Concentration in Precipitation, 2010



The NADP Networks (III)

5. Ammonia Monitoring Network (AMoN)
   - Atmospheric ammonia concentrations
   - 54 sites; ~3,200 samples since 2007

Ammonia Monitoring Network (AMoN)

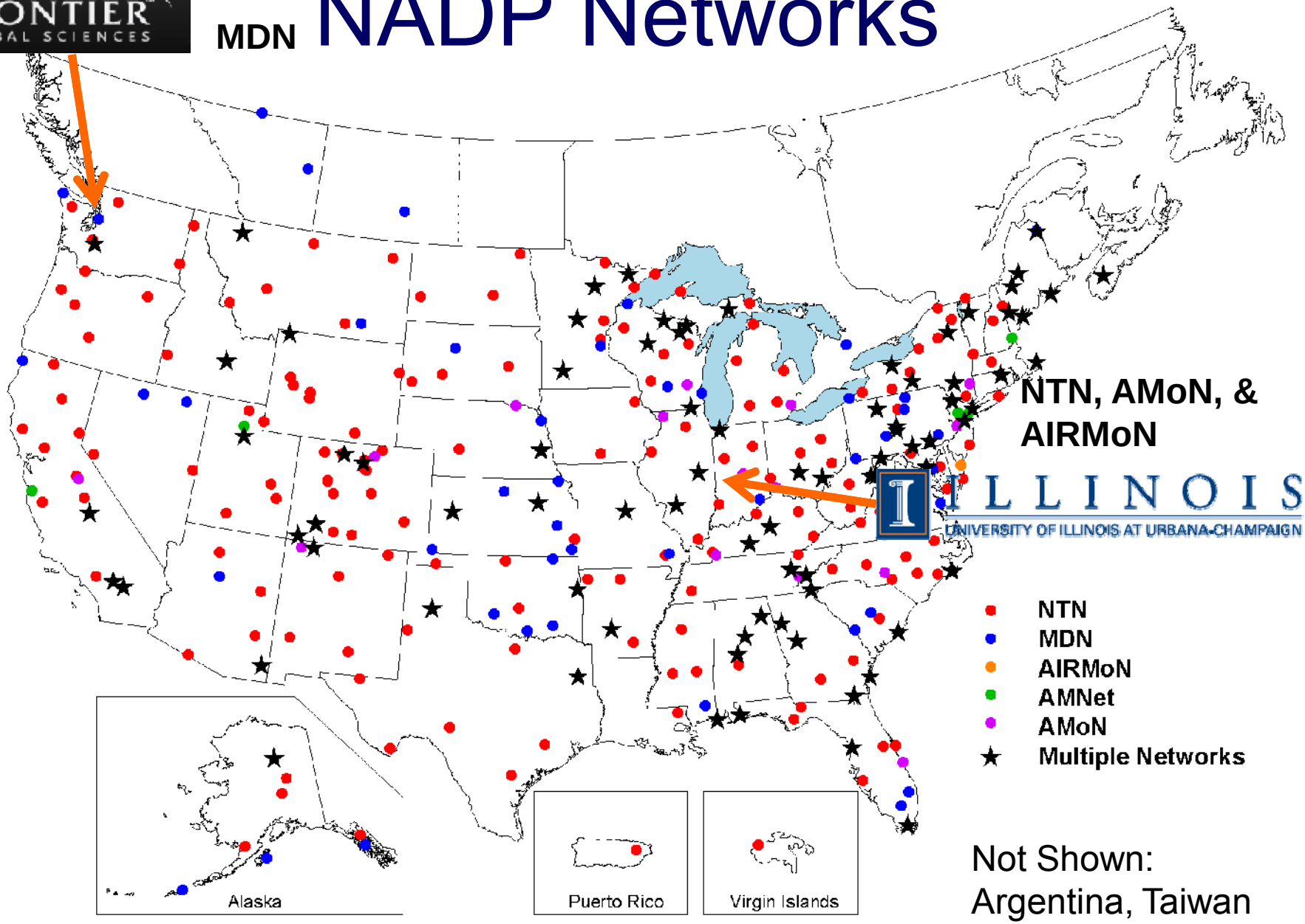
Routt County, Colorado (3234 m)

Boulder County, Colorado (3520 m)

Lessons Learned…

1. Have a diversity of financial support
2. Provide a means for stakeholders to contribute to (but not dominate) decision making
3. Actively engage and support field site personnel

MDN NADP Networks



Central Analytical Laboratory Team

Supplies

Supplies

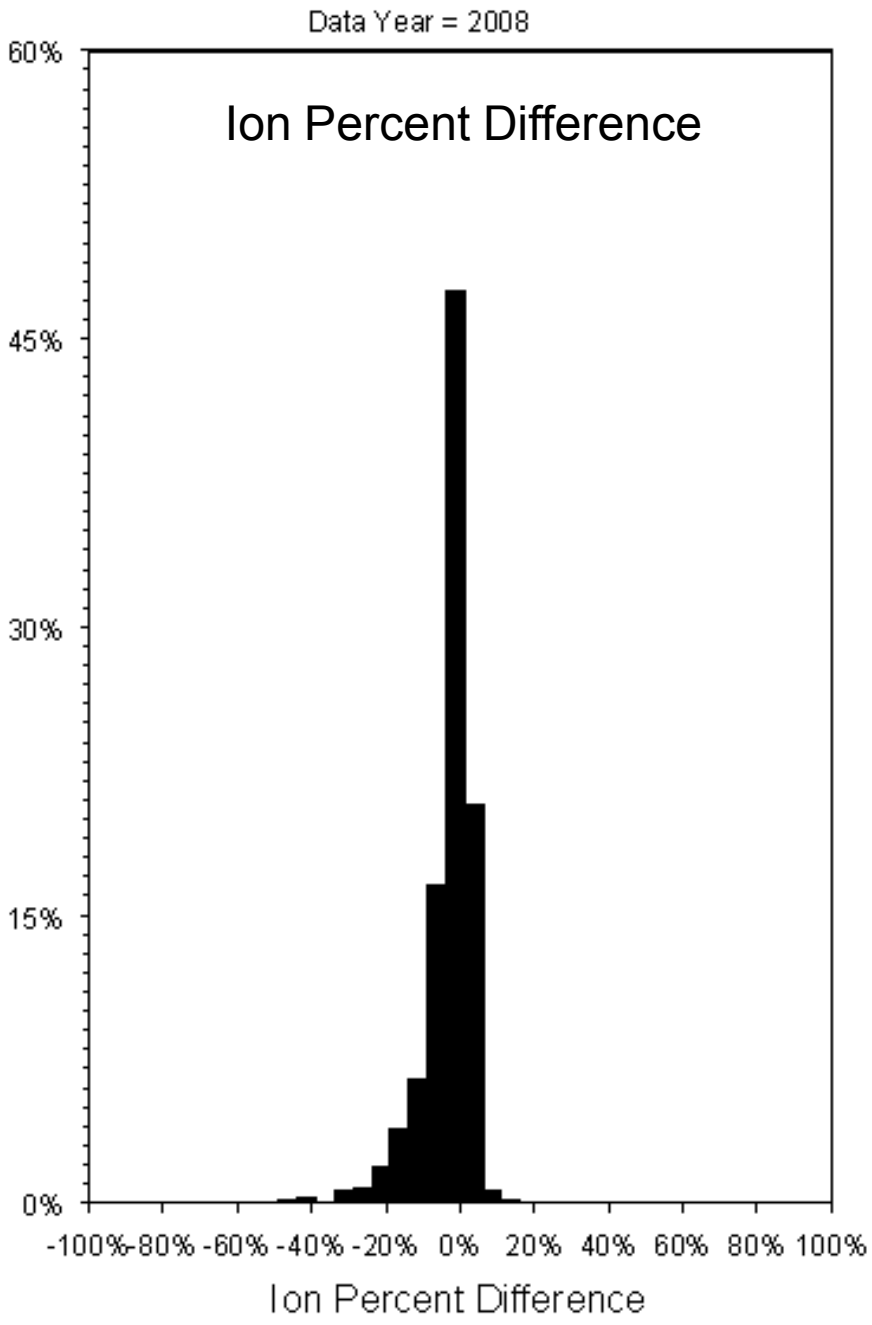

Thermo
Forma
Laboratory Washer
Thermo
Forma
Laboratory Washer

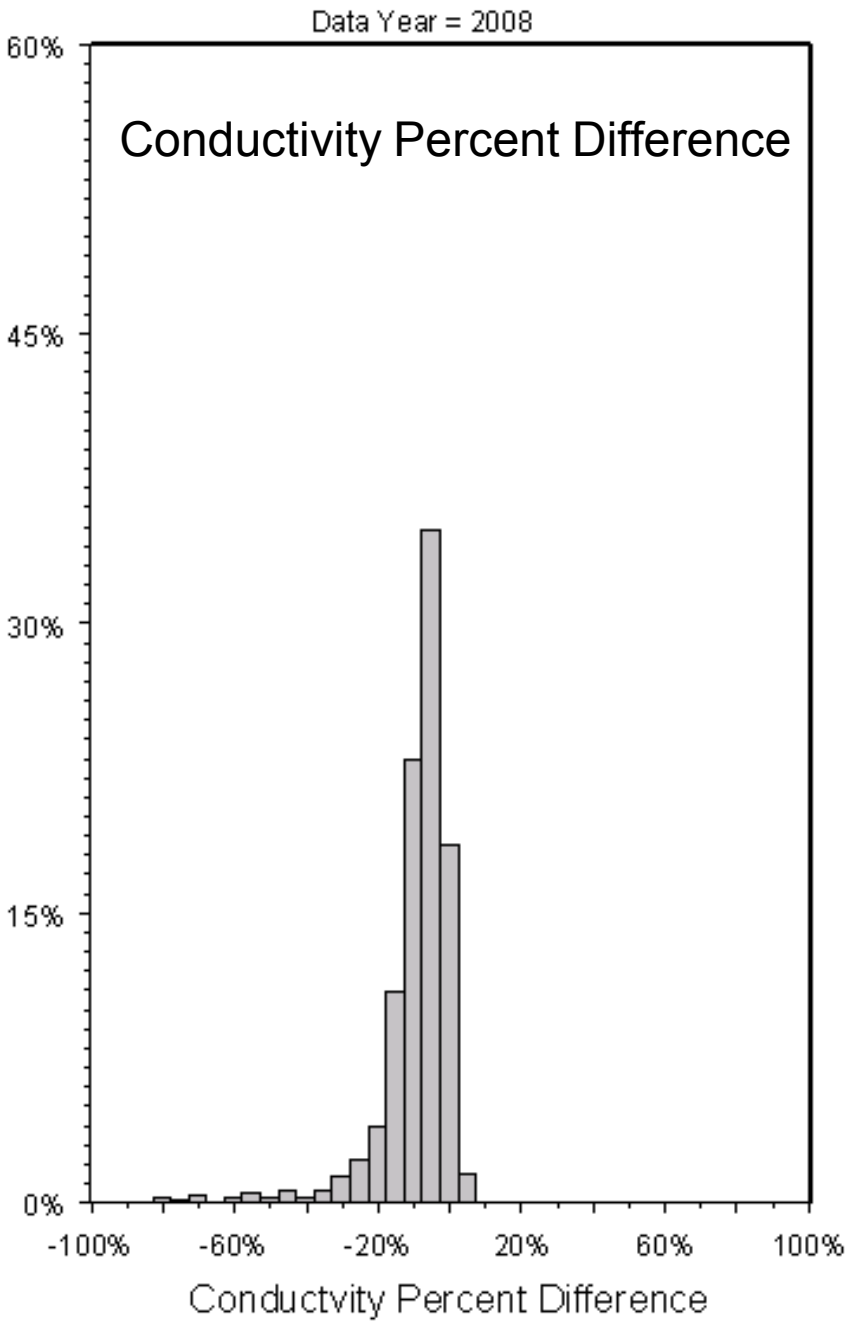
Supplies

Lessons Learned…

1. Have a diversity of financial support
2. Provide a means for stakeholders to contribute to (but not dominate) decision making
3. Actively engage and support field site personnel
4. Have one central analytical laboratory for all supplies and analyses

Quality Assurance & Site Support


Data Year = 2008
Ion Percent Difference
60%
45%
30%
15%
0%
-100% -80% -60% -40% -20% 0% 20% 40% 60% 80% 100%
Ion Percent Difference

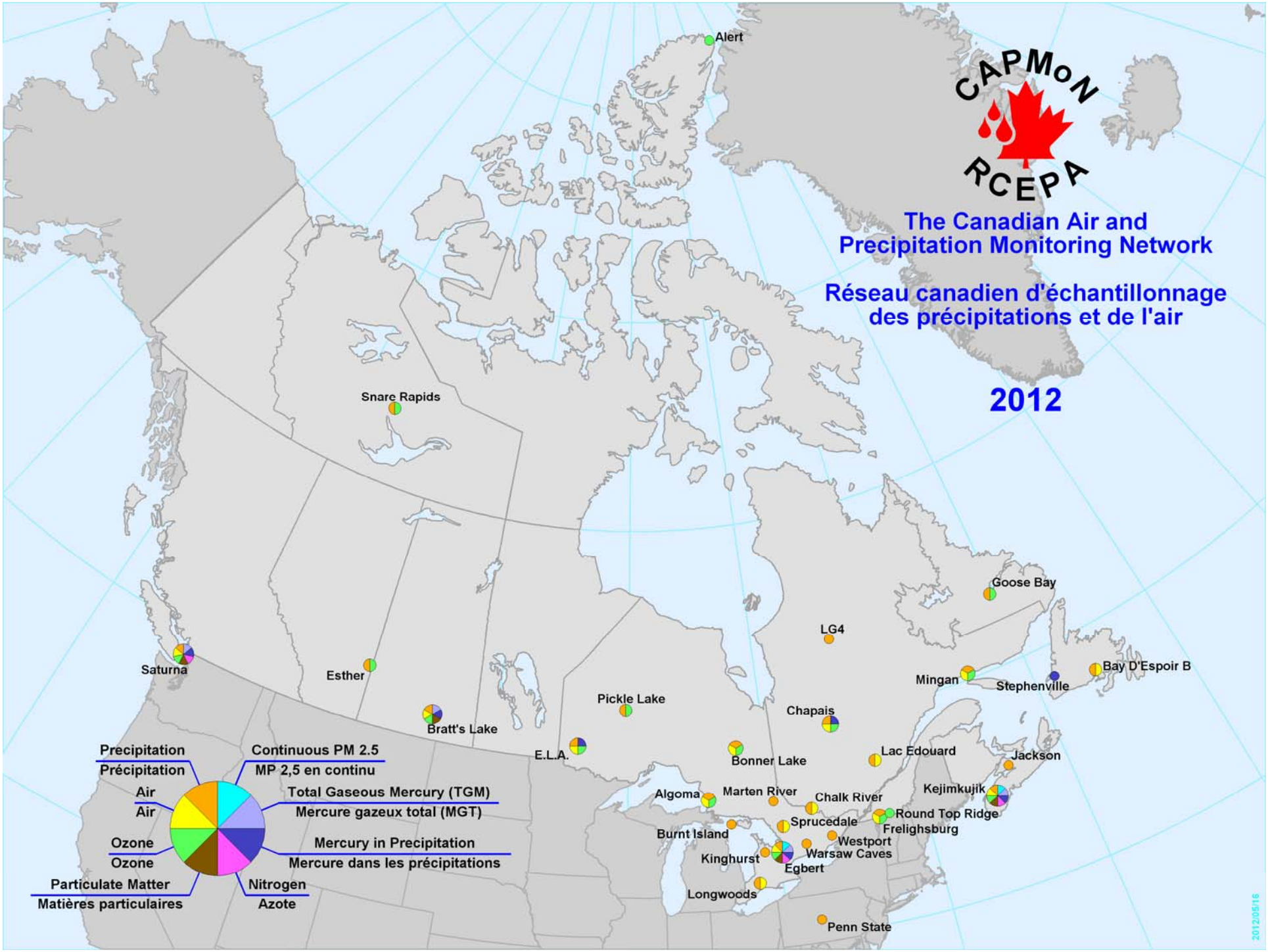

Data Year = 2008
Conductivity Percent Difference
60%
45%
30%
15%
0%
-100% -60% -20% 20% 60% 100%
Conductvity Percent Difference

Quality Assurance & Intercomparisons

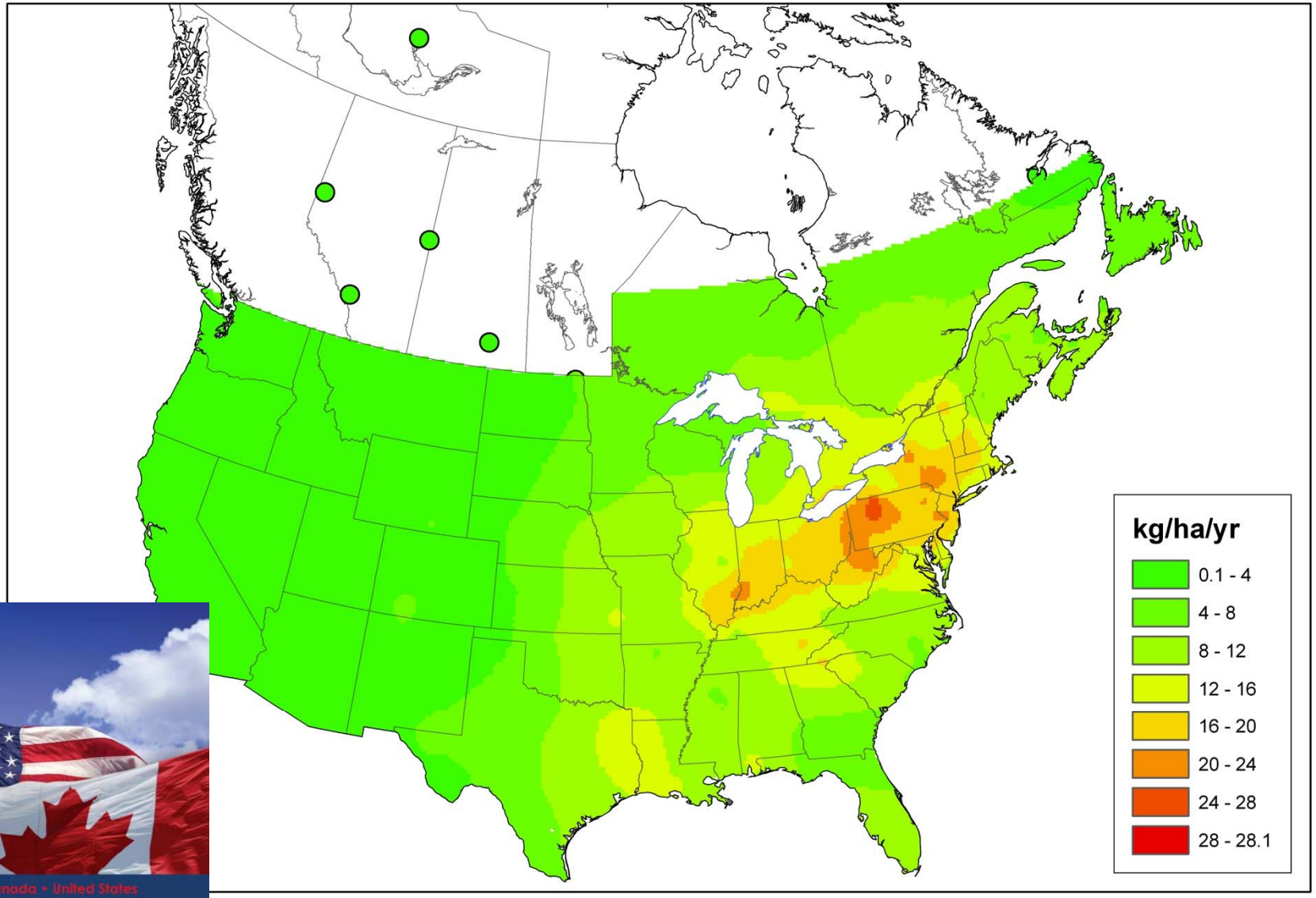
Study Identifier	Managing Agency	Details and Results
Interlaboratory Comparison Program	U.S. Geological Survey	http://bqs.usgs.gov/precip/interlab_overview.php
Study 43 and 44	World Meteorological Organization/Global Atmospheric Watch (WMO/GAW)	http://www.qasac-americas.org/
Study 96 and 97	Environment Canada Proficiency Testing Program	Available upon request
Study 27	Norwegian Institute for Air Research (NILU)	Available upon request

Lessons Learned…

5. Emphasize that quality results are the highest priority


CAPMoN
RCEPA
The Canadian Air and Precipitation Monitoring Network
Réseau canadien d'échantillonnage des précipitations et de l'air
2012
Alert
Snare Rapids
Saturna
Esther
Bratt's Lake
Pickle Lake
E.L.A.
LG4
Chapais
Bonner Lake
Goose Bay
Mingan
Stephenville
Bay D'Espoir B
Lac Edouard
Jackson
Kejimkujik
Algoma
Marten River
Chalk River
Sprucedale
Round Top Ridge
Frelighsburg
Burnt Island
Westport
Warsaw Caves
Kinghurst
Egbert
Longwoods
Penn State
Precipitation
Précipitation
Air
Air
Ozone
Ozone
Particulate Matter
Matières particulaires
Continuous PM 2.5
MP 2,5 en continu
Total Gaseous Mercury (TGM)
Mercure gazeux total (MGT)
Mercury in Precipitation
Mercure dans les précipitations
Nitrogen
Azote
2012/05/16

2007 $nssSO_4^{2-}$ Wet Deposition (kg/ha/yr)



Canada-United States Air Quality Agreement: Progress Report, 2010

Cooperation with Canadian Air and Precipitation Monitoring Network (CAPMoN)

- Two long-term inter-comparision sites:
  - Frelighsburg, Que. (Since 2001)
  - Penn State University (Since 1986)
- NADP contributes data to the Canadian National Atmospheric Chemistry (NAtChem) database to evaluate N. American wet deposition.
- Ongoing support of NADP/Mercury Deposition Network Sites

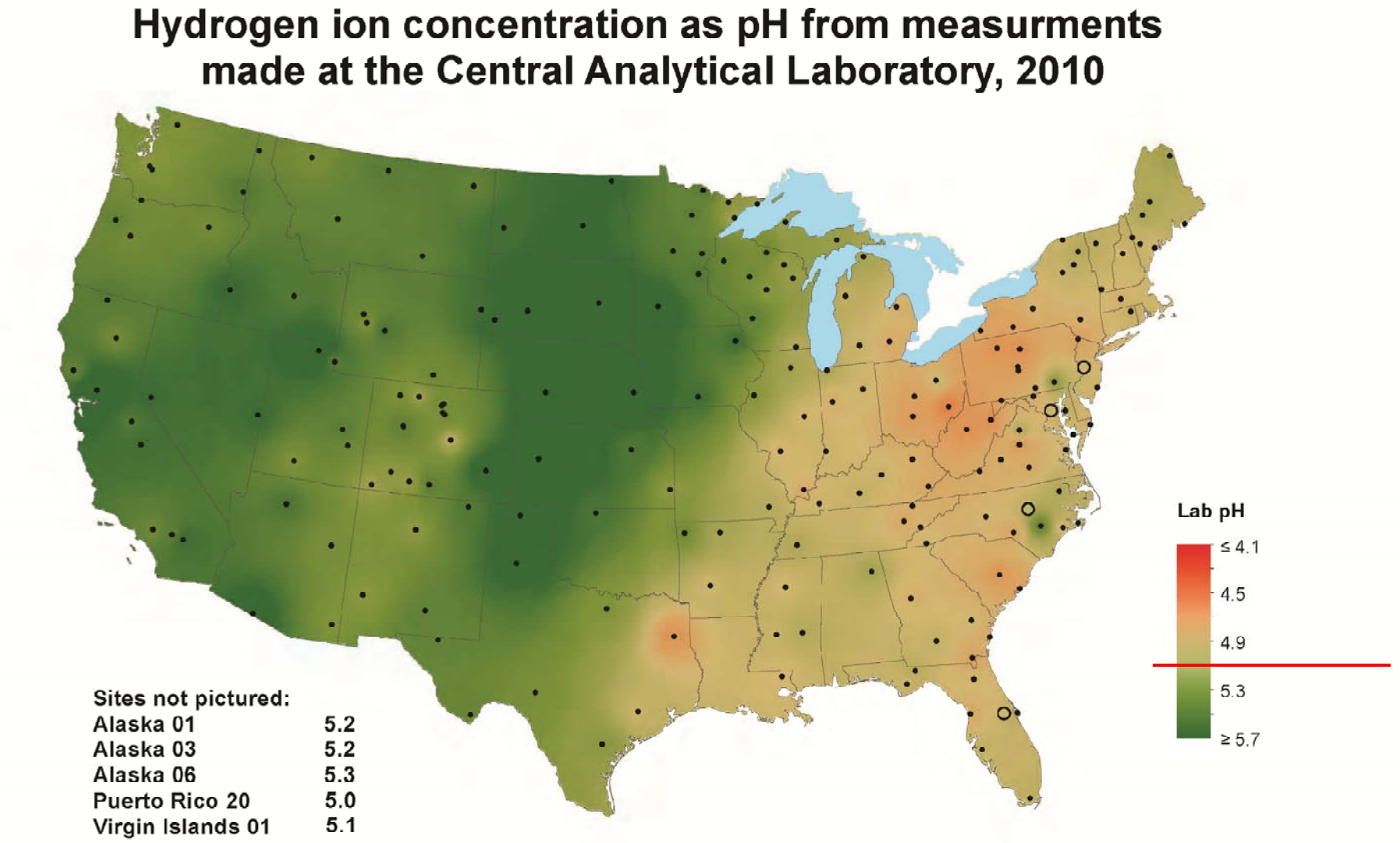
Lessons Learned…

5. Emphasize that quality results are the highest priority
6. Cooperate and collaborate with neighboring regions/jurisdictions

What trends do we see in our data?

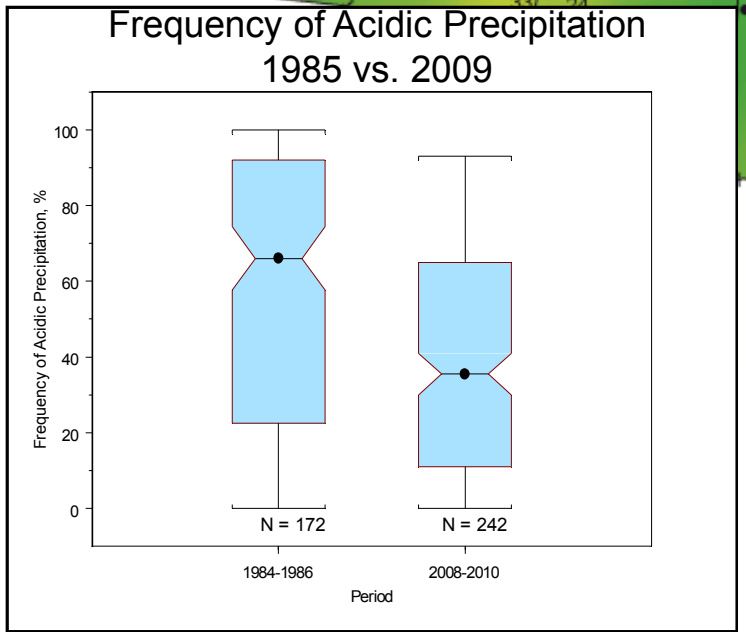
NADP/National Trends Network

Is “Acid Rain” still an issue for the US?



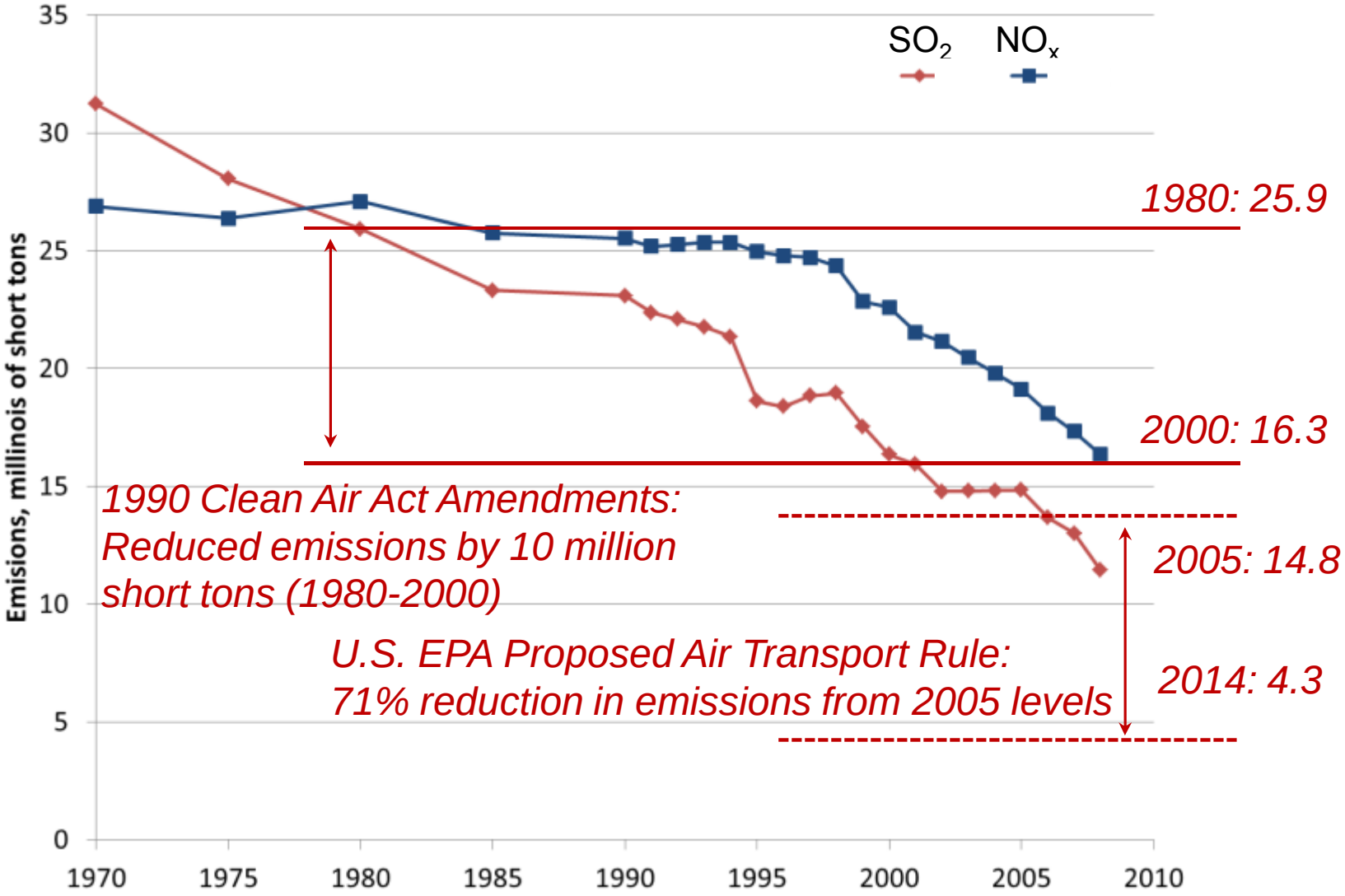
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Frequency of Acidic Precipitation, 2009



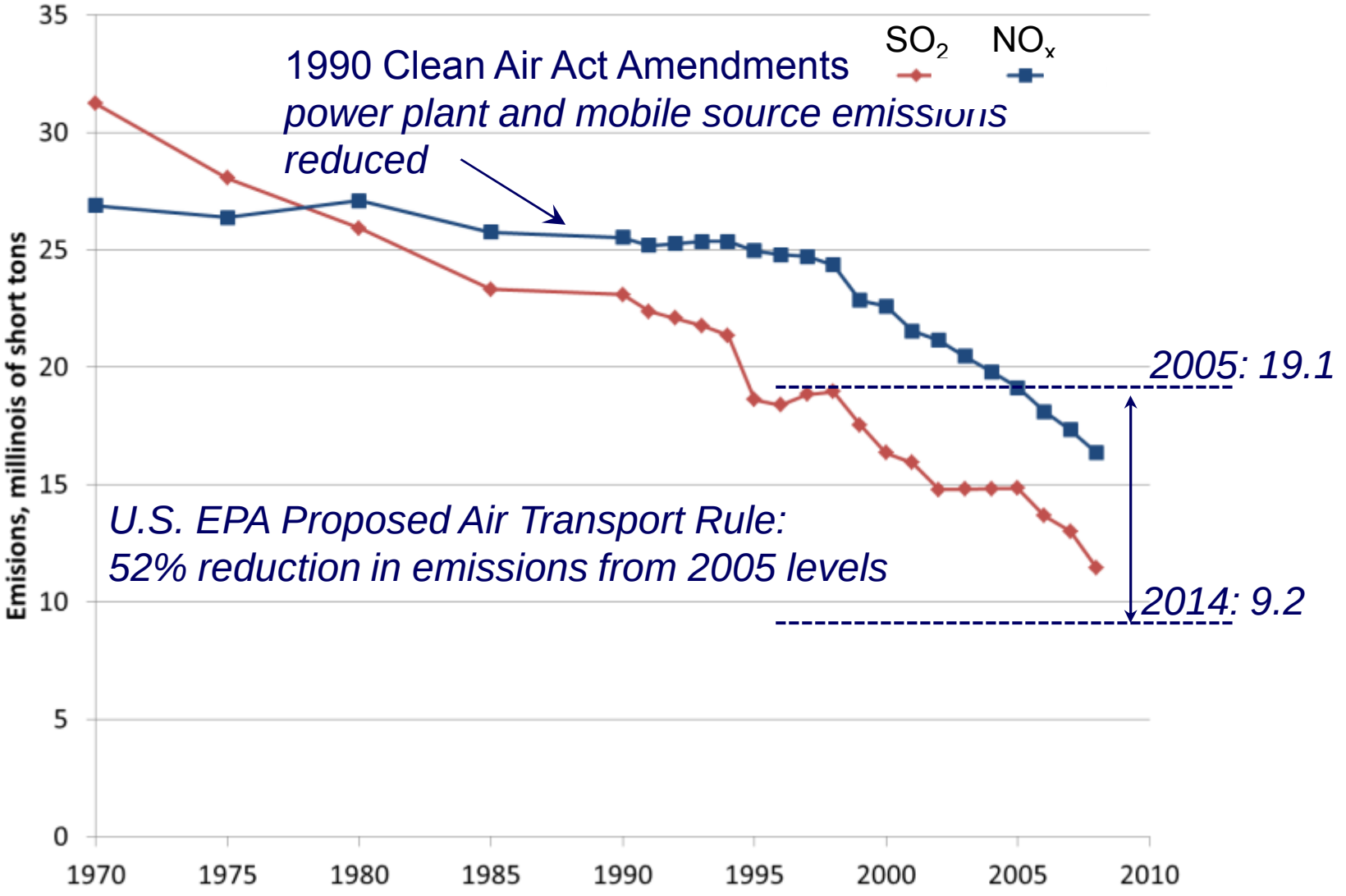
includes all valid samples
2008 - 2010

Trends in US Emissions



Source: U.S. EPA

Trends in US Emissions



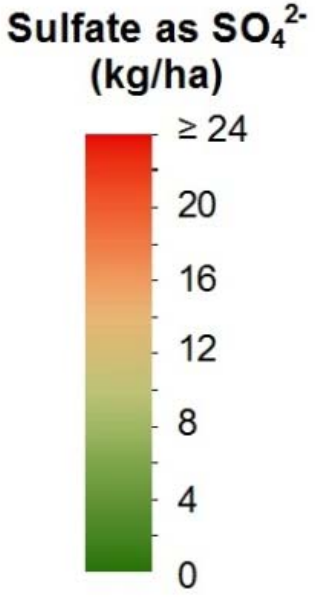
Source: U.S. EPA

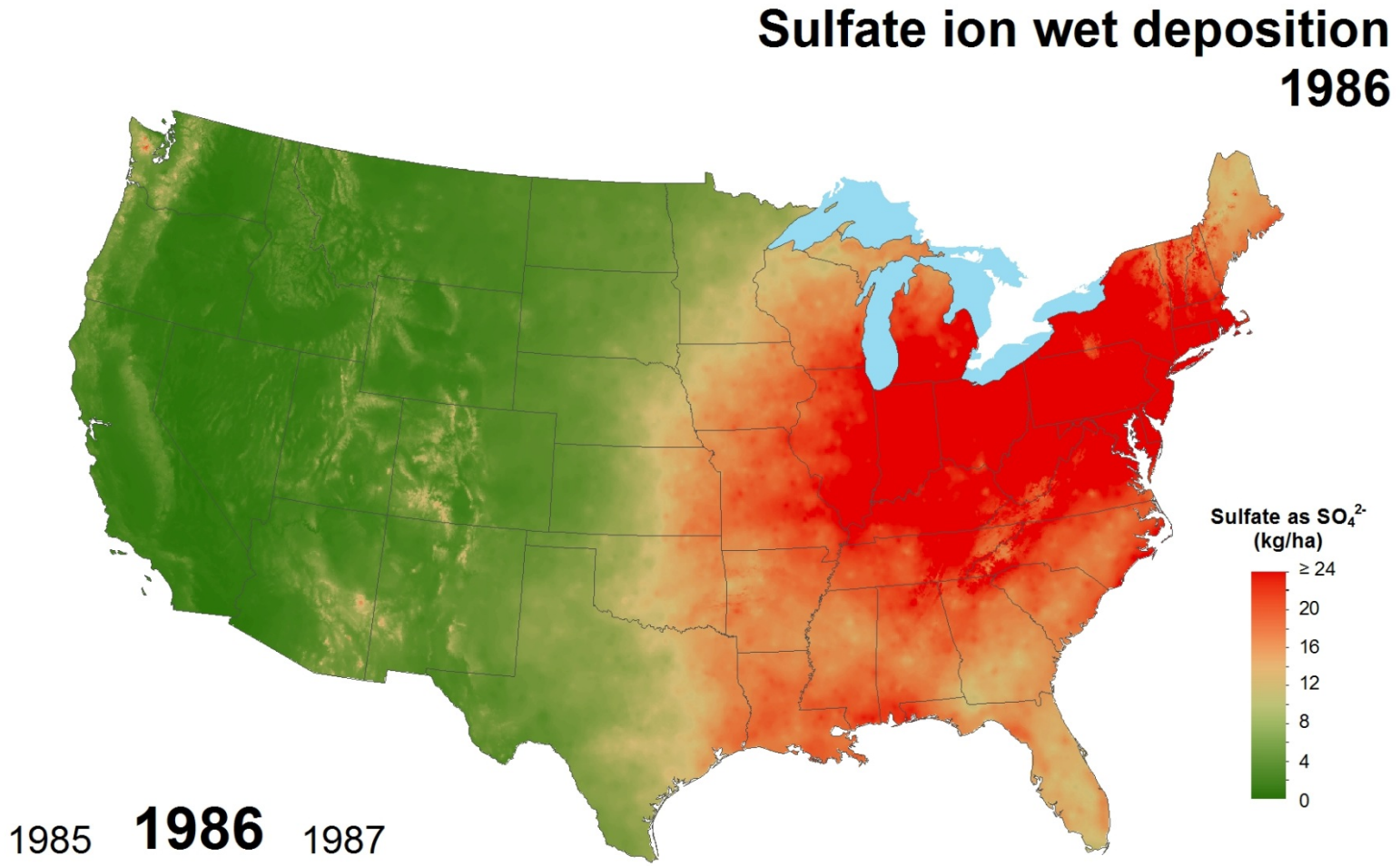
Lessons Learned…

7. Strive to maintain consistency to facilitate evaluation of long-term trends…

Sulfate Ion
Wet Deposition Trends

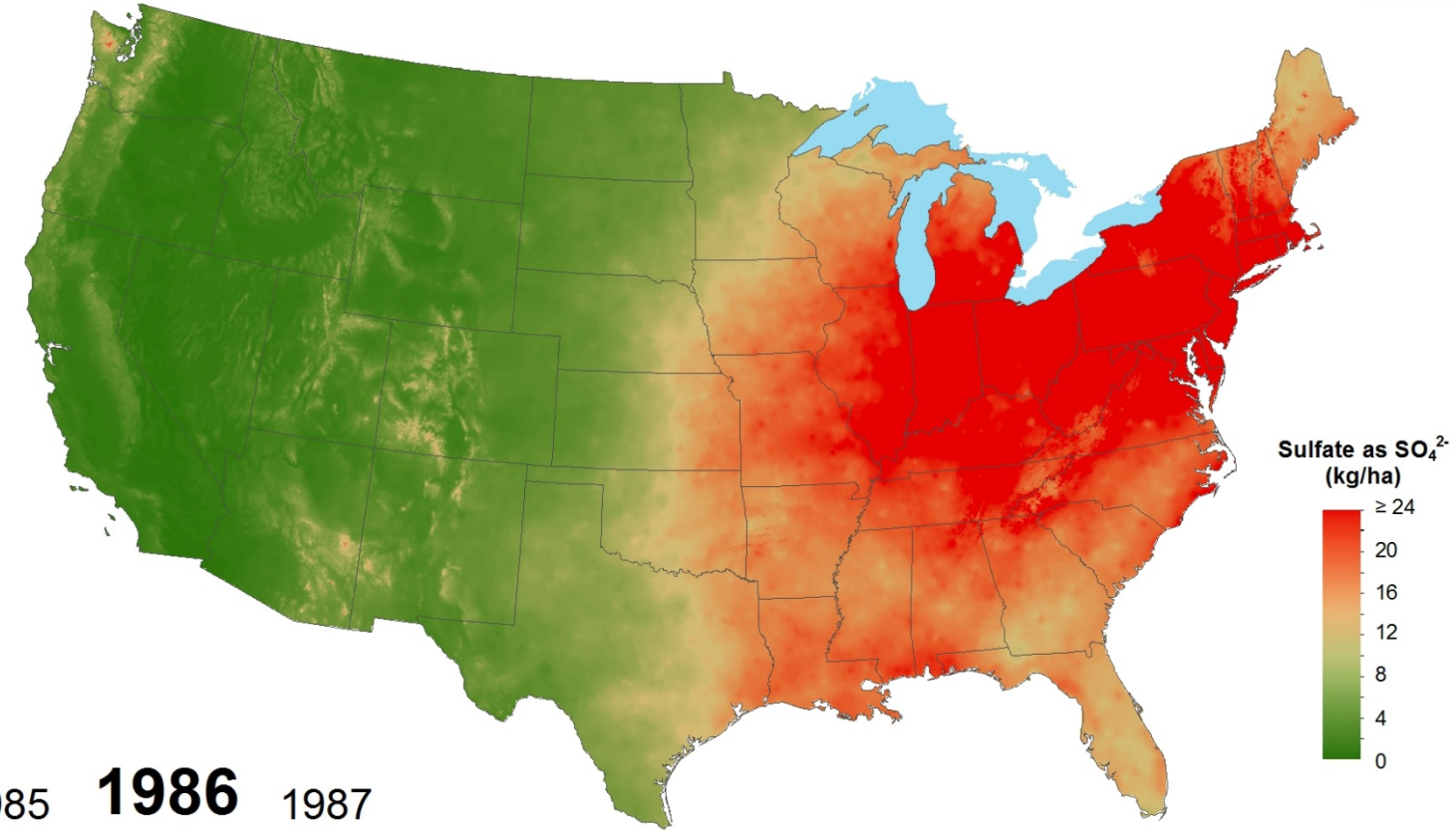
3-year running
annual average
(1985 – 2010)





Wet deposition is calculated by augmenting NADP's precipitation data with PRISM (Parameter-elevation Regressions on Independent Slopes Model) data set.

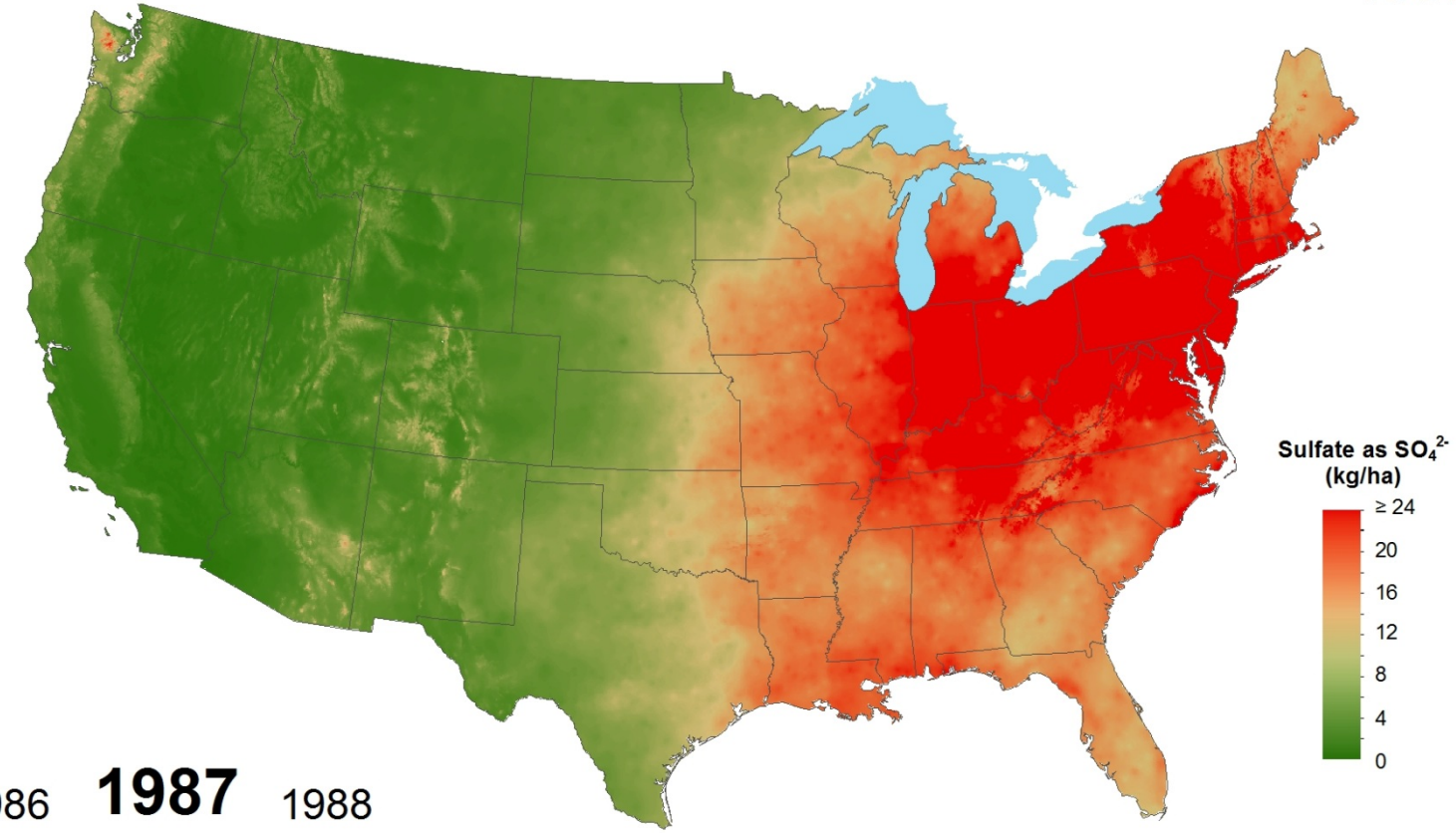
Sulfate ion wet deposition
1986



1985 **1986** 1987

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

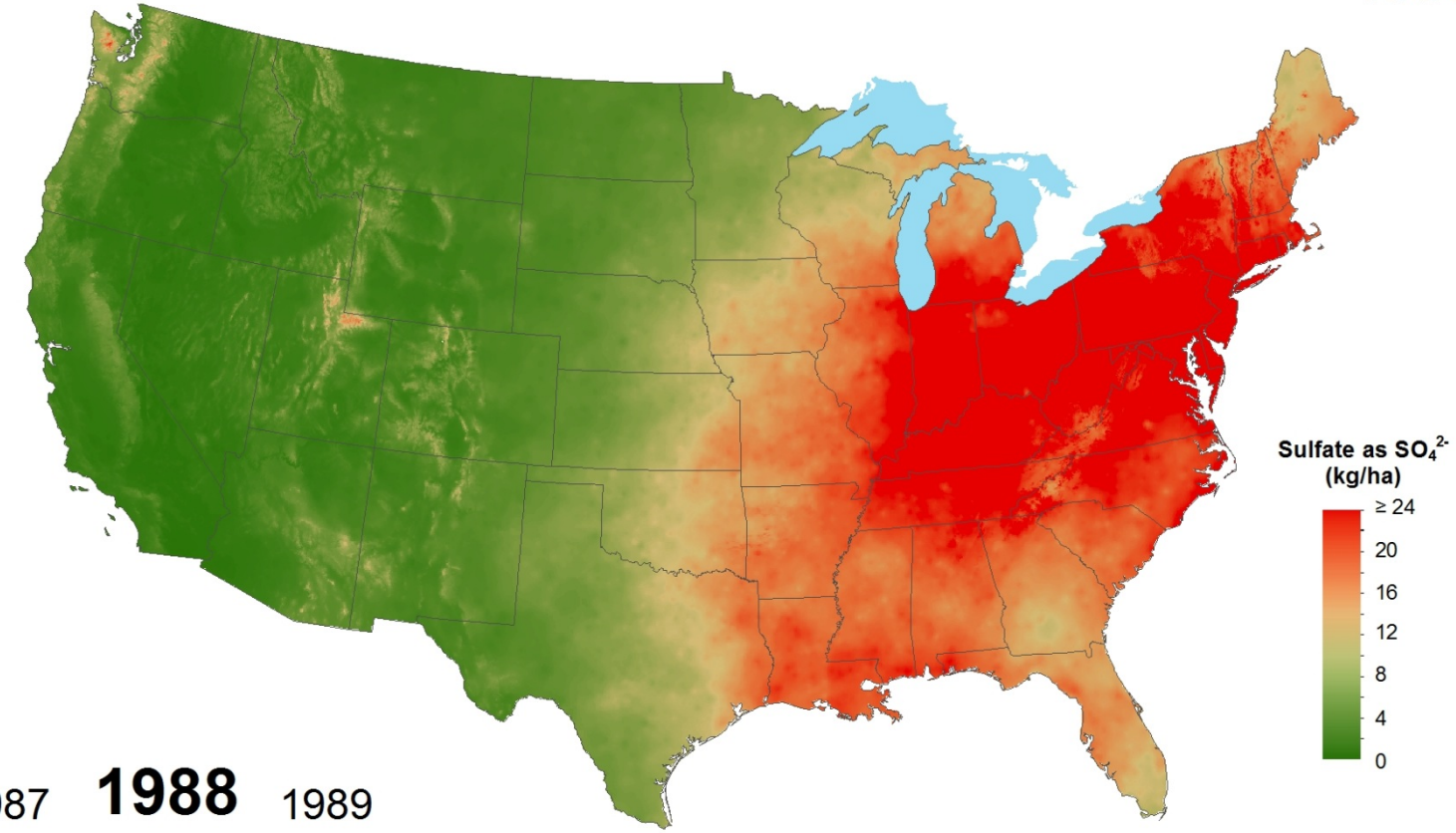
Sulfate ion wet deposition
1987



1986 **1987** 1988

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

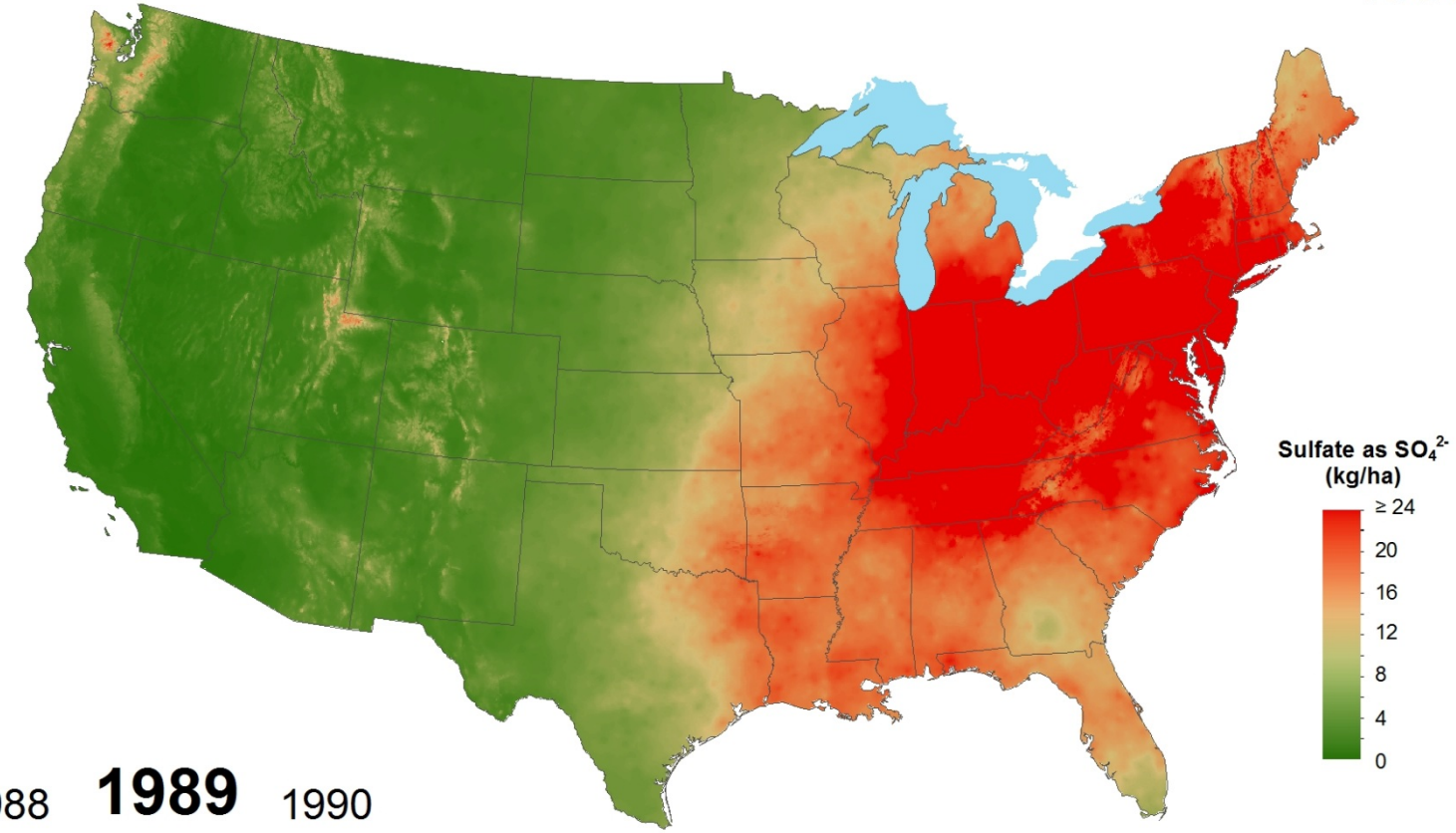
Sulfate ion wet deposition
1988



1987 **1988** 1989

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Sulfate ion wet deposition
1989



1988 **1989** 1990

National Atmospheric Deposition Program/National Trends Network
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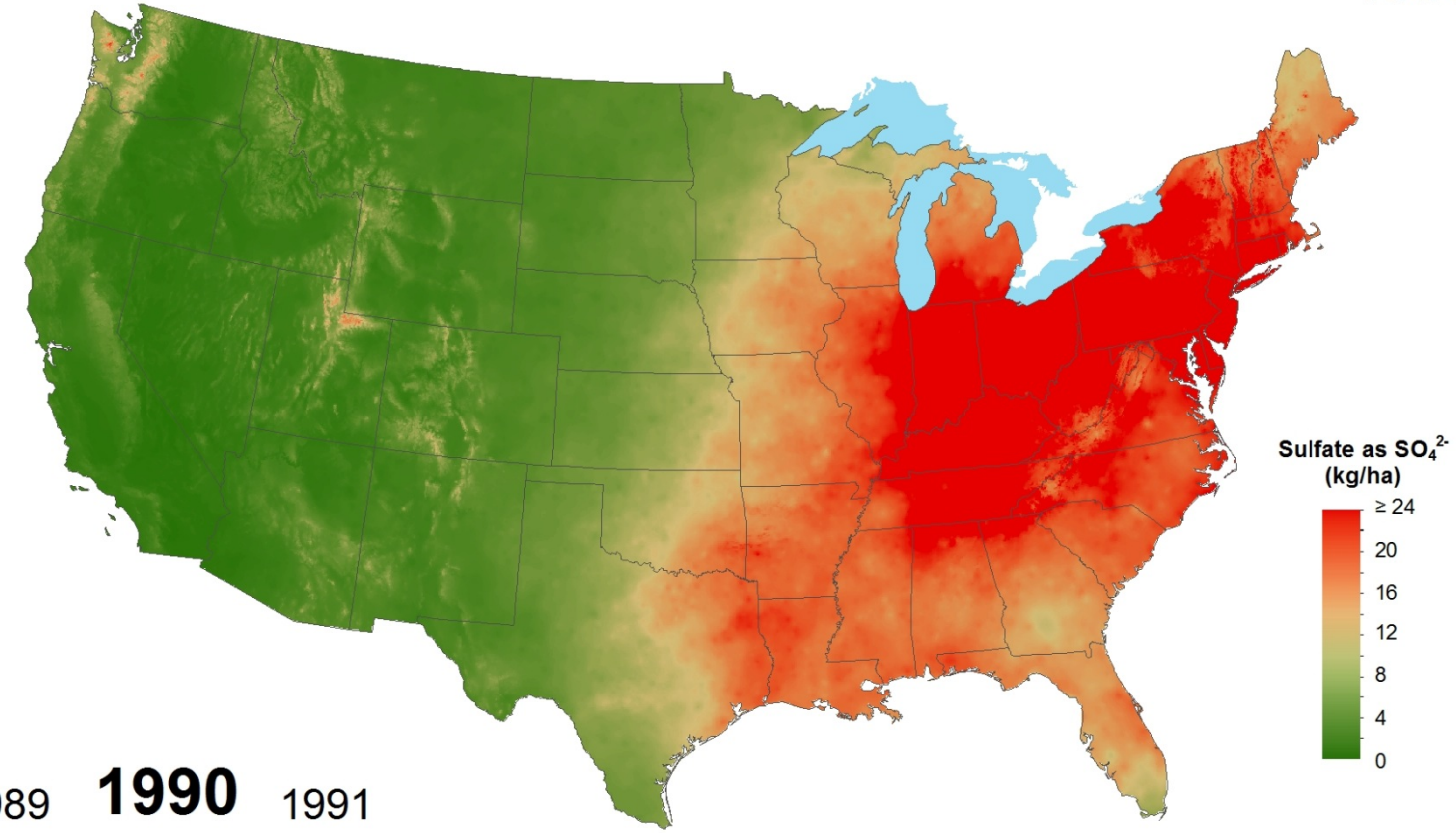
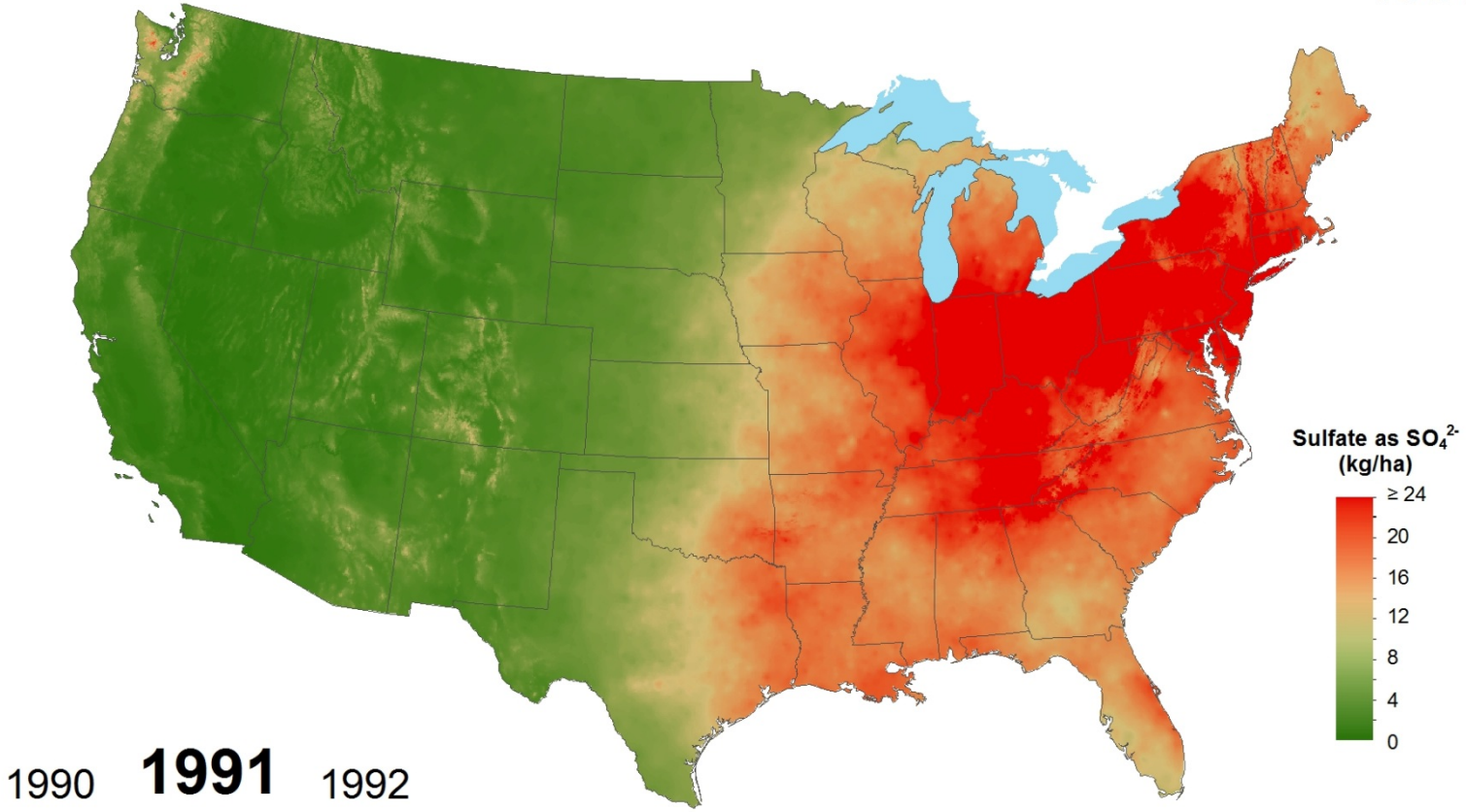
Sulfate ion wet deposition
1990



1989 **1990** 1991

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Sulfate ion wet deposition
1991



1990 **1991** 1992

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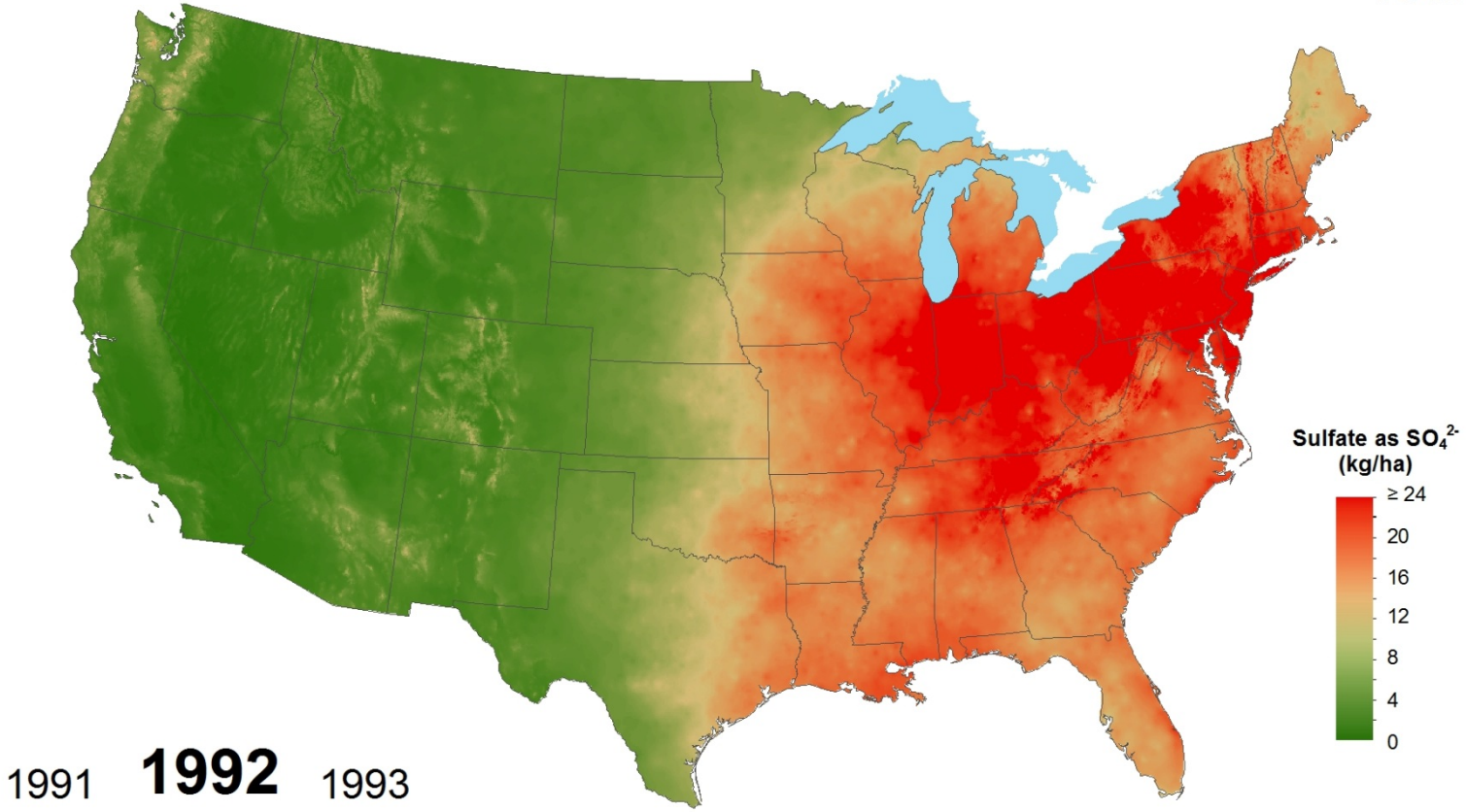
Sulfate ion wet deposition
1992



1991 **1992** 1993

National Atmospheric Deposition Program/National Trends Network
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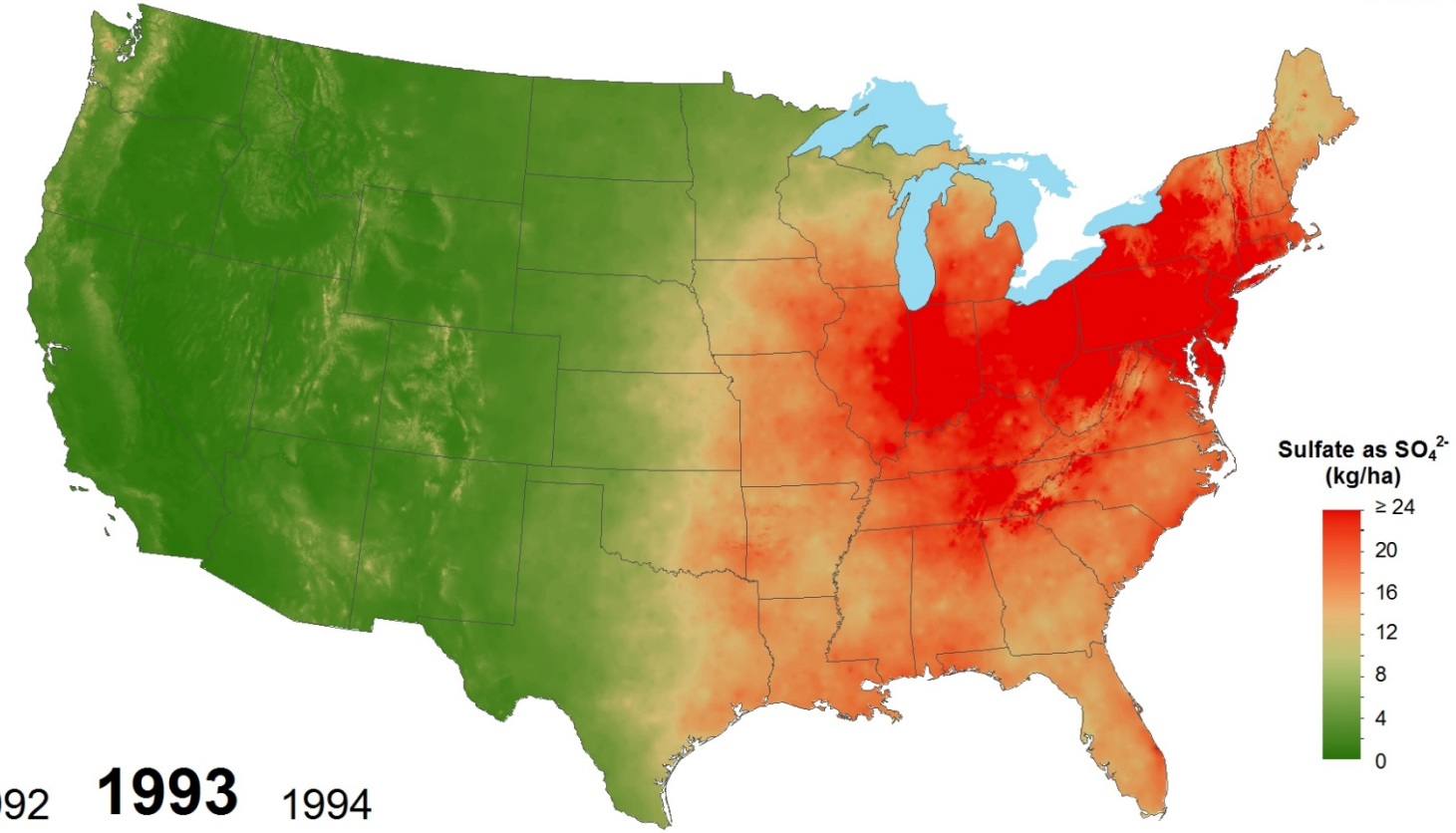
Sulfate ion wet deposition
1993



1992 **1993** 1994

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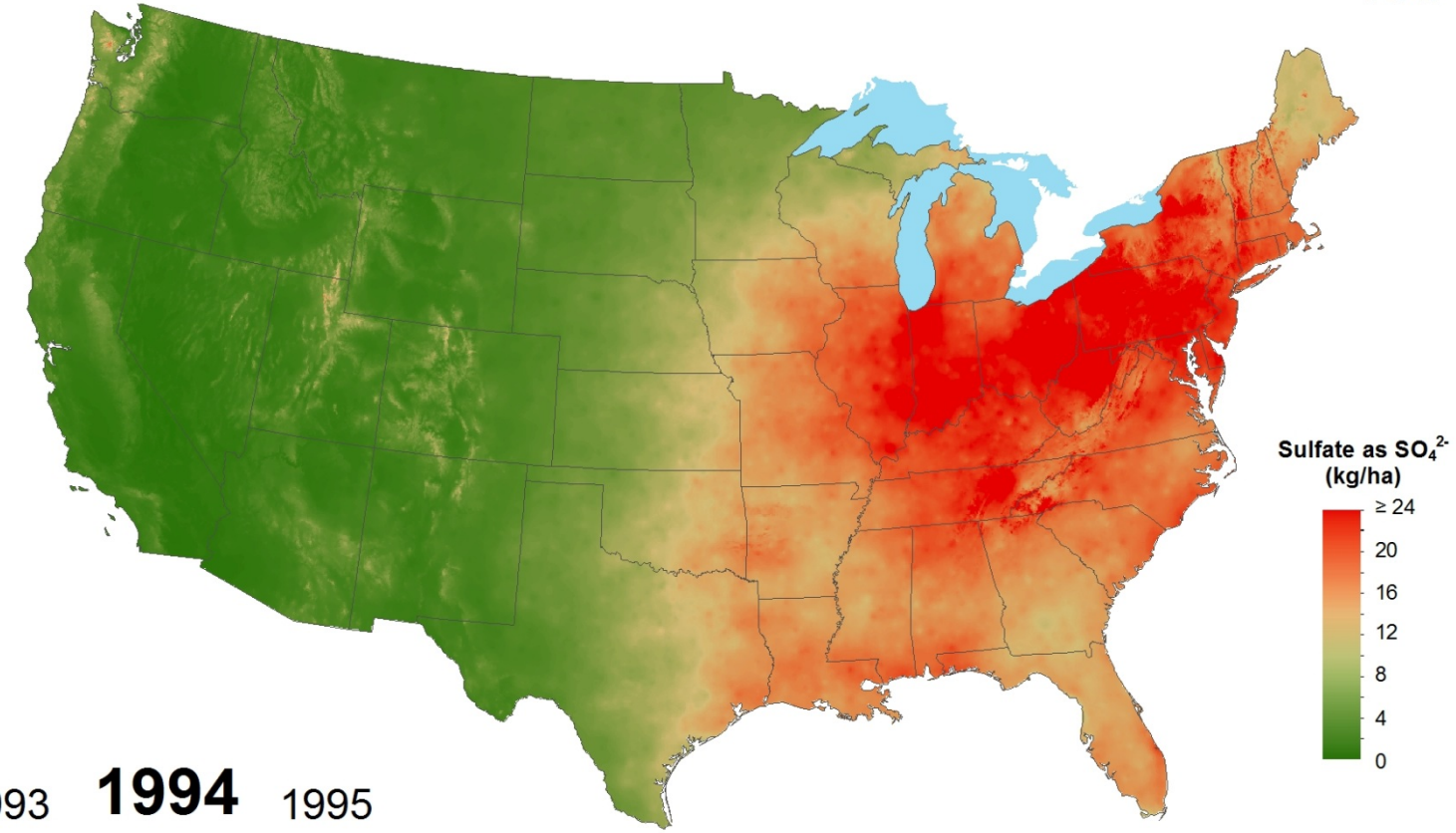
Sulfate ion wet deposition
1994



1993 **1994** 1995

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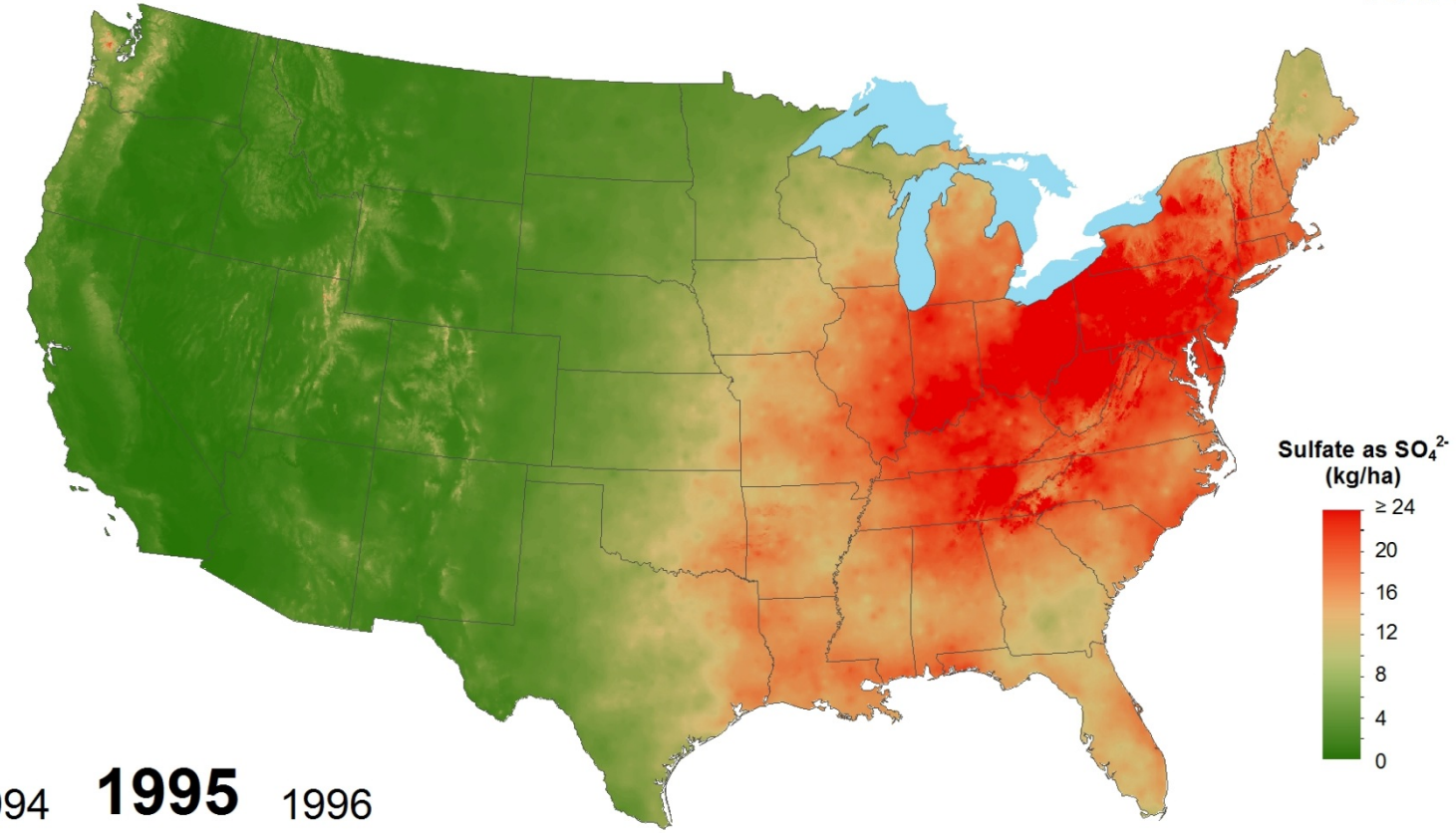
Sulfate ion wet deposition
1995



1994 **1995** 1996

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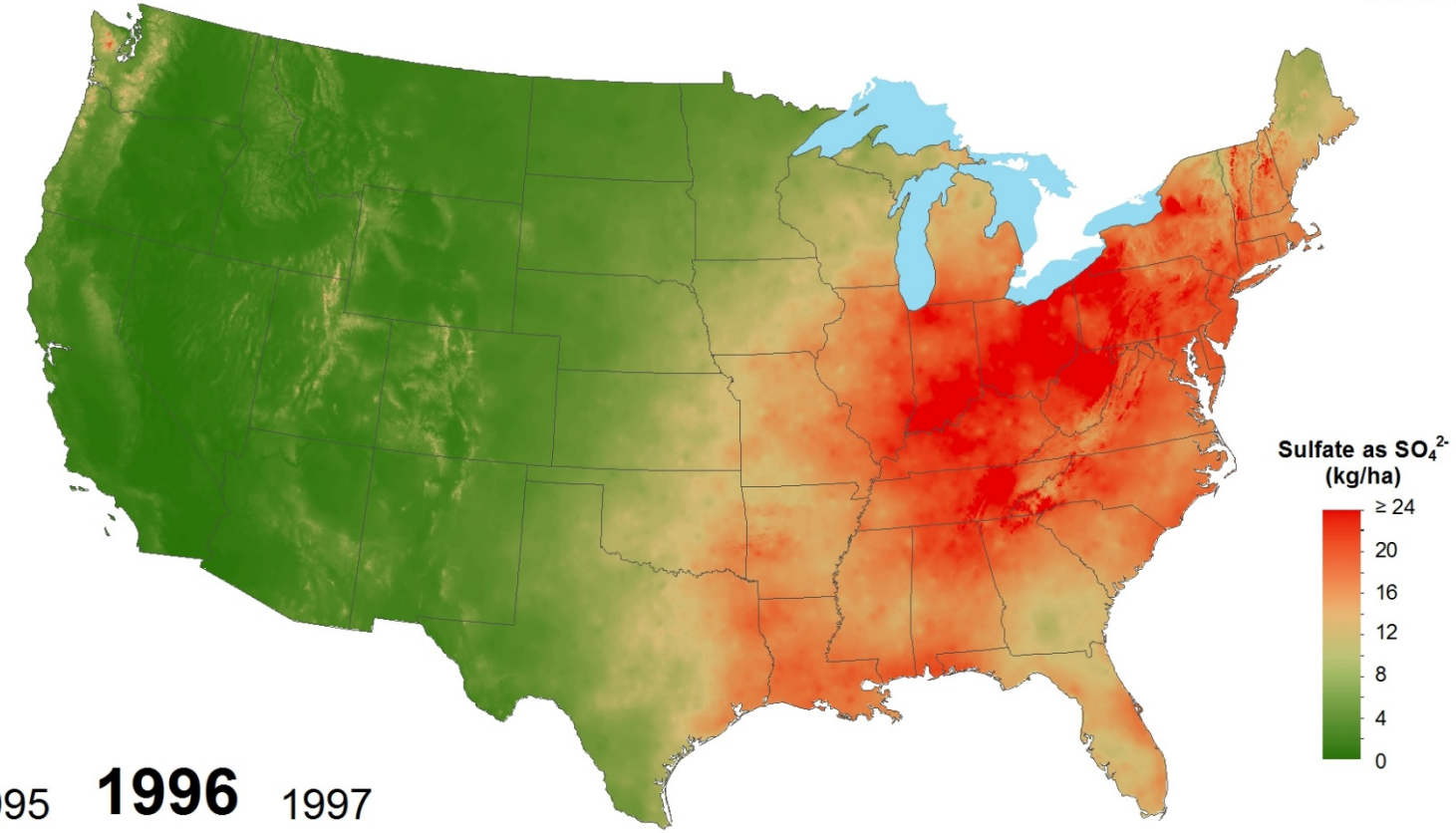
Sulfate ion wet deposition
1996



1995 **1996** 1997

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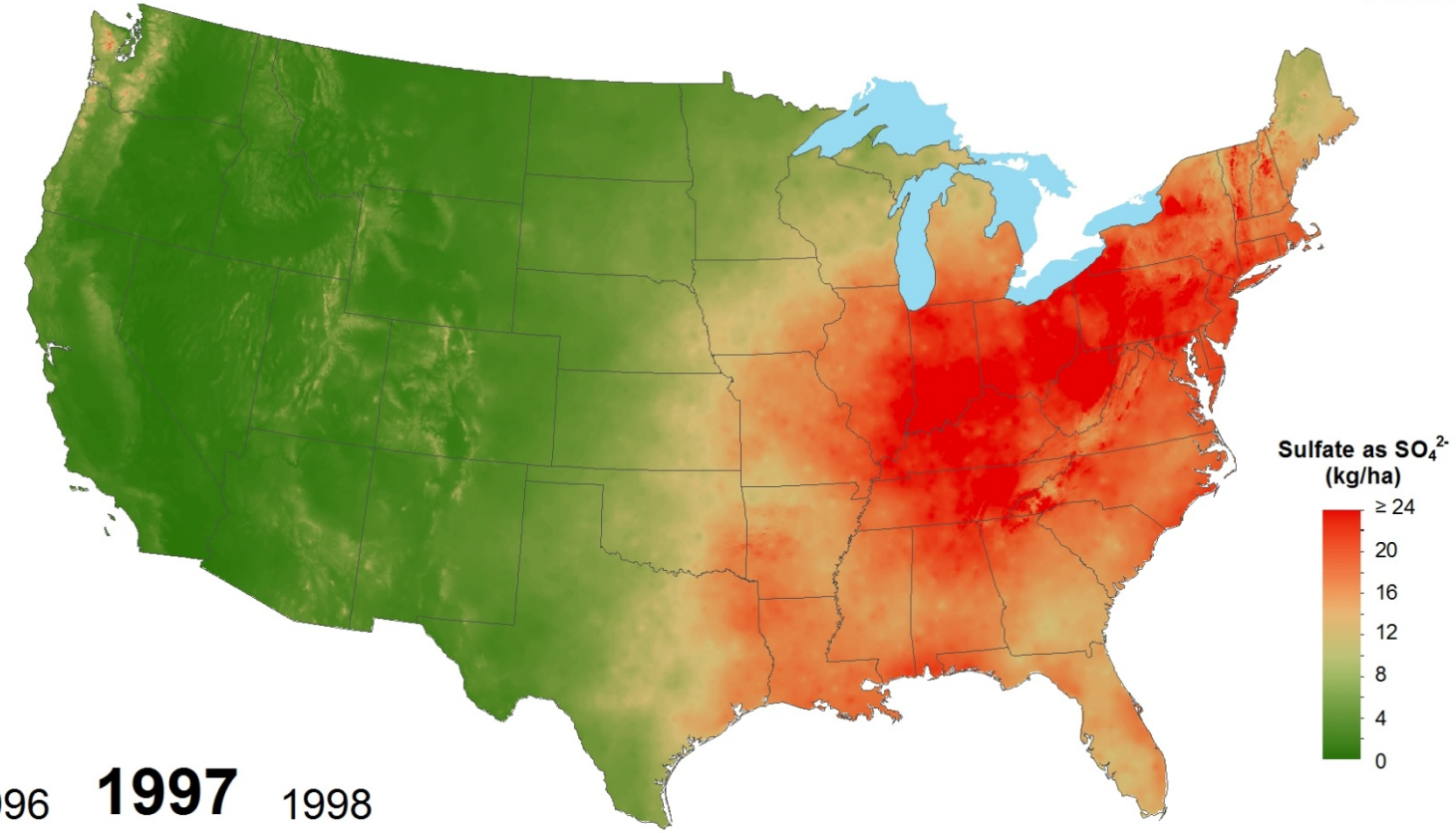
Sulfate ion wet deposition
1997



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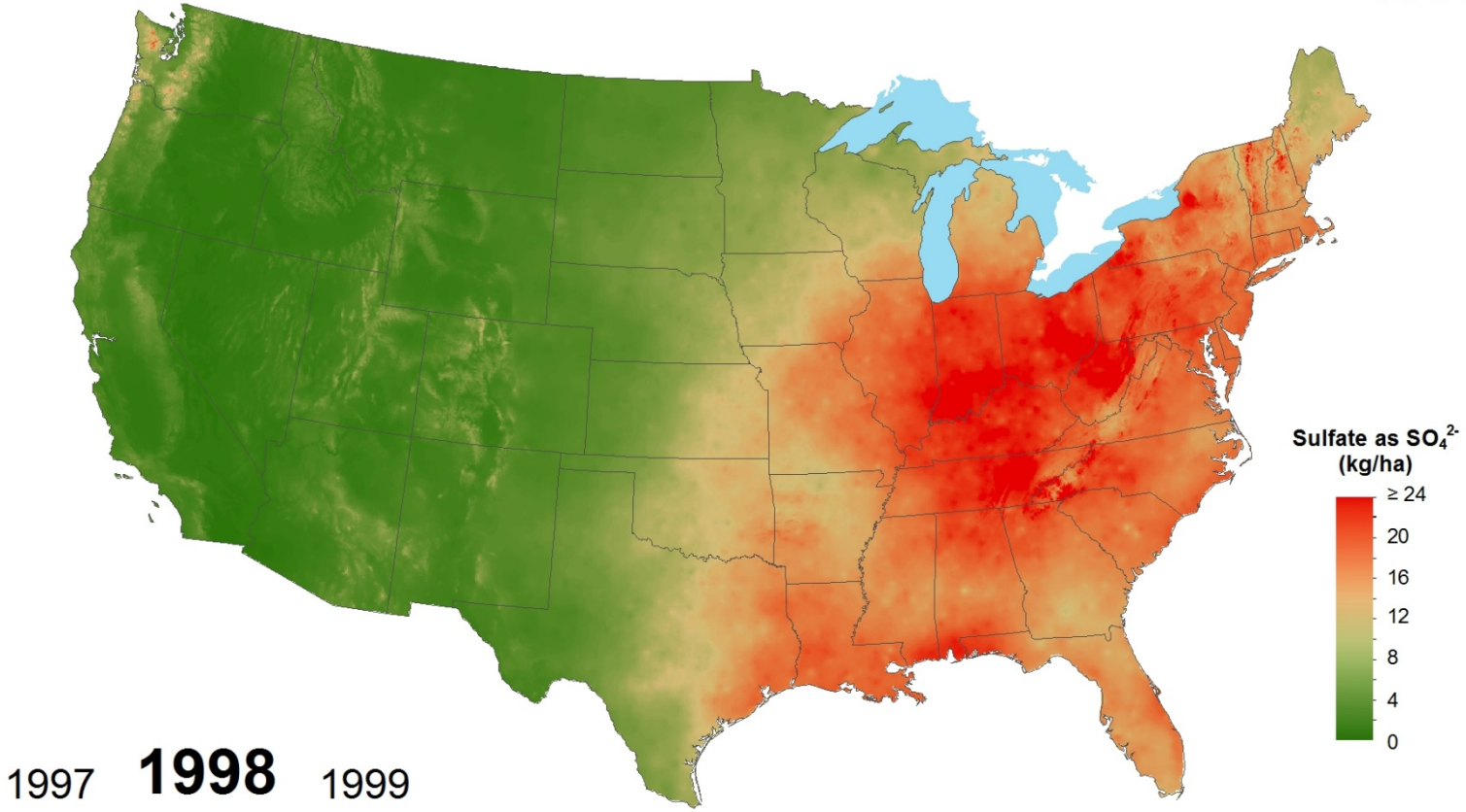
Sulfate ion wet deposition
1998



1997 **1998** 1999

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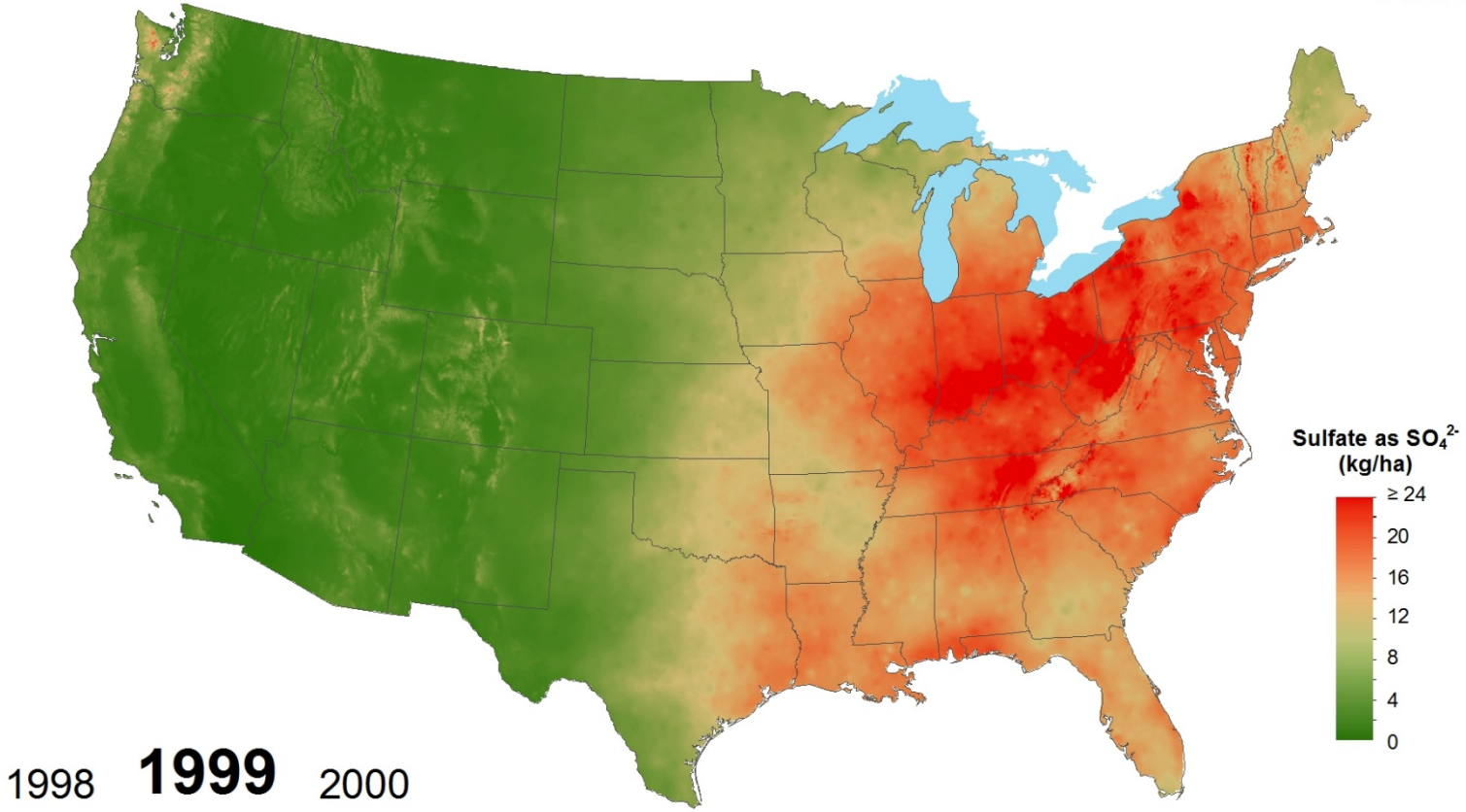
Sulfate ion wet deposition
1999



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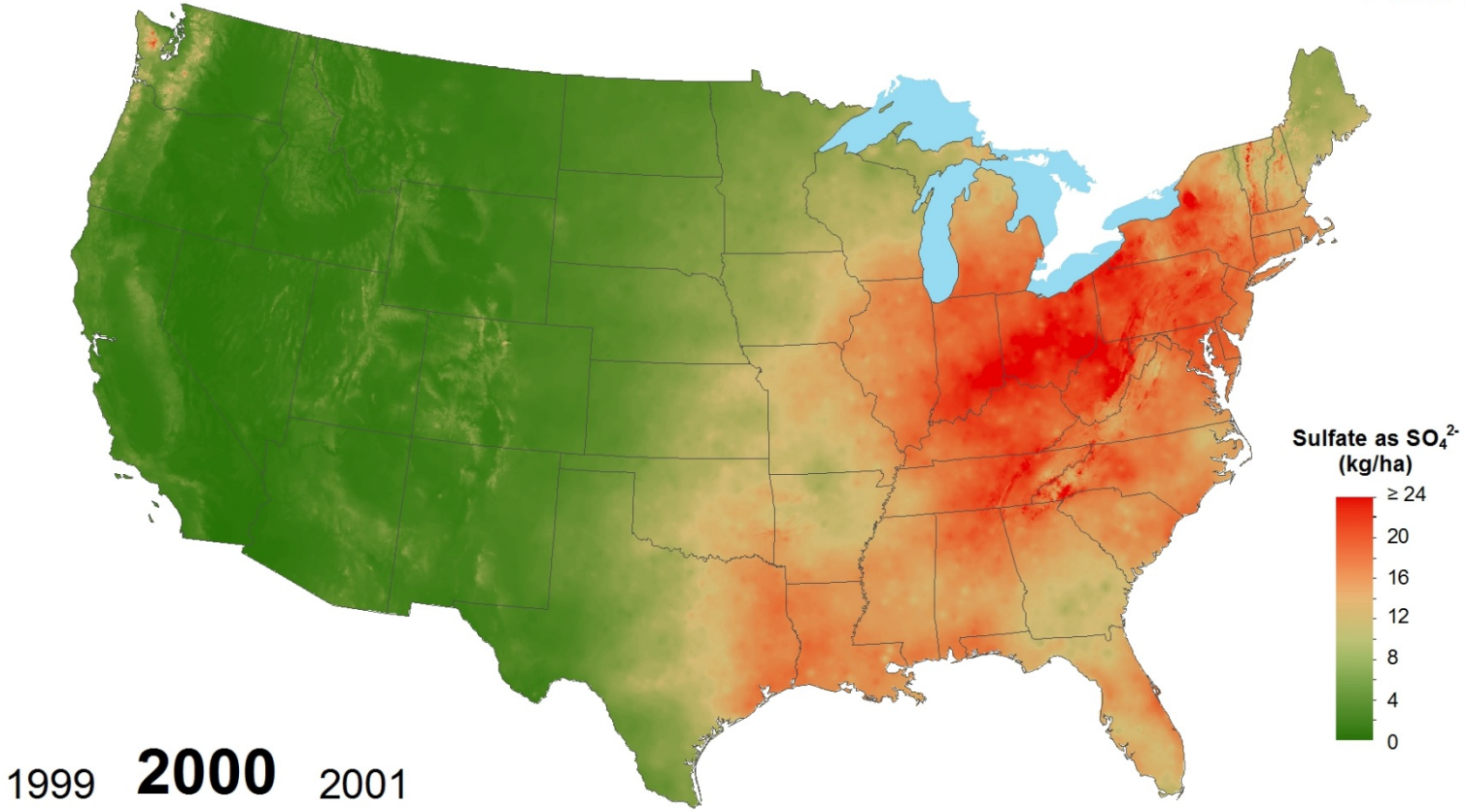
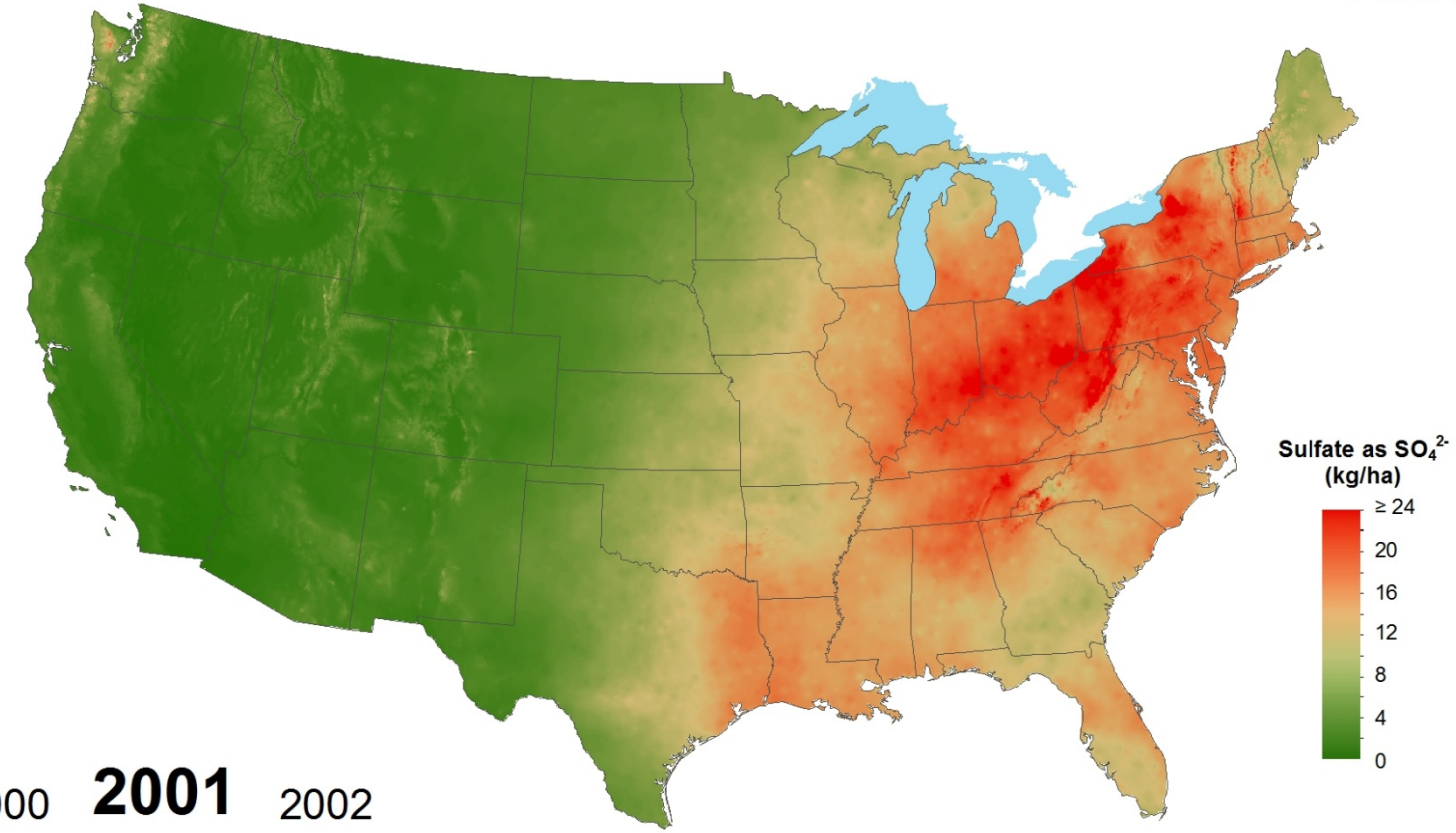
Sulfate ion wet deposition
2000



1999 **2000** 2001

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Sulfate ion wet deposition
2001



2000 **2001** 2002

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Sulfate ion wet deposition
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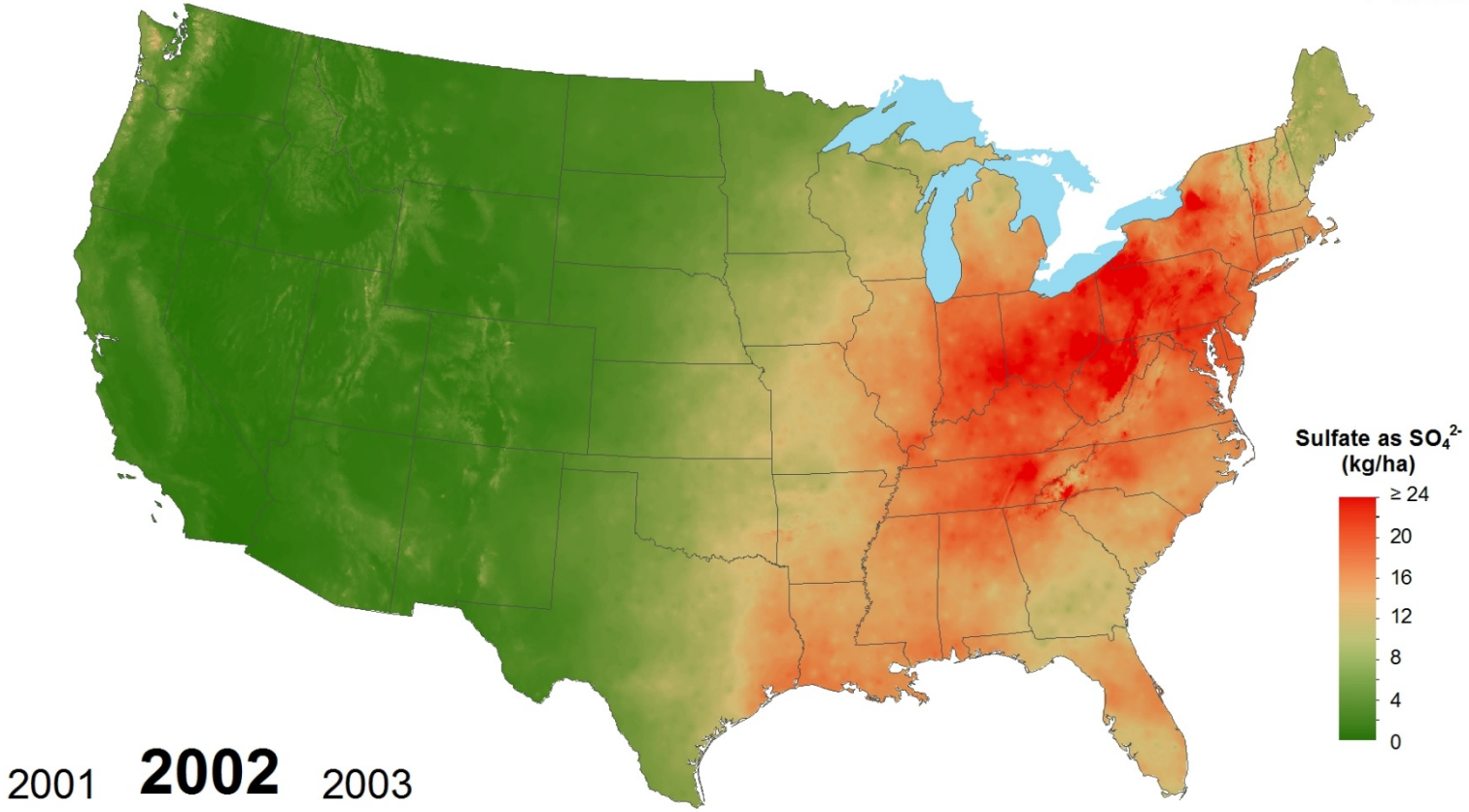

2001 **2002** 2003

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Sulfate ion wet deposition
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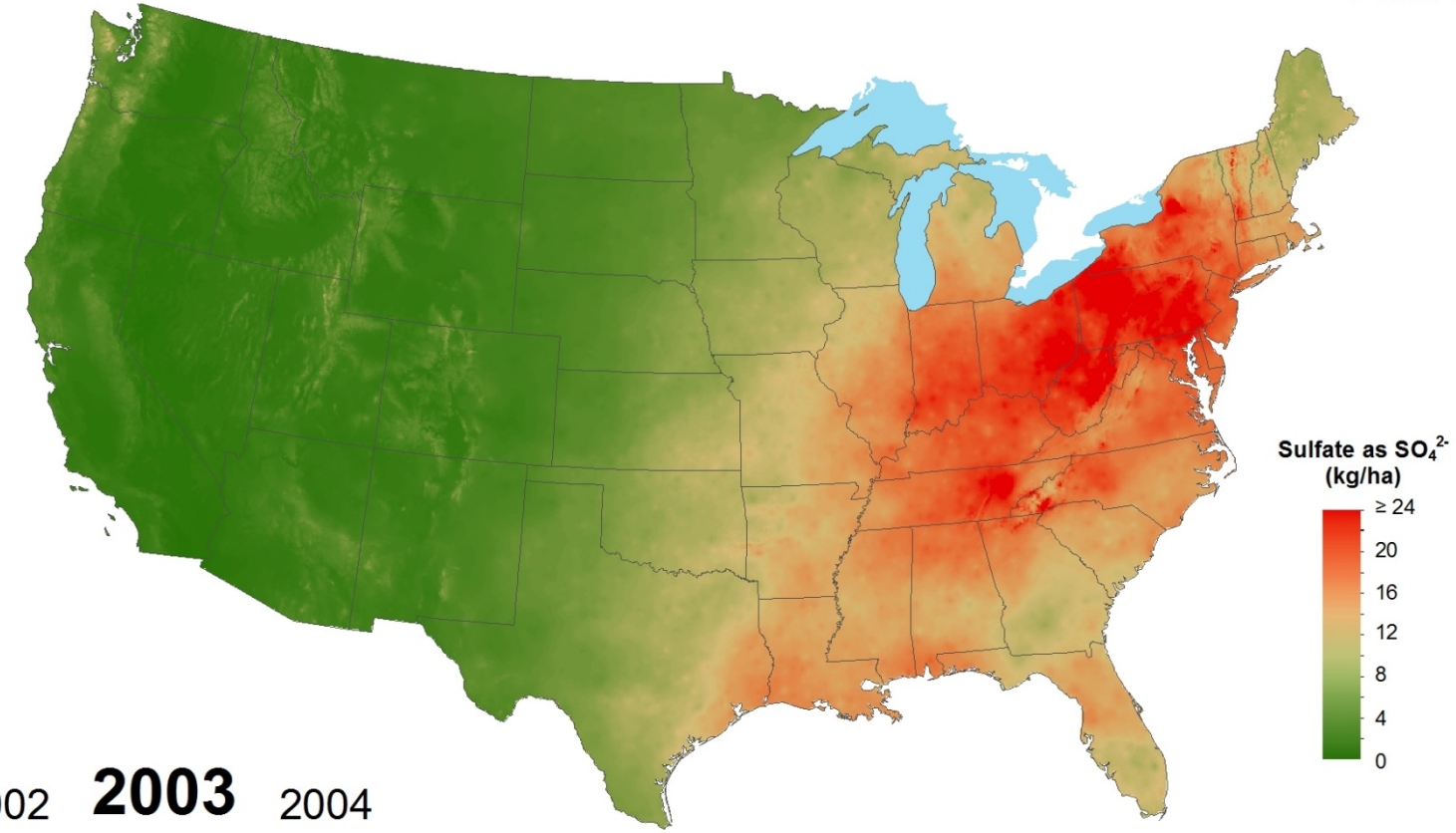
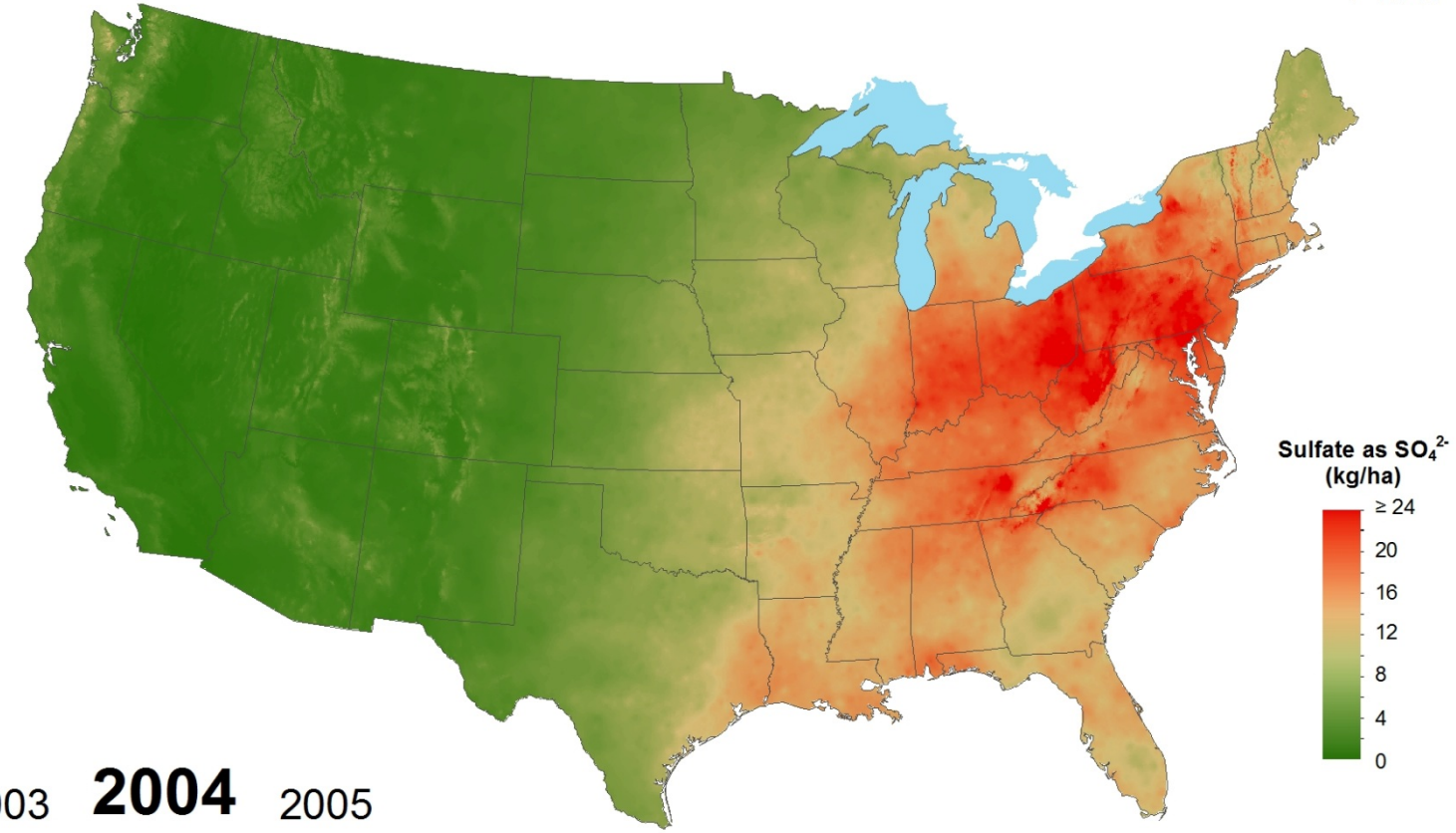


2002 **2003** 2004

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Sulfate ion wet deposition
2004



2003 **2004** 2005

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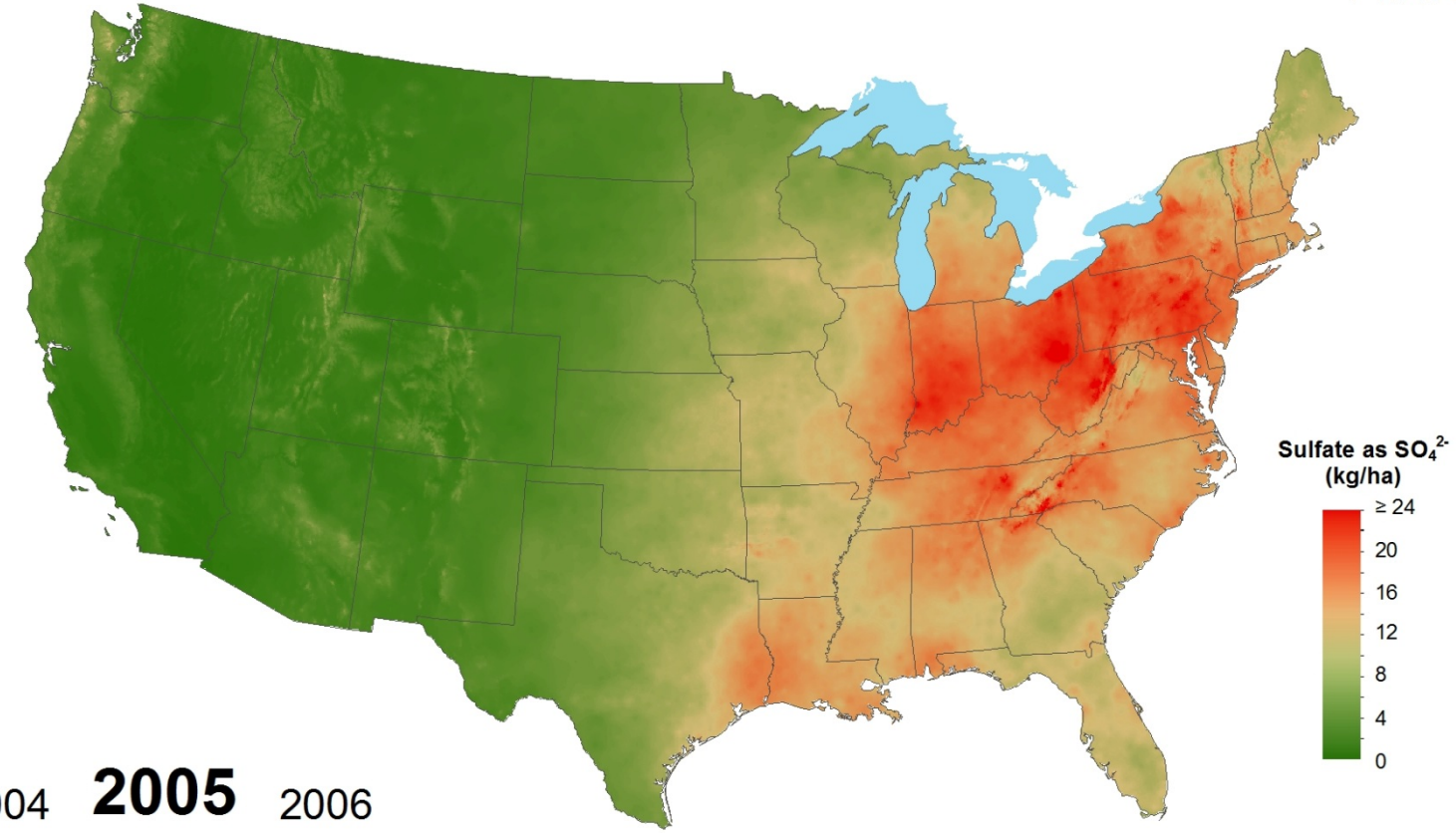
http://nadp.isws.illinois.edu

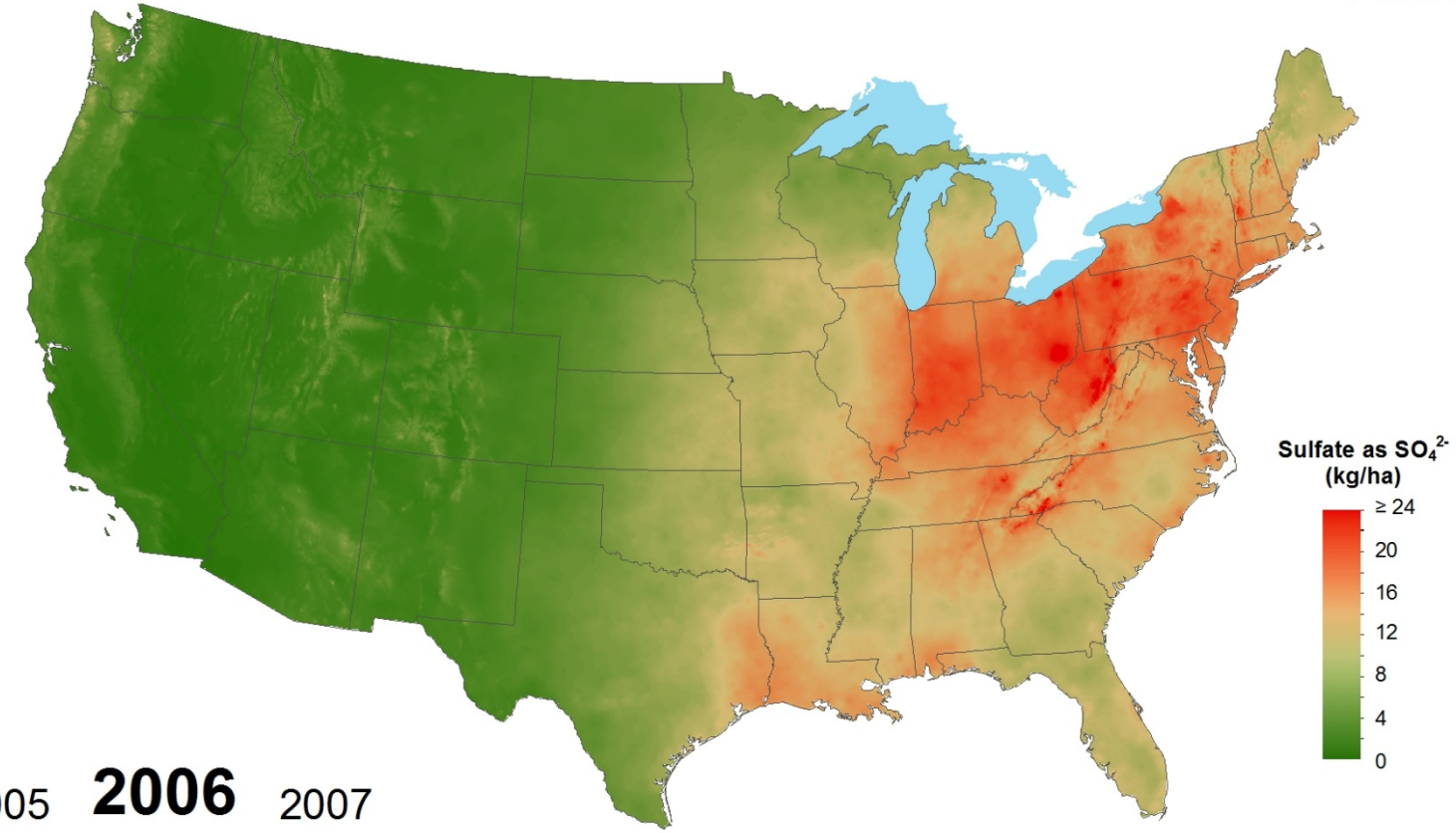
Sulfate ion wet deposition
2005



2004 **2005** 2006

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

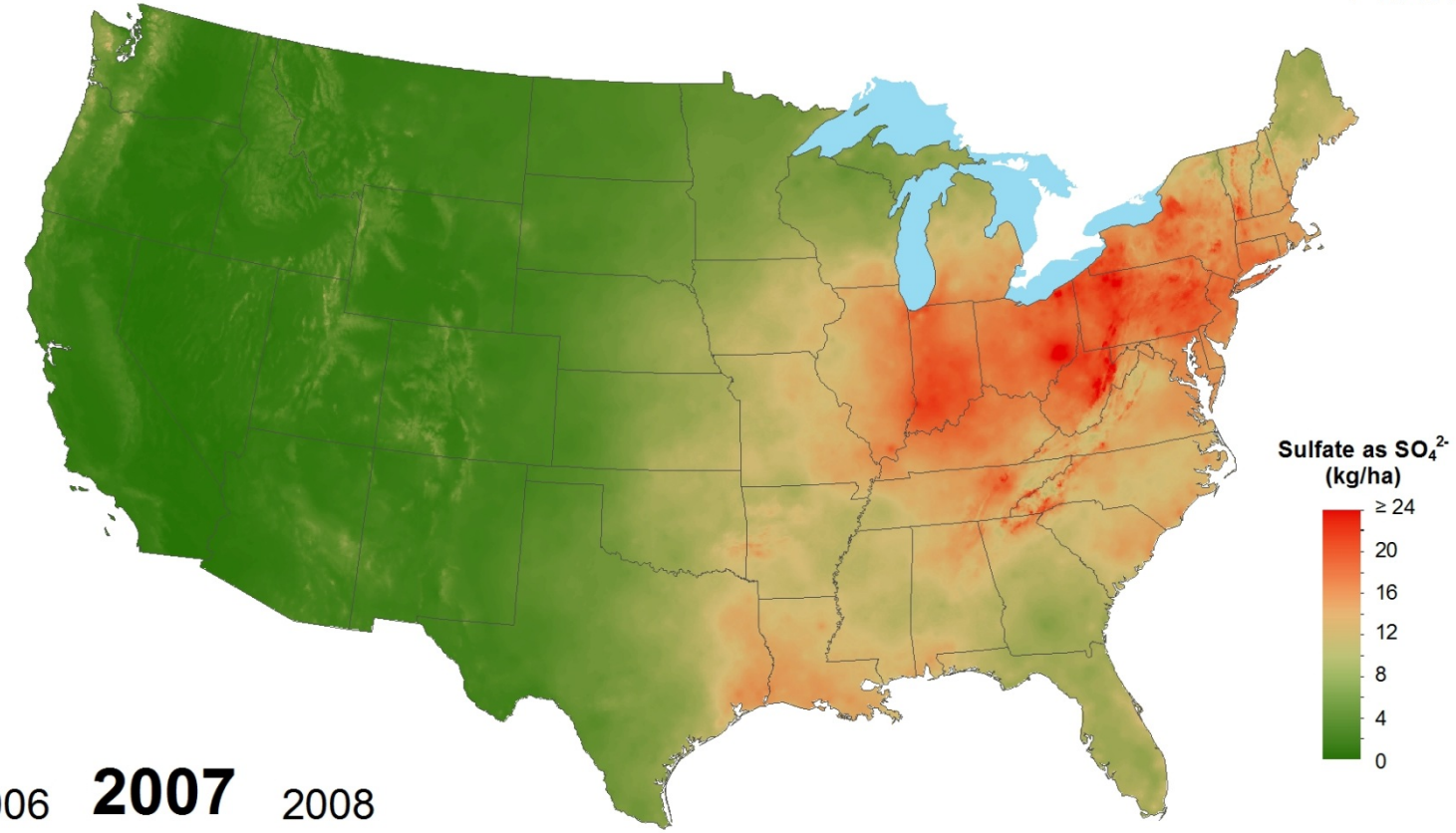
Sulfate ion wet deposition
2006



2005 **2006** 2007

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

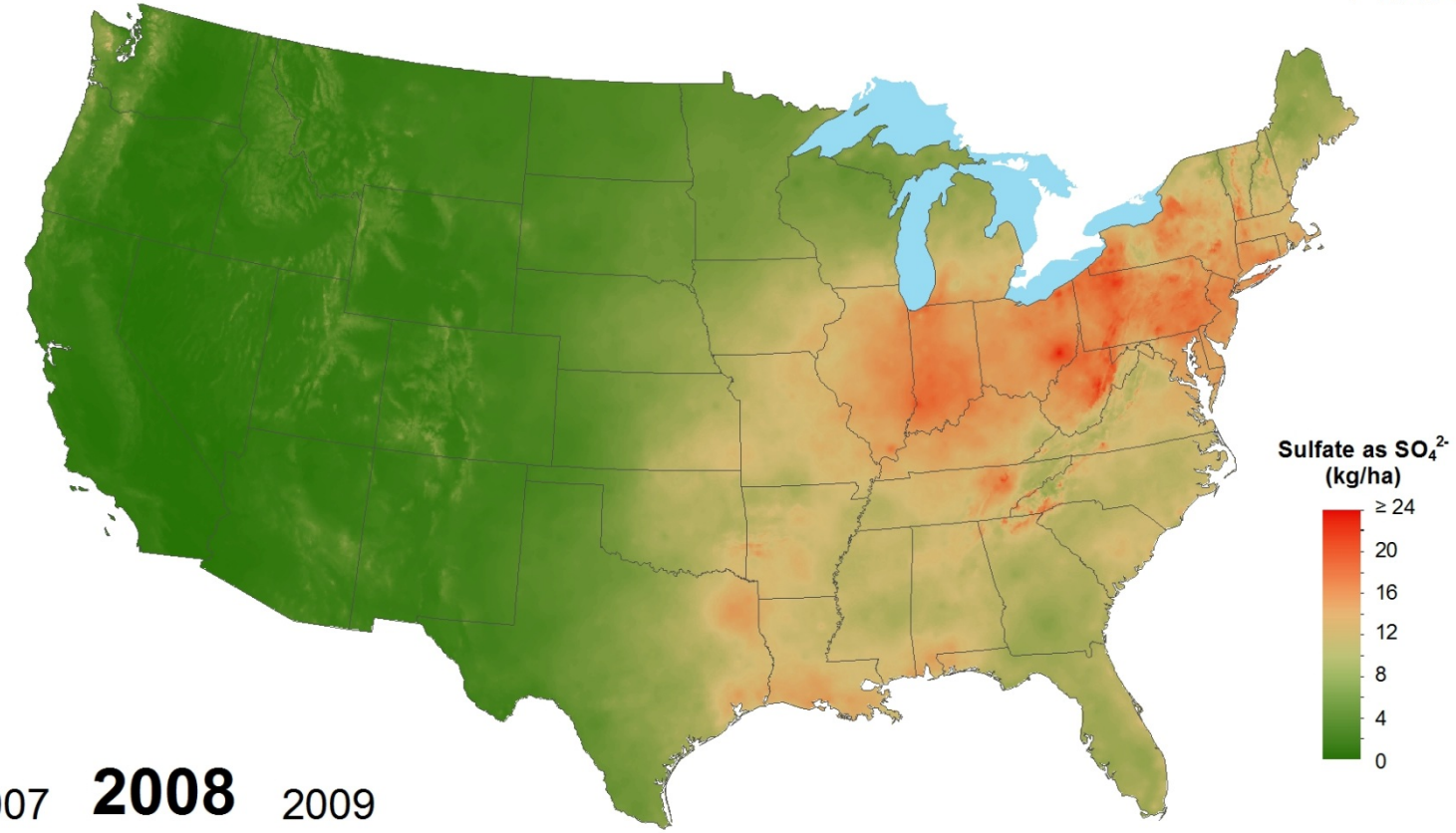
Sulfate ion wet deposition
2007



2006 **2007** 2008

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Sulfate ion wet deposition
2008



2007 **2008** 2009

National Atmospheric Deposition Program/National Trends Network
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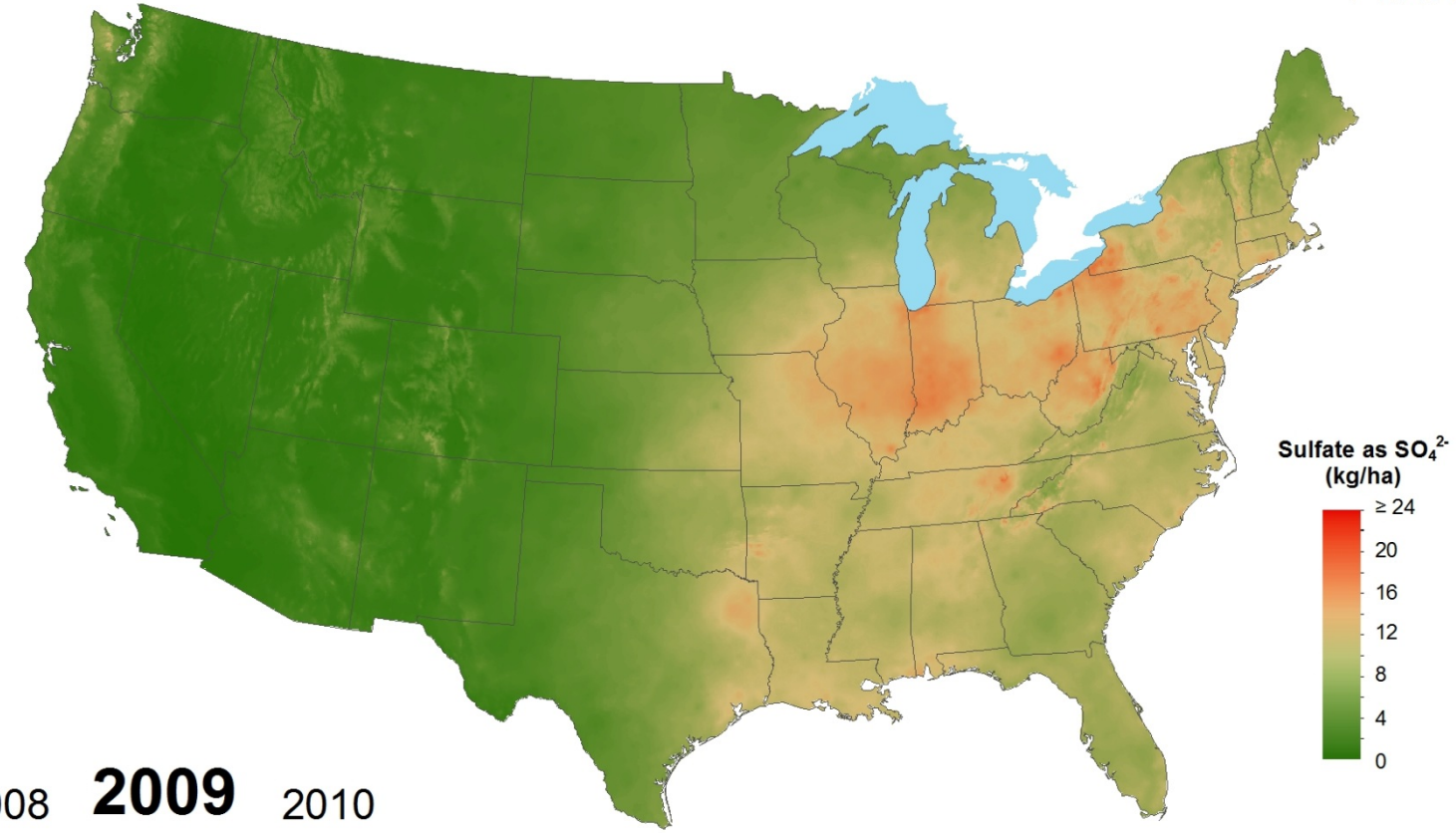
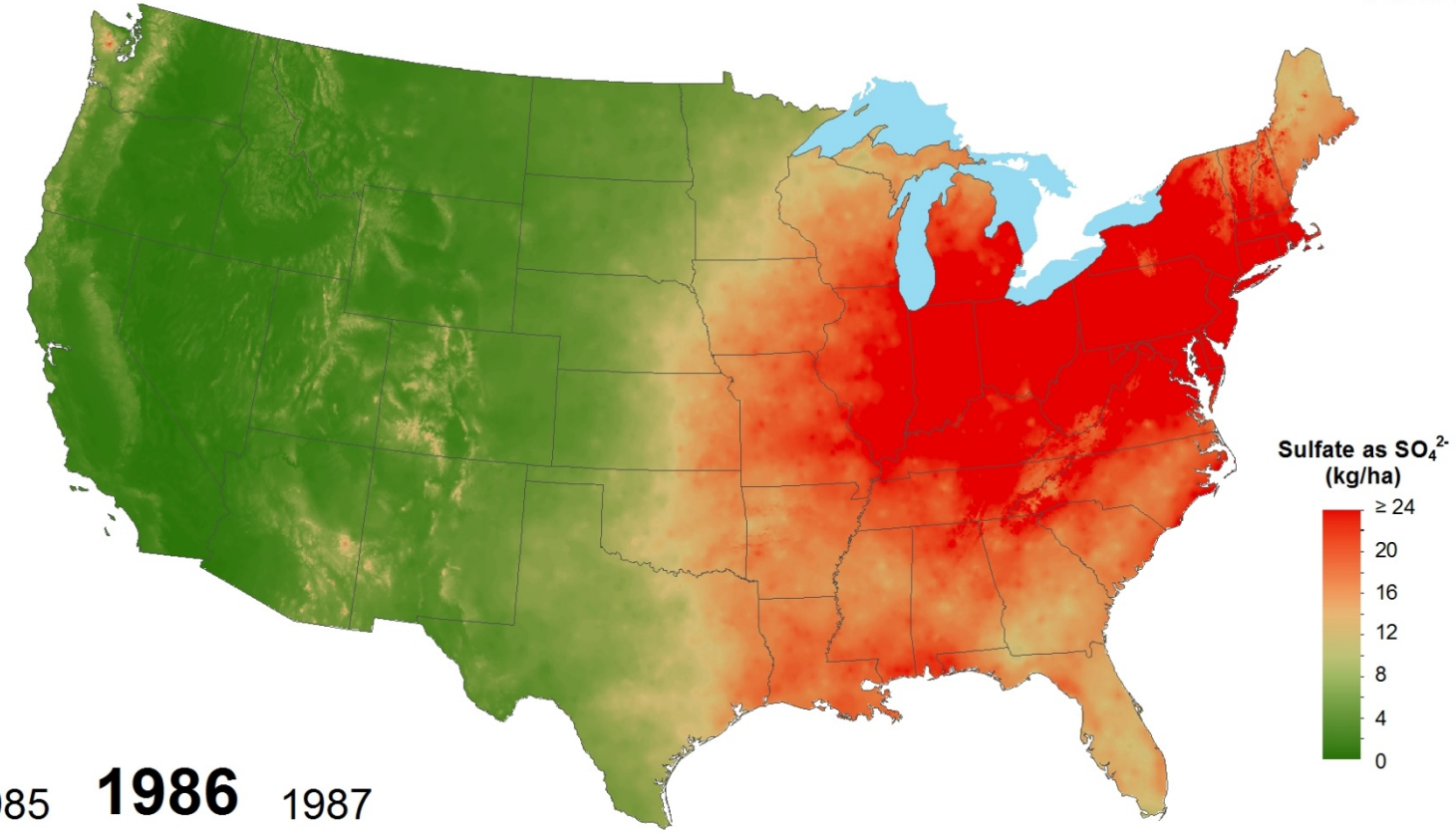
Sulfate ion wet deposition
2009



2008 **2009** 2010

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Sulfate ion wet deposition
1986

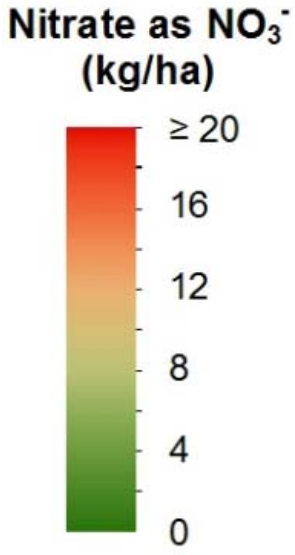


1985 **1986** 1987

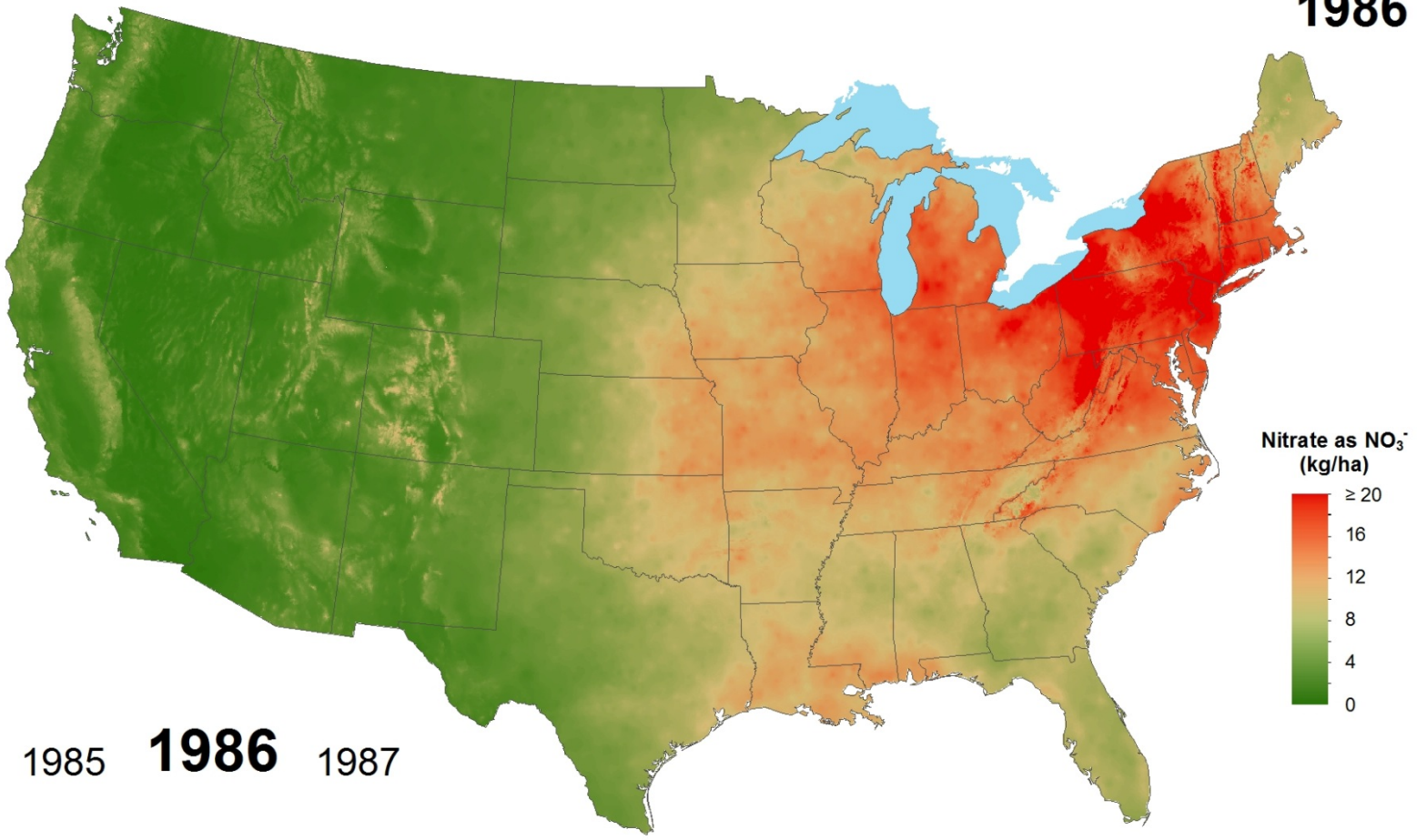
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate Ion
Wet Deposition Trends

3-year running
annual average
(1985 – 2010)

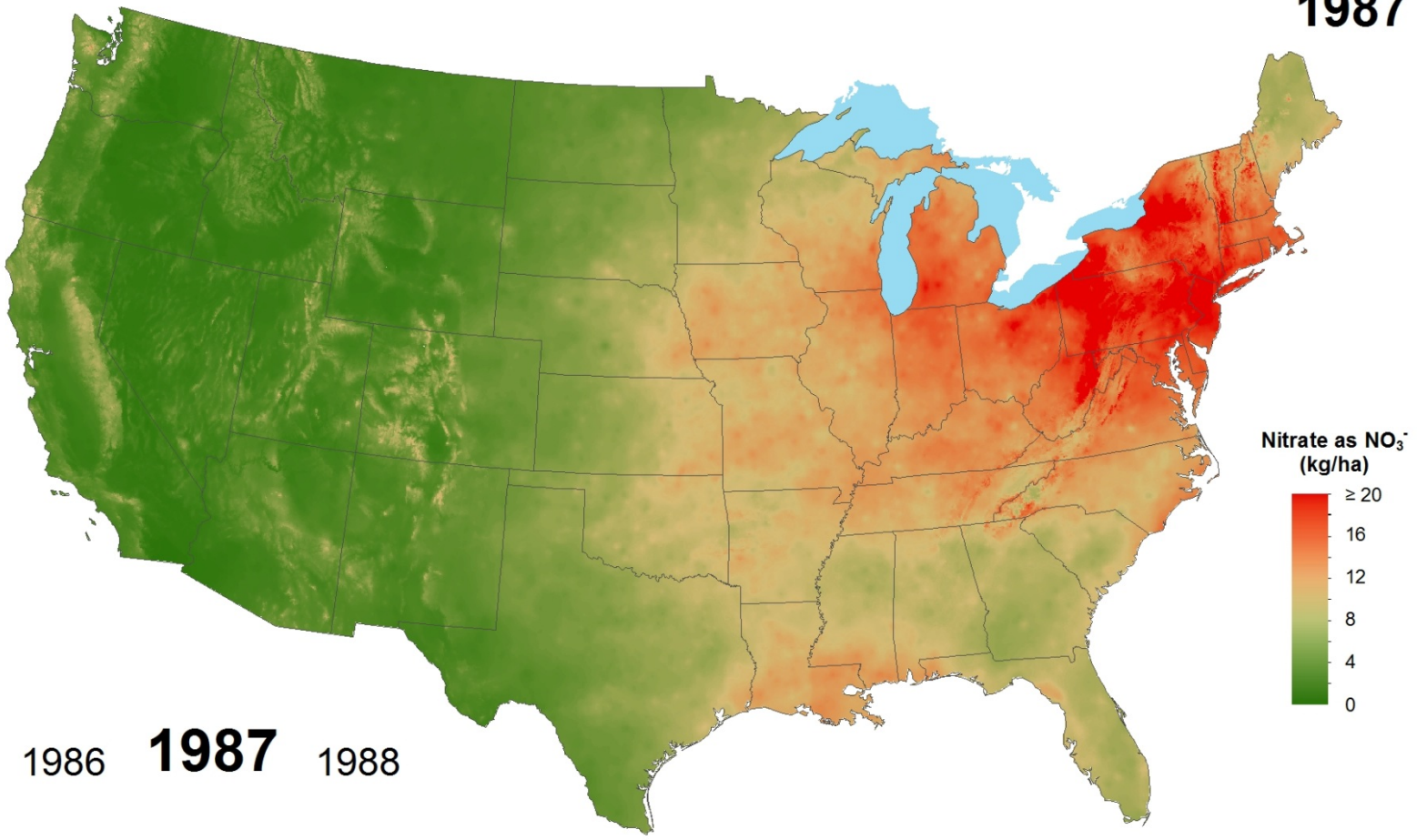


Nitrate ion wet deposition
1986



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate ion wet deposition
1987



1986 **1987** 1988

National Atmospheric Deposition Program/National Trends Network
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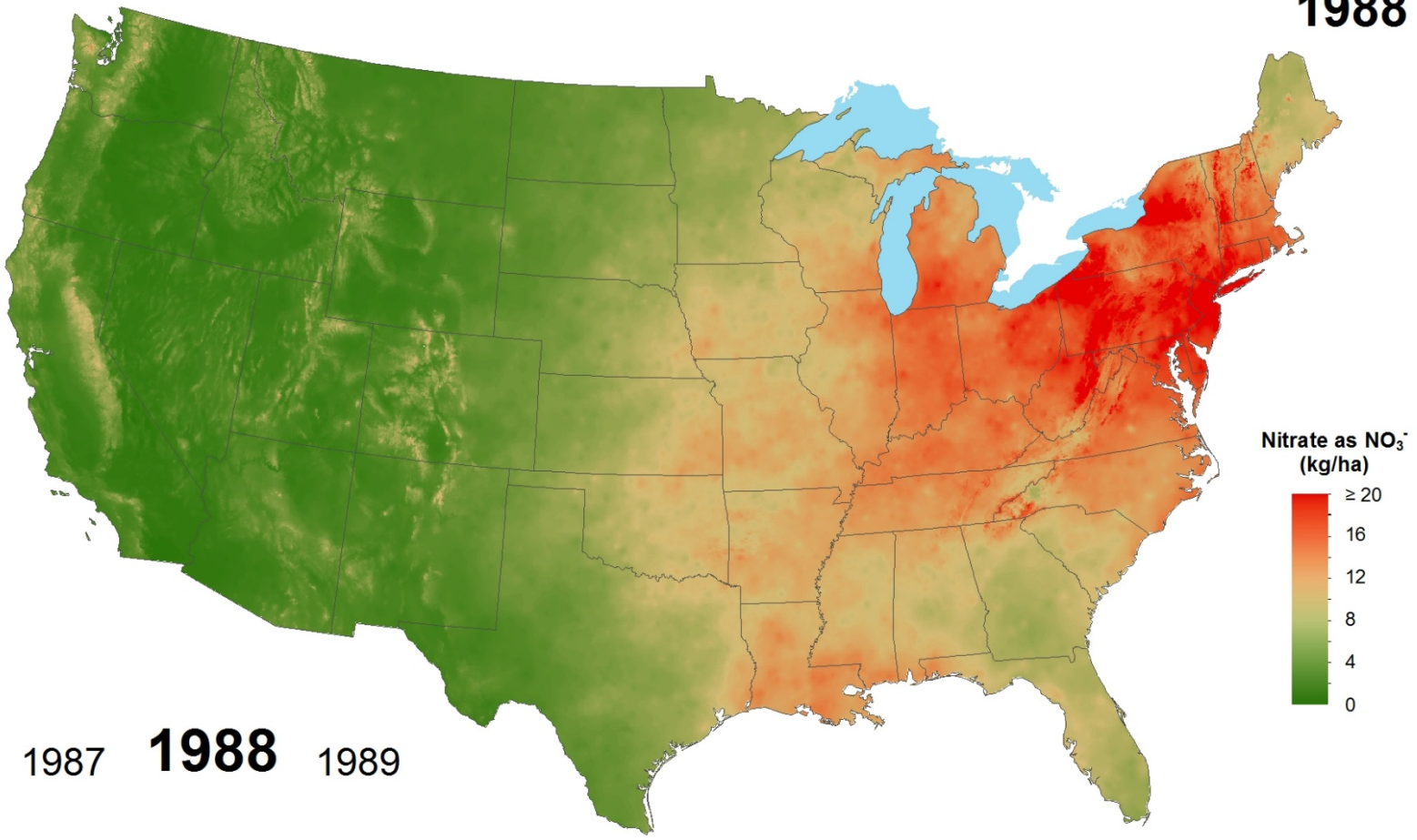
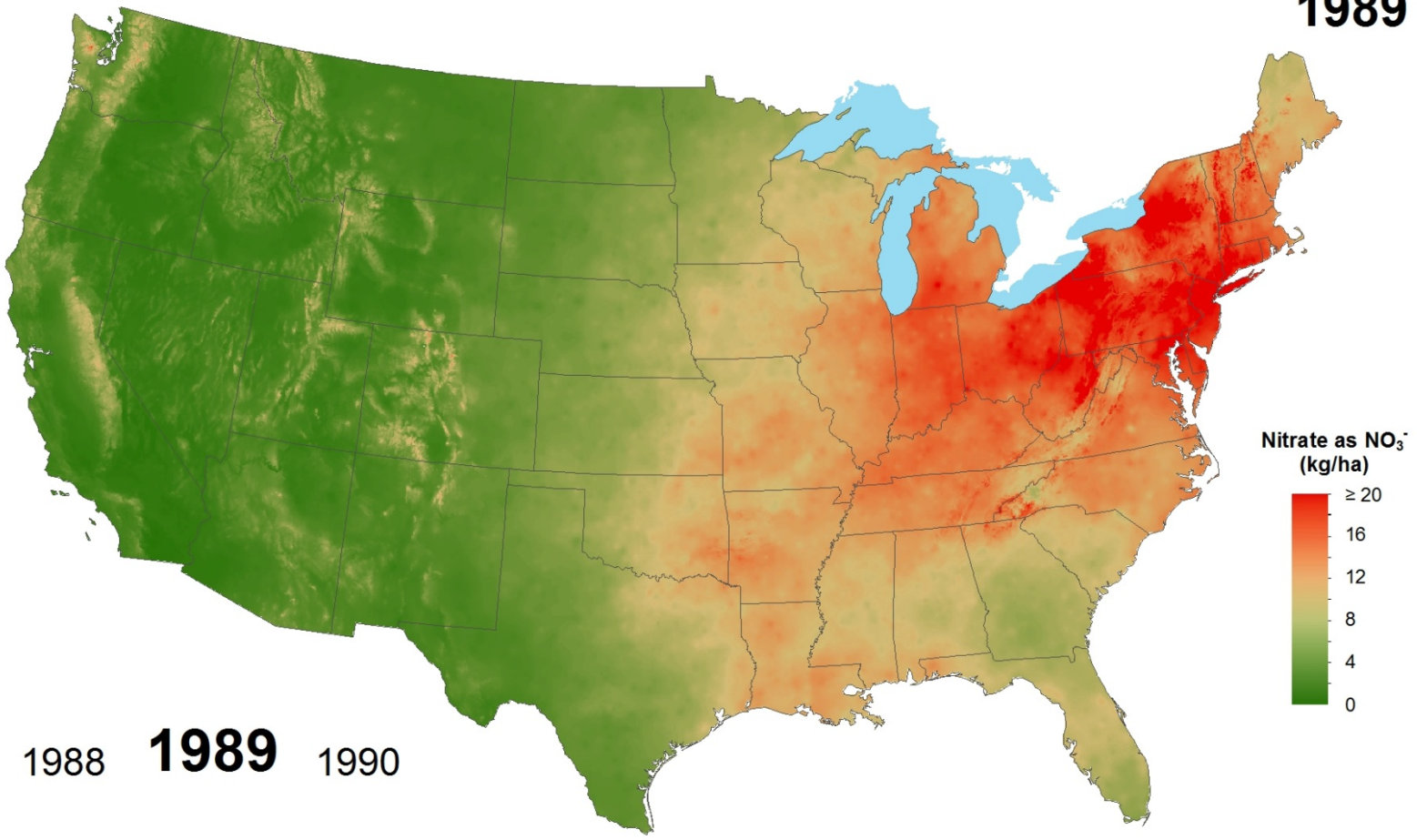
Nitrate ion wet deposition
1988



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate ion wet deposition
1989



National Atmospheric Deposition Program/National Trends Network
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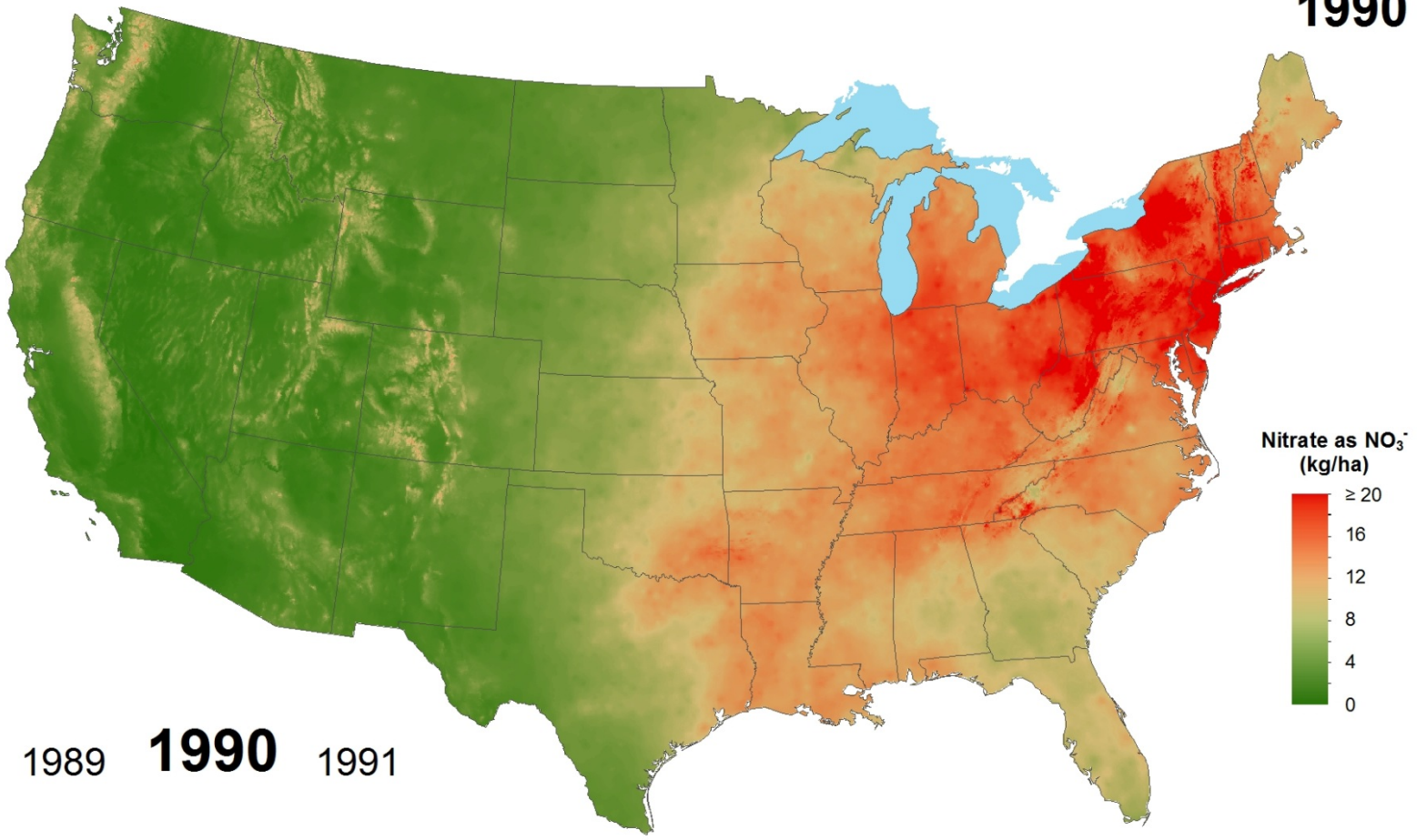
Nitrate ion wet deposition
1990



National Atmospheric Deposition Program/National Trends Network
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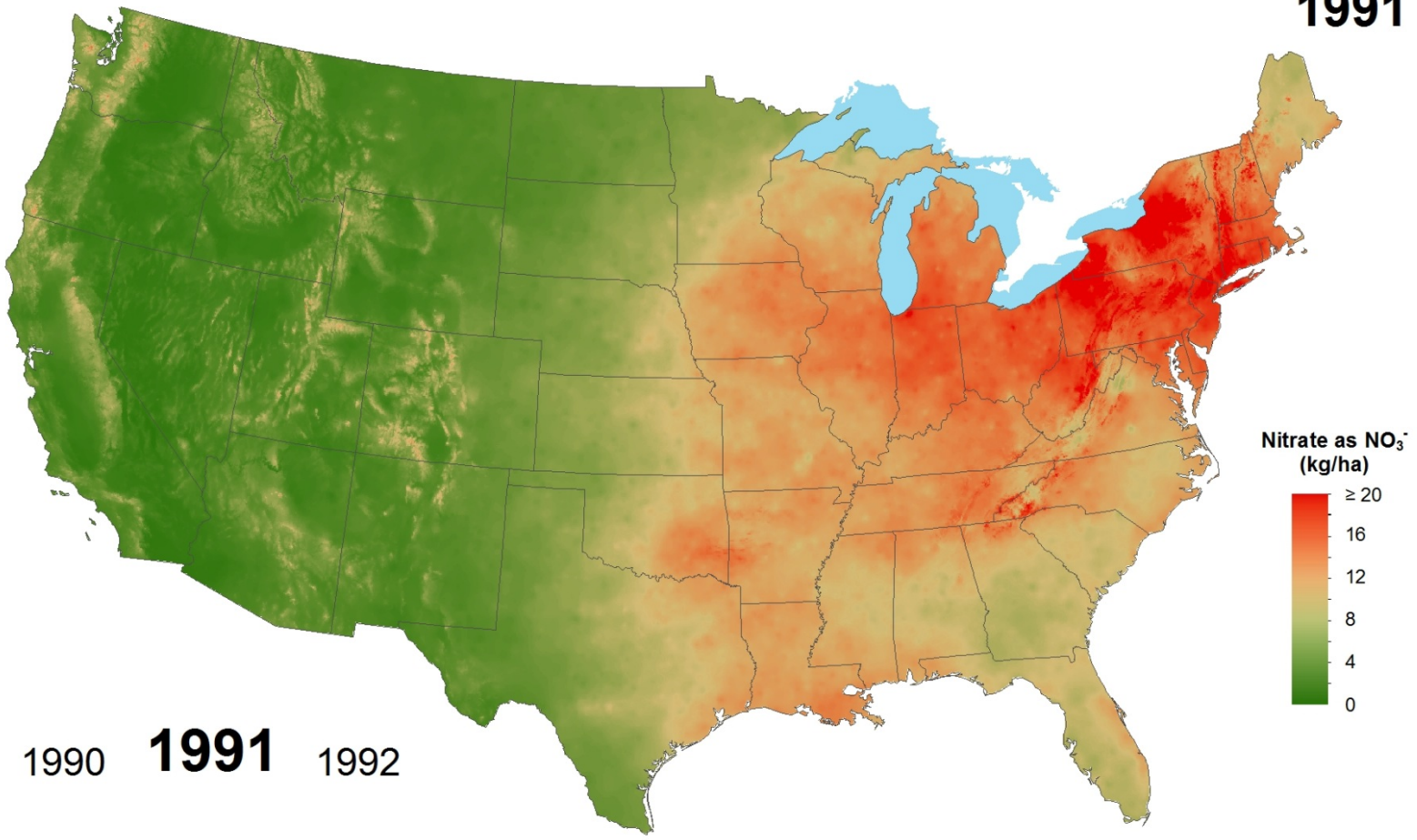
Nitrate ion wet deposition
1991



National Atmospheric Deposition Program/National Trends Network
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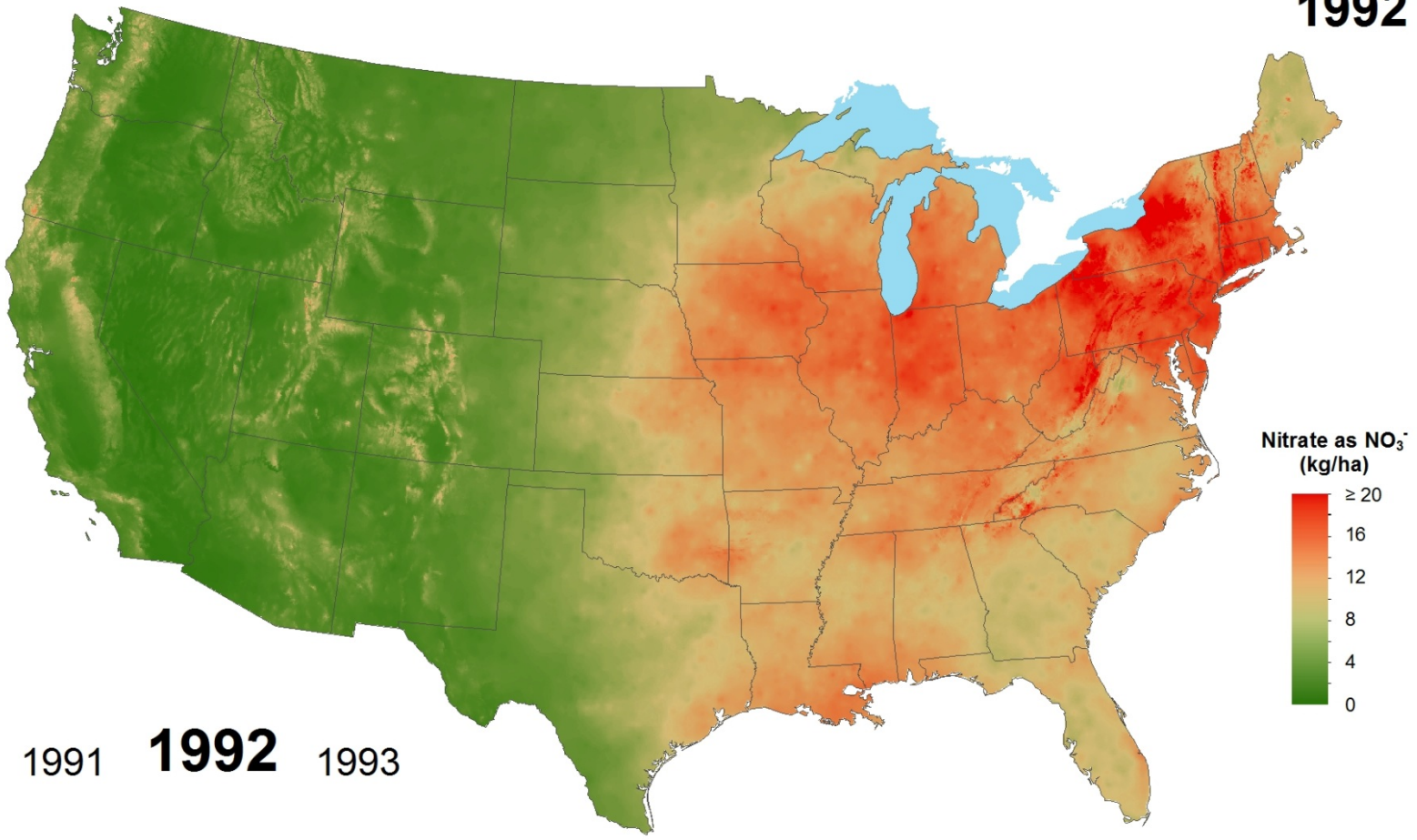
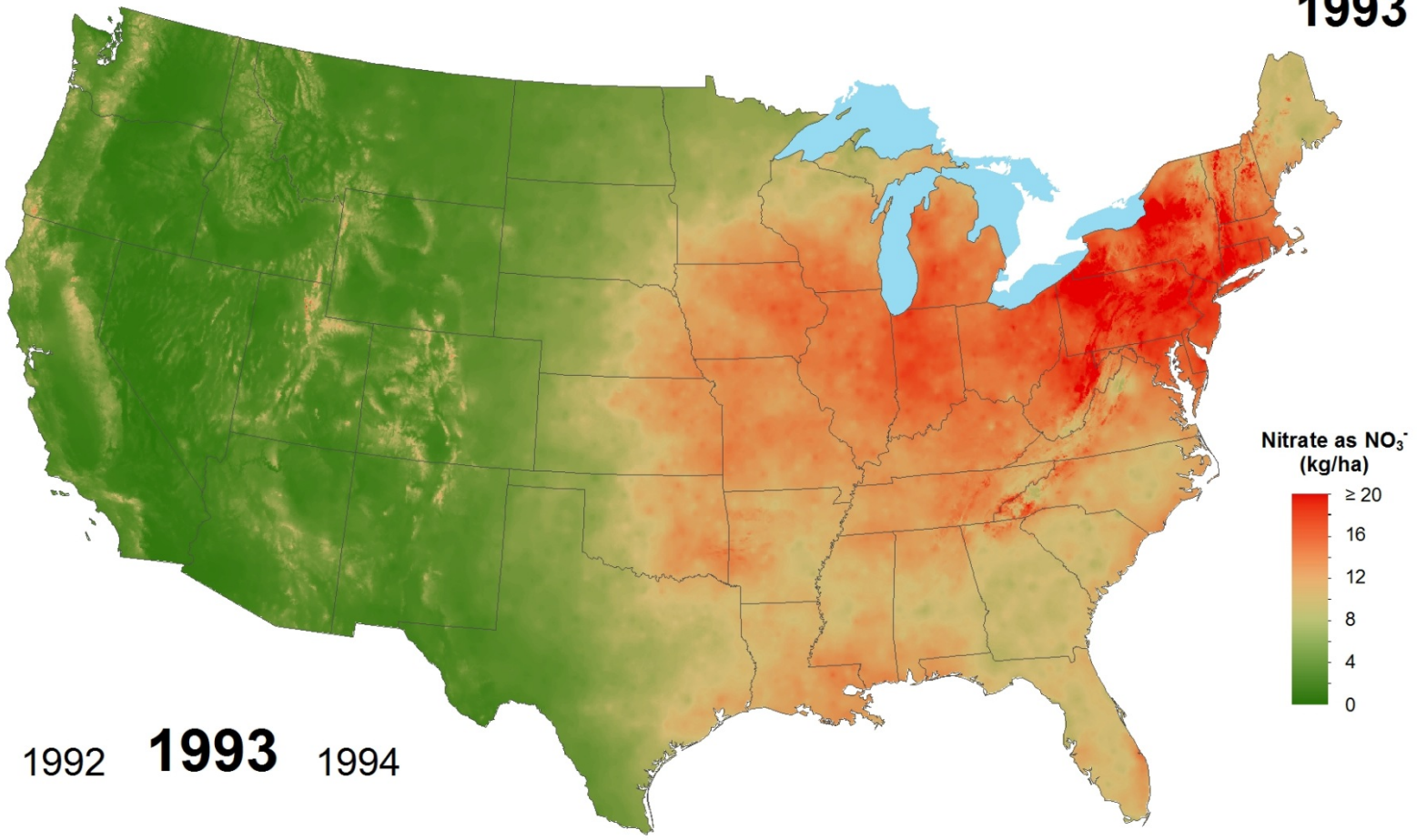
Nitrate ion wet deposition
1992



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate ion wet deposition
1993



National Atmospheric Deposition Program/National Trends Network
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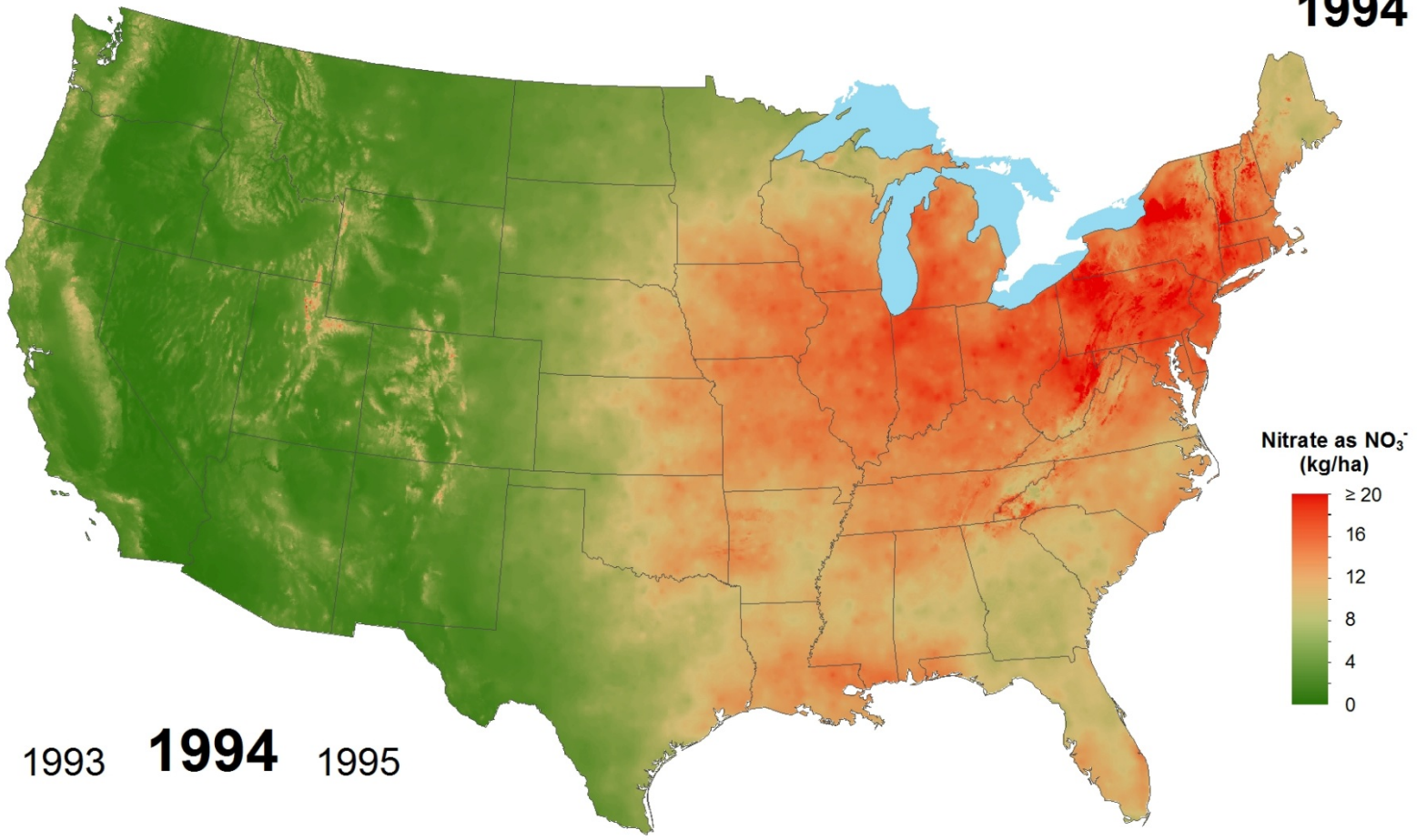
Nitrate ion wet deposition
1994



National Atmospheric Deposition Program/National Trends Network
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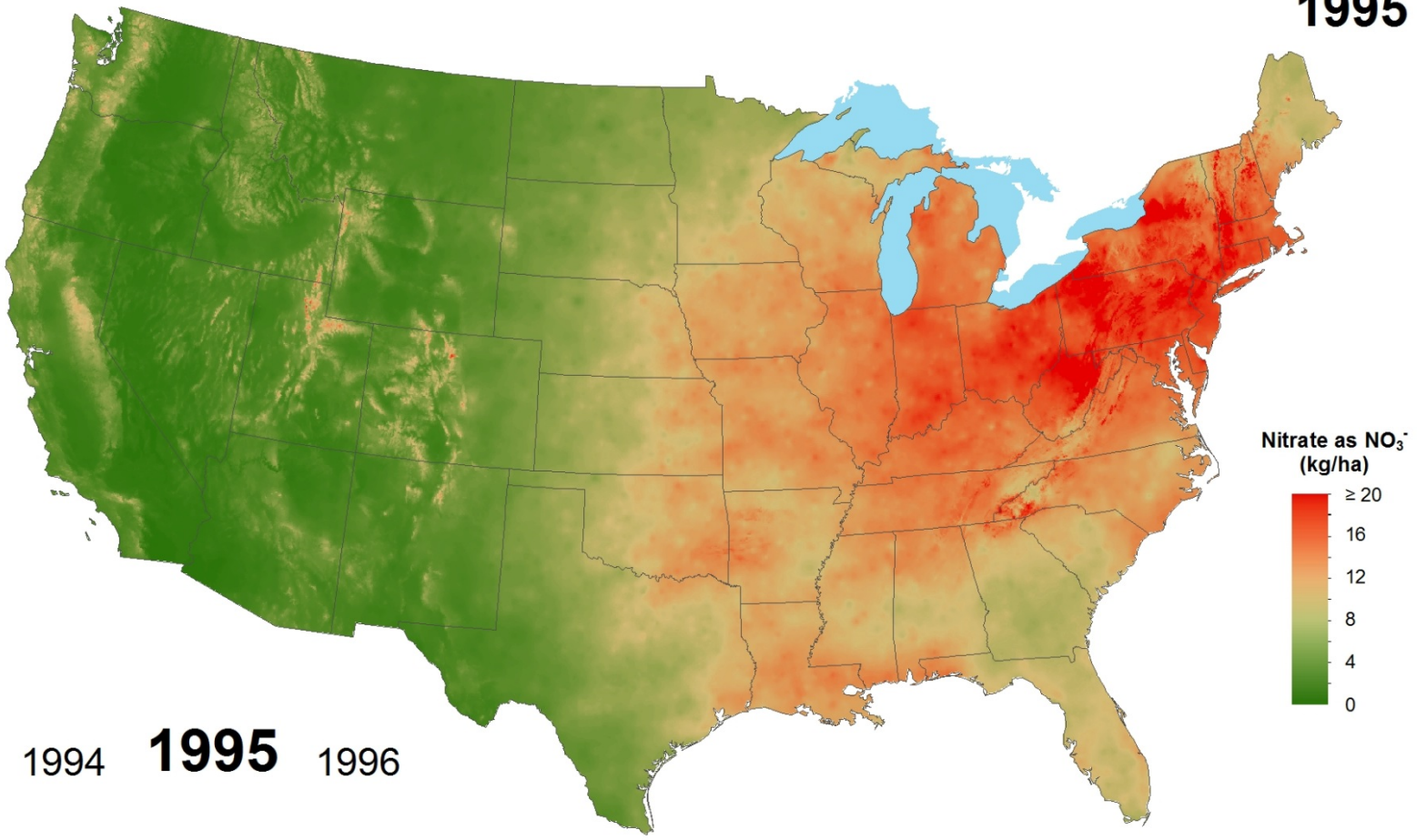
Nitrate ion wet deposition
1995



National Atmospheric Deposition Program/National Trends Network
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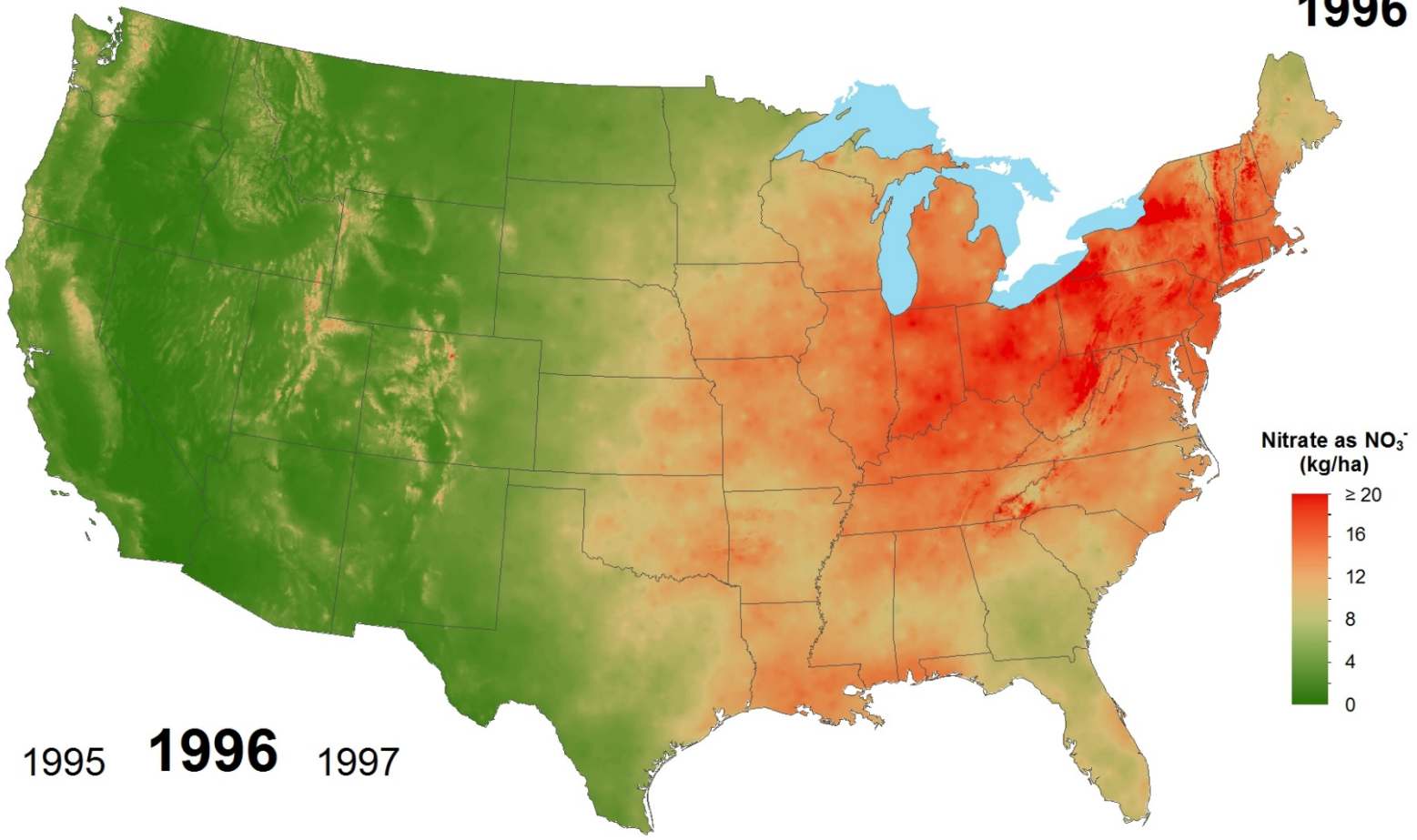
Nitrate ion wet deposition
1996



National Atmospheric Deposition Program/National Trends Network
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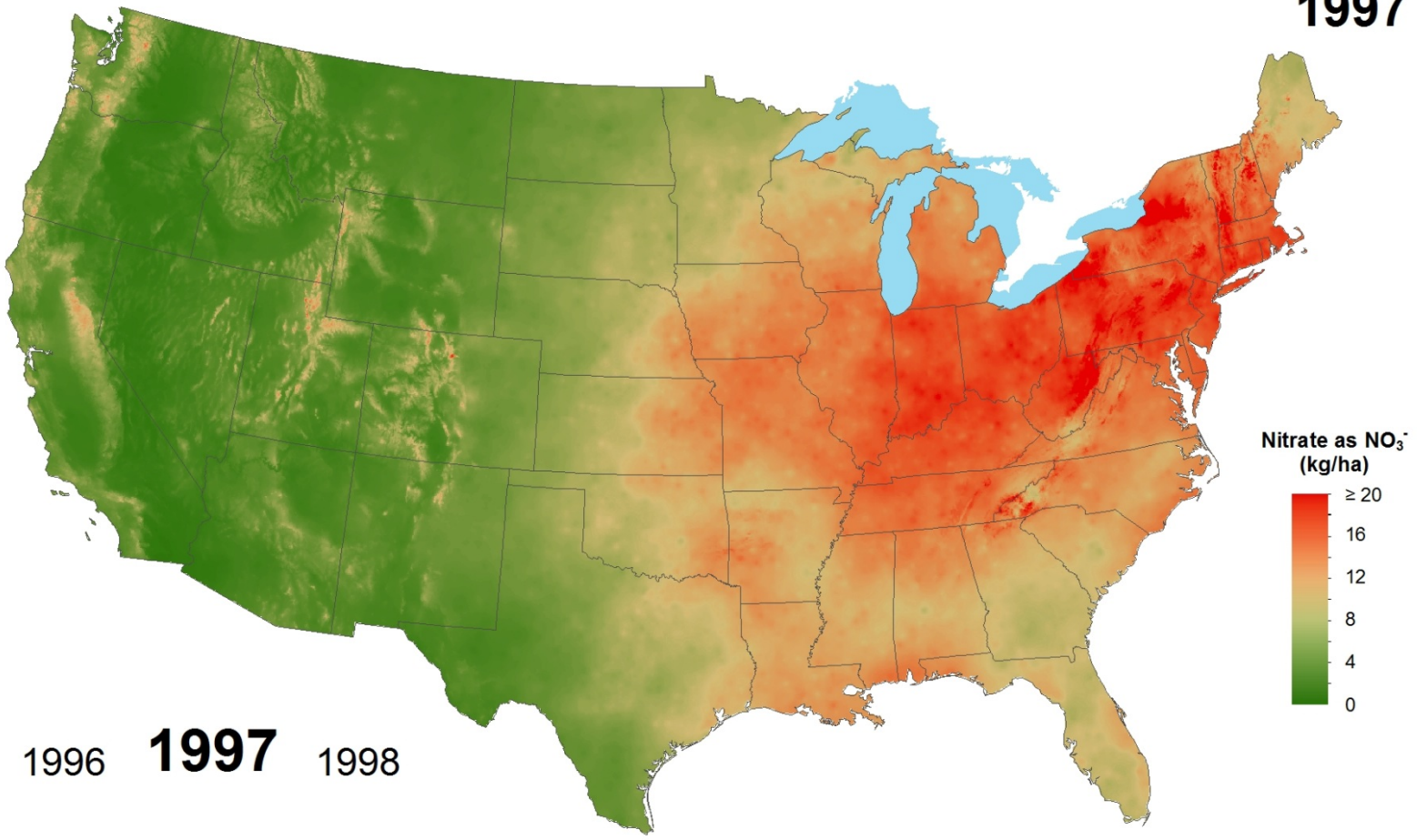
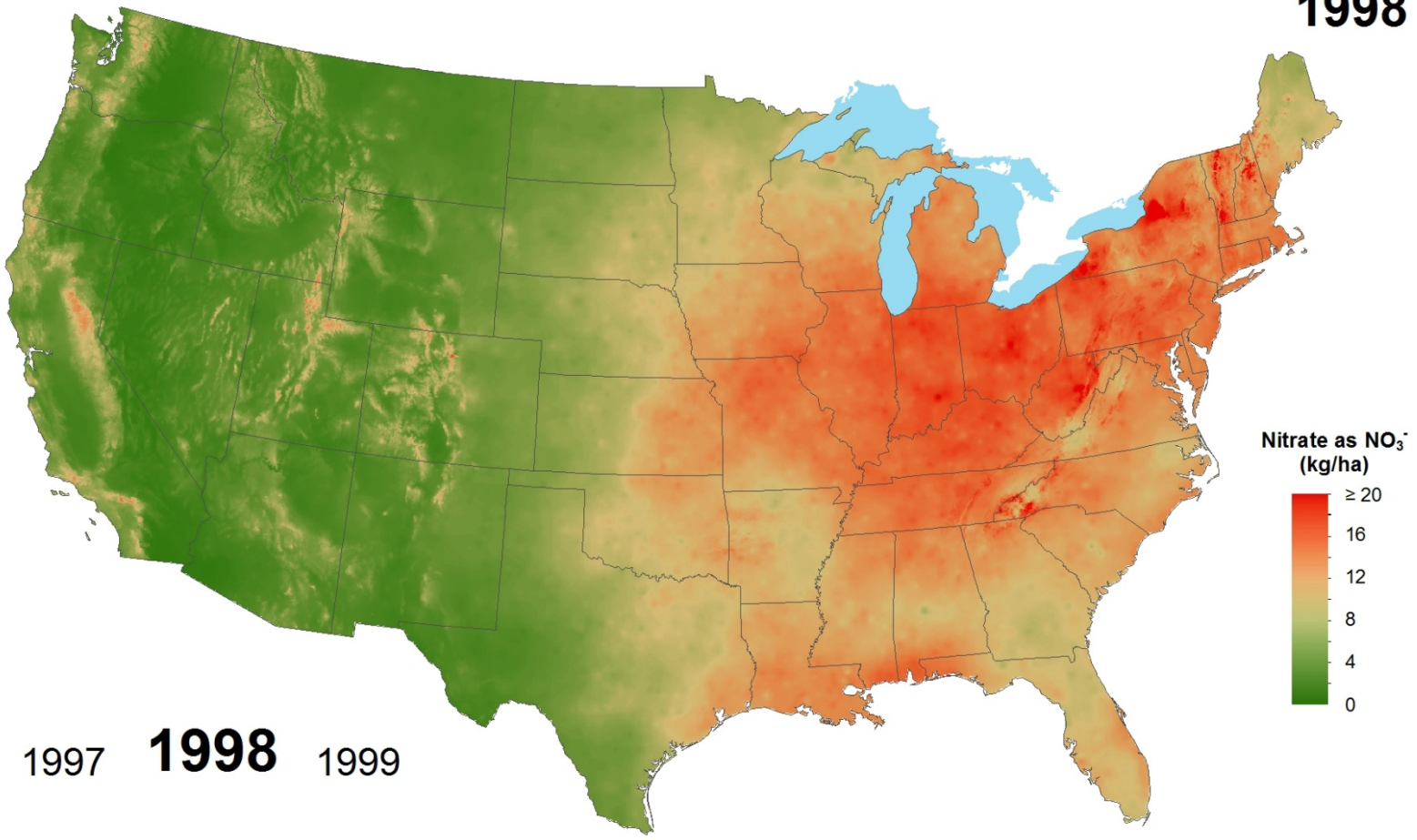
Nitrate ion wet deposition
1997



1996 **1997** 1998

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate ion wet deposition
1998



1997 **1998** 1999

National Atmospheric Deposition Program/National Trends Network
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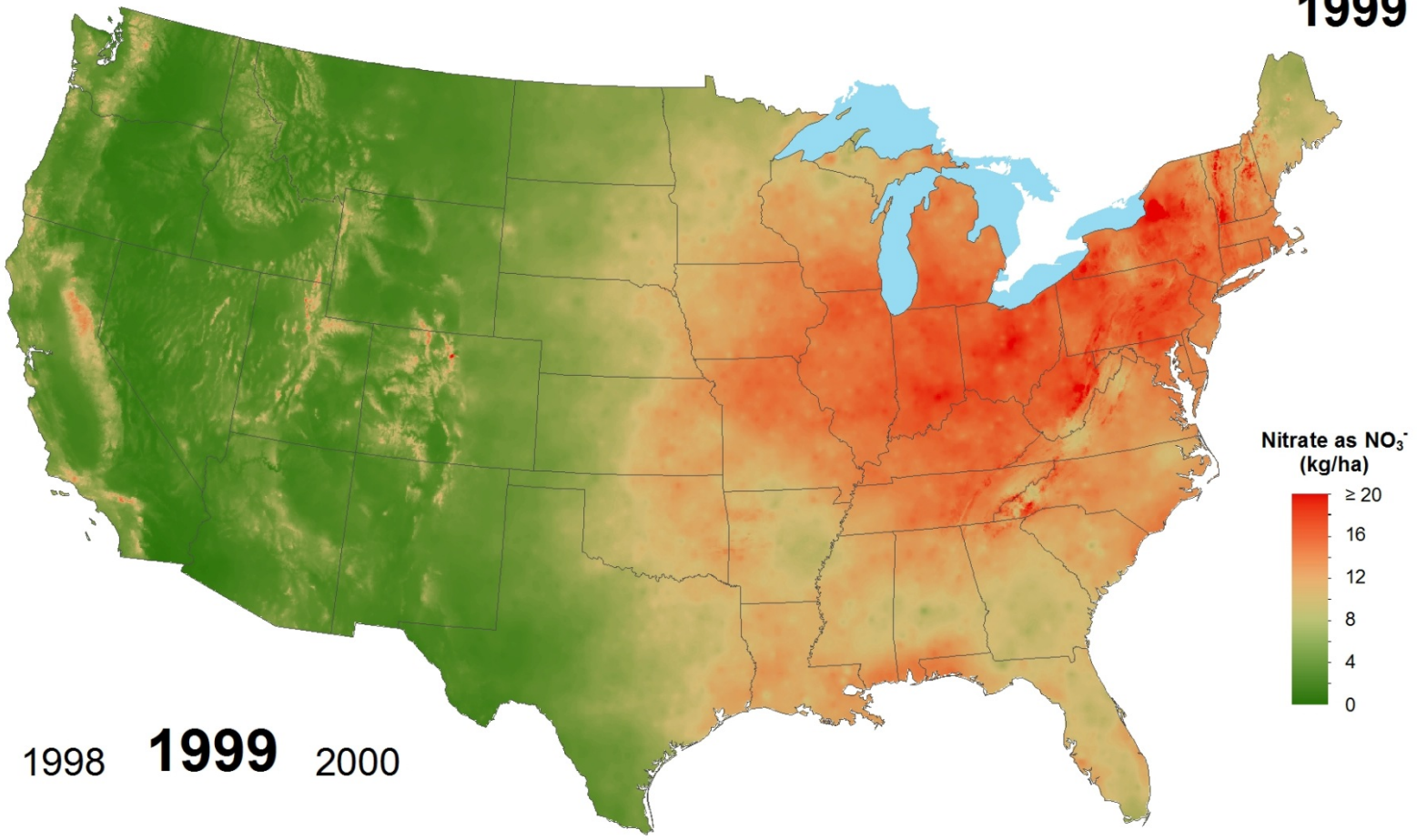
Nitrate ion wet deposition
1999



National Atmospheric Deposition Program/National Trends Network
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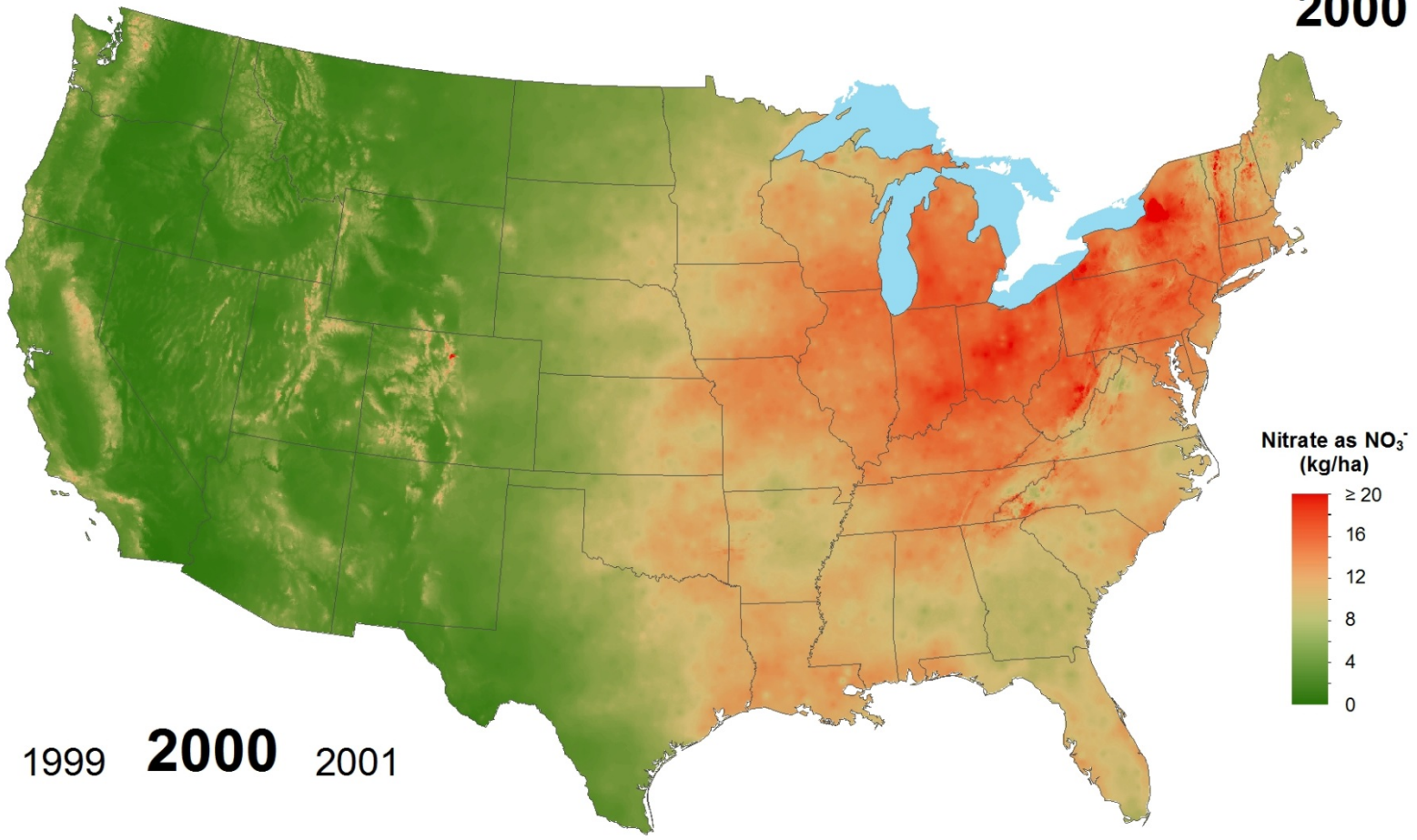
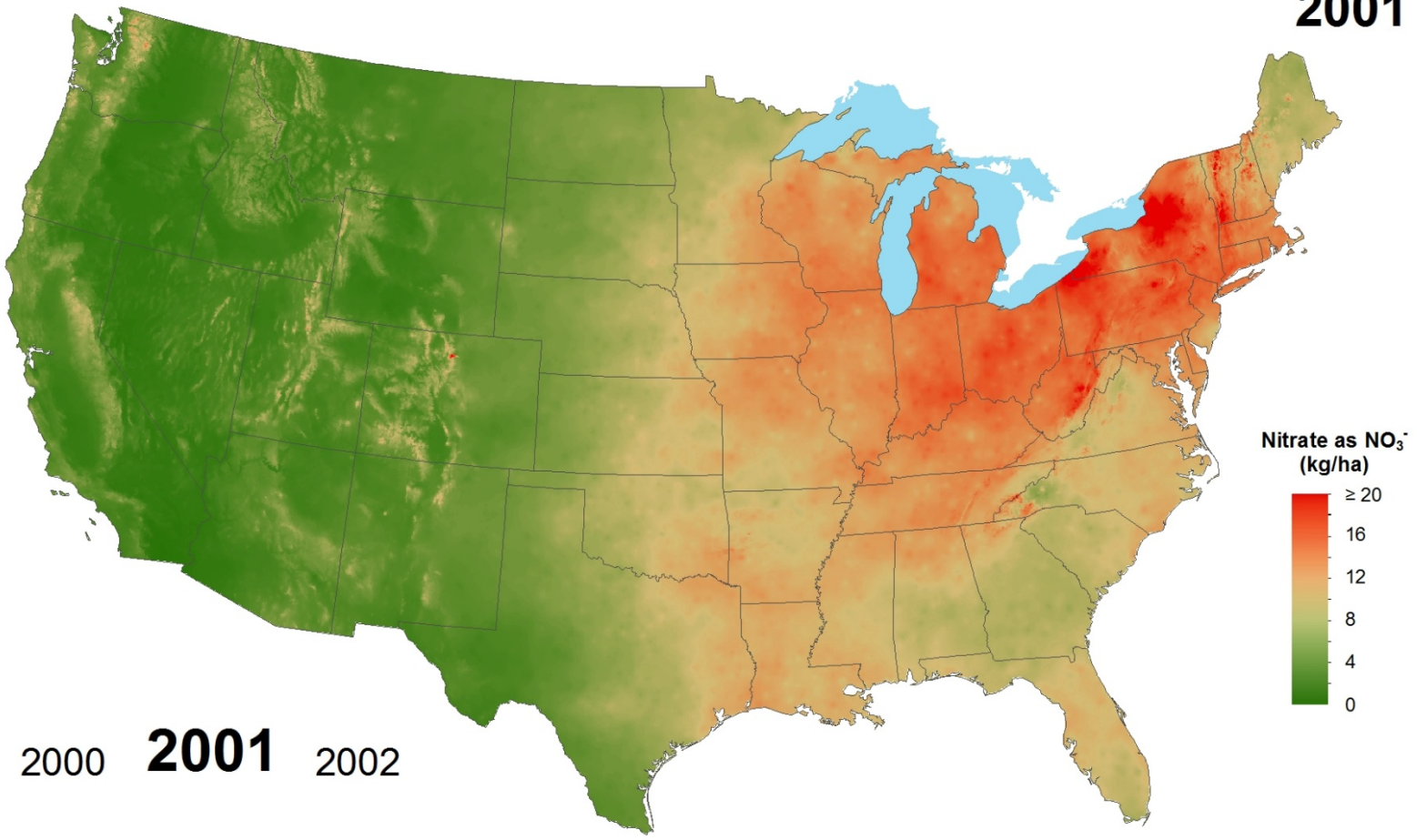
Nitrate ion wet deposition
2000



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate ion wet deposition
2001



National Atmospheric Deposition Program/National Trends Network
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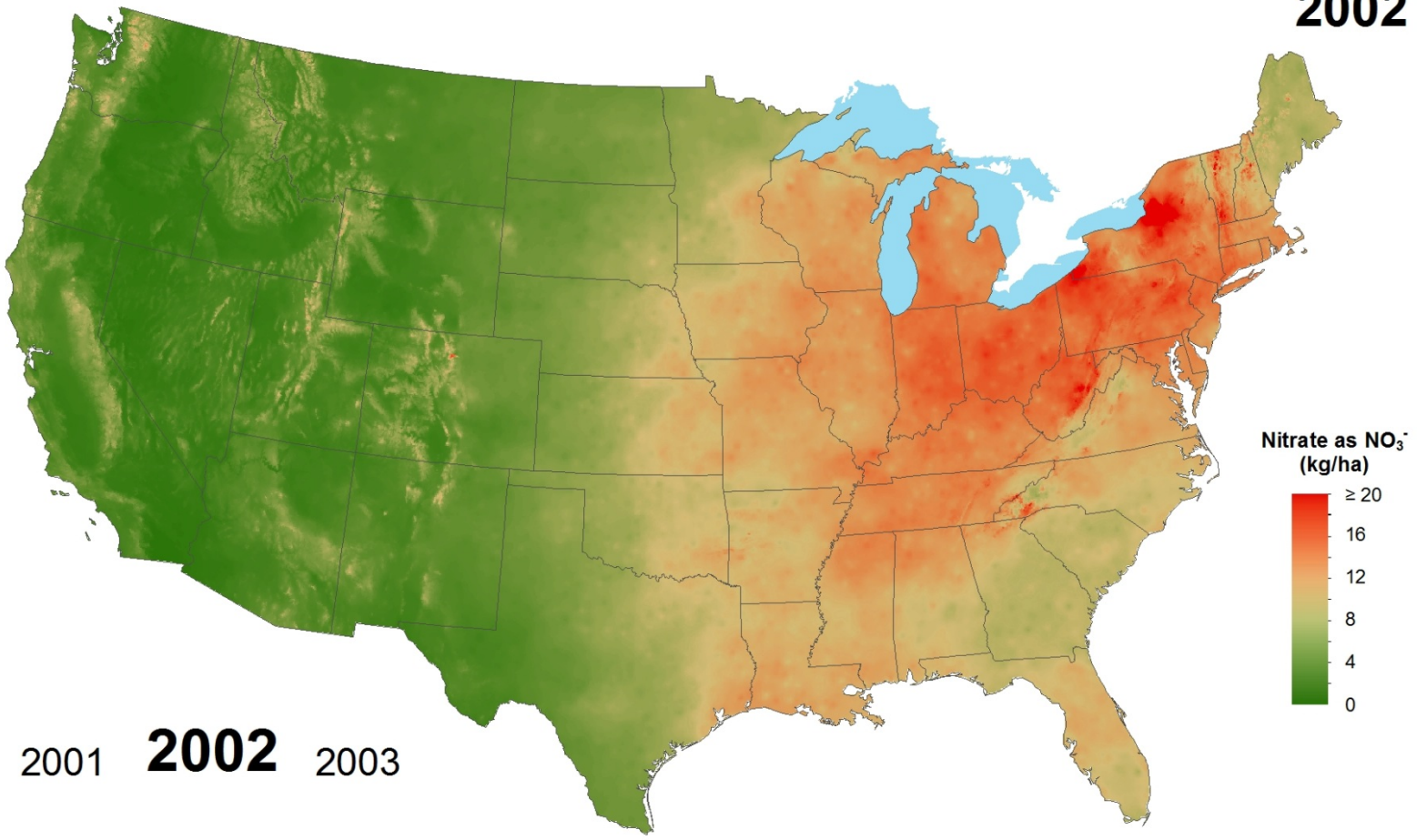
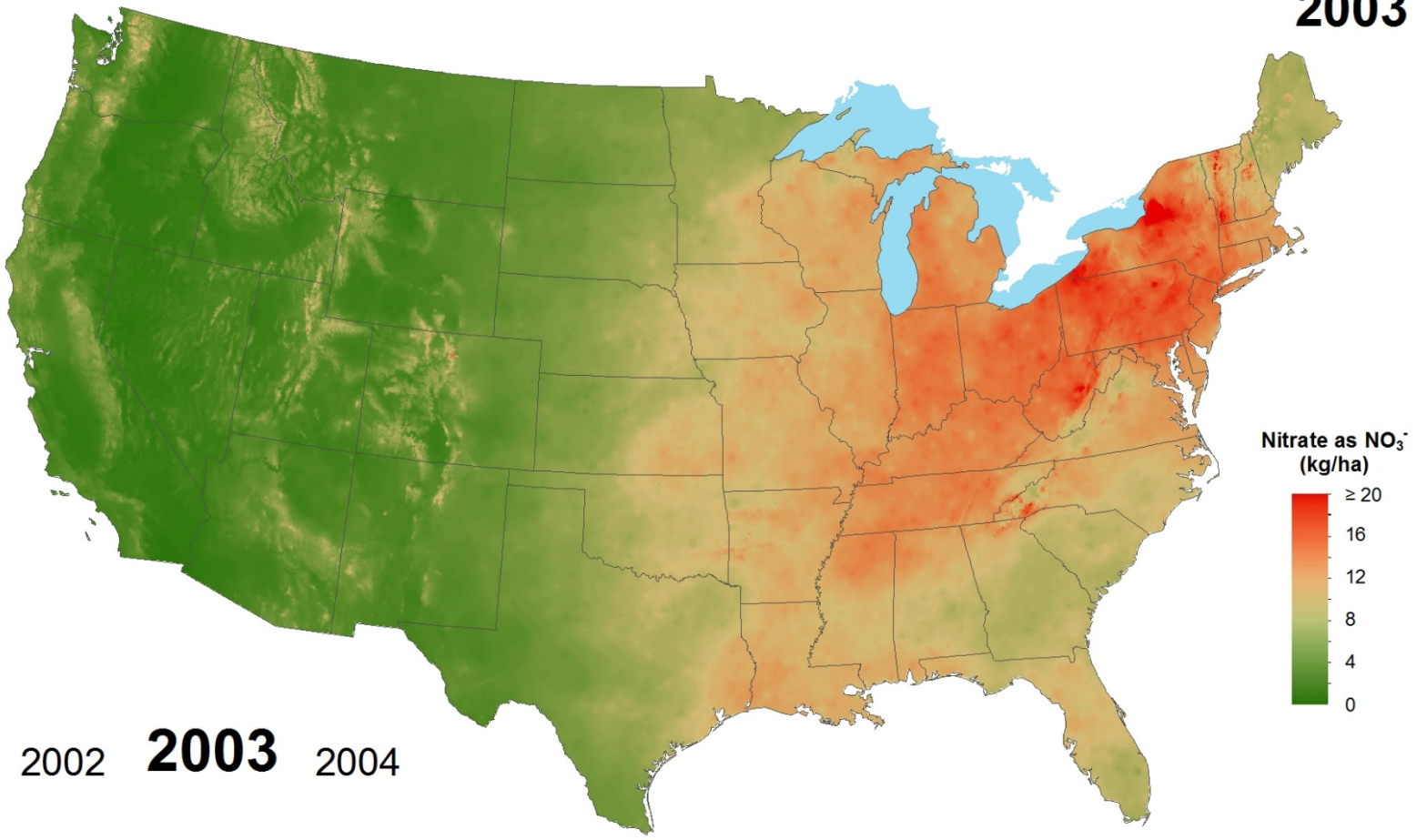
Nitrate ion wet deposition
2002



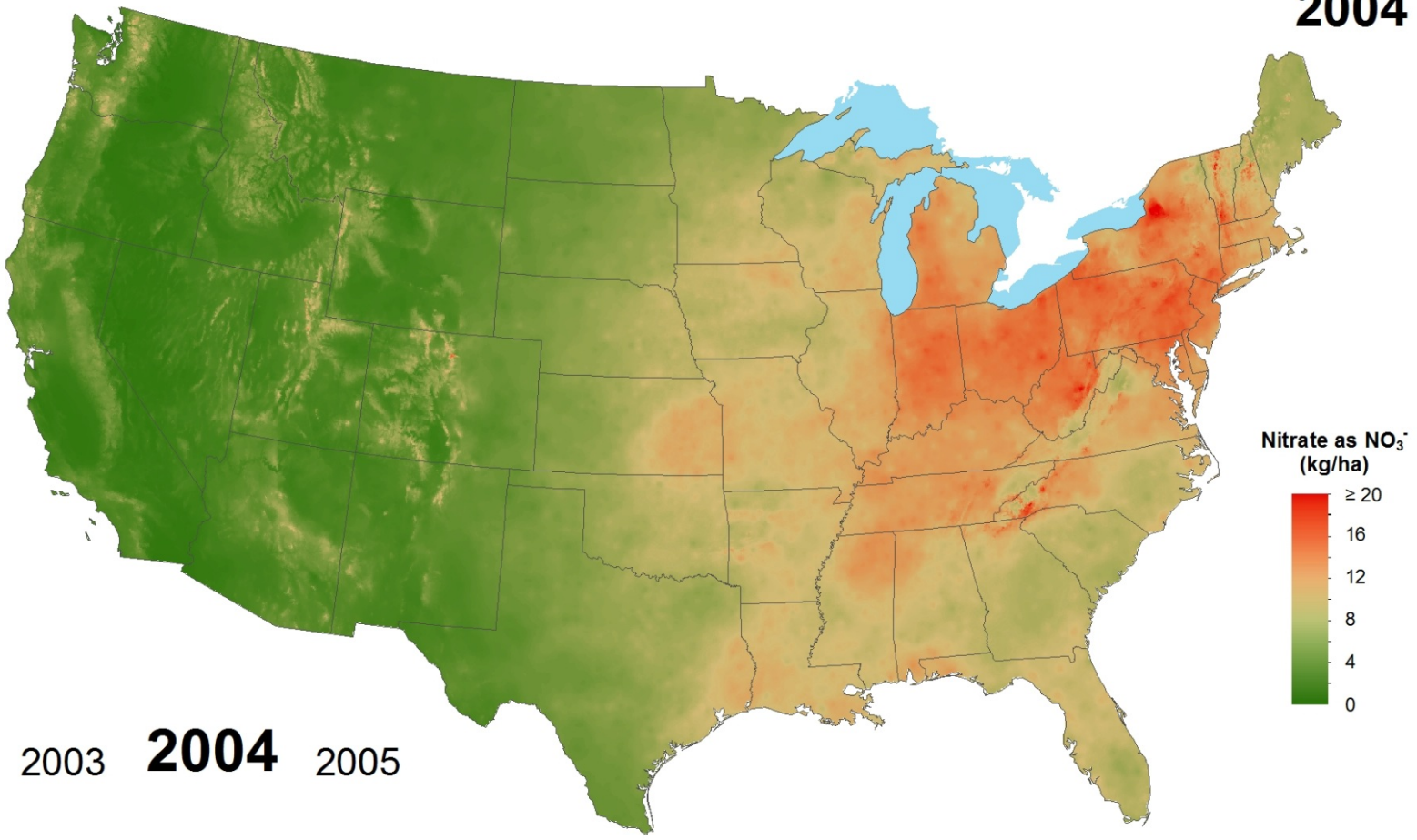
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate ion wet deposition
2003



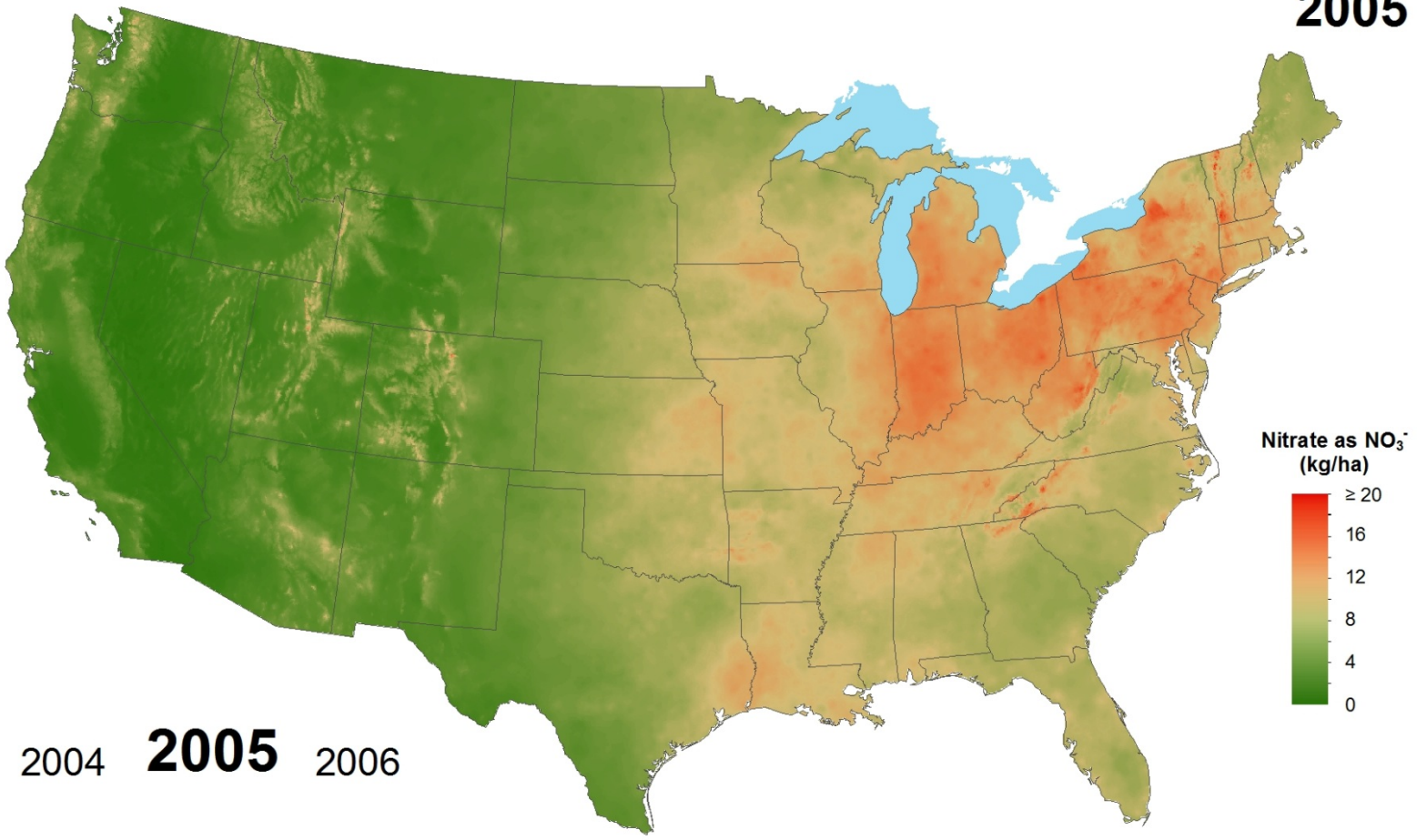
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate ion wet deposition
2004



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Nitrate ion wet deposition
2005



National Atmospheric Deposition Program/National Trends Network
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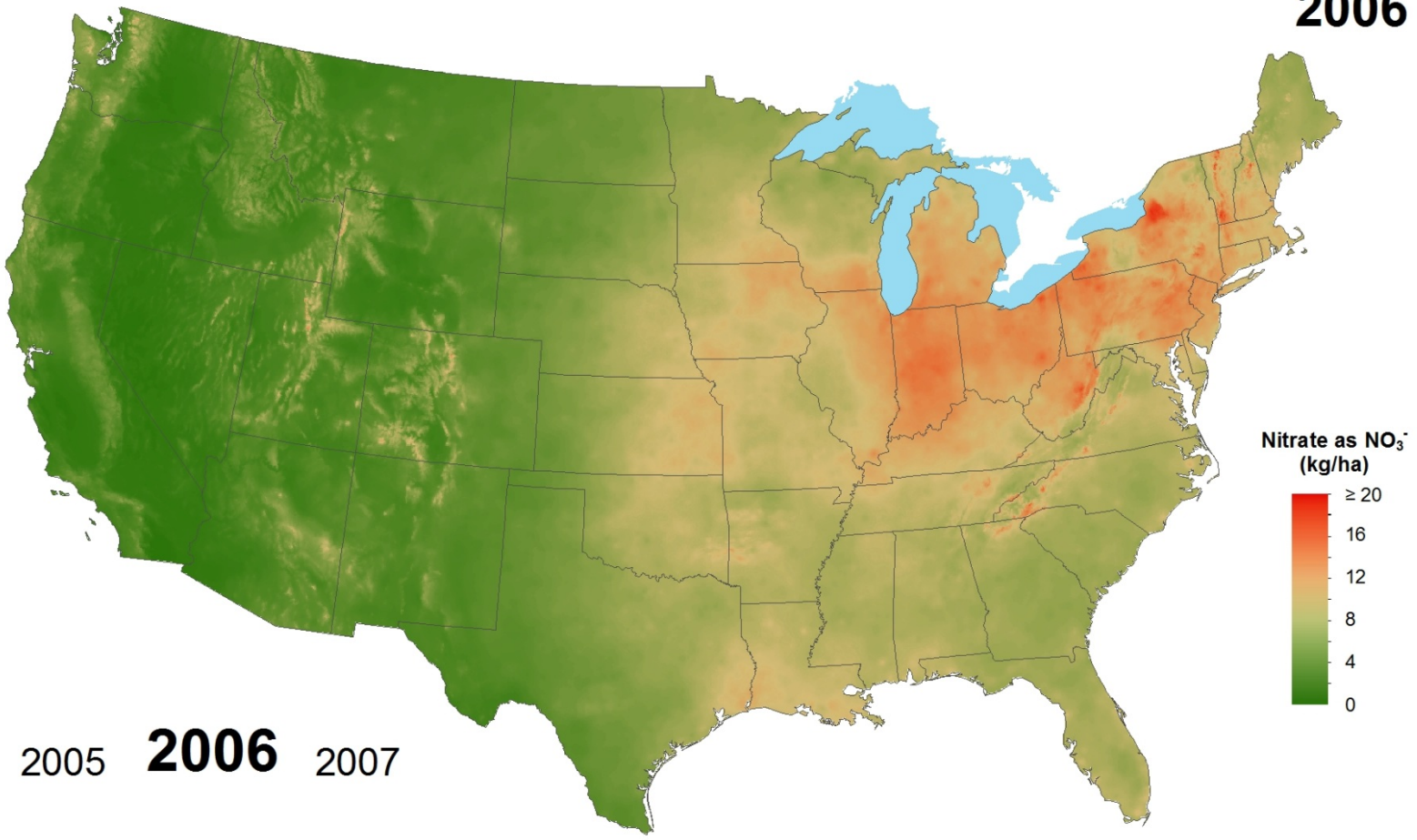
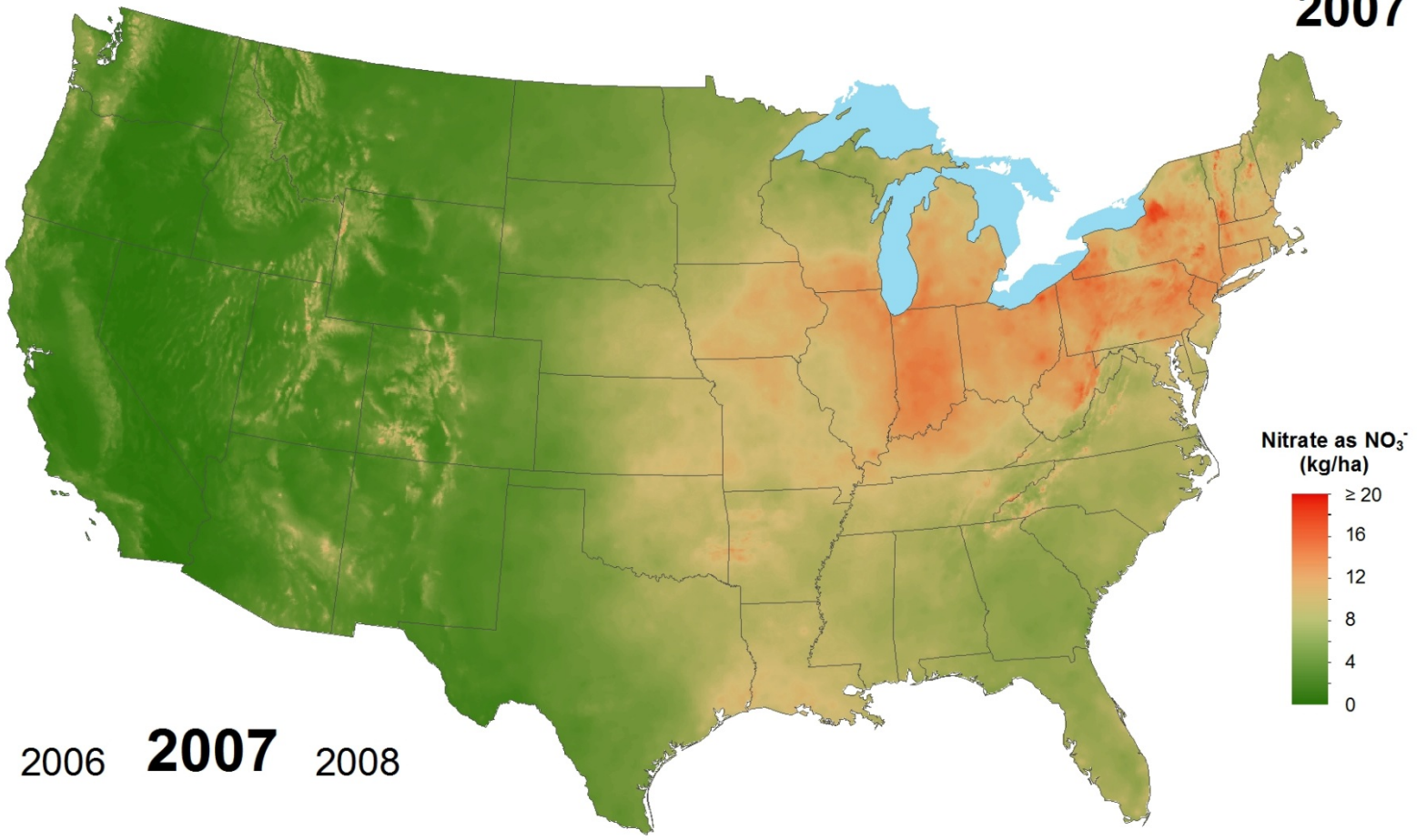
Nitrate ion wet deposition
2006



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

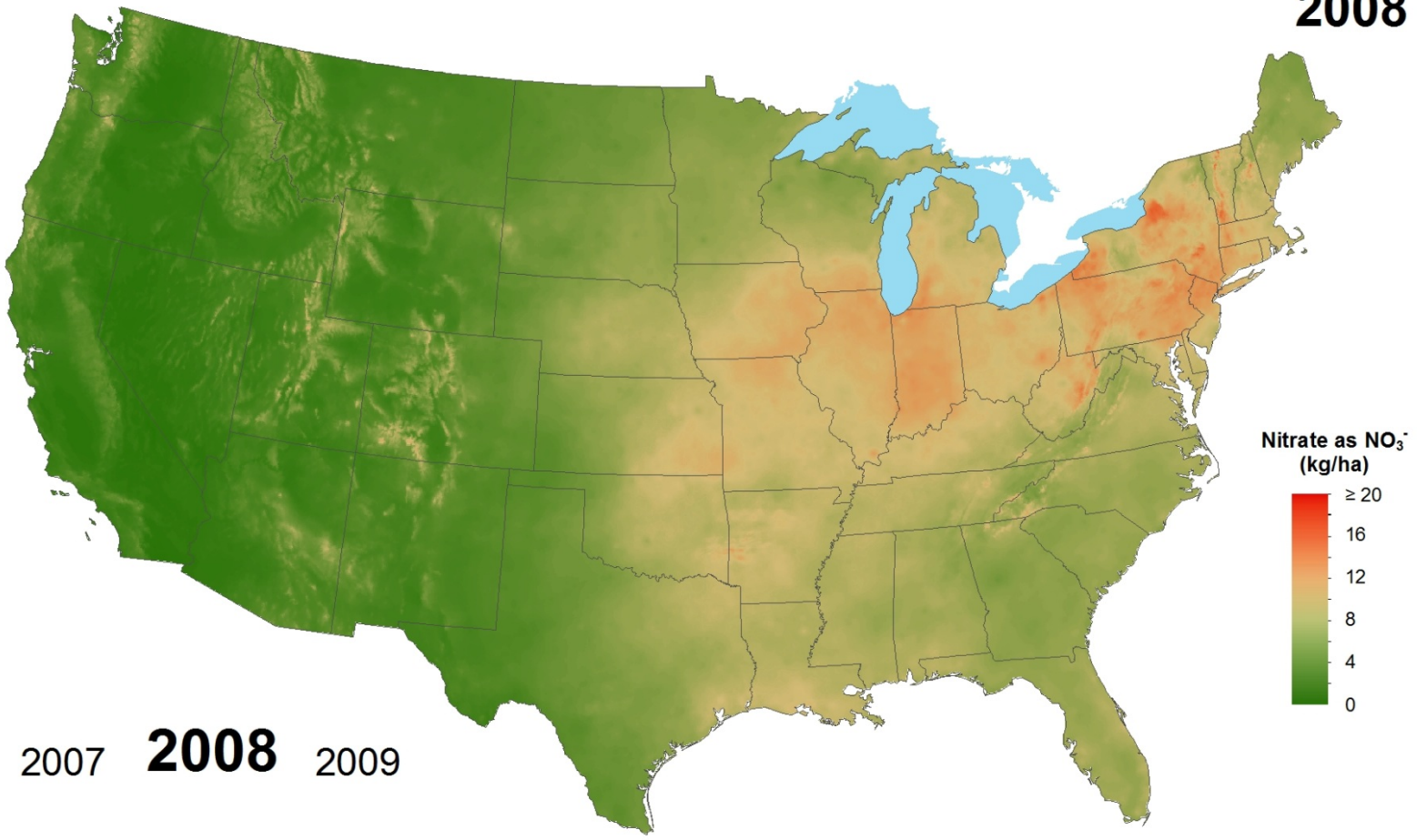
Nitrate ion wet deposition
2007



2006 **2007** 2008

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

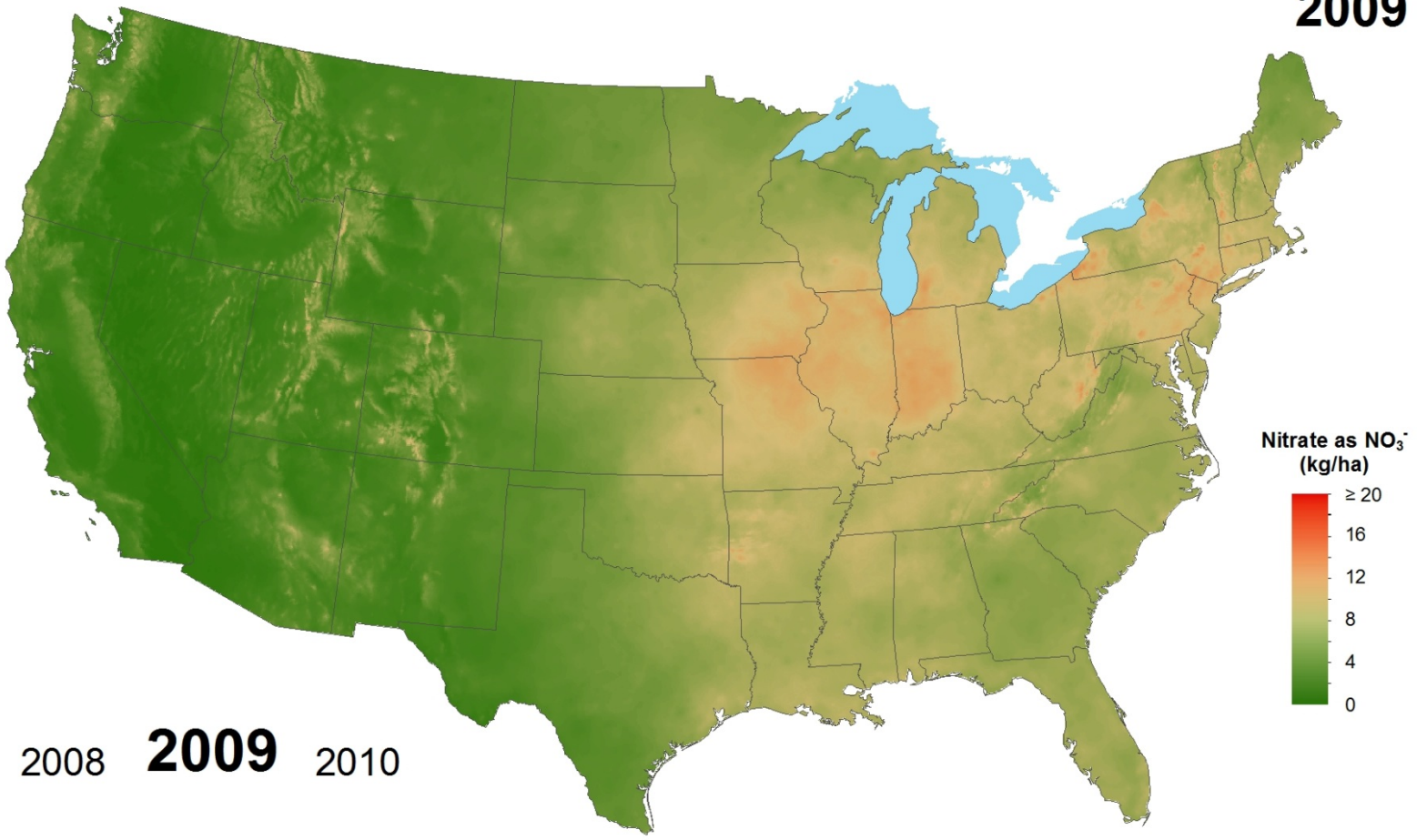
Nitrate ion wet deposition
2008



2007 **2008** 2009

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

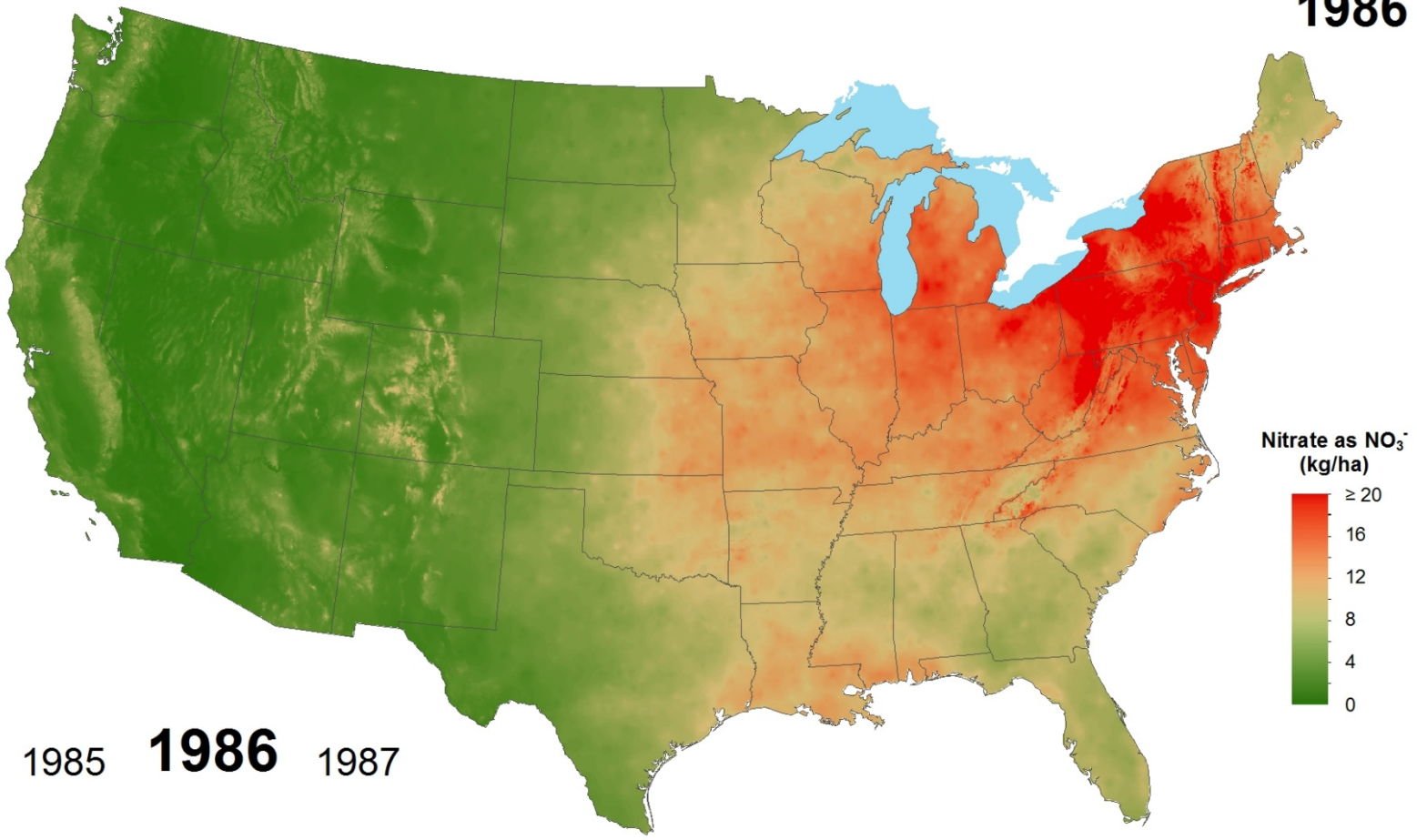
Nitrate ion wet deposition
2009



2008 **2009** 2010

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

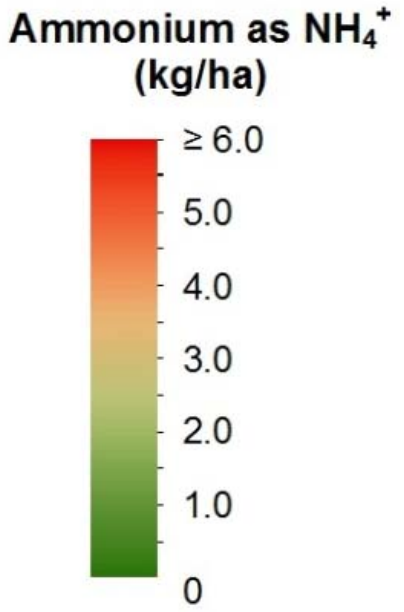
Nitrate ion wet deposition
1986



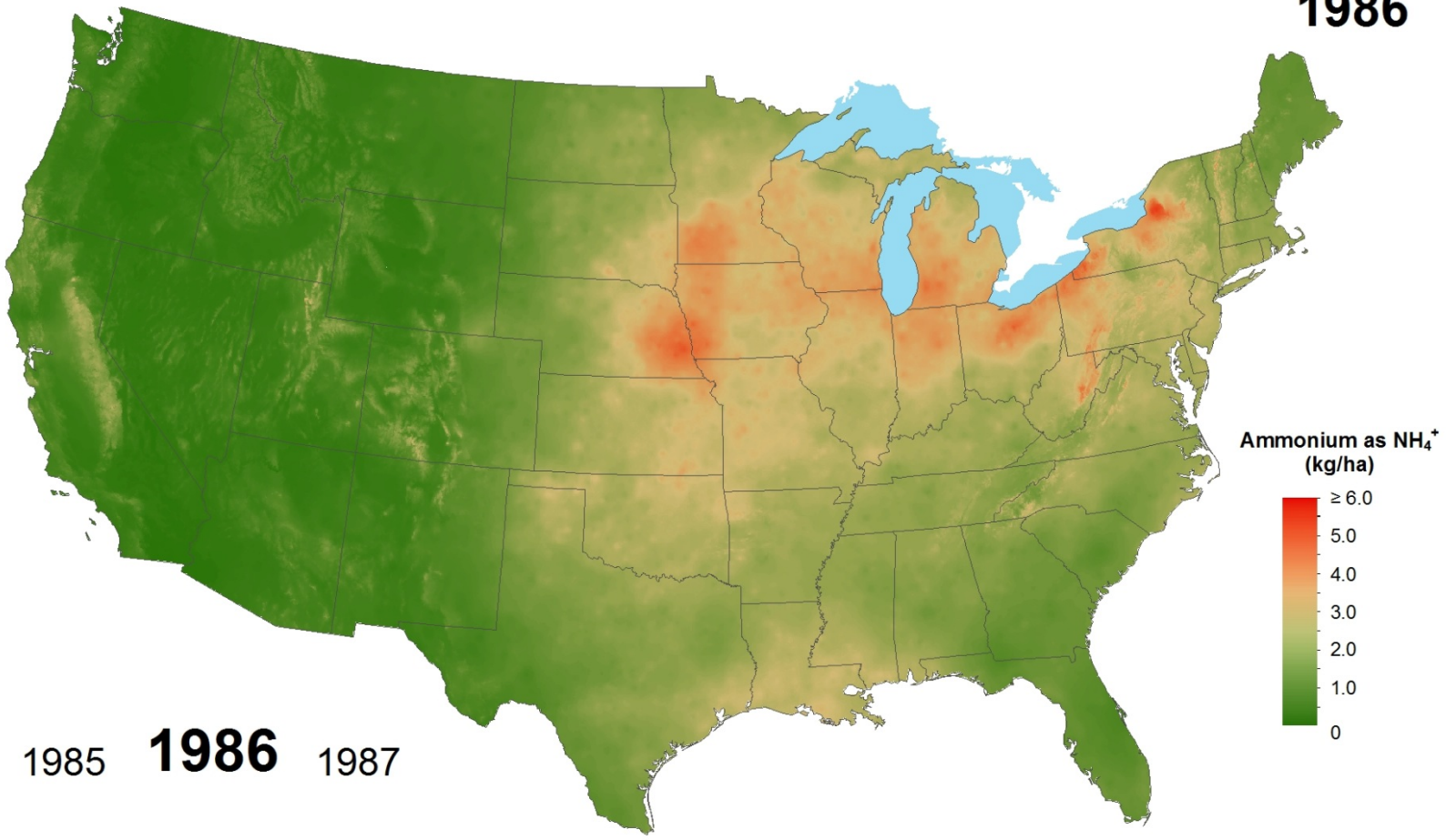
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium Ion
Wet Deposition Trends

3-year running
annual average
(1985 – 2010)



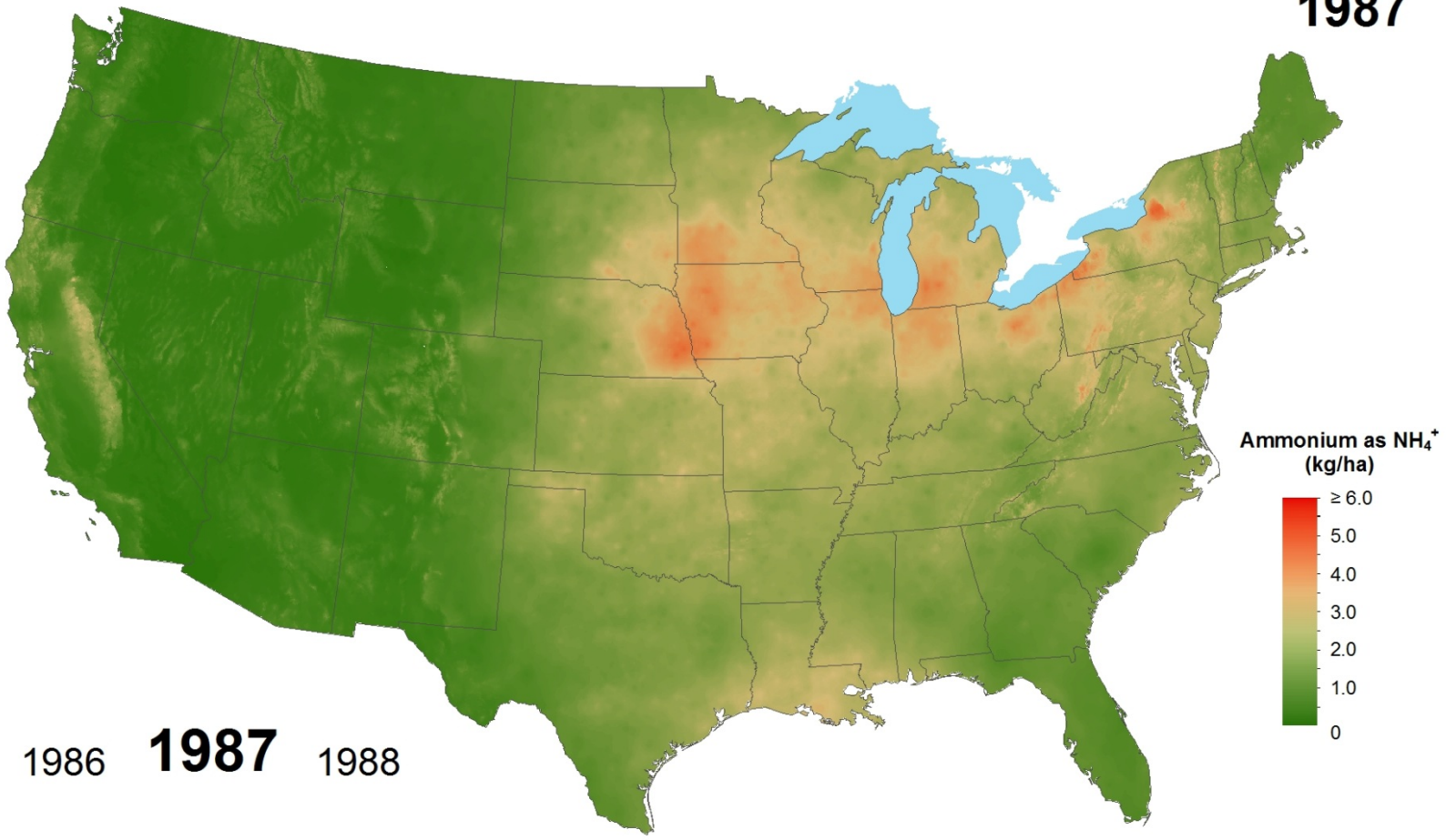
Ammonium ion wet deposition
1986



1985 **1986** 1987

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
1987



1986 **1987** 1988

National Atmospheric Deposition Program/National Trends Network
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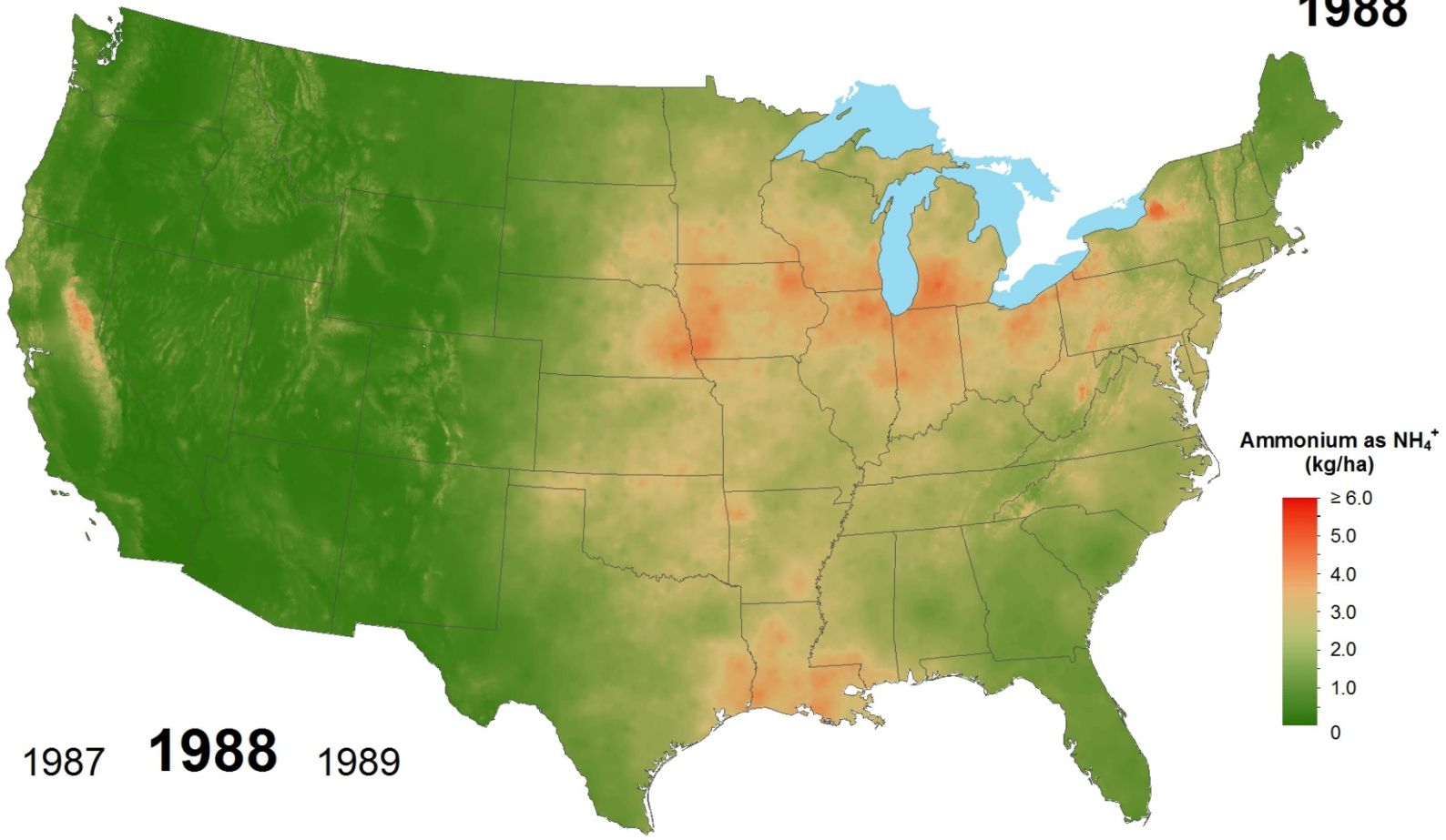
Ammonium ion wet deposition
1988



1987 **1988** 1989

National Atmospheric Deposition Program/National Trends Network
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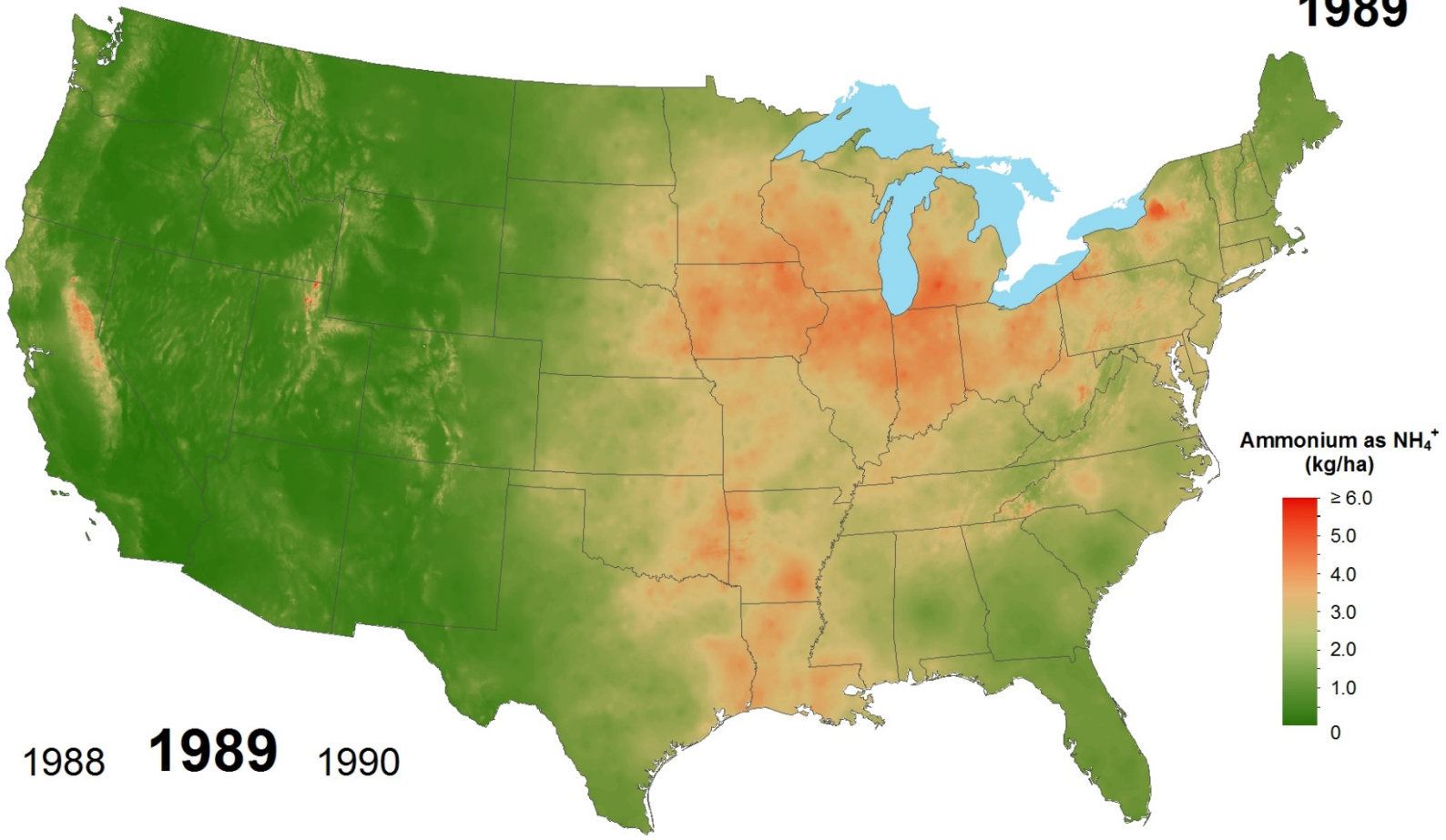
Ammonium ion wet deposition
1989



1988 **1989** 1990

National Atmospheric Deposition Program/National Trends Network
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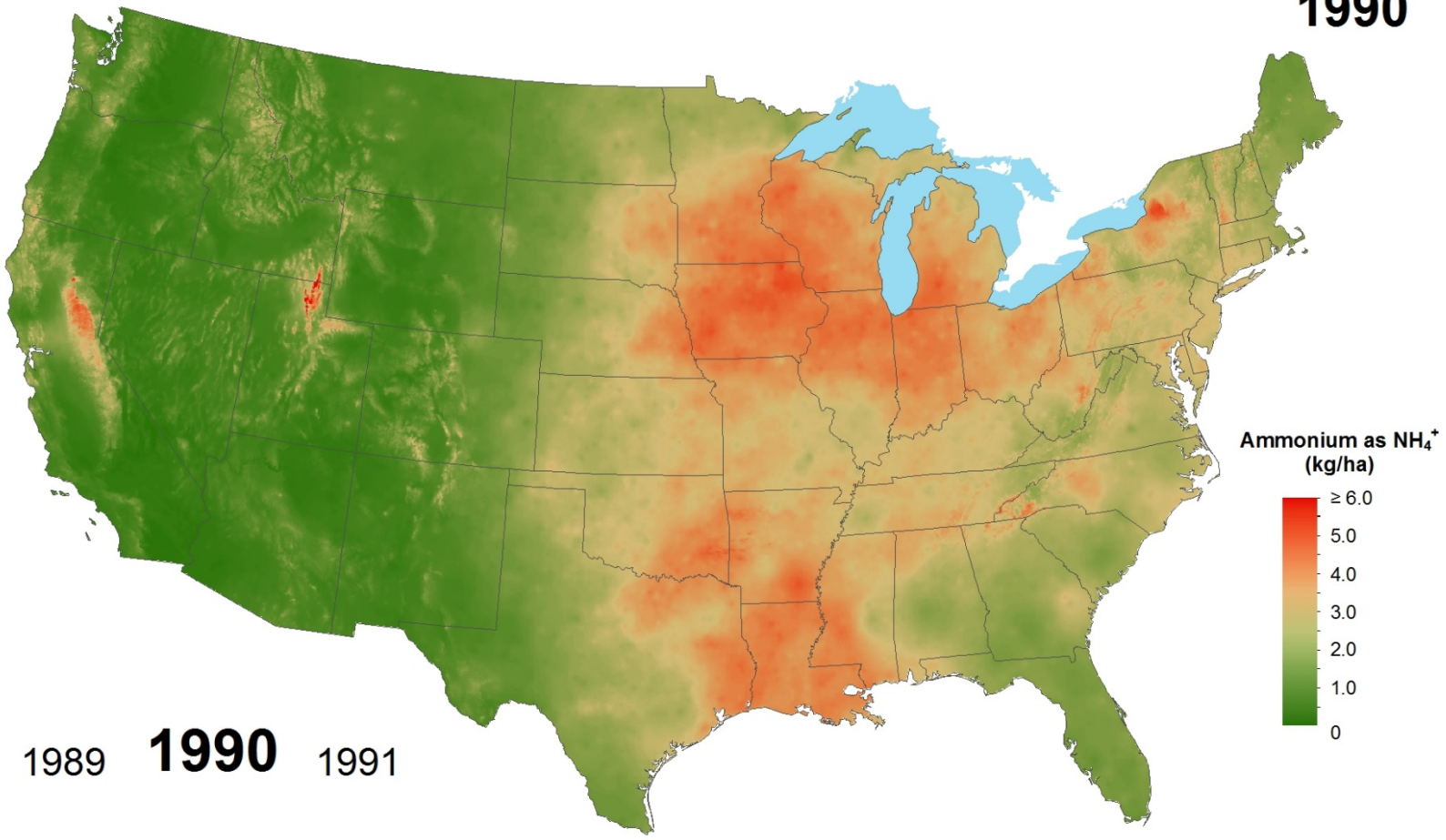
Ammonium ion wet deposition
1990



1989 **1990** 1991

National Atmospheric Deposition Program/National Trends Network
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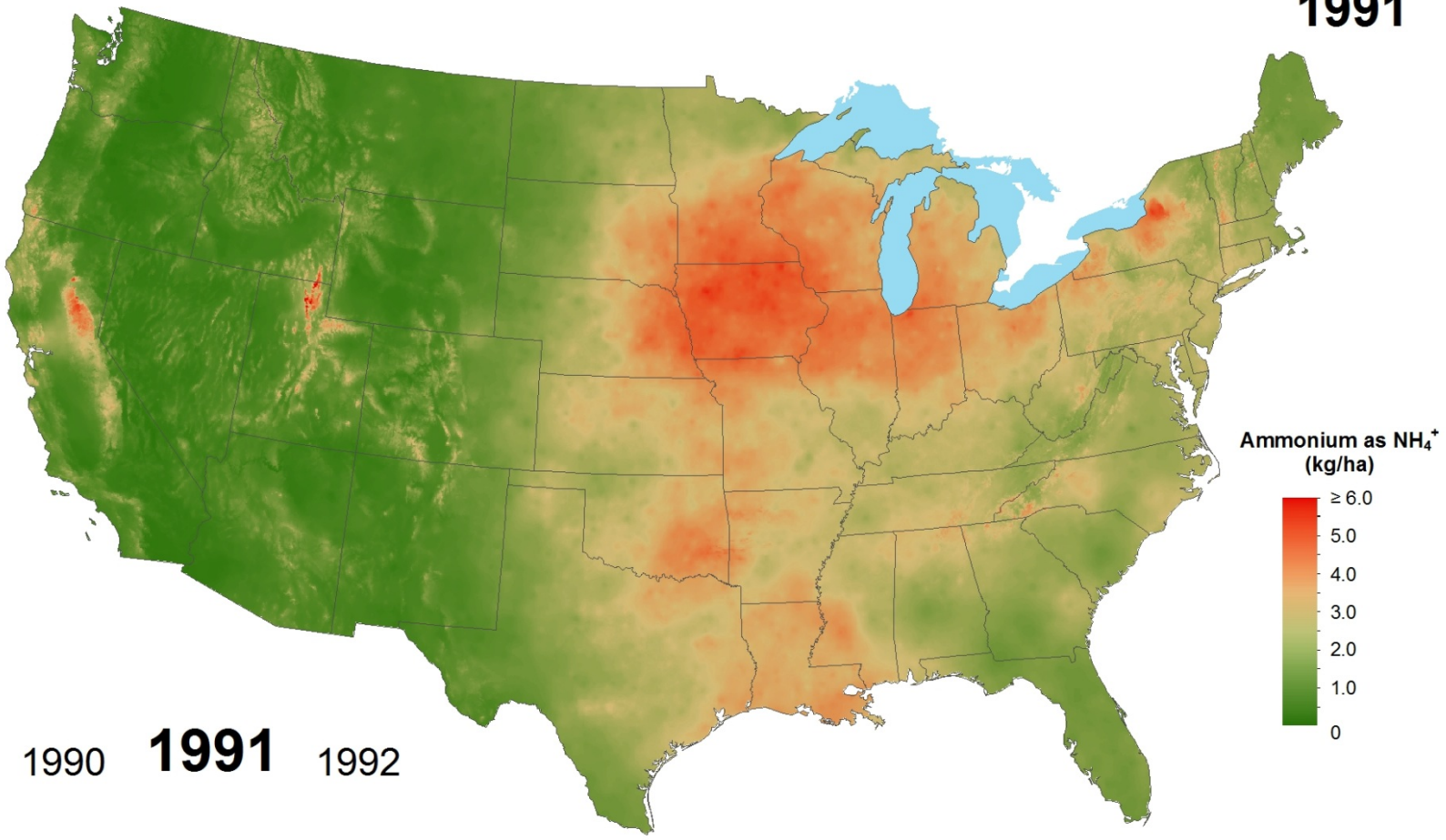
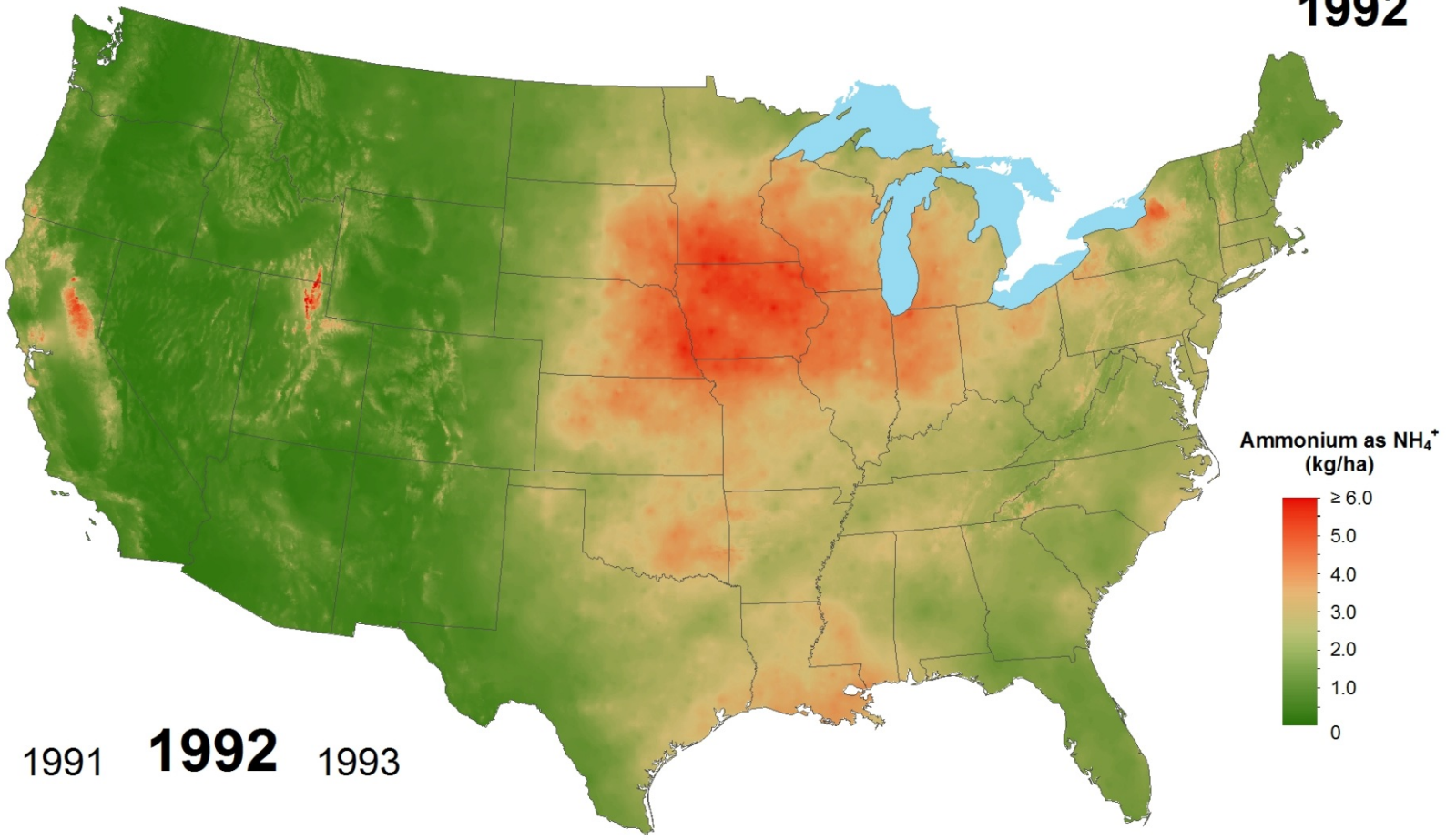
Ammonium ion wet deposition
1991



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
1992



National Atmospheric Deposition Program/National Trends Network
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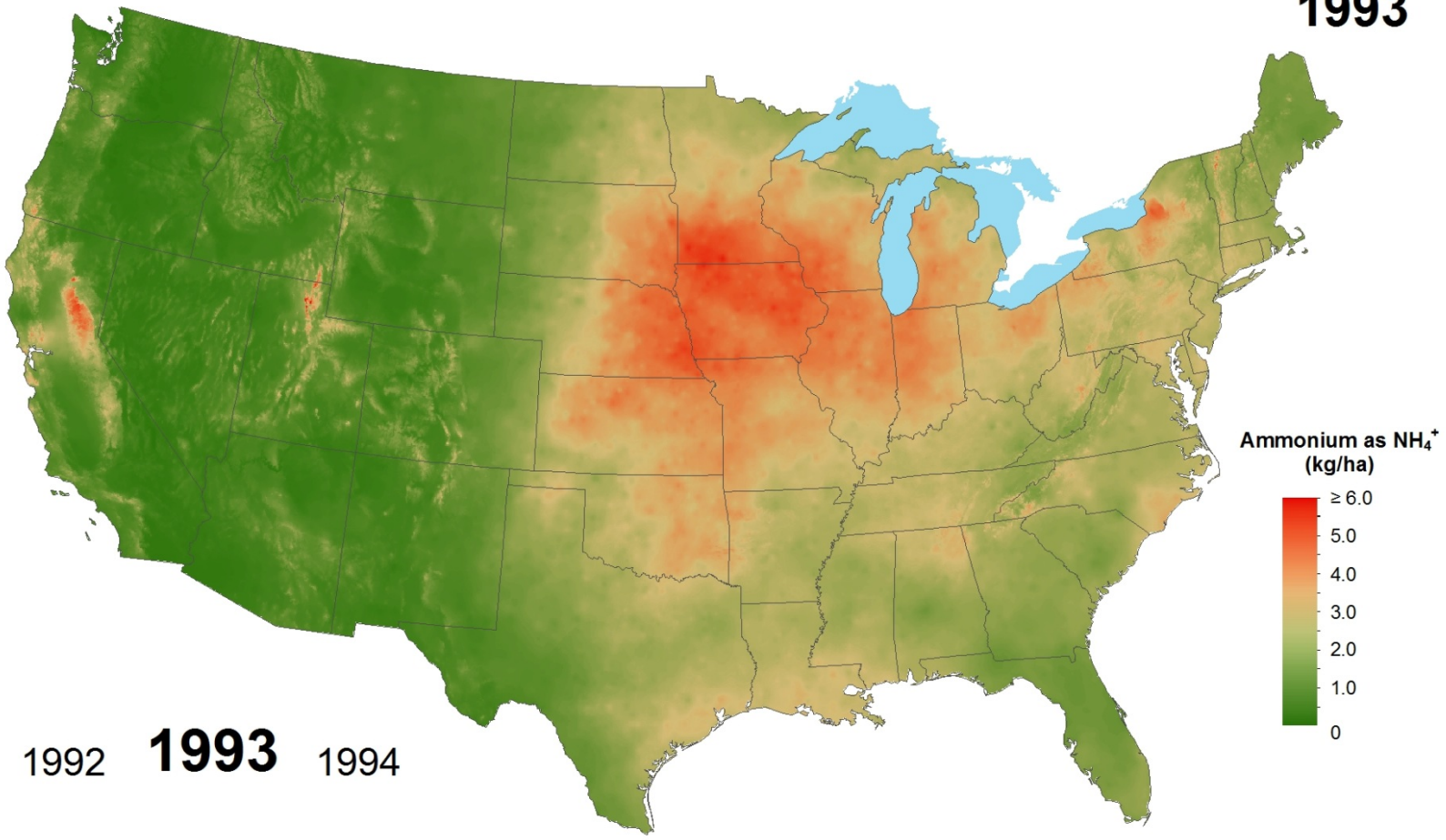
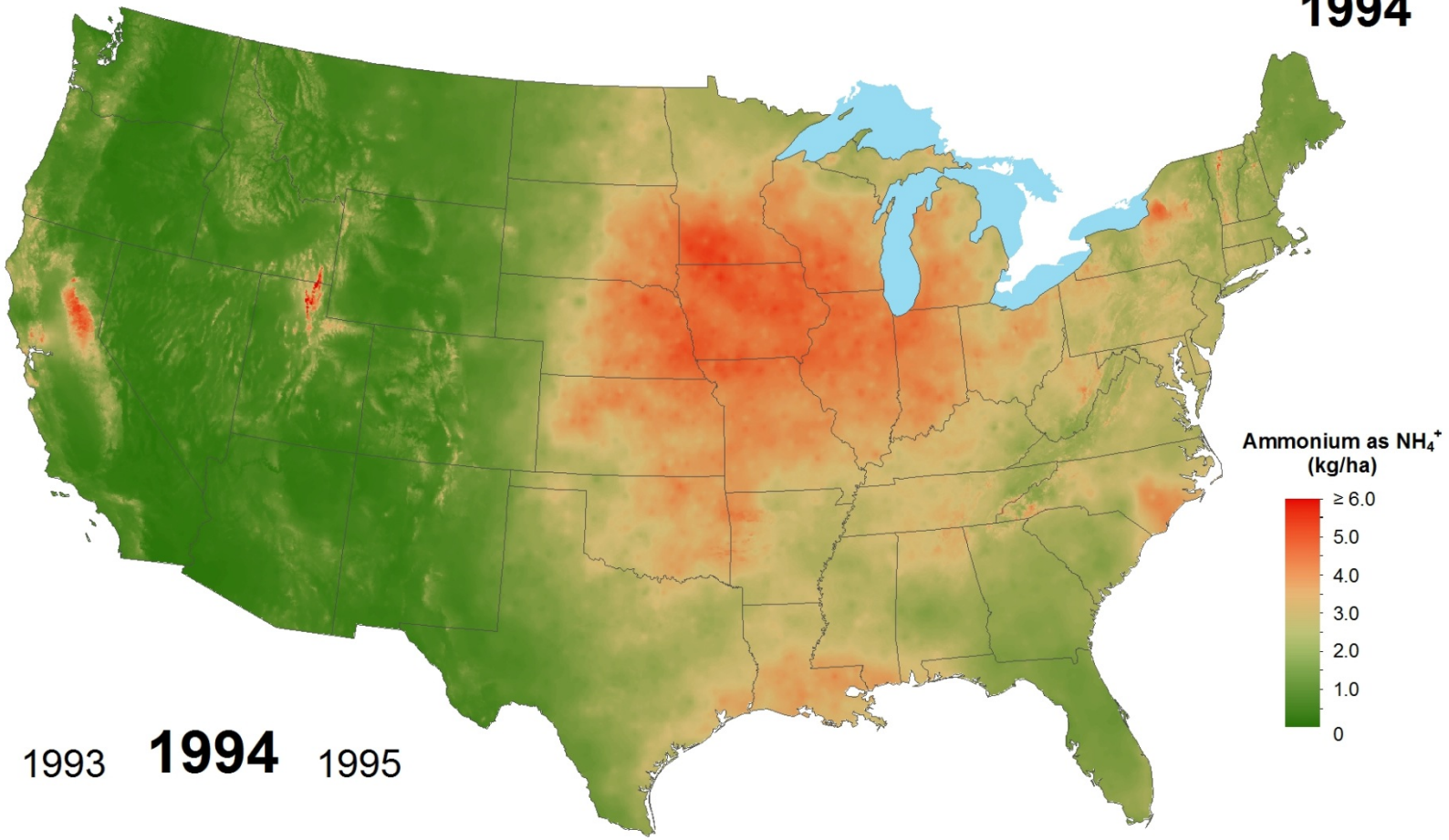
Ammonium ion wet deposition
1993



1992 **1993** 1994

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
1994



National Atmospheric Deposition Program/National Trends Network
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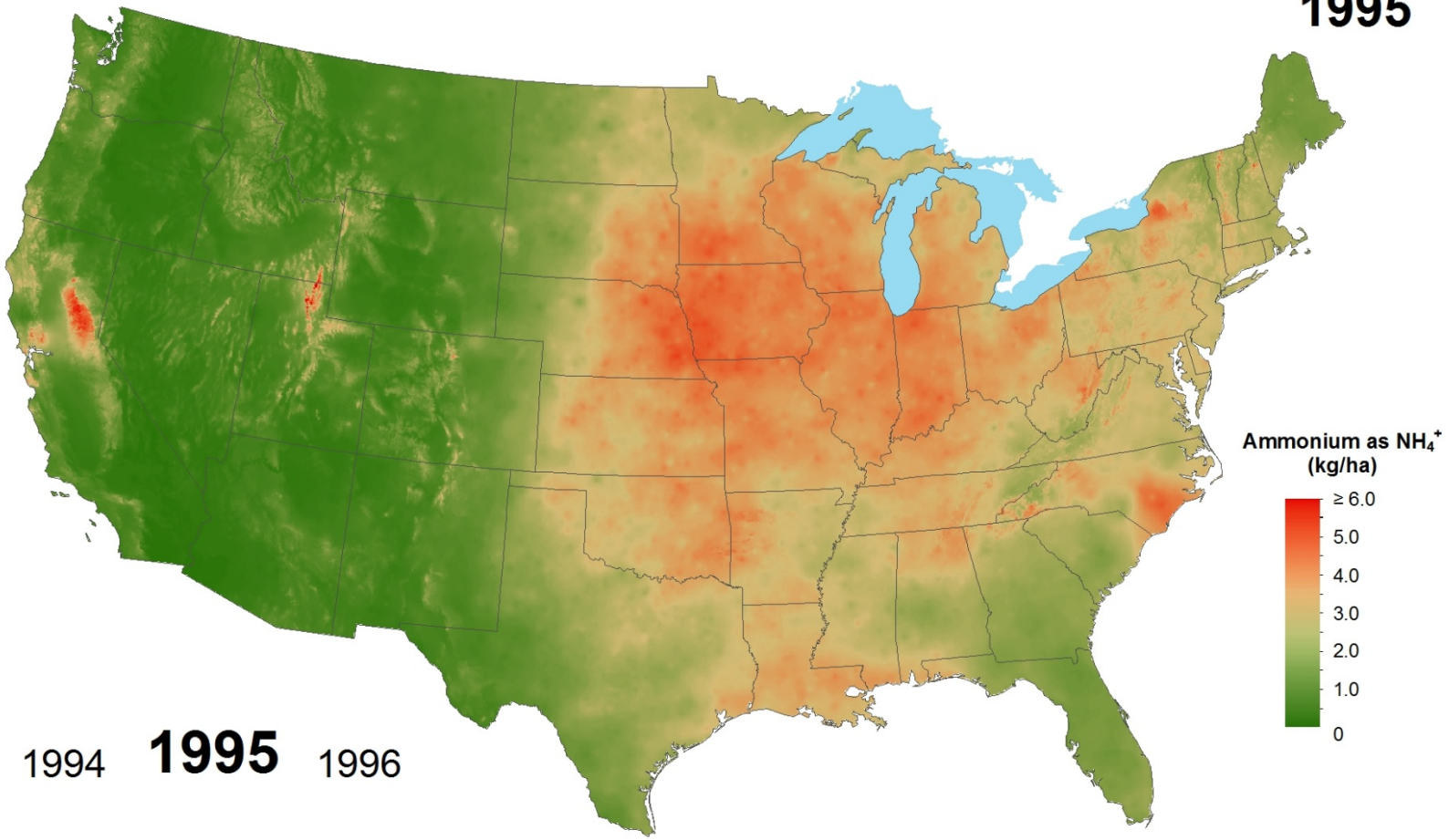
Ammonium ion wet deposition
1995



National Atmospheric Deposition Program/National Trends Network
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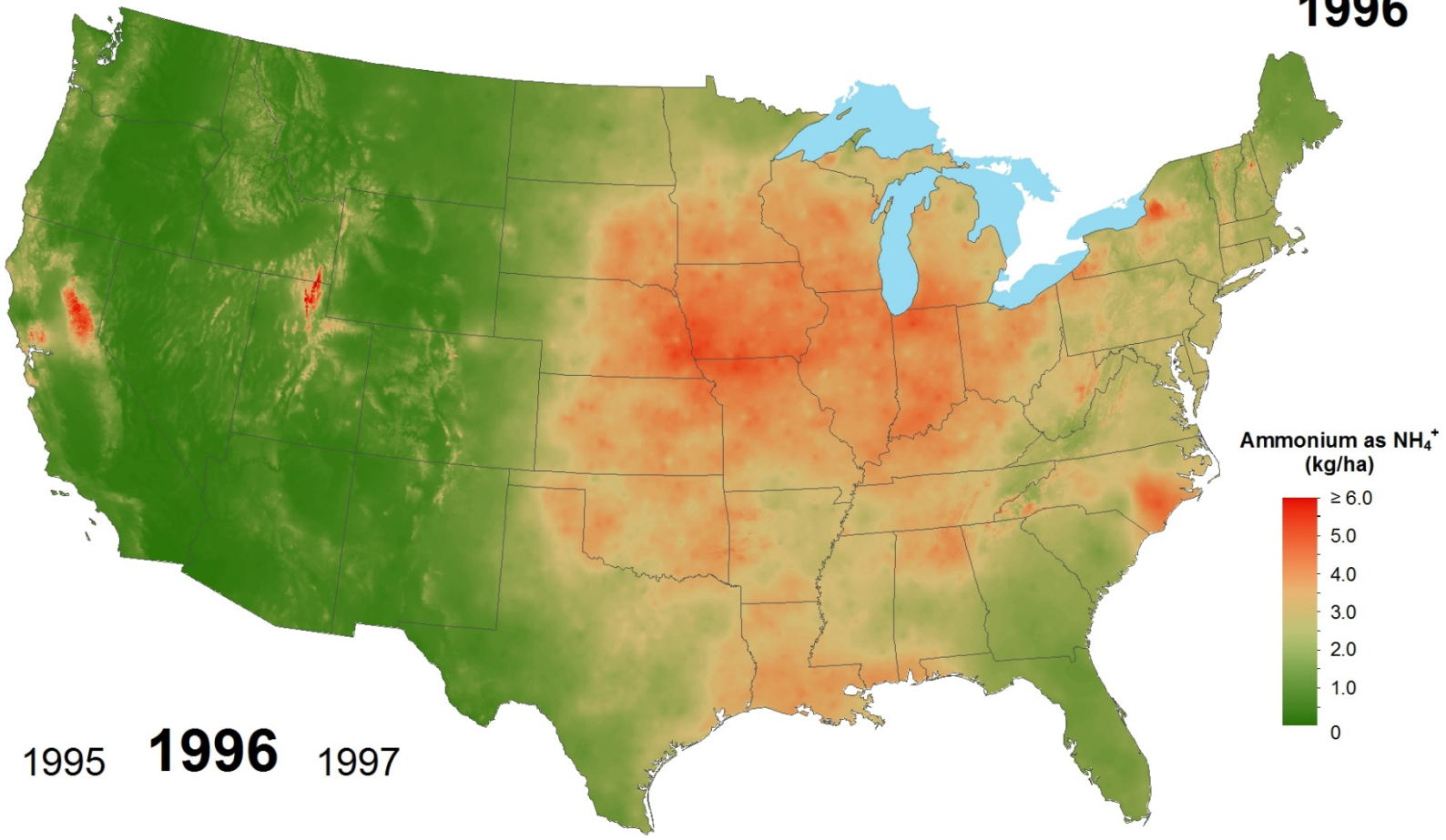
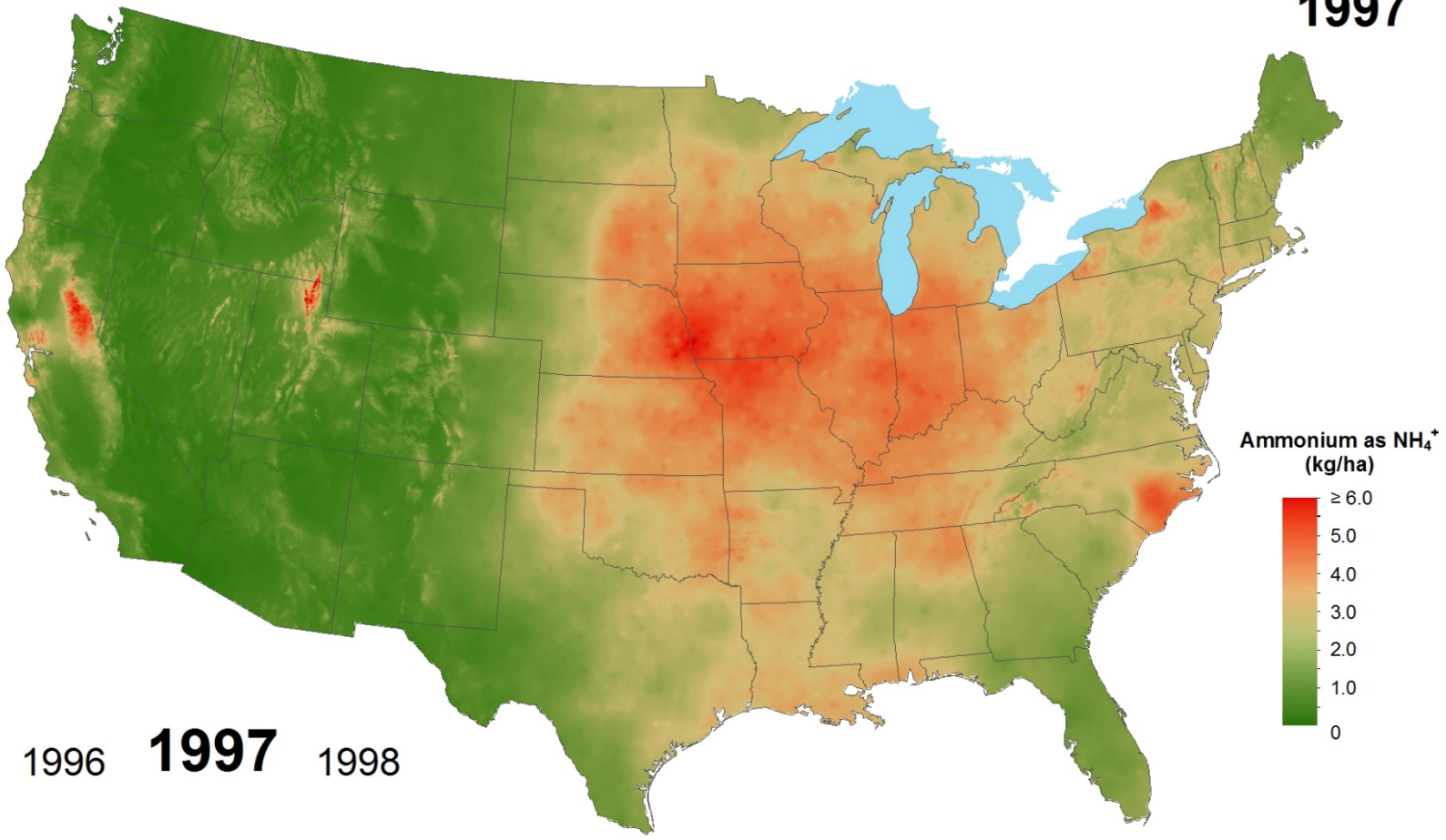
Ammonium ion wet deposition
1996



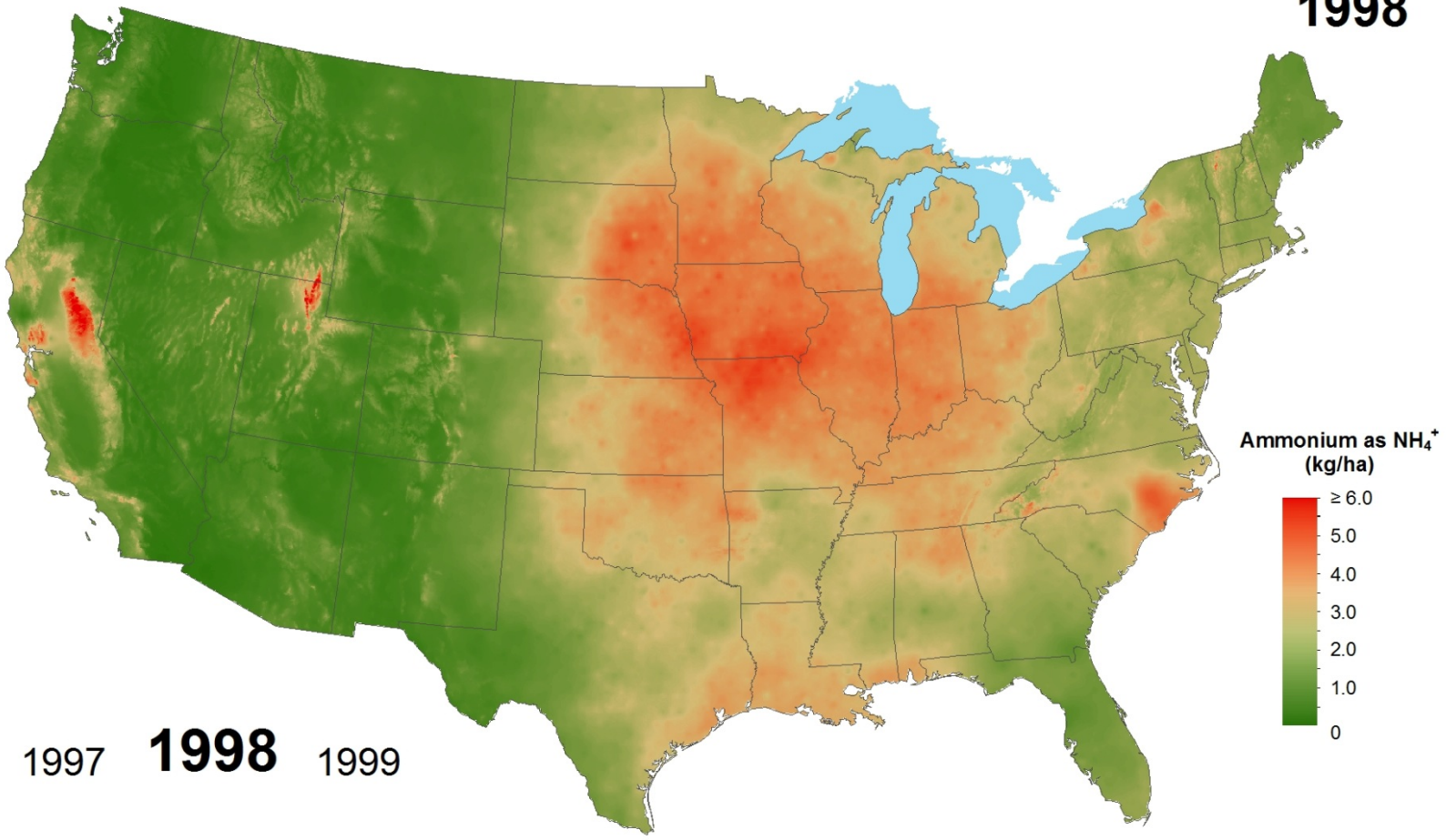
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
1997



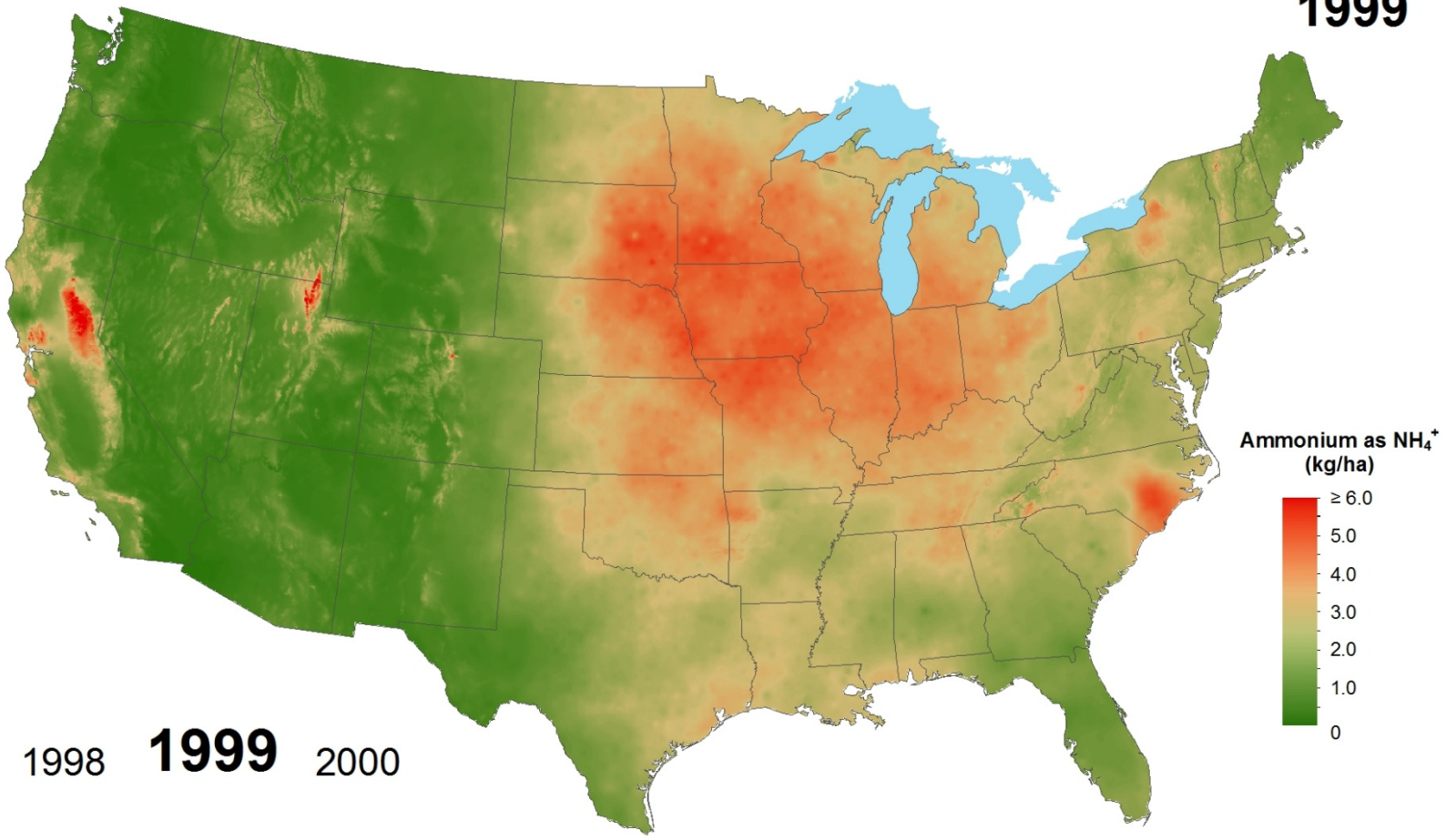
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
1998



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

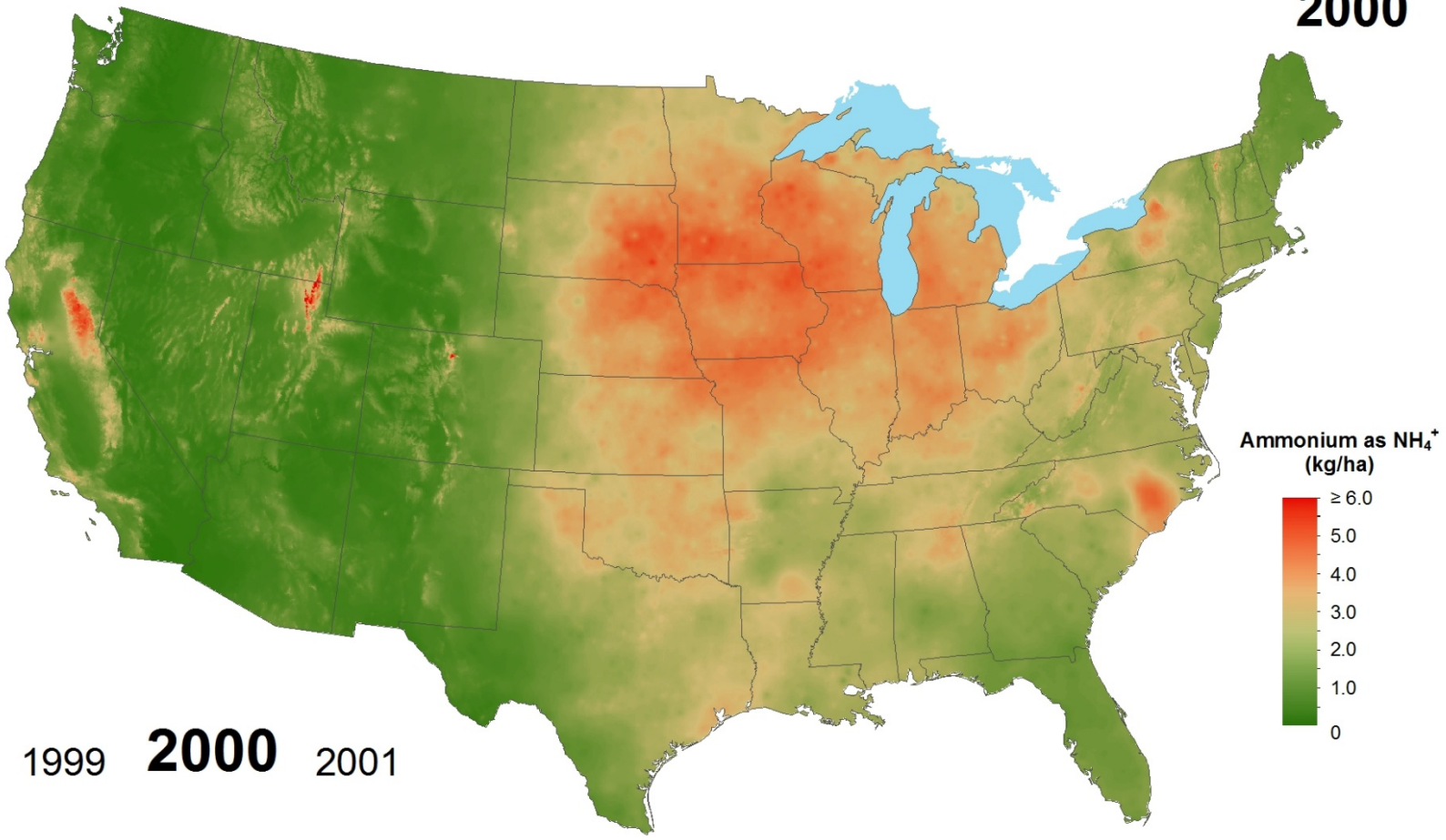
Ammonium ion wet deposition
1999



1998 **1999** 2000

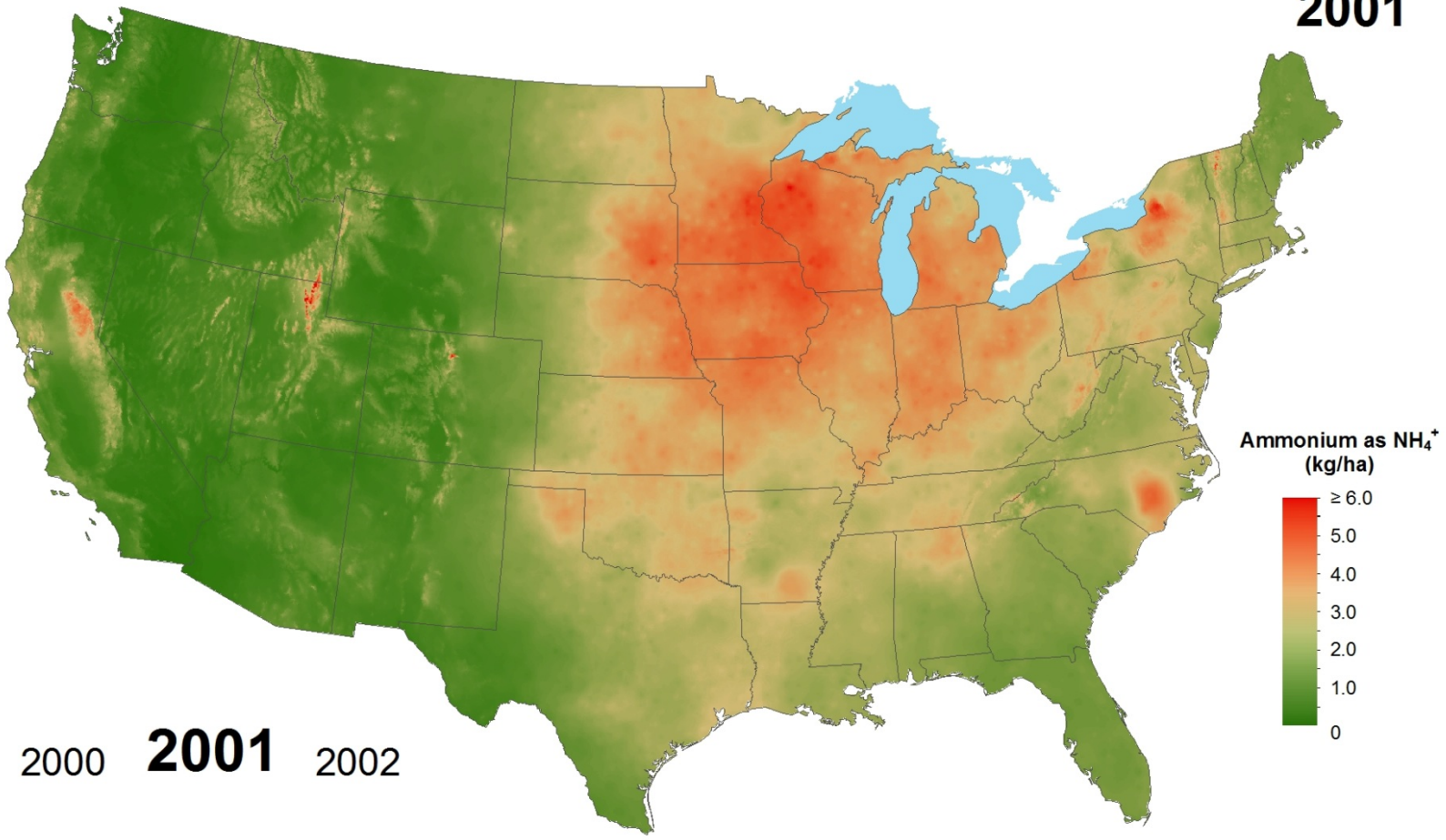
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
2000



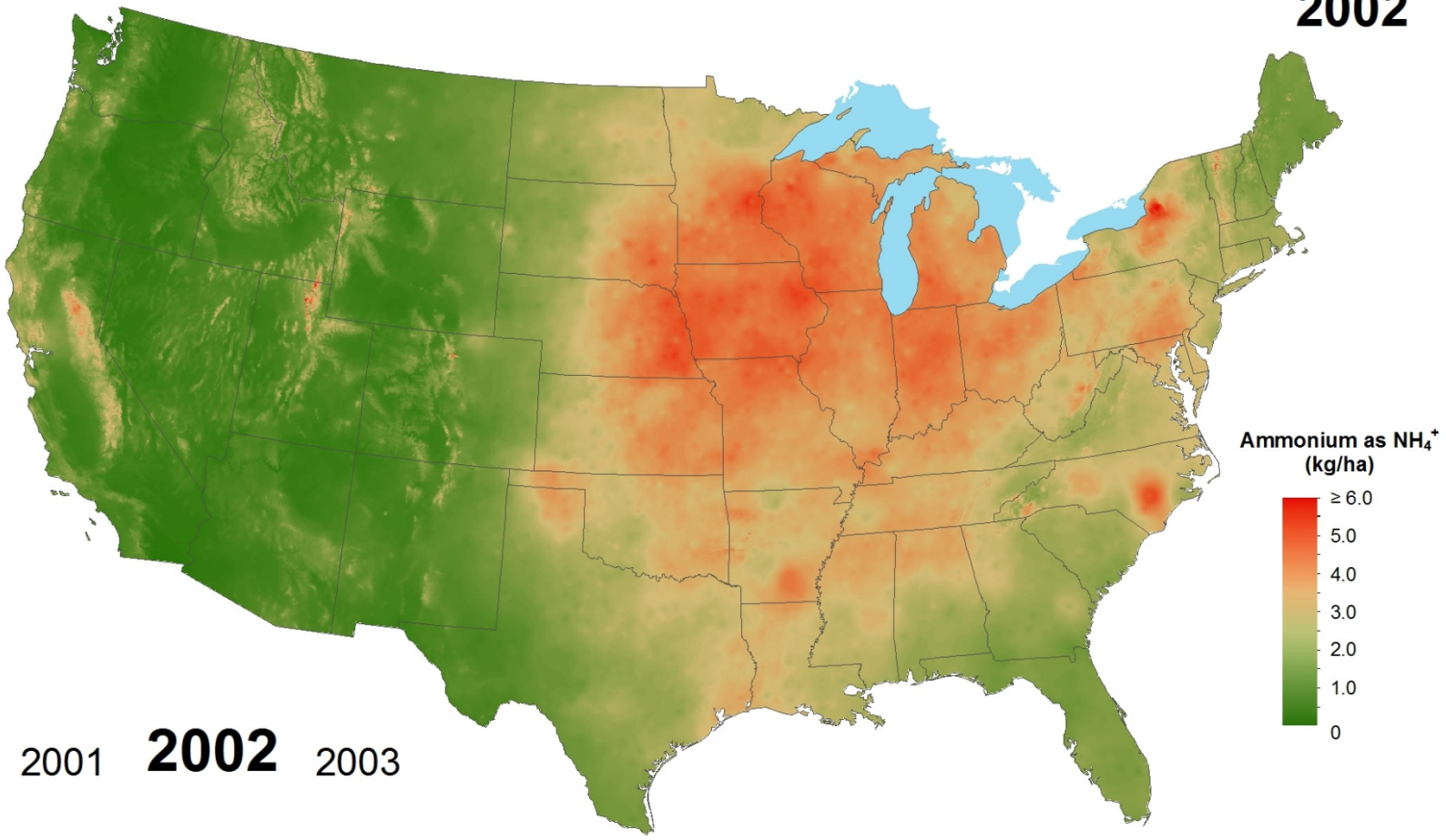
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
2001



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

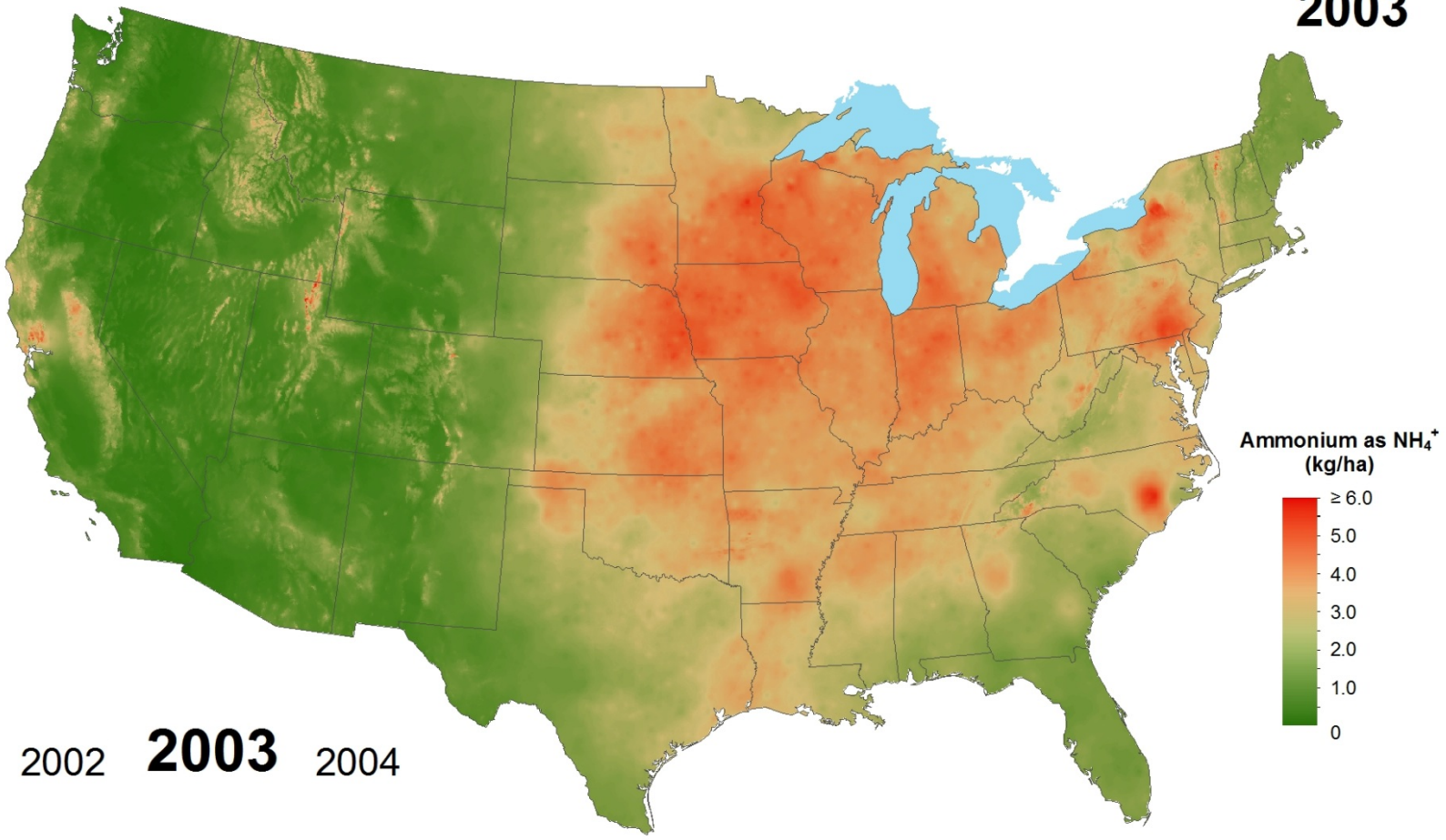
Ammonium ion wet deposition
2002



2001 **2002** 2003

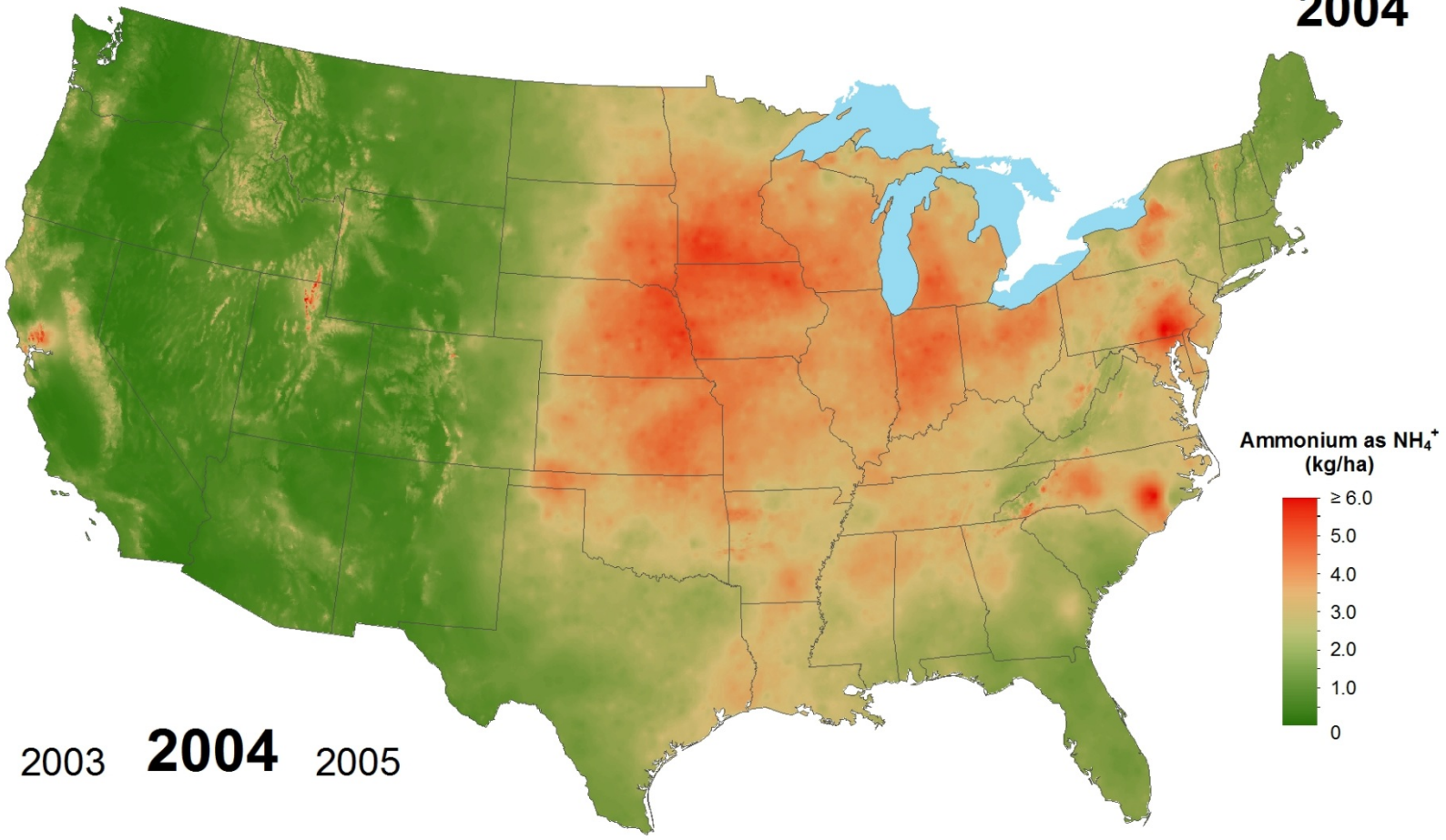
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
2003



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

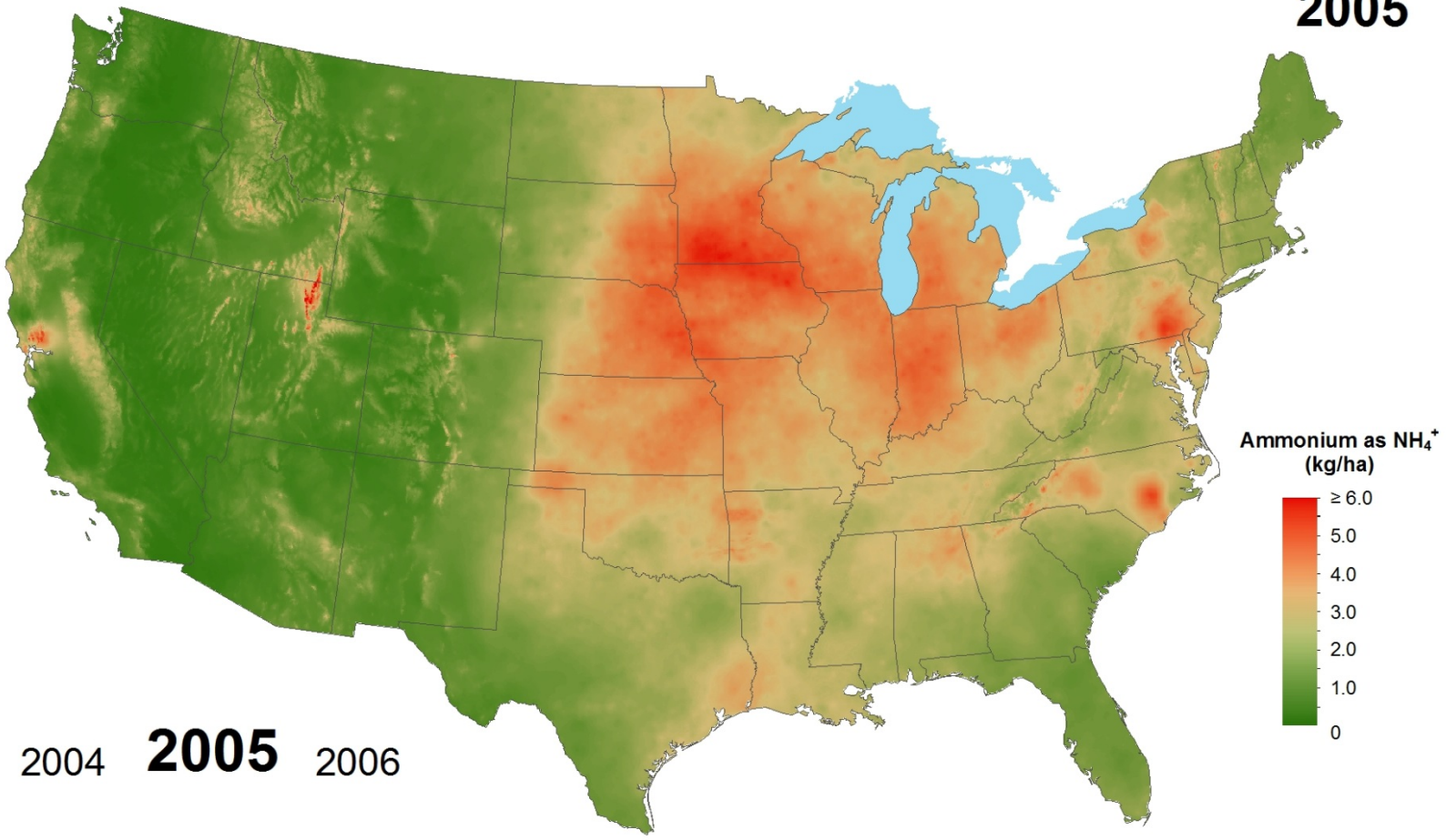
Ammonium ion wet deposition
2004



2003 **2004** 2005

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

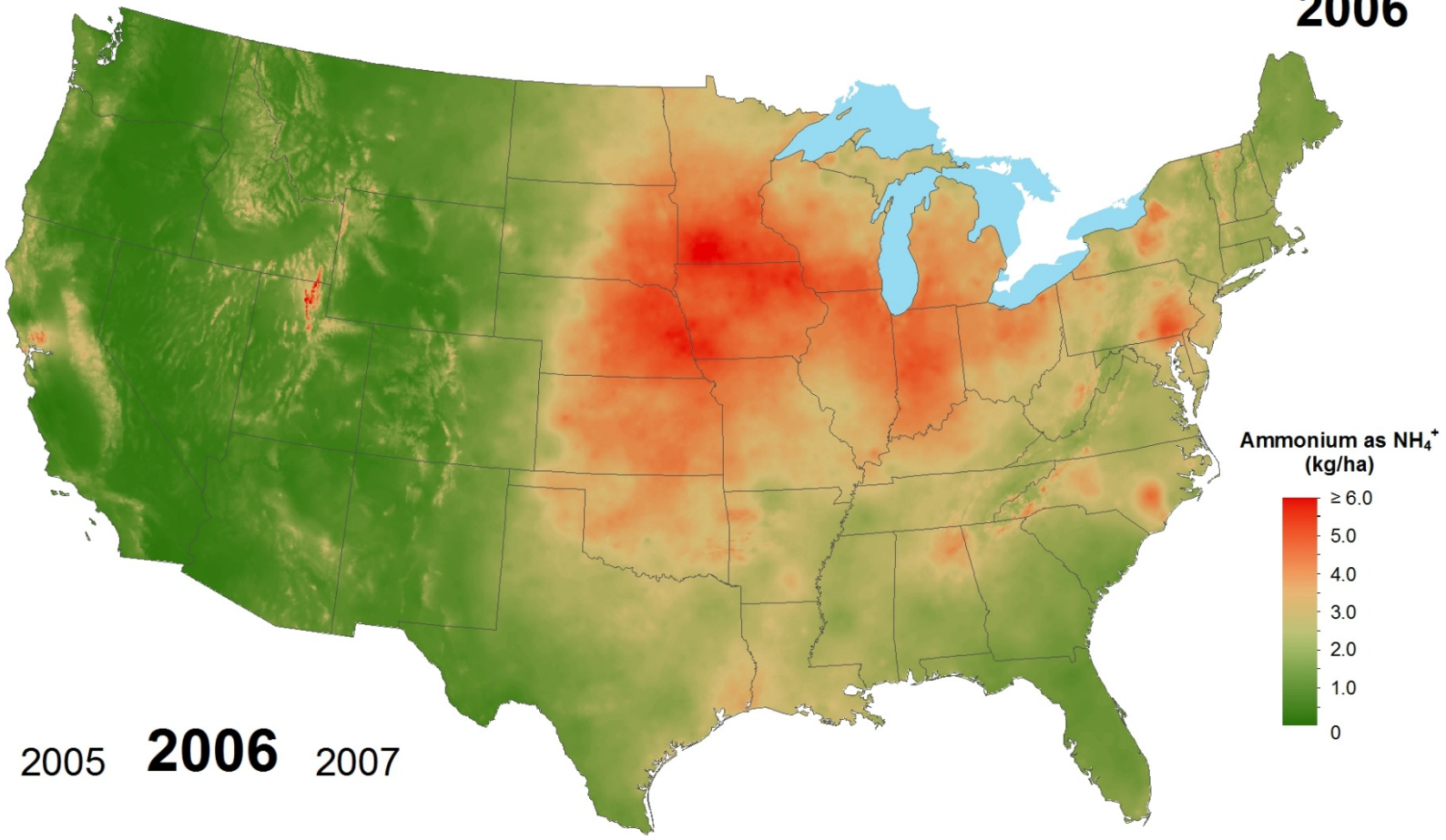
Ammonium ion wet deposition
2005



2004 **2005** 2006

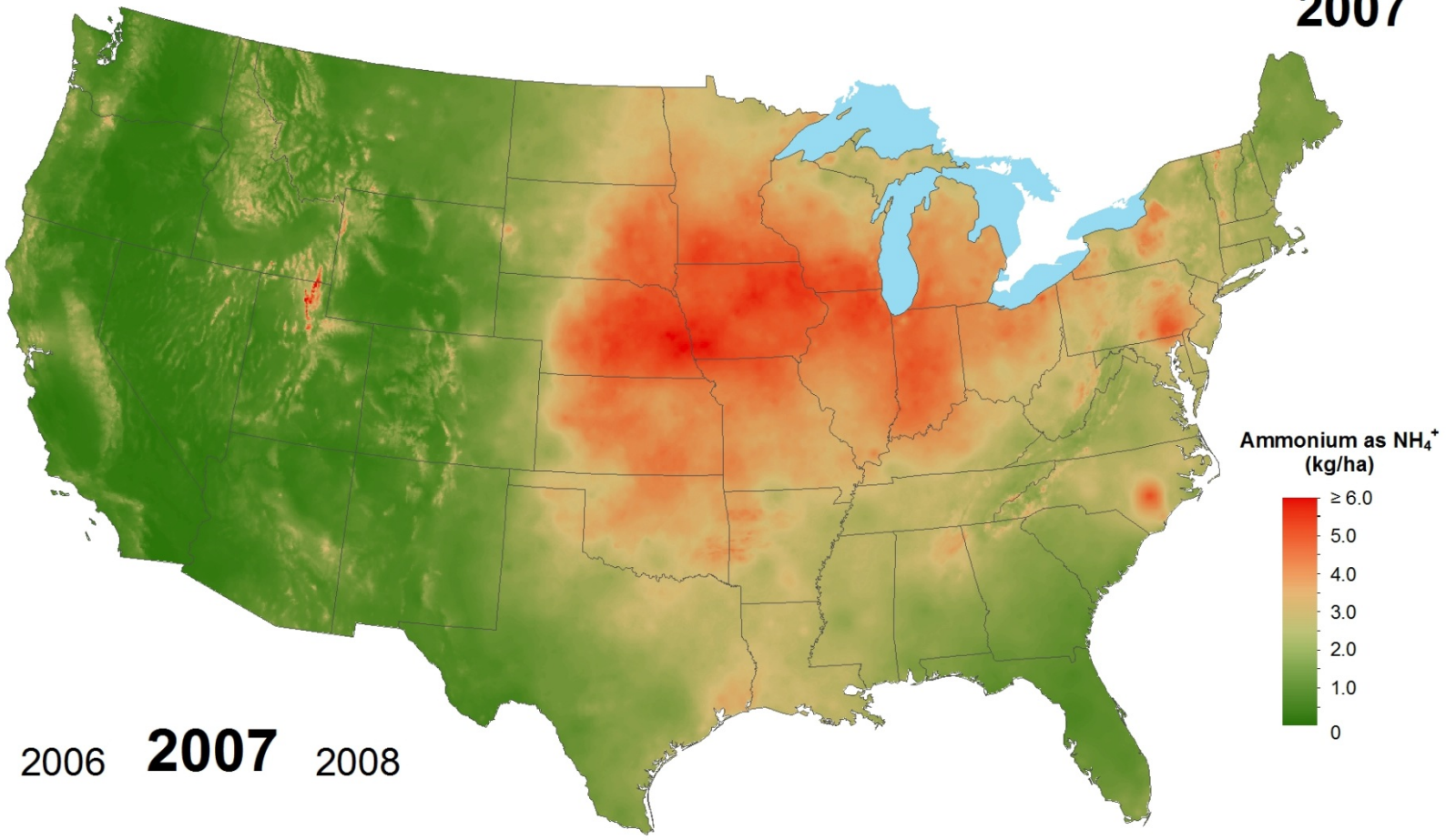
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
2006



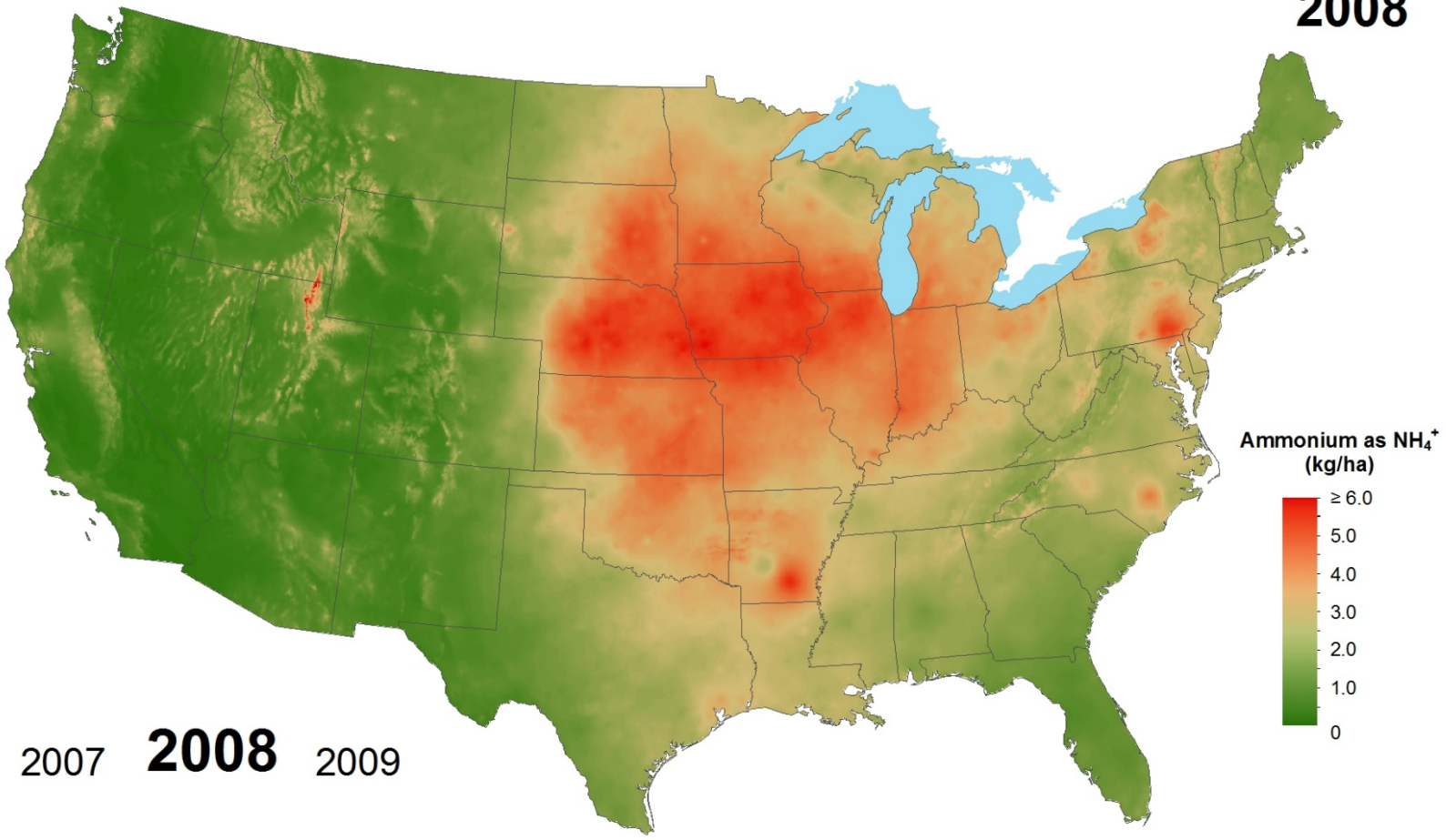
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
2007



National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

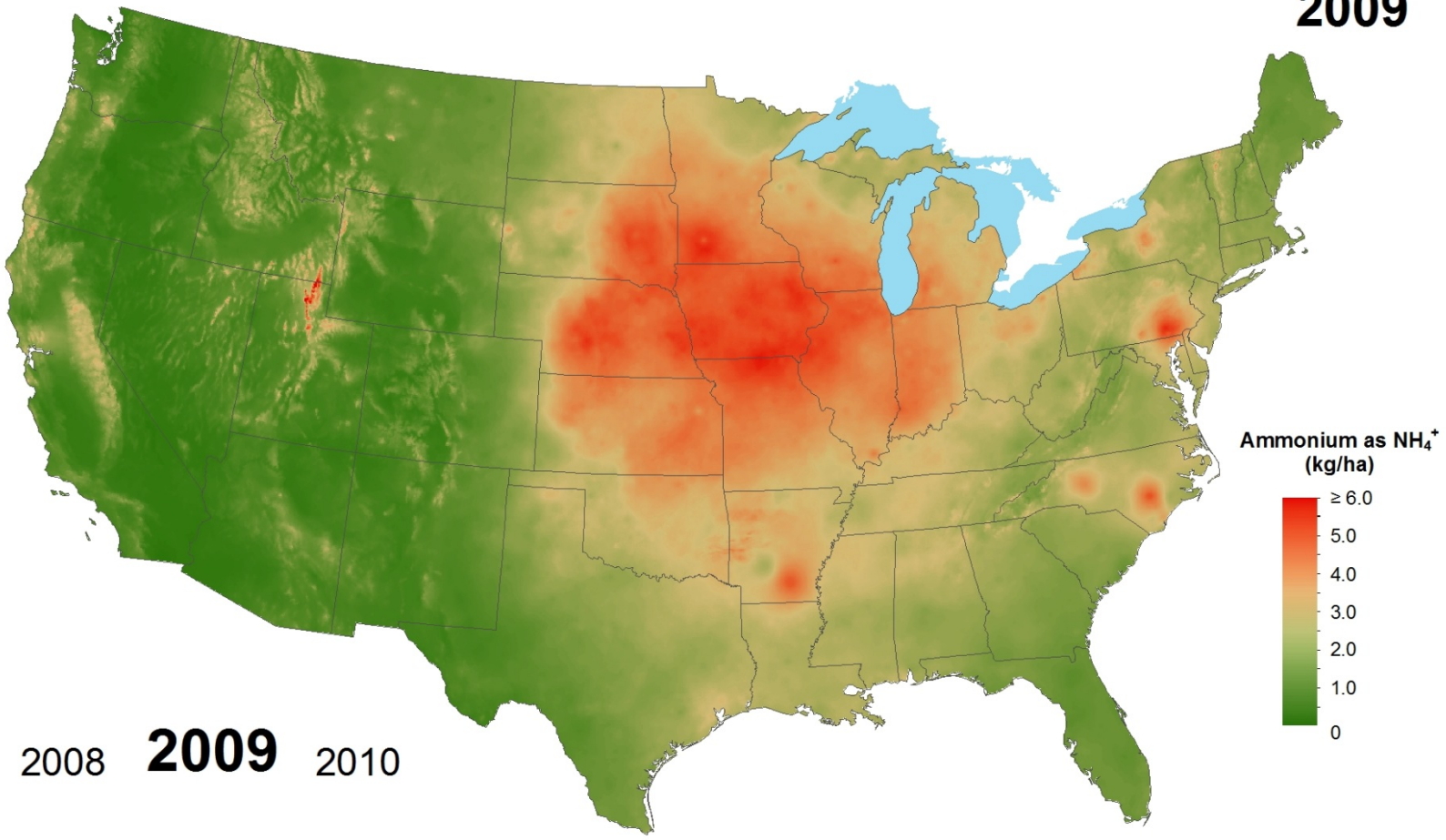
Ammonium ion wet deposition
2008



2007 **2008** 2009

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

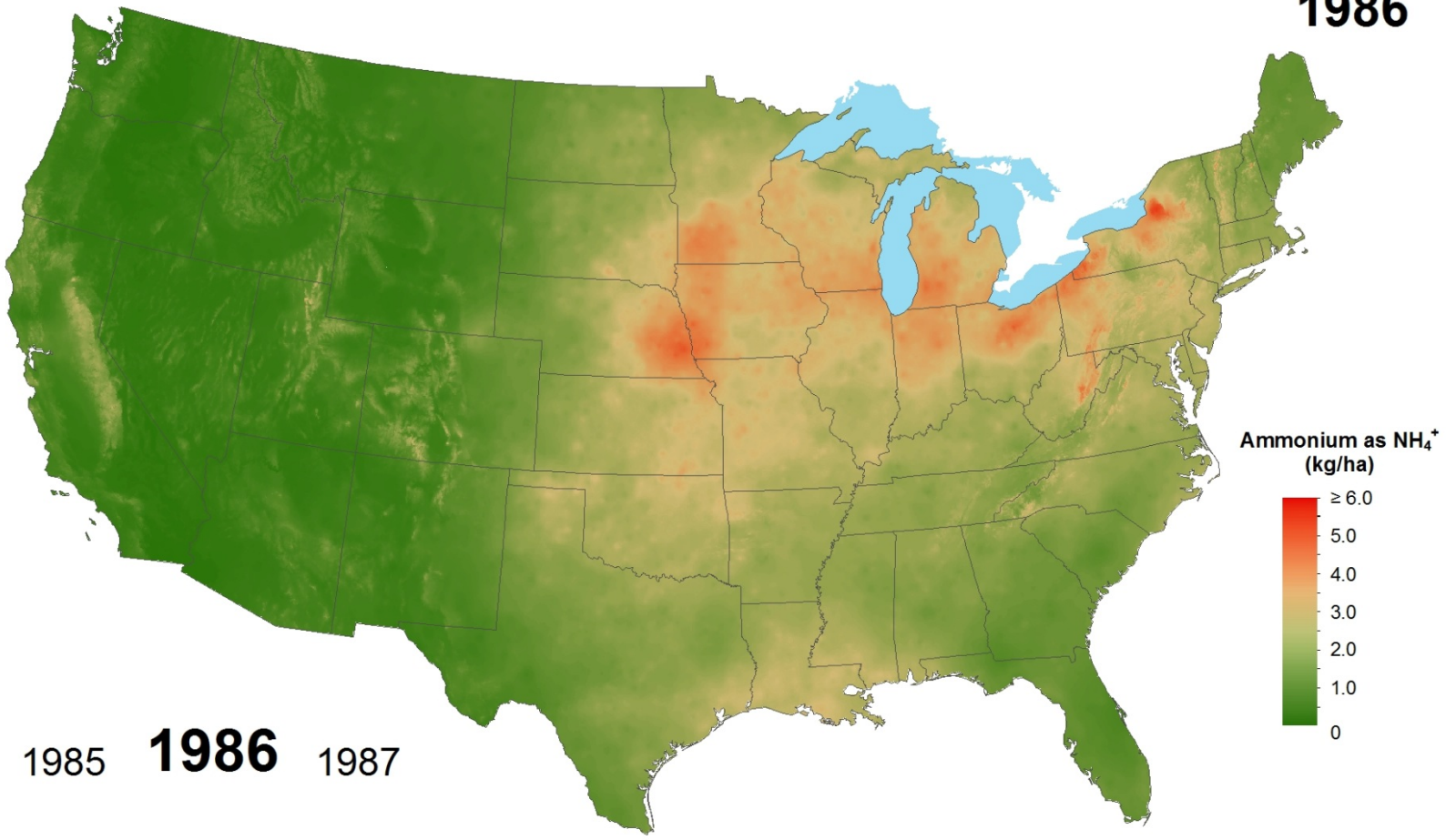
Ammonium ion wet deposition
2009



2008 **2009** 2010

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Ammonium ion wet deposition
1986



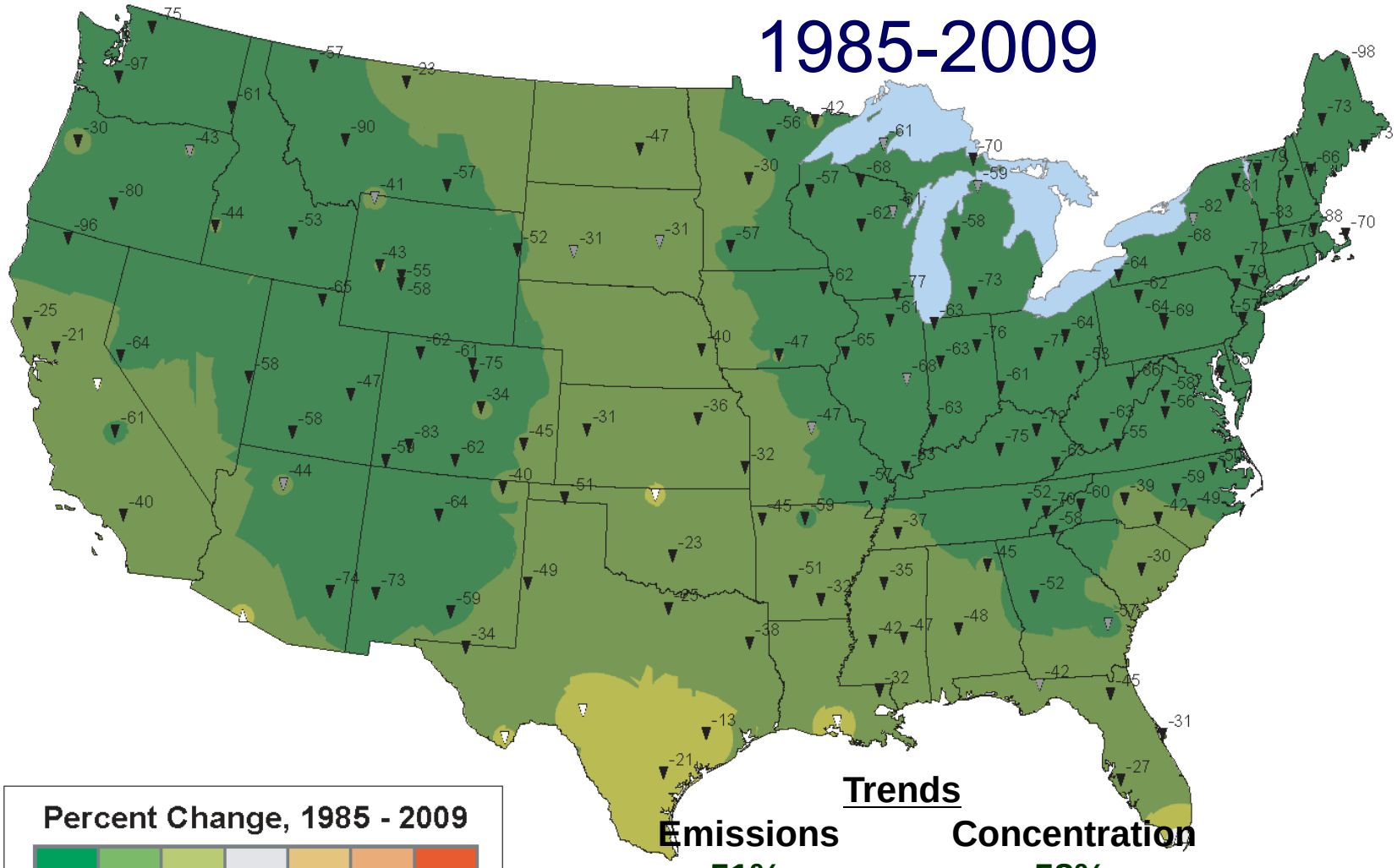
1985 **1986** 1987

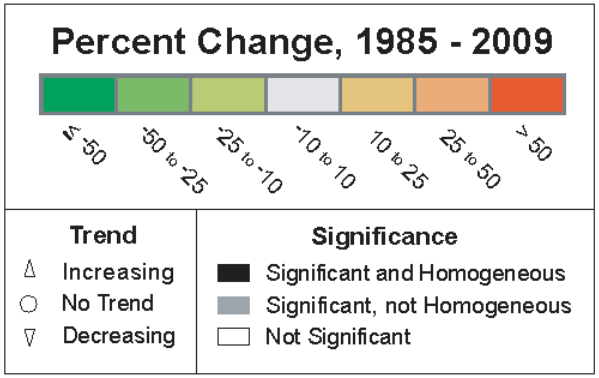
National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Evaluating Trends in NADP-NTN Data

- Data from 151 sites, operational between 1985-2007 (~210,000 weekly data sets)
- Precipitation-weighted mean seasonal averages
- Seasonal Kendall Trend Test
  - Null Hypotheses:
    - Trend is zero (no trend)
    - Trends are homogeneous (same in every season)
  - Significance Level
    - $p \leq 0.1$ for trend significance
    - $p > 0.1$ for homogeneity
  - Trend magnitude by Sen's Median Estimator

Sulfate Trend in Precipitation 1985-2009

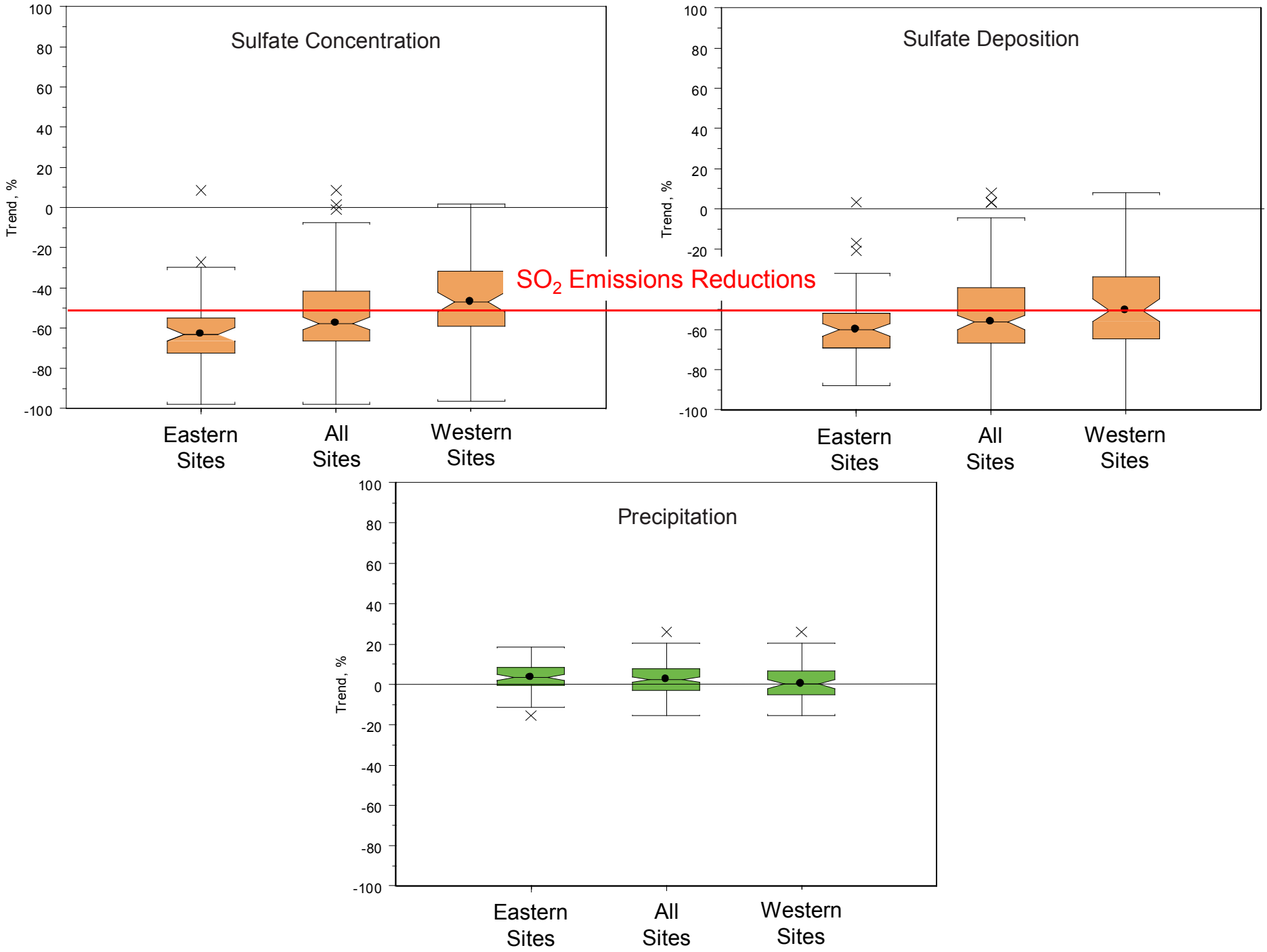




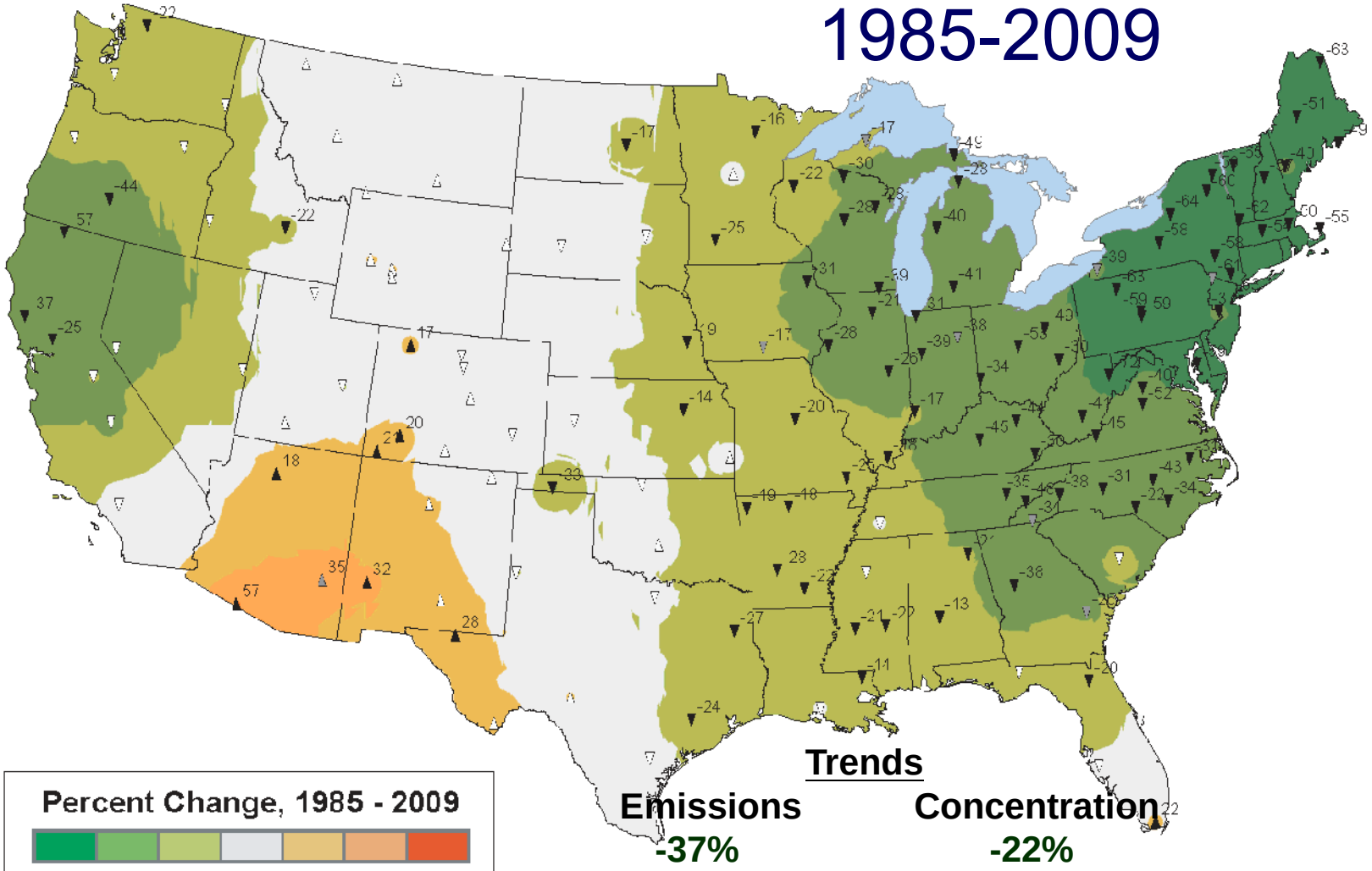
Trends

Emissions	Concentration
-51%	-58%

INCREASING Trend		DECREASING Trend	
Number of Sites	Number Significant	Number of Sites	Number Significant
2	0	149	144


Sulfate Concentration
Trend, %
100
80
60
40
20
0
-20
-40
-60
-80
-100
Eastern Sites
All Sites
Western Sites
Sulfate Deposition
Trend, %
100
80
60
40
20
0
-20
-60
-80
-100
Eastern Sites
All Sites
Western Sites
SO2 Emissions Reductions
Precipitation
Trend, %
100
80
60
40
20
0
-20
-40
-60
-80
-100
Eastern Sites
All Sites
Western Sites

Nitrate Trend in Precipitation 1985-2009

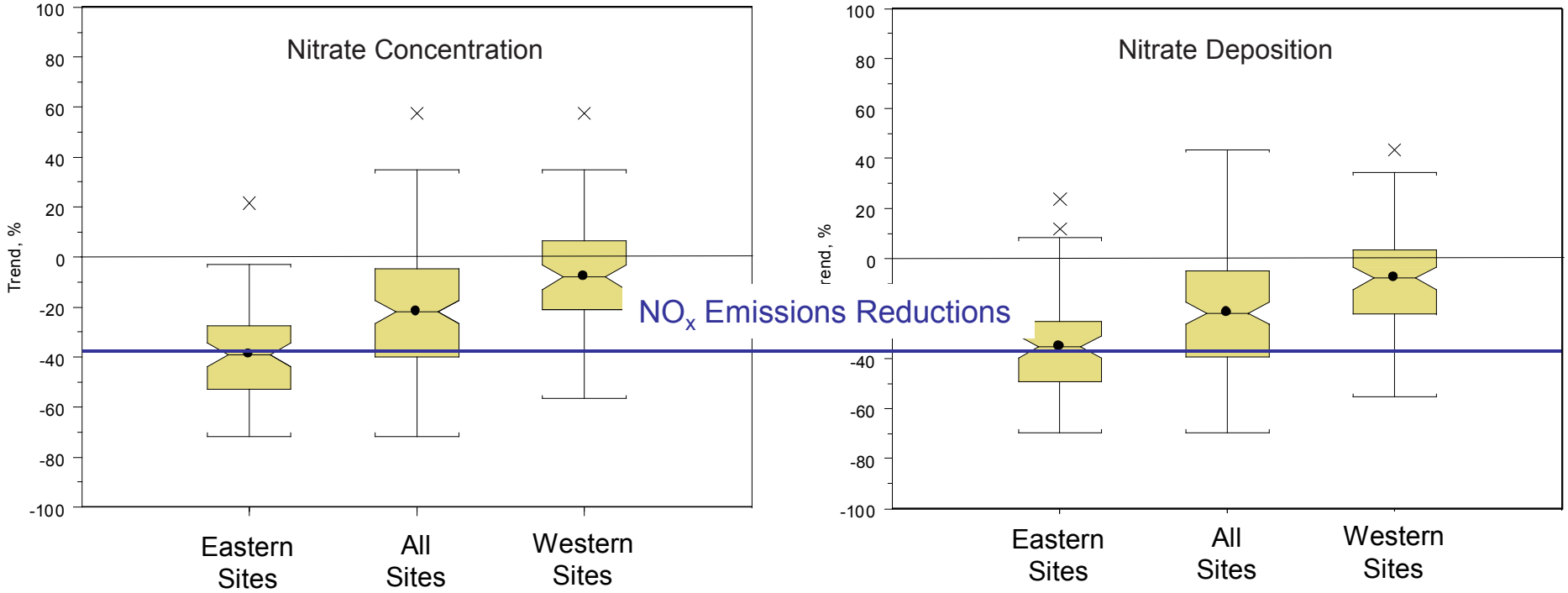


Trends

Emissions **-37%**

Concentration **-22%**

INCREASING Trend		DECREASING Trend	
Number of Sites	Number Significant	Number of Sites	Number Significant
29	9	122	92


Nitrate Concentration
Trend, %
100
80
60
40
20
0
-20
-40
-60
-80
-100
Eastern Sites
All Sites
Western Sites
NOx Emissions Reductions
Nitrate Deposition
rend, %
100
80
60
40
20
0
-40
-60
-80
-100
Eastern Sites
All Sites
Western Sites

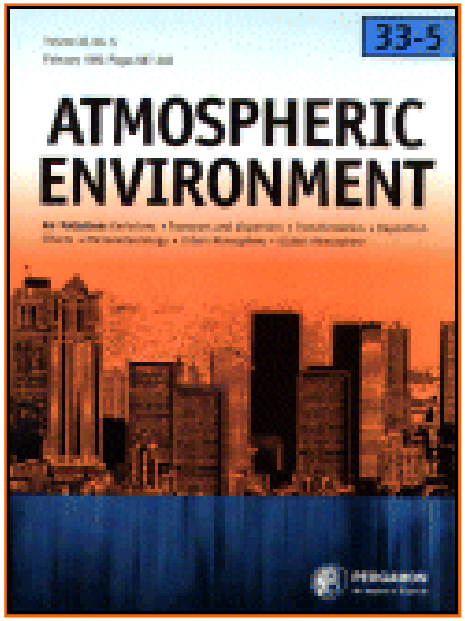
Annual Wet Deposition of Ammonium Ion (map, kg/ha) and
Average Atmospheric Ammonia Concentration (bars, µg/m^3)

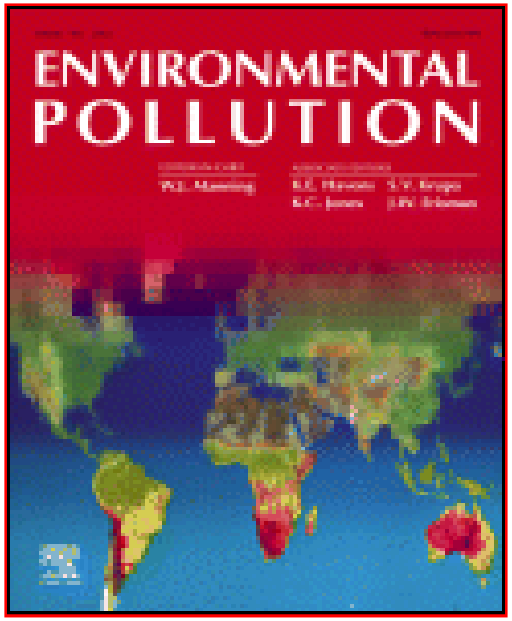
Lessons Learned…

7. Strive to maintain consistency to facilitate evaluation of long-term trends…
8. …but still change and adapt to the needs of research community

Publications

- For 2011, 172 researchers/groups have cited NADP data in the peer-reviewed literature





Monitoring Long-Term Trends of Acidic Wet Deposition in US Precipitation: Results from the National Atmospheric Deposition Program

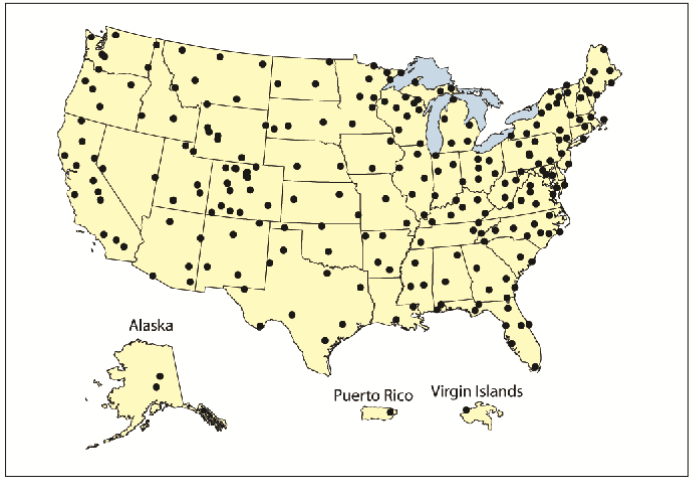
Christopher M. B. Lehmann and David A. Gay

ABSTRACT

The National Atmospheric Deposition Program has measured long-term trends in acidic wet deposition since 1978. Over the past thirty-plus years, most of the continental United States has experienced significant trends in ion species affecting acidic deposition. Some of these trends appear directly attributable to the 1990 Clean Air Act Amendments.

INTRODUCTION

Atmospheric deposition is the process whereby airborne particles and gases are deposited on the Earth's surface. These pollutants come either from natural sources, such as forest fires, volcanoes, and oceanic salts, or from human-generated sources, such as power plants, agricultural animal waste, and motor vehicle exhaust emissions. Precipitation efficiently captures gaseous and particulate pollutants in the atmosphere so measurements of chemical concentrations in precipitation can be used to track changes and trends in the chemical balance in and pollutant removal from the Earth's atmosphere.



Lessons Learned…

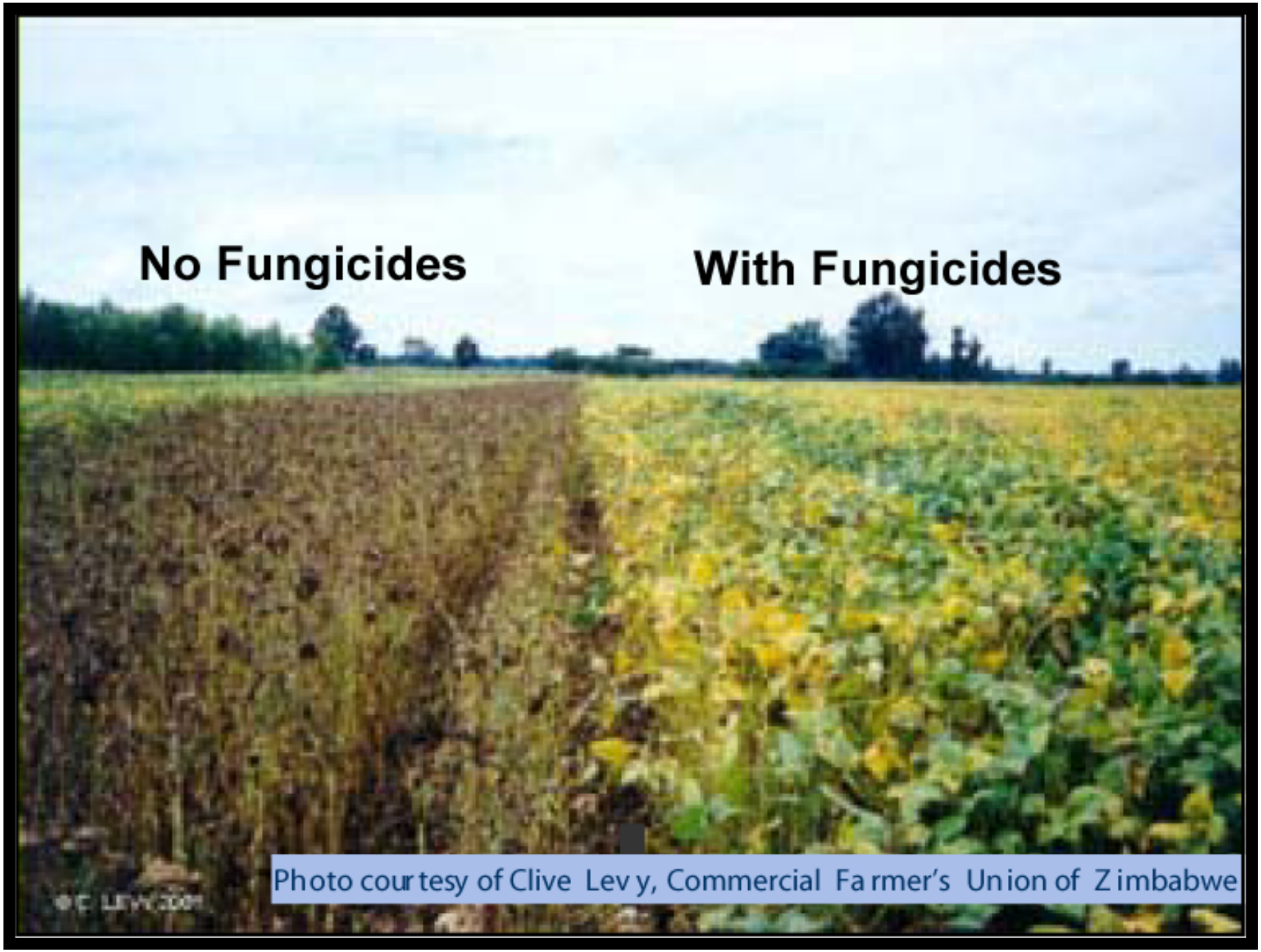
9. Strive to be recognized for contributions to the research community, or risk being made redundant

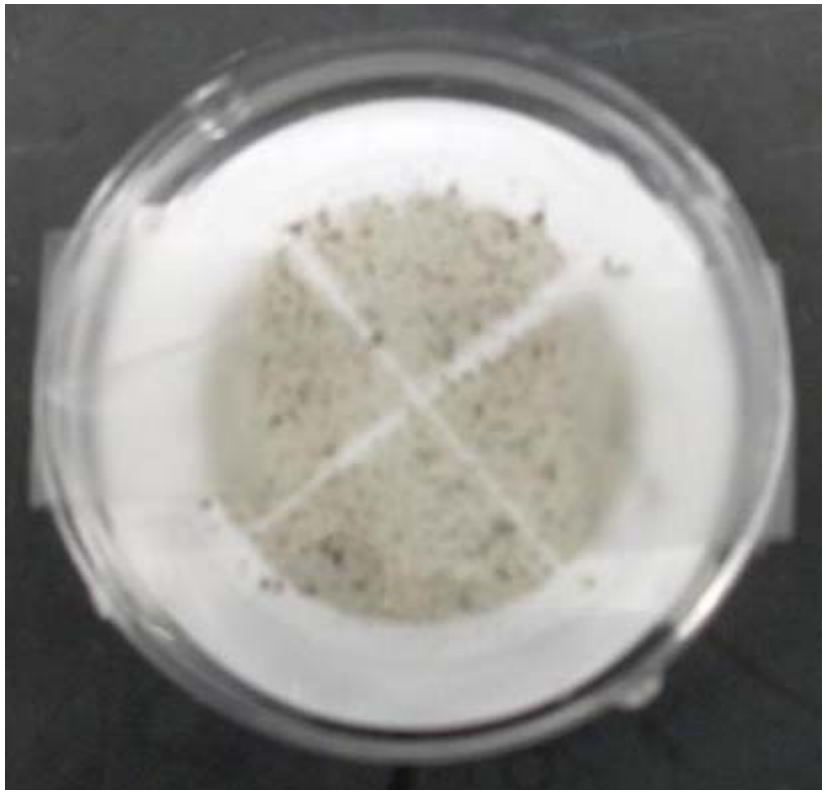
Other interesting things we do….

Asian Soybean Rust

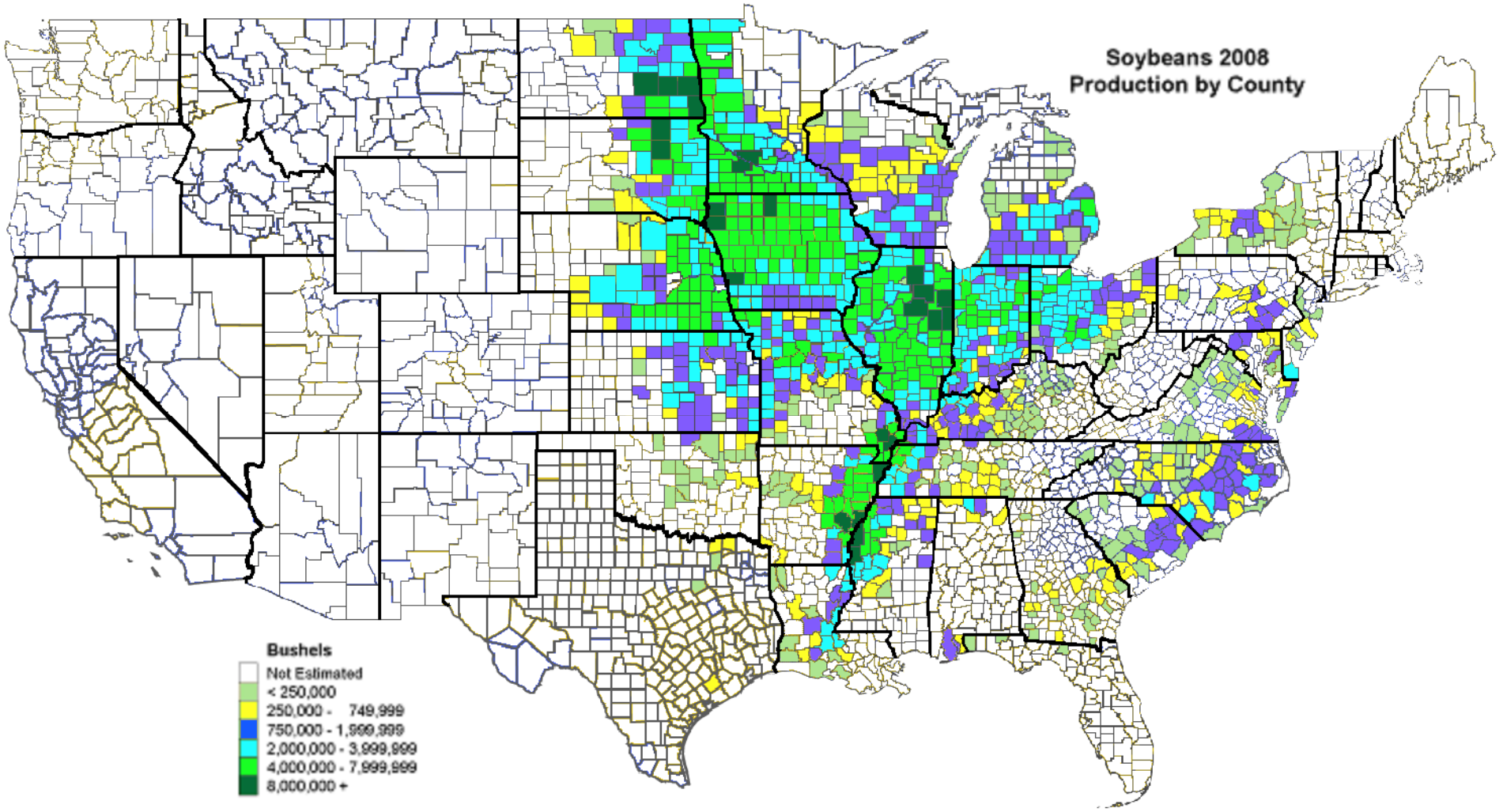
Phakopsora pachyrhizi spore

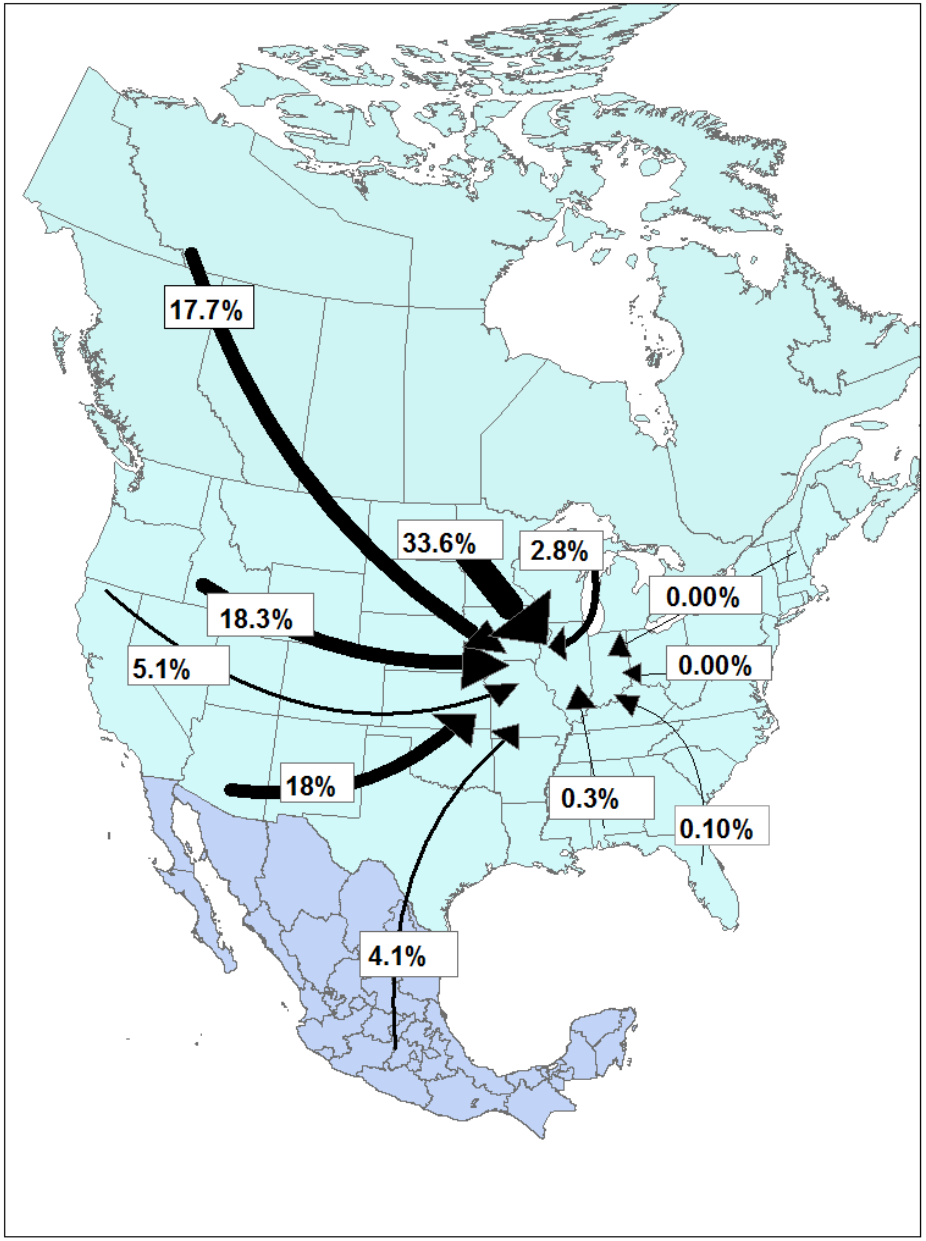
Infected Soybean Leaves


No Fungicides
With Fungicides
Photo courtesy of Clive Levy, Commercial Farmer's Union of Zimbabwe

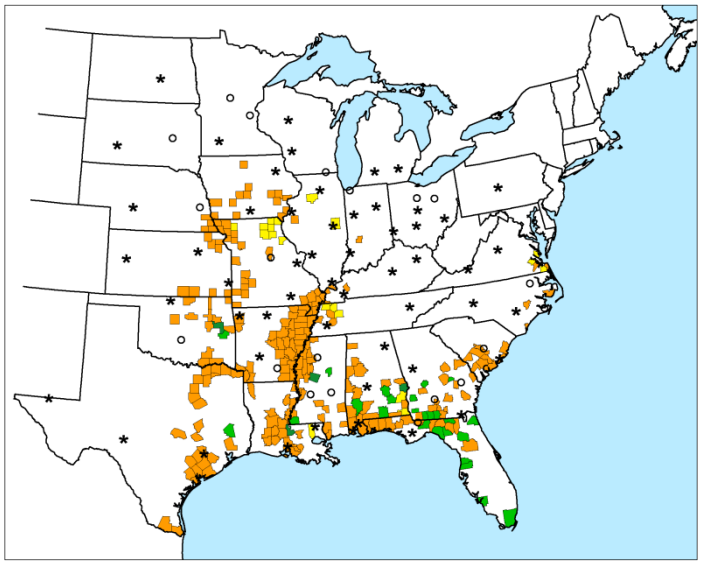


Soybean Acreage – 2008
(by county)

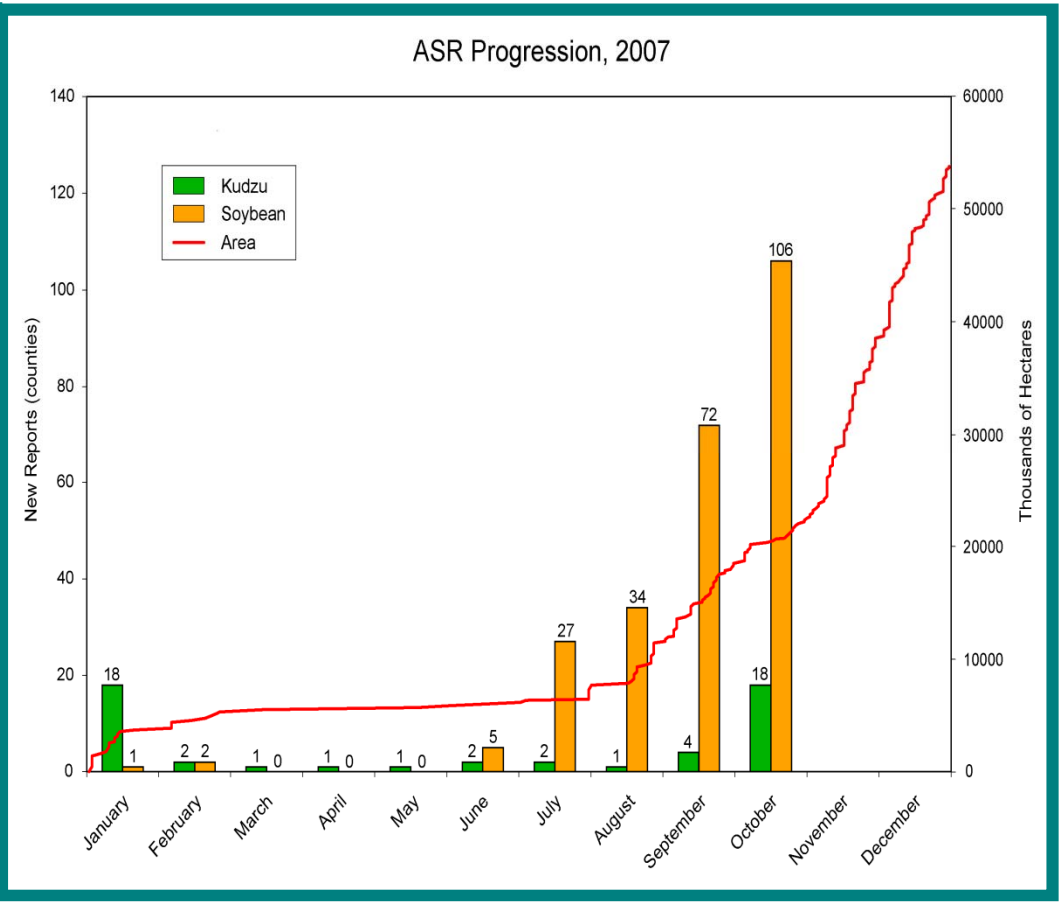



17.7%
33.6%
2.8%
0.00%
18.3%
5.1%
0.00%
18%
0.3%
0.10%
4.1%

2007 ASR Summary



Soybean Rust – 2007 (19 states – 251 counties)



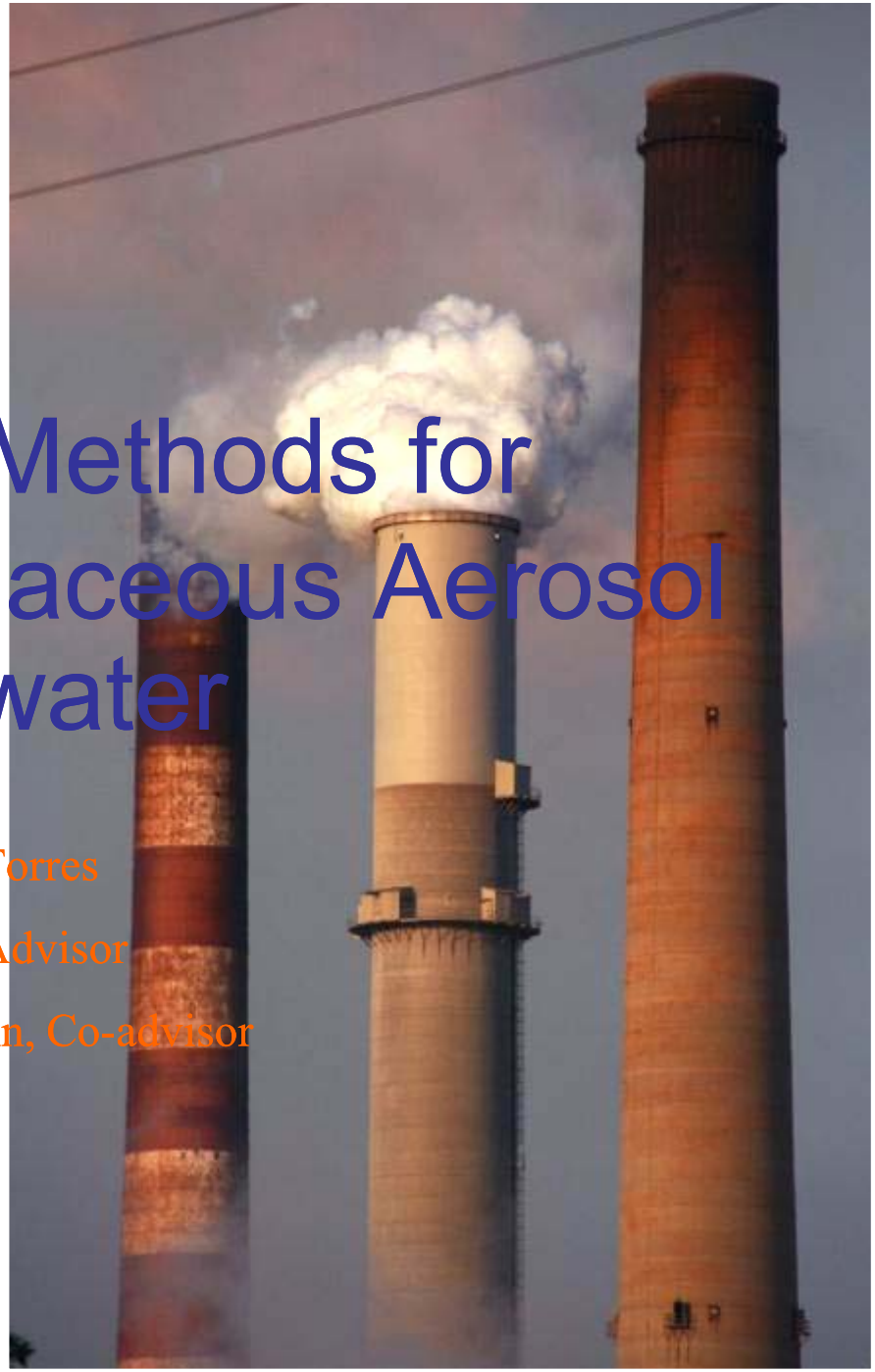
53.7 M hectares

Evaluation of Methods for Measuring Carbonaceous Aerosol in Rainwater

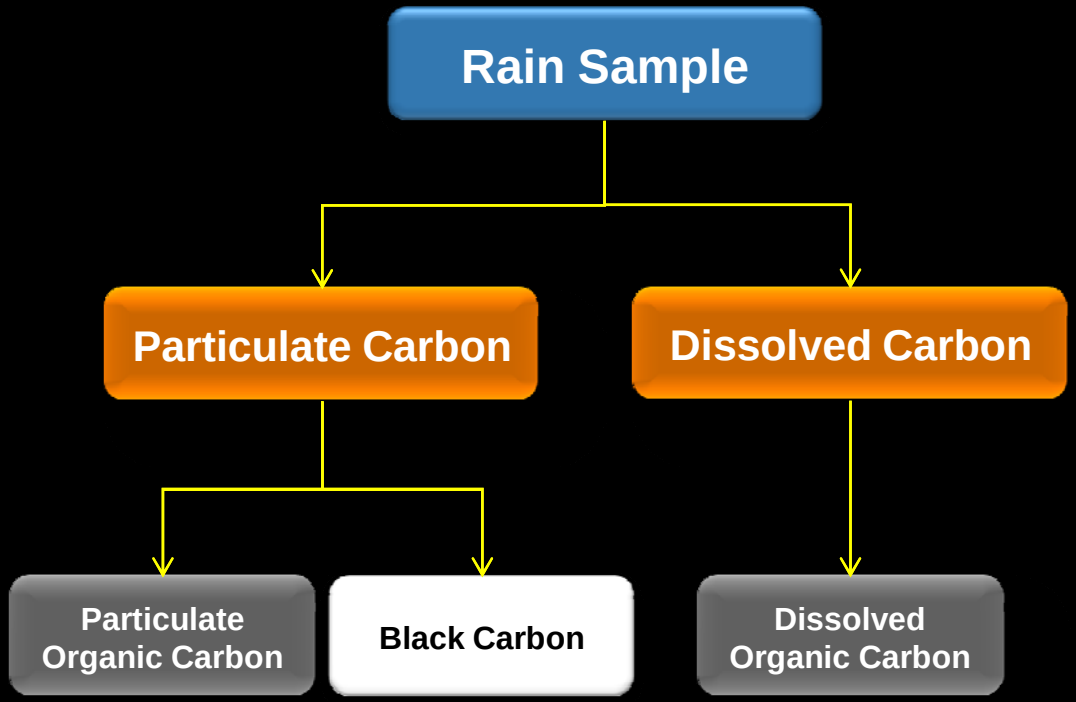
Alexander Torres

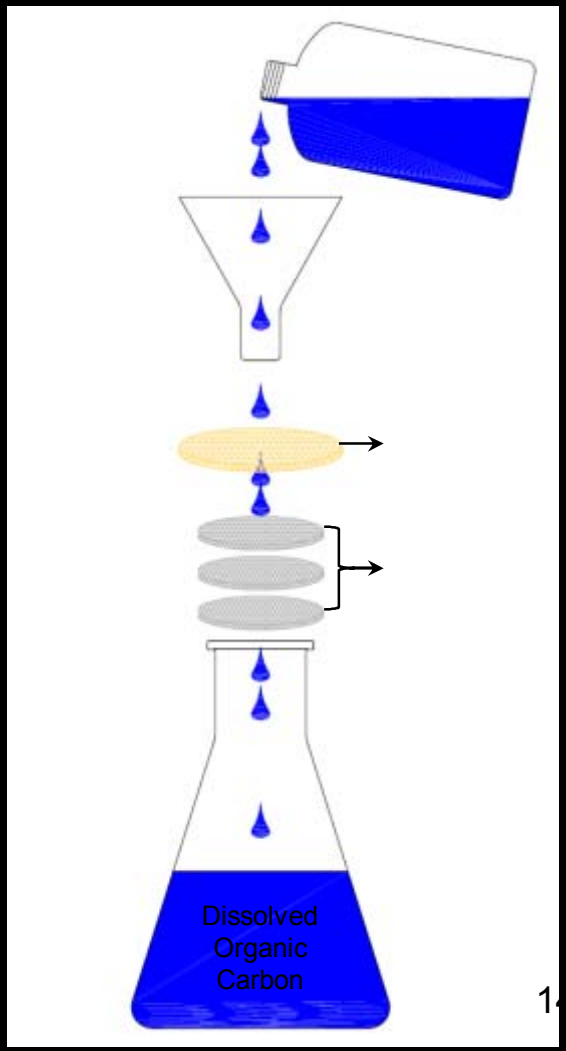
Tami Bond, Advisor

Christopher Lehmann, Co-advisor



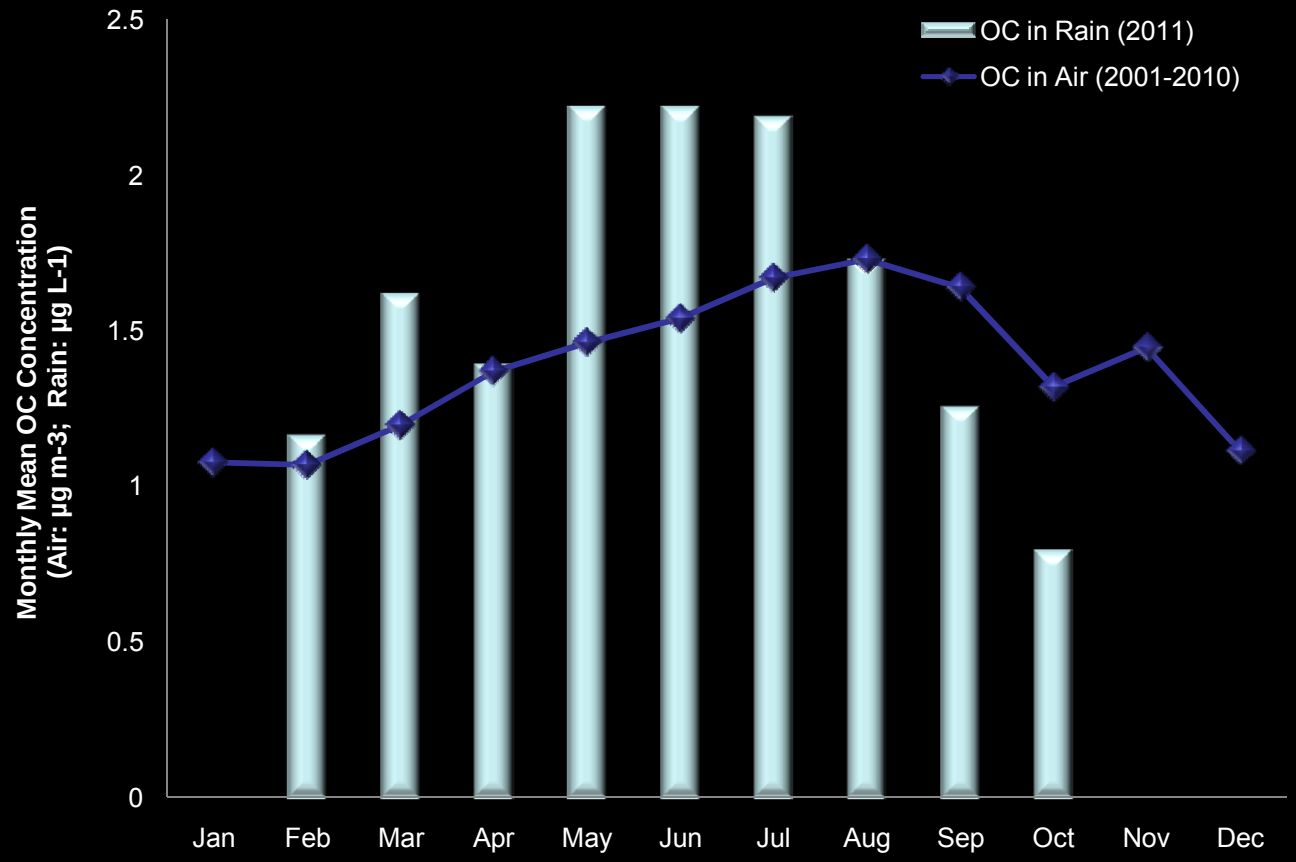
Analytical Approach



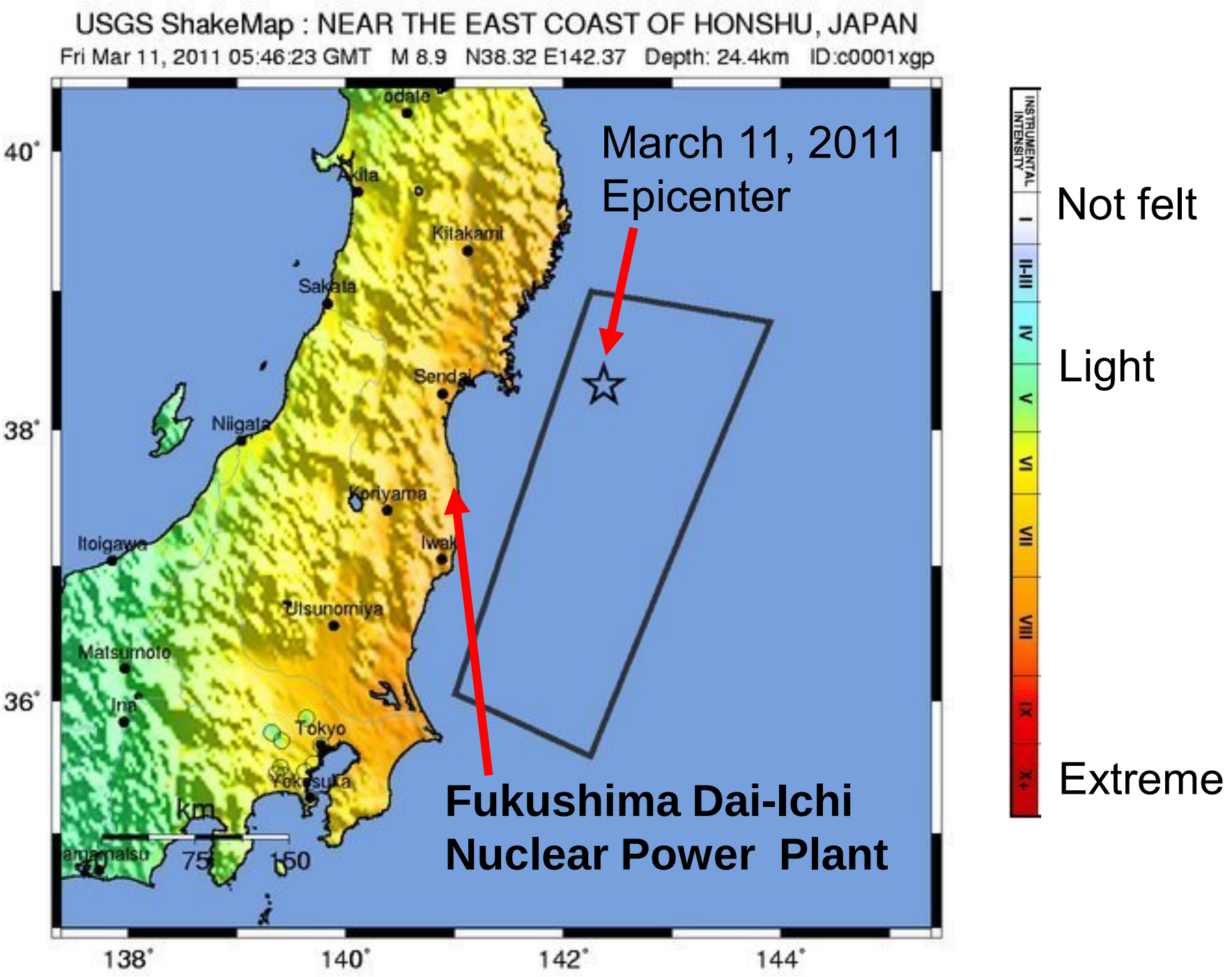


Dissolved Organic Carbon: Preliminary Results

- Comparison of the monthly mean concentration of DOC in rain vs. historical record of OC in air measured at Bondville, IL.



Active NADP/NTN Sites during the April 1986 Chernobyl Nuclear Power Plant Explosion


USGS ShakeMap : NEAR THE EAST COAST OF HONSHU, JAPAN
Fri Mar 11, 2011 05:46:23 GMT M 8.9 N38.32 E142.37 Depth: 24.4km ID:c0001xgp
March 11, 2011
Epicenter
Fukushima Dai-Ichi
Nuclear Power Plant
Odate
Akita
Kitakami
Sakata
Sendai
Niigata
Koriyama
Iwaki
Itoigawa
Utsunomiya
Matsumoto
Ina
Tokyo
Yokosuka
Hamamatsu
km
75
150
40°
38°
36°
138°
140°
142°
144°
INSTRUMENTAL INTENSITY
I
II-III
IV
V
VI
VII
VIII
IX
X+
Not felt
Light
Extreme

Lessons Learned…

9. Strive to be recognized for contributions to the research community, or risk being made redundant
10. Make all data and methods freely-available to the research community

For more information, see **http://nadp.isws.illinois.edu** or email **clehmann@illinois.edu**