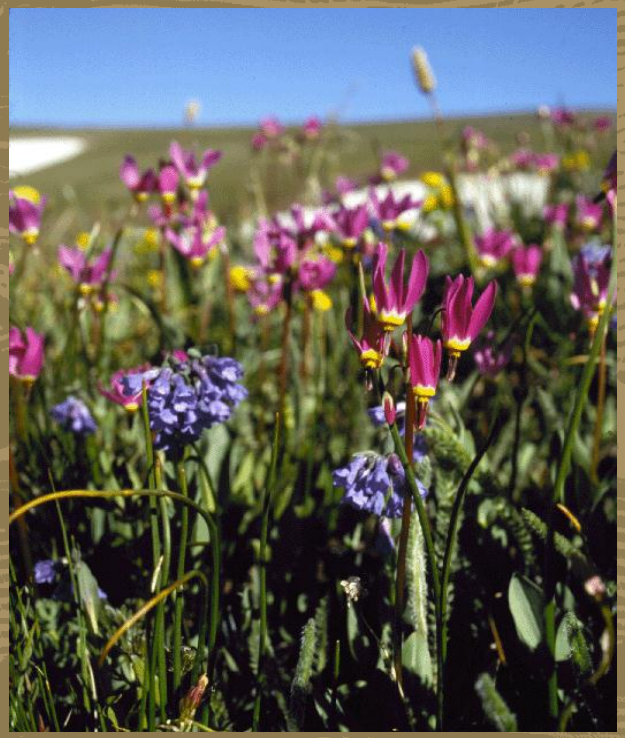
USFS Air Quality Briefing
PAPA Operators Annual Meeting
August 5, 2014



Terry Svalberg
Air Quality Specialist
R4/Bridger-Teton NF

Air Quality Related Mandates

"Wilderness areas…shall be administered…in such a manner as will **leave them unimpaired** for future use and enjoyment as wilderness…" (Wilderness Act of 1964)

"…**preserve, protect and enhance the air quality** in national parks, national wilderness areas, national monuments, national seashores…" (Clean Air Act as amended in 1977)

"…National Forest wilderness resources shall be managed to promote, perpetuate and, where necessary, restore the wilderness character of the land…" (FS Regs Implementing the Wilderness Act, 1997)

"In cases of doubt the land manager should err on the side of protecting the air quality-related values for future generations." (Senate Report No. 95-127, 95th Congress, 1977)

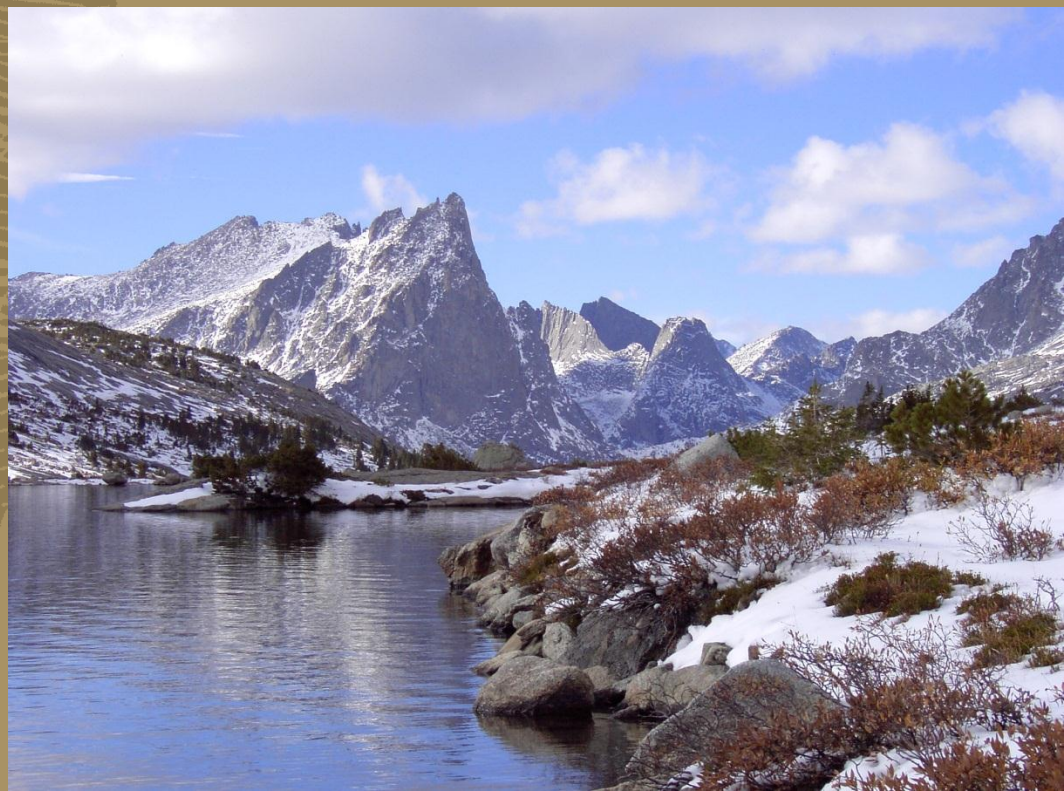
Under the Clean Air Act, Federal Land Managers are given the "affirmative responsibility" to protect Class I Areas, but no authority to do so.

Why are sensitive high elevation areas in GYA at risk?

- Shallow soils
- Granitic bedrock
- Scant vegetation
- Higher precipitation/deposition
- Very good visibility

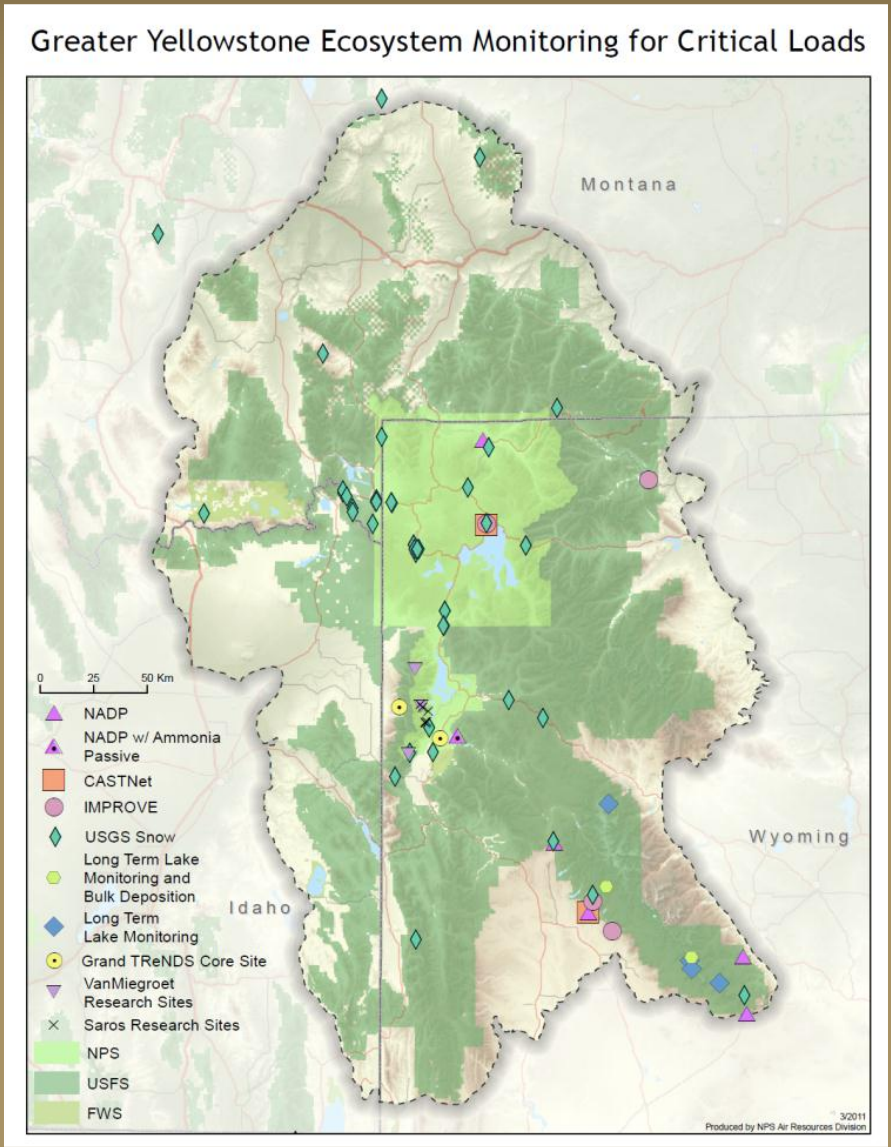
USFS Monitoring

- **Deposition**
  - NADP (4 monitors)
  - Bulk Deposition (2 Monitors)
- **Lake Chemistry** (6 long-term lakes)
  - Inlet
  - Outlet
  - Hypolimnion
  - Epilimnion
  - Macroinvertebrates
- **Visibility**
  - Aerosol (2)
  - Transmissometer
  - Camera

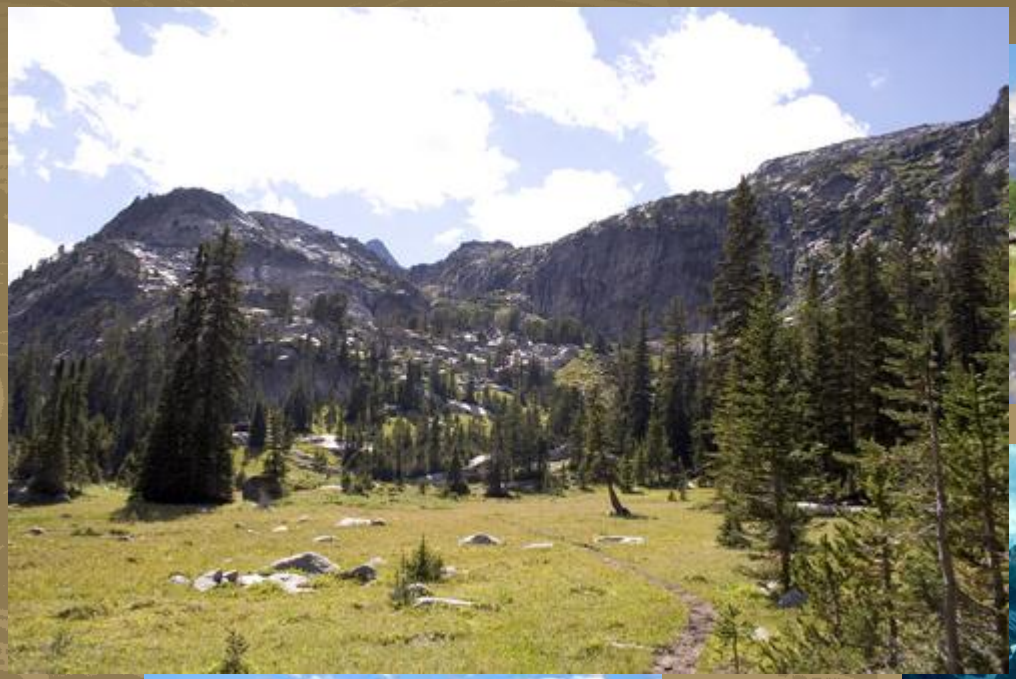


Methods for Estimating Deposition

- Deposition Monitoring
  - NADP
  - CASTNet
  - Passive Ammonia
  - Bulk sampling
    - Snow surveys (USGS)
    - Containers (USFS)
    - Ion exchange resins
- Deposition Models
  - Using PRISM (a precipitation model)
  - CMAQ emission-based model

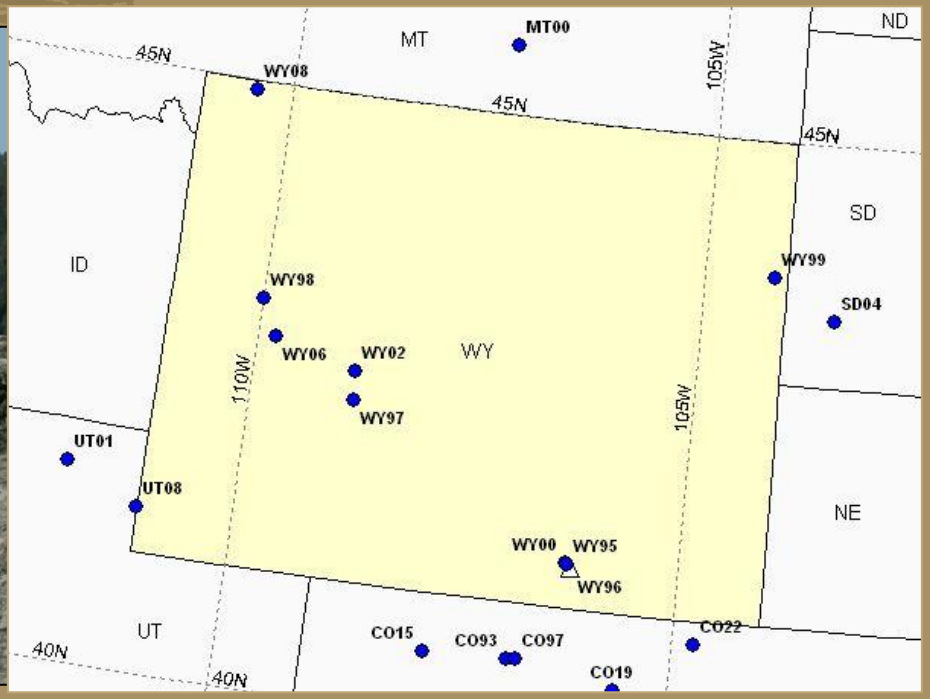


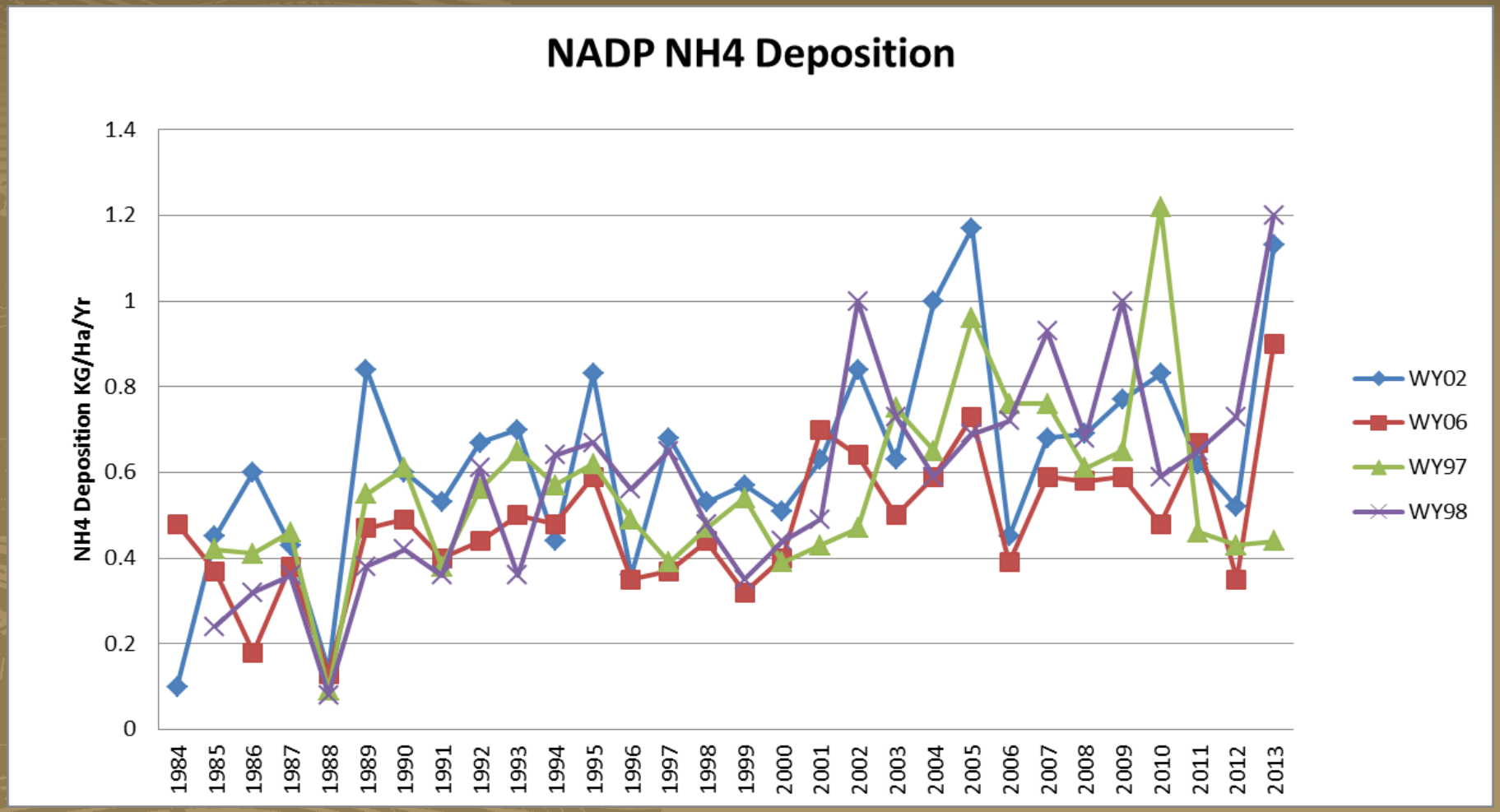
Data Overview

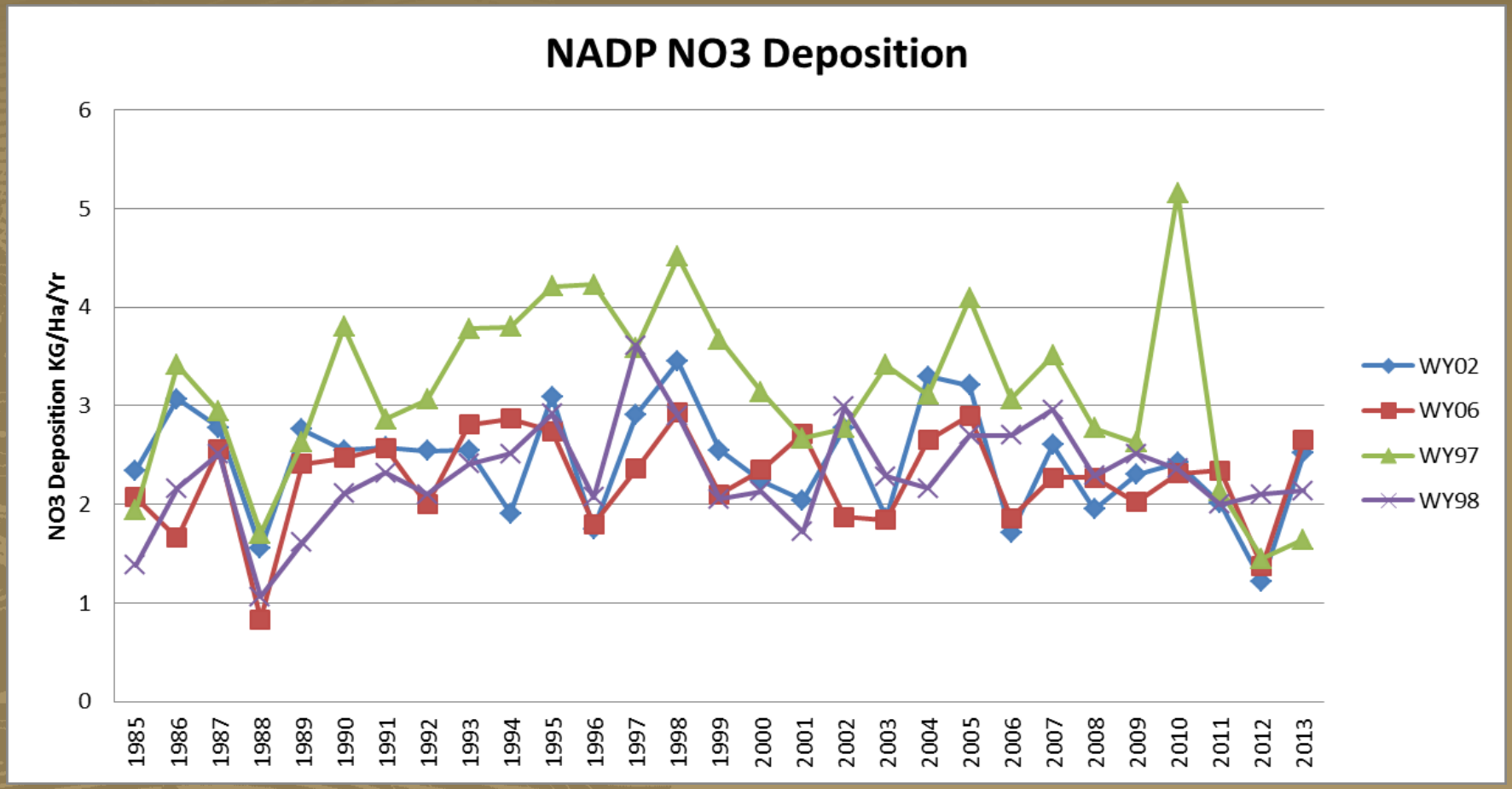


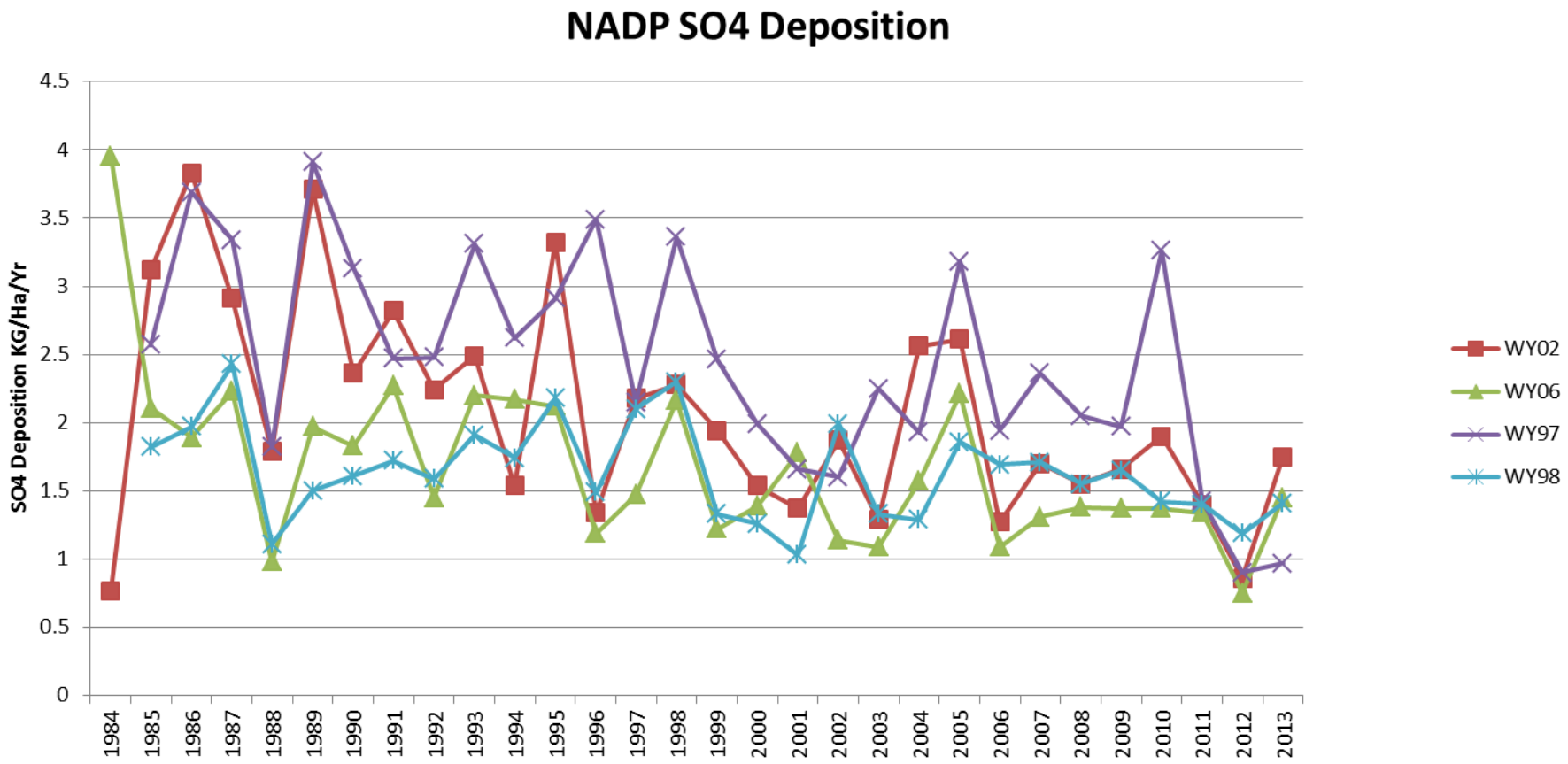
NADP Annual Trends (1986-2010)

Variable	Yellowstone (NPS)	Gypsum Creek (BTNF)	Murphy Ridge (BLM)	Pinedale (BLM/BTNF)	Sinks Canyon (BLM)	South Pass (BTNF/SNF)
NH4	↑	↑	↑	↑	↑	↑
NO3	–	–	–	–	–	↑
SO4	↓	↓	↓	↓	↓	↓



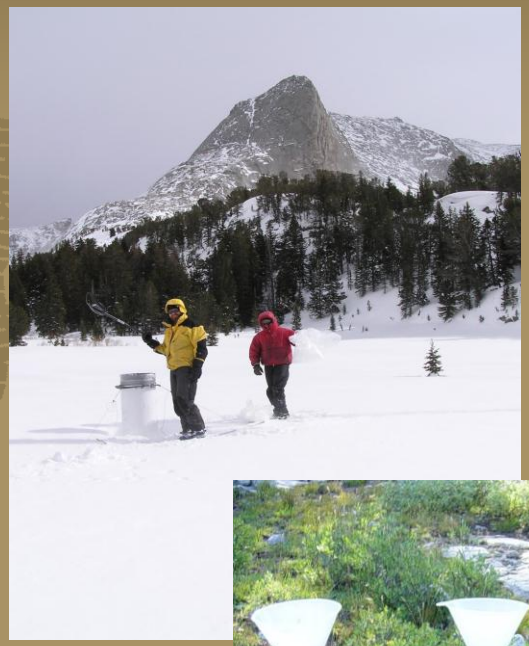

NADP NH4 Deposition
NH4 Deposition KG/Ha/Yr
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
WY02
WY06
WY97
WY98


NADP NO3 Deposition
NO3 Deposition KG/Ha/Yr
0
1
2
3
4
5
6
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
WY02
WY06
WY97
WY98


NADP SO4 Deposition
SO4 Deposition KG/Ha/Yr
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
WY02
WY06
WY97
WY98

Annual Bulk Deposition Trends at Hobbs and Black Joe Collectors (1984-2010)

Variable kg/ha	Hobbs (BTNF)	Black Joe (BTNF)
NH_4^+	*** ↑	** ↑
NO_3^-	*** ↑	* ↑
Total N	*** ↑	** ↑
SO_4^{2-}	---	---
Precipitation	** ↑	---

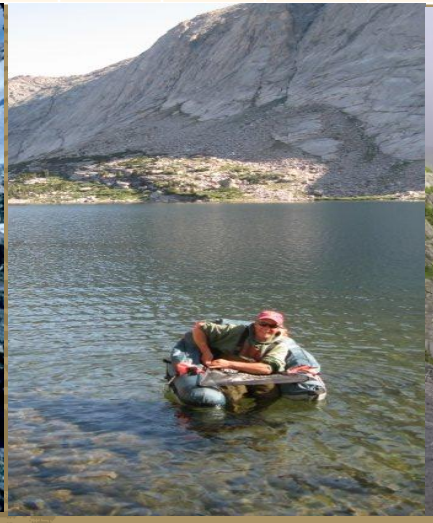


* = p<0.1, **= p<0.05, ***= p<0.01, **** = p<0.001

Significant Trends for Long-Term Lakes (1984-2010)

	Black Joe (BTNF)			Hobbs (BTNF)			Deep (BTNF)			Ross (SNF)			Lower Saddlebag (SNF)		
	Inlet	Outlet	Hypo	Inlet	Outlet	Hypo	Inlet	Outlet	Hypo	Inlet	Outlet	Hypo	Inlet	Outlet	Hypo
ANC	–	–	–	–	↓	–	–	–	–	↓	↓	↓	↓	–	–
NH4	–	↑	↑	↑	↑	↑	–	–	↑	ND	ND	ND	ND	ND	ND
NO3	↑	–	–	–	–	↓	–	–	↑	↑	–	–	↑	–	↑
SO4	↑	–	–	–	–	–	–	–	–	–	↓	↓	–	–	–

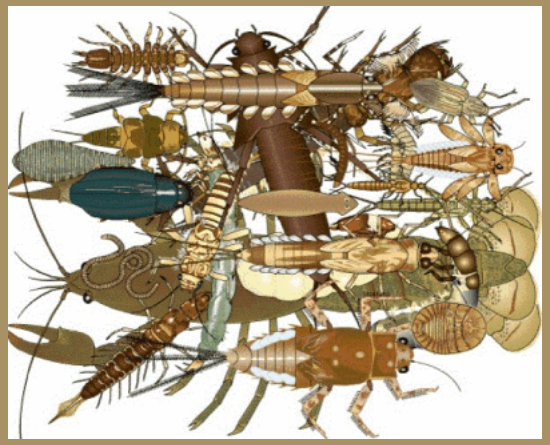
ND=Not Determined



Excess nitrogen in aquatic systems

- Increases above N critical loads for eutrophication in GYE is cause for concern
- Changes in macroinvertebrate biodiversity may be occurring - currently unknown (ongoing analysis)

Increases in algae



Decreases in biodiversity

Studies in the Rocky mountains indicate:

<u>3-4 kg/ha/yr is N critical load for faster growth of alpine grasses</u>: Since current GYA deposition is at or greater than this amount, alpine plants may be affected now…

Air Quality Impact Thresholds

Pollutant Load

SO4, NH4, NO3
Hg, POPs
NOx, SO2

Annual averages
Seasonal patterns

Chemical Variables

ANC, pH, Nitrogen,
Base Saturation, Ca/Al

Annual averages
Seasonal extremes

Biological Responses

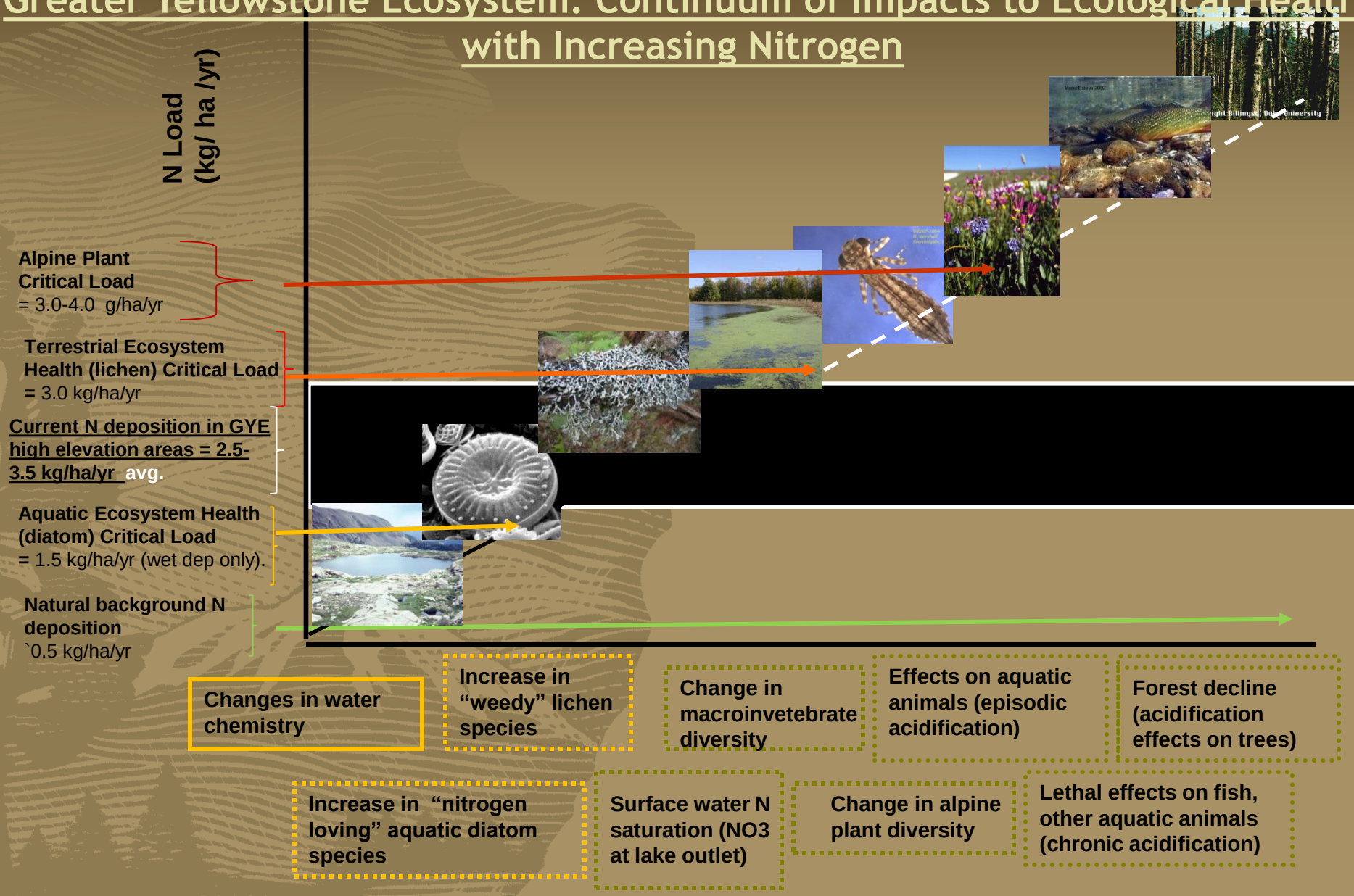
Death of Indicator species, Decline in Condition of individuals
Decreased Reproductive Success

Loss of species
Change in biodiversity

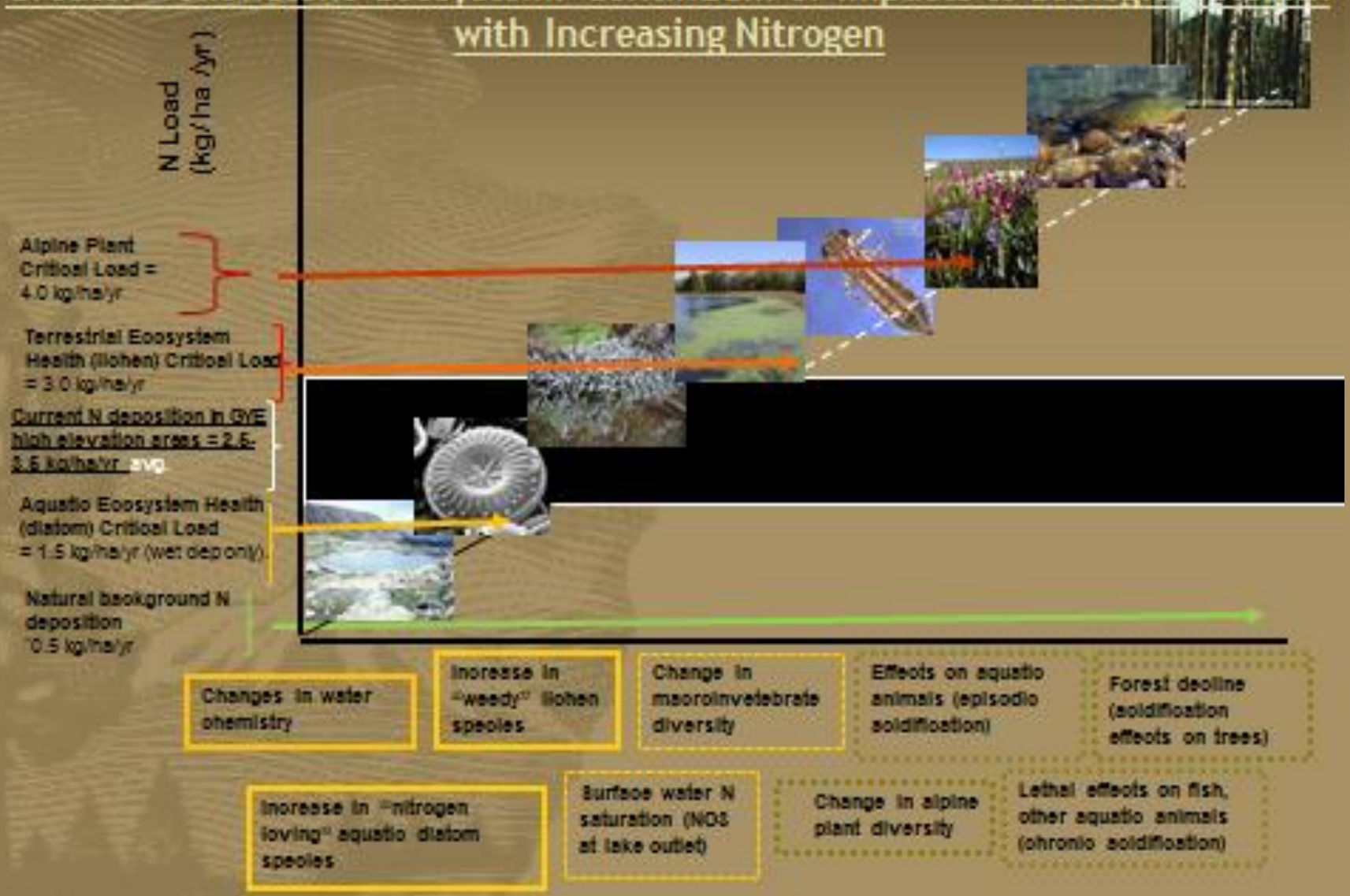
"Critical Load"-
deposition loading at which something happens in an ecosystem

"Ecological Threshold" -
Chemical or biological limit defining when "something happens" in an ecosystem

Greater Yellowstone Ecosystem: Continuum of Impacts to Ecological Health with Increasing Nitrogen



Greater Yellowstone Ecosystem: Continuum of Impacts to Ecological Health with Increasing Nitrogen



State of the Science in the GYA:

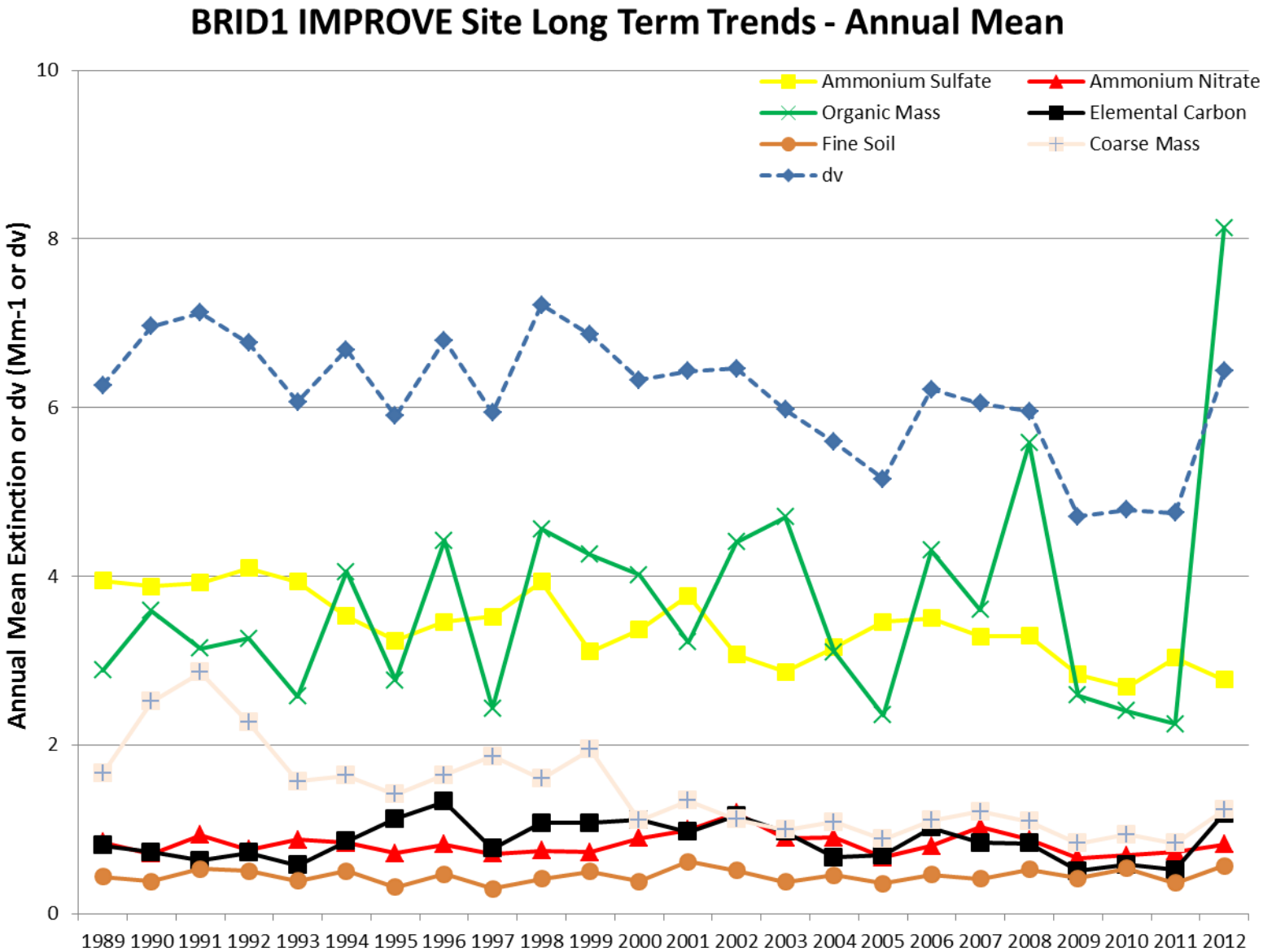
- Nitrogen deposition is increasing in many regions of the GYA
- Some GYA lakes are likely experiencing eutrophication
- Some GYA lakes are beginning to show signs of acidification
- Lake sediment cores show increasing influence of anthropogenic N (diatom shifts)
- Critical loads of deposition established for other areas suggest that additional effects on lichen, soils, alpine vegetation may soon occur in GYA

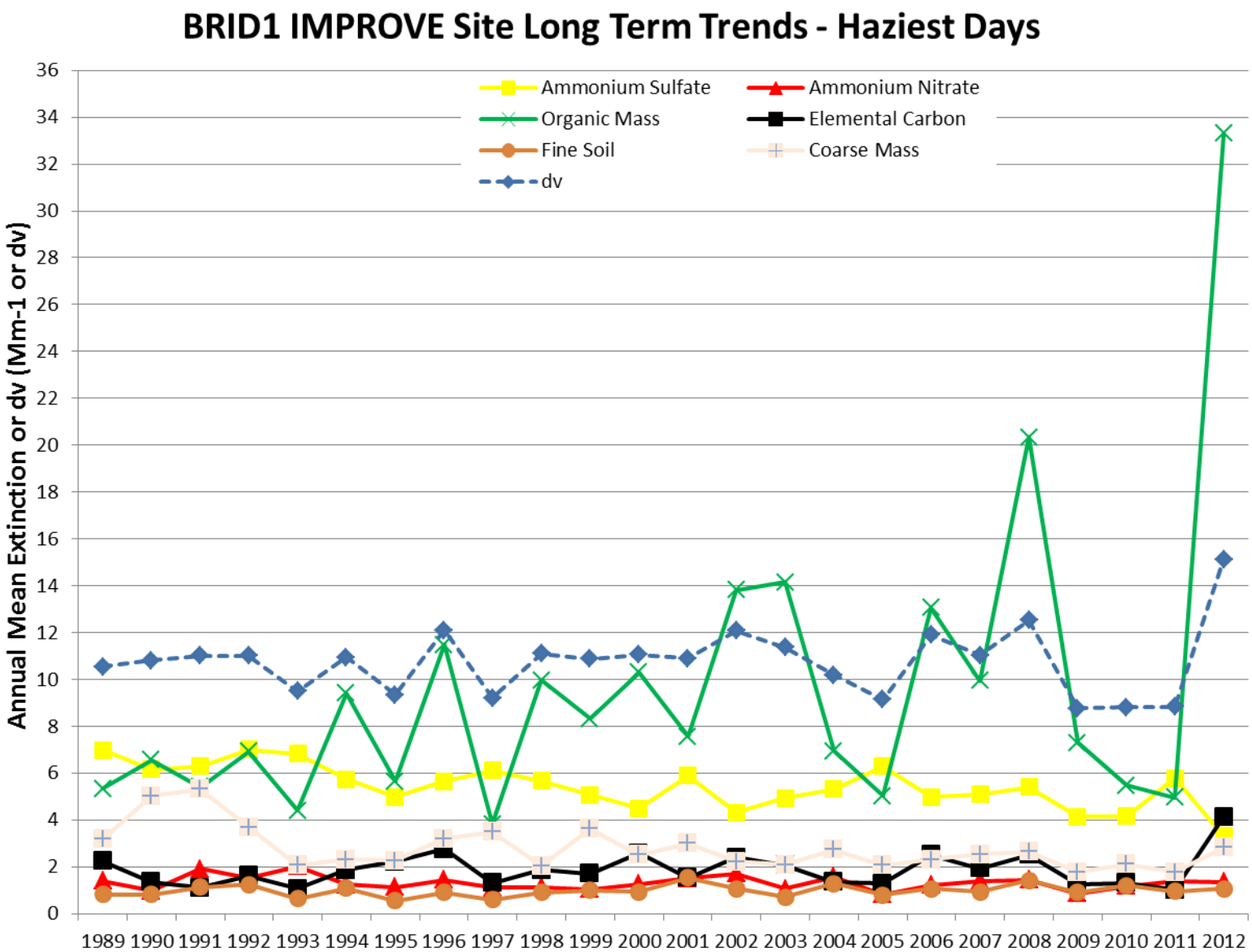
Visibility

SVR = 350 Km

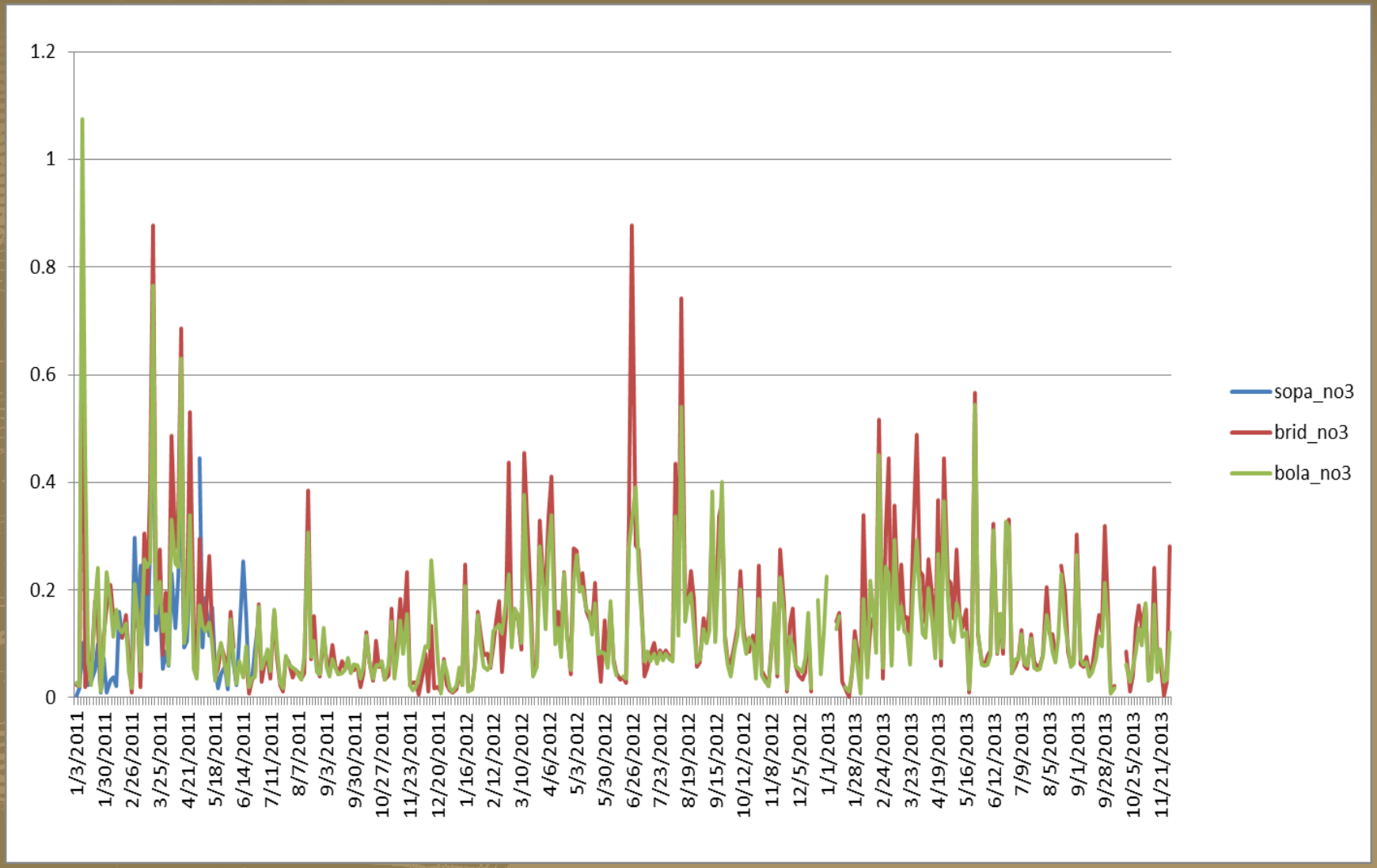
SVR = 60 Km

SVR = 20 Km

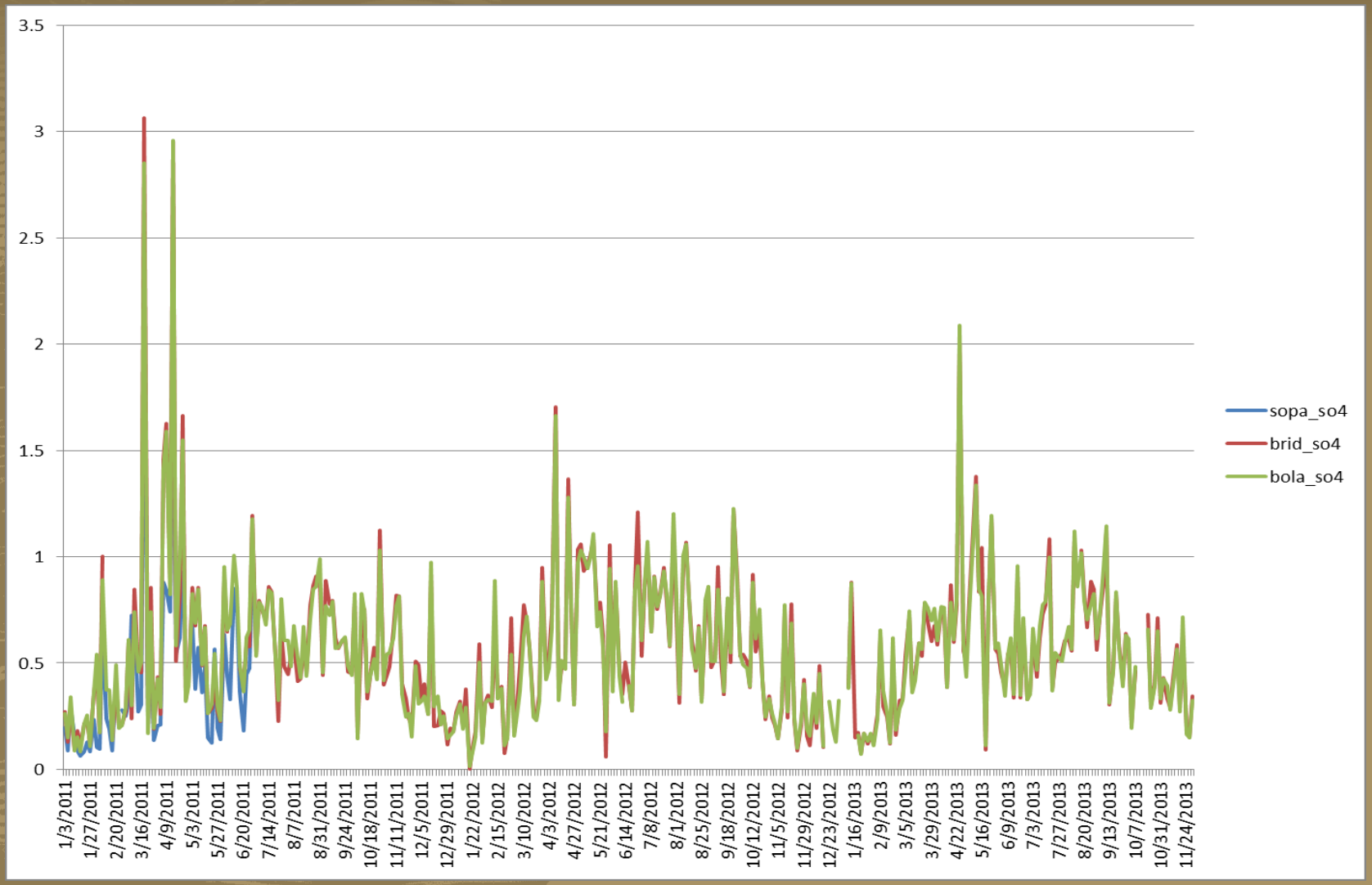

BRID1 IMPROVE Site Long Term Trends - Annual Mean
Annual Mean Extinction or dv (Mm-1 or dv)
10
8
6
4
2
0
Ammonium Sulfate
Ammonium Nitrate
Organic Mass
Elemental Carbon
Fine Soil
Coarse Mass
dv
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012


BRID1 IMPROVE Site Long Term Trends - Haziest Days
Annual Mean Extinction or dv (Mm-1 or dv)
Ammonium Sulfate
Ammonium Nitrate
Organic Mass
Elemental Carbon
Fine Soil
Coarse Mass
dv
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

NO3 at 3 IMPROVE Monitors



SO4 at 3 IMPROVE Monitors

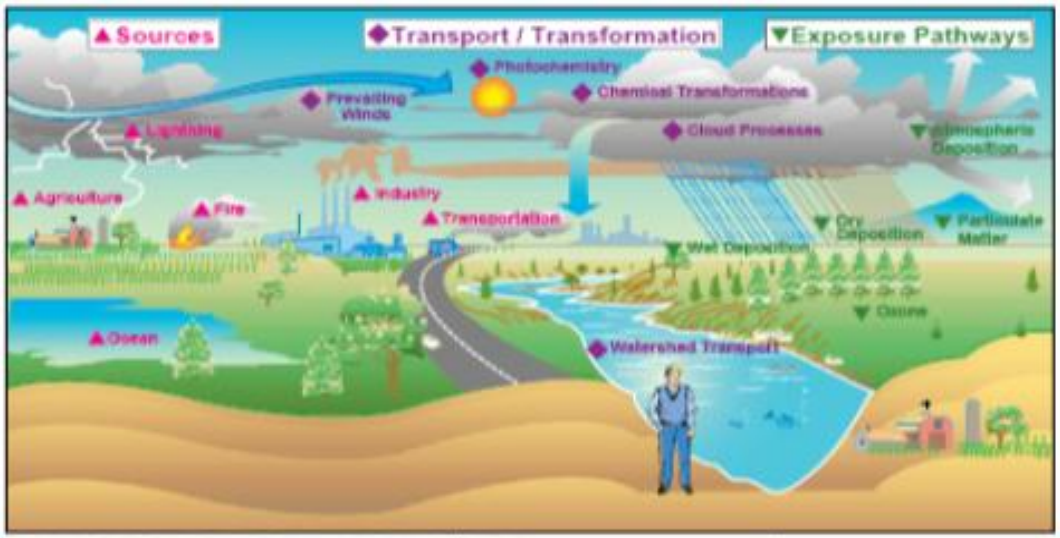


Visibility Trends

- Visibility is improving in line with the Regional Haze Rule.
- Nearby fires result in spikes of organic mass and nitrates.
- The Boulder Lake and Bridger sites track very well in normal conditions.
- The Bridger site tends to show higher nitrates than Boulder Lake in smoky conditions. (elevation)

Three State Study Data Warehouse

- **States**
  - Wyoming
  - Utah
  - Colorado
- **Federal Agencies**
  - USFS
  - BLM
  - NPS
  - EPA
  - FWS



Source	Emissions	Deposition
Combustion: Vehicles Energy development Energy production	NO_x VOCs	NO_3^- HNO_3
Agriculture: Livestock production Crop production	NH_3	NH_4^+

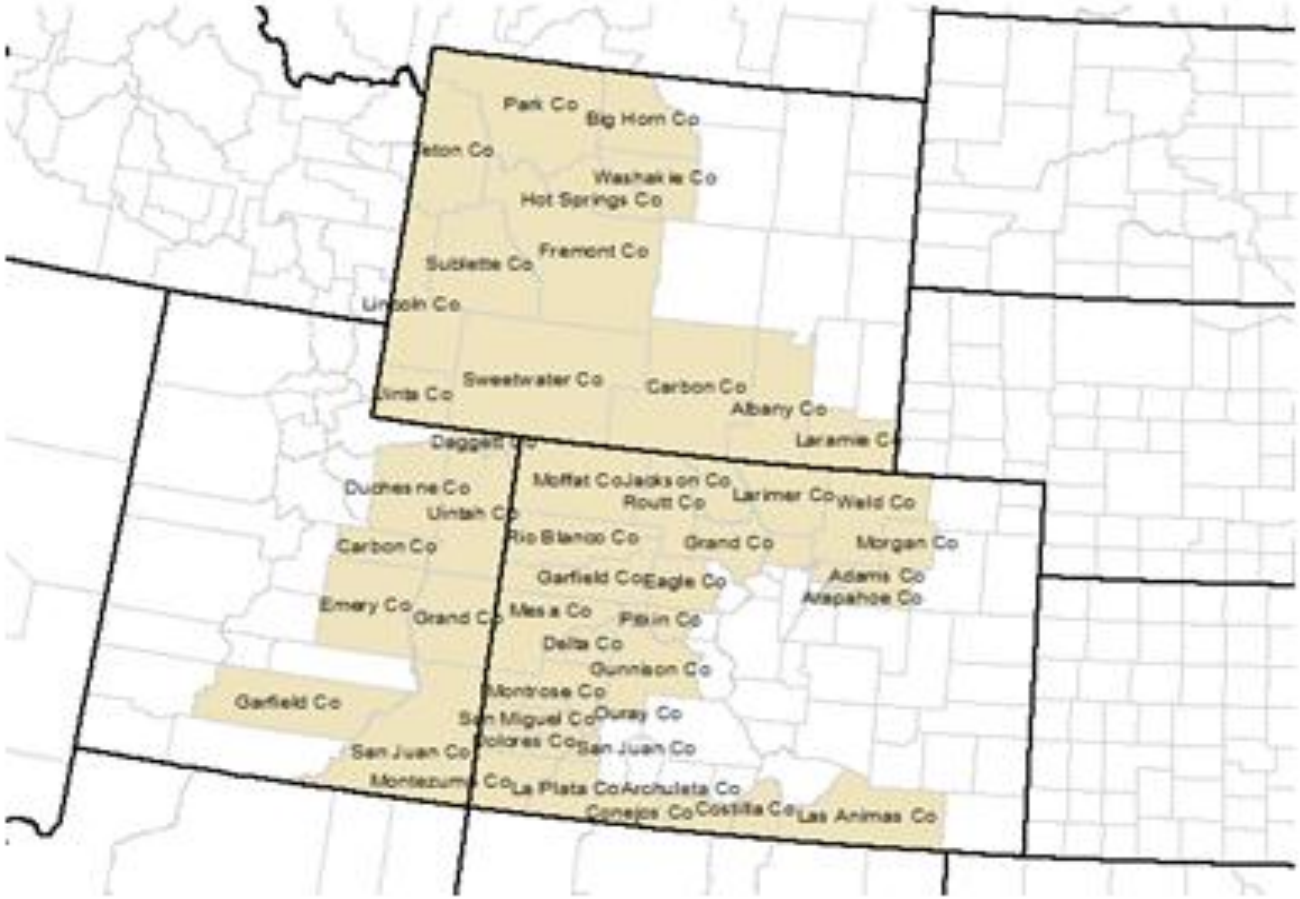
Purpose of the Data Warehouse:

- **Develop a database to:**
  - Get up-to-date emission inventories in 1 place.
  - Provide consistent QA/QC data and metadata for air quality modeling.
  - Provide consistent data for modeling that is validated by the stakeholders.
  - Focus on Ozone, PM and AQRVs.
  - Collecting additional ozone data across the study area for use in modeling.
  - WY BLM will test this data warehouse platform on the Converse County EIS and the Hiawatha EIS Projects.

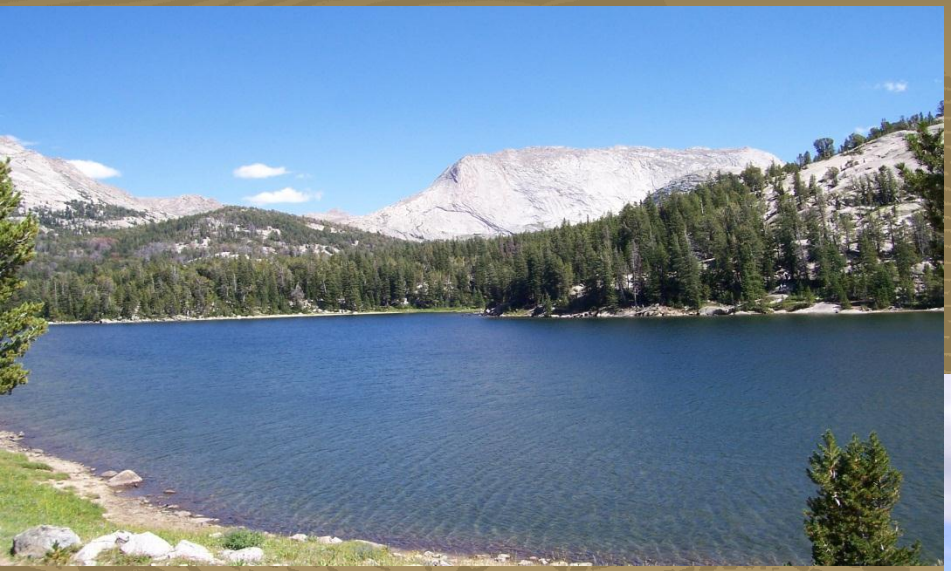
Benefits of the Data Warehouse:

- Greatly decreases the time needed to conduct emission inventories.
- Saves money.
- Provides consistent, standardized data to be used for air quality models.
- Facilitates regional modeling across large areas vs project by project. (Ozone)
- Implementation (data access) expected in 2014.

3SAQS Emissions Analysis Domain



Questions?



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