The Secret to Successful Long-Term Monitoring

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Cary Institute of Ecosystem Studies

Hudson River Watershed Alliance Workshop

December 5, 2019

Cary Institute
of Ecosystem Studies

Topics for this talk

- Why do long-term monitoring – why it matters
- How to manage the data
- How to use the data
- Different approaches to monitoring – e.g., community (citizen) science

The 7 Habits of Highly Effective Monitoring Programs*

1. Design the program around clear and compelling scientific questions.

2. Choose measurements carefully and with the future in mind, e.g., basic measures of system health, indicators of change, or variables of particular human interest.

3. Include monitoring within an integrated research program.

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5. Include review, feedback, and adaptation in the design.

6. Continually examine, interpret, and present the monitoring data.

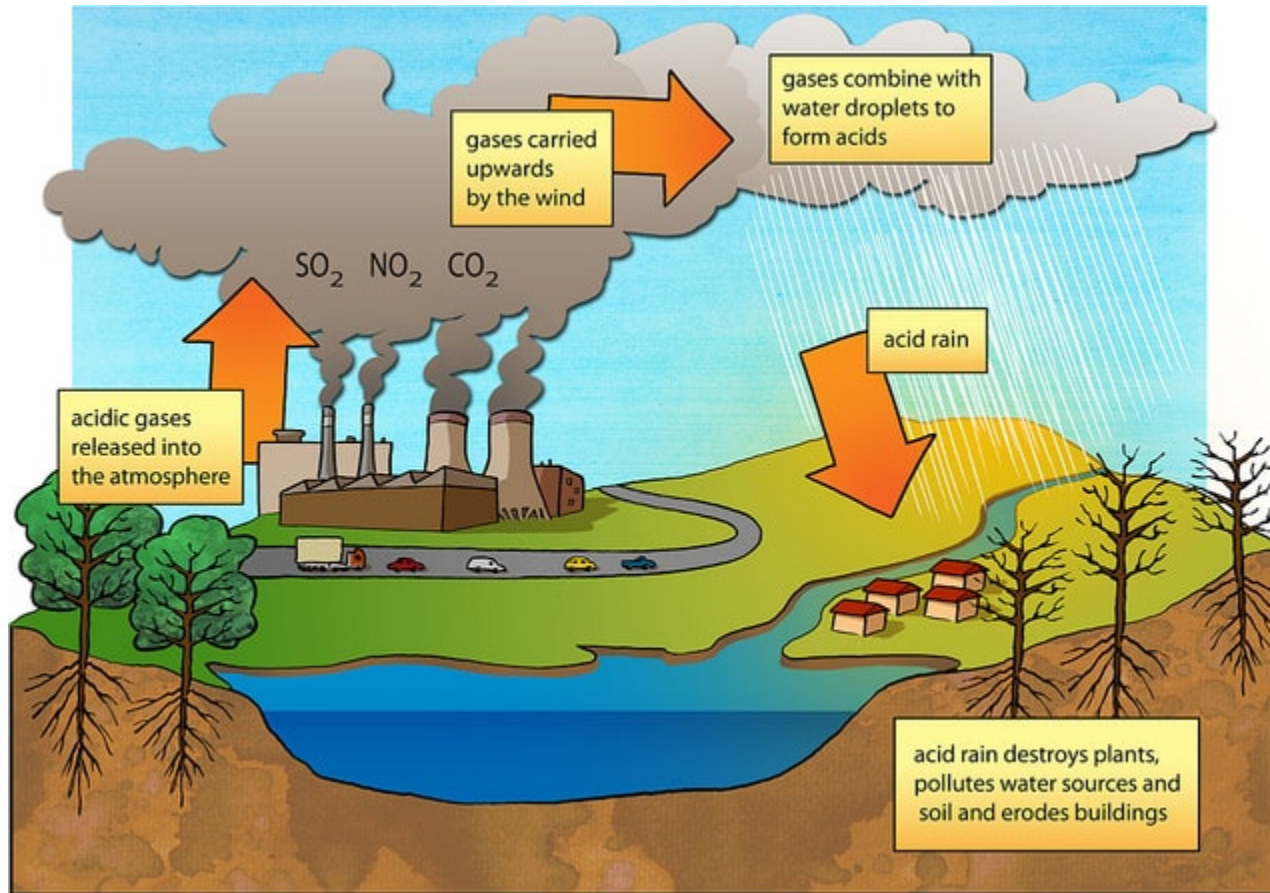7. Plan for long-term data accessibility and [possibly] sample archiving.

Why do long-term monitoring
Cary Institute Story 1984-present

Acid Rain

Air Quality Was Extremely Poor

Water Quality Was Just As Bad

1969 Cuyahoga River fire in Cleveland, Ohio

Clean Air Act 1970

Nixon signs the Clean Air Act of 1970 as William Ruckelshaus (*left*), head of the newly formed Environmental Protection Agency, and Russell Train (*right*), chairman of the Council on Environmental Quality, look on.

Associated Press

Clean Air Act Amendments 1990 Addresses Acid Rain

President Bush signing the Clean Air Act Amendments of 1990.
Standing left to right are EPA Administrator William K. Reilly, Energy
Secretary James Watkins, and Vice President Dan Quayle.

Clean Water Act 1972

Passed Congress, Vetoed By Nixon, Veto Overridden by Congress

Air, Precipitation & Stream Monitoring at Cary began 1984 & 1985

# Program Consisted of In-Stream Sensors

Monthly Grab Samples

Broad-brush Approach to Monitoring

CA	concentration of Ca+2 (mg/L)
CL	concentration of Cl- (mg/L)
COND	conductivity (umho)
DATE	date sample was collected
K	concentration of K+ (mg/L)
MG	concentration of Mg+2 (mg/L)
NA	concentration of Na+ (mg/L)
NH4	concentration of NH4+ (mg/L)
NO3	concentration of NO3- (mg/L)
PH	pH
PO4	concentration of PO4-3 (mg/L)
Q	stream flow rate at site 2 (m^3/s)
SIO2	concentration of SiO2 (mg/L)
SITE	site on Wappinger Creek
SO4	concentration of SO4-2 (mg/L)
STM_HT	Stream height (cm)
STM_TMP	Stream temperature (deg C)

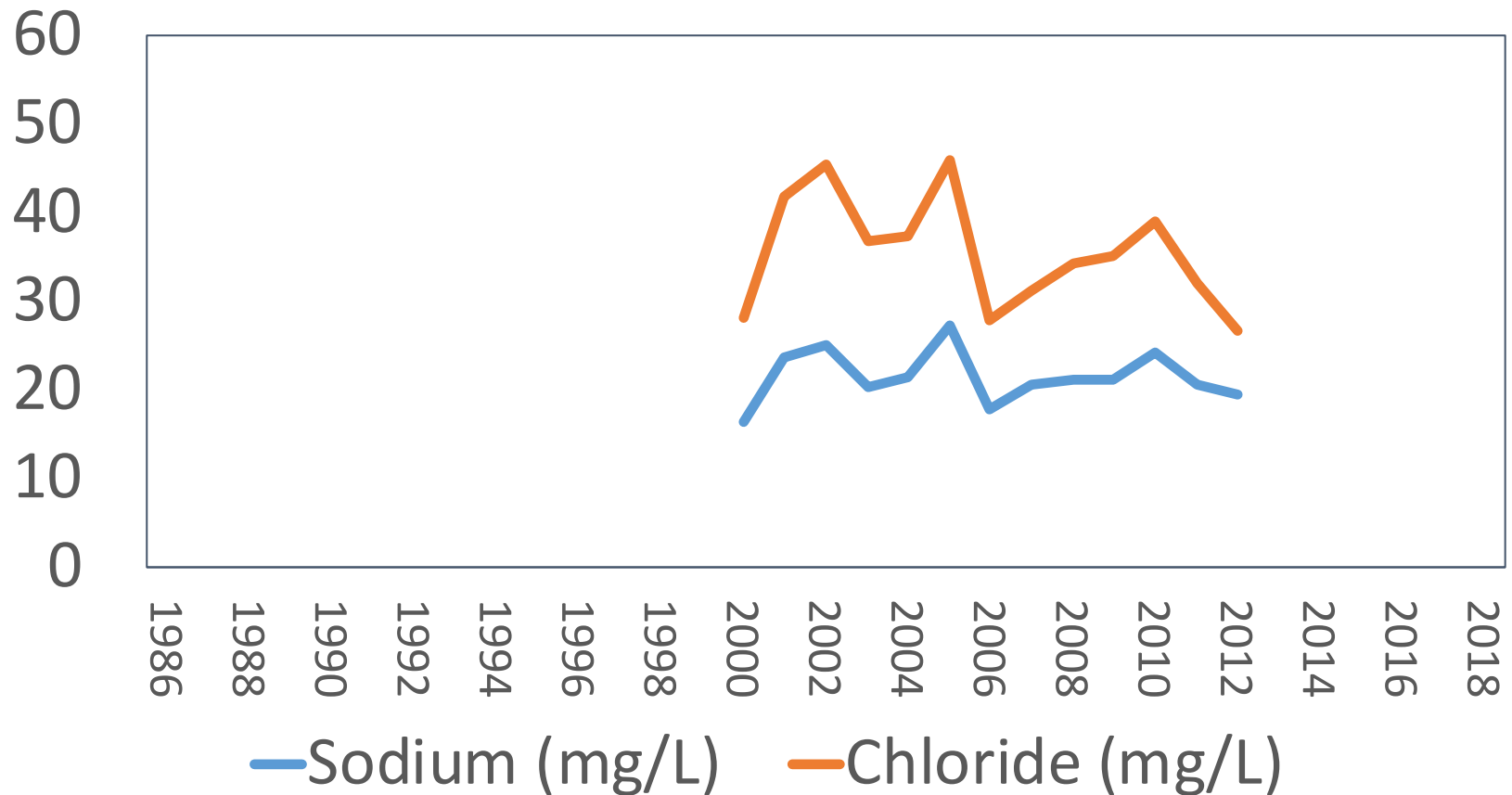# Acid Rain Components in East Branch Wappinger Creek at Cary
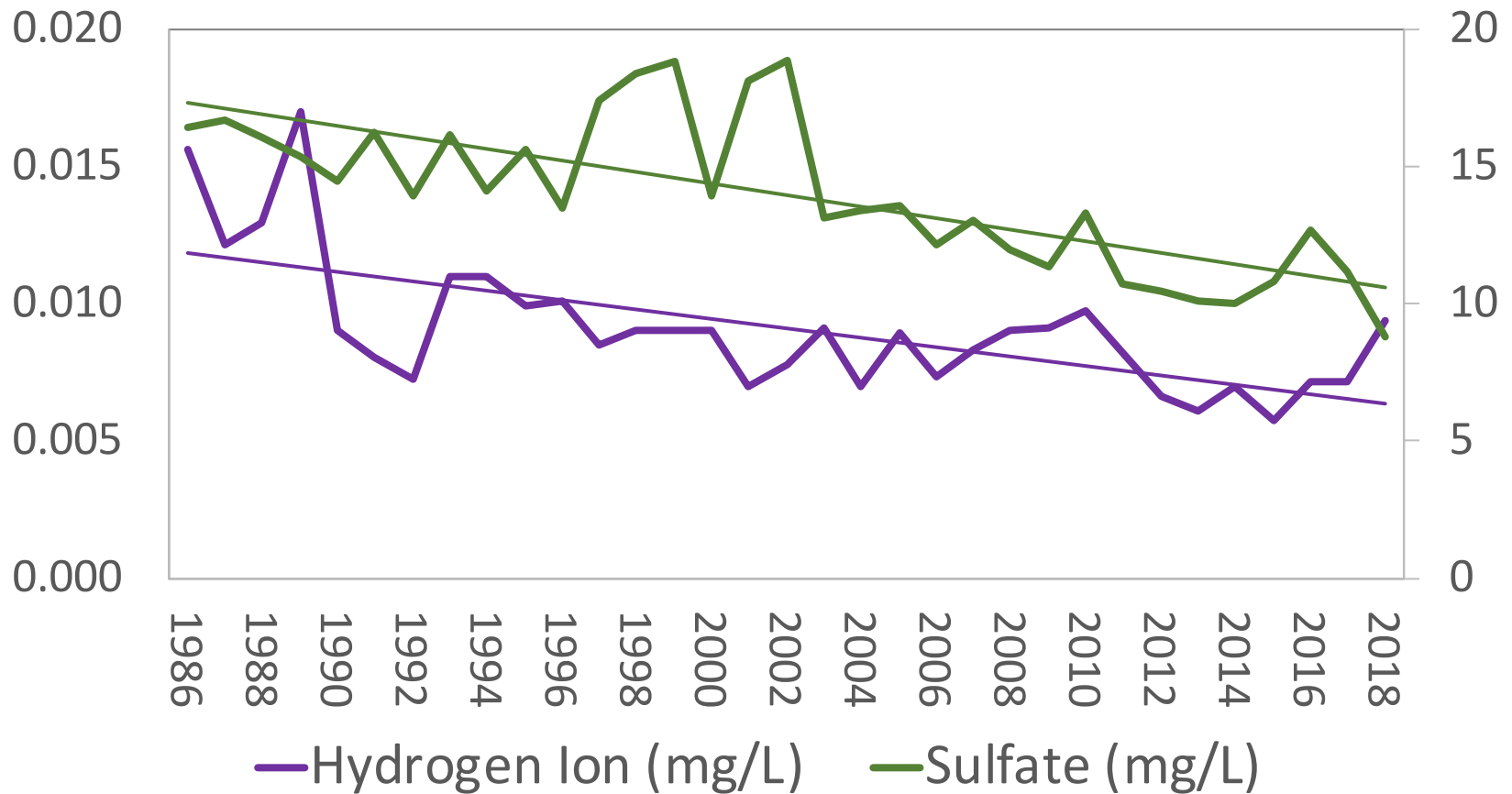
Na & Cl in East Branch Wappinger Creek at Cary
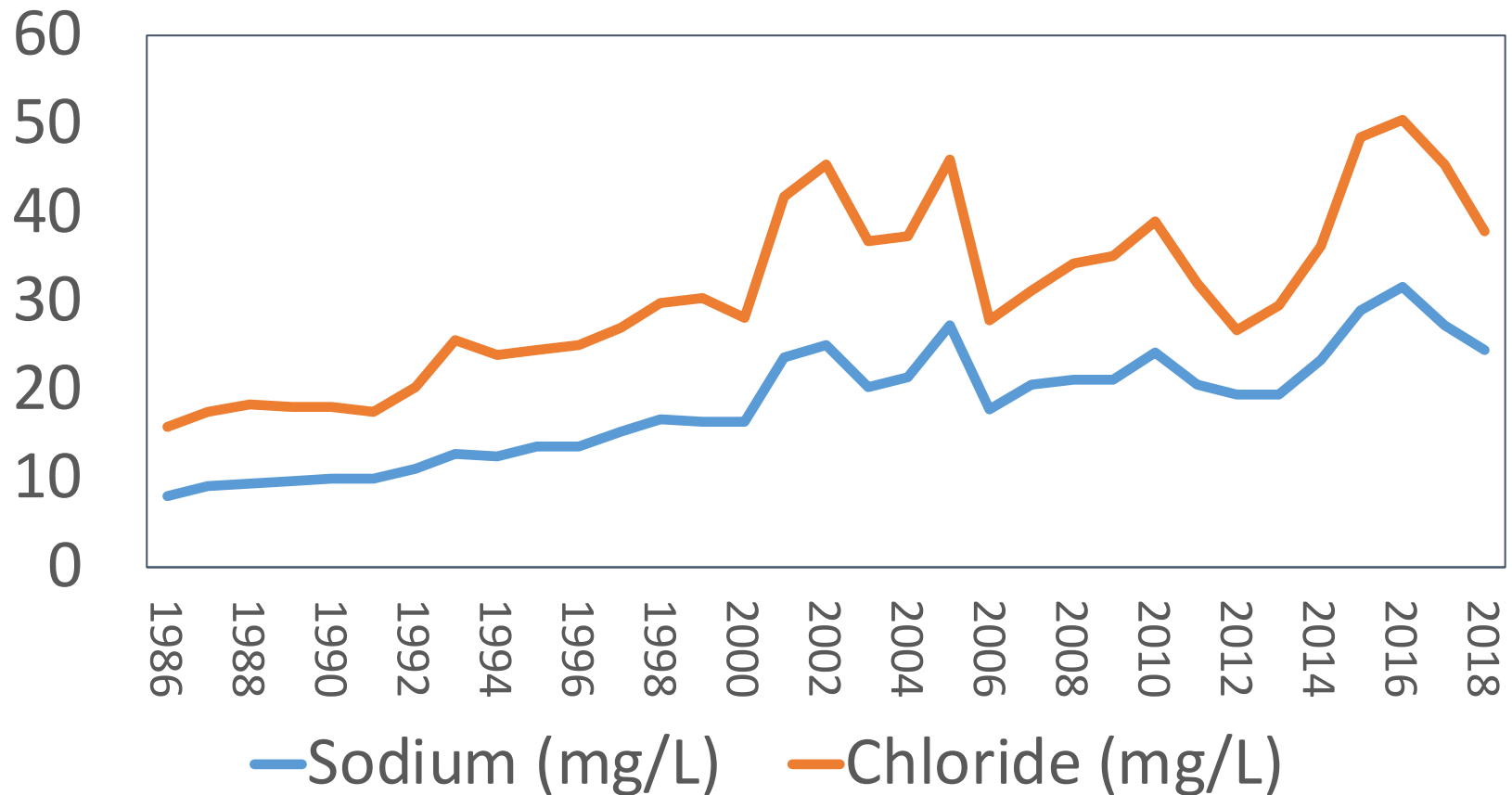
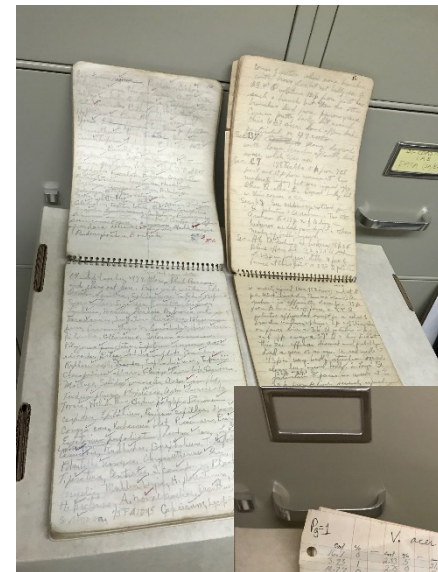Na & Cl in East Branch Wappinger Creek at Cary

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How to Manage the Data
Maintaining Data & Ensuring Data Quality

Data from Cary Analytical Lab
(note Lab has its own QC)

Wappingers Creek _Jul2018-Mar2019.xlsx - Excel

A1 — Data Summary Report

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1			Data Summary Report																				
2			IES Analytical Laboratory																				
3	Scientist	Cost Center	0008,,		11/15/19																		
4	Project Contact	Matrix	Water																				
5	Project Name	Preservative	F/4C																				
6	Comments																						
7	Sample Information				Data																		
8	Date Submitted	Lab Sample ID	Project Sample ID	Collection Date	Test:																		
9							Ammonium-N	Calcium-ICP		Chloride	gnesium-ICP		Nitrate-N		Phosphate-P		otassium-ICP		Silicate	Sodium-ICP			
10	07/30/18	1807008-001	7/30/2018 WC 2F	07/30/18				36.2	mg/L	53.3	mg/L	10.4	mg/L				1.51	mg/L	8.5	mg/L	33.9	mg/L	8.
11	07/30/18	1807008-002	7/30/2018 WC 4F	07/30/18				37.2	mg/L	56.3	mg/L	9.07	mg/L				1.2	mg/L	8.5	mg/L	33.5	mg/L	9.
12	07/30/18	1807008-003	25JUL2018 Test Blank	07/30/18				0.05	mg/L	0.04	mg/L	0.03	mg/L				<0.02	mg/L	<0.1	mg/L	0.29	mg/L	<0.
13	07/30/18	1807008-004	7/30/2018 WC 2F/A	07/30/18	0.03	mg/L								0.52	mg/L	0.107	mg/L						
14	07/30/18	1807008-005	7/30/2018 WC 4F/A	07/30/18	0.05	mg/L								0.32	mg/L	0.048	mg/L						
15	07/30/18	1807008-006	Test Blank Acidified	07/30/18	0.02	mg/L								<0.02	mg/L	<0.002	mg/L						
16	08/24/18	1808011-001	WC 2F	08/24/18				29.9	mg/L	37.6	mg/L	7.73	mg/L				1.32	mg/L	9.2	mg/L	24.9	mg/L	7.
17	08/24/18	1808011-002	WC 4F	08/24/18				33.3	mg/L	45	mg/L	7.43	mg/L				1.26	mg/L	9.5	mg/L	28.9	mg/L	8.
18	08/24/18	1808011-003	WC 2F/A	08/24/18	0.03	mg/L								0.3	mg/L	0.038	mg/L						
19	08/24/18	1808011-004	WC 4F/A	08/24/18	0.03	mg/L								0.34	mg/L	0.028	mg/L						
20	09/24/18	1809008-001	WC2 F	09/24/18				29.3	mg/L	33.7	mg/L	7.56	mg/L				1.27	mg/L	9.5	mg/L	23.6	mg/L	7.

IES_ResultsReport

Ready — 100%

Put data in file so it can be appended to long-term dataset

Quality Control

Archiving/Storing Data

- Email it to yourself &/or collaborators

- Cloud storage, e.g., Google Drive, Dropbox, etc.

- External Hard Drive

- Data repositories – may need a researcher

- ***Include Metadata***

Guidelines for Good Data Management

- Document what you did – notebooks
- Keep a copy of the original data file unchanged
- Versioning – Save the file with a new name every time you change it. Document your file naming method – e.g., Filename_Date – date refers to the date it was changed, keep all versions, describe how data were changed
- ***METADATA*** – Units, time (EST or DST), location - GPS coordinates, sampling protocol, analysis information, description of project, see attached
- Backup – 3 ways (your computer, external hard drive, google drive, 2 different sites (you, a collaborator, the cloud)

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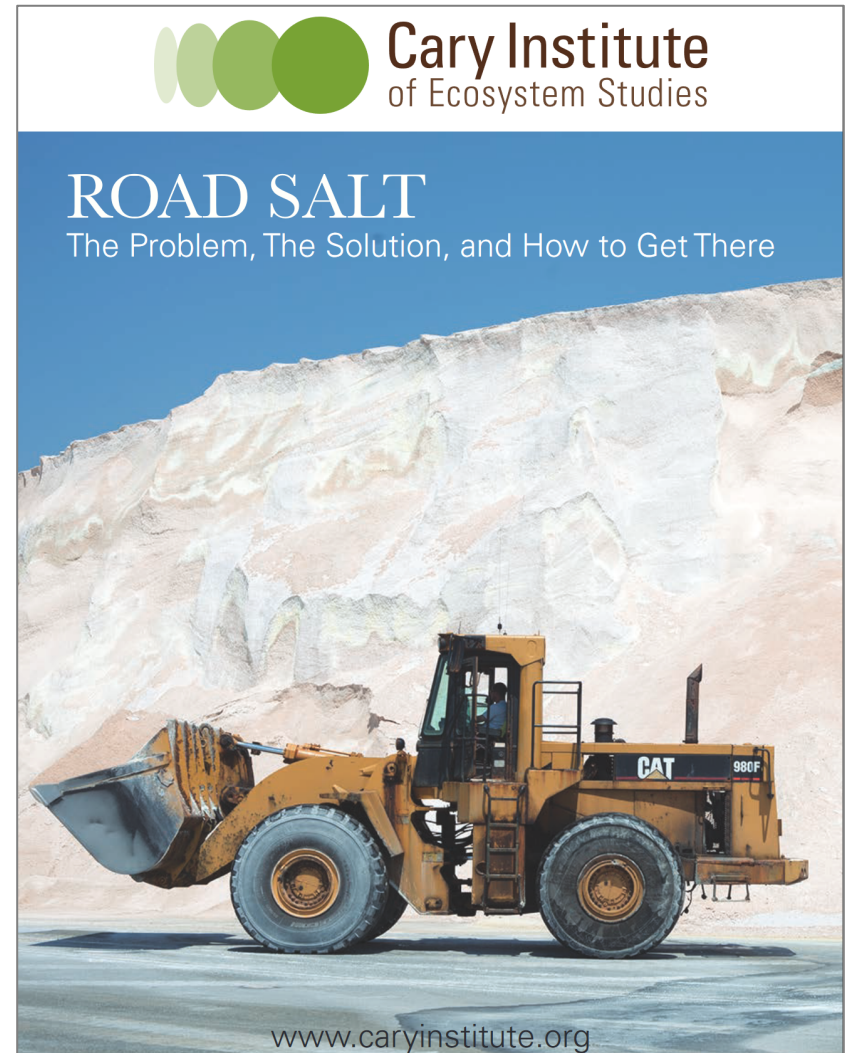*Lovett et al. 2007. Frontiers in Ecology & the Environment 5(5): 253–260
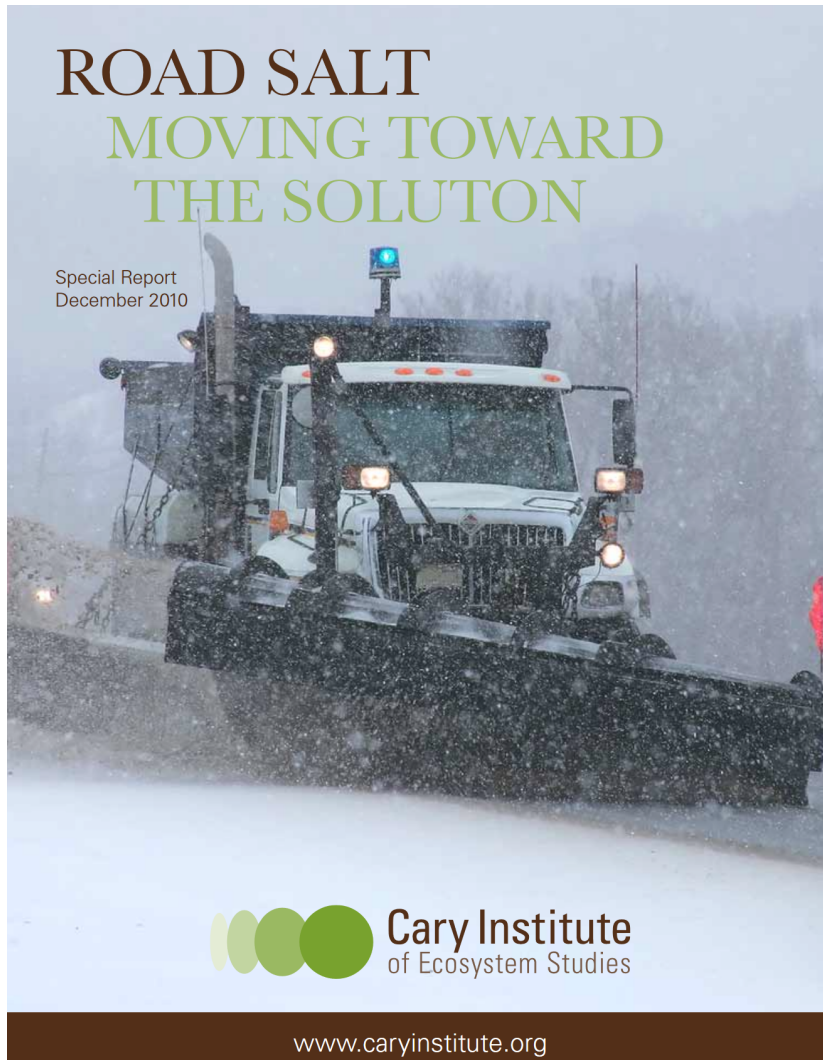
How To Use The Data

Examine, interpret, and present the monitoring data

Connect with Public Policy & Practice

Engage The Public

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Different Approaches To Monitoring

- Engage a researcher
- Community (Citizen) Science
- Join/form a network (HRECOS, EMMA, THuRST…)

EMMA
Environmental Monitoring
and Management Alliance

HRECOS
Hudson River Environmental
Conditions Observing System

The Hudson River Subwatershed & Tributary (THuRST) Research Network

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Thank You!
Questions

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