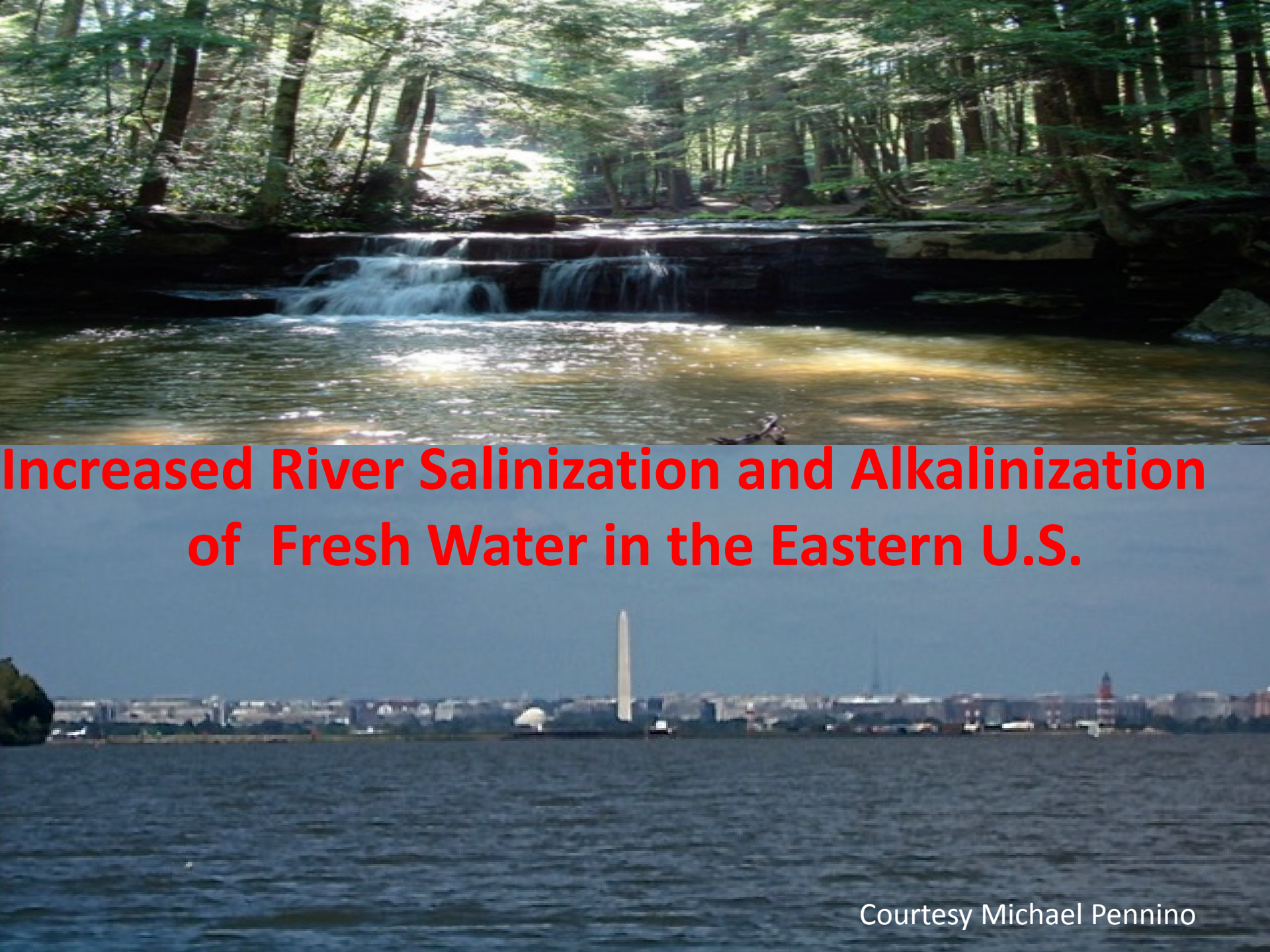
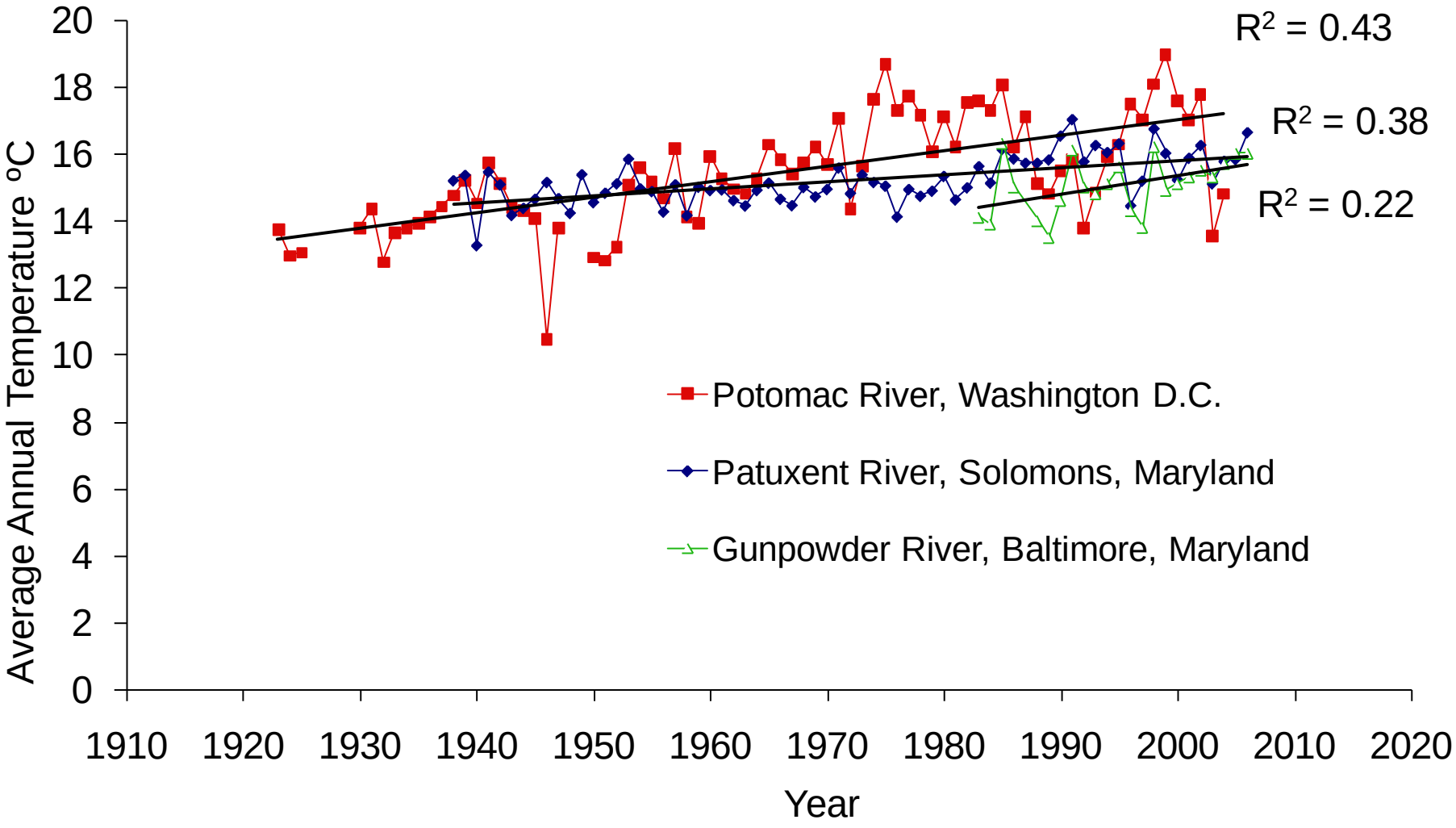


Increased River Salinization and Alkalinization of Fresh Water in the Eastern U.S.

Courtesy Michael Pennino

River Temperatures in Maryland-Washington D.C.



Other warming rivers in New York, Montana, Oregon…

Kaushal et al. (2010), *Front. in Ecol. And Env. Science*

Outline

I. How are human activities increasing alkalinization of fresh water?

II. How are human activities increasing salinization of fresh water?

Outline

I. How are human activities increasing alkalinization of fresh water?

II. How are human activities increasing salinization of fresh water?

I. Background

- Streams and rivers are transporters of carbon
- Bicarbonate alkalinity is buffering capacity
- Alkalinity can be influenced by land use
- Chemical weathering can generate alkalinity

Objectives

- Investigate trends and identify predictors of river alkalinization in the eastern U.S.

- Investigate impacts of land use and hydrologic variability on river alkalinization

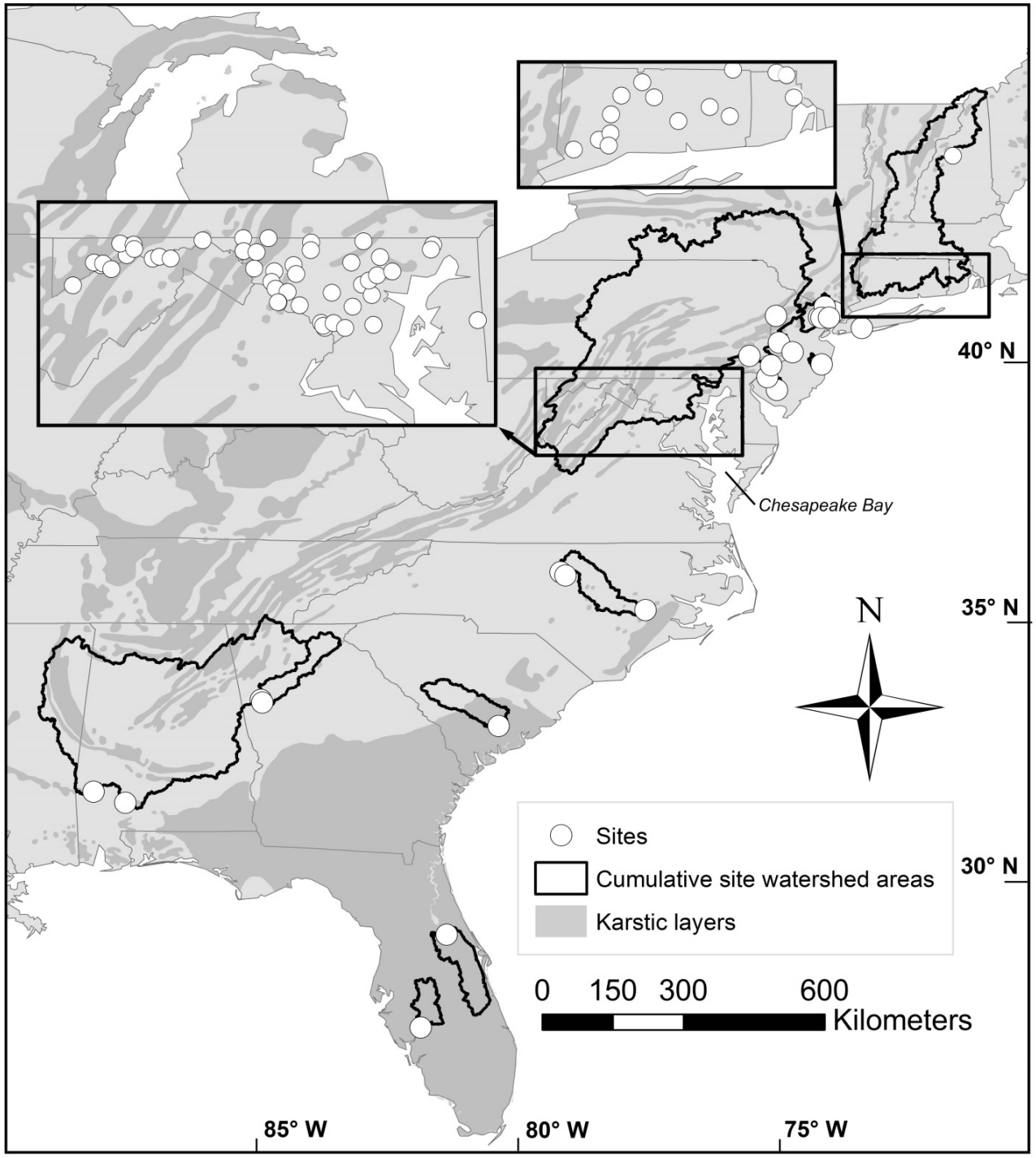
97 Sites Spanning:

Watershed Size

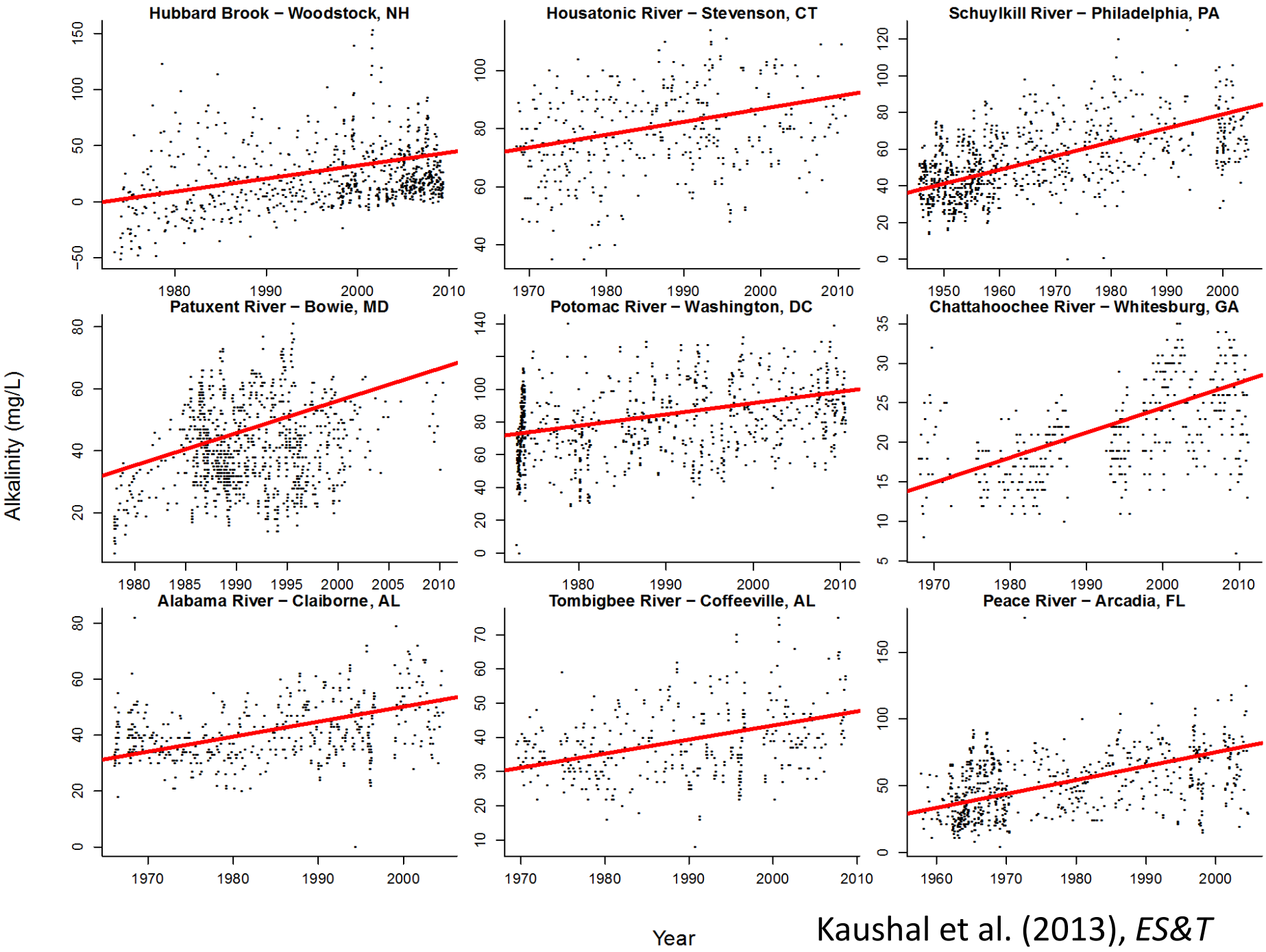
Elevation

Lithology

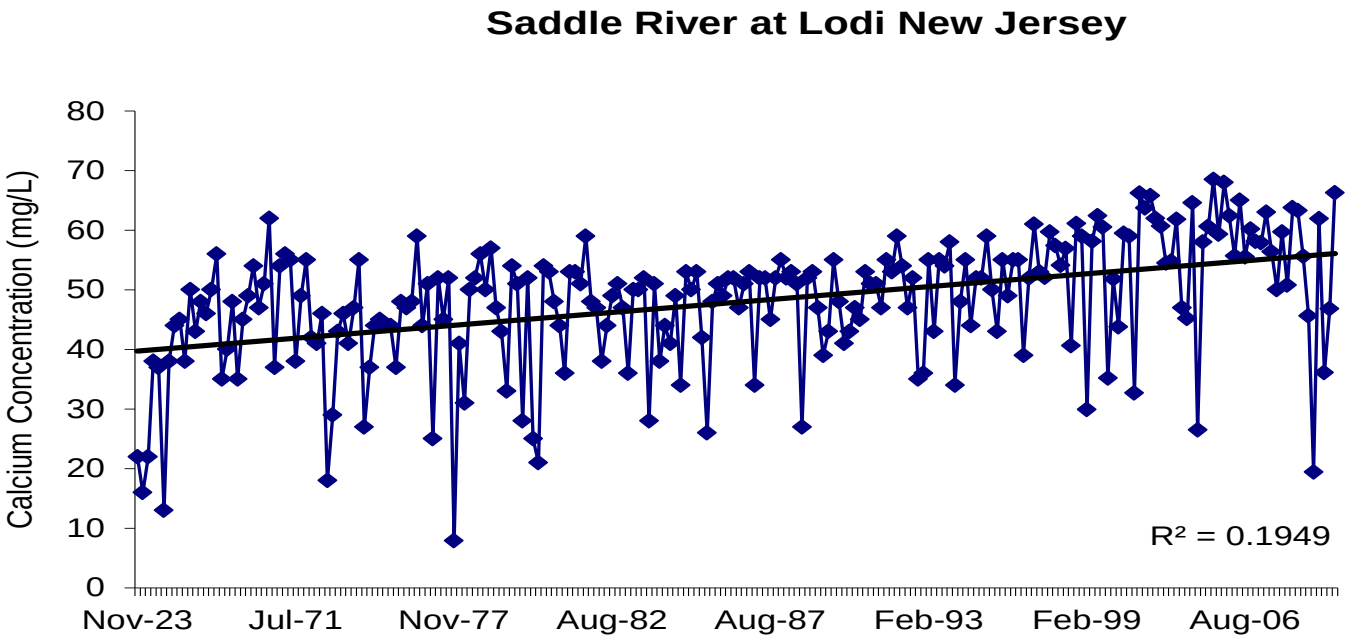
Land Use

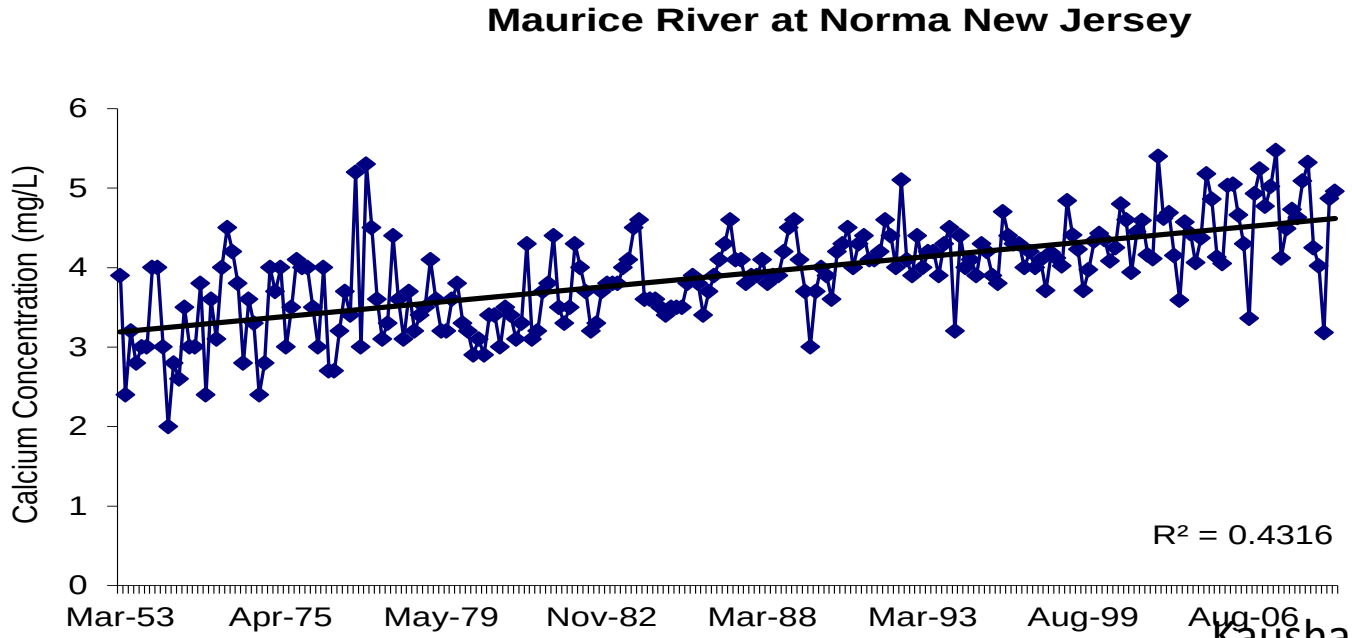


Kaushal et al. (2013), *ES&T*



Kaushal et al. (2013), *ES&T*





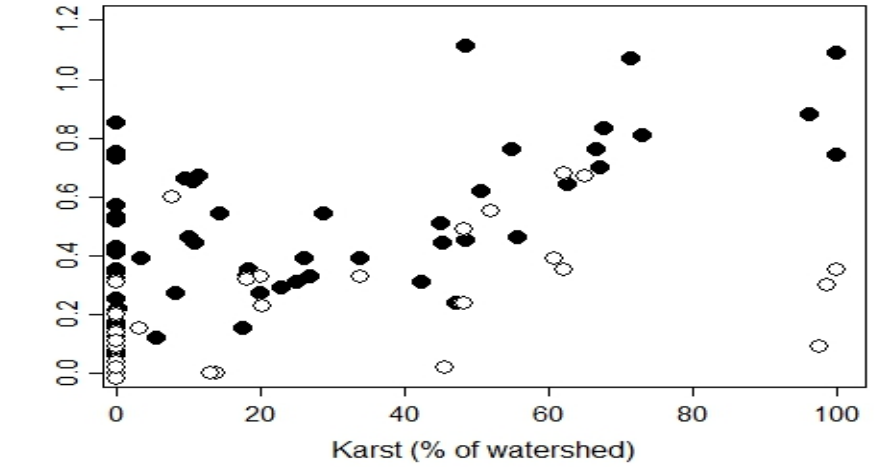
Kaushal et al. (2013), *ES&T*

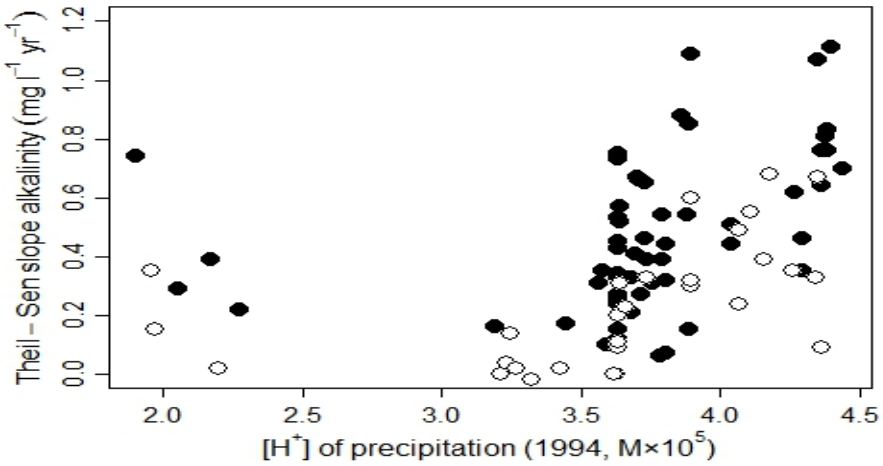
40% of Variation in River Alkalinization Rates Predicted by:

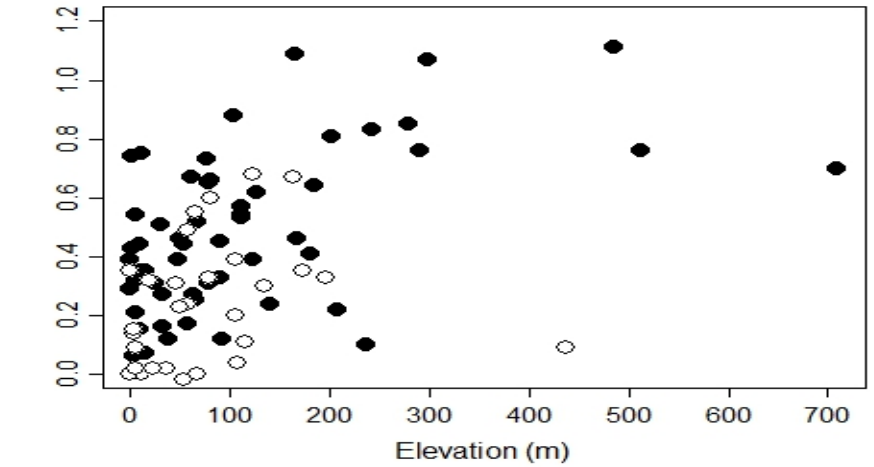
Lithology

Acid Deposition

Elevation







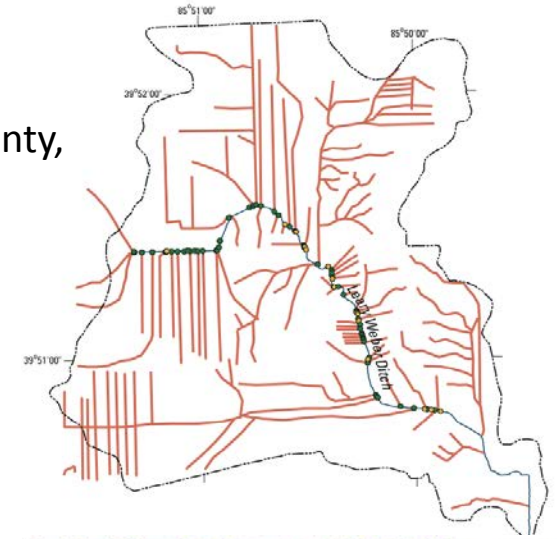
Kaushal et al. (2013), *ES&T*

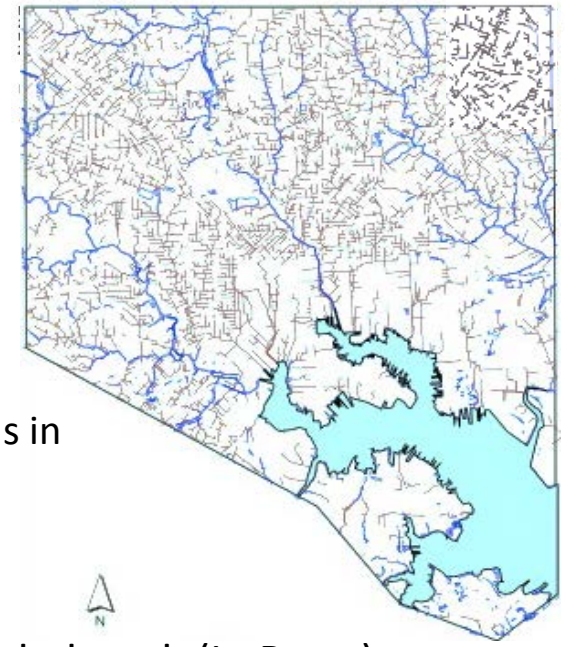
Land Use and Stream Alkalinization

- Land development
  - Liming, Fertilizer, Tile Drains
  - Concrete, Sewage, Storm Drains

- Land use impacts on stream alkalinization?

Tile drains in Hancock County, Indiana

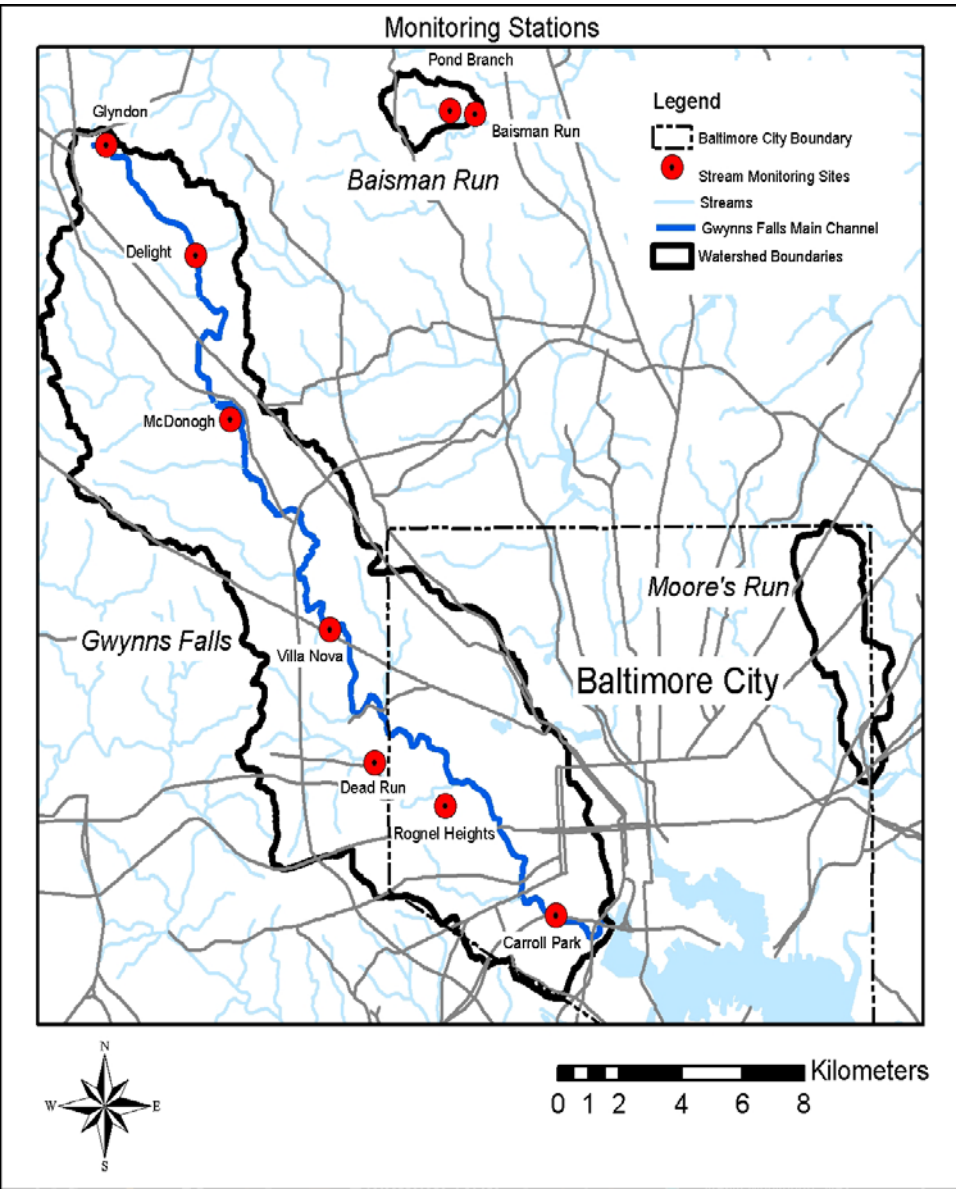




Storm drains in Baltimore, Maryland

Kaushal and Belt (2012), Kaushal et al. (In Press)

Baltimore Ecosystems Study LTER

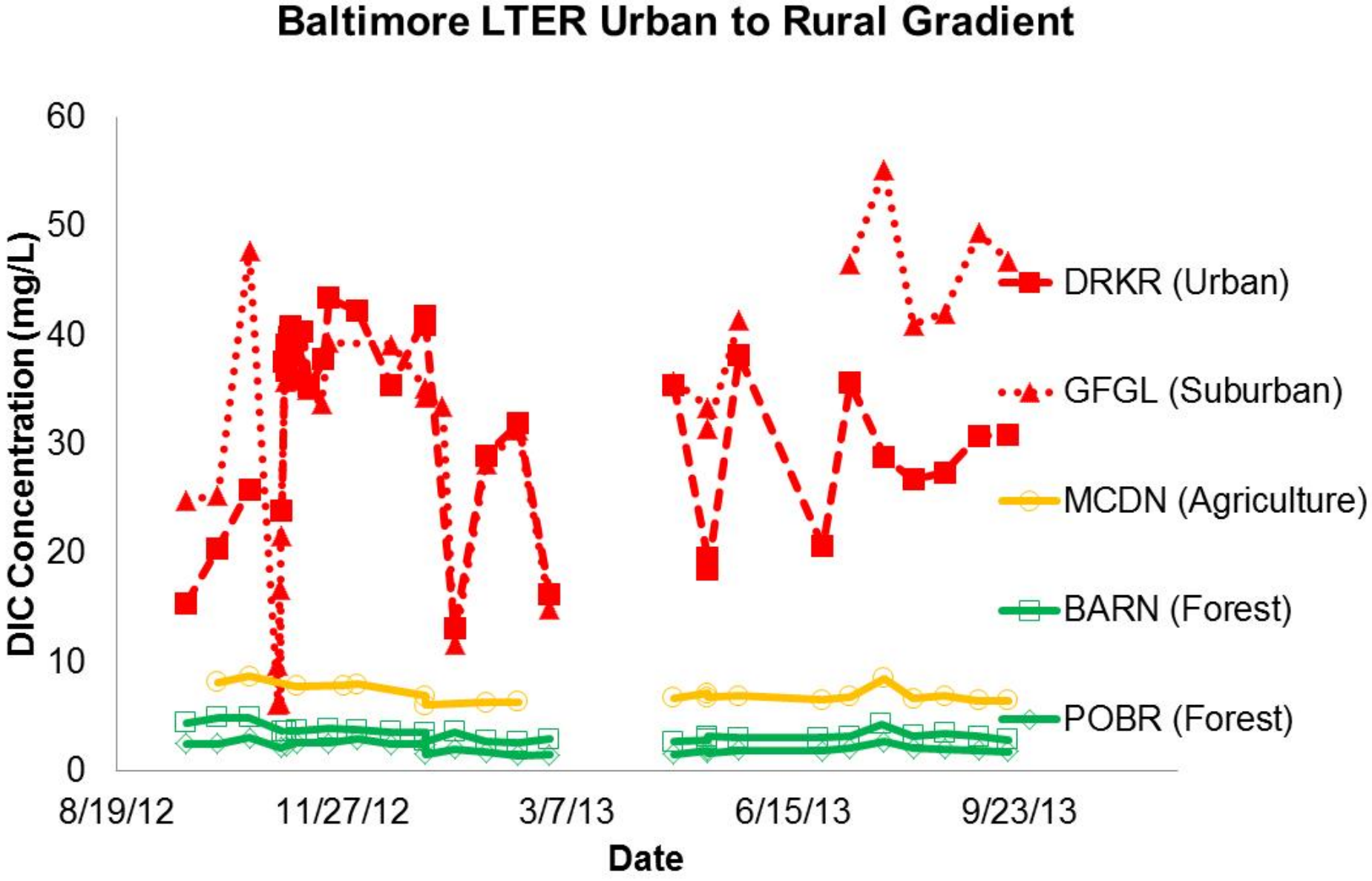


Forested Watersheds

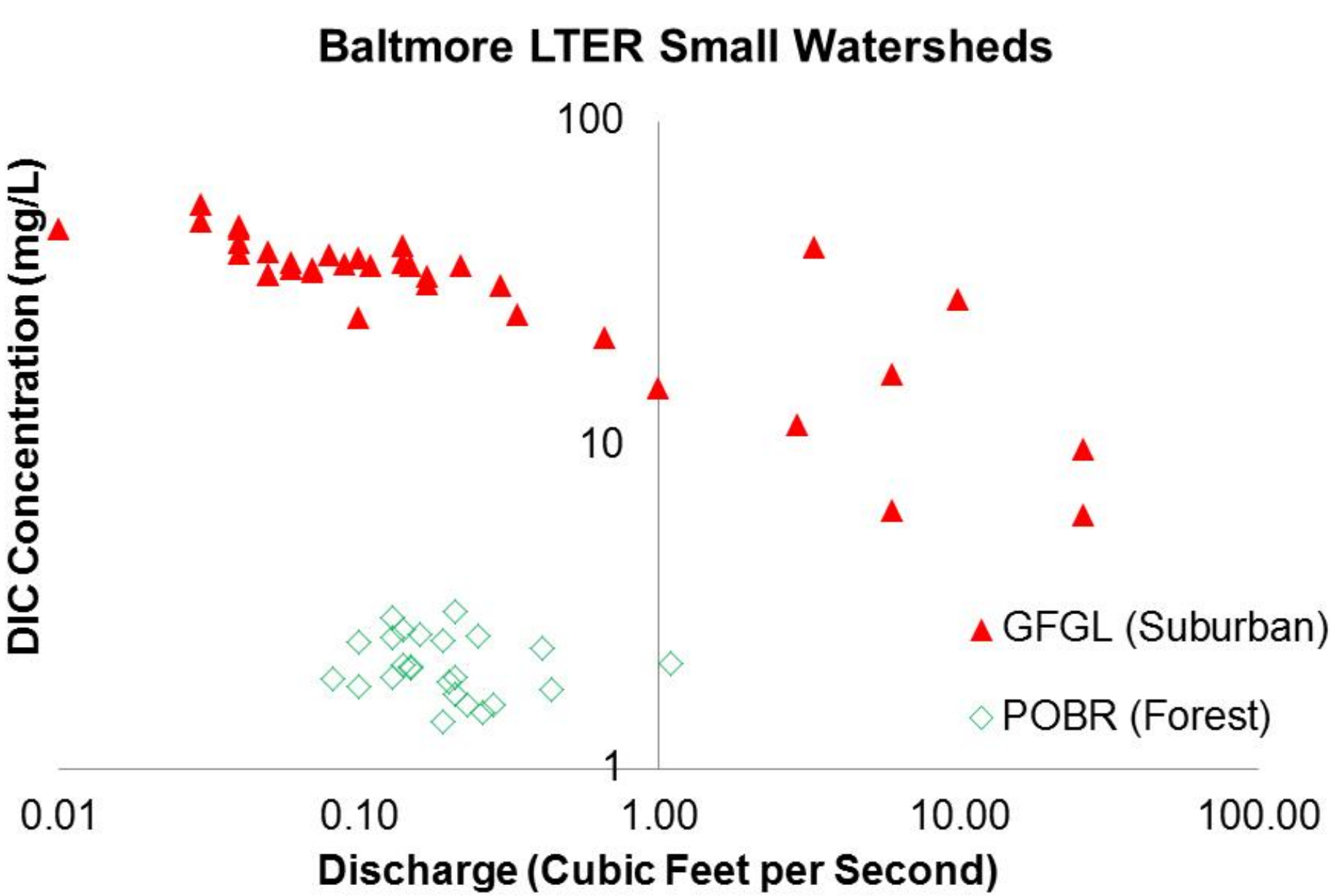
Agricultural Watersheds

Suburban Watersheds

Urban Watersheds



Kaushal et al. (Unpub Data)



Kaushal et al. (Unpub Data)

Outline

I. How are human activities increasing alkalinization of fresh water?

II. How are human activities increasing salinization of fresh water?

II. Increased salinization of fresh water

Overview

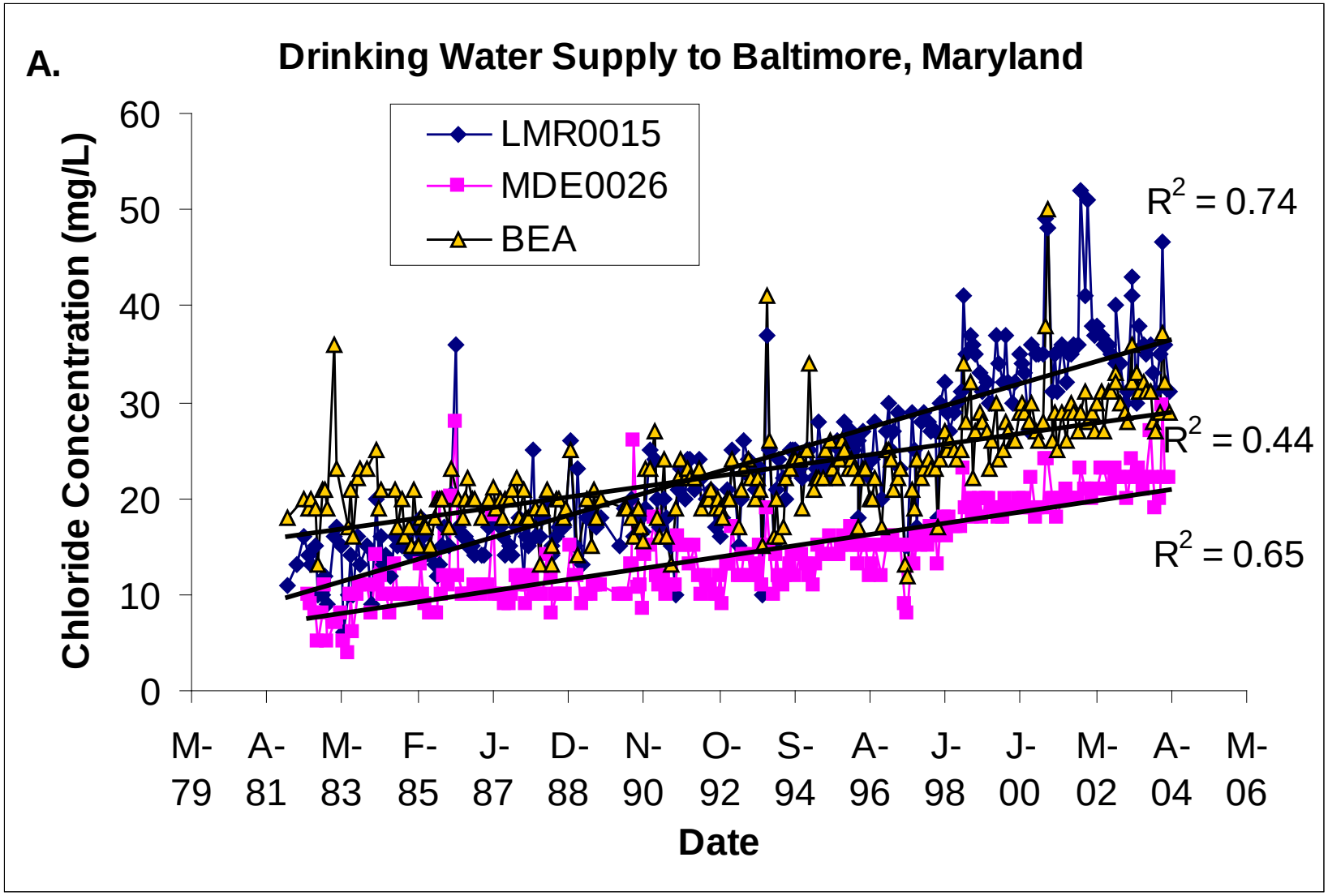
- Impervious surfaces in U.S. approaches the state of Ohio (112,610 km^2)
- 10,000 miles of new roads and 1 million single-family homes in this decade
- Salt is commonly used above 39° N latitude

Salt

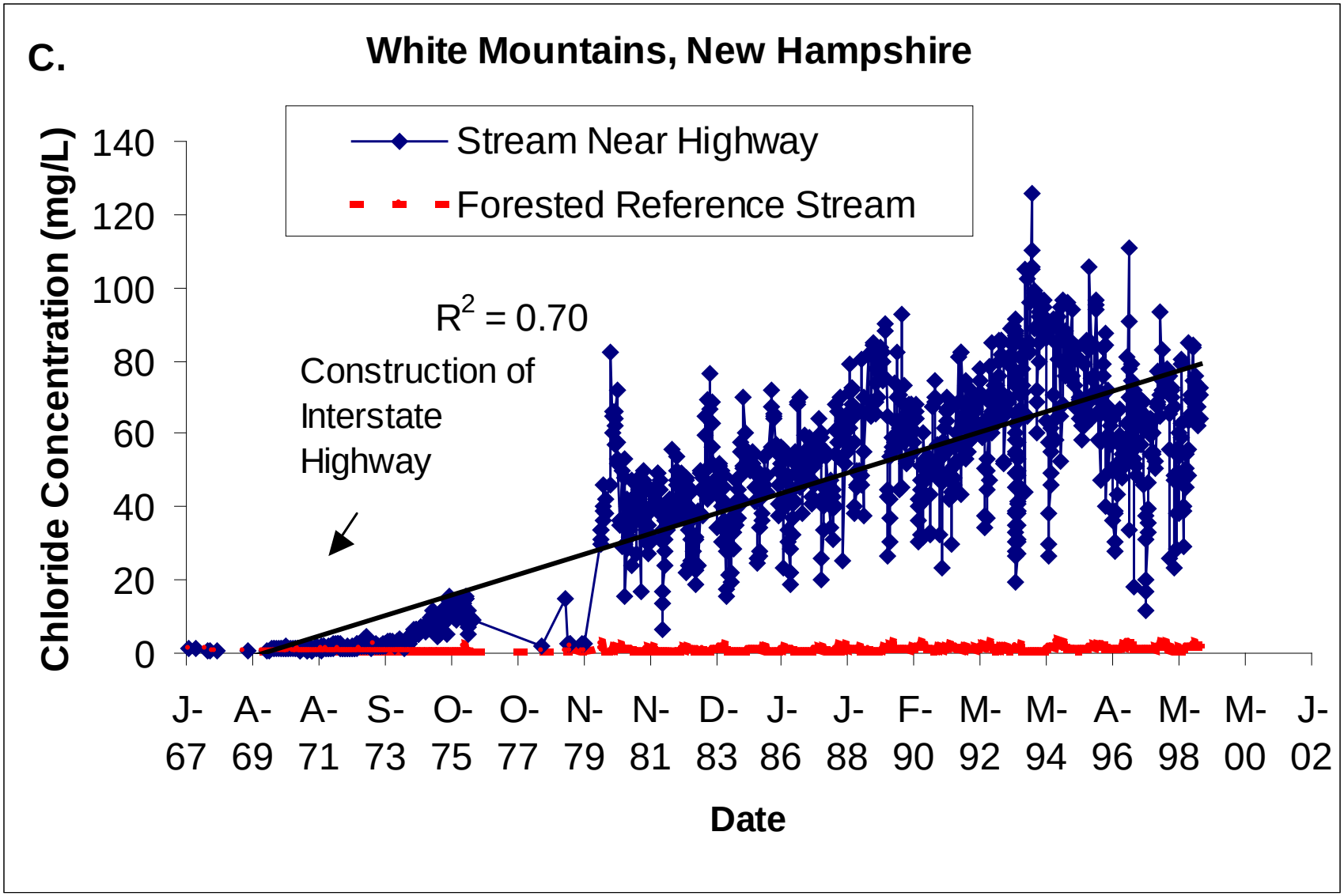
- Concentrations of sodium and chloride have been increasing for decades in the Northeast
- Chronic concentrations of chloride > 250 mg/L may be toxic to some sensitive freshwater life
- Road salt is currently not regulated in the United States

Objective

- Investigate relationship between land use change and increased salinity of streams in northeastern U.S



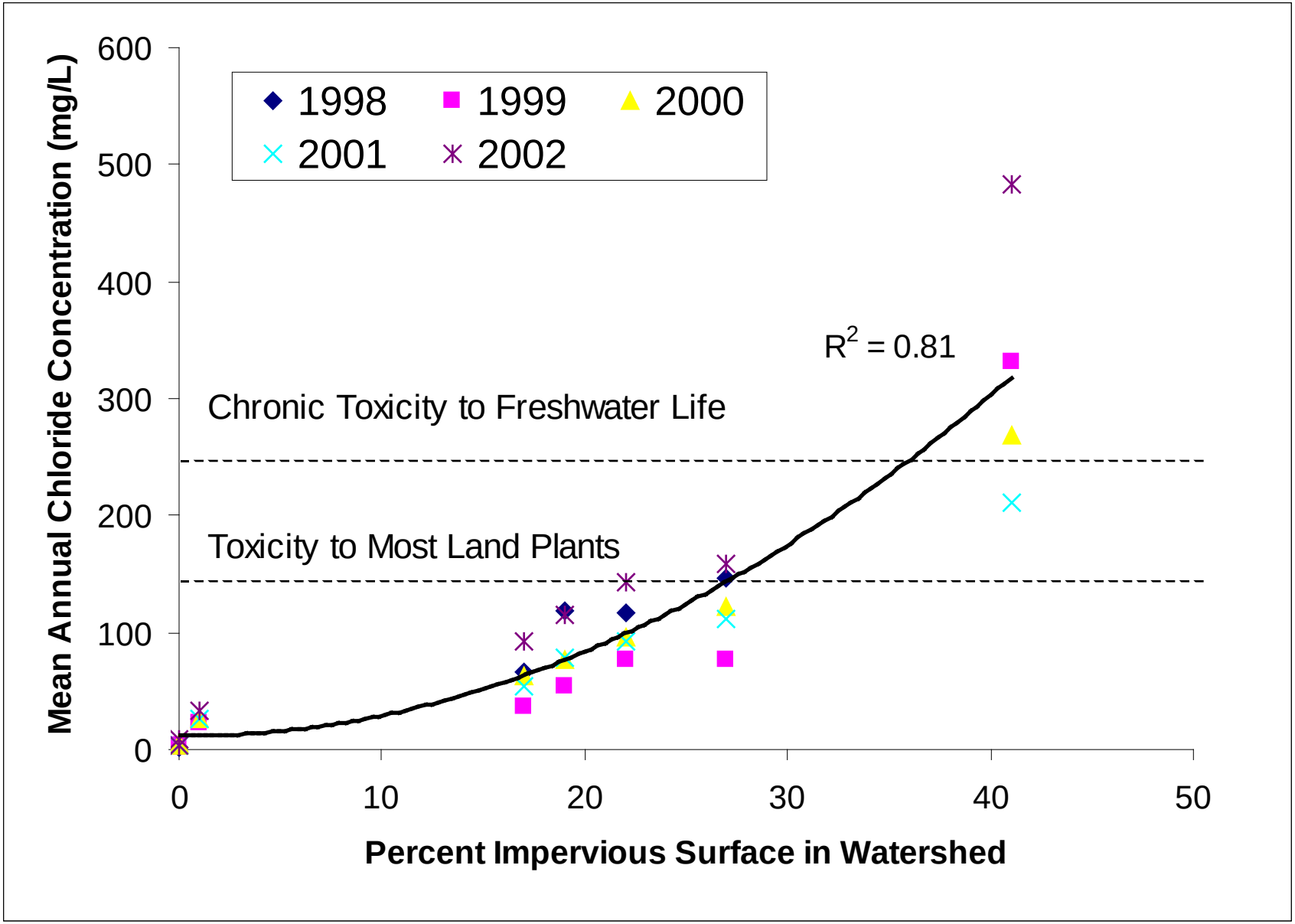
Kaushal et al. (2005) *PNAS*



Kaushal et al. (2005) *PNAS*

Study Sites

- Impervious surface has increased by > 40% from 1990 to present
- Typically only 18.2 inches of snow



Kaushal et al. (2005) *PNAS*

Summary

- Long-term shift from freshwaters to saline and alkaline throughout Eastern U.S.
- Acid rain, land use, geology linked to alkalinization
- Current rate of development and application of road salt can lead to long-term salinization
- Salinization remains chronically high during summer

Acknowledgements

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