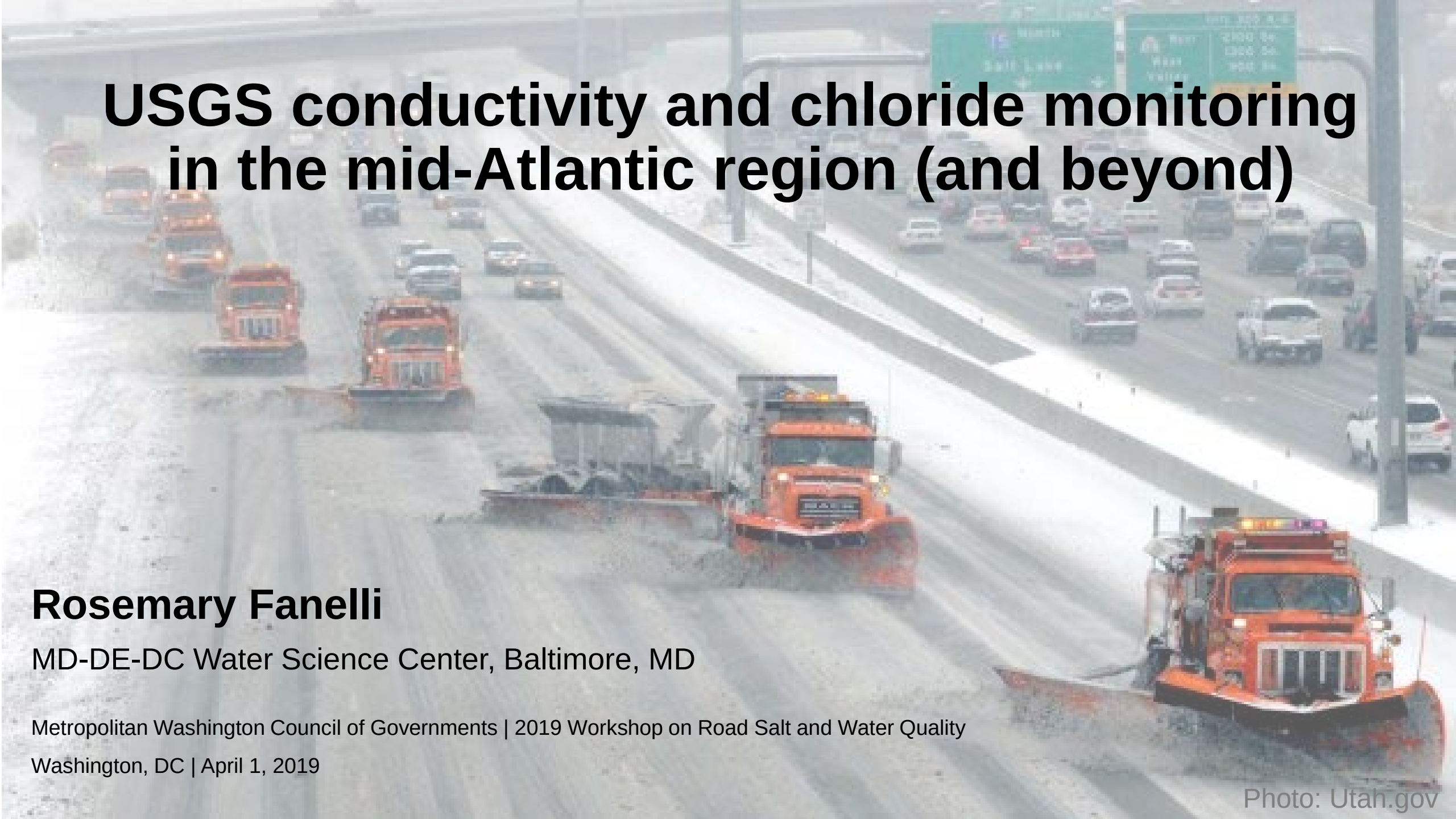
USGS conductivity and chloride monitoring in the mid-Atlantic region (and beyond)



Rosemary Fanelli

MD-DE-DC Water Science Center, Baltimore, MD

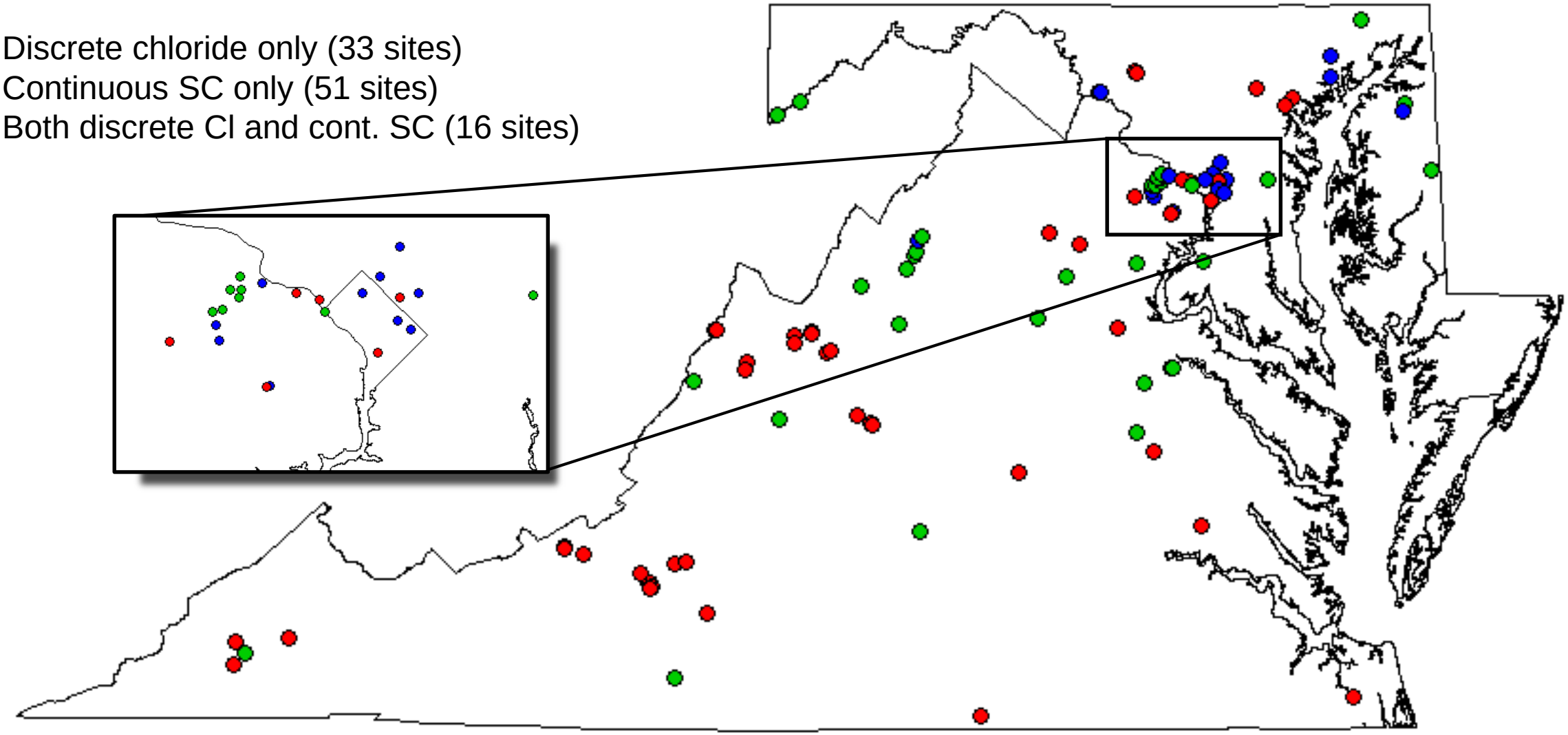
Metropolitan Washington Council of Governments | 2019 Workshop on Road Salt and Water Quality

Washington, DC | April 1, 2019

Photo: Utah.gov

Current USGS monitoring efforts

- = Discrete chloride only (33 sites)
- = Continuous SC only (51 sites)
- = Both discrete Cl and cont. SC (16 sites)



Quantifying stream chloride exceedence patterns using high-frequency monitoring

Joel Moore, Towson University

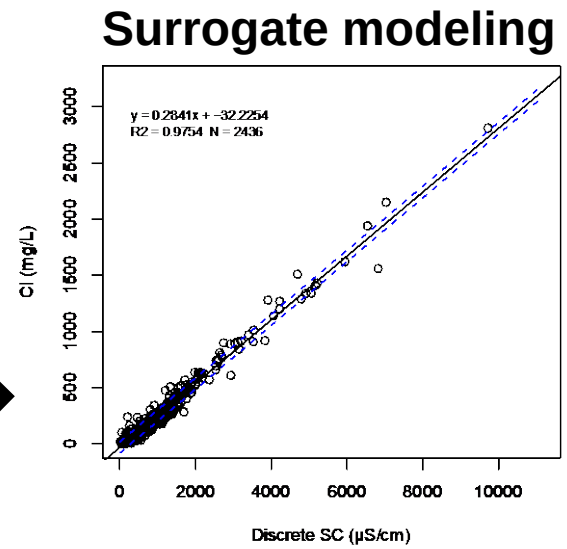
Rosemary Fanelli, USGS MD-DC-DE WSC

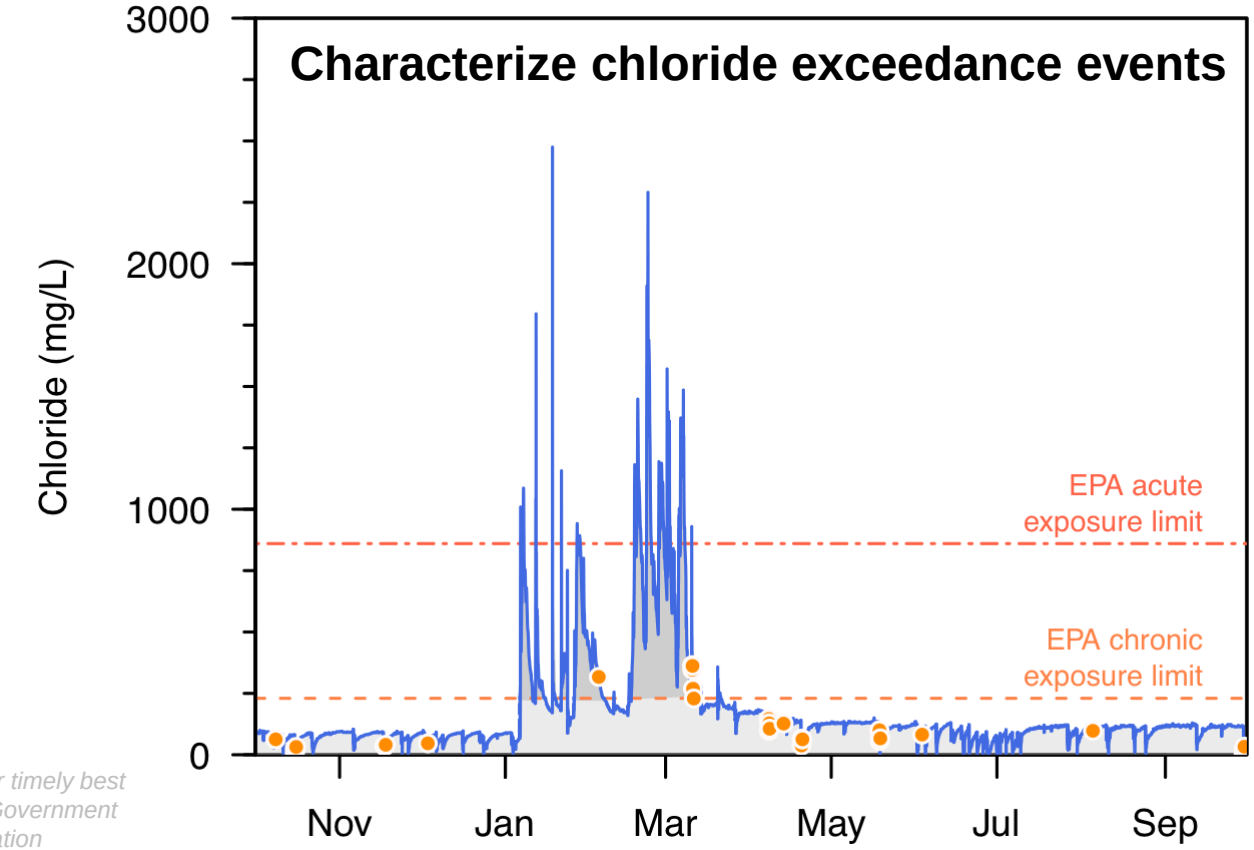
Purpose: Quantify temporal patterns of stream chloride concentrations to assess the ecological effects of road salt applications

Objectives:

1. Develop surrogate models using high-frequency SC and discrete chloride data
2. Quantify frequency and severity of events above EPA exceedence criteria

Sites: Over 90 USGS stations across East Coast (20+ sites in mid-Atlantic)





Questions for this session

1. How useful is conductivity as a surrogate for quantifying salt concentrations?
2. Do current monitoring efforts capture the status and trend in salt concentrations?
3. What is the best sampling strategy for monitoring concentrations or loads of individual salt constituents?

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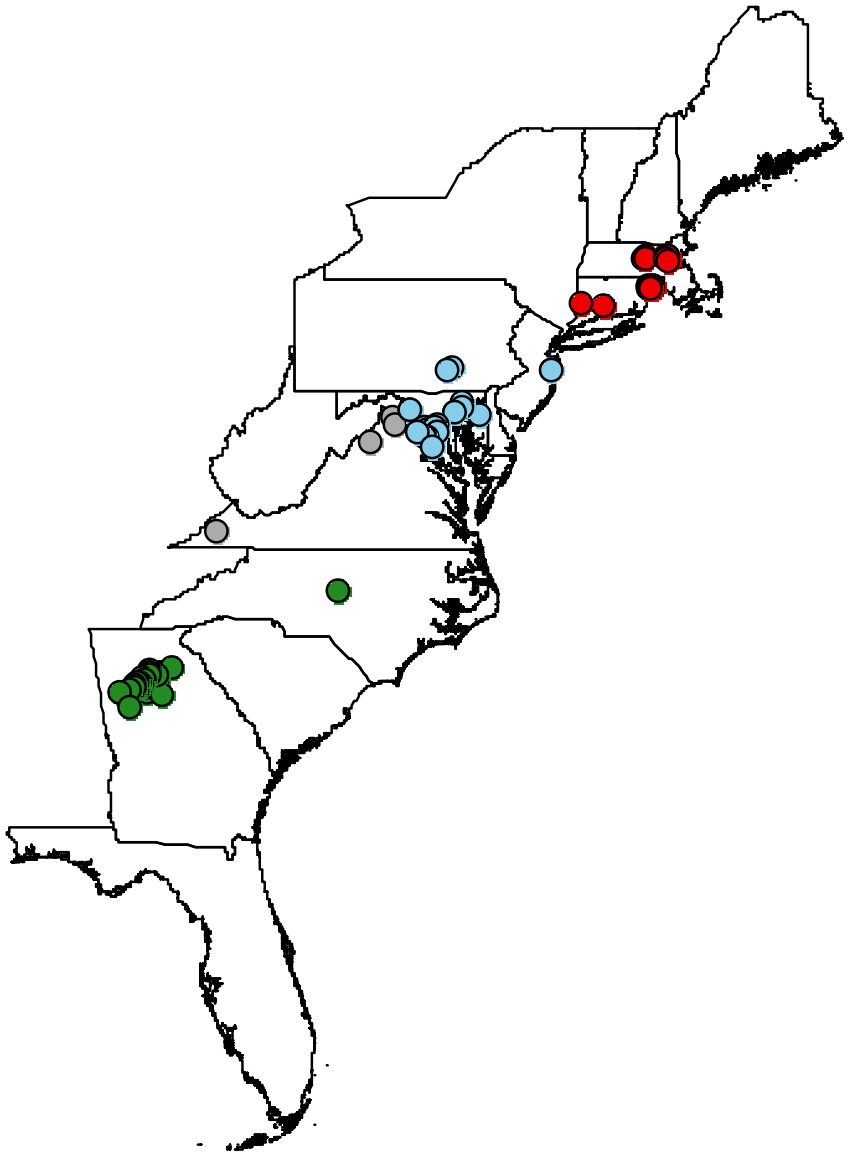
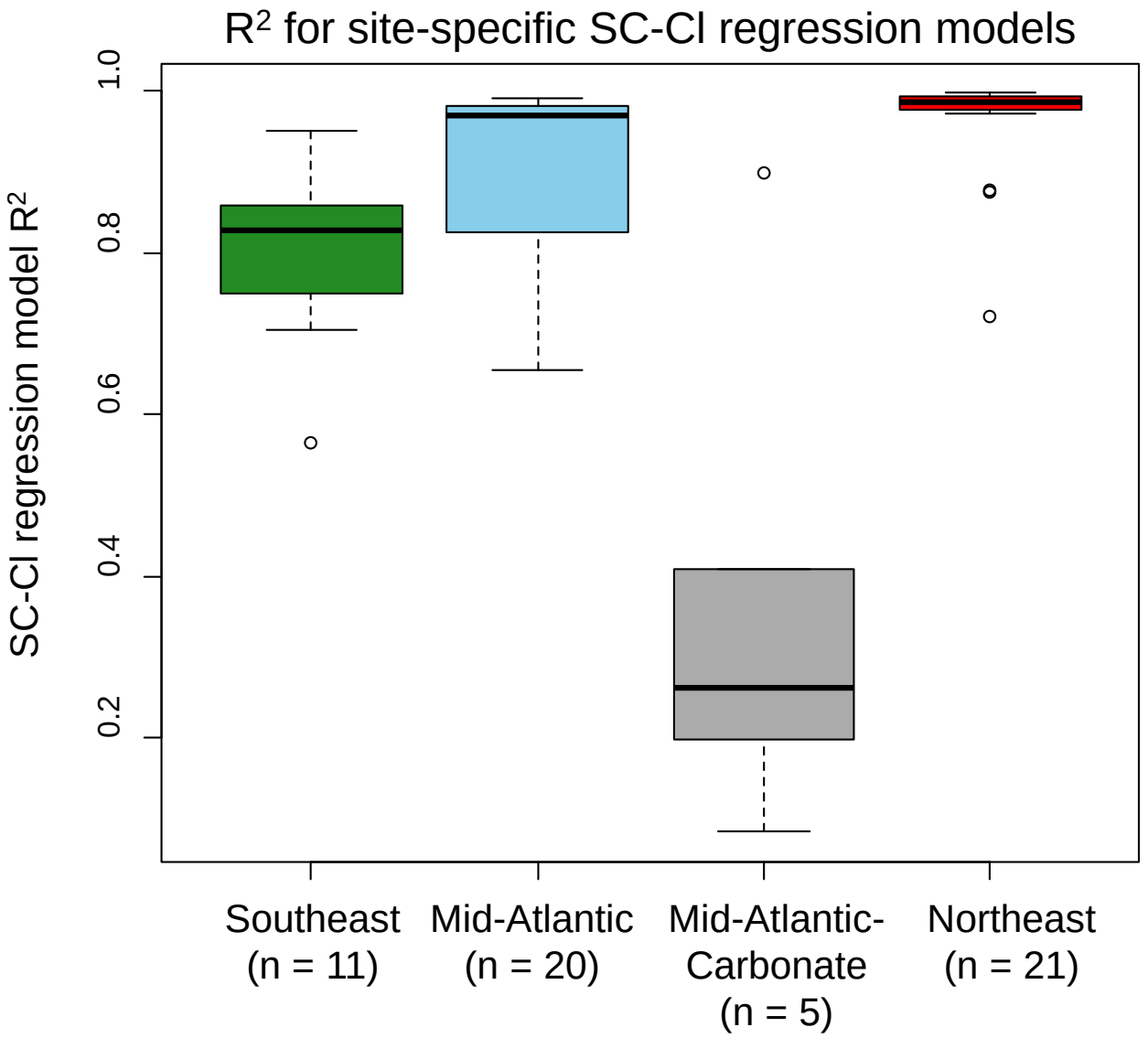
Using conductivity (SC) as a surrogate for chloride





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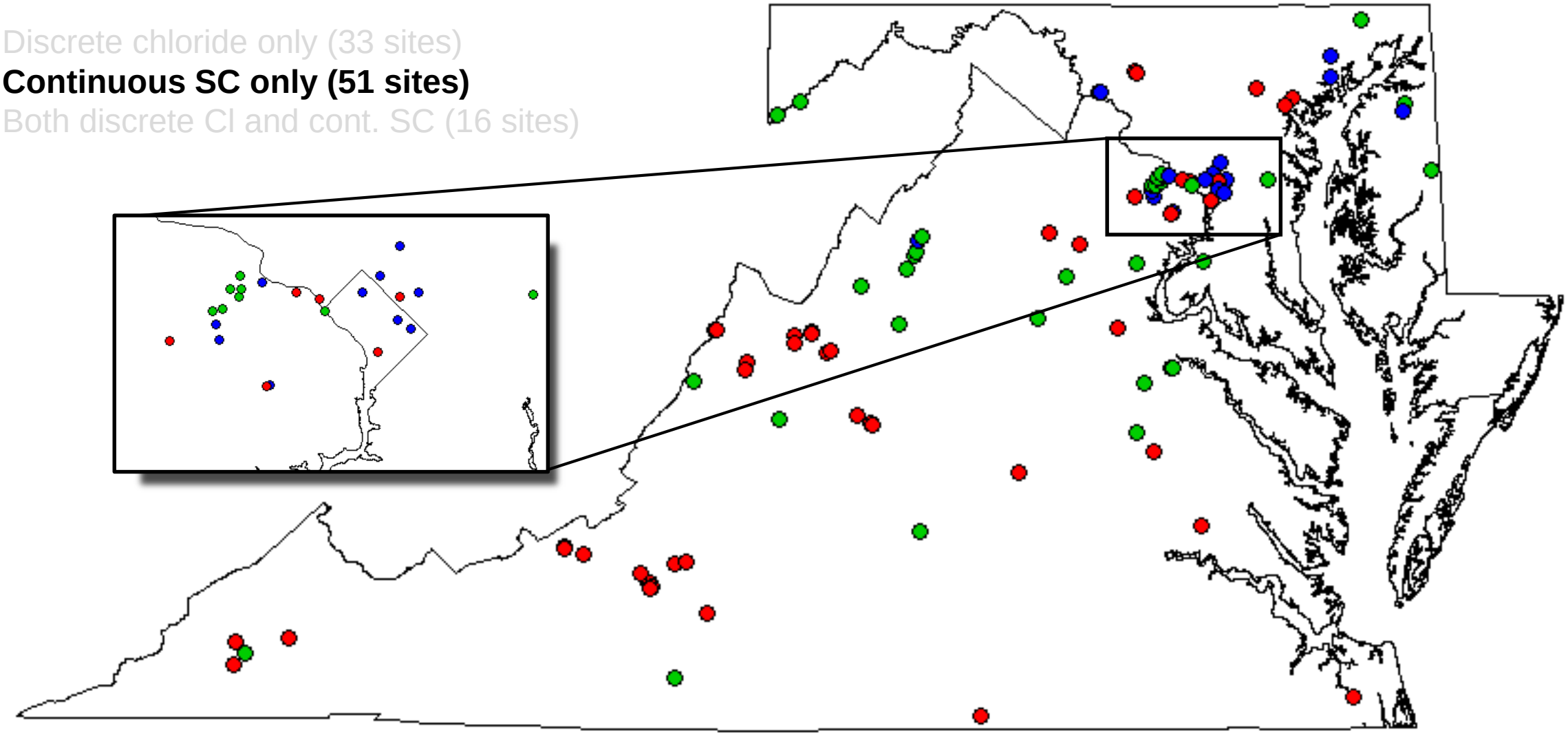
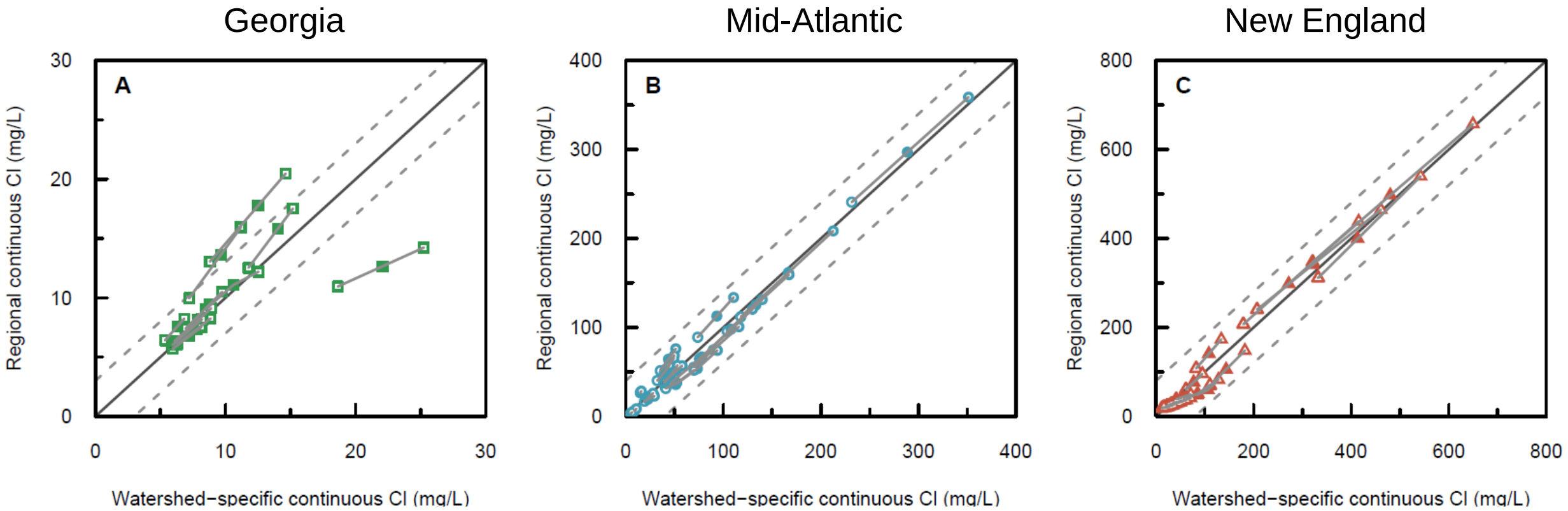


Regional SC-Cl models can be used to estimate Cl concentrations where only SC is monitored



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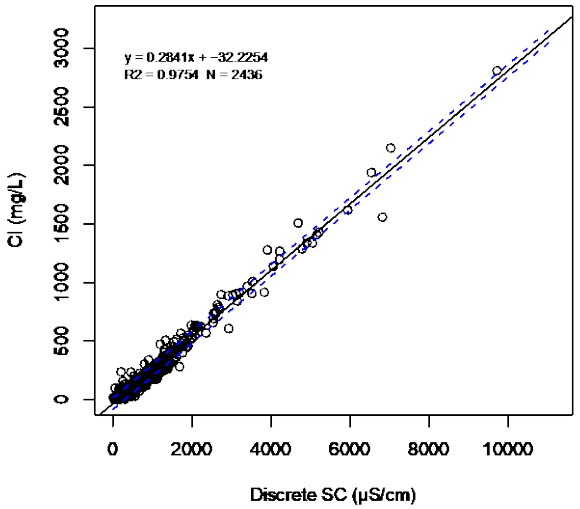
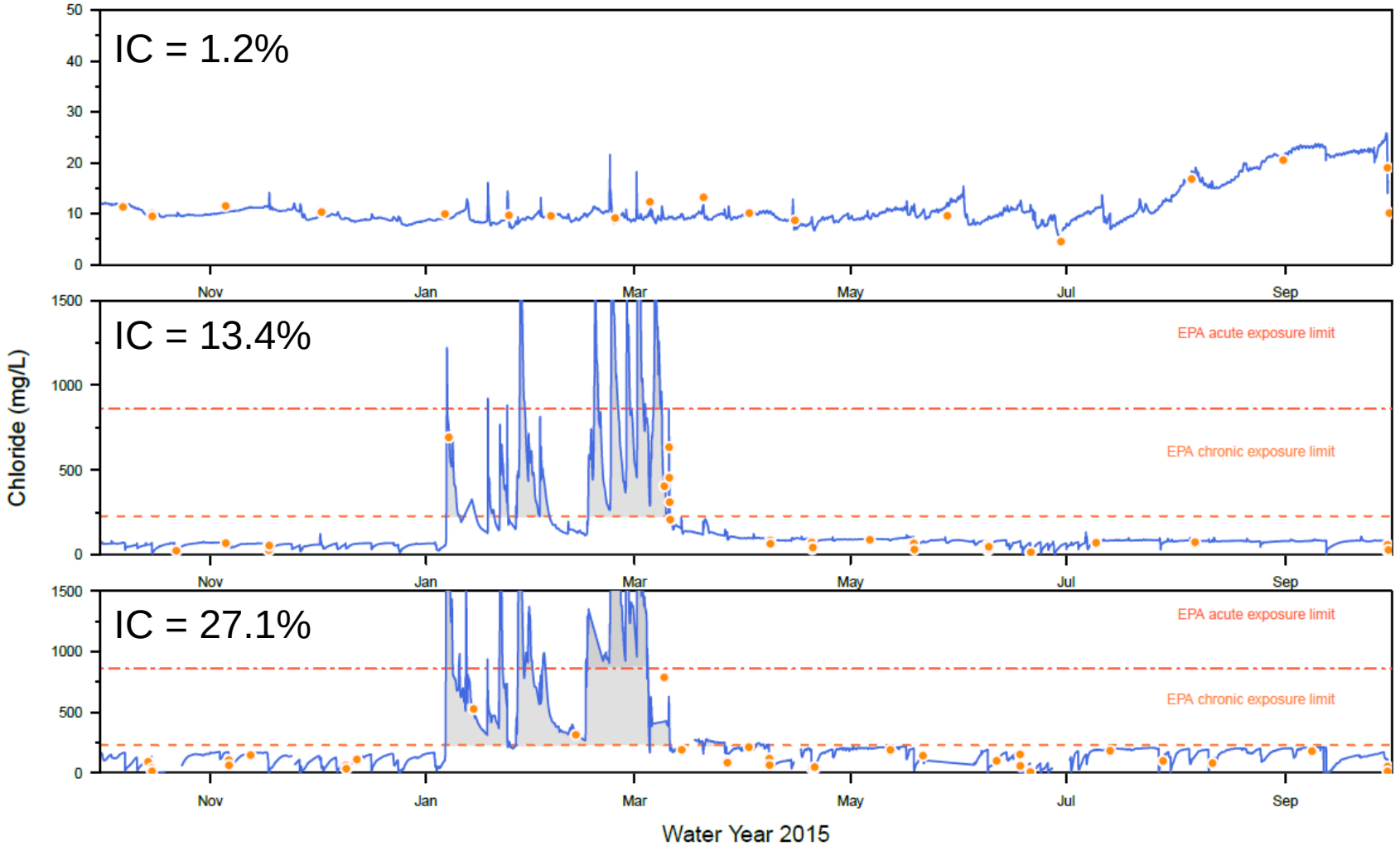
Quantifying EPA exceedances to quantify impacts of road salt on stream ecosystems

Surrogate modeling



Chronic = 4 days above 230 mg/L
Acute = 1 hour above 860 mg/L



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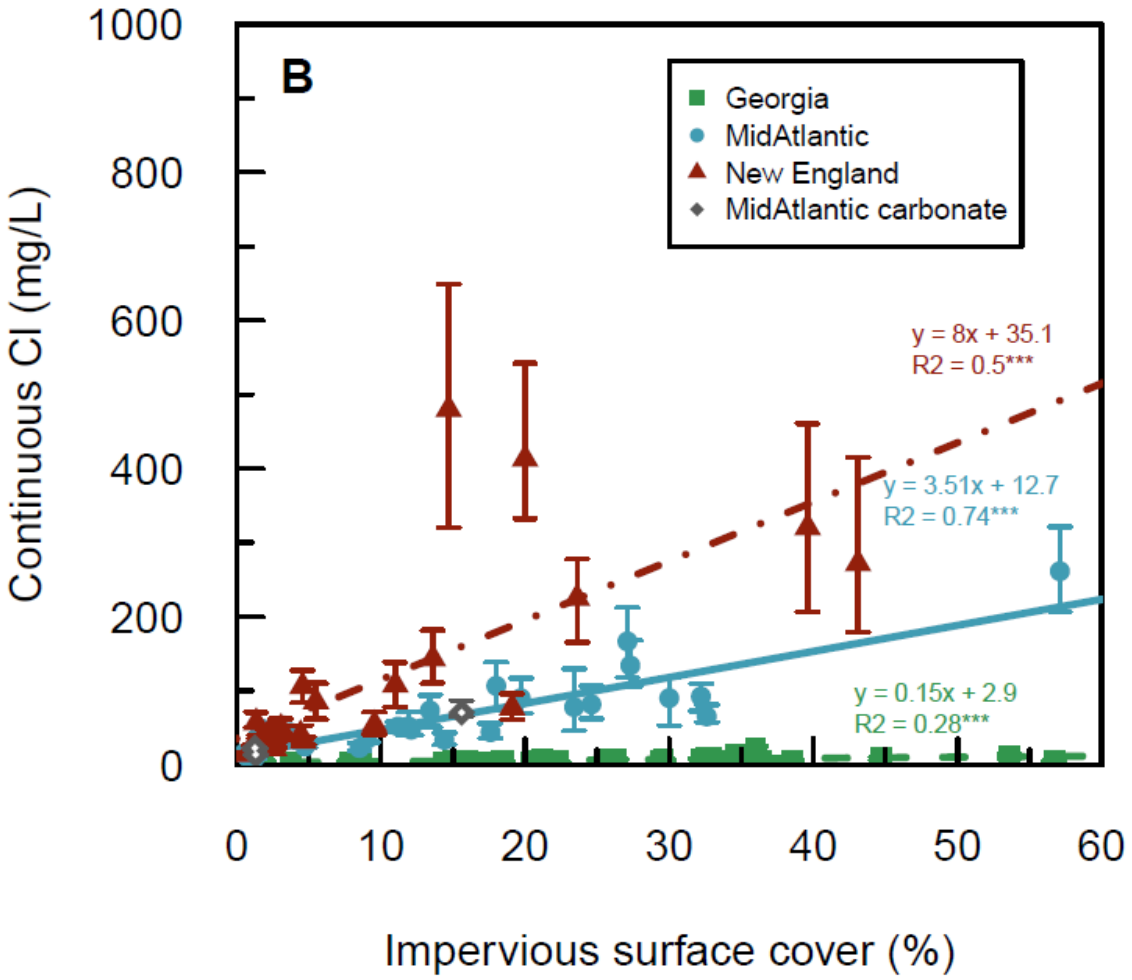
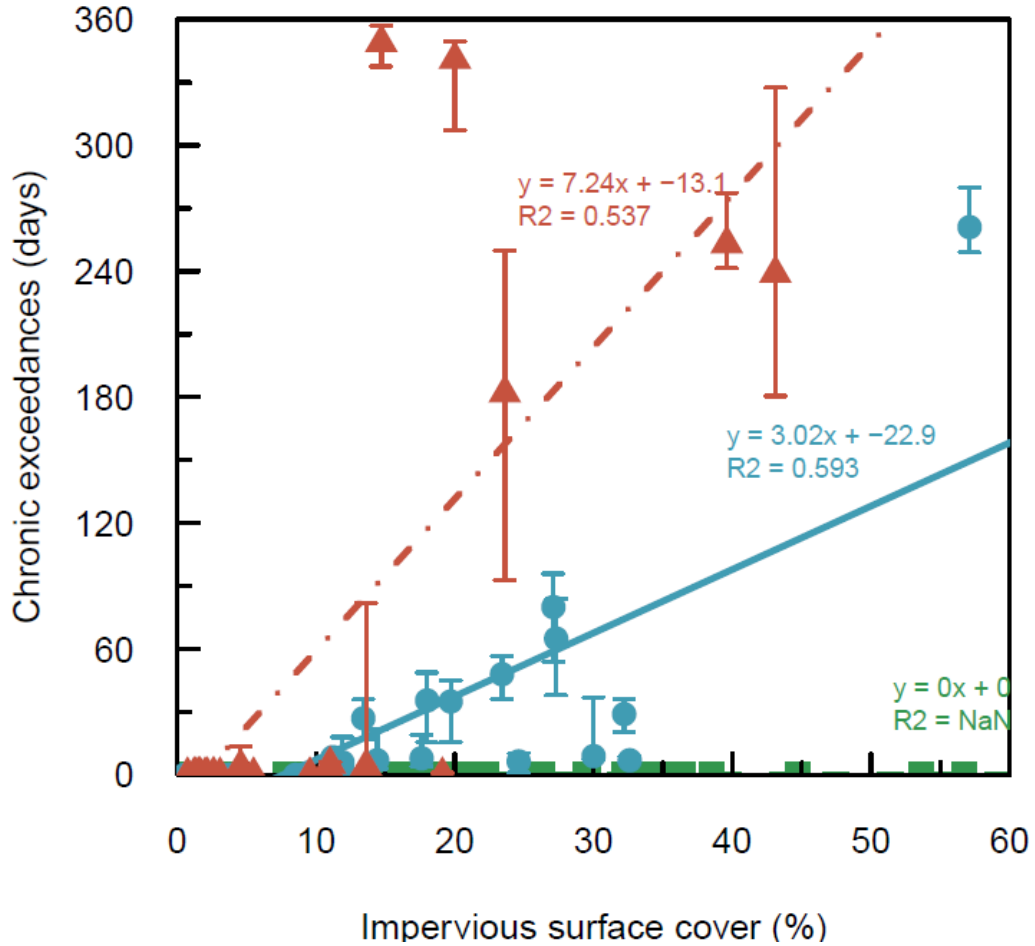
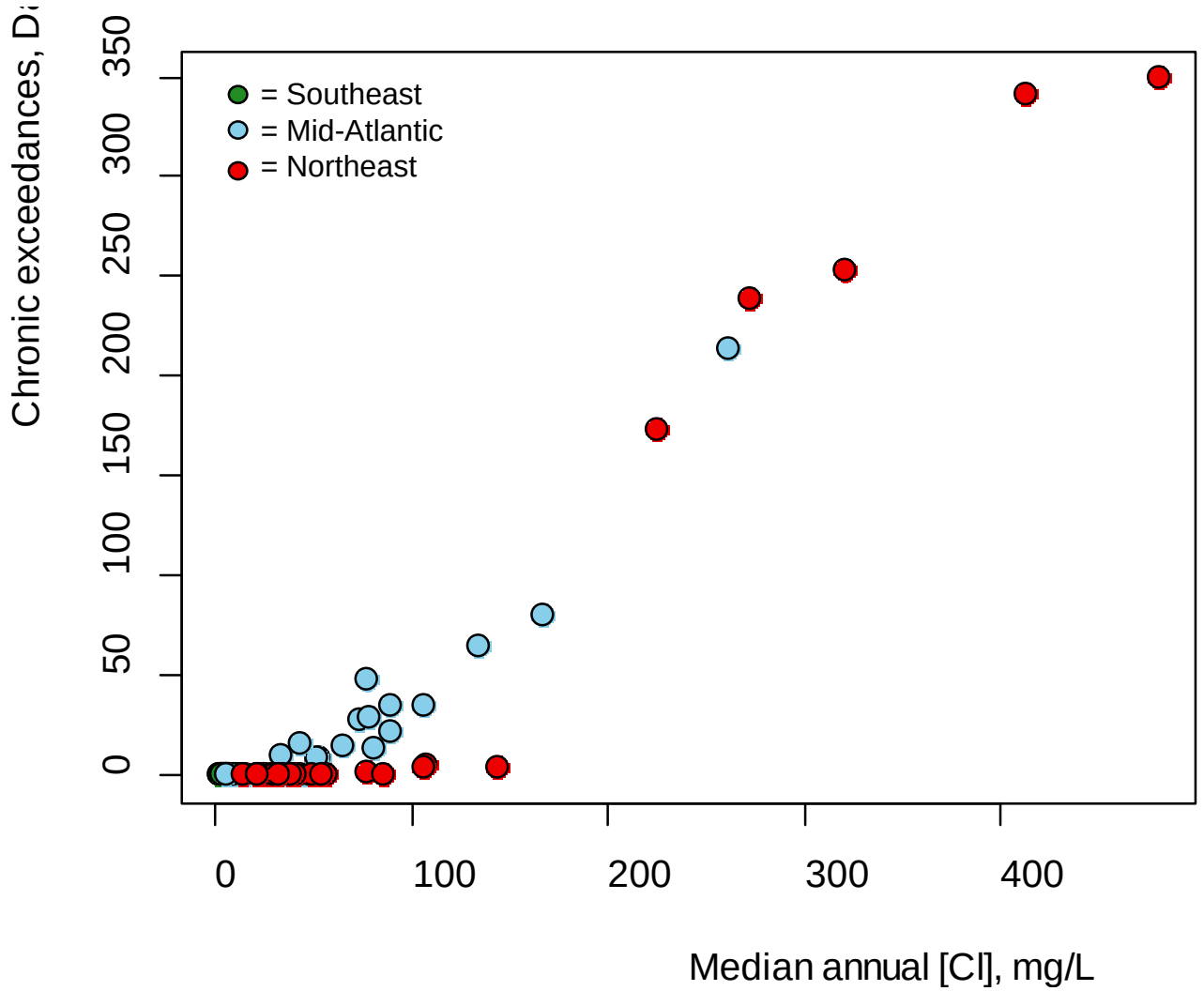




Higher annual median [Cl] may reflect chronic exceedances



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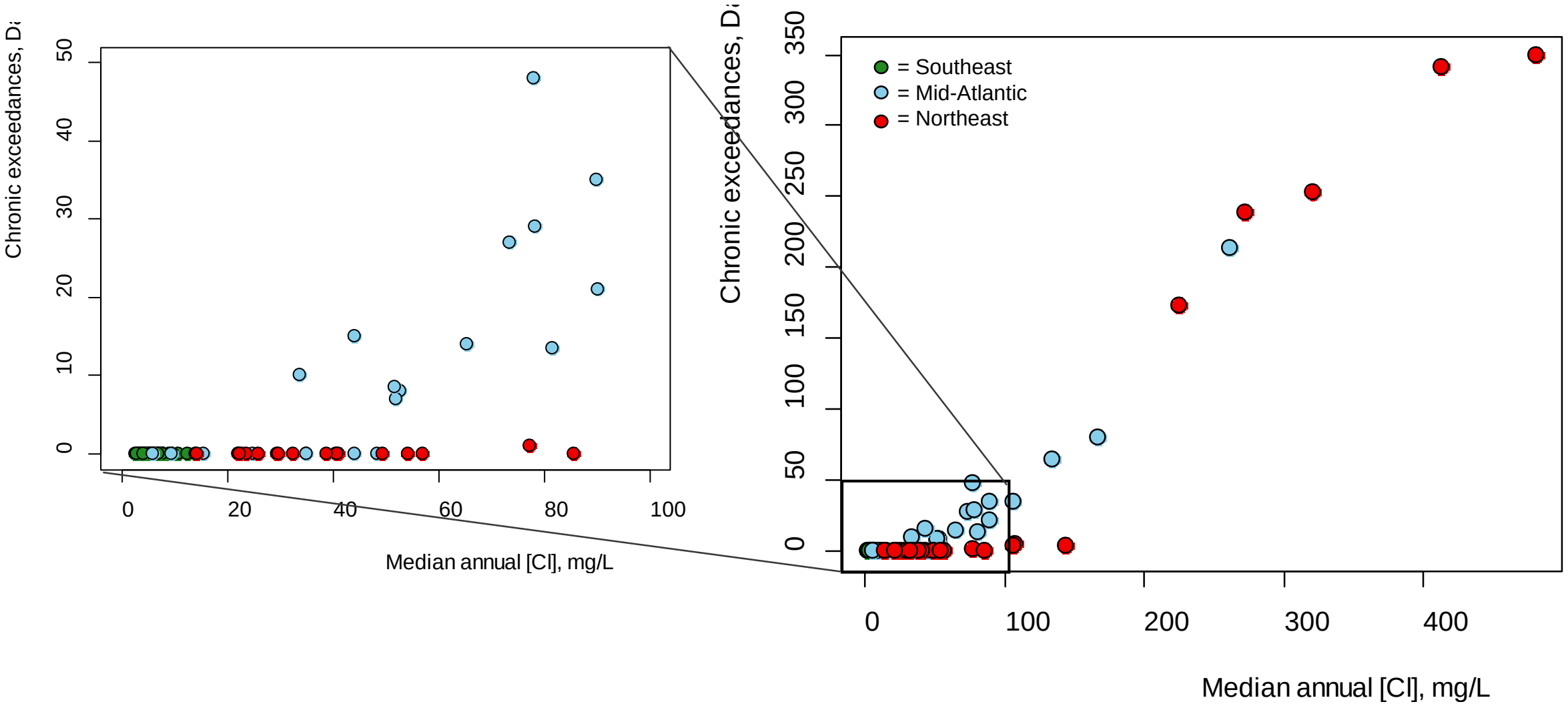

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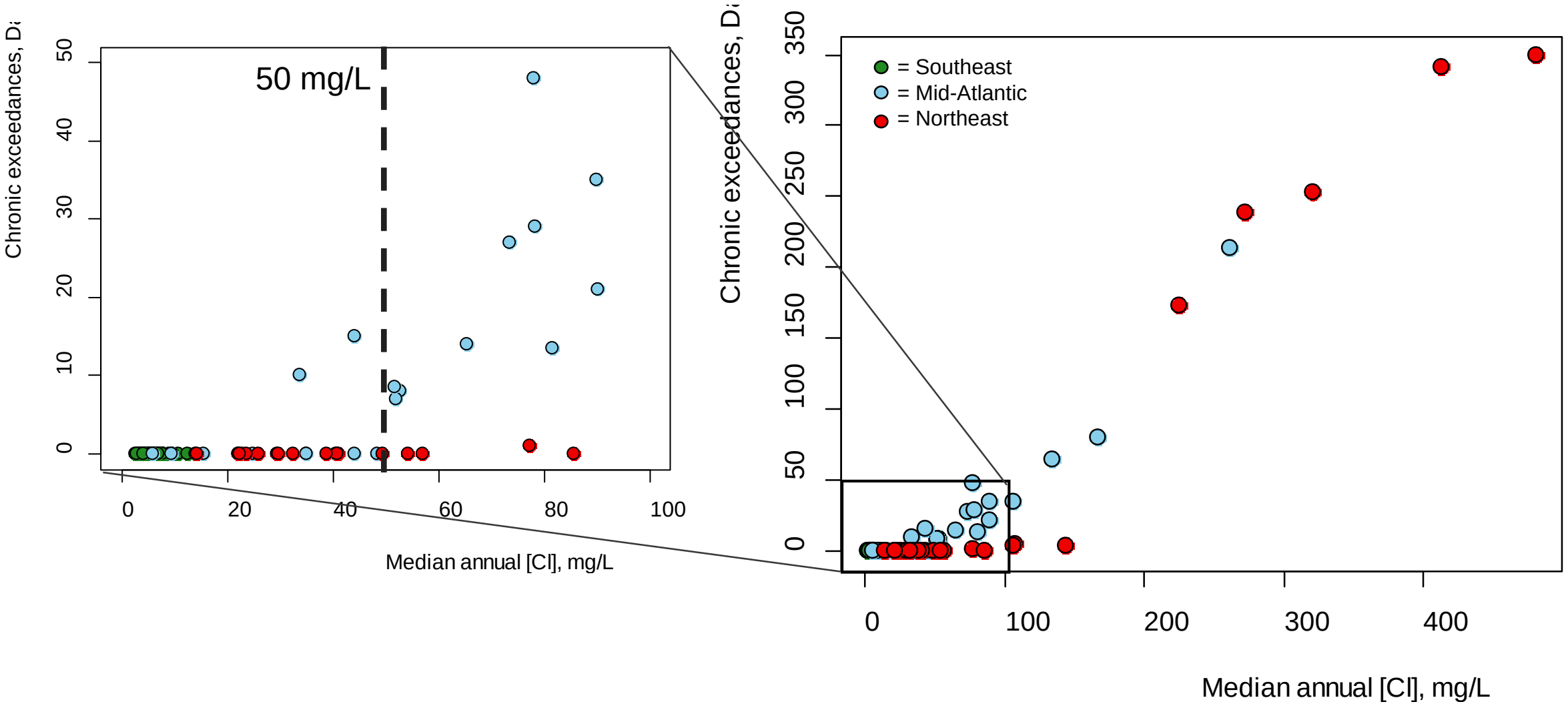
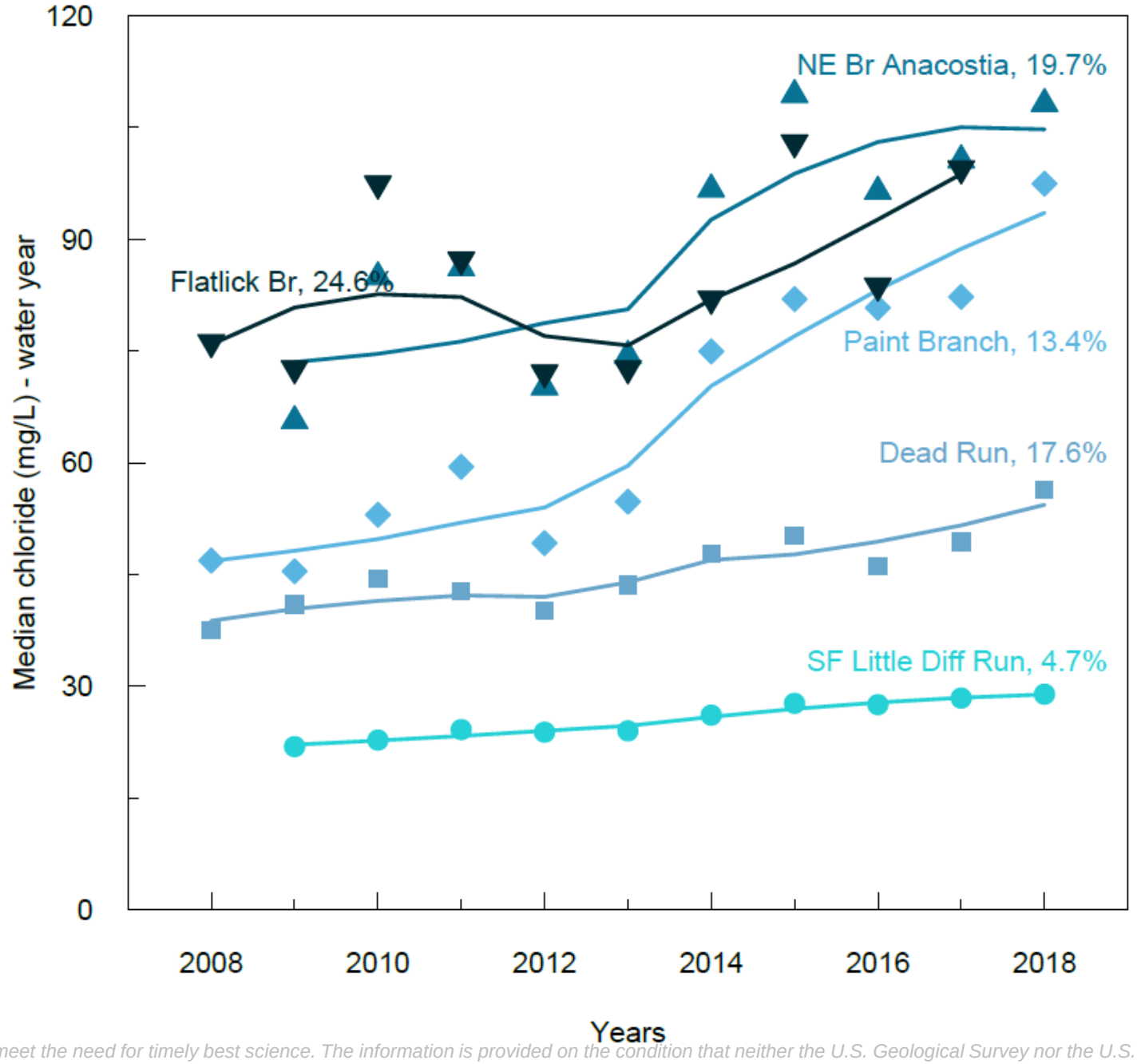


Trends in median annual [Cl]

- Increasing median [Cl] observed in sites in mid-Atlantic region with 10+ years of continuous [Cl] data
- Inter-annual variability observed with road salt app and weather patterns
- Rural Virginia site still increasing (only 5% impervious cover)



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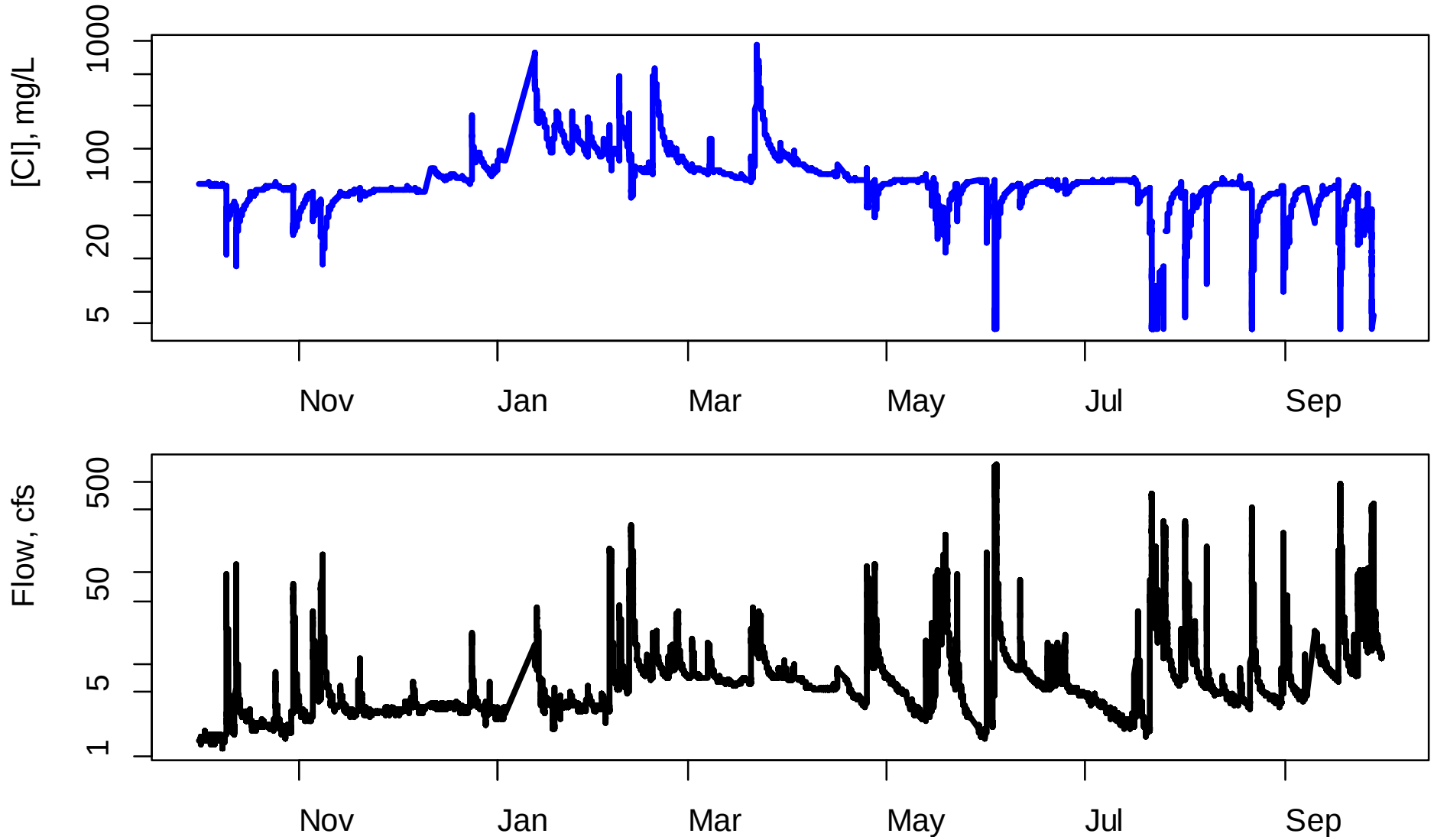
Sampling strategies for discrete chloride monitoring



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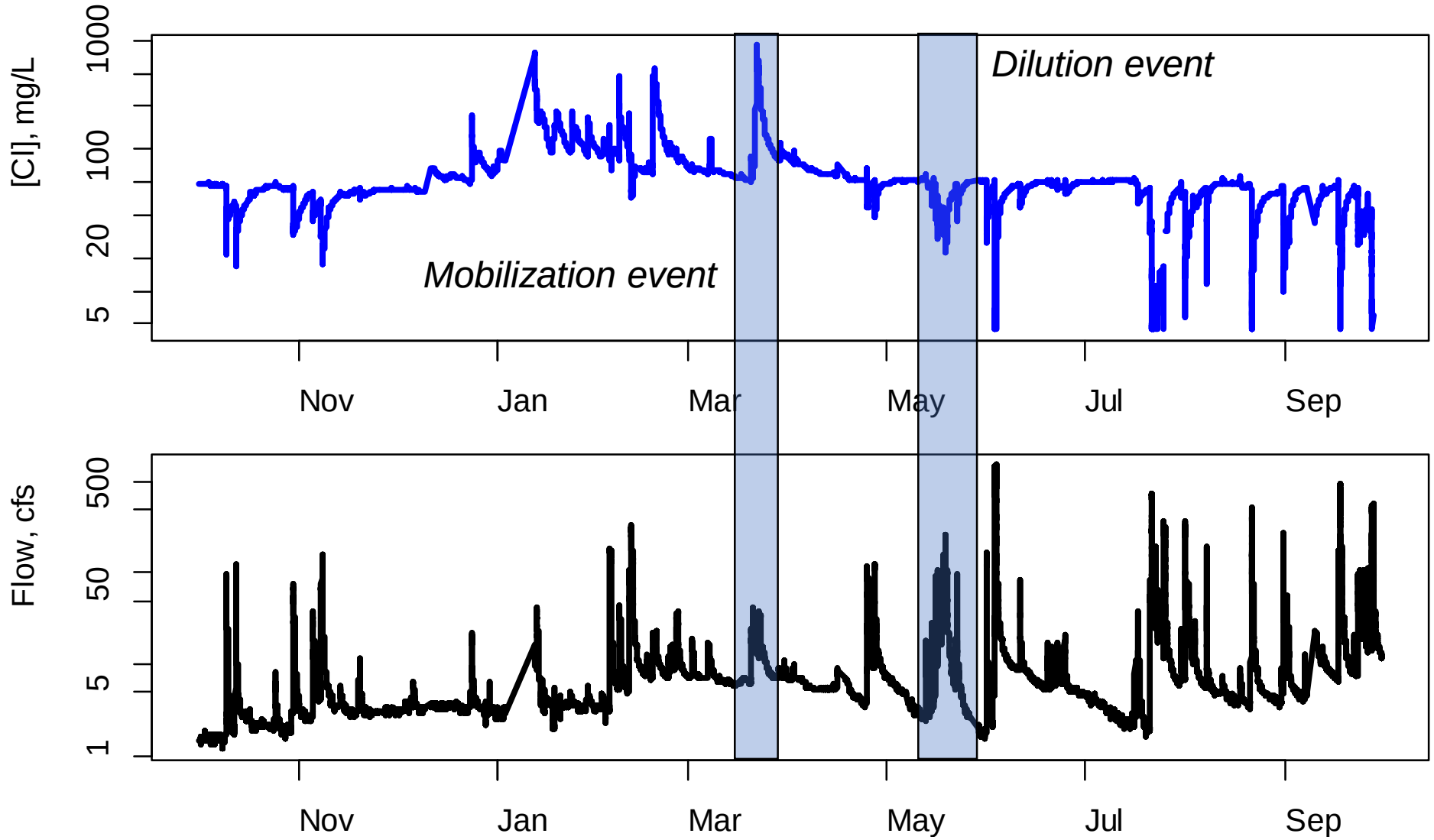
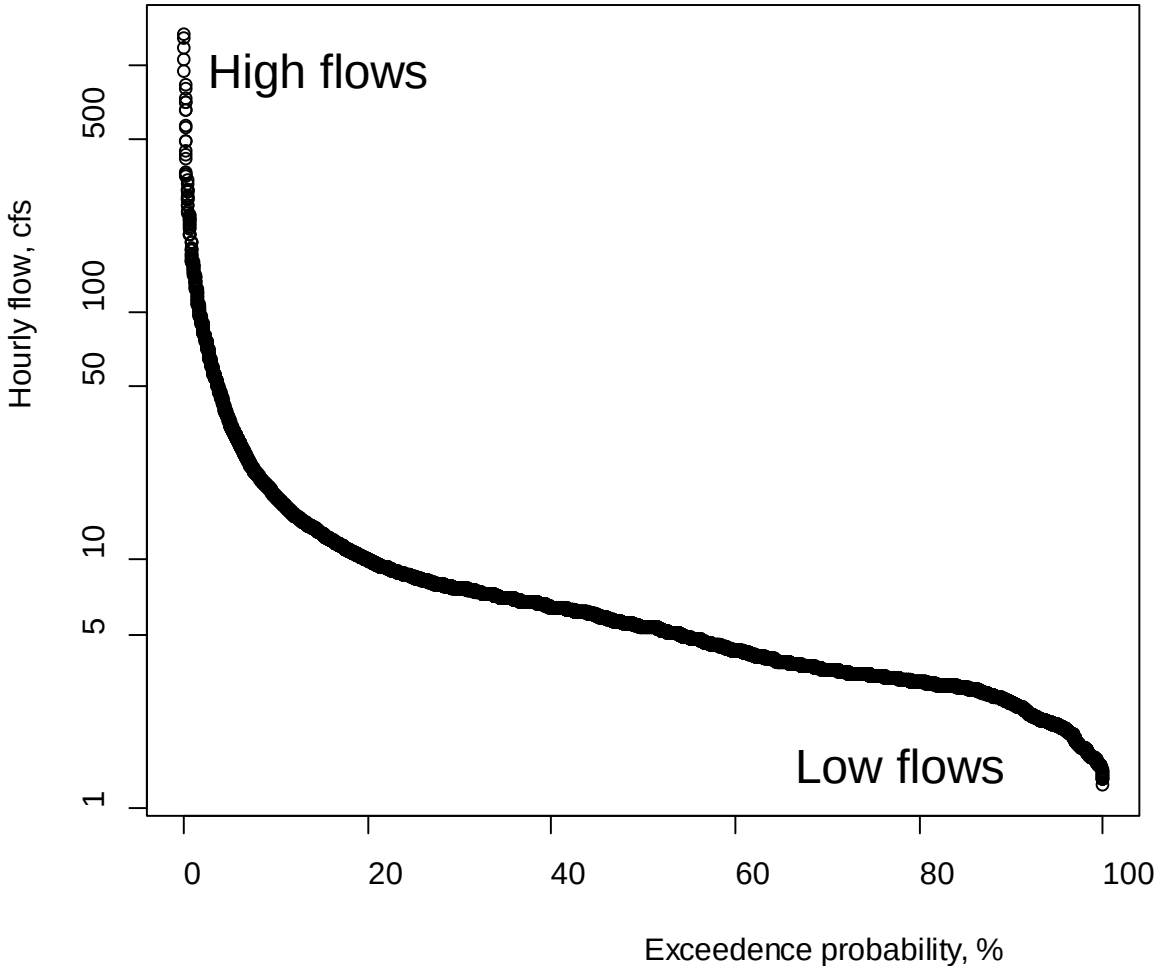


Continuous SC data collection not feasible everywhere

Sampling strategies for discrete chloride monitoring

- Used a subsampling routine **to explore effects of storm sampling for estimating median annual [Cl]**
- Used high-frequency estimates of [Cl] for WY 2018 at Paint Branch
- Extracted 12 random samples that matched certain flow criteria to reflect **storm** and **non-storm** conditions
- Repeated this 1000 times



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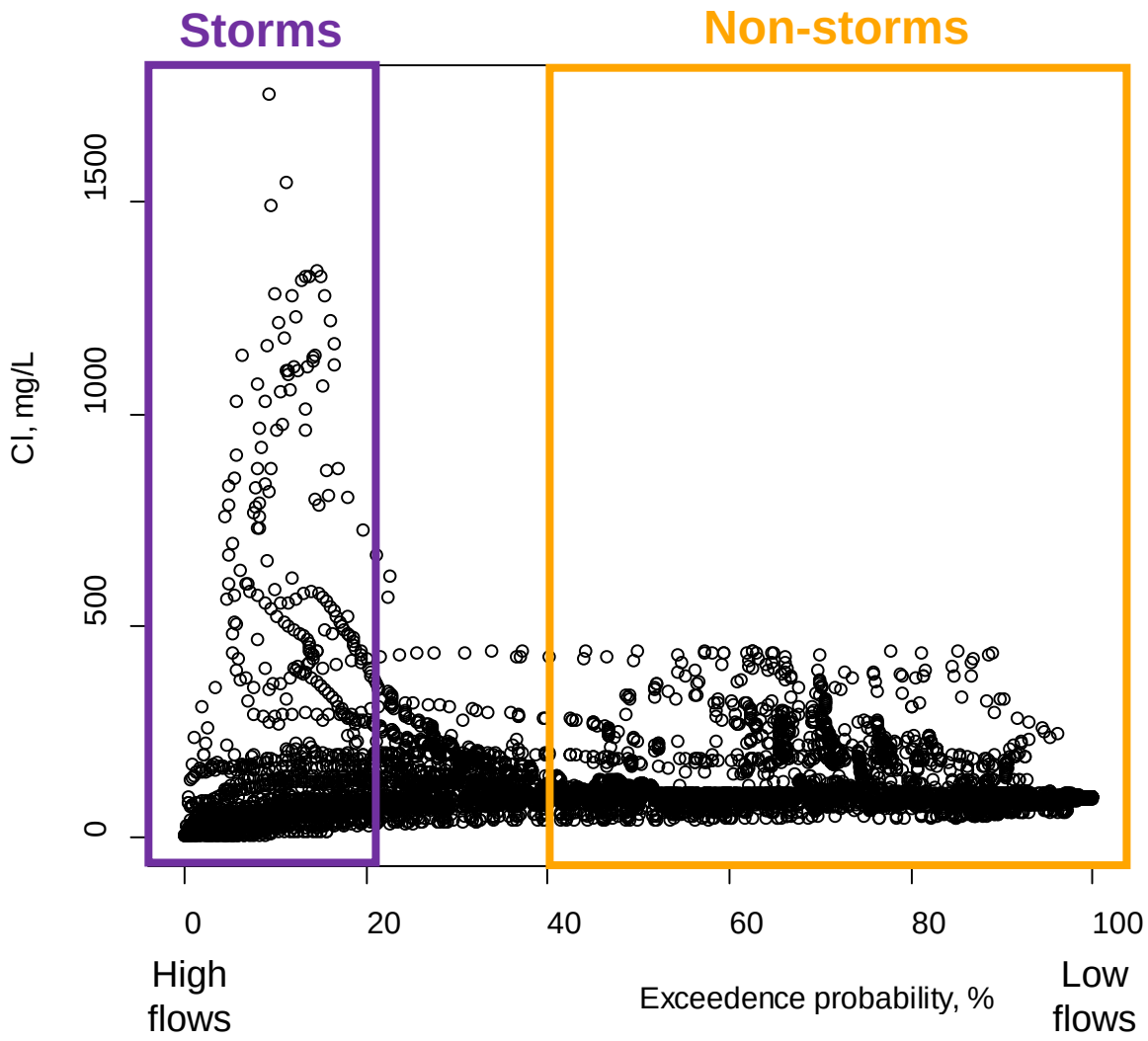

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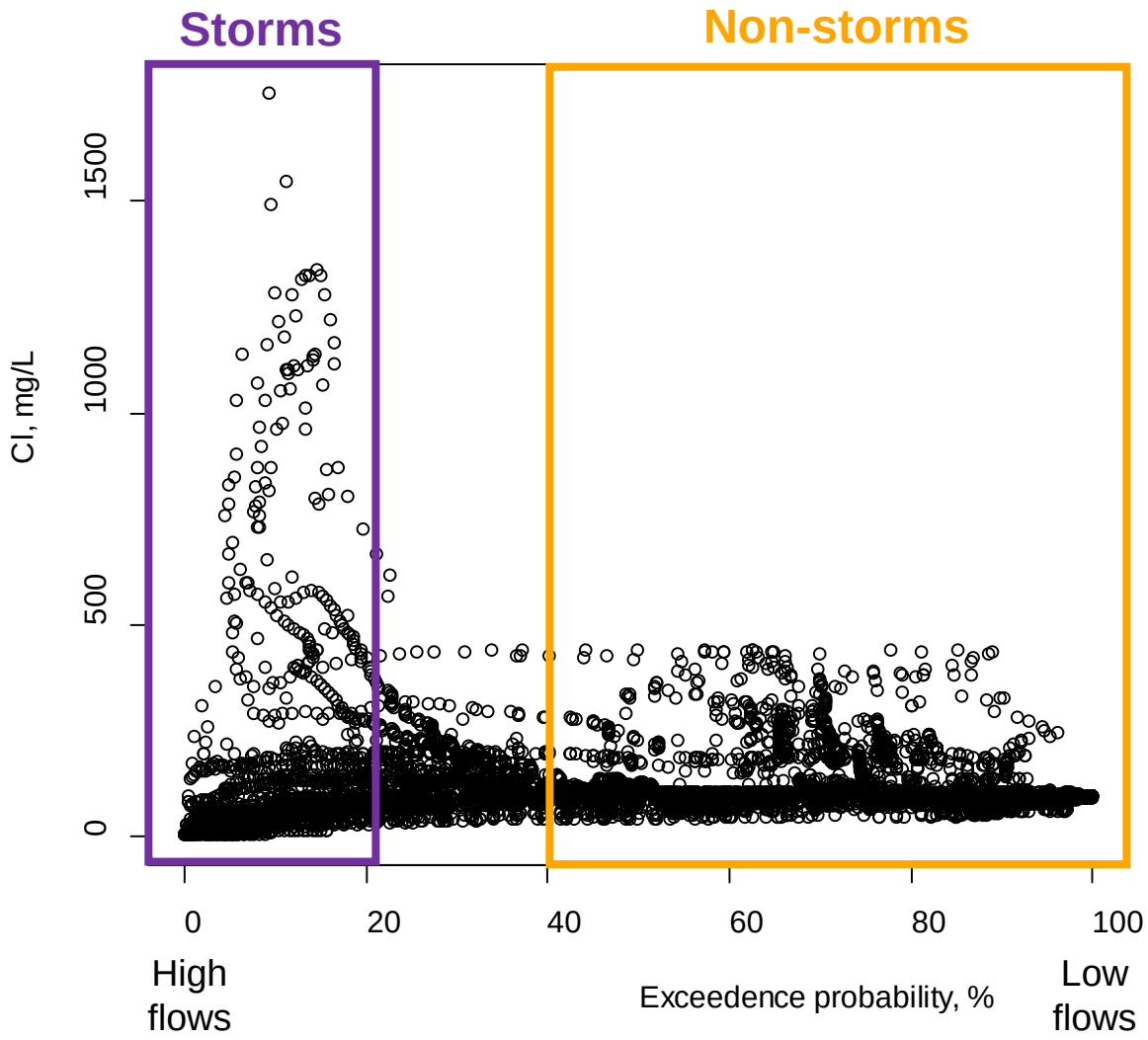

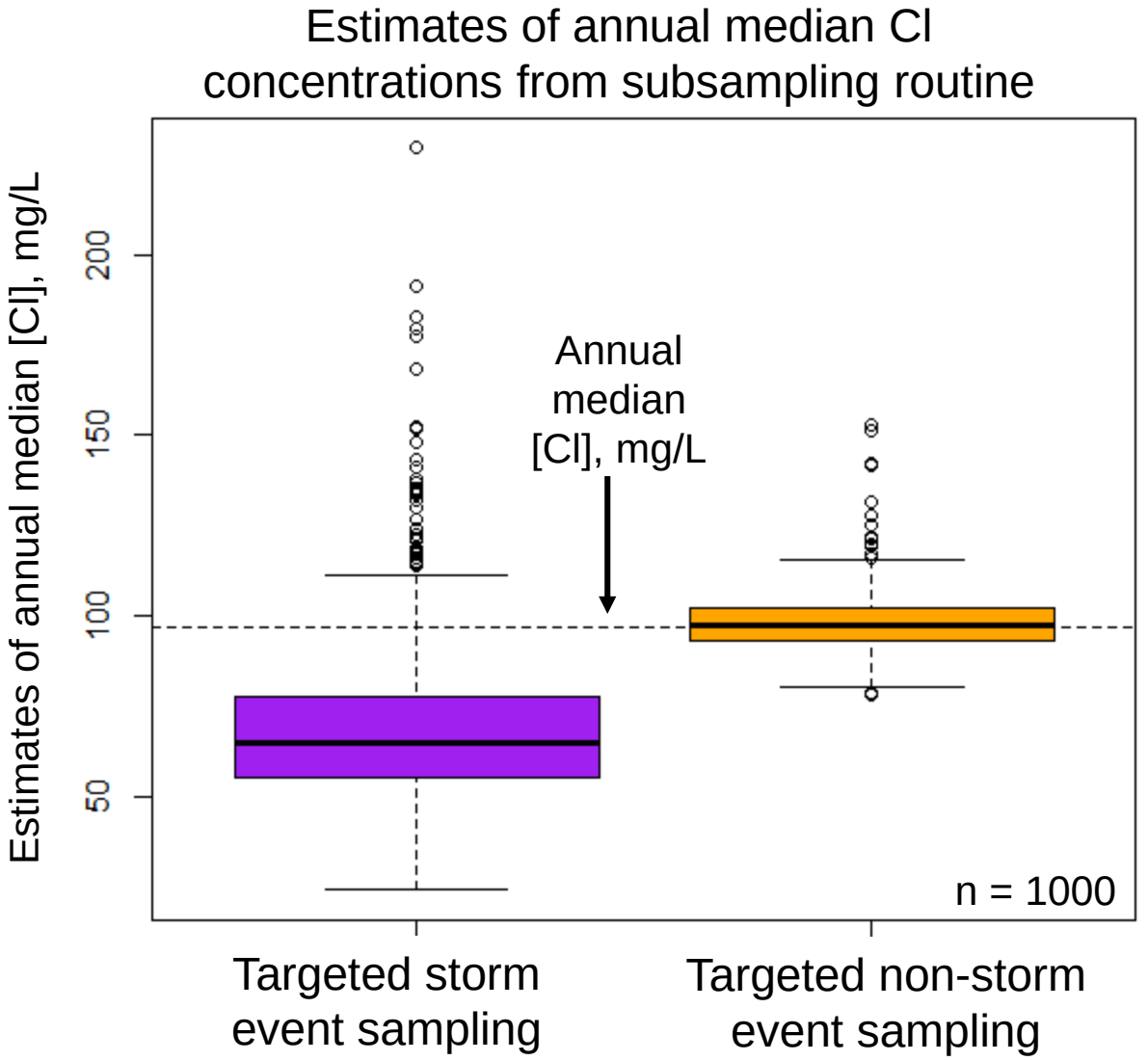

Questions for this session

1. How useful is conductivity as a surrogate for quantifying salt concentrations?
   - Yes, in non-carbonate settings SC correlates highly with [Cl]
   - May be able to use regional surrogate models where no [Cl] exists
2. Do current monitoring efforts capture the status and trend in salt concentrations?
   - Median [Cl] and chronic EPA exceedances increases with % impervious
   - Issues are worse in northern regions with more road salt applications
   - Median [Cl] increasing in many sites in mid-Atlantic
3. What is the best sampling strategy for monitoring concentrations or loads of individual salt constituents? It depends on the metric:
   - ***For "average" conditions:*** Discrete, non-storm or FF sampling
   - ***For EPA aquatic criteria:*** High-frequency SC and discrete Cl
   - ***For loads:*** Storm and non-storm sampling, plus SC monitoring

Questions?

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Joel Moore | Towson University, Towson, MD

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Photo: Utah.gov