Developing Critical Loads of Acidity for Stream Ecosystems in the Adirondack of New York State
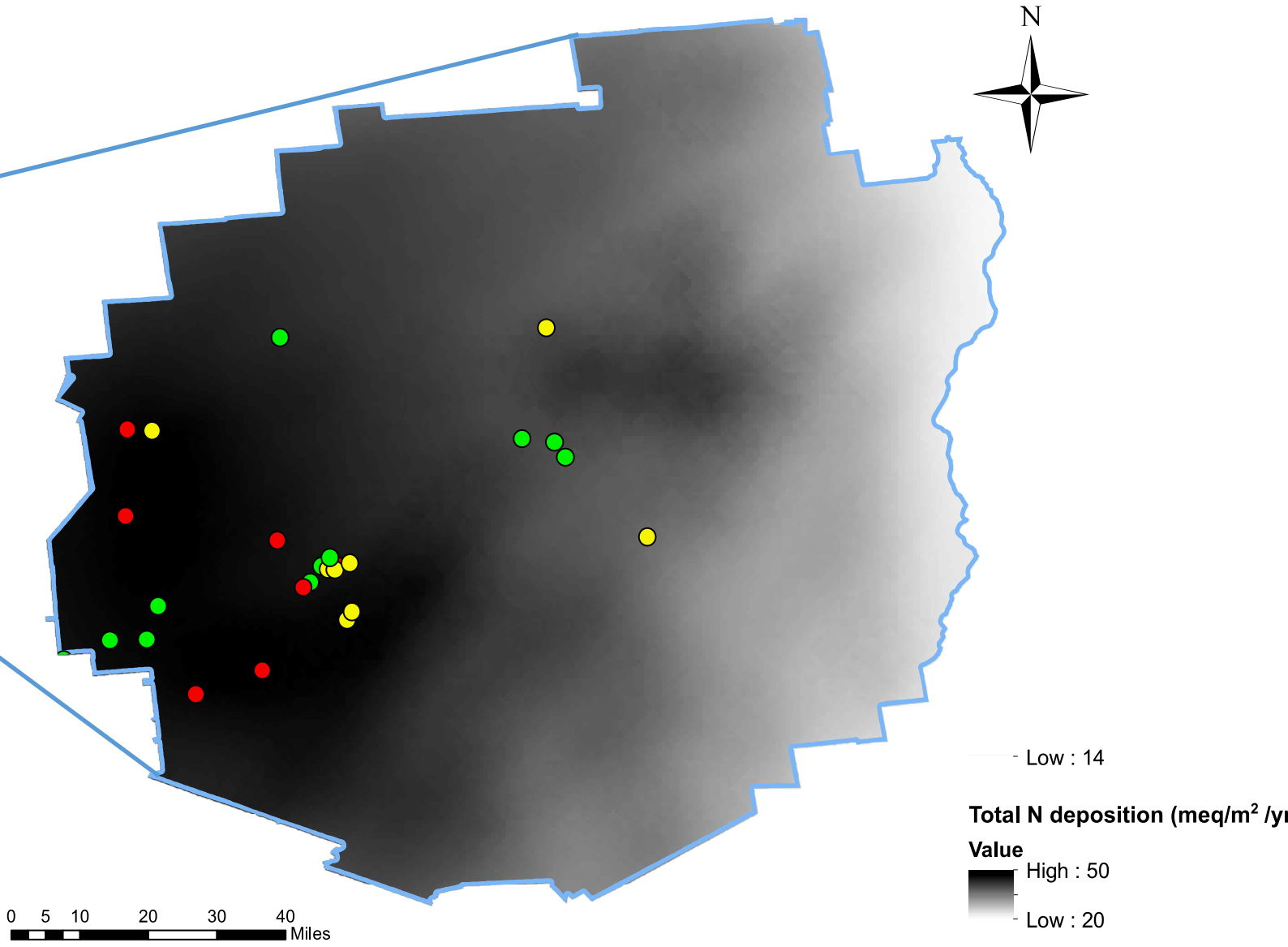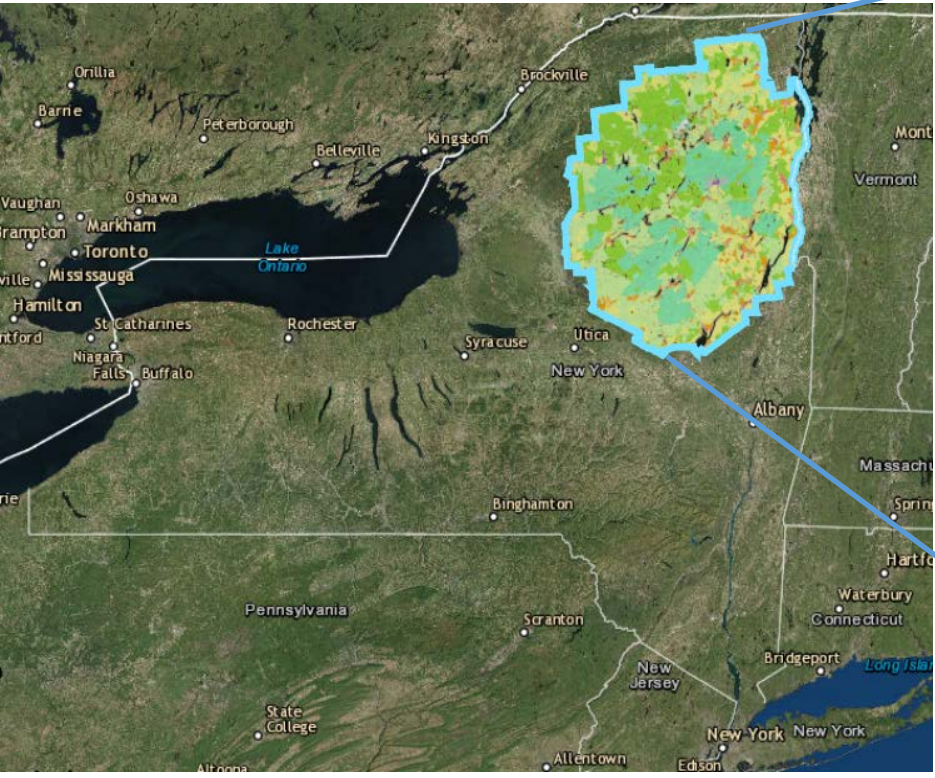
S. Shao
C. Driscoll
D. Burns
G. Lawrence
T. Sullivan
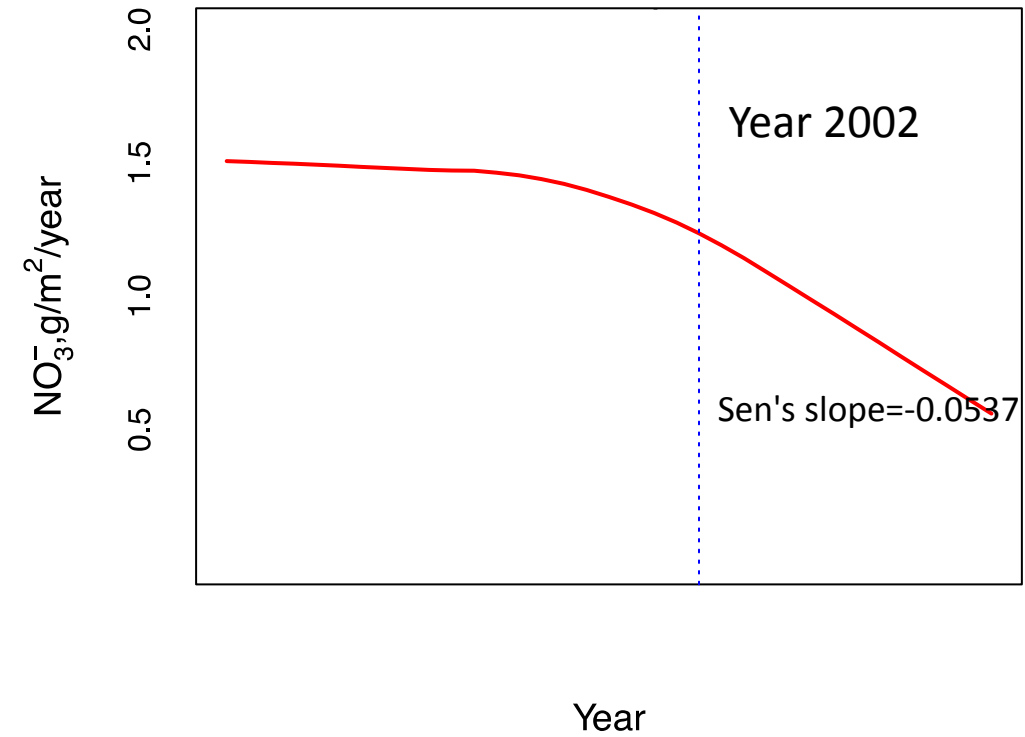
NADP Fall Meeting, San Diego, CA, November, 2017

Study sites

Total N deposition (meq/m² /yr)

Value

High : 50

Low : 20

Low : 14

0 5 10   20   30   40
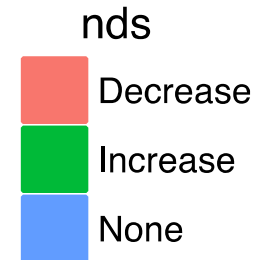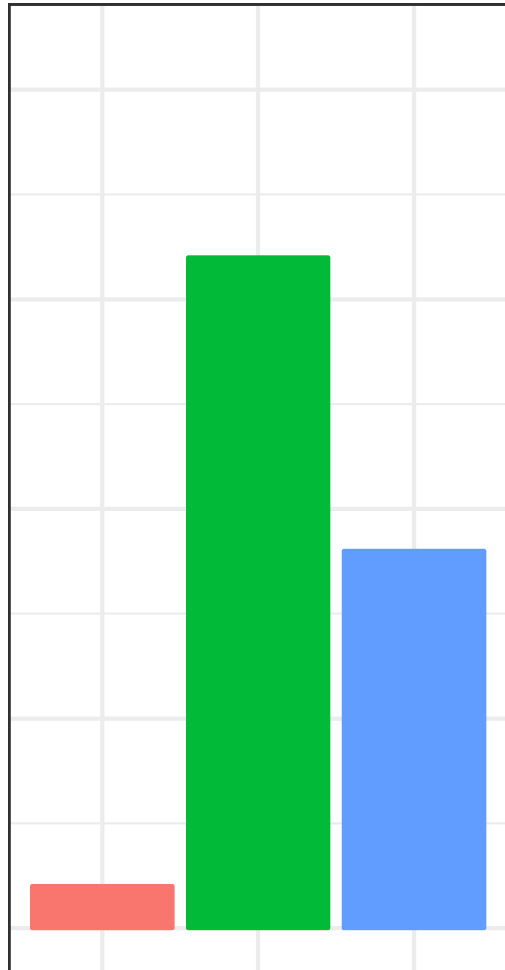   Miles

Deposition of SO_4^{2-} and NO_3^- (NY20, NADP)

——— Seasonal Kendall's Test

Sen's slope=-0.0539

$NO_3^-, g/m^2/year$
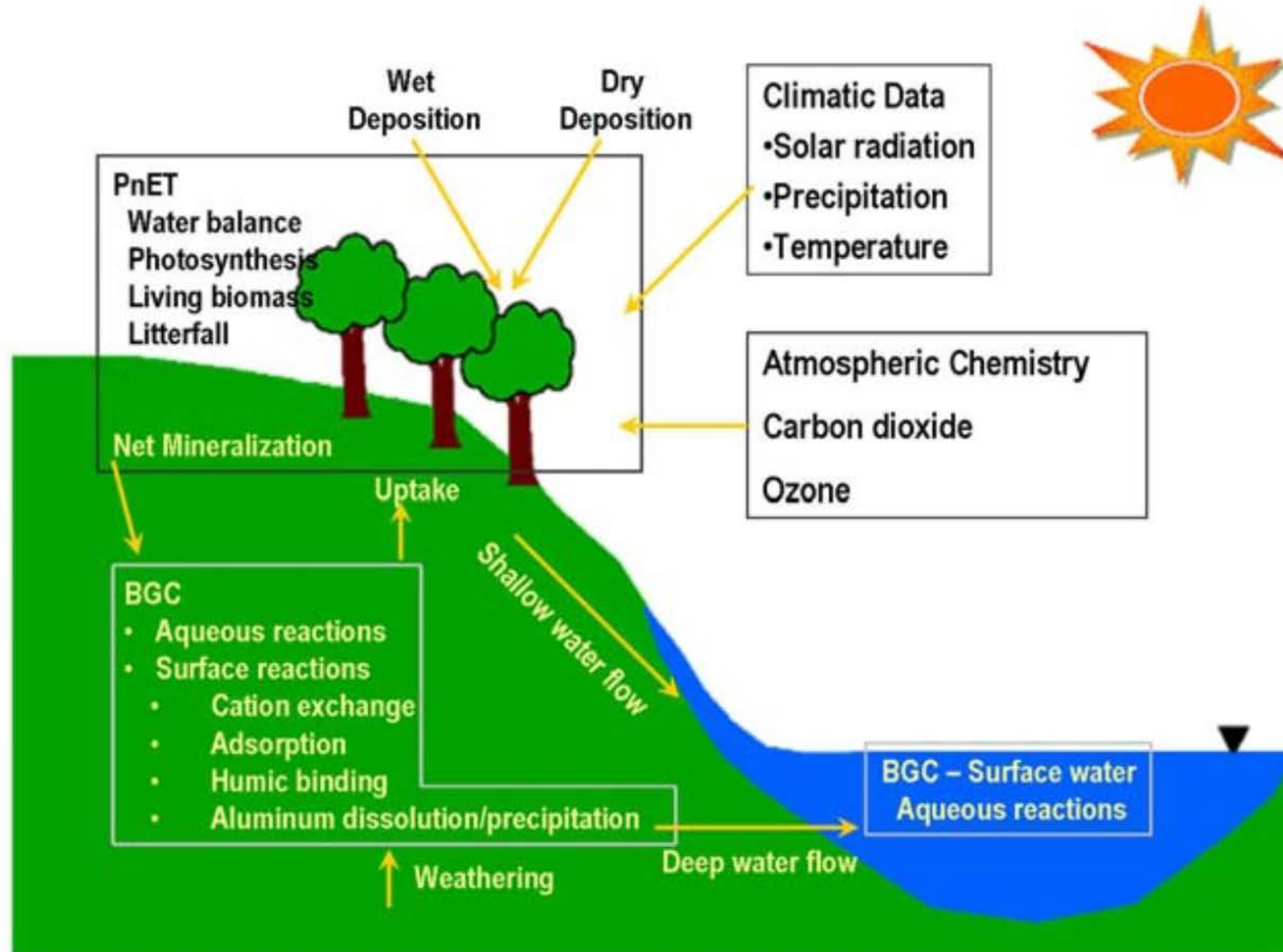
Year 2002

Sen's slope=-0.0537

Year
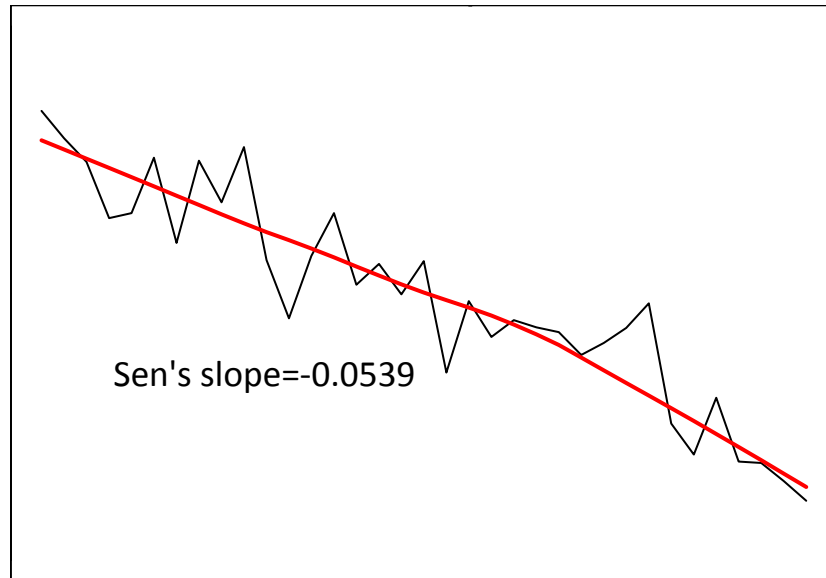
Trend analysis of model-simulated stream water chemistry (1980-2015)

❖ Coinciding with decreases in atmospheric SO_4^{2-} and NO_3^- deposition in Adirondack, stream chemistry has shown changes in acid-base chemistry.

# Model description

Data development (Huntington Forest)

- Deposition data

I. Wet deposition: Wet deposition has been monitored at Huntington Forest (HF) in the central Adirondacks since 1978 through the National Atmospheric Deposition Program (NADP NY20).

II. Dry deposition: PnET-BGC estimates dry deposition of chemical constituents based on the inputs of dry to wet deposition ratios.

III. Reconstruction of historical deposition data:

Remote areas	Linear ramp	Regression model	NY20

1000   1850   1900   1978   2016
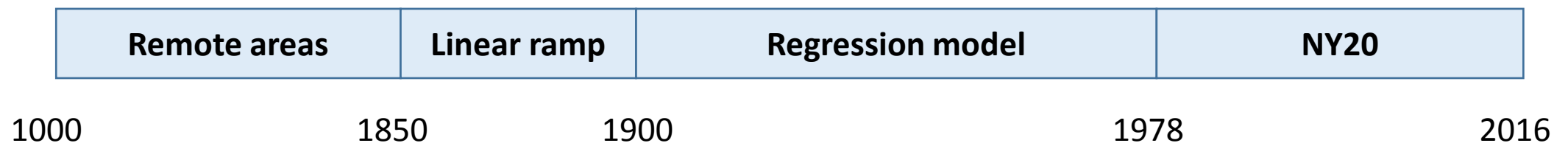
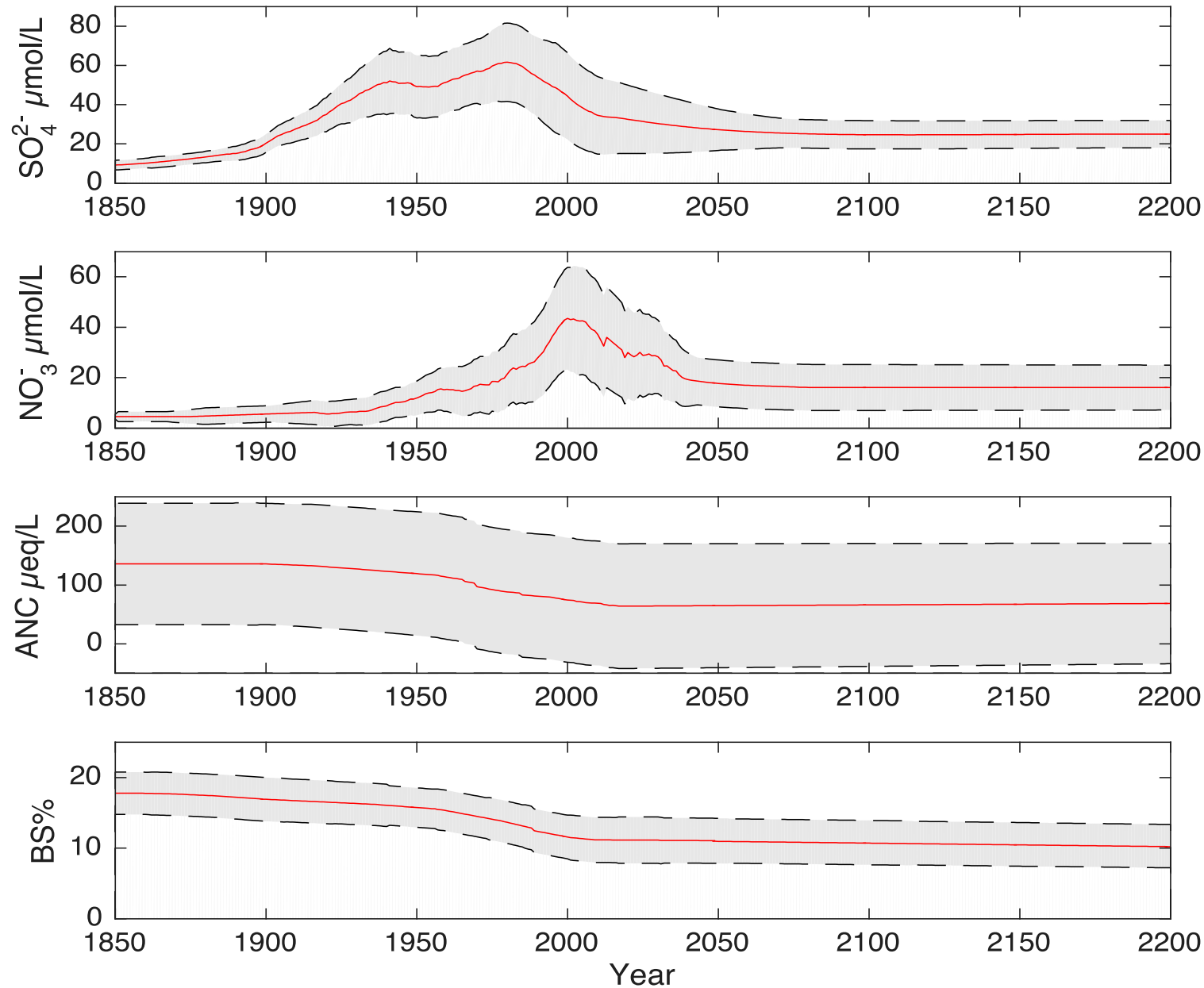# Atmospheric deposition and reduction scenarios
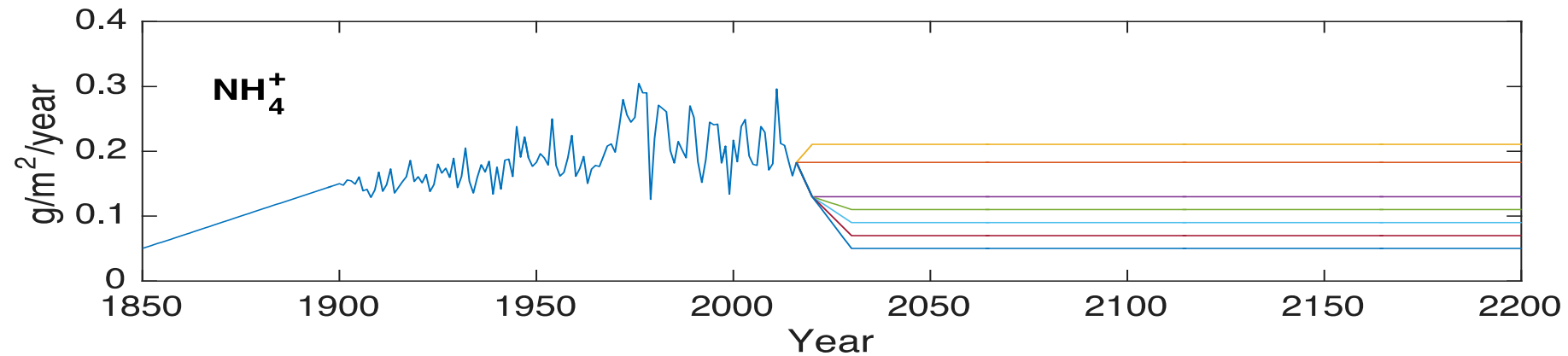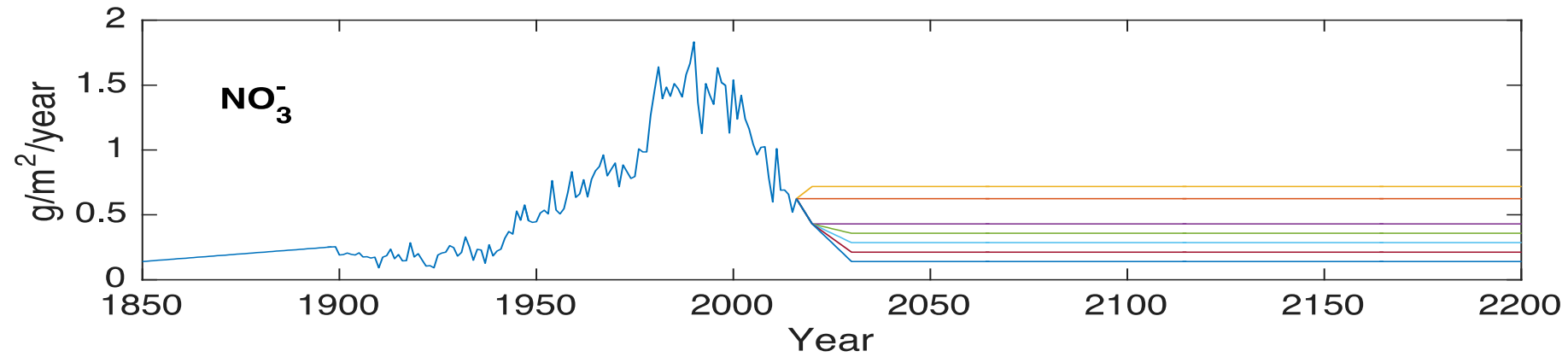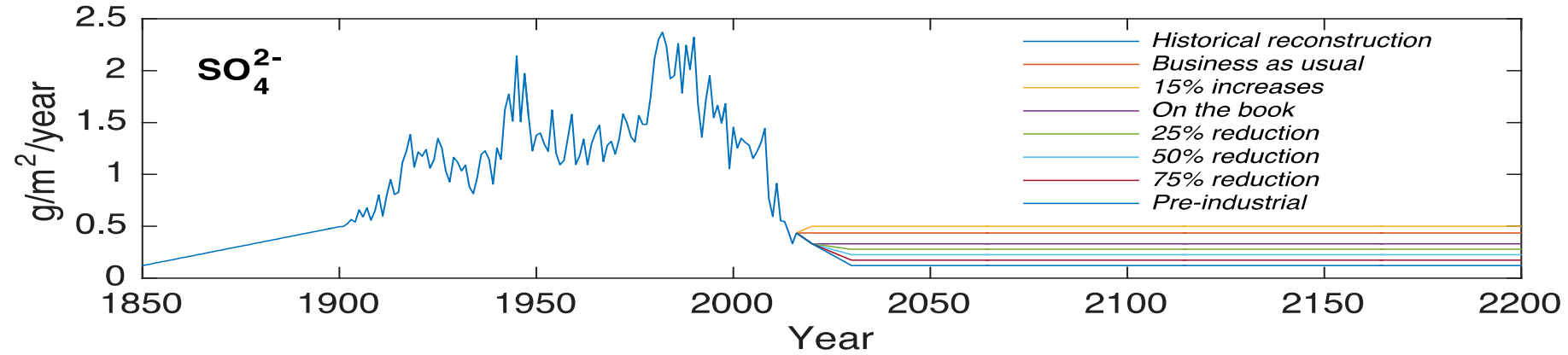
Model calibrations
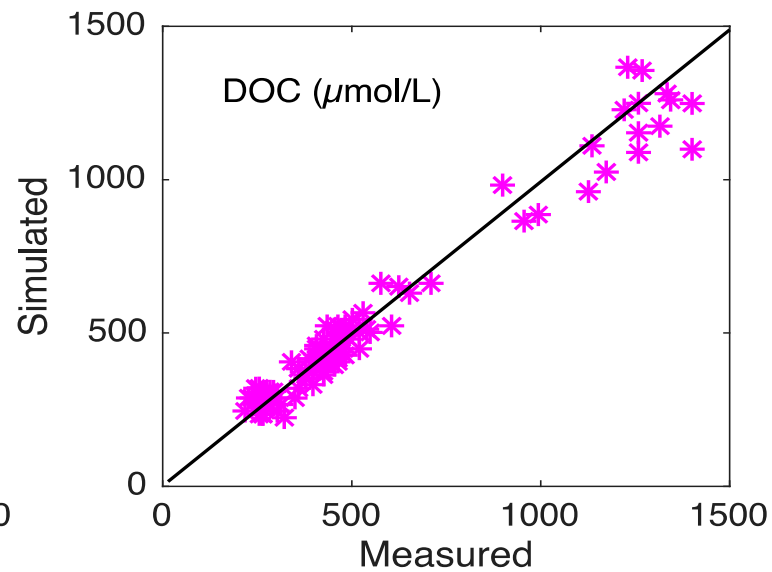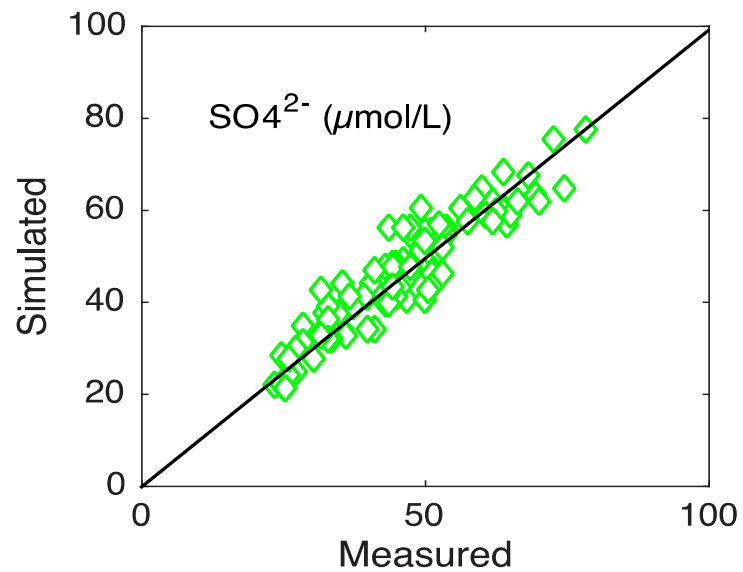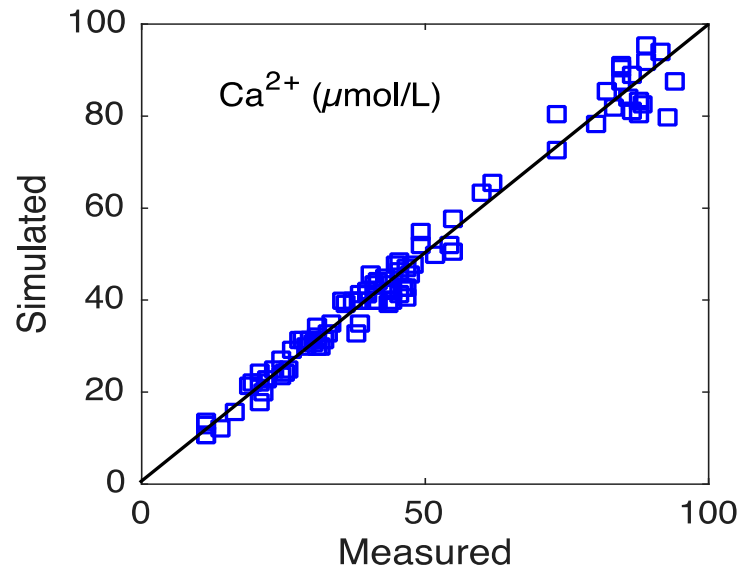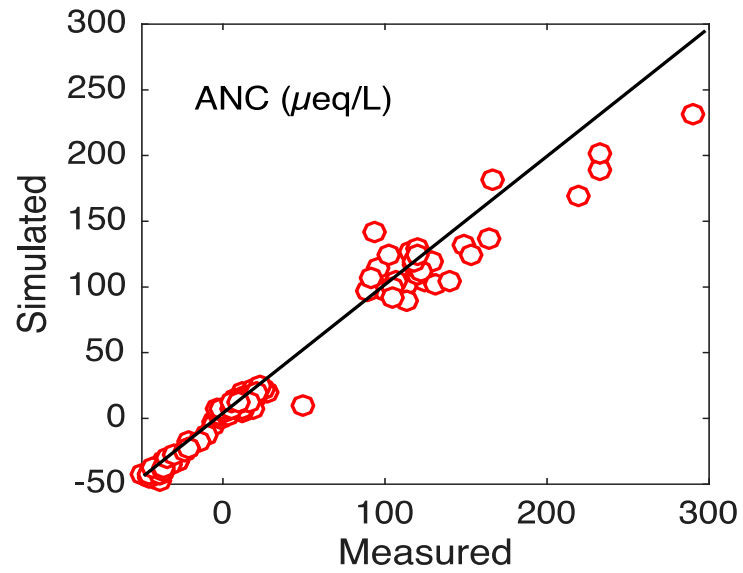
- PnET-BGC is quite effective at simulating stream ANC, SO_4^{2-}, Ca^{2+} and DOC.

- limited availability of monitoring data (sparse data).

- Unable to represent the annual volume-weighted conditions.

# Median (± standard deviation) of simulated stream and soil chemistry


- None of the study streams are estimated to have preindustrial ANC less than 20 µeq/L; 6 of the sites on the streams are estimated to have preindustrial ANC between 20 - 50 µeq/L, and the remaining 20 sites are estimated to have ANC > 50 µeq/L.

- Hindcast simulations of soil chemistry suggest that soil acidification occurred due to the historical acidic deposition

# ANC responses to different load reduction scenarios
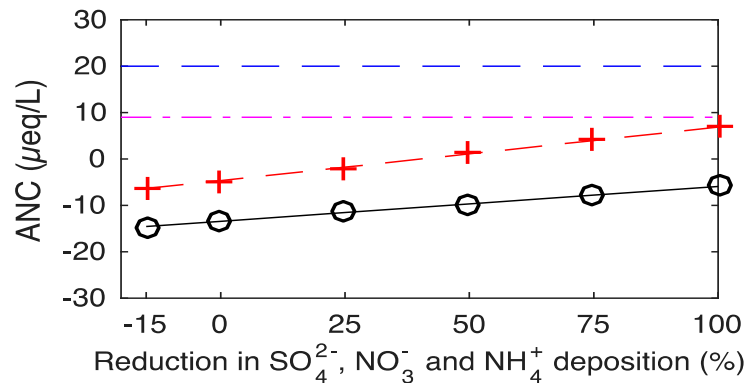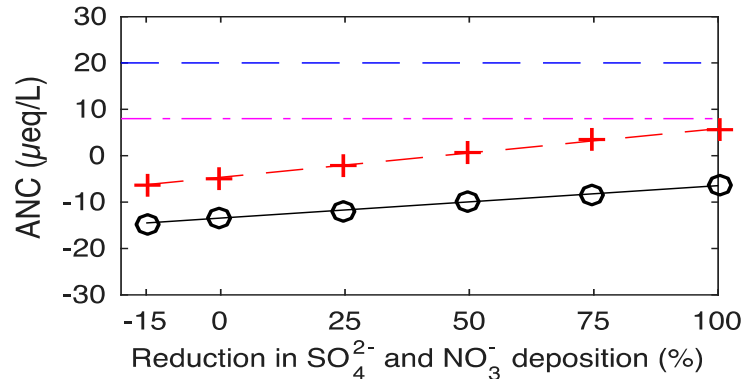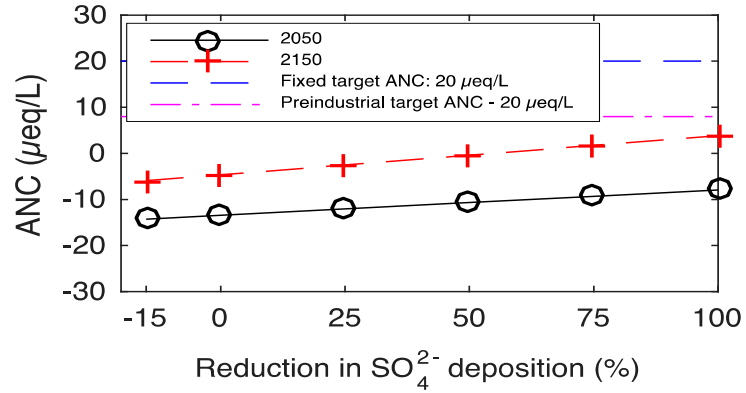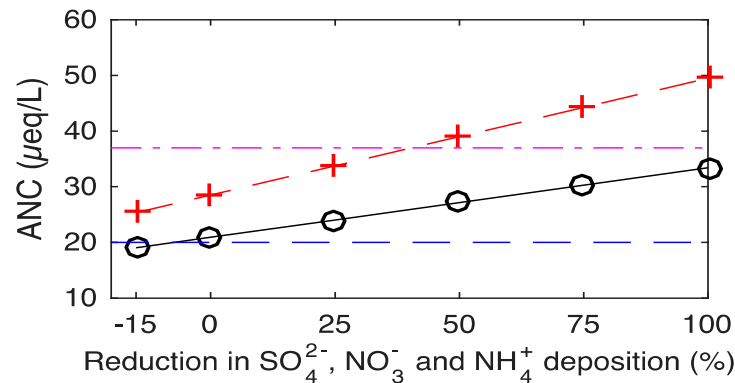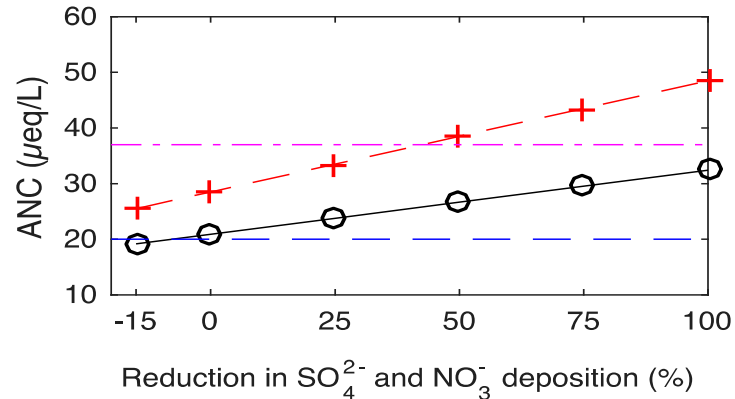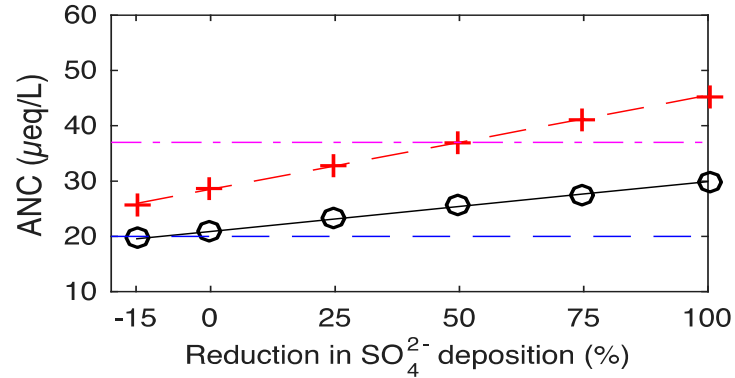
❑ Model results suggest that increases in surface water ANC are greatest in the scenarios involving combined load reduction of SO_4^{2-}, NO_3^- and NH_4^+.

❑ However, SO_4^{2-} and NO_3^- load reduction essentially achieve the same level of recovery in stream ANC compared to SO_4^{2-}, NO_3^- and NH_4^+ load reduction.

Number of streams attain target ANCs at 2050 and 2150
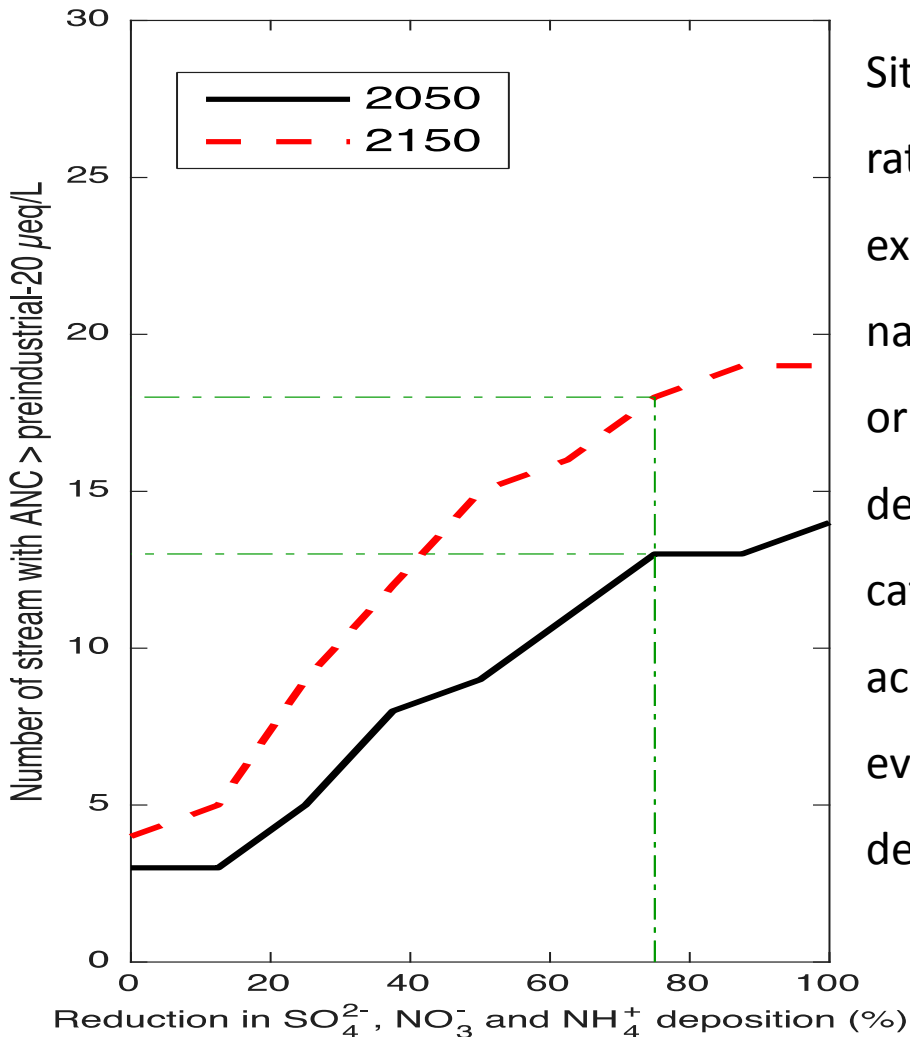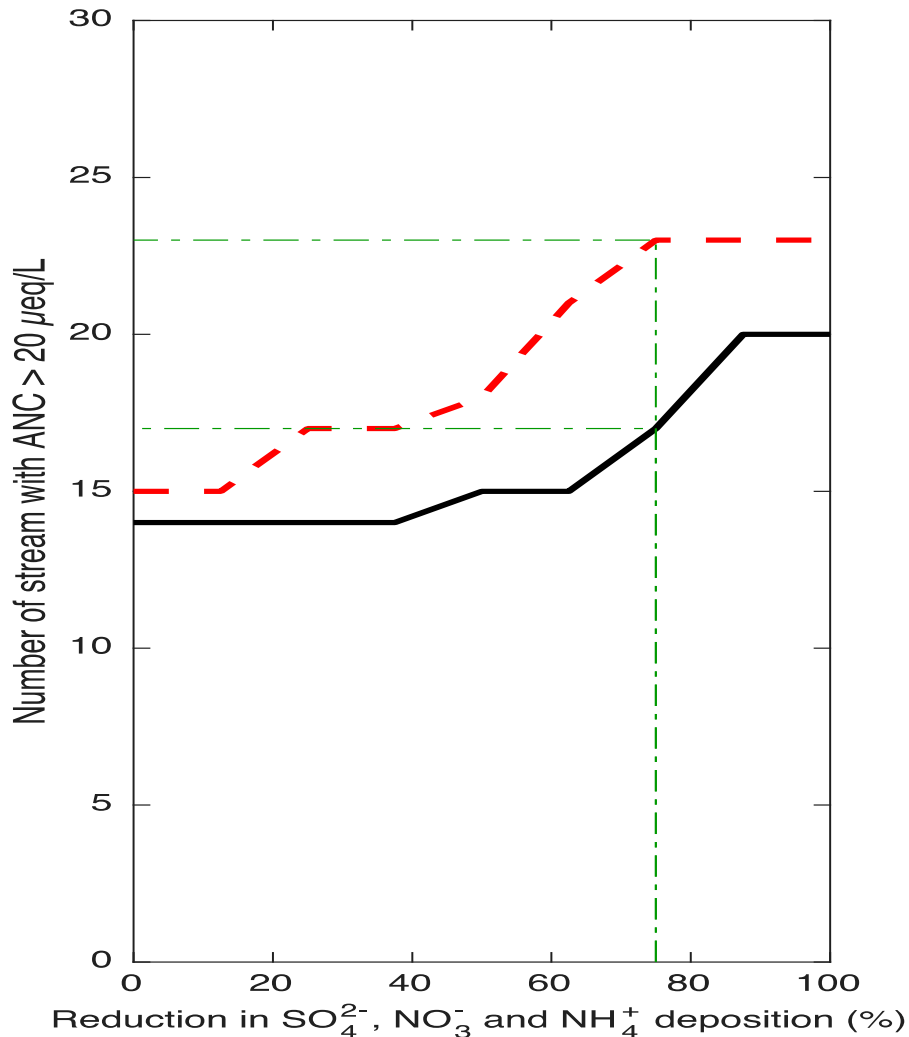
Sites have naturally very low rates of base cation supply; experience elevated inputs of naturally occurring organic acids; or historical acid deposition has depleted soil available base cations. They are not be able to achieve an ANC recovery target even under low future acid deposition.

Thank you!