Examining Sulfate Behavior along a North-South Gradient of Unglaciated Eastern U.S. Catchments

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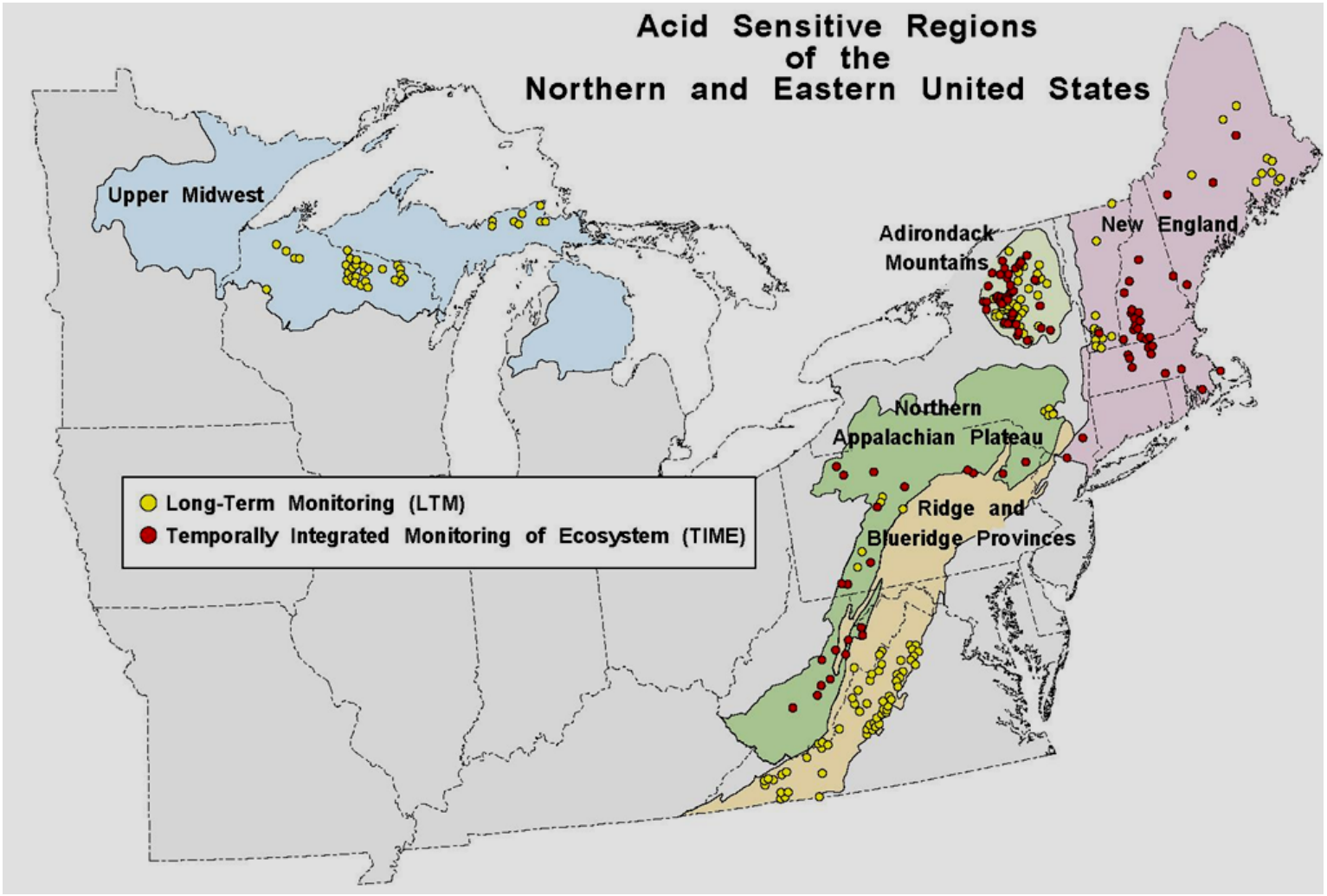
Previous Findings

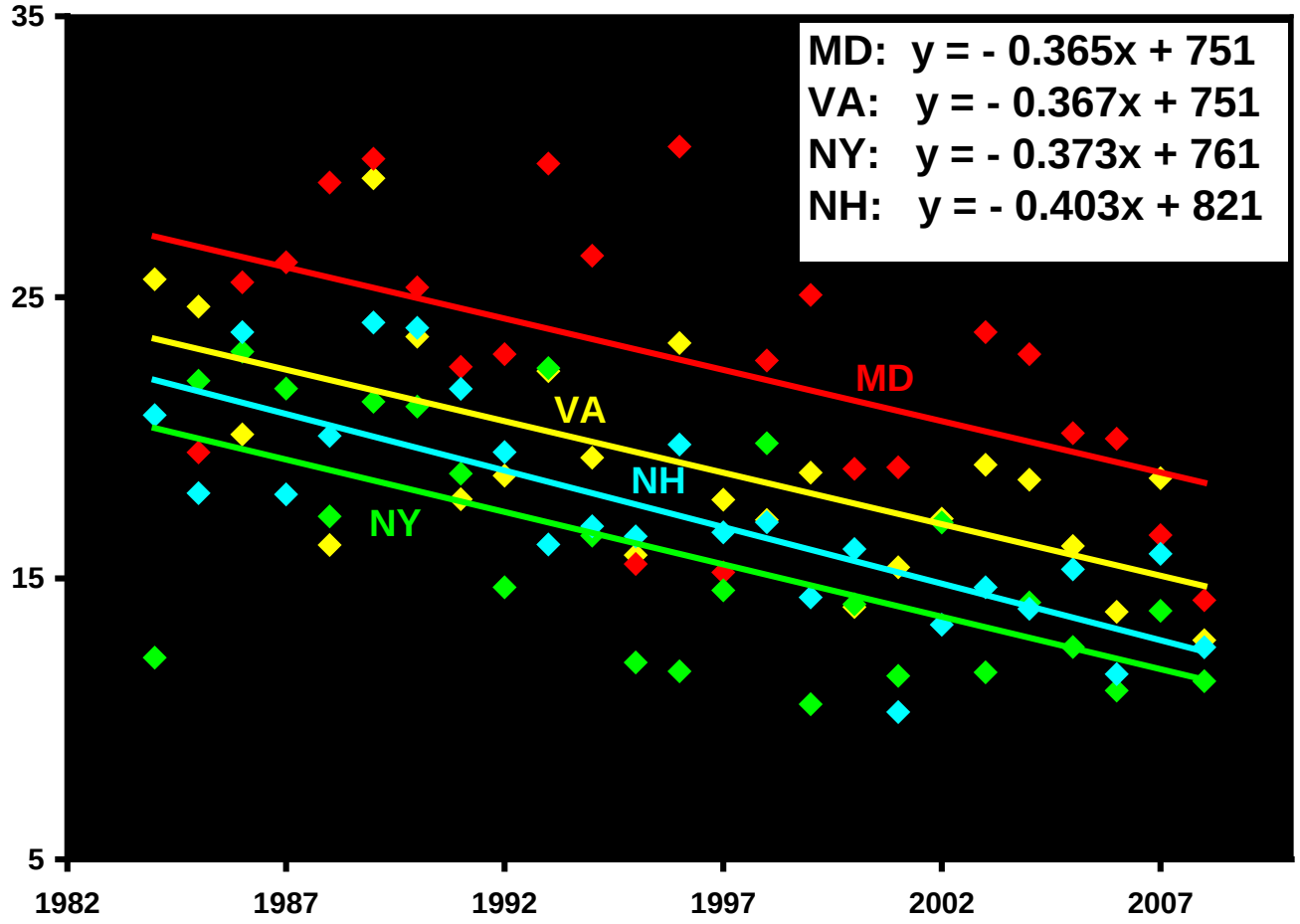
The Mid-Appalachian region was identified as one of the two areas that is most affected by acidic deposition and the one area that is most likely to experience further acidification (NAPAP)



Previous Findings

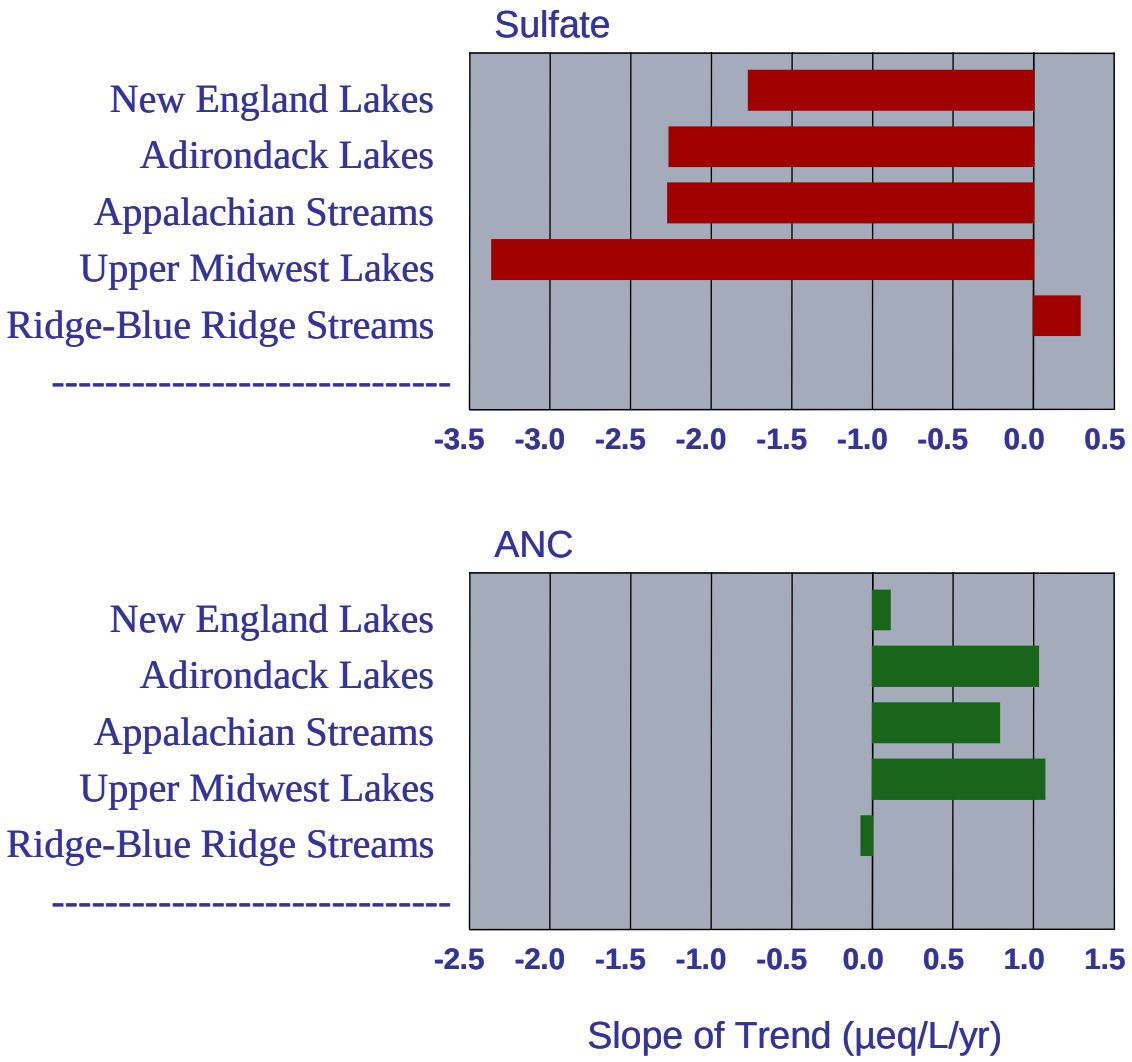
Emissions reductions during the 1980's and 1990's resulted in significant declines in wet deposition of sulfur in this region

NADP Annual Wet Deposition Sulfate, kg/ha



Previous Findings

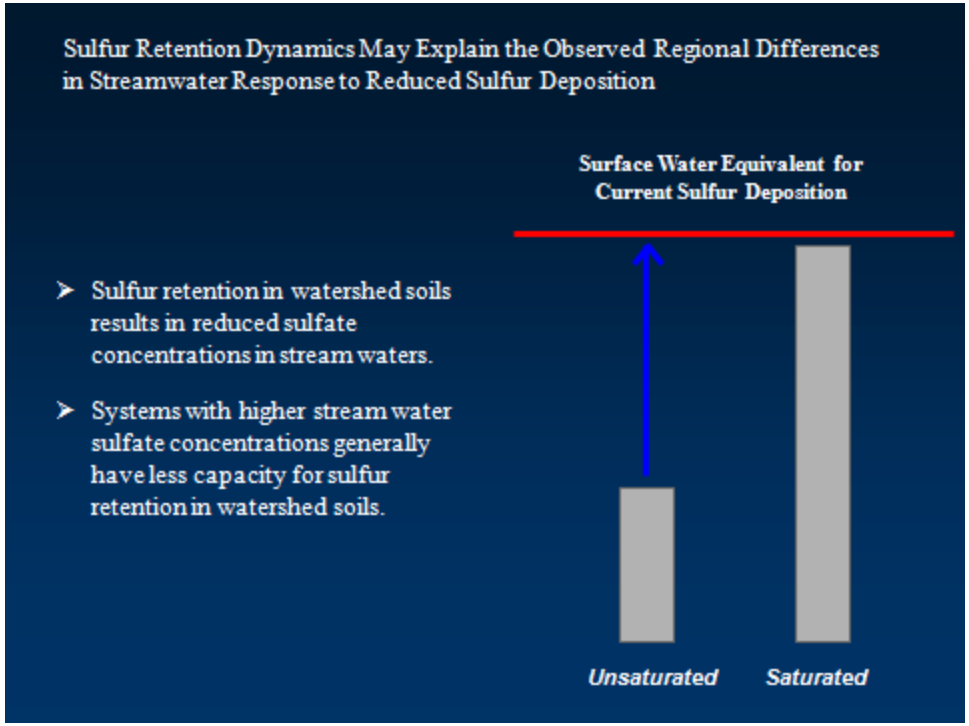
Analysis of regional trends in surface water acid-base composition for 1990-2000 found no evidence of recovery among western Virginia streams (EPA)

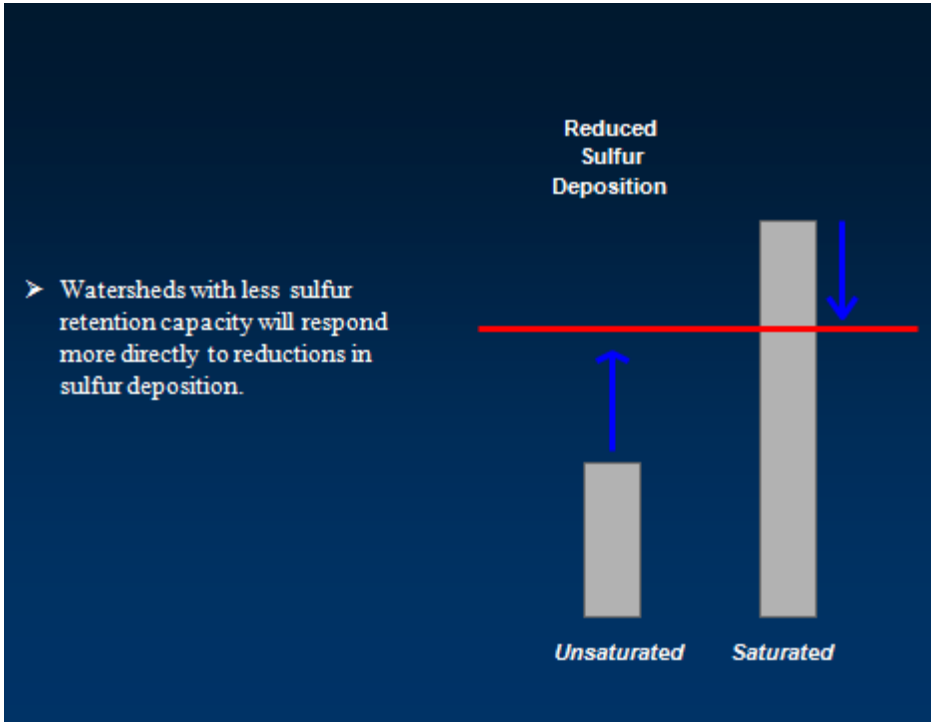


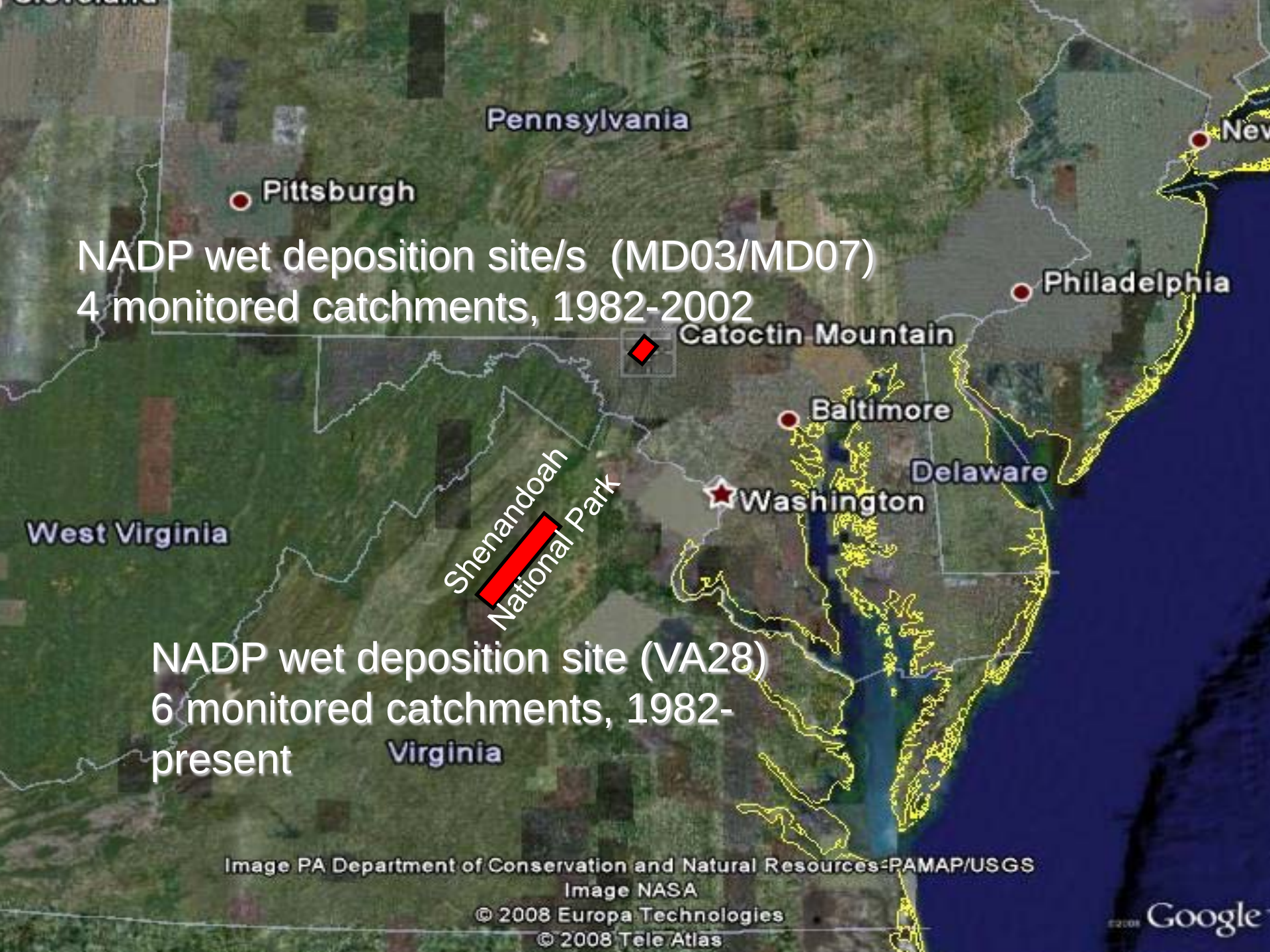
Objectives

- Use watershed flux data from long-term deposition and stream-water quality monitoring sites to examine possible explanations for lack of response for sulfate in the Mid-Atlantic

- Examine whether input/output mass balance of sulfate at these sites is consistent with sulfate adsorption hypothesis






Pennsylvania
Pittsburgh
NADP wet deposition site/s (MD03/MD07)
4 monitored catchments, 1982-2002
Philadelphia
Catoctin Mountain
Baltimore
Delaware
Washington
West Virginia
Shenandoah
National Park
NADP wet deposition site (VA28)
6 monitored catchments, 1982-present
Virginia
Image PA Department of Conservation and Natural Resources-PAMAP/USGS
Image NASA
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Analyses

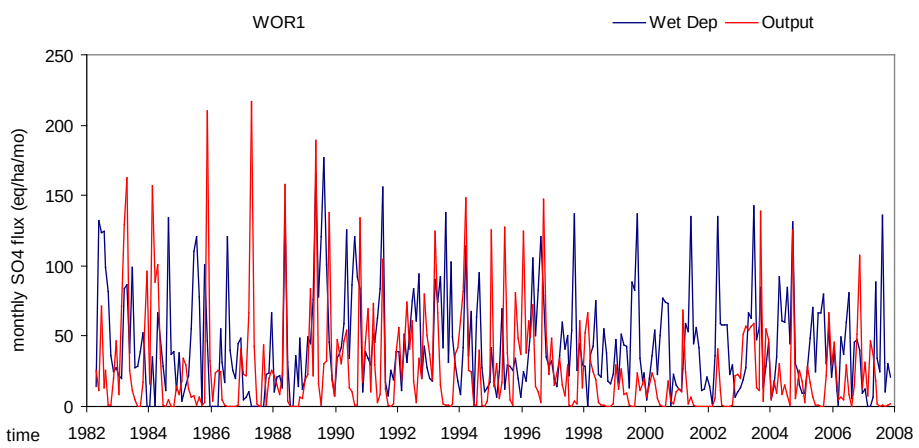
Input/Output and Cumulative Net Fluxes

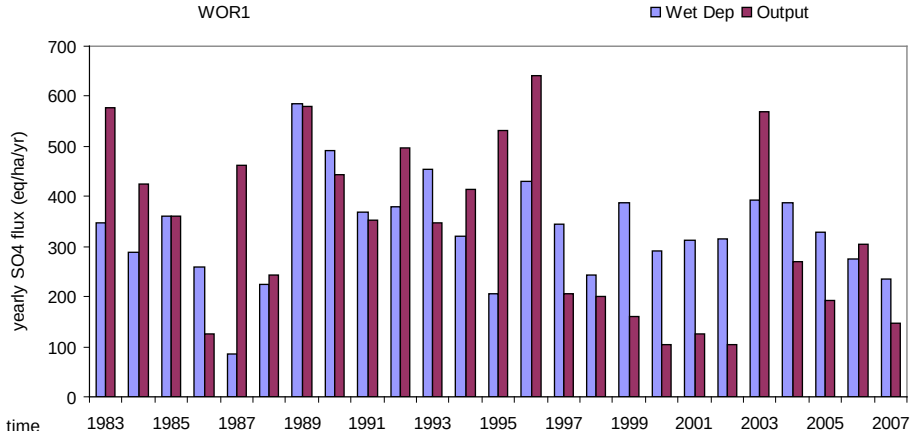
<u>Total output flux</u> -- long-term monitoring sites with Q to permit output flux calculations

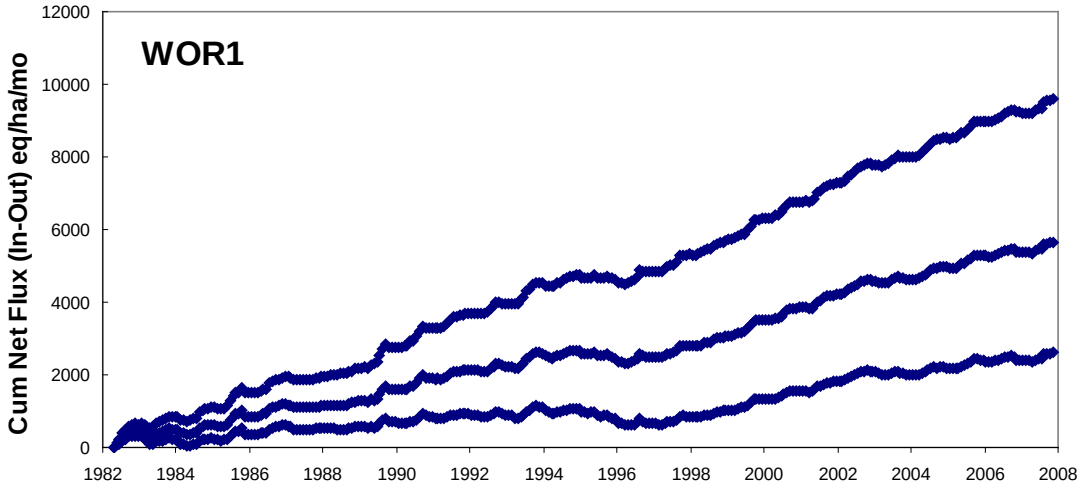
<u>Total input flux</u> -- NADP wet deposition, uncertainty in dry deposition, i.e., 3 levels: 1.2x, 1.55x, 2.0x

<u>Why Cumulative Net Flux ?</u>

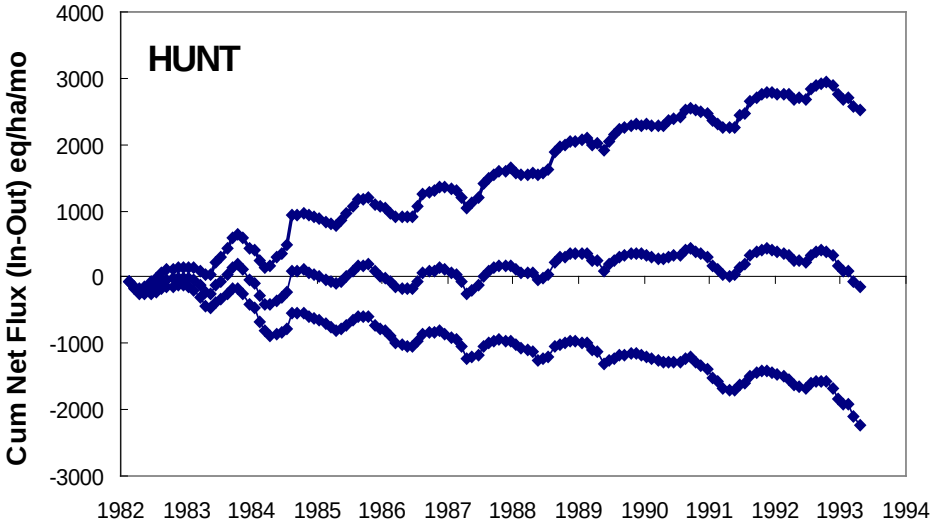
Smooths interannual noise, provides robust estimate of long-term behavior

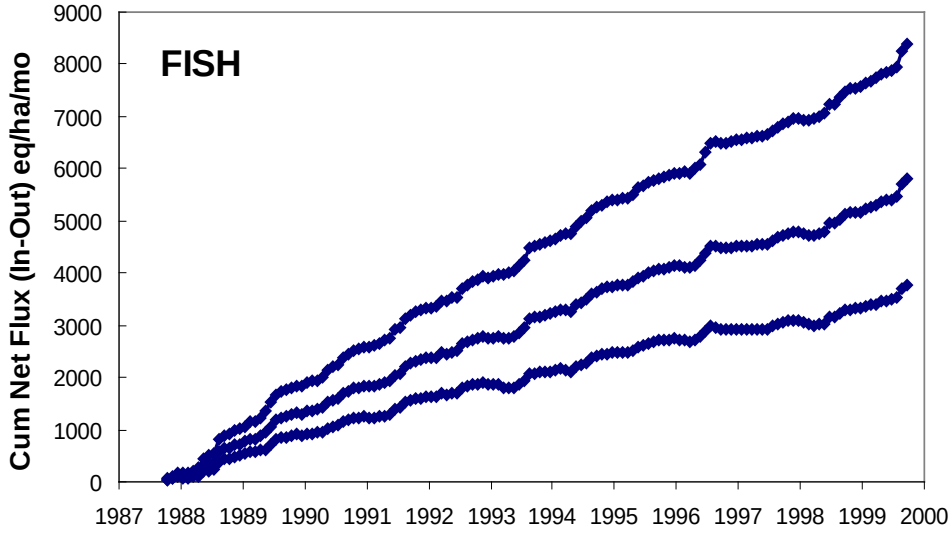


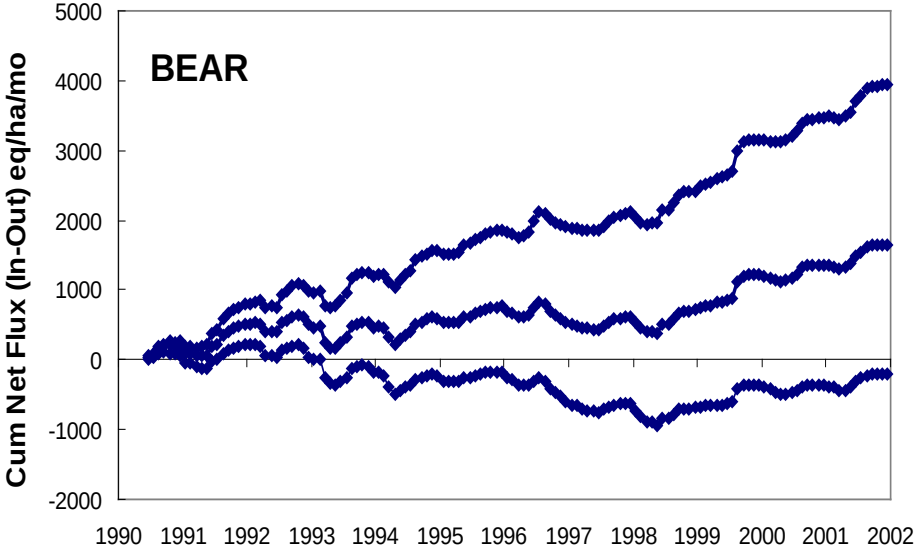


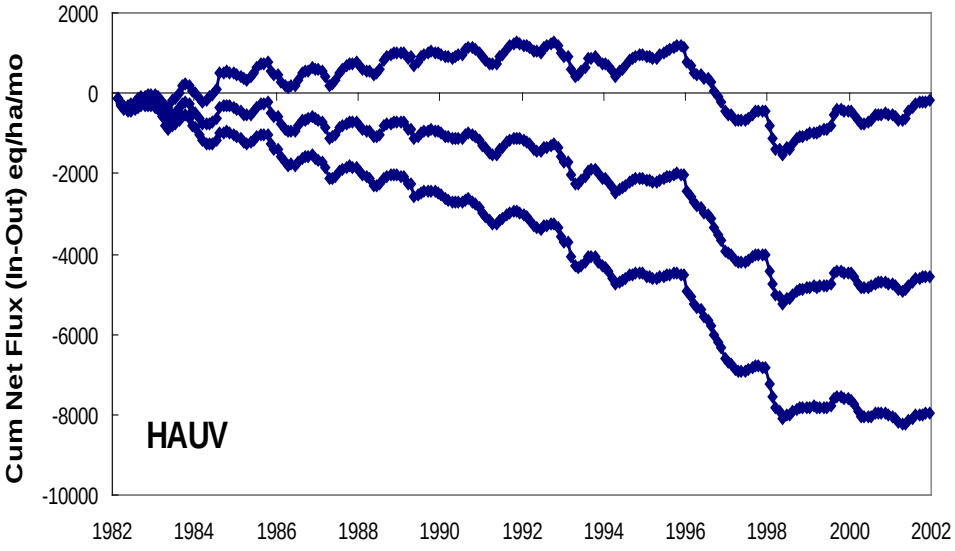


Maryland Sites

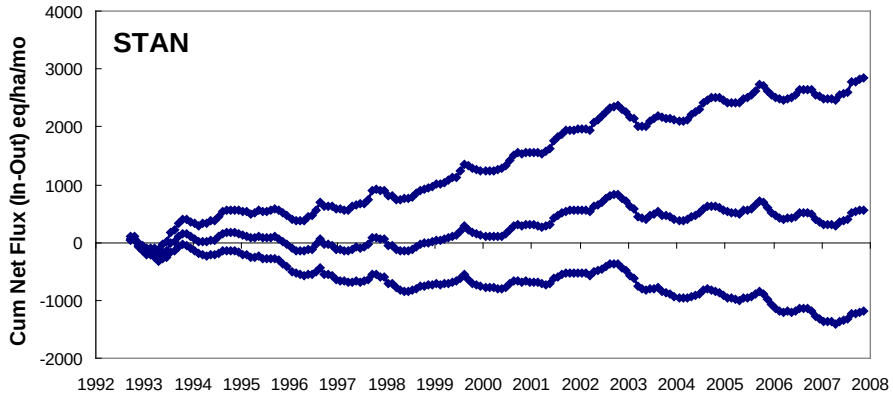


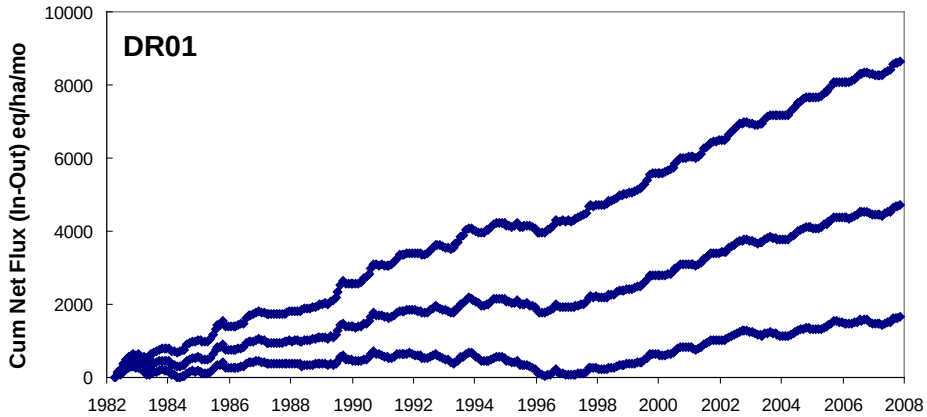


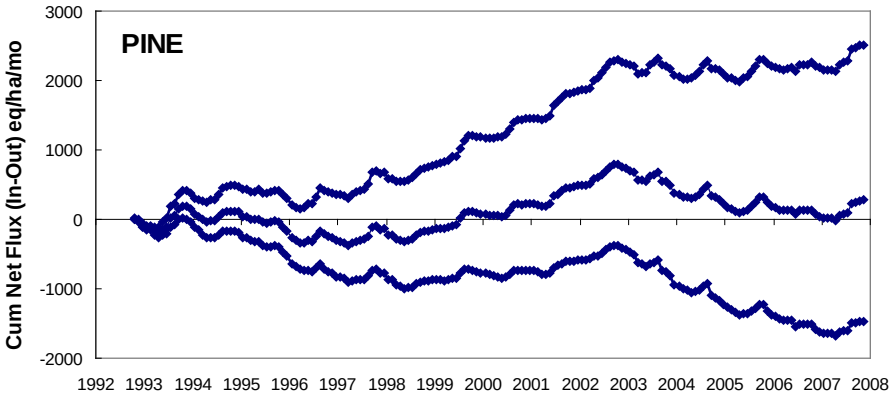


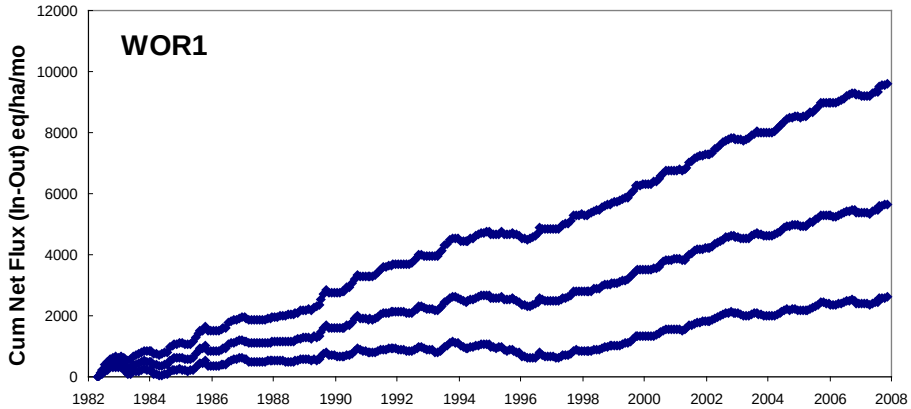


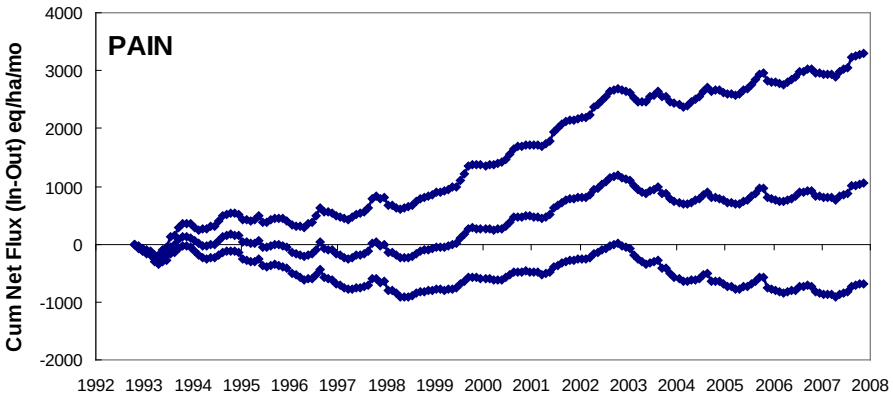
Virginia Sites

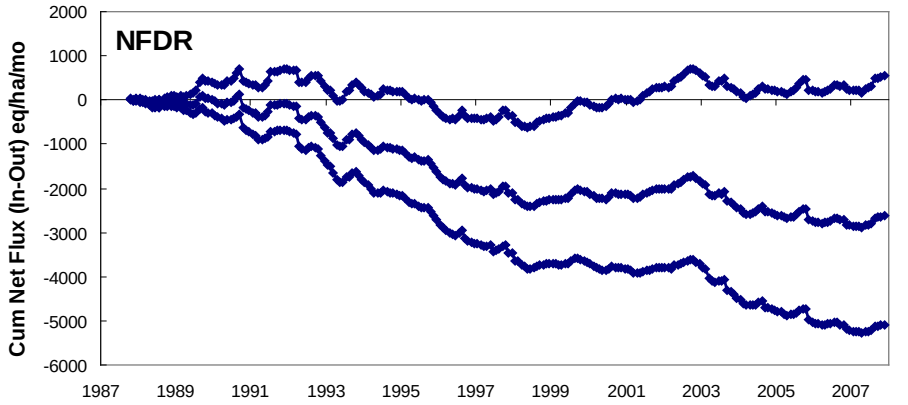




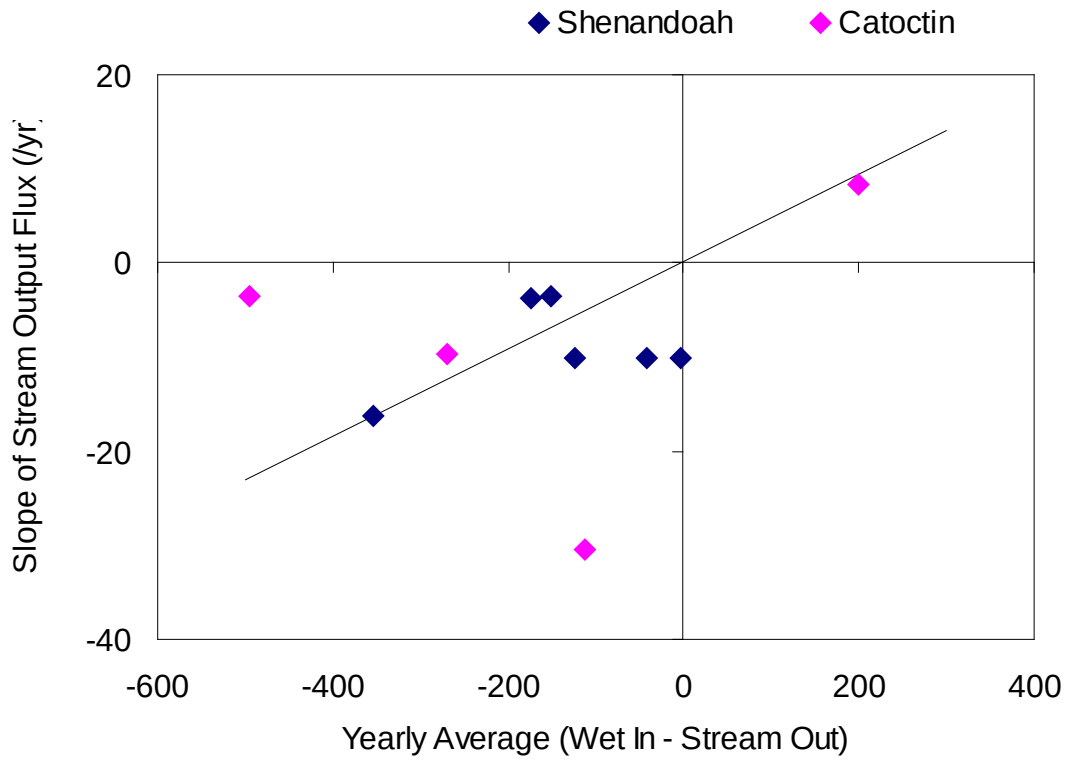








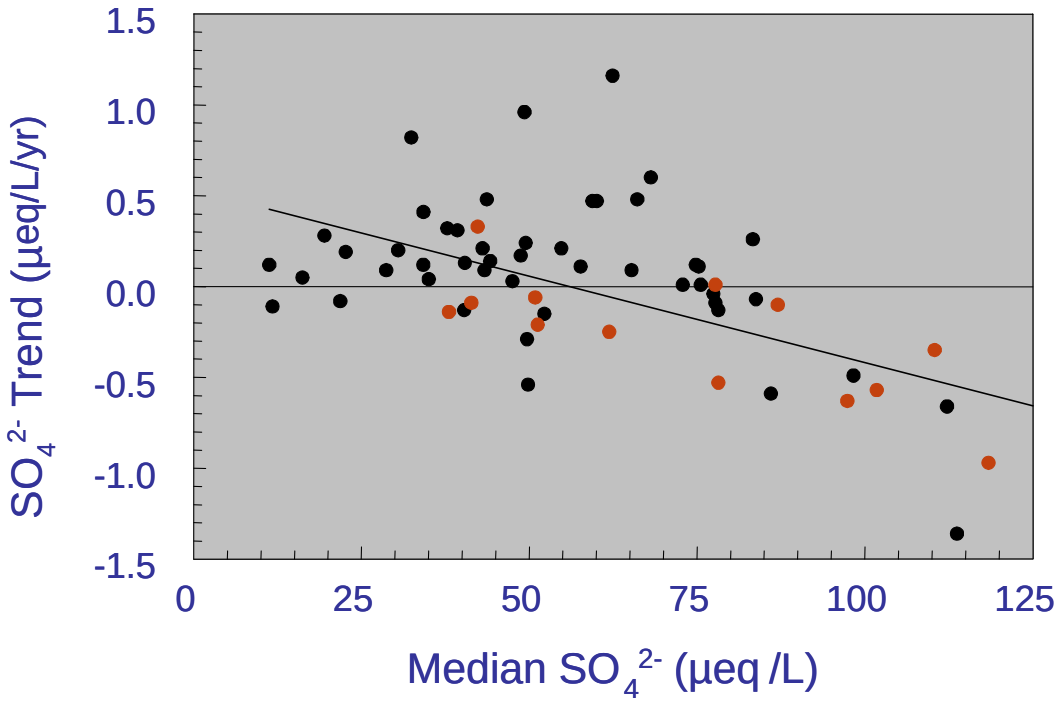
Expected behavior of stream fluxes to changes in both atmospheric deposition and soil export



Analysis of input and output fluxes (eq/ha/yr) for the period of record at each of the ten sites

Expected behavior of stream fluxes to changes in both atmospheric deposition and soil export

Stream Water Sulfate: 1988-2001
Concentration Change in Relation to Median Concentration



Conclusions

• Despite declines in sulfate deposition throughout the Mid-Atlantic, there is no clear trend in the response of output fluxes of sulfate in streams

• Analysis of input/output fluxes at 10 Mid-Atlantic sites (MD and VA), suggests that uncertainty in the input/output balance is dominated by uncertainty in estimates of dry deposition

• Current levels of reduction have not been sufficient to produce uniform recovery (reduced sulfate concentrations) in streams

• If larger sulfate reductions are achieved, what will be the fate of adsorbed sulfur and how quickly will these streams recover (implications for CL)?

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