Atmospheric N-Deposition for Climate Change Scenarios

Modeling Workgroup Conference Call – September 2019

Gopal Bhatt, Jesse Bash, Breck Sullivan, Lewis Linker, and Modeling Team

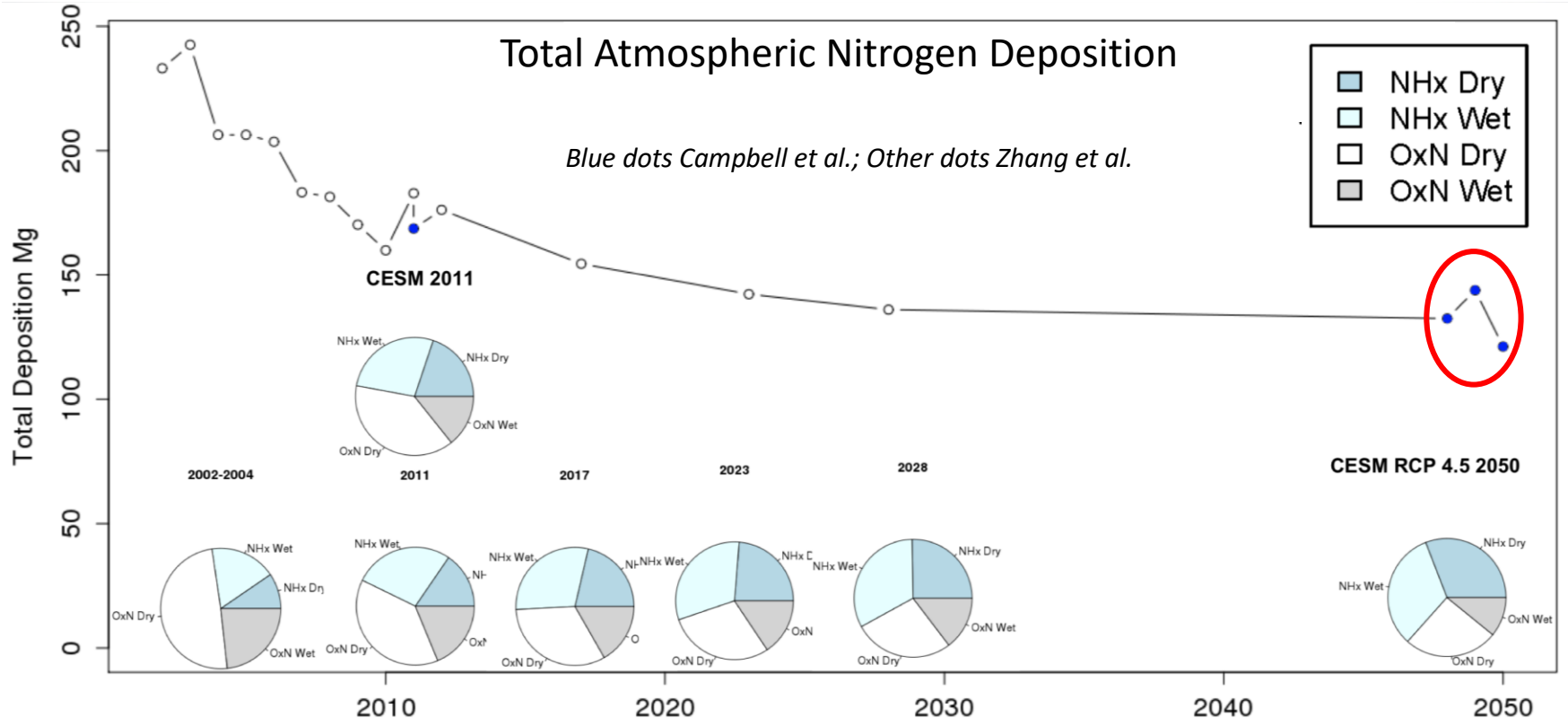
Objectives

- Analyze the Community Multistate Air Quality Model's (CMAQ's) 2050 atmospheric N-deposition data projections for (a) average, (b) wet, and (c) dry climate scenarios to determine how it varies with rainfall volume.
- Develop relationships that can be then applied to adjusting existing atmospheric N-deposition data to account for changes in rainfall (climate change scenarios).
- Look at the other lines of evidence (e.g. Phase 6, NADP data) for corroboration or new information.

Trends in CMAQ Atmospheric N-Deposition Estimates

Climate + Emissions Changes lead to:

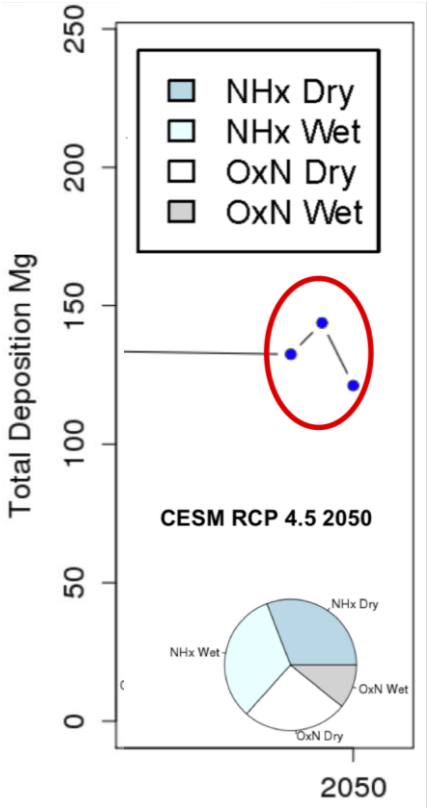
- Overall decreasing trend in Total N deposition to the Chesapeake Bay Watershed.
- Decreases in the proportion of dry and wet deposition of Oxidized N.
- Increases in the proportion of dry and wet deposition of NHx.
- *The climate influence on atmospheric nitrogen deposition is much smaller than the reduction due to emissions reductions*.



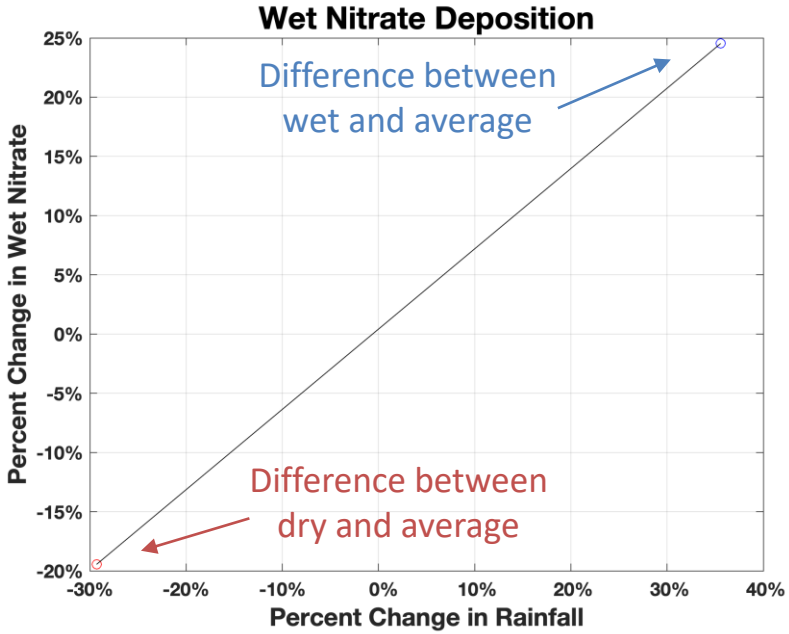
Bash et al., 17th Annual CMAS Conference. Oct 2018.; Campbell et al. in review

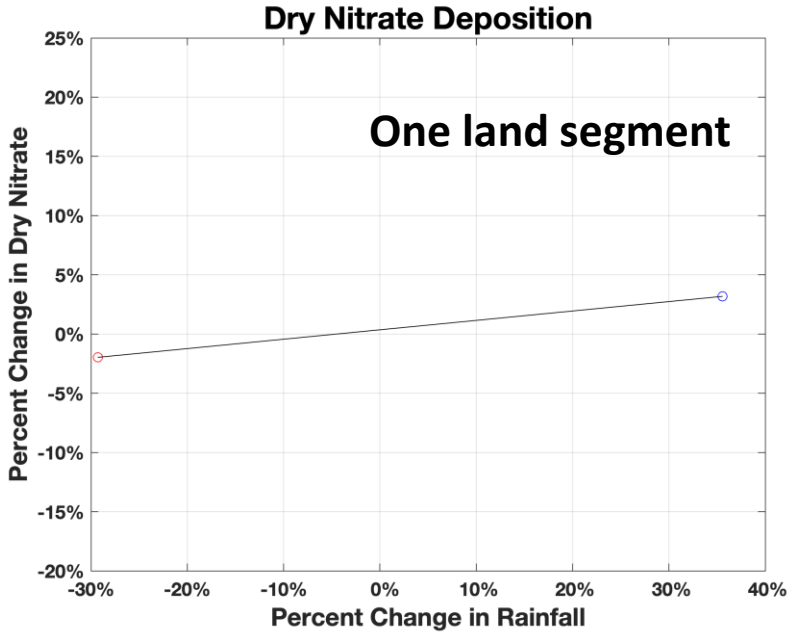
2050 CMAQ Atmospheric N-Deposition Data

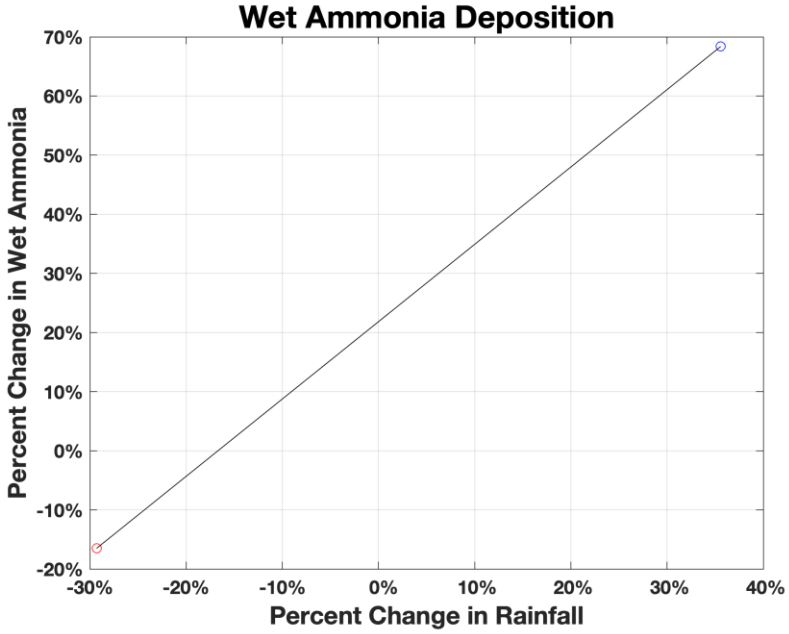
- Dynamically downscaled climate scenario
- Monthly time intervals
- Broken up into Phase 6 land segments
- Rainfall (inches)
  - 2048 – Average rainfall scenario (moderate)
  - 2049 – High rainfall scenario
  - 2050 – Low rainfall scenario
- Loads (lb/acre)
  - WN03 – Wet oxidized N-deposition
  - DN03 – Dry oxidized N-deposition
  - WNH3 – Wet reduced N-deposition
  - DNH3 – Dry reduced N-deposition

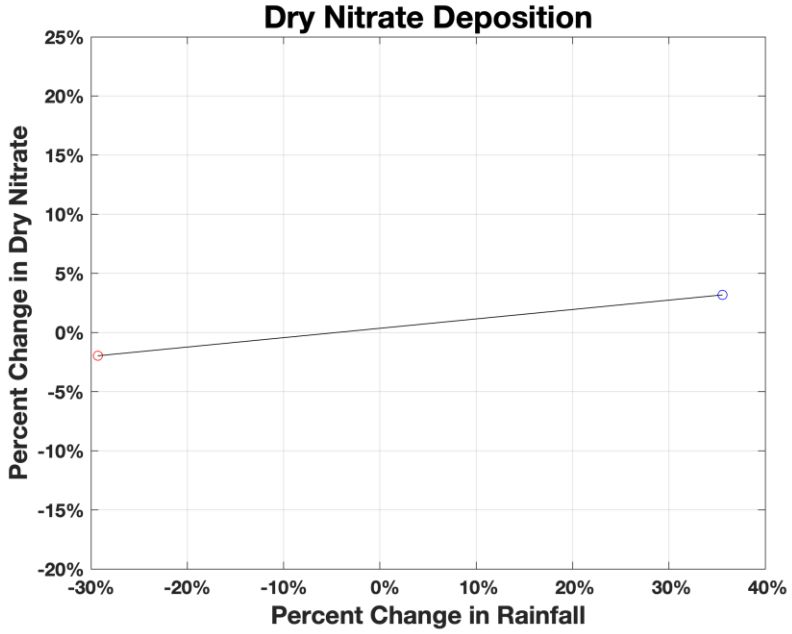


Changes in annual N-depositions vs. changes in rainfall









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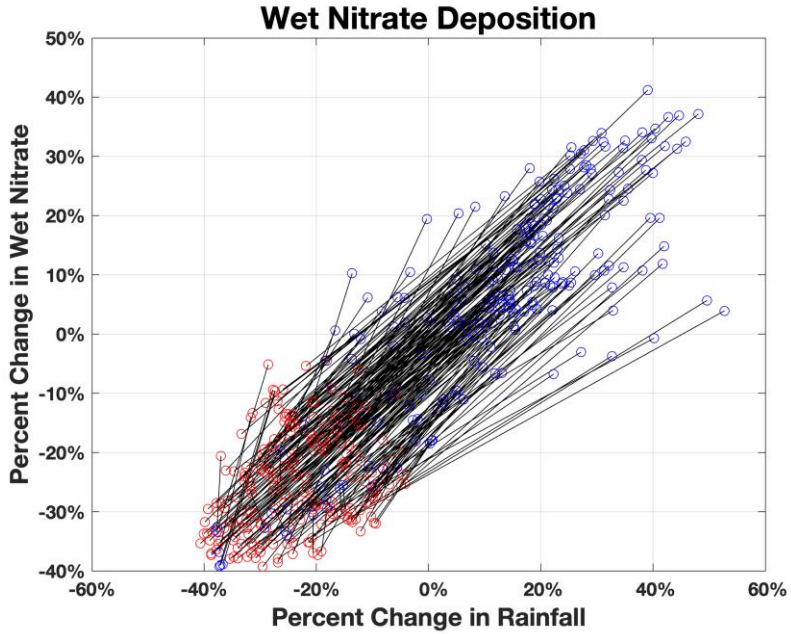
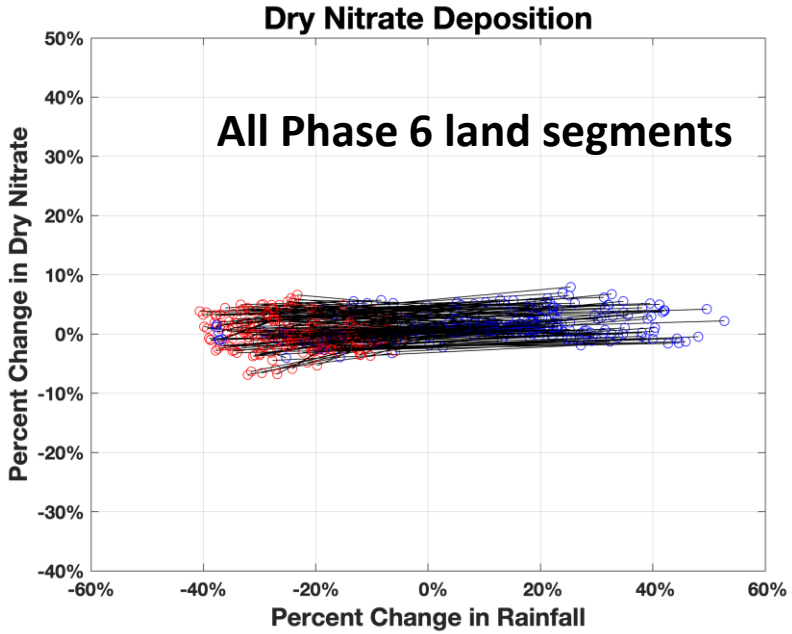
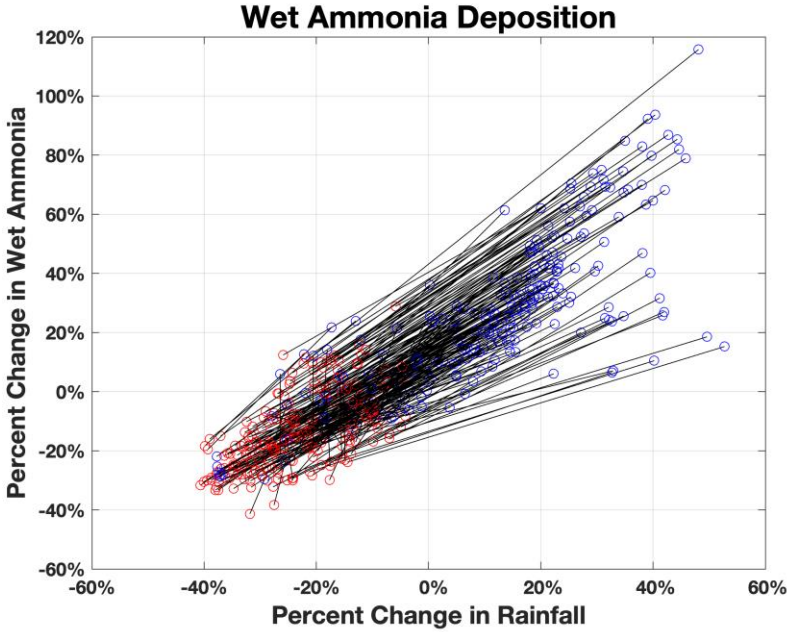
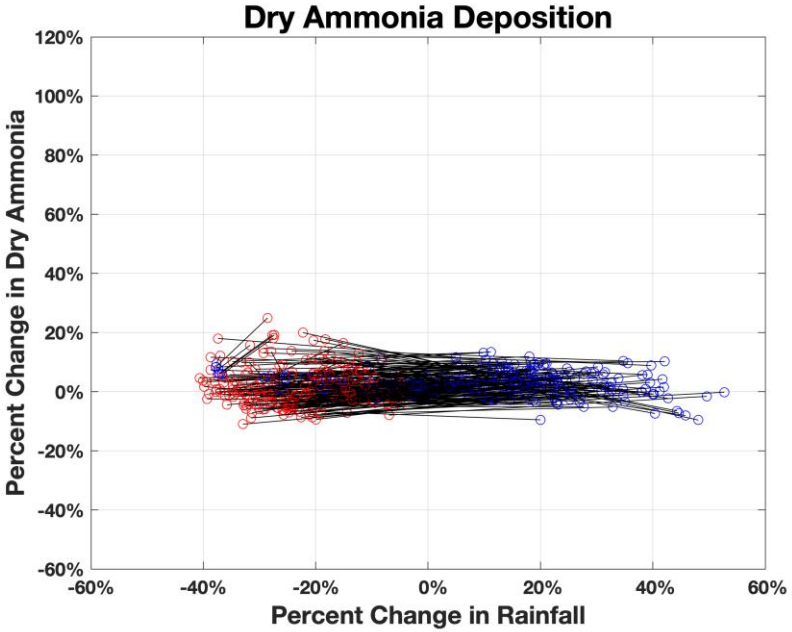
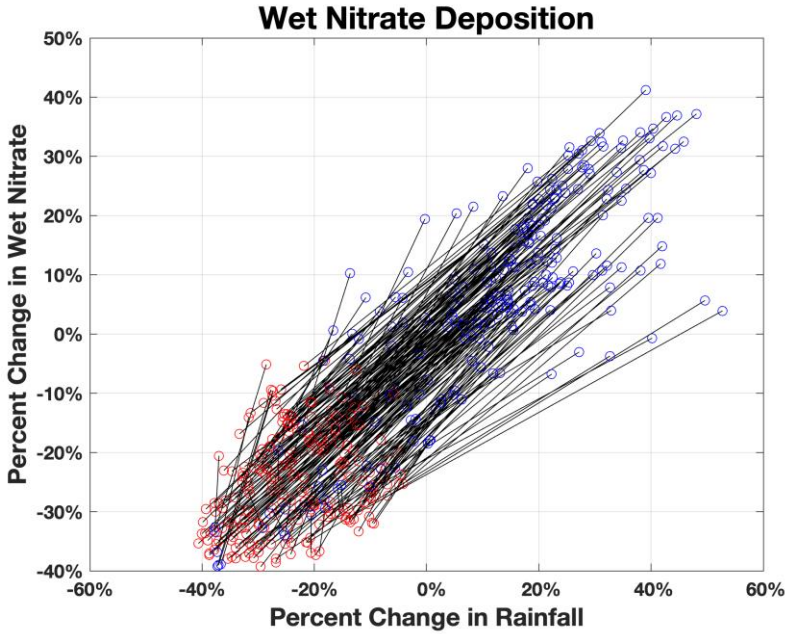


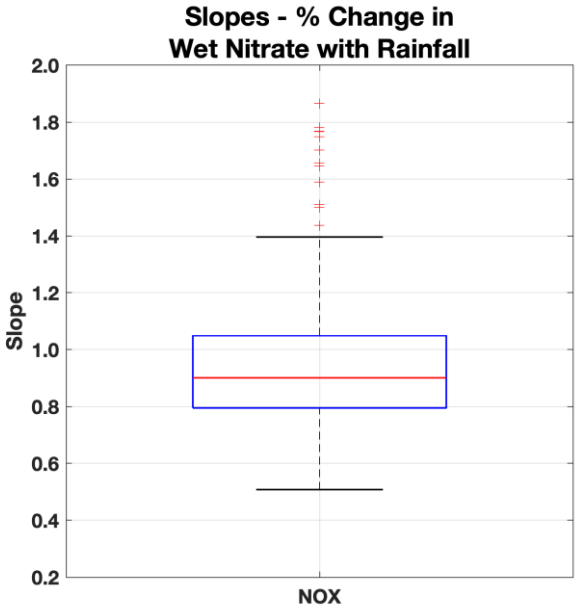




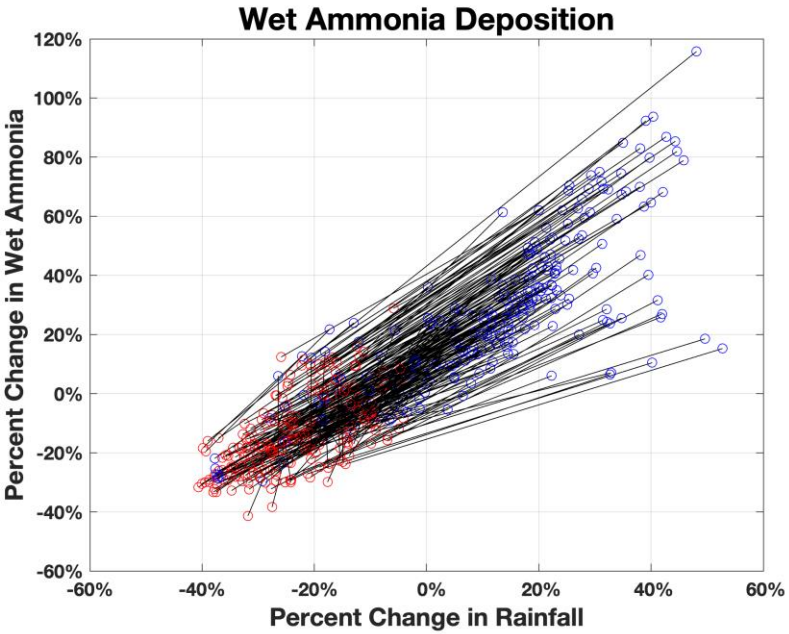


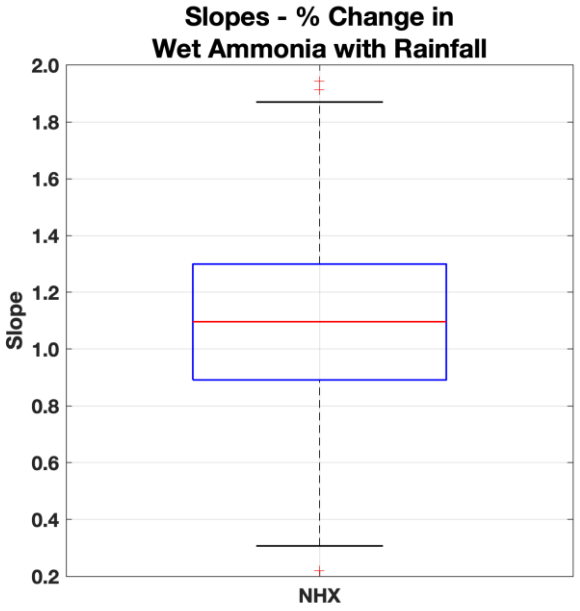
Changes in annual N-depositions vs. changes in rainfall





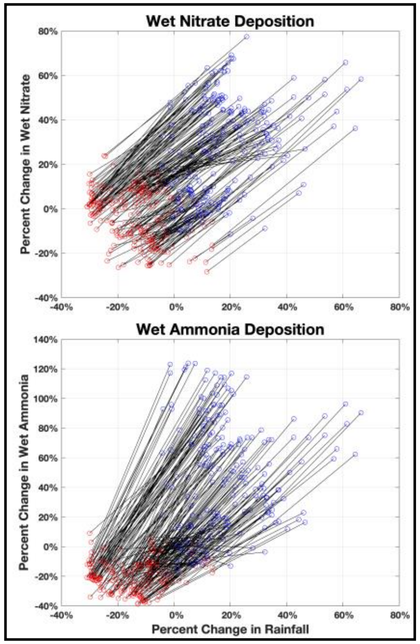
Median
0.901





Median
1.096

Phase 6 Atmospheric N-Depositions* (Dry-Average-Wet)



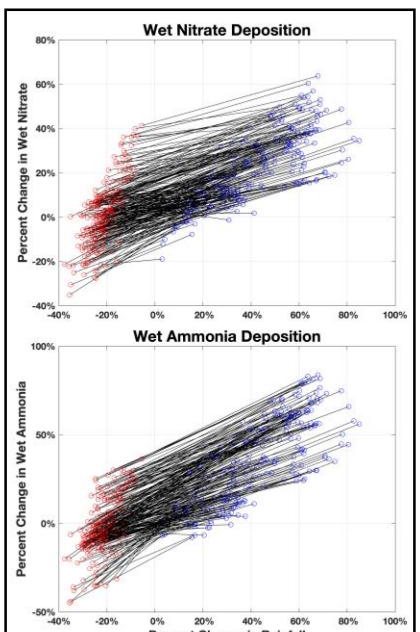
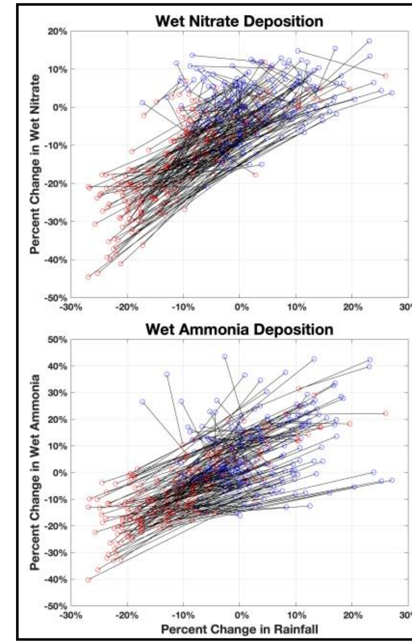
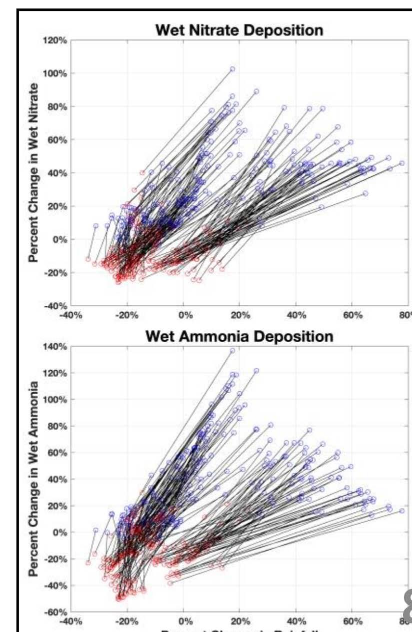


Table: Median slopes (% change in wet N-depositions with % change in rainfall)

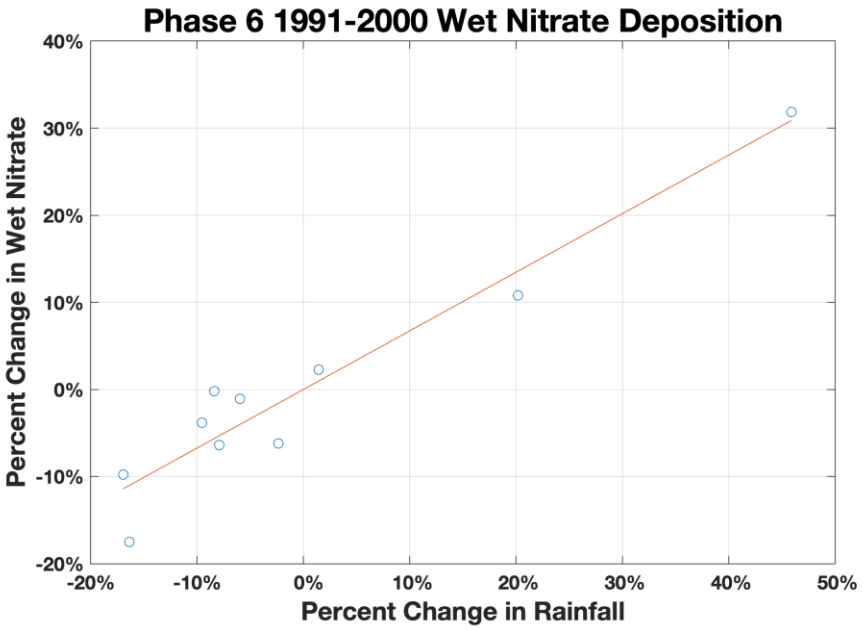
Dry-Avg-Wet	Nitrate	Ammonia
1988-1987-1989	0.977	2.005
1995-1993-1994	0.781	0.763
2001-2002-2003	0.442	0.569
2010-2009-2011	1.773	2.580
Average	0.993	1.479

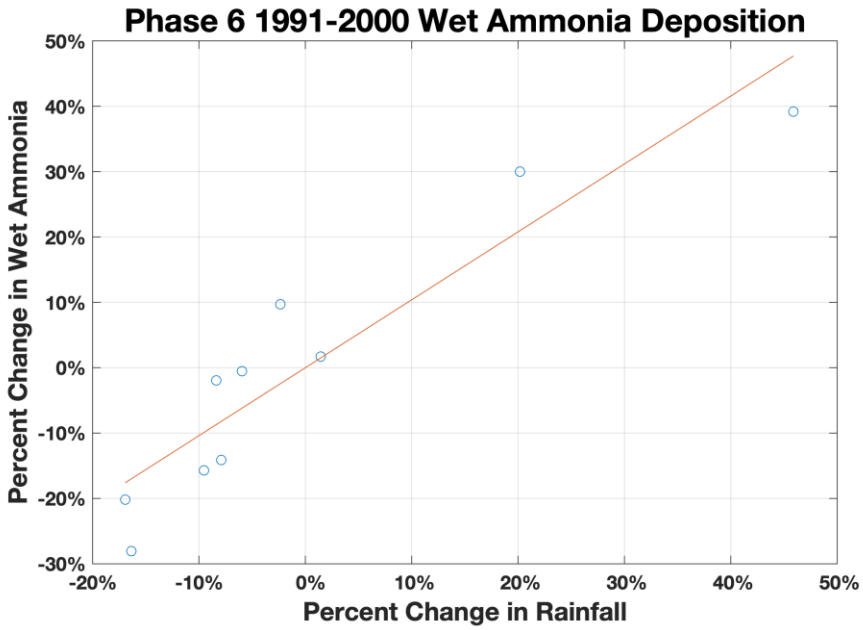




**Detrended data were used because they do not include emissions trends; but raw wet deposition data resulted in similar median slopes.*

Phase 6 Atmospheric N-Depositions (1991-2000)

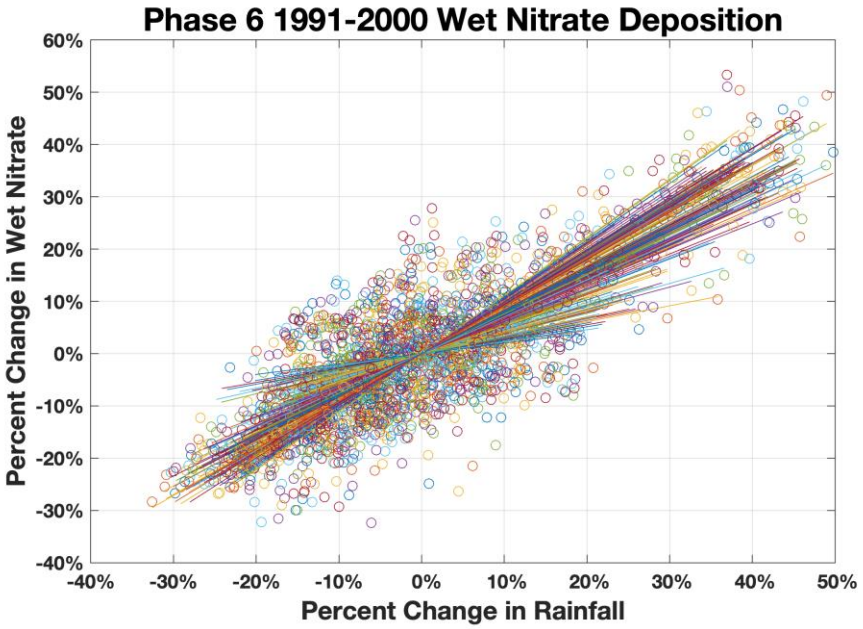




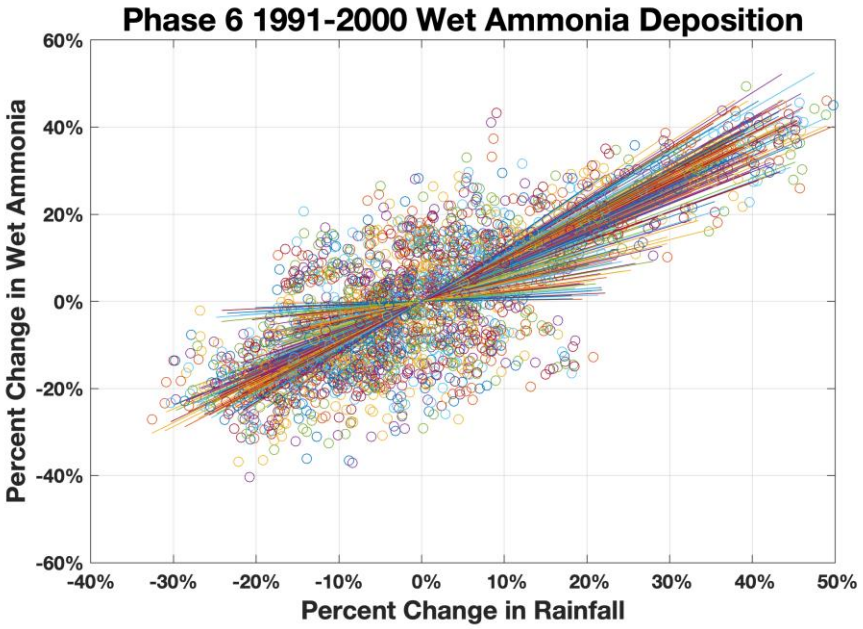
For one land segments
10 points for years 1991-2000

Phase 6 Atmospheric Deposition (1991-2000)

All Phase 6 land segments



Median 0.770



Median 0.837

Summary and Next Steps

- The analysis showed (a) a linear relationship between changes in rainfall and wet atmospheric N-depositions, and (b) no changes in dry atmospheric N-depositions.
- Multiple lines of evidence and analysis methods are being used for estimating slope parameter between rainfall and wet atmospheric N-depositions.

Table: Median slopes (% change in deposition with % change in rainfall)

Data Source	Dry-Avg-Wet	Nitrate	Ammonia
CMAQ 2050	2050-2048-2049	0.901	1.096
3-Yr Phase 6 Data	1988-1987-1989	0.977	2.005
	1995-1993-1994	0.781	0.763
	2001-2002-2003	0.442	0.569
	2010-2009-2011	1.773	2.580
	Average	0.993	1.479
10-Year P6 Data	**1991-2000**	**0.770**	**0.837**