

Phase 7 WSM Development – Extension of the Watershed Model Simulation Period

Modeling Workgroup Quarterly Meeting – January 2022

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Purpose

With this effort the simulation period is being extended from 30 years (1985-2014) to 36 years (1985-2020). It has been done *without* any recalibration of the model but with an anticipation that the simulation period can be extended periodically.

1. Collaboration – CHAMP; STAC Climate Change 2.0 Workshop request for adding year 2018^[1]; others
2. Support Non-Tidal TMDL Load Indicator (currently under development) that has a lag-time component
3. Develop a workflow for supporting periodic (annual) extension of the model simulation period
4. Phase 7 Watershed Model development, calibration, and applications.

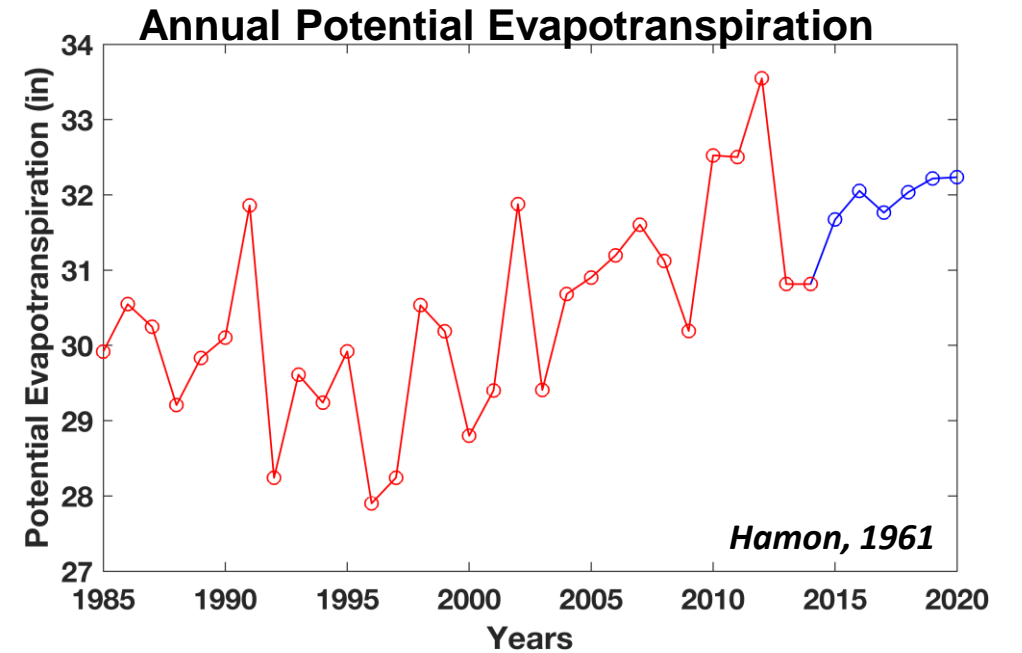
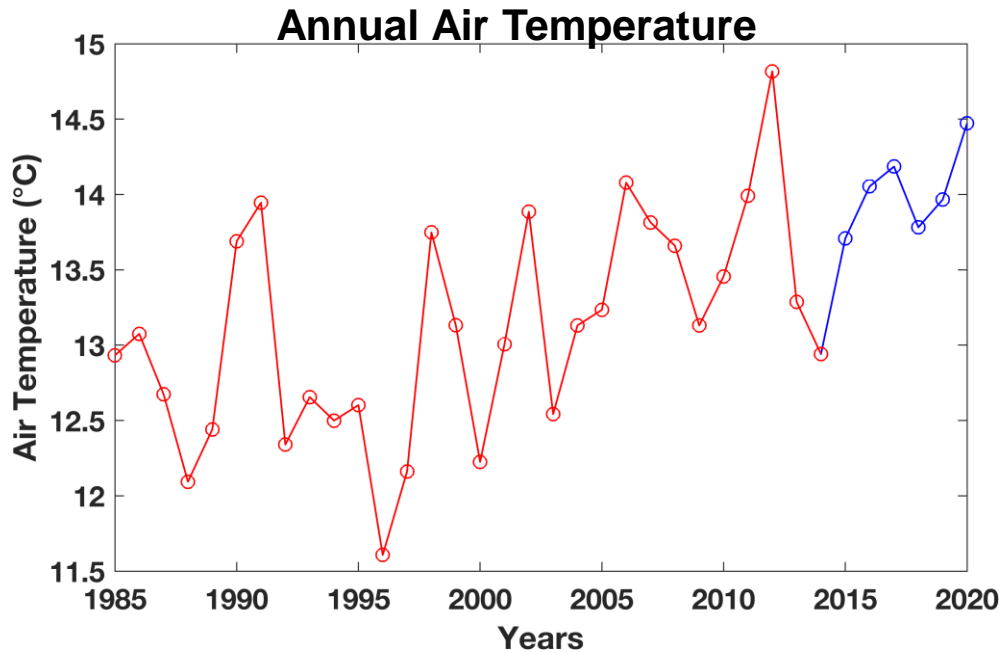
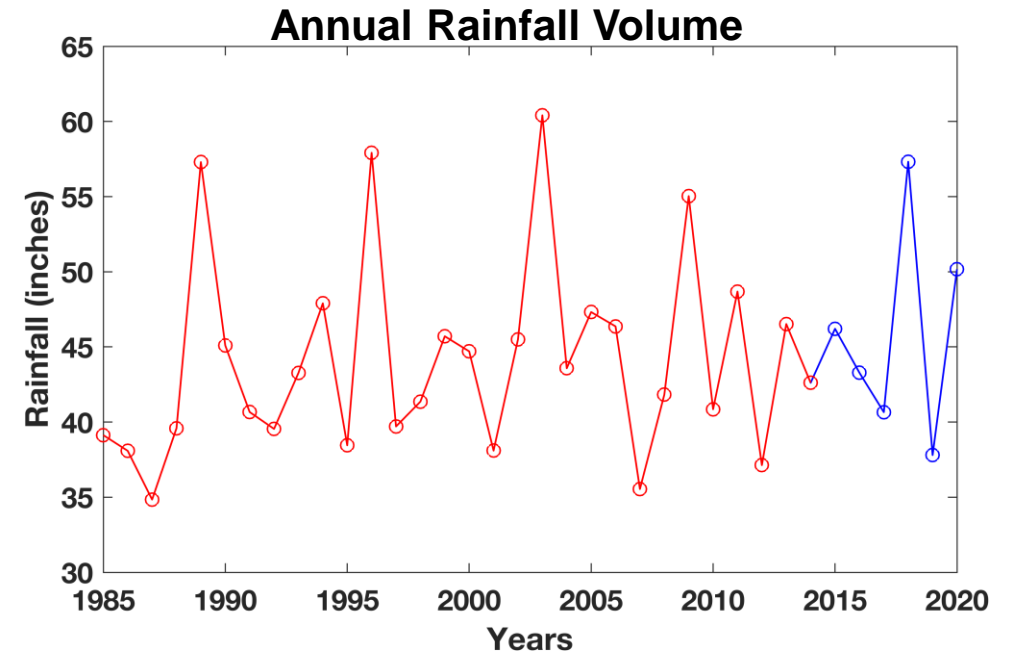
Presentation Outline

1. Rainfall and Meteorological inputs
2. Estimation of Atmospheric N-deposition
3. Other inputs for the model prototype
4. Model results – prototype verification

1. Rainfall and Meteorological Inputs

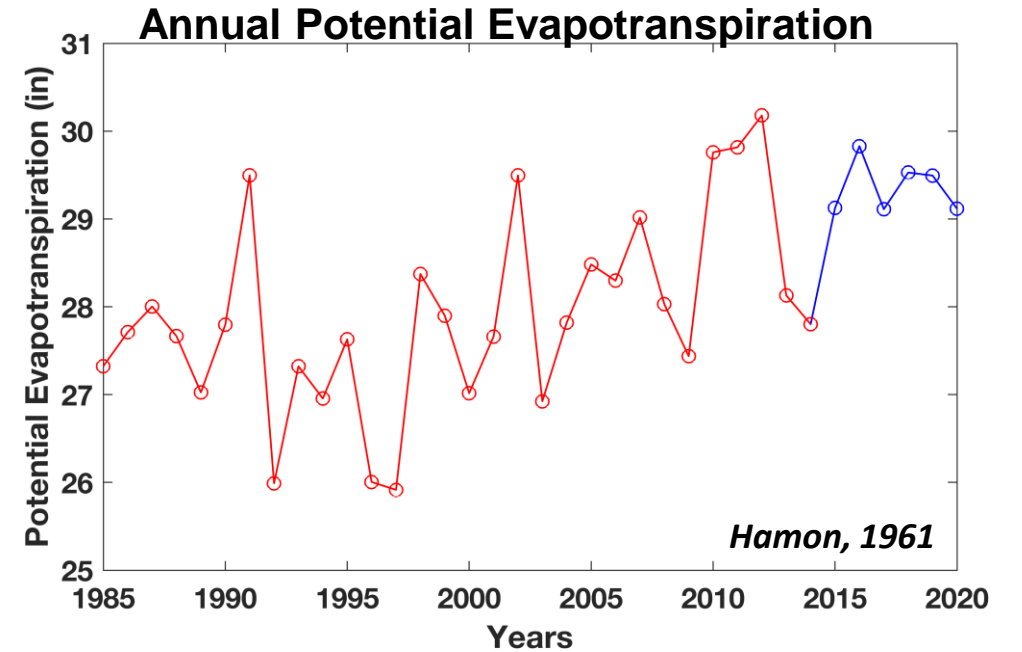
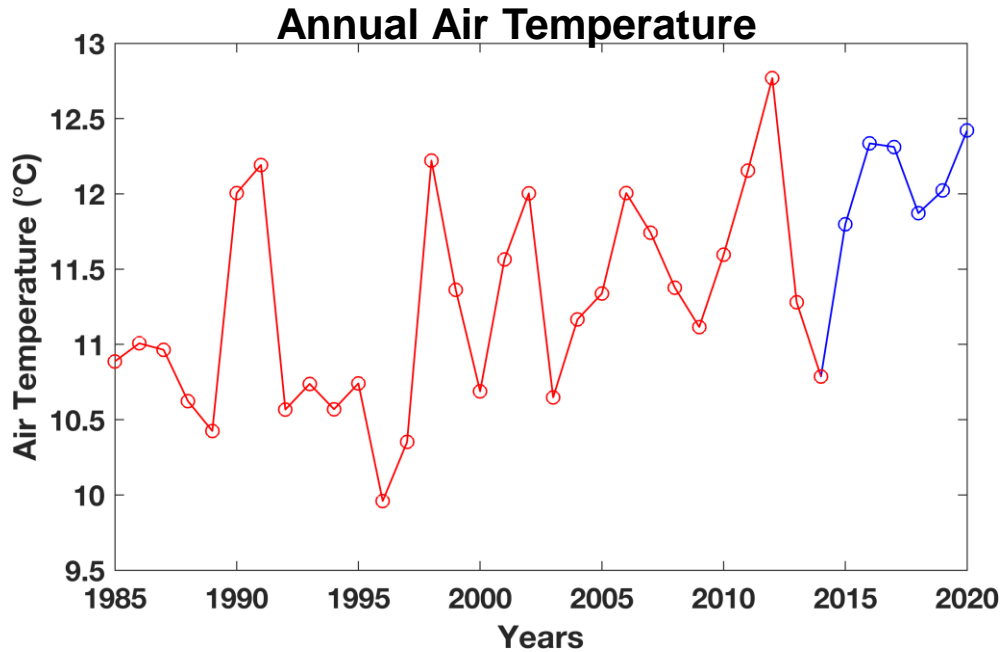
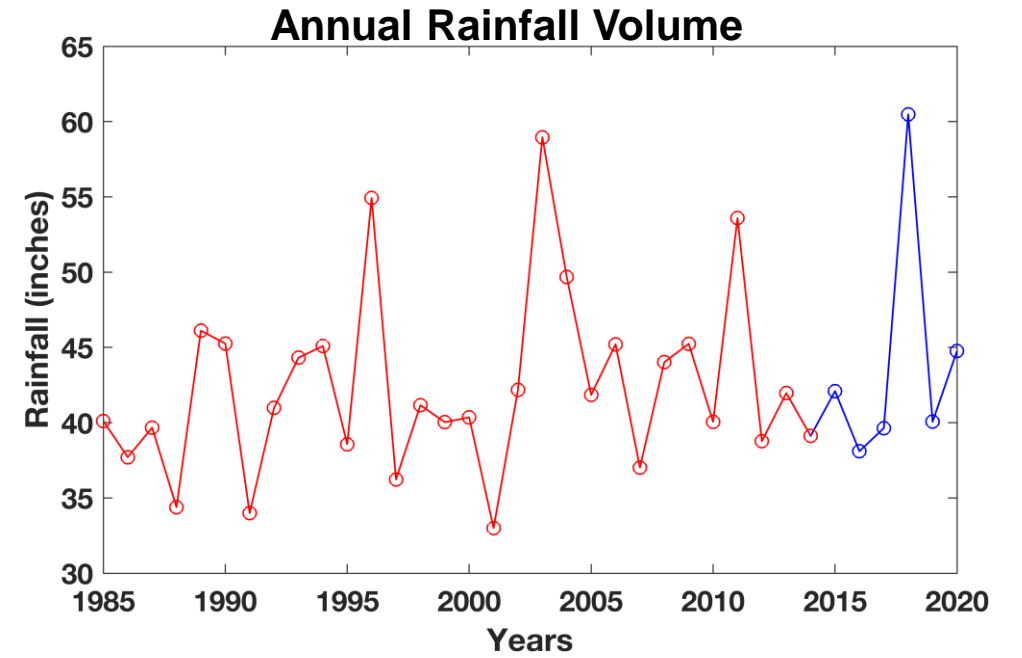
One Land Segment (county scale)

Model input variables include (a) rainfall, (b) air temperature, (c) potential evapotranspiration, (d) dewpoint temperature, (e) wind speed, (f) solar radiation, and (g) cloud cover



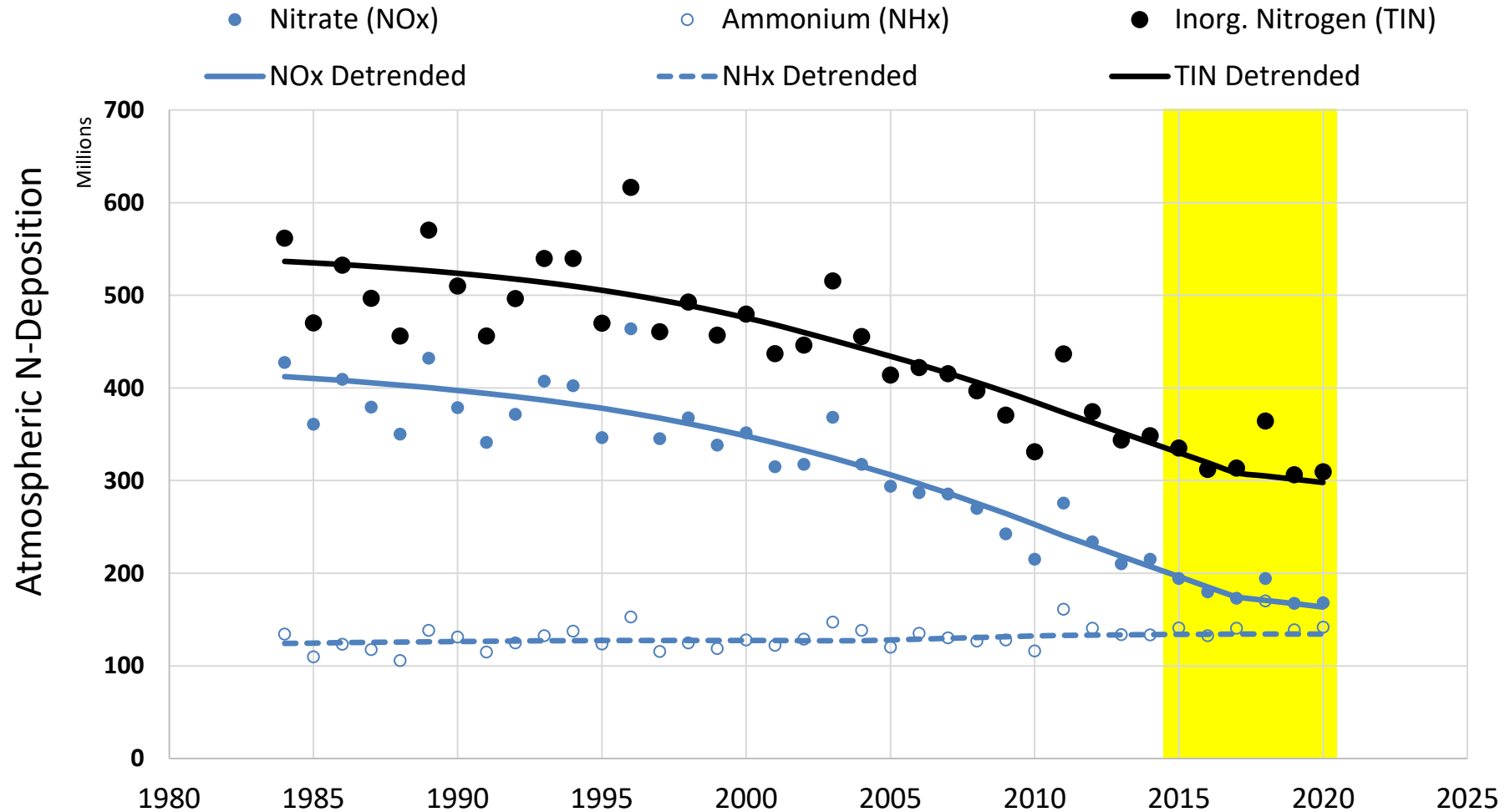
Watershed Average

Model input variables include (a) rainfall, (b) air temperature, (c) potential evapotranspiration, (d) dewpoint temperature, (e) wind speed, (f) solar radiation, and (g) cloud cover



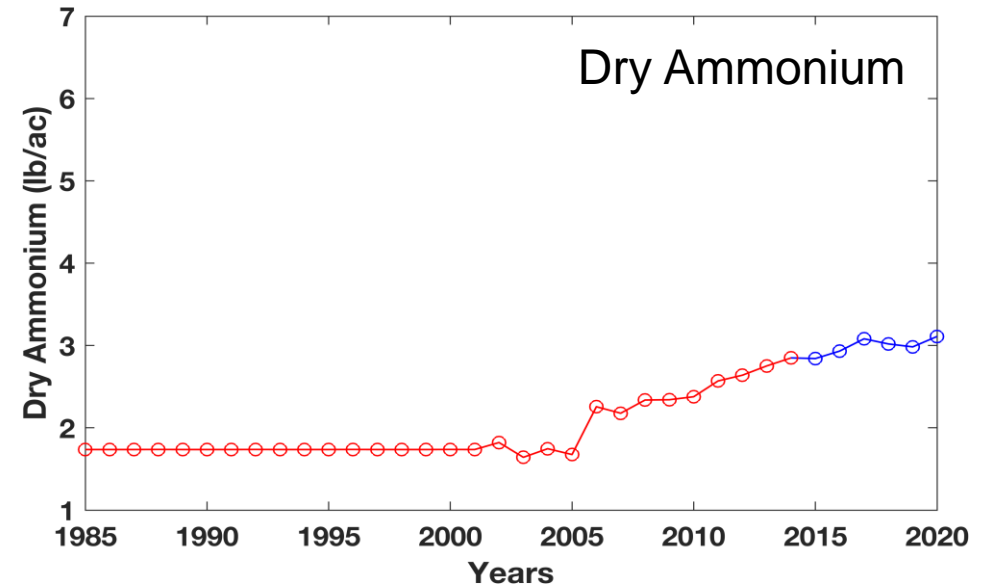
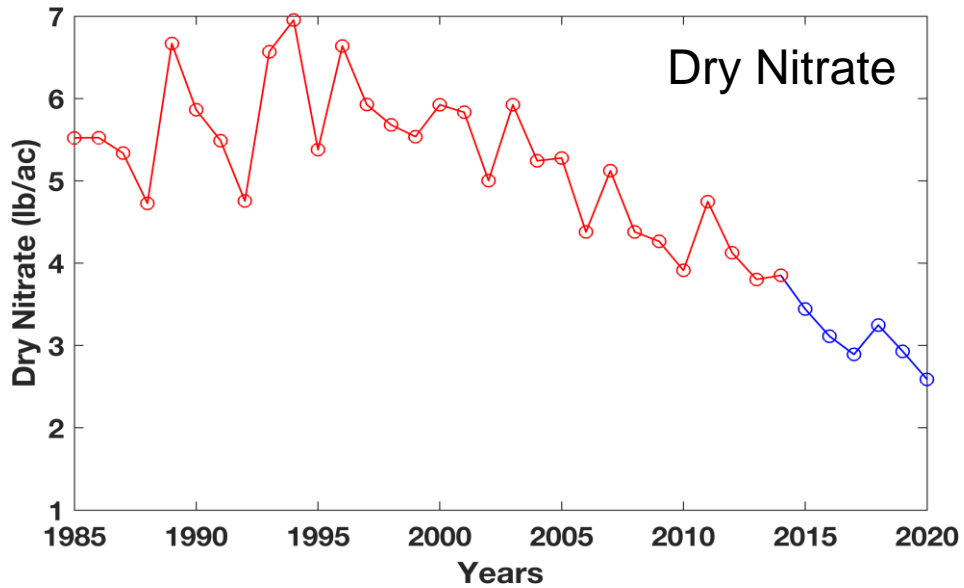
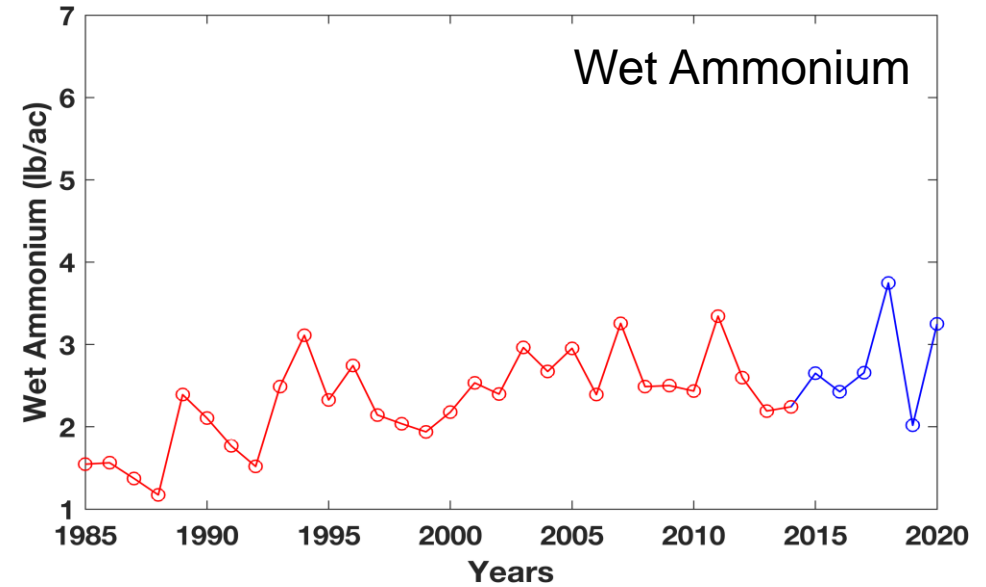
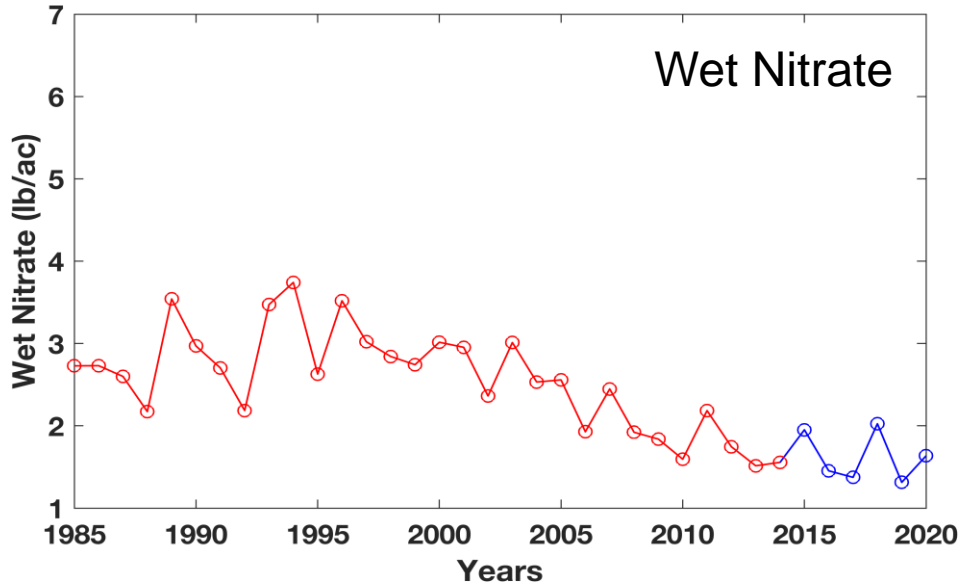
2. Estimation of Atmospheric N-deposition

Watershed Average (Annual Data → Trend → Estimate)



Dots for the years 2015-2020 were estimated by adding rainfall variability to the trend data.

One Land Segment (Annual Data → Trend → Estimate)



3. Other inputs for the model prototype

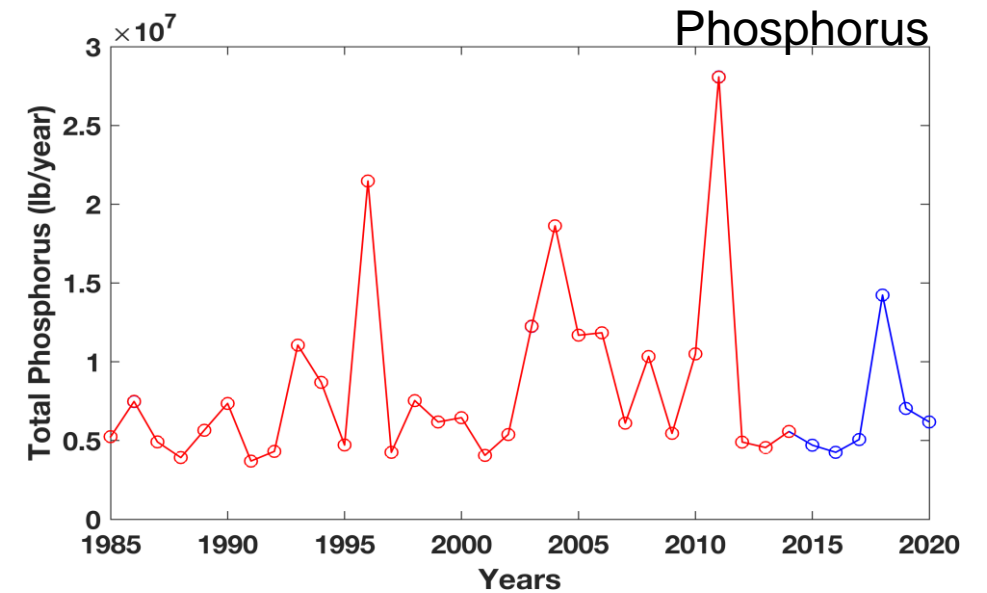
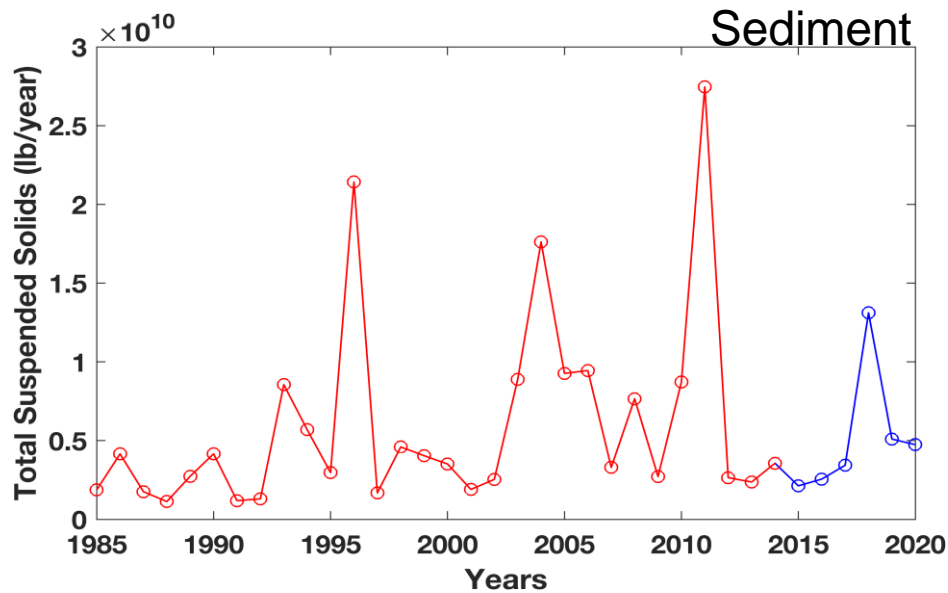
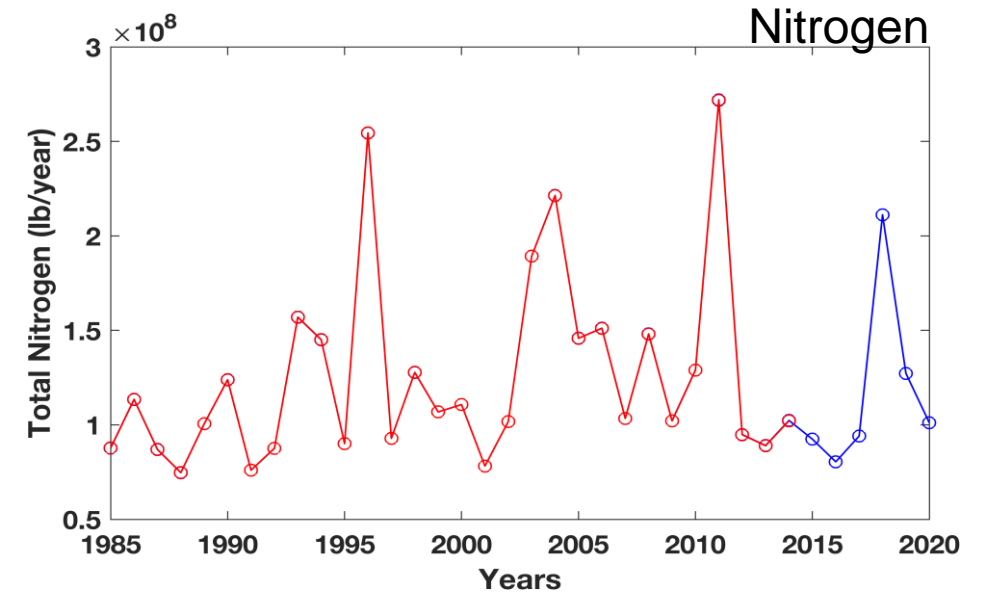
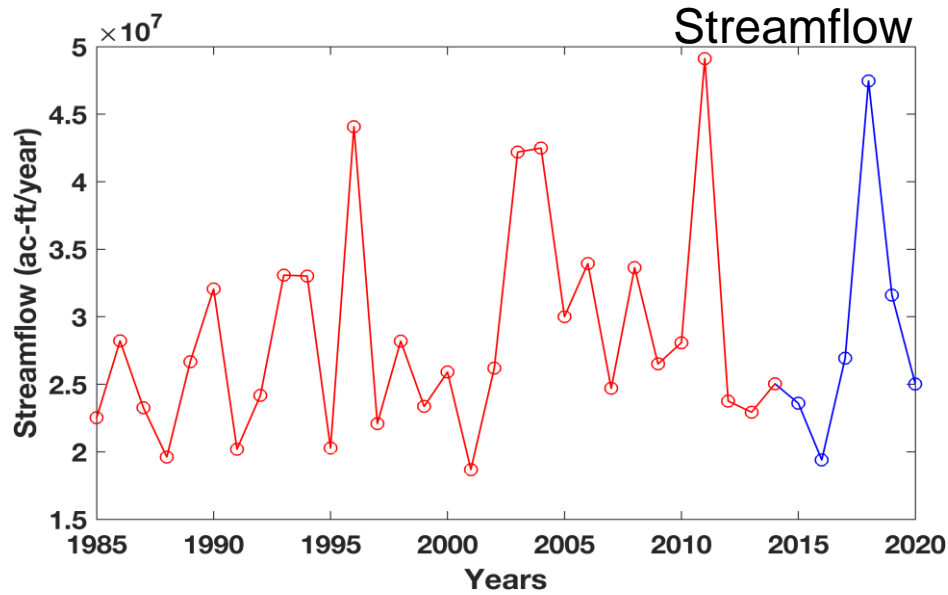
Prototype 1985-2020 Calibration Scenario (*using draft model inputs*)

- Using available data for developing model simulation
 - Municipal (1985-2014, 2015-2019 Annual Progress, 2020 = 2019)
 - Industrial (1985-2014, 2015-2019 Annual Progress, 2020 = 2019)
 - Combined Sewer Overflow (1985-2014)
 - Rapid Infiltration Basin (1985-2014, 2015-2020 = 2013)
 - Riparian Pasture Deposition (1985-2014, 2015-2020 = 2013)
 - Feeding Operations FSP/FNP (1985-2014, 2015-2020 = 2013)
 - Septic (1985-2014, 2015-2020 = 2013)
 - Fertilizer, Manure, Legume, Cover, Uptake etc. (1985-2014, 2015-2020 = 2013)
 - Surface water withdrawals (1985-2014, 2015-2020 = 2014)
 - Stream Bed and Bank Load -> 1985-2013; i.e., 2014 onwards in predictive mode
 - Land Calibration Target -> 1985-2013; i.e., 2014 onwards in predictive mode

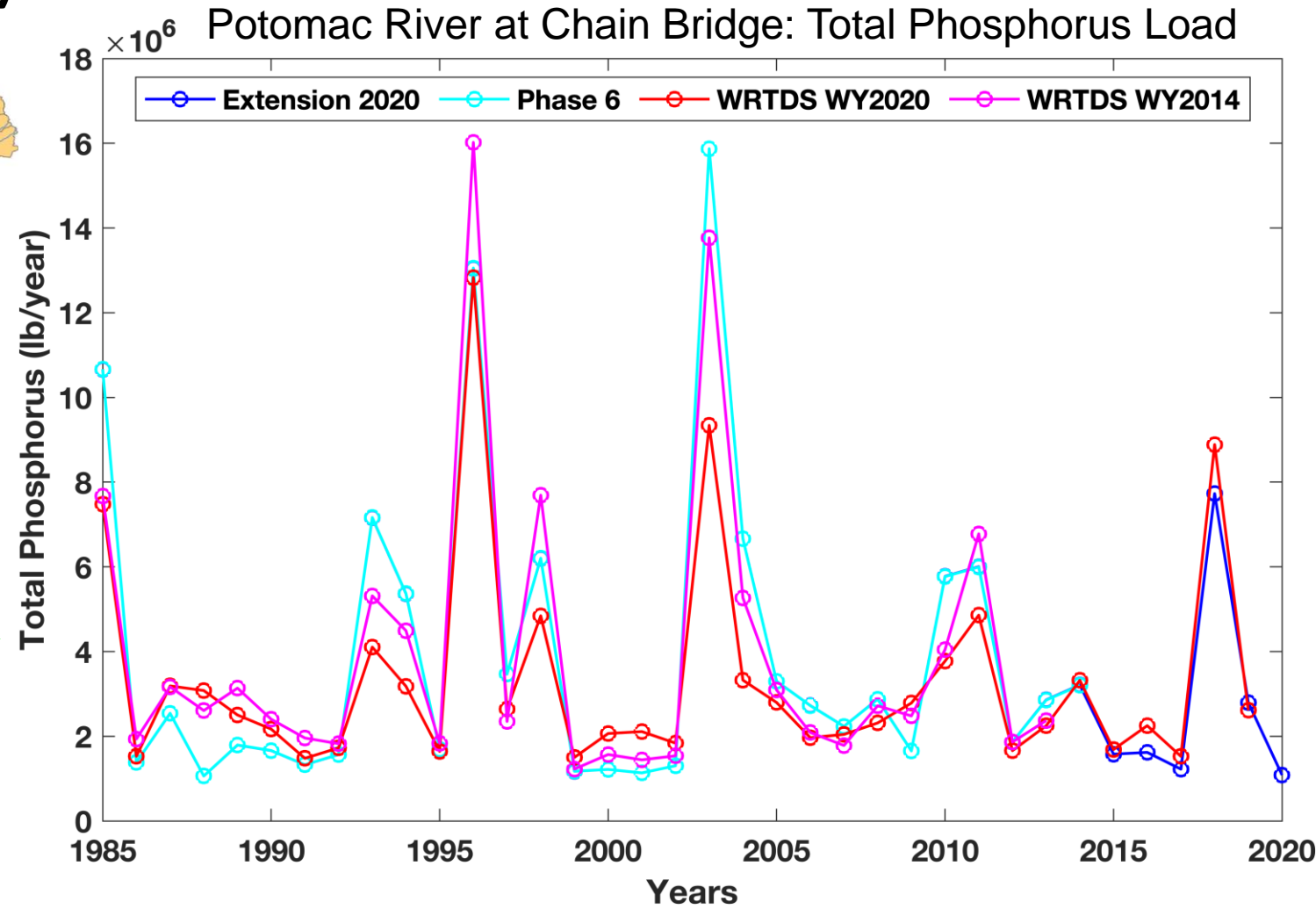
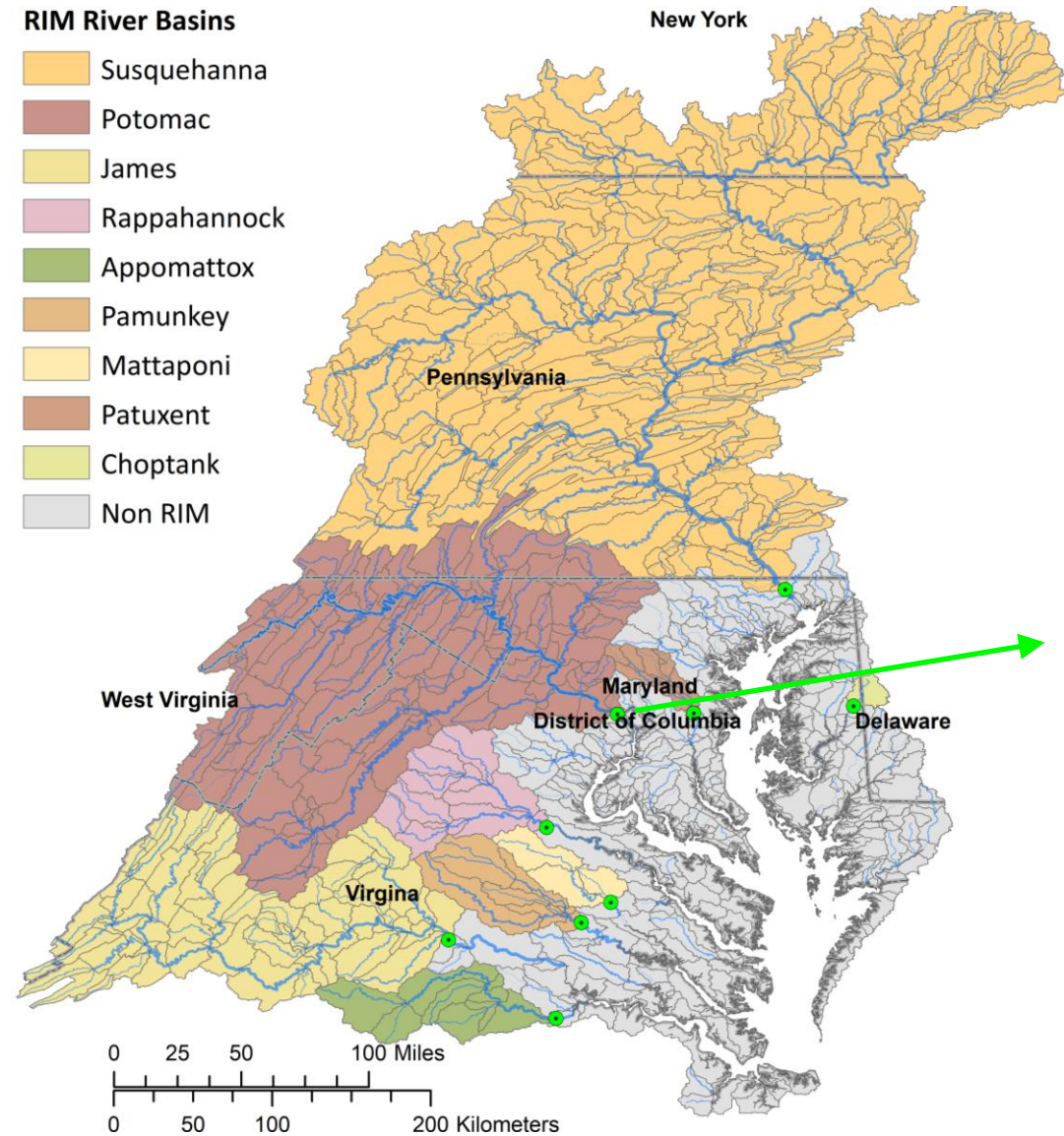
4. Model results – prototype verification

Data for a Susquehanna at Marietta, PA is shown

Simulated outputs – one river segment



River Input Monitoring (RIM)



Phase 6 vs. WRTDS (1985-2013) cyan vs. magenta	1%
Extension vs. WRTDS (1985-2019) blue vs. red	14%
WRTDS (1985-2013) red vs. magenta	-15%

RIM – Total Freshwater

Sum of Nine River Input Monitoring (RIM) Stations

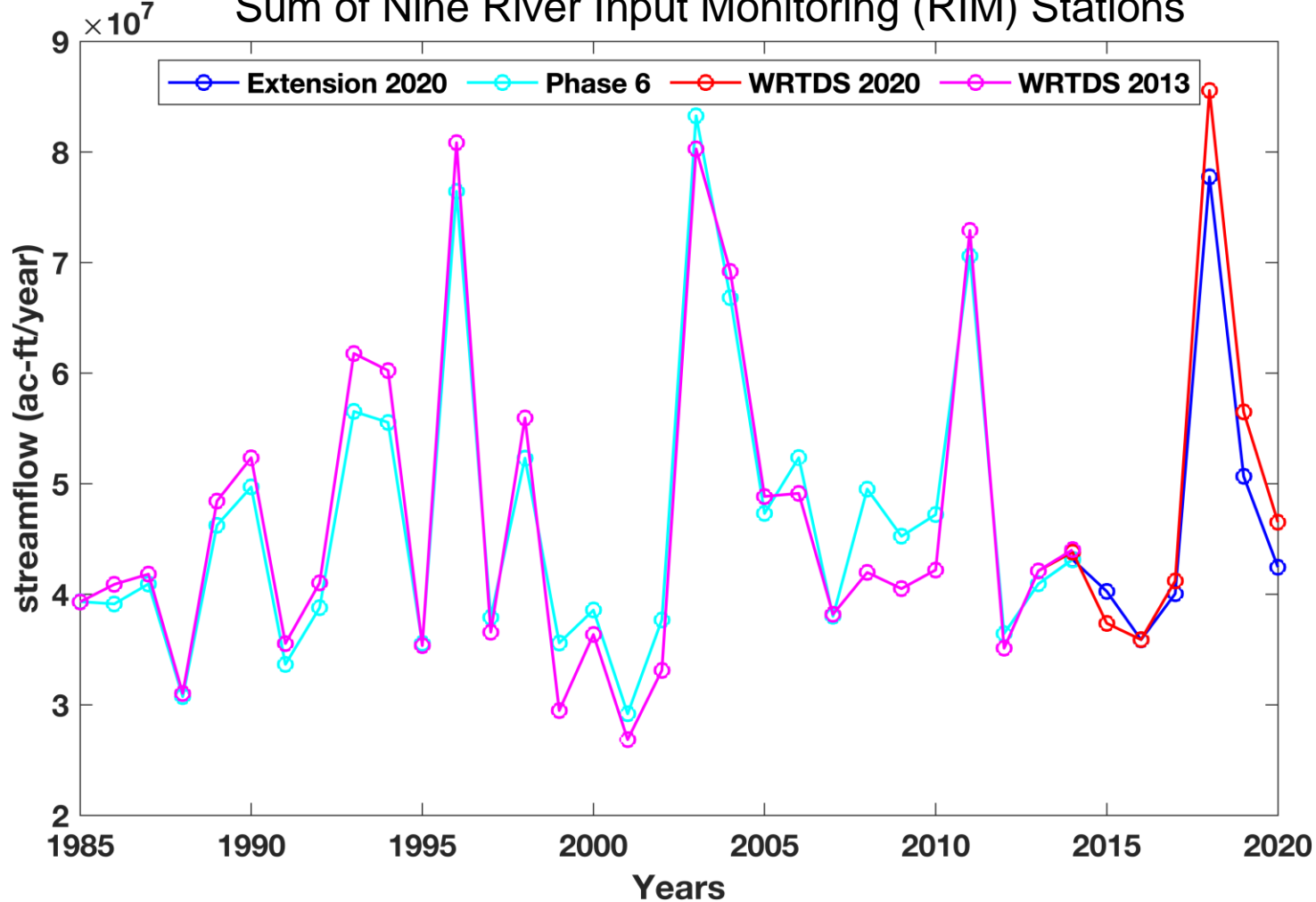


Table: Percent difference in loads

	Phase 6 vs. WRTDS (1985-2013)	Extension vs. WRTDS (1985-2019)	WRTDS (1985-2013)
RIVER INPUT	0%	-1%	0%
SUSQUEHANNA	1%	1%	0%
POTOMAC	-3%	-4%	0%
JAMES	1%	-2%	0%
RAPPAHANNOCK	2%	-2%	0%
APPOMATTOX	-4%	-3%	0%
PAMUNKEY	-4%	-2%	0%
MATTAPONI	-2%	-3%	0%
PATUXENT	-1%	-3%	0%
CHOPTANK	-2%	-5%	0%

RIM – Total Nitrogen Loads

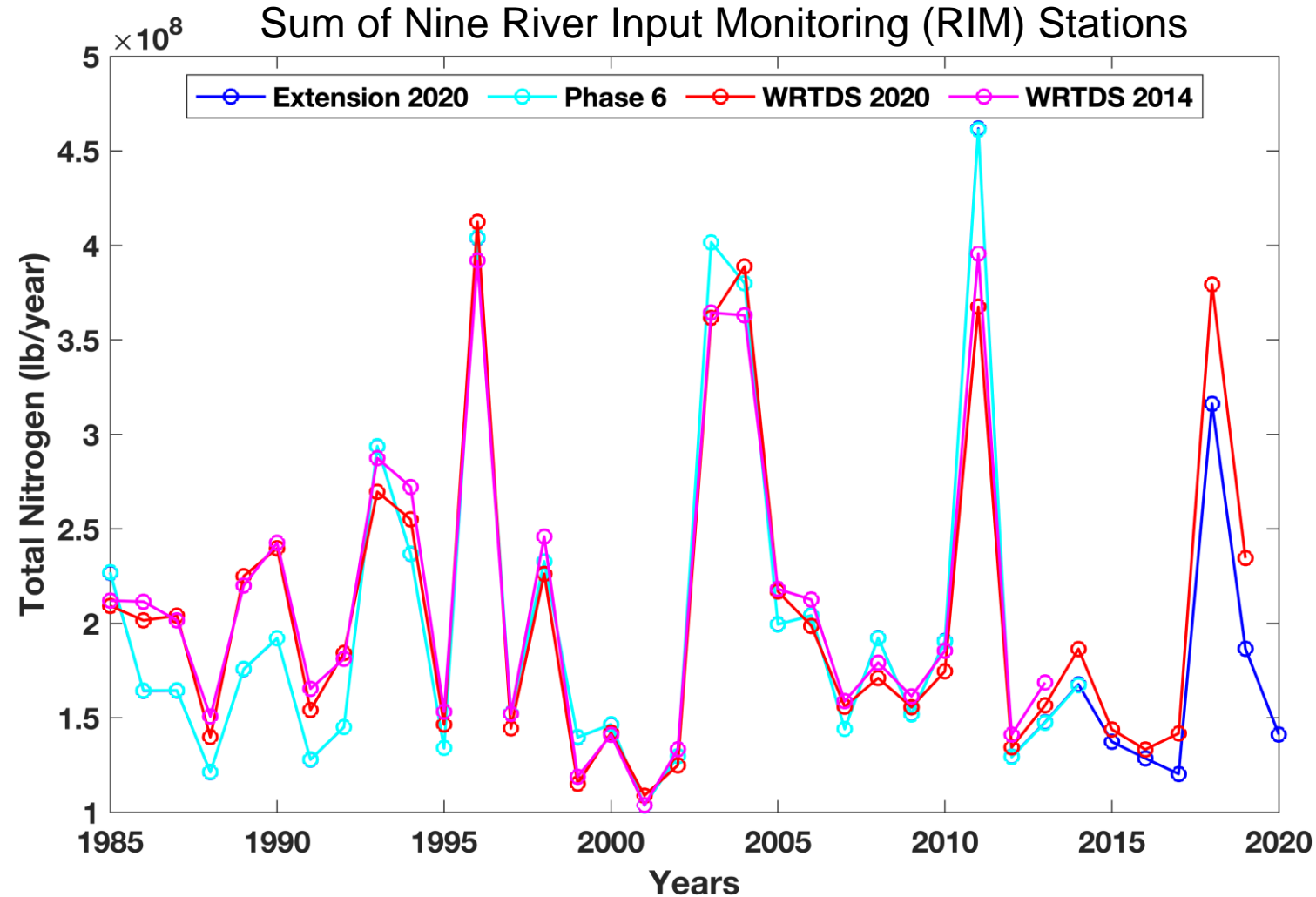


Table: Percent difference in loads

	Phase 6 vs. WRTDS (1985-2013)	Extension vs. WRTDS (1985-2019)	WRTDS (1985-2013)
RIVER INPUT	-4%	-4%	-2%
SUSQUEHANNA	-5%	-4%	-3%
POTOMAC	-3%	-4%	-1%
JAMES	0%	2%	-6%
RAPPAHANNOCK	1%	-2%	-4%
APPOMATTOX	3%	4%	0%
PAMUNKEY	3%	4%	-2%
MATTAPONI	7%	4%	0%
PATUXENT	4%	4%	-1%
CHOPTANK	-5%	-12%	1%

RIM – Total Phosphorus Loads

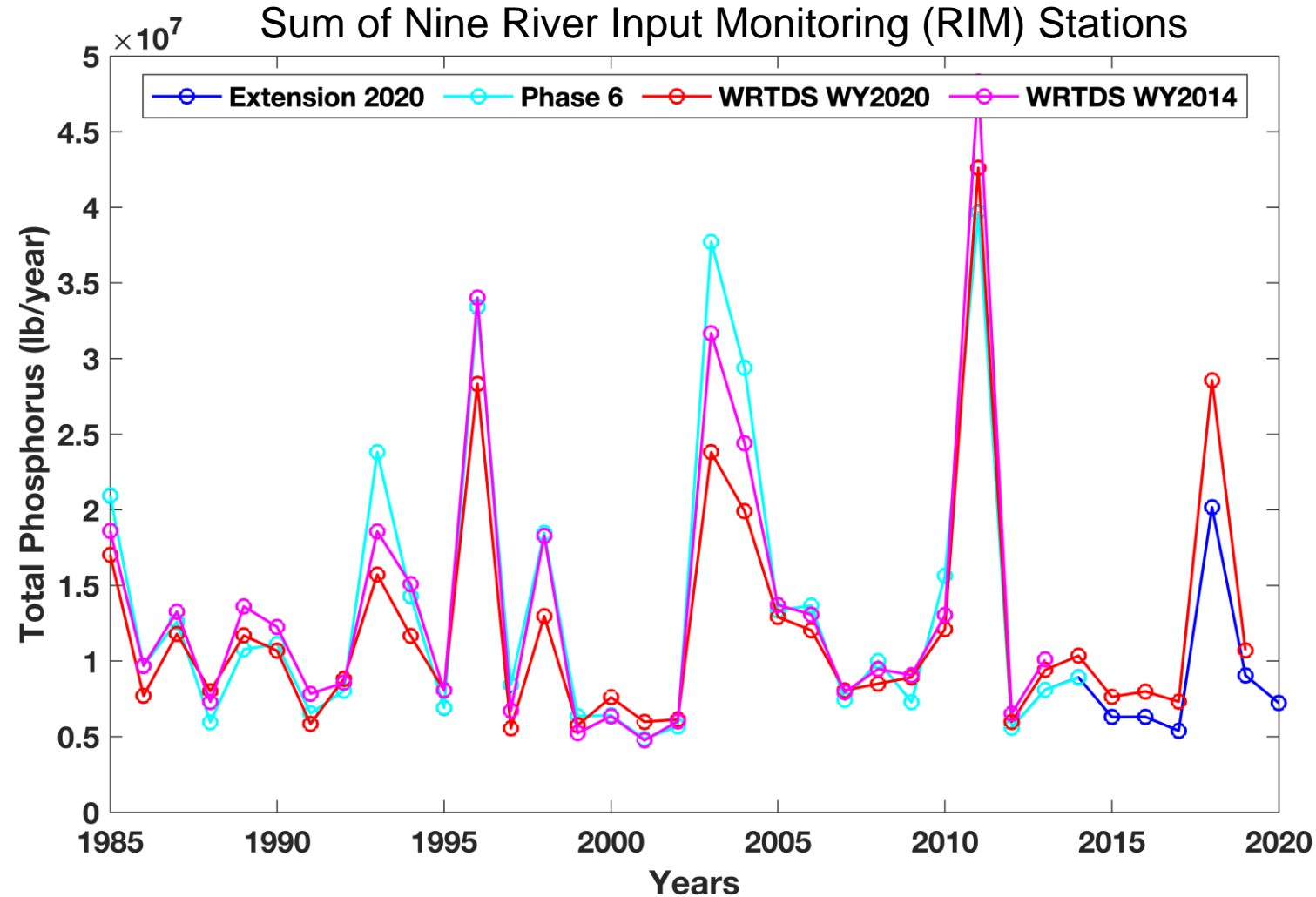


Table: Percent difference in loads

	Phase 6 vs. WRTDS (1985-2013)	Extension vs. WRTDS (1985-2019)	WRTDS (1985-2013)
RIVER INPUT	0%	8%	-12%
SUSQUEHANNA	2%	8%	-10%
POTOMAC	1%	14%	-15%
JAMES	-5%	1%	-12%
RAPPAHANNOCK	-4%	-5%	-13%
APPOMATTOX	-2%	-2%	0%
PAMUNKEY	0%	3%	-6%
MATTAPONI	2%	4%	-3%
PATUXENT	2%	9%	-7%
CHOPTANK	-2%	-9%	-6%

RIM – Total Suspended Sediment Loads

Sum of Nine River Input Monitoring (RIM) Stations

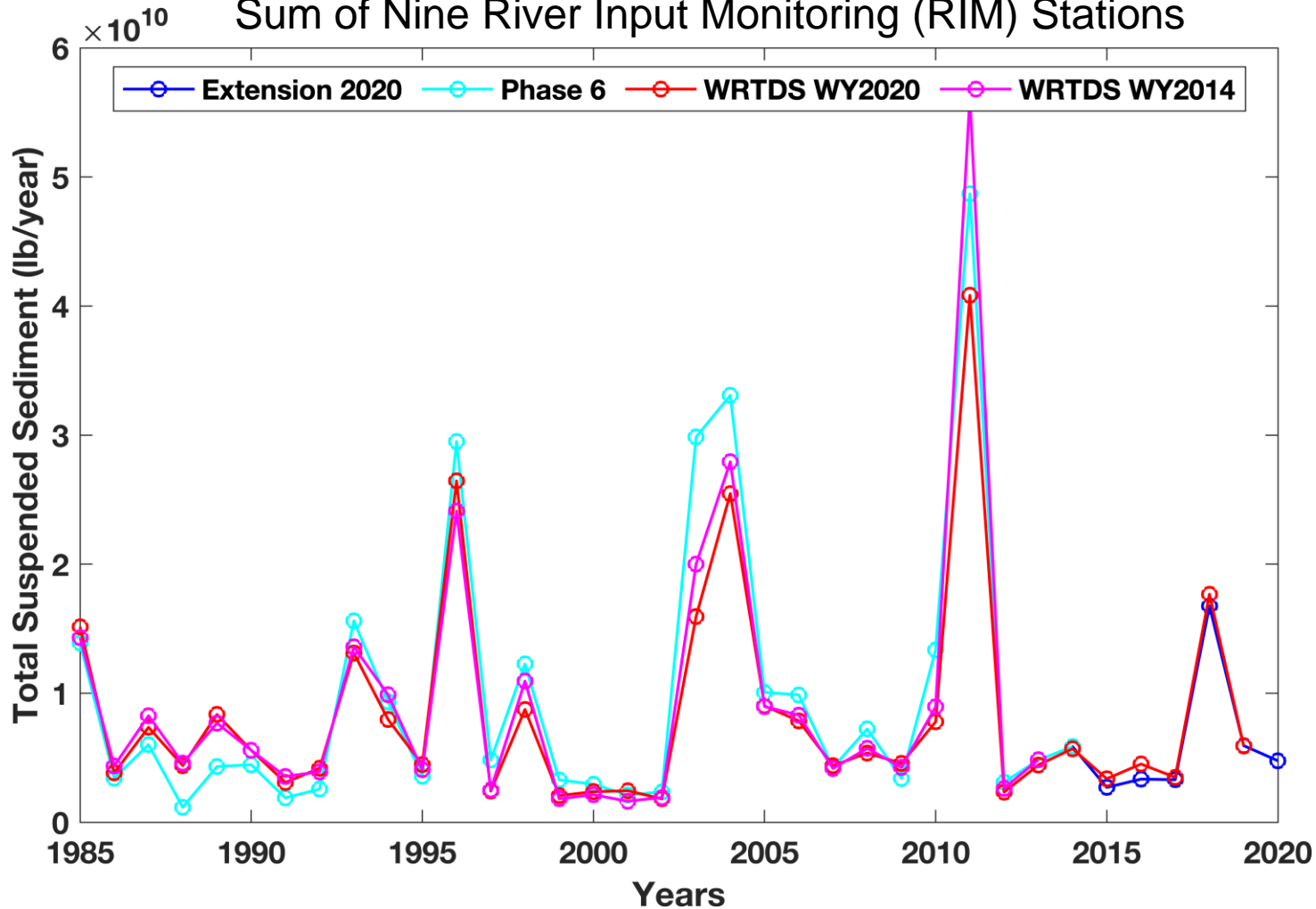


Table: Percent difference in loads

	Phase 6 vs. WRTDS (1985-2013)	Extension vs. WRTDS (1985-2019)	WRTDS (1985-2013)
RIVER INPUT	5%	13%	-9%
SUSQUEHANNA	8%	31%	-16%
POTOMAC	3%	13%	-12%
JAMES	1%	-19%	14%
RAPPAHANNOCK	0%	-22%	10%
APPOMATTOX	14%	1%	11%
PAMUNKEY	2%	-19%	20%
MATTAPONI	-1%	-29%	39%
PATUXENT	10%	19%	-10%
CHOPTANK	16%	21%	-10%

Summary

- Watershed Model simulation period was extended from 30 years (1985-2014) to 36 years (1985-2020).
- Model prototype developed using draft datasets performed well showing good agreement with simulation for the shorter time period.
- For most part, differences as compared to USGS-WRTDS loads were due to changes in the WRTDS data.
- Model will be ready for providing 1985-2020 data needed for various efforts after best available inputs are incorporated in the model simulation.

