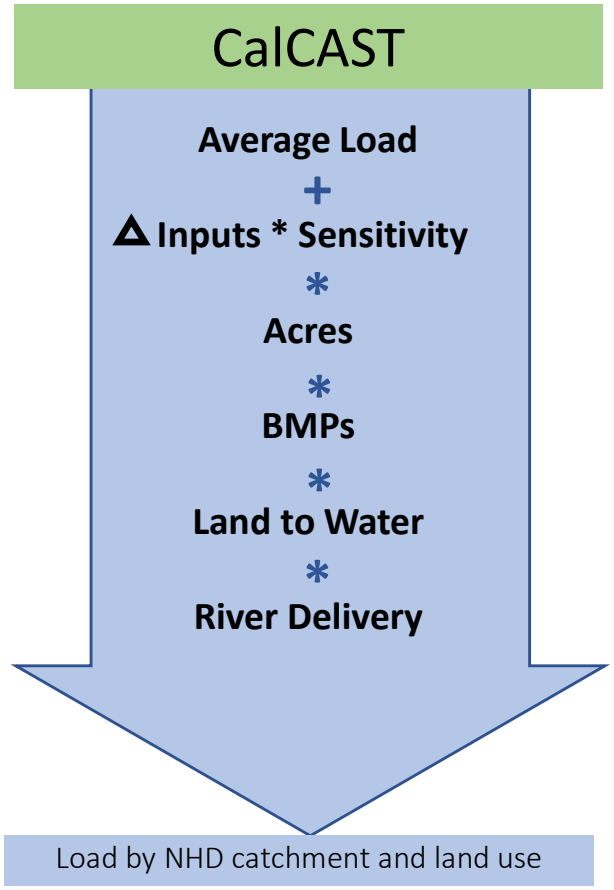
CalCAST Updates

Isabella Bertani, Gopal Bhatt, Joseph Delesantro, Lewis Linker, and the Modeling Team

Modeling Workgroup Quarterly Review

07/09/2024

Land classes represented in CalCAST so far



Land classes represented in CalCAST so far CBP (2013 1-meter Land Use Data classes)

Broad Class	Land Class
Cropland	Cropland
Cropland	Feeding space
Pasture	Pasture
Developed	Impervious non-roads
Developed	Impervious roads
Developed	Tree canopy over impervious
Developed	Tree canopy over turfgrass
Developed	Turfgrass
Natural	Forest
Natural	Water
Natural	Floodplain wetlands
Natural	Other wetlands
Natural	Mixed open

Expanded representation of same load sources as in CAST

Jess Rigelman performed crosswalk and downscaling of load source acres and inputs to NHDPlus scale for 1985-2023

Broad Class	Land Class	Load Source
Cropland	Cropland	Double Cropped Land
Cropland	Cropland	Full Season Soybeans
Cropland	Cropland	Grain with Manure
Cropland	Cropland	Grain without Manure
Cropland	Cropland	Other Agronomic Crops
Cropland	Cropland	Silage with Manure
Cropland	Cropland	Silage without Manure
Cropland	Cropland	Small Grains and Grains
Cropland	Cropland	Specialty Crop High
Cropland	Cropland	Specialty Crop Low
Cropland	Feeding space	Non-Permitted Feeding Space
Cropland	Feeding space	Permitted Feeding Space
Pasture	Pasture	Ag Open Space
Pasture	Pasture	Leguminous Hay
Pasture	Pasture	Other Hay
Pasture	Pasture	Pasture
Developed	Impervious non-roads	CSS Construction
Developed	Impervious non-roads	Regulated Construction
Developed	Impervious non-roads	CSS Buildings and Other
Developed	Impervious non-roads	MS4 Buildings and Other
Developed	Impervious non-roads	Non-Regulated Buildings and Other
Developed	Impervious roads	CSS Roads
Developed	Impervious roads	MS4 Roads
Developed	Impervious roads	Non-Regulated Roads
Developed	Tree canopy over impervious	CSS Tree Canopy over Impervious
Developed	Tree canopy over impervious	MS4 Tree Canopy over Impervious
Developed	Tree canopy over impervious	Non-Regulated Tree Canopy over Impervious
Developed	Tree canopy over turfgrass	CSS Tree Canopy over Turf Grass
Developed	Tree canopy over turfgrass	MS4 Tree Canopy over Turf Grass
Developed	Tree canopy over turfgrass	Non-Regulated Tree Canopy over Turf Grass
Developed	Turfgrass	CSS Turf Grass
Developed	Turfgrass	MS4 Turf Grass
Developed	Turfgrass	Non-Regulated Turf Grass
Natural	Forest	CSS Forest
Natural	Forest	True Forest
Natural	Forest	Harvested Forest
Natural	Water	Water
Natural	Floodplain wetlands	Non-tidal Floodplain Wetland
Natural	Other wetlands	Headwater or Isolated Wetland
Natural	Mixed open	CSS Mixed Open
Natural	Mixed open	Mixed Open

Total Nitrogen Annual Flow-Normalized

Non-point source load generated by «True Forest» load source in catchment c and year t:

Watershed-wide average FOR loading rate (lbs/ac)

Difference between local TN input from atm dep in catchment c and year t and watershed-wide long-term average TN input from atm dep (lbs/ac)

Change in atm dep load exported from FOR per change in unit of atm dep input on FOR

$$NPS_{FOR,c,t} = AVE_{FOR} + \left(TN_{ATM,c,t} - \widehat{TN_{ATM}}\right) * SENS_{FOR,ATM}$$

$$*$$

Acres of FOR in catchment c and year t

$$ACRES_{FOR,c,t}$$

$$*$$

BMP pass-through factor for FOR in catchment c and year t

$$BMP_{FOR,c,t}$$

$$*$$

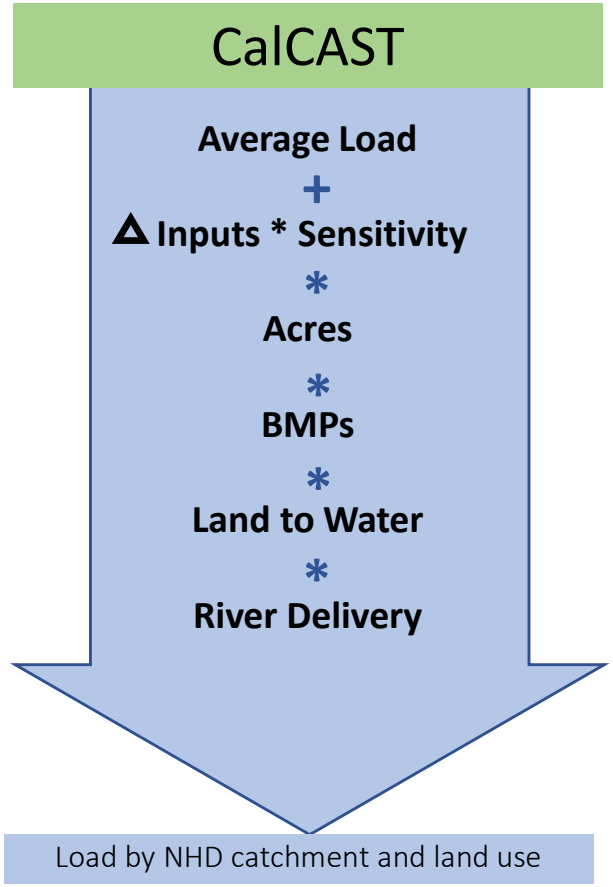
Land-to-water delivery factor for catchment c

$$L2W_c$$

$$*$$

$$DEL_c$$

Stream delivery factor for catchment c



Accounting for lags in nutrient transport

Only a fraction of the non-point source (NPS) load introduced to a catchment in year t is delivered in the same year due to lags in nutrient transport through different flow paths (e.g., surface flow vs. groundwater).

As a result, the NPS load delivered in year t is the sum of fractions of NPS loads introduced in previous years as well.

Example of calculation of the NPS load delivered in a catchment in year 2014, assuming that the load delivered in a certain year is influenced by loads introduced in the previous 3 years:

$$NPS\_DEL_{c,2014} = NPS_{c,2012} * lag_{c,2} + NPS_{c,2013} * lag_{c,1} + NPS_{c,2014} * lag_{c,0}$$

- $NPS\_DEL_{c,2014}$: Load delivered in catchment c in year 2014
- $NPS_{c,2012}$: Load introduced in catchment c in year 2012
- $lag_{c,2}$: Fraction of load introduced in year t that is delivered 2 years later. P6 lag parameters used for now (vary by P6 land-segment)

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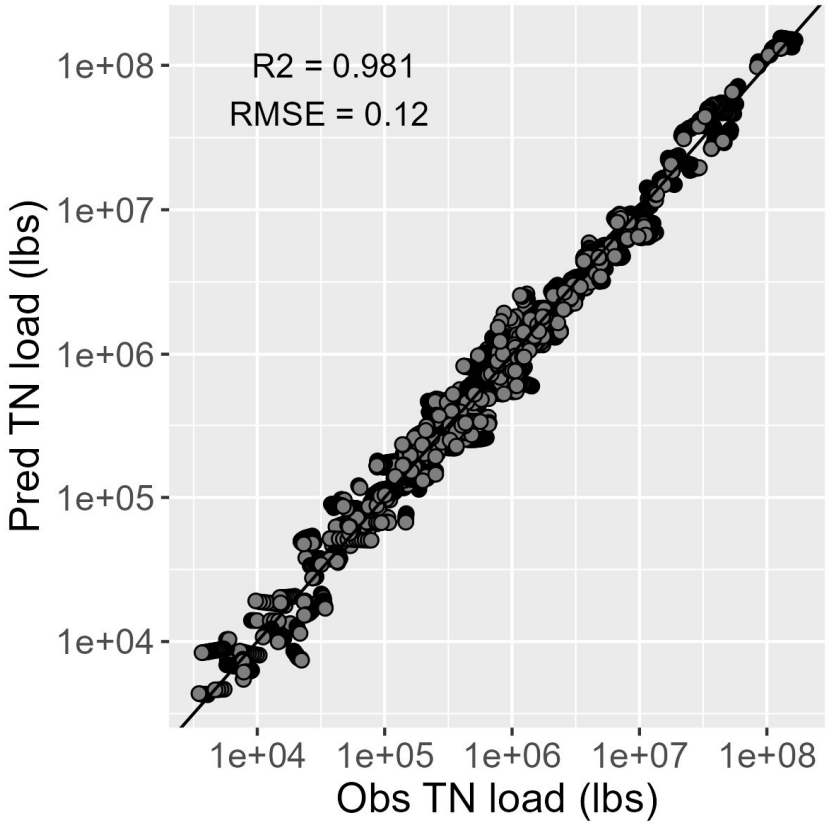
The load in each year is split between two flow paths (surface and groundwater), each with a different lag:

$$NPS_{c,2012} * lag_{c,2} = NPS_{c,2012} * (SUR_c * lag\_sur_{c,2} + GW_c * lag\_gw_{c,2})$$

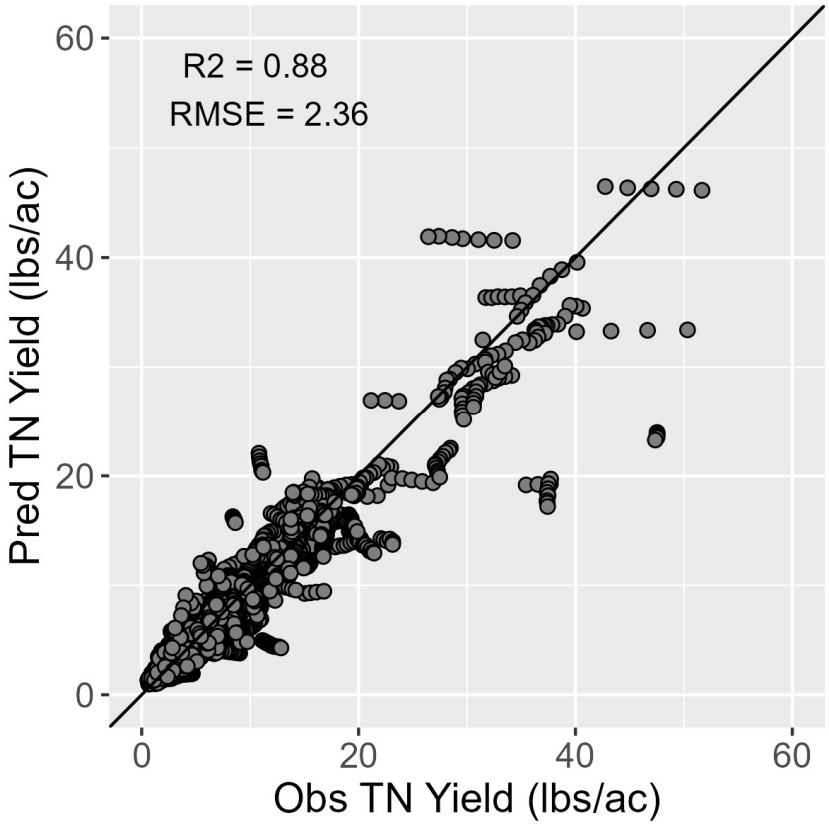
- SUR_c, $lag\_sur_{c,2}$, GW_c, $lag\_gw_{c,2}$: Fraction of load traveling through surface(SUR) and groundwater (GW) flow paths (currently estimated by CalCAST-stormflow)

Total Nitrogen Annual Flow-Normalized

TN load



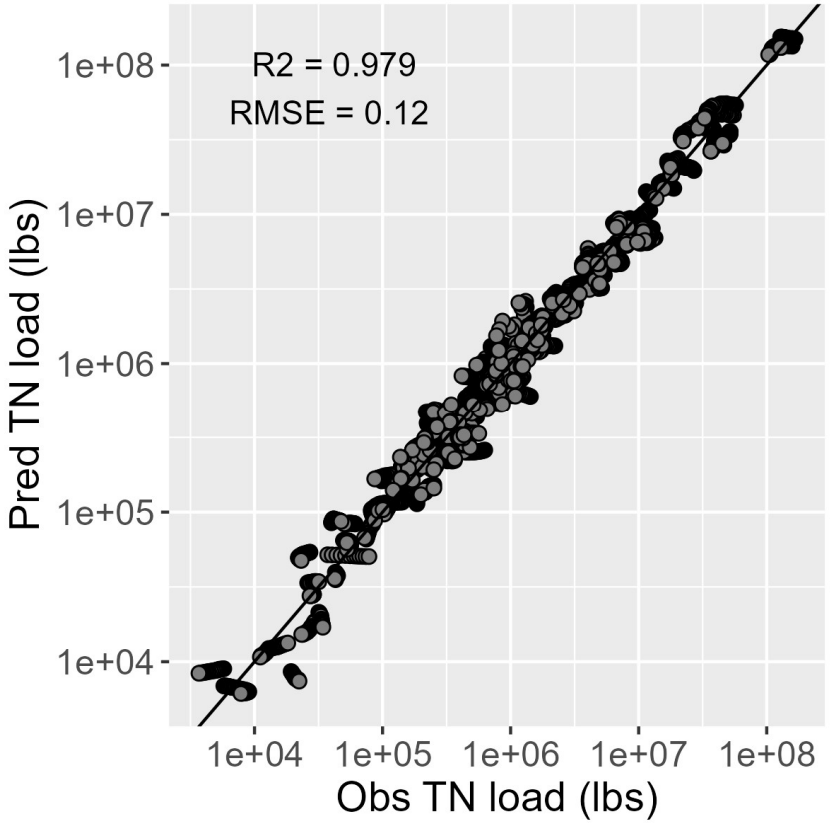
TN yield



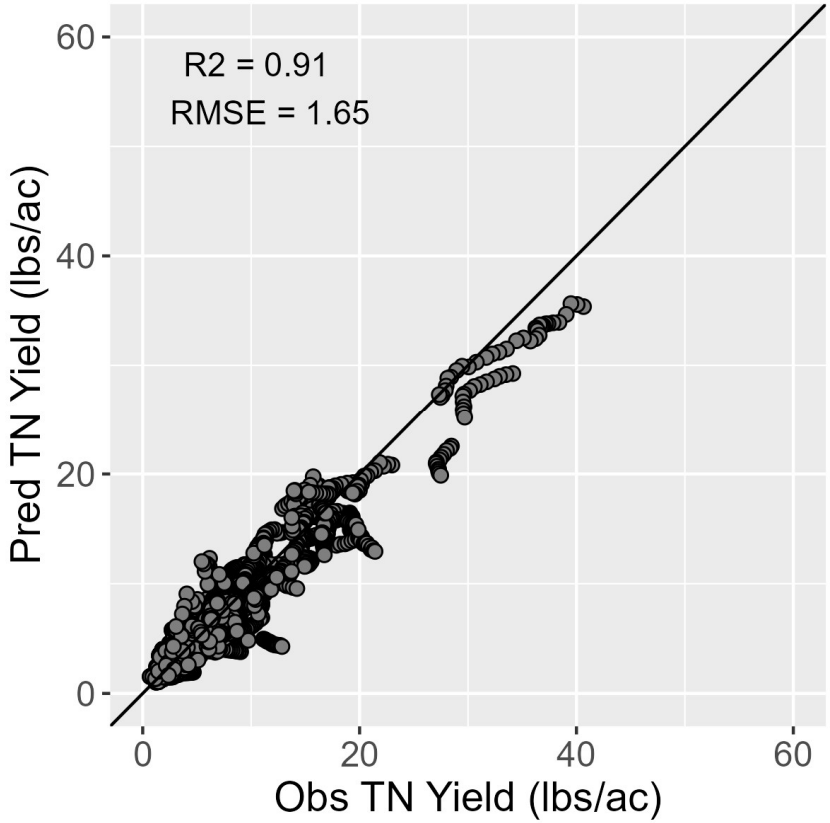
Total Nitrogen Annual Flow-Normalized

150 stations with >= 10 years of data

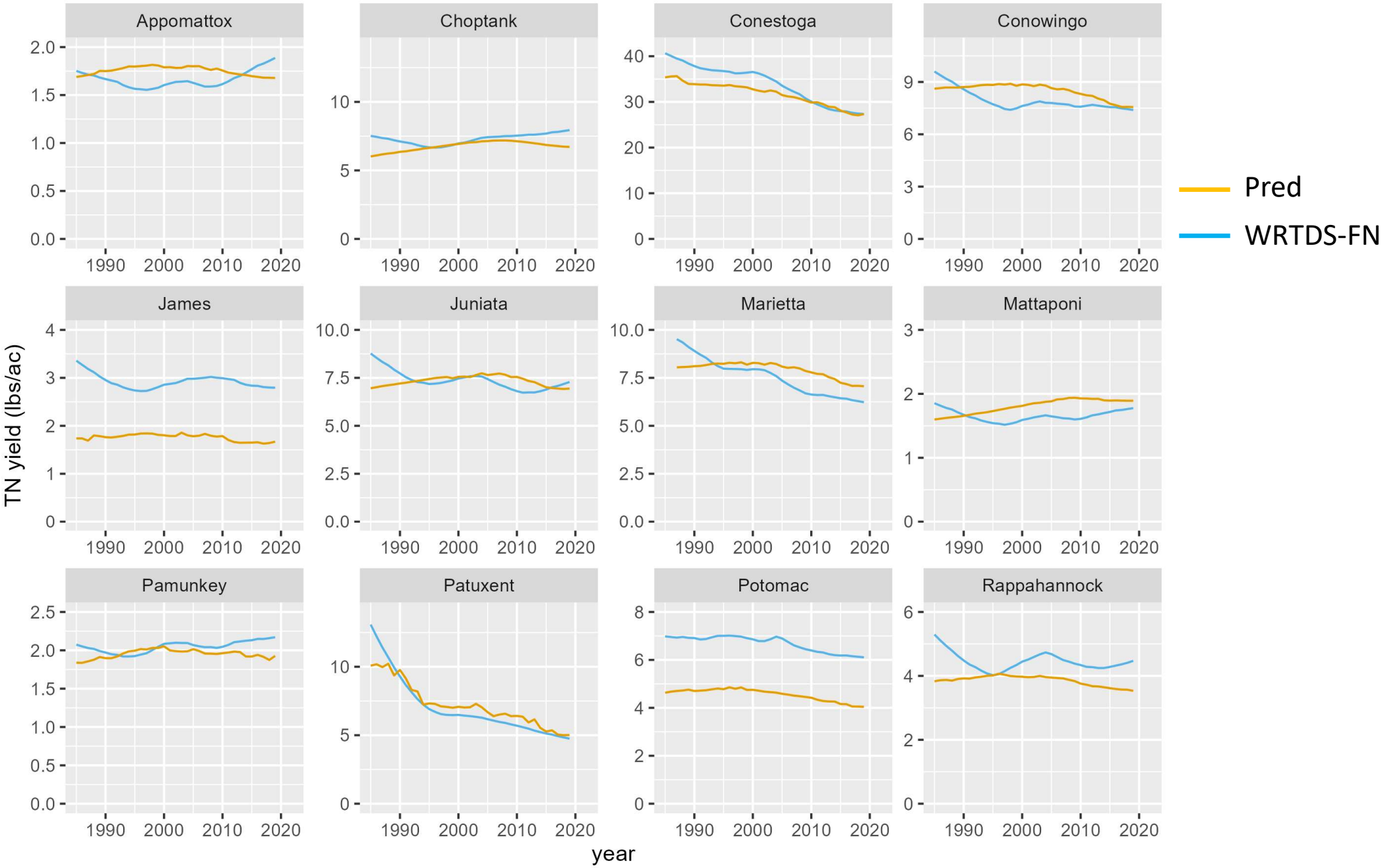
TN load



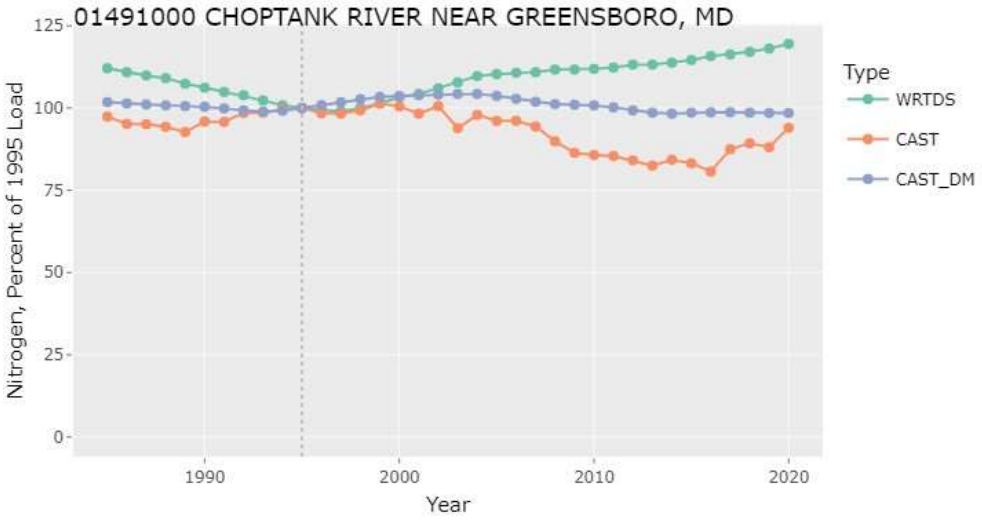
TN yield

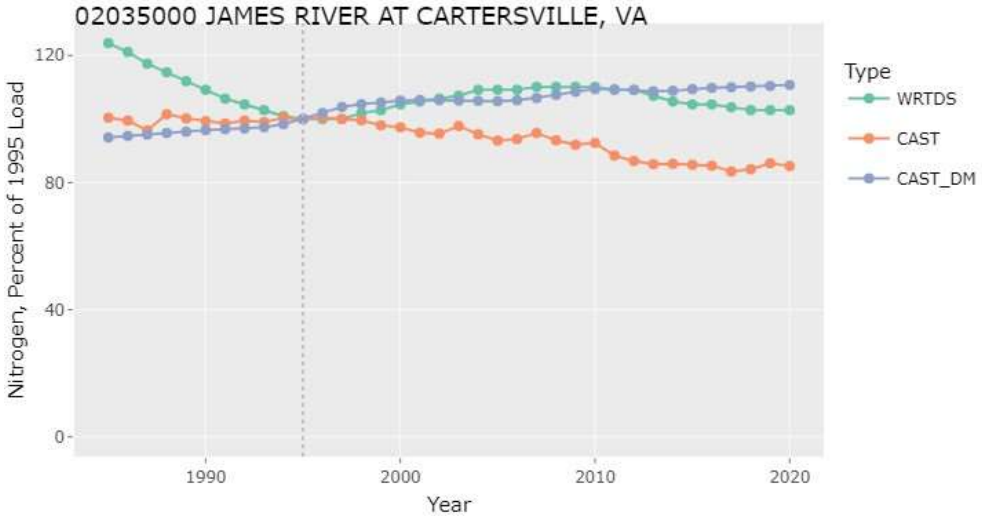


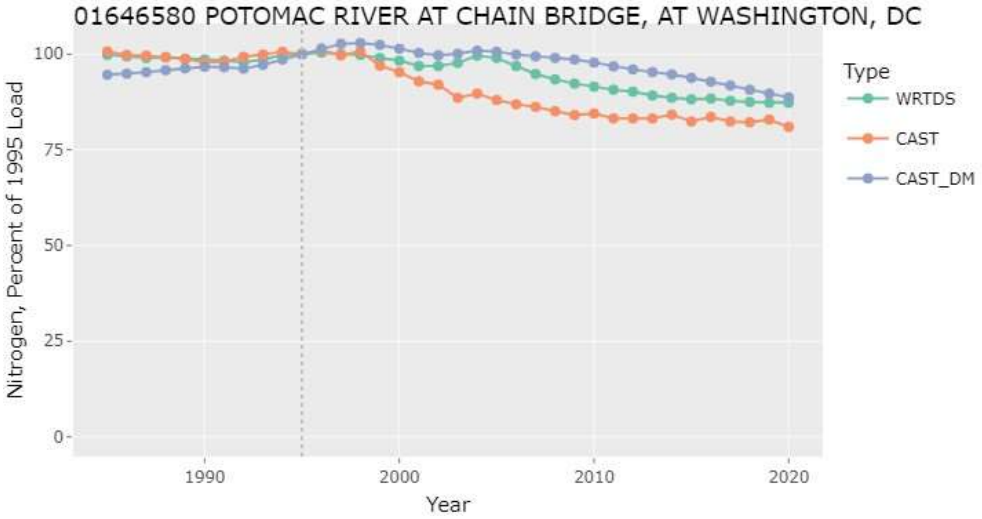
Total Nitrogen Annual Flow-Normalized

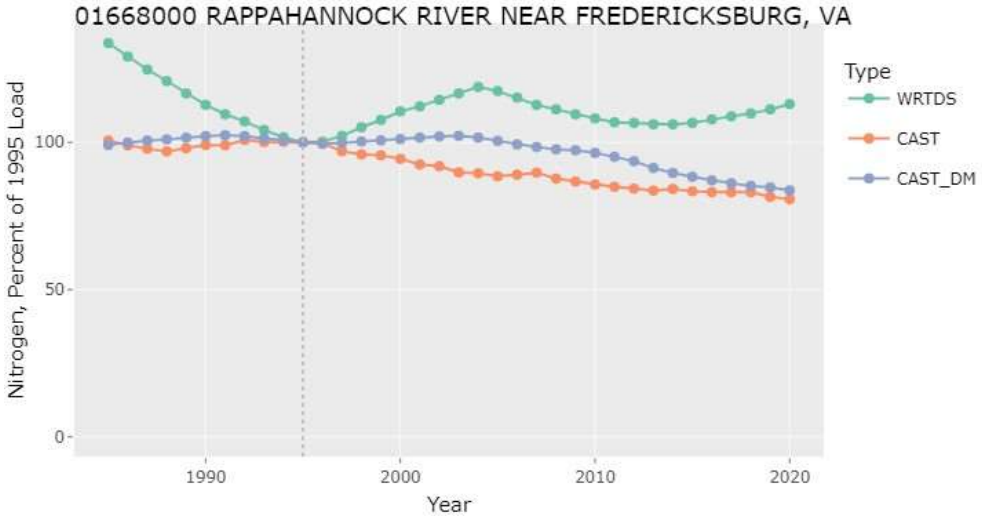


Monitored and Expected Total Reduction Indicator for the Chesapeake (METRIC)



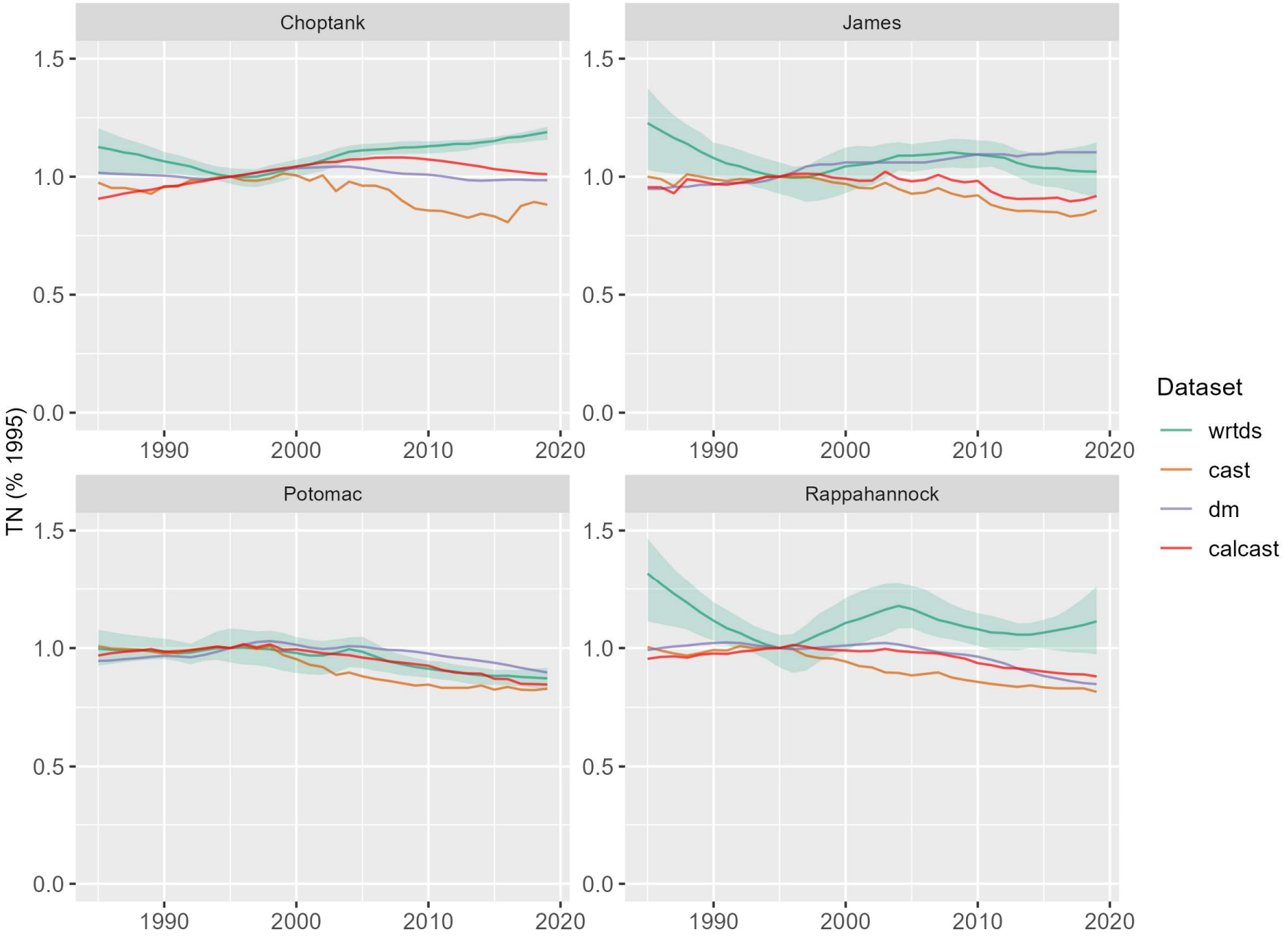






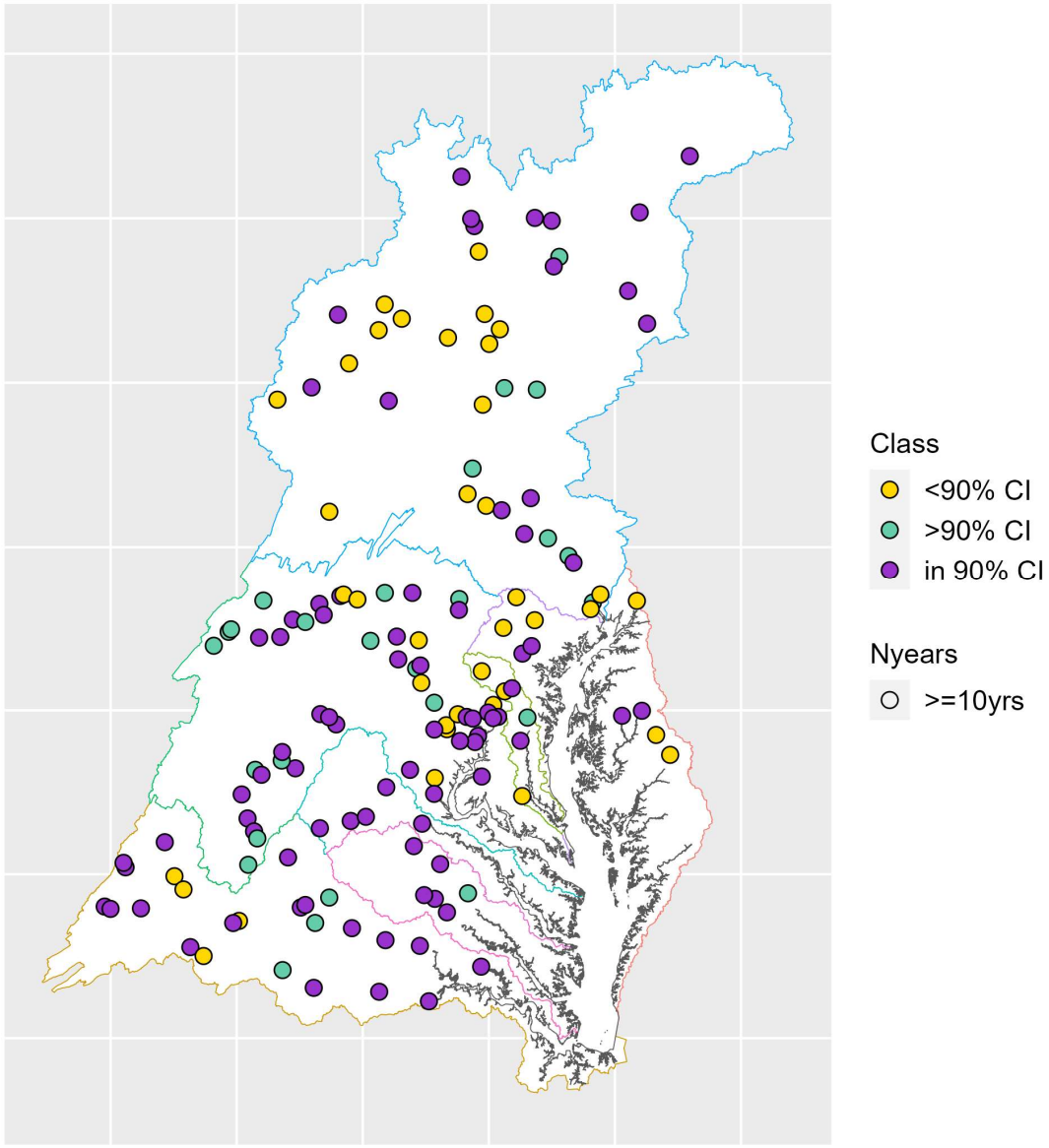
https://zhangqian0324.shinyapps.io/CBNTN_TMDL_Indicator/

Total Nitrogen Annual Flow-Normalized

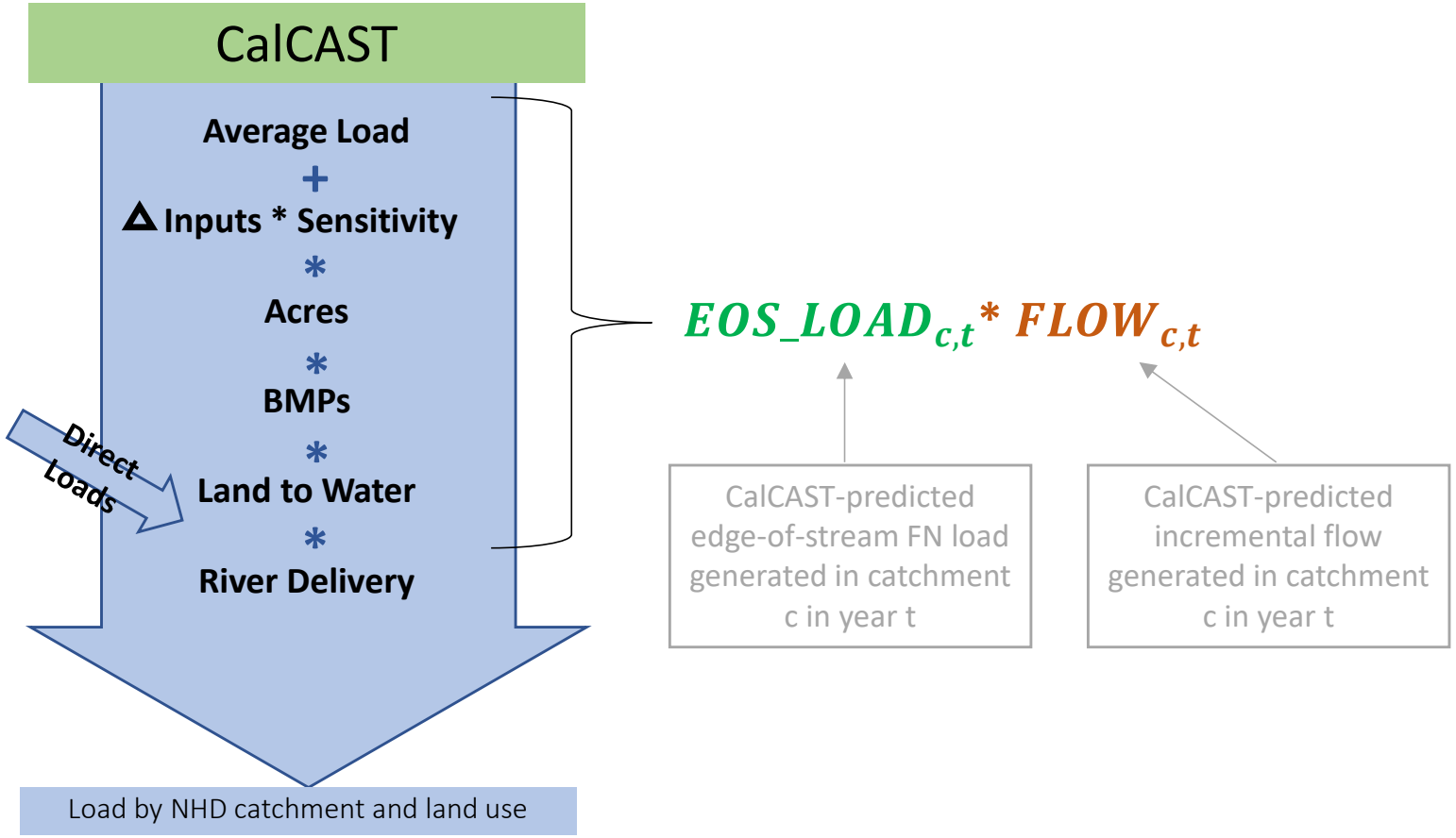


Total Nitrogen Annual Flow-Normalized

Trend agreement (stations >= 10 years)

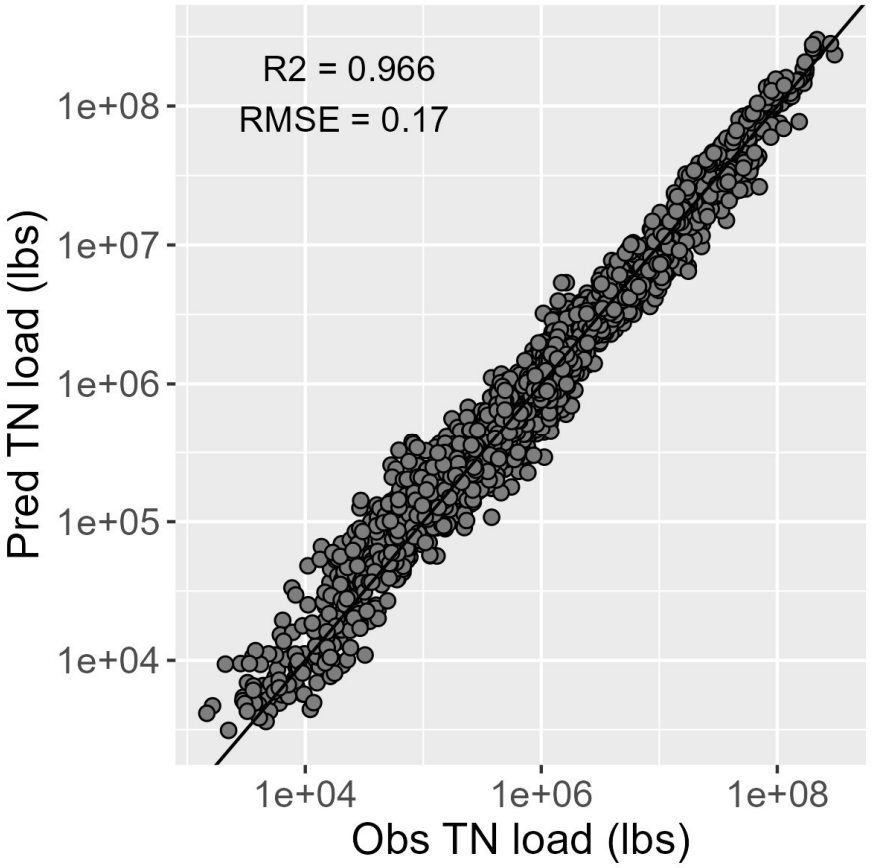


Total Nitrogen Annual True Conditions

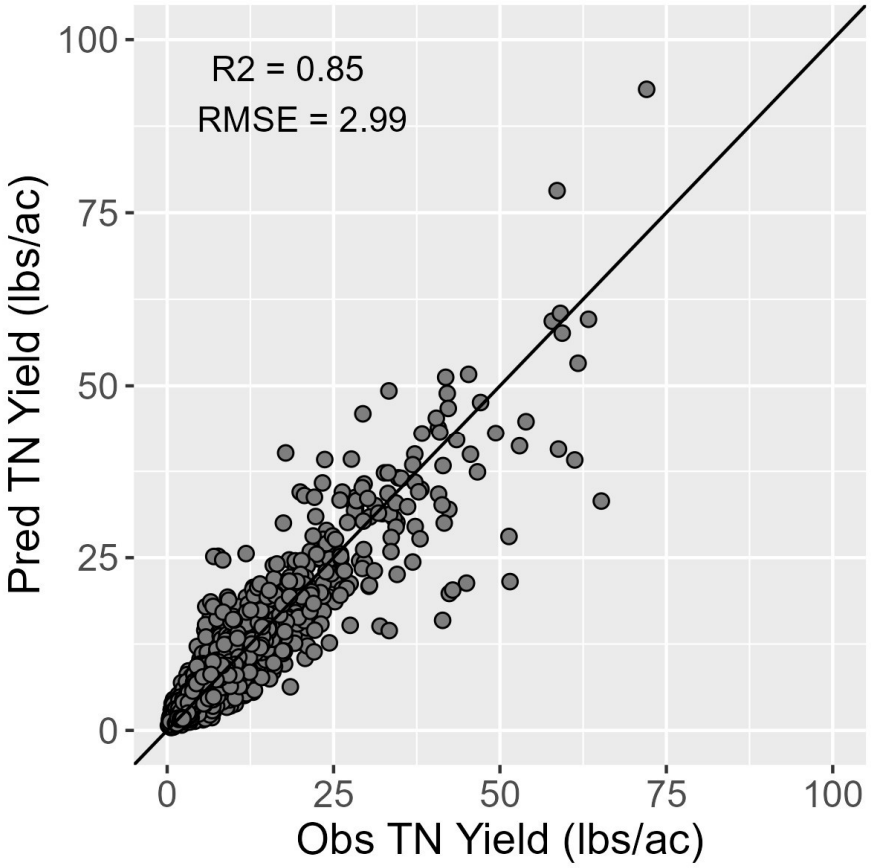


Total Nitrogen Annual True Conditions

TN load

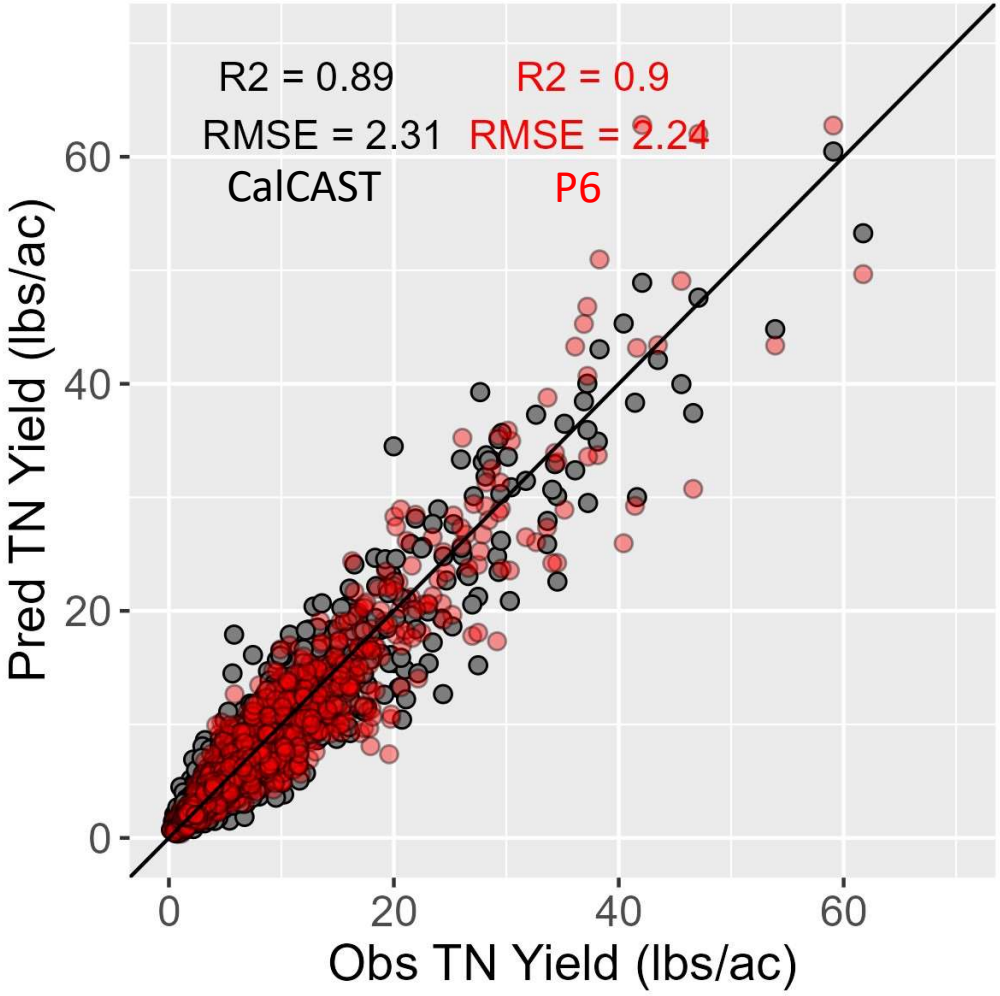


TN yield



Total Nitrogen Annual True Conditions

Comparison with P6 at 82 NTN stations



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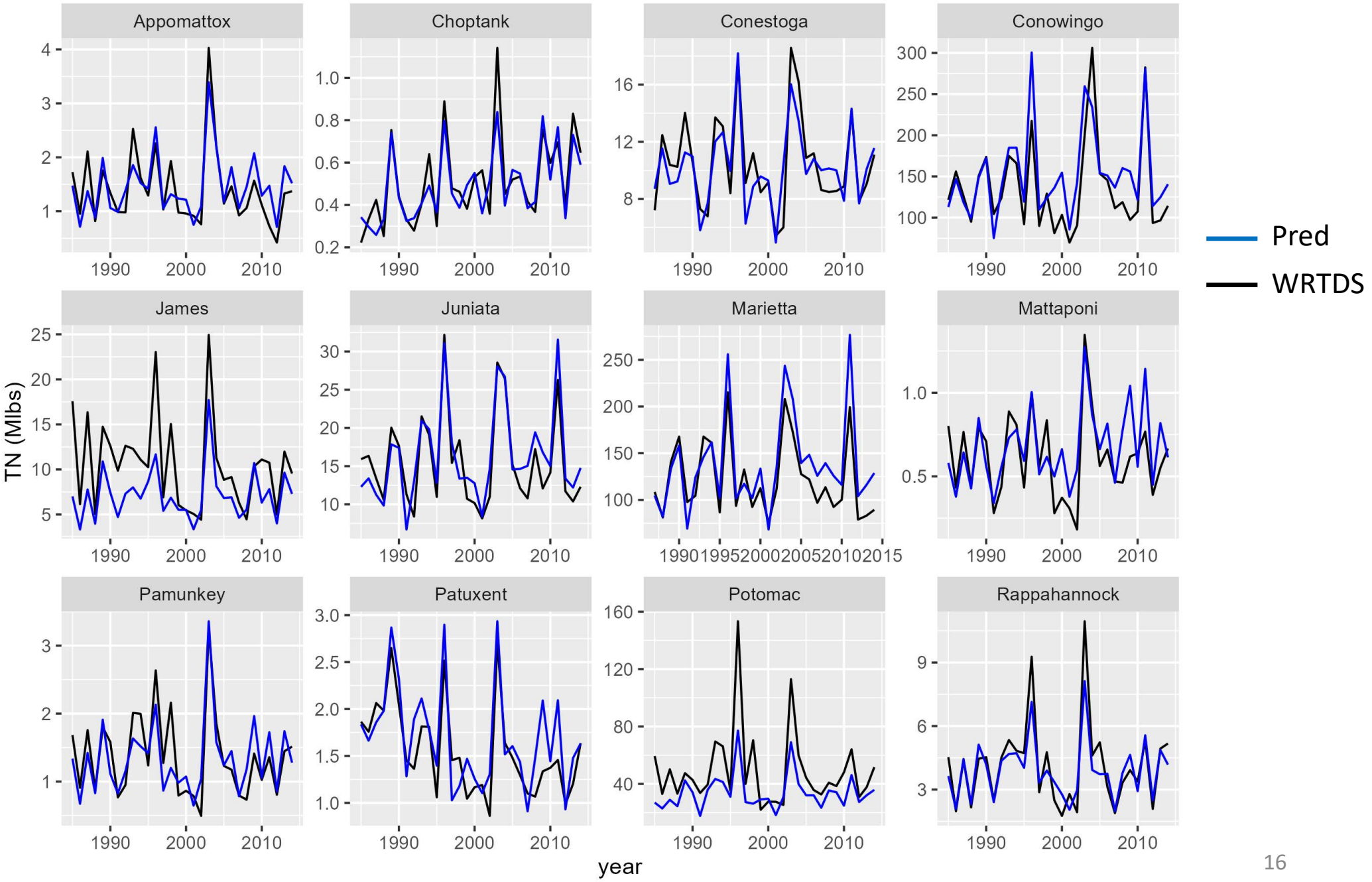

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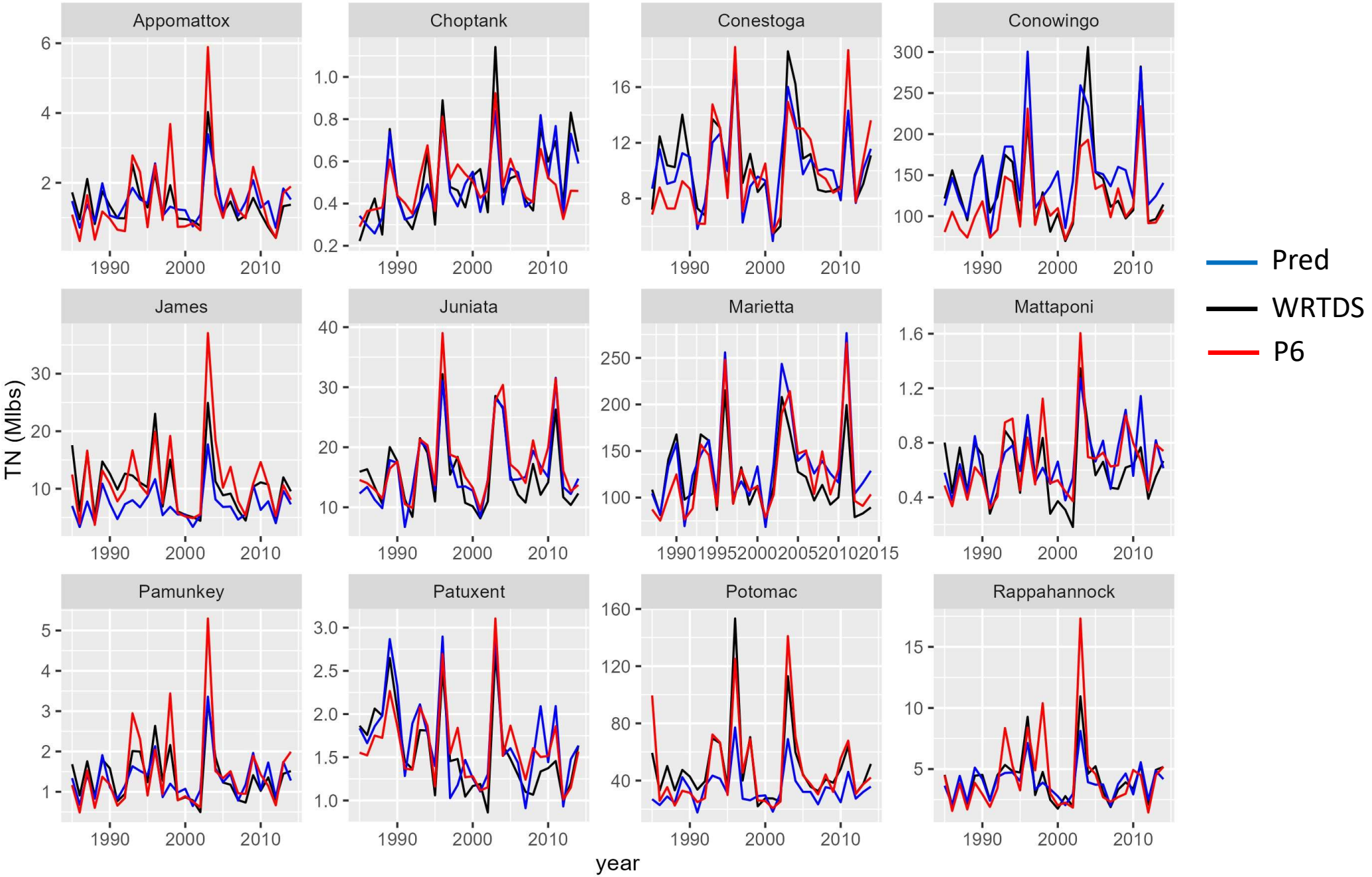

Next Steps

- Finalize annual models for TP and TSS
- Improve all annual models
- Examples of areas of potential improvement/refinement:
    - Sensitivities
    - Land to water / Stream delivery
    - Lag formulation