

CalCAST Flow Model Calibration and Sediment Edge of Field Loading

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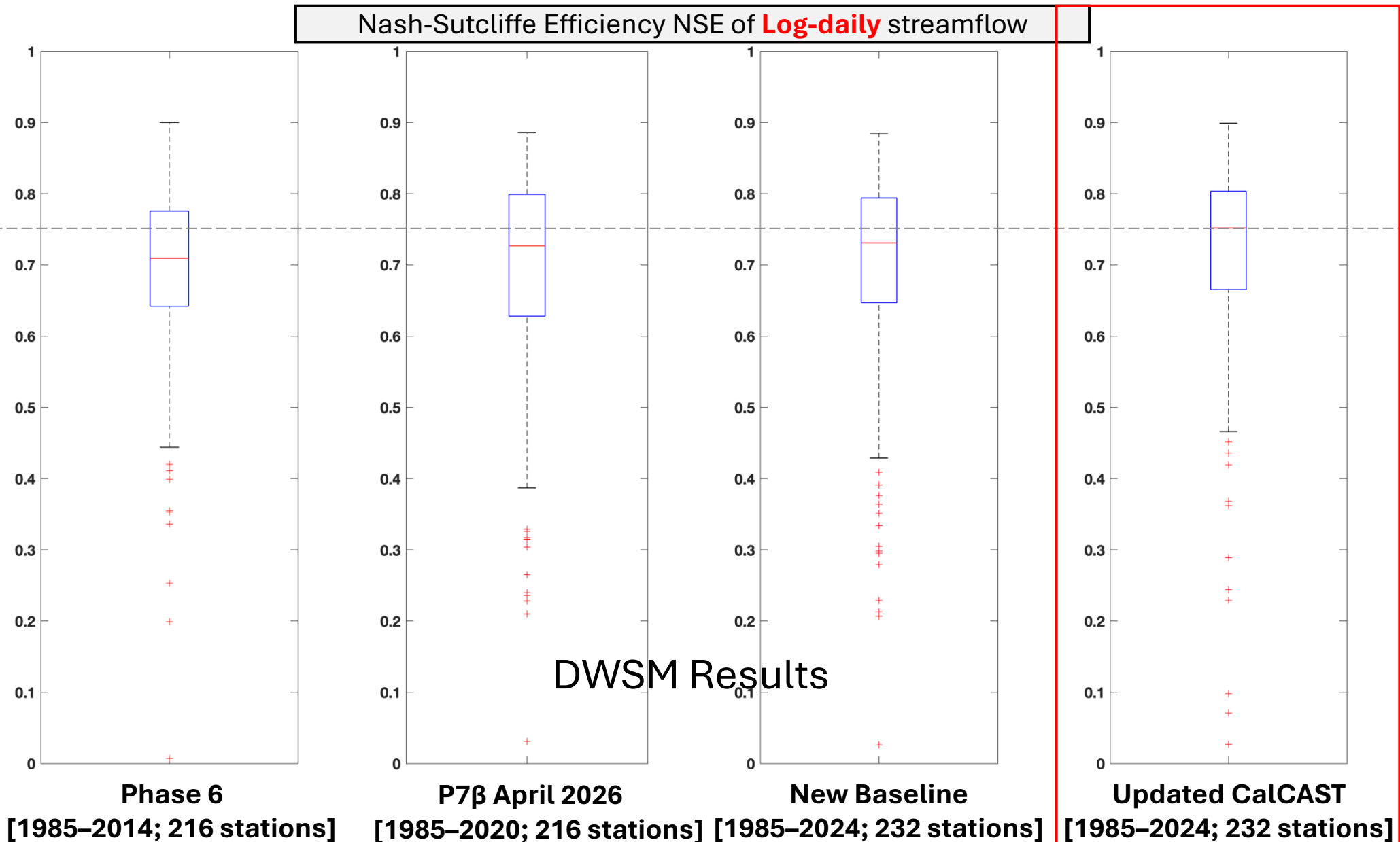
Chesapeake Bay Program

Science, Restoration, Partnership

We have an 'as good or better' hydrology calibration

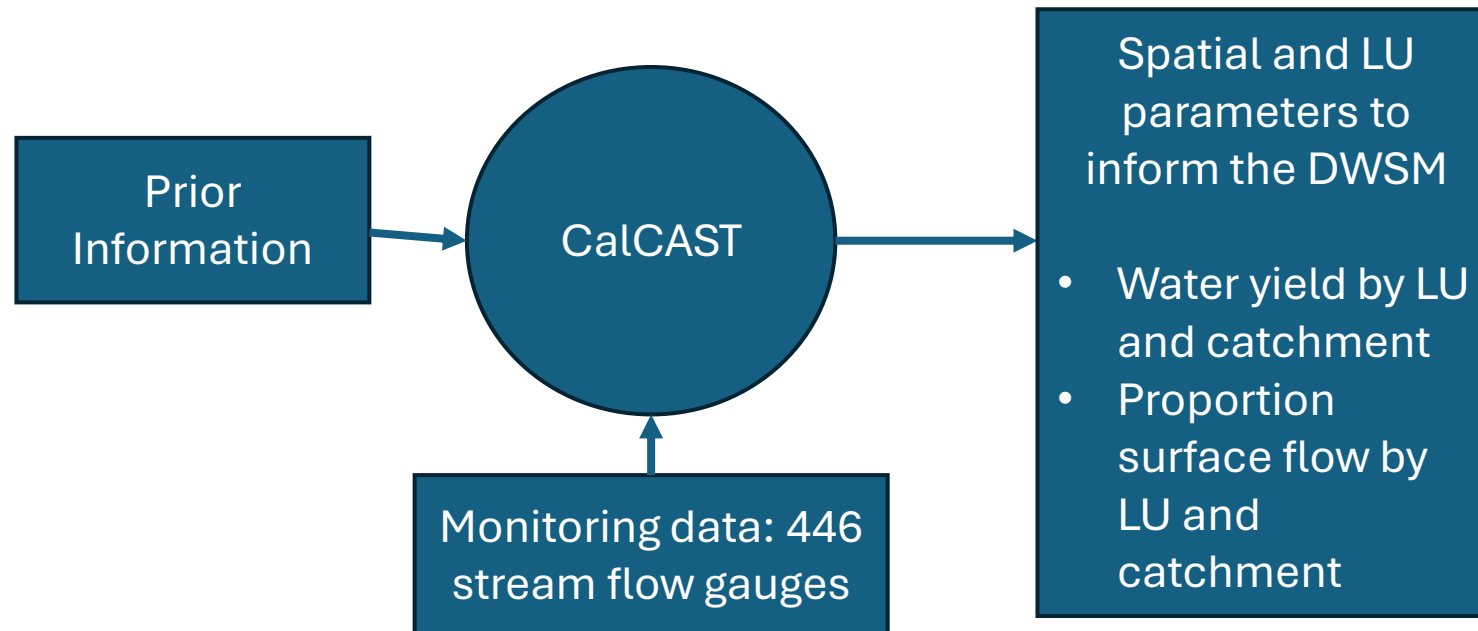


Closer to 1 is better

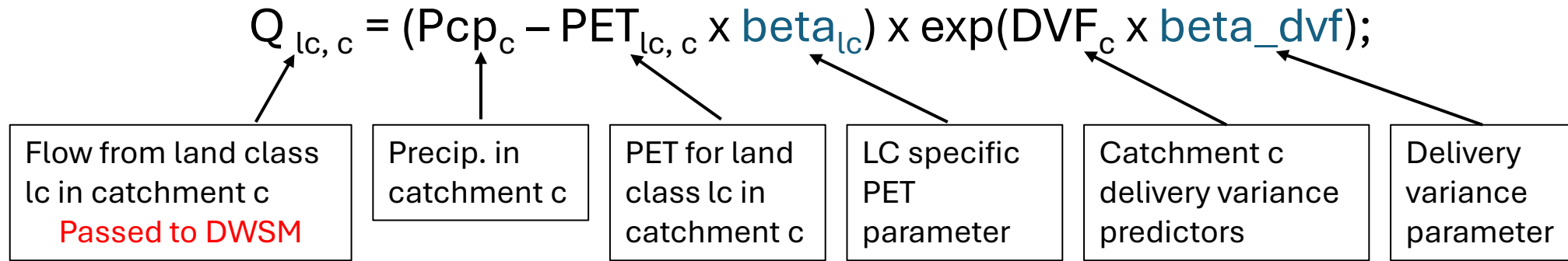


CalCAST Flow Models

- Incorporate data-driven lines of evidence into modeling approach
- Probabilistically test hypotheses on LU and other factors' impact on the spatial variation in total flow and stormflow
- Predict long-term average water yield by LU and catchment



CalCAST Total Flow



$$Q_{(gauge)} = \sum_{lu} (Q_{lc, c}) + \text{Upstream Q} - \text{Withdrawals} + \text{Direct Loads}$$

CalCAST Stormflow

$$SQ_{lc,c} = (Pcp_c \times \text{beta_SQ}_{lc} - PET_{lc,c} \times \text{beta}_{lc}) \times \text{TotQ_DVF} \times \exp(\text{DVF_SQ}_c \times \text{beta_dvf_SQ});$$

Surface Flow from
land class lc in
catchment c

LC specific surface
flow parameter

Precip. in
catchment c

PET for land
class lc in
catchment c

LC specific PET
parameter

Catchment c
delivery variance
from total flow
model

Surface flow
delivery
predictors

Surface flow
delivery
variance
parameter

$$\text{SurfaceQ}_{(\text{gauge})} = \sum_{lu} (SQ_{lc,c}) + \text{Upstream SQ} - \text{Withdrawals} + \text{Direct Loads}$$

Fit to USGS PART estimates of
baseflow:quickflow partitioning

Delivered to DWSM: $SQ_{lc,c} / Q_{lc,c}$

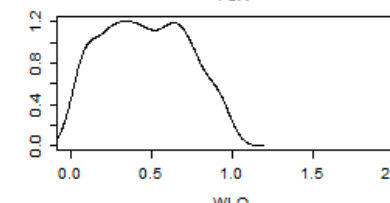
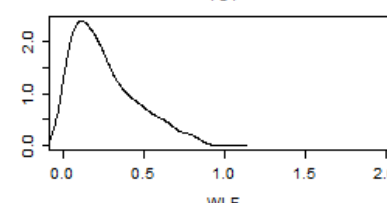
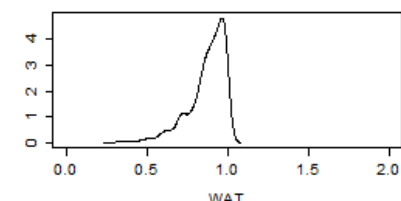
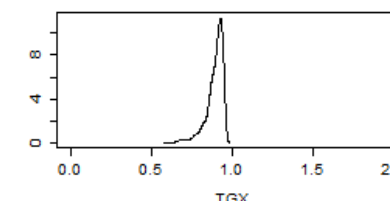
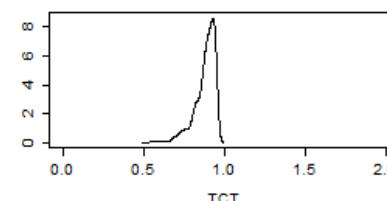
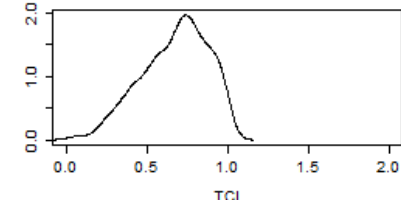
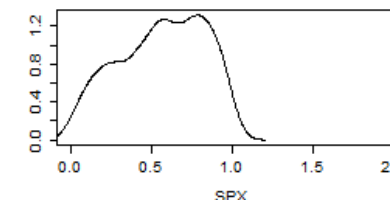
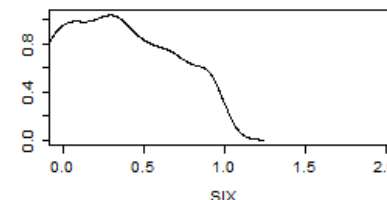
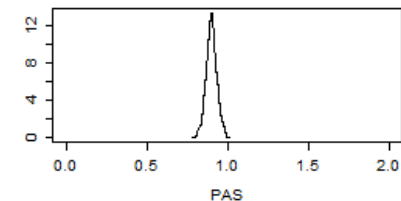
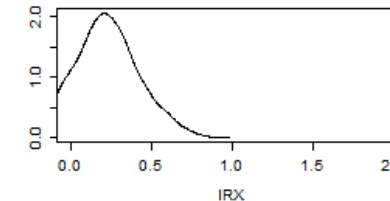
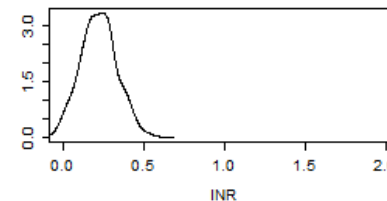
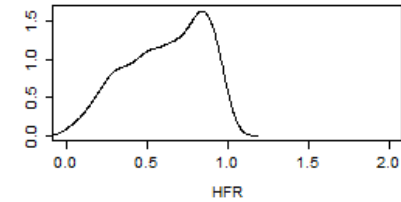
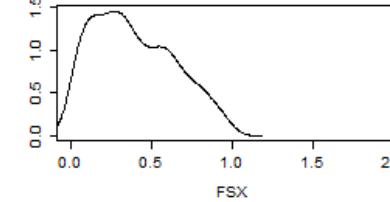
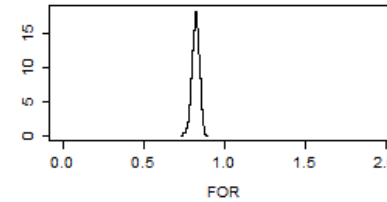
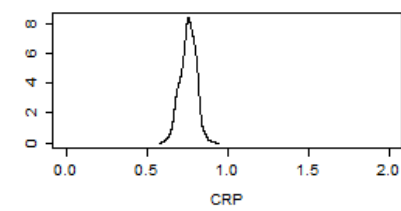
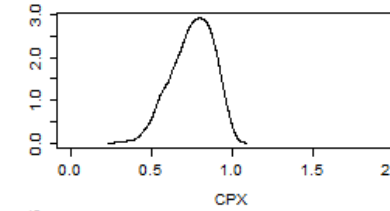
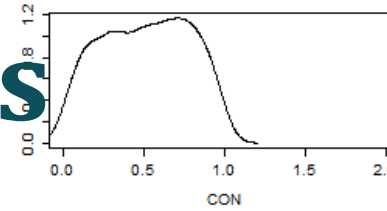
Details

- PRISM weather and climate data
- Priestley-Taylor PET
 - Comparable performance to Hamon with no bias across latitude
- Priors are relational based on P6
 - e.g. harvested forest PET beta is 0.8 forest
 - New LUs: SOI:INR, SOP:COP:MO
 - Priors are weak, std=.5 for pervious and .25 for impervious
- Average annual model, weighted to stations by log(years obs.)

Total Flow LU Betas

- High confidence in the large land uses

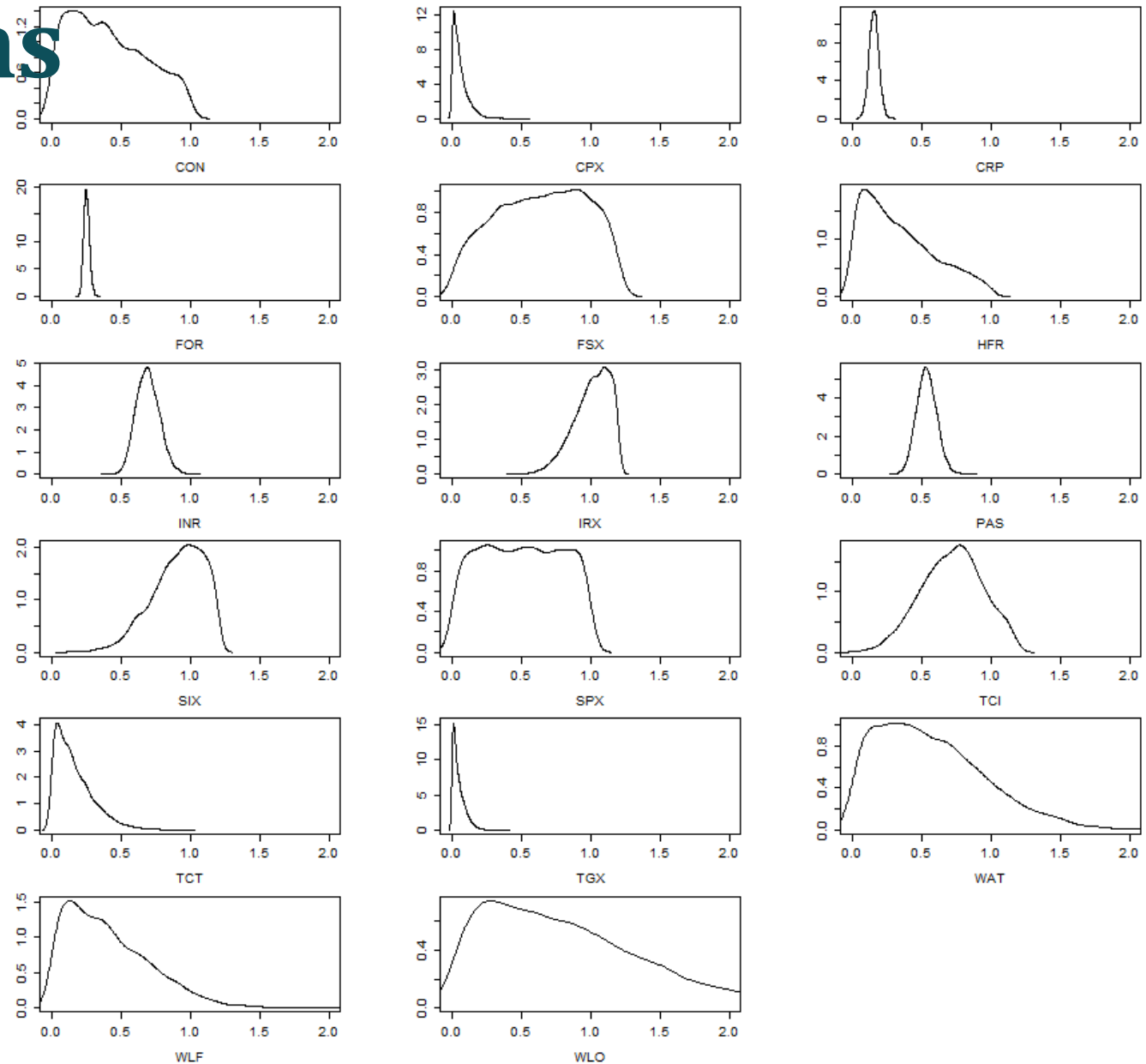
CON – Construction
 CPX – Construction Pervious
 CRP – Cropland
 FOR – Forested
 HVF – Harvested Forest
 INR – Impervious Non-road
 IRX – Impervious Roads
 SIX – Solar Impervious
 SPX – Solar Pervious
 TCI – Tree Canopy over Imp.
 TCT – Tree Canopy over Turf
 TGX – Turf Grass
 WLF – Wetland Floodplain
 WLO – Wetland Other



Stormflow LU Betas

- High confidence in the large land uses

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Land-to-Water Predictors

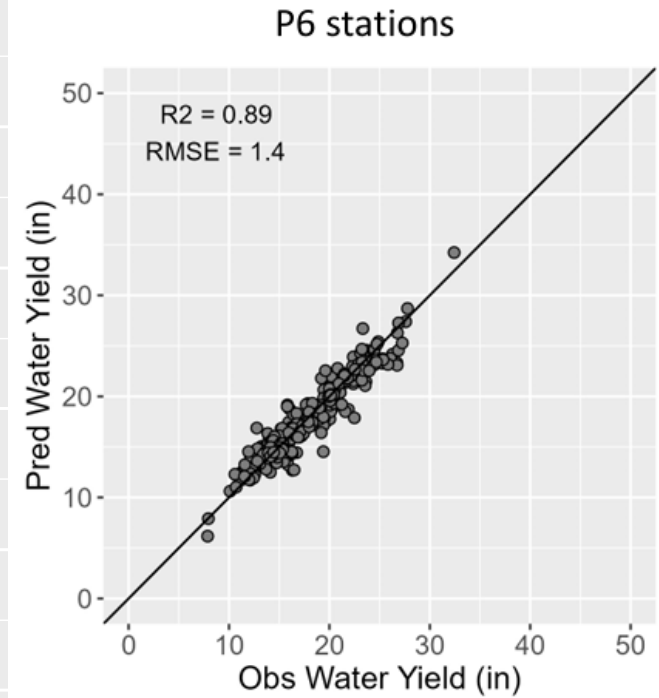
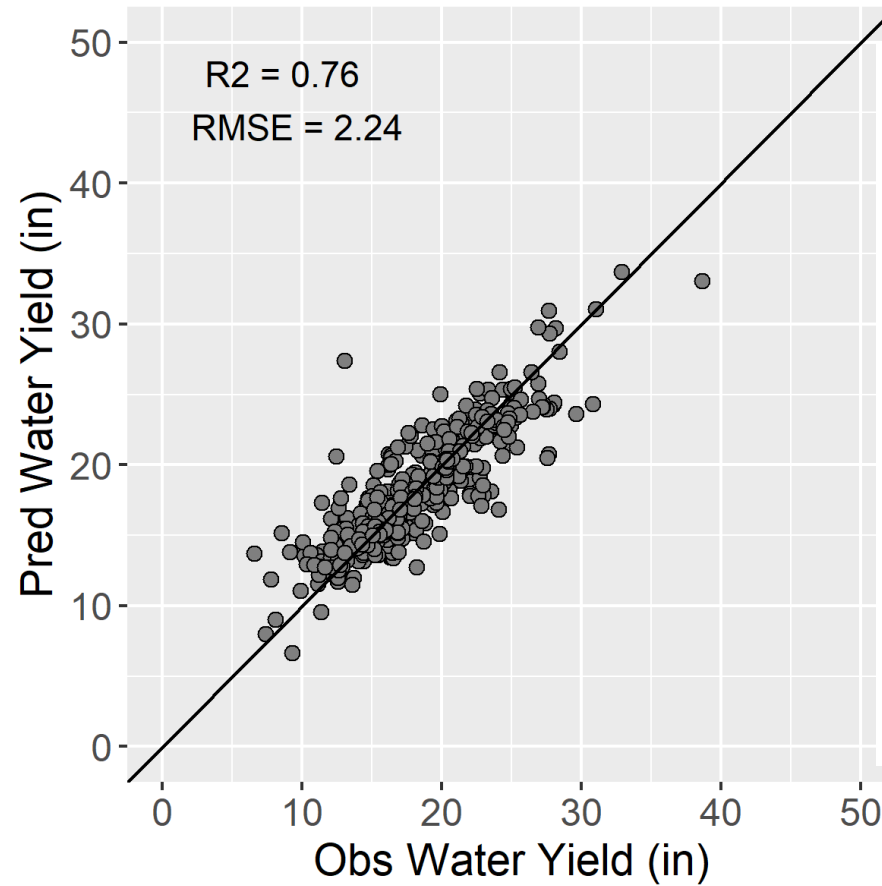
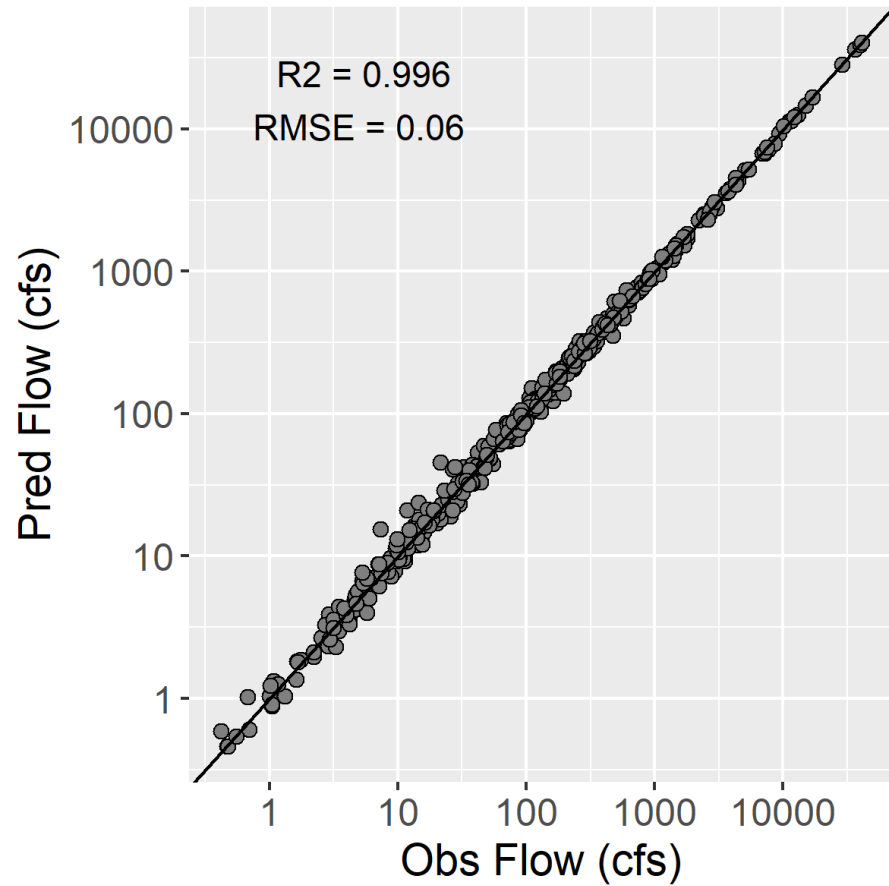
Total Flow

- Temp. (avg. annual, degrees)
- Elevation (cat. Mean, m)
- Hunt geo unit: Sandy and stony (%)
- Mesozoic Lowland (%)
- Anthracite Mine Land (%)
- Soller surficial geo.: Sandy glacial till (%)
- Slope (cat. Mean)

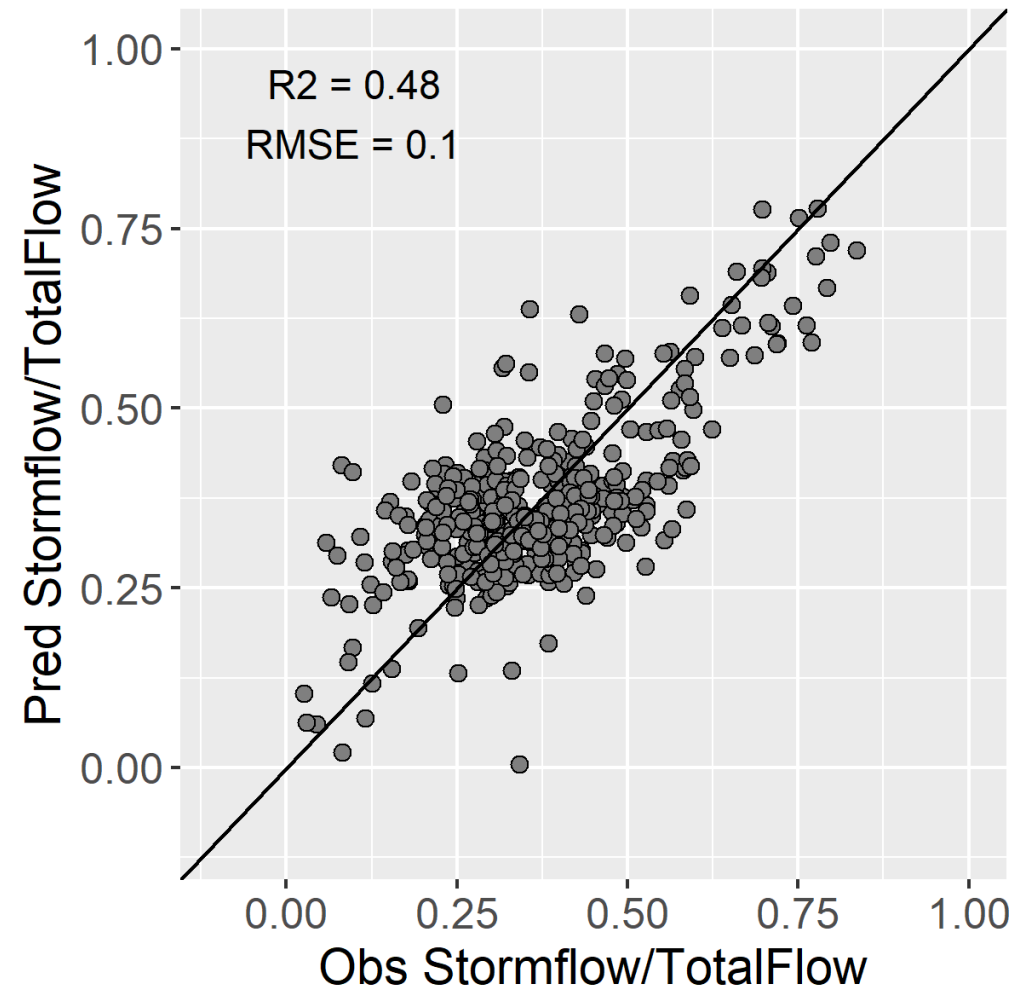
Stormflow

- Hyper Resolution Stream Density
- Carbonate Geology (%)

Total Flow Model Performance

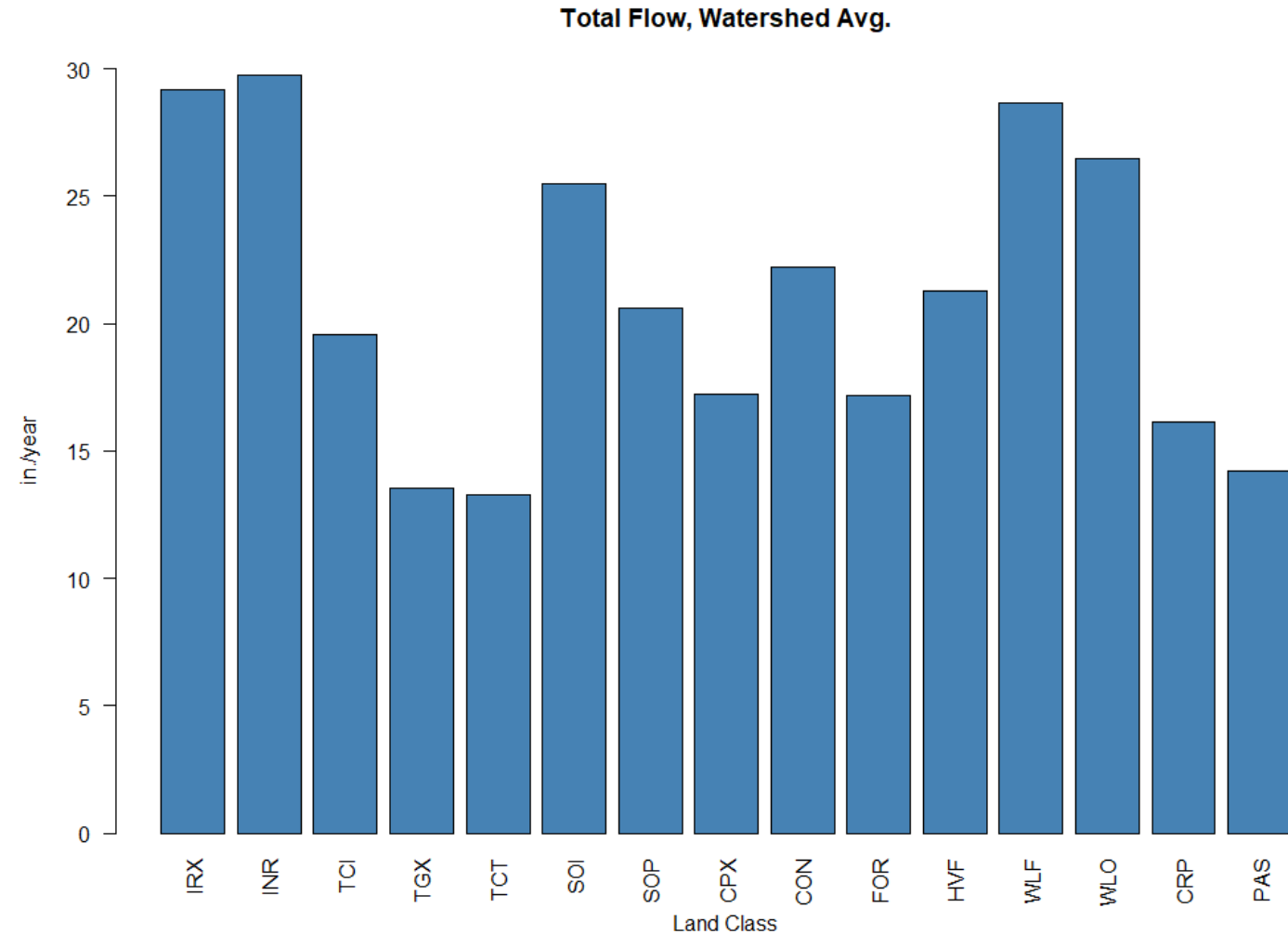


Stormflow Model Performance



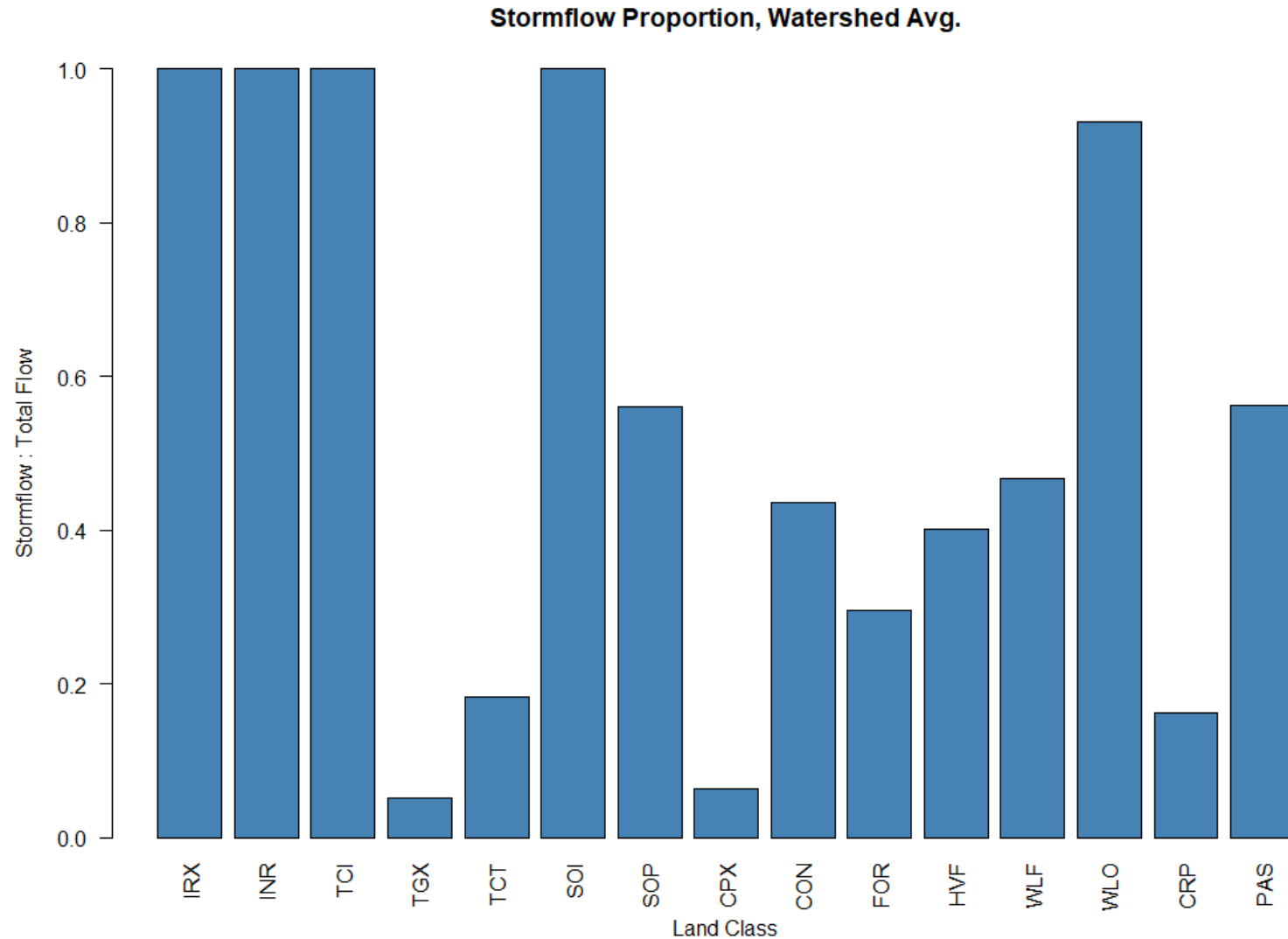
Total Flow Results

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Questions

Edge of Field Sediment Loading

Methods, consistent with P6

Handled via BMPs



1. The R, K, and LS factors are determined at a 10-meter scale. R factors are monthly while the K and LS factors are constant through time
2. The R, K, and LS factors are aggregated to major land use class and catchment-county model unit.
3. A monthly C factor is generated for each pervious land use and catchment-county model unit. The land uses in this step are the Phase 7 land uses.
4. Monthly sediment washoff is calculated as $R * K * LS * C$ and then aggregated to a long-term average by land use and catchment-county model unit.
5. Impervious and non-mapped land use loading rates calculated relative to forest and turfgrass loading rates.

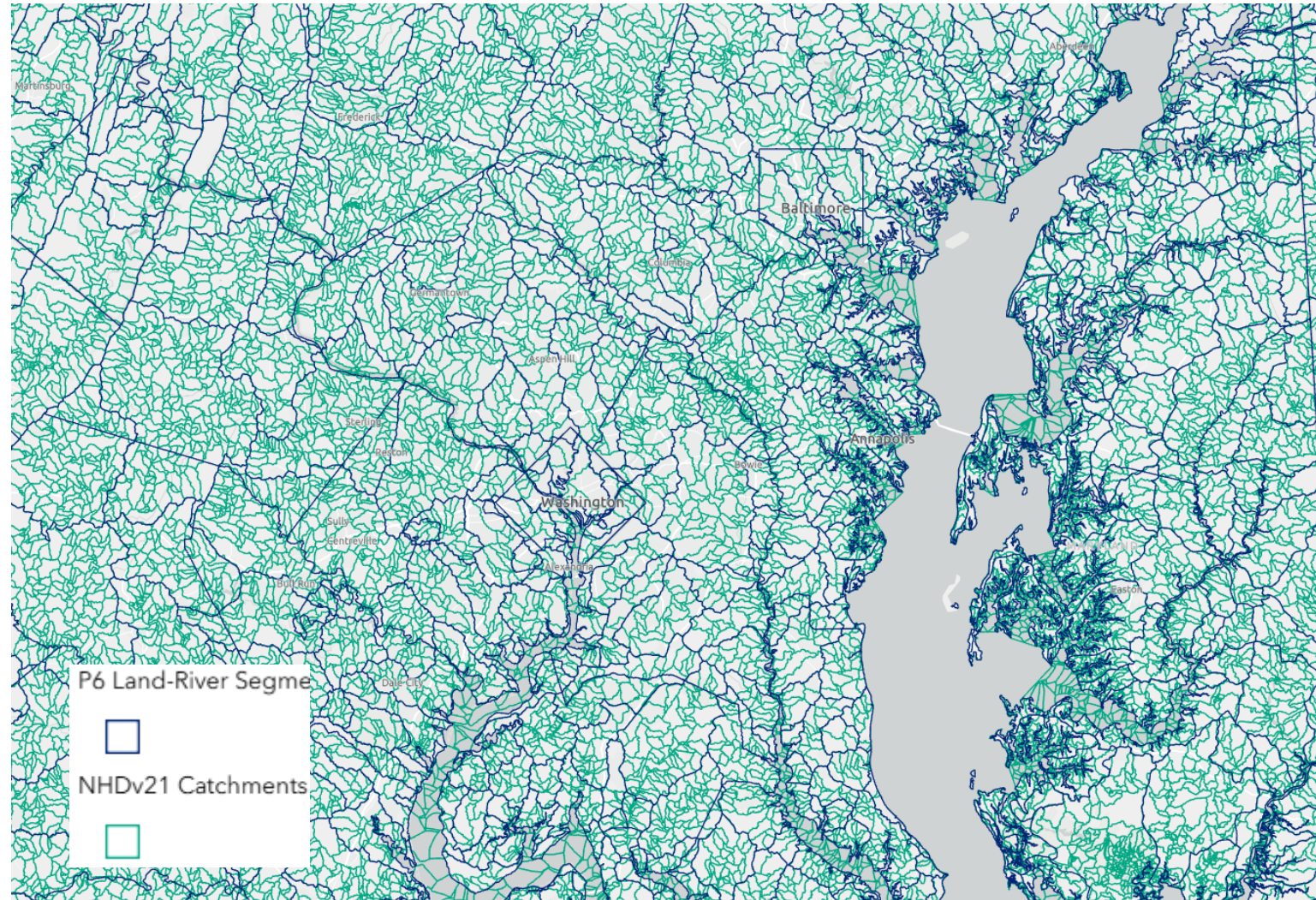
$$\text{EOF Load} = R * K * LS * C * \text{P}$$

- **R** – Rainfall erosivity (energy of raindrops and overland flow)
- **K** – Soil erodibility (sensitivity of soil to erosion)
- **LS** – Topographic factor (slope length and steepness)
- **C** – crop cover and vegetation management
- **P** – Practice, BMP not used in EOF calculation.

Methods, consistent with P6

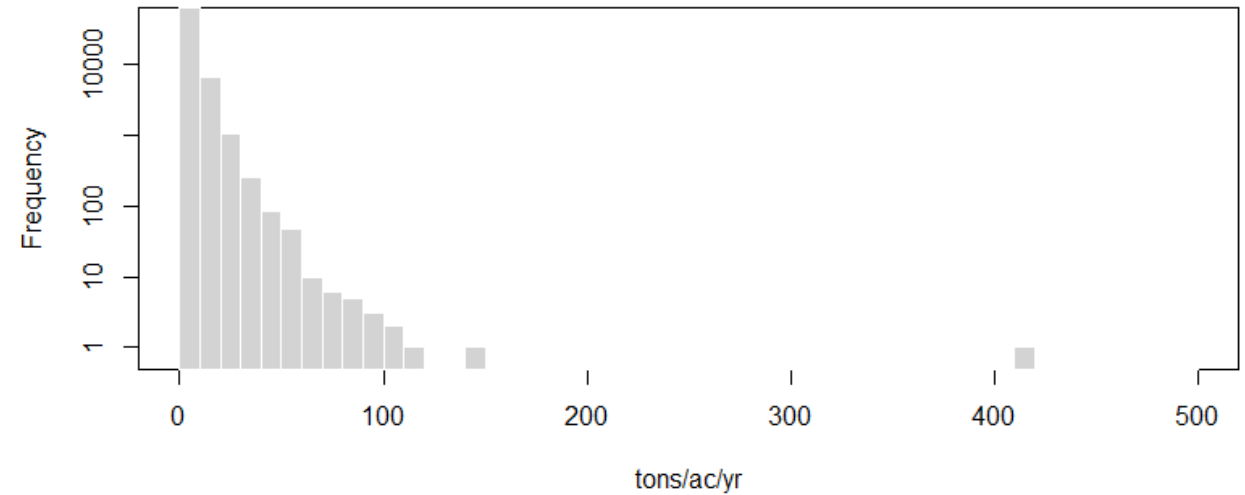
What's different in P7?

- Spatial scale. P6 Lrseg to P7 catchment-county. Much finer spatial resolution.
- P7 Land classes and land uses.
 - New C-factors and translation factor from workgroups.

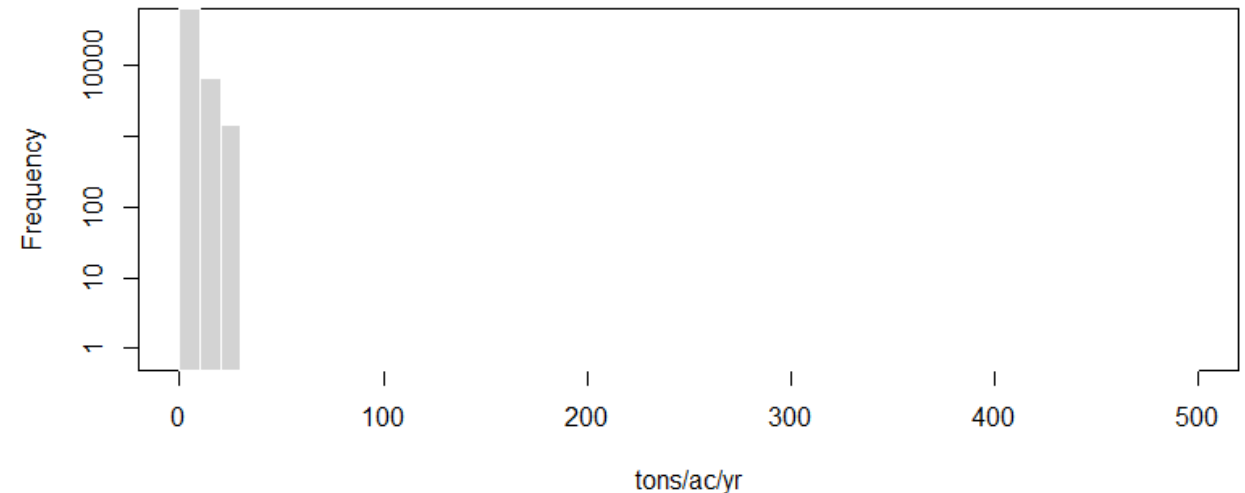


- When P6 sediment methods and RKLS data are applied at the much finer P7 catchment-county scale there are anomalous values.
- Applying a simple 1%-99% bounding removes anomalous values at the finer spatial scale...
- Without significantly altering the distribution or mean of EOF loading rates at larger scales.

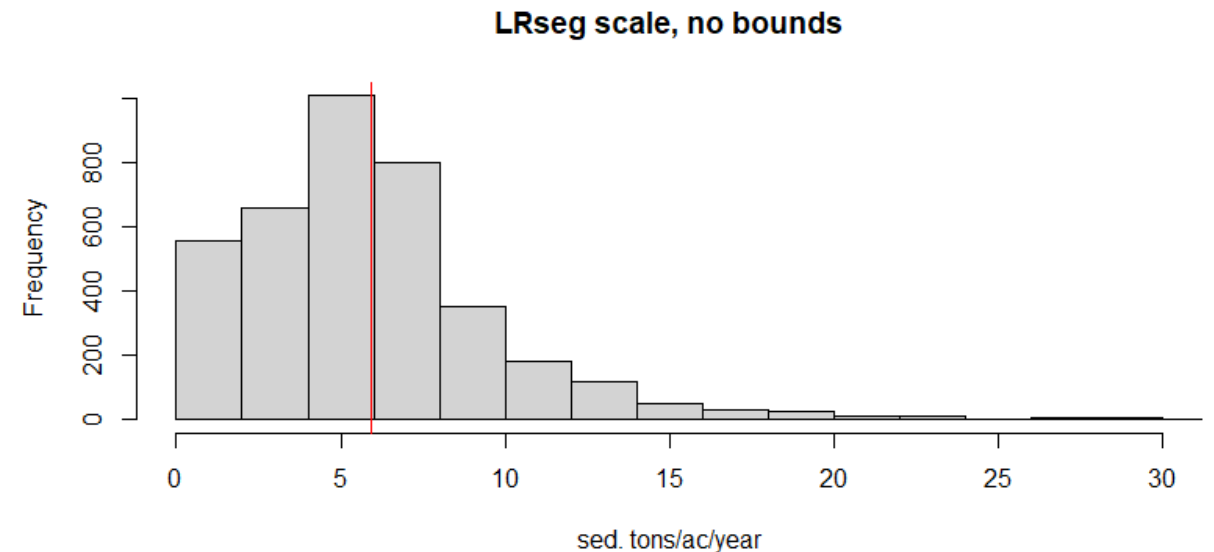
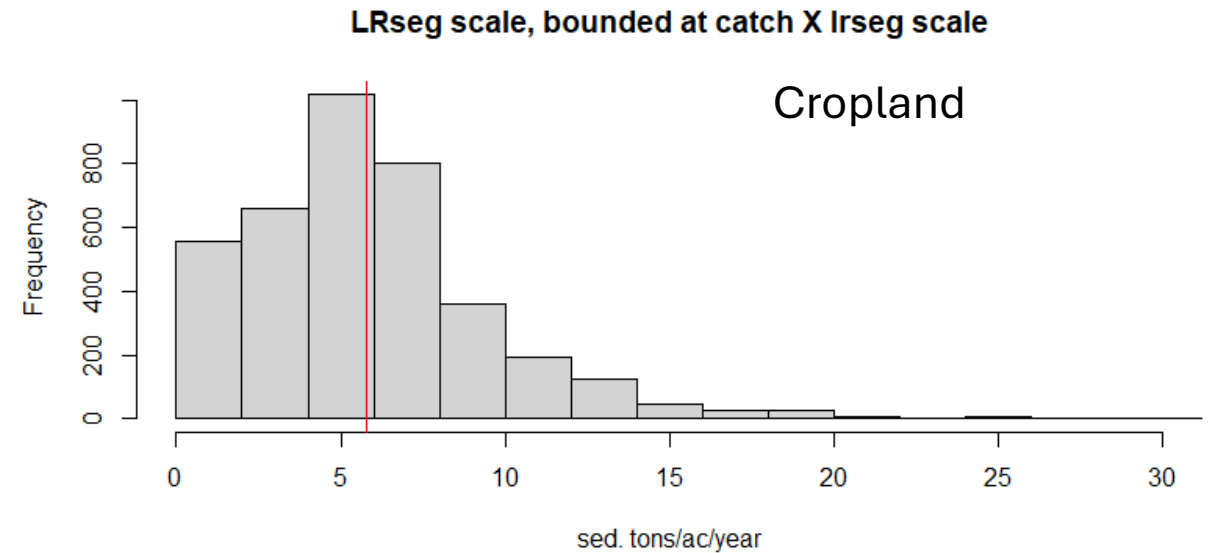
Cropland EOF Sediment Loading, Catch X County Scale



With 99 Percentile Bounds

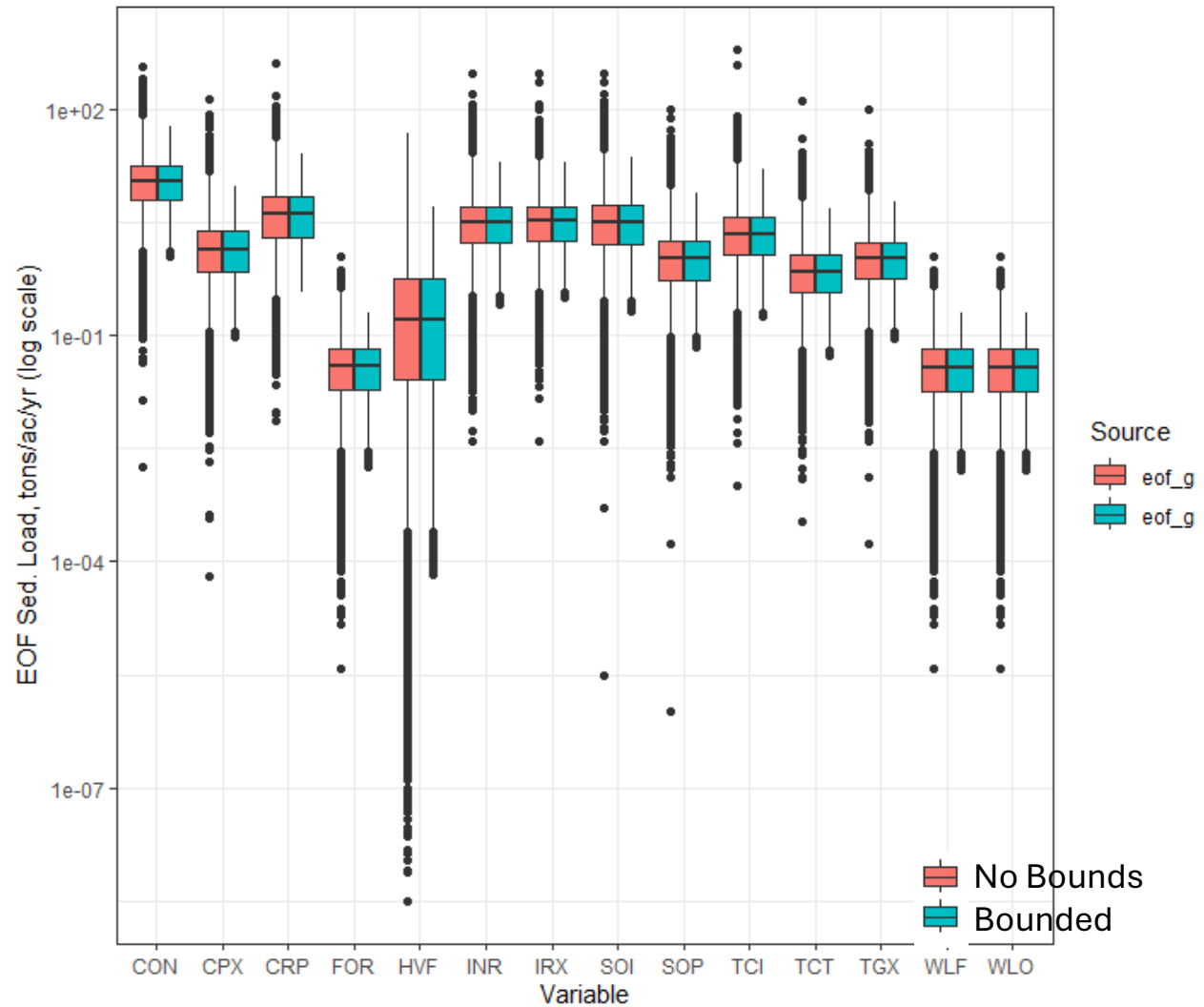


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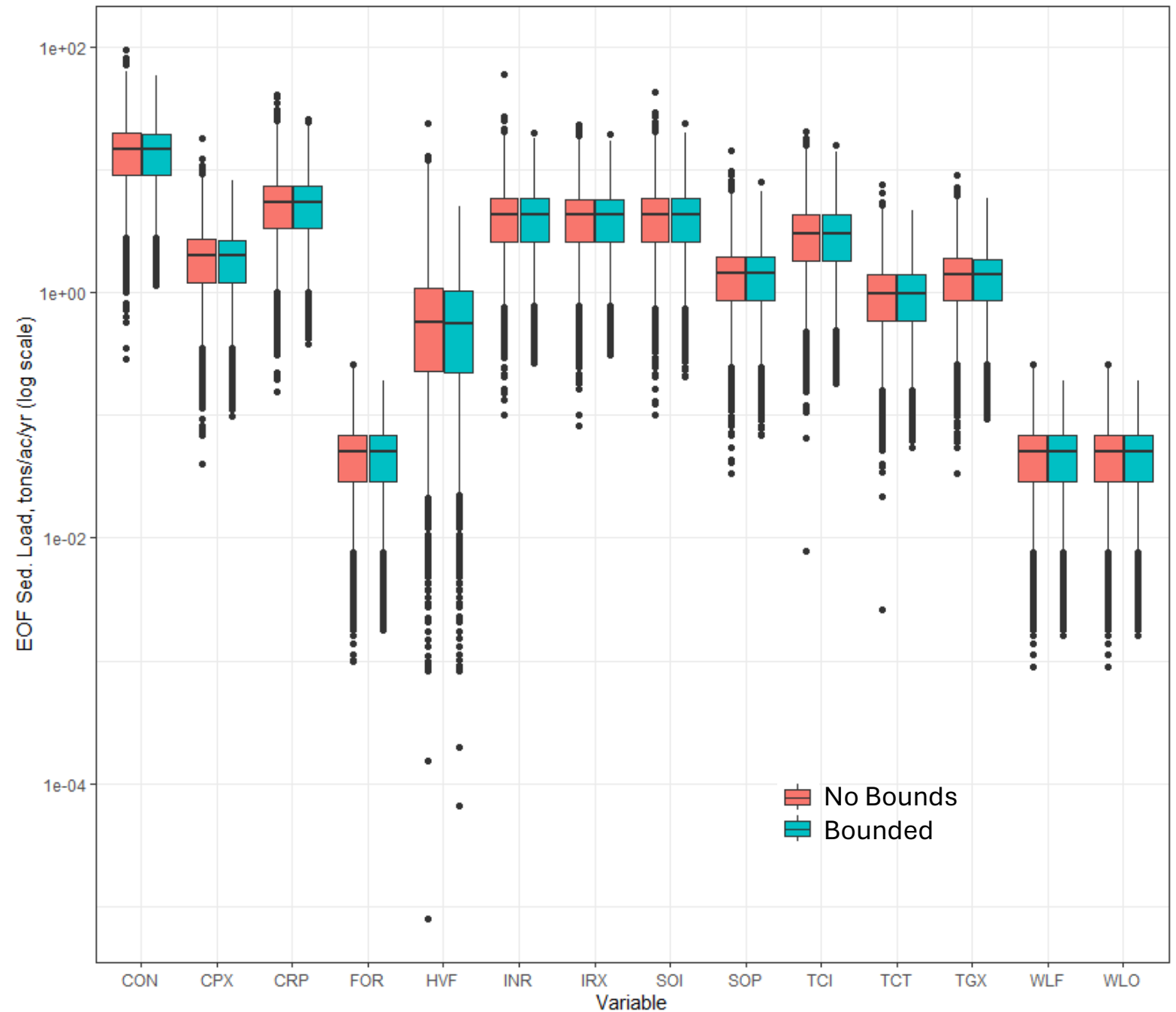
Catchment x County Scale

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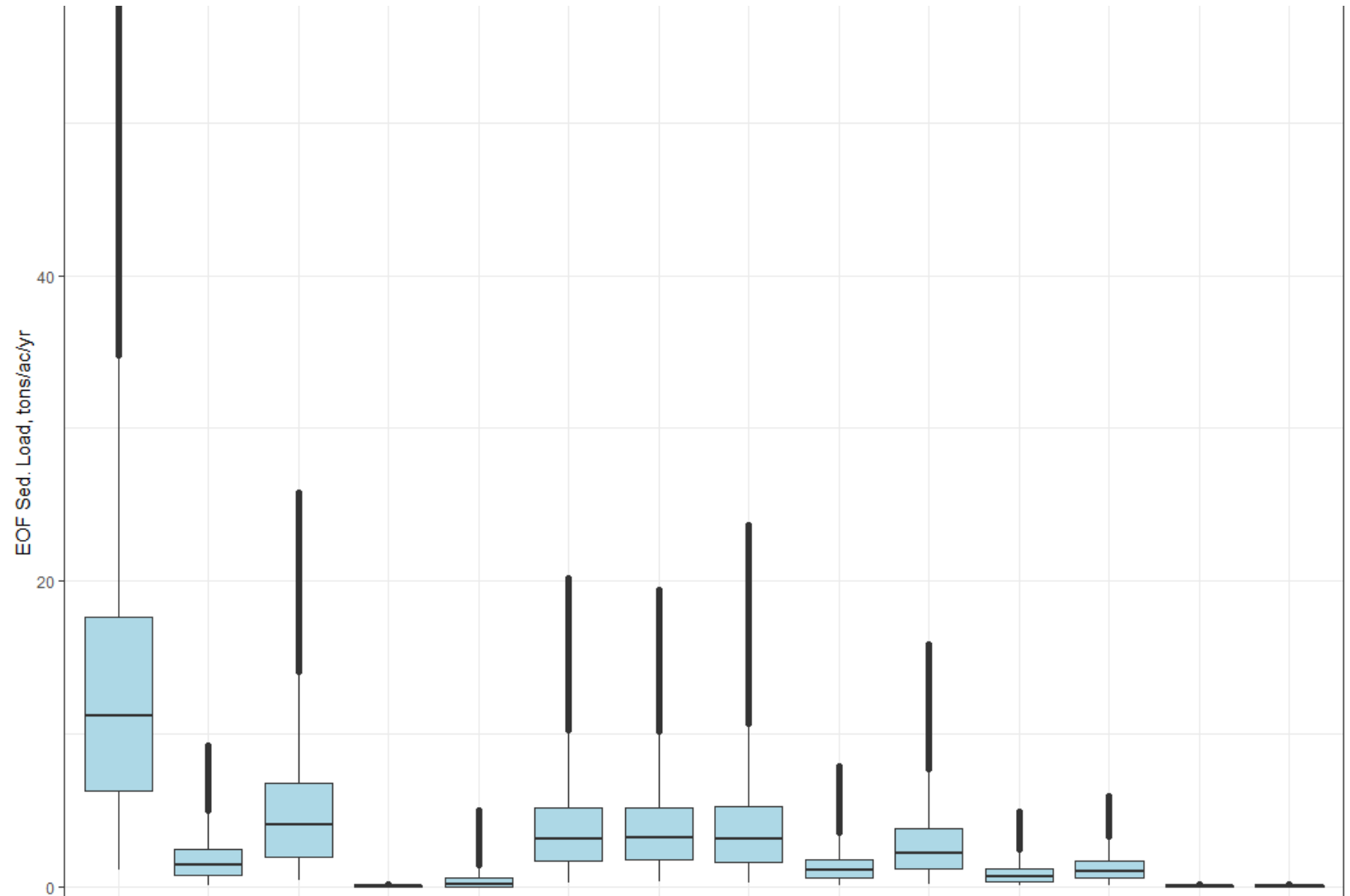
LRseg Scale

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