

Chesapeake Bay Streamflow Base and Critical Period Diagnostics

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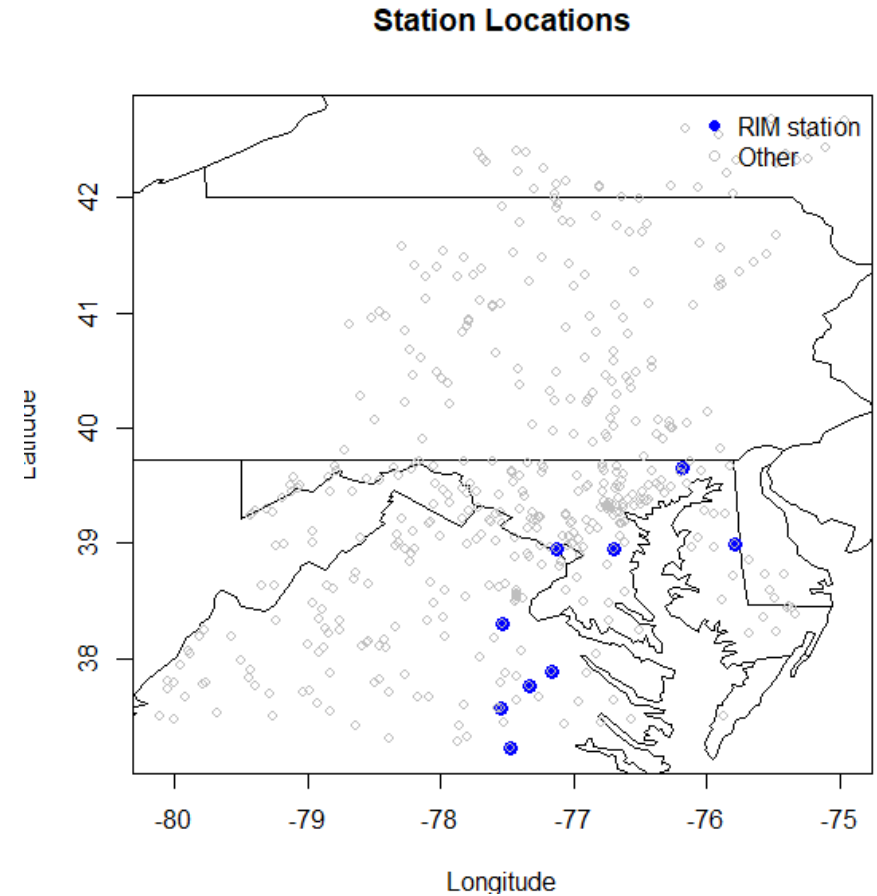
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River Input Monitoring (RIM) station 10-year rolling window approach

- Daily USGS streamflow records were compiled for all stations and padded to a continuous daily sequence.
- Analyses were restricted to **Water Years 1976–2024** to reflect the modern hydroclimatic period.
- Annual metrics were computed only for water years with:
 - **≥ 90% daily data completeness**, and
 - **≥ 330 observed daily values** per water year.
- Rolling windows were evaluated only when **all years within the window met annual completeness criteria**.
- This screening minimizes influence of partial records, start/end-of-record artifacts, and padded years.

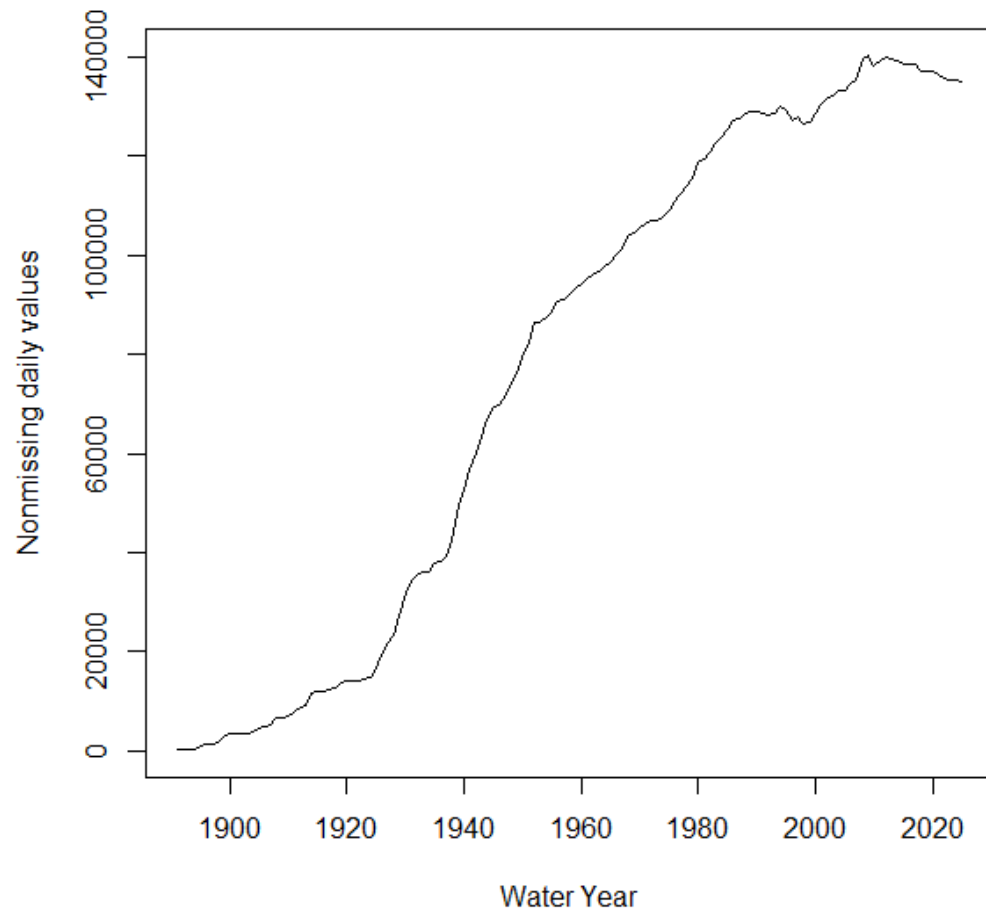
Stations included in base/critical period analysis

- RIM stations define basin-scale freshwater inputs used for model calibration.
- Secondary tributary stations will supplement this analysis to refine characterization of critical and high-stress hydrologic periods
- Basin-scale summaries will incorporate relative flow contribution weighting, following the framework illustrated in Appendix G.

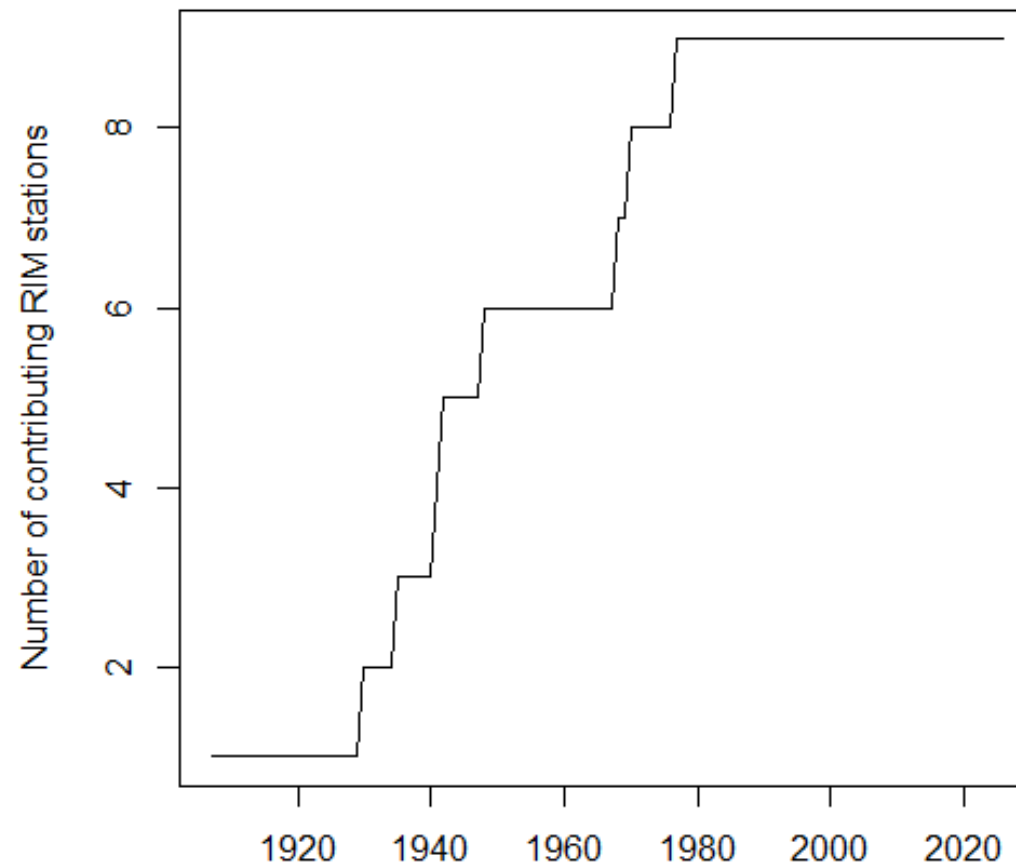


Preliminary Information-Subject to Revision. Not for Citation or Distribution

Total RIM Daily Observations per Water Year

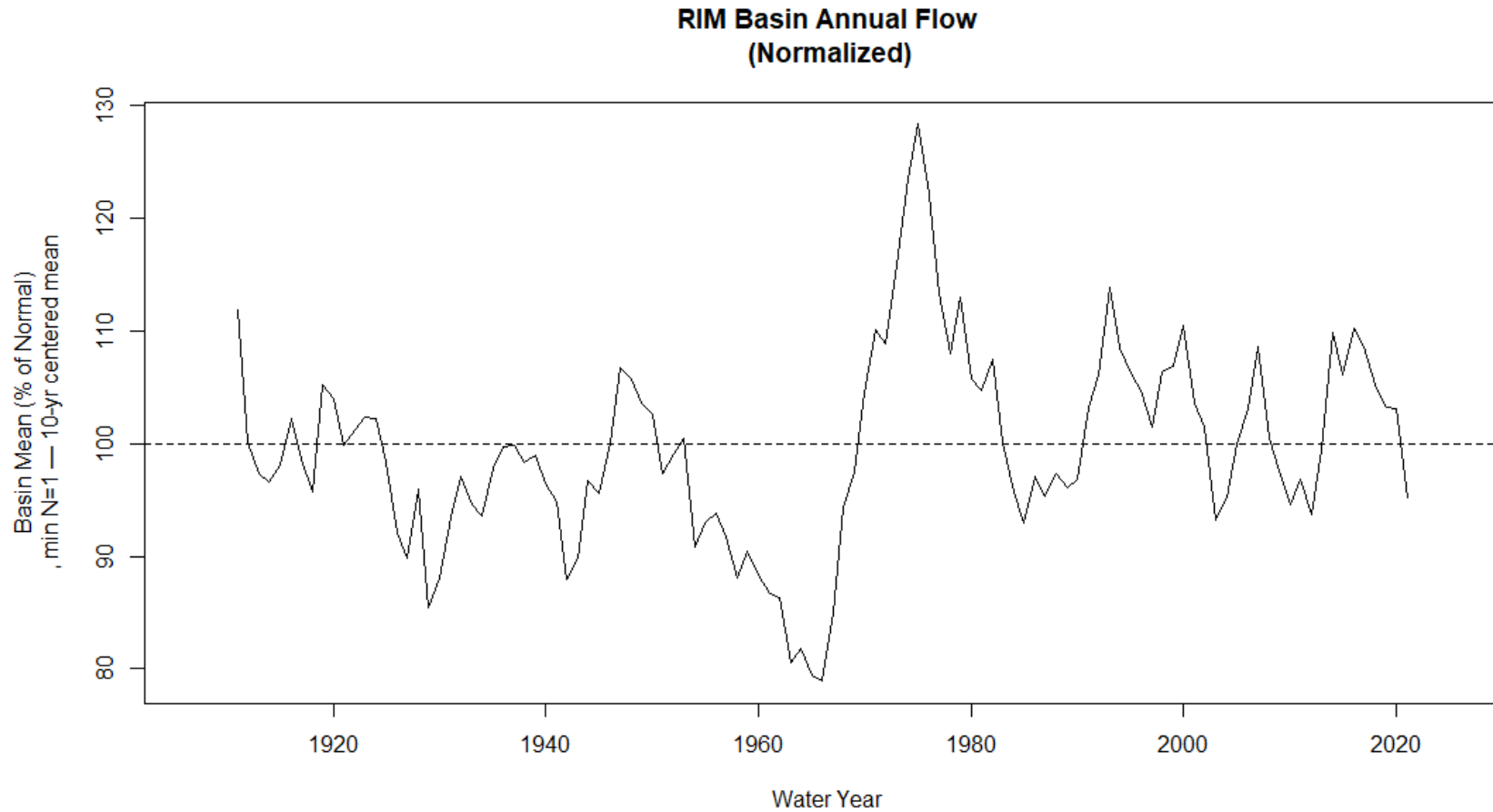


RIM station count



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Entire record- (all RIM stations, equal weighting)

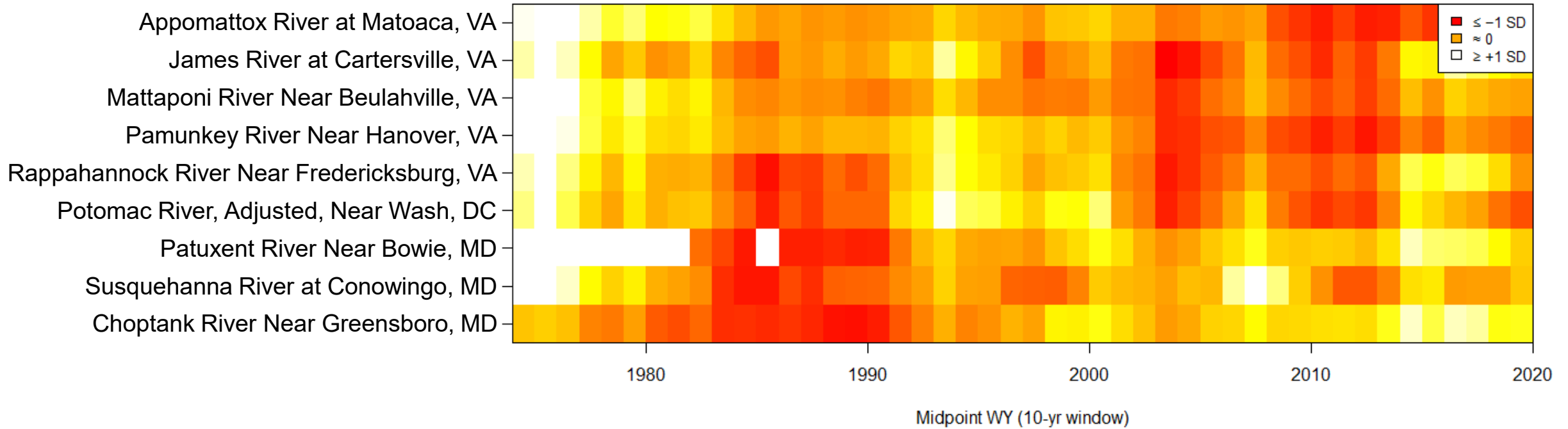


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Annual metrics

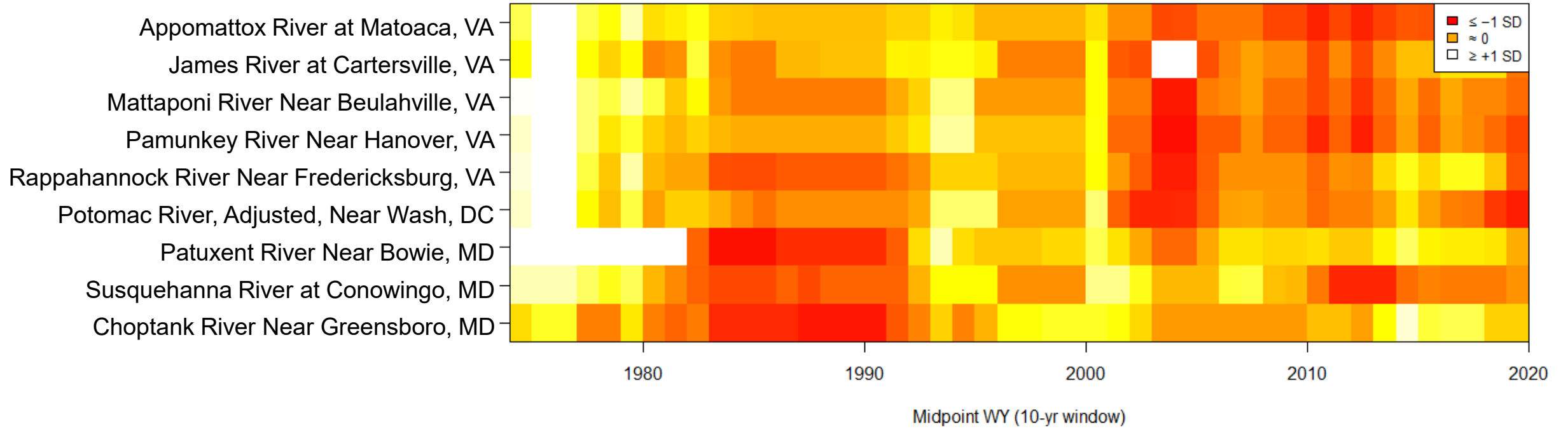
- Daily streamflow are summarized to **annual metrics** for each station:
 - Mean and median daily flow
 - Lower tail quantiles (Q05, Q10)
 - Upper tail quantiles (Q90, Q95)
 - Variability metrics (e.g., coefficient of variation)

RIM stations: rolling 10-yr mean annual Q (z-score)



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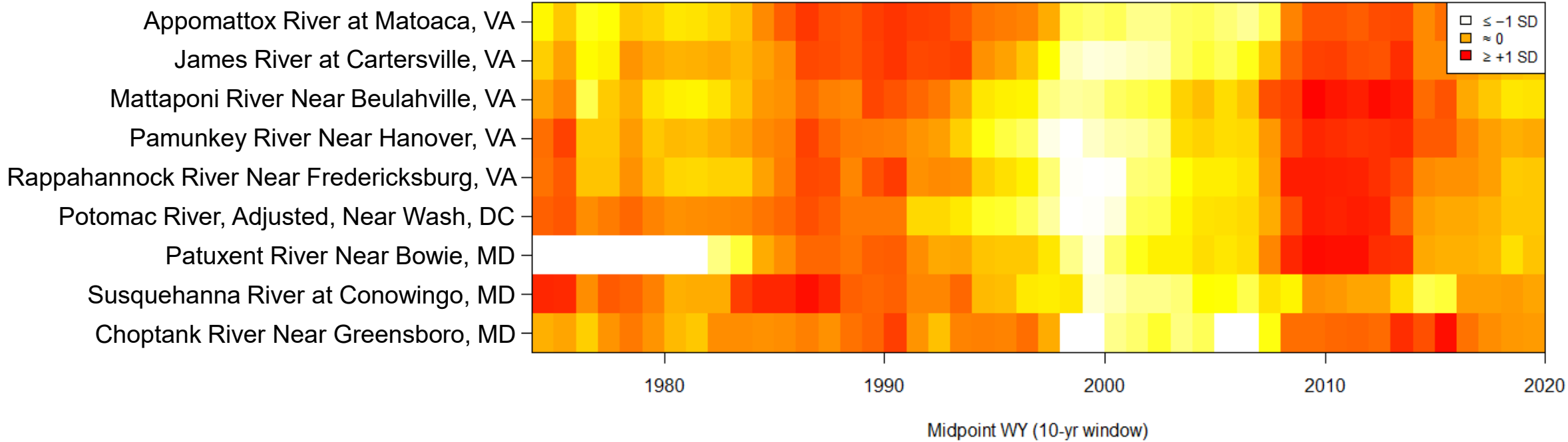
RIM stations: rolling 10-yr median annual Q (z-score)



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Annual flow variability (standard deviation)

RIM stations: rolling 10-yr S.D. annual Q (z-score)

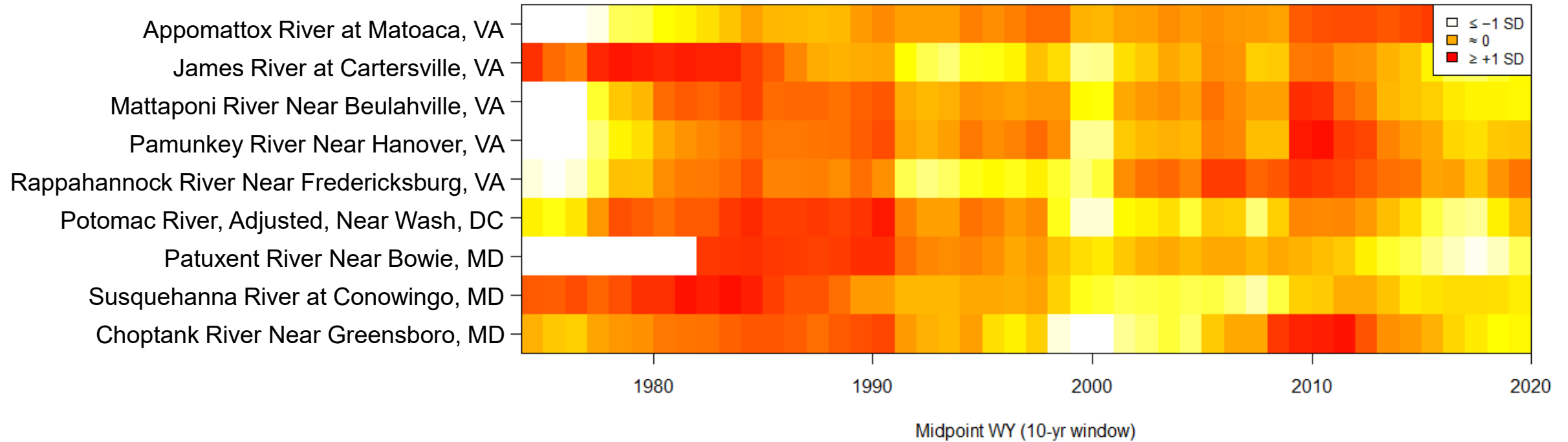


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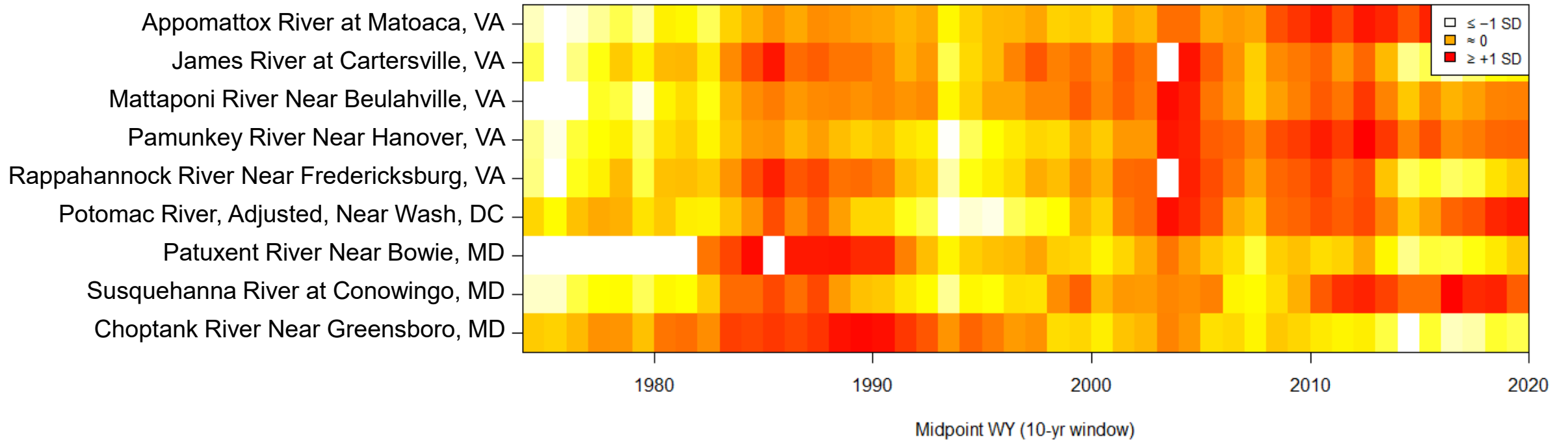
Low flow magnitudes (Q05)

RIM stations: rolling 10-yr Q05 annual Q (z-score)

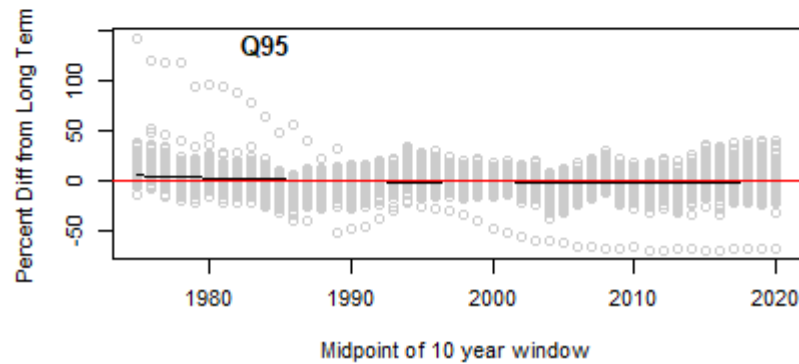
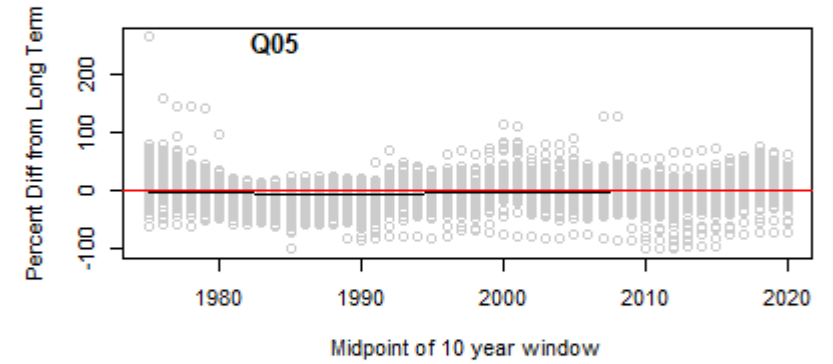
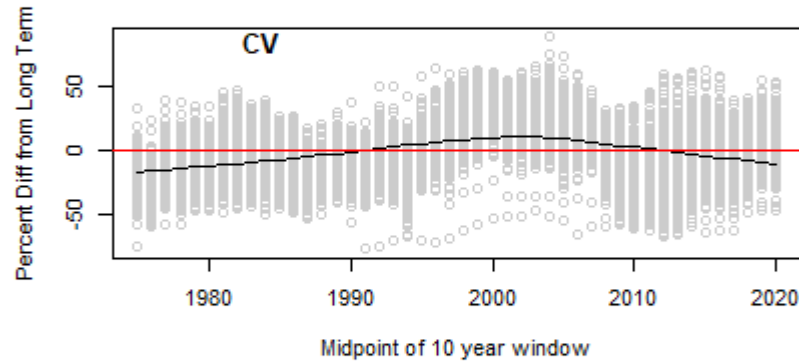
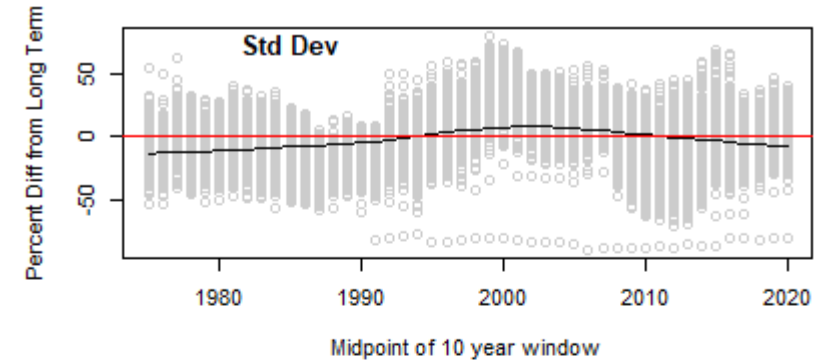
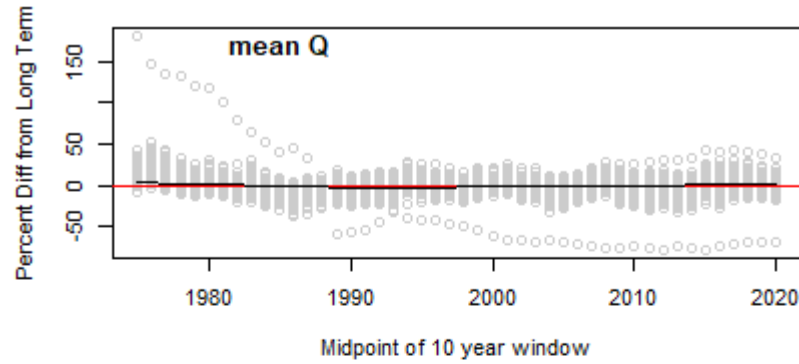


High flow magnitudes (Q95)

RIM stations: rolling 10-yr Q95 annual Q (z-score)

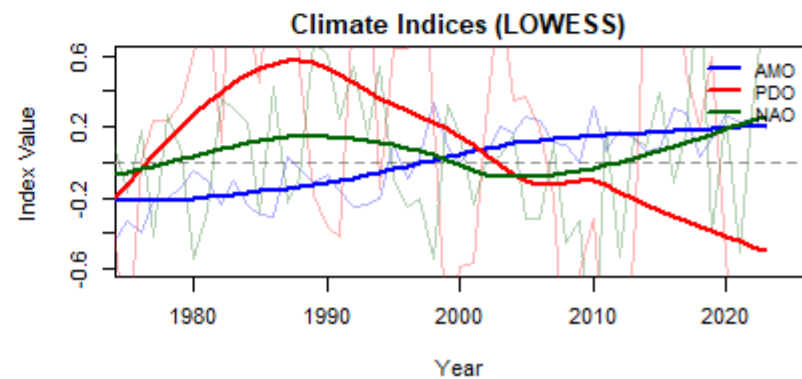
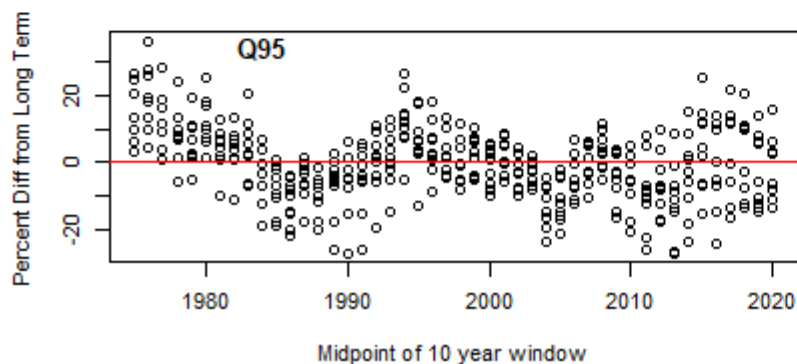
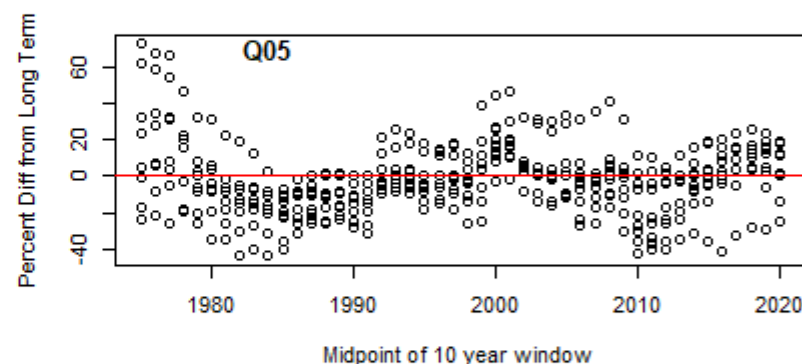
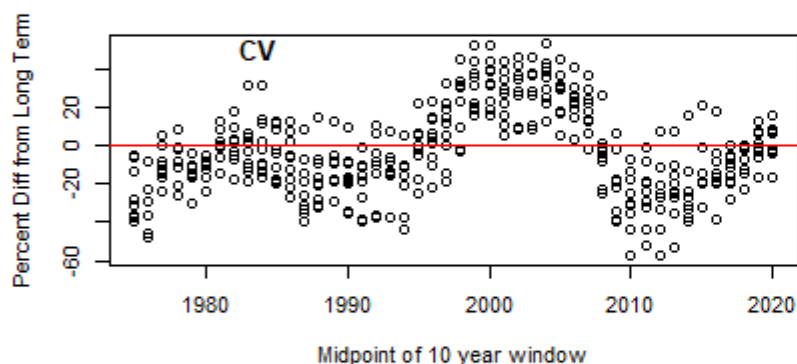
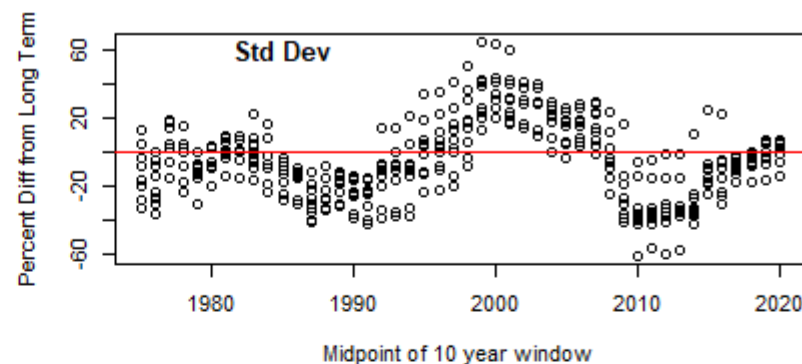
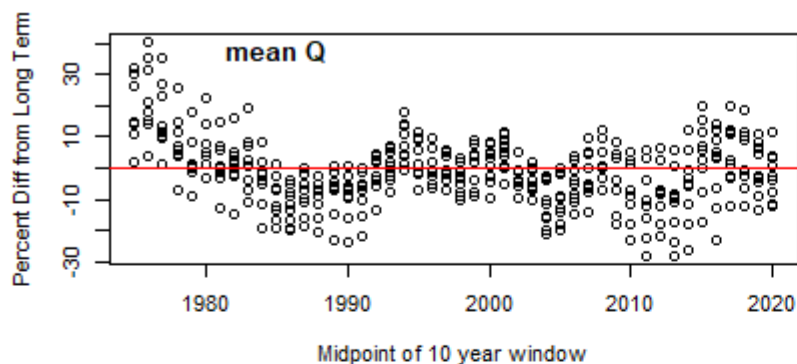


Larger station network with tribs

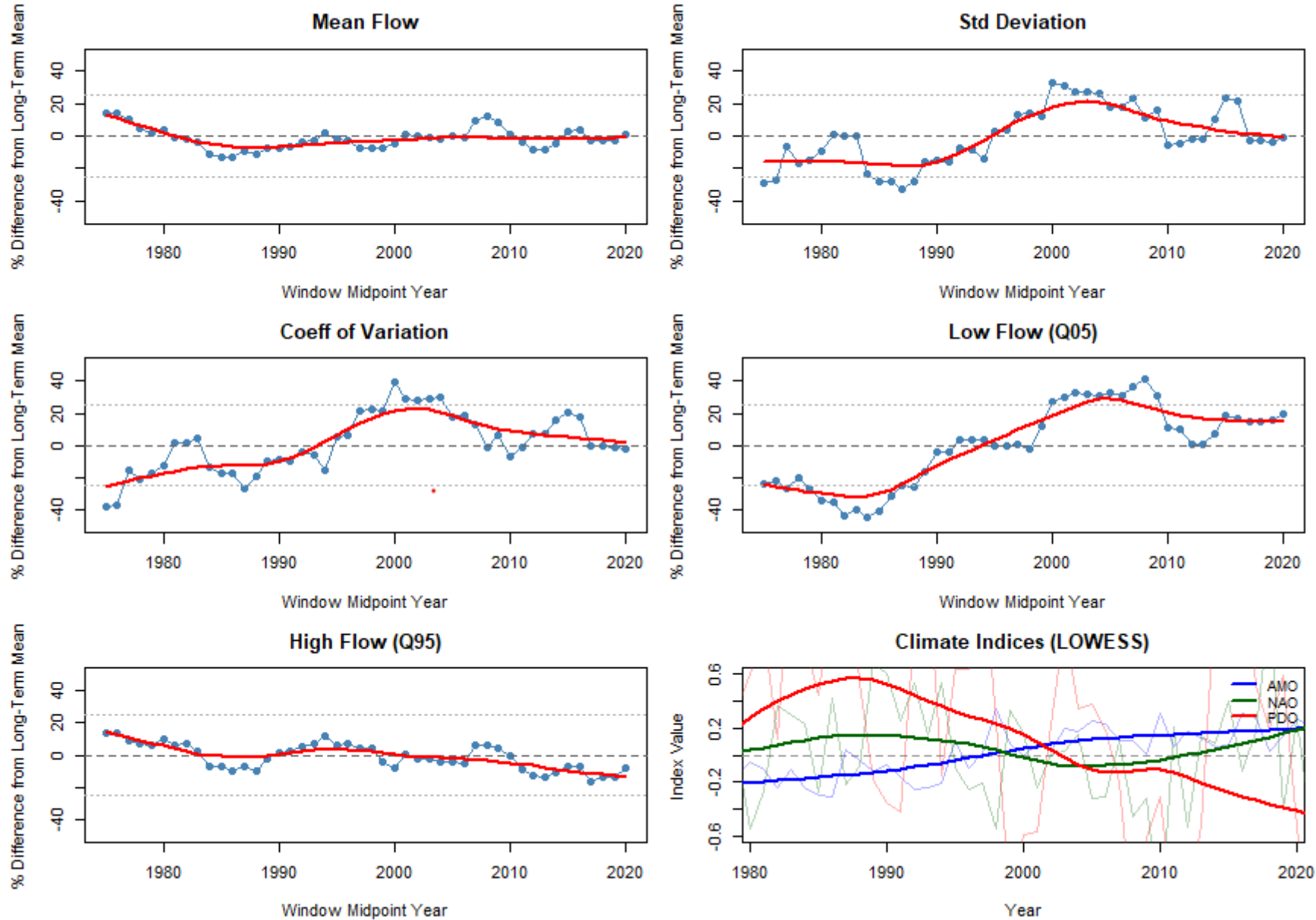


10-Year Window Statistics vs. Long-Term Mean | Chesapeake Bay Gages

RIM stations only



10-Year Window Statistics — Susquehanna River at Conowingo, MD



Possible teleconnection with NAO?

Kam and Sheffield, 2016: Interannual variability of low flows as increased due to anti-correlation with NAO and PNA

NAO: strength and location of the Atlantic jet stream and storm track

(+)NAO: fewer cold-air outbreaks and decreased storminess

(-) NAO stronger cold-air outbreaks and increased storminess

Base Period Scoring: Methodology

- Windows scored by Mean Absolute Percent Difference (MAPD) from long-term statistics

$$\text{MAPD} = \frac{1}{n} \sum_{i=1}^n \left| \frac{S_w - S_{LT}}{S_{LT}} \right| 100$$

where:

S_w = statistic for 10-year window

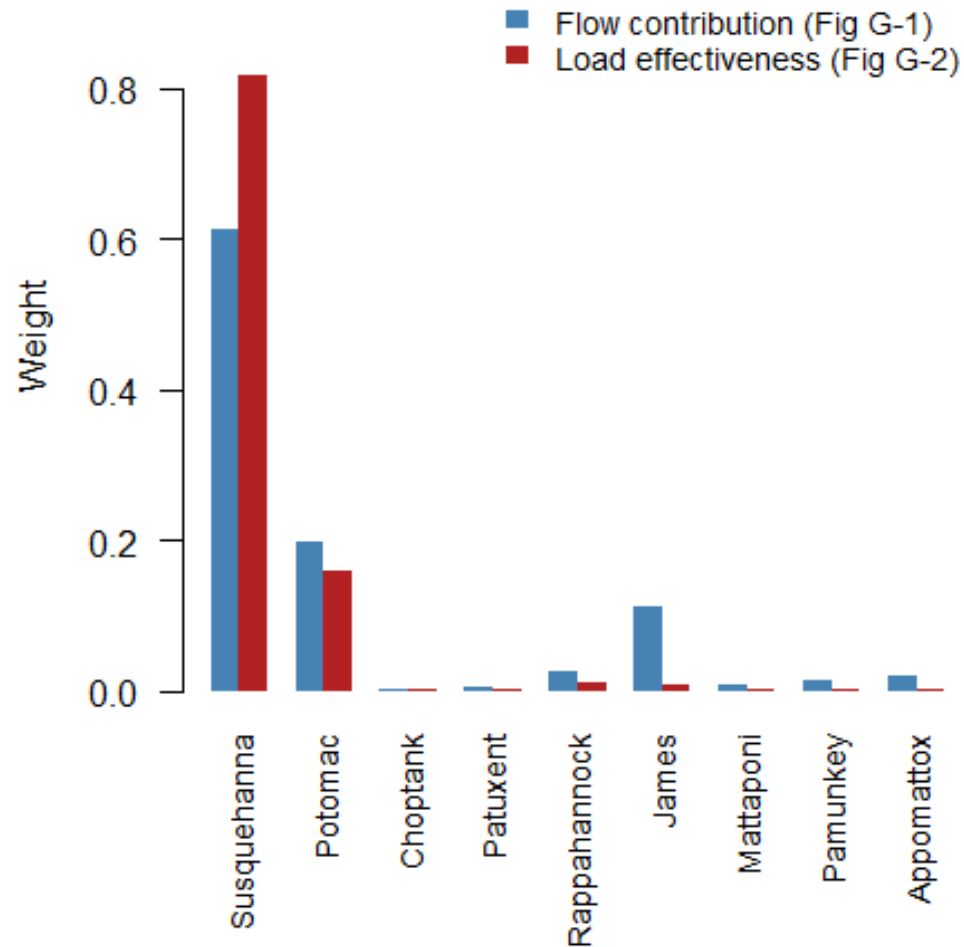
S_{LT} = long-term mean statistic

n = number of metrics and gages

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- Builds on previous analysis (appendix F):
 - Nearly double the candidate period (1970-2024)
 - Added Q05, Q95, CV

Computed across: mean Q, SD, CV, Q05, Q95

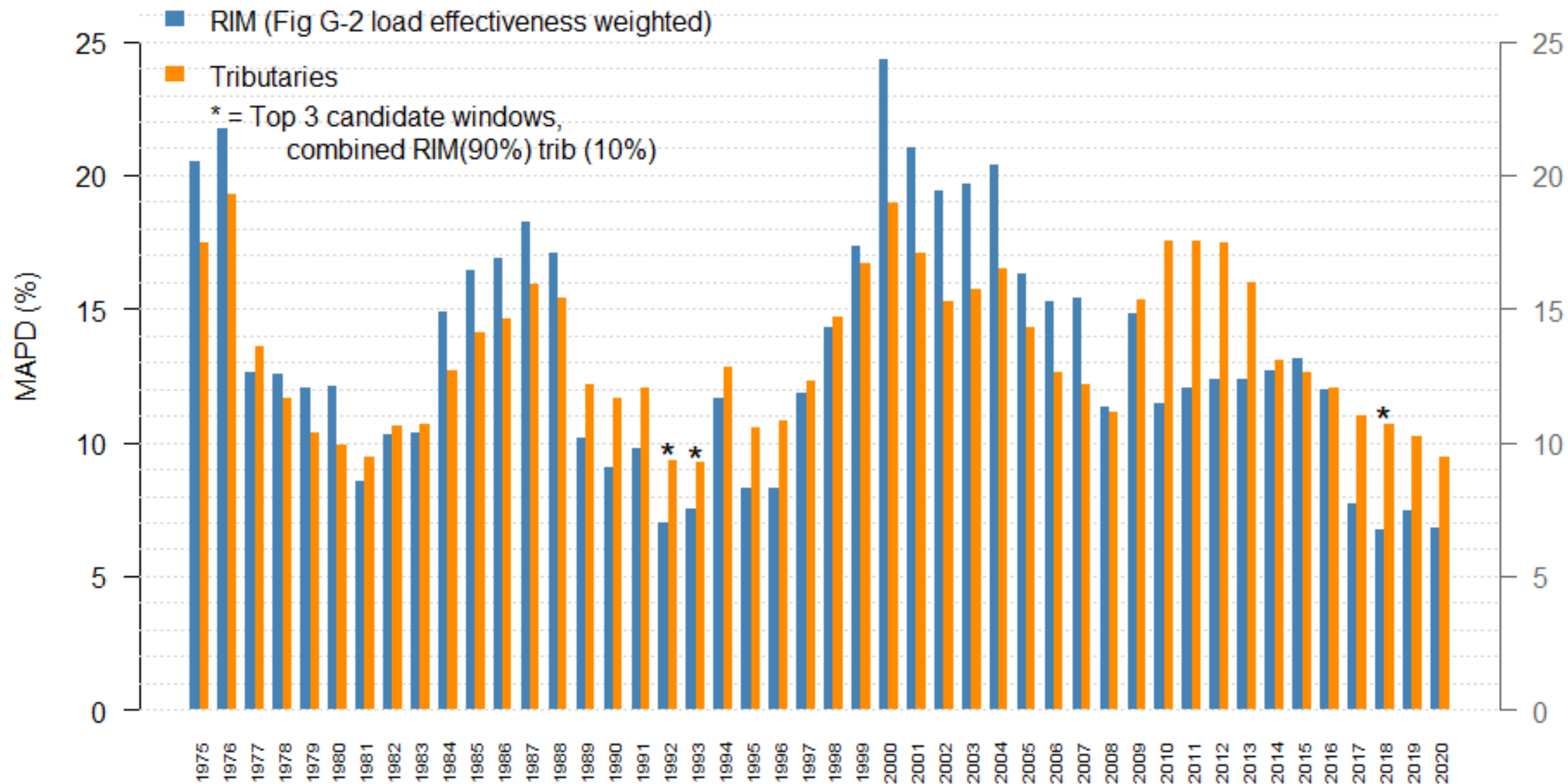
RIM Station Weights: Flow Contribution vs Load Effectiveness



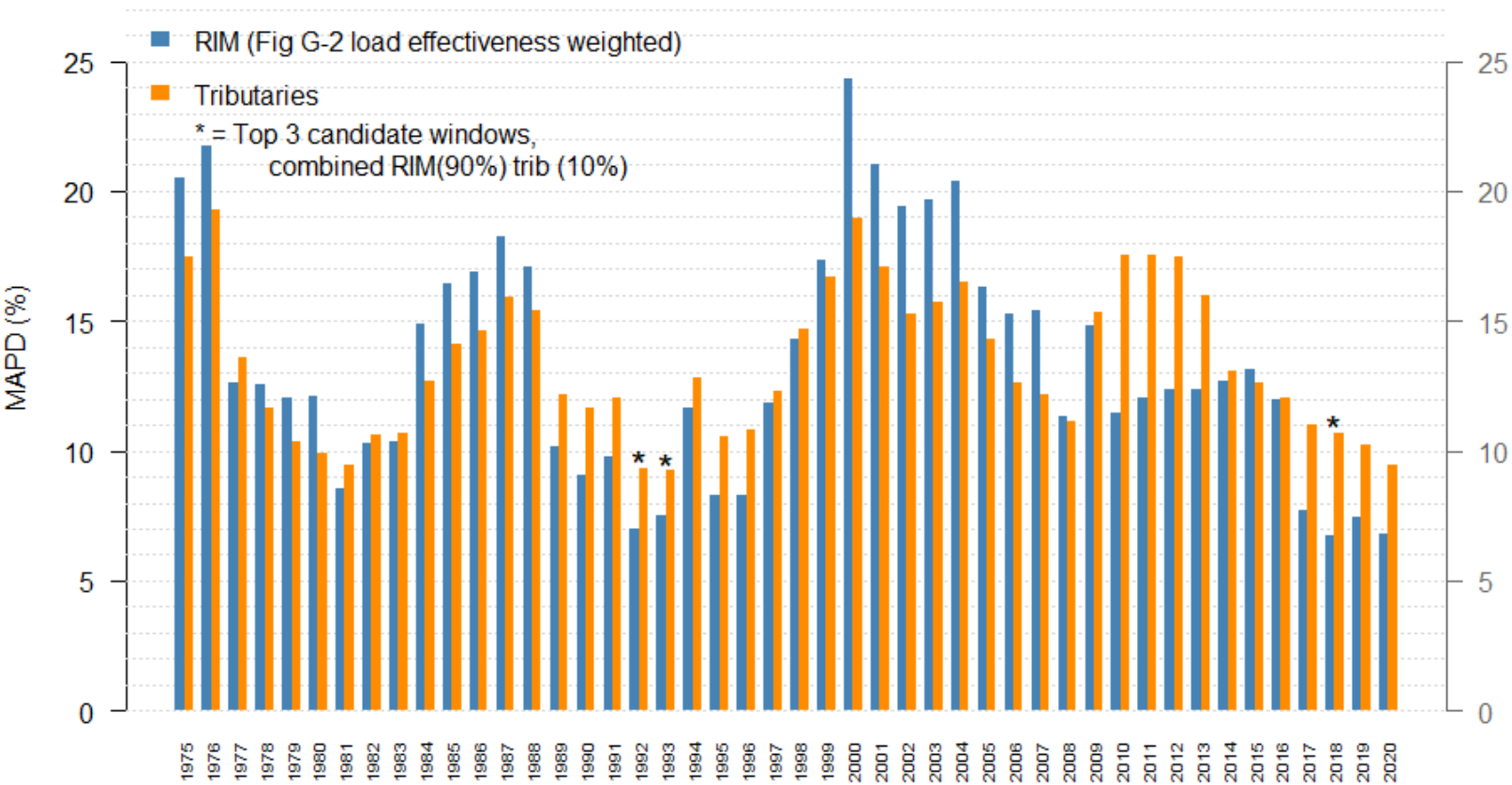
RIM Station Weighting: Flow vs. Effective Contribution (Fig G-1 vs G-2)

- Susquehanna: 61% → 82%
- Potomac: 20% → 16%
- James & Rappahannock: significant reduction
- Smaller tributaries: minor influence under both approaches
- Choptank: unchanged and small despite high raw multiplier

MAPD by Component — RIM vs Tributary Stations



MAPD by Component — RIM vs Tributary Stations



Top 3 RIM stations (load effectiveness weighted):

- 1992 → window **1987–1996**
- 1993 → window **1988–1997**
- 2018 → window **2013–2022**

Top 3 Tributary stations (unweighted):

- 1993 → window **1988–1997**
- 1992 → window **1987–1996**
- 2020 → window **2015–2024**

Top 3 Combined 90/10:

- 1992 → window **1987–1996**
- 1993 → window **1988–1997**
- 2018 → window **2013–2022**

Next steps

- Confirm equal statistical weighting on MAPD, or adjust to emphasize high flows
- Add Kolmogorov-Smirnov test statistic for distribution fit (Appendix F method)
- Update load effectiveness weights to Phase 6 values
- Finalize RIM-trib weighting split
- Present final ranked candidate windows for group decision

