Understanding Trends in Load

Gary Shenk, Isabella Bertani, Scott Ator, Andrew Sekellick

Modeling workgroup 10/6/2020

Partners

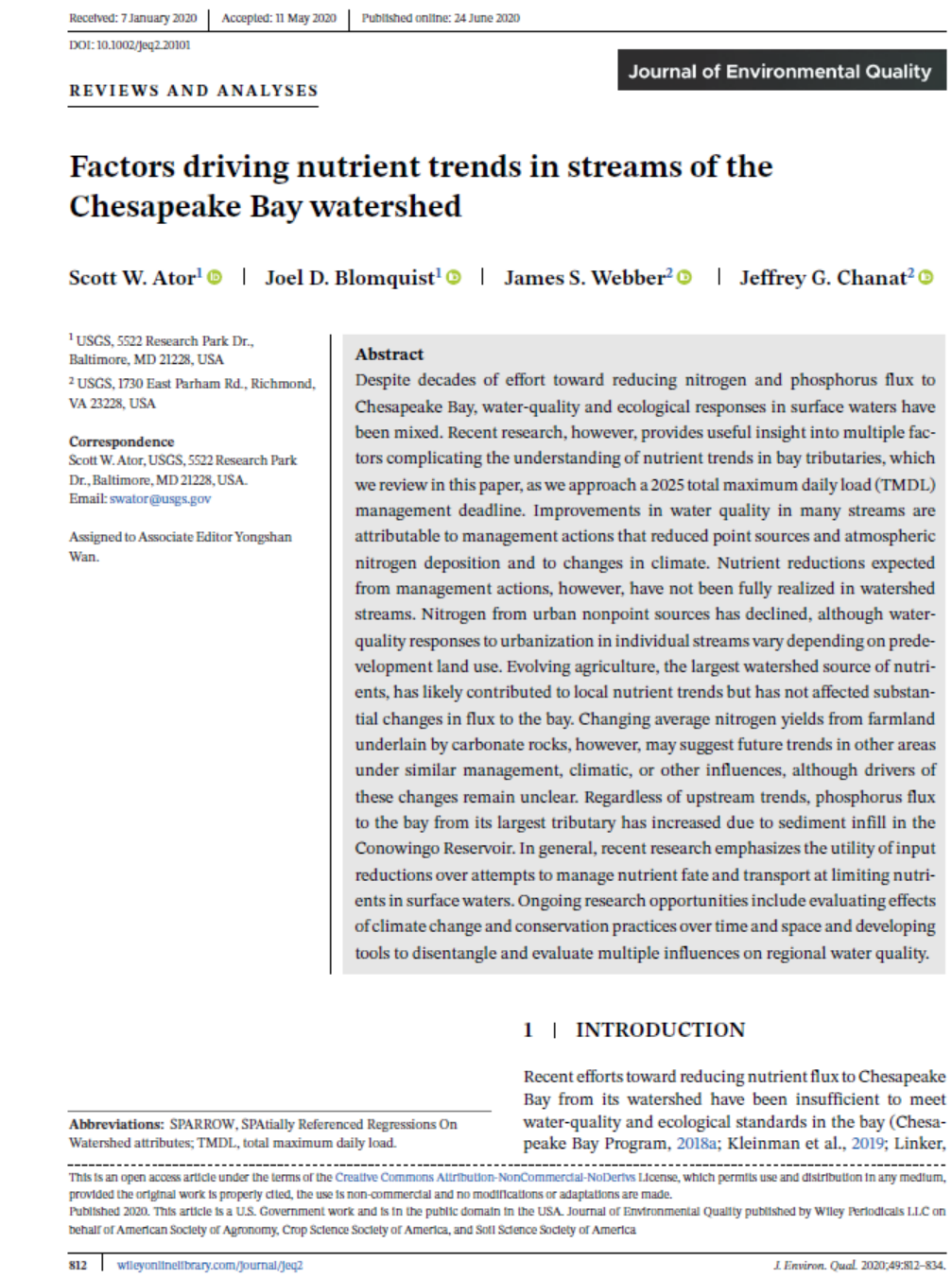
- Factors Team
  - Investigating reasons for non-tidal trends
  - Working closely with CBPO group
- Scientific Gap Analysis
  - Watershed group asking the same question about 2025
  - Review of past STAC work

Management Question

- TMDL: Implement the practices by 2025 that will eventually lead to meeting water quality standards
- CAST prediction: What is the long-term load resulting from a given state of the watershed (land use, point sources, management actions, etc)
- WRTDS- flow normalized loads: based on a moving relationship between flow and concentration, how do loads change over time if annual flow is the same
- Science question: How do we use monitoring data to validate the predictions of CAST

CAST and WRTDS Differences

- Unrealistic expectations
  - Implementation amount
  - BMP effects
- Lag times
  - Implementation / maturation of BMPs
  - Groundwater
  - Soil equilibration
- Insufficient Monitoring –
  - Quantified as uncertainty in WRTDS trends
- Competing effects
  - Conowingo
  - Climate change
  - Weather cycle effects



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REVIEWS AND ANALYSES

Factors driving nutrient trends in streams of the Chesapeake Bay watershed

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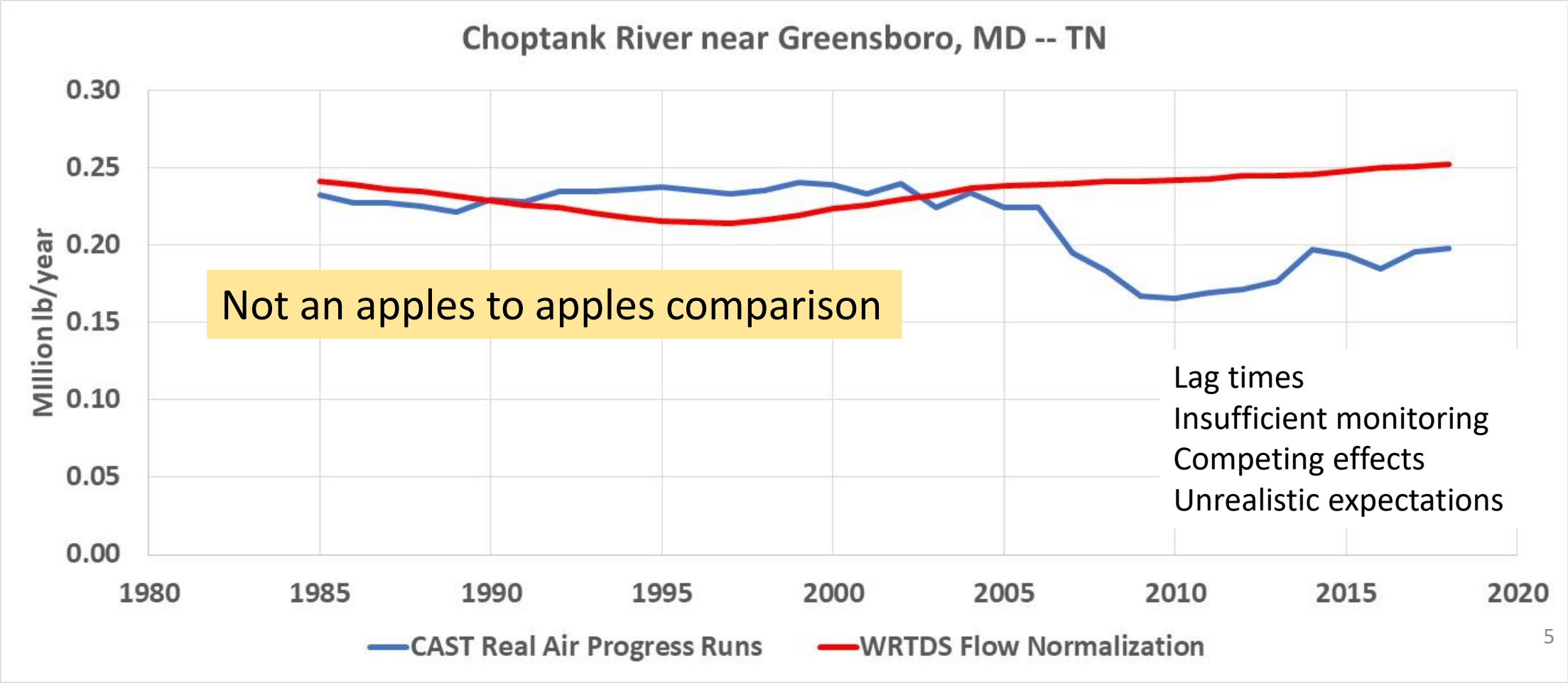
Abstract
Despite decades of effort toward reducing nitrogen and phosphorus flux to Chesapeake Bay, water-quality and ecological responses in surface waters have been mixed. Recent research, however, provides useful insight into multiple factors complicating the understanding of nutrient trends in bay tributaries, which we review in this paper, as we approach a 2025 total maximum daily load (TMDL) management deadline. Improvements in water quality in many streams are attributable to management actions that reduced point sources and atmospheric nitrogen deposition and to changes in climate. Nutrient reductions expected from management actions, however, have not been fully realized in watershed streams. Nitrogen from urban nonpoint sources has declined, although water-quality responses to urbanization in individual streams vary depending on predevelopment land use. Evolving agriculture, the largest watershed source of nutrients, has likely contributed to local nutrient trends but has not affected substantial changes in flux to the bay. Changing average nitrogen yields from farmland underlain by carbonate rocks, however, may suggest future trends in other areas under similar management, climatic, or other influences, although drivers of these changes remain unclear. Regardless of upstream trends, phosphorus flux to the bay from its largest tributary has increased due to sediment infill in the Conowingo Reservoir. In general, recent research emphasizes the utility of input reductions over attempts to manage nutrient fate and transport at limiting nutrients in surface waters. Ongoing research opportunities include evaluating effects of climate change and conservation practices over time and space and developing tools to disentangle and evaluate multiple influences on regional water quality.

1 | INTRODUCTION

Recent efforts toward reducing nutrient flux to Chesapeake Bay from its watershed have been insufficient to meet water-quality and ecological standards in the bay (Chesapeake Bay Program, 2018a; Kleinman et al., 2019; Linker,

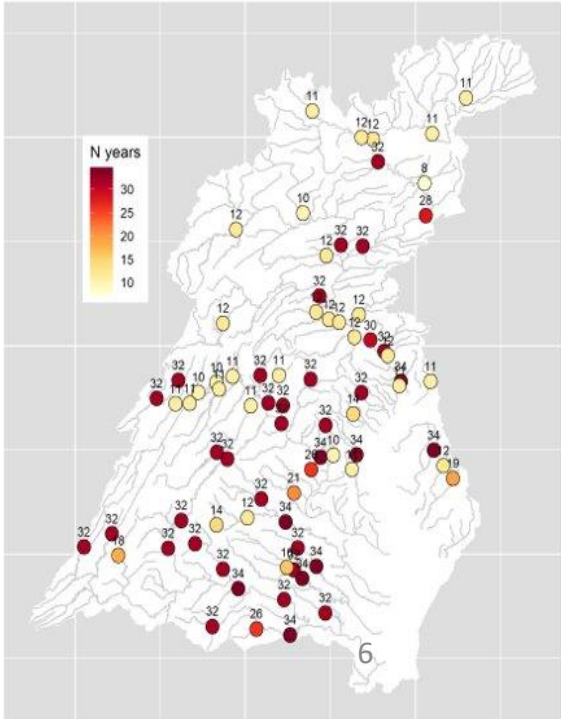
Abbreviations: SPARROW, SPAtially Referenced Regressions On Watershed attributes; TMDL, total maximum daily load.

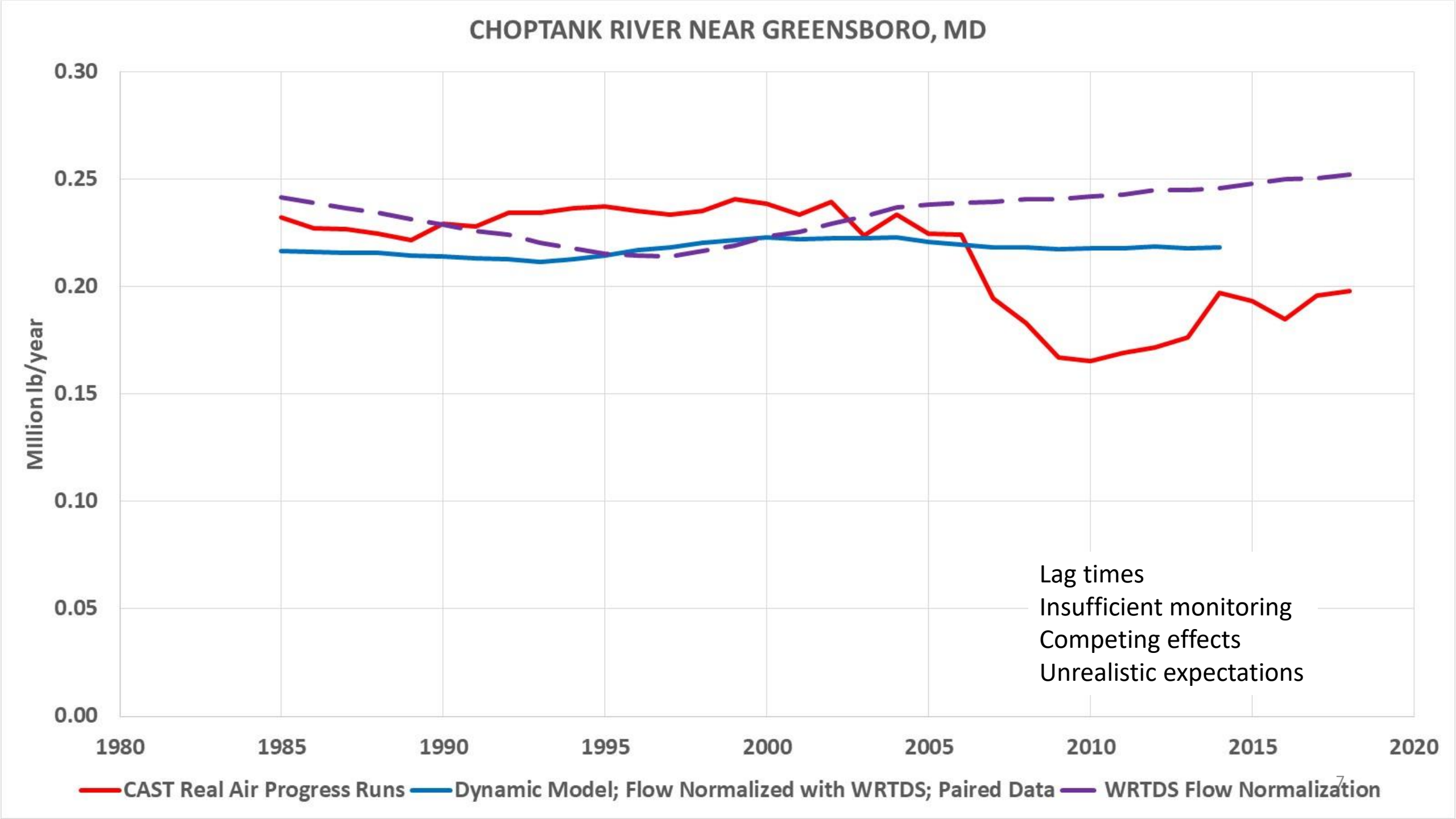
- CAST – trends in management using a long-term average hydrology
- WRTDS Flow Normalized Loads – Regression model based on observations



Next steps

- Generalize understanding of
  - Lag times
  - Insufficient monitoring
  - Competing effects
- Build a statistical model to look for patterns related to unrealistic expectations
  - Decade
  - Land use
  - Nutrient source
  - Source
  - Region
  - Management
  - …




CHOPTANK RIVER NEAR GREENSBORO, MD
Million lb/year
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0.25
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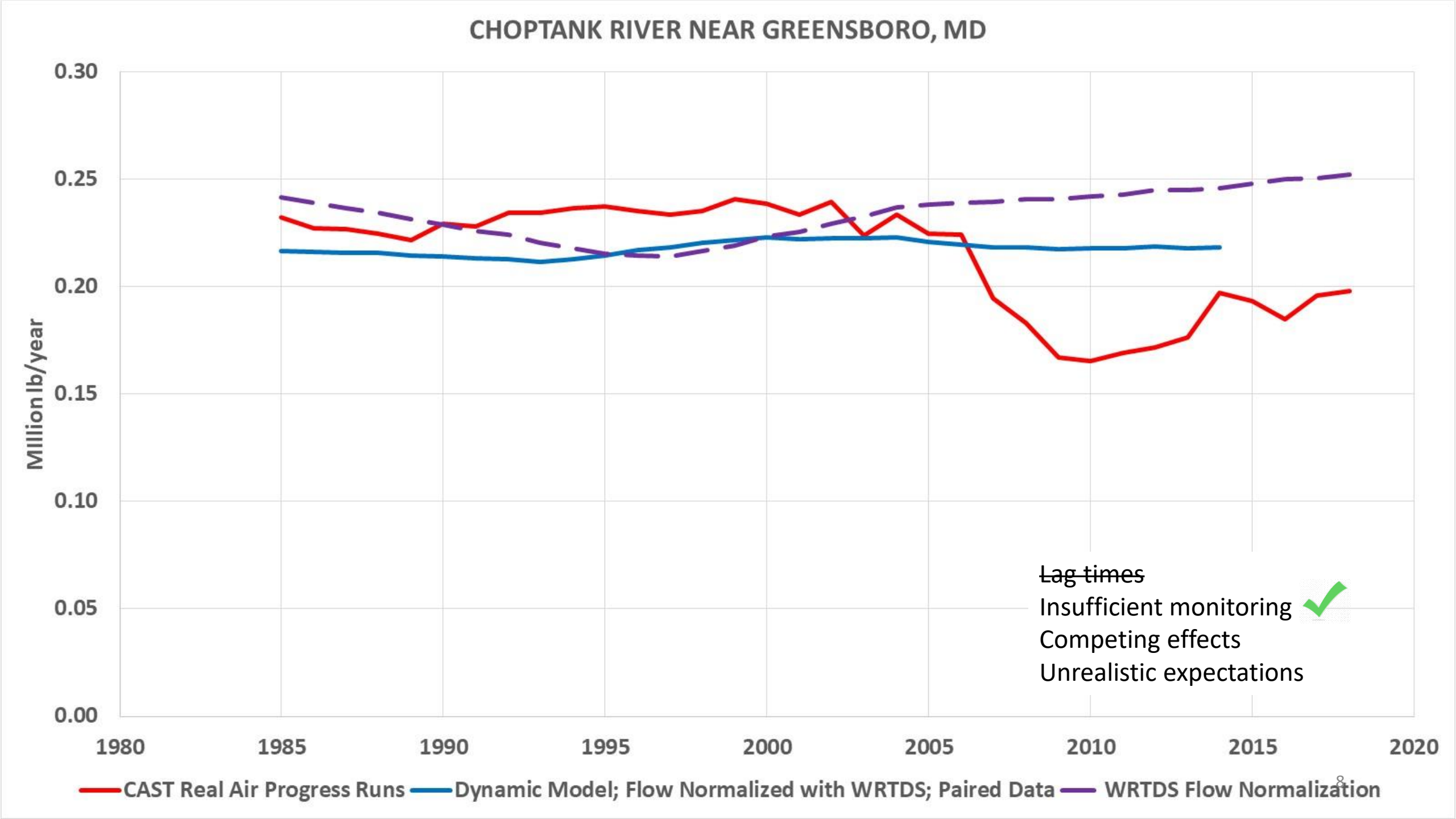
0.15
0.10
0.05
0.00
1980
1985
1990
1995
2000
2005
2010
2015
2020
Lag times
Insufficient monitoring
Competing effects
Unrealistic expectations
CAST Real Air Progress Runs
Dynamic Model; Flow Normalized with WRTDS; Paired Data
WRTDS Flow Normalization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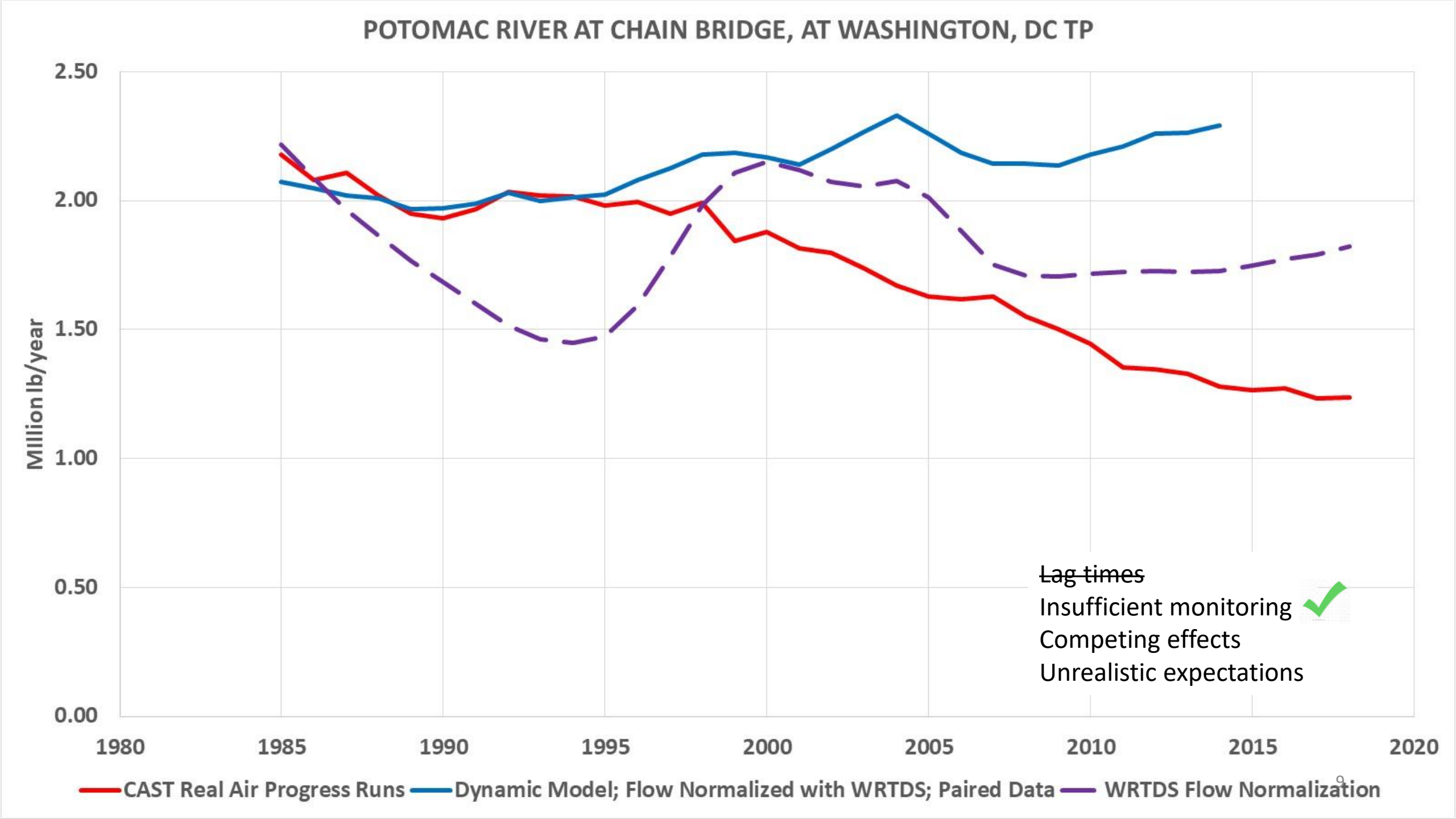
POTOMAC RIVER AT CHAIN BRIDGE, AT WASHINGTON, DC TP
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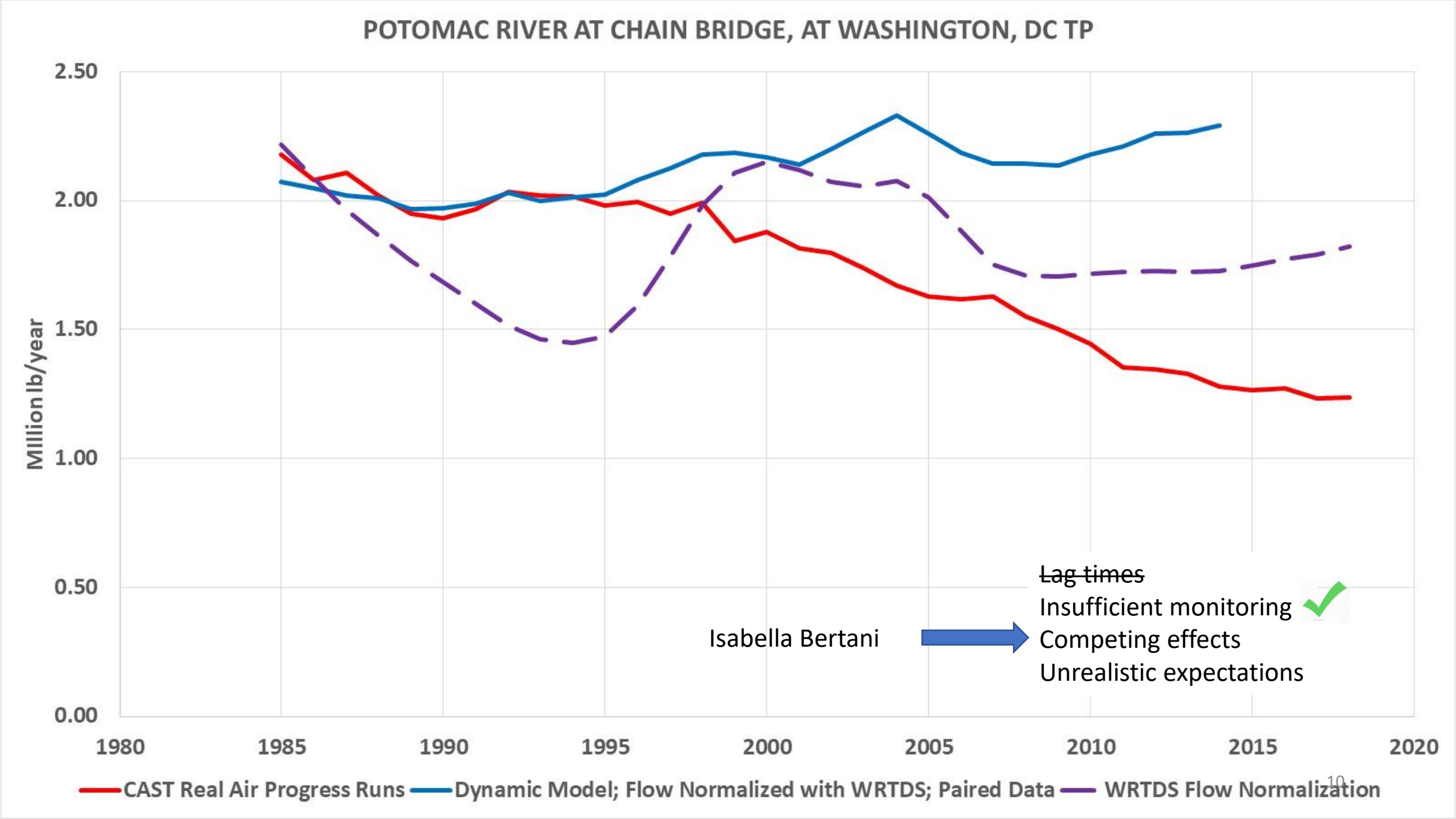
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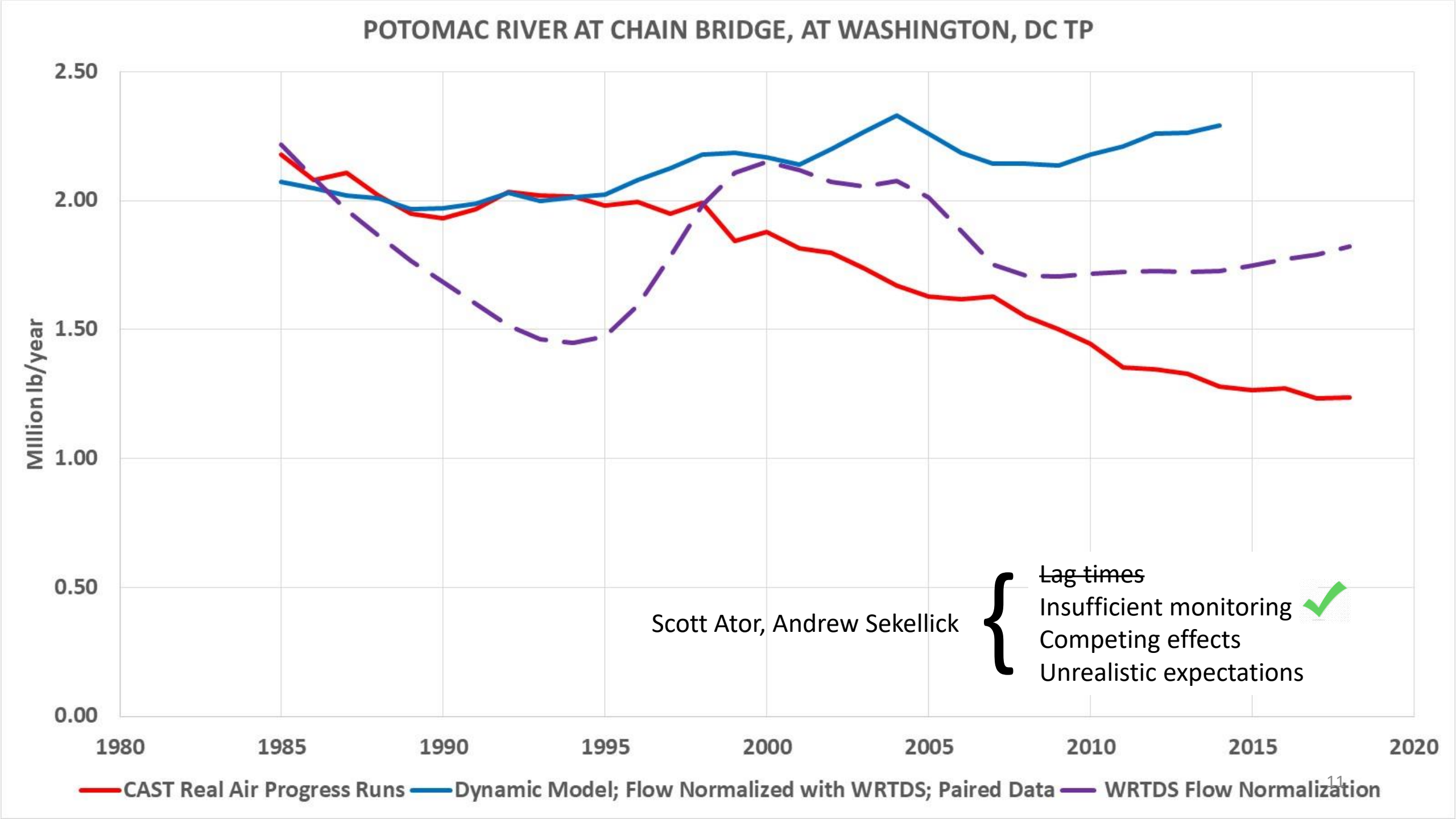
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