Use of Change Factor Methodology to Estimate Dissolved Oxygen Under Various Loading Conditions

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The following slides describe ongoing staff research as of February 10, 2025, and do not necessarily reflect policies or proposals of the Delaware River Basin Commission.

This presentation is provided as a contribution to an ongoing dialogue in the spirit of advancing collective understanding of environmental processes.

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What is a change factor analysis?

Why use a change factor analysis?

How did we perform a change factor analysis?

How can this product be utilized in future work?

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What is a change factor analysis?

- Commonly applied to address uncertainty in global climate models
- Characterize the change that is expected relative to a baseline condition
- Preserves characteristics of the observed dataset
- A combination of additive and multiplicative change factors was employed: Linear regression

"Change Factors"

(a.k.a. "delta change factors")

In climate science, difference between simulated future and simulated historic conditions.

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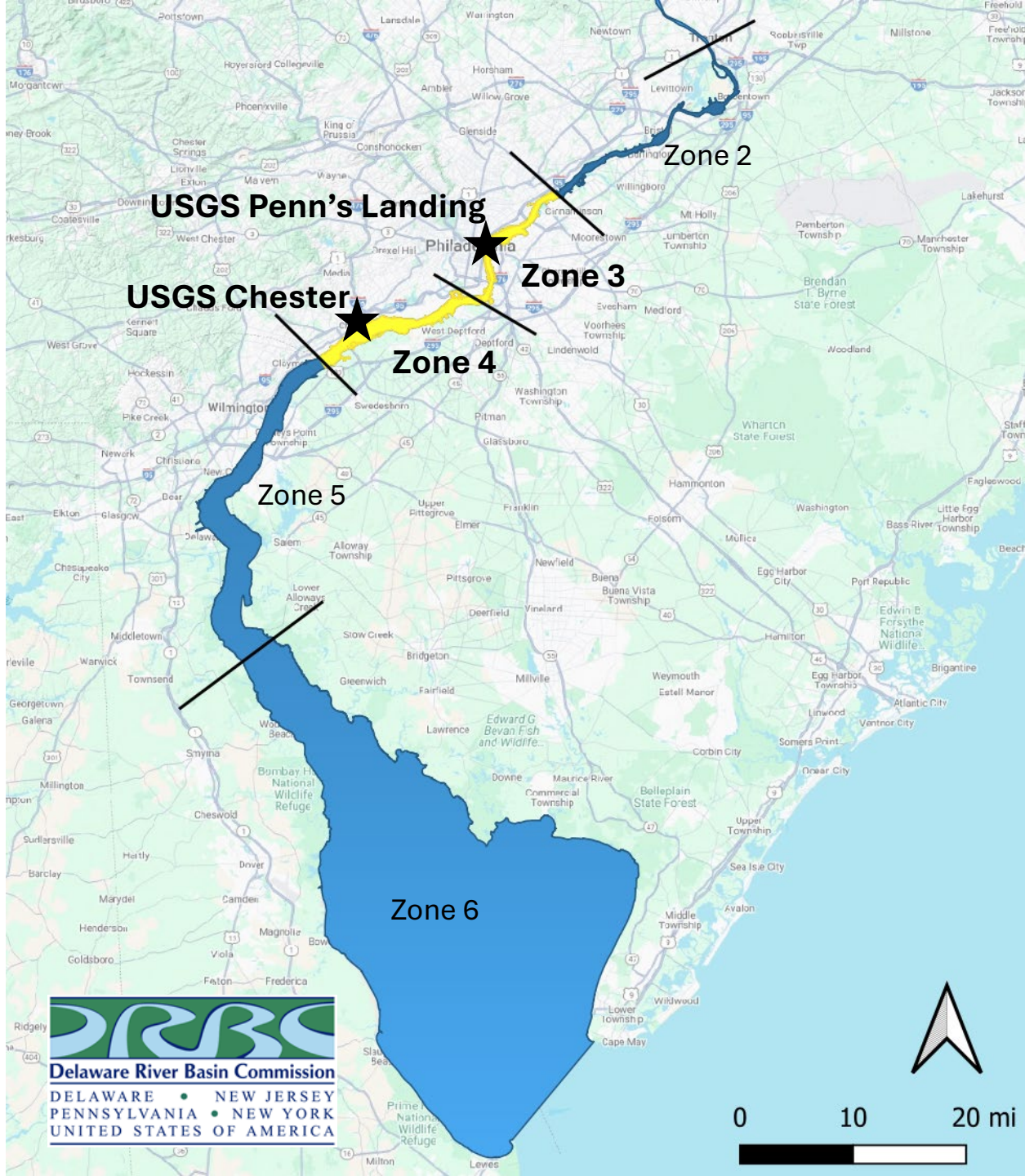
Why use a change factor analysis?

- Leverage the strengths of
  - EFDC–WASP model and
  - Years of continuous observed DO

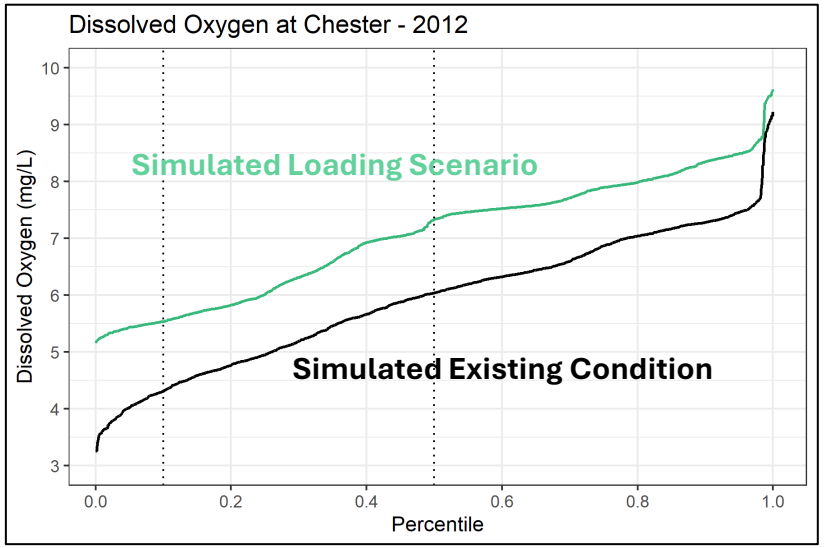
- Improve estimation of DO
  - In **unmodeled years**
  - At **unmonitored locations** and
  - Across different **loading scenarios**
  - **Beyond** what is possible with either model output or continuous data **alone**



How did we perform a change factor analysis?

Data Inputs

- WASP model DO predictions in **2012, 2018, and 2019**
  - Simulated Existing Condition
  - Simulated Loading Scenario



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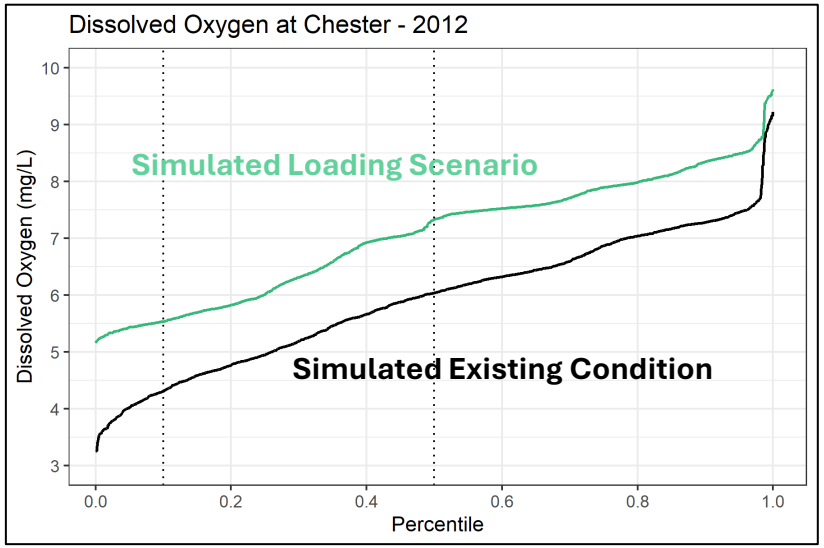
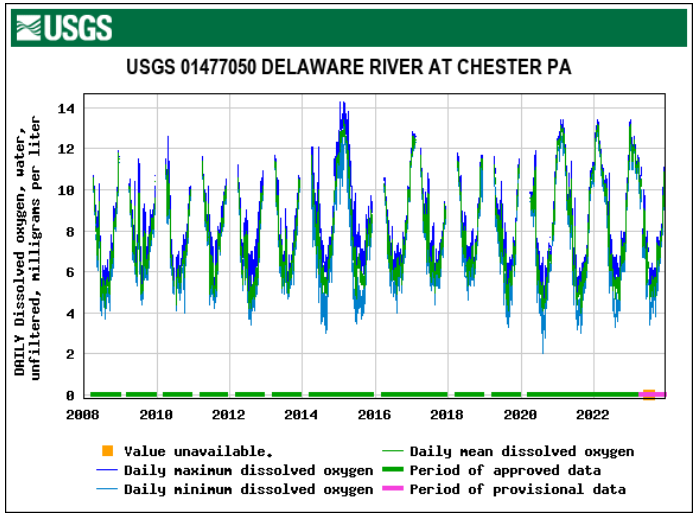


- Continuous USGS DO from **2008 – 2023**
  - Chester, Pennsylvania (01477050)
  - Penn's Landing, Pennsylvania (01467200)



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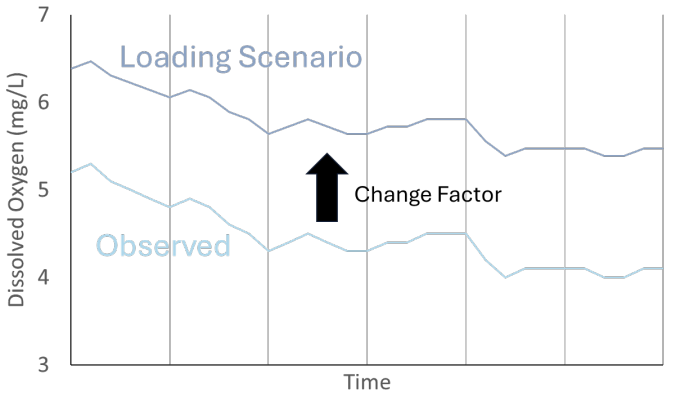
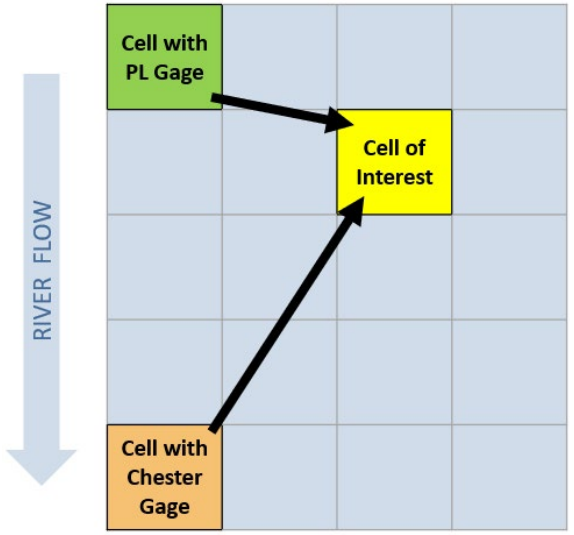
How did we perform a change factor analysis?

1. Develop and apply a loading scenario change factor to estimate DO at gaged locations over the 15-year period.



2. Develop and apply a spatial change factor to estimate DO at ungaged locations over the 15-year period.



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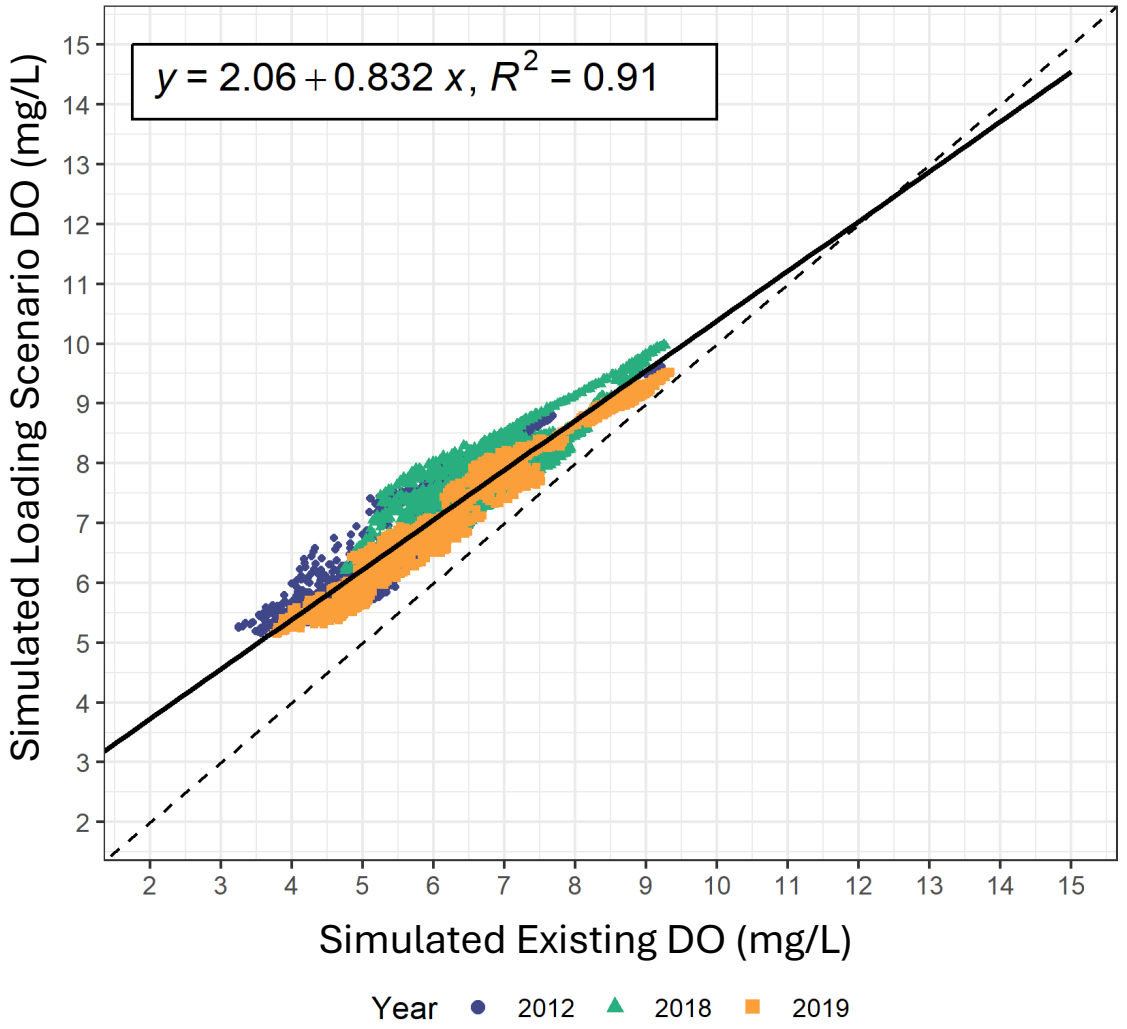
Develop change factor by regressing loading scenario DO against existing DO using model data



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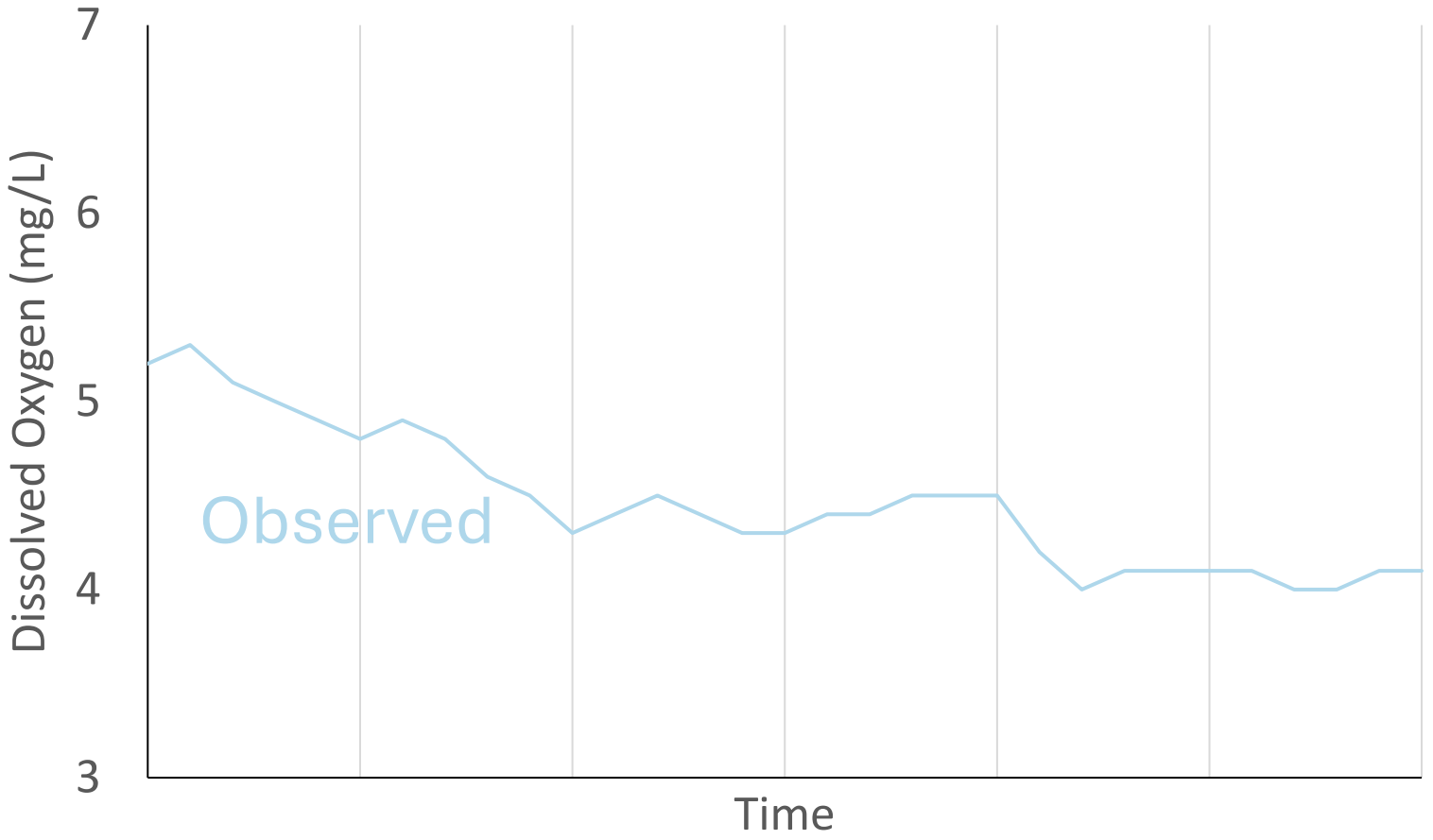
Apply change factor to **observed gage data** to estimate **loading scenario DO** in any year



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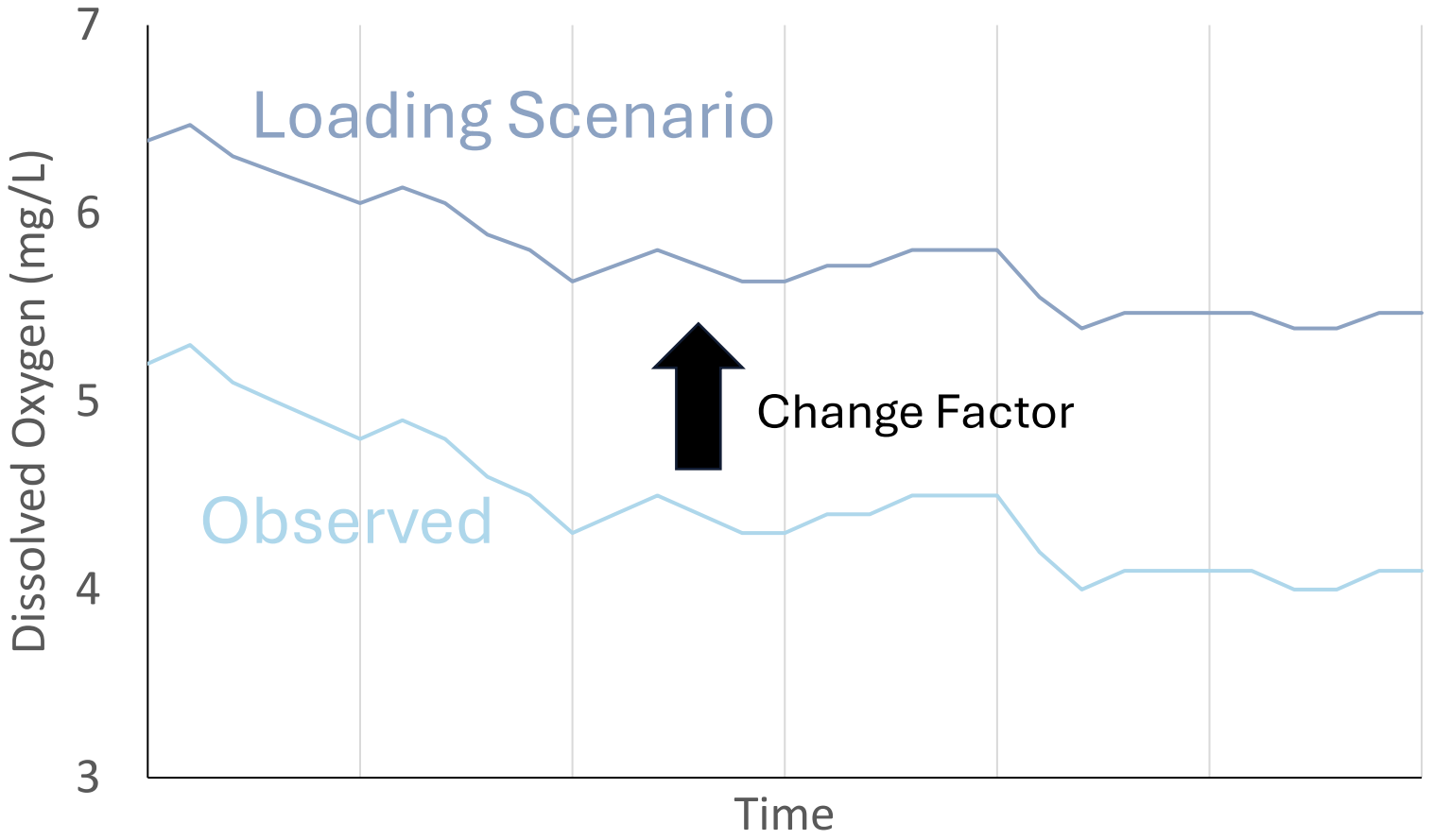

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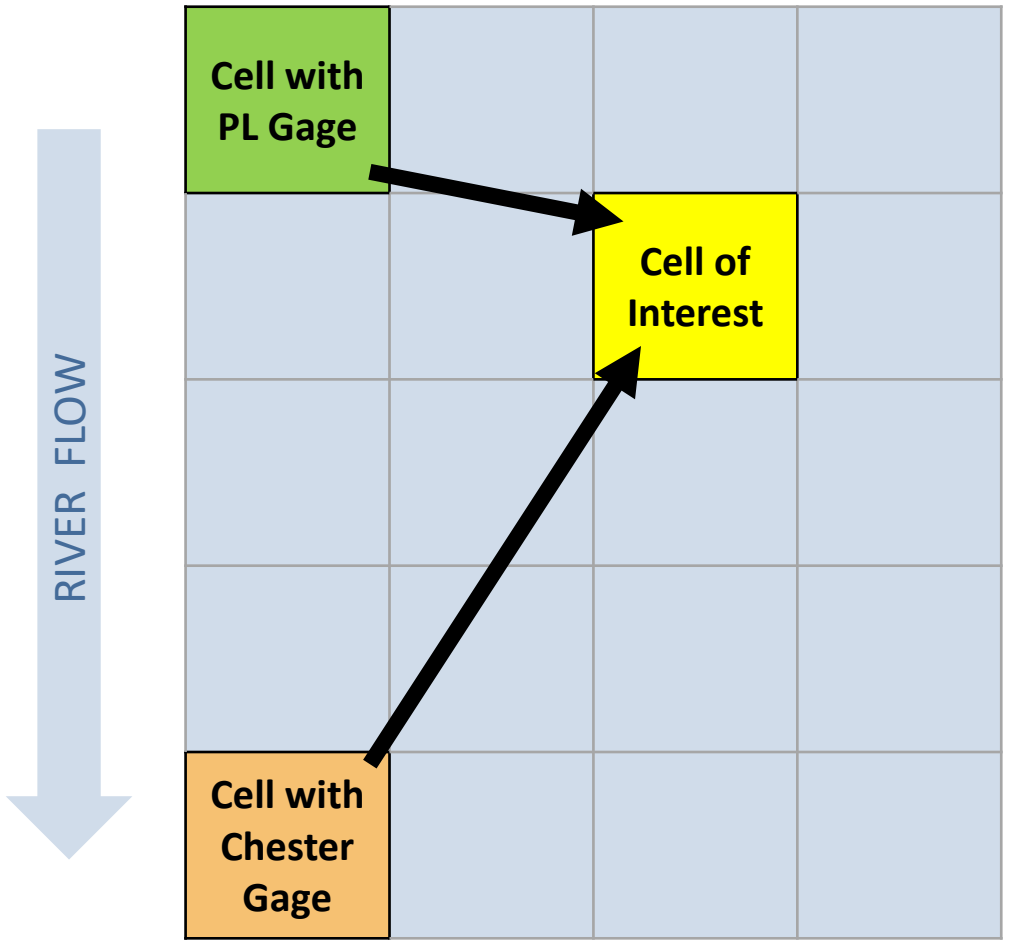
Develop a second, spatial change factor



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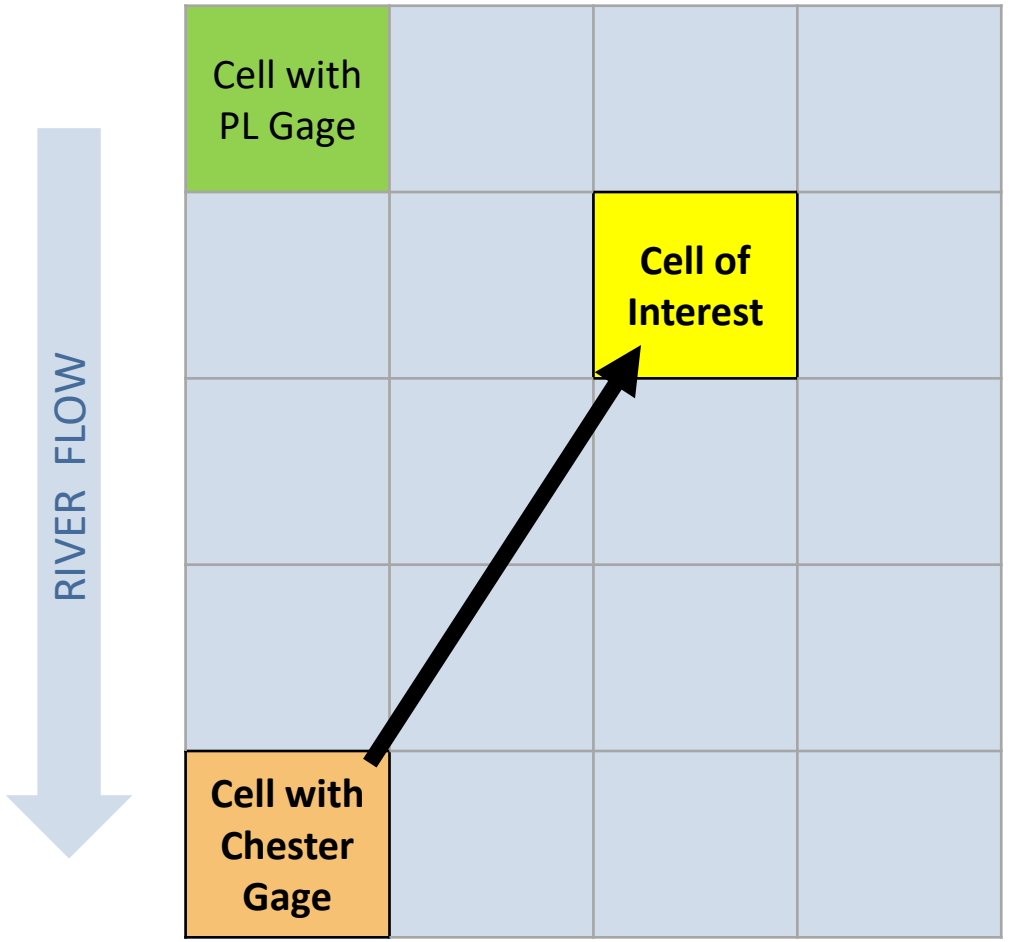
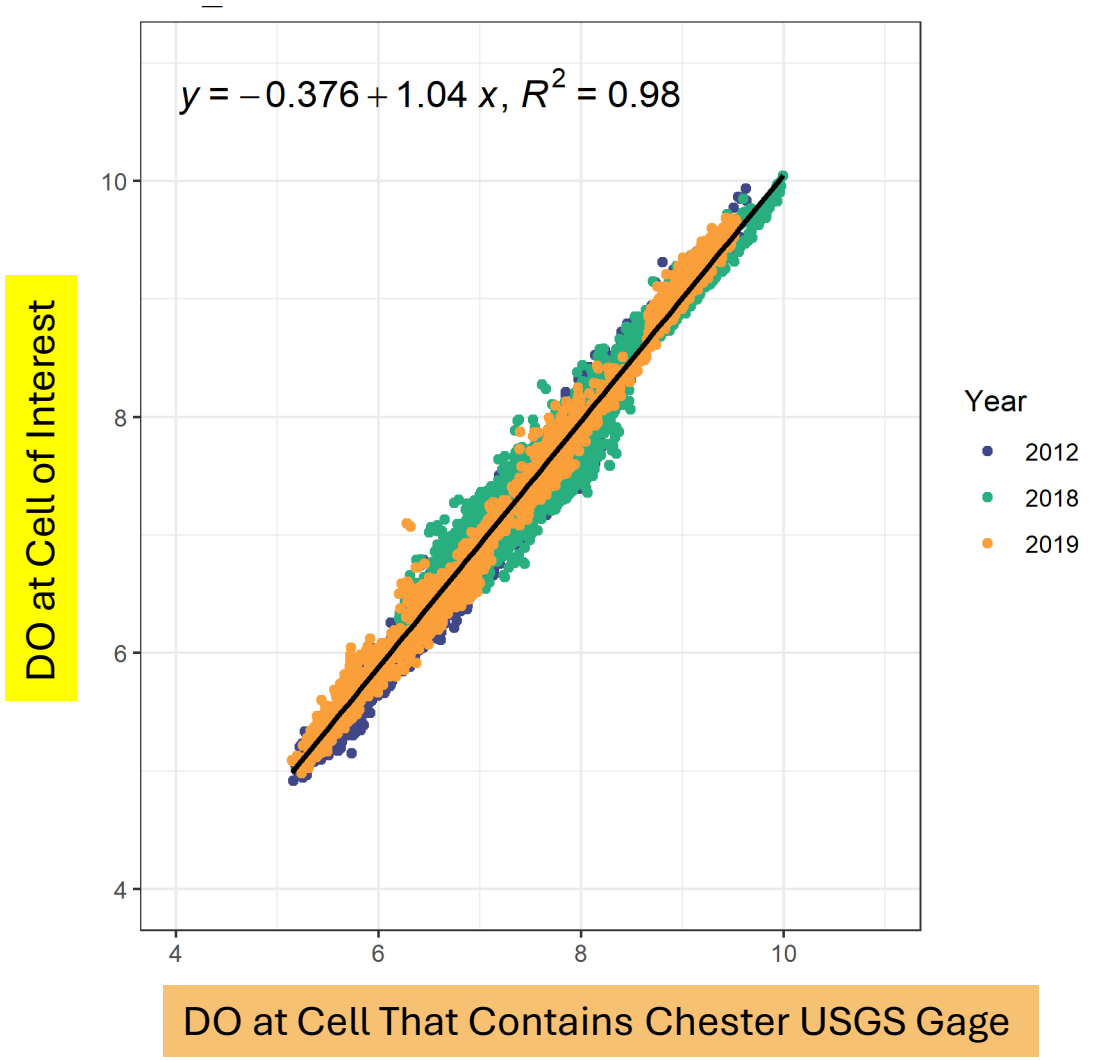
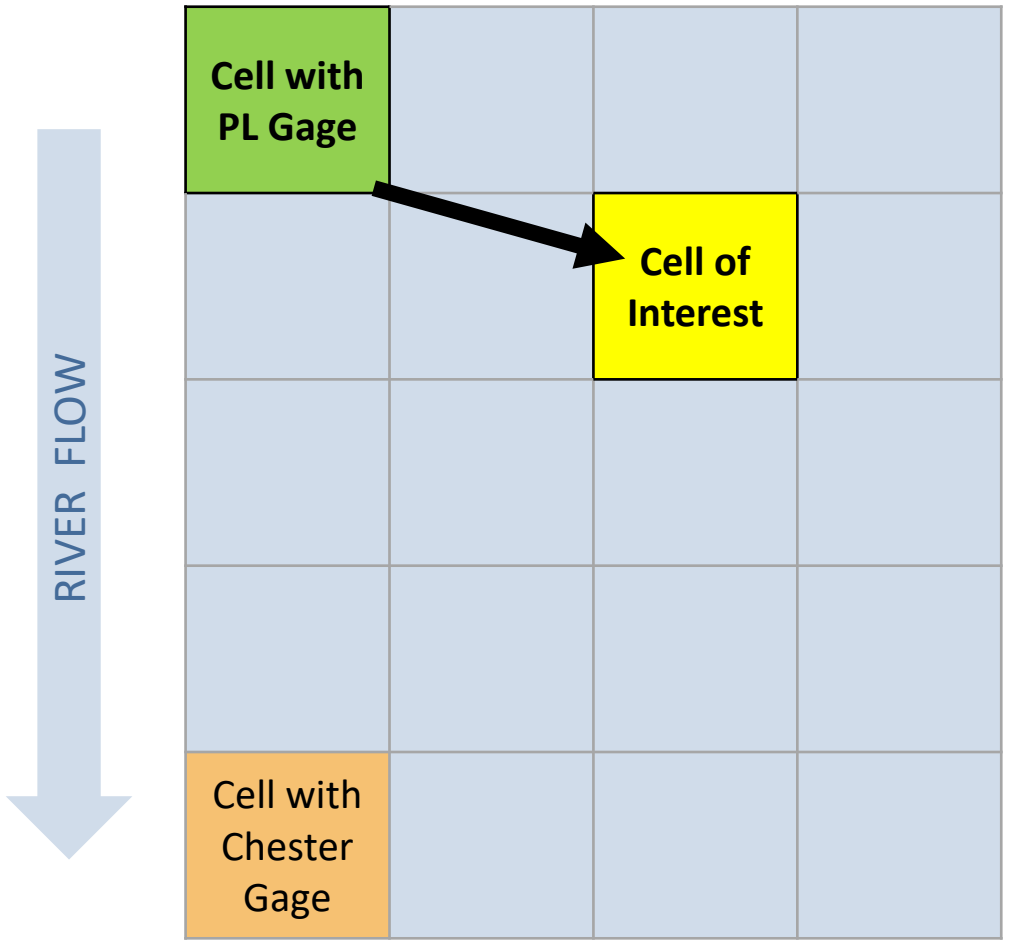
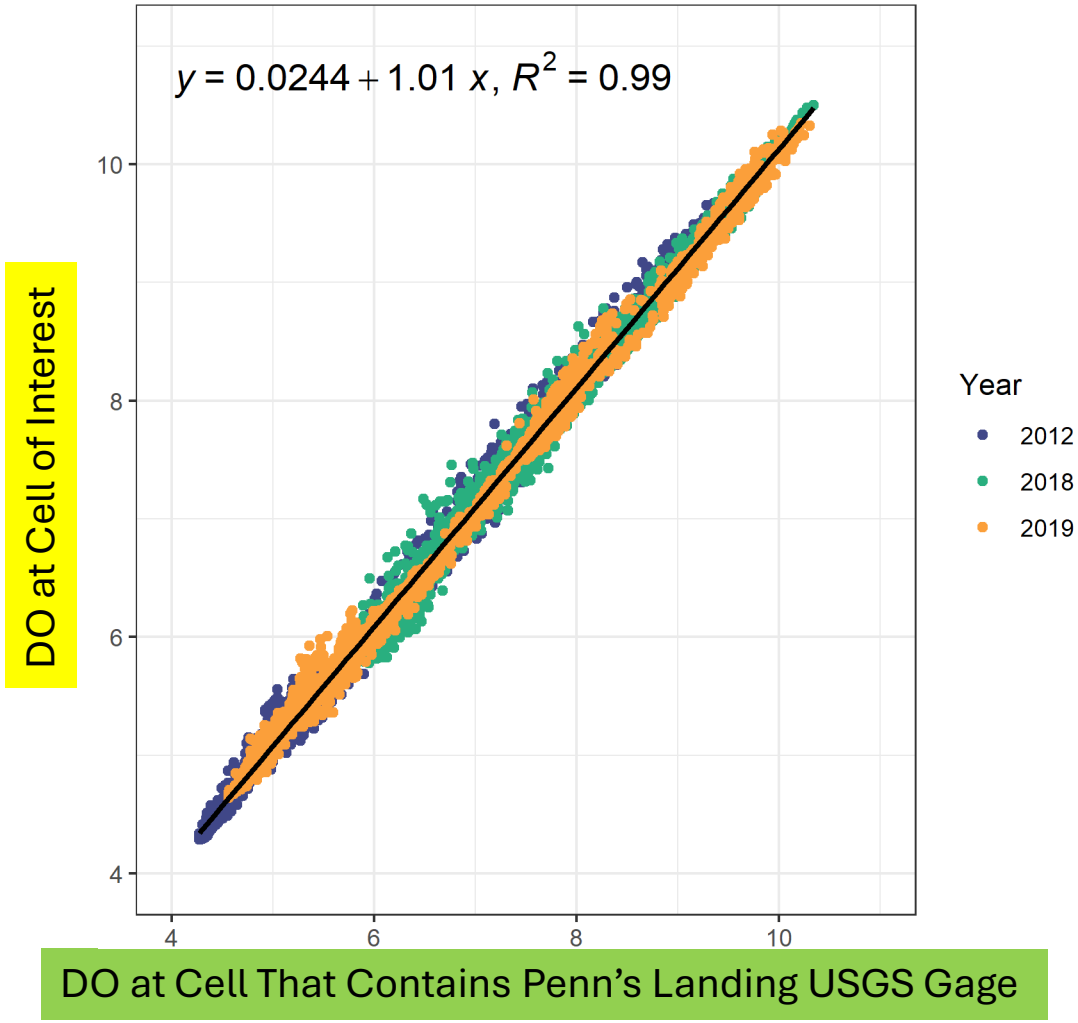
Develop spatial change factor by regressing DO at any model cell against DO at Chester using loading scenario model data





Develop spatial change factor by regressing DO at any model cell against DO at Penn's Landing using loading scenario model data





Apply spatial change factor to projected loading scenario data at gage

Cell Location	Penns Landing Based Prediction	Chester Based Prediction	Final Value
River Mile 102	4.0 mg/L	4.6 mg/L	?
River Mile 92	4.3 mg/L	5.0 mg/L	?
River Mile 83	4.7 mg/L	5.2 mg/L	?

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Apply a weighting factor to estimate loading scenario conditions at any location

Cell Location	Penns Landing Based Prediction	Chester Based Prediction	Final Value
River Mile 102	4.0 mg/L	4.6 mg/L	?
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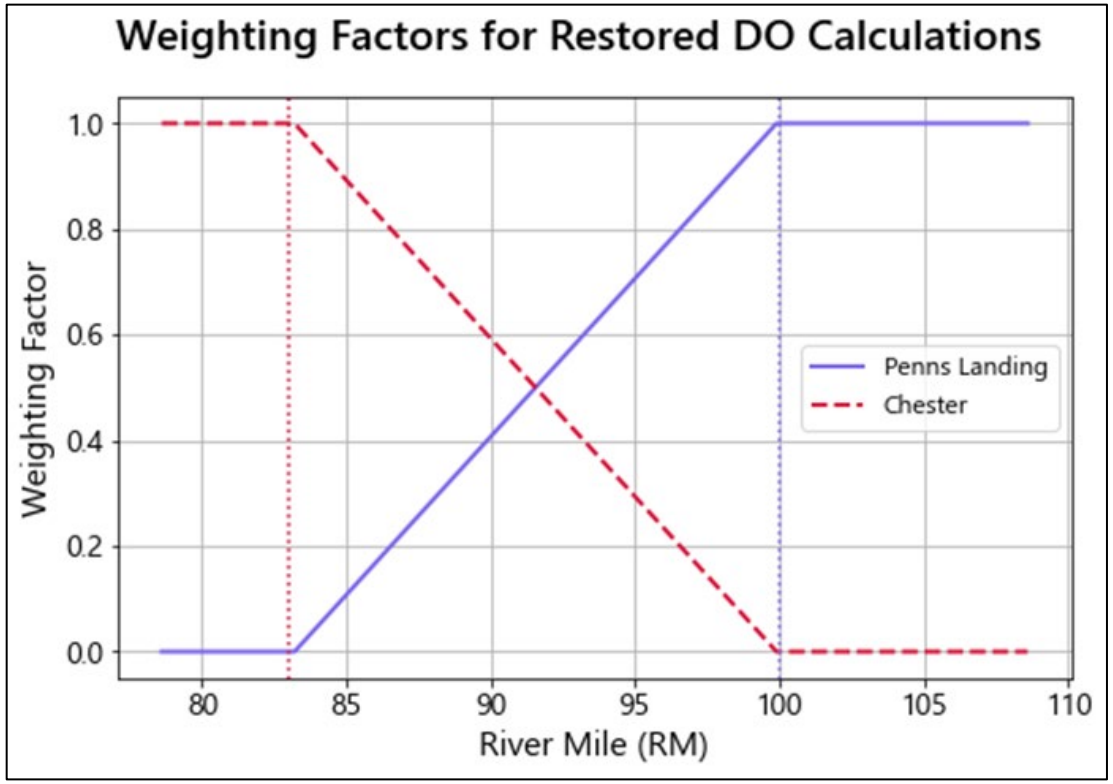

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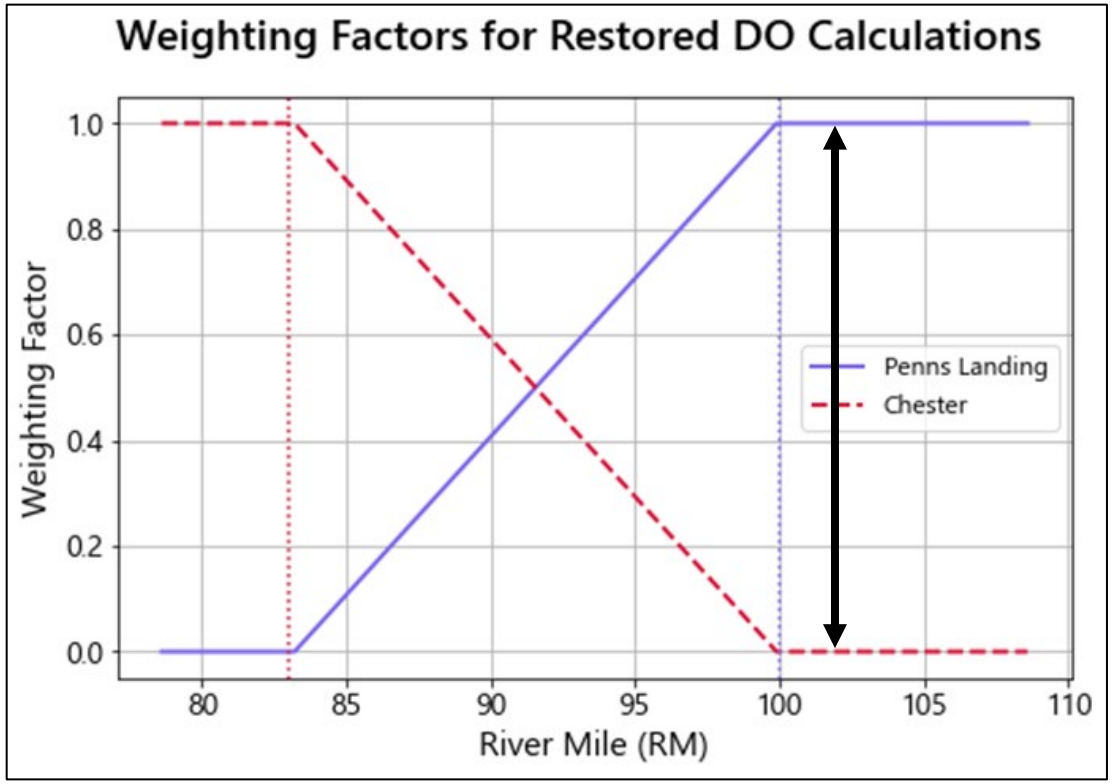

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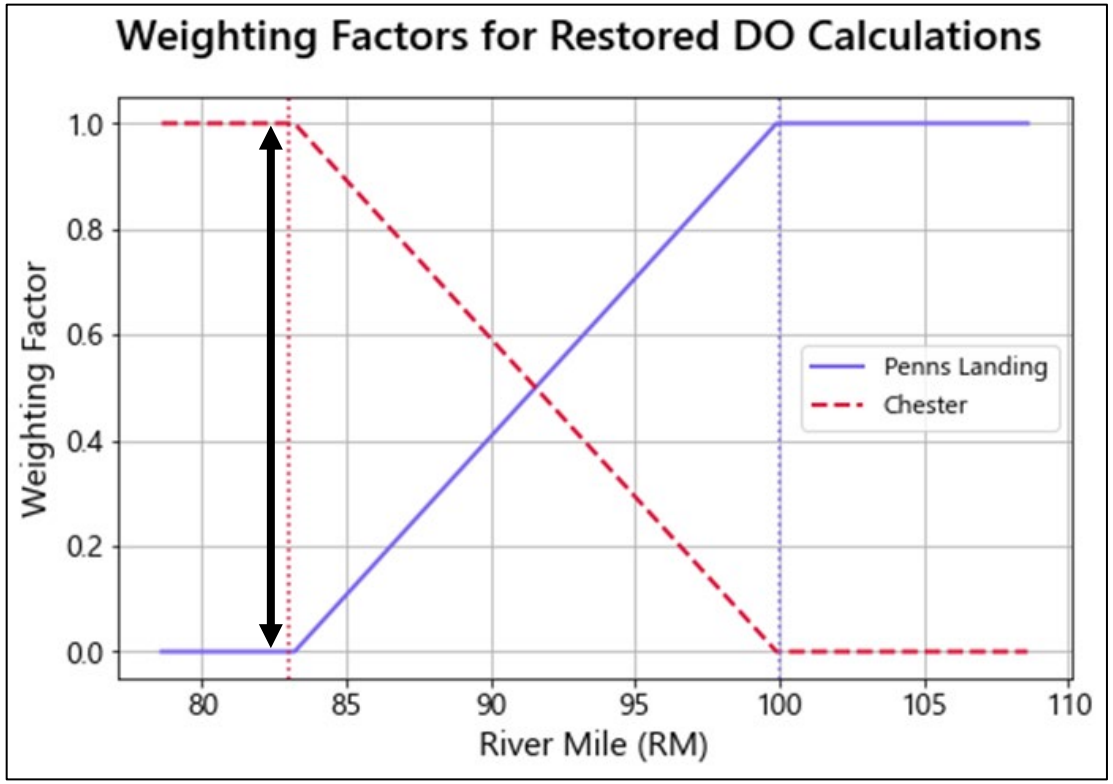

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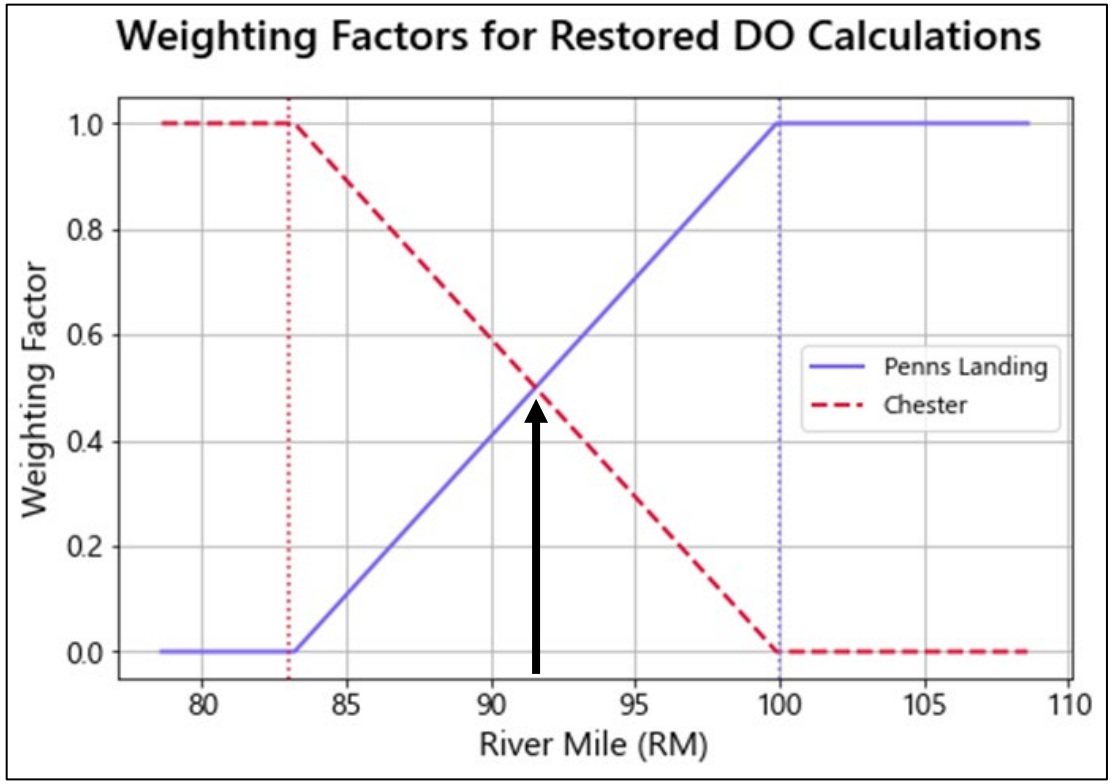

- Captures simulated years in context of **overall inter-year variability**
- Extends analysis **beyond gage location** while still reflecting observations

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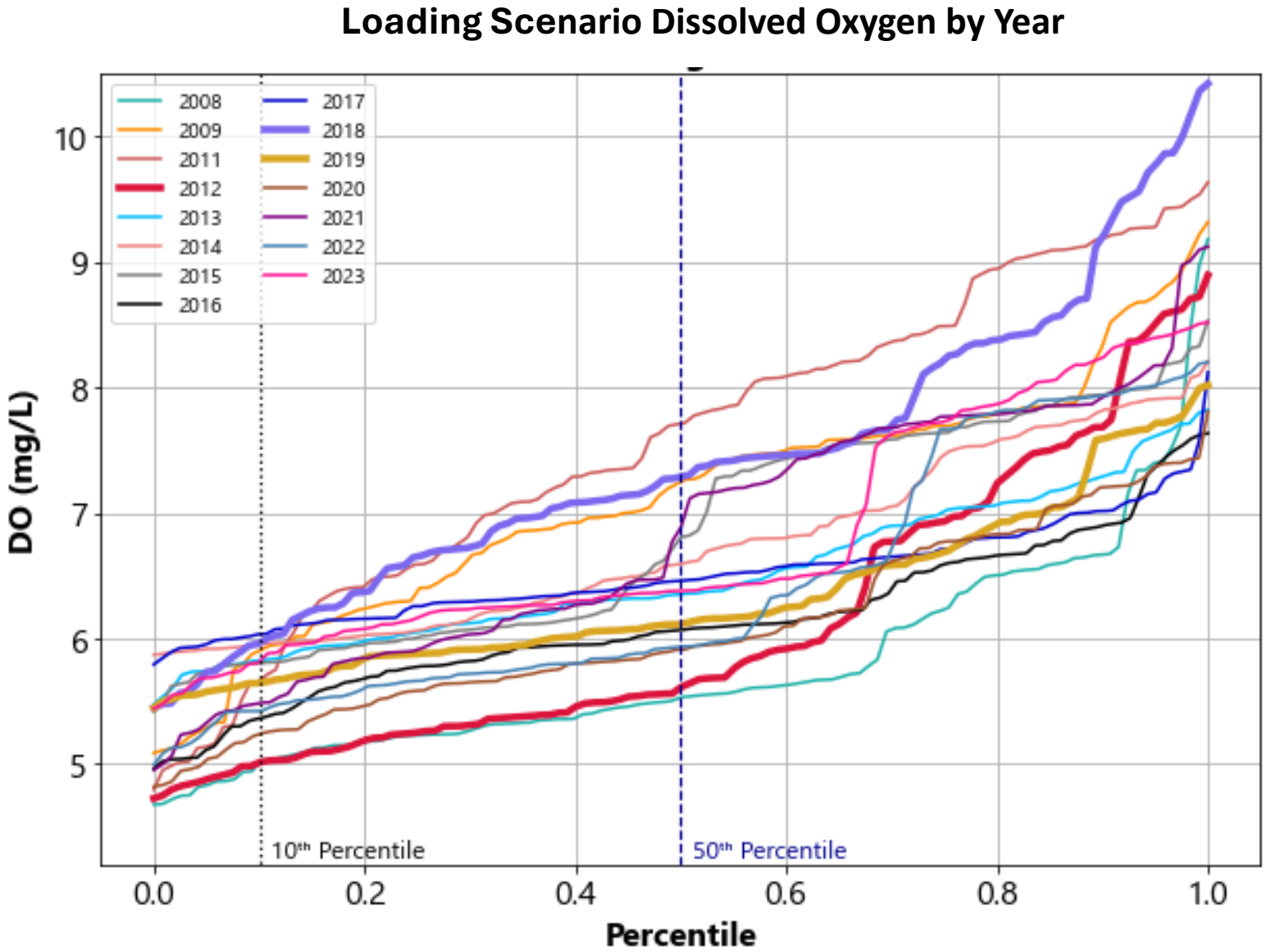

How can this product be utilized in future work?

- Strengthen our estimation of future DO scenarios for use in waste load allocations
- Improve estimation of DO
  - In **unmodeled years**
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  - **Beyond** what is possible with either model output or continuous data **alone**

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Questions?

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