Progress report on Phase 7 criteria assessment

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Modeling Quarterly Review Meeting

Annapolis, July 10, 2024

Objective

- Progress report on method development for Phase 7 based on an early test case.

- Approximate WIP scenario by reducing nutrient loads by the same percent across the watershed.

- Approximate climate change scenario for 2025.

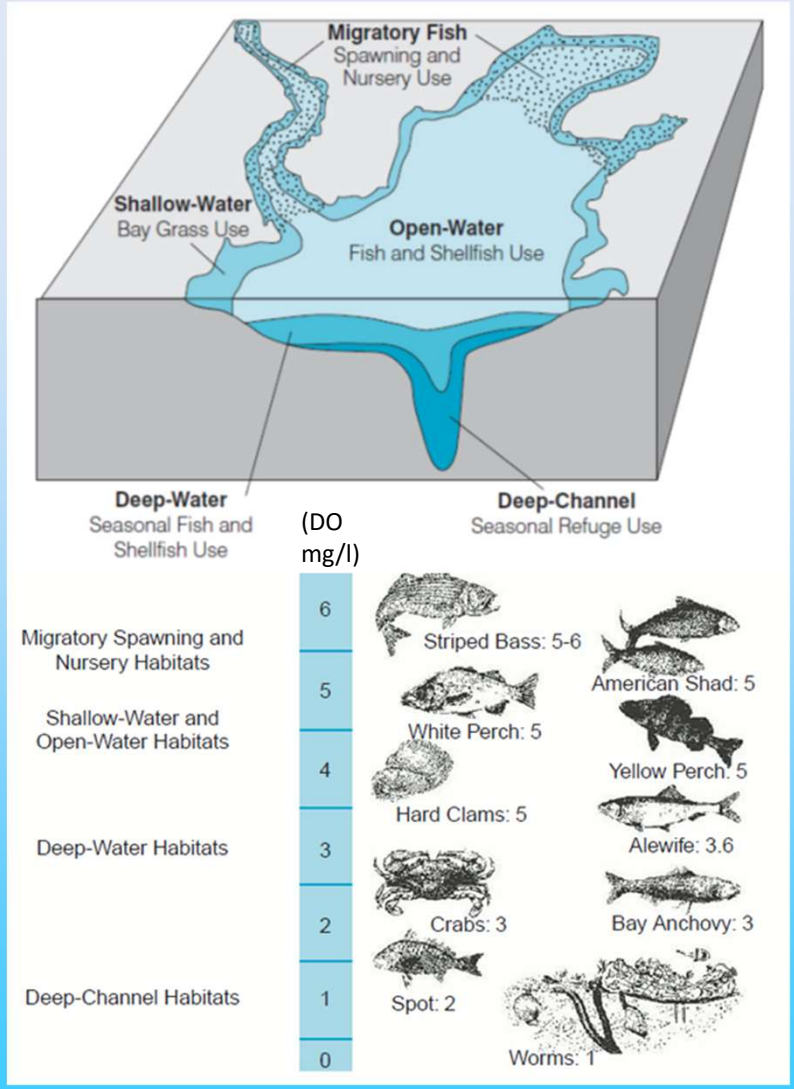
- Early look into the model responsiveness to nutrient reduction and climate change.

Designated Uses (DUs)

Six DUs:

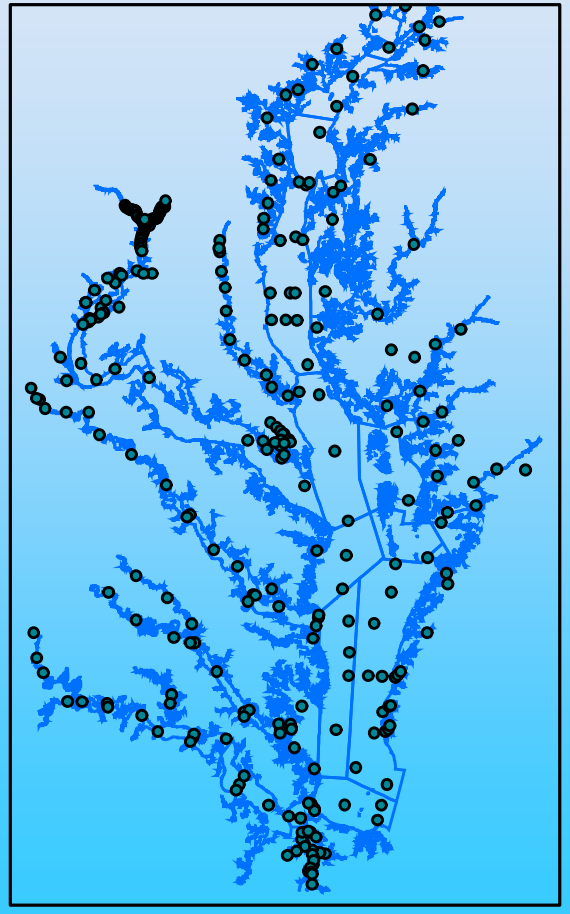
- **DC: deep channel.**
- **DW: deep water.**
- **OW: open water.**
- **MSN: migratory fish spawning and nursery.**
- **Chlorophyll: James and Anacostia rivers.**
- **Water clarity and SAV: Shallow waters.**

p.s.: Basically, everything we do needs to go through criteria assessment: Nutrient reduction, carrying capacity, TMDL, management scenarios, climate change impact.

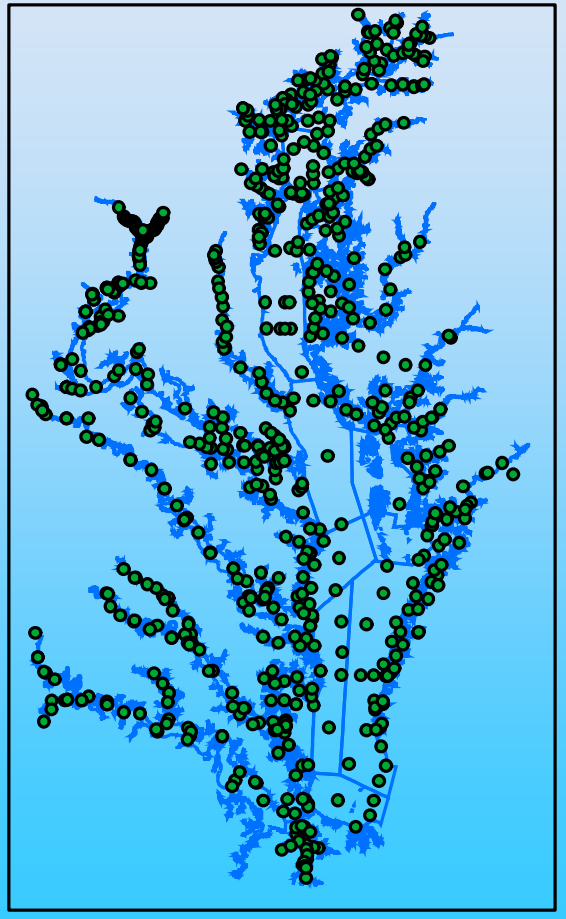


Tidal stations included in criteria assessment and segmentation

Phase 6 (304 stations)

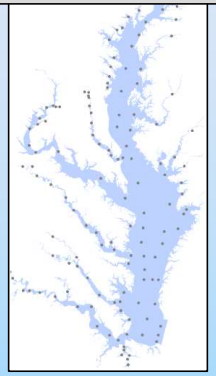


Phase 7 (763 stations)

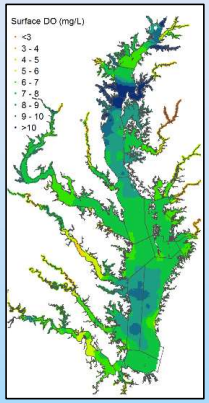


WQS Criterion Assessment

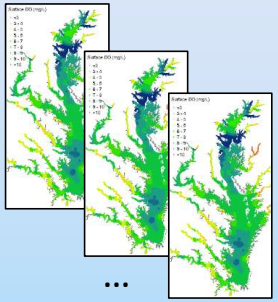
1. Collect bi-weekly to monthly data at each monitoring station



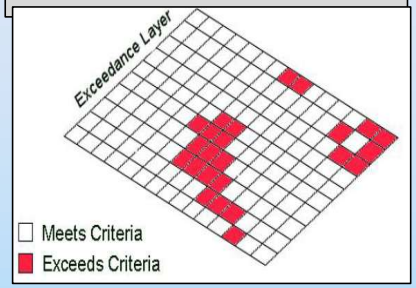
2. Convert the station DO data to Baywide values using the CBP interpolator



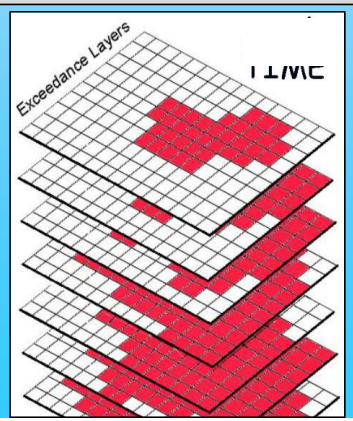
3. Combine interpolations for a season over the 3-year period



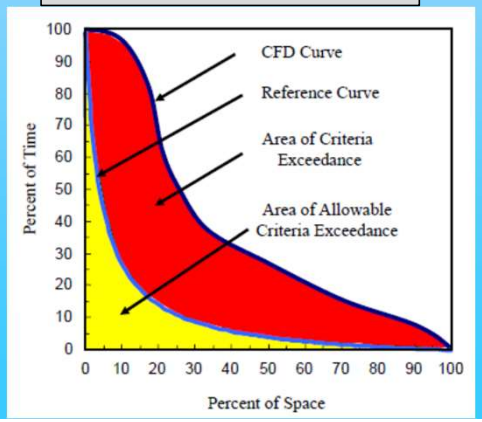
4. Compare the interpolated values with appropriate criterion values to compute the spatial extent of exceedance



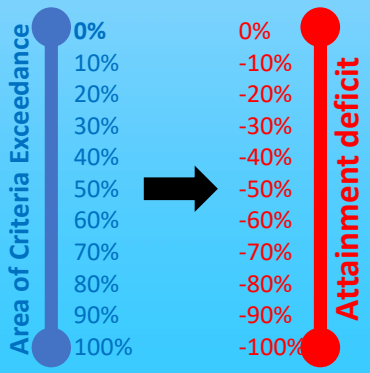
5. Repeat Step 4 for each sampling event in the 3-year period to determine the cells' extent of exceedance



6. Calculate the cumulative probability distribution (CFD) for extent of exceedance for all cells within each segment



7. Quantify attainment status (attaining or not) for the 3-year period



Phase 7 Deep Channel Non-attainment percent (1993-1995)

Segment	Calib	CH3D_WIP3	SCH_WIP3_Run07	SCH_WIP3_Run09
CB3MH	7.17%	0.00%	0.00%	0.00%
CB4MH	44.95%	5.02%	0.00%	15.71%
CB5MH_MD	20.72%	0.00%	0.00%	0.14%
CB5MH_VA	4.06%	0.00%	0.00%	0.00%
POTMH_MD	15.66%	0.00%	0.00%	0.00%
RPPMH	13.37%	0.00%	0.00%	0.39%
CHSMH	16.38%	0.00%	0.00%	0.00%
EASMH	18.03%	5.62%	0.00%	2.21%
PATMH	22.03%	0.00%	0.00%	0.00%

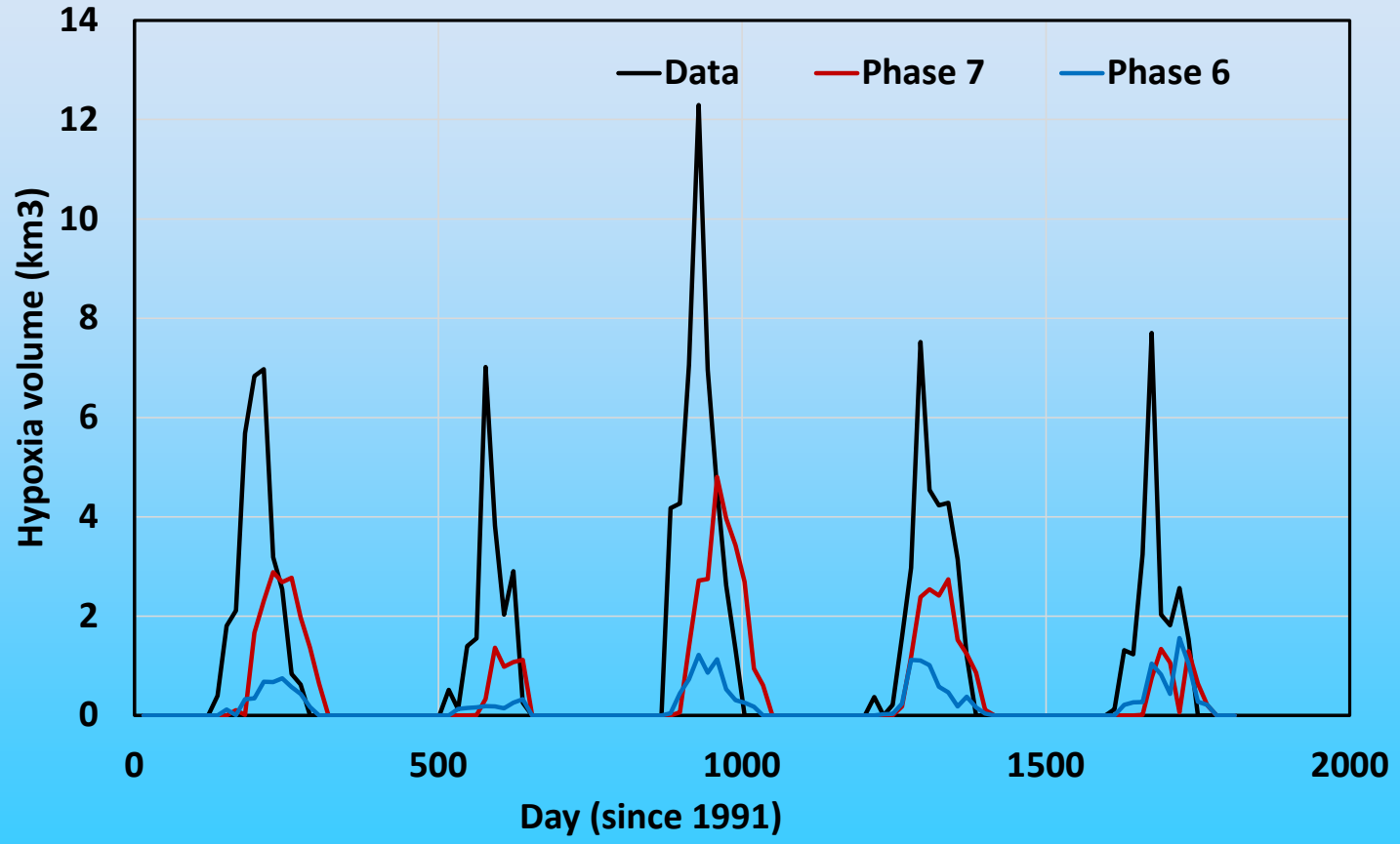
Phase 7 Deep Water Non-attainment percent (1993-1995)

Segment	Calib	CH3D_WIP	SCH_WIP3_ Run07	SCH_WIP3_ Run09
CB3MH MD	2.37%	0.05%	0.35%	0.69%
CB4MH MD	23.96%	4.82%	7.22%	10.93%
CB5MH_MD M	10.13%	0.67%	0.70%	3.67%
CB5MH_VA V	0.66%	0.00%	0.00%	0.00%
CB6PH VA	1.27%	0.00%	0.51%	0.00%
CB7PH VA	0.06%	0.00%	0.00%	0.00%
PATMH MD	9.00%	0.43%	0.00%	0.00%
MAGMH MD	55.63%	0.00%	27.63%	38.71%
SOUMH MD	23.68%	0.00%	14.58%	17.47%
SEVMH MD	7.93%	0.00%	0.00%	0.13%
PAXMH MD	12.79%	0.00%	0.00%	0.09%
POTMH_MD M	6.77%	0.00%	0.00%	0.62%
RPPMH VA	10.57%	0.00%	0.00%	1.24%
YRKPH VA	0.00%	0.00%	0.00%	0.00%
SBEMH VA	0.70%	0.00%	0.00%	0.00%
CHSMH MD	6.14%	0.00%	0.00%	0.00%
EASMH MD	3.35%	0.45%	0.02%	1.45%

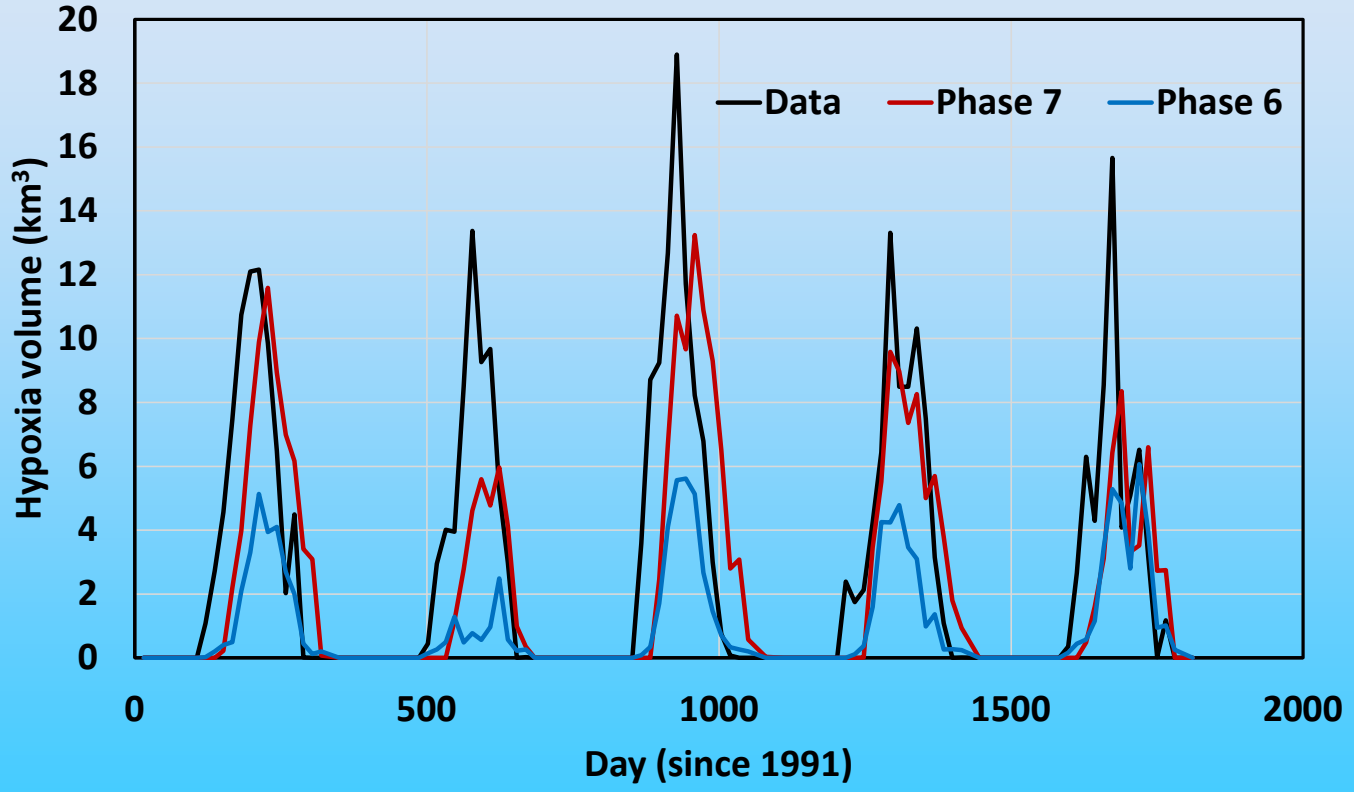
Phase 7 Open Water Non-attainment percent (1993-1995)

Segment	Calib	CH3D_WIP3	SCH_WIP3_Run07	SCH_WIP3_Run09
CB7PH VA	5.46%	0.23%	1.88%	2.89%
GUNOH MD	4.59%	4.59%	4.59%	0.00%
PAXTF MD	9.11%	7.76%	0.00%	0.00%
WBRTF MD	4.59%	4.59%	4.59%	0.00%
PAXOH MD	20.65%	0.00%	0.00%	3.35%
ANATF_DC	18.00%	0.00%	1.91%	2.05%
ANATF_MD	27.95%	1.81%	11.68%	11.39%
PISTF MD	4.42%	0.63%	0.00%	3.88%
CRRMH VA	24.53%	5.75%	17.92%	11.59%
PMKTF VA	11.01%	8.62%	6.90%	8.62%
WBEMH VA	11.05%	7.80%	0.00%	5.50%
SBEMH VA	34.47%	17.82%	0.00%	12.56%
EBEMH VA	22.74%	7.72%	0.00%	5.98%
SASOH MD	7.38%	0.56%	7.38%	7.38%
WICMH MD	11.21%	4.96%	0.00%	0.00%

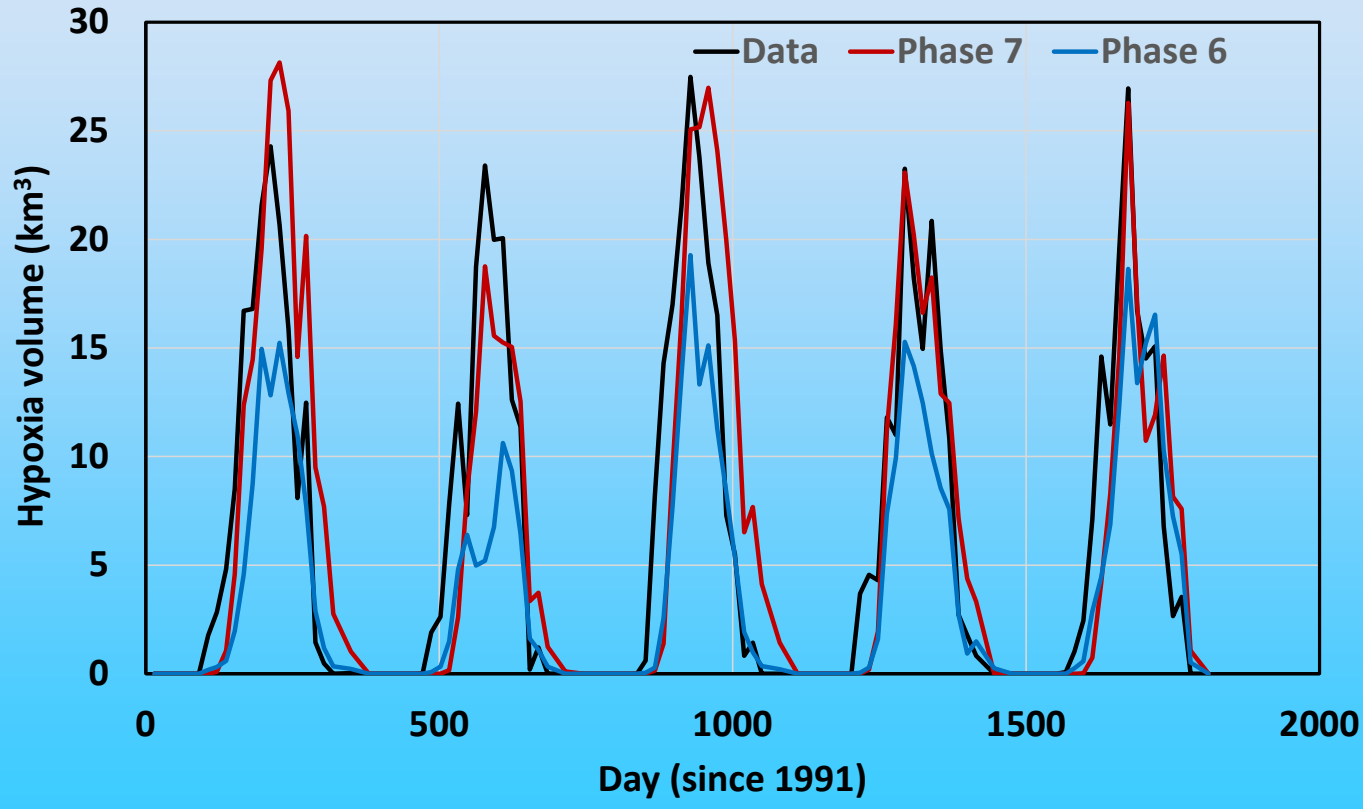
Comparison of hypoxia volume between observation and calibration (< 1 mg/l)



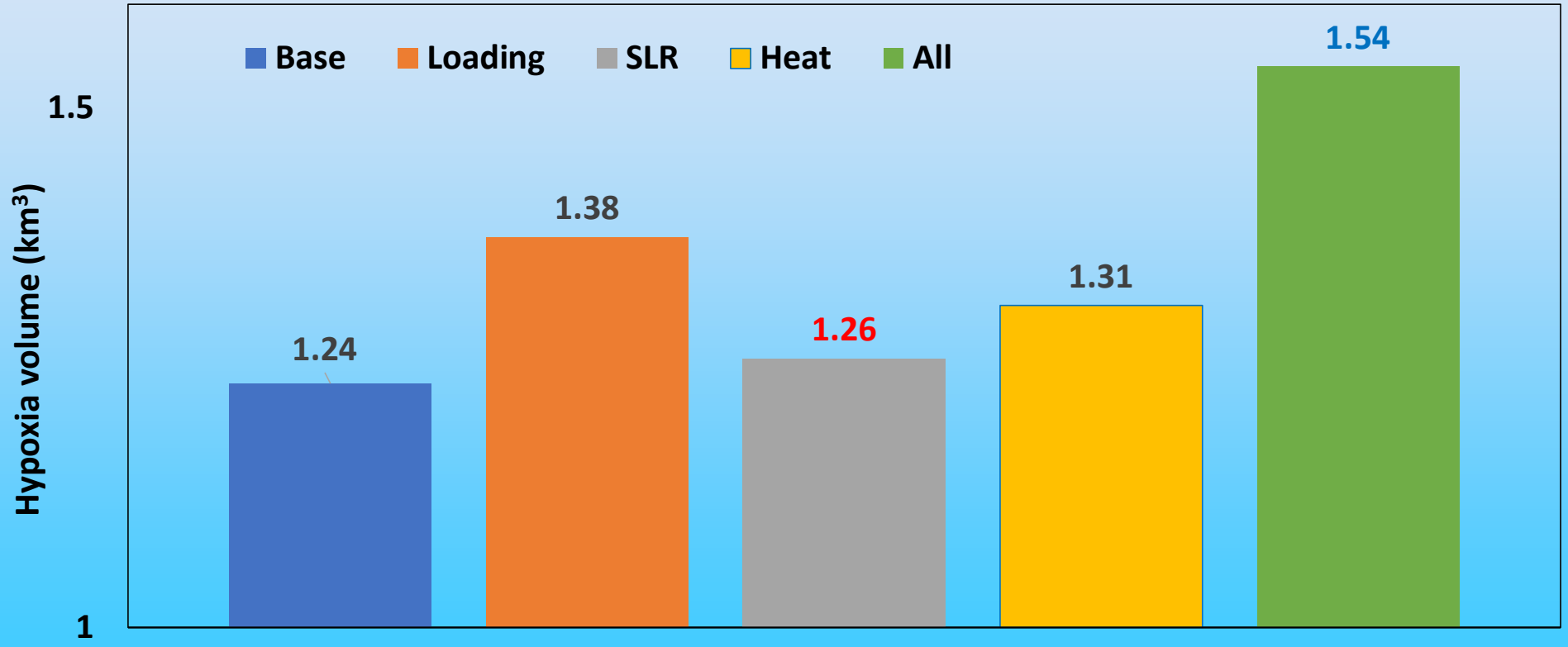
Comparison of hypoxia volume between observation and calibration (< 3 mg/l)



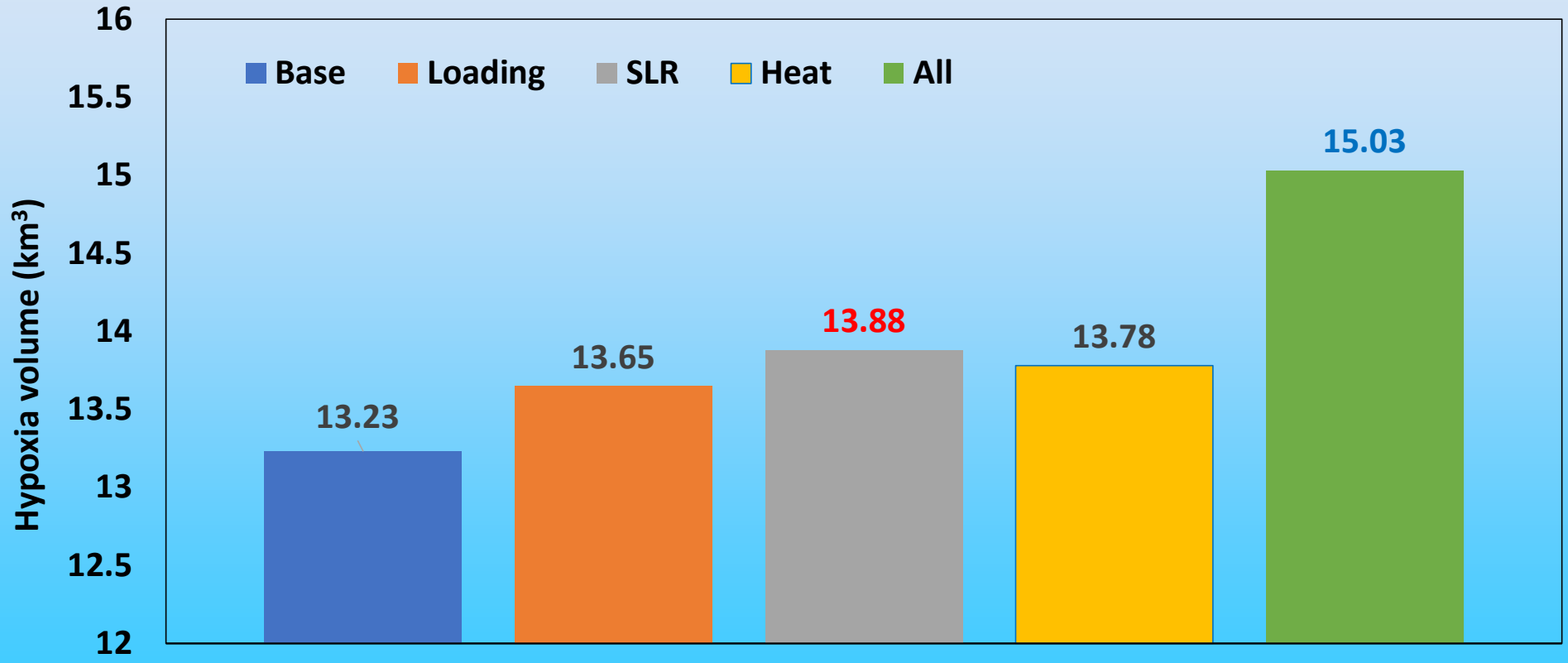
Comparison of hypoxia volume between observation and calibration (< 5 mg/l)



2025 summer (Jun.-Sep.) average hypoxia volume (<1 mg/l) in the Whole Bay under WIP condition



2025 summer (Jun.-Sep.) average hypoxia volume (<5 mg/l) in the Whole Bay under WIP condition



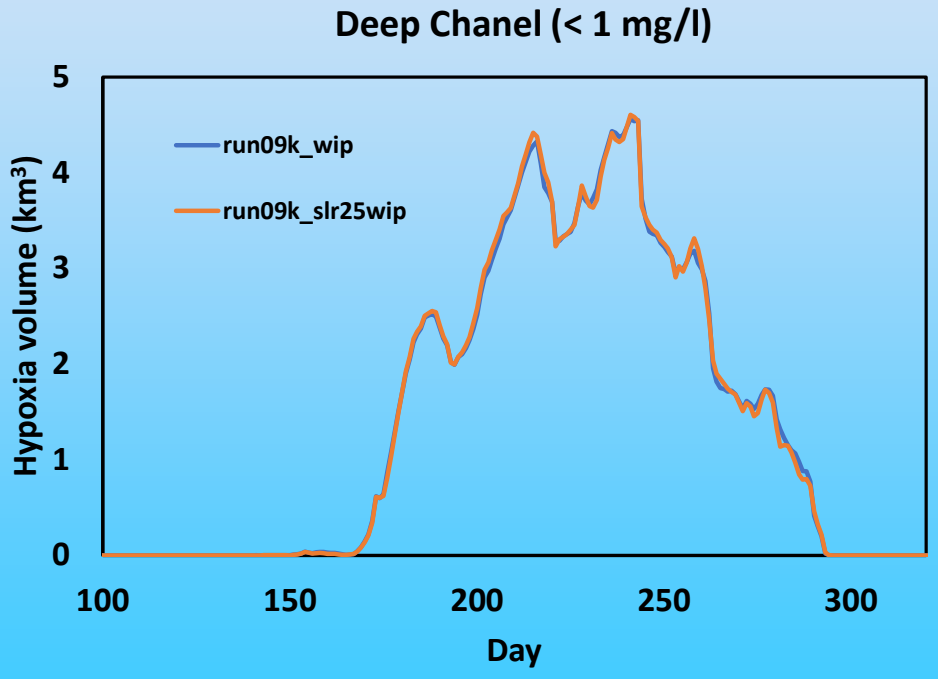
Sea level rise impact on water quality non-attainment (Based on model outputs without transformation)

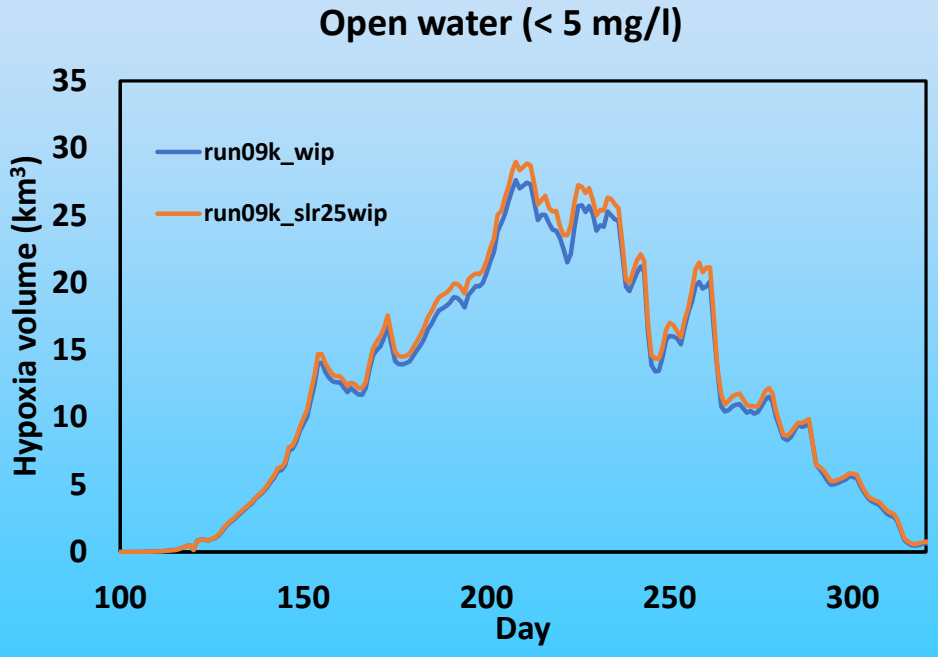
Deep Channel Segment	WIP (model direct)	WIP_SLR25
CB3MH MD	0.00%	0.00%
CB4MH MD	14.04%	13.84%
CB5MH_MD M	0.00%	0.10%
CB5MH_VA VA	0.00%	0.00%
POTMH_MD MI	0.00%	0.00%
RPPMH VA	0.00%	0.00%
CHSMH MD	0.00%	0.00%
EASMH MD	0.00%	0.00%
PATMH MD	0.00%	0.00%

Deep water Segment	WIP (model direct)	WIP_SLR25
CB3MH MD	0.67%	0.76%
CB4MH MD	19.86%	19.62%
CB5MH_MD M	3.07%	3.70%
CB5MH_VA VA	0.00%	0.00%
CB6PH VA	0.00%	0.00%
CB7PH VA	0.00%	0.00%
PATMH MD	0.00%	0.00%
MAGMH MD	0.00%	0.00%
SOUMH MD	0.00%	0.00%
SEVMH MD	0.00%	0.00%
PAXMH MD	0.00%	0.00%
POTMH_MD MI	0.00%	0.91%
RPPMH VA	0.00%	0.00%
YRKPH VA	0.00%	0.00%
SBEMH VA	0.00%	0.00%
CHSMH MD	0.00%	0.00%
EASMH MD	0.09%	0.02%

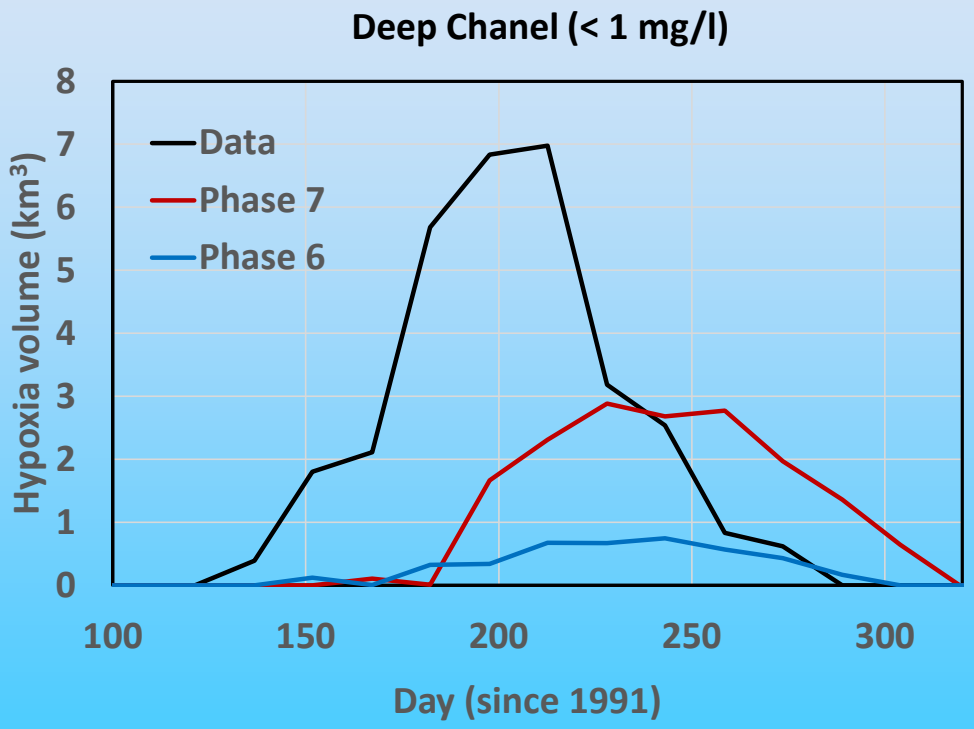
Open water Segment	WIP (model direct)	WIP_SLR25
CB4MH	0.71%	0.54%
CB5MH_MD	1.07%	1.28%
BACOH	0.00%	4.59%
POTMH_MD	0.14%	0.41%
JMSTFL	28.49%	29.90%
SBEMH	1.13%	0.72%
EBEMH	5.16%	5.16%
CHOMH1	0.51%	0.46%
TANMH_VA VA	0.02%	0.54%

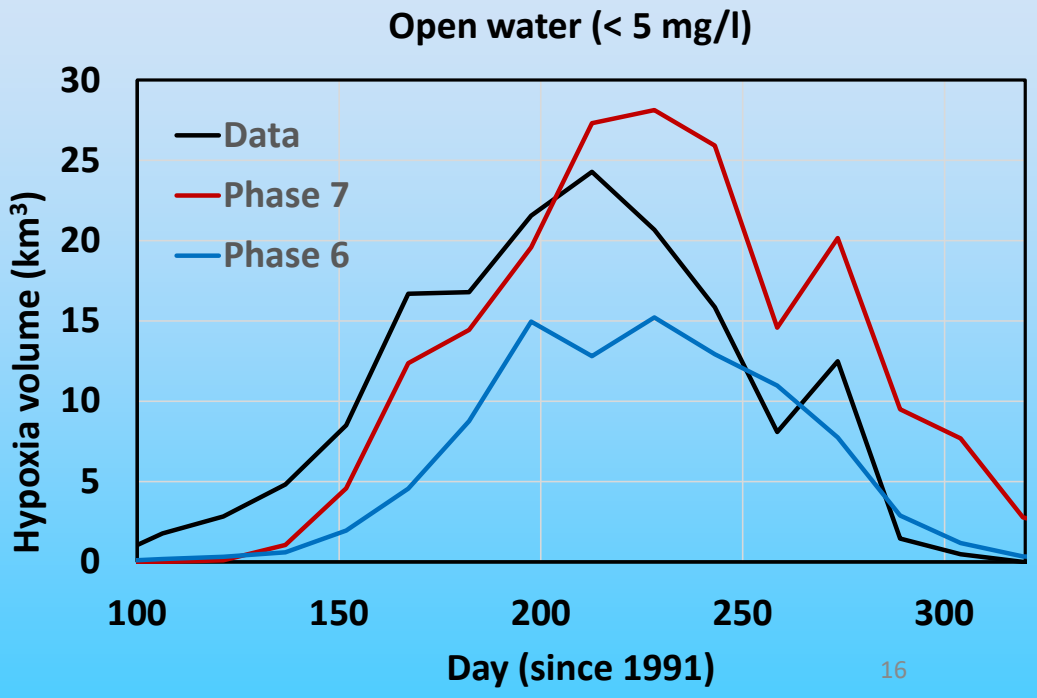
Sea level rise (2025) hypoxia volume in 1991 in the Whole Bay compared with the initial WIP scenario.





Timing of hypoxia - Observation versus model prediction





Next steps

- **Complete DO assessment.**
- **Chlorophyll.**
- **Water clarity.**
- **4D interpolator.**