Fishing Bay Ideas Discussion

BORG meeting
May 18, 2026

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Planning

- We are still testing and modifying parts of the 4D code, particularly linking together the pieces of the interpolation and fitting the parameters used in the daily cycles and correlation components.
  - *This work will slightly impact the results over the next 3 months.*
  - *All results are draft here.*

- But we can use these draft results to discuss and set-up what we want to compare for Fishing Bay (and other) tests.

Ideas

- Visualize and evaluate 4D DO results:
  - *Plots showing interpolation results next to the data.*
  - *Map showing low DO thresholds by location.*
  - *Annual cycle of low DO thresholds: hourly and daily.*
  - *Compare year-to-year and to other segments.*
- Comparison of monthly average interpolations between 3D and 4D interpolations.
- Discussions needed on how results could be used in criteria assessment: Building CFDs, averaging periods, comparing to other approaches.
- Caveat: Historical results and first-cut examinations of 2022-2024 suggest relatively high DO compared to OW criteria. We will also look closely at other segments as case studies where DO is lower and there are more designated uses.

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Have some examples of these today

To do soon

Need to discuss

What we are generating

- By segment:
  - Grid cell,
  - Depth,
  - Date & hour
  - Designated use
- DO interpolation result

	uidstr	depth	y_obs	date_time	sim	pycno_layer
1	4120004234000	0.5	11.040	2022-01-01 00:00:00	1	1
2	4120004234000	0.5	10.964	2022-01-01 01:00:00	1	1
3	4120004234000	0.5	10.717	2022-01-01 02:00:00	1	1
4	4120004234000	0.5	10.830	2022-01-01 03:00:00	1	1
5	4120004234000	0.5	11.208	2022-01-01 04:00:00	1	1
6	4120004234000	0.5	10.896	2022-01-01 05:00:00	1	1
7	4120004234000	0.5	10.783	2022-01-01 06:00:00	1	1
8	4120004234000	0.5	10.921	2022-01-01 07:00:00	1	1
9	4120004234000	0.5	10.715	2022-01-01 08:00:00	1	1
10	4120004234000	0.5	10.931	2022-01-01 09:00:00	1	1
11	4120004234000	0.5	10.906	2022-01-01 10:00:00	1	

i.e, 1 = open water;
2 = deep water;
3 = deep channel.
(will vary daily only in appropriate seasons and segments with the DUs)

What we are generating

- By segment:
  - Grid cell,
  - Depth,
  - Date & hour
  - Designated use
- DO interpolation result
- Multiple simulations

	uidstr	depth	y_obs	date_time	sim	pycno_layer
1	4120004234000	0.5	11.040	2022-01-01 00:00:00	1	1
2	4120004234000	0.5	10.964	2022-01-01 01:00:00	1	1
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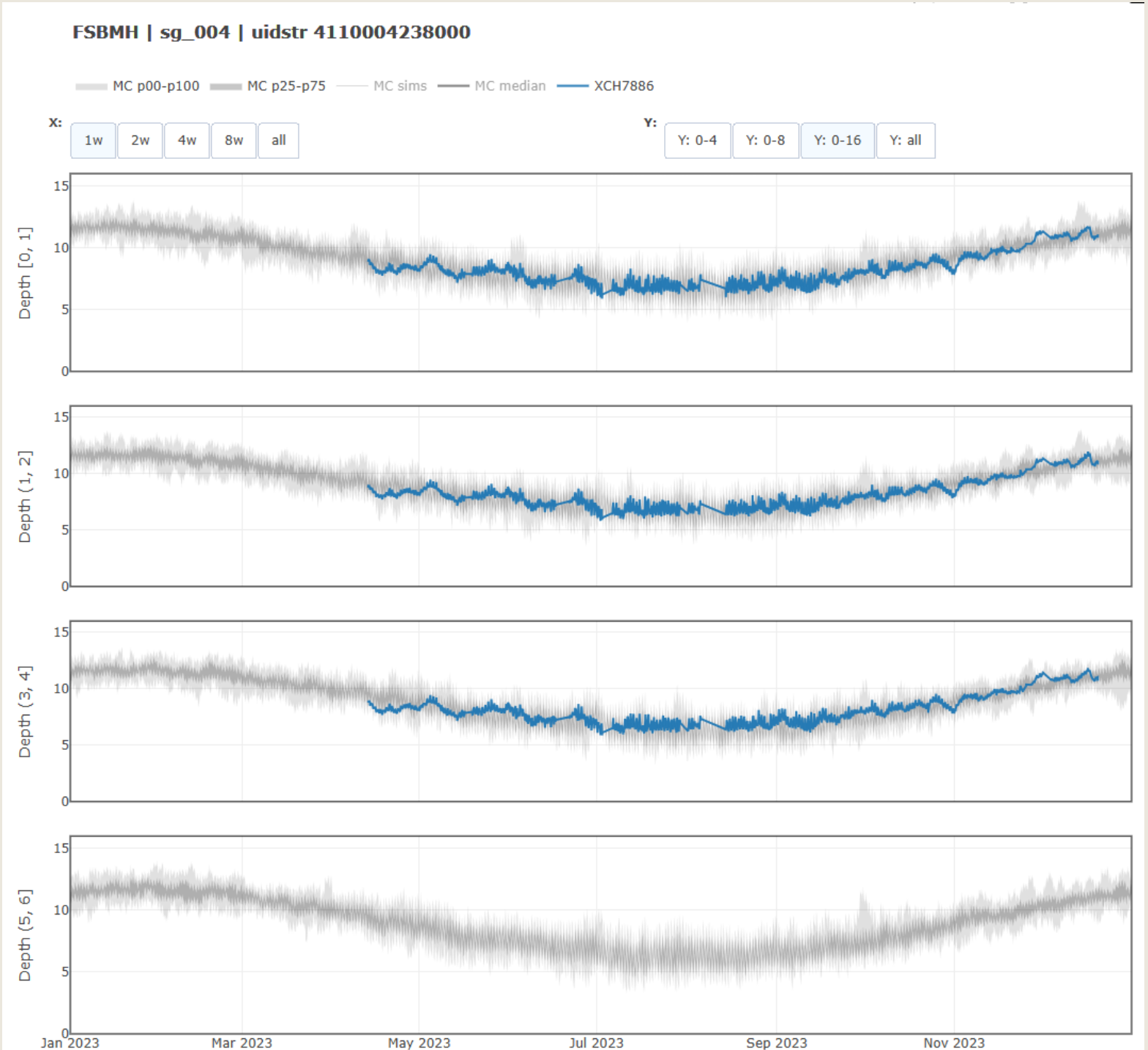
6	412	0.5	10.896	2022-01-01 05:00:00	1	1
7	412					
8	412					
9	412					
10	412					
11	41					

	uidstr	depth	y_obs	date_time	sim	pycno_lay
228853	4120004234000	2.5	11.882	2022-02-15 12:00:00	9	
228854	4120004234000	2.5	12.187	2022-02-15 13:00:00	9	
228855	4120004234000	2.5	11.910	2022-02-15 14:00:00	9	
228856	4120004234000	2.5	12.263	2022-02-15 15:00:00	9	
228857	4120004234000	2.5	12.239	2022-02-15 16:00:00	9	
228858	4120004234000	2.5	11.798	2022-02-15 17:00:00	9	
228859	4120004234000	2.5	12.142	2022-02-15 18:00:00	9	
228860	4120004234000	2.5	11.766	2022-02-15 19:00:00	9	
228861	4120004234000	2.5	11.878	2022-02-15 20:00:00	9	
228862	4120004234000	2.5	11.836	2022-02-15 21:00:00	9	

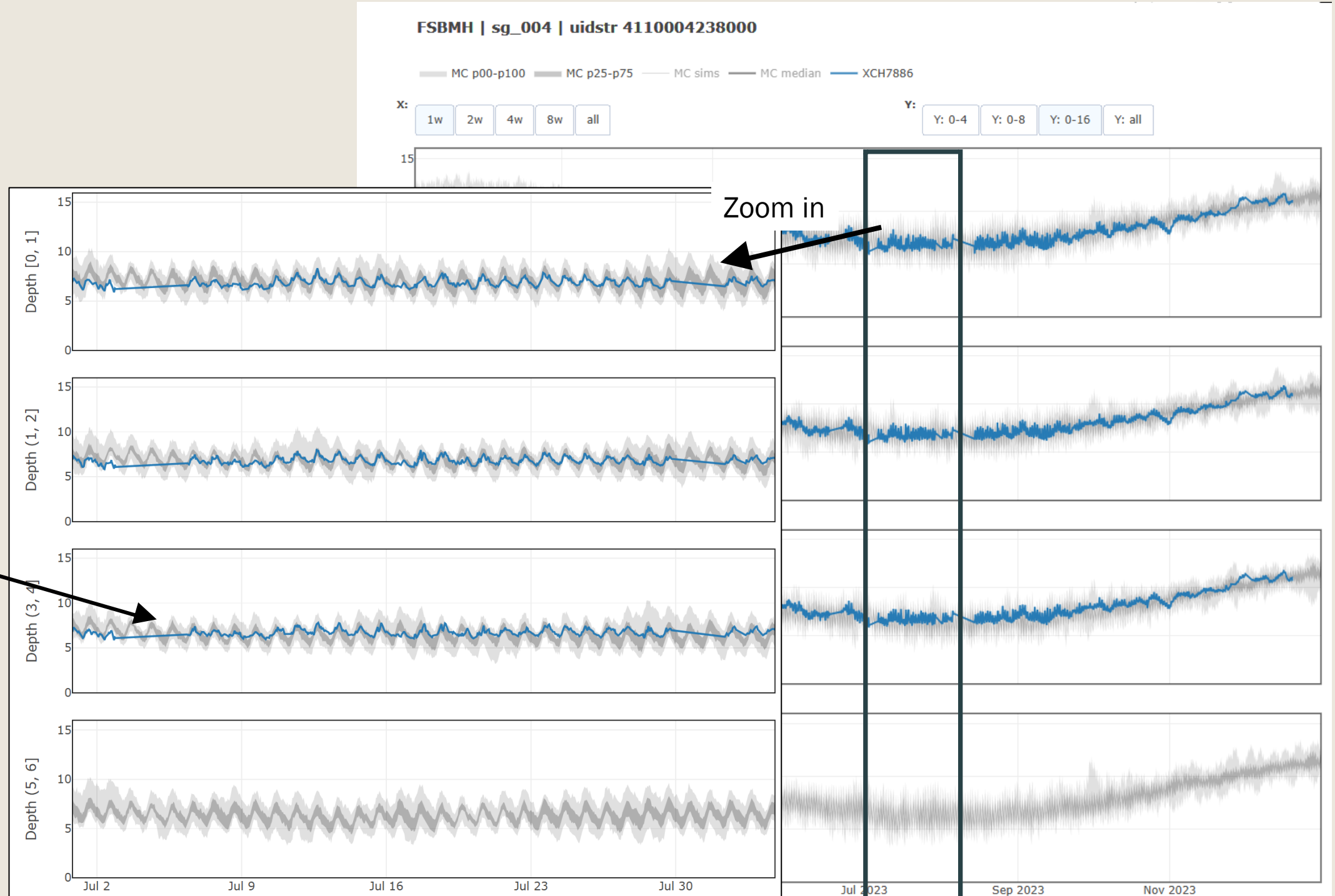
Draft plots

Mid-Fishing Bay station in 2023. Closest interpolation results shown.



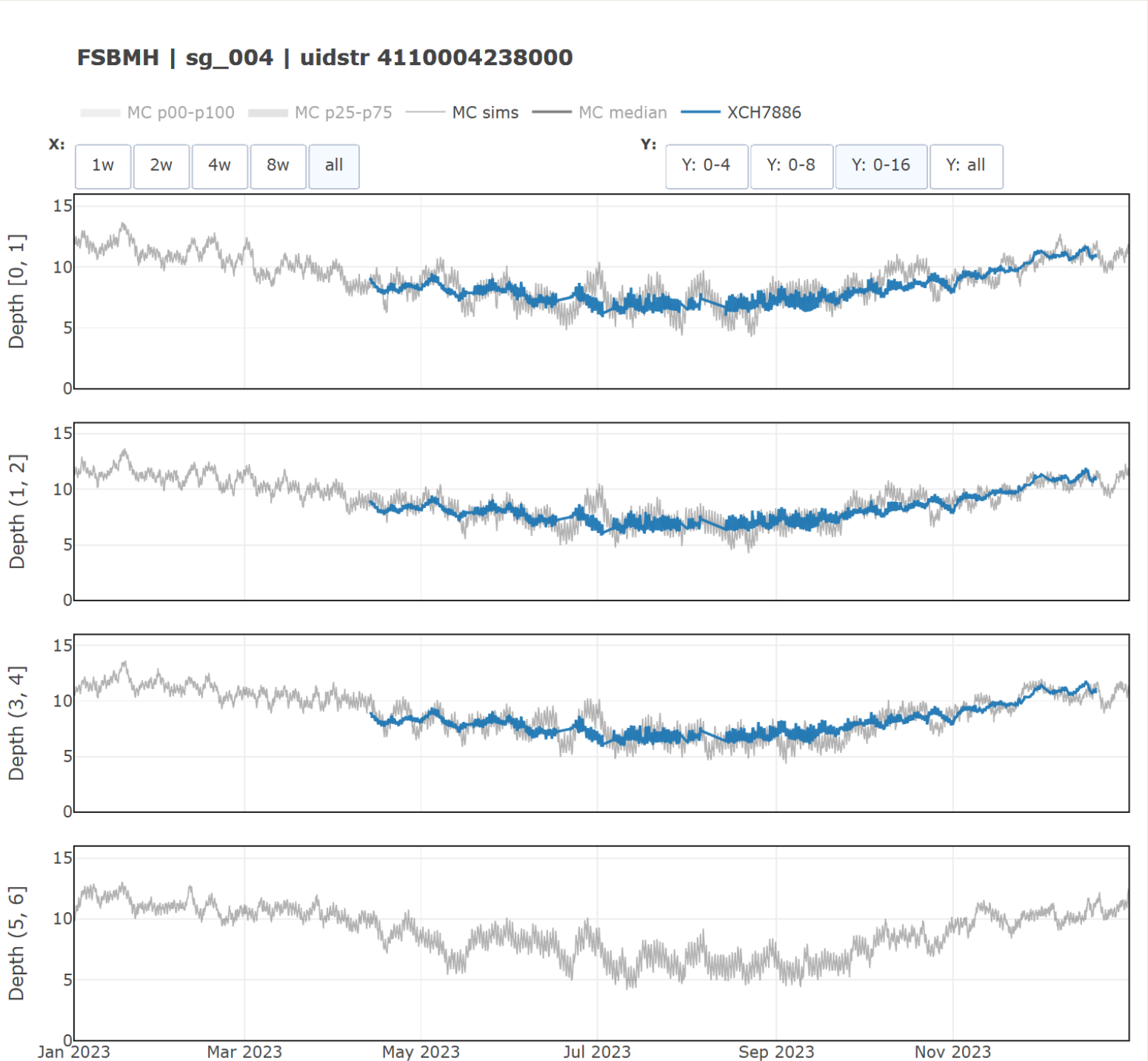
High frequency data is close to the middle of the simulations.

Places with data gaps would be just an average in many other interpolation techniques.

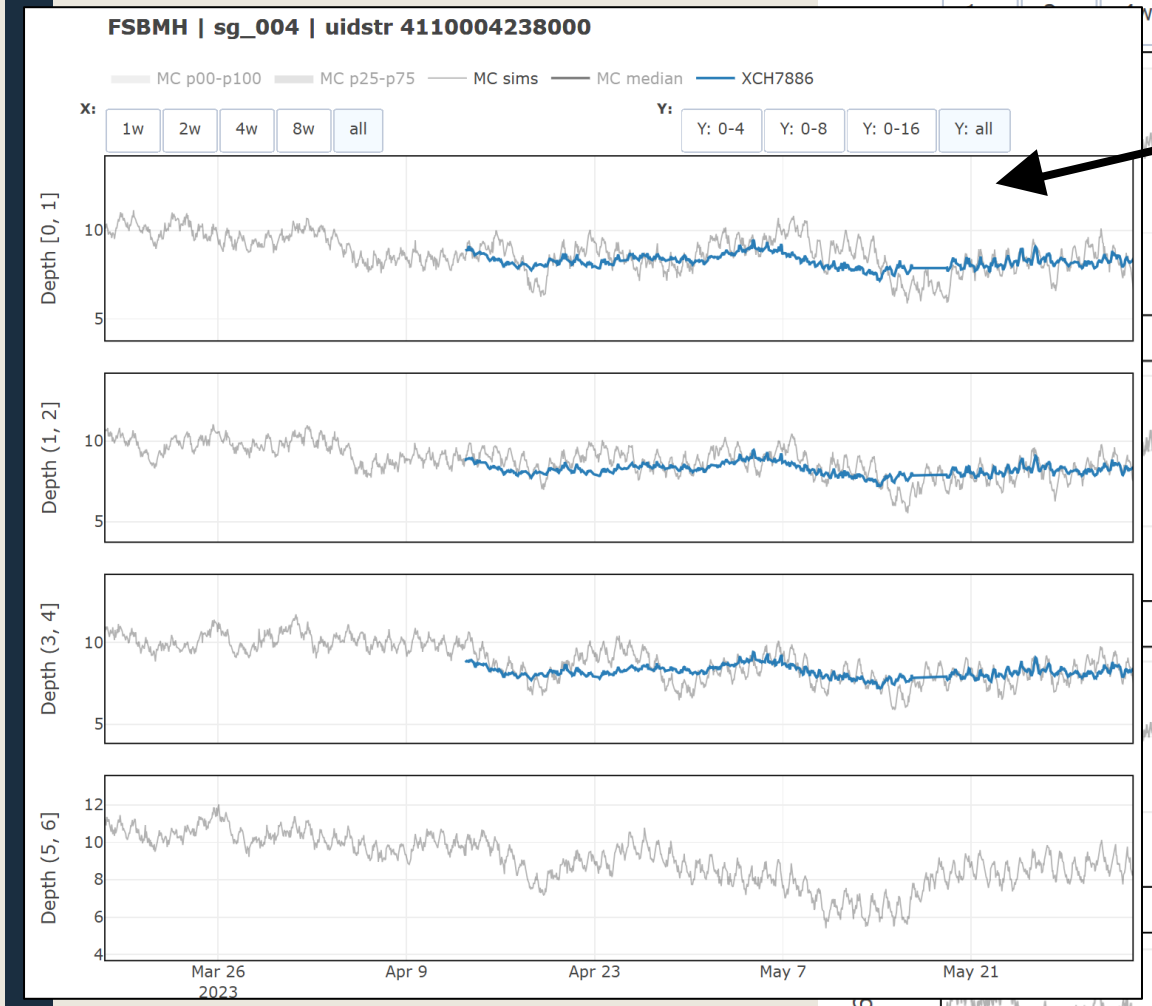


Just one simulation

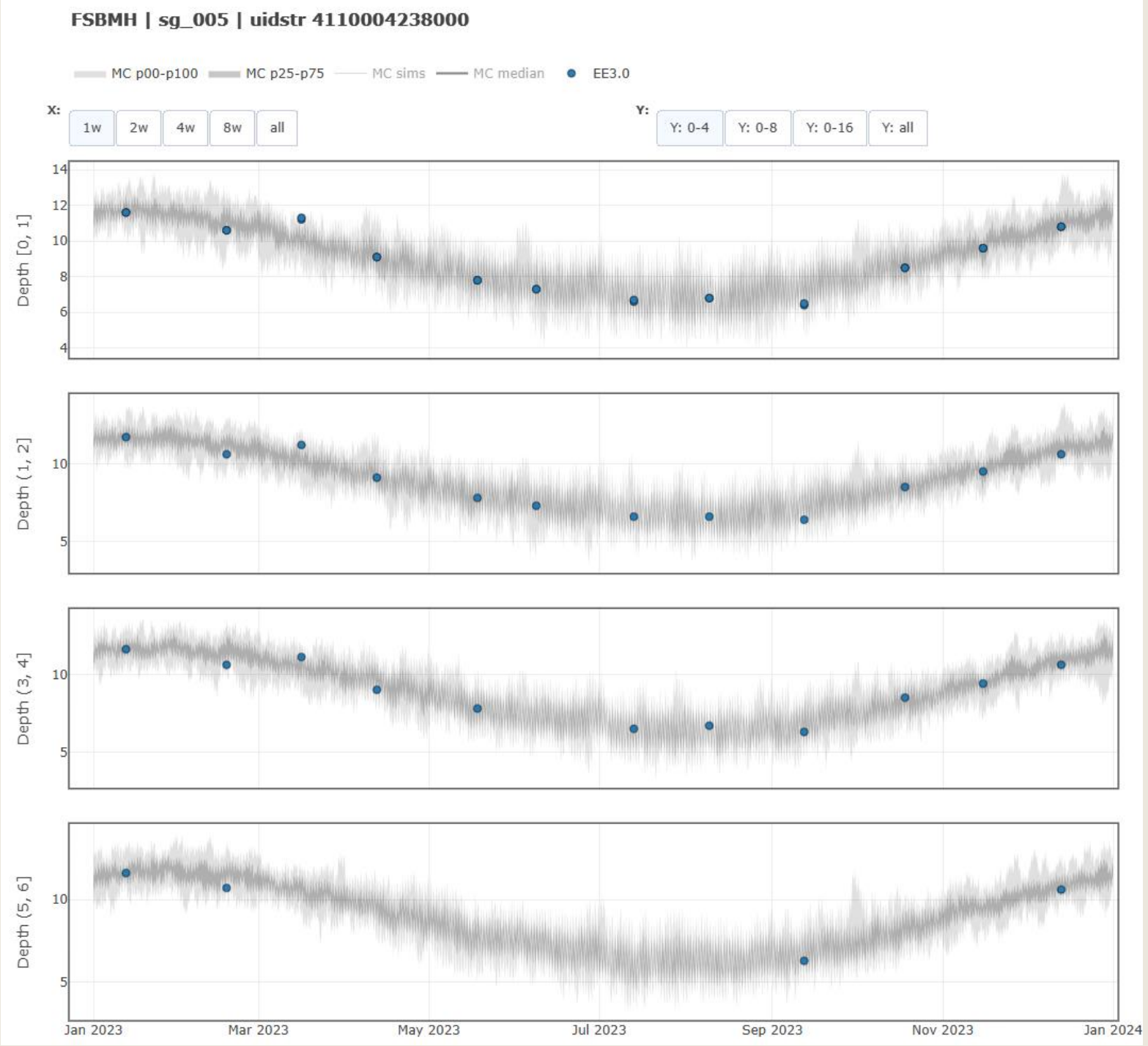
Can view just one simulation to see if we are capturing the nature of the data movements.



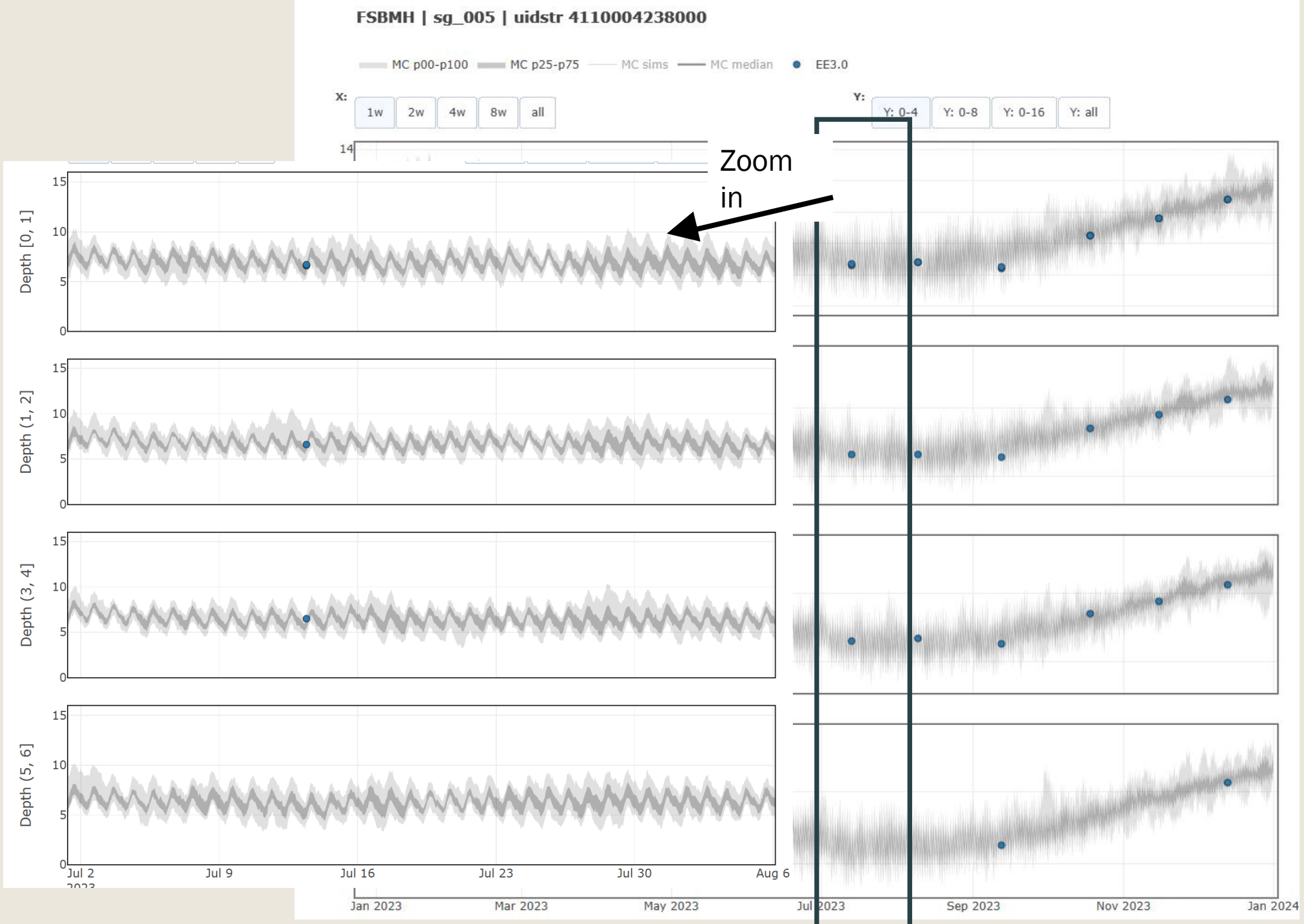
Y-axis rescaled for visibility

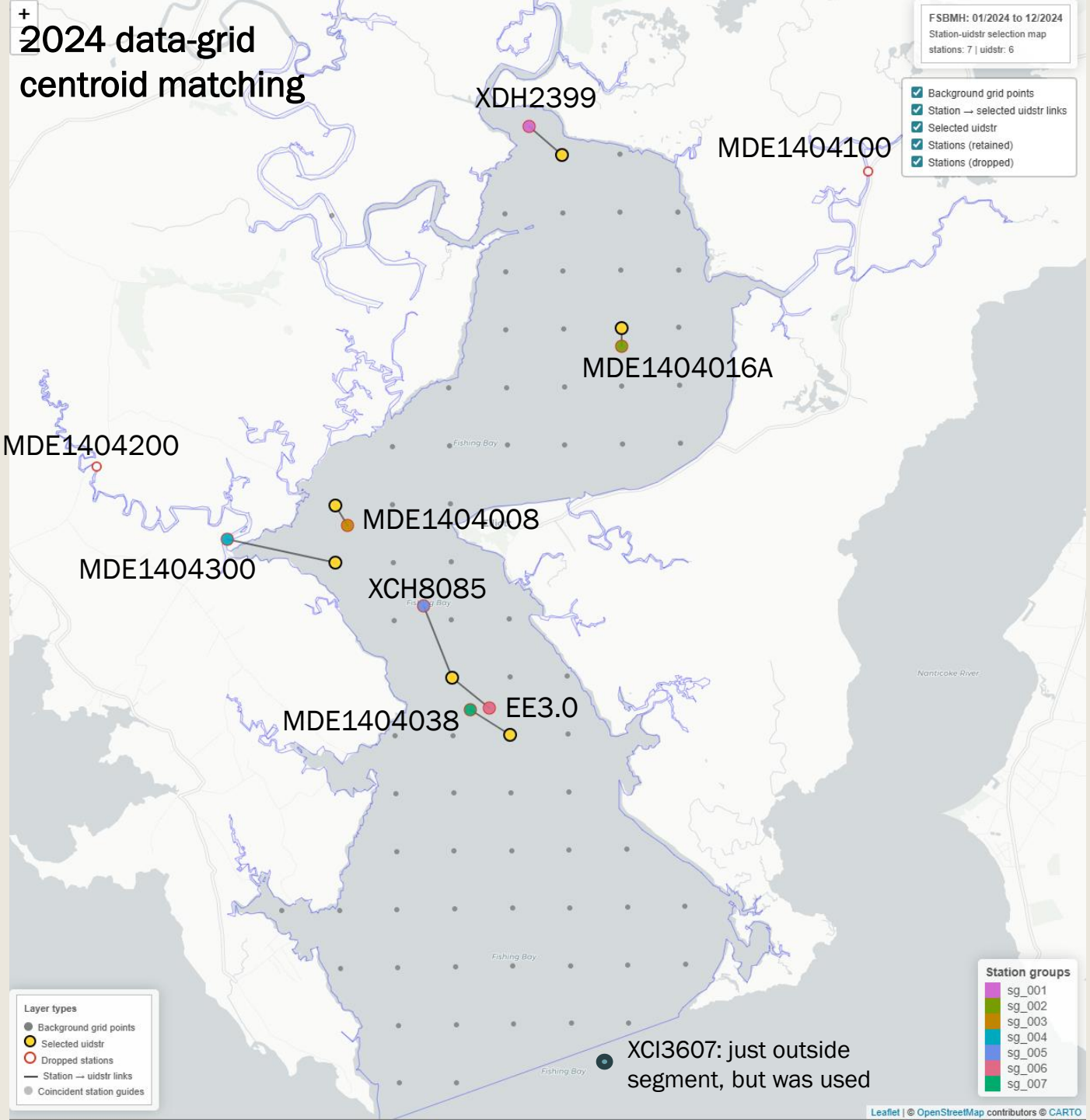


Similar multi-day up and down pattern of the data with just one simulation.

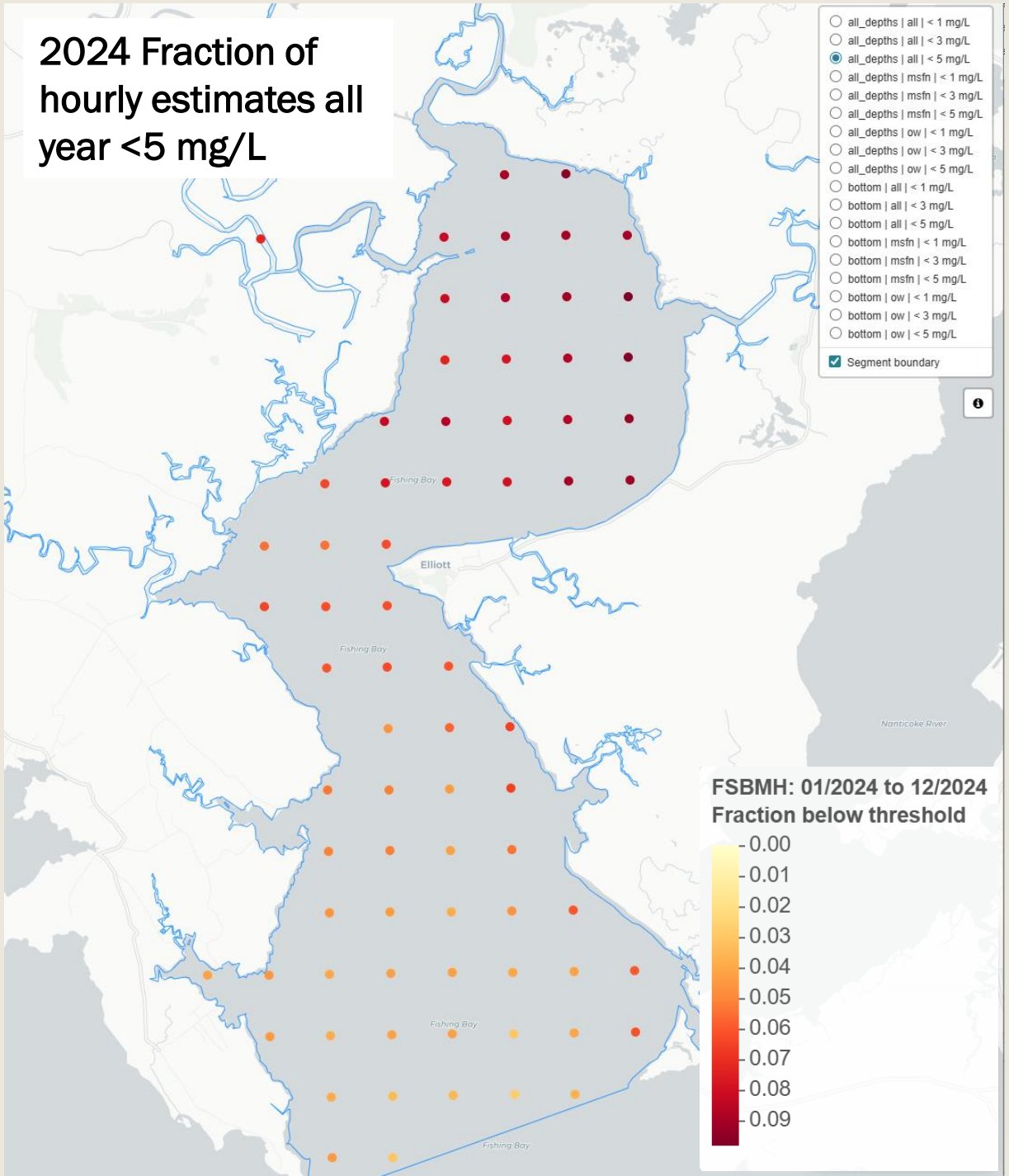

FSBMH | sg_005 | uidstr 4110004238000
MC p00-p100
MC p25-p75
MC sims
MC median
EE3.0
X:
1w
2w
4w
8w
all
Y:
Y: 0-4
Y: 0-8
Y: 0-16
Y: all
Depth [0, 1]
Depth (1, 2]
Depth (3, 4]
Depth (5, 6]
Jan 2023
Mar 2023
May 2023
Jul 2023
Sep 2023
Nov 2023
Jan 2024

When there's no high frequency data, the interpolation is needed to fill those gaps



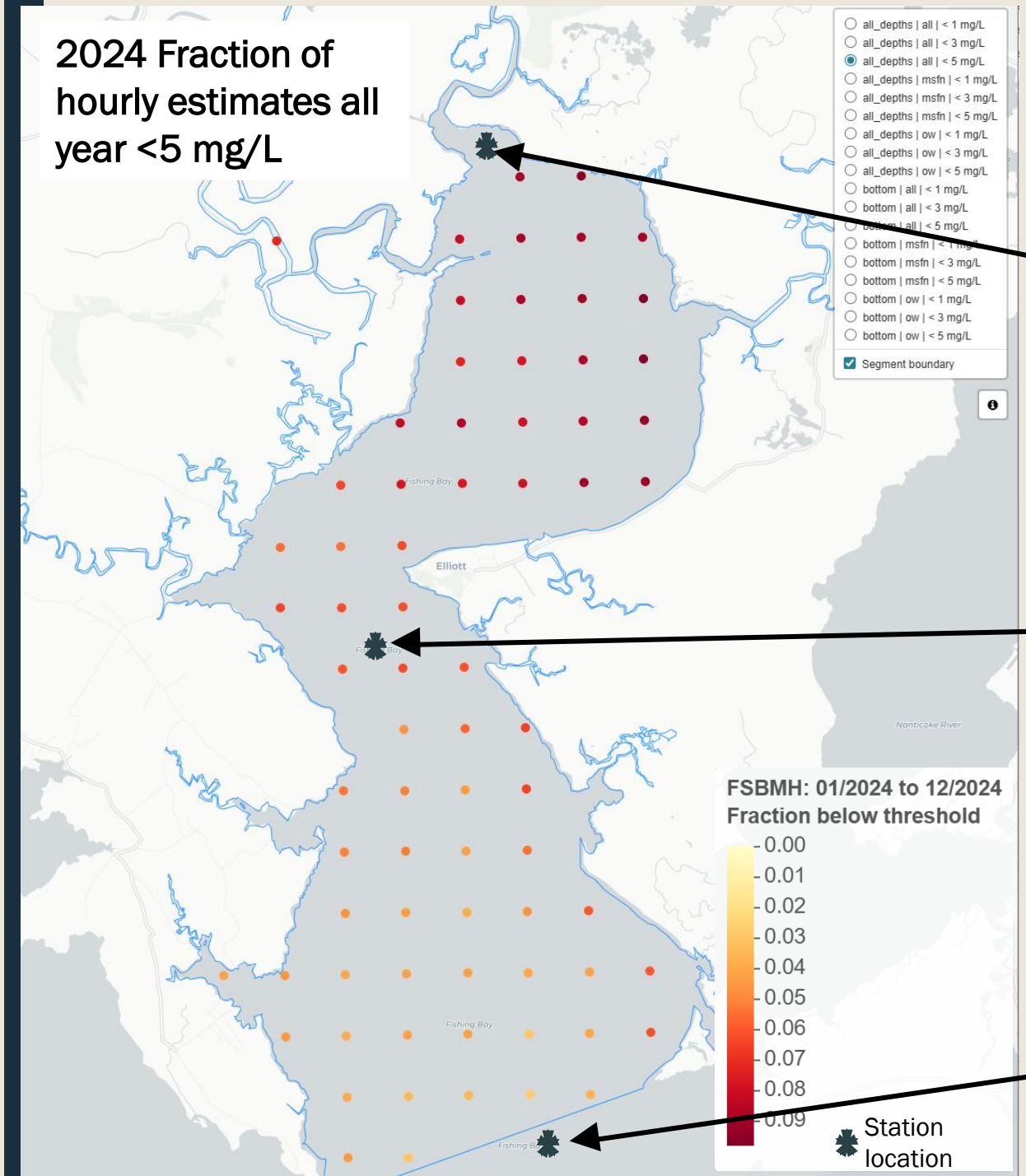


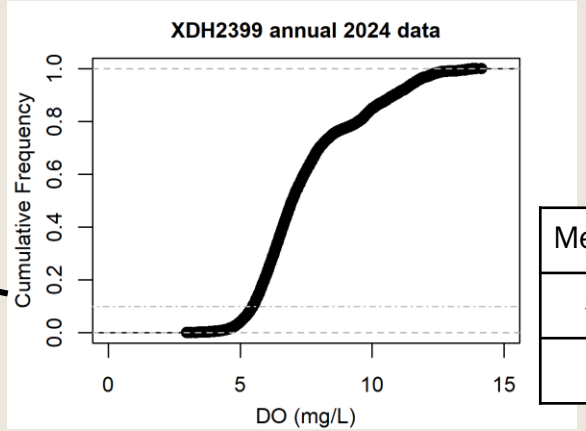
- The lines match observations to grid centroids for purpose of graphing only.
- All data (plus boundary segments) are included in the interpolation.
- Note the extent of the interpolator grid does not go into the small tributaries.
  - *This is exactly the same as the current, 3D, interpolator.*
  - *But is something to consider.*



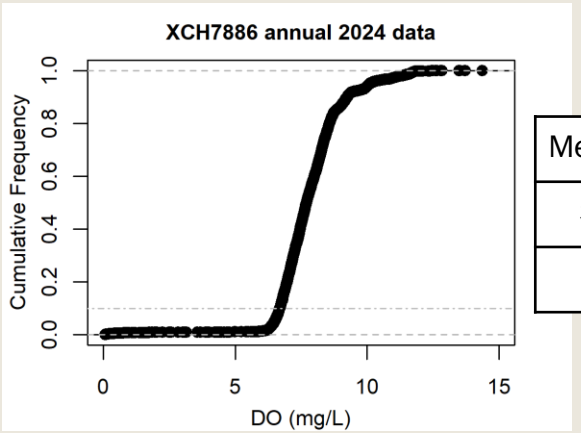
- These are very small fractions (max 9.75%).
- But spatial pattern makes sense with the data ⇒

2024 Fraction of hourly estimates all year <5 mg/L



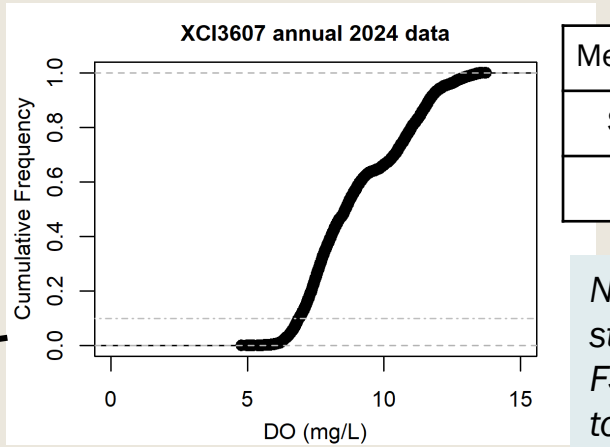


Median observed DO (mg/L)	
Summer	Annual
6.2	7.0



Median observed DO (mg/L)	
Summer	Annual*
7.2	7.7

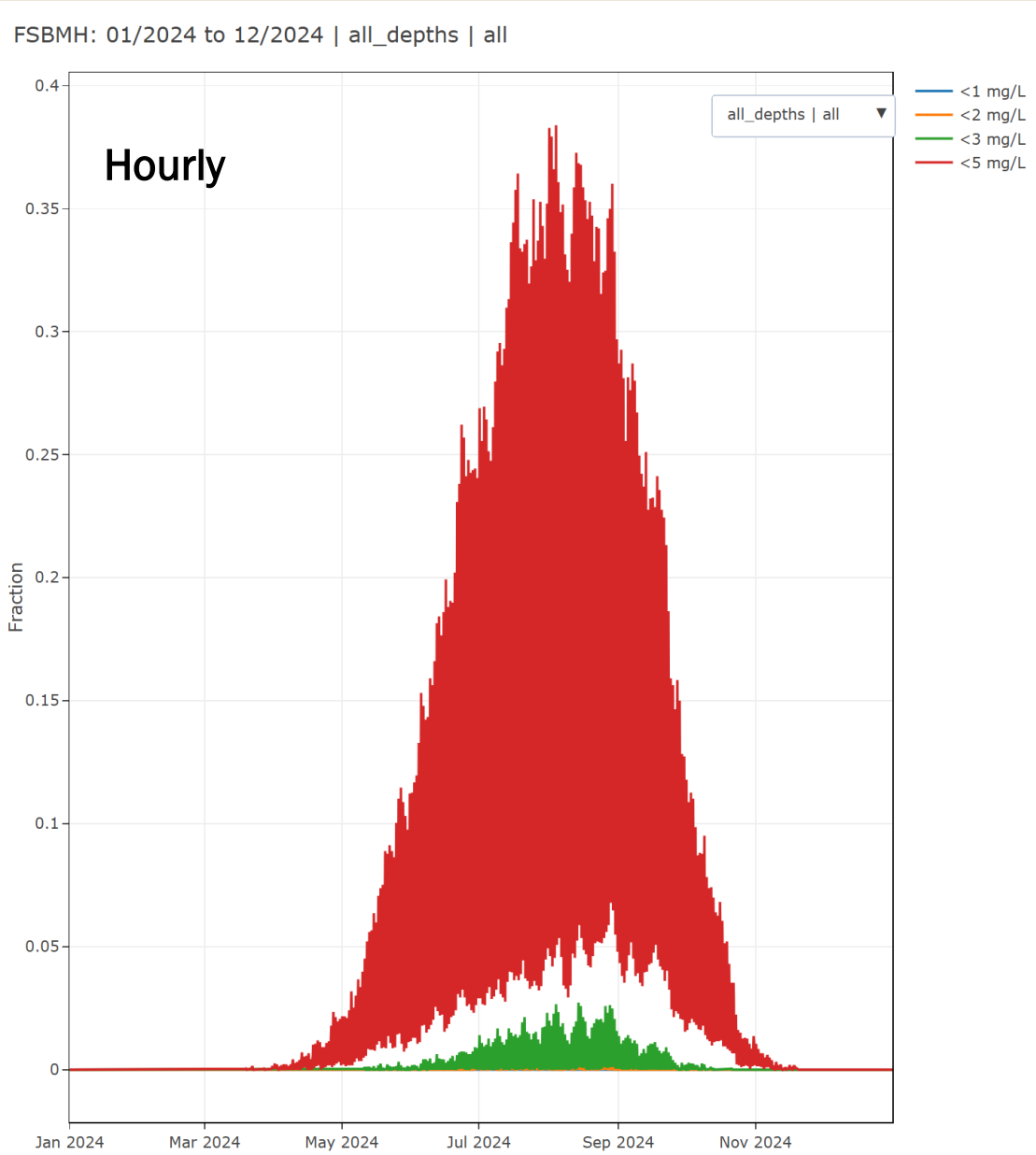
*didn't start until May

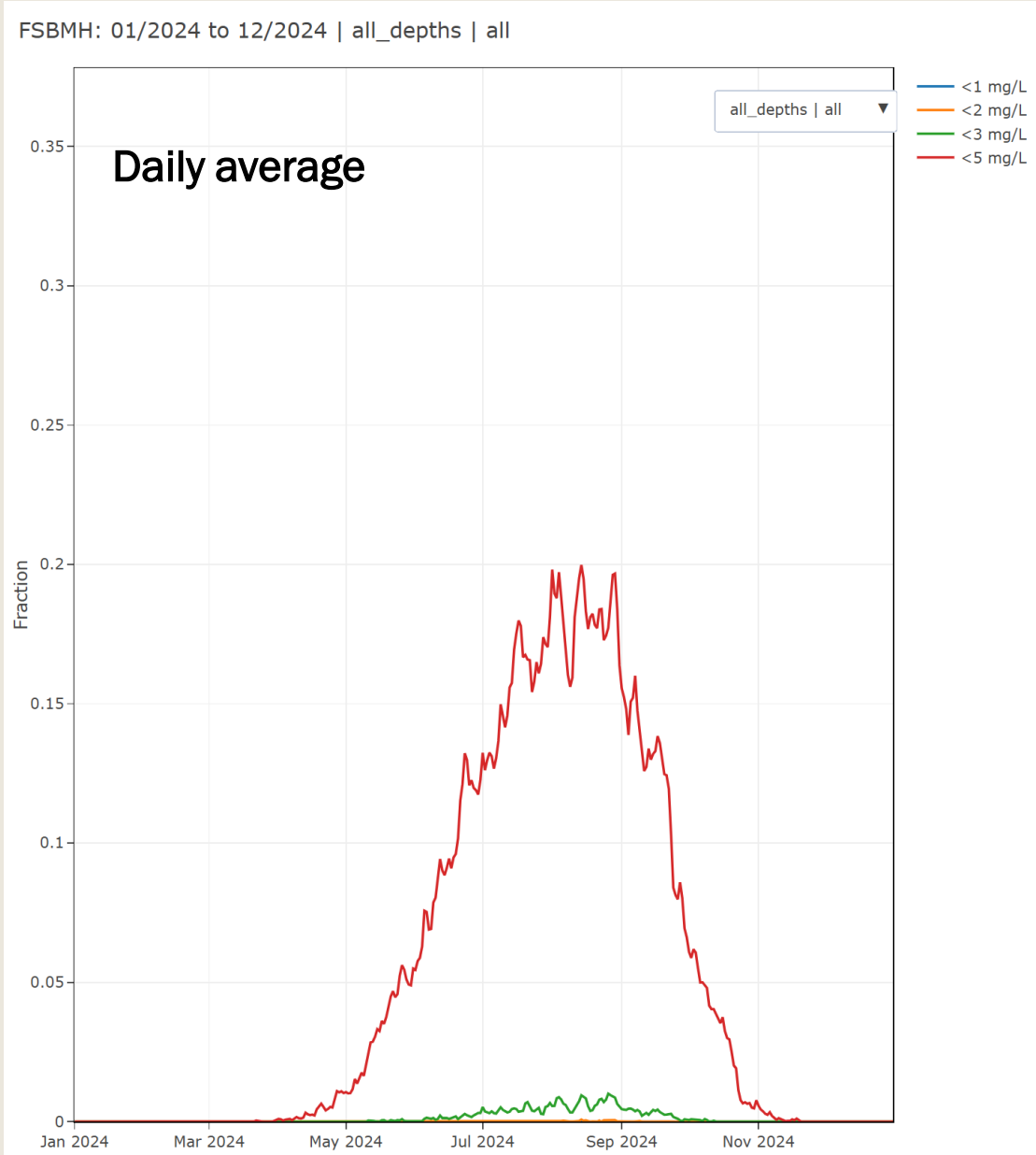


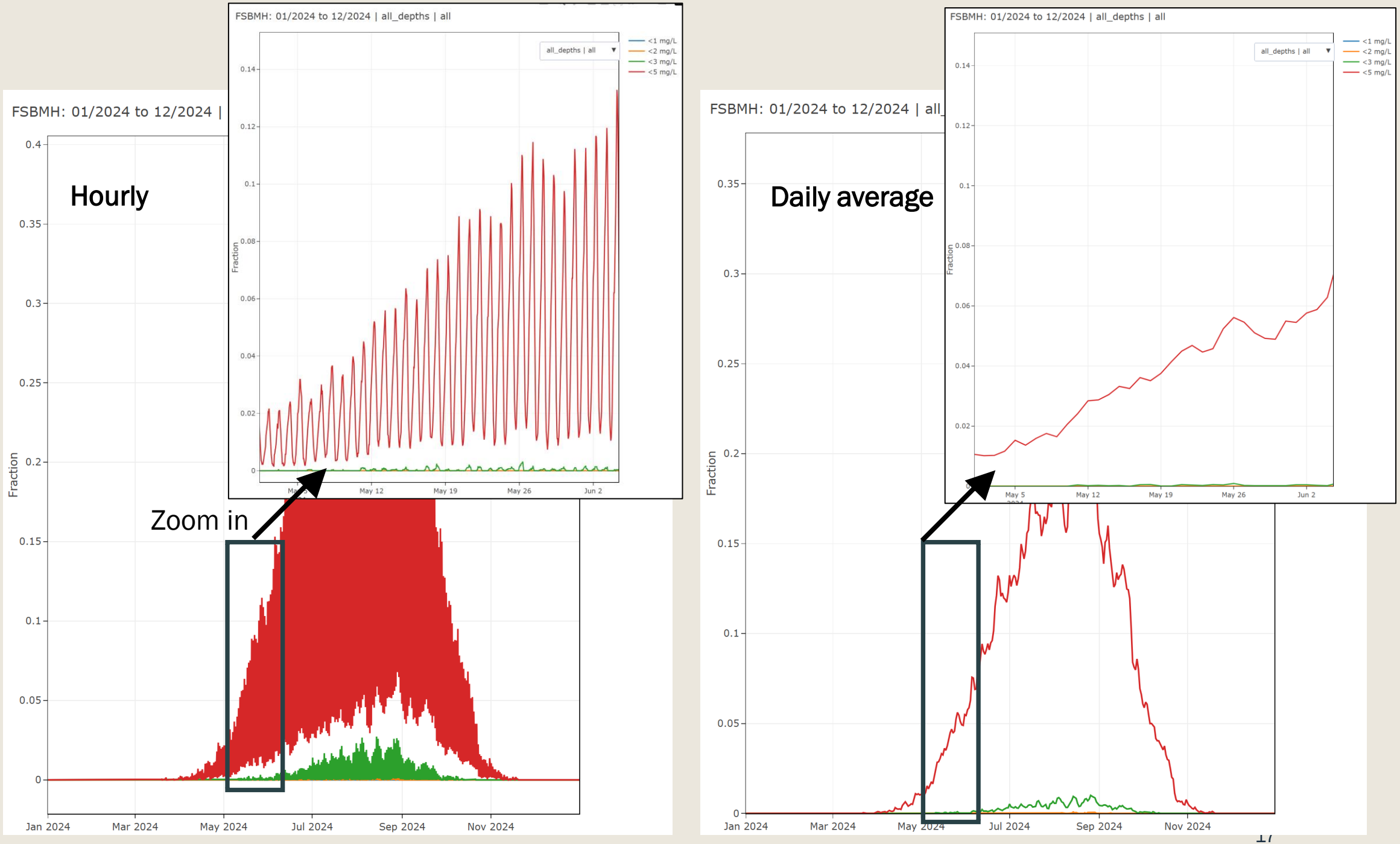
Median observed DO (mg/L)	
Summer	Annual
7.3	8.6

Note: Only the 3 high frequency stations are shown. Seven other FSBMH stations' data was used too, plus boundary stations.

Fraction of volume less than DO thresholds: Hourly and daily average segment-wide summaries 2024: Draft interpolation (20 simulations) for FSBMH






FSBMH: 01/2024 to 12/2024 | all_depths | all
all_depths | all
<1 mg/L
<2 mg/L
<3 mg/L
<5 mg/L
Fraction
May 5
May 12
May 19
May 26
Jun 2
Hourly
Zoom in
FSBMH: 01/2024 to 12/2024 |
Fraction
Jan 2024
Mar 2024
May 2024
Jul 2024
Sep 2024
Nov 2024
Daily average
FSBMH: 01/2024 to 12/2024 | all_

Looking at the criteria

Could start to list out decisions needed on things like averaging periods to build some example CFDs.

Table 1. Chesapeake Bay dissolved oxygen criteria.

Designated Use	Criteria Concentration/Duration	Protection Provided	Temporal Application
Migratory fish spawning and nursery use	7-day mean ≥ 6 mg liter^{-1} (tidal habitats with 0-0.5 ppt salinity)	Survival/growth of larval/juvenile tidal-fresh resident fish; protective of threatened/endangered species.	February 1 - May 31
	Instantaneous minimum ≥ 5 mg liter^{-1}	Survival and growth of larval/juvenile migratory fish; protective of threatened/endangered species.	
	Open-water fish and shellfish designated use criteria apply		June 1 - January 31
Shallow-water bay grass use	Open-water fish and shellfish designated use criteria apply		Year-round
Open-water fish and shellfish use	30-day mean ≥ 5.5 mg liter^{-1} (tidal habitats with 0-0.5 ppt salinity)	Growth of tidal-fresh juvenile and adult fish; protective of threatened/endangered species.	Year-round
	30-day mean ≥ 5 mg liter^{-1} (tidal habitats with >0.5 ppt salinity)	Growth of larval, juvenile and adult fish and shellfish; protective of threatened/endangered species.	
	7-day mean ≥ 4 mg liter^{-1}	Survival of open-water fish larvae.	
	Instantaneous minimum ≥ 3.2 mg liter^{-1}	Survival of threatened/endangered sturgeon species.[1]	
Deep-water seasonal fish and shellfish use	30-day mean ≥ 3 mg liter^{-1}	Survival and recruitment of bay anchovy eggs and larvae.	June 1 - September 30
	1-day mean ≥ 2.3 mg liter^{-1}	Survival of open-water juvenile and adult fish.	
	Instantaneous minimum ≥ 1.7 mg liter^{-1}	Survival of bay anchovy eggs and larvae.	
	Open-water fish and shellfish designated-use criteria apply		October 1 - May 31
Deep-channel seasonal refuge use	Instantaneous minimum ≥ 1 mg liter^{-1}	Survival of bottom-dwelling worms and clams.	June 1 - September 30
	Open-water fish and shellfish designated use criteria apply		October 1 - May 31

[1] At temperatures considered stressful to shortnose sturgeon (>29°C), dissolved oxygen concentrations above an instantaneous minimum of 4.3 mg liter^{-1} will protect survival of this listed sturgeon species.

From EPA 2003 Ambient Water Quality Criteria

Thoughts/suggestions?

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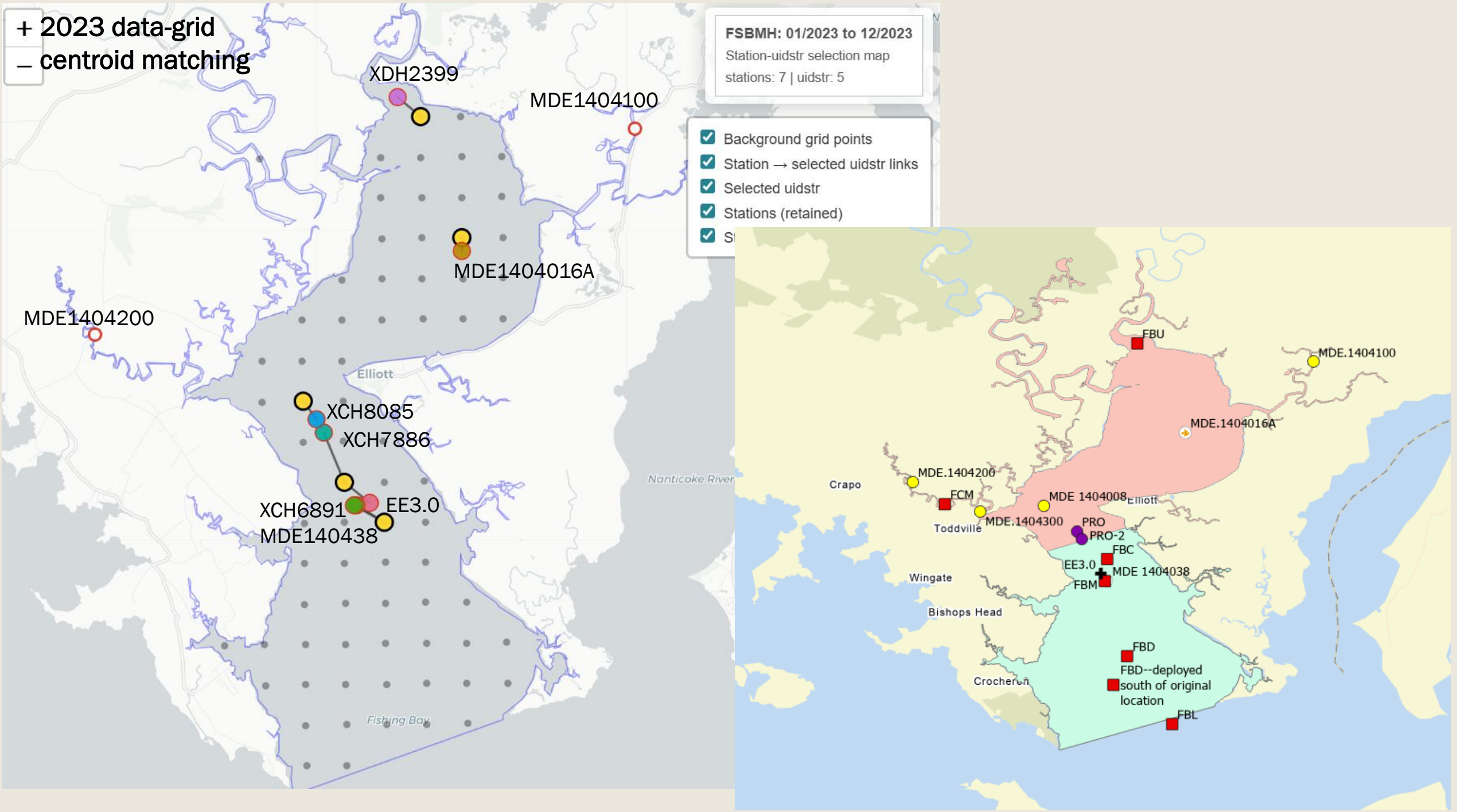
To do soon

Need to discuss

extras

2022 data-grid centroid matching

- This matching is just for making plots.
- All data is included in the interpolation.
- Note the extent of the interpolator grid though.


+ 2023 data-grid
– centroid matching
FSBMH: 01/2023 to 12/2023
Station-uidstr selection map
stations: 7 | uidstr: 5
Background grid points
Station → selected uidstr links
Selected uidstr
Stations (retained)
XDH2399
MDE1404100
MDE1404016A
MDE1404200
Elliott
XCH8085
XCH7886
XCH6891
EE3.0
MDE140438
Nanticoke River
Fishing Bay
FBU
MDE.1404100
MDE.1404016A
MDE.1404200
Crapo
FCM
MDE 1404008
Elliott
Toddville
MDE.1404300
PRO
PRO-2
FBC
EE3.0
MDE 1404038
FBM
Wingate
Bishops Head
FBD
FBD--deployed south of original location
Crocheron
FBL