# The future of our Chesapeake Bay water quality criteria assessment – decision needs for 4D supported assessment

Peter Tango with collected input of ideas from DNR, MDE, VADEQ, USGS, UMCES colleagues ☺
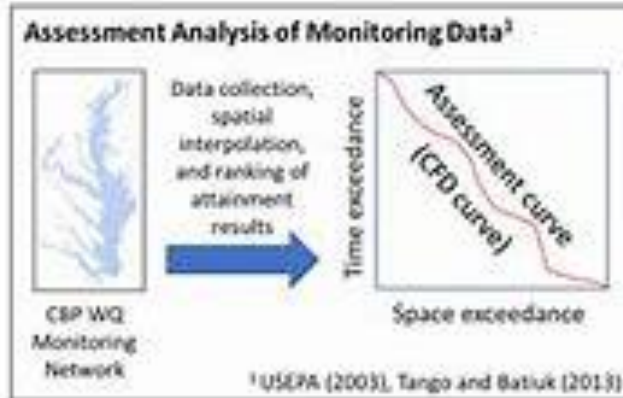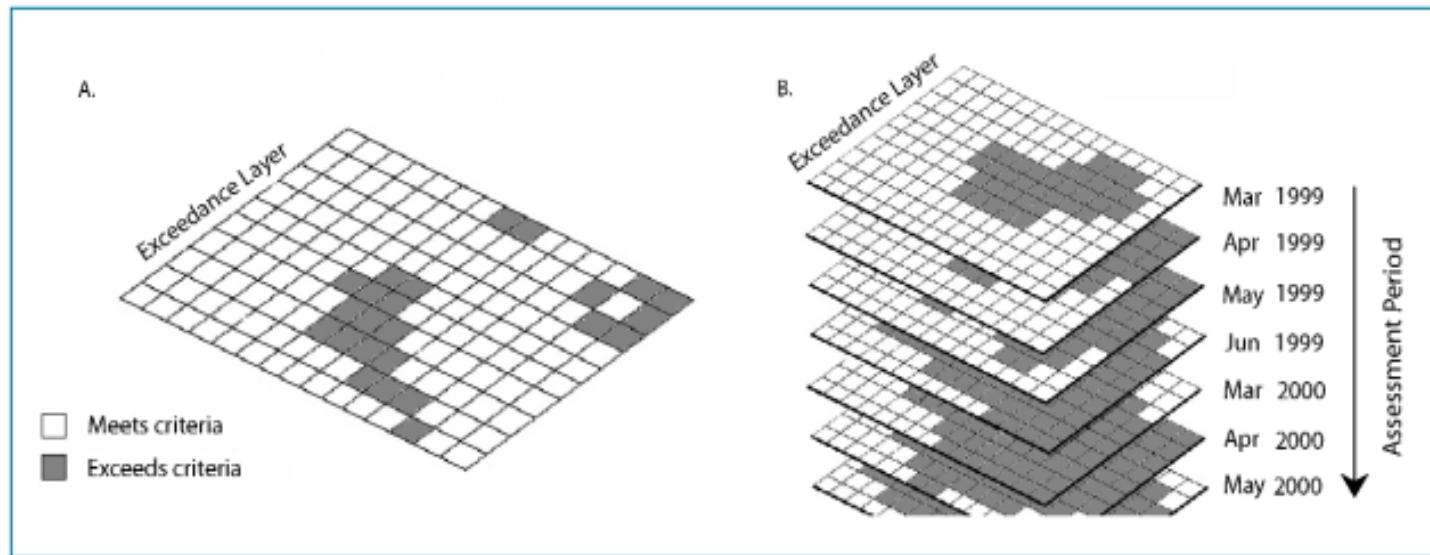
USGS@CBPO

CAP WG

7-6-2023

Assessing all criteria



A

**The Chesapeake Bay Water Quality Criteria Attainment Assessment Framework**

**Assessment Analysis of Monitoring Data[1]**

Data collection, spatial interpolation, and ranking of attainment results

CBP WQ Monitoring Network

Time exceedance

Assessment curve (CFD curve)

Space exceedance

[1] USEPA (2003), Tango and Batiuk (2013)

**Compliance Decision Framework[2]**

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Water Quality Standard Non-compliance space

Space exceedance

Time exceedance

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Reference curve*

Compliance region

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Figure VI-4. For a given sampling event, cells that exceed the criterion are determined by comparing the interpolator estimated water quality value in each cell (e.g., chlorophyll *a*) to the appropriate criterion value (a) as in Figure VI-3. The same process is repeated for each sampling event through the assessment period (b).
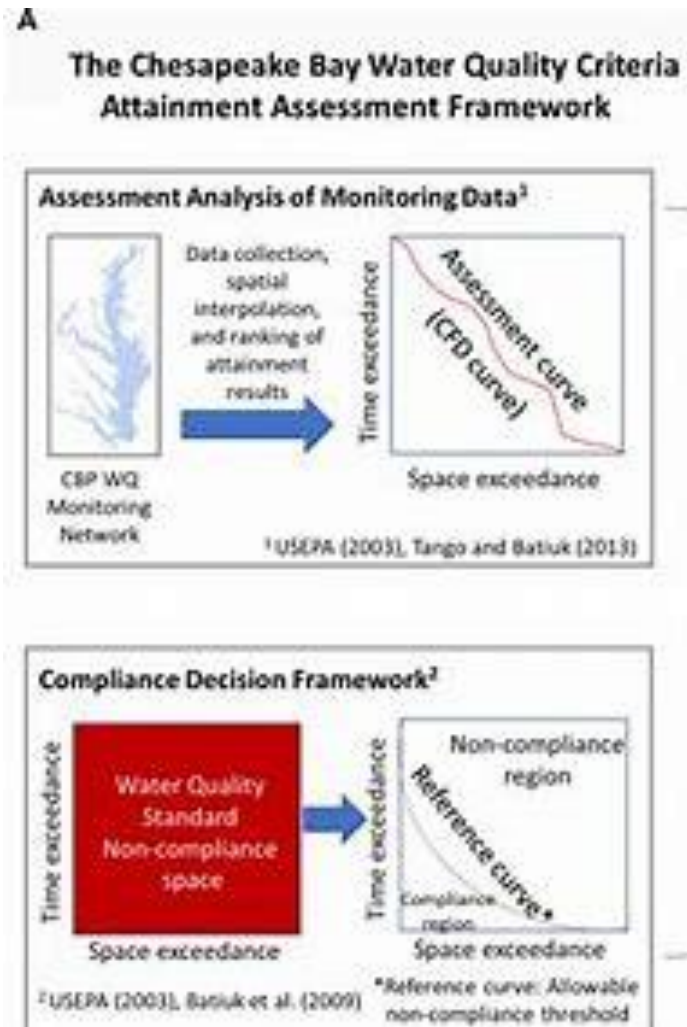
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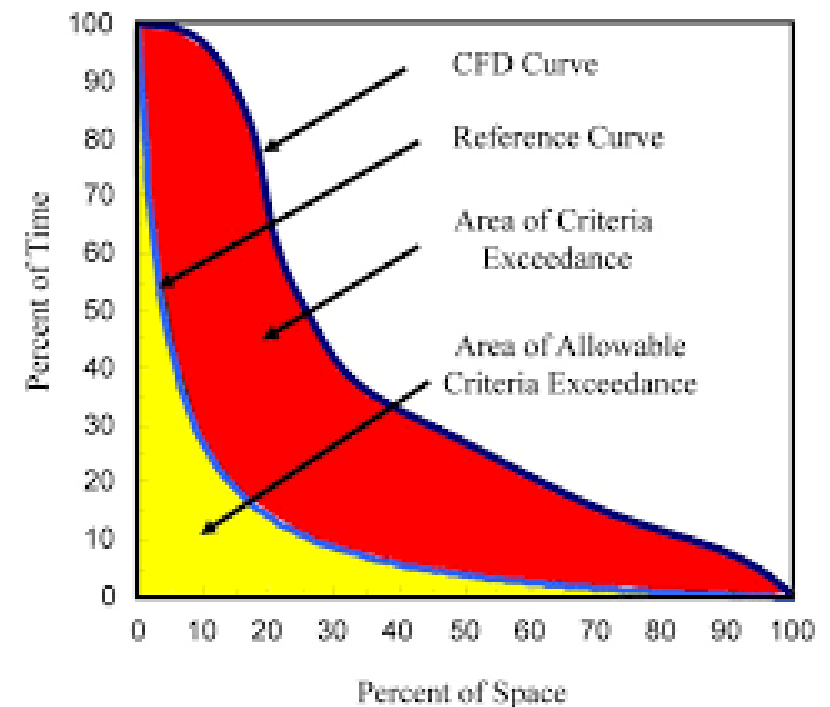


USEPA (2003): The CFD Attainment Test

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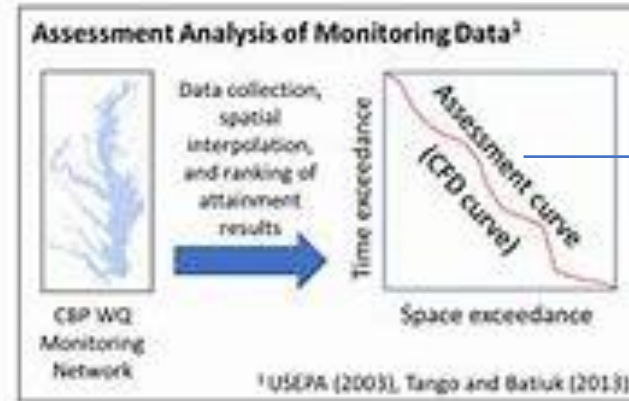
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* 7 day means
* 1 day means
* Instantaneous minimum

Chlorophyll *a* has
* Seasonal means



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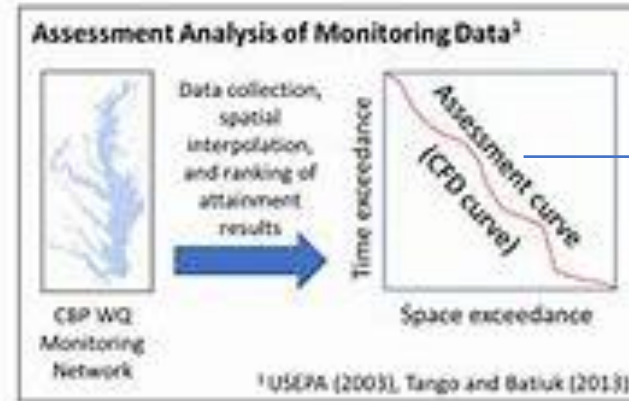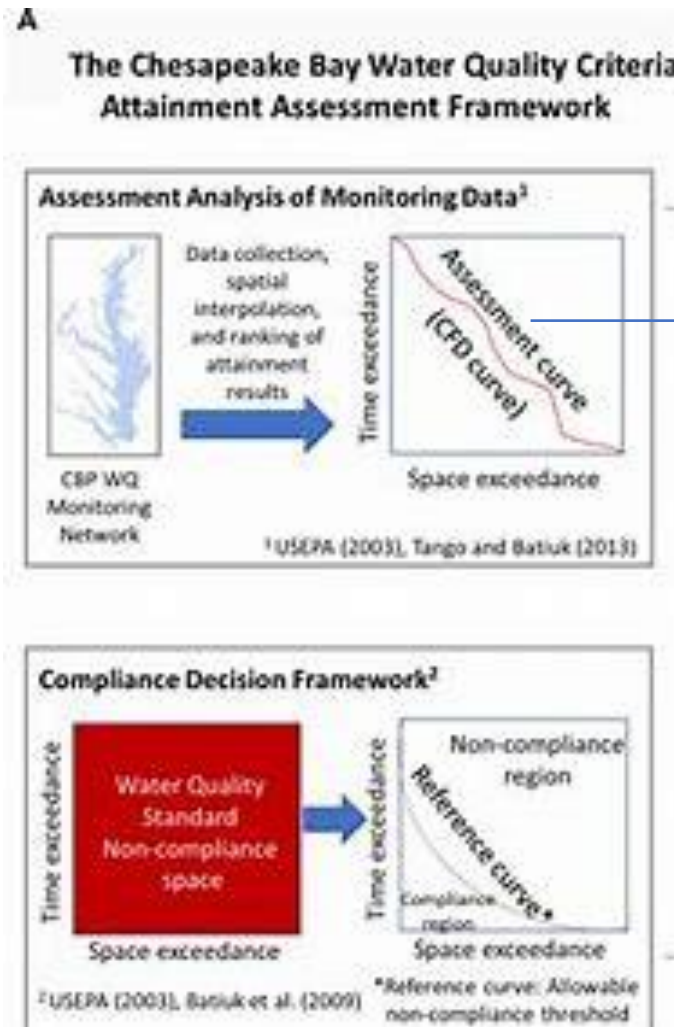
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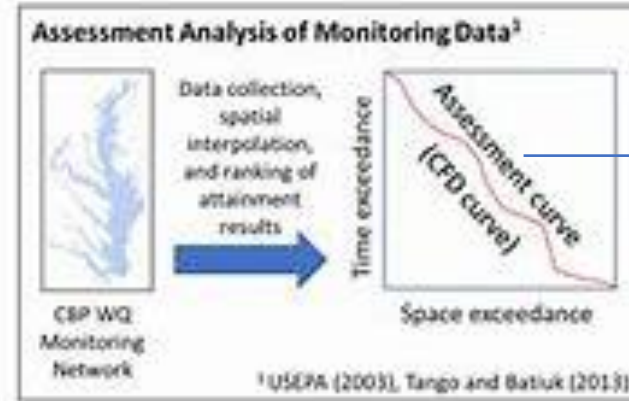
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Dissolved Oxygen mg/l  CB Trust Test Deployment @ CB 4.3E
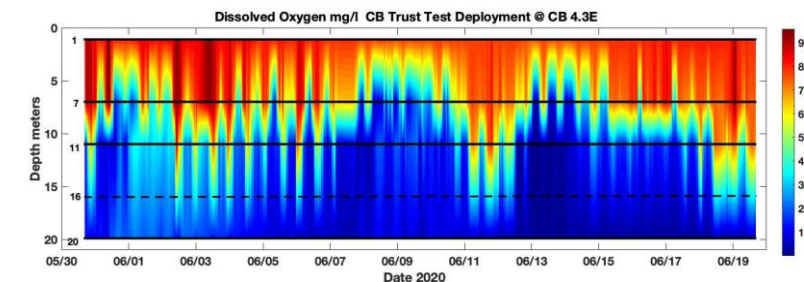
# New 4-D water quality interpolation is under development (Bay Oxygen Research Group):

Space-time interpolation with GAMs

## Simulator components

### Long term temporal patterns

*Smoothly varying change from observations aided by deterministic relationships with continuously available information (flow, wind, temperature, dynamic model output, etc)*

Key data example: Long-term fixed network

**+**

### Spatial structure

*Spatial autocorrelation; anisotropy in depth direction; deterministic relationships to other spatial data (bathymetry, satellite images, etc)*

Key data example: Dataflow

**+**

### Short term temporal variability

*Daily & tidal cycling, temporal autocorrelation, etc*

Key data example: Conmon
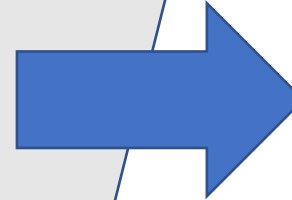


*"4d" Spatial & temporal estimates of DO*

$d_1, t_1$    $d_2, t_1$    $d_3, t_1$   ...

$d_1, t_2$    $d_2, t_2$    $d_3, t_2$

DO (mg/L)
- <0.2
- 0.2-1
- 1-2
- 2-3
- 3-4

...

Source: R. Murphy

# Where we are heading: Assessment of all Bay oxygen water quality criteria for 2025

A new analysis system, built on an expanded data collection effort, is envisioned that will allow assessment of all water quality criteria. Figure 1 shows the flow of information in the proposed system.
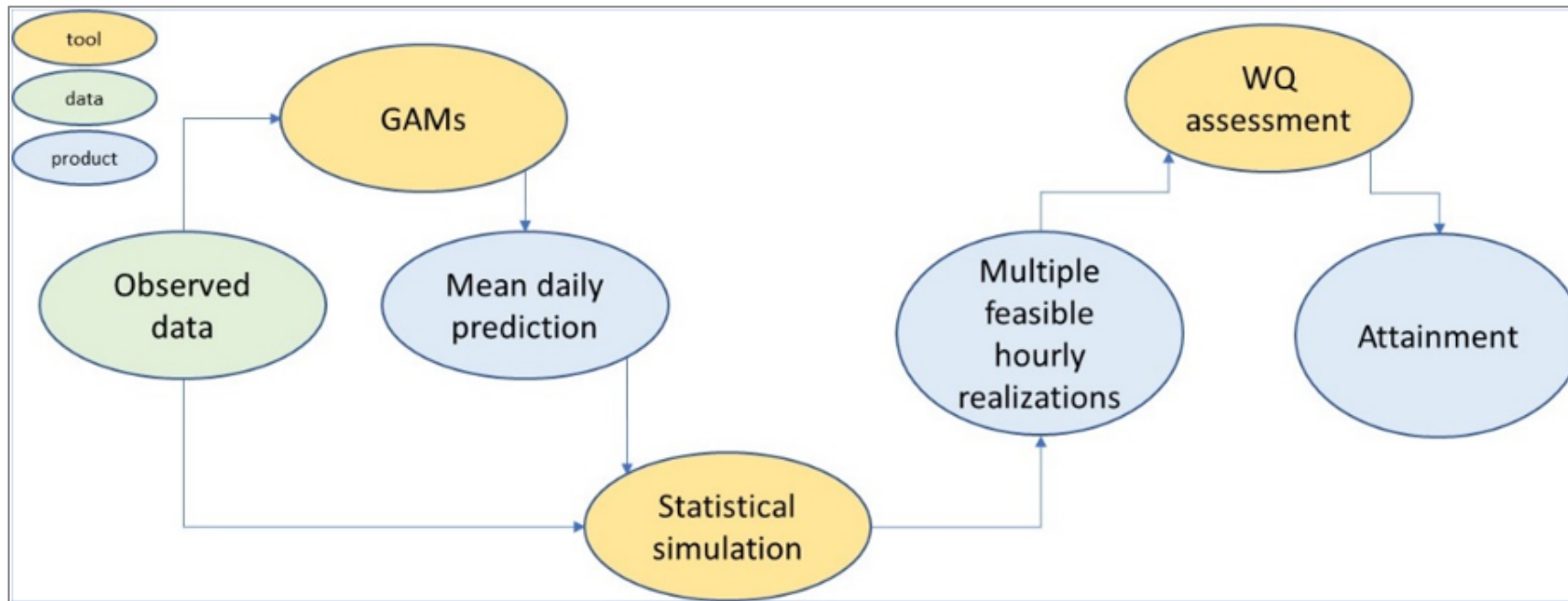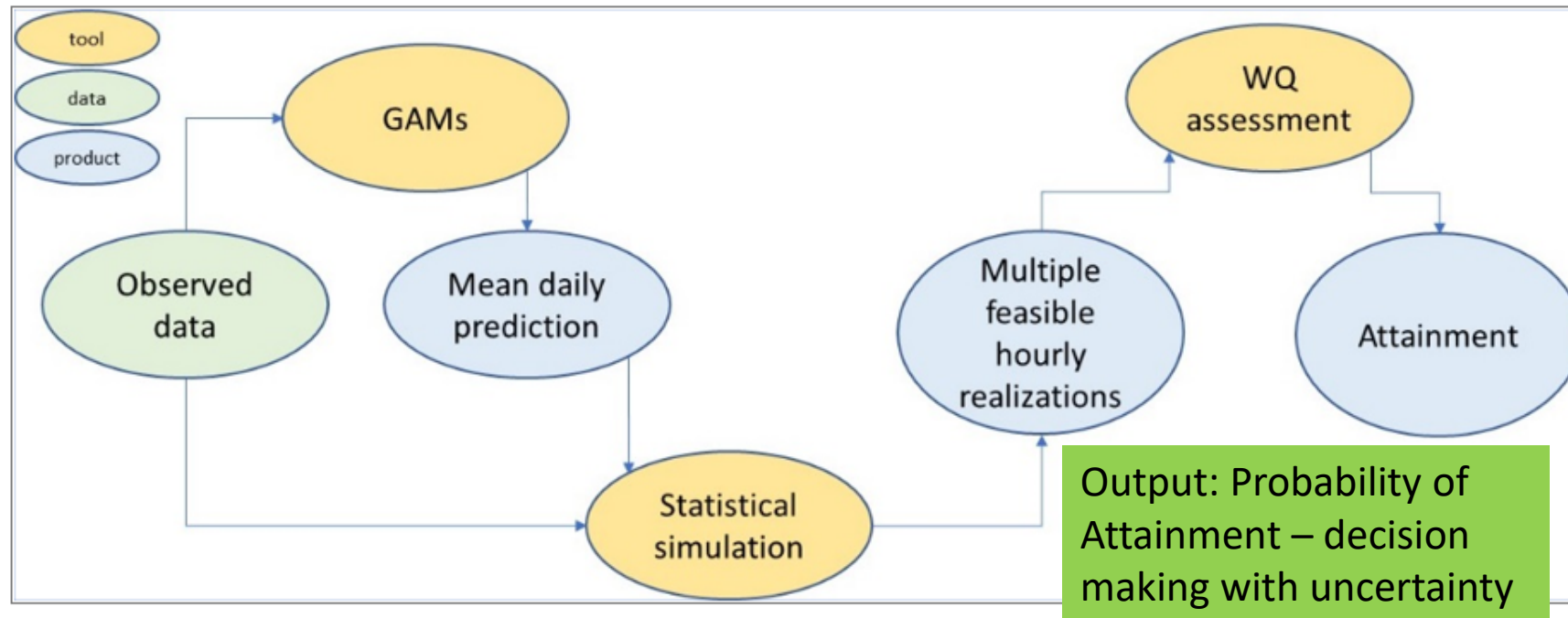


Figure 1: Interpolation and attainment assessment system

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Figure 1: Interpolation and attainment assessment system

Output: Probability of Attainment – decision making with uncertainty

Source: G. Shenk

# Assessment accounting using published method – curvy decisions needed ahead
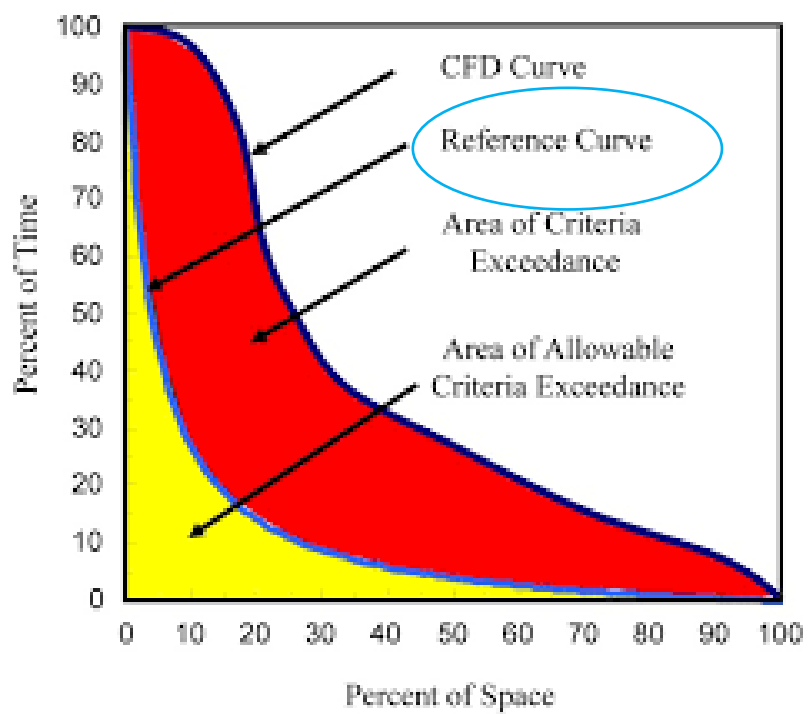


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| D.O. Criteria | Presently | 4D needs |
|---|---|---|
| 30-day mean | 10% reference curve | We can use 10% curve if we compute monthly means |
| 7 day mean | No curve | Input needed – research needed? |
| 1 day mean | No curve | Input needed – research needed? |
| Instantaneous min | Bioreference curve | Built originally on data from 2 cruises per month. Do we just use criterion as threshold? Research: Can new data provide support for a reevaluation of the IM bioreference? |

# Question for EPA

- Can we have interim decision rules between now and 4D application that uses a weight of evidence from the continuous monitoring data?

    - At a minimum, need a discussion with our friends in EPA Region 3 on this pathway for supporting our assessment futures.

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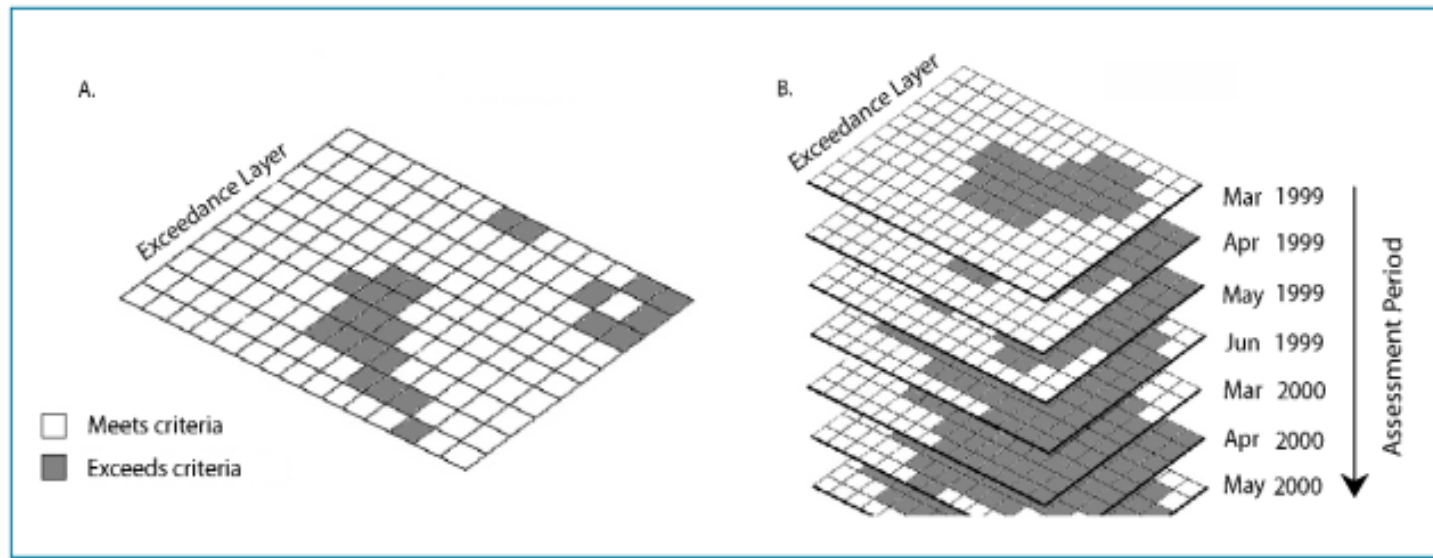


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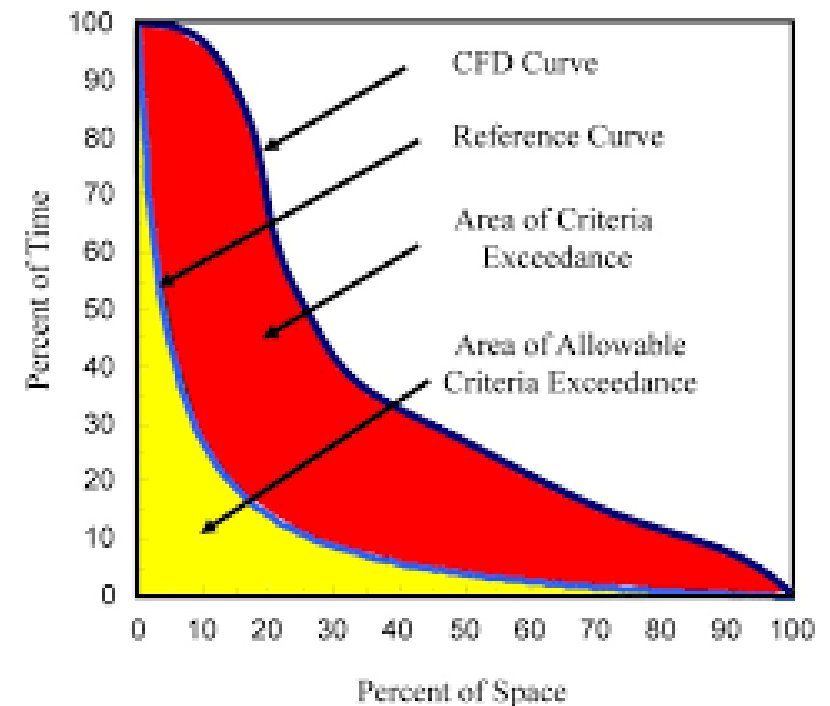
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# The deep water seasonal hypoxia is important - loss of thermal refuge, forage, nutrient cycling feedbacks...



Eyes on the Bay, MD DNR 2023