Chesapeake Bay Initiative update: Water quality assessment in support of the Commonwealth’s intensified restoration effort

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To remind you of the elements of the Chesapeake Bay Initiative:

- Use of spatially and temporally intensive instruments and techniques to monitor attainment of EPA criteria for designated uses in Virginia tributaries
  - Fixed station datasondes - for continuous data collection, single depth
  - DataFlow - for large areal assessment of shallow water areas
  - ACROBAT - for 3-D assessment of dissolved oxygen in open/deep water
  - Vertical profiler - for continuous data collection, multiple depths, fixed station (lower York, Coast Guard pier)

- Monitoring Sites
  - Potomac: fixed station and DataFlow in large creeks
  - Rappahannock: DataFlow, fixed stations, ACROBAT
  - York: DataFlow, fixed stations, ACROBAT, vertical profiler
  - James: DataFlow, fixed stations
Objective of shallow water program: provide water quality assessments for shallow water using a combination of:

Fixed Stations
and High Frequency Spatial WQ Mapping:

- **DataFlow**
  - Monthly cruises
  - Sample every 3-4 seconds
  - 50 m sample interval
  - Depths of 1 m or less

- **Measurements**
  - Salinity and Conductivity
  - Temperature
  - Dissolved Oxygen
  - pH
  - Turbidity
  - Chlorophyll
  - Depth and GPS
Scope of Work - Shallow Water Program

- DataFlow - monthly cruises
  - YRKMH, RPPMH, CRRMH, Potomac embayments, April - October 2007, 2008

- Fixed Stations - starting Feb 2007, 15 min intervals
  - RPPMH (2), RPPOH (1), RPPTF (1), CRRMH (1)
  - Potomac embayments - Coan, Yeocomico, Machodoc, Nomini
  - YRKPH, PMKTF

- Measurements - DataFlow and Fixed stations:
  - water temperature, conductivity, salinity, percent saturation, dissolved oxygen concentration, water depth, pH and turbidity
Objectives of Open/Deep Water Program:

- **ACROBAT**: determine 3-D distributions of DO and chlorophyll in the York and Rappahannock Rivers
  - York River (years 1, 2) - bimonthly, June - Sept. 3D cruises
  - Rappahannock (year 2) - bimonthly, June - Sept. 3D cruises
  - Interpolate and compute hypoxic volume and chlorophyll water column distributions.

- **Vertical profiler** (lower York - all year hourly intervals)
  - vertical distributions of temperature, salinity, DO, and chlorophyll.
  - Interpolate between Acrobat surveys, providing the best-possible estimates of 30, 7, and 1-day mean as well as instantaneous minimum DO concentrations.
## Assessment of Chesapeake Bay DO Criteria

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<th>Open-Water</th>
<th>Deep-Water</th>
<th>Deep-Channel</th>
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A. Cross-Section of Chesapeake Bay or Tidal Tributary

- **Open-Water:** Fish and Shellfish Use
- **Deep-Water:** Seasonal Fish and Shellfish Use
- **Deep-Channel:** Seasonal Refuge Use

**Deep-Channel:** N/A
Data analysis and modeling - Open water program:

ACROBAT data

- Raw data from SeaBird CTD
- QA/QC
- Convert to UTM meters
- Reformat for CB Interpolator
- 3D Interpolation
- Volume calculations

Profiler data

- Raw data from YSI (telemetry to VIMS)
- QA/QC
- Reformat for GIS
- Interpolate

+ Dataflow
+ Fixed Stations

DYNAMIC MAPPING
Post-Neap Tide

3D ACROBAT MONITORING
York River DO
Jun 11, 2007

Plan View
(Minimum DO)

Legend:
0. mg/l
2.
4.
6.
8.
10.
12.

Center Transect

York

37° 30'

North

40 m

Chl-a (mg m⁻³):

Sigma-t (kg m⁻³):
Post-Spring Tide

3D ACROBAT MONITORING
York River DO
Jun 21, 2007

Legend:
0. mg/l
2.
4.
6.
8.
10.
12.

Center Transect

Chl-a (mg m⁻³):

Sigma-t (kg m⁻³):

North

40 m
3D ACROBAT MONITORING
York River DO
Jul 10, 2007

Legend:
0. mg/l
2.
4.
6.
8.
10.
12.

Plan View
(Minimum DO)

Center Transect

Chl-a (mg m⁻³):

Sigma-t (kg m⁻³):

Post-Neap Tide
Post-Spring Tide

3D ACROBAT MONITORING
York River DO
Jul 17, 2007

Legend:
Minimum DO

Chl-a (mg m⁻³):

Sigma-t (kg m⁻³):

North

40 m
Post-Neap Tide

3D ACROBAT MONITORING
York River DO
Aug 8, 2007

Plan View
(Minimum DO)

Legend:
0. mg/l
2.
4.
6.
8.
10.
12.

Center Transect

York

37° 30'
North

40 m

Chl-a (mg m⁻³):

Sigma-τ (kg m⁻³):
Post-Spring Tide

3D ACROBAT MONITORING
York River DO
Aug 15, 2007

Legend:
(Minimum DO)
0. mg/l
2.
4.
6.
8.
10.
12.

Plan View
Center Transect

York

Chl-a (mg m⁻³):

Sigma-t (kg m⁻³):

40 m
Hypoxic Volume
(volume below each DO threshold)

Mesohaline York

Polyhaline York

\[
\text{DO, mg L}^{-1}
\]

- 0.5
- 1
- 2
- 3
- 4
- 5
3D Acrobat Monitoring
Planview of Surface 1 m Chlorophyll a
Continuous Fixed Station Vertical Profiler

• York River - Continuous year-round vertical profiling (DO, Chlorophyll $a$, Salinity, Temperature) in lower York.
Profiler: April 24, 2007-August 30, 2007: Interpolated Data

**TEMPERATURE**

**SALINITY (PPT)**

**SIGMA-t (kg/m³)**

**DISSOLVED OXYGEN (mg/L)**

**CHLOROPHYLL A (μg/L)**

**TURBIDITY (NTU)**

**Legends:**

- **Temperature:**
  - 12
  - 14
  - 16
  - 18
  - 20
  - 22
  - 24
  - 26
  - 28
  - 30

- **Salinity:**
  - 13
  - 14
  - 15
  - 16
  - 17
  - 18
  - 19
  - 20
  - 21
  - 22
  - 23
  - 24

- **Sigma-t:**
  - 9
  - 10
  - 11
  - 12
  - 13
  - 14
  - 15

- **Dissolved Oxygen:**
  - 2
  - 4
  - 6
  - 8
  - 10

- **Turbidity:**
  - 2
  - 5
  - 10
  - 15
  - 20
  - 25
  - > 3

- **Chl-a:**
  - 2
  - 5
  - 10
  - 15
  - 20
  - 25
  - > 3
Profiler Data for 9/07 shows evidence of red tide bloom:
In the future ACROBAT and profiler data will be used to calibrate the HEM3D model.

Figure 3. TecPlot 3D visualization of York River DO concentrations from our HEM3D test dataset.
We believe that we have an awesome data set that will explain the dynamics of DO in the York River; however the future of the Chesapeake Bay Initiative is currently uncertain and awaiting more details of DEQ budget cuts