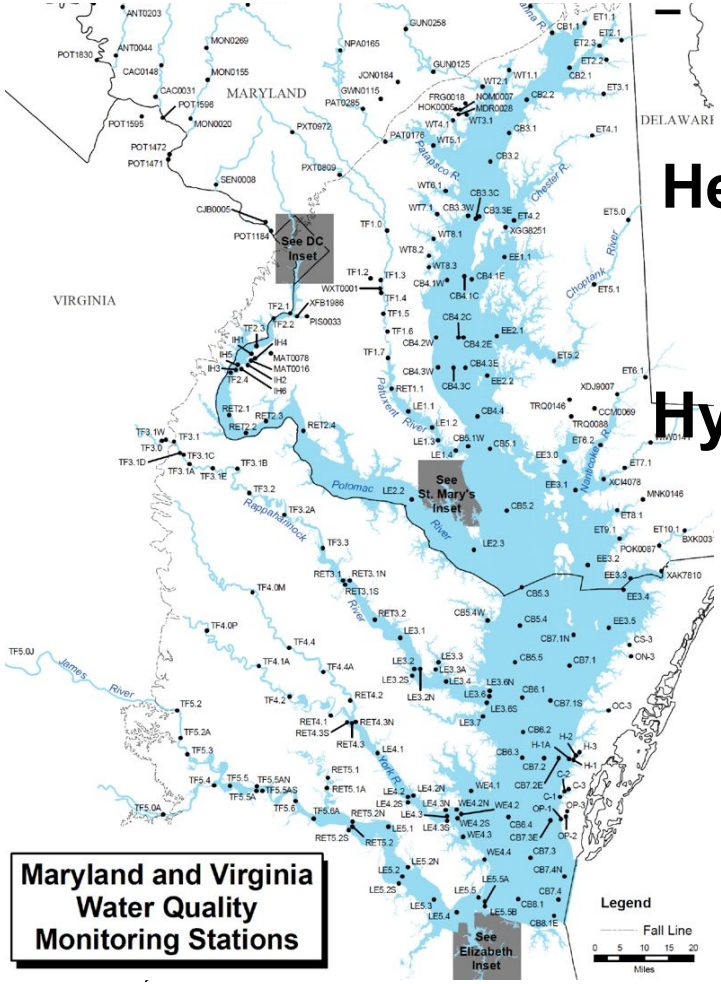

Project EDDIE Webinar:
Helping students critically evaluate data

Module:
Hypoxia in Coastal Marine Ecosystems

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Rider University

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Rider University

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NES-LTER

Context

This module was originally designed for use in an introductory oceanography course at Rider University in Lawrenceville, NJ.

- 4000 students - lecture 25-30 students - lab size 12-16 students

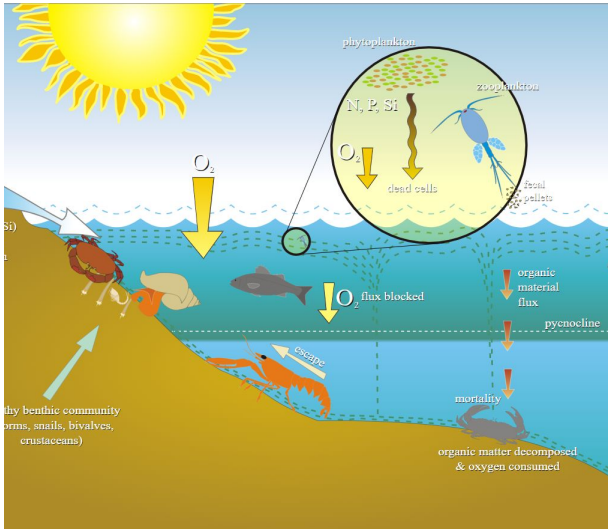
The module was designed for students to:

- Develop their own explanation for the hypoxic events.
- Link evidence with background knowledge about dead zones, fish kills, and harmful algal blooms.
- Consider solutions to prevent future events.

Module Overview

Introductory Classes

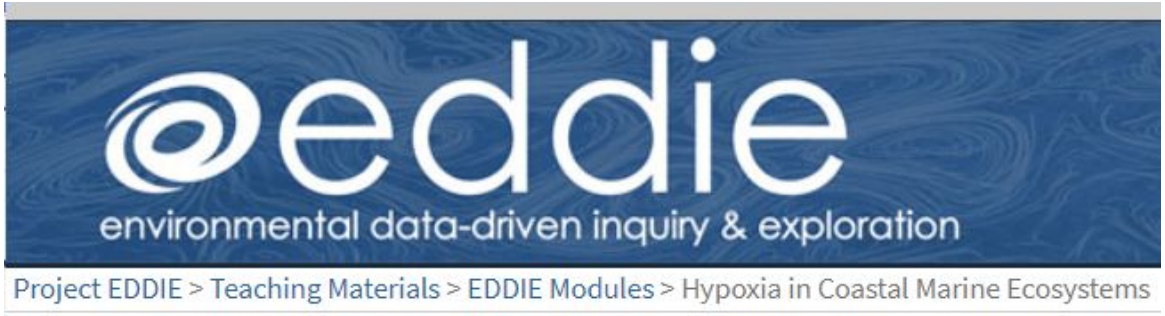
- **Activity A:**
  - plot a time series of 2 variables (top and bottom dissolved oxygen);
  - observe patterns and differences;
  - *think critically* about the magnitude of related **physical** factors (temperature, salinity)
- **Activity B:**
  - do spreadsheet calculations
  - plot 2 different variables (dissolved oxygen and density difference) in a time series
  - consider correlations
- **Activity C:**
  - *think critically* about possible causes of hypoxic events
  - plot additional **biological** variables and look for correlations
  - consider solutions and manageable measures



Advanced Classes / students could add

- **Optional Activity D:** Add statistical analysis to quantify correlations
- **Optional Activity E:** Consider global frequency and role of anthropogenic influences.

Teaching Materials:



Instructor Manual

Instructor Slide Deck

Student Handout

Dataset

Student Excel file

Instructor Excel file

Instructor Cross correlation and T-test Excel file

Instructor Answer Sheet

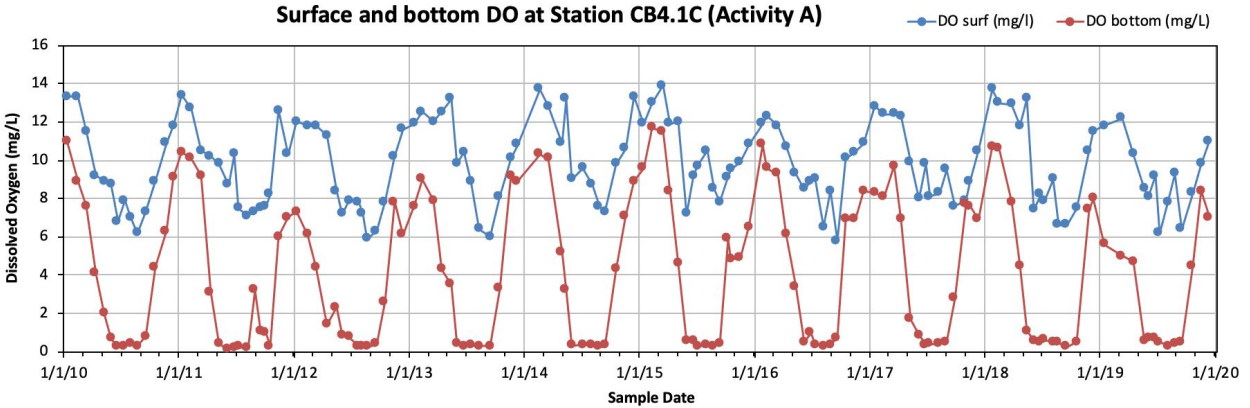
Example: Activity A

Goals:

- Help students learn to graph data sets (Excel, Google sheets)
- Observe and describe patterns, define the problem (low dissolved oxygen in bottom water affects the ecosystems)
- Use data interpretation and reasoning skills to begin thinking about what causes this problem

Chesapeake Bay Program data - student(1)

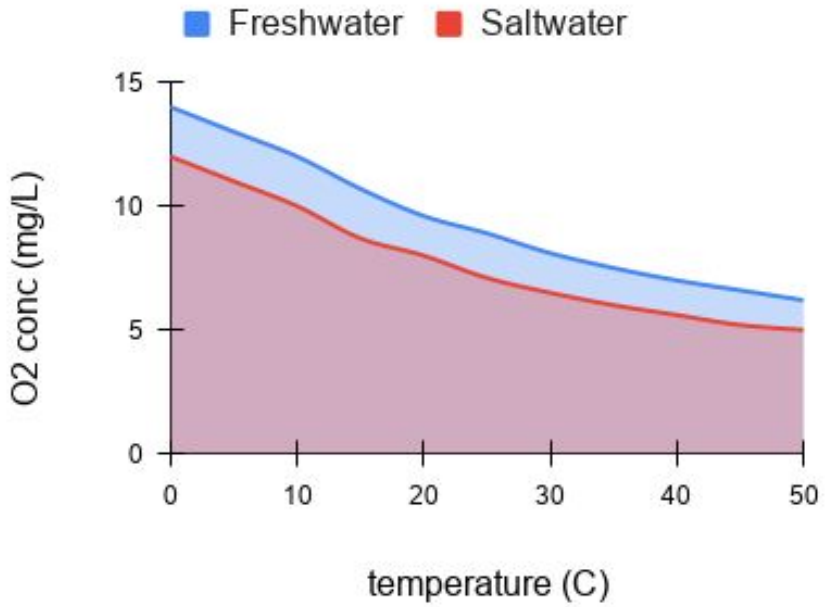
	A	B	C	D	E	F	G	H
1	SampleDate	SampleTime	DO surf (mg/l)	DO bottom (mg/L)	Wtemp surf (deg C)	Wtemp bottom (deg C)	Salinity surf (ppt)	Salinity bottom (ppt)
2	1/13/10	10:25:00	13.3	11	0.2	2.8	9.33	16.49
3	2/15/10	11:33:00	13.3	8.9	0.8	2.6	10.37	17.31
4	3/16/10	12:26:00	11.5	7.6	6.1	3.4	10.24	17.45
5	4/13/10	12:28:00	9.2	4.1	13.6	7.3	5.94	16.84
6	5/11/10	12:15:00	8.9	2	16	14	8.44	17.38
7	6/2/10	12:30:00	8.7	0.7	23.4	17.3	9.46	17.59
8	6/22/10	12:30:00	6.8	0.24	25.6	19.8	9.85	17.18
9	7/13/10	12:10:00	7.9	0.28	27.1	24.8	12	19.52
10	8/3/10	11:57:00	7	0.39	27.6	25.8	13.19	18.97
11	8/24/10	12:36:00	6.2	0.3	26.6	26.3	12.99	20.64
12	9/21/10	13:44:00	7.3	0.8	23.5	25	15.88	20.08
13	10/19/10	12:15:00	8.9	4.4	17.6	20	13.06	19.11
14	11/23/10	9:25:00	10.9	6.3	11.7	12.9	12.59	22.04
15	12/16/10	15:15:00	11.8	9.1	2.6	7.4	10.76	18.28
16	1/11/11	15:02:00	13.4	10.4	0.9	2.2	13.59	19.59
17	2/9/11	14:23:00	12.7	10.1	1.1	1.5	15.54	20.36
18	3/15/11	12:03:00	10.5	9.2	5.8	4.8	6.31	16.43
19	4/12/11	12:20:00	10.2	3.1	9.5	8	8.44	16.77
20	5/10/11	12:11:00	9.8	0.4	16.3	12.3	3.53	12.07
21	6/7/11	12:07:00	8.7	0.14	22.8	16.6	3.3	16.09

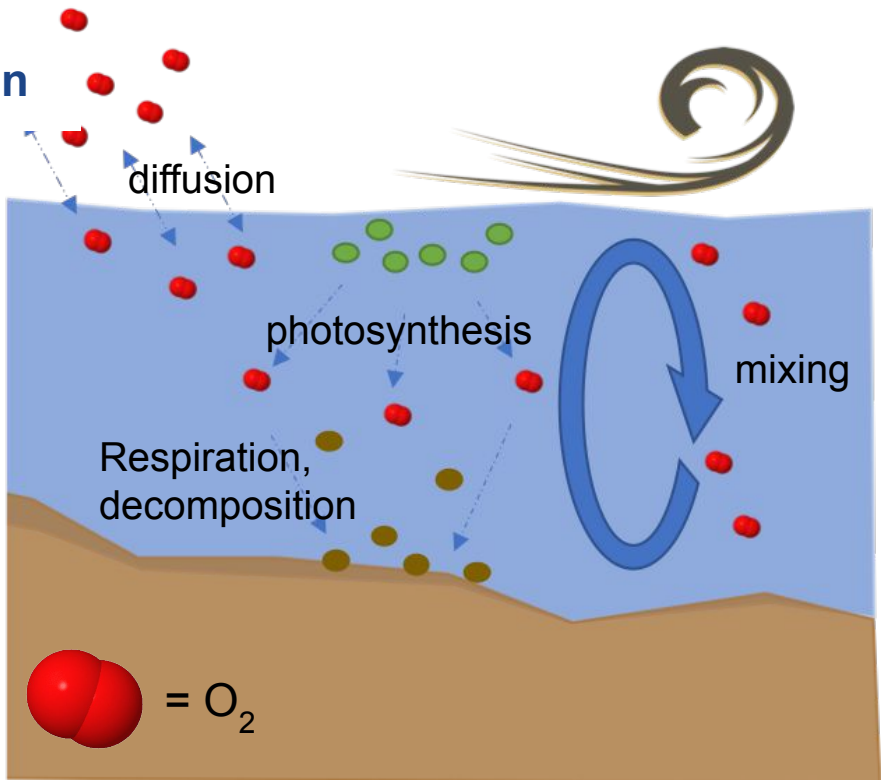


Some background provided on instructor slide deck:

What affects the amount of dissolved oxygen (DO) in water?

- **Diffusion**
- **Temperature**
- **Salinity**
- **Mixing (wind, waves)**
- **Photosynthesis**
- **Respiration/decomposition**



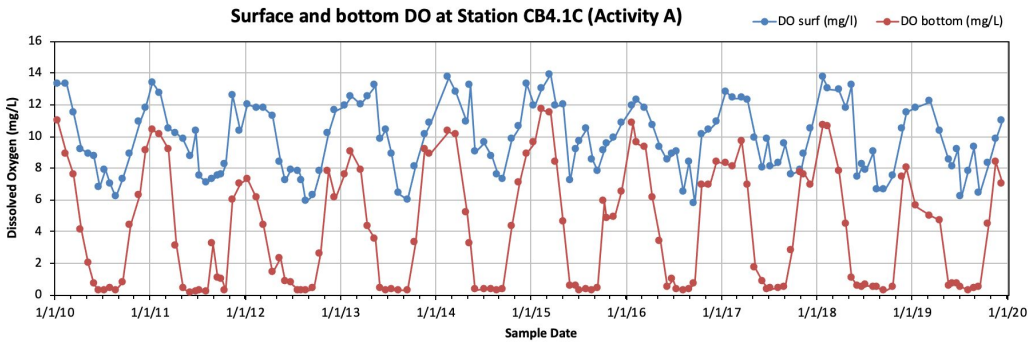


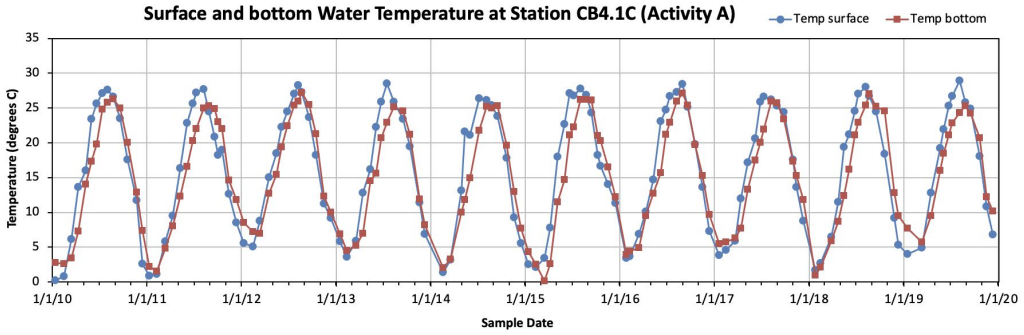
Example: Activity A

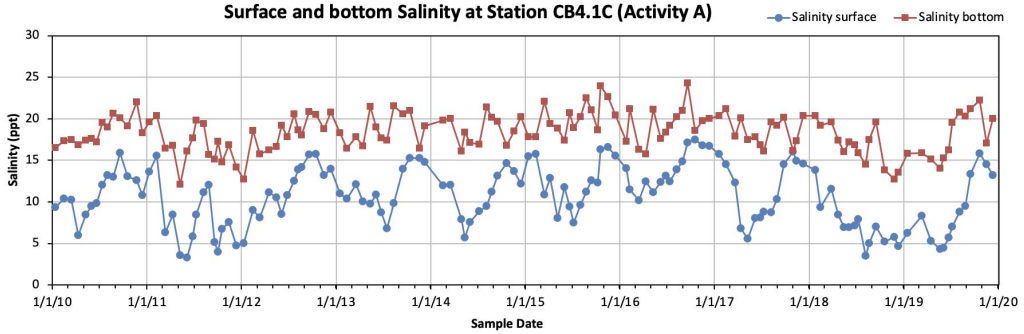
Goals:

- Help students learn to graph data sets (Excel, Google sheets)
- Observe and describe patterns, define the problem (low dissolved oxygen in bottom water affects the ecosystems)
- Use data interpretation and reasoning skills to begin thinking about what causes this problem

Are temperature and salinity responsible for problem of low DO in bottom water?







Breakout rooms:

Are temperature and salinity responsible for problem of low DO in bottom water?

- Graphs & sample questions from student handout:
  - link to Google doc in Chat
- In breakout rooms:
  - Discuss data and background
  - Try to answer the two questions (2nd page)
  - How might students do with this activity?

Sample questions from student handout:

1. Use the figure below to estimate the approximate maximum and minimum dissolved oxygen (DO) concentrations expected in water at the ranges of temperature and salinity found in your plots.

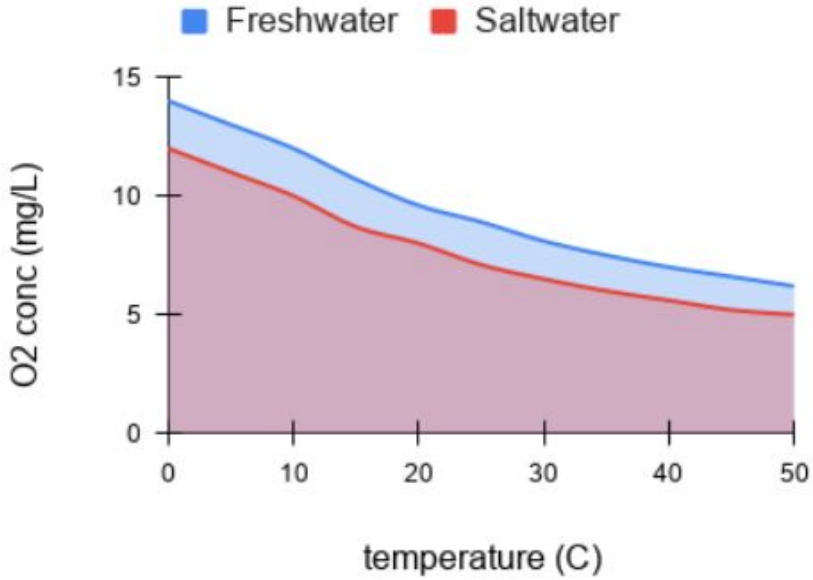
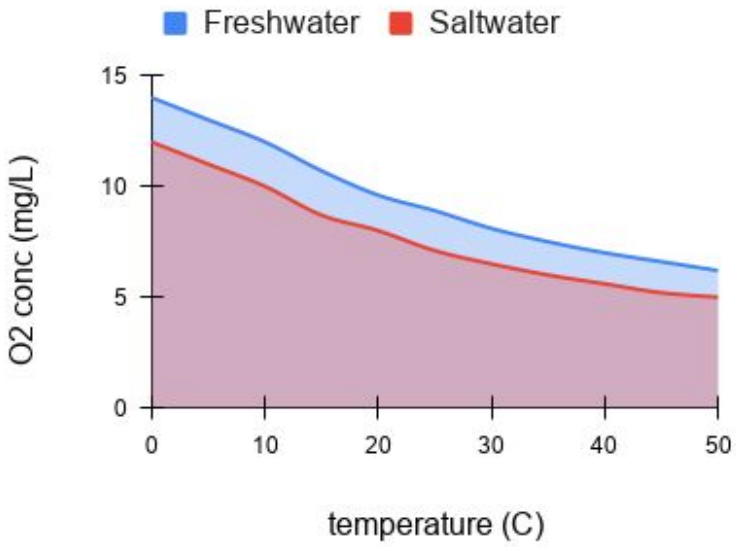


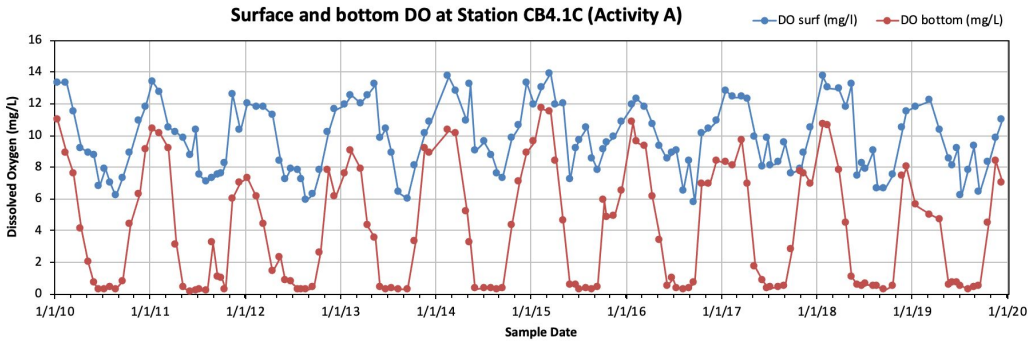
Fig. 1 Expected oxygen concentrations (100% saturation) in freshwater and saltwater (35 ppt) at different temperatures.

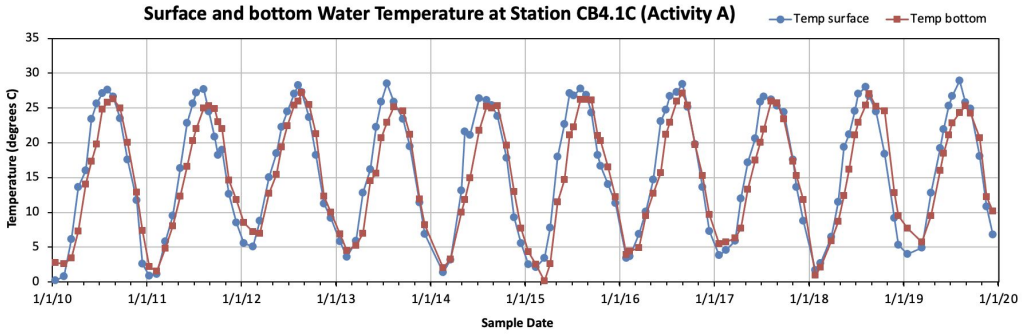
2. Based on your data and analysis, do temperature or salinity differences alone explain the pattern of DO concentrations found in the bottom water? Explain our reasoning.

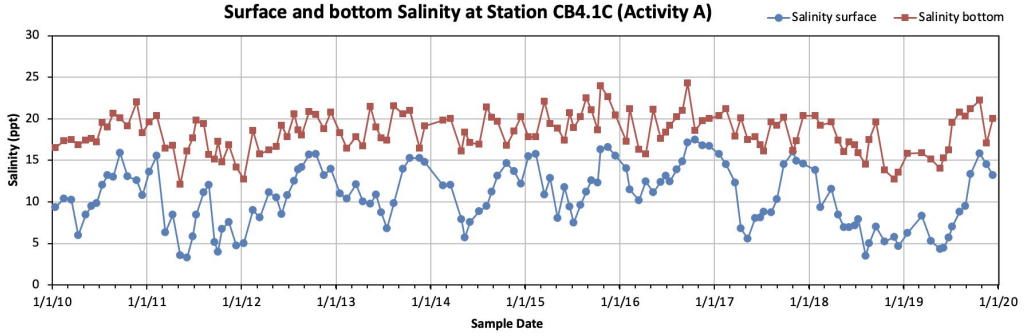
Zoom Poll:

Are temperature and salinity responsible for problem of low DO in bottom water?



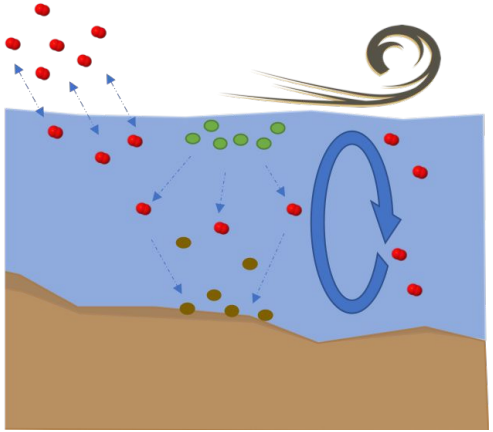


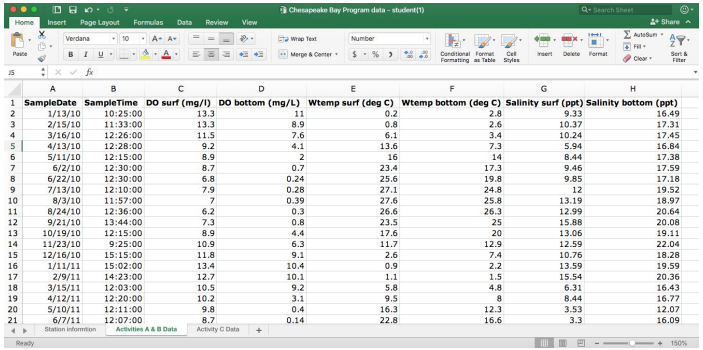




In Chat:

How do you think your students will do with this kind of exercise?





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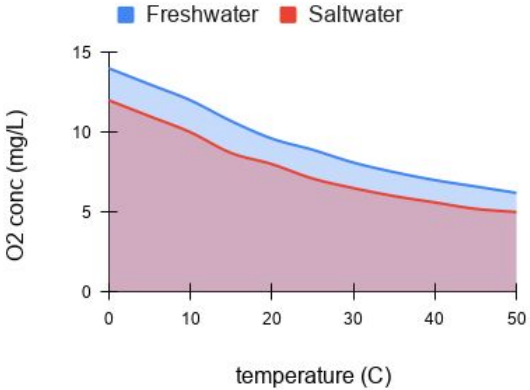
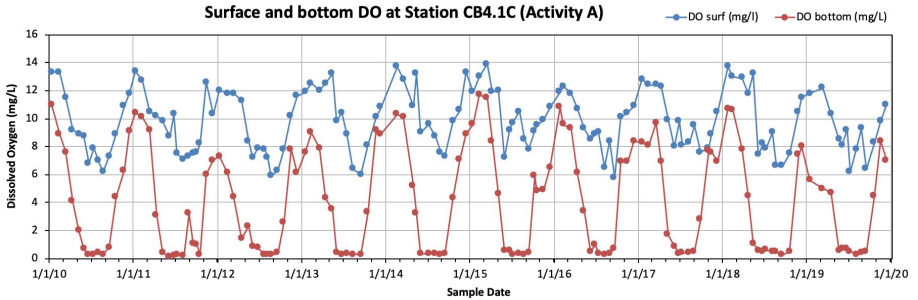




Student responses-- advice added in **Instructor Manual**

Activity A

- Question 6: Students **might be inclined to decide Temp or Salinity would explain** the low oxygen events, however, neither individually can explain them. Ask for their ideas to see what they think at this point.
- Questions 7-9: To help them see T & S individually will not explain the events, we ask them to practice their graphing skills to look at both, describe the patterns in the data, then **study the graph provided in their handout and slide 7 for maximum and minimum DO concentrations possible for fresh and saltwater,** and finally compare those concentrations to their data set. (slide 13)
- Question 10: Ask students to **make an attempt** to answer this question, **then discuss**. Before moving on to Activity B, **make sure they hear from you that T or S individually cannot explain the low oxygen event**s. If DO is present at saturation within the range of temperature or salinity found in the data, the low levels observed in the bottom DO data would not be possible as shown in the graph included with Q9. **Address misconceptions/misunderstandings** (some examples in slide 13 notes) if they surface in discussions. Activity B will guide the students to look at other data to determine a best explanation. (slide 13)

Discuss our modifications based on experience

-- how we modified Activity A to address student responses

-- virtual vs in-person:

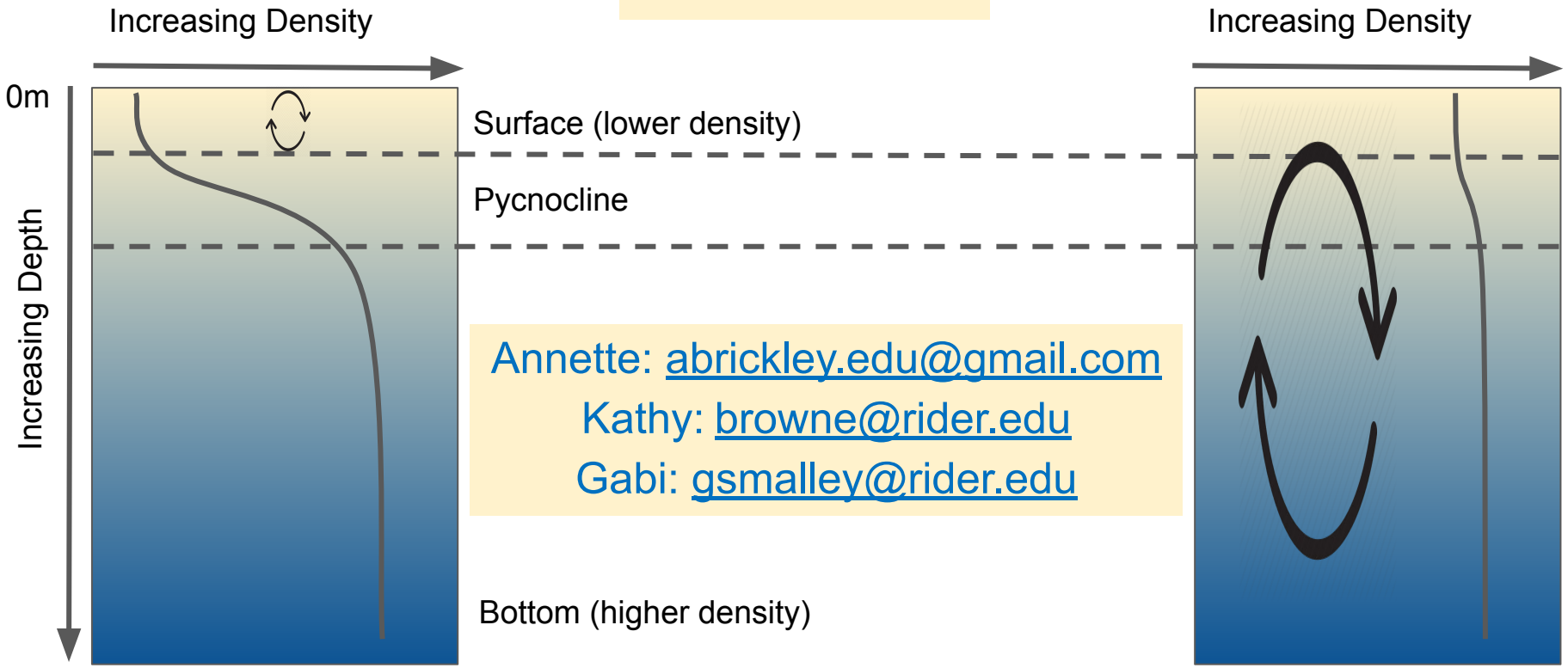
- time required; moving some ahead while helping others
- software options

-- other modifications we might consider

- just one year vs all 10 years (e.g. 2014 or 2017); or 2 yrs (2013 & 2014)

-- your ideas?

Thank you!



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