Apr 5th, 3:30 PM - 3:45 PM

Variability in water column respiration in Salish Sea waters and implications for coastal and ocean acidification

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University of Washington, janewton@uw.edu

Response of **water-column** processes and pelagic organisms to long-term change.

Ocean-climate pressures

Human pressures

1. Apple
2. Bos
3. Mickett
4. Brown
5. Munsch
6. Greene

Water

Nutrients & biochem.

Foodweb

Benthos

Variability in respiration of Salish Sea waters and implications for coastal and ocean acidification

Jude Apple, Claire Cooke, Nicole Burnett, Heath Bohlmann, Shauna Bjornson

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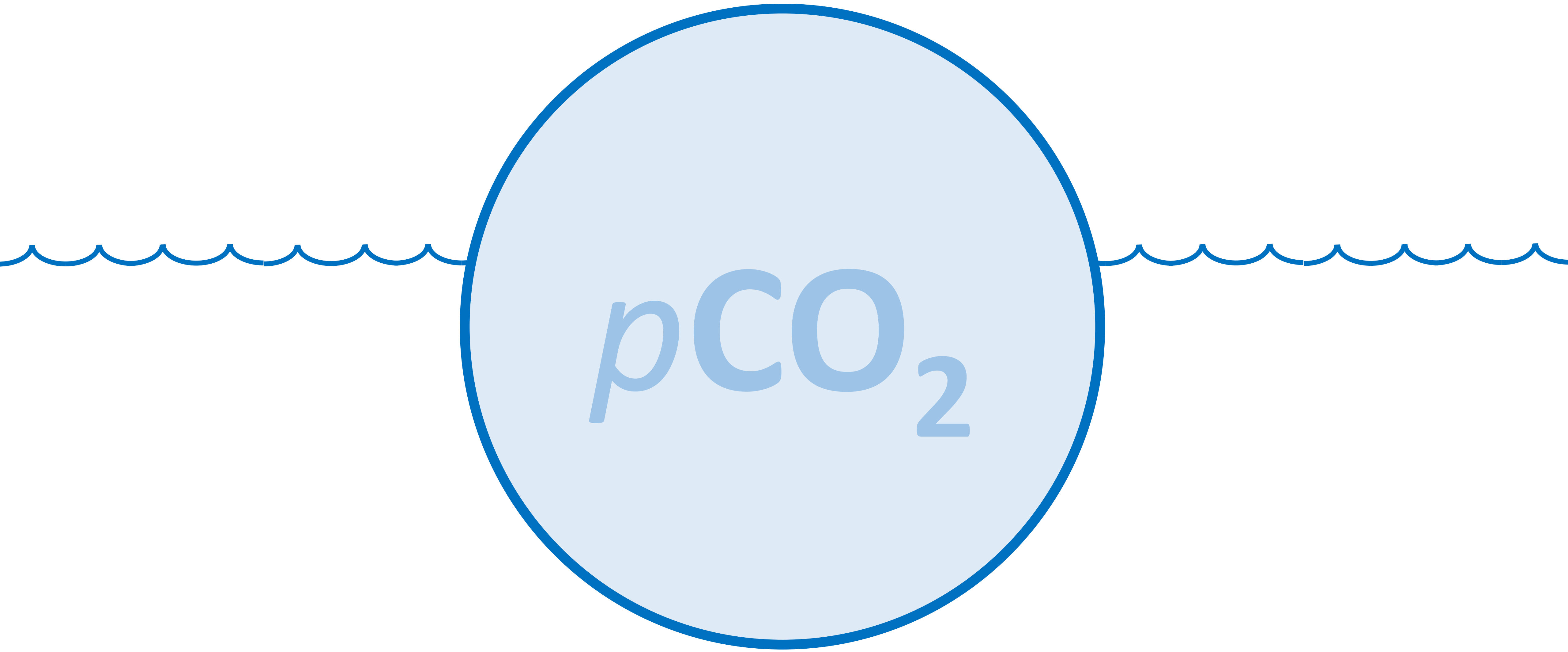
Courcelle Stark – *NOAA Hollings Scholar Program/Smith College*

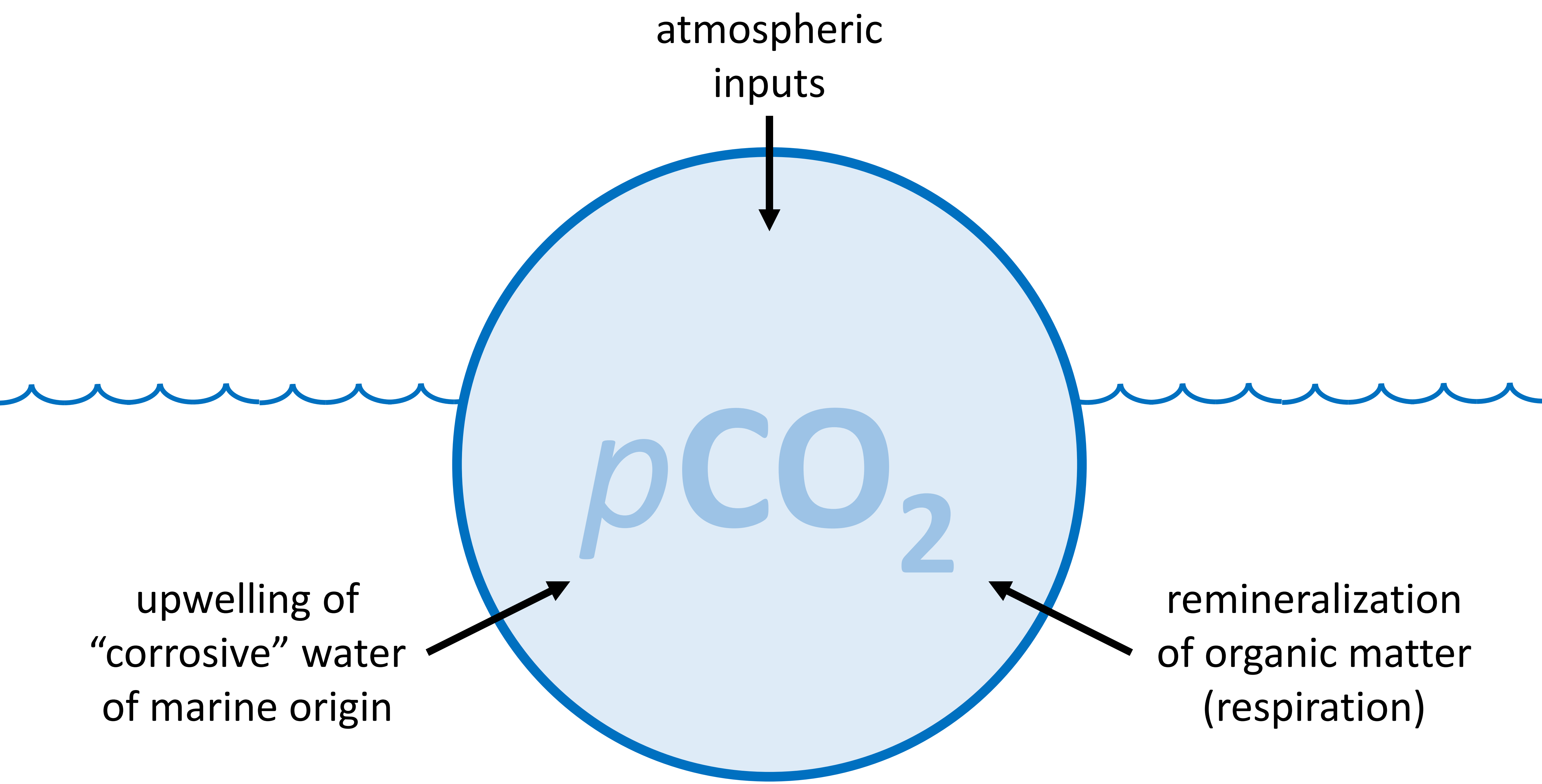
2018 Salish Sea Ecosystem Conference

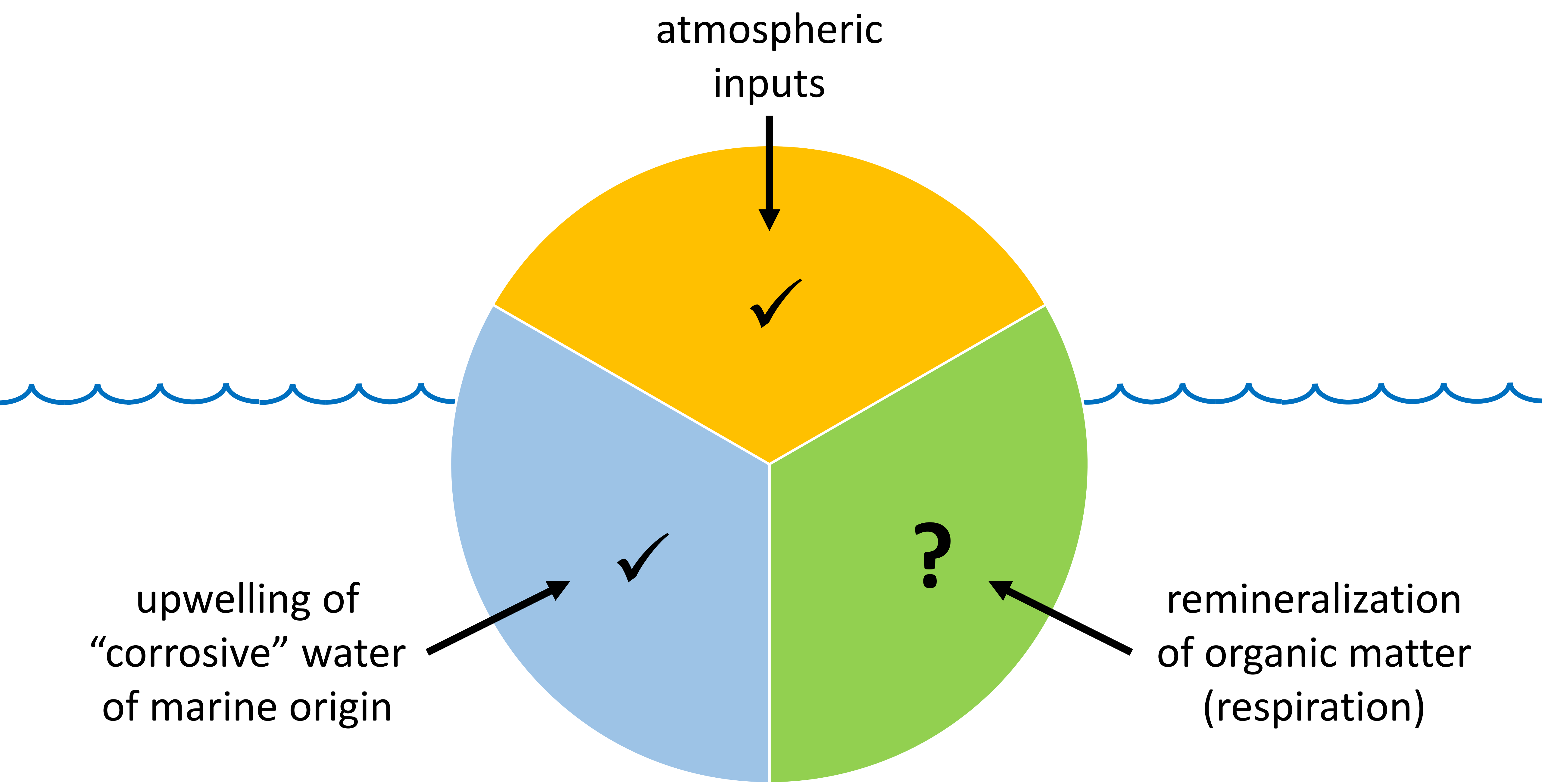
japple@padillabay.gov

Padilla Bay National Estuarine Research Reserve

DEPARTMENT OF ECOLOGY State of Washington


pCO2


atmospheric
inputs
pCO2
upwelling of
“corrosive” water
of marine origin
remineralization
of organic matter
(respiration)



atmospheric
inputs
✓
✓
?
upwelling of
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of organic matter
(respiration)

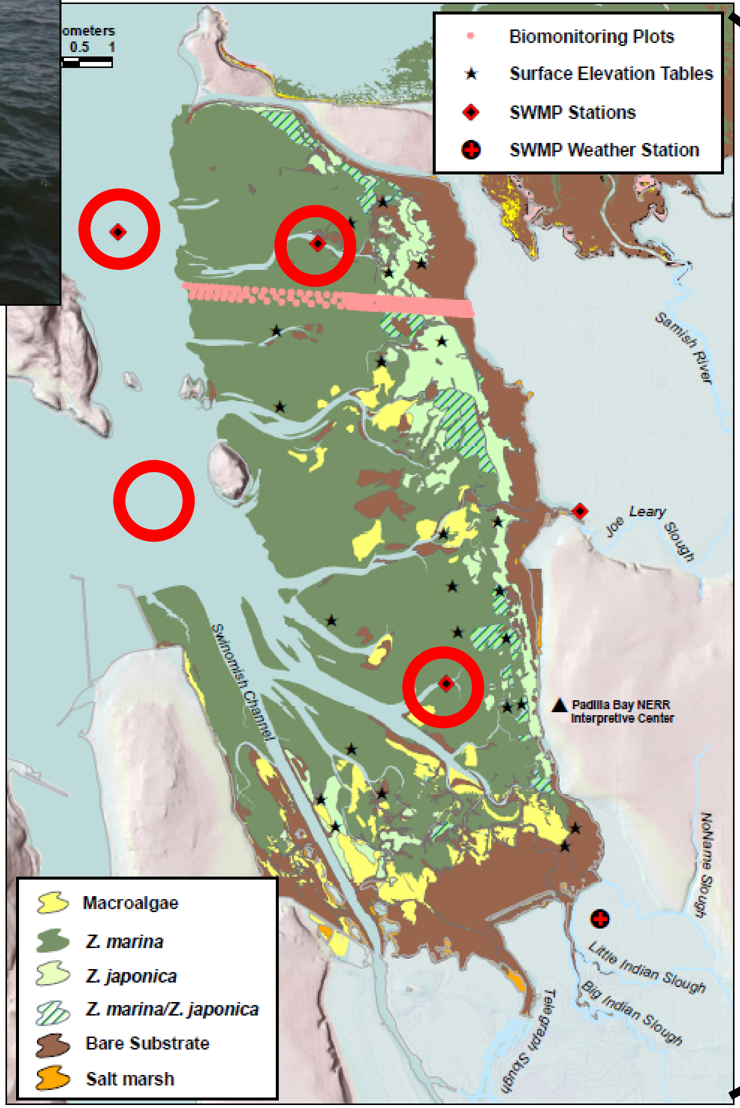
Three Key Questions

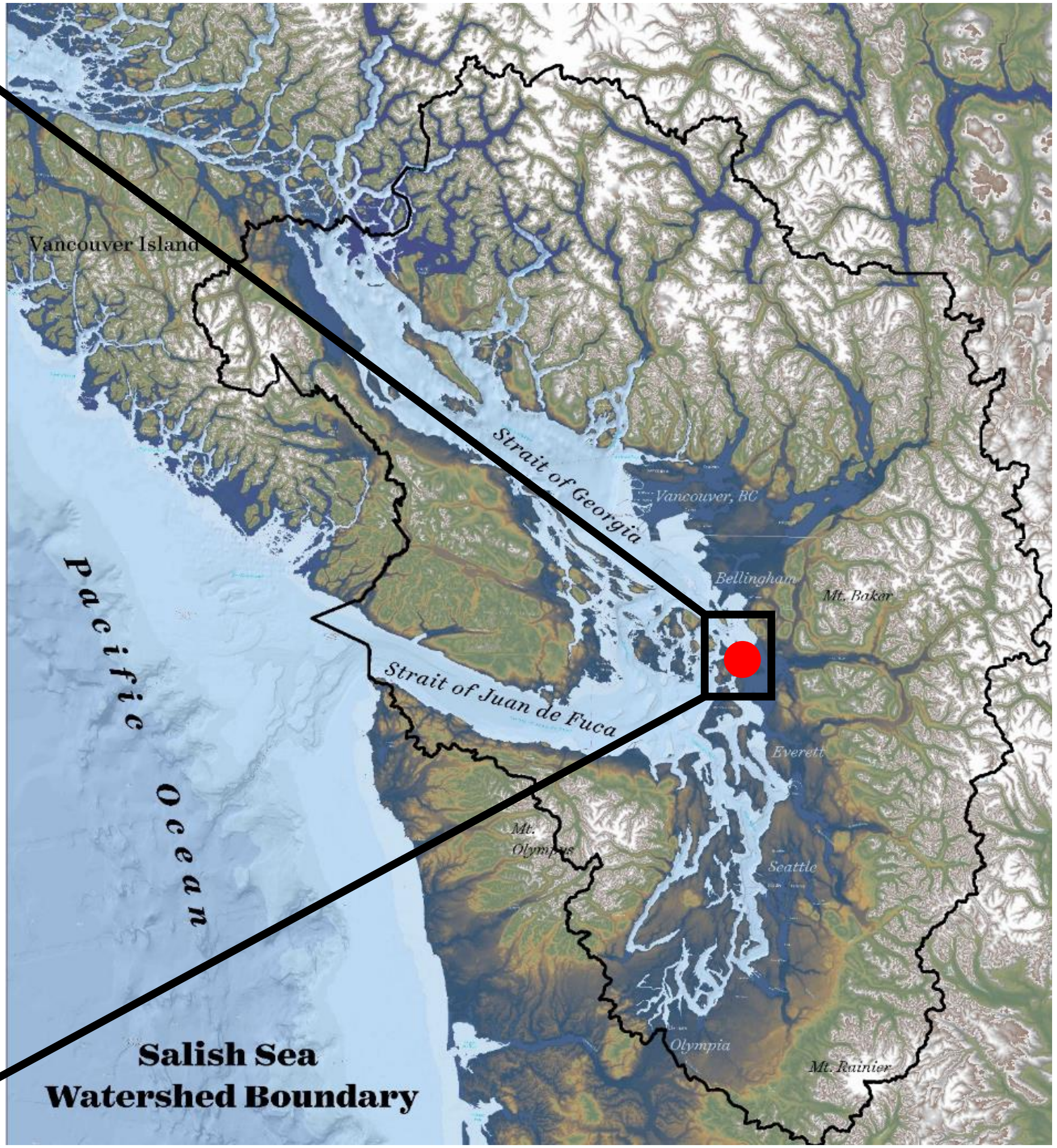
1. How does pelagic respiration vary throughout the year?

2. What are representative rates of respiration in surface and deep waters of the Salish Sea?

3. What are the environmental factors that control respiration?

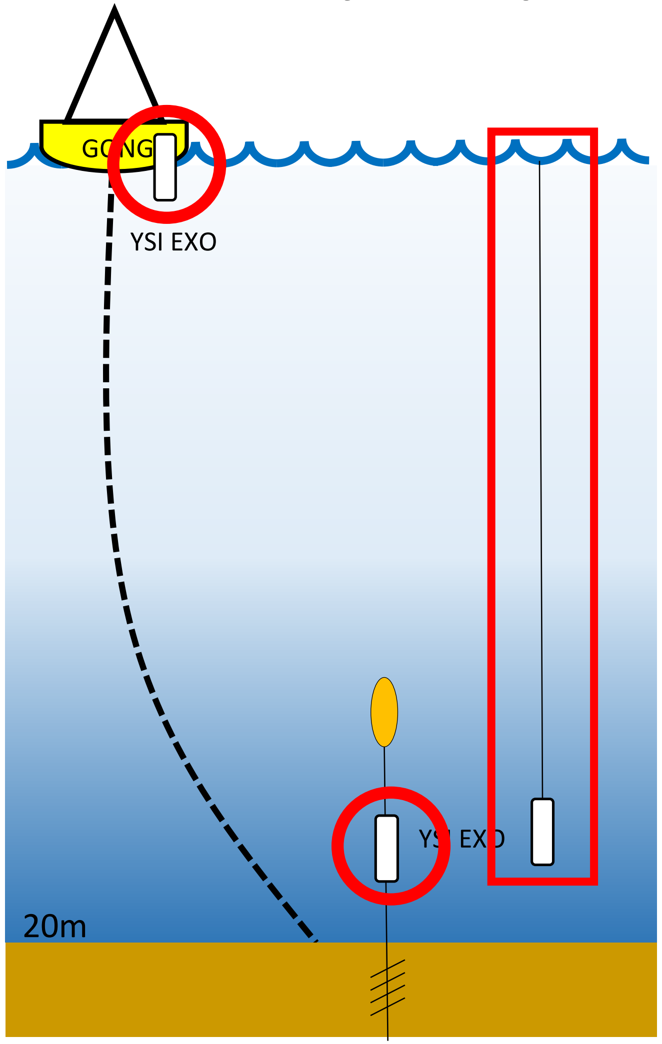
Gong Buoy

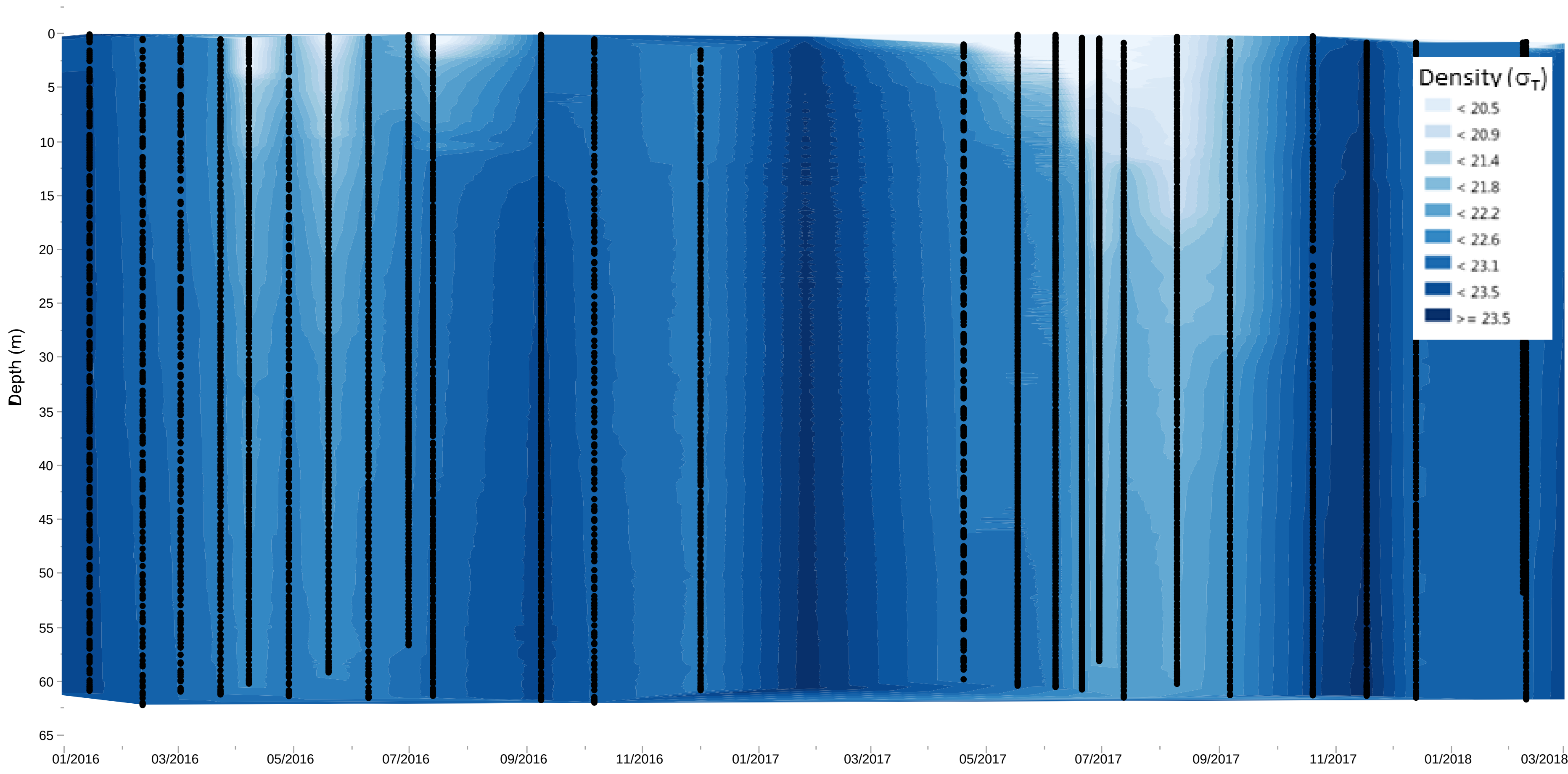




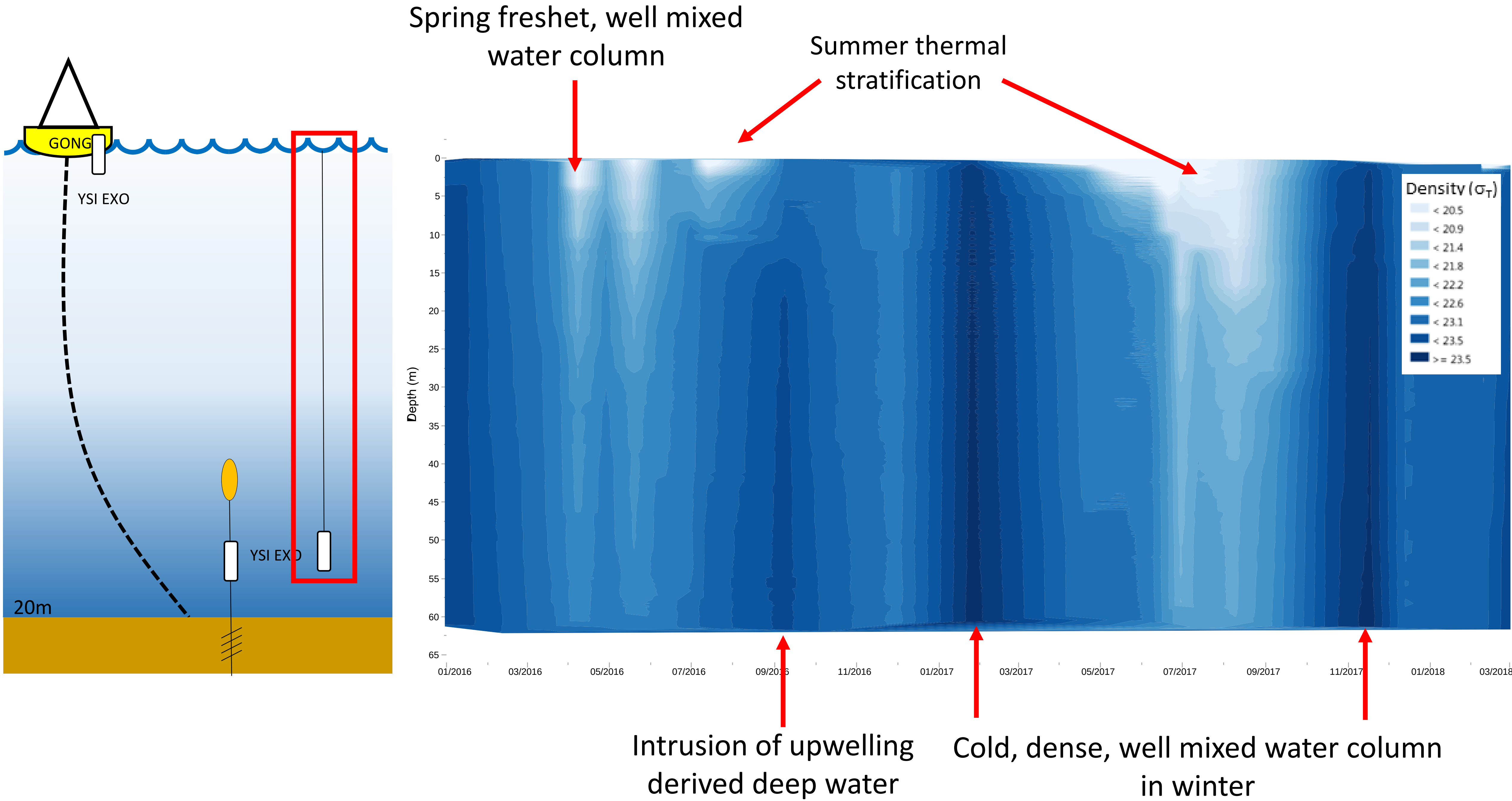
Maps courtesy of Suzanne Shull (PBNERR)

Water column profiles are conducted ~monthly in deep waters adjacent to Padilla Bay. Respiration is measured in surface and deep waters.

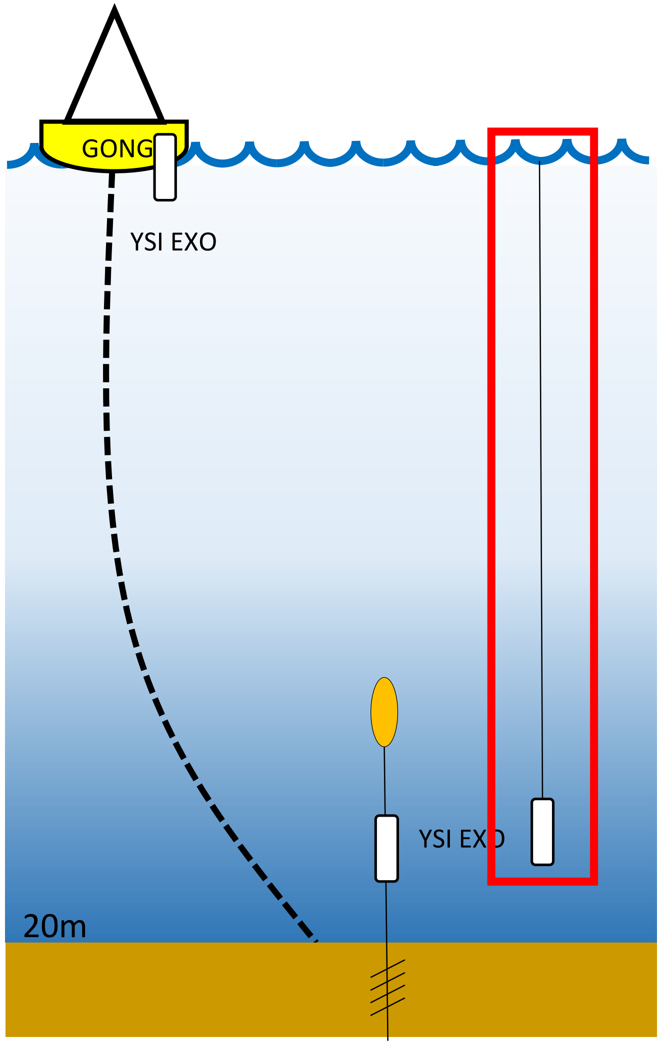


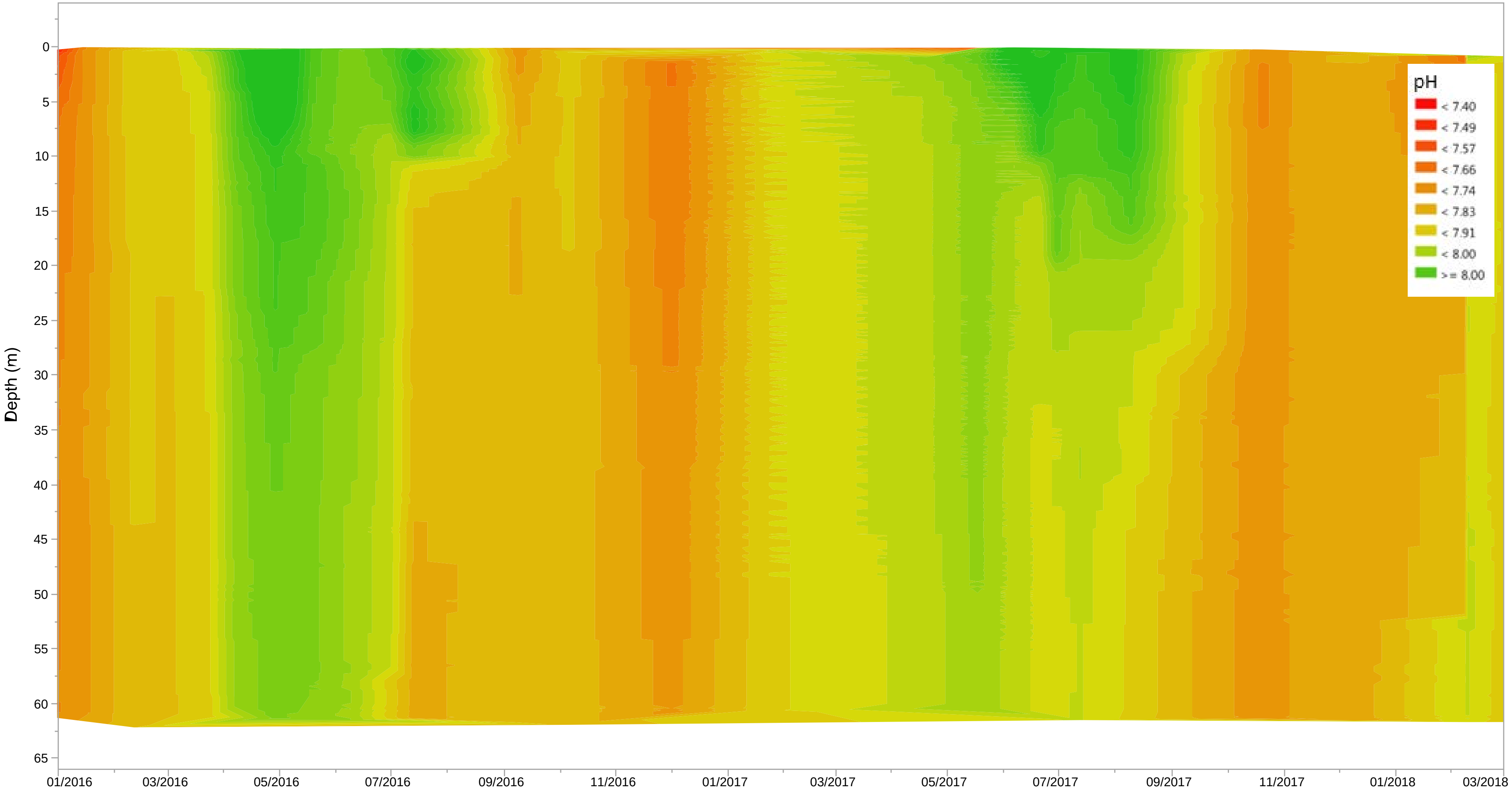


Water column profile data from January 2016 – March 2018


GONG
YSI EXO
YSI EXO
20m
Spring freshet, well mixed water column
Summer thermal stratification
Density (σT)
< 20.5
< 20.9
< 21.4
< 21.8
< 22.2
< 22.6
< 23.1
< 23.5
>= 23.5
Depth (m)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
01/2016
03/2016
05/2016
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
Intrusion of upwelling derived deep water
Cold, dense, well mixed water column in winter

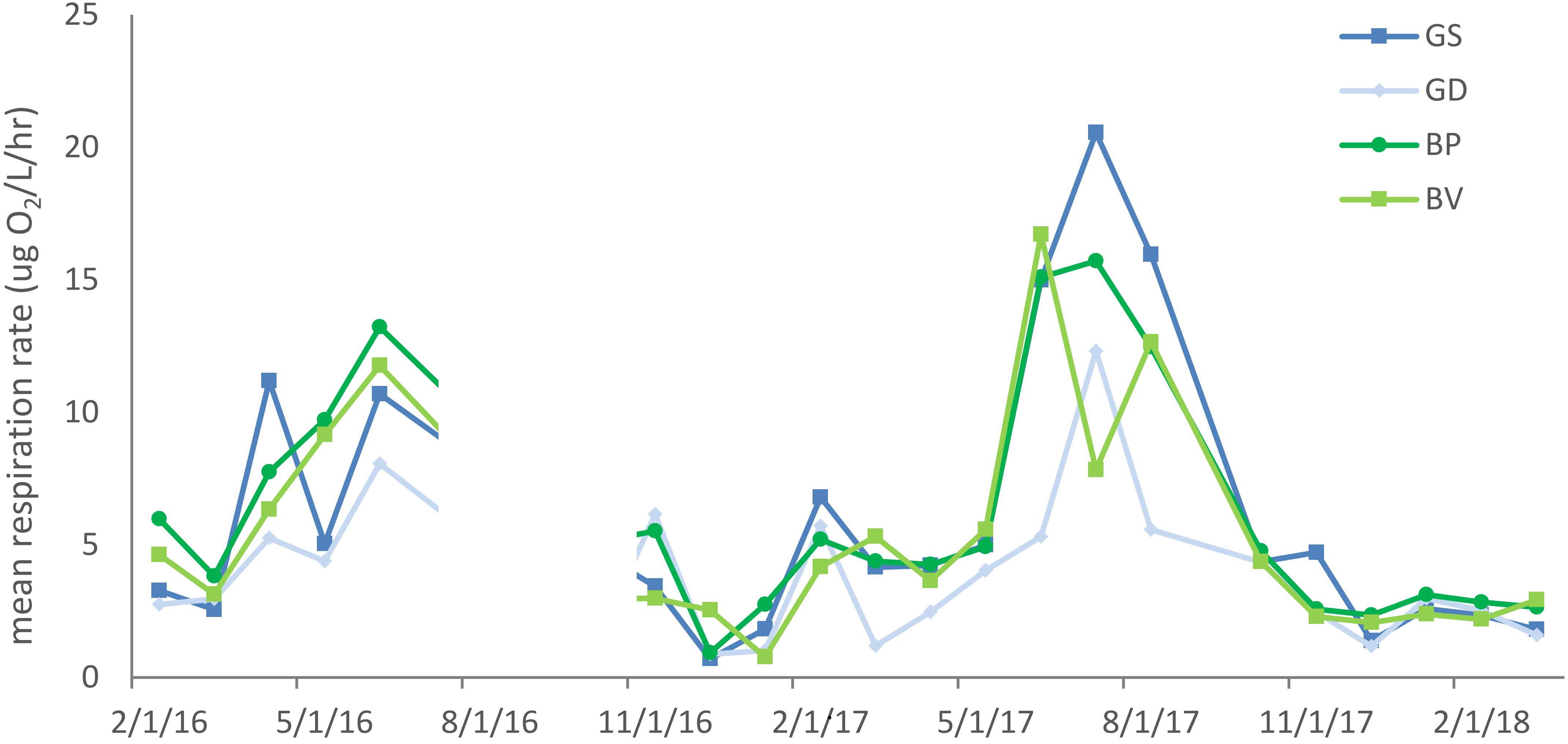
pH is high in surface waters during summer, while underlying deep water has more corrosive conditions (pH<7.5). pH in fall and winter is low.





Water column profile data from January 2016 – March 2018

1. How does pelagic respiration vary throughout the year?



Respiration is higher in the resource-rich, warmer summer months and consistently lower in deep waters

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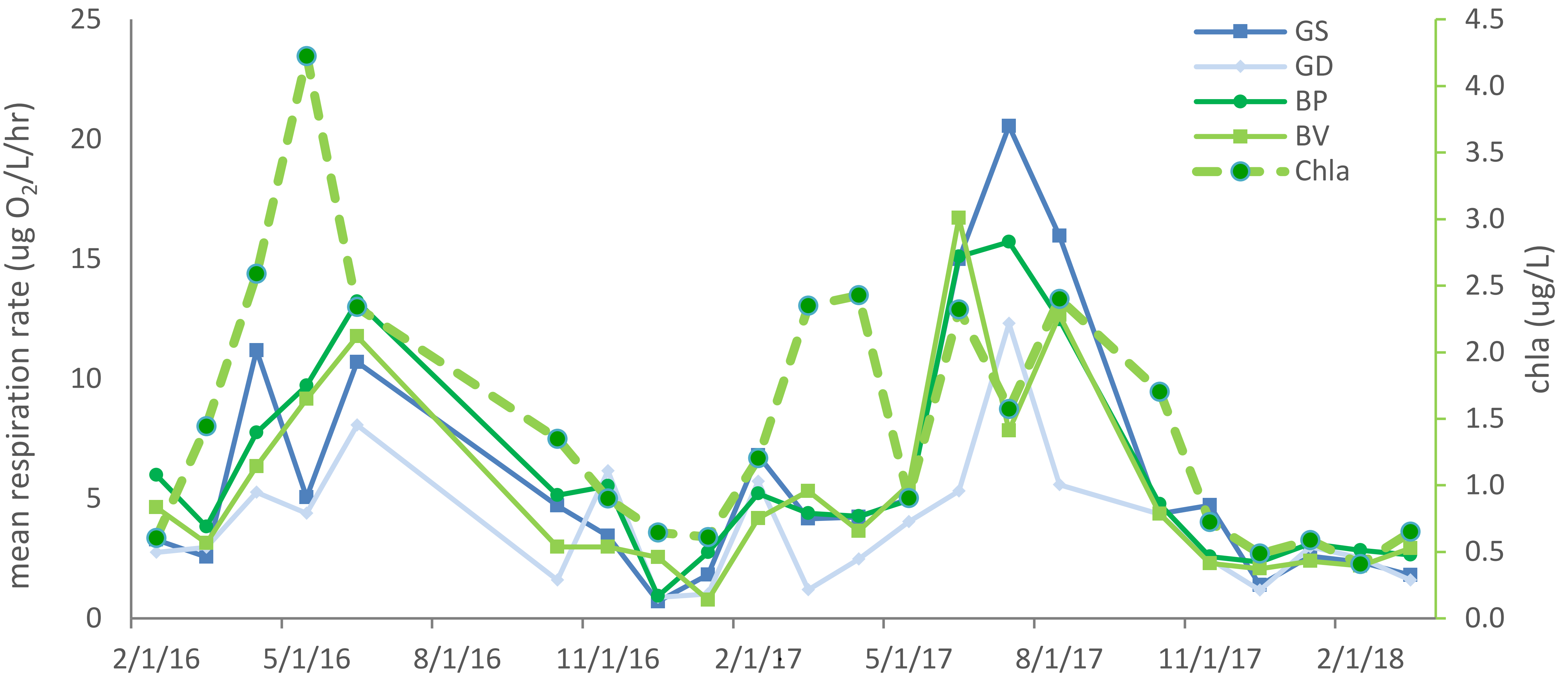
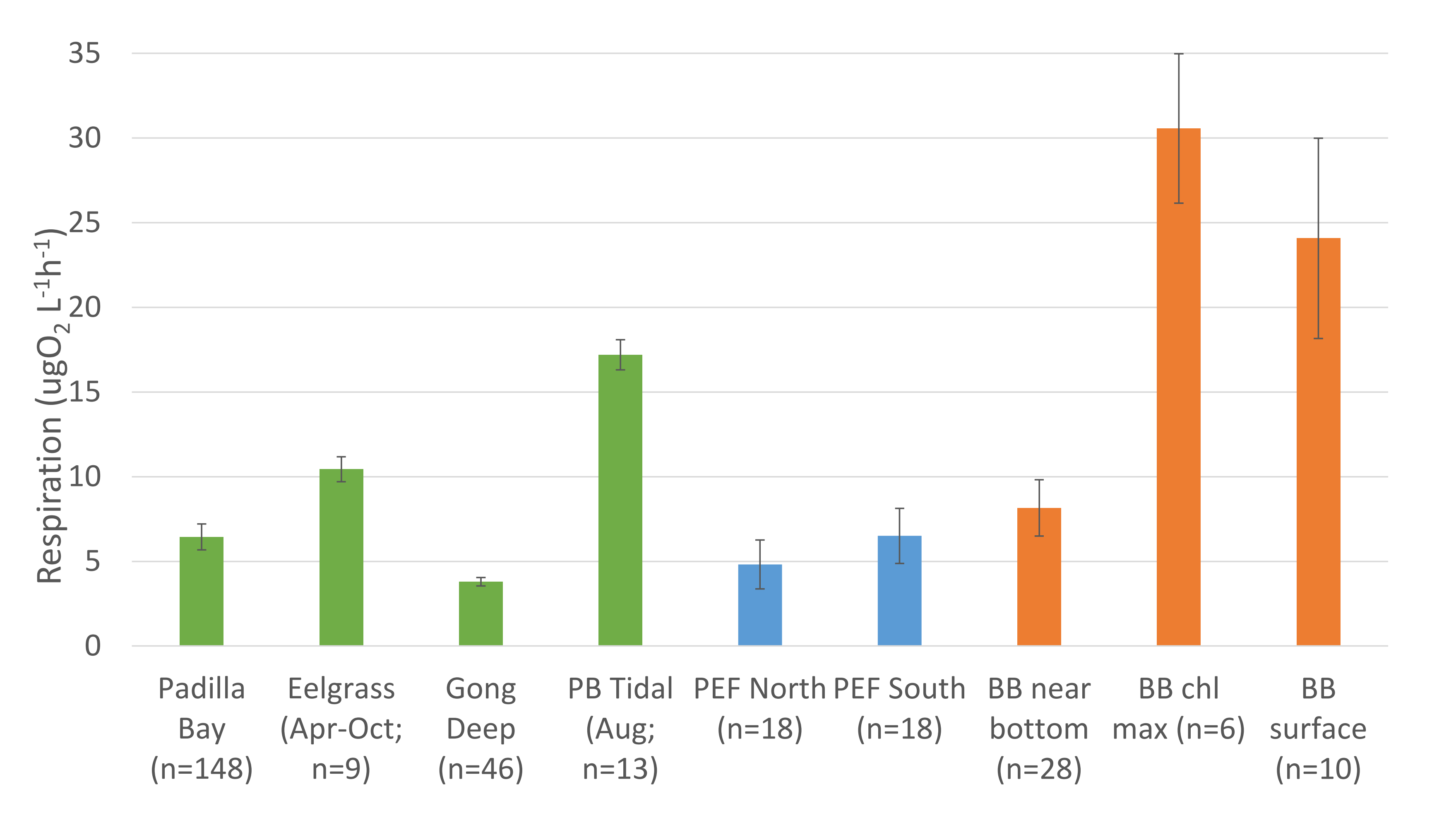


Respiration is higher in the resource-rich, warmer summer months and consistently lower in deep waters

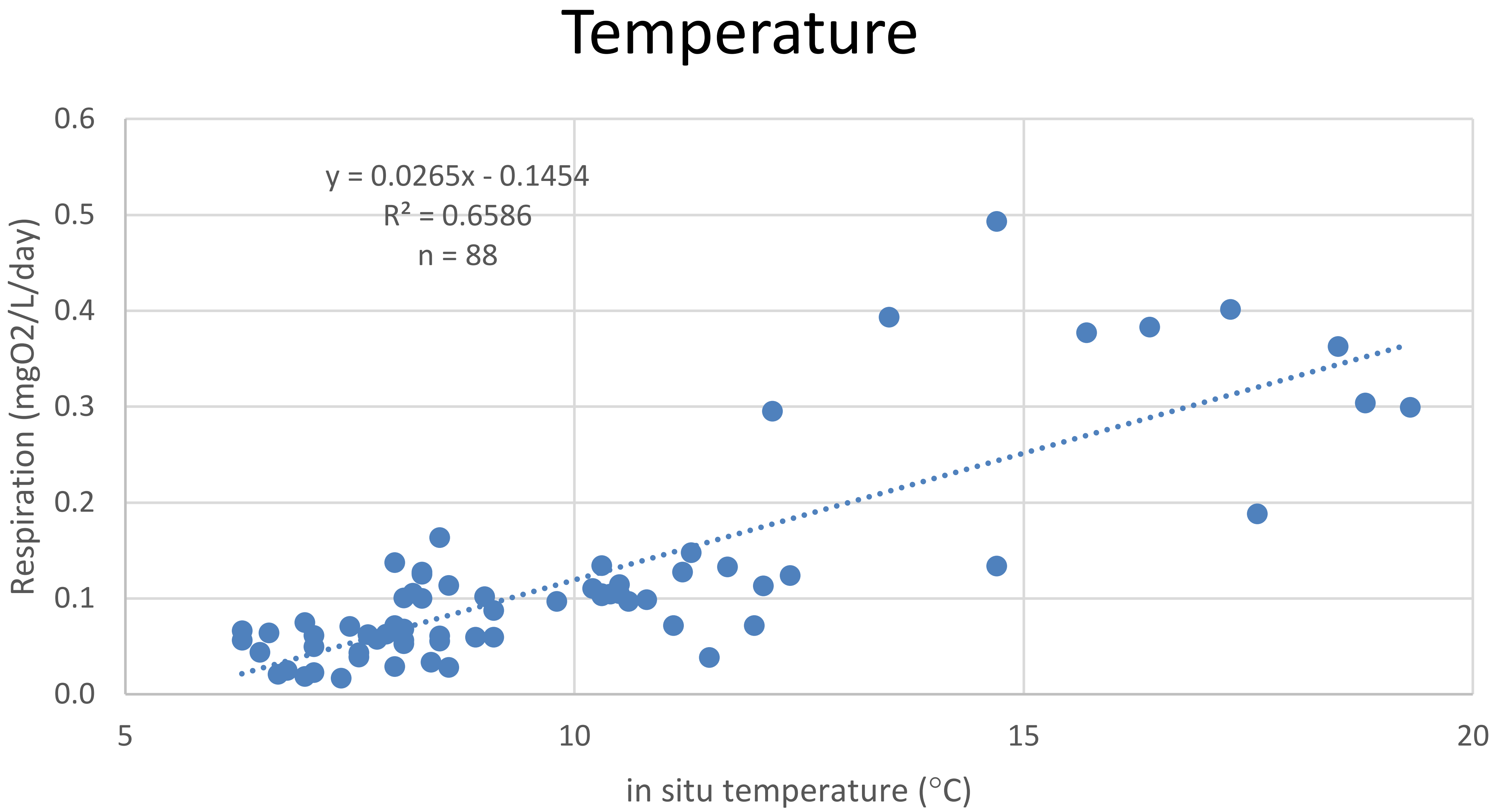
2. What are representative rates of respiration in surface and deep waters of the Salish Sea?



Respiration varies in Salish Sea waters, higher and more variable in surface waters, consistently low in deep waters.

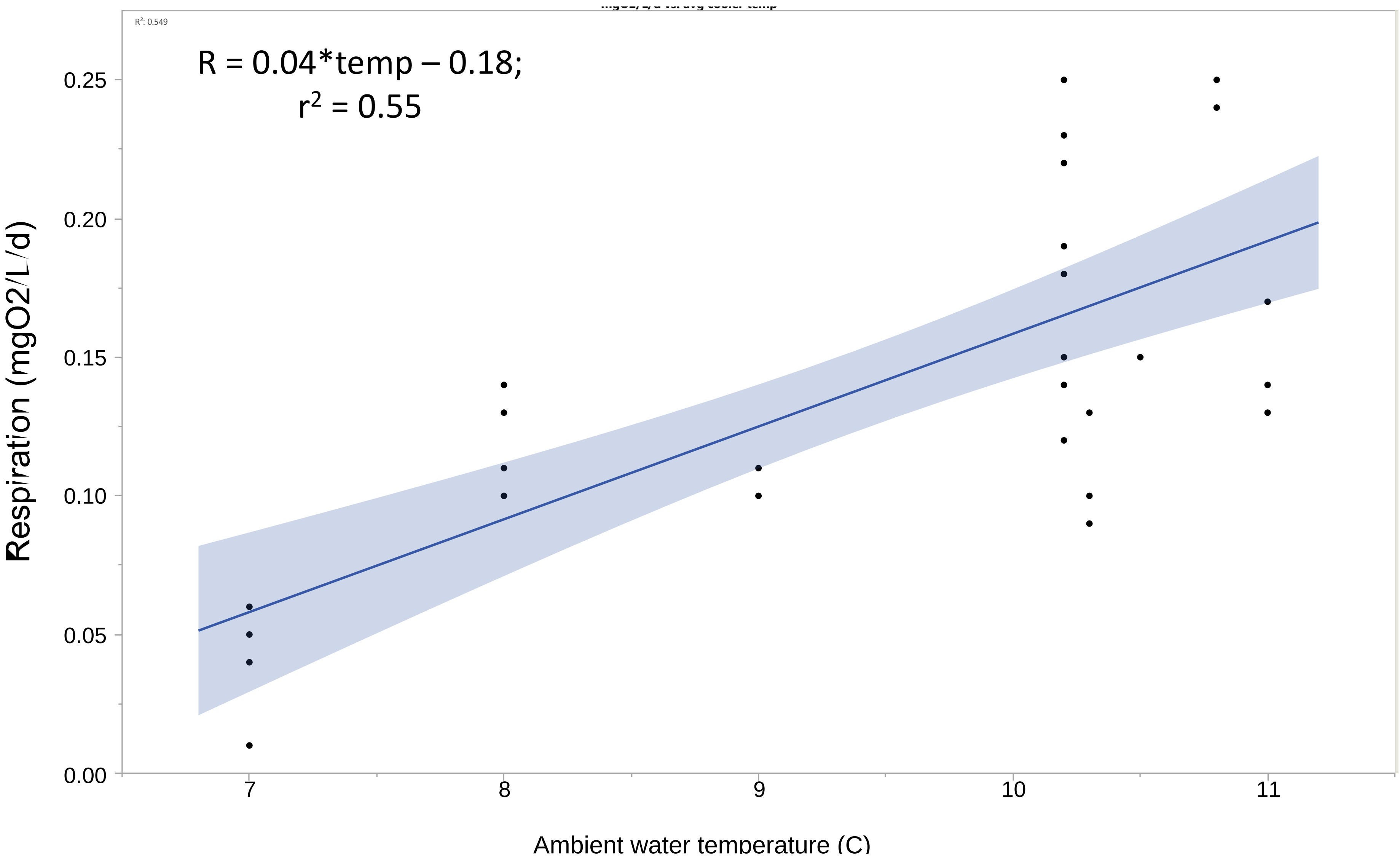
Deep water respiration is remarkably similar among over 100 sites - 5.8 µg O_2 L^{-1} h^{-1} (0.15 mg O_2 L^{-1} d^{-1}); n = 110

3. What are the environmental factors that control respiration?



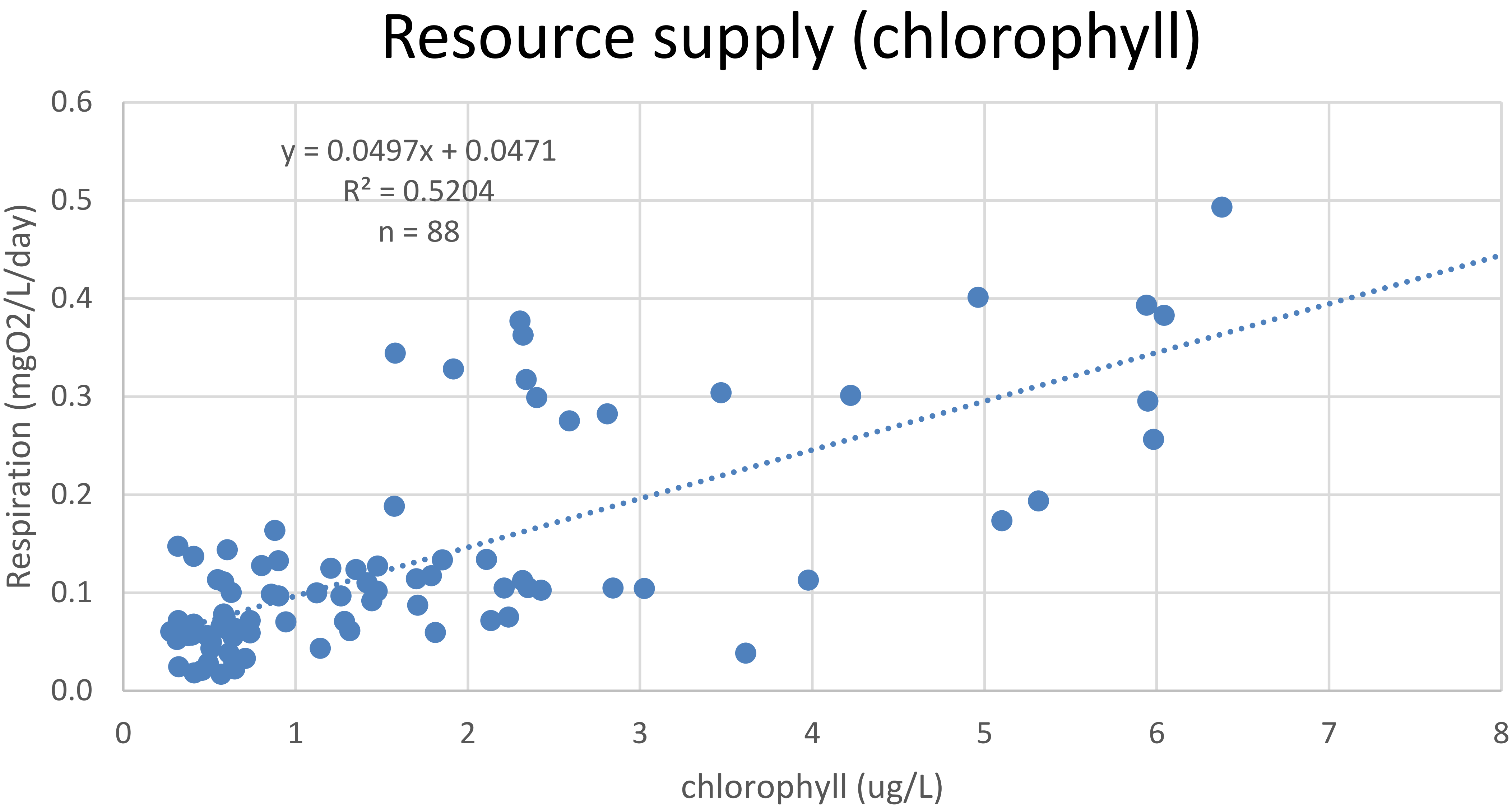
There is a strong temperature dependence of respiration that reveals a Q_{10} value >2.

3. What are the environmental factors that control respiration?



Experimental data reveal a similar positive response to temperature (slope = 0.04; Q_{10} = 2.5)

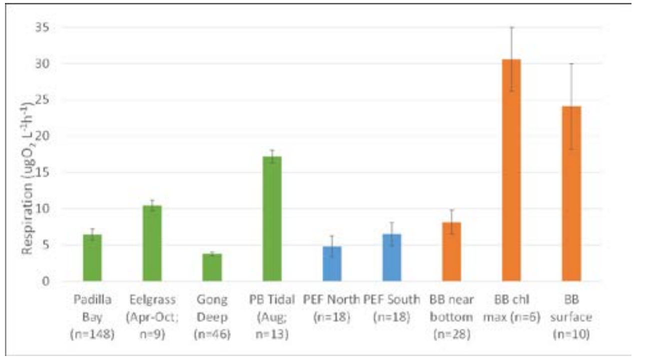
3. What are the environmental factors that control respiration?



Respiration also increases in response to chlorophyll – proxy for algal DOM/POM as well as phytoplankton respiration

Conclusions and implications…

- Respiration of deep waters is predictable (~6 µg O_2 L^{-1} h^{-1})



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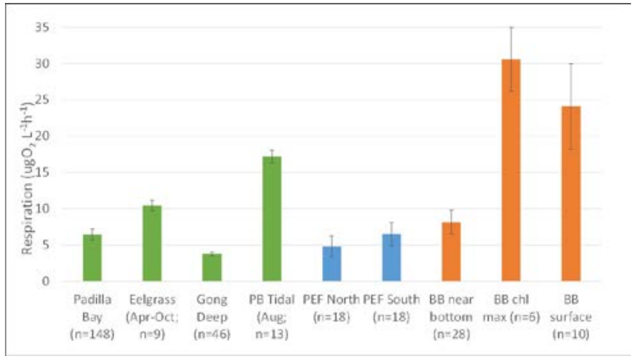
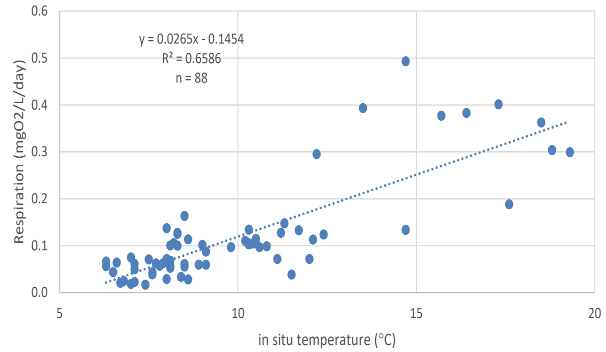


- Respiration responds strongly to increases in temperature and organic matter inputs – both of which we predict will increase with climate change



- A 5°C increase would almost double rates of respiration (and yield a corresponding increase in production of CO_2)

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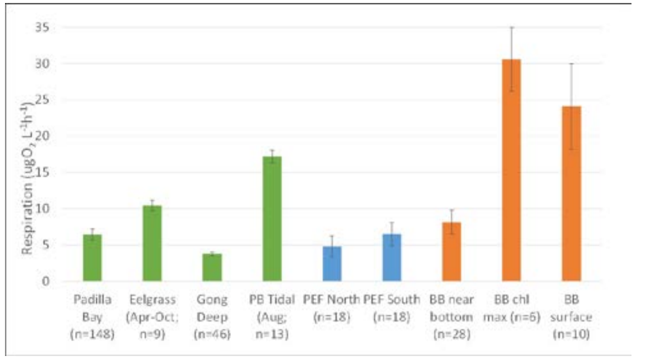

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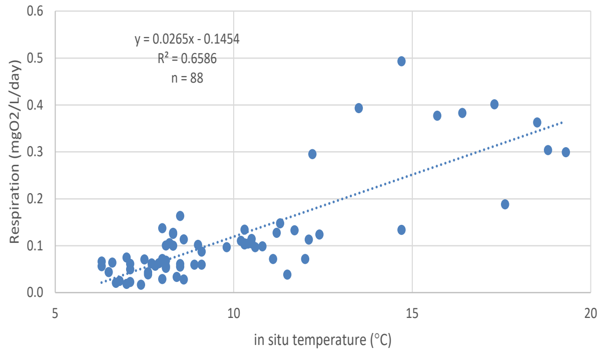

- A 5°C increase would almost double rates of respiration (and yield a corresponding increase in production of CO_2)

- Contribute rates to the coupled hydrodynamic-water quality model for oxygen and pH in the Puget Sound/Salish Sea.