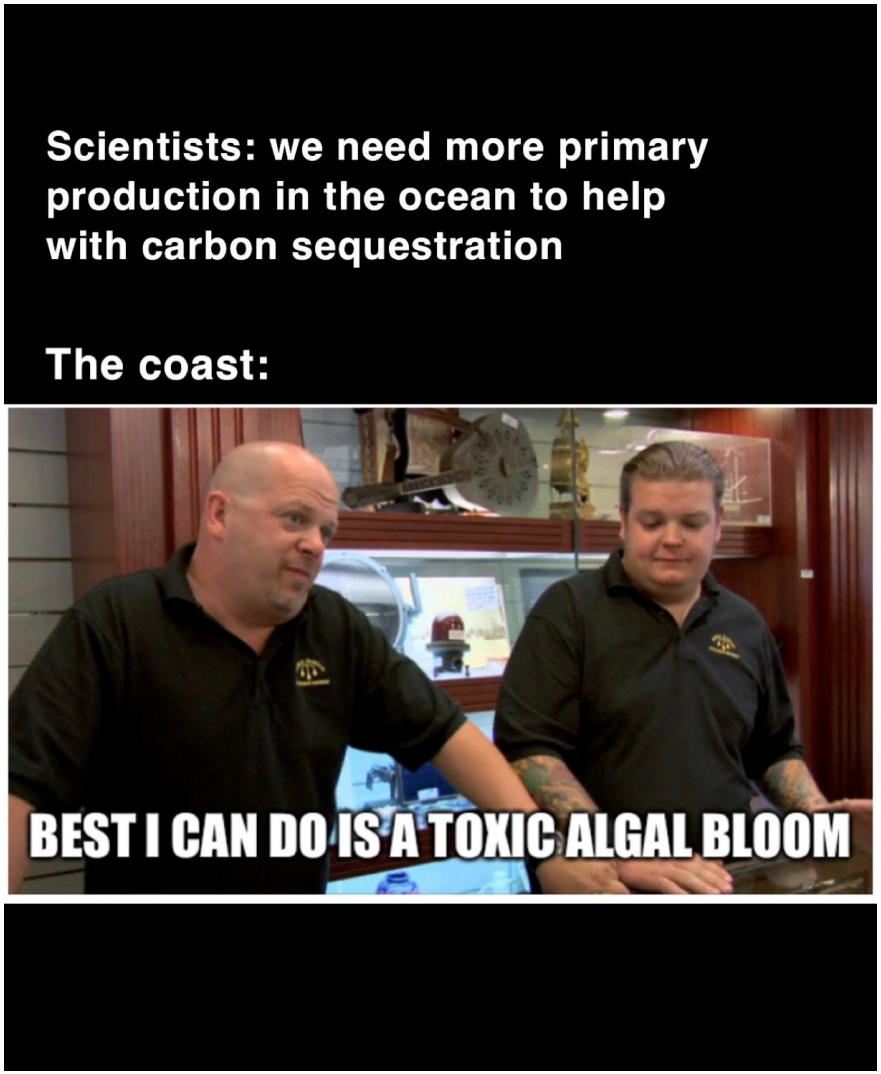
Not a lake and not a river: RIL HAB solutions

Desiree Tullos



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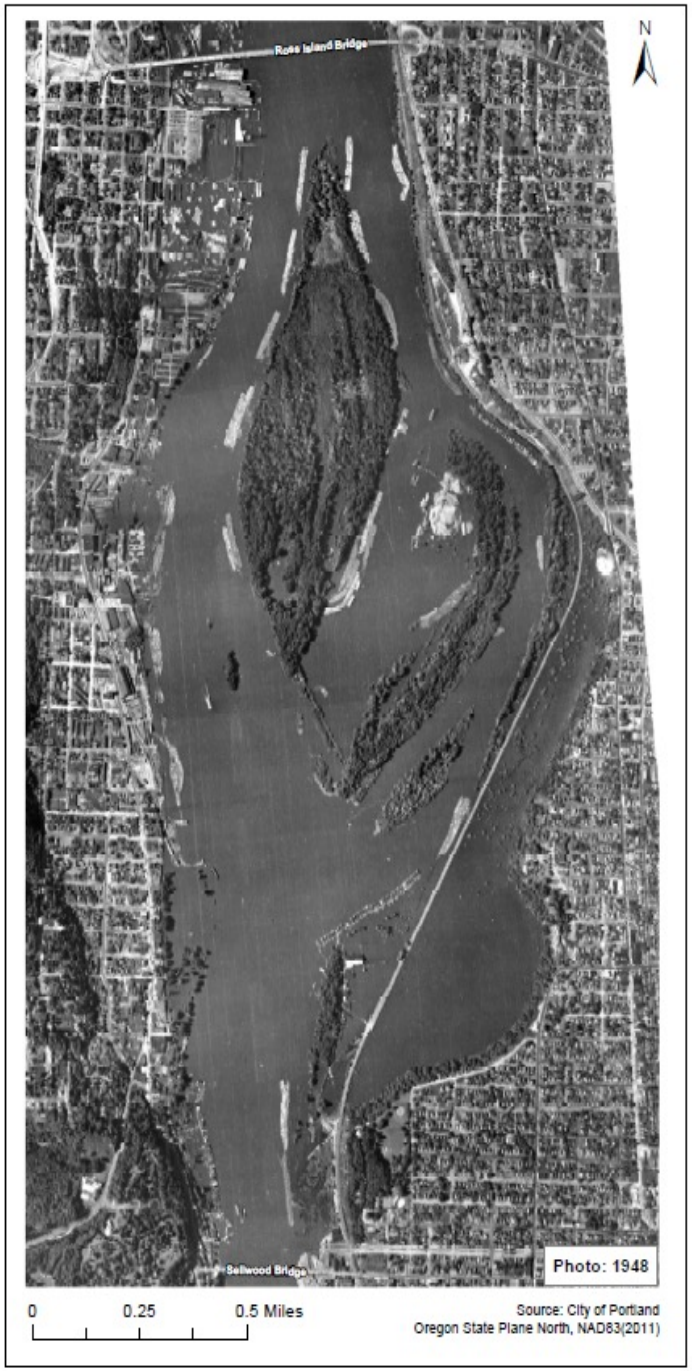

Ross Island Bridge
N
Sellwood Bridge
Photo: 1948
0
0.25
0.5 Miles
Source: City of Portland
Oregon State Plane North, NAD83(2011)


Ross Island Bridge
N
Sellwood Bridge
Photo: Summer 2015
0
0.25
0.5 Miles
Source: City of Portland
Oregon State Plane North, NAD83(2011)

Tackling limiting conditions for RIL HAB

Stagnant water

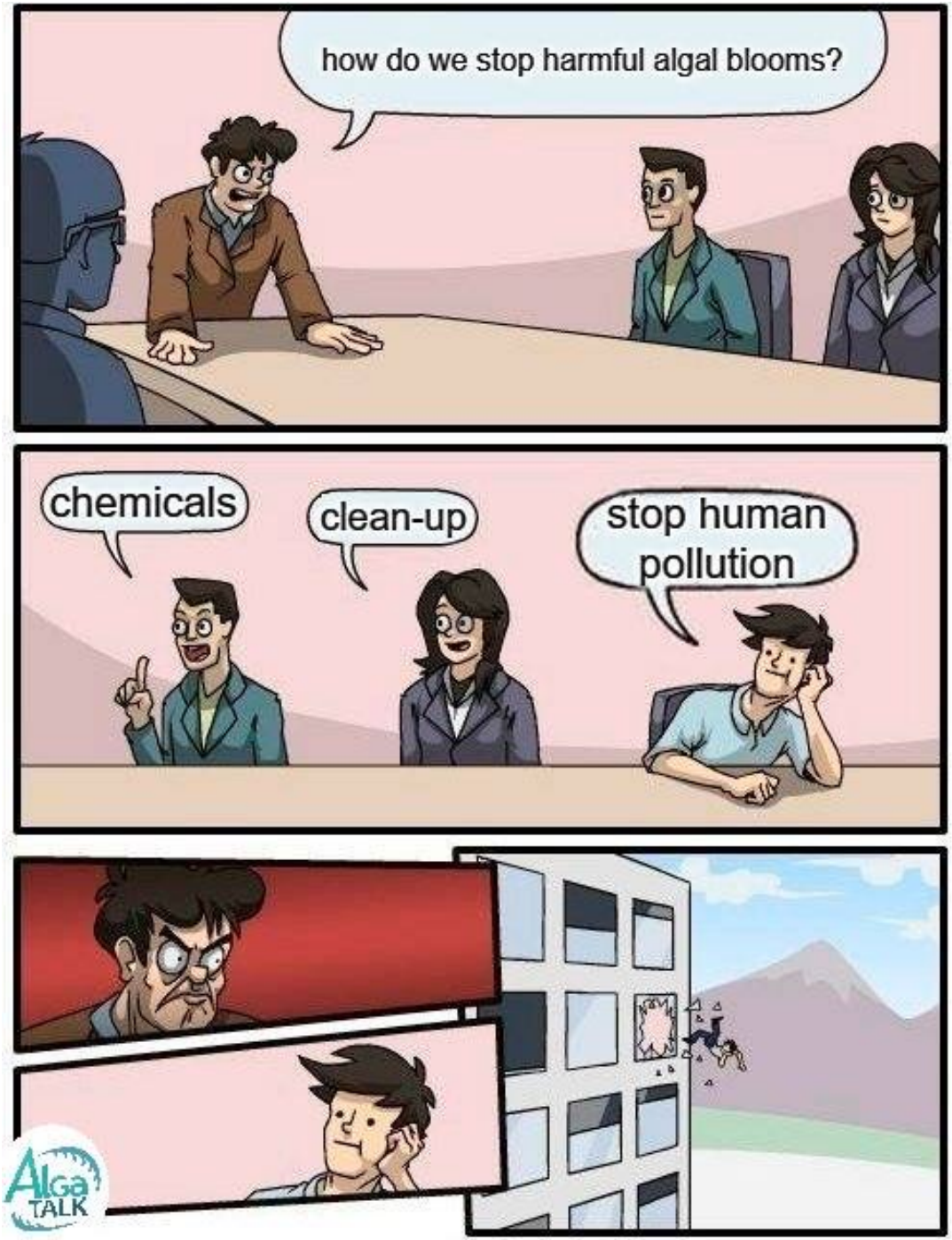
1. Destratification
2. Gated flushing channel

Hot water (>16C)

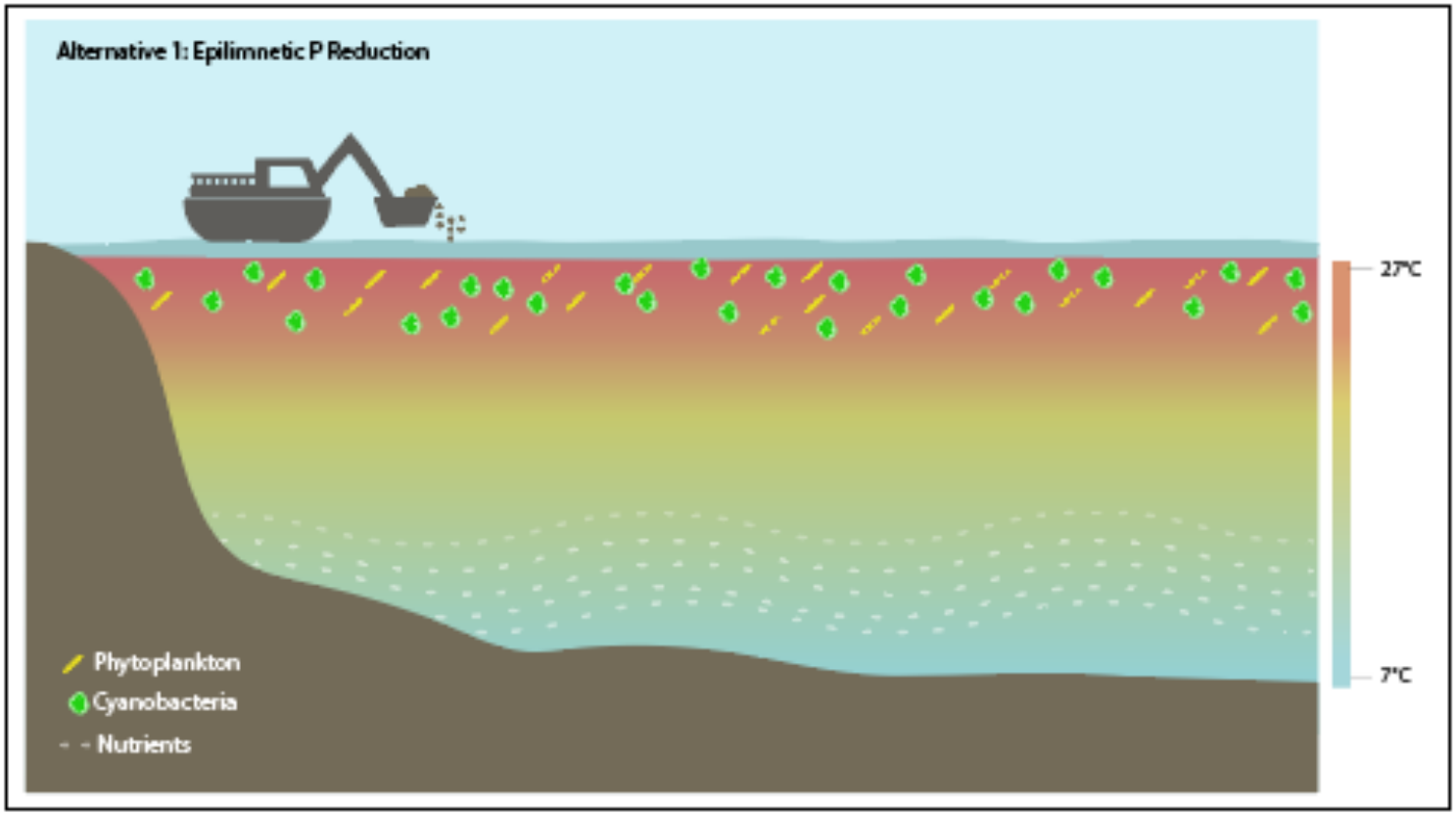
3. Mixing up cold water

Excess nutrients

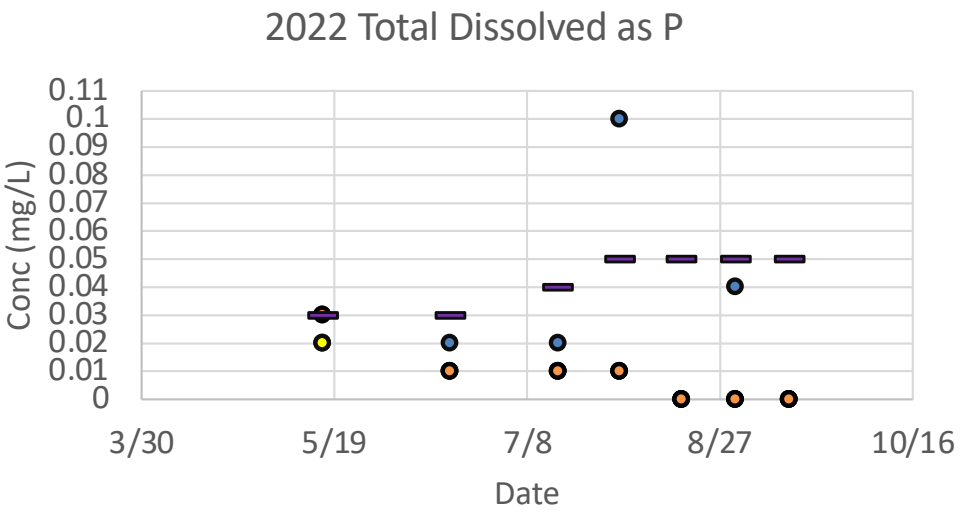
4. Phosphorus immobilization

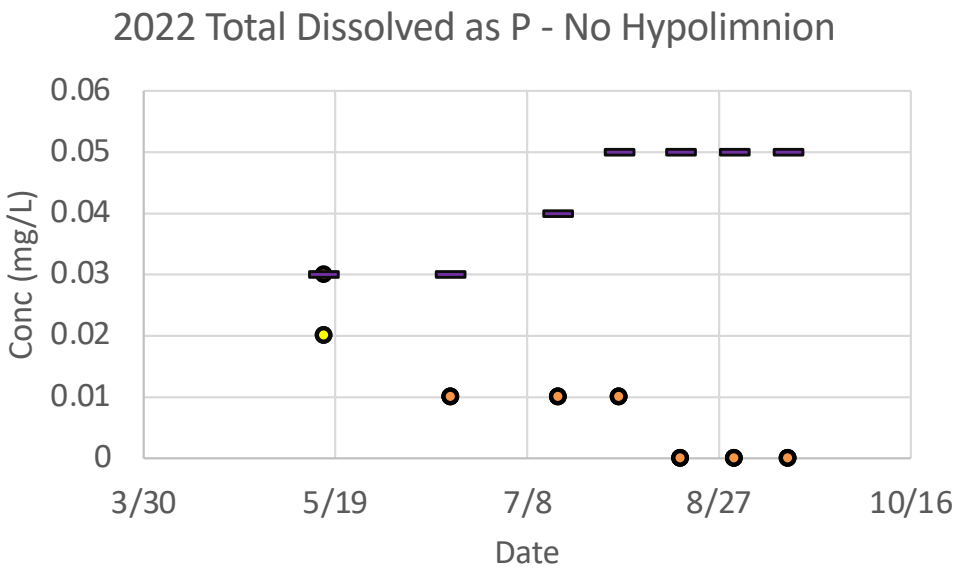

how do we stop harmful algal blooms?
chemicals
clean-up
stop human pollution
Alga TALK

P limited → Could Phosphorus immobilization earlier in the summer be effective?



Lagoon Phosphorus 2022





- Note P source in the hypolimnion/bottom – old dead algae
- Surface P goes to ND after May
- Decline in P over time even at the entrance

P immobilization effectiveness

- The bloom may become P limited mid-summer
  - but more strongly limited by light (& temp)

Most successful where there is little/no refreshing of phosphorus in the epilimnion and in lakes with a hydraulic residence time of several years.

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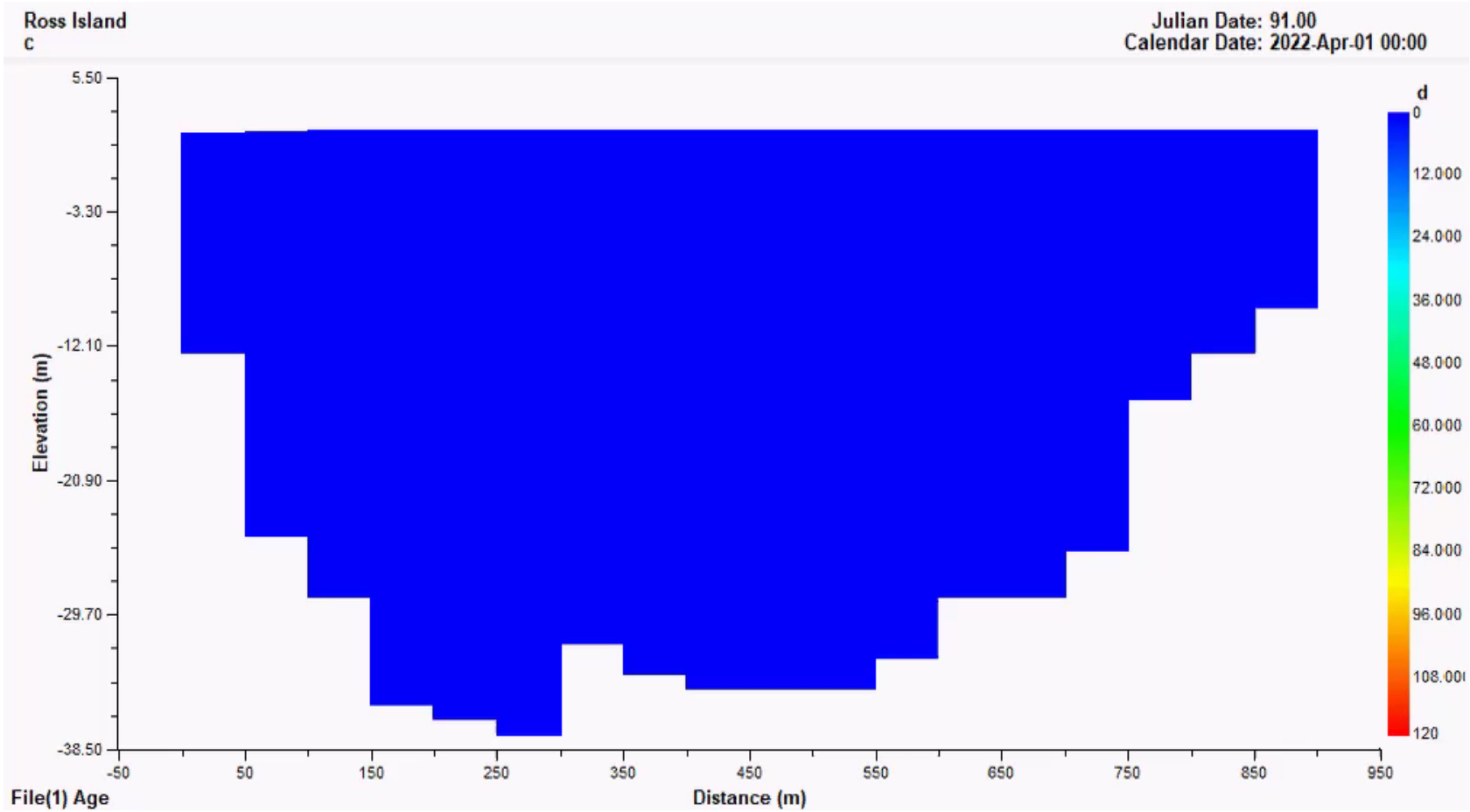
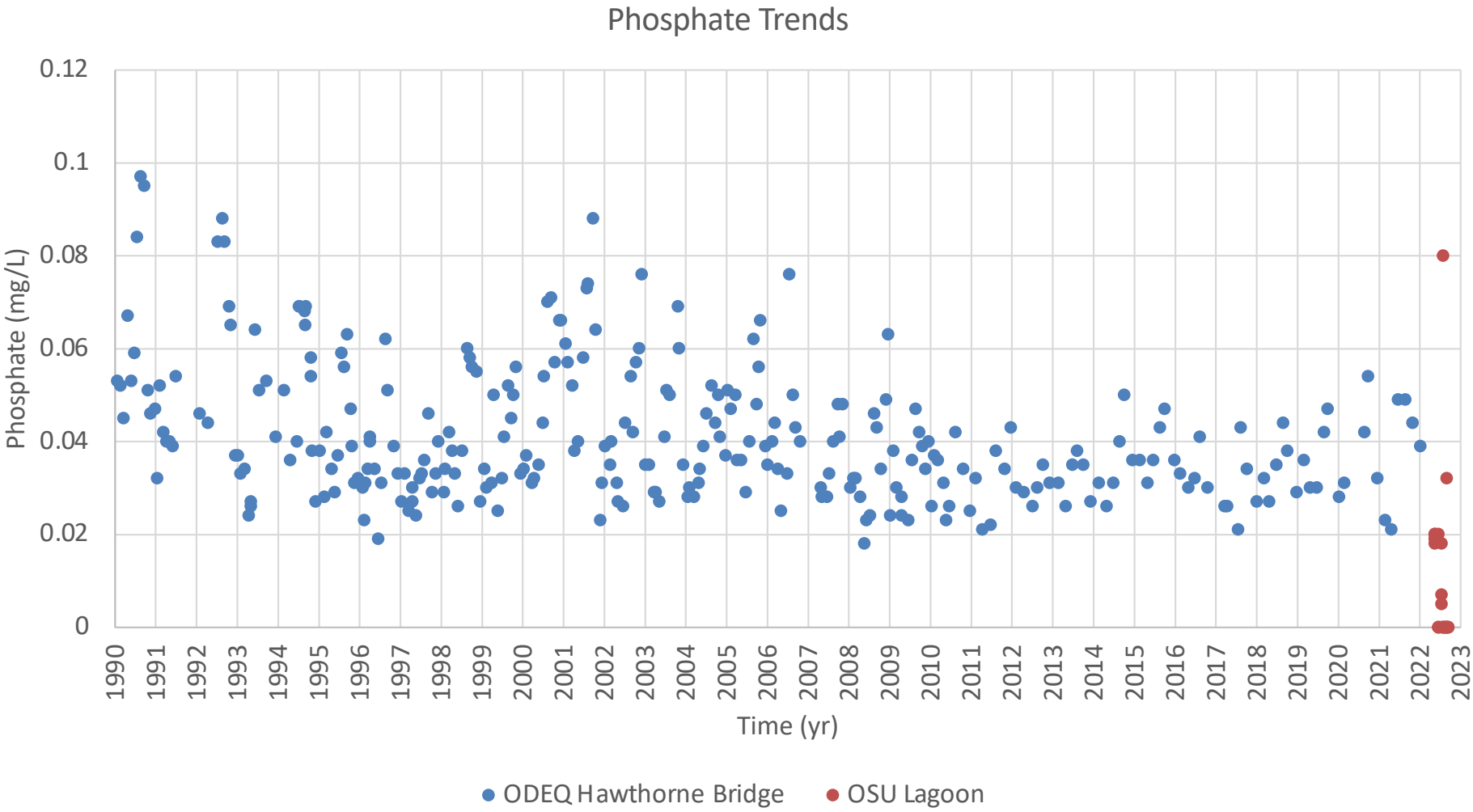
Tidal mixing in the lagoon

- Daily tides bring in “fresh” river water and draws algae out
- Margins only get mixed every ~2 days by late summer.



Not a lake and not a river.

Long term Phosphate trends

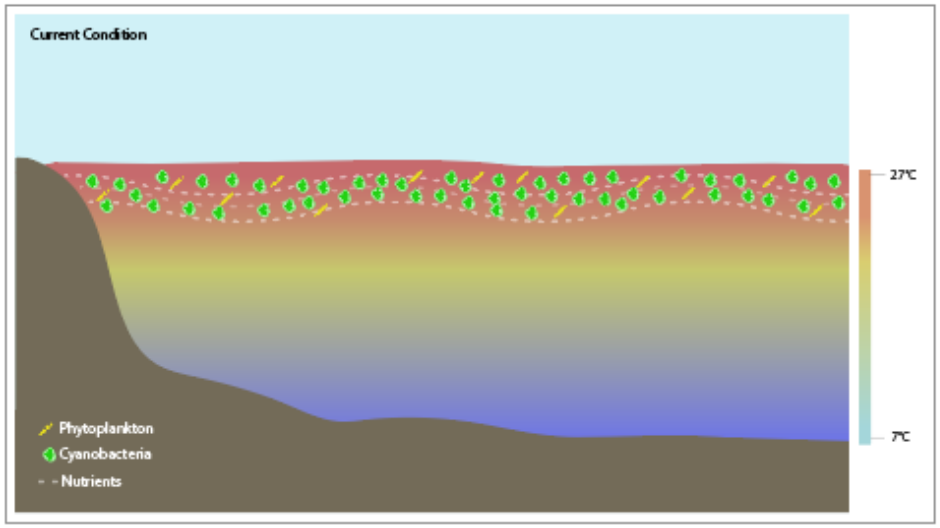


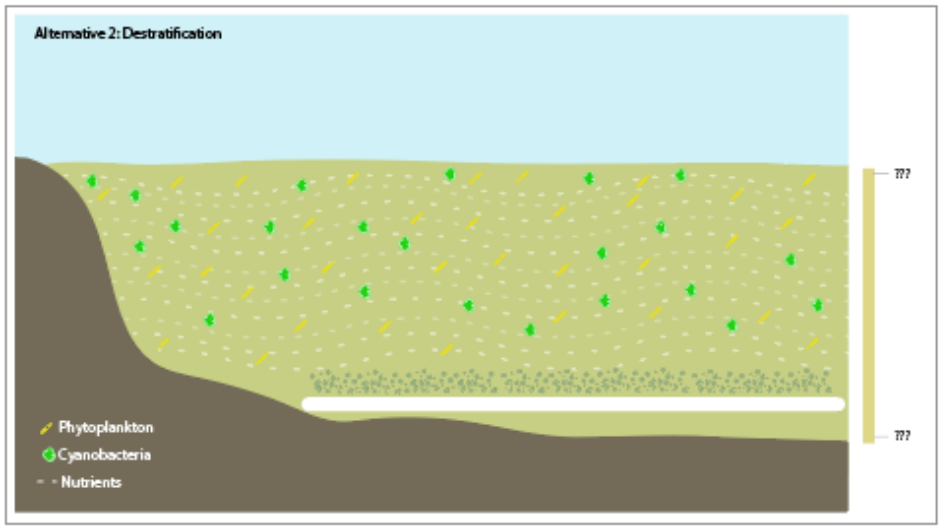
Effectiveness: P immobilization

- The bloom may become P limited mid-summer
- Adequate nutrients in the river for a bloom
  - The tide likely recharges the lagoon with nutrients each day

- Limited effectiveness of P immobilization for areas mixed by the tide.
- Possible effectiveness in the margins

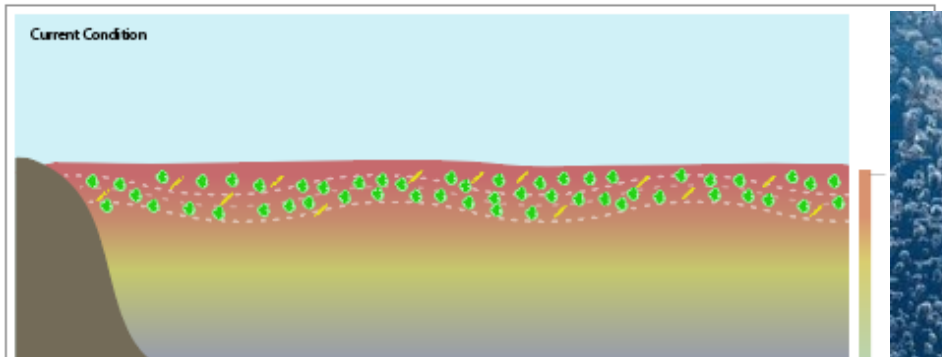
Effectiveness: Destratification with bubble curtains



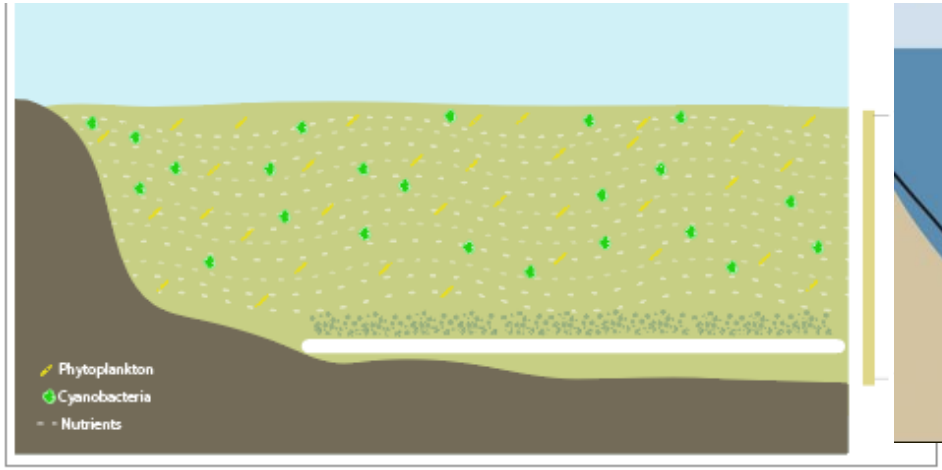


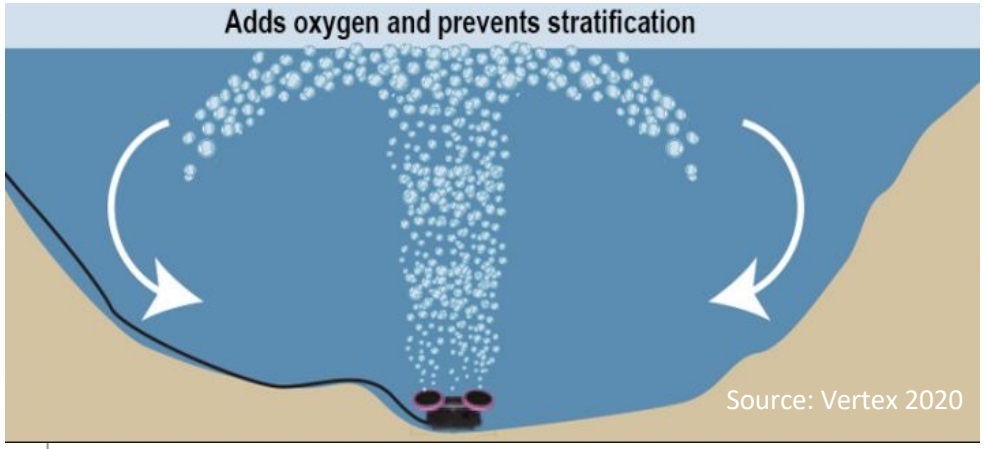
Remove competitive advantage of cyanobacteria (vertical migration) and create light limitation by circulating cyanos to depth

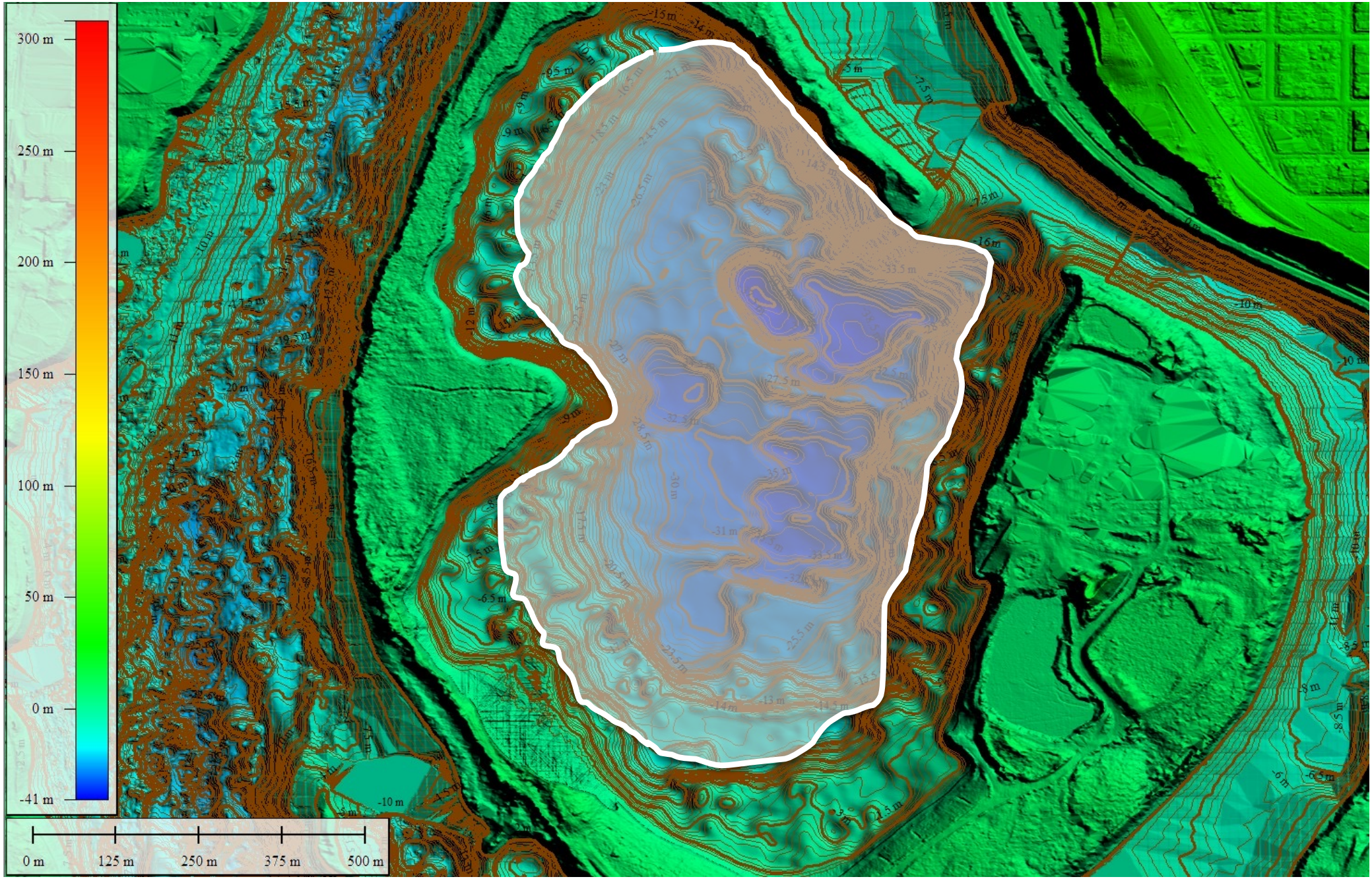
Effectiveness: Destratification with bubble curtains



Bubble curtains are most effective on blooms in stratified lakes.





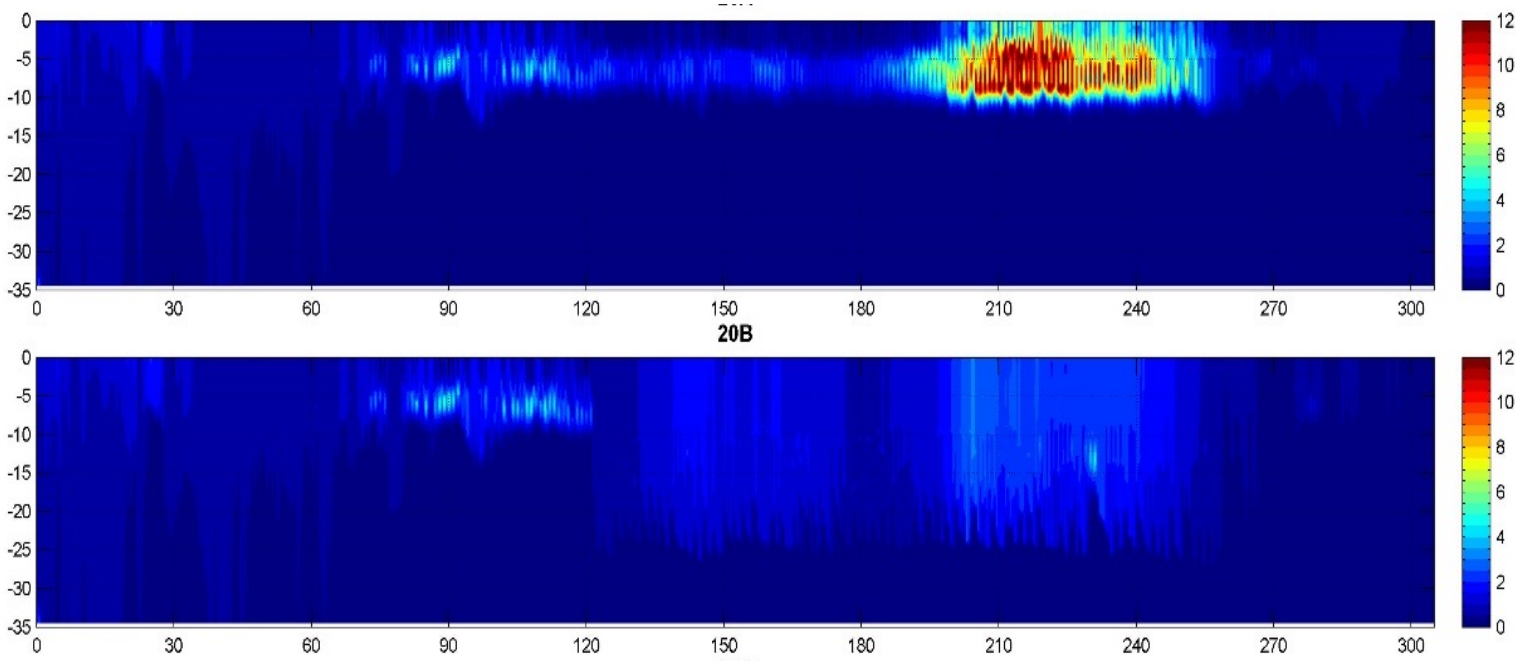


Not a lake and not a river

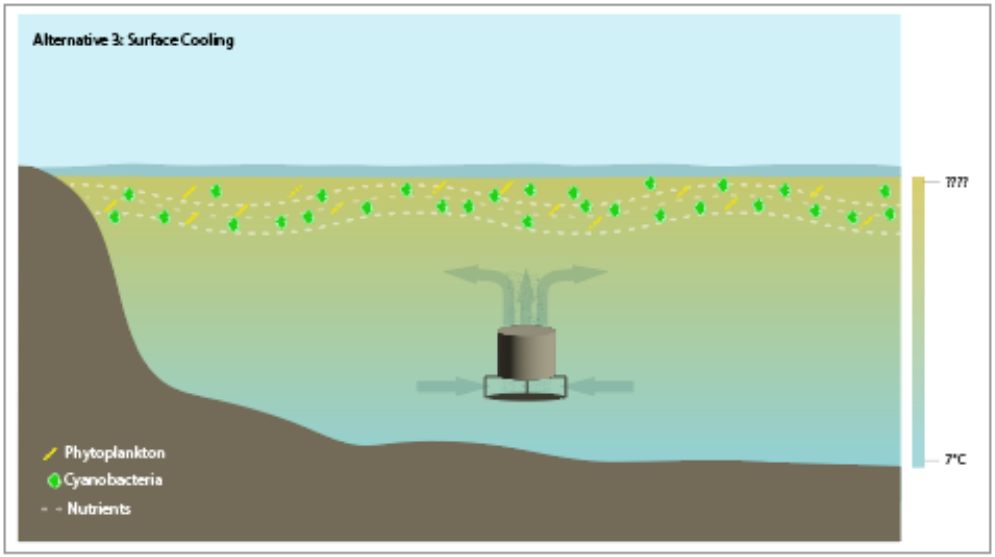
Effectiveness: Destratification with bubble curtains

- Models indicate bubble curtain will be effective at reducing *Microcystis* biomass & BGA-attributable Chl A

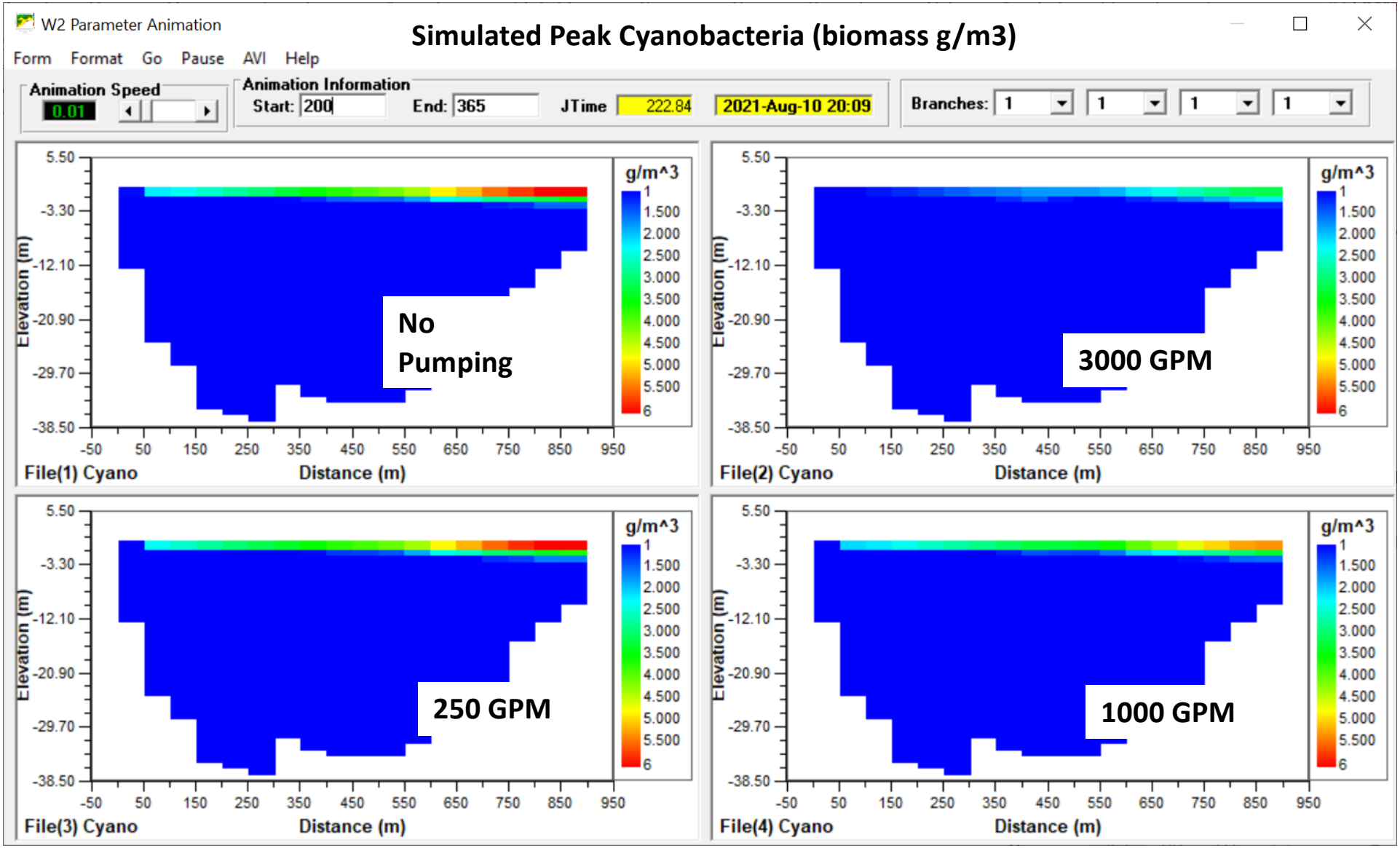
- Will require 40-50 kW electrical compressor operating continuously from May 1st until Oct 1st.



Effectiveness: Surface cooling w/o destratification

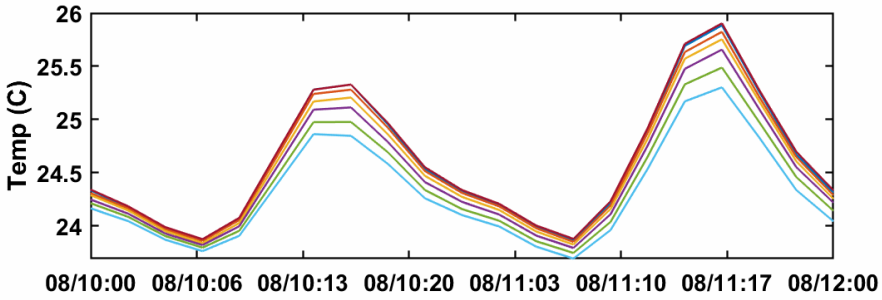


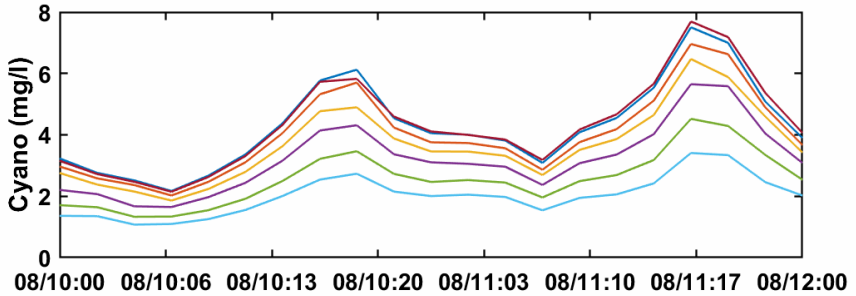
- Mechanical pumps to bring 8C water to cool surface and slow production
- Avoiding hypolimnetic nutrients
- Avoiding exhausting the cold water pool and destratification

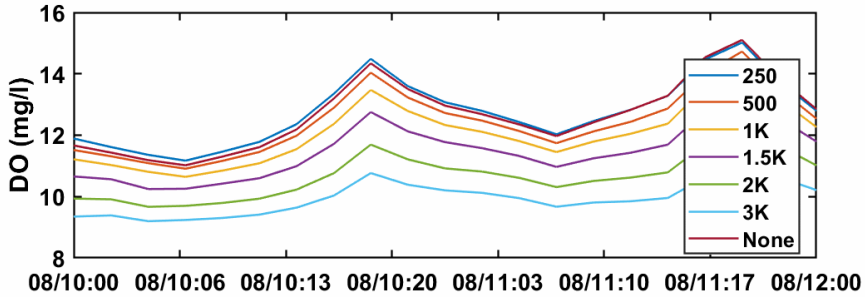

W2 Parameter Animation
Simulated Peak Cyanobacteria (biomass g/m3)
Form Format Go Pause AVI Help
Animation Speed
0.01
Animation Information
Start: 200
End: 365
JTime 222.84
2021-Aug-10 20:09
Branches: 1 1 1 1
No Pumping
3000 GPM
250 GPM
1000 GPM
Elevation (m)
5.50
-3.30
-12.10
-20.90
-29.70
-38.50
-50 50 150 250 350 450 550 650 750 850 950
Distance (m)
g/m^3
1
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6
File(1) Cyano
File(2) Cyano
File(3) Cyano
File(4) Cyano

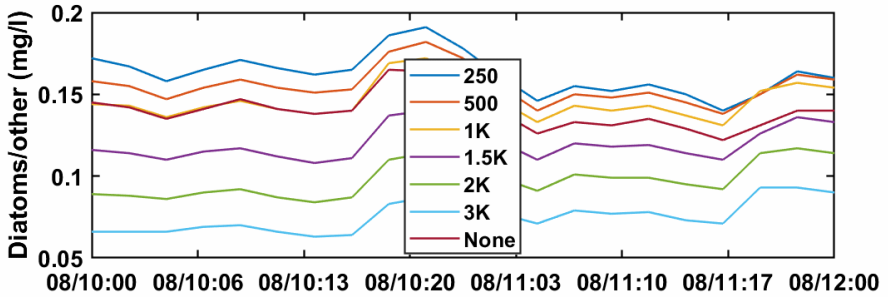
Effectiveness: Surface cooling w/o destratification

- Cooler surface, lower DO, lower overall productivity, greater impact on cyanos
- Modest impact from one pump

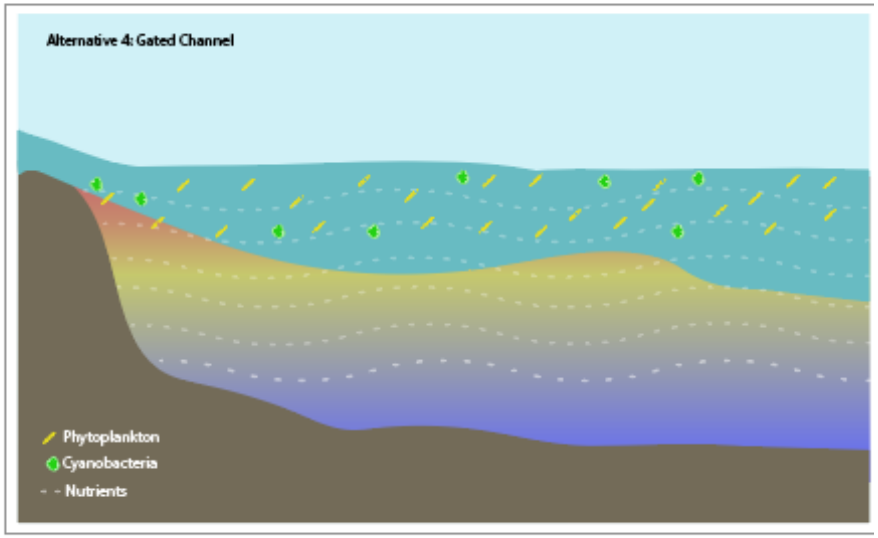


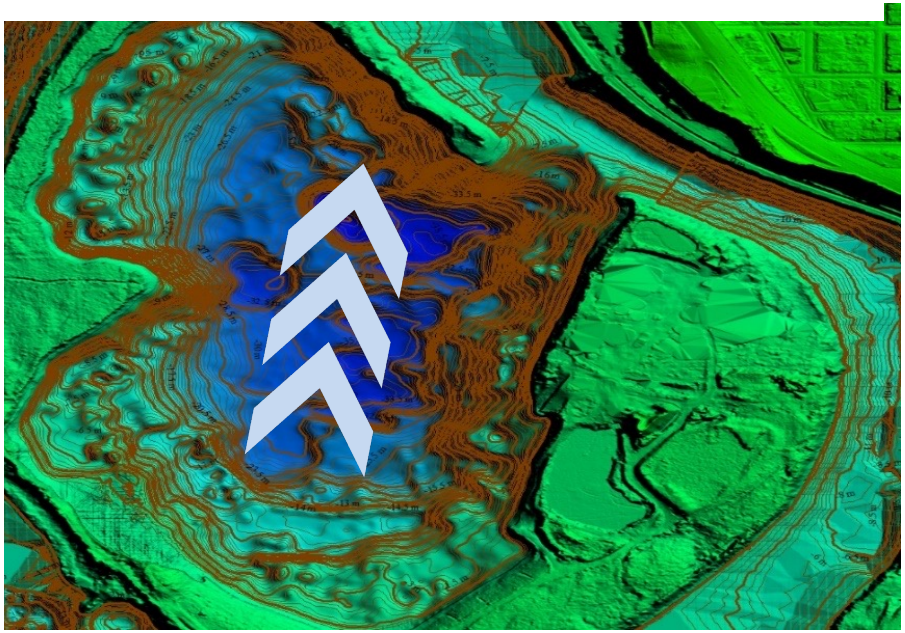






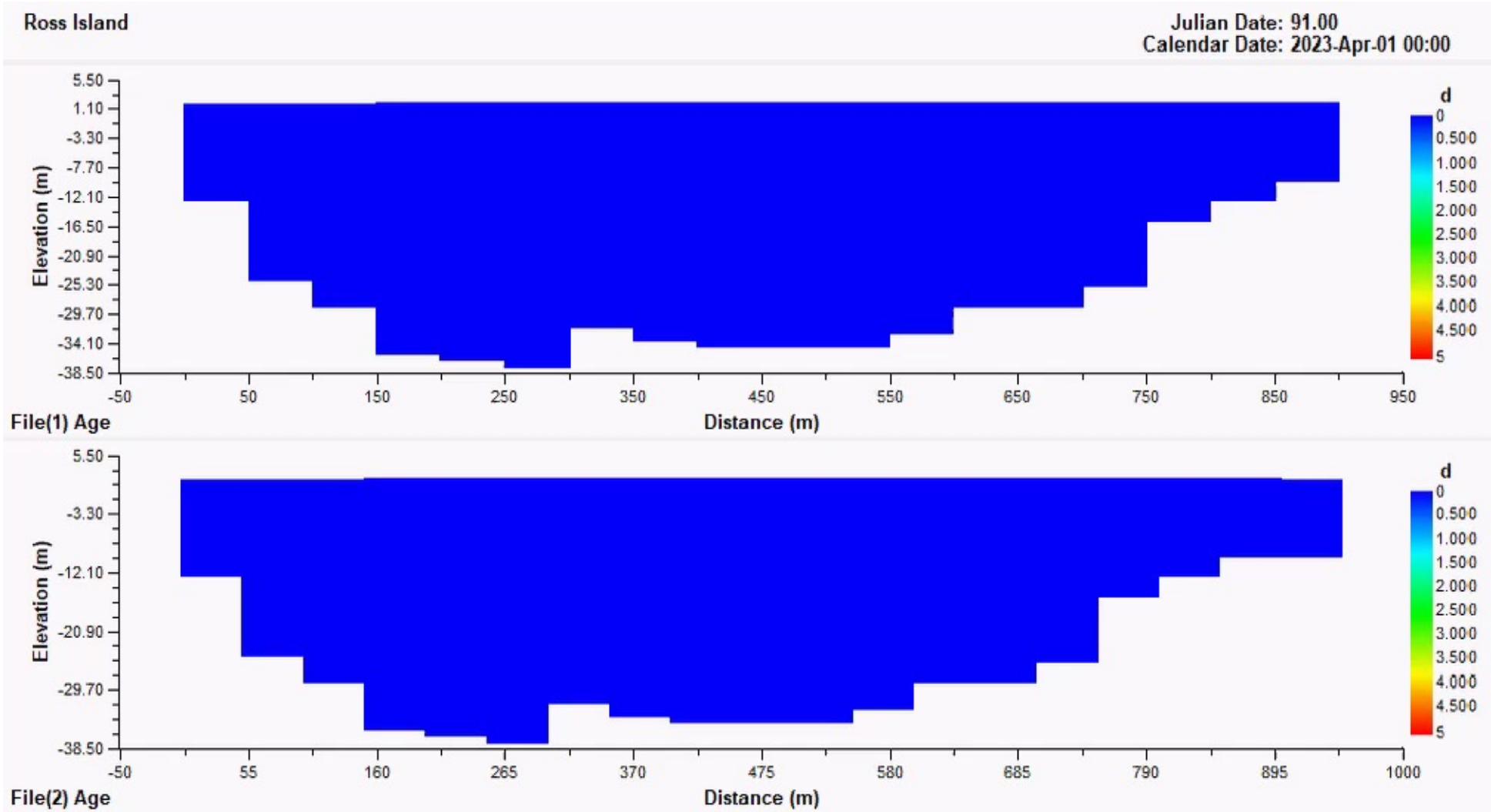
Effectiveness: Flushing channel





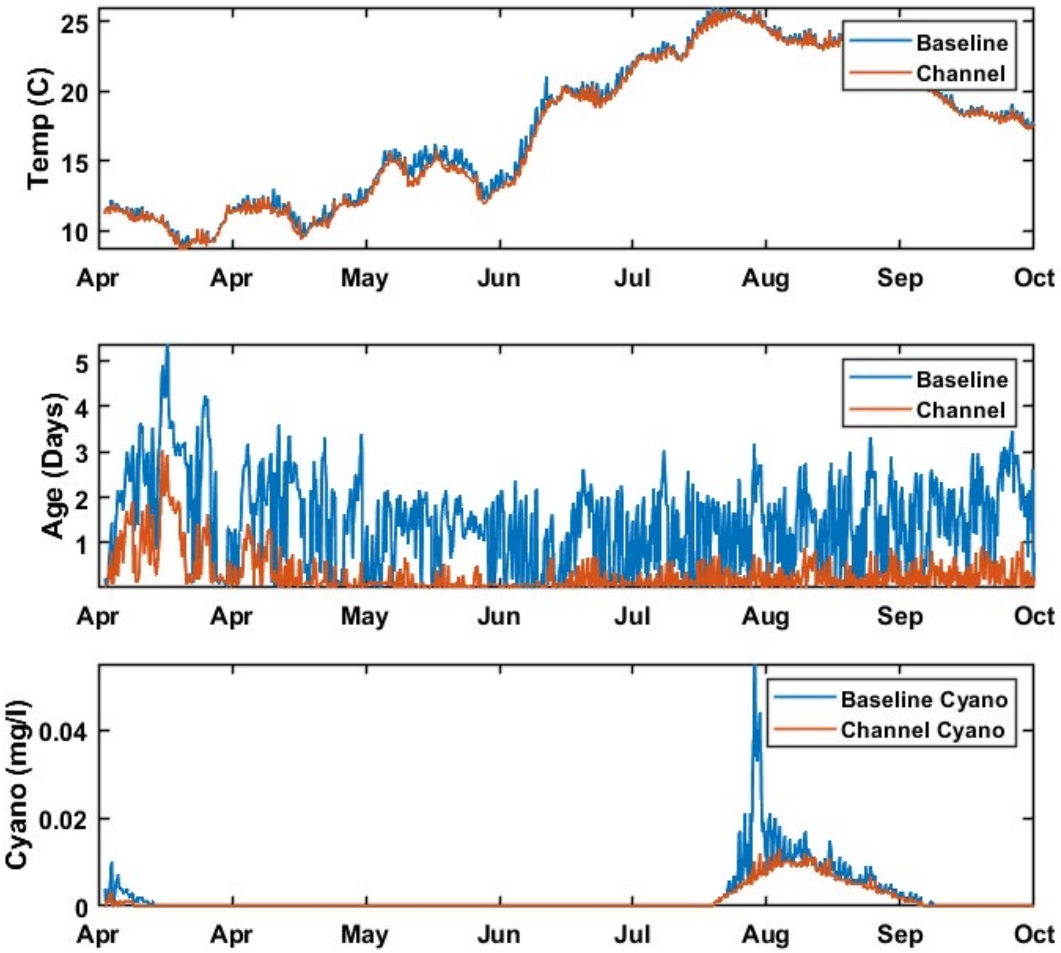
- Gated weir
- Comparing design for flushing photic zone (~5m) vs. entire epilimnion (~11m)
- Produces less algae or just flushes out algae?

Initial Channel Model: Impacts on water age



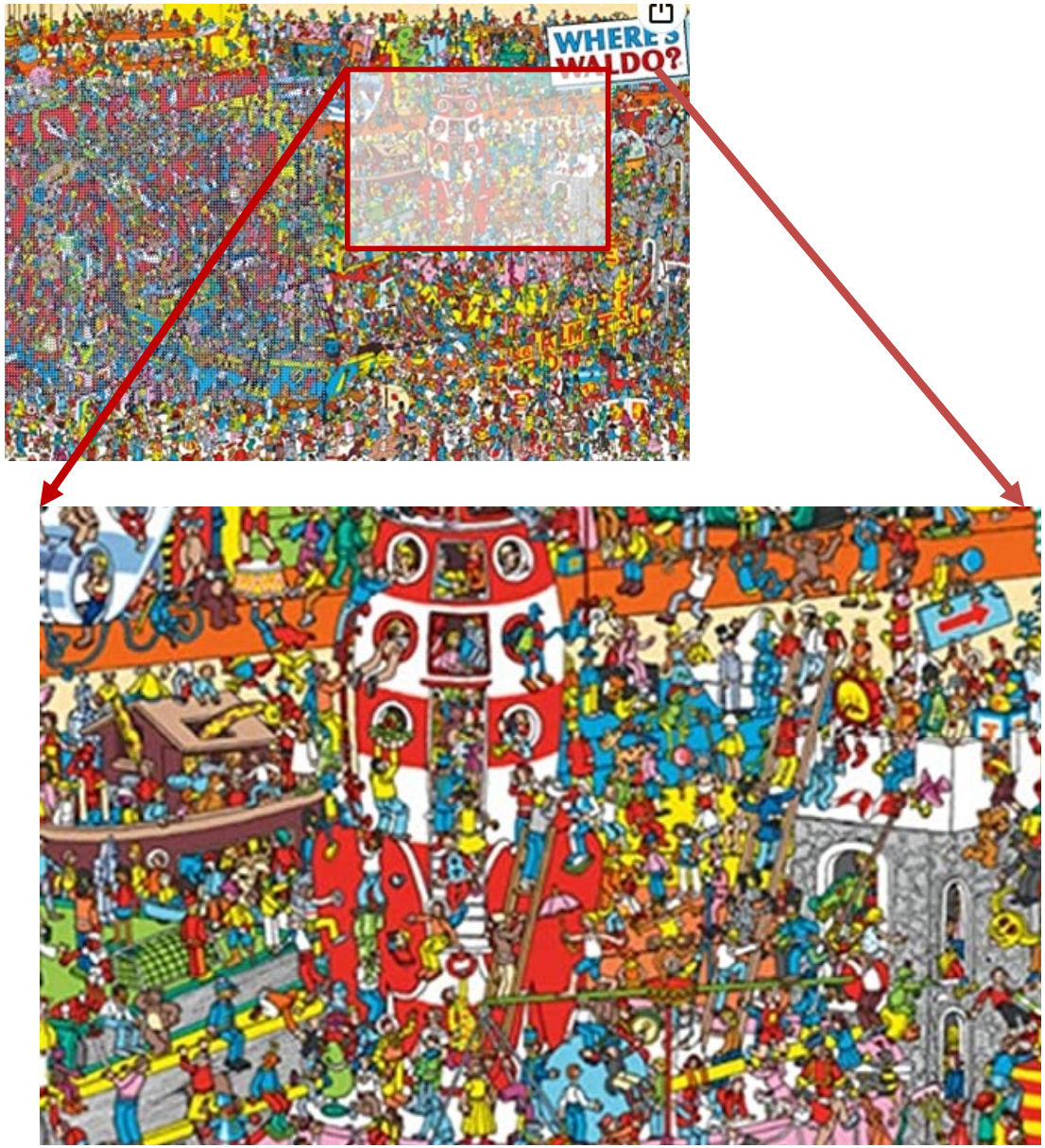
Initial results suggest channel will:

- reduce residence time (age)
- help regulate algal growth, including cyanobacteria



design limitations → uncertainty

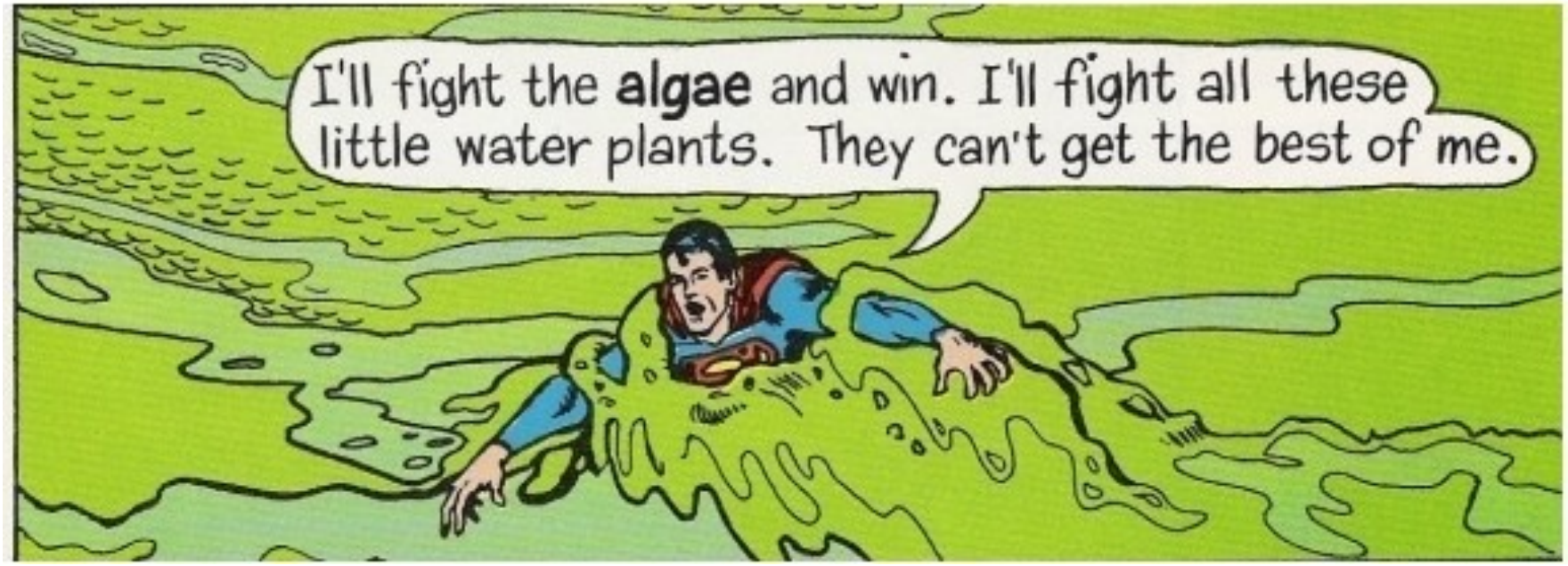
- How much treatment is “enough?”
- Ecological/HAB models (universally) capture big picture processes but are not great.
    - Key processes: P limitation, vertical migration of cyanobacteria to light, temperature limitation
- Permitting



Summary

- RIL is not a lake and not a river.
  - Deep stratified middle
  - Shallow, mixed margins
- Unlikely that any solution will suppress the bloom 100%, but mixing strategies are likely to be good "enough."

Discussion…



Thanks! Kellie Vache, Willie Levinson, DSL, PGE/TNC, City of Portland, ODEQ, BES, and others.

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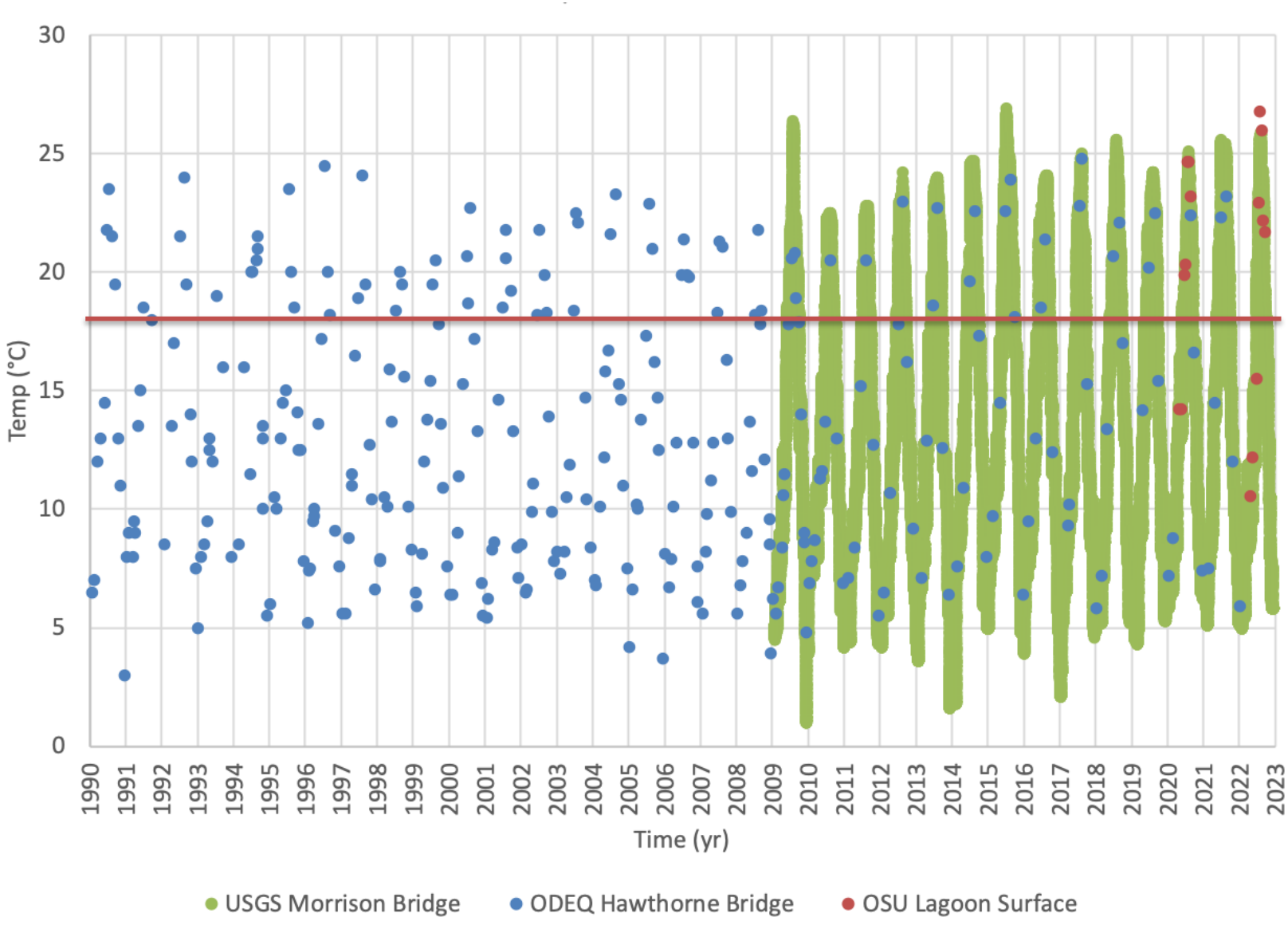
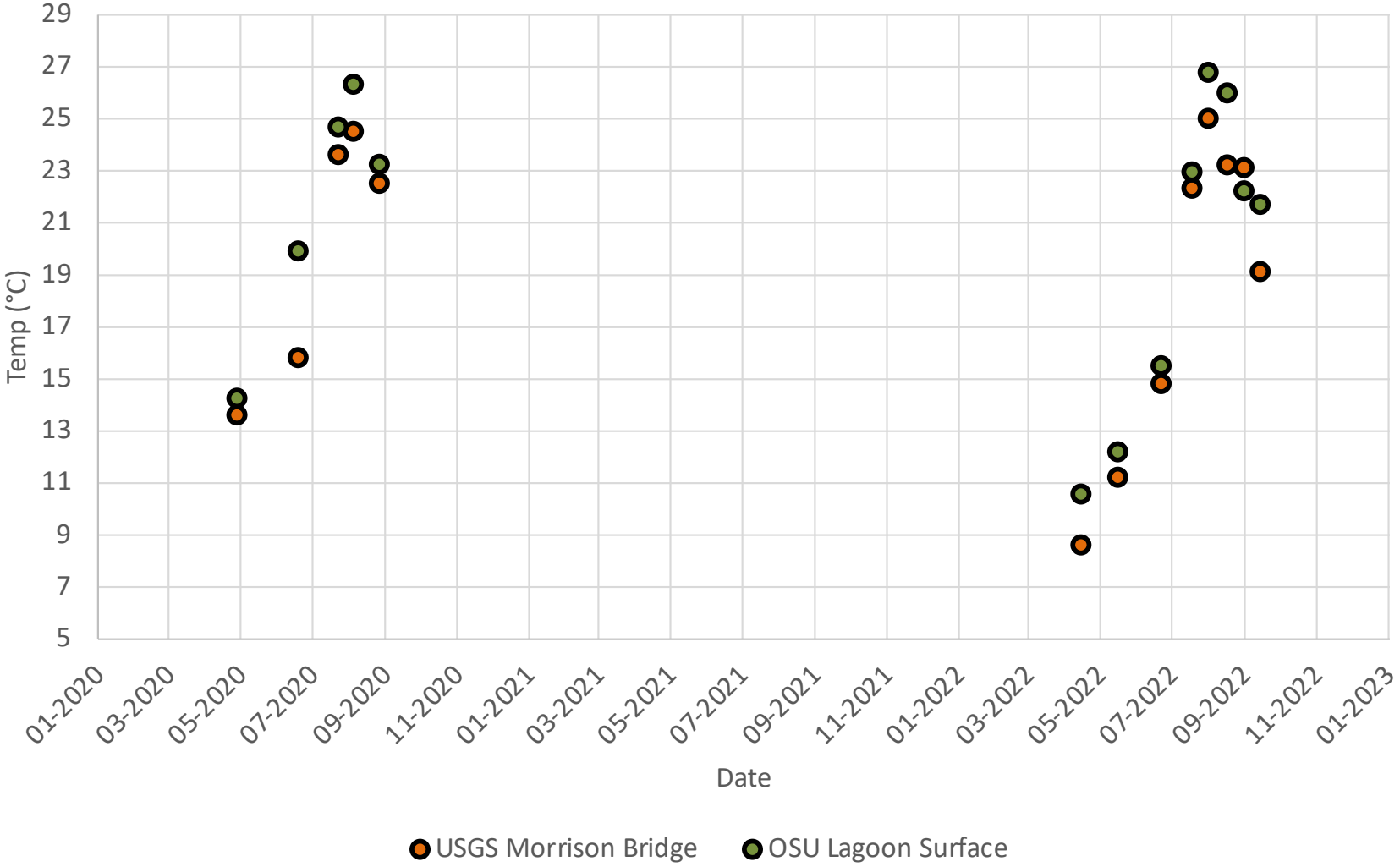
Longish-term lower W. temperature



Lagoon surface vs. USGS gage



Longish-term lower W. chl a