RMP
REGIONAL MONITORING
PROGRAM FOR WATER QUALITY
IN SAN FRANCISCO BAY

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Insights from Sensors

Understanding the Complex Dynamics of Dissolved Oxygen in Lower South Bay

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OUTLINE

Why does dissolved oxygen matter?

What are the principle drivers?

How can we untangle them?

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CONCLUSION

Dissolved oxygen varies in every dimension

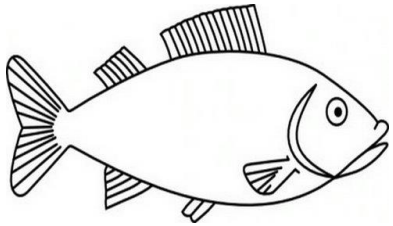
CONCLUSION

Dissolved oxygen varies in every dimension,

but how much?

And why should we care?

WHY SHOULD WE CARE?



Why should we care?

$$CH_2O + O_2 \rightleftharpoons CO_2 + H_2O$$

Why should we care?

$$CH_2O + O_2 \rightleftharpoons CO_2 + H_2O$$

← Photosynthesis dominates

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Why should we care?

Respiration →
dominates

$$CH_2O + O_2 \rightleftharpoons CO_2 + H_2O$$

Why should we care?

The SF Bay food web depends on DO

We can directly influence DO

We need to know how much is natural vs…?

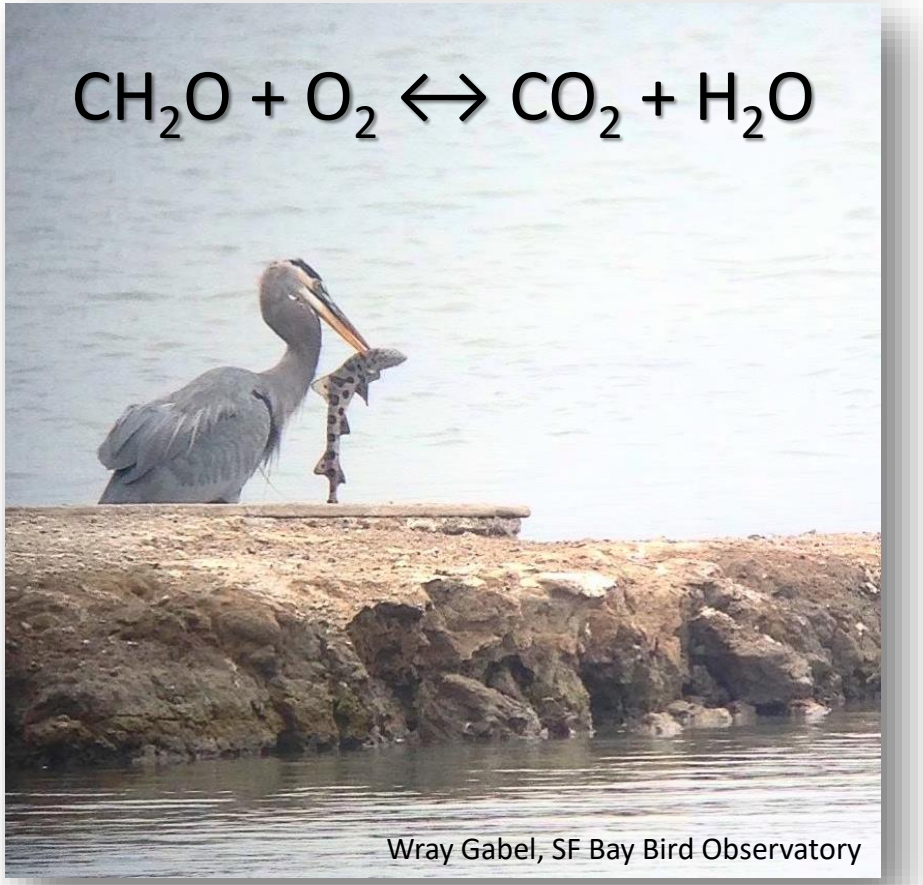
Wray Gabel, SF Bay Bird Observatory

Why should we care?

The SF Bay food web depends on DO

We can directly influence DO

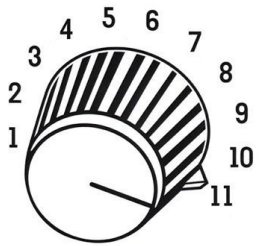
We need to know how much is natural vs…?



Constraining variability allows us to estimate rates, slough-to-basin scale budgets, and habitat quality and the effects of nutrient loads

Wray Gabel, SF Bay Bird Observatory

THE DRIVERS OF CHANGE



Drivers of variability in DO

Interfaces:

air–water

sediment–water

Production vs. Respiration:

Phytoplankton/zooplankton/nekton/detritus/bacteria

Connections:

ponds

marshes

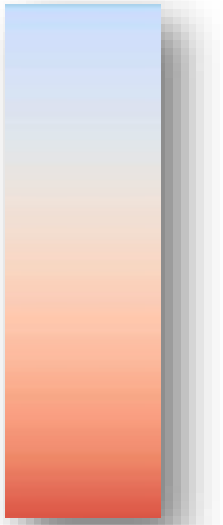
bay

ocean

land

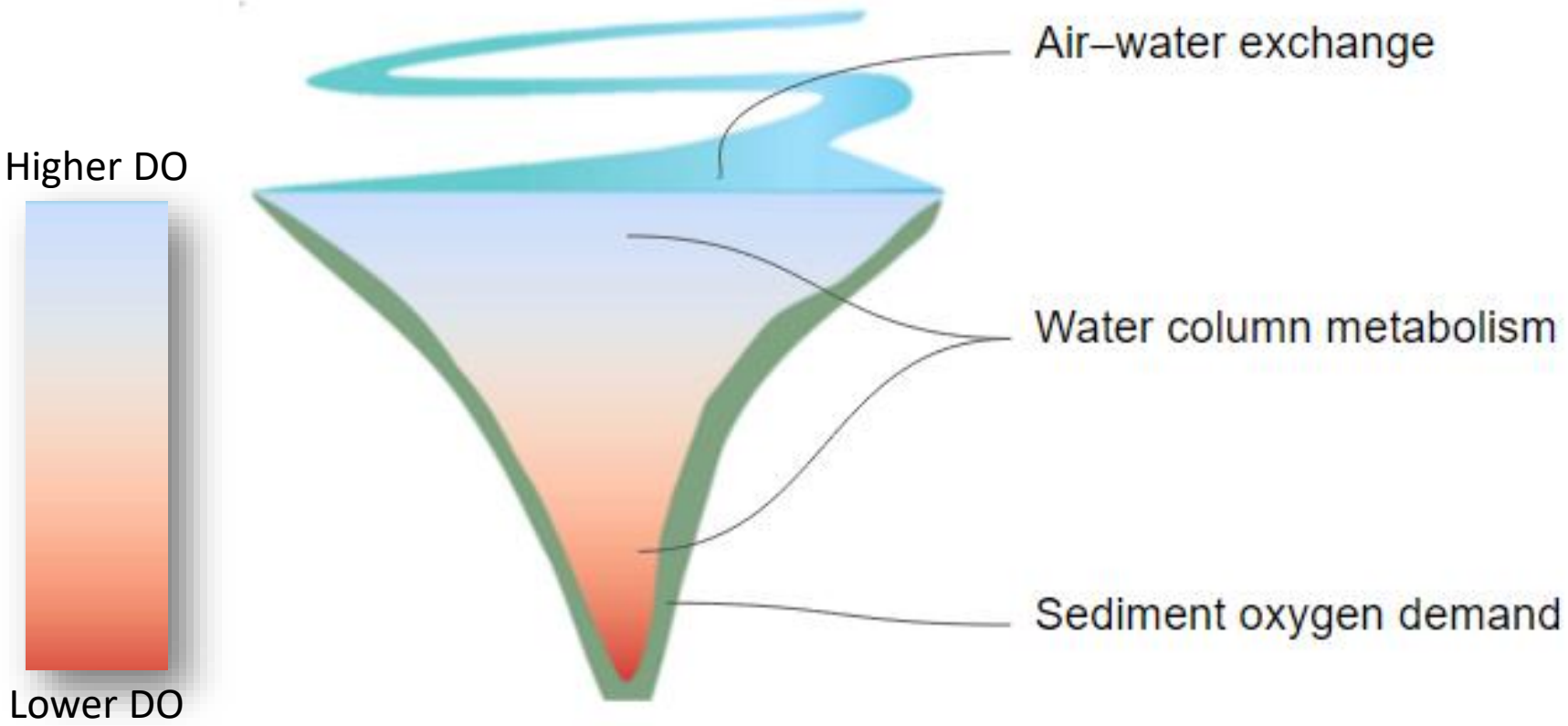
Drivers of variability in DO

Higher DO

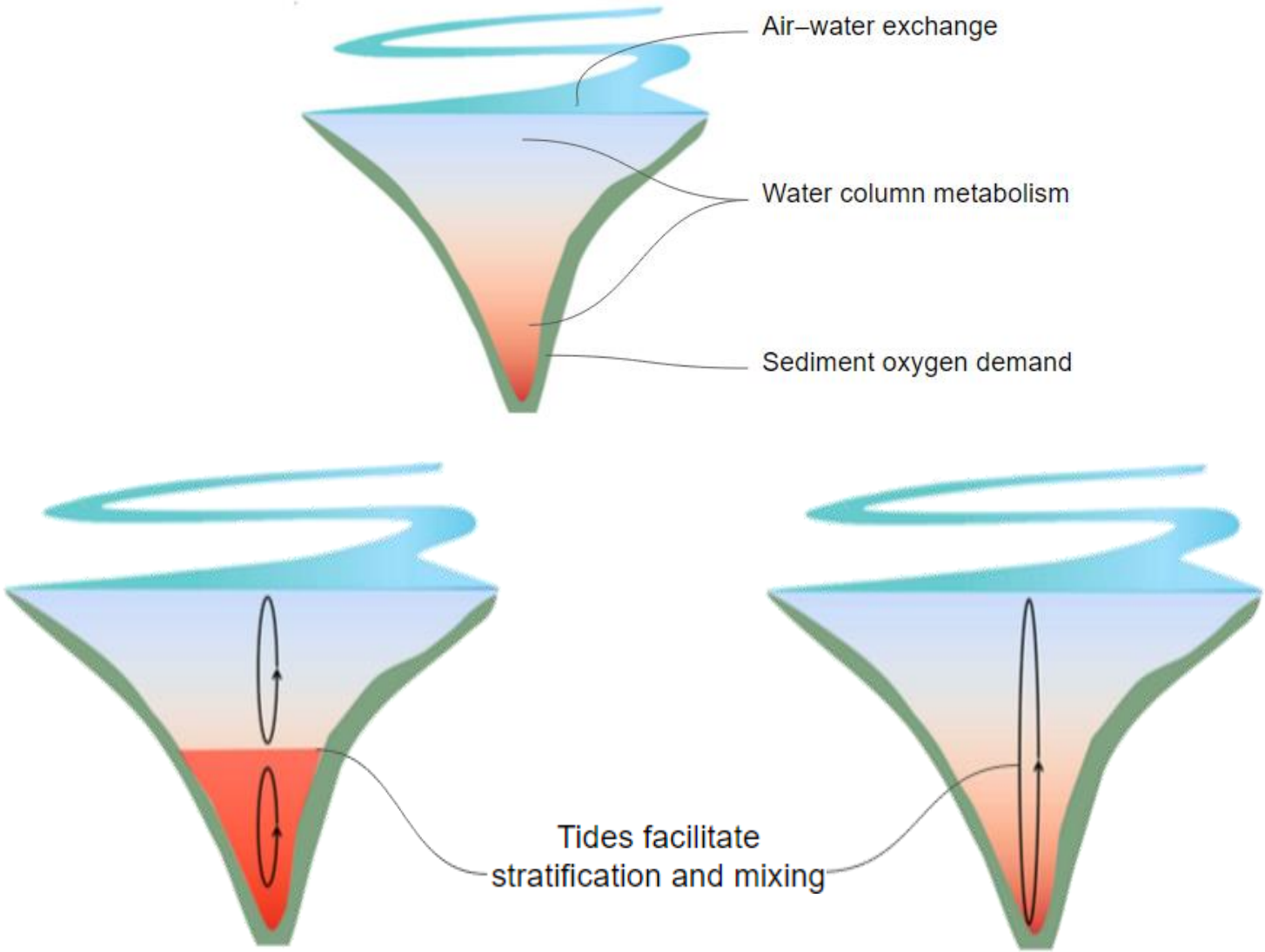


Lower DO

Drivers of variability in DO

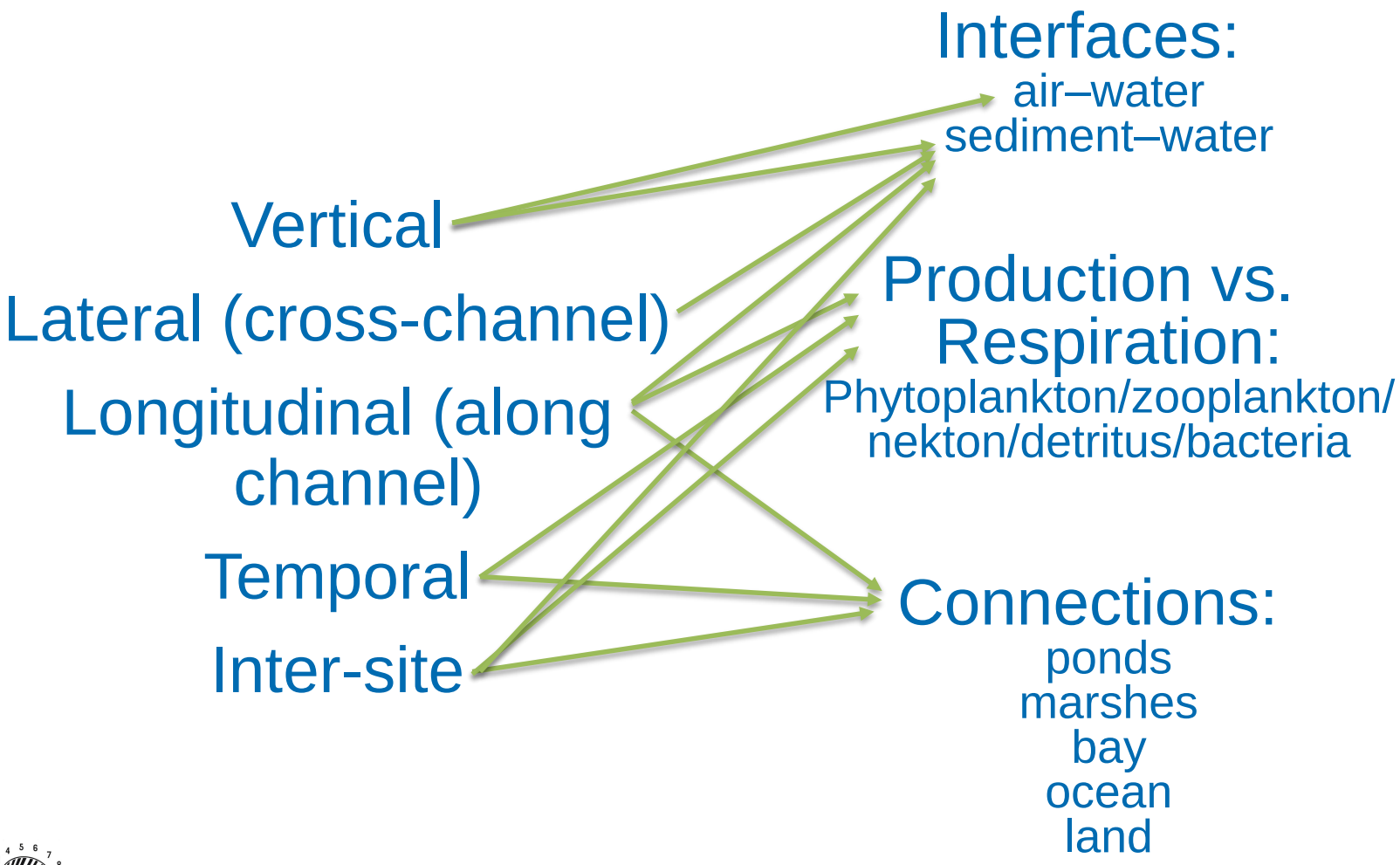


Drivers of variability in DO



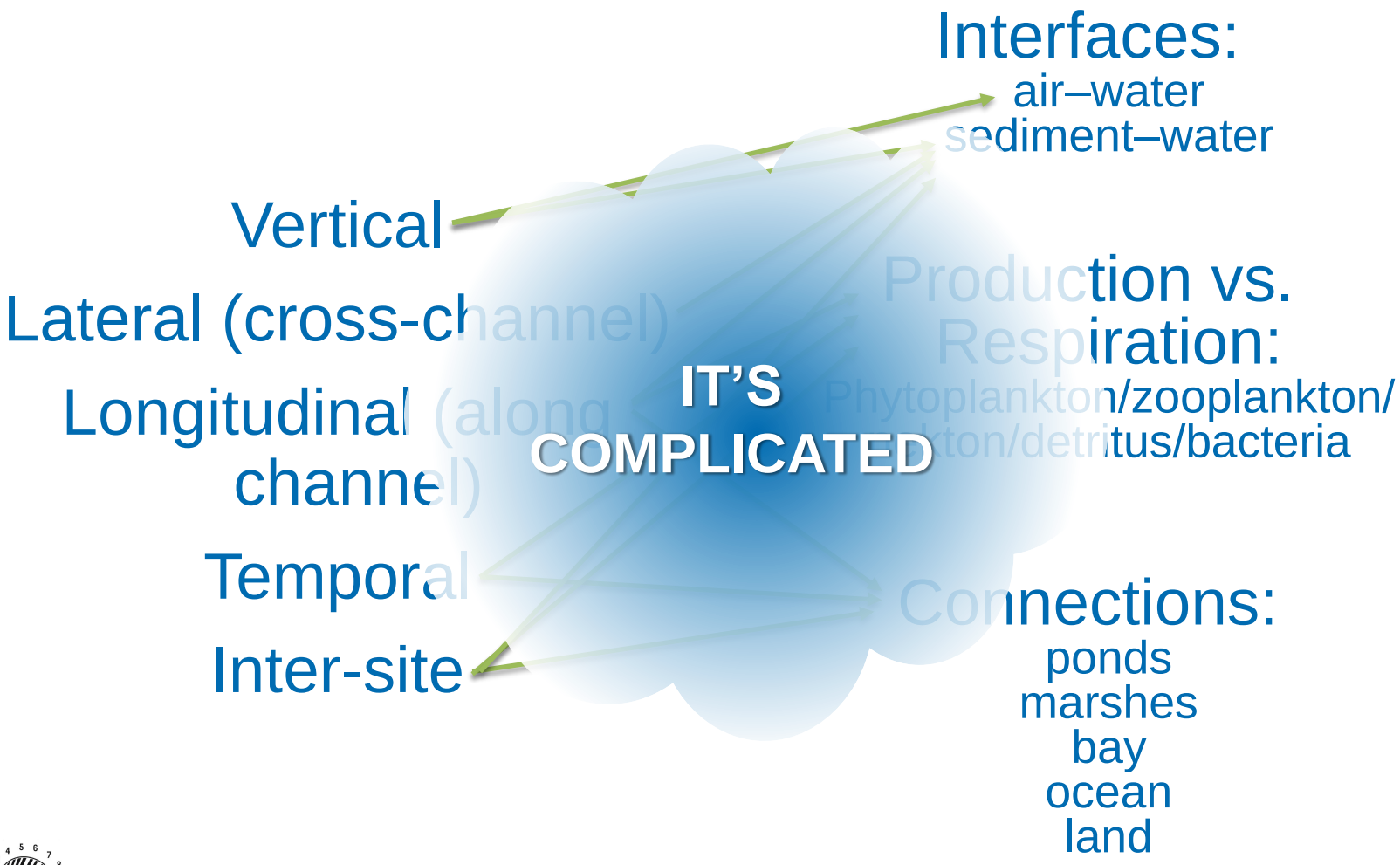
Dimensions

~~Drivers~~ of variability in DO



Dimensions

~~Drivers~~ of variability in DO



DISENTANGLING VARIABILITY

Vertical ?

Cross-channel ?

Along-channel ?

Inter-site ?

Temporal ?

DISENTANGLING VARIABILITY

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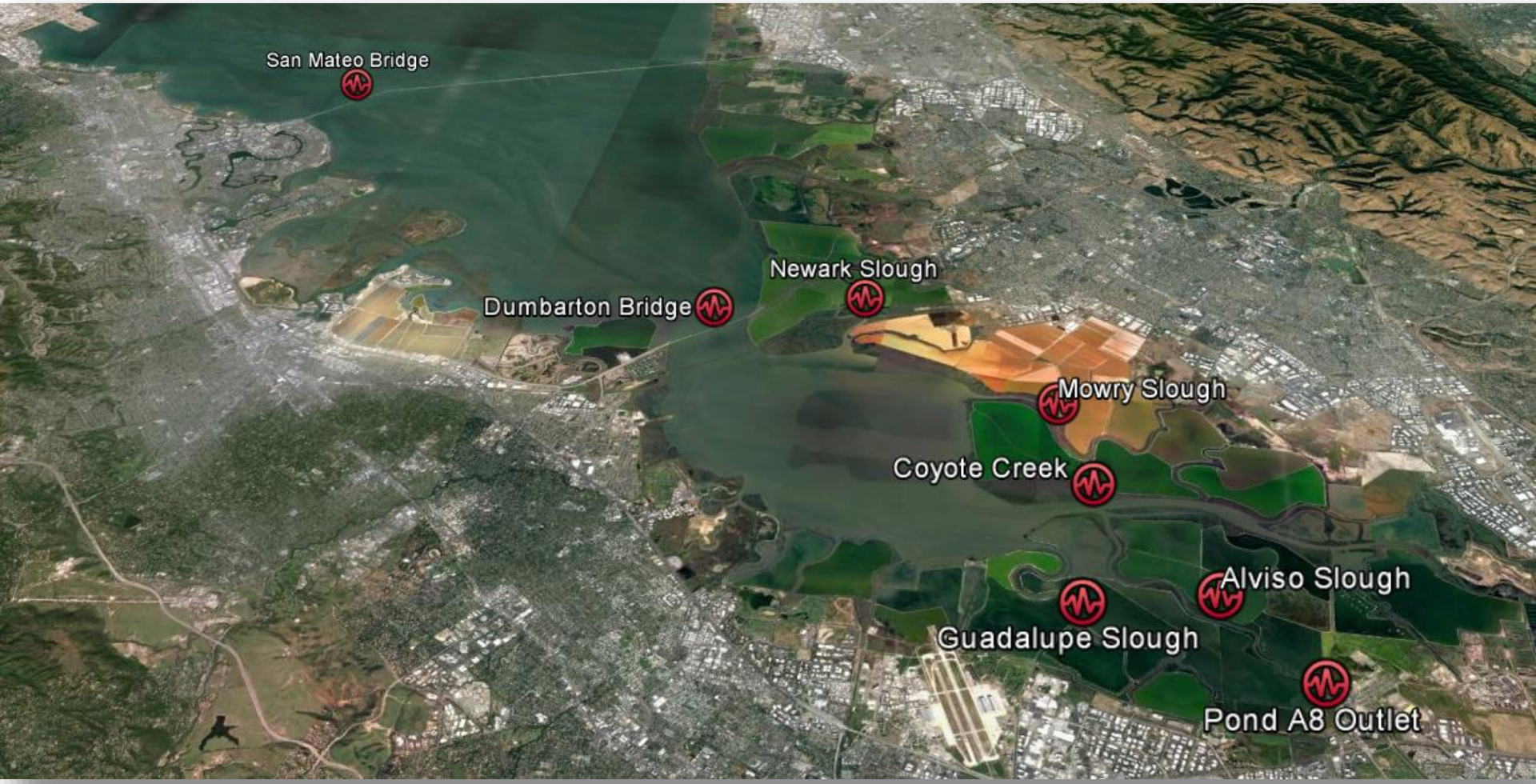
The LSB Network



The LSB Network

Vertical ?

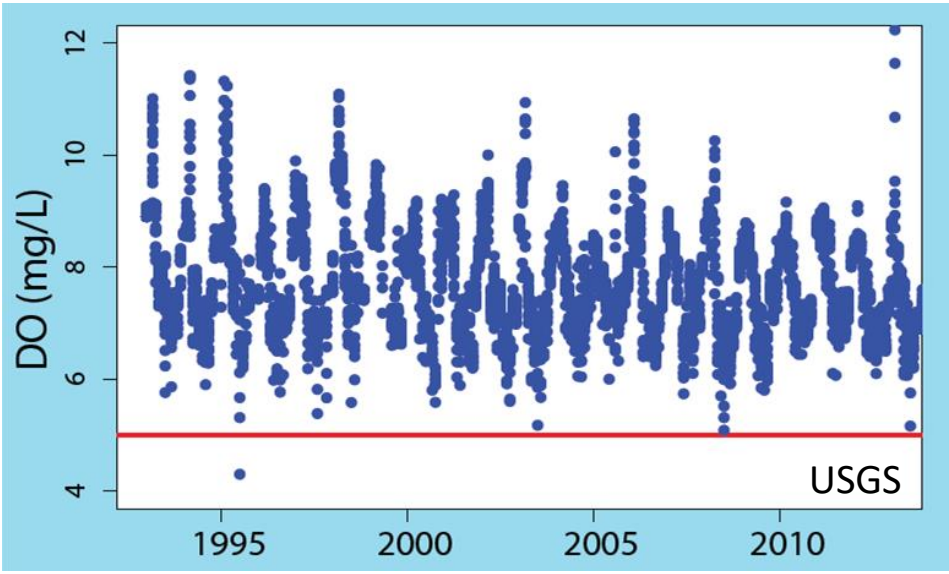
Cross-channel ?

Along-channel ?

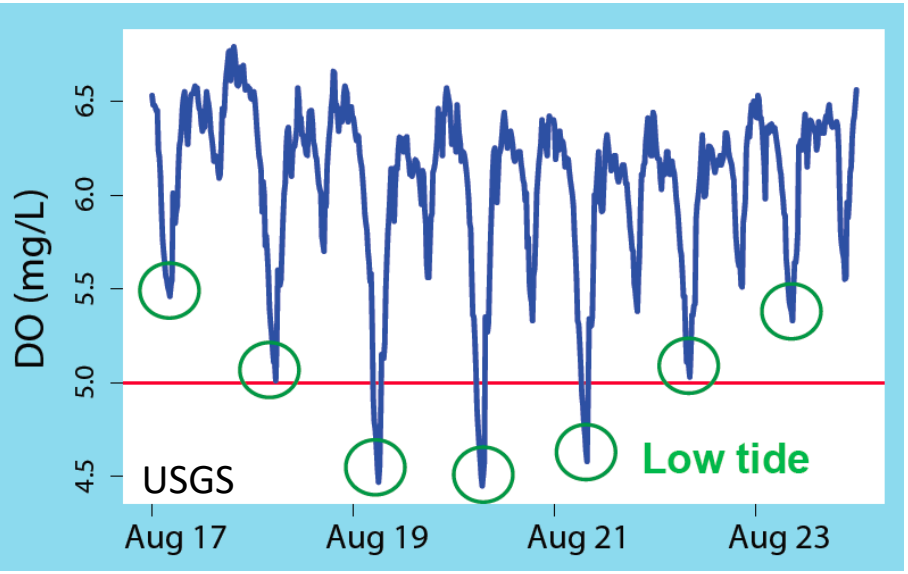
Inter-site ?

Temporal ✓

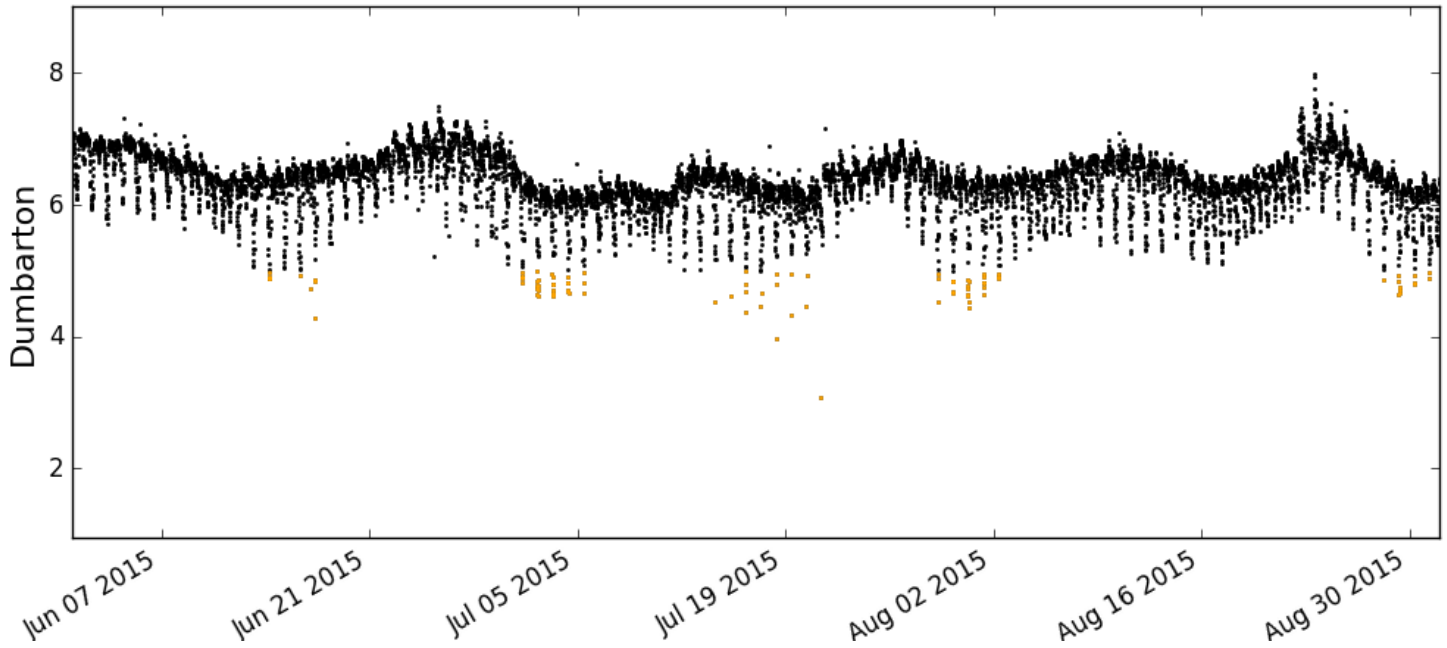
Deep Subtidal Biweekly-Monthly sampling



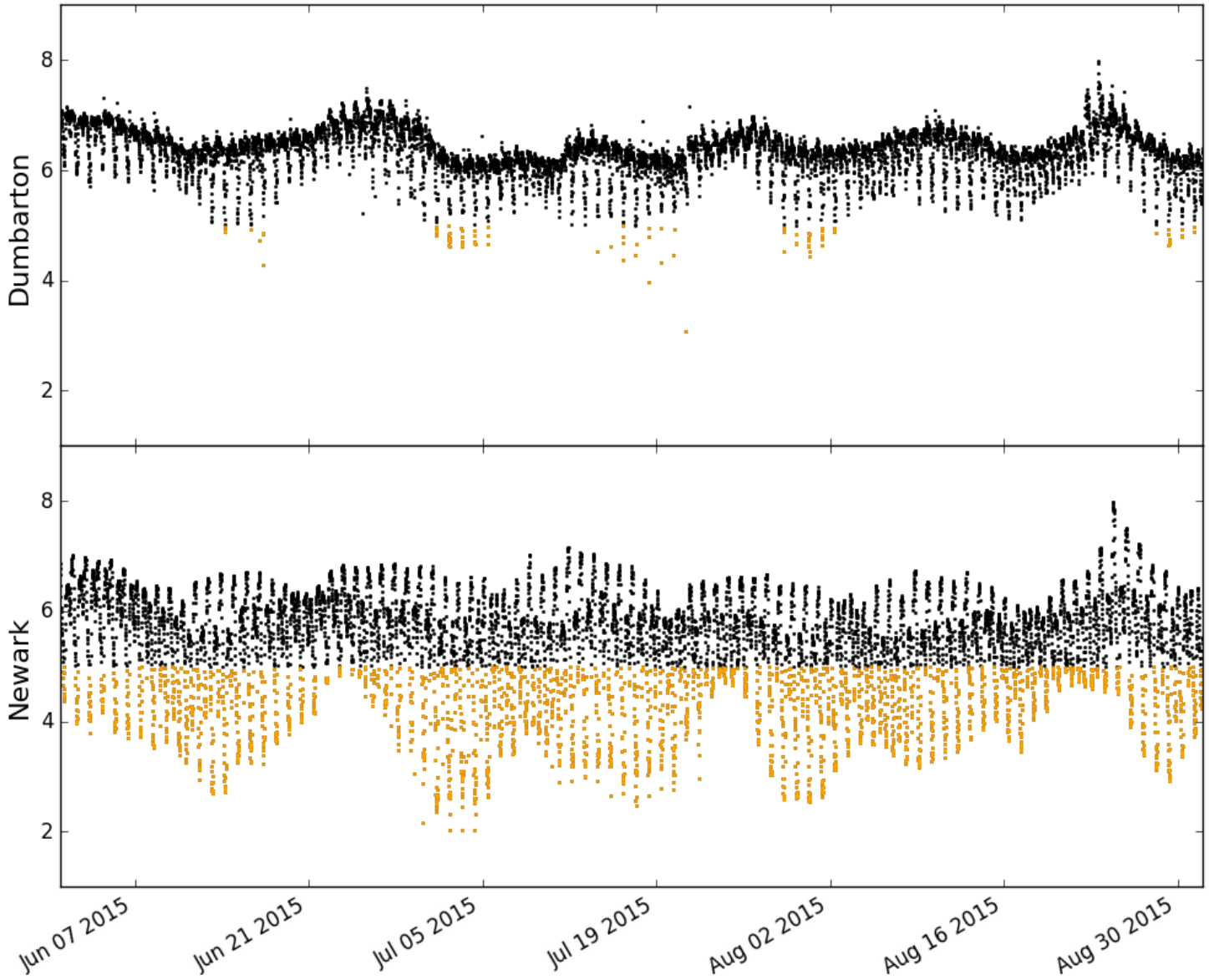
High-frequency measurements – Dumbarton



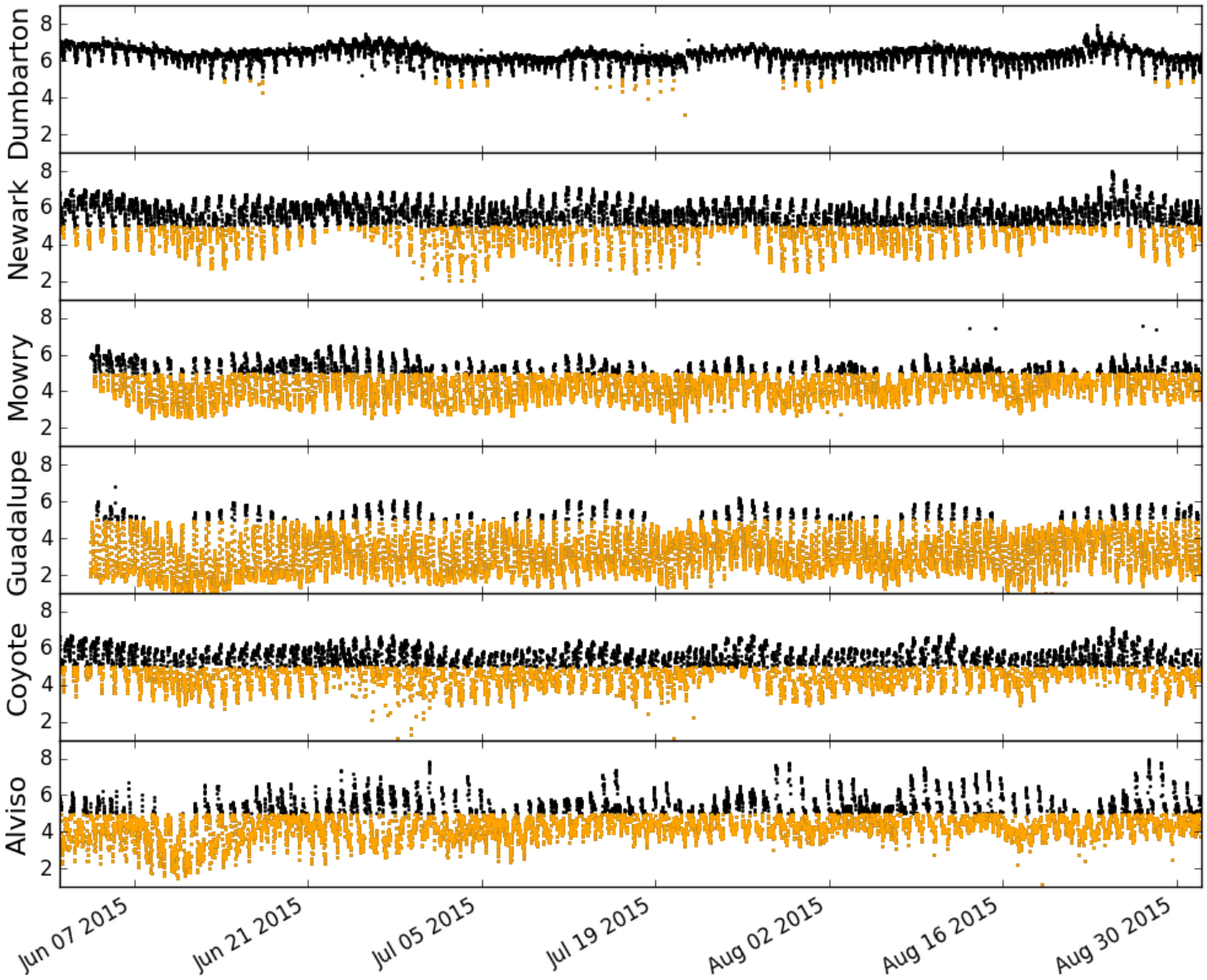
The LSB Network



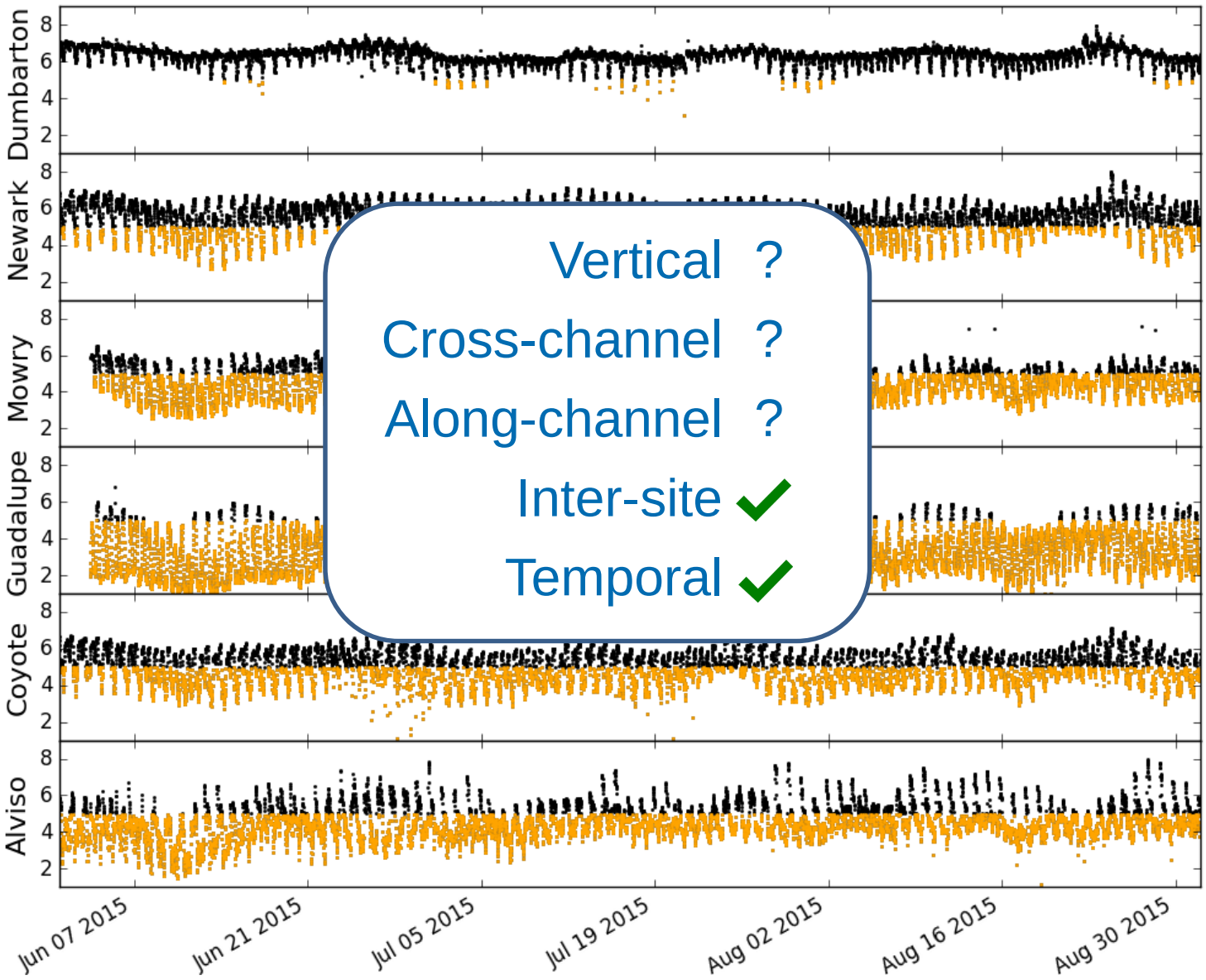
The LSB Network



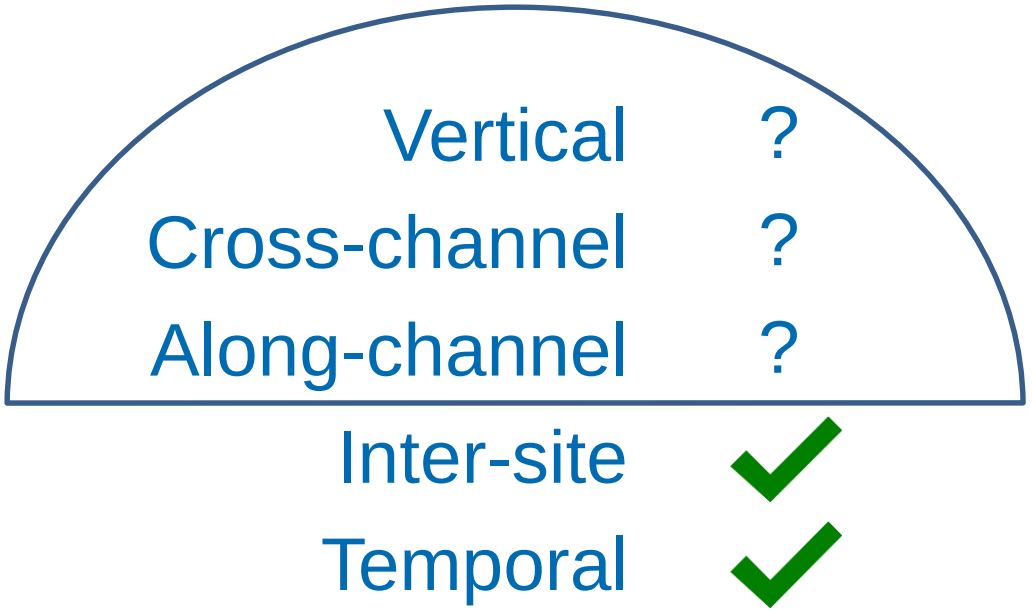
The LSB Network



The LSB Network



Measurements in all dimensions



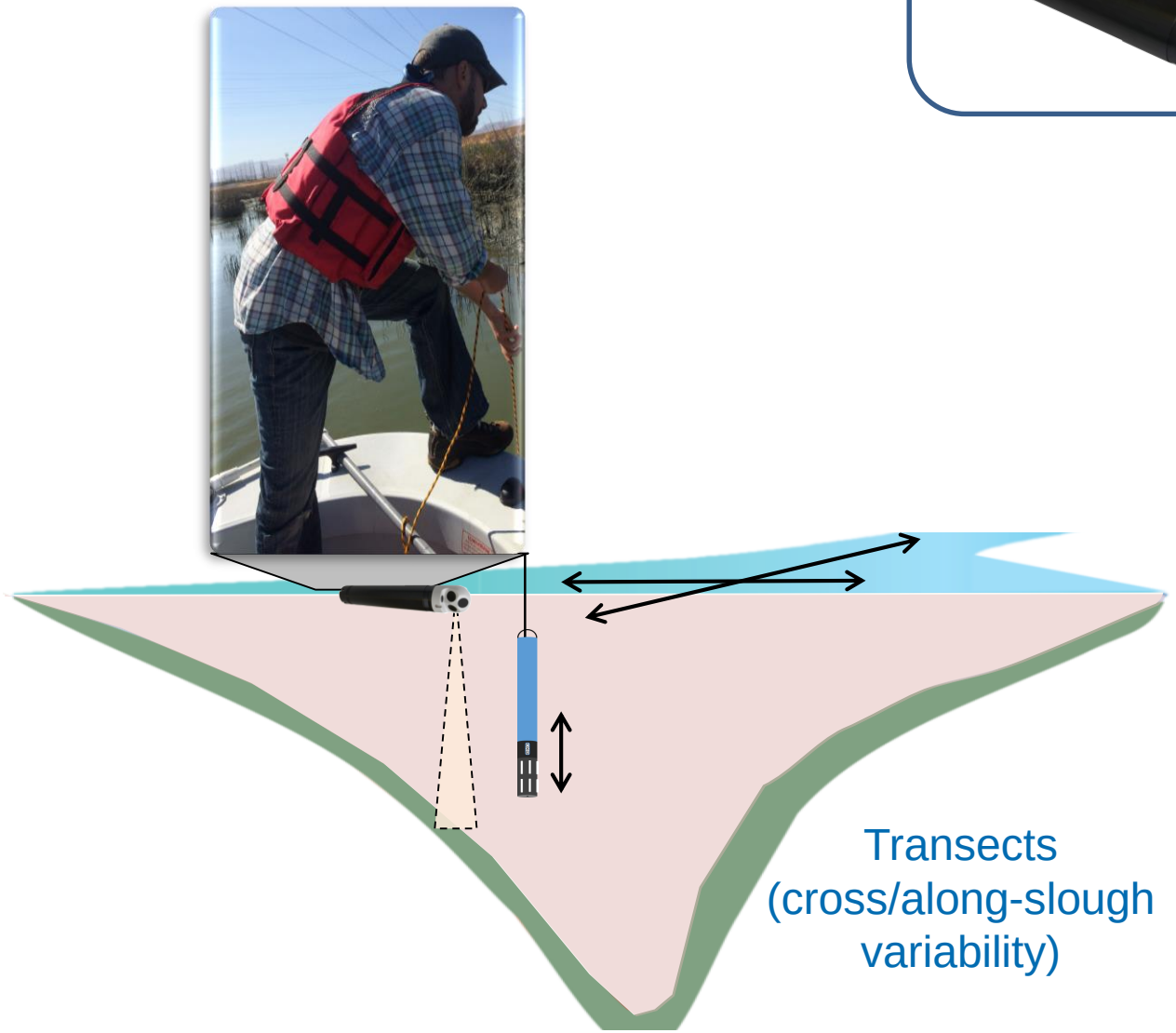
Transect location:

Mooring location:

Dissolved oxygen

Multi-probe: T, sal, DO, chl turb, depth

Velocity



Transects (cross/along-slough variability)

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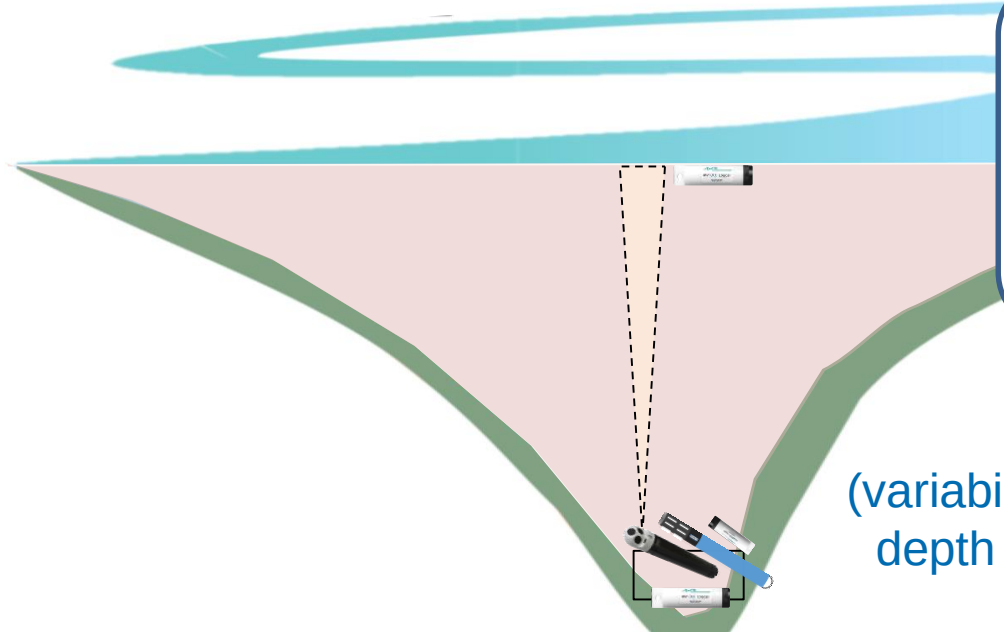
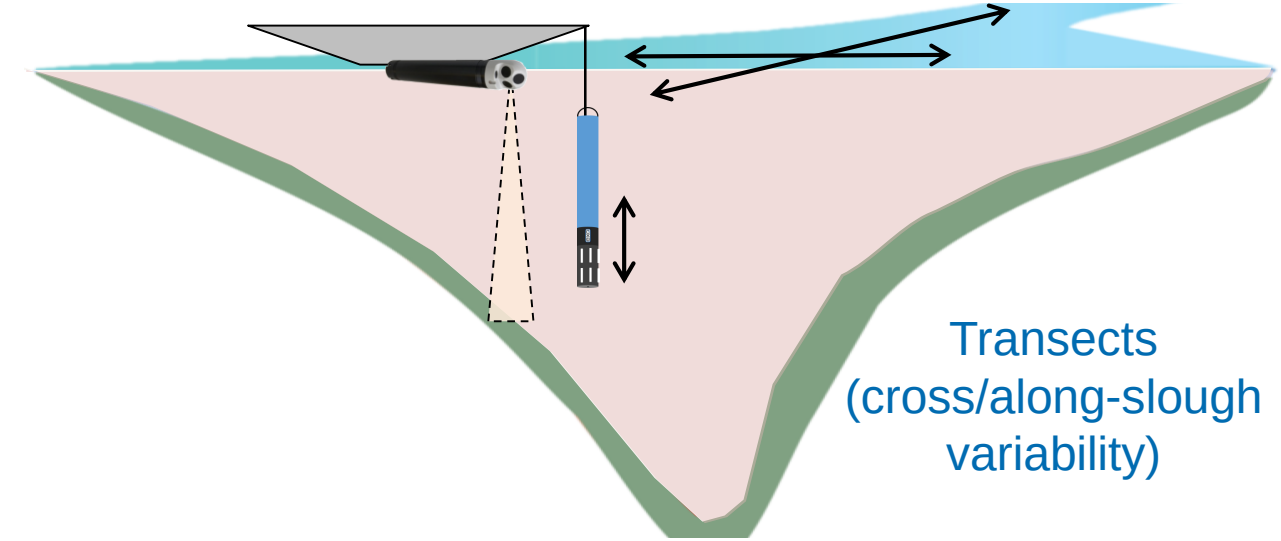


Dissolved oxygen

Multi-probe: T, sal, DO, chl turb, depth

Velocity

Moorings
(variability over time and depth at one location)



Transects
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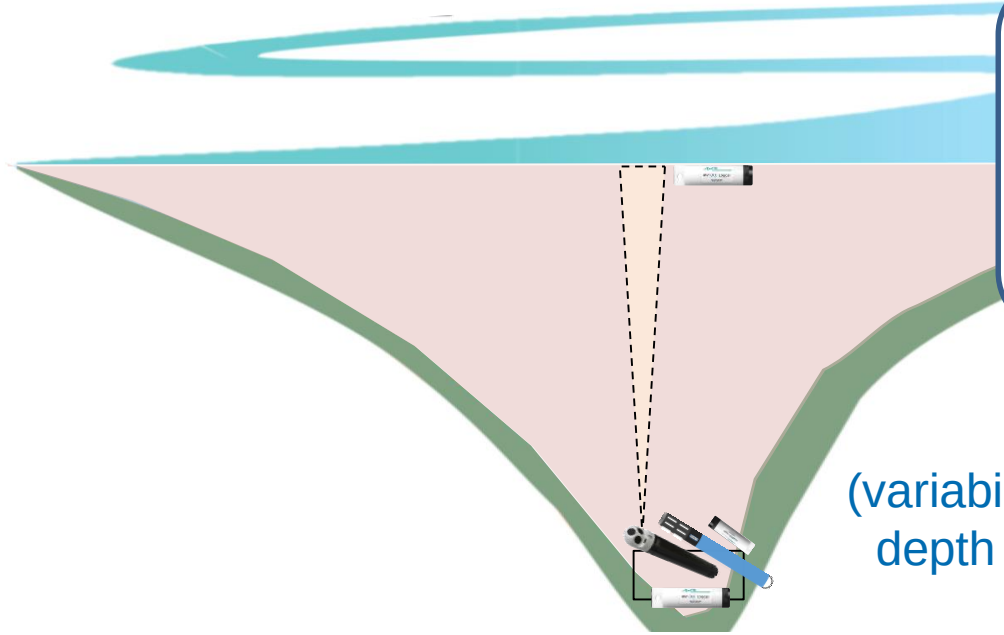

Dissolved oxygen

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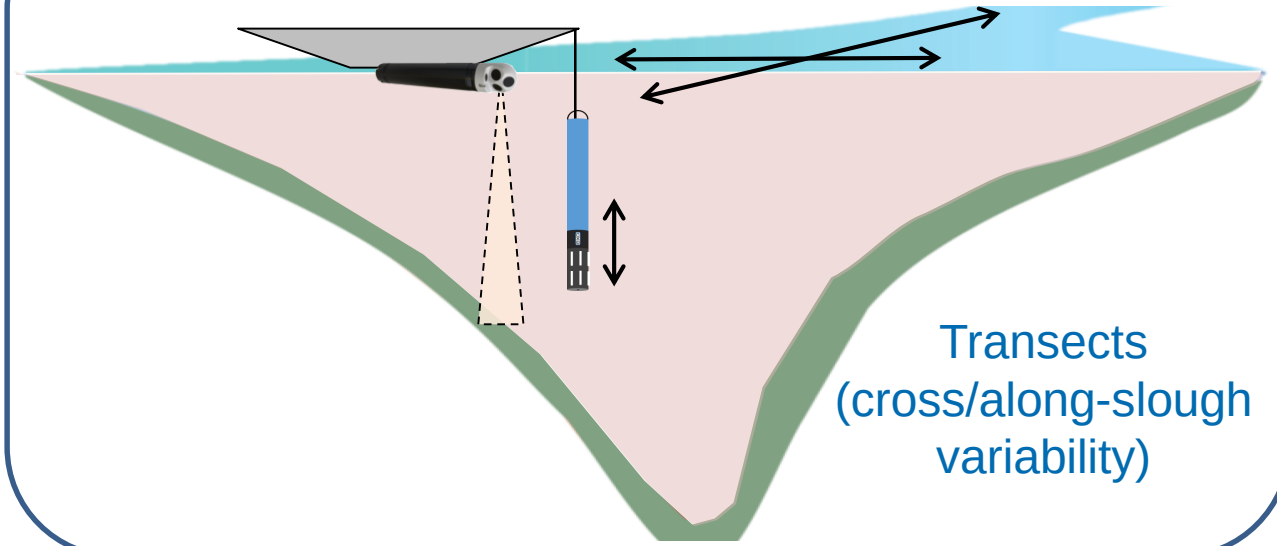

Transects
(cross/along-slough variability)

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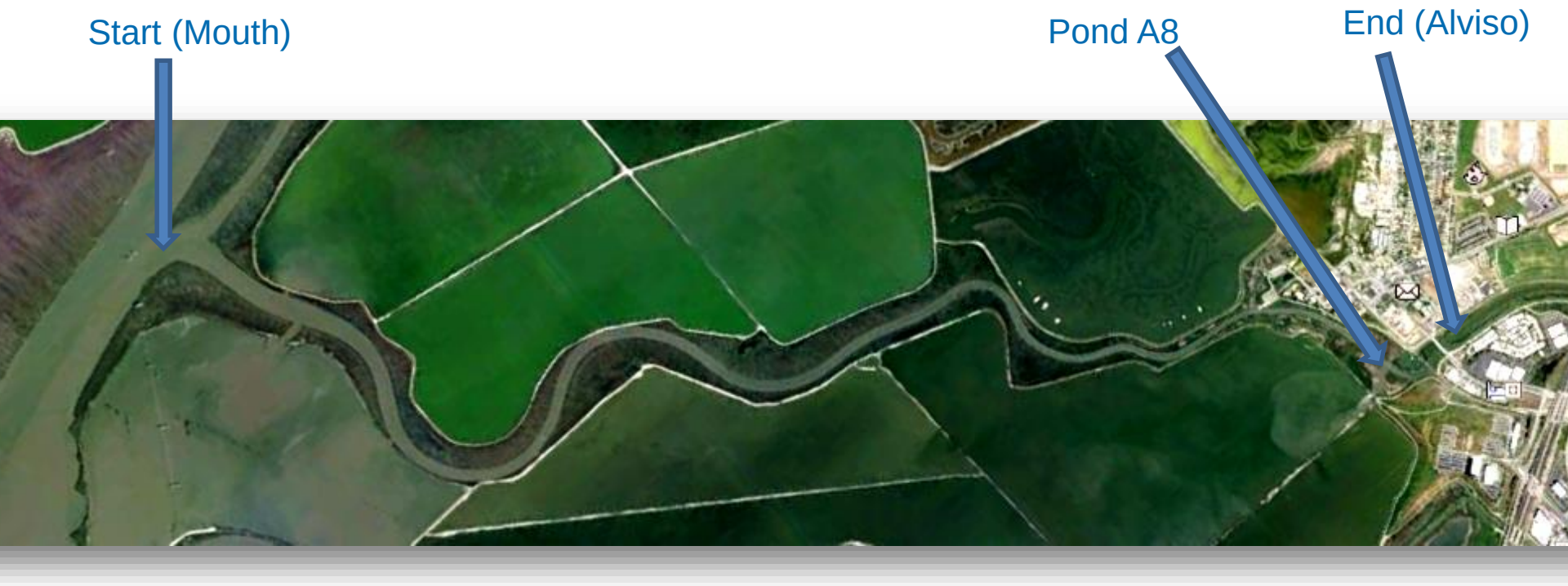
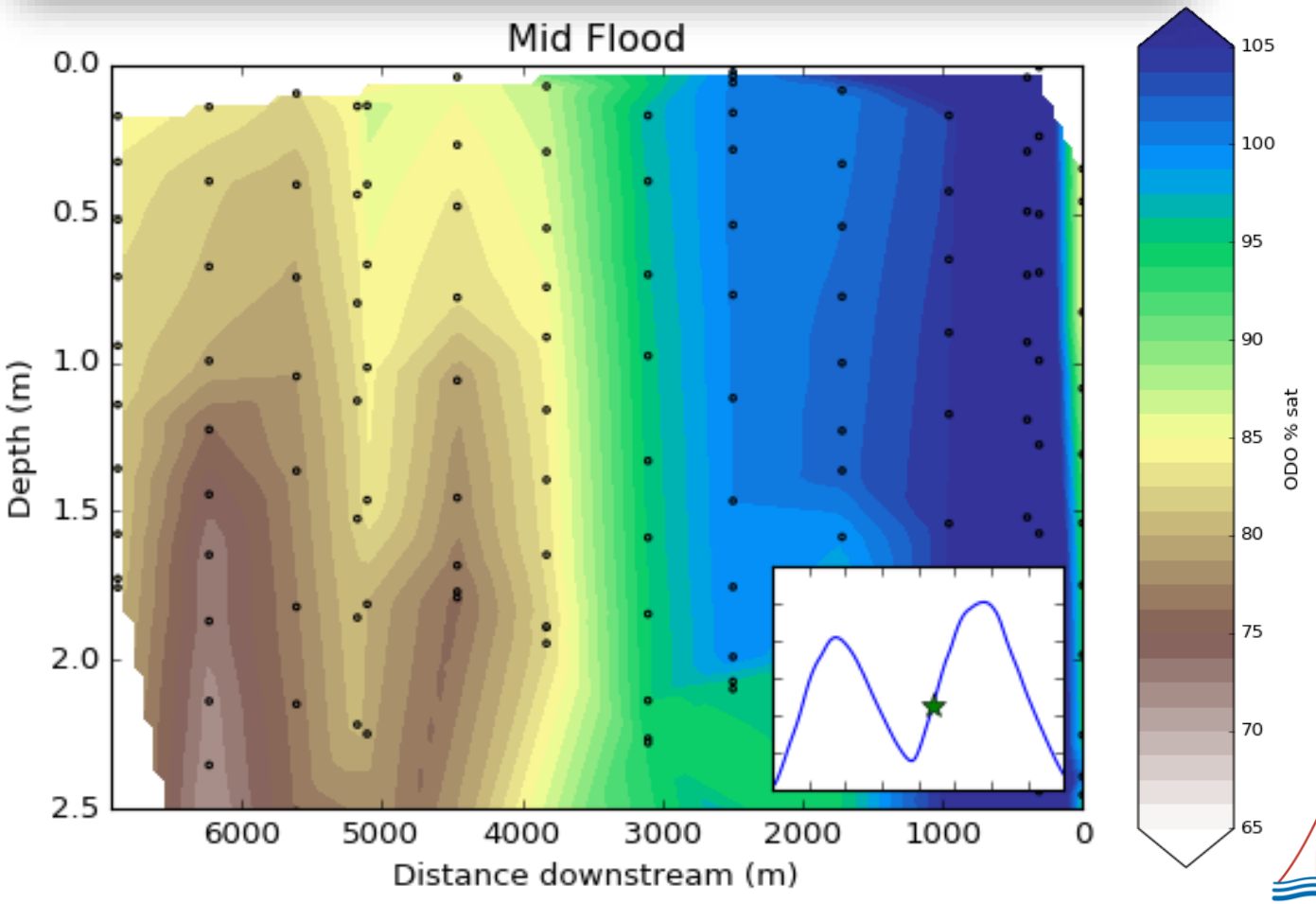
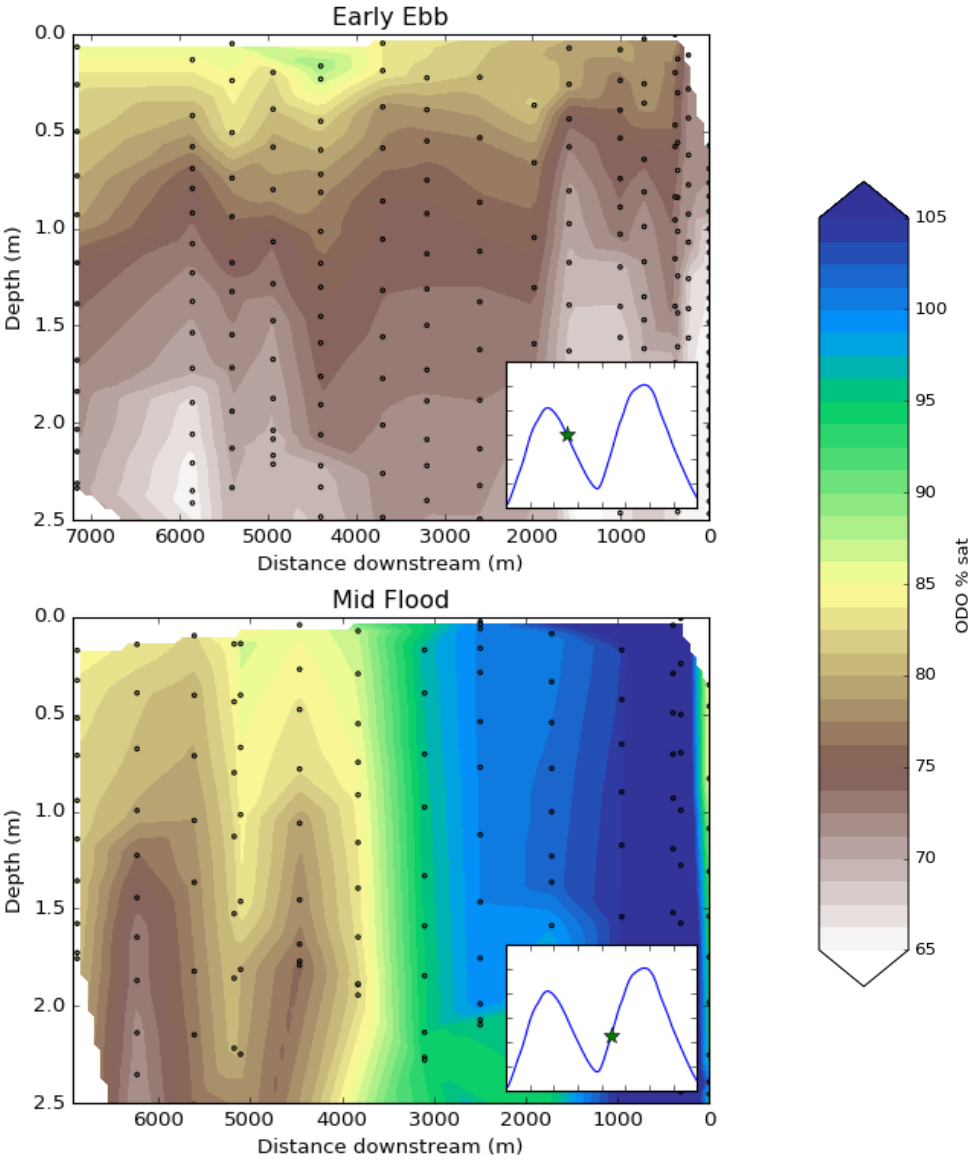
Along-Slough: Alviso




Mid Flood
Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
6000
5000
4000
3000
2000
1000
0
Distance downstream (m)
ODO % sat
105
100
95
90
85
80
75
70
65

Vertical/Along-Slough Variability



Vertical/Along-Slough Variability

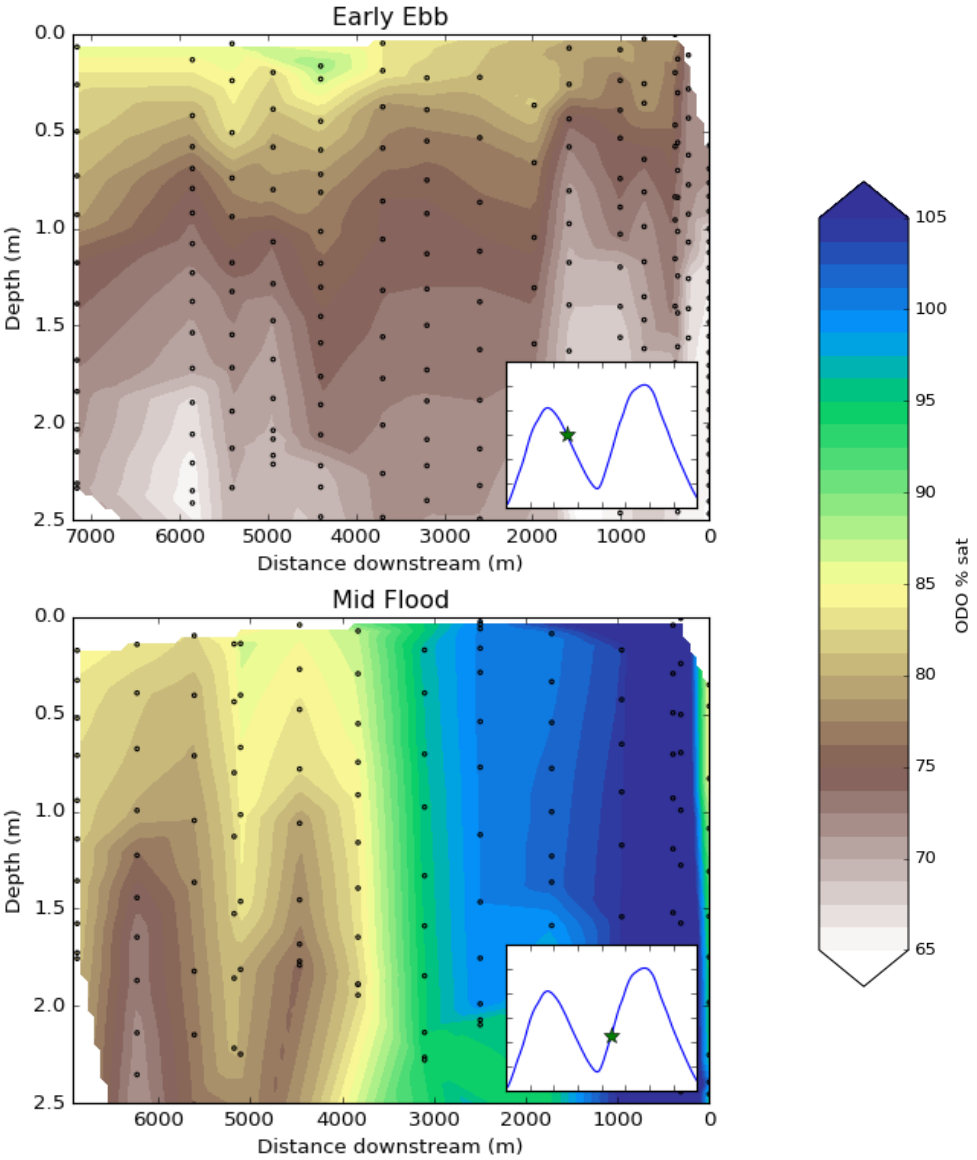
Vertical ✓

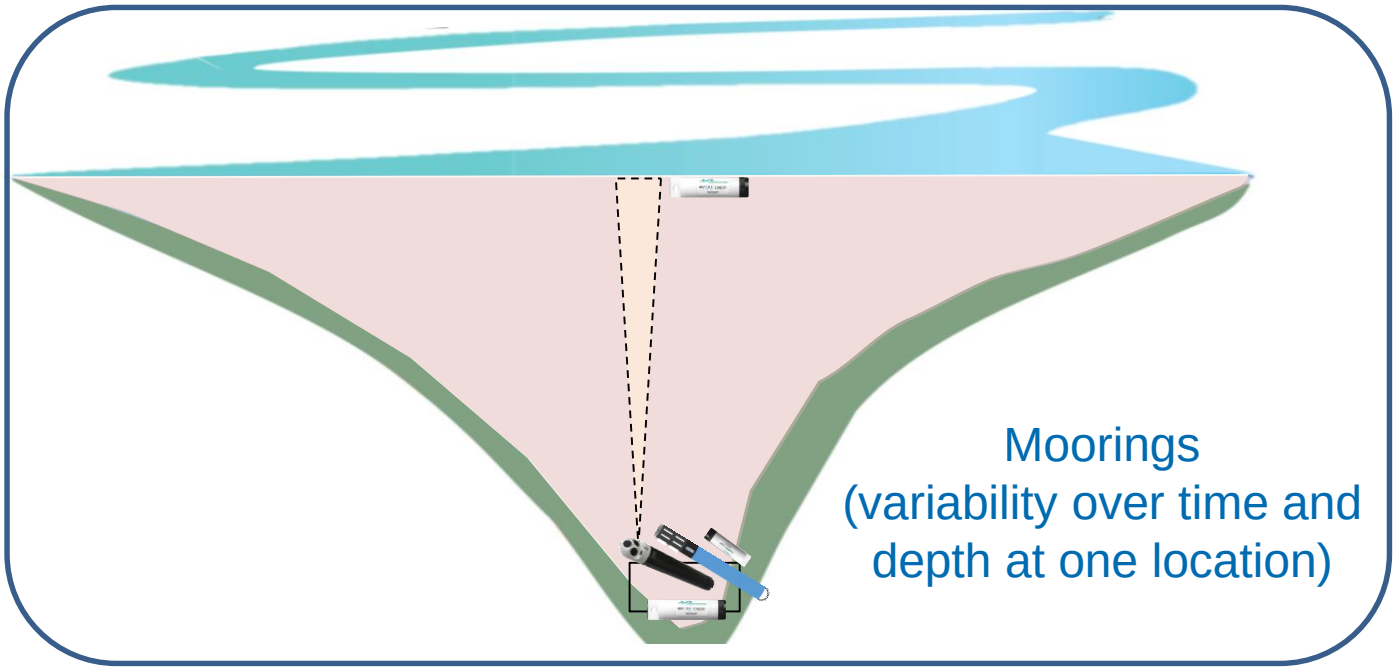
Cross-channel ?

Along-channel ✓

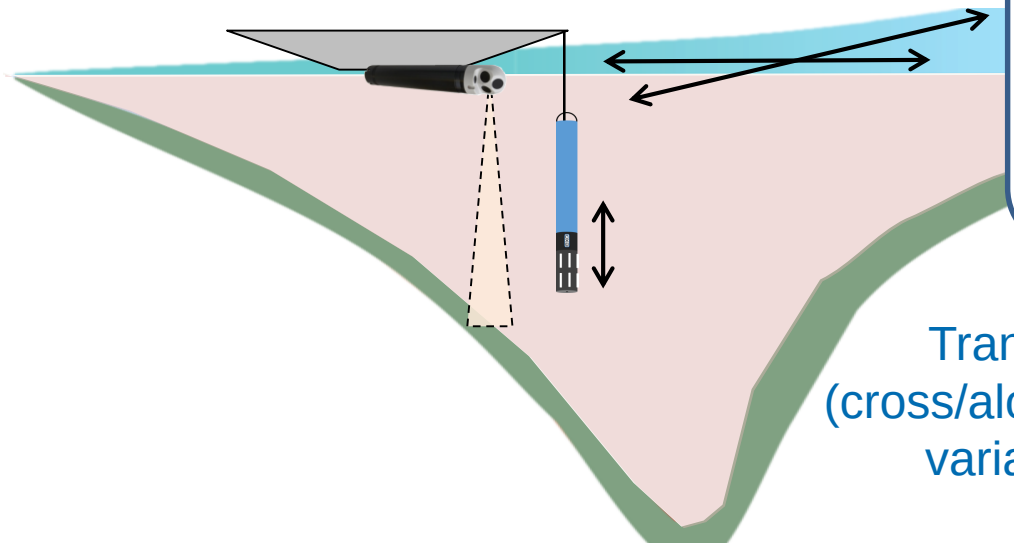
Inter-site ✓

Temporal ✓





Moorings
(variability over time and depth at one location)



Dissolved oxygen

Multi-probe: T, sal, DO, chl turb, depth

Velocity

Transects
(cross/along-slough variability)

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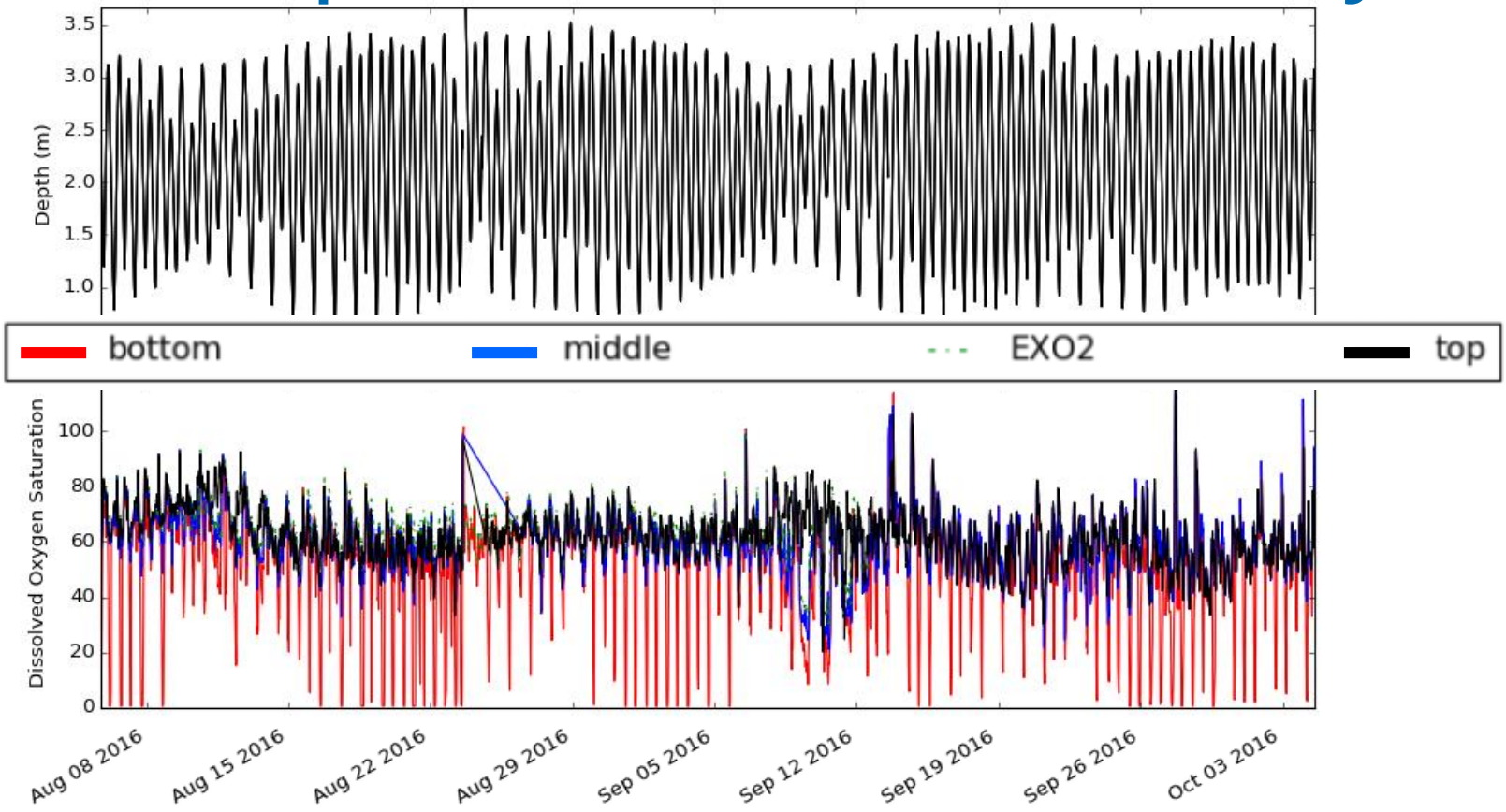
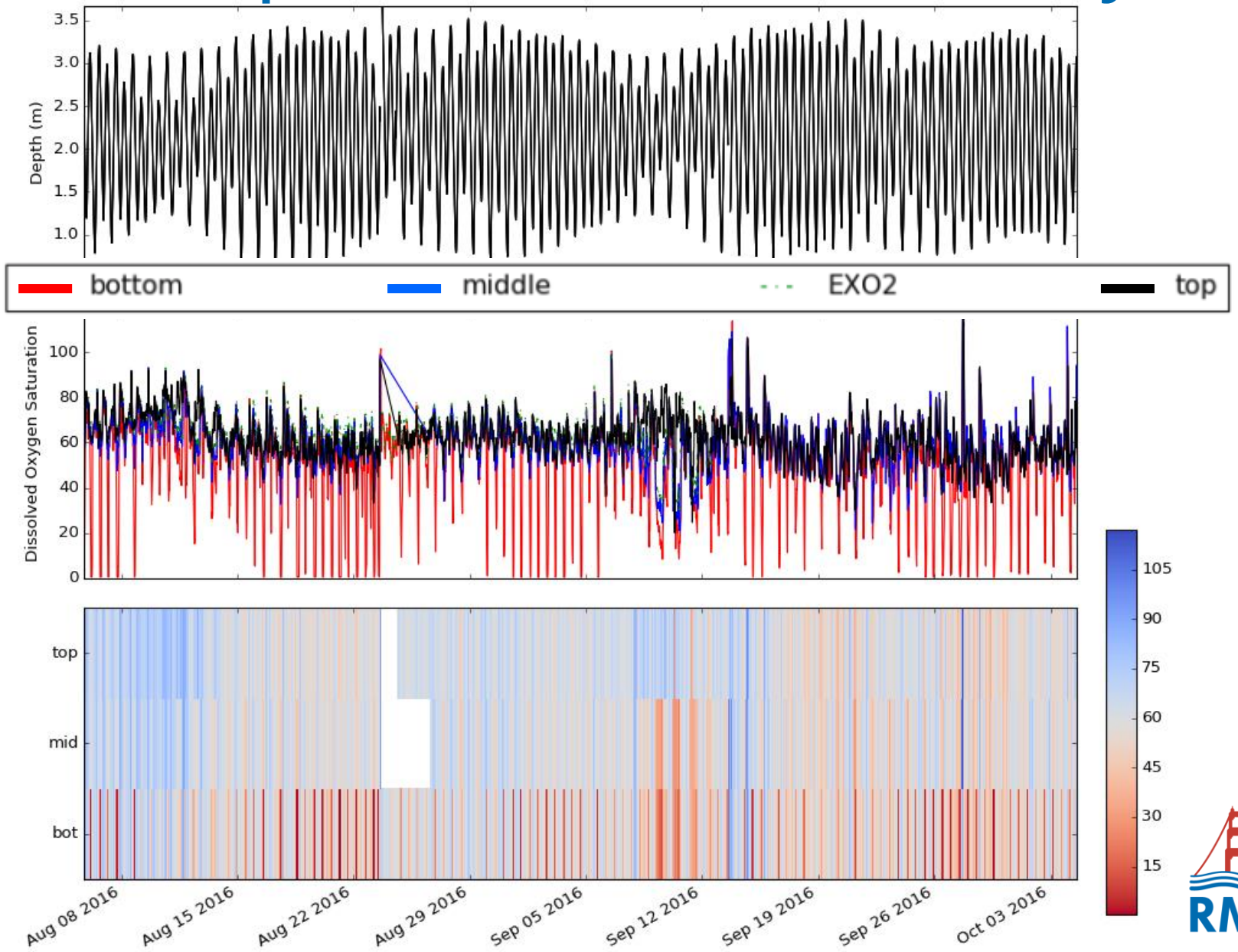
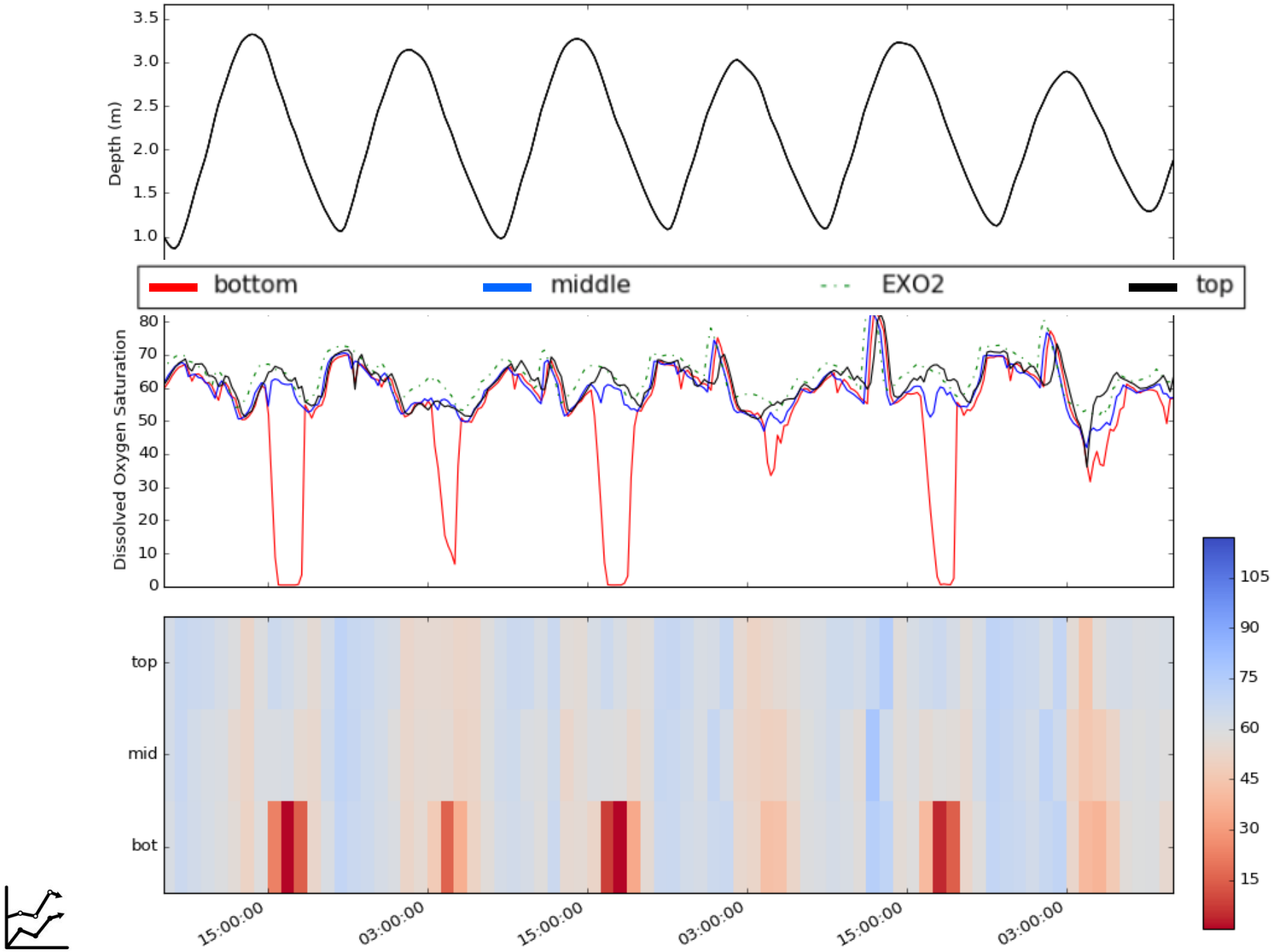
Temporal Vertical Variability

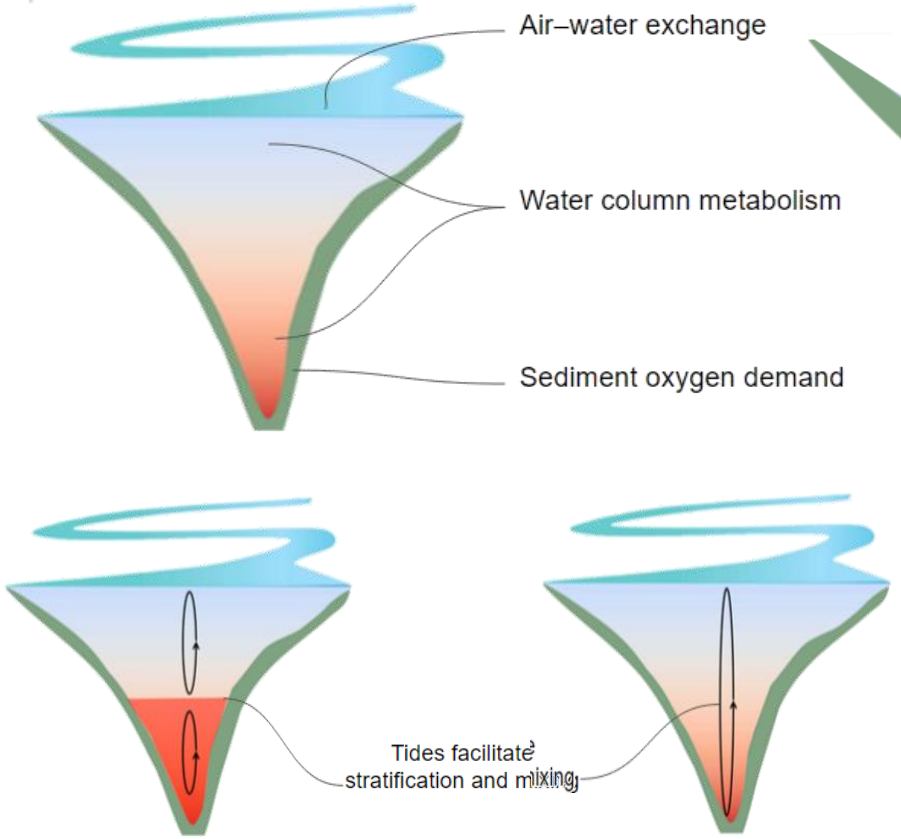


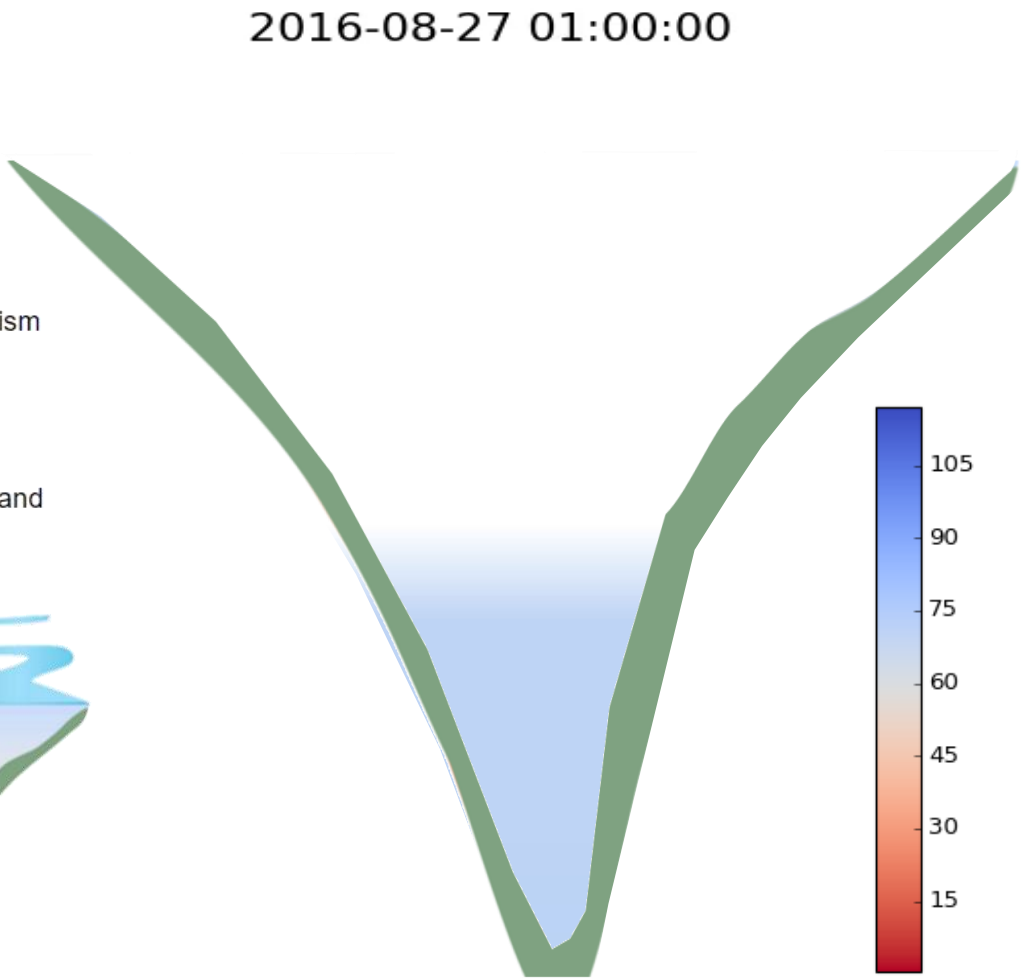
Temporal Vertical Variability




Depth (m)
3.5
3.0
2.5
2.0
1.5
1.0
bottom
middle
EXO2
top
Dissolved Oxygen Saturation
80
70
60
50
40
30
20
10
0
top
mid
bot
15:00:00
03:00:00
15:00:00
03:00:00
15:00:00
03:00:00
105
90
75
60
45
30
15

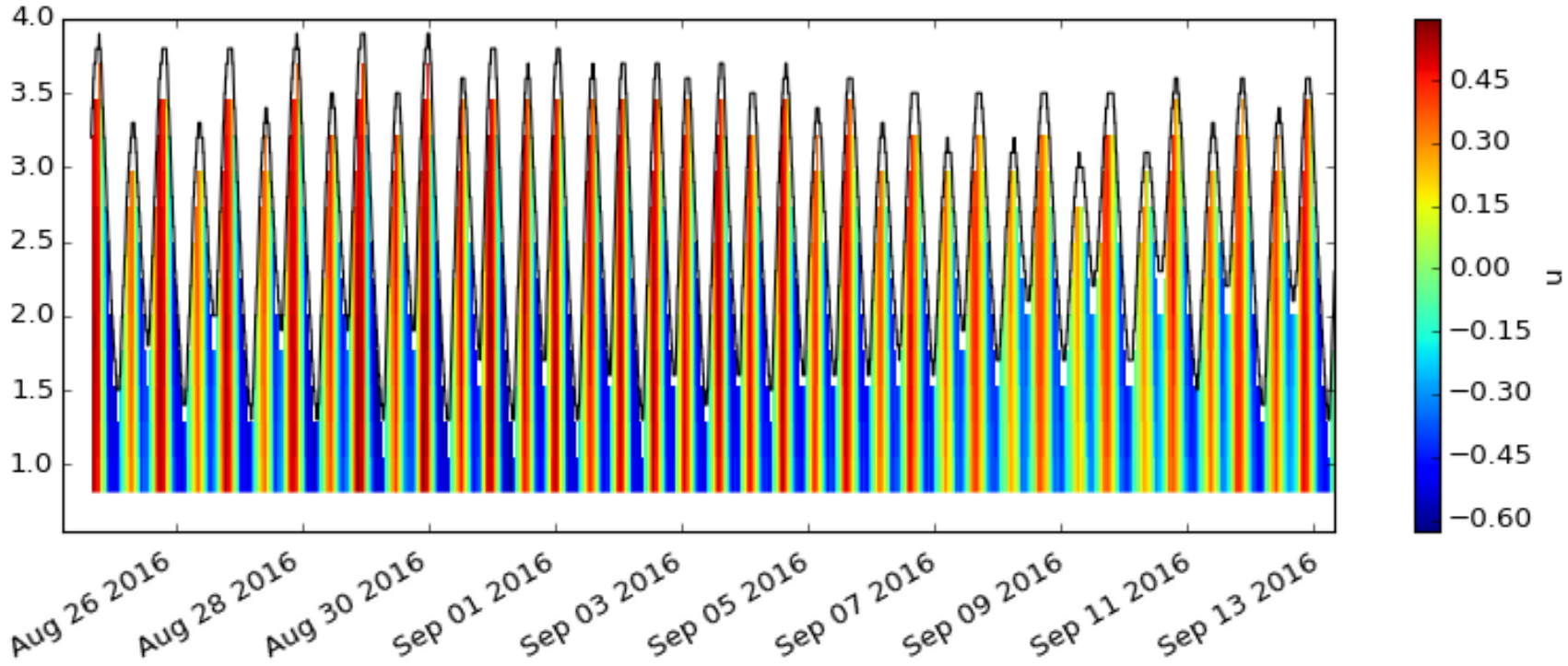
Putting it all together





Next Steps

Combine with velocity data to calculate fluxes



Preliminary Conclusions

DO varies in all dimensions

Inter-site variability is enormous

Temporal variability is strong

Vertical variability is ephemeral

~~Cross-slough variability is weak to non-existent~~

~~Along-slough variability is apparent but constrained~~

To determine LSB biogeochemical variability, we need inter-site, vertically resolved time-series

The variability we've constrained allows us to estimate rates and slough-to-basin scale budgets and 4-D habitat quality

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Thanks!

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Frank Spada
Kara Scheu
Craig Jones
Steve LaMothe

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