

Location Matters:

Oxygen Variability Across Space and Time



Phil Bresnahan, Rusty Holleman, Zephyr Sylvester, Emily Novick,
Maureen Downing-Kunz, David Senn

SFEI

**AQUATIC
SCIENCE
CENTER**

USGS
science for a changing world

Outline



Why does dissolved oxygen matter?



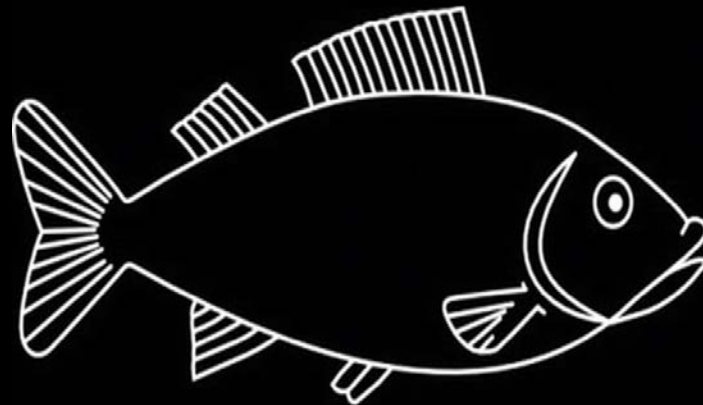
What are the principle drivers?



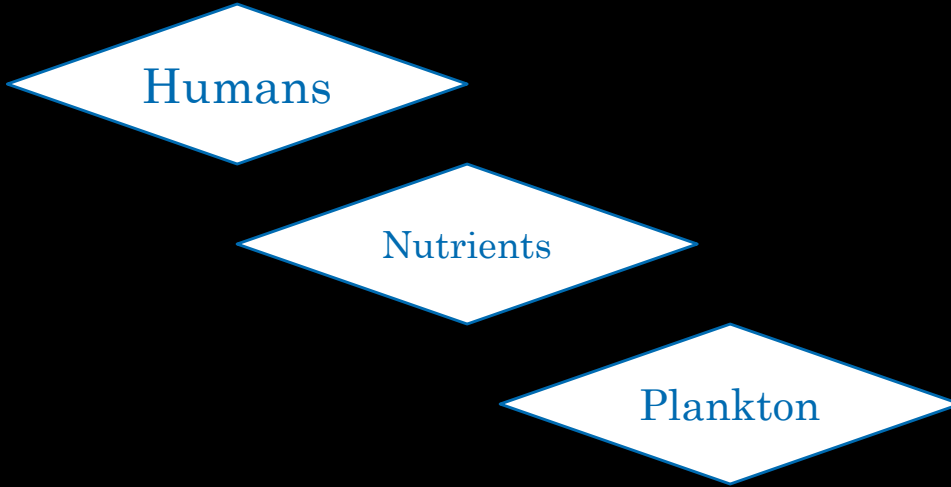
How can we untangle them?



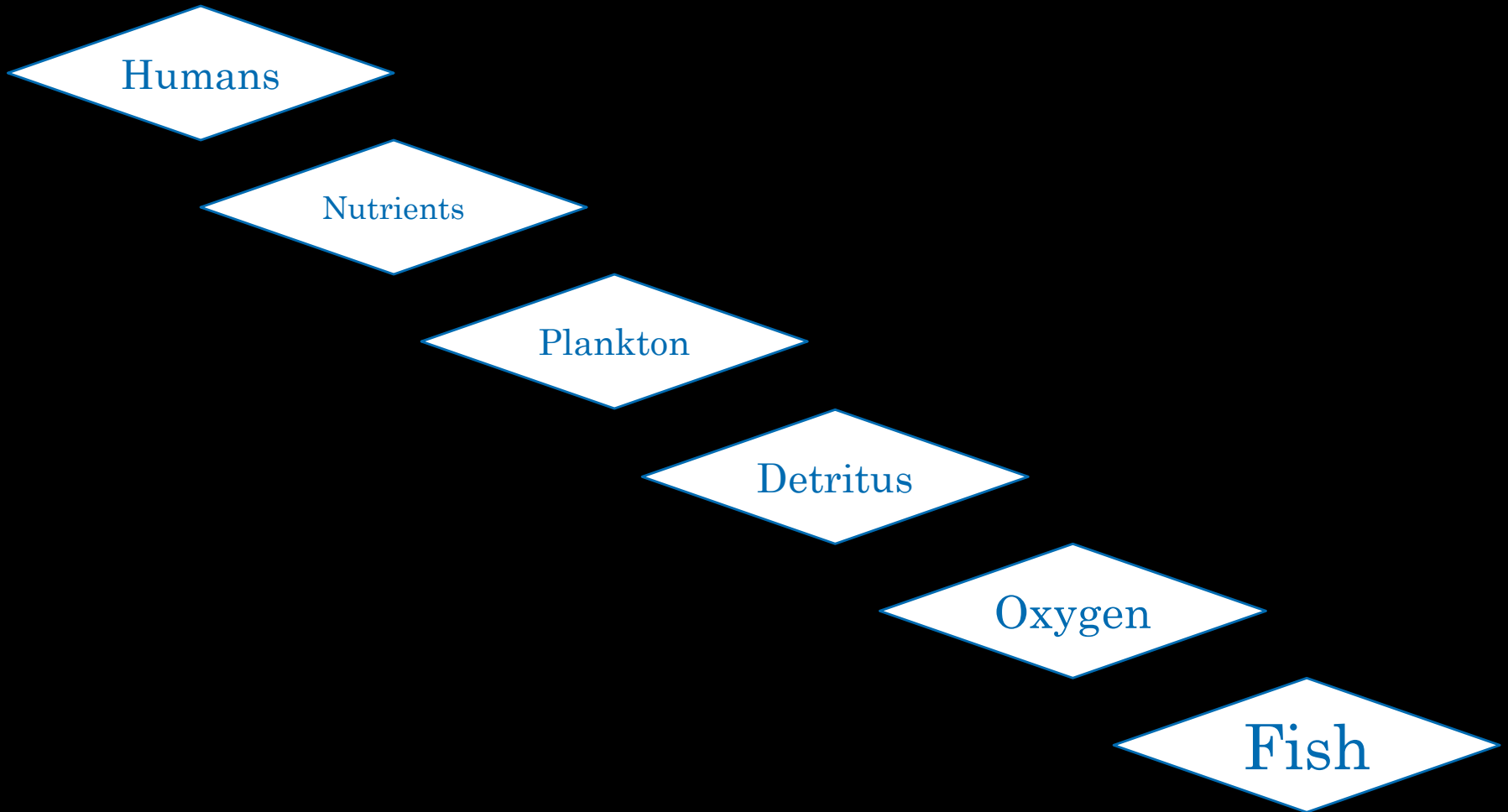
Why should we care?



Drivers of variability in DO



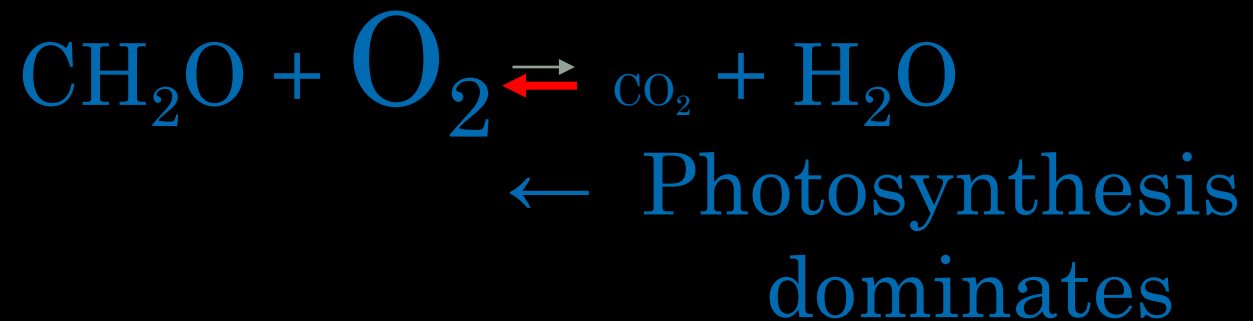
Drivers of variability in DO



Why should we care?

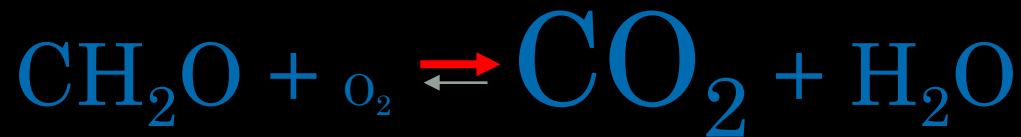


Why should we care?



Why should we care?

Respiration →
dominates



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



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

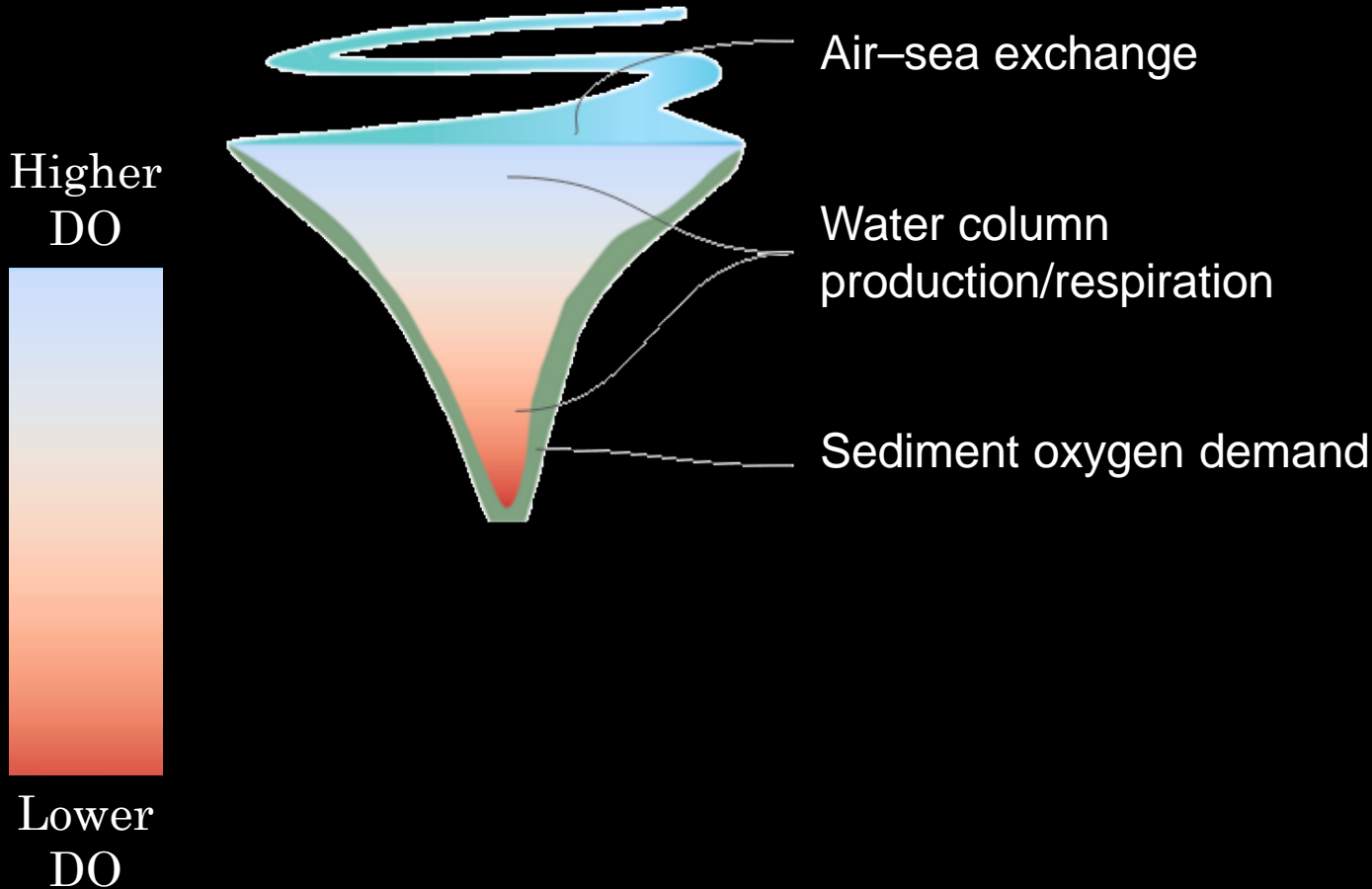
Higher
DO



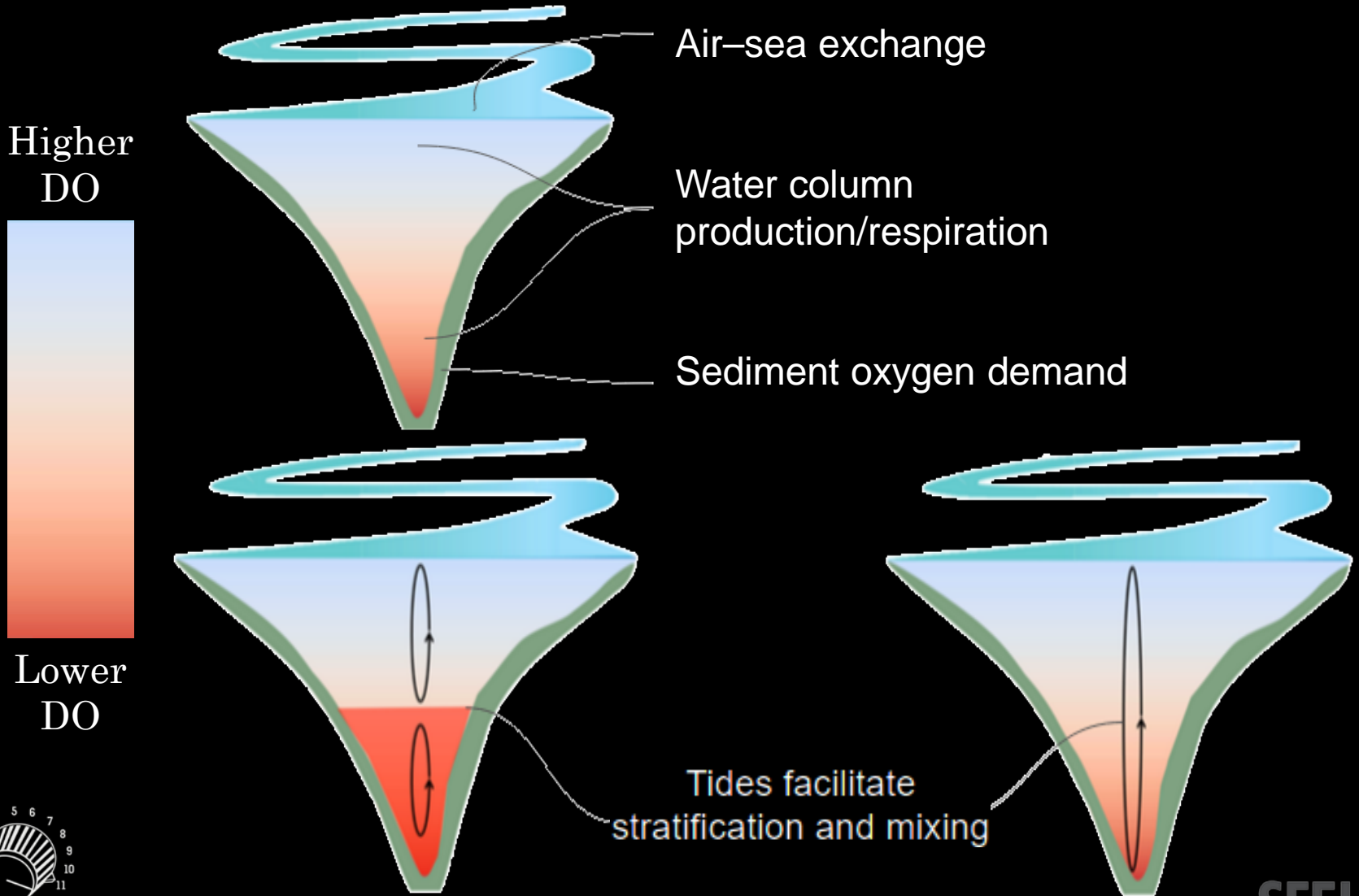
Lower
DO



Drivers of variability in DO

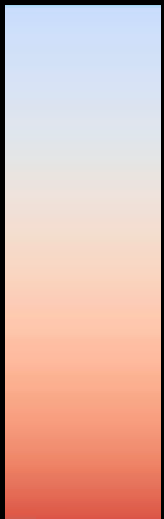


Drivers of variability in DO



Drivers of variability in DO

Higher
DO



Lower
DO

Studying the
DIMENSIONS
of variability will
provide critical insight
into the
DRIVERS of
variability

Air-sea exchange

Tides facilitate
stratification and mixing



Disentangling Variability



Disentangling Variability

Vertical ?

Cross-channel ?

Along-channel ?

Inter-site ?

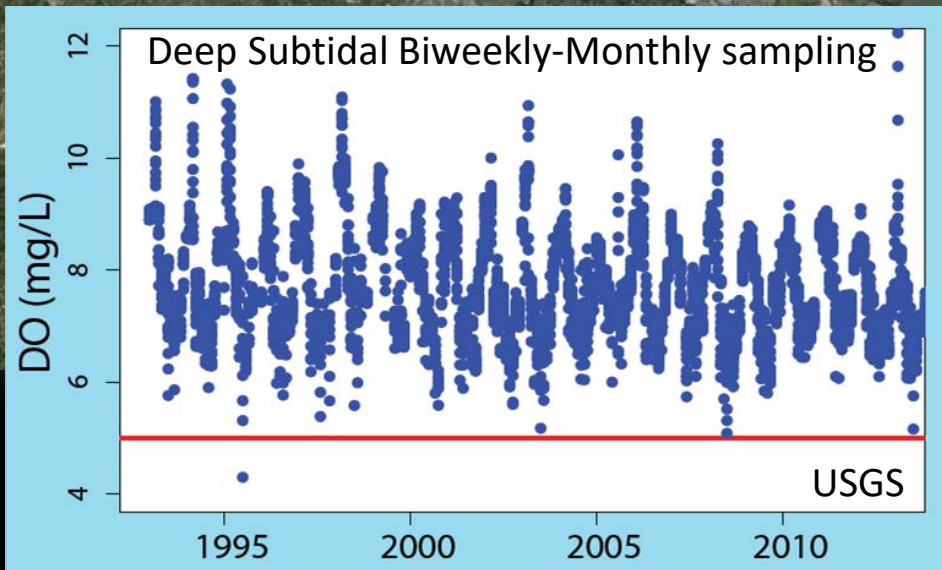
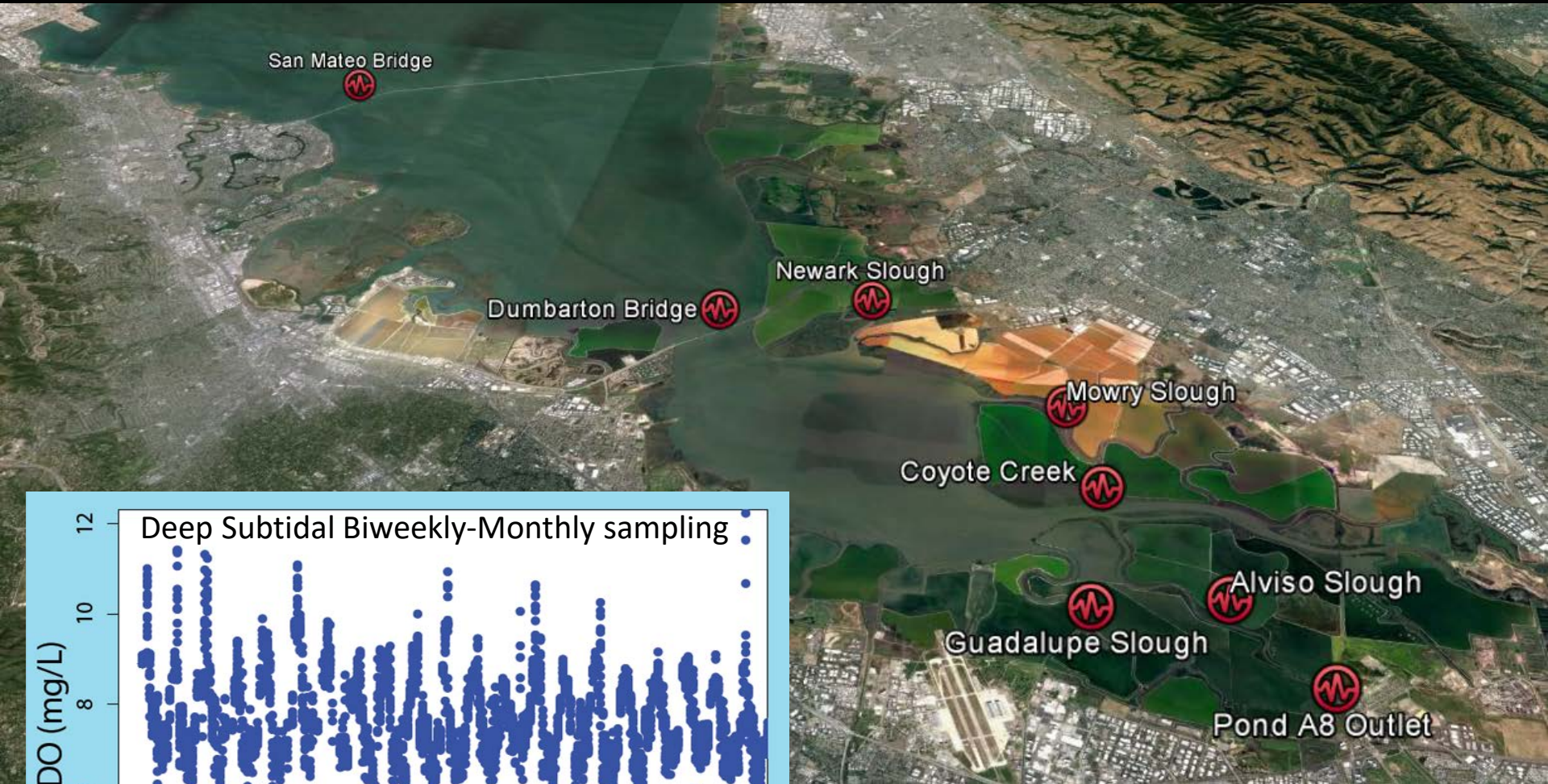
Temporal ?



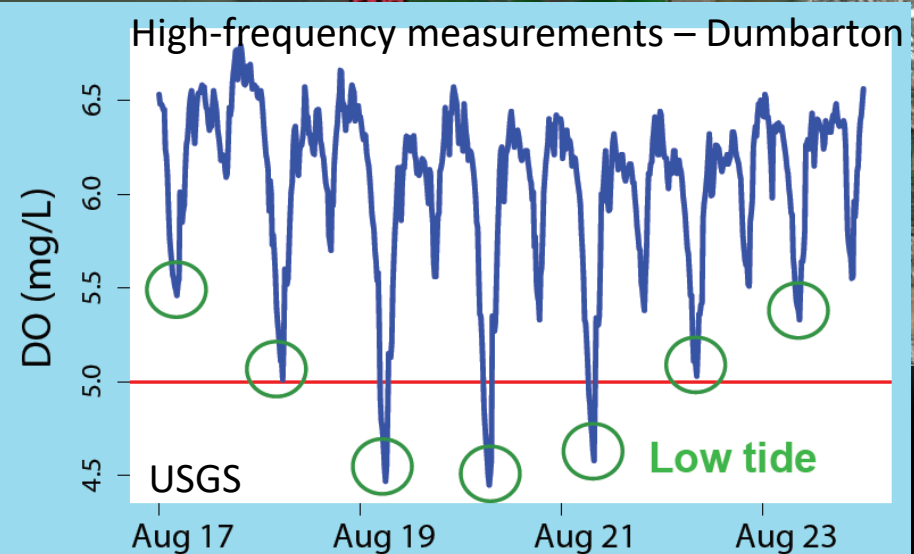
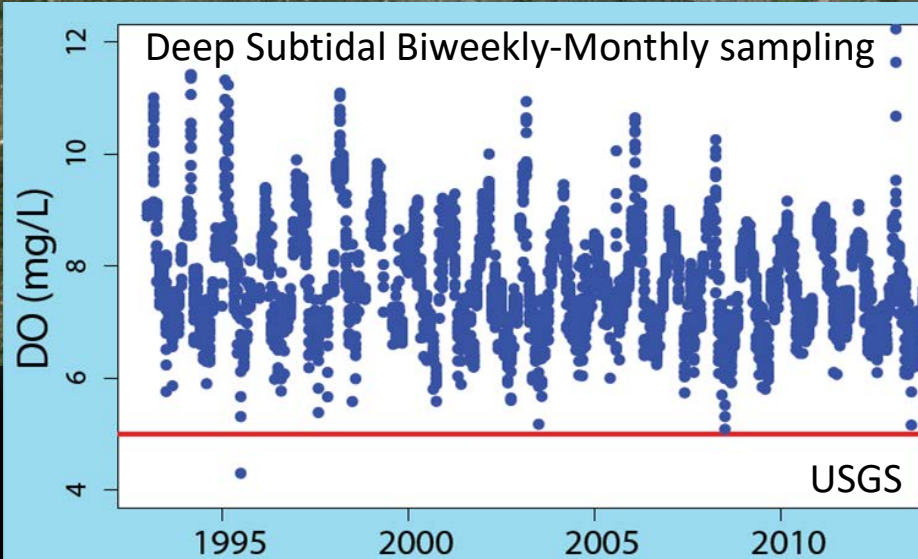
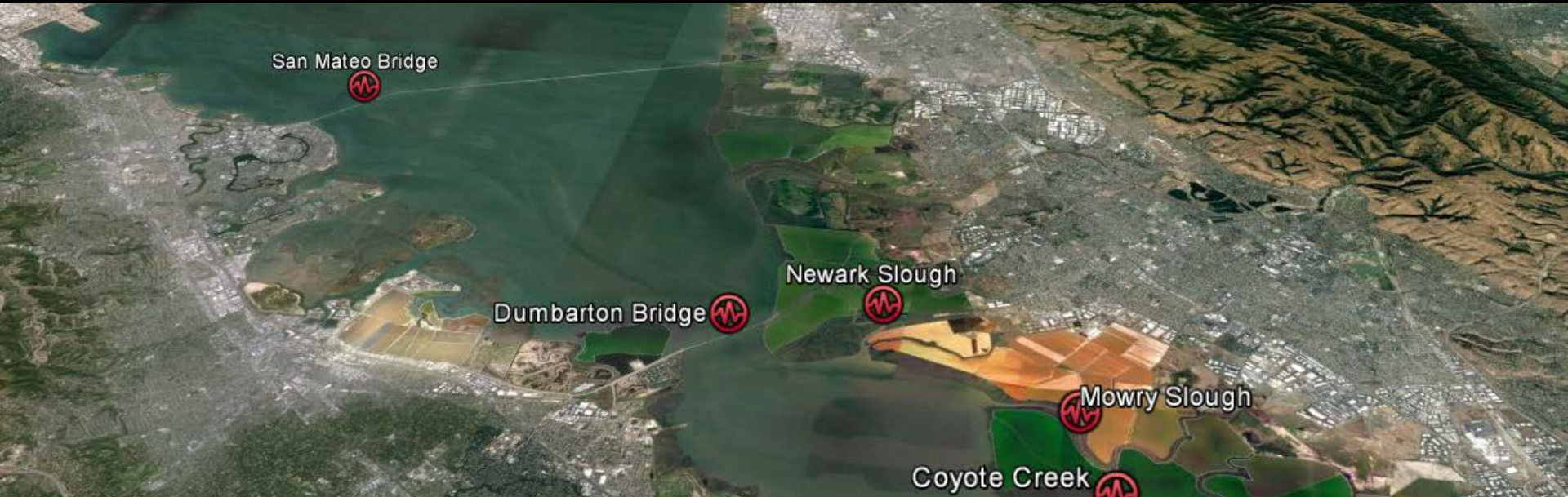
The LSB Network



The LSB Network

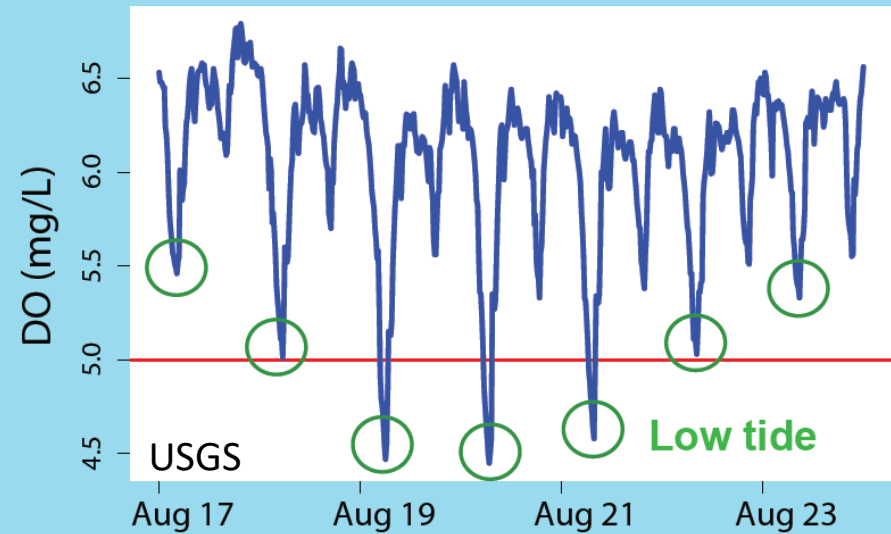
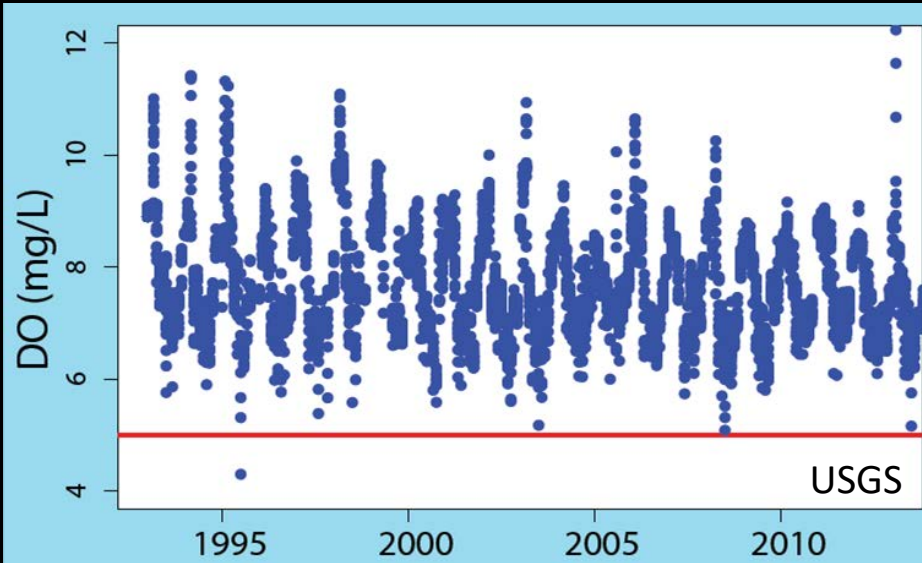


The LSB Network

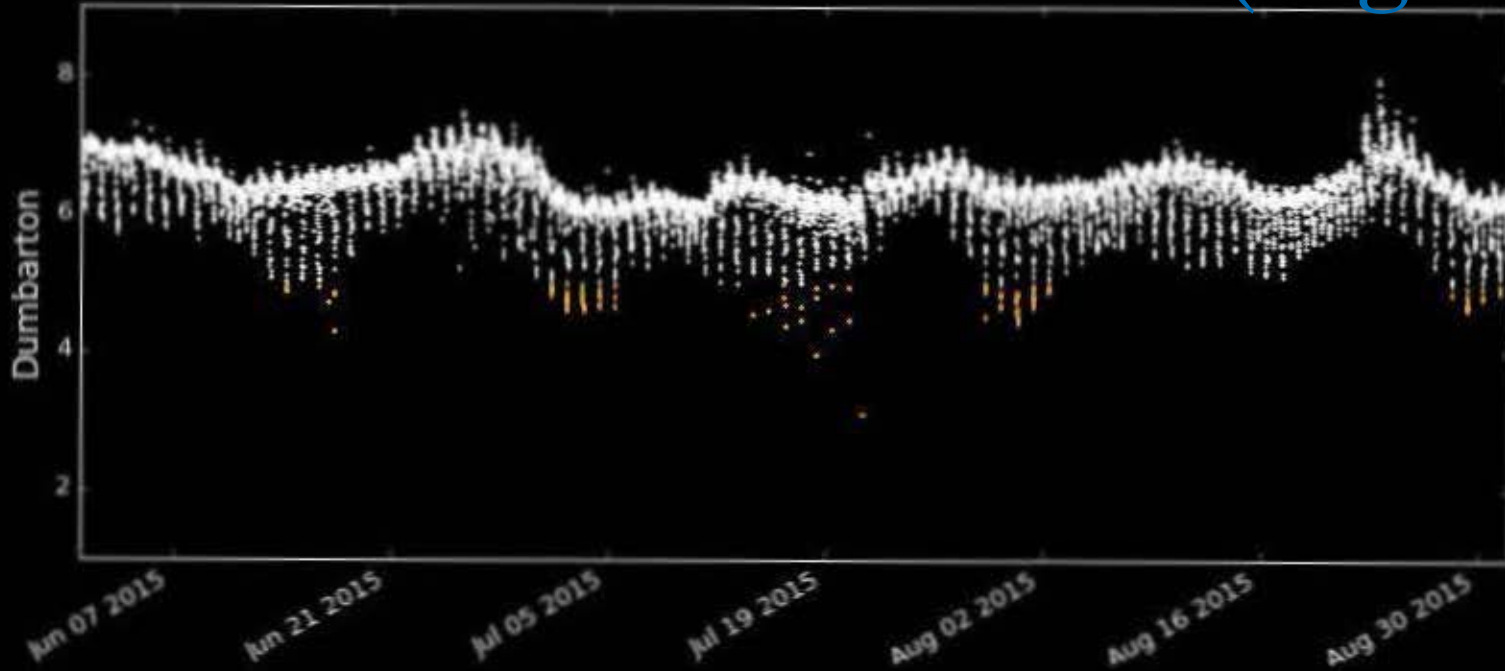


The LSB Network

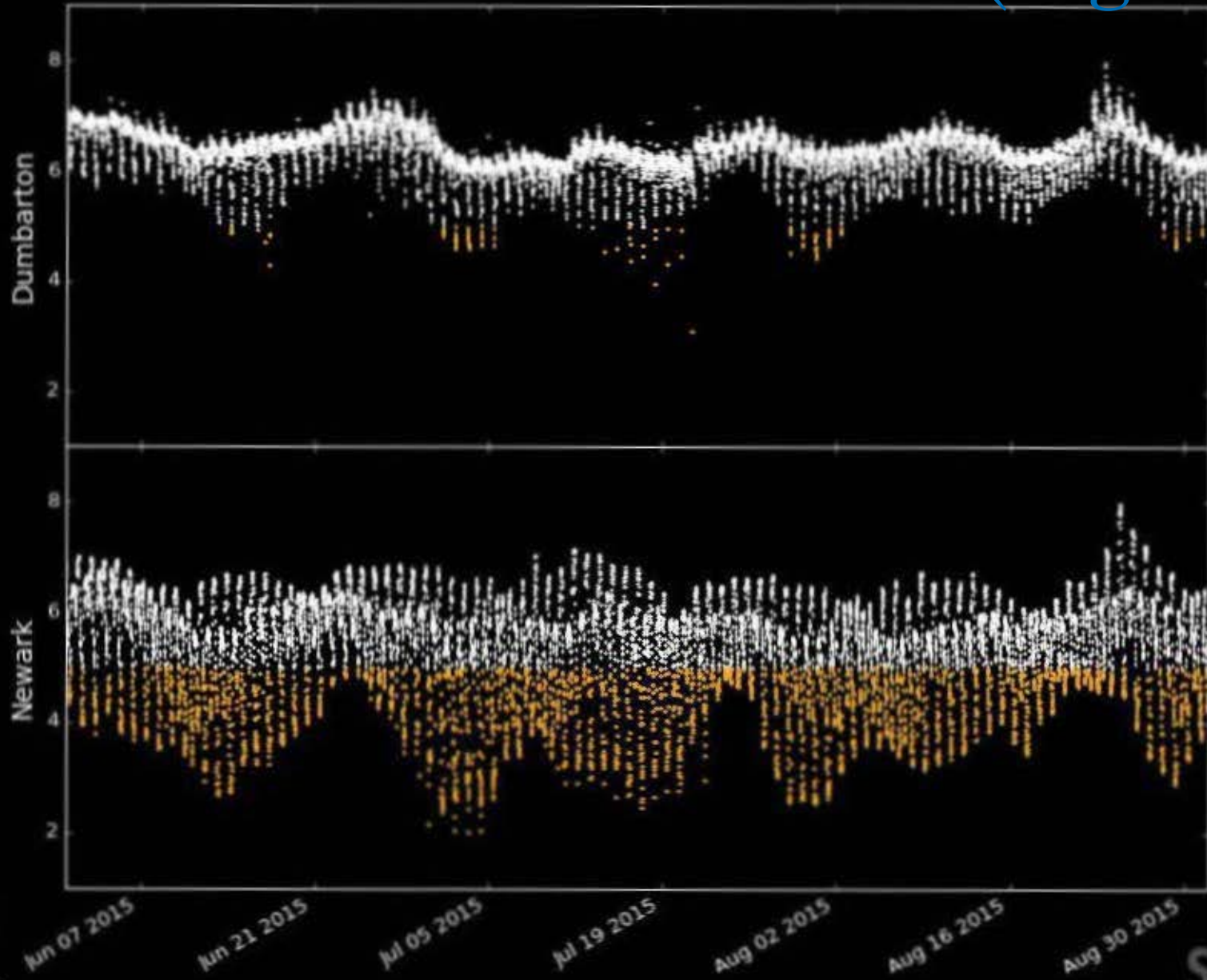
- Vertical ?
- Cross-channel ?
- Along-channel ?
- Inter-site ?
- Temporal ✓



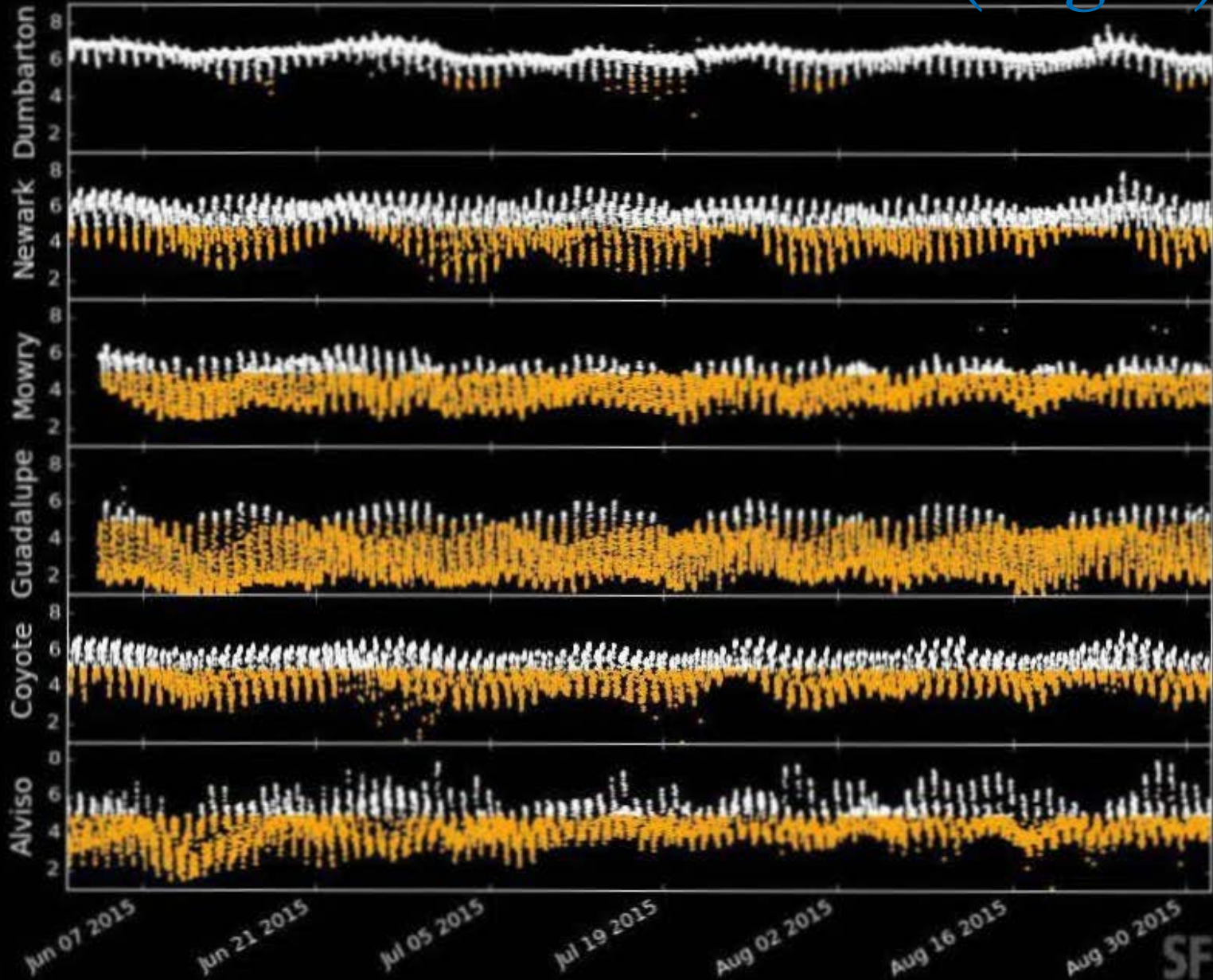
The LSB Network: DO (mg/L)



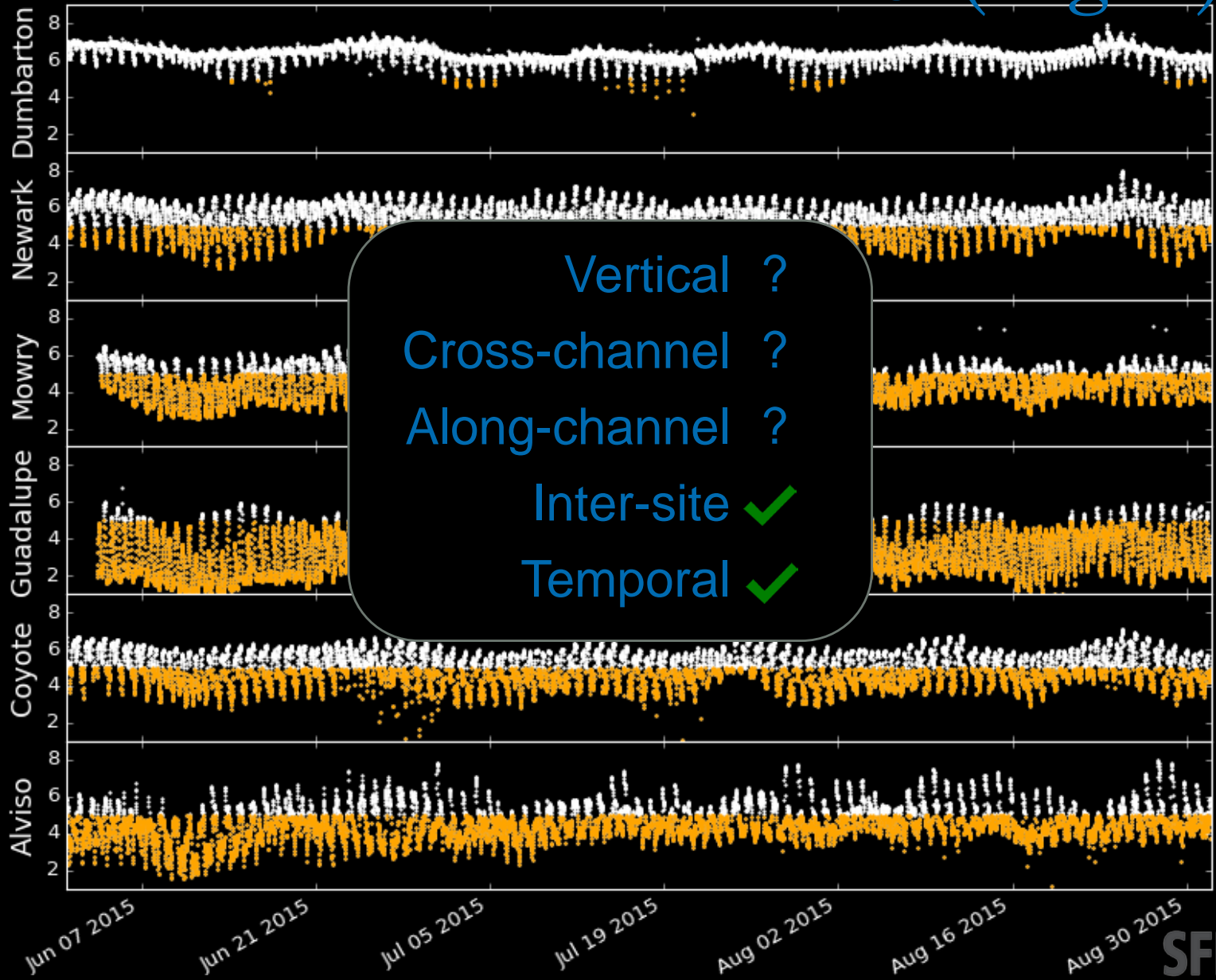
The LSB Network: DO (mg/L)



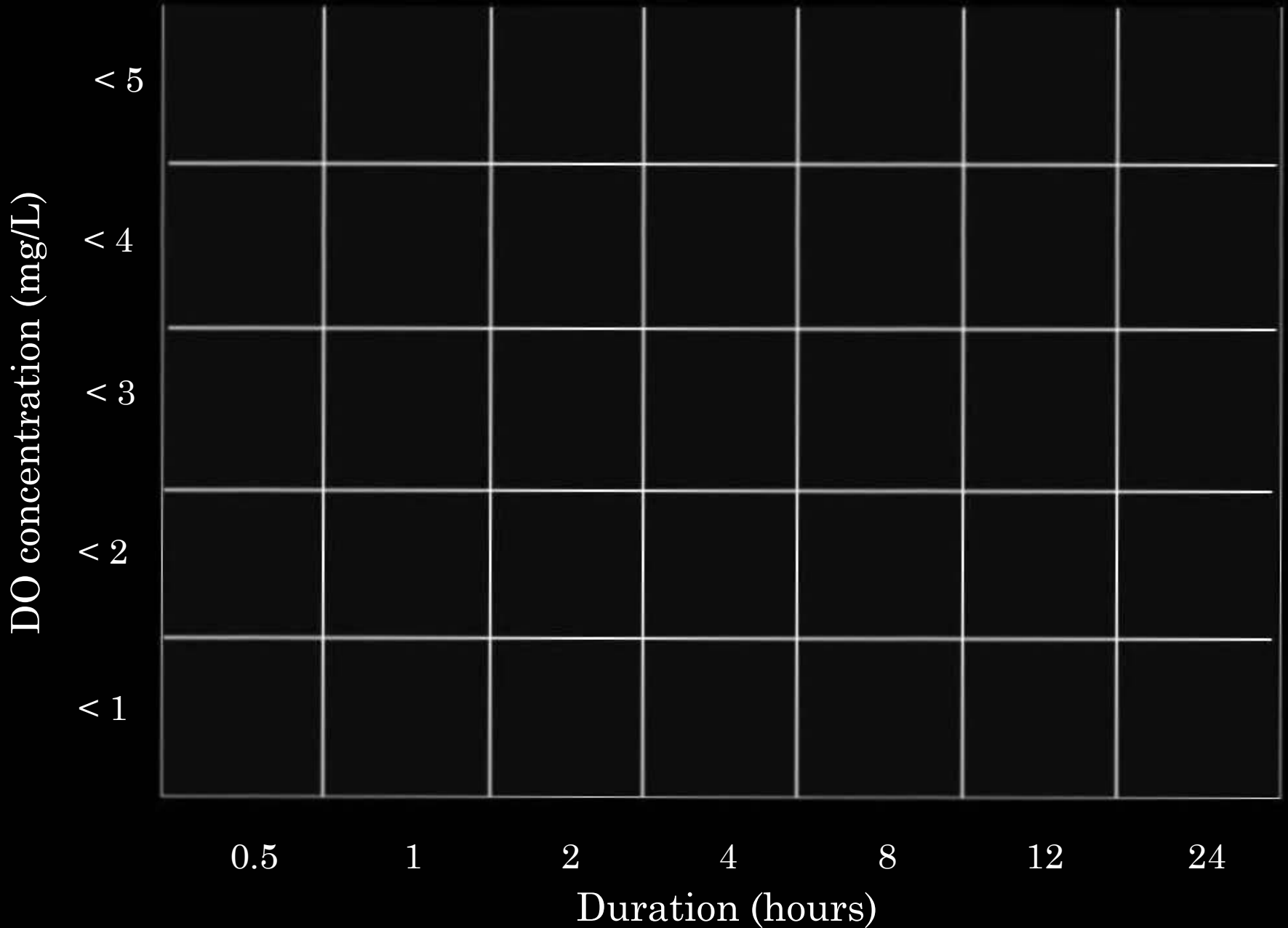
The LSB Network: DO (mg/L)



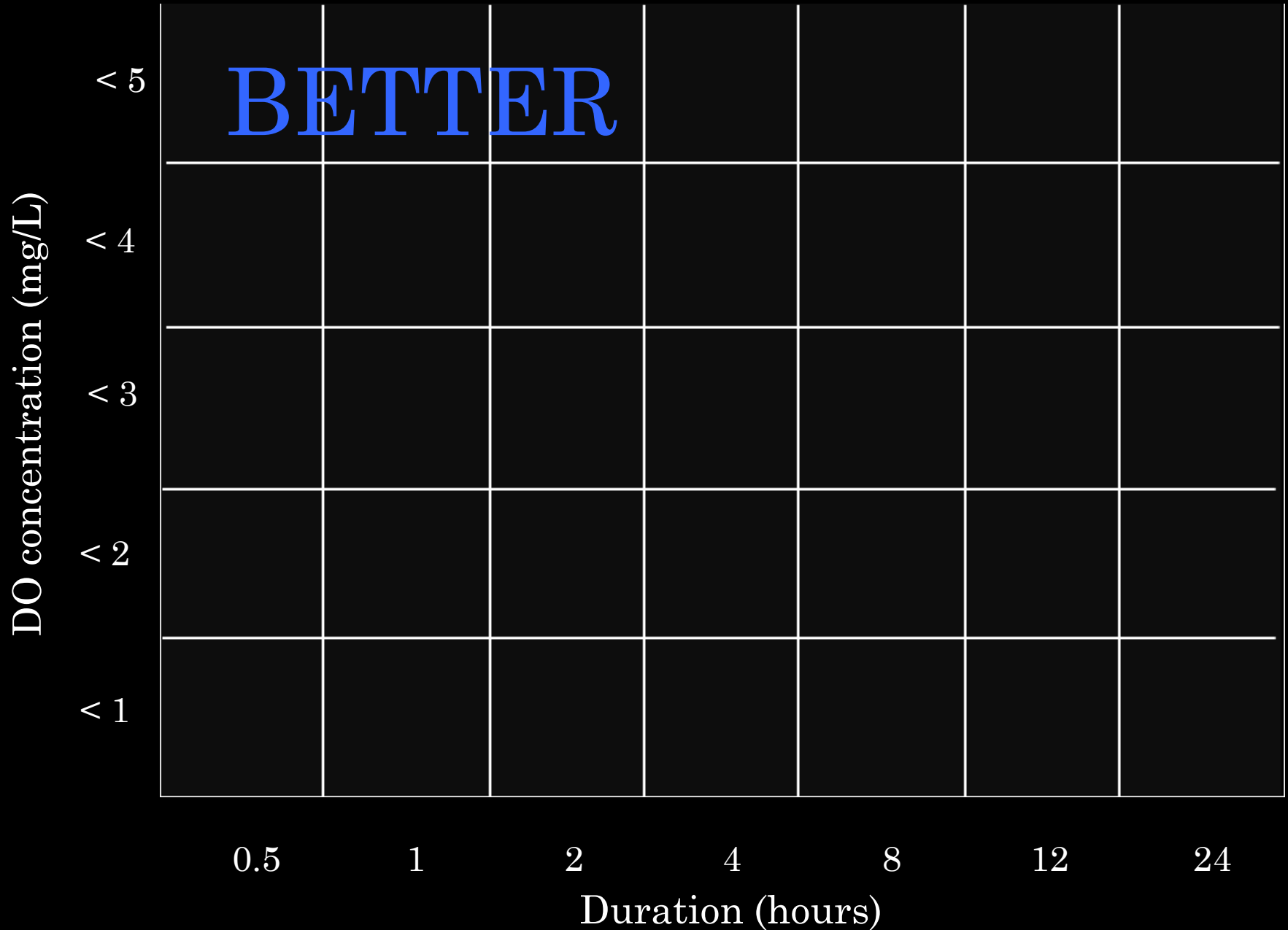
The LSB Network: DO (mg/L)



What do aquatic organisms experience in LSB habitats?



What do aquatic organisms experience in LSB habitats?



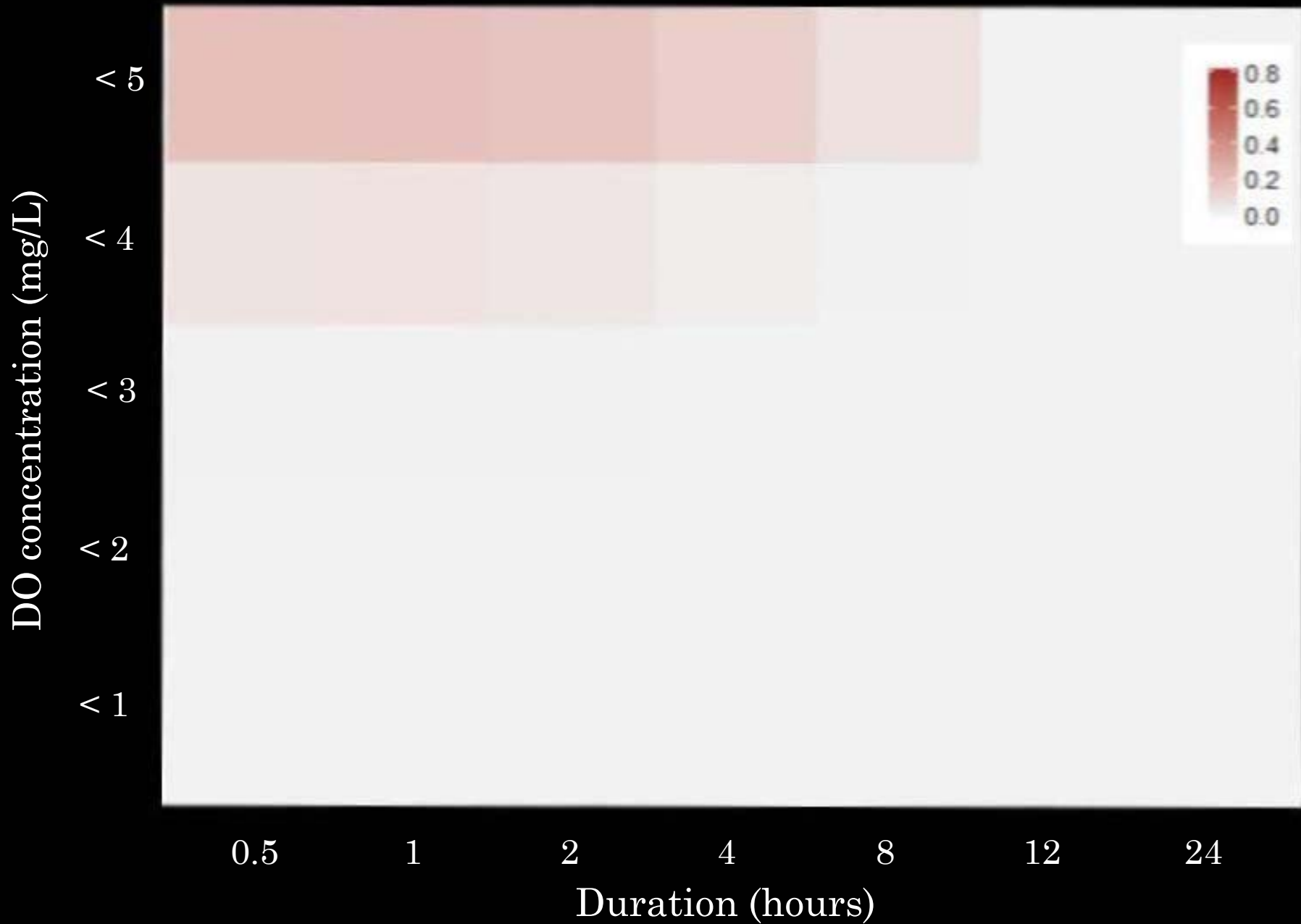
What do aquatic organisms experience in LSB habitats?



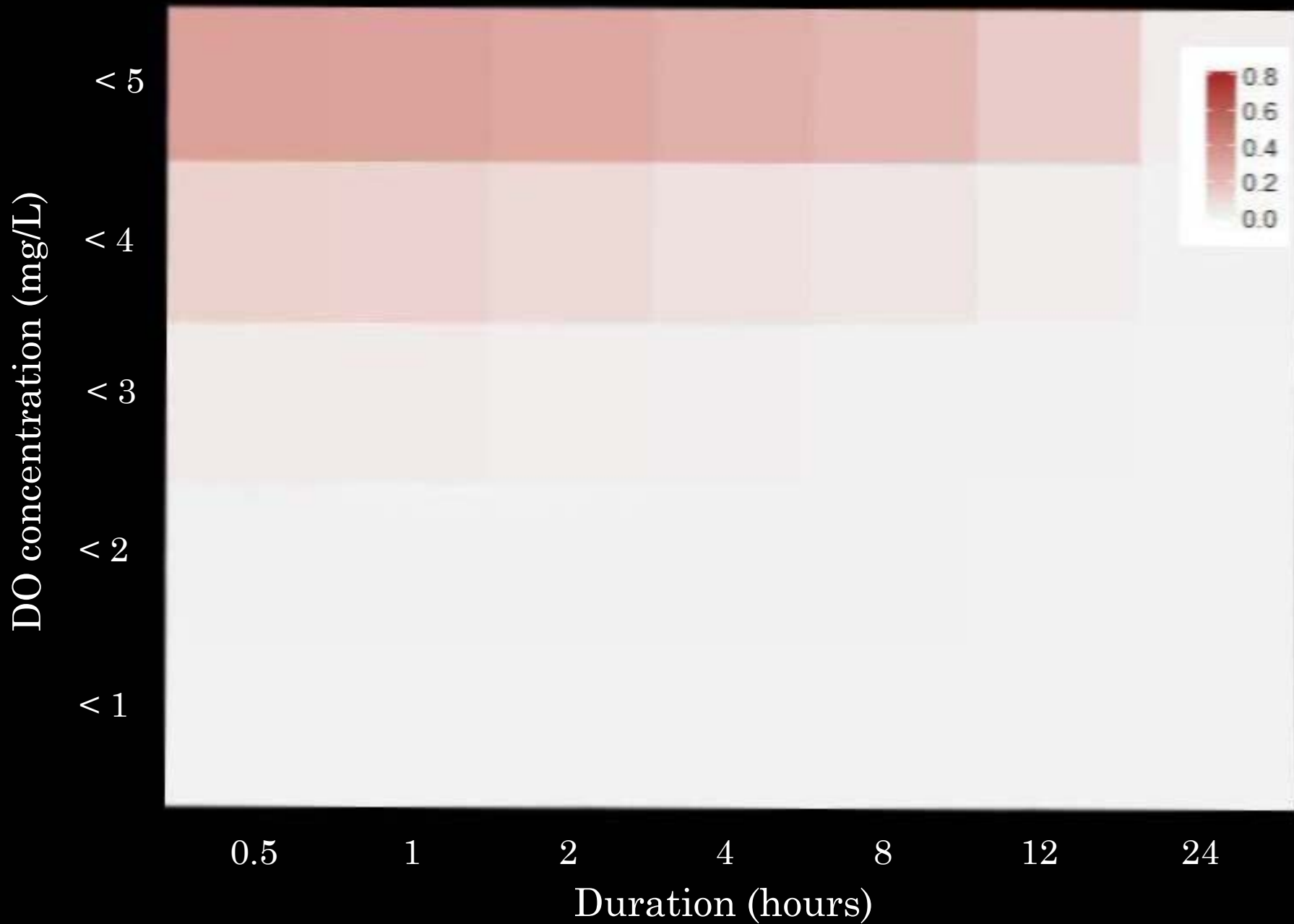
What do aquatic organisms experience in LSB habitats?



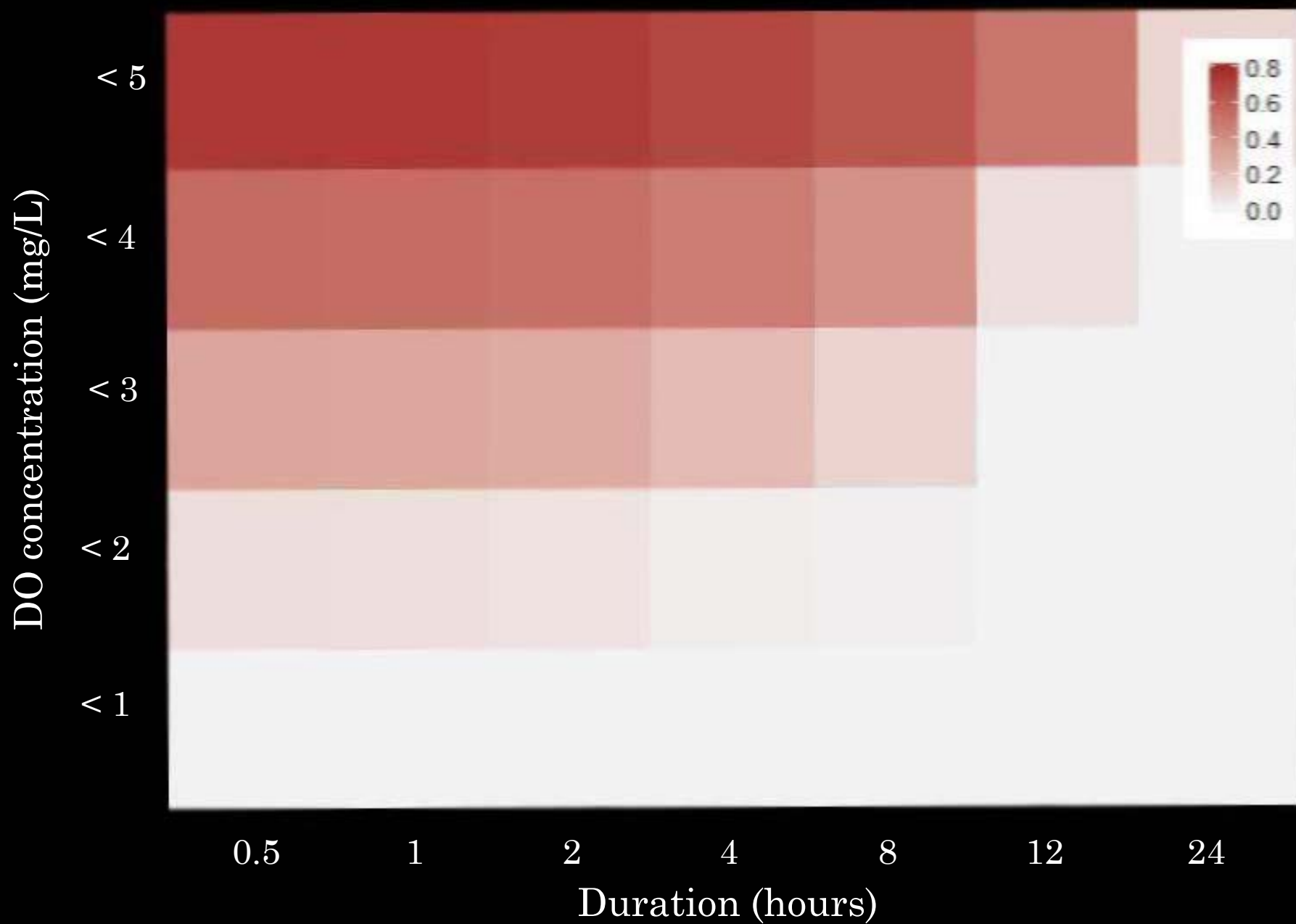
Newark Slough



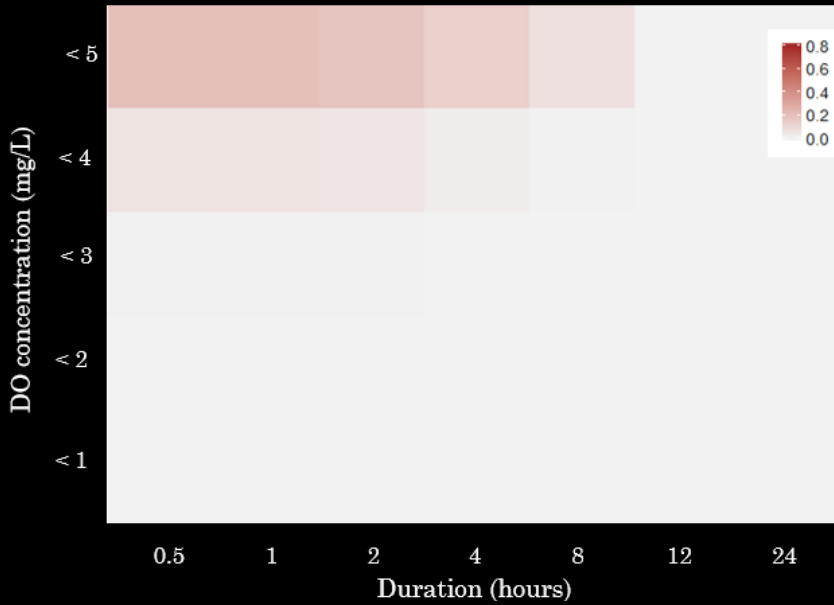
Alviso Slough



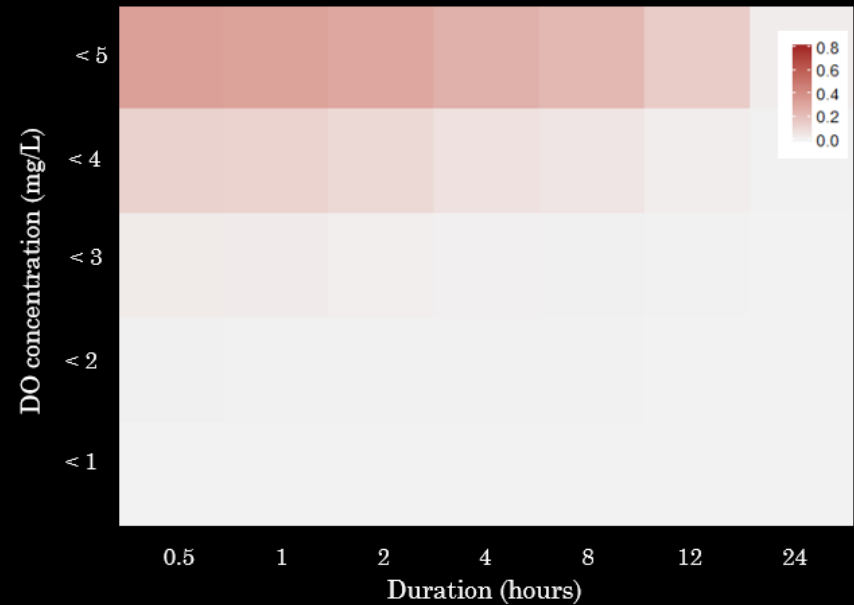
Guadalupe Slough



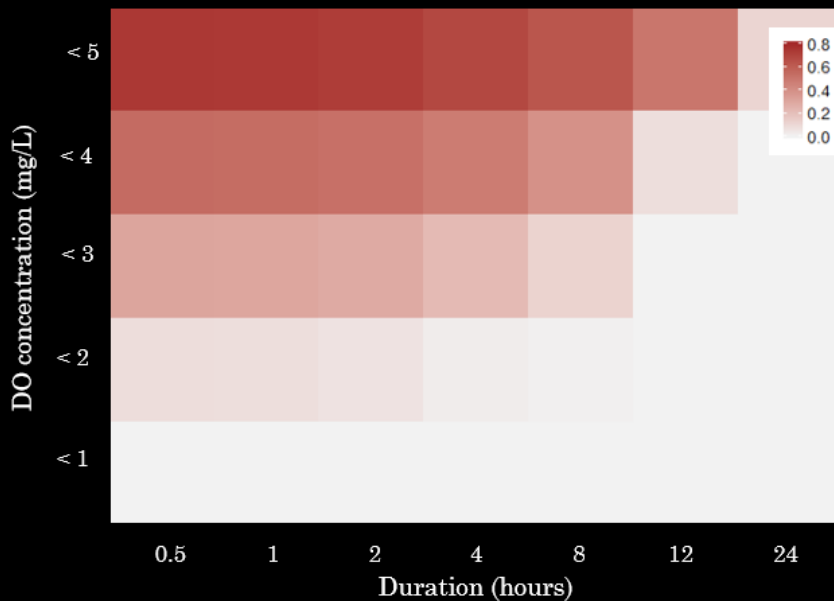
Newark Slough



Alviso Slough

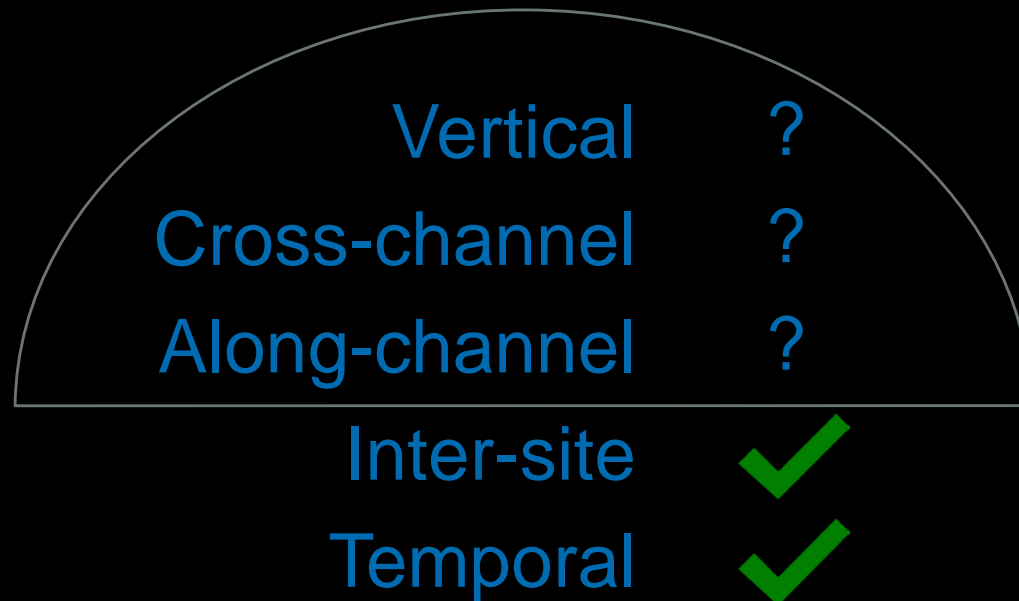


Guadalupe Slough



Species
dependent
responses!

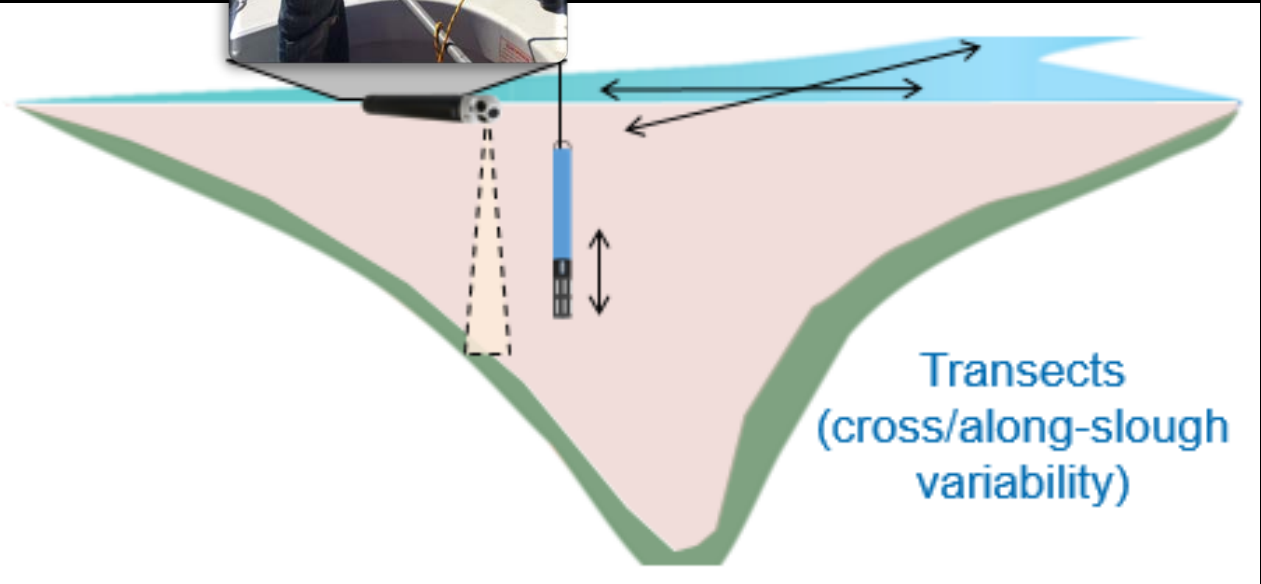
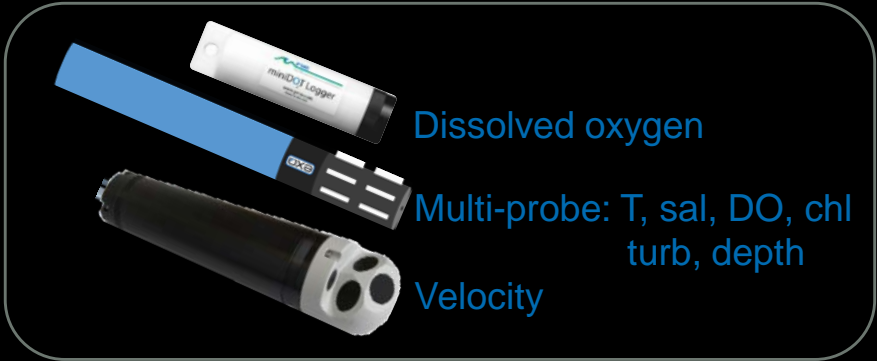
Measurements in all dimensions

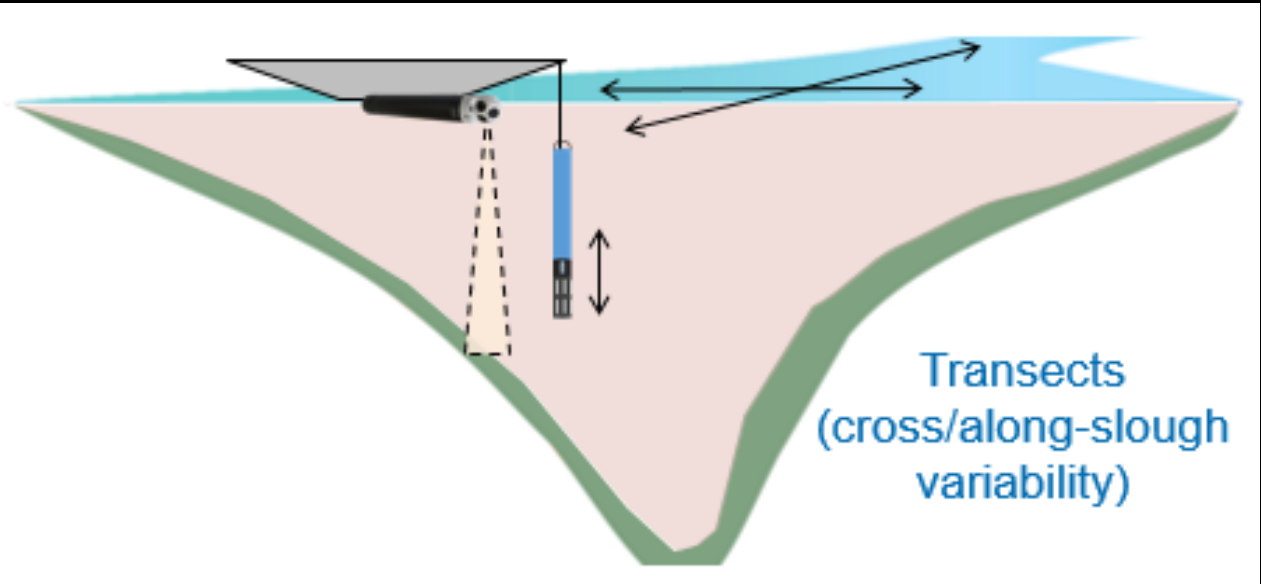
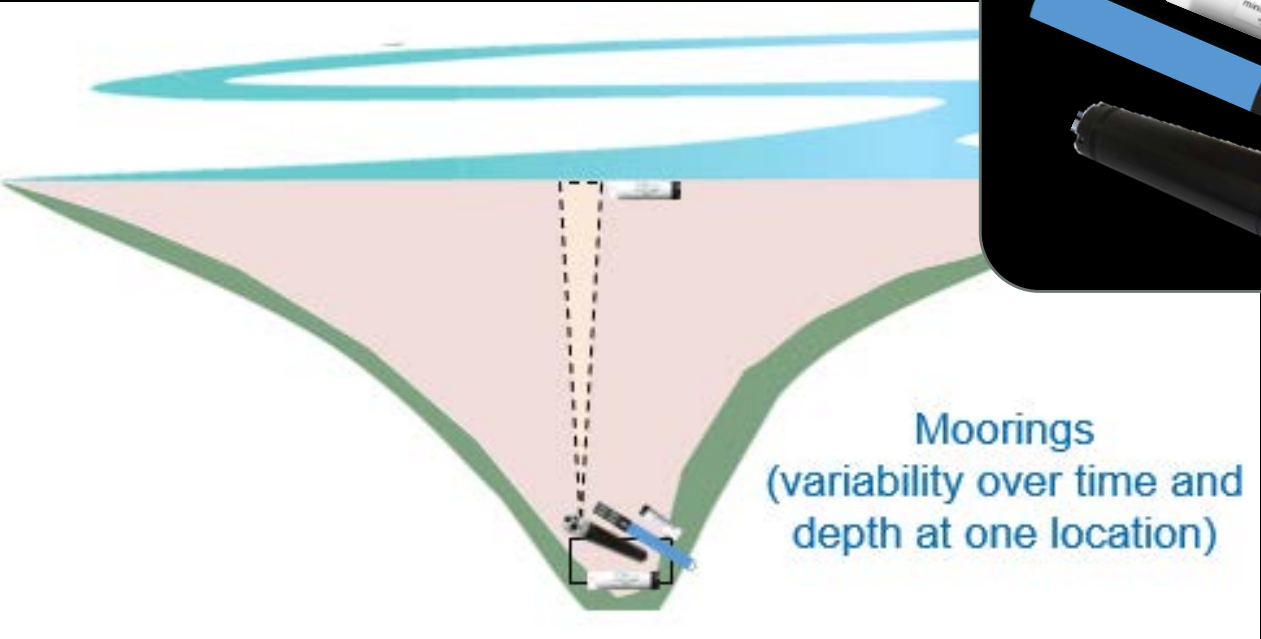
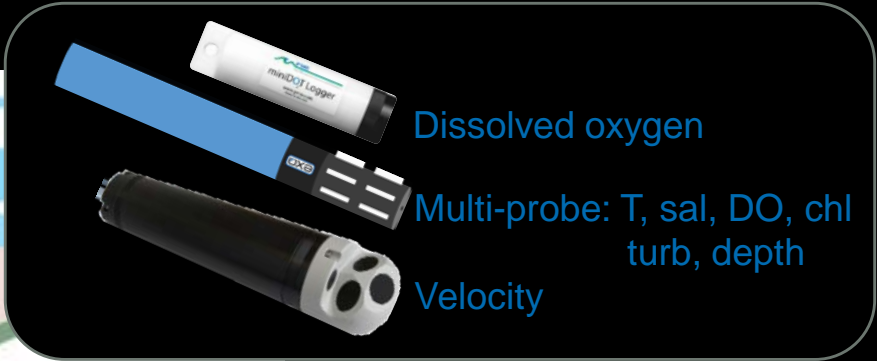


 transect location:

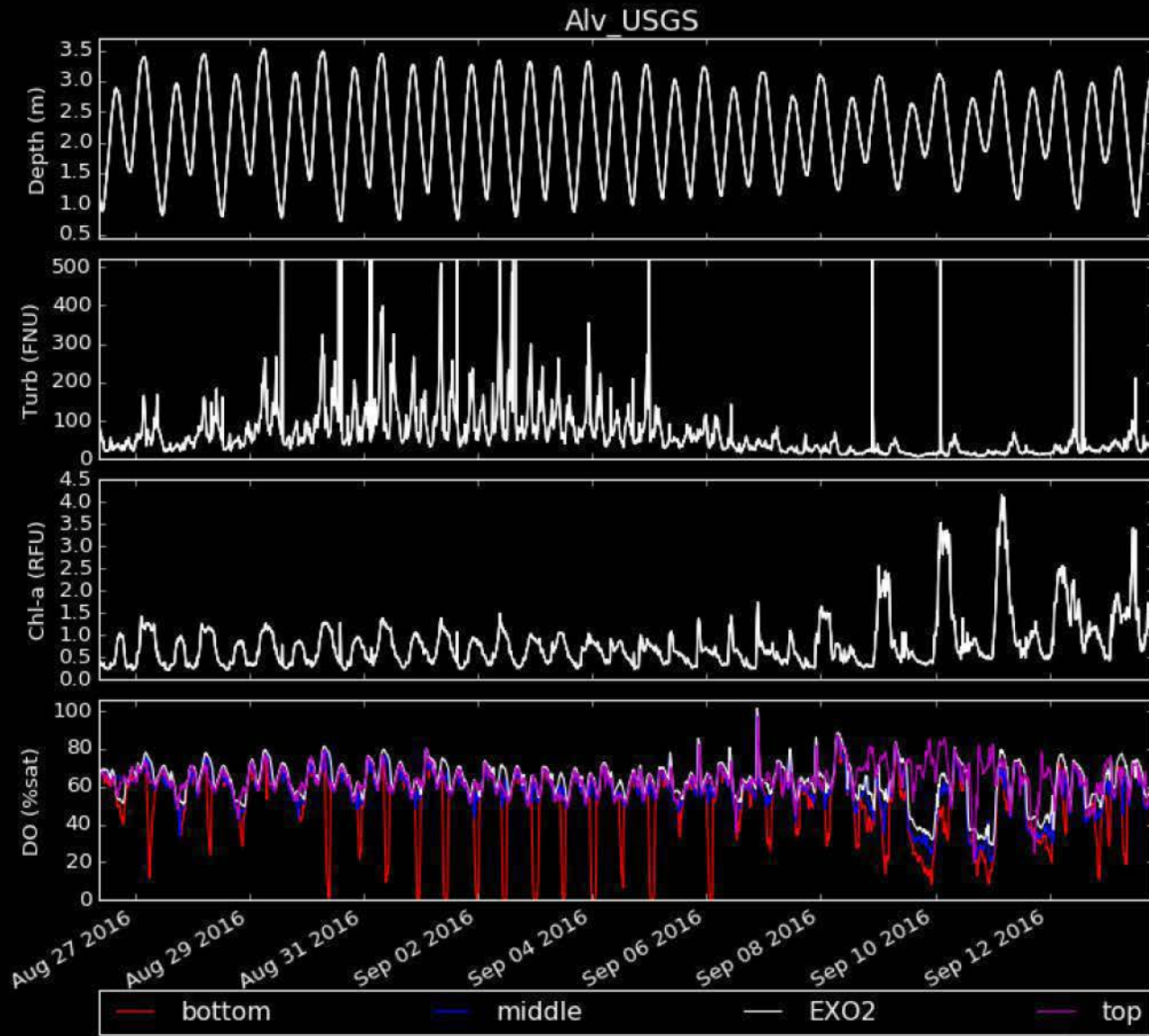
 mooring location:



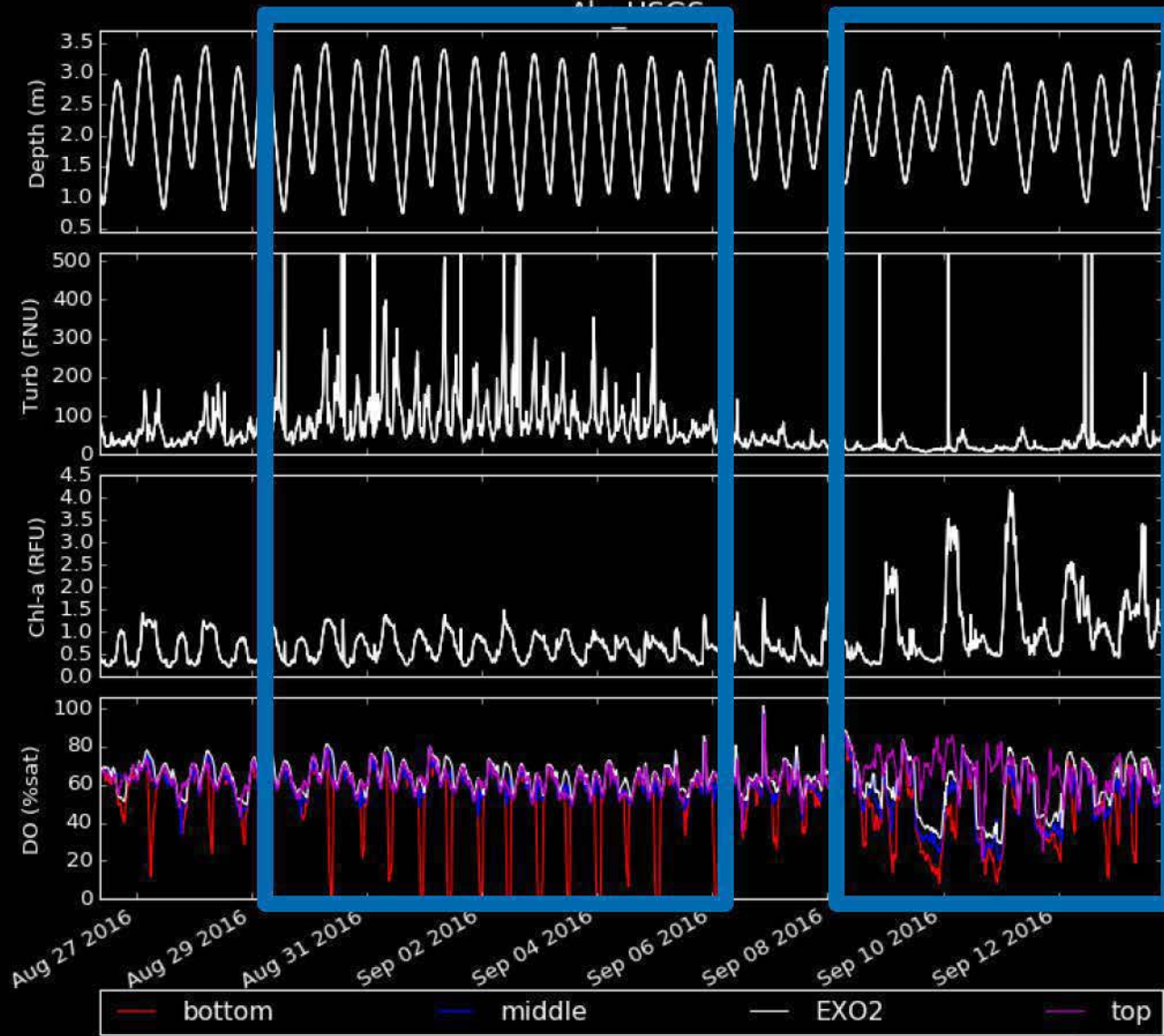




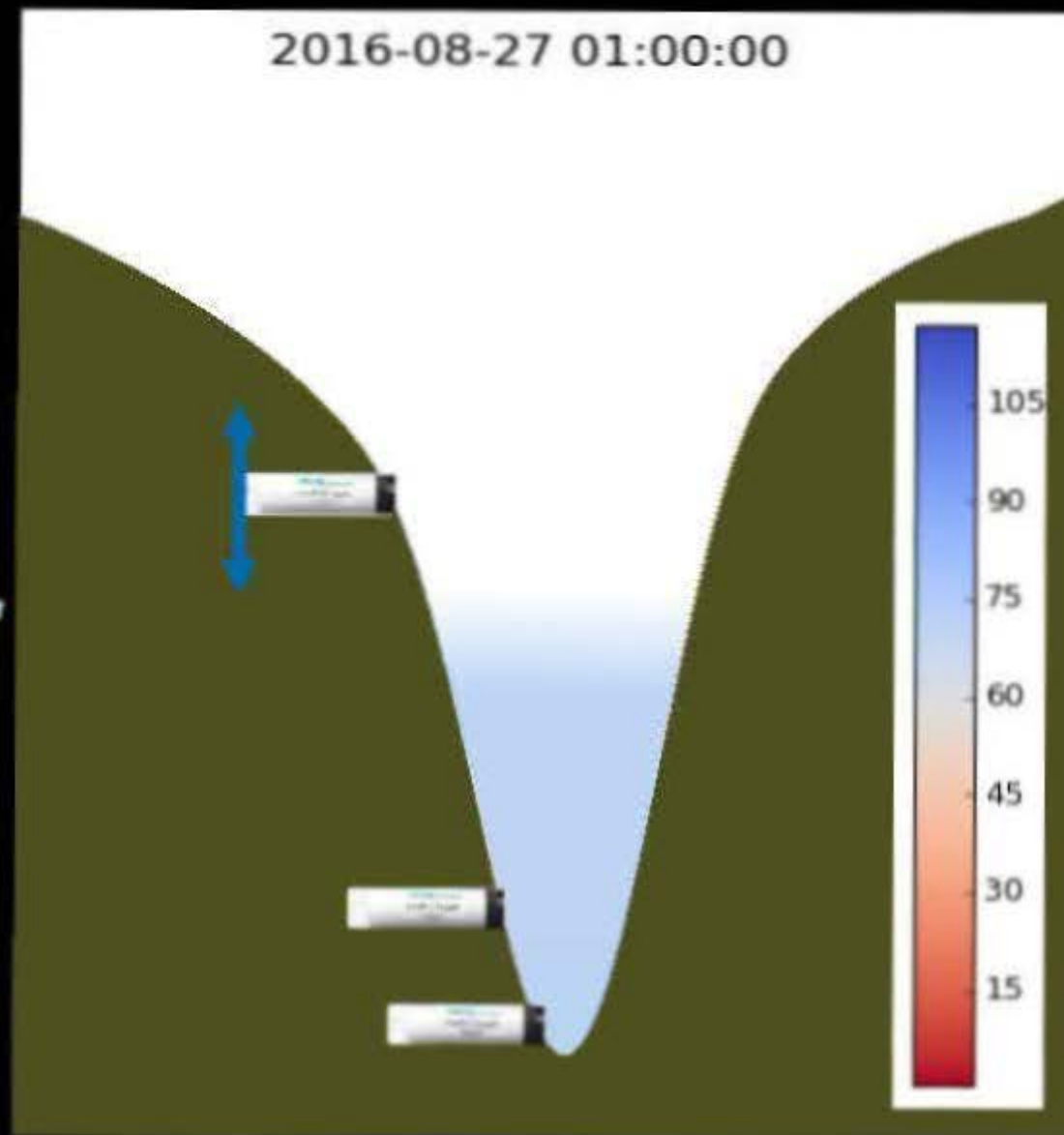
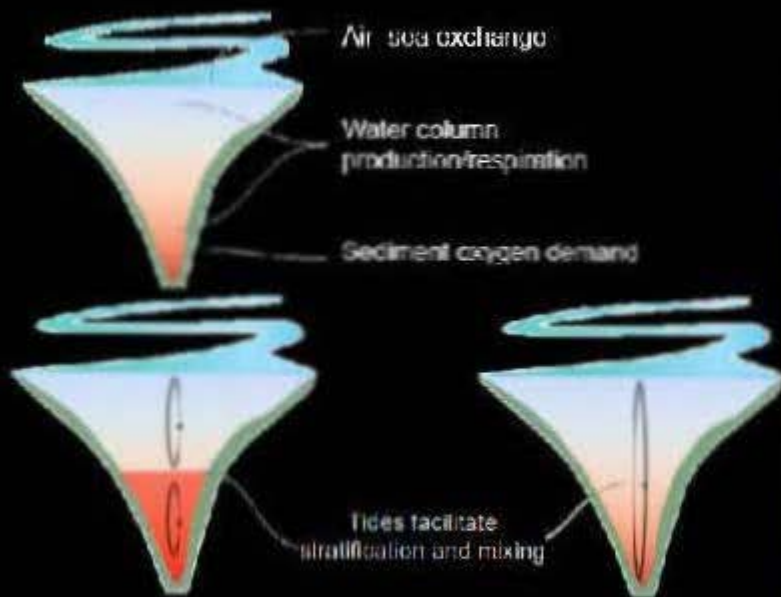
Temporal Vertical Variability



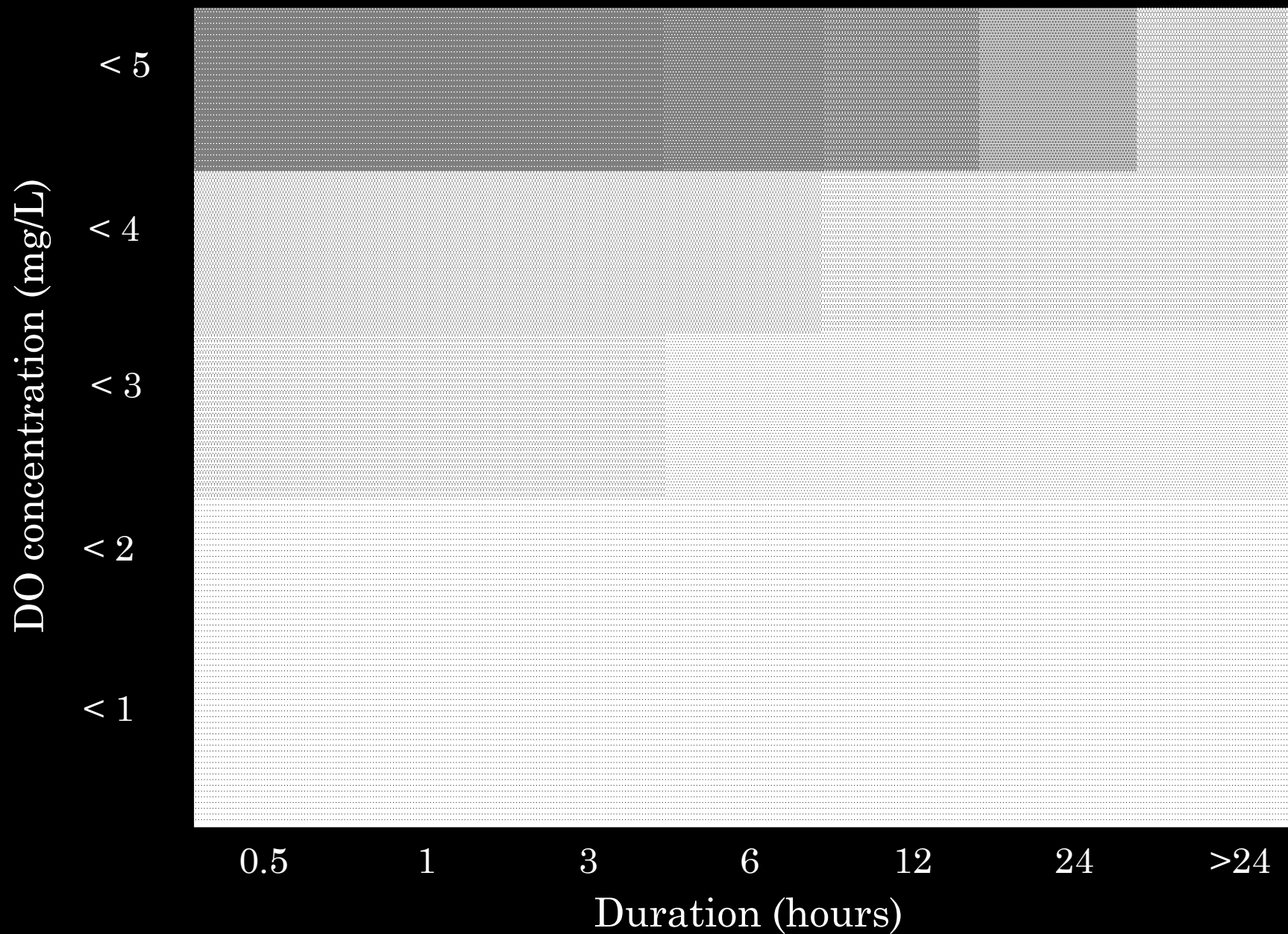
Temporal Vertical Variability



Putting it all together

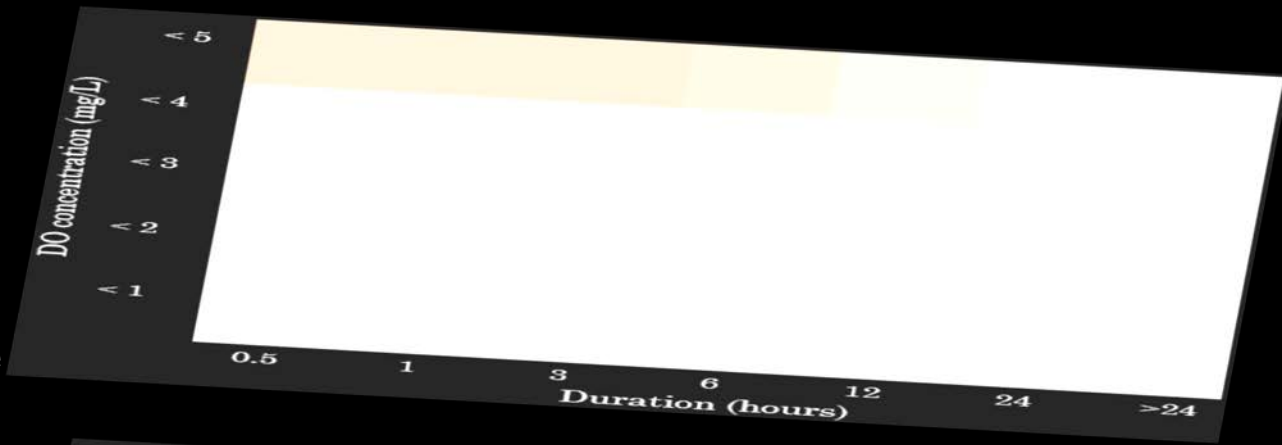


Alviso Slough, 50 cmab

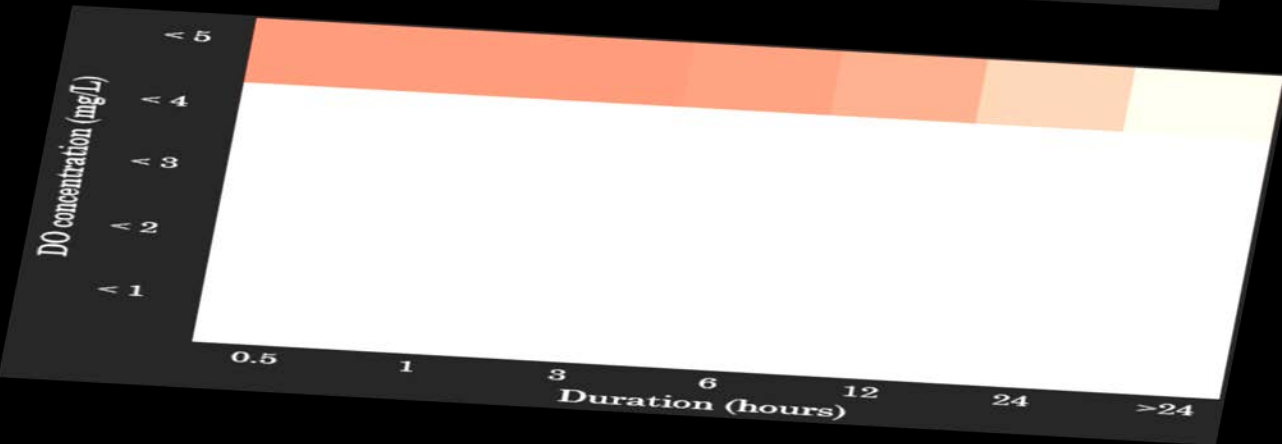


Alviso Slough

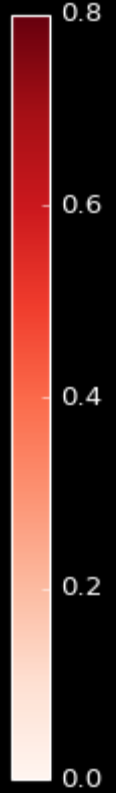
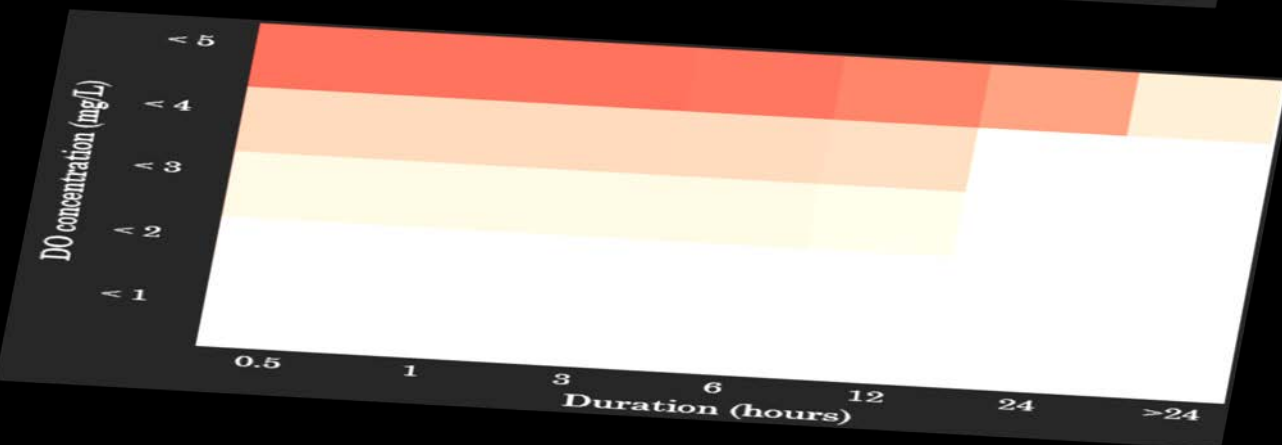
Surface



50 cm ab



5 cm ab



Preliminary Conclusions

Vertical	✓
Cross-channel	✗
Along-channel	✓
Inter-site	✓
Temporal	✓

Preliminary Conclusions

Vertical	✓
Cross-channel	✗
Along-channel	✓
Inter-site	✓
Temporal	✓

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

Thanks!

USGS Sacramento:

Kurt Weidich

Darin Einhell

Maureen Downing-Kunz

Dave Schoellhamer

Daniel Livsey

San José-Santa Clara Regional
Wastewater Facility:

Eric Dunlavey

Bryan Frueh

NMS Funding

SFEI Teammates

Jen Hunt, Phil Trowbridge, Ila

Shimabuku,

SFEI Environmental Informatics

Integral Consulting and
Leviathan Consulting:

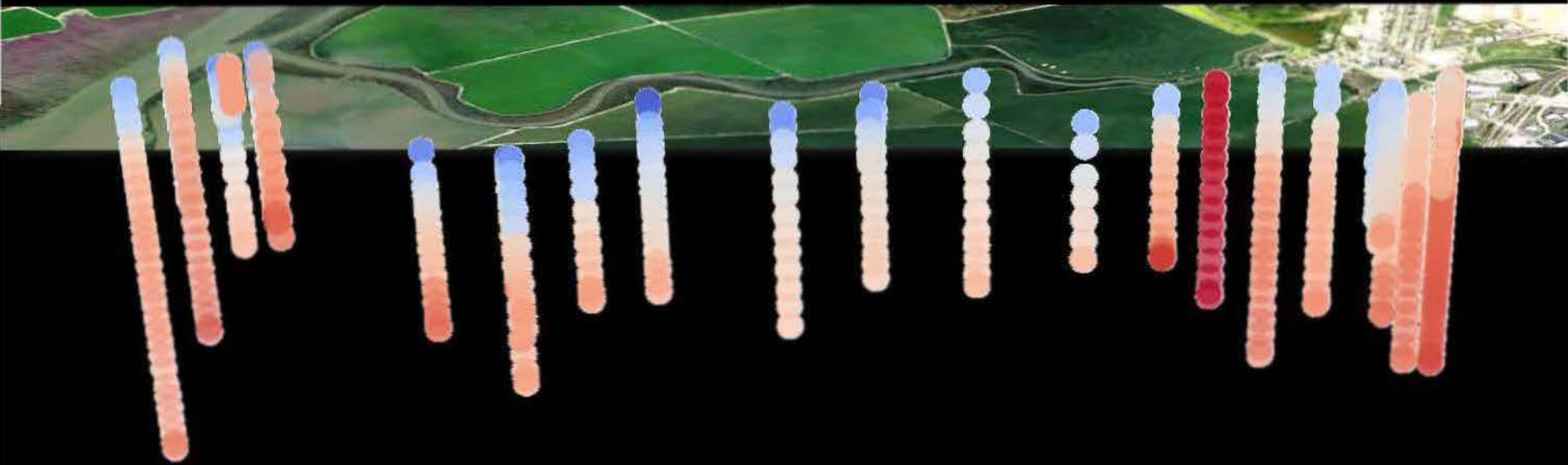
Frank Spada

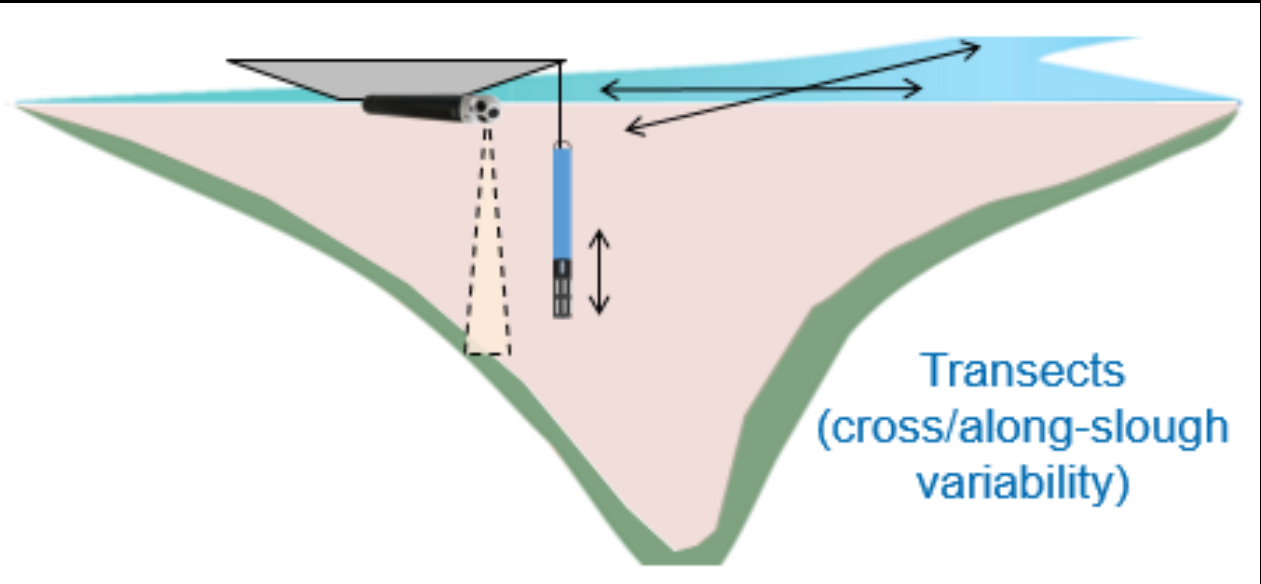
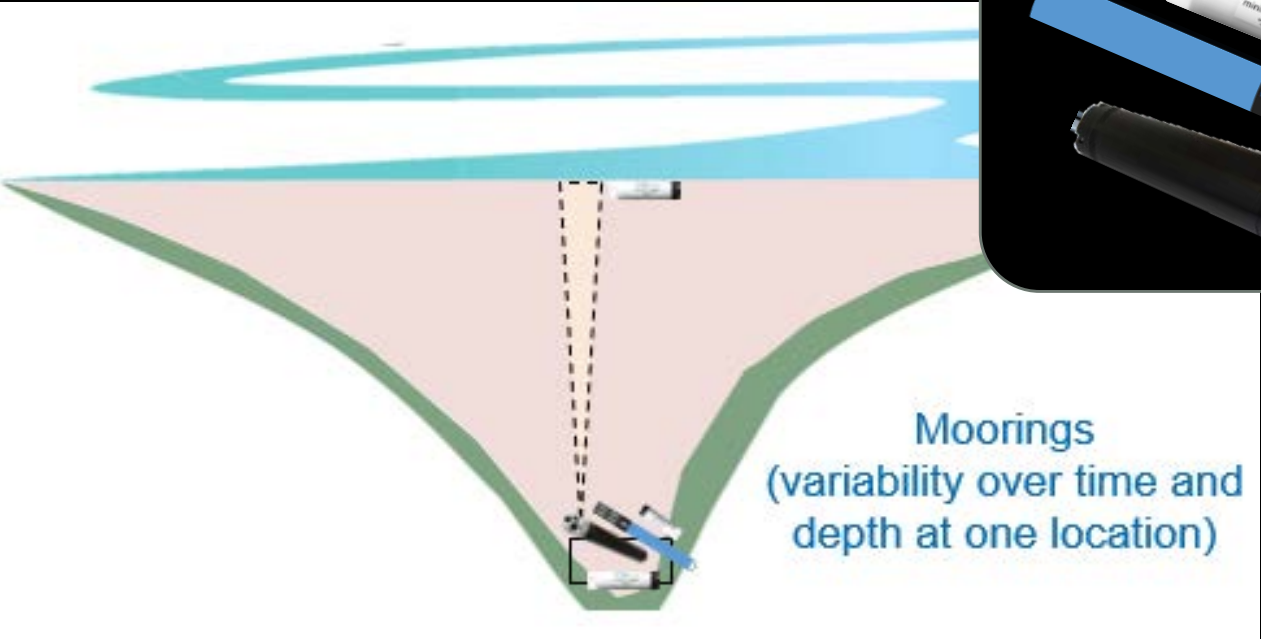
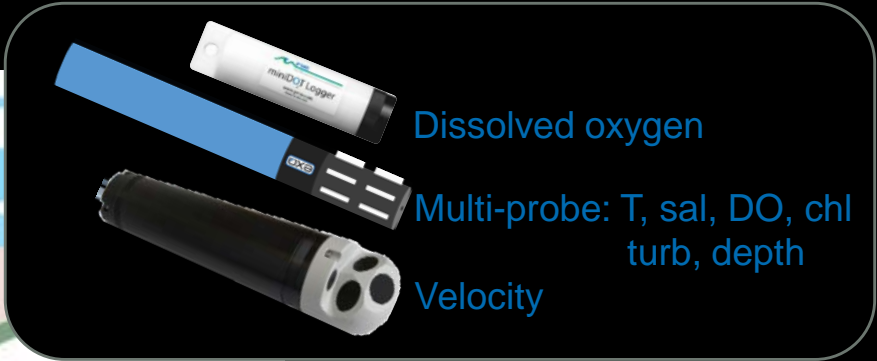
Kara Scheu

Craig Jones

Steve LaMothe

Alviso Slough





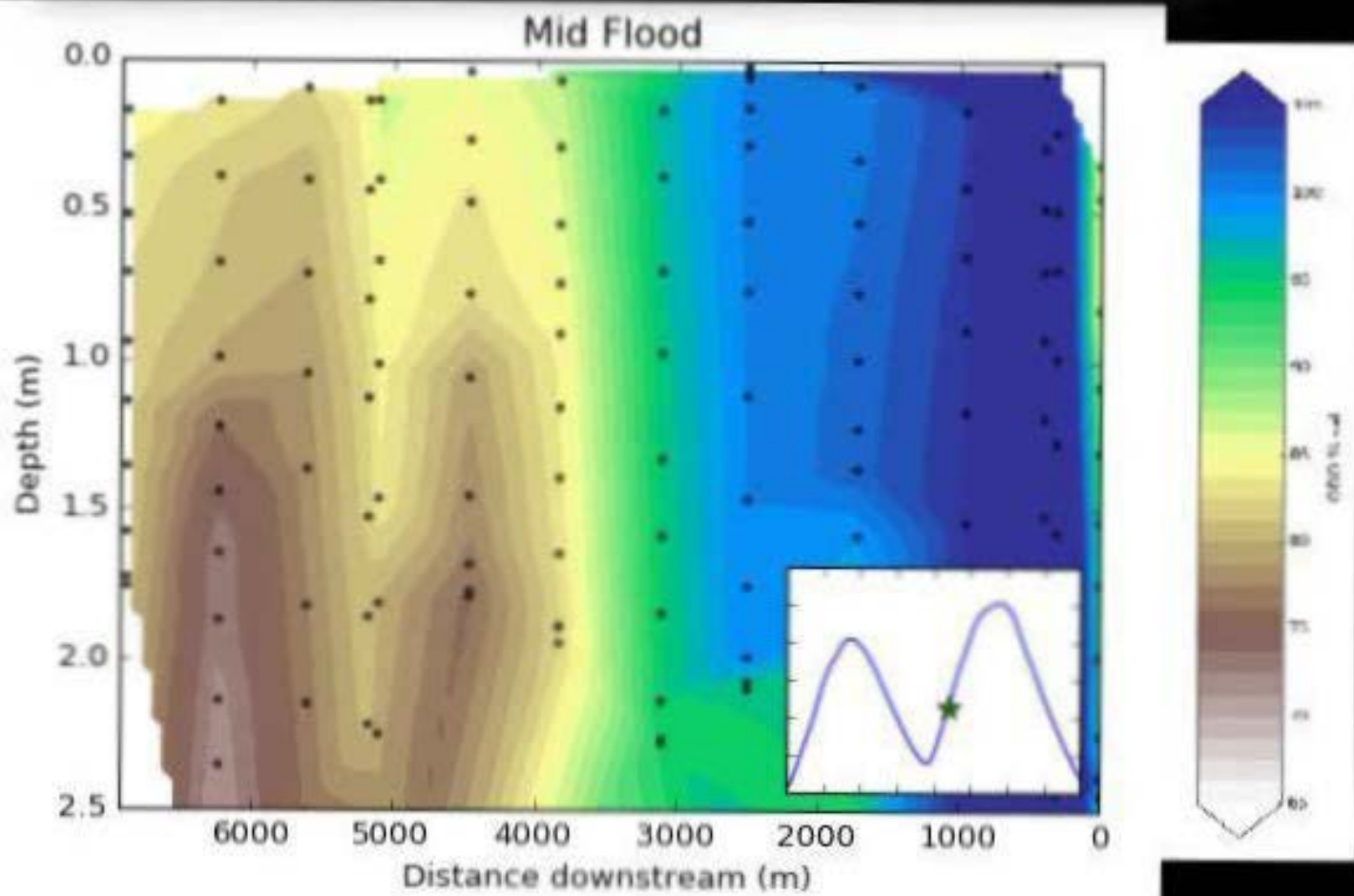
Along-Slough: Alviso

Start (Mouth)

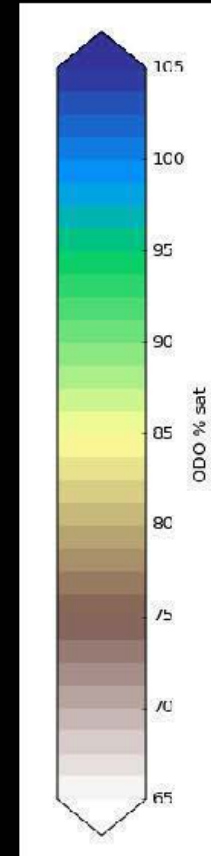
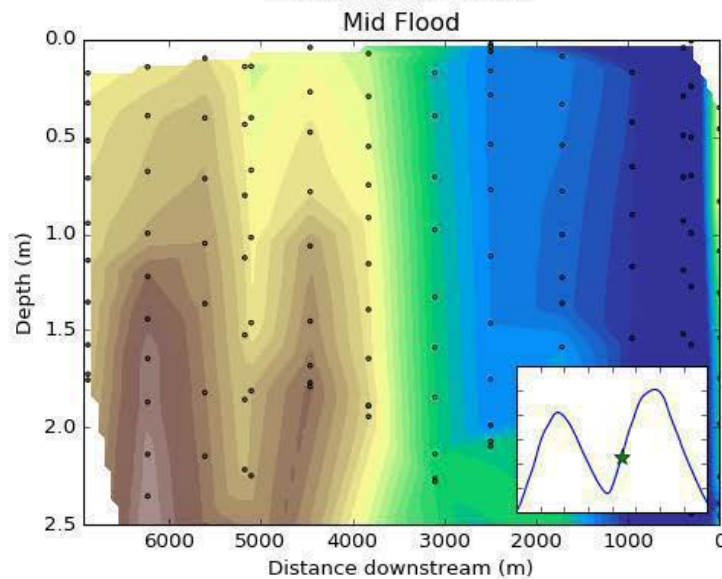
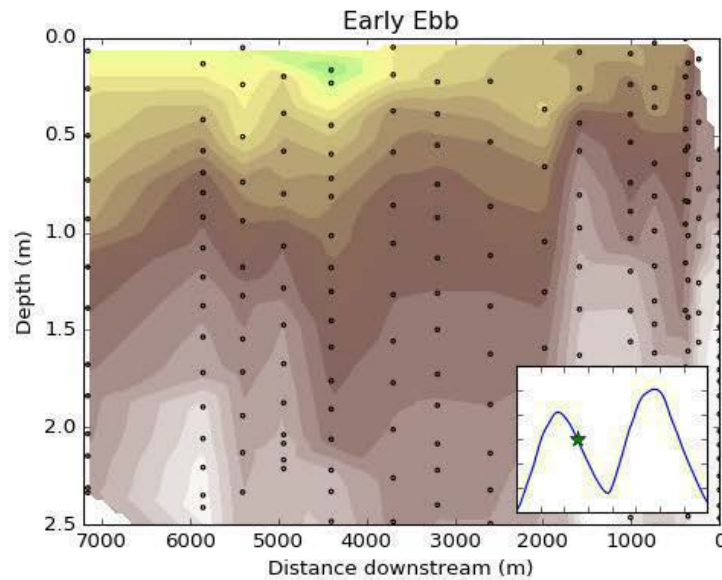
Pond A8

End (Alviso)



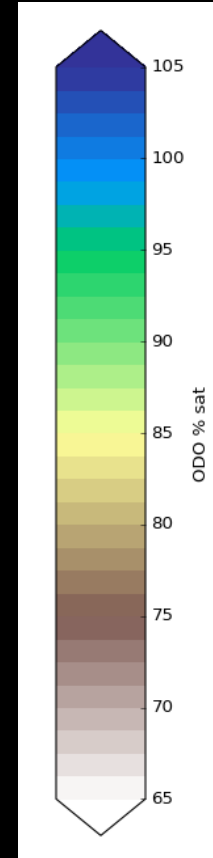
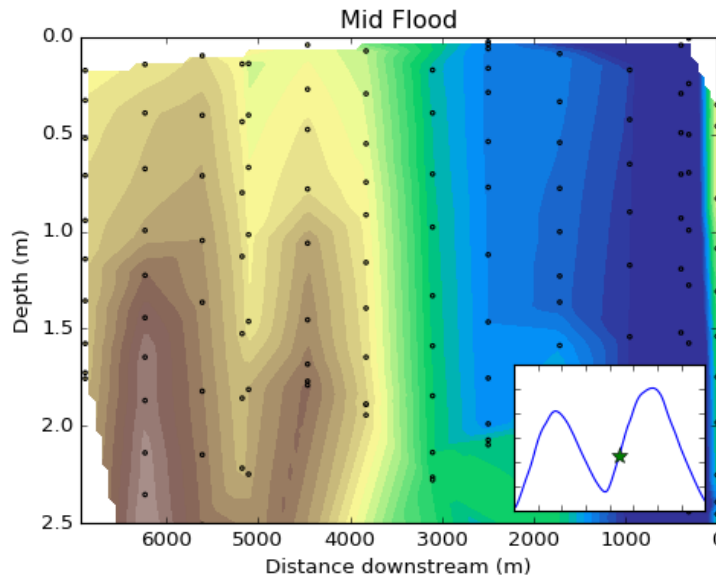
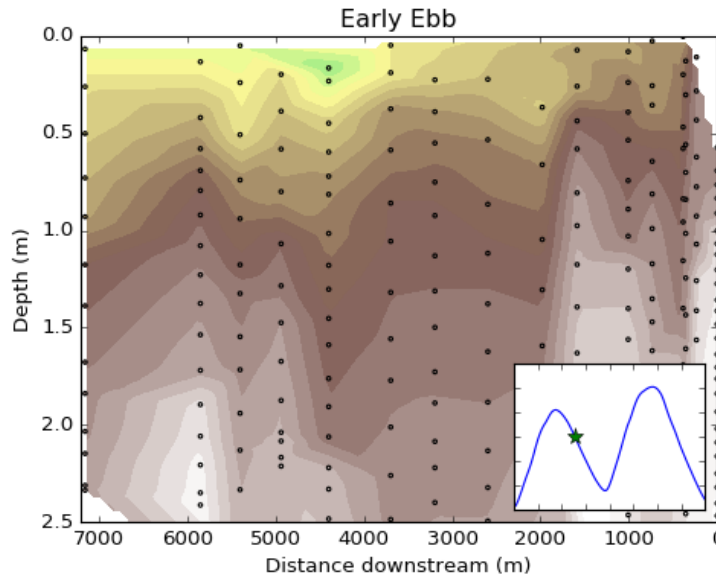


Vertical/Along-Slough Variability

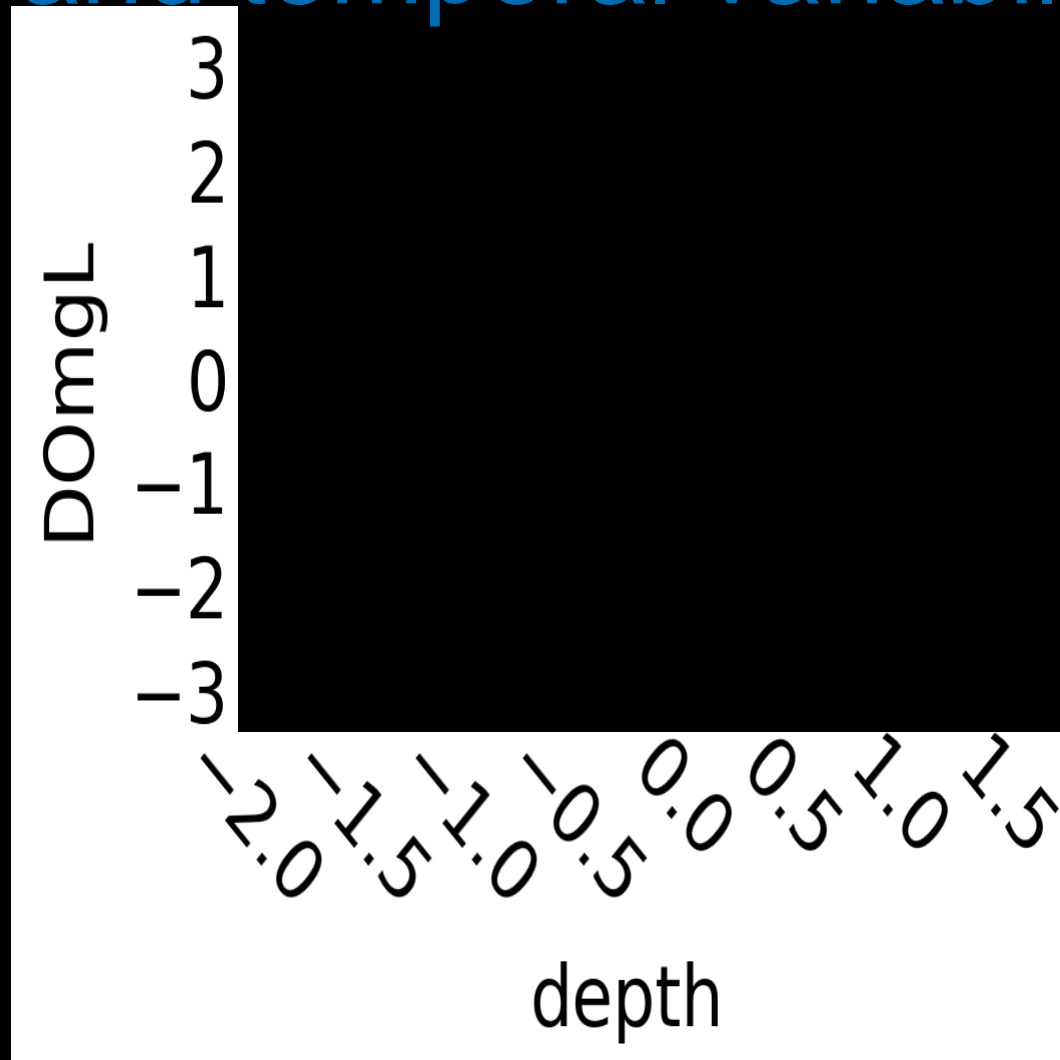


Vertical/Along-Slough Variability

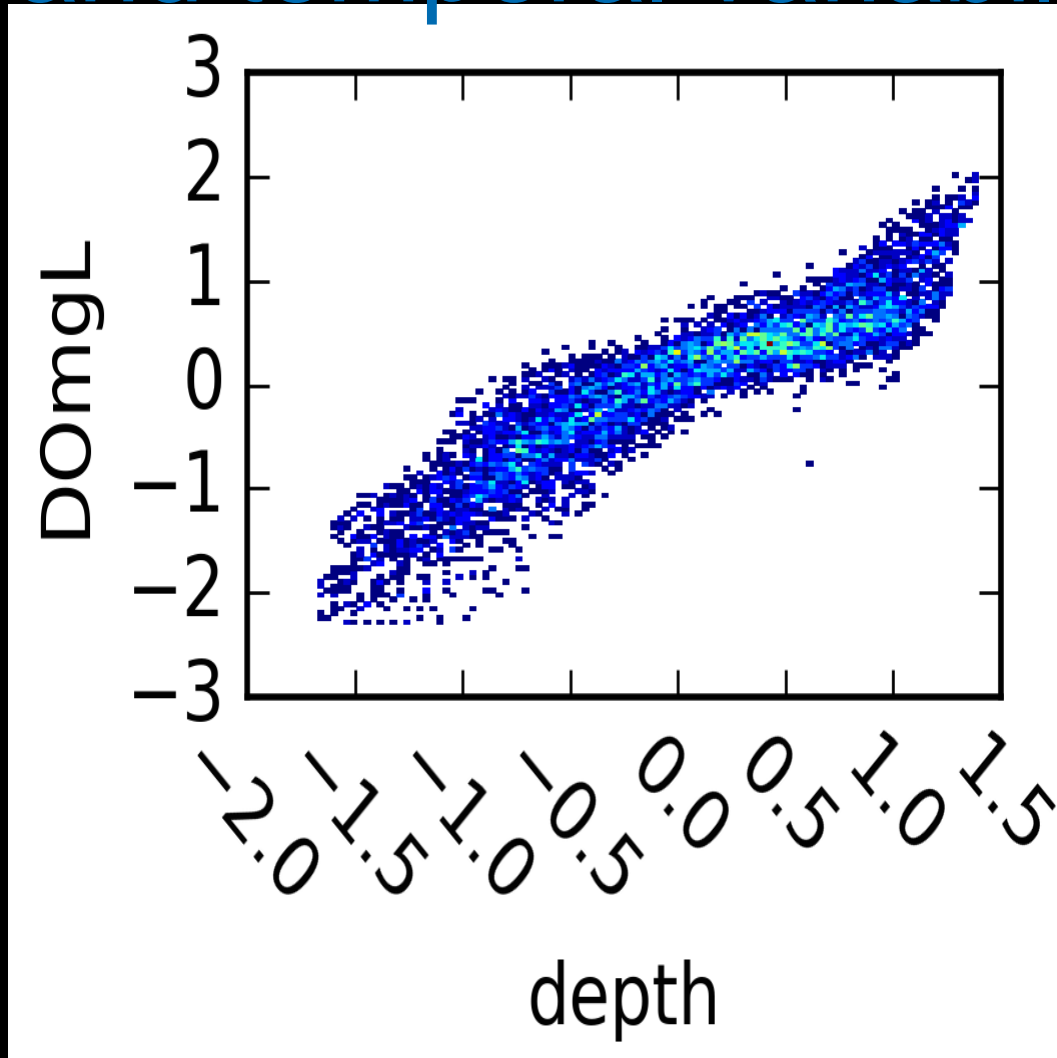
- Vertical ✓
- Cross-channel ?
- Along-channel ✓
- Inter-site ✓
- Temporal ✓



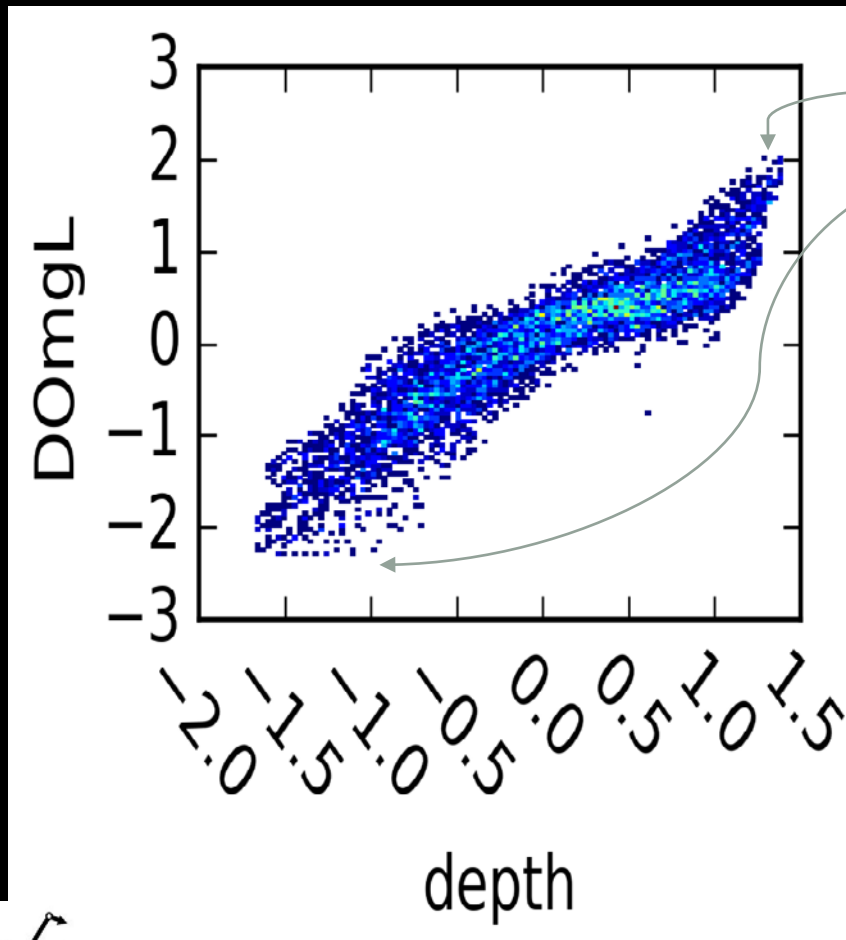
What causes inter-site and temporal variability?



What causes inter-site and temporal variability?



What causes inter-site and temporal variability?



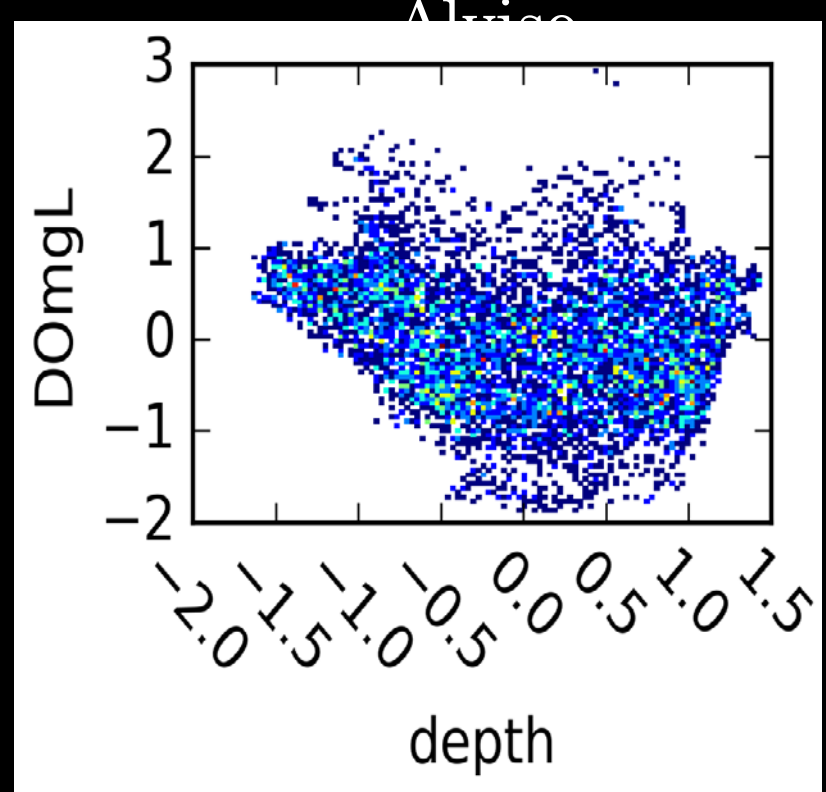
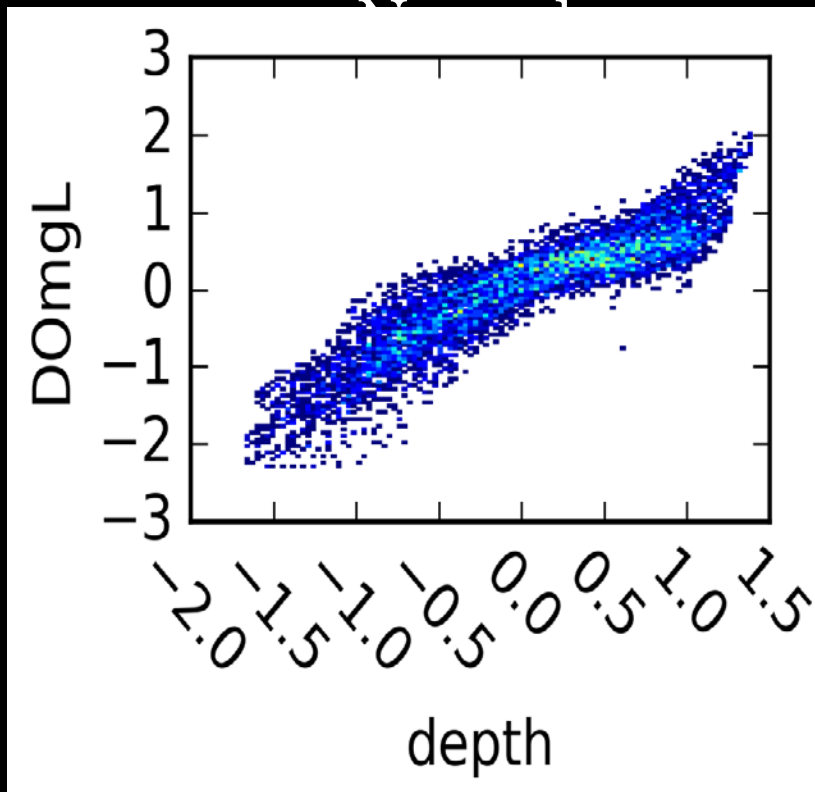
Open Bay is well mixed, well aerated
Marshes and sediments (mud) are net heterotrophic



And then there's Alviso...

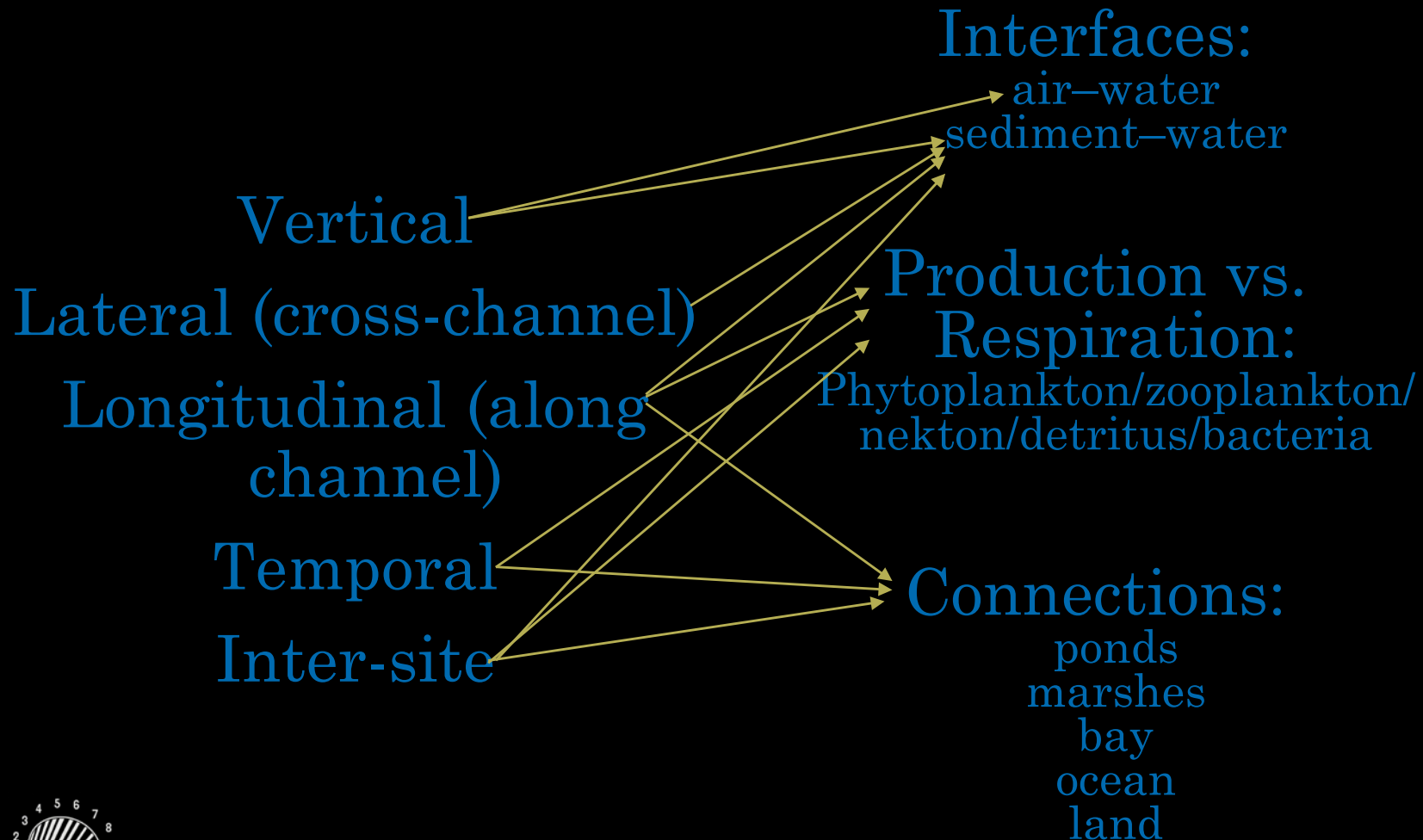


And then there's Alviso...



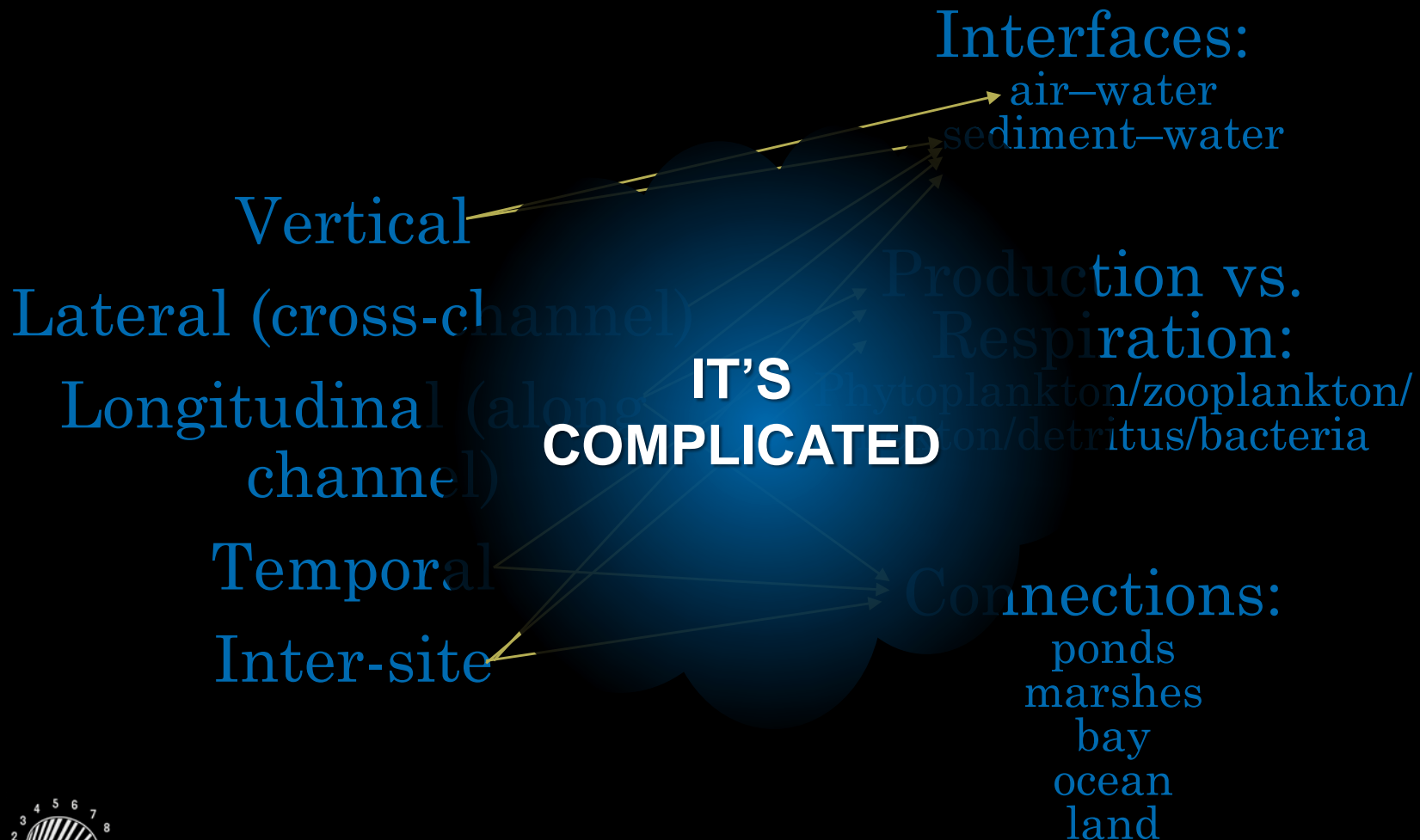
Dimensions

Drivers of variability in DO



Dimensions

Drivers of variability in DO



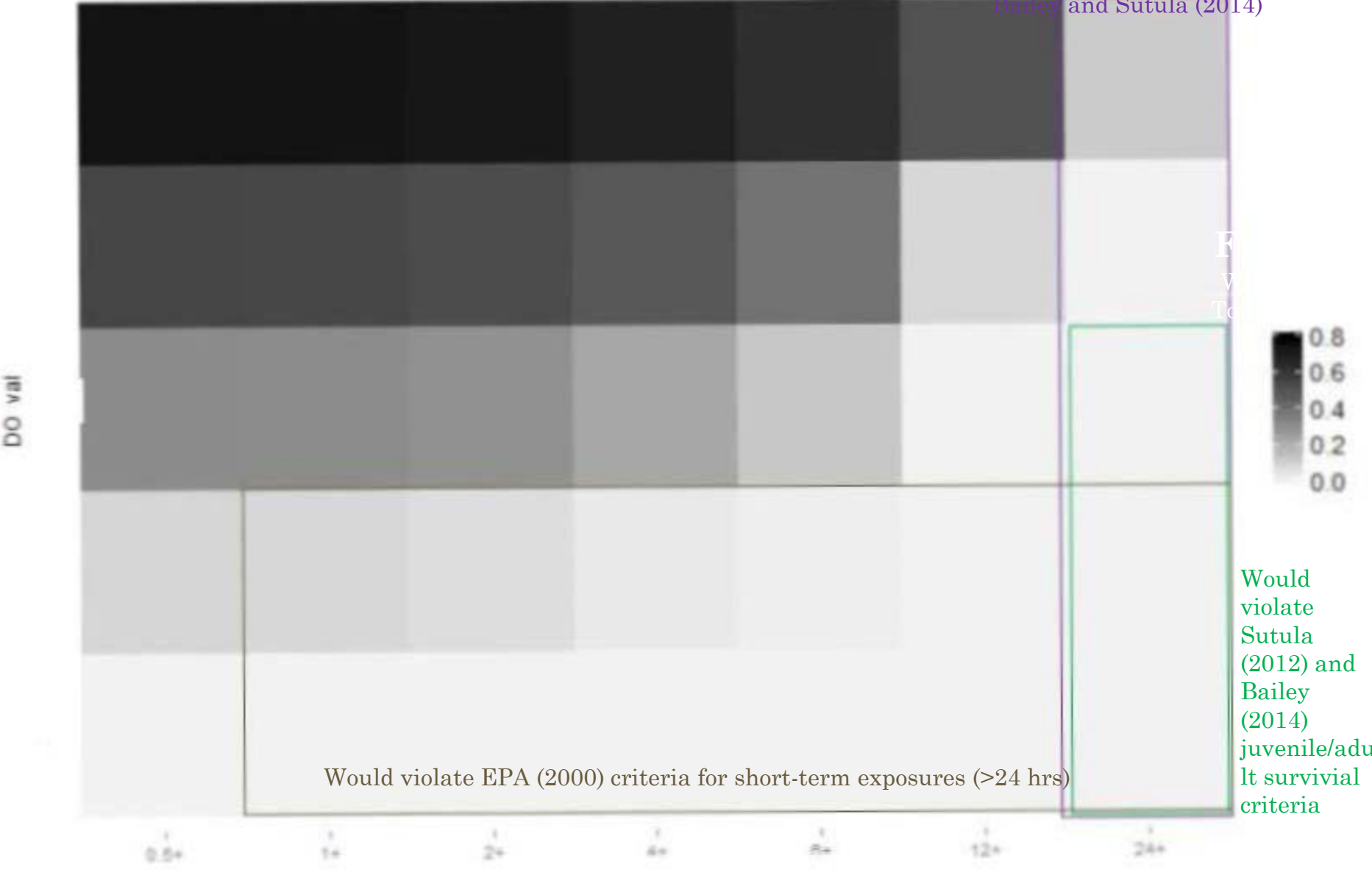
We then passed this data through some existing suggested criteria from other regions (knowing that the indicator species may not be most appropriate for SFB):

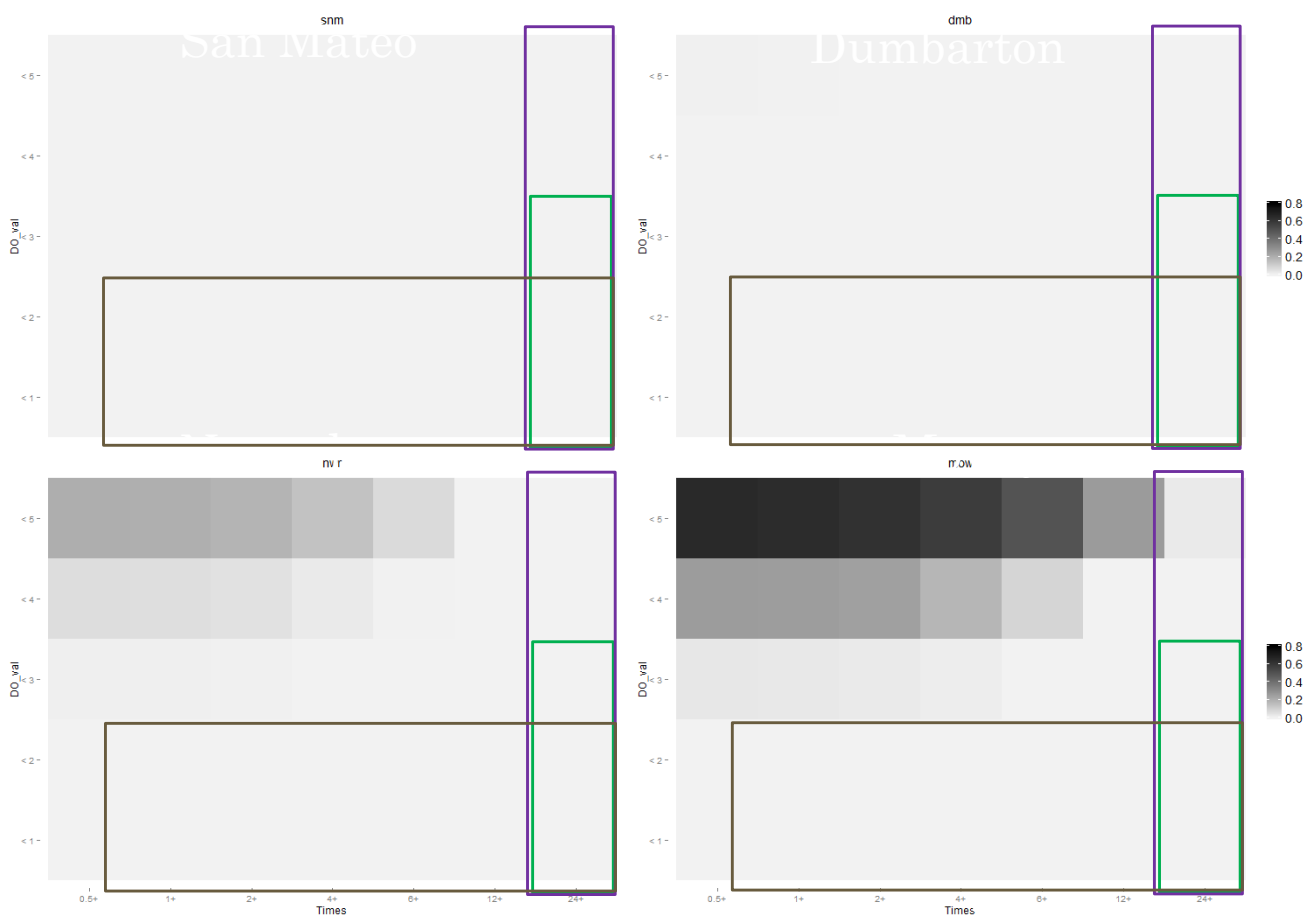
--EPA (2000): for Virginia Province

--Sutula (2012): all of CA, except SFB

--Bailey (2014): Suisun Marsh, in SFB

Would violate growth criteria from EPA (2000), Sutula (2012) and Bailey and Sutula (2014)





- Relevant species for Lower South Bay?
- DO chronic data for those species?

