An aerial photograph of a coastal town and estuary. The town is built on a hillside overlooking a large body of water, likely an estuary or bay. The water is a mix of blue and brown, indicating sediment. In the background, there are mountains under a clear blue sky. The text is overlaid on the image.

First Results from the Catalina Dynamic Ocean Chemistry (CDOC) Program

Craig Gelpi
CalCOFI Conference
La Jolla, CA

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www.catalinamarinesociety.org

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Introduction

- Realizations and ramifications of ocean acidification will depend greatly on local conditions
- Conditions around Santa Catalina differ markedly from most other Channel Islands
- CDOC to determine island averages, seasonal modulations, depth gradients and insights for pH

Instrumentation



Executed with Xylem YSI EXO sondes.

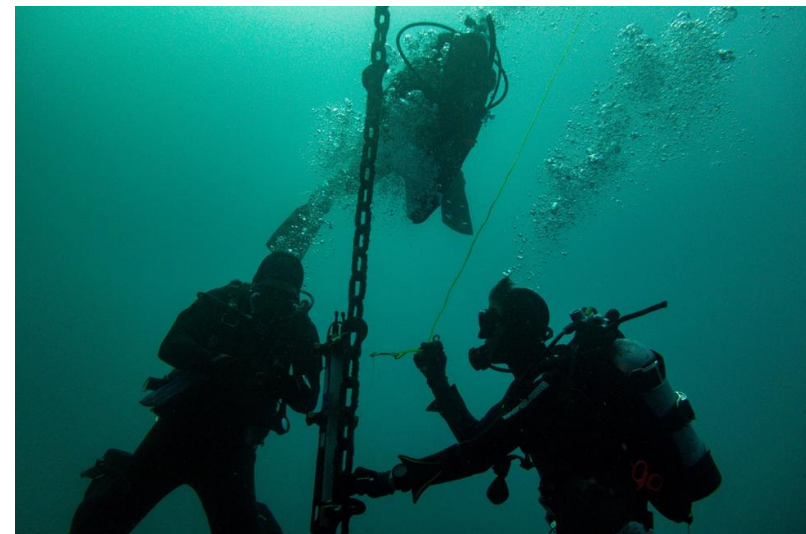
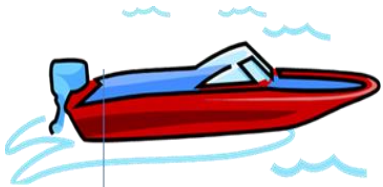


Parameter	Accuracy
Temperature Sonde	$\pm 0.2^{\circ} \text{C}$
Temperature thermographs	$\pm 0.2^{\circ} \text{C}$
Conductivity	$\pm 1.0\%$
pH	$\pm 0.1 \text{ pH unit}$
Dissolved Oxygen	$\pm 0.1 \text{ mg/l or } 1\% \text{ of reading}$
Chlorophyll	Not calibrated

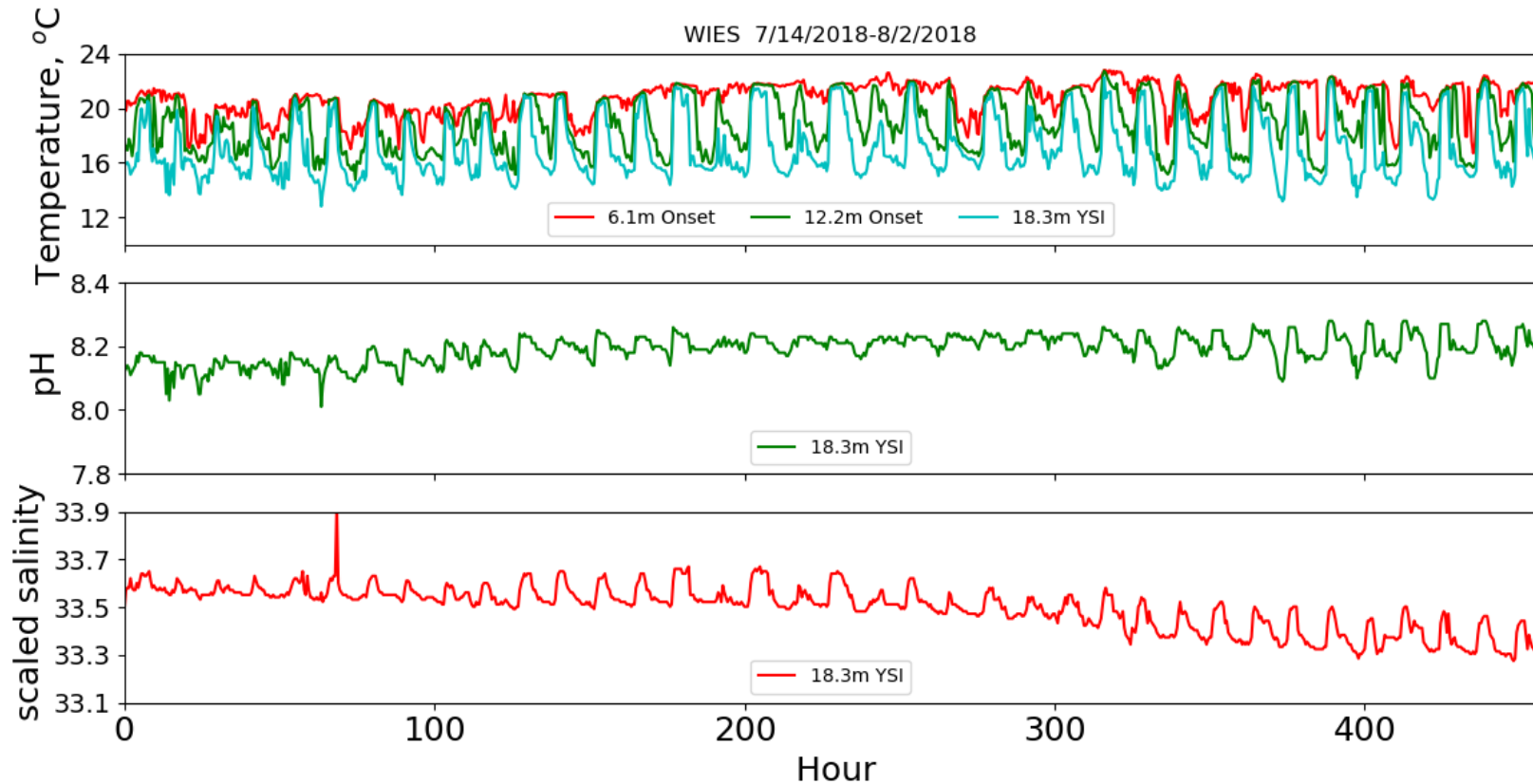


Two Protocols

1. Fixed-depth, 18.3-m depth on mooring, 5 expeditions
 - Additional thermograph string 6.1, 12.2 and 24.4 m
2. Depth-profiling: 15 expeditions, 5 depths
 - 6.1, 12.2, 18.3, 24.4, 30.5 meters



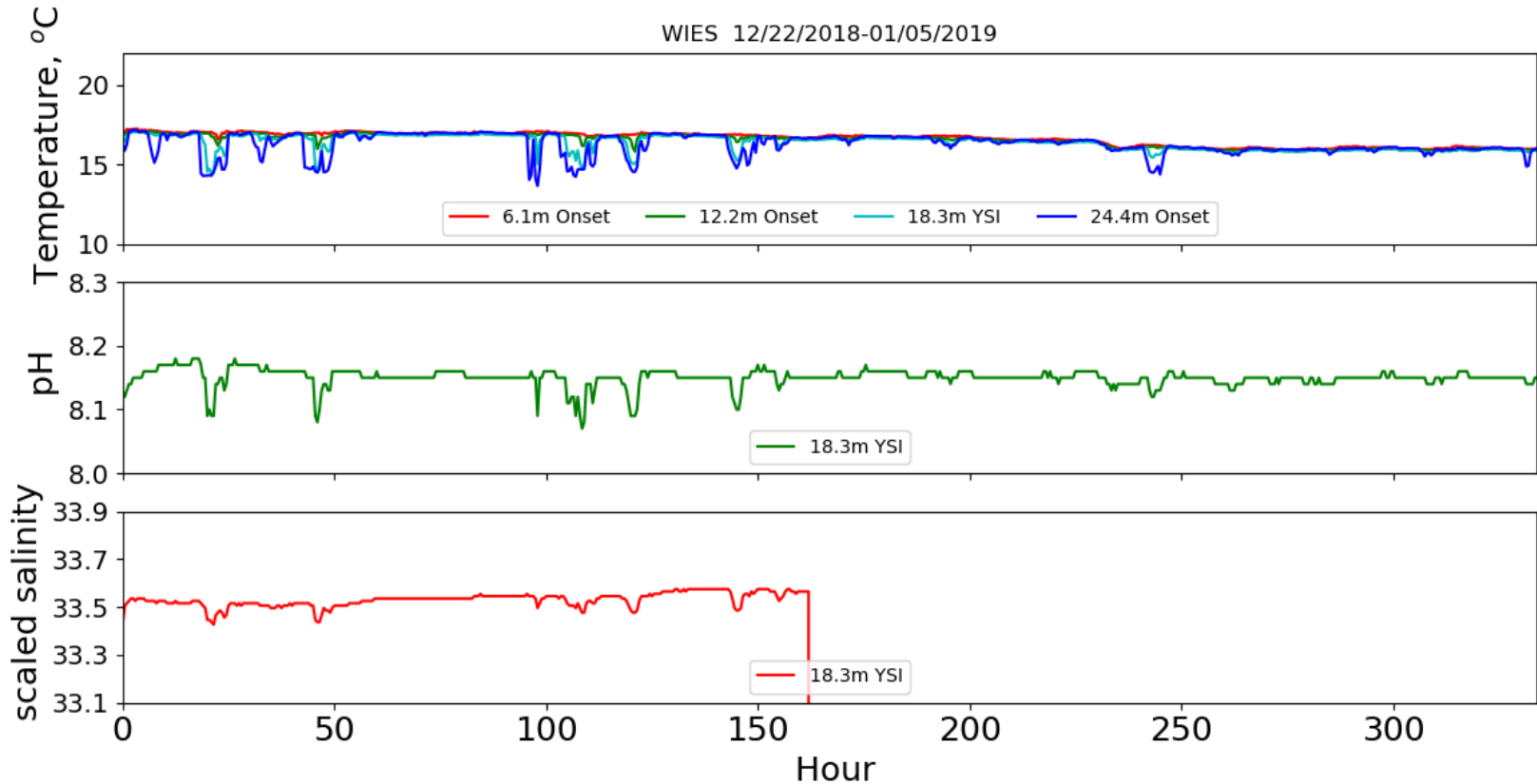
Typical summer conditions at mooring



pH modulated with internal waves, 0.1 unit change

Changing source water with lower salinity, higher pH

Winter conditions at mooring



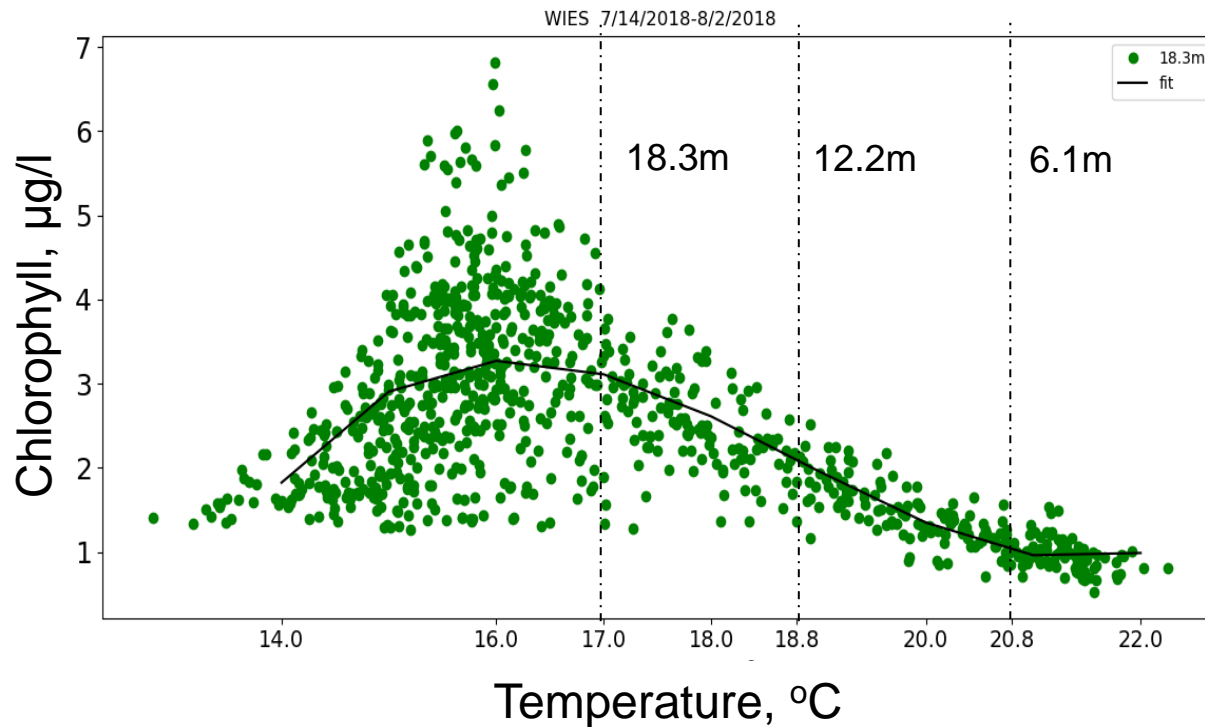
pH drops correspond to upwellings

Chlorophyll from Mooring & Depth Dependences, July 2018



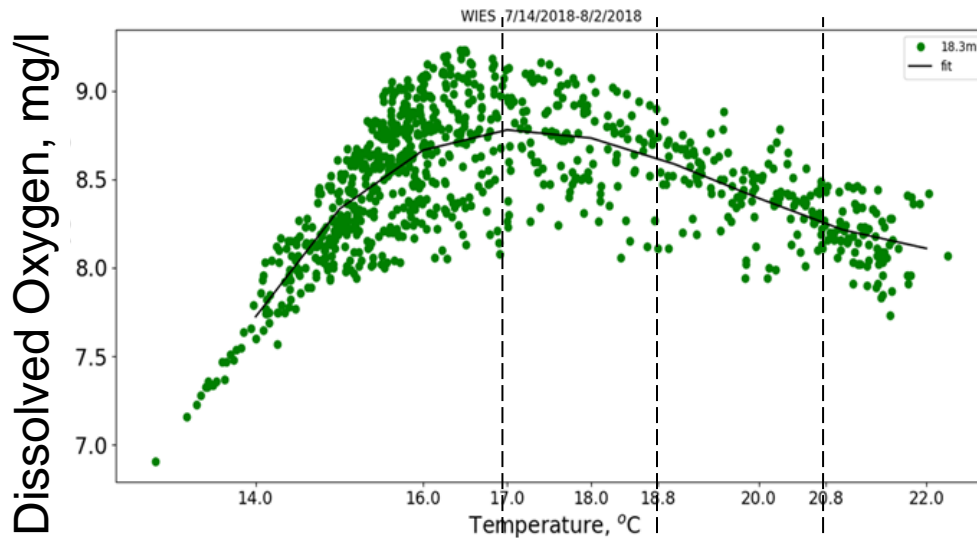
Data = $D(T)$ at fixed depth, $T = T(z)$ from thermograph string, $D = D(T(z))$

$\langle T(z) \rangle_{time}$

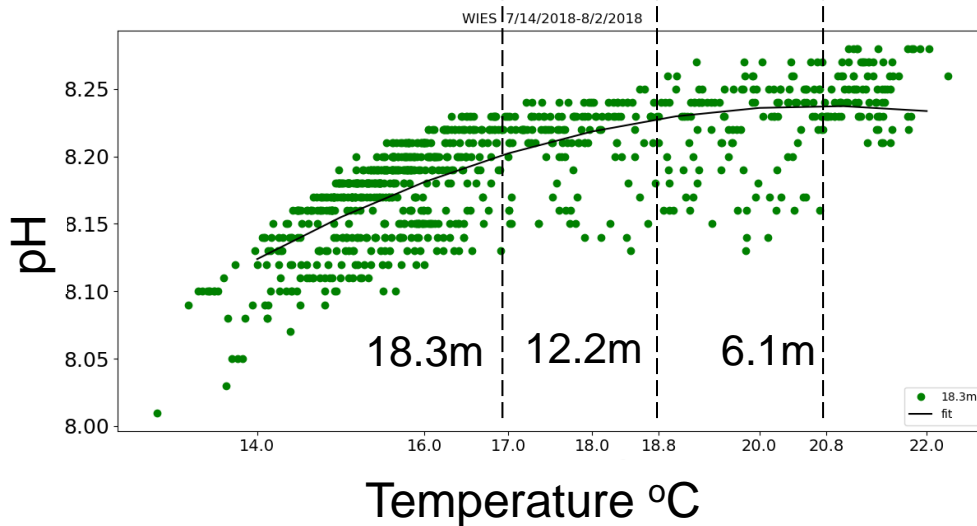


Chlorophyll maximum typically is below the sonde.

Inferred Depth Dependence for Dissolved Oxygen and pH

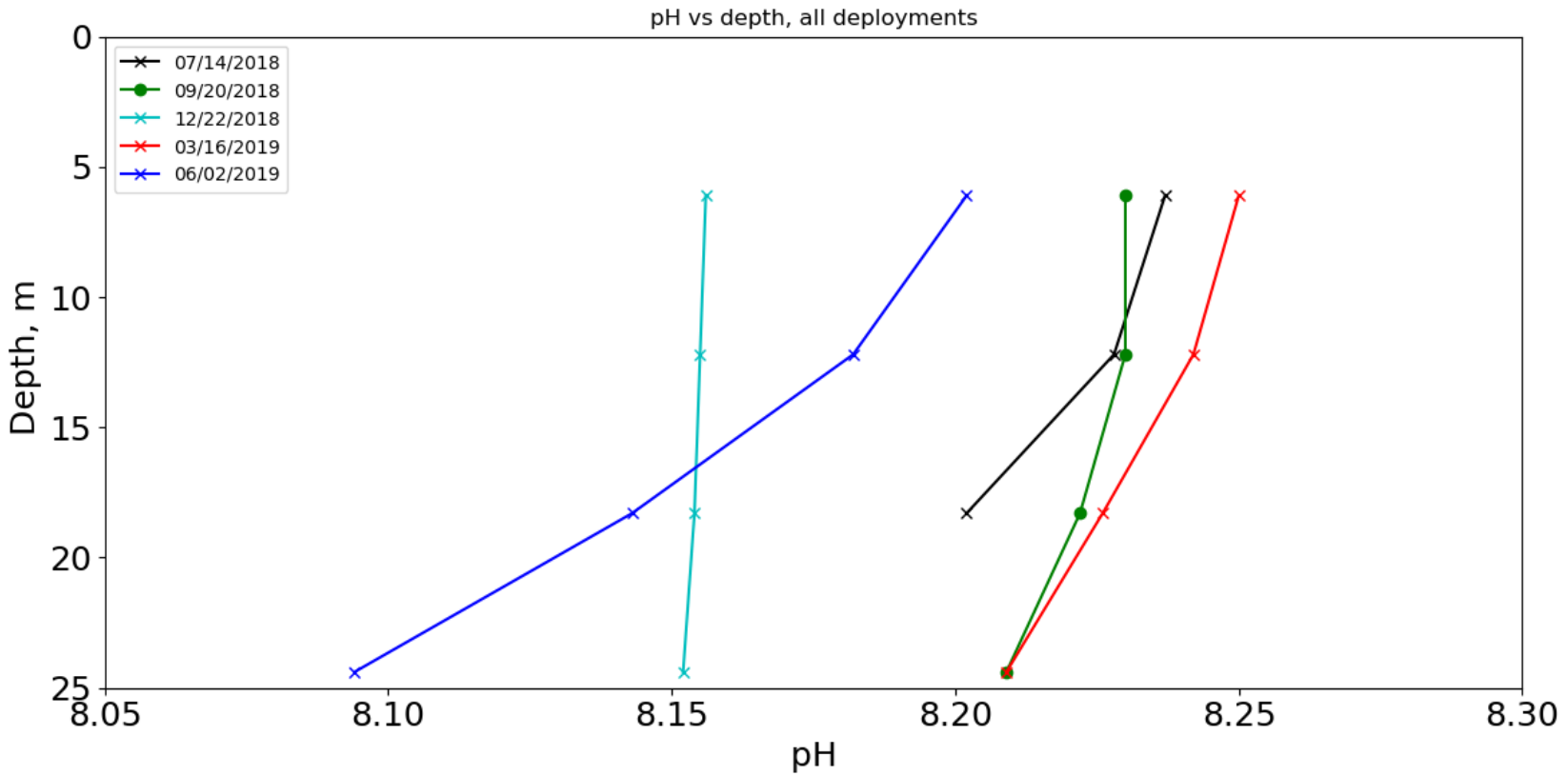


Oxygen maximum is below sonde.



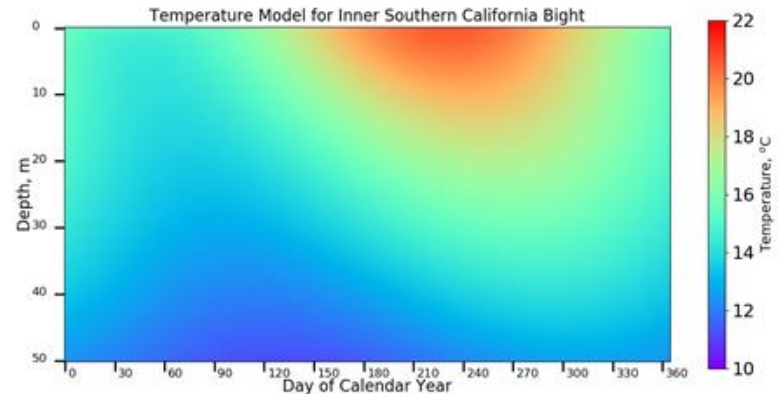
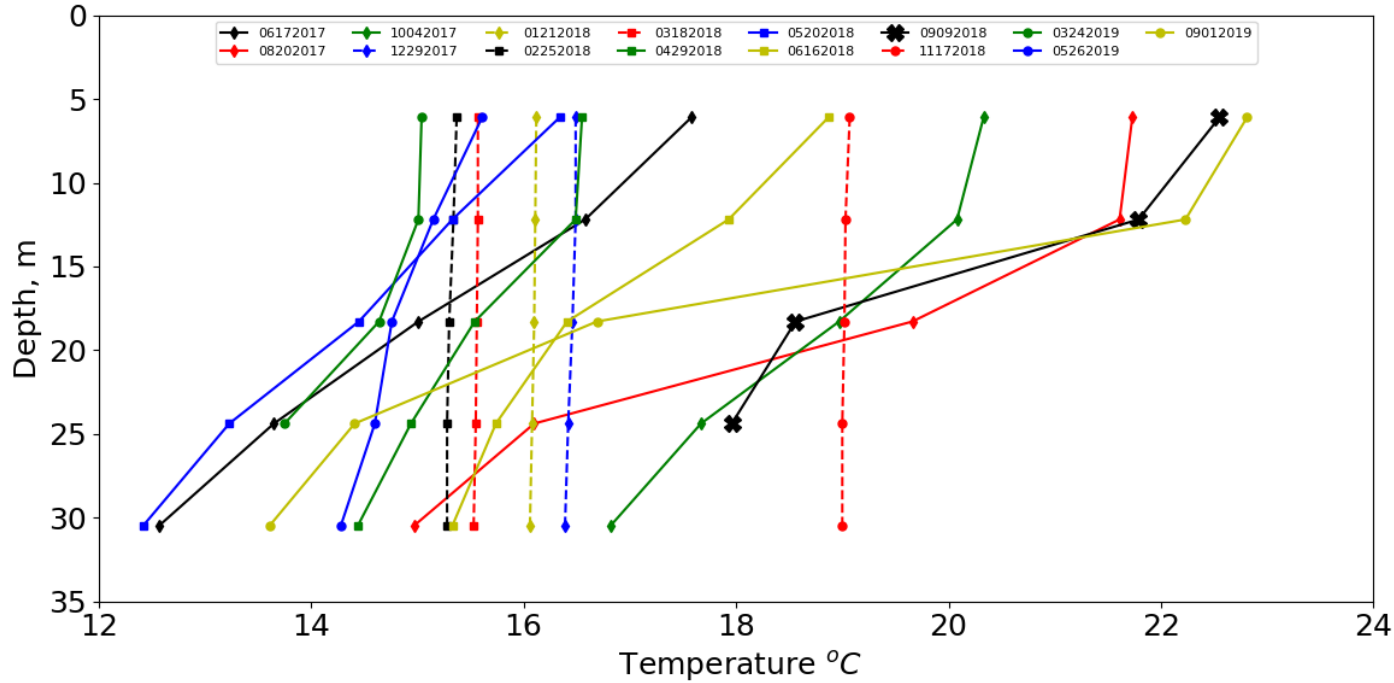
No obvious relation between pH and biological activity.

Inferred pH profile from mooring



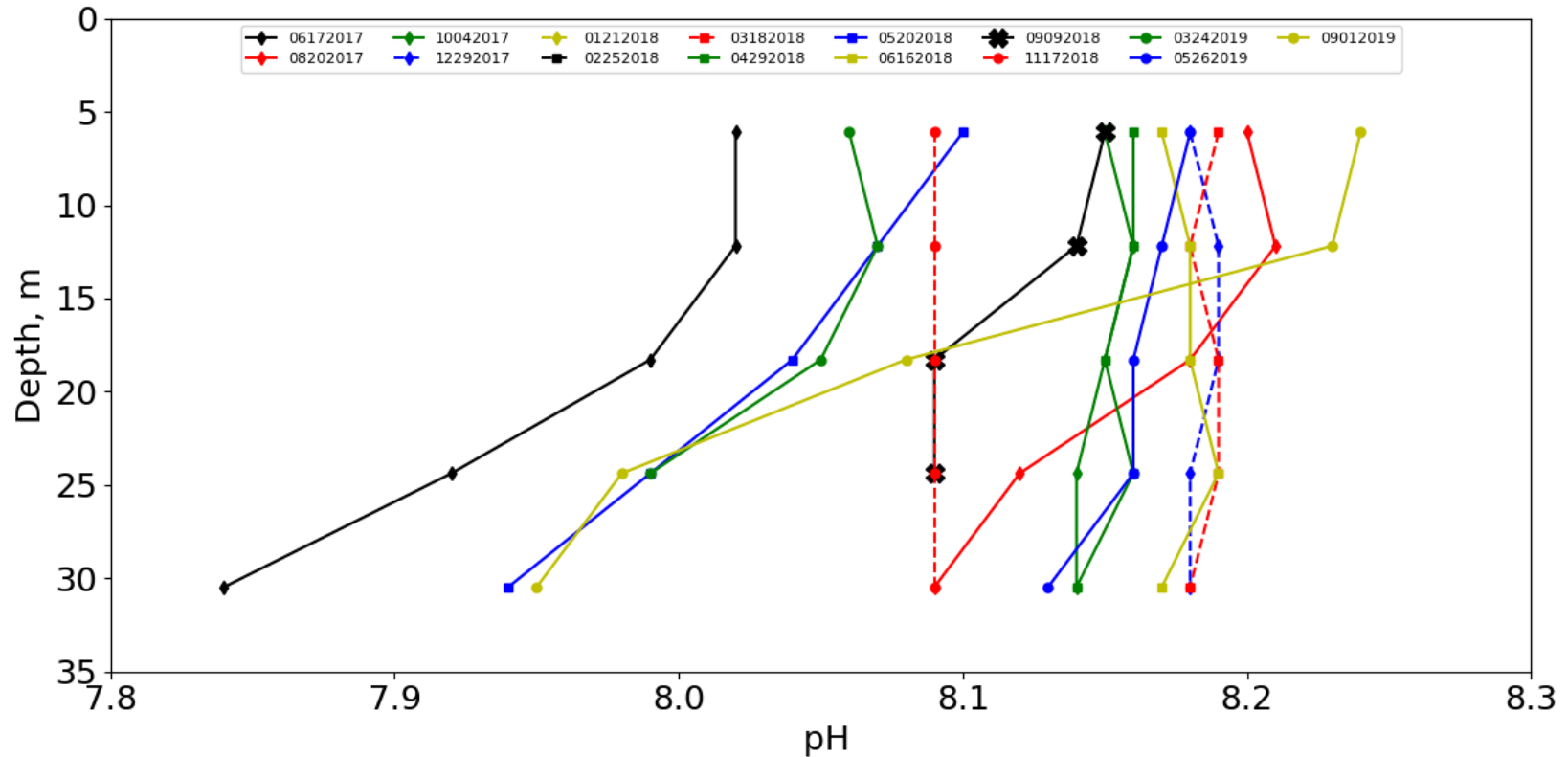


Temperature from Depth Profiles



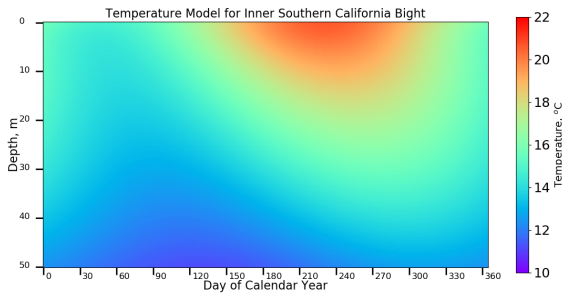
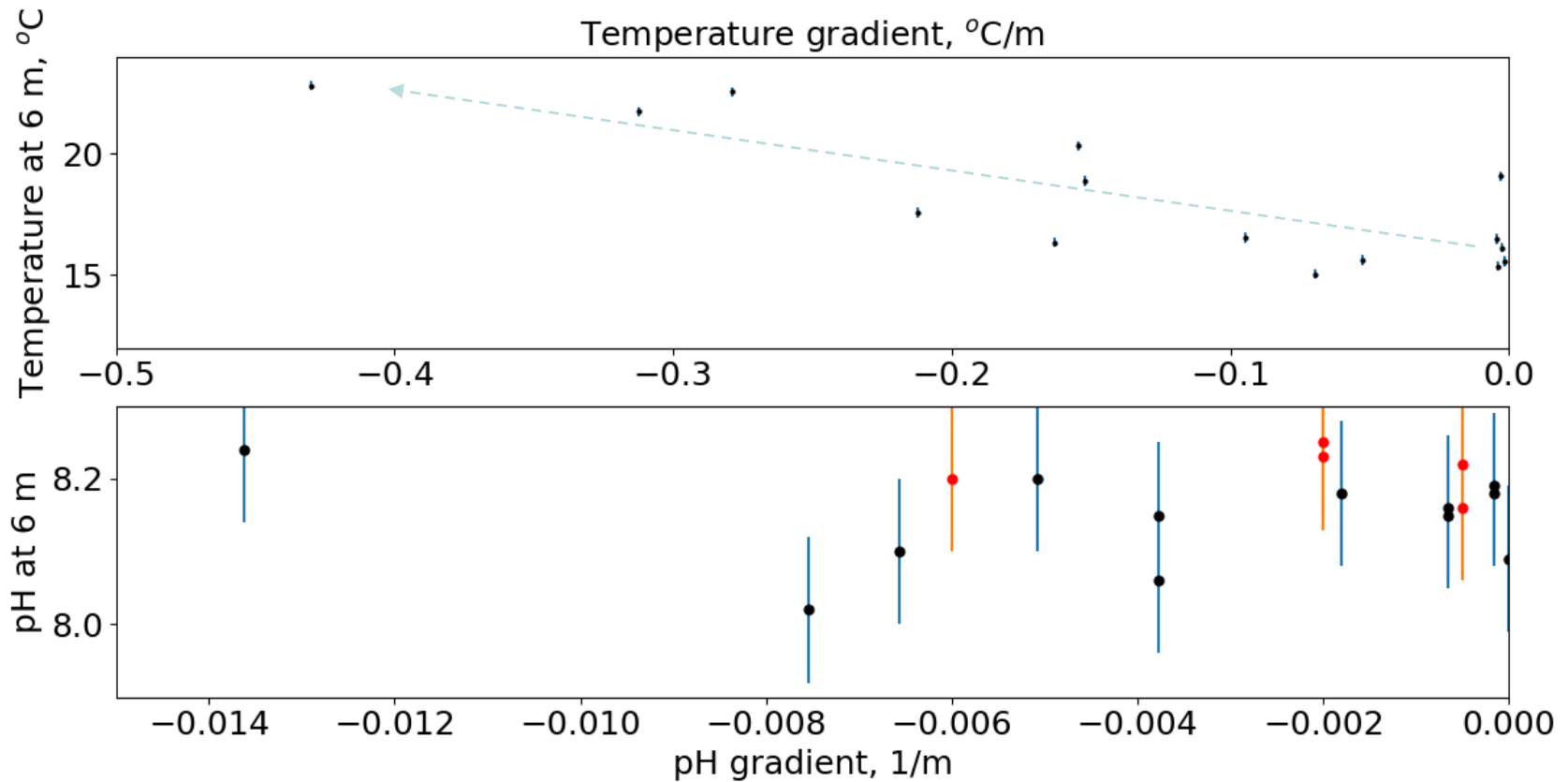


pH from Depth Profiles



Max change is 0.3 unit 6 m to 30 m

Surface value vs gradient



Near-surface pH is independent of pH gradient



pH Averages

Mooring 18.3 m

Date	Average pH
07/14/2018-08/02/2018	8.19
09/20/2018-10/12/2018	8.21
12/22/2018-01/05/2019	8.14
03/16/2019-03/30/2019	8.22
06/01/2019-06/15/2019	8.12

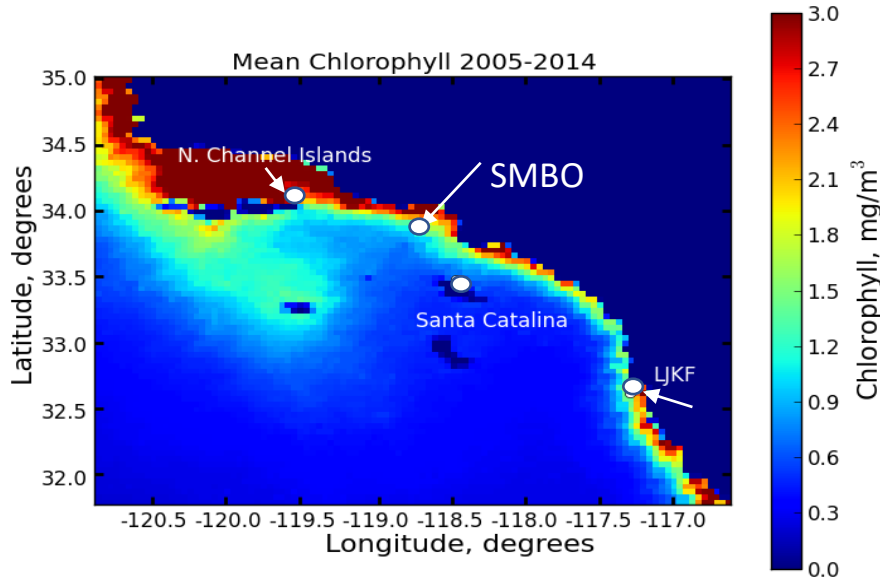
Profiles

Mean 8.18

Depth, m	Average pH
6.1	8.14
12.2	8.14
18.3	8.12
24.4	8.10
30.5	8.09



pH Comparison and Discussion



Frieder et al., (2012) La Jolla Kelp Forest pH measurements

7.9 median value (17-m depth)

Leinweber and Gruber (2013) at Santa Monica Bay Observatory

8.08 median value (surface to 20 m)

Kapsenberg and Hofmann (2016) N. Channel Islands

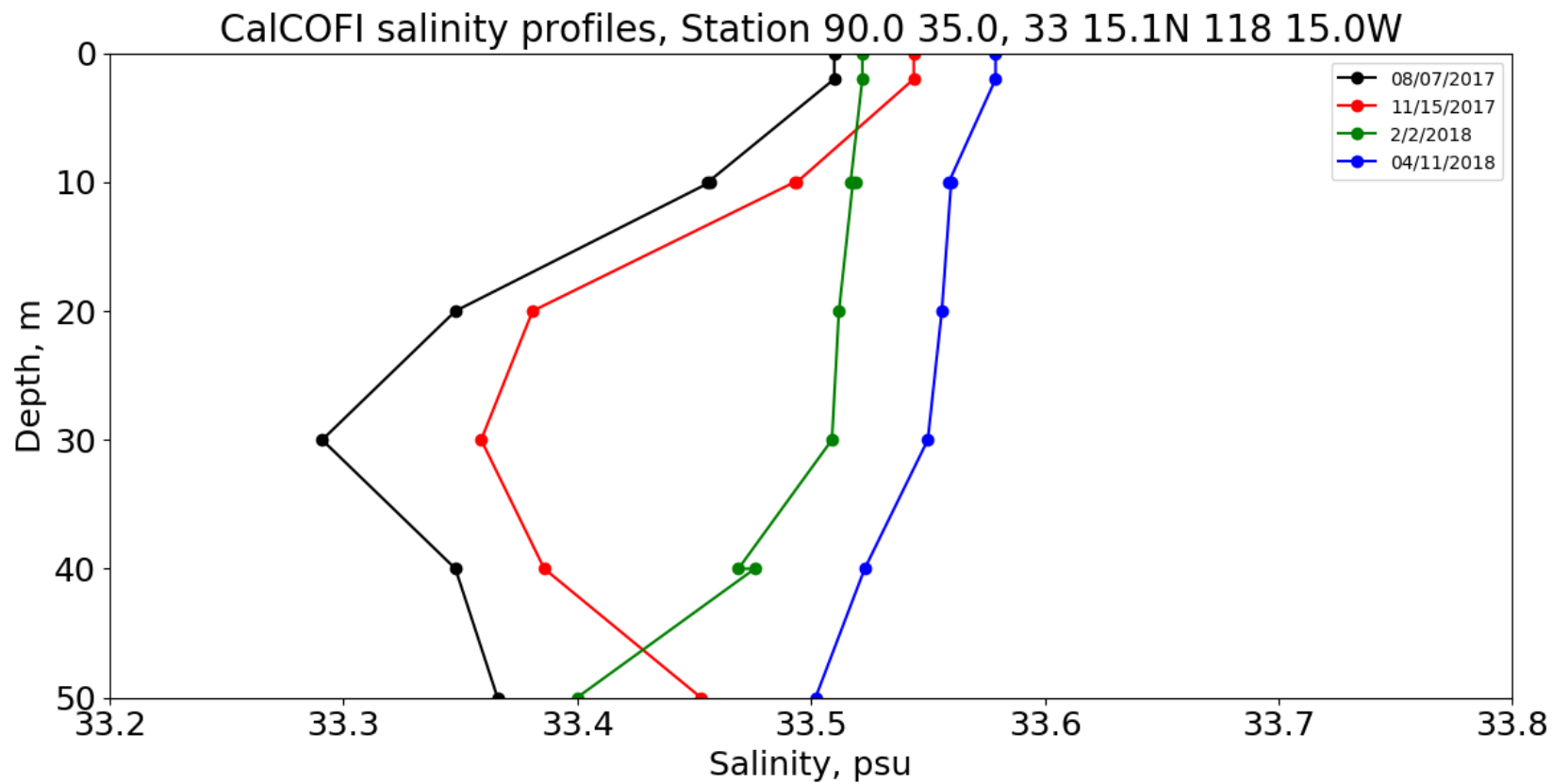
8.00 +/- 0.043 Anacapa Landing Cove (6-m depth?)

pH is higher at Santa Catalina



Conclusions

- Catalina average pH (~ 8.15) is higher than values found at Northern Channel Islands and mainland sites.
- Large pH modulations (>0.1) produced by internal-wave vertical advection
 - Larger modulations at depth relative to surface
- pH depth gradients follow seasonal stratification (0 unit/m to 0.012 unit/m)
 - However, pH behaves differently than temperature
 - sources/sinks?





WIES 7/14/2018-8/2/2018

