



Apr 5th, 2:30 PM - 2:45 PM

Salish Sea model: ocean acidification module and the response to regional anthropogenic nutrient sources

G. J. Pelletier

Washington (State). Department of Ecology, greg.pelletier@ecy.wa.gov

Laura Bianucci

Canada. Department of Fisheries and Oceans, laura.bianucci@gmail.com

Wen Long

Tecplot, United States, w.long@tecplot.com

Tarang Khangaonkar

Pacific Northwest National Laboratory (U.S.), tarang.khangaonkar@pnnl.gov

Teizeen Mohamedali

Washington (State). Department of Ecology, tmoh461@ecy.wa.gov

See next page for additional authors

Follow this and additional works at: <https://cedar.wwu.edu/ssec>



Part of the [Fresh Water Studies Commons](#), [Marine Biology Commons](#), [Natural Resources and Conservation Commons](#), and the [Terrestrial and Aquatic Ecology Commons](#)

Pelletier, G. J.; Bianucci, Laura; Long, Wen; Khangaonkar, Tarang; Mohamedali, Teizeen; Ahmed, Anise; Figueroa-Kaminsky, Cristiana; and Bednarsek, Nina, "Salish Sea model: ocean acidification module and the response to regional anthropogenic nutrient sources" (2018). *Salish Sea Ecosystem Conference*. 362. <https://cedar.wwu.edu/ssec/2018ssec/allsessions/362>

This Event is brought to you for free and open access by the Conferences and Events at Western CEDAR. It has been accepted for inclusion in Salish Sea Ecosystem Conference by an authorized administrator of Western CEDAR. For more information, please contact westerncedar@wwu.edu.

Speaker

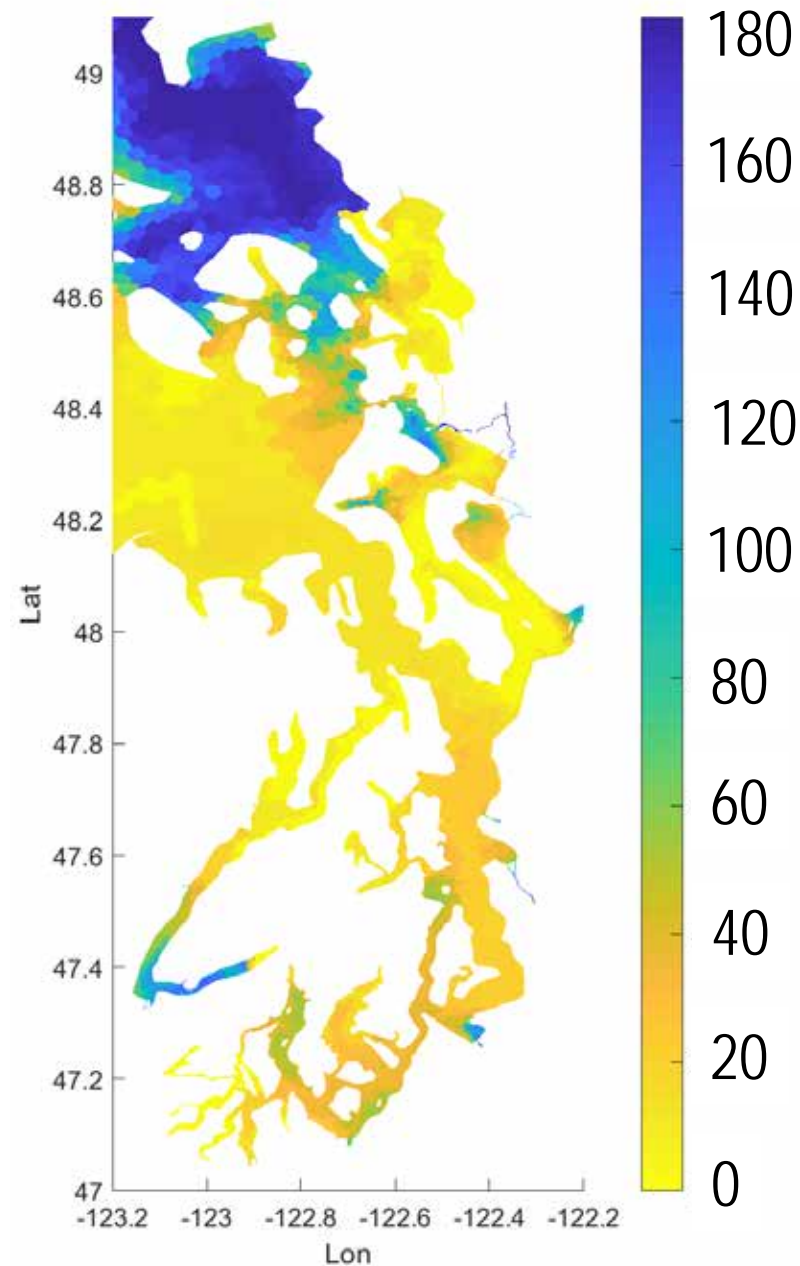
G. J. Pelletier, Laura Bianucci, Wen Long, Tarang Khangaonkar, Teizeen Mohamedali, Anise Ahmed, Cristiana Figueroa-Kaminsky, and Nina Bednarsek

Salish Sea Model

Ocean acidification and
the response to regional
anthropogenic nutrient
sources

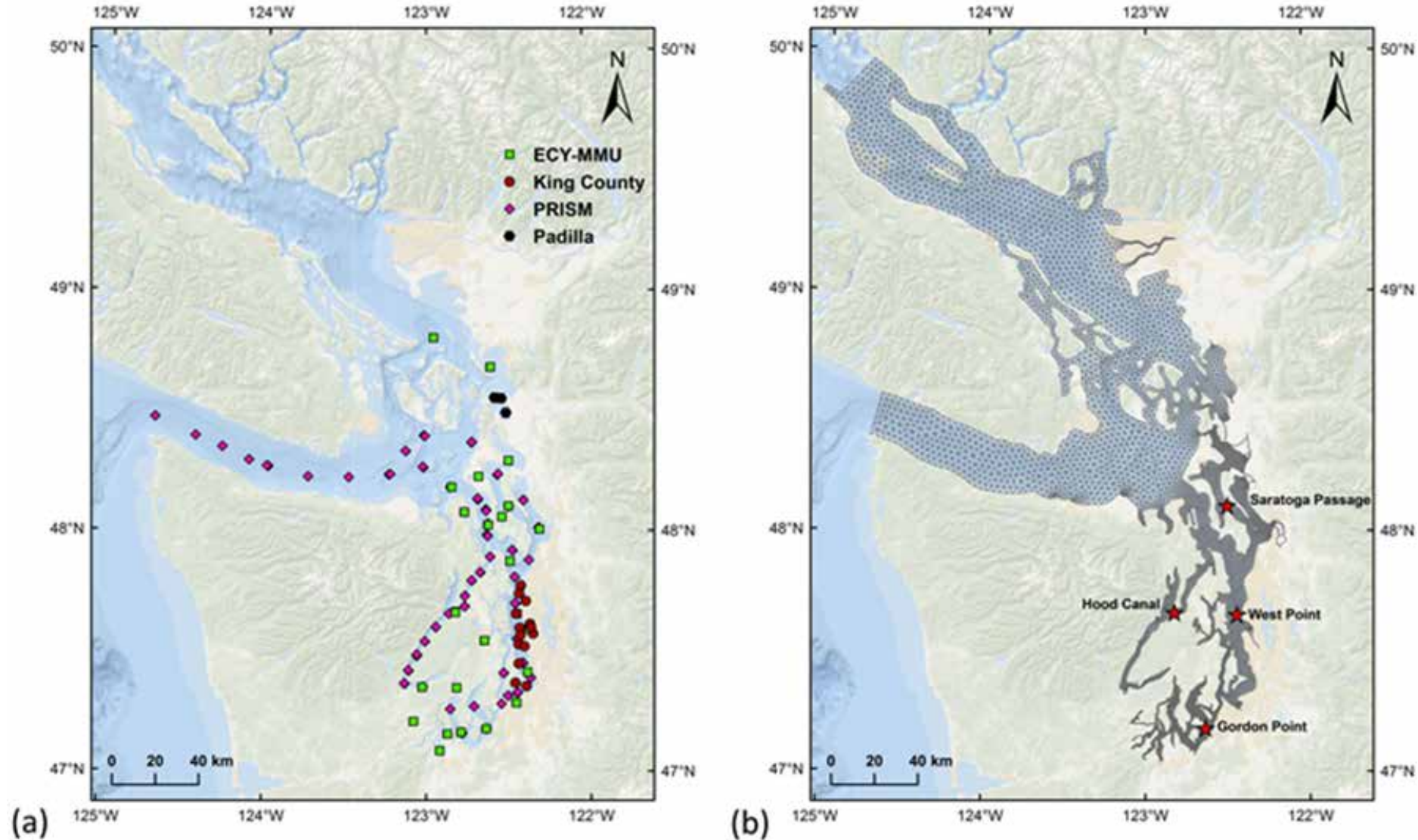
Greg Pelletier, Laura Bianucci,
Wen Long, Tarang Khangaonkar,
Teizeen Mohamedali, Anise
Ahmed, Cristiana Figueroa-
Kaminsky, and Nina Bednaršek

Department of Ecology
Pacific Northwest National Laboratory
SCCWRP
SSEC2018, 05 Apr 2018



Apr-Sep 2008
cumulative
days with
 $\Omega_A < 1$
for > 7 days,
0-20m

Bianucci *et al.* 2018 (doi.org/10.1525/elementa.151)

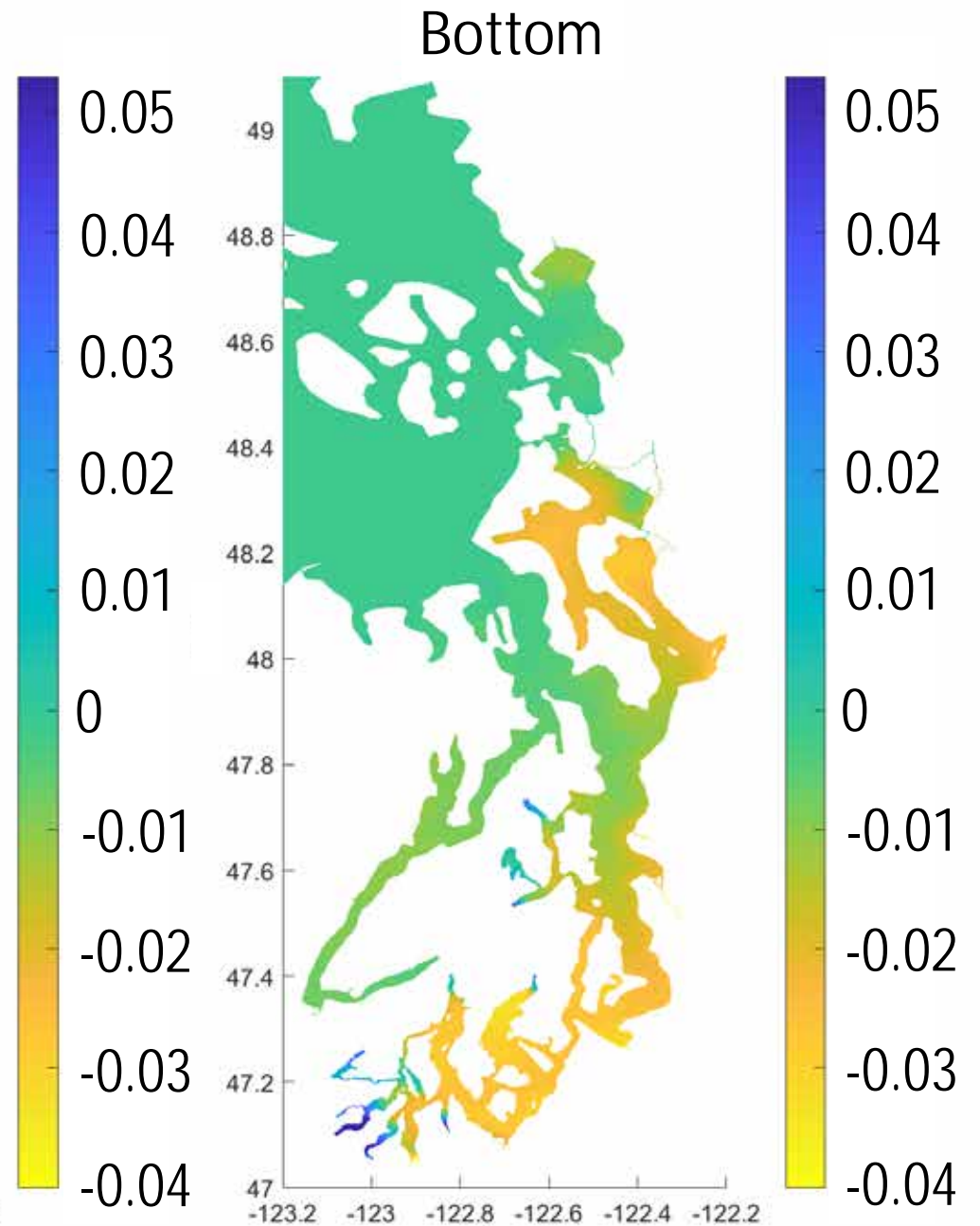
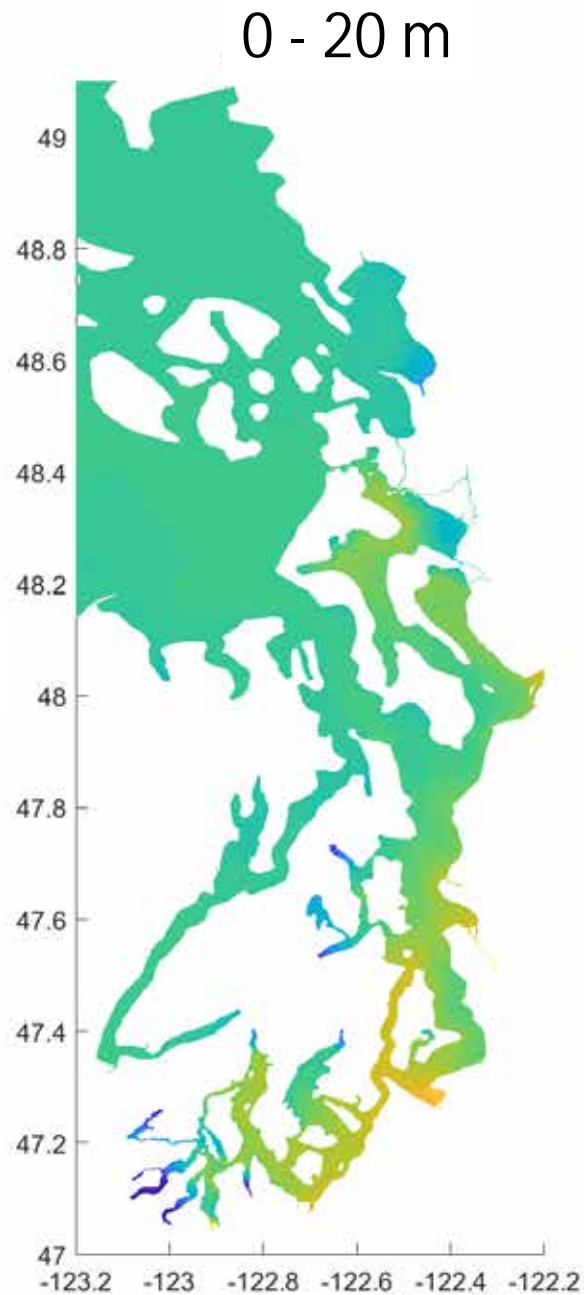


(a) Location of observations in 2008, and (b) the Salish Sea Model domain.

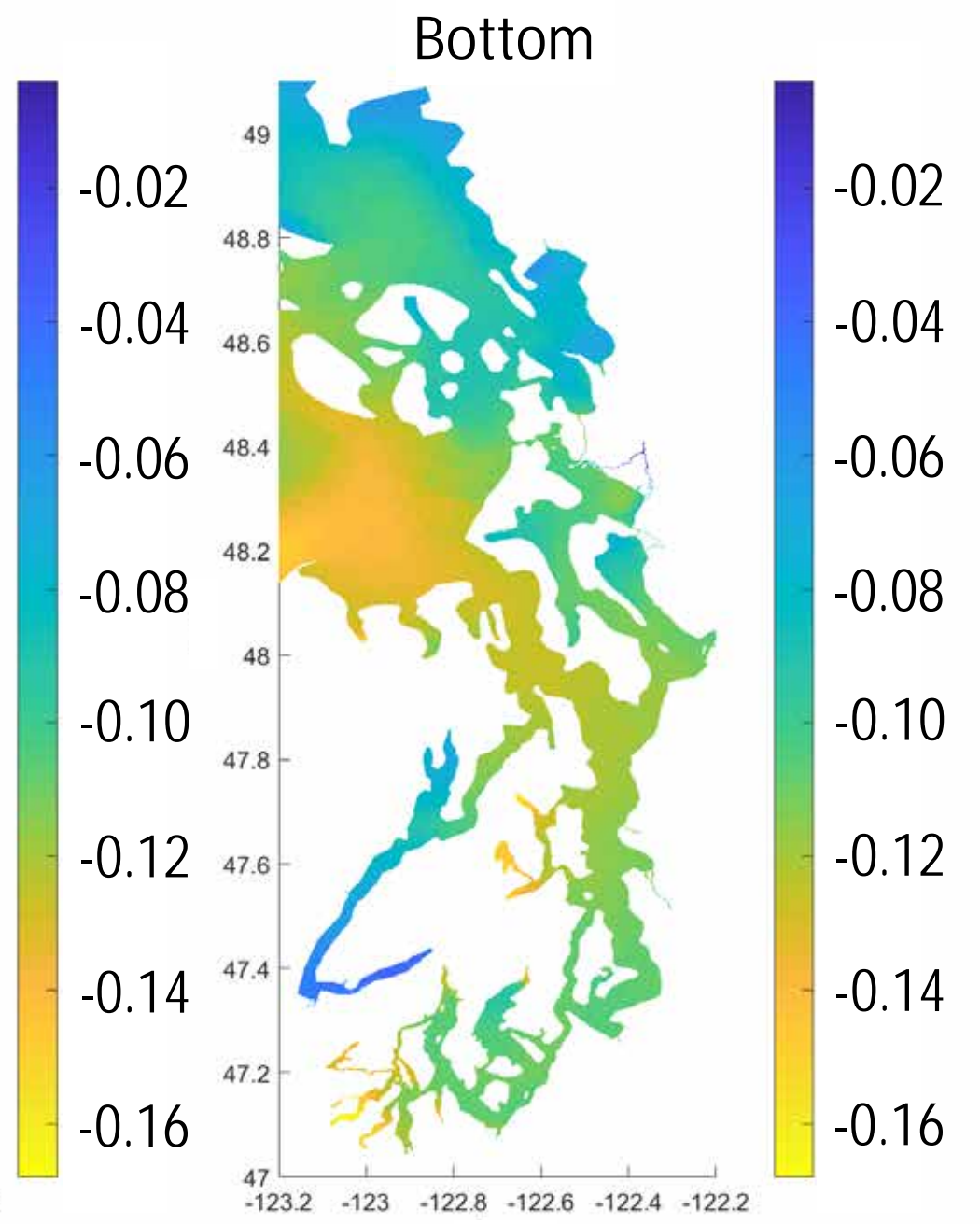
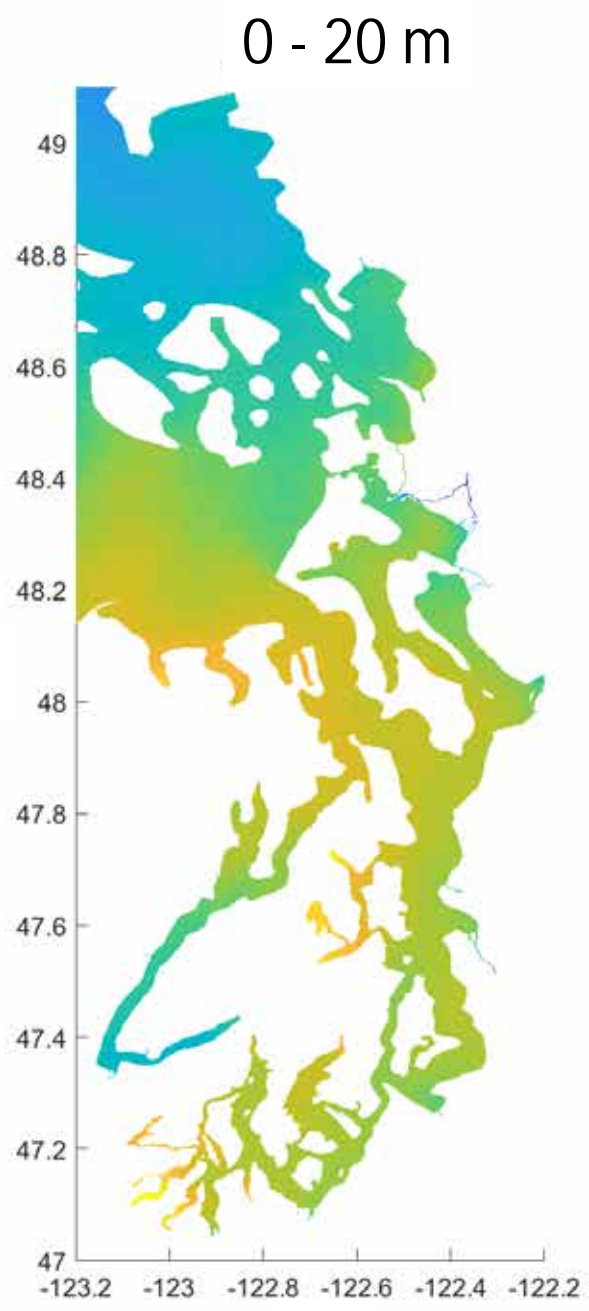
Model scenarios

1. Realistic historical conditions during 2008
2. Reference conditions that are the same as historical 2008 conditions, except with regional anthropogenic nutrient sources excluded
3. Reference conditions that are the same as historical 2008 conditions, except with atmospheric $p\text{CO}_2 = 280$ ppm, and ocean $p\text{CO}_2$ reduced by 110 ppm
4. Reference conditions without regional anthropogenic nutrients and without global anthropogenic atmospheric CO_2

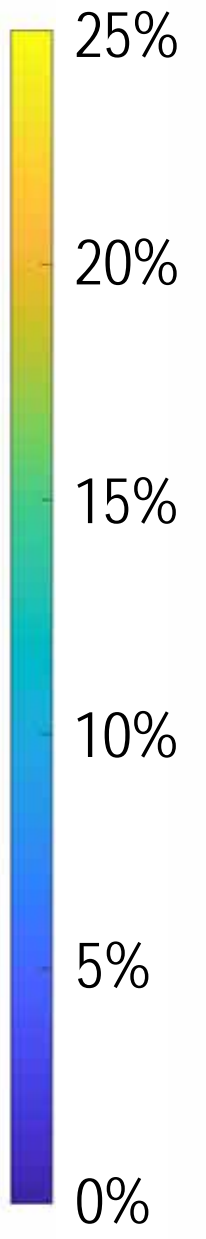
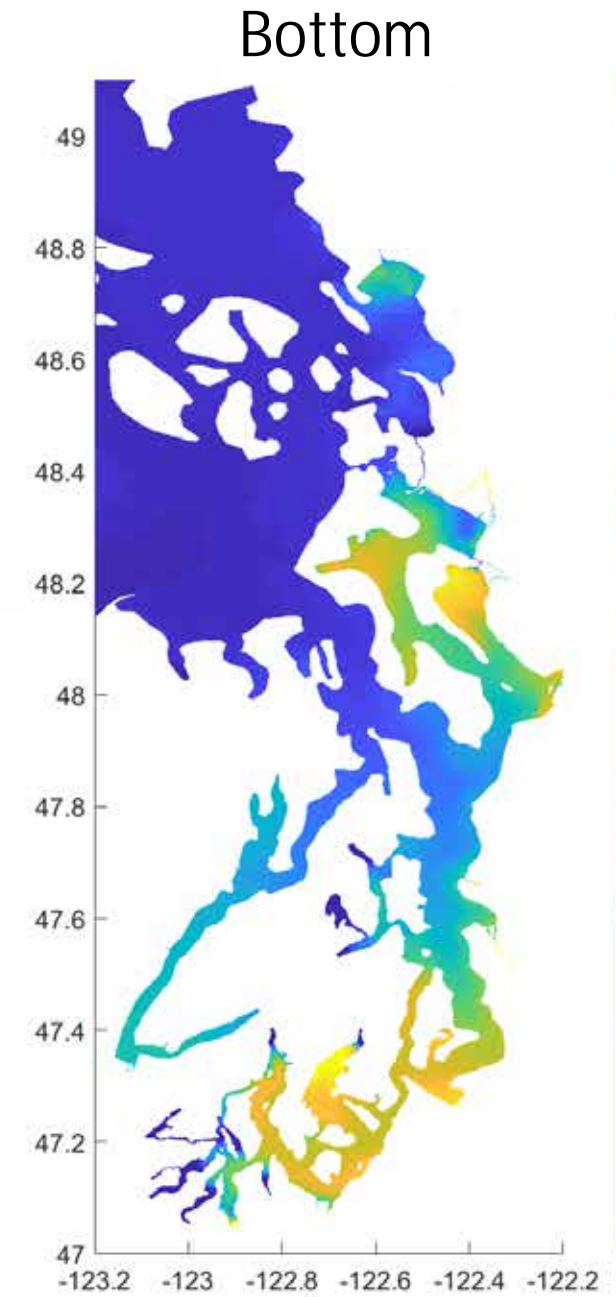
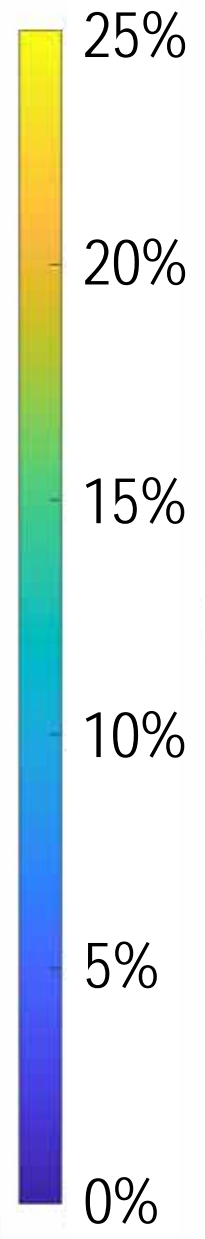
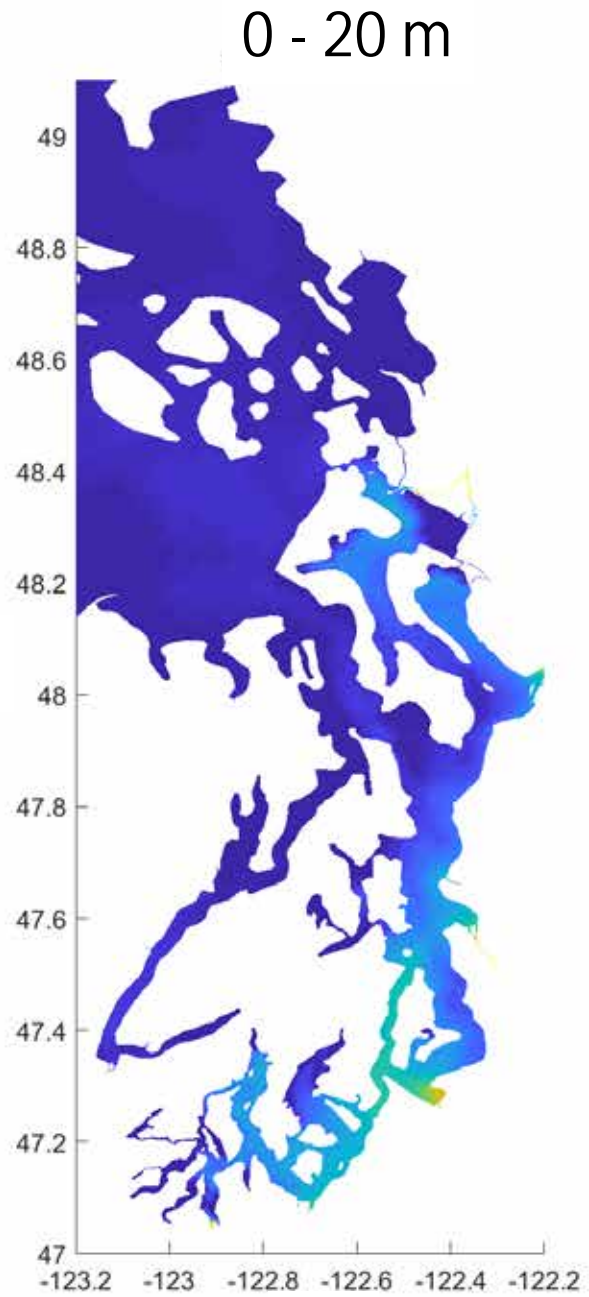
Annual average change in Ω_A due to regional anthropogenic nutrients



Annual average change in Ω_A due to global anthropogenic CO_2



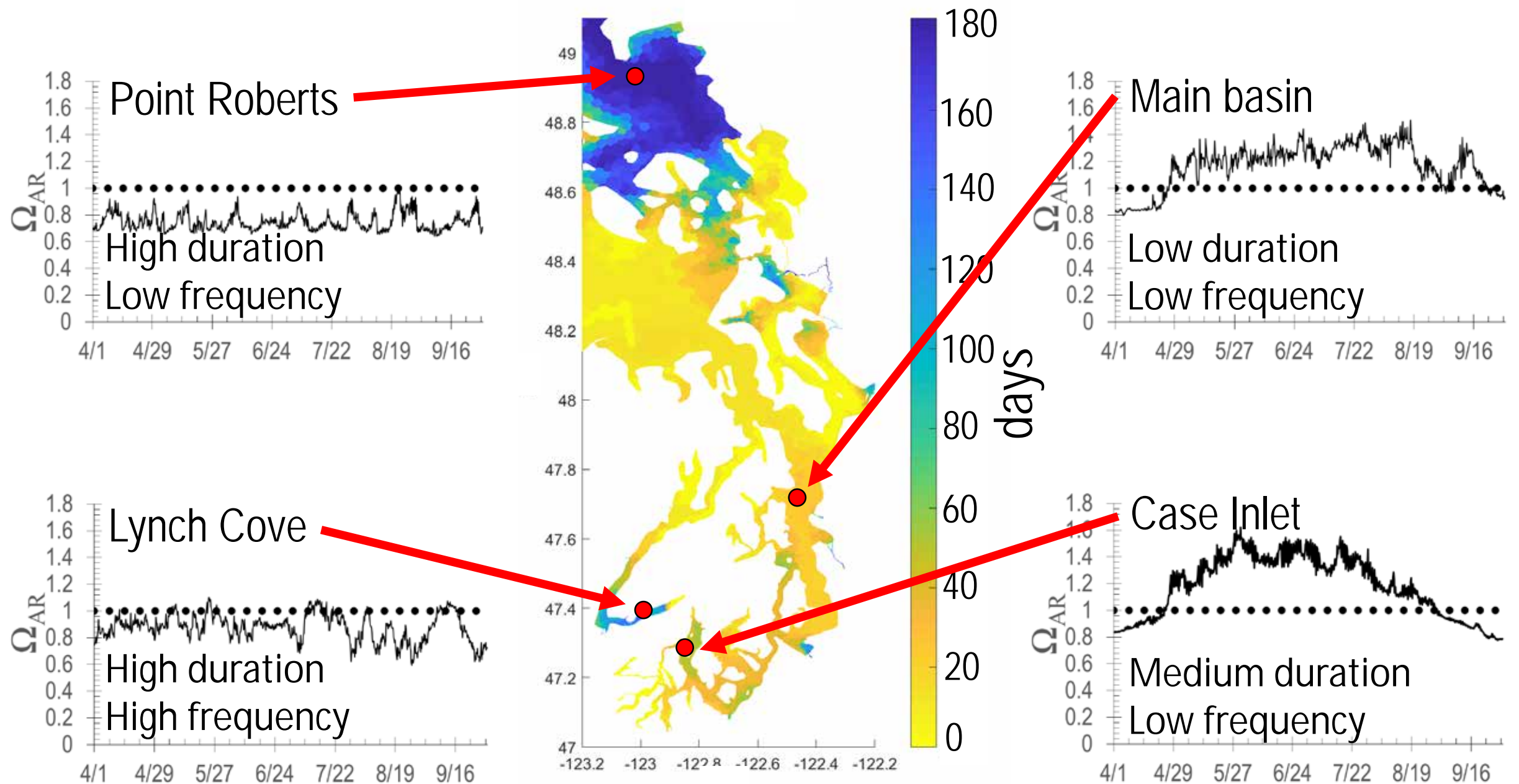
Annual average change in Ω_A due to regional anthropogenic nutrients as a percentage of the total change from nutrients and CO_2



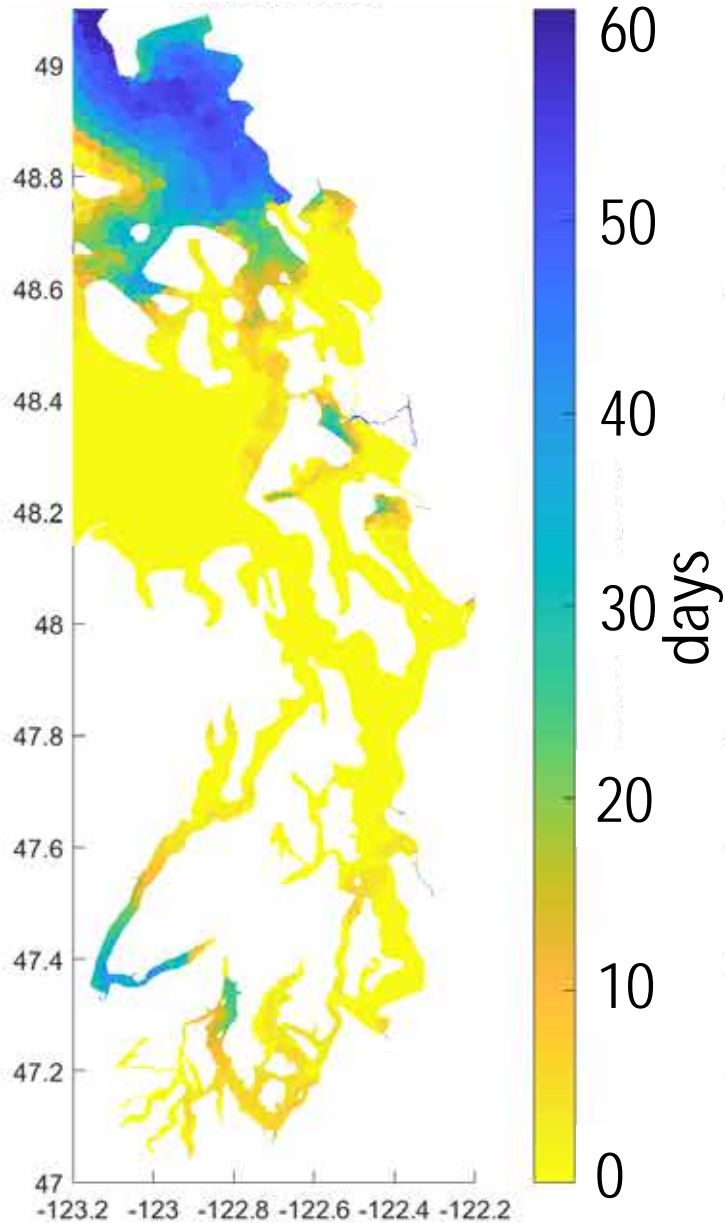
Thresholds for adverse impact on pteropods (Bednaršek *et al.*, in prep)

- Egg development
- Survival
- Respiration
- Growth/calcification
- Severe dissolution
- Mild dissolution

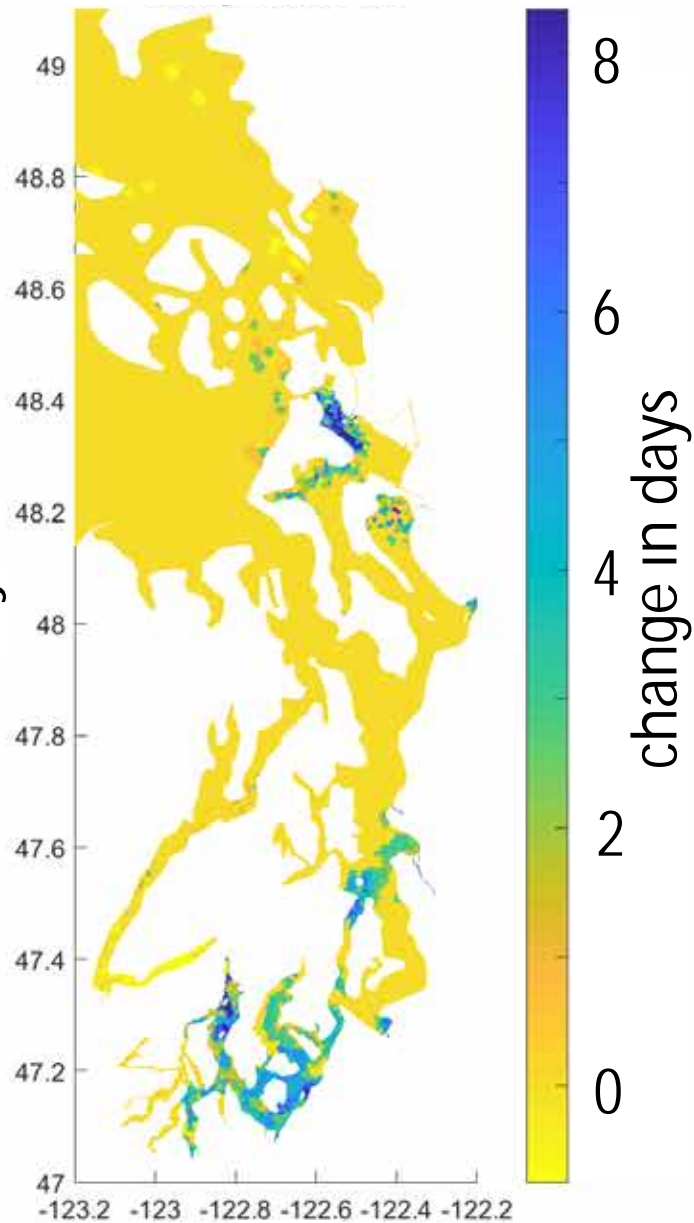
Apr-Sep cumulative days with $\Omega_A < 1$ for > 7 days, 0-20m



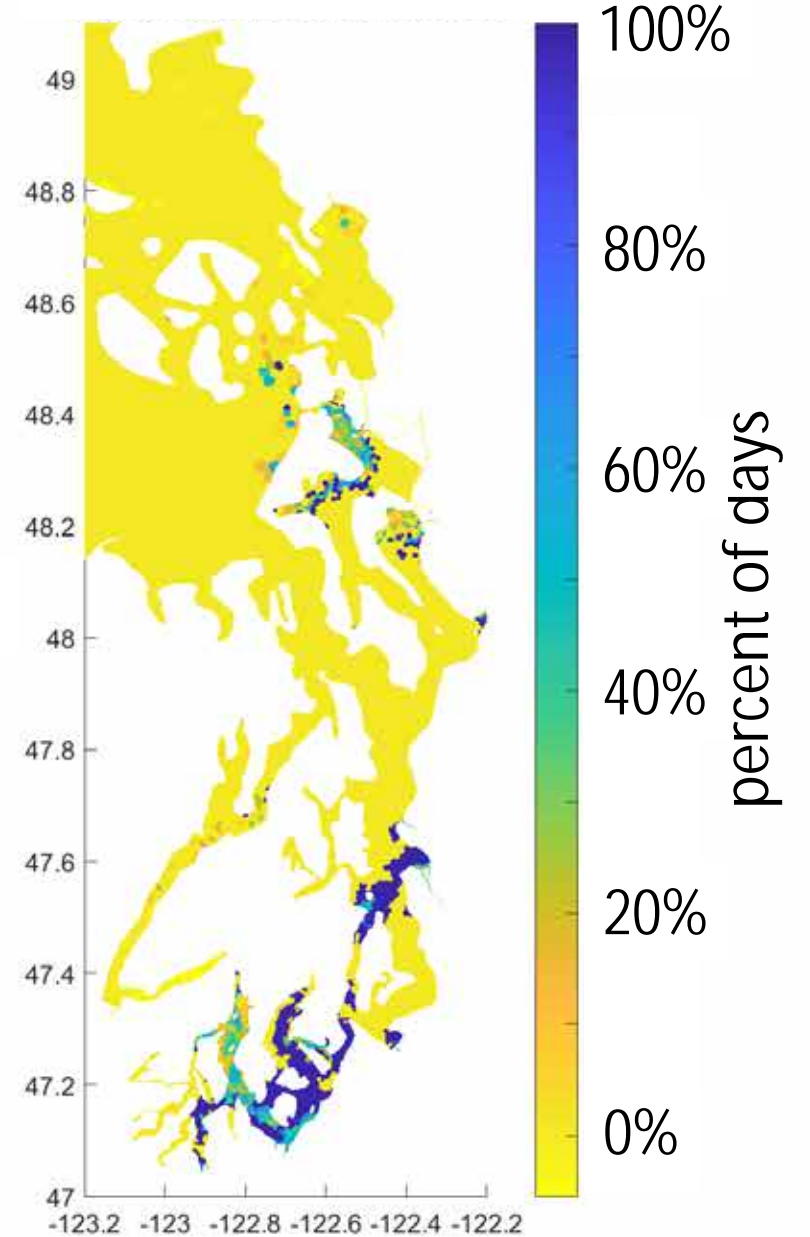
Duration in Aug-Sep 2008



Change due to nutrients



Percent due to nutrients



Aug-Sep cumulative days with $\Omega_A < 0.9$ for > 2 days, 0-20m

Conclusions

- Significant changes in carbonate system variables are due to regional anthropogenic nutrient sources and global atmospheric CO₂
- Added nutrients significantly decrease Ω_A and pH, and increase DIC, especially in deeper water
- Added nutrients significantly increase the duration of exposure of pteropods to corrosive conditions below vulnerability thresholds.

The End

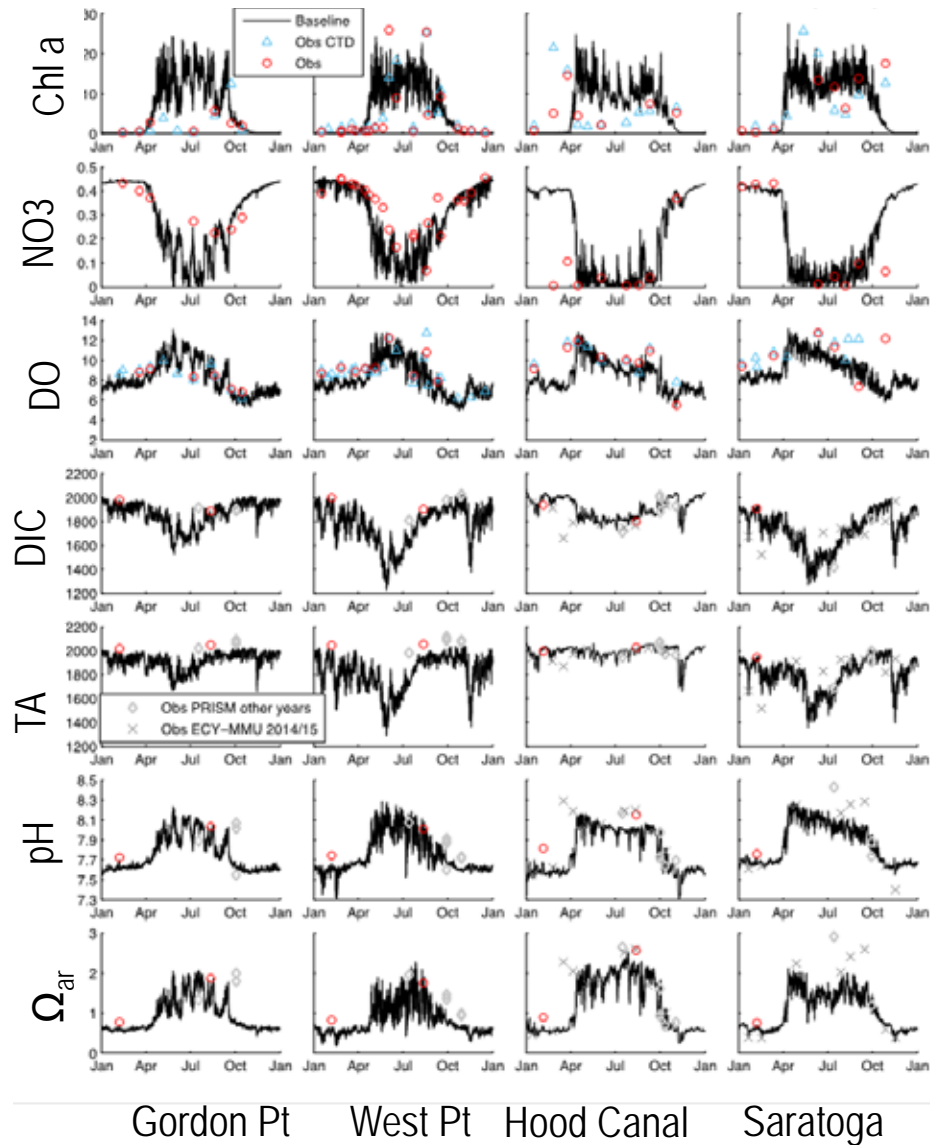
Following are extra slides in case
they are needed for Q + A

Skill metrics for the Salish Sea Model

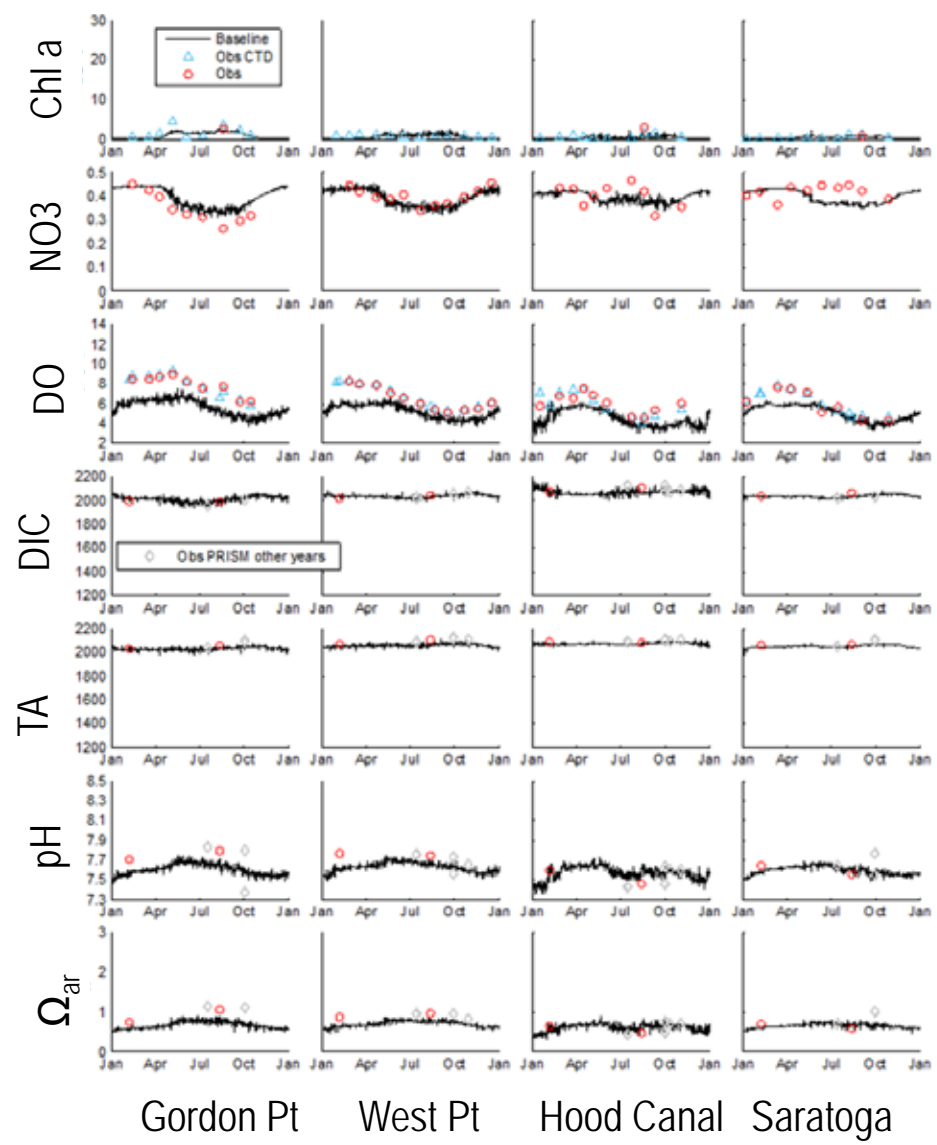
	R ²	RMSE	Bias	RMSE _{diff}
T (°C)	0.81	1.48	1.28	
S (psu)	0.37	1.33	-0.68	
Chl (µg/L)	0.25	2.78	-0.30	
DO (mg/L)	0.64	1.80	-1.56	0.10
NO ₃ (mg/L)	0.64	0.08	-0.001	
DIC (µmol/kg)	0.59	70.33	-20.13	0.76
TA (µmol/kg)	0.66	60.89	-38.75	0.23
pH (total scale)	0.41	0.14	-0.07	0.0061
pCO ₂ (uatm)	0.42	330.33	183.4	26.2
Ω _{arag}	0.47	0.32	-0.12	0.027

Time-series of predicted and observed variables at four locations

Surface layer



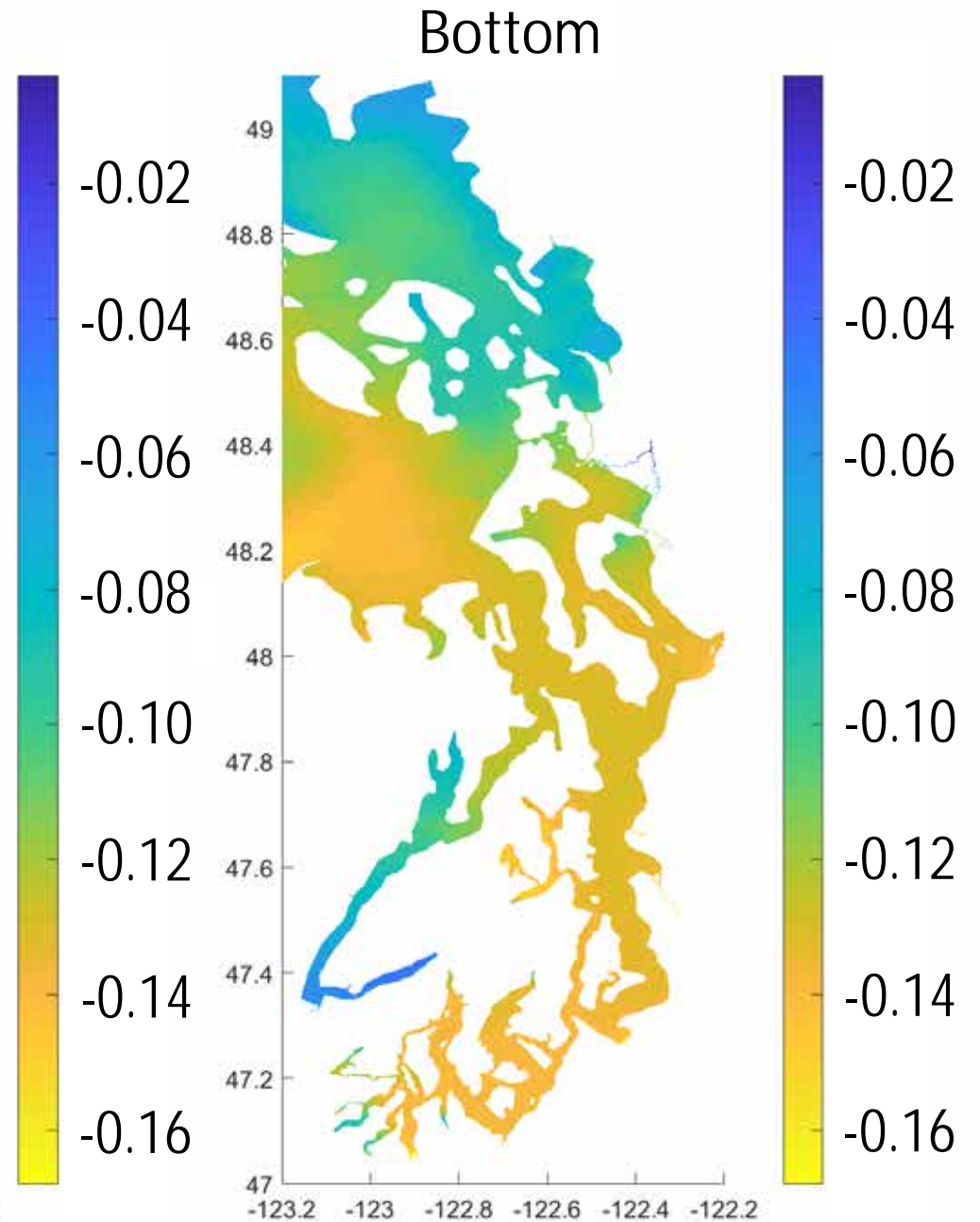
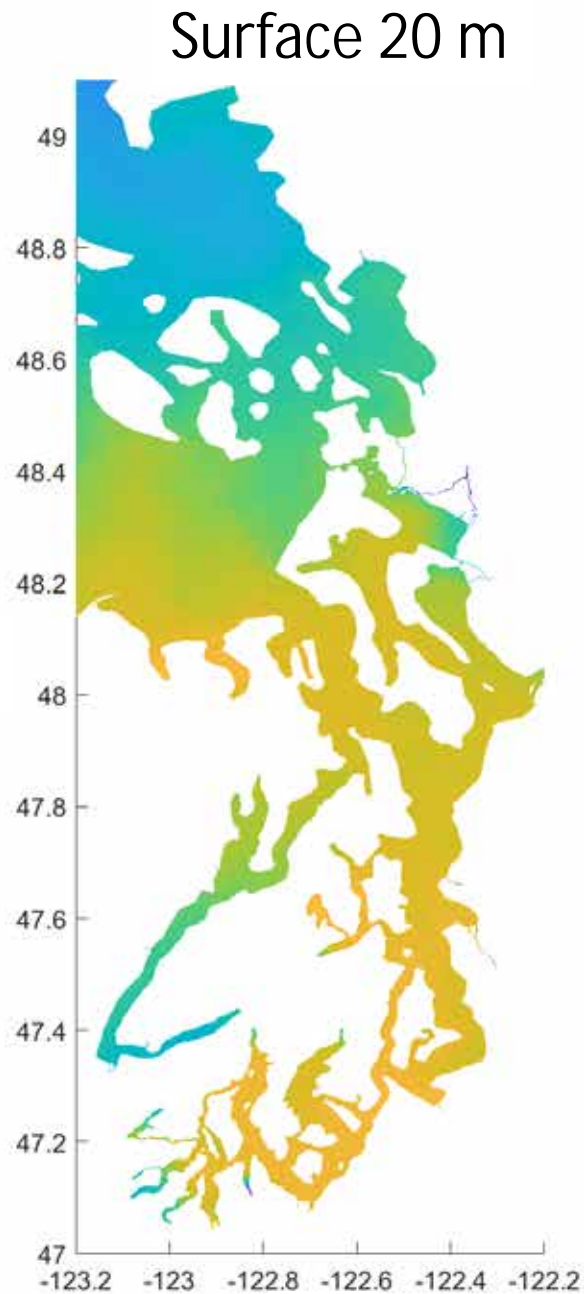
Bottom layer



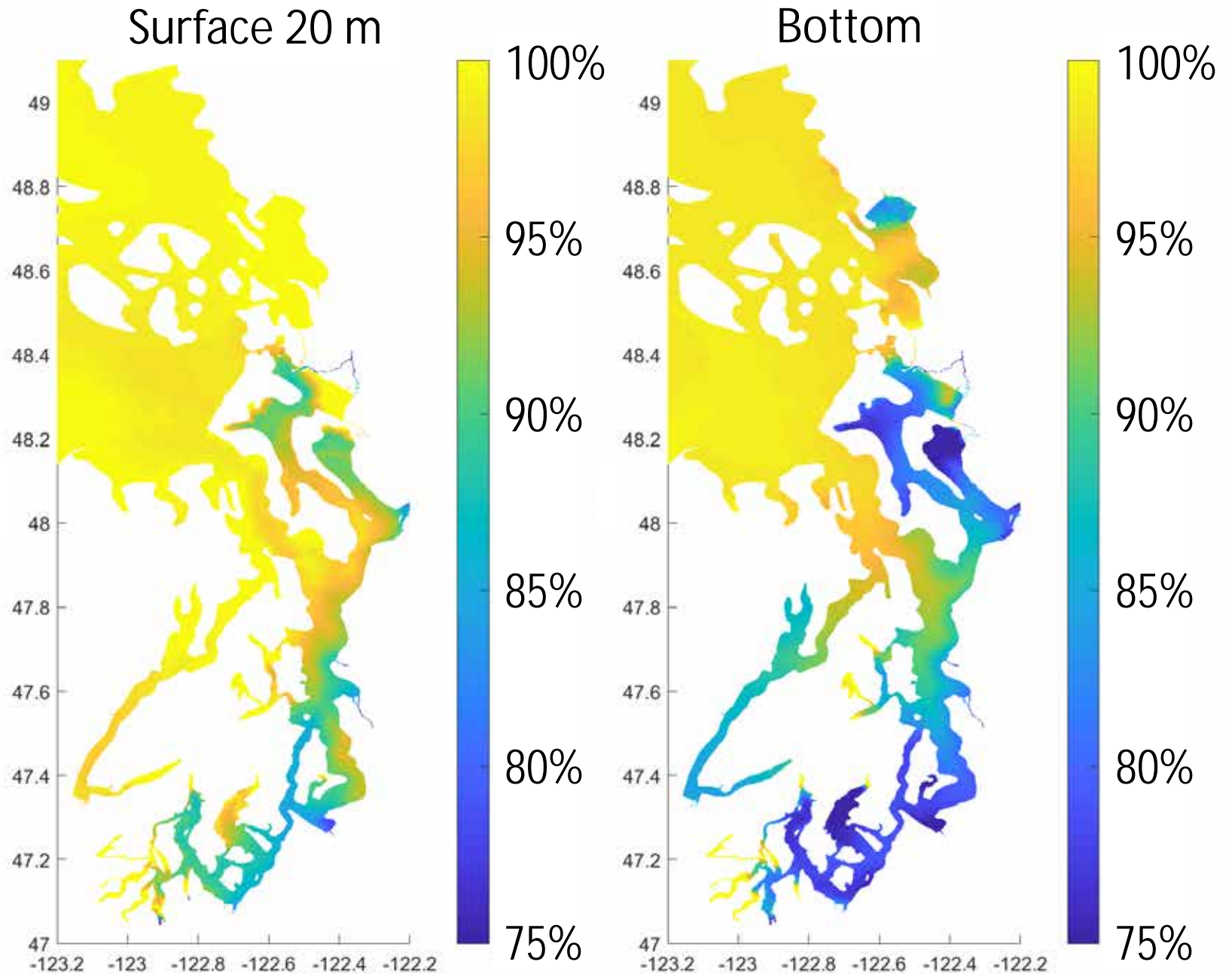
Changes in pH and Ω_{arag} due to anthropogenic sources

	Regional anthropogenic nutrient sources (this study)	Global anthropogenic sources (Feely et al. 2010)
	Range of monthly average differences between historical (2008) and estimated pre-industrial	Difference between cruise observations (February and August, 2008) and estimated pre-industrial
pH (surface 20 m)	-0.07 to 0.06	-0.11 to 0.03
pH (bottom)	-0.10 to 0.05	-0.06 to 0.00
Ω_{arag} (surface 20 m)	-0.06 to 0.19	-0.33 to -0.09
Ω_{arag} (bottom)	-0.12 to 0.17	-0.16 to -0.02

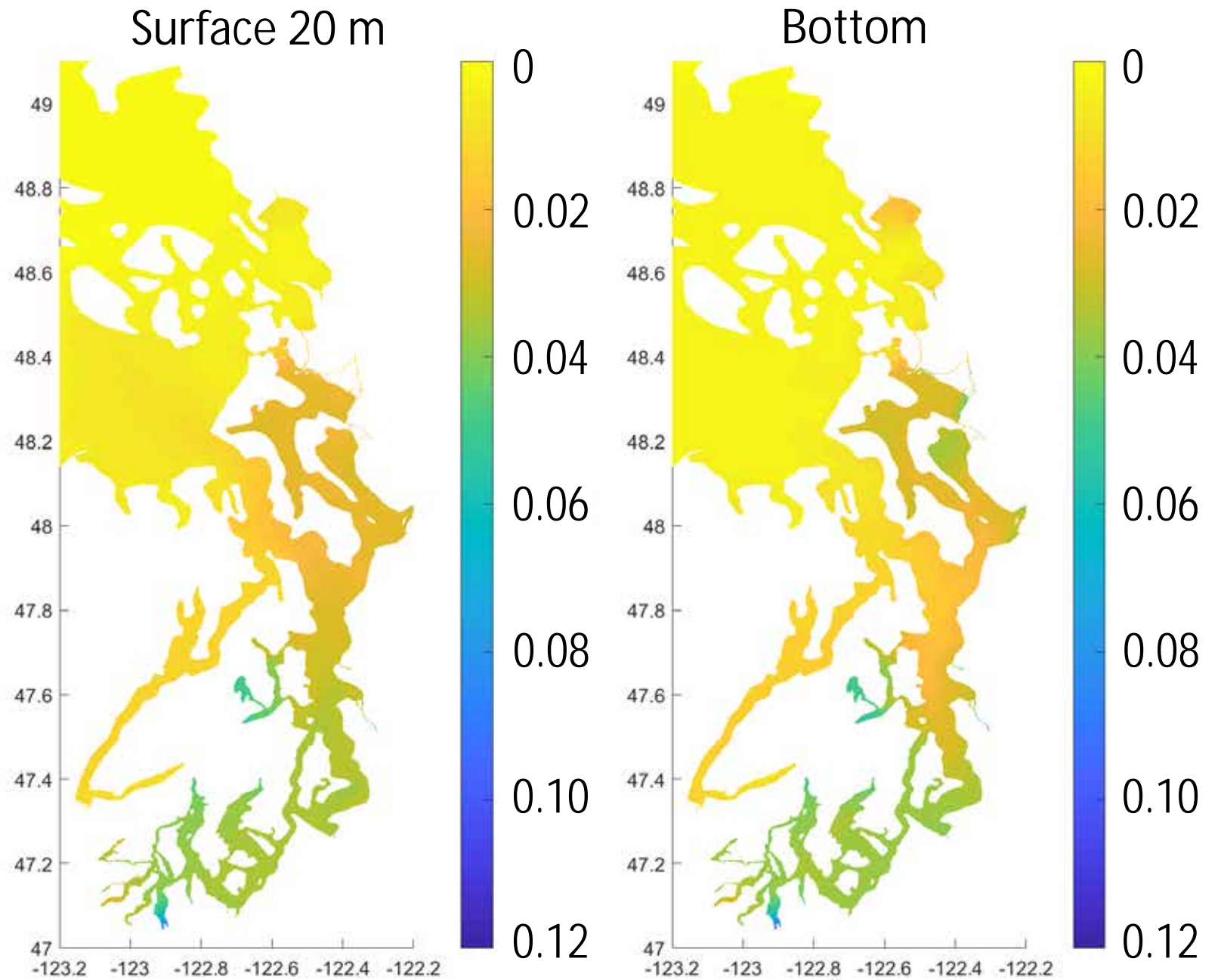
Annual average change in Ω_A due to combined regional anthropogenic nutrients and global CO_2



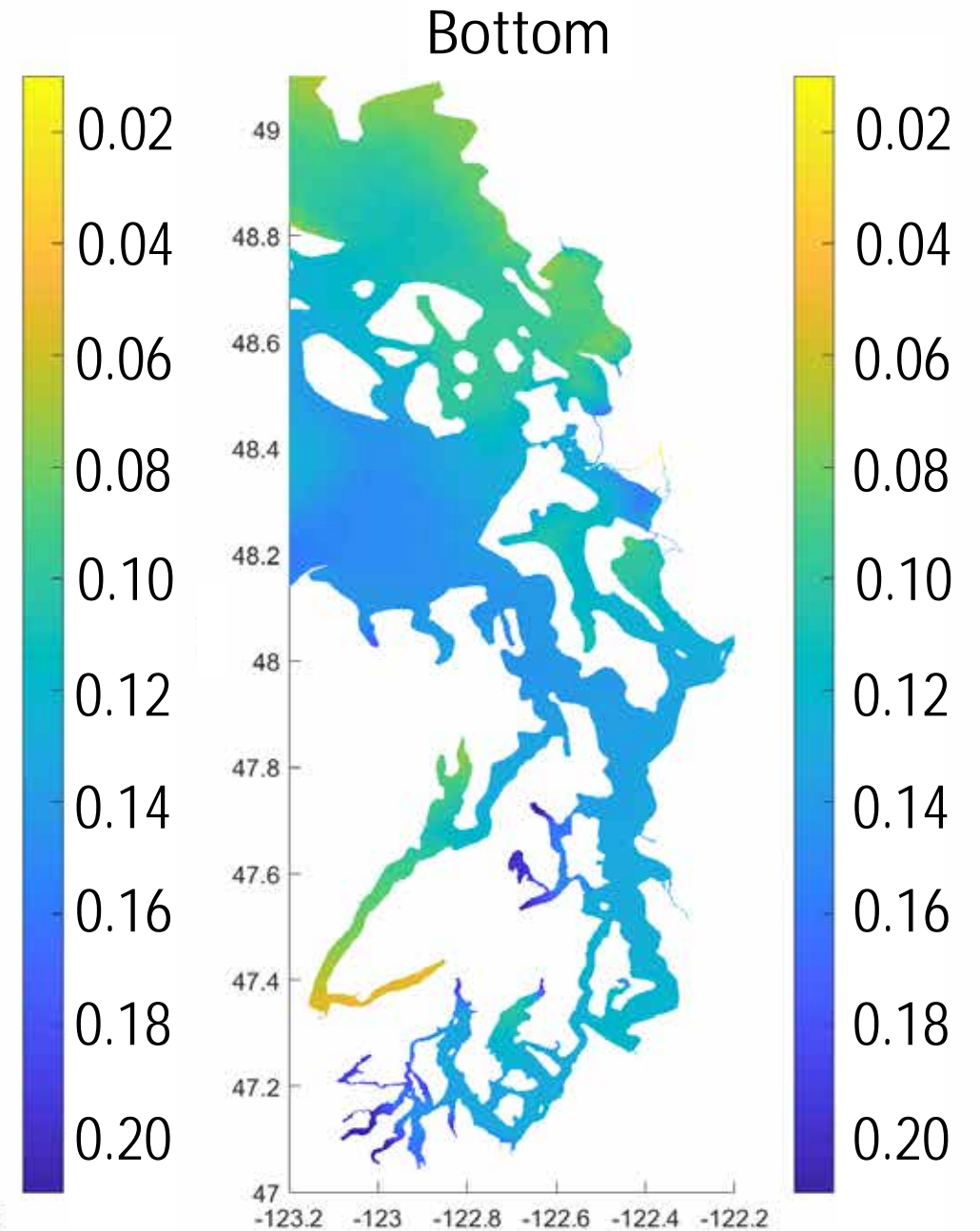
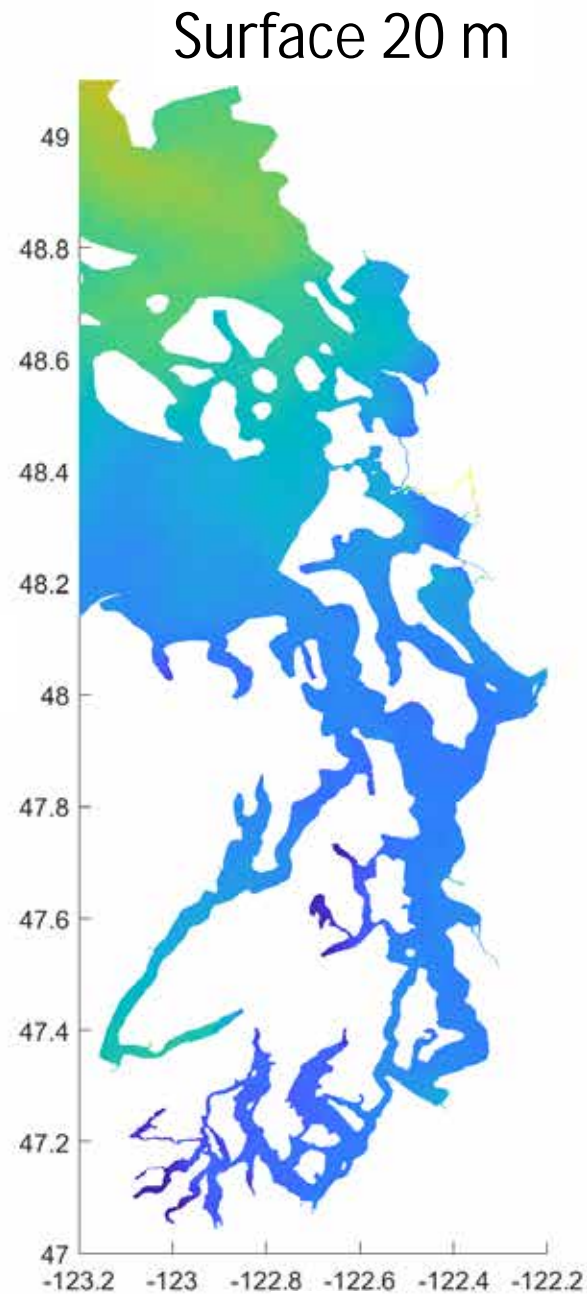
Annual average change in Ω_A due to global anthropogenic CO_2 as a percentage of the total change from nutrients and CO_2



Maximum monthly average decrease in Ω_A due to regional anthropogenic nutrients



Maximum monthly average decrease in Ω_A due to global anthropogenic CO_2



Maximum monthly decrease in Ω_A due to regional anthropogenic nutrients as a percentage of the max total depletion

