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

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

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Salish Sea Model

Ocean acidification and the response to regional anthropogenic nutrient sources

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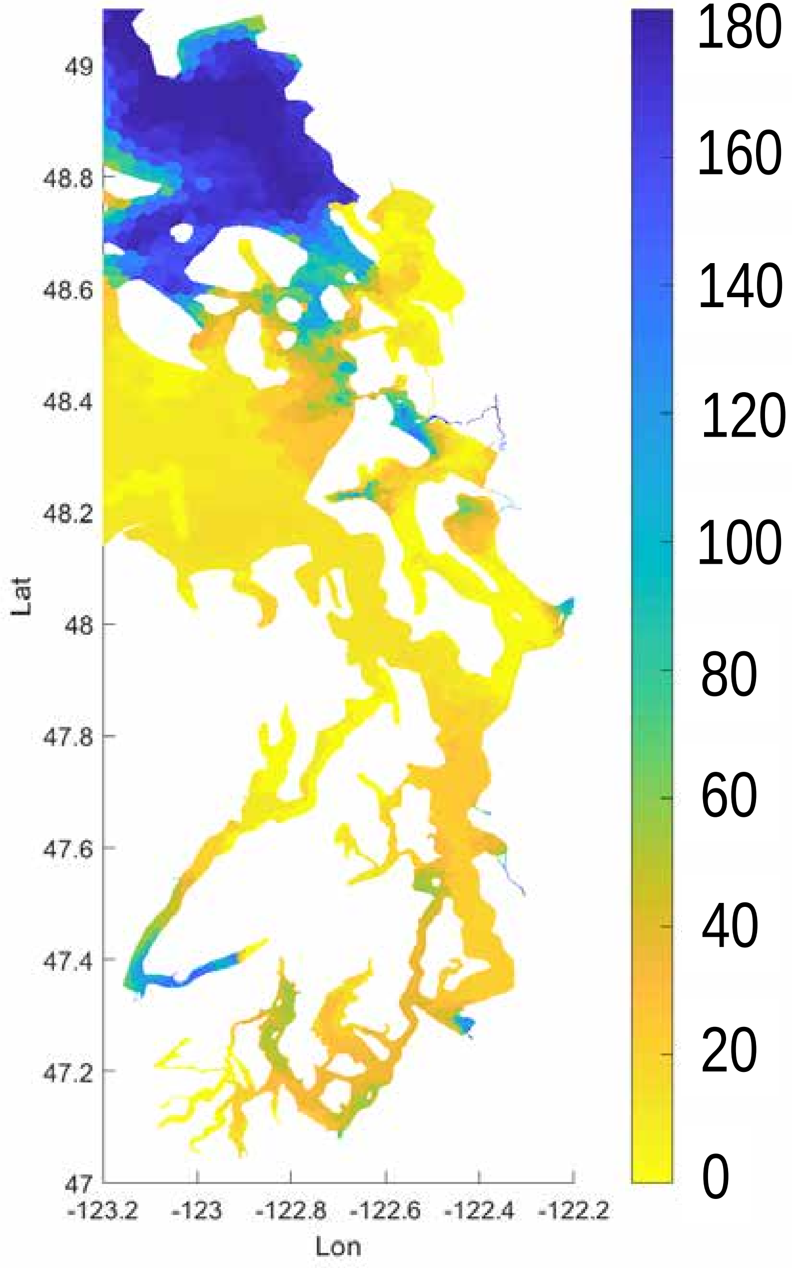
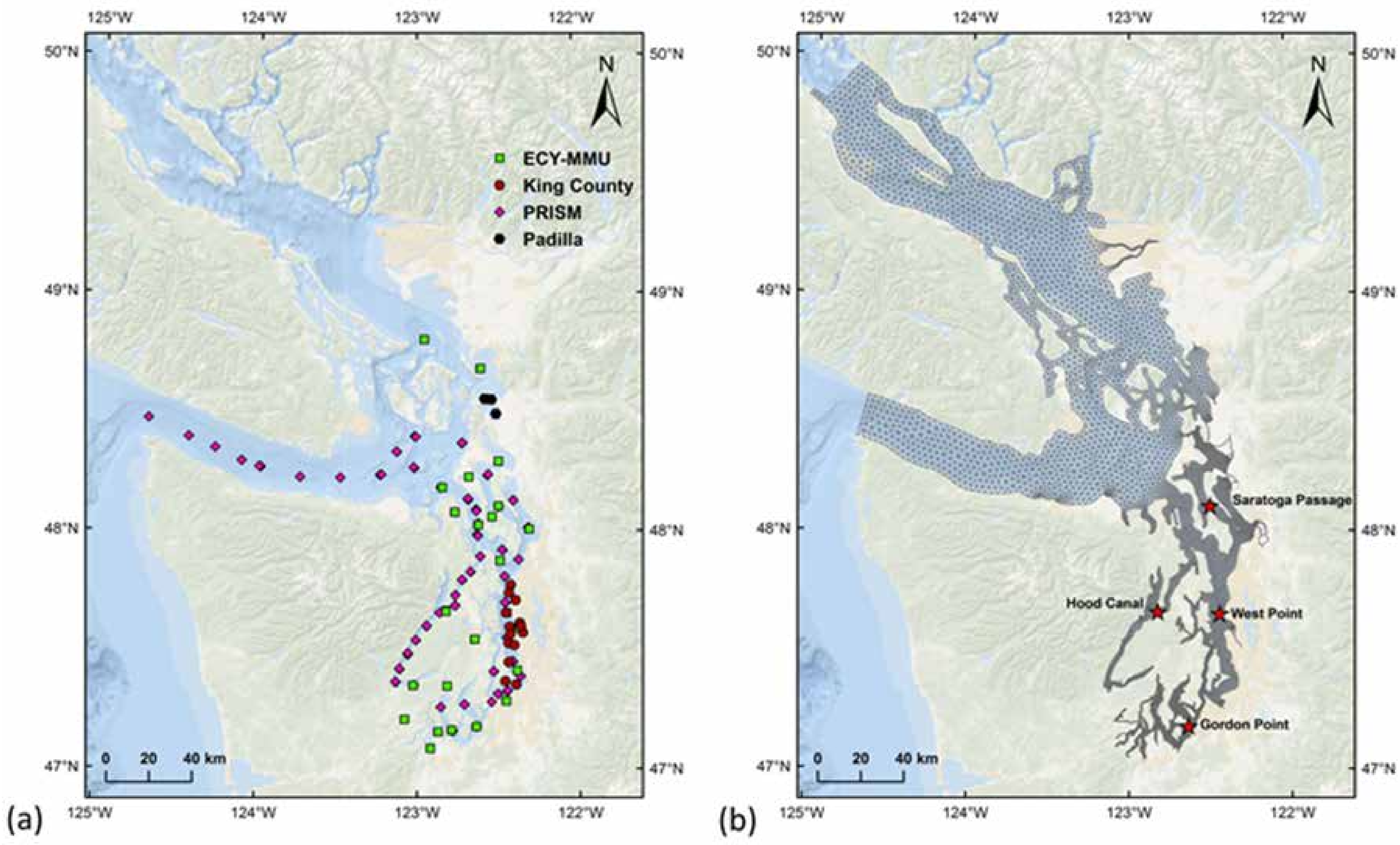


Apr-Sep 2008 cumulative days with $\Omega_A < 1$ for > 7 days, 0-20m

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

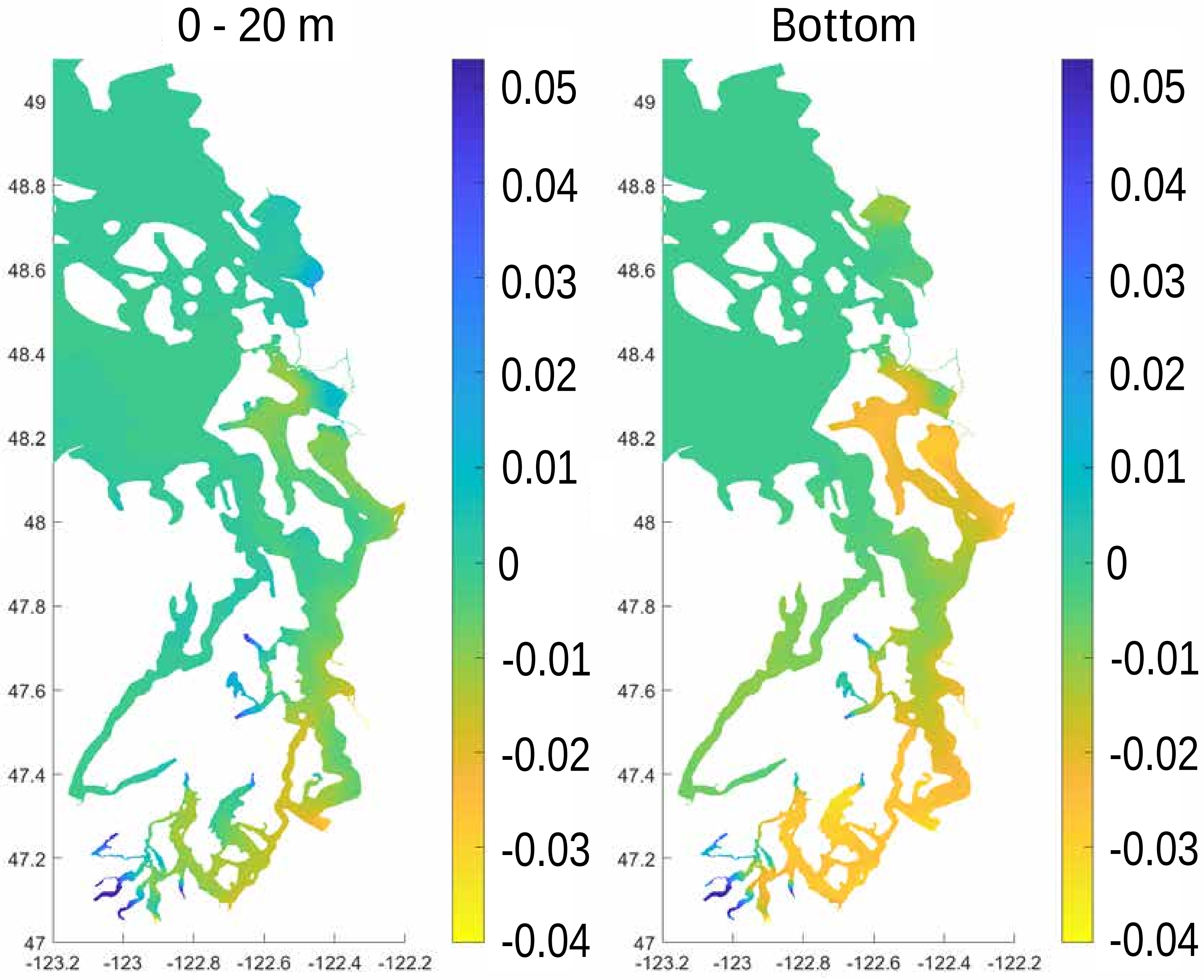


(a) Location of observations in 2008, and (b) the Salish Sea Model domain.

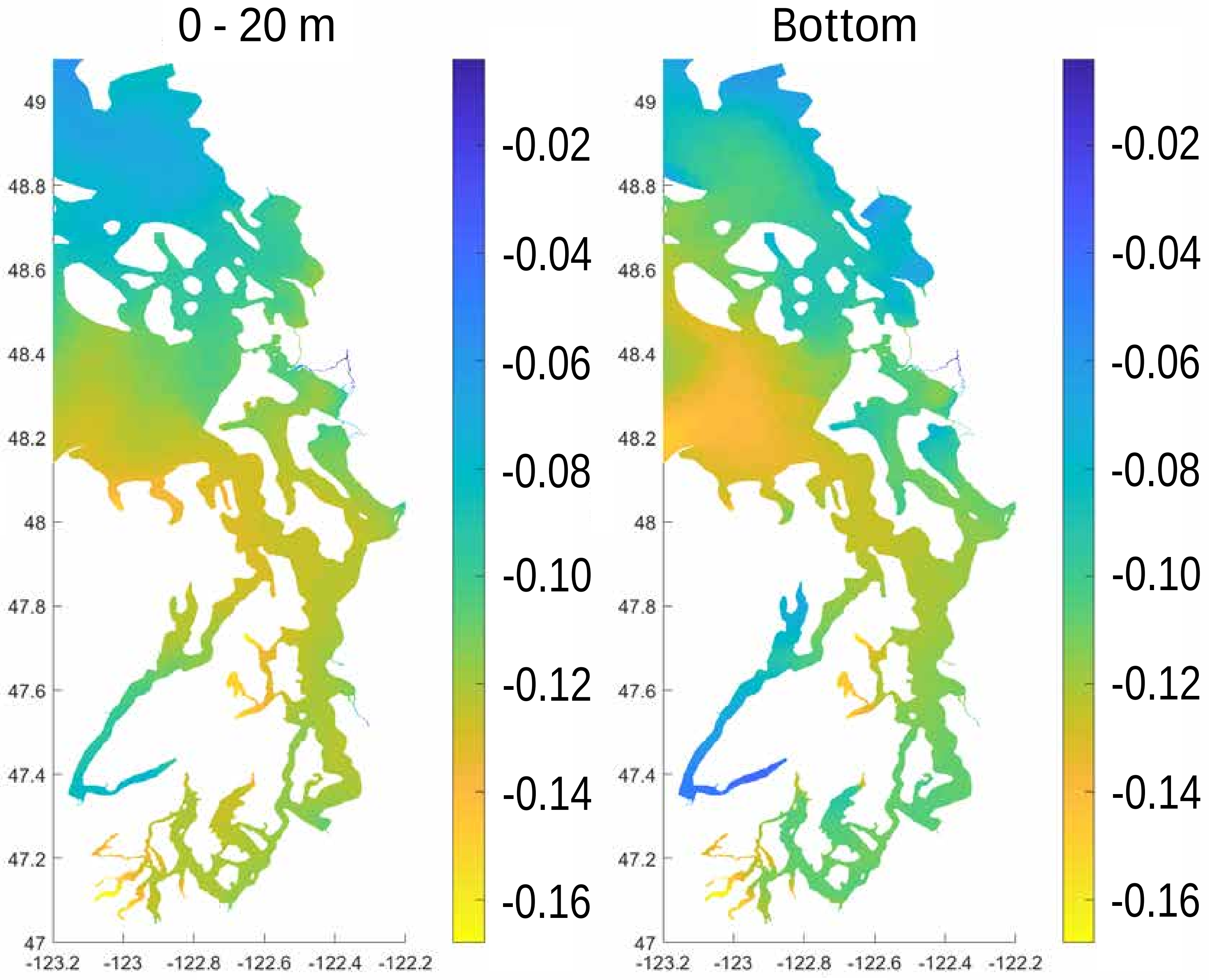
Model scenarios

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 pCO_2 = 280 ppm, and ocean pCO_2 reduced by 110 ppm
4. Reference conditions without regional anthropogenic nutrients and without global anthropogenic atmospheric CO_2

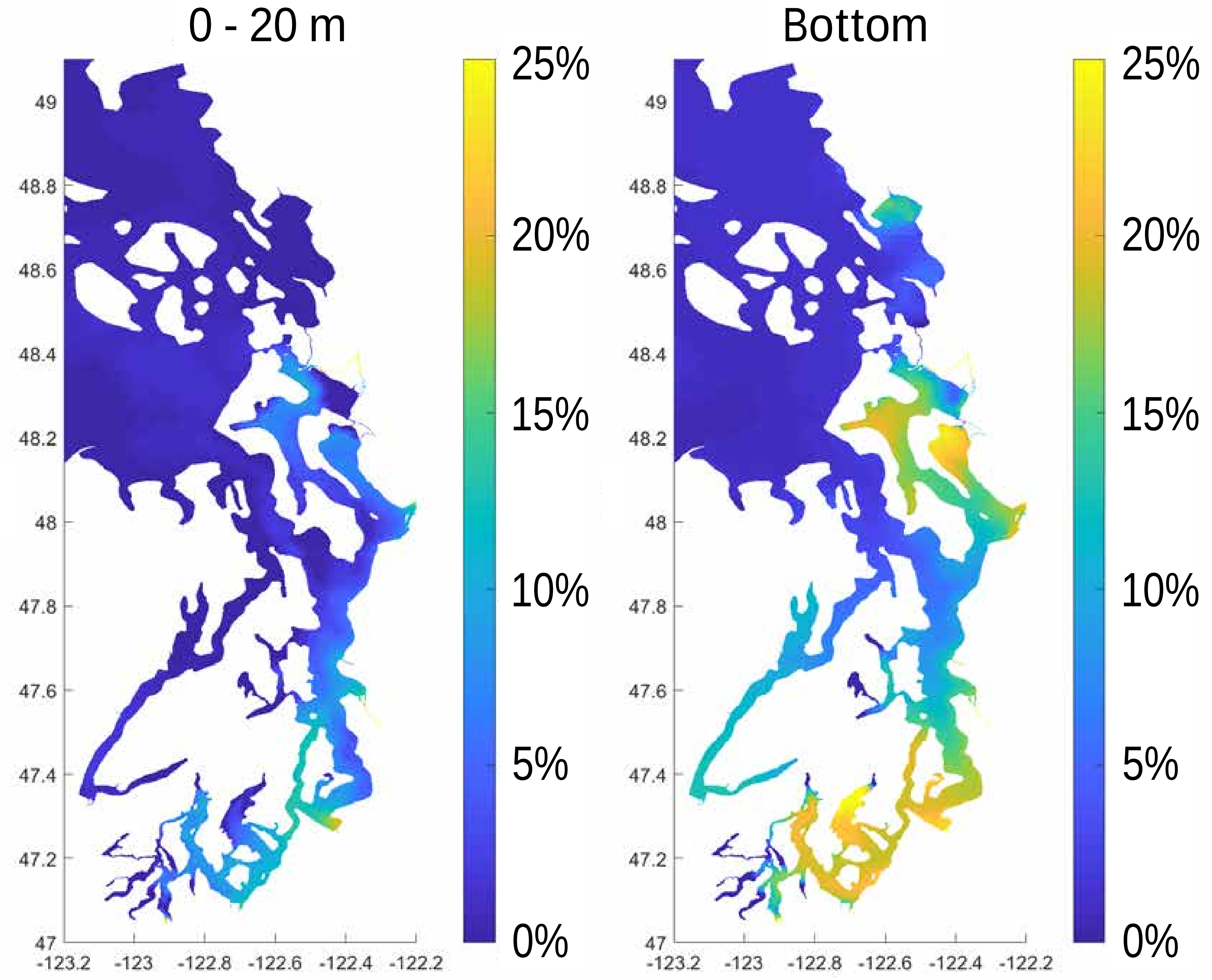
Annual average change in Ω_A due to regional anthropogenic nutrients



Annual average change in Ω_A due to global anthropogenic CO_2



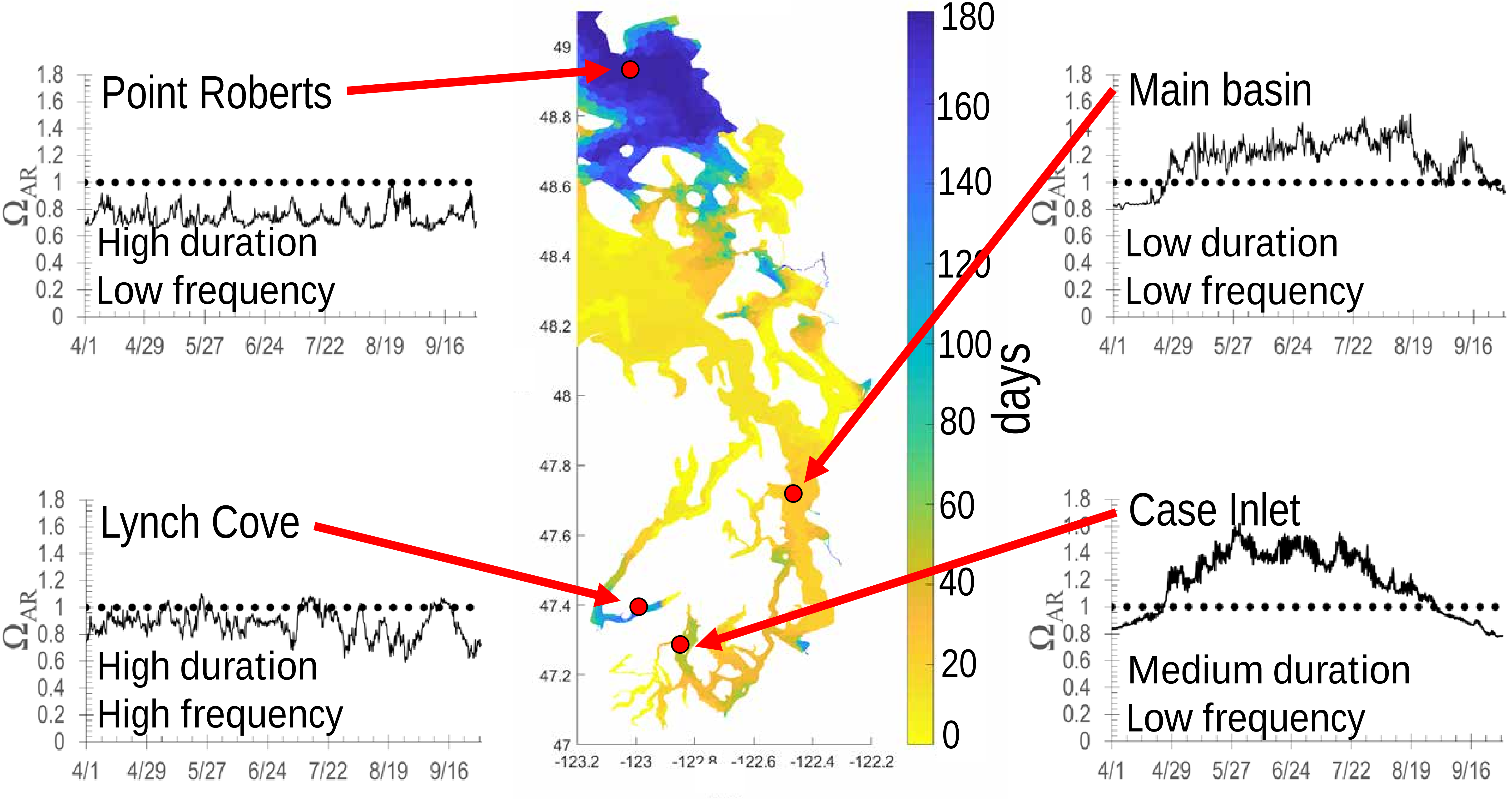
Annual average change in Ω_A due to regional anthropogenic nutrients as a percentage of the total change from nutrients and CO_2

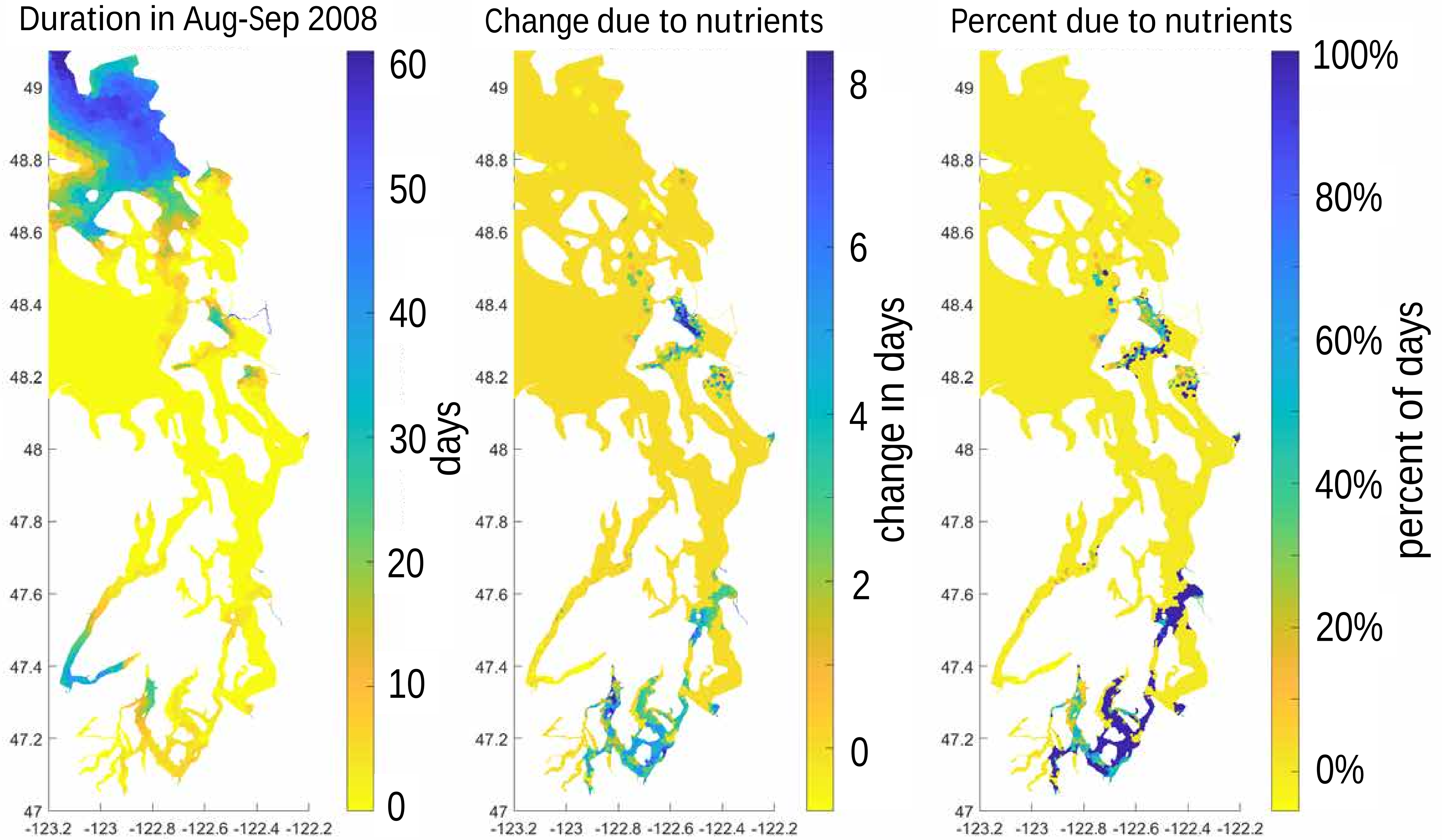


Thresholds for adverse impact on pteropods (Bednaršek *et al.*, in prep)

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

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





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 CO_2
- 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.

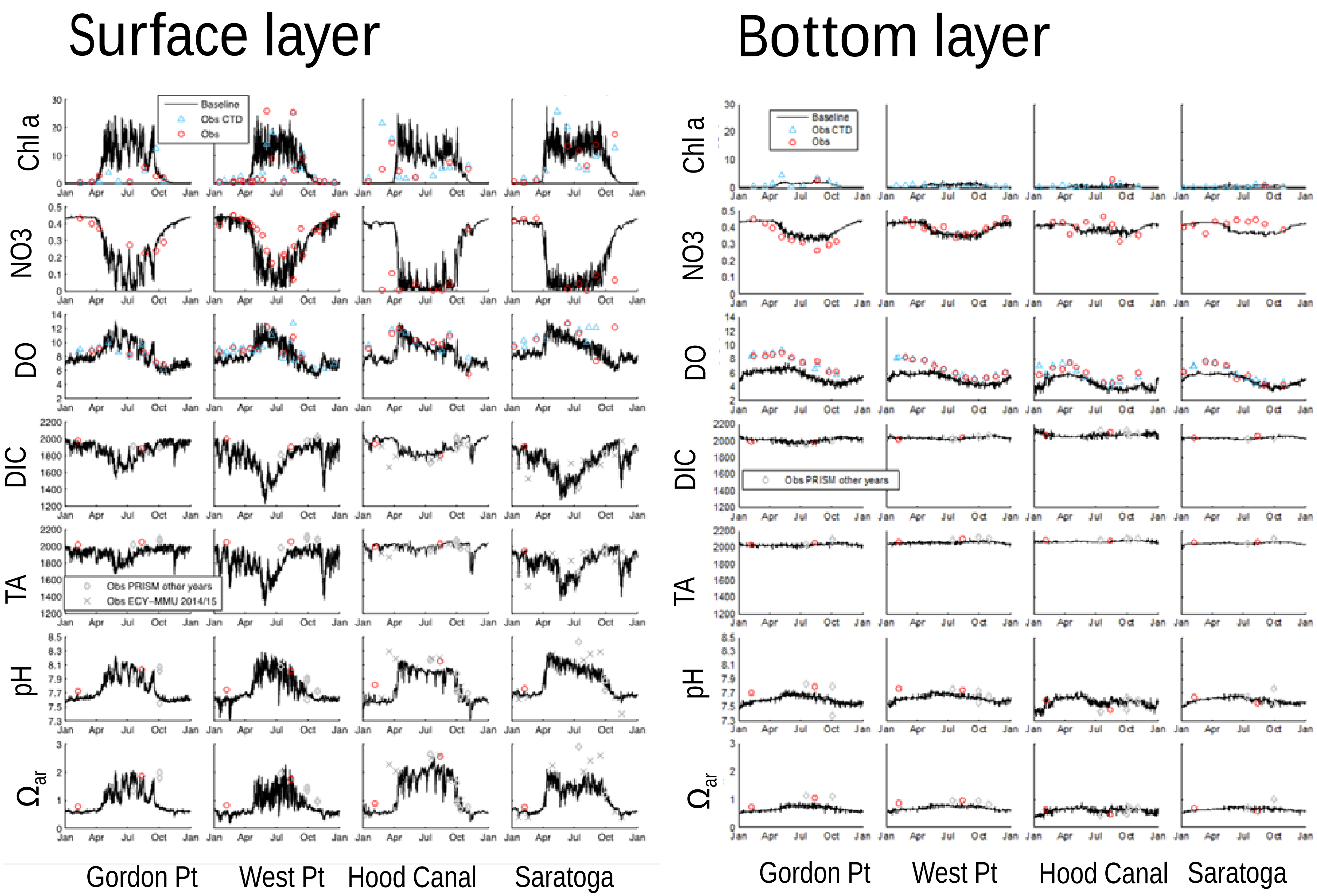
The End

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

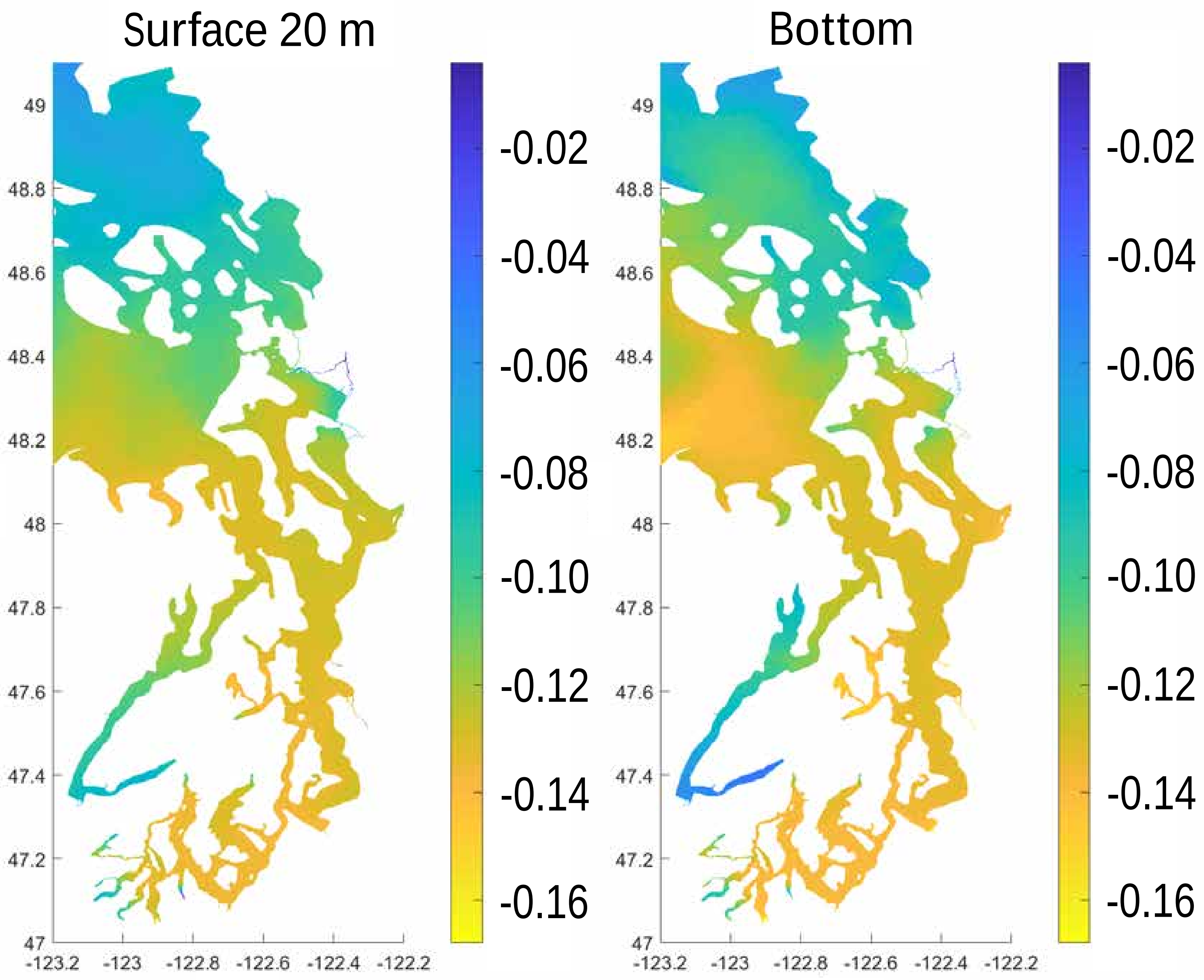
Time-series of predicted and observed variables at four locations



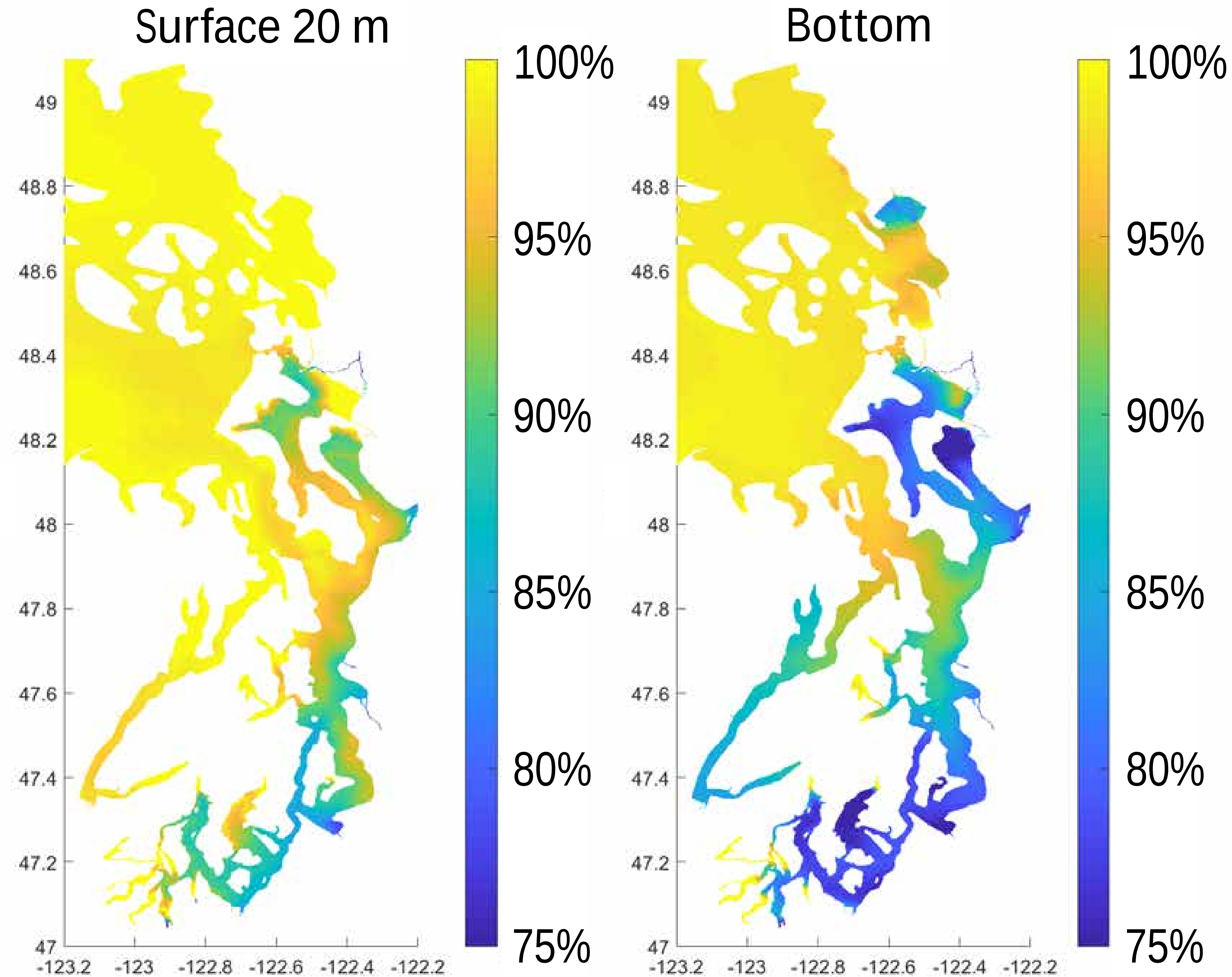
Changes in pH and Ω_{arag} due to anthropogenic sources

	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

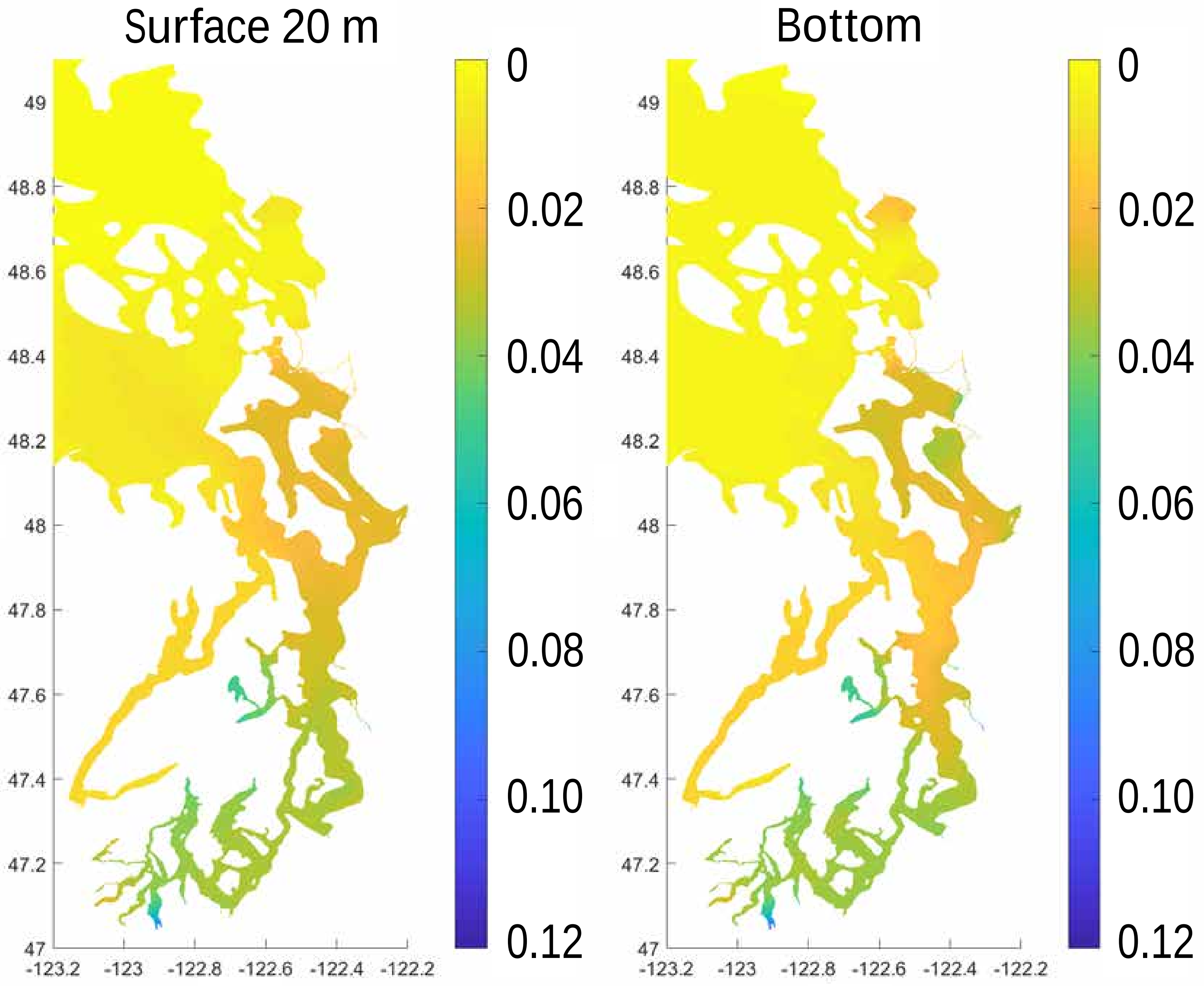
Annual average change in Ω_A due to combined regional anthropogenic nutrients and global CO_2



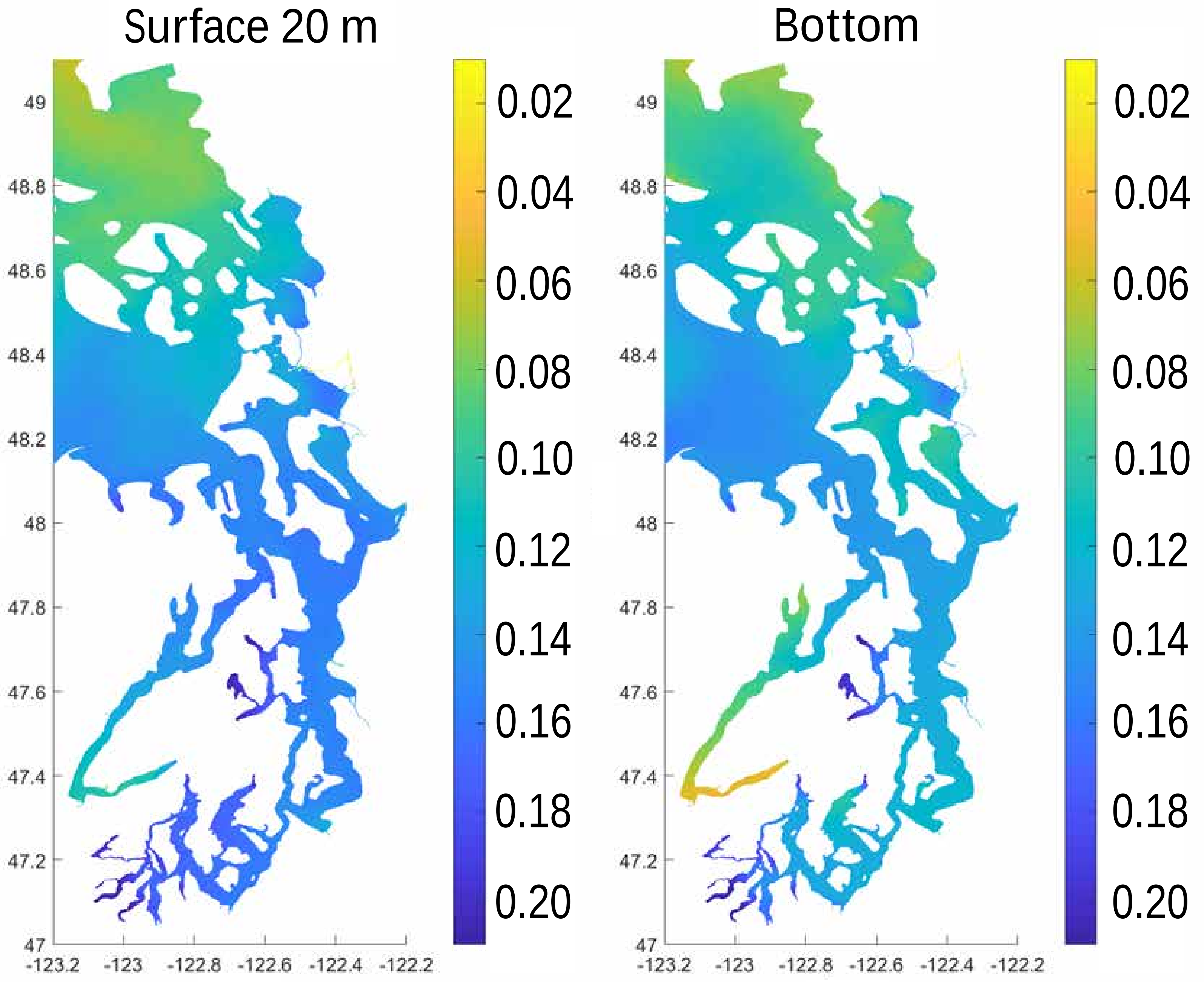
Annual average change in Ω_A due to global anthropogenic CO_2 as a percentage of the total change from nutrients and CO_2



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