



High - resolution carbonate dynamics of Netarts Bay, OR from 2014 - 2019

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Setting

90 km south of the Columbia River mouth

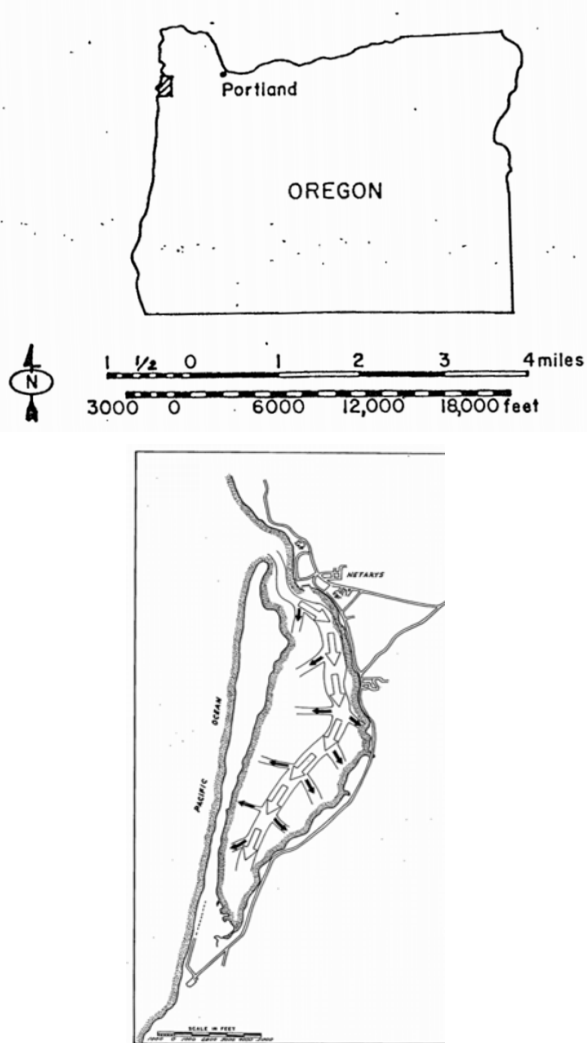
Bar-built, temperate, macrotidal lagoon

12-16 perennial streams

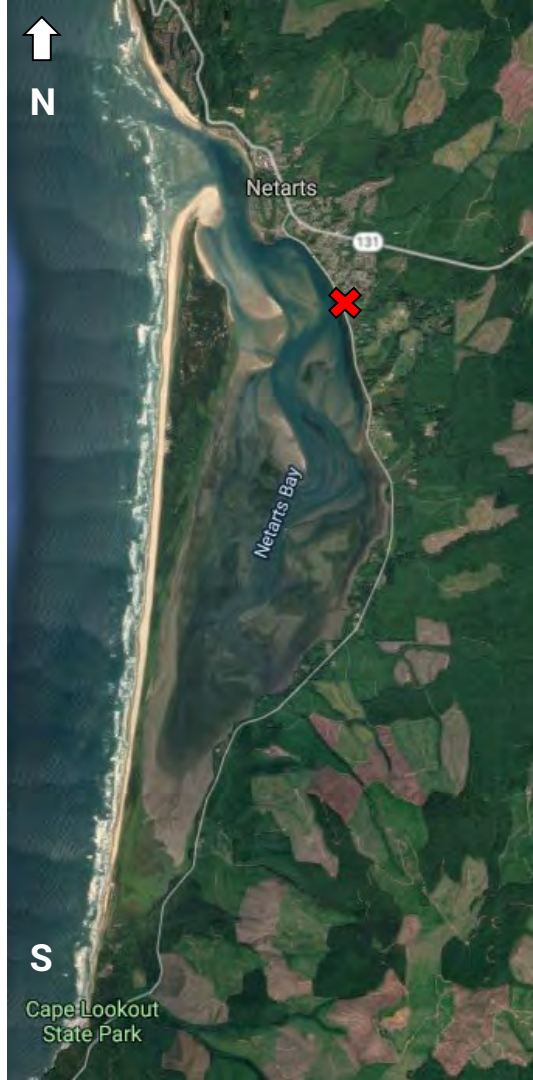
Average depth ~3m, tide range ~2-3m

Water residence time < 12 hours, with $\frac{2}{3}$ of all water flushed during ebb tide

Extensive eelgrass beds (*Zostera spp.*), salt marsh covers southern extent



*McCallum (1977)



Setting

Whiskey Creek Shellfish Hatchery

Impacted by shellfish seed crisis
(2007, 2008)

Continuous monitoring efforts
began in 2011

Seawater buffering + timing of
intake water = larval success



pCO₂ measurements*

Rapid headspace equilibration

Gas is transported in a loop through equilibrator and a LiCOR 840

Gas detected via non-dispersive infrared absorbance



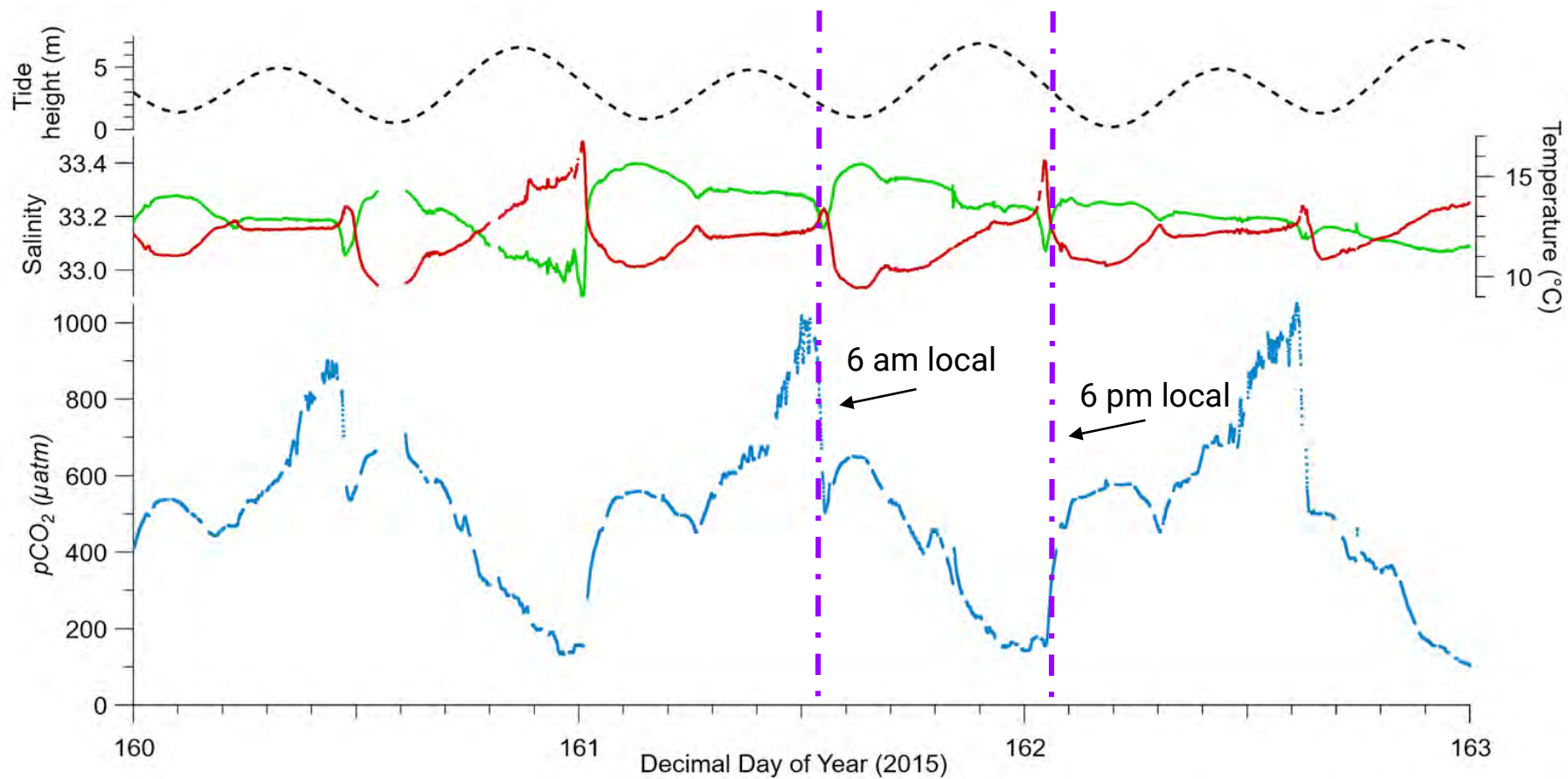
TCO₂ measurements*

Steady state, mass balance CO₂ stripping

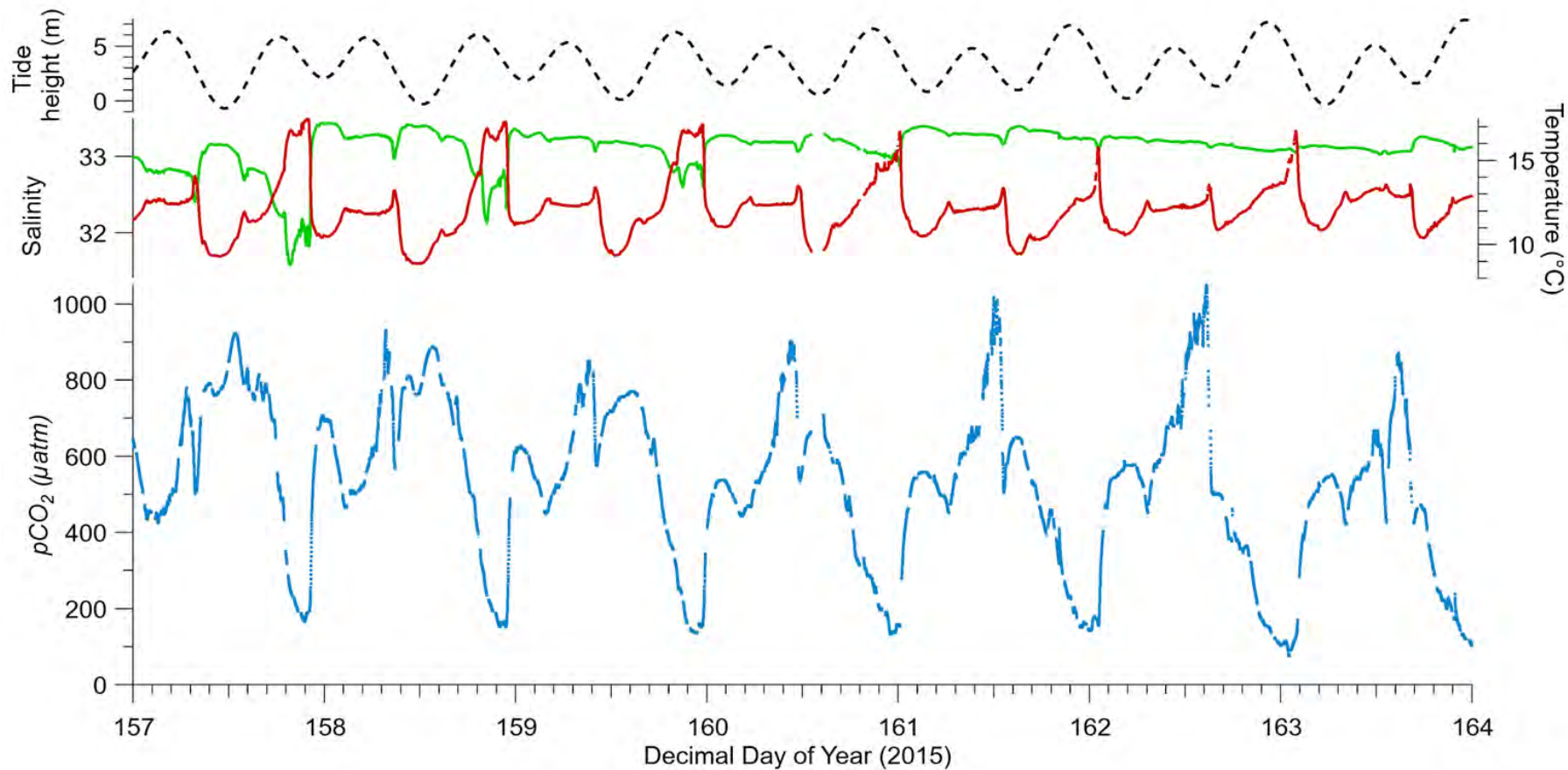
Sample stream acidified w/ 10% HCl at 1:100 flow ratio

CO₂ gas diffuses through membrane contactor, swept away by carrier gas, detected via NDIR

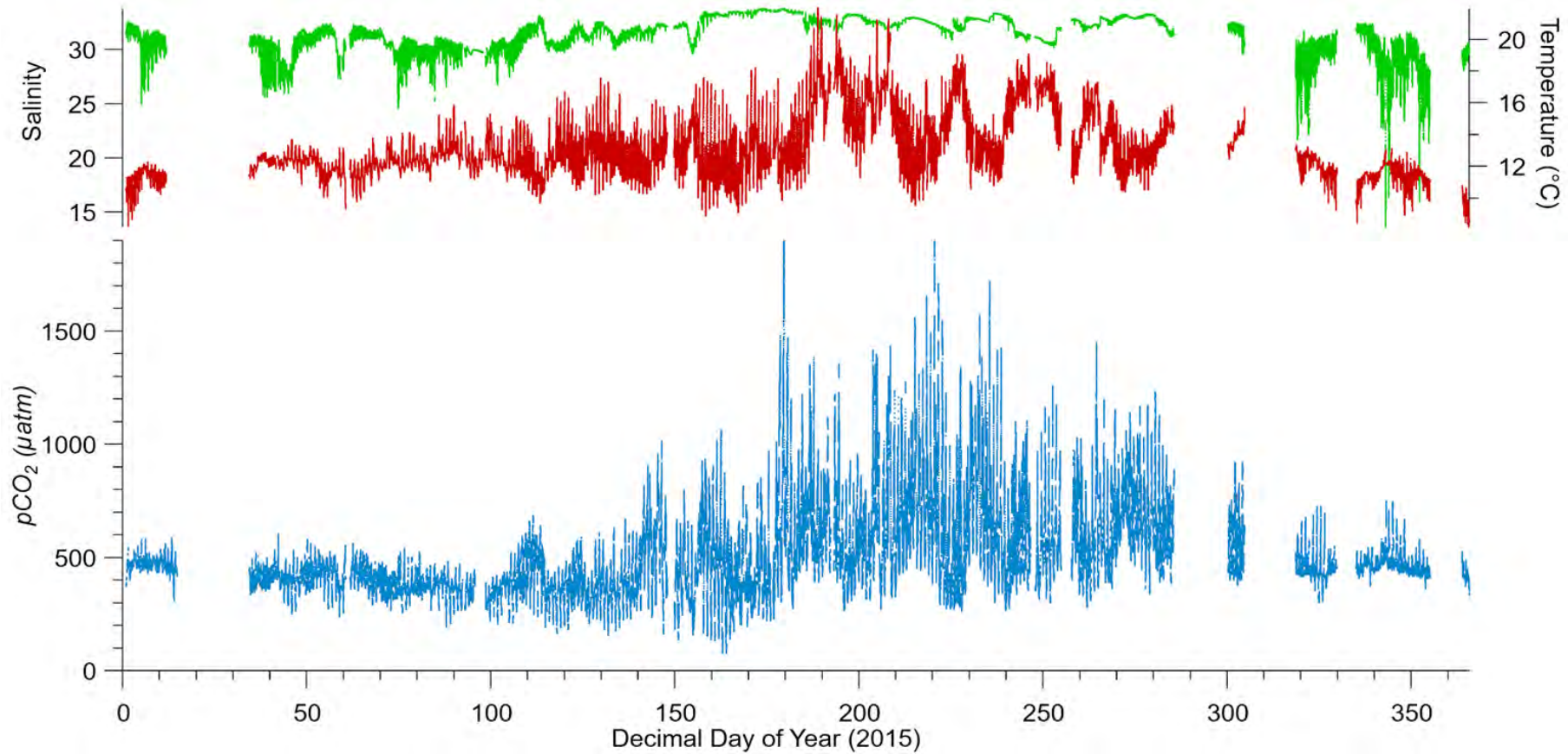
*Hales et al (2004), Bandstra et al. (2006), Vance (2012, MS thesis)



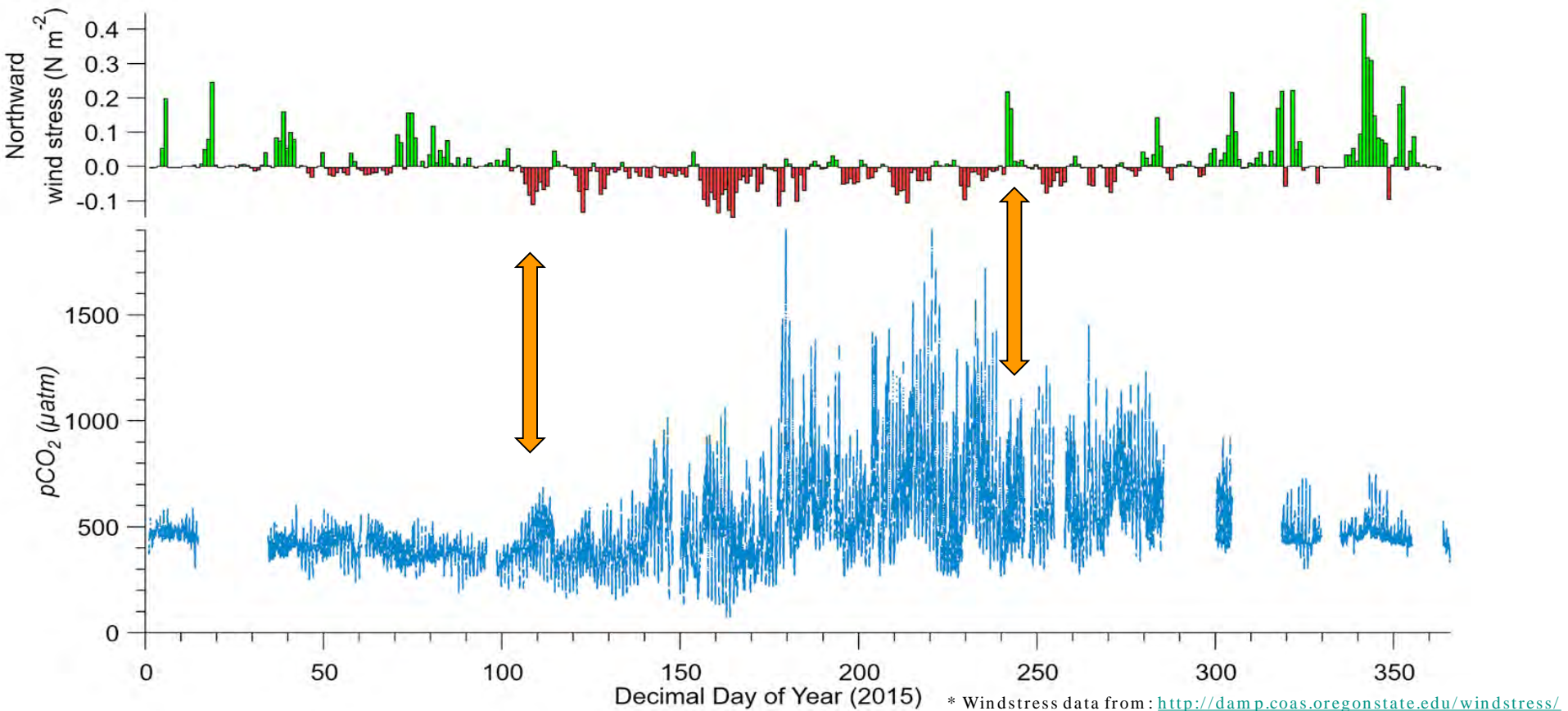
Results - pCO₂ variability



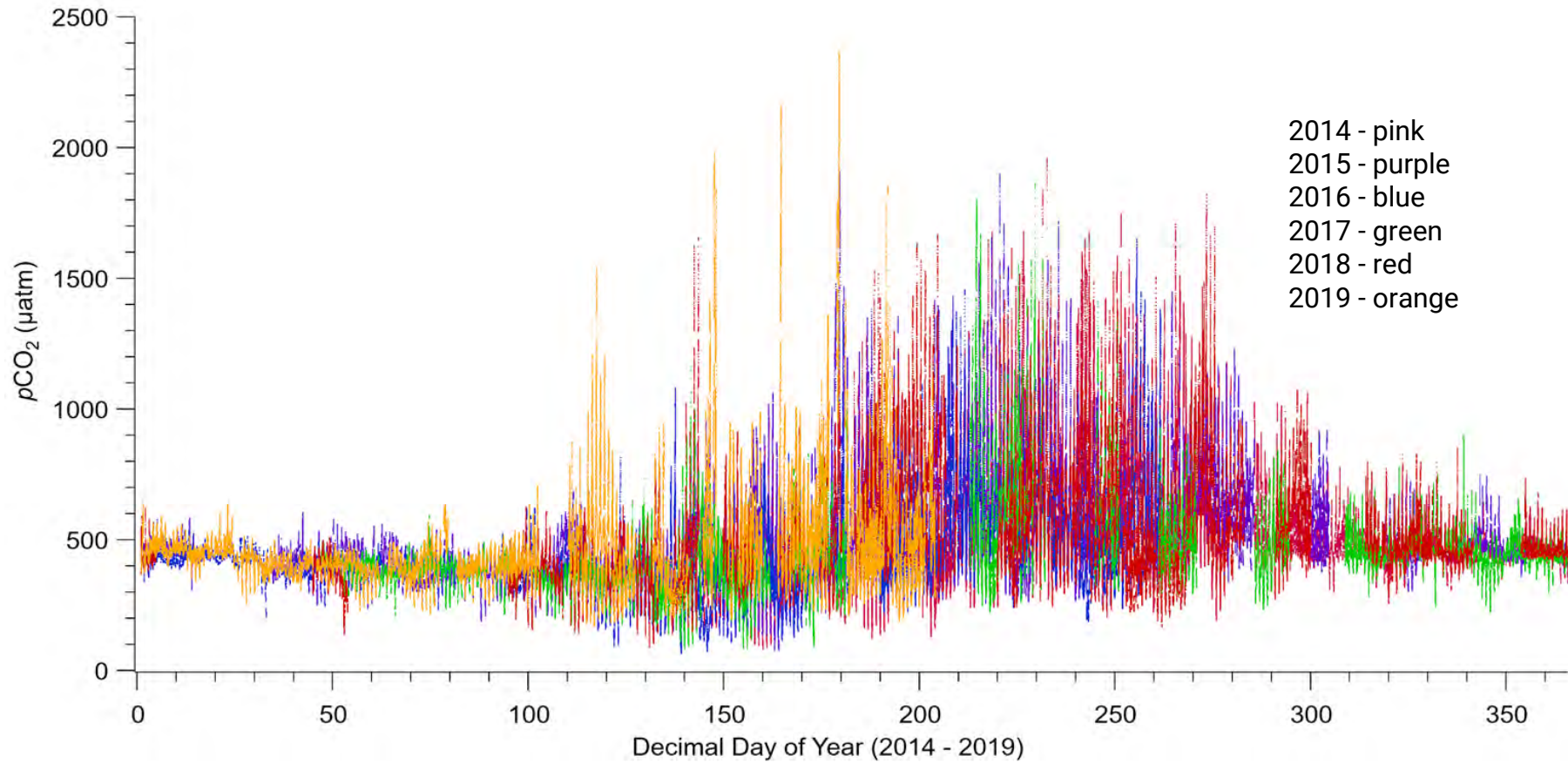
Results - pCO₂ variability



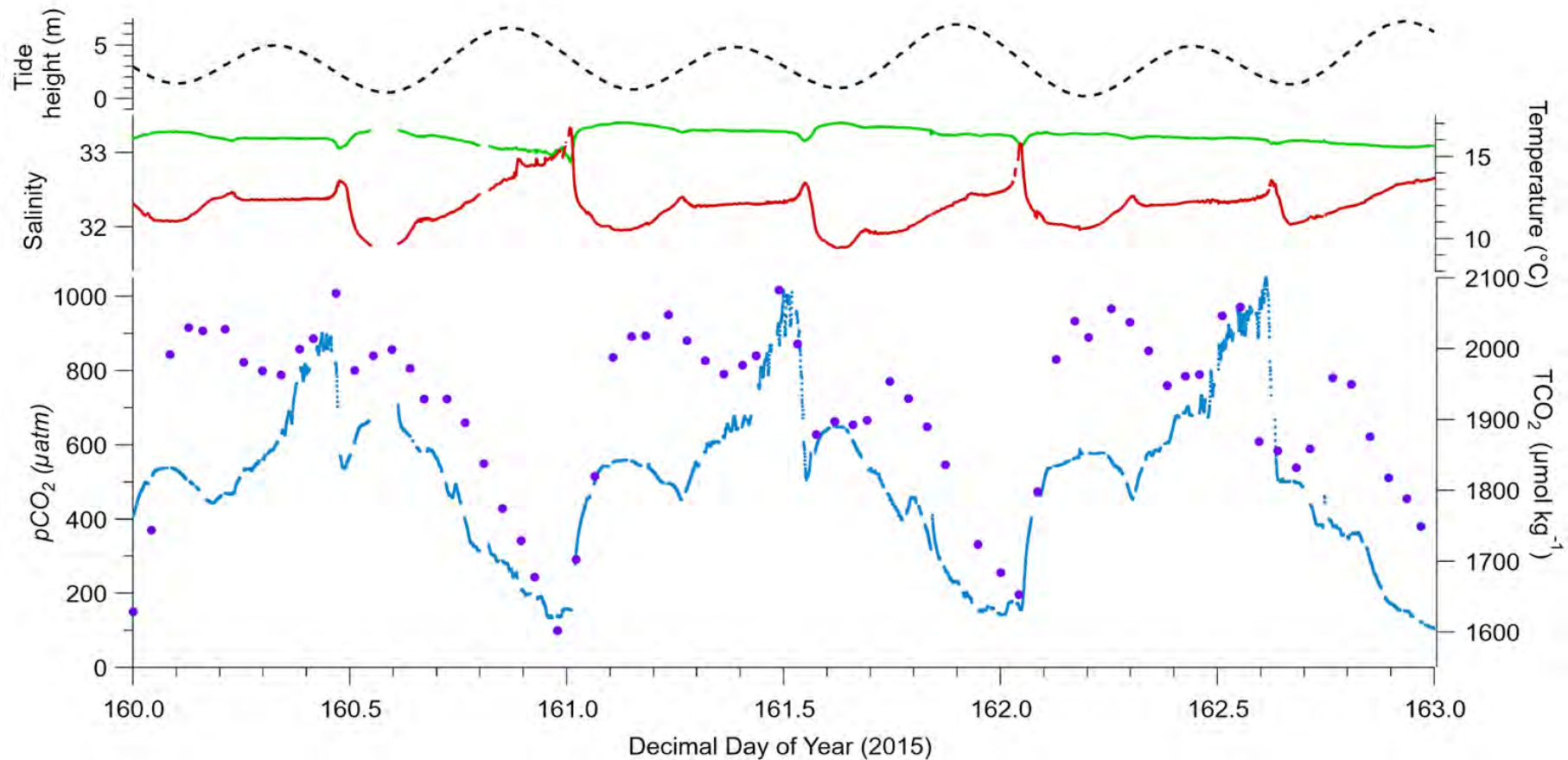
Results - Annual variability



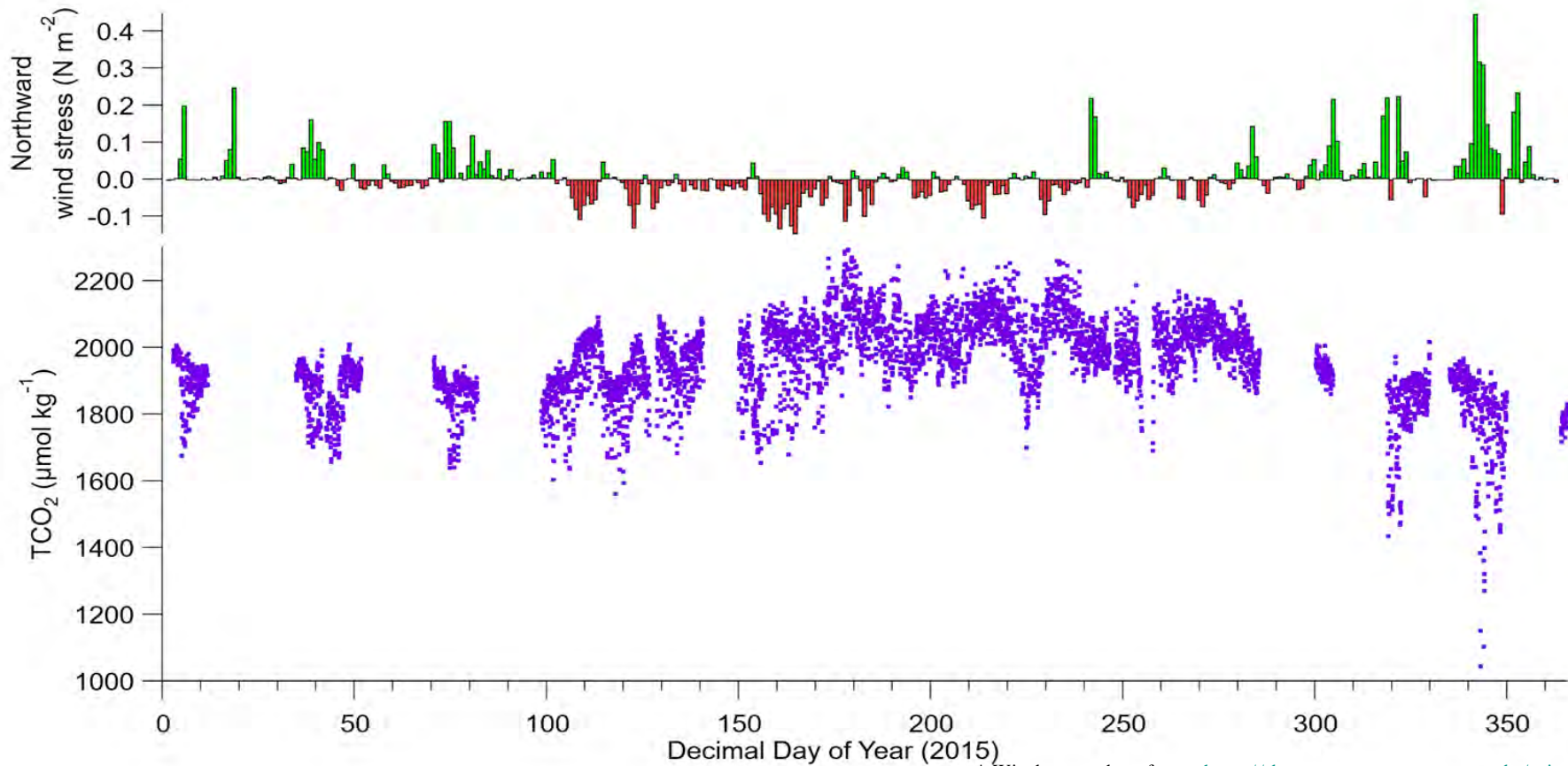
Results - Annual variability



Results - Composite $p\text{CO}_2$

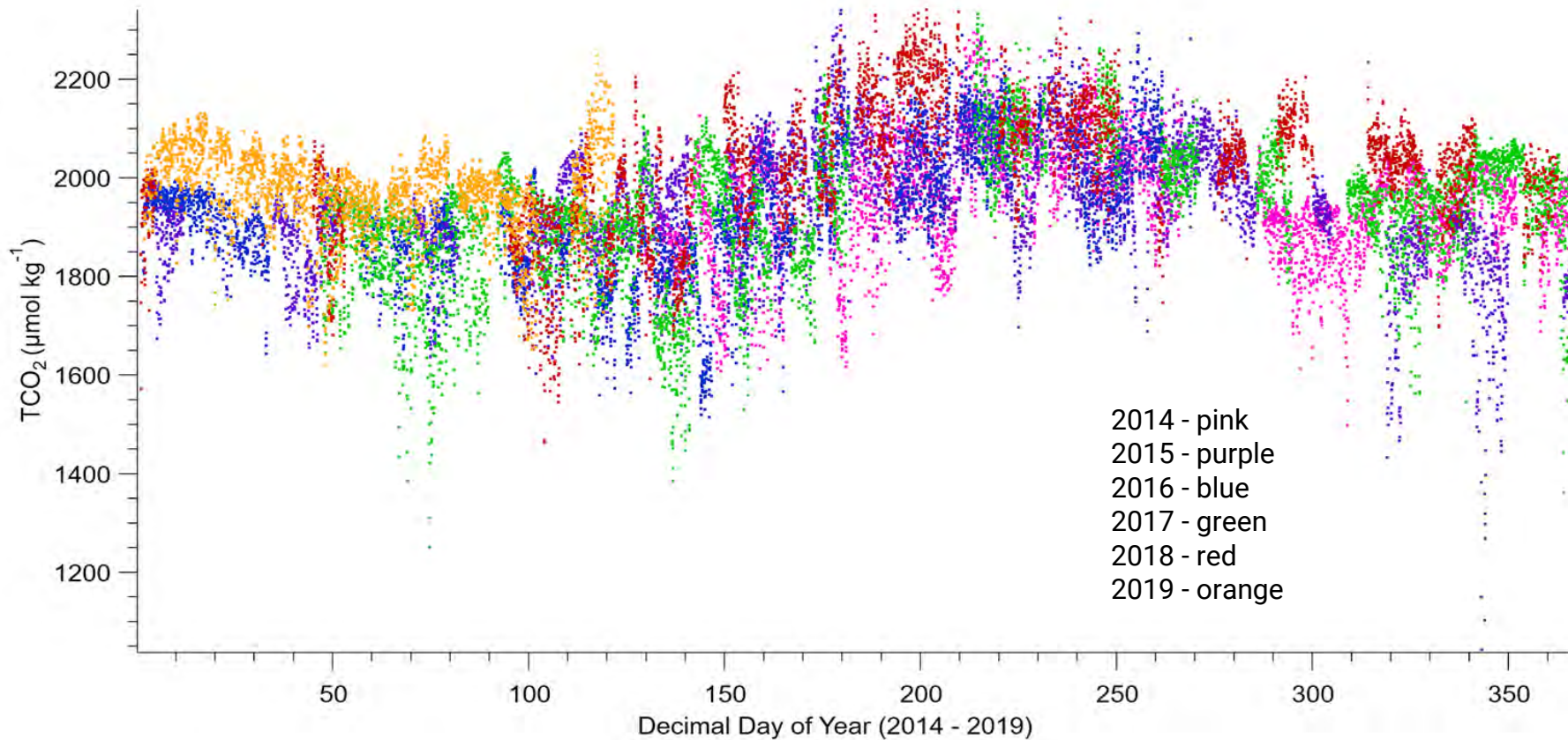


Results - TCO₂ measurements

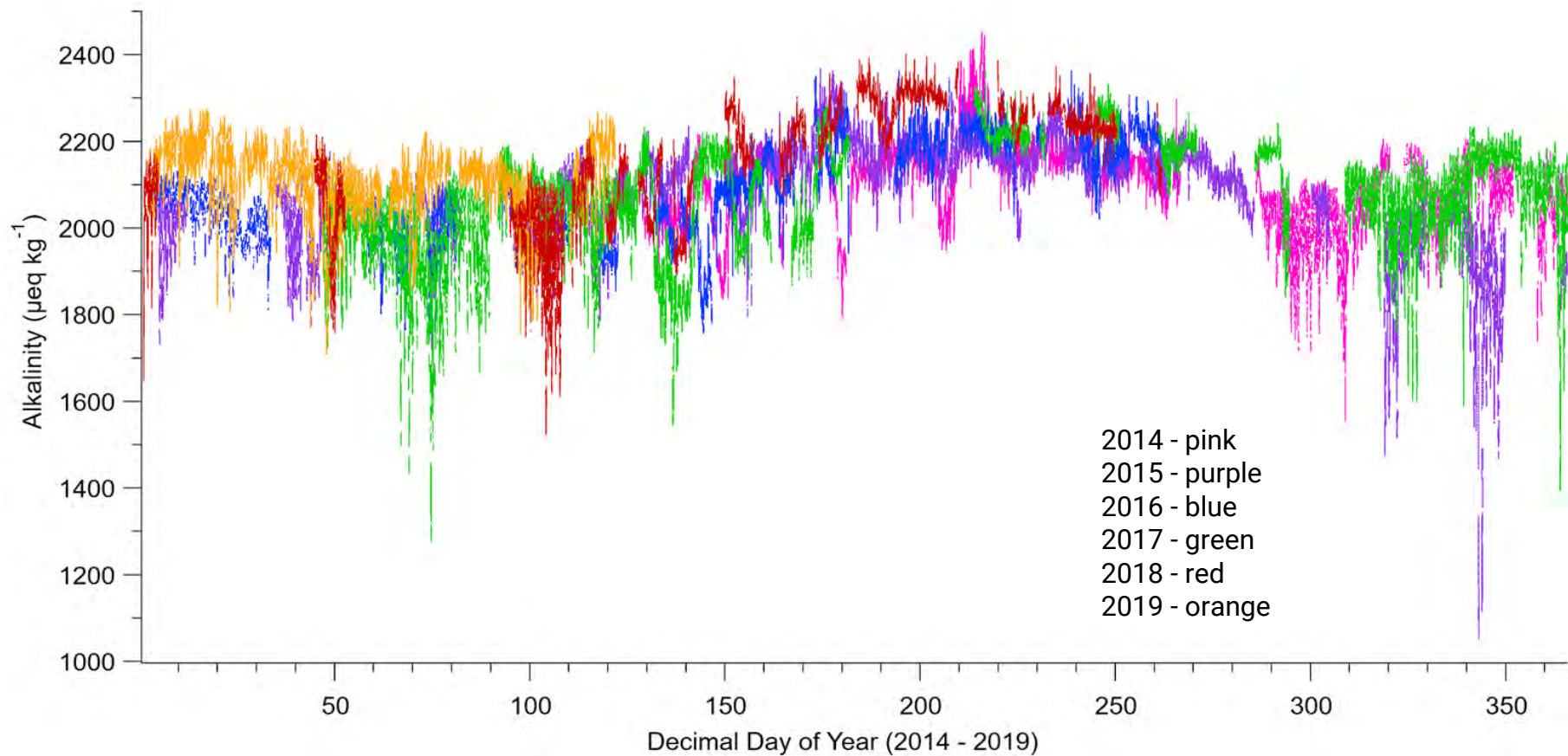


* Windstress data from: <http://damp.coas.oregonstate.edu/windstress/>

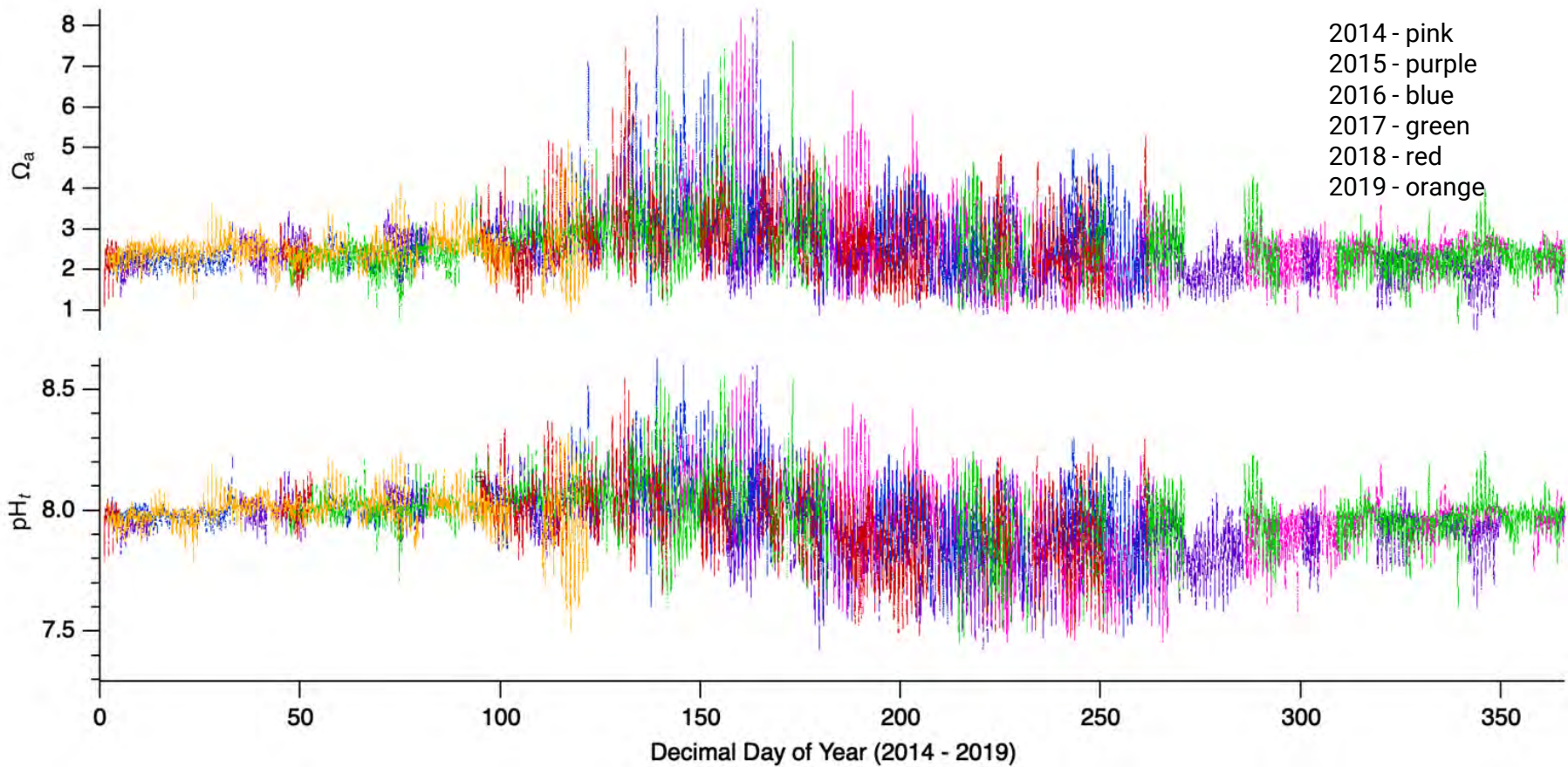
Results - Annual TCO_2 trends



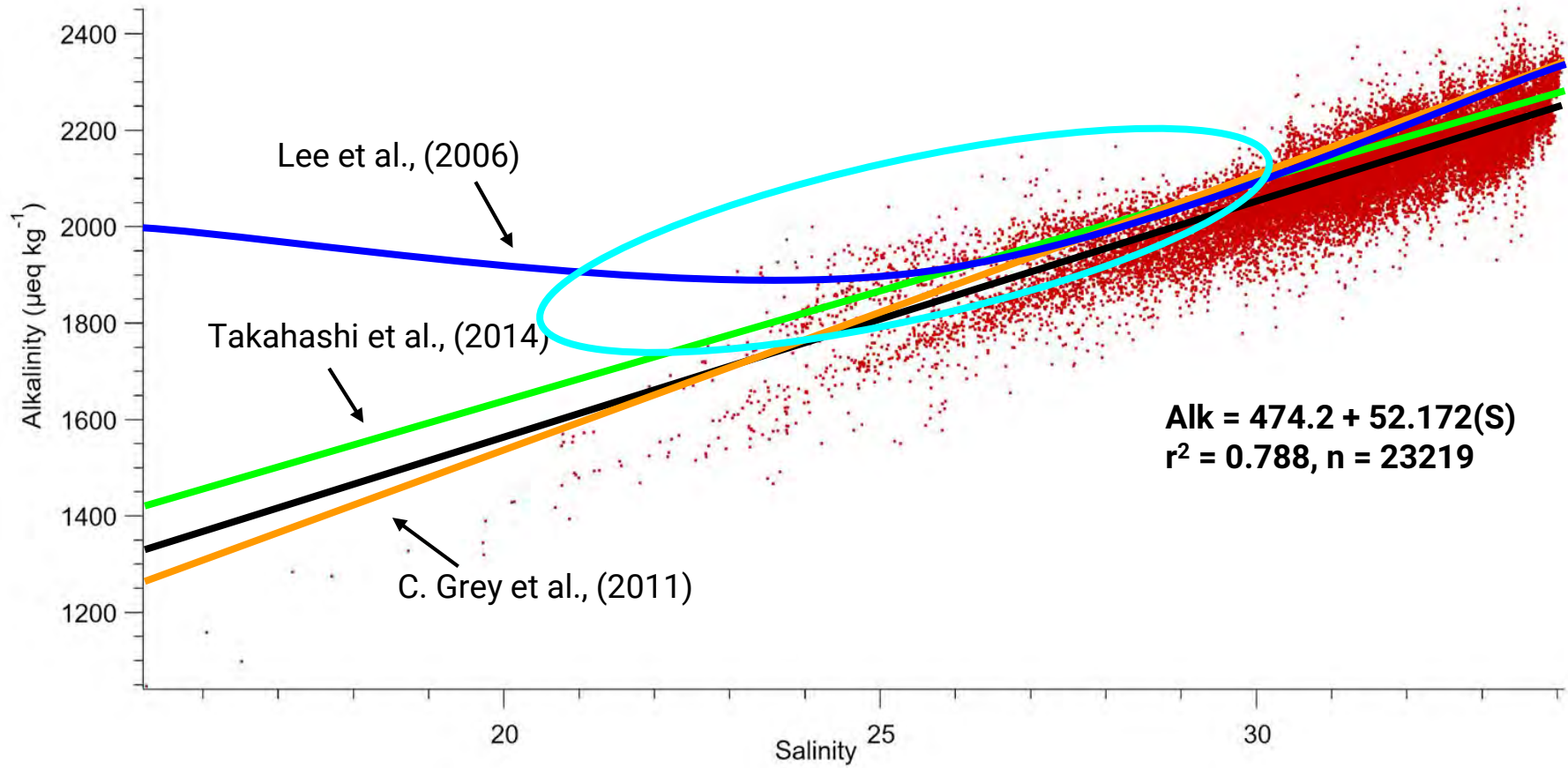
Results - TCO₂ composite



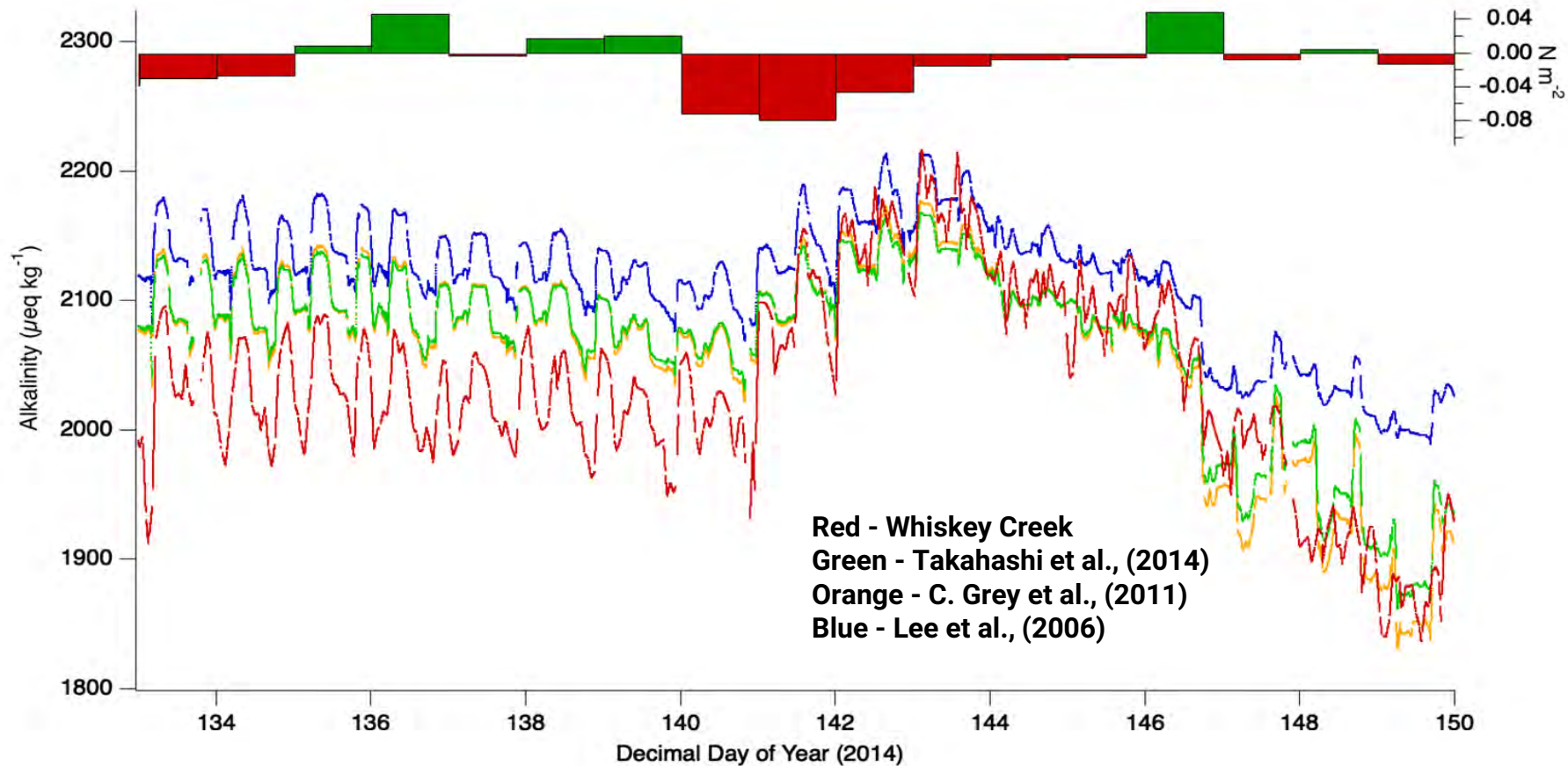
Results - Alkalinity composite



Results - pH / omega composite



Results - Alk/S relationship



Results - Regional Alk/S relationships

	Avg. offset	RMS offset	Max offset	Min. offset
Alkalinity	87.2 ^a	100.9	440.4	-187.8
	49.2 ^b	67.8	208.5	209.9
	43.2 ^c	64.1	224.5	-228.9
TCO ₂	77.5 ^a	89.3	380.1	-64.7
	43.4 ^b	59.9	191.3	-184.1
	38.1 ^c	56.7	208.6	-198.2
pH _t	0.016 ^a	0.019	0.098	-0.032
	0.009 ^b	0.012	0.047	-0.035
	0.008 ^c	0.012	0.053	-0.038
Ω _{aragonite}	0.131 ^a	0.155	0.305	-0.567
	0.073 ^b	0.105	0.49	-0.346
	0.066 ^c	0.099	0.447	-0.375

^a **Lee et al., (2006)** - Global relationship of alkalinity and salinity with temperature in surface water of world's oceans

^b **C.Grey et al., (2011)** - Applications of in situ pH measurements for total inorganic carbon calculations

^c **Takahashi et al., (2015)** - Climatological distributions of pH, pCO₂, alkalinity, and CaCO₃ saturation in the global surface ocean, and temporal changes at selected locations

Results - Variables derived from regional North Pacific relationships

Conclusion

Netarts Bay is highly metabolic in summer

Wintertime downwelling, spring-transition, and summer upwelling dominate hydrographic regimes

Regional Alk/S models fail to capture variable freshwater end members, in-bay calcification/dissolution events, and sulfate reduction

Regional models produce varying degrees of pH and omega predictability



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Whiskey Creek Shellfish Hatchery



Check Samples

Grab samples are collected during routine maintenance and analyzed on campus

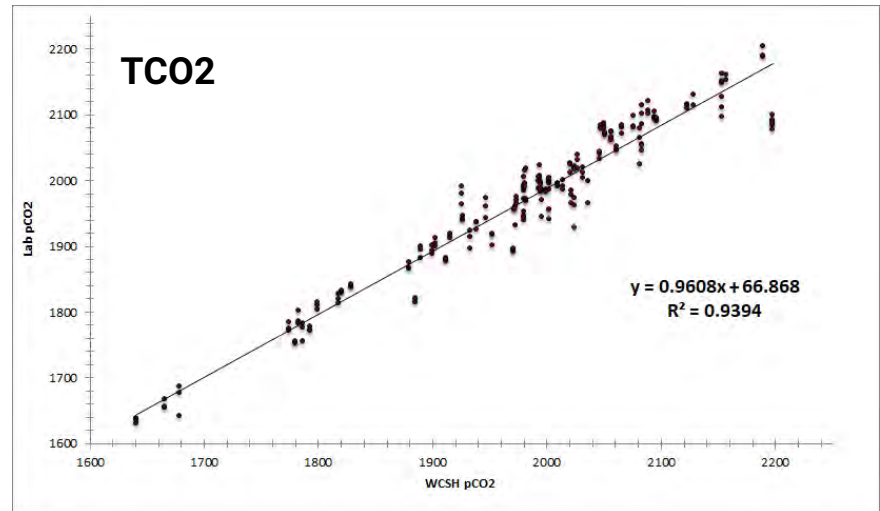
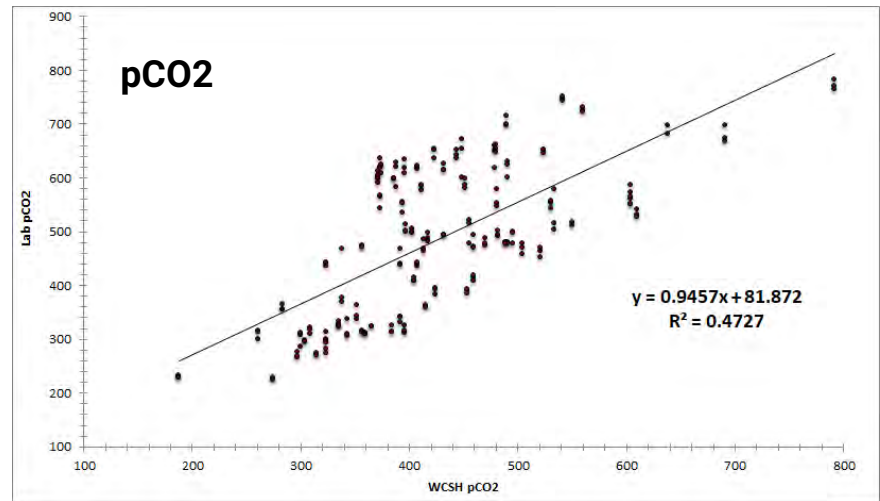
Lab TCO_2 analysis on average 0.4% lower than WCSH

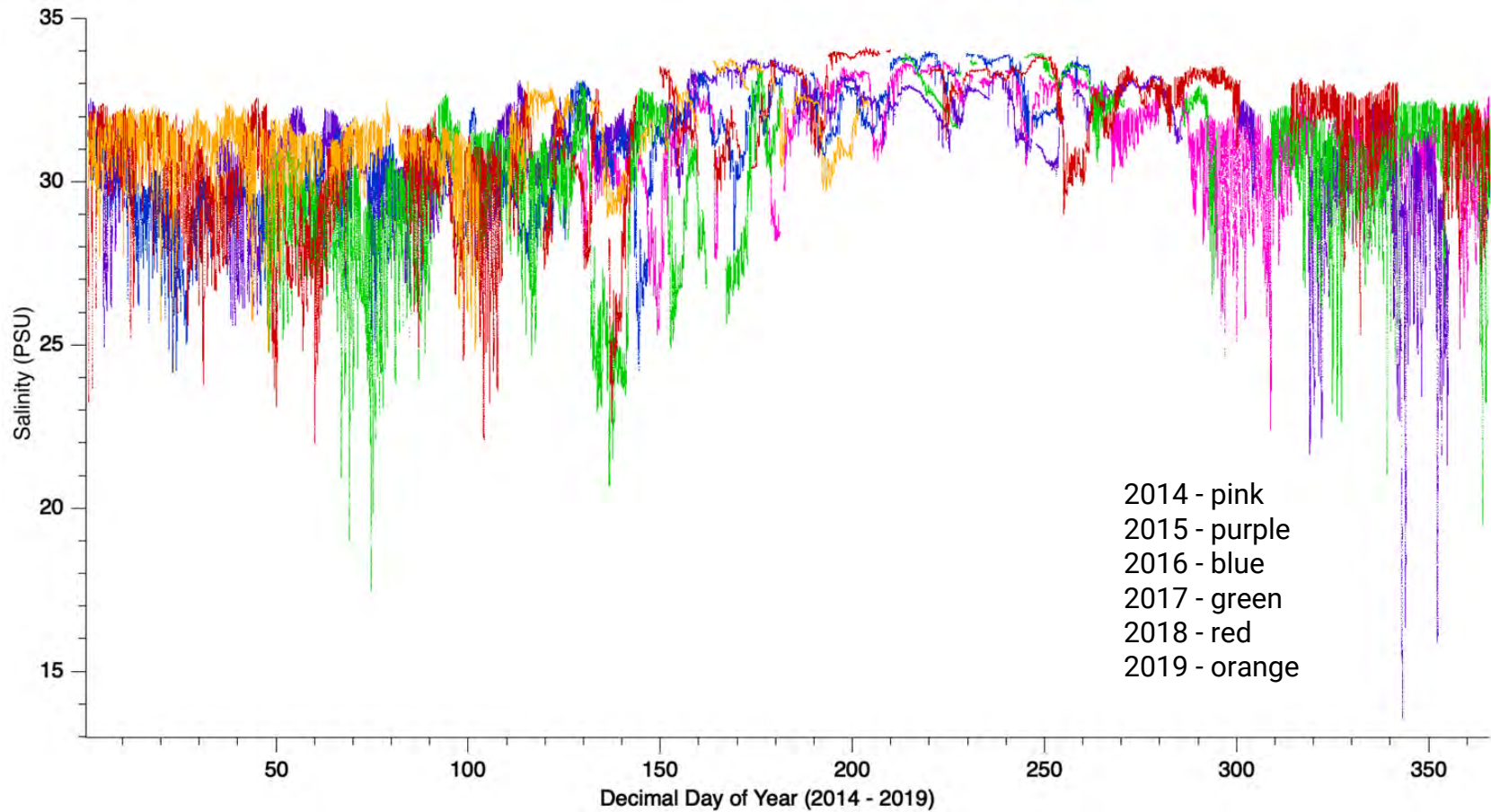
Lab pCO_2 analysis on average 5% higher than WCSH

Combined measurement uncertainty

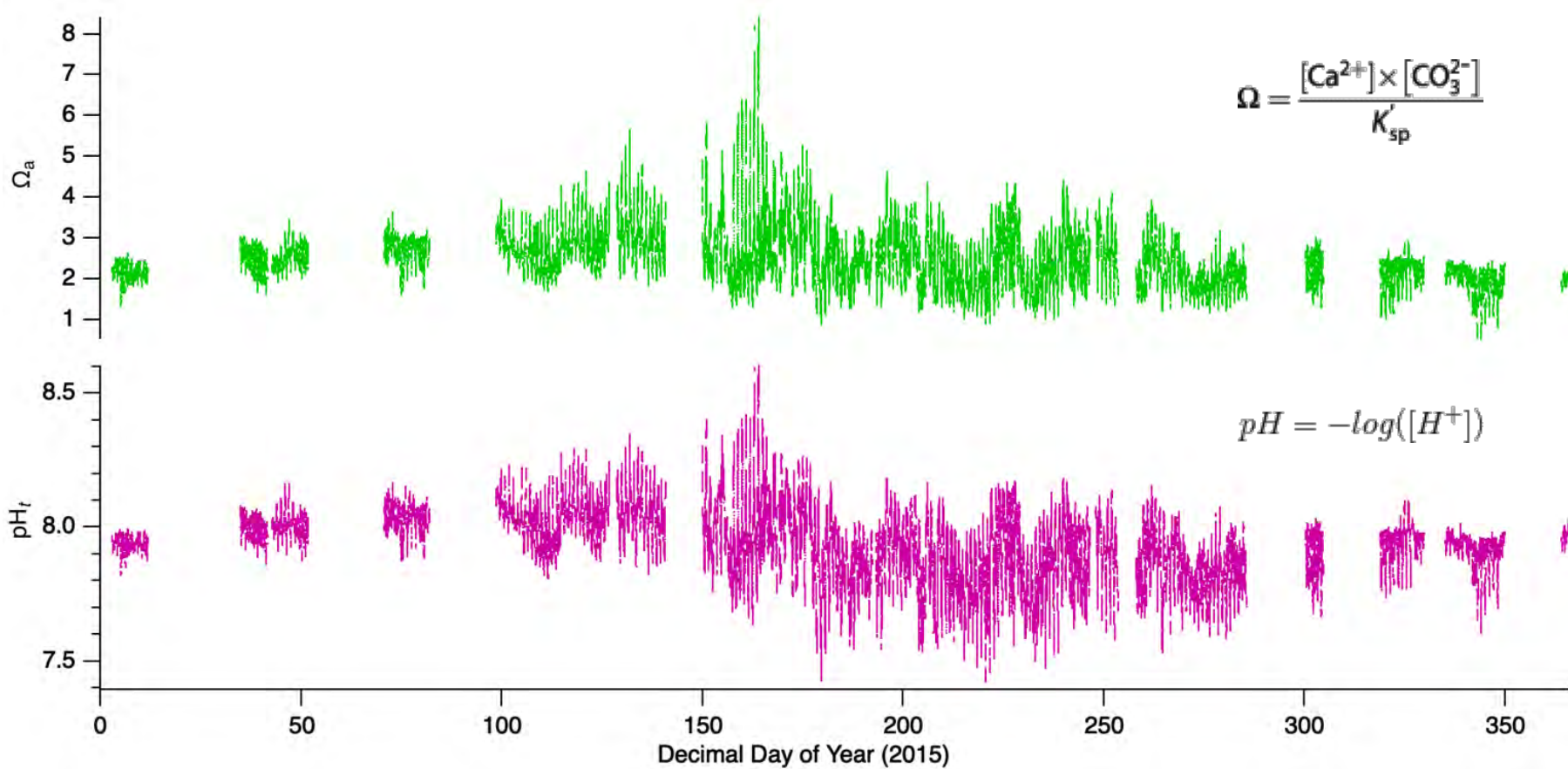
pCO_2 : 5%

TCO_2 : $\sim 10 \mu\text{mol/kg}$

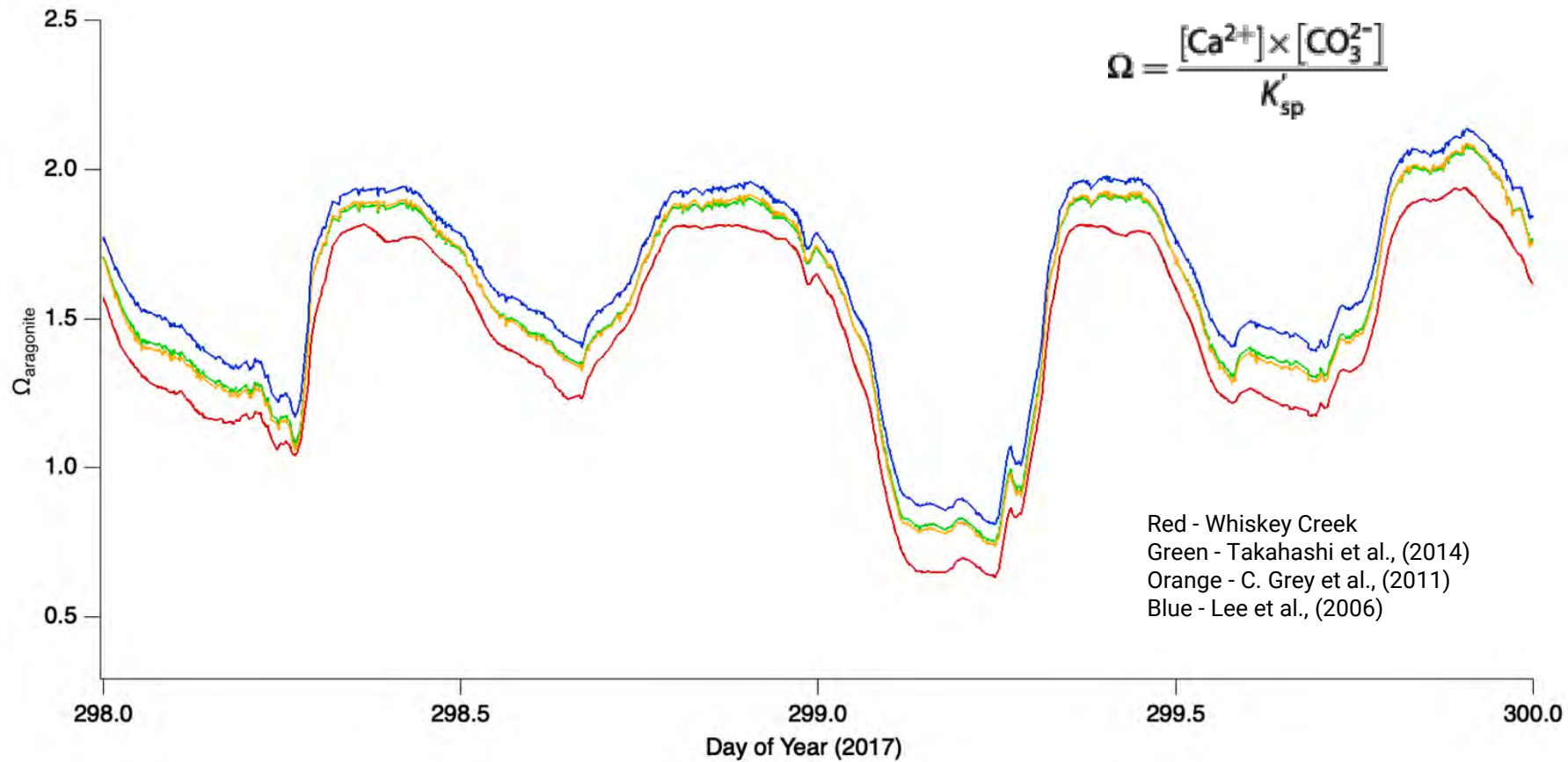




Results - Composite salinity



Results - Annual pH & omega variability



Results - Saturation States