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Patterns and drivers of nearshore particulate organic matter composition

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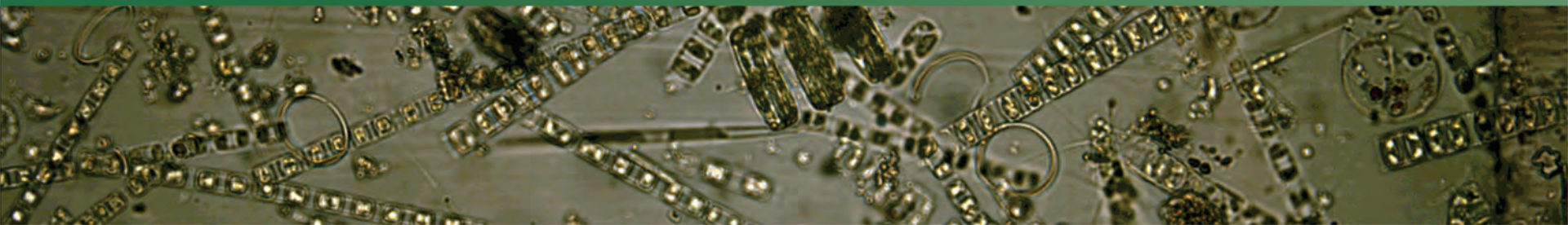
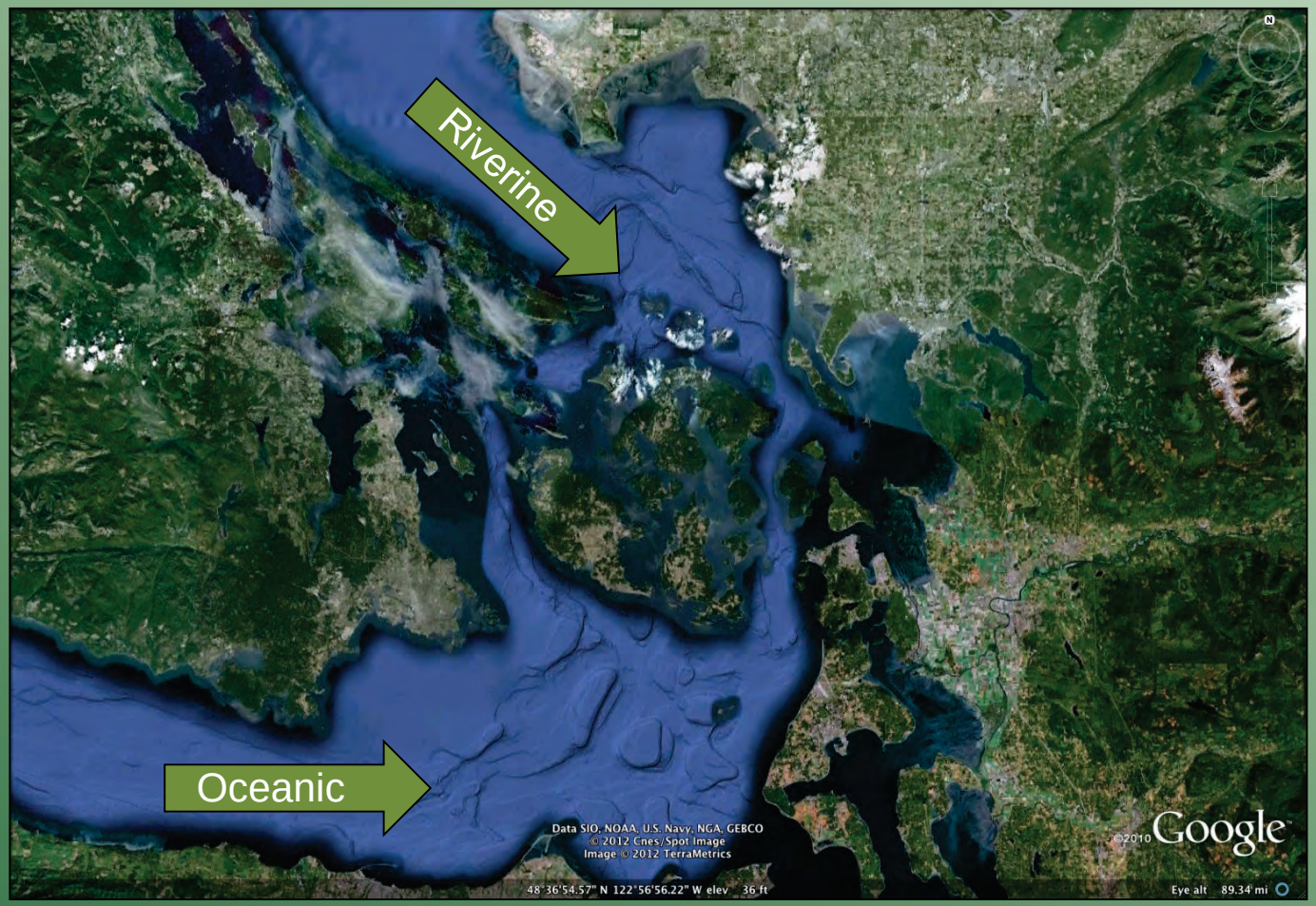
Patterns and drivers of particulate organic matter composition (POM) in the Salish Sea

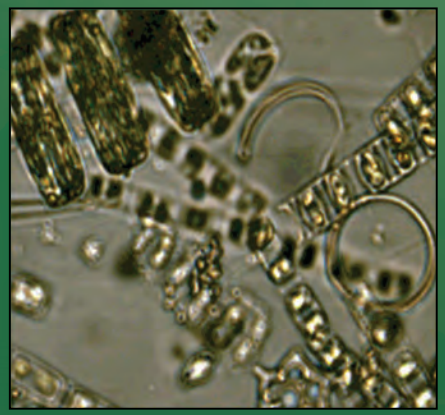
Alex Lowe

AWE Galloway, JS Yeung, MN Dethier, DO Duggins

April 30, 2014




Riverine
Oceanic
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2012 Cnes/Spot Image
Image © 2012 TerraMetrics
©2010 Google
48°36'54.57" N 122°56'56.22" W elev 36 ft
Eye alt 89.34 mi

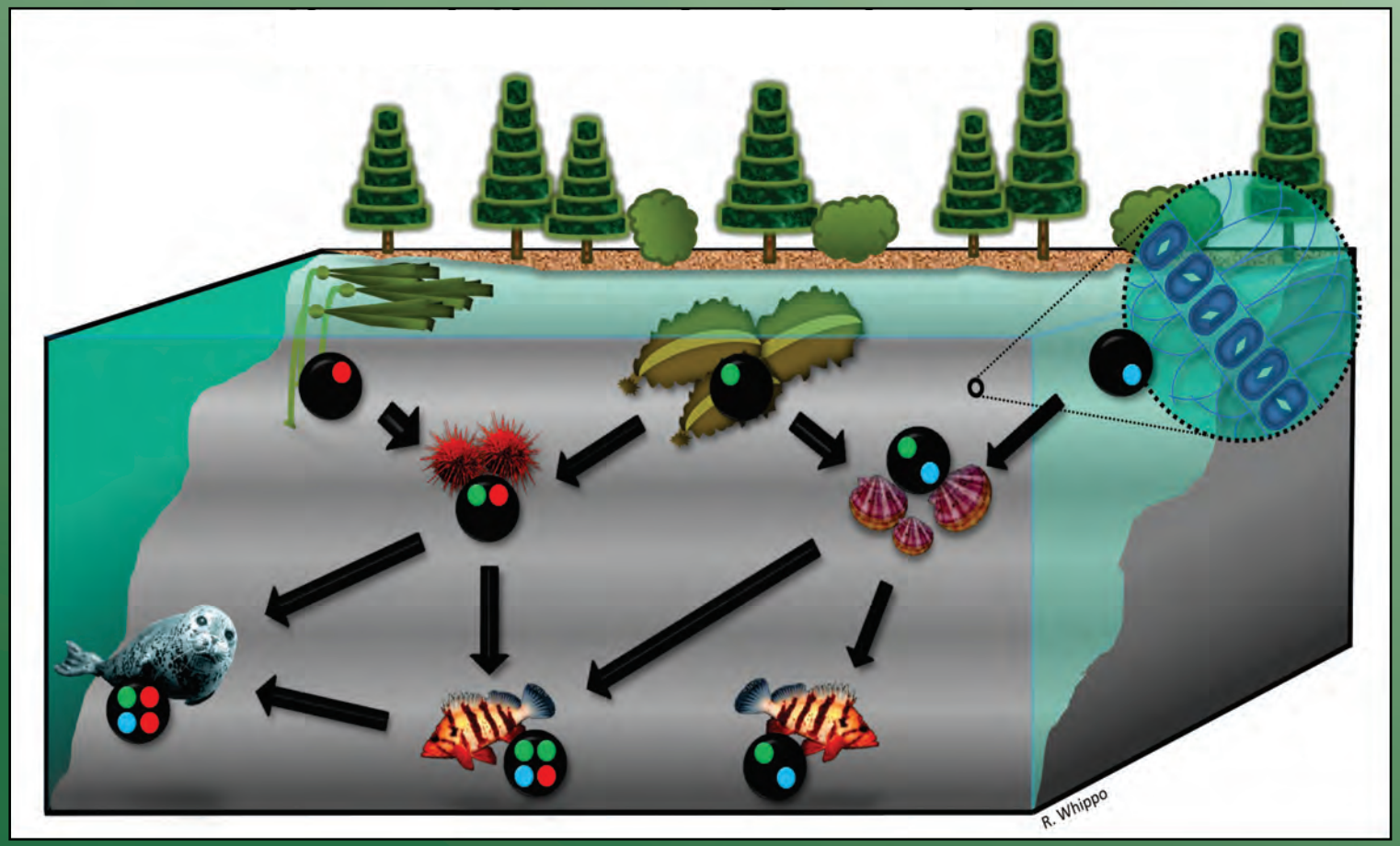


http://landsat.visibleearth.nasa.gov

Why are we interested in particulate organic matter (POM)?

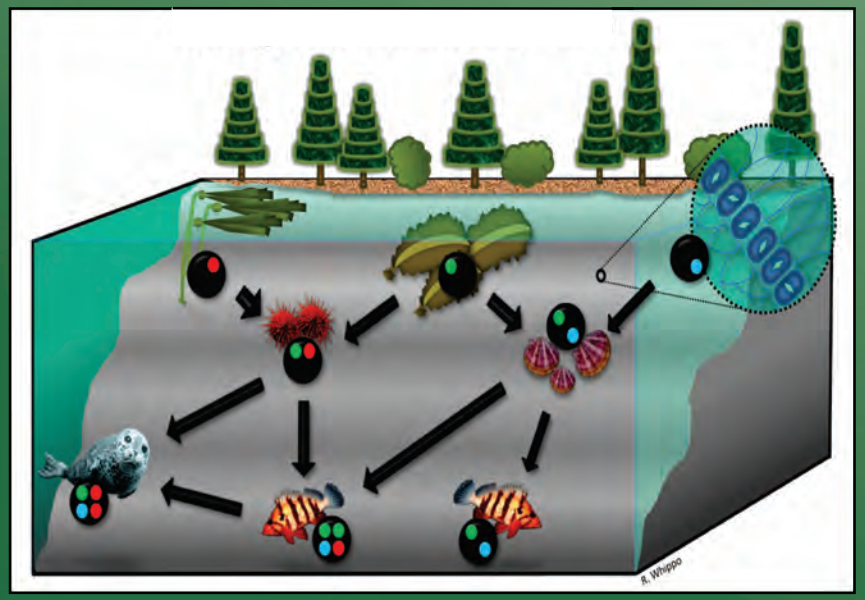
- Primary food of many consumers
  - Allochthonous vs autochthonous?
- Improved understanding of ecosystem dynamics
- Composition debated
  - What do biomarkers tell us?

Biomarkers



Biomarkers

- Multiple Stable Isotopes
  - $\delta^{13}C$, $\delta^{34}S$ → Source indicators
  - $\delta^{15}N$ → Nutrient/Trophic level indicator



- Fatty Acids
  - Synthesized by primary producers, bacteria, some consumers
  - Essential fatty acids (EFA) important for POM consumers

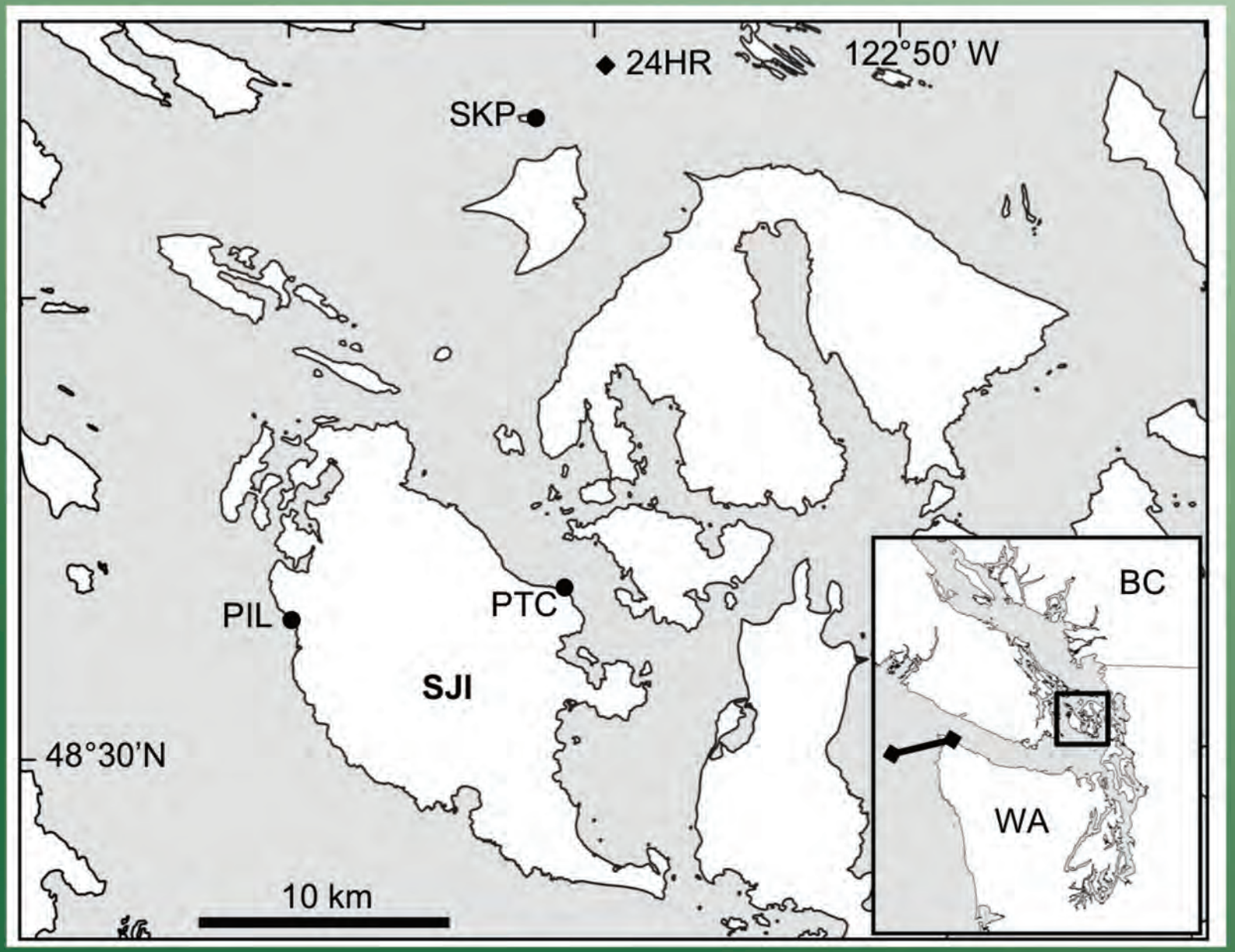
Research goals

1. Quantify spatial and seasonal variability of energy sources available in POM

2. Determine drivers of variability (composition and environmental factors)

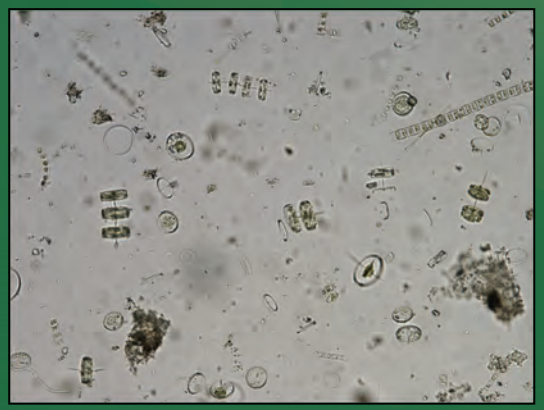
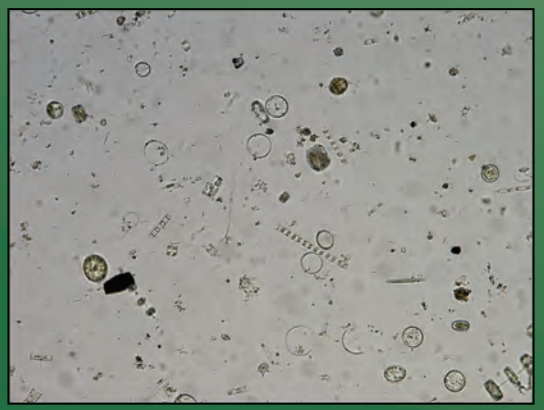
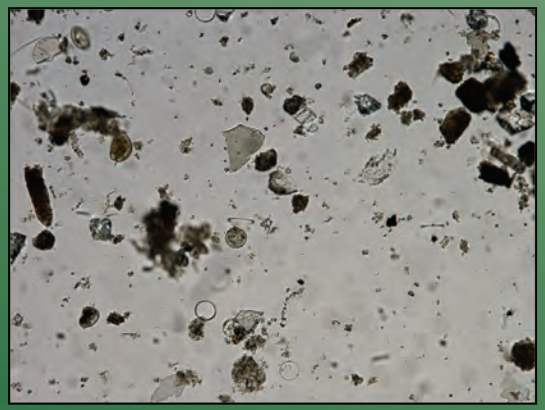
Can we predict???

Study sites in the San Juans



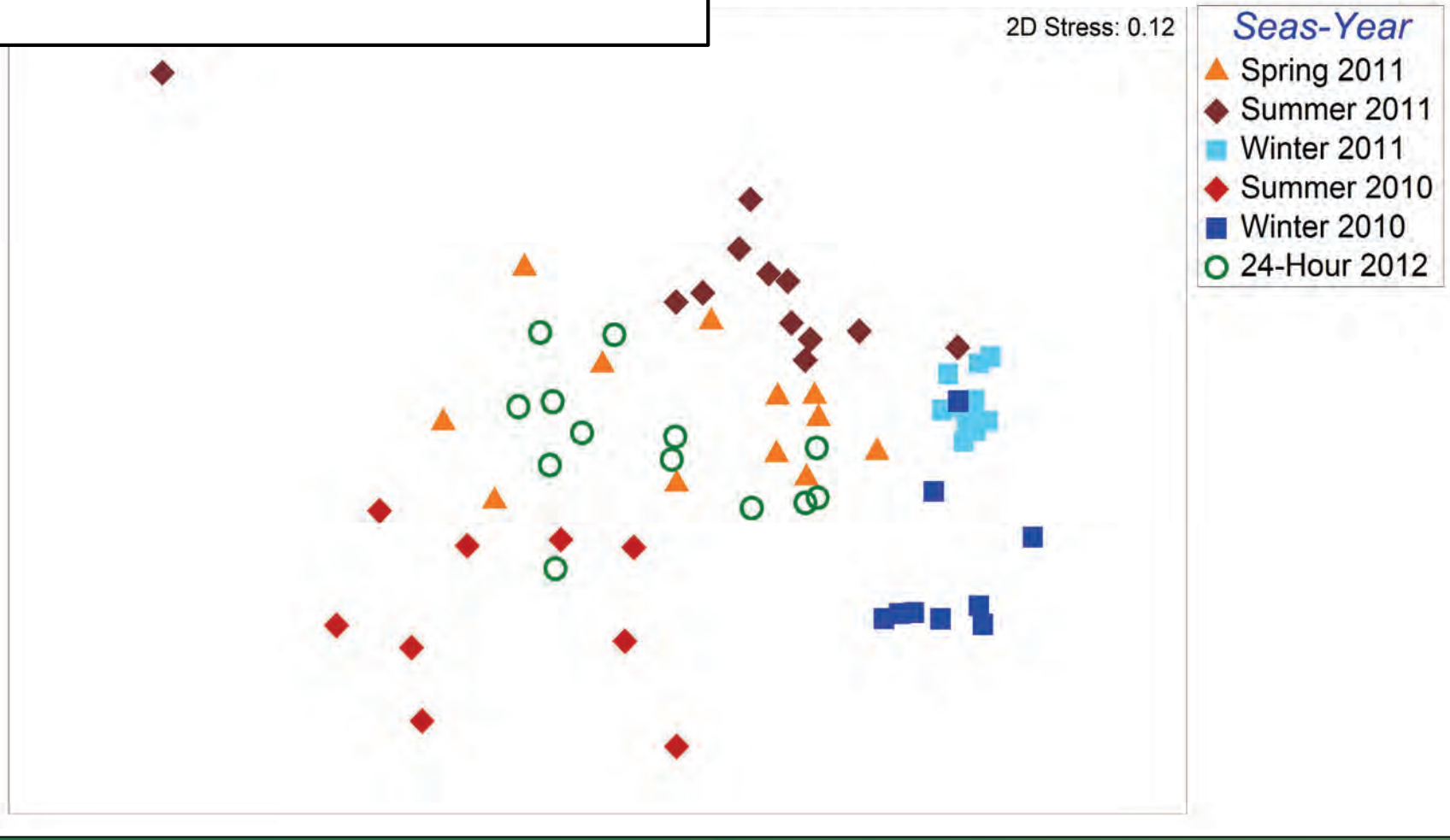
Capturing POM Dynamics

- Collect nearshore POM in 20 – 190 µm size fraction
- For each sample, quantify:
  - Percent bio-area of living and detrital groups
  - Stable isotopes of Carbon, Nitrogen and Sulfur
  - Fatty acids: taxon-specific and essential FA

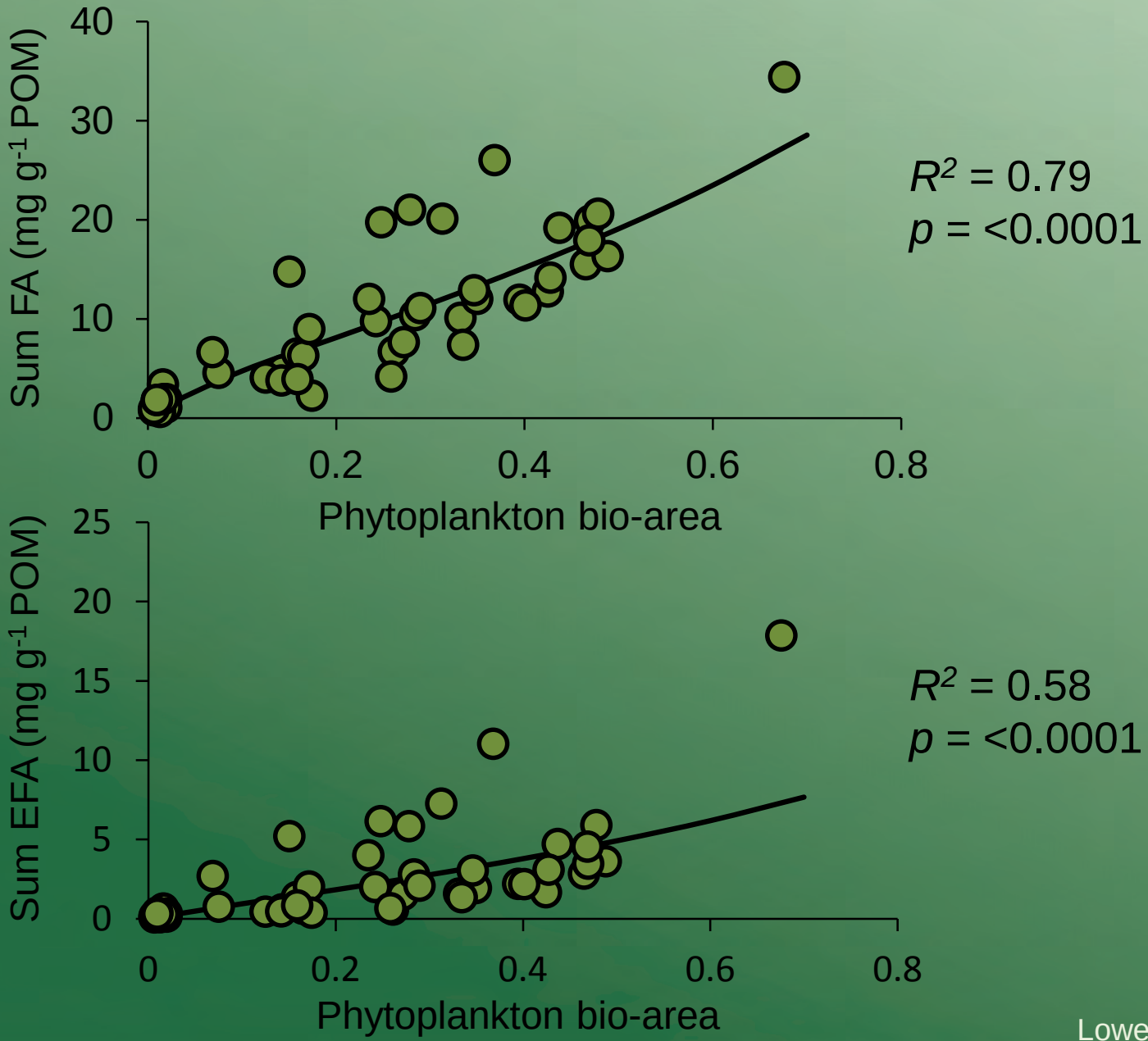
Variation in POM composition

Distance-based multivariate models:
- MSI: 59.6%



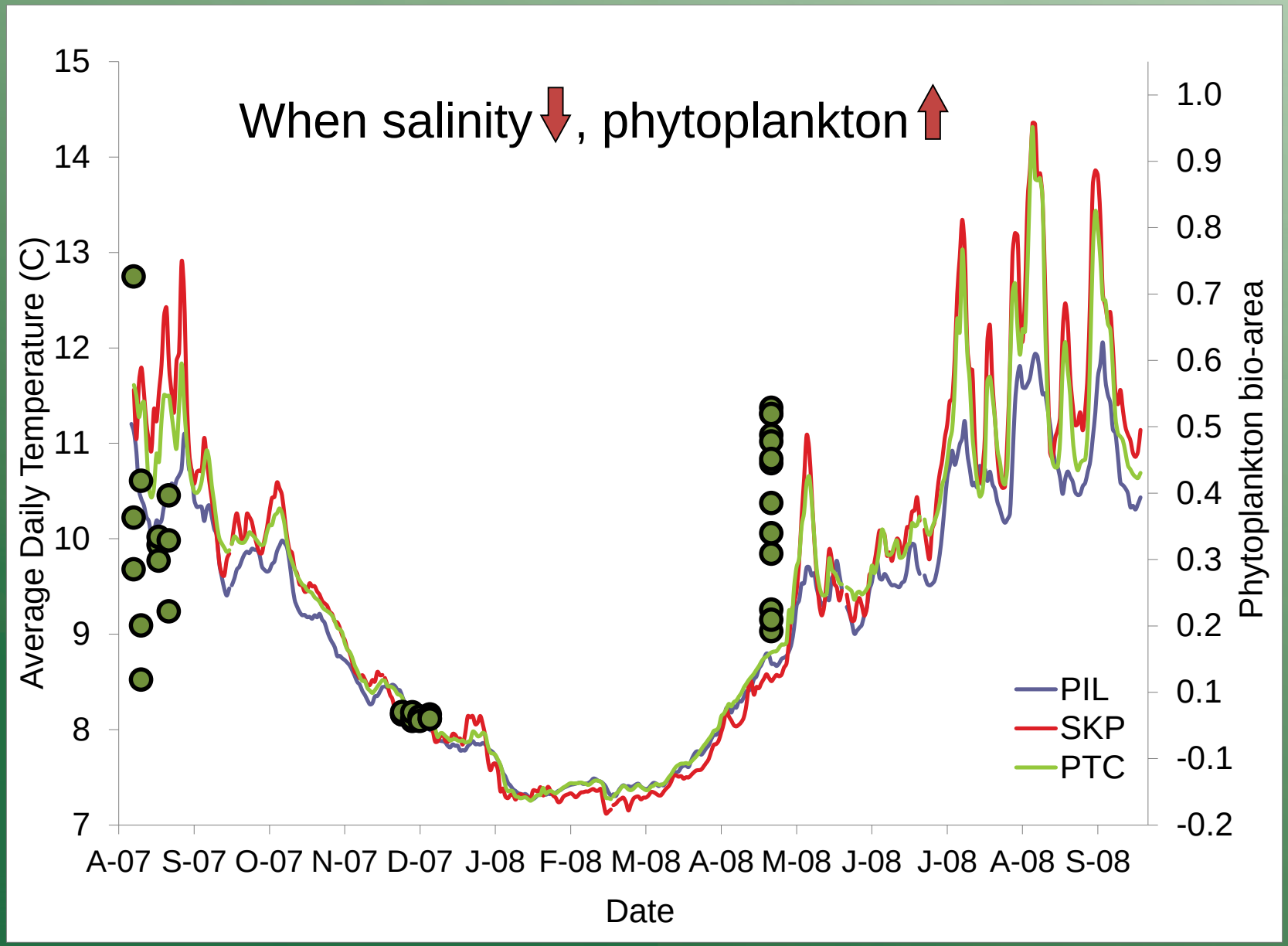
Lowe et al. Oikos

Influence of phytoplankton



Lowe et al. Oikos

Temporal phytoplankton variability

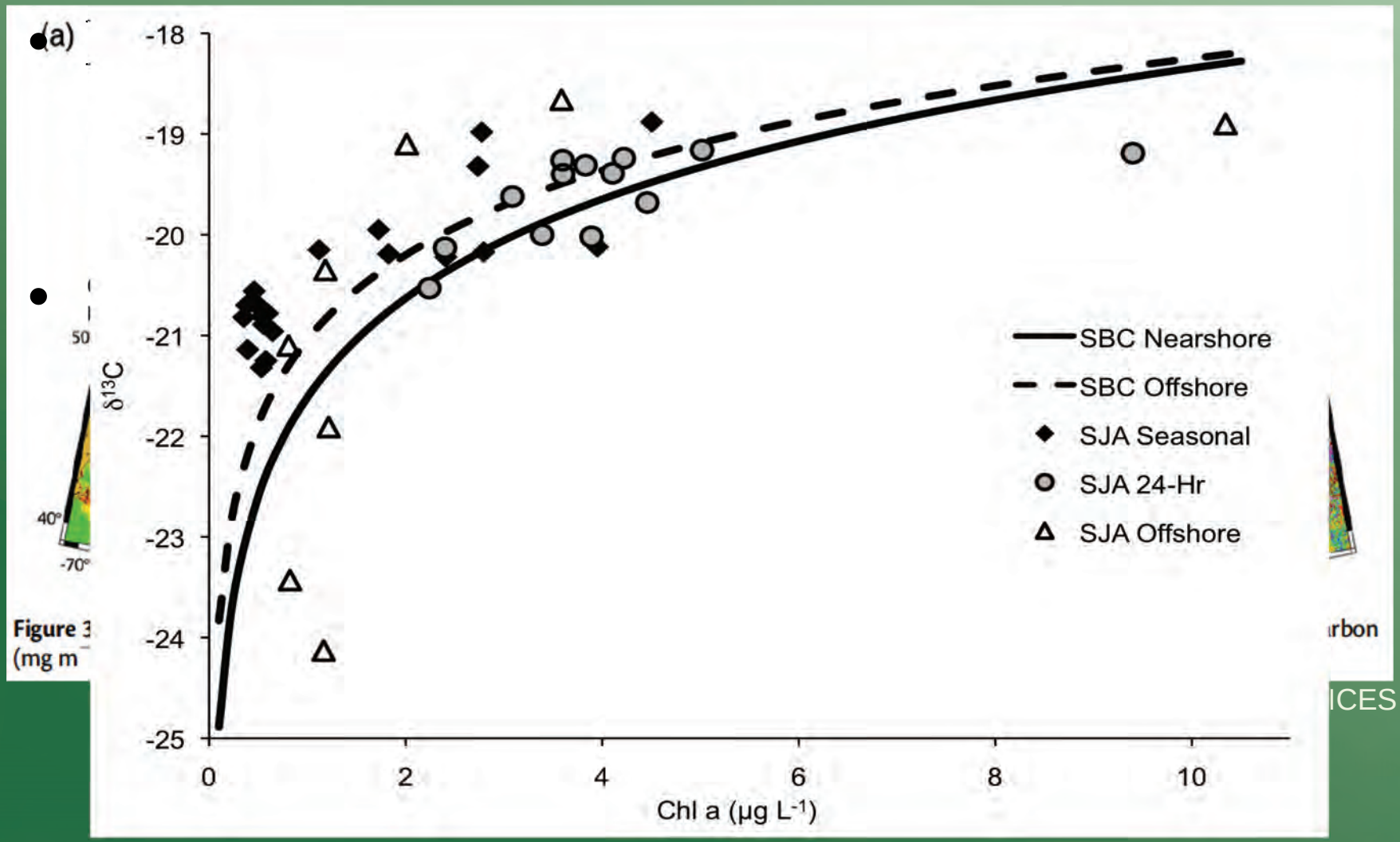


Data from Hobo temperature-salinity loggers

Lowe et al. in prep

Future directions

- Method allows comparison among systems



Lowe et al. 2014 Oikos, data from Miller et al. 2013

Conclusions

- Phytoplankton biomass drives variability in POM MSI and FA signatures
  - When biomass is high, species composition drives variation
  - When biomass is low (winter), resuspension of marine detritus
- Combination of MSI and FA can pick apart detritus
  - Often no single answer

Acknowledgements

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Literature cited:

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Lowe et al. (in press) Broad sampling and diverse biomarkers allow characterization of nearshore particulate organic matter. Oikos.

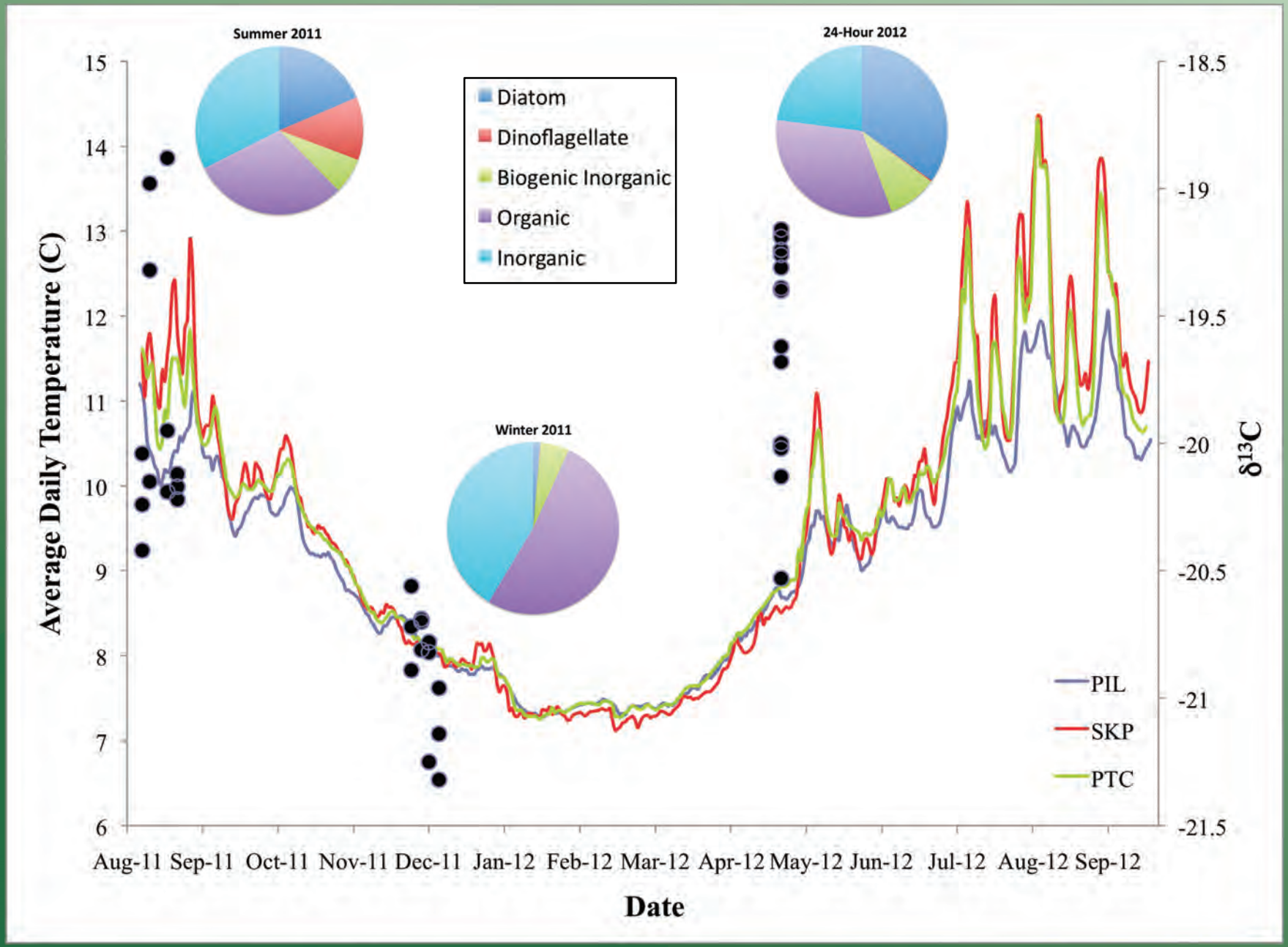
Miller et al. (2013) MEPS 474: 53–66.

University of Washington
Friday Harbor Laboratories

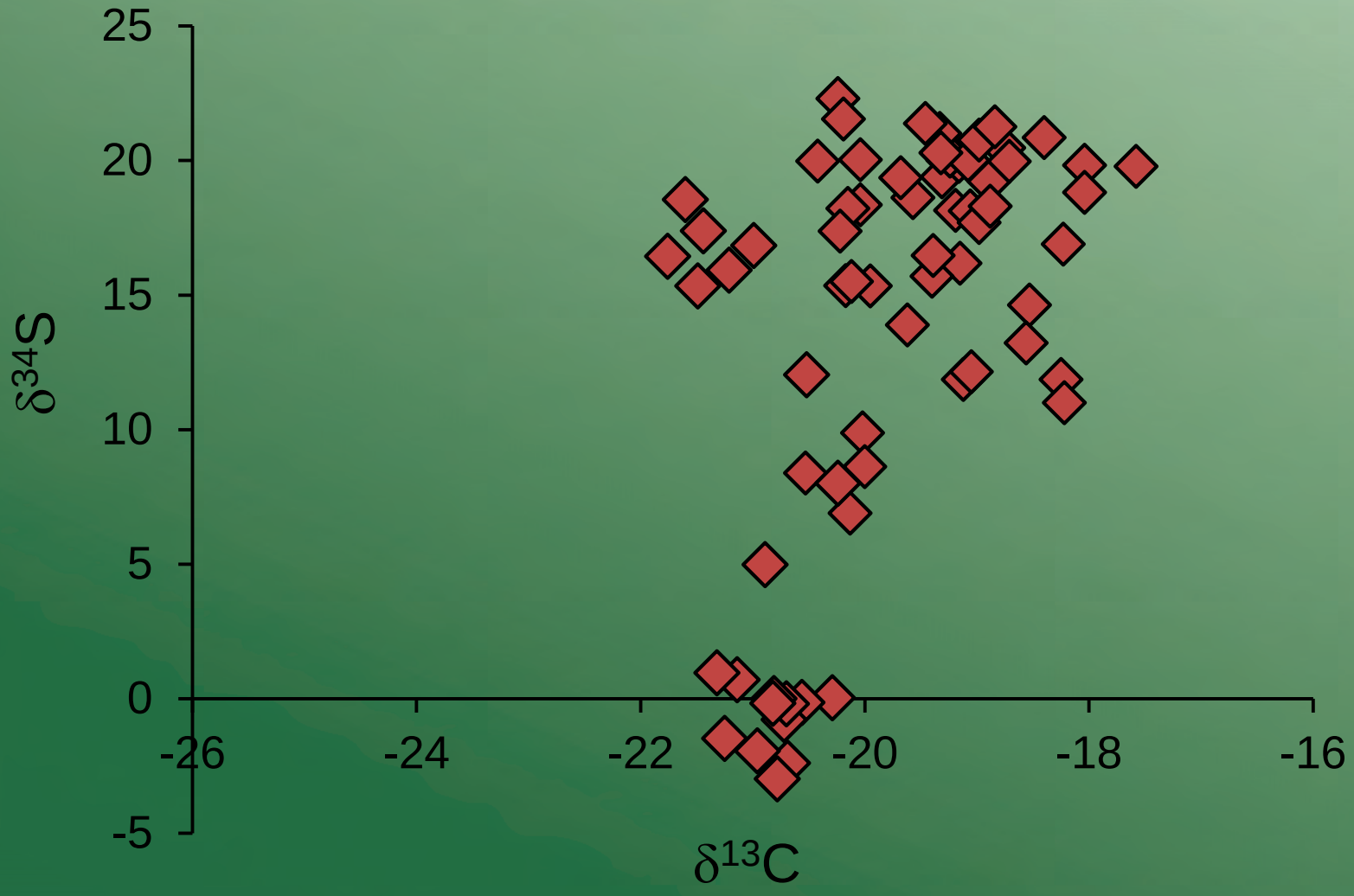
SALINITY

Sampling	Parameter	**Mean <30**	n	**Mean >30**	n	***P***
Tide only	Salinity	29.03	8	30.09	5	**<.0001**
	Temperature (°C)	8.56	8	8.40	5	**0.017**
	Chl *a* (µg L^{-1})	5.67	8	2.53	5	**0.005**
	All Phytoplankton	42.10%	8	21.36%	5	**0.003**
	$\delta^{13}C$	-19.33	8	-20.06	5	**0.005**
	$\delta^{34}S$	18.65	8	9.54	5	**<.001**
	POM Community	mv	8	mv	5	**0.001**
	MSI	mv	8	mv	5	**0.003**
	EFA	mv	8	mv	5	**0.035**
Seasonal	Salinity	28.50	26	30.50	27	**<.0001**
	Temperature (°C)	11.29	26	8.74	27	**<.0001**
	Chl *a* (µg L^{-1})	2.43	10	0.49	11	**<.0001**
	All Phytoplankton	25.76%	26	14.03%	27	**0.003**
	$\delta^{13}C$	-19.42	26	-20.26	27	**0.005**
	$\delta^{34}S$	16.13	26	9.96	27	**0.005**
	POM Community	mv	26	mv	27	**0.004**
	MSI	mv	26	mv	27	**<.0001**
	EFA	mv	21	mv	15	**0.001**

Lowe et al. in prep


Summer 2011
24-Hour 2012
Winter 2011
Diatom
Dinoflagellate
Biogenic Inorganic
Organic
Inorganic
PIL
SKP
PTC
Average Daily Temperature (C)
δ13C
Date
15
14
13
12
11
10
9
8
7
6
-18.5
-19
-19.5
-20
-20.5
-21
-21.5
Aug-11 Sep-11 Oct-11 Nov-11 Dec-11 Jan-12 Feb-12 Mar-12 Apr-12 May-12 Jun-12 Jul-12 Aug-12 Sep-12

Observed POM



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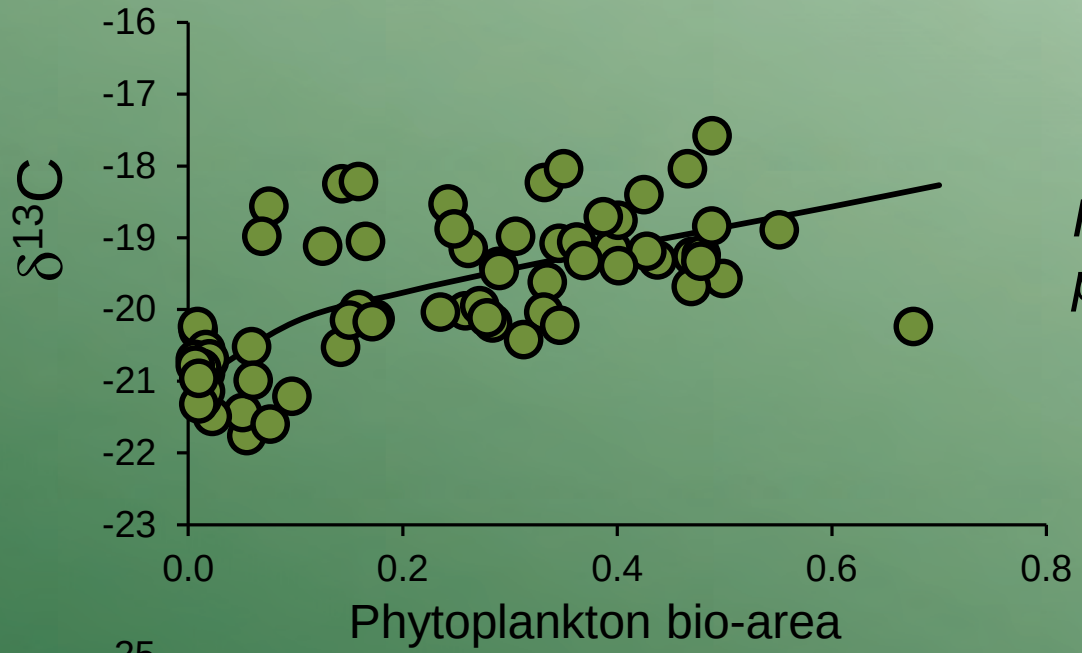
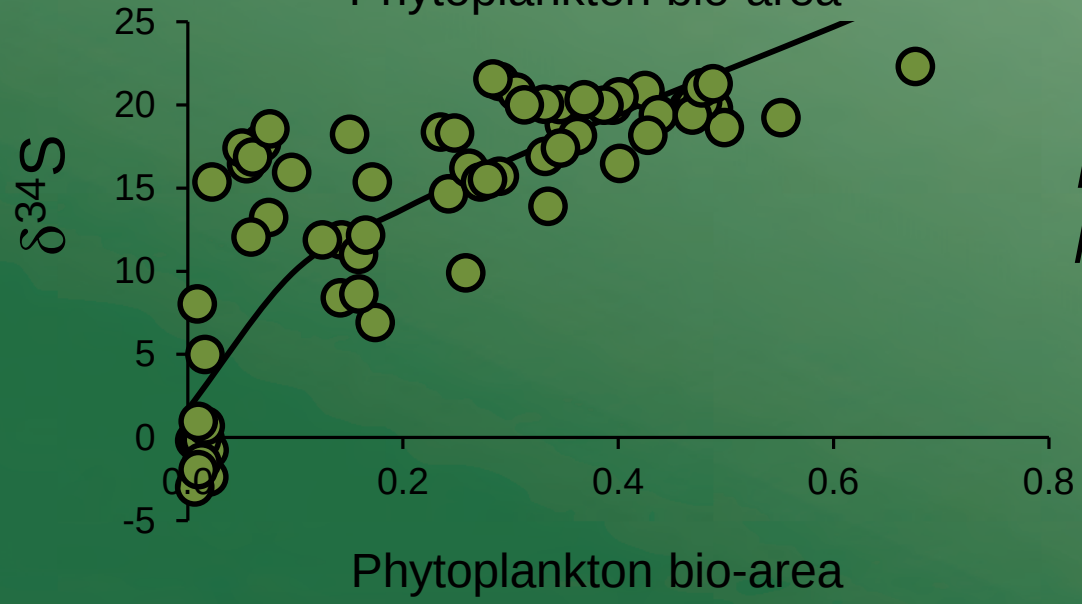


R^2 = 0.46
p = <0.0001



R^2 = 0.67
p = <0.0001

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