Introduction
Global oceanic food web models commonly use chlorophyll estimates, standardized conversions to carbon (C), and allometric scaling of biomass to model net primary productivity. Estimates of each component (i.e. chlorophyll a, particulate organic carbon (POC), and cell volume) and their ratios are subject to pronounced variability, and thus uncertainty. Marine POC is comprised of heterotrophic bacteria, micro-zooplankton, detritus and phytoplankton, which vary geographically in their relative abundance. The C density of cells and C-to-chlorophyll relationships are confounded by a lack of knowledge of whether chlorophyll concentrations scale with biomass, or are a result of photoacclimation processes. To better constrain the relationships between ecosystem C components, we reanalyzed data from cruise transects to major ocean basins in the North Atlantic, tropical Pacific, and eastern Indian Oceans, along with the high nutrient Bering Sea and Peruvian upwelling zone.

Methods
On each cruise, samples for POC, PON, POP, nutrients and chlorophyll a were taken in the surface 200 m and analyzed with standard techniques. Flow cytometry cell counts were performed on fixed samples, and C cell^{-1} determined using empirical relationships described by Casey et al. (2013), which was used to calculate the biomass of of nanoplanckton (<20μm; Cnano).

POC to chlorophyll relationships were used to derive total autotrophic biomass (Cphyto), and Cnano was subtracted to estimate large autotroph biomass (Cmicro).

Distributions of autotrophic biomass to total particulate organic carbon. Mean and standard deviation of all data = 0.381 ± 0.375; median = 0.257. Inter- and intra-cruise variability likely due to nutrient availability and diversity, and the interaction between the two.

Biomass partitioning between Cnano (filled circles) and Cmicro (open circles) as a function of total POC. 10% and 50% lines provided for reference. Squares in RR1604 plot are semi-empirical Cmicro derived from FlowCAM analysis (C cell^{-1} from Menden-Deuer & Lessard (2000)).

Re-analysis of Cphyto-POC distribution using modified linear regressions of POC to chlorophyll (left panels), distinguished by high and low nutrient regions of the AE1319 and NH1418 transects.

Stoichiometric relationships show that low Cphyto:POC (low-nutrient, cyanobacteria dominate) correlates with high POC:POP. Dissolved and particulate N:P have no consistent pattern, maybe due to lack of detectable nutrients in ocean surface.

Conclusions
- Autotrophic biomass (Cphyto) makes up a significant portion of total POC. It is variable but constrained.
- High- and low-nutrient regimes have definitive biomass signatures.
- Carbon-to-chlorophyll relationships are problematic. There is a need to improve capture of large (>20 μm) phytoplankton biomass (e.g., FlowCAM).
- Diversity likely correlates to bulk particle stoichiometry.

Acknowledgments
NSF and NASA funding. UNOLS captains and crew. Many technicians, grad students and postdocs of Lomas, Martiny, and Twining labs, and BATS and BEST programs.

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References