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Interactive comment on "Temperature and phytoplankton cell size regulate carbon uptake and carbon overconsumption in the ocean" *by* S. E. Craig et al.

Anonymous Referee #1

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This is a manuscript with potentially interesting results, which suggests the possibility that significant carbon fixation takes place during summer when nutrient availability and phytoplankton standing stocks (or at least chl a levels) are low. However, there seems to be a problem with the reported estimates of phytoplankton carbon, which seem too high by approximately one order of magnitude. I explain below why I think these C estimates may be in error. Because this is such a central part of the manuscript, I will restrict the current review to this problem, leaving aside all other aspects of the manuscript, which will be commented upon in future reviews.

Fig. 5 indicates that mean phytoplankton C values in winter may be around 0.025 molC m-3, equivalent to 300 mgC m-3. Given that mean winter chl a is ca. 0.5 mg m-3, this

gives a C:Chla ratio of 600. This C:Chla ratio is at least 10 times higher than what can be expected for phytoplankton experiencing low light levels and high-nutrient conditions (Taylor et al 1997 MEPS 152:51 and references therein).

In spring, there is around 0.1 molC m-3 of phytoplankton C, which together with a chl a concentration of 4 mg m-3 gives a C:Chla of 300. The commonly observed value for C:Chla during diatom blooms is 50.

In summer, similar calculations yield a C:Chla of >2000, which seems impossible. Typical C:Chla ratios in phytoplankton experiencing high irradiance and low nutrient availability (conditions that lead to the highest possible C:Chla ratios), for instance in surface waters of the subtropical gyres, are 100-200 (see Table 3 in Marañón et al 2005 L&O 50:299 and references therein).

The data reported by Li et al (Proc Roy Soc 273:1953) for Bedford Basin (presumably a more biomass-rich system than the HL station) suggest that phytoplankton C concentrations are around or below 100 mgC m-3 during most of the year, corresponding to values <0.01 molC m-3 (their Fig. 6). In constrast, Fig. 5 of the current ms indicates values that are often around 0.1 molC m-3.

All this seems to suggest that there has been an error in the calculation of phytoplankton C. Because net community production (NCP) rates are computed as differences between phyto C in consecutive months, if the C estimates are overestimated, then NCP will also be overestimated.

Interactive comment on Biogeosciences Discuss., 10, 11255, 2013.