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Interactive comment on "Review: phytoplankton primary production in the world's estuarine-coastal ecosystems" *by* J. E. Cloern et al.

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Comment on Cloern, Foster, Kleckner

General Comments: This is a comprehensive review of the literature quantifying phytoplankton productivity at the world's land-sea interface (estuaries, bays, lagoons, tidal rivers, inland seas, and nearshore coastal marine waters), compiling 1148 values of Annual Phytoplankton Primary Production (APPP) from131 locations worldwide. It is an update of the first such review by Boynton et al. (1982), who compiled estimates from ∼45 locations. The authors clearly describe the process by which the inventory was compiled, including the selection criteria for inclusion, and the methods and as-

sumptions in calculating APPP for each study. This was followed by a discussion of: 1) the patterns of variability in the sampling effort, 2) the variability in measurements of APPP themselves, and 3) the key environmental drivers that control phytoplankton productivity (light, nutrients, mixing, advection, etc). Additionally, a simulation exercise was conducted on a common hypothetical sample to illustrate how varying the incubation method assumptions strongly affected the calculated rates of phytoplankton production. The authors include a section entitled 'Two Grand Challenges' wherein they argue that further advances in understanding coastal zone productivity hinge on: 1) discovering how multiple drivers interact to generate variability, and 2) designing and implementing a global sampling program to measure estuarine-coastal primary productivity using consistent methodology, and with consistent spatial, seasonal and inter-annual coverage. This is a well-written and comprehensive review. I applaud the effort, recognizing that such a review is technically difficult, given that studies have used a wide variety of methods and approaches, and have used varying and uneven sampling designs (spatial, seasonal, interannual), such that each study comes with unique assumptions and limitations. Overall, I found the figures provided a clear and compelling summary of the results. However I offer some specific suggestions on a couple of figures to enhance the information content (see below). My main critique of this manuscript is that the overall tone, anchored by the Grand Challenges section, tended to overshadow the accomplishments of this paper in particular and the scientific field in general. The overwhelming message appeared to be that our current understanding of coastal zone productivity is hopelessly hampered by unacceptably high variability, however this summary demonstrated that median APPP varied by ∼10X, of which ∼3X is potentially attributable to methods. One might argue that this range of variability is sufficiently small to constrain global budgets given the small collective area of the coastal zone relative to global surface area. What we have learned from many individual studies, and from this synthesis, is that phytoplankton production is highly variable in space and time and the available data suggests a clear central tendency (i.e. median APPP of ∼185 g C m-2 y-1). It is unclear to me whether a global

sampling program would fundamentally change these estimates of the magnitude of variability or the magnitude of the central tendency. Perhaps the authors could speculate, based on our current understanding of the environmental drivers, how far and in which direction a true global median might deviate from our current best estimates. While I agree that consistent methods, and more comprehensive global coverages are desirable goals, I also think the authors should emphasize how this compilation provided a valuable update to the Boynton review, and expanded and reinforced the key patterns observed in the earlier paper. This might provide a bit more hopeful outlook to balance out the current emphasis on pointing out the inadequacies of the available data. Specific suggestions

Fig 1. This is a nice summary of the distribution of sampling effort. However, would it be possible to add an identical set of panels to show mean/variance estimates of APPP along these different categories? Such a modified figure would be more informative because it would simultaneously show the distributions of both the sampling effort and the magnitude of APPP in each of these bins.

Fig 2: It might be more intuitive to remove the left hand panel and simply annotate the right hand panel with the number of observations in each latitude bin.

Fig 4: I am curious about how this cumulative distribution, would compare to Figure 3 in Boynton et al. 1982? How would Boynton's 45 values (properly normalized), expressed as a ranked cumulative distribution, overlay with the $\sim$160 or so values in this figure? My guess is that the two curves would be very similar; the differences between them would be a way to represent what we have learned in the intervening 30 years.

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