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Interactive comment on “Current systematic carbon cycle observations and needs for implementing a policy-relevant carbon observing system” by P. Ciais et al.

Anonymous Referee #1

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In this paper the authors present a very comprehensive view on global carbon observations and a global carbon observation system. This is a long paper covering a wide range of disciplines that is difficult to review in detail comprehensively. I will therefore focus this review on some general remarks and on the ocean part of the carbon system, which is my specialty. Obviously this article is not a science article in the sense that it presents new data, but more of a policy paper. The authors do, in general, a very good job in covering the major aspects of global carbon cycle observations. It is obvious that this document has evolved during a long time-period, something that is sometimes evident by lacking some recent key references. I support the publication of this article, but I have some remarks that I think the authors should consider.

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The manuscript covers a wide range of programs, agencies, variables etc. Please make sure that abbreviations are spelled out on the first use. Possibly it could be very useful to have a list of abbreviations for such a long article as well. Page 11493, line 11: "Emissions needs to be measured at a 1-10 km scale". This is a very ambitious goal. The motivation given is "to be comparable or better than those currently accepted for inventories by developed nations". In my mind, this is a poor motivation for such an ambitious goal, and it tells me that the system requirements are already in place (at least in the developed world). I suggest a scientific rationale to make the point. Similarly, on page 11495, line 14, it is stated that "to improve estimates. . . . a resolution of 1 km, hourly over the globe is needed". I read this and think; "if that is what it takes to make an improvement it seems that we are doing pretty fine with the current system, why should we invest to make this better". Please state the scientific (and societal) relevance for such a system (of observations and modeling activities). Section 4.6.1: What is the motivation for a so much denser sampling network over the north Pacific (every 200-600 km) vs. the north Atlantic (ever 1500 km)? I would think that it should be the other way around. It would be good to be able to compare this to the current state, but under that section a different metrics is used. Also, in this section it is referred to an amount of "samples" when you probably mean "crossings". Page 11504, section 1: This text is very similar to the text in the GO-SHIP white paper. This would be a good place to refer to this initiative. Page 11505, section 7: I could not agree more on the need of coordination of carbon (and acidification) sampling. This is not anything new, obviously, and there are groups that are doing coordination. This would be a good place to mention IOCCP (International Ocean Carbon Coordination Project), for instance. Minor comments: Page 1452, line 19: "For the period. . . .". This is an abrupt switch from CH₄ to CO₂, without any wording stating so. Page 1454, line 6: Add reference after "1959". Page 11468, line 9: Is the order of figures correct? Page 11486, line 13: Figure 3B? Page 11471, line 8: The data collection PACIFICA is now finalized and published at <http://cdiac.ornl.gov/oceans/PACIFICA/> Page 11471, line 10: The global scale uptake of anthropogenic CO₂ in the ocean is documented by a large

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range of publications (several of them listed in the review by Sabine and Tanhua, 2010), but I would agree that the global-scale accumulation is not quantified yet. Page 11472, line 5: A number of carbon related (pCO₂, TA, pH, DIC) sensors for ocean use on autonomous vehicles are being developed and tested. This should be mentioned here, and appropriate referenced. 11477, line 24: It could be worth mentioning that the information on the flux of carbon to the ocean from land is essential to close the ocean carbon budget. Page 11489, line 28: The authors refer to the need to quantify the uncertainty here. I could not agree more on the need to carefully document uncertainties. However, the combined effect of uncertainty (random deviations from the “true” value) and accuracy (systematic biases) should be the key variable to document. I suggest making the distinction between uncertainty and accuracy more consequent throughout the manuscript, not just on this occasion. Page 11498, line 11: I have not done the math, but I would think that having atmospheric stations spaced 200 km from each other over the globe would be significantly more than 2000 stations. I think the authors meant something else, please make this clear. Page 11506, section 2 (upper): Sediment traps are not “remote sensing”, although that data would be useful for calibration of remote sensors. Table 2: Data standardization; this is stated as “low”, but this is not true for oceanic CO₂ data where the data are reported on standardized formats. Similarly, for “data access” there is probably a distinction to be made between different carbon data streams where some are more easy to access than others. Is “continuous, hourly” really a valid for a carbon observation system (under the line “temporal continuity”) in general? I can see this be possible for some atmospheric observation systems, for instance, but not as a whole for the system described in this article. Figure 1B: The “Long term baseline station” square mention Mauna Loa. Unfortunately, the Mauna Loa observatory is located several thousand meters above the ocean. A better example for the ocean would be HOTS (Hawaii Ocean Time-Series). Figure 5A: State which data set this figure is based on. Figure 5D: This figure looks like the GO-SHIP plan, and does not necessarily reflect actual measurements the last decade. It would seem appropriate to mention GO-SHIP here as well. Figure 4B: Please explain the

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acronyms in the title of the graphs, and add units on the X-axis.

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