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Interactive comment on "Free Ocean CO_2 Enrichment (FOCE) systems: present status and future developments" *by* J.-P. Gattuso et al.

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This paper provides a nice review of the Free Ocean CO2 Experiment (FOCE) systems that are designed for in situ manipulation of seawater chemistry for experimentation on the impacts of climate change and ocean acidification on benthic communities. These experimental systems represent a novel approach to in situ experimentation that allows for longer duration perturbation experiments not accomplished using other technology. The utility, benefits, and limitations of the FOCE systems are discussed in addition to plans for establishing a network and user group of FOCE systems. There are clear limitations with use of the technology and some uncertainty as to how to simplify or standardize system components for use by a network user group. However, the development and testing of existing FOCE systems represents a significant step forward in

perturbation experiments that may facilitate examination of multi-stressor impacts. The ability to control pH in perturbation experiments as an offset from ambient is a major advantage. The paper is basically well written with the exception of minor grammatical errors that can be corrected in a final editorial review. Additionally, I have made some organizational suggestions to improve readability, and recommendations on areas that could use more detail to better explain concepts.

It seems that the main goal and motivation of this paper is to introduce the xFOCE program to the scientific community to promote awareness and availability as an important resource for ocean acidification studies, and to build a user community. This should be stated in the abstract and introduction. The information in section 6, pg. 4028 should be moved up front to make this clear.

The readers also need to be clearly informed up front on the concept that the xFOCE system has been developed as a modular system to provide some flexibility for modifying to fit specific environments. The concept of modularity for flexibility and the motivation for that should be addressed before a description of the general system. The sections describing the specific FOCE systems should more clearly point out the differences between the systems and how the system was customized for each environment. . .along with advantages and disadvantages as examples.

A generalized diagram of the xFOCE system concept and standard modular elements common to most/all FOCE systems would be helpful for readers who are not familiar with mesocosm technology. Even better would be inclusion of concept diagrams for each of the different FOCE systems (as in figure 4) highlighting their differences since the pictures of each of the FOCE systems in figure 3 look like completely different systems.

Section 7 (overarching activities, pg. 4029) could use some more thought and detail. It seems more like a list of proposed program elements that need to be developed for a network of FOCE experiments, and these are common to all regional and global

network programs. There have been several FOCE experiments in different environments, so there has likely been some insight into lessons learned, what has worked well and has not, and some thought on how to approach inter-comparison exercises, data management, dissemination and outreach etc. The issues within each of these elements that are unique to FOCE technology should be explored, discussed, and recommendations made on how to proceed with a robust network program. For example, it seems like a first logical step forward is an inter-comparison exercise among the existing FOCE systems that seem to use different sensor packages to examine the comparability of results with existing units.

I am unable to locate the xFOCE open source package of plans and software at the url provided http://www.xfoce.org. I found reference to Kecy et al. 2013 http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=6741086 regarding open source instrumentation nodes for the oceanographic community. But no other publications, plans, or software are available. If the information is not yet available, then state an expected time frame for delivery.

In the conclusions, a statement is made that all current FOCE users have experienced setbacks due to engineering issues or failures. A discussion of the specifics of these and how future modifications can be made to overcome them would be particularly useful for new users to know.

Specific comments: Pg. 4008, line 27: dpFOCE – spell out acronyms on first use in text throughout the paper.

Pg. 4014, line 6: Yates et al. 2007 reference is missing from reference list.

Pg. 4016, line 23: insert the word data between “meaningful” and “to”

Pg 4017, line 13: It is stated that pH sensors with a precision better than 0.003 pH unit are required for FOCE experiments and a few sensors are discussed on pg. 4018, lines 1 – 14. But no precision or accuracy values are given for these sensors. This

information should be included.

Pg. 4019, lines 22-25: Information in available systems for continuous CT measurements. Also see the work of Burke Hales (OSU) and Alec Wang (WHOI) who have developed CT sensors.

Pg. 4020, line21: typo – community production

Pg. 4020, line 24-26: sentence needs to be restructured

Pg. 4022, line 1-2: sentence grammar

Pg. 4022, line 18-19: sentence beginning “Hydrodynamics. . .” is not a complete sentence

Pg. 4029, line 19-20: delete “be” from the sentence.

Pg. 4038, Table 1. It would be most helpful to include in this table a list of benefits and limitations of each system to help compare and contrast them. Also include system materials and design.

Pg. 4046, Figure 4. I have some concerns about the use of heaters at the in/out flow changing seawater chemistry in the system outside of natural temperature ranges or if the heaters can keep up with ice production. This will be an interesting test.

Interactive comment on Biogeosciences Discuss., 11, 4001, 2014.