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Ocean Science Discussions

Interactive comment on "Optical tools for ocean monitoring and research" *by* C. Moore et al.

Anonymous Referee #2

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Review of “Optical Tools for Ocean monitoring and Research,” by C.M. Moore, A. Barnard, P. Fietzek, M. R. Lewis, H. Sosik, S. White, and O. Zielinski

This paper was written as result of the OceanSensors08 Workshop held in Germany in 2008. The authors have done a masterful job in presenting an up-to-the-date review of the various optical instrumentation that are available or are being developed at various stages for optical, biological, biogeochemical, and physical research in the ocean (and in some cases even for lakes and rivers). This task is nontrivial as the field of optical instrumentation is fast moving because of the burgeoning technologies and the growing concern for environmental impacts and changes. There are many reasons why the instrumentation described in this review are so important. Areas of relevance include: underwater visibility and imaging, phytoplankton physiological response to light variability, primary productivity, harmful algal blooms, eutrophication, hyperoxia and anoxia, location of marine resources such as mineral deposits and gas hydrates,

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various forms of pollution, marine ecology, vision in oceanic animals, biogeochemical cycling, global climate change, hydrothermal vents, the contribution of the penetrative component of solar radiation, and remote sensing of ocean color, especially in terms of obligatory calibration and validation of satellite-based radiometers (the authors have mentioned several, but not all of these, I believe).

The paper is logically constructed, taking the reader through discussions of inherent and apparent optical properties and their measurements along with relevant measurement platforms and applications. They follow with the class of fluorescence and bioluminescence sensors (single and multi-wavelength excitation and emission). This section is especially interesting in that it addresses two areas not normally considered in similar reviews, namely excitation relaxation and time resolved fluorometry. Flow cytometry, a powerful method finding its way into the biological oceanographer’s toolbox for in situ, time series and spatial sampling of particles and organisms of small scales. The section on other spectroscopic techniques is yet another valuable new review area for the oceanographer. The laser Raman spectrographic method, laser-induced breakdown spectroscopic method, and the surface plasmon resonance method are all exciting and little discussed to date in our community. Finally, the growing area of optical methods applied to chemical analyzers is discussed. This is especially important for many of the problems listed above and allows key interdisciplinary problems to be addressed using concurrent multi-disciplinary data sets. The review includes a most appropriate Forward-looking section that mentions some of the emerging fundamental technologies that will need to be drawn upon by future oceanographers. The Conclusions section places the review in context and should stimulate the reader to be active in applications of optics for a host of oceanographic problems.

Specific Comments:

1. The authors have cited some of the papers (e.g., Jaffe’s Chapter 10) in the recent HABWATCH book entitled Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms: Theory, Instrumentation and Mod-

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elling edited by Babin, Roeseler, and Cullen. I think that citation of a few of these papers in the early parts of the subsections where appropriate would be useful. Heidi is a contributor to the book, so thought the book may not be readily available, I expect that she can track down the citations. Chapters in the book that strike me as useful include: Chapters 2, 3, 4, 5, 6, 7, 8, 12. These papers provide more detailed discussions than are possible in this review paper, and would really help a reader get to the next level. 2. A bit more on the biofouling problem and some references would be useful. Chapter 12 in the HABWATCH book by Lehaitre et al. would be one I can think of right away. 3. A bit more on limitations and needed developments might be useful. 4. Just at the end of Section 1, I think the disclaimer is very good, but perhaps a comment to the effect that the authors have attempted to write the review showing no partiality toward a specific manufacturer. The website guide to manufacturers is very good and will assist potential users. 5. At the beginning of Section 2, I think it would be important to clearly define IOPs and AOPs. I realize the authors have likely done this over and over in other papers, but since this is directed toward a general audience, one more time, please. Also, I think it worth emphasizing the limitation of biofouling for measurements of IOPs and AOPs as well as several other optical methodologies discussed in the paper. Again, a bit of expansion on this or perhaps a short Appendix devoted to the problem and solutions might be very useful for many readers. 6. I noticed the Mueller et al. 2003 reference. I suspect that one or more of the authors may have a good citation for an active website that updates the content of the Mueller et al. document. I believe there was a NASA SIMBIOS or other ocean color site that had many detailed reports of relevance. 7. Hyperspectral needs to be defined on p. 8 it looks like to me. Also the CMO Oceanography special volume 17(2) in 2004 with an intro by Dickey would be a nice hyperspectral citation for the general reader. [see Dickey, T., 2004, Studies of coastal ocean dynamics and processes using emerging optical technologies, Oceanography, 17(2), 9-13.] 8. There is an upcoming issue on ALPS that includes several papers on various new platforms (gliders, AUVs, and more) that would be a nice citation also [see Dickey, T.D., E.C. Itsweire, M. Moline, and M.J. Perry,

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Introduction to the Special Limnology and Oceanography Volume on Autonomous and Lagrangian Platforms and Sensors (ALPS), 2008, Limnology and Oceanography,] 9. In the 2nd paragraph on p. 8, it would be useful to discuss gelbstoff, CDOM, CDM, etc. briefly and to give a review citation. 10. p. 9 1st full paragraph, perhaps a paper or two by Ed Frye on the spherical absorption instrument?? 11. On p. 14 at the top, it might be useful to add a short paragraph discussing the merits of stable platforms like FLIP, BRUSSOLE, MOBY and YBOM. 12. Earlier I mentioned the citation of some HABWATCH papers. On p. 14, under b. Spectral Fluorometers, Babin’s Chapter 6 would be a good citation. Similarly Marlon Lewis’ chapter on AOPs and Roeseler and Boss’ Chapter 5 on IOPs, and Sosik’s Chapter 8. 13. I did not see a reference to the natural fluorescence sensor area (i.e., Kiefer and Chamberlin work). I was curious if the authors feel it is worth a few sentences since some users may need some guidance. 14. p. 16, subsection e. A good recent review paper citation might be useful. I suspect that Edie Widder would be a good source. 15. In the BL sensor section, I was wondering if mention of a commercial sensor described in Herren et al., 2005 might be useful. 16. Section 4. A more recent review paper on flow cytometry with ocean applications might be useful. I suspect Heidi or Lisa Campbell has one of her own or know of one? Some discussion on the size range of particles that can be effectively measured with flow cytometry would be useful. 17. On p. 23 in 1st sentence on SPR wrt Wood (1902), I believe there is a typo. Should the word “usual” actually be “unusual”? 18. Section 6. It seemed to me that Bob Byrne’s SEAS work might fit here? Casey has info on this in O-SCOPE reports or elsewhere I believe. 19. A useful citation for MEMS at the bottom of p. 28 might be the following: Tokar, J.M. and T.D. Dickey, 2000, Chemical sensor technology - Current and future applications, Chemical Sensors in Oceanography, Gordon and Breach Scientific Publishers, Amsterdam, 303-329. There may be something more recent or appropriate?

This is one of the finest papers on optical methodologies I have read. It is well-written and up-to-date in content. The figures are well done and very useful for emphasizing

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some of the principal ideas and technologies presented in the paper. I heartily commend the authors for their excellent contribution, which should be published as soon as possible to allow the community to benefit from its content. I may be identified as the reviewer and will send my margin notes (writing aspects and a few ideas and comments discussed above) to Casey for his consideration.

Sincerely, Tommy Dickey

Interactive comment on Ocean Sci. Discuss., 5, 659, 2008.

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