Author comment and review response on "Detecting marine hazardous substances and organisms: sensors for pollutants, toxins, and pathogens" by O. Zielinski et al.

First of all, the authors like to thank all reviewers and collaborators for their feedback, comments and support in preparing this review manuscript. We appreciate that this feedback is generally in support of our approach and we strive to include the most of the specific feedback, where it is appropriate. In the following, we will respond directly to the three comments published within OSD.

OLIVER ZIELINSKI

Referee Comment by Anonymous Referee #1 (26 Jun 2009)

This paper presents an overview of emerging technology and sensors for detection of marine contaminants, marine biotoxins and pathogens in the marine environment. The review is very broad in its scope and covers a wide range of parameter groups and technologies. Specifically, it examines remote sensing technologies, in situ platform measurement and in situ point measurement, although some of the techniques discussed in the latter section might not be classed as in situ. It is comprehensive in its coverage of these areas and well referenced. I found it clear and well written, generally well structured, and informative.

AUTHORS RESPONSE: We thank the reviewer for these positive comments.

Specific comments
In the introduction section (line25 p 995) listing examples of global and regional monitoring programmes a 6th example could be the monitoring in accordance with regional sea conventions such as OSPAR and HELCOM

AUTHORS RESPONSE: Included.

P958 Line 18. This is a query: I am surprised to see agricultural feed/growth promoters listed as a major source of hormones. Maybe that is true globally but certainly in Europe their use is now banned.

AUTHORS RESPONSE: The authors are aware of the European ban of hormones in agriculture, worldwide they provide certainly still a part of the sources of hormones in the environment. Furthermore, municipal sludge is often used to fertilise agricultural land, and exposes more land-based animals to these chemicals that are not sufficiently removed in wastewater treatment. We will reformulate this sentence and put an emphasis on other anthropogenic sources of hormones to the environment.

In section 3.1.1 (p965 – 966) dealing with remote sensing it is highlighted that while remote sensing of toxins is not possible, detection of blooms is possible and may be a proxy for detecting toxic occurrences. It could be noted for completeness that toxic events can often be associated with low biomass limiting these techniques in these instances (e.g. azaspiracids).

AUTHORS RESPONSE: The aspect is shortly stressed in the given paragraph. Details are given in the subsequent spatial scale descriptions.

3.1.2. This section understates some of the practical difficulties in using sensors in the field, most obviously the effect of fouling on data quality. In mentioning the need for "..hardened, reliable instruments for long duration deployment", the authors could also highlight the need for appropriate and consistent accuracy, sensitivity and selectivity that is required for use in monitoring programmes. Sensor performance needs to be underpinned by quality assurance data using reference methods. In many instances deployment of autosamplers alongside sensors enables collection of reference samples for this purpose. (Alternatively this could be brought out at the end of section 4)

AUTHORS RESPONSE: Good aspect, shortly seized suggestion in 3.1.2, more detailed in section 4.

Technical corrections

P 957 13 ": : :distinguish between man-made marine pollution: : :" I suggest the term anthropogenic is better than man-made as the latter suggests only synthetic substances.

AUTHORS RESPONSE: Followed suggestion.

P958 Line 10 "petroleum hydrocarbons, including mineral oils and polyaromatic hydrocarbons" might be more accurate

AUTHORS RESPONSE: Followed suggestion.

P969 Line 17 & 24. BSA – Should this be BSH?

AUTHORS RESPONSE: Corrected.

P978 Line 25: Should state Endocrine-disrupting compounds (not hormones). The substances such as phthalates used as platicizers mimic hormones.

AUTHORS RESPONSE: Corrected.

P984 Line 12: would read better as ": : :risk of releasing toxic substances over time."

AUTHORS RESPONSE: Followed suggestion.

P986 Line 9 Should read: "A largely overlooked hazard: : :".

AUTHORS RESPONSE: Corrected.

Table 1. does not cover all commercially available sensors, e.g. envirotech in situ nutrient analysers

AUTHORS RESPONSE: The authors highly appreciate input to table 1.

Fig.2 Typo – Substance and Organism

AUTHORS RESPONSE: Corrected.

Interactive Comment by Chris Scholin (04 Jul 2009)

Following referee #1.

I share the view that the paper is well written, very informative and comprehensive. The reference list is a treasure trove of information. I expect this to be of great interest to wide range of readers from various disciplines stemming from industry, academia and government. A nested ocean sensing approach is obviously required to address the problems posed in this review. The authors aptly captured a sense of the challenges and current limitations associated with that long-held vision.

AUTHORS RESPONSE: Thank you for these very encouraging comments.

Consider adding a few sentences or paragraph in section 4 or 5 on autonomous, adaptive response. For example, modeling can be applied to help cast projections of biological, chemical and physical properties. By directing small fleets of mobile platforms or altering the operation of a fixed array of sensors and samplers within that domain, a distributed network could be variably "tuned" to detect specific phenomena remotely. Such ideas are not new, but they are becoming easier to approach with the observatory infrastructure now available. It's worth pointing out that growing opportunity, and highlighting the need for interdisciplinary collaborations to move the field forward.

AUTHORS RESPONSE: Very good suggestion. Added to section 4.

Couple updates re: ESP. The work of Doucette et al. on domoic acid detection is now in press:
Doucette, G.J., C.M. Mikulski, K.L. Jones, K.L. King, D.I. Greenfield, R. Marin III, S. Jensen, B. Roman, C.T. Elliott, C.A. Scholin. Remote, subsurface detection of the algal toxin domoic acid onboard the Environmental Sample Processor: assay development and initial field trials. Harmful Algae

AUTHORS RESPONSE: Updated.

A new overview paper on the ESP is available that is more current than the work cited:
Scholin, C, G. Doucette, S. Jensen, B. Roman, D. Pargett, R. Marin III, C. Preston, W. Jones, J. Feldman, C. Everlove, A. Harris, N. Alvarado, E. Massion, J. Birch, D. Greenfield, R. Vrijenhoek, C. Mikulski, K. Jones. Remote detection of marine microbes, small invertebrates, harmful algae and biotoxins using the Environmental Sample Processor (ESP). Oceanography 22:158-167

AUTHORS RESPONSE: Included.

Referee Comment by Duncan Purdie (20 Jul 2009)

This paper represents a lengthy review of the range of sensors available for detecting marine pollutants, toxins and pathogens that may present hazards to the marine environment. Initially the scope of marine health hazards to be considered in the review is defined. The current status of health hazard detection systems addressing a range of space scales from large (i.e. remote sensing), intermediate (e.g. in situ platforms) and small scales (in situ point measurements) is then reviewed in detail. Under each of these space scale headings, marine pollution, marine toxins and toxigenic organisms, high biomass harmful algal bloom organisms and marine pathogenic agents are considered. A useful section on gaps in health hazard detection is also included which sets an agenda for future research and development. The review is generally well written, presents a wide scope of coverage and is comprehensively referenced. The review is a useful addition to this special edition of Ocean Science Discussions and I recommend it be published subject to a few minor corrections/additions.

AUTHORS RESPONSE: We thank the reviewer for these positive comments. We think that the length of the paper is inherent in the broad scope of the review. However we strived to make it most compact and complete at the same time and provide a structure to orientate for the reader.

Table 1 could include more details of the YSI probes for chlorophyll and phycoerythrin fluorescence /oxygen/turbidity sensors.

AUTHORS RESPONSE: The authors highly appreciate input to table 1.

Page 967 line 16 suggested change “hardened” to “robust”

AUTHORS RESPONSE: Followed suggestion.

Page 972 line 10 change “quantitation” to “quantification”

AUTHORS RESPONSE: Not changed, as method is named here, not process.

Page 973 line 18 change “moorage” to “mooring”

AUTHORS RESPONSE: Followed suggestion.

Page 975 line 3 insert space between “chlorophyll” and “a”

AUTHORS RESPONSE: Typo not in original text, but in OS printout.

Page 980 line 24 more details of “Cytobuoy” could be included e.g. more recent publication (Thyssen et al 2008 Journal of Plankton Research 30, 333-343) and could be added to Table 1.

AUTHORS RESPONSE: Reference included. The authors acknowledge the great potential of flow cytometry. A more detailed description is not possible within the frame of this overview paper. For further details the authors refer to the suggested reference in the text.