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Interactive comment on "Satellite detection of multi-decadal time series of cyanobacteria accumulations in the Baltic Sea" *by* M. Kahru and R. Elmgren

M. Kahru and R. Elmgren

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Dear Emmanuel,

Thank you for reading our updated manuscript and making valuable suggestions for improvement.

1. Last sentence in the abstract is not clear. Units of FCA and chlorophyll are different. Do you mean to compare in %?

We have modified that sentence and specified that the statement of higher interannual variations in FCA compared to that in Chla refers to the more than 5 times higher

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coefficient of variation. The last paragraph in the Discussion provides the numerical values that this comparison is based on.

2. How are 'valid' and 'turbid' decided upon? It should be made clear better that 'turbid' are also 'valid' pixels while there are 'valid' that are not 'turbid'. Using 'valid' to also denote days can be confusing.

"Valid" represents a satellite view of the surface that is not obstructed by clouds and has the ability of detecting accumulations when they exist. For ocean color sensors there is a clear definition in section 2.2.2 that states that a pixel is classified as a valid ocean pixel only if none of the listed flags are set. For AVHRR passes there is additional requirement that the pass has to be within 2 hours of the local noon as early and late passes during the day are not good at detecting water turbidity. We combine satellite passes from multiple satellites, files (granules) and orbits into daily maps of "valid" and "turbid" pixels and use those merged daily datasets to estimate FCA. In order to quantify the amount of data available from multiple sensors over years, we have used the number of those daily datasets (former Table 5, new Table 2). We have added a clarification that "a pixel needs to be a valid ocean pixel in order to be classified as a turbid ocean pixel" to section 2.3.

3. P. 3328, l.10 : above you say you inspected visually the green wavelengths of all the sensors. Can you describe how and what you were looking for?

We were mostly looking for false positives. In section 2.2.2 we discuss false positives, i.e. pixels classified as turbid that are probably not cyanobacteria accumulations (and may not be turbid). This includes many "pepper" type pixels (as part of the "salt and pepper" type variability) in SeaWiFS imagery. It also includes some turbid plumes clearly originating from the coast that are extended into the area used in calculations. We have manually eliminated these plumes from the analysis based on visual inspection. As typical Nodularia blooms cover open sea areas, elimination of some of these isolated coastal plumes is not difficult.

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4. Given the ambiguity with non-cyano turbidity events shouldn't it be better to exclude from the analysis the often turbid areas of Gdansk Bay, Gulf of Riga and eastern Gulf of Finland?

While there was some ambiguity in some cases, we believe that during more than 22 years of working with these images, we have accumulated enough experience to deal with these cases. This is also made easier by the fact that while it is common in June to have periods of precipitation that produce extensive turbidity plumes spreading out from the mouths of big rivers like Vistula (Wisla); in July and August precipitation is low and turbidity plumes originating from these rivers are not extensive. We are confident that we have separated most of these kinds of sediment plumes from cyanobacteria accumulations. For example, we were satisfied to find that the high turbidity area in the Bay of Gdansk classified by us as cyanobacteria accumulation was confirmed to be caused by cyanobacteria by their high phycocyanin fluorescence in Algaline transects (Fig. 8, A-C). In similar fashion, we have found good correspondence between our detection of cyanobacteria accumulations and multiple in situ dataset from these "problem" areas. For example, we have compared our satellite detection with the 2001-2013 monitoring of cyanobacteria biomass and nodularin concentration (toxin produced by Nodularia) (dataset assembled by Justyna Kobos, Laboratory of Biochemical Ecology and Microorganisms, Institute of Oceanography, University of Gdansk, Poland) and found good agreement in the Gdansk Bay. We have not included these comparisons in the manuscript as quantitative analysis is hard to perform considering the fact that these in situ data were often collected in spots and times when cyanobacteria blooms were clearly visible.

5. P. 3331: l. 21 spelling of minima Thank you! Corrected.

l.28: was there no GPS for navigation? Yes, they had GPS navigation. We removed the reference to "navigation errors" which were negligible compared to the effects of possible advection during the time between the ship and satellite measurements.

5. Table 1- can you provide the center wavelength and width of the band used?

Thank you for this suggestion. We have added a column specifying the respective red band that has been used.

7. Table 2-5 can be merged with a column added to table 5 that has the number of scenes for each satellite.

Yes, that is a good idea. We have got rid of the small former Tables 2, 3, 4 and revised the former Table 5 (now Table 2).

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