

## ***Interactive comment on “Seasonal variability of upwelling radiance polarization over the Southern Baltic surface” by Włodzimierz Freda***

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The comments of the reviewer #2 are quoted below, the reply is given under each question.

Q1: The manuscript presents a very important topic in ocean color remote sensing and uses an extensive dataset combined with Monte carlo simulations. In my opinion the manuscript requires some revision to improve flow of text and aims of the study.

Reply: Thank you for appreciating my subject and for a number of detailed comments. I hope they will help me improve my paper.

Q2: Here are some aspects that could help improve the manuscript General questions after reading the manuscript i am wondering -would polarization be useful in winter

times assuming more days of overcast skies and diffuse light?

Reply: Remote sensing in the Baltic Sea area is very difficult in the winter season. This is due to very short days and a small number of sunny days. I hope that the polarization will be useful in the winter season. However, my article does not provide an analysis of the optical properties of the atmosphere in winter and therefore I am not able to give a judicious answer to this question.

Q3: -what are the uncertainties in your observed dataset?

Reply: The measurements were made using the ac-9 meter. Of course, these measurements are burdened with uncertainties that arise from two reasons. The first is multiple scattering inside the reflecting tube, and the second one is the imperfection of the mirrored walls of the tube.

Q4: -i am missing the statistical analysis of the data in Table 1 to show the 'seasonal variability' of the dataset or at least the simulated dataset.

Reply: I agree, that such information is needed. Standard deviations are added to the table 1 after Sagan 2008.

Q5: In my opinion since the goal of remote sensing is to get Remote sensing reflectance an essential climate variable, i am wondering would it not be possible for your study to derive Rrs from the insitu (as- suming this will be your reference dataset) measurements assuming a Bb etc then you also do the same for simulated polarized light to estimate the Rrs and compare the two Rrs from simulation and insitu looking at differences over seasons

Reply: Thank you for that suggestion, it is interesting. But it goes beyond the subject of my work. Possibly I will do it in my next paper.

Q6: -the IOPs of the different water types would vary seasonally and i am wondering do you have any additional data to support some of the points you raise in the discussion that is measurements of the water constituents and backscattering maybe even from



satellite as a proxy. e.g Primary production enhanced or algal bloom could lead to higher scattering of the target region in the open water

Reply: Additional measurement results are included in Sagan's book (2008). This is a comprehensive analysis written as a habilitation dissertation (next academic degree after PhD in my country).

Q7: -what is the message from Table 2 how can one use such information? what are the implications of this study findings in advancing ocean color remote sensing

Reply: The data from table 2 allows one to recreate the function that describes the correlation between absorption to attenuation ratio and value of the DoP peak. Moreover there is answer to your question Q11.

Q8: additional comments Abstract line 1 -revise 'Polarization of light may be used to improve the remote colour sensing of sea water.', is it not something like 'Polarization of light leaving the ocean surface has the potential to improve quality of information retrieval from ocean color remote sensing (OCRS)'

Reply: Sounds better – done.

Q9: line 2 -'sun glints' do you mean 'surface reflected and sky glint'

Reply No, I do not. Sun glints are very bright flashing solar reflections, that can be seen above sea surface. They create silver area seen from high altitude and disturb the OCRS.

Q10: line 8 -'several years' can you put a number to this?

Reply: Yes measurements were performed for a total of four years. Done.

Q11: line 11 -'strong correlated' can you put some numbers to this as this is a qualitative statement

Reply: I added the sentence: The coefficient of determination R2 for different SZA and

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wind speed varies between 0.906 and 0.996. These data are in Table 2.

Q12: Introduction line 16 -replace 'marine' with 'aquatic' to include all water types

Reply: Done.

Q13: paragraph 1 -there is an interesting paper by Brady might be of interest to you  
Brady et al 2015. Open ocean fish reveal an omnidirectional solution to camouflage in  
polarized environments. Science. 350(6263):965-969

Reply: I admit that this is a very interesting article. My congratulations to all authors. Added sentence: "Recent videopolarimetry measurements have shown that open-ocean fish species have higher camouflage abilities in polarized light than those that live nearshore, see Brady et al 2015."

Q14: paragraph 3 -replace 'colour remote sensing' with OCRS ->ocean color remote sensing

Reply: Done.

Q15: line 17 - what do you mean by this sentence 'Another factor that disturbs the colour remote sensing is surface reflected light that comes both from sky reflections and sun glints, that for some directions makes it difficult to gain a signal from water depth.' -is it not the case that surface reflected and sky glint affect OCRS -> because they are part of total water leaving radiance (glint + water constituents)?

Reply: Thats the clue. The water leaving radiance is the part of upwelling light that physically was in water (under the surface). One have to distinguish two components of upwelling radiance, namely "water leaving" and surface reflected. The first one is scattered (single or multiple) by water constituents and hence it is affected by them, and the second is just reflected by the surface. See for example: Mobley 1999 Estimation of the remote-sensing reflectance from above-surface measurements or [http://www.oceanopticsbook.info/view/overview\\_of\\_optical\\_oceanography/reflectances](http://www.oceanopticsbook.info/view/overview_of_optical_oceanography/reflectances) The water leaving radiance (its direction, spectrum and polarisation) is changed by



water constituents. That's why it contain useful information and that's why we want to measure its properties.

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Q16: line 2 page 6 - 'after ?.' what does this mean?

Reply: Thank you. That's just a mistake – removed.

Please also note the supplement to this comment:

<https://www.ocean-sci-discuss.net/os-2017-97/os-2017-97-AC2-supplement.pdf>

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Interactive comment

Interactive comment on Ocean Sci. Discuss., <https://doi.org/10.5194/os-2017-97>, 2017.

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