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Interactive comment on "Prioritization of the vector factors controlling *Emiliania huxleyi* blooms in subarctic and arctic seas: A multidimensional statistical approach" *by* Dmitry Kondrik et al.

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General comments

This paper is a useful contribution to help unravel the environmental forcing of E. huxleyi blooms in the northern hemisphere high-latitude oceans and seas. The authors have used a random forest approach applied to remote sensing data to examine the relative roles of temperature, salinity, Light availability (PAR), Ekman Layer Depth, and surface current speeds as forcing factors (FFs) of Ehux blooms in six ocean

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basins/seas. The results indicate that the importance of FFs is basin-specific and overall good performance of the Random Forest Model. I would recommend publication of this work in BG, but have some specific comments that should be addressed to help improve the paper.

Specific comments

Why did you use Ekman Layer Depth as an FF instead of the Mixed-Layer-Depth (MLC)? As far as I know, Ekman Layer Depth has never been shown to be a significant factor in determining Ehux blooms, whereas MLD has. MLD products are also available at a global scale on a weekly basis, so can be easily incorporated in your statistical analyses.

Further thoughts on the list of FFs considered in the analyses: it seems to me that rather than the absolute PAR, the average PAR to which the Ehux cells are exposed in the Mixed-Layer is important to consider. This is generally referred to as the "mean PAR in the Mixed Layer: PAR_ML; See for example Eq. 3 in Lacour et al. 2015 (Lacour, L., H. Claustre, L. Prieur, and F. D'Ortenzio (2015), Phytoplankton biomass cycles in the North Atlantic subpolar gyre: A similar mechanism for two different blooms in the Labrador Sea, Geophys. Res. Lett., 42, doi:10.1002/ 2015GL064540.). Also, PAR_ML is easy to obtain on a global scale and on a weekly basis.

E. huxleyi has many morphotypes (types A, B, B/C, C, T, O, R etc.) adapted to specific environmental conditions. E.g. morphotype A is considered "warm water" , while Type C is considered "cold water". It seems to me that this is an important aspect to mention when unravelling the FFs of E. huxleyi blooms and growth, and might explain why the importance of your FFs are regionally specific.

It seems to me that the lack of any ocean carbonate chemistry parameter as a potential forcing factor in your statistical analyses is a serious limitation and this should be clearly stated in the various sections of your manuscript, foremost the abstract. Why don't you just add the Takahashi pCO2 data or similar ocean carbonate chemistry datasets (other

than the World Ocean Atlas, which you find to be insufficient)?

You have found (P6) that “CHL influence was very low in all target seas and time periods. For that reason, the CHL data have been removed from further statistical analyses . . .Âż. This contradicts the results of many other studies that have found a successional bloom pattern between diatoms and Ehux blooms, particularly in the Northern Hemisphere (Iglesias-Rodriguez et al., 2002 ; Hopkins et al., 2015 to name a few). I believe this is just an artefact of your analyses which included CHL data up to 4 weeks prior to the Ehux bloom onset, which is too short in many of your target seas where the CHL peak typically occurs 6 to 12 weeks prior to the Ehux bloom. I suspect you will find different results if you extended your time window to 12 weeks prior to the Ehux bloom inset to include the CHL peak.

Finally, the FFs considered in your analyses are now much reduced to just five factors: temperature, salinity, Light availability (PAR), Ekman Layer Depth, and surface current speeds. This should be expressly put in your abstract as a limitation of the approach.

Technical comments

P1, L13: (Abstract) “is known” suggest to be more careful and replace by “is thought”.

P2, L14: “tendency to proliferate poleward” was recently clearly demonstrated in the Northern Hemisphere by Neukermans et al. (2018, Glob Change Biol. 2018;24:2545–2553, DOI: 10.1111/gcb.14075)

P2, L18-23: broadly divided into two groups, viz. vector and scalar factors; not clear

P6, L13-17: Rivero-Calle et al. (2015, Science, 10.1126/science.aaa8026) has also used Random Forests in a study to examine the importance of over 20 forcing factors of Ehux in the North Atlantic over the past 50 years. She has made an extensive comparison between the different statistical techniques, and showed that among the multitude of multivariate statistical approaches RF came out as best performing. I believe a reference to her work would be appropriate, and may help you strengthen

your choice for RFs.

P6, L25: Reference to Iglesias-Rodriguez et al. 2002 would be appropriate. Iglesias-RodrÄś′guez, M. D., C. W. Brown, S. C. Doney, J. Kleypas, D. Kolber, Z. Kolber, P. K. Hayes, and P. G. Falkowski, Representing key phytoplankton functional groups in ocean carbon cycle models: Coccolithophorids, Global Biogeochem. Cycles, 16(4), 1100, doi:10.1029/2001GB001454, 2002.

P11, L16-20: too speculative

Figures:

Legend to figure 1, please define the categories (i)-(iii) and explain boxes and whiskers extent

Figure 3: Given the huge number of data shown in your scatter plot, a density plot would be more appropriate. Why do you have a bimodal SST – CC relationship in the Labrador Sea?

A map of your study regions would be very useful.

Figure 4: why do you only show pastcast results for half of your study areas?

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