

Interactive comment on “Simulation of factors affecting *E.huxleyi* blooms in arctic and subarctic seas by CMIP5 climate models: model validation and selection” by Natalia Gnatiuk et al.

Anonymous Referee #2

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General comments

This study evaluates (and ranks) the performance of 34 climate models in simulating 5 physical parameters [namely, sea surface temperature (SST) and salinity averaged over 0-30 m (SSS); surface wind speed at a height of 10 m (WS); ocean surface current speed (OCS); shortwave downwelling solar radiation (SDSR)] on a sub-regional scale in the Arctic and Subarctic regions. These 5 parameters are selected as “forcing factors (FFs) controlling *E. huxleyi* blooms in arctic and subarctic seas” (p. 2, line 21) and tested in six seas (Barents, Bering, Greenland, Labrador, North and Norwegian seas) where the coccolithophore *Emiliana huxleyi* is known to form blooms.

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I believe the core of the study is interesting and merits publication, but I think the authors could and should do a better job at discussing (all) the results. By not having a primary focus on *E. huxleyi* blooms in the Introduction, the reader will be able to recognize the wider implications of this extensive intercomparison of climate models – it will also alleviate some of the major issues of neglecting “what else” underpins coccolithophore blooms and their occurrences. Nothing wrong with mentioning your motivation for selecting the regions of interest and the potentially relevant abiotic parameters, but as is, the reader is expecting more than is actually presented re. coccolithophore blooms (see below).

Specific comments

The authors explain that this study is a precursor for another study (in prep/planned by Kondrik et al.), in which these FFs will be applied to “model the future dynamics of *E. huxleyi* blooms” – so in fact, the current study has very little to do with *E. huxleyi* blooms apart from being the motivation for the presented set-up. There is no objection to test the model performance of the selected parameters, but the authors should do a better job at explaining why these factors were selected, and others ignored (i.e. because they cannot be assessed in the models? I wonder). Because it could be easily argued that the authors miss a crucial parameter in their line-up of FFs – nutrient availability – that arguably underpins any phytoplankton bloom (i.e. sustained exponential growth). Any biotic factors (e.g. grazing pressure) are ignored herein. Indeed, it is unclear what correlations are sought between the various FFs and *E. huxleyi* blooms – what do you mean with “affecting”? – e.g., the onset (triggers), the duration/maintenance of blooms, other affects?

After reading the ms, I felt that the study is a valid and interesting intercomparison of climate models, raising important issues in simulating abiotic parameters, but that the initial focus on *E. huxleyi* seems too specific here; i.e. without it, all results could be presented just as well – or even better as these parameters surely affect more than just *E. huxleyi*, thus giving the study a wider relevance. In fact the authors conclude

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rather generally, without discussing specific implications for the next / planned study by Kondrik et al. – so that also gives the impression that the initial motivation need not take central stage in this ms (or the title). Still, I don't fully understand what the strategy would be in "selecting the best models" for such follow-up study, given the multivariate outcomes, this could/should be better explained in the final discussion and conclusion.

Figure 9 ("heat map") is a good visual representation of the amount of work performed and the complexity of the outcomes; not only does it show the range in performance between the listed models (1-34), but also how within one model the chosen parameters are simulated at different strengths – and, possibly even more intriguing (disconcerting?) that a model that performs very well for one sea, does not in another (for example, compare model 1, ACCESS1-3 in Barents and Bering Seas). Indeed, the authors conclude that the results "show that there is no optimal model ensemble or one top-model which could best simulate all factors across all of the study regions. Despite the fact that the Arctic is often considered as one single region in many studies, our results show that CMIP5 climate models do not have consistent performance across such a large area" (p.8, L. 12-15).

What I miss, is an in-depth discussion why these inter-model, inter-parameter and inter-subregional differences exist – is this due to issues of spatial resolution, initial parameterization of each model (what it was built for) or real physical differences between the seas that models cannot address/capture? Again, I don't know, but would be interested to learn what factors could underpin the results in Fig. 9. Currently, the "results and discussion" section reads as a list of figure descriptions rather than highlighting the main take-home messages (while figure captions could do with more information). Moreover, only one of the 5 factors is highlighted (SST) as "an example" – I believe the paper would have a much greater impact if the other parameters get equal treatment or at least their highlights mentioned and discussed in the main text, not only in a supplement.

Abstract: first sentence, shortly name the reasons; why only carbon cycle mentioned

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here, as opposed to carbon and sulphur cycles in first sentence of Intro?

Line 25 (last paragraph): too much information (and acronyms) for abstract. Remove.

Intro, p. 4. Lines 8 -14 - this paragraph "goes without saying"; what follows is generic order of methods, results, discussion.

Intro/Methods: What is a CMIP5 climate model / the CMIP5 project? Define and describe – currently not done anywhere.

Figure 1 (if kept as motivation for selected regions), please state what type of data are shown and cite data sources in caption.

General: Many figure captions need more details for reader to follow or identify data sources.

Technical corrections

If you decide to keep *Emiliana huxleyi* in, know to write the full species name the first time the species is introduced in the text, as well as any time you start a sentence with "E. huxleyi" (change to "Emiliana huxleyi"). Also put space between E. and huxleyi. Alternatively, as motivation you could mention "coccolithophore blooms" as a more generic way – and comment that many of the blooms in the Arctic and Subarctic are indeed formed by one species.

Check: Winter et al., publication year is 2014?

p. 5, Line 7: delete "the" between "under" and "study" / and consider replacing as "under investigation". Add "seas" after list of sea names.

Line 18: add: "The" seasonal cycle

p. 7, Line 32: models (plural)

p. 8, Line 28: add "the" before proposed methodology

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