

Interactive comment on “From the chlorophyll a in the surface layer to its vertical profile: a Greenland Sea relationship for satellite applications” by A. Cherkasheva et al.

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Review: os-2012-97: From the chlorophyll a in the surface layer to its vertical profile: a Greenland Sea relationship for satellite applications. Cherkasheva, A., A. Bracher, E.-M. Noethig, E. Bauerfeind, C. Melsheimer.

General Remarks.

This paper presents important new data which are analysed from the perspective of a requirement to parametrise chlorophyll profiles accurately at high latitudes in primary production models. The value of the paper would be greatly enhanced if a little more information about the dataset were provided, including a map of profile locations, with

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some representation of the months during which biogeographically distinctive areas were profiled. This would help constrain the interpretation of the data in terms of surface chlorophyll variability/seasonality and nutrient/mixed layer regimes (e.g. in Section 4.1). A map of the categories assigned would likewise aid interpretation – does the high CHL category always occur to the edge/centre of the basin? A graph showing surface chlorophyll against penetration depth would likewise be helpful for interpretation. Some statements about the results need to be qualified for accuracy (see detailed remarks below), and the English needs to be corrected (see grammatical/typographical corrections below).

Detailed Remarks.

Page 3569, Line 4: Was any error calculation made, comparing the production estimated by some simple, standard PP model using the refined profiles vs estimation using Morel & Berthon (1989), for example? Although I realise it may be the subject of a future paper, a preliminary, indicative calculation and error budget would contribute significantly to this paper, especially given the degree of within-group variability that you found (Figure A1).

Page 3571, Line 3: It would be extremely helpful to include a map of the input data for this study. The introduction mentions sea ice, yet April and June profiles suggest deep maxima rather than ice margin blooms; did the study include profiles within the ice zone? Although you provide a reference to Matrai et al. (2010), that paper does not appear to have been published yet. Similarly, at Line 15, it would be helpful to report whether the surface values in the profile dataset spanned the same range of chlorophyll- a values as the underway dataset. These minor alterations would give the reader a clearer idea of how representative your data are of the Greenland Sea (and of arctic ecosystems generally).

Page 3573, Line 4: Do I understand this method of choosing the bounds of each category correctly: You ordered the profile by surface chlorophyll concentration, then

divided them into equally sized bins, placing the bounds automatically every ~200 profiles, so the category boundaries emerge as the spacing between your chosen number of bins (categories) ? It's useful that you report alternative approaches (lines 13 to 17), but what is the result of relating Csurf against depth of chlorophyll maximum – would this provide a more immediate approach to answering your main question? Again, some further exploration of variability seems appropriate given the degree of spread in Figure A1.

Page 3574, Line 16: Was the dataset checked for heteroscedasticity?

Page 3574, Line 20 & Page 3577, Line 6: Whilst the correlation between Cpd and Ctot is certainly significant for the full dataset, values of Cpd <~ 0.7 may indicate Ctot anywhere within an order of magnitude of Cpd, and vice versa. I suggest qualifying this statement, perhaps with reference to confidence bounds which could be added to Figure 1.

page 3575, Line 10: I strongly recommend including the supplementary Figure A1 in the main text, since it enables the reader to gauge much more clearly the variability in the data. I would also recommend including information about the median/std. dev. penetration depth values for each category, perhaps as horizontal lines on Figure A1 or within Table 1.

Page 3577, Line 20 to Page 3578, Line 17: It could be inferred from the beginning of this argument that salinity stratification drives mixed layer depth throughout the Greenland Sea, which is misleading. Thermal stratification dominates in the central basin away from the seasonal ice zone and East Greenland Current, and these two zones (ice zone and always ice free) represent quite distinct biogeochemical regimes. This should be made more clear on Page 3578. The interpretation of profiles within the rest of the paragraph needs to consider the known domain of the profiles explicitly – the co-ordinates of the profiles are known, so even a simple map of category locations would help here, and if you are prepared to invest more time in it, then overlaying ten-

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year mean monthly surface SST contours, for example, might help. I am continually wondering whether you observe geographical coherence in your categorisation.

Page 3578, Line 28: The phytoplankton bloom begins during March/April at the seasonal ice zone, and later in the open Greenland Sea. To interpret your observation of April peak CHL mixes up the lateral with the temporal variability – you need to clarify the location of sites with an April CHL peak in order to decide whether your dataset concurs with Behrenfeld's (controversial on account of semantics) interpretation. It's not at all clear to me from what you currently show in the paper that you have sufficient temporal resolution within any year and biogeographical domain to draw firm conclusions about bloom timing.

Minor/Typographic Errors.

Title: '..vertical profile: A Greenland...'

Page 3568: Lines 4-7: Suggest re-arranging motivations, since the fact that the Arctic phytoplankton populations are thought to be bio-optically distinct from the global 'average' sampled for algorithm development is more important than the fact that these communities are under-sampled, and this is important for primary production estimates (line 2) because those estimates are based on chlorophyll estimation. E.g. 'Current estimates of global marine primary production range over a factor of two. Improvement of these estimates requires accurate knowledge about chlorophyll vertical profiles, since these are the basis for most primary production models. At high latitudes, uncertainty in production estimates may be greater than the global average because here, phytoplankton absorption shows specific characteristics due to low-light adaptation, and in situ data and ocean color observations are scarce.'

Line 16: 'combined with data from the ARCSS-PP.'

Line 21: Ambiguous – does this statement refer also to the class with surface chlorophyll > 0.7 mg/m3? Suggest either 'The maxima of all chlorophyll profiles moved from

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lower depths..' or 'The chlorophyll maxima for this group moved..'

Line 25: grammar: 'While the variability..Sea season follows the global...'

Lines 27-28: grammar: '...significantly from the model in other months (July-September), when ..'

Page 3569: Lines 4-6: Not clear whether this is a recommendation or a statement of future work. Suggest either 'These can be used as input to satellite-based primary production models for Arctic regions' or 'This will be used as input... in further studies.'

Line 29: Should this be 'particulate organic carbon' instead of 'carbon dioxide'?

Page 3570: Line 19: relationships.. Line 22: '..global one of Morel..' Line 26: I think this should say 'north from the Arctic circle..' ?

Page 3571: Line 15: '..on the ARCSS-PP ...' Line 19: '..In cases where several profiles were measured at one ...' Line 21: '..considered it to be a new profile.' Line 24: '..increments for further..'

Page 3572: Line 11: Please put equation 1(a,b) together with the relevant citation directly below this sentence, or else print it in full earlier in the Introduction. Line 25: '.. regardless of their..'

Page 3573: Line 3: 'According to the method of Morel..' Line 8: suggest '..gives less weight to outliers..'

Page 3574: Line 10: Cpd should be Ctot.

Page 3575: Line 8: Suggest e.g. 'Within this range, the magnitude of the April-May CHL maximum is equal to or greater than that during September..' Line 9: Suggest '..represents a transitional state..' Line 11: '.. is more difficult to distinguish..' Line 14: 'This is the only range..' Line 15: 'fourth' (not forth) Line 15: '..shows a clear seasonal cycle in [CHL / profile] evolution..' Lines 18-19: '.. median profiles that are quite different appear nearly identical as fitted..' Line 20: 'However, the main..' Line 25:

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'..showing intermediate values.'

Page 3576: Line 22: '..usually an indication of SCM..' Line 23-24: suggest e.g. '.. with maximum values exceeding surface CHL by up to a factor of three..'

Page 3577: Line 12: '..in respect of..' or '..with respect to..' Line 20: '..critical for phytoplankton growth..'

Page 3578: Line 2: '..depending on whether the CHL..' Line 3: '.. in case of low ..' Line 27: Is the Greenland Sea really classified as 'subarctic Atlantic' ? Surely, since it's north of 66N, it's arctic Atlantic?

Interactive comment on Ocean Sci. Discuss., 9, 3567, 2012.

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