Earth Syst. Sci. Data Discuss.,
https://doi.org/10.5194/essd-2018-101-AC1, 2018

Open Access Earth System Science Data Discussions

Interactive comment on "A synthetic satellite dataset of *E. huxleyi* spatio-temporal distributions and their impacts on Arctic and Subarctic marine environments (1998–2016)" *by* Dmitry Kondrik et al.

Dmitry Kondrik et al.

ekazakov@niersc.spb.ru

Received and published: 7 November 2018

Dear Dr. Poulton,

Thank you for your thoughtful comments and recommendations. We are especially appreciative of the list of references.

Below are our answers.

Pg.1. Ln. 1: a) We will certainly change E. huxleyi for Emiliania huxleyi.

b) For all target seas we collected published reports from in situ/shipborne/laboratory studies explicitly indicating that the coccolithophore blooms were produced by E. huxleyi (see the attached specific list of references) with two exceptions for the Norwegian and Iceland seas, where along with E. huxleyi, Coccolithus pelagicus composes the coccolithophore community. However, as in situ determinations showed in the overwhelming cases the concentrations of cells of Coccolithus pelagicus were marginal (see e.g. Dylmer et al., 2015). This is the reason why we prefer leaving E. huxleyi instead of coccolithophores. A large number of papers on calcifying alga blooms in our targeted seas define the bloom-producing species as E. huxleyi.

Pg. 1, Ln. 7: By "activity" we meant the release of CaCO3 in water and a decrease of uptake of dissolved CO2 by E. huxleyi cells (e.g. Kondrik et al., 2018). In the revised version of the paper we will specify the actual meaning of the employed word "activity".

Pg. 1., Ln.16: It appeared to us that the issue of consequences of ongoing climate change–driven consequences is presently a commonplace, not requiring any further specialization. Indeed, the consequences are multifaceted, with numerous forward and feedback interactions and relate to many spheres of knowledge. So we choose to extend this phrase a little bit and provide this sentence with a reference that reasonably overarches the main dimensions of this phenomenon.

Pg. 1, Ln. 20: Yes, we will change for "the most widespread coccolithophore".

Pg. 1. Ln. 25; You are right, and we will add the reference "Winter et al., 2014".

Pg. 2., Ln 6:We agree that this phrase is kind of awkward and we will reword it as follows: "solely satellite remote sensing approach is. . ."

Pg. 2. Ln. 21: the following change will be made: the North, Labrador (with adjacent North Atlantic open waters), Norwegian, Barents, Greenland and Bering seas.

Pg. 4, Lns 30-32+ Figure 2c: The total content of PIC, Mpic, was determined for each 8-day time-period through multiplication of the carbon mass per coccolith, m, the coc-

colith concentration, Ccc, MLD and the bloom area, S. The value of m was equalled to 0.2pg. While most historical reports support this estimation, it is likely that the employment of this conversion might lead to either (i) some underestimation of PIC since it nevertheless neglects rare, relatively large, suspended calcite particles (PIC concentration per coccolith is $\sim$0.26 pg by Balch et al.(1991) and 0.5-0.6 pg by Holliganet al.(1983)) or (ii) some underestimation as there are in situ data indicating that many coccoliths in E. huxleyi blooms are either fragmented due to wave action (Holliganet al. 1993b) or just of a smaller size (PIC concentration is 0.13 pg) (Fernandez et al. 1993, Fritz 1999). Thus on balance, the selected value of m, in all probability, is a reasonably good estimate which is supported by the historical literature (Balch et al. 2005). The respective details are provided in section 2. Accordingly, the numbers in Figure 2c are indeed in tons as they reflect the content of PIC in a pixel-size column with the vertical extent equal to the respective MLD that was ascribed to each pixel within the bloom area. The respective methodology is described in detail in Kondrik et al., 2017 and will be given in the text.

Again, we express our gratitude to the referee for his very valuable comments.

Publications explicitly indicating the kind of coccolithophore species forming bloom in the target seas:

Barents Sea (Olson & Strom, 2002)

Bering Sea (Sukhanova and Flint, 1998)

North Sea (Holligan et al., 1993b; Buitenhuis et al., 1996)

Norwegian Sea (Baumann et al., 2000)

Labrador Sea (Okada & McIntyre, 1979)

North Atlantic (Holligan et al., 1993a)

Greenland Sea (Dylmer et al., 2015)

References

Balch, W. M., P. M. Holligan, S. G. Ackleson, and K. J. Voss. 1991. “Biological and Optical Properties of Mesoscale Coccolithophore Blooms in the Gulf of Maine.” Limnology and Oceanography 36: 629–643. doi:10.4319/lo.1991.36.4.0629

Balch, W. M., H. Gordon, B. C. Bowler, D. T. Drapeau, and E. S. Booth. 2005. “Calcium Carbonate Measurements in the Surface Global Ocean Based on Moderate-Resolution Imaging Spectrometer Data.” Journal of Geophysical Research110: C07001. doi:10.1029/2004JC002560

Baumann, Karl-Heinz &Andruleit, HA &Samtleben, C. (2000). Coccolithophores in the Nordic Seas: Comparison of living communities with surface sediment assemblages. Deep-sea Research Part Ii-topical Studies in Oceanography - DEEP-SEA RES PT II-TOP ST OCE. 47. 1743-1772. 10.1016/S0967-0645(00)00005-9.

Buitenhuis, E., J. van Bleijswijk, D. Bakker, and M. Veldhuis, Trends in inorganic and organic carbon in a bloom of Emilianiahuxleyi in the North Sea, Mar. Ecol. Prog. Ser., 143, 271-282, 1996

Dylmer, C. V., Giraudeau, J., Hanquiez, V., &Husum, K. (2015). The coccolithophoresEmilianiahuxleyi and Coccolithuspelagicus : Extant populations from the Norwegian–Iceland Seas and Fram Strait. Deep Sea Research Part I: Oceanographic Research Papers. https://doi.org/10.1016/j.dsr.2014.11.012

Fernandez, E., P. Boyd, P. M. Holligan, and D. S. Harbour. 1993. “Production of Organic and Inorganic Carbon within a Large Scale Coccolithophore Bloom in the North Atlantic Ocean.” Marine Ecology Progress Series 97: 271–285. doi:10.3354/meps097271

Fritz, J. J. 1999. “Carbon Fixation and Coccolith Detachment in the Coccolithophore E. Huxleyi in Nitrate-Limited Cyclostats.” Marine Biology 133: 509–518. doi:10.1007/s002270050491

Holligan, P. M., M. Viollier, C. Dupouy, and J. Aiken. 1983. “Satellite Studies on the

Distribution of Chlorophyll and Dinoflagellate Blooms in the Western English Channel." Continental Shelf Research 2 (2–3): 81–96. doi:10.1016/0278-4343(83)90009-2

Holligan, P. M., E. Fernández, J. Aiken, W. M. Balch, P. Boyd, P. H. Burkill, M. Finch, et al. 1993a. "A Biogeochemical Study of the Coccolithophore, Emilianiahuxleyi, in the North Atlantic." Global Biogeochemical Cycles 7: 879–900. doi:10.1029/93GB01731.

Holligan PM, Groom SB, Harbour DS (1993b) What controls the distribution of the coccolithophore, Emilianiahuxleyi, in the North Sea? Fish Oceanogr 2(3/4):17

Kondrik Dmitry, Dmitry Pozdnyakov & Lasse Pettersson (2017) Particulate inorganic carbon production within E. huxleyi blooms in subpolar and polar seas: a satellite time series study (1998–2013), International Journal of Remote Sensing, 38:22, 6179-6205, DOI: 10.1080/01431161.2017.1350304

Kondrik, D. V., Pozdnyakov, D. V., and Johannessen, O. M.: Satellite evidence that E. huxleyi phytoplankton blooms weaken marine carbon sinks, Geophysical Research Letters, 45, 2, 846-854, doi:10.1002/2017GL076240, 2018

Okada, H., and A. McIntyre. 1979. "Seasonal Distribution of Modern Coccolithophores in the Western North Atlantic Ocean." Marine Biology 54: 319–328. doi:10.1007/BF00395438

Olson, M. B., and S. L. Strom. 2002. Phytoplankton growth, microzooplankton herbivory and community structure in the southeast Bering Sea: Insight into the formation and temporal persistence of an Emilianiahuxleyi bloom. Deep-Sea Res. II 49: 5969–5990

Sukhanova, I. N., and M. V. Flint, Anomalous blooming of coccolithophorids over the eastern Bering Sea shelf, Oceanology, 38, 502 – 505, 1998

Winter, A., Hendericks, J., Beaufort, L., Rickaby, R.E.M., and Brown, C.W.: Poleward expansion of the coccolithophore Emiliania huxleyi, J. Plankton Res., 36, 316-325, doi: 10.1093/plankt/fbt110, 2014

Interactive comment on Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2018-101, 2018.