

Interactive comment on “Phytoplankton distribution in the Western Arctic Ocean during a summer of exceptional ice retreat” by P. Coupel et al.

Anonymous Referee #4

Received and published: 31 August 2011

General comments: The manuscript by Coupel and co-workers builds on a large dataset of phytoplankton composition (determined by HPLC accessory pigment analysis), biomass (expressed in Chl-a and mg C m⁻³) and productivity across the Chukchi shelf to the central Arctic (Canadian) basin. The biological dataset is linked to the hydrographical regime and the prevailing physical-chemical (salinity, temperature, light and nutrients) conditions. Given the poor spatial-temporal data coverage of this region the large dataset by Coupel et al. is of high relevance for comparative studies and the detection of climate change induced shifts in this integral part of the marine food web. I therefore hope to see this manuscript published. However, in its current state the manuscript does not merit publication. The manuscript is very tedious to read, overly

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long, not well structured, largely descriptive and suffers from poor English. I have refrained from correcting the English because it would have distracted from the scientific content. The authors use a lot of inappropriate wording, wrong grammar and sometimes mix up past and present tense. I therefore highly recommend that the manuscript is carefully checked by a native speaker prior to re-submission. The authors use a lot of abbreviations for geographical locations, accessory pigments and water masses throughout the text which makes it difficult to read. The authors should consider an additional table with geographic/water mass abbreviations (as has been done for pigments). Some of these abbreviations (e.g. SCM, AMZ, PML and SFL) were apparently coined by the authors themselves. I am for example not aware that Cota et al. 1996 and Hill and Cota 2005 explicitly used the term SCM. The authors should rather use commonly used terms or at least explain their new terms better. The figures and tables are difficult to read due to their small size and small font of the axis labels. For a better comparison it would be helpful if the same scale would be used in some of the figures. Although mentioned in the material and methods there is hardly any mention of data from microscopic cells counts apart from general categories like diatom, dinoflagellate, nano- and picophytoplankton abundances and biomass. I was hoping to see more species-specific data as there are huge differences between species within these very generic categories. In the conclusions the authors state “A strong divide between the shelf and open ocean waters was noted in terms of species composition...”, this is not justified given the low taxonomic resolution of the study. Instead the authors devote a lot of text to the description of the CHEMTAX analysis. The message of the manuscript gets lost in the overly long description of results and discussion. The conclusion is far too long (>1 page) and should instead briefly summarize the main findings of the study. Part of the material and methods are already included in the end of the introduction. Furthermore the introduction should not include figures.

Specific comments:

Abstract:

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Page 6920, line 6: 2008 was not an exceptional ice retreat but followed the general sharp decline observed since 2007 (see Stroeve et al. 2011 and Perovich et al. 2010).

Page 6920, lines 13-25: How does the first part of the paragraph (productive ice free Chukchi shelf vs. oligotrophic ice covered Canadian basin) fit with the latter part (1. unproductive ice free conditions, 2. productive MIZ (or AMZ) and 3. heavy ice cover and low biomass)? Introduction:

Page 6921, lines 11-12: Use more recent literature (e.g. Stroeve et al. 2011 and Perovich et al. 2010).

Page 6921, line 16: Use more recent literature (e.g. Wang&Overland 2009 and Boe et al. 2009)

Page 6922, line 12: Be more specific! I assume large cells $> 5 \mu\text{m}$ are mainly diatoms.

Page 6922, lines 21-23: Why is the reduction in ice algae associated with reduced carbon export? It is well known that phytoplankton sink and they usually account for the much larger fraction of annual primary production and biomass build-up.

Page 6922, lines 23-24: Species composition cannot be delayed. Why is the timing of the spring bloom delayed by early ice retreat? I thought the opposite is true!

M&M:

Page 6924, paragraph 2.2: At which depths were nutrients sampled? What is the vertical resolution? This is important to know for the nutricline determination.

Page 6924 and 6925, line 22 and 3: orthosilicic acid instead of acid orthosilicic

Page 6925, paragraph 2.3: The vertical resolution of pigments is very low (2-3 samples per profile). Was Chl-a sampled at a higher vertical resolution? This is important to know for the determination of the SCM.

Page 6926, line 9: chrysophytes and prymnesiophytes should be written in lower case

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as the other groups

Page 6927, lines 2-3: I assume the screens were not made of steel!

Page 6927, lines 3-4: How much 13-C was added?

Results:

Page 6929, line 16: What exactly is a polar mixed layer and what distinguishes it from a “normal” surface mixed layer?

Page 6929, lines 18-19: Why is the PML thinner over ice free waters? Wind mixing should increase with open water conditions.

Page 6929, lines 28-30: How do SFL and PML relate to each other? For example in the Beaufort Gyre the PML is shallow whereas the SFL is deep. Isn't the SFL determining the surface mixed layer depth?

Page 6931, lines 16-19: Are the high nitrate and silicate concentrations associated with upwelling along the shelf break?

Discussion:

Page 6935 and 6936, section 4.1.1: This section could be used for a more methodological paper and not needed in this detail here.

Page 6935, line 20: no need to show figures of non-significant regressions (fig. 9b and c).

Page 6937, line 8: Is the productivity ratio a commonly used term? Shouldn't it be chlorophyll specific productivity (productivity normalized to chlorophyll)?

Page 6937, lines 23-26: The high Chl-a/C ratio is an adaptation to the low light levels experienced in the SCM (shade adaptation).

Page 6942, line 21: Write species name full: *Melosira arctica*

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Page 6942, lines 20-23: What about the microscopic phytoplankton data from this study? Do they corroborate the presence of diatoms near the surface and which species were present?

Page 6945, line 15: Abundances of 4970 and 504 cells l⁻¹ are actually very low. I assume you are referring to abundances per ml?

Page 6946, lines 10-12: How do you justify this conclusion (haptophytes dominating during ice retreat while diatoms dominate at high irradiance)?

Page 6948, lines 8-12: To what extent is your conclusion (that your observation in 2008 does not fit into the general trend of increased productivity with increased ice melting) biased by the late summer season encountered during the cruise?

References:

Page 6952, line 18: Piepenburg D instead of Piepenburg P

Figures and tables:

Page 6955, Table 1: Use either haptophytes or prymnesiophytes

Page 6958: Fig. 2 c and d should be the same scale

Page 6961: Fig. 5 a, b and e should be the same scale.

Page 6963, Fig. 7: I do not see where Chl-a is depicted in this figure.

Page 6964, Fig. 8: This figure is way too small.

Page 6966, Fig. 10: Why do the dinoflagellates show up in panel f and not in panel c?

Page 6967, Fig. 11: Panel labels (a, b, c ...) and y-axis (depth in m) are missing.

Suggested references:

Stroeve JC, Maslanik J, Serreze MC, Rigor I, Meier W and Fowler C (2011) Sea ice response to an extreme negative phase of the Arctic Oscillation during winter 2009/2010.

Geophysical Research Letters 38.

Perovich DK, Meier W, Maslanik J and Richter-Menge R (2010) Sea Ice Cover [in Arctic Report Card 2010], <http://www.arctic.noaa.gov/reportcard>.

Wang MY and Overland JE (2009) A sea ice free summer Arctic within 30 years? Geophysical Research Letters 36.

Boe JL, Hall A and Qu X (2009) September sea-ice cover in the Arctic Ocean projected to vanish by 2100. Nature Geoscience 2(5): 341-343.

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