

Title: Regional-scale phytoplankton dynamics and their association with glacier meltwater runoff in Svalbard

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General comments:

The manuscript examines summer phytoplankton bloom in the fjords of Svalbard region and its association with glacier meltwater runoff, sea ice and ocean variables- MLD and SST for the period 2003-2013. Satellite derived surface CHL data and model simulation data is used for getting RUNOFF, SEAICE, SST and MLD. The manuscript shows correlation of summer bloom (CHL data) with the model variables. And reports that 50% (7 of 14) hydrological regions of Svalbard showed CHL increase in summer when RUNOFF increases. But the correlation was limited only up to 10 km distance from the coast. The manuscript suggests that the association can be due to subglacial plume upwelling and estuarine circulation. For other 50% hydrological regions that do not follow the correlation between summer bloom and glacial melt, role of other players, including land terminating glaciers and sea ice, is attributed.

The manuscript also discusses phytoplankton dynamics of the fjords of Svalbard in the productive season from April to August, and compares it with other Arctic fjords.

One of the purposes of the manuscript is to explore the feasibility of regional scale monitoring of phytoplankton. And it shows that indeed monitoring by satellites can be useful where in-situ monitoring is not possible or data is not available, though satellites have limitations such as cloud cover, sea ice and lack of sub surface overview.

In literature, such studies are mainly reported for Greenland fjords with limited information on Svalbard fjords. Thus, the gaps identified are valid and the manuscript has attempted to fill the gap.

Good points:

The study adds key data to existing literature. It combines regional physical oceanography with biogeochemistry of phytoplanktonic bloom of an important region of the Arctic-Svalbard. Though the study is regional, the factors discussed are universal in nature and may apply to any similar setting.

The manuscript is well written considering the literature search and identifying the gaps. The study region, and material and methods are defined elaborately.

Limitations:

There are some limitations that the authors can perhaps rectify.

How is the association with other variables accounted for while discussing the partial effects of chl with each predictor variable?

What could be the reasons for 50% of the fjords not complying with the said pattern? It would be good to add a paragraph in discussion related to this point?

Estuarine circulation fuelled by downfjord winds is mentioned as an alternative mechanism. Winds are an important parameter as they can mix the water column irrespective of glacier meltwater runoff. Checking surface winds can perhaps explain some of the cases which did not follow the pattern.

Also, checking turbidity data from satellite products can add information about the dominant character of runoff in a region. It will again help in explaining the other 50 % cases that did not follow the pattern.

Further, though limitations of satellite data are discussed, limitation of the model data (if any) may also be included.

How modelling approaches and satellite remote sensing are going to up-scale in-situ observations in the present context? Does it imply identification of hotspots to be studied or suitable time to access the locations?

Minor remarks:

Abstract

Line 3: Replace 'loads' with 'load'

Line 4 and line 478: See the usage of counteracting. At places it is written with a hyphen '-'. Keep it consistent throughout. 'Counteracting' should be ok.

Line 20: Replace 'Pan-Arctic' with 'pan-Arctic'

Introduction

Line 38: Correct quote marks

Line 58: may add silicate to the list with suitable reference as it is one of the nutrients contributed by runoff

Line 88: Replace 'On Svalbard' with 'In Svalbard'

Research region

Line 152: "Svalbard fjords can be regarded as broad fjords, i.e. fjord circulation is influenced by rotational dynamics or 'Coriolis' effects (Svendsen et al., 2002; Cottier et al., 2010)." The sentence comes abruptly and doesn't flow with the last sentence and with the paragraph in which it is mentioned.

Material and methods

Both present and past tense are used in the material and methods section. Past is preferable. Please make it consistent throughout the section.

Line 233 and 234: replace 'time-series' with 'timeseries'. Keep it consistent throughout.

Line 243, 258, 261, 262, 265: Replace 'normal distributed' with 'normally distributed'. Please make the same change throughout the manuscript.

Line 249: "Variables were selected by step-wise adding terms if leading to lower value of the Akaike Information Criterion corrected for small sample size, AICC "The sentence needs revision to make it clearer.

Line 263: Replace 'indications' with 'indication'

Line 266: "If outliers were identified, we refitted the model with the outliers removed and report significant changes in results, but kept the outliers in the presented model." The sentence needs revision. Maybe you can split it into two.

Results

Line 280: Replace "The model reveals significant positive association in all regions and regardless of distance from the coast, as expected." With "The model reveals significant positive association in all regions regardless of distance from the coast, as expected."

Line 295: Replace 'association' with 'associations'

Line 311: Replace "There are both negative and positive associations with CHL and any of the physical ocean and sea ice variables, although only for a limited number of regions." with "There are both negative and positive associations of CHL with any of the physical ocean and sea ice variables, although only for a limited number of regions."

Discussion

Line 339: Replace 'tidewater-glacier drained area' with 'tidewater glacier-drained area'

Line 340: Replace 'less, than' with 'less than'

Line 361: Replace 'productions' with 'production'

Line 370: Replace 'timeperiod' with 'time period'

Line 387: As the authors have not checked the estuarine circulation in the methods, perhaps it is better to say that it may contribute to the positive association.

So, replace "plumes, we cannot exclude that also the enhancement of the general estuarine circulation contributes to the observed positive effect of glacier runoff on marine primary productivity." with "plumes, we cannot exclude that enhancement of general estuarine circulation may also contribute to the observed positive effect of glacier runoff on marine primary productivity."

Or otherwise, authors may check that component and can then give a quantitative or specified mention.

Line 424: Replace 'will discuss' with 'discuss'

Line 430: Replace '2003-1013' to '2003-2013'