



Impacts of cyclones on the phytoplankton chlorophyll and sea surface temperature spatial and temporal dynamics in the Barents Sea as revealed from space

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Introduction

Knowledge about concentration of phytoplankton chlorophyll (chl) as a measure of primary productivity variations in the Arctic Seas is important for organization of this national economy and sustainable development of this area.

The impact of cyclone passing is wellstudied in tropical latitudes. This effect performed for the first time across the polar region.

Objectives

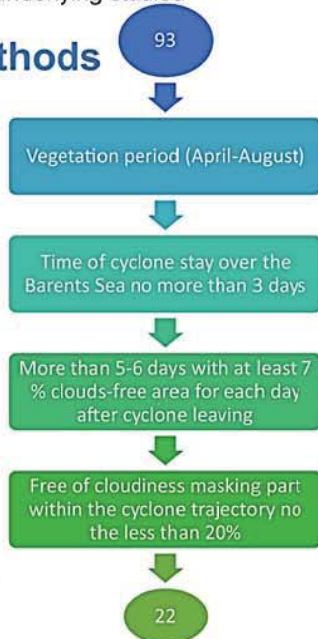
To reveal the features of impact of cyclone passing on chl concentration – to perform numerical estimations and to detect physical mechanisms, underlying studied phenomenon.

Materials & Methods

Data sources:

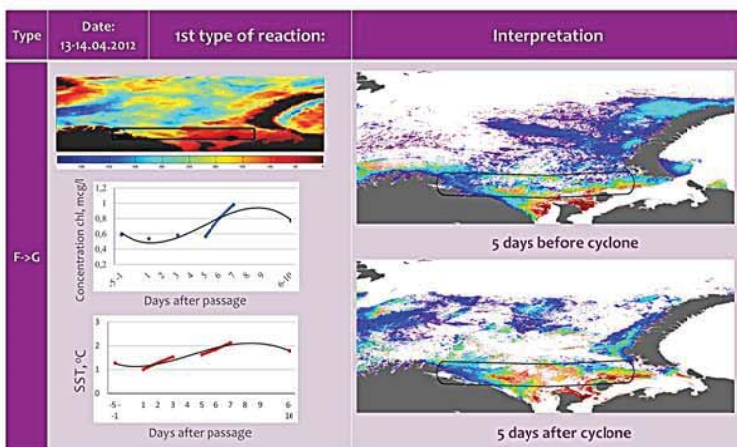
- ocean color from SeaWiFS, MODIS (Terra & Aqua), concentration of chl was retrieved with NASA algorithms OC4 for SeaWiFS and OC3 for MODIS
- SST from MODIS
- cyclones trajectory from reanalysis data on the geopotential of the 1000 mbar isobaric surface from NCEP/NCAR as 200km width strip centered in the cyclone's "eye"
- wind speed from QuickSCAT

93 cyclones were found, but only 22 of them were used according following



1st type:

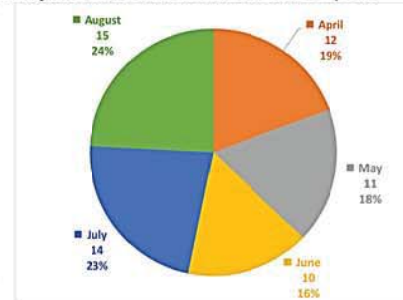
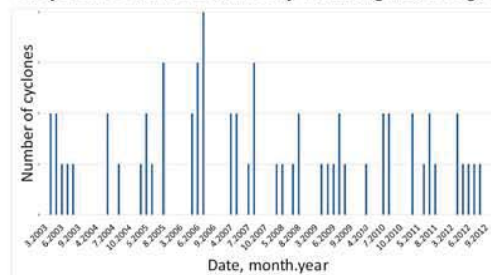
decreasing of chl и SST in the first days after cyclone passage, which than turns to gradual increase of these parameters mixing->raising nutrients



Results

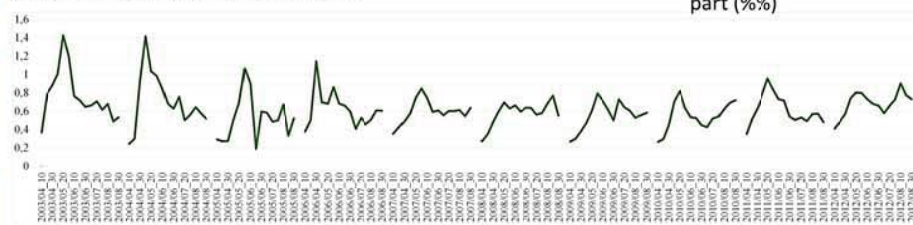
Statistics of cyclone passing

The amount of all cyclones/per month was maximum in 2005-2007 (3-4), but mainly there were 1-2 in each month only and this number didn't increase. The biggest number of cyclones was seen in July and August, but generally their month distribution is equal.



Seasonal dynamics 2003-2012

To estimate cyclone contribution to current time serie of chl concentration was derived.



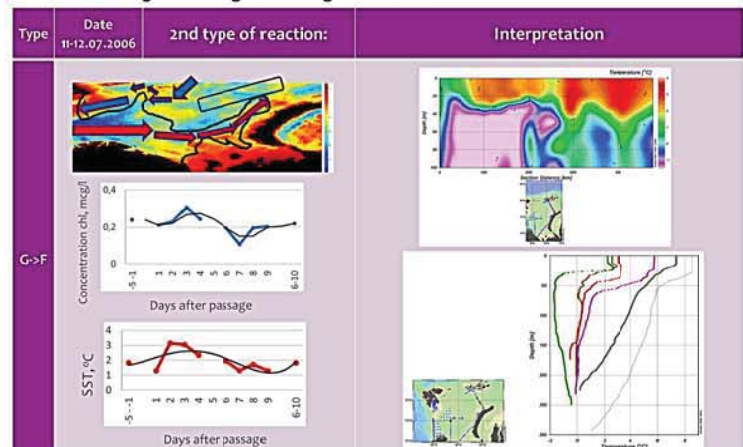
Cyclone impact

3 types of reaction on chl concentration field were revealed:

3d type: practical absence of any reaction of chlorophyll concentration field on cyclone passage (chl <0,1 mcg/l) low productive season

2nd type:

brief increase chl и SST in the first days after cyclone passage, which turns to gradual decreasing of mentioned parameters, and after that small growth of them was observed again deepened chlorophyll concentration due to atlantic waters maximum raising->mixing->raising nutrients

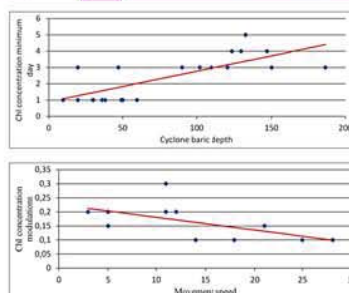


Correlation analysis and multilinear regression

Statistical dependence between chl modulations and cyclone parameters

$$\Delta chl = -0.00516638 * H_{cycl} + 0.000661515 * V_{tr} + 0.180391348,$$

where Δchl – excess of chlorophyll concentration growth over its falling, H_{cycl} – cyclone baric depth, V_{tr} – cyclone passing speed. Determination coefficient is 0,75.



Conclusions

The cases of cycle-driven increase in chl proved to be prevalent and is potentially capable of boosting the primary productivity in the Barents Sea, however its degree is not high according to indirect estimations

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