Geophysical Research Abstracts
Vol. 19, EGU2017-7328-2, 2017
EGU General Assembly 2017

Eco-physiological Baltic picoplankton analysis and its implementation in Synechoccocus species life cycle numerical algorithm

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Picocyanobacteria strain of the genus Synechococcus are extremely important organisms in the world's oceans. Synechococcus sp. is distributed widely in the oceans and freshwater ecosystems. However, the presence of picoplankton and its account for marine biomass were ignored in environmental studies before 1970. This was probably connected with too low accuracy of research equipment for examining such small organisms. In 1979 the picoplankton assemblages were defined to be present en masse in marine environments. Despite its association with open ocean systems, it is becoming increasingly evident in recent years that Synechococcus sp. is a significant contributor to cyanobacterial blooms. Moreover, bloom of picocyanobacteria, accompanied by a drastic ecological crisis was a new phenomenon in Europe, which needed careful investigation.
In the Baltic Sea, picocyanobacteria belongs mainly to the genus Synechococcus. Depending on pigment content, they are classified as red strains with phycoerythrin, green strains rich in phycocyanin, and the phycourobilin (brown strains) containing cyanobacteria rich in phycoerythrin. So far, picocyanobacteria in the area of interest have been being studied insufficiently. The knowledge of picocyanobacteria life cycle needs to be improved as these microorganisms can comprise even about 98% of marine biomass and are able to excrete many toxic and harmful substances.
Different eco-physiological conditions influence growth of Baltic picocyanobacteria. In this study, three strains of Synechococcus sp. (red: BA-120, green: BA-124 and brown: BA-132) were isolated from the coastal zone of the Gulf of Gdańsk (southern Baltic Sea) and analyzed in laboratory under previously determined eco-physiological conditions. These conditions were as follows: temperature from 15 to 25ºC, salinity from 3 to 13 and insolation in Photosynthetically Active Radiation (PAR) spectrum from 10 to 190 μmol photons m-2 s-1. Scenarios reflecting all possible mixtures of conditions were applied in the laboratory experiments. Results from these experiments were the foundation to create picocyanobacteria life cycle algorithm - pico-bioalgorithm. The form of algorithm bases on the Ecological Regional Ocean Model formulas for functional phytoplankton groups. According to this, in pico-bioalgorithm the dependence on temperature and salinity of water body and the occurrence of nutrients are provided along with the coefficients determining mortality of picoplankton cells and coefficients of respiration and growth rates. In order to prescribe the limiting properties, modified Michaelis-Menten formula with squared arguments as a limiting function was used.
Picoplanktonic organisms are very specific and can live in environments, which may be initially defined as impossible for such organisms to survive. The issue of picoplanktonic species inhabiting the Baltic Sea needs to be explored in details. Present study and proposed algorithm comprise an important step in this scientific exploration.

This work has been funded by the National Centre of Science project (contract number: 2012/07/N/ST10/03485) entitled: "Improved understanding of phytoplankton blooms in the Baltic Sea based on numerical models and existing data sets".
The Author (AC) received funding from National Centre of Sciences in doctoral scholarship program (contract number: 2016/20/T/ST10/00214);