ASSESSMENT OF EUTROPHICATION IN THE BALTIC SEA COASTAL WATERS FROM SATELLITE IMAGERY

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Eutrophication is an urgent environmental problem of the Baltic Sea. It causes such negative processes as increasing of phytoplankton biomass, declining of transparency, increasing of blooms of toxic algae, extension of bottom anoxic area (1,2,3,4). Coastal zone, land–locked shallow lagoons, and river runoff areas of the Baltic Sea are recognized as the most vulnerable areas towards eutrophication (5,6,7). The South–Eastern Baltic presents a particular sensitive marine area which includes all these factors: coastal waters, shallow land–locked lagoons − the Curonian and Vistula Lagoons, and runoff areas of the Vistula River, Baltiysk and Klaipeda Straits.

Chlorophyll *a* concentration is a core indicator for assessment of the eutrophication status, water quality, and biological productivity of natural waters (8,9,10,11). This water characteristic in the near-surface layer can be estimated from data of satellite ocean colour scanners.

PURPOSE OF THE STUDY

The main purpose of the study is to examine eutrophication status and water quality of the South–Eastern Baltic from satellite data on chlorophyll *a* concentration.

METHODS

Chlorophyll *a* concentration was obtained from 1027 MODIS images (TERRA and AQUA satellites) for the decade 2003–2012, spatial resolution 1 km. Satellite data were processed using SeaDAS Virtual Appliance (version 6.4) and BEAM VISAT (version 4.10.3) software provided by Brockmann Consult/ESA. In the study area it was retrieved with a regional algorithm for MODIS data developed by Bukanova et al. (12). The accuracy of chlorophyll *a* concentration estimation is 1.2 mg/m^3 and the mean systematic error is 34%.

Eutrophication status and water quality of the South-Eastern Baltic were assessed according to classifications developed (6) and (13).

RESULTS

The increased values of mean year chlorophyll *a* concentration was observed in the coastal area (Figure 1). The maximum values of chlorophyll *a* concentration (more than 4 mg/m^3) are observed along the northern coast of the Sambian peninsula, the Curonian Spit, the area affected by the Curonian lagoon hyper eutrophic waters and the Neman and Deima Rivers runoff and in the Gulf of Gdansk, which is the area of the Vistula River runoff.

Coastal area waters correspond to eutrophic level (chlorophyll *a* concentration 4-10 mg/m^3), and the open part of the region present waters with mesotrophic level (chlorophyll *a* concentration 0.8-4 mg/m^3) (Figure 2). Mean year area of waters with eutrophic level cover 29 % of the South–Eastern Baltic and mesotrophic level waters - 71 %. Waters are classified according to (6).

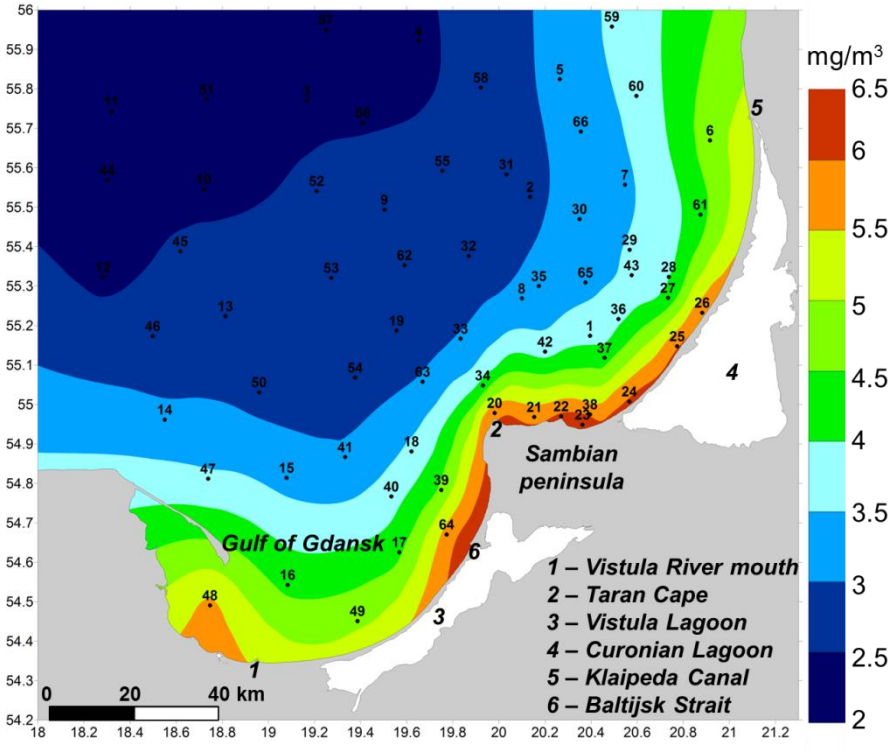

Figure 1: Spatial distribution of mean chlorophyll "a" concentration for 2003-2012.

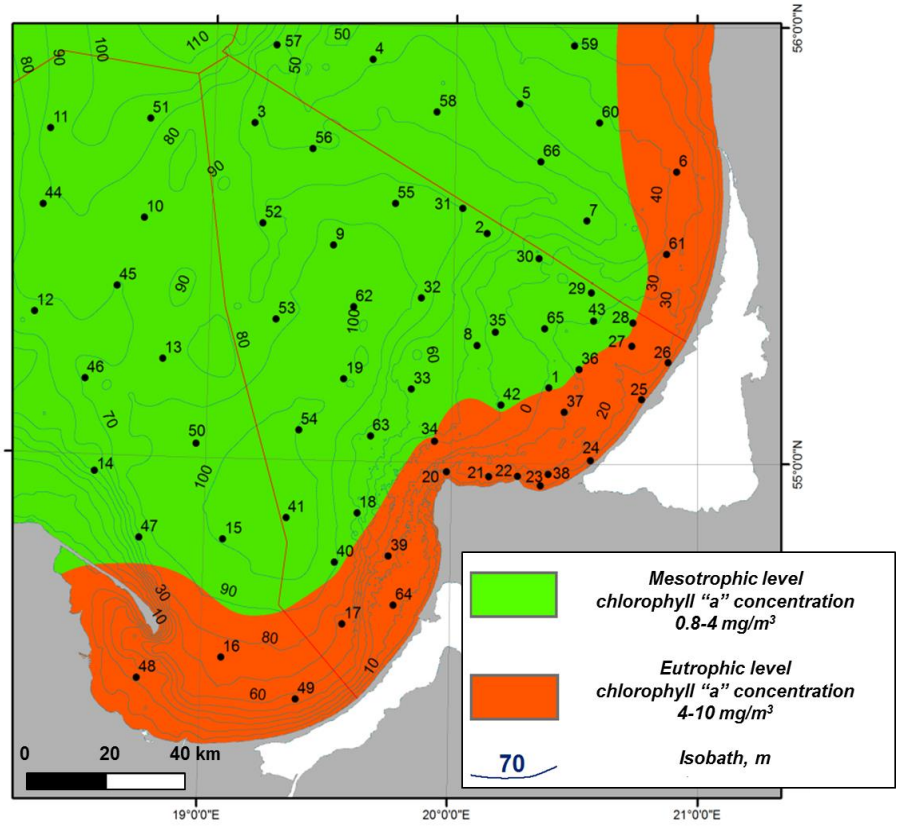

Figure 2: Eutrophication level of the South-Eastern Baltic for 2003-2012.

Waters of three classes of quality are observed in the investigation area: I class (excellent quality with chlorophyll *a* concentration < 2 mg/m^3), II class (good quality with chlorophyll *a* concentration 2-4 mg/m^3), and III class (satisfactory quality with chlorophyll "a" concentration 4-12 mg/m^3). Wa-

ters are classifyed according to (13). Mean year area of waters with excellent quality cover 11% of the South–Eastern Baltic, good quality - 60 %, and satisfactory quality - 29 %.

CONCLUSIONS

The South-Eastern Baltic is one of the most eutrophic area of the Baltic sea, thus it requires special attention for monitoring and control of core environmental indicators such as chlorophyll *a* concentration.

The investigated period (2003–2012) is characterized by increased chlorophyll *a* concentration in the coastal area, affected by three main sources of highly productive waters: The Vistula river mouth in the Gulf of Gdansk, Klaipeda Strait, which carry waters of the hypereutrophic Curonian lagoon, and Baltiysk Strait carrying waters of the Visula lagoon.

The South-Eastern Baltic waters are presented by eutrophic waters in the coastal area and mesotrophic in the open part.

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