THE BLACK SEA ECOSYSTEM STATE MONITORING: DEVELOPMENT OF THE APPROACH BASED ON REMOTE SENSED DATA

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Abstract
Approach to application of remote sensing and regional models for development of productivity and habitat conditions indicators and their application for operative monitoring of the Black Sea ecosystem state were given.

Keywords: Bio-indicators, Remote sensing, Models, Black Sea

Ocean color sensors information gives unique opportunities for development Operational Monitoring of the Black Sea ecosystem state using regional algorithms. The regional algorithms developed based on the Black Sea peculiarities of bio-optical properties [1-4] allow to transform correctly optical data of satellite sensors to set of parameters: chlorophyll a concentration (Chl), organic carbon to chlorophyll a ratio, biomass of phytoplankton (B), water transparency (k_d), suspended and dissolved organic matter light absorption coefficient($a_{CDM}(490)$), total and new primary production (PP). These parameters could be considered as indicators of waters productivity (total and new PP), of habitat conditions (k_d, $a_{CDM}(490)$), of phytoplankton bloom intensity and frequency (B, Chl). Development of the indicators requires: (a) designation of the regions with similar features of the parameters; (b) assessment of "reference point" of the indicator for each regions; (c) testing of sensitivity of indicators to pressures. The long-time series (1998 – 2013) of the parameters have been calculated with high spatial (4x4 km) and temporal (2 weeks) resolution (http://blackseacolor.com). For these parameters long-term annual average, monthly means, anomalies and standard deviations (SD) have been calculated for the regions designated before based on spatial and temporal variability of these parameters (Fig. 1).

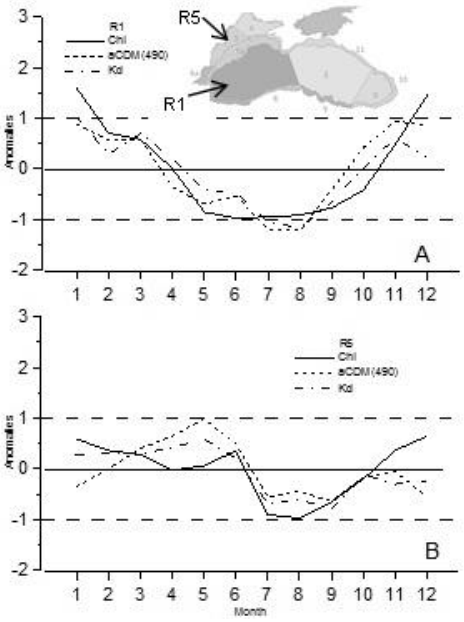

Fig. 1. Annual cycles of anomalies (normalized on standard deviation) of Chl, $a_{CDM}(490)$, k_d for waters with contrast trophic status: near Danube estuary region 5 (A), western deep-waters region 1 (B).

It was proposed to consider annual cycle of particular parameter's anomalies (normalized on SD) as "reference cycle" relevant to sustainable ecosystem functioning. Disturbance ecosystem functioning due to any pressures could be identified based on comparison to the "reference cycle". The Black sea is semi-enclosed basin, strongly affected by riverine run off (mainly of Danube). It results in significant eutrophication pressure impact on the western part of the Black Sea ecosystem due to appearance of redundant phytoplankton biomass, which is described correctly by obtained reference levels of the indicators in comparison to deep-water region (Fig 1). The sensitivity of phytoplankton biomass indicator (expressed as Chl) to eutrophication pressure was tested based on inter-annual variability in intensity of phytoplankton bloom in June and relative degree of Danube discharge, for assessment of which $a_{CDM}(490)$ was used. It was shown, that in June of different years (1998 – 2013) anomalies of Chl and $a_{CDM}(490)$ exceeded their long-term means synchronously (Fig. 2).

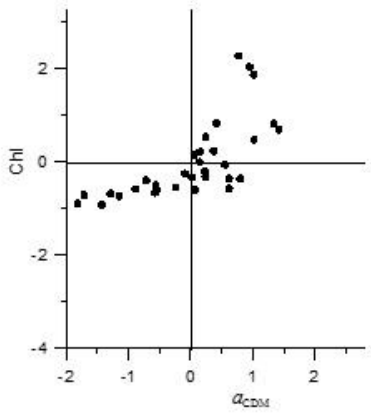

Fig. 2. Relationships between anomalies of Chl and a_{CDM} relevant for June of different years (1998 – 2013) for waters near Danube estuary.

The obtained results showed that Chl is sensible indicator, which immediately responds to anthropogenic eutrophication associated with river runoff. The proposed approach for development of indicators, assessment of their reference levels and application for operative monitoring of the Black Sea ecosystem state could be really important for management perspective.

References

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