Answers to the reviewer comments:

All the comments of the reviewer were exhausted in detail in corrected in the manuscript. We agree with reviewer suggestions and the paper was corrected.

Q1: The simulations where made using several assumptions about the future change in temperature, PAR, wind and nutrients. Are these assumptions realistic? How where these trends calculated? To my understanding it is purely an extrapolation of the trends in the period (1965-1998), or a part of this period (this is not clear). Is this really a realistic projection of future changes? It is assumed that the nutrient concentration (or nutrient loading, not clear) will increase 1% per year. What is then the concentration in 2050, is it realistic (not presented)?

The data presented in this paper are the results of the numerical simulations based on several assumptions which is one of many possible. "Scenario of future changes" was made on the basis of the changes for the 1965-1998 period, mainly in the Gulf of Gdańsk.
We will never know (and probably nobody knows) how our assumptions are realistic or not - this is the main reason why people examine different scenarios. So we examined a several options of the one scenario which was based on the historical data (1965-1998). Some of them were extrapolations, some were not.

The most important factors, that have dominant influence on primary production are PAR, nutrients and temperature. Fourier analysis of the archived data (34 past years) provides seasonal and annual variation of the sea surface temperature and nutrient concentrations in the past and shows the main trend of increasing temperature and nutrient during over 4 past decades in the southern Baltic Sea, mainly at the Gdańsk Deep. This equation was used by Renk (2000) to analyze data collection from the Sea Fisheries Institute (Gdynia).
Based on this trend, seasonal variability were calculated for the next 50 years. This main trend was used as a scaling factor for the future Baltic climate scenario.

Description of the method :

The long term variations of the examined parameters we assumed to be:
$S = So + Sa\,(Yd - 2000)$, where:
S – examined parameter (can be temperature, nutrient, …)
So – mean value of each day for the years 1965-1998 at every time step
Sa – average annual rice of the *S* parameter
Yd – time (as a fraction of the year)

Line 10, page 682, point 4: nutrients increase 1% of an average annual value per year (it means 0.0036 mmolP m^{-3} and 0.022 mmolN m^{-3} at Gdańsk Deep for the period 1965-1998 after Renk (2000)). It will give nutrients concentration in 2050 higher than in 1965-1998 of 0.18 mmolP m^{-3} for phosphate and 1.1 mmolN m^{-3} for total inorganic nitrogen.
For Bornholm Deep and Gotland Deep, we assumed the lower values: 0.0034 mmolP m^{-3} and 0.021 mmolN m^{-3}. The nutrients increasing include the inflow of nutrient compounds from the river and atmosphere. The increase of nutrient concentrations in the southern Baltic Sea over a period of many years has resulted in the increase of the average annual primary production by about 2 to 3% (Renk, 2000: eq. 39) and the increase of average annual chlorophyll concentrations by about 2% (Renk, 2000: eq. 40).

The average increasing of daily solar energy in Gdynia was 0.2% ≅ 0.03 MJ m^{-2} d^{-1} in the spring and summer and decreasing about 0.05%≅0.0053 MJ m^{-2} d^{-1} during the winter. The calculations were made on the basis of experimental data provided by the Institute of Meteorology and Water Management in Gdynia.

Q2: Are the POC concentration estimated with a transient simulation over all years?

In this paper, the POC concentration was determined as the sum of phytoplankton, zooplankton and pelagic detritus concentrations:

$$\frac{\partial POC(z,t)}{\partial t} = \frac{\partial Phyt(z,t)}{\partial t} + \frac{\partial Zoop(z,t)}{\partial t} + \frac{\partial DetrP(z,t)}{\partial t}$$

meaning the value is determined for each time and space (vertical) step.

Q3: How is the ecological model coupled to the physical model? A short description is presented at page 680 but why and how are the physical fields interpolated? I looked in (Dzierzbicka-Glowacka et. al. 2010) for a clearer description but found instead an almost identical text at page 629.

All physical components such as velocities, salinity and temperature were calculated in the 3D hydrodynamic model. The output from this model as an average values for the period 1960-2000 (ECOOP IP WP 10.1.1, Osinski 2008 Ph.D. Thesis) on temporal and special vertical scale for three selected areas (Gdansk Deep, Bornholm Deep, Gotland Deep, one cell area is ~9×9 km^2) was linear interpolated at every time and vertical step of the 1D POC model. The dynamical characteristics remain almost unchanged in a horizontal plane in comparison to vertical changes. Hence, the magnitudes of the lateral import/export are lower, and the above assumption can be made.

Q4: The model is validated at Gdansk Deep in (Dzierzbicka-Glowacka et. al. 2010) but the manuscript lacks model observation comparison at Bornholm Deep and Gotland Deep. At page 686 there is a short discussion about the models ability to simulate PP and POC. The authors claim that PP and POC agrees well with experimental data for the period 1965-1998 and 2010 with two references. However, one of them are from 1984 and could not possibly been compared to observations in 2010 or 1998. Have I misunderstood something? The other reference is again (Dzierzbicka-Glowacka et. al. 2010). This reference does validate POC concentrations for the year 2007 and 2008 in Gdansk Deep but no model-observation comparison of PP is to be found.

Ten days average value of chlorophyll-a concentration Chla (mgChlam^{-3}) for three considered areas and the primary production PP (mgC $m^{-2}d^{-1}$) for two areas (Gdansk Deep and Bornholm Deep) for the 1965-1998 period were shown by Renk (2000: Table 8). Also the monthly primary production (gC m^{-2} $month^{-1}$) in different areas of the southern Baltic Sea as averaged for the 1966-1995 period for the Gdansk Deep and Bornholm Deep and 1970-1971 and 1982-1996 for Gotland Deep also were presented by Renk (2000: Table 11).
The simulations and measurements at the investigated areas were compared. The correlations for the primary production and chlorophyll-a were quite good ($r>0.6$) (results unpublished). The differences between measurements and modeled data depend on the time and place where the calculations were made. They also depend on the C/Chla ratio for converting simulated

carbon contents to chlorophyll-a, which was assumed as the variable obtained for the Gulf of Gdansk (after Witek (ed), 1993). The Pearson product – moment correlation coefficient for above variables PP and Chla were higher at Gdansk Deep than Bornholm Deep and Gotland Deep because the parameterization of parameters describing the primary production was made for the Gulf of Gdansk.
I am sorry for misleading sentence: lines 13-14, section 5, page 686.
Should be: Modeled primary production (PP) values for the 1965-1998 period and POC concentration for 2010 agree very good with experimental data for PP as average values over the 1965-1998 period and for POC from the year 2007 and 2008 (see Dzierzbicka-Glowacka et al., 2010) and from next two years 2009 and 2010 (data presented on the **Baltic-C Third Scientific Study Workshop**, **Lund, Sweden, 8-10 November 2010,** *POC/DOC for model validation by* Anna Maciejewska).

Detailed remarks
1) In the introduction it is mention that trends and average values of nutrient concentrations, temperature and PAR are used in the simulations. But in section "Scenarios of future changes" it is only mentioned that temperature and chlorophyll trends has been provided from this dataset.

Section "Scenarios of future changes" was corrected (completed).

2) How are the average wind speed and direction calculated?

Point 3 (line 9, page 682) is faulty (wrong). I am sorry for misleading sentence, this was corrected. Should be: flow field is assumed at the same level as average value from the 1960-2000 period from the hydrodynamic model (were not changed, only daily average values were calculated).

3) At page 681: "In the first step of our study, the calculations were made assuming the following". What is the next step in the study? Are the presented results based on more assumptions than these? If so they should be explained.

This paper is the first step of our studies toward various scenarios of the POC in the southern Baltic Sea. So here, is no next step. So I think the second part of this question does not require any comment.

4) The authors make a distinction between surface water (0-1 meter depth) and upper layer (0-10 meter depth). What is the reason for this and why is the surface layer only presented in Gdansk Deep? Also, these definitions are first mentioned in section "Scenarios of future changes" but defined later in the text.

The calculated were made for the surface layer and upper layer for the all considered areas. The upper layer (0-10 meter depth) illustrates mainly the effect of decreasing radiation on the primary production by exponent function. The results for the surface layer at the Bornholm Deep and Gotland Deep are similar as in the case of the Gdansk Deep considering the quality and shape distributions; however in relation to quantity they are a bit lower, therefore the analysis of the numerical results was made only for the Gdansk Deep.

We would like to express our thanks to Reviewer for his/her very instructive and profound comments.