Answers to the reviewer 1 comments:

(1) Our simulations are meant to be compared with field observation data for POC not only but also for the investigated pelagic variables and temperature. Calibration of the model and comparison of model results with measurements for temperature and the pelagic variables are given in a previous paper Dzierzbicka-Glowacka et al. (2009c) (see Figures 10 and 11).

The simulations and measurements in 1995-2000 were compared. With respect to all the parameters, the correlations of the observed regularities decreased from the surface to the bottom. The correlations for the layers from the surface down to 50 m for $Nutr_P$ and to 60 m for $Nutr_N$ were quite good (> 0.7) during late winter and autumn and down to 40 m (> 0.6) in summer. The simulated phytoplankton biomass was compared with those and chlorophyll-a concentration measured in the 10 m layer as average value including carbon to chlorophyll a ratio in phytoplankton in the Gdańsk Gulf in the 0-15 m layer after Witek et al. (1993). The simulation of phytoplankton was the weakest, despite a correlation coefficient of 0.61.

The consistency of the calculated values with those measured in the vertical distribution was particularly good with regard to temperature. This results also testifies to the fact that the environmental conditions did not change radically and that the applied various processes were regular.

The simulated annual cycle of POC was compared to field observations (from several sources) merging available data referenced in the literature. The results of the measured POC concentrations in the surface layer varied from 103±12 mg C m^{-3} in winter to 1032±33 mg C m^{-3} in the late spring. The measured POC concentrations are somewhat higher than the calculated ones, except autumn data. However, POC concentration, as the sum of detritus, phytoplankton and zooplankton, might fluctuate with high temporal and spatial resolution. This was confirmed for the Gdansk Deep e.g. by Burska et al. (2005), who sampled the surface sea water for POC measurements at the P1 station in late spring 2001 through 8 successive days. The range of POC concentrations for 27 measured samples was from 290 to 1430 mg C m^{-3}. This also indicates that experimental approach to establish temporal and spatial POC distribution must be based on prolonged and extended measuring programs.

Experimental POC data collected in March, 2008 suggested earlier start of phytoplankton bloom than it was observed in 2007. Such inter annual shifts were observed in the Baltic Sea (Voipio, 1981). They resulted from different temporary environmental conditions decisive for phytoplankton growth, i.e. nutrients availability, light, water temperature. On the other hand extremely high POC concentrations noticed in May, 2008 (1032±33 mg C m^{-3}) indicated more intensive phytoplankton activity than it was observed in a comparable period in 2007.

Results obtained by Dzierzbicka-Głowacka et al. (2009c) indicated that the 1D POC model might be a useful tool for actual carbon cycle and pelagic variables investigations and prediction of theirs changes. Comparison of measured and modeled POC (POC $= Phyt + Zoop + DetrP$) and pelagic variables $Phyt$ and $Zoop$ concentrations confirm appropriate functioning of the model .
It will presented in this paper (see Figure 2).

(2) In this paper, the critical moulting mass is obtained by: $C_m = \left(C_k + \sqrt{2}C_r\right)/\left(1 + \sqrt{2}\right)$,

assuming that the half saturation value is equal $C_h = 2C_m - C_r$ (Moll and Stegert, 2007), which ensures that ingestion is not reduced before transfer starts and that the function fm_i describing the limitation of ingestion rate as molting weight is $fm_i(C_h) = 0.5$ (Fig. 3B). The transfer rate TRN_i from stage i to the next $i+1$ is given by a sigmoidal function depending on the W_i and C_m with a reference weight, C_r, as a threshold mass, below which no transfer takes place and

$TRN_i(C_m) = 0.5$ (Fig. 3B). This was not included in previous versions of the model (Dzierzbicka-Glowacka, 2005; Dzierzbicka-Glowacka et al., 2006, 2009a).

The ingestion rate ING_i for specific developmental stages is dependent firstly on the maximum ingestion rate, secondly on available food $Food_j$ (Fig. 3A), thirdly on temperature T, following a constant Q_{10} (2.6) law (Fig. 3A) applicable to the temperature range of 5-18°C and fourthly on individual weight using C_m by the function fm_i (Fig. 3B). Q_{10} was used to estimate the t_2 coefficient; consequently, the parameter t_2 had a value of 1.1. Coefficient t_1 was calculated so that fte was equal to 1 at 15 °C and, therefore, t_1 was equal to 0.239. Coefficients t_1 and t_2 were identical for all stages. Additionally, a parabolic threshold function ft_2 (with $T_o = 18°C$, $t_3 = 0.6$ and $K_1 = 1.3$) realizes a decrease at higher temperatures as a result of physiological depression. So, growth follows an exponential curve up to the optimal temperature of ~18°C and decreases for higher temperatures. This was not included in previous versions of the model (Dzierzbicka-Glowacka et al., 2006, 2009a).

In this paper, the vertical distributions of the annual biomass for the selected state variables representing *Acartia* spp. stage dynamics shown in Fig. 5 are demonstrated. Figure 6 presents the simulated stage biomasses, which are the algebraic sum of the products of the weights, W_i, and numbers, Z_i, of each stage, as vertical mean values and also the number of *Acartia* spp. generations in the southern Baltic Sea (Gdansk Deep) is illustrated. This was not included in previous versions of the model (Dzierzbicka-Glowacka et al., 2006,2009a).

In this paper, the field observations of zooplankton was presented on a large scale. This was not included in previous versions of the model (Dzierzbicka-Glowacka, 2005; Dzierzbicka-Glowacka et al., 2009a). An analysis of the information given in paper demonstrate, that the experimental total mezozooplankton biomass was characterized by two biomass peaks in a year, in June (ca. 130 mg C m^{-3}) and August (ca. 80 mg C m^{-3}), similar to the modeled zooplankton. These values are slightly lower than those of the total zooplankton biomass, which was modeled using the bulk formation because the microzooplankton biomass was not included in the experimental data. Generally, the biomasses of total zooplankton and *Acartia* spp. biomass are in agreement with observations.

Fig. 7 shows the results of numerical simulations and observed data for three successive regions of Gdansk Gulf for total biomass of *Acartia* spp. (in mgC m^{-3}) as monthly averages in the upper 20 m layer.

Other zooplankton biomass data will shown in figure too. In the Gdańsk Gulf, cladocera only occurs from May to August; the other three taxa of mezozooplankton: copepoda, rotatoria and meroplankton in 1999 and 2000 occurred in different proportions during the whole year. From September to April, copepods dominated assuming 75-96% of total biomass mezozooplankton. In the period from May to August, the dominant groups were: in May – rotatoria (56%), June – cladocera (53%), July – copepoda (77%) and in August – cladocera (66%) (Mudrak, 2004). Proportional participation of copepoda in mezozooplankton, outside the dominant month, was not large – from 20% in June (min) to 32% in August (see Figure 8). Copepoda accounted for 24% of total mezozooplankton biomass in the entire area of Gdańsk Gulf, and exceeded 50% in the region of Puck Lagoon (M2) only.

The dominant part on score of copepoda biomass with exception in November and June played *Acartia* spp. They reached a maximum (98%) in September and minimum (23%) in June. However, in months of copepoda dynamic development, this participation reduces

overbalance of *Temora longicornis* (in November – 52% and June – 66%) and in a less degree, *Centropages hamatus* (11%) and *Eurytemora* sp. (5%) in the coastal waters and *Pseudocalanus minutus elongatus* (15%) in the deep regions of the Gdańsk Gulf (see Figure 9).

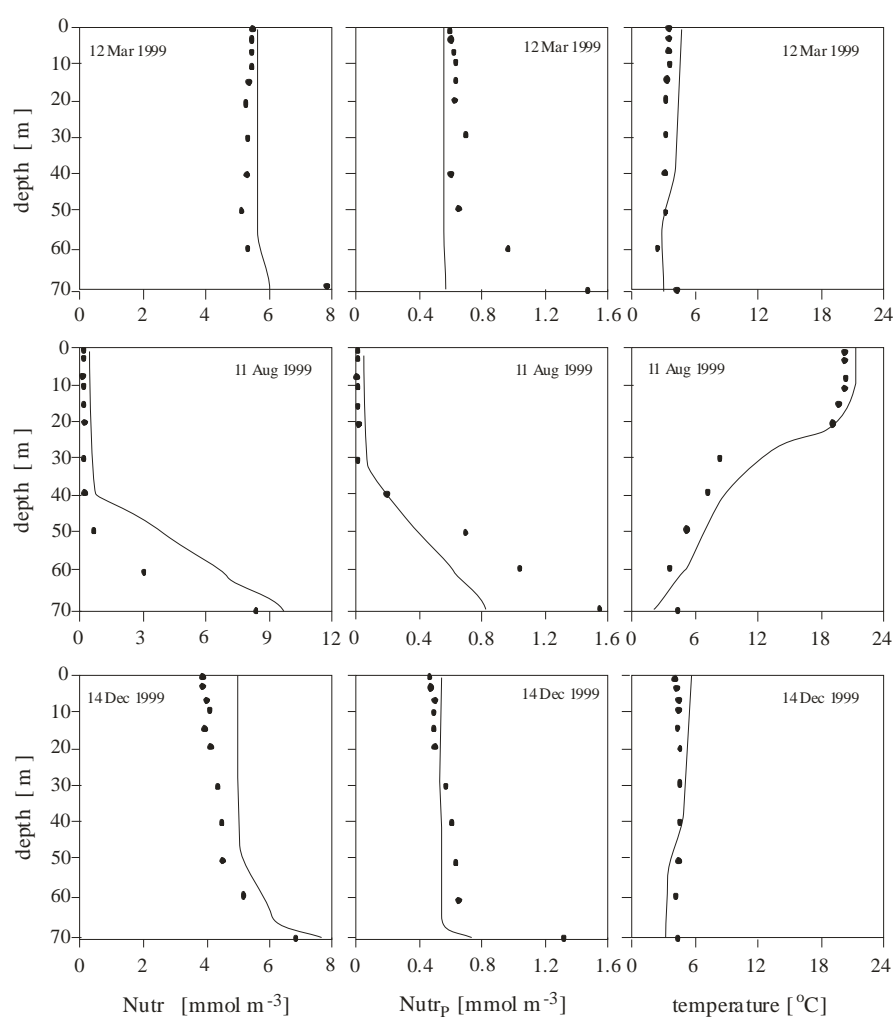I would like to express my thanks to Reviewer for his/her very instructive and profound comments.

Figure 10. Seasonal variability in 1999 of the observed vertical distributions (circle) and the modeled (line) parameters: total organic nitrogen, $Nutr_N$, phosphate, $Nutr_P$ and temperature in the Gdańsk Deep at the station P1. (Dzierzbicka-Glowacka et al. 2009c)
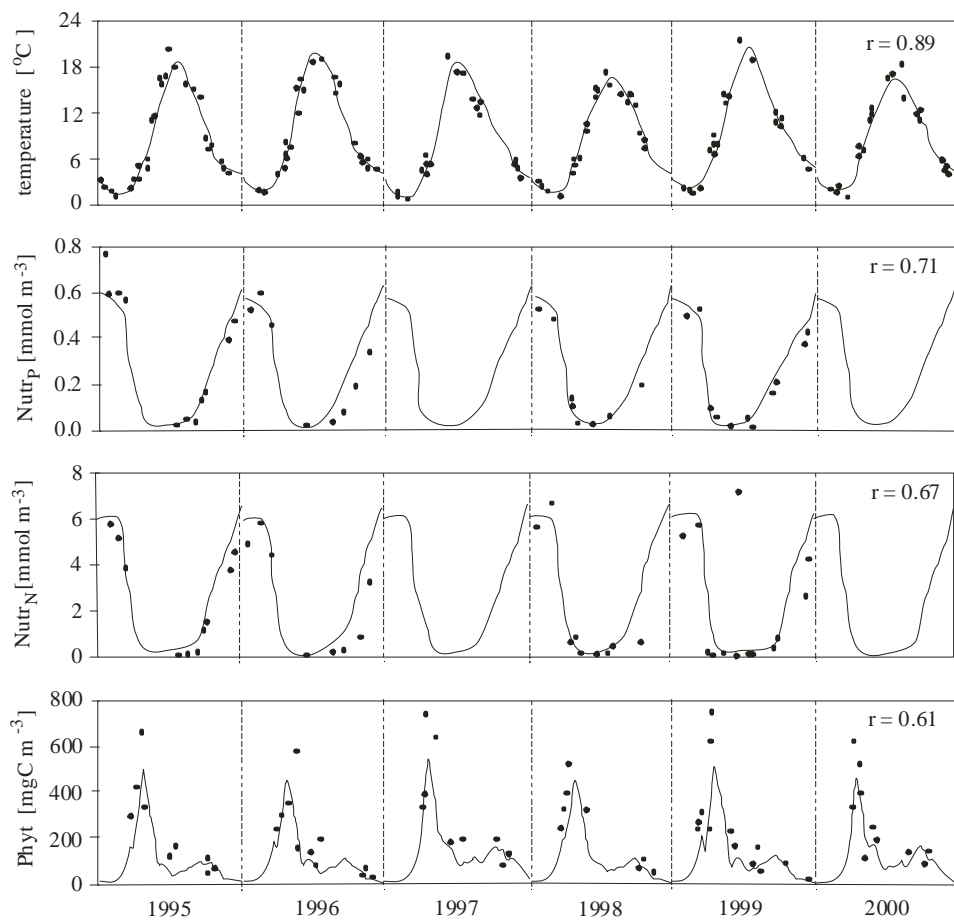
Figure 11. The temporal distribution (1995-2000) of the observed (circle) and modeled (line) parameters: temperature, phosphate, $Nutr_P$, total organic nitrogen, $Nutr_N$, and phytoplankton biomass, $Phyt$, in the Gdańsk Deep at the 0 m depth. (Dzierzbicka-Glowacka et al. 2009c)
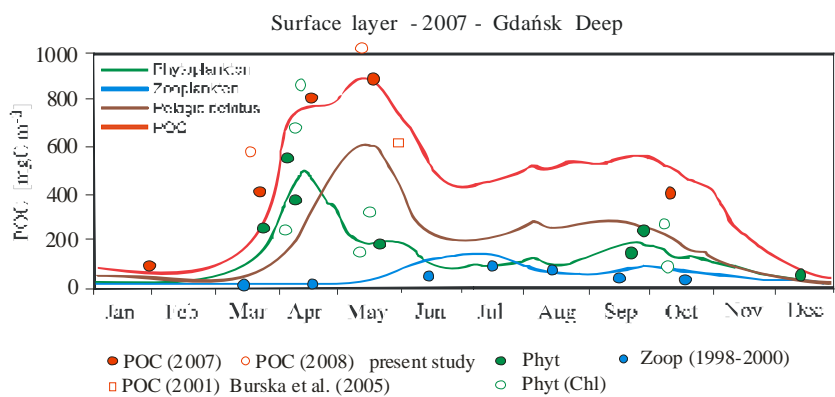

Figure 2. Modelled POC seasonality presented against background of $Phyt$, $Zoop$ and $DetrP$ and in situ measured POC concentrations. (Dzierzbicka-Glowacka et al. 2009c)
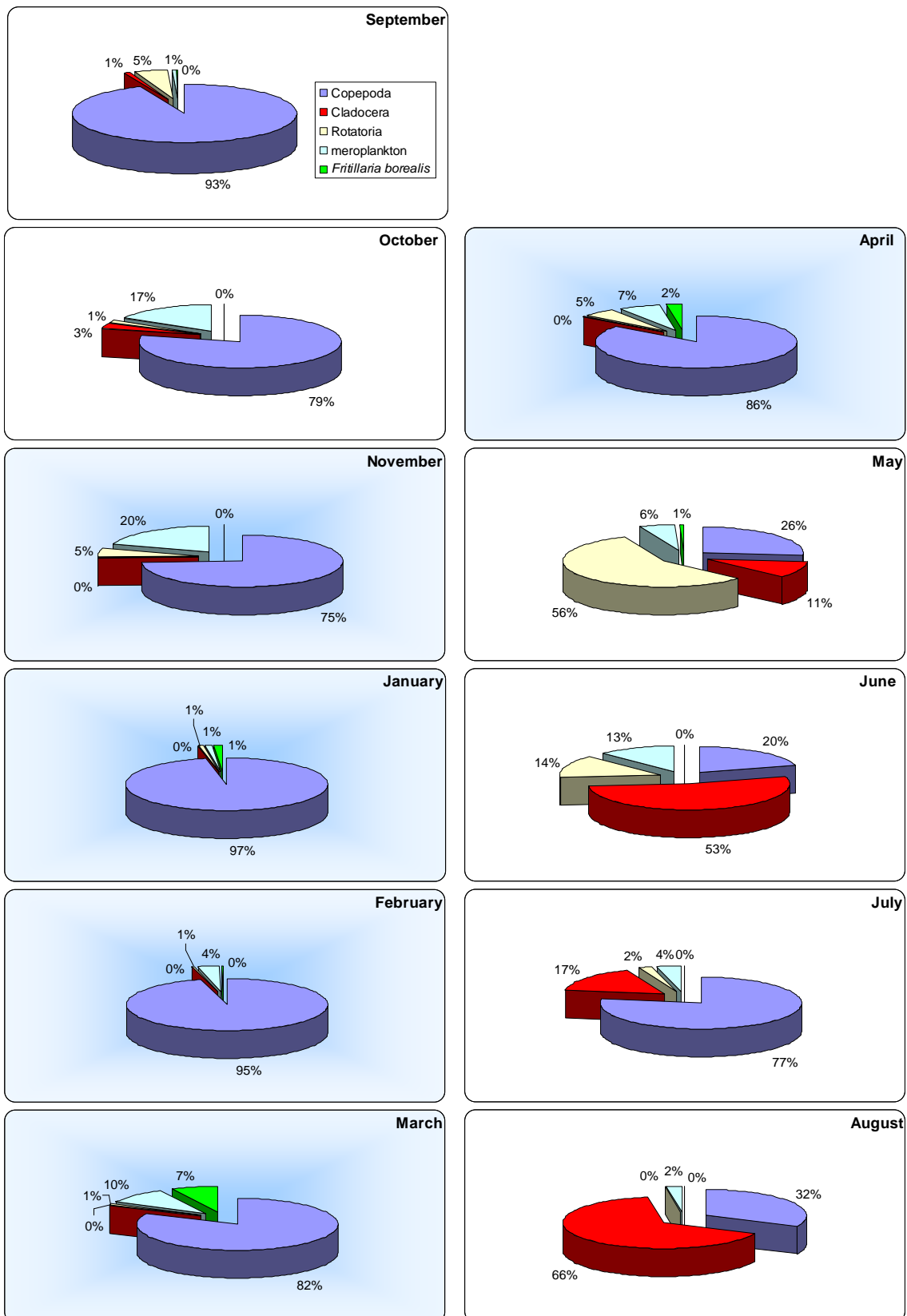
Figure 8. Seasonal variability of biomass structure of zooplankton in the Gulf of Gdańsk from September 1999 to August 2000 [blue – months of stagnancy period] (Mudrak 2004).
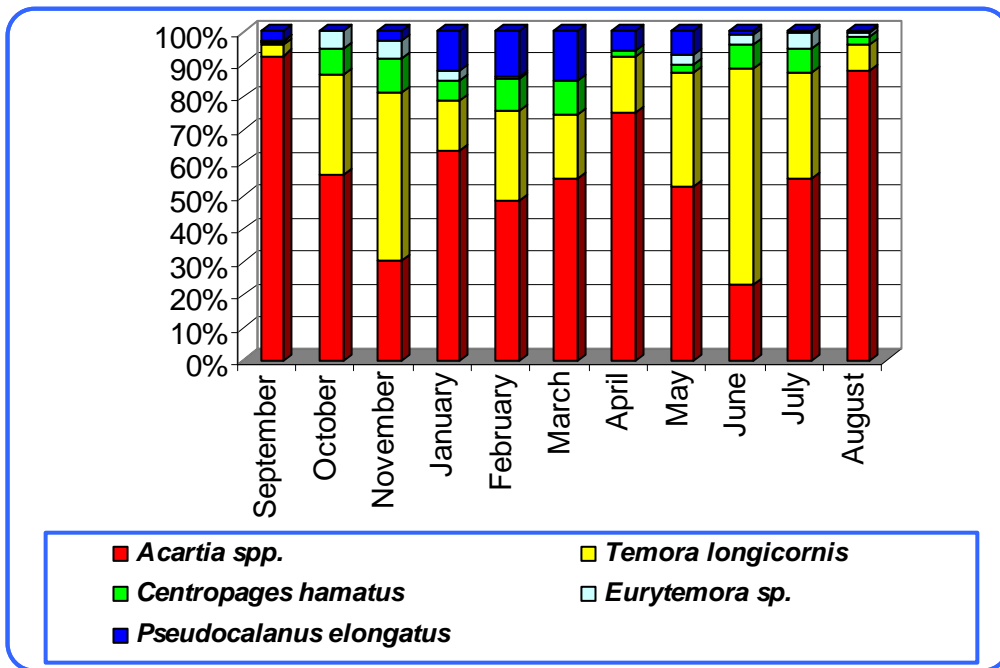
Figure 9. Taxonomical structure of Copepoda in the Gulf of Gdańsk
from September 1999 to August 2000 (biomass) (Mudrak 2004).