TERRESTRIAL BIOSPHERE RESPONSE TO ANTHROPOGENIC CHANGES IN GROWING SEASON IN EUROPEAN MID-LATITUDINAL REGIONS FROM MODEL SIMULATIONS

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Regional droughts and terrestrial biosphere response to anthropogenic changes from simulations of a coupled atmosphere-ocean general circulation model IPSL-CM2 with a carbon cycle (Friedlingstein et al., 2001; Dufresne et al., 2002; Berthelot et al., 2002) for the 1860-2100 period are analyzed (Mokhov et al., 2002; Mokhov et al., 2004). According to (Mokhov et al., 2004) the increase of probability of meteorological droughts (expected in the XXI century) does not necessary lead to the decrease of the terrestrial biospheric productivity.

Model simulations are based on anthropogenic scenarios with the carbon dioxide emissions due to fossil and land use from observations up to 1990 and the IPCC SRES98-A2 emission scenario from 1990 to 2100. Different scenarios have been used, in particular the coupled scenario run (computed CO2 changes with A2-SRES scenario and computed climate), the control run (no CO2 emissions and computed climate) and the fertilization run (computed CO2 changes with A2-SRES scenario and climate changes from control run). In particular, changes of net primary production (NPP) and net ecosystem production (NEP) during growing season are studied. Model results are analyzed for European regions in the middle latitudes, in particular for Eastern European region (EER: 46.1-53.2N, 30.4-50.6E) and Western European region (WER: 46.1-53.2N, 0-11.2E) for growing season (May-July).

Figure 1(a,b) shows interannual changes of NPP (a) and NEP (b) in EER for growing season (May-July). Values of NPP and NEP from coupled (solid grey curves) and fertilization (broken grey curves) runs are normalized by their corresponding mean values in May-July for the 30-years period 1961-1990. Black curves display the 30-years running means for NPP and NEP. There is a general increase of NPP and NEP in the XXI century with the increase of their variability. The general increase of NPP and NEP in the coupled run is less than that in the fertilization run. So, the anthropogenic climate changes in EER lead to the decrease of NPP and NEP. The total rise of these values is due to CO2 increase.

Figure 2(a,b) similar to Fig. 1(a,b) shows corresponding changes of normalized values of NPP (a) and NEP (b) in EER. There is also a general increase of NPP and NEP in the XXI century with the increase of their variability. The variability of the normalized NPP is remarkably larger in EER than that in WER. It should be noted that the mean NPP values are remarkably larger in WER in comparison to EER. The difference of mean values for NEP in WER and EER is not so large as for NPP. The general increase of NEP in the coupled run is generally less than that in the fertilization run. Differences between two runs for NPP in WER are small but for the coupled run the NPP values are slightly larger than that for the fertilization run. The general increase of NPP and NEP in the coupled run is slightly larger than that in the fertilization run. So, the anthropogenic climate changes lead to the decrease of NEP and to the very little increase of NPP in WER.

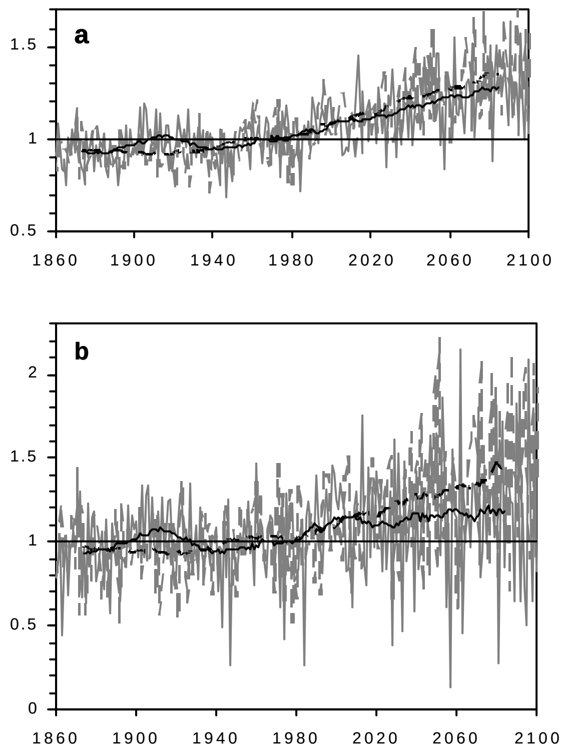

Fig.1. Changes of NPP (a) and NEP (b) in EER.

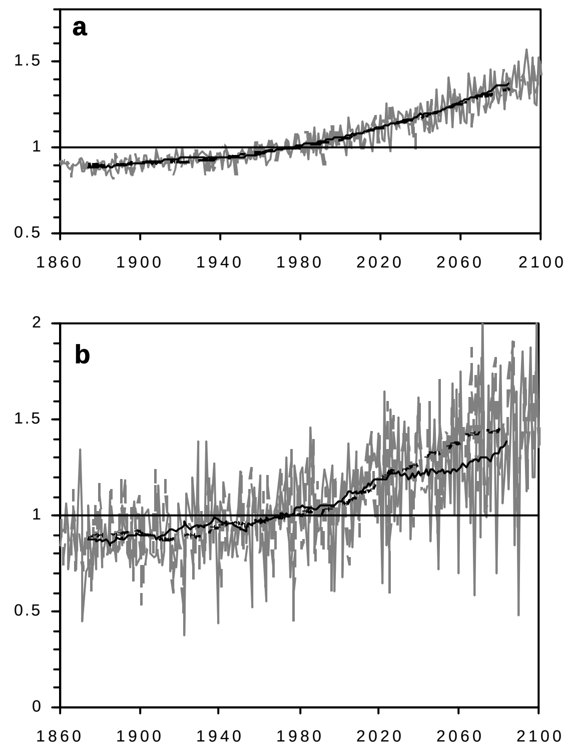

Fig.2. Changes of NPP (a) and NEP (b) in WER.

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References

Berthelot, M., P. Friedlingstein, P. Ciais, P. Monfray, J.-L Dufresne, H. LeTreut , and L. Fairhead,, 2002: Global response of the terrestrial biosphere to CO2 and climate change using a coupled climate-carbon cycle model. *Global. Biogeochem. Cycles*, **16**, 1084, doi:10.1029/.

Dufresne, J.-L., P. Friedlingstein, M. Berthelot, L. Bopp, P. Ciais, L. Fairhead, H. Le Treut, P. Monfray, J. Orr, 2002: Direct and indirect effects of future climate change on land and ocean carbon. *Geophys. Res. Lett.*, **29**, 1405, doi:10.1029/2001GL013777.

Friedlingstein P., L. Bopp, P. Ciais, J.-L Dufresne, L. Fairhead, H. LeTreut, P. Monfray, and J. Orr, 2001: Positive feedback between future climate change and the carbon cycle. *Geophys. Res. Lett.*, **28**, 1543-1546.

Mokhov, I.I., J.-L. Dufresne, V.Ch. Khon, H. Le Treut, and V.A. Tikhonov, 2002: Regional regimes with drought and extreme wet conditions: Possible changes in XXI century from IPSL-CM2 simulations. *Research Activities in Atmospheric and Oceanic Modelling, H. Ritchie (ed.)*, WMO/TD-No.1105, 07.31-07.32.

Mokhov, I.I., J.-L. Dufresne, H. Le Treut, and V.A. Tikhonov, 2004: Climate extremes and net primary production in Eastern Europe: Changes in XIX-XXI centuries from model simulations. *Research Activities in Atmospheric and Oceanic Modelling, J. Cote (ed.)*, WMO/TD-No.1220, 07.33-07.34.