ACCURATE SIMULATION OF LOCAL DAILY CARBON FLUXES USING LARGE SCALE CLIMATE DATA SETS: EXAMPLE OF EUROFLUX SITES

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ABSTRACT
A Dynamic Global Vegetation Model SEVER [*Venevsky, Maksyutov*, 2005] was applied for the fourteen EUROFLUX sites [*Valentini*, 2003] with a large scale daily NCEP climate data as an input (0.5º x 0.5º degree spatial resolution) for years 1997-2000 and net ecosystem exchange (NEE) calculated and observed were compared. Requirements for accurate estimate of local daily NEE flux from a large scale climate data set were found.

INTRODUCTION
An application in contemporary DGVMs of interpolated linearly daily temperature and precipitation from their mid-month values, which are obtained from large scale climate data sets, does not allow reliable estimates of local daily carbon and water fluxes needed for atmospheric chemistry and climatology. We made modifications in the process descriptions of LPJ DGVM [*Sitch et.al*., 2003] to overcome this shortcoming of the vegetation model and checked the new model for 14 EUROFLUX sites.

METHODS
A state-of-the-art model LPJ DGVM was modified from a pseudo-daily time step to a daily time step [*Venevsky, Maksyutov*, 2005]. Potential evapotransporation (PET), fire and soil temperature modules were changed, estimate of daily cloudiness (Cl) was added and other modules were modified to a daily time step. The resulting model SEVER was applied for the fourteen EUROFLUX sites [*Valentini*, 2003] with a large scale daily climate data as an input (0.5º x 0.5º degree spatial resolution) for years 1997-2000 and net ecosystem exchange (NEE) calculated and observed were compared. NCEP global daily climate data (http://www.cpc.ncep.noaa.gov/) for the period 1997-2000 was interpolated to 0.5°x0.5° degree resolution and used for test runs of the SEVER DGVM model for the fourteen sites. The data included daily temperature T, precipitation P and short-wave radiation SW of the nearest to the EUROFLUX sites grid cells. The three sites situated at Southwest -Northeast gradient in Europe, Bordeaux (44° NL), Tharandt (50° NL) and Norunda (60° NL) were studied in depth. Six possible variants with pseudo-daily interpolations obtained from the large-scale NCEP climate data were studied in order to determine a combination of pseudo-daily interpolations providing best accuracy of fit for the three sites. The six variants of interpolations included 1) daily T,P and Cl ; 2) PSD interpolation of three variables T,P and Cl; 3) PSD interpolation of Cl and daily T and P; 4) T and P interpolated and Cl daily; 5) P not interpolated and T and Cl interpolated; 6) temperature daily and precipitation and cloudiness PSD interpolated. The net ecosystem exchange of six input combinations from the large-scale climate data were compared with the NEE simulated by SEVER DGVM driven by actual meteorological data at the three sites and the closest variant was chosen as a basic for further simulation of total carbon flux at another eleven EUROFLUX sites. Correlations of six running means (1 day, 5 days, 10 days, 15 days, 20 days and one month) for observed and calculated NEE were compared to identify an acceptable time step of simulation of local carbon fluxes from the large-scale climate data.

RESULTS
Correlation coefficient between simulated and observed NEE for 13 EUROFLUX sites with NCEP large scale daily climate data (see example at Fig. 1 for Tharandt site in the year 1997) vary between 0.32 and 0.75 with the average 0.53. The simulation failed at one (from four) Mediterranean site (Collelongo) because of absence of description for deep root water uptake in the SEVER DGVM [*Sohnke*, personal communication].

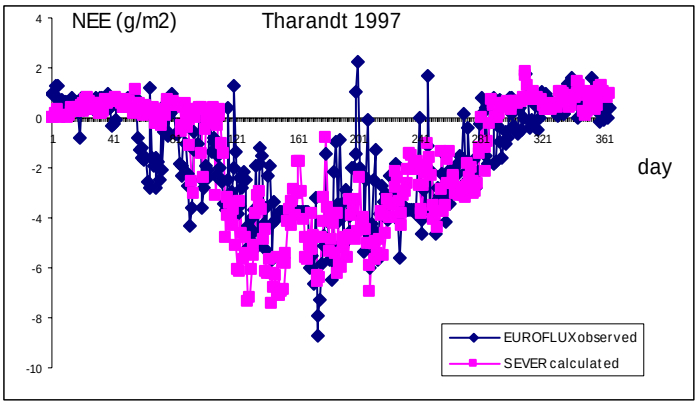

Fig. 1. Calculated and observed net ecosystem exchange in the year 1997 at Tharandt site, Germany

It was shown on the example of the three sites, Bordeaux in Mediterranean zone, Tharandt in the temperate zone and Norunda in the boreal zone, that averaging and further pseudo-daily distribution of cloudiness calculated from the incoming shortwave radiation at the daily step improves performance of the SEVER model. PSD interpolation of the NCEP large scale daily precipitation only does not significantly affect accuracy of the calculated NEE in comparison with the PSD interpolation of temperature (see Fig.2 example for Tharnadt site).Thus a combination of daily T and SW from large scale climate data sets and PSD interpolation of daily precipitation and cloudiness obtained from large scale climate data sets may provide most feasible fit for local NEE flux. However, validity of this conclusion should be confirmed for arid environments by comparison of observed and calculated NEE, when new carbon flux data will arrive.

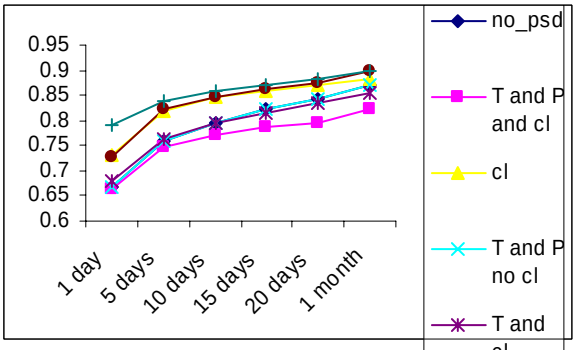

Fig. 2. Correlation coefficients (NEE observed/NEE calculated running means) for the six variants of PSD interpolation of NCEP daily climate data for Tharandt site in 1997-2000. The closet fit to NEE simulated from the actual data (the most upper line) is provided by the combination daily T and SW from the NCEP large scale data and PSD interpolated P and Cl. The similar results were obtained for Bordeaux and Norunda sites.

When the combination of daily T and SW and PSD interpolation of daily precipitation and cloudiness from the NCEP climate data set was applied to the 13 EUROFLUX sites the averaged by all sites correlation coefficient between daily NEE observed and calculated indeed increased to 0.6. Comparison of correlation coefficients for six running means (1 day, 5 days, 10 days, 15 days, 20 days and one month) reveals that for 5 days averaged observed and calculated NEE performance of the SEVER improves visibly (with increase of averaged correlation coefficient for all sites to 0.67), while for further averaging step an improvement of performance is moderate (e.g. 0.7 for 10 days, 0.71 for 15 days)

REFERENCES

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