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Quantifying the carbon uptake by vegetation for Europe on a 1 km^2 resolution using a remote sensing driven vegetation model

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Abstract. In this study we compare monthly gross primary productivity (GPP) time series (2000–2007), computed for Europe with the Biosphere Energy Transfer Hydrology (BETHY/DLR) model with monthly data from the eddy covariance measurements network FLUXNET. BETHY/DLR with a spatial resolution of 1 km^2 is designed for regional and continental applications (here Europe) and operated at the German Aerospace Center (DLR). It was adapted from the BETHY scheme to be driven by remote sensing data (leaf area index (LAI) and land cover information) and meteorology. Time series of LAI obtained from the CYCLOPES database are used to control the phenology of vegetation. Meteorological time series from the European Centre for Medium-Range Weather Forecasts (ECMWF) are used as driver. These comprise daily information on temperature, precipitation, wind speed and radiation. Additionally, static maps such as land cover, elevation, and soil type are used. To validate our model results we used eddy covariance measurements from the FLUXNET network of 74 towers across Europe. For forest sites we found that our model predicts between 20 and 40% higher annual GPP sums. In contrast, for cropland sites BETHY/DLR results show about 18% less GPP than eddy covariance measurements. For grassland sites, between 10% more and 16% less GPP was calculated with BETHY/DLR. A mean total carbon uptake of 2.5 PgC a^{-1} (±0.17 PgC a^{-1}) was found for Europe. In addition, this study reports on risks that arise from the comparison of modelled data to FLUXNET measurements and their interpretation width. Furthermore we investigate reasons for uncertainties in model results and focus here on V_{max} values, and finally embed our results into a broader context of model validation studies published during the last years in order to evaluate differences or similarities in analysed error sources.

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