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Recalibration of a modified version of the BIOME-BGC model with multitemporal MODIS imagery for the estimation of Net Ecosystem Exchange in a poplar plantation

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Objective of the research is to model the carbon exchange in poplar plantations. An experimental site located in the alluvial area of the Ticino river is used for calibration and validation activities. The site belongs to the CARBOEUROFLUX network and is equipped for the measurement of gases exchange by means of the eddy covariance technique.

The net ecosystem exchange (NEE) was simulated with a modified version of the process based model BIOME-BGC recalibrated against LAI temporal series derived from remote observations (MODIS 250m daily surface reflectance data).

The BIOME-BGC model was modified in order to improve its simplified description of canopy radiation regime (e.g. the model assumes a constant shortwave surface albedo during the growing season). Therefore, the model has been coupled with the PROSAIL radiative transfer model. The daily LAI values simulated by BGC were used as input for the PROSAIL model in order to compute daily surface shortwave and PAR albedo. Finally, the modelled albedo values were forced into the BGC model in order to achieve a more realistic description of the fraction of PAR absorbed by the deciduous plantation.

MODIS 250m daily surface reflectance images were used to estimate the temporal

trend of LAI at the poplar plantation. The original MODIS time series were initially processed with a procedure based on the iterative application of a Savitzky and Golay filter, in order to reconstruct an high-quality NDVI time-series data set. This data set was finally used to derive LAI temporal trends by using a semi-empirical regression between NDVI values and LAI ground measurements collected through the 2003 growing season. The LAI trajectories retrieved from MODIS data were then used for the recalibration of the modified version of the BIOME-BGC.

The optimization technique was based on the minimization of the differences between MODIS LAI and BGC LAI values in order to re-parameterize some input parameters (i.e. ecophysiological and site). In particular, the C:N ratio, the percent of leaf nitrogen in RUBISCO, the allometric relationships between fine root and leaf and the soil depth were selected for optimization because, as shown by a simplified sensitivity analysis, they significantly affect the model output.

The comparison of carbon and water budget estimated by the model with the values measured with the eddy covariance technique show an improvement of the accuracy with respect to the traditional use of the Biome BGC.