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Evaluation of the DayCent model to predict carbon fluxes in French crop sites

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Croplands in temperate regions are an important component of the carbon balance and can act as a sink or a source of carbon, depending on pedoclimatic conditions and management practices. Therefore the evaluation of carbon fluxes in croplands by modelling approach is relevant in the context of global change.
This study was part of the Comete-Global project funded by the multi-Partner call FACCE JPI. Carbon fluxes, net ecosystem exchange (NEE), leaf area index (LAI), biomass, and grain production were simulated at the site level in three French crop experiments from the CarboEurope project. Several crops were studied, like winter wheat, rapeseed, barley, maize, and sunflower. Daily NEE was measured with eddy covariance and could be partitioned between gross primary production (GPP) and total ecosystem respiration (TER). Measurements were compared to DayCent simulations, a process-based model predicting plant production and soil organic matter turnover at daily time step. We compared two versions of the model: the original one with a simplified plant module and a newer version that simulates LAI. Input data for modelling were soil properties, climate, and management practices.
Simulations of grain yields and biomass production were acceptable when using optimized crop parameters. Simulation of NEE was also acceptable. GPP predictions were improved with the newer version of the model, eliminating temporal shifts that could be observed with the original model. TER was underestimated by the model. Predicted NEE was more sensitive to soil tillage and nitrogen applications than measured NEE.
DayCent was therefore a relevant tool to predict carbon fluxes in French crops at the site level. The introduction of LAI in the model improved its performance.