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Annual-scale adaptation of a soil heterotrophic respiration model to three agricultural sites in Belgium and South-Western France.

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This study aims at modelling soil heterotrophic respiration fluxes at an annual timescale over three agricultural sites situated in Belgium (Lonzée) and in France (Auradé and Lamasquère). These sites present many climatic, edaphic and crop management differences. This will allow investigating the impacts of temperature, soil moisture content, soil texture and cultural practices.

To reach these objectives, a daily-time step model derived from CENTURY was parameterized, initialized and calibrated for each of the three sites. Biochemical features were taken from the literature while the soil characteristics and the crop residue quantities were based on field estimations at the three sites.

In a first step, the model was used to study annual to inter-annual soil heterotrophic respiration variations. The initialization phase was necessary to distribute the total soil carbon content into the model pools. The model was seen to be very sensitive to this carbon repartition between pools. First comparisons between the model outputs and field soil chamber measurements (either automatic in Lonzée or manual in Lamasquère and Auradé) performed on bare soil in 2007 were carried out at each site. At the Lonzée site, the model showed a fairly good agreement with field data. Soil temperature was found to be the most important driver.

In order to study long term soil carbon dynamics, the model will also be calibrated using soil respiration and soil carbon content measurements performed at the Liroux experimental site situated near Lonzée in Belgium. At this site, a long term comparison of crop management techniques has been developed since 1959, different plots being submitted to different residue restitutions. Manual soil chamber measurements will be carried out on these plots, which will allow assessing the influence of crop residue management techniques on soil carbon dynamics and on the associated fluxes.

To go further with the soil heterotrophic respiration model development, its validation with flux data will be continued and the potential model-data discrepancies will be analyzed. This sub model is intended to be part of a more complete soil respiration model focused on agricultural ecosystems and developed at the annual and ecosystem scales. Later, autotrophic respiration will also be included.

Keywords: Soil heterotrophic respiration, Agricultural soils, Semi-mechanistic model, Calibrations.