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The estimation of soil parameters using observations on crop biophysical variables and the crop model STICS improve the predictions of agro environmental variables.

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Dynamic crop models are very useful to predict the behavior of crops in their environment and are widely used in a lot of agro-environmental work. These models have many parameters and their spatial application require a good knowledge of these parameters, especially of the soil parameters. These parameters can be estimated from soil analysis at different points but this is very costly and requires a lot of experimental work. Nevertheless, observations on crops provided by new techniques like remote sensing or yield monitoring, is a possibility for estimating soil parameters through the inversion of crop models.

In this work, the STICS crop model is studied for the wheat and the sugar beet and it includes more than 200 parameters. After a previous work based on a large experimental database for calibrate parameters related to the characteristics of the crop, a global sensitivity analysis of the observed variables (leaf area index LAI and absorbed nitrogen QN provided by remote sensing data, and yield at harvest provided by yield monitoring) to the soil parameters is made, in order to determine which of them have to be estimated. This study was made in different climatic and agronomic conditions and it reveals that 7 soil parameters (4 related to the water and 3 related to the nitrogen) have a clearly influence on the variance of the observed variables and have to be therefore estimated.

For estimating these 7 soil parameters, a Bayesian data assimilation method is chosen (because of available prior information on these parameters) named Importance Sampling by using observations, on wheat and sugar beet crop, of LAI and QN at various dates and yield at harvest acquired on different climatic and agronomic conditions. The quality of parameter estimation is then determined by comparing the result of parameter estimation with only prior information and the result with the posterior information provided by the Bayesian data assimilation method. The result of the parameter estimation shows that the whole set of parameter is better estimated when data assimilation is made, and the quality of estimation is better when the data assimilation is performed with observations on sugar beet than on wheat crop.

The prediction of the crop behavior when estimating the soil parameters is then studied. Indeed, the quality of prediction of agro environmental variables of the STICS crop model (yield, protein of the grain and nitrogen balance at harvest) is determined by comparing the result of the prediction using the prior information on the parameters and the result using the posterior information. As for the estimation of soil parameters, the prediction of the variable is made on different climatic and agronomic conditions. According to the result of parameter estimation, the quality of prediction is better when using parameter values estimated with data assimilation than using the prior information. Moreover the results show that the quality of prediction is better when the data assimilation is performed with observations on sugar beet than on wheat crop.