

The effect of soil parameter upscaling on the predictive accuracy of DSSAT crop simulation modeling of soybean yields

J. Fry, Guber A.K., M. Ladoni, J.-D. Munoz-Robayo, A.N. Kravchenko
 Department of Plant, Soil, and Microbial Sciences, Michigan State University

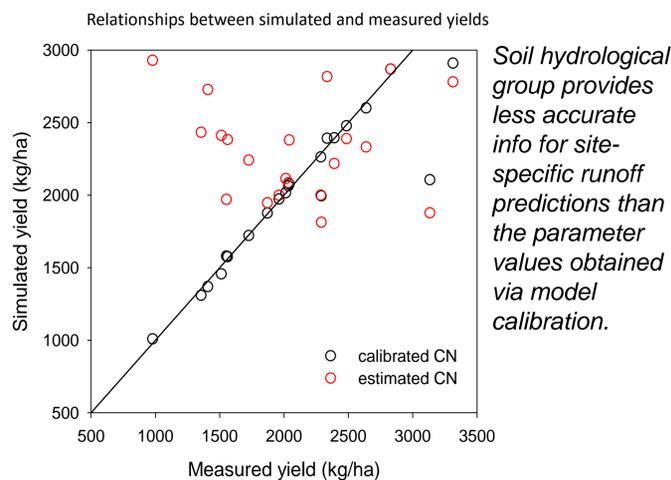
Introduction

The Decision Support System for Agrotechnology Transfer (DSSAT) consists of crop simulation models for over 28 crops and has been in use by researchers, policymakers, growers, and extension agents for over 20 years. A common practice is to estimate model parameters from publicly available soil maps (such as SSURGO) or other coarse-scale field information. This may limit the suitability of the model for use in precision agriculture. This study was performed at the KBS-LTER in southwest Michigan and examines the effects of using up-scaled parameters on model performance. We offer recommendations when the use of up-scaled parameters is unavoidable, as well as caveats when interpreting studies performed using up-scaled parameters.

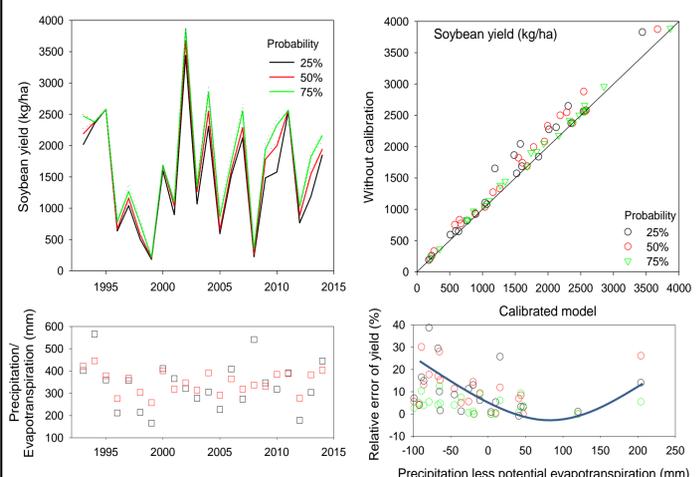
Results and Discussion

2010 soybean plot scale yield predictions at field sampling sites using measured soil properties and the runoff CN values:

- 1) Obtained in DSSAT calibration to actual yield,
- 2) Estimated from the soil hydrological group

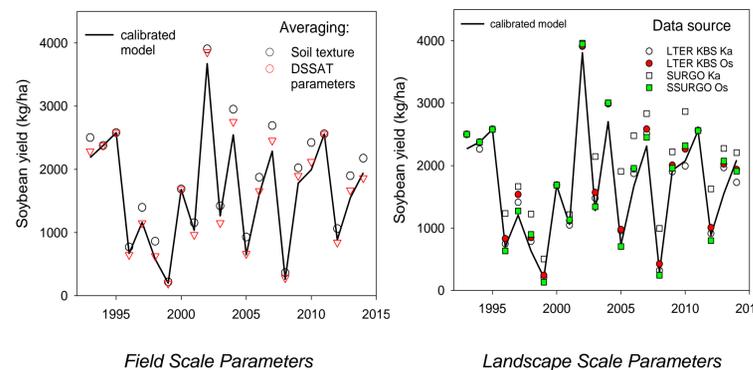


Predicted soybean yields in 1993-2014 growing seasons using field measured soil properties with calibrated (solid lines) and estimated (dash lines) CN values

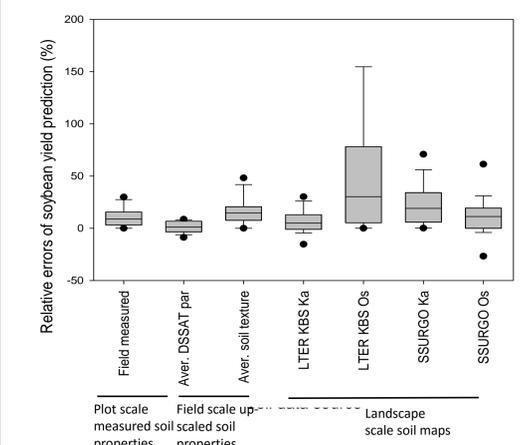


Soybean yields predicted for 1993-2014 growing seasons using two different scales and associated soil parameters:

- 1) Field scale
- 2) Landscape scale



The effect of the spatial scale of soil data on relative errors of soybean yield predictions for 1993-2014 growing seasons

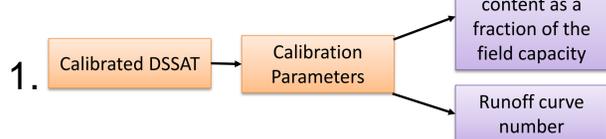


Experimental Procedure

What to use for performance comparisons

Field Measurements

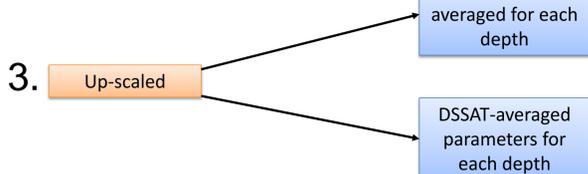
Plot Scale:



Individual

Individual DSSAT runs with soil properties measured in all locations

Field Scale:



Soil Maps

Landscape Scale:



Conclusions and Recommendations

- Up-scaling is not a suitable approach for precision agriculture and should be avoided. It leads to averaging crop yield across an entire field and to losses of spatial variability of yield. A higher spatial resolution than up-scaling can achieve is necessary for accurate yield predictions in this context.
- If up-scaling cannot be avoided, averaging the model parameters is preferable to averaging soil properties at the field scale. A soil map provides too coarse of a resolution for field scale purposes and causes the largest yield prediction errors. Therefore, this type of up-scaling cannot be recommended for field scale modeling.
- There is a marked decrease in model performance in yield prediction when using up-scaled parameters for unusually wet and dry years. Special caution should be taken when interpreting model results for these types of years.