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Analyzing the impact of changing size and composition of a crop model ensemble

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The use of an ensemble of crop growth simulation models is a practice recently adopted in order to quantify aspects of uncertainties in model simulations. Yet, while the climate modelling community has extensively investigated the properties of model ensembles and their implications, this has hardly been investigated for crop model ensembles (Wallach et al., 2016). In their ensemble of 27 wheat models, Martre et al. (2015) found that the accuracy of the multi-model ensemble-average only increases up to an ensemble size of ca. 10, but does not improve when including more models in the analysis. However, even when this number of members is reached, questions about the impact of the addition or removal of a member to/from the ensemble arise. When selecting ensemble members, identifying members with poor performance or giving implausible results can make a large difference on the outcome. The objective of this study is to set up a methodology that defines indicators to show the effects of changing the ensemble composition and size on simulation results, when a selection procedure of ensemble members is applied.

Ensemble mean or median, and variance are measures used to depict ensemble results among other indicators. We are utilizing simulations from an ensemble of wheat models that have been used to construct impact response surfaces (Pirttioja et al., 2015) (IRSs). These show the response of an impact variable (e.g., crop yield) to systematic changes in two explanatory variables (e.g., precipitation and temperature). Using these, we compare different sub-ensembles in terms of the mean, median and spread, and also by comparing IRSs. The methodology developed here allows comparing an ensemble before and after applying any procedure that changes the ensemble composition and size by measuring the impact of this decision on the ensemble central tendency measures. The methodology could also be further developed to compare the effect of changing ensemble composition and size on IRS features.

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