FACCE-MACSUR

DC-3.3 Report on results of scaling exercise

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Abstract/Executive summary

The MACSUR scaling exercise investigates the effects of scaling crop model data in combination with different data types (climate, soil and management). For this purpose the effect of aggregating model input as well as spatial sampling schemes were tested with a range of crop models under varying conditions. From findings for winter wheat yield of the region of North Rhine-Westphalia (Germany) it can be concluded for most models, that regional water-limited yield simulations in a temperate humid region are on average little affected by aggregating soil or climate data up to 100 km resolution. However, some models showed considerably larger biases. Consequently, models need to be assessed individually for their robustness to input data aggregation when simulating regional yields. Aggregating soils partially led to aggregation effects larger than from averaged climate data, in the range or larger than the inter-annual yield variability or differences between models. This can thus be a dominant source of uncertainty when assessing spatial yield patterns of heterogeneous regions. Simultaneous use of aggregated climate and soil data is likely to increase these aggregation effects further. However, large negative aggregation effects were found in areas with soils characterized by high available water holding capacity and large positive aggregation effects in areas with soils of predominantly low available water holding capacity. This indicates that the direction and magnitude of aggregation effects may be estimated from a limited number of soil variables.

Similarly, the precision of simple random sampling (SimRS) and variations of stratified random sampling (StrRS) schemes in estimating regional mean water-limited yields were evaluated. We found that the precision gains of StrRS varied considerably across stratification methods and crop models. Precision gains for compact geographical stratification were positive, stable and consistent across crop models. Stratification with soil water holding capacity had very high precision gains for twelve models, but resulted in negative gains for two models. Increasing the sample size monotonously decreased the sampling errors for all the sampling schemes. We conclude that compact geographical stratification can modestly but consistently improve the precision in estimating regional mean yields. Using the most influential environmental variable for stratification can notably improve the sampling precision, when the sensitivity behaviour of a crop model is known.

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