Performance of an integrated modeling framework for spring wheat yield simulation in Western Canada

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The crop model is an efficient tool to simulate the growth of crops and the interaction processes between crops, soil, and air. However, crop models are developed based on experiments at the field scale, which limits their application at the regional scale. In this paper, we comprehensively evaluate the performance of a crop model, AquaCrop, at the regional scale in western Canada by integrating the soil, and daily meteorological grid data. The study area is located in the agricultural area of Saskatchewan, which is divided into 167 0.5OX0.5O grids. To overcome the drawback of soil moisture simulation of AquaCrop in winter, we couple a soil moisture simulation model, SHAW, with AquaCrop. Results show that the performance of AquaCrop can be improved significantly by coupled SHAW. In the extreme drought years (SPEI<-2), the relative error can be improved 60%. In moderate drought (-2<SPEI<-1), normal (-1<SPEI<1), and moderate wet (1<SPEI<2) years, the NRMSE (normalized root-mean-square error) can be improved average 11.2%. AquaCrop performs reasonably in the simulation of spring wheat yield with the long-term average regional yield simulation: the linear regression R2 is 0.729 and the NRMSE is 1.29%. The performance of AquaCrop varies in different grids: the r (Pearson correlation coefficient) ranges from 0.1 to 0.95 and the NRMSE range from 9% to 29%. An underestimation simulation happens in the northern area of the study area. This assessment should contribute to studies of the effects of climate change on crop yield and the seasonal crop yield projection in western Canada.