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Effect of uncertainty in temperature and precipitation inputs and spatial resolution on the crop model

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This study addresses the effect of uncertainty in temperature and precipitation on crop yield and harvested area simulation results at the national level for Hungary and Romania. At first, crop yield and harvested area for maize and winter-wheat were simulated using the improved crop yield model based on the Global-Agro-Ecological Zones model (iGAEZ) for the years 1990-1999 with different climate inputs. The first experiment used the Climate Research Unit high resolution climate data, version 2.1. (CRU TS 2.1) while the second experiment used climate data interpolated from the projections by a 0.1875 degree grid global climate model (MRI-GCM20). Calculation was performed in the same resolution (0.5 degree grid). As the result, it found that the differences between crop yield and harvested area obtained from the constraint-free and moisture limited crop yield of two experiments demonstrate that uncertainty in temperature and precipitation has large influence into a considerable uncertainty in crop yield and harvested area at 0.5 degree grid. Next, we simulated at 0.5 and 0.25 degree grid using MRI-GCM20, and the effect of averaging of climate data was evaluated by comparing crop simulation results at 0.25 degree grid with results at 0.5 degree grid. As the result, the comparison of the FAO yield statistics with crop yield and harvested area that simulation results at 0.25 degree grid is much better than that at 0.5 degree grid. We concluded that the grid size of 0.25 degree is an appropriate resolution in this case. There is clear advantage in simulating crop yields at 0.25 degree grid, but we found that harvested area have large error for the level of agreement between simulated and statistical values. We will have to investigate as follows: (1) the feature of the high-resolution simulation for a lot of countries which have the large and small area, (2) the relation between uncertainty in model inputs with crop yield and harvested area on high-resolution system. Furthermore, improvements of the crop simulation model should focus on harvested area fraction which indicates the fraction of each grid cell in which crop is grown.

Keywords: crop yield, climate conditions, spatial resolution, MRI-GCM20, uncertainty, small countries