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Impacts of bias correction over climate change projections applied to crop yield simulations

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ABSTRACT (< 600 WORDS)

A major issue in impact assessment from climate models, such as the effects of climate change on crop yield, is the influences of the climate model systematic errors. The present work evaluated the systematic errors of climate simulations and their impact over soybean yield in southern Brazil under current and future climate scenarios.

The climate simulations were performed with RegCM4 (Regional Climate Model version 4), nested in the HadGEM2-ES global climate model for the RCP8.5 scenario. Soybean yield simulations were performed with the CROPGRO-Soybean model, through DSSAT (Decision Support System for Agrotechnology Transfer).

In several regions the maximum temperatures simulated by RegCM4 are up to 3 ^{o}C below the current observed values. Considering a projection increase of 4 ^{o}C in relation to the current climate, the maximum temperatures projected by RegCM4 for future scenario would be about 1 ^{o}C above those currently observed. Crop yield simulated using climate projections without bias correction would probably result in

similar yield levels as those observed for the current climate, taking as an example of the impacts of maximum temperatures on crop development and yield.

To overcome this limitation, three bias correction methods were implemented and applied over the RegCM4 simulations. In the first method the average monthly bias were removed from the climatic simulations. The second method consists in the application of a quantil-quantil correction, considering the annual frequency distributions. Finally, the quantile-quantile correction was applied for each month frequency distributions. Five sets of soybean yield simulations were then processed, differing according to the climatic data set: (i) observed climatic data; (ii) original simulations of the RegCM4 model – without bias correction; (iii) RegCM4 simulations with the mean bias correction; (iv) RegCM4 simulations with quantil-quantil correction method; (v) RegCM4 simulations with monthly quantil-quantil corrections.

CROPGRO-Soybean simulations with RegCM4 data without bias correction present deviations up to 50% when compared with simulations using bias corrected datasets. The simulations with the corrected climate model data for present weather conditions, with all bias correction methods, presented values similar to those obtained with the observed climatic data.

Climate change impacts on soybean yield (mean and standard deviation) were compared for the different bias corrections methods. Yield anomalies with the original RegCM4 data presented differences in relation to the simulations with bias correction, reaching up to 40% differences. Simulations with all bias correction methods presented similar results for average yield anomalies. Results obtained using the Delta method for bias correction, one of the most commonly used, underestimated the climate change impacts on the average soybean yield and its interannual variability, related to the bias correction simulations. The results shows the need to correct the systematic errors of the climate models for impacts assessments applications.