

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

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Introduction

▪ 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.

Methodology

▪ 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.

▪ Different bias corrections were applied over the RegCM4 simulations.

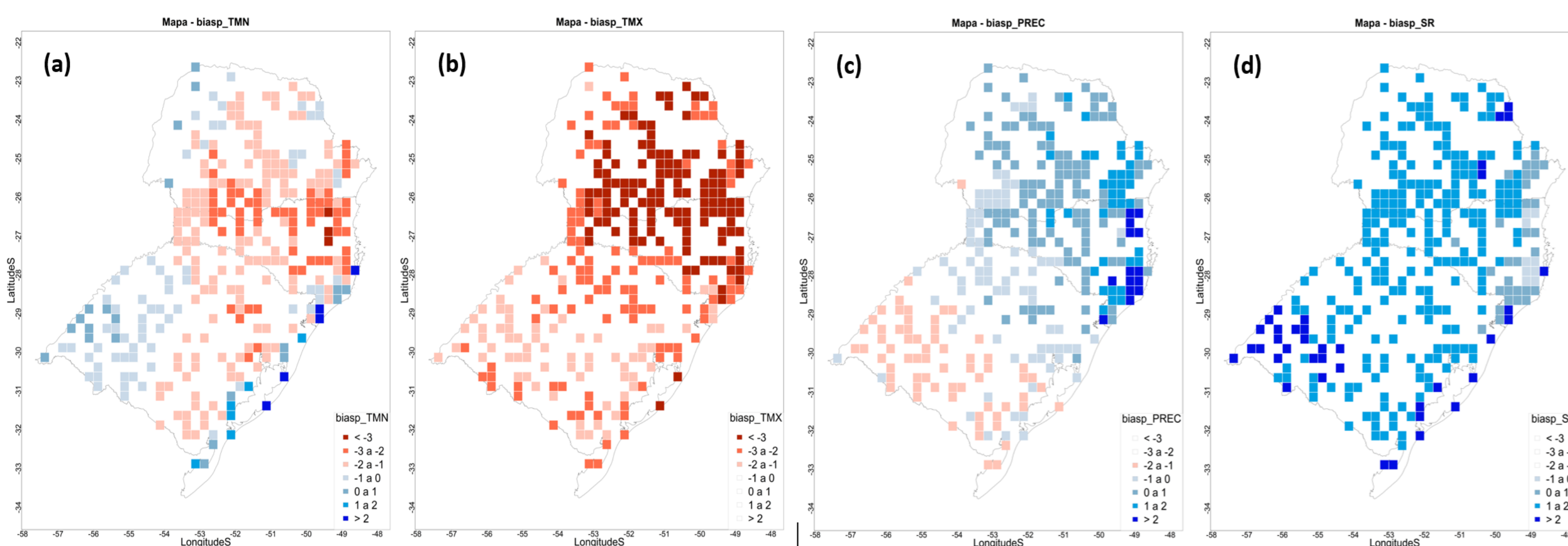


Figure 1. RegCM4 bias for (a) minimum air temperature (°C), (b) maximum air temperature (°C), precipitation (mm day⁻¹), and solar radiation (MJ day⁻¹).

▪ Five sets of soybean yield simulations were then processed with the CROPGRO-Soybean model, through DSSAT (Decision Support System for Agrotechnology Transfer), 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.

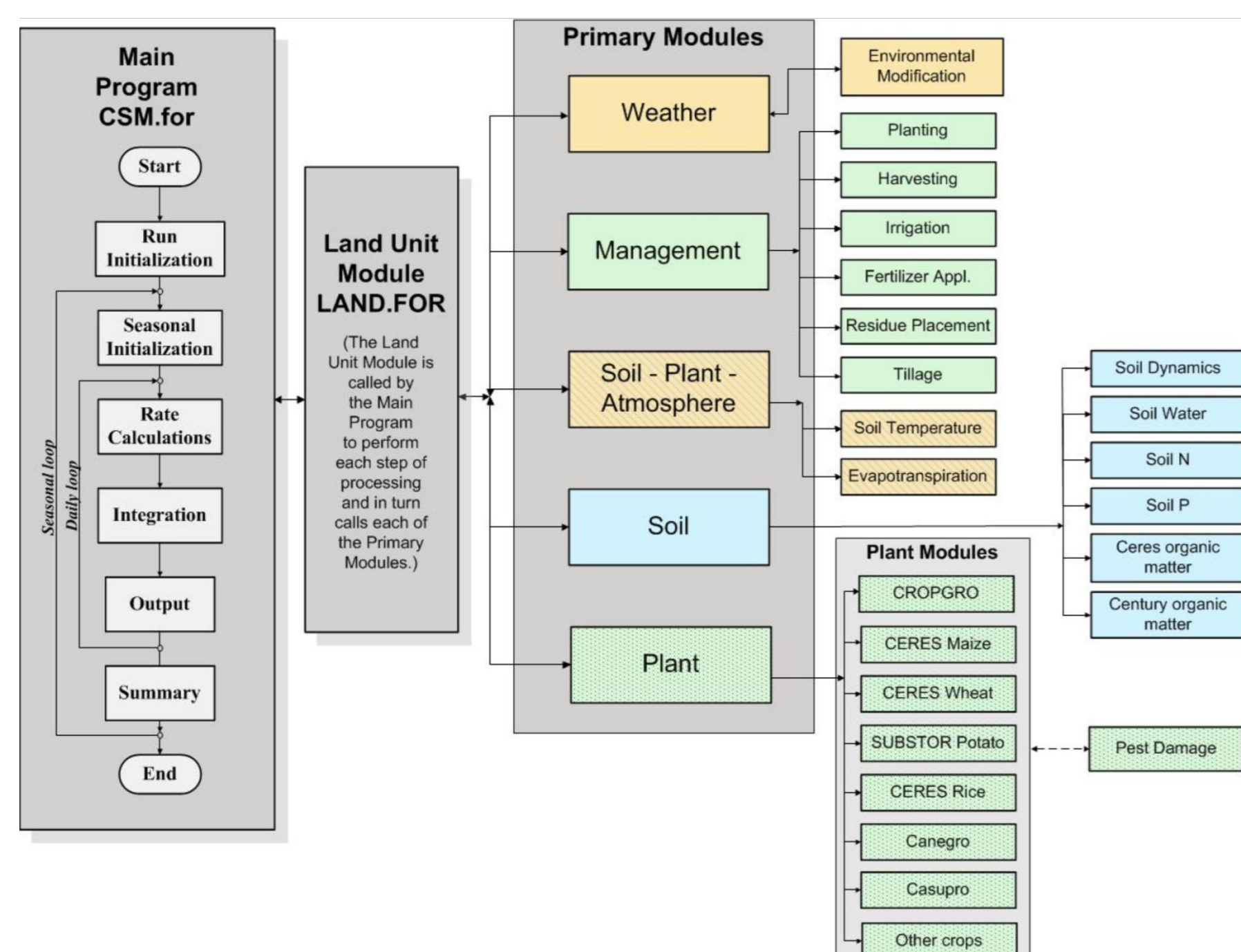


Figure 2. DSSAT Cropping System Model schematic .

Results

▪ CROPGRO-Soybean simulations with RegCM4 data without bias correction present deviations up to 50% when compared with simulations using bias corrected datasets.

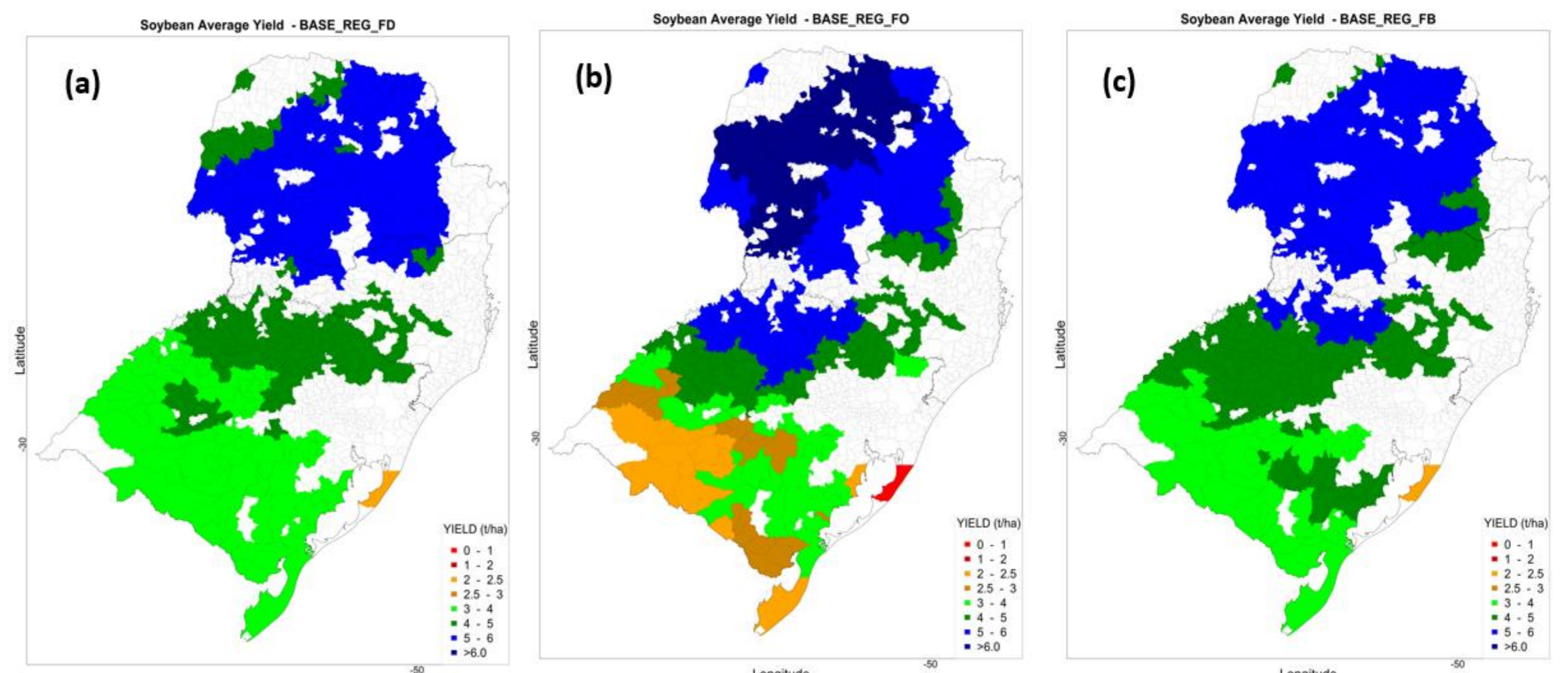


Figure 3. Attainable soybean yield (potential limited by water deficiency) simulated by the CROPGRO-Soybean model with: (a) observed climate data, (b) RegCM4 without original, and (c) RegCM4 with bias correction.

▪ 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.

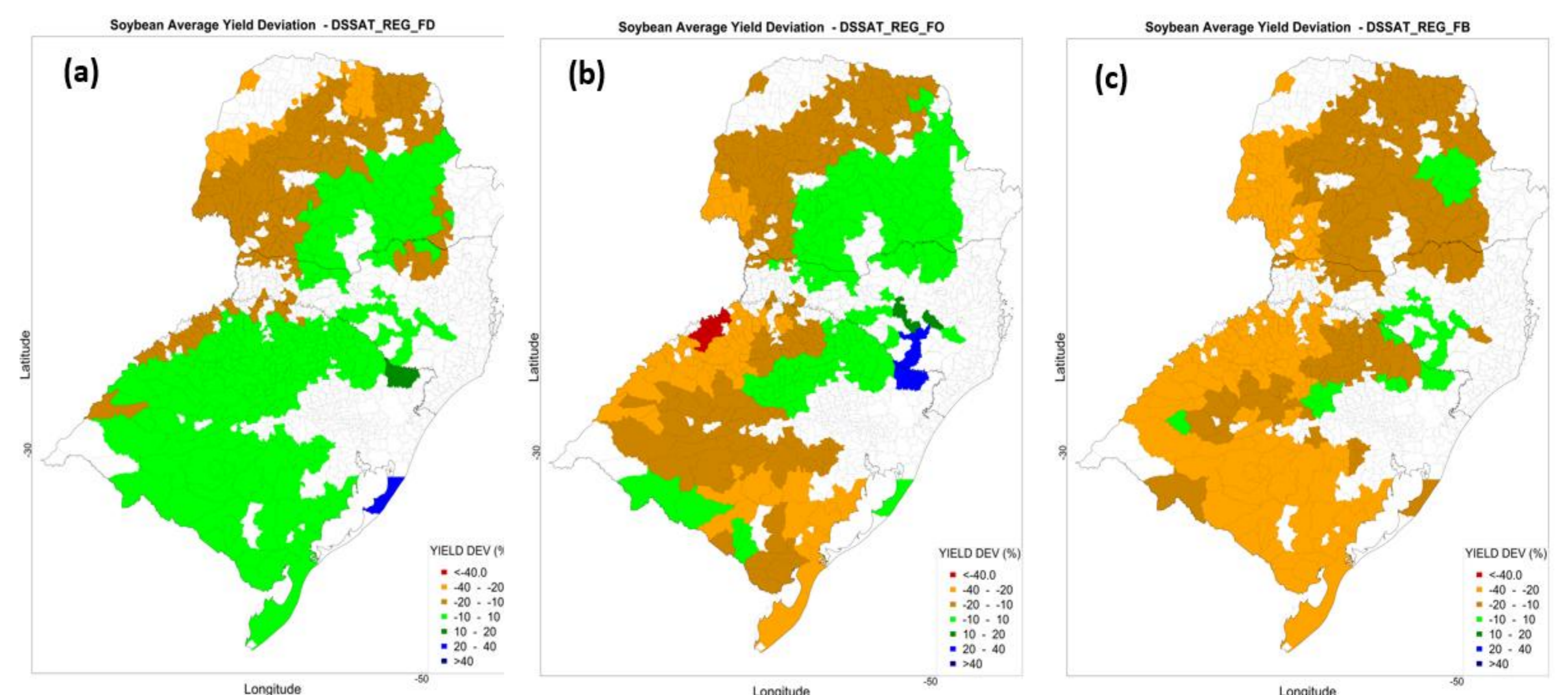


Figure 3. Average yield change projected for the RCP 8.5 scenarios with the climatic scenarios generated through: (a) "Delta Method" (climatic anomaly superimposed on historical data), (b) RegCM4 without bias correction, and (c) RegCM4 with bias correction.

Main Point

▪ The results shows the need to correct the systematic errors of the climate models for impacts assessments applications.