Modeling U.S. Cotton Yields and Climate Stresses during 1979-2005: Preliminary Result

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The cotton growth model GOSSYM is coupled with the regional climate model CWRF to simulate historical U.S. cotton yields and climate stresses. This study presents the physics improvement, interface development and numerical implementation for consistent coupling, and validates the new GOSSYM as driven by climate variations observed during 1979-2005. By adjusting the geographic distribution of initial soil fertility and the statewide specification of irrigation practice, the model realistically reproduces the mean cotton yields, within +/- 10% of observations over almost the entire Cotton Belt. This is a remarkable advance over the original GOSSYM, which produces substantial yield overestimation by 14-162% statewide and 102% overall. While still underestimating the interannual variability, the new model captures certain key signals of climatic stresses on cotton yields, having significant correlations with observations over 45% of the harvest areas. The model also faithfully depicts the predictive role of July-August air (August-September soil) temperature anomalies on annual cotton yield changes over non-irrigated lands. The modeled cotton yields exhibit high, positive correlations with June-August leaf nitrogen weight and July-September leaf area index, suggesting the potential predictive value of satellite retrievals. These results provide a baseline reference for further model improvements and applications of the coupled CWRF-GOSSYM system to study climate-cotton interactions.

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