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Potential benefits of changing the planting date to account for seasonal climate forecasts

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The stabilization of crop yields is a crucial task to enhance food security. Crop development is affected by climate conditions, so recent development of improved climate forecasting technologies has made it increasingly possible to predict future crop yields. However, effective use of these technologies to improve food security remains limited. If before planting, we can predict climatic conditions during the growing season, and if we can choose optimal planting dates based on that knowledge, will it be possible to increase crop yields? Here, we present the potential benefits of seasonal crop-yield forecasts for improving the choice of planting date. For this purpose, we used a model system (PRYSBI-2) that has successfully predicted crop yields for both maize and soybean. This system uses a Bayesian statistical approach to estimate the parameters of a process-based crop growth model. We found that the global average crop yield could potentially be increased by about 30% through optimal selection of planting date and that seasonal forecasting of crop yield offered large benefits in and near eastern Brazil and India for maize and in northern China for soybean. Analysis based on the highly accurate output of the SINTEX-F2 coupled global circulation model (GCM) for seasonal forecasting also increased yield by changing the planting date each year. The results were particularly notable for areas of China, India, and northern Brazil. The benefits were retained even when we used crop model with yield estimation errors as high as 10 to 30%. Our results highlight the importance of developing a system to forecast seasonal climate to improve global crop yields.