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Adaptation to Interannual and Interdecadal Climate Variability in Agricultural Production Systems of the Argentine Pampas

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Agricultural ecosystems play a central role in world food production and food security, and involve one of the most climate-sensitive sectors of society—agriculture. We focus on crop production in the Argentine Pampas, one of the world's major agricultural regions. Climate of the Pampas shows marked variability at both interannual and decadal time scales. We explored the scope for adaptive management in response to climate information on interannual scales. We show that different assumptions about what decision makers are trying to achieve (i.e., their objective functions) may change what actions are considered as "optimal" for a given climate context. Optimal actions also were used to estimate the economic value of forecasts of an ENSO phase. Decision constraints (e.g., crop rotations) have critical influence on value of the forecasting system. Gaps in knowledge or misconceptions about climate variability were identified in open-ended "mental model" interviews. Results were used to design educational interventions.

A marked increase in precipitation since the 1970s, together with new production technologies, led to major changes in land use patterns in the Pampas. Continuous cropping has widely replaced agriculture-pasture rotations. Nevertheless, production systems that evolved partly in response to increased rainfall may not be viable if climate reverts to a drier epoch. We use historical data to define a range of plausible climate trajectories 20-30 years hence. Regional scenarios are downscaled using semi-parametric weather generators to produce multiple realizations of daily weather consistent with decadal scenarios. Finally, we use the synthetic climate, crop growth models, and realistic models of decision-making under risk to compute risk metrics (e.g., probability of yields or profits being below a threshold). Climatically optimal and marginal locations show differential responses: probabilities of negative economic results are much higher in currently marginal areas if precipitations decrease.