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# Multi-Decadal Climate Information for Agricultural Planning in Southeastern South America

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Traditional dynamical downscaling approaches in the climate change context use coupled general circulation model (CGCM) outputs to provide realizations of the expected future changes in variables such as temperature and precipitation for a specific region. The coarse resolution CGCMs do not resolve weather transients or the physical mechanisms related to extreme precipitation events. Downscaled climate models may be able to capture some of the higher resolution processes (e.g., weather transients) and may even represent how these are impacted by large-scale climate. However, the regional models cannot correct most errors and biases in the large-scale climate fields. Both global and regional climate models may be able to provide some useful information for current and future climate, but it is increasingly clear that neither global or regional climate model outputs alone are adequate to directly drive impacts models, such as crop models. Here we explore a different approach to the provision of multi-scale climate information for agricultural planning wherein the weather and climate information inferred by the models is interpreted through the observations to inform changes to weather characteristics for use by crop models.

To explore this methodology for Southeastern South America, we start with a decomposition of the climate time series into inter-annual, decadal and long-term signal components for the NCAR-CCSM4 global model and NCEP/NCAR Re-Analysis. The first result is that the global model does not capture the magnitude of the wetting trend that has been observed, and the dynamical downscaling does not improve that simulation. We then examine changes in the weather characteristics and interannual-to-decadal climate in the observations, NCAR-CCSM4, and NCAR-WRF regional model for 1981-1990, 2001-2010 and 2021-2030. We find that global and regional simulations adequately represent the statistical characteristics of decadal-scale rainfall when compared to observations. We also find that the models represent well the regional rainfall response to large-scale climate such as ENSO and the Southern Annual Mode, which allows us to explore the possible connection between the large-scale climate variability and variability in the weather characteristics. Due to the timing of decadal variability for our chosen periods in the model and observations, and the lack of notable trend in the model, any changes in weather characteristics in the model is presumed to be due to decadal variability and in the observations is presumed to be due to trend. This information can potentially be merged to produce synthetic, but representative time series, that would provide better constrained weather and climate inputs for crop models. For the 2020s, the mean decadal precipitation and days with extreme precipitation (R95p) are projected to be lower than in the 2000s, while the frequency of consecutive dry days is expected to be higher.