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Transitioning from Corn to Switchgrass in the US Great Plains: Implications for Climate and Water Resources

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Much attention has been paid in recent years to the use of corn as a biofuel, increasingly, however, it is recognized that other types of vegetation are likely to be more efficient producers of biofuel. In particular, switchgrass (the primary component of prairie long grass) may be a very efficient producer in much of the U.S, where it is an indigenous species. A transition from corn to switchgrass may have numerous benefits, both because it may be a better source of biofuels, and because in water-scarce regions such as the U.S. Great Plains it would likely make better use of available water resources. In addition to these positive benefits, however, there may be effects on the climate of this region that can be deleterious. While switchgrass, with its deep and extensive root system may be less subject to drought, and less needing of irrigation, than corn, it also cycles much less water during its growing season. This reduction in water input to the atmosphere means less water available for local and regional precipitation, and also dramatically affects the surface energy balance, resulting in more sensible and longwave heating of the atmosphere. This may cause a significant increase in surface air temperature and stabilization of the atmosphere, leading to a reduction in precipitation as well as increased evaporative potential (both of which would help negate any increased water efficiency of switchgrass) . We use the MM5 and WRF regional climate models to investigate these effects over the U.S. Great Plains. Simulations were made assuming all corn ('irrigated cropland') and all switchgrass ('grassland')

and compared to a control using present-day land use types that is largely a mix of the two. Model runs are being made for three years with normal precipitation, plus years with precipitation above and below normal (as based on observations). The high-resolution North American Regional Reanalysis provides lateral and initial conditions for the model simulations. Preliminary results suggest that a transition from corn to switchgrass can increase daily maximum temperatures by up to 4 C, with smaller increases in daily minimums. Precipitation decreases by 15-25%. Overall, the tendency is for warmer and drier conditions. These results also mean that effects due to global warming may be enhanced by a large-scale change to switchgrass.