122. Changes in biophysical climate regulation services from converting native grassland to bioenergy production in the US Midwest

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Project Goals: Promoting our understanding and quantification of changes in biophysical climate regulation services as a result of converting native grassland to bioenergy production in the US Midwest.
Abstract: Converting unmanaged grassland to managed bioenergy crops not only alters biogeochemical cycles, but also modifies surface biophysics, such as albedo, surface roughness, rooting depth, stomatal conductance, and leaf area. These biophysical perturbations subsequently change radiation budget at land surface and land-atmosphere exchange in sensible heat, evapotranspiration (ET), and momentum fluxes, which consequently influence atmospheric temperature, moisture, and circulation patterns. Climate regulation services from these biophysical effects are comparable to biogeochemical benefits of bioenergy production, with particular significance at the local and regional scales. Such biophysical effects, however, are often neglected in current climate policies; there is growing recognition that they should be additionally included to complement GHG values of land-based mitigation activities.

In this research, we combine in situ field measurements and remote sensing observations to improve our understanding of changes in biophysical climate regulation services from converting grassland to perennial bioenergy crops. In the US Midwest, albedo change as a result of cultivating native grassland for cellulosic bioenergy feedstocks could enhance the net greenhouse gases (GHGs) mitigation benefit of cellulosic bioenergy production (116.5 MgCO2 ha-1) by 20% over a time horizon of 50 years. With an integrated climate-agroecosystem model, parameterized with in situ and remote sensing data, we further demonstrate that considering interactions between agroecosystem processes and atmospheric circulation could result in noticeable difference in simulated regional climate (e.g. precipitation, temperature, and radiation budget), highlighting the importance of additionally including biophysical climate services in evaluating land-based mitigation activities, such as bioenergy production.

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