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Mitigation of Regional Temperature Extremes with Climate-Effective Land Management

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Limiting global warming to well below 2 ˚C is an imminent challenge for humanity. However even if this global target can be met, some regions are still likely to experience substantial warming relative to others. Using idealized global climate simulations we examine the potential of land management options in affecting regional climate, with a focus on crop albedo enhancement and irrigation (Climate-effective Land Management). The implementation is performed over all crop regions globally to provide an upper bound. We find that the implementation of both crop albedo enhancement and irrigation can reduce hot temperature extremes by more than 2 ˚C in North America, Eurasia and India over the 21st century relative to a scenario without management application. The efficacy of crop albedo enhancement scales linearly with the magnitude, where a cooling response exceeding 0.5 ˚C was achieved with a large (i.e. ≥ 0.08) change in land surface albedo. We use a surface energy balance decomposition to evaluate regional differences in the response of temperature extremes to Climate-effective Land Management. Regional differences were attributed to the surface energy balance response with temperature changes mostly explained by latent heat flux changes for irrigation and net shortwave radiation changes for crop albedo enhancement. Our results overall demonstrate that regional warming of hot extremes in our climate model can be partially mitigated when using an idealized treatment of Climate-effective Land Management.