ABSTRACT: We studied the impacts of vegetation and weather variations on carbon and energy fluxes at a restored tallgrass prairie in Illinois. The prairie was a strong carbon sink, despite a prolonged drought period and vegetation changes due to the presence of a non-native biennial plant. Albedo and energy fluxes were similarly affected by drought and vegetation changes. Drought reduced latent heat and sensible heat fluxes because of the lack of precipitation and depleted soil water content, which decreased the water available for evapotranspiration. In addition, lower plant productivity and reduced plant canopy density increase radiation reaching the surface soil. The reduced LE and increased H resulted in a higher Bowen ratio (H/LE) by 51%, than in normal-precipitation years. Although the growing season of 2006 experienced normal precipitation, soil water content, and soil temperature, the dominance of the non-native *M. alba* resulted in a Bowen ratio similar to that under the drought conditions as a consequence of reduced LE and increased H fluxes. These effects on energy fluxes are most likely due to differences in the canopy structure and phenology of *M. alba* versus native vegetation. *Melilotus alba* forms very dense canopies that (1) effectively reduces incoming radiation to the soil surface, thus reducing the energy available for evaporation, and/or (2) physically reduces the exchange of heat with the atmosphere. Furthermore, vegetation changes reduced the C uptake period in 2006 by disrupting the typical seasonal succession of C3 and C4 prairie plants and reducing the transpiration flux and enhancing H flux, particularly after *M. alba* senescence in early August. Reduction in daily mean albedo supports the hypothesis that plant phenological changes, not climate, affected energy fluxes during that year. Vegetation changes had the strongest effect on C cycling, reducing net ecosystem production by 55%, compared to a 50-year drought year and by 68% compared to normal precipitation years. We use a modeling approach to separate the effects of environmental drivers and biotic responses on net ecosystem exchange. Analysis of the model predictions suggest that the vegetation factor was more important than abiotic factors in describing changes in C fluxes at this grassland site. Changes in species dominance had the strongest effect in reducing net ecosystem production and albedo and increasing sensible heat flux. These effects may result in positive feedbacks on warming and microclimate changes.