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Modeling the juniper encroachment in the western north America grasslands with a Cellular Automata model

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Grasslands of western North America have experienced dramatic changes over the last 140 years as a result of woody plant encroachment (WPE). WPE is characterized as increase in density, cover and biomass of indigenous woody plants in grasslands. In this study we examine the environmental factors that trigger the WPE at a semiarid site using the CATGraSS ecohydrologic plant coexistence model. CATGraSS is a spatially distributed model driven by spatially explicit irradiance and runs on a fine-resolution gridded domain. In CATGraSS each cell can hold a single plant type or can remain empty. Plant competition is modeled by keeping track of mortality and establishment of plants, both calculated probabilistically based on soil moisture stress.
For this study CATGraSS is improved with a stochastic fire and a grazing function, and its plant establishment algorithm is modified. Using CATGraSS, western juniper encroachment is studied in a small catchment (11.8 km2) located within the Ochoco National Forest, Crook County, OR, where juniper encroachment has been observed since the mid 1800s. The outcome of the changes in observed climate, fire frequency, and grazing intensity are investigated through numerical modeling scenarios. The model is able to reproduce the encroachment, simulating an increasing of the juniper from 11% in 1870 to 86.5% in 2010 (actual juniper percentage) highlighting as more influent factors the reduced fire frequency and the increased grazing intensity.