

OKLAHOMA EPSCoR UPDATE

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Juniper Woody Plant Encroachment into Grasslands Impacts Local Climate

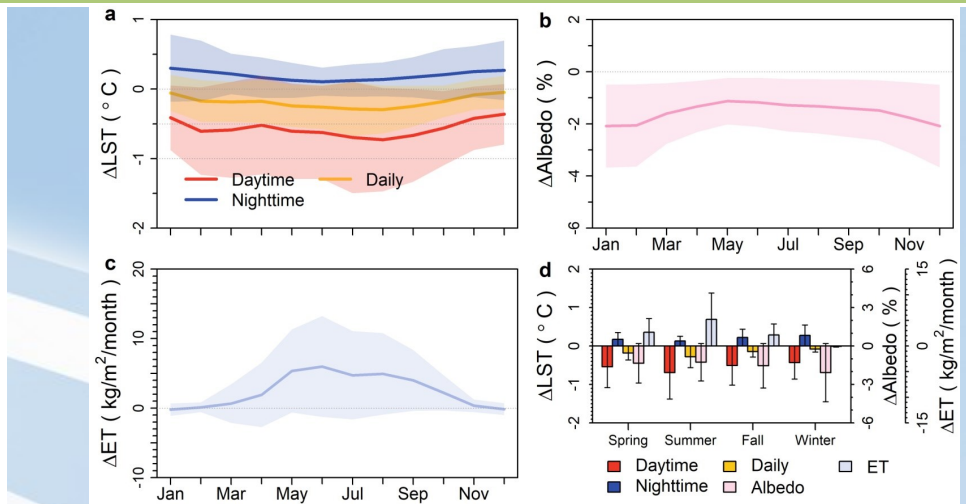
Juniper is a conifer woody species that commonly encroaches the native grasslands and shrublands in the Great Plains. Woody plant encroachment (WPE) into grasslands is a result of passive land management, changing climate, and human activities, and has significant impacts on the socio-economic and ecological systems. WPE may have negative effects on water availability, forage for livestock, and risk of wildfire. WPE can also affect the local and regional climate by altering the exchange of mass and energy between the land surface and the atmosphere. The lack of studies on how WPE affects local climate hinders our understanding of the interactions between climate and the changes in the vegetation cover. Hence, Dr. Xiangming Xiao from the



University of Oklahoma's Department of Microbiology and Plant Biology led a team of graduate students, post-doctoral researchers, and research scientists (Jie Wang, Jeffrey Basara,

Xiaocui Wu, Rajen Bajgan, Yuanwei Qin, Russell Doughty, and Berrien Moore III) to determine the impacts of Juniper woody plant encroachment (JWPE) on the local land surface temperature (LST), albedo, and evapotranspiration (ET) within the grasslands in Oklahoma based on satellite observations.

The research team used phenology-based algorithm, microwave images (Phased Array type L-band Synthetic Aperture Radar, PALSAR) and optical images (Landsat) to generate the 30-m juniper forest encroachment maps for Oklahoma. The resultant maps were used to quantify



Seasonal dynamics of a) Land Surface Temperature, b) Albedo, c) Evapotranspiration, and summary of ΔLST , $\Delta Albedo$, and ΔET (represents the difference of each variable between juniper-encroached grasslands and adjacent pure grasslands during 2000-2015.

spatial-temporal changes in juniper forest encroachment during 2000-2015.

"We analyzed the differences in LST, albedo, and ET between juniper encroached grasslands and adjacent pure grasslands at annual and seasonal scales using 16 years of remote sensing data," Xiao said. "We also characterized relationships between differences in LST, albedo, and ET and the proportion encroached by Juniper in landscapes and examined how the effects of JWPE on local climate vary with different hydrological years (dry, normal, pluvial years)."

"We found that JWPE into grasslands reduced daytime LST and albedo, but increased nighttime LST and ET from an annual scale analysis," Xiao said.

"Our results showed that JWPE significantly affected the local climate. With 1% increase in Juniper cover, there was an average annual daytime cooling of about 0.026°C and nighttime warming of about 0.01°C . Increasing Juniper cover leads to a decrease in $\Delta albedo$ at about 0.053% and an increase in ΔET at about 1.3 mm/year ," Xiao added.

The research team suggested that JWPE into grasslands cools the local land surface in the daytime but warms the grasslands in the nighttime significantly. Moreover, JWPE's effect on the local climate were found to be stronger in dry years than in normal and pluvial years. These results have demonstrated the potential of satellite technologies and Big Earth Observation Data to better understand the WPE and its impacts on local climate. The effects of the observed local climate in the JWPE on animals (e.g., birds, small and large mammals) and ticks are not known, yet, and therefore, more research is needed, as it could have large implications on tick dynamics and tick-borne diseases in Oklahoma.

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Upcoming Event:

Tinkerfest 2021 (9/25/2021)

