

Interactive Effects of Precipitation, Temperature, And Grazing Pressure on the Net Ecosystem Carbon Balance of Grazing Lands Across the Continental United States

Background/Objective

Grazing lands cover approximately one-third of the contiguous United States, are an important component of the U.S. terrestrial carbon budget, and are the dominant land use in regions ideally suited for land conversion. This study quantified net ecosystem carbon balance (NECB) across heterogeneous U.S. grazing lands and evaluated how climate and management interact to control carbon balance.

Approach

Researchers synthesized multi-year carbon fluxes measured by eddy covariance and methane emissions estimated from enteric fermentation and manure-derived emissions across seven USDA Long-Term Agroecosystem Research Network grazing-land sites. Annual NECB was evaluated against precipitation, temperature, vegetation and moisture classes, fertilization history, and grazing pressure.

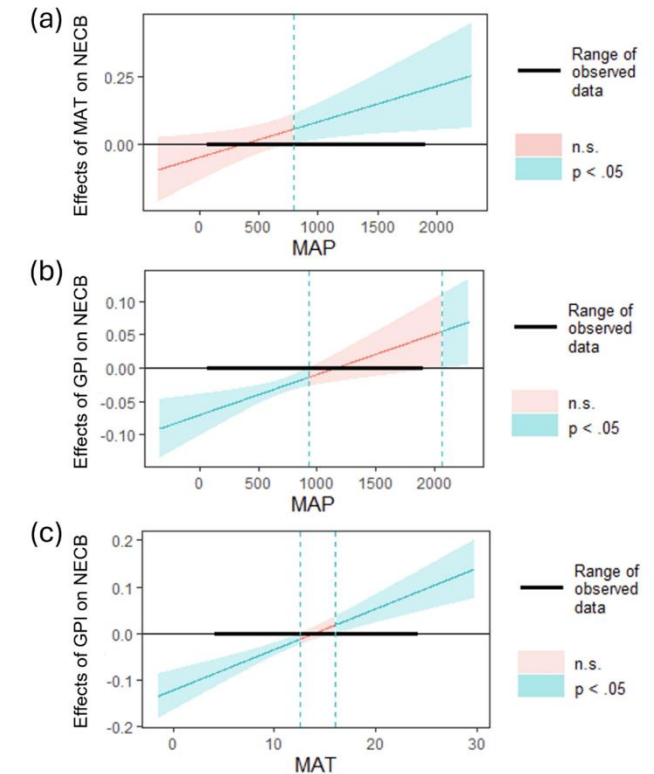
Results

Most grazing lands were carbon sinks or approximately carbon neutral. NECB increased with precipitation and, under sufficiently wet conditions, with temperature; NECB decreased with higher grazing pressure in drier and cooler systems. Key thresholds: temperature effects became positive when precipitation exceeded ~750 mm, while grazing reduced NECB when precipitation was $< \sim 1000$ mm or temperature was $< \sim 12$ °C.

Significance/Impacts

Climate-dependent thresholds show when management can impact grazing-land carbon sinks. These results advance ability to evaluate the carbon consequences and resilience of managed perennial landscapes and support site-specific strategies for resilient land-use systems.

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Climate-dependent thresholds in NECB responses to temperature and grazing pressure. Blue regions indicate statistically significant effects ($p < 0.05$).