Climatic and biotic controls over the interannual variability of net carbon exchange inferred from partitioning theory in a rain-fed maize ecosystem

Hui Zhang[1], Tianhong Zhao[1], Sidan Lyu[1], Hang Wu[1], Yang Yang[1], and Xue-Fa Wen[1]

[1]Affiliation not available

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Abstract

The interannual variation (IAV) of net ecosystem carbon production (NEP) plays an important role in understanding the mechanisms of the carbon cycle in the agriculture ecosystem. NEP is usually partitioned into the diffecence between gross ecosystem productivity (GEP) and ecosystem respiration (RE), or the integration of the carbon uptake or release peak and the corresponding duration. In this study, the climatic and biotic controls of the IAV of NEP, which were expressed as annual values and anomalies, were investigated based on an eddy covariance dataset of rain-fed spring maize during 2005–2018 in the northeast of China. The annual NEP was 270±115 g C m-2yr -1. Annual values and anomalies of NEP were positively correlated with that of precipitation (PPT), GEP and daily maximum NEP (NEPmax). 78.9% of annual anomalies of NEP were explained by the interaction of climate, soil and plant variables, and the atmospheric water vapor deficit (VPD) played a dominated role. Annual anomalies of NEP were dominantly and positively controlled by the soil water content (SWC) through GEP and the soil temperature (Ts) through RE. In comparison, annual anomalies of NEP were dominantly and negatively controlled by summer VPD through the NEPmax, positively adjusted by spring precipitation and the effective accumulative temperature through the beginning date (BDOY) of the affecting carbon uptake period (CUP), and by autumn precipitation and leaf area index through the end date (EDOY) of the affecting CUP. Residues restrained the carbon release at the beginning of the year, and accelerated the carbon release at the end of the year. Our results hightlight that NEP might be more sensitive to the change of water condition (such as PPT, SWC and VPD) induced by the climate changes.

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