**Disentangling biotic and climatic effects on annually variability in water use efficiency across terrestrial ecosystems in China**

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Evaluating the independent contributions of environmental variability to the interannual variability (IAV) in ecosystem water use efficiency (WUE) and understanding their controlling mechanisms help us better understand the interactions between carbon and water cycles. However, few studies have separated the interaction effects of environmental factors to examine the individual contribution of environmental factors to ecosystem WUE over a long term. We synthesized flux and micrometeorological observations (2003-2010) in growing season from 7 eddy covariance flux sites across China, and analyzed the sensitivity of ecosystem gross primary productivity (GPP), evapotranspiration (ET) and WUE to biotic and climatic factors based on the combined method of principal component analysis (PCR) and partial least squares regression (PLSR) at annual scale.

Our results showed that there was a significant positive correlation between the IAV in GPP, ET and their annual values, which revealed different water management strategies in across ecosystems. Generally, ecosystem GPP showed relatively high sensitivity to air temperature ($T_a$), and ET showed strongly sensitive to solar radiation (Rad). WUE was highly sensitive to Rad across ecosystems and sensitive to soil water content (SWC) for dry areas. The sensitivity of ecosystem WUE to climatic and biotic factors depends on different responses of GPP and ET. Ecosystem ET showed more sensitive to environmental factors than GPP, so the sensitivity of ecosystem WUE to environmental factors was mostly negative among ecosystems.

The inter-site different sensitivity of GPP, ET and WUE to LAI was related to the climatic effects. Rad was strongly correlated with sensitivity of GPP to LAI ($S_{LAI\_GPP}$) and sensitivity of ET to LAI ($S_{LAI\_ET}$). The inflection point of the correlation between $S_{LAI\_WUE}$ and $T_a$ occurred at about 18℃ and of the correlation between $S_{LAI\_WUE}$ to SWC occurred at about 0.18 $m^3m^{-3}$. Our approach effectively estimates the independent contribution of climatic and biotic factors to the variation of ecosystem GPP, ET and WUE, which can fill the gap between field experiments and model simulation at ecosystem scale.