Multiple drivers of seasonal and interannual variation in P_{max}: Implications for leaf photosynthesis of *Artemisia ordosica*

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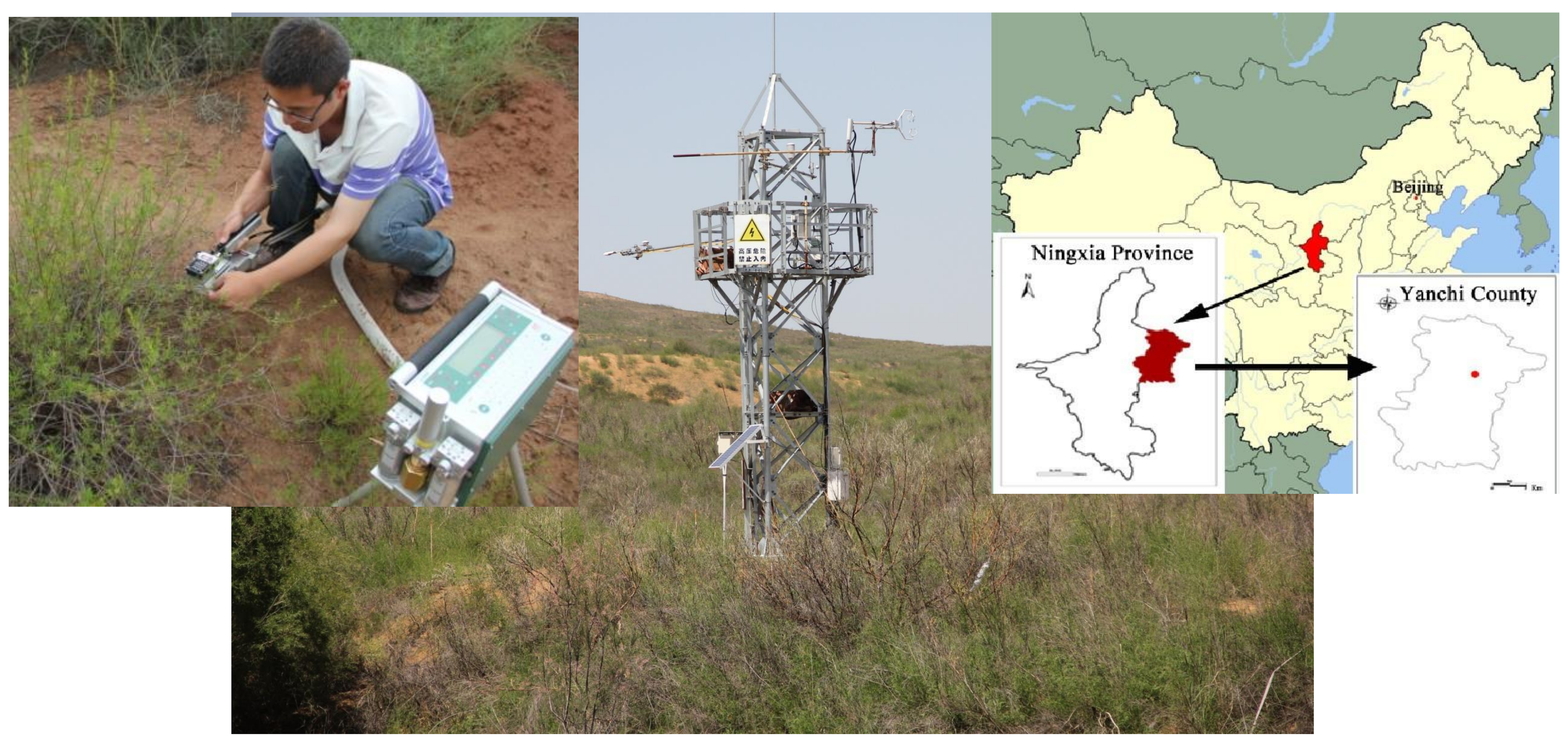
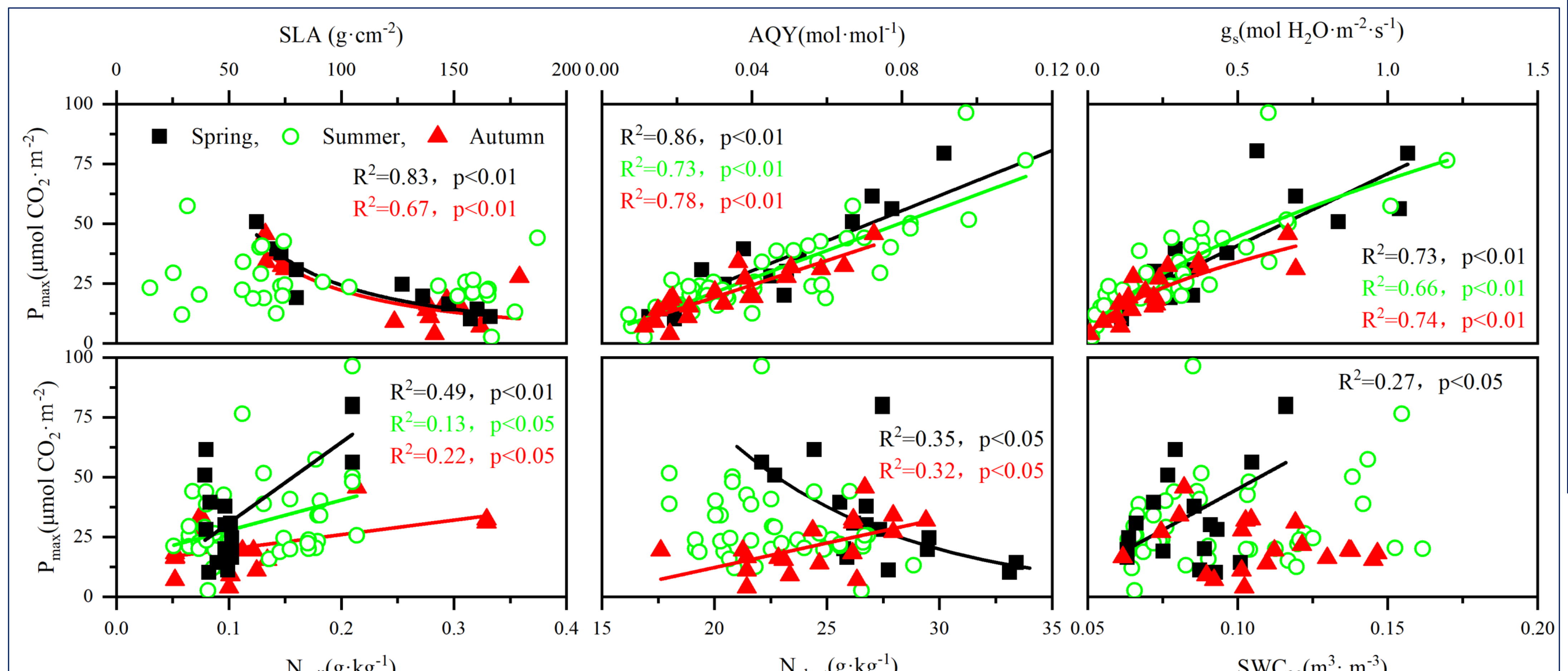
Background

Arid and semi-arid ecosystems play an essential role in the global C cycle, and are highly sensitive to year-to-year climatic variations (Ahlström et al., 2015).

As photosynthesis is the critical process controlling carbon uptake and biomass accumulation, climate change would finally alter the temporal growth patterns in ranging from seconds to years (Bowling et al., 2018). In the arid and semi-arid ecosystems, drought, high irradiance and high temperature for short of long periods may dramatically influence the gas exchange patterns of plants and limit their production (Zha et al., 2017). However, the relationship between seasonal and inter-annual variations in photosynthetic capacity of dominated plant and the driven factors remains to be clarified for arid and semi-arid areas.

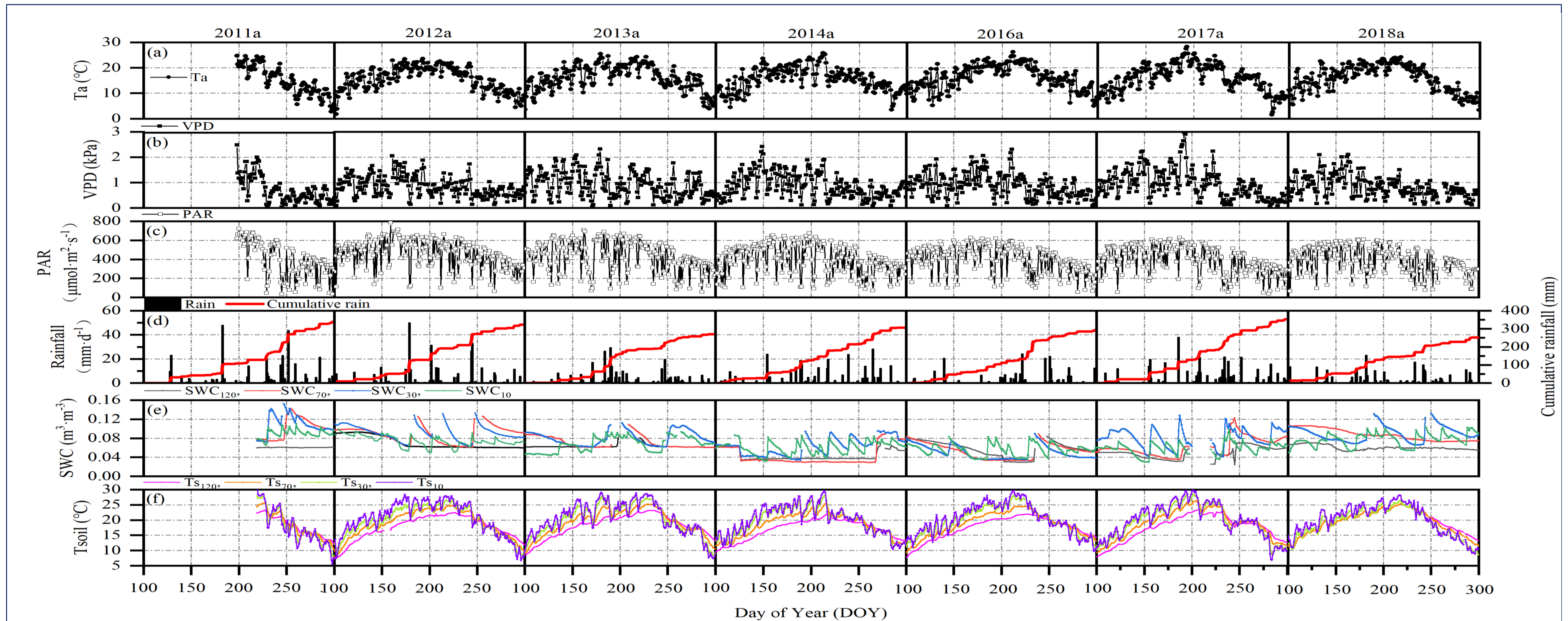
The vast Eurasia arid and semi-arid areas are expected to undergo increases in temperature and altered precipitation patterns (Liu et al., 2016). In this respect, the long-term uncertainty in regional C sequestration potential and the community succession direction lies primarily in the sensitivity of shrublands to climate variability.





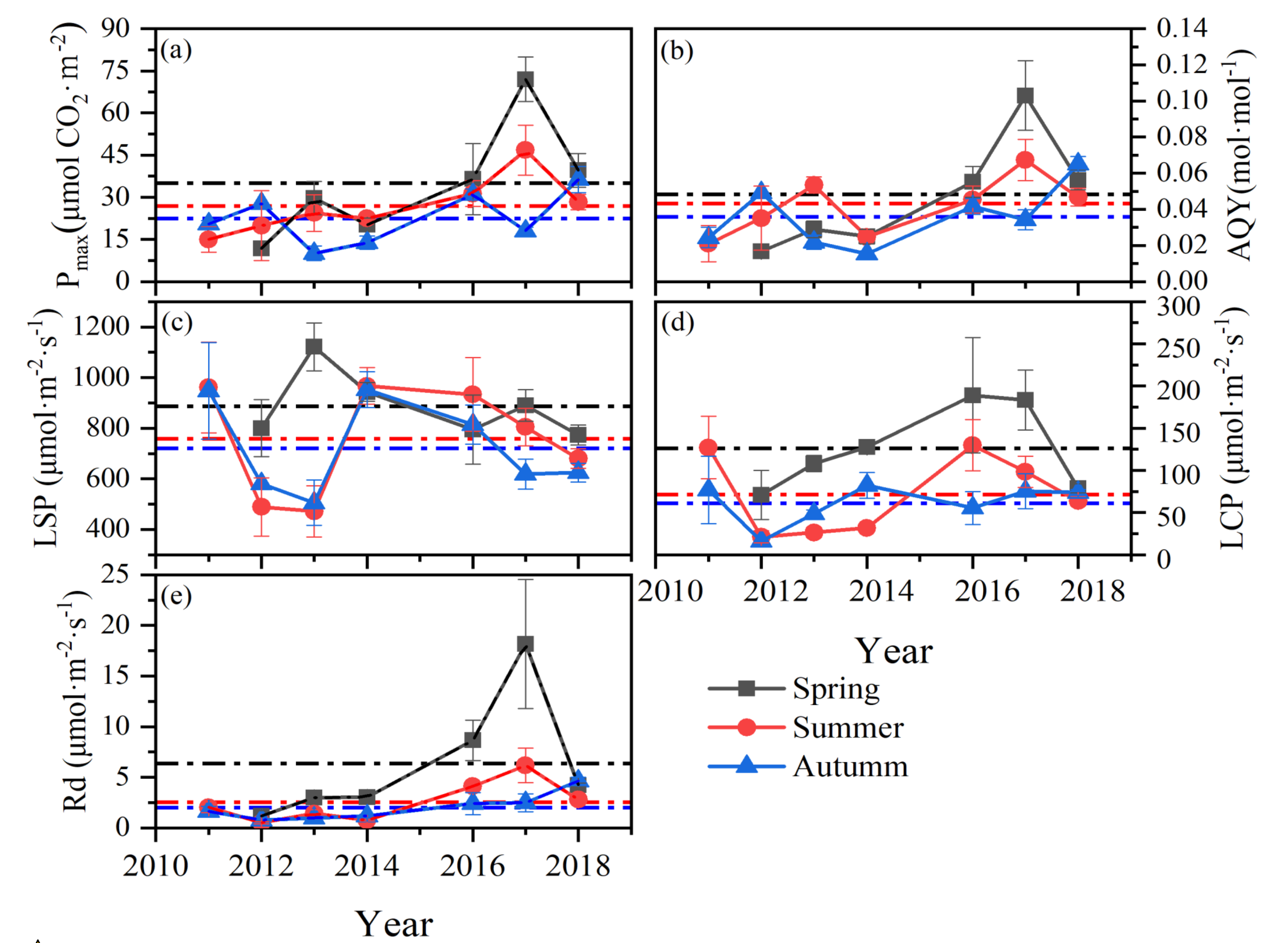
The relationship of P_{max} and related factors during different growth seasons

The relationship of P_{max} and related factors changed with the seasonal variation. P_{max} showed a strong negative correlation with SLA. And the P_{max} decreased exponentially with increasing N_{plant} during the spring, and increased linearly in autumn.



Temporal variation in environment factors

The seasonal patterns of temperature, *VPD*, PAR and T_{soil} were similar among the seven years; whereas rainfall and soil moisture showed contrasting seasonal patterns.



Temporal variation in A-PAR photosynthetic parameters

These A-PAR photosynthetic parameters showed a similar trend, which was spring> summer> autumn over the growing season of seven years.

Objective

The light response curve was used to examine how leaf maximum photosynthetic capacity (leaf photosynthesis) of *Artemisia ordosica* in a shrubland of northern China varied over seven years (2011–2018) with biotic and abiotic factors.

Conclusions

This simulation based on situ ecophysiological research suggest that P_{max} of *A. ordosica* responded to the environmental factors of seasonal and inter-annual variations.

The mean value of light-response curve parameters, the P_{max}, AQY, Rd, LSP and LCP had a gradual decline with the growth (spring> summer>autumn).

The driven factors of P_{max} in growing season changed, but stomatal conductance (g_s) was the dominant factor in all stages.

These results highlight the soil water content is the major environment factor influencing P_{max} in spring and summer, while Ta is the major one in autumn.

Abbreviations & symbols

Ta, air temperature; ***VPD***, vapor pressure deficit; ***PAR***, photosynthetically active radiation; ***SWC***, soil water content (at 10, 30, 70 and 120cm depth); ***T_{soil}***, soil temperature (at 10, 30, 70 and 120cm depth); ***P_{max}***, the maximum net photosynthetic rate; ***AQY***, apparent quantum efficiency; ***LSP***, light saturated point; ***LCP***, light compensated point; ***R_d***, dark respiration; ***g_s***, stomatal conductance; ***SLA***, specific leaf area; ***N_{soil}***, soil nitrogen content; ***N_{plant}***, leaf nitrogen content.

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