

Tradeoff in the supply and demand for CO₂ dominates the divergence of net photosynthesis rates of functional plants in alpine ecosystems

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Abstract

As regional heterogeneity on the Qinghai Tibetan Plateau (QTP), the “greening rate” between alpine steppe in the west and alpine meadow ecosystems in the east is difference during the past several decades. To investigate the difference, the net photosynthetic rate (A_n) and the supply (mesophyll conductance (g_m), stomatal conductance (g_s)) and demand (the maximum rates of Rubisco carboxylase activity (V_{cmax}) and photosynthetic electron transport (J_{max})) for CO₂ of three plants functional types (PFTs) were measured. Other functional traits and influencing factors were compared among ecosystems along the altitudinal gradients of QTP. The A_n of the PFTs was simulated under potential future conditions. At high altitudes, grass was found to maintain a relatively stable A_n by decreasing V_{cmax} , J_{max} , and g_s , while slightly increasing g_m , compared with that at a low altitude. The A_n of sedge and shrubs increased with rising V_{cmax} , J_{max} and g_s and g_m values, resulting in a large increment in the A_n at low altitudes. Grass seemed to be less sensitive to the environment by reducing the supply of and holding onto CO₂, while sedge and shrub increased both. Grass and sedge should be divided into two PFTs rather than remaining as one based on their opposite physiological and morphological functions in response to climate change. The ecosystem at 3600 m was transitional. C_a was likely to be a more dominant factor than T_a in affecting the A_n of grass. The order of rising A_n in PFTs was shrub > sedge > grass and the A_n of alpine meadow was found to increase more under the two future climate scenarios.

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