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Inter-annual shifts in aridity regulate functional diversity of three grasslands in Northern China

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Understanding how inter-annual shifts in aridity mediate the functional diversity of grasslands is a question of considerable ecological interest that remains unclear. We evaluated the differences of community-weighted means (CWM) of plant traits and functional dispersion (FDis) between two years with contrasting aridity. Four traits were taken into account, including specific leaf area (SLA), leaf dry matter content (LDMC), leaf nitrogen concentration (LNC) and the maximum plant height. We conducted the experiments in three types of grasslands in Northern China. We found that both CWM and FDis were influenced by the inter-annual shifts in aridity. CWM for SLA of the alpine meadow increased in the dry year while the temperature steppe in Qinghai showed the opposite changes. CWM of LDMC in two temperate steppes became higher. LNC in all grasslands became significantly lower in the dry year than in the wet year. However, community mean plant height of all grasslands was constant across years. Functional dispersion of traits also varied with aridity, except FDis of SLA. Surprisingly, FDis was not necessarily lower in the dry year. Functional dispersion of plant height was higher in the dry year for two temperate steppes. Compared to the wet year, FDis of LDMC in the alpine meadow and FDis of LNC in the temperature steppe in Qinghai became lower in the dry year. Only in the temperature steppe in Qinghai did the multiple FDis of all traits experience a significant increase in the dry year. Then for the differences of functional diversity between two years, we separated the sources of variations into two parts. In general, most of the changes in CWM and FDis between two years were explained by the intraspecific variations rather than shifts in species composition. This study highlights that the intraspecific variations in trait value across years are important for functional diversity to the changing environment. Our results also suggest that it would be necessary to consider habitat types when modelling the response of ecosystems to global climate changes, as different grasslands showed different patterns.