Supplementary Material

Biophysical controls on net ecosystem CO_2 exchange over a semiarid shrubland in northwest China

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Methods for leaf area index (LAI) measurements

For measuring LAI, we deployed a 4 × 4 grid of 16 quadrats (10 m × 10 m each) within a 100 m × 100 m plot centered on the flux tower in late March 2012. LAI was measured at roughly weekly intervals. The starting and ending dates for LAI measurements were specified for each species based on phenological observations. The plot-level LAI was calculated as the sum over all component species.

LAI for *Artemisia ordosica* was measured from 22 April to 20 October. At each measurement time, we sampled leaves from about 30 randomly selected healthy individuals within the plot. Three nodes were sampled and the number of nodes counted for each individual. All sampled leaves were scanned using a leaf area meter (YMJ-C, TOP Instrument Inc., Hangzhou, China). Assuming cylindrical-shaped leaves of *A. ordosica*, the projected area was multiplied by 3.14 to obtain the light interception area (Tang et al., 2013). Projected leaf area was measured for all the other species due to their blade-shaped leaves. Whole-plant leaf area was estimated as (mean leaf area per node) × (number of nodes on each individual). We also measured the crown height and diameter to establish allometric relationships between crown size and whole-plant leaf area. Crowns were viewed as ellipses in a two-dimensional space, and the geometric mean of long and short diameters was used as an estimation of crown diameter. The allometric relationships were then used for rapid estimation of whole-plant leaf area for all individuals in each quadrat. Leaf area was then summed over all the 16 quadrats to produce a total leaf area (TLA) for *A. ordosica*. LAI for *A. ordosica* at the plot-level was calculated as TLA/(16 × 100 m^2).

LAI for *Hedysarum mongolicum* was measured from 21 April to 9 October. At the first three measurements (on 21, 27 April and 2 May) when only a few shoots were newly emerged, leaf area in each 10 m × 10 m quadrat were estimated as (number of leaves) × (mean area per leaf, n = 30). Two subsequent measurements (on 11 and 17 May) estimated the leaf area for each quadrat as (number of shoots) × (mean leaf area per shoot, n = 10). For the first five measurements, LAI for *H. mongolicum* was calculated as TLA/(16 × 100 m^2). At each measurement thereafter, the high stand density forced us to subsample leaf area by randomly deploying three small quadrats (1 m × 1 m) in each 10 m × 10 m quadrat. In each small quadrat, leaf area was estimated as (number of shoots) × (mean number of branches per shoot, n = 10) × (mean number of leaves per branch, n = 10) × (mean area per leaf, n = 30). Leaf area was then summed over all the 48 small quadrats to produce a total leaf area (TLA) for *H. mongolicum*. LAI for *H. mongolicum* at the plot-level was calculated as TLA/(48 × 1 m^2).

LAI for *Hedysarum scoparium* was measured from 27 April to 18 July. The method was similar to that for *A. ordosica,* with the difference that allometric relationships were established between whole-plant leaf area and mean basal diameter or stem length for about 30 individuals. We also made biweekly measurements of green area index (GAI) for twigs from 1 June to 15 October. At each measurement time, we sampled twigs from about 25 randomly selected healthy individuals within the plot. Five twigs were sampled and the number of twigs counted for each individual. Surface area of all sampled twigs were determined based on their length and diameter (i.e., cylindrical-shaped). Whole-plant green twig area was estimated as (mean surface area per twig) × (number of twigs on each individual). Allometric relationships were then established between whole-plant green

twig area and mean basal diameter or stem length for estimating GAI. LAI for *Salix psammophila* was measured from 22 April to 16 October. The method was similar to that for *H. scoparium*.

LAI for *Agropyron cristatum* was measured from 3 June to 21 October. At each measurement time, leaf area was subsampled by randomly deploying ten small quadrats (0.5 m × 0.5 m) in each 10 m × 10 m quadrat. In each small quadrat, leaf area was estimated as (number of tillers) × (mean area per tiller, n = 30). Leaf area was then summed over all the 160 small quadrats to produce a total leaf area (TLA) for *A. cristatum*. LAI for *A. cristatum* at the plot-level was calculated as TLA/(160 × 0.25 m^2).