**Table S1 Site information in this study**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Site | Latitude(°N) | Longitude(°E) | MAT†(℃) | MAP(mm) | Grassland type |
| NQG | 31.37  | 91.90  | -1.30  | 620.50  | Grassland |
| SJG01 | 34.35  | 100.48  | -0.50  | 538.80  | Grassland |
| SJG02 | 34.40  | 100.40  | -0.34  | 511.32  | Grassland |
| FHG | 34.72  | 92.89  | -4.50  | 272.00  | Grassland |
| SACOLG | 35.95  | 104.13  | 7.78  | 400.04  | Grassland |
| ASG | 36.86  | 109.32  | 9.35  | 579.53  | Grassland |
| HYG | 36.95  | 100.85  | 1.00  | 354.20  | Grassland |
| SPD | 37.53  | 105.03  | 11.45  | 136.50  | Desert |
| HBG | 37.62  | 101.32  | -0.76  | 582.10  | Grassland |
| HBS | 37.67  | 101.33  | -1.43  | 498.62  | Shrub |
| YCS | 37.71  | 107.23  | 9.04  | 322.36  | Shrub |
| YKG | 38.01  | 100.24  | -4.45  | 490.35  | Grassland |
| ARG | 38.05  | 100.46  | 0.05  | 444.81  | Grassland |
| SLG | 38.42  | 98.32  | -3.89  | 370.47  | Grassland |
| YLS | 38.45  | 109.47  | 8.64  | 427.50  | Shrub |
| HZD | 38.77  | 100.32  | 9.10  | 166.40  | Desert |
| SSD | 38.79  | 100.49  | 8.90  | 139.70  | Desert |
| DSG | 38.84  | 98.94  | 2.66  | 319.60  | Grassland |
| MWS | 38.88  | 109.37  | 7.80  | 420.00  | Shrub |
| BJD | 38.92  | 100.30  | 9.00  | 103.30  | Desert |
| TZD | 38.96  | 83.65  | 10.00  | 50.00  | Desert |
| KBG | 40.38  | 108.55  | 7.50  | 180.00  | Grassland |
| SZG01 | 41.79  | 111.89  | 6.70  | 180.00  | Grassland |
| SZG02 | 41.79  | 111.90  | 6.70  | 180.00  | Grassland |
| HHD01 | 42.00  | 101.13  | 12.30  | 24.80  | Grassland |
| DLG01 | 42.05  | 116.28  | 3.02  | 354.54  | Desert |
| DLG02 | 42.06  | 116.28  | 2.32  | 502.06  | Grassland |
| HHD02 | 42.11  | 100.99  | 10.10  | 36.10  | Desert |
| NMD | 42.92  | 120.70  | 7.53  | 265.10  | Desert |
| TYD | 43.35  | 122.65  | 7.70  | 365.40  | Shrub |
| KED | 43.35  | 122.65  | 7.49  | 400.65  | Desert |
| XHG01 | 43.55  | 116.67  | 1.93  | 227.33  | Grassland |
| XHG02 | 43.55  | 116.67  | 1.51  | 202.00  | Grassland |
| XLG | 44.08  | 113.57  | 2.80  | 156.44  | Grassland |
| SNG | 44.08  | 113.57  | 3.20  | 184.00  | Grassland |
| XHG03 | 44.13  | 116.33  | 1.90  | 228.67  | Grassland |
| MDG | 44.16  | 116.49  | 3.15  | 307.16  | Grassland |
| FKG | 44.28  | 87.93  | 6.60  | 157.09  | Grassland |
| FKD | 44.28  | 87.93  | 6.60  | 157.63  | Desert |
| TYG01 | 44.34  | 122.92  | 6.07  | 384.57  | Grassland |
| TYG02 | 44.42  | 122.87  | 6.61  | 305.74  | Grassland |
| NMG | 44.53  | 116.67  | 1.38  | 271.37  | Grassland |
| CLG | 44.58  | 123.50  | 5.86  | 346.71  | Grassland |
| ABD | 44.62  | 83.57  | 7.67  | 100.00  | Desert |
| HLG | 49.35  | 120.10  | -2.99  | 329.70  | Grassland |

†MAT, mean annual temperature; MAP, mean annual precipitation.

**Table S2 The first principal component (PC1) explains the variance of the total variance of each group**

|  |  |  |  |
| --- | --- | --- | --- |
|  | GPP† | ER | NEP |
| Vegetation factors | 67.15% | 67.15% | 68.59% |
| Soil factors | 92.46% | 92.46% | 92.15% |
| Climate factors | 78.37% | 78.37% | 76.33% |

†NEP, net ecosystem productivity; GPP, gross primary productivity; ER, ecosystem respiration.

**Table S3. Correlation analysis between explanatory variables and carbon flux (GPP, ER and NEP).**

|  |  |  |  |
| --- | --- | --- | --- |
| Carbon fluxes | Factors | r | p |
| GPP† | LNC | -0.407 | <0.05 |
| GPP | LAI | 0.638 | <0.05 |
| GPP | MAT | -0.297 | >0.05 |
| GPP | MAP | 0.549 | <0.05 |
| GPP | Soil N | 0.682 | <0.05 |
| GPP | SM | 0.693 | <0.05 |
| ER | LNC | -0.272 | >0.05 |
| ER | LAI | 0.654 | <0.05 |
| ER | MAT | -0.417 | <0.05 |
| ER | MAP | 0.589 | <0.05 |
| ER | Soil N | 0.701 | <0.05 |
| ER | SM | 0.616 | <0.05 |
| NEP | LNC | -0.327 | <0.05 |
| NEP | LAI | 0.146 | >0.05 |
| NEP | MAT | 0.039 | >0.05 |
| NEP | MAP | 0.086 | >0.05 |
| NEP | Soil N | 0.156 | >0.05 |
| NEP | SM | 0.313 | <0.05 |

†MAT, mean annual temperature; MAP, mean annual precipitation; LAI, leaf area index; Soil N, soil total nitrogen content; LNC, leaf nitrogen content; SM, soil moisture; NEP, net ecosystem productivity; GPP, gross primary productivity; ER, ecosystem respiration.



**Figure S1. Variation of carbon fluxes (GPP, ER and NEP) in different ecosystems in arid and semiarid areas of China.** NEP, net ecosystem productivity; GPP, gross primary productivity; ER, ecosystem respiration.