

**Table A1** Sampling date, location, mean annual precipitation (MAP), mean daily growing period precipitation ( $P_G$ ), species name and  $^{13}\text{C}$  discrimination ( $^{13}\Delta$ ) of material collected in the 2005 and 2006 sampling campaigns.

Sampling date	Longitude (°)	Latitude (°)	Elevation (m a.s.l.)	MAP (mm yr <sup>-1</sup> )	$P_G$ (mm day <sup>-1</sup> )	Species	$^{13}\Delta$ (‰)
July 2005	115°52'	43°57'	1087	278	0.7	<i>S. grandis</i>	15.9
July 2005	115°43'	43°50'	1087	276	0.7	<i>S. grandis</i>	17.5
July 2005	115°39'	43°55'	1087	275	0.7	<i>S. grandis</i>	17.4
July 2005	115°24'	43°54'	1086	273	0.7	<i>S. grandis</i>	17.4
July 2005	115°07'	43°58'	1145	263	0.6	<i>S. grandis</i>	17.0
July 2005	114°40'	43°57'	1092	232	0.5	<i>S. grandis</i>	17.5
July 2005	114°04'	43°51'	1077	214	0.4	<i>S. grandis</i>	16.0
July 2005	113°15'	43°47'	1026	177	0.3	<i>S. gobica</i>	15.7
July 2005	112°47'	43°44'	984	168	0.2	<i>S. gobica</i>	16.8
July 2005	112°15'	43°37'	951	146	0.1	<i>S. gobica</i>	15.5
July 2006	107°13'	47°45'	1548	258	1.7	<i>S. krylovii</i>	16.9
July 2006	107°19'	47°34'	1707	269	1.8	<i>S. krylovii</i>	19.3
July 2006	107°30'	47°21'	1458	236	1.6	<i>S. krylovii</i>	18.3
July 2006	107°41'	47°01'	1388	227	1.5	<i>S. krylovii</i>	18.0
July 2006	108°05'	46°42'	1295	201	1.3	<i>S. unidentified</i>	16.9
July 2006	108°27'	46°19'	1244	201	1.3	<i>S. glareosa</i>	18.7
July 2006	109°35'	45°18'	1295	137	0.8	<i>S. unidentified</i>	15.8
July 2006	109°25'	45°48'	1022	176	1.1	<i>S. glareosa</i>	16.9
July 2006	109°35'	45°18'	1007	137	0.8	<i>S. unidentified</i>	15.6
July 2006	110°48'	44°44'	1016	130	0.7	<i>S. glareosa</i>	18.0
July 2006	111°08'	44°27'	1017	146	0.7	<i>S. krylovii</i>	17.8
July 2006	111°22'	44°03'	1075	149	0.7	<i>S. glareosa</i>	18.0
July 2006	111°29'	43°56'	1074	144	0.6	<i>S. glareosa</i>	16.9
July 2006	111°42'	43°48'	964	132	0.5	<i>S. unidentified</i>	16.7
July 2006	111°51'	43°43'	965	125	0.5	<i>S. unidentified</i>	17.2
July 2006	111°31'	43°41'	1015	142	0.6	<i>S. unidentified</i>	16.2
July 2006	111°17'	44°02'	1072	151	0.7	<i>S. unidentified</i>	15.4
July 2006	112°01'	45°10'	1183	184	0.9	<i>S. unidentified</i>	17.6
July 2006	112°38'	45°12'	1080	183	0.9	<i>S. unidentified</i>	17.3
July 2006	113°52'	45°18'	1257	214	1.0	<i>S. krylovii</i>	18.4
July 2006	114°27'	45°34'	1352	243	1.1	<i>S. krylovii</i>	18.0
July 2006	114°45'	45°38'	1318	221	1.0	<i>S. grandis</i>	18.4
July 2006	114°52'	45°40'	1253	257	1.2	<i>S. grandis</i>	18.6
July 2006	115°19'	45°54'	1104	264	1.2	<i>S. grandis</i>	17.9
July 2006	114°43'	46°03'	978	239	1.1	<i>S. grandis</i>	18.2
July 2006	114°08'	46°06'	1034	225	1.1	<i>S. grandis</i>	17.8
July 2006	113°23'	46°53'	1088	214	1.1	<i>S. grandis</i>	19.1
July 2006	113°25'	46°10'	990	221	1.1	<i>S. grandis</i>	19.7
July 2006	113°20'	47°02'	1117	215	1.2	<i>S. grandis</i>	18.6
July 2006	112°57'	46°46'	985	209	1.1	<i>S. grandis</i>	18.4
July 2006	112°20'	46°49'	1052	241	1.3	<i>S. grandis</i>	17.6
July 2006	111°48'	47°02'	1123	266	1.5	<i>S. grandis</i>	17.3
July 2006	111°16'	47°15'	1171	268	1.5	<i>S. grandis</i>	17.5
July 2006	110°31'	47°23'	1137	267	1.6	<i>S. grandis</i>	17.2
July 2006	109°60'	47°23'	1189	270	1.6	<i>S. grandis</i>	17.1
August 2006	109°37'	47°27'	1335	279	1.7	<i>S. grandis</i>	18.0
August 2006	109°08'	47°39'	1368	284	1.8	<i>S. grandis</i>	18.8
August 2006	108°29'	47°42'	1318	253	1.7	<i>S. grandis</i>	18.3
August 2006	107°41'	47°45'	1702	265	1.8	<i>S. krylovii</i>	18.2

**Table A2** Source of external data sets, location, species name, mean daily growing period precipitation ( $P_G$ ) determined by kriging between meteorological stations and  $^{13}\text{C}$  discrimination ( $^{13}\Delta$ ).

Source	Longitude (°)	Latitude (°)	Elevation (m a.s.l.)	$P_G$ (mm day <sup>-1</sup> )	Species	$^{13}\Delta$ (‰)
Cerling and Harris 1999	102°00'	49°00'	1600	1.2	<i>S. krylovii</i>	15.8
Chen et al. 2005	116°33'	43°32'	1200	0.7	<i>S. grandis</i>	15.3
Liu et al. 2004	116°00'	43°00'	1200	1.2	<i>S. baicalensis</i>	18.2
Liu et al. 2004	116°00'	43°00'	1200	1.2	<i>S. grandis</i>	18.8
Liu et al. 2004	116°00'	43°00'	1200	1.2	<i>S. krylovii</i>	17.5
Wang et al. 2005	104°06'	36°31'	1730	2.2	<i>S. breviflora</i>	18.3
Wang et al. 2005	104°06'	36°31'	1730	2.2	<i>S. breviflora</i>	18.8
Wang et al. 2005	104°06'	36°31'	1730	2.2	<i>S. breviflora</i>	18.1
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	19.0
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	19.0
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	18.7
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	18.7
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	18.7
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	19.0
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	18.8
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	18.7
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	18.7
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	18.3
Gao 2004 <sup>1</sup>	116°40'	43°30'	1300	1.8	<i>S. grandis</i>	18.2
Ivanov et al. 2007	102°42'	43°15'	2170	0.6	<i>S. glareosa</i>	16.7
Ivanov et al. 2007	102°42'	43°15'	2170	0.6	<i>S. glareosa</i>	16.0
Liu et al. 2005	103°57'	36°20'	1646	2.3	<i>S. bungeana</i>	16.7
Liu et al. 2005	103°57'	36°20'	1646	2.3	<i>S. bungeana</i>	19.1
Liu et al. 2005	104°16'	35°50'	1833	2.5	<i>S. bungeana</i>	17.4
Liu et al. 2005	104°37'	35°35'	1900	2.6	<i>S. bungeana</i>	17.5
Liu et al. 2005	104°38'	35°00'	1744	2.7	<i>S. bungeana</i>	18.0
Liu et al. 2005	105°02'	35°41'	1800	2.7	<i>S. bungeana</i>	17.0
Liu et al. 2005	105°40'	34°52'	1222	3.0	<i>S. bungeana</i>	19.8
Liu et al. 2005	106°38'	36°05'	1837	3.0	<i>S. bungeana</i>	18.2
Liu et al. 2005	106°40'	35°32'	1409	3.1	<i>S. bungeana</i>	19.5
Liu et al. 2005	106°40'	35°32'	1409	3.1	<i>S. bungeana</i>	20.3
Liu et al. 2005	107°04'	36°03'	1348	3.1	<i>S. bungeana</i>	19.7
Liu et al. 2005	107°21'	34°30'	782	3.4	<i>S. bungeana</i>	19.3
Liu et al. 2005	107°30'	38°23'	1315	2.4	<i>S. bungeana</i>	17.6
Liu et al. 2005	107°30'	38°23'	1315	2.4	<i>S. bungeana</i>	18.4
Liu et al. 2005	107°37'	35°53'	1468	3.2	<i>S. bungeana</i>	19.1
Liu et al. 2005	107°38'	35°42'	1396	3.2	<i>S. bungeana</i>	19.3
Liu et al. 2005	107°39'	35°04'	1015	3.4	<i>S. bungeana</i>	20.0
Liu et al. 2005	107°42'	35°15'	1222	3.3	<i>S. bungeana</i>	19.3
Liu et al. 2005	107°42'	35°15'	1222	3.3	<i>S. bungeana</i>	19.9
Liu et al. 2005	107°55'	35°58'	1044	3.2	<i>S. bungeana</i>	19.2
Liu et al. 2005	107°58'	35°55'	1140	3.3	<i>S. bungeana</i>	19.3
Liu et al. 2005	108°04'	34°57'	1112	3.4	<i>S. bungeana</i>	18.2
Liu et al. 2005	108°04'	34°57'	1112	3.4	<i>S. bungeana</i>	20.8

**Table A2** continued

Source	Longitude (°)	Latitude (°)	Elevation (m a.s.l.)	P <sub>G</sub> (mm day <sup>-1</sup> )	Species	<sup>13</sup> Δ (‰)
Liu et al. 2005	108°27'	37°19'	1555	3.0	<i>S. bungeana</i>	19.1
Liu et al. 2005	108°38'	35°16'	1257	3.5	<i>S. bungeana</i>	21.5
Liu et al. 2005	108°40'	36°08'	1185	3.3	<i>S. bungeana</i>	19.9
Liu et al. 2005	109°06'	35°24'	1240	3.5	<i>S. bungeana</i>	19.3
Liu et al. 2005	109°06'	35°52'	984	3.4	<i>S. bungeana</i>	19.2
Liu et al. 2005	109°06'	35°52'	984	3.4	<i>S. bungeana</i>	20.2
Liu et al. 2005	109°19'	34°10'	517	3.7	<i>S. bungeana</i>	19.3
Liu et al. 2005	109°19'	35°45'	989	3.5	<i>S. bungeana</i>	20.3
Liu et al. 2005	109°28'	36°35'	1095	3.3	<i>S. bungeana</i>	19.2
Liu et al. 2005	108°28'	36°35'	1362	3.3	<i>S. bungeana</i>	20.8
Liu et al. 2005	109°28'	36°35'	1362	3.3	<i>S. bungeana</i>	19.7
Liu et al. 2005	109°48'	37°21'	1058	3.1	<i>S. bungeana</i>	17.9
Liu et al. 2005	110°08'	36°00'	884	3.5	<i>S. bungeana</i>	20.1
Liu et al. 2005	110°11'	36°04'	922	3.5	<i>S. bungeana</i>	20.7
Gong et al. 2008	116°43'	43°35'	1300	1.8	<i>S. grandis</i>	19.7
Gong et al. 2008	116°43'	43°35'	1300	1.8	<i>S. grandis</i>	19.4
Gong et al. 2008	116°43'	43°35'	1300	1.0	<i>S. grandis</i>	16.9
Gong et al. 2008	116°43'	43°35'	1300	1.0	<i>S. grandis</i>	17.2

**Table A3** Collected species, their mean  $\delta^{13}\text{C} \pm 1$  standard deviation (number of samples), their site-specific contribution to aboveground biomass (remainder mostly C4 species) and the site-mean discrimination of C3 species  $^{13}\Delta_3$  calculated from the site specific  $\delta^{13}\text{C}$  weighted by contribution to C3 biomass

Species	Mean $\delta^{13}\text{C}$ (‰)	Contribution to above-ground biomass (%)											
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 9	Site 12	Site 13	Site 14	
	-25.8 ± 1 (n=3)		20	30	5								
<i>Agropyron michnoi</i>													
<i>Allium spp.</i>	-24.5 (n=1)			40									
	-28.5 ± 0 (n=2)								20	20			
<i>Artemisia spp.</i>													
<i>Caragana microphylla</i>	-26.4 (n=1)						10			5			
<i>Caragana stenophylla</i>	-23.1 (n=1)											20	
	-26.9 ± (n=2)									10			
<i>Chenopodium spp.</i>													
	-24.9 ± 0.6 (n=6)		60	30	60	80			80				
<i>Leymus chinensis</i>													
<i>Medicago falcata</i>	-25.6 (n=1)						25						
	-23.8 ± 0.65 (n=3)											80	70
<i>Stipa gobica</i>													90
	-24.8 ± 0.76 (n=4)	90	10		10					5			
<i>Stipa grandis</i>													
unknown C3	-24.4 (n=1)						40						
Site mean $^{13}\Delta_3$ (‰)		15.9	17.4	17.3	17.3	18.0	17.4	17.5	19.8	15.7	16.5	15.5	