

Supplementary Materials

A new net primary productivity model and new management strategy of grassland classification based on CSCS in China

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Table S1. The root: shoot ratio coefficient among different grassland types (unit: g/g C) (Piao *et al.* 2001; 2004)

Grassland type	The ratio of below to aboveground biomass	The ratio of aboveground to total biomass
Temperate meadow-steppe	5.26	0.16
Temperate steppe	4.25	0.19
Temperate desert-steppe	7.89	0.11
High-cold meadow steppe	7.91	0.11
High-cold steppe	4.25	0.19
High-cold desert steppe	7.89	0.11
Temperate steppe-desert	7.89	0.11
Temperate desert	7.89	0.11
High-cold desert	7.89	0.11
Tropical herbosa	4.42	0.18
Tropical shrub herbosa	4.42	0.18
Warm-temperate herbosa	4.42	0.18
Warm-temperate shrub herbosa	4.42	0.18
Lowland meadow	6.31	0.14
Temperate montane meadow	6.23	0.14
Alpine meadow	7.92	0.11
Marsh	15.68	0.06

References

- Piao, S. L., Fang, J. Y., and Guo, Q. H. (2001) Application of casa model to the estimation of Chinese terrestrial net primary productivity. *Chinese Journal of Plant Ecology* (05), 603-644. [in Chinese]
- Piao, S. L., Fang, J. Y., He, J. S., and Xiao, Y. (2004). Spatial distribution of grassland biomass in China. *Chinese Journal of Plant Ecology* (04), 491-498. [in Chinese]

Table S2. Land cover type of MODIS-IGBP (Moderate-resolution Imaging Spectroradiometer-International Geosphere-Biosphere Programme)

Number	Class name	Description
1	Evergreen Needleleaf Forests	Dominated by evergreen conifer trees (canopy >2 m). Tree cover >60%.
2	Evergreen Broadleaf Forests	Dominated by evergreen broadleaf and palmate trees (canopy>2 m). Tree cover >60%.
3	Deciduous Needleleaf Forests	Dominated by deciduous needleleaf (larch) trees (canopy >2m). Tree cover >60%.
4	Deciduous Broadleaf Forests	Dominated by deciduous broadleaf trees (canopy >2 m). Tree cover >60%.
5	Mixed Forests	Dominated by neither deciduous nor evergreen (40-60% of each) tree type (canopy >2 m). Tree cover >60%.
6	Closed Shrublands	Dominated by woody perennials (1-2 m height) >60% cover.
7	Open Shrublands	Dominated by woody perennials (1-2 m height) 10-60% cover.
8	Woody Savannas	Tree cover 30-60% (canopy >2 m).
9	Savannas	Tree cover 10-30% (canopy >2 m).
10	Grasslands	Dominated by herbaceous annuals (<2 m).
11	Permanent Wetlands	Permanently inundated lands with 30-60% water cover and >10% vegetated cover.
12	Croplands	At least 60% of area is cultivated cropland.
13	Urban and Built-up lands	At least 30% impervious surface area including building materials, asphalt, and vehicles.
14	Cropland/Natural Vegetation Mosaic	Mosaics of small-scale cultivation 40-60% with natural tree, shrub, or herbaceous vegetation.
15	Permanent Snow and Ice	At least 60% of area is covered by snow and ice for at least 10 months of the year.
16	Barren	At least 60% of area is non-vegetated barren (sand, rock, soil) areas with less than 10% vegetation.
17	Water bodies	At least 60% of area is covered by permanent water bodies.

Table S3. MODIS IGBP land cover type merger plan

Merge type	MODIS IGBP type (code)
Water body (1)	Water body (0)
Woodland (2)	Evergreen Needleleaf Forest (1), Evergreen Broadleaf Forest (2), Deciduous Needleleaf Forest (3), Deciduous Broadleaf Forest (4), Mixed Forests (5), Closed Shrublands (6), Open woodland (18)※
Grasslands (3)	Open Shrublands (7), Savannas (9), Grasslands (10), Permanent Wetlands (11), Barren or Sparsely Vegetated (16)*, Woody Savannas(8)※
Human occupation (4)	Cropland (12), Urban areas (13), Cropland-Natural Vegetation Mosaic (14)
Permanent snow (5)	Permanent snow (15)
Difficult to use land (6)	Difficult to use land (17)*

* Reclassify IGBP's "Barren or Sparsely Vegetated" type (16), and define the area with an NDVI value of less than 0.1 every August as hard-to-use land (Gobi, desert, tidal flat, etc.), and the rest was divided into desert grassland; ※ The "Woody Savanna" types (8) scattered in the southern part of China were corrected with grassland resource type maps. Both MODIS IGBP and ground surveys believe that grassy areas were divided into tree-rich tropical grasslands (8), and the rest were divided into sparse woodland (18).

Table S4. The relationship between class and its corresponding super-class group in CSCS (Ren *et al.* 2008)

Code	GDD0 (°C)	K-value	Super-class group	Included Class code ^a
1	0-1300	>0	Tundra and alpine steppe	IA1, IB8, IC15, ID22, IE29, IF36
2	1300-5300	0-0.3	Frigid desert	IIA2, IIIA3, IVA4
3	1300-6200	0.3-0.9	Semi desert	IIB9, IIIB10, IVB11, VB12
4	1300-6200	0.9-1.2	Steppe	IIC16, IIIC17, IVC18, VC19
5	1300-3700	1.2-2.0	Temperate humid grassland	IID23, IIID24, IIE30, IIIE31
6	1300-5300	>1.2	Temperate forest steppe	IVD25, IVE32, IIF37, IIIF38, IVF39
7	5300-8000	>1.2	Sub-tropical forest steppe	VD26, VID27, VE33, VIE34, VF40, VIF41
8	>8000	>1.5	Tropical forest steppe	VIIE35, VIIF42
9	>5300	0-0.3	Warm desert	VA5, VIA6, VIIA7
10	>6200	0.3-1.5	Savanna	VIB13, VIIB14, VIC20, VIIC21, VIID28

Refer to Appendix Table 5 for the name and coding of category a.; K-value (moisture index) is expressed as the ratio between annual precipitation and > 0°C annual cumulative temperature: $K = r / (0.1 \times \text{GDD0})$ where: r is annual precipitation, GDD0 (°C) is > 0°C annual cumulative temperature.

Table S5. The code and its name of classes (1-42) in CSCS (Ren *et al.* 2008)

Code	Name	Code	Name
IA1	Frigid-extrarid frigid desert, alpine desert	ID22	Frigid-subhumid moist tundra, alpine meadow steppe
IIA2	Cold temperate-extrarid montane desert	IID23	Cold temperate subhumid montane meadow steppe
IIIA3	Cool temperate-extraid temperate zonal desert	IIID24	Cool temperate-subhumid meadow steppe
IVA4	Warm temperate-extrarid warm temperate zonal desert	IVD25	Warm temperate-subhumid forest steppe
VA5	Warm-extrarid subtropical desert	VD26	Warm-subhumid deciduous broad leaved forest
VIA6	Subtropical-extrarid subtropical desert	VID27	Subtropical-subhumid sclerophyllous forest
VIIA7	Tropical-extrarid tropical desert	VIID28	Tropical-subhumid tropical xerophytic forest
IB8	Frigid-arid frigid zonal semidesert, alpine semidesert	IE29	Frigid-humid tundra, alpine meadow
IIB9	Cold temperate-arid montane semidesert	IIE30	Cold temperate-humid montane meadow
IIIB10	Cool temperate-arid temperate zonal semidesert	IIIE31	Cool temperate-humid forest steppe, deciduous broad leaved forest
IVB11	Warm temperate-arid warm temperate zonal semidesert	IVE32	Warm temperate-humid deciduous broad leaved forest
VB12	Warm-arid warm subtropical semidesert	VE33	Warm-humid evergreen-deciduous broad leaved forest
VIB13	Subtropical arid subtropical desert brush	VIE34	Subtropical-humid evergreen broad leaved forest
VIIIB14	Tropical arid tropical desert brush	VIIIE35	Tropical-humid seasonal rain forest
IC15	Frigid-semiarid dry tundra, alpine steppe	IF36	Frigid perhumid rain tundra, alpine meadow
IIC16	Cold temperate-semiarid montane steppe	IIF37	Cold temperate perhumid taiga forest
IIIC17	Cool temperate-semiarid temperate typical steppe	IIIF38	Cool temperate perhumid mixed coniferous broad leaved forest
IVC18	Warm temperate-semiarid warm temperate typical steppe	IVF39	Warm temperate perhumid deciduous broad leaved forest
VC19	Warm-semiarid subtropical grasses-fruticous steppe	VF40	Warm-perhumid deciduous-evergreen broad leaved forest
VIC20	Subtropical-semiarid subtropical brush steppe	VIF41	Subtropical perhumid evergreen broad leaved forest
VIIC21	Tropical-semiarid savanna	VIIF42	Tropical-perhumid rain forest