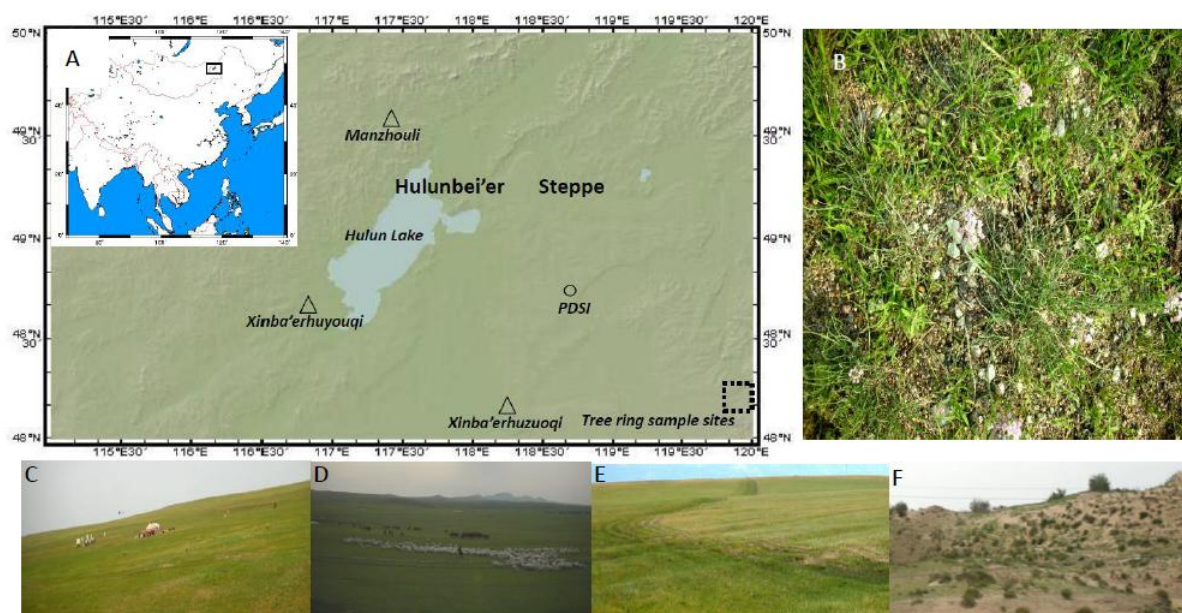
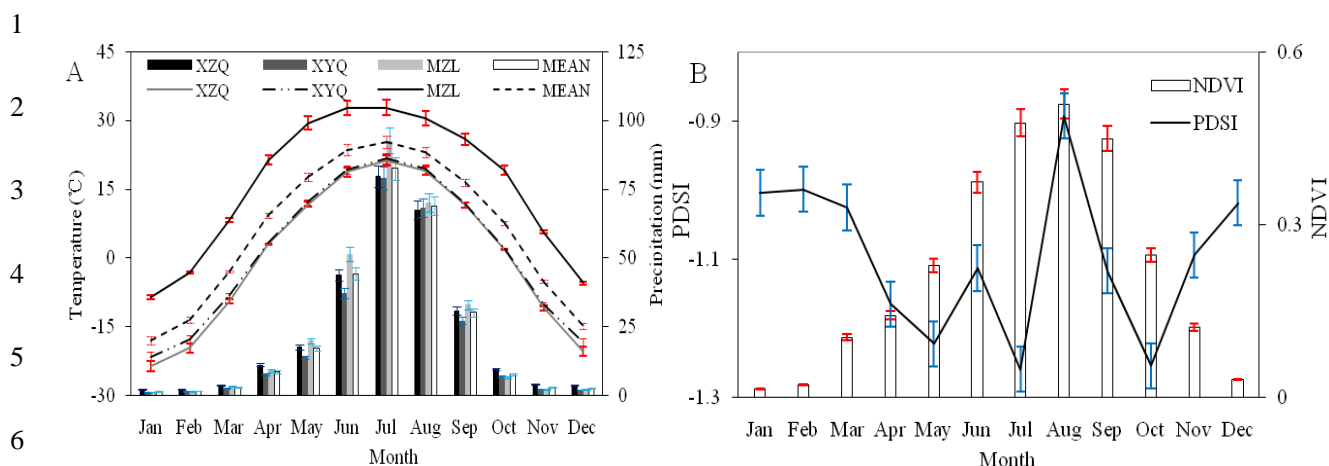


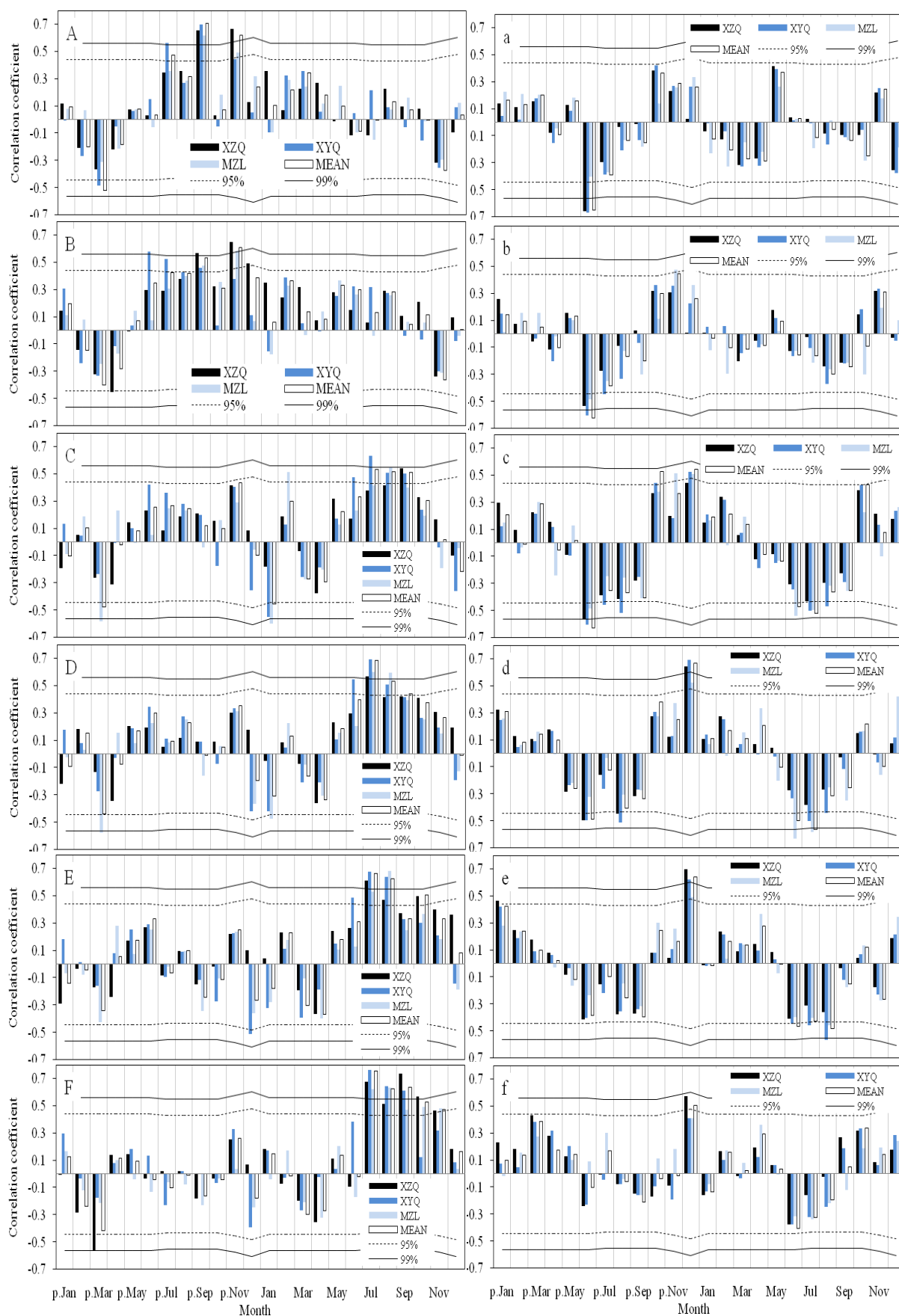
1 **Appendix material**

2  
 3 Appendix Fig. 1. (A) Locations of the selected NDVI area (satellite image), tree-ring sampling  
 4 sites (rectangle with dashed line rim), meteorological stations (triangle), gridded PDSI (circle)  
 5 in the typical steppe of the Hulunbei'er, Inner Mongolia. (B) some dominant species of  
 6 perennial and annual grasses for land cover; (C) temporary residence of nomad; (D) nomadic  
 7 pasture; (E) highly disturbed grassland; and (F) grassland desertification.

8



7 **Appendix Fig. 2.** (A) Monthly mean temperatures (curves) and monthly total precipitation  
 8 (histograms) with their error bars (5%) based on the available records from the Manzhouli  
 9 (MZL, December, 1956 to December, 2007), Xinba'erhuzuoqi (XZQ, November, 1958 to  
 10 December, 2007), Xinba'erhuyouqi (XYQ, October, 1957 to December, 2007) meteorological  
 11 station and their average (MEAN; January, 1959 to December, 2007); and (B) Monthly mean  
 12 PDSI (curve, January, 1891 to December, 2005) and monthly mean NDVI (histograms, July,  
 13 1981 to October, 2001) with their error bars (5%) for the selected study area.



**Appendix Fig. 3.** Correlations of May, June, July, August, September and October NDVI with monthly precipitation (A, B, C, D, E, and F, respectively) and temperatures (a, b, c, d, e and f,

1 respectively) from meteorological station of Manzhouli (MZL), Xinba'erhuyouqi (XYQ),  
2 Xinba'erhuzuoqi (XZQ) and their average (MEAN). The black dashed lines are the 95%  
3 confidence limits and the black solid lines are the 99% confidence limits. "p." denotes the  
4 prior year.  
5

1 **Appendix Table 1. Statistics for the correlation analysis<sup>@</sup>**

(A)	$r_m$	$r_y$	$r_r$	$PCI_m$	$PCI_y$	$PCI_r$	Time span
Precipitation	0.623**	0.749**	0.245*~0.822**	75.09%	81.16%	67.72%~83.90%	1959~2008
Temperature	0.936**	0.965**	0.733**~0.980**	95.75%	97.69%	86.43%~96.25%	1959~2008
(B)							
NDVI <sub>a</sub>	0.539*		0.053~0.850**				1981~2001
NDVI <sub>r</sub>	0.602**		0.355**~0.955**				1891~2005

2 \* indicates  $p < 0.05$ , and \*\* indicates  $p < 0.01$ .

3 <sup>@</sup> (A) correlations of precipitation and temperature between the three selected meteorological stations; and  
 4 (B) correlations of NDVI between different month from May to October. NDVI<sub>a</sub> and NDVI<sub>r</sub> indicate actual  
 5 NDVI and reconstructed NDVI respectively.  $r_m$ ,  $r_y$  and  $r_r$  indicate the mean correlation coefficient of  
 6 monthly, the mean correlation coefficient of yearly and the range of correlation coefficient of monthly and  
 7 yearly meteorological variables between the three selected meteorological stations respectively.  $PCI_m$ ,  
 8  $PCI_y$  and  $PCI_r$  indicate the mean first principal component ( $PCI$ ) variance explanation of monthly, the  
 9 mean  $PCI$  variance explanation of yearly, and the range of  $PCI$  variance explanation of monthly and yearly  
 10 meteorological variables between the three selected meteorological stations respectively.

11

1 Appendix **Table 2** The significant peaks ( $\geq 95\%$  confidence level) of MTM spectral density  
 2 for the NDVI reconstructions

Time span	$\alpha(\%)$	Significant Periodicity (year)			
		8~10	6~7.9	4~5.9	2~3.9
	95	8.0~8.3	6.8~7.5	4.0,4.1	2.4,2.6
May	99				2.5
	95		6.7~7.4	4.6,4.8,4.9	2.5,3.7,3.8
June	99				
	95				
July	99			4.1	2.4
	95			4.0~4.1	2.3,2.5,2.6,3.7~3.9
August	99				2.4
	95		6.7~7.1	4.1,4.3,4.4,4.6,4.8,4.9	2
September	99				
	95		6.8,7.1~7.5	4.1,4.8,4.9	3.7
October	99		6.9,7.0		
	95	8.0~8.2	6.1,6.2,6.6,6.7,7.6~7.9	4.2,4.8,4.9	2.4,2.5,3.7,3.8
Mean	99		6.8~7.5	4.0,4.1,4.3~4.6	
	95			4.1	2.3,2.4,3.7
Mean*	99			4.0	3.8,3.9

3  $\alpha$  indicates confidence level; Mean indicates the seasonal reconstructions from May to October; and \*

4 indicates the tree-ring based reconstruction