

Changes of Ecosystem & Societies on the Mongolia Plateau: Coupled Regulations of Landuse and Changing Climate

Jiquan Chen, Ranjeet John, Nan Lu, Burkhard Wilske, Changliang Shao, Linhao Li,
Lin Zhen, Shiqiang Wan, and others



LANDSCAPE ECOLOGY &
ECOSYSTEM SCIENCE



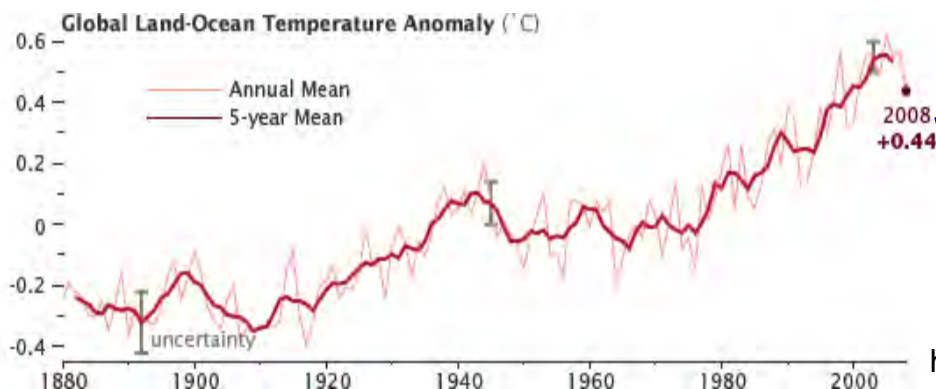
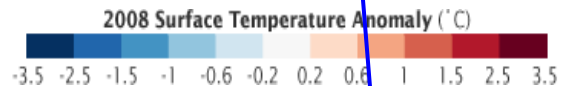
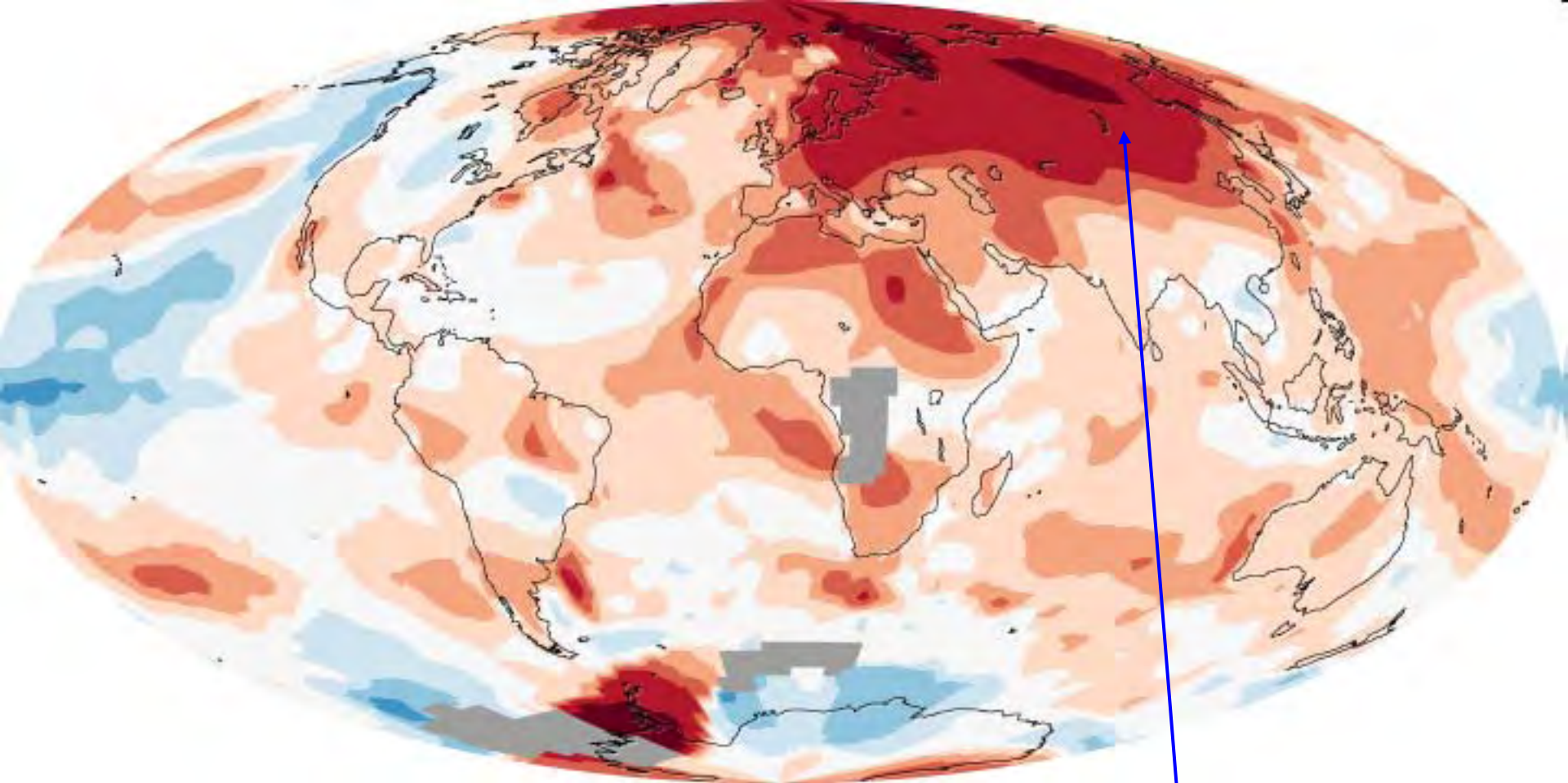
The NEESPI Region



MG

IM

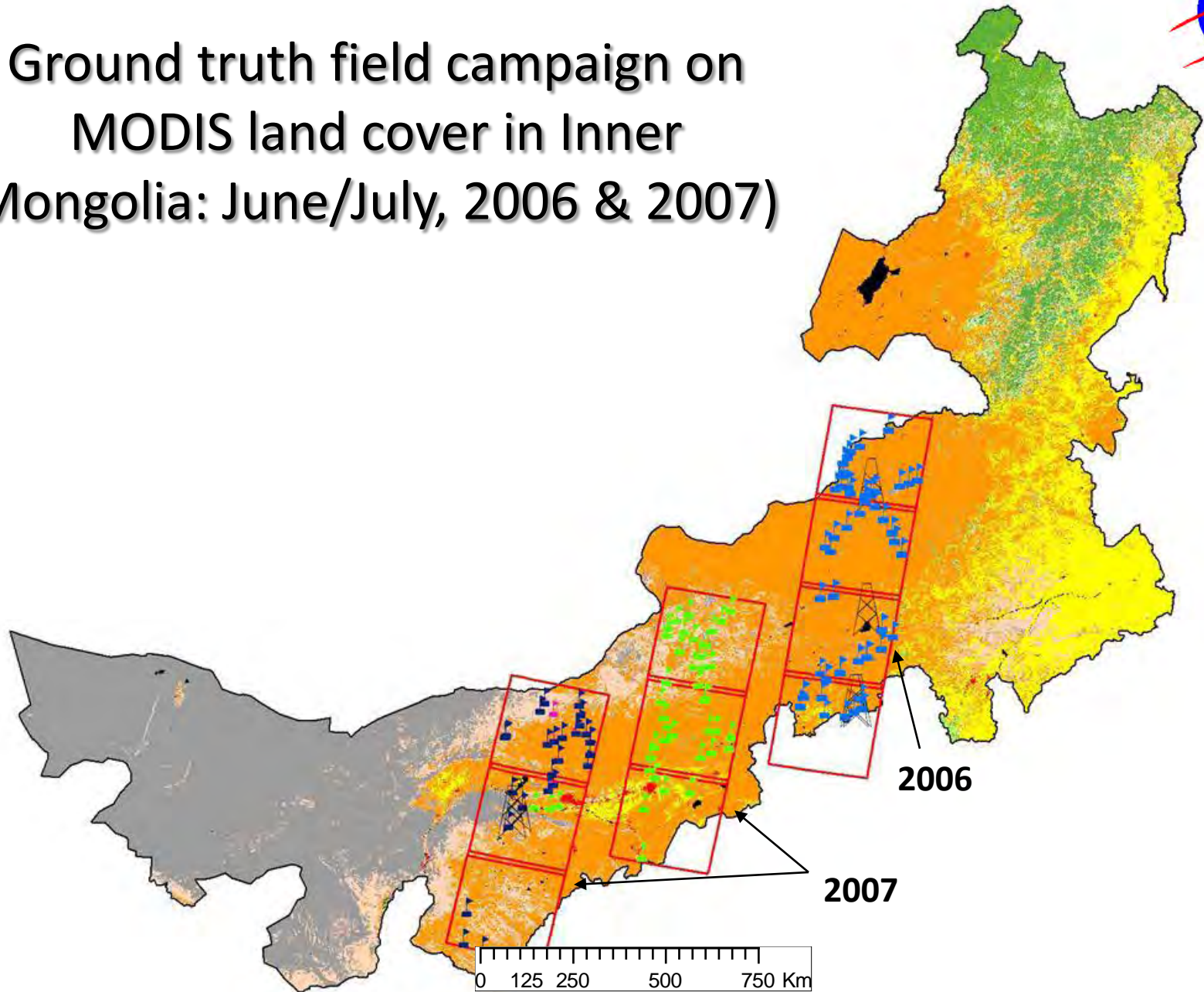
Groissman et al , 2009



Why focus research on Mongolia Plateau ?



Ground truth field campaign on MODIS land cover in Inner Mongolia: June/July, 2006 & 2007)





Typical grassland in Dongwu



Degraded grassland in Xilinhot



Stipa krylovii grassland in Duolun



Cropland in Duolun



Direct measurements of surface reflectance

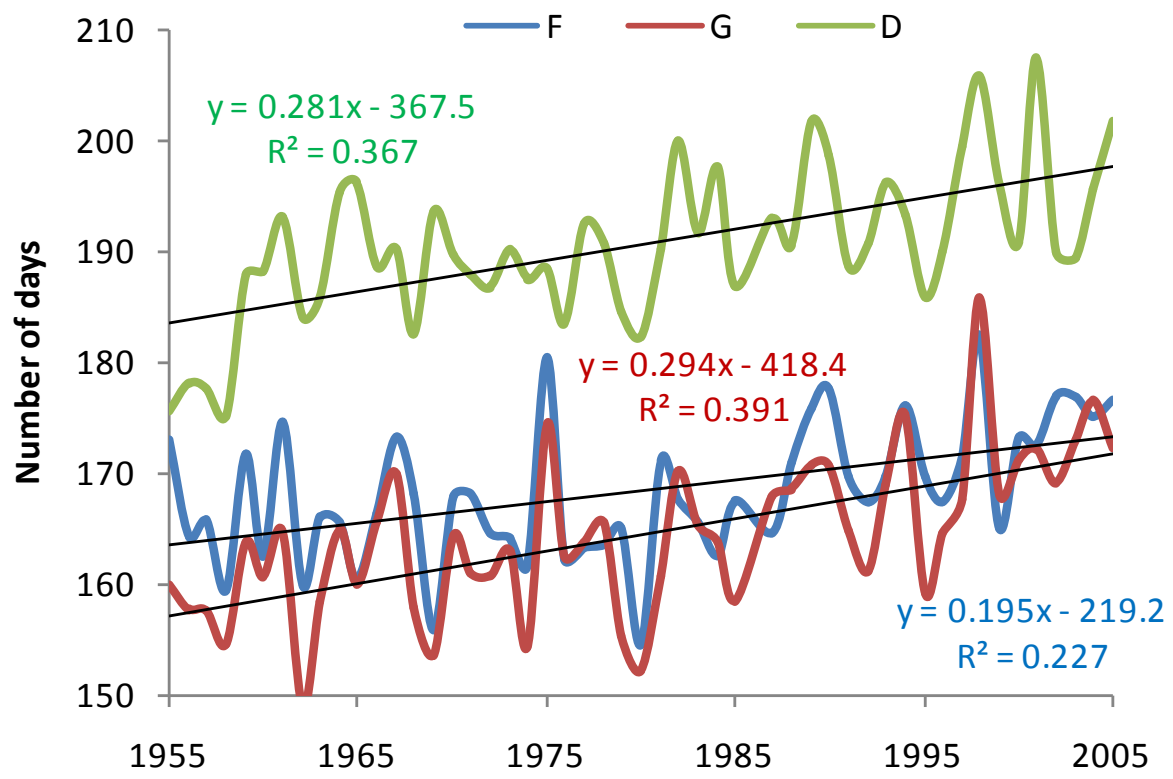


Direct measurements of vegetation and soil properties

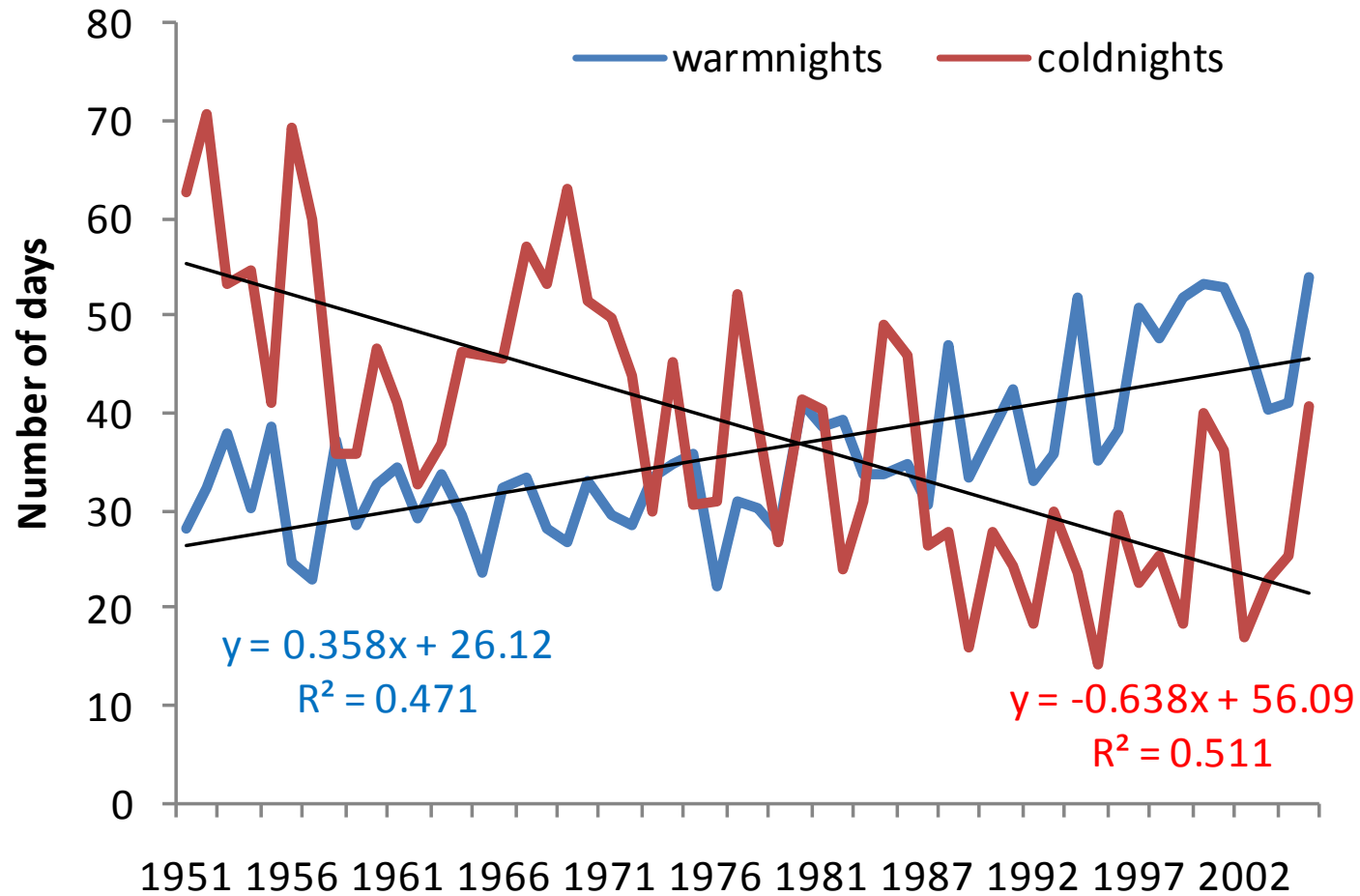




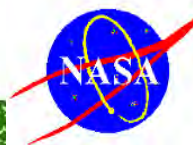
Comparison of trend in growing season length (GSL) among three biomes



Regional trend of warm nights and cold nights

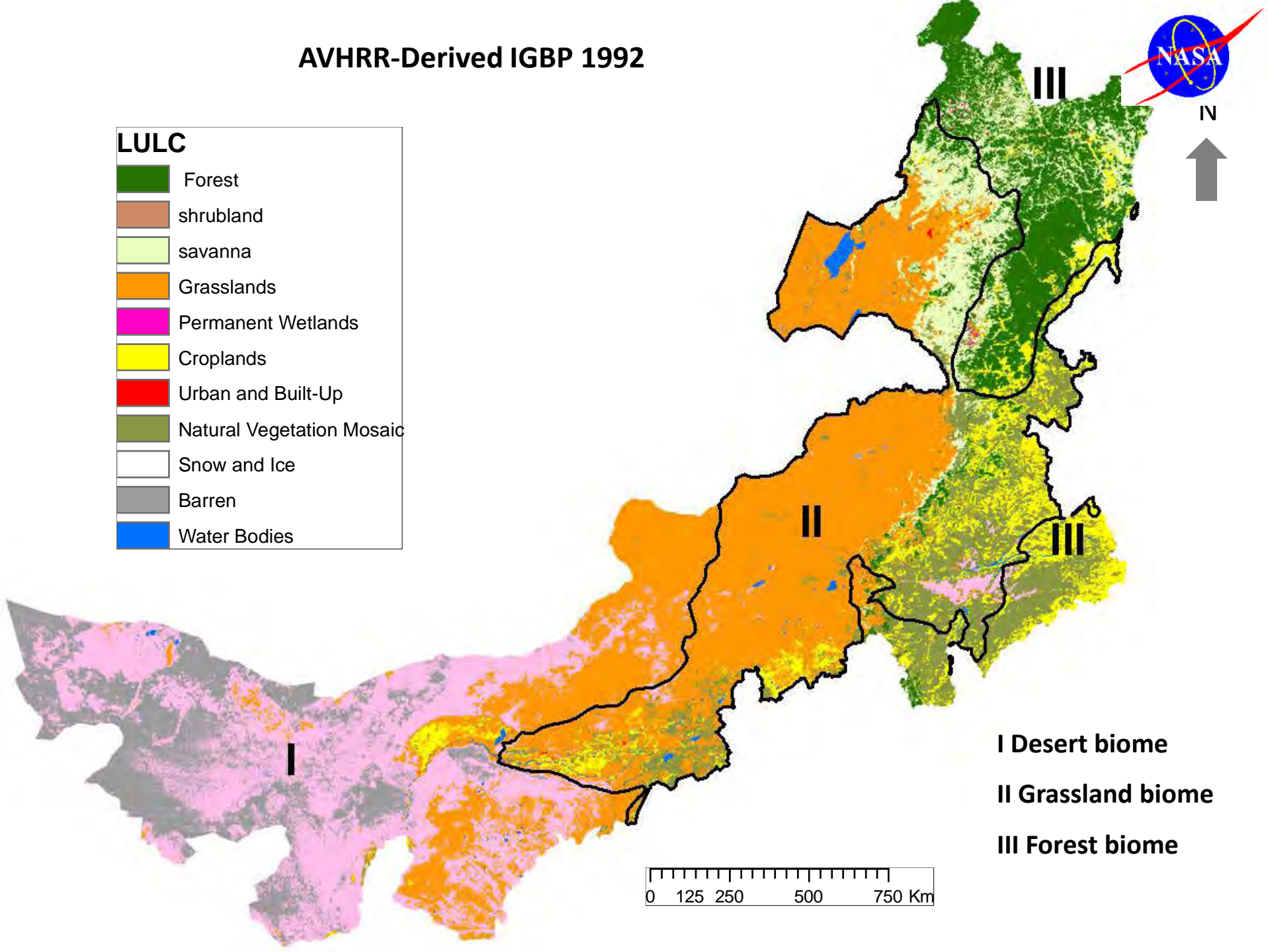


AVHRR-Derived IGBP 1992

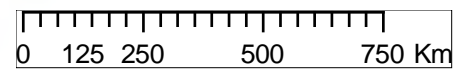


LULC

- Forest
- shrubland
- savanna
- Grasslands
- Permanent Wetlands
- Croplands
- Urban and Built-Up
- Natural Vegetation Mosaic
- Snow and Ice
- Barren
- Water Bodies



- I Desert biome
- II Grassland biome
- III Forest biome



MODIS-Derived IGBP 2004



IV



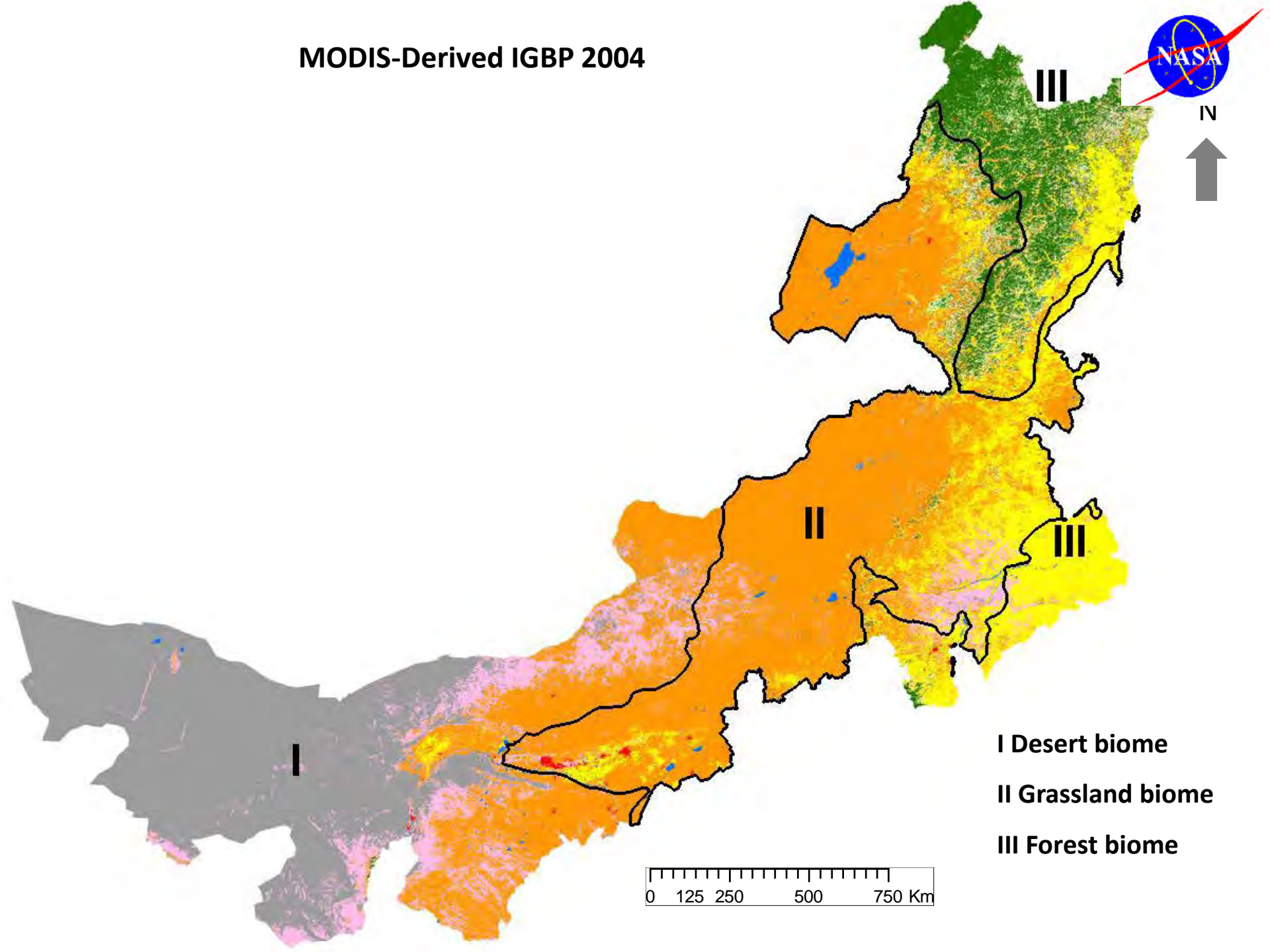
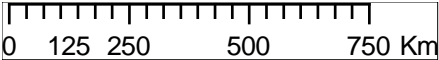
III

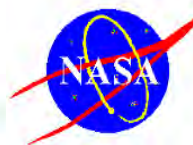
II

III

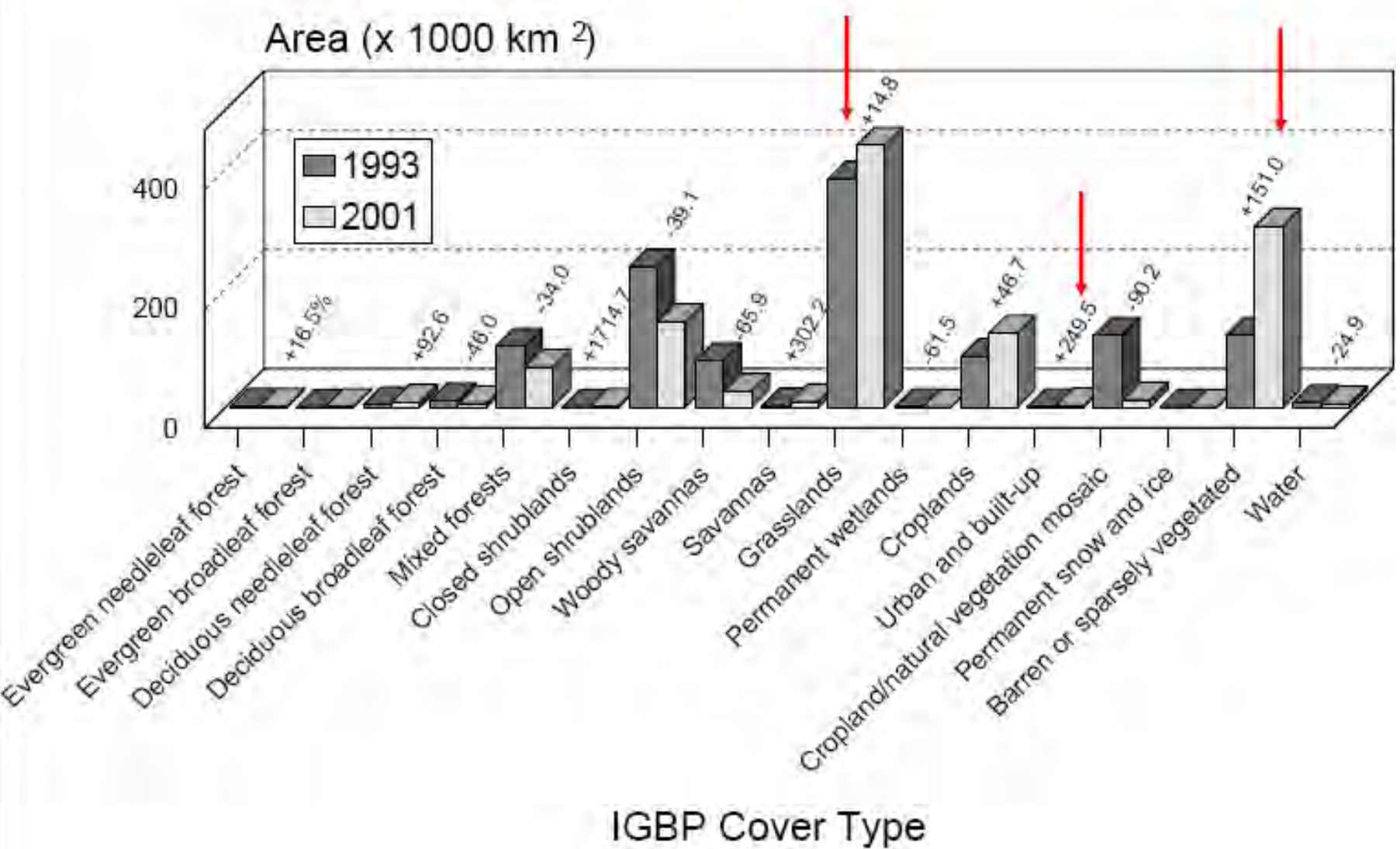
I

- I Desert biome
- II Grassland biome
- III Forest biome



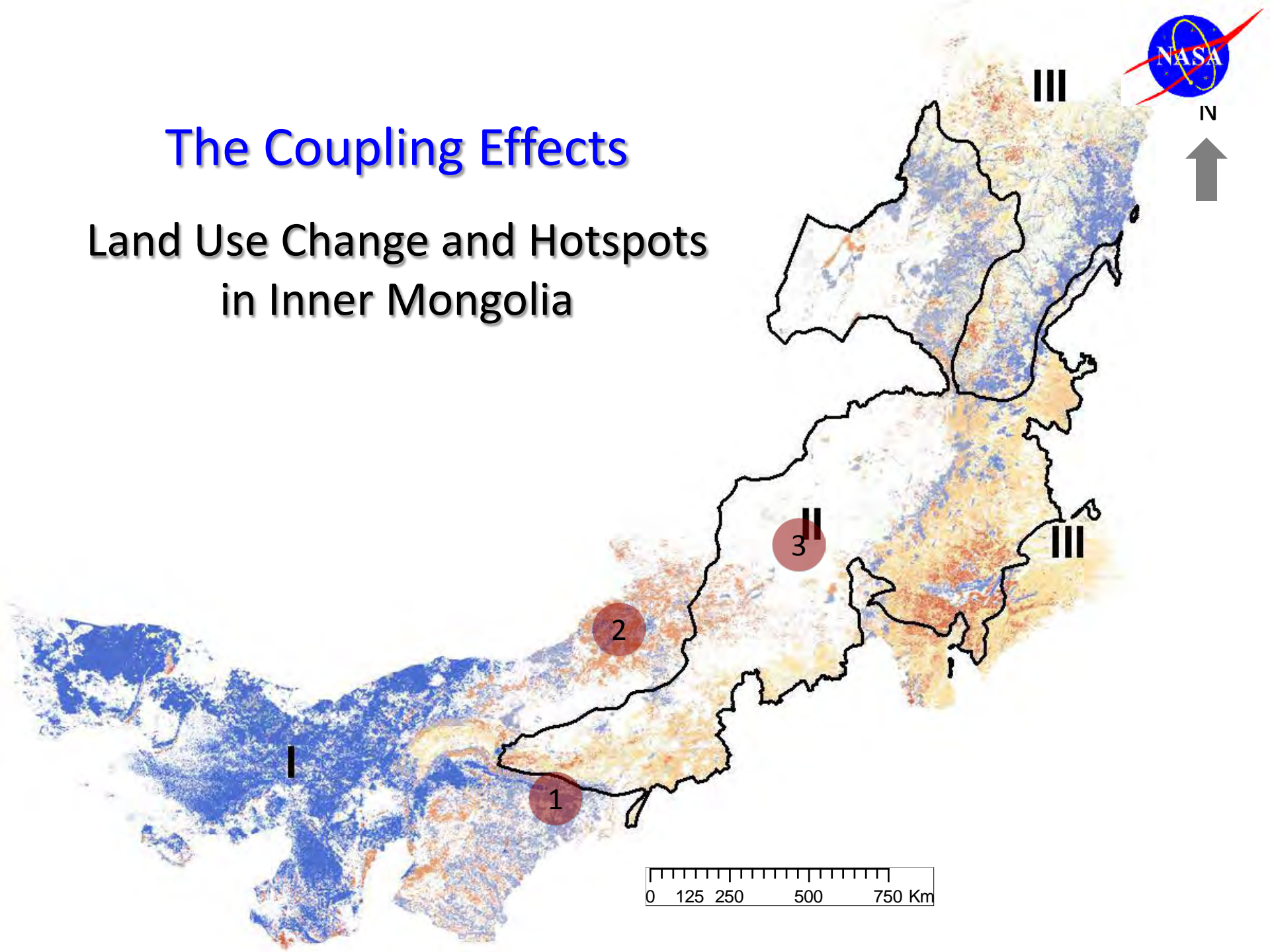


Land cover change between 1993 and 2001 in Inner Mongolia. The numbers are net percent change with negative sign indicating a decrease.



The Coupling Effects


Land Use Change and Hotspots in Inner Mongolia






Repeated ANOVA tests: Coupled Effects of Climate and Landuse on GPP & ET

(1) Gross Primary Production (GPP)

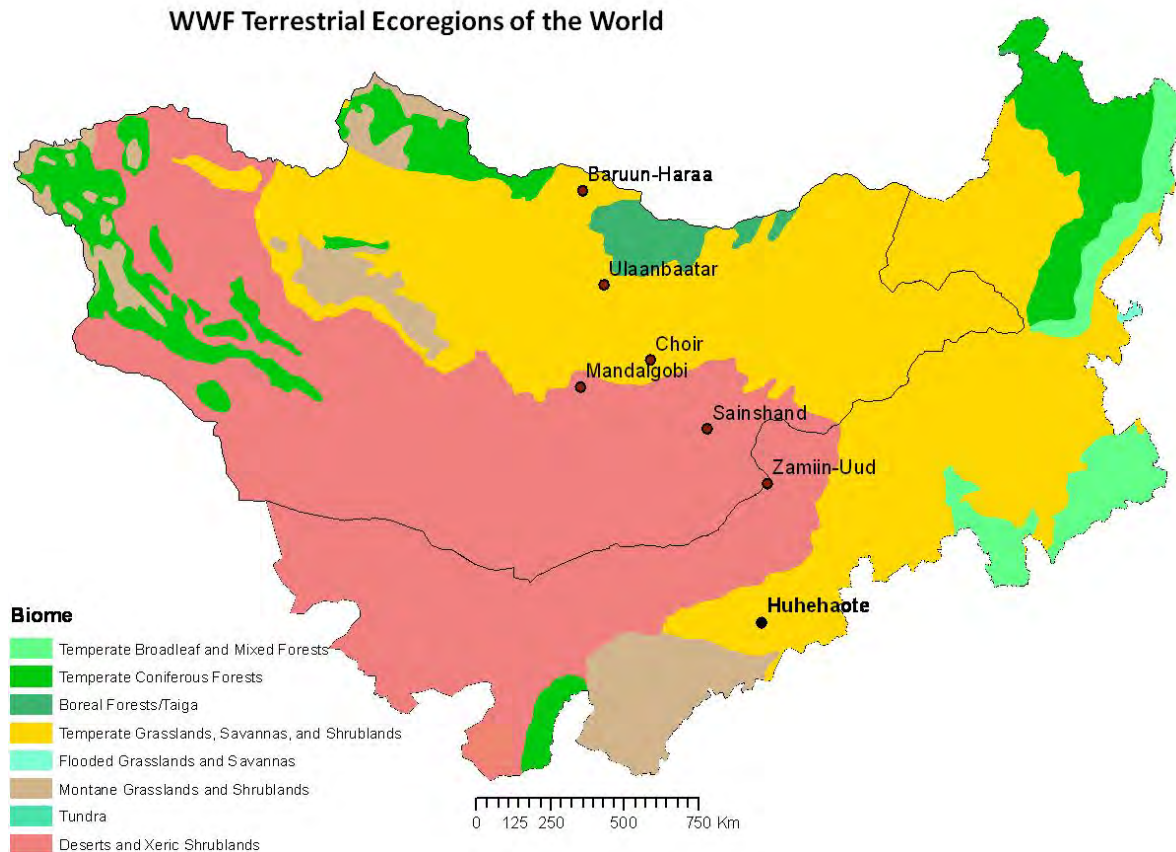
	SSE	%	
Type	2.8924	64.3	 2.4
Year	1.20423	26.8	
Year*type	0.40085	8.9	
total	4.49748		

(2) Evapotranspiration (ET)

	SSE	%	
Type	11425.4	83.6	 5.77
Year	1981.1	14.5	
Year*type	257.1	1.9	
total	13663.6		

Moving Forward: Mongolia Plateau

- Two contrasting counties (IM & MG)
- Adaptation as the central focus
- Natural and Human System as one Unit



Interactive Changes of Ecosystems and Societies on the Mongolian Plateau Coupled Regulations from Land Use and Changing Climate



US Institutions: Jiquan Chen (Univ of Toledo); Steve McNulty & Ge Sun (SGCP-USDA)

Chinese Inst.: Lin Zhen & Xiangzheng Deng (IGSNRR-CAS); Jian Ni, Ke Guo & Linghao Li (IBCAS-CAS)

Mongolian Inst.: Ochirbat Batkhishig & Dechingungaa Dorjgotov (IG, Mongolian Academy of Sciences)

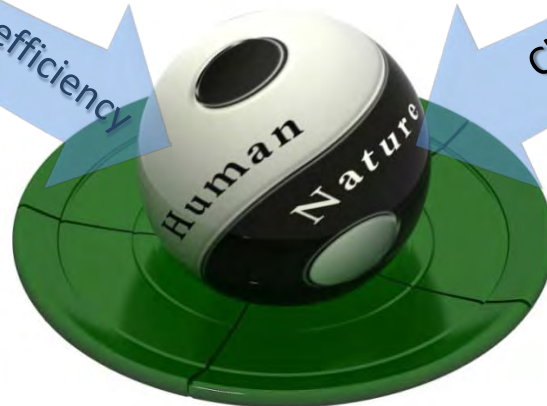
Project Supporting Webpage: <http://research.eeescience.utoledo.edu/lees/NASA06/chn/>

Land Use & Change

Climate Change

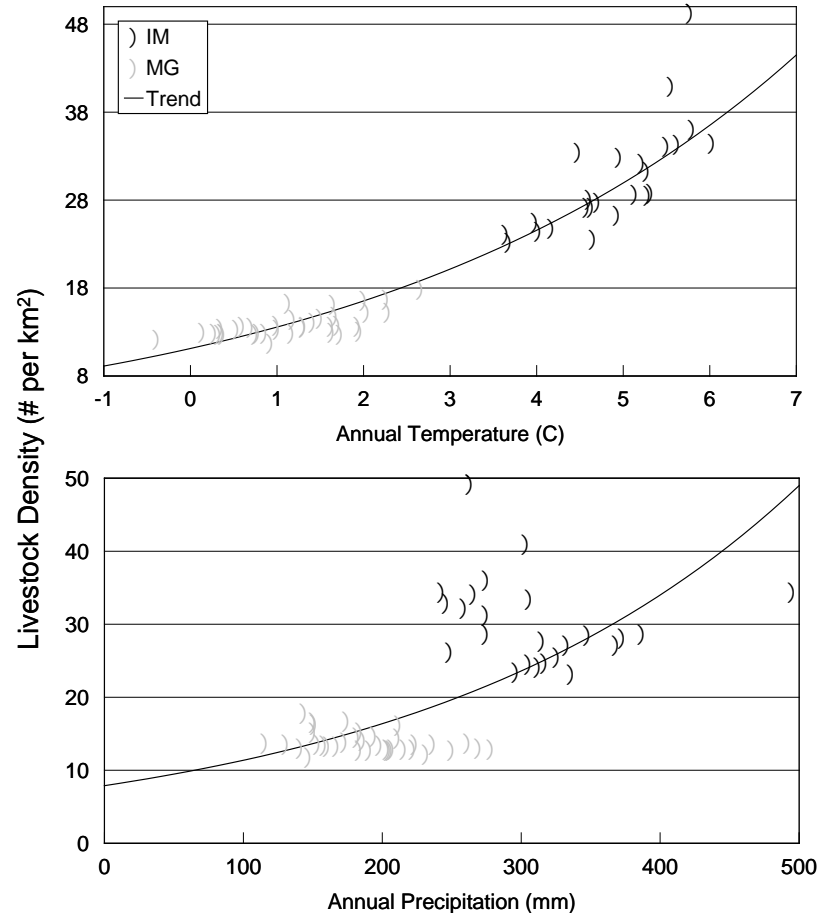
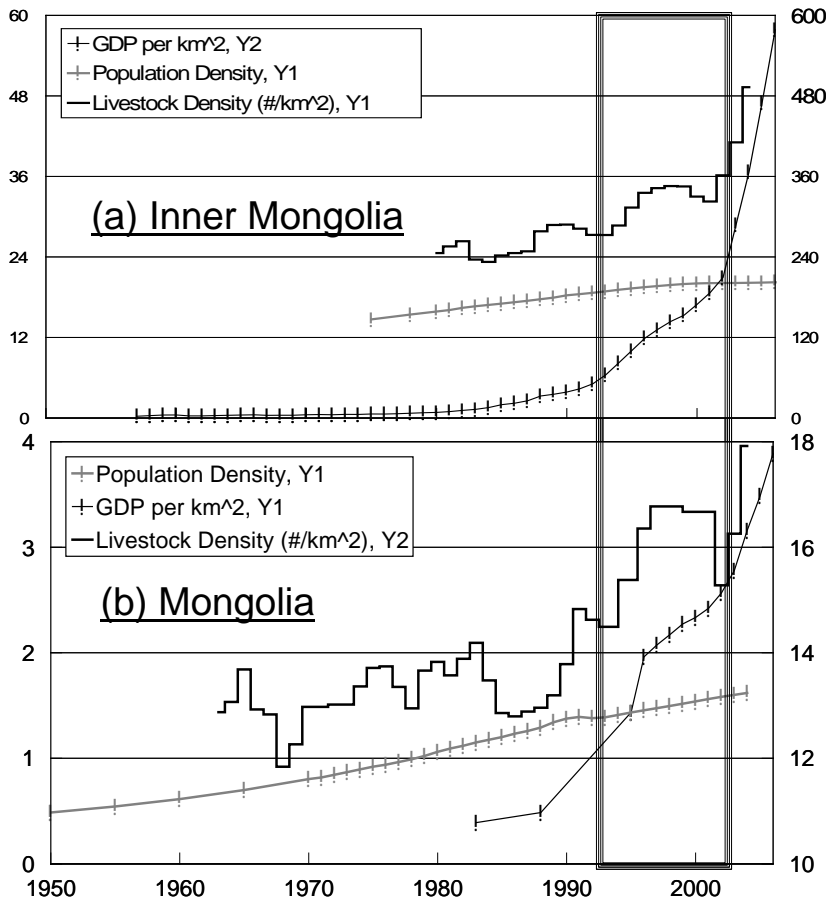
Resource availability & use efficiency

Climatic change and adaptation



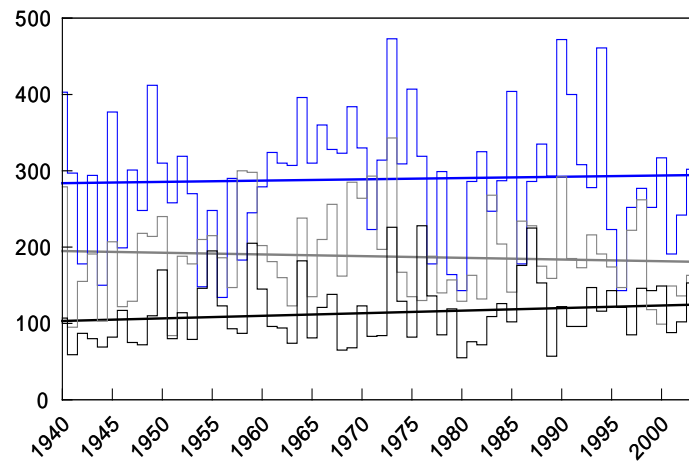
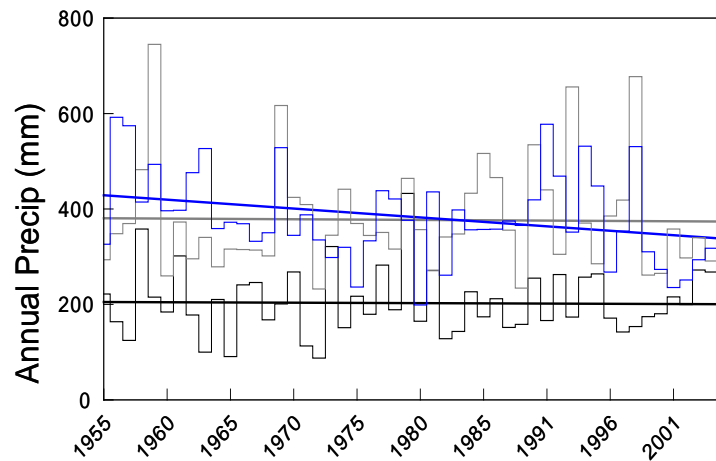
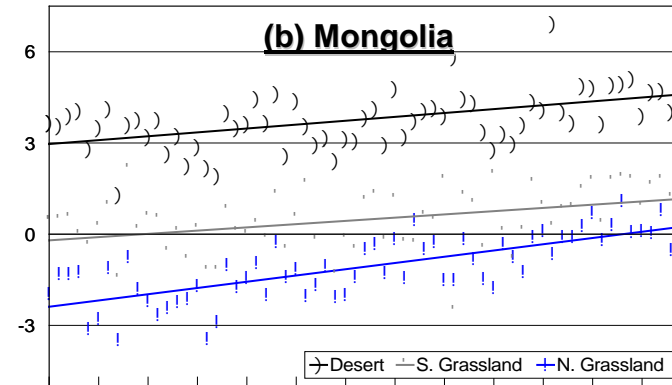
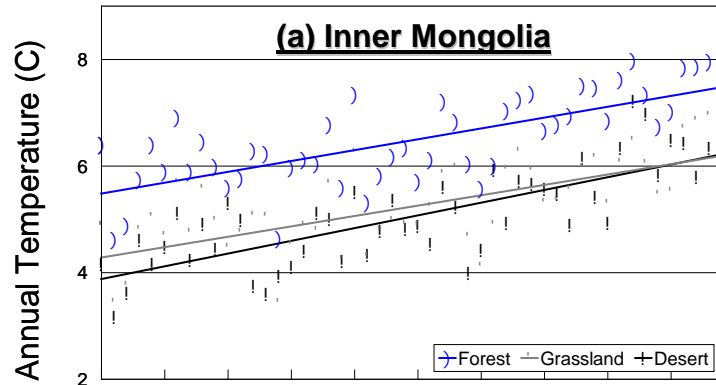


Changes in three socioeconomic variables, temperature, and precipitation. While similar patterns between IM and MG exist, MG had significantly lower magnitudes of all three variables.

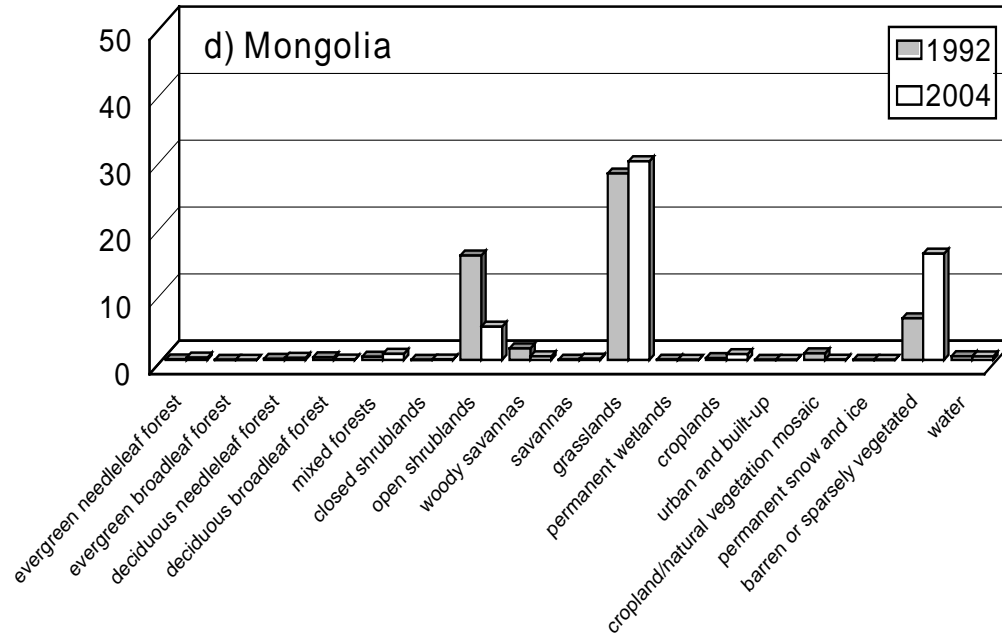
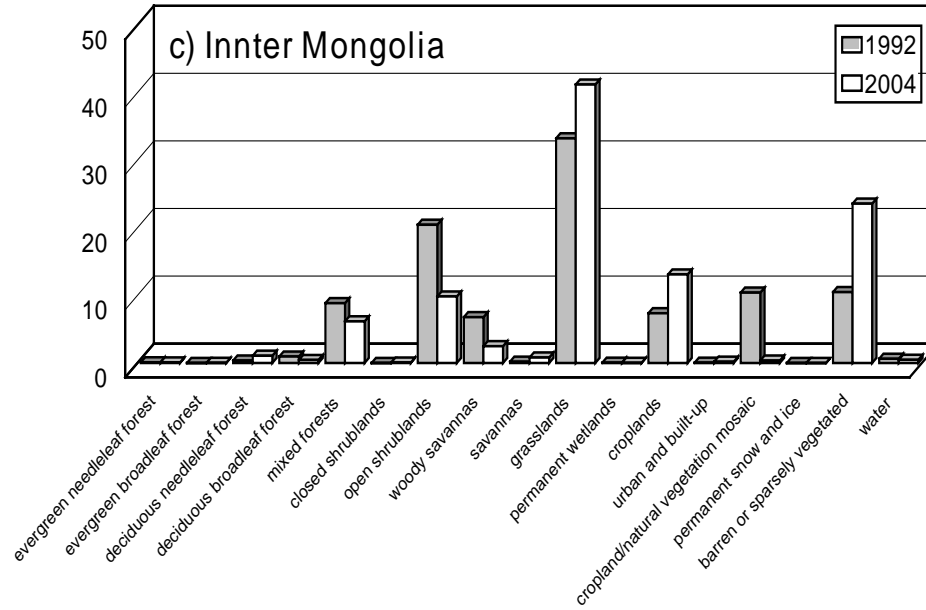




Changes in climate (temperature, precipitation from 12 selected stations) and land use in IM and MG in recent decades.



Land Use Change





Objective

To examine and model the interactive changes of **NS** and **HS** in the time and space of **IM** and **MG** under similar climate but different land-use conditions.

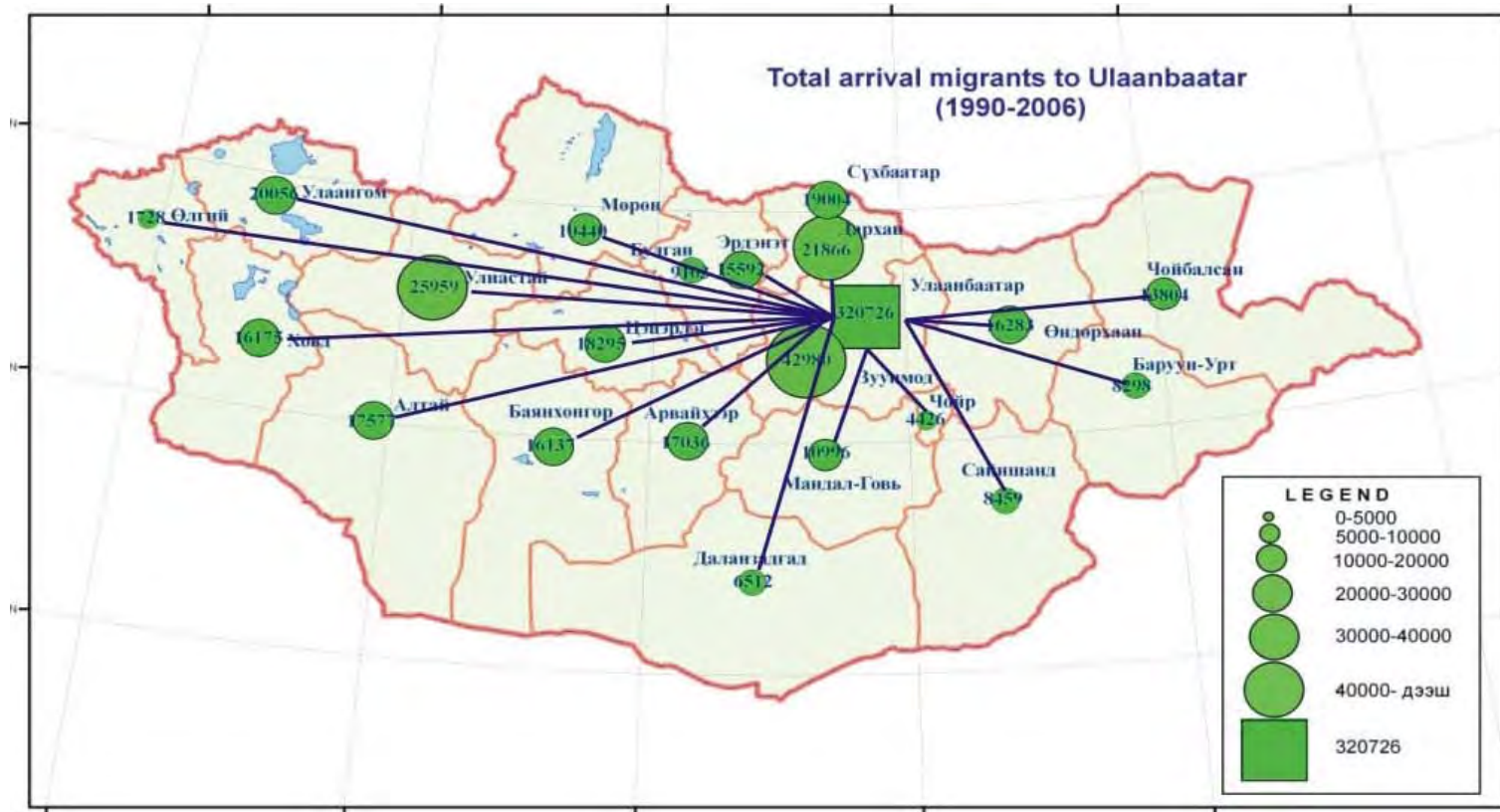




Table 1. Selected measures of the *HS* and *NS* as well as the interactions and feedbacks between the elements of the *HS* and *NS*

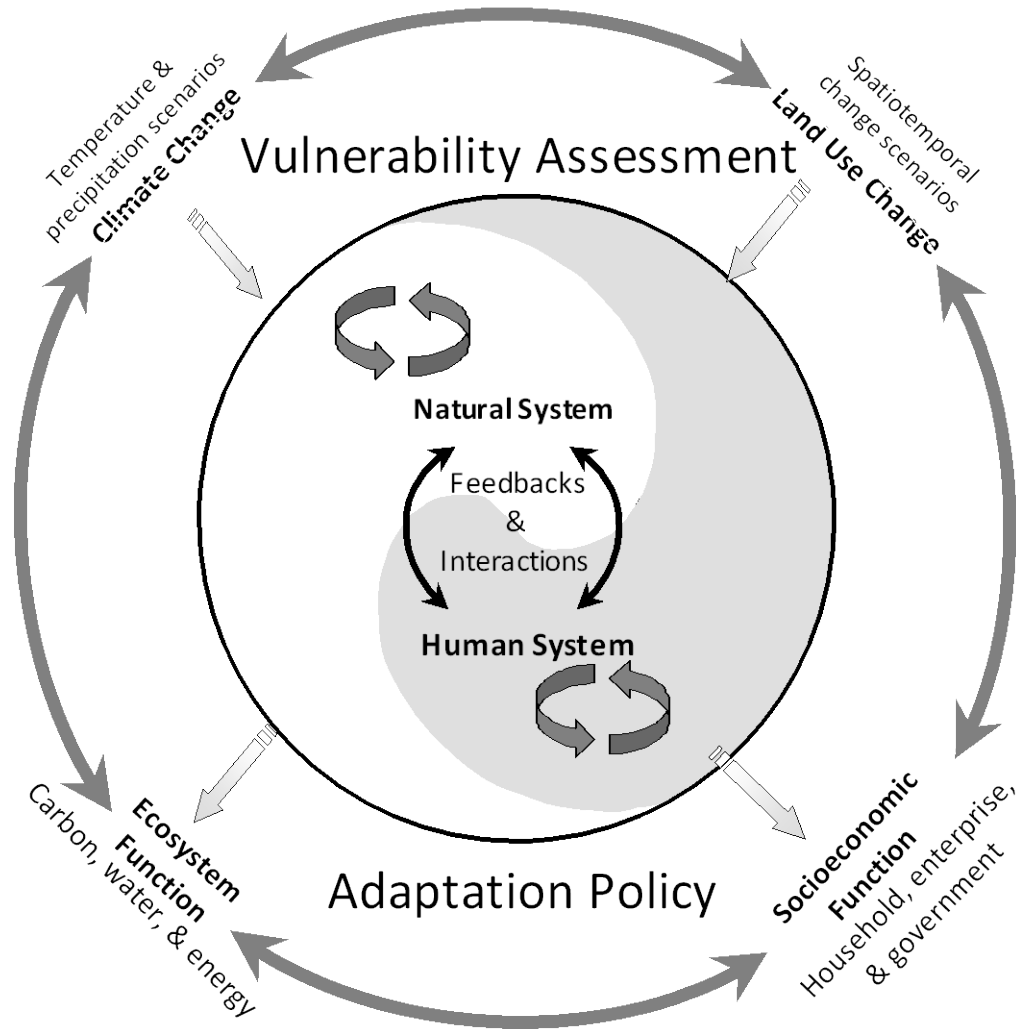
Measure	IM	MG
Human System (HS)		
Population (POP)(2006)	23924000	2533100
Population Density (POPD) (No. km ⁻²)	20.2	1.7
Livestock (LS) (heads, 2006)	58332000	28027900
GDP (billion \$)	70.256	6.08
GDP per capital (\$)	2936	2401
Livestock per person	2.438	11.065
Natural System (NS)		
Land Area (km ²)	1183000	1564116
(km ²)	225533	(10.87)
(%)	(19.06)	
Grassland (km ²)	548441	(44.09)
(%)	(46.36)	
Desert (km ²)	372478	(44.98)
(%)	(31.49)	
Temperature Increase (ΔT) ($^{\circ}\text{C}.\text{decade}^{-1}$)	0.4329	0.2935
GPP (Kg C.m ²)	0.919	0.707
(STD)	(0.298)	(0.328)
Total GPP (Pg C.year ⁻¹) (2006)	1.0872	1.1052
Water Resource (WR, m ³ .m ⁻²)	0.01	0.025
GPP:WR (Mg C.m ⁻³)	91.90	28.26
Interactions (NS ~ HS)		
GPP:Pop (Mg C.Person ⁻¹)	45.44	436.29
GDP:GPP		
LS:POP (No.Person ⁻¹)	2.438	11.065
WR:Pop (m ³ .person ⁻¹)	494.5	15436.8
GPP:LS	18.64	39.43
GDP:GPP (\$.Mg C ⁻¹)	64.62	5.50
GDP:WR (\$.m ⁻³)	5.94	0.16

Present situation of population migration in Mongolia



The internal migration where the flow is oriented toward to Ulaanbaatar and the central region of MG has been a trend. Nearly 70% of the migrants is concentrated in such cities area as Ulaanbaatar, Darkhan, Orkhon and Selenge *aimags* or along the general roads and railway lines. Since 1990, 320 thousand have migrated from rural areas to Ulaanbaatar city and 34 thousands from cities to the countryside (J. Oyungerel, Mongolian Academy of Sciences, 2008).

Conceptual framework





Thank You and Questions!

