人类活动于生态系统变化:

Human Activities and Global Change – Case Study in China

以中国为例来研究人类活动与全球变化

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Science Motivation

- To what extent have human activities affected regional climate change? Or
- To what extent has the climate change affected human system?

- How to discern the human impacts on China's ecosystem dynamics from climate impacts?

Human Activities & Climate Change

- Economic development
- Resources Development
- Population change

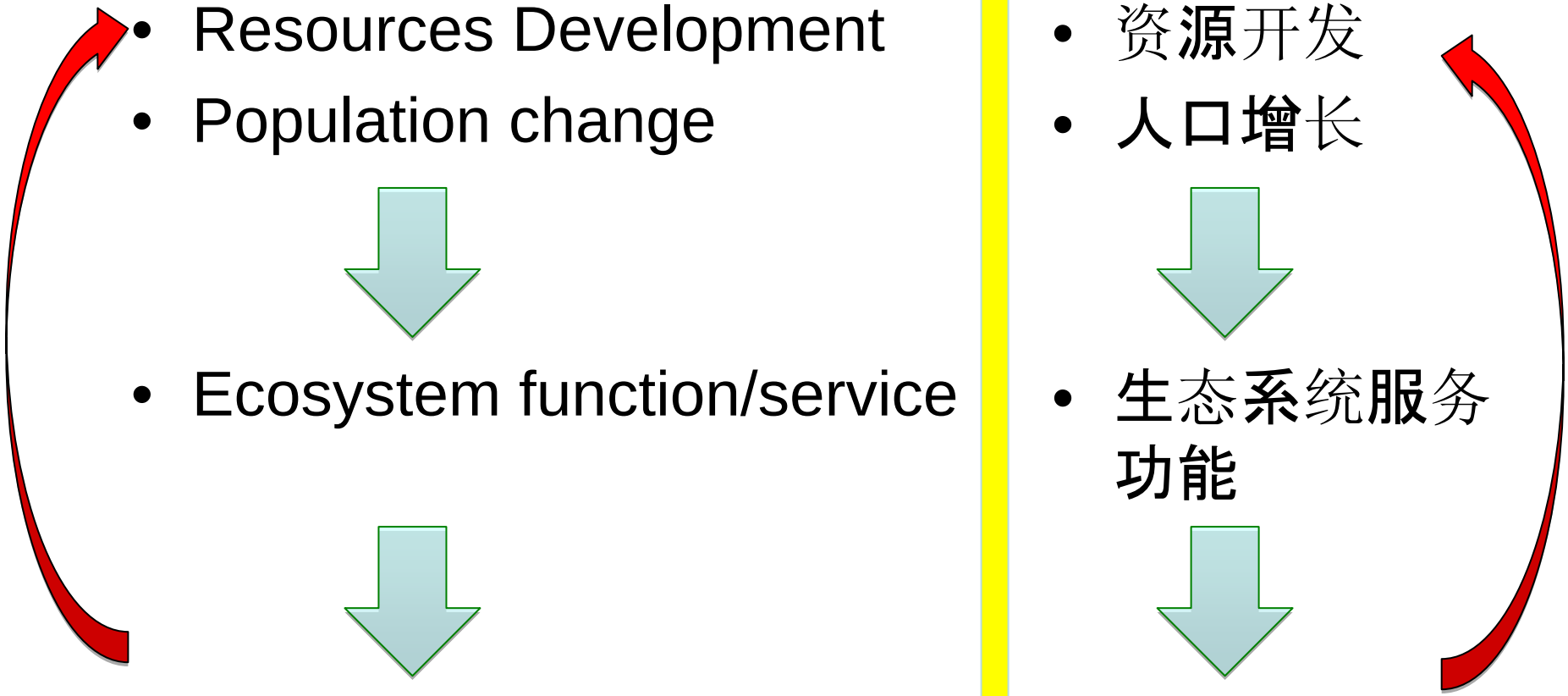
- Ecosystem function/service

- Climate change

- 经济发展
- 资源开发
- 人口增长

- 生态系统服务功能

- 全球气候变化

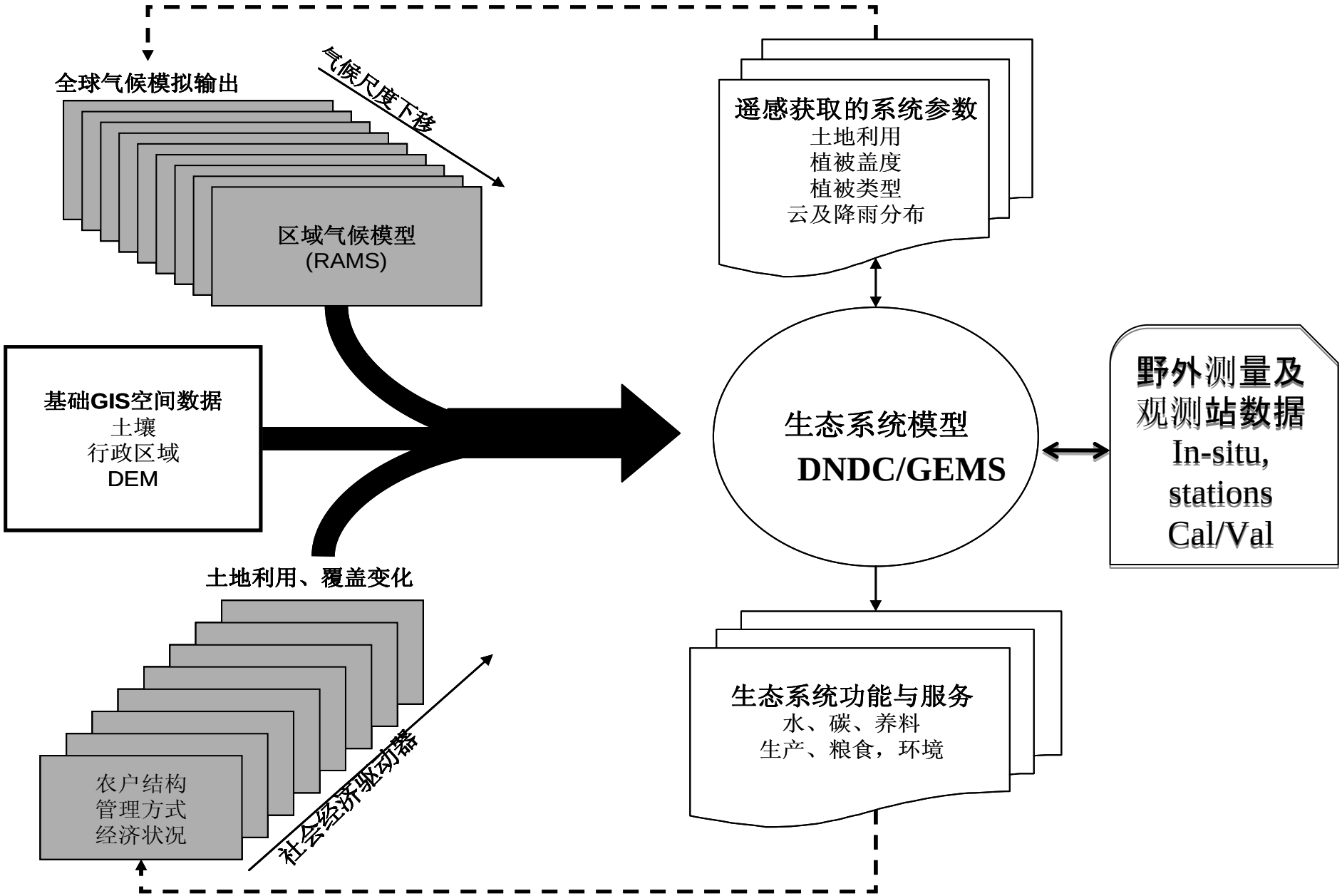


Objectives

- ***Primary Obj.*** Develop a ***system model*** that couples climate models and human activities via ecosystem models. More specifically.

- ***Secondary Obj***.
  - Assess climate change impacts on ecosystem function (C,N,GHG)
  - Assess LULCC impacts on regional climate (P,T)

System Modeling – 系统模型

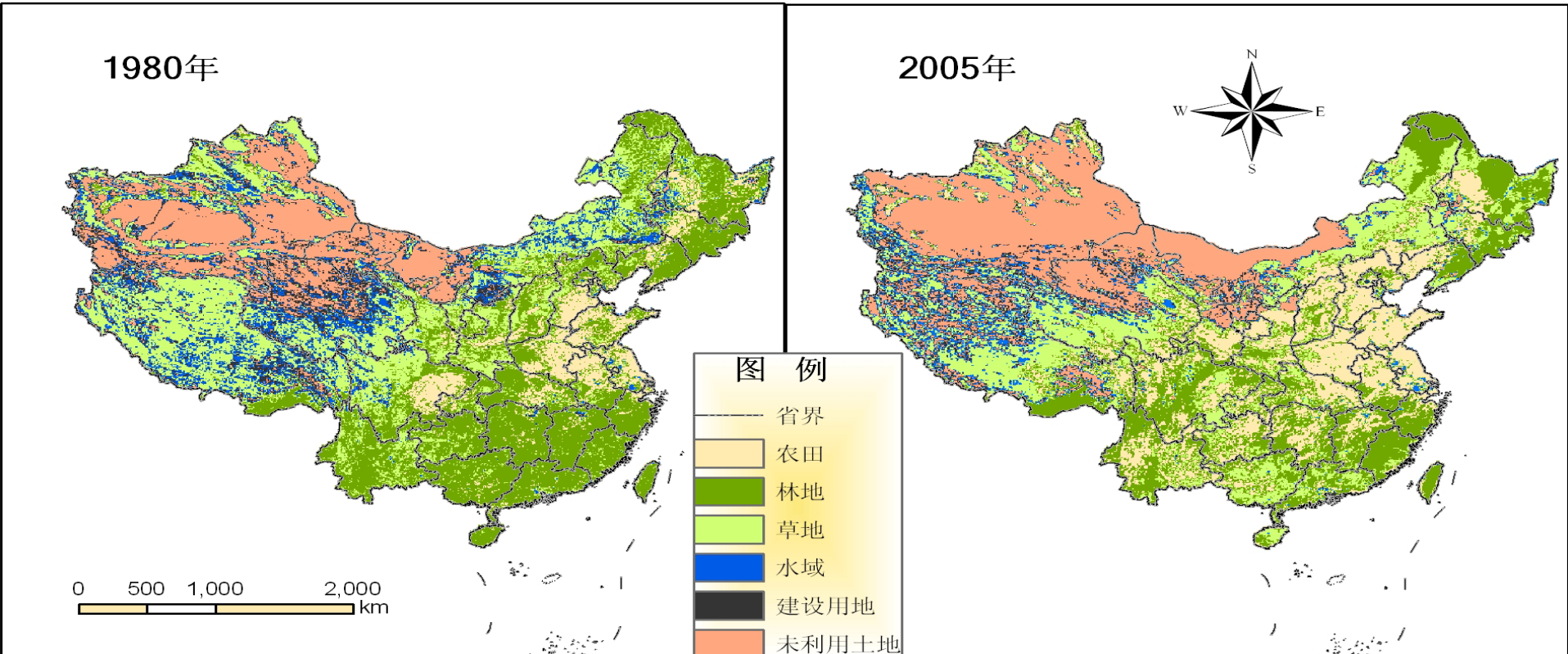


Input Data

- Land use and land cover (grassland type database (1:1M))
- Soil database (1:1,000,000)
- Climate database(10KM resolution daily national climate data)

Land use changes over the past 30 years

土地利用	面积(万亩)			变化比例
	1997	2005	变化面积	
林地	207052	213631	6579	3.18%
草灌	521522	415541	-105981	-20.32%
耕地城镇	317162	403820	86658	27.32%
水体	18635	15798	-2837	-15.22%
未利用土地	360272	379560	19288	5.35%
总面积*	1426497			-



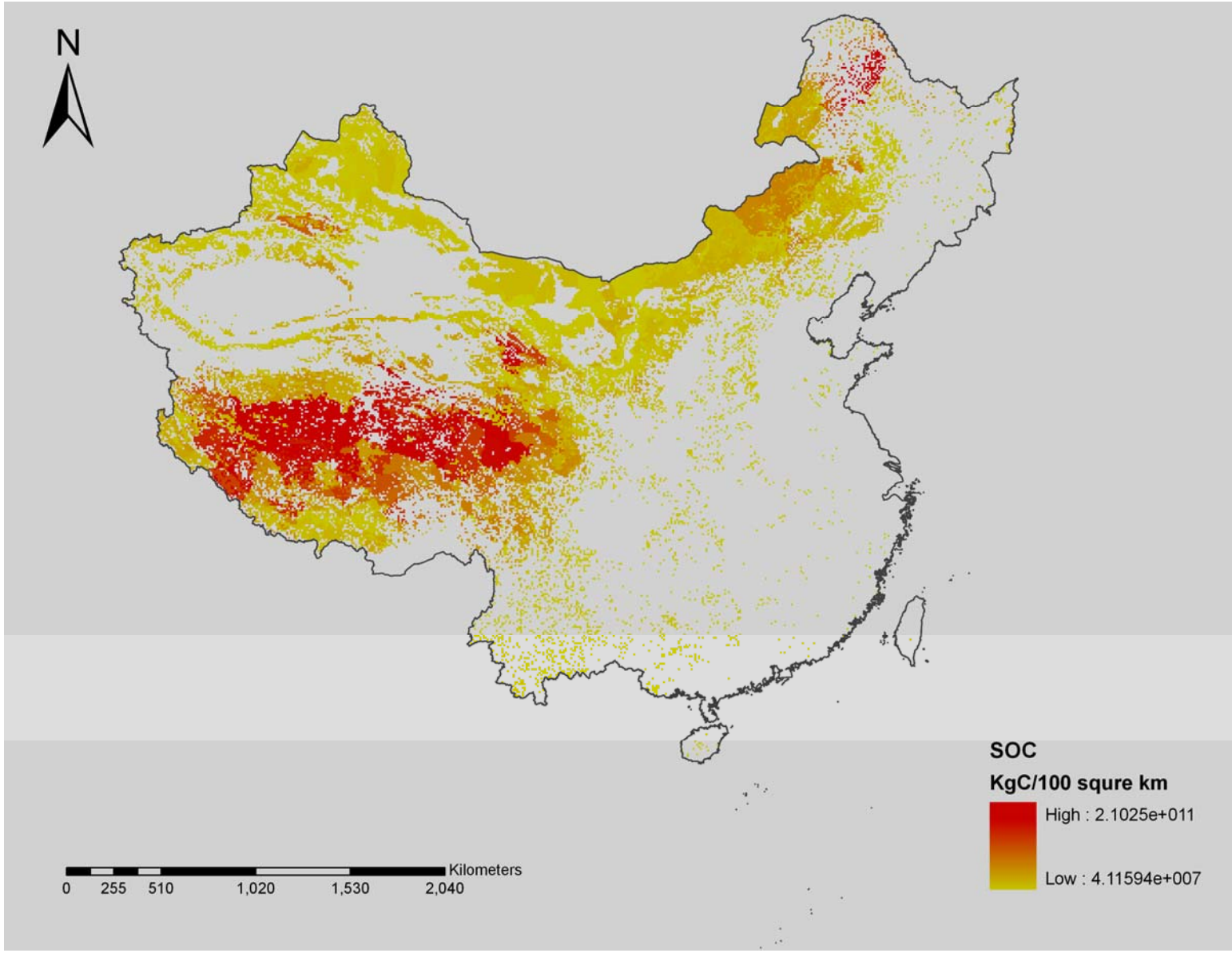
Preliminary Results

Part I: Climate → Ecosystem (Grasslands)

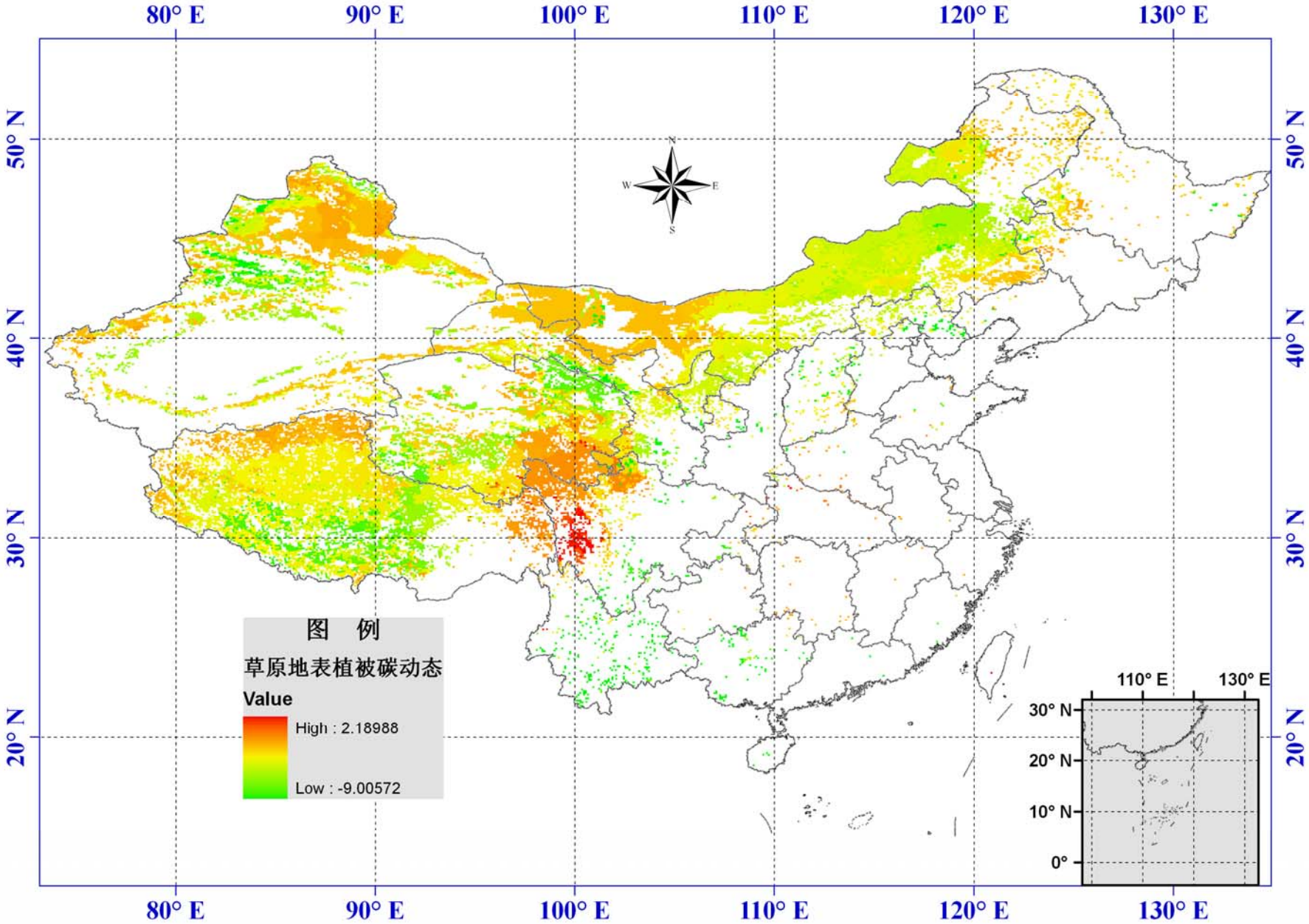
Part II: LULC → Climate

Part III: Policy/Programs → Carbon?

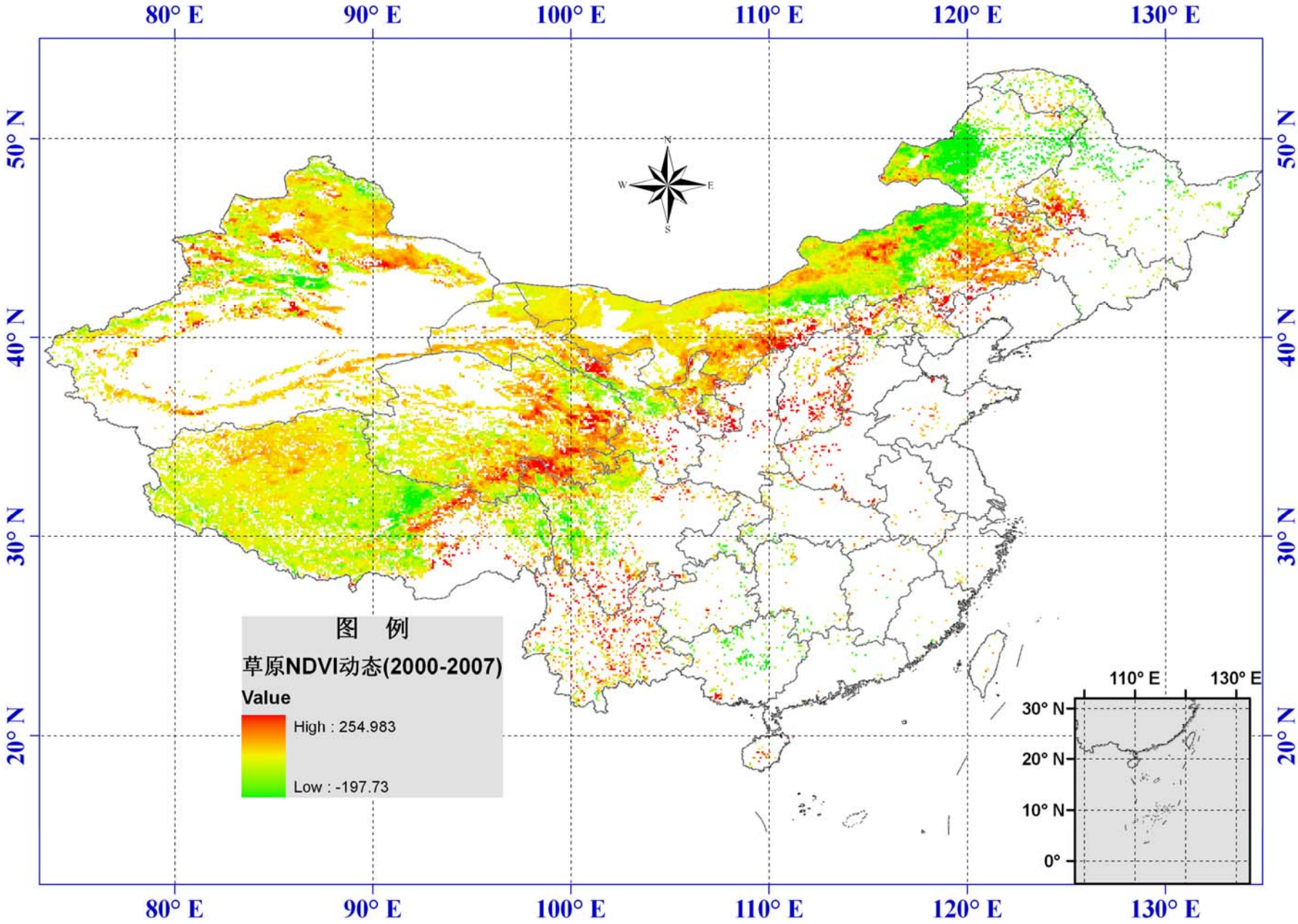
Grassland SOC storage



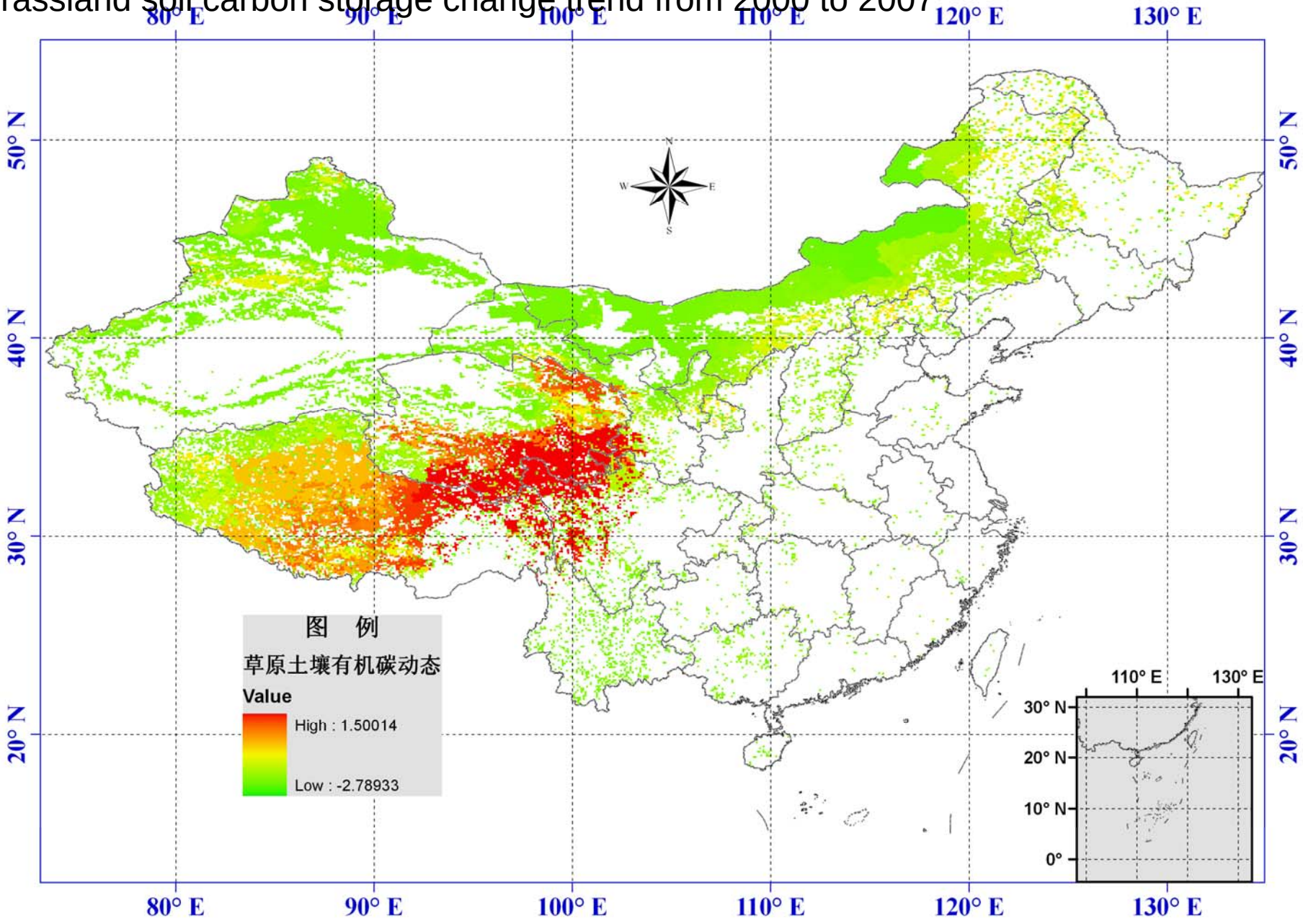
Grassland above ground carbon change trend from 2000 to 2007



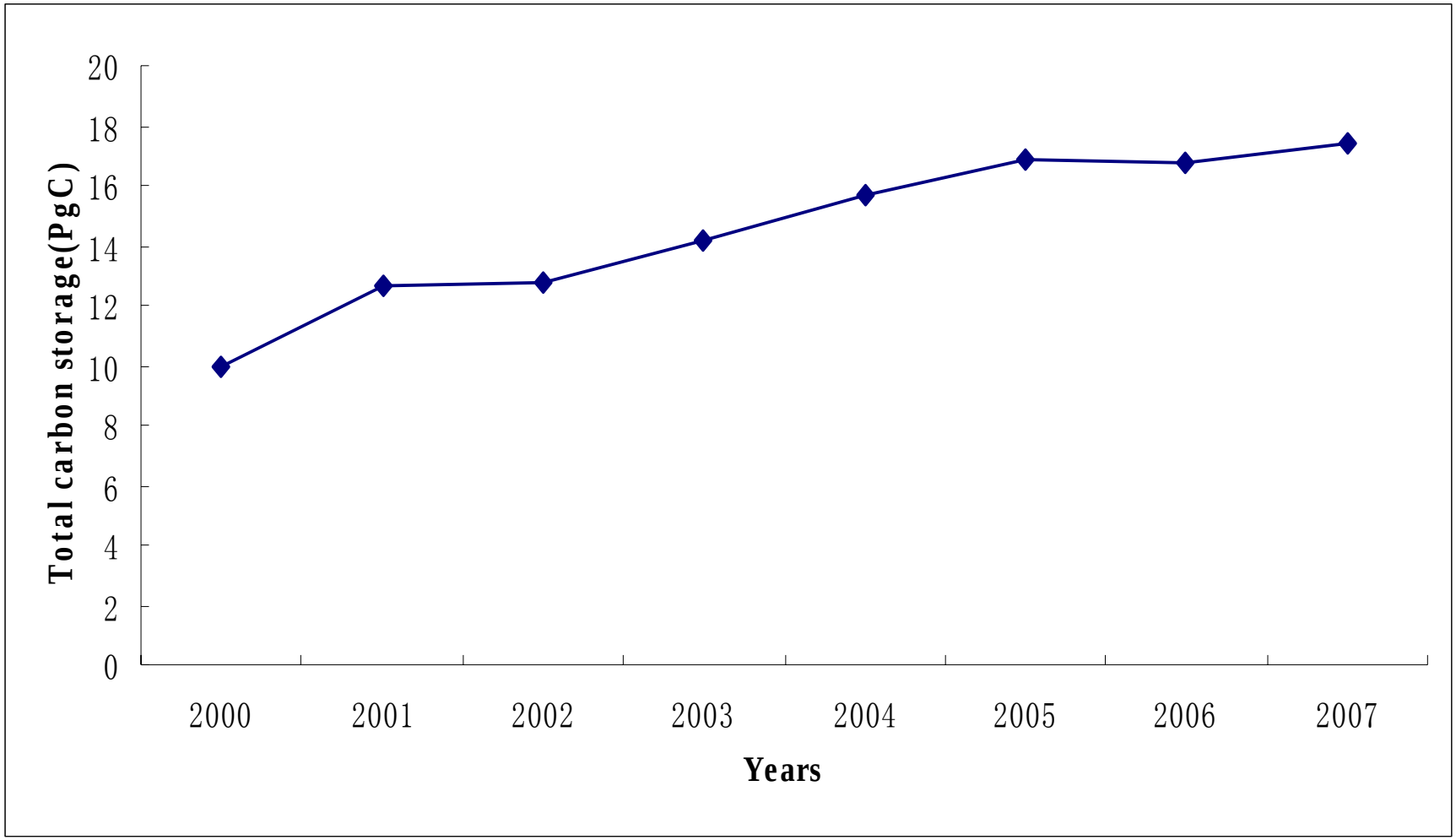
Grassland NDVI change from 2000 to 2007(MODIS 500M 16-days composite product)

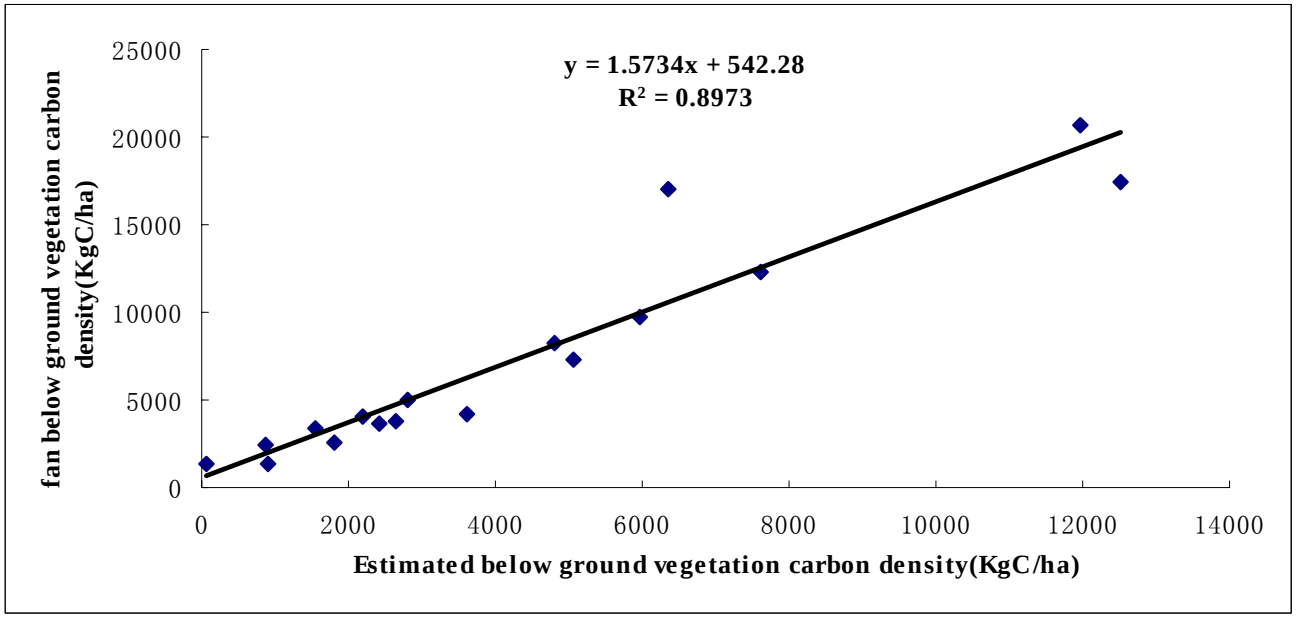


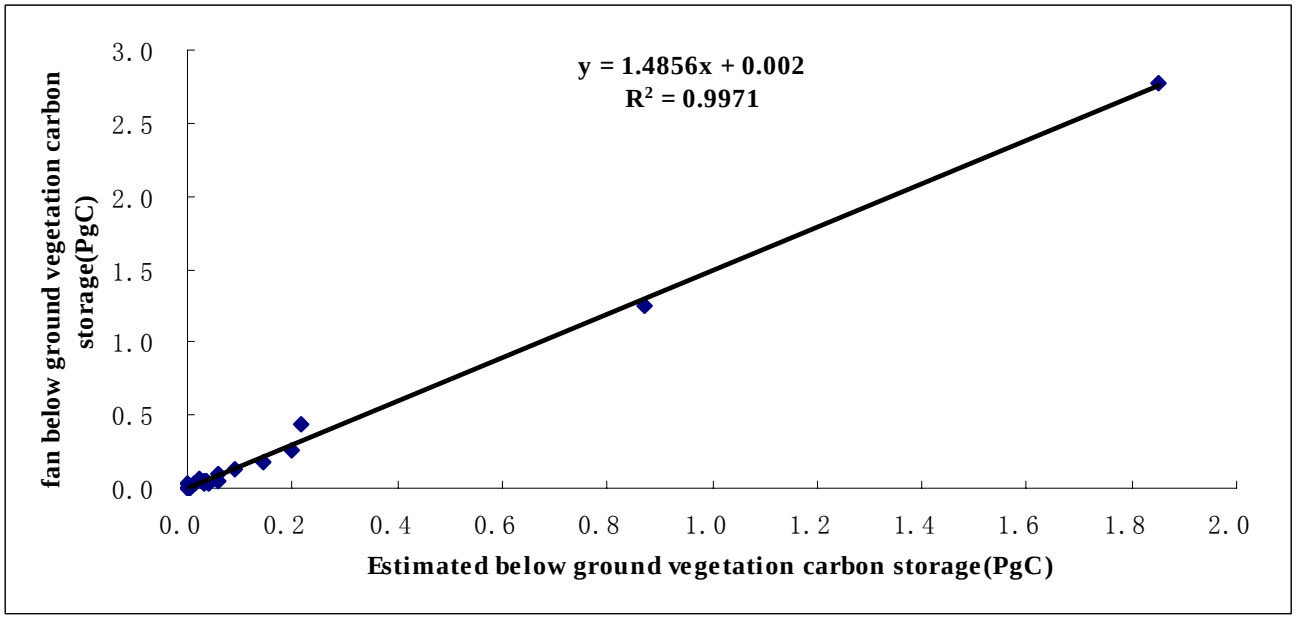
Grassland soil carbon storage change trend from 2000 to 2007

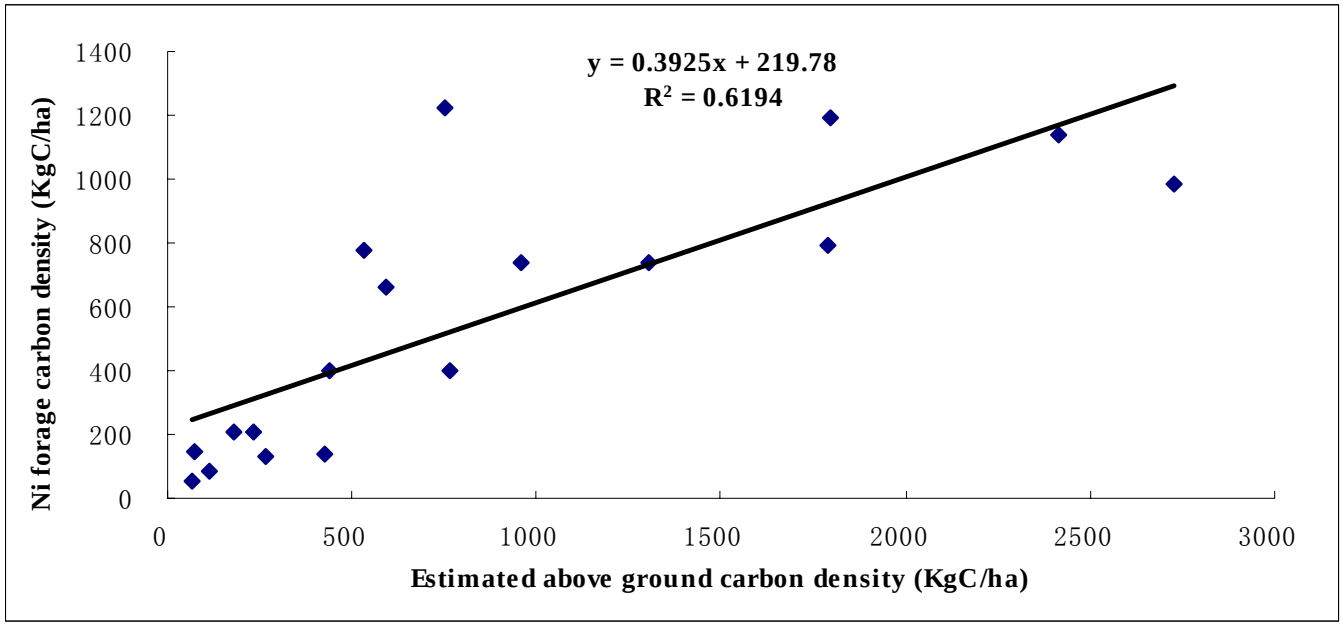


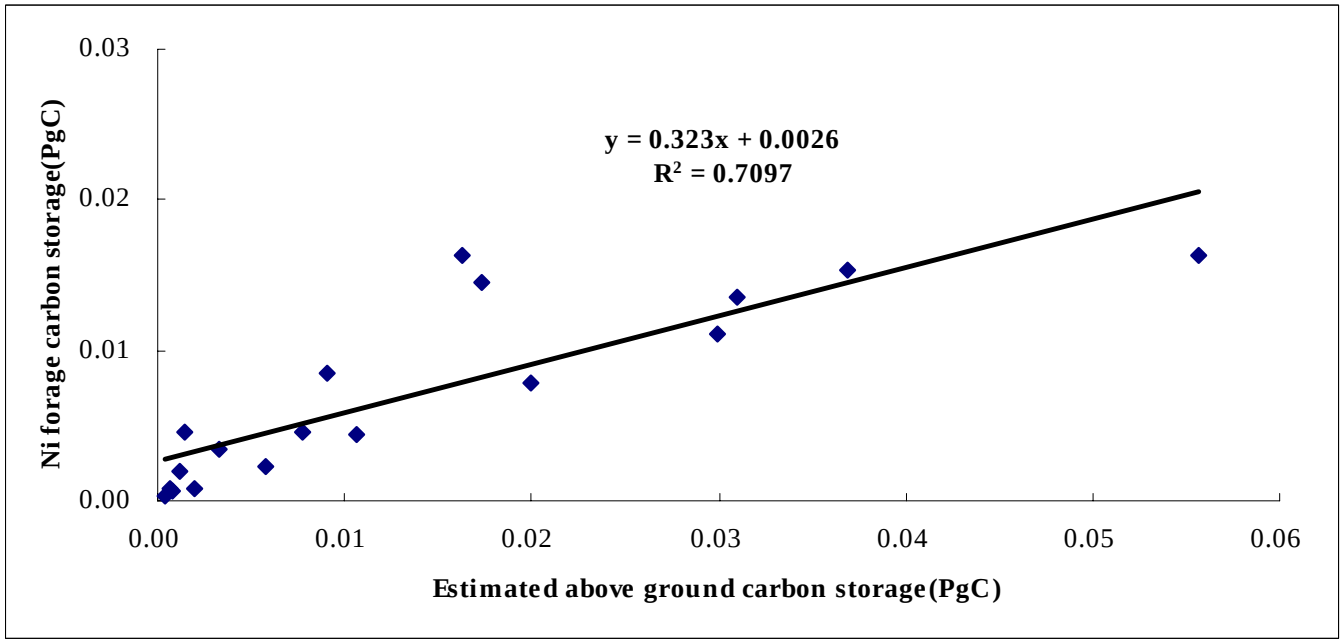
Total C storage change from 2000-2007



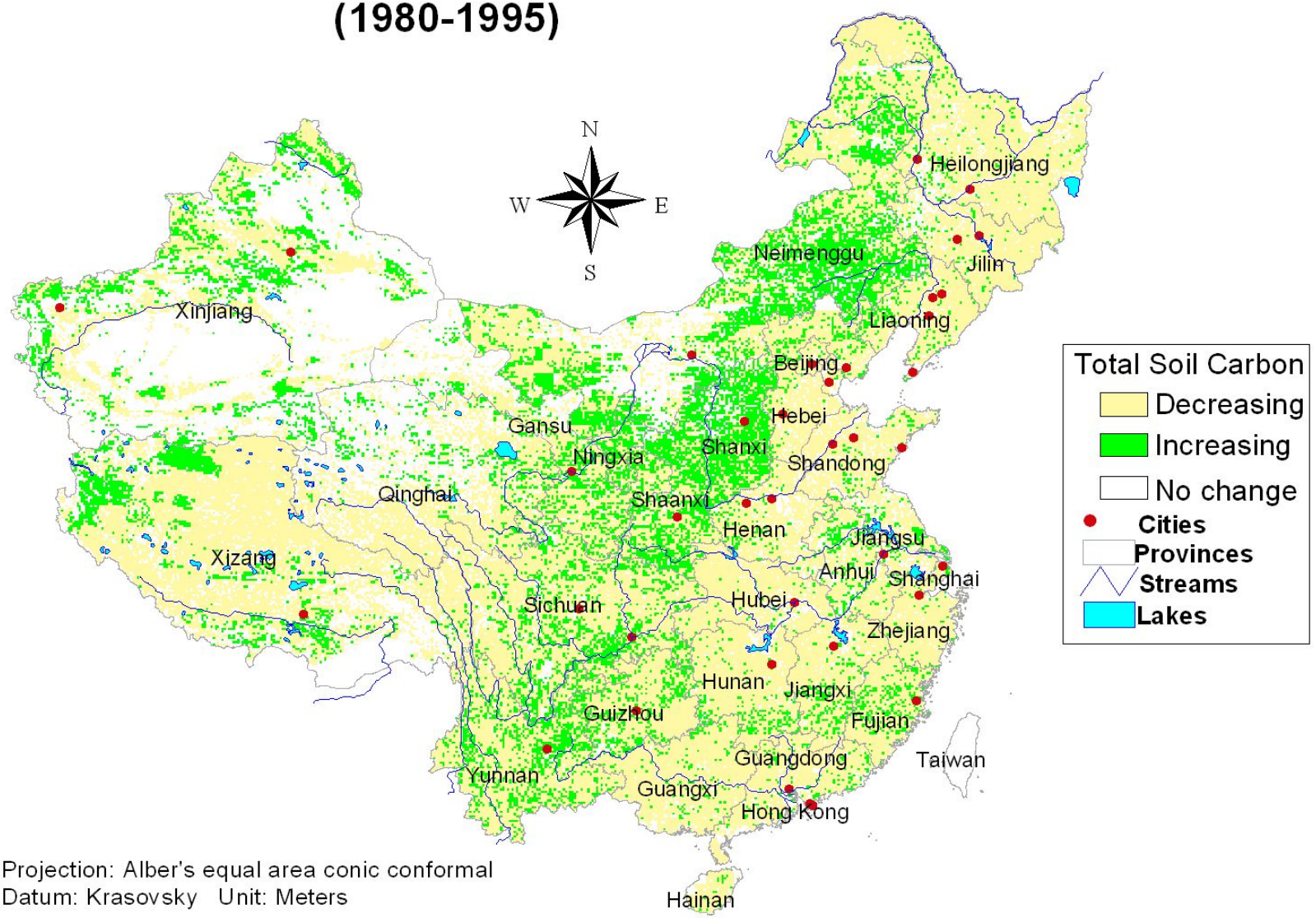

y = 1.5734x + 542.28
R² = 0.8973
fan below ground vegetation carbon density(KgC/ha)
Estimated below ground vegetation carbon density(KgC/ha)
25000
20000
15000
10000
5000
0
0
2000
4000
6000
8000
10000
12000
14000


y = 1.4856x + 0.002
R² = 0.9971
fan below ground vegetation carbon storage(PgC)
Estimated below ground vegetation carbon storage(PgC)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0


y = 0.3925x + 219.78
R2 = 0.6194
Ni forage carbon density (KgC/ha)
Estimated above ground carbon density (KgC/ha)
0
200
400
600
800
1000
1200
1400
0
500
1000
1500
2000
2500
3000


y = 0.323x + 0.0026
R2 = 0.7097
Ni forage carbon storage(PgC)
Estimated above ground carbon storage(PgC)
0.00
0.01
0.02
0.03
0.00
0.01
0.02
0.03
0.04
0.05
0.06

Trend of Total Soil Carbon Dynamics in China (1980-1995)



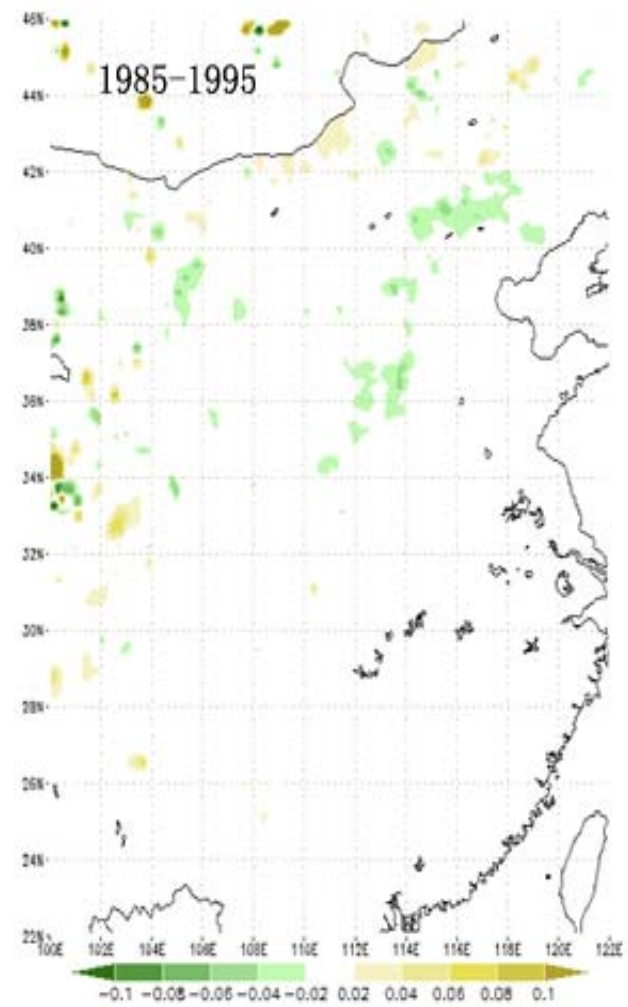
Preliminary Results

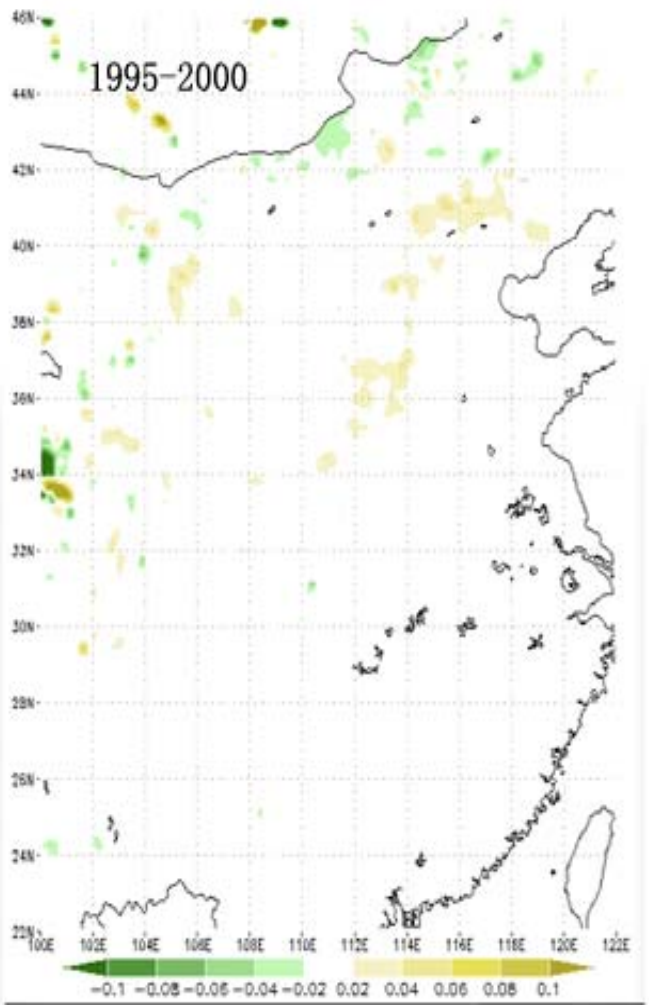
Part I: Climate → Ecosystem (Grasslands)

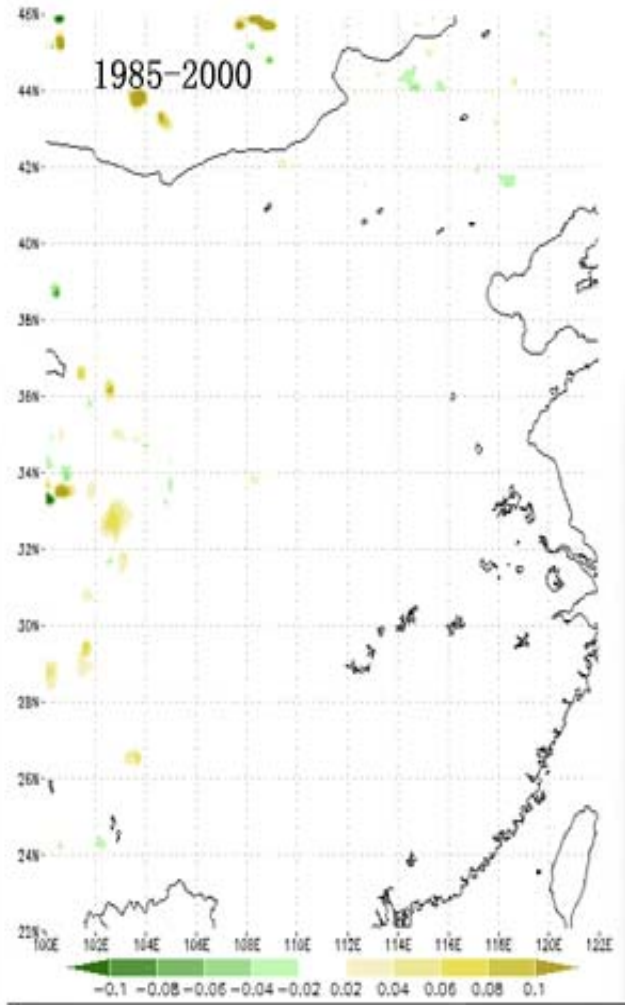
Part II: LULC → Climate

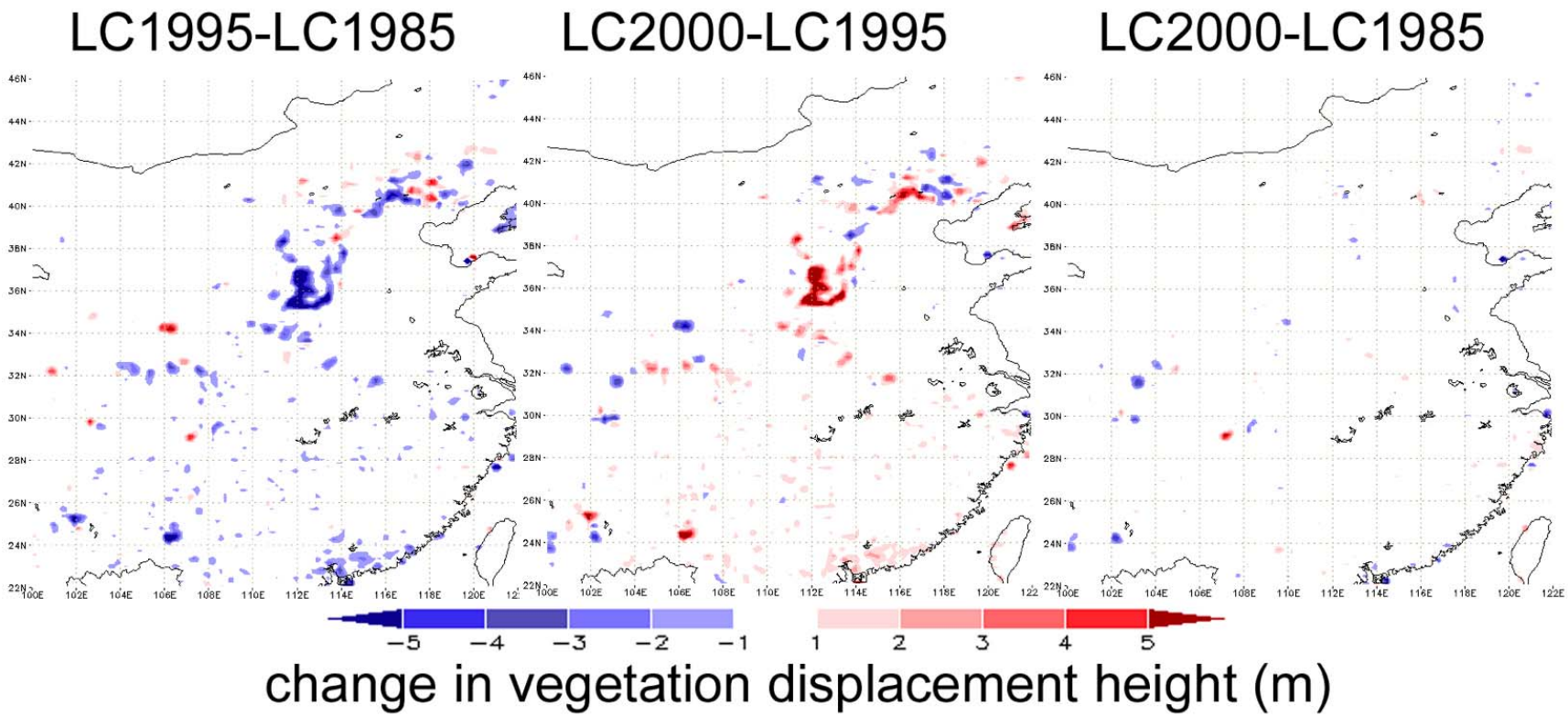
Part III: Policy/Programs → Carbon?

Changes in albedo as represented in RAMS modeling –反照率变化

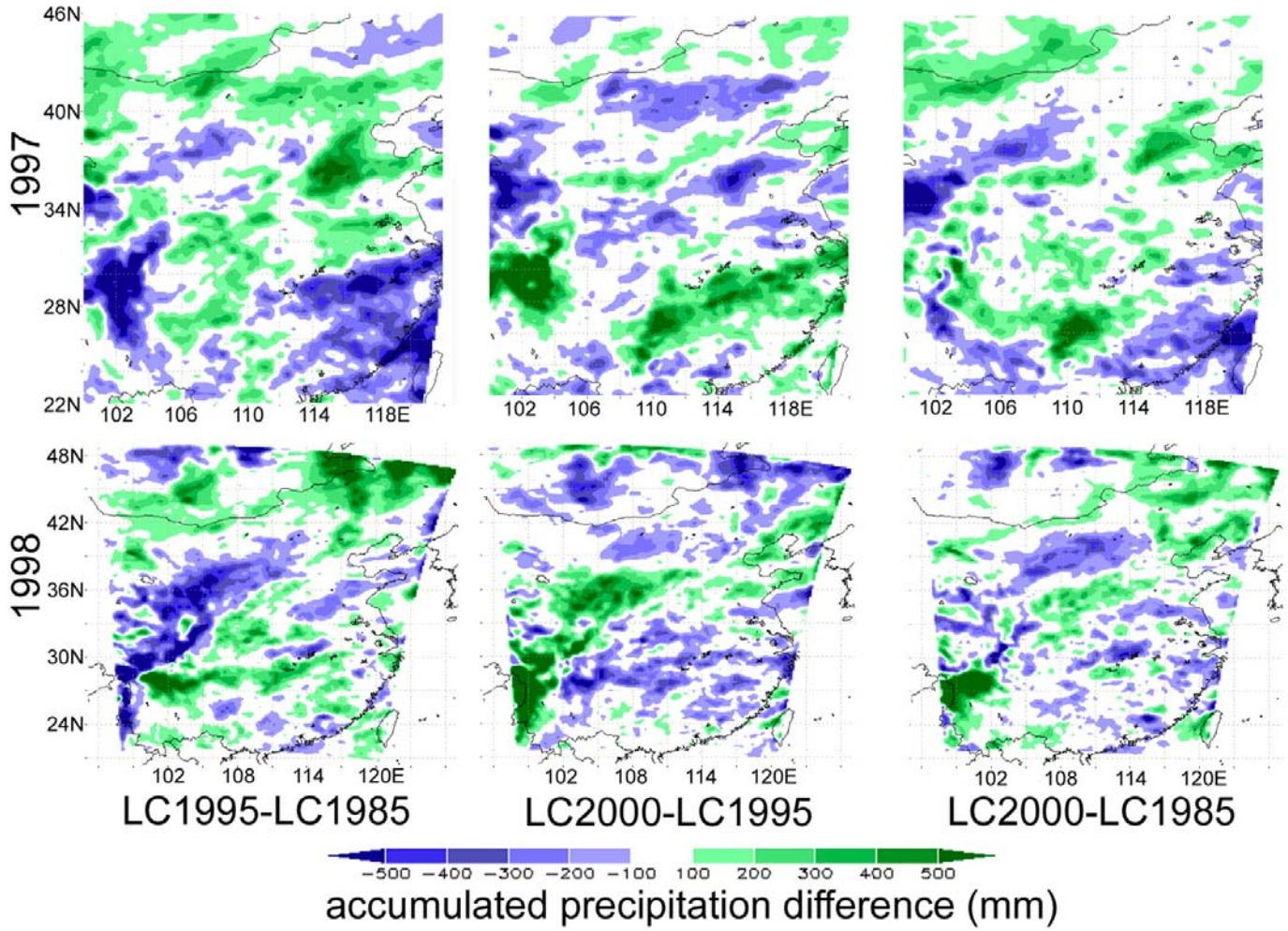






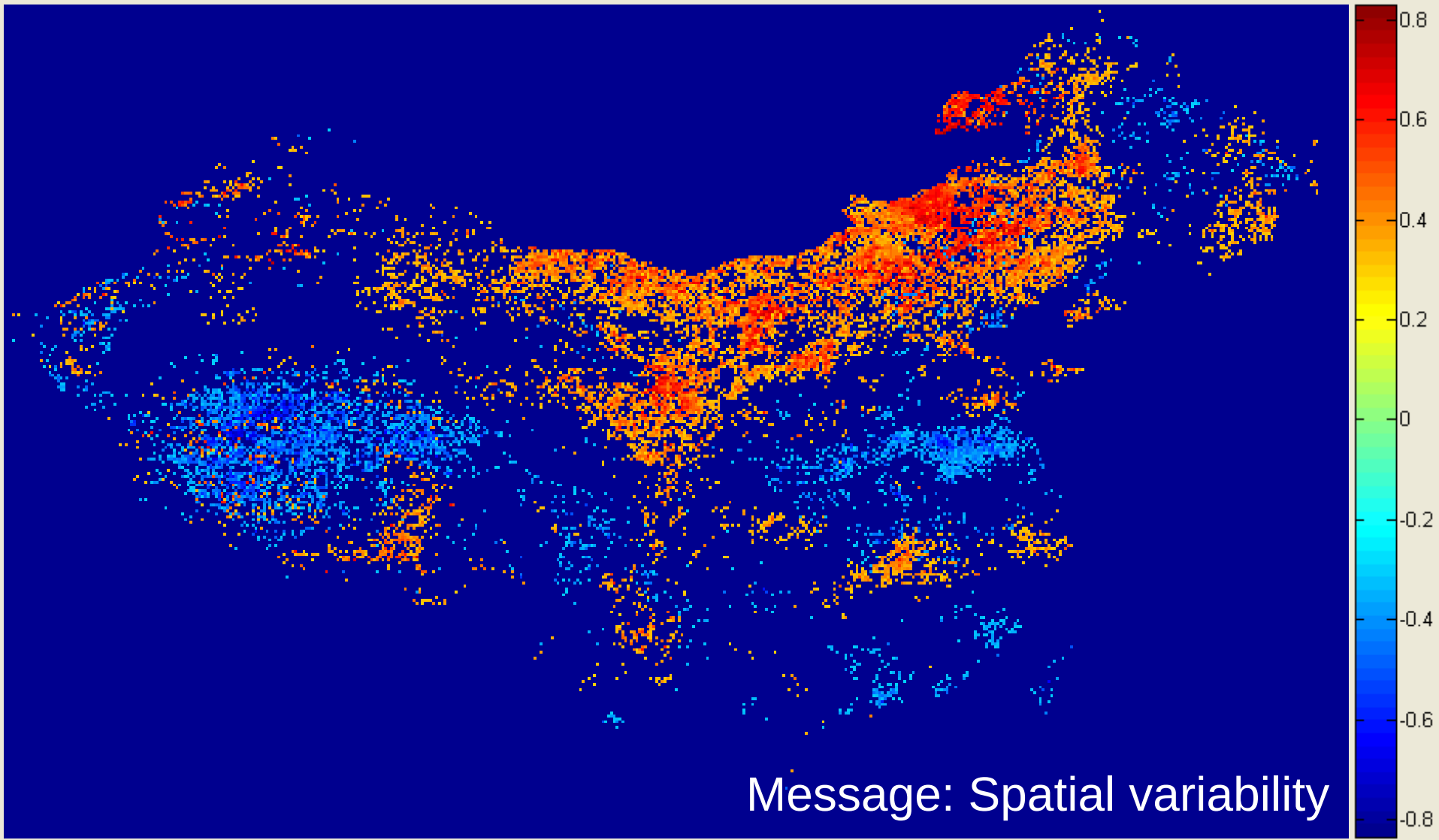


Changes in vegetation displacement height as represented in RAMS simulations. Replacement of forest with agriculture has a strong effect on average grid-cell vegetation displacement height; reforestation has virtually the exact opposite effect in northern areas, but is lower in magnitude in the southern coastal areas.



Changes in precipitation (Feb 20th to Oct 15th) in the growing seasons of 1997and 1998. Strong synoptic-scale latitudinal features are evident and are associated with forest/agriculture transitions. Reforestation results in rainfall changes opposite in sign from the deforestation effects and largely showing similar spatial organization and scale. Downwind effects (eastern/coastal areas) show similar scale effects and are likely the result of complex interactions between rain-producing features and landscape change forcings in the model.

Summer Rainfall (J,J,A) vs. small integral

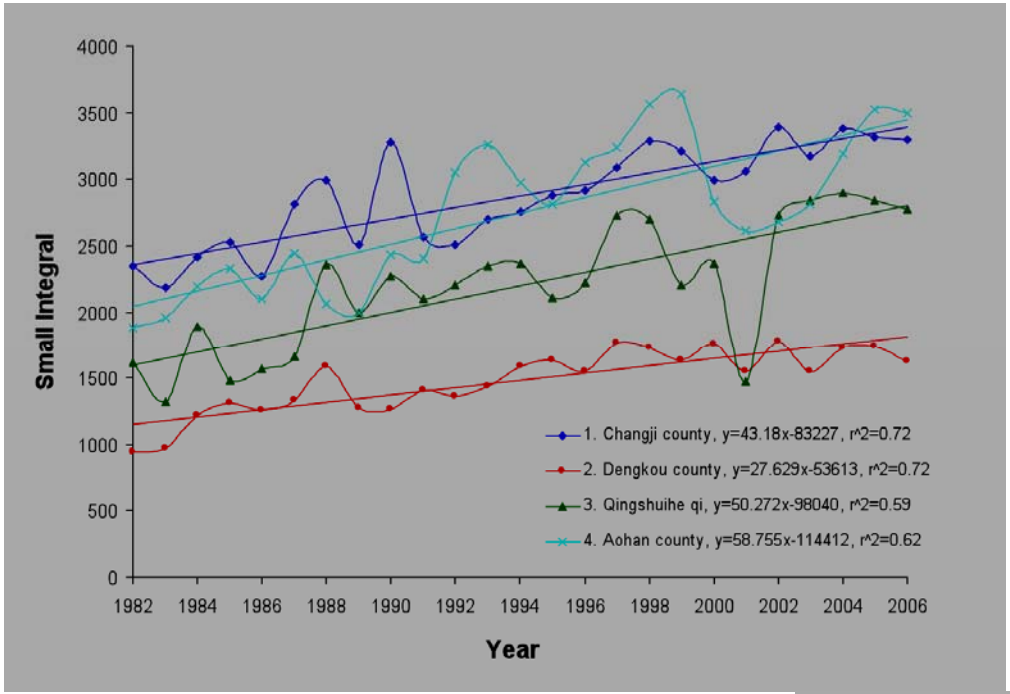


Preliminary Results

Part I: Climate → Ecosystem (Grasslands)

Part II: LULC → Climate

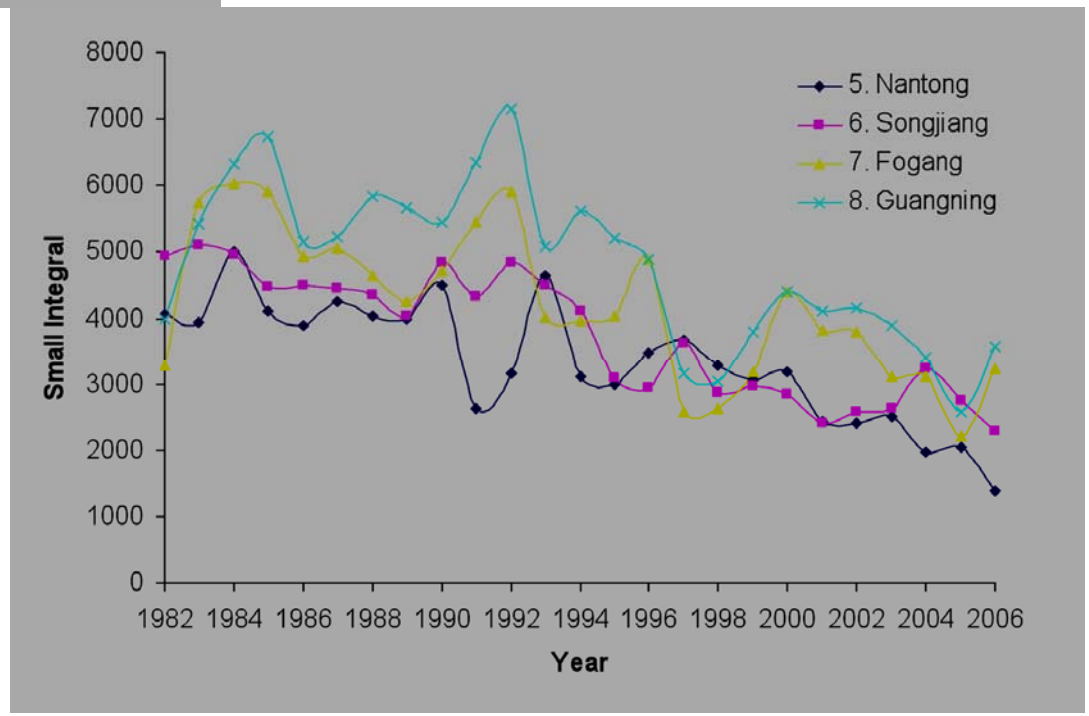
Part III: Policy/Programs → Ecosystem (C)

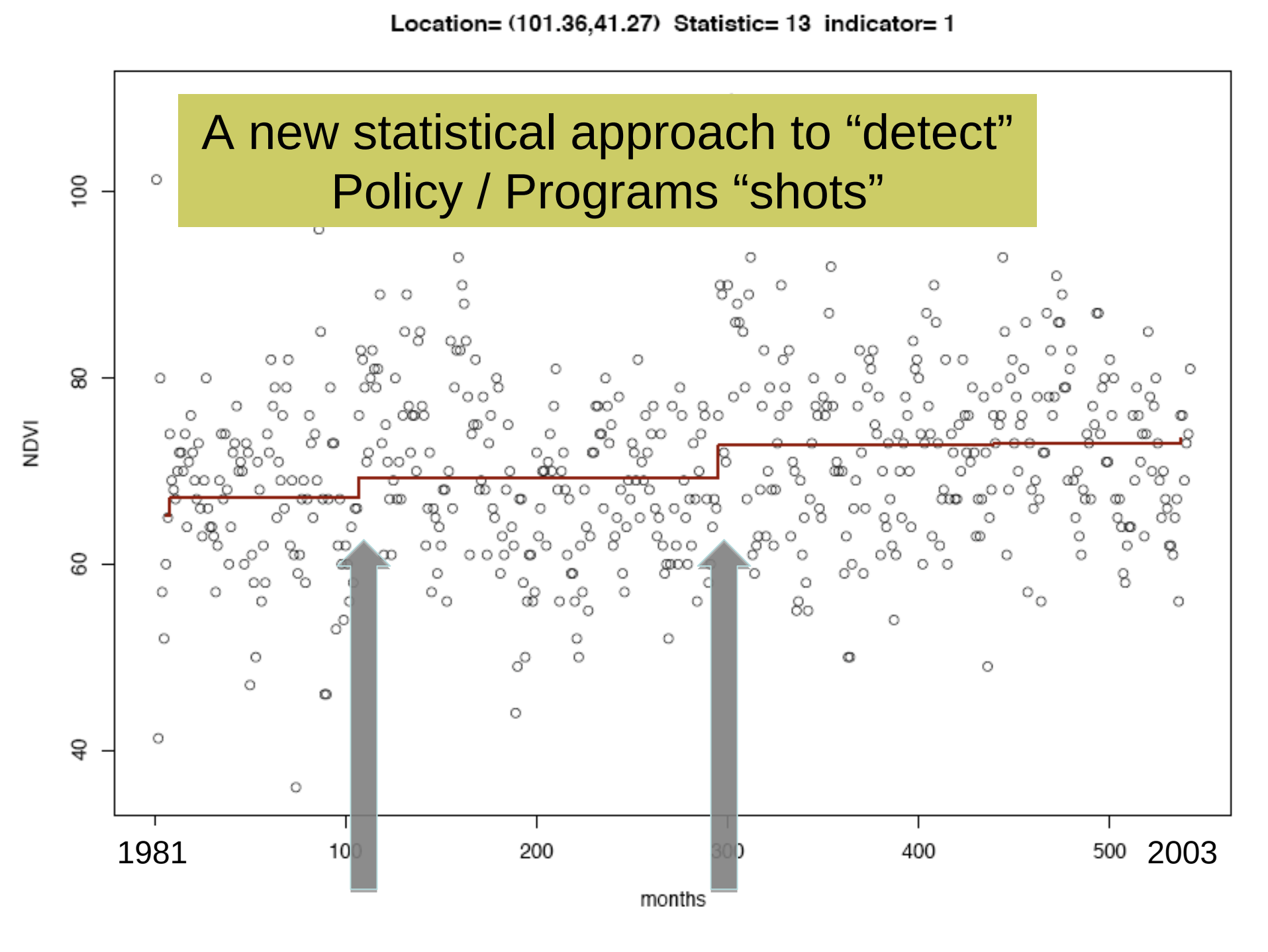


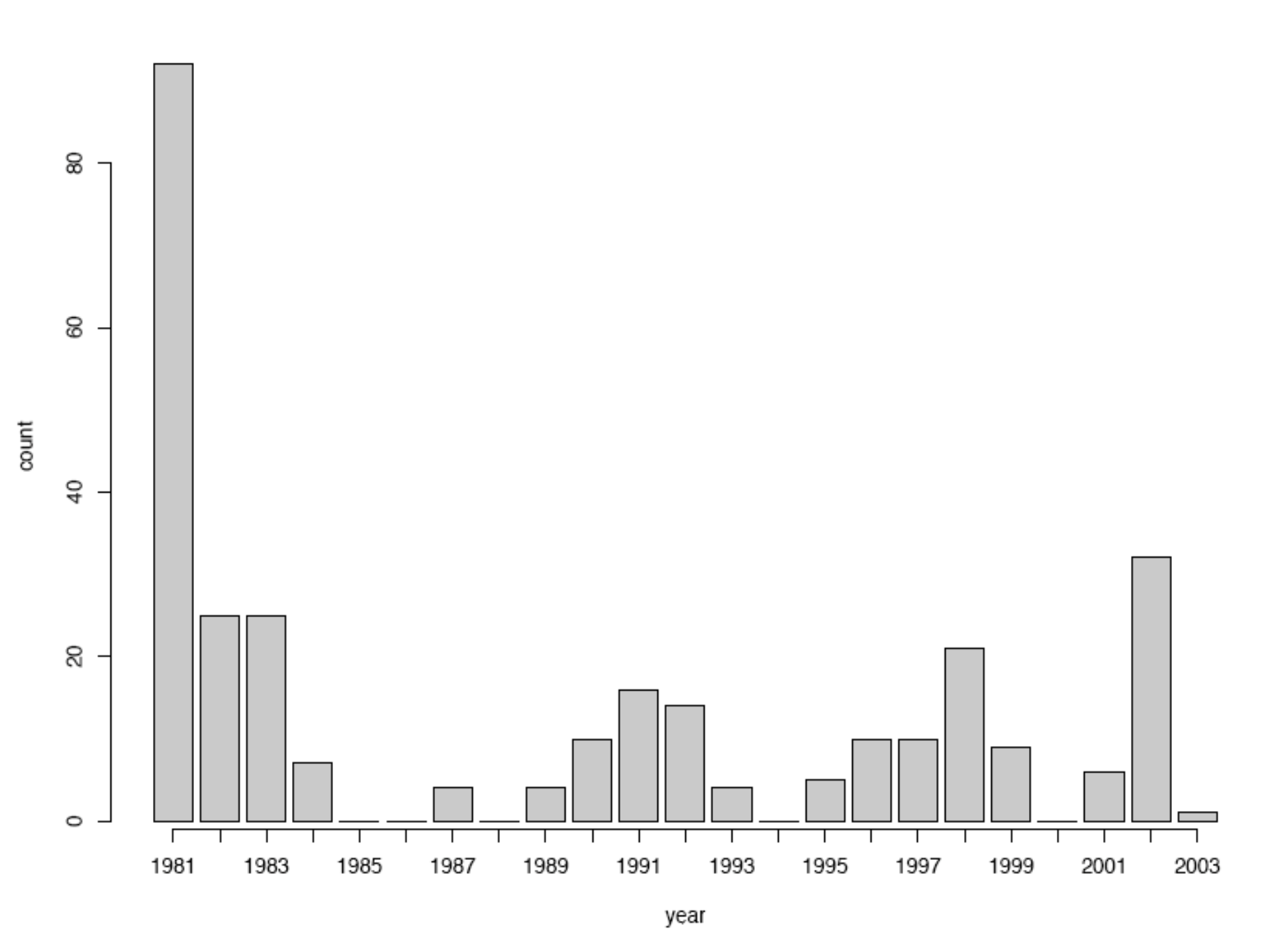
Infer policy/programs from time series:

Can we?

The time series of selected counties that shows trend of decrease during 1982 to 2006




Location= (101.36,41.27) Statistic= 13 indicator= 1
A new statistical approach to “detect” Policy / Programs “shots”
NDVI
100
80
60
40
1981
100
200
300
400
500
2003
months


count
0
20
40
60
80
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
year

Summary

- A system model was developed for China to link **Human** and **Climate** system; The linkage is through ecosystem function such as C & *N* cycles.
- Climate has ***significant*** impact on ecosystem and *vice versa*; the magnitude is location specific.
- Human policy/programs played a key role in shaping China's LUC & therefore, climate

- 建立了中国人类活动与气候变化，生态系统之间的定量关系；
- 全球气候变化对中国生态有很大的影响，反过来生态系统变化对周边大气也有很强的反馈；
- 政策与工程项目等对LULC及气候变化有很大的影响；

Summary-*cont*

- Allows one to:
  - Assess policy/programs/management impacts on Ecosystem and Climate
  - Assess future climate change (location and time) on ecosystem function (C,N cycles)
  - Simulate scenarios to analyze BMPs in DSS for mitigation and adaptation

- 该系统可以:
  - 研究政策等对生态系统的影响评估
  - 研究未来气候变化对生态系统影响的评估
  - 更好的设计减徘与适应策略

Acknowledgment

- All team members ;
- Especially our team leaders for their supports
- Staff and students
- The IGSNRR