

Study on Land-use/Land-cover Change and Terrestrial Carbon Cycle in China

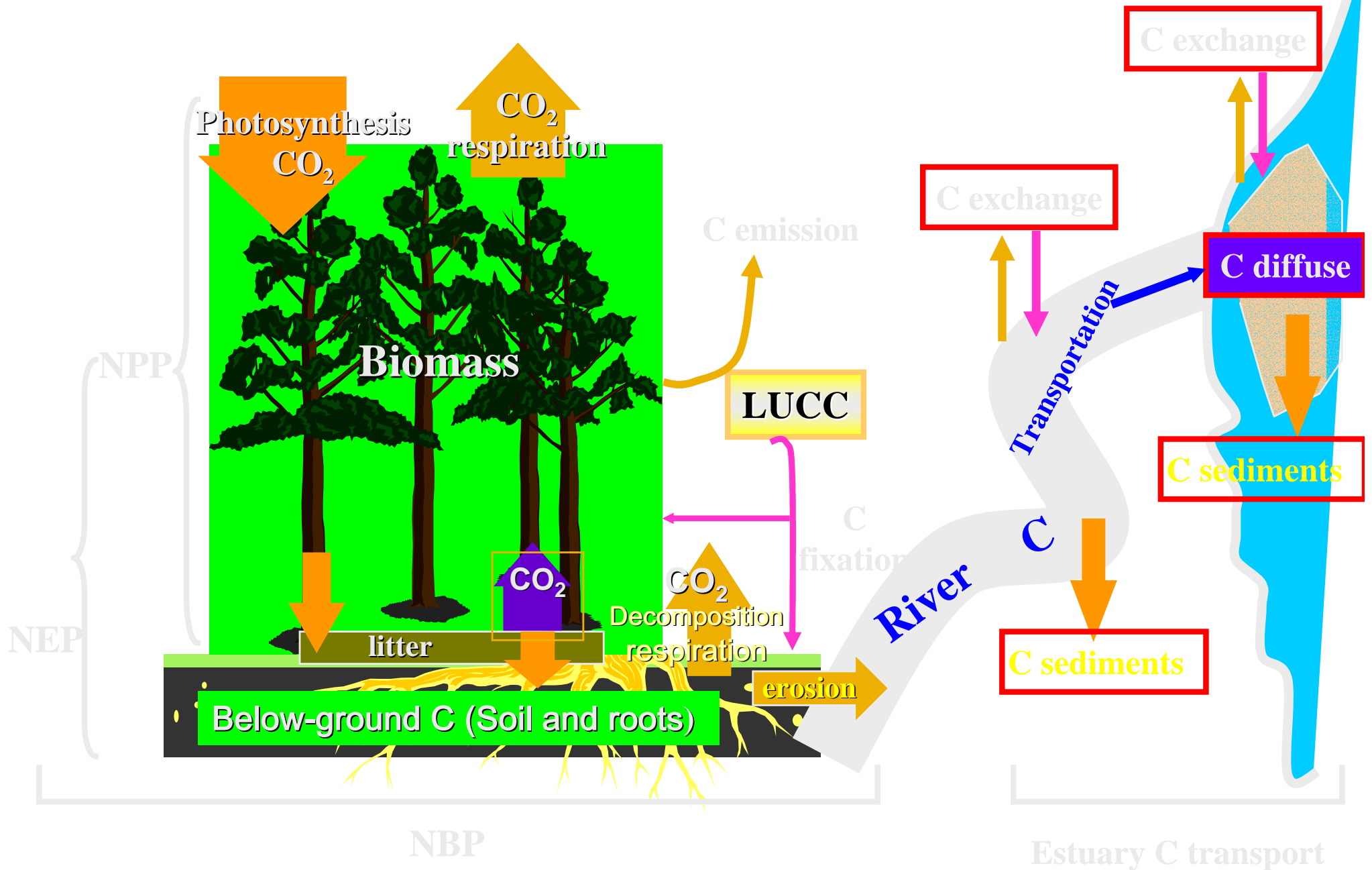
**Jiyuan Liu, Mingkui Cao, Zhiqiang Gao,
Mingliang Liu, Shaoqiang Wang, and
Hanqin Tian**

Institute of Geographical Sciences and
Natural Resources Research
Chinese Academy of Sciences

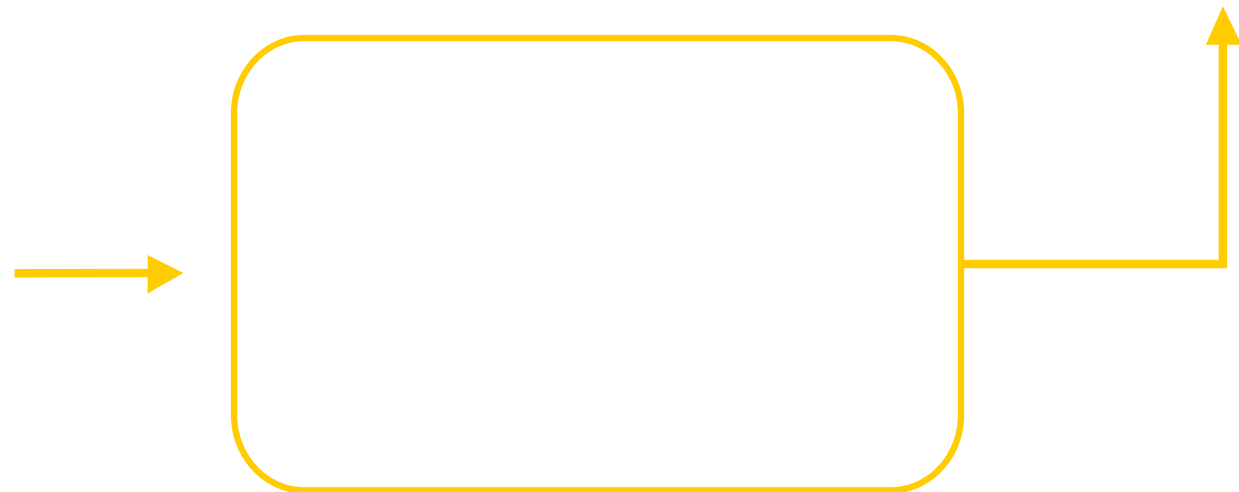
Terrestrial Carbon Cycle and LUCC

- ❖ Carbon cycle links human, biological, geochemical and atmospheric processes
- ❖ The change of the magnitude and spatial distribution of net carbon fluxes between ecosystems and the atmosphere is controlled mainly by prior disturbance and land-use/land-cover change

Processes of terrestrial ecosystem carbon cycle

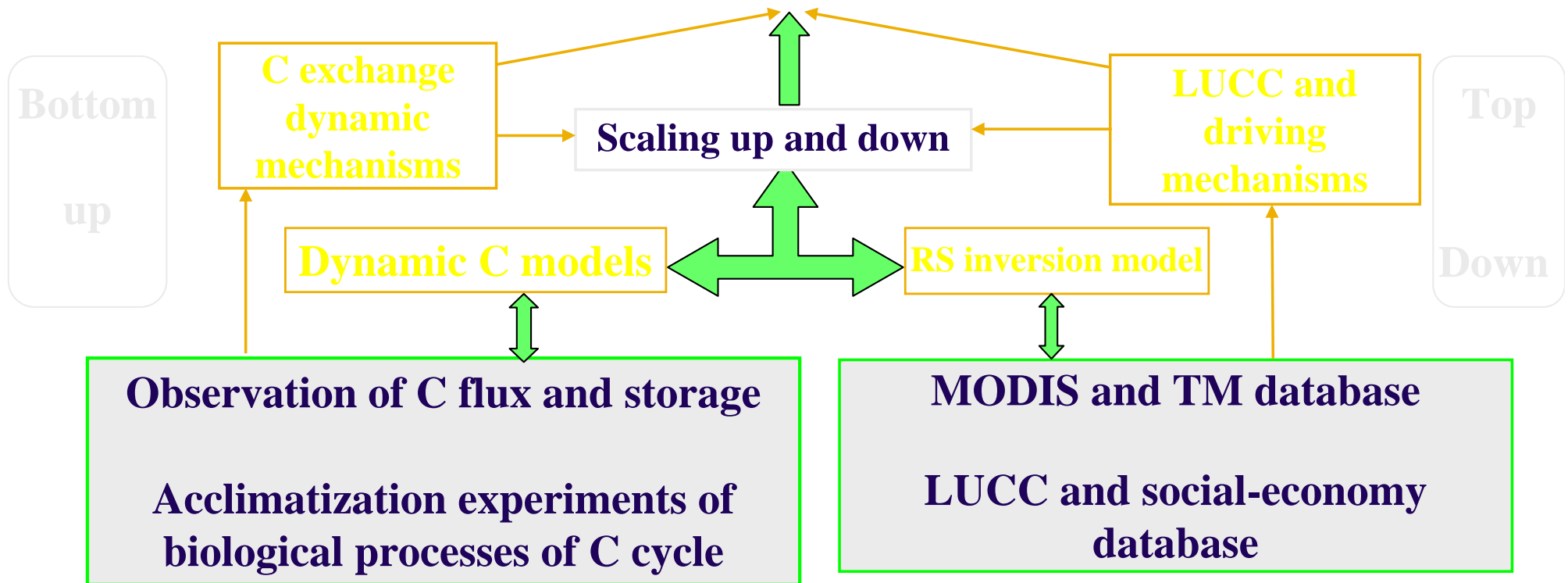


Mechanisms of Carbon Sink



Technique scheme of LUCC-CC

C sink/source: patters of spatial and temporal, history, future scenario
C cycle: control mechanisms, human perturbs, cycle period, acclimation
C sequestration: potential, cost and benefits, sustainable, leak



Research Process



❖ Terrestrial ecosystem carbon stock

❖ Land use/cover change

❖ Simulation of carbon cycle

Capability construction



Design of ChinaFLUX station and observation

Flux Observation Site of Inner Mongolia Grassland



Flux Observation Site of Changbaishan Temperate Deciduous Broad-leaved and Coniferous Mixed Forest



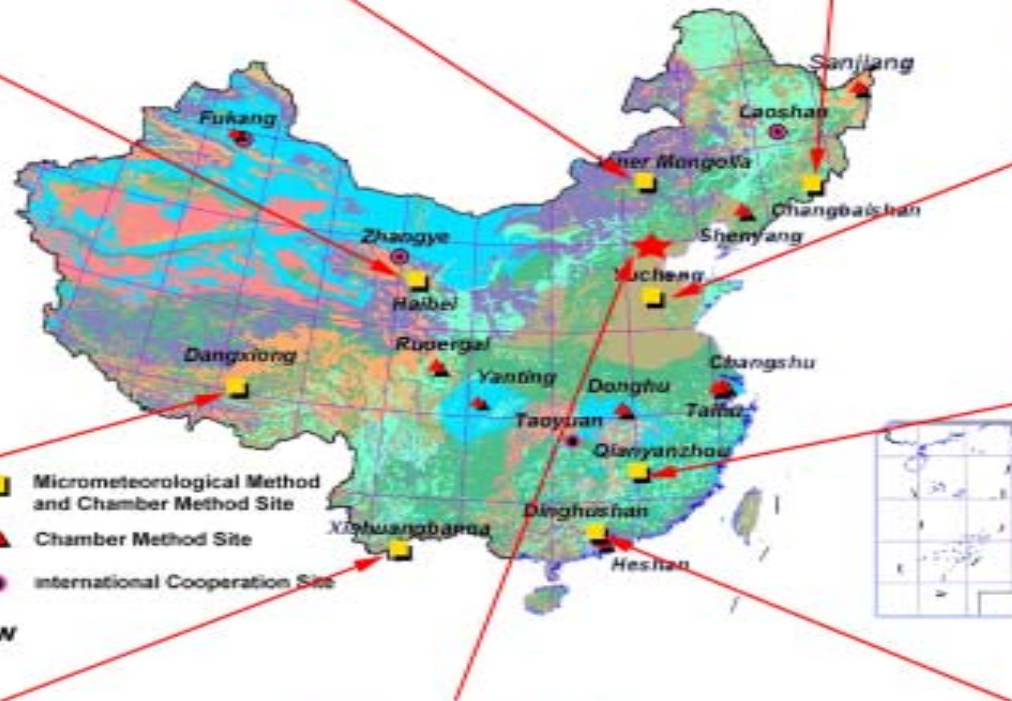
Flux Observation Site of Haibei Highland Frigid Meadow



Flux Observation Site of Yucheng Warmer Temperate Dry Farming Cropland



Flux Observation Site of Dangxiong Alpine Meadow



Flux Observation Site of Qianyanzhou Man-planted Forest on Red Soil Hill Region



Flux Observation Site of Xishuangbanna Tropic Seasonal Rainforest

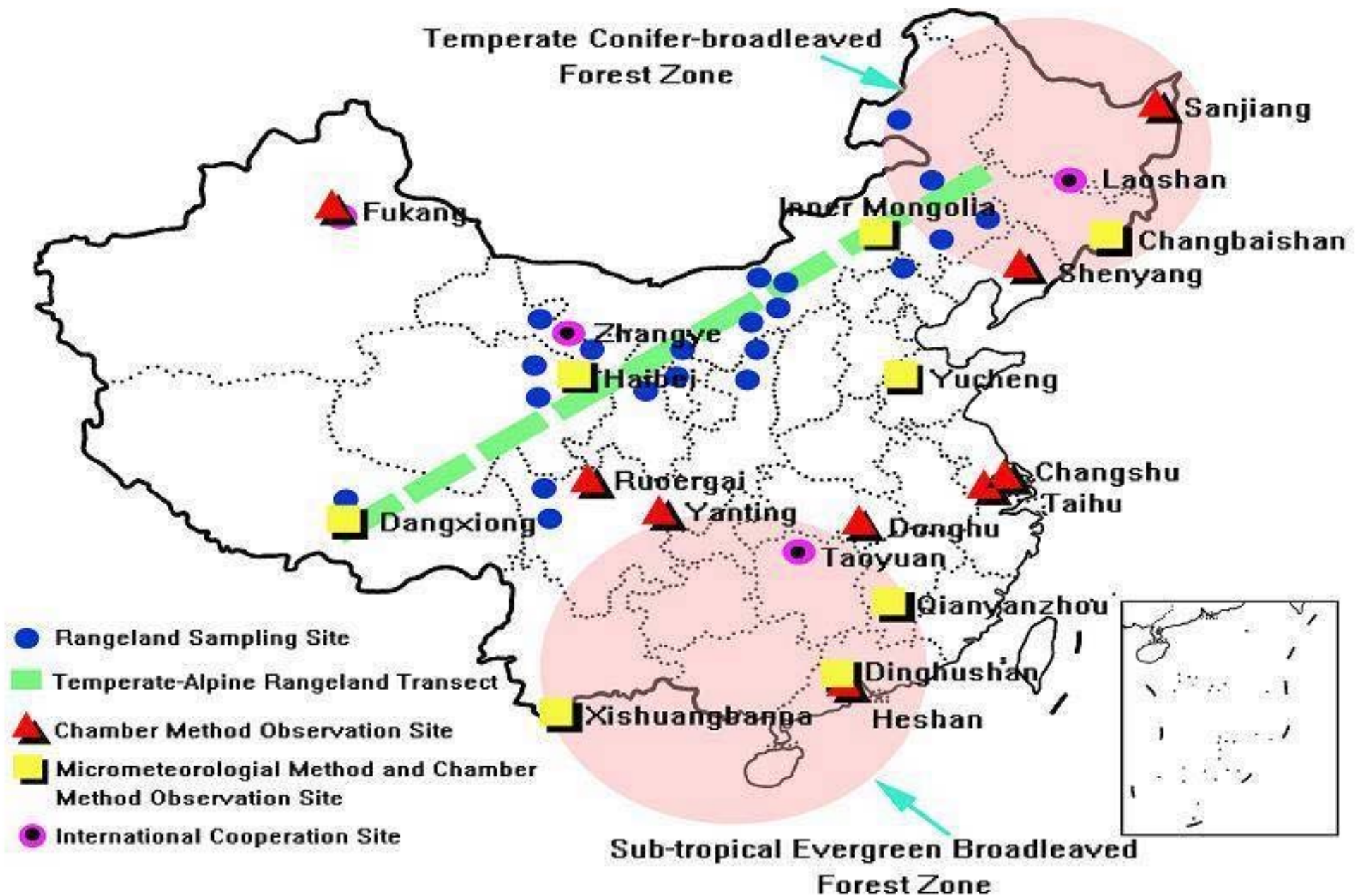


CERN ChinaFLUX Office

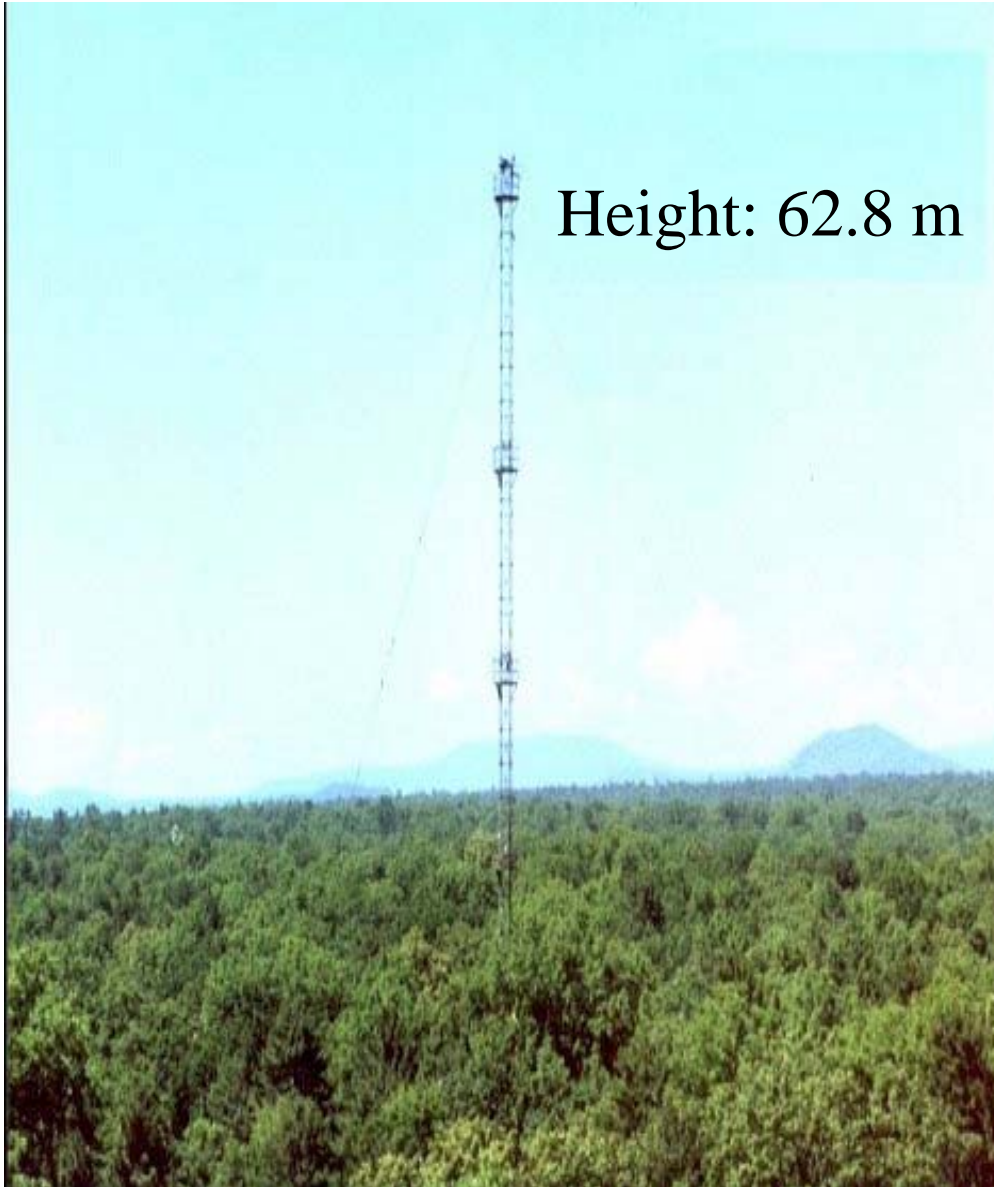


Flux Observation Site of Dinghushan Sub-tropic Typical Tropical Evergreen Broad-leaved Forest

Research zones and transect



Changbaishan



Qianyanzhou



Dinghushan



Xishuangbanna



Haibei



Yucheng



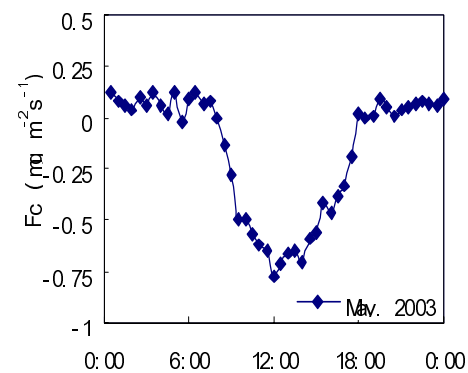
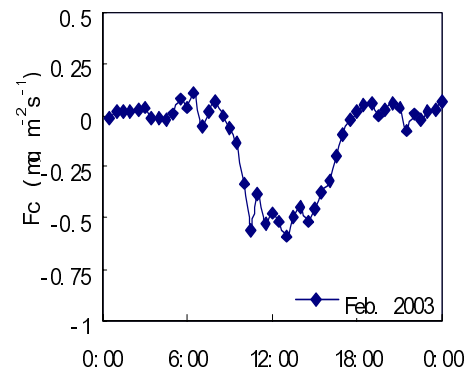
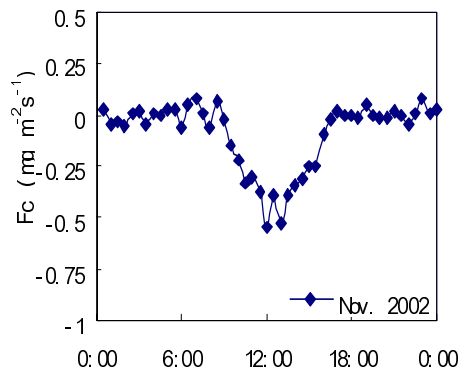
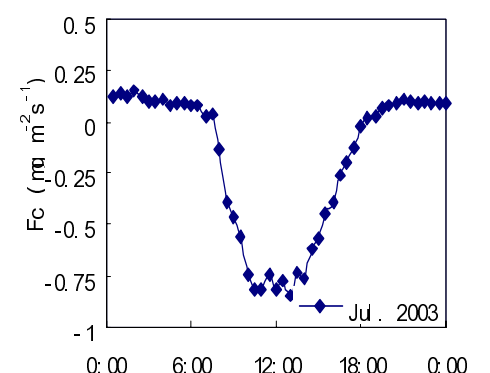
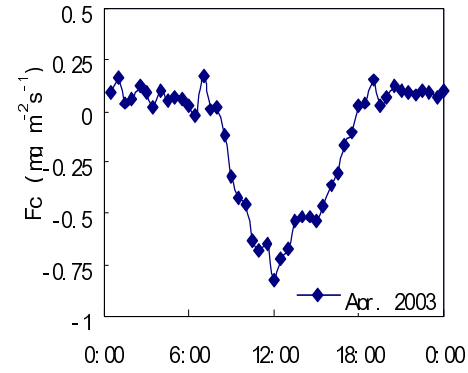
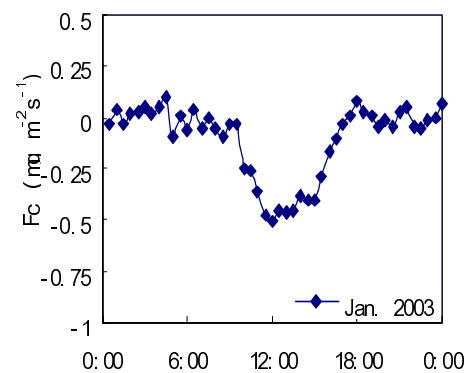
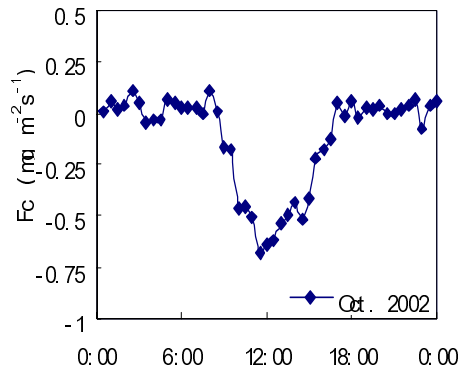
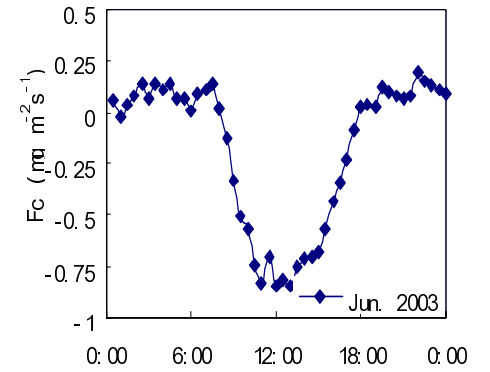
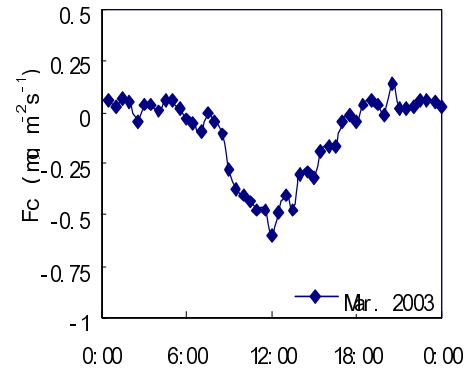
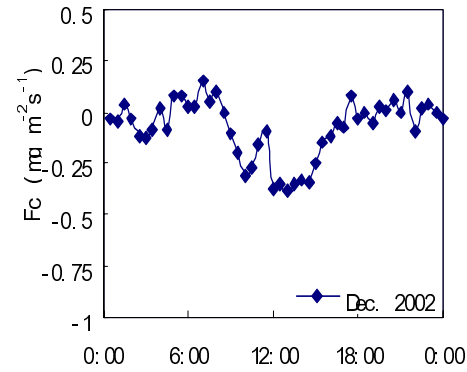
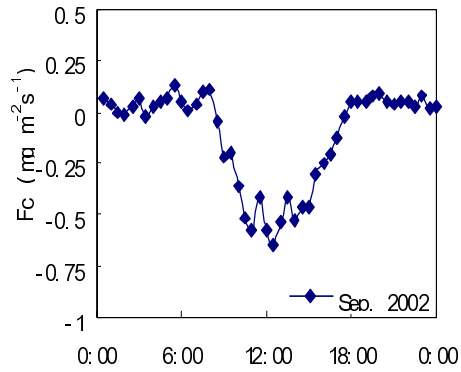
Dangxiong



Inner Mongolia

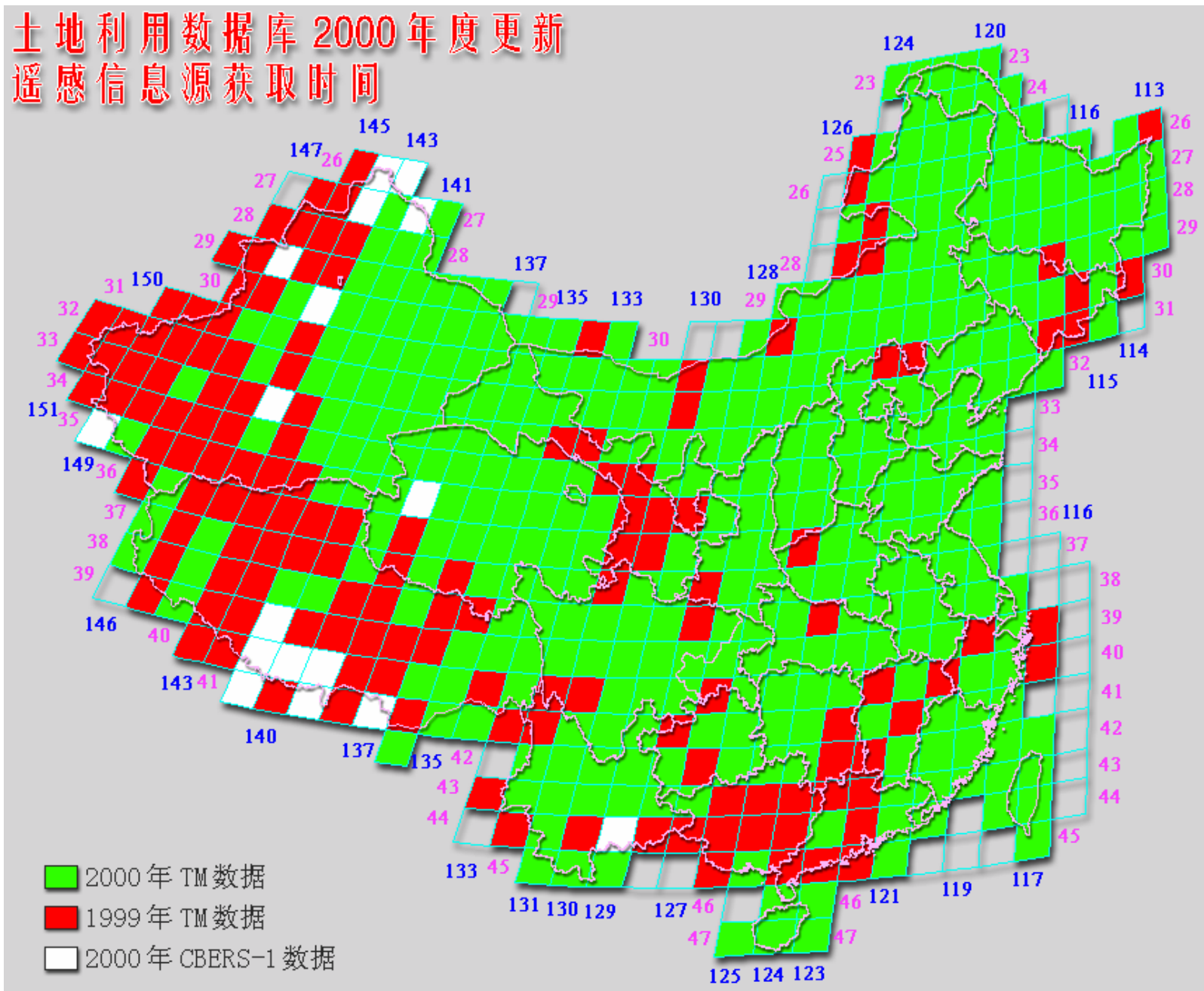


Diurnal Cycles of CO₂ flux in forest ecosystem (Qianyanzhou)



DIS: Landsat data source for LUCC study

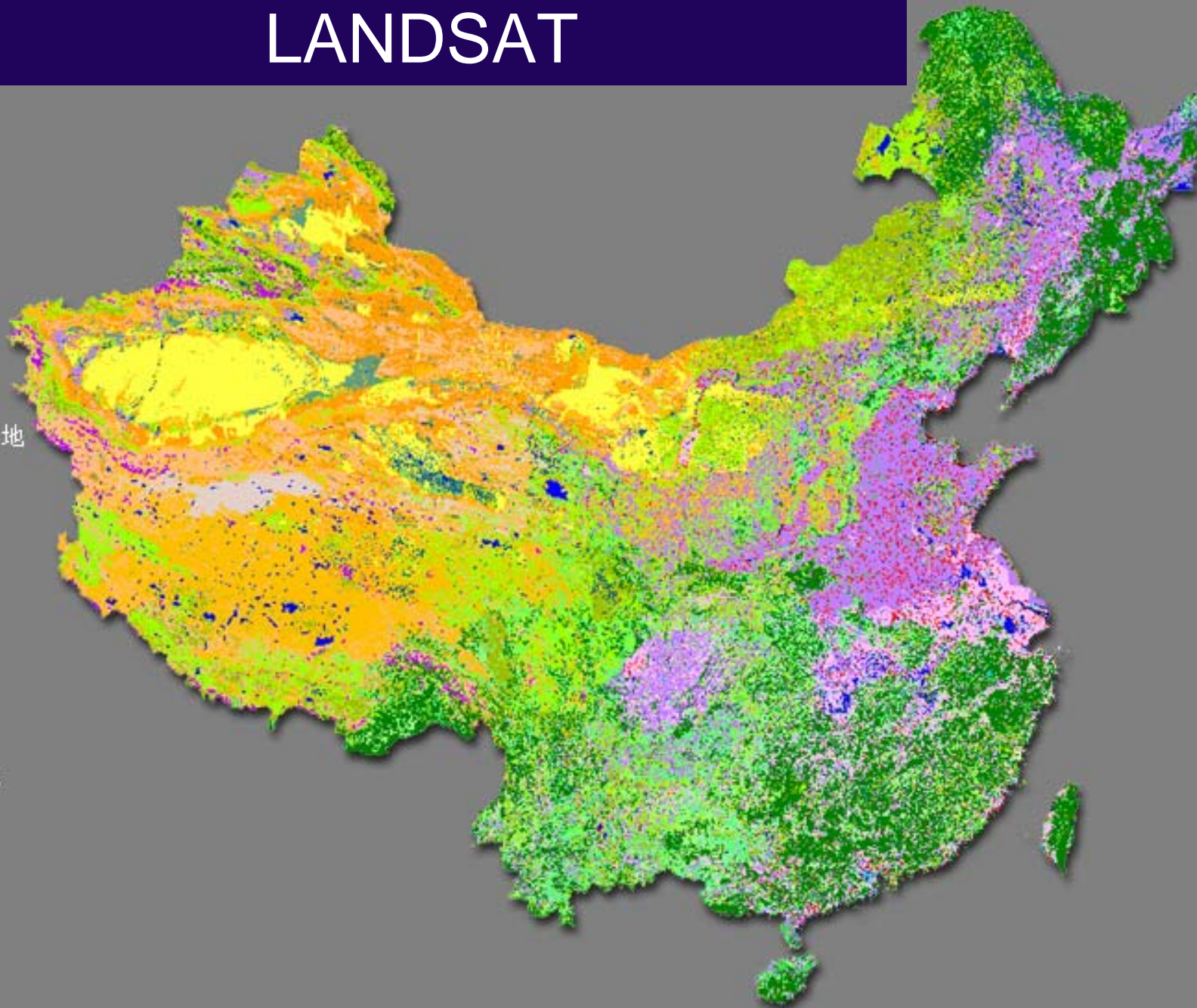
土地利用数据库 2000 年度更新
遥感信息源获取时间



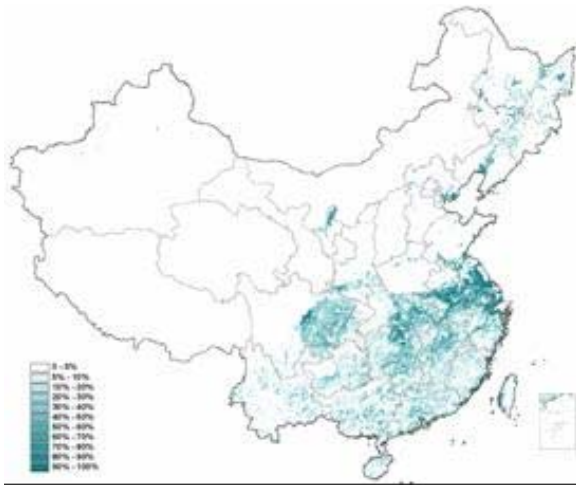
LAND USE MAP BASED ON LANDSAT

图例

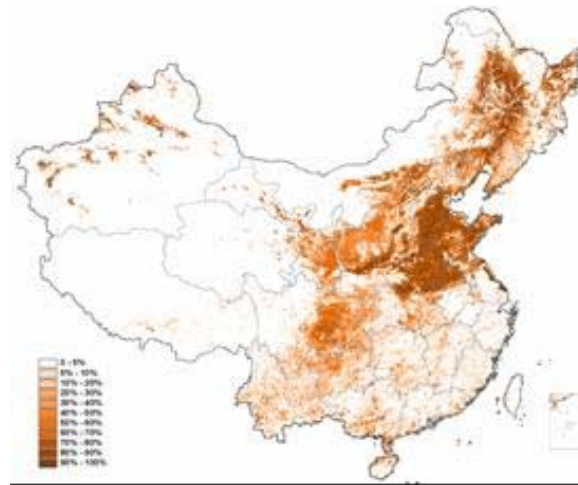
- 有林地
- 灌木林地
- 疏林地
- 其他林地
- 高覆盖度草地
- 中覆盖度草地
- 低覆盖度草地
- 河渠
- 湖泊
- 水库、坑塘
- 冰川和永久积雪地
- 海涂
- 滩地
- 城镇用地
- 农村居民点
- 工交建设用地
- 沙地
- 戈壁
- 盐碱地
- 沼泽地
- 裸土地
- 裸岩石砾地
- 其它未利用土地
- 山区水田
- 丘陵区水田
- 平原区水田
- >25° 度水田
- 山区旱地
- 丘陵区旱地
- 平原区旱地
- >25° 度旱地



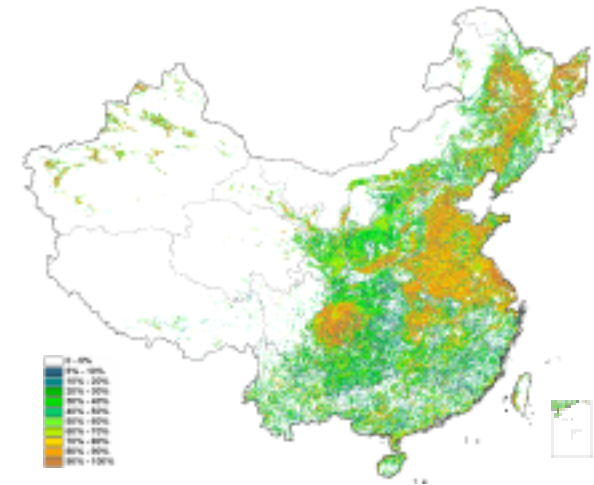
Land-use datasets



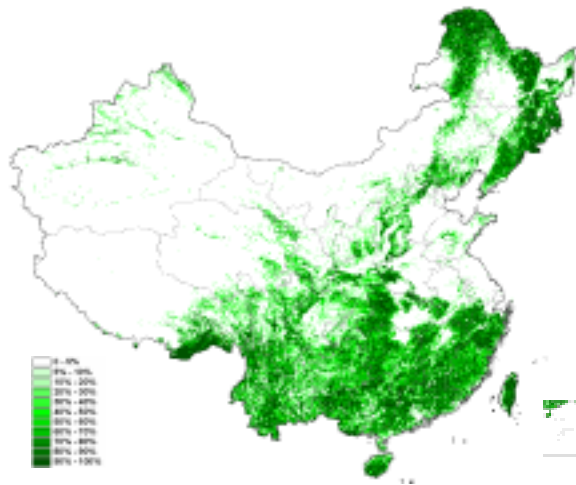
Paddy land



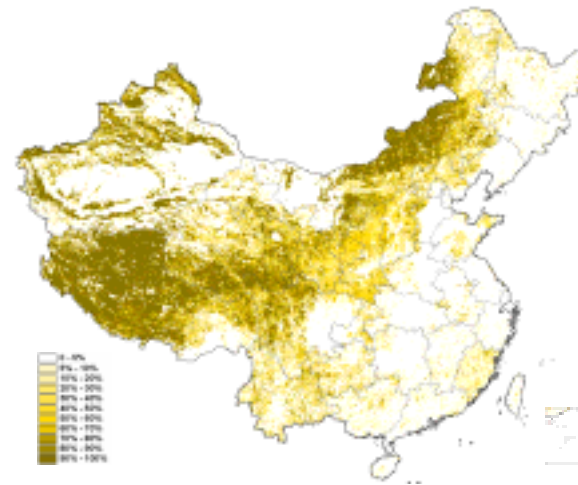
Dry farming land



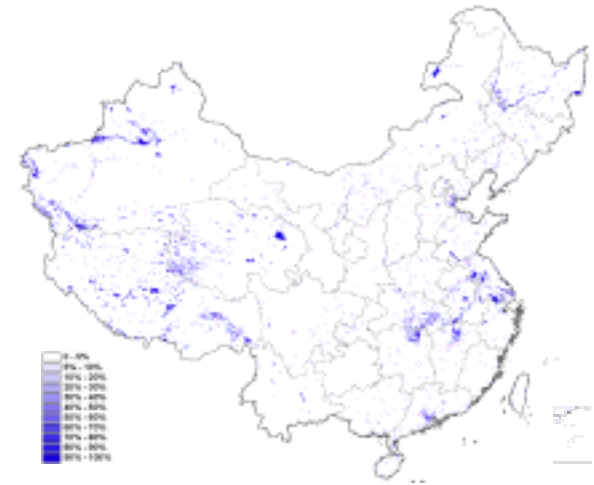
Total Cropland



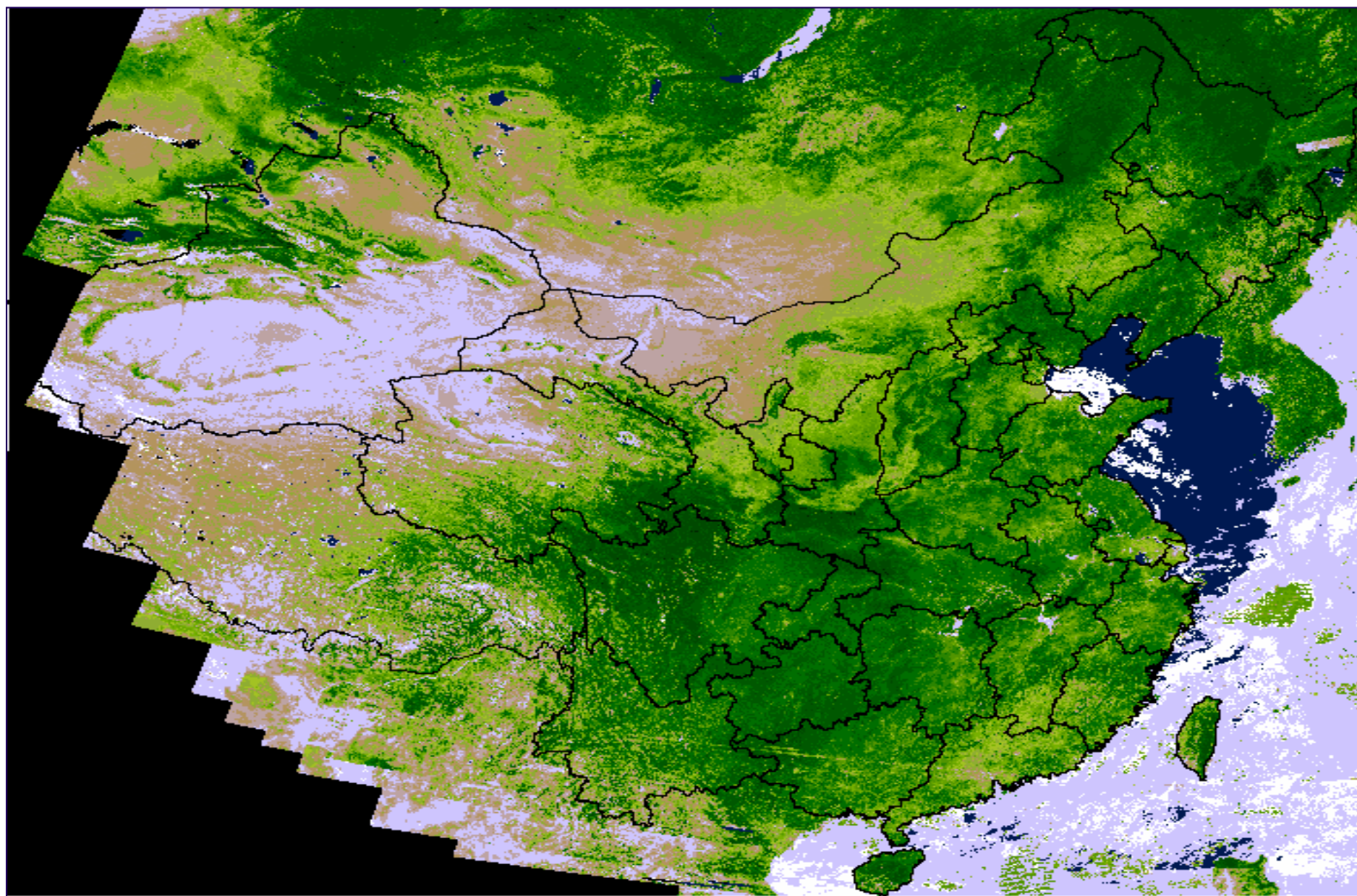
Woodland



Grassland



Water body



01-10, July-2002

Research Process

❖ Capability building

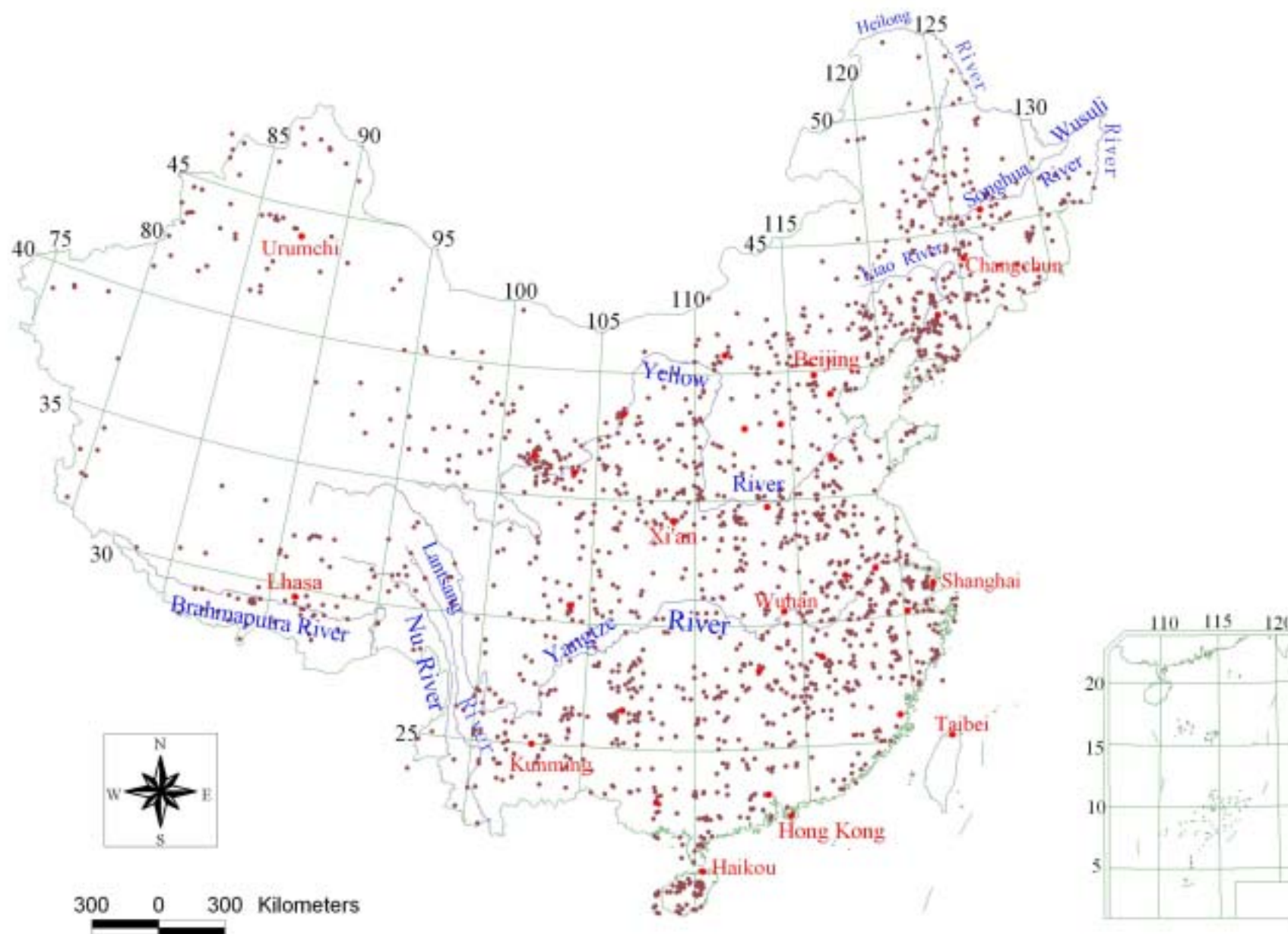


❖ Land use/cover change

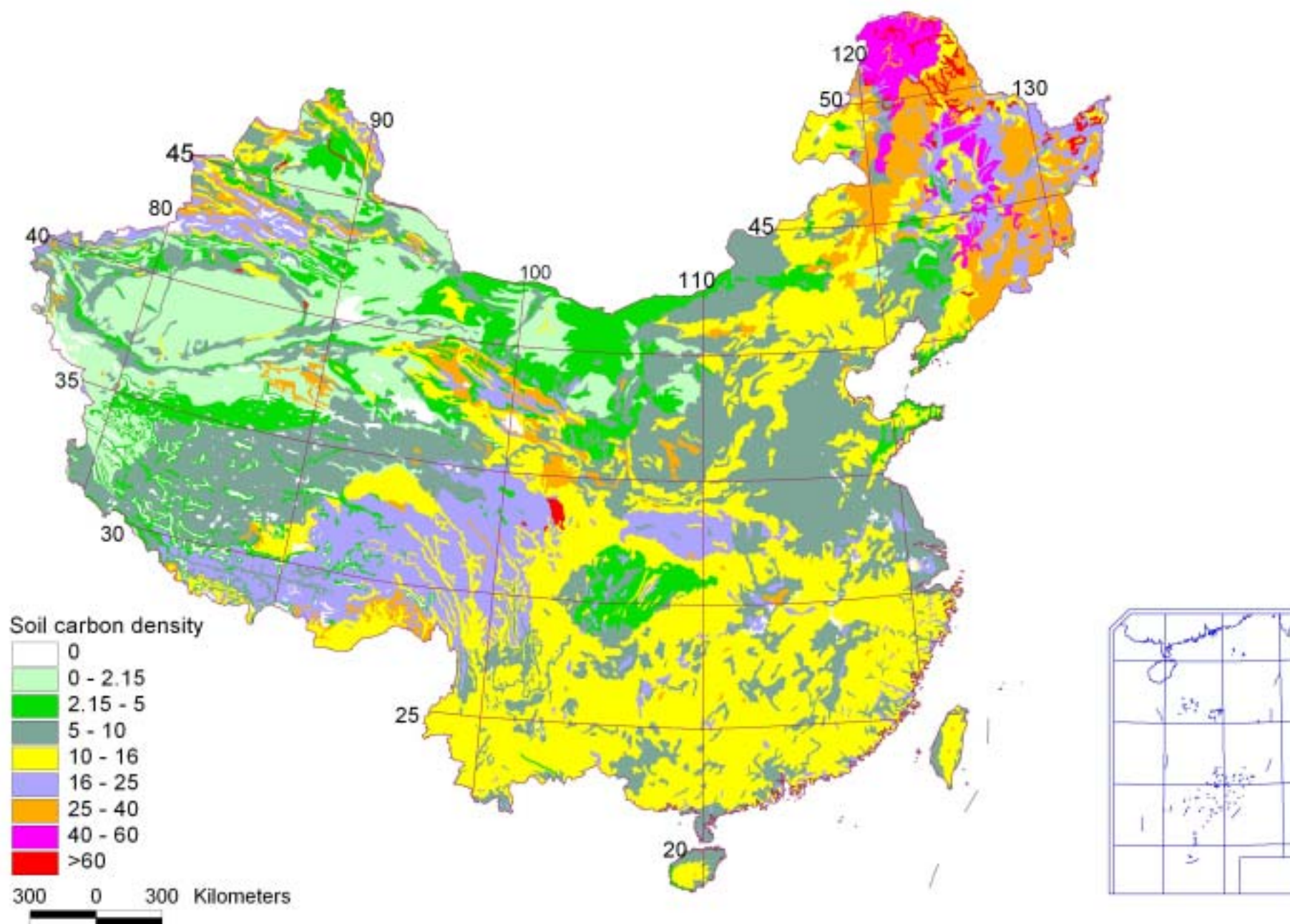
❖ Simulation of carbon cycle in China

Spatial distribution of soil profiles in China

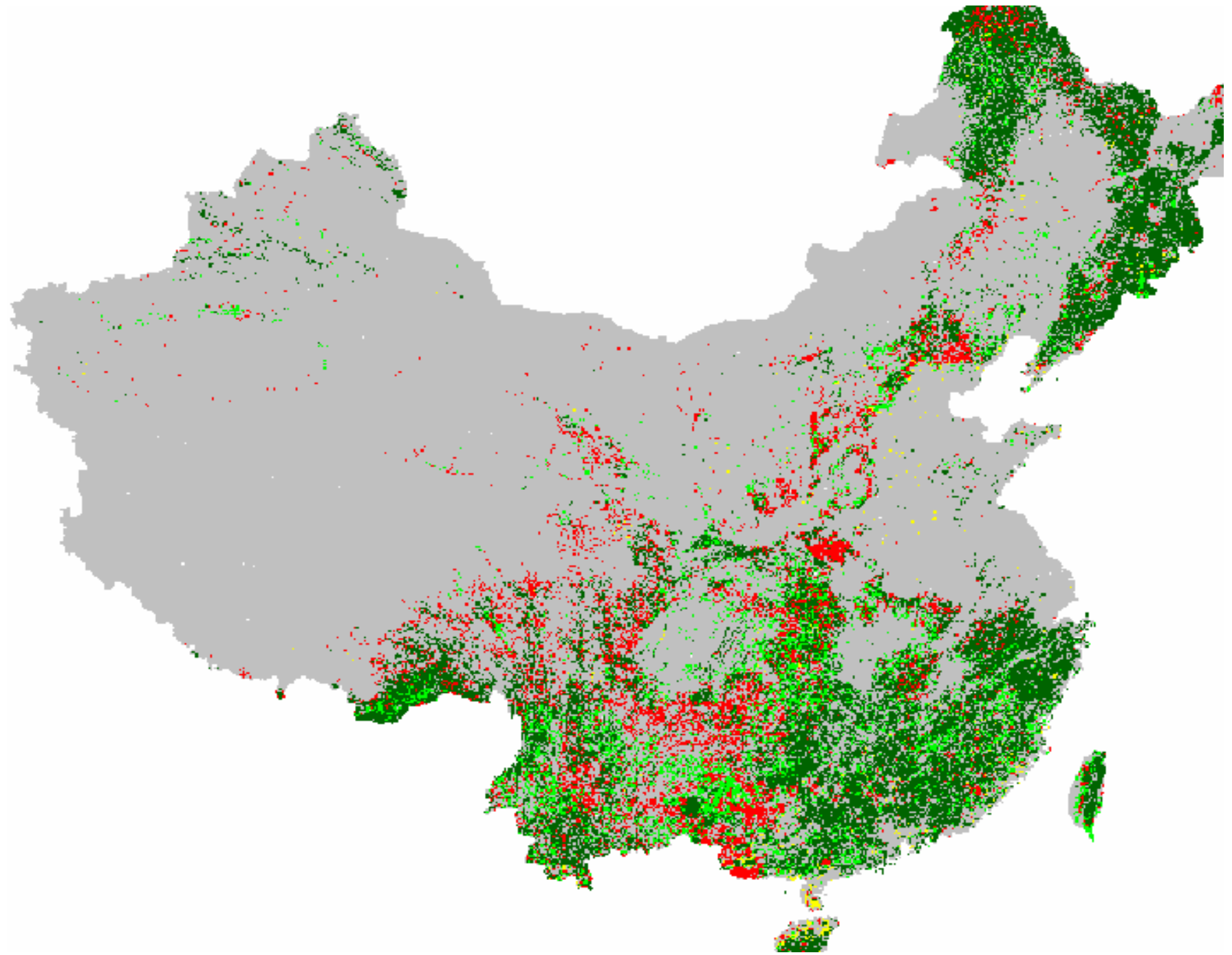
Second national soil general survey in 1980s; 2473 soil profiles



Spatial distribution of soil organic carbon in China



Forest Cover of China from Inventory



Forest Vegetation biomass in China by inventory



Research Process

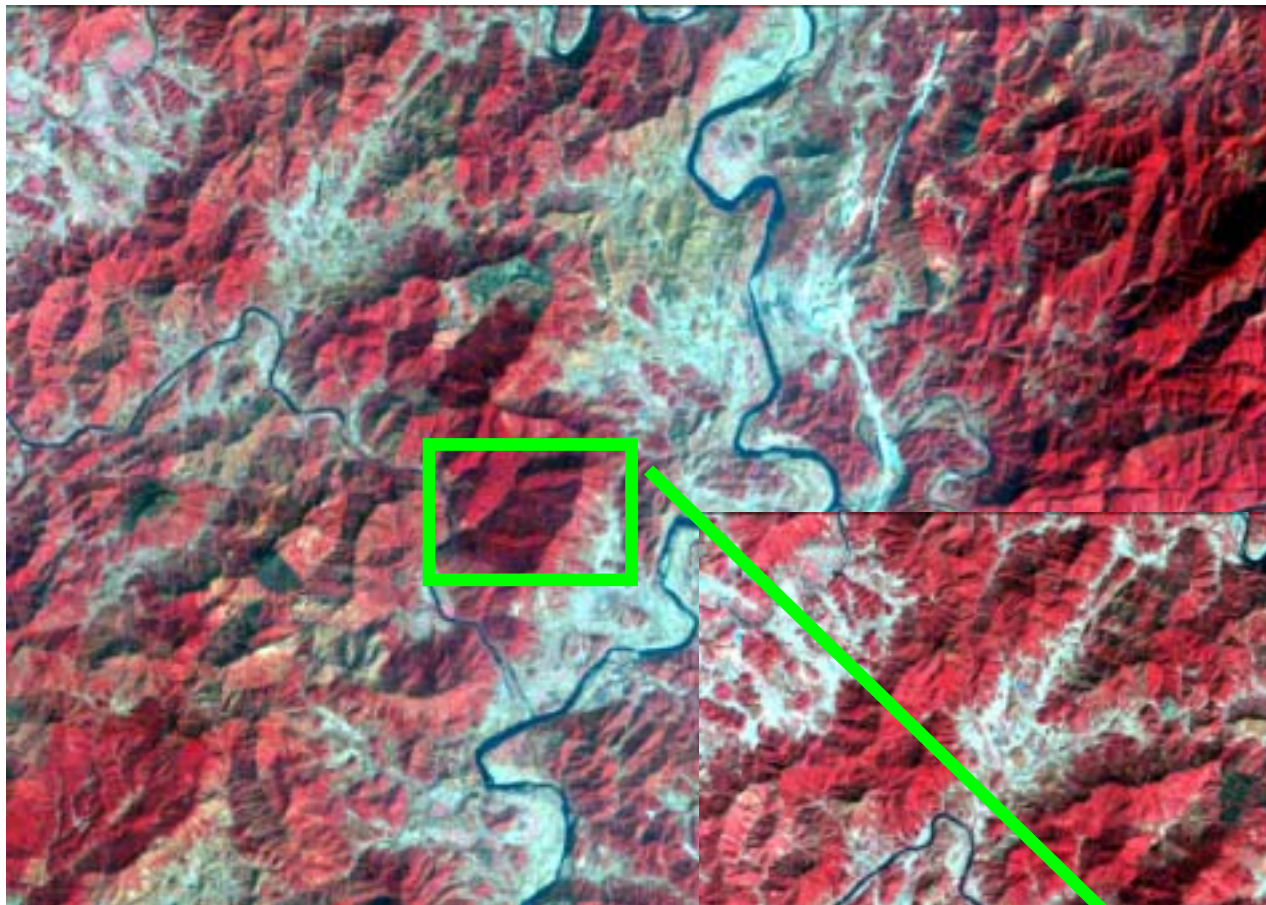
- ❖ Capability building
- ❖ Terrestrial ecosystem carbon stock
- ❖
- ❖ Simulation of carbon cycle in China

Some Examples of LUCC

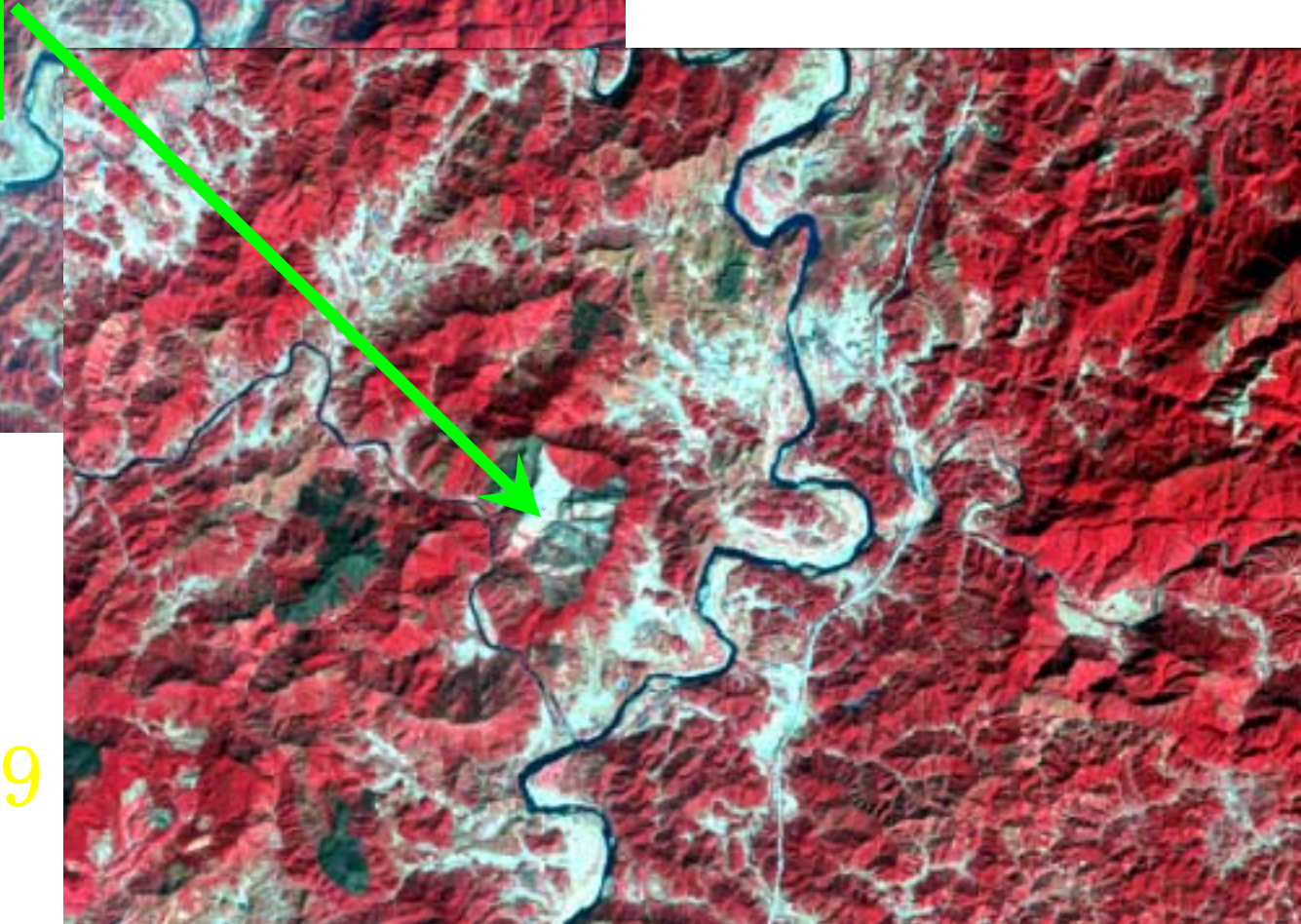


2000

1998

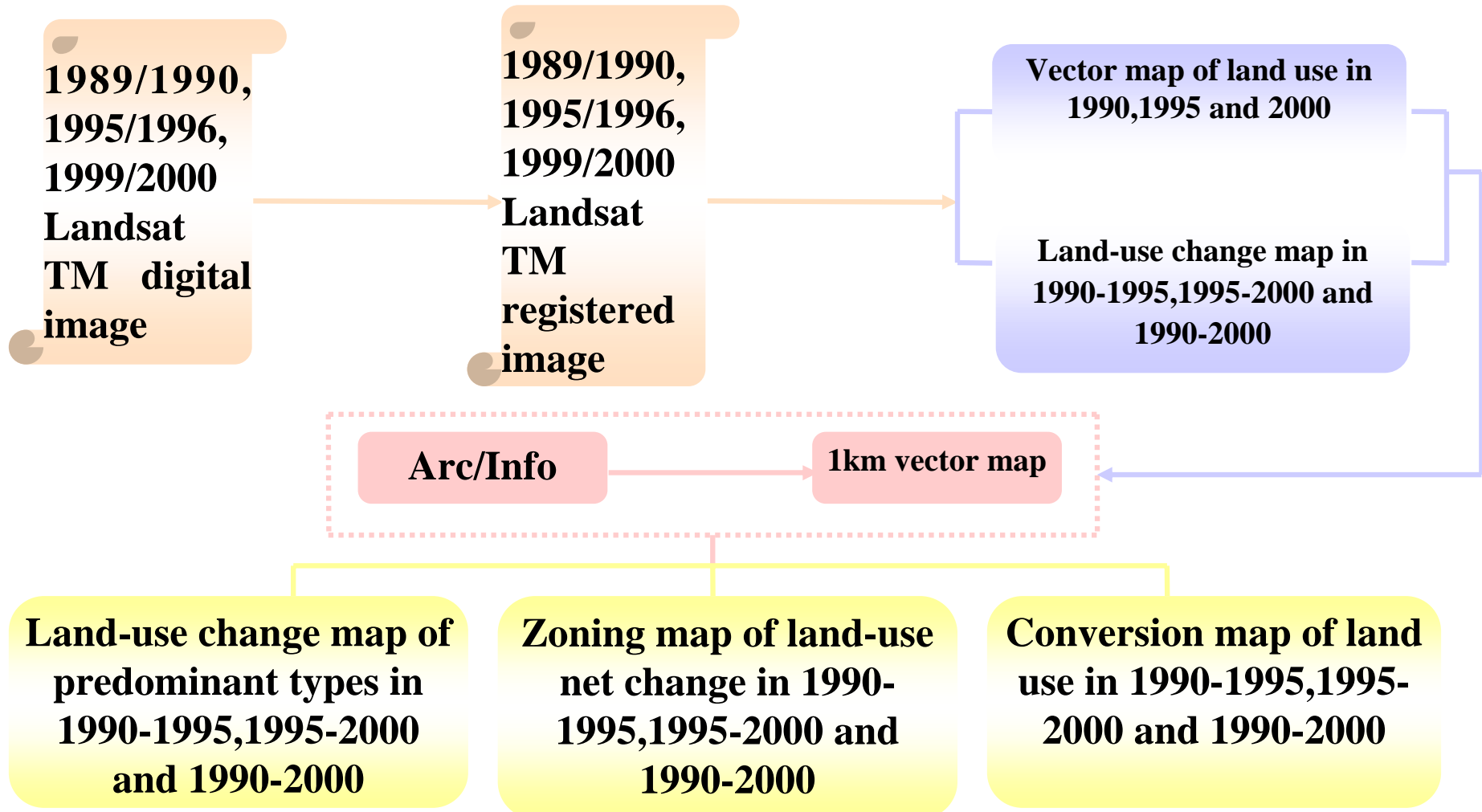


1996

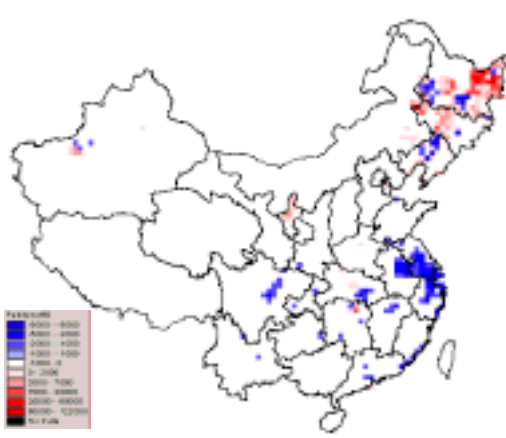


1999

Data analysis and Land use change mapping



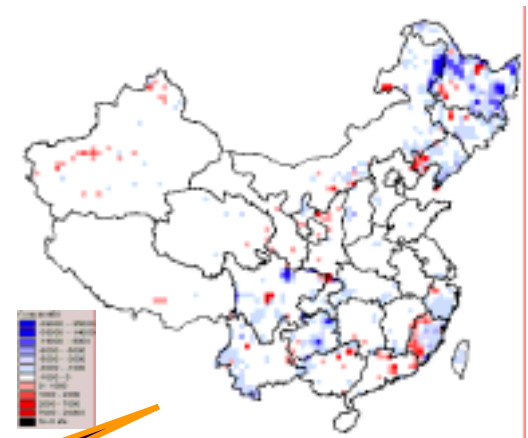
Net change of land-use/land-cover types



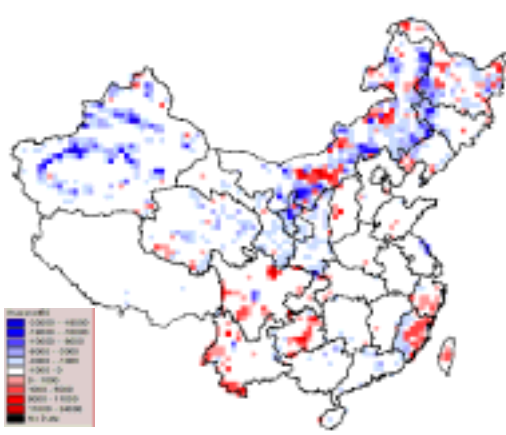
Paddy land



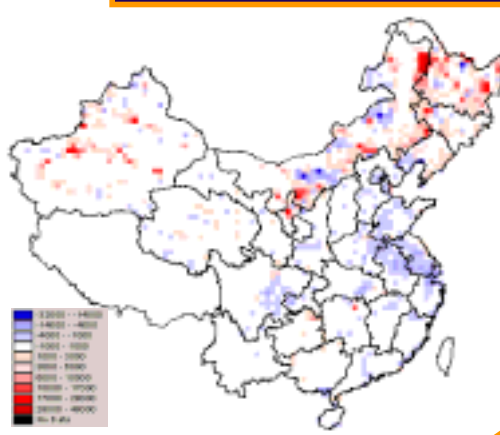
Dry farming land



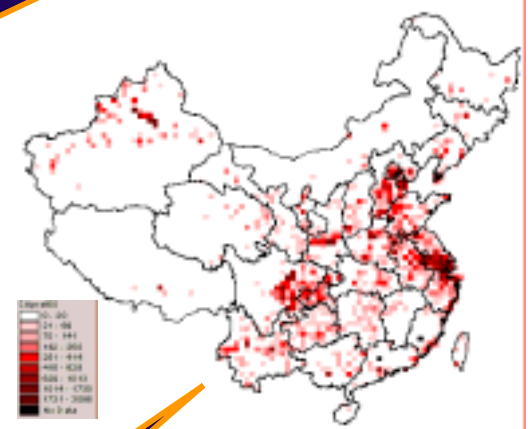
Forest land



Grassland



Unused land



Urban area

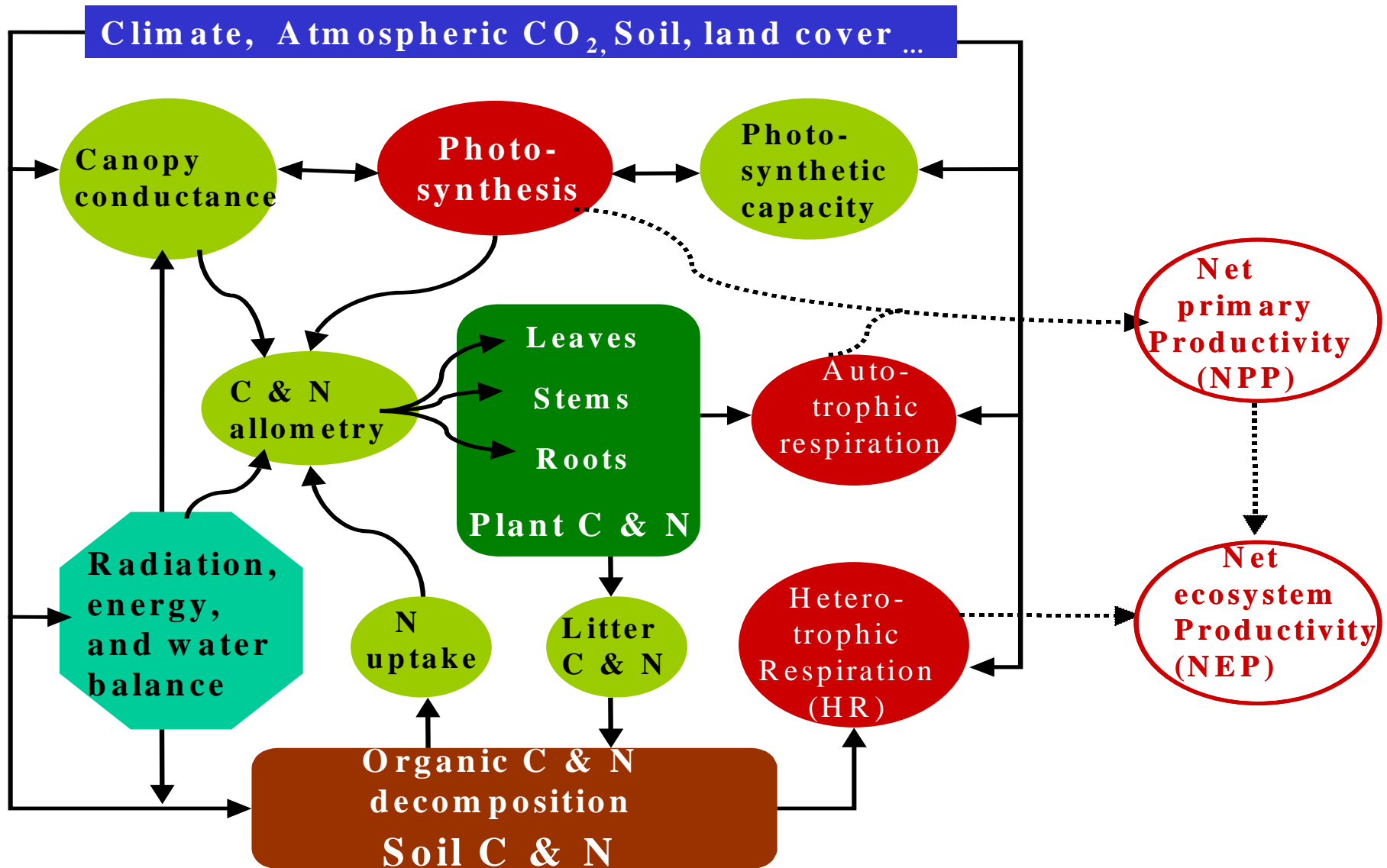
Rural residential area and other built-up

The comprehensive LUCC zoning and DI in China, 1990-2000

Research Process

- ❖ Capability building
- ❖ Terrestrial ecosystem carbon stock
- ❖ Land use/cover change
- ❖

Model(CEVSA)

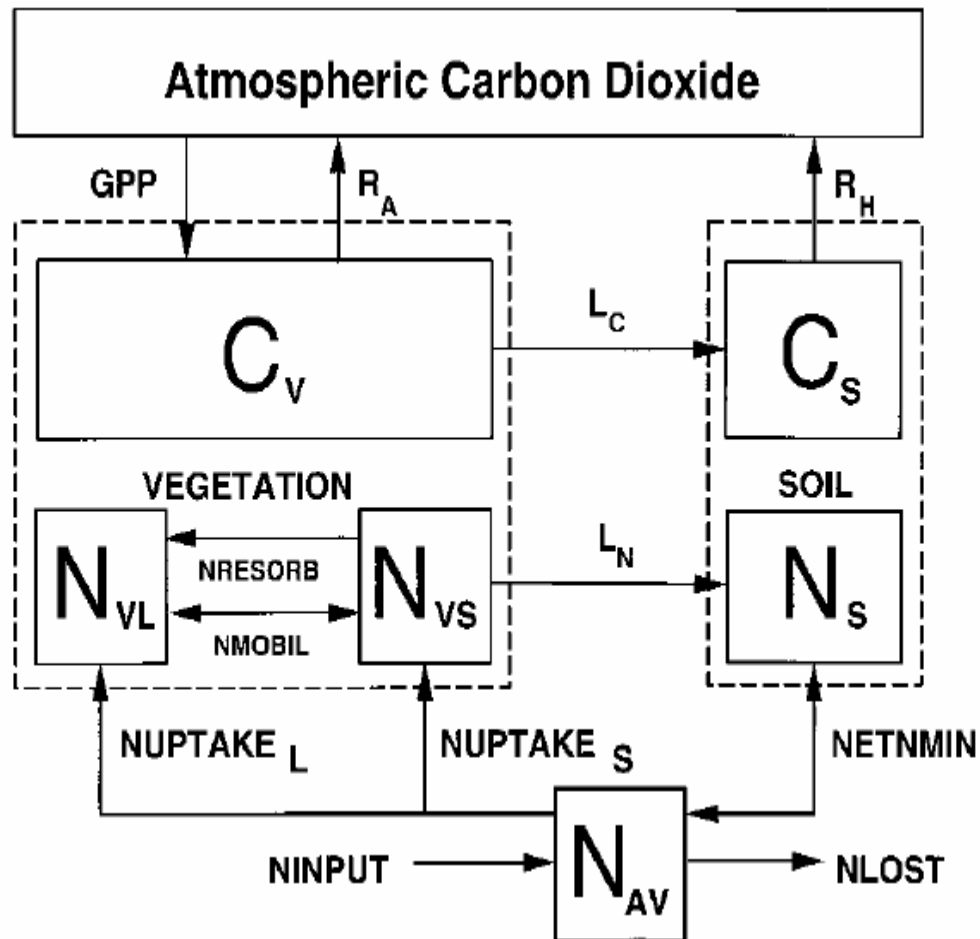


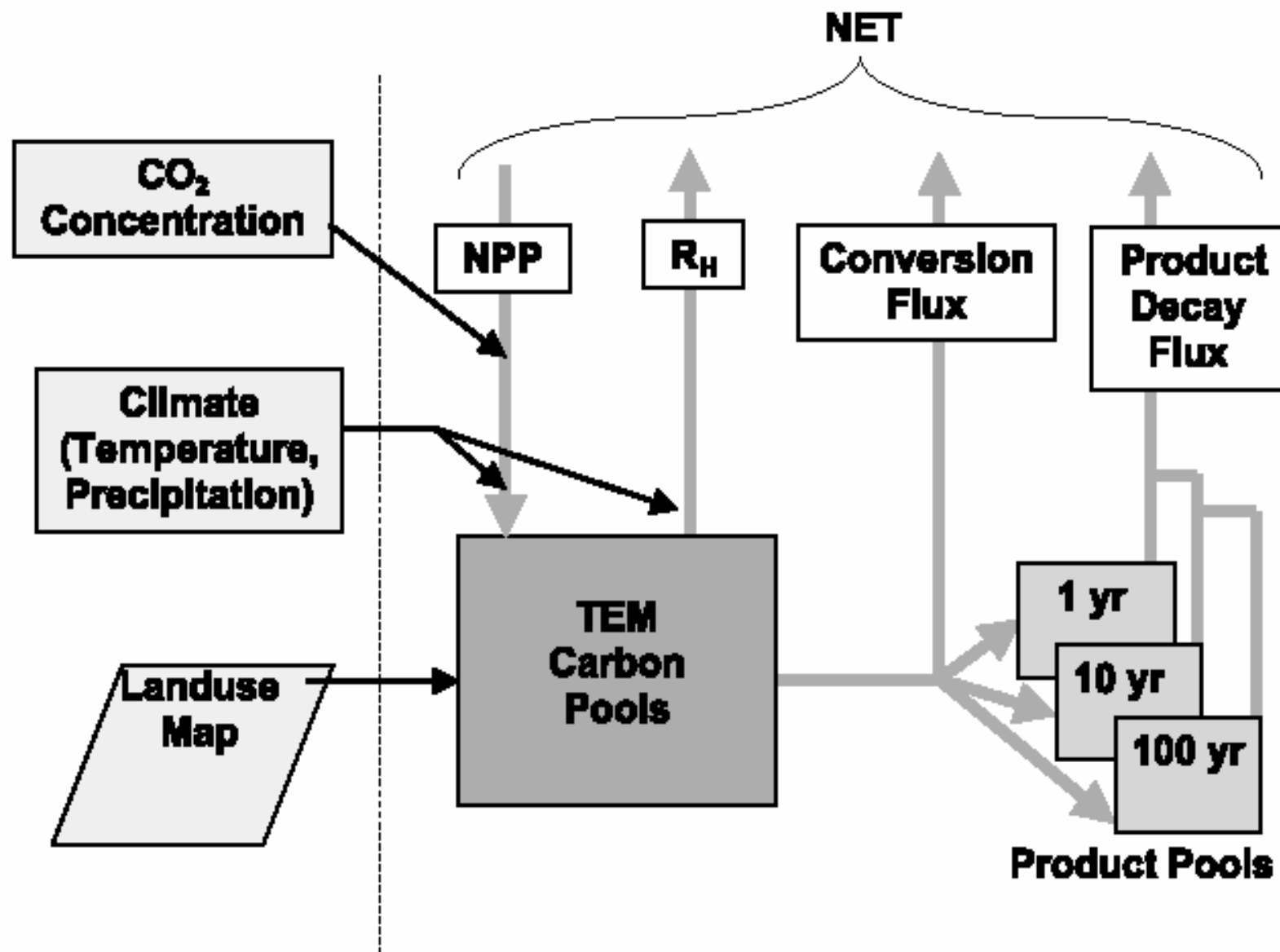
CEVSA includes three modules :

- The biophysical module
- The plant growth module
- The biogeochemical module

Model(TEM)

The terrestrial ecosystem model
(Tian et al., 1999)





Overview of the simulation by the Terrestrial Ecosystem Models (TEM) to assess the concurrent effects of increasing atmospheric CO₂, climate variability, and land use change during 1980-2000 (Tian et al., 2003)

Climate data input

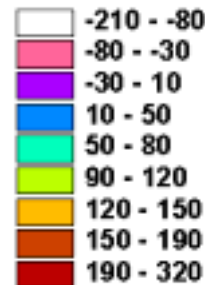


The meteorological observation stations for spatial extrapolation

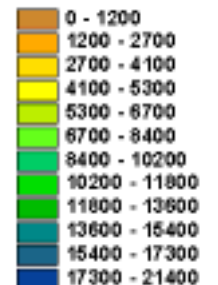
Annual mean temperature

Annual mean precipitation

(0.1°C)

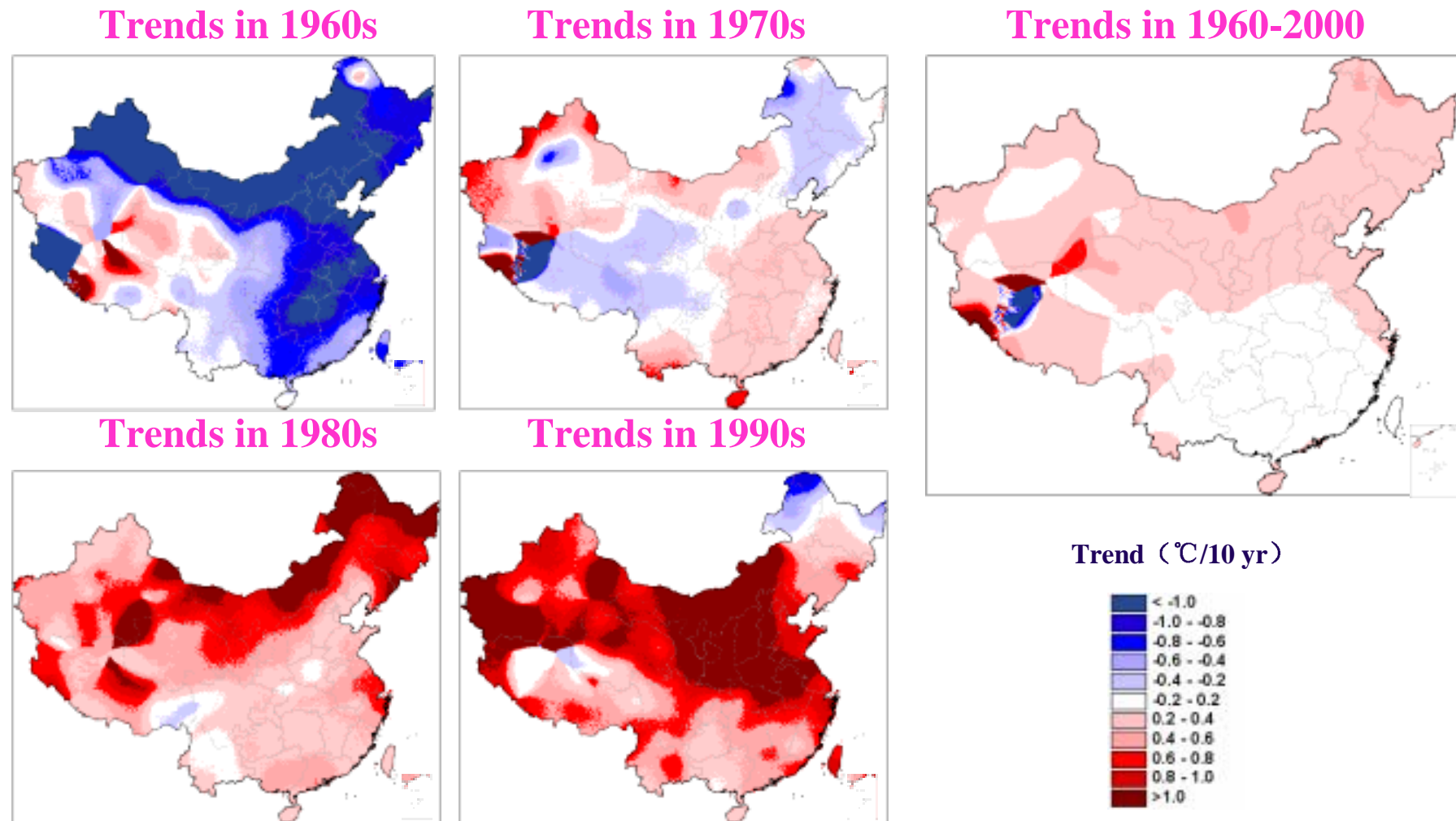


(0.1mm)



Climate change: Temperature

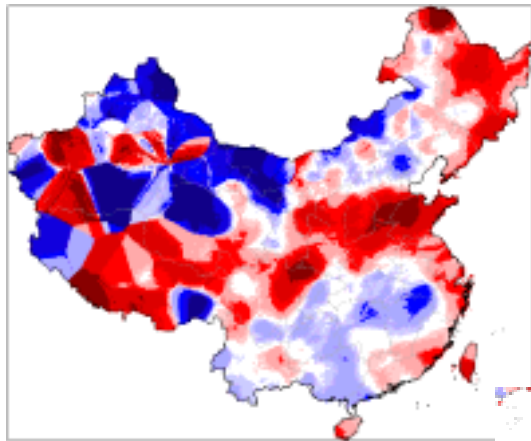
- ◆ Annual mean temperature increase 0.026°C annually, which higher than global average in the same period. And 1990s is the warmest period.



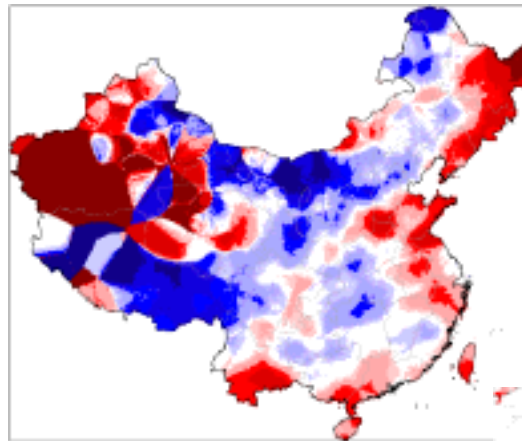
Climate change: Precipitation

- ◆ Precipitation increase 1.14 mm annually during last 40 years. But its dynamics is complicated and its spatial pattern is not consistent in large scale.

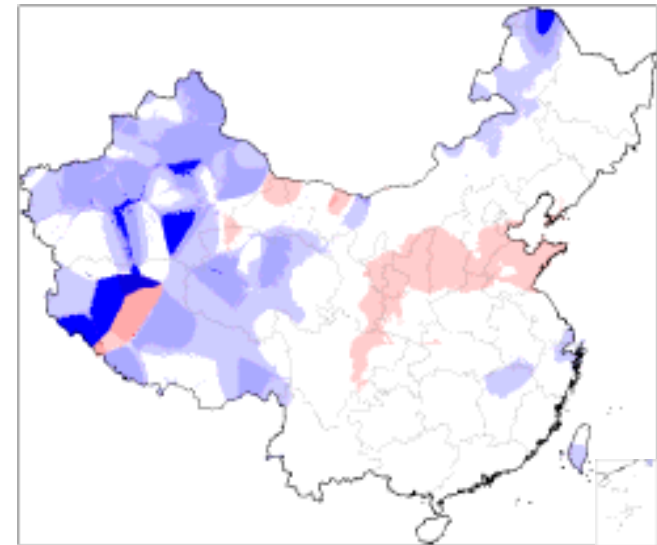
Trends in 1960s



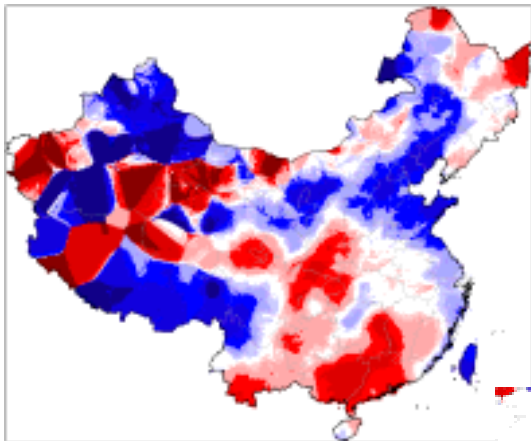
Trends in 1970s



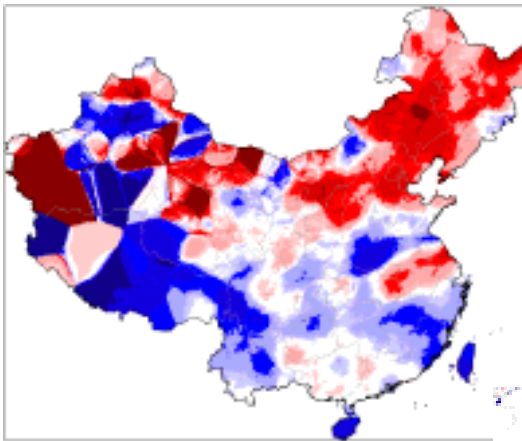
Trends in 1960-2000



Trends in 1980s



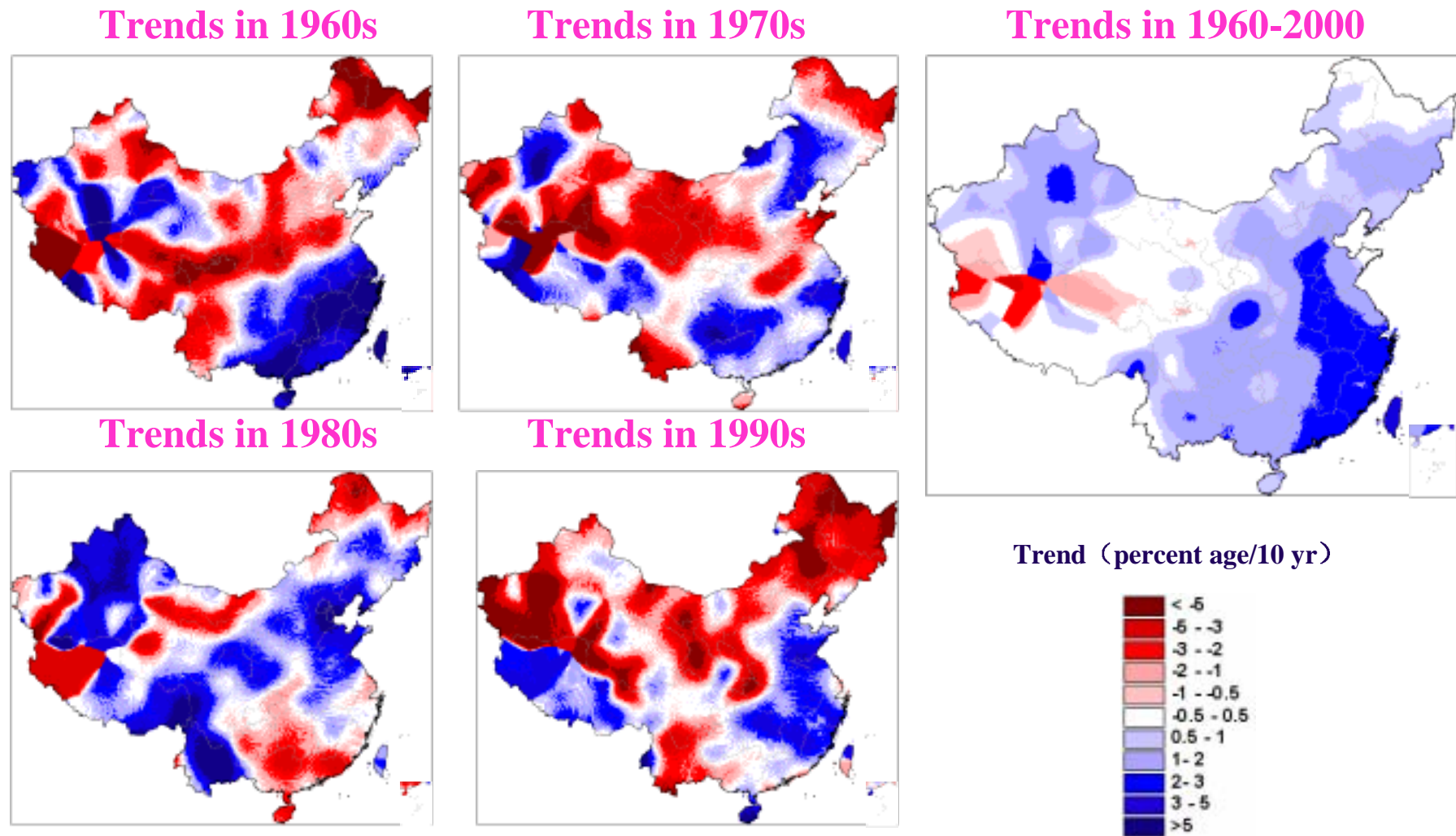
Trends in 1990s



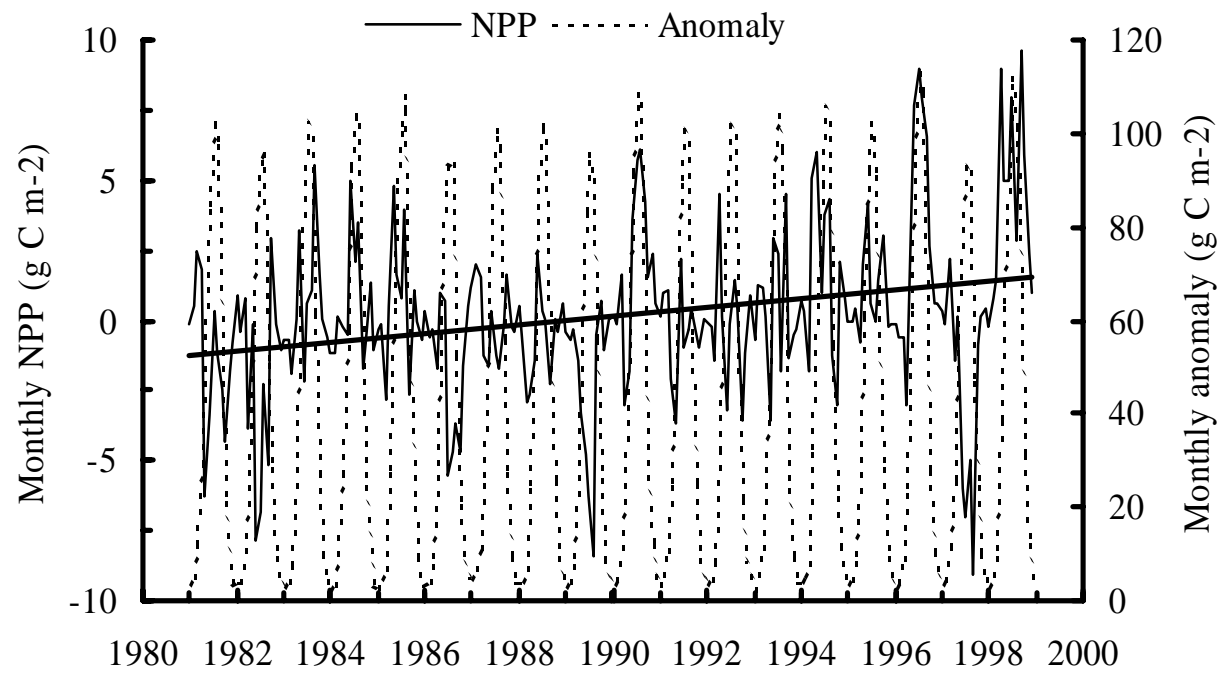
Trend (mm/10 yr)

Climate change: Cloudiness

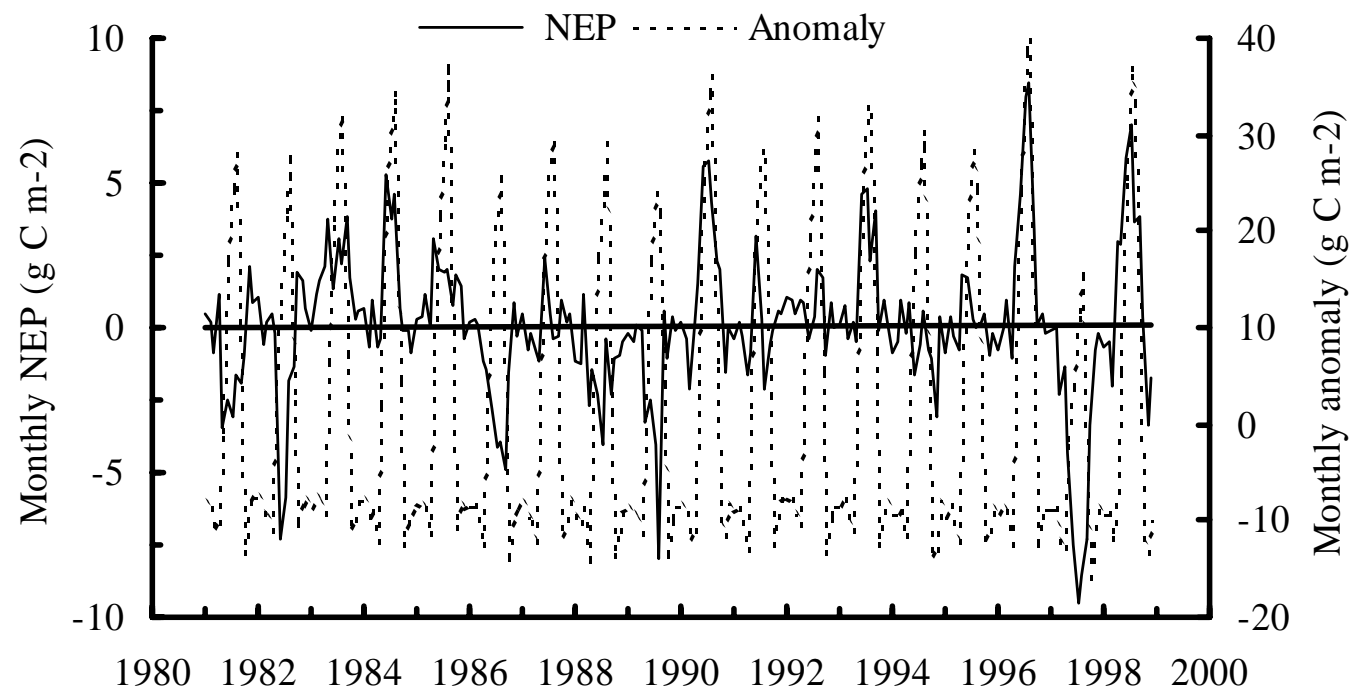
- ◆ Cloudiness has trend of increase during last 40 years in China, and the cloudiness increase about 0.1 percentage annually.

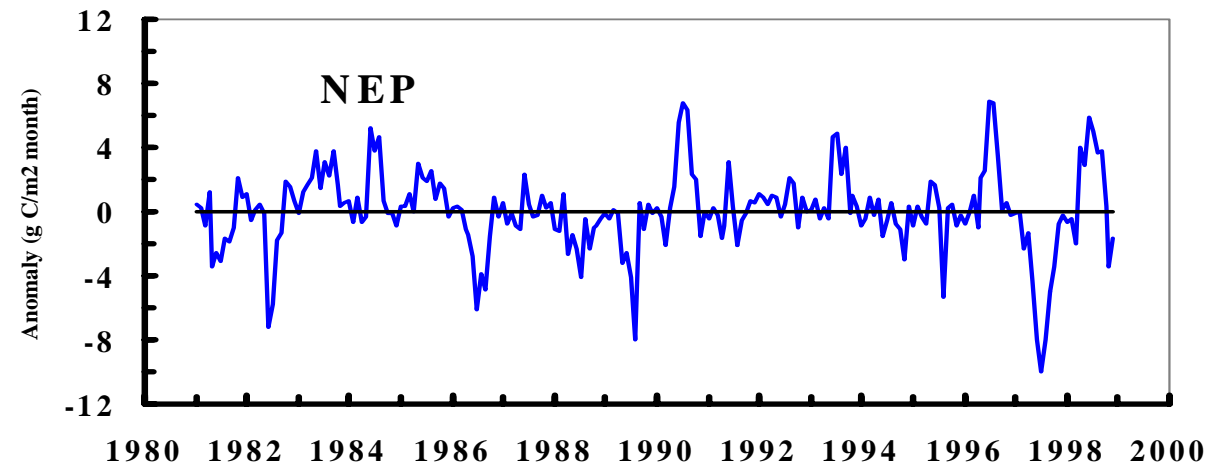
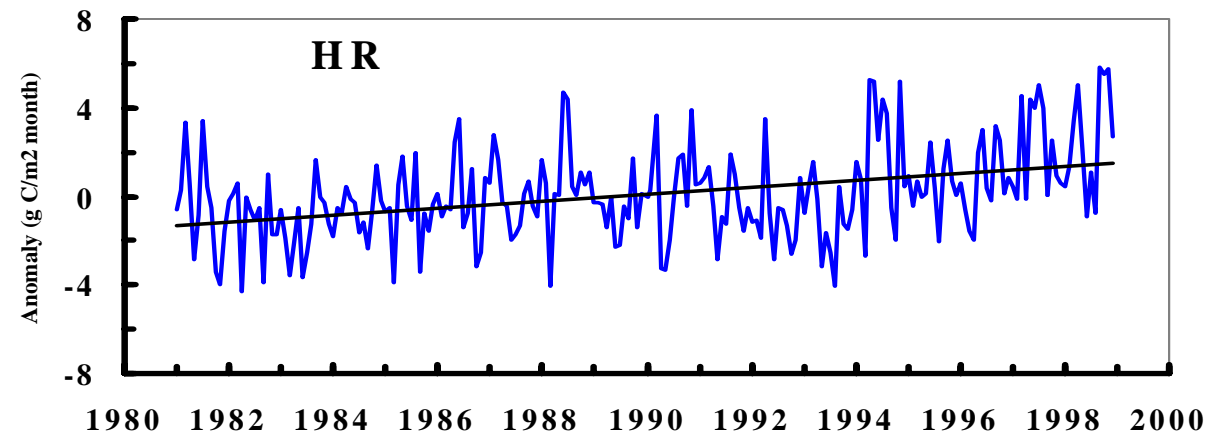
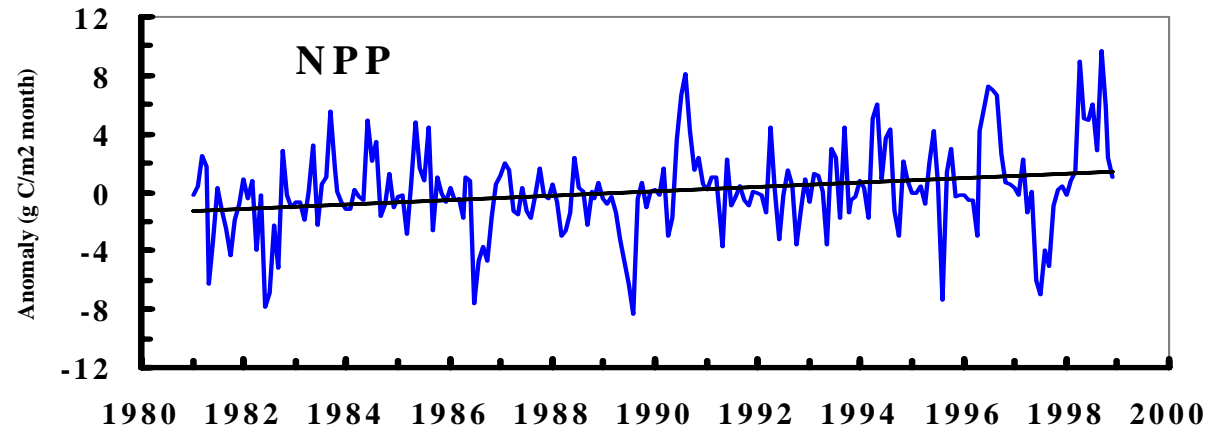


Interannual variations in NPP in China



Spatial-temporal change of terrestrial ecosystem carbon sink/source in China by CEVSA model

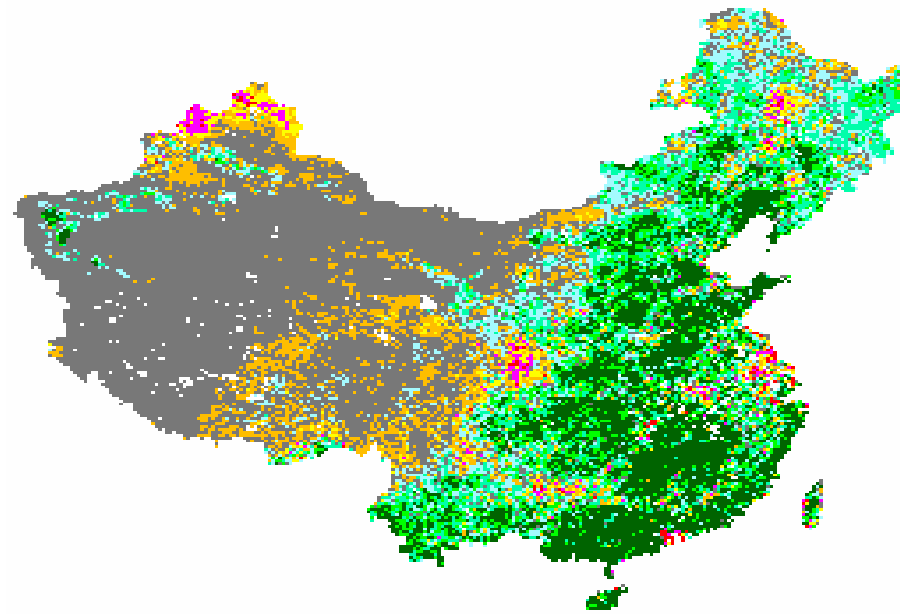
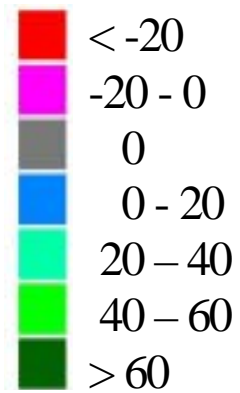




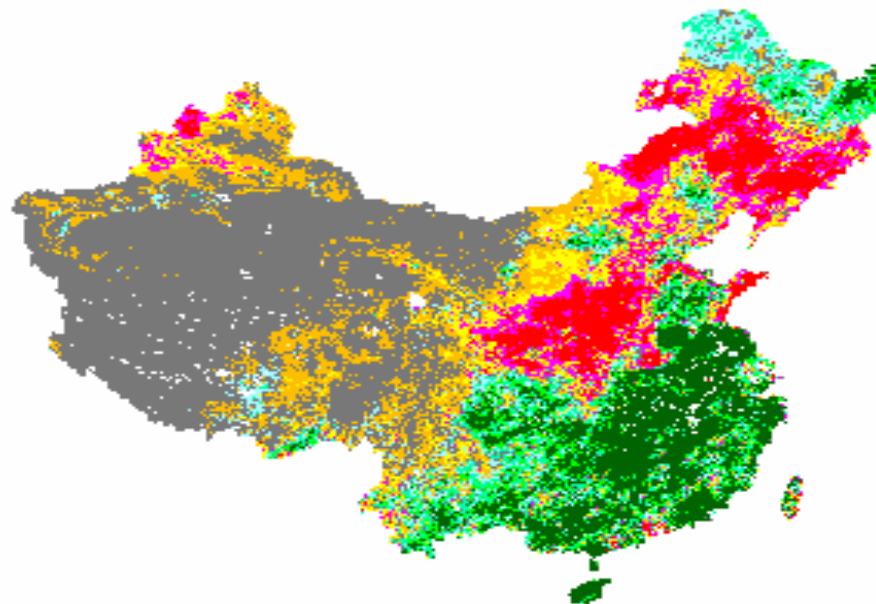
The impact of El Niño and La Niña on NPP in China

1996 La Niña

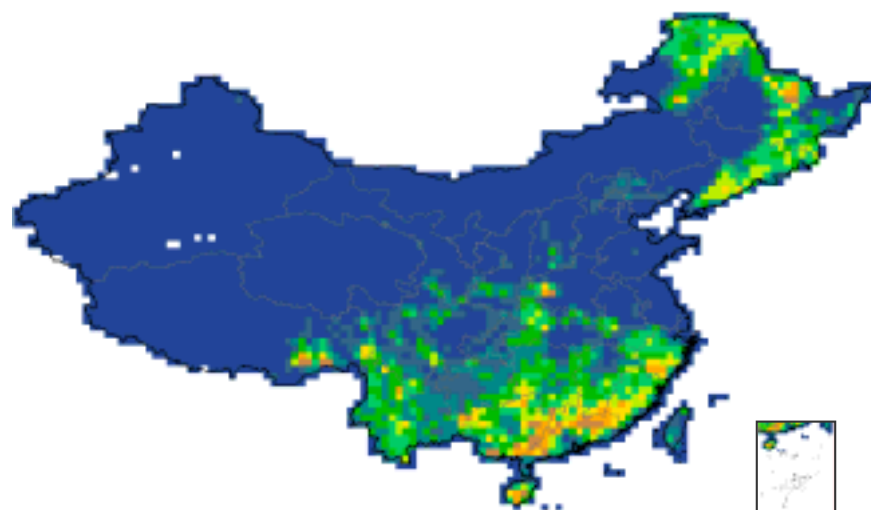
$\text{g C m}^{-2} \text{ yr}^{-1}$



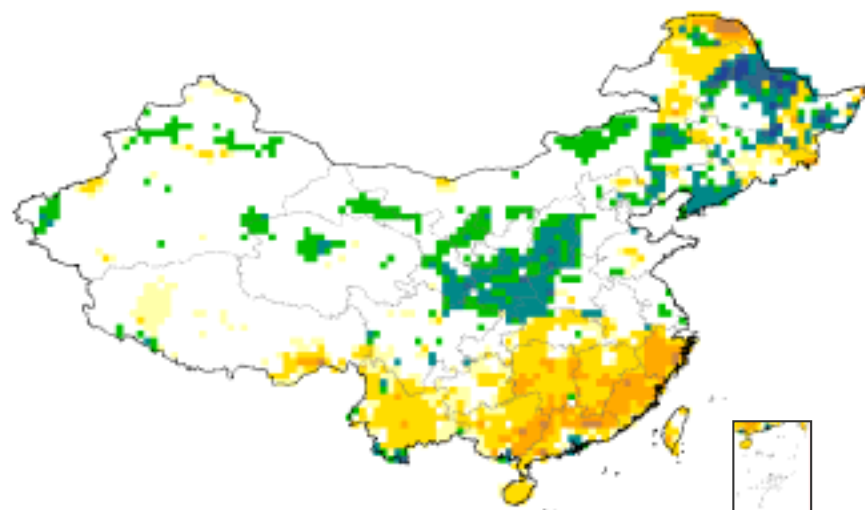
1997 El Niño



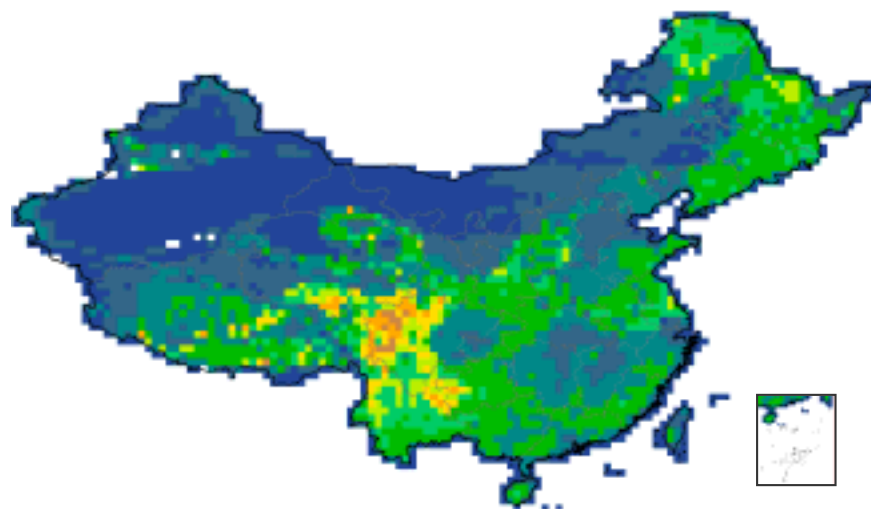
VegC 2000



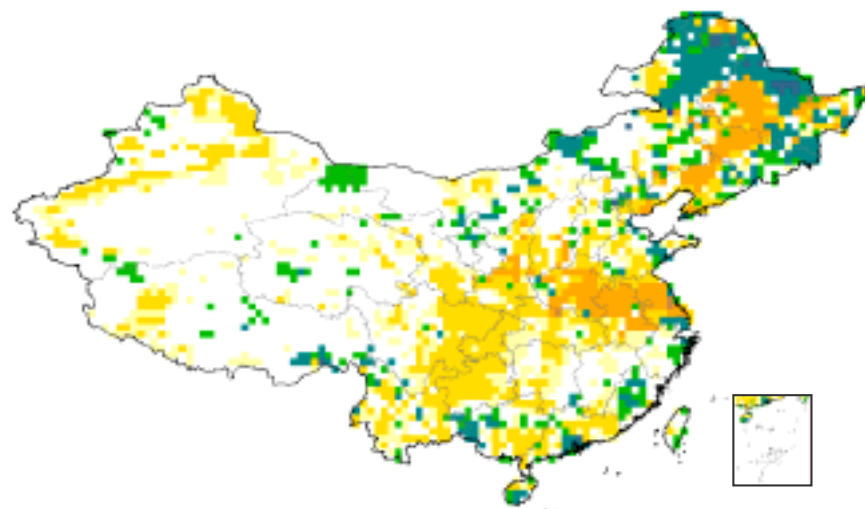
Change during 1990-2000



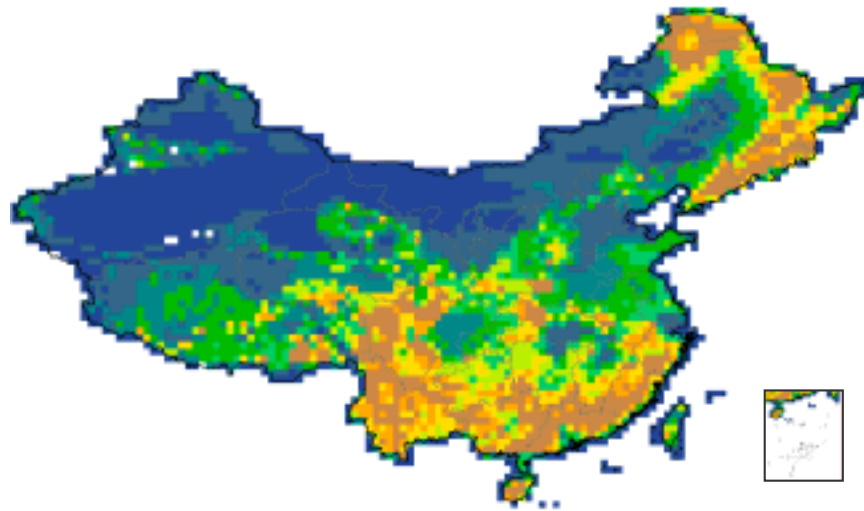
SoilorgC 2000



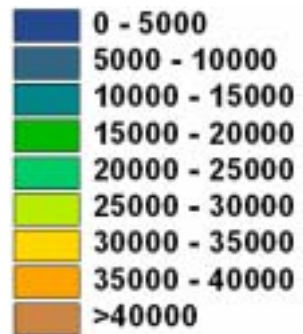
Change during 1990-2000



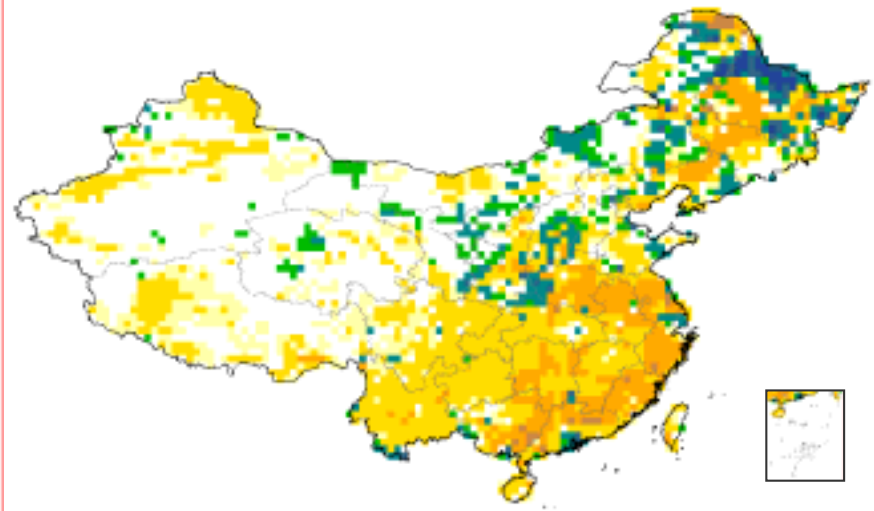
TotalC 2000



10^9gC/cell



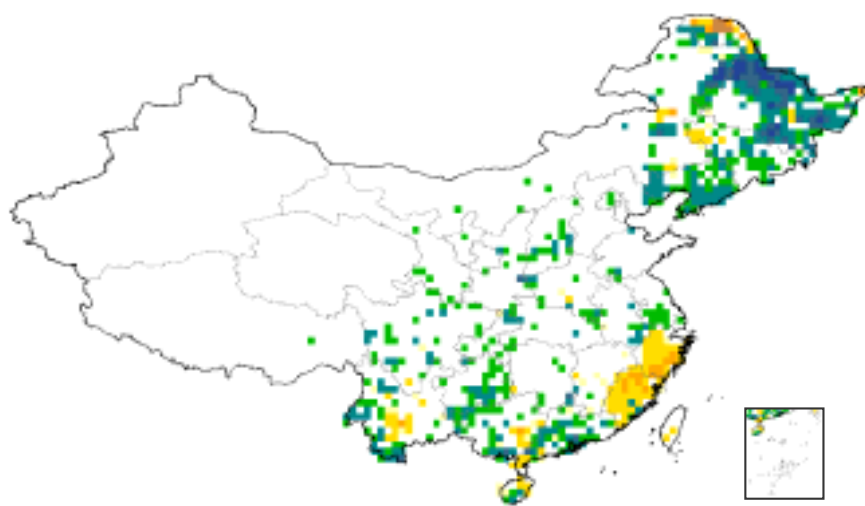
TotalC change during 1990-2000



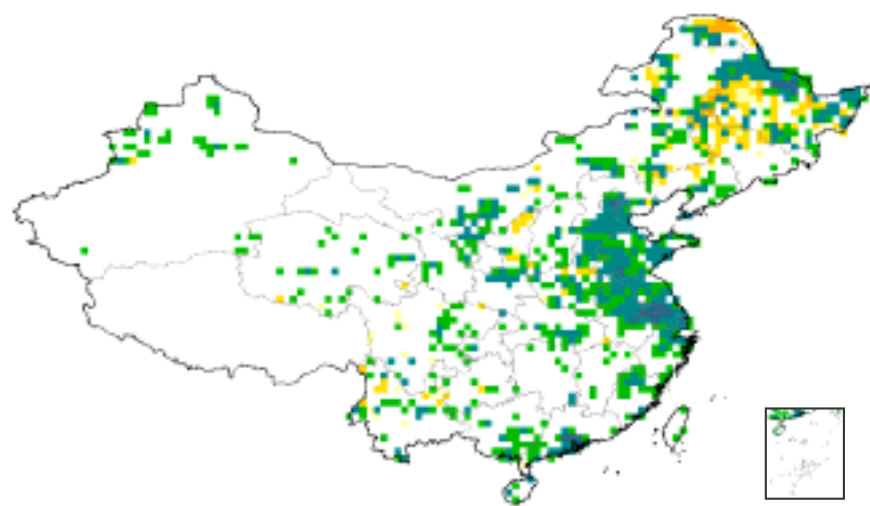
Change:
 10^9gC/cell



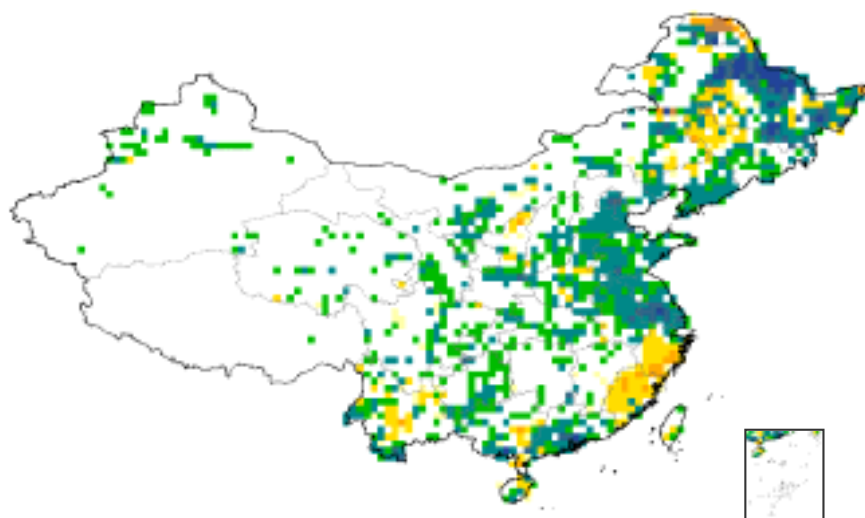
VegC



SoilorgC



TotalC

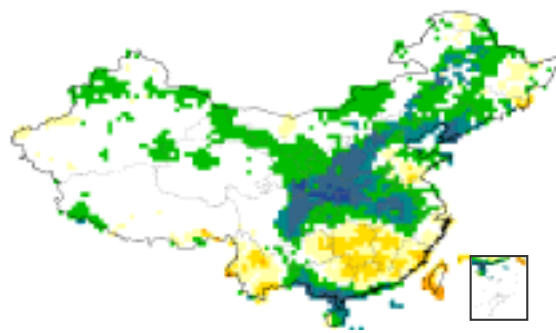
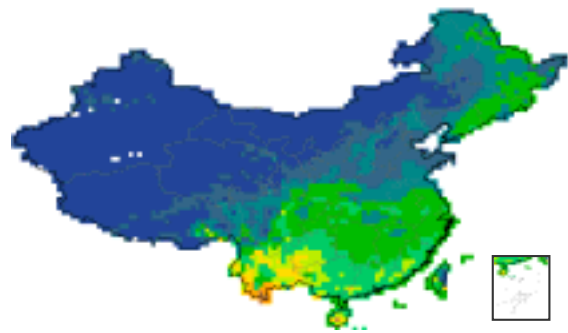


10^9gC/cell

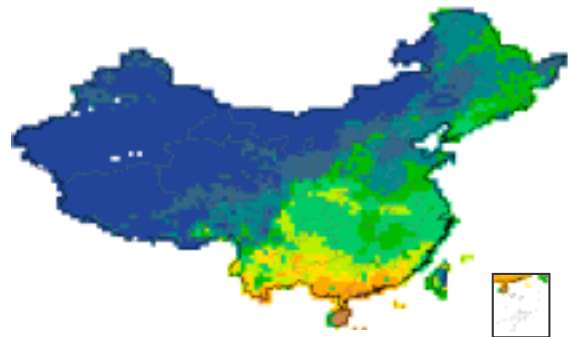


1990s

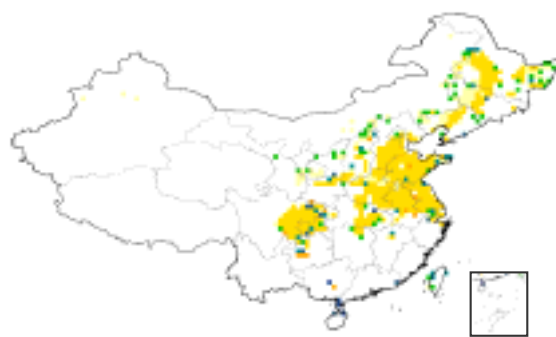
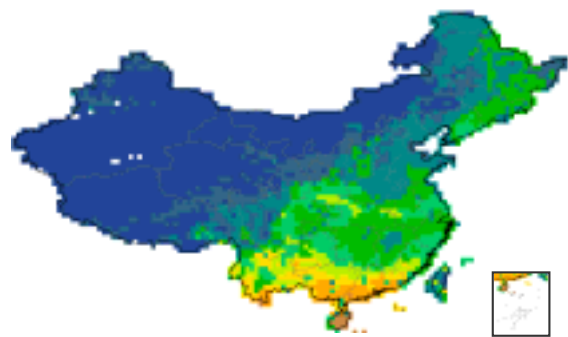
Change during 1980s-1990s



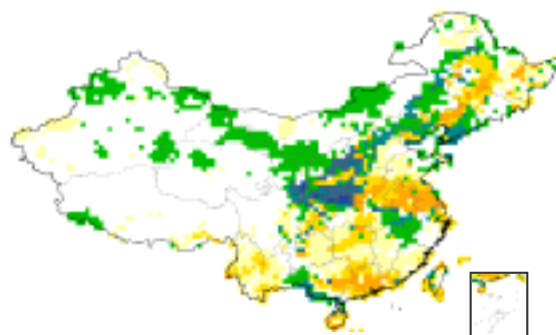
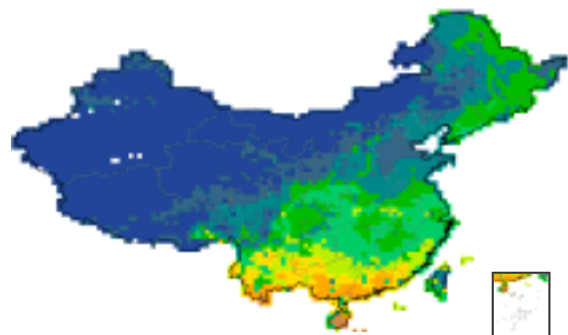
Climate



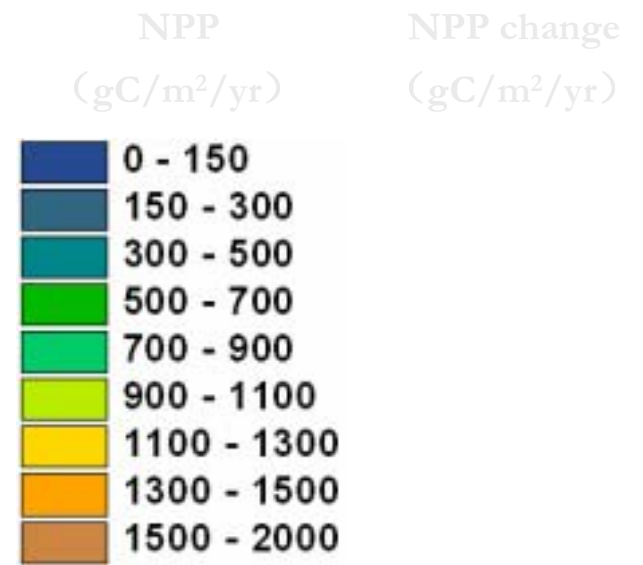
CO₂



LUCC



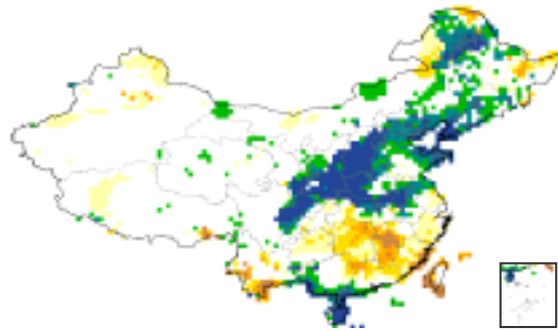
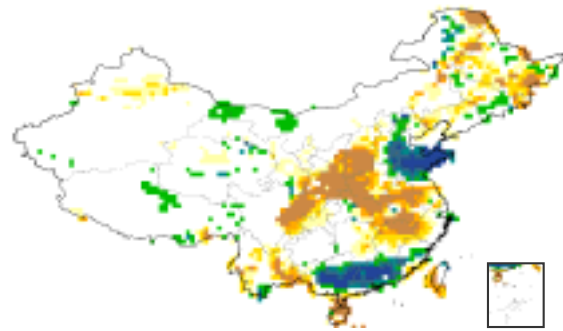
Climate+CO₂+LUCC



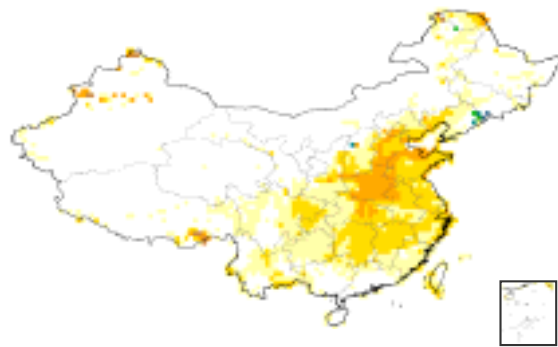
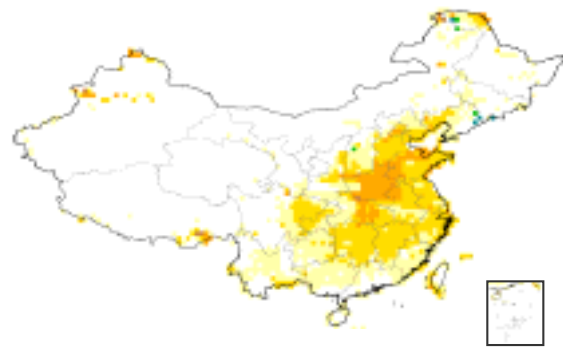
NPP

1980-1990

1990-2000

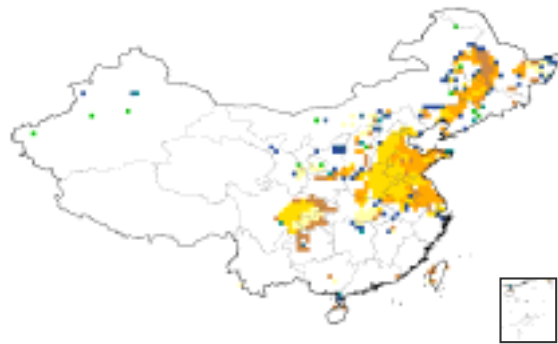
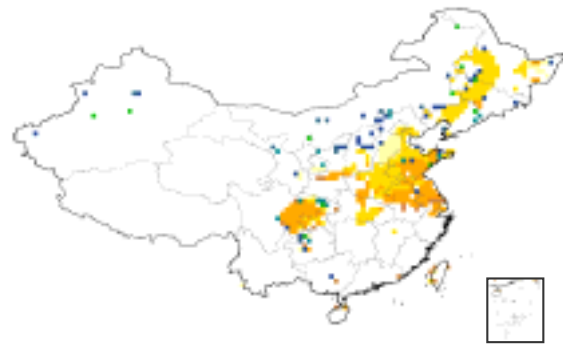


Climate

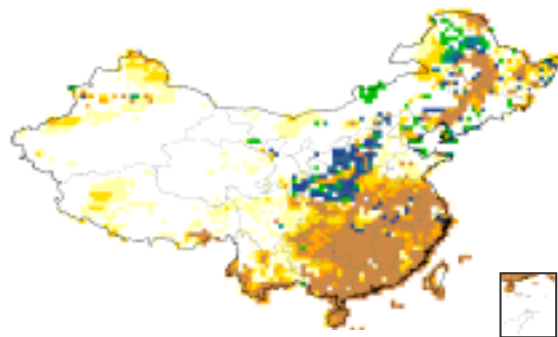
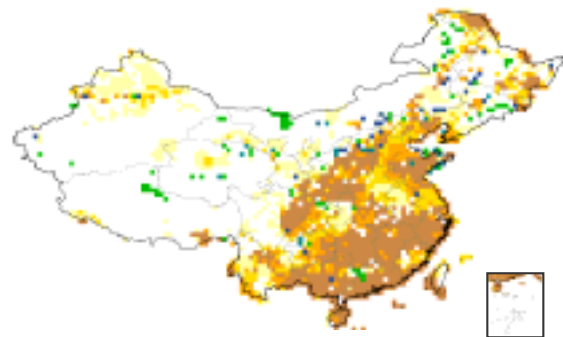


CO₂

Units: gC/m²/10 yr



LUCC



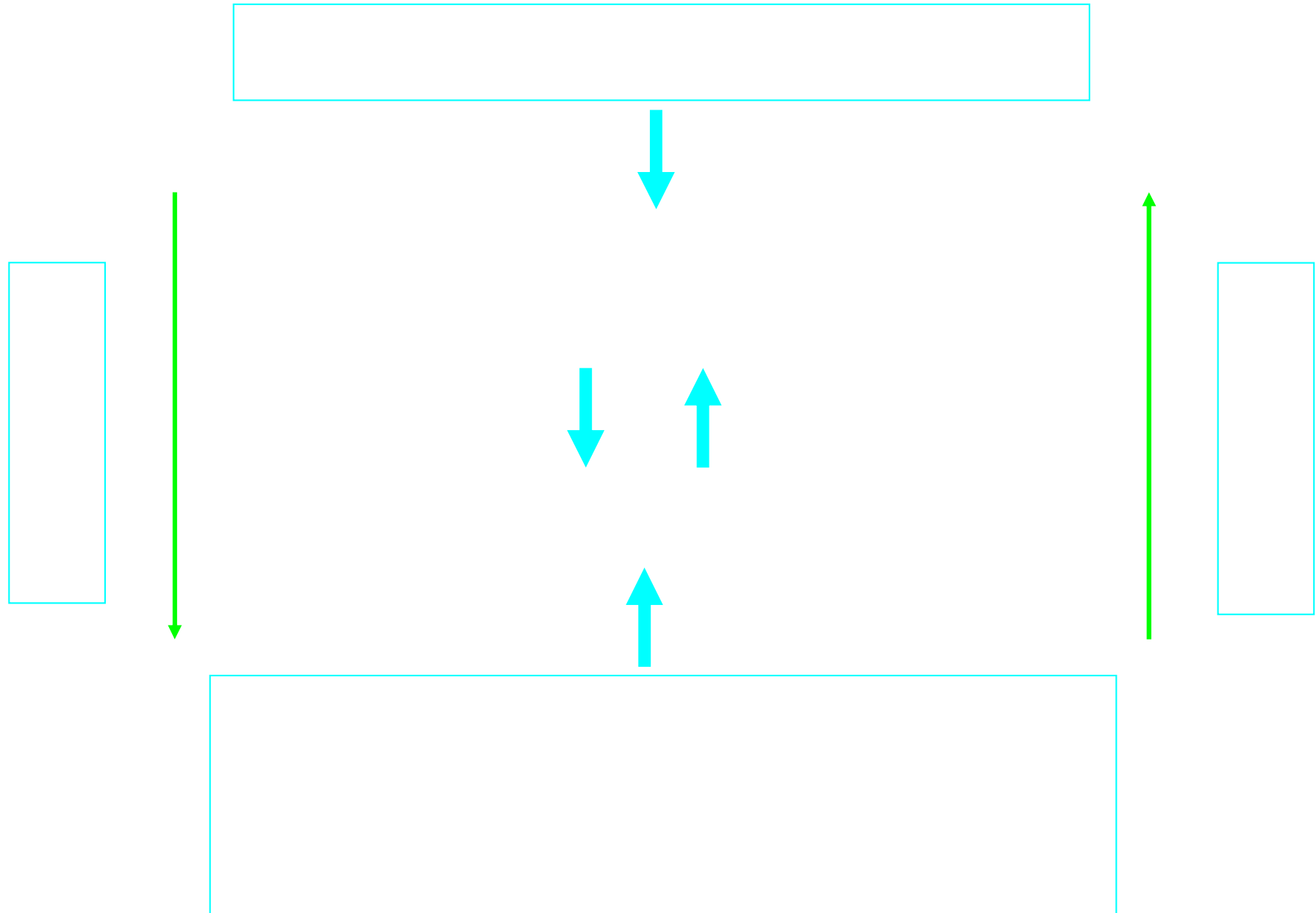
Climate+CO₂+LUCC

Carbon Storage

More studies should be done

- ◆ Model parameterization and calibration by Chinese terrestrial ecosystems
- ◆ Linking model results with field observation and remote sensing detection
- ◆ Combining more detail mechanisms of carbon processes due to land-use change in the model
- ◆ More long-term historical land-use data be introduced into running model

Linking RS and non-RS data together



Thanks!