Forest resource and conservation benefits from ecological restoration programs in China

Yong Pang

Institute of Forest Resource Information Techniques,

Chinese Academy of Forestry, Beijing, China

86-10-62889066, pangy@ifrit.ac.cn

Content

1. Introduction of ecological restoration programs in China

2. Forest resource and conservation benefits from remote sensing data

   - The Natural Forest Protection Project

   - The Three-North Forest Shelterbelt Project

   - Beijing-Tianjin Sandstorm Source Control Project

3. Summary

Key ecological restoration programs in China

a. The Natural forest protection project

b. The Three-North forest shelterbelt project

c. Beijing-Tianjin sandstorm source control project

d. The conversion of cropland to forest Program

e. The Shelterbelt construction project of the Yangtze River Basin

f. The Shelterbelt construction project of the Zhujiang River Basin

g. The Conversion of grazing land to grassland project

h. The ecological protection and construction in the headwaters of the Three Rivers

i. The controlling of karst rocky desertification in Southwest China project

Shao et al., Acta Geographica Sinica, 2022
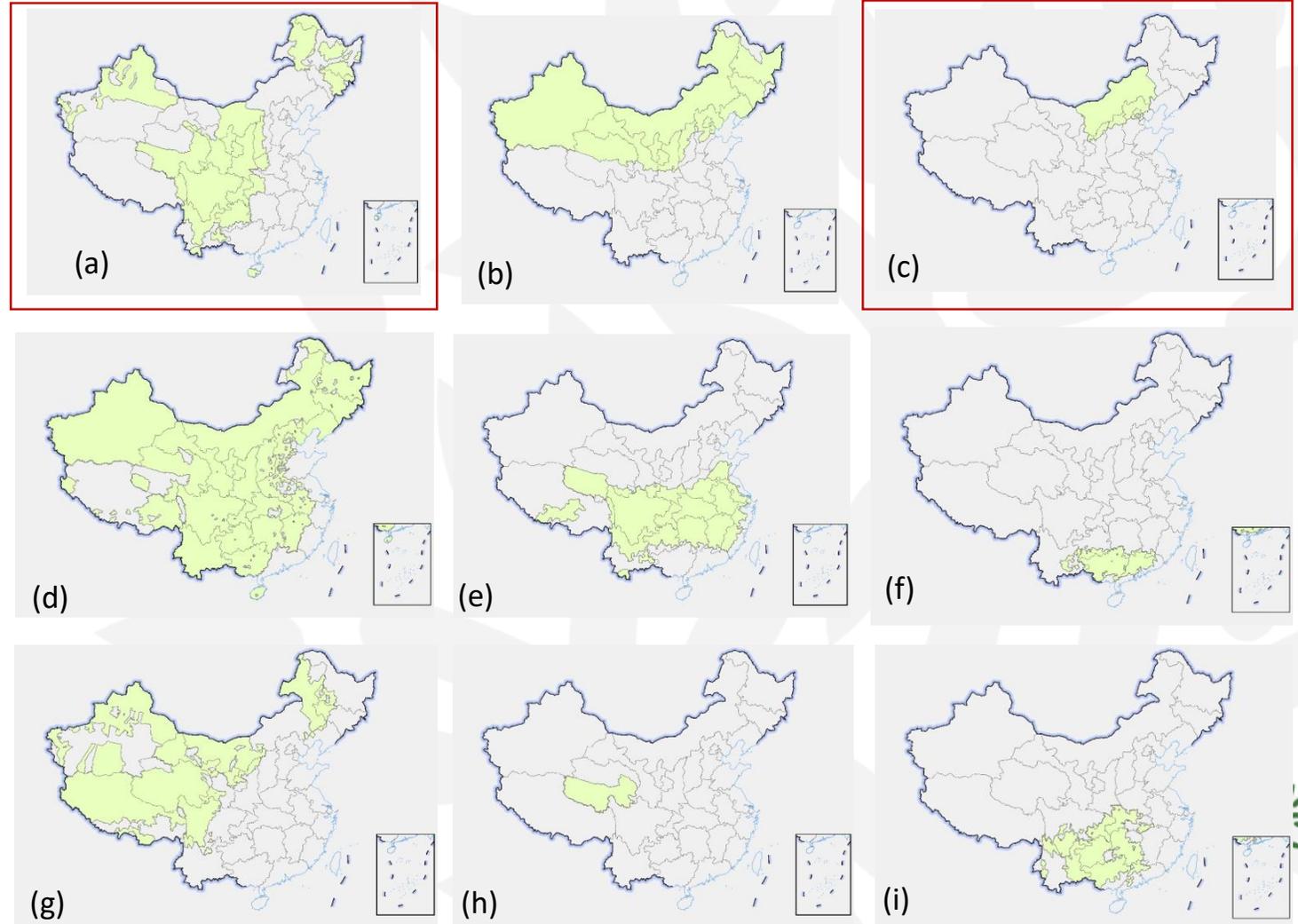
Key ecological restoration programs in China

Main objectives of these project

- ☐ Prevent the deterioration of the ecological environment
- ☐ Protect biodiversity
- ☐ Vegetation restoration
- ☐ Adjust the direction of forest resources management
- ☐ Protect natural forest resources
- ☐ Reduce desertified land
- ☐ Protect grassland
- ☐ Protect Yangtze River Basin
- ☐ Protect Zhujiang River Basin

......

Legend:
- Non projects
- 1 projects
- 2 projects
- 3 projects
- 4 projects
- 5 projects

0   500 km

南海诸岛

Shao et al., Acta Geographica Sinica, 2022
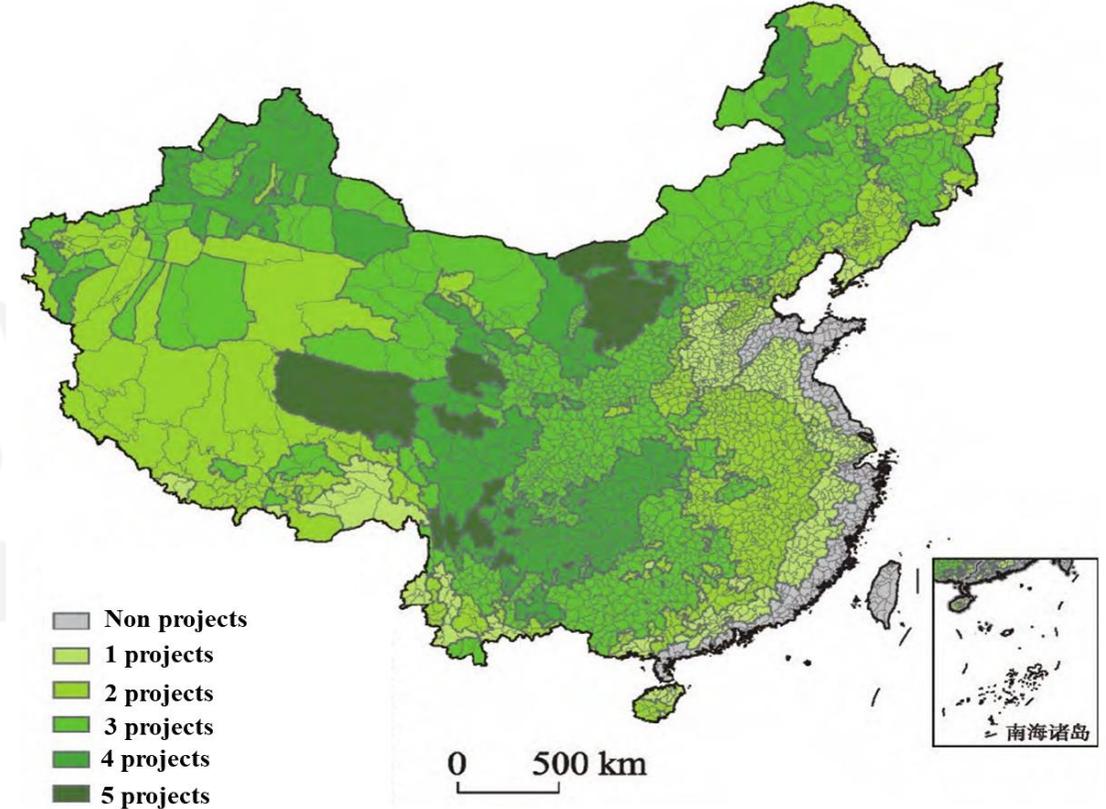
Key ecological restoration programs in China

Natural Forest Protection Program

Conversion of Cropland to Forest Program

Natural Reserve Development Program

Three-North Forest Shelterbelt Project

Shelterbelt construction project of the Yangtze River Basin

Coastal Sheltbelt Development Program

Content

1. Introduction of ecological restoration programs in China

2. Forest resource and conservation benefits from remote sensing data

- The Natural Forest Protection Project
- The Three-North Forest Shelterbelt Project
- Beijing-Tianjin Sandstorm Source Control Project

3. Summary

Data and Methods

Multiple scale remote sensing data

1. MODIS products
2. Landsat series
3. Sentinel-2
4. Chinese Gaofen-1/2/6
5. Airborne hyperspectral and Lidar data

Methods

1. Change detection
2. Comparison between the areas in and out the project
3. Trend analysis: Theil-Sen median, Mann-Kendall

Indicators from remote sensing

1. Forest coverage
2. Fractional vegetation coverage (FVC)
3. Net primary productivity (NPP)
4. Carbon sequestration

Data and Methods
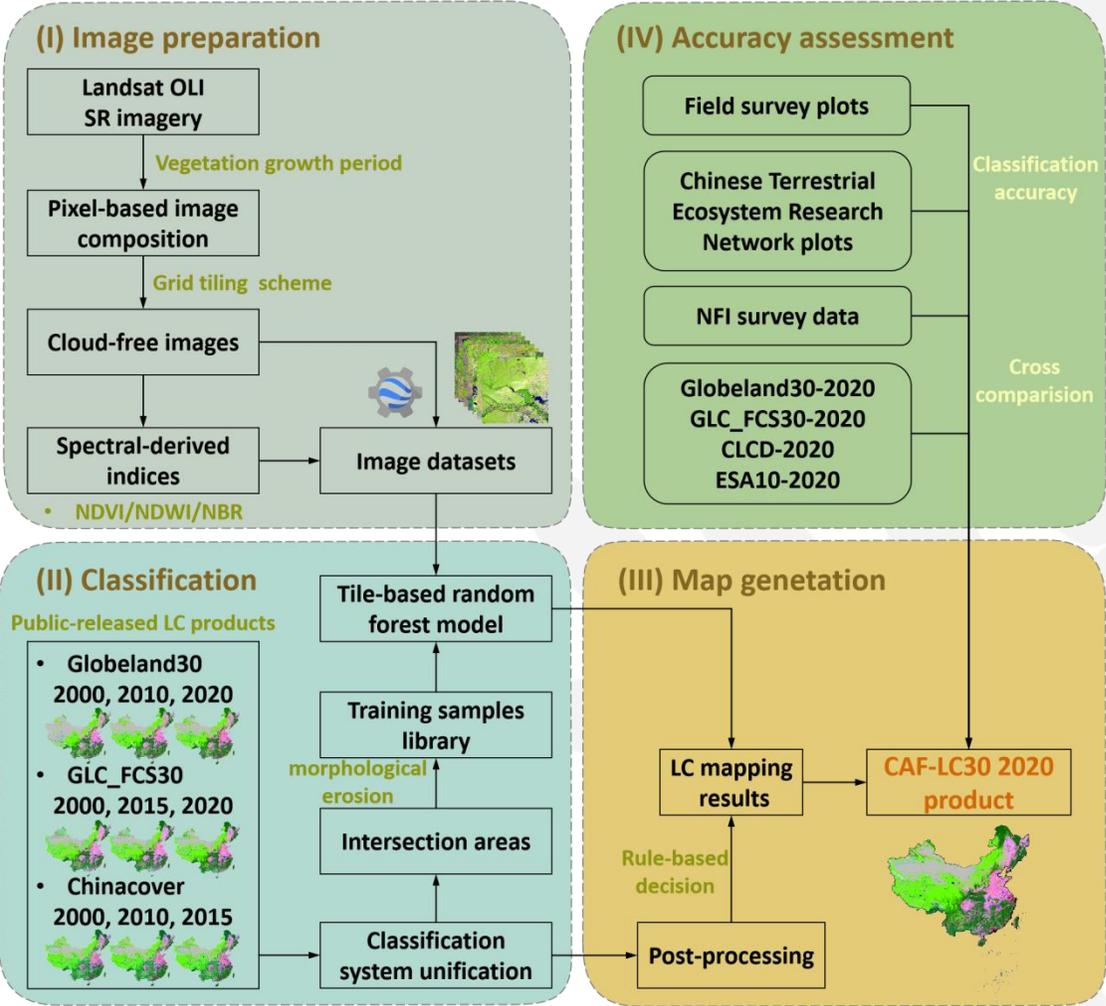
Improved forest cover mapping by harmonizing multiple land cover products over China

Data and Methods

- **Inside vs outside.**
- **Domestic vs abroad in typical international basins.**
- **Before vs after the implementation of the ecological restoration programs.**

Comparison between NFPP area and Non-NFPP area in different ecological zones in China

# Forest Change in Natural Forest Protection Project (NFPP) Area
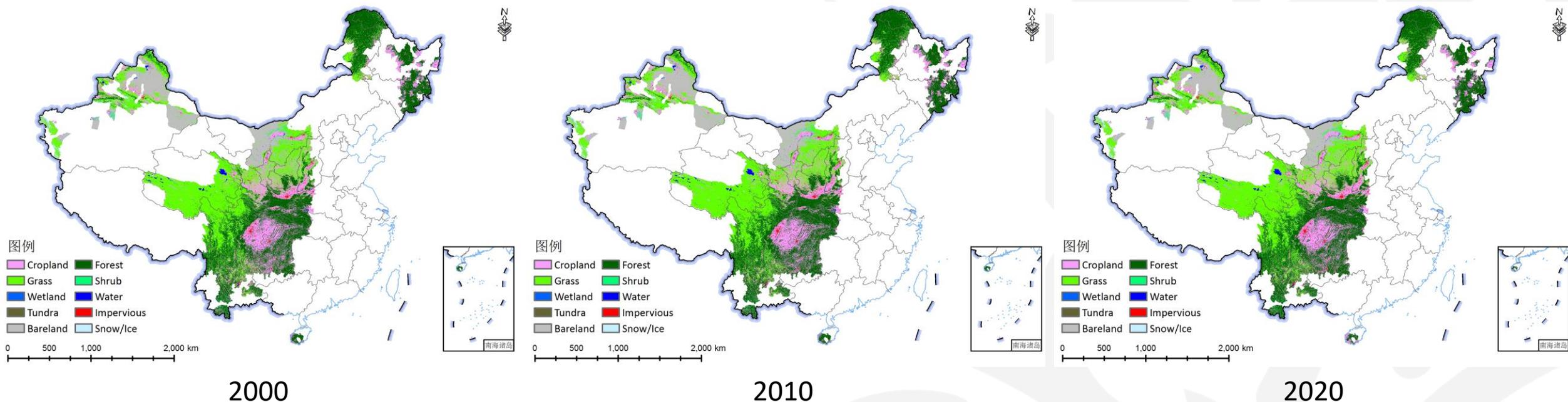
2000

2010

2020

Land cover map in NFPP area in 2000, 2010 and 2020

Global Forest Observations Initiative | Plenary 9-11 May 2023

Forest Change in Natural Forest Protection Project (NFPP) Area

2000

2010

2020
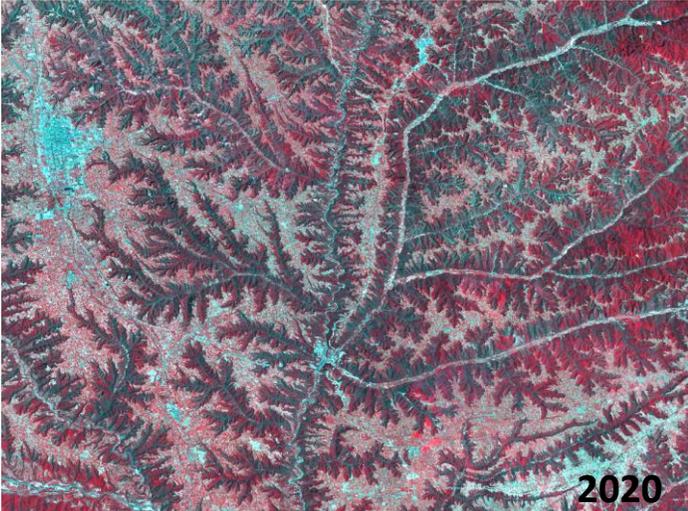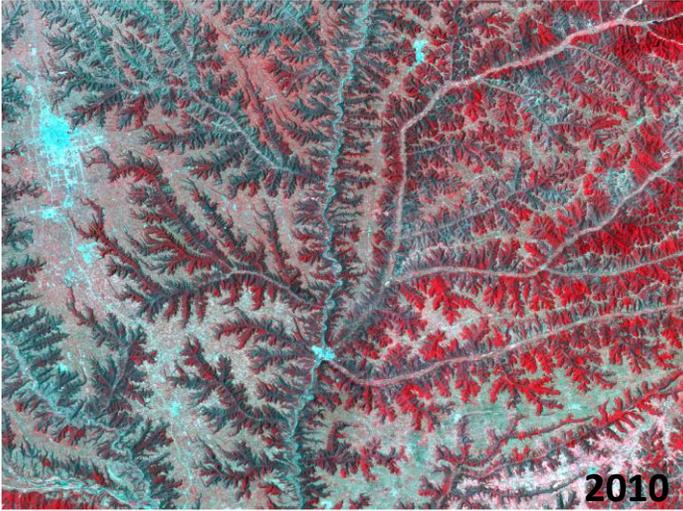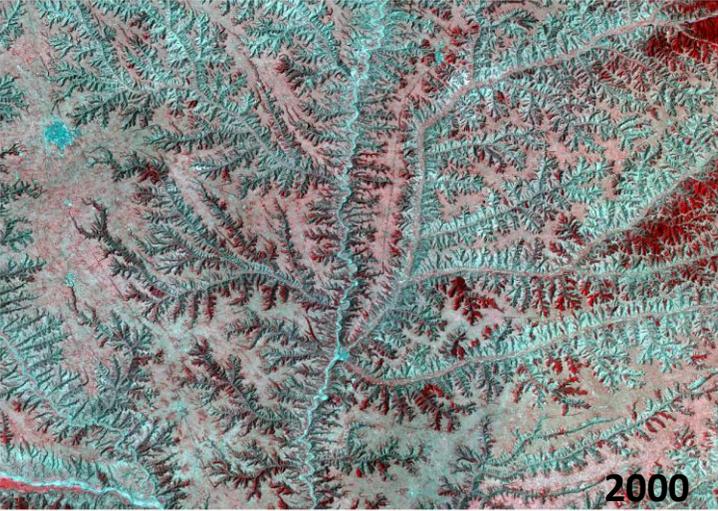
**Area in the upper and middle reaches of the Yellow River** （N35.626652°, E107.712034°）
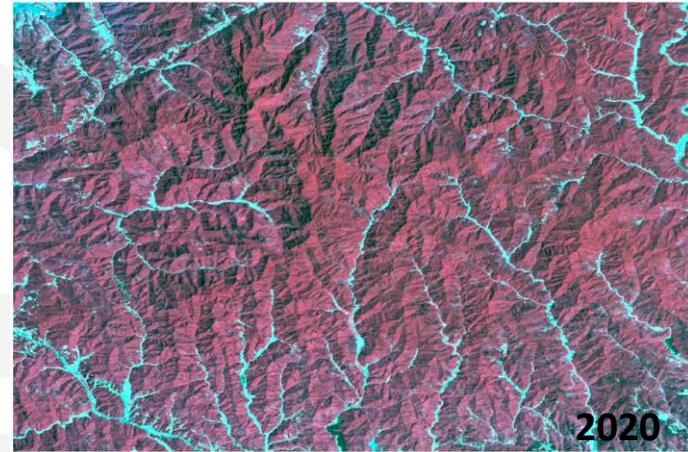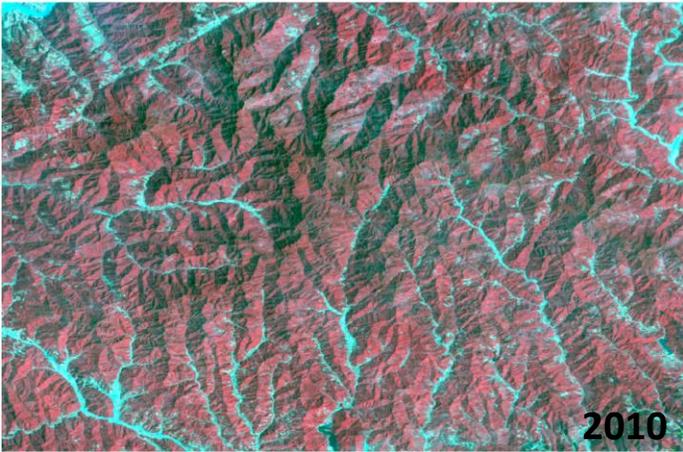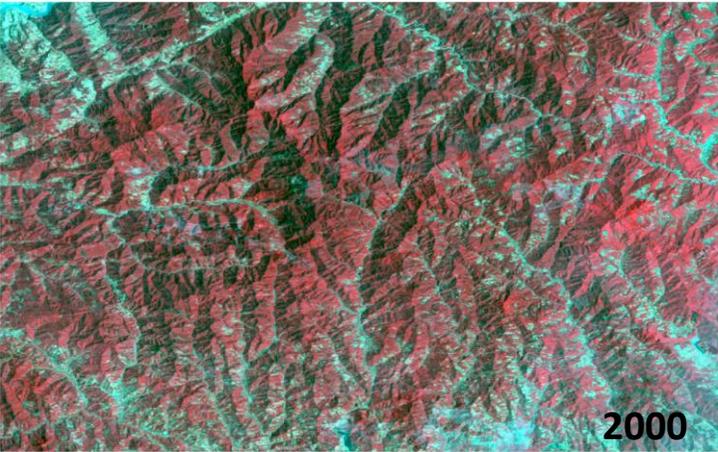
2000

2010

2020

Area in the upper Yangtze River （N32.171106°, E110.541715°）

Forest Change in Natural Forest Protection Project (NFPP) Area
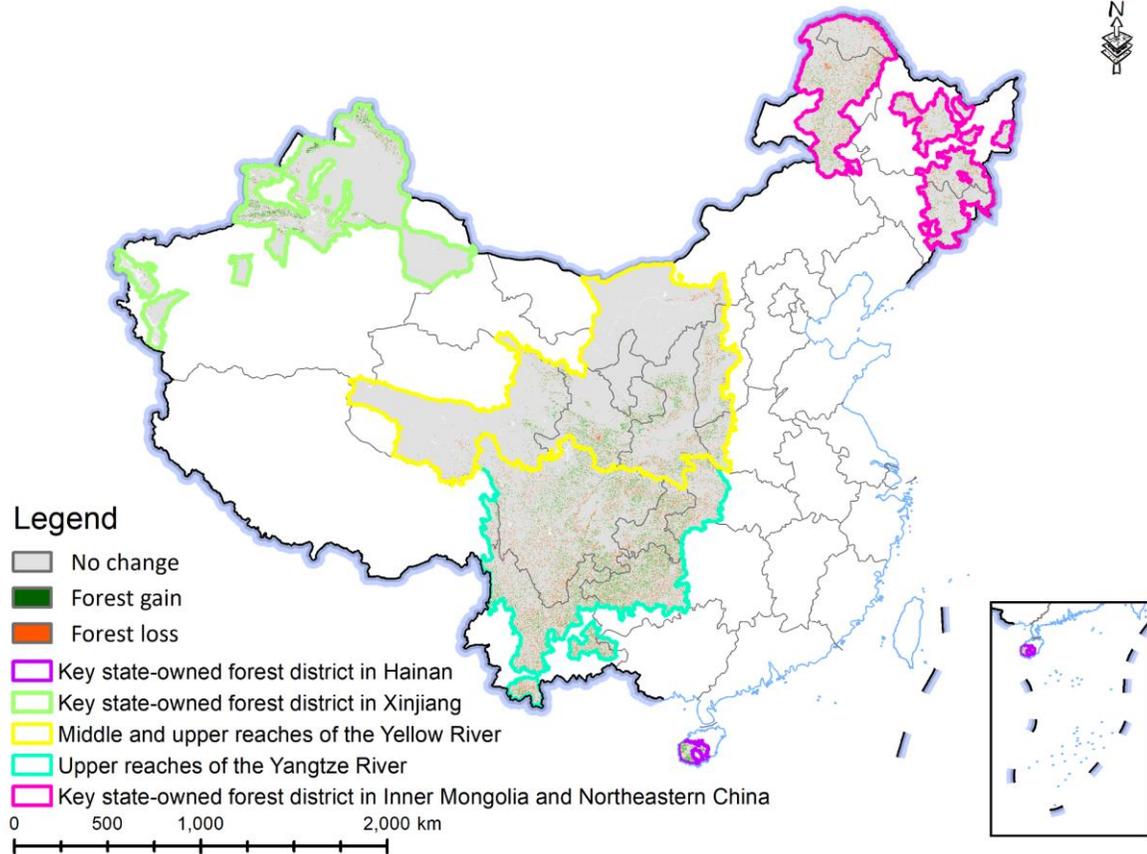

Forest change in NFPP area

Forest change in each area from 2000 to 2020

Area	2000	2010	2020	Increase proportion	Increase rate
NFPP	33.07%	33.48%	35.12%	2.05%	6.31%
Key state-owned forest areas in Northeast China and Inner Mongolia	71.24%	71.69%	72.87%	1.63%	1.65%
The upper reaches of Yangtze River	52.34%	53.10%	56.91%	4.57%	8.74%
The upper and middle reaches of Yellow River	14.36%	15.04%	15.81%	1.45%	10.03%
Key state-owned forest areas in Hainan	70.19%	71.03%	74.25%	4.06%	5.46%
Key state-owned forest areas in Xinjiang	3.56%	3.76%	3.78%	0.22%	6.76%
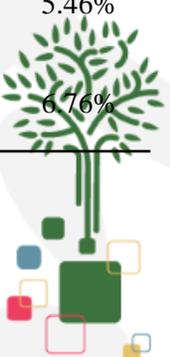
FVC Trend in Natural Forest Protection Project (NFPP) Area
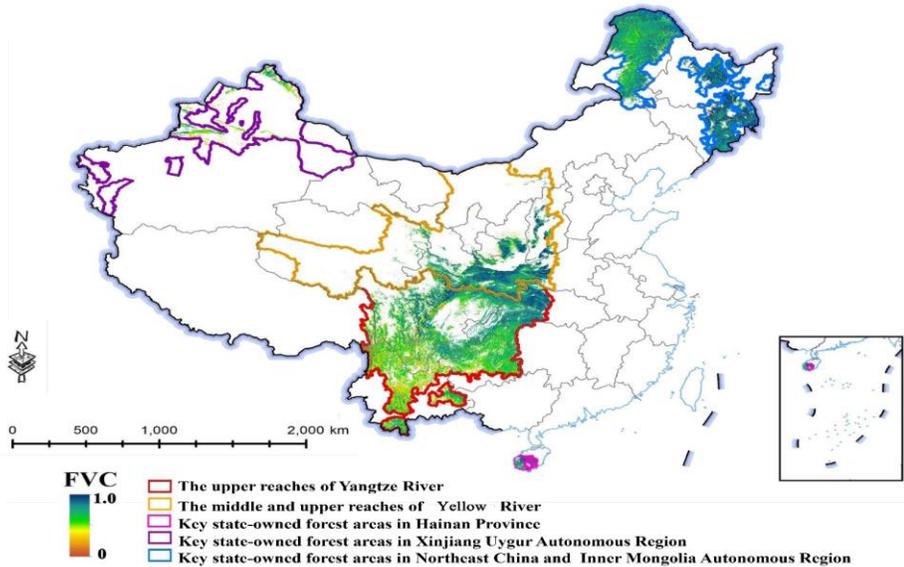
a FVC trend in the first stage of Natural Forest Protection Project (NFPP) of China (2000—2010)
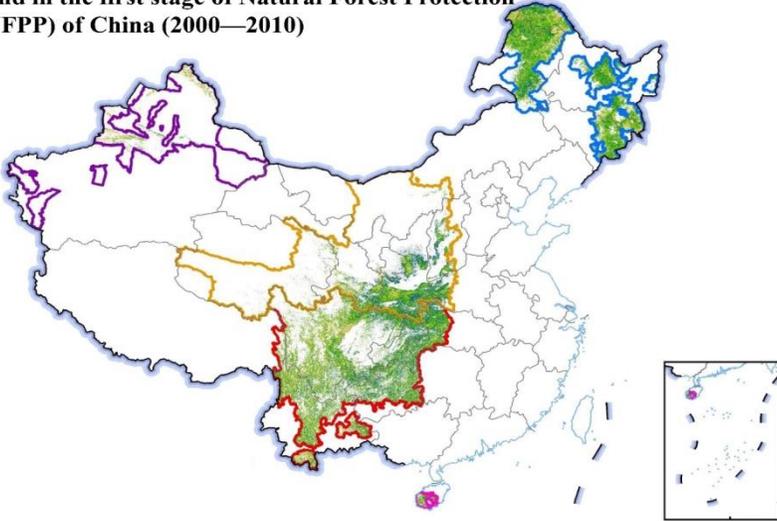
b FVC trend in the second stage of NFPP (2011—2020)
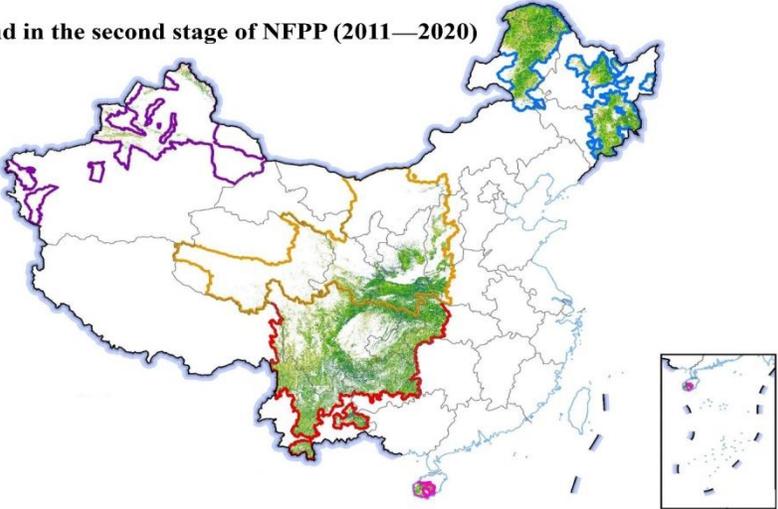
c FVC trend since the implement of NFPP (2000—2020)

FVC
1.0
0

- The upper reaches of Yangtze River
- The middle and upper reaches of Yellow River
- Key state-owned forest areas in Hainan Province
- Key state-owned forest areas in Xinjiang Uygur Autonomous Region
- Key state-owned forest areas in Northeast China and Inner Mongolia Autonomous Region

Increasing obviously
Increasing slightly
Stable
Decreasing slightly
Decreasing obviously

FVC trend in NFPP area

*Yu et al. Journal of Beijing Forestry University, 2023.*

FVC Trend in Natural Forest Protection Project (NFPP) Area

Time series of estimated FVC in NFPP area

❑ Area with increased FVC trend was about 78.22% of the total forest area, while area with decreased FVC only accounted for 9.56% of the total forest area.

❑ An obviously increasing trend of FVC could be found in the NFPP area, which indicated that the quality of the forest was increasing since the implement of NFPP.
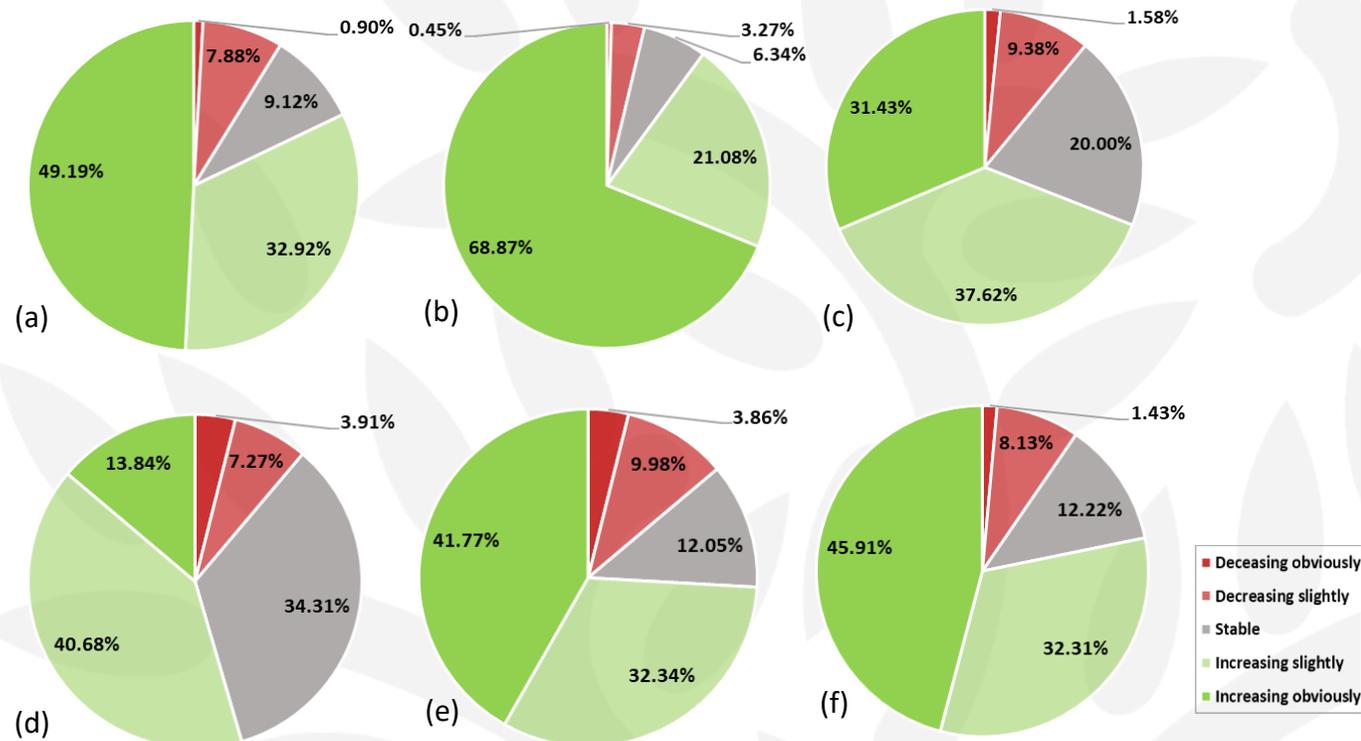
Fraction of FVC trend of in each area
(a: The upper reaches of Yangtze River; b:The middle and upper reaches of Huanghe River; c: Key state-owned forest areas in Northeast China and Inner Mongolia; d: Key state-owned forest areas in Xinjiang; e: Key state-owned forest areas in Hainan; f: NFPP area)

Legend:
- Deceasing obviously
- Decreasing slightly
- Stable
- Increasing slightly
- Increasing obviously

Forest Dynamics in Natural Forest Protection Project (NFPP) Area
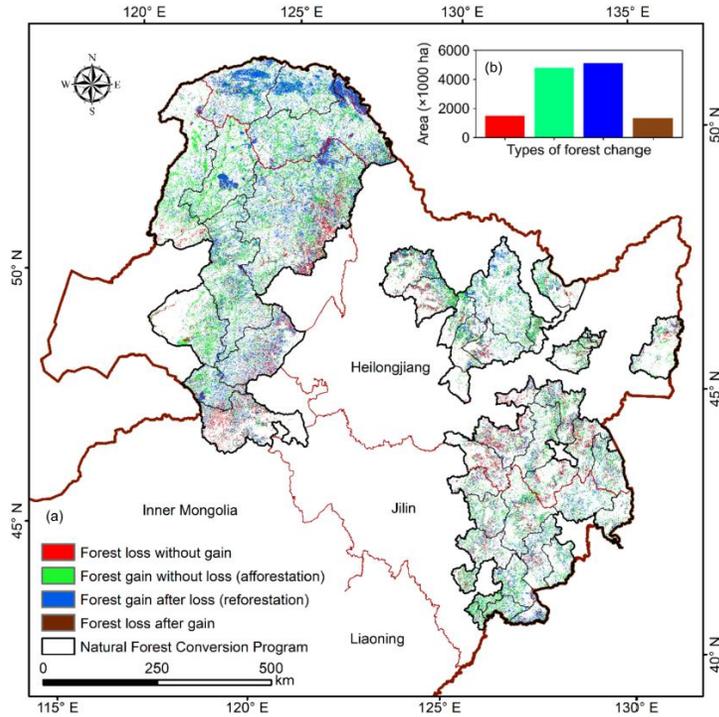
Forest change area from 1986 to 2018

Annual forest (a) loss and (b) gain from 1986 to 2018
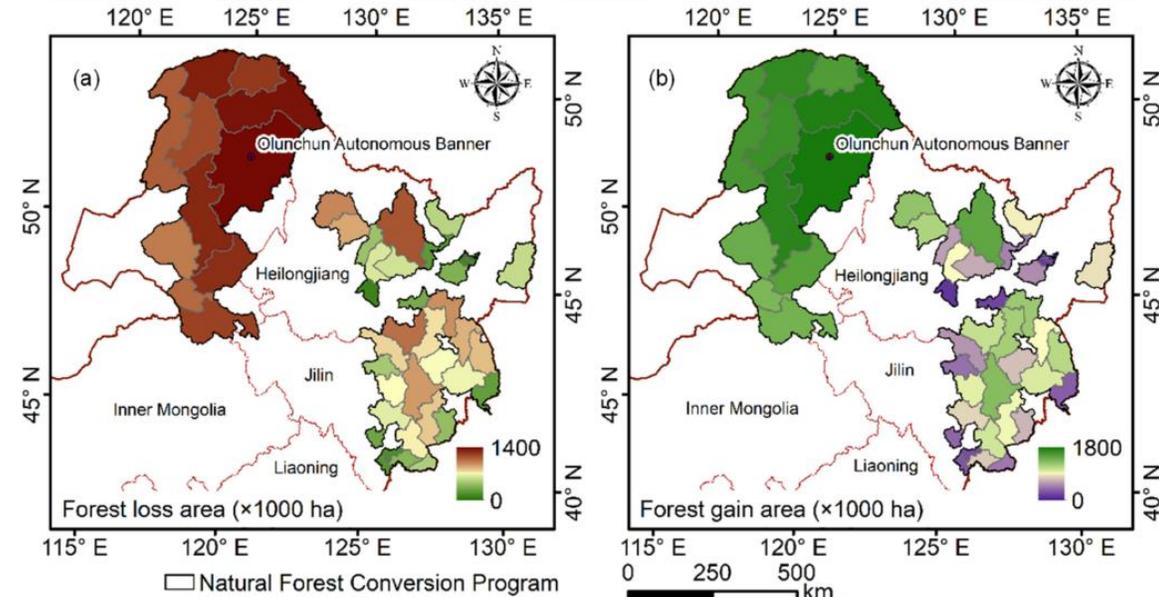
Spatial statistics of forest (a) loss and (b) gain in each county from 1986 to 2018

- ☐ The increased area of TCC was much larger than the decreased area, accounting for 59.68% and 40.34%, respectively.
- ☐ Deforestation was effectively curbed, the area of forest loss was significantly decreased, and the area of forest gain significantly increased.

Benefits of Natural Forest Protection Project (NFPP) Area
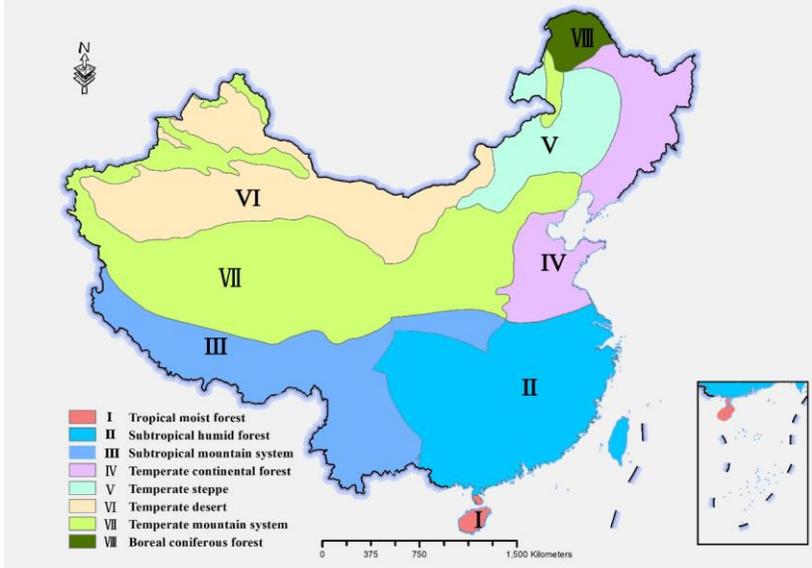
I   Tropical moist forest
II   Subtropical humid forest
III Subtropical mountain system
IV   Temperate continental forest
V   Temperate steppe
VI   Temperate desert
VII Temperate mountain system
VIII Boreal coniferous forest

Non NFPP area: decrease
Non NFPP area: stable
Non NFPP area: increase
NFPP area: decrease
NFPP area: stable
NFPP area: increase
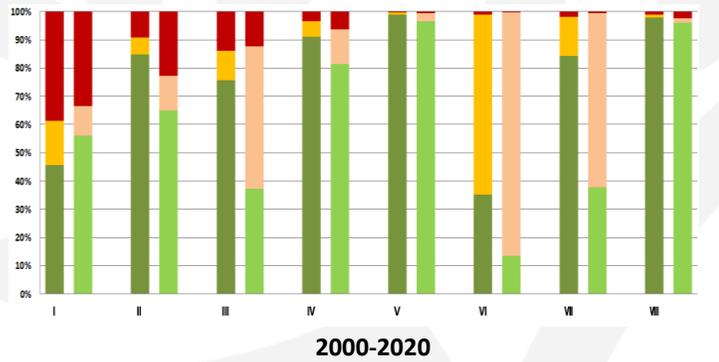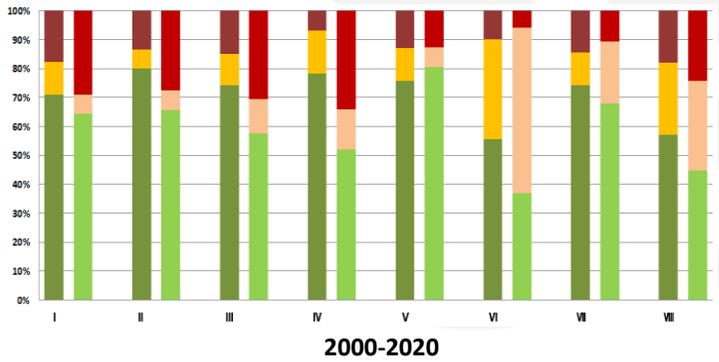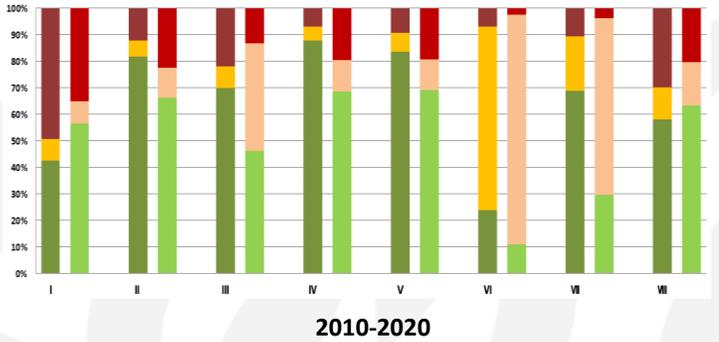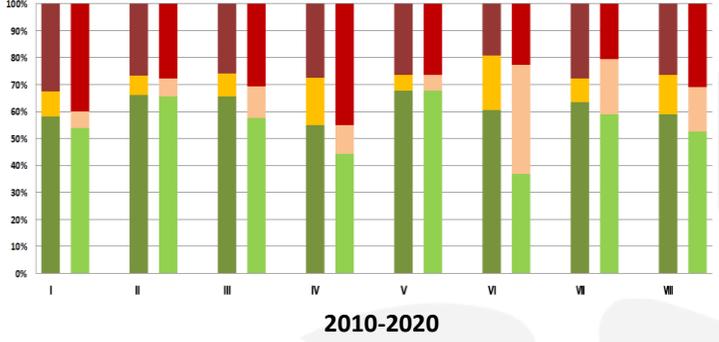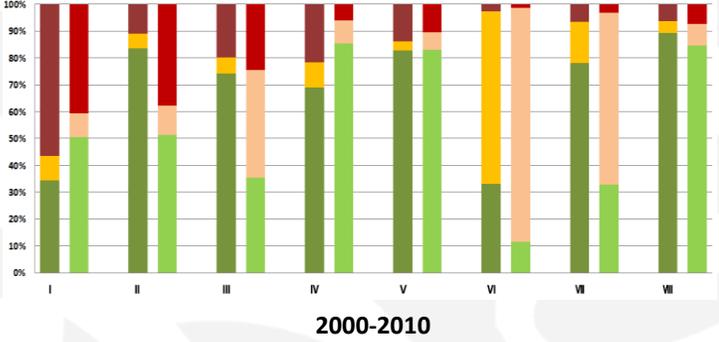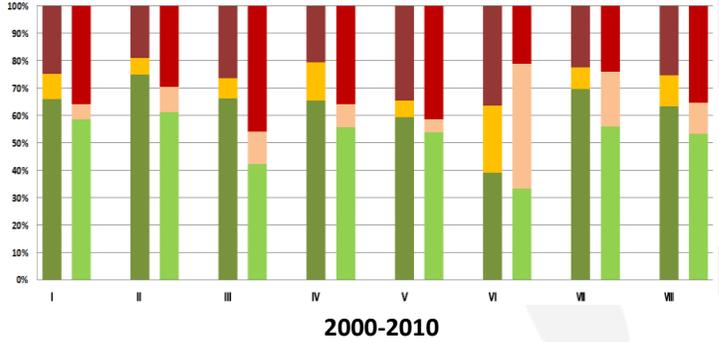
Comparison of FVC trend between NFPP area and Non-NFPP area in different ecological zones

Comparison of NPP trend between NFPP area and Non-NFPP area in different ecological zones

# Benefits of Natural Forest Protection Project (NFPP) Area
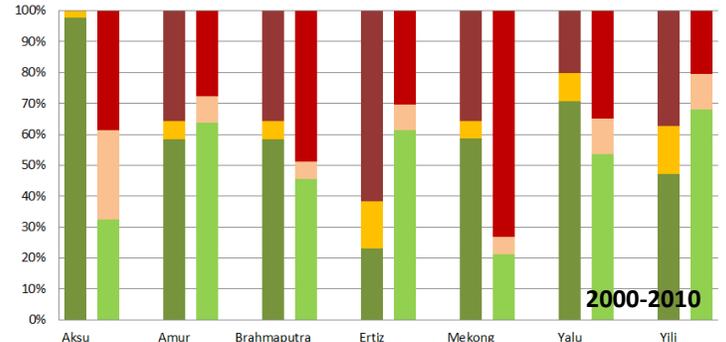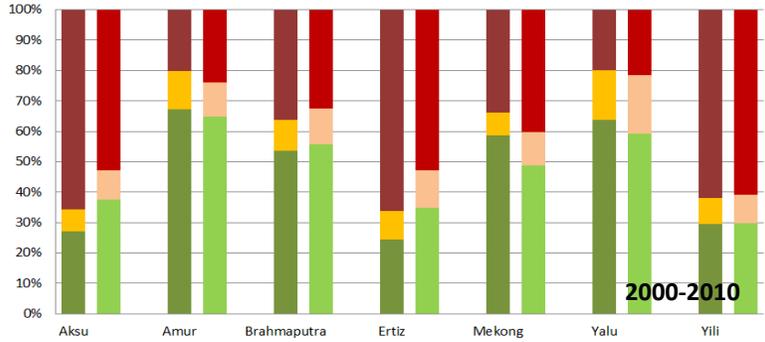
In general, the rate of increasing trend of FVC and NPP in China are larger than that in neighboring countries.

Comparison of FVC trend between areas in China and in neighboring countries in international typical basins

Comparison of NPP trend between areas in China and in neighboring countries in international typical basins
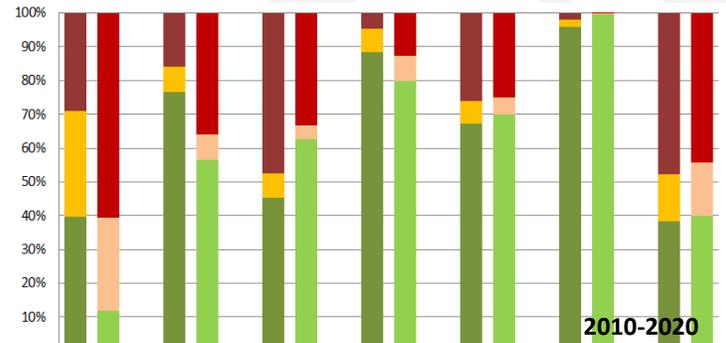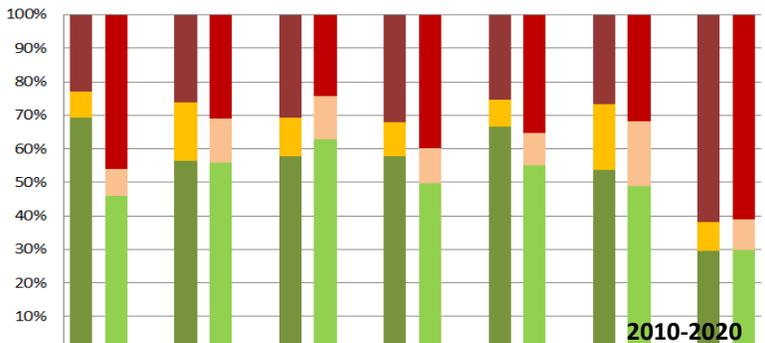
Legend:
- neighboring countries:decrease
- neighboring countries:stable
- neighboring countries:increase
- China:decrease
- China:stable
- China:increase
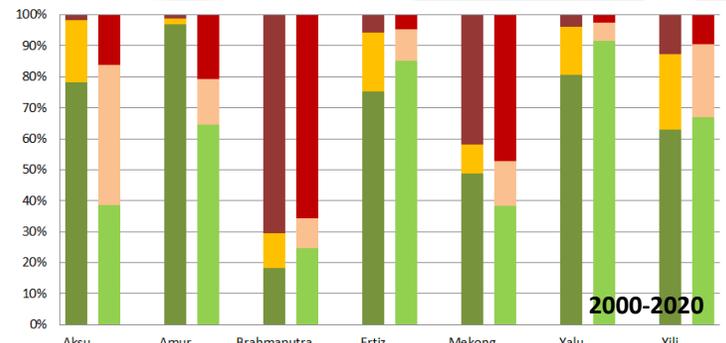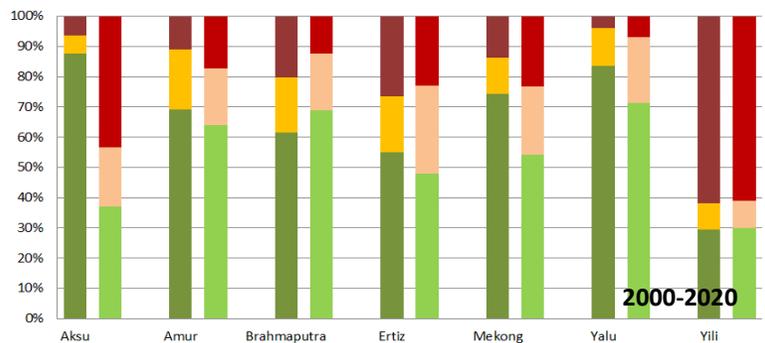
Desertification Land Change in the Beijing-Tianjin sandstorm source control project
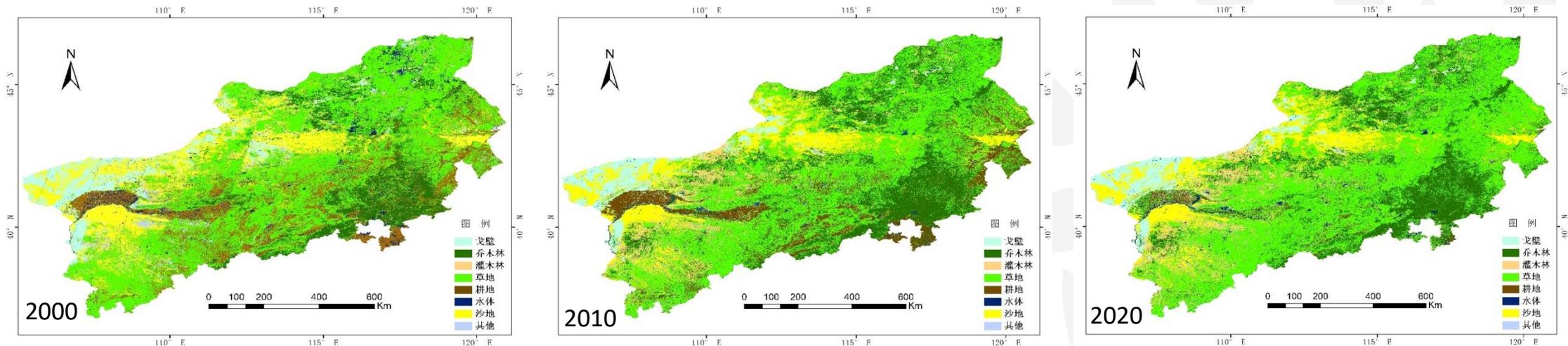
Land cover in Beijing-Tianjin sandstorm source control project area
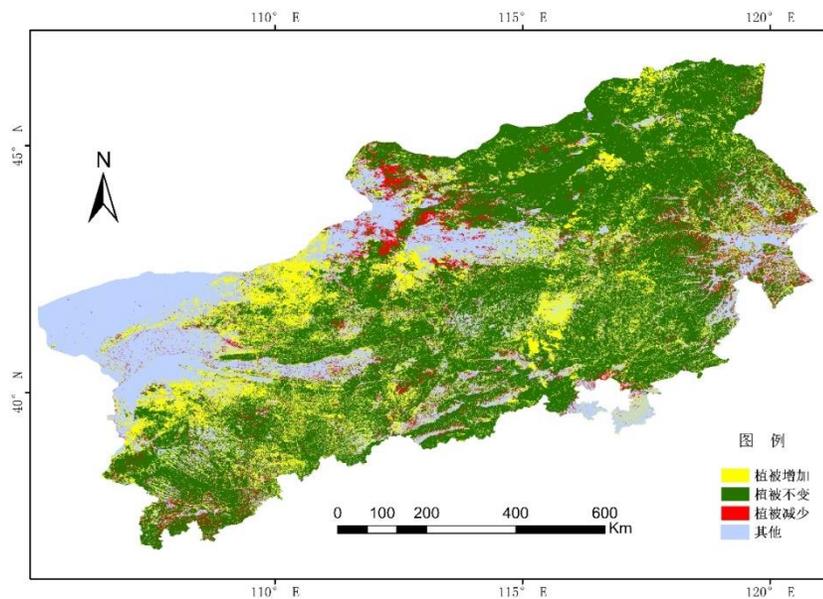
Vegetation change from 2000 to 2020
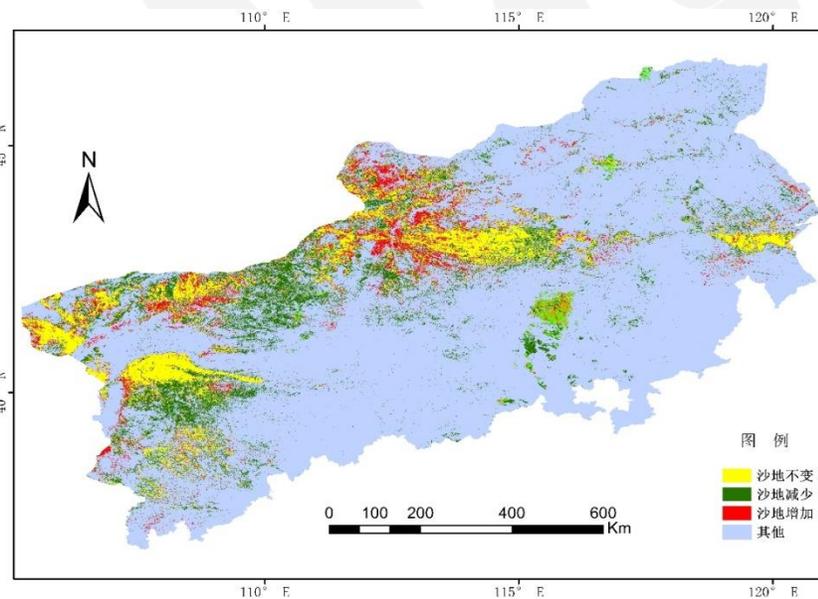
Desertification land change from 2000 to 2020

The area of desertification land decreased 150.51 km², and the area of arbor, shrub and grass land increased 450.55 km².

Li et al. Acta Ecological Sinica, 2022.

FVC trend in the Beijing-Tianjin sandstorm source control project
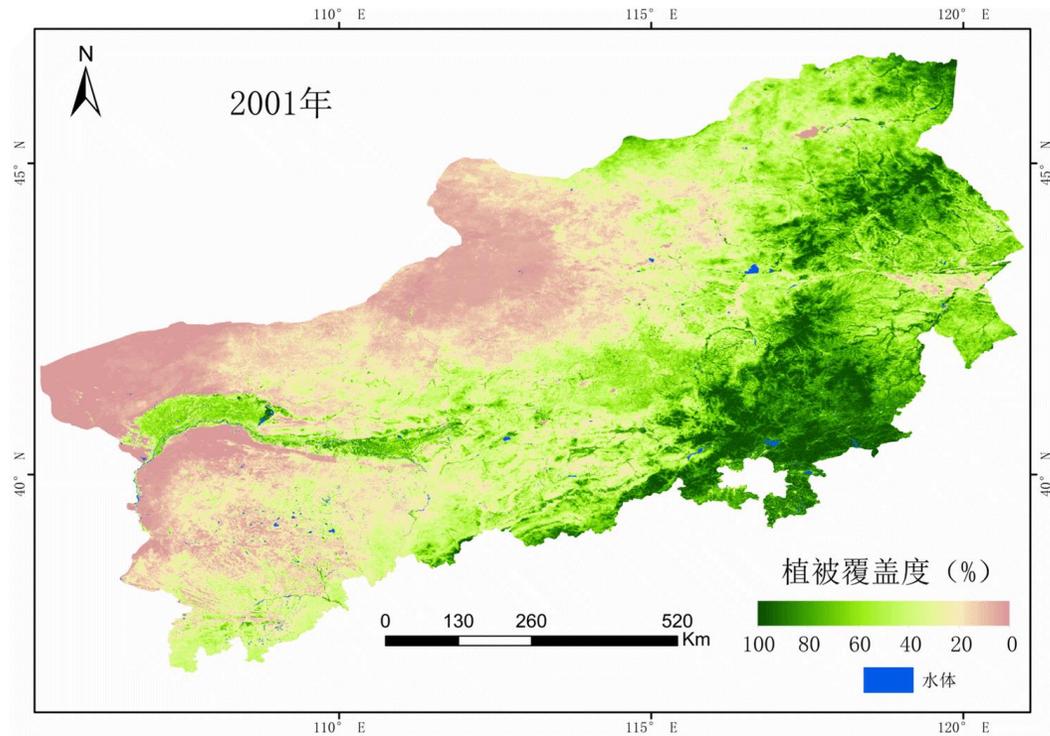
FVC from 2000 to 2020
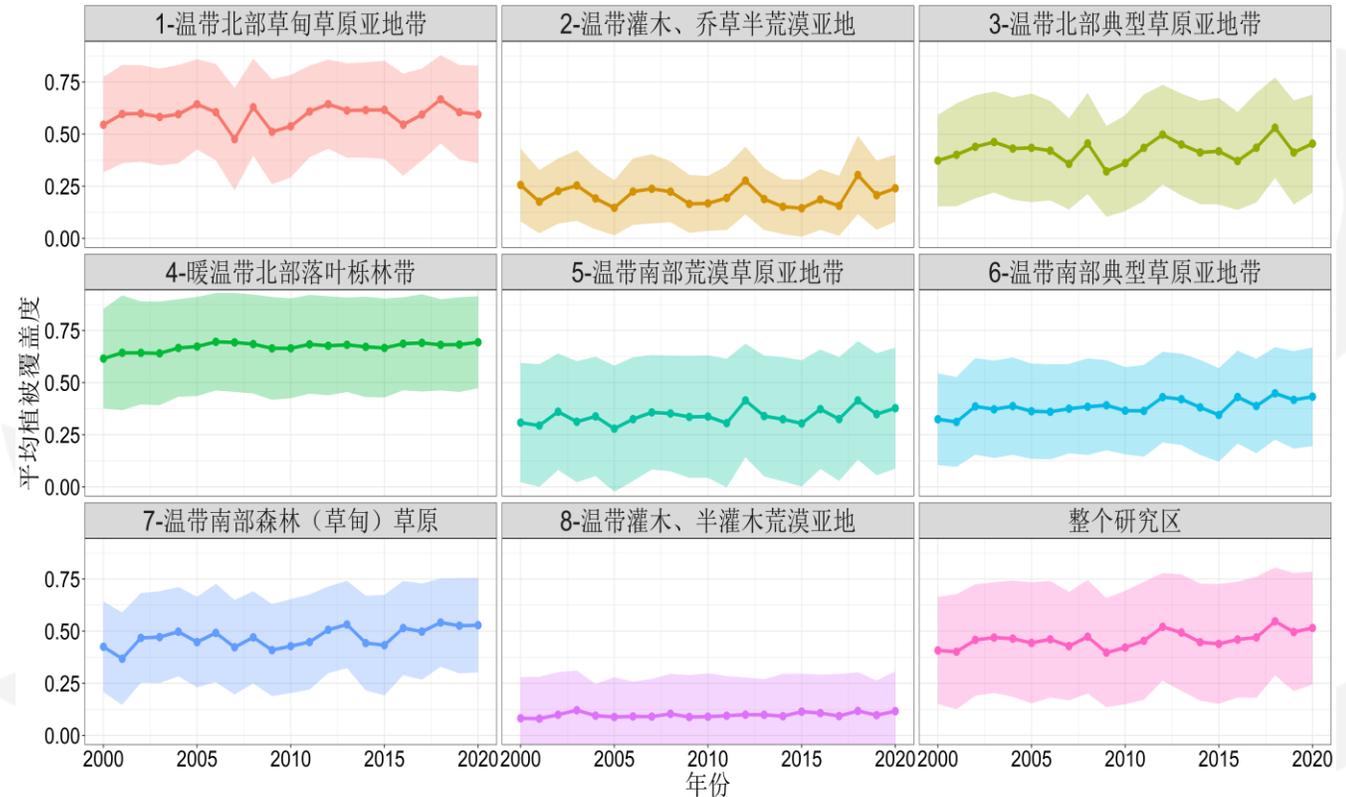

FVC trend in each land cover types

The average vegetation coverage in the study area increased from 0.422 (2000~2002) to 0.519 (2018~2020). Land degradation situation in the study area has been curbed, the vegetation situation is getting better, and the ecological environment is obviously improved.

Li et al. Acta Geographica Sinica, 2022.

Ecological Quality in the Beijing-Tianjin sandstorm source control project
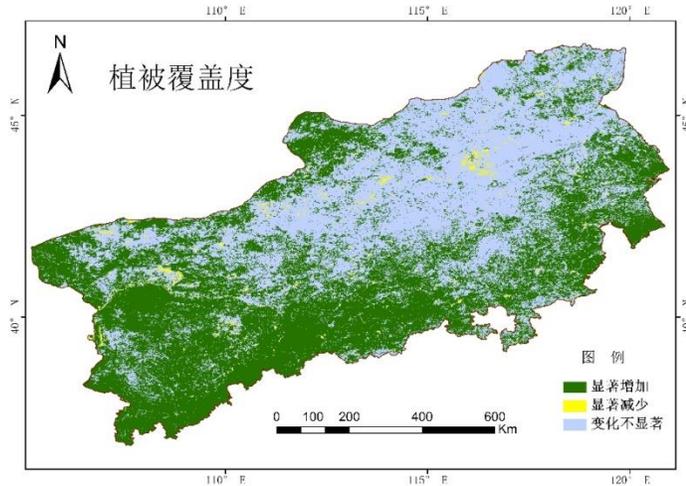
FVC change from 2000 to 2020
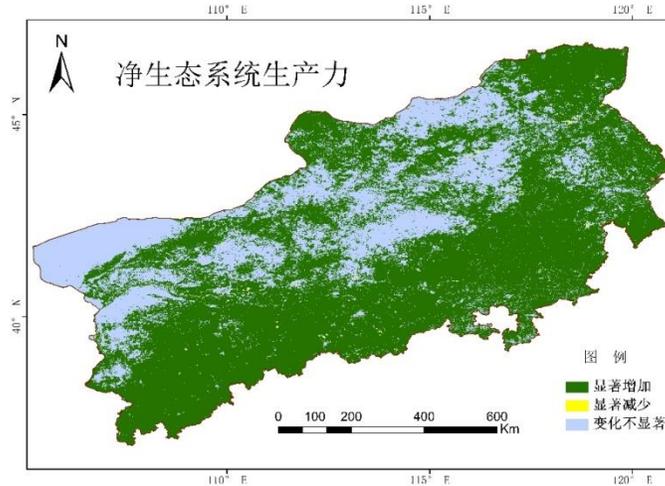
NPP change from 2000 to 2020
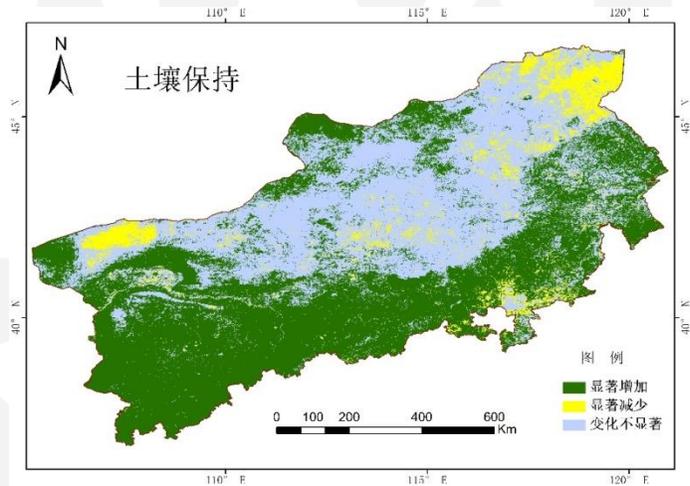
Soil conservation change from 2000 to 2020
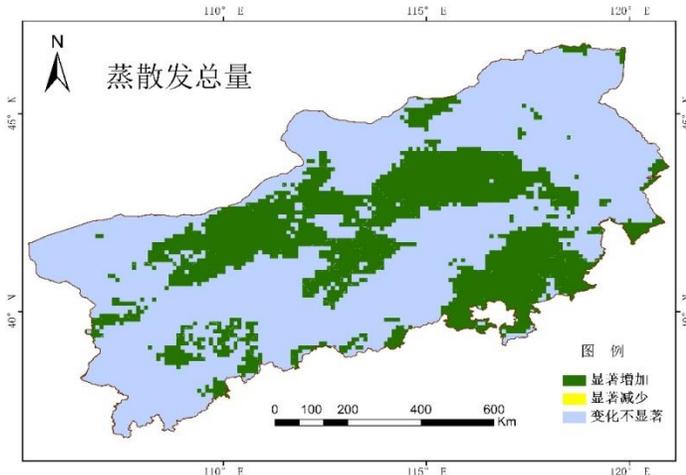
Evapotranspiration change from 2000 to 2020
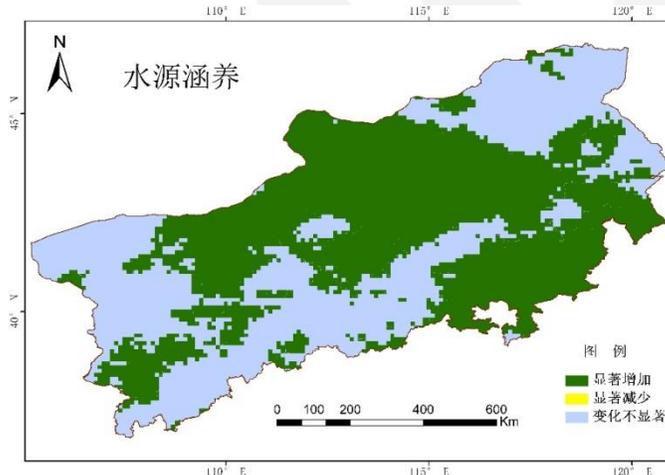
Water conservation change from 2000 to 2020
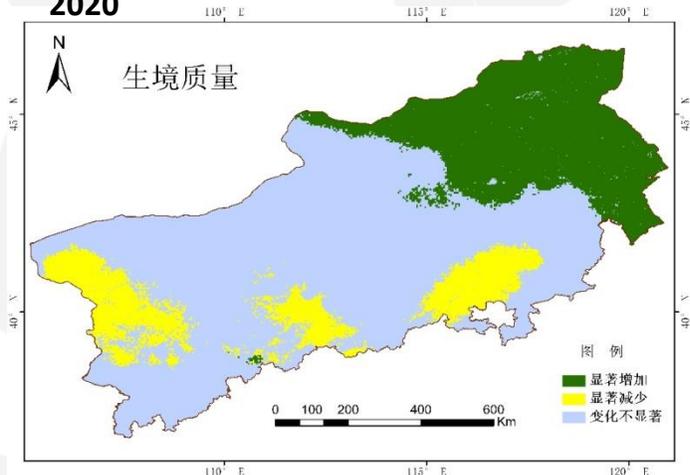
Habitat quality from 2000 to 2020

Area with significant increases in vegetation coverage, NPP, soil conservation, evapotranspiration, water conservation and habitat quality accounted for 50.94%, 68.88%, 50.00%, 32.43%, 56.11% and 25.59% of the total area, respectively.

Li et al., Ecological Indicators, 2023

Driving Factors of Ecological Quality Change in the Beijing-Tianjin sandstorm source control project

Main driving factors of ecological quality change

- 工程措施：38.18%
- 降水：26.80%
- 植被不显著：24.92%
- 气温：4.83%
- 三者：2.96%
- 工程+气温：1.63%
- 降水+气温：0.68%
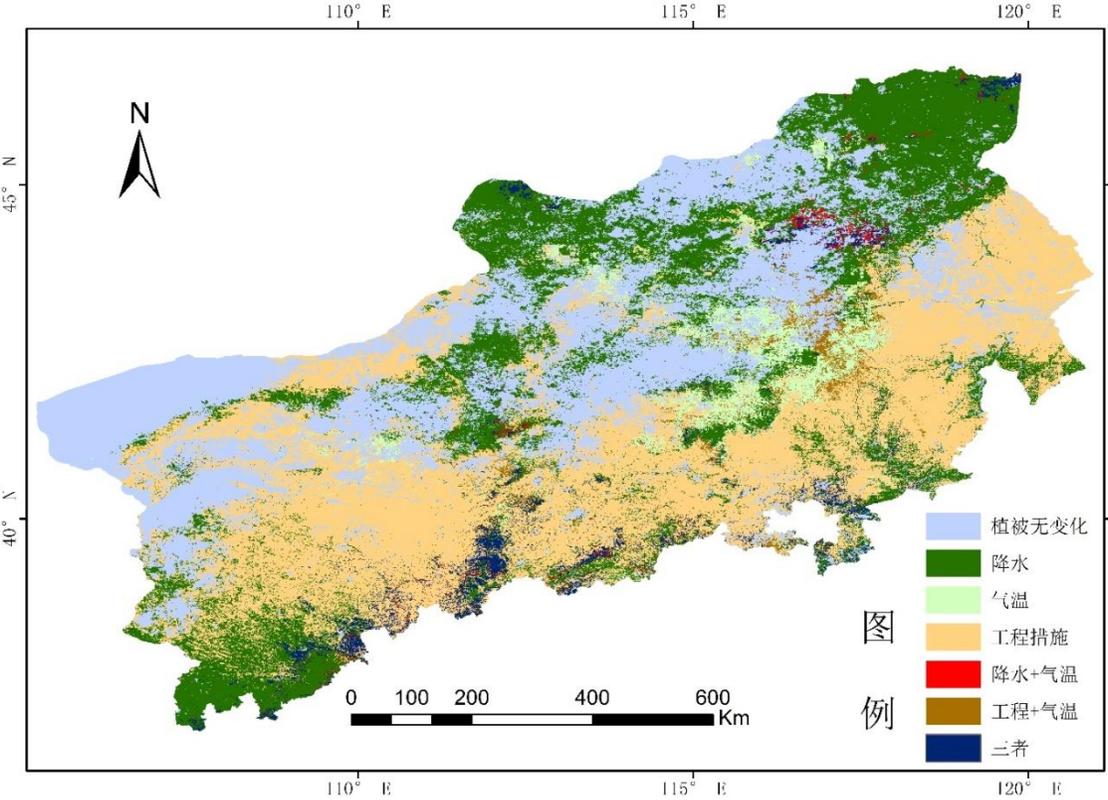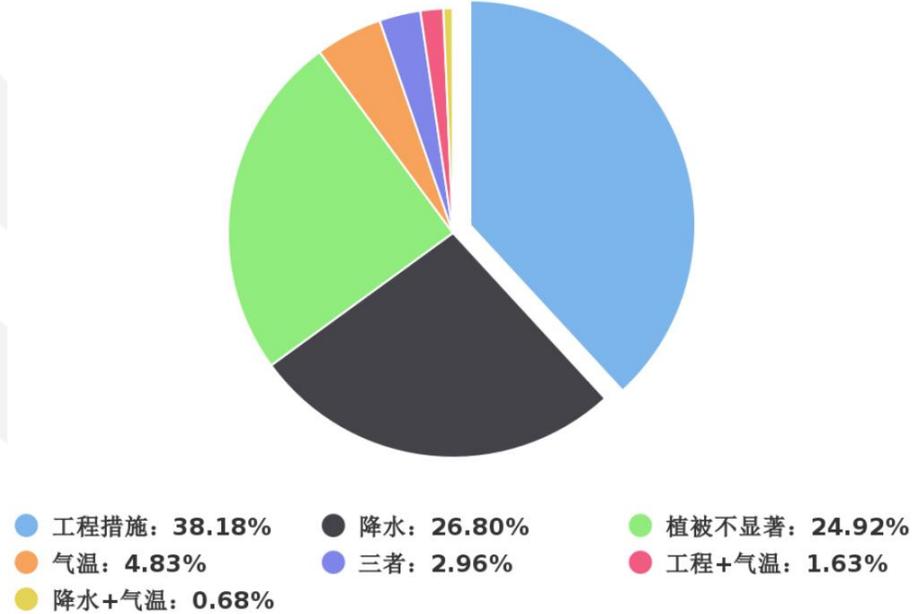
Area proportion of the main driving factors

Project measures account for the largest proportion, which is close to 40% of the whole study area. Followed by precipitation factor, which accounts for 30.44%. In particular, project measures are the main factor in Horqin Sandy Land and Mu Us Sandy Land, indicating that the project play a very important role in regional environmental improvement.

Summary

- ☐ Multiple remote sensing images provide good data source to evaluate the forest resource and conservation benefits from ecological restoration programs in China.

- ☐ In general, both of the forest quantity and quality are increasing since the implement of the Natural Forest Protection Project area and Beijing-Tianjin Sandstorm Source Control Project area. Ecological restoration programs have made notable achievements in China.

- ☐ More systematical evaluations are needed to integrate ground measurements (e.g. long-term NFI data, ecological research station observations) with RS observations for more quantitative indicators.

Thank you.

Yong Pang

Chinese Academy of Forestry

pangy@ifrit.ac.cn