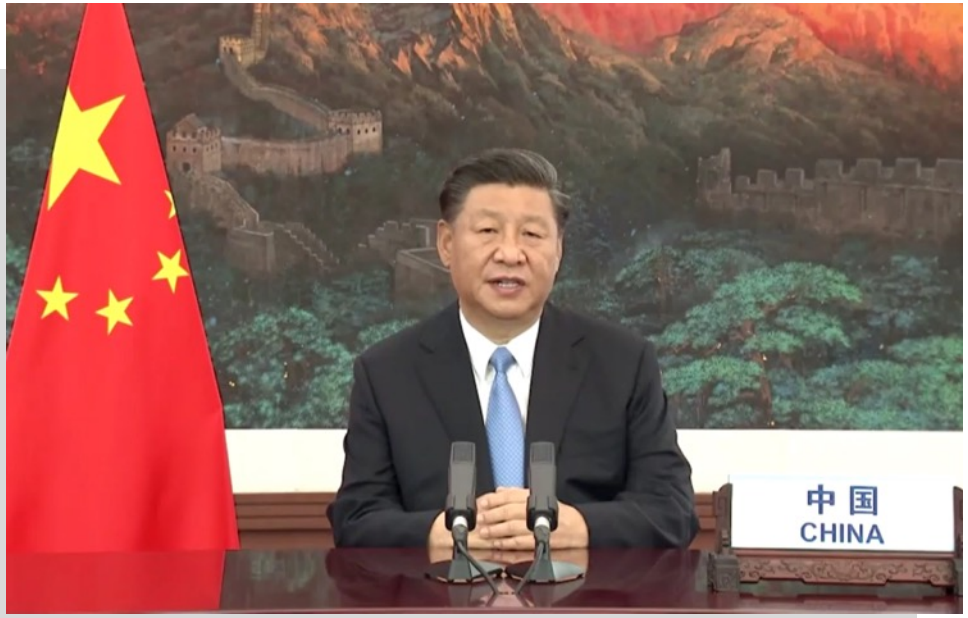
INTERNATIONAL RESEARCH CENTER OF BIG DATA
FOR SUSTAINABLE DEVELOPMENT GOALS
可持续发展大数据国际研究中心

CBAS: A New International Platform of TFM for SDGs



China will set up an **International Research Center of Big Data for Sustainable Development Goals** to facilitate the implementation of the 2030 Agenda for Sustainable Development.

-- President Xi's speech at 75th UN GA

Inauguration of CBAS on 6 September 2021

Congratulations to the Chinese Academy of Sciences on the new **International Research Centre of Big Data for the Sustainable Development Goals.**

This Research Centre will work side-by-side with the Regional Hub for Big Data to support the UN Global Platform. Together, we can mobilize scientific and technological communities to help achieve the SDGs.

--UN Secretary-General's video message for the Inauguration of CBAS

Inauguration of CBAS on 6 September 2021

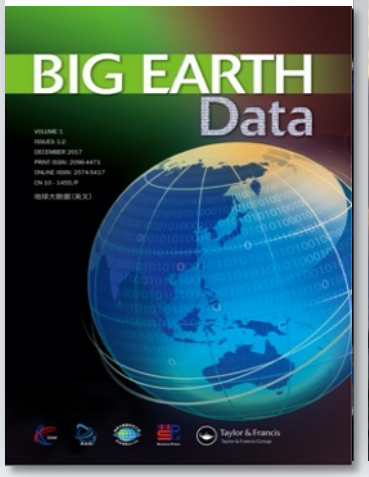
- My Department, stands ready to work with the Centre to **strengthen global partnership for the SDGs**. *--UN Under-Secretary-General for Economic and Social Affairs*
- I'm very pleased to see UNEP and the Chinese Academy of science is working together to **bridge the data gaps for the SDGs** and to **improve our effectiveness in using environmental data.** *--UN Under-Secretary-General and Executive Director of UNEP*
- We have a vision in the UNCCD of having a public **UNCCD Data Portal.** The UNCCD looks forward to cooperating with the CBAS. *--UN Under-Secretary-General and Executive Secretary of UNCCD*

Vision

Vision

The Center provides a range of services essential for **addressing** the most **challenging problems** such as **lack of data** and **technology barriers** in the implementation of the **SDGs**, including data sharing, technology solutions, decision-making support, as well as capacity building for developing countries.

Mission



- Develop SDG **data infrastructure and information and data products**
- Provide new **knowledges** for SDG monitoring and evaluations
- Develop and launch **a series of SDG Satellites**
- **Capacity development** for SDGs in developing countries

A research team with extensive domestic capacity

33 CAS Institute

96 Participating Organization

>1200 Scientist

A research platform with wide international impact

The extensive international cooperation platform provides a prerequisite for the international expansion of SDGs achievements.

- 57 countries, international organizations and plans
- Covering 4 continents
- 9 international working groups
- 8 international research centers of excellence
- 6 UN SDG goals

SDG Big Data Platform

Tailored services up to now for

Scientists

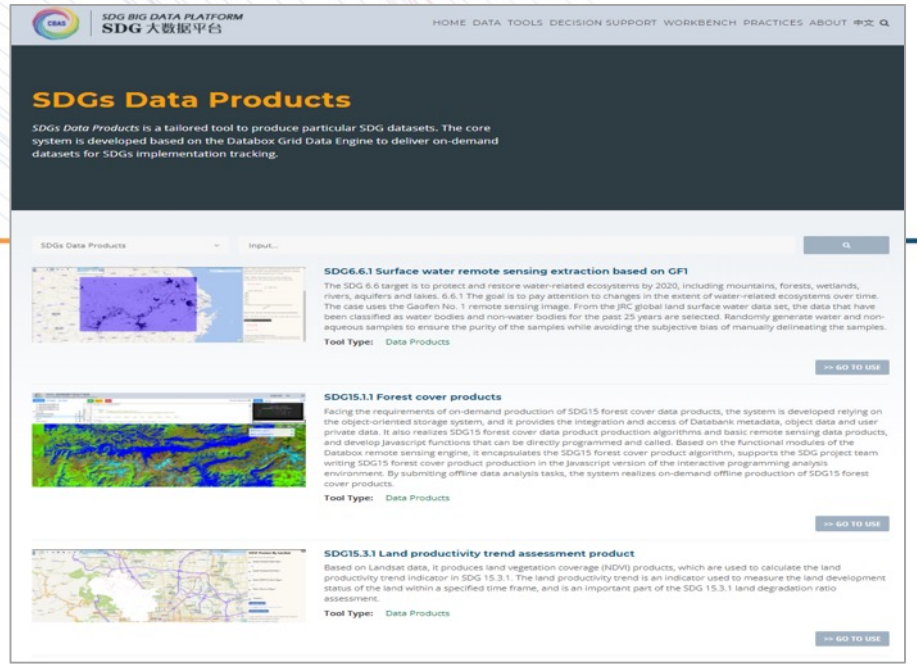
4 online indicator calculation
(6.6.1; 11.3.1; 15.1.1; 15.3.1)

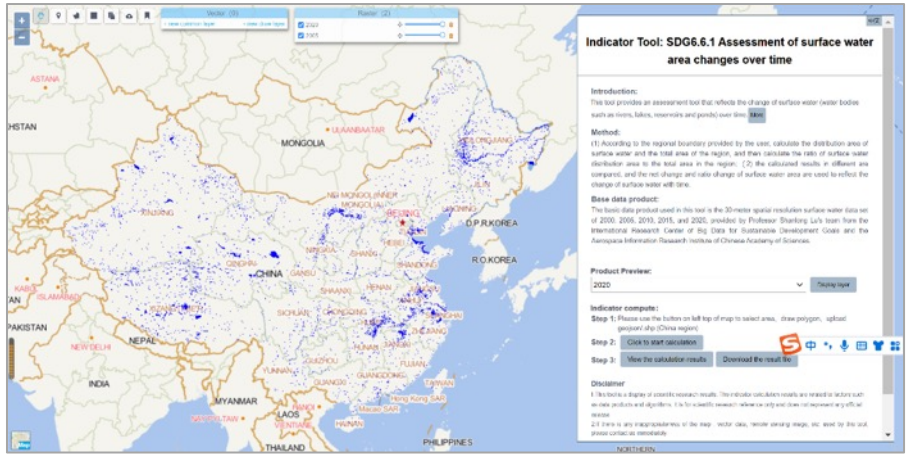
Decision makers

SDG data products
(Surface Water, Forest Cover, Land Productivity)

Public users

latest news





Combing multiple sources of data in geography, remote sensing, ground monitoring, and social statistics, the SDG Big Data Platform provides tailored services for SDGs research by integrating over a hundred popular algorithms and tools on the unified platform.

Data Sharing Platform

10PB
Total amount of data

40 years
Satellite Image Data

5.6PB
Biological and ecological data

4.6 million Scenes
Satellite image products

490,000
Items GBDB data record

3.8PB
EO Data

0.6PB
geographic data ground observation data Atmospheric and oceanic data

3.6 million
Items Catalogue of Life China

420,000
Items Microbial Data record

1 billion
pieces Omics data

◎ Each year, about 3PB will be updated on the Platform

◎ Data sharing service system was released on 15,Jan,2019. As of September 2021, more than 280,000 users in 174 countries have accessed the system, and the total online traffic has exceeded 57.97million times.

China's Earth Observation Satellites

Meteorological Satellites:
FY-1 series: polar orbit satellites; FY-2 series: stationary orbit satellites;
FY-3 series: polar orbit satellites; FY-4series: stationary orbit satellites.

Resource Satellites:
CBERS series: developed jointly by China and Brazil;
ZY3-01/02: surveying, mapping and resource investigation.

Ocean Satellites:
HY-1A/B: ocean color satellites; HY-2A: ocean dynamics and environment satellite; CFOSAT: surface wave.

Disaster Reduction and Environmental Satellites:

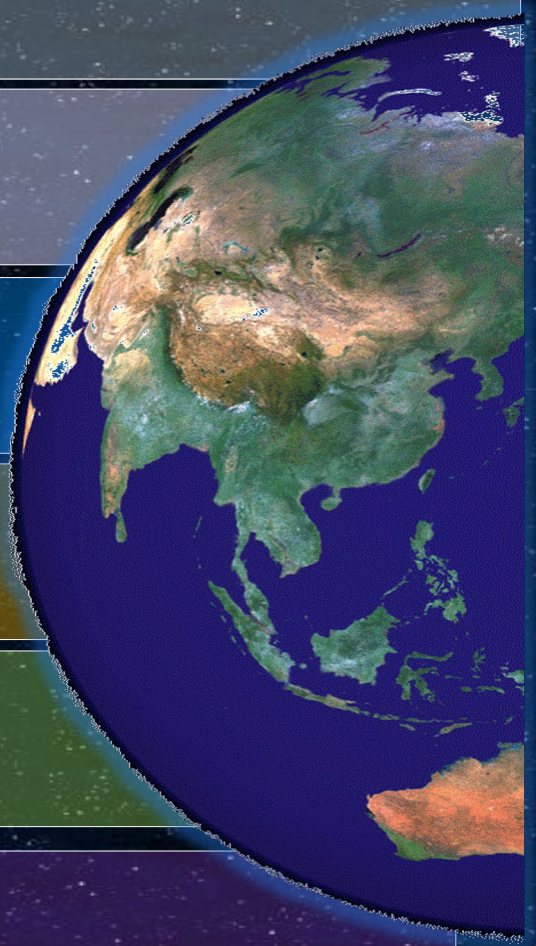
HJ-1A/B: optical sensors; HJ-1C: S-band SAR sensor.

High-resolution Satellites:

GF series: construction period: 2010-2020; including optical and SAR Satellites.

BeiDou Navigation and Positioning Satellites:

BeiDou series: including 35 satellites; global coverage.



SDG Satellite Launched on 5 November 2021

CBAS

SDGSAT-1
可持续发展科学卫星

- Thermal infrared + nighttime-light + multi-spectral
- Wide scale (300 km)
- High-resolution (10 m)

Explore new methods to sense Earth's environment

Data will be accessible during the second half of 2022

Big Earth Data in Support of SDGs

◎ Chinese Government released the Reports at 74th, 75thUN GA

Focusing on six SDGs, including Zero Hunger (SDG 2), Clean Water and Sanitation (SDG 6), Sustainable Cities and Communities (SDG 11), Climate Action (SDG 13), Life below Water (SDG 14), and Life on Land (SDG 15), the Report showcased the results of research, monitoring and evaluation of relevant SDGs and their indicators at local, national, regional and global scales.

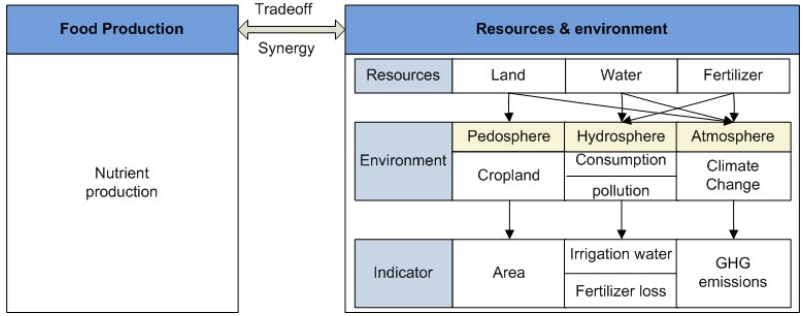
2019 Report

2020 Report

2021 Report

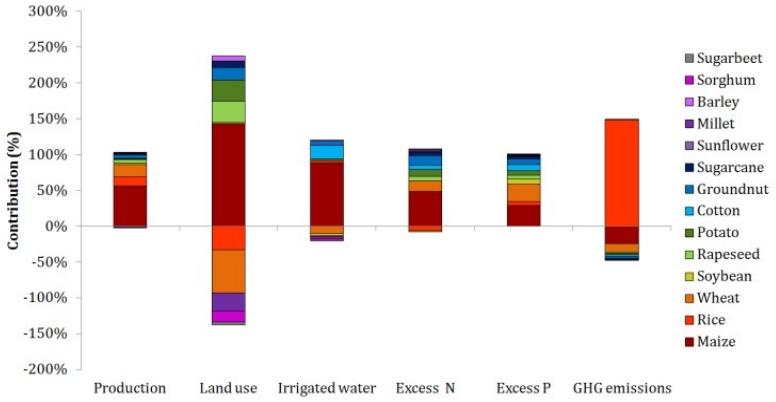
SDG2.4.1 Assessing progress towards sustainable cropping systems: The case of China

Conceptual framework



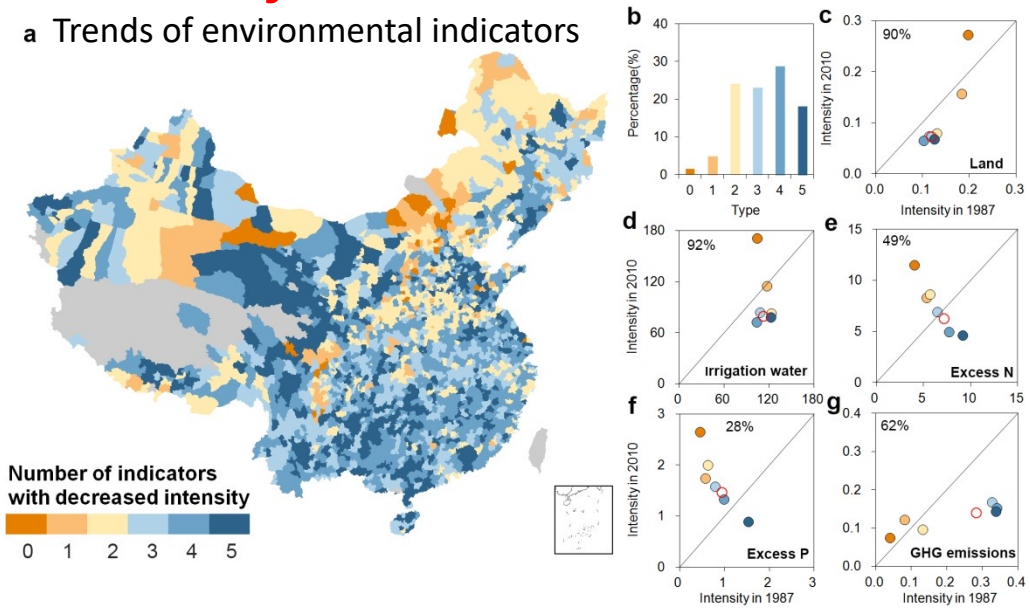
- Connect food production with environmental impacts
- Including impacts on land, water, and climate
- Indicators are measurable and easy to get large-scale data

Crop specific changes of each indicator



Case study - China

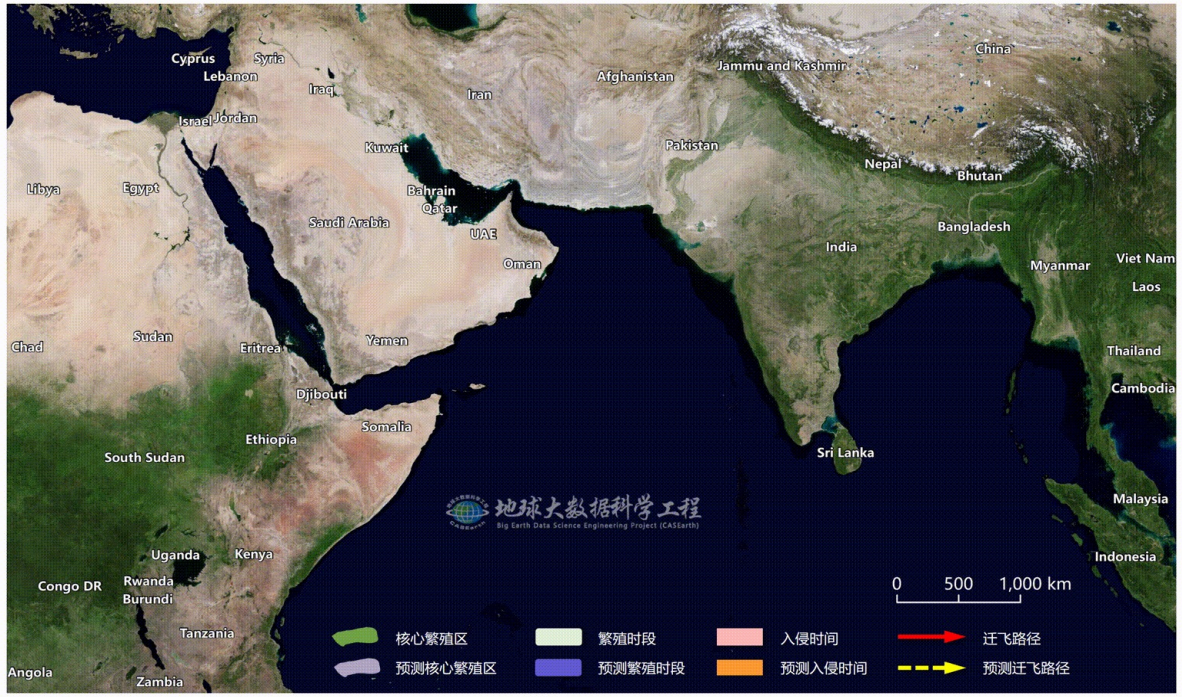
a Trends of environmental indicators

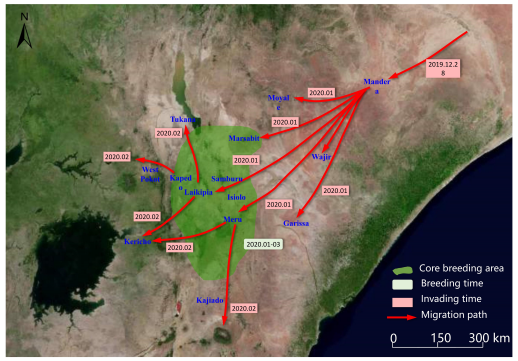


- China moved toward a more sustainable food supply. The environmental intensity of all five indicators declined across 18% of cropland and increased on just 2%.
- Farm management explained >90% of changes in crop production and environmental impact.

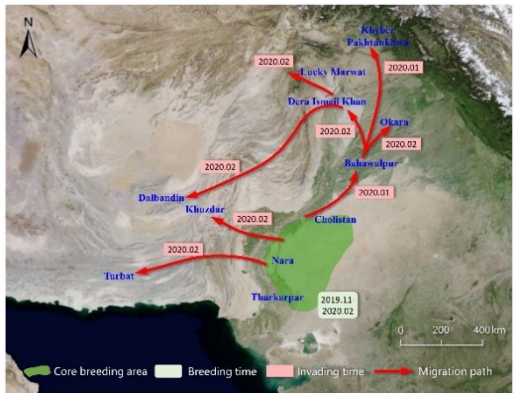
SDG2.4.1 Monitoring of Desert Locust in Africa and Asia

Core breeding area and migratory path of desert locust





Desert locust migratory path and damage in Kenya



Desert locust migratory path and damage in Pakistan

- Monitoring of Desert locust core breeding areas and migration paths in the Year 2018-2020 are conducted in Asian and African, especially in some severely damaged countries, including Pakistan, Ethiopia, Kenya, Somalia, and Yemen.
- The results were adopted by FAO to support multi-country joint pest prevention and control to ensure agricultural production.

SDG 6 indicators we mainly focused

Target: 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Indicator: 6.3.2 Proportion of bodies of water with good ambient water quality

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

Indicator 6.4.1: Change in water-use efficiency over time

Target 6.6: By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

Indicator 6.6.1: Change in the extent of water-related ecosystems over time

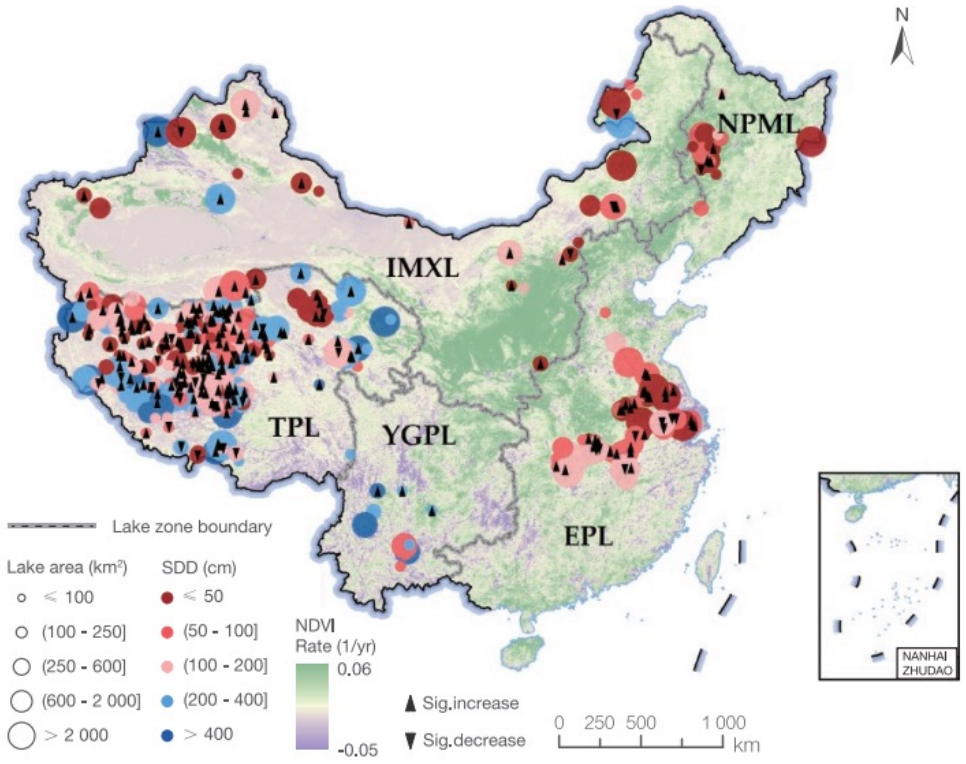
Table 1 Water-related Ecosystem Categories and their Applicable Extent Components

		Water-related Ecosystem Categories				
		Lakes	Rivers and Estuaries	Vegetated Wetlands	Aquifers	Artificial Waterbodies
Extent Components	Spatial Extent				N/A	
	Quality					
	Quantity	N/A		N/A		N/A

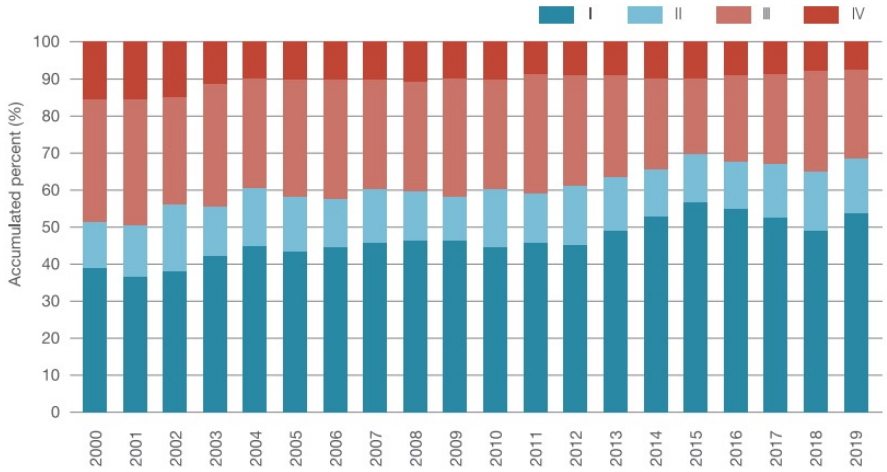
N/A = No requirement to monitor for Indicator 6.6.1

Cases of SDG 6 in Big Earth Data Program

Spatiotemporal patterns of water transparency in China's lakes



The mean SDD values of China's large lakes during 2000-2019

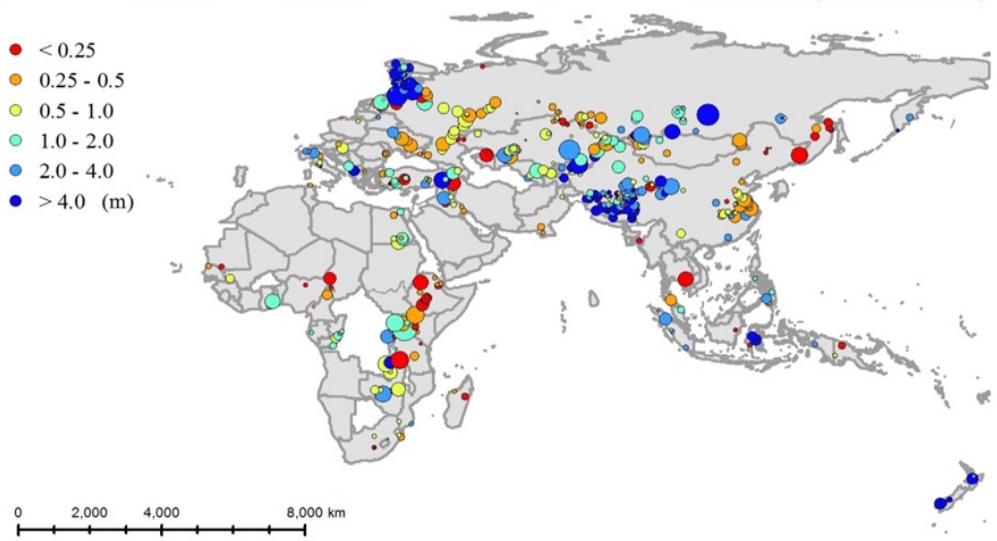


Proportions of lakes with different water clarity levels

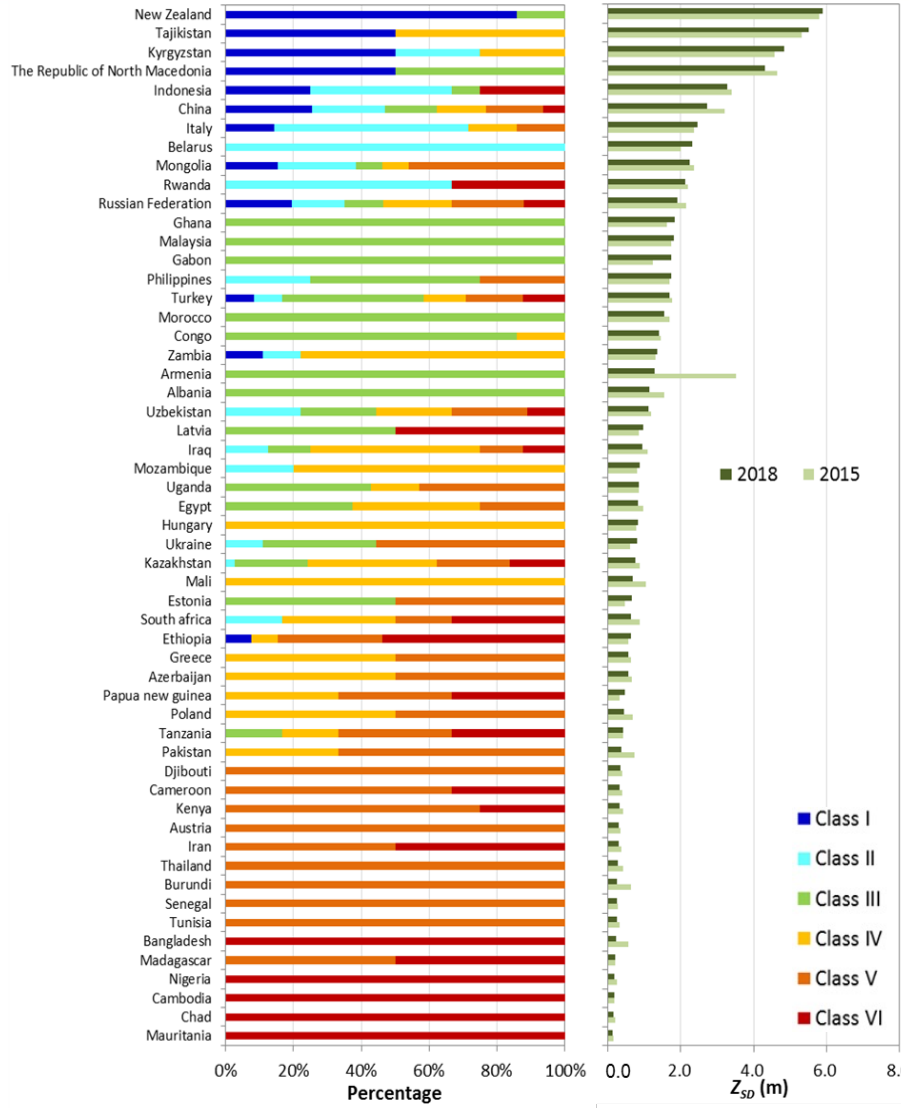
During 2000-2019, the water transparency of China's lakes showed a spatial pattern of "high in the west and low in the east". Overall, water clarity was good and showed a positive trend. The proportion of Types I, II, and III water bodies with good clarity increased from 84.11% in 2000 to 92.46% in 2019.

Cases of SDG 6 in Big Earth Data Program

Temporal and spatial distribution of the surface water transparency in the Belt and Road regions

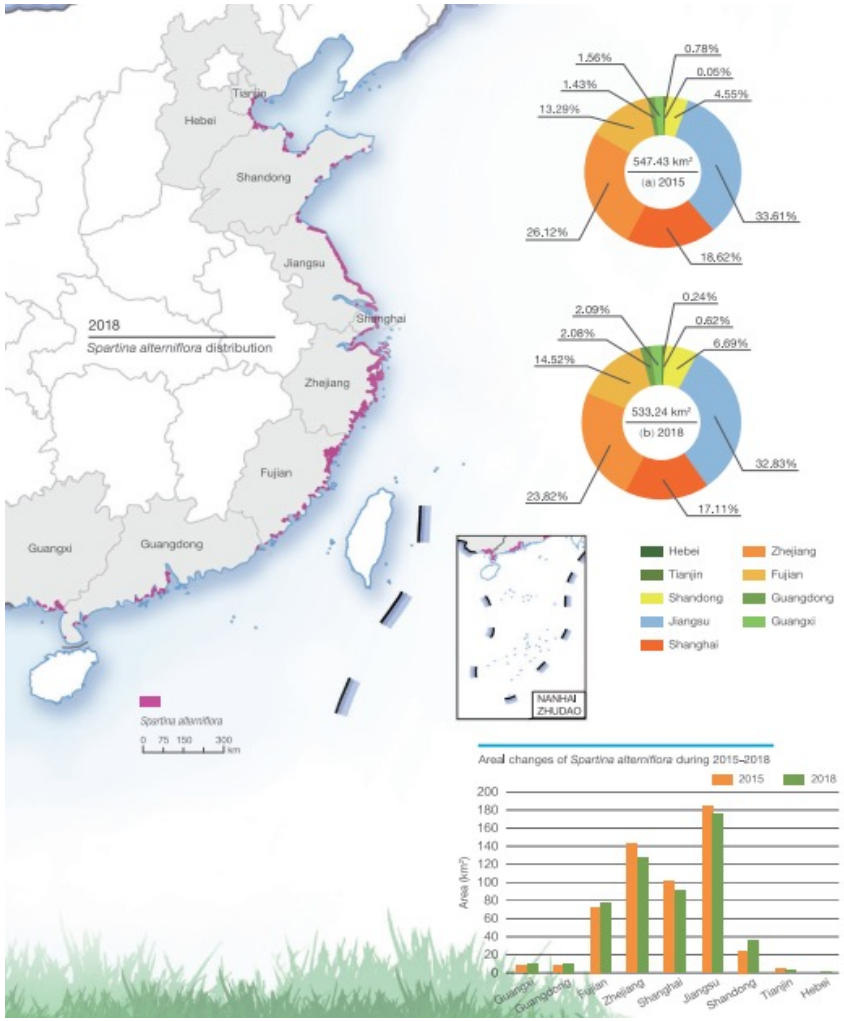


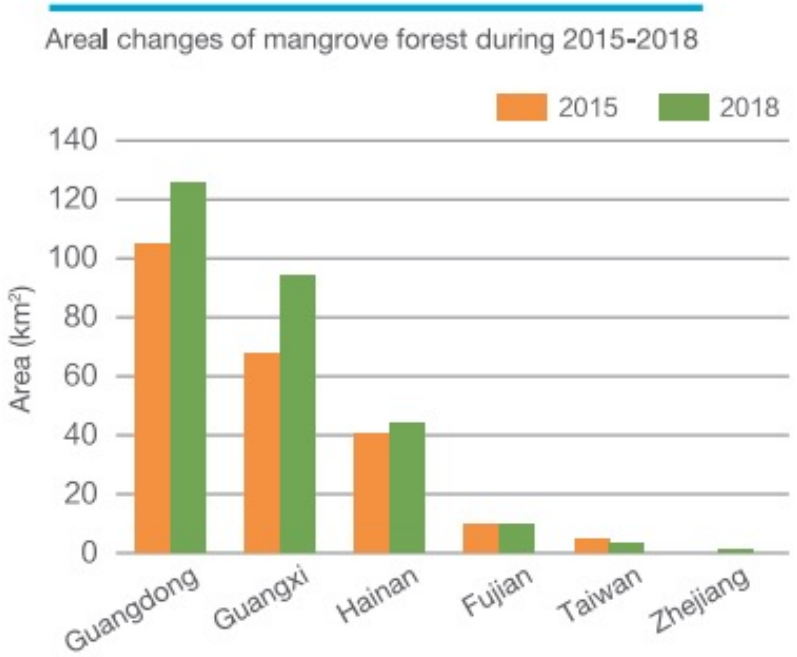
From 2015 to 2018, the transparency of lakes generally showed a downward trend, of which 68.3% decreased and only 31.7% increased.



Cases of SDG 6 in Big Earth Data Program

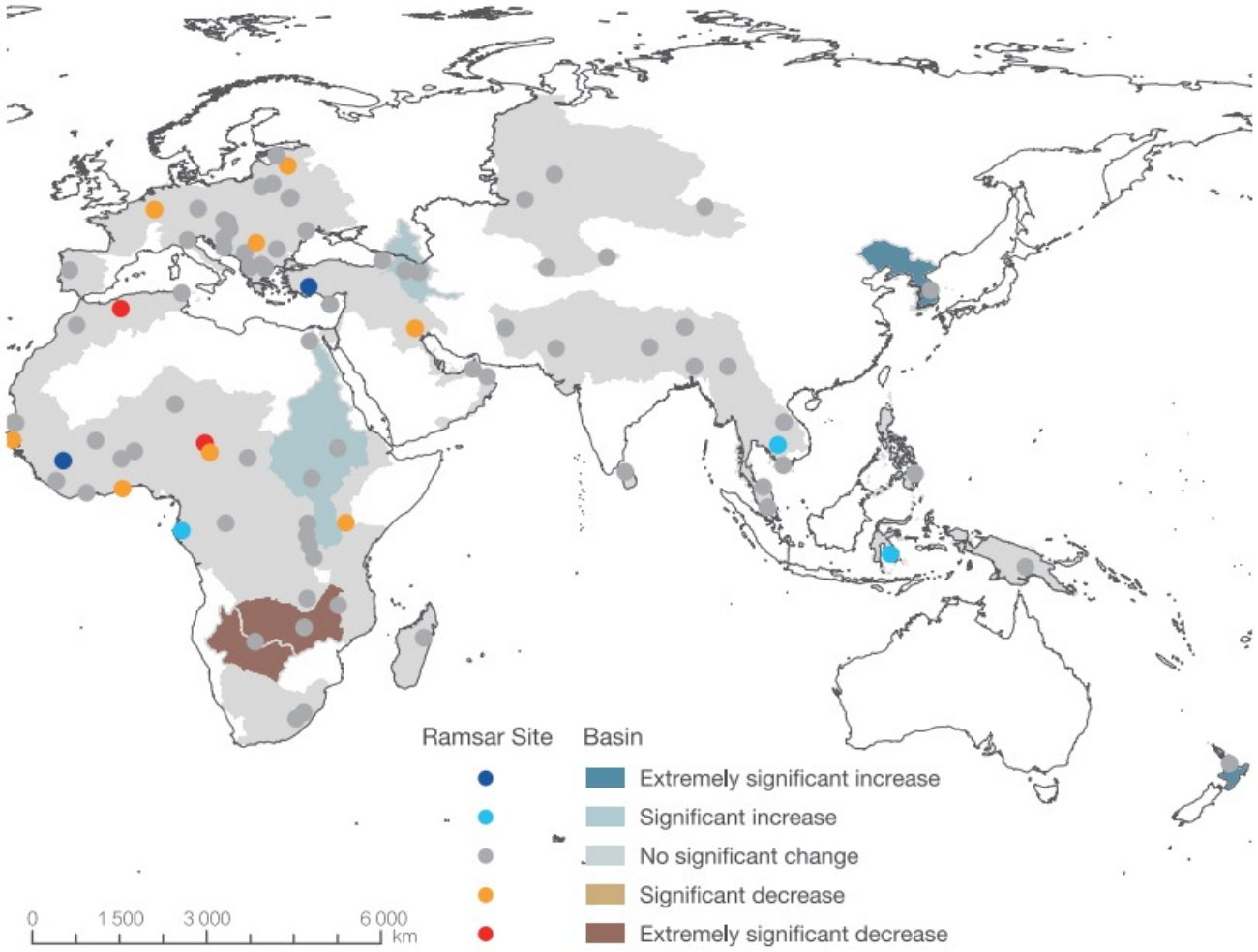
Spatiotemporal distribution of China's vegetated wetlands





From 2015 to 2018 the net increase in mangrove forests of China was 22.11%, and the net decrease in invasive Spartina alterniflora was 2.59%. The mangrove forests have been significantly restored and the invasion of Spartina alterniflora was under effective control.

Dynamic change of water body in Ramsar Sites



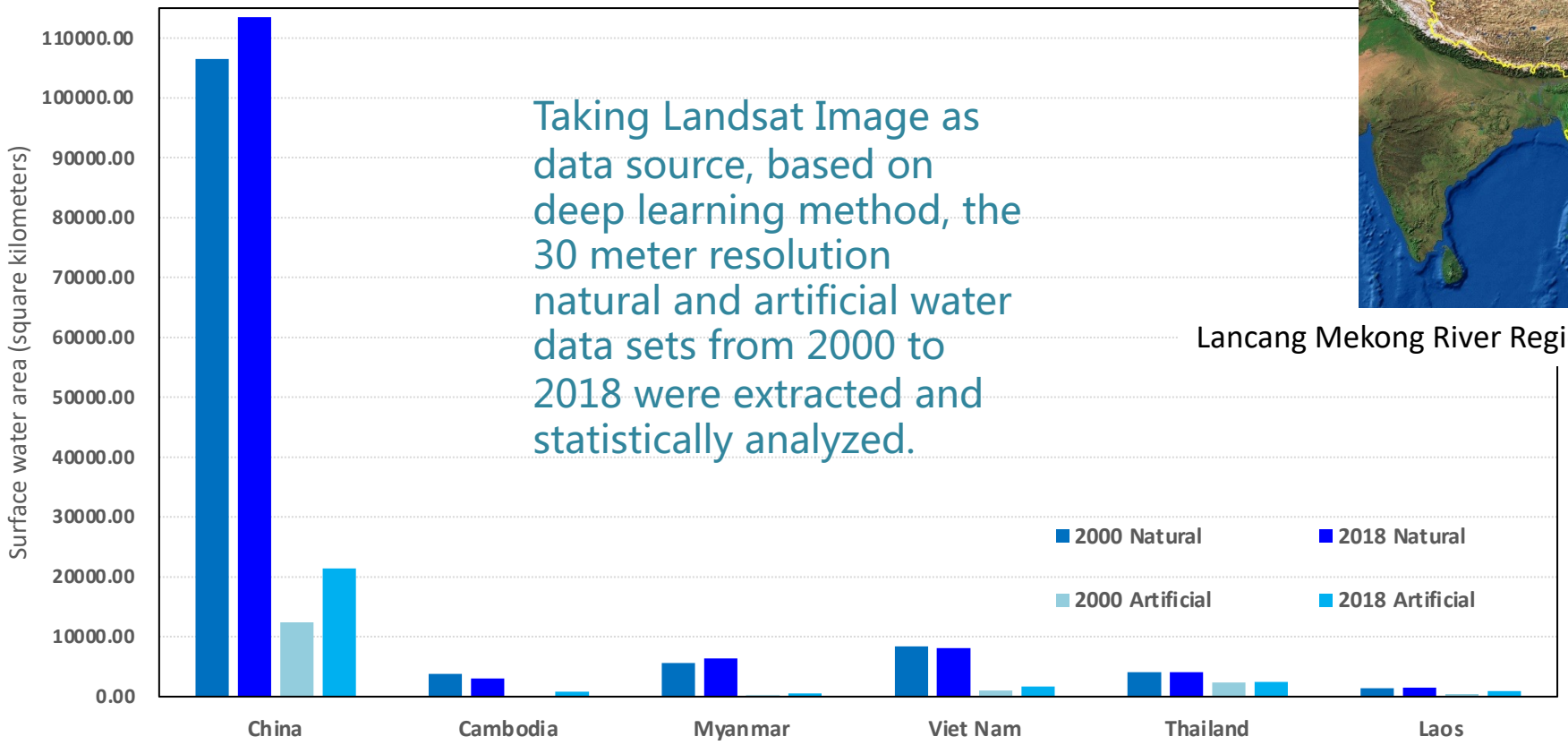
Seasonal fluctuation characteristics

Global water bodies dynamic datasets from 2000 to 2018, with a spatial resolution of 250 meters and temporal resolution of 8 days was used.

From 2000 to 2018, 50% of the Ramsar Sites in Asia, Europe, and Africa exhibited a trend of significant change, and most of them (58%) an upward trend.

Cases of SDG 6 in Big Earth Data Program

Changes of natural and artificial water bodies in Lancang Mekong Basin



Taking Landsat Image as data source, based on deep learning method, the 30 meter resolution natural and artificial water data sets from 2000 to 2018 were extracted and statistically analyzed.

Lancang Mekong River Region

From 2000 to 2018, the natural and artificial water areas in China, Myanmar and Laos showed an increasing trend, while in Cambodia, Vietnam and Thailand showed a decreasing trend.

SDGs focus on urban sustainability

Changing cities face many problems

Migration

Regional development imbalance

City traffic

Resource energy consumption

Ecosystem

Social and economic structural changes

Sustainable cities and communities

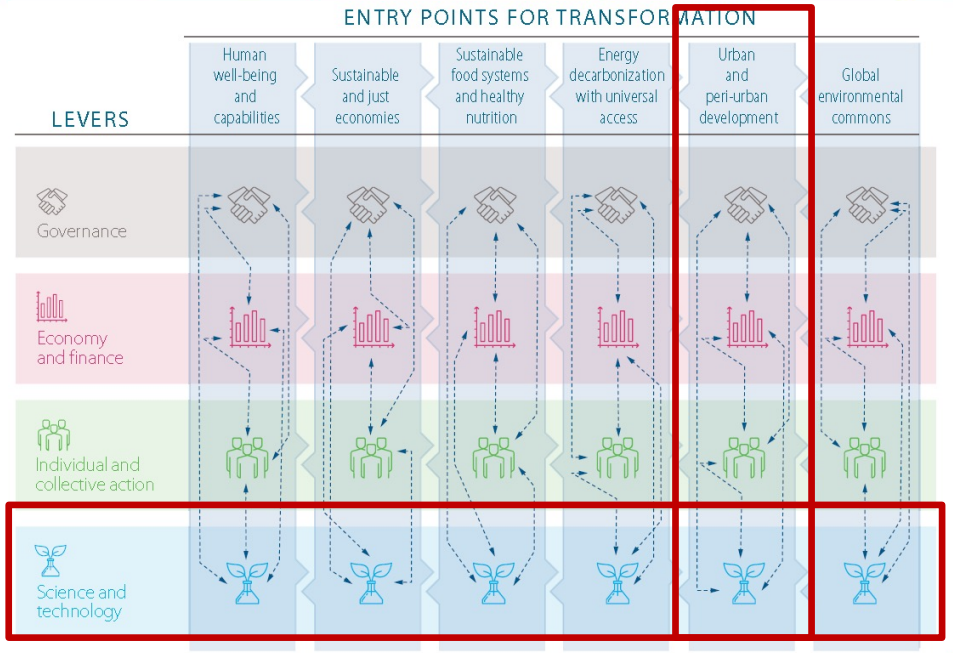
SUSTAINABLE DEVELOPMENT GOAL 11 Read more

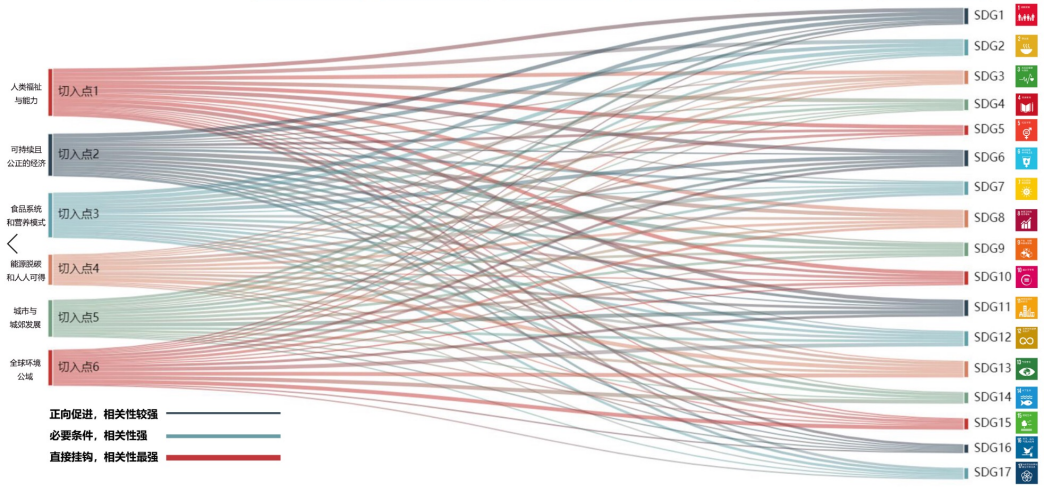
Make cities and human settlements inclusive, safe, resilient and sustainable

How to build a sustainable city?

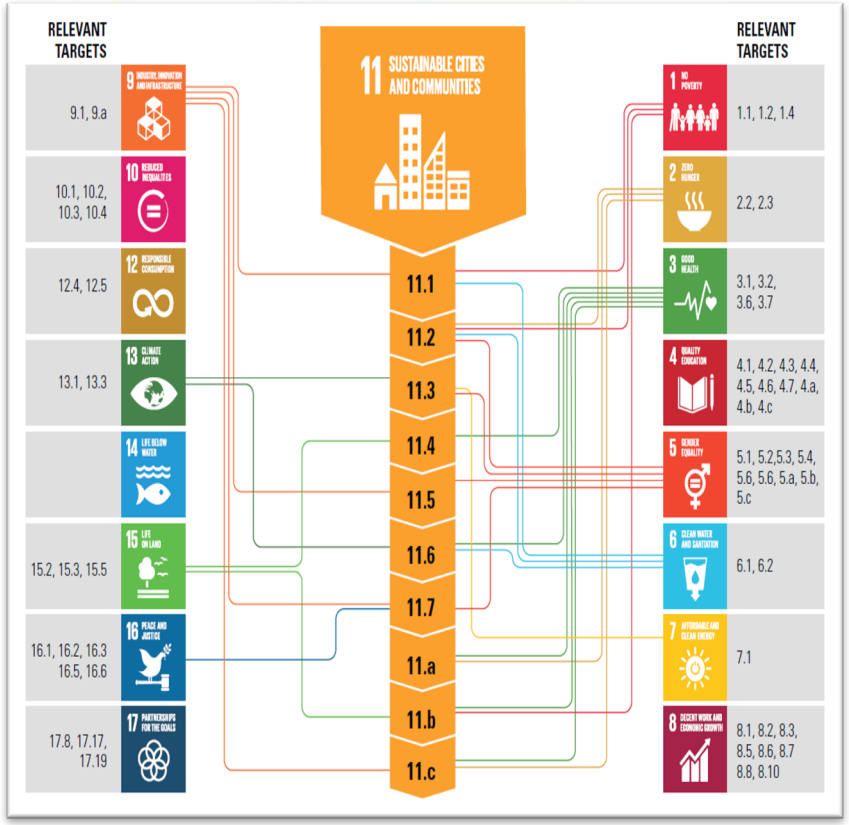
10	291	80	254
targets	partnerships	publications	documents

Transformation for urban sustainability





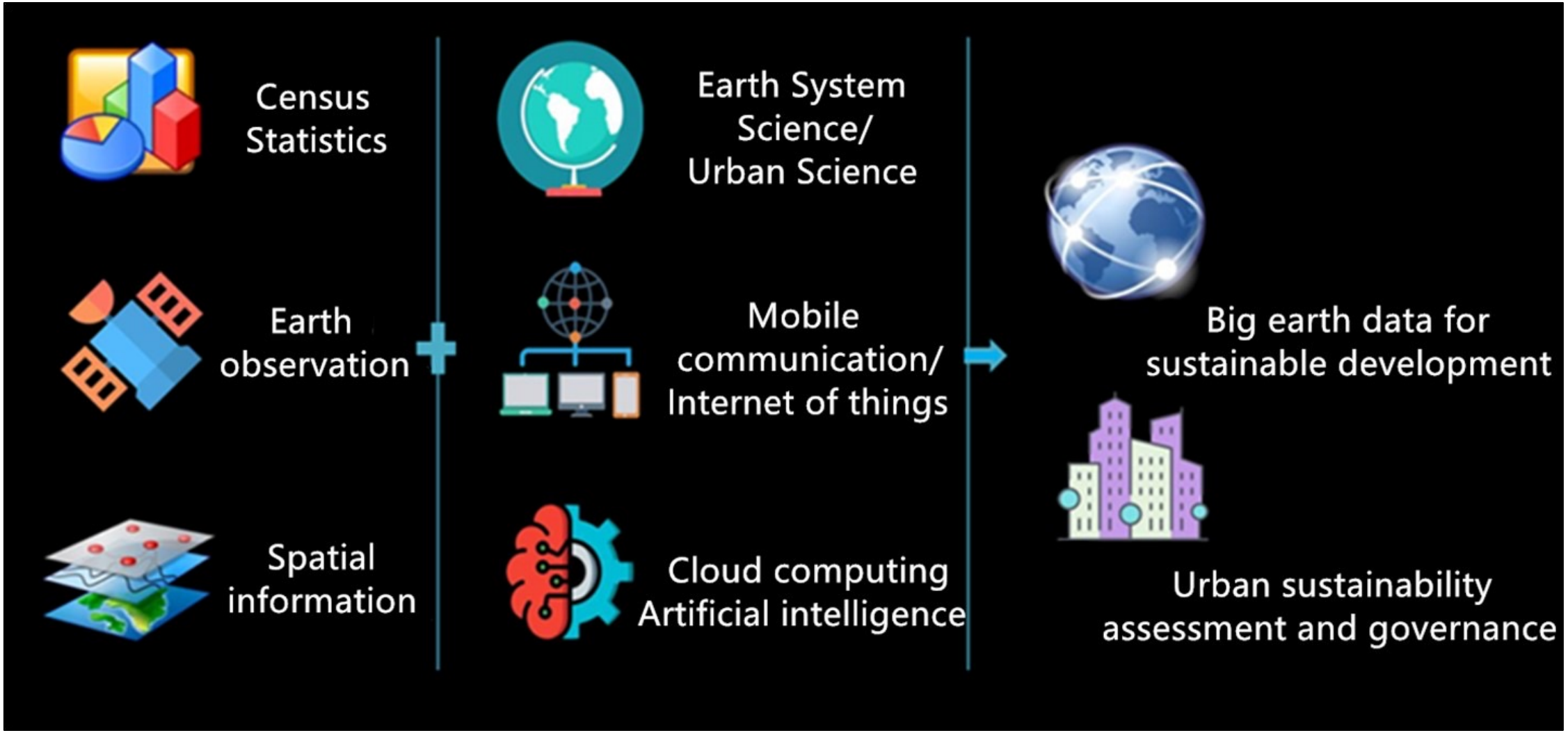
The relationship between 6 entry points and 17 SDGs



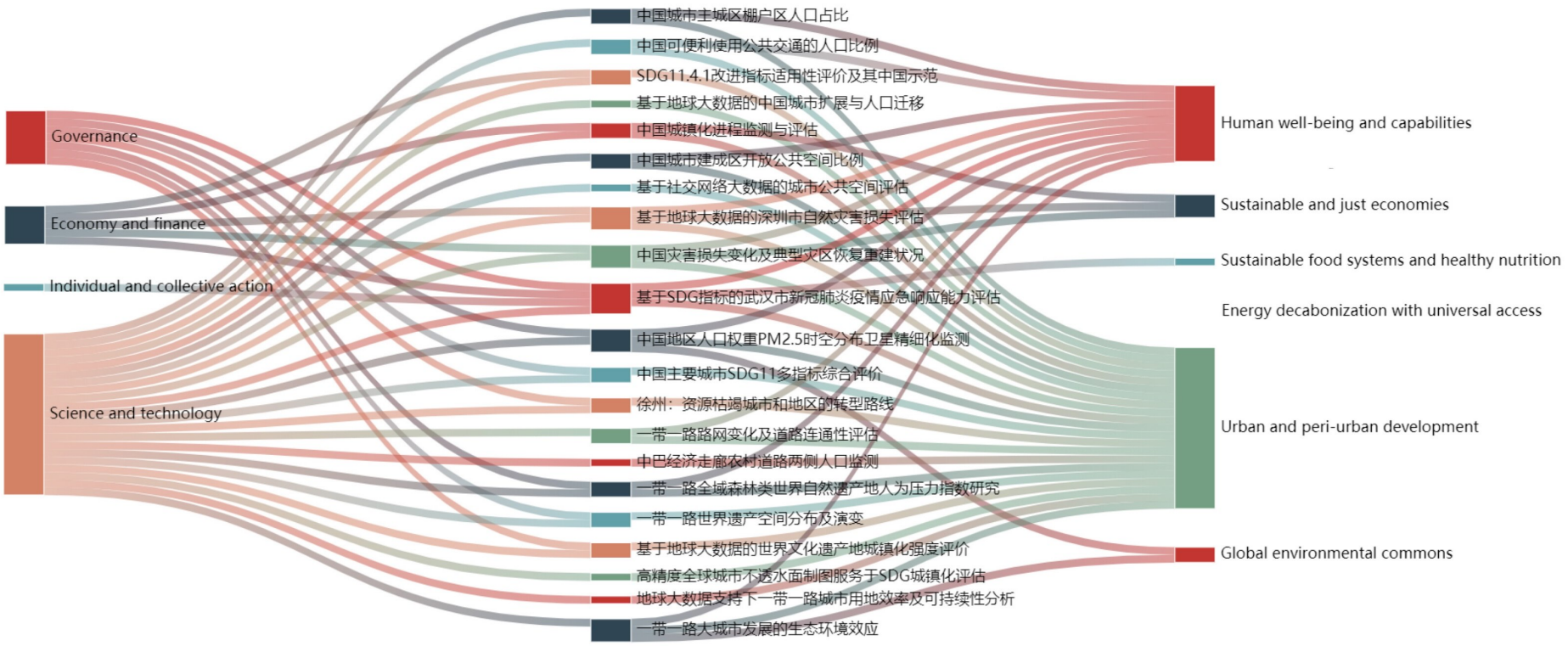
13 of 15 SDG 11 indicators **lack data**

Interconnections between SDG11 and other SDGs

How to measure and assess urban and pre-urban sustainable development?



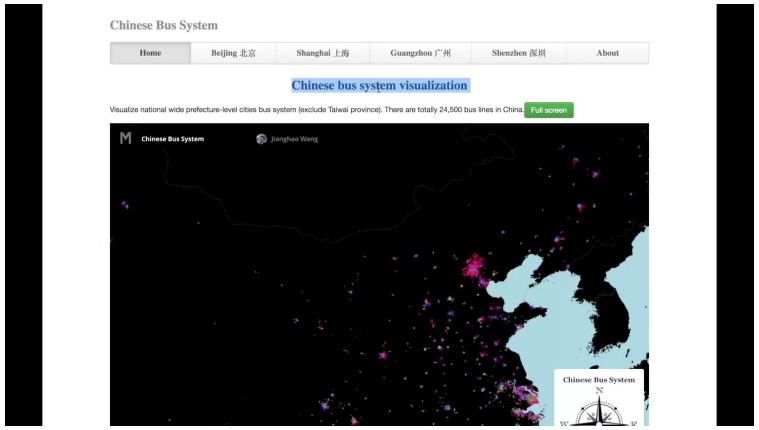
Big Earth Data for Urban/peri-urban Sustainability



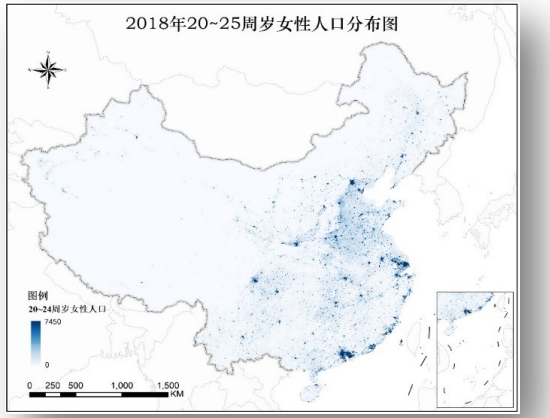
CASEarth conducts 21 typical cases centered on urban & peri-urban development and science & technology, and focuses on 8 main themes including urban public transportation, road network, open public space, heritage protection, urbanization, pollution, public health, and disaster prevention & mitigation.

Urban Public Transportation

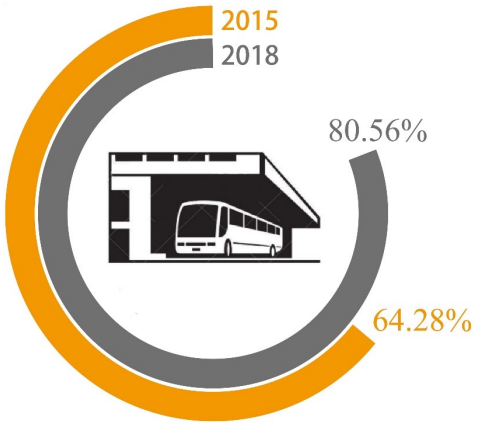
- Producing Chinese fine population grid data with 1km resolution by sex and age for 2015 and 2018.
- The proportions of the population with convenient access to public transportation were 64.28% and 80.56 in 2015 and 2018, respectively.

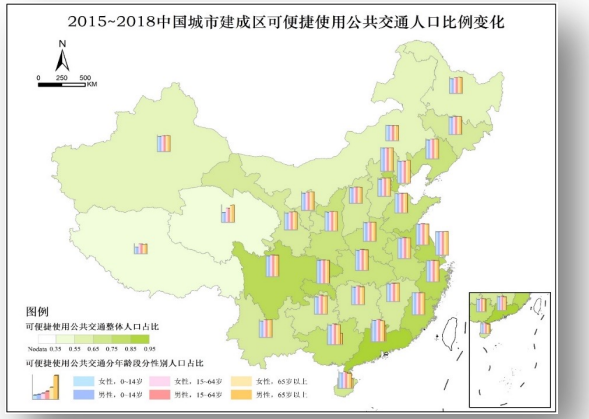


Chinese urban public transportation system



Urban population distribution by sex and age in China





Change of urban public transportation proportions from 2015 to 2018

Urban Road Network

- Road networks for 65 Belt & Road countries in 2015, 2017 and 2019.
- The total length of road has increased by 1.6 times, average road density increased from 0.58 to 0.78 km/km^2, and average road length increased from 7 m to 9 m per capita.
- Iran, Turkey, Bulgaria and China have the highest road connectivity importance among the 65 countries.

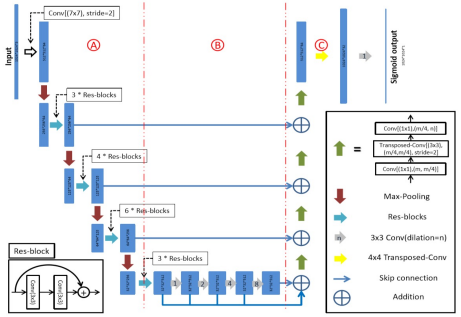
Big Earth Data

- Sentinel-1
- Sentinel-2
- Open Street Map
- World bank population

THE WORLD BANK
IBRD • IDA

Deep Learning

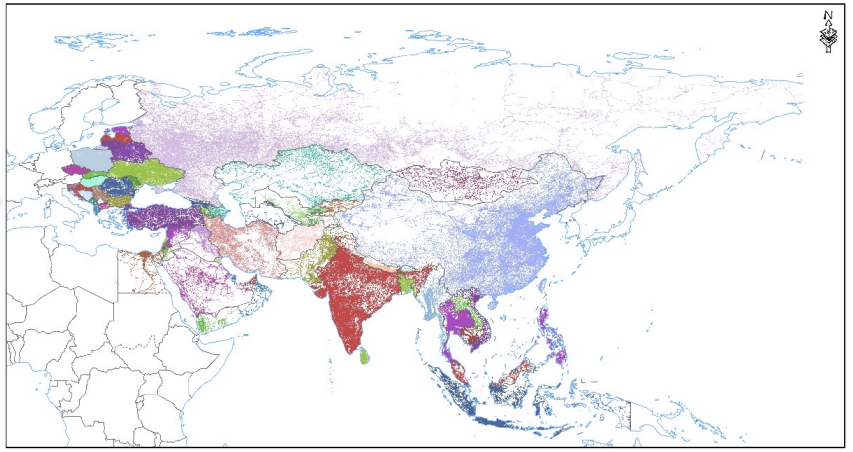
- Cloud Computing
- Transfer Learning
- Deep Networks



D-LinkNet

Road Dataset

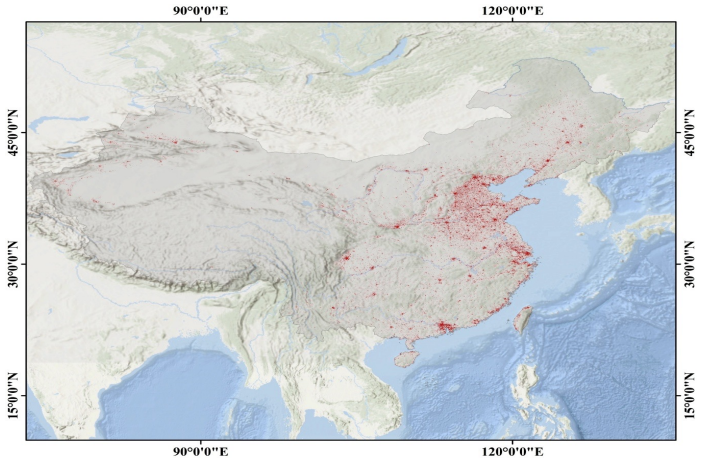
- 65 One Belt One Road countries
- 2015, 2017 and 2019
- Road length/density/connectivity

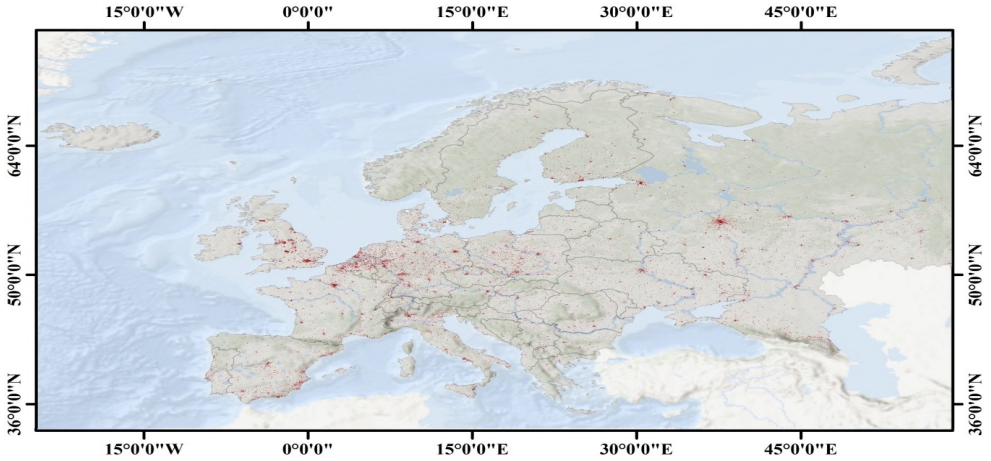


Urban Sprawl and Urbanization

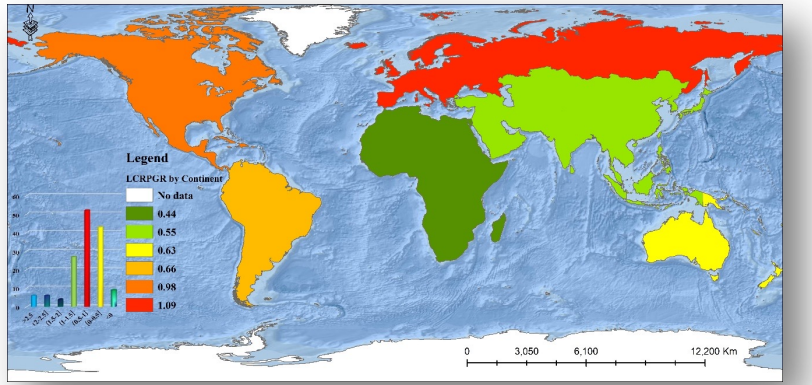
Global urban impervious surface mapping in serve of SDGS

- Global 10-meter resolution urban impervious surface products acquired in 2015 and 2018 were generated from multi-source Big Earth Data

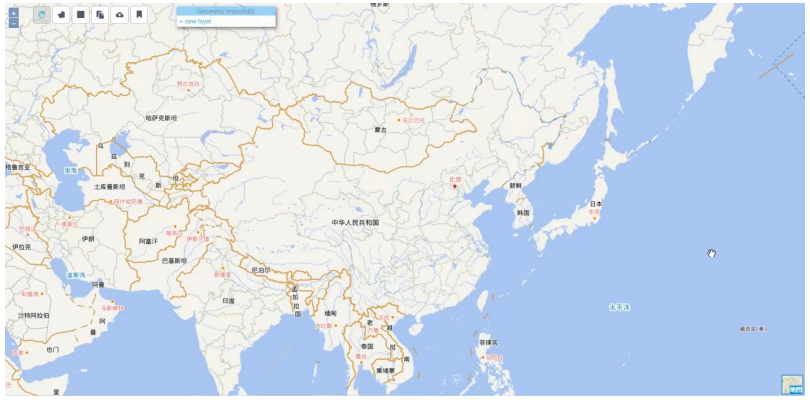




- Assessing global urbanization progress at continental and national scale from 2015 to 2018, results reveal that Africa as well as nearly 50% nations face major challenges ahead for urban sustainable development.



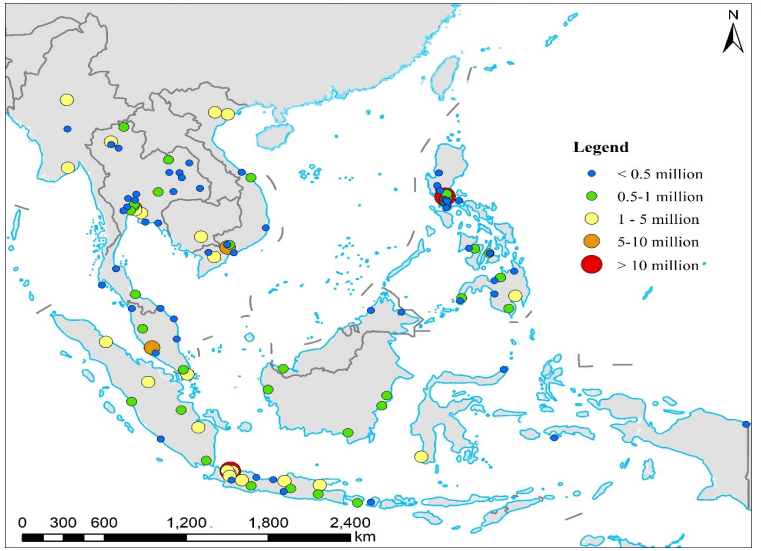
- Developed online computing and processing toolkit for SDG11.3.1 based on CASEarth cloud platform.

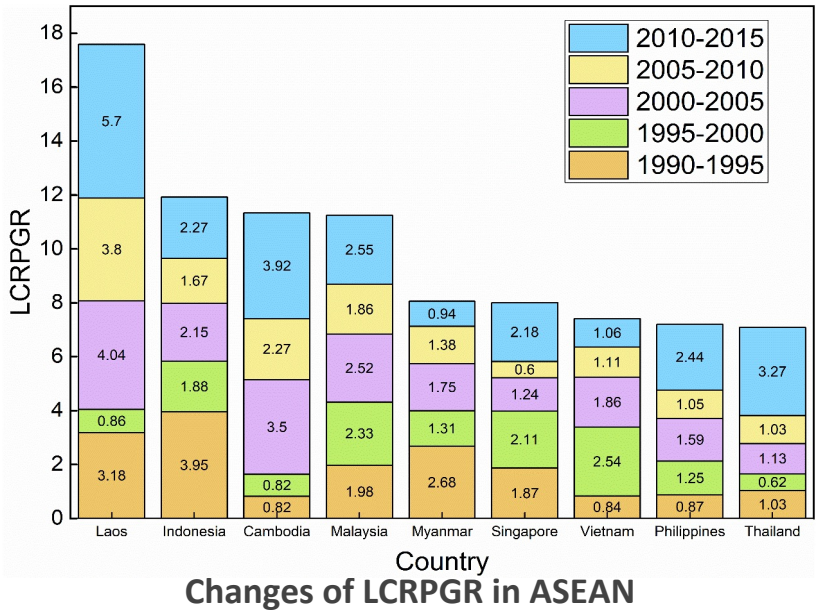


Urban Sprawl and Urbanization

Monitoring and assessing urbanization progress in Belt and Road (B&R)

- Monitoring and measuring the SDG 11.3.1 indicator for 1,500 cities with populations greater than 300,000 from 1990 to 2015 at 5-year intervals in the B&R region
- Proposed a new SDG11.3.1 indicator - the ratio of economic growth to land consumption rates (EGRLCR) in assessing China's urbanization
- In the B&R region, the results reveal that LCRPGR increased from 1.24 in 1990-1995 to 2.67 in 2010-2015.
- In China, the results shown that LCRPGR increased from 1.33 in 1990–1995 to 2.15 in 2010–2015 period, while EGRLCR fell from 2.96 to 1.69.
- Urban sustainability in B&R still faces major challenges.

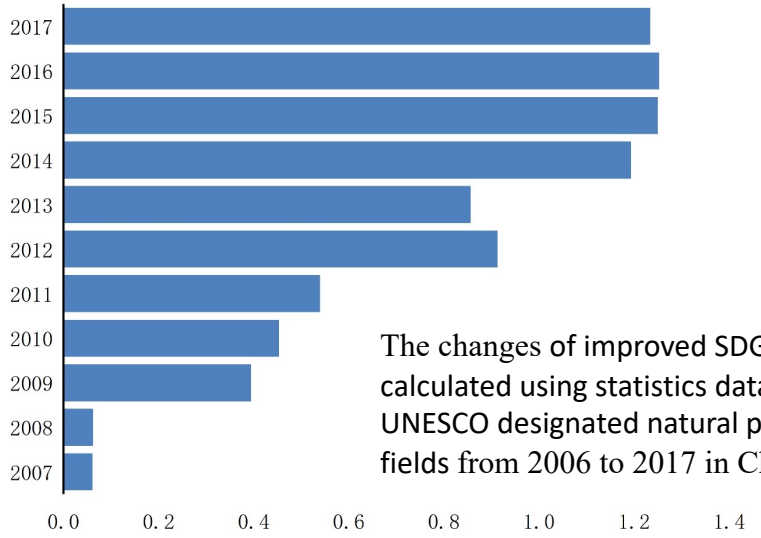




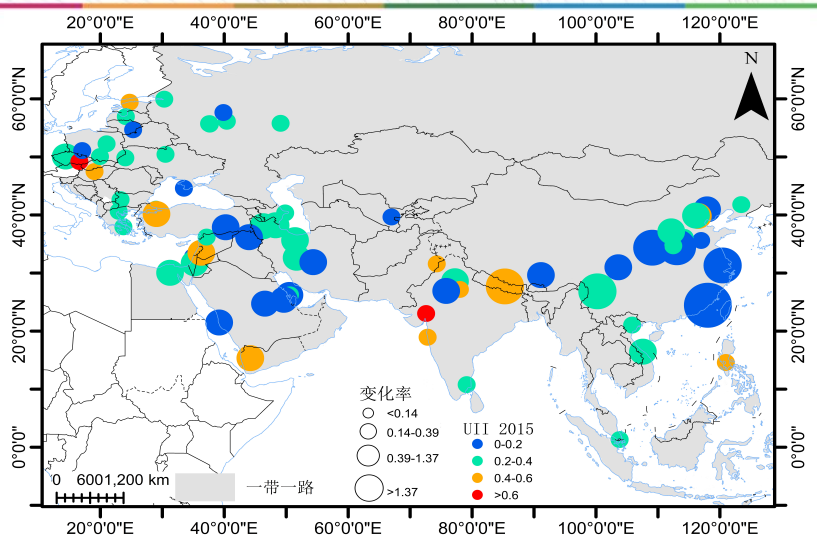
Changes of LCRPGR in ASEAN

Natural and Cultural Heritage Protection

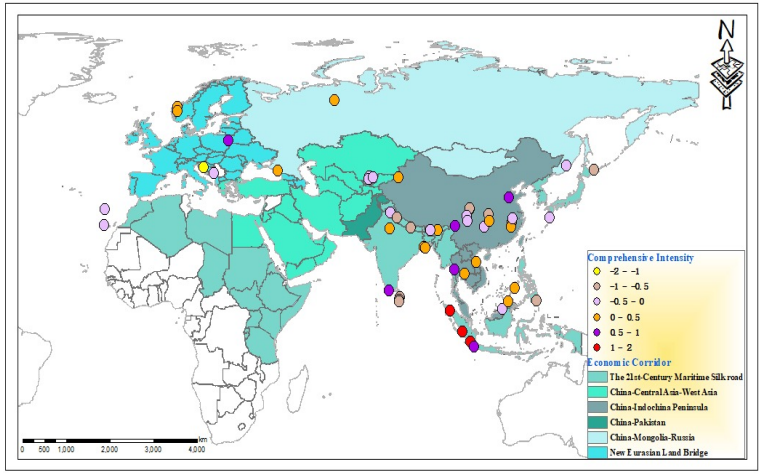
- Improved SDG11.4.1 indicator - “increase in capital investment per unit area to protect and safeguard the world’s cultural and natural heritage”. The sustainable development of Chinese world heritage was obviously improved from 2006 to 2017.
- Proposed urbanization intensity indicator (UII). The average UII of 79 world cultural heritage sites in the “Belt and Road” region increased from 0.26 in 2000 to 0.29 in 2015.
- Proposed human comprehensive intensity indicator. About 78% of the natural heritage sites is affected by human disturbance gradually during 1993 to 2016.



The changes of improved SDG11.4.1 calculated using statistics data for 39 UNESCO designated natural protected fields from 2006 to 2017 in China



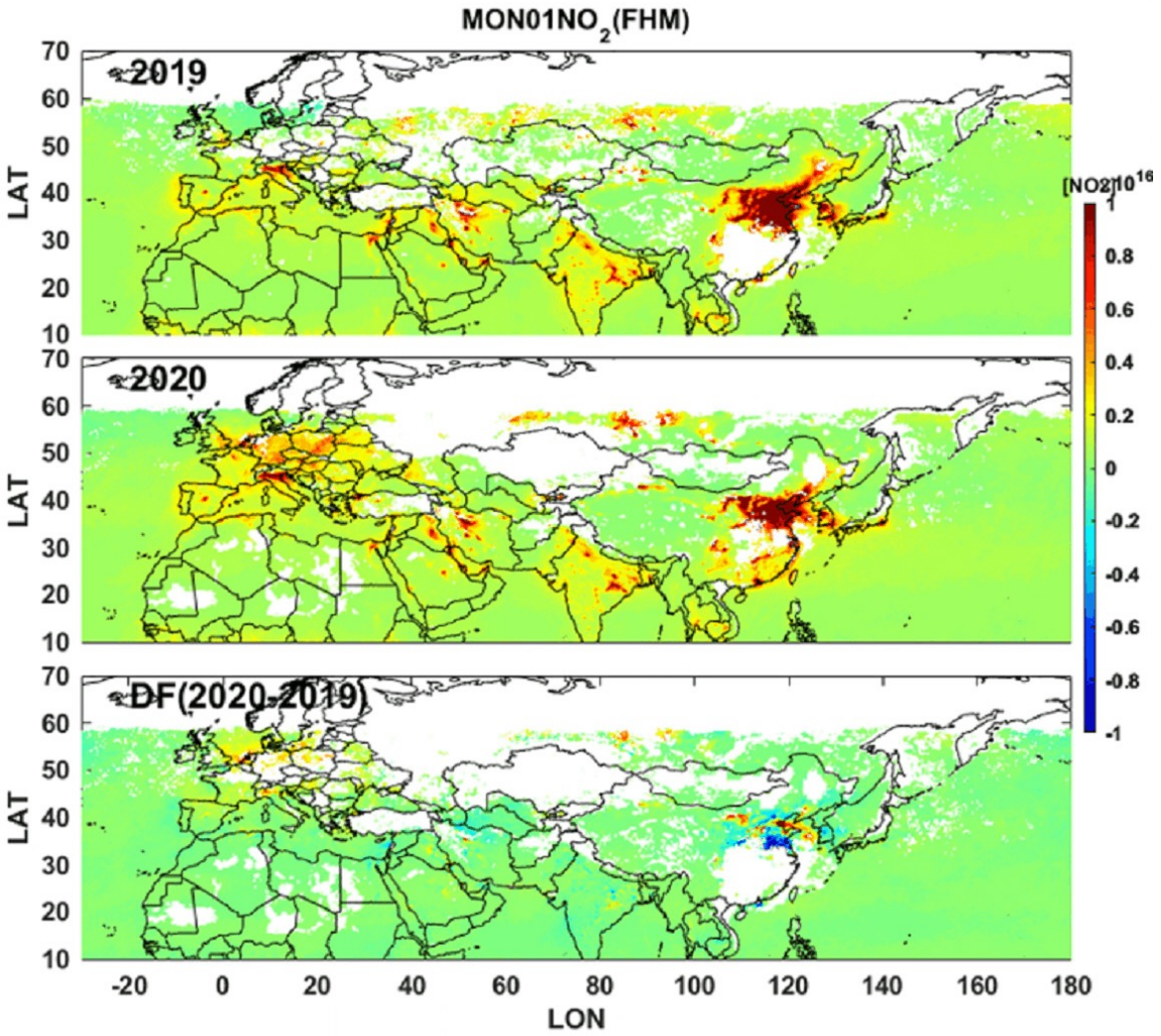
The changes of UII for cultural heritage sites along the Belt and Road from 2000 to 2015



Distribution map of comprehensive intensity of human disturbance in the natural heritage sites

Air Pollution

- Using NO_2 vertical column density changes derived from satellite data to analyze the impact of COVID-19 on countries along the B&R region.
- In China, NO_2 has shown a significant downward trend from late January to early March 2020, with a maximum decline of up to 31.76%; With the resumption of production and resumption of production, the tropospheric NO_2 vertical column density at the end of March returned to the level close to the same period in previous years.
- Globally, since early February, NO_2 hotspots in Europe, the Middle East, and India have also observed a clear downward trend because of COVID-19.



Air Pollution

Monitoring and analyzing fine particulate matter ($PM_{2.5}$) in China

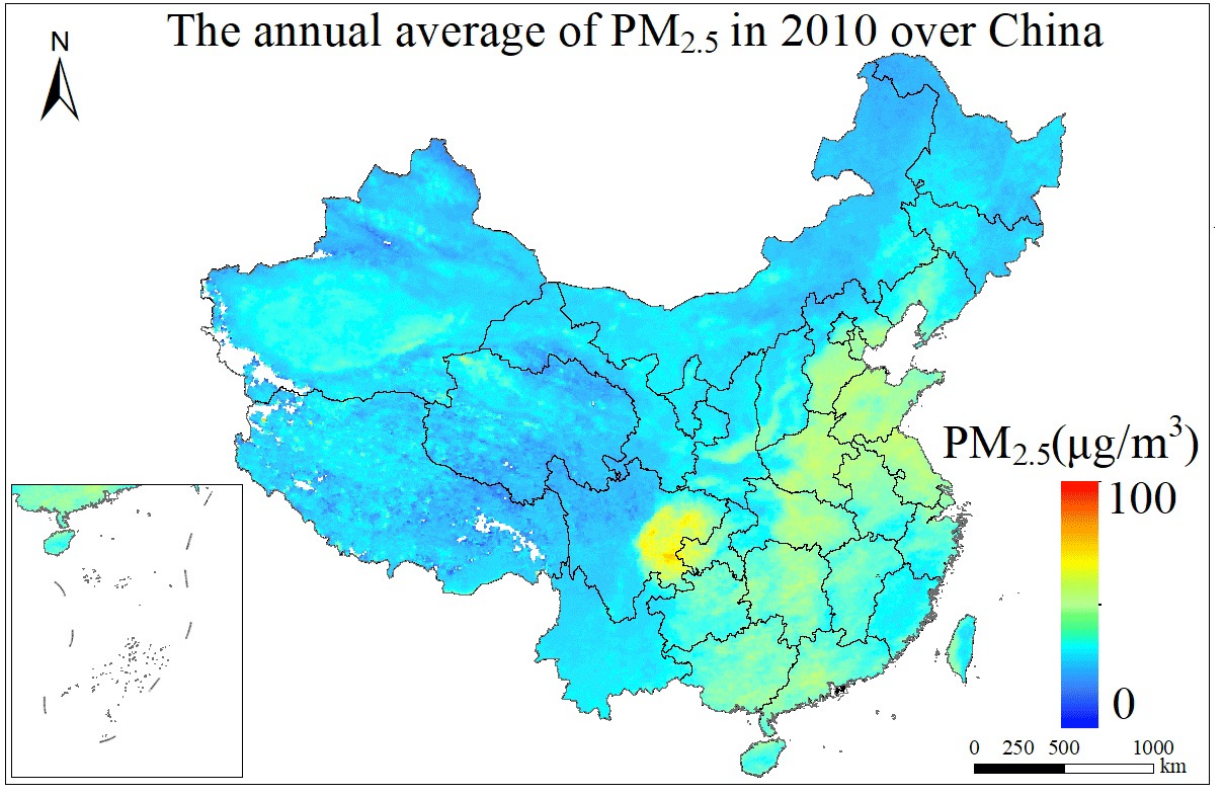
- Providing China's 2010-2018 annual average $PM_{2.5}$ data products.
- The Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta, and Chengdu-Chongqing regions showed an overall decreasing trend from 2010 to 2018.

Data and Computation Method

- Datasets: MODIS AOD and MODIS NDVI in the time series. Monitoring data included China's environmental monitoring stations, meteorological data, and reanalysis by ECMWF.
- Method

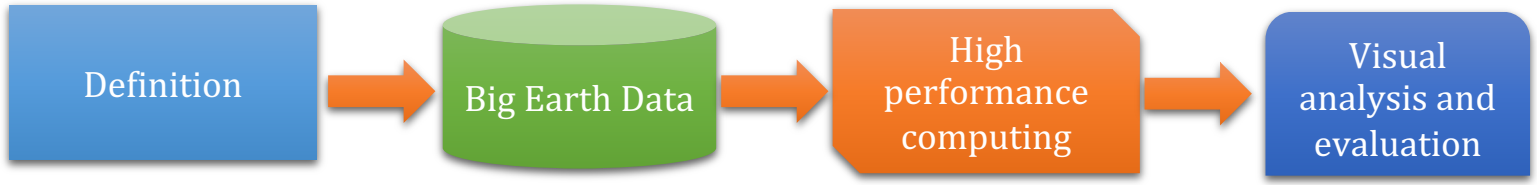
$$C_{agg}=SUM(C_{nat}*P_{nat})/SUM(P_{nat})$$

where C_{agg} is the estimation at the global scale, C_{nat} is the estimation at the country scale, and P_{nat} is the national population.



Urban Open Public Spaces

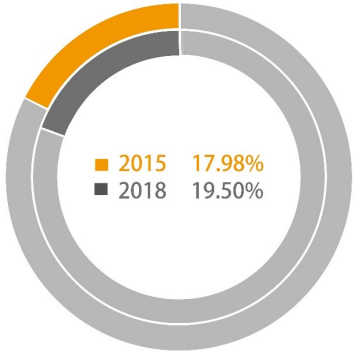
- The share of open public space (OPS) in built-up areas of Chinese cities were 17.98% and 19.50% in 2015 and 2018, respectively.
- The OPS scale increases with an increase in city size and economic development level, and the economic development level, residents' living standard, urbanization level and population size have sound explanatory powers on the scale.



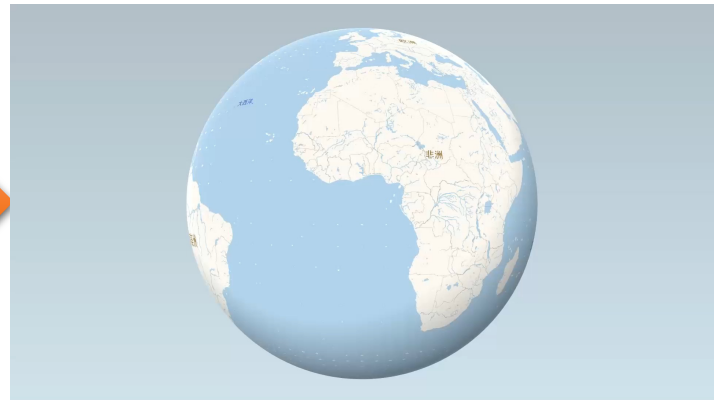
Public open space Public green spaces, parks, plazas, roads, etc.

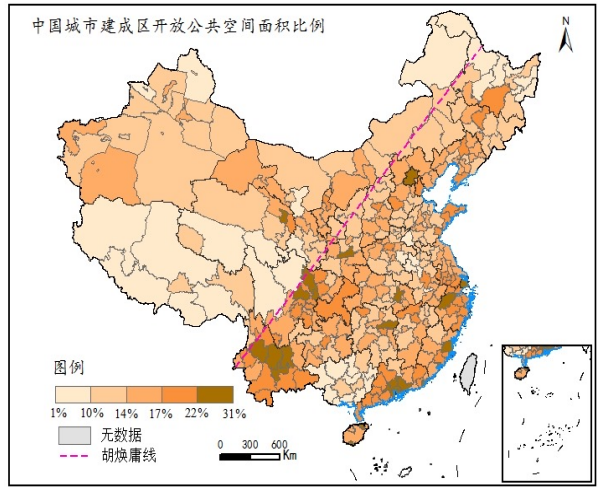
Fine-scale public space vector data; Fine-scale population distribution

TB Level Data Reading and Writing; Parallelization of GIS Operators



Proportion of urban open public spaces

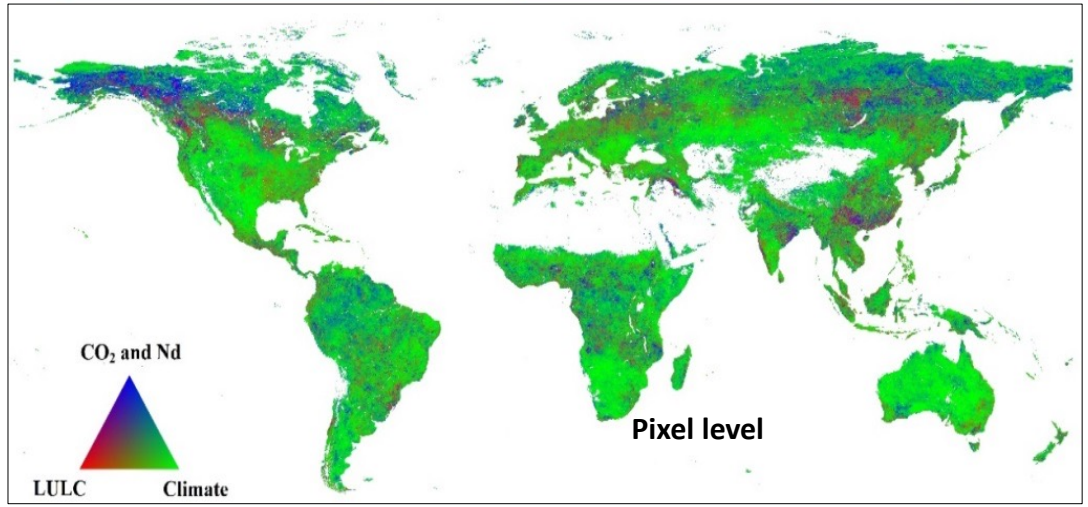


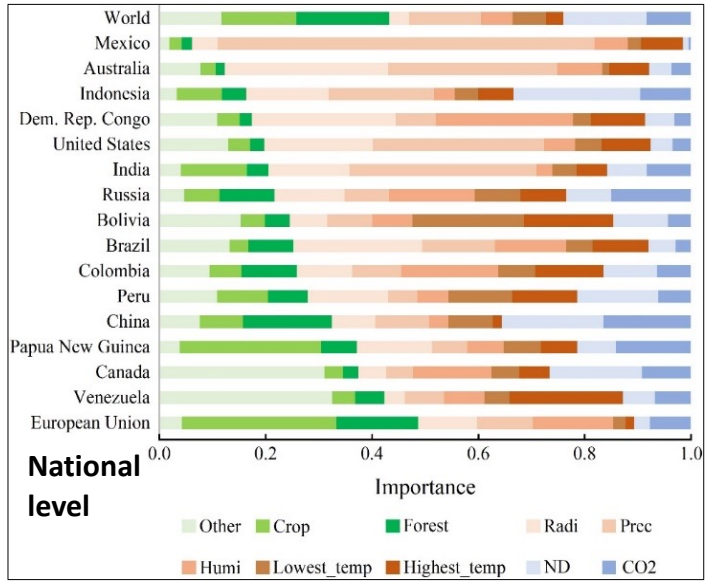


SDG 13—Climate Action

Target: SDG 13.2 Strategies for climate change
Case: Global terrestrial carbon sink and its driving factors

- ***Carbon sinks is estimated by combining Meteorological data, land use data, soil data and vegetation LAI data from remote sensing.***
- ***We found that about 40% of global carbon sink changes were attributed to the changes in land use/cover, and 30% of changes were attributed to climate change.***





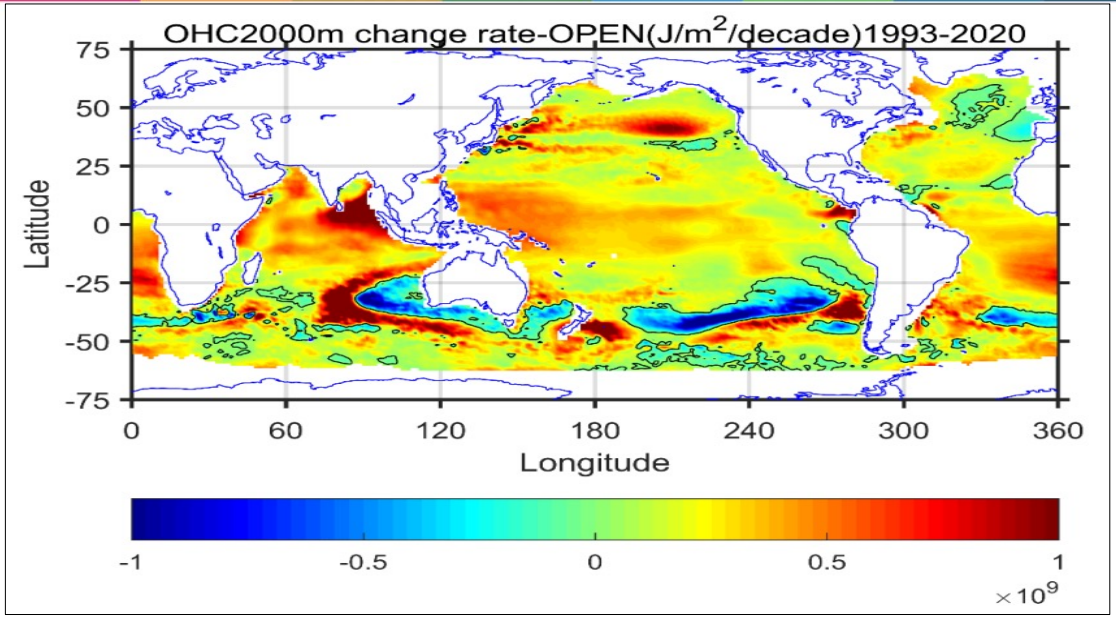
The importance of land use/land cover changes(LULC), Climate, CO_2 and nitrogen deposition (Nd) on NEP variations during the period of 2001-2019

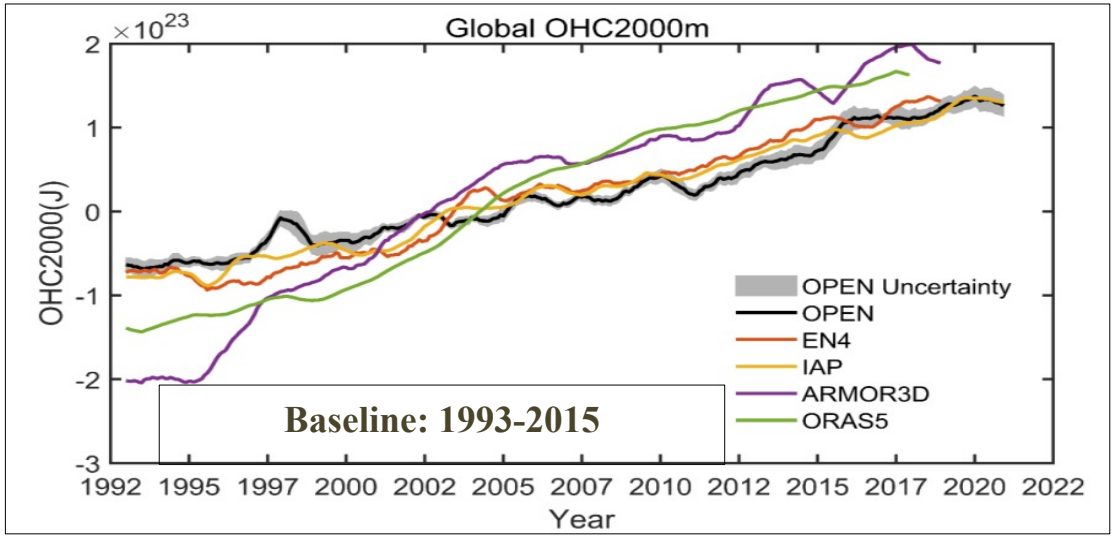
SDG 13—Climate Action

Target: SDG 13.3 Adaption to climate change

Case: Ocean Heat Content (OHC) increases rapidly

- ***A new dataset of global ocean heat content (named OPEN) for upper 2000m from 1993-2020 based on remote sensing is produced;***
- ***The ocean has experienced a worldwide and significant warming during recent decades (2.25×10⁸ J/m²/decade);***
- ***Heat uptake occurs significantly and unevenly in different ocean basin.***

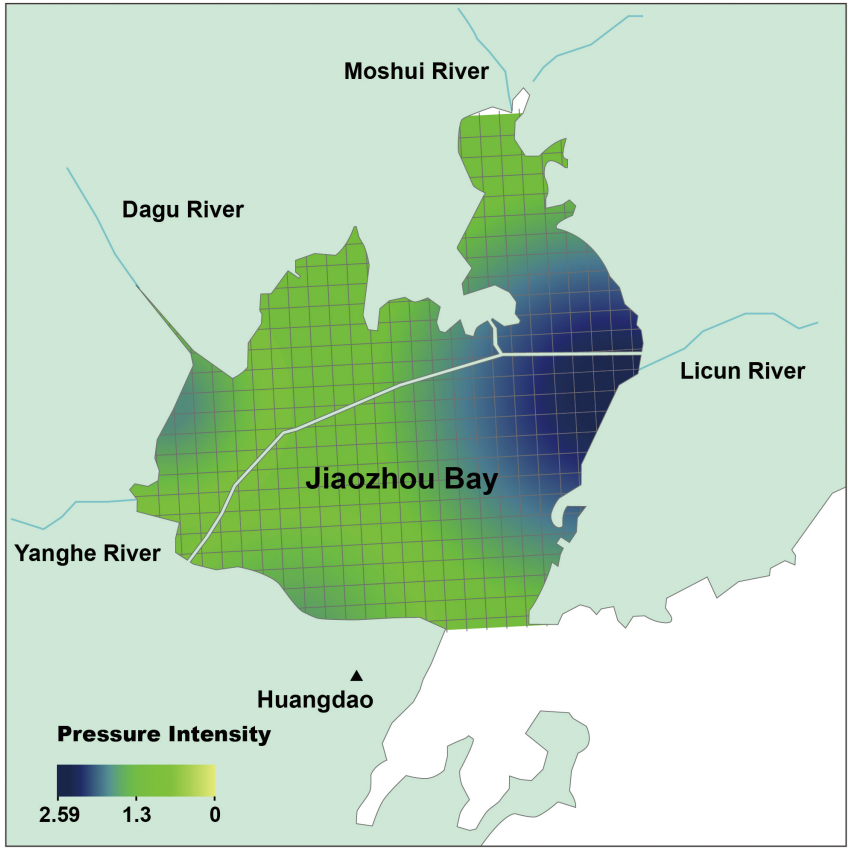




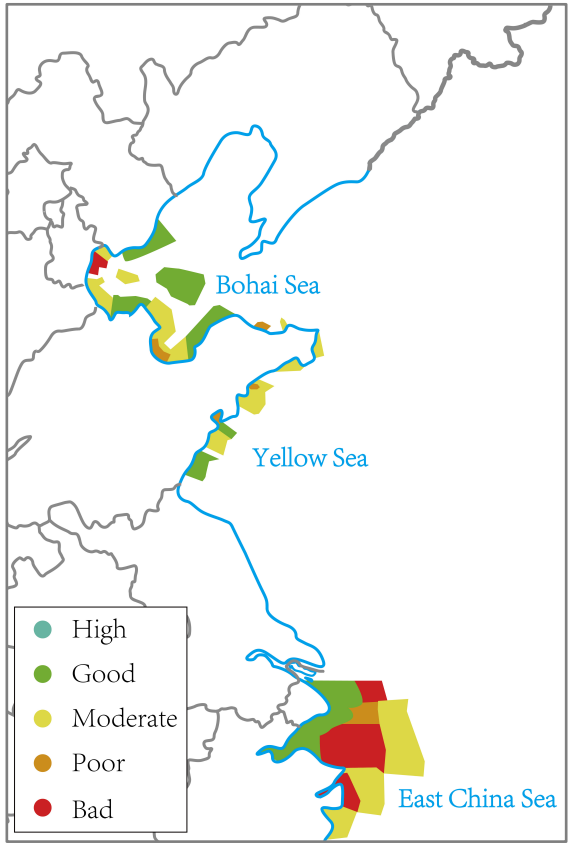
SDG14-Integrated Eutrophication Assessment in Typical Coastal Waters of China

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

Assessment of human pressure and typical eutrophication symptoms in Jiaozhou Bay



Evaluation of the trophic status in typical coastal waters of China

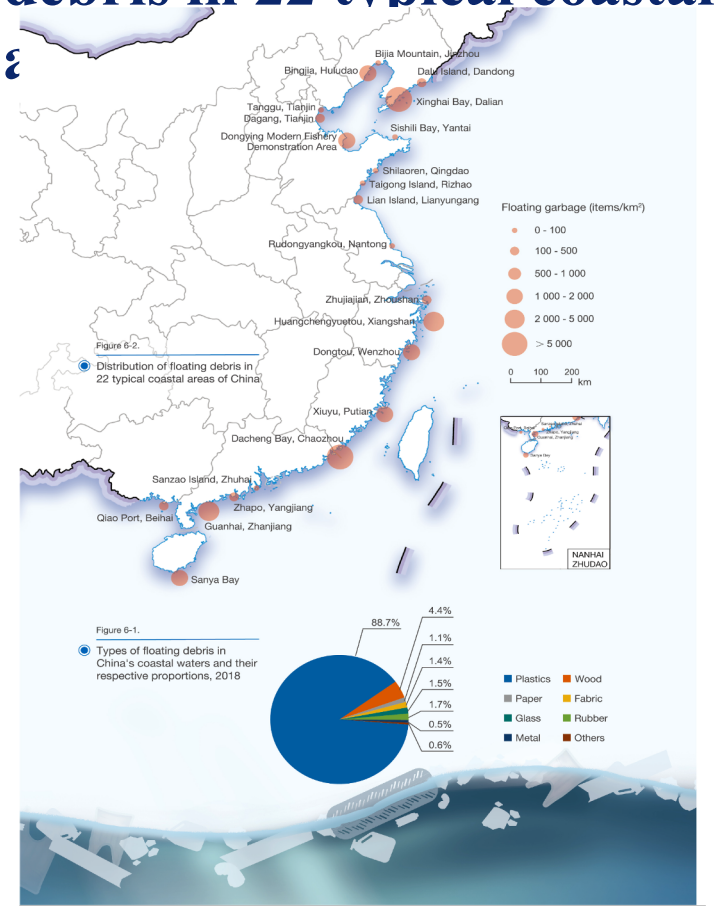


- The indicators of both human activity-derived pressures and ecological responses are relatively important and should all be taken into consideration.
- In typical waters along China's coast, the eutrophication problem in the inner bays and big estuaries were very serious where anthropogenic activities were dense, and the ecological responses were also serious.

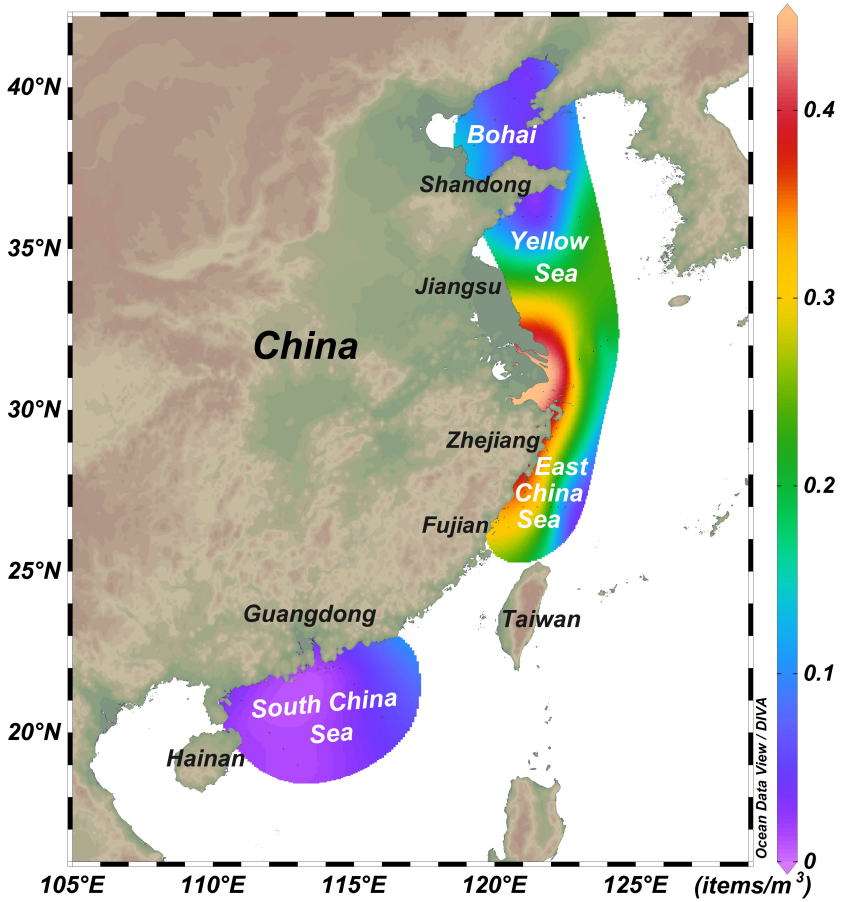
Analysis of the Distribution and Variation of Marine Debris and Microplastics in China's Coastal Waters

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

Distribution of floating debris in 22 typical coastal



Distribution of marine microplastics in China

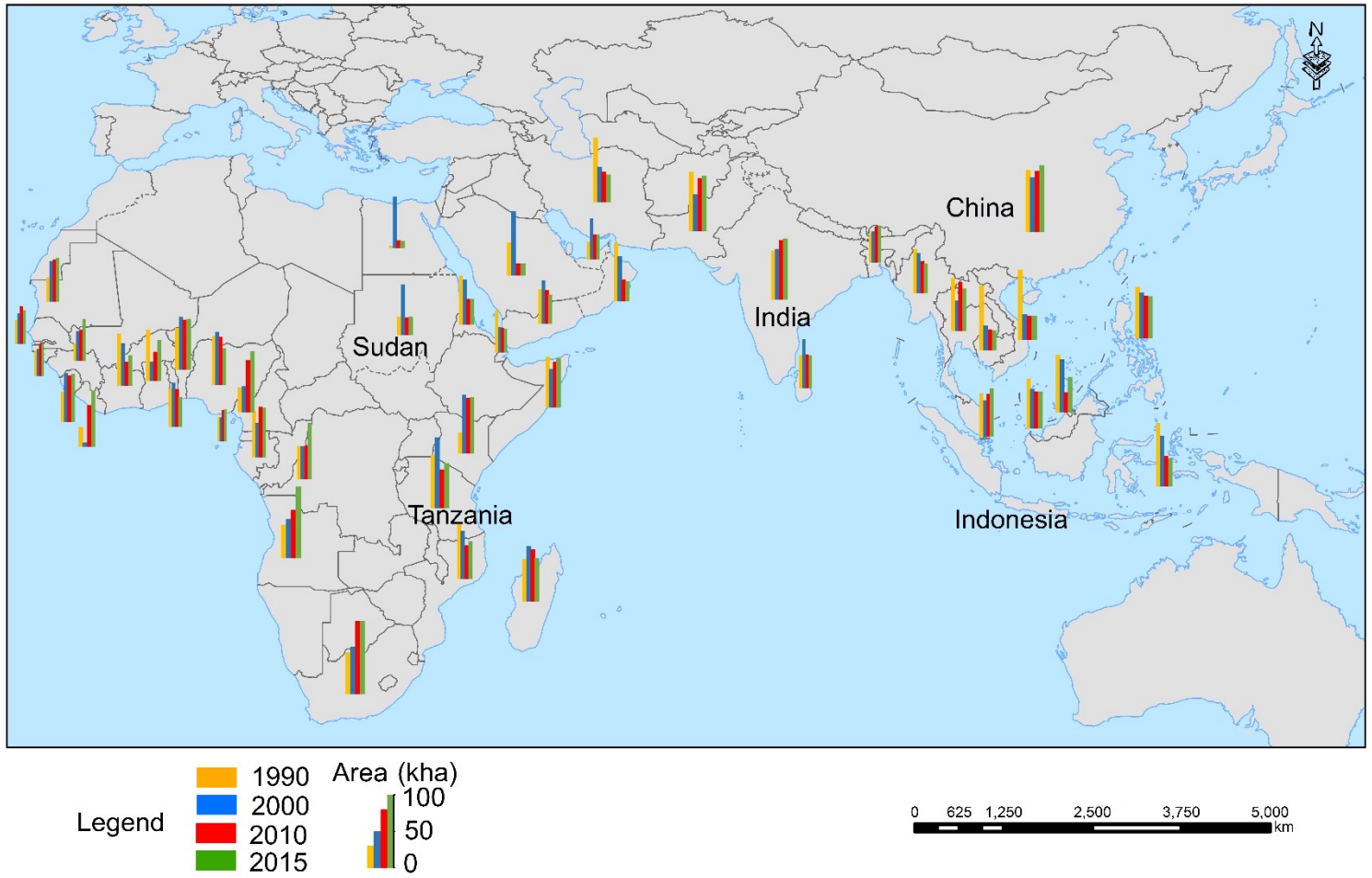


- The abundance of floating debris in China's coastal waters has been on a decline since 2015. The abundance of floating debris in 2018 was approximately 25% lower than the average of 3,207 pieces/km^2 recorded for the period 2010-2014.
- The average abundance of microplastics changed little from 2016 to 2019, and the pollution situation showed an improvement trend.

Monitoring the extent and dynamic change of mangrove forests along the Maritime Silk Road

Target 14.2: Sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

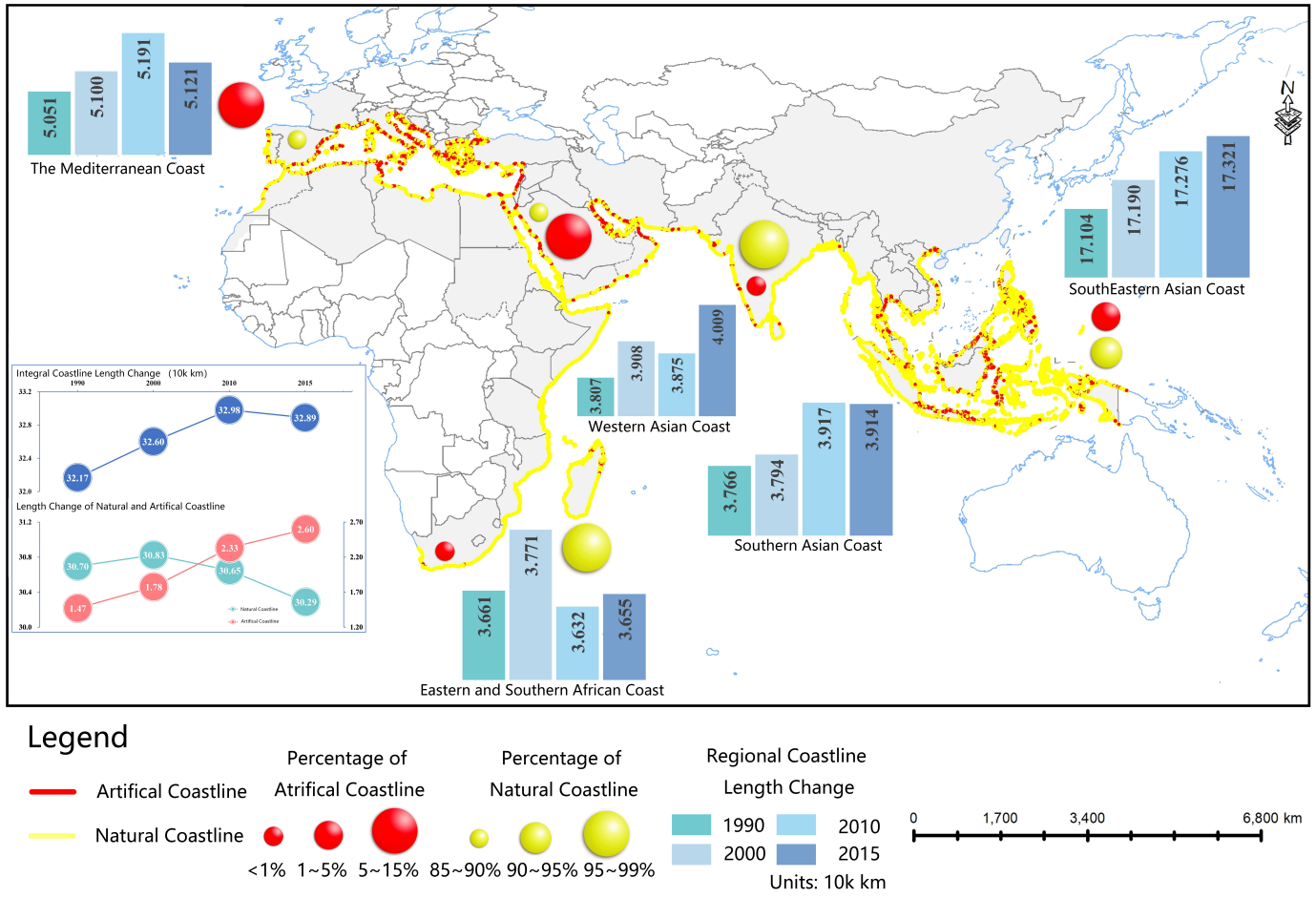
Change in mangrove area along the Maritime Silk Road from 1990 to 2015



- Asia：68.4% of mangroves in the Asian countries has continued to decrease
- Africa：66.4% of mangroves in the African countries has increased
- Human activities in Asian countries have a greater impact on mangroves, while African countries have less impact.
- GDP growth has a more impact on mangroves than population growth.

Conservation and utilization of the Coastline along the Maritime Silk Road

Target 14.5: By 2020, conserve at least 10% of coastal and marine areas, consistent with national and international law and based on the best available scientific information

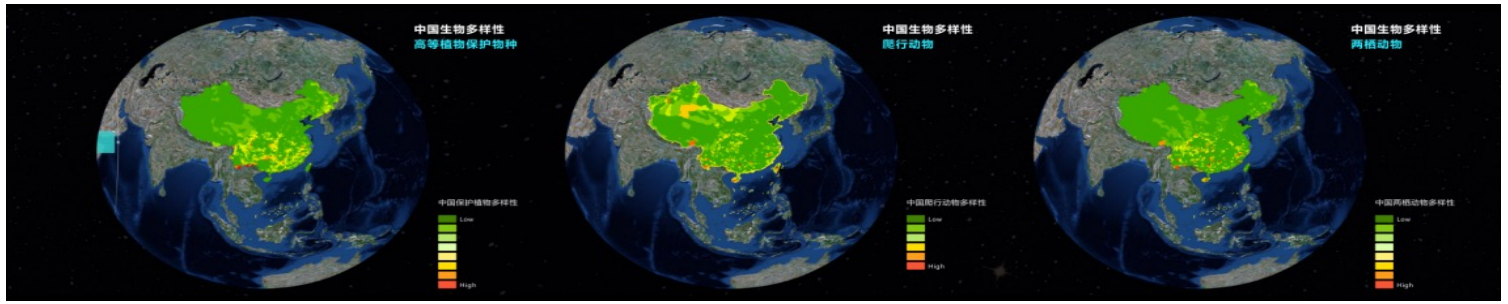


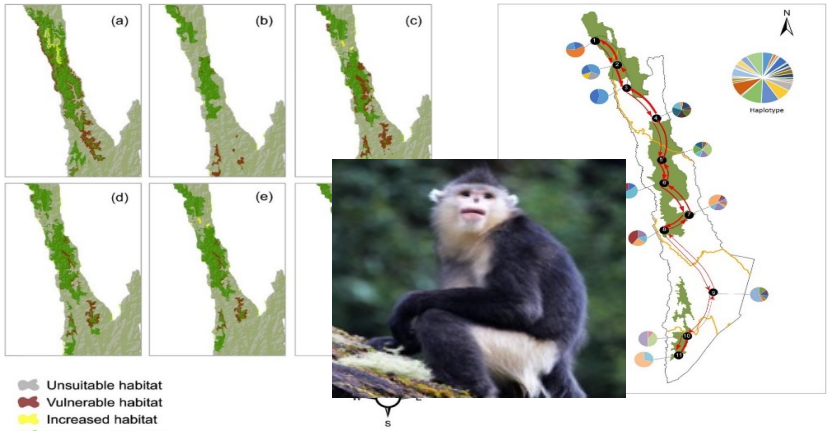
Distribution of coastline types and changes in coastline length along the Maritime Silk Road (1990-2015)

- From 1990 to 2015, the length of the coastline along the Maritime Silk Road showed an **overall steady growth trend,** especially most significantly in Southeast Asia.
- The length ratio of the **natural shoreline** has decreased from **95%** (306,959 km) in 1990 to **92%** (302,878 km) in 2015.
- The length of the **artificial shoreline** has increased from **5%** (14,715 km) in 1990 to **8%** (26,006 km) in 2015, with an average growth rate of 452 km/year.

MapBio: Mapping Biodiversity of China

Big species data helps to map biodiversity of china and answer where are the biodiverstiy hotspots, what species should be protected, and how to protect them.





Zhao X, Ren B, Li D, et al., Biological Conservation, 2019, 231: 88-97.

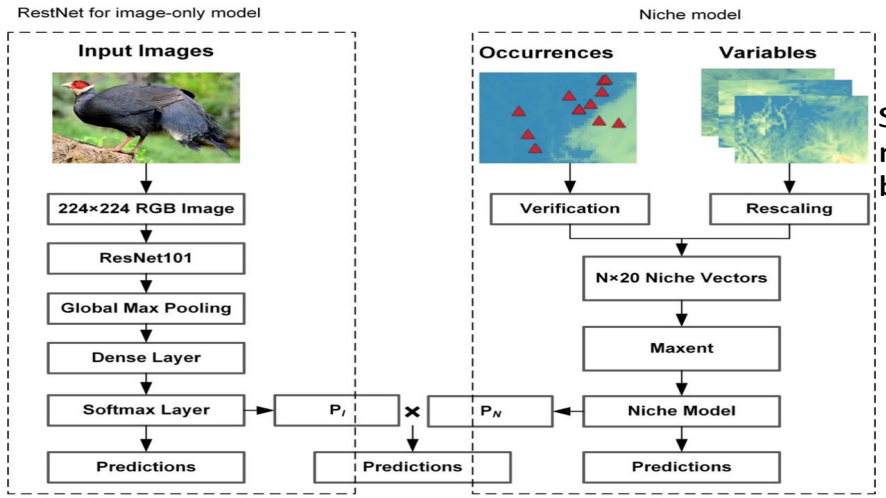
Big data of species distribution, human activity and gen supports research on habitat change and protection decision of primates.

- ✓ maps of >60,000 species
- ✓ >3,000,000 distribution records
- ✓ complete data quality assessment workflow
- ✓ anually updated according to research progress
- ✓ supporting species protection and hotspots research.

Huang, Lin, Ji*. 2020. Biodiversity and Conservation.

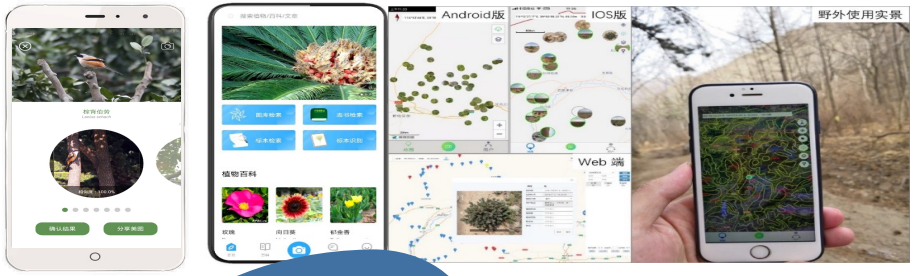
AI and Citizen Science for Biodiversity

- **Propose a new framework to combine ecological niche model and AI-based model for species identification.**
- **AI-based APPs for recognizing and recording species have been widely used in China.**



NicheNet: a framework for learning niche features for species identification

Lin et al., 2021. Ecological Informatics.

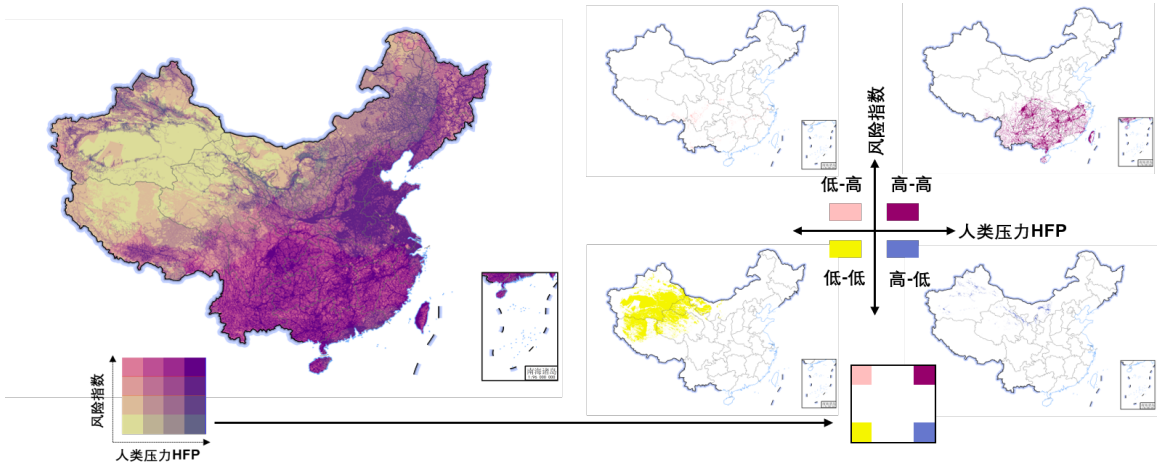


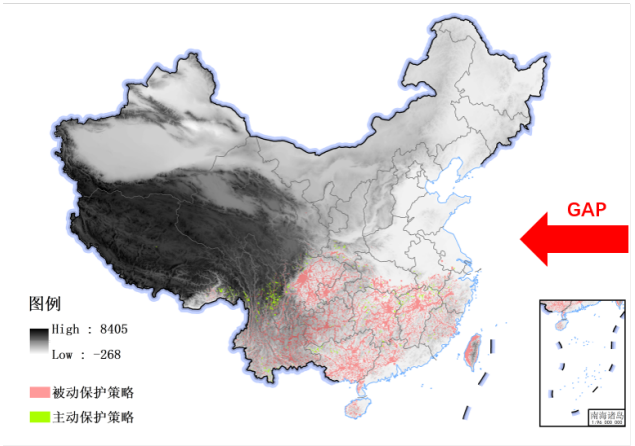
Several APPs with AI for recognizing species have been widely used

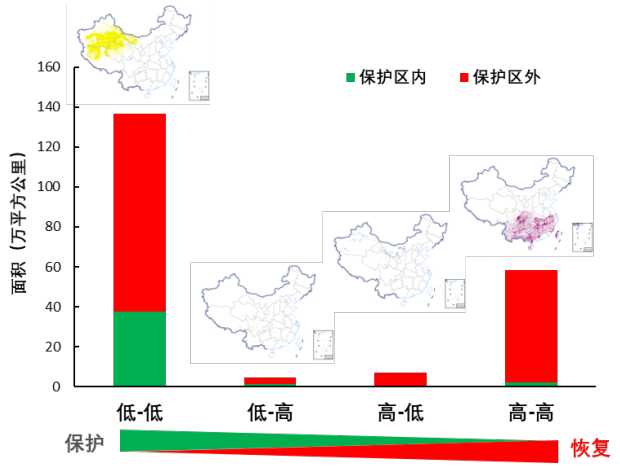
AI-based citizen science community promotes the ability to harvest biodiversity data sustainably.

Risk and Conservation of Plant Diversity

- **Proposing an optimized Biodiversity Risk Index (BRI) that describes the risk of extinction.**
- **In areas facing high risks and high pressures , only 4% are covered by protected areas, tailored strategies are necessary to address this gaps.**

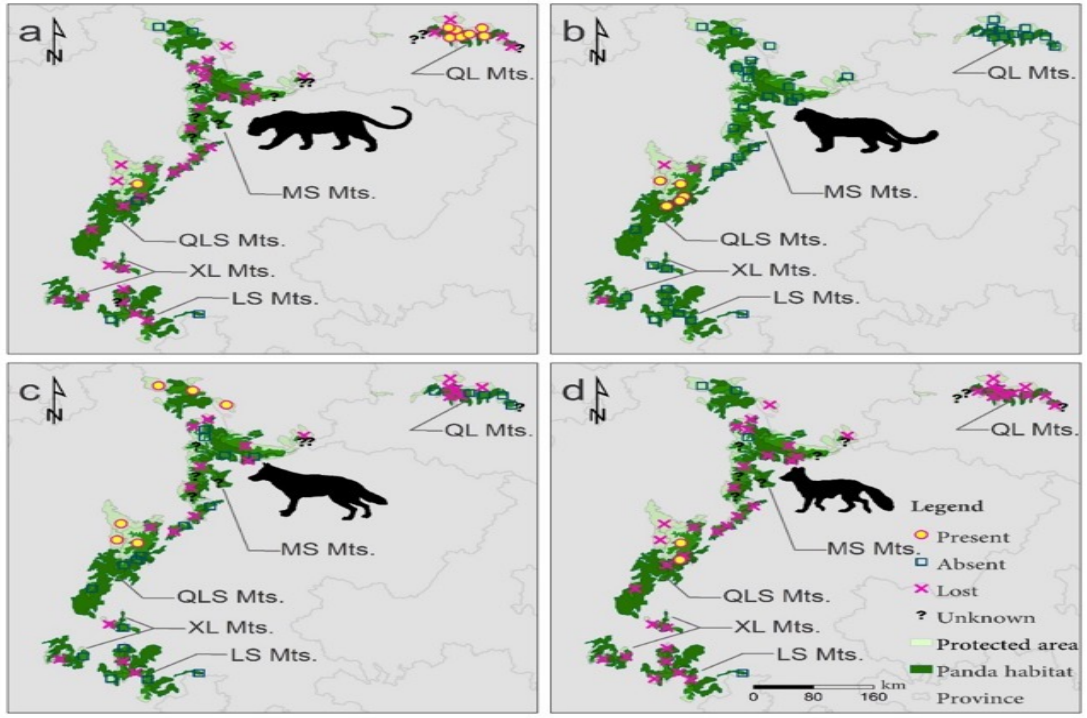




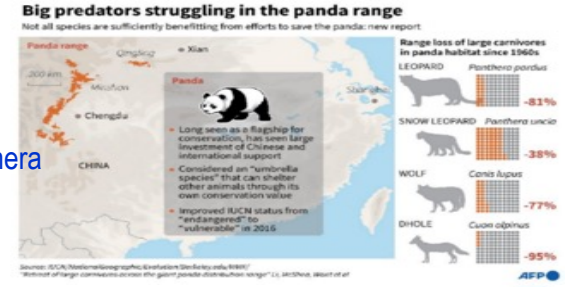


Urgency of Restoring Large Carnivore Populations

- A wide-ranging retreat of the four large carnivore species across the Giant Panda National Park .
- Opportunity to restore ecosystems that support greater trophic complexity.

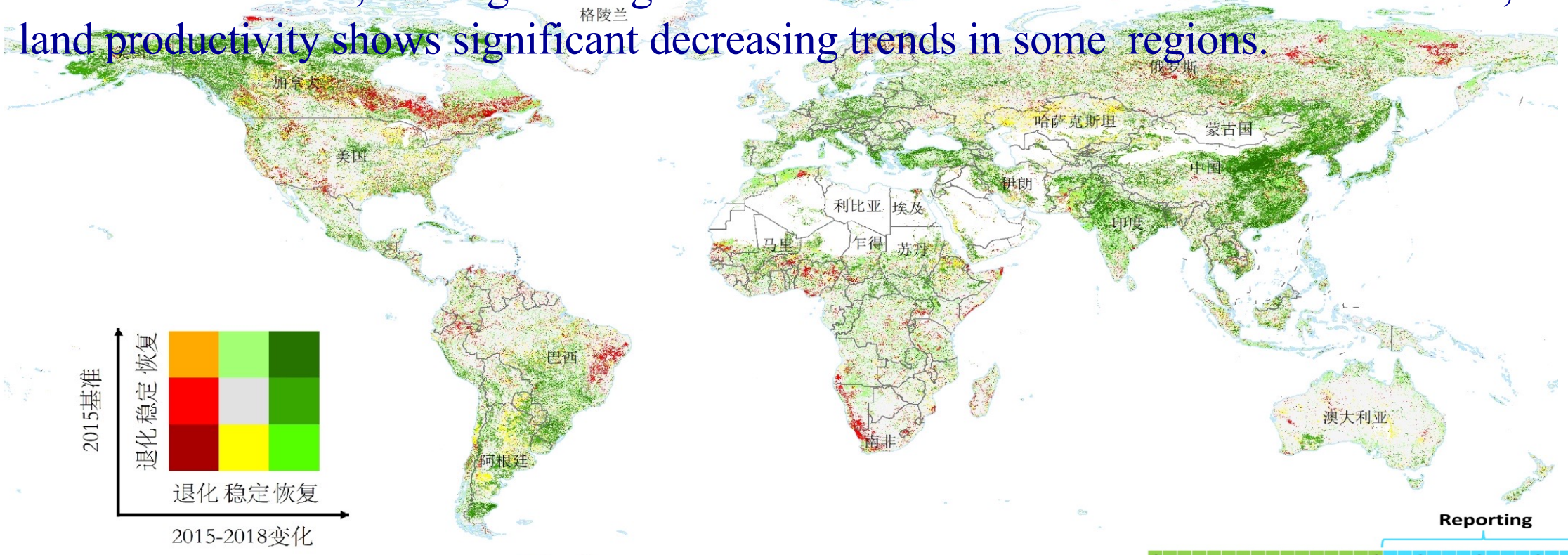


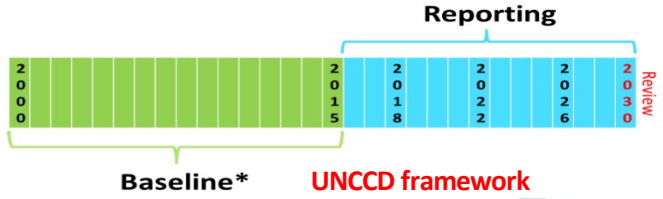
Big data from 2008-2018：
73 protected areas
across 5 mountains；
7,830 survey locations, 1690,000 camera days



Global Land Degradation Neutrality Tracking

- China's LDN status continues to improve. Compared with 2015, the net restored land area in 2018 increased by 60.30%, and the net restored land area accounted for about 1/5 of the world's total, making the largest contribution to the world.From 2015 to 2018, land productivity shows significant decreasing trends in some regions.





Spatial Distribution of Global Land Degradation Baselines and Dynamics

INTERNATIONAL RESEARCH CENTER OF BIG DATA
FOR SUSTAINABLE DEVELOPMENT GOALS
可持续发展大数据国际研究中心

THANKS

No.9 Dengzhuang South Road, Haidian District, Beijing 100094, China

Tel: +86-10-82178985

Fax: +86-10-82178980