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

Digital Earth in Facilitating of Sustainable Development Goals

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United Nation's Stratigic Framework

The humankind are facing the global challenges

SUSTAINABLE DEVELOPMENT GOALS

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION 2015-2030

Sustainable Development
UN SDGs

Measuring Status & Progress

Climate Action
Paris Agreement

Monitoring & Understanding

Disaster Risk Reduction
Sendai Framework

Supporting Resilient Infrastructure

The 2030 Agenda for Sustainable Development

In 2015, 193 countries around the world adopted the 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs) and 169 sub-goals.

17 Goals for a Changing World

UN Sustainable Development Summit 2015

Outline

- Technology Facilitation Mechanism
- A Digital Earth Platform: CASEarth
- CASEarth for SDGs Evaluation
- In’t Center of Big Data for SDGs

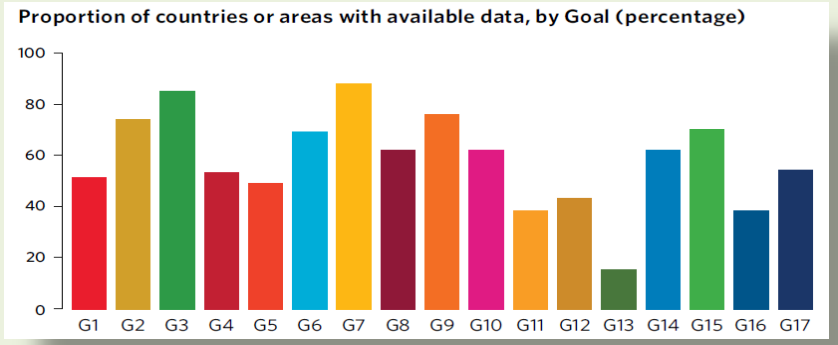
SDG Challenges

The Global Indicator Framework for Sustainable Development is a concrete implementation guideline of the UN 2030 Agenda and is used to assess the progress of global SDGs. It faces many challenges, such as lack of data, insufficient research on indicator systems, and uneven development in regional areas.

40% indicators lack of data support

	Method	Data	Year 2017	Year 2018	Year 2020
17 Goals	✓	✓	36%	40%	59%
169 Specific Goals	✓	✗	26%	31%	39%
240+ Indicators	✗	✗	38%	29%	2%

Non-suitable spatial coverage and timeless



The United Nations SDG Report (2021) states that national coverage data are not available for more than half of the countries in at least five SDGs

Only 4 global maps in the UN SDG Report 2020

UN Technology Facilitation Mechanism (TFM)

TECHNOLOGY FACILITATION MECHANISM | SUSTAINABLE DEVELOPMENT GOALS

UNITED NATIONS INTERAGENCY TASK TEAM ON STI FOR THE SDGS (IATT)	10-MEMBER GROUP TO SUPPORT THE TECHNOLOGY FACILITATION MECHANISM
MULTI-STAKEHOLDER FORUM ON SCIENCE, TECHNOLOGY AND INNOVATION FOR THE SDGS (STI FORUM)	ONLINE PLATFORM (2030 Connect) - GATEWAY FOR INFORMATION ON EXISTING STI INITIATIVES, MECHANISMS AND PROGRAMS

10-MEMBER GROUP TO SUPPORT THE TECHNOLOGY FACILITATION MECHANISM

- 10-Member Group 2016-2017

2018-2019

Dr. Paulo Gadelha (Brazil), Coordinator of the FIOCRUZ Strategy for the 2030 Agenda, Oswaldo Cruz Foundation (FIOCRUZ)

Prof. Huadong Guo (China), Chairman of Academic Committee, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences (CAS)

Dr. Heide Hackmann (South Africa), Executive Director, International Council for Science (ICSU)

Dr. Agnes Lawrence Kijazi (United Republic of Tanzania), Director General, Tanzania Meteorological Agency (TMA)

Dr. José Ramón López-Portillo Romano (Mexico), Chairman, Q Element Ltd.

Dr. Michiharu Nakamura (Japan), Senior Advisor (Former President), Japan Science and Technology Agency

Dr. Anne-Christine Ritschkoff (Finland), Senior Advisor VTT Technical Research Centre of Finland Ltd.

Dr. Špela Stres (Slovenia), Head of Innovation and Technology Transfer Center for Jožef Stefan Institute

Dr. Vaughan Turekian (USA), Senior Director at the National Academies of Sciences, Engineering, and Medicine

Dr. Ada Yonath (Israel), Director and Nobel Laureate, the Helen and Milton A. Kimmelman Center for Biomolecular Structure and Assembly of the Weizmann Institute of Science.

1999-2022 Digital Earth Roadmap

International Society for Digital Earth

Digital Earth


The 1st International Symposium on Digital Earth

November, 1999
The 1st International Symposium on Digital Earth
- Place: Beijing, China
- Theme: Towards Digital Earth

In November 1999, the first International Symposium on Digital Earth was hosted by CAS in Beijing. The Beijing Declaration on Digital Earth in 1999 was officially approved at the symposium.


Al Gore gave Digital Earth speech

January, 1998
US former Vice President Al Gore gave Digital Earth speech in Los Angeles


The 2nd International Symposium on Digital Earth

June, 2001
The 2nd International Symposium on Digital Earth
- Place: New Brunswick , Canada
- Theme: Beyond Information Infrastructure


The 3rd International Symposium on Digital Earth

September, 2003
The 3rd International Symposium on Digital Earth
- Place: Brno, Czech Republic
- Theme: Information Resources for Global Sustainability


The 4nd International Symposium on Digital Earth

March, 2005
The 4th International Symposium on Digital Earth
- Place: Tokyo, Japan
- Theme: Digital Earth as a Global Commons


International Society for Digital Earth officially inaugurated

May, 2006
International Society for Digital Earth officially inaugurated


2006 Digital Earth Summit

August, 2006
2006 Digital Earth Summit
- Place: Auckland , New Zealand
- Theme: Digital Earth Summit on Sustainability


The 5th International Symposium on Digital Earth

June, 2007
The 5th International Symposium on Digital Earth
- Place: Berkeley, USA
- Theme: Bring Digital Earth down to Earth


2008 Digital Earth Summit

November, 2008
2008 Digital Earth Summit
- Place: Potsdam, Germany
- Theme: Geoinformatics: Tools for Global Change Research


IJDE launching Ceremony

March, 2008
The International Society for Digital Earth in cooperation with Taylor & Francis Group, launching the academic journal - *International Journal of Digital Earth* (IJDE).


International Journal of Digital Earth

October, 2009
The IJDE was accepted in the SCI-Expanded.


Sixth Plenary Session of GEO

November, 2009
ISDE Joined the Group on Earth Observations (GEO)

Dr. José Achache, former Secretary-General of the GEO declared the ISDE being accepted as a new member of GEO at the Sixth Plenary Session of GEO, held on November 17-18, 2009, in Washington.

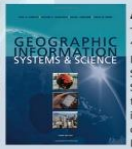

The 6th International Symposium on Digital Earth

September, 2009
The 6th International Symposium on Digital Earth
- Place: Beijing, China
- Theme: Digital Earth in Action

More than 1000 scholars, enterprises and managerial experts attended the conference that produced 200 abstracts of papers, 700 papers in full text, 25 oral presentations in parallel sessions by 190 Digital Earth experts. The Beijing Declaration on Digital Earth 2009 was fully adopted at the conference, reflecting the worldwide accomplishments attained in Digital Earth.


2010 Digital Earth Summit

June, 2010
2010 Digital Earth Summit
- Place: Nessebar, Bulgaria
- Theme: Digital Earth in the Service of Society: Sharing Information, Building Knowledge


GEOGRAPHIC INFORMATION SYSTEMS & SCIENCE

August, 2010
Text book "Geographic Information Systems and Science" remarked the ISDE as a key international organization in Digital Earth field.

June, 2010
IJDE gained its first Impact Factor

Journal Citation Reports (JCR), the international authoritative tool in journal evaluation, announced on June 18 that the IJDE gained its first impact factor, 0.864 for 2009.


Guo Huadong gave a statement in the Plenary Session

November, 2010
The ISDE attended the Seventh Plenary Session of the GEO. On behalf of the ISDE, Guo Huadong gave a statement on how ISDE will take an active role in Global Earth Observation System of Systems (GEOSS) in the Plenary Session.


Aerial photo of the ISDE7 delegates

August, 2011
The 7th International Symposium on Digital Earth
- Place: Perth, Australia
- Theme: The Knowledge generation


CODATA-ISDE MoU signing ceremony

October, 2011
ISDE and the Committee on Data for Science and Technology (CODATA, ICSU) signed a memorandum of understanding of the CODATA Hand-in-Hand Program.


2012 Digital Earth Summit

September, 2012
2012 Digital Earth Summit
- Place: Wellington, New Zealand
- Theme: Digital Earth and Technology


GEO Post-2015 Working Group Meeting

March, 2012
ISDE participated in GEO Post-2015 Working Group Meeting at the Headquarters of the World Meteorological Organization (WMO) in Geneva.


Digital Earth reports presented in the Special Session

April, 2012
ISDE organized Digital Earth Special Session in the High Level Academic Forum of the International Eurasian Academy of Sciences.


"Digital Earth Vision to 2020" Working Group

March, 2011
ISDE Working Group Meeting *"Digital Earth Vision to 2020"*

15 international experts from fields related to Digital Earth participated in the discussion of new Digital Earth vision.

June, 2011
In the annual Journal Citation Report by Thomson Reuters, the impact factor of the IJDE was 1.453.

August, 2013
The 8th International Symposium on Digital Earth
- Place: Sarawak, Malaysia
- Theme: Transforming Knowledge into sustainable practice

January, 2014
Digital Earth Research Initiative on disciplinary development was approved by the Academic Divisions of the Chinese Academy of Sciences. The workshop for this initiative, aiming at Digital Earth researches, was held in China.


2014 Digital Earth Summit

November, 2014
2014 Digital Earth Summit
- Place: Nagoya, Japan
- Theme: Digital Earth for ESD

July, 2014
IJDE obtained IF 2.212 for year 2013.


PNAS
NEXT-GENERATION DIGITAL EARTH

June, 2012
The paper entitled *"Next-Generation Digital Earth"* was published in the Proceedings of the National Academy of Sciences of the United States of America (PNAS).

April, 2013
A paper *"Digital Earth: Fifteen Years' Experience and Perspective"* was published in the Bulletin of Chinese Academy of Sciences.

July, 2016
2016 Digital Earth Summit
Place: Beijing, China
Theme: Digital Earth In the era of Big Data

October, 2015
The 9th International Symposium on Digital Earth
- Place: Halifax, Canada
- Theme: Towards a One-World
- Vision for the Blue Planet

June, 2015
IJDE Impact Factor Breaks 3.0
The impact factor of IJDE has reached 3.291, ranking 4th among the 28 international journals in remote sensing and 7th in the 46 international geographical journals, which indicates that the journal has entered the Q1 zone in the above two categories.

April, 2017
The 10th International Symposium on Digital Earth
- Place: Sydney, Australia
- Theme: Digital transformation-our future

June, 2019
IJDE Received Impact Factor 3.985

August, 2019
ISDE became a member of UN-GGIM Geospatial Societies

September, 2019
The 11th International Symposium on Digital Earth
- Place: Florence, Italy
- Theme: Digital Earth in a Transformed Society

ISDE11 11th International Symposium on Digital Earth
Florence (Italy), September 24 – 27, 2019
Digital Earth in a transformed Society

November, 2019
The first China Digital Earth Conference (CDEC) held in Beijing
Manual of Digital Earth was launched


Manual of Digital Earth

February, 2018
Big Earth Data Journal inauguration ceremony

April, 2018
2018 Digital Earth Summit
Place: El Jadida, Morocco
Theme: Digital Earth for Sustainable Development in Africa

July, 2020
Workshop on Digital Earth Vision towards 2030 held online


ISDE Workshop on Digital Earth Vision Towards 2030

November, 2020
2020 Digital Earth Summit
Theme: Digital Earth in a Changed World: Challenges and Opportunities

8th DIGITAL EARTH SUMMIT 2020

September, 2022
The 9th Digital Earth Summit
Place: Chennai, India
Theme: Digital Earth to Bridge Digital Divide for Attainment of Sustainable Development Goals

July, 2021
The 12th International Symposium on Digital Earth
Place: Salzburg, Austria

ISDE12

September, 2021
The second China Digital Earth Conference (CDEC)

1998 1999 2001 2003 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

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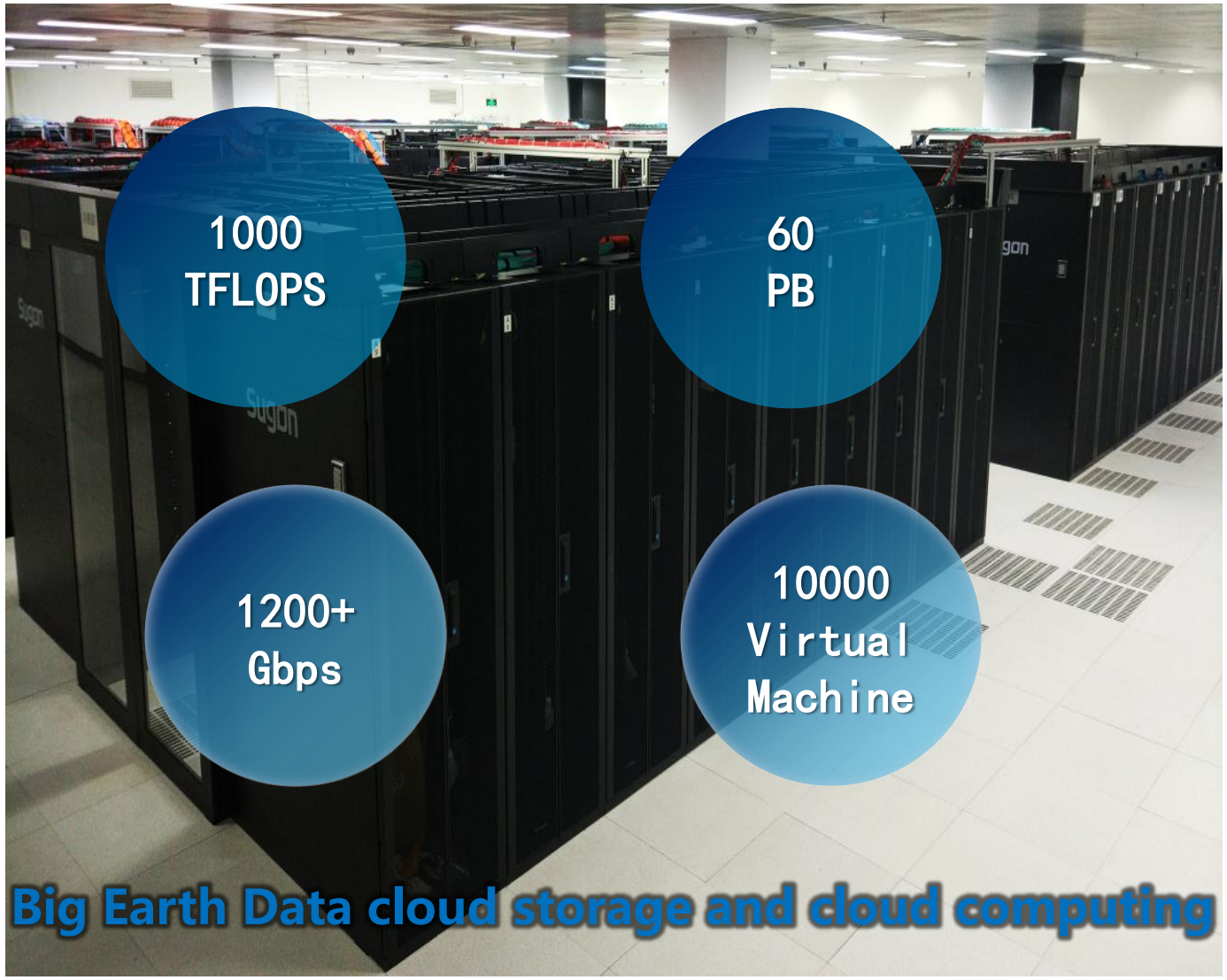
CASEarth: A Digital Earth Platform

- Build a **modern**, **technological** and **international** comprehensive display and integration system of Digital Earth;
- An integrated visualization environment with **immersive, experiential, 16K ultra-high-resolution, automatic natural interaction and intelligent analysis capabilities**;
- Provide a comprehensive **visual analysis system platform** for SDG research work, and support national sustainable development.

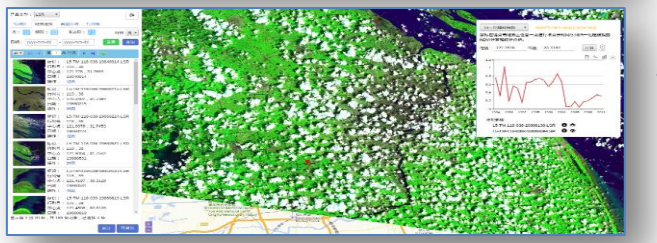
Digital Earth Infrastructure



Data as a service

Infrastructure as a Service

Analysis as a Service



Application as a Service

CASEarth DataBank

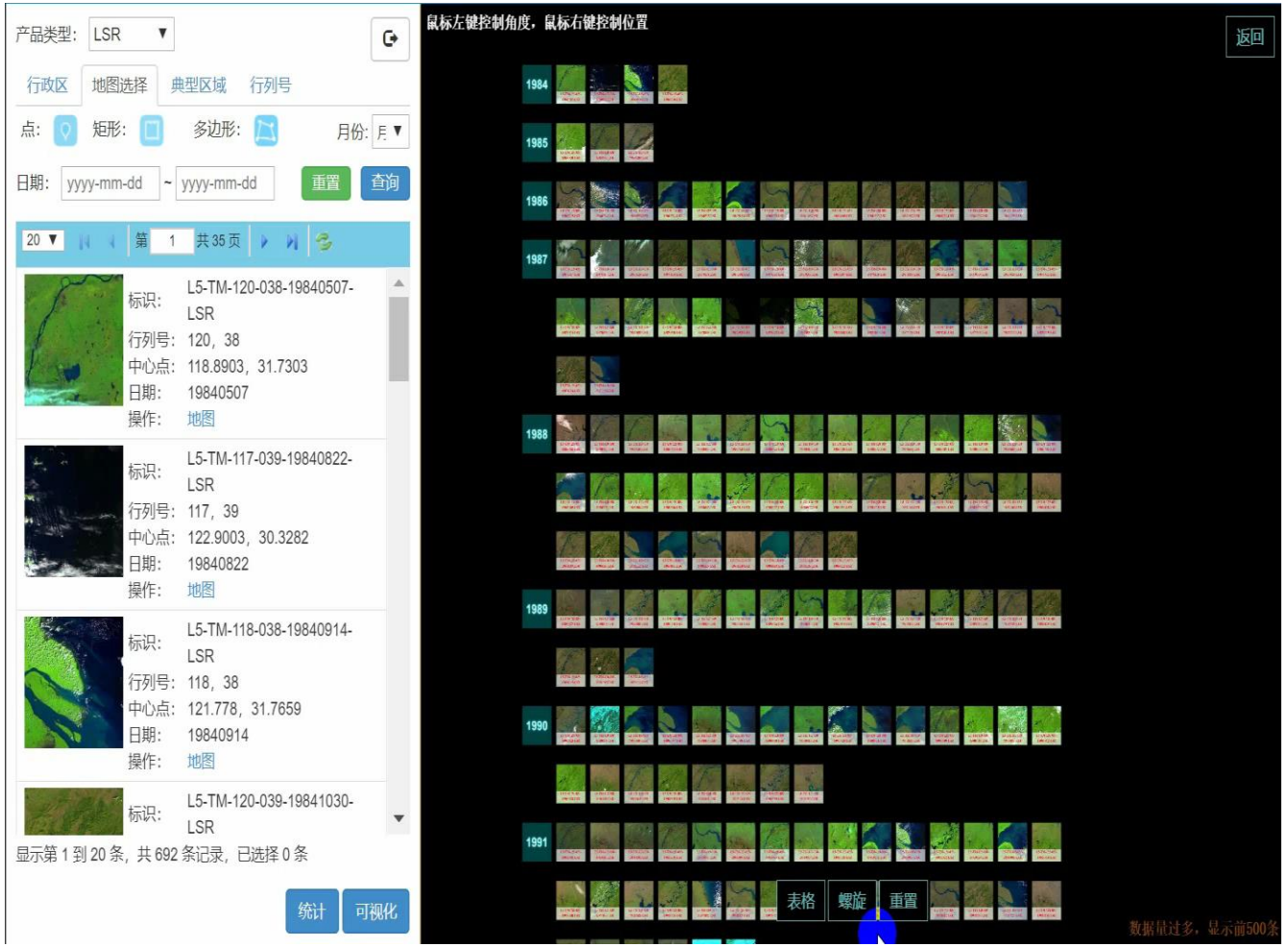
The platform provides:

Time-series EO products

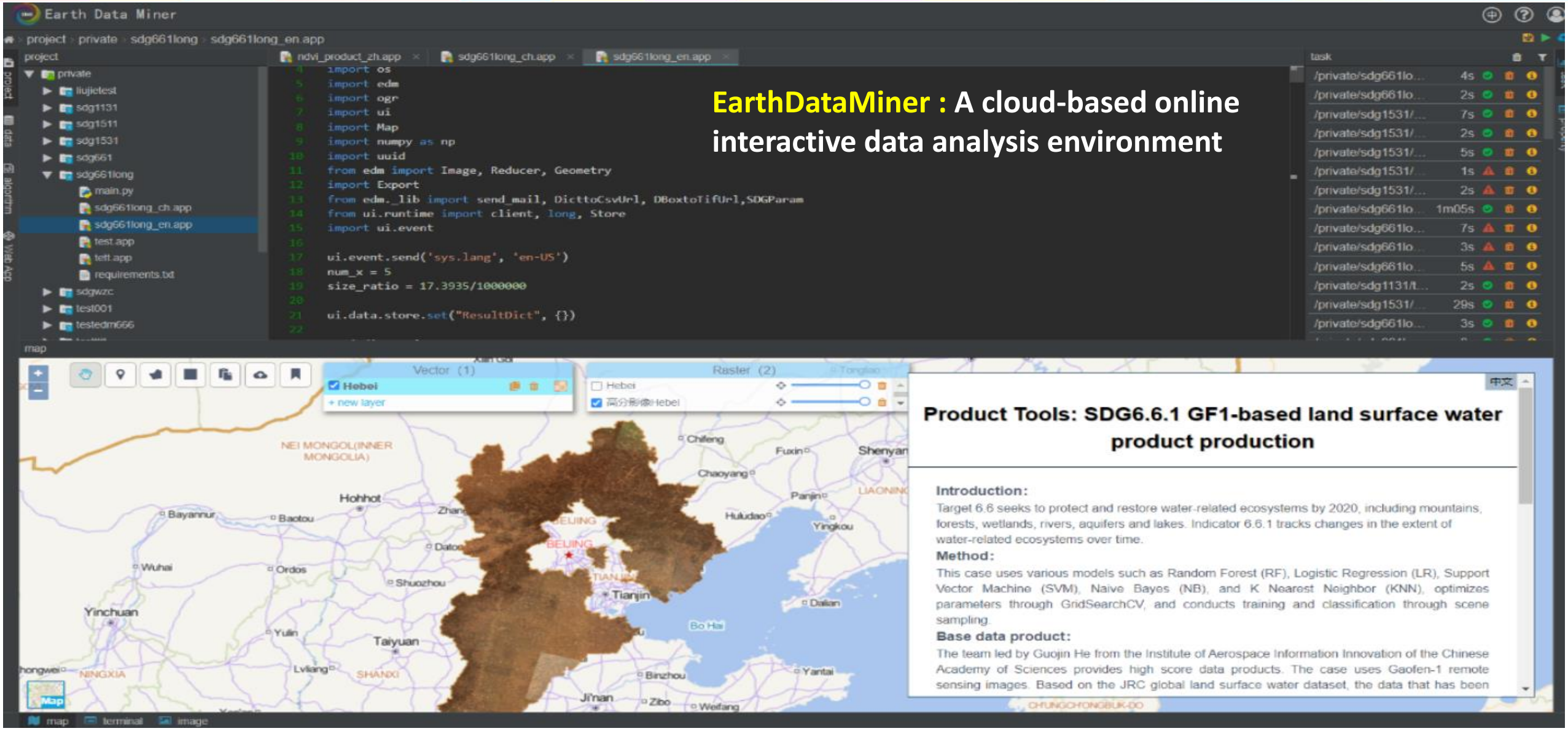
- Chinese satellite data: ZY, GF, HJ, CBERS, FY, HY
- USGS Landsat data since 1986, with 12 products
- Resolution: from kilometer to sub-meter
- Other data sources: DEM, vector

Infrastructure and services

- Data engine: Databox for time-series data, global tiling
- Computation engine: algorithms, distributed parallel computing, intelligent services
- Data visualization



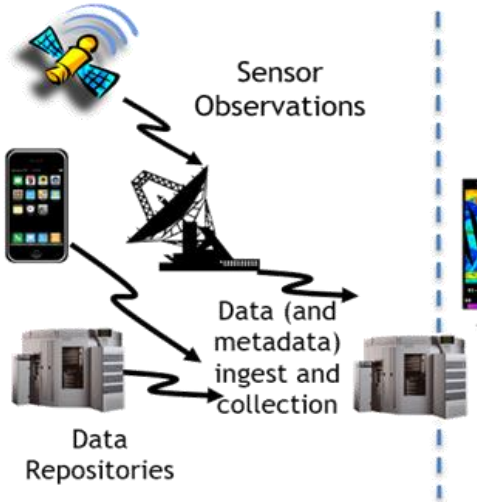
Earth Data Miner



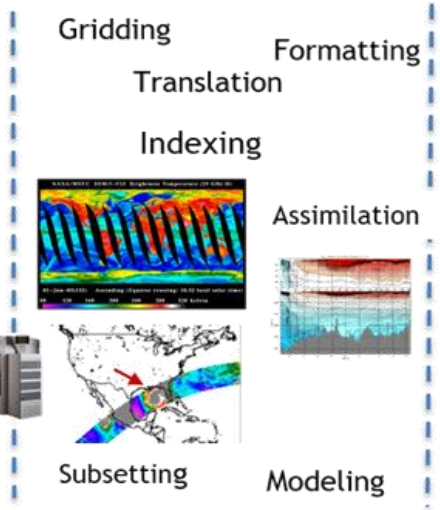
Big Data Analysis System

Big Data Infrastructure Key to SDGs Monitoring & Evaluating

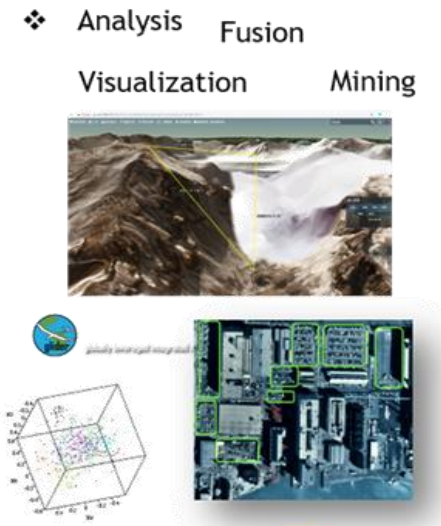
Multi-source data



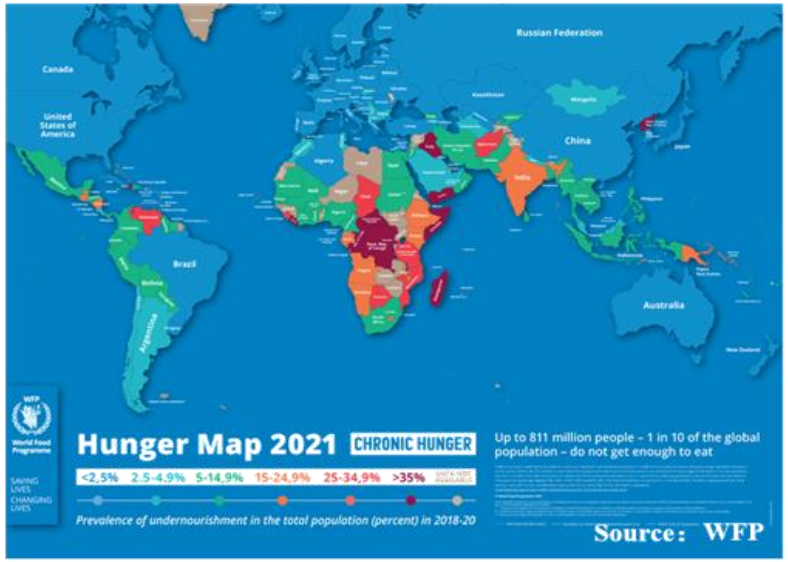
Models and Algorithms



Platforms



SDG targets/indicators



Infrastructure


Network


HPC


Cloud Computing


Cloud Storage

CASEarth Data Platform

15PB
Total amount of data

40 years
Satellite Image Data

7.2 million Scenes
Satellite image products

7.6PB
Biological and ecological data

5.8PB
EO Data

1.6PB
geographic data ground observation data Atmospheric and oceanic data

490,000
Items GBDB data record

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

◎ Released on 15,Jan,2019. As of **November 2022**, more than **570,000 IP** users in **174** countries have accessed the system, with total online traffic exceeding **98.79million** times.

SDGSAT-1: The World's first Science Satellite for SDGs

SDGSAT-1 satellite was Launched on Nov. 5, 2021

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

- *Explore new methods to sense Earth's environment*
- *Provide datasets for SDGs that representing interaction between human activities and natural environment*

Outline

- Technology Facilitation Mechanism
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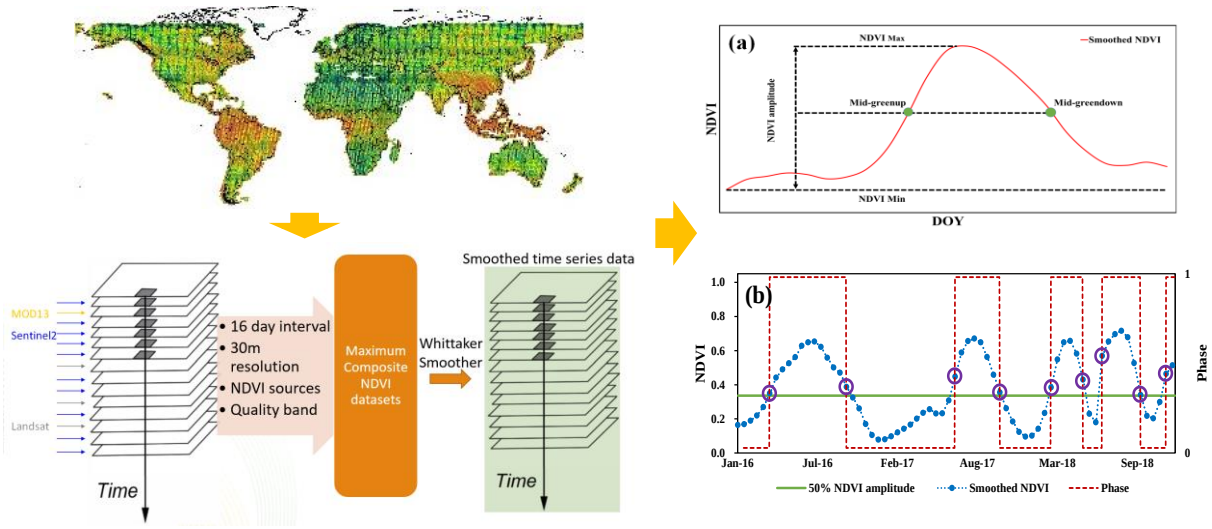
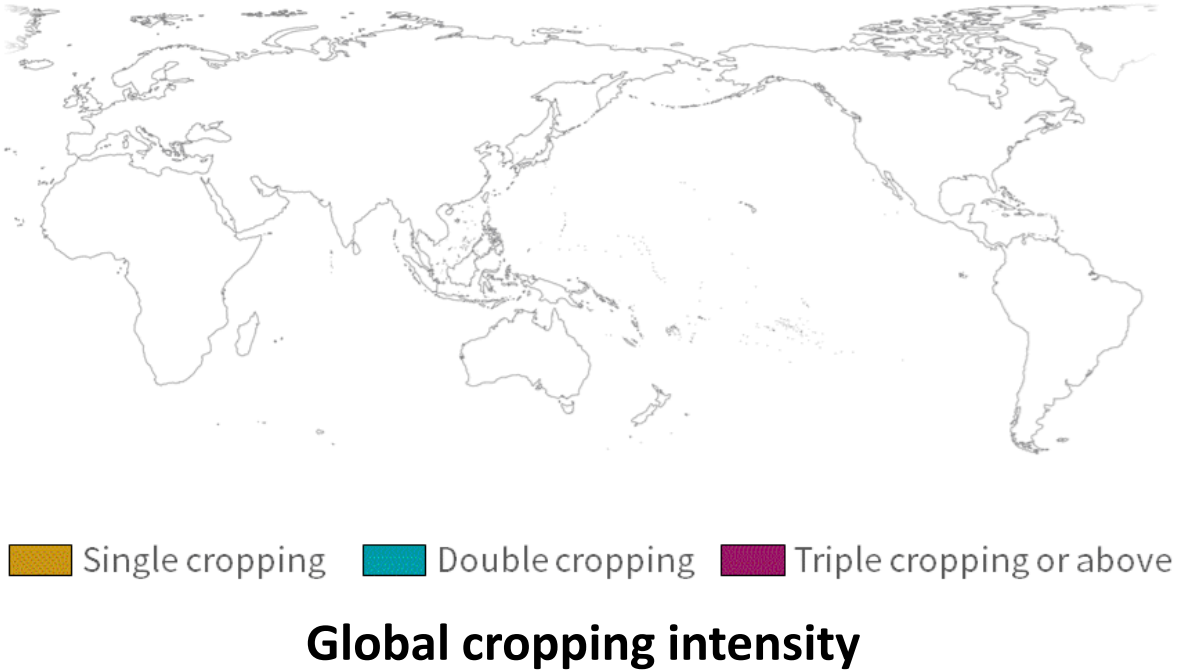
SDG 2 Zero Hunger

Spatial pattern of cropping intensity and gaps at global scale

- In 2020, about **85.2% of global cropland is single cropping**, and double cropping pattern mainly concentrated in the Indus Ganges Plain, Huang-Huai-Hai Plain, Parana River Basin, Mato Grosso and Nile River Delta.
- It is **expected to increase 0.23 billion tonnes of grain production** by closing the cropping intensity gaps, equivalent to 6.4% of the current **global** production.



Flow chart of methodologies



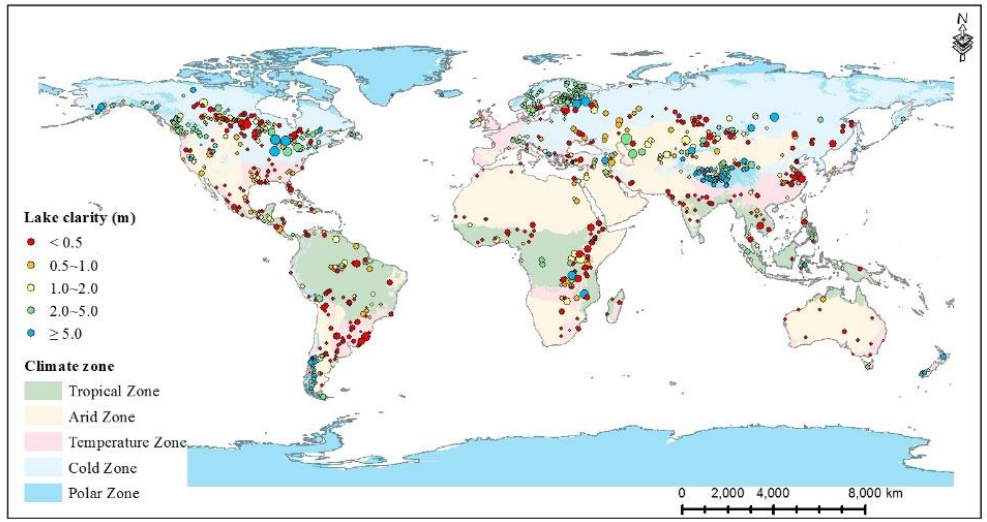
Global cropping intensity

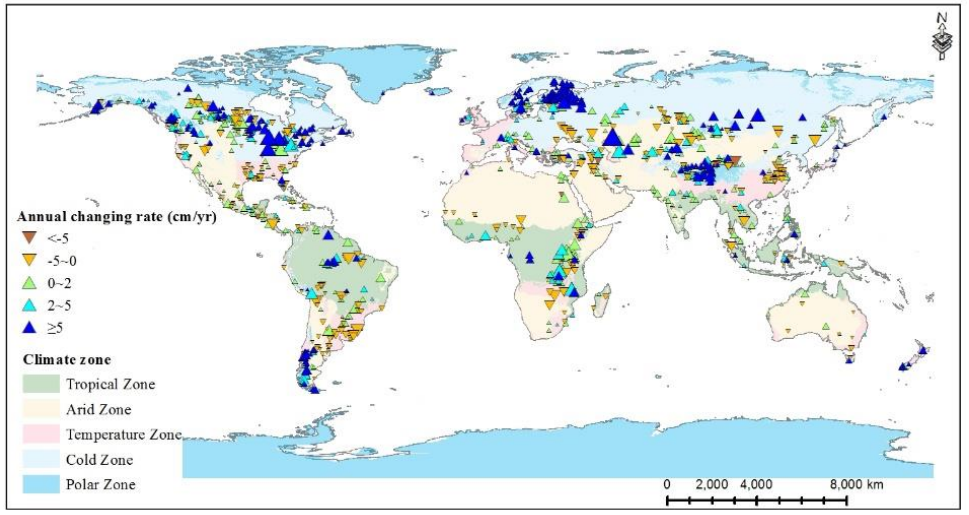
SDG 6 Clean Water and Sanitation

Temporal and spatial variations in water clarity in global large lakes during 2000-2021

- **1/3** of the large lakes are with water clarity **lower than 0.5 m** in 2021.
- Temporally, lakes in **high latitude generally have higher water clarity**, while lakes in **lower latitude have lower water clarity**.
- From 2000 to 2021, the water clarity in global large lakes has an **overall increasing trend**. **44.2%** significant **increase** while only **10.6%** significant **decrease.**
- Large lakes with **significant increasing** trend are mainly concentrated in the **Cold Temperature and Polar zones** in the globe.

Average lake clarity map for global large lakes in the year of 2021→



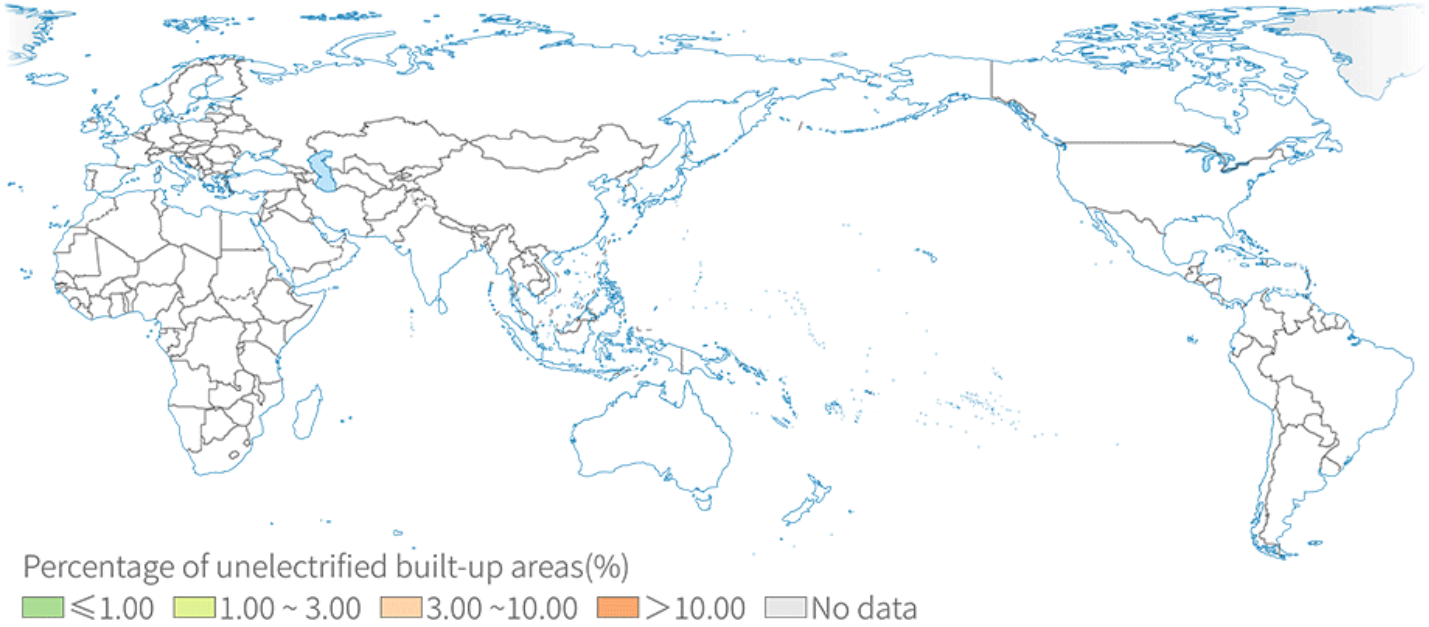


Annual changing rate of water clarity for global large lakes during ←2000-2021

SDG 7 Affordable and Clean Energy

Global identification of unelectrified built-up areas by big data

- 2014-2020, the **global electrified building area** was **increased** significantly by **2.91×10^4 km^2**
- The global un-electrified buildings are mainly distributed in Africa and Asia, especially in **sub Saharan Africa**.
- More than half of the countries (regions) where un-electrified built-up areas increased are in **fragile and conflict environments**.



Proportion of global un-electrified building area in 2020

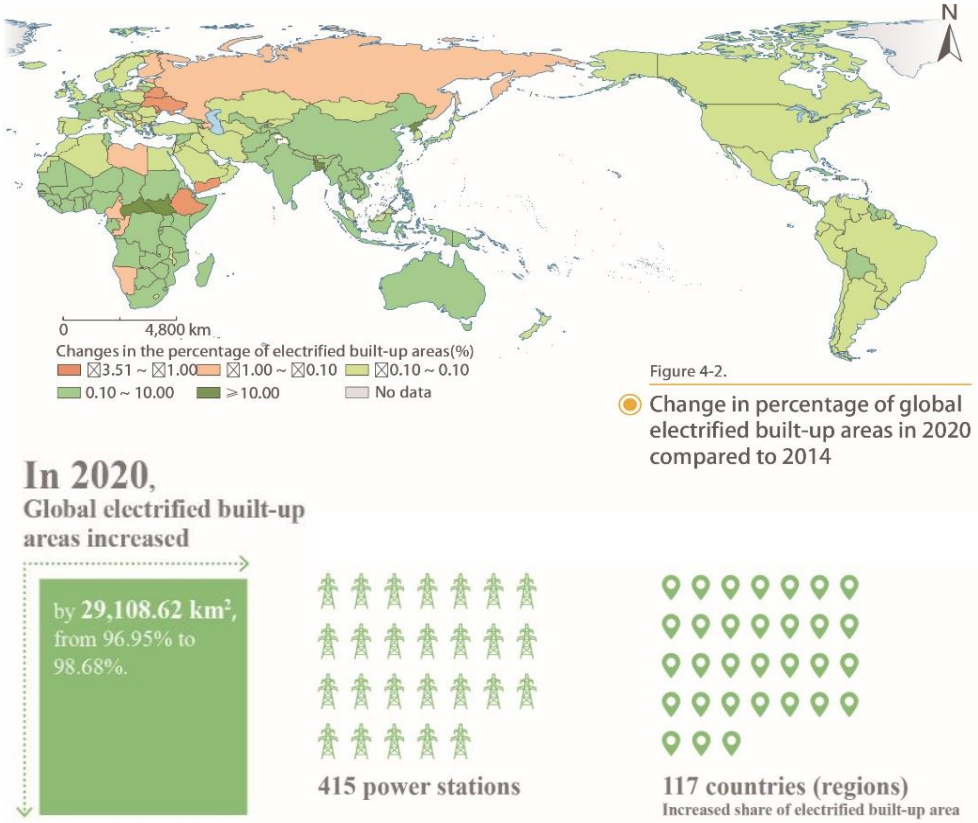


Figure 4-2.
Change in percentage of global electrified built-up areas in 2020 compared to 2014

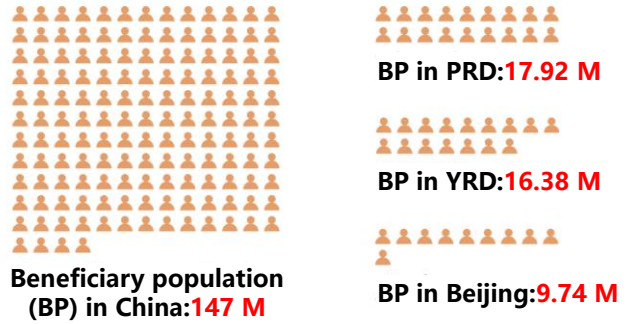
SDG 11 Sustainable Cities and Communities

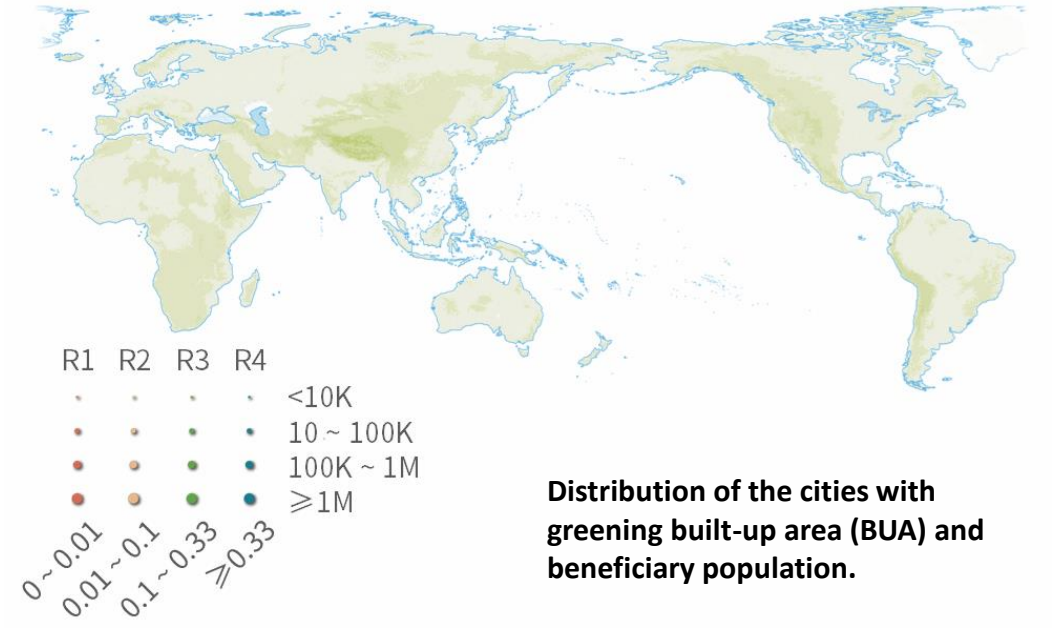
Changes of urban greenness and beneficiary population in global large cities

- **China has the largest greening urban area in the world**

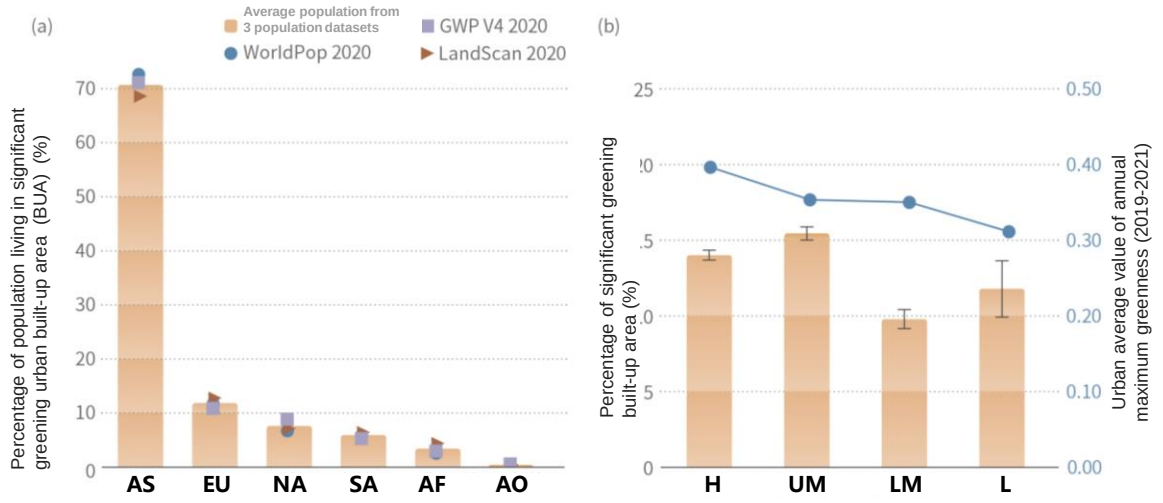
  China accounted for 28% of greening built-up areas (BUAs) with only 19% of the total BUA throughout the world

- **China accounts for nearly half（ 47% ）of the world’s beneficiary population in greening built-up area**
- **The improvement of urban ecology is closely related to income level, and urban greening has increased significantly in upper-middle-income（UM）countries**





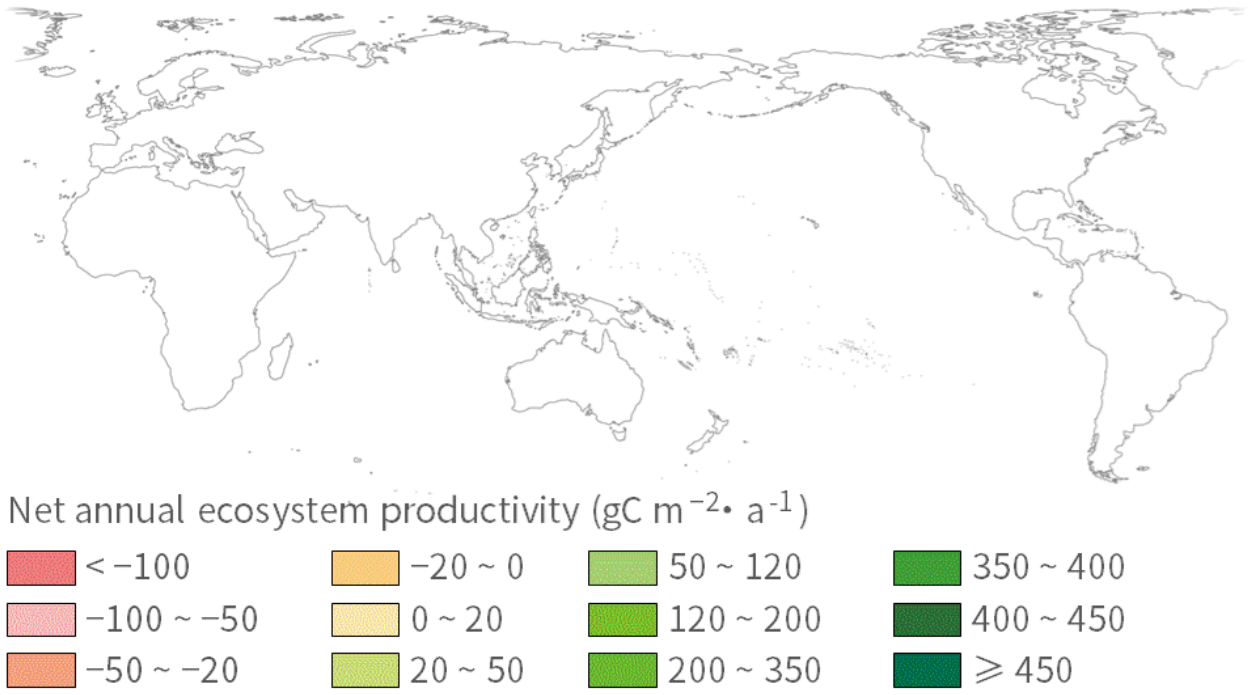
Distribution of the cities with greening built-up area (BUA) and beneficiary population.



（a）Percentage of population living in significant greening built-up area (BUA) across continents, （b）Percentage of significant greening BUA and urban average value of annual maximum greenness under different income levels.

SDG 13 Climate Action

Global terrestrial and ocean carbon sink estimated from big data



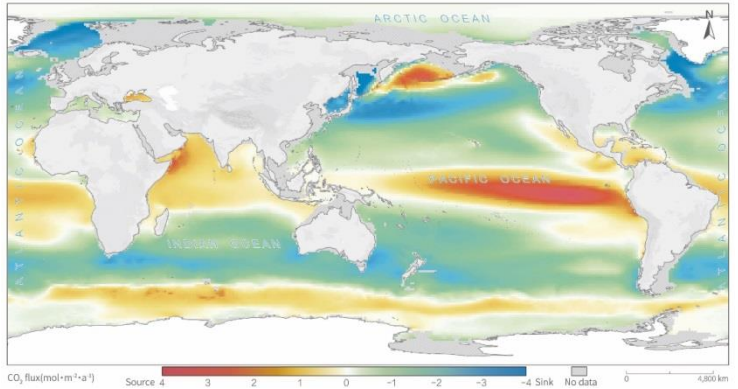
↑ **Global terrestrial average NEP during 2000-2020**

- **Global ocean carbon sink accelerated** since 2008, and the increasing rate reaches 0.075 Pg C/a during 2008-2020.

- Terrestrial net ecosystem productivity (**NEP**) and carbon dioxide partial pressure (**PCO_2**) of surface seawater are important parameters for quantitative estimation of carbon sink intensity of terrestrial and marine ecosystems, respectively.

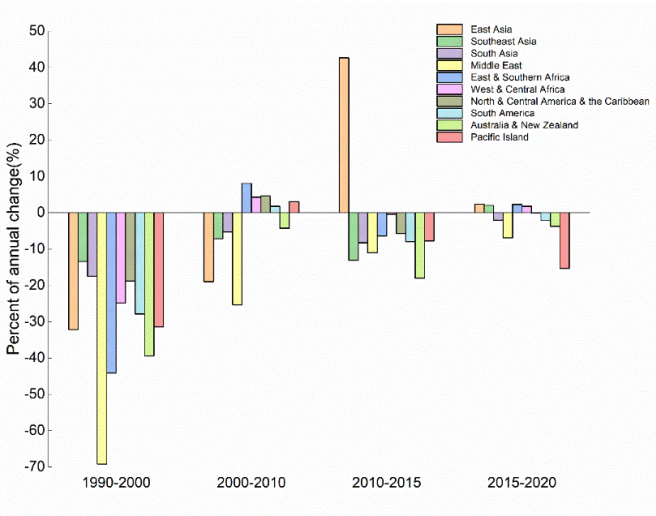
- **Global terrestrial NEP** showed a **significantly increased** trend from 2000 to 2020 (0.05 Pg C/a, $p<0.05$).

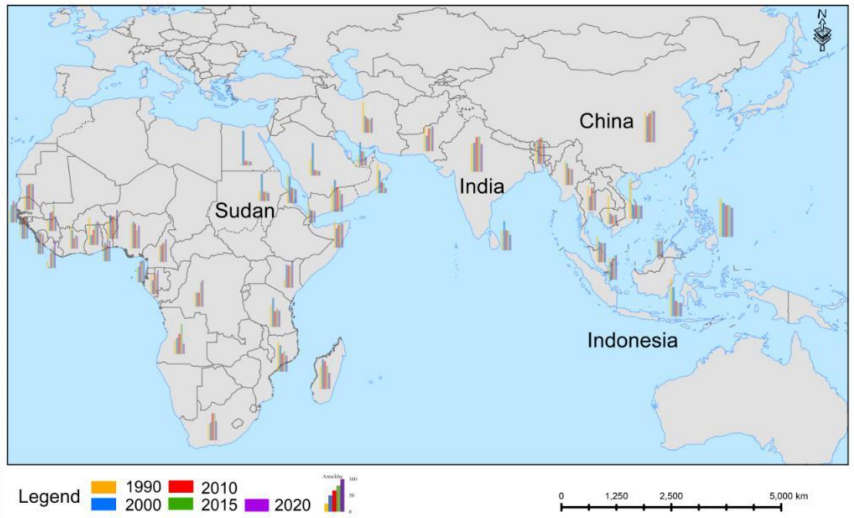
Average → distribution of global ocean CO_2 flux during 1992-2020



SDG 14 Life below Water

Monitoring the extent and dynamic change in mangrove forests





- **Asia**: **84.2%** of mangrove areas have continued to **decrease**.
- **Africa**: **57.8%** of mangrove areas have **increased**.
- **Human activities** have a greater impact on mangroves in Asian countries, while the impact is less in African countries.
- **GDP growth** has a greater impact on mangroves than population growth.

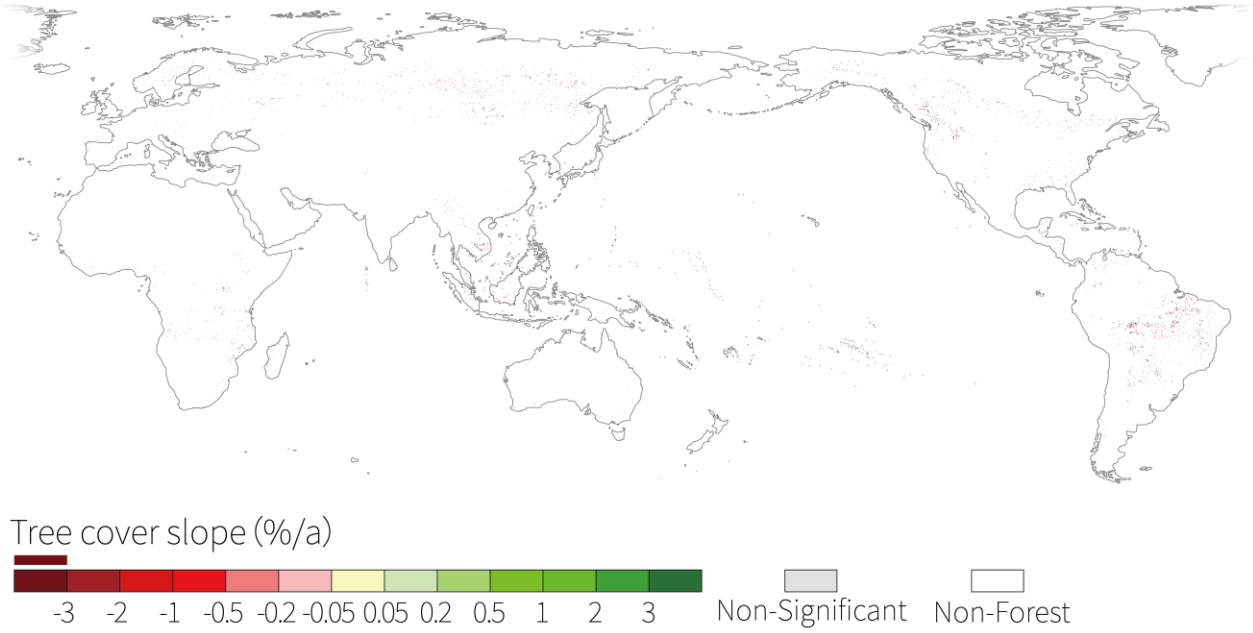
SDG 15 Life on Land

Interannual changes of global tree cover

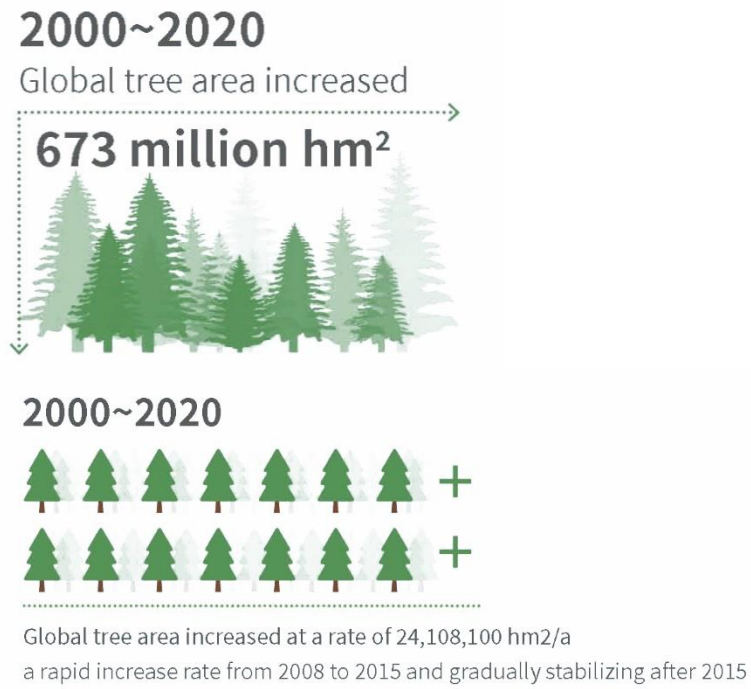
- **Global tree area increased by 673 million hm² from 2000 to 2020**

The global tree area increased at a rate of 24,108,100 hm²/a, with a rapid increase rate from 2008 to 2015 and gradually stabilizing after 2015.

- **Significant regional discrepancy exists in tree cover change, showing increase trends in temperate and boreal forests and heterogeneous patterns in tropical areas.**



Change trend of global tree cover from 2000 to 2020 (%/a)



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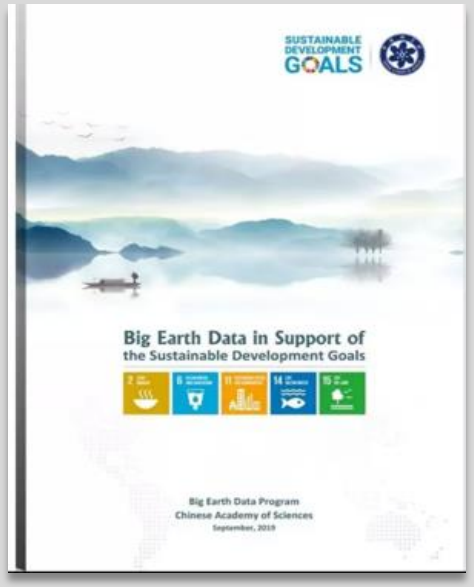
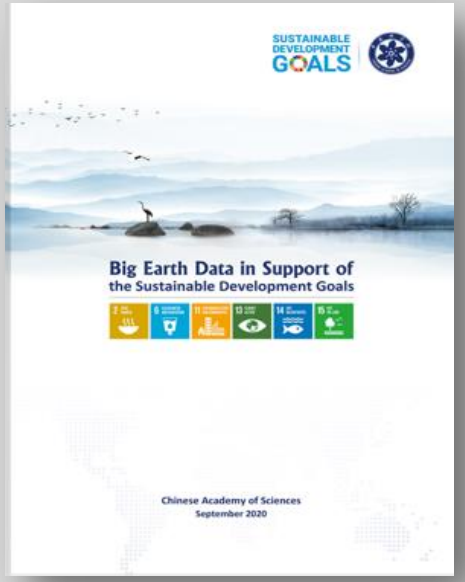
Big Earth Data in Support of SDGs

China has released 4 Reports in UN GA written by the CBAS

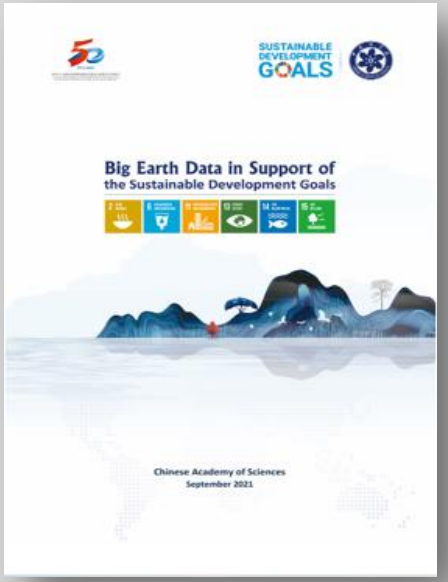
The Reports have showcased the results of research, monitoring and evaluation of relevant SDGs and their indicators at local, national, regional and global scales.



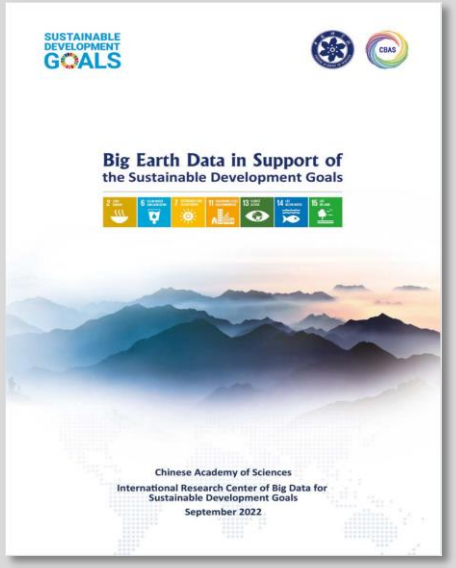
2019 Report



2020 Report



2021 Report



2022 Report

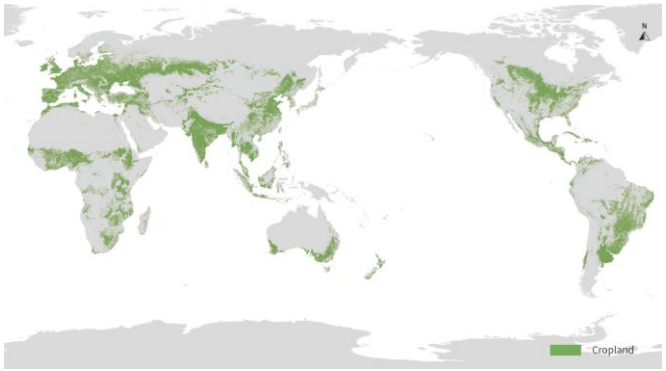
CBAS Mission

- 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**
- Establish a **think tank** for STI to promote SDGs
- **Capacity development** for SDGs in developing countries

CASEarth: a Partner of UN Online Platform

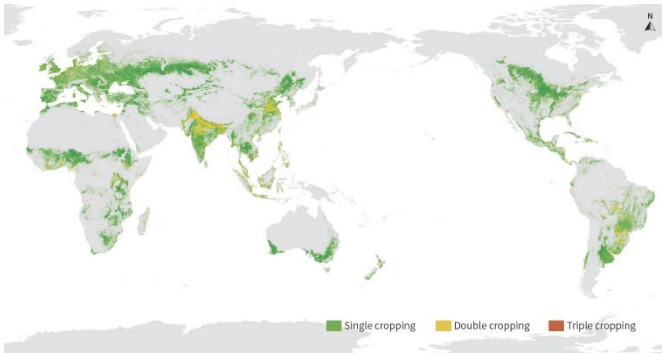
CASEarth was adopted into 2030 CONNECT as one of the 24 partners, and one of 6 in the category of Publications and Knowledge Resources.

CBAS offered 6 Global Data Products for SDGs to UN



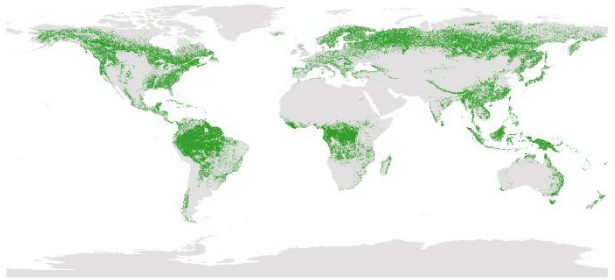
Global 30-m spatial distribution of cropland in 2020

- Total cropland area is 2.015 billion ha, of which Asia occupies the largest cropland area of 735 million ha.
- Top eight countries (U.S., China, India, Russia, Canada, Brazil, Australia and Argentina) account for over 50.03% of the world's total cropland.



Global spatial distribution of cropping intensity in 2020

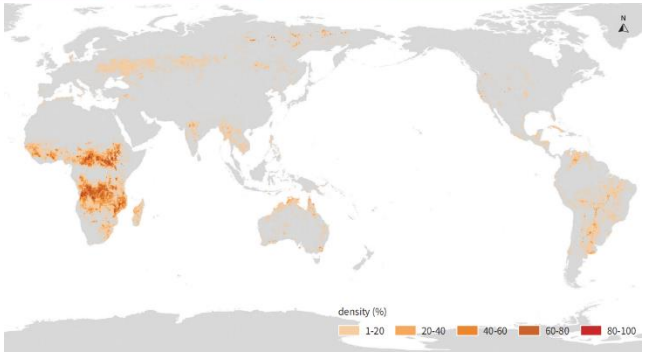
- Cropping intensity index, with 85.2% of cropland in single cropping, 14.4% in double cropping and only 0.4% in triple cropping or above.
- Cropland in multiple cropping pattern is mainly in East Asia, Southeast Asia, South Asia, and South America.



Global 30-m map of forest cover in 2020

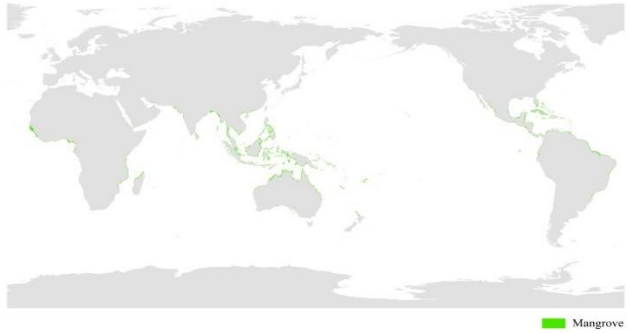
- Total global forest area was 3.684 billion hectares, accounting for 28.03% of the total global land area, equivalent to 0.47 hectares per person.

CBAS offered 6 Global Data Products for SDGs to UN



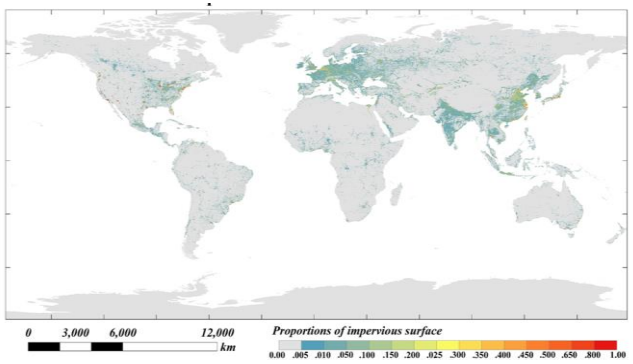
Global 30-m burned area distribution in 2020

- The burned areas are concentrated mainly in central and southern Africa, northern Australia, and central and southern South America.
- The total area of burned land in the world was 3,419,900 km^2. Africa had the largest burned area, accounting for 79.99% of the globe.



Global 30-m spatial distribution of mangroves 2000-2020

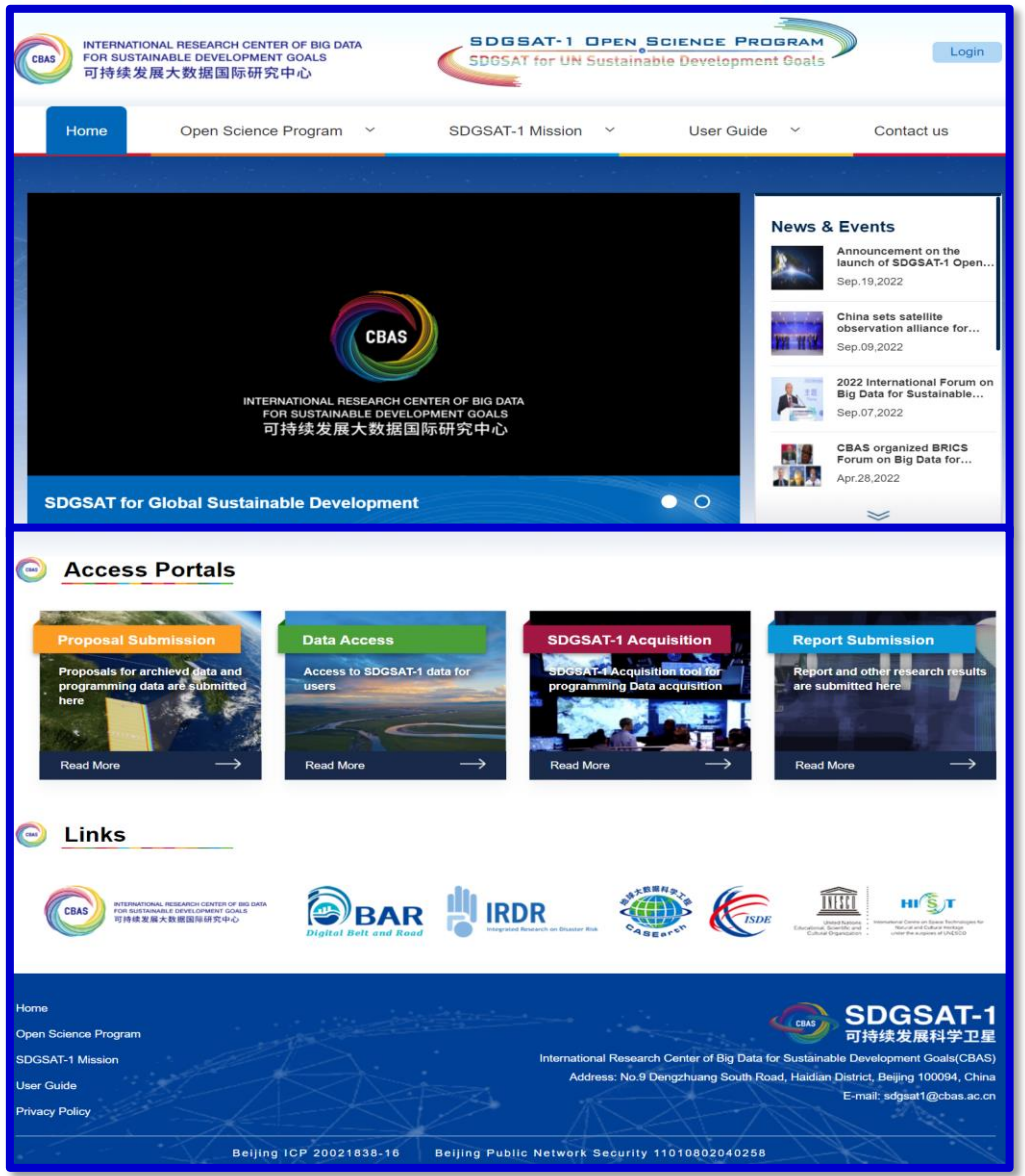
- The results evidence an overall net decrease of 8.76% in mangrove forests.
- Mangrove decline has slowed down since 2000 with an increase in public awareness of mangrove protection.



Global 30-m impervious-surface dynamic dataset 2000-2020

- It revealed a significant increase in global impervious surface from 696,000 km^2 in 2000 to 1,107,300 km^2 in 2020, a 59.08% increase about 411,300 km^2.

SDGSAT-1 Open Science Program



SDGSAT-1

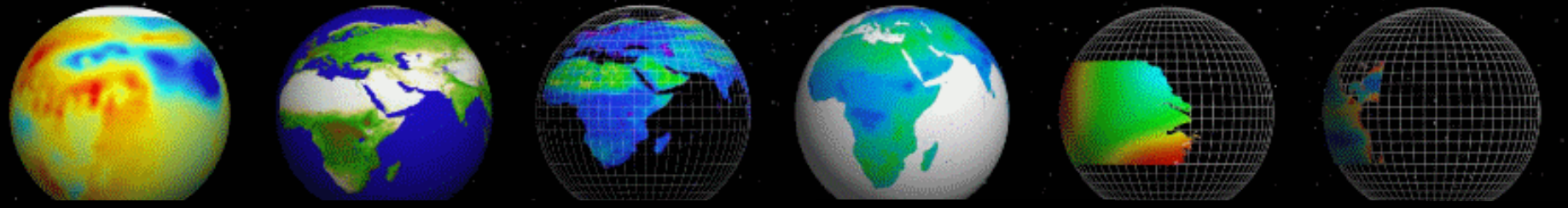
On Sept. 20, 2022, data collected by SDGSAT-1 are accessed globally free-of-charge to support the implementation of UN 2030 Agenda. Please visit "SDGSAT-1 Open Science Program" website:

www.sdgsat.ac.cn

SUSTAINABLE DEVELOPMENT GOALS

Digital Earth: a Tool to Drive SDGs

- Digital Earth allows us to better understand our world in order to optimize our actions and better pursue sustainable development.
- Digital Earth systems can provide powerful tools to understand and link complex interactions between human activity and earth systems at multiple scales to quantify social and environmental interactions.
- It can therefore be an invaluable platform for decision support and policy development, in addition to the monitoring and assessment of progress and implementation gaps.



INTERNATIONAL RESEARCH CENTER OF BIG DATA
FOR SUSTAINABLE DEVELOPMENT GOALS
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Thanks

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