TRAINING MODULE

"Utilizing Big Earth Data to Enhance
SDG Research, Monitoring and Reporting
in Thailand and Southeast Asia"
29-31 May 2023 in Bangkok, Thailand -

Jointly organized by















Introduction to CBAS and Recent Development of DBAR Program

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International Research Center of Big Data for Sustainable Development Goals (CBAS)

Contents





I. Introduction to DBAR and CBAS



II. Examples of CBAS' work for SDGs



III. Global Partnership and Data Platform

TFM Facilitates SDGs



Science, Technology, and Innovation STI for SDGs









15 LIFE ON LAND



















A technology facilitation mechanism (TFM) was adopted to facilitate the development of 2030 agenda.

UNITED NATIONS INTERAGENCY TASK TEAM ON STI FOR THE SDGS (IATT), INCLUDING THE 10-MEMBER GROUP MULTI-STAKEHOLDER FORUM ON SCIENCE, TECHNOLOGY AND INNOVATION FOR THE SDGS (STI FORUM)

ONLINE PLATFORM AS A GATEWAY FOR INFORMATION ON EXISTING STI INITIATIVES, MECHANISMS AND PROGRAMS

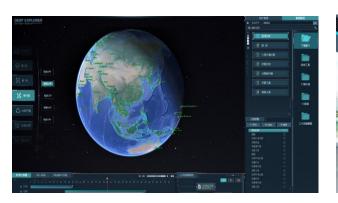
TFM Facilitates SDGs



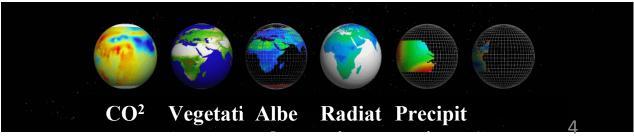
- Many SDGs Targets are related to STI progress (14 directly, 34 relatively, and 121 indirectly).
- Emphasize important role of STI in SDGs (Technology Facilitation Mechanism).
- Emphasize key role of the STI community in SDGs (provide data, expertise, evidence).

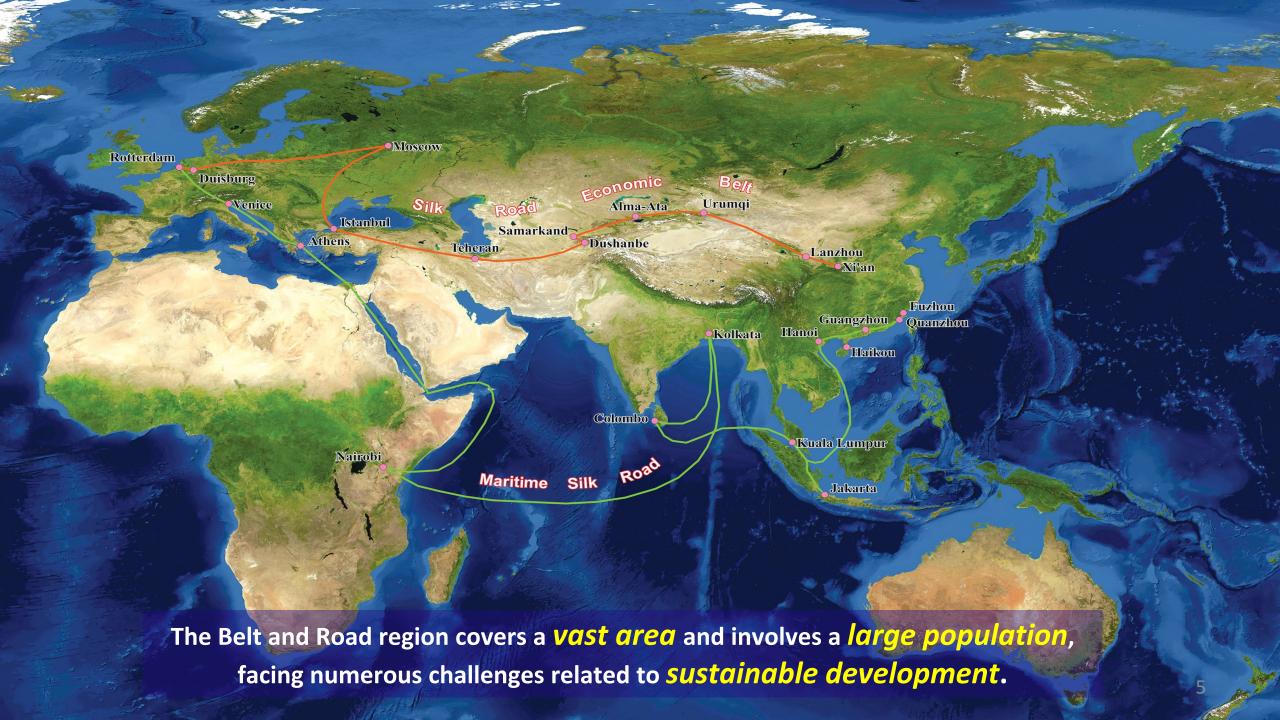
Recognizes the **natural and social domains** of Earth as a holistic research object.

Manifested as a scientific and virtual representation of the physical model, mathematical model, information model and computer model of Earth.









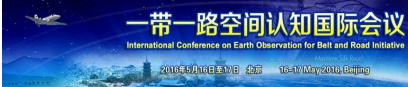


Digital Belt and Road – Sustainable Development Empowered by Data Science

Digital Belt And Road Program - May, 2016







Beijing Declaration on Earth Observation for Belt and Road

May 17, 2016



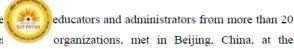
































Digital Belt and Road Program

- Establish an international Big Earth Data analysis and decision support system covering the Belt and Road region
- Develop an SDG indicators evaluation system for 8 related goals
- Achieve the scientific monitoring of the major SDG indicators along the Belt and Road

STI for SDGs along the Belt and Road





















DBAR Work Flow























Big Earth Data (DBAR-DATA)



Agriculture and Food Security (DBAR-AGRI)



Coastal Zone (DBAR-COAST)



Environment Change (DBAR-ENVI)



Natural and Cultural Heritage (DBAR-HERITAGE)



Disaster Risk Reduction (DBAR-DISASTER)



Water (DBAR-WATER)



DBAR High Mountain and Cold Regions (DBAR-HiMAC)



DBAR Urban Environment (DBAR-URBAN)

9 DBAR Working Groups



DBAR ICoEs: A global network for Big Earth Data knowledge, expertise and researchers



Inauguration of CBAS on 6 September 2021



President Xi and UN SG's Congratulatory Letter to CBAS' Launch on 6 September 2021



The sci-tech innovation and application of big data will help the international community to overcome difficulties and implement the UN 2030 Agenda globally.

-- President Xi's congratulatory letter



This Research Centre will work side-by-side with the Regional Hub for Big Data to support the UN Global Platform. Together, we can do more to end poverty, protect the planet and promote peace.

-- UN Secretary-General António Guterres' video message

Inauguration of CBAS on 6 September 2021









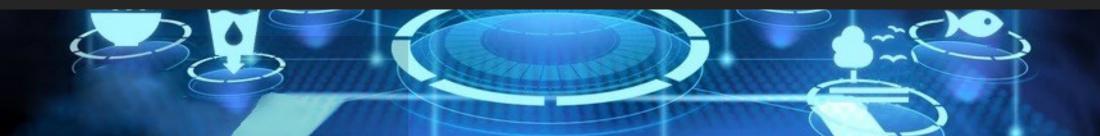
- My Department, stands ready to work with the Centre to strengthen global partnership for the SDGs. --UN Under-Secretary-General for Economic and Social Affairs
- I'm very pleased to see UNEP and the Chinese Academy of science is working together to bridge the data gaps for the SDGs and to improve our 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 of CBAS



Vision

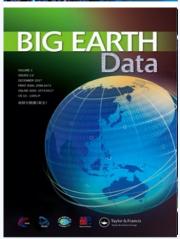
CBAS works towards a vision where data is open and accessible across borders and disciplines, technology is available to support the entire policymaking process, and knowledge and ideas are communicated and grown, especially among developing countries.



Mission of CBAS













- 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

Resources | Technical Human Resource Capacity



A leading interdisciplinary and cross-sector research team

CAS Institutes

ParticipatingOrganizations

>1200 Scientists



Resources International Advisory Committee



■ IAC Chair: Gretchen Kalonji, Former Assistant Director General for Natural Sciences of UNESCO

■ IAC Vice Chairs:

- **HE Changchui,** Vice Chairperson of the Academic Committee of the Academy of Digital China
- Stefano Nativi, Senior Researcher of the National Research Council of Italy

■ 18 IAC members:

• Experts from 12 countries working in areas of big data, earth observation and SDG.





































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

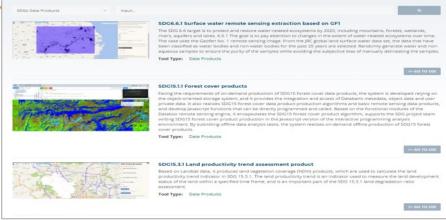
SDG data products (Surface Water, Forest Cover, Land Productivity)



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.

17

Data Sharing Platform



11PB

Total amount of data

40 years

Satellite Image Data 5.6PB

Biological and ecological data

4.6 million Scenes

Satellite image products

0.6PB

geographic data ground observation data Atmospheric and oceanic data

490,000

Items GBDB data record 3.8PB

EO 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 57.97 million 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;



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.

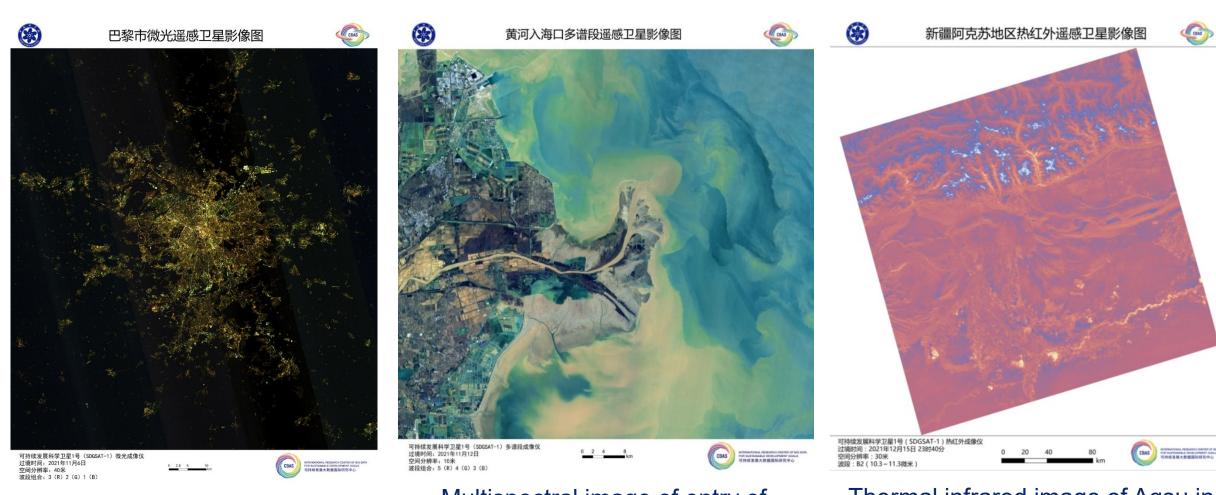


Explore new methods to sense Earth's environment

Data will be accessible at the end of 2022

Resources | First set of images Released on 20 December 2021





Glimmer image of Paris /40m

Multispectral image of entry of Yellow River /10m

Thermal infrared image of Aqsu in Xinjiang Uygur Autonomous Region /30m

Achievements | Scientific Reports



Big Earth Data in Support of SDGs

Chinese Government released a series of Reports drafted by CBAS since 2019

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.







Achievements | Evaluation of China's Progress on SDGs



Evaluation of China's Progress on SDGs Based on Big Earth Data (2010-2020)

	Indicators	Evaluated items	2010-2015	2015-2020
SDG 2	2.2.1	Under-five stunting	• †	• 🕇
	2.4.1	Land productivity, water resources use, and excess fertilizer application	• 🛊	
SDG 6	6.3.2	Water clarity in lakes and reservoirs	• 🛊	• •
	6.4.1	Water-use efficiency		• 🛊
	6.5.1	Integrated water resources management		• 🕇
	6.6.1	Areal extent of wetlands (riverine and lacustrine systems)	• 🛊	• 1
SDG 11	11.2.1	Proportion of population that has convenient access to public transport		• 🕇
	11.3.1	Ratio of land consumption rate to population growth rate	• +	• 🖈
	11.4.1	Unit Input in heritage sites	• 🛊	• •
	11.5.1	Interannual change in total loss from natural disasters at prefectural level	• 🕇	• 🕇
	11.6.2	Fine particulate matter in cities	• +	• 🖈
	11.7.1	Area of open space in cities		• 🖈
SDG 13	13.1.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	• 1	• 🕇
	13.2.2	Concentration of greenhouse gas		• 🕇
SDG 14	14.1.1	Marine debris and microplastics in coastal waters	• 🛊	• 🖈
	14.2.1	Area of mangrove	• 🛊	• 🖈
	14.7.1	Area of raft culture in coastal waters		• 🕇
SDG 15	15.3.1	Proportion of degraded land	• 🕇	• 1
	15.4.2	Mountain Green Cover Index		• •
	15.5.1	Red List Index	• 1	• 1

- China's SDG process between 2010 and 2020 was evaluated centering on 20 indicators of six SDGs
- The result shows between 2010 and 2015 two indicators worsened and 11 indicators improved; between 2015 and 2020 no indicator worsened and 16 improved.
- So far, of the 20 evaluated indicators, China is close to or has met four, including SDG 2.2.1, SDG 11.2.1, SDG 15.3.1 and SDG 15.4.2.

Colored circles indicate state of implementation

Very challenging

Close or achieved

Arrows indicate trend

↑ Improving→ Stable↓ worsening

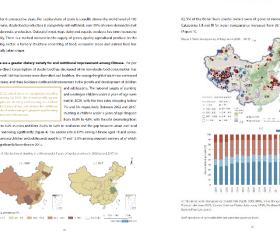
Bright green bars indicate the years covered by the evaluation during the period of 2010-2020. The example below indicates 2010-2018.

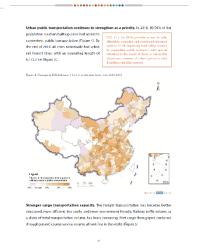
Achievements | Supporting China's VNR report



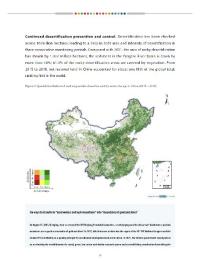
- Research outcomes based on Big Earth Data provided scientific proof to China's Voluntary National Review Report on Implementation of the 2030 Agenda for Sustainable Development.
- The Scientific figures with geospatial information presented a more comprehensive monitoring results of the SDG progress in China.









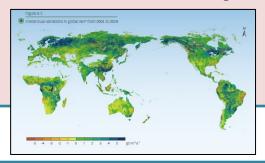


Achievements | Global Case Studies



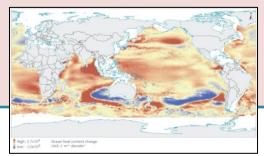
Impacts of land cover change on global Net Ecosystem Productivity (NEP)

Quantified the importance of land cover, climate, CO2 concentration and nitrogen deposition changes for global NEP with random forest algorithm



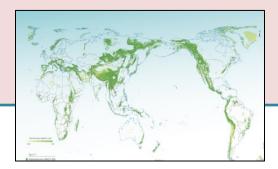
Global Ocean Heat Content (OHC) change

The ANN approach was used in combination with multisource satellite observations and ARGO float data to build a remote sensing inversion model for global-scale, multilayered, and long-time series estimation of OHC



High-resolution monitoring of global Mountain Green Cover Index (MGCI)

The first globally consistent and spatially comparable high-resolution mountain green cover index datasets for 2015 and 2020.



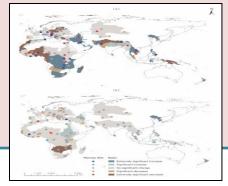
Assessment of change in global crop water-use efficiency

Evaluation of global crop water-use efficiency based on multisource remotely sensed data and crop growth processes to monitor in spatially comparable agricultural areas in the world.



Dynamic change of water body in Ramsar Sites

Based on the long-term water body dataset with high time resolution, the dynamic changes in water areas in RAMSAR Sites were analyzed



Achievements | Global Data Products

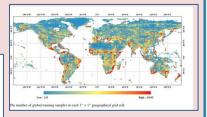


GLC_FCS30: Global land-cover product

Fine classification system at 30 m using time-series Landsat imagery

Earth Syst. Sci. Data, 13, 2753-2776, 2021



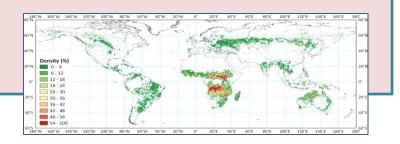


GABAM: Global Annual Burned products

Burned area at 30 m resolution

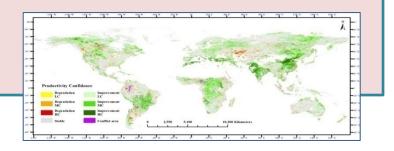
Long, T.; Zhang, Z.; He, G.; Jiao, W.; Tang, C.; Wu, B.; Zhang, X.; Wang, G.; Yin, R. 30 m Resolution Global Annual Burned Area Mapping Based on Landsat Images and Google Earth Engine.

Remote Sens. 2019, 11, 489.



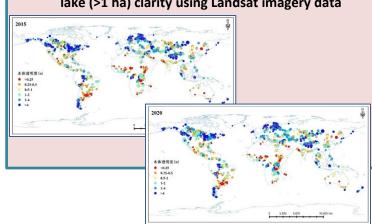
LPD: Global Land Productivity Dynamic products

Cui Y, Li X. A New Global Land Productivity Dynamic Product Based on the Consistency of Various Vegetation Biophysical Indicators. Big Earth Data, 2022



Global Lakes Product

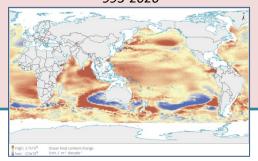
A unified model for high resolution mapping of global lake (>1 ha) clarity using Landsat imagery data



Climate Change Products

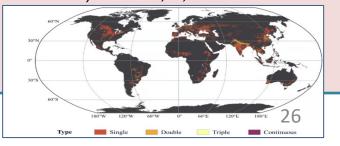
Global Ocean Heat Content

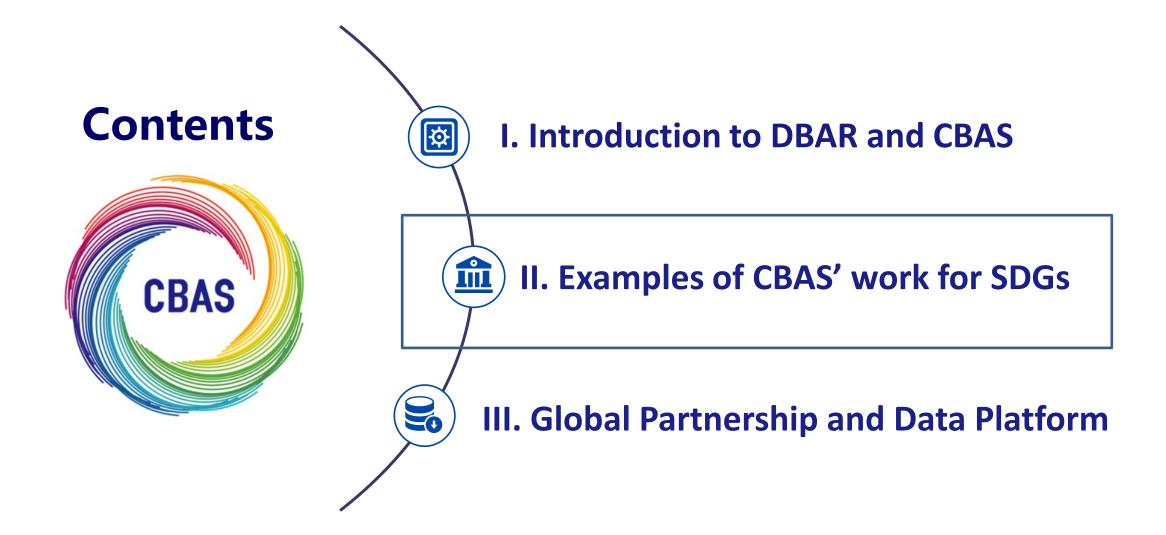
Su et al., 2021, Predicting subsurface thermohaline structure from remote sensing data based on long short term memory neural networks, Remote Sensing of Environment, 112465. 993-2020



Global Cropping Intensity Products

GCI30: 30m resolution global cropping intensity products
Zhang, M., Wu, B., Zeng, H., He, G., Liu, C., Tao, S., Zhang, Q.,
Nabil, M., Tian, F., Bofana, J., Beyene, A. N., Elnashar, A., Yan,
N., Wang, Z., and Liu, Y.: GCI30: a global dataset of 30?m
cropping intensity using multisource remote sensing imagery,
Earth Syst. Sci. Data, 13, 4799–4817





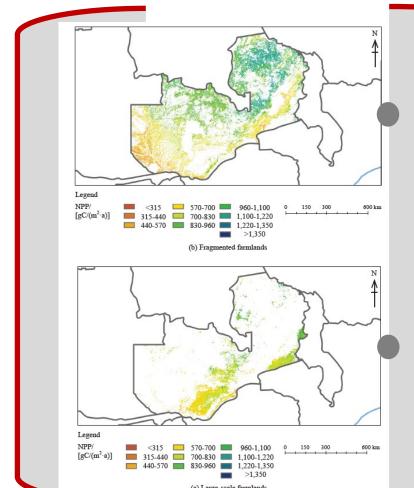


SDG2.3.1 | Spatial distribution of classes of farmland size and agricultural productivity in Zambia



The crop production of Zambia has shown rapid growth in the past ten years, making it a net grain exporter.

- ☐ Due to unstable weather conditions, productivity is generally low. The interannual fluctuation of agrometeorological conditions likely to increase with climate change.
- ☐ In the future, in addition to strengthening of the crop varieties and seeds, Zambia could optimize the agricultural development policies over different regions according to local conditions such as farmland size, land productivity and natural conditions
- ☐ With the support of Big Earth Data, more reasonable agricultural development policies could be implemented to increase the agricultural outputs, and Zambia might become an important food supplier in southern Africa in the future



Fragmented farmland and medium-scale farmland are dominant in Zambia

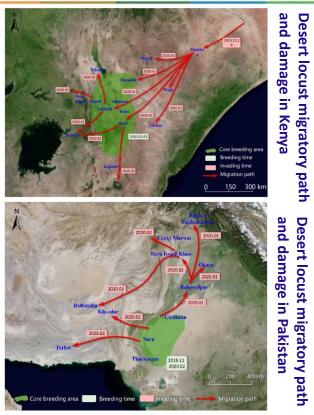
Zambia's large-scale, high-productivity farmland is spatially dislocated, mainly distributed in the central and southwestern regions.



SDG2.4.1 | Monitoring of Desert Locust in Africa and Asia





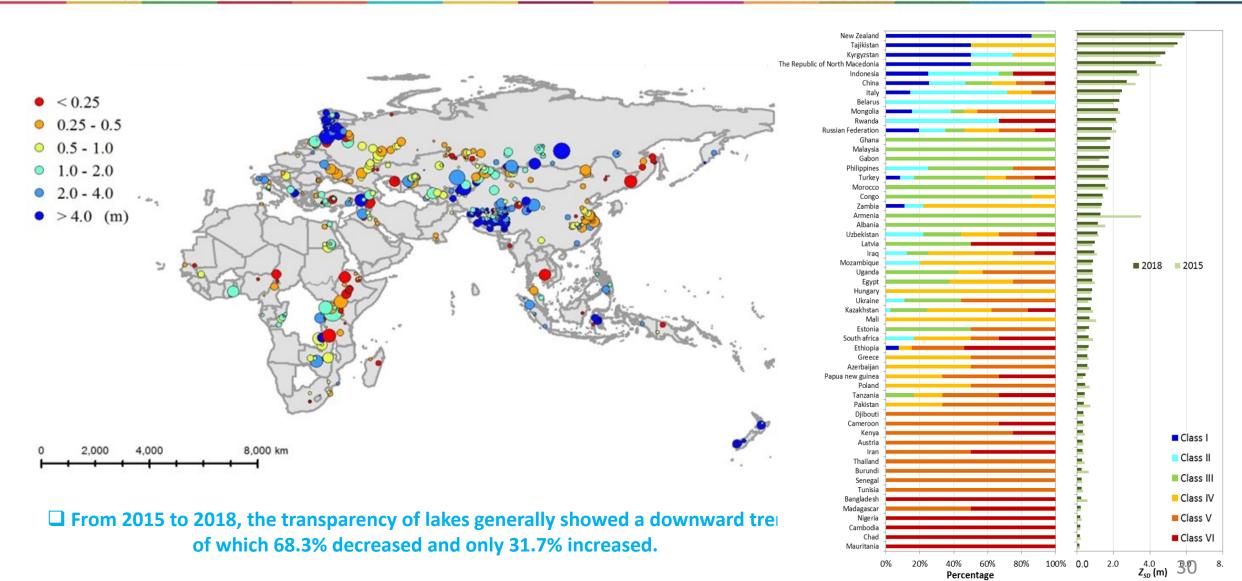


- Monitoring of Desert locust core breeding areas and migration paths in the Year 2018-2020 are conducted in Asian and African, especially in some severely damaged countries, including Pakistan, Ethiopia, Kenya, Somalia, and Yemen.
- □ The results were adopted by FAO to support multi-country joint pest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



SDG 6.3.2 | Temporal and spatial distribution of the surface water transparency in the Belt and Road regions

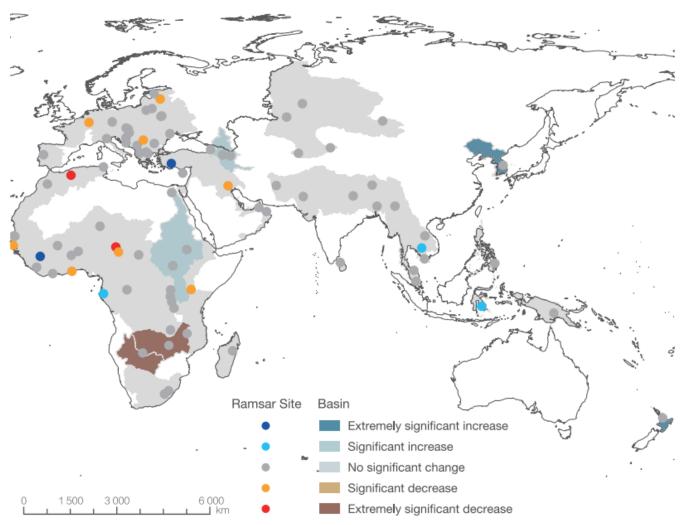






SDG 6.6.1 | Dynamic change of water body in Ramsar Sites





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.

Seasonal fluctuation characteristics

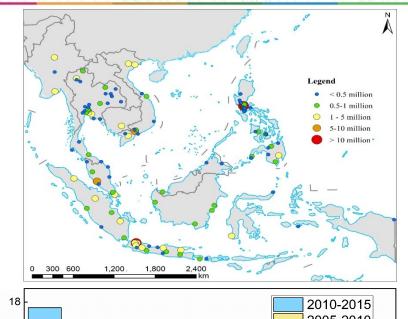


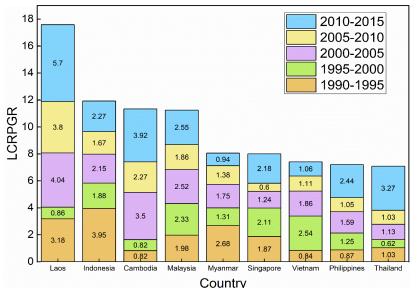
SDG11.3.1 | Urban Sprawl and Urbanization



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

- Monitored and measured 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
- The results reveal that the ratio of land consumption rate to population growth rate (LCRPGR) increased from 1.24 in 1990-1995 to 2.67 in 2010-2015.
- Urban sustainability in B&R still faces challenges.
- Proposed a new SDG11.3.1 indicator the ratio of economic growth to land consumption rates (EGRLCR), coupled with LCRPGR to evaluate the spatiotemporal evolution of urbanization in China from the economic, social and environmental perspectives.
- 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.





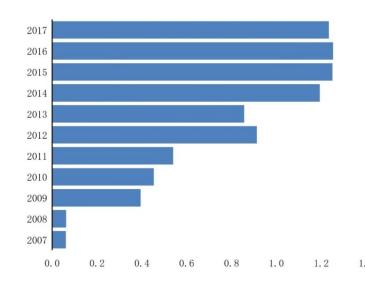
Changes of LCRPGR in ASEAN



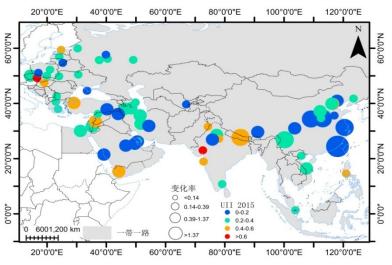
SDG 11.4.1 | Natural and Cultural Heritage Protection



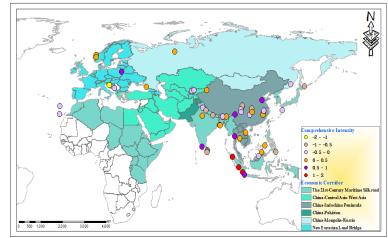
- Proposed an improved SDG11.4.1 indicator "increase in capital investment per unit area to protect and safeguard the world's cultural and natural heritage". The sustainable development of Chinese world heritage clearly improved from 2006 to 2017.
- Developed an Urbanization Intensity Index (UII). The 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.
- Developed a Human Disturbance Index (HDI). 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

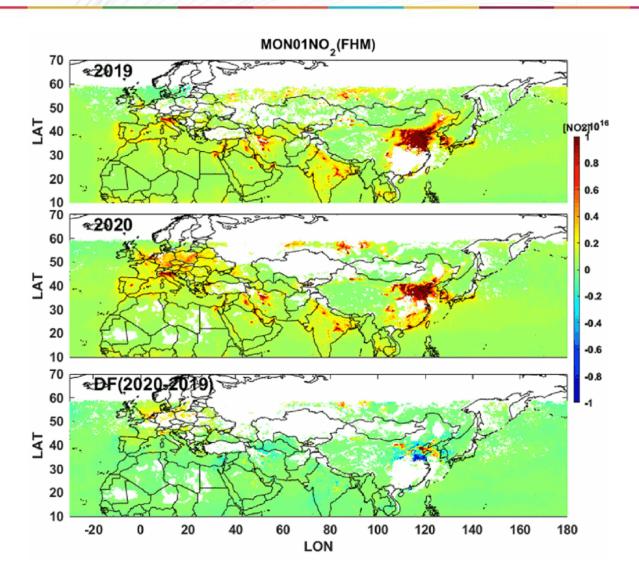


Distribution map of comprehensive intensity of human disturbance in the natural heritage sites



11.6.2 | Air Pollution (NO₂)





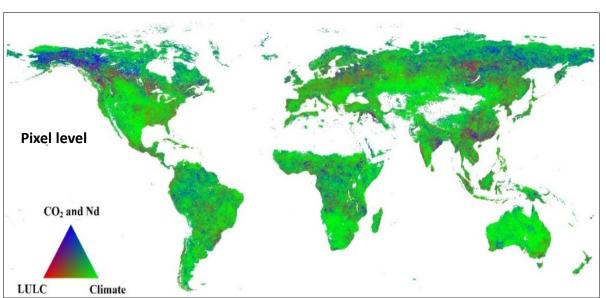
- Using NO₂ vertical column density changes derived from satellite data to analyze the impact of COVID-19 on countries along the B&R region.
- In China, NO₂ has shown a significant downward trend from late January to early March 2020, with a maximum decline of up to 31.76%; With the resumption of production and resumption of production, the tropospheric NO₂ vertical column density at the end of March returned to the level close to the same period in previous years.
- Globally, since early February, NO₂ hotspots in Europe, the Middle East, and India have also observed a clear downward trend because of COVID-19.

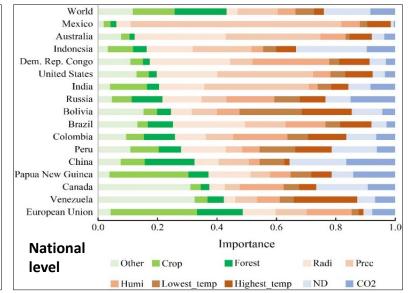


SDG 13.2 | Global terrestrial carbon sink and its driving factors



Target 13.2: Integrate climate change measures into national policies, strategies and planning





The importance of land use/land cover changes(LULC), Climate, CO₂ and nitrogen deposition (Nd) on NEP variations during the period of 2001-2019

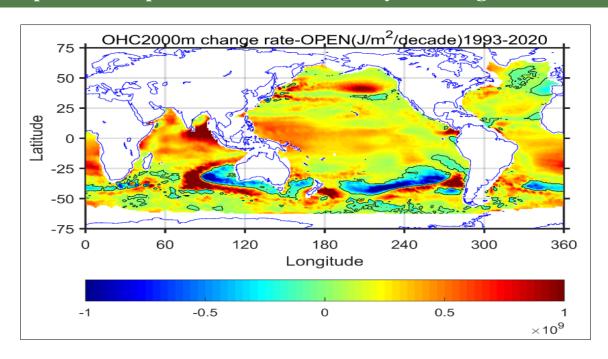
- Carbon sinks is estimated by combining Meteorological data, land use data, soil data and vegetation LAI data from remote sensing.
- We found that about 40% of global carbon sink area changes were attributed to the changes in land use/cover, and 30% of changes were attributed to climate change.

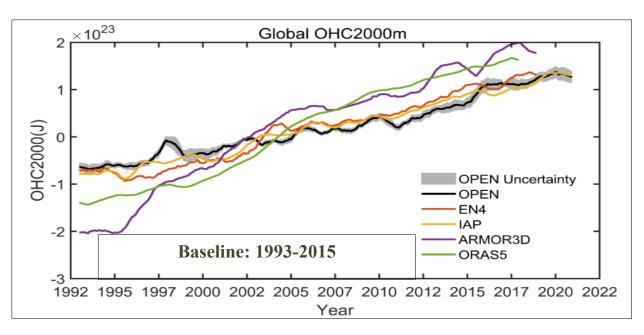


SDG 13.3 | Ocean Heat Content (OHC) increases rapidly



Target 13.3: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning





- 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.

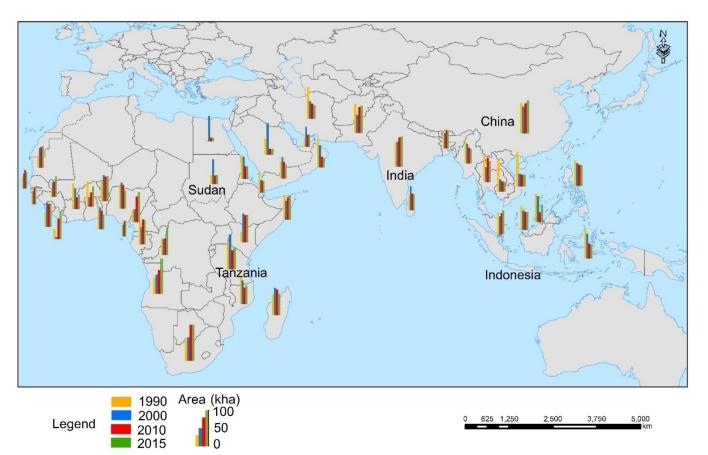


SDG 14.2 | Monitoring the extent and dynamic change of mangrove forests along the Maritime Silk Road



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



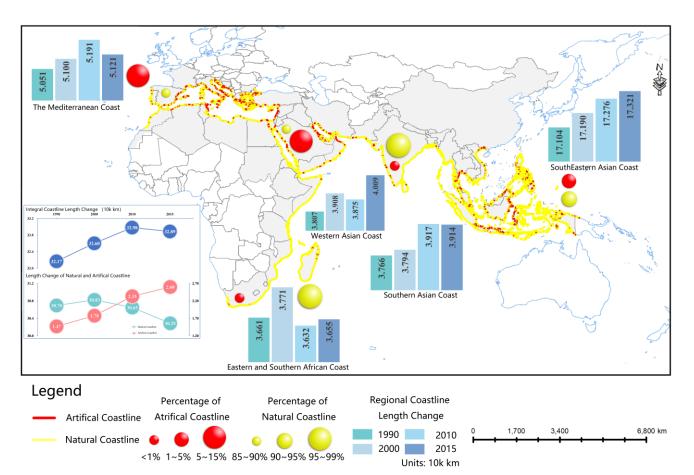
- **Asia:** 68.4% of Asian countries showed a **continuing decreasing trend** in the mangrove area
- **Africa:** 66.4% of African countries showed an **increasing trend** in the mangrove area
- Human activities in Asian countries have a greater impact on mangroves, while African countries have less impact.
- GDP growth has more impact on mangroves than population growth.



SDG 14.5.1 | 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



- From 1990 to 2015, the length of the coastline along the Maritime Silk Road showed an overall steady growth trend, especially 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.

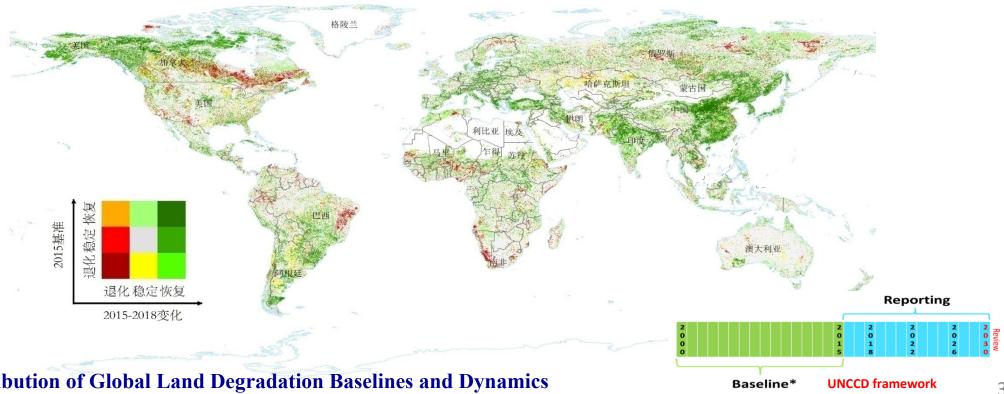
Distribution of coastline types and changes in coastline length along the Maritime Silk Road (1990-2015)

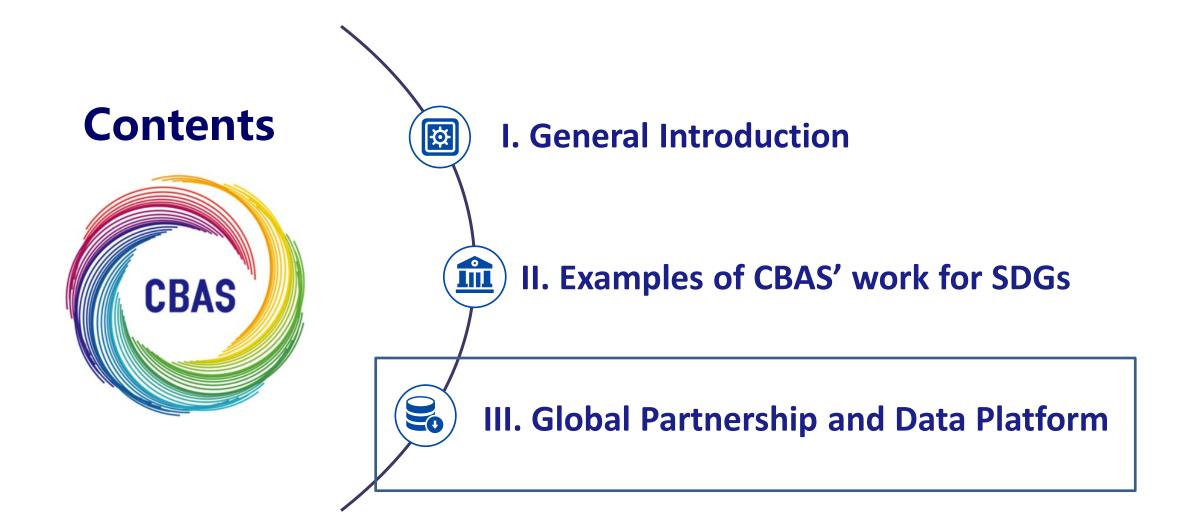


15.3.1 | Global Land Degradation Neutrality Tracking



■ China's LDN status continues to improve. Compared to 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.





Ongoing Engagement with UN



CBAS is devoted to support and promote TFM for SDGs through extensive international engagements with UN Agencies



One of the 24 partners of UN 2030 CONNECT Platform



Contributed to UNEP's reports and projects on Environment-irelated SDGs



Special Issue of Future Cities and New Economy copublished with UN-Habitat



Contributed to UNCCD's latest publication on Good Practice Guidance



Providing consultancy to UNDESA in utilizing existing ocean databases



Three datasets were included in FAO Hand-in-Hand Platform

International Cooperation & Collaboration



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



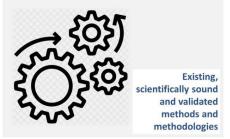
- 57 countries, international organizations and plans
- Covering 4 continents
- 9 international working groups
- 9 international research centers of excellence
- 7 UN SDG goals

Capacity Building | Big Earth Data in Support of the SDGs in Thailand

SDGs









Big Earth and

Socio-Economic data



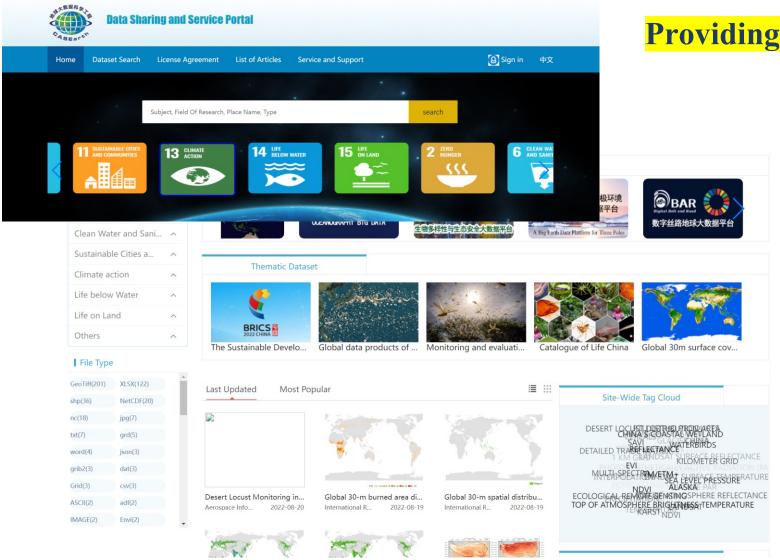
- National Conference: Thailand and the SDGs
 Actively involved in various of national conferences and capacity building events for Thailand to facilitate the utilization of Big Earth Data in the implementation of the
- Project on Application of Big Earth Data in Support of the SDGs in Thailand

Project Team: Asian Institute of Technology **Outputs:**

- Concrete and validated framework and methodologies for SDG evaluation
- Standardized database at national level
- Science-support polices and governance

CASEarth-Data Sharing and Service Portal





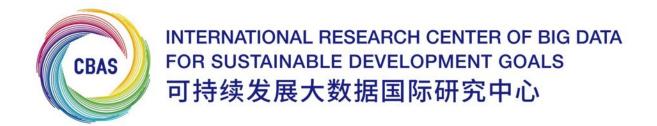
- Providing support to DBAR and its ICoE
 - Data mining models
 (classification, keyword search, tag cloud filtering, and association rules).
 - Multiple data acquisition patterns (online downloading and API access).
 - Online services for customized multiple data formats
 - Advanced functions Data evaluation, validation, download, and cloud analysis for customized needs

Open DBAR-DBAR Big Earth Data System





- SDG Data Hub for DBAR
- TerraView (Big Earth Data applications)
- DBAR and SDG News Library(Multimode media data processing and display)
- DBAR and SDG Knowledge Base(Science popularization)



THANK YOU

DBAR Secretariat

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

Tel: +86-10-82178985

Fax: +86-10-82178980



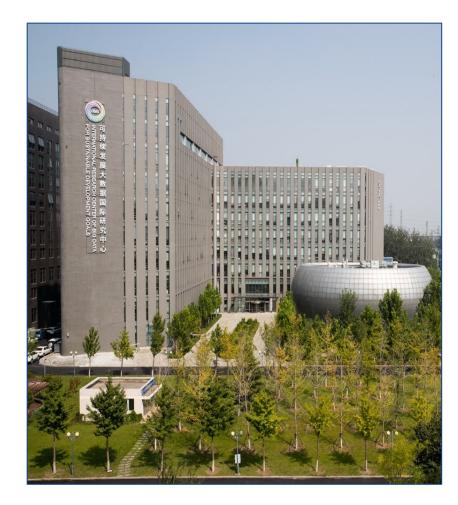
Introduction to the CASEarth Program for Big Earth Data and SDGs

Data Sharing Group

OUTLINE



- 1. Introduction to CASEarth Program
- 2. CASEarth Data Sharing Systems
- 3. CASEarth Classification System
- 4. CASEarth Data Products
- 5. CASEarth Thematic Datasets
- 6. Independent Review of CASEarth Data Policy by CODATA
- 7. Practical Guide to CASEarth Data Sharing Service Portal





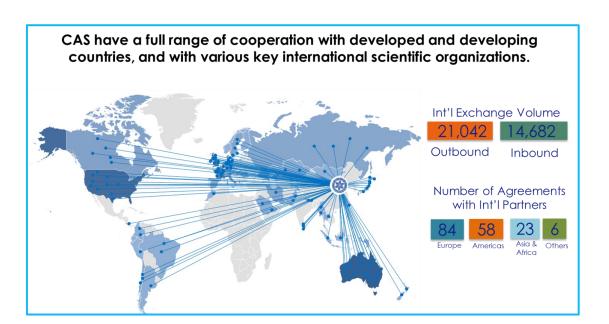
CASEarth Program

——Establishment of CASEarth for Advancing Big Earth Data and SDGs

Big Earth Data Science Engineering Program (CASEarth)



The Big Earth Data Science Engineering Program (CASEarth), A Strategic Priority Research Program (Class A) of CAS, was officially launched on February 12, 2018, with an initial implementation period of five years.



The Program was founded as a major data infrastructure and research project that seeks to accelerate the use of various data resources of CAS, generally from remote sensing sources, to create scientific knowledge. Upon its successful completion, the entire CASEarth infrastructure has been taken over by the International Research Centre of Big Data for Sustainable Development Goals (CBAS).

CASEarth resolves major scientific and technological problems concerning overall long-term development.

CASEarth integrates technical problem-solving with team- and platform-building.

CASEarth provides a new impetus for interdisciplinary, cross-scale, macro-scientific discoveries using Big Earth Data.

Big Earth Data Science Engineering Program (CASEarth) - Objectives



Build an International Center for Big Earth Data Science

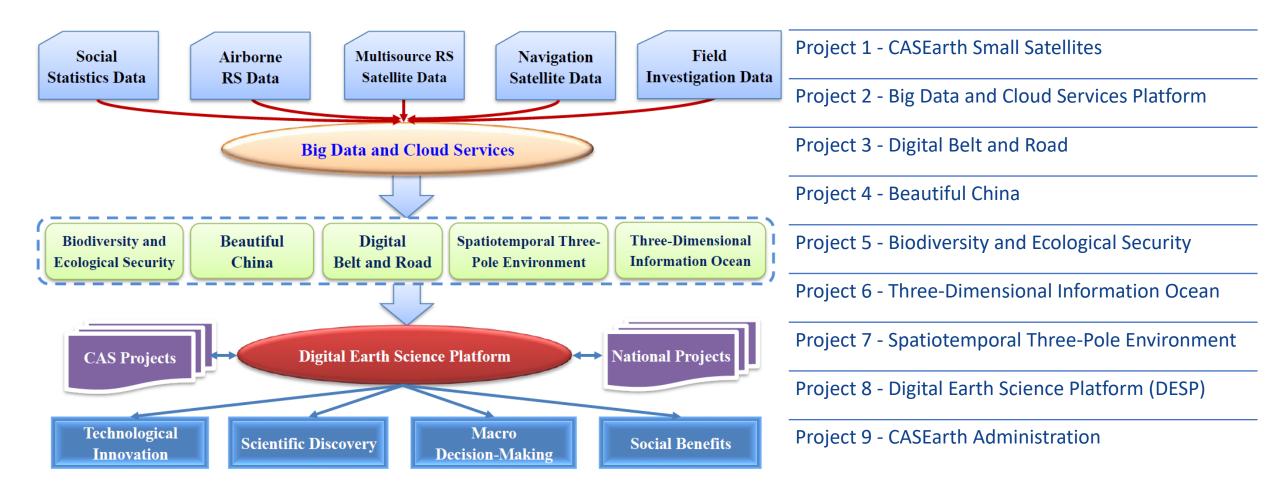


- Build a state-of-the-art Big Earth Data infrastructure
- Develop a world-class Big Earth Data platform to drive research and innovation

Construct a decision support system

Big Earth Data Science Engineering Program (CASEarth) - Framework







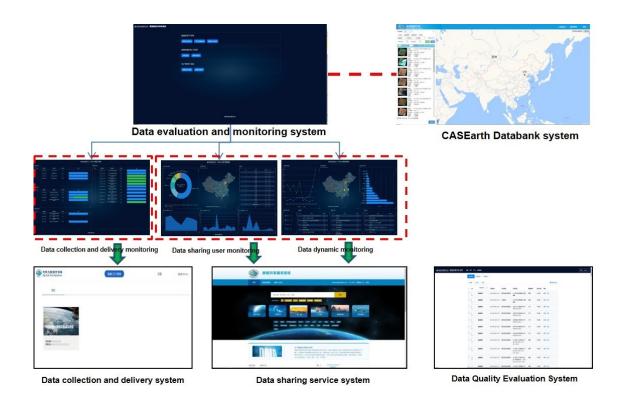
CASEarth Data Sharing Platform

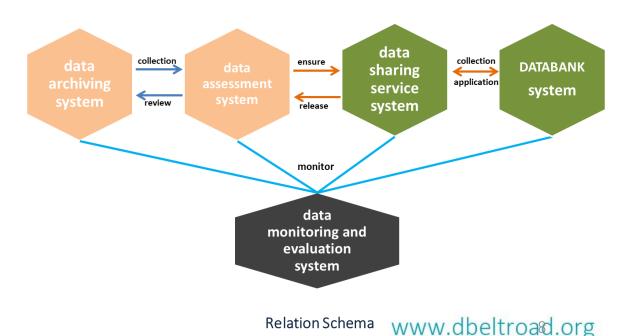
 Full-life-circle Data Management and Distributed Sub-systems for Big Earth Data and SDGs

Big Earth Data Science Engineering Program (CASEarth) – Data Sharing Platform



- The data sharing service platform has an operational and management mechanism for displaying and tracking the "full life circle of data". For realizing this purpose, we have developed several distributed subsystems to support this platform. Now all these systems are up and running.
- ☑ Every dataset on this platform is assigned a unique identifier DOI (US), PID (EU), and CSTR (China).





Big Earth Data Science Engineering Program (CASEarth) – Data Sharing Platform



- ☑ Build a big data-driven, high impact digital Earth science platform;
- ☑ Develop a unique and multi-disciplinary big Earth data service system;
- ☑ Explore the formation of a new scientific research paradigm driven by big data and multidisciplinary integration.

Earth observation data

Geographic resource data Ecosystem ground observation data

Biodiversity and ecological safety data

Ocean data

Three-pole area integrated data

One Belt One Road" regional integration data SDG support data

Basic Data Products

Public Data Products

Application Products



Data Sharing Sub-systems



Data Sharing Sub-systems

Big Earth Data Science Engineering Program (CASEarth) – Data Sharing Sub-systems

Centralized Systems Data Archiving Sub-system

Data Monitoring and Assessment Sub-system

Data Sharing Service Platform

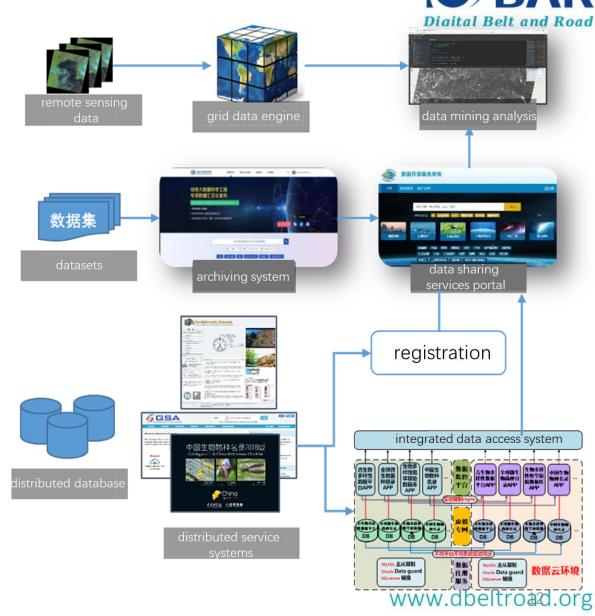
CASEarth Thematic Sub-system

Computation-oriented Data Access Sub-system

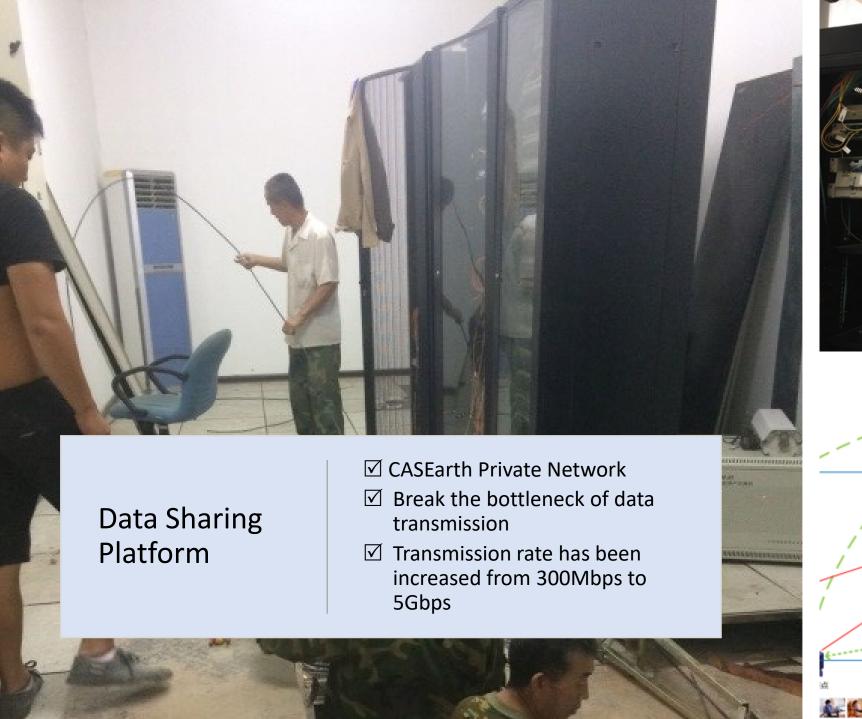
Cloud Services Big Data Storage Sub-system
Computing and Processing Sub-system
Mining Analysis Sub-system
Data Management Sub-system

Distributed Systems

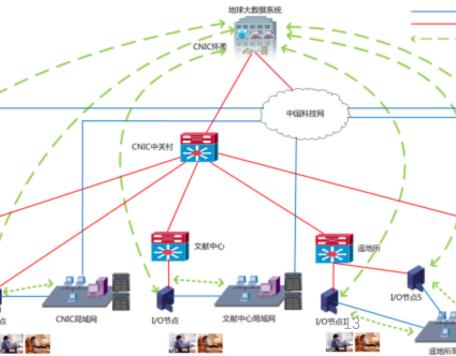
Deepbone Platform
Oceanography Big Data Platform
Spatiotemporal Three-pole Environment Platform
DATABANK Remote Sensing Data Engine
Biodiversity and Ecological Security Platform



DOI PID CSTR



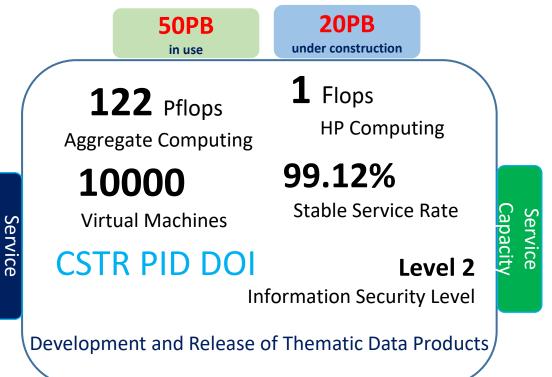




Platform

Big Earth Data Science Engineering Program (CASEarth) – Data Sharing Sub-systems





- Breakthroughs in ultra-large scale multi-source data management and analysis
- Activating and opening up open research services



Data Search and Download from CASEarth Portal https://data.casearth.cn/en/

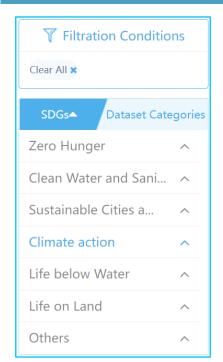
Big Earth Data Science Engineering Program (CASEarth) – Data Sharing Portal



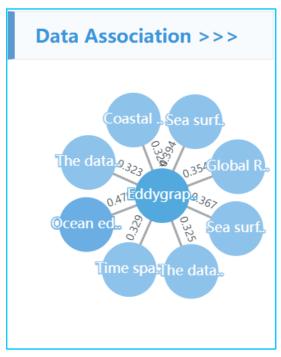
One-stop Data Sharing Portal

- ☑ Massive Earth Science data from CAS
- Aggregates data from 9 sub-projects of CASEarth
- ☑ Free data at your fingertips

Multi-disciplinary | Multi-source | PB-level



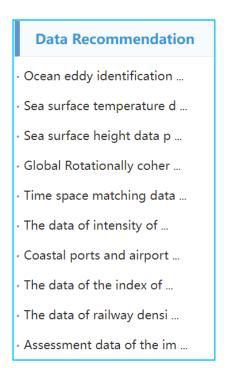
Filtration Tags



Data Association



http://data.casearth.cn



Data Recommendation

File Type	
GeoTiff(187)	XLSX(122)
shp(35)	NetCDF(20)
nc(18)	jpg(7)
txt(7)	grd(5)
word(4)	json(3)
grib2(3)	Grid(3)
csv(3)	ASCII(2)
adf(2)	IMAGE(2)
Envi(2)	pkl(2)
www.apeitroad.org File Types	

40 years Satellite image data

4.6 million scenes
Satellite image products

7.6PB Bio-ecological data 4.8PB remote sensing data

1.6PB
basic geographic data,
ground observation
data,
atmospheric and
marine data

16PB Total data

49 million
GBDB data records

360 million
lists of biological,
species in China

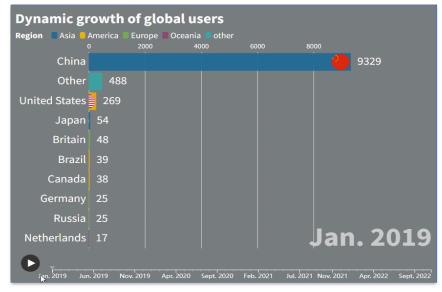
42 million microbial resource data One billion omics data

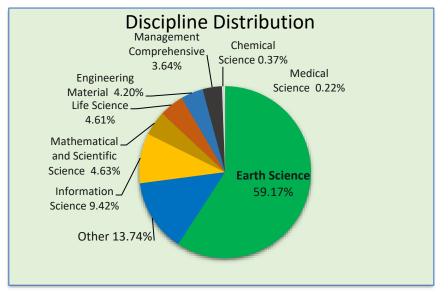
The CASEarth data sharing service system was launched on January 15, 2019. As of now, it has gathered a total of 16.4 PB of data. The system has received 570,000 unique IP visits from 174 countries and regions, amounting to over 100 million views and over 1.68 million downloads.

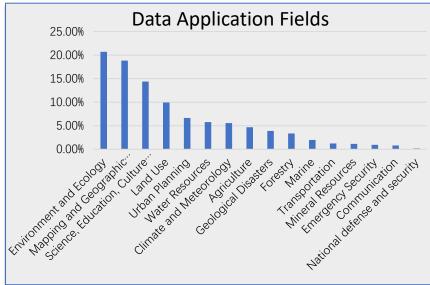


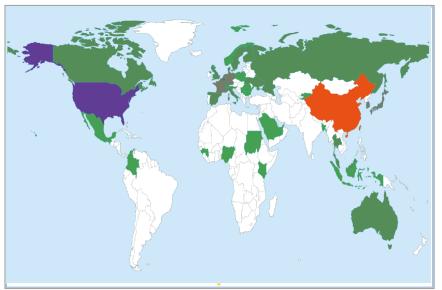
Big Earth Data Science Engineering Program (CASEarth) – Data Sharing Services for global and domestic users











The Data Sharing Service
Platform provides free Earth
science data resources that
are available for users all over
the world, mainly from China,
the United States, and Europe.
Many of these users are in the
field of Earth science.

Big Earth Data Science Engineering Program (CASEarth) – Distributed Sub-systems











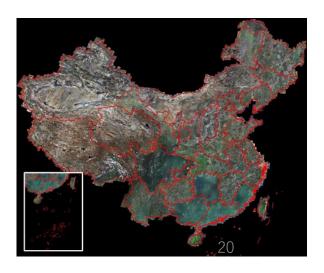
Big Earth Data Science Engineering Program (CASEarth) – Data Bank Sub-system



- Completed 500,000 scenes, 12 types per scene, and a total of about 6 million RTU products
- Phase 10 has a 30-meter resolution of global image
- Phase 4 has a 2-meter resolution of national image
- More than 20,000 scenes of RTU products in key sub-regions







Big Earth Data Science Engineering Program (CASEarth) – Data Monitoring Sub-system







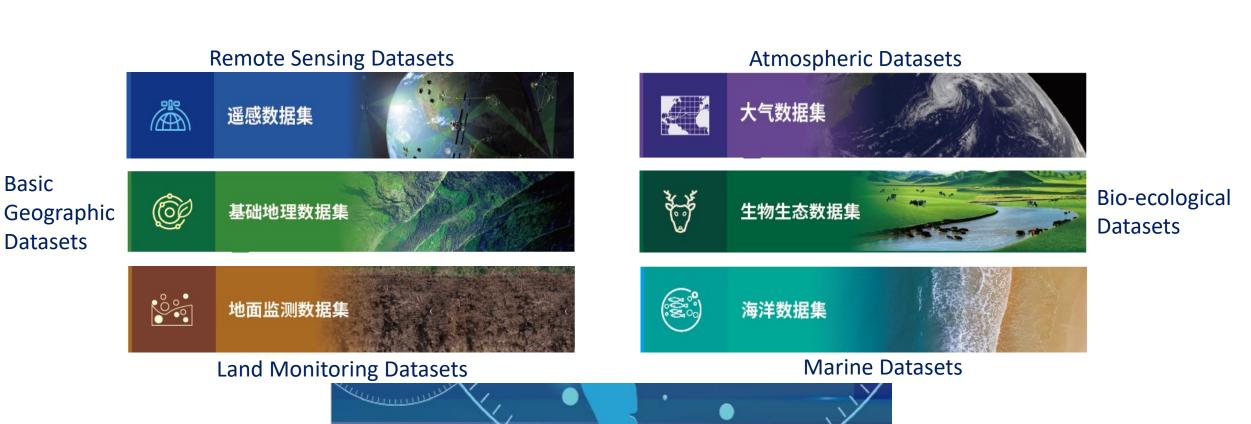
CASEarth Classification System

——Data recommendation, Data Filtration, Data association, etc.

Big Earth Data Science Engineering Program (CASEarth) – Datasets

Basic





Thematic Datasets

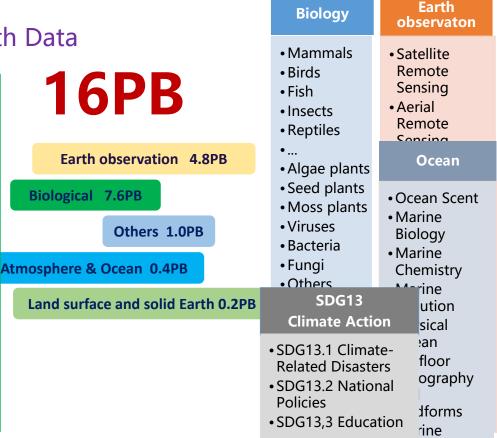
Big Earth Data Science Engineering Program (CASEarth) – Classification Systems for SDGs and Big Earth Data



For big Earth data resources, continuous and systematic methods are applied to enhance its classification systems and whole-life management. SDG Centre unifies the two classification systems for SDGs and Big Earth Data.

Discipline Classification for Big Earth Data

The **level 1 category** consists mainly of Earth system circles, which are further divided into ten major sub-circles, including atmosphere, land surface, human, biology, ocean, cryosphere, solid Earth, solar-terrestrial space physics and astronomy, and Earth observation. The **level 2 category** contains keywords for each circle, a total of 148 indicators.



Land surface Land use/cover Temperature Terrain Altitude Landforms Precipitation • Soil Humidity / Dryness Desert/Deser Evaporation Wetlands Sunlight Forests Barometric pressure Wind Surface Water Radiation **SDG2 Zero Hunger** • SDG2.1 Zero Hungernospheric • SDG2.2 End all forms of vapor

- malnutrition
- SDG2.3 Agricultural productivity and income
- SDG2.a Investment

G2.b Trade

52.c Food prices

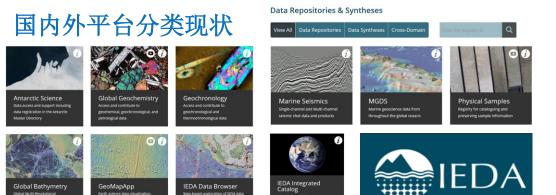
Establish a complete classification structure, principles and standards, and data coding rules for big Earth data resources.

Big Earth Data Science Engineering Program (CASEarth) – Classification Systems for SDGs and Big Earth Data



- Discipline Classification for Big Earth Data
- Classification System for SDGs

Targeting the 6 SDG goals, the level 1 category includes SDG2 Hunger Eradication, SDG6 Clean Water and Sanitation, SDG11 Sustainable Cities and Communities, SDG13 Climate Action, SDG14 Marine Resources, and SDG15 Terrestrial Ecosystems. The level 2 category contains sub-goals within each goal, a total of 60 indicators.





SDGs Level 1 Category reference: https://country-profiles.unstatshub.org/chn#goal-2

SDGs Level 2 Category reference (English):

Æarth Life

https://unstats.un.org/sdgs/indicators/Global%20Indicator% 20Framework%20after%202021%20refinement_English.xlsx

SDGs Level 2 Category reference (Chinese):

https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202021%20refinement.Chinese.xlsx

Big Earth Data Science Engineering Program (CASEarth) – Classification Systems for SDGs and Big Earth Data



Tag Extraction Technology for Big Earth Data

Based on the Internet, computer and geographic information technology, we established a service system with metadata storage and semantic recognition of Big Earth Data. The prototype system shows the interface of discipline classification and SDGs classification. By clicking the corresponding level 2 category indicators, the metadata information of the dataset can be associated, and the assigned tags are presented at the same time.

The Big Earth Data Database Repository List currently has 1,178 items provided by Aerospace Information Research Institute, CAS.

Features: word segmentation; part-of-speech tagging; adding user-defined dictionaries and many other features

Each word segmentation tool is evaluated based on its precision (P), recall (R), and F-measure (F) values to select out the one with the best performance.







Big Earth Data Science Engineering Program (CASEarth) – List of Datasets







Global and Regional Data Products

——Development and Release of Basic Data, Public Products

Development and publication of basic data, public products, and thematic Products 2022 for SDGs



□ Basic Data

Fields

Atmosphere, land surface, humanities, biology, ocean, cryosphere, solid Earth, solar-terrestrial space physics and astronomy, Earth observation, and others.

Spatial Scope

Global / Regional / National / (SDG integrated application demonstration provinces, cities and counties)

Time Range

Continuous since 2015

Data source

Particular focus on domestically produced data Standardized to meet SDG M&E requirements for quality

全球SDG大数据产品信息表(2022年)

序号	数据产品名称	数据格式	空间范围	时间跨度	时间分辨率(更新 頻率)	空间分辨率	子课題号
1	全球城市不透水面产品	栅格	全球	2015、2018、2021	三年	10米	XDA19090121
2	温室气体(CO ₂)排放产品	栅格	全球	2010-	月	10千米	XDA19080303
3	全球干旱指数产品	栅格	全球	2000-	年	1千米	XDA19030202
4	全球30木工地復置精细分 类产品 (2000\2010\2015\2020	栅格+ 矢 量	全球	2000-	五年	30米	XDA19090125
5	全球火烧迹地产品	栅格	全球	2015-	五年	30米	XDA19090300
6	全球森林覆盖及变化产品	栅格	全球	2015-	年	30米	XDA19090300
7	全球作物种植面积产品	栅格	全球	2000-2019	年	500米	XDA19080303
8	全球冰雪覆盖数据集	栅格	全球	2000-2019	年	500米	XDA19070100 XDA19070300 XDA19070500
9	全球冰雪年度覆盖百分比 产品	栅格	全球	2000-2019	年	500米	XDA19080303
10	全球水域年度覆盖百分比 产品	栅格	全球	2000-2019	年	500米	XDA19080303
11	全球归一化差值植被指数 产品	栅格	全球	2000-2019	年	500米	XDA19080303
12	全球大型地表水体透明度 产品	栅格	全球	2015、2018、2021	/	500米	XDA19080304
13	全球土地退化和恢复指标 数据集	栅格	全球	2018、2021	/	250米	XDA19090124
	全球PM2.5/PM10谣感反演 求SDG大数据产品信息表 (2022年	TIME ATTO THE COLOR	人 *** 大数据产品信息表(2022年) 中国CD	G大数据产品信息表(2	クススケン 十円曲	型区域SDG大数据产品信息

Global SDG Data Product Sheet (2022)

Development and publication of basic data, public products, and thematic Products 2022 for SDGs



□ Public data

Produce public products focusing on SDG monitoring and evaluation. The accuracy of the products shall be endorsed by international peers or of better quality than similar products worldwide.

		全球区域S	DG大数据产品	信息表(2	022年)			
序号	数据产品名称	数据 格式	空间范围	时间跨度	时间分辨率 (更新頻率)	空间 分辨率	子课題编号	负责人
1	东南亚典型示范区水稻种植区提取数据集		东南亚				项目外	张红
2	南极冰架融化等级产品		南极				项目七	张露
3	泛三极多年冻土及区域热融灾害时空分布		泛第三极				项目七	牛富俊
4	亚非沙漠蝗灾情监测与评估数据集		亚非地区				项目八	董莹莹
5	极区雪盖产品				1次/年	10m	项目一	车涛/黄艳
6	极区典型区域冰川/冰架冰裂隙产品				1次/年	10m	项目一	李新武/赵京京
7	极区河湖冰产品及典型区冰面融池产品				1次/年	10m	项目一	上官冬辉/邱玉宝
8	极区夜间灯光指数产品				1次/年	40m	项目一	王钦军/常定坤
9	东亚白额雁适宜栖息地分布数据集	栅格	东亚地区			1km	项目二	夏少霞
10	北半球物候球原型		北半球	1963- 2020年	天 (1期)	0.5° × 0.5°	项目二	戴君虎
11	南亚东南亚精细分辨率水田空间分布			2020年			项目三	曾红伟
12	非洲8个典型国家30m分辨率果园数据集		非洲地区	2020年			项目三	张淼
13	非洲30m分辨率全覆盖耕地数据集		非洲地区	2020年			项目三	张淼
14	海上丝绸之路沿线PM2.5/PM10運感反演产品		海上丝绸之路 沿线地区		每月/年		项目三	白林燕
·	全球区域SDG大数据产品信息表 (2022年) 中	T 国SDG大数i	居产品信息表 (20	22年) 「	 - 国典型区域SDG	大数据产品的	言息表 (2022年)	⊕

SDG Data Product Sheet for Global Regions (2022)
SDG Data Product Sheet for China (2022)
SDG Data Product Sheet for Typical China Regions (2022)

4



Global and Regional Data Products

——Development and Release of <u>Thematic</u> Data Products

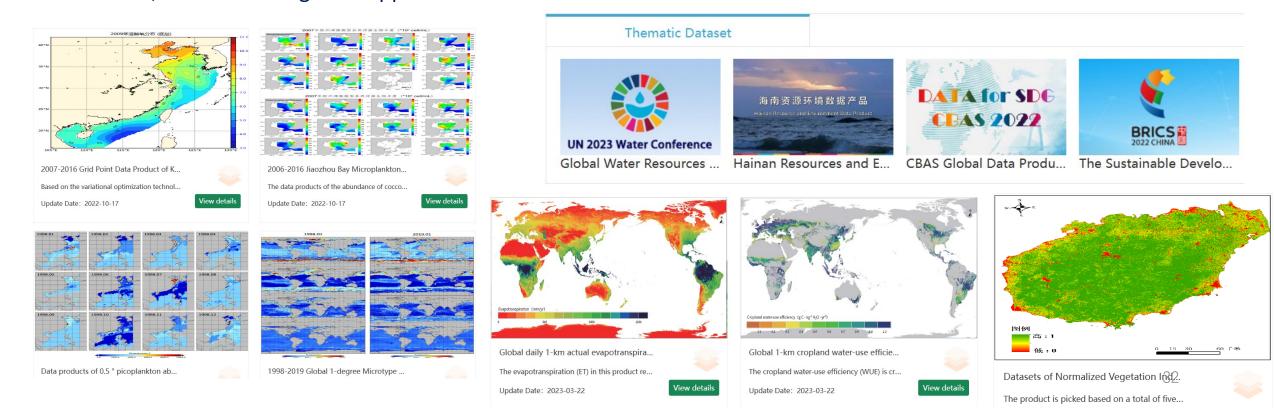
Big Earth Data Science Engineering Program (CASEarth) – Thematic Datasets



https://data.casearth.cn/thematic/brics_2022_china?lang=en_US

□Thematic

Proposed 5 products such as resource environment, biological ecology, disaster emergency, etc., that are reliable, complete in regional coverage, and have a suitable resolution for global, regional, and national SDG monitoring and assessment, as well as integrated application demonstration.



Big Earth Data Science Engineering Program (CASEarth) – Thematic Datasets







Data Products for BRICS Countries



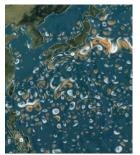
Global Water Resources
Data Products



List of biological species in China



Global surface coverage fine classification products



CBAS Global Data Products WW Global data products of ocean eddies



Global and Regional Data Products

——Development and Release of Thematic Data Products for BRICS Countries



Develop SDGSAT-1 satellite data sharing policy and open data

BAR
Digital Belt and Road

SDGSAT-1 is the world's first scientific satellite dedicated to serving the United Nations 2030 Agenda for Sustainable Development, and the first Earth observation satellite from CAS, as a part of the "Space Science (Phase II)" Pilot Project under CBAS. By following the principle of "open data", SDGSAT-1 takes full advantage of the value of data throughout its life cycle, adheres to the national scientific data sharing policy, and follows the UN 2030 SDGs as guidelines for developing open data sharing policies to support scientific research and achieve the SDGs.





Launch of the world's first sustainable development science s "SDGSAT-1"





First Earth Science Satellite of CAS

Delicate delineation of "traces of
human activities"

4 Nov. 2021 Successful launch



A Chinese Long March 6 rocket lifts off from Taiyuan Satellite Launch Centre carrying SDGSAT-1 on Nov. 4, 2021.



- Equipped with three payloads of thermal infrared, low light level and multi-spectral imageries for integrated design and multi-modal manipulation with high accuracy and the highest microscopic resolution in the world.
- ✓ Serve the SDGs and support indicator studies reflecting human-nature interactions.
- Achieve global data collection to support unbalanced development and bridge the digital divide.



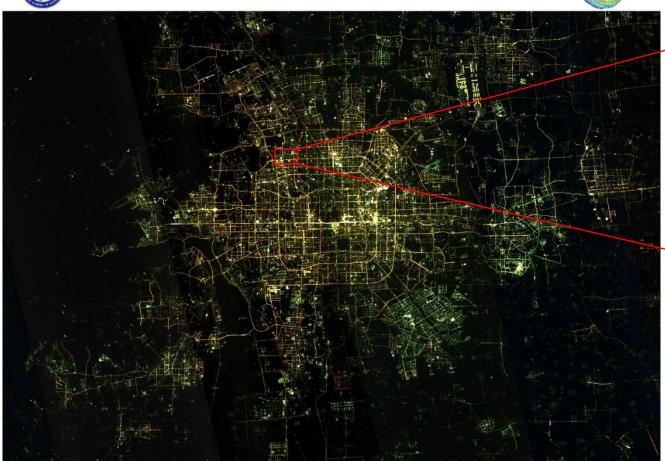
The first images of Sustainable Development Science Satellit 1 (SDGSAT-1) were officially released in Beijing on Dec. 20,





2021

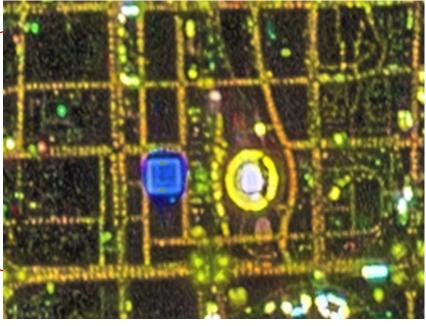
北京市微光遥感卫星影像图



可持续发展科学卫星1号(SDGSAT-1)微光成像仪 过境时间:2021年11月26日

空间分辨率:40米 波段组合:3(R)2(G)1(B)



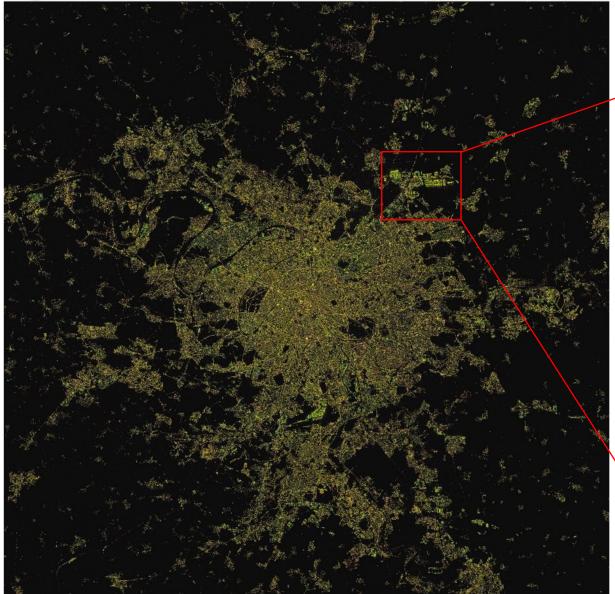


The Bird's Nest and the Water Cube

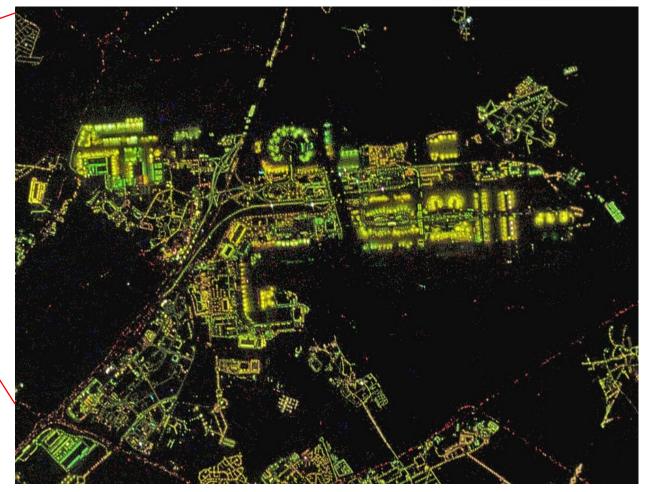
- Precisely show the city road network, buildings and other patterns.
- ☑ Clearly identify the real color scenes of the Water Cube (blue), neon lights (red) and streetlights (yellow) at night.

巴黎市微光遥感卫星影像图









De Gaulle International Airport

Synthetic color glimmer image / 10m, Paris, France www.dbeltroad.org



过境时间: 2021年11月6日

空间分辨率: 40米 波段组合: 3(R) 2(G) 1(B)





Data Product of Sustainable Development Satellite 1 (SDGSA)

1) for BRICS countries

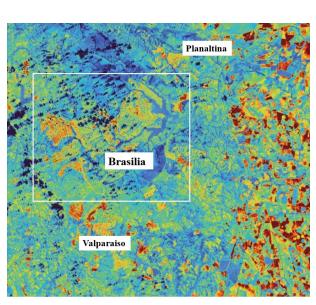


SDGSAT-1, equipped with three payloads of thermal infrared, low-light level, and multi-spectral imageries, can obtain high-quality data as well as full-time monitoring to facilitate the evaluation of SDG indicators representing the interaction between human activities and nature.









Mosco

Spatial resolution: 40 m Band combination: B3 (R) B2(G) B1(B)

New Delhi

Spatial resolution: 40 m
Band combination: B3 (R) B2(G) B1(B)

Pretoria

Spatial resolution: 40 m Band combination: B3 (R) B2(G) B1(B)

Brasilia

Spatial resolution: 30 m
Band combination: TIS B2 (10.3-11.3 µm)



Launch of SDG Data Products



Launch of SDG Data Products for Global and BRICS Countries

- SDG data products were launched at national and regional scales for global and BRICS countries. (Zero Hunger, Sustainable Cities and Communities, Climate Action, Terrestrial Life)
- SDGSAT-1 satellite data products for typical regions

Data included in annual release

- Spatial distribution of core urban built-up areas in BRICS cities with population over 300,000 in 2000-2020;
- Global 30-m impervious-surface dynamic dataset in 2000-2020;
- Global 30-m spatial distribution of forest cover in 2020;
- Global 30-m spatial distribution of cropland in 2020;
- Global 30-m cropping intensity in 2020;
- Global 30-m burned area distribution in 2020;
- Global 30-m spatial distribution of mangroves in 2000-2020;
- Data product of SDGSAT-1 for typical regions in BRICS countries in 2022;

Launch Time

Phase I: April 2022 (BIRCS Forum on Big Data for Sustainable

Development)

Phase II: September 2022 (2022 International Forum on Big Data for

Sustainable Development Goals)



Spatial distribution of core urban built-up areas in BRICS cities with population over 300,000 in 2000-2020 (One page from the brochure)

www.dbeltroad.org

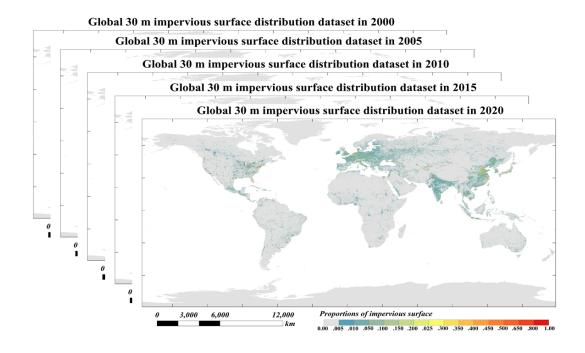


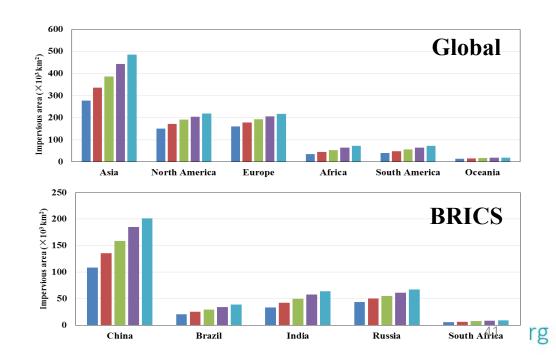
GISD30: global 30-m impervious-surface dynamic dataset from 2009

to 2020



GISD30 revealed a significant increase in the global impervious surface from 696,000 km² in 2000 to 1,107,300 km² in 2020, a 59.08% increase about 411,300 km², Meanwhile, the growth rate of the BRICS countries exceeded the global average, accounting for 40.7% of the global total increase.



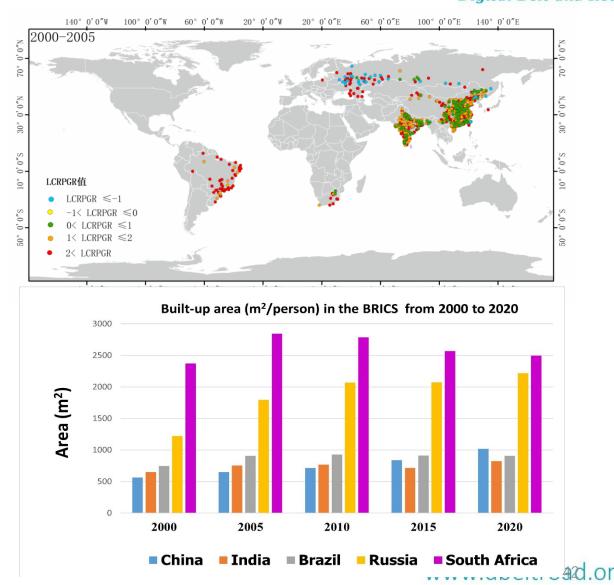






Monitoring and assessing urbanization progress in the BRICS countries from 2000 to 2020

- From 2000 to 2020, the land consumption rate (LCR) and population growth rate (PGR) of the BRICS countries shown that the urban expansion was faster than its population growth rate.
- The overall LCRPGR shows a downward trend, and there is a trend towards equilibrium in urban sustainable development, but the coordinated development of population and land urbanization still faces challenges.



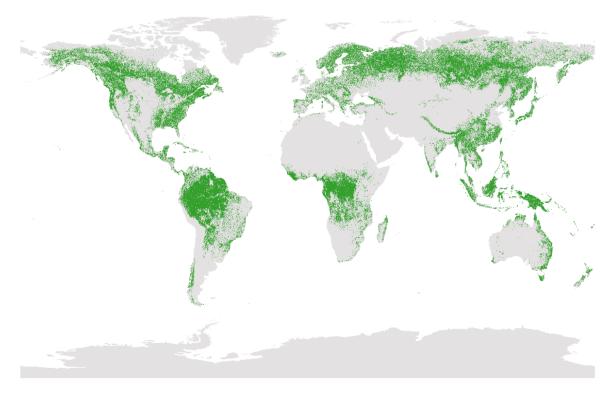




GFC30: Global 30-m <u>spatial distribution of forest coverage</u> 2020

BAR
Digital Belt and Road

- ◆ By the end of 2020, the total forest area in the world was 3.684 billion hectares, accounting for 28.03% of the total global land area, equivalent to 0.47 hectares per person.
- ◆ BRICS countries contributed 38.70%, with forest coverage reaching 36.15%, exceeding the global average.
- ◆ The validation results showed that the GFC30 dataset achieved an overall accuracy over 85%.



Global 30-m map of forest cover in 2020



Global and Regional Data Products

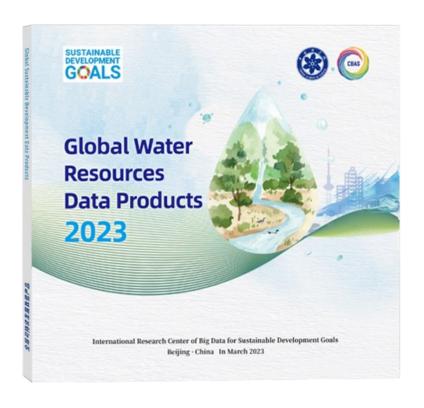
——Development and Release of Thematic Data Products for UN Water Conference 2023 to address SDG6



Global Water Resources Data Products



To serve **SDG6** monitoring and assessment, CBAS has developed **7 sets of global and regional** water resources data products. These products were presented to the President at the UN 2023 Water Conference.



- ☑ Global daily 1-km actual evapotranspiration from 2000 to 2021
- ☑ Global 1-km cropland water-use efficiency product from 2001 to 2020
- ☑ Global annual maximum land surface water cover (2000, 2005, 2010, 2015, 2021; 30m)
- ☑ Global surface water extent dynamics (2000–2020, 8-day, 250m)
- ☑ Global 500-m Forel-Ule Index product of large lakes in 2000–2021
- ☑ Algal blooms of global large lakes(2000–2021, 250m)
- ☑ Groundwater storage change in Africa (2003–2020, 0.5°)



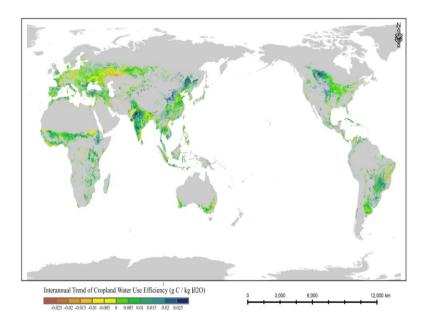
GCWUE_2001-2020: Global 1-km cropland water-use efficience

product from 2001 to 2021

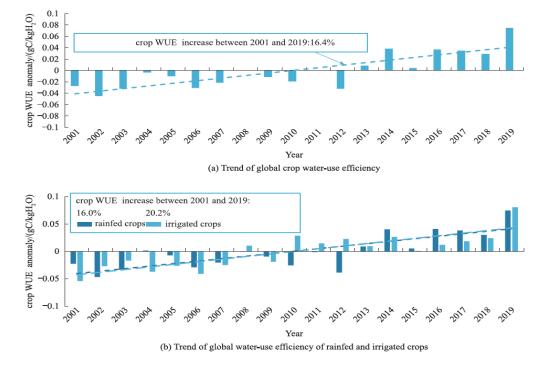
 The results showed that cropland water-use efficiency in agricultural areas around the world has increased (16.4% on global average) in the past 20 years, but there were significant spatial variations.

Similar increase can be found in rainfed and irrigated crops (by 16% and 20.2%,

respectively).



Spatial distribution of interannual trend of global cropland water-use efficiency





Global and Regional Data Products

——Development and Release of Thematic Data Products for Biodiversity and Ecological Security

Big Earth Data Science Engineering Program (CASEarth) – Release of *the List of Biological Species* in China



The 2022 edition of the List of Biological Species in China contains approximately 135,000 species and infraspecific units, including 122,000 species and 13,000 infraspecific units.

Among them, there are about 66,000 species in the animal world, 38,000 species in the plant world, and 31,000 species in the biological groups such as fungi, bacteria, pigments, protozoa and viruses.

Provide Data Support to

- □ relevant national ministries and commissions, conservation management departments at all levels, domestic and foreign research institutions, universities and enterprises, and provided core fundamental biodiversity data.
- Support a series of biodiversity-related scientific research, conservation decision-making, scientific popularization and international communication activities.
- Support the national implementation of the Convention on Biological Diversity.

Published on

May 2022 Biodiversity Day





Review of CASEarth Data Policy

——Independent Review of CASEarth Data Policy and Implementation by CODATA

Big Earth Data Science Engineering Program (CASEarth) – Open Data – FAIR Principles



•FAIR principles aim to enhance the usability and impact of data, promoting transparency, reproducibility, and knowledge sharing in the scientific community.

FINDABLE

Unique identifiers and metadata are used to allow data to be located quickly and efficiently



ACCESSIBLE

Data is open, free and universally available for research discovery efforts



REUSABLE

All data is clearly described and outlines associated data-use standards



INTER-OPERABLE

A common programming language is used to allow use in a broad range of applications



Big Earth Data Science Engineering Program (CASEarth) – CASEarth Data Sharing Policy

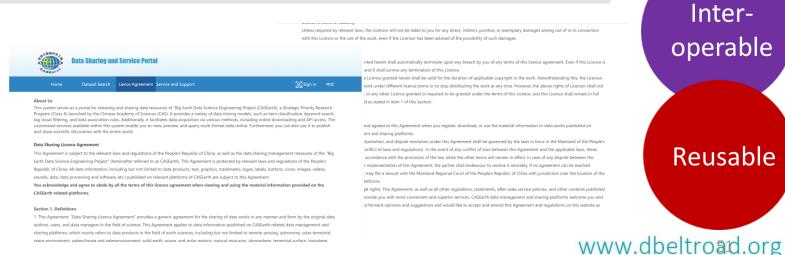


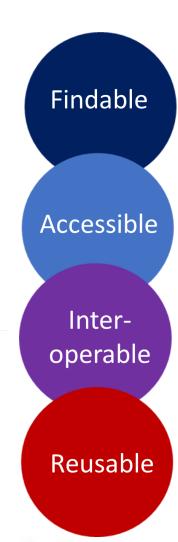
Open science and Open data

CBAS has established a platform for data-sharing under the full-life-circle data management, with an aim to continuously support the SDGs as outlined in the UN 2030 Agenda, global development initiatives, and global climate and environmental hotspots. As such, CBAS is now a leading practitioner in the development of scientific discovery driven by open data.



There will be some measures taken if CASEarth data policies are violated. Please view the *data sharing license agreement* for more details (https://data.casearth.cn/en/statement).





Big Earth Data Science Engineering Program (CASEarth) – Independent Review of CASEarth Data Sharing Policy by CODATA Belt and Road

Opening Big Data for a Sustainable Future: Review of the CASEarth Program's Data Policy

CODATA conducted an independent 1.5-year review of CASEarth's Data Policy and Implementation. The consultants recognized that CASEarth has made great contributions to developing advanced SDG data products that support decision making and scientific research.



Simon HODSON

Executive Director of CODATA; Vice-chair of the UNESCO Open Science Advisory Committee;



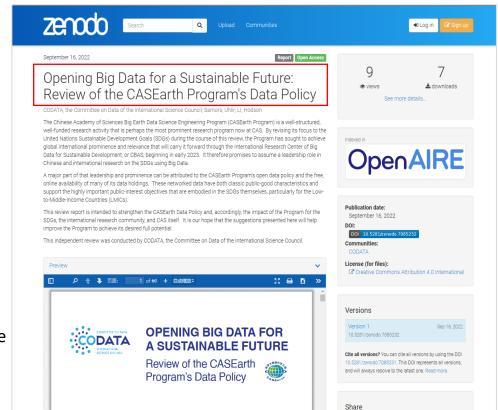
Robert SAMORS

Senior Scholar for the APARD Initiative; Coordination Officer for e-I&DM Project; Senior External Relations Manager in GEO;



Paul UHLIR

Founder and former Director of the Board on Data and Information of NAS; Past Chair of the CODATA Data Policy Committee;





Big Earth Data Science Engineering Program (CASEarth) – Recent Reports



"Scientific Data Management Plan (2021)"

"Monthly Data Sharing Report for Big Earth Data"

"Annual Data Sharing Report for Big Earth Data (2020)"

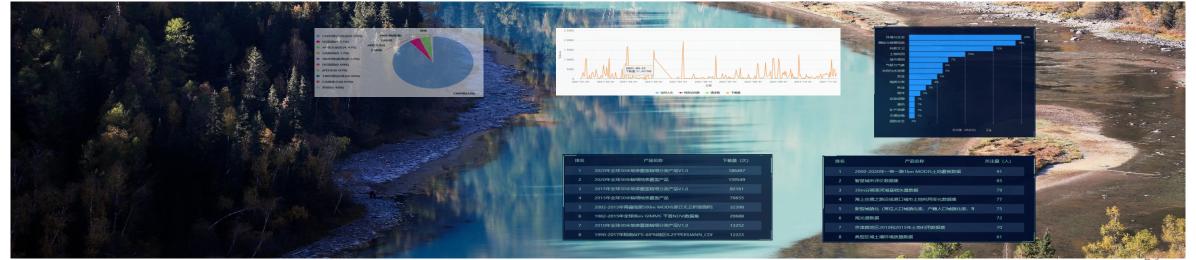
"List of Shared Datasets 2020"

"Data Assessment Report 2020"

"Opening Big Data for a Sustainable Future – Review of the

CASEarth Policy"





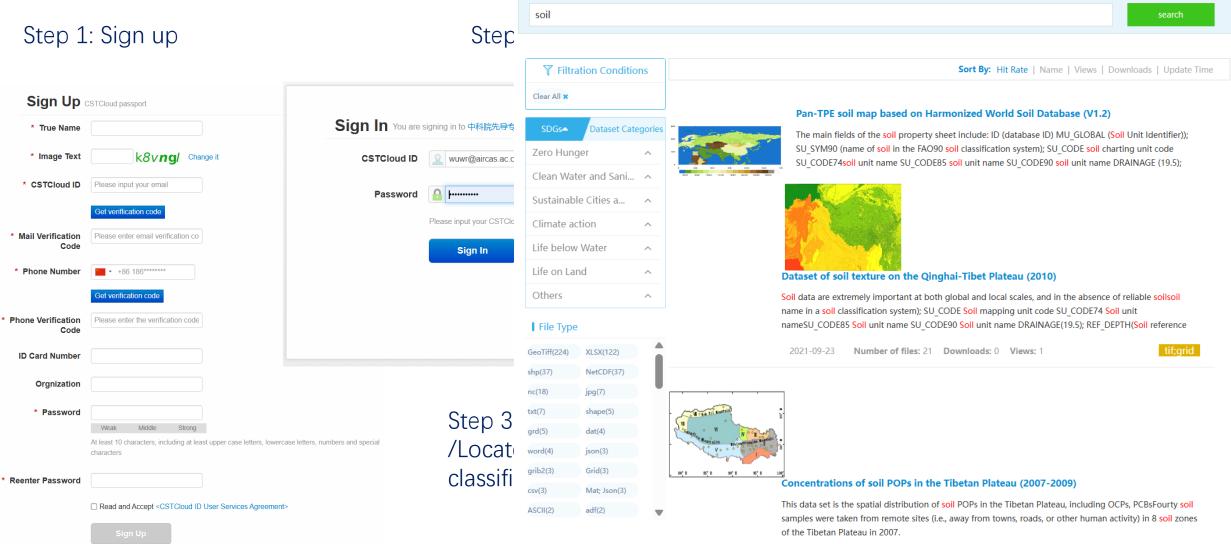


Practical Guide to CASEarth Data Sharing Platform

——Registration/Data Search/Data Download

Big Earth Data Science Engineering Program (CASEarth) – Guide to the Data Sharing Service Portal





Big Earth Data Science Engineering Program (CASEarth) – Guide to the Data Sharing Service Portal



Step 4: Data Download

1990 global 30m surface coverage fine classification products

Release Date: 2021-09-23

Data Identification

DOI: 10.12237/casearth.6123651428a58f70c2a51e43 CSTR: 31104.11 casearth 6123651428a58f70c2a51e43 PID: 21.86109/casearth.6123651428a58f70c2a51e43

Land-cover is an indispensable basic information for climate change research, ecological environment assessment and geographical situation monitoring. In recent years, with the continuous improvement of Remote Sensing Science and technology and computer storage and computing capacity, the application demand of long time-series global 30m land-cover dynamic monitoring products is becoming more and more urgent. To achieve the goal of automatically monitoring long time-series global 30-m land-cover dynamics, we used our newly global 30-m landcover products with fine classification system in 2020 (GLC FCS30-2020) as the benchmark reference dataset, and then proposed a novel and automatic land-cover monitoring strategy by coupling with continuous land-cover change detection models with the dynamic updating algorithms, and finally produced the time-series global 30-m land-cover dynamic monitoring products (every 5-years) using the continuous time-series Landsat imagery. It should be noted that our global land-cover dynamic monitoring products inherited the classification system of GLC_FCS30-2020, containing 29 land-cover types. I Zhang, X., Liu, L., Chen, X., Gao, Y., Xie, S., Mi, J., 2021. GLC_FCS30: global landcover product with fine classification system at 30 m using time-series Landsat imagery. Earth Syst. Sci. Data 13, 2753-2776, https://doi.org/10.5194/essd-13-2753-2021. Zhang, X., Liu, L., Wu, C., Chen, X., Gao, Y., Xie, S., & Zhang, B. (2020), Development of a global 30 m impervious surface map using multisource and multitemporal remote sensing datasets with the Google Earth Engine platform, Earth System Science Data, 12, 1625-1648. https://doi.org/10.5194/essd-12-1625-2020. Liu, L., Zhang, X., Gao, Y., Chen, X., Shuai, X., Mi, J., 2021. Finer-Resolution Mapping of Global Land Cover; Recent Developments, Consistency Analysis, and Prospects, Journal of Remote Sensing 2021, 1-38.

Liangyun Liu, Xiao Zhang. 1990 global 30m surface coverage fine classification products. Beijing: Aerospace Informatio n Research Institute, Chinese Academy of Sciences,2021.doi:10.12237/casearth.6123651428a58f70c2a51e43

Start Date: 1985-01-01 End Date: 1990-12-31 Spatial Resolution: 30m Time Resolution: 5 years Geographical Scope: Global land area Sharing Method: Public share

The copyright of this dataset is owned by the Institute of Aerospace Information, Chinese Academy of Sciences. Users can use these data for free for scientific research. Research results need to indicate the source of the data. The data may not be used for commercial purposes

Product Number: XDA19090125 003

Create Institution:

Aerospace Information Research Institute, Chinese Academy

of Sciences

Created By: Chinese Academy of Sciences Creation Date: 2022-03-30 Liangyun Liu, Xiao Zhang

File Size: 963

Downloads: 401 Data Format: GeoTi

Type Of Data: Raster

Storage Capacity: 20.48GB

Add label, confirm with Enter

File Name Aerospace Information Research Institute File name Chinese Academy of 5 2020 UserGuid Phone: 010-82178163 liuly@radi.ac.cn 5 2020年全球30分 Data Association >>> 0 E0N10.tif 0 E0N15.tif 0 E0N20.tif 0 E0N25.tif Data Recommendation · 1985 global 30m surface c ... 0 E0N30.tif 1995 global 30m surface c. 2000 global 30m surface c __ 0 E0N35.tif 2005 global 30m surface c · 2010 global 30m surface c ... 0 E0N40.tif · 2015 global 30m surface c .. 2020 global 30m surface c __ 0 E0N45.tif Global land surface water National Land Cover Class · 0.25°Global near-surface .. otal 963 records API

otal 0 records

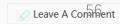
File Name

File name	File size	Date	operation
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GLC_FCS30_1990_E0N55.tif	11.87MB	2021-09-23	Preview Metadata Downloads FileID
GLC_FCS30_1990_E0N65.tif	4.47MB	2021-09-23	Preview Metadata Downloads FileID
GLC_FCS30_1990_E100N0.tif	29.45MB	2021-09-23	Preview Metadata Downloads FileID
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GLC_FCS30_1990_E100N35.tif	31.14MB	2021-09-23	Preview Metadata Downloads FileID

Current page 2, total 963 records first page « User Comment(0) API

Current page 1, total 0 records

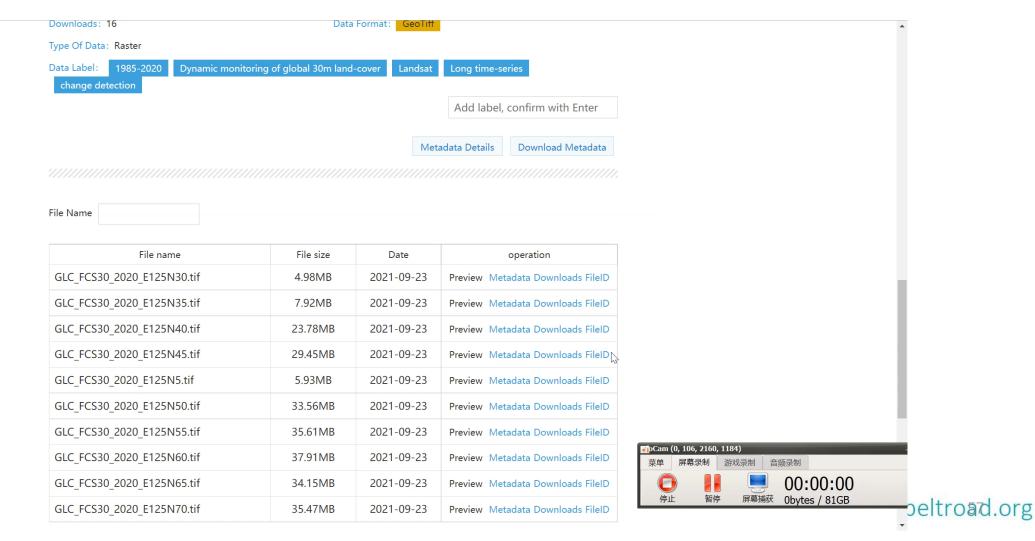
Rating



Big Earth Data Science Engineering Program (CASEarth) – Guide to the Data Sharing Service Portal

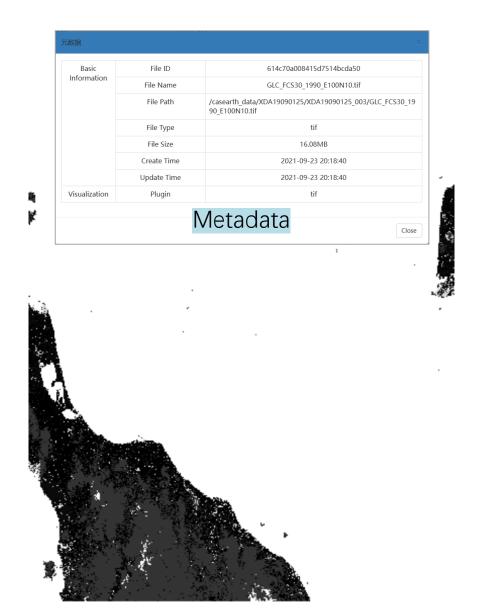


Step 4: Data Download

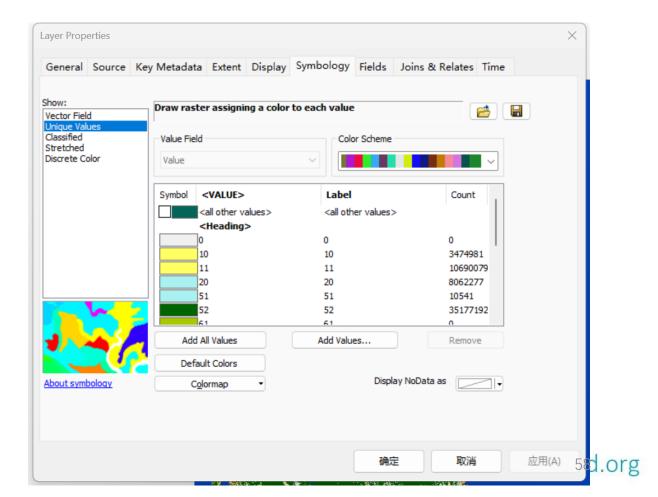


Big Earth Data Science Engineering Program (CASEarth) – Guide to the Data Sharing Service Portal – Case Study





Step 5: Viewing and Processing data using ArcGIS or ENVI



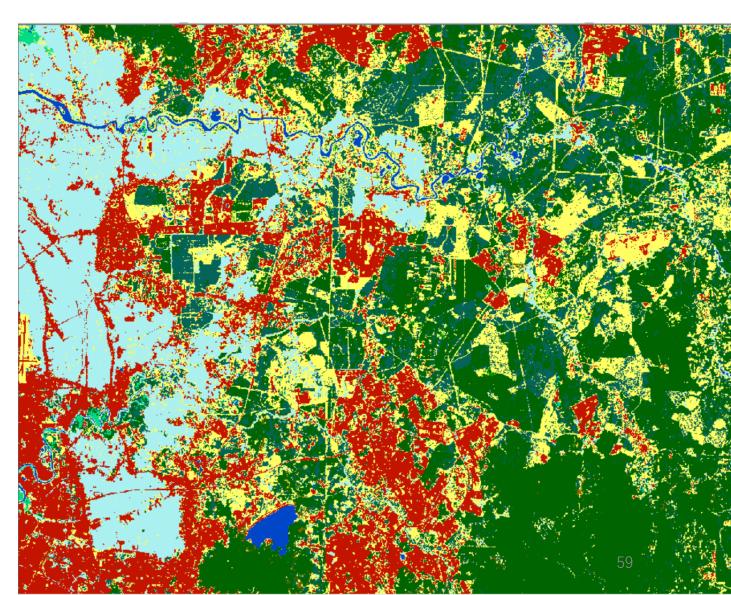
Big Earth Data Science Engineering Program (CASEarth) – Guide to the Data Sharing Service Portal – Case Study



Step 5: Viewing and Processing data using ArcGIS or ENVI

> Classification system

LC id	Classification System	Color
10	Rainfed cropland	(255,255,100)
11	Herbaceous cover	(255,255,100)
12	Tree or shrub cover (Orchard)	(255,255,0)
20	Irrigated cropland	(170,240,240)
51	Open evergreen broadleaved forest	(76,115,0)
52	Closed evergreen broadleaved forest	(0,100,0)
61	Open deciduous broadleaved forest (0.15 <fc<0.4)< td=""><td>(170,200,0)</td></fc<0.4)<>	(170,200,0)
62	Closed deciduous broadleaved forest (fc>0.4)	(0,160,0)
71	Open evergreen needle-leaved forest (0.15< fc <0.4)	(0,80,0)
72	Closed evergreen needle-leaved forest (fc >0.4)	(0,60,0)
81	Open deciduous needle-leaved forest (0.15< fc <0.4)	(40,100,0)
82	Closed deciduous needle-leaved forest (fc >0.4)	(40,80,0)
91	Open mixed leaf forest (broadleaved and needle-leaved)	(160,180,50)
92	Closed mixed leaf forest (broadleaved and needle-leaved)	(120,130,0)
120	Shrubland	(150,100,0)
121	Evergreen shrubland	(150,75,0)
122	Deciduous shrubland	(150,100,0)
130	Grassland	(255,180,50)
140	Lichens and mosses	(255,220,210)
150	Sparse vegetation (fc<0.15)	(255,235,175)
152	Sparse shrubland (fc<0.15)	(255,210,120)
153	Sparse herbaceous (fc<0.15)	(255,235,175)
180	Wetlands	(0,220,130)
190	Impervious surfaces	(195,20,0)
200	Bare areas	(255,245,215)
201	Consolidated bare areas	(220,220,220)
202	Unconsolidated bare areas	(255,245,215)
210	Water body	(0,70,200)
220	Permanent ice and snow	(255,255,255)
250	Filled value	(255,255,255)



Follow CBAS



https://data.casearth.cn/

http://www.cbas.ac.cn/en/

http://www.casearth.com/

Contact Us

datasharing@aircas.ac.cn

Thanks

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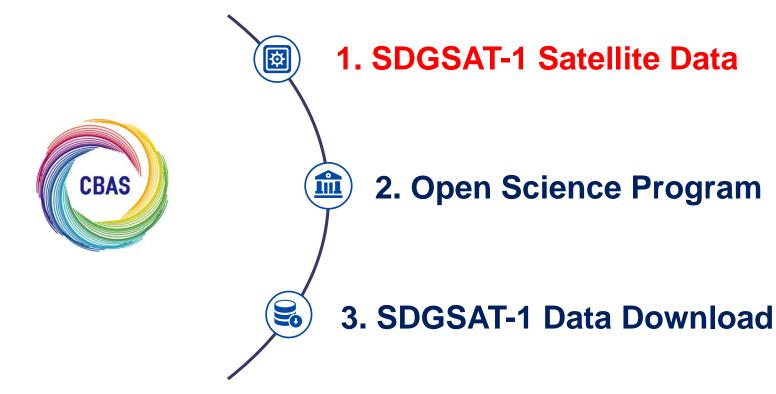
SDGSAT-1: Satellite and Open Science Program

Yunwei TANG

2023-5-29

Outlines





SDGSAT-1 Scientific Satellite







Synergetic observation by three sensors, with 300km swath width

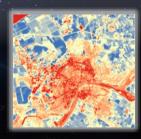
- ➤ Glimmer: 10m panchromatic & / 40m RGB
- > TIR: 3 bands, 0.2K temp. recognition
- ➤ Multispectral: 2 deep blue &1 red edge bands



Multispectral



Glimmer



Thermal Infrared





Technical Specifications



Designed life: 3 years

Orbit type: sun-synchronous

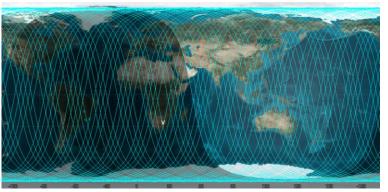
❖ Orbit altitude: 505 km

Orbit inclination angle: 97.5°

Swath width: 300 km

Data collect mode: TIR+Glimmer (night), TIR+Multispectral (day), and single sensor.





Tracks of satellite nadir points of SDGSAT-1

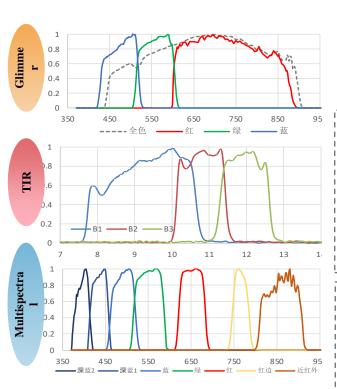
Digital Belt an				
Туре	Index	Specifications		
Thermal Infrared	Bands	8~10.5 μm 10.3~11.3 μm 11.5~12.5 μm		
Spectrom eter	Spatial Resolution	30 m		
	Bands /Glimmer	P: 444~910 nm B: 424~526 nm G: 506~612 nm R: 615~894nm		
	Resolution /Glimmer	P: 10 m, RGB: 40 m		
Glimmer /Multispe ctral Imager	Bands /Multispectral	B1: 374 nm~427 nm B2: 410 nm~467 nm B3: 457 nm~529 nm B4: 510 nm~597 nm B5: 618 nm~696 nm B6: 744 nm~813 nm B7: 798 nm~911 nm		
	Resolution /Multispectral	10 m		

www.dbeltroad.org

Characteristics of SDGSAT-1



◆ The world's best comprehensive performance indicator for its wide swath width and high spatial resolution



Innovation design

- 10m/40m
- 10m (PAN) + 40m (color)
- 300km

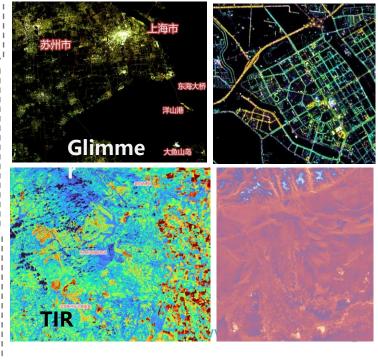
Highest ratio of swath width and spatial resolution

- 30m
- 0.2°C (@300K)
- 3 bands
- 300km

Advantage in monitoring water and vegetation

- 2 deep blue
- 1 red edge
- 300km

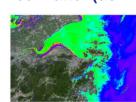
Depict traces of anthropic activities

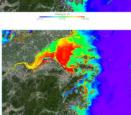


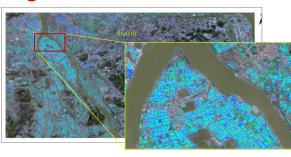
Multispectral Sensor: water monitoring

- Corresponding indicator:
 - SDG 6 water environment
 - SDG 14 marine environment
- Advantage: 10m, 300km wide, 2 deep blue bands, 1 red edge band

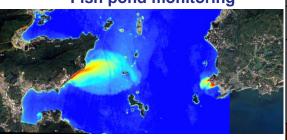
Chlorophyll-a (up) and total suspend ed matter (down)







Fish pond monitoring



Outfall monitoring

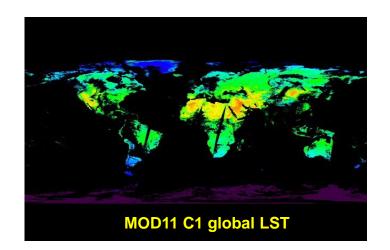
Landsat	-8 OLI	Sentinel-2		SDGSA		
Spectral range (µm)	Resolutio n (m)	Spectral range (µm)	Resolutio n (m)	Spectral range (µm)	Resolution (m)	AR d Road
				0.380-0.420	10	
0.43-0.45	30	0.430-0.457	60	0.420-0.460	10	Deep Blue
						Diao
0.450-0.515	30	0.480-0.500	10	0.460-0.520	10	Blue
0.525-0.600	30	0.537-0.583	10	0.520-0.600	10	Green
0.630-0.680	30	0.655-0.685	10	0.630-0.690	10	Red
		0.695-0.715	20			rtou
		0.731-0.749	20			
		0.765-0.793	20	0.765-0.805	10	Red
						edge
		0.837-0.847	10	0.805-0.900	10	NIR
0.845-0.885	30	0.855-0.875	20			d.org

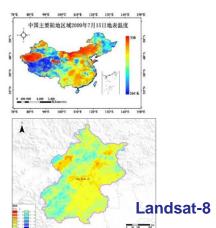
TIR Sensor: fine-scale temperature distribution

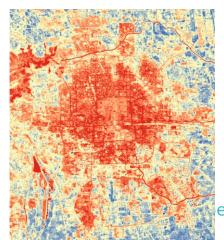


- Corresponding indicator:
 - SDG 2 sustainable agriculture,
 - SDG 6/14 water environment
 - SDG 11 city environment
- Advantage: 30 m (highest resolution for civil use), 300km wide, 3 bands

Satellite	Landsat-8		MODIS-1B		SDGSAT-1		
TIR band	10	11	31	32	1	2	3
Center wavelength (µm)	10.9	12	11.03	12.02	9.35	10.73	11.72
Spectral range (µm)	10.6-11.2	11.5-12.5	10.78- 11.28	11.77- 12.27	8-10.5	10.3-11.3	11.5-12.5
Swath width (km)	185 100		2330		300		
Resolution (m)			1000		30		







SDGSAT-1 eltroad.org

Glimmer Sensor: explore the intensity and state of urban economic activity at night



SDGSAT-1

- Corresponding indicator: SDG
 11 Sustainable Cities and
 Communities
- Advantage: 10 m Pan/40m RGB, 300km wide, high dynamic range

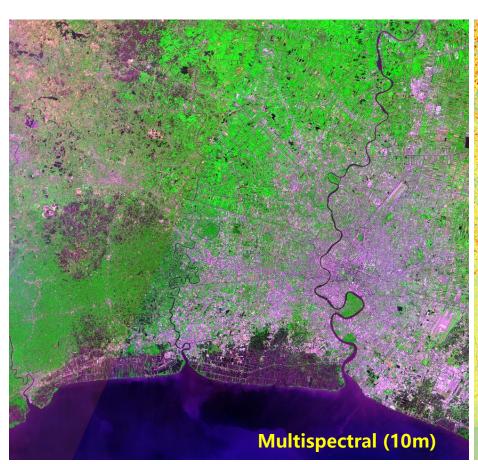
	Data	VIIRS	LJ1-01	DMSP/OL S	ISS	FY-3E	SDGSAT-1
	Spectral range (nm)	505- 890	480-800	400-900	400-1000	500-900	424-900
· [Swath width (km)	3000	260	3000	200	2500	300
	Resolution (m)	541	130	2700	400	1000	RGB40 / P10

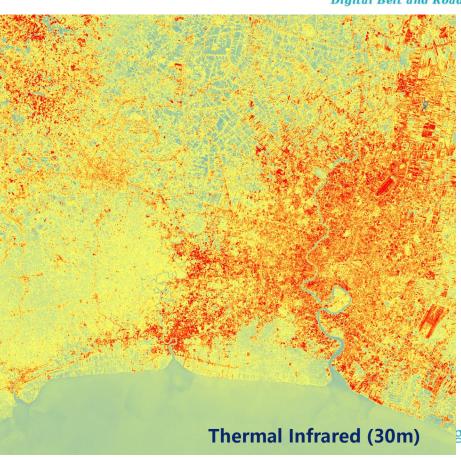


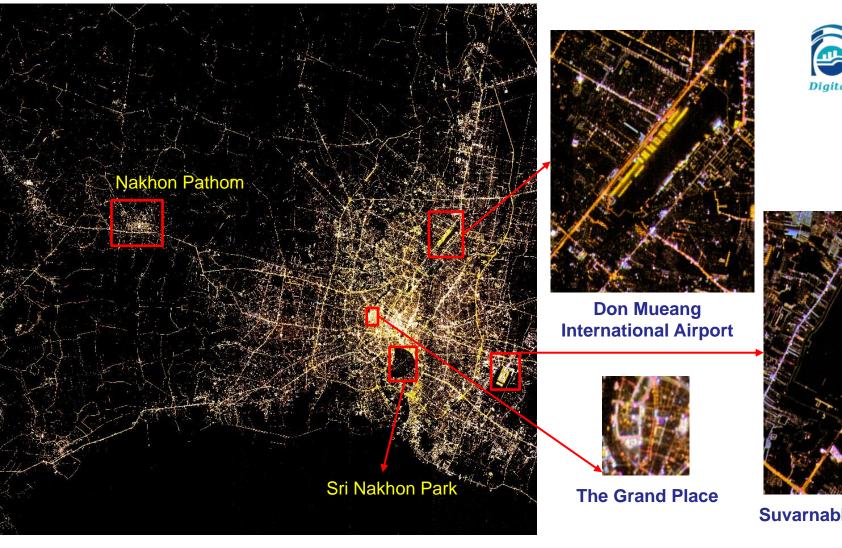


Images of Bangkok













Suvarnabhumi Airport

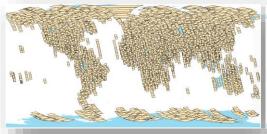
Data Storage



About 90,000 images and 168TB of L4 data has been acquired by SDGSAT-1

Data statistics (by May 15, 2023)

Sensor	Level	Scene #	
Glimmer	L4A	13,477	
Multispectral	L4A/L4B	16,061	
TIR	L4A/L4B	60,632	
Tot	90,170		





Thermal Infrared datasets coverage (Night)

Thermal Infrared datasets coverage (Day)



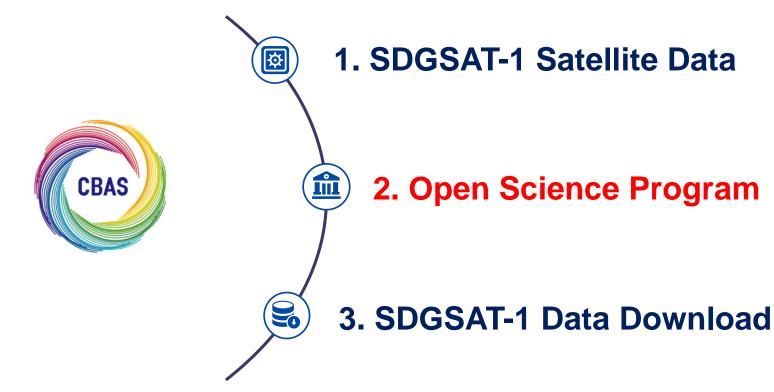




Glimmer datasets coverage www.dbeltroad.org

Outlines







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

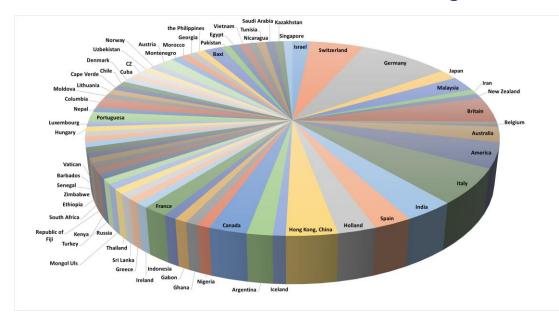
SDGSAT-1 Open Science Program



www.sdgsat.ac.cn



More than 90,000 SDGSAT-1 images shared with scientists from 70 countries and regions



It is one of the seven practical measures to implement the deliverables of the Global Development High-Level Dialogue.

Purpose of the Program



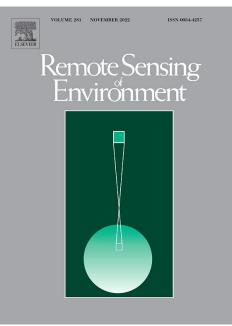
- The program aims to promote multi-disciplinary research on social, environmental and economic dimensions of SDGs and fill in existing data gaps limiting progress towards SDGs.
- SDGSAT-1 Open Science Program is well suited to support the development of scientific applications and publicly accessible SDG products.

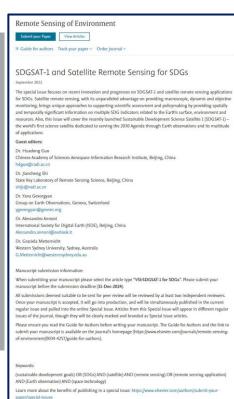
We will skip the proposal reviewing process and authorize the access to the SDGSAT-1 data after registration.

Special issues of SDGSAT-1



IF: 13.85





Interested in becoming a guest editor? Discover the benefits of guest editing a special issue and the valuable

contribution that you can make to your field: https://www.elsevier.com/editors/role-of-an-editor/guest-editors

IF: 4.61



Special Issue Editor(s)

- Dr. Peter Atkinson, Faculty of Science and Technology, Lancaster University
- Dr. Zongming Wang, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences zongmingwang@neigae.ac.cn
- Dr. Rosa Lasaponara, Italian National Research Council
- Dr. Evangelos Spyrakos, Department of Biological and Environmental Sciences, University of Stirling evangelos.spyrakos@stir.ac.uk
- Dr. Changyong Dou, International Research Center of Big Data for Sustainable Development Goals (CBAS)

Innovative approaches and applications on SDGs using SDGSAT-1

The Earth is facing challenges in sustainable development. Rapid urbanization, land degradation, water shortages, food security, frequent occurrences of disasters, huge ecosystem changes, et., at lall aff or systematic and innovative solutions to overcome them. Adopted by the UN General Assembly in 2015, the UN 2030 Agenda for Sustainable Development (2030 Agenda) with is 17 Sustainable Development (2030 Agenda) with is 17 Sustainable Development (2030 Agenda) with is 17 Sustainable Development calos (SOGs), serves as an overall framework to shape a prosperous and bright future and to guide global development directions. However, some challenges, such as the lack of data, insufficient research methods, and uneven development, still hinder the progress of the global achievements of the SDCs.

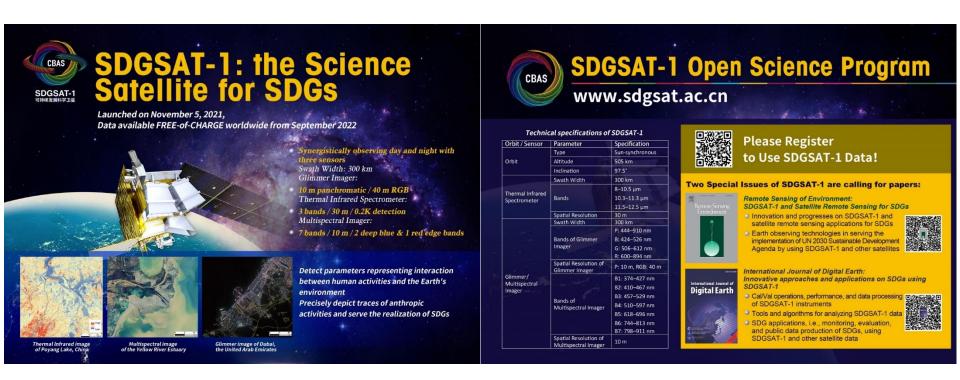
Earth observation, with its unparalleled advantages in providing macroscopic, dynamic, and objective monitoring, brings effective measures to support scientific assessment and policymaking by providing spatially and temporally valuable knowledge on SDGs related to environment, socioeconomic development, and human activities. The successful launch of the Sustainable Development Science Satellite 1 (SDGSAT-1), the world's first science satellite dedicated to serving the implementation of the 2030 Agenda, made a significant step in practicing the aforementioned ideas. In the need for monitoring, evaluating, and studying SDG indicators, especially those representing human-environment interactions, SDGSAT-1 aims to depict traces of anthropogenic activities through synergistic observation with its three sensors, i.e., the Thermal Infrared Spectrometer, Glimmer Imager, and Multispectral Imager, throughout the day and night, providing high-quality data to facilitate the achievement of SDGs. To promote multi-disciplinary research on the social, economic, and environmental dimensions of SDGs and fill existing data gaps limiting progress towards SDGs, the SDGSAT-1 Open Science Program (www.sdgsat.ac.cn) was launched in September 2022. The data acquired by SDGSAT-1 will be available free of charge globally, underpinning the potential values of SDGSAT-1 in accelerating the achievement of SDGs. This collection focuses on recent innovations and progress on SDGs using data from SDGSAT-1 and other satellites to validate the effectiveness and capability of SDGSAT-1 for monitoring and evaluating SDG indicators.

The scope of this special issue includes, but is not limited to, the following topics:

- Cal/Val operations, performance, and data processing of SDGSAT-1 instruments
 SDG applications of SDGSAT-1, including individual applications using SDGSAT-1's single sensor or integrated applications using SDGSAT-1's multi-sensors and other satellites
- . Tools and algorithms for analyzing SDGSAT-1 data
- Monitoring, evaluation, and public data production of SDGs using SDGSAT-1 and other
 The data are supplied to the supp

Welcome to use our data!





Alliance of Sustainable Development Goals Satellites (ASSA)





SDGSAT Series

1 satellite, SDGs, TIS/Nighttime Light/ Multispectral











Gaofen Satellite Series (GF-)

28 satellites, Mapping/Resources, Optical/Laser /SAR





Global Development Initiative (GDI)



• Fengyun Satellite Series (FY-)

7 satellites, Meteorological /Climate, Optical/Thermal Infrared







●Haiyang Satellite Series (HY-)

6 satellites, Ocean Dynamics/Color, Optical/Microwaves





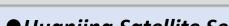


• Ziyuan Satellite Series (ZY-)

7 satellites, Land Resource Optical/SAR/Hyperspectral















2 satellites, Land Detect, SAR



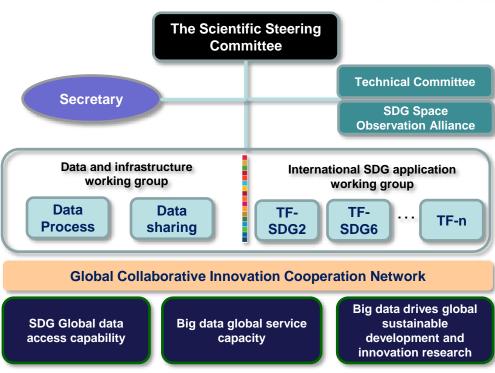


- Constructing data products and evaluation system;
- Producing global public data products and organizing application research targeting for global SDGs.

Space Technologies for Sustainable Development Goals (STS)

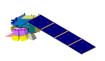


- Establish an international research team, formulate cooperation roadmap, and provide top-level design and action guidance;
- Construct a sustainable development satellite collaborative observation network, and cultivate global fullcoverage, full-spectrum, all-day, nearreal-time, three-dimensional SDG data acquisition capability;
- Build a global academic exchange platform and an S&T cooperation network for spatial observation with relevant institutions and academic organizations all over the world.



STS Organizational Framework

www.dbeltroad.org

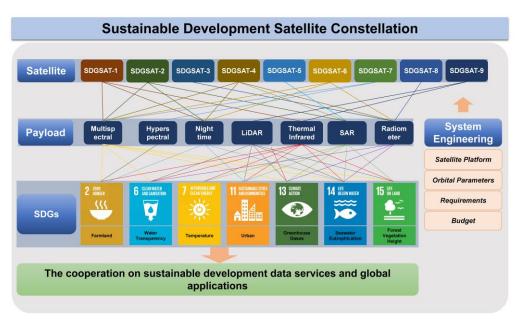


Sustainable Development Satellite Constellation Plan



- Developing and operating series of SDG satellites constellation
- The cooperation on SDG data services and global applications
- The global collaborative Earth Observation network for SDGs

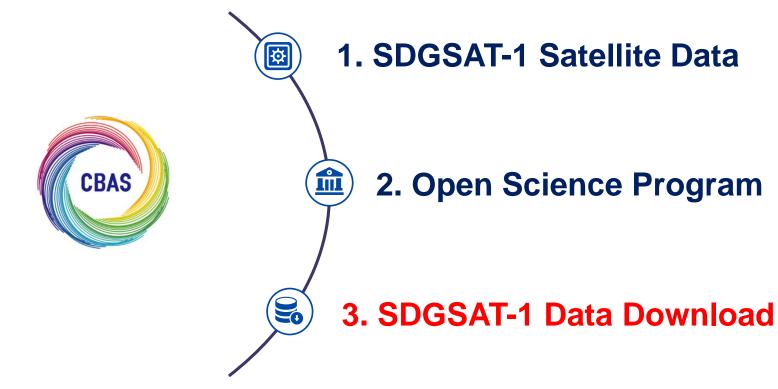




Launching a Sustainable Development Satellite Constellation Plan, developing and sharing data and information for Sustainable Development Goals monitoring. -Deliverables of the High-level Dialogue on Global Development (24 June 2022)

Outlines





Website guidance www.sdgsat.ac.cn





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

SDGSAT-1 OPEN SCIENCE PROGRAM
SDGSAT for UN Sustainable Development Goals



Home

Open Science Program

SDGSAT-1 Mission

User Guide

Contact us



Purpose and application



Proposal template

Satellite product introduction



Users' manual

FAQs & documents



Operating manual

Website function



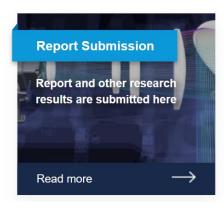
Main function modules:

- Proposal Submission: submit proposal to apply for SDGSAT-1 data
- Data Access: browse and download image data
- SDGSAT-1 Acquisition: programming data acquisition
- Report Submission: report and data product submission



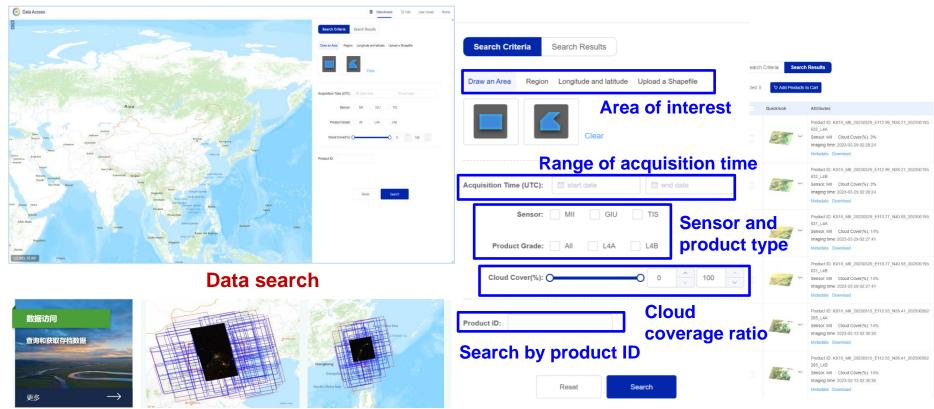






Data search and download





Module portal

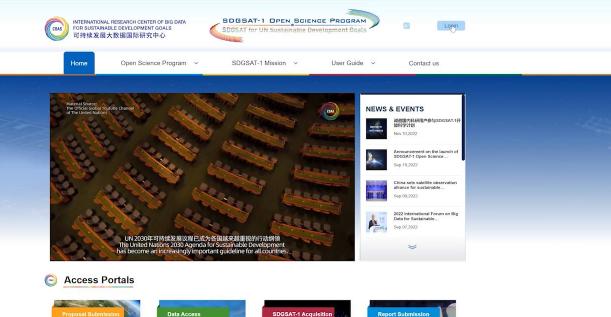
Search results

Search criteria setting

Results list

Demonstration







Proposals for archieve data and programming data are





Access to SDGSAT-1 data

Read more



Read more







Read more

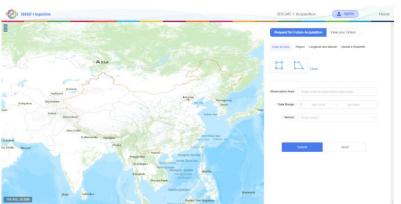
Report and other research results are submitted here

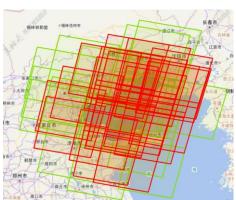


Data usage

BAR
Digital Belt and Road

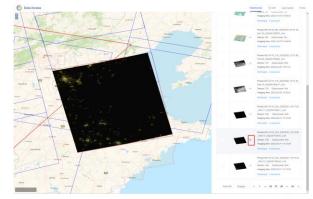
- The acquired data can only be used for scientific research.
- The amount of data requested should be within the confines of the study area and scope of the research.
- The data requests are also expected to remain within reasonable spatial and temporal limits of the research.







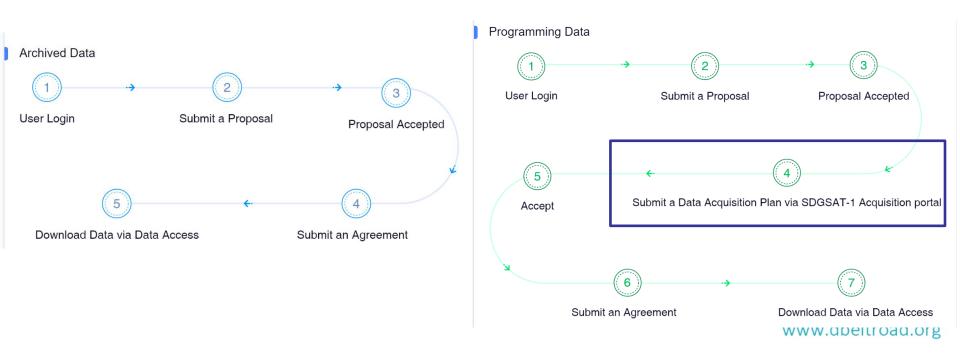
Key areas



Archived Data and Programming Data



Applicants can have access to two types of data: archived data and programming data (i.e., the data acquired according to the request of the applicant).



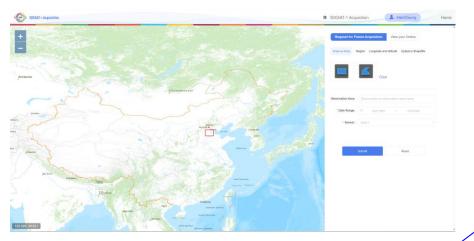
Customized Data Requirement Service

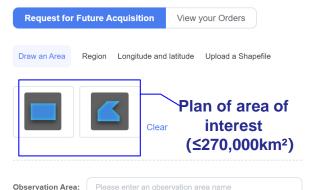




Data Acquisition Plan







Date Range:

* Sensor:



SDGSAT-1 Acquisition

for programming Data

Portal

Manager will review the acquisition plan according to the satellite transit and weather condition

Data acquisition website



Satellite orbit in the area of interest

- Setting date range
- Selection sensors:
- TIR+Multispectral;
- TIR+Glimmer;
- TIR
- Multispectral
- Glimmer



Acquisition criteria setting

www.dbeltroad.org

What is next?



- How to process SDGSAT-1 image?
- What can SDGSAT-1 data do?
- How to monitor SDGs indicators?

Module 3 Data management and data sharing

SDGSAT-1 Data Process and SDG Cases

Thanks

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Big Earth data for sustainable cities and communities

Linlin Lu

Dr., Associate Professor

International Research Center of Big Data for Sustainable Development Goals

May 29th, 2023

Contents





1. Background

2. Urban growth

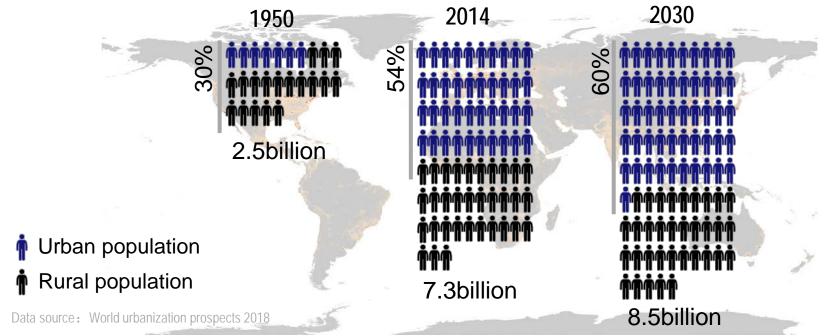
3. Urban environment

4. Case study

5. Conclusions

1. Background

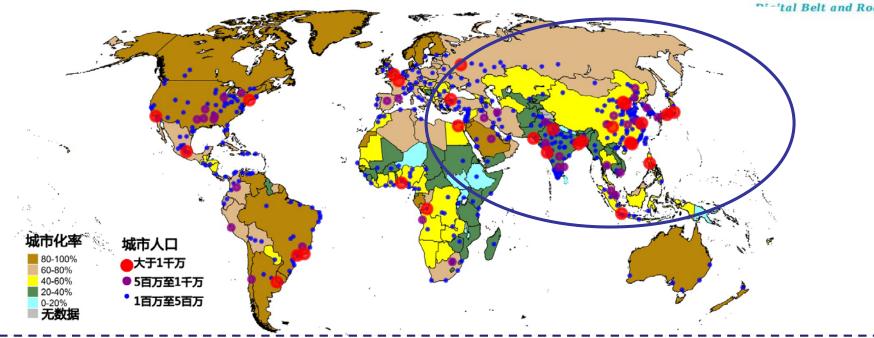




☐ The process of urbanization describes a shift in a population from one that is dispersed across small rural settlements in which agriculture is the dominant economic activity towards one where the population is concentrated in larger, dense urban settlements characterized by industrial and service activities (Montgomery et al., 2004).

1. Background





- ☐ In the Belt and Road region, the total population is 4.7 billion with 2.3 billion living in urban areas. The average urbanization level is 47.9%, which is lower than the global average urbanization level by 54%.
- □ 21 countries have an urbanization level lower than 50%. Sri Lanka, Nepal, Cambodia, Afghanistan, and Tajikistan have the lowest urbanization level which is below 30%.

1. Background



■ With good planning and governance, the increasing concentration of people in urban settlements can facilitate economic and social development. However, rapid and unplanned urban growth brought a series of challenges to people's lives, health, and environment, and threatens sustainable development.

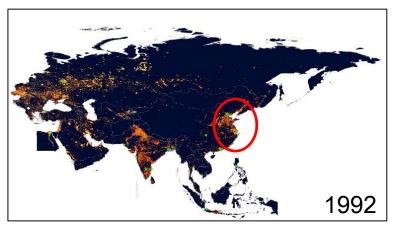


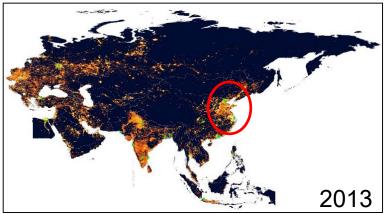
www.dbeltroad.org

1. Background



☐ Big Earth data has advantages in macro, dynamic, and continuous aspects, providing accurate, consistent, and timely information for urban planning and management. It has become an important tool for global, regional, and national scale urban environmental monitoring, change analysis, and land use mapping.



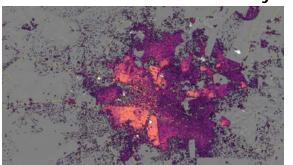






☐ The expansion of urban land is the most direct manifestation of urbanization development. Satellite remote sensing data is widely used for the extraction and mapping of urban land, and there are currently more than ten global or national urban land products based on remote sensing data.

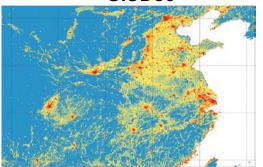
Global human settlement layer



World settlement footprint

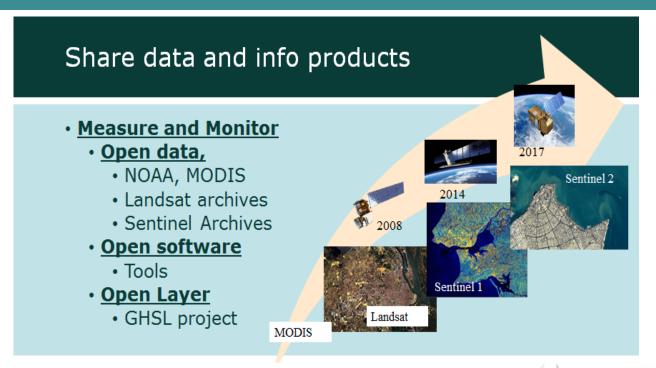


GISD30



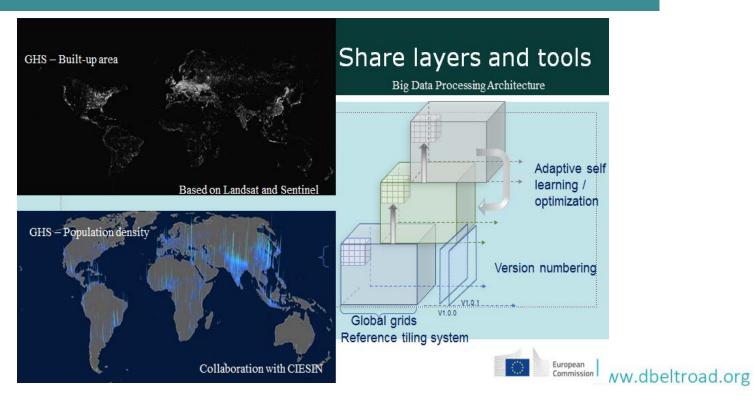


Global human settlement mapping





Global human settlement mapping





GHSL – Understand urbanization



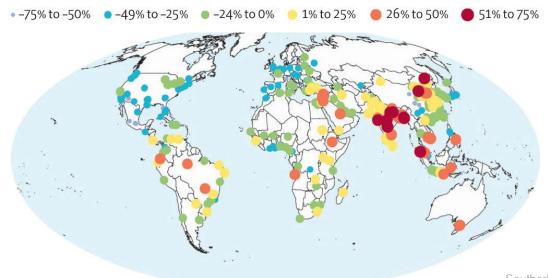


Global PM2.5 concentrations estimation from satellite observations

- The World Health Organization identifies air pollution as the leading environmental risk affecting human health. Long term exposure to fine particulate matter(PM2.5) can lead to cardiovascular and respiratory diseases.
- 98% of cities with over 100000 people in low and middle-income countries are unable to meet WHO air quality standards.



Changes in population-weighted ambient PM2.5 concentration



Southerland et al., 2022, Lancet Planetary Health.

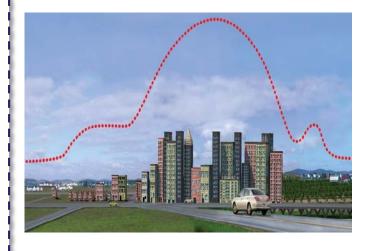
■ Between the years 2000 and 2019, most of the world's urban population lived in areas with unhealthy levels of PM2.5, leading to substantial contributions to non-communicable disease burdens.



Thermal infrared remote sensing for urban heat island monitoring

Causes of Urban heat island

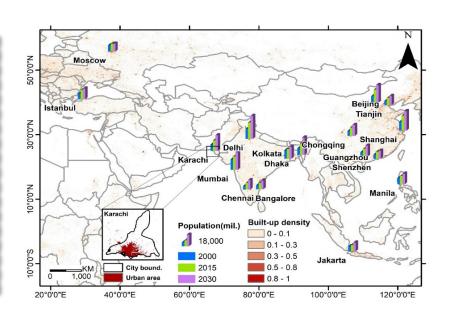
- Albedo & Infrastructure: Asphalt, concrete and brick absorbrather than reflect-the sun's heat, causing surface temperatures and air temperatures to rise due to their storage capacity.
- Reduced vegetation: Minimizes natural cooling effects of shading and evapotranspiration from soil and vegetation.
- Anthropogenic heat: Vehicles, air-conditioning units, buildings and industrial facilities all emit heat into the urban environment.
- <u>Urban geometry:</u> Buildings act as obstacles and reduce wind flow which can bring cooling effects
- ☐ Geography: Nearby mountains can block wind or create wind patterns that pass through a city.





Urban environmental change analysis using remote sensing time series

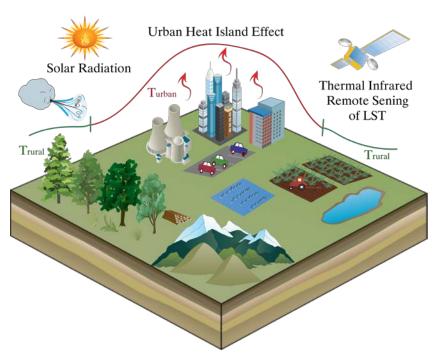
- ☐ An integrative framework was developed for an environmental change assessment across the heterogeneous urban environment in the mega cities along the Belt and Road by using remote sensing time series and products from various sources.
 - ☐ A comprehensive evaluation index (CEI) combined changes in particulate matter, land surface temperature, and vegetation coverage in urban areas.



4. The case study of Bangkok Metropolitan Region



Introduction



Schematic diagram of Urban Heat Island Effect

Definition: The urban heat island effect refers to the phenomena that the development of urbanization causes the temperature of a city to be higher than that of the surrounding suburbs.

Consequence: The UHI effect can exacerbate the intensity and frequency of extreme heat events, cause higher human health risks, enhance environmental pollution, and increase energy consumption.

Significance: The investigation of UHI is of great importance for developing thermal mitigation strategies and enhancing thermal resilience of urban settlements, thereby contributing to the achievement of United Nation's sustainable development goals in urban areas.

4. The case study of Bangkok Metropolitan Region



Introduction





Spatial resolution:30 m Temporal resolution:16 days



Spatial resolution: 1000 m Temporal resolution: Daily/8 days

Previous studies have extensively analyzed the spatiotemporal variation characteristics of SUHI in different regions using remote sensing data, but there are still some limitations:

Low availability

Tropical cities have high cloud cover due to climate conditions, making remote sensing data difficult to obtain

Unable to delve deeper

There is a lack of high spatiotemporal resolution remote sensing data for in-depth analysis of SUHI

Less research

The spatiotemporal fusion model can produce products with high spatiotemporal resolution.

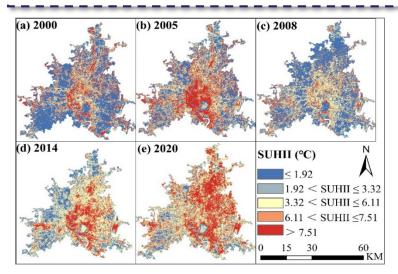
4. The case study of Bangkok Metropolitan Region

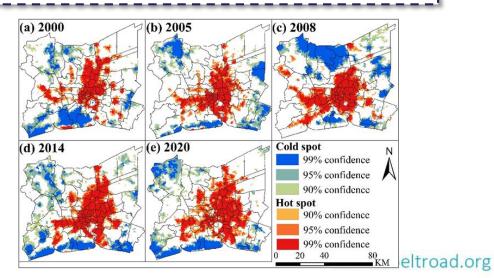


Results

Spatiotemporal variation of SUHI

- ☐ The very high-level areas of SUHI gradually expanded and the most noticeable SUHII increases occurred in the eastern part of the study area.
- Hot spots were mostly concentrated in the urban core, and cold spots were scattered in the urban fringe and southern coastal areas. The hot spot areas were observed to spread from the urban centre to the surrounding areas across time.





Urban Environment Working Group



DBAR-U Objectives

- Technology development and capacity building for human settlement information derivation and spatial analytics using Earth Observation data input.
- Support the implementation of UN sustainable development goals, the New Urban Agenda and the UN Framework Convention on Climate Change along the Belt and Road.
- Develop detailed studies of climatic adaptations in built environments, including urban morphology, land surface processes in the built space and other relevant EO data as well as appropriate process models.



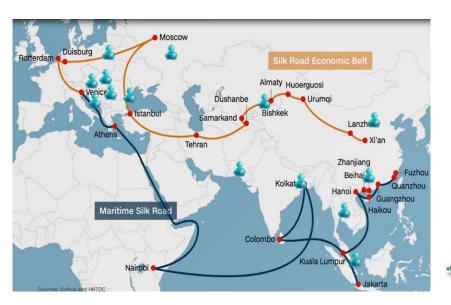
DBAR-U Network

























Co-chairs: Linlin Lu CBAS, China

Martino Pesaresi EC JRC, Italy

Yifang Ban KTH Royal Institute of Technology, Sweden

Members: 20 experts from 15 countries

Thanks

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Coast Region and SDGs

DBAR-COAST WORKING GROUP

DATE Beijing, China

Outline





DBAR Core Objectives





Knowledge Gaps



To address
knowledge gaps in
earth system
processes that
constrains the
attainment of the
SDGs in B&R
countries.

Big Earth Data



To promote advanced science and decision support services to extract effective information from massive, diverse and ever-growing volumes of Big Earth Data.

Capacity Building

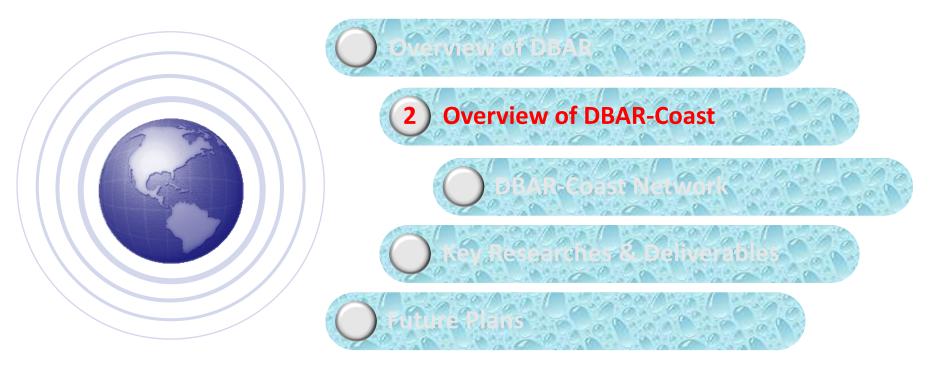


To enhance capacity building and technology transfer within a system of partnerships and research networks.

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Outline

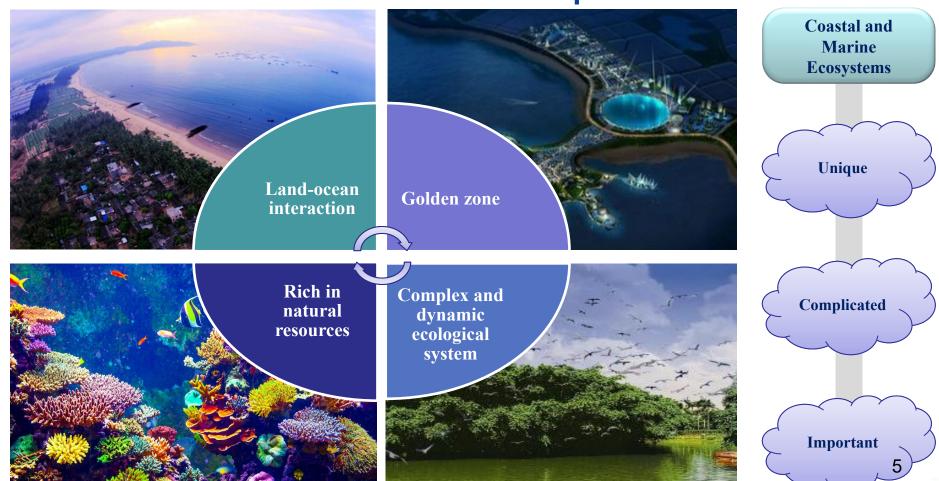




Overview of BAR COAST







DBAR-Coast Core Objectives





Supports the communication strategy development for coast-related data sharing, aligned with institutional (of MSR countries) objectives and mandates for supporting the coastal zones sustainable development.



Identifies needs and ways to improve the communication systems and research programs of the sub-working groups to support the sustainable development of coastal and marine resources for societal benefits.



Supports sub-working groups related to MSR research and policy and promotes effective communications between front line scientists and end-users for sharing knowledge and information.



To serve the UN 2030 SDGs (SDG-6, -11, -14, -15) and to ensure the sustainable development and scientific management of countries along the B&R.









Significance of Coastal Zones



More than half of the world's population lives within a range of about 60 km along the coast, and more than two-thirds of cities with a population of 2.5 million or more are located near the coast. The coastal zone has a complex environment with frequent natural disasters and extreme weather.

The Maritime Silk Road (MSR) includes more than 50 countries, spanning 12 major sea areas and 13 typical offshore areas. It has the characteristics of wide spatial scope and regional diversity.



Ports are a key nodes of the MSR, which promote international cooperation and exchange. Along the Maritime Silk Road, coastal port city is an important hub for air and sea transportation in the world. The container throughput of more than half of the Maritime Silk Road port cities has been among the top 100 in the world.

The coastal aquaculture industry is an important part of the national economy along the Maritime Silk Road and has made tremendous contributions to economic development and food security.



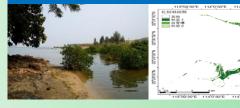


Coastal Eco-Environmental Problems Are Serious

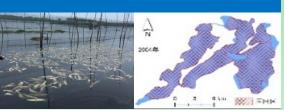
Coastal Erosion



Mangroves & Wetlands Degradation



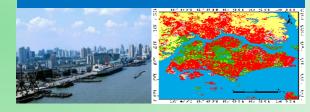
Aquaculture Pollution



Ports Encroachments on Ecological Lands



Port Cities Expansion



Atmospheric Pollution





Extreme Weather

Sea-level Rising

Mangrove Degradation

Coastal Water
Quality

Forests Logging

Destruction Of Coastal Resources

Ocean Pollution

Reduced Stability
Of Ecosystem



Coastal Crisis: Mangrove at Risk



NORTH

The 36% of the world's mangroves disappeared during 1995-2005, and their destruction and disappearance rate is greater than that of tropical rain forests and other inland forests.

PACIFIC

Since the 1980s, the global mangrove area has been reduced by at least one-fifth, and the current global mangrove area is still decreasing at a rate of 0.7% per year. The global mangroves are facing serious survival problems. (UNEP, 2010)

Mangroves along the Maritime Silk Road account for more than half of the world's total area, and are mainly distributed in tropical-subtropical regions.

SN	Country	Area (ha)	% of global total	Cumulative %	Region
1	Indonesia	3,112,989	22.6	22.6	Asia
2	Australia	977,975	7.1	29.7	Oceania
3	Brazil	962,683	7.0	36.7	South America
4	Mexico	741,917	5.4	42.1	North and Central America
5	Nigeria	653,669	4.7	46.8	Africa
6	Malaysia	505,386	3.7	50.5	Asia
7	Myanmar (Burma)	494,584	3.6	54.1	Asia
8	Papua New Guinea	480,121	3.5	57.6	Oceania
9	Bangladesh	436,570	3.2	60.8	Asia
10	Cuba	421,538	3.1	63.9	North and
					Central America
11	India	368,276	2.7	66.6	Asia
12	Guinea Bissau	338,652	2.5	69.1	Africa
13	Mozambique	318,851	2.3	71.4	Africa
14	Madagascar	278,078	2.0	73.4	Africa
15	Philippines	263,137	1.9	75.3	Asia





Area	Global Proportion of Mangroves
Asia	42%
Africa	20%
North America	15%
Oceania	12%
South America	_{11%} 10

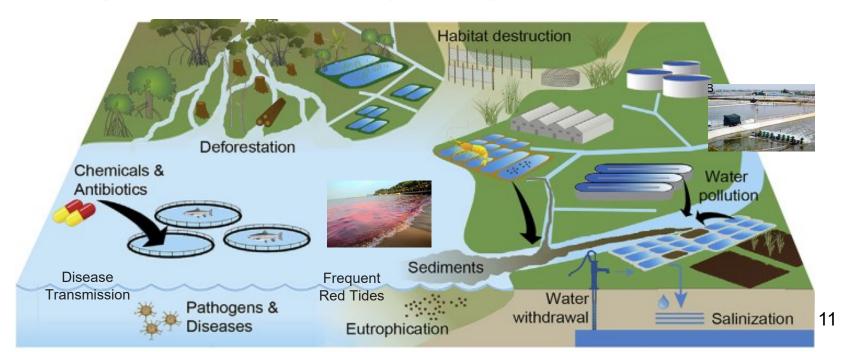


Coastal crisis: Aquaculture at Risk





The coastal aquaculture industry is an important part of the national economy along the "Maritime Silk Road" and has made tremendous contributions to economic development and food security. According to the FAO report, the distribution and regional development of offshore aquaculture in the world is quite different. Asia is the most developed area of aquaculture (89%) along the MSR.





	GOALS	SPECIFIC GOALS	INDEX	TIER CLASSIFICATION	SUBMITTED DATA PRODUCTS
; ;	6. Ensure availability and sustainable management of water and sanitation for all	6.6. By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1. Change in the extent of water-related ecosystems over time	Tier II	Dataset on the distribution of mangrove distribution along the coast of the Maritime Silk Road, 30m resolution, (1990, 2000, 2010, 2015, 2020)
	11. Make cities and human settlements inclusive, safe, resilient and sustainable	11.3. By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.1. Ratio of land consumption rate to population growth rate	Tier II	Related but no direct product
		11.6. By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1. Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities	Tier I	Port city PM2.5 dataset along the Maritime Silk Road (1000 meters, 2013-2020 (daily))









GOALS	SPECIFIC GOALS	INDEX	TIER CLASSIFICATION	SUBMITTED DATA PRODUCTS
	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			Temporal and spatial distribution of nearshore aquaculture ponds and marine chlorophyll-a monitoring products for representative aquaculture countries on the Indochina Peninsula in 2000, 2010 and 2015
	14.2 By 2020, 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			1990, 2000, 2010 and 2015 mangrove datasets for the Maritime Silk Road coastal zone











GOALS	SPECIFIC GOALS	INDEX	TIER CLASSIFICATION	SUBMITTED DATA PRODUCTS
	14.5 By 2020, conserve at least 10 percent of coastal and marine areas, consistent with national and international law and based on the best available scientific information			Dataset on land expansion and shoreline change in port cities along the Maritime Silk Road coastline in 1990, 2000, 2010 and 2015
	14.7 By 2030, increase the economic benefits to small island developing states and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.			Data on the distribution of coastal aquaculture areas along the Maritime Silk Road (30 meters, five periods in 1990, 2000, 2010, 2015, 2020)









	GOALS	SPECIFIC GOALS	INDEX	TIER CLASSIFICATION	SUBMITTED DATA PRODUCTS
pro of t ecc ma des and des	15. Protect, restore and promote sustainable use	15.1. By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	15.1.1. Forest area as a proportion of total land area	Tier I	Related but no direct product
	of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss		15.1.2. Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type	Tier I	Related but no direct product
	blodiversity 1033	15.2. By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	15.2.1. Progress towards sustainable forest management	Tier I	Related but no direct product



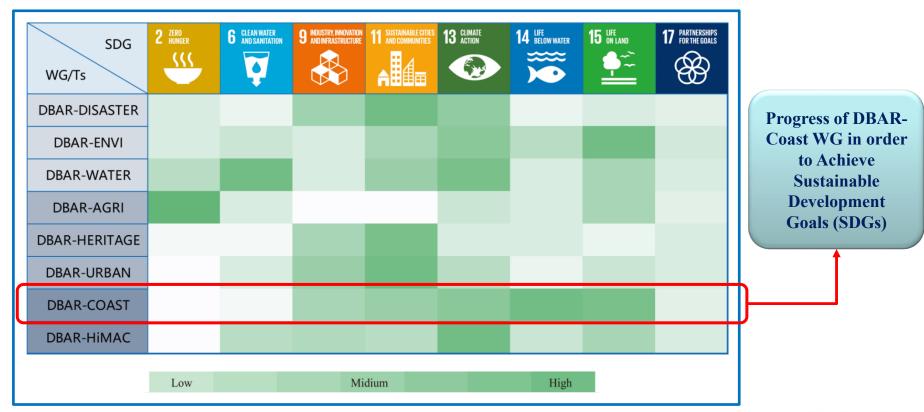






DBAR-COAST in support of the SDGs





Outline







International Symposium on EO for MSR





The International
Symposium on Earth
Observation for the
Maritime Silk Road
(EMSR) was held in
Sanya in 2015, releasing
the "Sanya Declaration on
International Cooperation
on Earth Observation for
Maritime Silk Road
Development".





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The ICoE-Coast at USC





ICoE-Coast: an interdisciplinary team

Cuizhen Wang (Chair)

Bio-environmental remote sensing

Susan Cutter (Co-Chair)

Disaster vulnerability/resilience science

Li Zhang (Co-Chair)

Ecosystem modeling; land-surface dynamics

Core faculty

James Morris: Biological and Marine Sciences
Jean Ellis: Coastal and aeolian geomorphology
Zhenlong Li: Big Data Science

A Research Hub of Big Earth Data on U.S. Atlantic Coast University of South Carolina: the flagship university of SC; Est. 1801; 30,000+ Undergrads/6,500 Grads; a Sea-Grant Univ. (1+7 campus)

USC Geography: top ten of U.S. PhD granting departments in Geography (NRC, "S" ranking)



To enable and support scientific activities by advancing Earth Observation science, technology, and data/knowledge dissemination in environmental and disaster monitoring of coastal zone, and to contribute towards achieving the DBAR legacy.

Networking with partner from Indonesia and Malaysia



Supporting the application of Indonesian Society for Remote Sensing for **APN project** and successfully **get funded**.





Joint Publication of the joint work within the framework of SPBEA project

Networking with partner from Indonesia and Malaysia

Feb 15th – **19**th **2021**, we attended the training for Spatial-Planning-Based Ecosystem Adaptation (SPBEA), with over 70 trainee from **20 countries/regions**.



16:53:42 From Lusita Meilana 对 所有人: it's such a very useful and helpful Demo! thank you so much

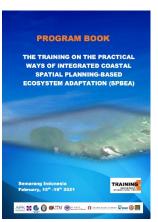
<u>16:53:57 From Lency Muna 对 所有人: Thank you</u>

16:54:12 From Miguel Garcia 对 所有人: Thank you so much

16:54:13 From Lusita Meilana 对 所有人: 谢谢老师

16:54:18 From BPPT_Zilda Dona 对所有人: Thank you so much. It is my first time to learn R program and it's really challen

16:54:33 From BPPT_Zilda Dona 对所有人: *challenging @













Networking with partner from Bangladesh







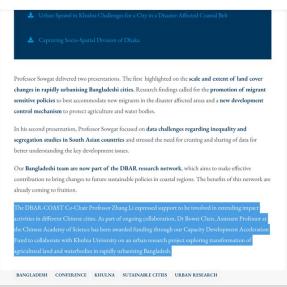




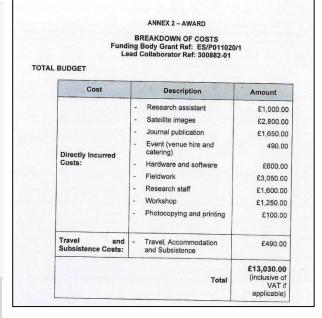




Awarded one SHLC-funded international collaborative project as only Chinese PI, with the supporting rate < 5% with a total of £13030, together with our partner from Bangladesh.



News coverage of promoting DBAR from SHI C



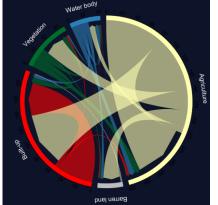


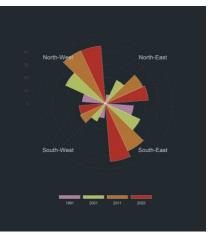
Networking with partner from Bangladesh

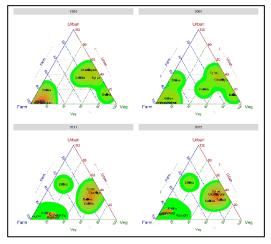
Supporting SDG assessment of Bangladesh

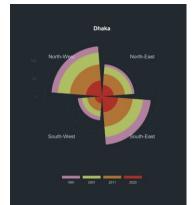














第五届全国定量遥感学术论坛

On June 28, 2021, our joint work was presented at the 2021 quantitative remote sensing forum, with over 100 people attend the presentation.

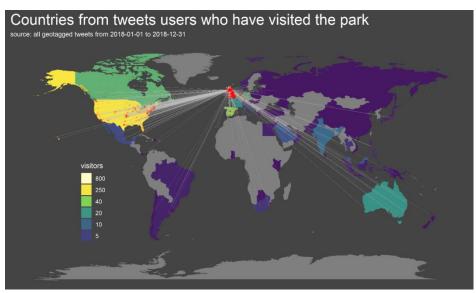


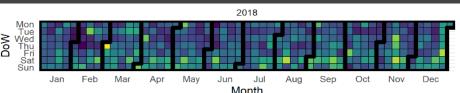


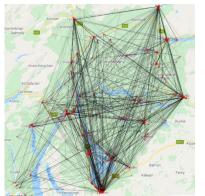
Networking with partner from UK



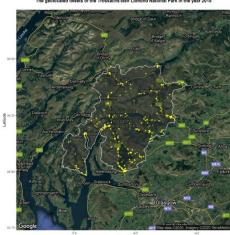
Working together with the **UK Forest Research**, introducing **Twitter data** into the **UK national park** management system **for the first time**, reducing the time and improving the accuracy.

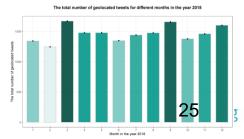












The 2nd Asia-Europe Scientists Conference Strengthen the Existing Network for Supporting SDGs in Coastal Areas



The 2nd Asia-Europe Scientists Conference on SDGs for Supporting Coastal Areas was held on December 14th-15th 2020, with experts from our DBAR and domestic partners to share the knowledge of how big earth data could contributes to SDGs for costal areas.









第二届亚欧科学家海岸带环境可持续发展研讨会在三亚举行

海南日报客户端 2020-12-15 19:48:30

据海南日报客户端|记者李艳玫

12月14日至15日,第二届亚欧科学家海岸带环境可持续发展研讨会在三亚举行。来自英国、西班牙、印度尼西亚、孟加拉国、巴基斯坦等国家以及国内多家知名科研院校的专家学者参加研讨会。

海岸带是海南最宝贵的自然资源之一,也是海南良好生态环境的重要组成部分,丰富的海岸带资源为海南的经济发展提供了优质空间。本次研讨会采用线上与线下相结合的方式举行,围绕"地球大数据服务于海岸带生态环境监测及联合国可持续发展目标(SDGs)实现"主题,探讨空间对地观测技术在海岸带生态环境中的应用以及服务海南自由贸易港建设和联合国可持续发展目标的作用。

依托海南省及三亚市"海智计划"工作站、"数字丝路"国际科学计划(DBAR)等国际合作平台,本次会议为国内外专家学者提供了一个高层次学术交流与合作的国际化平台。据悉,今后"海智计划"工作站将进一步推动海南省、三亚市的生态环境建设,充分发挥国内外人才、数据和技术优势,打造服务于海岸带环境监测的系统平台,形成国际科技合作的示范基地。

本次会议由海南省科学技术协会、三亚市科学技术协会和"数字丝路"国际科学计划 (DBA R) 联合主办。海南省地球观测重点实验室和数字经路海岸带工作组联合承办。26

Exploring & Expanding Network



The DBAR-COAST Working Group intensively working on to build partnership with various national and international organizations.

DBAR-COAST has built multiple partnerships primary targeting regional cooperations. The MoUs with IUCN-Bangladesh and GISTDA-Thailand are in works to facilitate research and collaboration with these partners in the next phase.

Sr.	Name of Partners	Country	Type of Organization/Partner
1	International Union for Conservation of Nature (IUCN)	Bangladesh	Intergovernmental Organization
2	Geo-informatics and Space Technology Development Agency (GISTDA)	Thailand	Research Organization
3	Graciela Metternicht	Australia	Research Fellow/Academician
4	Bangladesh Forest Department	Bangladesh	Government Organization

International Students



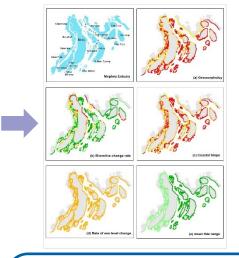
CAS-TWAS Scholarship

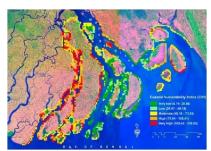


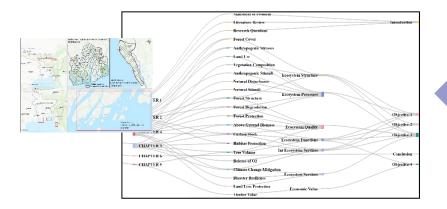
Riffat Mahmood Ph.D. Student

From Department of Geography and Environment, Faculty of Life and Earth Sciences, Jagannath University, Dhaka

Research Interests: Coastal Vulnerability Assessment









CAS-TWAS Scholarship



Mohammad Emran Hasan Ph.D. Student

From Department of Geography and Environment, Faculty of Life and Earth Sciences, Jagannath University, Dhaka

Research Interests: Ecosystem Quality and Services 28

International Students



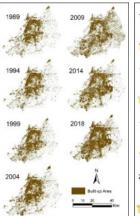
China Scholarship Council

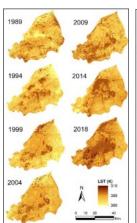


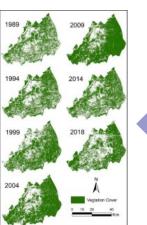
M. M. Abdullah Al Mamun Ph.D. Student

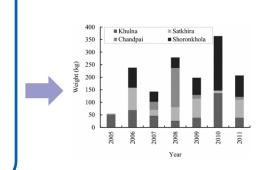
From the Institute of Forestry and Environmental Sciences, University of Chittagong (IFESCU), Bangladesh

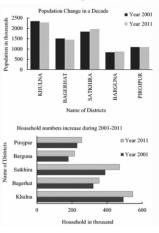
Research Interests: Ecosystem Services Assessment











ANSO Scholarship



Syed Ahmed Raza M.Phil. Student

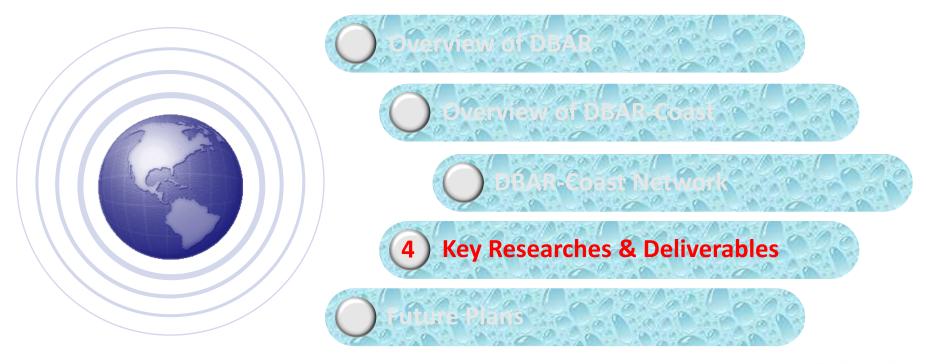
From Department of Space Science, University of the Punjab, Lahore, Pakistan

Research Interests: Land Cover Change

29

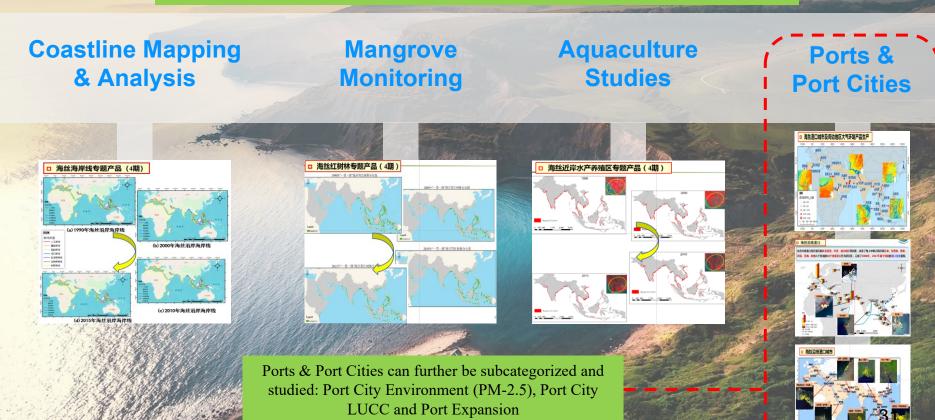
Outline



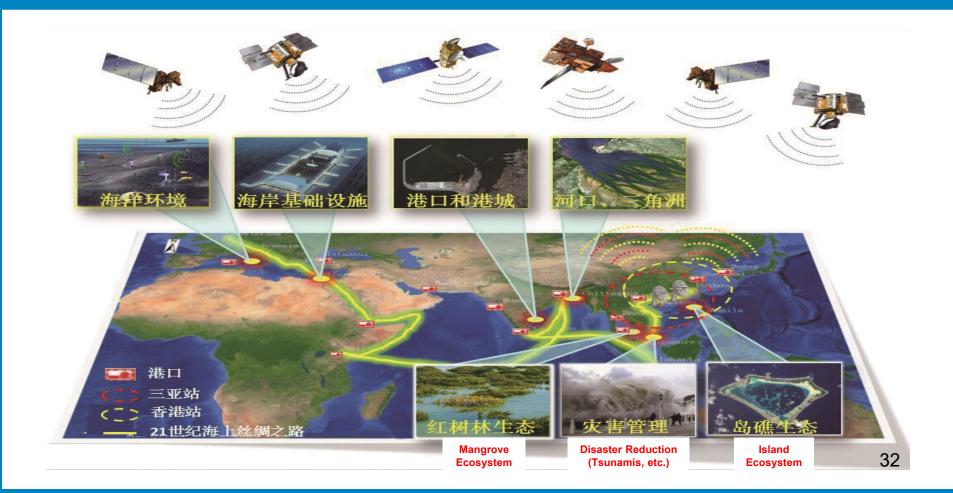


Domains of Study Fall Under DBAR-Coast WG

The research focuses of DBAR-Coast Working Group, but not limited to, are Coastline Mapping & Analysis, Mangrove Monitoring and Analysis, Aquaculture Studies and Ports & Port Cities.

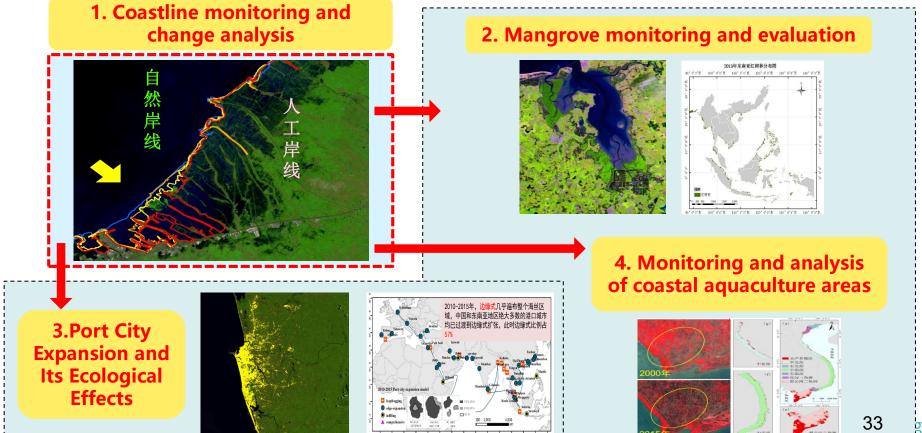


Earth Observation for Coast Research



Analysis and Evaluation of Coastal Eco-environment





Serving the Sustainable Development Goals BAR







Targets	Cases	Report	
SDG 14.1	Spatiotemporal patterns of coastal aquaculture ponds on the Indochina Peninsula and their impact on offshore chlorophyll-a concentration	dynamic salong the 2020. Big Earth Data in support of the Sustainable Development Goals on of the	
SDG 14.2	Monitoring the extent and dynamic change in mangrove forests along the Maritime Silk Road		
SDG 14.5	Conservation and utilization of the coastline along the Maritime Silk Road.		
SDG 6.6	Mapping the extent and dynamic change of mangrove forests in Southeast Asia	2019. Big Earth Data in support of the Sustainable Development Goals	

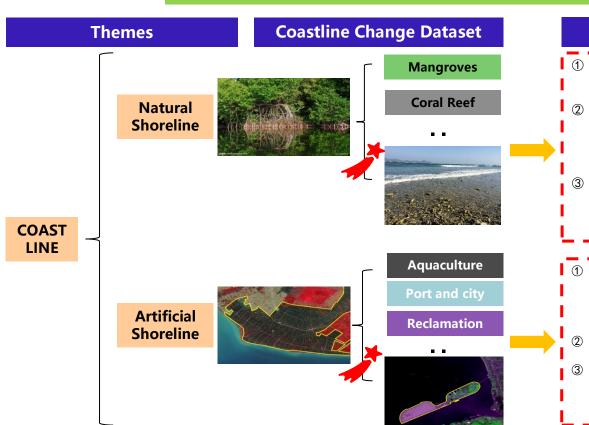




Mapping Coasts and Islands



The time-series coastline dataset was extracted along the Maritime Silk Road.



SDG indicator implementation

- ① The coastline data extraction method was used to extract the vector dataset of the 5th coastline along the Maritime Silk Road
- ② Analysis of biomass shoreline and protected areas formed by mangrove shoreline and coral reef shorelines, as well as artificial; shoreline and type conversions formed by coastal framed fish ponds,
- ③ Serving SDG 14.5.1 and 14.7.1. indicators, serving the sustainable development of the ocean from the perspective of shoreline monitoring and analysis.
- The artificial shoreline formed by port construction, breeding pond construction and reclamation project is at the cost of cutting and destroying mangroves forest along the coast.
- ② Analysis of the conversion ratio of natural shoreline-artificial shoreline.
- 3 Serving SDG 15.1.2 and 15.2.1 indicators to support sustainable forest management and land-sea biodiversity conservation along the coast of the Maritime Silk Road









Publications



Coastline Mapping & Analysis

- Fan Yang, Li Zhang, Bowei Chen, Kaixin Li, Jingjuan Liao, Riffat Mahmood, Mohammad Emran Hasan, M. M. Abdullah Al Mamun, Syed Ahmed Raza, Dewayany Sutrisno. Long-Term Change of Coastline Length along Selected Coastal Countries of Eurasia and African Continents. Remote Sensing, 2023.
- Riffat Mahmood, Naser Ahmed, Li Zhang. Coastal Vulnerability Assessment of Meghna Estuary of Bangladesh using Integrated Geospatial Techniques. International Journal of Disaster Risk Reduction, 2020, 42.
- Mohammad Emran Hasan, Li Zhang, Huadong Guo. Application of Geospatial Science in Spatio-Temporal Monitoring, Modelling and Assessment of Rohingya Impact on Forest Ecosystem of Bangladesh. (Submitted)
- Mohammad Emran Hasan, Li Zhang, Ashraf Dewan, Huadong Guo, Riffat Mahmood. Spatiotemporal pattern of forest degradation and loss of ecosystem function associated with Rohingya influx: A geospatial approach. Land Degradation & Development, 2020, 32 (13).



Publications



Mangrove Monitoring

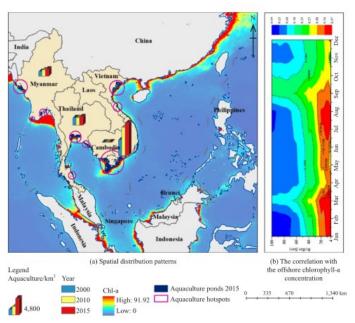
- Bin Zhu, Jingjuan Liao, Guozhuang Shen. Combining time series and land cover data for analyzing spatio-temporal changes in mangrove forests: A case study of Qinglangang Nature Reserve, Hainan, China. Ecological Indicators. 2021
- Guo Y, Liao J, Shen G, A deep learning model with Capsules embedded for high-resolution image classification, IEEE JSTARS, 2021, 14: 214-223.
- Guo Y, Liao J, Shen G, Mapping large-scale mangroves along the Maritime Silk Road from 1990 to 2015 using a novel deep learning model and Landsat data, Remote Sens. 2021, 13, 24



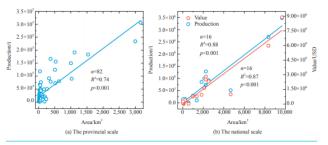
Aquaculture Ponds of Indo-China Peninsula



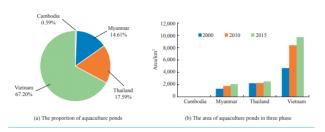
Spatiotemporal patterns of coastal aquaculture ponds on the Indo-China Peninsula and their impact on offshore chlorophyll-a concentration.



Spatial distribution patterns of aquaculture ponds in the Indo-China Peninsula and the correlation with the offshore chlorophyll-a concentration



Correlation between aquaculture production/value and aquaculture area on the provincial scale and national scale



The proportion of aquaculture ponds in the coastal area (0-40 km) of the Indo-China Peninsula countries in 2015 and the area of aquaculture ponds in three phase

Target: SDG-14.1

Publications



Aquaculture Studies

- Juhua Luo,Ruiliang Pu,Ronghua Ma,Xiaolong Wang,Xijun Lai,Zhigang Mao,Li Zhang,Zhaoliang Peng,Zhe Sun. Mapping Long-Term Spatiotemporal Dynamics of Pen Aquaculture in a Shallow Lake: Less Aquaculture Coming along Better Water Quality[J]. Remote Sensing, 2020, 12 (11)
- Zhe Sun, Juhua Luo, Jingzhicheng Yang, Qiuyan Yu, Li Zhang, Kun Xue and Lirong Lu. Nation-Scale Mapping of Coastal Aquaculture Ponds with Sentinel-1 SAR Data Using Google Earth Engine. Remote Sens. 12, 3086, 2020.
- Zhe Sun, Juhua Luo, Jingzhicheng Yang, Qiuyan Yu, Li Zhang. Dynamics of coastal aquaculture ponds in Vietnam from 1990 to 2015 using Landsat data[J]. IOP Conference Series Earth and Environmental Science, 502:012029, 2020.

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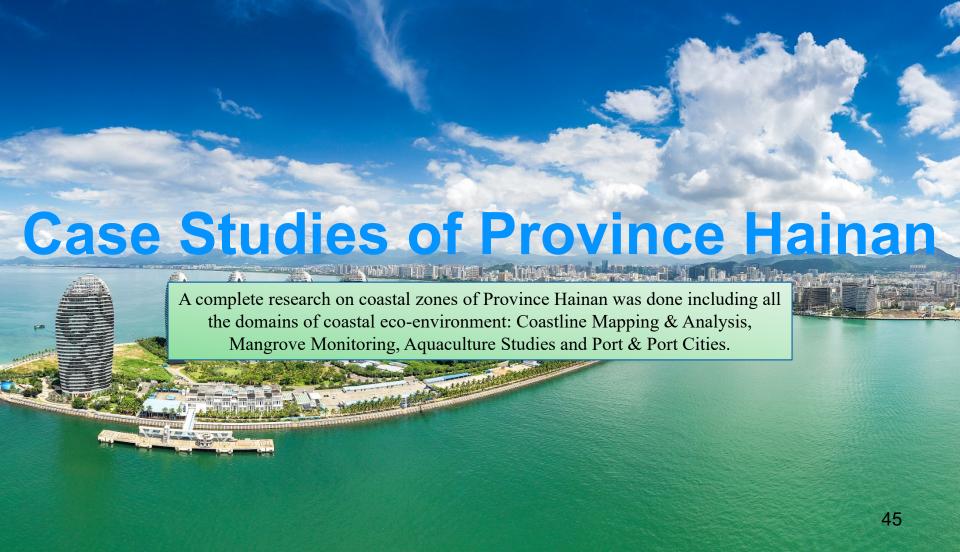


Publications



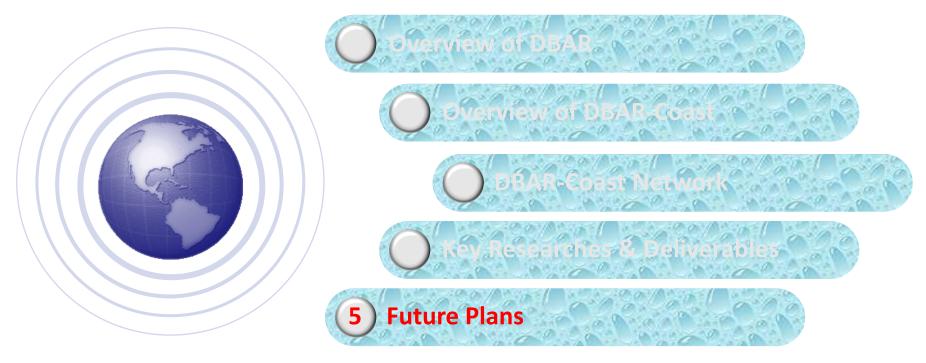
Ports and Port Cities

- Li Zhang, Yu Gu, Graciela Metternicht, Min Yan, Linyan Bai. Understanding urban growth patterns of Port-Cities along the Maritime Silk Road: a remote sensing-based approach. Landscape and Urban Planning.
- Mahmood, R., Kulsum, U., Zhang, L. 2020. Surface urban heat island risk assessment based on the population dynamics- urban expansion-land surface temperature in Dhaka mega urban region. Environment and Urbanization Asia. SAGE Publications.



Outline









1

Connect and reach out to the decision makers, policy makers, researchers and scientists of all the MSR countries to build up a contingency plan to setup the strategies and action plan to sustainably manage the coast and coastal environment through:

- Strengthening of the existing network of professionals and government officials and establish new networks and partners along the MSR countries.
- ☐ Functioning of ICOE-Coast to facilitate the networking process and designing the coastal management cooperation within the MSR countries.
- Organizing knowledge sharing event and meetings with the experts group to gather and update coastal management knowledge and strategies.

2

Functioning **WG Sub-research groups**:

- Deepen the current research implemented by each sub-group and share the data through the data platform.
- Designing and implementing joint and international research within theme of the sub groups.
- Collection and gathering of findings and results of already completed researches within the theme of the subgroups along the MSR countries.





3

4

Monitoring, Evaluation, update and planning the Work and Networking

- ☐ Tracking the progress as designed and modify as required due to the updated situation and research demand.
- ☐ Identifying problems and crucial coastal variables.

Joint Publication and Dissemination

- ☐ Publishing influential research findings to the journals
- Dissemination of the results through scientific workshop, conference and meeting.



Formation of DBAR-COAST Subgroups





Island Environment & Resources



Harbor and Port City



Aquaculture



Mangrove Ecosystems

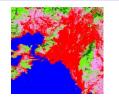


Estuary and Delta

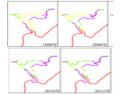


Offshore Water Environment

Data & Product



Port City LUCC

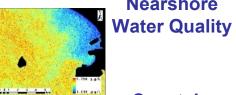


Coastline

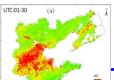


Mangrove

Nearshore

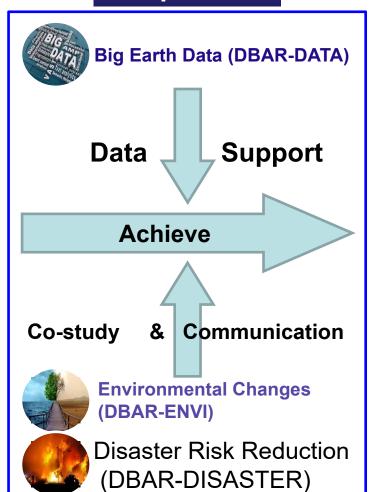


Coastal



Urban Aerosol

Cooperation





SDG



Sustainable Cities & Communities

SDG-11.3.2

SDG-11.6.2 SDG-11.a.1



Life Below Water

SDG-14.1 SDG-14.2

SDG-14.3.1

SDG-14.5.1



Life On Land

SDG-15.1.1 **SDG-15.2** SDG-15.b.1

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Thanks

Any potential research aligned with DBAR-COAST, suggestion or recommendation will be warmly welcomed.

DBAR Secretariat

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Fax: +86 10 82178959

www.dbeltroad.org



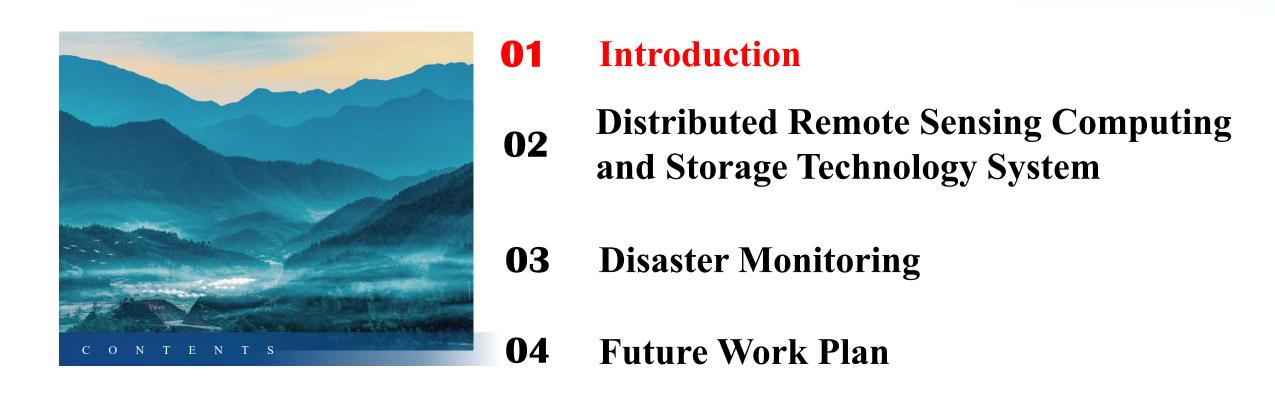
Monitoring Natural Disasters with Big Earth Data over Southeast Asia

Wanjuan SONG, Meimei ZHANG, Shiguang XU, Lei WANG, Huicong JIA, Bo YU

Aerospace Information Research Institute, Chinese Academy of Sciences

E-mail: songwj@aircas.ac.cn







Research Background

Southeast Asia is one of the regions most vulnerable to natural disasters in the world. Hydrologic and geological disasters occur frequently in this region, which are destructive and difficult to predict. With climate change, the rising sea water temperature will provide more energy for future typhoons, resulting in stronger winds and gusts. At the same time, global warming keeps the water vapor in the atmosphere, which means that more precipitation pours along the typhoon path. This will lead to more serious flash floods. More and more earthquakes and geological activities will make the surface soil more loose. When typhoon or monsoon strikes, destructive landslides may occur.









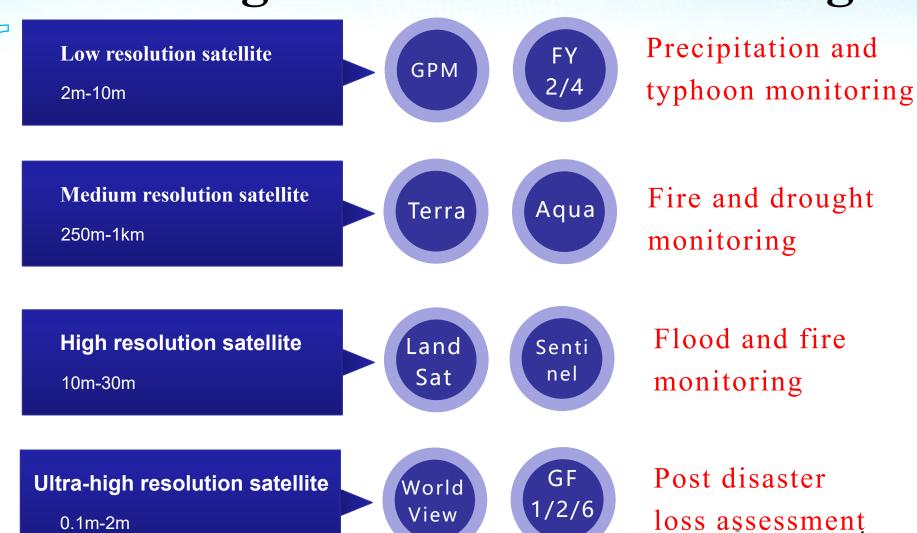
Advantages and Application of Satellite Remote Sensing in Disaster Monitoring

Satellite Remote Sensing

Large monitoring range

Low data cost

Wide application field





Medium Resolution Satellite

■ MODIS (MODerate-resolution Imaging Spectroradiometer)

250, 500, 1000m



Long time cycle



Wide application range



Complete product categories



Free data

Channel 20~36μm channel NE ΔT Main Purpose Resolution 1 620~670 128 Land 250 2 841~876 201 Cloud boundary 250 3 459~479 243 Land 500 4 545~564 228 Cloud characteristics 500 5 1230~1250 74 500 500 6 1638~1652 275 500 500 7 2105~2135 110 500 500 8 405~420 880 Ocean color 100 9 438~448 8380 Phytoplankton 100 10 483~493 802 Biogeography 100 11 526~536 754 Chemistry 100 12 545~556 750 100 13 662~672 910 100 14 673~683 1087 1087	· (m)
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14 6/3~683 108/	
15 743~753 586 100	_
16 862~877 576 100	
17 890~920 167 Atmosphere water 100)
18 931~941 57 Atmosphere, water 100)
19 915~965 250 vapour 100)
20 3.660~3.840(μm) 0.05 Forth surface and 100)
21 3 929~3 989(um) 2 Earth surface and 100	
22 3 929~3 989(um) 0.07 cloud top 100	
23 4.020~4.080(µm) 0.07 temperature	
11 /	
25 4.482~4.948(μm) 0.25 temperature 100	
26 1.360~1.390(μm) 1504 100	
27 6.535 \sim 6.895(μ m) 0.25 Cirrus clouds, 100	
28 $7.175 \sim 7.475 (\mu m)$ 0.25 water vapor 100	
29 8.400~8.700(μm) 0.05 100)
30 $9.589 \sim 9.880 (\mu m)$ 0.25 Ozone 100)
31 10.780° 0.05 Earth surface and 100 11.280(μ m))
32 11.770~ cloud top 12.270(μm) 0.05 temperature 100)
33 13.185~ 0.25 100)
34 13.485~΄ 13.785(μm) 0.25 100d top height)
35 13.785~ 0.25 100	5
36 14.085~ 0.35 100)



High Resolution Satellite

☐ Sentinel-2

10, 20, 60m



- Sentinel-2 is a high-resolution, multispectral imaging mission.

 One satellite has a revisit period of 10 days, and the two satellites complement each other. The revisit period is 5 days.
- It is divided into A and B, and the complete imaging of the Earth's equatorial region can be completed every 5 days. For regions with higher latitude, this cycle only takes 3 days.

Compared with Landsat 8, Sentinel-2's constellation leads in spatial resolution, spectral resolution and temporal resolution.



High Resolution Satellite

□ GF (Gaofen in Chinses) Series Satellite $0.8 \sim 16 \text{m}$

A series of satellites developed and launched to address the lack of high-resolution satellite data

Visible/near-infrared, hyperspectral, radar, tilt photography



Satellite name	Spatial resolution	Launch time	Band	
GF 1 A/B/C/D	2m(panchromatic)/ 8m multispectral	2013/2018	4	
GF 6	2m(panchromatic)/ 8m multispectral	2018	4	
GF 2	1m(panchromatic)/ 4m multispectral	2014	4	7



High Resolution Satellite

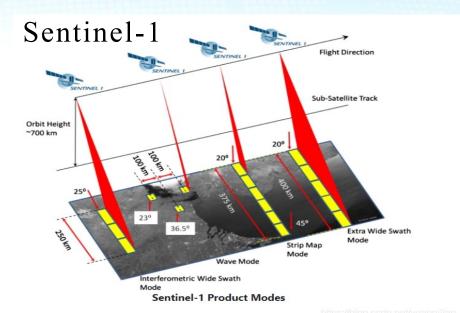
□ SAR (Synthetic Aperture Radar)

It can penetrate clouds and has all-weather monitoring capability.

It is sensitive to surface water and can be used for monitoring water and soil moisture.

It has a certain penetration ability to the surface, and the penetration depth is related to the surface characteristics. It is of great value in resource exploration, military affairs, etc

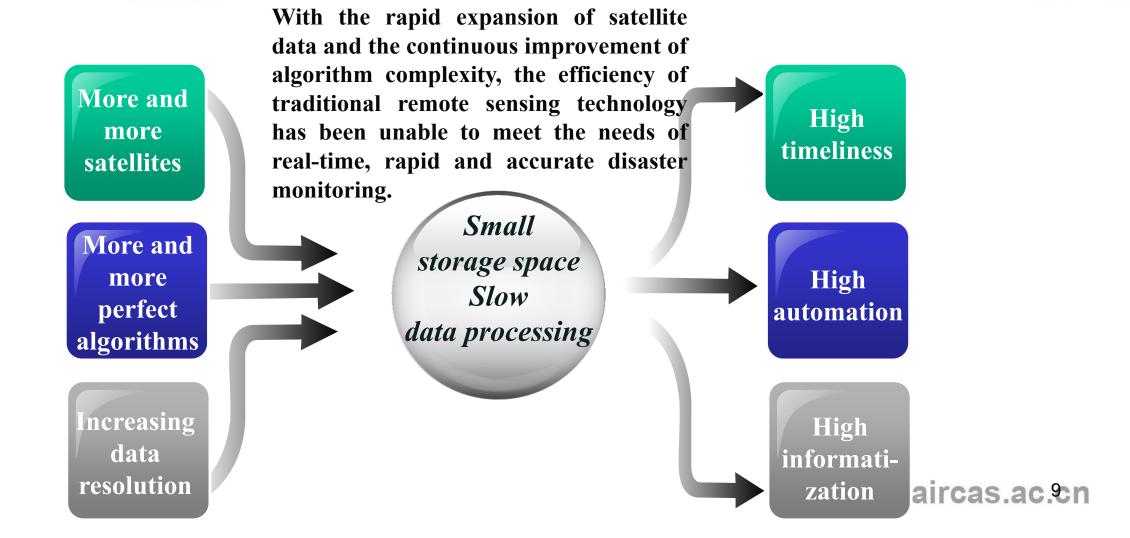
Blocked by the terrain, a blind area is formed at the back of the mountain







Bottleneck of Traditional Remote Sensing Technology in Disaster Monitoring





Research Objectives

• Aiming at the bottleneck and pain point of remote sensing technology in disaster monitoring, a series of distributed remote sensing technology systems have been developed at the storage, computing and system levels to achieve automatic, near real-time monitoring of various natural disasters in Southeast Asia.

Storage 1

- •High I/O speed
- •High security
- •Low redundancy

Computing 2

- •Fast processing/ calculation for TB level remote sensing data
- •Large scale parallel computing supporting remote sensing/ mathematical/image models

System 3

- •Multi dimension:
- 2D, 3D
- •Multi platform:
- desktop, web, mobile
- •Multi form:
- vector, grid, chart,

animation www.

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- **01** Introduction
- **O2** Distributed Remote Sensing Computing and Storage Technology System
- **03** Disaster Monitoring
- **04** Future Work Plan

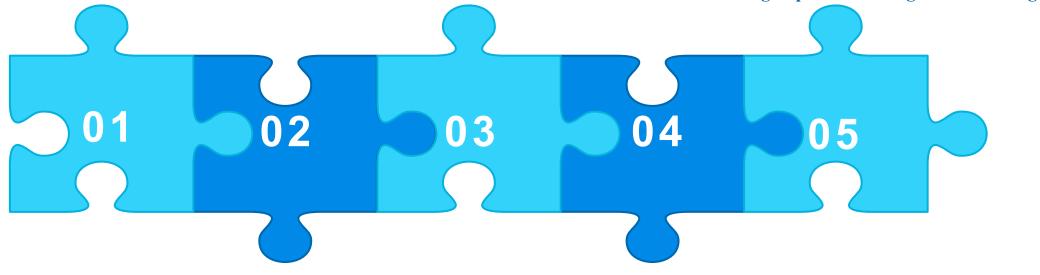


Technology Chain of Distributed Remote Sensing Monitoring Platform

Customized acquisition/
automatic acquisition
capability
of remote sensing data

Organization, storage, management and security mechanism of remote sensing big data

Design, construction, testing and operation and maintenance of actual business system based on distributed remote sensing big data storage/processing technology

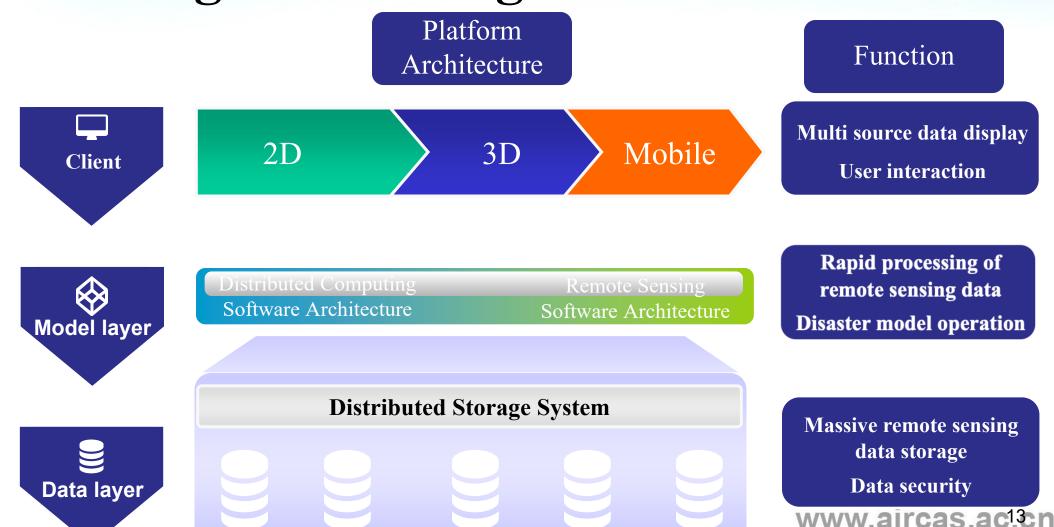


Preprocessing technologies such as format conversion, projection transformation, spatial registration and spectral matching of multi-source heterogeneous data

Software and hardware architecture of remote sensing big data distributed computing



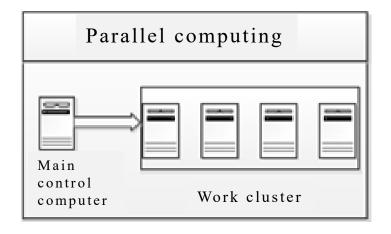
Architecture of Distributed Remote Sensing Monitoring Platform





Distributed Computing Technology

Distributed Computing Platform



Preprocess of massive remote sensing data

Emergency response calculation of remote sensing

Distributed computing of remote sensing/mathematical model

Deep Learning

Minute and second level query and statistics of remote sensing big data

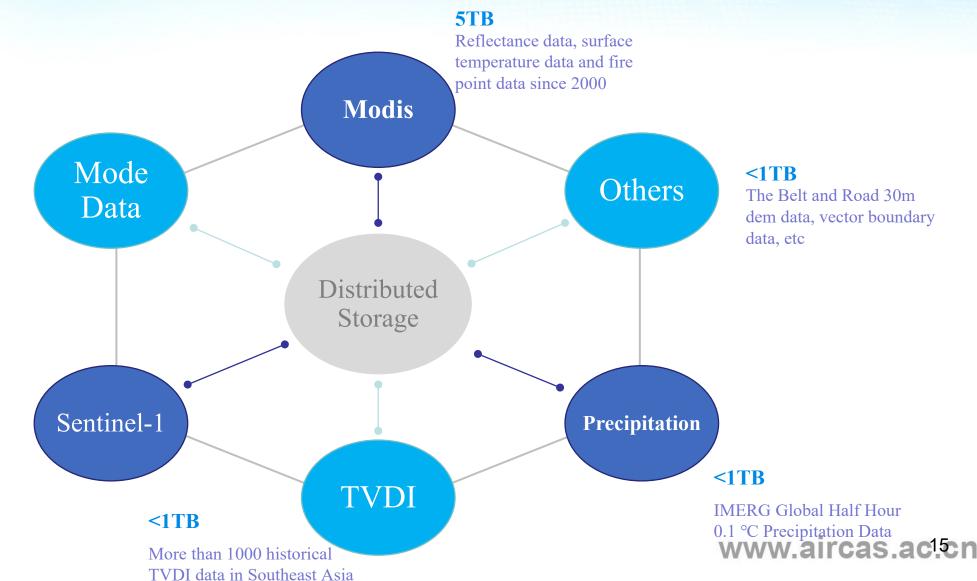
Spatial/spectral matching of multi-source data

Spatial and temporal fusion of massive remote sensing data

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Distributed Storage and Data Storage



6TB

Sentinal 1 A/B data in Southeast Asia since September 1, 2021



Platform Introduction

Construction Objectives

Automatic acquisition, processing and distributed storage of massive remote sensing data

Realization of minute and second level calculation of key parameters of drought, flood, fire and other disasters

Integration, statistics and analysis of historical, real-time and forecast data









Functional Module

- Remote sensing data preprocessing module

 Function: Automatic downloading, format conversion, mosaic and warehousing
- Long time series remote sensing data fusion and analysis module

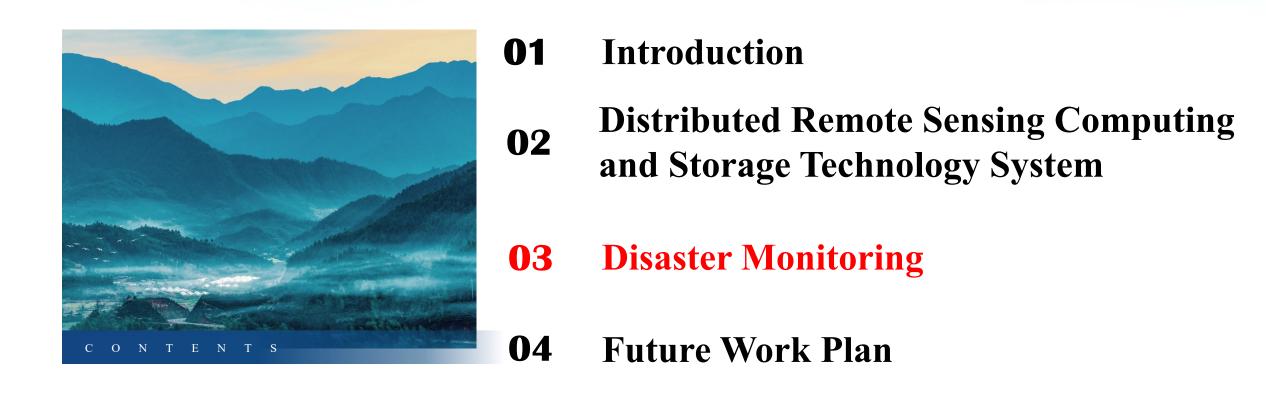
 Function: Fast calculation, fusion and visualization of long time series
 remote sensing data
- Near real time calculation module of disaster key parameters

 Function: Calculation of the key parameters of disasters in near real time,

 parameter adjustment, result preview and data download according
 to the remote sensing inversion model
- Query, statistics, analysis and result visualization module of massive remote sensing data Function: Minute and second level query and statistical analysis of multi-source,

long time series remote sensing data, and charting of scientific data







Function

Flood emergency monitoring

Calculation, statistics and graphical representation of flood information

Flood monitoring in key areas

Module

Sentinel 1 A/B data automatic download

Automatic preprocessing and warehousing of Sar data

Sar data long time series synthesis

Threshold dynamic adjustment and visualization analysis

Time series of water bodies in key areas

Calculation and visualization of satellite precipitation data

Animation of FY satellite cloud map



□ SAR Data Acquisition and Preprocessing

Determine the monitoring area

Specify time range

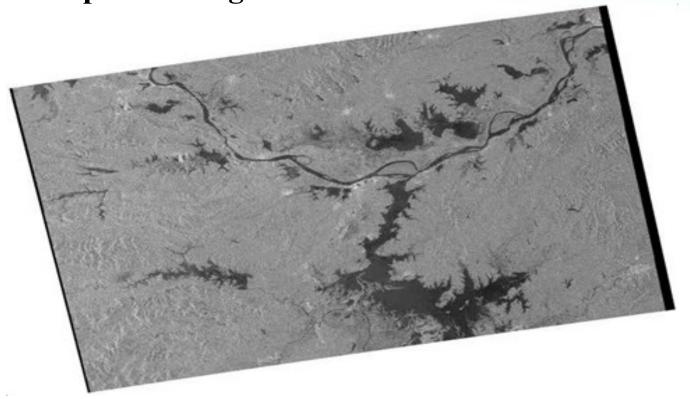
Data download

Radiometric calibration

Data conversion

Multi view, filtering

Topographical correction

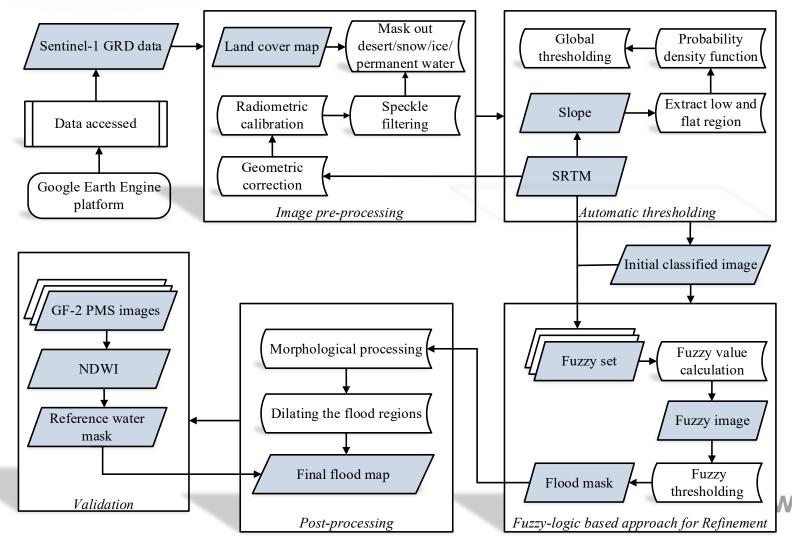


Advantages of SAR image for flood monitoring:

- SAR data can be obtained all-day and all-weather
- The DB value of water in SAR image is significantly lower than that of land, making it easy to extract water



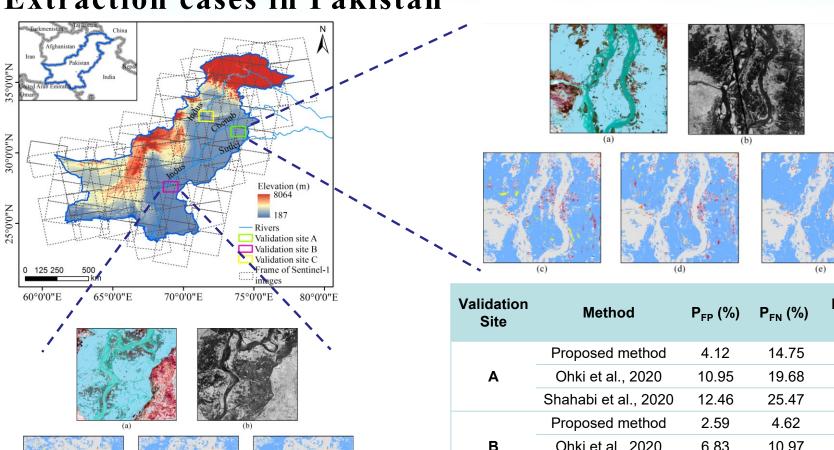
■ Model construction



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□ Extraction cases in Pakistan

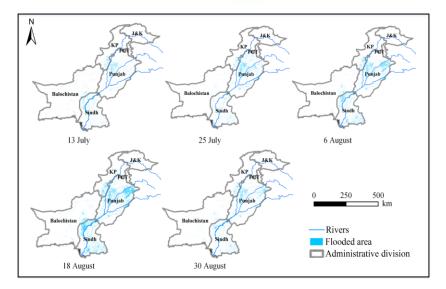


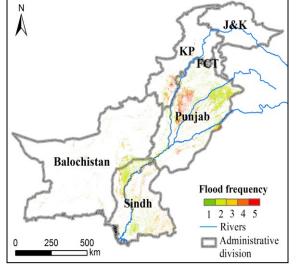
- ✓ Data coverage in 2015
- ✓ The proposed method has an overall accuracy over 90%

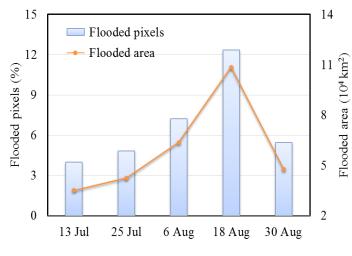
Validation Site	Method	P _{FP} (%)	P _{FN} (%)	F-Measure (%)	Карра	Overall Accuracy (%)
	Proposed method	4.12	14.75	90.25	0.893	91.1
Α	Ohki et al., 2020	10.95	19.68	84.46	0.826	83.5
	Shahabi et al., 2020	12.46	25.47	80.51	0.795	78.4
	Proposed method	2.59	4.62	96.38	0.954	96.6
В	Ohki et al., 2020	6.83	10.97	91.05	0.895	89.4
	Shahabi et al., 2020	5.96	12.29	90.76	0.873	88.1
C	Proposed method	4.03	10.89	92.41	0.918	93.4
	Ohki et al., 2020	5.21	17.69	88.11	0.841	_{87.6} 21
	Shahabi et al., 2020	14.35	13.84	85.90	0.837	85.4



□ Extraction cases in Pakistan







Flood inundation map in the summer of 2015

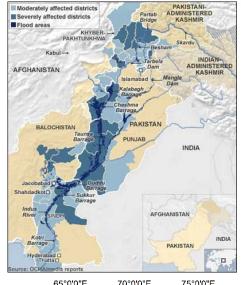
Flood inundation frequency for 2015

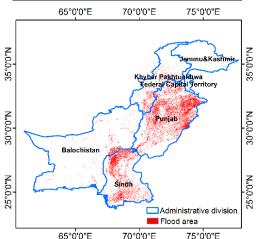
- ✓ The flood spreads quickly, with the widest inundation range in mid August, accounting for approximately 12.33% of the national land area;
- ✓ The areas with the most severe flooding are the Indus River and the Kinab River;
- ✓ The monsoon season will continue until September, and there is still a possibility of floods in the future.

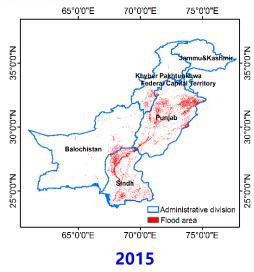
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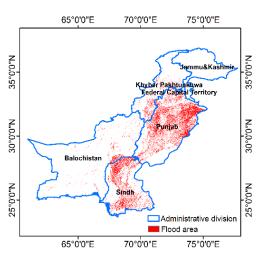


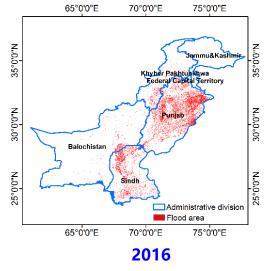
□ Extraction cases in Pakistan

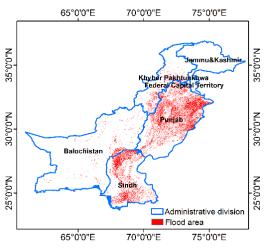












- ✓ The floods in Pakistan mainly occur in Punjab and Sindh provinces in the eastern region.
- ✓ In 2019, the flood area continued to expand and further spread to the eastern edge of Punjab province.
- ✓ Khyber Pakhtunkhwa province in the northwest also suffered varying degrees of impact.

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2017

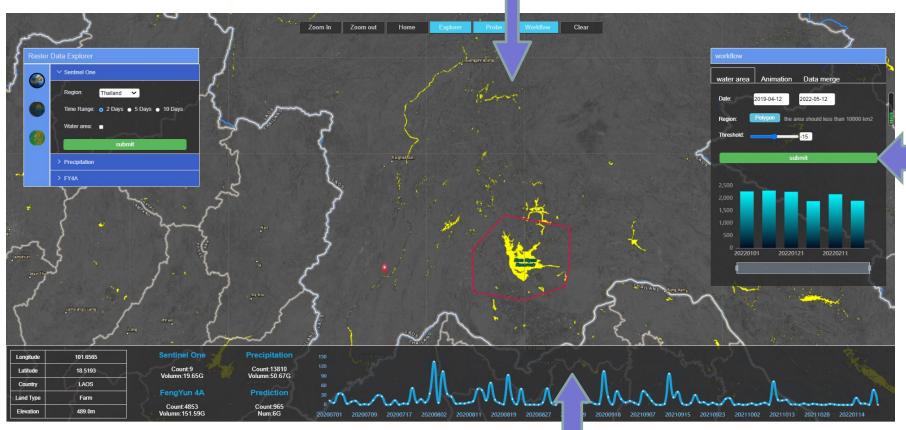
2018

2019



☐ SAR data synthesis and water detection

Near real-time synthesis of multi scene images within a specified space-time range (computing time<1min)



Long time series precipitation data extraction

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Long time series water

area calculation



Function

Distributed computing of remote sensing image pixel by pixel

Global/regional TVDI fast calculation

Parameter adjustment, curve fitting and result visualization

Module

MODIS data preprocessing module

Parameter setting module

TVDI distributed computing module

TVDI result visualization module

Query and statistics module



□ Temperature Vegetation Drought Index (TVDI)

✓ The Normalized Vegetation Index (NDVI) can reflect the physiological state of vegetation. B_{NIR} and B_R are the reflectivities in the near-infrared band and the red band, respectively:

$$NDVI = \frac{B_{NIR} - B_R}{B_{NIR} + B_R}$$

- ✓ The land surface temperature (LST) is a parameter that reflects the water shortage and soil moisture conditions during the vegetation growth period.
- ✓ Temperature Vegetation Drought Index (TVDI) was proposed based on the sim-plified NDVI-LST twodimensional feature space:

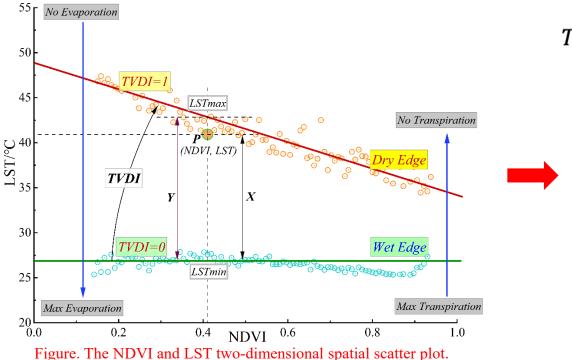
$$TVDI = \frac{(LST - LSTmin)}{LSTmax - LSTmin}$$

$$LSTmin = a + b \times NDVI$$

$$LSTmax = c + d \times NDVI$$



□ Temperature Vegetation Drought Index (TVDI)

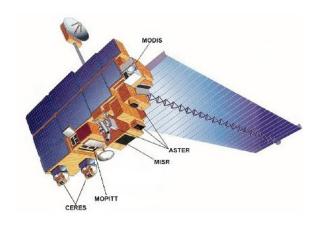


- $TVDI = \frac{LST (a + b \times NDVI)}{(c + d \times NDVI) (a + b \times NDVI)}$
 - Extracting the minimum and maximum values of the LST corresponding to each NDVI pixel (LSTmin, LSTmax).
 - Linearly fit all LSTmin and LSTmax values to obtain the Wet edge and Dry edge in the feature space.
 - ✓ a and c are the intercepts of the wet and dry edges.
 - ✓ b and d are the slopes of the wet and dry edges.
- \checkmark The TVDI value of the pixel point P is expressed as the ratio of X and Y.
- ✓ X represents the difference between the observed surface temperature of the point P and the minimum temperature at point P.
- ✓ Y represents the difference between the maximum temperature and the minimum temperature at point P. www.aircas.ac27cn



☐ Application of TVDI using MODIS Data products

NDVI: MODIS13Q1



✓ The MODIS Normalized Difference Vegetation Index (NDVI) complements NOAA's AVHRR NDVI products and provides continuity for time series historical applications.

Science Data Sets	Name	Bit Type	Fill	Valid Range	Multiply by scale factor
250m 16 days NDVI	NDVI	16-bit signed integer	-3000	-2000,10000	0.0001

✓ The MODIS11A2 product provides an average 8-day per-pixel LST with a 1 kilometer (km) spatial resolution in a 1200 by 1200 km grid.

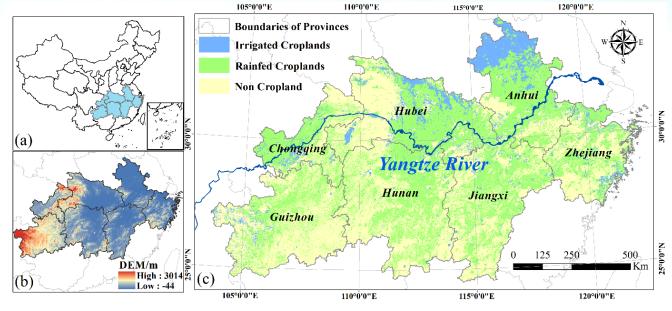
Data Type	Product Level	Nominal Data Array Dimensions	Spatial Resolution	Temporal Resolution	Map Projection
MOD11A2	L3	1200 rows by 1200 columns	1 km	Eight days	Sinusoidal

LST: MODIS11A2



□ Application of TVDI based on satellite data

- ✓ The middle and lower reaches of the Yangtze River in China.
- ✓ Different levels of TVDI.



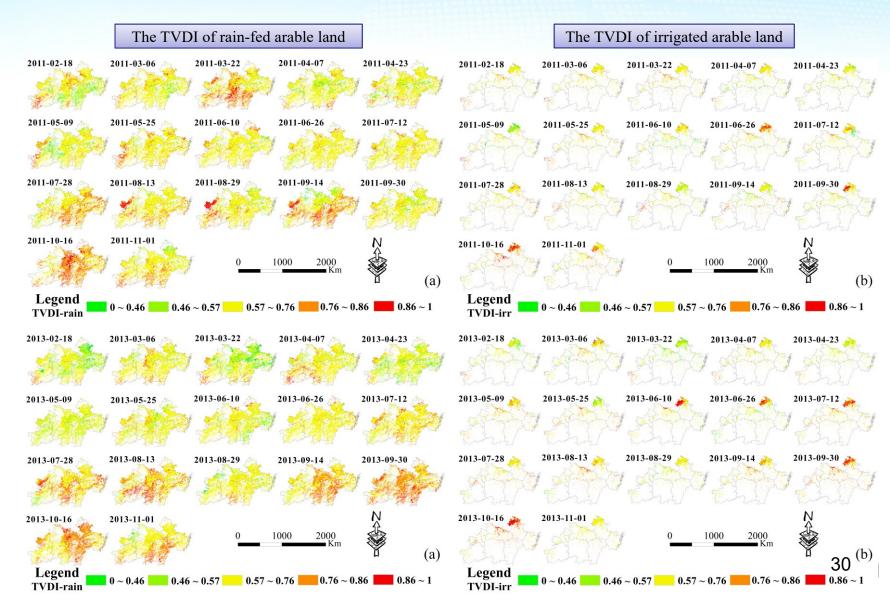
TVDI	Drought Levels	Soil moisture status
0 < TVDI < 0.46	No drought	Wet or normal land surface, no drought
$0.46 \le \text{TVDI} < 0.57$	Mild drought	Land surface with less evaporation and near land surface with dry air
$0.57 \le \text{TVDI} < 0.76$	Moderate drought	Dry soil surface and wilted near land surface vegetation leaves
$0.76 \le \text{TVDI} < 0.86$	Severe drought	Thicker dry soil layers and dry vegetation
$0.86 \le \text{TVDI} < 1$	Extreme drought	Dry or dead land surface vegetation
TVDI	Drought Levels	Soil moisture status





☐ Spatial Distribution of TVDI

- ✓ Figures show the spatial distribution of the TVDI in the middle and lower reaches of the Yangtze River in China in 2011 and 2013, with a temporal resolution of 16 days.
- Compared with rainfed land, drought has a greater impact on irrigated land, indicating that irrigated lands are more sensitive to drought. However, artificial irrigation measures and projects have a certain ability to control droughts, which can alleviate the growth-related stress of drought on vegetation.





Function

Latest fire point query

Fire point spatial distribution statistics

Analysis and calculation of mid infrared remote sensing data

Module

Fire point query of Modis

Query and display of mid infrared band of FY 4A

Analysis and display of spatial density of historical fire points

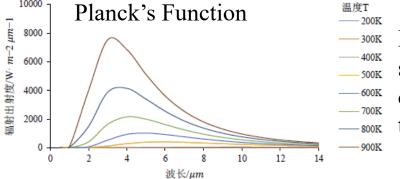
Synthesis of mid infrared data of FY 4A



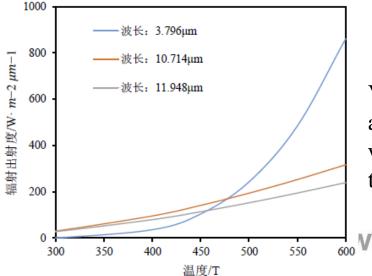
☐ Fire pixels extraction and refining

History of FY series





Blackbody radiation spectrum curves at different temperatures



Variation of radiance at different wavelengths with temperature

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☐ Fire pixels extraction and refining

✓ Potential fire pixels

$$\begin{cases} T_{20} - T'_{20,min} > 10K \\ \Delta T > [\overline{\Delta T}, \overline{\Delta T'}]_{min} \\ T_{20} > T'_{20,hist-99.9\%} + 3K \end{cases}$$

✓ Fire pixels refining by dynamic threshold method

$$\begin{cases} T_{20} > 315K \\ T_{20} > T'_{20,hist-99.99\%} \end{cases}$$

✓ Fire pixels refining by moving widow filter

$$\rho_{base} = \frac{\overline{T'_{20}} - T'_{20,min}}{\overline{T'_{24}} - T'_{24,min}}$$

$$\rho_{pixel} = \frac{T_{20} - T'_{20,min}}{T_{24} - T'_{24,min}} \longrightarrow \rho_{pixel} - \rho_{base} > 0.10$$



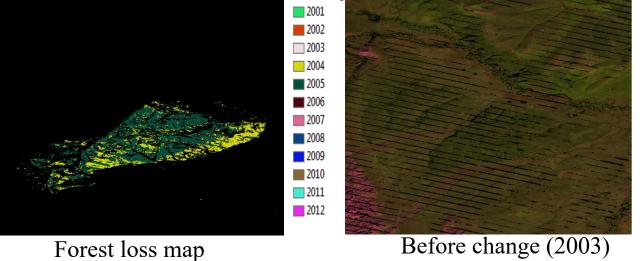


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□ Forest fires examples

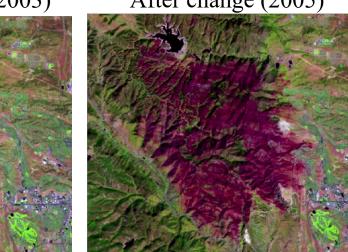
Yukon Territory, Canada 66.375 N, 139.052W



no change



no chang
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012



Colorado, US 38.931N, 104.938W

Forest loss map

Before change (2003)

After change (2005)



□ Datasets

- ✓ Annual forest loss map
 Forest loss year is from 2001 to 2012
- ✓ Annual ETM+ cloud-free image composites from 1999 to 2012
 - 8 bands

5 direct bands: band 3, band 4, band 5, band 7, minimum NDVI

3 derived bands:

NDVI=(band4- band3) /(band4+band3)

NDMI=(band4-band5)/(band4+band5)

NBR=(band4-band7)/(band4+ band7)

• 10 layers

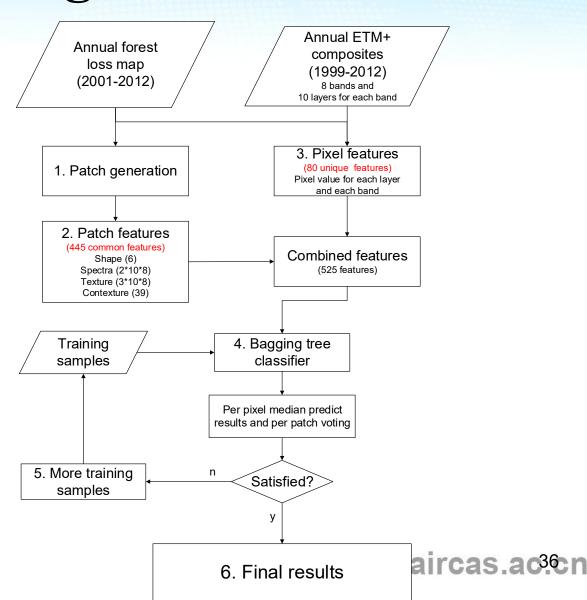
If the pixel is a forest loss pixel, we get all the values of the current pixel (totally 14 values for each band)

For the year without values, we ignore it and count how many values are available We sort those values, and use min, 10%, 25%, 50%, 75%, 90%, max, max-min, 90%-10%, 75-25%.



□ Methodology

- ✓ Patch generation
- ✓ Patch features and peer pixel features
- ✓ Training samples
- ✓ Bagging tree classifier

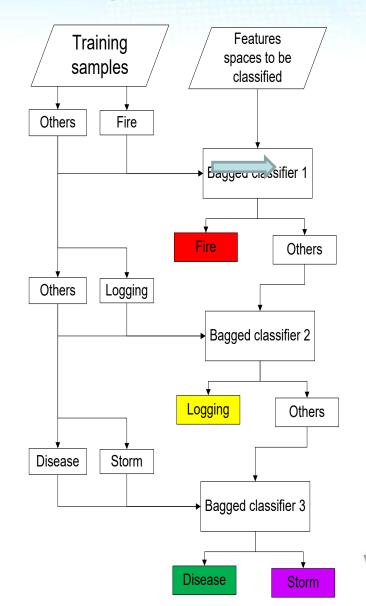


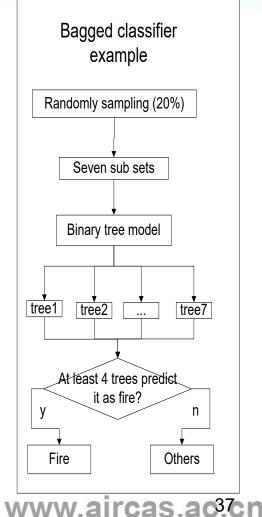


□ Methodology

- ✓ Bagging tree classifier
 - Deal with one specific class at a time
 - Bootstrap aggregation (bagging): create 7 tree models using 20% training sample for each tree
 - Fist fire, then logging, and finally disease and storm

	Training sample	15	Each subset	
Туре	Fire caused	Others caused	Fire caused	Others caused
Boreal	94,796,186	31,332,709	500,000	165,263
Australia	36,234,694	3,188,972	500,000	100,000
Others	1,915,883	75,057,945	100,000	500,000



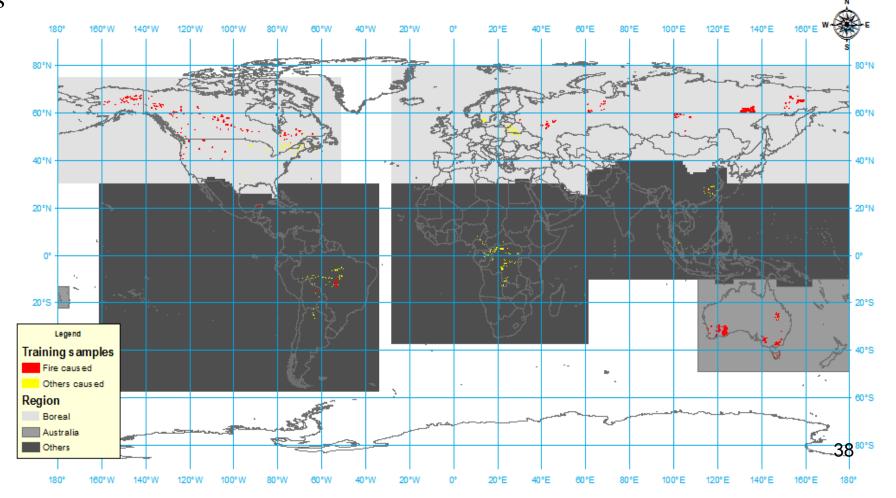




□ Methodology

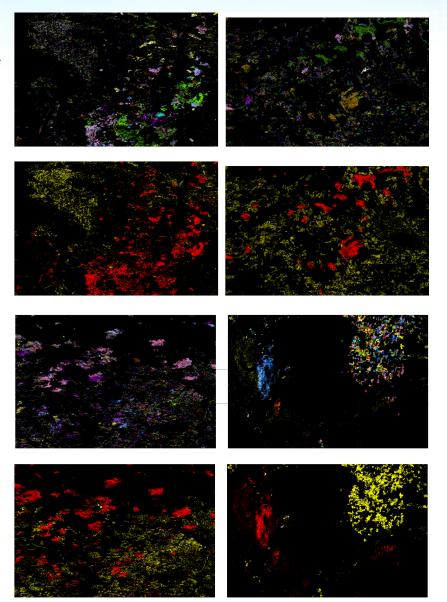
✓ Training samples

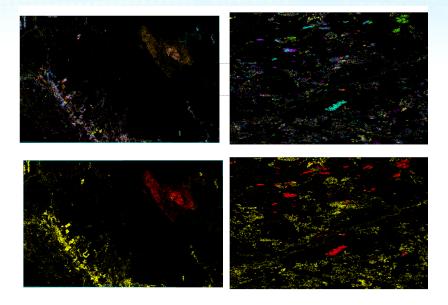
Different regions of forest loss have their own characteristics Slash and burn area in tropical area will be confused with forest loss caused by fire Three region for models and training samples distribution





☐ Results and Validation





Forest loss map

- 1. US
- 2. Canada
- 3. Bolivia
- 4. Russia
- 5. Russia
- 6. Australia

Results

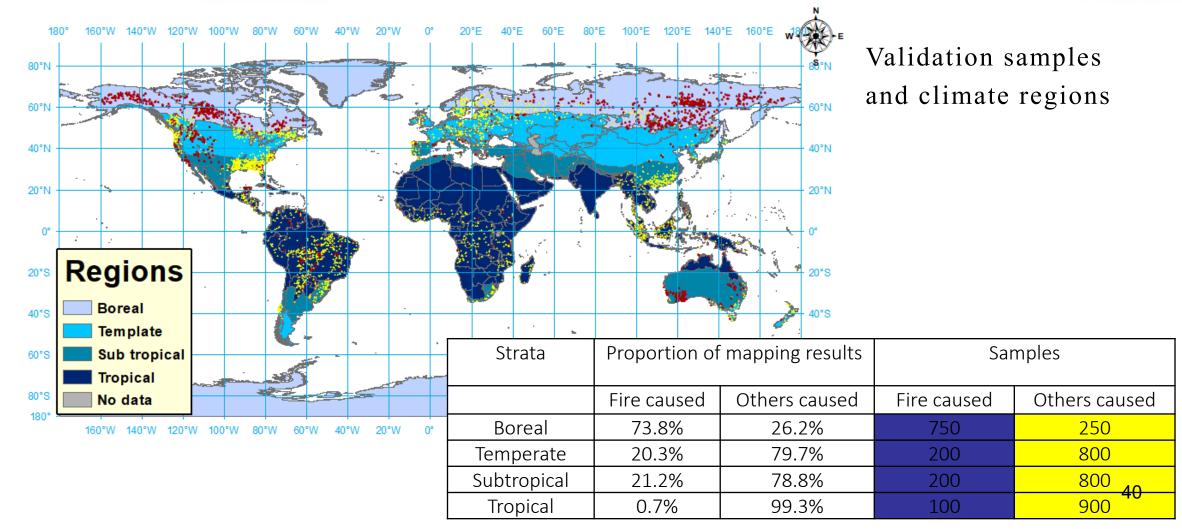


Others

w.aircas.ac3cn



□ Results and Validation





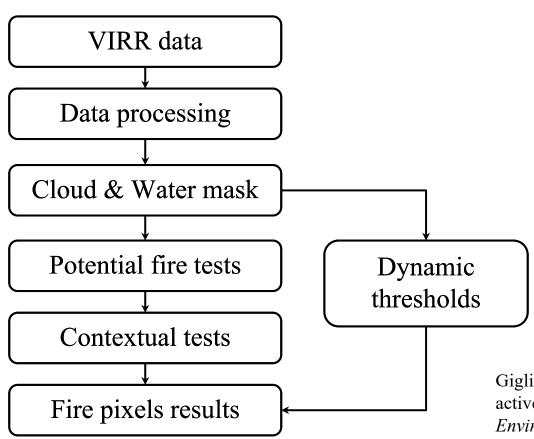
□ Results and Validation

Class₽	1₽	2₽	Total₽	Mapped area[ha] ₋	Wi₽
Boreal-1	711₽	8₽	719 ₽	44,825,548	0.196
Boreal-2	6₽	231₽	237₽	15,872,878	0.069
Temperate-1	153₽	23₽	176 .	5,544,425	0.024
Temperate-2	10₽	748₽	758₽	21,770,188	0.095
Subtropical-1	174₽	13₽	187 .	6,484,918	0.028
Subtropical-2	14₽	741 ₽	755₽	24,098,566	0.105
Tropical-1	47₽	24₽	71 ₽	721,976 ₽	0.003
Tropical-2₽	13₽	809₽	822 _°	109,858,664	0.479
4	47	4J	47	₽	₽
Total-1₽	1085 _°	68₽	1153 _°	57,576,867	0.251
Total-2₽	43₽	2529₽	2572₽	171,600,296	0.749₽

Class	1 .	2₽	Total₄	User's₊	Producer's.	Overall₽
1 _{\varphi}	0.243	0.008	0.251₽	0.97±0.01 _°	0.95±0.01	0.98±0.00 _°
2₽	0.013	0.736	0.749₽	0.98±0.01 _°	0.99±0.01 _e	Ę.
Total₂	0.255₽	0.745	1 .	₽	ę.	₽
Error adju	Error adjusted estimated area for class 1			ę.	58,532,021.4±1,	,173,642.1 _°
[ha]₄						



□ V1 contextual algorithm (main procedure)



Potential fire pixels

$$T_3 - T'_{3,min} > 10K$$

$$\Delta T > {\overline{\Delta T}, \overline{\Delta T'}}_{\min}$$

Dynamic thresholds

$$\rho_{\text{base}} = \frac{\overline{T_{3,valid}} - T_{3,valid,min}}{\overline{T_{4,valid}} - T_{4,\min 3}}$$

$$\rho_{\text{pixel}} = \frac{T_3 - T_{3,valid,min}}{T_4 - T_{4,\min 3}}$$

True fire pixels

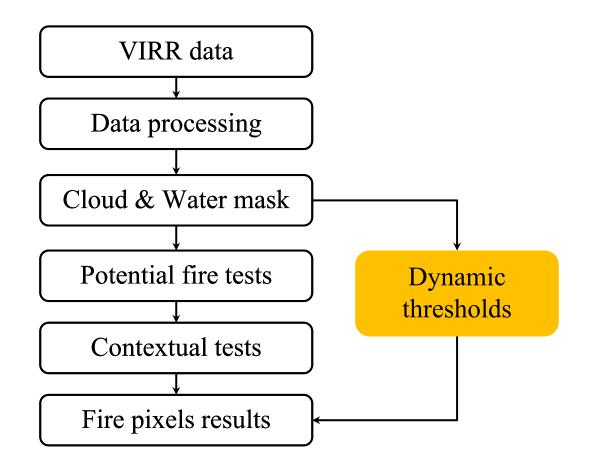
$$\rho_{\text{pixel}} - \rho_{\text{base}} > 0.10$$

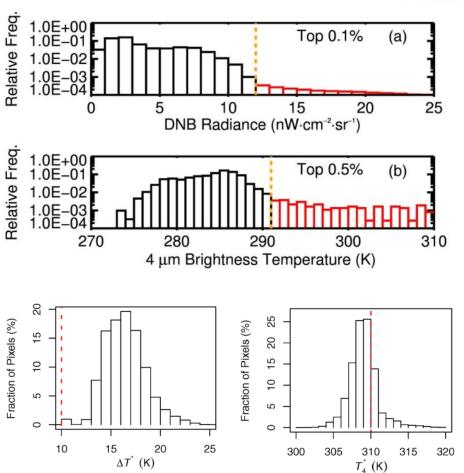
Giglio, L., Schroeder, W., & Justice, C.O. (2016). The collection 6 MODIS active fire detection algorithm and fire products. *Remote Sensing of Environment*, 178, 31-41

Polivka, T.N., Wang, J., Ellison, L.T., Hyer, E.J., & Ichoku, C.M. (2016). Improving Nocturnal Fire Detection With the VIIRS Day-Night Band. *Teee Transactions on Geoscience and Remote Sensing*, 54, 5503-5519



□ V1 contextual algorithm (main procedure)







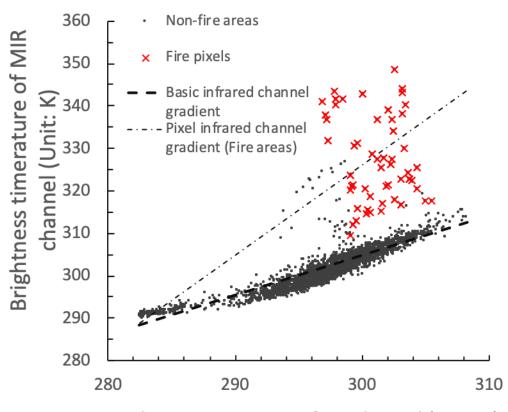
☐ Highlights of the V1 contextual algorithm

However, if fire pixels are detected according to the absolute brightness temperatures, false alarms will be made.

Therefore the dynamic thresholds are involved as below:

$$\rho_{\text{base}} = \frac{\overline{T_{3,valid}} - T_{3,valid,min}}{\overline{T_{4,valid}} - T_{4,\min 3}}$$

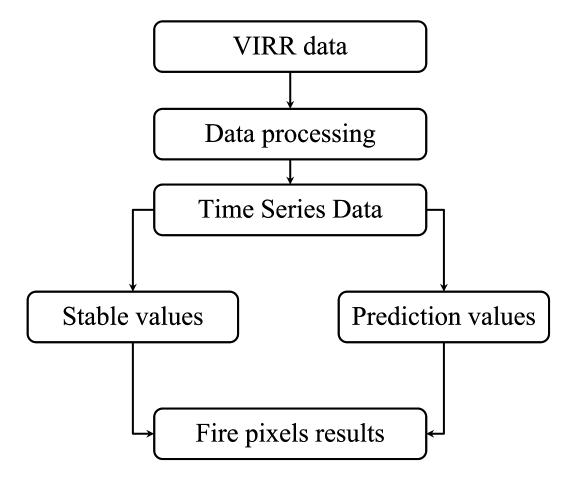
$$\rho_{\text{pixel}} = \frac{T_3 - T_{3,valid,min}}{T_4 - T_{4,\min 3}}$$

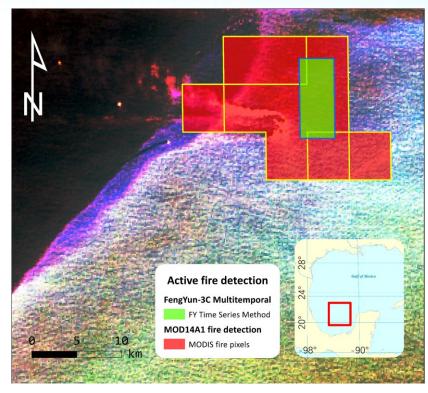


Brightness timerature of TIR channel (Unit: K)



□ V2 multitemporal algorithm (main procedure)

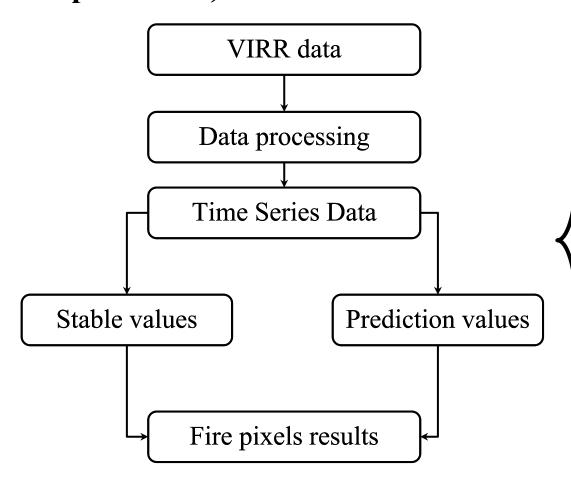




Active fire detection results for part of the Gulf of Mexico where an explosion occurred in early April 2015. The background consists of Landsat OLI images and shows the precise locations of the fires. The results obtained using the VIRR multi-temporal method and MOD14A1 aræs also marked.



□ V2 multitemporal algorithm (main procedure)



Making predictions

$$[T_{MIR,After\ SVD}, T_{TIR,After\ SVD}] = u_1 \times \sigma_1 \times v_1^T$$

$$T_{MIR,After\ SVD} = a \times T_{TIR,After\ SVD} + b$$

$$T_{MIR} = aT_{TIR} + b,$$

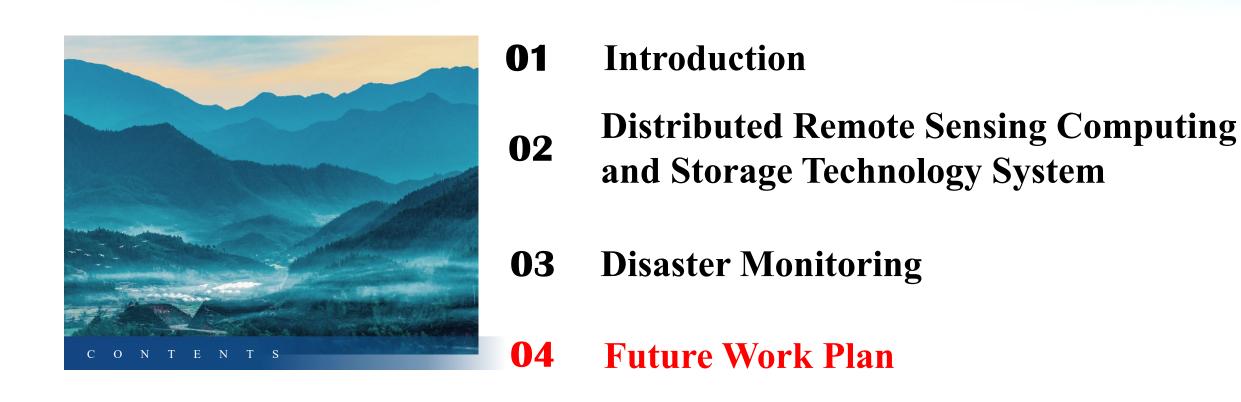
$$s.t.min \sum_{i=1}^{D} (aT_{TIR,i} + b - T_{MIR,i})^2$$

Fire detections

$$\begin{cases} \Delta T_1 > \Delta T_2 + \delta_{MIR,TS} + 3 \\ T_{TIR} > 280K \ and \ T_{TIR} > T_{TIR,threshold} \\ T_{MIR} > T_{MIR,threshold}, \\ \Delta T_2 > 0 \\ \begin{cases} \Delta T_1 > \Delta T_2 + \delta_{MIR,TS} + 3 \\ T_{MIR} > 330 \end{cases}$$

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Inversion Algorithm

- To establish inversion algorithm of flood and fire point applicable to Southeast Asia
- To develop post disaster loss assessment technology based on high score data
- To introduce satellite data from Southeast Asian countries in various forms
- To increase social and economic data such as population and roads

Data Storage

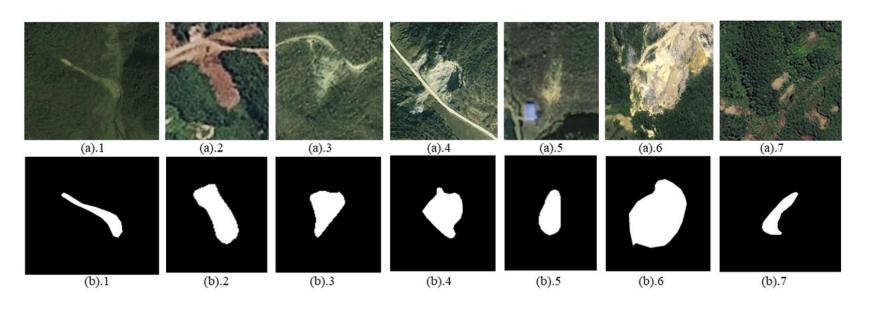
Computing Resource

- To increase computing nodes to improve platform processing speed
- To build a distributed computing system and realize the interconnection of computing resources in multiple regions
- To building a multilingual disaster monitoring application platform
- To improve system usability and stability

System Construction



☐ Landslides in remote sensed images



Satellite	Spatial resolution	
RapidEye	5m	
Geoeye	2m	
Planet	3m	
TripleSat	0.8m	
Sentinel-2	10m	
GaoFen-2	1m	
Landsat	30m	

Train/validation dataset construction

Model construction

Evaluate/Application

49cm



□ Datasets used for training and evaluation

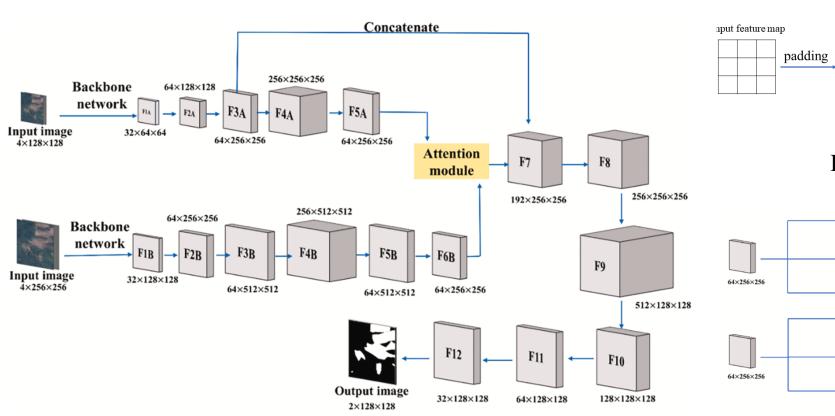
Table 1General information of each landslide inventory dataset.

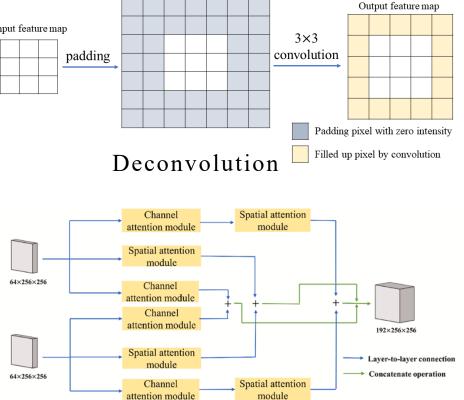
Place	Event time	Data Source	Spatial resolution	Landslide area/study area	NO. of landslide	NO. of small landslide
Lushan	2013-04-20	RapidEye	5m	821798/651712795	11094	7095
Jiuzhaigou	2017-08-08	Geoeye-1	2m	2810252/108529172	4739	2817
Wenchuan	2008-05-12	Google Earth	17m	598949/268896068	14484	9305
Iburi	2018-09-05	Planet	3m	7166788/452252126	9291	2606
Bijie		TripleSat	0.8m	21687975/150783123	770	48
Haiti	2021-08-14	Sentinel-2	10m	17049584/241120800	789	20
Zhouqu	2018-07-12	GaoFen-2	1m	875811/721565663	93	3
Taiwan		Google Earth	2.39m	426650/122378240	138	22

Rows marked in gray represent training datasets; rows marked in white represent evaluating datasets. Small landslides are defined as an area smaller than 1000 m². The landslide area/study area ratio is the ratio of the landslide pixel number and the total pixel number in the study region.



□ Model construction





Padded feature map

Attention module www.aircas.ac.tn



□ Model evaluation/application

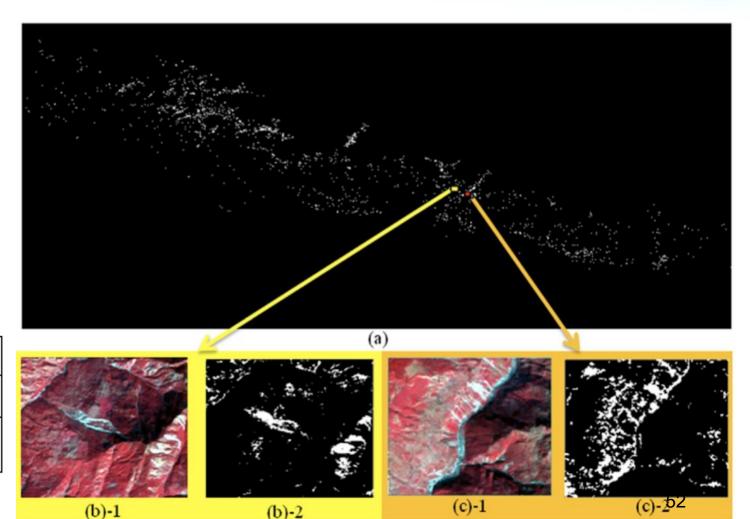
$$Precision = \frac{N_{TP}}{N_{TP} + N_{FP}}$$

$$Recall = rac{N_{TP}}{N_{TP} + N_{FN}}$$

$$F1-measure = \frac{2 \times Precision \times Recall}{Precision + Recall}$$

$$IOU = rac{N_{TP}}{N_{FP} + N_{TP} + N_{FN}}$$

Label	Landslide	Background	
Landslide	N_{TP}	N_{FN}	
Background	N_{FP}	N _{TN}	





☐ Buildings in remote sensed images







Building extraction is of great significance for assessing the impact of earthquakes on cities and towns.



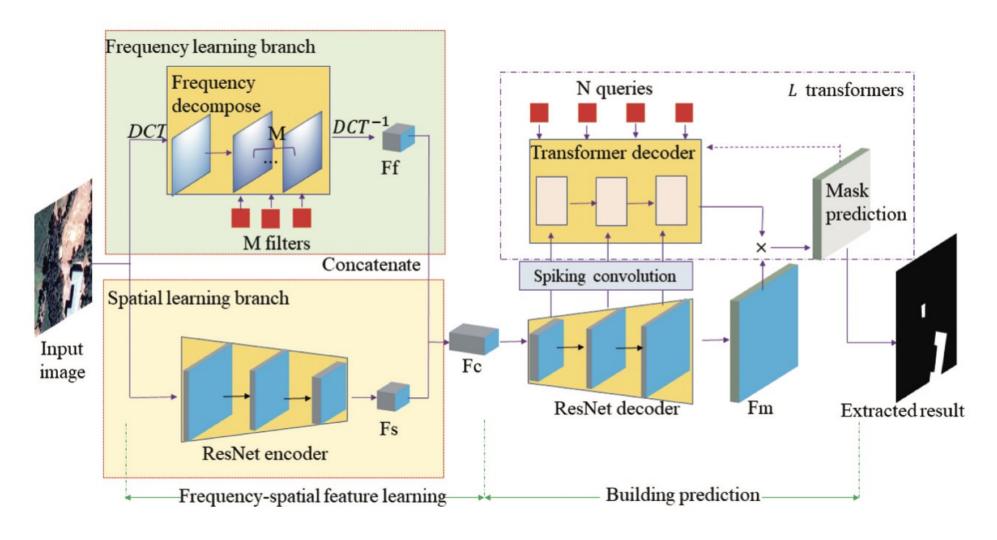
□ Datasets used for training and evaluation

Table 1. Training and evaluation dataset construction.

	Spatial resolution	lmaging sensor	Study area	Training/evaluating the model
Inria Aerial Image Dataset	0.3 m	Aerial Image	810 km ² of multiple cities	Training
WHU-Building Satellite Dataset II	0.45 m	Satellite images	860 km ² of East Asia	Training
xBD Building Dataset	0.3 m	WorldView-3	45,361.79 km ² of 15 countries	Training
Massachusetts Buildings Dataset	1 m	Aerial Image	340 km ² of Boston	Evaluating I
WHU-Building Satellite Dataset I	0.3 m to 2.5 m	QuickBird, Worldview series, IKONOS, ZY-3	860 km ² of East Asia	Evaluating II
xBD hold-out dataset	0.3 m	WorldView-3		Evaluating III
xBD test dataset	0.3 m	WorldView-3		Evaluating IV



□ Model construction



.ac5cn



□ Model evaluation

(b)

(c)

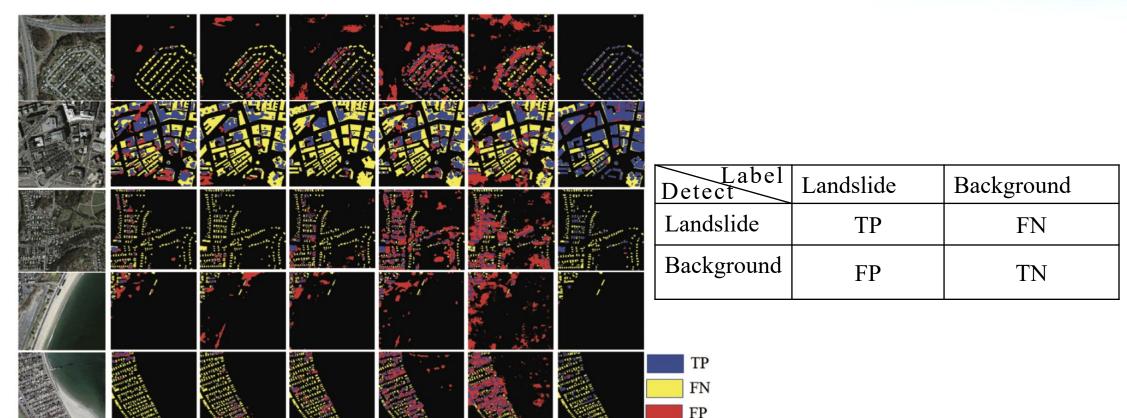


Figure 5. Visual comparison of extracted building instances using the different methods of evaluation dataset I: (a) original images; (b) results from BiSeNet; (c) results from DeepLabv3+; (d) results from HRNet; (e) results from PSPNet; (f) results from SegNet; (g) results from MSFTrans, TP indicates true positive pixels, FN and FP represent false-negative and false-positive pixels, respectively.

(e)

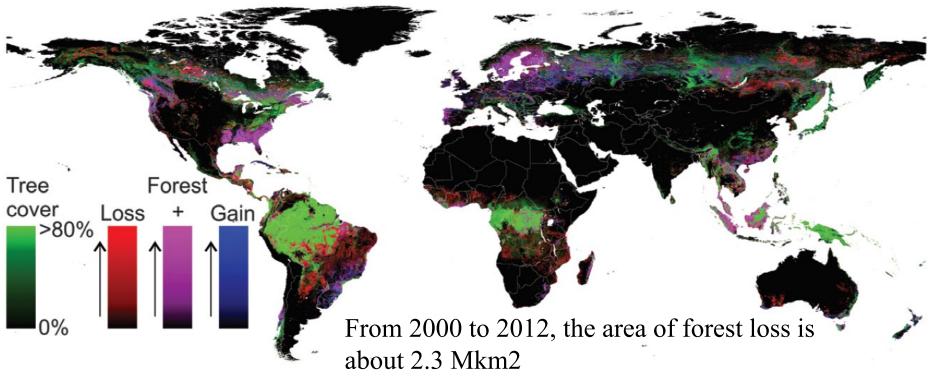
(f)

(d)





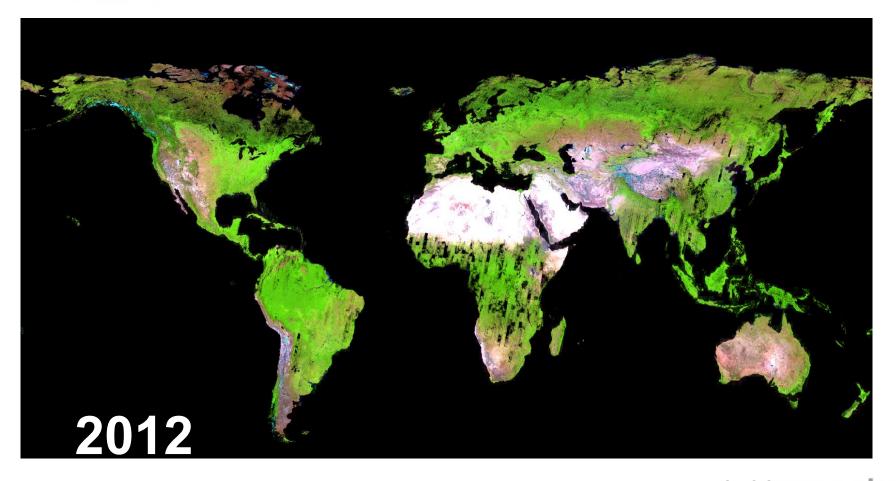
☐ Global Forest distribution and disturbance during 2000-2012



Since 2013, Hansen's group updates annual 30m forest loss and composite of Landsat imagery. Hansen, 2013, Science http://earthenginepartners.appspot.com/science-2013-global-forest



□ Landsat Level 3 Products





Cloud Detection

Function

FY 4A remote sensing data preprocessing and warehousing

Visualization of FY remote sensing data

Fine grained distributed model operation

Module

FY data visualization

Time series query statistics of FY data

Cloud detection by threshold method based on FY data

Cloud detection model training based on random forest

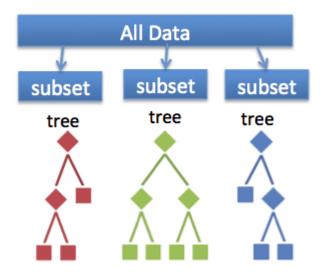


Cloud Detection

☐ Introduction of Random Forest Algorithm

✓ Random forest is used for cloud detection

Random forest



Advantages

- 1.It can process data with high dimensions (many features) without dimension reduction and feature selection.
- 2.It can judge the importance of features and the interaction between different features.
- 3.It is not prone to over fit.
- 4. The training speed is fast, and it is easy to make parallel methods.
- 5. For unbalanced data sets, it can balance the error.
- 6.If a large part of the features are lost, the accuracy can still be maintained.

Disadvantages

- 1.Random forests have been proved to be over fitting in some noisy classification or regression problems.
- 2. For data with attributes with different values, attributes with more values will have greater impact on random forests, so the attribute weights produced by random forests on such data are not credible. **www.aircas.ac61cn**



Cloud Detection

□ Modeling and result display interface of FY 4A cloud identification based on

random forest

Cloud identification results based on random forest (FY4A)





DBAR Professional Training Program on "Utilizing Big Earth Data to Enhance SDG Research, Monitoring and Reporting in Thailand and Southeast Asia"

Monitoring surface water dynamics based on multi-source remote sensing big earth data in cloudy and rainy regions

Guoqiang Jia

China-ASEAN Regional Innovation Center for Big Earth Data (CARIC)





Contributors: Yubao Qiu, Qiaoting Qin, Ning Zhao

Contents



- Water on Earth
- Long-term surface water monitoring
- High-resolution surface water monitoring



Water on Earth



- Water is essential for human well-being, energy and food production, healthy ecosystems, gender equality, poverty reduction and more.
- Water is invaluable for people's living, production, transportation, and recreation, and as a habitat for a myriad of plants and animals.



Water in body



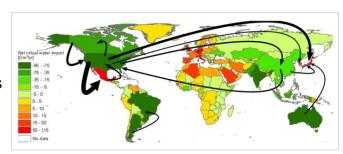
Hydropower, irrigation, recreation



Water ecosystems: home to living beings



Trades by shipping



Virtual Water Trade

GRACE Communications Foundation, 2022 Our World in Data, 2020 www.dbeltroad.org

Water on Earth



The water on the surface of Earth is found mainly in its oceans (96.44 percent) and polar ice caps and glaciers (1.89 percent), with the balance in freshwater lakes, rivers, and groundwater.

< 0.06 percent

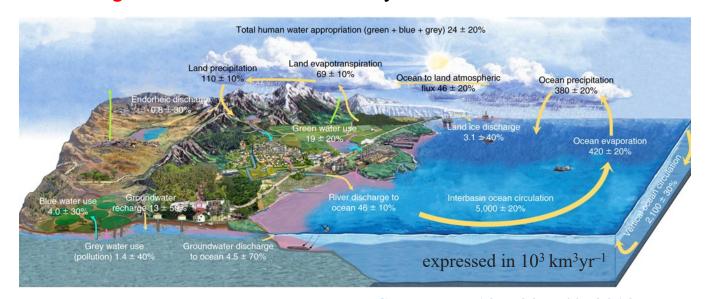
- ✓ Rivers
- √ Fresh lakes
- ✓ Reservoirs
- ✓ Wetlands
- ✓ Soil moisture
- ✓ Renewable groundwater



Water on Earth



 Less than 10% of annual terrestrial precipitation and 25% of annual river flow are sustainably available for human consumptive use, and only 1–5% of fresh groundwater is sustainably extractable.



Water and sustainable development



- Transforming our world: the 2030 Agenda for Sustainable Development
- In 2015, United Nations Member States committed to the ambitious but achievable 2030 Agenda for Sustainable Development, charting a new path of balance for humanity and the planet.





































17 goals169 targets232 global indicators

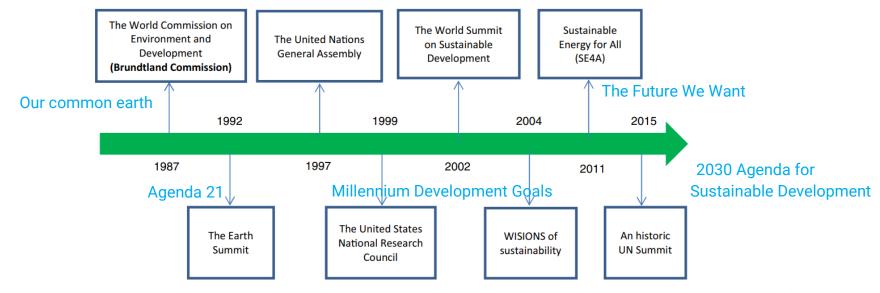
SDG 6 targets water and sanitation

UN, 2015

Water and sustainable development



- The 2030 Agenda for Sustainable Development provides a shared blueprint for peace and prosperity for people and the planet, now and into the future.
- The SDGs build on decades of work by countries and the UN.



Water and sustainable development



 Water is at the core of sustainable development. It supports all aspects of life on Earth, and access to safe and clean water is a basic human right.



- Means for development and preservation of natural processes
- Enablers of sustainable development and human wellbeing
- 6.1.1 Drinking Water
- 6.2.1 Sanitation and Hygiene
- 6.3.1 Wastewater
- 6.3.2 Water Quality

- 6.4.1 Water Use Efficiency
- 6.4.2 Water Stress
- 6.6.1 Ecosystems

- 6.5.1 Water Management
- 6.5.2 Transboundary Cooperation
- 6.a.1 International Cooperation
- 6.b.1 Stakeholder Participation



SDG6 with other SDGs

quality

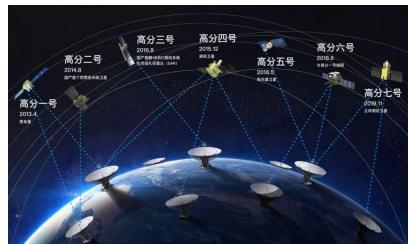
availability

management

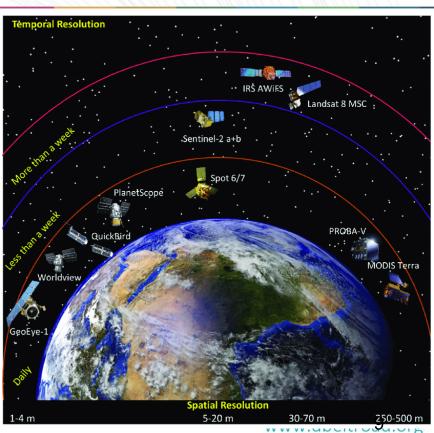
www.dbeltro&d.org



- Providing an effective earth observation with global coverage, high frequency, and long-term operation.
- Monitoring the environment, recourses, hazards, human activities, including water.

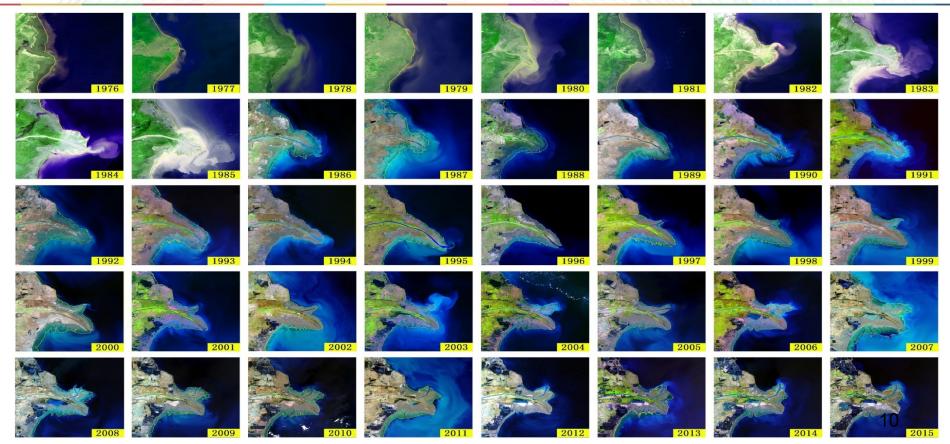


China Gaofen satellite constellation

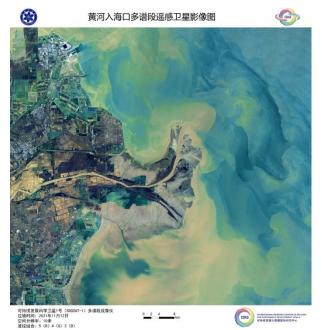


Agronomy 2020, 10(5), 641





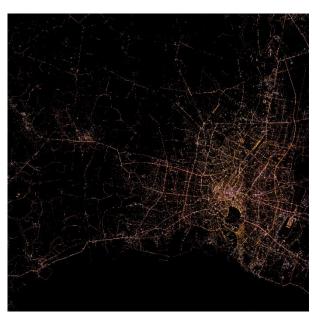




Multispectral image of Yellow River Estuary (10m)



Fused Colored Glimmer Image of Beijing (10m)



Fused Colored Glimmer Image of Bangkok (10m)

www.dbeltroad.org





https://streamlit.gishub.org 1984 Laem Chabang Landsat Timelapse

Contents



- Water on Earth
- Long-term surface water monitoring
- High-resolution surface water monitoring

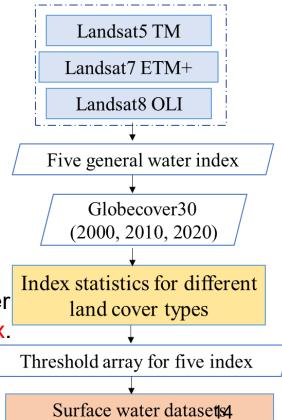


Long-Term Surface Water Monitoring



method

- The water extraction methods based on optical remote sensing imageries could be summarized as three categories: water index threshold, classification, and feature identification.
- The method of water index threshold is practical and efficient, but has low precision when single water index used.
- A practical and reasonable comprehensive surface water extraction method by combining five general water index.



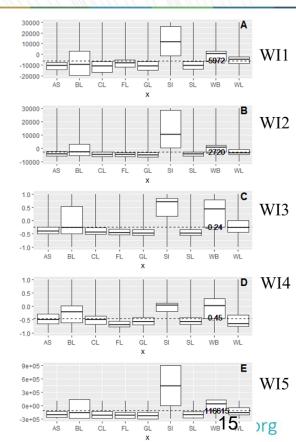
Long-Term Surface Water Monitoring



method

Water index	Configuration
NDWI	(G – NIR)/(G + NIR)
MNDWI	(G - SWIR1)/(G + SWIR1)
$AWEI_{nsh}$	$4 \times (G - SWIR1) - (0.25 \times NIR + 2.75 \times SWIR1)$
$AWEI_{sh}$	$B + 2.5 \times G - 1.5 \times (NIR + SWIR1) - 0.25 \times SWIR2$
HRWI	$6 \times G - R - 6.5 \times NIR + 0.2$
WI2015	$1.7204 + 171 \times G + 3 \times R-70 \times NIR-45 \times SWIR1-71 \times SWIR2$

Note: B, G, R, NIR, SWIR1, SWIR2 represent Landsat's blue (~0.4 – 0.5 μm depending on the sensor), green (~0.5 – 0.6 μm), red (~0.6 – 0.7 μm), near infrared (~0.8 – 0.9 μm), short-wave infrared 1 (~1.6 – 1.8 μm), and short-wave infrared 2 bands (~2.1 – 2.4 μm), respectively.

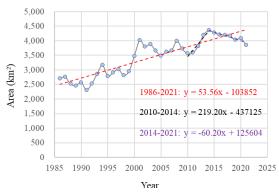


Long-Term Surface Water Monitoring (**) BAR



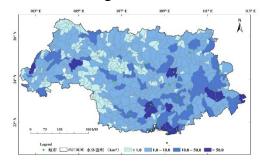
Water dynamics in Guangxi (southwest China)

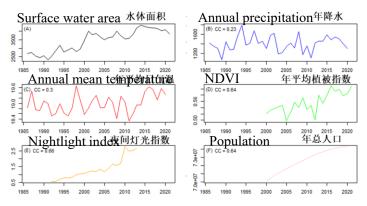
Surface water yearly dataset for 1986-2021



An increasing trend for surface water area in the Southern China in the past 36 years

- Most of subsheds have surface water area more than 1 km².
- Surface water abundance was located in the main river and coastal regions.





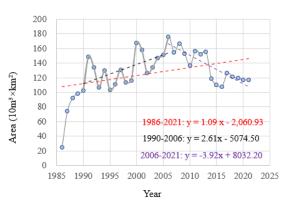
- Good linear relationship between annual surface water area and NDVI, nightlight index and population.
- Human drivers matter to surface water dynamics

Long-Term Surface Water Monitoring BAR

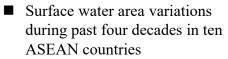


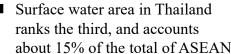
Water dynamics in ASEAN countries

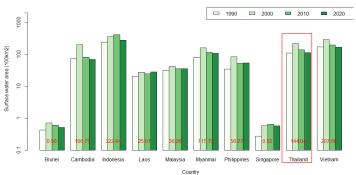
Surface water yearly dataset for 1986-2021

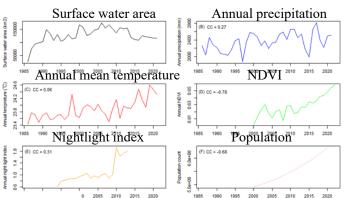


- An increasing trend for surface water area in the ASEAN countries in the past 36 years
- Decreasing trend in recent years (2006-2021)









- Good linear relationship between annual surface water area and NDVI, and population.
- Environmental and human drivers contribute together to surface water dynamics

www.dbeltrddd.org

Contents

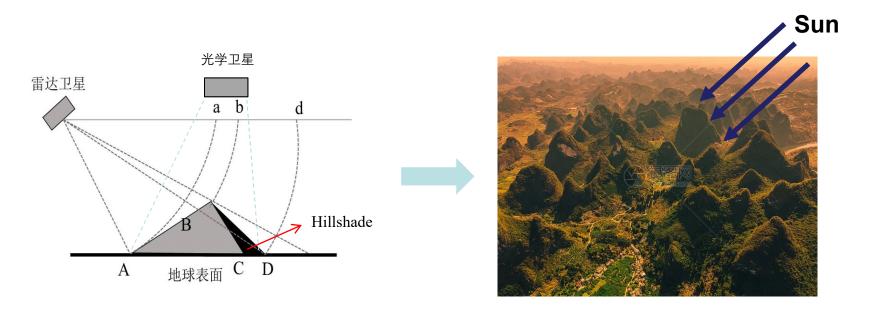


- Water on Earth
- Long-term surface water monitoring
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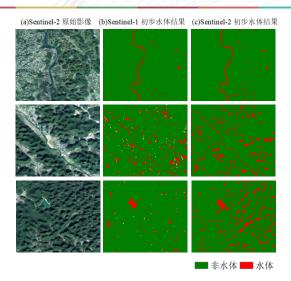




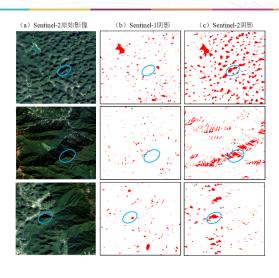
A Novel Method specifically developed for mountain area, like South West China, Guilin as a good example.



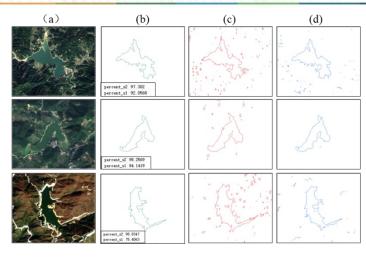




Results from radar and optical imagesPreliminary water extraction



Position comparison of radar shadow and optical shadow



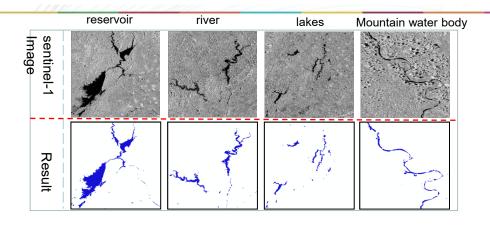
- (a)Sentinel-2 original image;
- (b) The intersection of Sentinel-1 and Sentinel-2 water extraction results;
- (c)Sentinel-1 preliminary water extraction results; (d)Sentinel-2 preliminary water extraction results

Raster Extract and Vector Intersection Process Tool

The mountain shadow effectively eliminated by the extraction of sentinel-1 and sentinel-2 imaging geometric topological relationship.

www.dbeltr20d.org





	water body	Non- water body	total	User's Accurac y (%)	mapping accuracy (%)	Commiss ion Errors (%)	Omission Errors (%)
water body	408	52	460	88.70	97.61	11.30	2.39
Non- water body	10	590	600	98.33	91.90	1.67	8.10
total	418	642	1060				

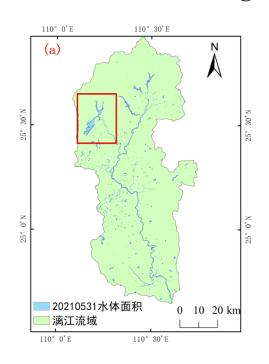


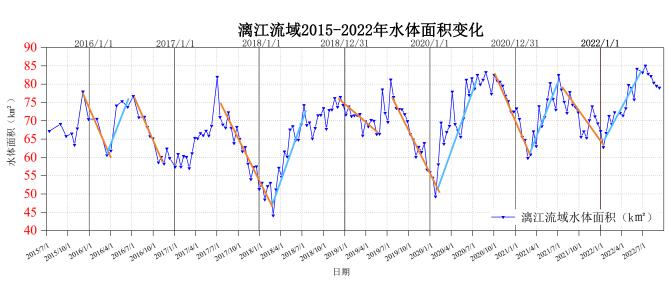
The overall classification accuracy reached 94.15% and Kappa coefficient

was 0.8796. www.dbeltr24d.org

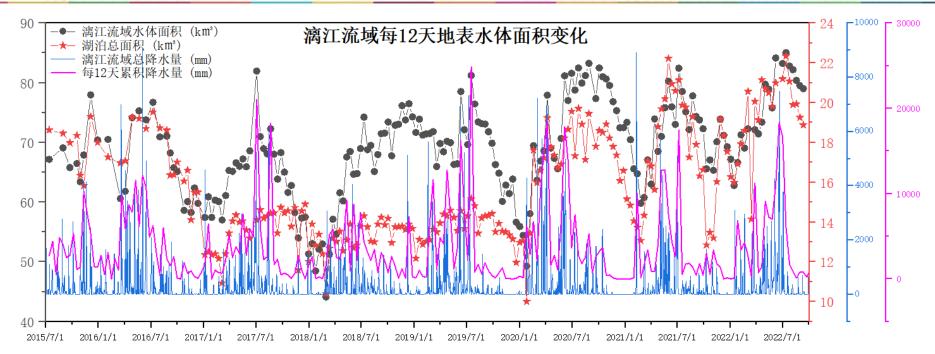


Change of Water body in Lijiang Watershed every12 days









It can be seen from the curve that there is a strong correlation between water body area and precipitation www.dbeltr23d.org

Thanks

DBAR Secretariat

No.9 Dengzhuang South Road

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www.dbeltroad.org



Geoscience data sharing and standard

Juanle WANG

State Key Lab of resources and environmental information systems Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences 2023.05.29





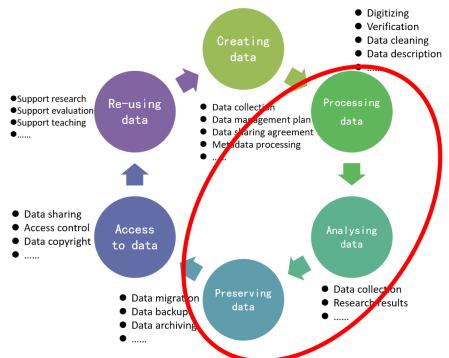
- 1. International Trends of Scientific Data Sharing
- 2. Geoscience Data sharing and standards in China
- 3. Cases for Scientific Data Management in fields



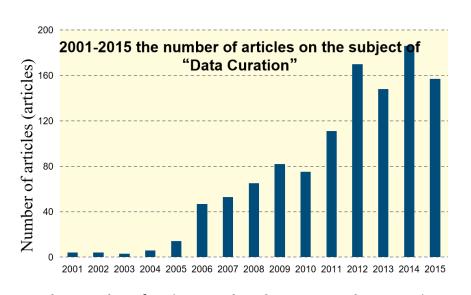
International Trends of Scientific Data Sharing

(1) Data science, scientific data management and citizen science are developing rapidly





Scientific Data Curation has became a hot spot in the field of professional disciplines, information science and library science.



In the Web Of Science database, used "Curation Data" as the theme of retrieval, found that only 44 relevant literatures during the 1900-2000 years, from 2001-2016 years is increased to 1615.

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(2) Management and deployment of scientific data at the national level



Developed countries have raised the continuous accumulation and open utilization of scientific data to the height of the national science and technology strategy for deployment. Through years of continuous accumulation, a number of <u>authoritative</u>, <u>long-sequence</u>, <u>multi-scale</u> **scientific databases** have been formed, which have played **an important role** in the scientific research process.

- Lausanne Agricultural Experiment Station in the UK,
- ARGO Global Ocean Monitoring and Observing Network,
- National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA) and National Institutes of Health (NIH) are in authoritative positions in this field.











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(3) Authoritative data centers gather global resources



Developed countries actively rely on authoritative scientific data centers to continuously integrate and aggregate global scientific data resources, and gradually form standardized scientific data collection, management and storage solutions.

The Global Biodiversity Information Network (GBIF) is currently the **largest** biodiversity information service organization in the world. It has formed a comprehensive information service on **global biodiversity** for users worldwide by promoting the sharing of primary data on biodiversity through various means such as cooperation with seed funds.

Research Fields	Authoritative database/dataset	Country	
Genomics	Genbank	USA	
Biodiversity	BHL	USA	
Astronomy	CDS	France	
Remote Sensing	MODIS/Landsat	USA	
Atmosphere	WDCGG	Japan	
Ocean	PANGAEA	Germany	
Nuclear	IAEA-NDS	USA, Europe, Japan, China and Russia	
Chemical	ACS	USA	
Material physics	MAtNavi	Japan	
Medicine	PDB	USA	
Comprehensive	SRD	USA	

(4) Data center management model

PDB data center of the United States

U.S. foundation Dryad data warehousing

Germany World Data Center, Remote Sensing Atmospheric Data Center









(5) Scientific data publishing model (Academic Journal + data Journal)

ICDCD Qualitative Data Denocitory 生

Social Sciences



(6) Data exchange management model of science and technology plan project







NSF 11-1 January 2011 Chapter II - Proposal Preparation Instructions NOAA data sharing policy was released in October 2011. The environmental data and information that is created or derived should be visualized and available timely (usually no later than 2 years after the data generation).



RESEARCH COUNCILS UK

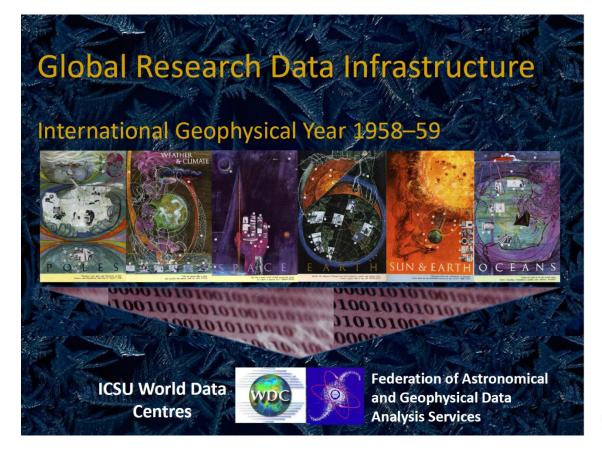
Excellence with Impact

After 1st October 2003, the application will be demanded to join a data sharing program

The object of data sharing policy is an academic journal or a paper published in the conference, implemented since 1st April 2013.

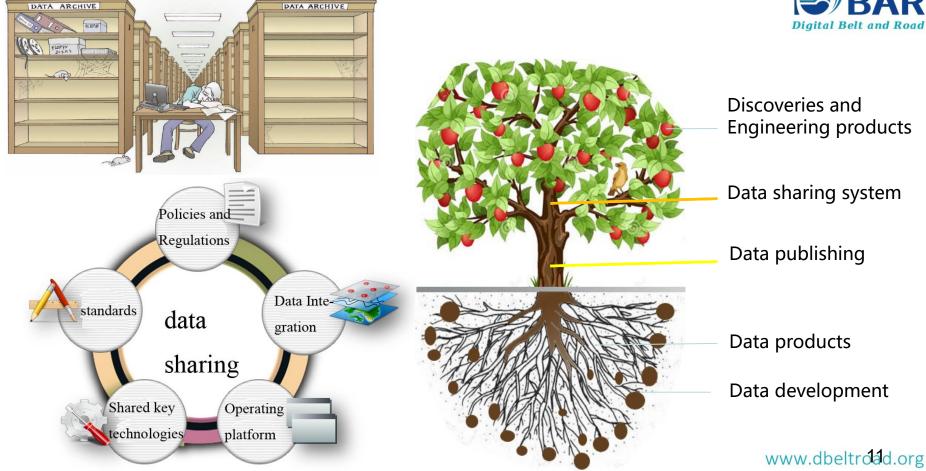
(7) Rapid development of International Scientific Data Organization





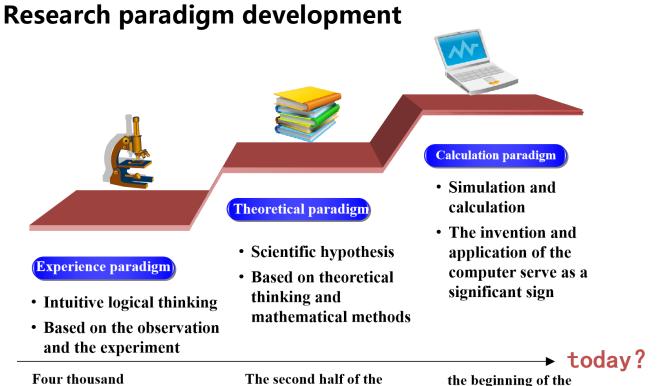
(8) Scientific data ecology needs to be strengthened





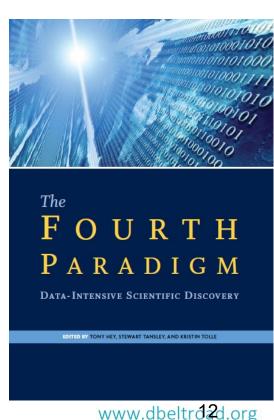
(9) The rapid development of data-driven knowledge discovery

twentieth century



fifteenth century

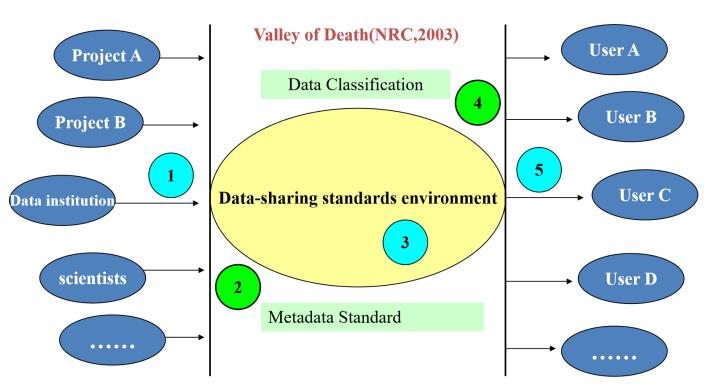
vears BC



Digital Belt and Road

(10) Data sharing standard and mechanism





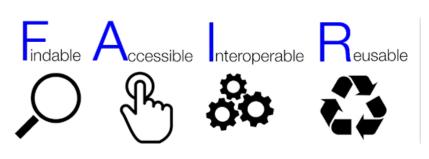
(11) Development of big science plan——Deep-time Digital Earth DDE



Describe Digital Carth (DDE) aims to link and transmitted links and share gland geoscience knowledge with the goal of stimulating data-driven discoveries in the study of Earth's evolution through deep time.



(12) The FAIR Principal





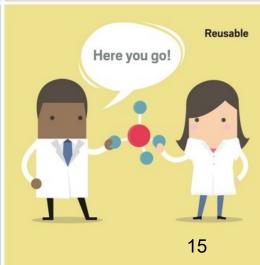


SUBJECT CATEGORIES » Research data » Publication characteristics

OPEN Comment: The FAIR Guiding Principles for scientific data management and stewardship

Mark D. Wilkinson et al.#





(13) Open data is an important part of the open science

initiative

Open Science Recommendation

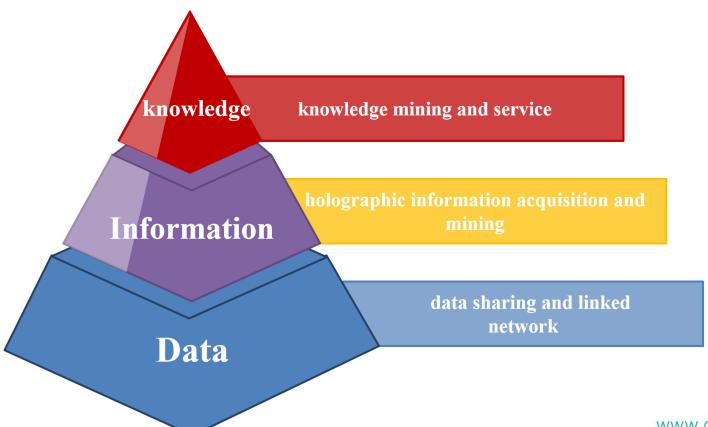


Adopted by 193 countries at the UNESCO General Conference on 23 November 2021



(14) Knowledge service

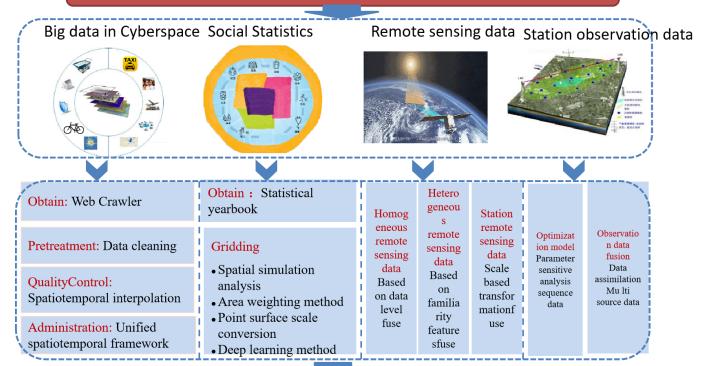




(15) Big earth data technology



Integration and standardization of global big data



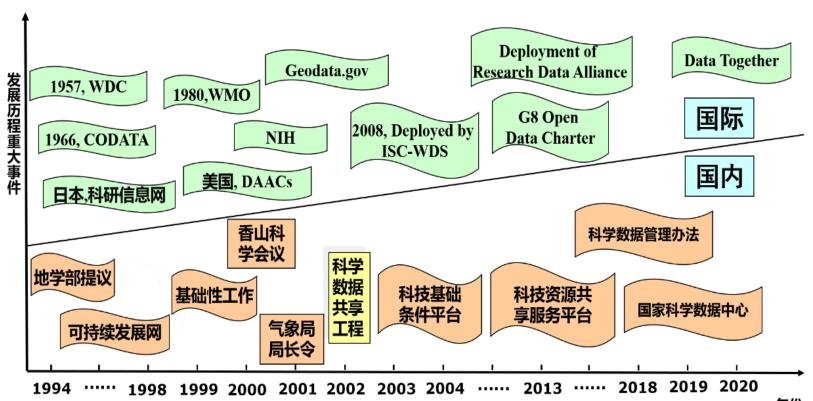
Big data driven knowledge discovery and Application



Geoscience data sharing and standards in China

Progress of scientific data integration and sharing in China

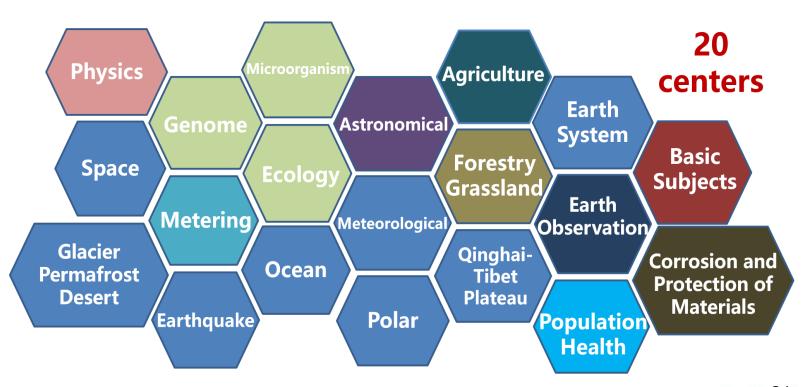
Construction of scientific data centers and data science centers.



Digital Belt and Road

National Science Data Center





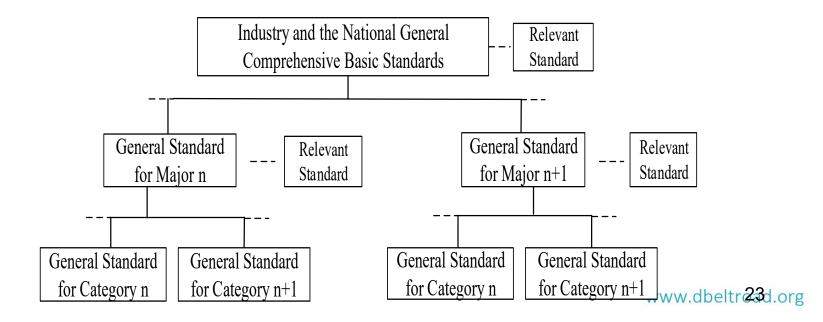
The Definition of Standard Reference Model



- > Standard is a document to stipulate and guide activities to the best effect in specific field, which is established and approved by recognized institutions. (GB/T 13016-2009)
- Standard system means a combination which consists of some relevant standards and their inner link. The standard system may contain standard system structure, standards list, standards statistics table and description for drawing up standard.
- > Standard reference model describes the overall demand of standardization and basic principles for scientific data sharing ,the reference model defines a series of standard architecture framework related to scientific data sharing.

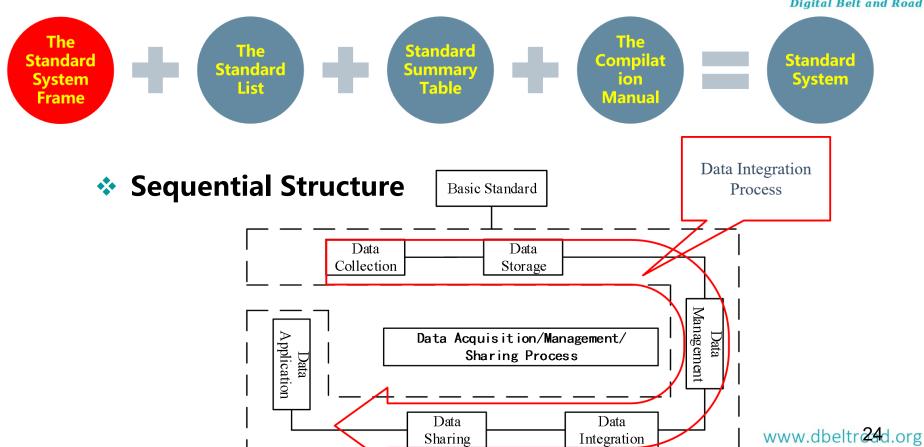
Standard system is the core of data integration





Standard System

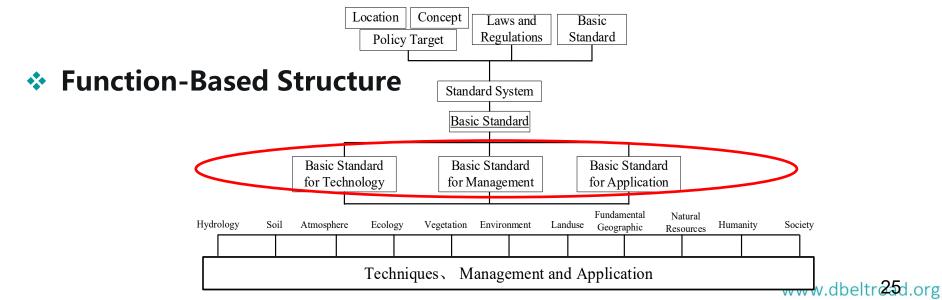




Standard System







Data sharing standards system research

Organizations	Main Achievements
Federal Geographic Data Committee(FGDC)	FGDC standard reference model
Unsymmetrical Slope Chamber Bottom(USCB)	Topologically Integrated Geographic Encoding and Referencing(TIGER)
Multipurpose European Ground Related Information Network(MEGRIN)	Geographical Data Description Directory
Canadian General Standards Board(CGSB)	CGSB Earth Spatial Dataset
The Australia New Zealand Land Information Council(ANZLIC)	Core Metadata Elements
National Aeronautics and Space Administration(NASA)	Directory of Interchange Format Manual(DIF)
International Science Organization/Technical Committees(ISO/TC211)	ISO Geographical Information Metadata Standards
Open GIS Consortium (OGC)	OGC Reference Model
American National Standards Institute(ANSI)	ANSI Standard

The United States began construction of distributed data archive center groups from 1990, some relevant data sharing policies and standards were formulated, which laid a solid foundation for the construction of "Digital Earth".



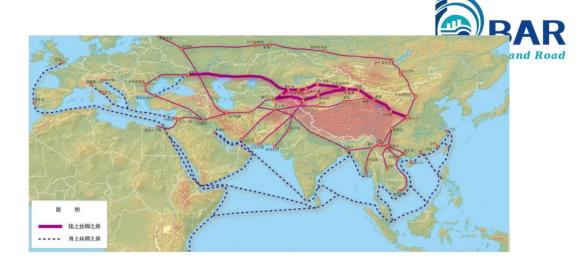
Cases for Scientific Data Management in fields



Data collection and integration in North East Asia area

Belt and Road Initiative

The Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road in March 2015.

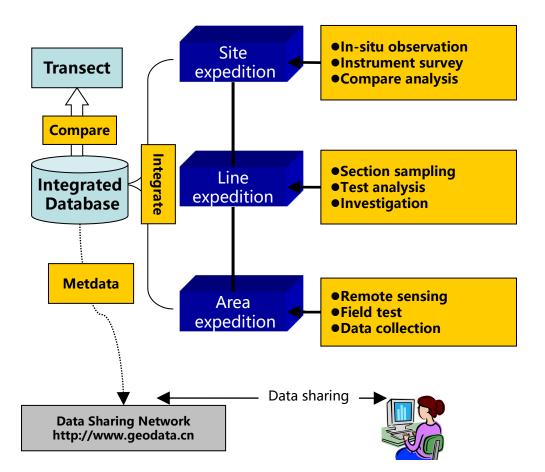


The Silk Road Economic Belt focuses on bringing together China, Central Asia, Russia and Europe; linking China with the Persian Gulf and the Mediterranean Sea through Central Asia and West Asia; and connecting China with Southeast Asia, South Asia and the Indian Ocean.

The 21st-Century Maritime Silk Road is designed to go from China's coast to Europe through the South China Sea and the Indian Ocean in one route, and from China's coast through the South China Sea to the South Pacific in the other.

www.dbeltr29d.org

Expedition activities





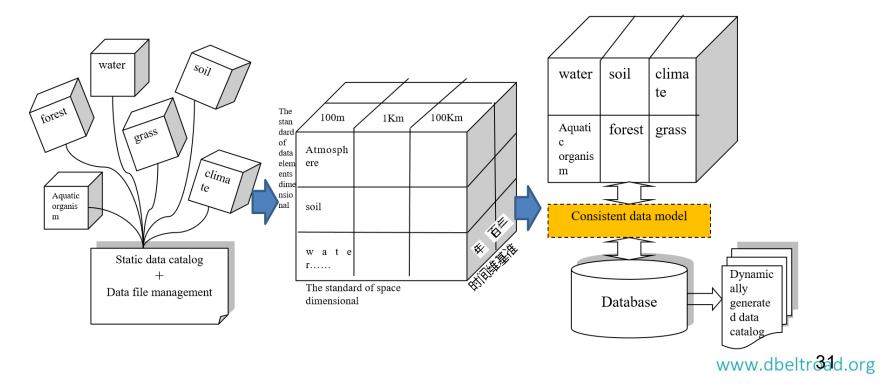


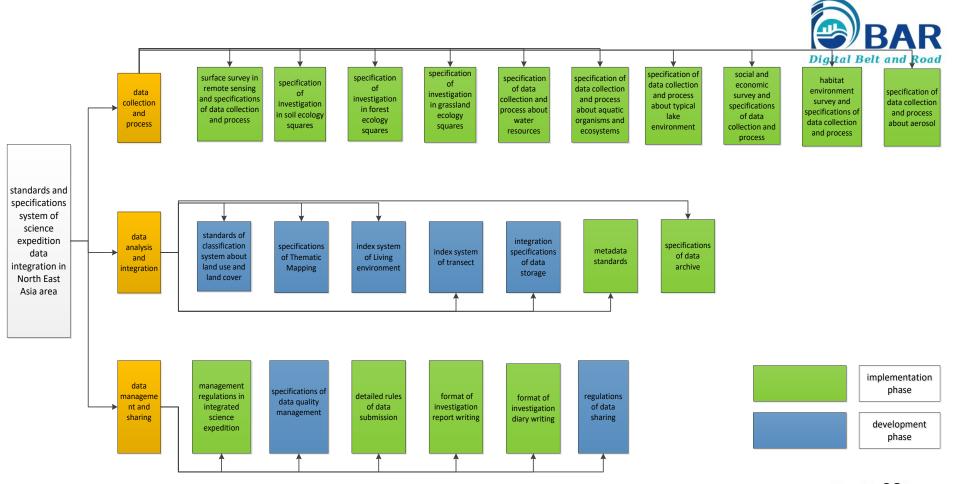
Data integration methods

Digital Belt and Road

Scientific

Based on the standard of common dimensional comprehensive scientific investigation "data cube" model





Distribution of soil profile sampling location in North East Asia area



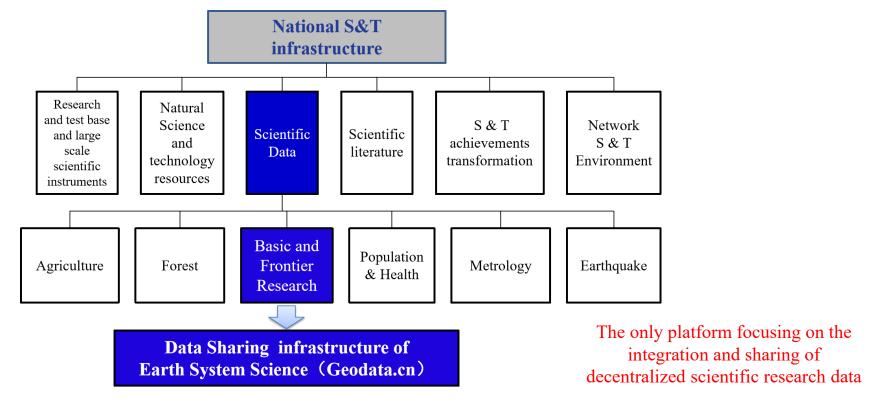


National Earth System Science Data Sharing Infrastructure

Platform positioning(平台定位)

National Science & Technology Infrastructure(NSTI) Framework



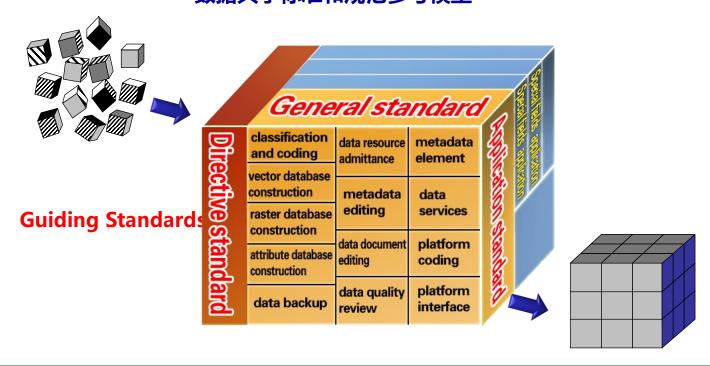


tr**35**d.org

Standards and specification system (标准和规范体系)

Data sharing Standards and specifications reference model 数据共享标准和规范参考模型

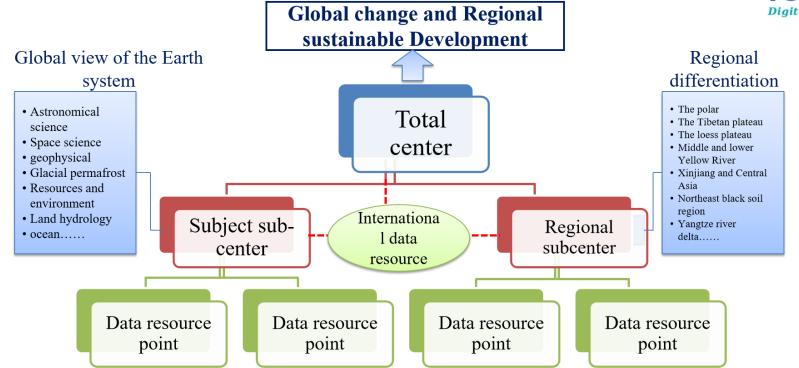




It covers data classification, description, integration, database building, distribution, service and quality control etc. It can guide the detailed specifications making.

Organization Structure(组织体系)

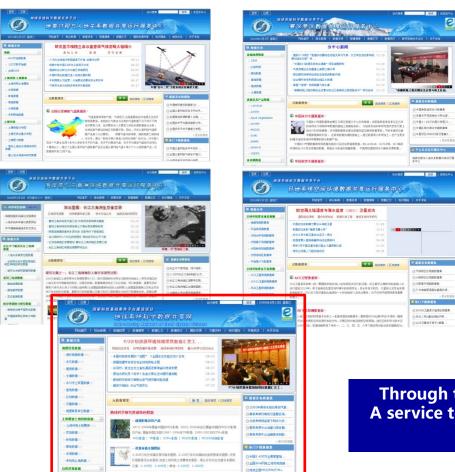




The integration and service of the subject and the typical regional data resources

Through disciplines, regional sub-centers and data resource points, it drives the integration and personalized service of data resources of disciplines and typical regions

Shared service platform (共享服务平台)



Conternet I (8)







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事状が北大学発展

PROPERTY

直线开启中书架

森林沙森州市里

Through the one-stop service network and full-time professional A service team that continuously and uninterruptedly provides free data sharing services to the outside world

S20MF 包括展型77、音符、17中省和内容区区部

, 本区将建設高市工業行山、予選中洋的株果

9.对自然结核分异常着重要作用。从不而百气样

自己的女子最后,中于李公建;从来的北方便温度。

ORENWEE MAKENET, CHARGINE

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Disaster Risk Reduction Knowledge Service

Organize architecture (组织架构)

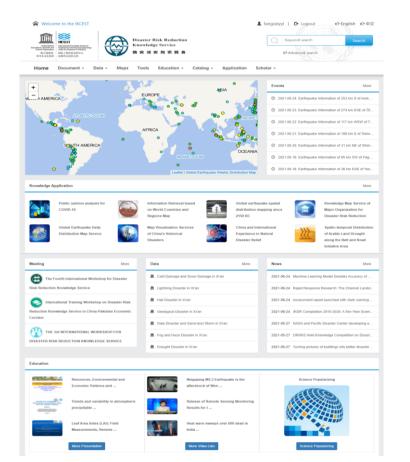




The project is hosted by the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences.

项目实施单位:中国科学院地理科学与自然资源研究所。

DRRKS platform(防灾减灾知识服务平台)





Main function

- DRR metadata service
- DRR scientific data service
- DRR experts and Institution database service
- 4. DRR thematic knowledge application
- 5. DRR **thematic** knowledge service
- 6. DRR **training** service
- 7. DRR popular science service

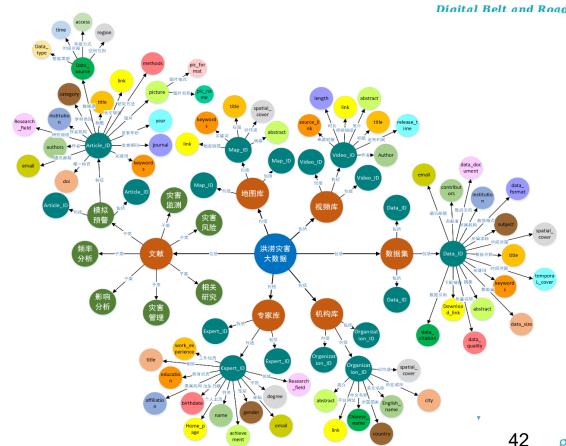
Flood disaster data organization model

洪涝灾害数据组织模型

本研究涉及的洪涝灾害数据来自于防 灾减灾知识服务系统(DRRKS), 包括数据集、文献、机构库、专家库、 视频库、地图库等。

Research data comes from Disaster Risk Reduction Knowledge service(DRRKS), including data sets, literatures, experts, organizations, videos, and maps.







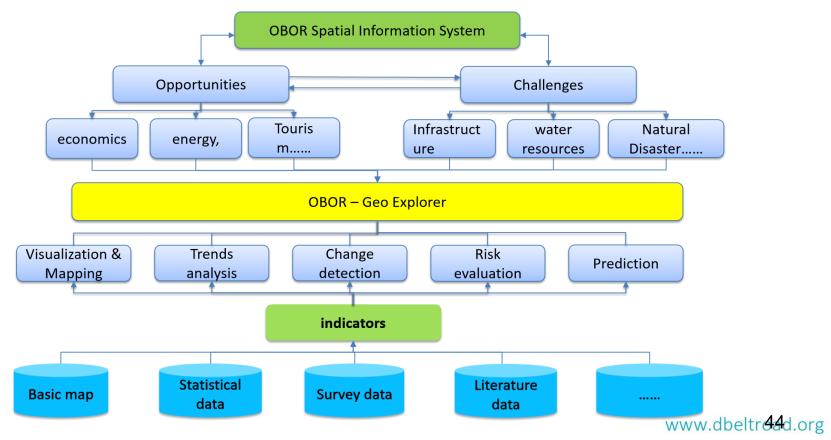
Report summary

> Big (earth) data driven Geoscience

- > Data intensive science for Geosphere
- > Knowledge service for Geoscience

Framework of Belt and Road spatial information system





Thanks

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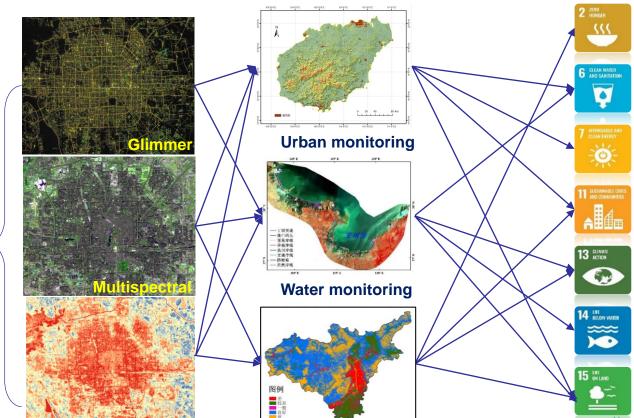
Applications of SDGSAT-1 Data

Yunwei TANG

2023-5-30

SDG monitoring and assessment





Land monitoring



SDGSAT-1 Satellite

Supporting SDGs

What is the purpose of this course?



- How to process SDGSAT-1 image?
- What can SDGSAT-1 data do?
- How to monitor SDGs indicators?

Data Product

Level 4 standard product

Product naming convention: Product ID.zip

KX10_GIU_20220207_E109.36_N19.03_202200014089_L4A.zip

Parameter specifications

Name Identification	Example	Illustration
Satellite ID	KX10	SDGSAT-1 Satellite code: KX10
Payload ID	MII TIS GIU	Multispectral imager Thermal infrared spectrometer Glimmer imager
Imaging date	20220207	Date of image, YYYYMMDD
Central longitude	E109.36	Central longitude, Exxx.xx /Wxxx.xx
Central latitude	N19.03	Central latitude, Nxx.xx / Sxx.xx
Task number	20220001408	This number corresponds to the production task number in the system
Product level	L4A/L4B	Level-4 product



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- **KX10**_MII_20211112_E118.97_N38.95_202200121305_L4A.zip
- KX10_TIS_20220103_E117.66_N36.91_202200112573_L4A.zip

A zip file includes:

- Image file (*.tif)
- File of absolute calibration parameters (*.calib.xml)
- Meta data file (*.meta.xml)
- Browse image (*.browse.png)
- Thumbnail (*.thumb.png)
- KX10_TIS_20220103_E117.66_N36.91_202200112573_L4A.browse.png
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Satellite attitude parameters

Image's information

GIU panchromatic bands:

> **High Dynamic Range** (HDR), Panchromatic Low (PL), and **Panchromatic High** (PH), where the HDR is the 50% weighted average of PL and PH data.

> > Radiometric calibration

Geometric information

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Calibration File



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L = DN \times Gain + Bias
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where L is the apparent radiance ($W/m^2/sr/\mu m$), DN is the digital number of the pixel, and Gain and Bias are the calibration coefficients.

Sensor	Band	Gain	Bias
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	B2	0.036241353	0
	В3	0.023316835	0
MII	B4	0.015849666	0
	B5	0.016096381	0
	B6	0.019719039	0
	B7	0.013811458	0
	PL	0.00008832	0.0000167808
	PH	0.00008757	0.0000183897
GIU	R	0.00001354	0.0000136754
	G	0.00000507	0.000006084
	В	0.0000099253	0.0000099253
TIS	B1	0.003947	B1
	B2	0.003946	B2
	В3	0.005329	В3





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</GIU>

<!-->Thermal Infrared Spectrometer, 高分辨率热红外成像仪</--> <!-->定标系数更新日期: 2022年6月20日</-->

<!-->更新说明:提供每个波段的辐射定标系数,适合5月14日以后的L4A级产品</--> <!-->B1:8-10.5µm;B2:10.3-11.3µm;B3:11.5-12.5µm;</--> <!-->注意: 中心波长为等效值</-->

<bandsIDList>1, 2, 3</bandsIDList>

<bar><bandsCenter UNIT="µm">9.35,10.73,11.72</bandsCenter></bandsCenter> <formula L UNIT="W/m2/sr/µm">L = DN * GAIN + BIAS</formula L>

<VERSION NO = "V3.0" DATE = "2022/06/20"> <RADIANCE GAIN BAND 1>0.005329/RADIANCE GAIN BAND 1> <RADIANCE BIAS BAND 1>0.222530</RADIANCE BIAS BAND 1>

<RADIANCE GAIN BAND 2>0.003938/RADIANCE GAIN BAND 2> <RADIANCE BIAS BAND 2>0.210495</RADIANCE BIAS BAND 2>

<RADIANCE GAIN BAND 3>0.003946</RADIANCE GAIN BAND 3> <RADIANCE BIAS BAND 3>0.124622/RADIANCE BIAS BAND 3>

</VERSION>

</TIS>

peltroad.org

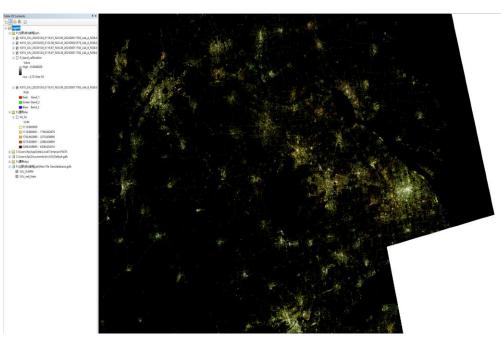


Practice I How to display SDGDAT-1 image to show the best effect?

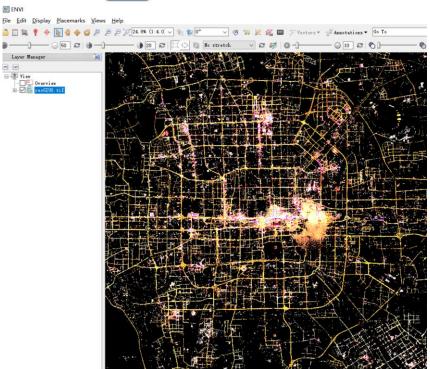
Software





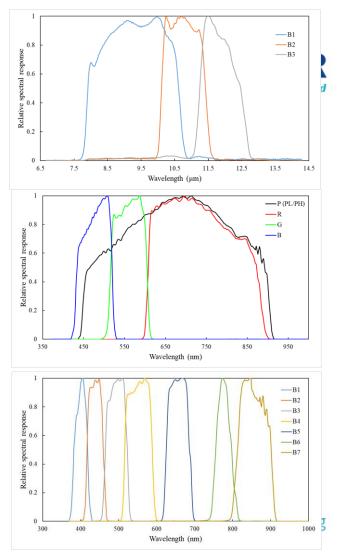






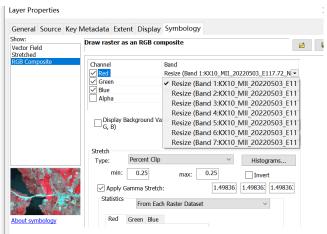
Spectral response

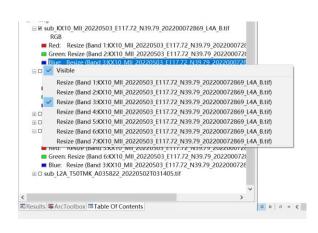
Туре	Index	Specifications
Thermal Infrared Spectrometer	Bands	8~10.5 μm 10.3~11.3 μm 11.5~12.5 μm
	Spatial Resolution	30 m
	Bands /Glimmer	P: 444~910 nm B: 424~526 nm G: 506~612 nm R: 615~894nm
	Resolution /Glimmer	P: 10 m, RGB: 40 m
Glimmer /Multispectral Imager	Bands /Multispectral	B1: 374 nm~427 nm B2: 410 nm~467 nm B3: 457 nm~529 nm B4: 510 nm~597 nm B5: 618 nm~696 nm B6: 744 nm~813 nm B7: 798 nm~911 nm
	Resolution /Multispectral	10 m

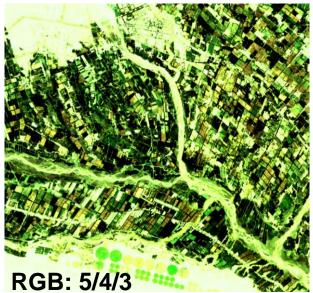


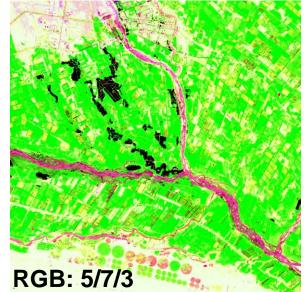
1) Multispectral

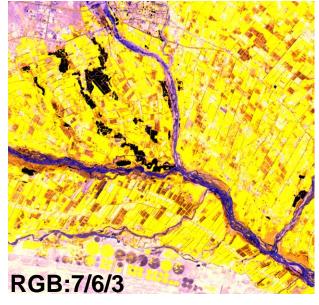
Change band composite





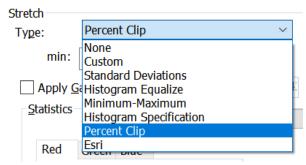






Change image stretch type





Task: Try to set the optimal band composite and stretch type for a multispectral image



Standard deviation n=2



Minimum-Maximum



Percentage clip min:1 max: 1







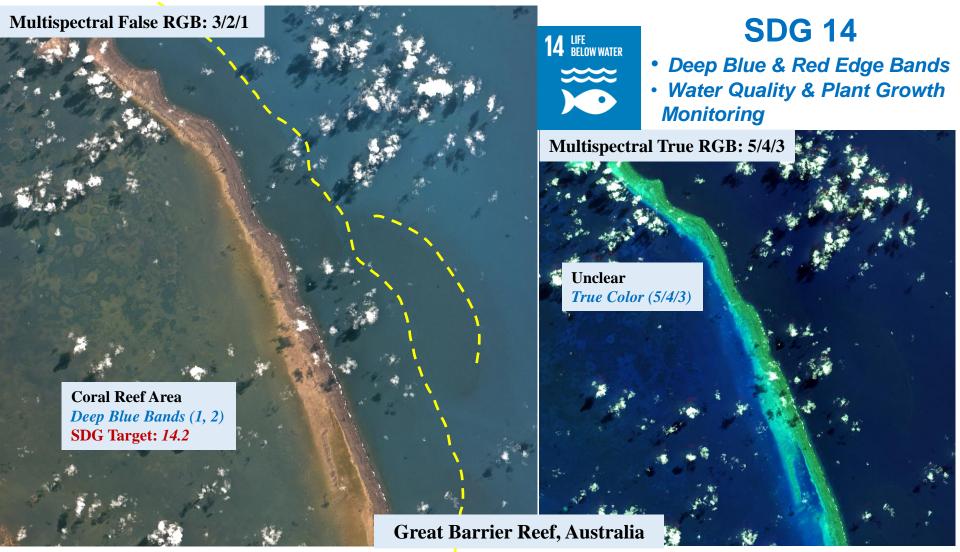


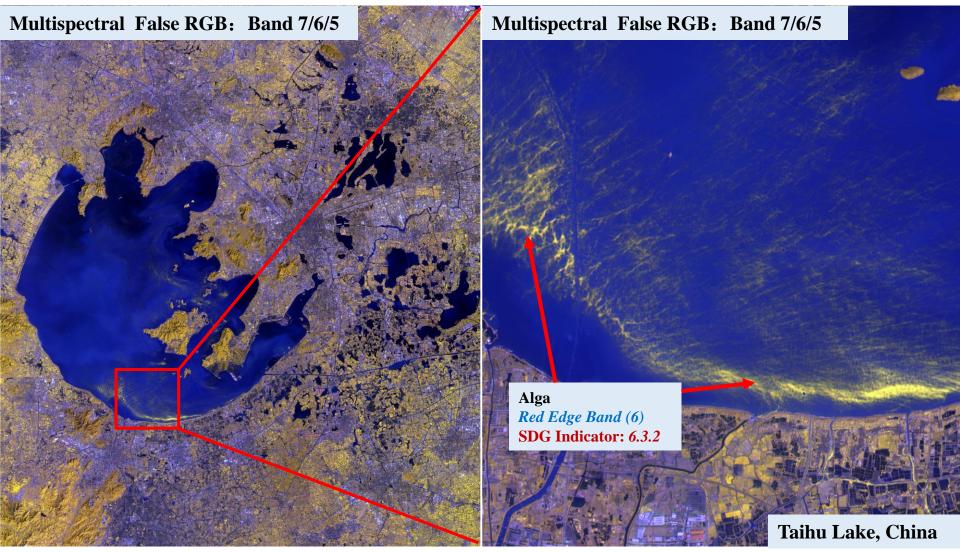
Multispectral image of Yellow River Estuary (10m)

True color composition: band 5/4/3

SDG 6/14

- Water Quality Monitoring
- Vegetation Growth Status Monitoring
- Land and Costal Ecosystem Study





2) Glimmer

BAR Digital Belt and Road

RGB is in the order of B1, B2 and B3, no need to change band composite



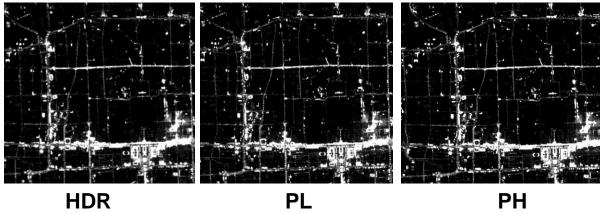
RGB

recGIVO. tif

Band 1
Green: Band 2
Band 3
Band 3
Blue: Band 3



PAN is in the order of HDR, PL and PH, choose one band to use

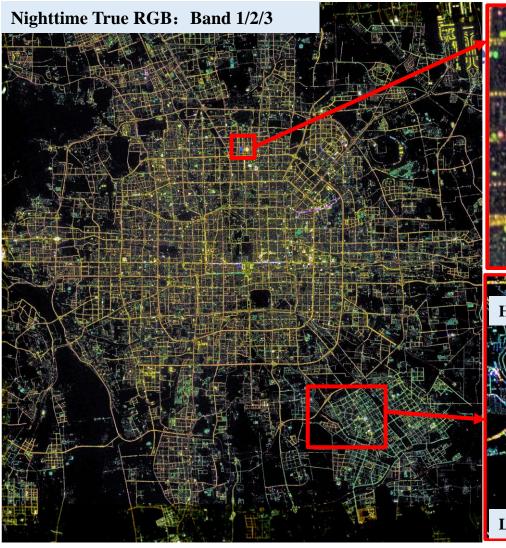


No much difference

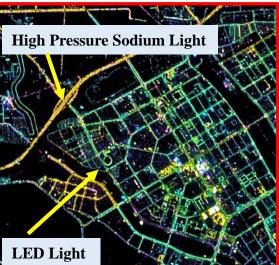
Background value is not zero but low

Lights are shown in the true color

www.dbeltroad.org





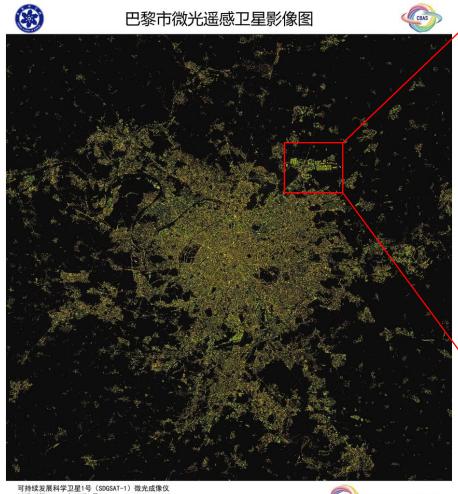


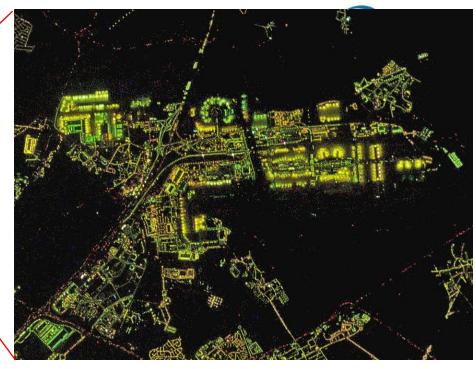


SDG 11

- RGB & Panchromatic Bands of 10 m
- Road Map (Transportation Condition),
- SDG Target 11.2
- Light color (urban function area),
- SDG Target 11.3

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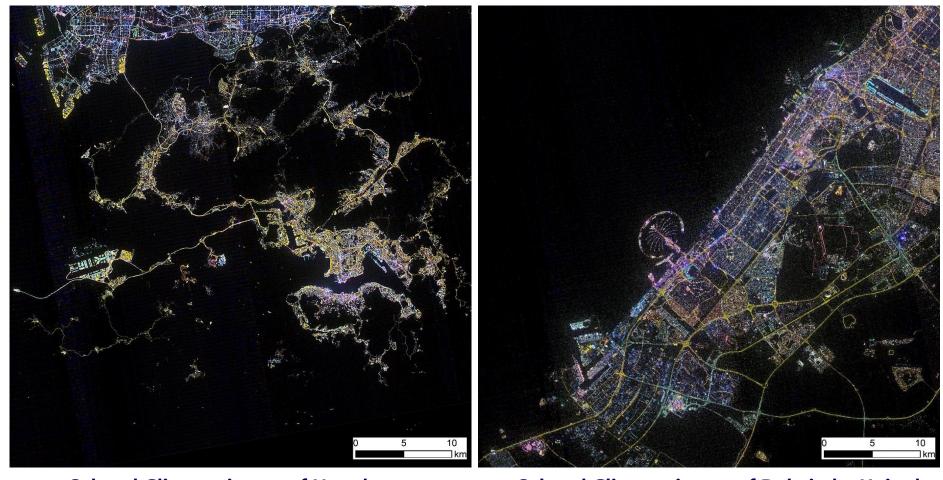




Charles de Gaulle Airport

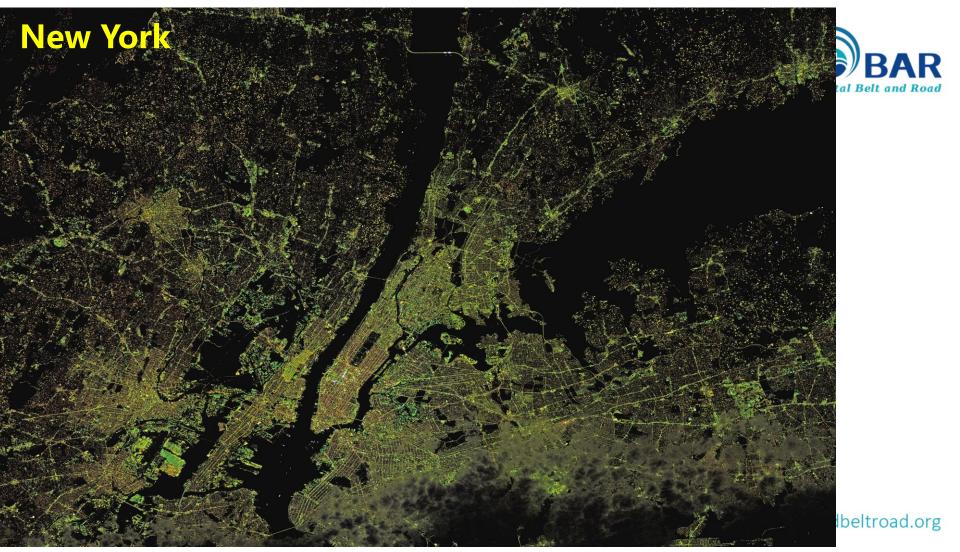
Colored Glimmer image of Pairs, France (10m)





Colored Glimmer image of Hongkong, China (10m)

Colored Glimmer image of Dubai, the United Arab Emirates (10m)





Light changes in Shanghai affected by COVID-19 BAR





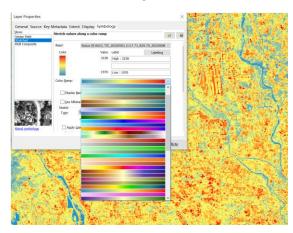
www.dbeltroad.org

3) Thermal Infrared

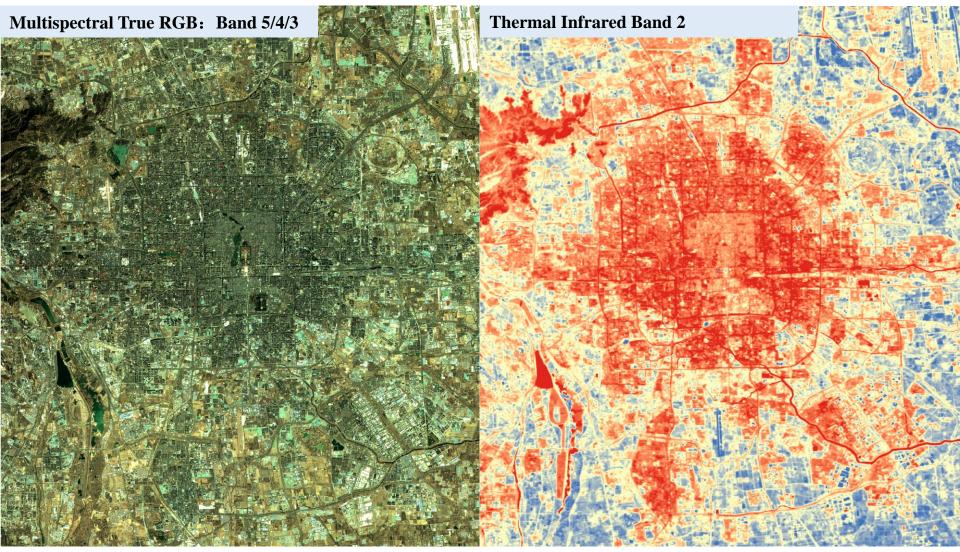


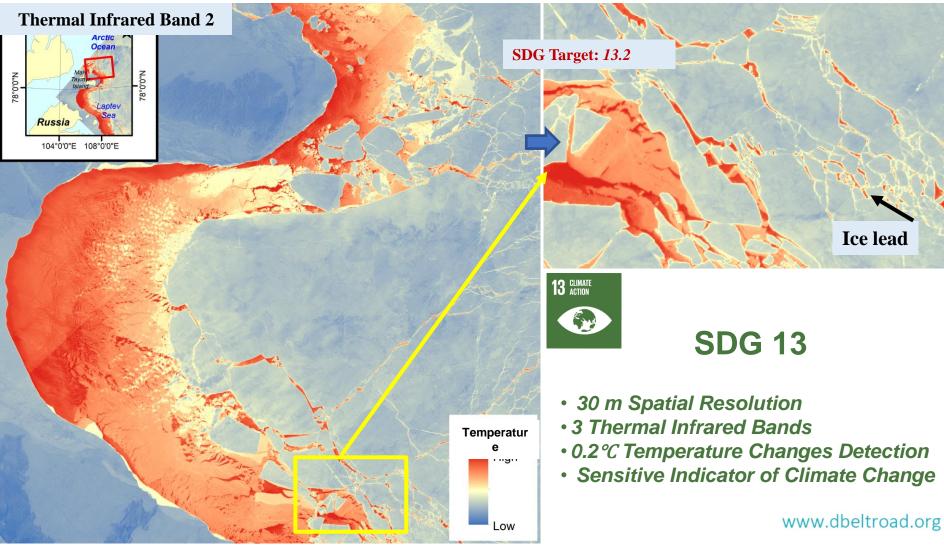
Satellite	Lan	dsat-8	MOD	IS-1B	SDGSAT-1		
TIR band	10	11	31	32	1	2	3
Center wavelength (µm)	10.9	12	11.03	12.02	9.35	10.73	11.72
Spectral range (µm)	10.6-11.2	11.5-12.5	10.78-11.28	11.77-12.27	8-10.5	10.3-11.3	11.5-12.5
Swath width (km)	,	185	23	30	300		
Resolution (m)	,	100	10	00	30		

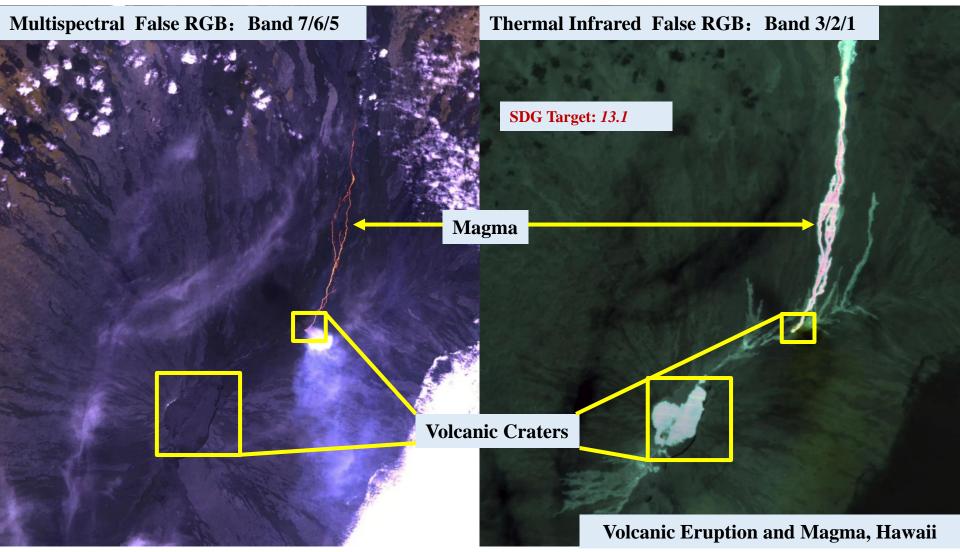
Band 2 and 3 of SDGSAT-1 are comparable with Band 10 and 11 of Landsat-8, and Band 31 and 32 with MODIS-1B. Any band can reflect the hot source distribution.



Change the color bar to reveal the hot-cold relation









Practice II How to process SDGSAT-1 image to extract desired information?

Image merge

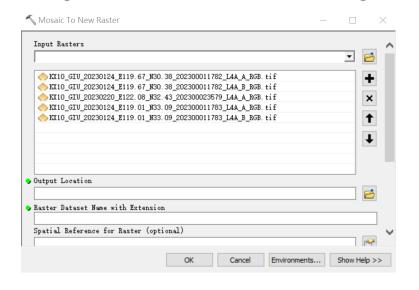


ArcToolbox **■ ③** 3D Analyst Tools 🛚 Analysis Tools 🖩 🕲 Cartography Tools ■ Section Tools 🛮 🕯 Data Interoperability Tools Data Management Tools ★ Archiving ■ Solution Distributed Geodatabase **⊞ S** Domains ■ September Feature Class ■ Feature Class ■ S Fields ■ Separation File Geodatabase ⊕ Seneral ■ Sene ⊞ Seneralization ■ Seodatabase Administration ■ Seometric Network ■ S Graph ■ Indexes ■ Soins **■ STAS Dataset** ■ Section Laborated Head Table Views ⊕ Seckage ■ Beckage ■ Beck **⊞** Mosaic Dataset ■ See Raster Catalog **■** Saster Dataset √ Download Rasters Mosaic Mosaic To New Raster

√ Workspace To Raster Dataset

■ Selationship Classes

Mosaic To New Raster: Input multiple images and mosaic them to a new image



Overlay a vector layer to glimmer imagery

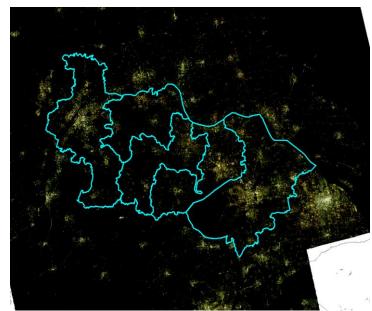
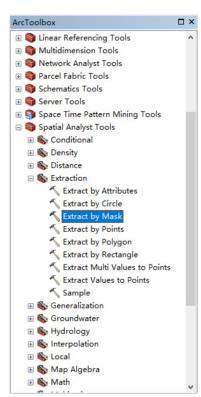
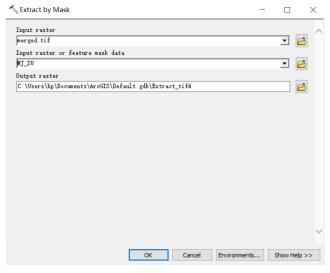


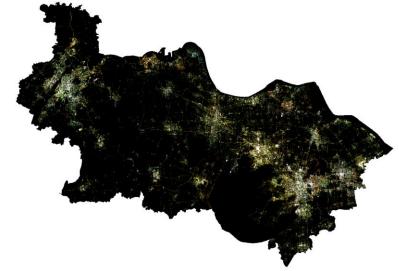
Image clip





Extract by Mask: Input an image and a mask (vector layer) and output a clipped image





Radiometric calibration

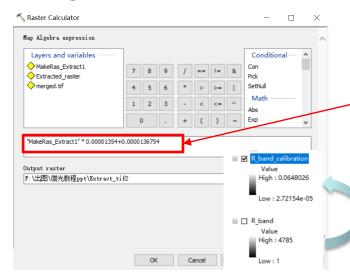
■ ArcToolbox 🛚 🕯 Analysis Tools ■ Section Tools

■ Section Tools ■

■ Data Interoperability Tools ■ Section Description
■ Beta Management Tools ■ Section Editing Tools ■ SENVI Tools ■ Seocoding Tools ■ Multidimension Tools ■ Solution States States Tools
■ Solution States ■ Parcel Fabric Tools ■ Schematics Tools ■ Server Tools Spatial Analyst Tools **⊞** Seconditional ■ S Density **⊞** Sistance **⊞** See Extraction **⊞ S** Generalization **⊞** Groundwater **⊞** Shydrology **⊞ S** Interpolation **⊞ S** Local ■ See Map Algebra

⊞ S Math

Raster Calculator: Input an equation to recalculate the image value



When is it necessary to do radiometric calibration?

Task: Try to perform radiometric calibration to multispectral and TIR images



			-	_
	PL	0.00008832		0.0000167808
	PH	0.00008757		0.0000183897
GIU	- R	0.00001354		0.0000136754
	G	0.00000507		0.000006084
	В	0.0000099253		0.0000099253

Application	Radiometric calibration
Land cover / land use	×
Image segmentation	×
Object recognition	×
Heat-island effect	×
Light-econimic related indices	$\sqrt{}$
Temperature	$\sqrt{}$
Water quality	$\sqrt{}$
aerosol optical depth	$\sqrt{}$

Zonal statistics

Network Analyst Tools

Spatial Analyst Tools

Parcel Fabric Tools

Schematics Tools

Server Tools

⊞ S Conditional

⊕ Solution
 ⊕ Solution

⊞ Separation

⊕ Ward Hydrology

■

 Reclass

Surface
 Sonal

■ Solar Radiation

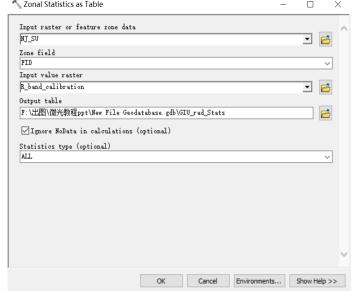
✓ Zonal Fill
 ✓ Zonal Geometry
 ✓ Zonal Geometry as Table
 ✓ Zonal Histogram

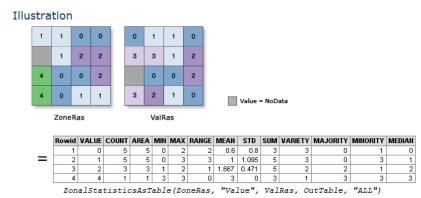
■ Segmentation and Classification

⊞ Interpolation



ArcToolbox Zonal Statistics as Table: Summarize ■ Section Tools statistics of image according to the Data Interoperability Tools 🛮 🕯 Data Management Tools ■ Sediting Tools spatial unit of a vector layer ENVI Tools Geocodina Tools Geostatistical Analyst Tools Zonal Statistics as Table Linear Referencing Tools Multidimension Tools





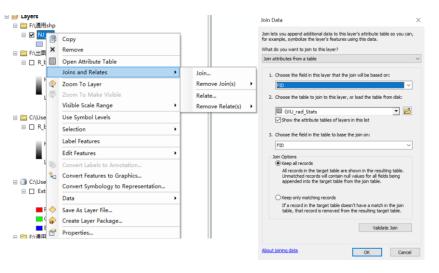
J_rad_Stats									
OBJECTID *	FID *	COUNT	ARBA	MIN	MAX	RANGE	MBAN	STD	SUM
1	0	4113741	6581985600	0.000027	0.060862	0.060835	0.000799	0.003452	3288. 638894
2	1	2400982	3841571200	0.000027	0.060605	0.060578	0.000463	0.00223	1110. 8006
3	2	5423949	8678318400	0.000027	0.064803	0.064775	0.001163	0.003521	6308. 624516
4	3	2731632	4370611200	0.000027	0.061824	0.061797	0.000656	0.002611	1790. 662879
5	4	2900825	4641320000	0.000027	0.062135	0.062108	0.001128	0.003917	3270. 82889

Count, area, min, max, range, mean, std, sum, variety, majority, minority, median, ...

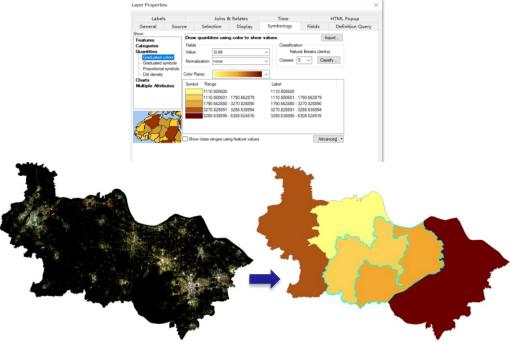
Join table to vector



Joins and Relates → Join... FID field relates statistical table and vector layer



Layer Properties→ Symbology→Graduate colors
→Value: SUM

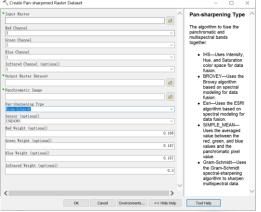


Show results of light intensity by spatial unit

Glimmer image fusion



Create Pan-sharpened Raster Dataset: pansharpened RGB image by cartography Tools cartography Tools

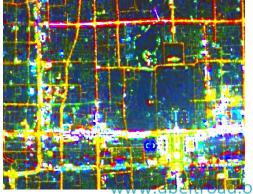






RGB

PAN



Fused image

Task: Try to use different pan-sharpening methods and choose one with the best effect

Data Management Tools ★ Archiving **■ S** Data Comparison ⊞ S Domains **⊞** Seature Class ⊕ Seatures ■ September File Geodatabase **⊞** Seneralization **⊞** Geodatabase Administration **⊞ S** Geometric Network ⊞ 🗞 Graph **⊞** Soins **⊞ S** LAS Dataset ⊞ S Package ■ Section Photos ⊞ Some Projections and Transformations **■** Saster **⊞ S** Mosaic Dataset ⊞ S Raster Catalog **⊞** Saster Dataset ■ Raster Processing √ Clip [←] Compute Pansharpen Weights Create Pan-sharpened Raster Datase ≦ Extract Subdataset Resample

Compare light changes



ArcToolbox	
■ Solution Box Solutio	
⊞ ③ Cartography Tools	

■

■ Conversion Tools ■

■ Data Interoperability Tools 🖩 🕯 Data Management Tools

⊞ ⑤ Editing Tools

⊞ S ENVI Tools

■ Seocoding Tools

■ Seostatistical Analyst Tools

Multidimension Tools

■

■ Network Analyst Tools

■ Schematics Tools ■ Server Tools

■ Space Time Pattern Mining Tools

Spatial Analyst Tools

⊞ Some Conditional

⊕ Some Density

■ Separation

⊞ S Groundwater

⊞ Shydrology

⊞ S Interpolation

⊕ S Local

■ S Map Algebra

 ■ Multivariate **⊞** S Neighborhood

⊞ S Overlay

■ Seclass

√ Lookup

Reclass by ASCII File

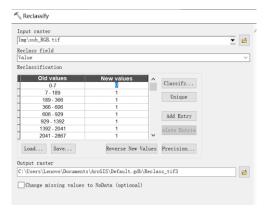
Reclass by Table

Reclassif

Rescale by Function

√ Slice

a. Reclassify: rectify the background pixels' value to 0, and the other pixels' value to 1, converting the glimmer image to a binary map.



c. Raster to polygon: covert difference image to a vector layer and overlay with glimmer image to show light changes

b. Raster calculator: ImageT1 -ImageT2, output a raster image reflects light changes

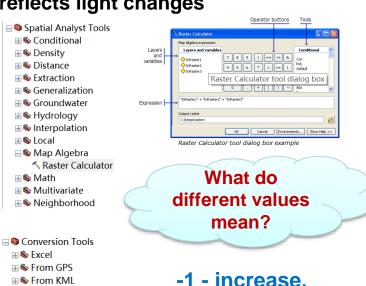
■ Second PDF

■ Second From Raster

Raster to ASCII

Raster to Float

Raster To Video



-1 - increase.

0 - unchanged,

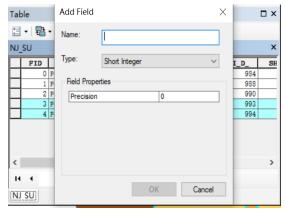
1 - increase

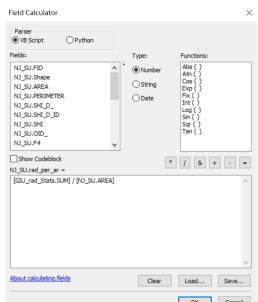
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Nighttime light index



Add Field→Field Calculator





Total Light Intensity (TNL), Average Light Intensity (I), Light Area Ratio (S), and Comprehensive Light Index (CNLI), ...

(CNLI), ...

$$LPB = \frac{1}{N} \sum_{i=1}^{n} L_{i}$$

$$CS_{m,n} = \frac{1}{N} \sum_{i=1}^{n} LPB_{j}$$

$$\sum_{i \neq j, i \neq v, j \neq v}^{j=1} \frac{g_{ivj}}{g_{ij}}$$

$$I = rac{TNL}{(DN_{max}\!\! imes N_L)},$$

$$\sum_{i \neq j, i \neq v, j \neq v} g_{ij}$$

$$\sum_{i \neq j, i \neq v, j \neq v} g_{ij}$$

$$S=A_{n}/A,$$

$$C_i^w = \frac{1}{2s_i(k_i - 1)} \sum_{j,h} a_{ij} a_{ih} a_{jh} (w_{ij} + w_{ih})$$

$$CNLI = I \times S$$
,

$$density = \frac{2I}{n(n-1)}$$

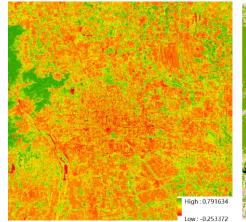
- 1. Chen, J.; Zhuo, L.; Shi, P.-J.; Toshiaki, I. The study on urbanization process in China based on DMSP/OLS data: Development of a light index for urbanization level estimation. *J. Remote Sens.* 2003, *7*, 168–175.
- 2. Zhuo, L.; Shi, P.; Chen, J. Application of compound night light index derived from DMSP/OLS data to urbanization analysis in China in the 1990s. *Acta Geogr. Sin.* 2003, *58*, 893–902.

Task: Calculate different nighttime light indices

Remote sensing indices

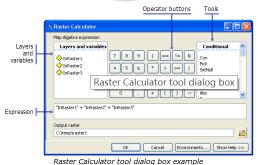


Optical Remote Sensing Index	Calculation Formula	Reference
Normalized Difference Vegetation Index, NDVI	$ ext{NDVI} = rac{ ext{NIR} - ext{Red}}{ ext{NIR} + ext{Red}}$	Rouse et al., 1974
Enhanced Vegetation Index, EVI	$\mathrm{EVI} = \mathrm{H} imes rac{\mathrm{NIR} - \mathrm{Red}}{\mathrm{NIR} + \mathbf{f}^{\lambda} \mathrm{Red} - \mathbf{C}_{\mathbf{j}^{\lambda}} \mathrm{Blue} + \mathbf{f}_{\mathbf{L}}}$	Huete et al., 2002
Soil-Adjusted Vegetation Index, SAVI	$ ext{SAVI} = rac{ ext{(NIR-Red)} imes ext{(1+L2)}}{ ext{NIR+Red+L2}}$	Huete, 1988
Ratio Vegetation Index, RVI	$\mathrm{RVI} = rac{\mathrm{NIR}}{\mathrm{Red}}$	Jordan, 1969





How to calculate NDVI?



 $NDVI = \frac{B7 - B5}{B7 + B5}$

Raster calculator

NDVI based on SDGSAT-1



Extracted vegetation

Range



Define an proper threshold based on natural breaks

oad.org

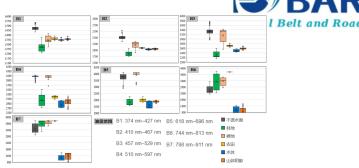
-0.253371865 - 0.336748973

0.336748973 - 0.791633785

Image classification



Select training samples



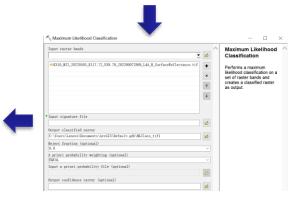
Class seperability in different bands

LeNet



Image classification tool

Output classification result



Choose a classifier and set parameters

Software

- ArcGIS Pro
- ENVI
- Matlab
- Python: Sklearn, Keras, PyTorch, TensorFlow
- R: e1071, rpart, ...

Classifier

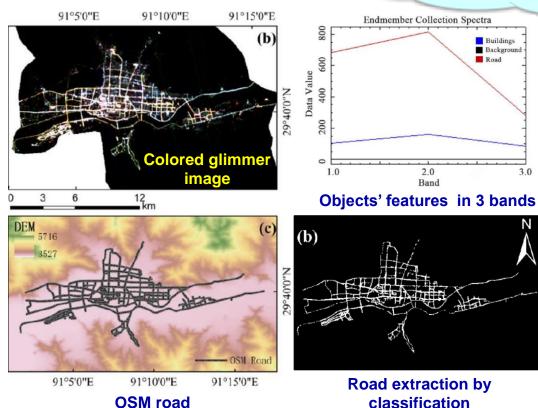
- MLC ResNet
- DT U-Net
- RF SegNet
- · SVM · RNN
- · KNN · YOLO

Advanced software are suggested to classify image accurately.

Image classification

Can glimmer and TIR images be used for classification?





Chang et al. 2022. Research on Road Extraction Method Based on Sustainable

Development Goals Satellite-1 Nighttime Light Data. Remote Sensing, 14, 6015.

Szeged TIR image

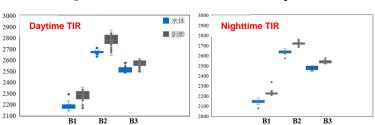
at nighttime



Szeged TIR image

at daytime

N .



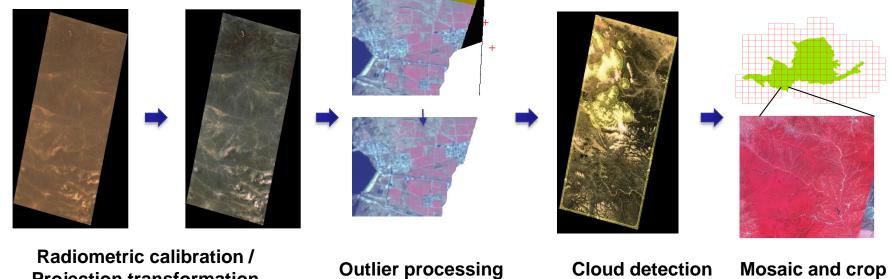
ation

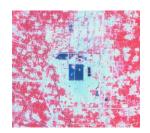
Class seperability

Class seperability in daytime and nighttime TIR

Automatic classification process

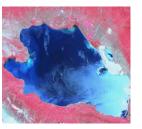




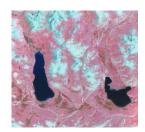


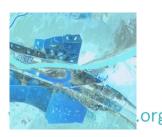
Projection transformation











Mosaic and crop