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

IRDR
Integrated Research on Disaster Risk

Capacity Building Workshop for Small Island Developing States: Leveraging Big Earth Data to Evaluate the SDGs Progress

SDGSAT-1 Satellite Data Supports Sustainable Development Monitoring in Small Island Developing States

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Introduction of SDGSAT-1 Satellite

Data Receiving Station

Miyun Station, Beijing

Arctic Station, Kiruna

Kunming Station, Yunnan

Sanya Station, Hainan

Sustainable Development Science Satellite 1

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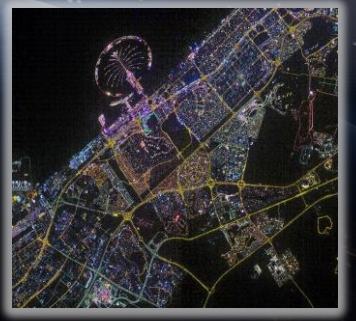
CBAS

Launched on Nov. 5th 2021, depicting anthropic interaction with Earth's environment

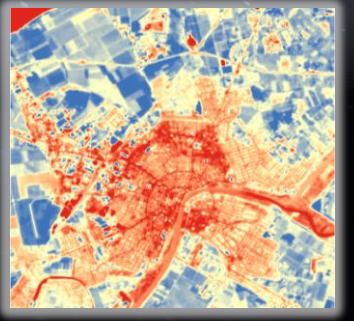
Synergetic observation by three sensors, with **300km** swath width

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

Multispectral



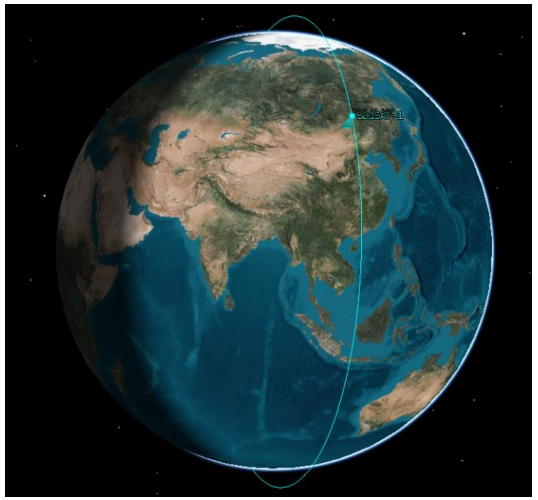
Glimmer



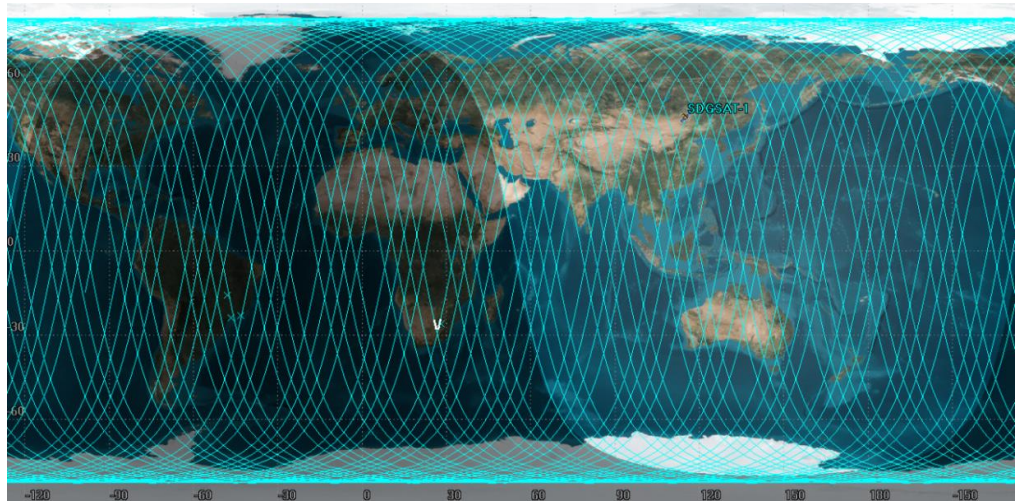
Thermal Infrared

Technical Specifications

- Orbit type: sun-synchronous
- Orbit altitude: 505 km
- Orbit inclination angle: 97.5°
- Swath width: 300 km
- Data collect mode: TIS + Glimmer (night), TIS + Multispectral (day), and single sensor.



The orbit of SDGSAT-1



Tracks of satellite nadir points of SDGSAT-1

Type	Index	Specifications
Thermal Infrared Spectrometer	Bands	8~10.5 μm 10.3~11.3 μm 11.5~12.5 μm
	Spatial Resolution	30 m
Glimmer /Multispectral Imager	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
	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

Characteristics of SDGSAT-1

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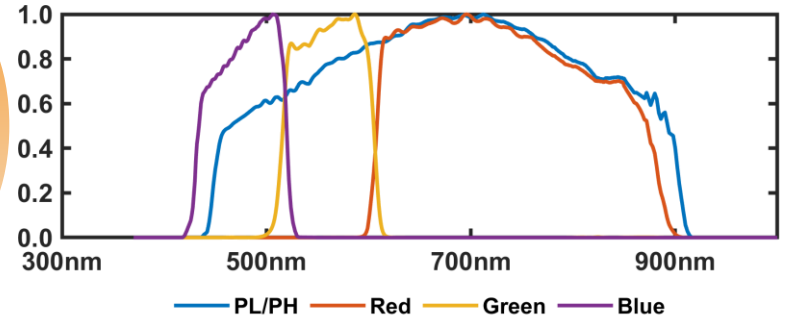
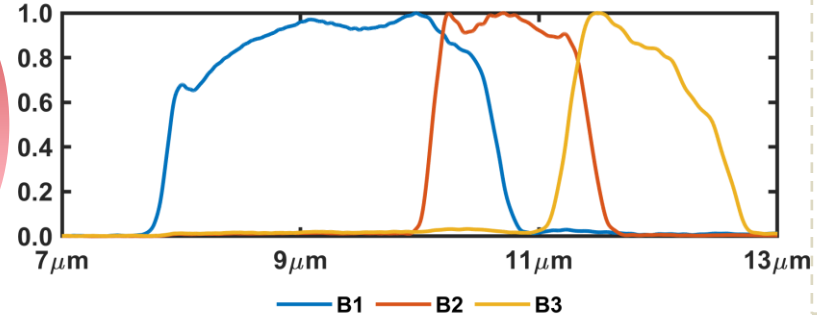
◆ The world's **best** comprehensive performance indicator for its **wide swath width** and **high spatial resolution**

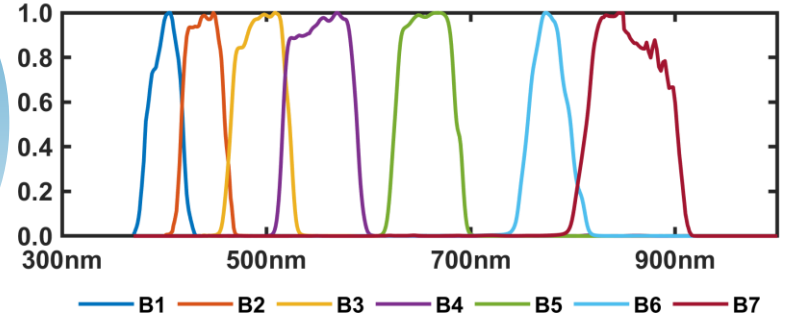
GLI



TIS



MSI



Innovation design

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

Highest ratio of swath width and spatial resolution

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

Advantage in monitoring water and vegetation

- 2 deep blue
- 1 red edge
- 300km

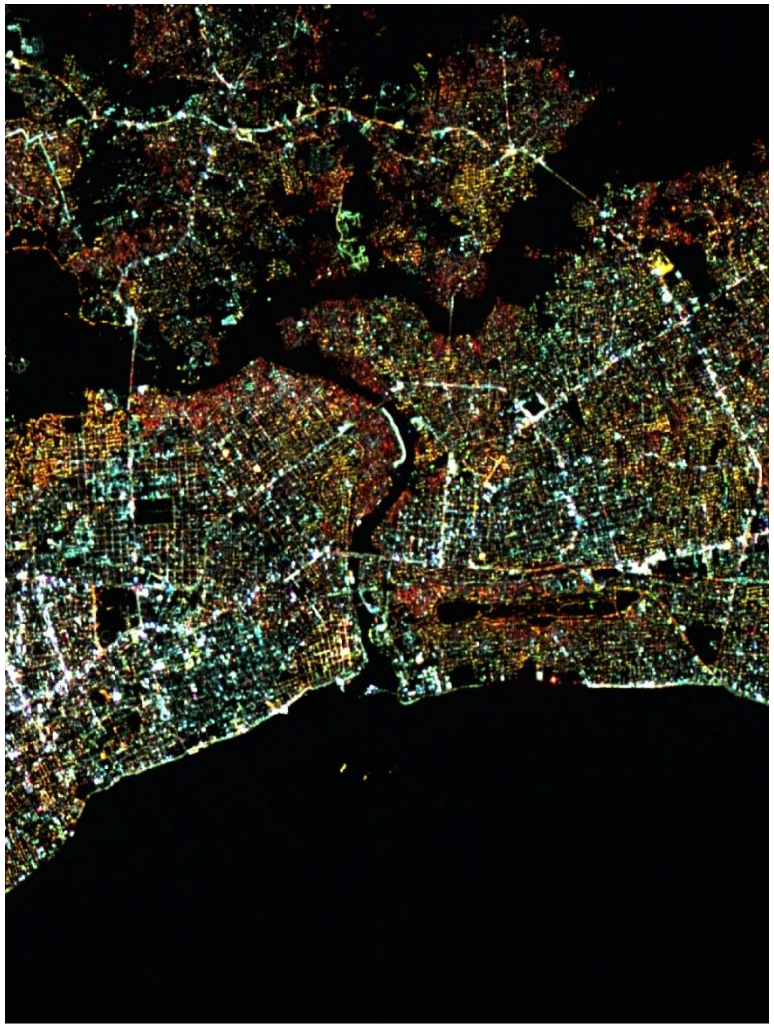
Depict traces of anthropic activities


Glimmer image of Beijing


TIS image of factories in Tangshan

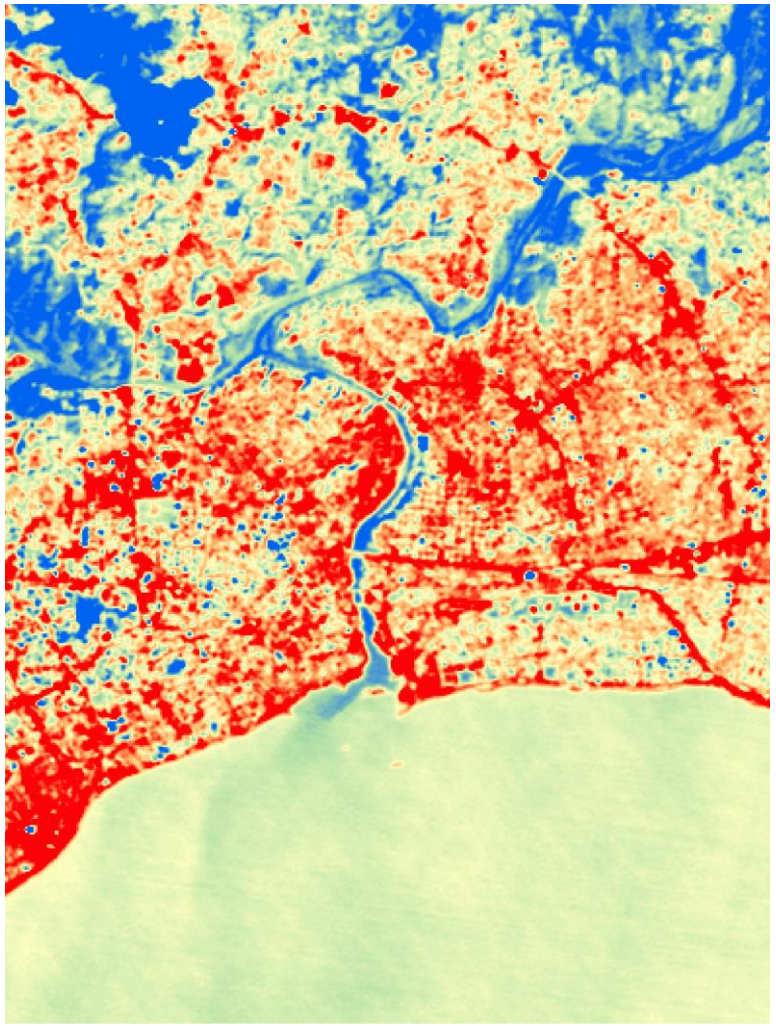
Example SDGSAT-1 Images

Santo Domingo, Dominican Republic



GLI Image
2023/01/30

MSI Image
2024/12/11



Daytime TIS Image
2024/12/11

Data Storage

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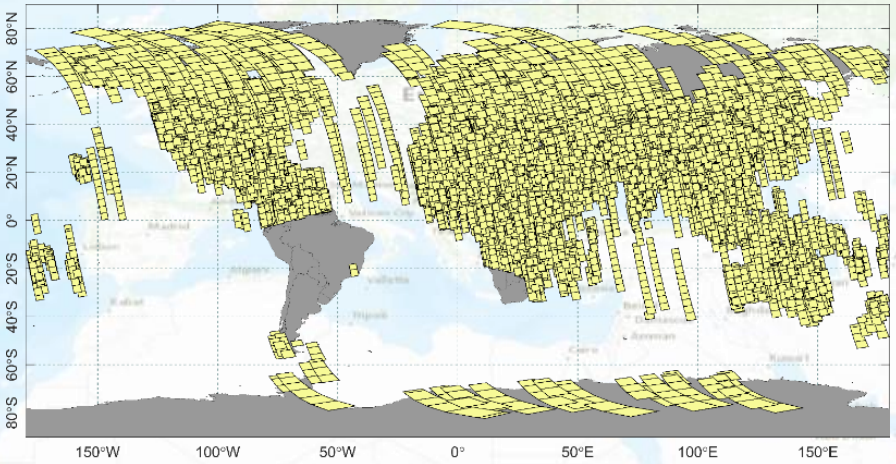
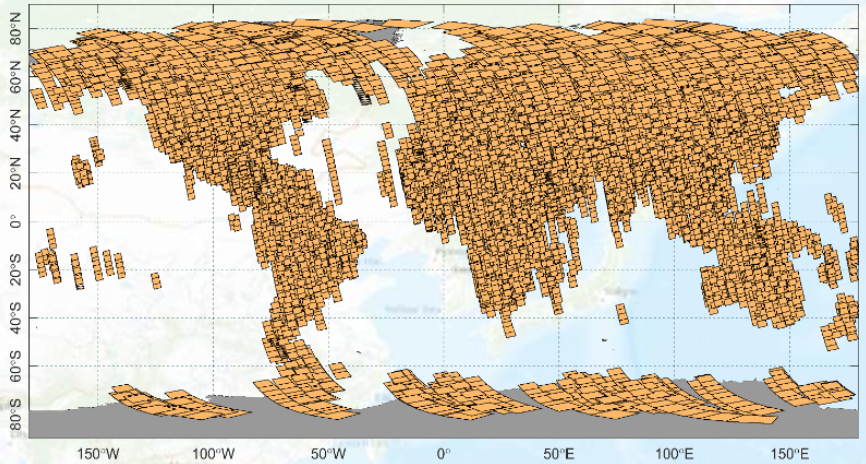
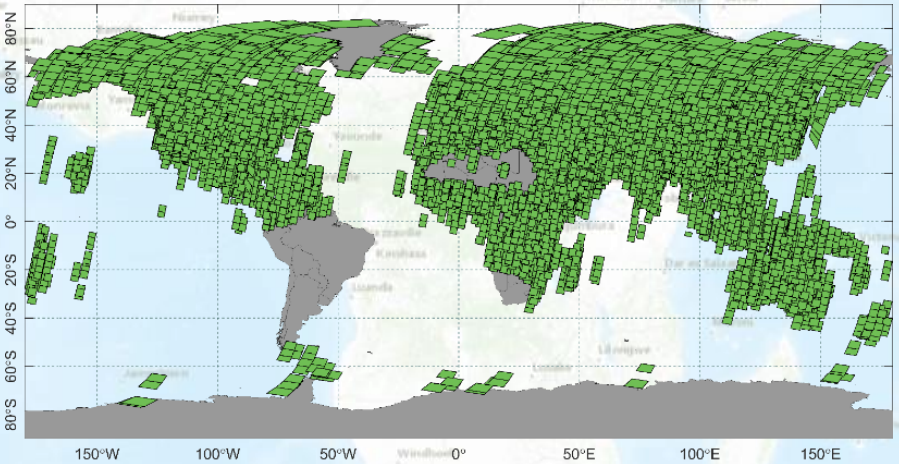
Over 460,000 images and 2.0 PB of L4 data has been acquired by SDGSAT-1



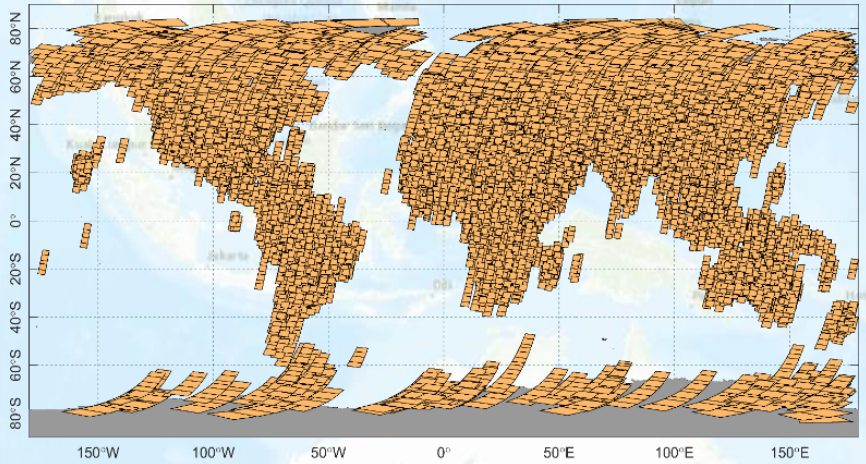
Glimmer datasets coverage



Thermal Infrared datasets coverage (Night)



Multispectral datasets coverage



Thermal Infrared datasets coverage (Day)

SDGSAT-1 Open Science Program

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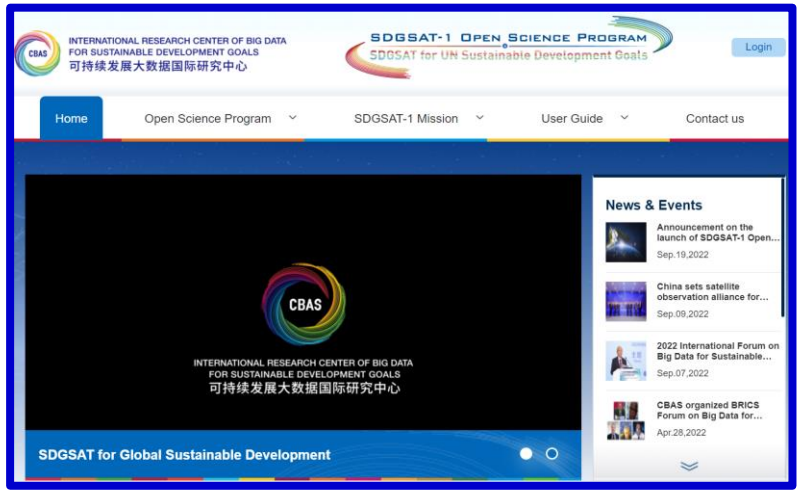
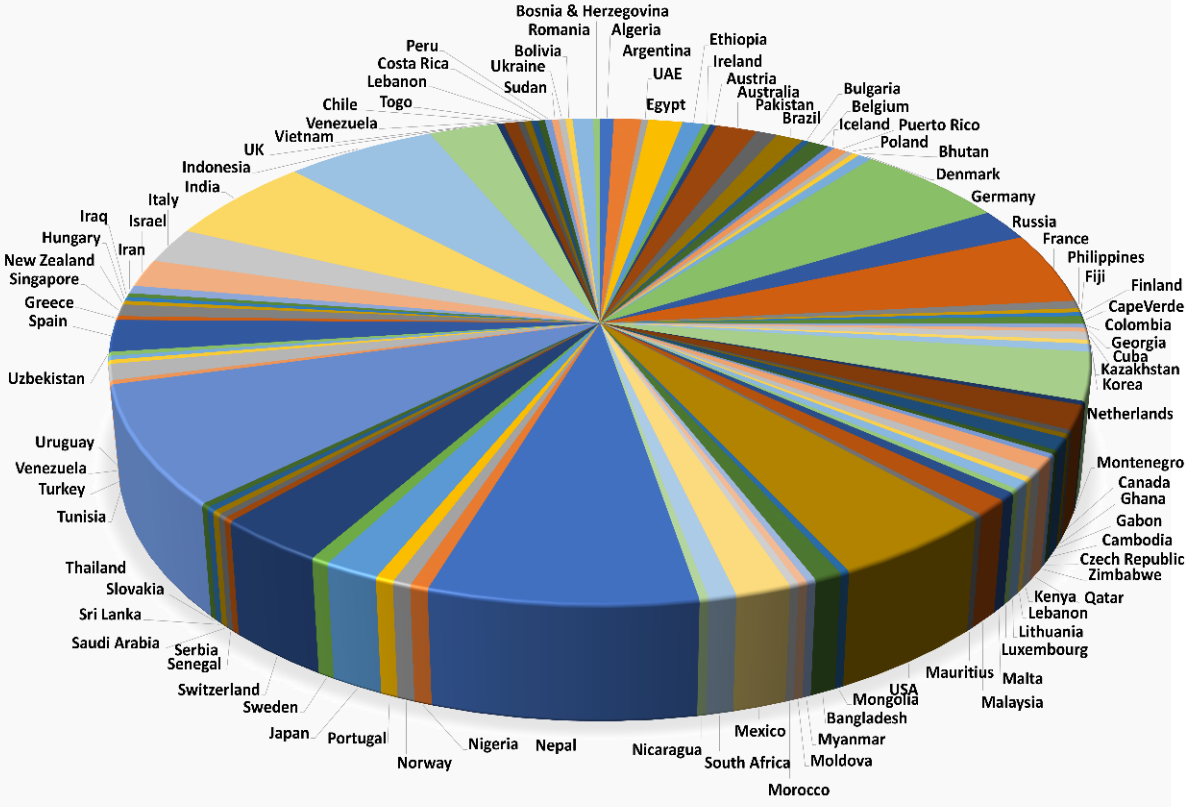
www.sdgsat.ac.cn



Since the program launched in Sep., 2022, more than 460,000 SDGSAT-1 images are shared with scientists from 106 countries



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

SDGSAT-1 Contributions

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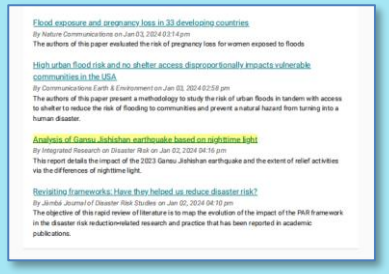
A multitude of contributions has been made based on SDGSAT-1 data for SDGs, i.e., technical training, international collaboration, etc.

Technical Training

- SDGSAT-1 ***technical training*** sessions have been organized for international communities

International Collaboration

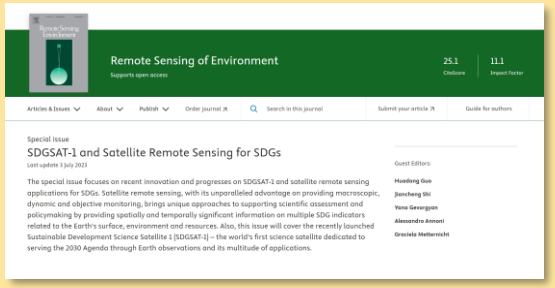
- ***10+ reports*** in collaboration with ***IRDR UNOSAT*** and ***UNDRR***.



Gaza, Turkey-Syria Earthquake, Libya Flood....

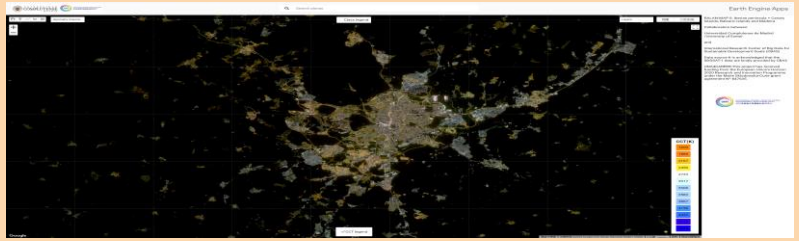
Academic Contributions

- ***167 papers*** published in world-renowned journals, including ***Remote Sensing of Environment*** and ***International Journal of Digital Earth***



Data Products Development

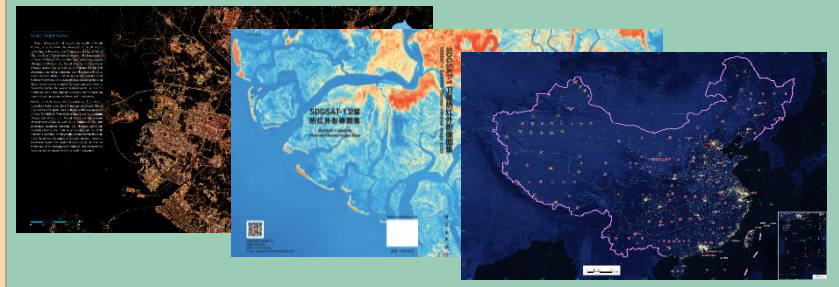
- Developing ***Iberian peninsula light pollution data product*** with Complutense University of Madrid based on SDGSAT-1



https://pmisson.users.earthengine.app/view/sdgsat-1-p-iberica

High-resolution Atlases Publication

- Release the ***First High-Spatial Resolution Nighttime Atlases***
- Developing ***High-Spatial TIS Atlas***



Technical Support & Case Study

- Support ***~200 researchers*** for SDG research
- Compile ***SDGSAT-1 Application Cases in Support of Sustainable Development Goals***

SDGSAT-1 Satellite Serves SDG Monitoring

SDGs Monitoring and Evaluation

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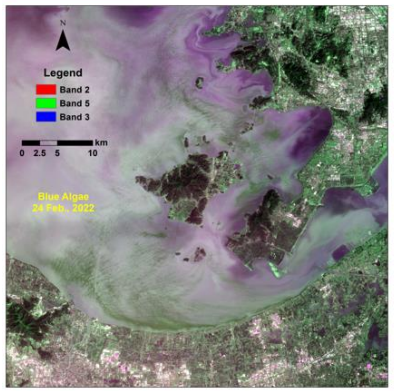
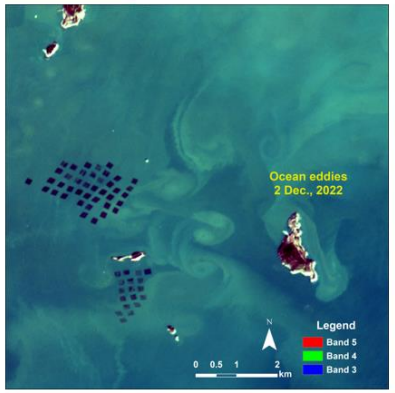
SDGs 6.1 Safe and affordable drinking water

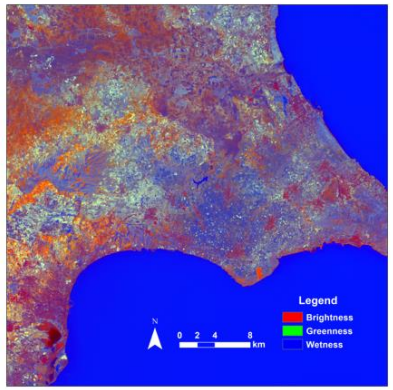
SDGs 14.2 Protect and restore marine and coastal ecosystems

SDGs 2.4 Sustainable food and resilient agricultural practices

MSI







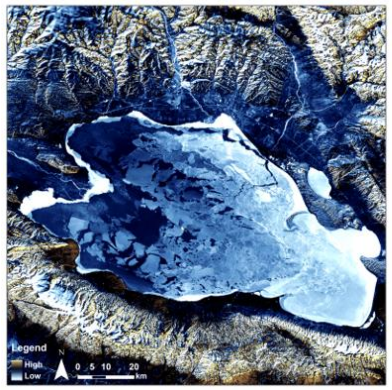
Water: Indispensable for Human Life and Survival

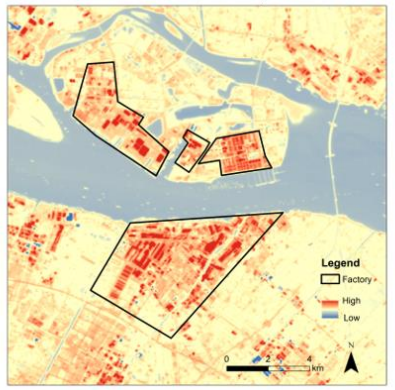
SDGs 13.2 Integrate climate change measures into policy and planning

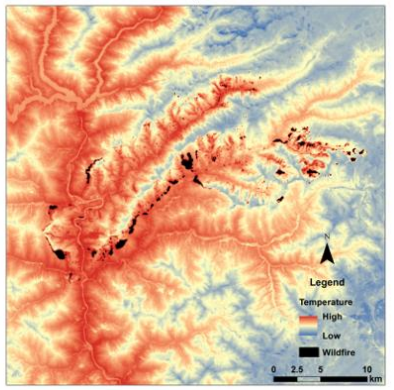
SDGs 9.4 Upgrade all industries and infrastructures for sustainability

SDGs 15.1 Conserve and restore terrestrial and freshwater ecosystems

TIS







Heat: Economic Production Activities

- **SDGSAT-1 demonstrates the critical role of EO satellites in advancing SDGs and supporting over 23 SDG targets.**
- **4 gaps filled and 20 upgraded**

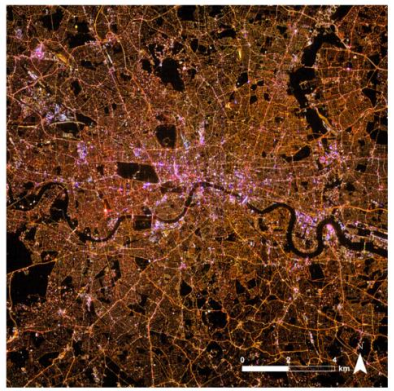
SDGs 7.3 Double the improvement in energy efficiency

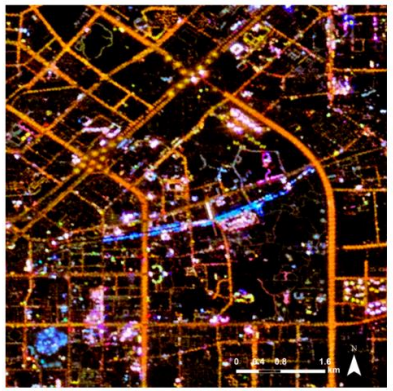
SDGs 3.4 Reduce mortality from non-infectious diseases

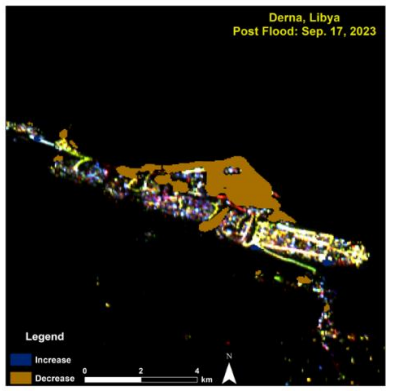
SDGs 11.5 Reduce the adverse effects of natural disasters

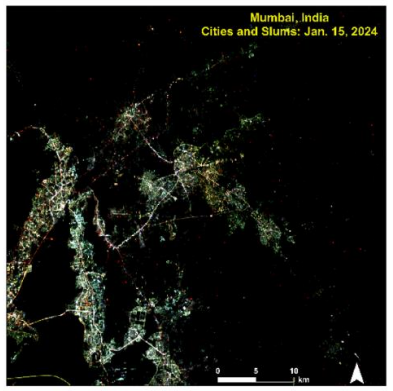
SDGs 1.1 Eradicate extreme poverty for all people

GLI



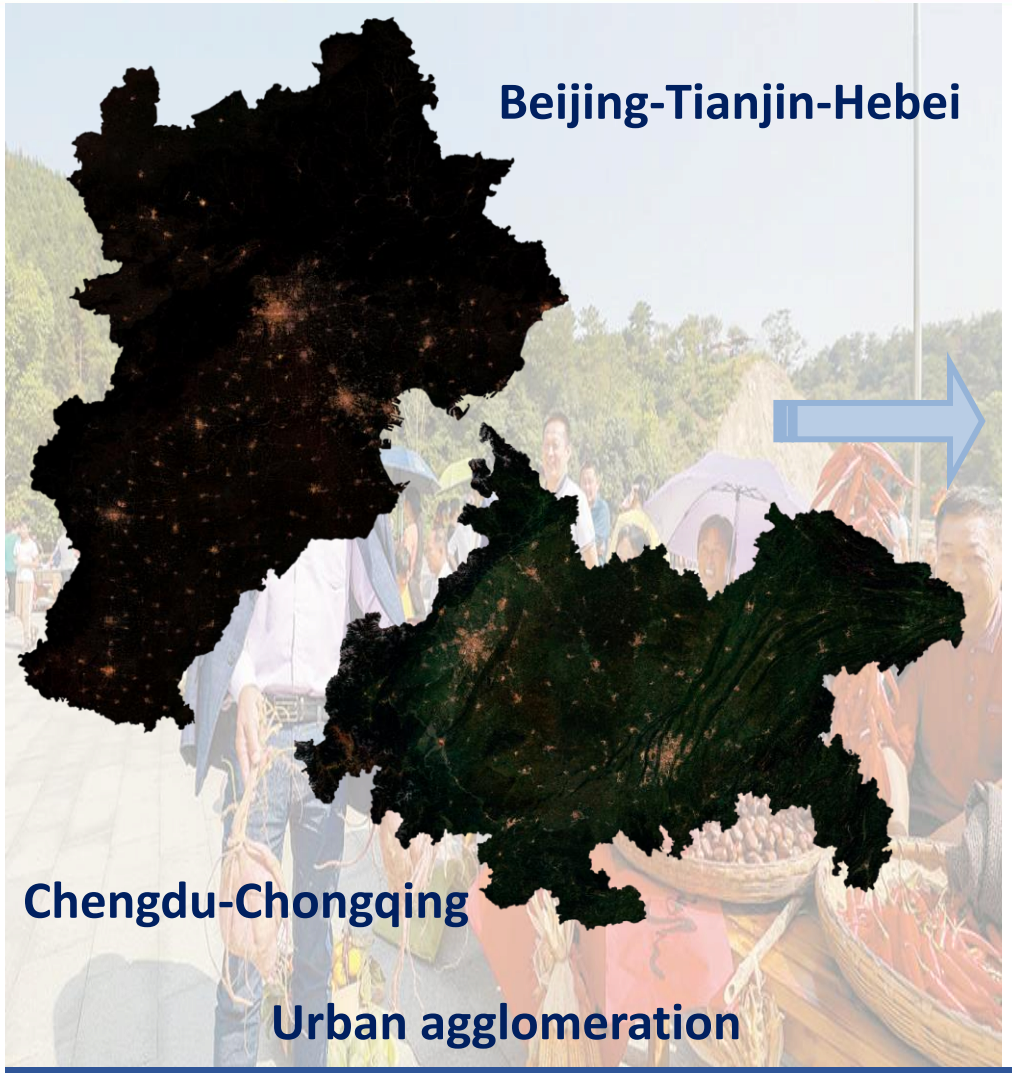






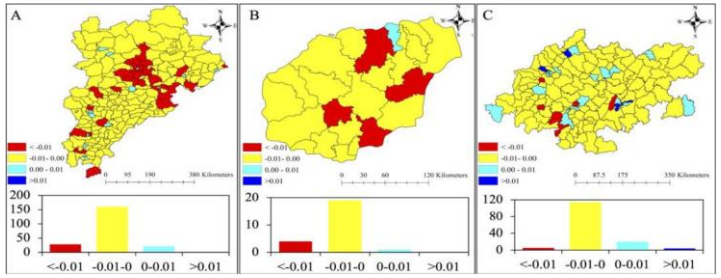
Light: Traces of Nighttime Activities

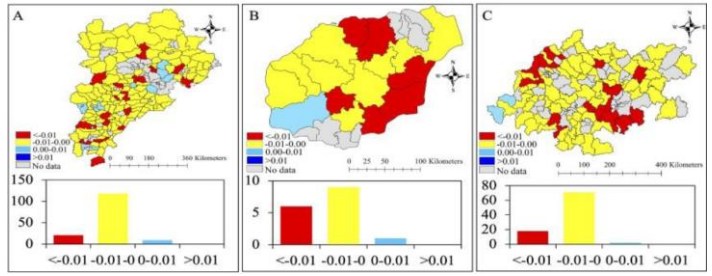
GLI for Poverty Reduction Assessment



SDG 1 End Poverty

- ***Proportion of the population living below the international poverty line***
- ***SDG.1.1***



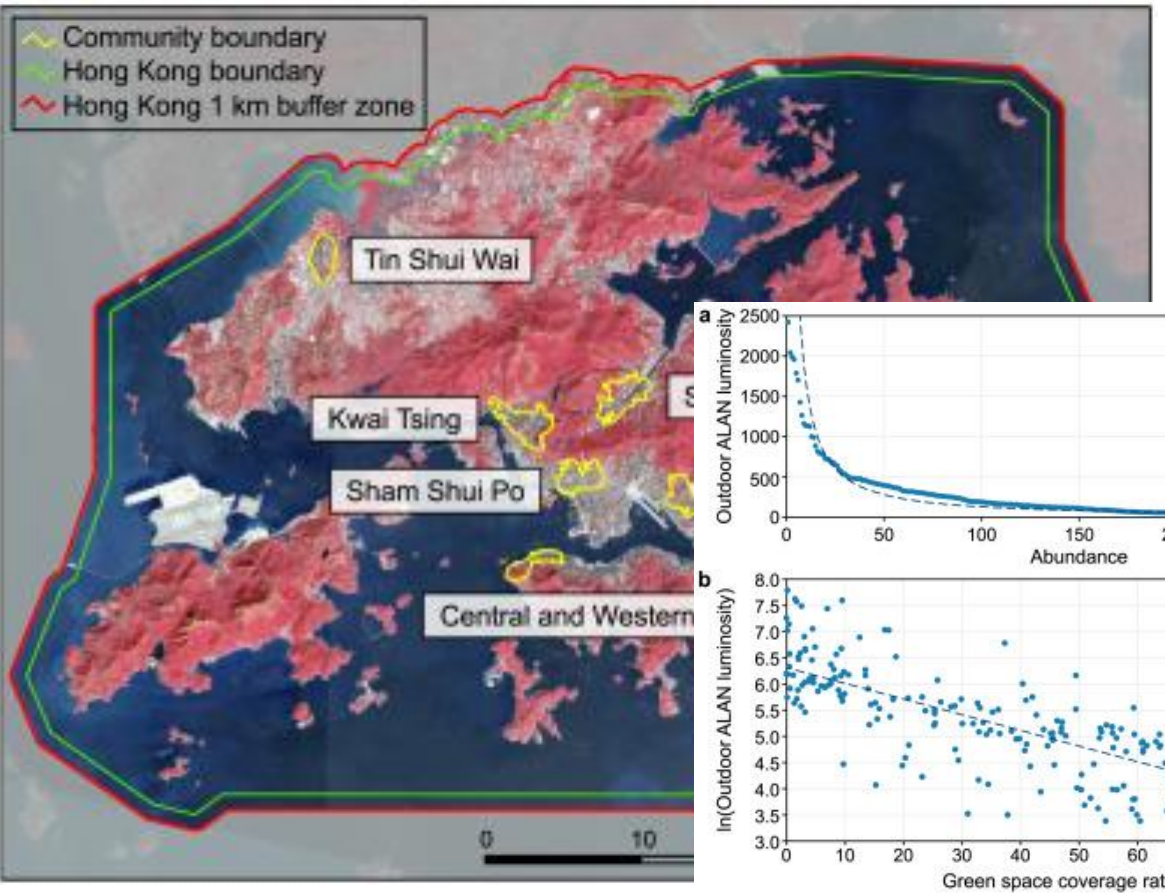


- **Nighttime light intensity is positively correlated with GDP.**
- **The time-series county-level poverty analysis demonstrates the effectiveness of poverty reduction programs.**

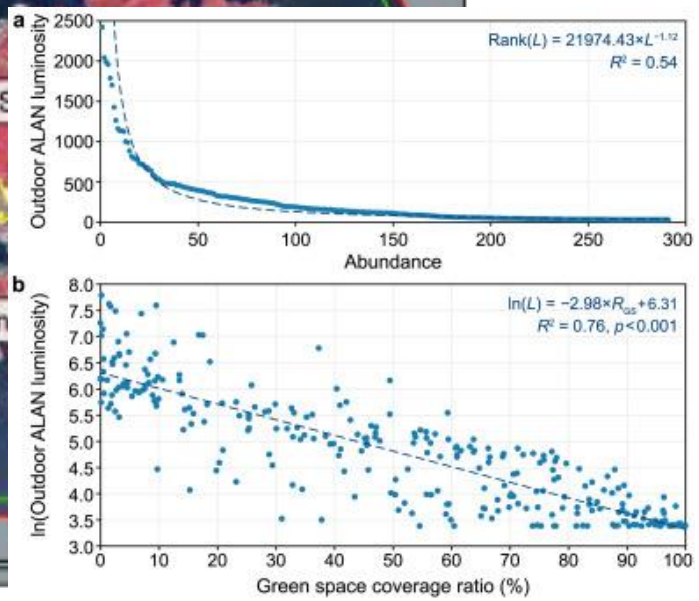
  More then 90% of the counties experienced a reduction in poverty in Beijing-Tianjin-Hebei region.
- **SDGSAT-1 glimmer data can provide reliable poverty analysis foundation for sustainable development and policy-making.**

➢ Yu, B., Chen, F., Ye, C., et al. (2023) Temporal expansion of the nighttime light images of SDGSAT-1 satellite in illuminating ground object extraction by joint observation of NPP-VIIRS and Sentinel-2A images. ***Remote Sensing of Environment***, 295, 113691.

GLI for Outdoor Nighttime Light Exposure Analysis



Study area in Hongkong



Negative association between green space coverage and outdoor nighttime light

3 GOOD HEALTH AND WELL-BEING

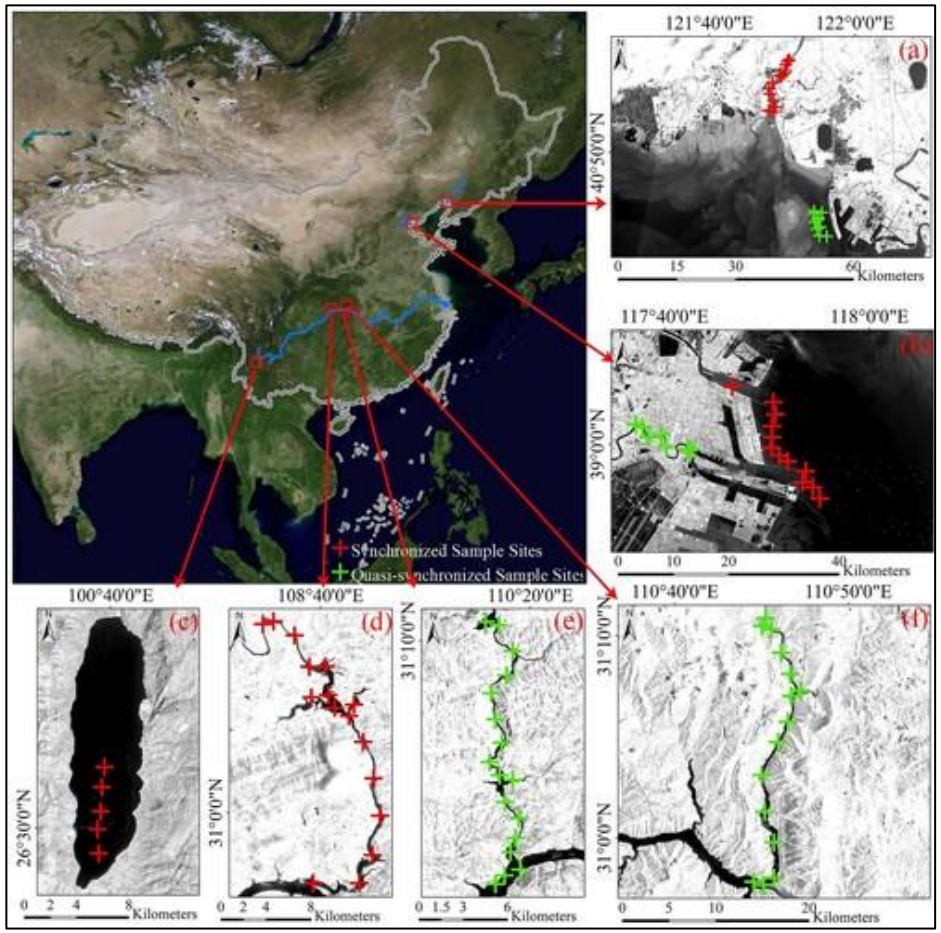
SDG 3

- *Reduce illnesses and deaths from pollution*
- *SDG 3.9*

- Urbanization has caused a deficiency in nature and the abundance of artificial nighttime light. **High-resolution GLI data** offers the opportunity to profile the **nighttime light exposure.**
- Research analysed participants' spatial-temporal activity trajectory to find their exposure to green space and nighttime light.
- Results show a **negative association between green space coverage and outdoor nighttime light.**

➢ Liu, Y., Kwan, M., Wang, J., et al. (2024). Confounding associations between green space and outdoor artificial light at night: Systematic investigations and implications for urban health. ***Environmental Science and Ecotechnology***, 21, 100436.

MSI for Total Suspended Matter Estimation



Location of study areas and field sampling sites. (a) Liao River; (b) Hai River; (c) Chenghai Lake; (d) Pengxi River; (e) Shennongxi River; (f) Xiangxi River.

6 CLEAN WATER AND SANITATION

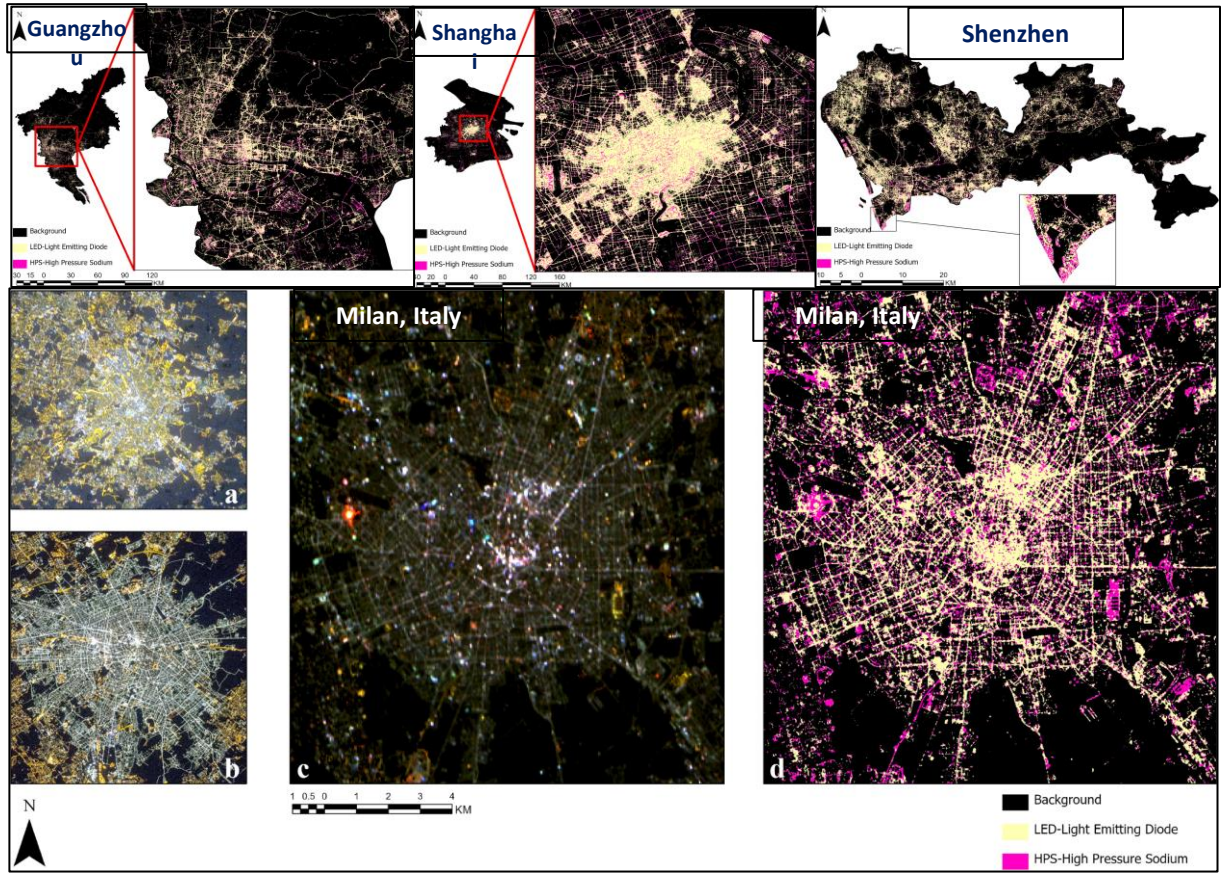
SDG 6

- *Improve water quality by reducing pollution*
- *SDG 6.3*

- **Total suspended matter (TSM) is a fundamental parameter of water quality, the precise derivation of which will facilitate SDG 6 monitoring.**
- **MSI data was used as the input for a new TSM model that considers atmospheric correction issues.**
- **The new model shows promising results at testing sites at Hai and Liao Rivers in northern China.**

➢ Wang, S., Mao, Z., Zhang, B., et al. (2024). Evaluation of SDGSAT-1 MII data in total suspended matter estimation in clear to extremely turbid rivers. ***International Journal of Digital Earth***, 17(1), 2413104.

GLI for Light Source Classification



SDGSAT-1 glimmer images and classification results of urban lighting types

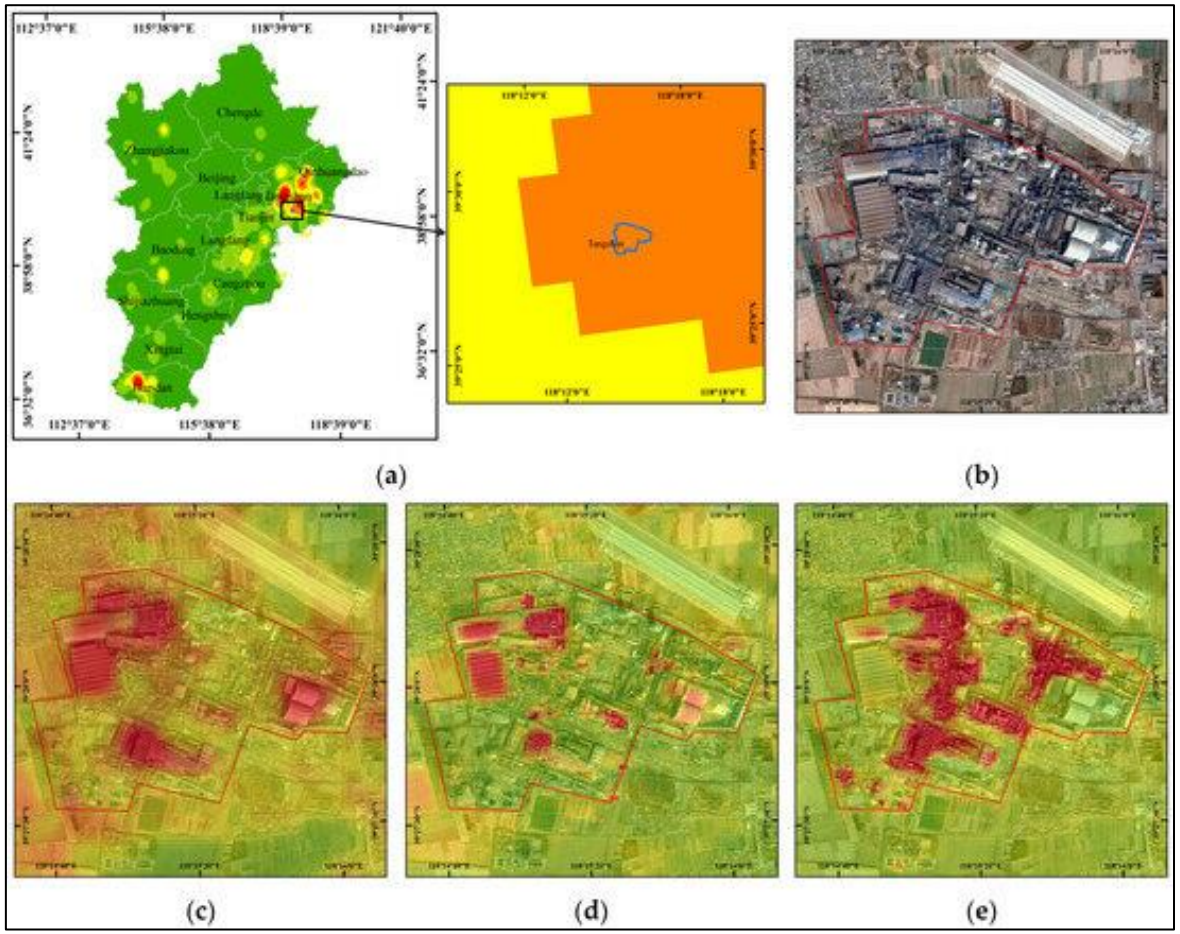
SDG 7 Energy Power

- *Global rate of improvement in energy efficiency*
- *SDG 7.3*

- Using SDGSAT-1 glimmer and land use data, **classification of urban light types** can be achieved with good generalizability at the regional scale.
- In 2022, Beijing, Shanghai, Guangzhou and Shenzhen all reached **more than 50% of LED lighting**, with Guangzhou and Shenzhen reaching more than 75% of urban LED lighting due to industry clustering.
- By replacing 10% of High-Pressure Sodium (HPS) lamp to LED lights every year, municipal funding pressures can be **effectively mitigated**.

➢ Lv, Z., Guo, H., Zhang, L., et al. (2024) Urban public lighting classification method and analysis of energy and environmental effects based on SDGSAT-1 glimmer imager data. ***Applied Energy***, 355, 122355.

TIS for Industrial Heat Detection



Identification of industrial heat sources

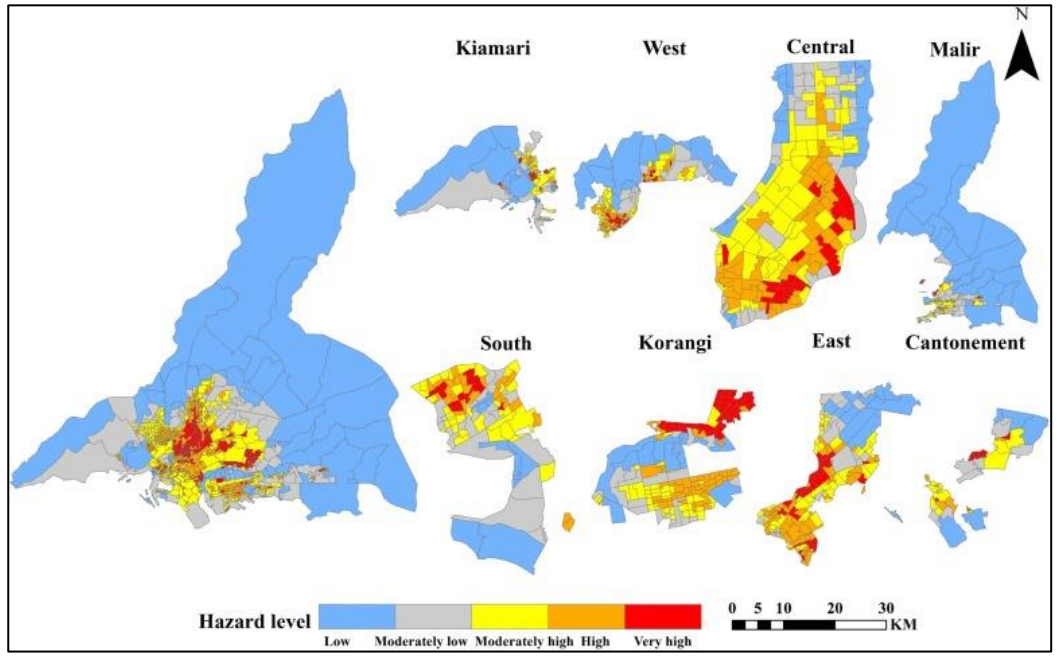
SDG 9

- *Upgrade all industries and infrastructures for sustainability*
- *SDG 9.4*

- Traditional detection of ground industrial source based on legacy remote sensing data sources has a low spatial resolution with insufficient details.
- In TIS images, industrial heat sources have **precise distribution**. It is possible to locate multiple sources within a single factory.
- The validation results show that the detection result has achieved an **accuracy around 95%**, offering reliable regional industrial heat assessment.

➢ Xie, Y., Ma, C., Zhao, Y., et al. (2024). The Potential of Using SDGSAT-1 TIS Data to Identify Industrial Heat Sources in the Beijing–Tianjin–Hebei Region. ***Remote Sensing***, 16(5), 16050768.

TIS for Heat-related Health Risks Mapping



TIS-based Spatial distribution of heat hazard across Karachi and district-wise at census ward level.

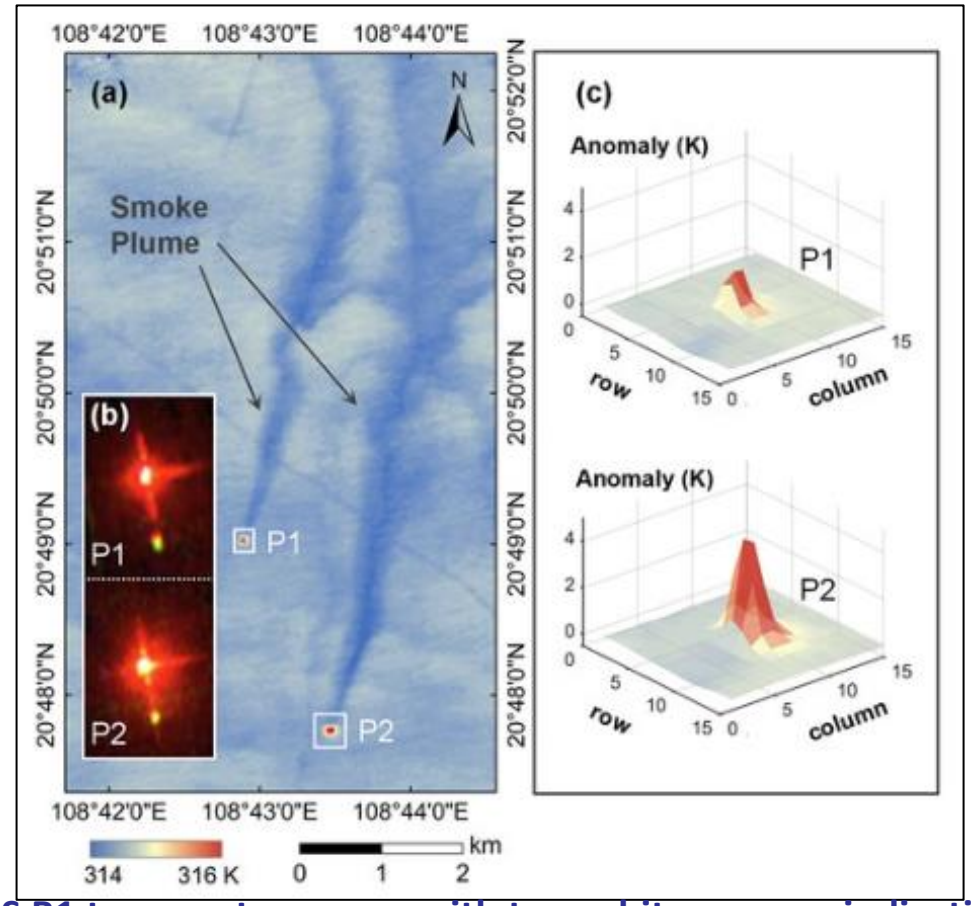
SDG 11

- *Inclusive and sustainable urbanization*
- *SDG 11.3*

- Urbanization and climate change have introduced significant heat-related health risks in cities. Precise hazard level mapping is crucial for urban health management.
- SDGSAT-1 TIS is the basis for deriving high-resolution urban ground temperature, which, together with heat vulnerability factors, were applied to calculate the Heat Health Risk Index (HHRI).
- Areas with packed buildings experience most overall risks.

➢ Baqa, M., Lu, L., Guo, H., et al. (2025). Investigating heat-related health risks related to local climate zones using SDGSAT-1 high-resolution thermal infrared imagery in an arid megacity. ***International Journal of Applied Earth Observation and Geoinformation***, 136, 104334.

Synergistic Observations of oil and gas platforms



(a) TIS B1 temperature map, with two white squares indicating the locations of high-temperature platforms (P1 and P2) and the low-temperature smoke plume. (b) Co-measured GLI images for the two platforms. (c) Temperature anomalies

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

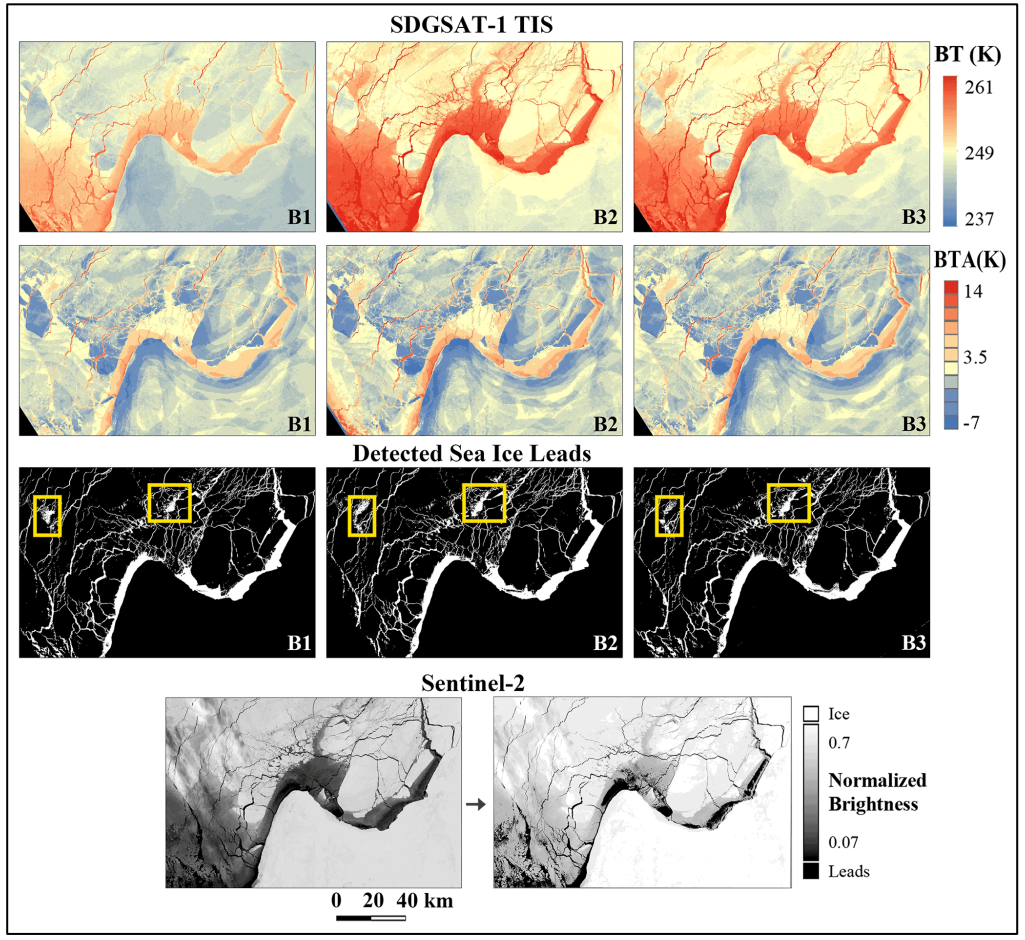
SDG 12

- *Sustainable management and use of natural resources*
- *SDG 12.2*

- Monitoring offshore oil and gas (OG) platforms will provide crucial information for understanding regional energy structure and global decarbonization endeavours.
- Synergic SDGSAT-1 TIS and GLI data provide the opportunity for pinpointing offshore OG platforms and offering insights into their light and heat characteristics.
- 113 active OG platforms in the South China Sea were detected using TIS and GLI data.

➢ Qiu, Y., Li, X., Yan, L., et al. (2024). Synergic sensing of light and heat emitted by offshore oil and gas platforms in the South China Sea. ***International Journal of Digital Earth***, 17(1), 2441932.

TIS for Sea Ice Observation



Ice lead detection using SDGSAT-1 TIS data acquired over the Laptev Sea

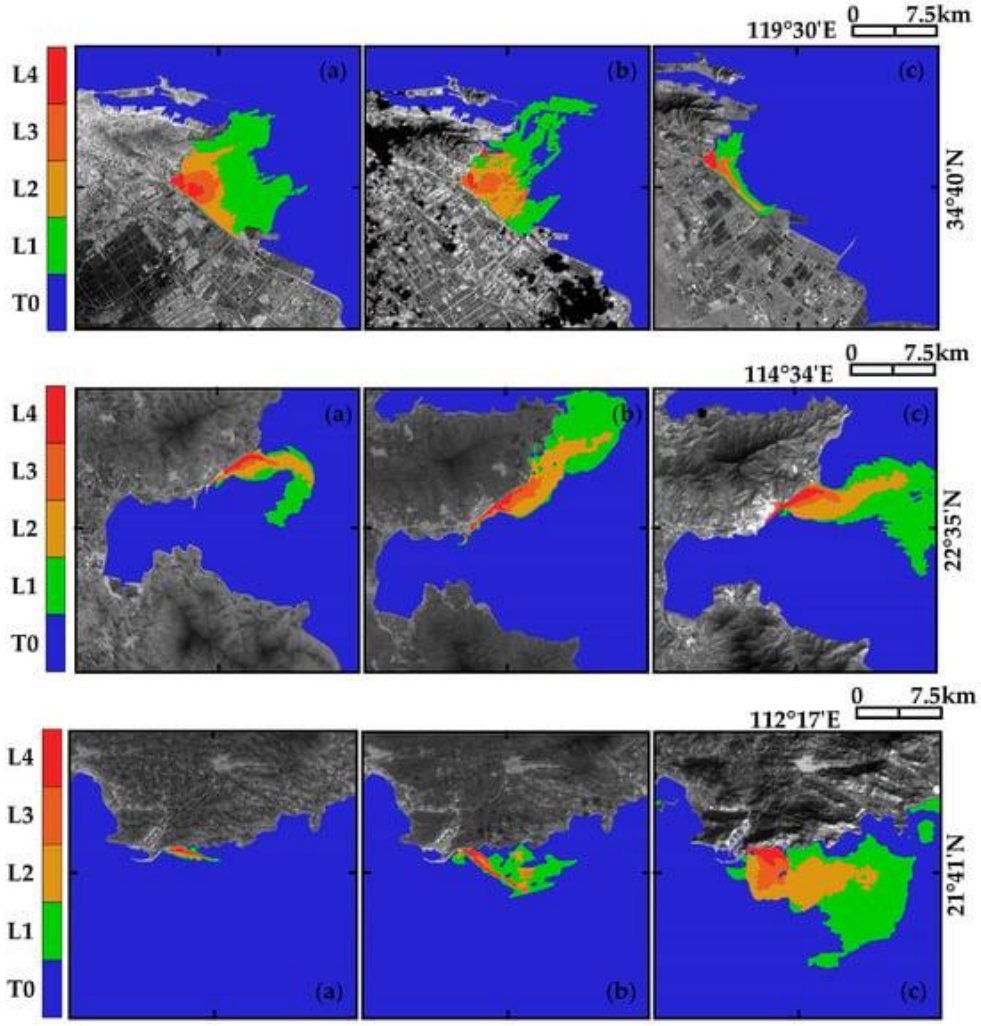
SDG 13

- *Integrate climate change measures into national policies, strategies and planning*
- *SDG 13.2*

- The time series SDGSAT-1 TIS data with **sufficiently high resolution** can provide **new insights** into the contribution of **narrow leads to rapid sea ice changes in the Arctic.**
- The Arctic sea ice region can be effectively observed with high-resolution TIS data. 415 sea ice leads were found, with a **detection accuracy of 96.3%.**
- The SDGSAT-1 TIS data has excellent potential for detecting sea ice leads formation and refreezing in polar regions.

➢ Qiu, Y., Li, X., Guo, H. (2023) Spaceborne thermal infrared observations of Arctic sea ice leads at 30 m resolution. ***The Cryosphere***, 17(7), 2829–2849.

TIS for Monitoring Coastal Thermal Discharge



Sea temperature rising near nuclear power stations observed in TIS images

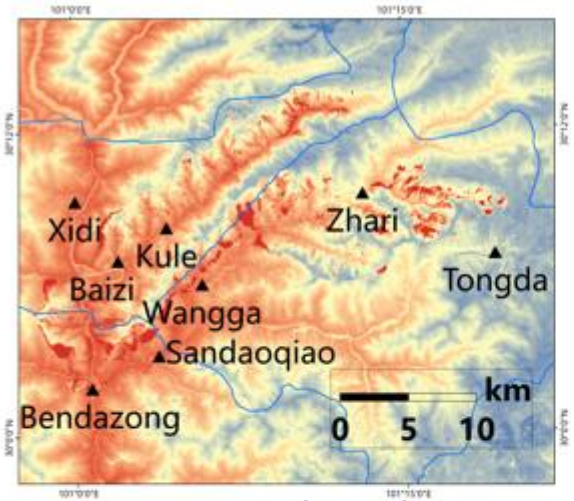
SDG 14

- *Protect marine and coastal ecosystems to avoid significant adverse impacts*
- *SDG 14.2*

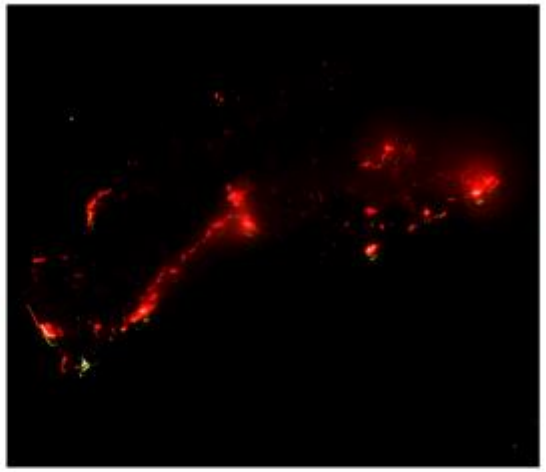
- Thermal discharges from coastal nuclear power stations impose considerable threats to coastal organisms. SDGSAT-1 TIS provides a **cost-efficient approach to monitor thermal discharges.**
- A **simplified split-window-based (SW) temperature retrieval method** was developed for the temperature rise detection.
- Results show that the SW method can **correct atmospheric effects and obtain more accurate sea surface temperature.**

➢ Huang, W., Jiao, J., Zhao, L., et al. (2024). Thermal Discharge Temperature Retrieval and Monitoring of NPPs Based on SDGSAT-1 Images. ***Remote Sensing***, 15(9), 2298.

Synergistic Observations for Wildfire Assessment



TIS image of wildfire



GLI image of wildfire

MSI image before the wildfire

MSI image captured after wildfire

SDG 15

- *Conserve terrestrial ecosystems*
- *SDG 15.1*

- Wildfires can cause significant impacts on terrestrial ecosystems. Remote sensing is well-applied in wildfire monitoring for its rapid response and cost-efficient advantages.
- SDGSAT-1 monitors day-and-night wildfire optical and thermal signals, which are useful for fire distribution and landcover change extraction.
- This research shows the potential of SDGSAT-1 data for accurate wildfire assessment.

➢ Dou, C., Tang, Y., Jiang, N., et al.(2024). Analysis of Sichuan wildfire based on the first synergetic observation from three payloads of SDGSAT-1. ***The Innovation***, 5(6), 100707.

Future Development

Alliance of Sustainable Development Goals Satellites (ASSA)

IRDR Integrated Research on Disaster Risk

CBAS

ASSA 可持续发展卫星观测联盟 Alliance of Sustainable Development Goals Satellites

ASSA was established on Sep. 6, 2022 by 7 Chinese EO departments and organizations.

- *International Research Center of Big Data for Sustainable Development Goals*
- *Earth Observation System and Data Center, China National Space Administration*
- *National Satellite Meteorological Center*
- *National Satellite Ocean Application Service*
- *China Centre for Resources Satellite Data and Application*
- *Satellite Application Center for Ecology and Environment*
- *Land Satellite Remote Sensing Application Center*

www.assa4sdg.org.cn

ASSA is a **nonprofit** and **academic group** working on scientific research and technological innovation, aiming to provide **data services and sci-tech support** for the implementation of the UN 2030 Agenda and GDI.

Sustainable Development Satellite Constellation Plan

SDGSAT-1 has achieved important results in *data sharing* and *international cooperation*, contributing to the achievements of the global SDGs. However, *one satellite is insufficient for SDGs implementation*.

SDG Indicator Framework

16 SDG
73 SDGs

Satellite May Contributes (CEOS)

7 SDG
20 SDSs

Satellite Supported

- Require more *satellite observation data*
- Should focus more on *human activities*

Sustainable Development Satellite Constellation

China is on the move

- In 2021, President Xi Jinping proposed the *'Global Development Initiative'* at the 76th UN General Assembly, aiming to *accelerate the implementation of UN 2030 Agenda*
- In 2022, President Xi Jinping chaired the High-level Dialogue on Global Development and declared, *'Launching a Sustainable Development Satellite Constellation Plan'*
- In 2023,Vice President Han Zheng attended the 78th Session of the UN General Assembly, *emphasizing the importance of advancing* the *'Sustainable Development Satellite Constellation Plan'*

There is an urgent need to implement the Sustainable Development Satellite Constellation Plan, and seize the strategic high ground in space technology in support of global sustainable development

Sustainable Development Satellite Constellation Plan

IRDR Integrated Research on Disaster Risk

CBAS

CBAS has completed the draft proposals of the *SDGSAT2~SDGSAT10* satellites to address the issue of sustainable development satellite constellation plan to uncover the *mechanisms and evolutionary laws of key processes in the human-nature interactions*.

SDGSAT-2	SDGSAT-3	SDGSAT-4	SDGSAT-5	SDGSAT-6	SDGSAT-7	SDGSAT-8	SDGSAT-9	SDGSAT-10
Anthropocene Science Satellite	Earth Dynamics Observation Satellite	Water Resources Observation Satellite	Terrestrial Ecosystem Detailed Observation Satellite	Thermal Environment Change Observation Satellite	Vertical Space Structure Observation Satellite	Global Climate Change Observation Satellite	Cryosphere Elements Observation Satellite	Agroforestry Health Observation Satellite

SDG 2.3 | SDG 2.4 | SDG 6.3 | SDG 6.6 | SDG 7.3 | SDG 11.1 | SDG 11.3 | SDG 11.4 | SDG 11.5 | SDG 11.6 | SDG 11.b | SDG 13.1 | SDG 13.2 | SDG 14.1 | SDG 14.2 | SDG 14.7 | SDG 15.1 | SDG 15.2 | SDG 15.3 | SDG 15.4 | SDG 15.5

Main SDGs supported by Satellite Observation

Satellite system engineering

- Satellite platform
- Orbital parameters
- Requirements for use
- Project budget

1. Forward-oriented cutting-edge scientific issues
2. Practically solve the dilemma of SDGs realization
3. Achieve international leadership

1. Demand for research on the SDG indicator system
2. Demand for global SDGs monitoring, assessment
3. Demand for production of global SDGs data products

1. Conceptual innovativeness
2. Stability of engineering technology
3. Degree of advancement and maturity

Sustainable Development Satellite Constellation Plan (Stage I)

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

Thank you !