The Sustainable Development Data Products for BRICS Countries

International Research Center of Big Data for Sustainable Development Goals

April 2022 Beijing·China

CONTENTS

support
SDGs

Data Product of Sustainable Development Science Satellite 1 (SDGSAT-1) for BRICS countries

Introduction

SDGSAT-1 science satellite (SDGSAT-1) was launched into space from the Taiyuan Satellite Launch Center in northern China on November 5, 2021. Being the first Earth-observation satellite for the Chinese Academy of Sciences, it is also the first satellite customized for the UN 2030 Agenda for Sustainable Development. SDGSAT-1, equipped with three payloads of thermal infrared, glimmer, and multi-spectral imagers (see table 1 for key technical parameters), is capable of obtaining high-quality data as well as full-time monitoring to facilitate the evaluation of SDG indicators representing the interaction between human activities and nature.

Dataset citations:

International Research Center of Big Data for Sustainable Development Goals (CBAS). Data Product of Sustainable Development Science Satellite 1 (SDGSAT-1) for BRICS countries, Beijing: International Research Center of Big Data for Sustainable Development Goals (CBAS), 2022. doi: 10.12237/casearth.625e1760819aec2a46dcd2d7

↓ Table 1 Key technical parameters of SDGSAT-1

Type	Index	Task/Sub-index
Satellite	Orbit	Sun-synchronous
	Altitude	505 km
	Orbital inclination	97.5°
	Swath width	≥ 300 km
Thermal Infrared sensor	Pixel size	30 m
	Detection spectrum	B1: 8~10.5 μm
		B2:10.3~11.3 μm
		B3:11.5~12.5 μm
Glimmer sensor	Pixel size	P: 10 m
		RGB: 40 m
	Bands	P: 0.45 ~0.9 μm
		B1: 0.43 ~0.52 μm
		B2: 0.52 ~0.615 μm
		B3: 0.615 ~0.9 μm
Multi-spectral sensor	Pixel size	10 m
	Bands	B1: 0.38 ~0.42 μm
		B2: 0.42 ~0.46 μm
		B3: 0.46 ~0.52 μm
		B4: 0.52 ~0.6 μm
		B5: 0.63 ~0.69 μm
		B6: 0.765 ~0.805 μm
		B7: 0.805 ~0.9 μm

QR code

Product URL
http://data.casearth.cn/thematic/brics_2022_china

Data product description for SDGSAT-1

SDGSAT-1 is currently being tested in orbit, and its product was radiometrically and geometrically corrected.

❶ Data product files

The data product includes images, metadata, browsing images and thumbnails, storing in the same directory. Naming Rule: Product ID.File Type

Examples:

KX10_MII_20220401_E116.73_N38.98_202200032426_L4A_A.tiff
KX10_MII_20220401_E116.73_N38.98_202200032426_L4A_B.tiff
KX10_MII_20220401_E116.73_N38.98_202200032426_L4A.meta.xml
KX10_MII_20220401_E116.73_N38.98_202200032426_L4A_A.browse.png
KX10_MII_20220401_E116.73_N38.98_202200032426_L4A_A.thumb.png
……

↓ Table 2 Product parameters

Identifier	Length (bytes)	Description
Satellite	4	KX10: The code of SDGSAT-1
Sensor	3	MII: Multi-spectral sensor
		TIS: Thermal infrared sensor
		GIU: Glimmer sensor
		GPI: Glimmer polar mode
Acquisition date	8	Date when the image was taken (UTC) Format YYYYMMDD
Central longitude	6	E/ Wxxx.xx
Central latitude	5	N/ Sxx.xx
Task number	12	Twelve digits representing the order number of system production tasks

❷ Description of data product image file

Thermal infrared sensor: The image files are saved as one image in GeoTIFF format with B1, B2 and B3 bands;

Multi-spectral sensor: The image files are saved as two images in GeoTIFF format with B1-B7 bands according to camera A and camera B;

Glimmer sensor: The image files are saved as four images in GeoTIFF format based on the synthesis of the Panchromatic PL/PH and RGB bands for each camera.

❸ Description of data product metadata file

Each product has a metadata file named *.meta.xml.

❹ Browsing image and thumbnail description of data product

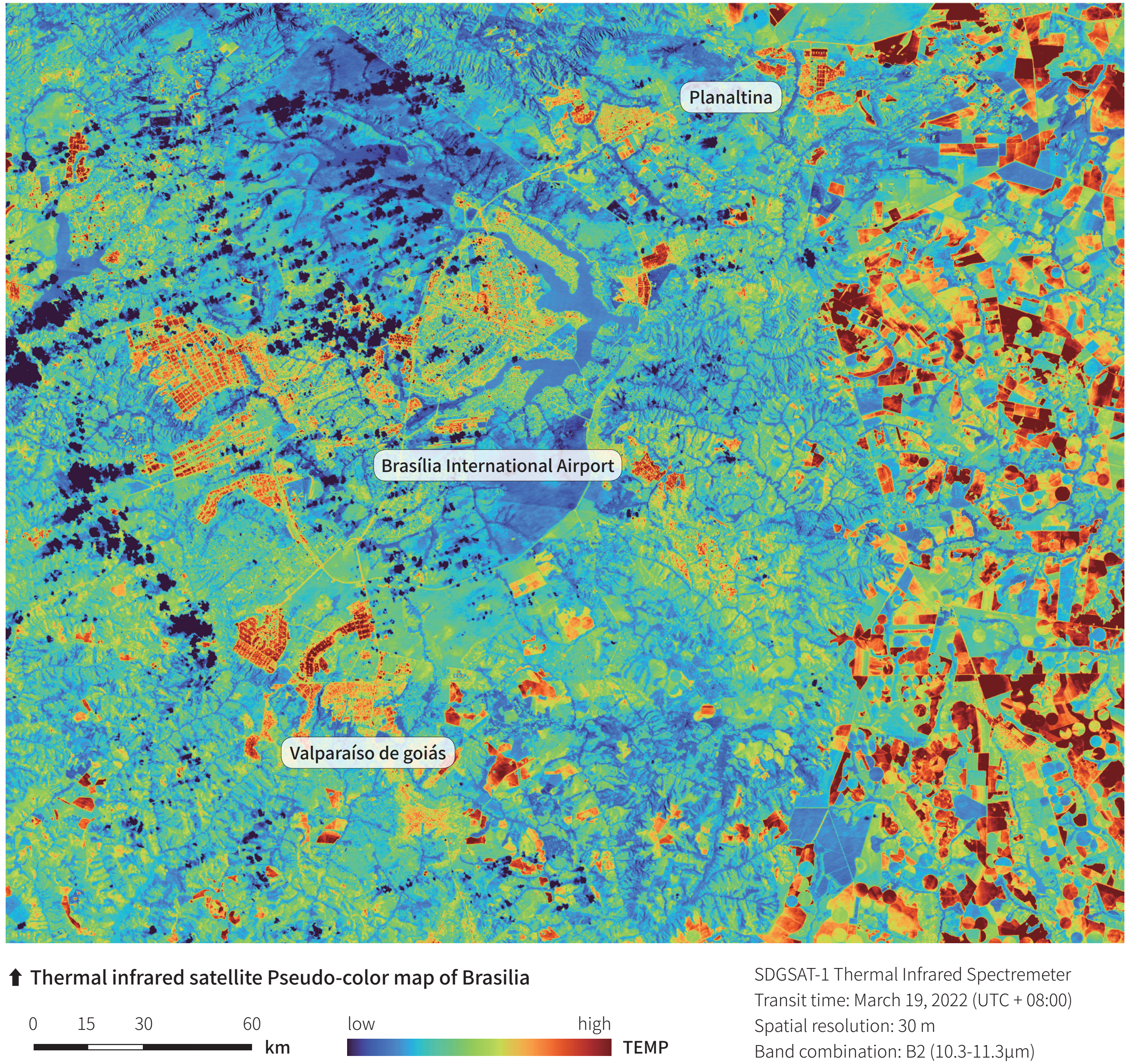
The browsing image is a JPG file after 16 times downsampling the full resolution image of the scene, named as *.browse.jpg.

The thumbnail is a JPG file downsampling the browsing image, named as *.thumb.jpg.

Thermal infrared sensor: color composite images of camera, composed of three bands including B3 (red), B2 (green) and B1 (blue);

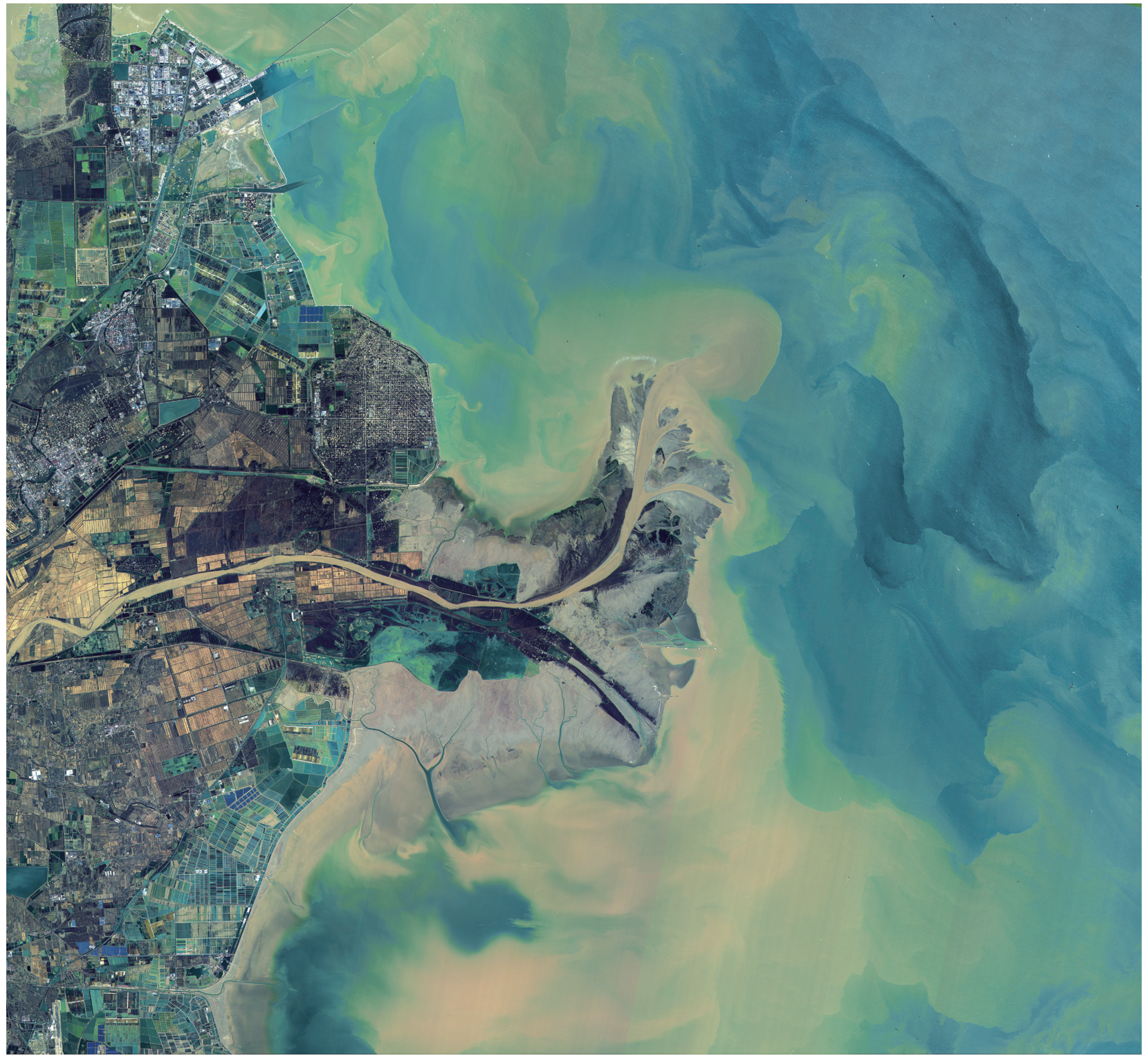
Multi-spectral sensor: color composite images of camera A and B, composed of three bands including B5 (red), B4 (green) and B3 (blue);

Glimmer sensor: panchromatic grayscale image file of PL/PH bands and color composite images of three bands including B3(red), B2 (green) and B1 (blue) of camera A and B.



⬆ Thermal infrared satellite Pseudo-color map of Brasilia

SDGSAT-1 Thermal Infrared Spectremeter
Transit time: March 19, 2022 (UTC + 08:00)
Spatial resolution: 30 m
Band combination: B2 (10.3-11.3μm)



⬆ **Multi-spectral satellite image of Yellow River Estuary**

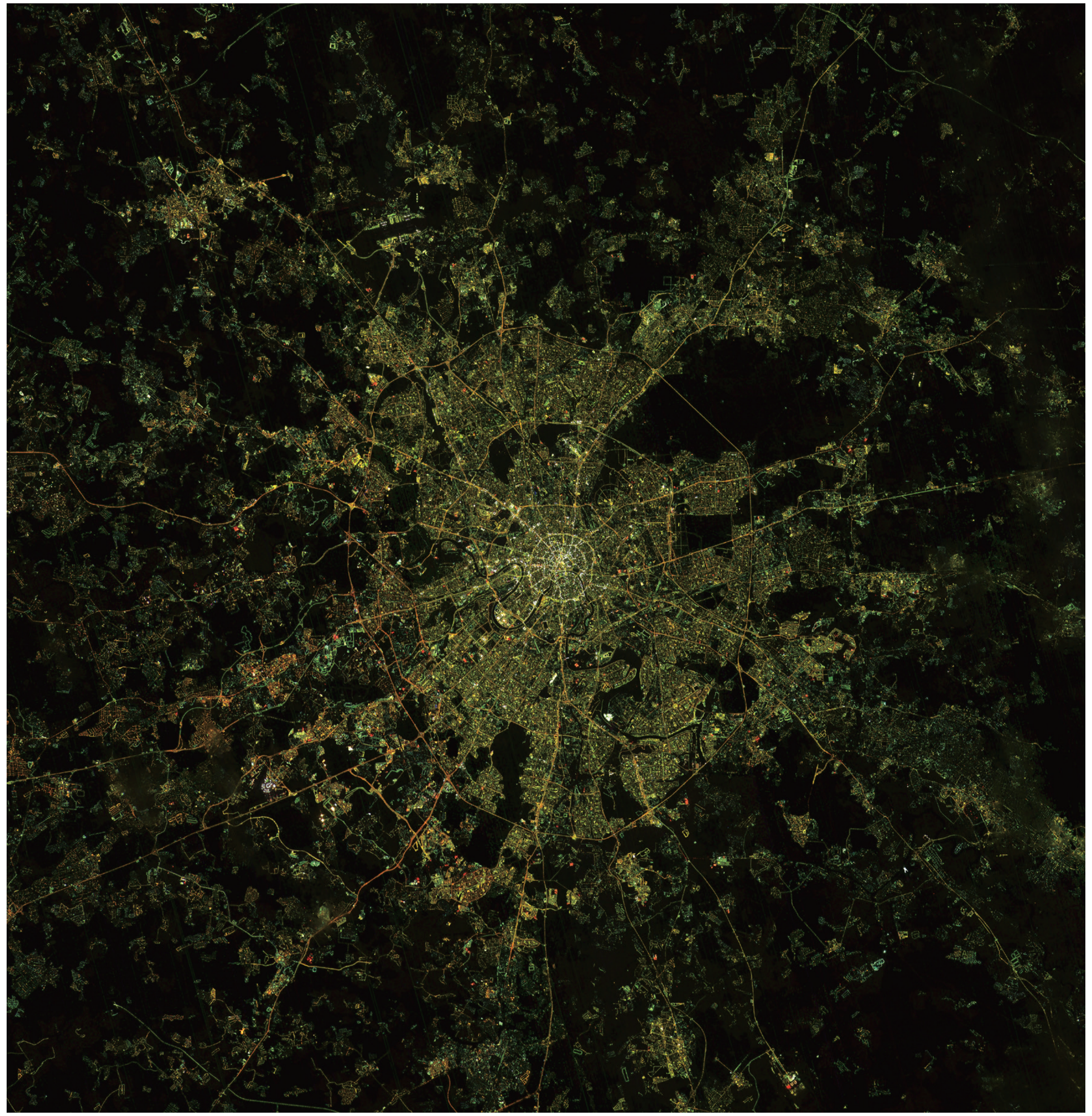
0 2 4 8 km

SDGSAT-1 Multi-spectral Imager for Inshore Regions
Transit time: November 12, 2021 (UTC + 08:00)
Spatial resolution: 10 m
Band combination: B5 (R) B4(G) B3(B)

⬆ **Multi-spectral satellite image of the coastal zone of Mumbai**

0 5 15 30 km

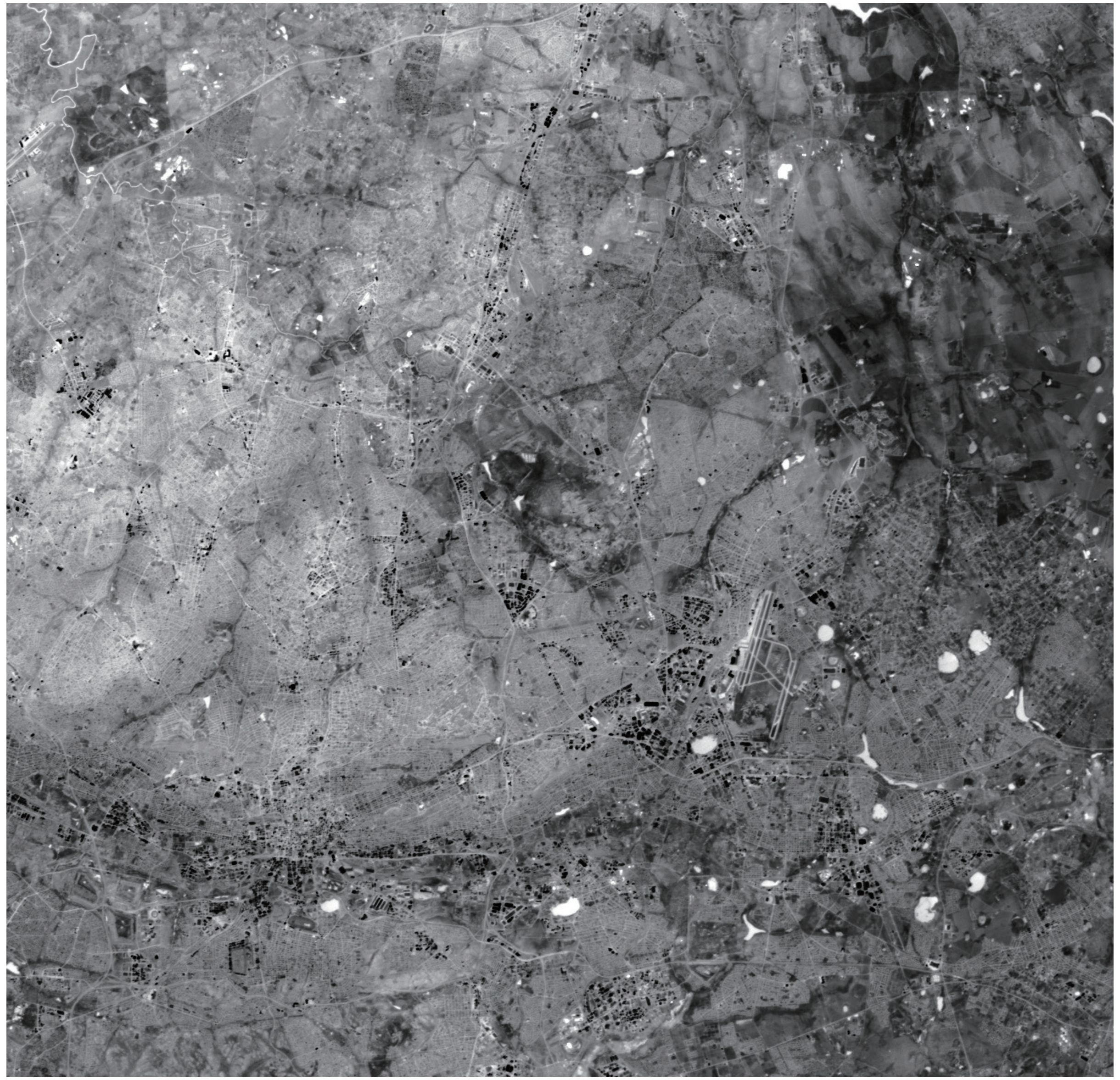
SDGSAT-1 Multi-spectral Imager for Inshore Regions
Transit time: March 18, 2022 (UTC + 08:00)
Spatial resolution: 10 m
Band combination: B7 (R) B5(G) B2(B)



⬆ **Glimmer satellite image of Moscow**

0 5 10 20 km

SDGSAT-1 Glimmer Imager for Urbanization
Transit time: March 14, 2022 (UTC + 08:00)
Fusion Data Spatial resolution: 10 m
Band combination: B3 (R) B2(G) B1(B)



⬆ **Thermal infrared satellite image of Johannesburg**

0 1.25 2.5 5 km

SDGSAT-1 Thermal infrared imager
Transit time: April 13, 2022 (UTC + 8:00)
Spatial resolution: 30 m
Band combination: B2

Global 30-m impervious-surface dynamic dataset in 2000-2020 (GISD30_2000-2020)

Product summary

The impervious-surface area is defined as a land cover where surface water is unable to penetrate the ground due to the presence of anthropogenic materials, such as steel, cement, asphalt, bricks, and stone, leading to blockage of the natural evapotranspiration process.

Temporal

GISD30 dataset includes five global 30-m impervious-surface maps, i.e., 2000, 2005, 2010, 2015 and 2020.

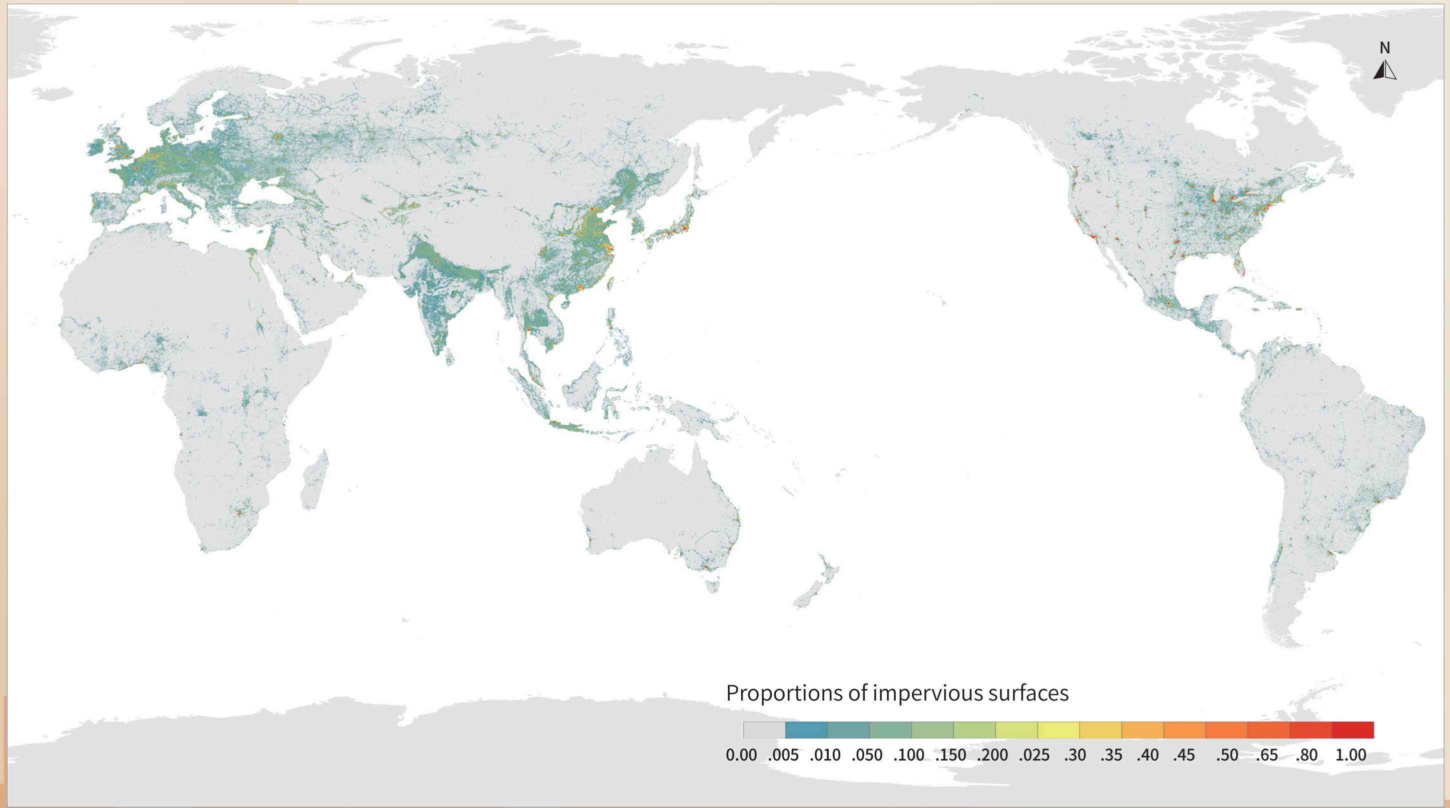
Geo Scope

180° W–180° E
60° S–80° N

support SDGs

SDG 11.3, sustainable urbanization

Global 30-m map of impervious-surface in 2020

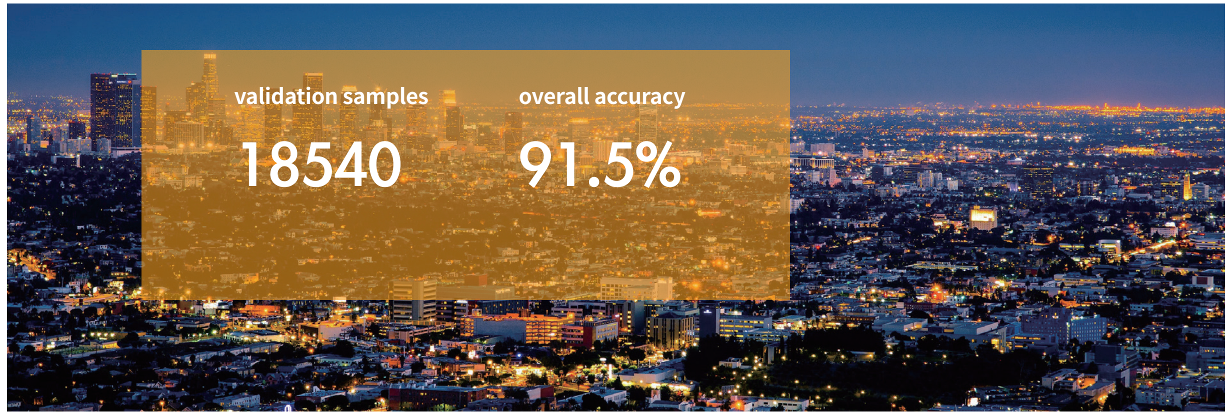


The Sustainable Development Data Products for BRICS Countries

Methodology

To produce GISD30, a high confidence training dataset at global scale was collected by utilizing a prior land cover data according to a series of extraction rules. The spectral generalization approach and a sample migration strategy were designed to achieve long-term dynamic monitoring of impervious surfaces. The GISD30 dataset was ultimately produced by classifying the time-series Landsat reflectance imagery and integrating the local adaptive random forest model and the spectral generalization approach (Zhang et al. 2021, 2022).

Accuracy assessment



The stratified random sampling strategy was utilized to assess accuracy. A total of 18,540 time-series validation samples were collected based on the visual interpretation method. The validation results show that the GISD30 dataset achieved an overall accuracy of 91.5% and a kappa coefficient of 0.866, which is significantly higher than similar products in China and internationally.

Product details

The product is stored using the WGS84 coordinate system (EPSG: 4326) with a spatial resolution of 30-meter. The output format is GeoTIFF. Each tiled file covers a 5°×5° geographical grid corresponding to 18,554×18,554 pixels. The dataset contains a total of 961 tiled files.

For accurate usage and reference, the GISD30 files are named in the following format: GISD30_1985-2020_E/W***N/S***.tif

where 'E/W***N/S***'is the longitude and latitude coordinates found in the upper left corner of the tile data. Each tiled file contains a single-layer map that showcases the surface status with 0 and 1, representing pervious surfaces and impervious surfaces, respectively.

Scientific Results:

GISD30 revealed a significant increase in impervious-surface area at global scale. It increased from 696,000 km^2 in 2000 to 1,107,300 km^2 in 2020, with an increase of 411,300 km^2 (59.08%). Meanwhile, the growth rate of the BRICS countries exceeded the global average, accounting for 40.7% of the global total increased impervious areas.

Citation and disclaimer for data use

Users of this product shall clearly indicate the source as "Global 30-m impervious-surface dynamic dataset in 2000-2020 (GISD30_2000-2020)" in all forms of research output, including, but not limited to, published and unpublished papers, theses, manuscripts, books, reports, data products, and other academic output. The data producers are not responsible for any losses caused by the use of the data. The boundaries and marks used in the maps do not represent any official endorsement by or opinion of the data producers.

Dataset citations:

Liangyun Liu, Xiao Zhang. Global 30-m impervious-surface dynamic dataset in 2000-2020 (GISD30_2000-2020), Beijing: International Research Center of Big Data for Sustainable Development Goals (CBAS), 2022. doi: 10.12237/casearth.625e14c1819aec2a46dcc033

References:

Zhang, X., Liu, L., Chen, X., Gao, Y., and Jiang, M.: Automatically Monitoring Impervious Surfaces Using Spectral Generalization and Time Series Landsat Imagery from 1985 to 2020 in the Yangtze River Delta, Journal of Remote Sensing, 2021, 1-16, https://doi.org/10.34133/2021/9873816.

Zhang, X., Liu, L., Zhao, T., Gao, Y., Chen, X., and Mi, J.: GISD30: global 30-m impervious surface dynamic dataset from 1985 to 2020 using time-series Landsat imagery on the Google Earth Engine platform, Earth System Science Data, 2022, 14, 1831–1856, https://doi.org/10.5194/essd-2021-285.

QR code

Product URL

http://data.casearth.cn/thematic/brics_2022_china

Contact information

Liangyun Liu, lyliu@cbas.ac.cn

Spatial distribution of core urban built-up areas in BRICS cities with population over 300,000 in 2000-2020 (CBUAD_BRICS_2000-2020)

Product summary

The built-up area is a pivotal indicator for characterizing the urbanization level. It covers areas of impervious surfaces, green space, and others. A dataset on spatial distribution of the built-up area provides explicit reference for the urban administrators to optimize cities' functional layout and take effective measures to regulate urban expansions. The dataset can also provide support for assessment of the land-use efficiency (LUE), which is enrolled in the UN's sustainable development goals.

Temporal

The remote sensing imageries, including Landsat series, Sentinel series, and Chinese high resolution satellites images (GF-1 and GF-6), acquired in 2000, 2005, 2010, 2015, and 2020, were used to generate core built-up area datasets in BRICS cities with population over 300,000 (CBUAD_BRICS).

Geo Scope

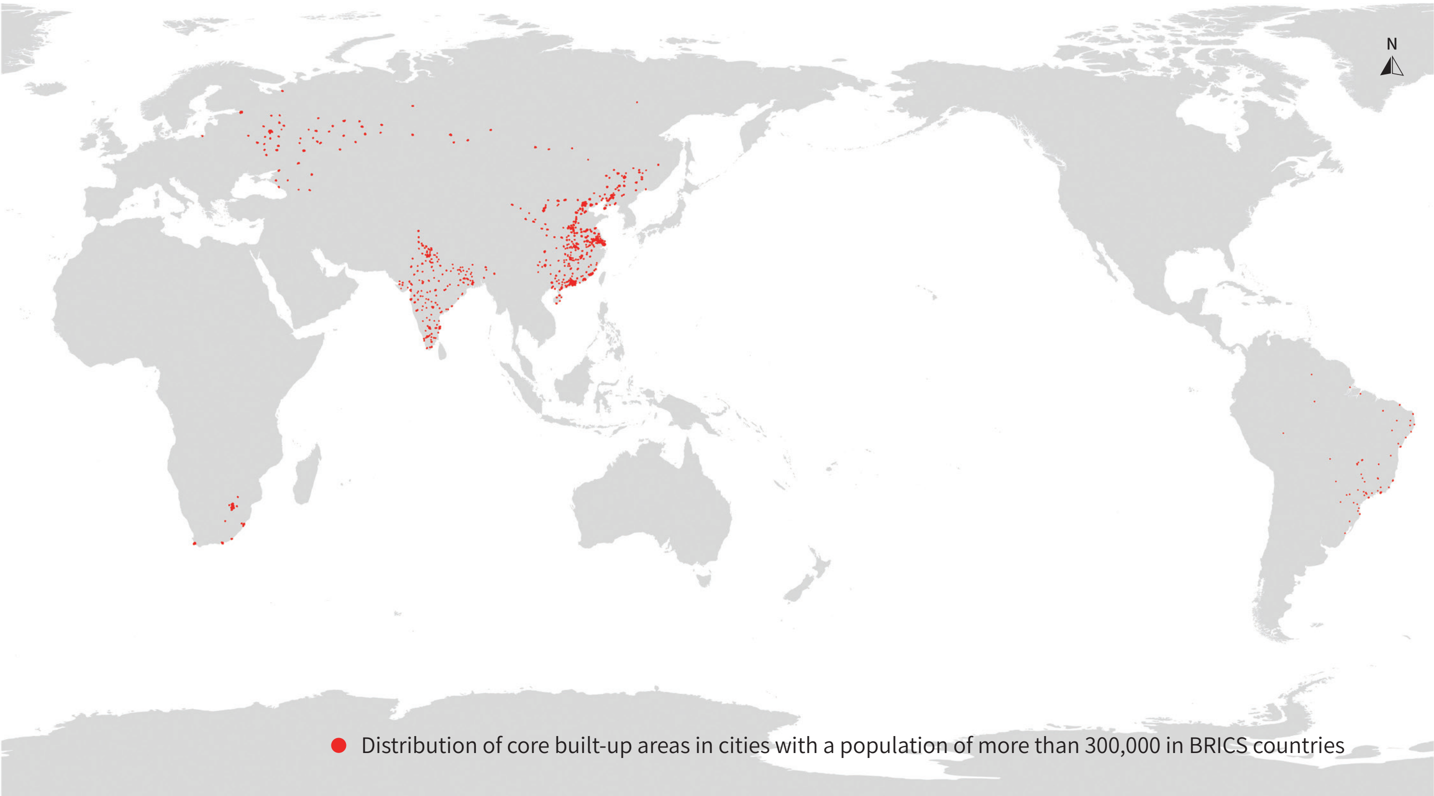
The geographic scope is 69° W-136° E, 33° S -66° N, covering 716 BRICS cities with a populations over 300,000[1].

[1] For the list of cities that had a population over 300,000, the authors consulted the World Urbanization Prospects 2020 published by the UN Department of Economic and Social Affairs (DESA).

support SDGs

This product supports SDG11.3.1 – ratio of land consumption rate to population growth rate.

Map of core built-up areas in BRICS cities with population over 300,000 (2000-2020)



↓ Table of core built-up areas in BRICS cities with population over 300,000 in 2000-2020 (Unit: km^2)

Country	Number of cities	2000	2005	2010	2015	2020
	433	18624.84	25363.40	32991.90	44558.95	62052.35
	157	10567.66	13870.26	15983.61	16840.76	22025.01
	65	6055.80	9071.96	10756.36	11260.15	12514.19
	50	4277.00	5646.57	6260.78	6642.13	7121.59
	11	3909.74	5335.78	5895.99	6161.46	6742.11

Methodology

The source datasets include high-resolution remote sensing images collected from Landsat, Sentinel series and Chinese GF series satellites. The imagery data was then processed in big data computing cloud platform by utilizing a machine learning model based on SmileCART classification tree. Training samples were generated and culminated into an auto-recognized algorithm for impervious surfaces. The original built-up areas were subsequently converted into core built-up area datasets in accordance with the reference provided by the UN-Habitat[2].

[2] See SDG Goal 11 Monitoring Framework: A guide to assist national and local governments to monitor and report on SDG goal 11 indicators. UN Habitat (2019)

Accuracy assessment

CBUAD_BRICS has good consistency with the built-up area datasets derived from the World Bank and UN-Habitat. Compared with the built-up area datasets from the National Statistical Yearbook of China, the correlation coefficient (R^2) is greater than 0.8.

Product details

The datasets took city as the analytic unit. It adopted the WGS84 coordinate system, latitude and longitude projection (EPSG: 4326), and Shapefile format for coordination, projection and storage respectively.

Scientific Results:

The datasets of the urban built-up areas in BRICS cities with a population over 300,000, show a pattern of expansion. The areas varied from 43,435 km^2 in 2000 to 110,455 km^2 in 2020. During 2000-2020, the Land Consumption Rate (LCR) of all the BRICS cities were higher than the Population Growth Rate (PGR), and the ratio of the these two indicators (LCRPGR) dropped from 2.27 (2000-2005) to 2.07 (2015-2020). This suggested that the expansion of the built-up areas was slowing down, and the land-use efficiency was enhanced, although there were still challenges to be solved in reaching a coordinated development pace between population growth and urbanization.

Citation and Disclaimer for Data Use

Users of this product shall clearly indicate the source as "Spatial distribution of core built-up area in BRICS cities with population over 300,000 in 2000-2020" in all forms of research output, including, but not limited to, published and unpublished papers, theses, manuscripts, books, reports, data products, and other academic output. The data producers are not responsible for any losses caused by the use of the data. The boundaries and marks used in the maps do not represent any official endorsement by or opinion of the data producers.

Dataset citations:

Zhongchang Sun. Spatial distribution of core urban built-up areas in BRICS cities with population over 300,000 in 2000-2020 (CBUAD_BRICS _2000-2020), Beijing: International Research Center of Big Data for Sustainable Development Goals (CBAS), 2022. doi: 10.12237/casearth.625e1760819aec2a46dcd2d9

References:

Jiang H., Sun Z., Guo H., Xing Q., Du W., and Cai G. A standardized dataset of built-up areas of China's cities with populations over 300,000 for the period 1990–2015, Big Earth Data, 2022, 6(1): 103–126. DOI: 10.1080/20964471.2021.1950351.

Jiang H., Sun Z., Guo H., Weng Q., Du W., Xing Q., and Cai G. An assessment of urbanization sustainability in China between 1990 and 2015 using land use efficiency indicators, 2021, 1 (34). npj Urban Sustainability, DOI: 10.1038/s42949-021-00032-y.

QR code

Product URL

http://data.casearth.cn/thematic/brics_2022_china

Contact information

Zhongchang Sun, zcsun@cbas.ac.cn

The Sustainable Development Data Products for BRICS Countries

Global 30-m spatial distribution of forest cover in 2020(GFC30_2020)

Product summary

"Forest" in the "Global 30-m spatial distribution of forest cover in 2020" product refers to land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10% , or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

Temporal

The product was generated preferentially from all available data during the peak season of global forest growth in 2020. When optimal timing cannot be met due to cloud cover or data quality, try to select data with a similar time.

Geo Scope

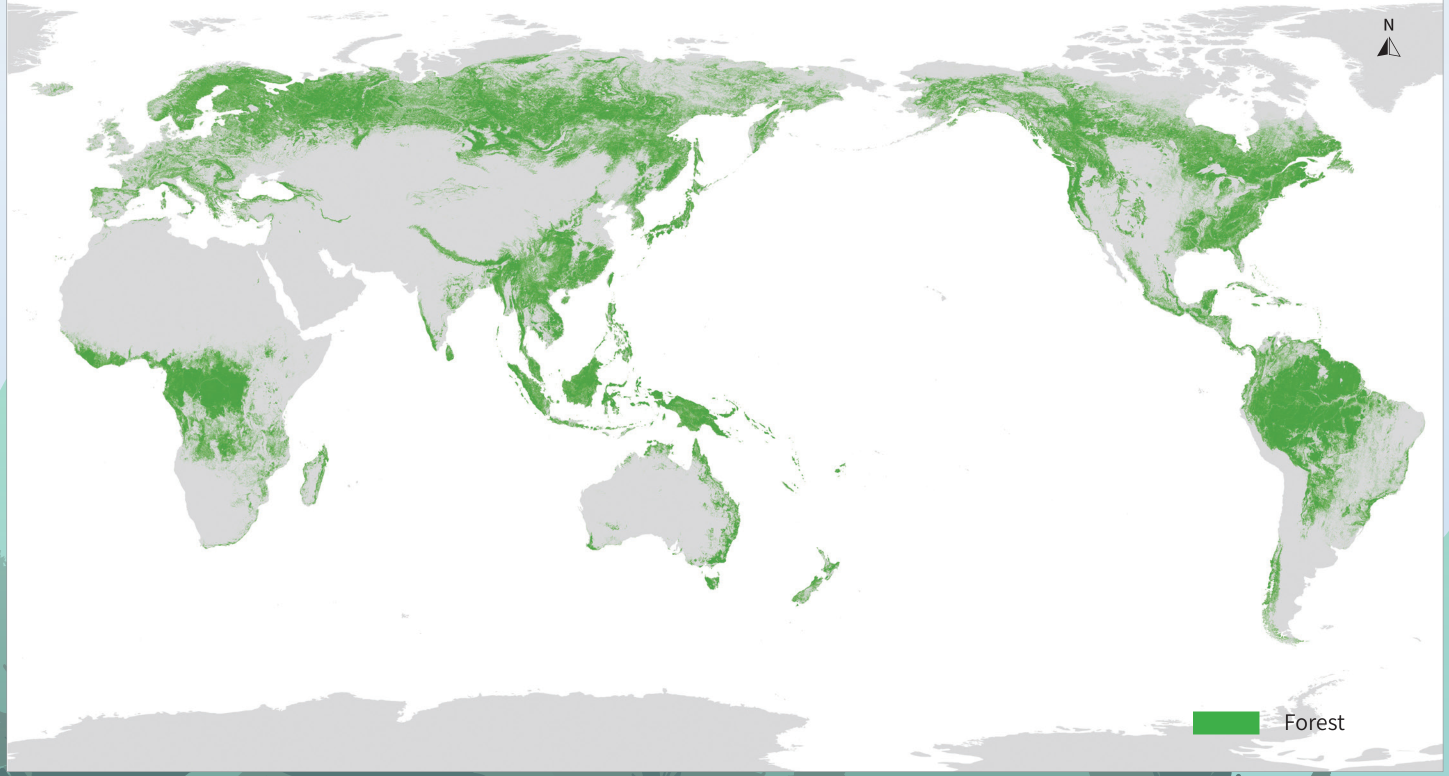
180° W–180° E

60° S–80° N

support SDGs

SDG 15.1.1, forest area as a proportion of total land area

Global 30-m map of forest cover in 2020



Method and data resources

The data sources of the product were acquired from the Landsat series, GF-1, and GF-6 satellites, and the product was generated based on global ecosystem partitions, multi-source sample data, and machine learning algorithms (Zhang et al., 2020).

Referring to the FAO Global Ecological Zones (GEZ) (FAO, 2000) map, the world was divided into different forest cover zones. Taking into account both spatial continuity and moderate size, the regions with good consistency of forest cover types and non-forest cover types were divided together. Finally, the global land was divided into 43 regions with consistent forest and non-forest characteristics.

The stratified random sampling method was used to obtain samples from multi-source data such as global flux sites and the global forest sample plot data of the Global Forest Dynamics Monitoring Network, and a total of 61,653 sample points were obtained. High-resolution satellite images such as GF-1, GF-2, GF-6 and QuickBird were used for validation.

Accuracy assessment

High-resolution satellite images such as GF and other related data products, combined with part of the field survey data, were used as reference data. A total of 39900 validation points were collected. The accuracy verification results showed that the overall accuracy of global forest cover products reached over 85%.

Product details

The product was projected in a geographic (Lat/Long) projection at 0.00025° (approximately 30-m resolution), with the WGS84 horizontal datum and the EPSG:4326 vertical datum. The results consist of 504 tiles of 10°×10°, and each tile contains about 40,000×40,000 pixels. The data format is GeoTIFF.

Each tile is coded according to the latitude and longitude shown in the upper left corner, with latitude in the front and longitude in the back. Latitude is two digits, with a prefix of N/S; longitude is three digits, with a prefix of E/W, where N is used at 0° latitude, and E is used at 0° longitude. Each tile file contains a layer in which the value of 1 represents forest and the value of 0 represents non-forest area.

Scientific Results:

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, of which, BRICS countries contributed 38.70%, with forest coverage reaching 36.15%, exceeding the global average.

The spatial distribution of global forests is uneven, with obvious distinctions from different climate zones. "Tropical forest" covers the largest area, accounting for almost half (47.40%) of the total global forest area, with the forest coverage of 29.54%. Although the forest area of the north frigid zone is only about a quarter of the world, the forest coverage is the highest, reaching 52.89%.

There are significant differences in the distribution of forests across the six continents (excluding Antarctica). Asia has the largest land area and the largest forest area, ranking fourth in the world in terms of forest coverage. Although the forest area of South America ranks second in the world, it has the highest forest coverage at 43.6%, which is related to the distribution of large areas of tropical rainforest in the Amazon Basin. The forest area of North America accounts for 19.78% of the globe, with a forest coverage of 32.68%.

Citation and disclaimer for data use

Users of this product shall clearly indicate the source as "Global 30-m spatial distribution of forest cover in 2020" in all forms of research output, including, but not limited to, published and unpublished papers, theses, manuscripts, books, reports, data products, and other academic output. The data producers are not responsible for any losses caused by the use of the data. The boundaries and marks used in the maps do not represent any official endorsement by or opinion of the data producers.

Dataset citations:

Xiaomei Zhang, Guojin He, Tengfei Long, et al. Global 30-m spatial distribution of forest cover in 2020 (GFC30_2020), Beijing: International Research Center of Big Data for Sustainable Development Goals (CBAS), 2022. doi: 10.12237/casearth.625e1760819aec2a46dcd2d8

References:

Zhang X, Long T, He G, et al. Rapid generation of global forest cover map using Landsat based on the forest ecological zones[J]. Journal of Applied Remote Sensing, 2020, 14(2):1.

QR code

Product URL

http://data.casearth.cn/thematic/brics_2022_china

Contact information

Xiaomei Zhang, xmzhang@cbas.ac.cn

The Sustainable Development Data Products for BRICS Countries

International Research Center of Big Data for Sustainable Development Goals

Address: No. 9 Dengzhuang South Road, Haidian District, Beijing

Postal code: 100094

Telephone: +86 10 82177601

E-mail: datasharing@cbas.ac.cn

Map Approval Number: GS（2022）1928

BRICS
2022 CHINA