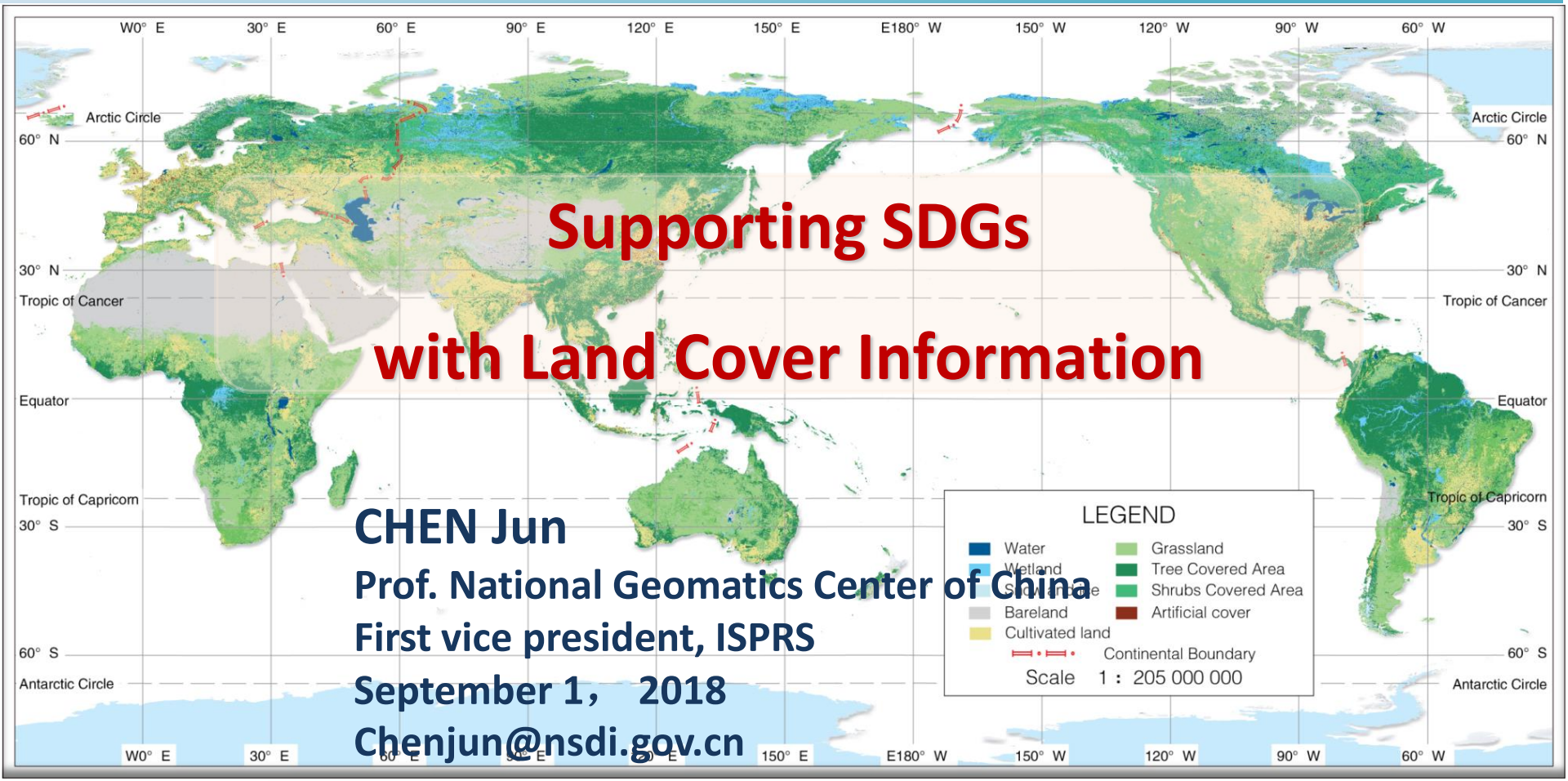
CAPACITY BUILDING FOR HIGH-RESOLUTION LAND COVER INTERCOMPARISON AND VALIDATION



Supporting SDGs

with Land Cover Information

CHEN Jun

Prof. National Geomatics Center of China

First vice president, ISPRS

September 1， 2018

Chenjun@nsdi.gov.cn

isprs information from imagery

POLITECNICO MILANO 1863

NGCC 国家基础地理信息中心 National Geomatics Center of China

WORLD BANK

REGIONAL CENTRE FOR MAPPING OF RESOURCES FOR DEVELOPMENT

Outlines

1. Introduction
2. GlobeLand30
3. Applications
4. Future Works

SDGs--Sustainable Development Goals

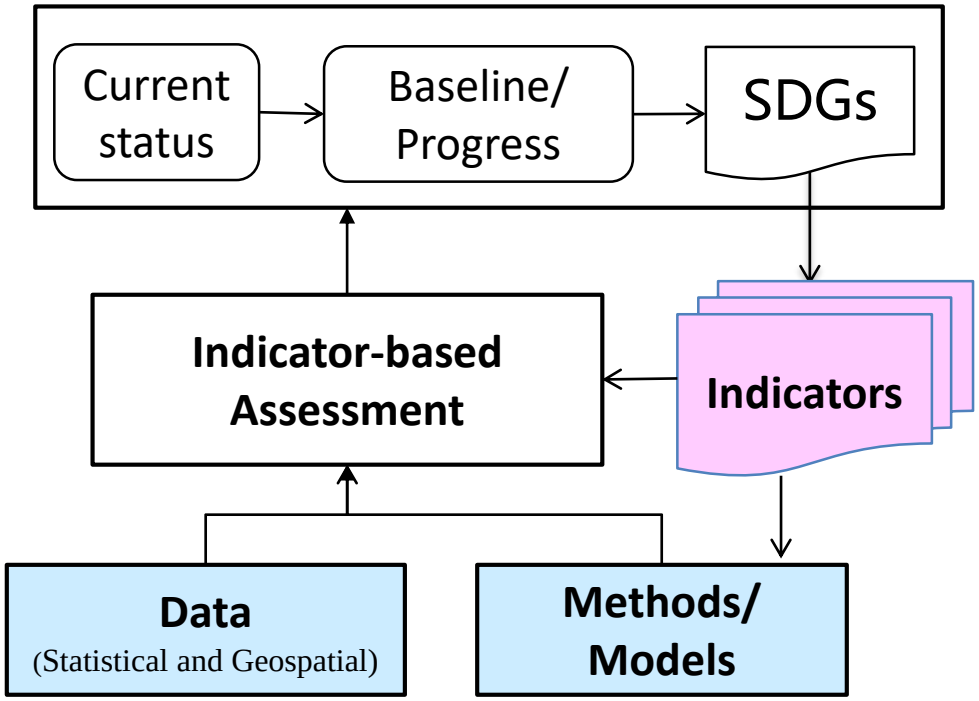
Nowadays, the Implementation and progress monitoring of 17 Sustainable Development Goals (SDGs) is a top priority for many UN member nations and international communities

Defined in the 2030 17 Sustainable Development Agenda adopted by United Nations Summit in Sept. 2015

- Economic growth, Social inclusion and Environmental protection.

Data-driven Monitoring

UN proposed to conduct a data-driven monitoring and evidence-based analysis using statistical/geospatial information



Three Key Challenges

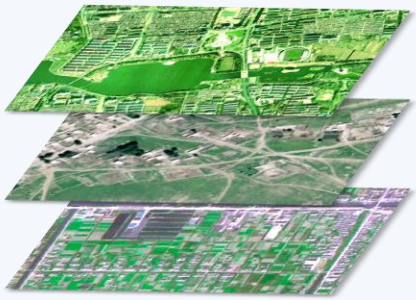
Items	Problem Description
1. Indicator framework	▪ Numerous indicators may not well describe 17 SDGs goals, and meta –data far from completed ▪ Global indicator framework must be tailored or localized at the country or local level
2.Computing methods	▪ No existing/agreed methods for about 80 indicators ▪ Approaches for comprehensive SDGs evaluation to be developed
3. Data availability	▪ Both Statistical and geospatial data as well as their integration needed ▪ Data and collection capacity is missing for many counties, especially developing countries

Geospatial Data for SDGs

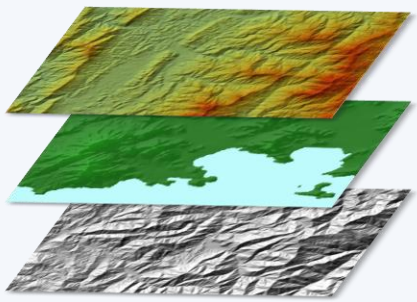
In principle, reliable geospatial data be collected by each member nation with a set of technical requirements, such as spatial resolutions, thematic accuracy and temporal periodicity)

Example of core geospatial data

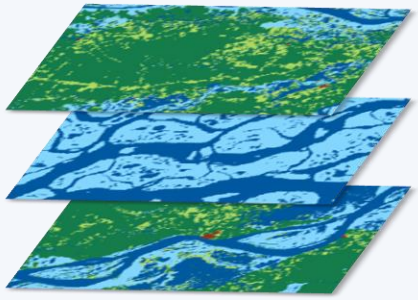
Maps



Imagery



DEM



Land Cover

One possible solution is to utilize global (international) data to augment or even provide the data rs

Contribution of Global Data

UN IAEG-SDGs:WGGI examined possible contribution of global data and discussed its role as well as utilization

National data

- Official data products generated by authoritative agencies of a nation
- Covering the nation's territory

Global Data

- Developed by international/national organizations and even private companies
- covering the whole earth or large regions with higher consistency across space

- as Supplementing National Data
- Covering Trans-boundary or Cross-border areas
- supporting the preparation of global reporting.

Utilisation of Global Data

There are several issues to be considered when selecting suitable global data for use in the computation of SDG indicators and national reporting:

- Data quality – validation and inter-comparison
- Data augmentation
- Disaggregation and aggregation

Outlines

1. Introduction
2. **GlobeLand30**
3. Applications
4. Future Works

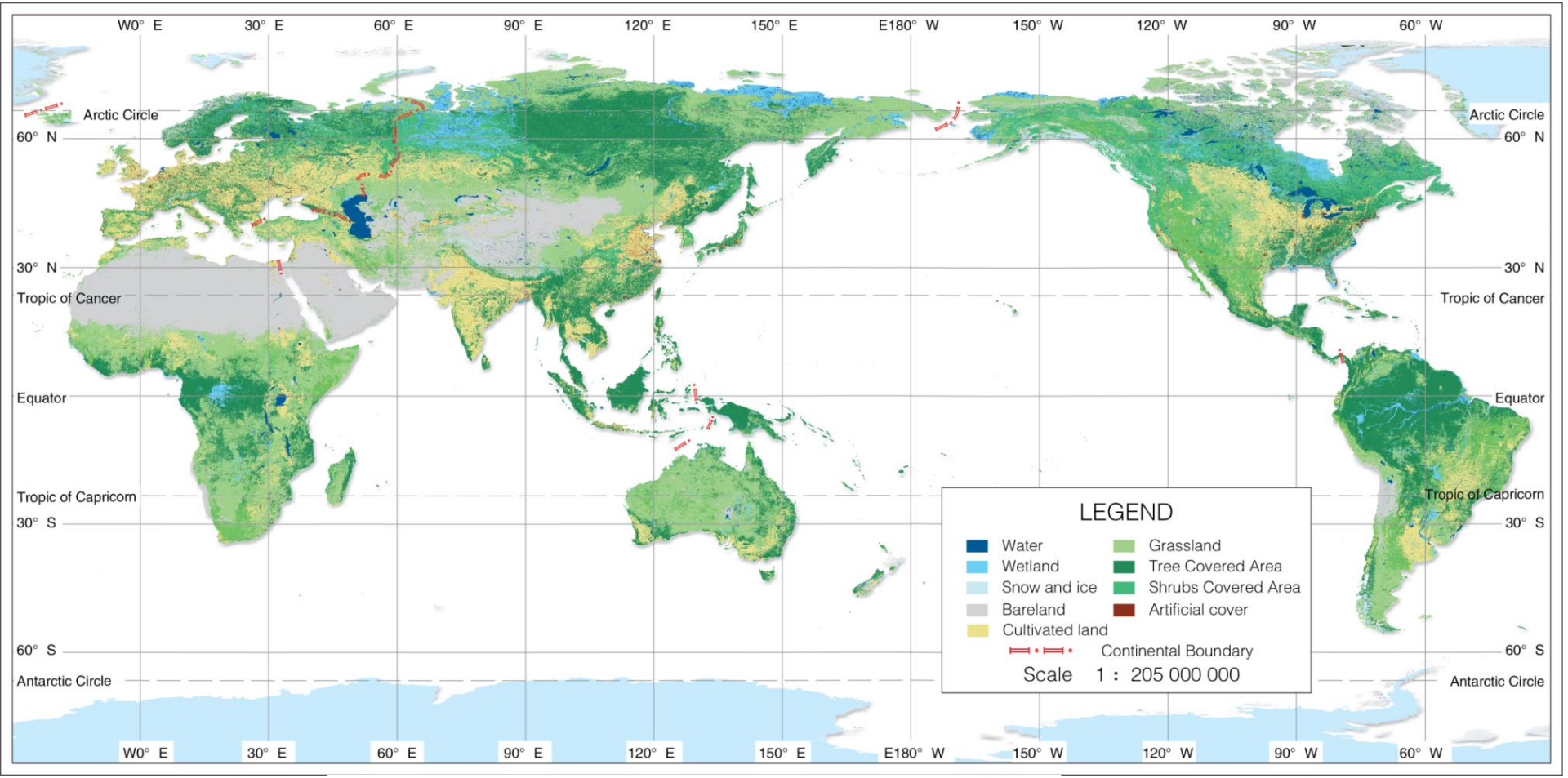
Global Land Cover Data

Global land cover mapping has witnessed significant progress in spatial and temporal resolutions, as well as thematic accuracy,

Global Land Cover data sets with fine resolution

Product	Spatial resolution	Coverage of years	Contents/ accuracy
GlobeLand30	30 m	2000, 2010, 2015	10 classes/ 80.3%
Global tree cover	30 m	Annual (2000-)	One class(forest)/
ESA Land Cover CCI	300 m	1998-2002, 2003-2007 and 2008-2012	22 classes/ 74%(2008-2012)

GlobeLand30

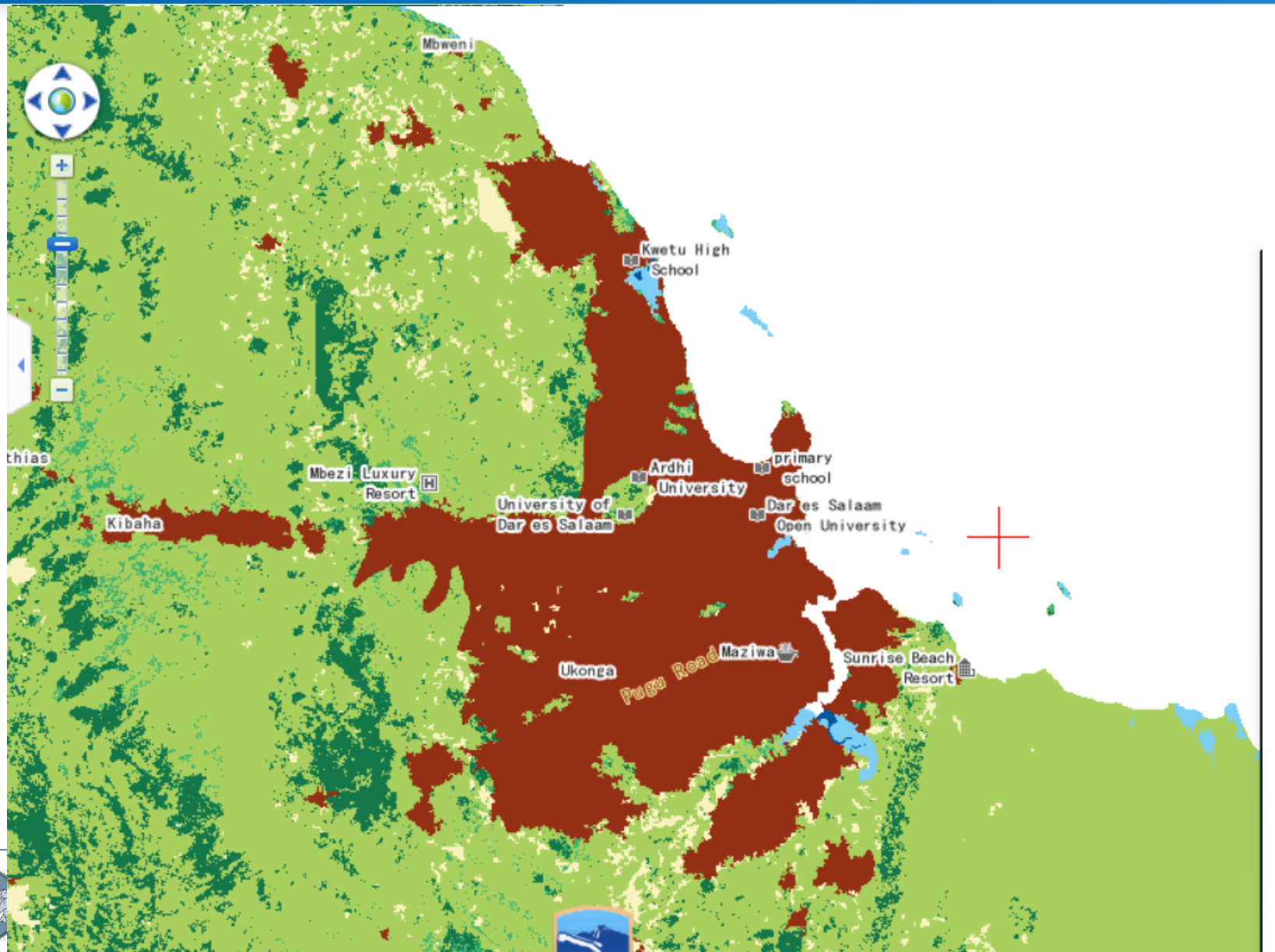


Chen Jun, et.al., 2014, Nature, 514:434, Oct. 2014

GlobeLand30- 10 Classes

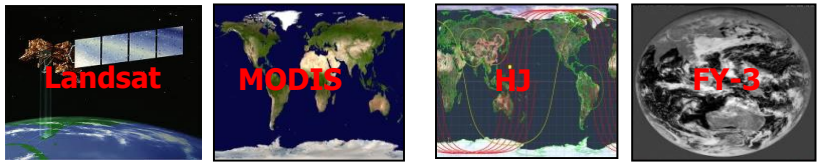
Code	Type	
10	Arable land (Cropland)	dry land, paddy field, Land for greenhouses, vegetable field, Artificial Tame Pastures, economic cropland which is planted shrub crop or herbaceous crop, abandoned by the land reclamation of arable land
20	Forest	broadleaved deciduous forest, evergreen broad-leaf forest, deciduous coniferous forest, evergreen coniferous forest, mixed broadleaf-conifer forest
30	Grassland	typical grassland, meadow grassland, alpine grasslanddesert grassland, grass
40	Shrubland	desert scrub, mountain scrub, deciduous and evergreen shrubs
50	Wetland	lake swamp, river flooding wetlands, seamarsh, shrub/forest wetlands, mangrove forest, tidal flats/salt marshes
60	Open Water	lake, reservoir/fishpond, river
70	Tundra	brush tundra , poaceae tundra, wet tundra , bare tundra , mixed tundra
80	Artificial Cover	settlement place, industrial and mining area , traffic facilities
90	Bare Land	saline-alkali land , sand, gravel, rock , microbiotic crust
100	Perm.snow & Glac.	permanent snow, ice sheet and glacier

Tanzania


Mbweni
Kwetu High School
Mbezi Luxury Resort
Kibaha
University of Dar es Salaam
Ardhi University
primary school
Dar es Salaam Open University
Ukonga
Pugu Road
Maziwa
Sunrise Beach Resort

POK-based Operational Mapping

development and delivery of reliable data products within a pre-defined time schedule

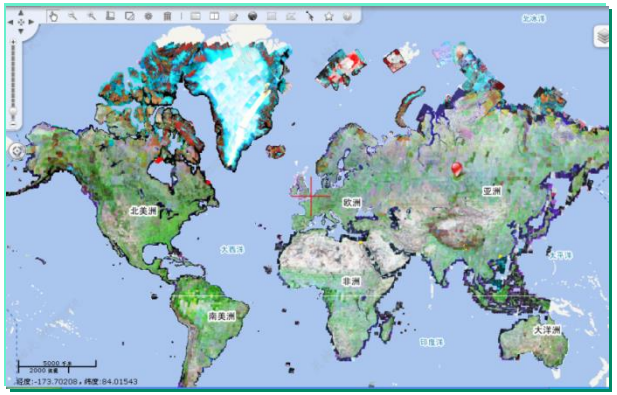


30m Imagery (2000)

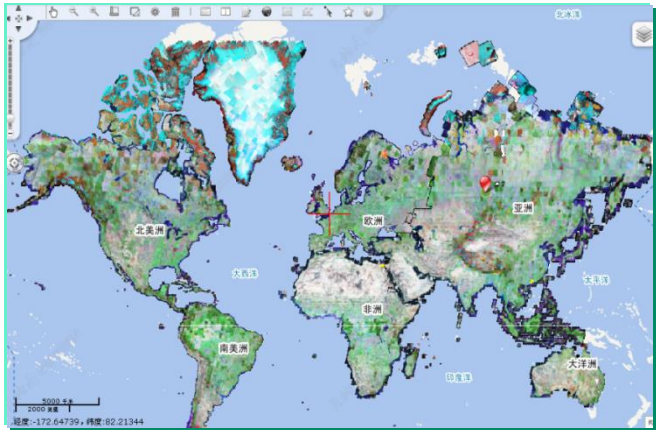
30m Imagery (2010)

Image classification

GlobeLand30 (2000/2010)



2000-10270 Landsat scenes

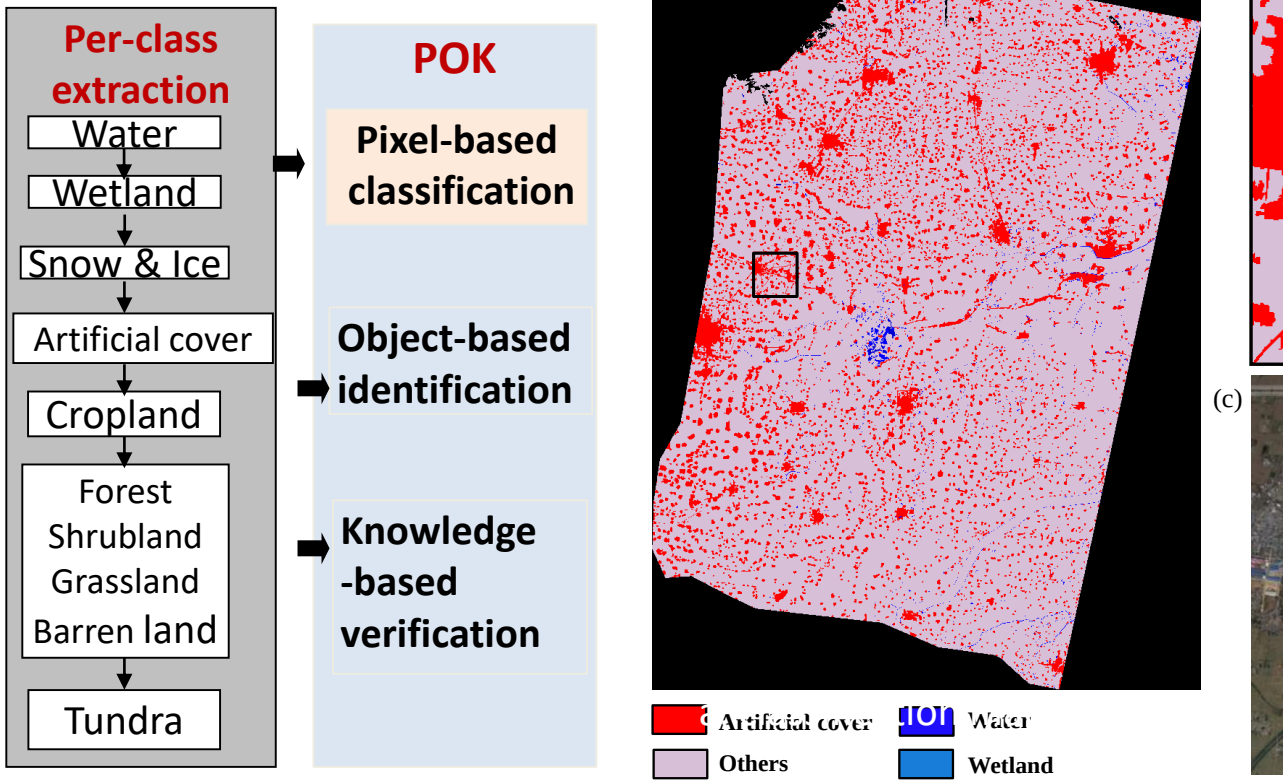


2010- 9907 Landsat scenes

- 2640 Chinese HJ scenes

POK-based Operational Mapping

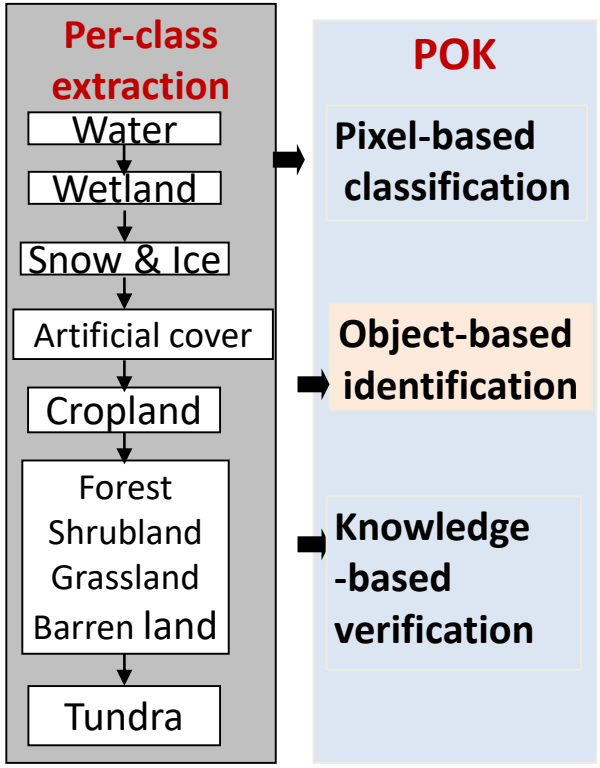
Develop and deliver reliable data products

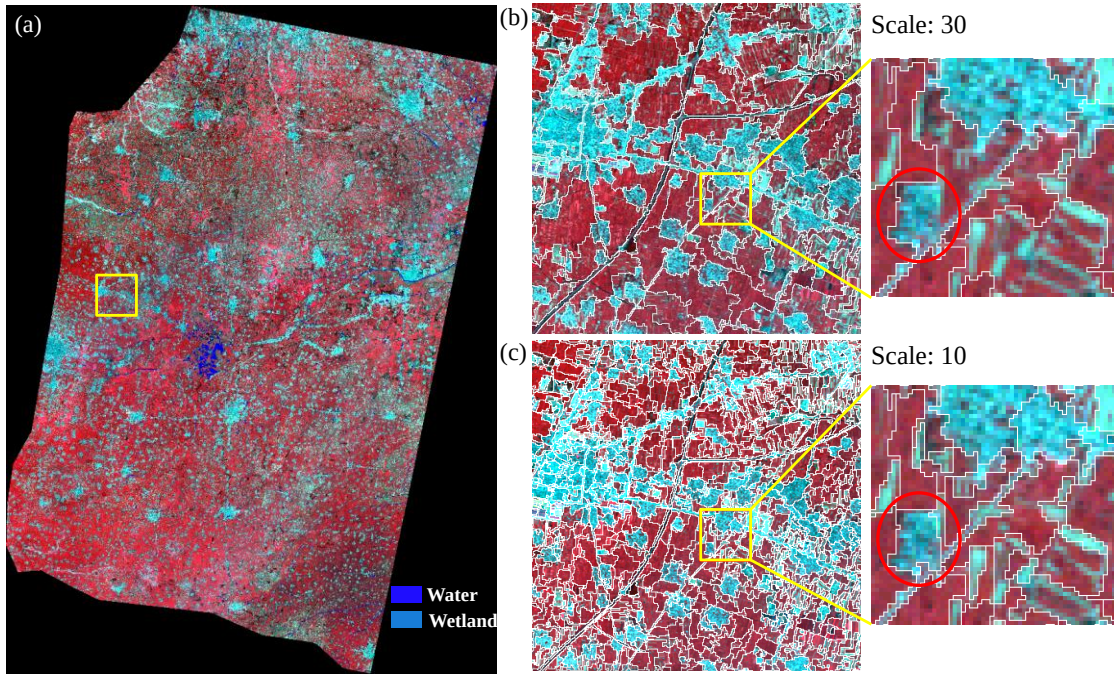


Chen Jun, et.al., 2015. Global Land Cover Mapping at 30m Resolution: a POK-based Operational Approach，ISPRS Journal of Photogramme try and Remote Sensing , 103 (2015): 7-27

POK-based Operational Mapping

Develop and deliver reliable data products



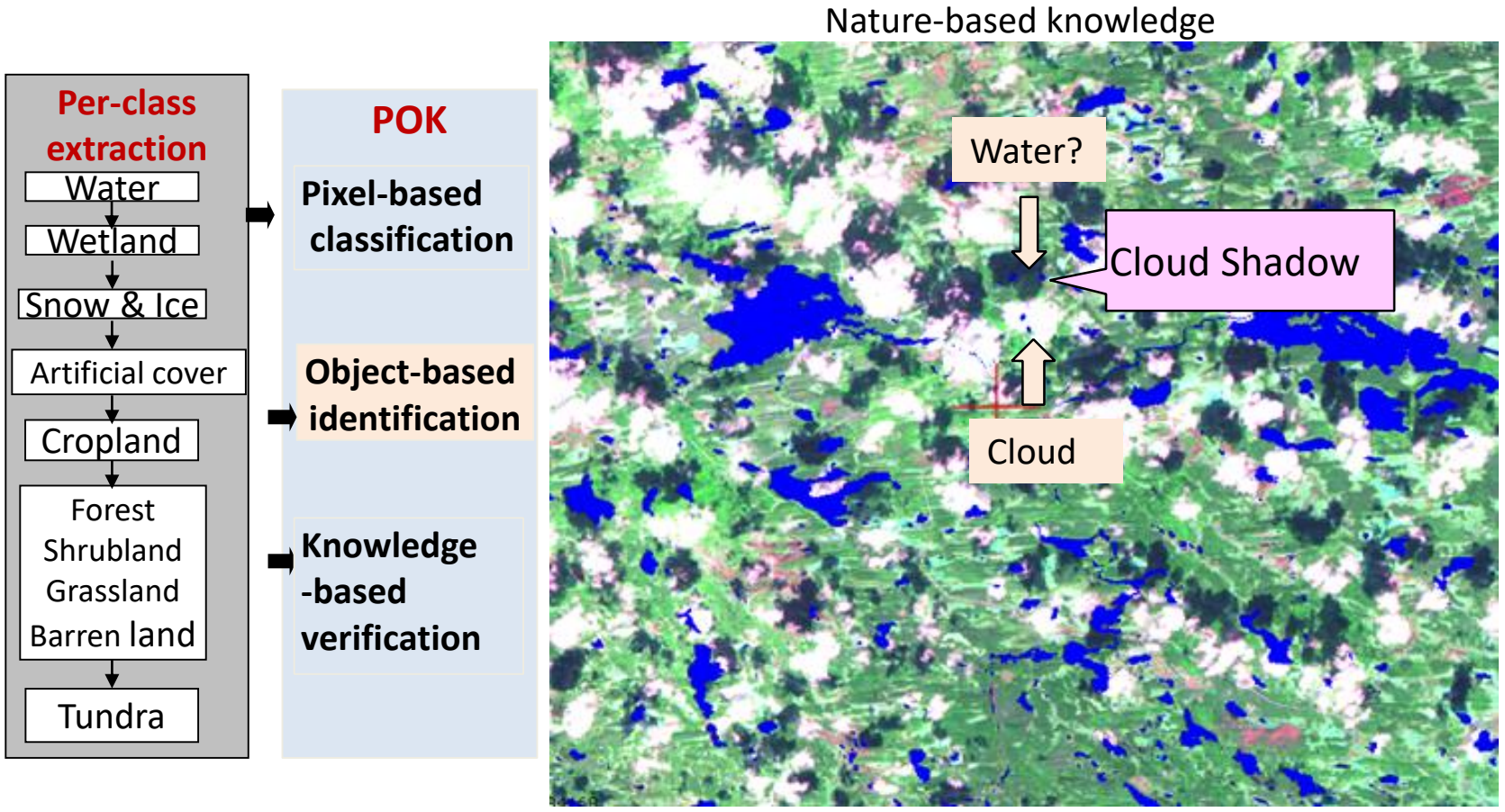


a. Landsat image b. Segmentation of sub-image with large scale;
c. Segmentation of sub-image with small scale)

Chen Jun, et.al., 2015. Global Land Cover Mapping at 30m Resolution: a POK-based Operational Approach，ISPRS Journal of Photogramme try and Remote Sensing , 103 (2015): 7-27

POK-based Operational Mapping

Develop and deliver reliable data products



Chen Jun, et.al., 2015. Global Land Cover Mapping at 30m Resolution: a POK-based Operational Approach，ISPRS Journal of Photogramme try and Remote Sensing , 103 (2015): 7-27

Preliminary Separate Validation

Some separate and independent accuracy assessments of some 30-m products have being made

regional	Sample size	accuracy	Investigators	sources
Water ,N. Europe		91%	ETH/IIASA	GIM, Dec., 2014

Country/area	Accuracy	Sources
Germany	92%	Int. J Digital Earth, 2016(on line)
Greece(Thessaly Region)	91%	Land, 2015, 4,1-18
Iran(6 study sites)	77.9%	Habitat International,2016,1-7
Italy(8 areas)	>80%	Remote Sensing, 2015(7), 2107-2122
China	82.3%	ISPRS J P&RS， 2017

Brovelli M A, Molinari M E, Hussein E, et al. The first comprehensive accuracy assessment of GlobeLand30 at a national level: Methodology and results[J]. Remote Sensing, 2015, 7(4): 4191-4212.

GEO-led Validation

25 GEO members and 15个others（UN-GGIM、CO-DATA）joined the activities

GROUP ON
EARTH OBSERVATIONS

Our Ref: 2016-13/GEO/Land Cover
Encl.: 2
ct

GEO Principals

Geneva, 22 January 2016

Dear GEO Principals,

The GEO Secretariat wishes to extend an invitation to GEO Members and Participating Organizations to participate in the Data Validation of Global Land Cover (GLC) Datasets activity.

Land Cover is an important dataset for both the GEO community and the UN Sustainable Development Goals (SDGs). To improve land cover quality and make more efficient use of existing resources and talent, partners of the GEO Global Land Cover Task (SB-02) have proposed to organize an effort titled, "Validation of Global Land Cover Datasets at 30m Resolution." The proposed validation scheme, its procedures, and many of the web-based tools have already been developed and are available to the entire community. Please find attached 1) a proposed GLC validation timeline and 2) the draft technical specification for the international validation of GLC products. Once the approach and toolset is implemented these will be available for validation of any global or large regional land cover datasets that arise in the future.

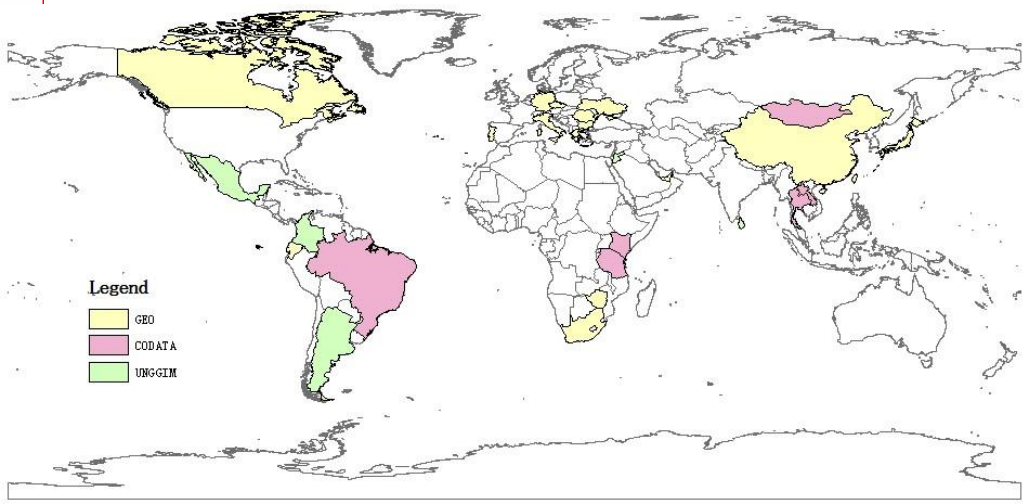
The focus of this activity is twofold. First, to develop a generic and coordinated approach and toolset for validating land cover data. The second is to employ the approach and tools so that validation of existing datasets can begin in a more harmonized manner. The proposed work will be initiated in early 2016 so that progress can be presented at the GEO-XIII Plenary in 2016.

If you have ongoing efforts in land cover, and/or are interested in strengthening these global validation efforts, please nominate a representative to join these validation activities by 15 February 2016, by contacting Dr Lijun Chen (chenlj@nsdi.gov.cn) (with a copy to secretariat@geosec.org). Of course please feel free to provide any thoughts or feedback you might have on the process by the same due date.

We look forward to this collaborative effort and thank you very much in advance for your consideration of this invitation.

Yours sincerely,

Barbara J. Ryan
Secretariat Director



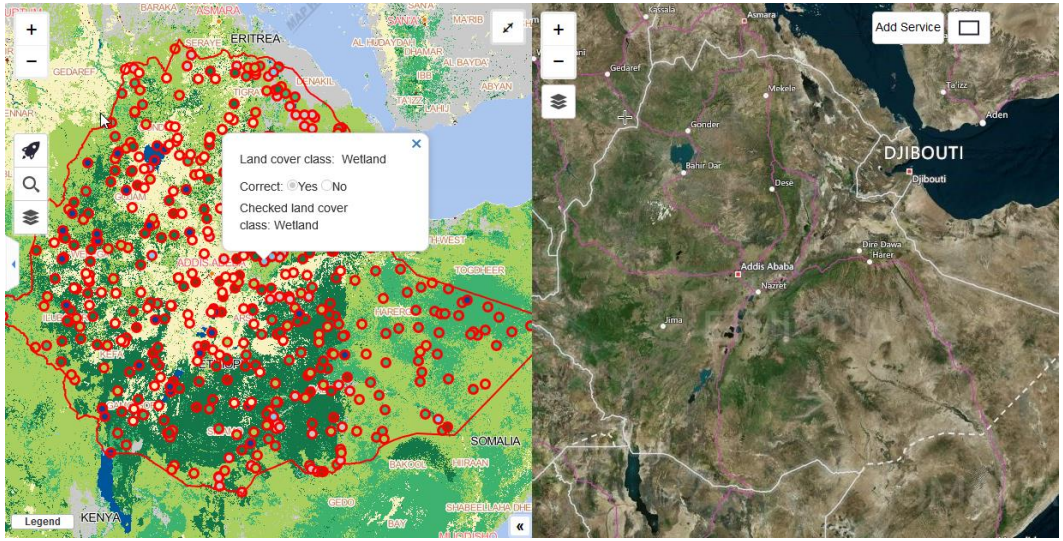
GEO-led Validation

Validation at 30-m is facing a number of challenges, such as high spatial heterogeneity of land cover in large areas and their impact on the sampling design and labeling.

Technical Specification

Table of Contents

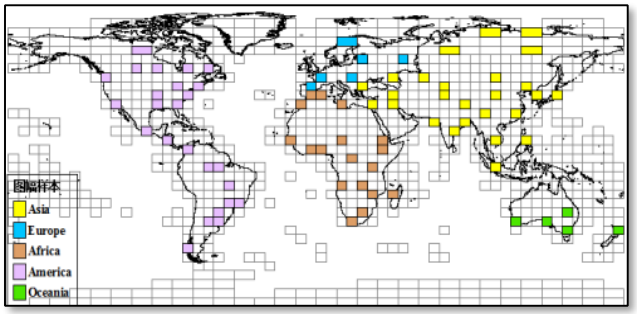
On-line Tool(s)



GEO-led Validation- Practices

1. two-rank sampling-based global validation

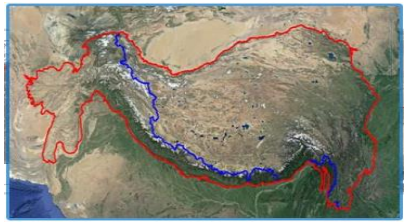
159,143 samples

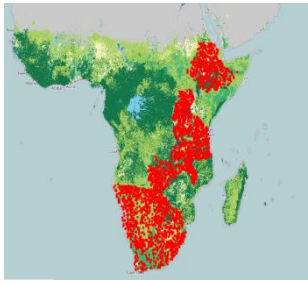


83.51%

2. LSI sampling-based validation (2 regions/ 17 countries)

6,714 samples





75.83%

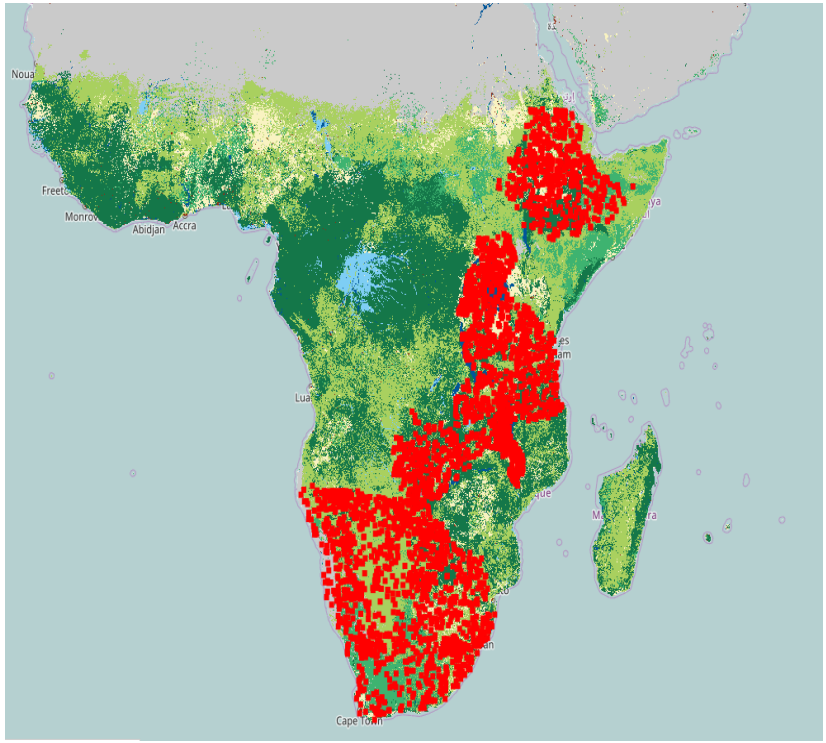
3.Big data based validation

37,140 samples

65.88%

Validation in Africa

RCMRD organized the validation in 10 countries with LSI sampling



3372 sample points

	Country	Sample number	Overall accuracy	Kappa
1	Botswana	399	88.94%	0.86
2	Ethiopia	499	87.58%	0.85
3	Lesotho	109	79.82%	0.73
4	Malawi	237	84.39%	0.81
5	Namibia	400	91.85%	0.90
6	Rwanda	96	77.08%	0.71
7	South Africa	500	93.61%	0.92
8	Tanzania	500	80.99%	0.77
9	Uganda	239	81.99%	0.78
10	Zambia	400	80.25%	0.76

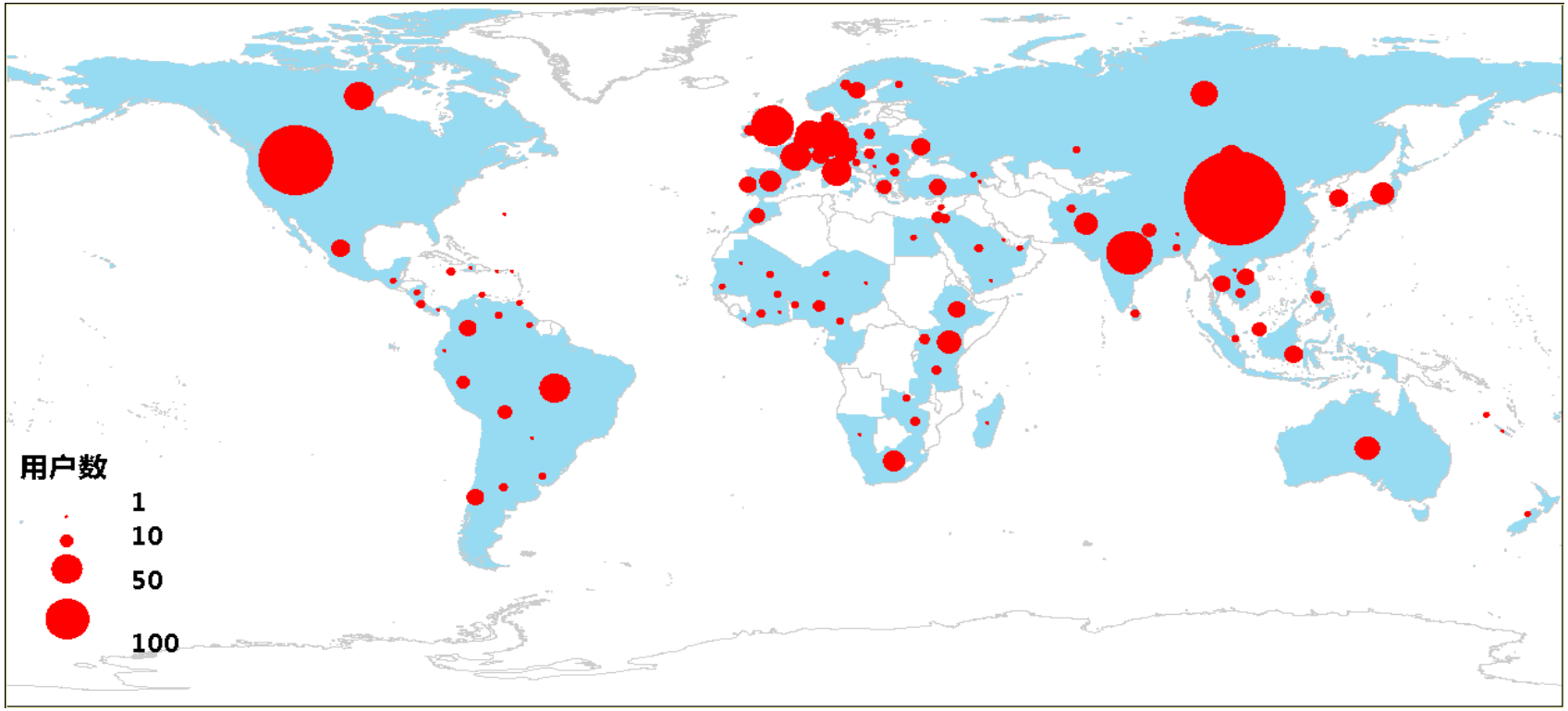
Chen F, Chen J, et al. A landscape shape index-based sampling approach for land cover accuracy assessment[J]. Science China Earth Sciences, 2016, 59(12): 2263-2274.

Outlines

1. Introduction
2. GlobeLand30
3. Applications
4. Future Works

Users Distribution of GlobeLand30

More than 130 countries and about 10,000 users

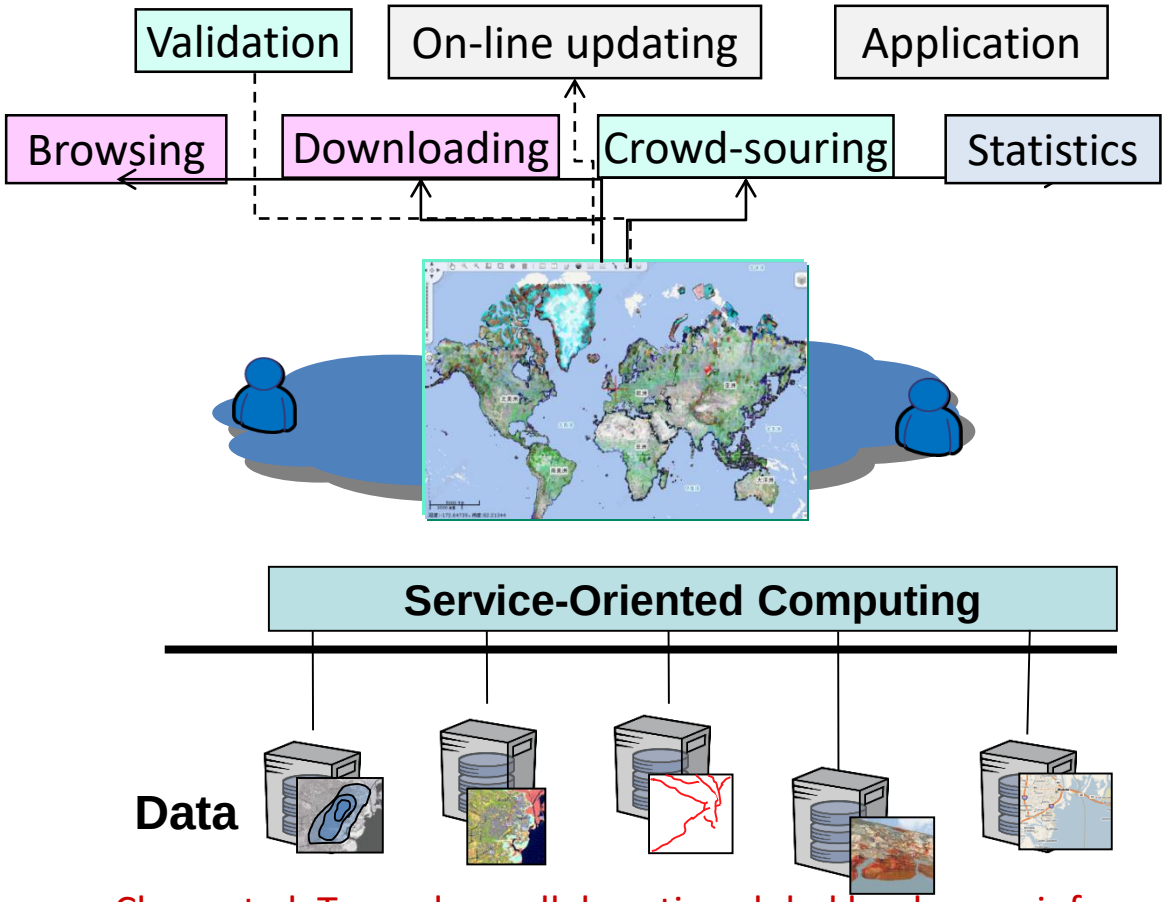


Chen et al., 2017. Analysis and Applications of GlobeLand30: A Review , ISPRS Int. J. Geo-Inf. 2017, 6, 230; doi:10.3390/ijgi6080230

GlobeLand30 Service Platform

Chen et al. Towards a collaborative global land cover information service[J]. International Journal of Digital Earth, 2017, 10(4): 356-370.

GlobeLand30 Service Platform

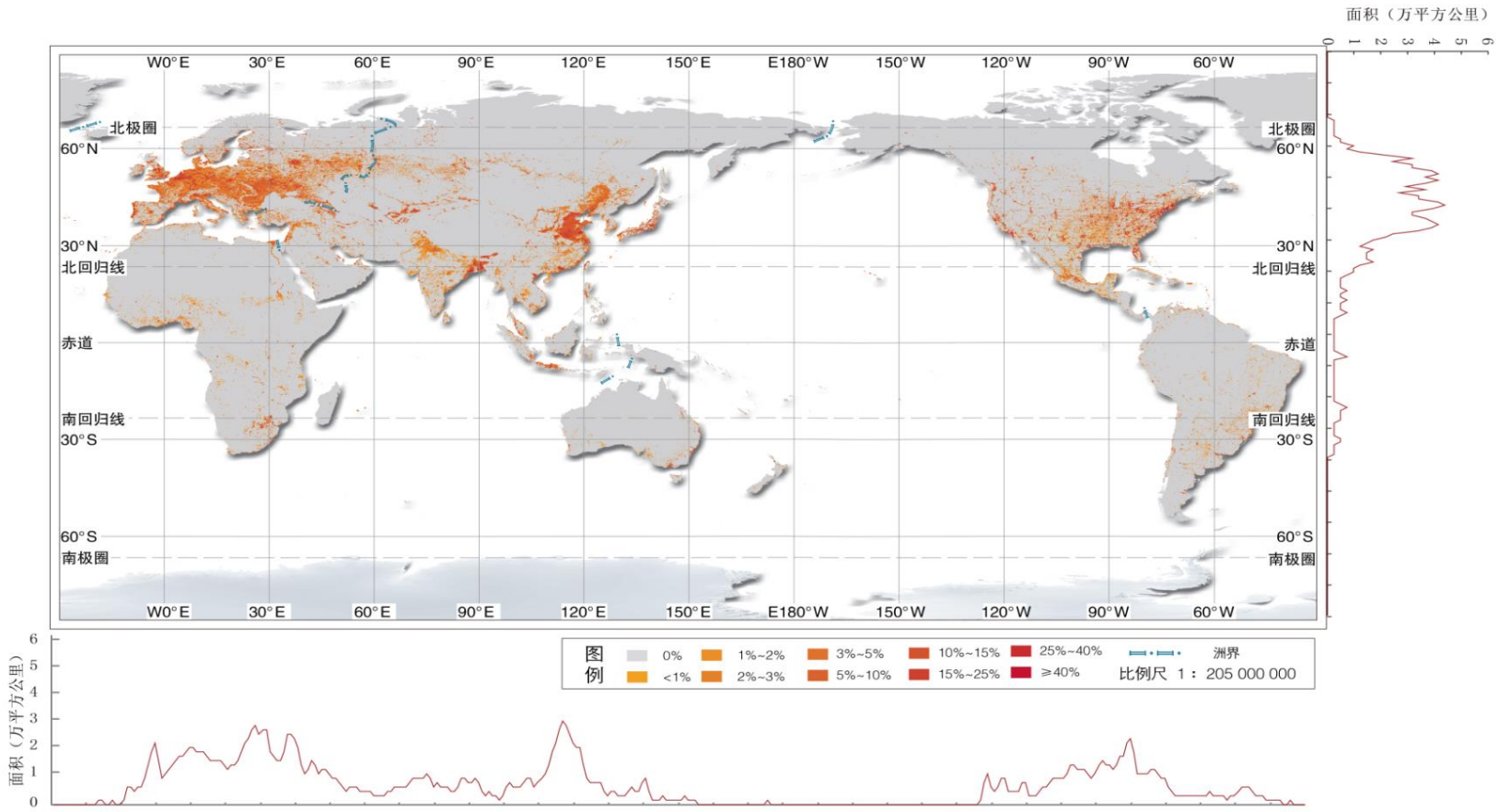


www.globeland30.org

- Providing on-line geo-tagging, updating, validation and value-added applications
- Enabling easier and more efficient data sharing and information service

Chen et al. Towards a collaborative global land cover information service[J]. International Journal of Digital Earth, 2017, 10(4): 356-370.

Global Artificial Surface Analysis



Chen J, et al. 2015. Spatial distribution and ten years change of global built-up areas derived from GlobeLand30. Acta Geodaetica et Vartographica Sinica, 44(11), 1181-1188.

Global Artificial Surface Analysis

Country/ Region	Area in 2000 (10,000 km2)	Area in 2010 (10,000 km2)	Variation Rate （%）	Increase Proportion （%）
China	14.49	16.10	11.17	28.17
U.S.A	22.38	23.56	5.26	20.48
Russia	9.50	9.83	3.46	5.73
Mexico	2.32	2.50	7.87	3.18
India	4.90	4.99	1.79	1.53
Brazil	3.18	3.24	1.83	1.01
Japan	2.50	2.54	1.55	0.67
France	2.86	2.90	1.29	0.64
Germany	3.02	3.02	0.03	0.01
Ukraine	4.09	4.09	<0.01	<0.01

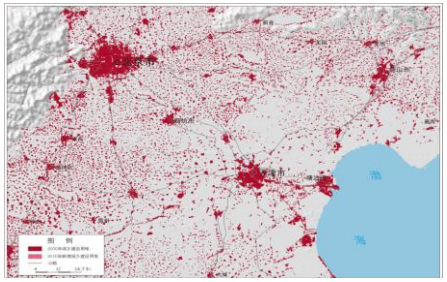
- Total area in 2010: 1.1875 million km2 (0.9% of earth land surface)
- Increase from 200-2010: 57,400km2 (rate of 5.08%. Asia- 43.55%, and Africa 4.81%
- USA and China are the largest and 2nd countries

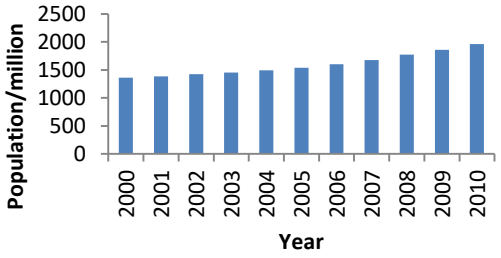
Chen J, et al. 2015. Spatial distribution and ten years change of global built-up areas derived from GlobeLand30. Acta Geodaetica et Vartographica Sinica, 44(11), 1181-1188.

Indicator 11.3.1 at Global Scale

11.3.1 **Ratio of land consumption rate to population growth rate**

Land consumption (artificial surface)



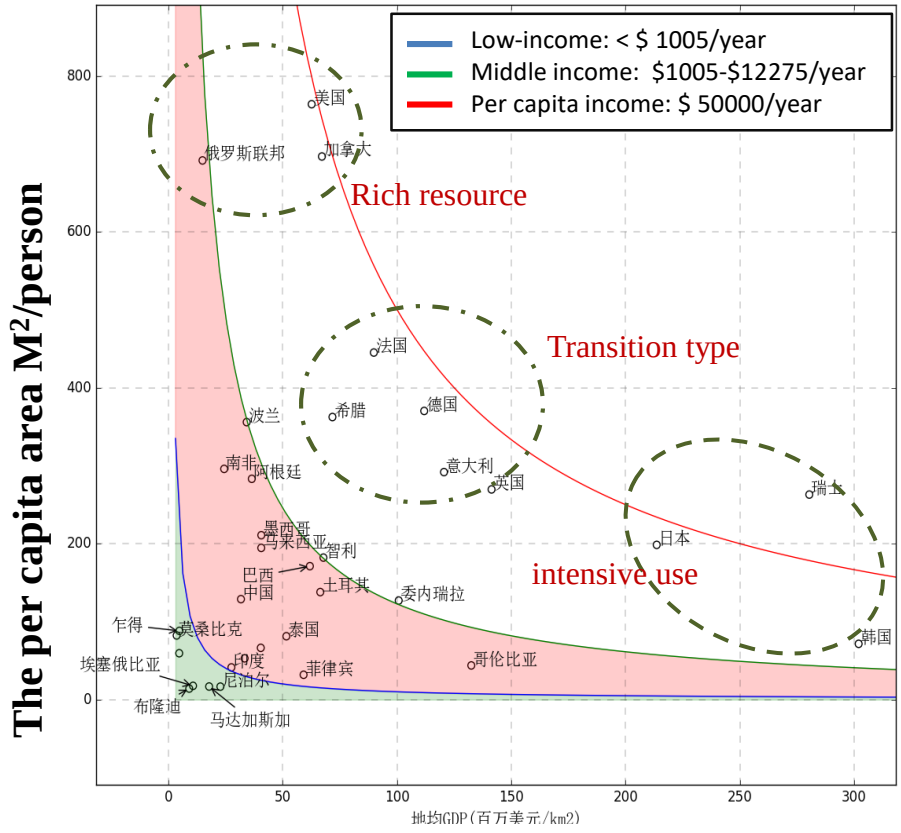


序号	Country	Urb_t (10^2km^2)	Urb_(t + n) (10^2km^2)	LCR (%)	Pop_t (万人)	Pop_(t + n) (万人)	PGR (%)	R
1	Korea	35.00	35.10	0.03	4700.81	4941.04	0.50	0.06
	Laos	10.00	10.10	0.10	534.29	626.05	1.59	0.06
	Switzerland	18.00	18.10	0.06	718.42	782.49	0.85	0.06
2	France	286.10	290.00	0.14	6091.25	6502.75	0.65	0.21
	DR Congo	40.00	50.00	0.69	4804.86	6593.87	3.17	0.22
3	UK	164.90	170.00	0.30	5889.25	6276.63	0.64	0.47
	Algeria	28.00	30.00	0.69	3118.36	3603.61	1.45	0.48
	Nigeria	74.00	84.00	1.27	12287.67	15942.47	2.60	0.49
	Botswana	12.00	13.00	0.80	173.66	204.78	1.65	0.49
4	Czech	51.00	52.00	0.19	1025.51	1047.44	0.21	0.92
	Namibia	7.00	8.00	1.34	189.79	219.36	1.45	0.92
	Honduras	5.90	7.10	1.71	624.31	750.38	1.84	0.93
	Norway	24.00	26.00	0.80	449.09	488.92	0.85	0.94
5	Peru	20.00	23.00	1.40	2591.49	2937.36	1.25	1.12
	Thailand	42.00	45.00	0.69	6269.33	6669.20	0.62	1.12
	Gana	21.00	28.00	2.88	1882.50	2431.77	2.56	1.12
6	Japan	250.00	254.00	0.16	12684.30	12807.00	0.10	1.65
	China	1451.00	1600.00	0.98	126264.50	133770.50	0.58	1.69

Indicator 11.3.1 at Global Scale

11.3.1 **Ratio of land consumption rate to population growth rate**

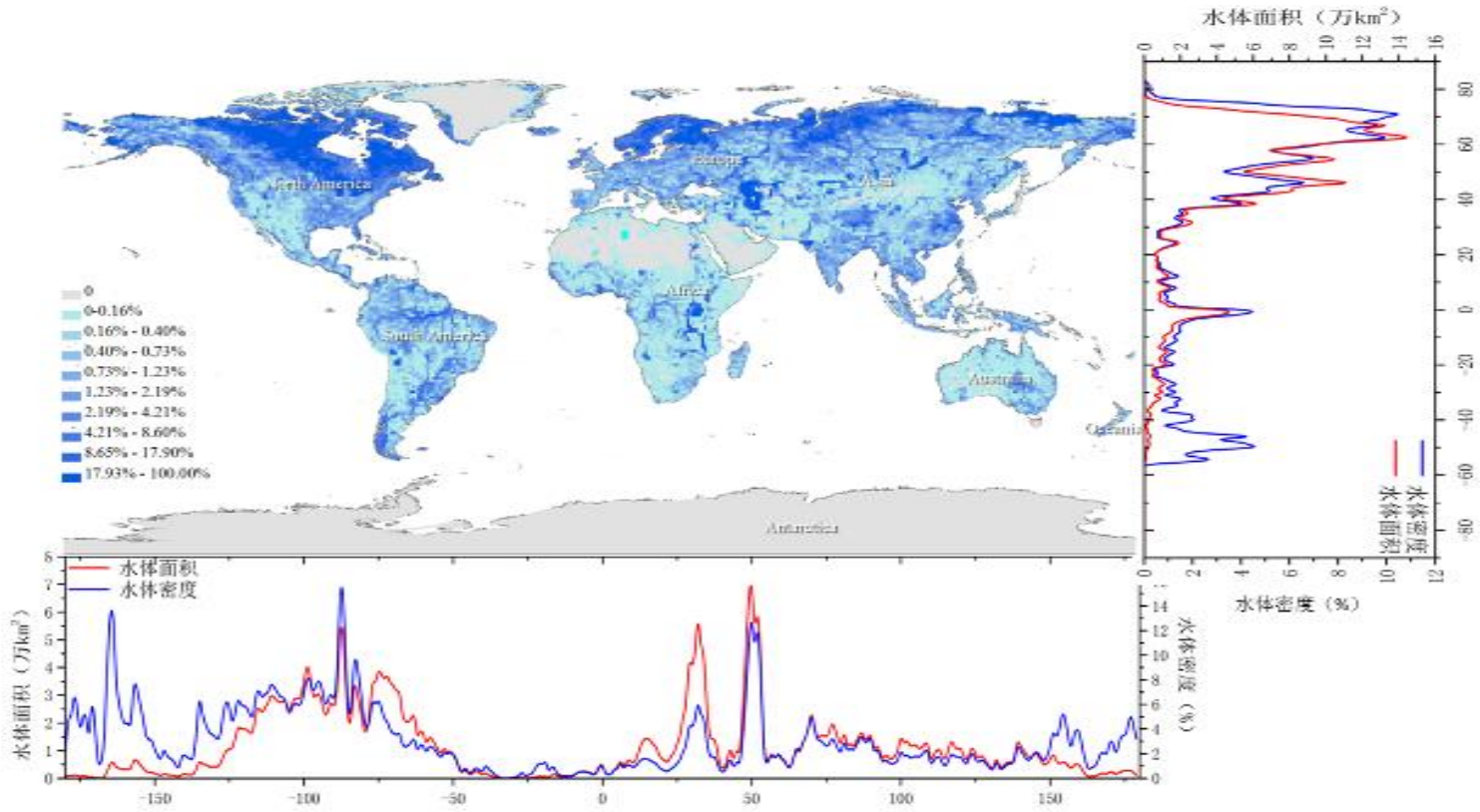
Structural difference of resource utilization



The **per capita GDP** million dollar/km^2

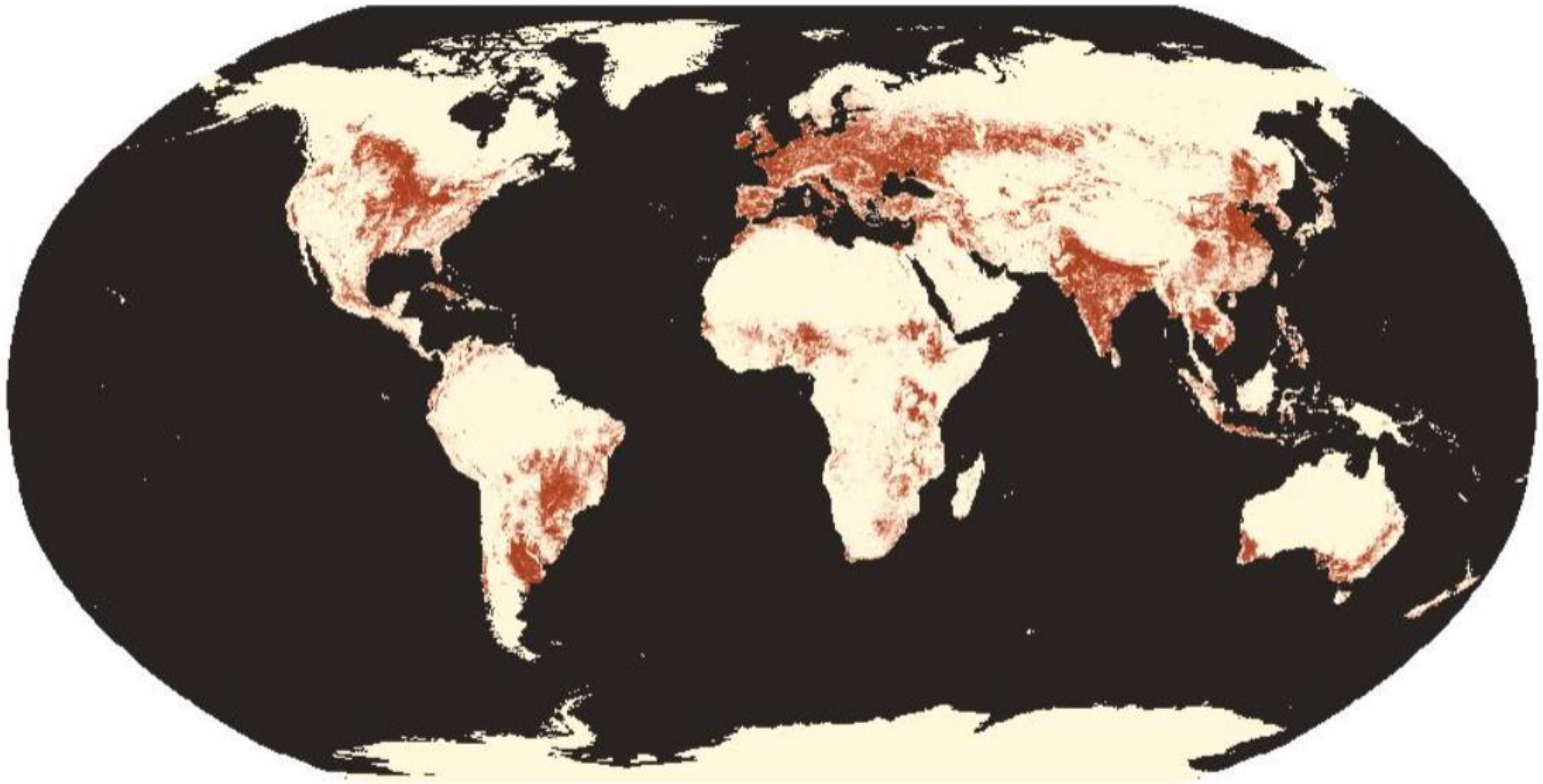
Li et al. Spatio-temporal pattern analysis of aritificial surface use efficiency based on Globeland30 (in Chinese). Scientia Sinica Terrae, 46, 1-10.

Global Land Surface Water Analysis



Cao X, et al. 2014. Preliminary analysis of spatiotemporal pattern of global land surface water. Science China: Earth Sciences, 57:2330–2339

Global CropLand Analysis



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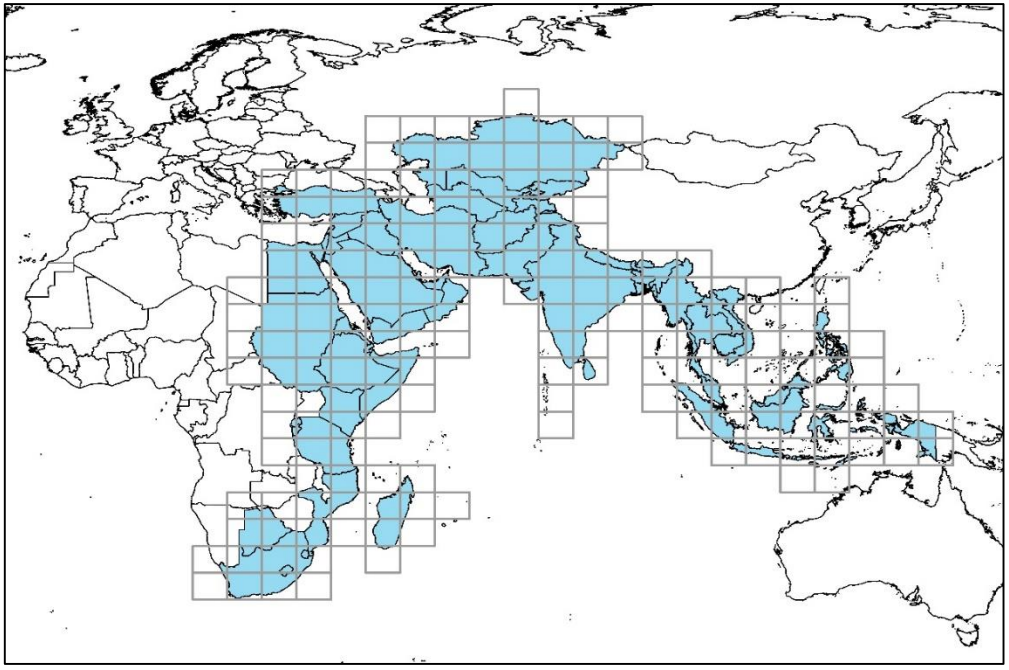
Continuous Updating of GlobeLan30

The 2015 version of GlobeLand30 is under preparation and about 3,000km2 was completed in 2017

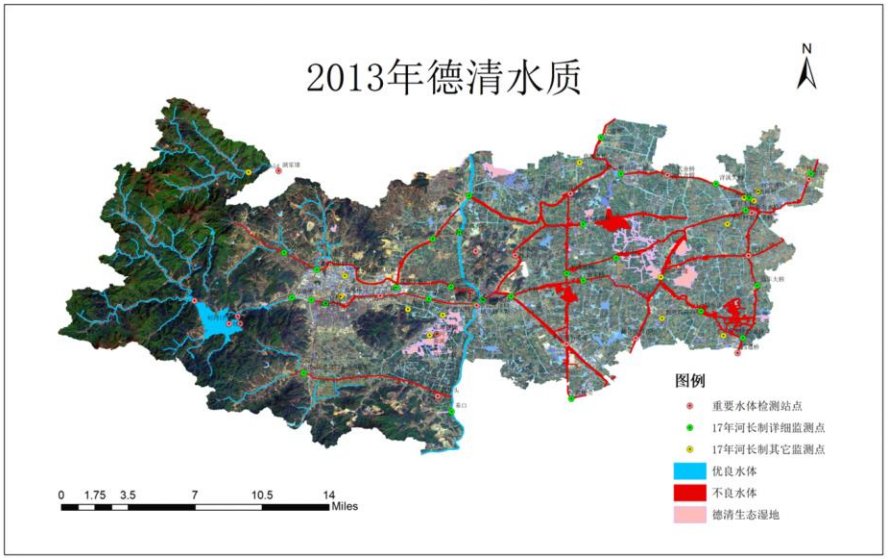


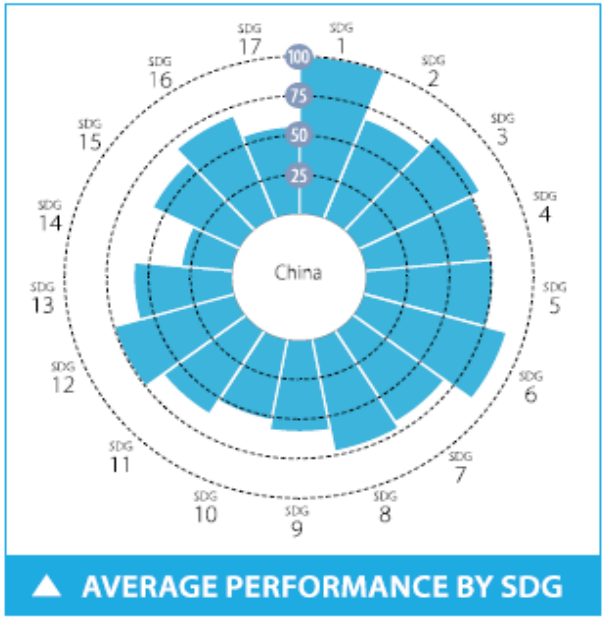
- ASEAN(10 Countries)
- South Asia(8Countries)
- Central Asia (5 Countries)
- Western Asia(15 Countries)
- Eastern Africa (18 Countries)

- Encourage and support national authorities to join the validation and even production of the international (global) data

Monitoring Progress towards SDGs

Deqing Case - venue of the 1st UN World Geospatial Information Congress





(1) how to measure and monitoring using geospatial- statistical data

(2) How is SDGs implemented in this region?

Thanks for Your Attention!

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