Role and Utilization of International (Global) Data

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May12, 2017, Kunming

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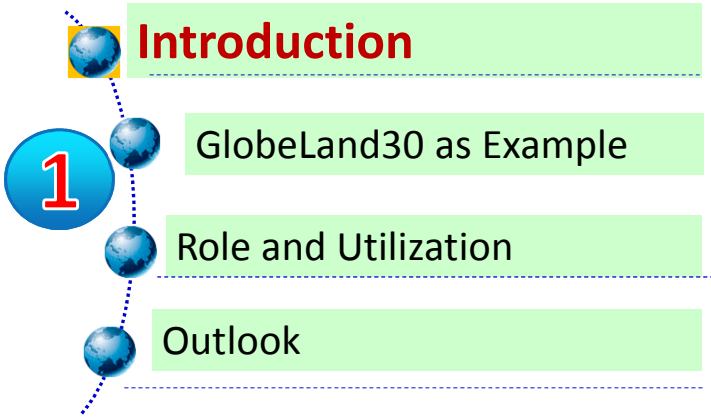
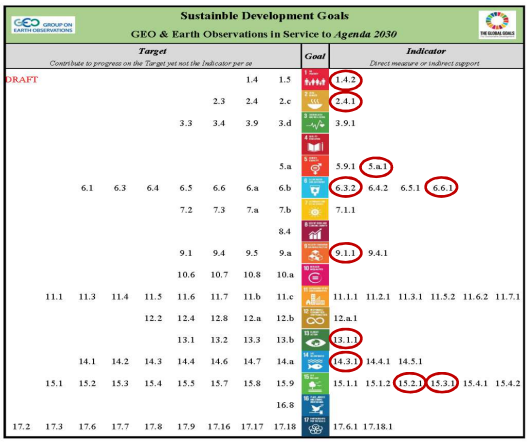


Geospatial Data for SDGs

A number of SDG indicators may be measured using geospatial data and their integration with statistical data.



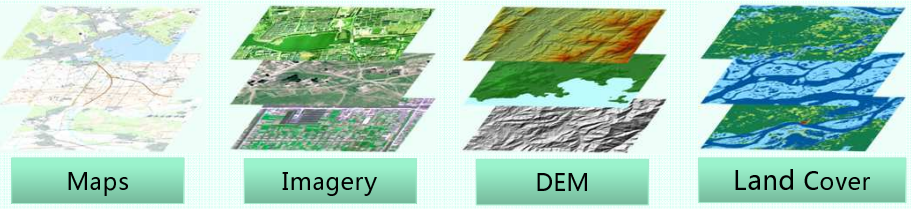
Obtaining reliable geospatial data is becoming crucial for preparing national reports and global reporting.

Geospatial Data for SDGs

In principle, reliable geospatial data be collected by each member nation with a set of technical requirements.

(i.e., spatial resolutions, thematic accuracy and temporal periodicity)

Example of core geospatial data



Some countries may have a shortage of these core data, while some others might lack the requisite data capture capacities.

Contribution of International (Global) Data

One possible solution is to utilize international (global) data to augment or even provide the data for certain SDG indicators

National data

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

International (Global) Data

- Developed by international/national organizations and private companies
- Covering the whole earth or large regions

Examine possible contribution of international (global) data by

- Examine GlobeLand30 as an example
- Discuss the role and utilization

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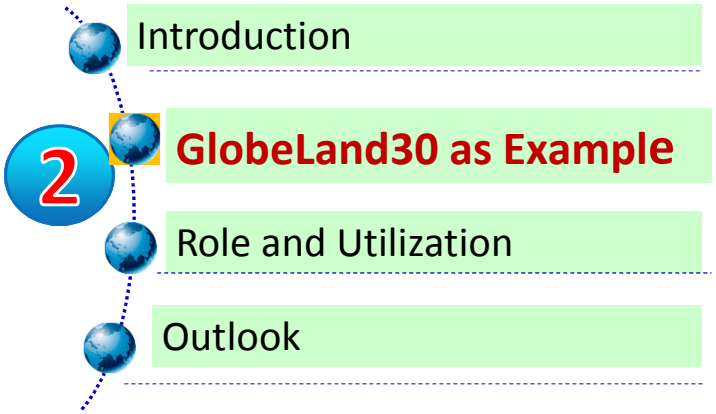
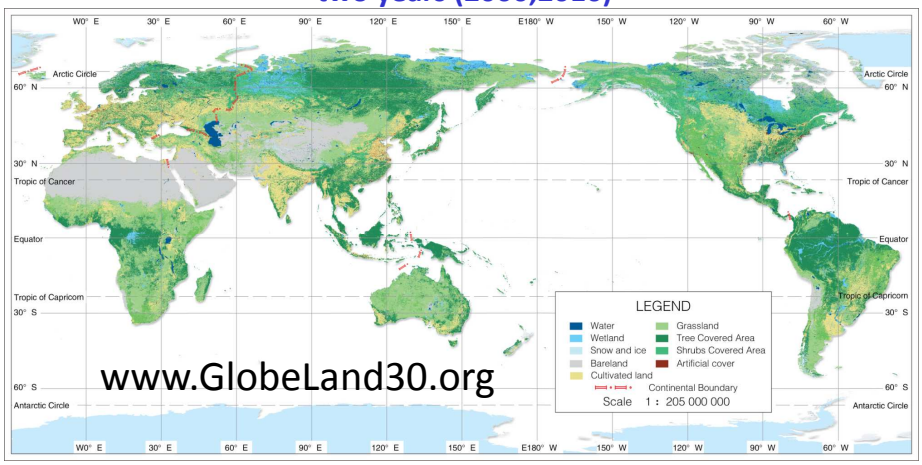


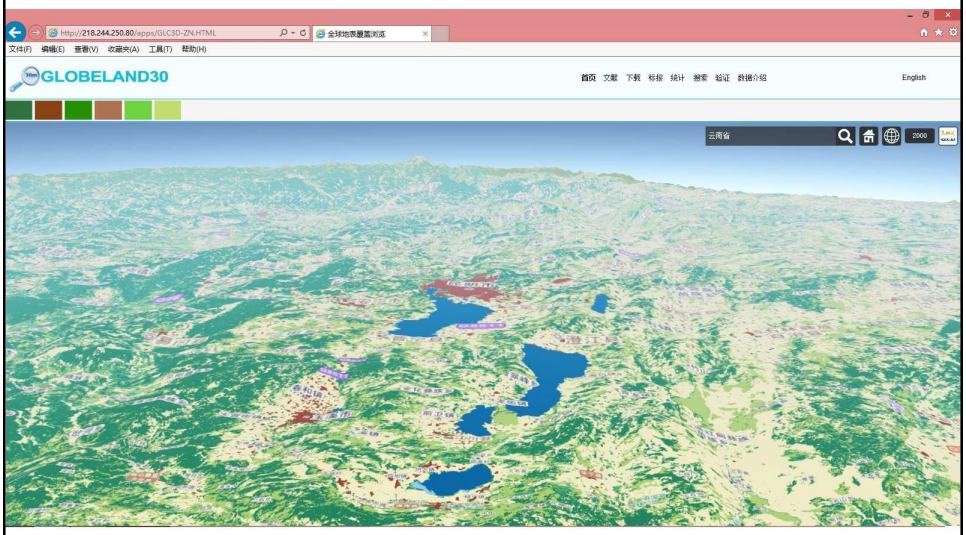
2.1 GlobeLand30

1st 30-m earth land cover map with 10classes and two years (2000,2010)

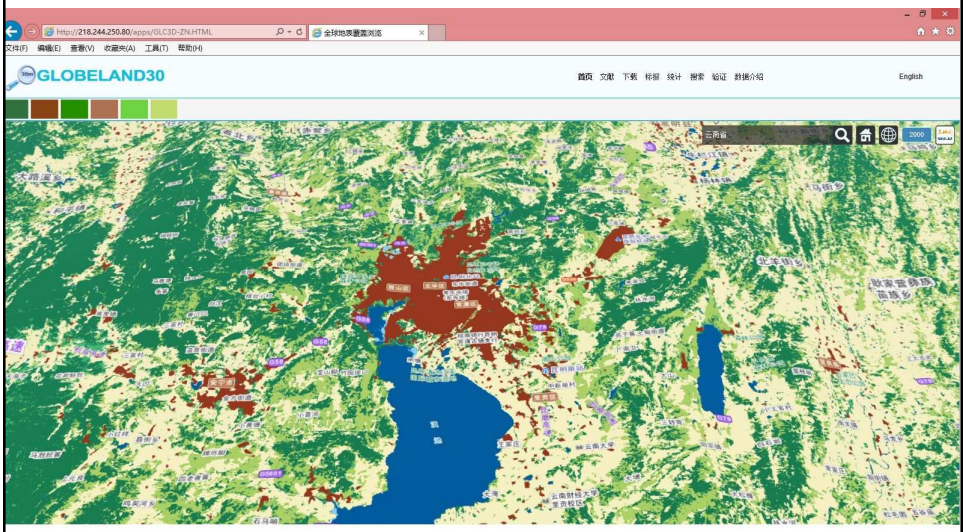


Chen et.al. 2015. Global land cover mapping at 30m resolution: a POK-based operational approach. ISPRS J. P&RS , 103 (2015): 7-27

Kunming

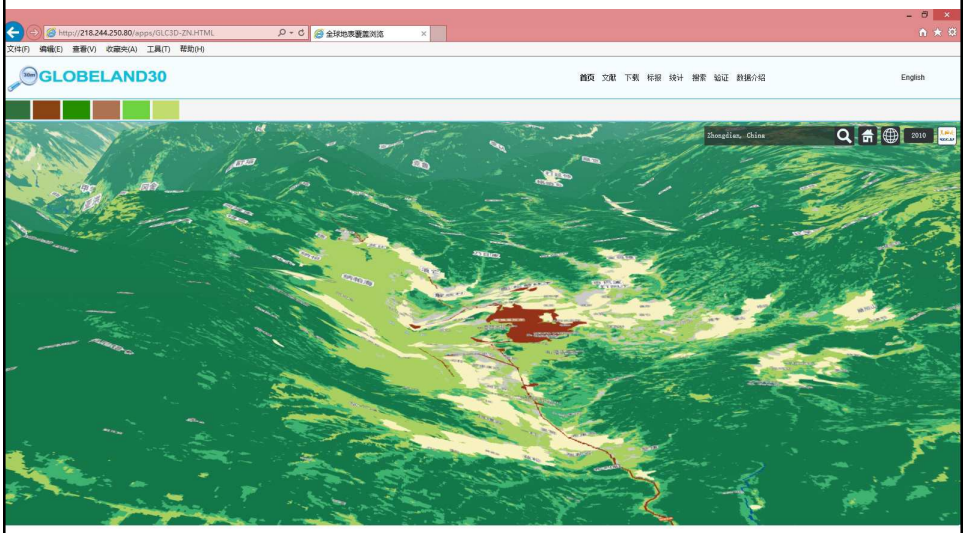


Kunming

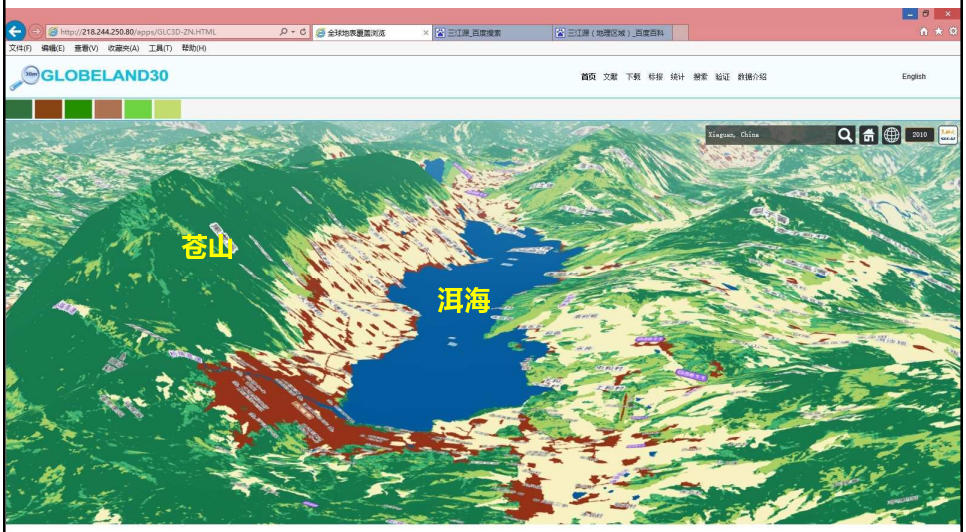


2000年

Shangri-La (香格里拉)

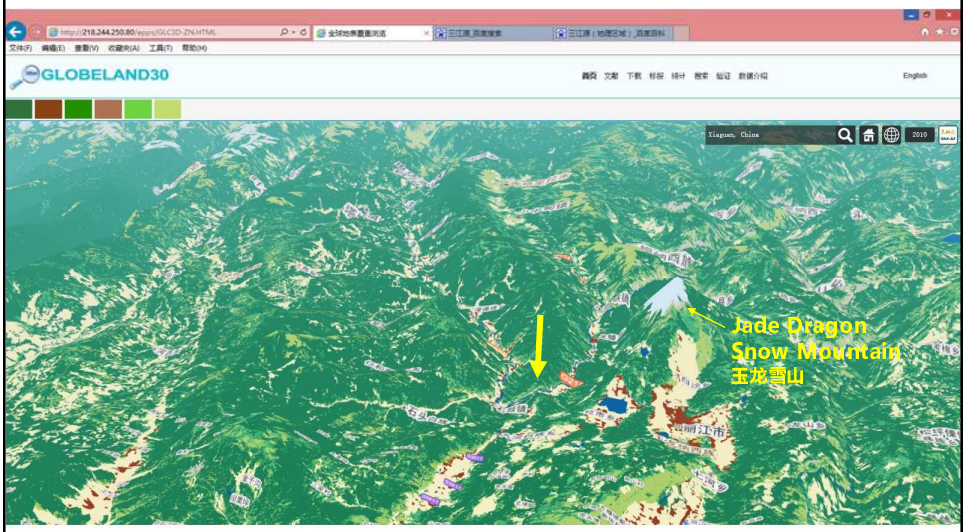


Dali (大理)



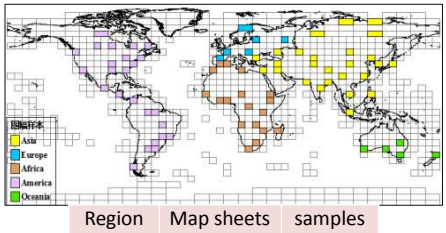
2000年

1st Turning of Yangtze River (长江第一湾)



2.2 Accuracy Assessment

Third-party experts selected more than 150,000 samples and gave a global accuracy around 80%



Region	Map sheets	samples
Asia	26	60165
Europe	6	12792
Africa	18	25656
America	25	45822
Oceanic	5	9635
Total	**80**	**154070**

	2010		
Class	User acc.	Area %	Total accur.
croplands	*83.06%*	*0.1619*	
forest	*89.00%*	*0.0174*	
grass	*76.88%*	*0.2910*	
shrub	*72.52%*	*0.0869*	*83.50% ±0.18%*
wetland	*79.63%*	*0.0340*	
water	*92.09%*	*0.0264*	
artificial	*86.97%*	*0.0100*	
bareland	*77.33%*	*0.1830*	
Ice	*75.86%*	*0.0203*	

Accuracy Assessment

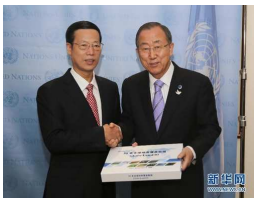
Some other experts conducted national or regional accuracy assessments

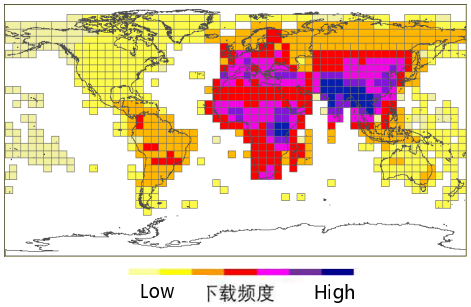
regional	Sample size	accuracy	Investigators	sources
Water ,N. Europe		91%	ETH/IIASA	GIM, Dec., 2014

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

2.3 GlobeLand30's Users

Globeland30 was donated to UN in Sept. 2014, New York, by Chinese government, and has so far more than 6000 users from 120 countries





Chen et.al., 2014, China: Open access to Earth land-cover map, Nature, 514:434, 23 Oct. 2014

Examples of International Users

- **Over 260 agencies**
- **More than 300 Univ.(49 in Times TOP 100, 7 in TOP 10）**

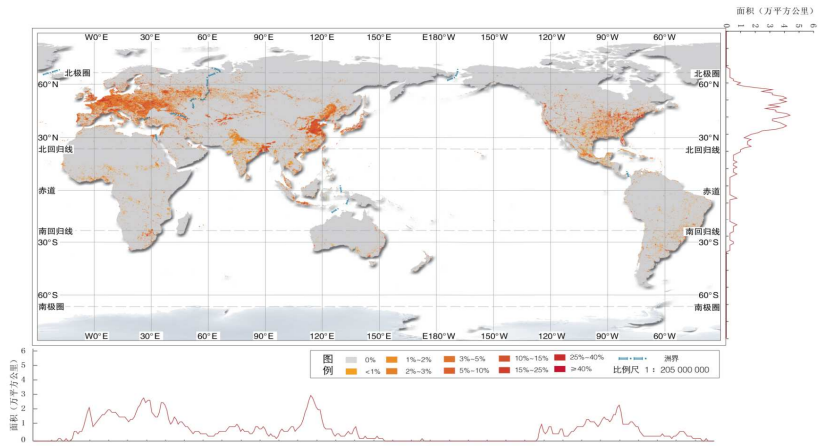
Users	Name of Organizations
UN systems	FAO、UNEP、UNCCD、UN-Habitat、UNMIS、ESCAP、UN Unit in Mali、UNESCO Islamabad,…
NGO	WWF、TNC, The Nature Conservancy)、Conservation International,…
GOV	USGS、NASA、GSFC、USGS、European Commission,…
Research institutes	JRC、DFZ、IIASA、INPE、Indian Institute of Science、Space Research Institute of Ukraine、IERSD/NOA,…
Universities	Harvard、Yale、Un. Maryland、Colombia Uni., …

2.4 Applications

1. Status and change analysis
2. Cause and consequence analysis
3. Coupling with Earth System Models
4. Generating new data sets

1) Status and change analysis

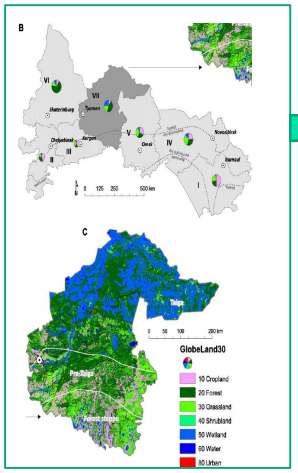
Statistical analysis of global artificial surface



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.

Status and change analysis

Land use change in West Siberia



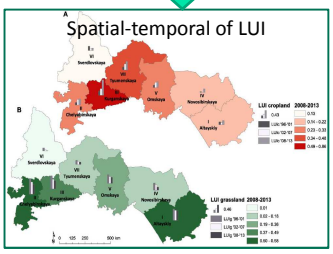
Land use intensity (LUI)

- Cropland (c) intensity for year i

$$LUIc_i = \frac{c_i - c_{min}}{c_{max} - c_{min}} \quad \text{with} \quad c = Fert * Pcrop * Pgrain$$

- Grassland (g) intensity for year i

$$LUIg_i = \frac{g_i - g_{min}}{g_{max} - g_{min}} \quad \text{with} \quad g = gLSD * Pgrass * Psubsist$$

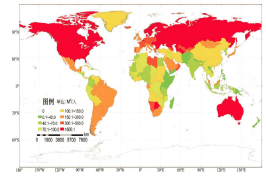


- Decreasing intensity on grassland (−0.015 LUI units per year)
- Intensification on cropland (+0.014 LUI units per year)

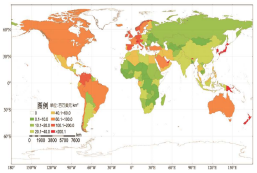
Kühling, I., et al. 2016. Spatio-temporal analysis of agricultural land-use intensity across the Western Siberian grain belt. Science of the Total Environment, 544, 271-280

2) Cause and consequence analysis

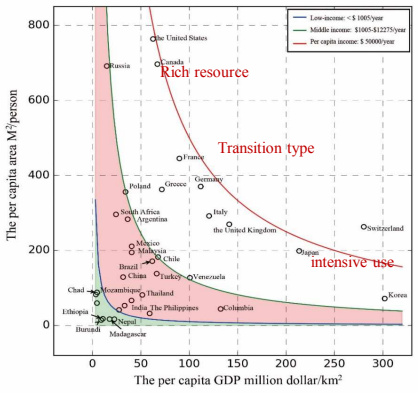
Land use efficiency analysis: global divergence



Artificial surface area per capita



GDP per capita



Li R, et al., 2016. Spatio-temporal pattern analysis of artificial surface use efficiency based on Globeland30. Scientia Sinica Terrae, 46: 1436–1445

Cause and consequence analysis

Urban expansion: intrinsic characteristics

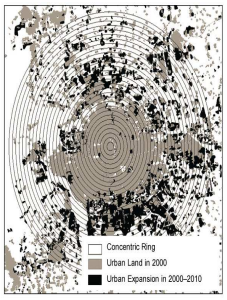
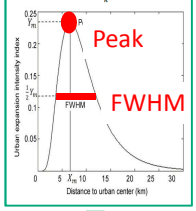


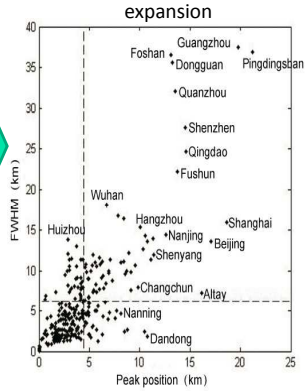
Figure 1 Urban expansion and partitioned concentric ring in Beijing.

Urban expansion intensity index (UEII)

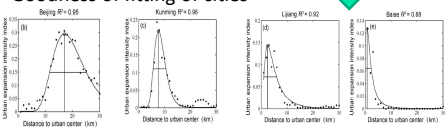
$$I_k = \frac{U_k^{t_2} - U_k^{t_1}}{A_k}$$



Characteristics of urban expansion



Goodness of fitting of cities

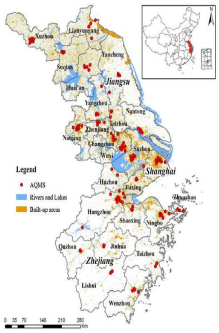


Yu X, et al. 2016. A method characterizing urban expansion based on land cover map at 30 m resolution. Science China Earth Sciences, 59: 1738–1744

Cause and consequence analysis

Relationship between urban form and air quality

Artificial surface from GlobeLand30



Landscape metrics

$$CA = \sum_{j=1}^{n} a_j (1/10000) \qquad LPI = \frac{\max a_j}{AREA} (100)$$

$$NP = n \qquad PARA\_MN = \frac{\sum_{j=1}^{n} (l_j / a_j)}{n}$$

$$ENN\_MN = d$$

Relationship between urban form and air quality

	SO_2	NO_2	PM_{10}	$PM_{2.5}$	CO	O_3
Total Urban Area (CA)	0.35	0.18	0.57**	0.54**	0.40*	0.30
Number of urban patches (NP)	0.44*	−0.10	0.69**	0.49*	0.57**	0.23
Largest Patch Index (LPI)	0.15	0.41*	0.12	0.29	−0.03	0.11
Mean Perimeter-area ratio (PARA_MN)	−0.55**	−0.05	−0.78**	−0.75**	−0.50*	−0.19
Mean Euclidean Nearest Neighbor Distance (ENN_MN)	−0.42*	−0.17	−0.58**	−0.54**	−0.42*	−0.29
Traffic Coupling Factor (CF)	−0.24	−0.09	−0.45*	−0.33	−0.24	−0.24

She Q, et al., 2017. Air quality and its response to satellite-derived urban form in the Yangtze River Delta, China. Ecological Indicators, 75, 297-306.

3) Coupling with Earth System Models

GlobeLand30 in climate model (BCC-CSM)

Convert GLC to climate model types

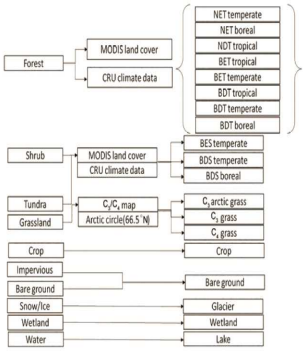


Figure 1 The transformation flowchartfromGlobeLand30 land cover type to AVIM_LC types.

Surface temperature difference simulated by 30m and 0.5° GLC

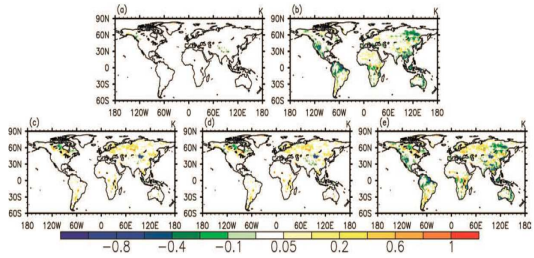


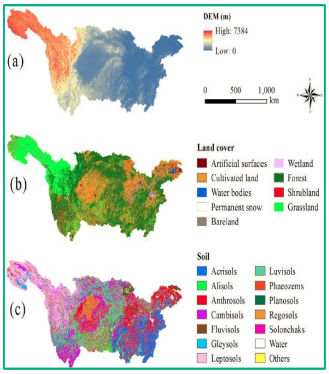
Figure 4 The spatial distribution of land surface temperature differences in the BCC_AVIM simulations based on GlobeLand30 and the AVIM_LC. (a), (b) Glacier and PFT; (c) wetland and lake; (d) non-vegetation types; (e) all LC types.

- With the new 30m LC data, the model biases between simulations and observations in the BCC climate model with original LC datasets were effectively reduced.

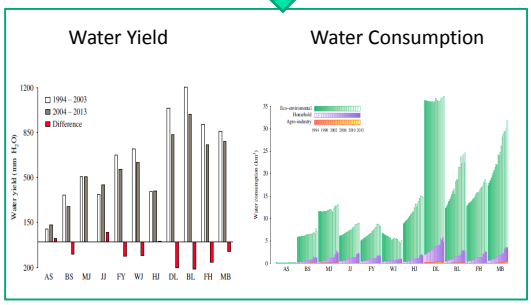
Shi X L, et al., 2016. Climate effects of the GlobeLand30 on the BCC climate model simulations. Science China Earth Sciences, 59: 1754–1764

Coupling with Earth System Models

GlobeLand30 for SWAT model



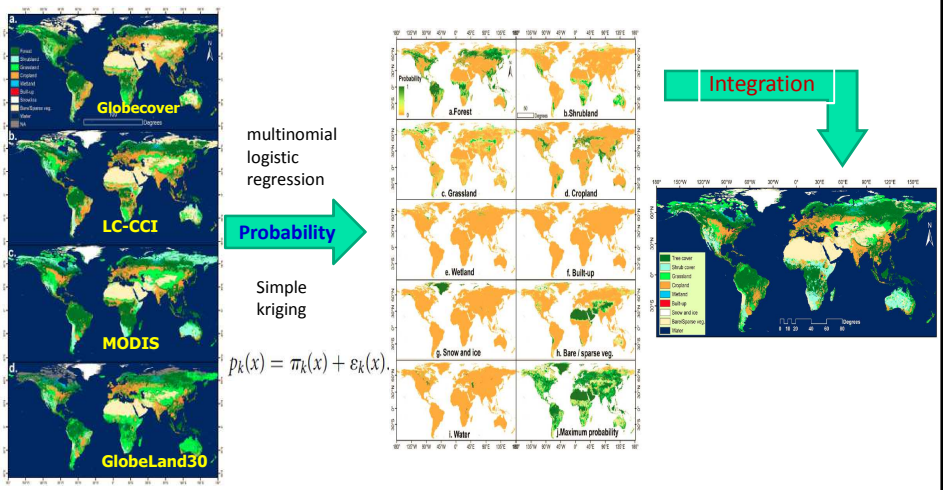
Soil and Water Assessment Tool (SWAT) model



Sun, F., et al. 2016. Mapping water vulnerability of the Yangtze River Basin: 1994-2013. Environment Management, 58:857-872.

4) Generating new data sets

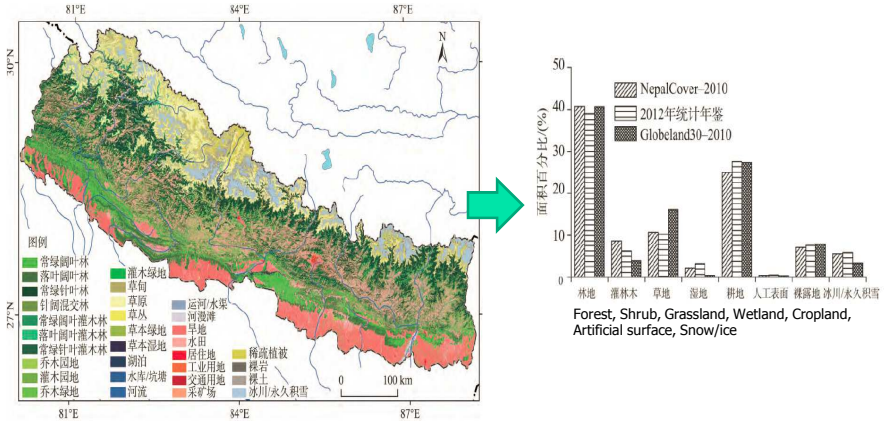
Create integrated global land cover map



Tsendbazar et al., 2016, Integrating global land cover datasets for deriving user specific maps. International Journal of Digital Earth

Generating new data sets

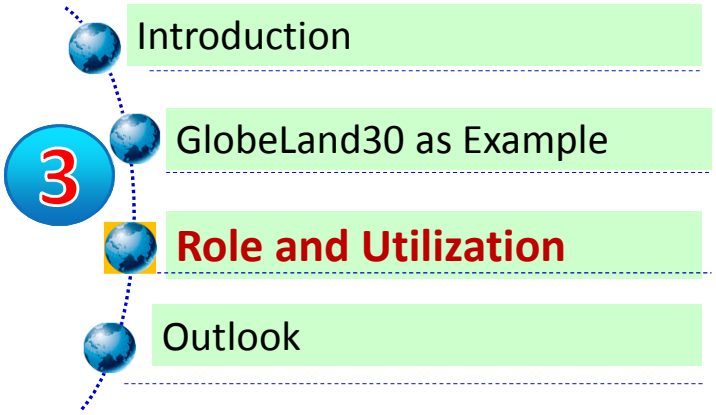
Nepal land cover mapping and statistics



Forest, Shrub, Grassland, Wetland, Cropland, Artificial surface, Snow/ice

Cao X, et al. 2016. Land Cover Mapping and spatial pattern analysis with remote sensing in Nepal. Journal of Geo-information Science, 18(10): 1384-1398.

Contents



National versus International (Global) Data

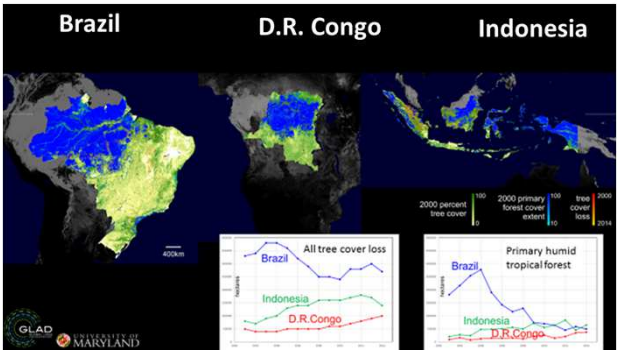
National data： generated by national experts and can be expected to be more accurate and have a better thematic resolution than global products.

International (Global) Data： may have higher consistency across space, thereby allowing a better comparability across countries and easier data handling as a single dataset.

→ Global data sets may have some limitations , such as lower temporal resolution and fewer thematic classes.

3.1 Role of International (Global) Data

1) as Supplement to National Data: Global datasets with relatively fine spatial resolution can offer a potential alternative when reliable national data not available

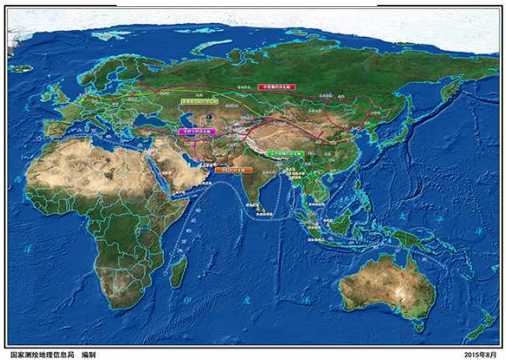


It is also possible to integrate national and global data sets for more effective SDGs monitoring, especially if the data have similar spatial resolutions

Role of International (Global) Data

2) Used for Trans-boundary or Cross-border areas: High quality global data sets facilitate operations that cover the trans-boundary or cross-border area

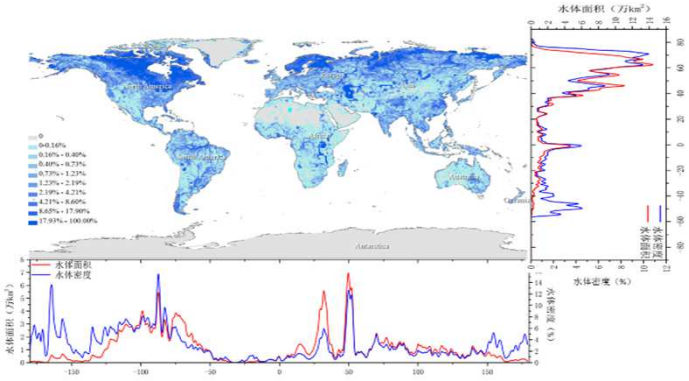
One Belt and one road



Natural disasters, displaced populations, environmental change, water shortages, pandemics, and widespread malnutrition do not stop at national borders or the water's edge.

Role of International (Global) Data

3) Supporting Global Reporting : Global data sets can serve as a sound basis for supporting the preparation of global reporting.



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

3.2 Utilisation of International (Global) Data

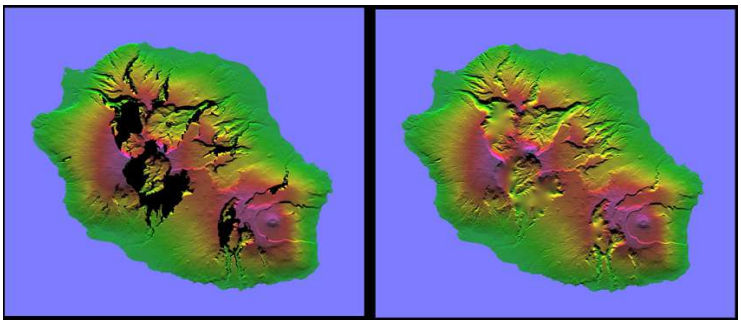
There are several issues to be considered when selecting suitable international (global) data sources for use in the computation of SDG indicators and national reporting:

- Data quality
- Data conversion/ augmentation
- Scale and integration
- Measure issues
- Securing national ownership

4.1 Data Quality

Data quality refers to geometric, thematic accuracy, as well as temporal aspects, and has significant influence on reliability of measures for SDG indicators

SRTM DEM problems: data voids - radar shadows



It is necessary to conduct a thorough evaluation of the uncertainty of the data before utilisation

4.2 Scaling and integration

Some data sets might not be in the appropriate scale for a particular SDG indicator.

- **1) Disaggregation:** generate a dataset with a more refined thematic content by combining global data and ancillary data sources.

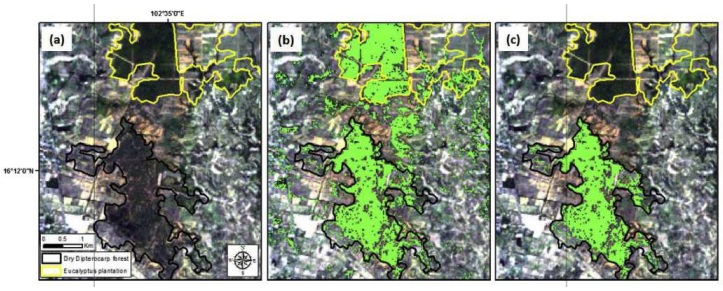
GlobeLand30 DMSP/OLS 30-m population density

Lu Nan, et al., Estimation of 30-m resolution population density for Shandong Province, Acta Geodaetica et Cartographica Sinica, 2015,44(12)

- **2) Aggregation :** downscale high-resolution national and international datasets into desirable scales. This process is also called generalization in cartographic community.

4.3 Scaling and integration

- **3) Data integration**: improve the quality of existing national data by adding intrenational (global) data

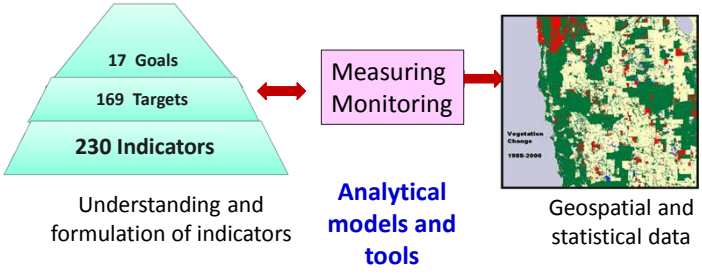


(a) Dry Dipterocarp forest and Eucalyptus plantation in the year 2000 (from the national land use map)
(b) tree cover map for the year 2000 (from the annual global tree cover maps) shown in light green
(c) extracted natural forest tree cover after integrating the national land use map and the annual global tree cover maps

Johnson, Brian A. , Applied Geography 62 (2015) 294e300

4.3 Analytical models and Tools

Analytical models, metrics and tools need to be developed for computing or deriving SDG indicators/ indices from geospatial data or combination with statistical data.



Understanding and formulation of indicators

Analytical models and tools

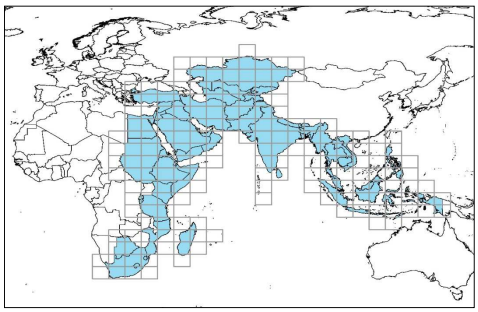
Geospatial and statistical data

Sensitivity analysis and uncertainty analysis need also be considered to test the efficacy and robustness of the Computing approaches

4.4 Securing national ownership

In cases of unavailability of national data sources, national involvement needs to be secured in the information flow

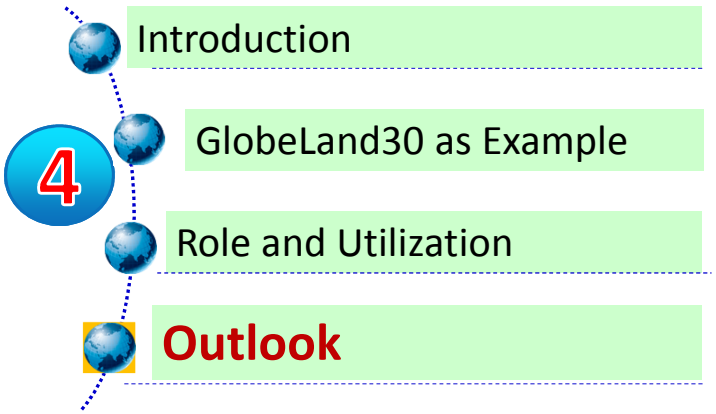
Develop GlobeLand30- 2015



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

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

Contents



5.1 Global Status Surveying

Topographic map is the most fundamental data, and a joint survey was completed by UN-GGIM and ISPRS in 2015.

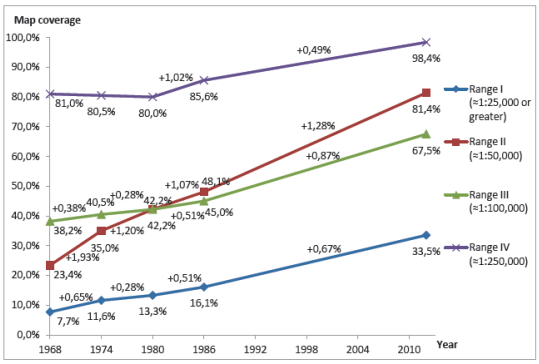


Chart 1: Percentages of total world area covered in each scale category, 1968-1974-1980-1986-2012

- 113 countries/regions replied the UNGGIM-ISPRS Questionnaire by 2015

- Various scale ranges have greatly increased between 1986 and 2012 [Konecny et al., 2015].

Global Topographic Mapping

Topographic map is the most fundamental data, and a joint survey was completed by UN-GGIM and ISPRS in 2015.

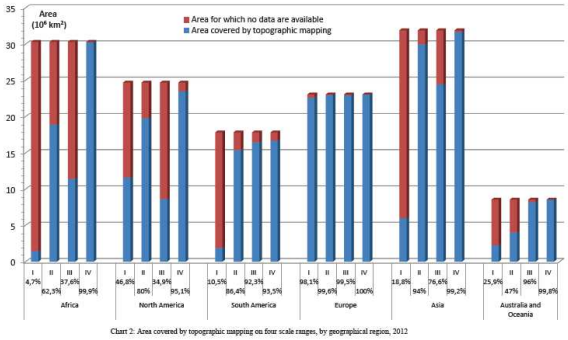


Chart 2: Area covered by topographic mapping on four scale ranges, by geographical region, 2012

Estimated global coverage

- 30% for 1:25,000 topographic map
- 75% for 1:50 000 mapping.

A number of countries are capable of updating their national topographic data at one- to two-year cycle, some other countries may be from 10 to 30 years old.

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

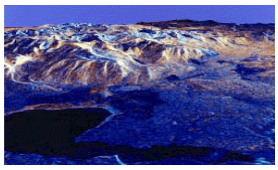
Product	Spatial resolution	Coverage of years	Contents/ accuracy
GlobeLand30	30 m	2000, 2010	10 classes/ 80.3%
Global tree cover	30m	Annual (2000-)	One class(forest)/
ESA Land Cover CCI	300m	1998-2002, 2003-2007 and 2008-2012	22 classes/ 74%(2008-2012)

DEM Data

DEM datasets have been collected at a global scale with the help of earth observation sensors

Global DEM data sets available

Product	Spacing	Vertical accuracy	Year	Remarks
SRTM	30m/90m	10–15 m	2000	Generated by Shuttle IfSAR, covering 56° N to 60°
ASTER GDEM	30m	7–14 m	2009-2011	Generated by ASTER and gaps filled with SRTM
World DEM	12m	2m (rel) 4m (abs)	2014	Generated by TanDEM-X; DSM and DTM commercially available at cost
ALOS World 3D	30m	5 m	2016	Generated by LOS PRISM; freely available and based on 5 m global DEM which is available commercially at cost



Dowman, 2017, Digital Earth

Image Data

Another main data source is satellite imagery in many different formats/resolutions and with often quite frequent updates.

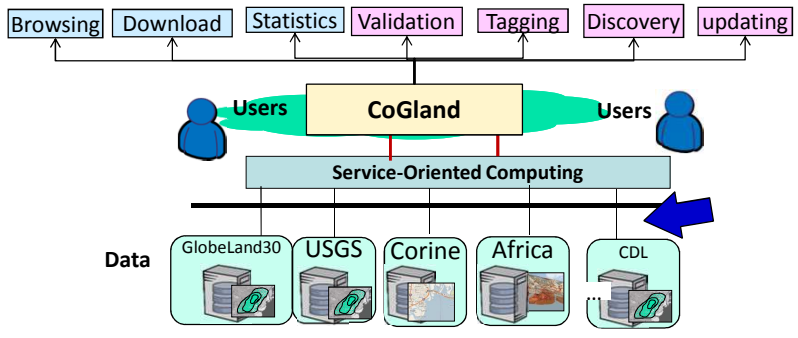
Examples of free satellite data

Satellite	Spatial resolution	SDG
Landsat 8	• 15 meters/30 meters/100 meters (panchromatic/multispectral/thermal)	• SDG-6: Water • SDG-15: Forest
Sentinel 1	• Strip Map Mode: 80 km swath, 5 x 5 m • Interferometric Wide Swath: 250 km swath, 5 x 20 m spatial • Extra-Wide Swath Mode: 400 km swath, 20 x 40 m spatial • Wave-Mode: 20 x 20 km, 5 x 5 m spatial resolution.	• SDG-6: Water • SDG-15: Forest
Sentinel 2	• 13 spectral bands: four bands at 10 m, six bands at 20 m and three bands at 60 m spatial resolution. The orbital swath width is 290 km.	• SDG-6: Water • SDG-15: Forest
ZY		

5.2 Collaborative Information Service

A 'one-stop' community-based collaborative information service needs to be set up by connecting all available global, regional and national geospatial data services.

- An implementation could be started developed from a collaborative global land cover information service (CoGland).



Chen et al.,2017. Digital Earth


Questions and
comments?