Supporting SDGs with Land Cover Information

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Outlines

1. Introduction
2. GlobeLand30
3. Applications
4. Future Works
Nowadays, the implementation and progress monitoring of 17 Sustainable Development Goals (SDGs) is a top priority for many UN member nations and international communities.


- 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.

Diagram:
- Current status
- Baseline/Progress
- SDGs
- Indicator-based Assessment
- Indicators
- Data (Statistical and Geospatial)
- Methods/Models
### Three Key Challenges

<table>
<thead>
<tr>
<th>Items</th>
<th>Problem Description</th>
</tr>
</thead>
</table>
| **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 |
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.
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 mapping has witnessed significant progress in spatial and temporal resolutions, as well as thematic accuracy,

**Global Land Cover data sets with fine resolution**

<table>
<thead>
<tr>
<th>Product</th>
<th>Spatial resolution</th>
<th>Coverage of years</th>
<th>Contents/ accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>GlobeLand30</td>
<td>30 m</td>
<td>2000, 2010, 2015</td>
<td>10 classes / 80.3%</td>
</tr>
<tr>
<td>Global tree cover</td>
<td>30 m</td>
<td>Annual (2000-)</td>
<td>One class (forest) /</td>
</tr>
</tbody>
</table>
GlobeLand30

### GlobeLand30 - 10 Classes

<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Arable land (Cropland)</td>
<td>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</td>
</tr>
<tr>
<td>20</td>
<td>Forest</td>
<td>broadleaved deciduous forest, evergreen broad-leaf forest, deciduous coniferous forest, evergreen coniferous forest, mixed broadleaf-conifer forest</td>
</tr>
<tr>
<td>30</td>
<td>Grassland</td>
<td>typical grassland, meadow grassland, alpine grassland, desert grassland, grass</td>
</tr>
<tr>
<td>40</td>
<td>Shrubland</td>
<td>desert scrub, mountain scrub, deciduous and evergreen shrubs</td>
</tr>
<tr>
<td>50</td>
<td>Wetland</td>
<td>lake swamp, river flooding wetlands, seamarsh, shrub/forest wetlands, mangrove forest, tidal flats/salt marshes</td>
</tr>
<tr>
<td>60</td>
<td>Open Water</td>
<td>lake, reservoir/fishpond, river</td>
</tr>
<tr>
<td>70</td>
<td>Tundra</td>
<td>brush tundra, poaceae tundra, wet tundra, bare tundra, mixed tundra</td>
</tr>
<tr>
<td>80</td>
<td>Artificial Cover</td>
<td>settlement place, industrial and mining area, traffic facilities</td>
</tr>
<tr>
<td>90</td>
<td>Bare Land</td>
<td>saline-alkali land, sand, gravel, rock, microbiotic crust</td>
</tr>
<tr>
<td>100</td>
<td>Perm. snow &amp; Glac.</td>
<td>permanent snow, ice sheet and glacier</td>
</tr>
</tbody>
</table>
POK-based Operational Mapping

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

- Landsat
- MODIS
- HJ
- FY-3


30m Imagery (2010)

2000-10270 Landsat scenes

2010- 9907 Landsat scenes
- 2640 Chinese HJ scenes
POK-based Operational Mapping

Develop and deliver reliable data products

<table>
<thead>
<tr>
<th>Per-class extraction</th>
<th>POK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Pixel-based classification</td>
</tr>
<tr>
<td>Wetland</td>
<td>Object-based identification</td>
</tr>
<tr>
<td>Snow &amp; Ice</td>
<td>Knowledge-based verification</td>
</tr>
<tr>
<td>Artificial cover</td>
<td></td>
</tr>
<tr>
<td>Cropland</td>
<td></td>
</tr>
<tr>
<td>Forest</td>
<td></td>
</tr>
<tr>
<td>Shrubland</td>
<td></td>
</tr>
<tr>
<td>Grassland</td>
<td></td>
</tr>
<tr>
<td>Barren land</td>
<td></td>
</tr>
<tr>
<td>Tundra</td>
<td></td>
</tr>
</tbody>
</table>

(a) classification map
(b) enlarged classification map of sub-image
(c)

POK-based Operational Mapping

Develop and deliver reliable data products

- Per-class extraction
  - Water
  - Wetland
  - Snow & Ice
  - Artificial cover
  - Cropland
  - Forest
  - Shrubland
  - Grassland
  - Barren land
  - Tundra

- POK
  - Pixel-based classification
  - Object-based identification
  - Knowledge-based verification


a. Landsat image  b. Segmentation of sub-image with large scale;  c. Segmentation of sub-image with small scale
POK-based Operational Mapping

Develop and deliver reliable data products

Nature-based knowledge

- Per-class extraction
  - Water
  - Wetland
  - Snow & Ice
  - Artificial cover
    - Cropland
      - Forest
      - Shrubland
      - Grassland
      - Barren land
      - Tundra

- POK
  - Pixel-based classification
  - Object-based identification
  - Knowledge-based verification

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

<table>
<thead>
<tr>
<th>regional</th>
<th>Sample size</th>
<th>accuracy</th>
<th>Investigators</th>
<th>sources</th>
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</thead>
<tbody>
<tr>
<td>Water, N. Europe</td>
<td>91%</td>
<td>ETH/IIASA</td>
<td>GIM, Dec., 2014</td>
<td></td>
</tr>
</tbody>
</table>

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

GEO-led Validation

25 GEO members and 15 OTHERS (UN-GGIM, CO-DATA) joined the activities

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) Databases 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 toolkit 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 toolkit 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 19 February 2016, by contacting DI Li-jun Chen (lijuan.chen@uni-potsdam.de) with a copy to secretariat@geoapigeo.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

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

<table>
<thead>
<tr>
<th>Country</th>
<th>Sample number</th>
<th>Overall accuracy</th>
<th>Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>399</td>
<td>88.94%</td>
<td>0.86</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>499</td>
<td>87.58%</td>
<td>0.85</td>
</tr>
<tr>
<td>Lesotho</td>
<td>109</td>
<td>79.82%</td>
<td>0.73</td>
</tr>
<tr>
<td>Malawi</td>
<td>237</td>
<td>84.39%</td>
<td>0.81</td>
</tr>
<tr>
<td>Namibia</td>
<td>400</td>
<td>91.85%</td>
<td>0.90</td>
</tr>
<tr>
<td>Rwanda</td>
<td>96</td>
<td>77.08%</td>
<td>0.71</td>
</tr>
<tr>
<td>South Africa</td>
<td>500</td>
<td>93.61%</td>
<td>0.92</td>
</tr>
<tr>
<td>Tanzania</td>
<td>500</td>
<td>80.99%</td>
<td>0.77</td>
</tr>
<tr>
<td>Uganda</td>
<td>239</td>
<td>81.99%</td>
<td>0.78</td>
</tr>
<tr>
<td>Zambia</td>
<td>400</td>
<td>80.25%</td>
<td>0.76</td>
</tr>
</tbody>
</table>

More than 130 countries and about 10,000 users

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

## Global Artificial Surface Analysis

Total area in 2010: **1.1875 million km\(^2\) (0.9\% of earth land surface)**

Increase from 200-2010: **57,400 km\(^2\) (rate of 5.08\%**.

Asia- 43.55\%, and Africa 4.81\%

USA and China are the largest and 2nd countries

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Area in 2000 (10,000 km(^2))</th>
<th>Area in 2010 (10,000 km(^2))</th>
<th>Variation Rate (%)</th>
<th>Increase Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>14.49</td>
<td>16.10</td>
<td>11.17</td>
<td>28.17</td>
</tr>
<tr>
<td>USA</td>
<td>22.38</td>
<td>23.56</td>
<td>5.26</td>
<td>20.48</td>
</tr>
<tr>
<td>Russia</td>
<td>9.50</td>
<td>9.83</td>
<td>3.46</td>
<td>5.73</td>
</tr>
<tr>
<td>Mexico</td>
<td>2.32</td>
<td>2.50</td>
<td>7.87</td>
<td>3.18</td>
</tr>
<tr>
<td>India</td>
<td>4.90</td>
<td>4.99</td>
<td>1.79</td>
<td>1.53</td>
</tr>
<tr>
<td>Brazil</td>
<td>3.18</td>
<td>3.24</td>
<td>1.83</td>
<td>1.01</td>
</tr>
<tr>
<td>Japan</td>
<td>2.50</td>
<td>2.54</td>
<td>1.55</td>
<td>0.67</td>
</tr>
<tr>
<td>France</td>
<td>2.86</td>
<td>2.90</td>
<td>1.29</td>
<td>0.64</td>
</tr>
<tr>
<td>Germany</td>
<td>3.02</td>
<td>3.02</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Ukraine</td>
<td>4.09</td>
<td>4.09</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

### Indicator 11.3.1 at Global Scale

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

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

#### Land consumption (artificial surface)

![Artificial surface consumption map](image)
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 area M²/person vs. The per capita GDP million dollar/km²

- Low-income: < $1005/year
- Middle income: $1005-$12275/year
- Per capita income: $50000/year

Global CropLand Analysis
Outlines

1. Introduction
2. GlobeLand30
3. Applications
4. Future Works
Continuous Updating of GlobeLand30

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

- ASEAN (10 Countries)
- South Asia (8 Countries)
- 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!

Contributors to the project:

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