Measuring and monitoring changes in land cover

..... Challenges and opportunities of Web-based approaches

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Land cover change mapping

Vital inputs:
1. Multispectral, topographic and other data
2. Ground truth and expert knowledge (training and validation)
3. High-quality classifiers and processing tools

Critical considerations for input and training data:
- Representativeness
- Reliability
- Coverage and consistency over time and space
- Availability and cost
Remote Sensing data and the Web

New opportunities:

- Discovering and sharing datasets
- Generating reproducible workflows
- Visualising and publicizing results
- Gathering data for training and validation

Plenty of NEW challenges!!
1. Remotely-sensed data

Portals and catalogues for discovering GEO data

- Searchable by region, theme, keywords etc.

- Data may be downloadable or directly accessible as a service

- Whole series of imagery (e.g., GLS) made accessible by Google, ESRI etc.
Catalogues are often based on standard metadata documents (ISO 19115, FGDC....). They MAY lead you to a dataset...
Portals are often designed for data download.....
.....or direct access through standard service interfaces (OGC WCS / WFS / WMS, REST...)

OGC Web Service Selector

Choose OGC Web Service to interact with

- Link to Web Coverage Service
- Link to Web Map Service
Web Coverage Service example

GML grid / geotiff...
Whole series of imagery (e.g., Landsat (GLS)) made accessible by Google, ESRI etc. inside their own interfaces.
GEOSS

(Global Earth Observation System of Systems)

‘will promote common technical standards so that data from the thousands of different instruments can be combined into coherent data sets’
Taking Earth’s temperature

Like thermometers in the sky, satellite instruments can measure the temperatures of Earth's surfaces. ESA's new GLOBTTemp project is merging these data from a variety of spaceborne sensors to provide scientists with a one-stop shop for land, lake and ice temperature data.

What lies beneath?

A field campaign dedicated to SMOS and GOCE has revealed unexpected similarities in the missions’ very different types of measurements. This surprising discovery could lead to a better understanding of what is happening deep under the Antarctic ice sheet.
Accessing remotely-sensed data via the Web

Critical considerations:

- Metadata can be patchy and incomplete
  - Often very little information on processing and lineage
  - Quality statements tend to represent the whole area, although quality may vary across space.
- Metadata doesn’t always tell you what you want to know
  - ‘The Tanzania section of this dataset has been successfully used and highly rated in 13 studies on ungulates. See the following cited publications for more information’.
- Catalogues often don’t point to accessible datasets or services
  - ‘For a DVD copy, please write to…..’
2. Ground truth

Constraints:
- Expensive to acquire
  - Many gaps in space and time
- Needs a proper sampling scheme to represent all classes
  - Representativeness of this sampling scheme is particularly important when monitoring CHANGE

New opportunities:
- Web 2.0 content (Flickr, Panoramio....)
- Volunteered Geographic Information (e.g., Open Street Map)
- citizen science projects (e.g., Geo-wiki, species-spotting, games...)
- Web-based tools to gather expert knowledge
Clustr + Flickr

http://code.flickr.net/2008/10/30/the-shape-of-alpha/

http://www.flickr.com/map/

180 results matching "melampyrum"
The goal of the project is to visit each of the latitude and longitude integer points. Pictures, and stories about the visits, will then be posted here.

53°N 14°E
2.2 km (1.4 miles) E of Angermünde-Sternfelde, Brandenburg, Germany [05-May-14]

54°N 13°E
2.2 km (1.4 miles) SSW of Düvier-Zarnelka, Mecklenburg-Vorpommern, Germany [05-May-14]

54°N 42°E
4.7 km (2.9 miles) SSW of Alemenyovo, Ryazanskaya oblast', Russia [05-May-14]

52°N 4°E
9.3 km (5.8 miles) WNW of Hoek van Holland, Zuid-Holland, Netherlands [05-May-14]

44°N 3°E
2.3 km (1.4 miles) NE of Roquefort-sur-Soulzon, Aveyron, Midi-Pyrénées, France [05-May-14]
Figure 3. Geographical extent of the study area in Vienna.

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Toward mapping land-use patterns from volunteered geographic information

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pages 2264-2278
Summary

This is a proposal to introduce the new key `landcover=` which can be used to describe the physical cover of an area (grass, trees etc) as distinct from `landuse=` which is used to describe the human use to which the area is put (residential, farm, forest etc) and also distinct from geographical features as described with `natural=`. These concepts are orthogonal, in that both a sports pitch and a car park can be covered with grass or asphalt; equally one can have a landcover of grass can be used within a park, a garden, a road verge, an aerodrome or a meadow for gazing cows which are all different landuses.

This distinction reflects the two traditional branches of geography [1]: Physical geography and Human geography. Clearer tagging of the form proposed will facilitate more rigorous scientific uses of OSM in the fields of biology, geography and geology. It will enable scientists to contribute their data to OSM, as well as the use of OSM as a scientific tool.

The current situation

Landuse information is already provided, mainly by `landuse=`, but landuses are also covered by `amenity=` (car parks, schools, universities, hospitals etc) and by `leisure=` (park, recreation ground etc).

Landcover information is also already available in OSM but is spread across many keys, but is spread across landuse, natural and surface. Some values of landuse are actually landcover, for example `landuse=grass`.

The current tagging makes it difficult to tag some features. For example, a military area which is covered with grass can't be tagged both with `landuse=military` and with `landuse=grass` and `natural=meadow` may not be right and `leisure=park` is definitely not right. An area of tress may be primarily being grown for timber and should correctly be tagged with `landuse=forest`, but more often a group of trees will be a 'landcover' (for example within a park or a nature reserve).

This proposal aims to provide a consistent mechanism to resolve some of the most serious semantic inconsistencies in the current tagging scheme and will ensure that it is always possible to provide both a landuse and a landcover for every location.

As of December 2012, key:landcover has 9628 uses according to taginfo.

The proposal

The existing `landuse=` tag would be retained for human uses of land, including: Economic activities, transportation, construction, tourism, history and culture, industry. Most of the `landuse=` definitions currently in use are indeed already a part of this domain, but some tags will need to be transitioned to reflect the more systematic tagging scheme. A 'landuse=highway' should be added to cover land forming part of a road (including carriageway, footways and verges). The 'landuse=grass' tag should be deprecated with `landcover=grass` taking its place.

The proposed key `landcover=` allows a systematic definition of physical geography characteristics including: Geology, soil, ecology, flora, vegetation, climate, landforms and water.

Natural key

The natural key will also be reviewed. Most of the values there actually describe geographic features, as distinct from landcover or landuse. but there is also some exceptions that might be better suited in landcover, for example `natural=sand`. 
LACOVAL – Validation tool for regional-scale land cover and land cover change

The LACOVAL on-line tool is an open-source solution openly available to the whole EO community, in order to facilitate standardized validations of land cover / land cover change maps in local to regional scales.

The tool is available as an alpha prototype and offers an intuitive interface and wizards to upload your data employing the GeoNode portal, to define sample designs and to interpret the samples using Google Earth or own reference data available through GGC WMS technology.

More information can be found in the Software Documentation.

Free registration is required in order to access the LACOVAL tool.
Example: Experts visually classifying imagery
Google Earth context
Confusion and correction
Ground truth from the Web

Critical considerations:
- Semantics
- Bias
- Coverage
- Quality assurance
Algorithms and models

Many new ways to share and combine models:
- Tools such as Taverna, Kepler etc.
- **Standards** such as OpenMI
- OGC Web Processing Services
- Google Earth Engine, ArcGIS Online...

‘Reproducible science’ has to replicate data inputs, parameters, computing environment, model version......
Web processing Services

INTAMAP
Interoperability and Automated Mapping

INTAMAP Clients
- Generic INTAMAP client
- INTAMAP Java API
- SeeSharp
- Mobile client

Sample Data
- Radiation data
- NO2 Diffusion tube data
- NO2 Satellite data

Crossvalidation service
- CrossValidation request
- CrossValidation results

Finally there are some example data sets which can be used with the INTAMAP system.

Show overlay: ☑ Mean ☑ Variance ☑ None /
Show observations

eHabitat - 2. Ecological niche modelling
Institute for Environment and Sustainability
Processing GEO data

The Global Earth Observation System of Systems (GEOSS) provides information for the benefit of society, encompassing climate change, agriculture, and deforestation. This data is processed to derive habitat models through input thematic maps. Key inputs include:
- % tree cover
- % herbaceous cover
- % barren cover
- Elevation in meters
- Slope in degrees
- Aridity index
- % water bodies
- NDVI
- NDWI
- OTHERS

The output includes catalogues of services, models, and data, facilitating various applications and analyses across different regions, such as Africa.
• Browser-based tools accessing spatial databases allow greater flexibility and shared editing.

• Reliable Web-based sources of EO data (and models for analysing that data) are increasing but are not trivial to exploit.

3 interesting challenges:
• Which resources will meet my needs?
• How can I show the trustworthiness of my results?
• How to document processes and lineage?
Which resources will meet my needs?

- Assessing **fitness-for-purpose**
- Need not just classical metadata, but also ratings and reports from scientific peers.

Open annotations, commentary metadata…
How can I show the trustworthiness of my results?

- Need to **encode**, **communicate** and **visualize** statistical information in formats like XML, JSON and netCDF / HDF.
How to document processes and lineage?

- **Unique identifiers** for datasets and models
- Shared models for representing **lineage** and **provenance**
Conclusions

- Stunning opportunities to share and merge datasets
- SOME of the sea of content out there may be really useful for classifying and validating landcover.
- In such a wilderness of information, finding the appropriate data / tools and documenting what we did becomes vital.
- For monitoring landcover change this is even more critical: dynamic validation and improvement of the classification becomes possible.
Thank you for your attention!

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