THE OVERALL EAGLE CONCEPT

GEBHARD BANKO,

30. MAY 2018, COPENHAGEN

ISO TC 211, STANDARDS IN ACTION SEMINAR
CONTENT

- Background and Motivation
- Criteria and Structure of Data Model
- Semantic decomposition
- EAGLE documentation & tools
- Summary
Many applications of LC/LU data lead to various different classification systems (on national, European & International level)

Effects:

- Mixture of LC and LU classes
- Specific fields of work have own emphasis on thematic categories
- Lack of comparability between nomenclatures hamper exchange of information between data sets
WHO AND WHAT IS „EAGLE“?

- **EAGLE** = **EIONET Action Group on Land Monitoring in Europe**
- Participants are:
  - National Land Monitoring experts and
  - Representatives of National Reference Centres (NRC) for Land Cover in the EEA´s EIONET (European Environmental Information and Observation Network)
- Established in 2009 as self-initiative
- Focus on object-oriented data modelling of LC & LU
- Open „membership“ based on own commitment
- Firstly no external funding, meanwhile supported by COPERNICUS/EEA funding.
CRITERIA FOR LC & LU DATA MODEL

- Clear separation between LC and LU
- Scale independent
- Object-oriented description additional to classification
- Complete coverage of themes LC and LU
- Modelling of temporal phenomena
- Applicable on national & European & International level
DE-COMPOSITION OF LANDSCAPE

From classification to object-oriented description
De-Composition of CORINE Land Cover classes

1.1.1. Continuous urban fabric:
Most of the land is covered by structures and transport network. Buildings, roads, and artificially surface areas cover more than 80% of the total surface. Non-linear areas of vegetation and bare soil are exceptional.

1.1.2. Discontinuous urban fabric
Most of the land is covered by structures. Buildings, roads, and artificially surface areas are associated with vegetated areas and bare soil which occupy discontinuous but significant surfaces. Between 10% and 80% of the land is covered by residential structures.
STRUCTURE OF THE EAGLE MATRIX & MODEL

- Information on landscape described with three separate blocks:
- APPLICABLE either on class-level or object level !!!
- IMPORTANT: controlled vocabulary (predefined classes) → presentation by S. Arnold
  - Defined semantic concepts

- I.) LAND COVER Components – LCC
  - Abiotic (Artificial + Natural), Vegetation, Water Surfaces

- II.) LAND USE Attributes – LUA
  - Agriculture, Forestry, Residential, Transportation etc.

- III.) CHARACTERISTICS – CH
  - coverage, spatial pattern, bio-physical parameters, cultivation measures, land management practices, status/condition etc.
APPLICATION OF LAND COVER COMPONENTS

- Agro-industrial production site
- In CLC classified with one class-label
- CLC-Code = 121 (industrial site)
APPLICATION OF LAND COVER COMPONENTS

- Description of land cover composition for each object (single land surface unit)
- Attaching more than 1 LCC to the unit

[Image of land cover components with labels: building, open sealed, waste, artificial unsealed, bare soil, deciduous trees, shrub, grass, water body]
APPLICATION OF LAND COVER COMPONENTS

- Describing land objects with
  - COUNT and
  - PERCENTAGE cover values
  - of each LCC

<table>
<thead>
<tr>
<th>LCC</th>
<th>polygon count</th>
<th>hectare</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
<td>12</td>
<td>0.68</td>
<td>4.3</td>
</tr>
<tr>
<td>Open sealed</td>
<td>2</td>
<td>0.17</td>
<td>1.1</td>
</tr>
<tr>
<td>Waste</td>
<td>1</td>
<td>0.16</td>
<td>1.0</td>
</tr>
<tr>
<td>Unsealed artifitial</td>
<td>11</td>
<td>1.15</td>
<td>7.2</td>
</tr>
<tr>
<td>Bare soil</td>
<td>6</td>
<td>4.12</td>
<td>25.9</td>
</tr>
<tr>
<td>Deciduous trees</td>
<td>16</td>
<td>1.60</td>
<td>10.1</td>
</tr>
<tr>
<td>Shrub</td>
<td>15</td>
<td>2.93</td>
<td>18.4</td>
</tr>
<tr>
<td>Grass</td>
<td>20</td>
<td>5.10</td>
<td>32.0</td>
</tr>
<tr>
<td>Waterbody</td>
<td>1</td>
<td>0.02</td>
<td>0.1</td>
</tr>
<tr>
<td>Sum</td>
<td>84</td>
<td>15.93</td>
<td>100</td>
</tr>
</tbody>
</table>
DETERMINING SPATIAL REFERENCE OBJECTS

- **Polygons**: single objects, distinct feature types,
- **Grid cells**: descriptive characterization, standardized spatial reference unit
EXAMPLE: „RURAL SETTLEMENT“

- **Land cover components (LCC):**
  - Conventional buildings
  - Trees, broad leaved
  - Herbaceous plants
  - Open sealed surfaces

- **Land use attributes (LUA):**
  - Permanent residential
  - Agriculture; own consumption
  - Road transportation network

- **Further characteristics (CH):**
  - Soil sealing degree = 35%
  - Built-up pattern = discontinuous, single houses
  - Agricultural measure: Mowing
TWO APPLICATION DOMAINS OF EAGLE DATA MODEL

- Object oriented data model is applicable for 2 main approaches
  - Tool for semantic comparison of definitions between different classification systems or single classes
    - Ontologie based reasoning
  - Guideline for descriptive characterization of landscape objects for data collection and future mapping initiatives
- data model in line with INSPIRE LC model
EAGLE UML MODEL

- UML Description
- UML graphs
- UML Application schema
- Enterprise Architect version
INTEGRATION OF DATA: INFORMAL DATA MODEL

- LC dataset
  - 1:n
  - LC unit
    - 1:n
    - Parametric observation
      - 1:n
    - LC observation
      - 1:n
    - LC components
      - 1:n
  - Level of Detail
    - 1:n
    - LC nomenclature
    - 1:n
    - EAGLE components
    - 1:n

Examples:
- NDVI 3/2016 = 0,2
- NDVI 8/2016 = 0,5
- CLC: 100% 111
- UA: 70% 11100
- HRL: 55% IMP
- HRL: 35% TCD
CHANGES IN LANDMONITORING

- Three main type of changes
- Temporal profiles and temporal vectors
- Data model has to handle different types of temporal dynamics
Sentinel-2: Paradigm Change

From semi-automatic CORINE landcover, HR land cover products (20x20m)
to operational, fully automatic S2 land monitoring services (10x10m)
using full time series
EAGLE DATA MODEL „TIME MACHINE“

- Within 1 LC-unit more than 1 LC component can exist over time (seasonal changes)
  - validFrom: Date
  - validTo: Date
Temporal profile of one LC unit (arable field)
Temporal sequence of LC components within a LC Unit
Herbeceous periodically.

bare soil

Herbeceous veg.

bare soil

Herbeceous veg.

bare soil

LC-Unit

LC-component

Parametric observation
Wheat – vegetation cycle

1. April
15. April
15. May
1. June
15. June
1. July
15. July
1. Aug.
15. Aug.
1. Sept.
15. Sept.
Harvest: 6 July 2007

Wheat

NDVI
NDVI

Herbeceous periodically.

Bare soil
Herbaceous vegetation
Bare soil
Herb. Veg.

LC-Unit
LC-component

Parametric observation

Wheat

SEMINAR: „STANDARDS IN ACTION“ – EAGLE PRINCIPLES
Parametric observation: NDVI

LC components

<table>
<thead>
<tr>
<th>Valid from</th>
<th>Valid to</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016-01-01</td>
<td>2016-01-08</td>
<td>Bare Soil</td>
</tr>
<tr>
<td>2016-07-08</td>
<td>2016-08-19</td>
<td>Bare Soil</td>
</tr>
<tr>
<td>2016-11-18</td>
<td>2016-12-30</td>
<td>Bare Soil</td>
</tr>
<tr>
<td>2016-01-08</td>
<td>2016-07-08</td>
<td>Herbaceous vegetation</td>
</tr>
<tr>
<td>2016-08-19</td>
<td>2016-11-18</td>
<td>Herbaceous vegetation</td>
</tr>
</tbody>
</table>

LC Unit

- Class: Herbaceous periodic
- Datasource: INVEKOS 2016
- Bare Soil Count: 3
- NDVI min: 395
- NDVI max: 898
- NDVI mean: 582
DOCUMENTATION AND TOOLS

- Online tool: EMPACT - EAGLE Matrix population and comparison tool
- Technical
  - EAGLE Matrix tool (EXCEL)
  - EAGLE UML model
  - PostGIS 2.0 database
  - ESRI database & Query tool
USE CASES OF EAGLE CONCEPT

- European wide application
  - COPERNICUS: development of 2nd generation CORINE Land Cover
    - CLC-backbone, CLC-Core, CLC+

- National applications
  - Hungary: bottom-up CLC generation (generalisation from national classes using EAGLE concept)
  - Germany: land surveying authorities: Semantic Analysis of the Feature Type Catalogue „Recent Land Use“, preparations for separate „land cover“ module
  - Rhineland-Palatinate [DE]: “NatFlo”, Ministry of Environment: Remote sensing based landscape objects for nature protection and habitat database
  - Spain: SIOSE – object oriented data model as successor to EAGLE
  - Austria: LISA – Land Information System Austria, Ontology based reasoning of CLC using LISA-classes

- Scientific applications
  - IIASA: Comparison of OpenStreetMap land use types with EAGLE
Transformation of LISA classes (Land Information System Austria) → EAGLE LCC

<table>
<thead>
<tr>
<th>LISA-class</th>
<th>EAGLE-classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>built-up</td>
<td></td>
</tr>
<tr>
<td>1 building</td>
<td>1111 Buildings</td>
</tr>
<tr>
<td>2 other constructed area</td>
<td>1112 OtherConstructions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>non-built up</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 bare soil</td>
<td>1223 BareSoils</td>
</tr>
<tr>
<td>4 scree</td>
<td>1221 MineralFragments</td>
</tr>
<tr>
<td>5 bare rock</td>
<td>1211 BareRocks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>water</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6 surface water</td>
<td>312 InlandWater</td>
</tr>
<tr>
<td>7 snow</td>
<td>321 Snow</td>
</tr>
<tr>
<td>8 ice</td>
<td>322 IceAndGlaciers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>woody</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9 trees</td>
<td>211 Trees</td>
</tr>
<tr>
<td>10 bushes</td>
<td>2121 RegularBushes/Shrubs</td>
</tr>
<tr>
<td>11 dwarf shrubs</td>
<td>2122 DwarfShrubs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>herbaceous vegetation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12 herbaceous vegetation</td>
<td>22 Herbaceous</td>
</tr>
</tbody>
</table>

| reeds | 2212 Reeds, Bamboos and Canes |

EXAMPLE FOR EAGLE LAND COVER COMPONENTS (LCC)
EXAMPLE FROM UML-MODEL: ABIOTIC VEGETATION

- http://land.copernicus.eu/eagle
  - > Documentation and tools
  - > semantic topics
  - > EAGLE data model
  - > UML application schema (web browser)

  - > Application Schema:
    - >> EAGLELandCoverVector
    - > >>EAGLELandCoverVector_LCComponents
    - >>>>>Abiotic/Non-Vegetated
SUMMARY

- The Eagle concept …
  - Instrument for semantic analysis, comparison, transformation and harmonisation of class definitions & systems,
  - can provide flexible framework for future mapping initiatives -> CLC+
  - helps to avoid redundant data capture,
  - applicable on raster, grid or polygon data,
  - follows principle of integrating bottom-up / top-down approach in the European land monitoring process and is INSPIRE compliant,
  - supported by EEA (European Environment Agency), observed by Eurostat

- Perceiving that EAGLE and LCML follow very similar basic concepts (using different technical approaches), a reasonable strategy would be to merge the two systems in a next version of the ISO standard
These are the EAGLE brains ..... 
 .....thank you for your attention
CONTACT & INFORMATION

Gebhard Banko
+43-1-31304-3330
gebhard.banko@umweltbundesamt.at

Umweltbundesamt
www.umweltbundesamt.at