THE OVERALL EAGLE CONCEPT

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ISO TC 211, STANDARDS IN ACTION SEMINAR

PERSPEKTIVEN FÜR UMWELT & GESELLSCHAFT umweltbundesamt

CONTENT

- Background and Motivation
- Criteria and Structure of Data Model
- Semantic decomposition
- EAGLE documentation & tools
- Summary

BACKGROUND AND MOTIVATION

- 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

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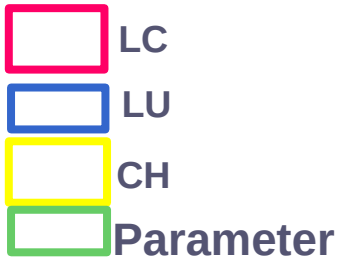
De-Composition of CORINE Land Cover classes

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.



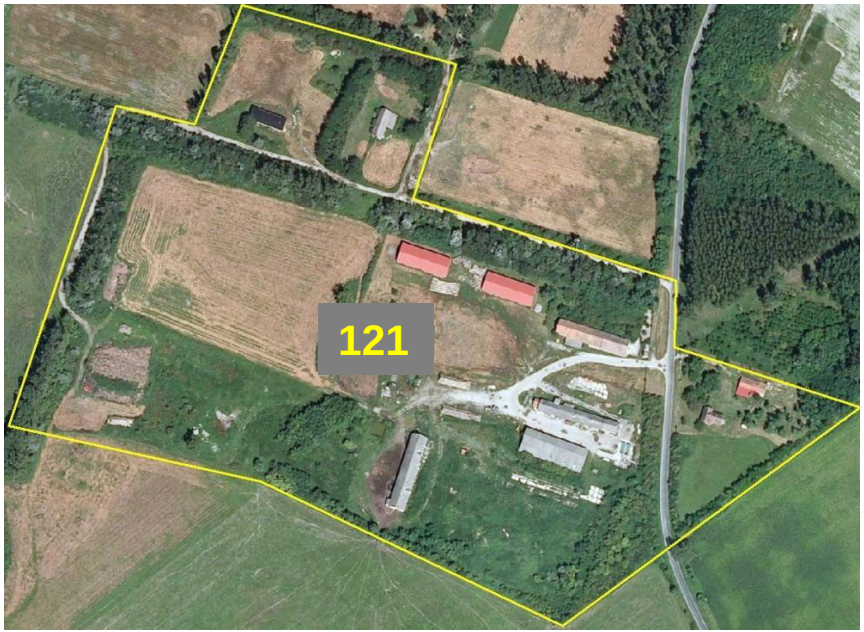
STRUCTURE OF THE EAGLE MATRIX & MODEL

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

APPLICATION OF LAND COVER COMPONENTS

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

	LCC	polygon count	hectare	%
	Building	12	0.68	4.3
	Open sealed	2	0.17	1.1
	Waste	1	0.16	1.0
	Unsealed artifitial	11	1.15	7.2
	Bare soil	6	4.12	25.9
	Deciduous trees	16	1.60	10.1
	Shrub	15	2.93	18.4
	Grass	20	5.10	32.0
	Waterbody	1	0.02	0.1
	Sum	84	15.93	100

EIONET Action Group EAGLE Land Monitoring in Europe

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DETERMINING SPATIAL REFERENCE OBJECTS

- **Polygons:** single objects, distinct feature types,
- **Grid cells:** descriptive characterization, standardized spatial reference unit

© M. Bock

EXAMPLE: „RURAL SETTLEMENT“

- **Land cover components (LCC):**
  - Conventional buildings
  - Trees, broad leaved
  - Herbaceous plants
  - Open sealed surfaces
- **Land use attributes (LUA):**
  - Permanent residantial
  - Agriculture; own consumption
  - Road transportation network
- **Further characteristics (CH):**
  - Soil sealing degree = 35%
  - Built-up pattern = discontinuous, single houses
  - Agricultural measure: Mowing

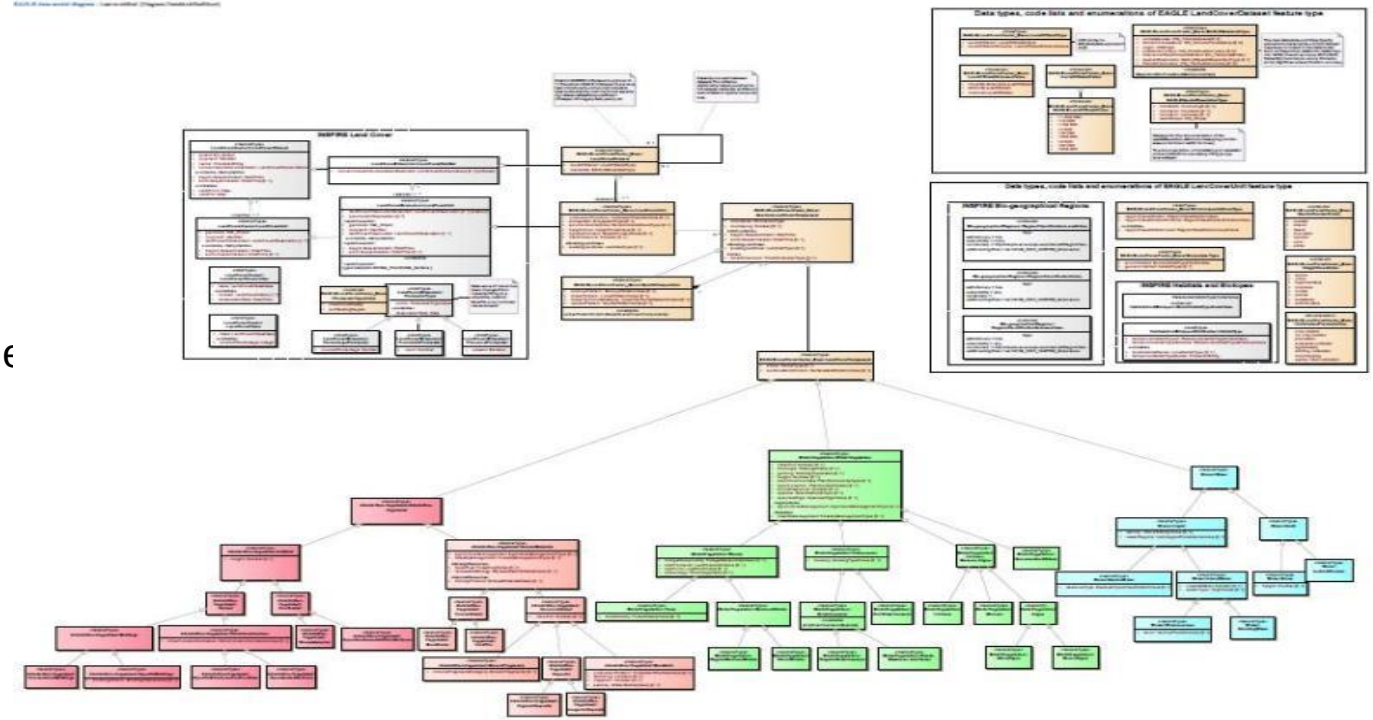
© B. Kosztra

TWO APPLICATION DOMAINS OF EAGLE DATA MODEL

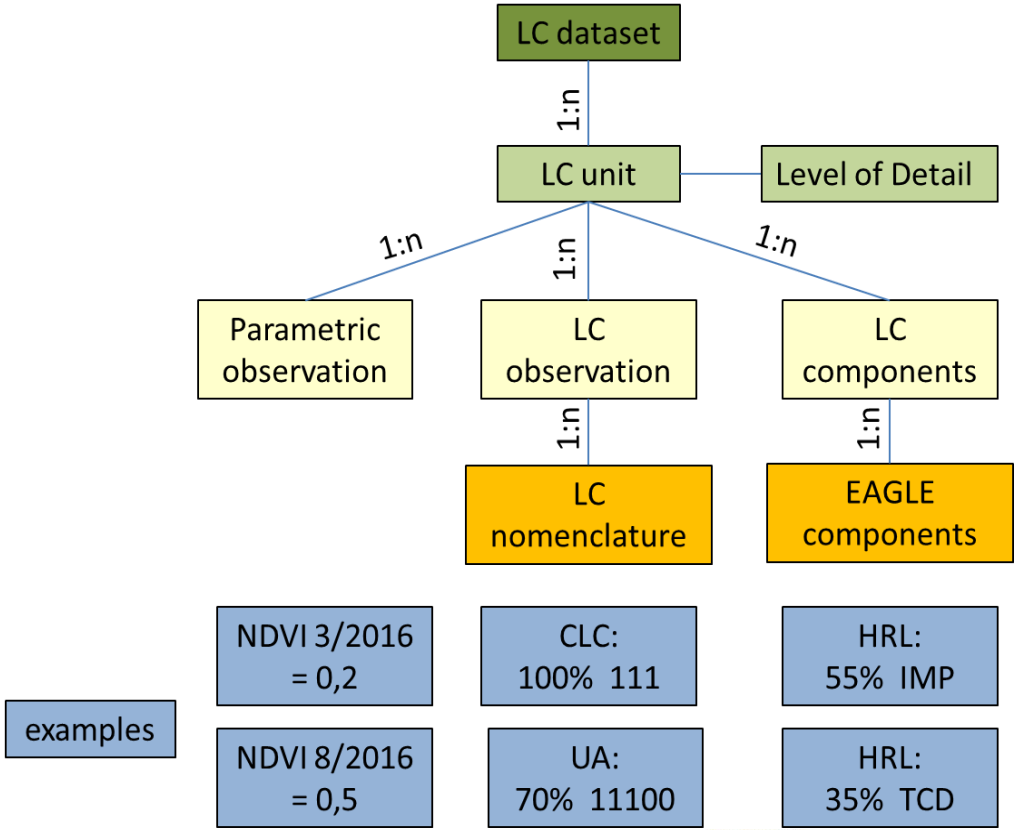
- Object oriented data model is applicable for 2 main approaches
  - Tool for semantic comparison of definitions between different classification systems or single classes
    - Onthologie based reasoning
  - Guideline for descriptive characterization of landscape objects for data collection and future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

EAGLE UML MODEL

- UML Description
- UML graphs
- UML Application sche
  web version
- Enterprise Architect
  version

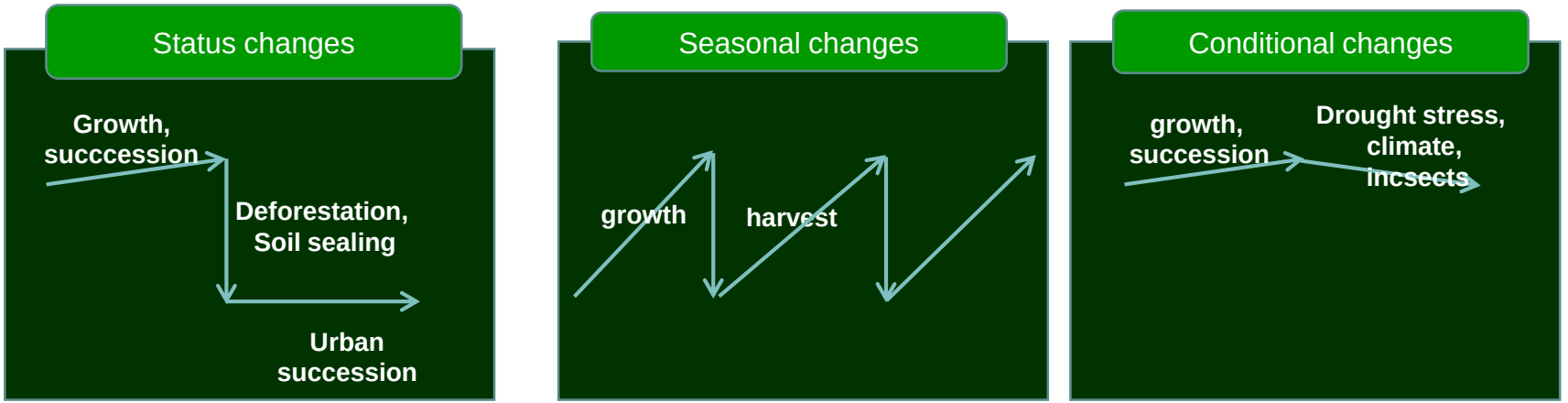


INTEGRATION OF DATA: INFORMAL DATA MODEL

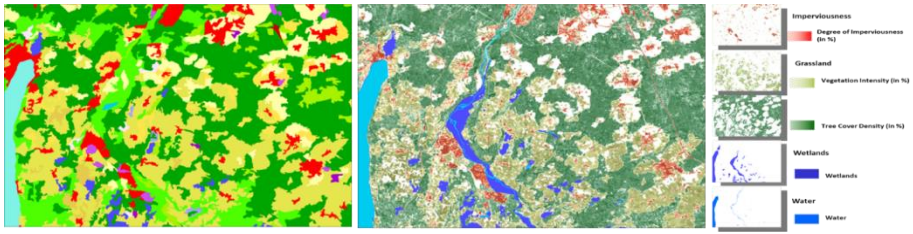


CHANGES IN LANDMONITORING

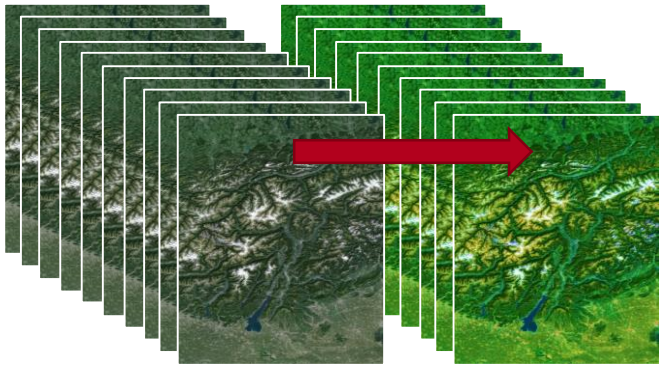
- Three main type of changes
- Temporal profiles and temporal vectors
- Data model has to handle different types of temporal dynamics



Sentinel-2: Paradigm Change



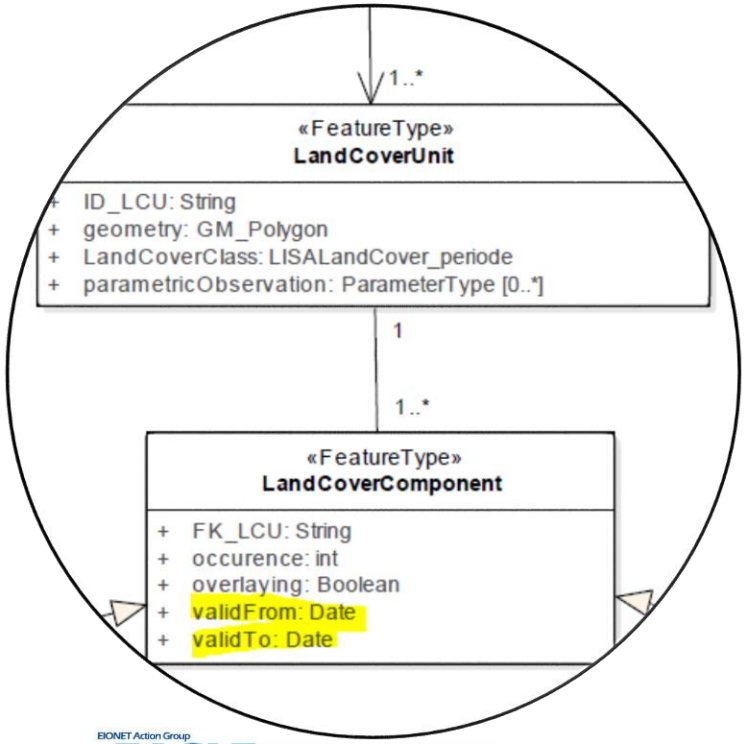
From semi-automatic CORINE landcover,
HR land cover products (20x20m)



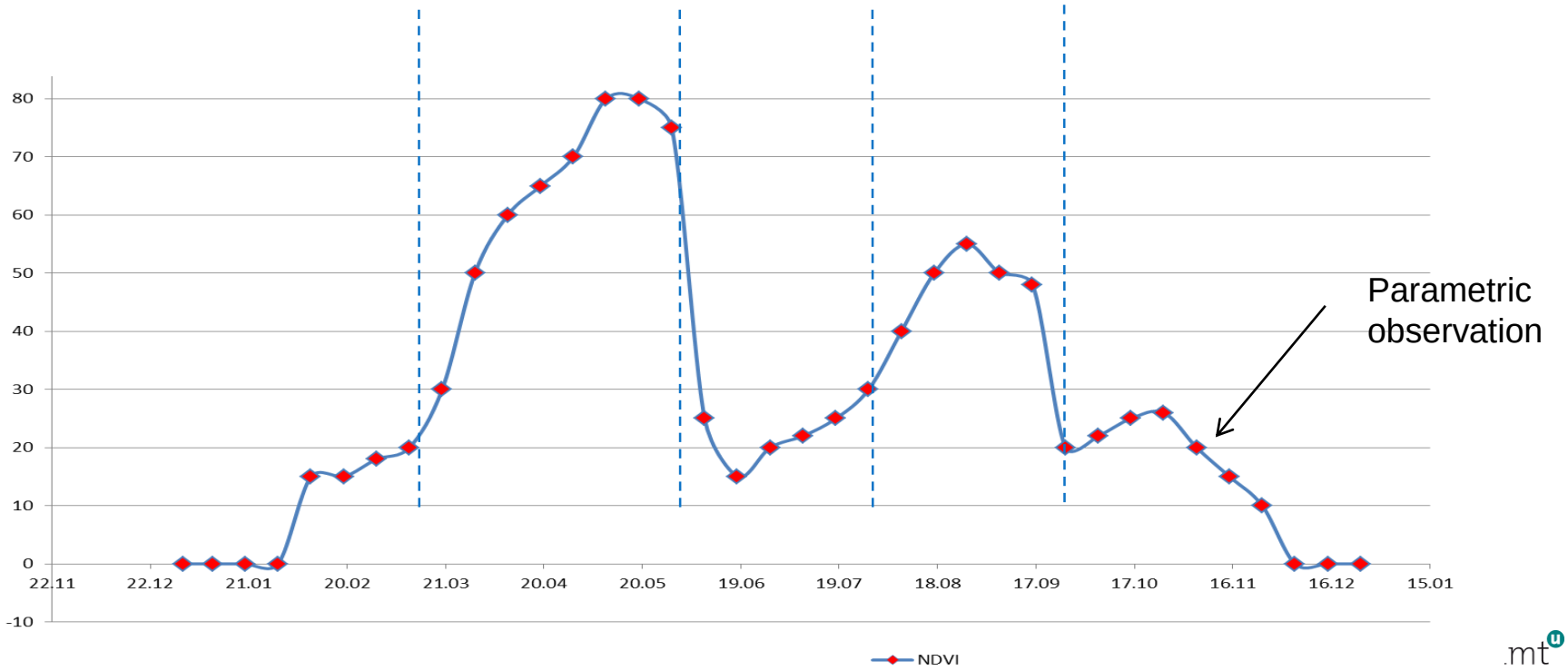
to operational, fully automatic S2 land monitoring services (10x10m) using <u>full time series</u>

EAGLE DATA MODEL „TIME MACHINE“

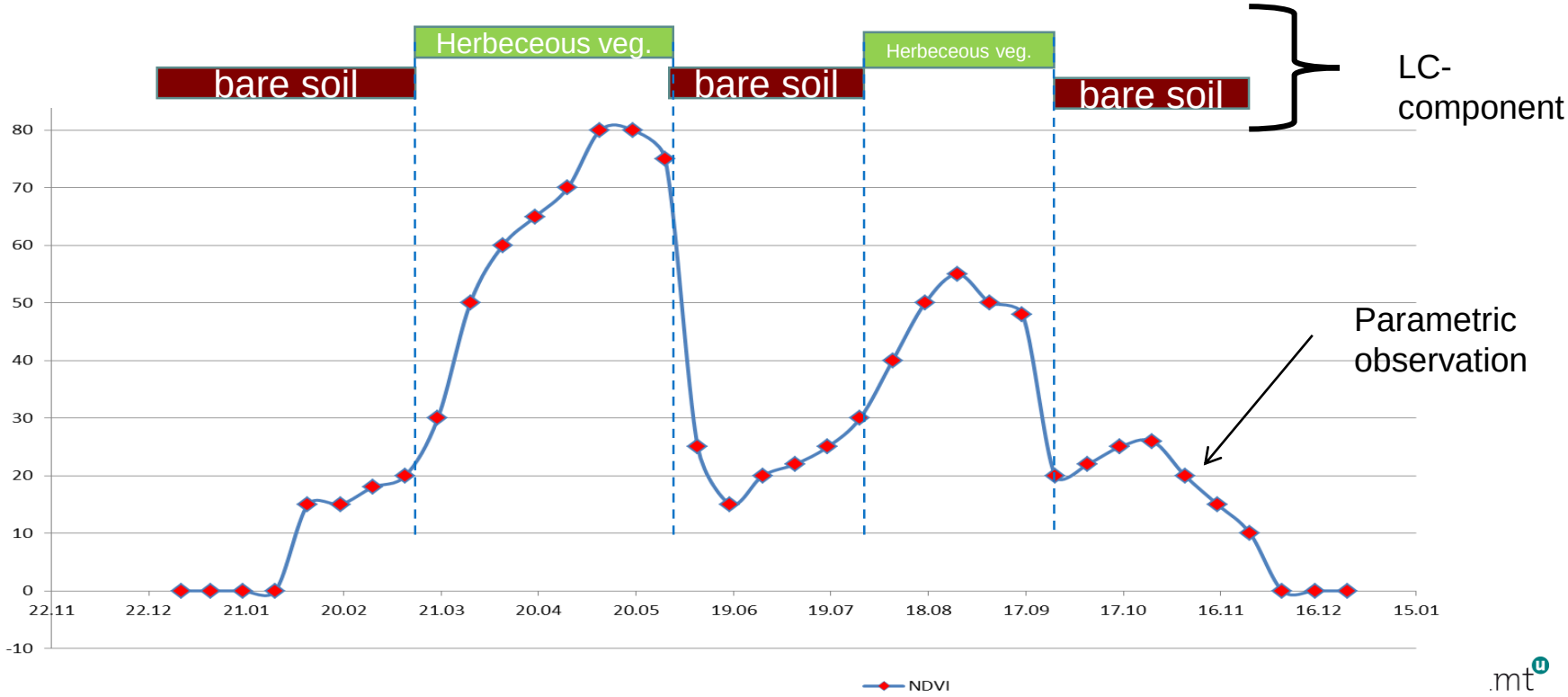
- Wihtin 1 LC-unit more than 1 LC component can exist over time (seasonal changes)
  - validFrom: Date
  - validTo: Date

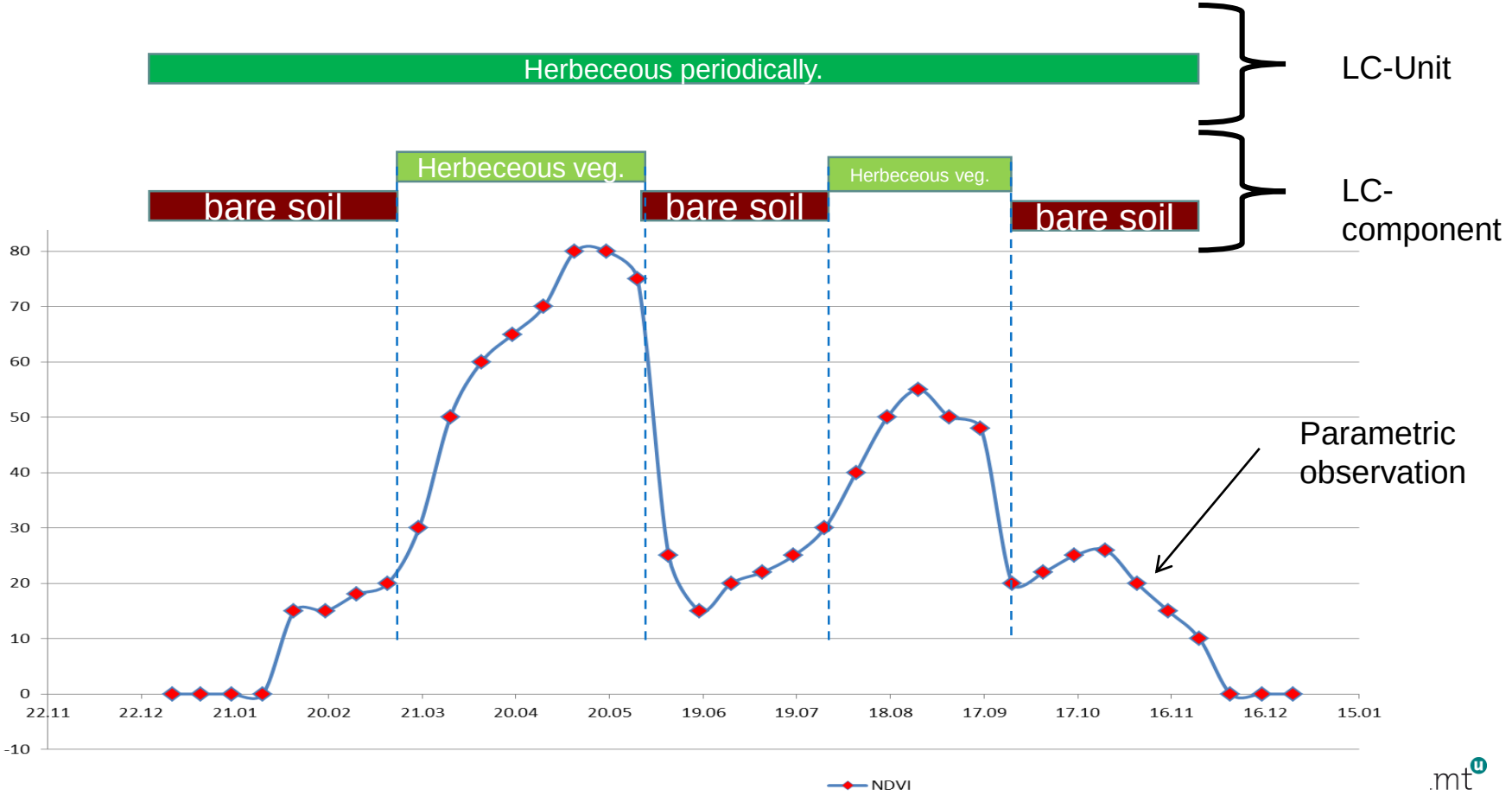


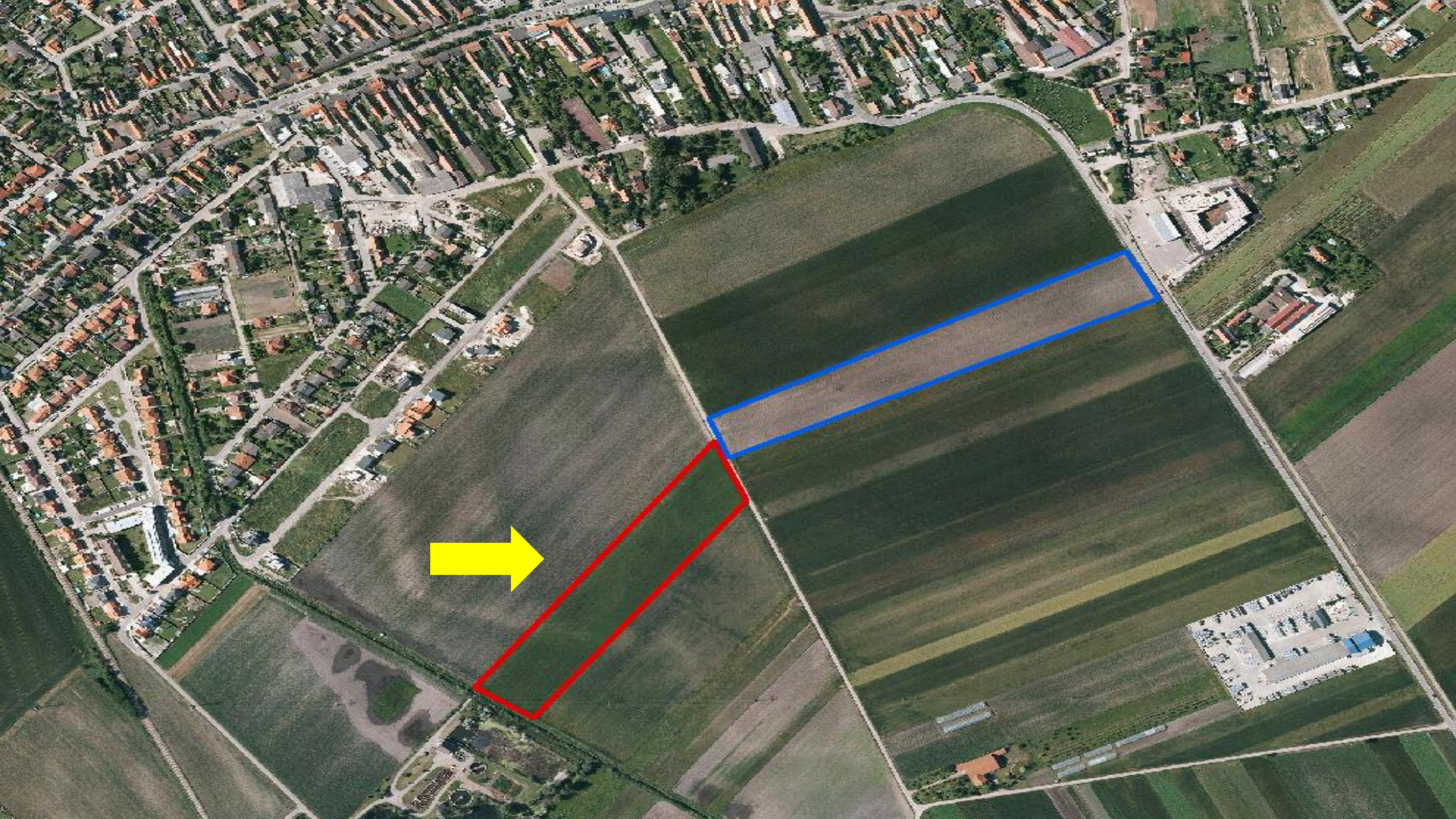
Temporal profile of one LC unit (arable field)



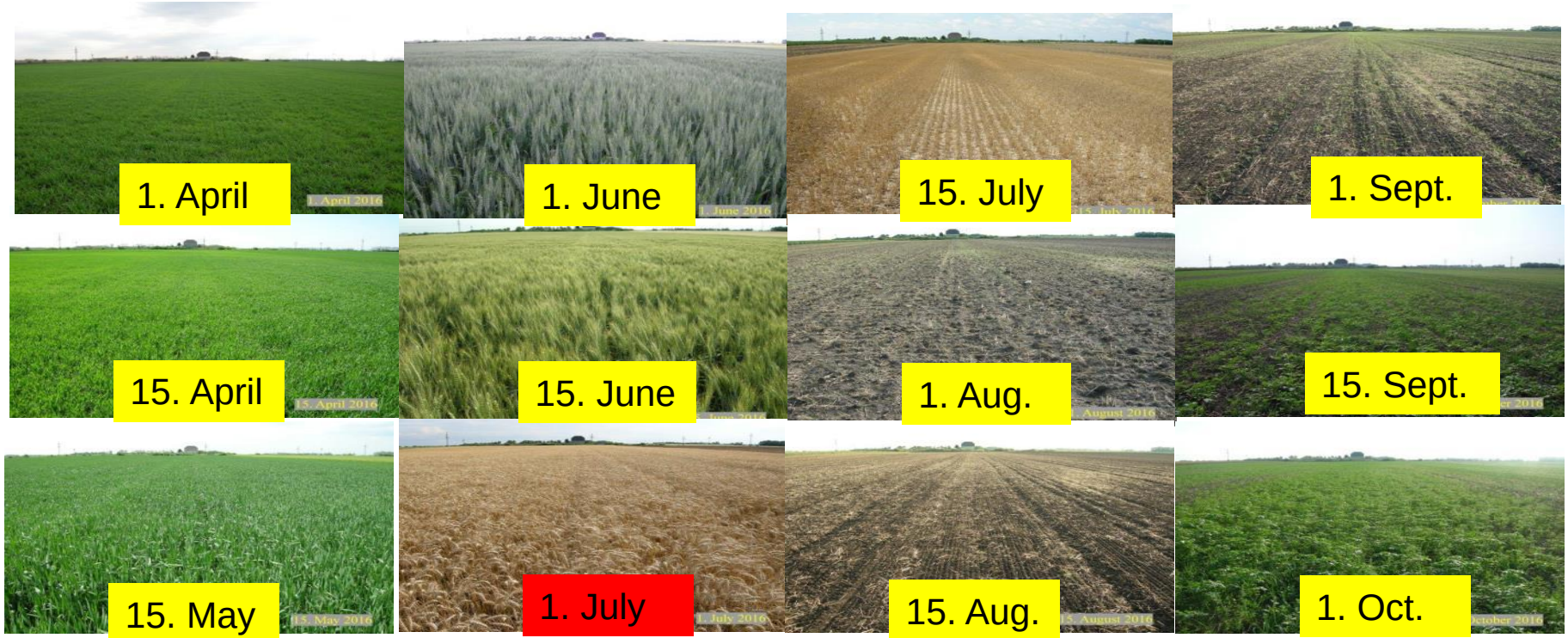
Temporal sequence of LC components within a LC Unit

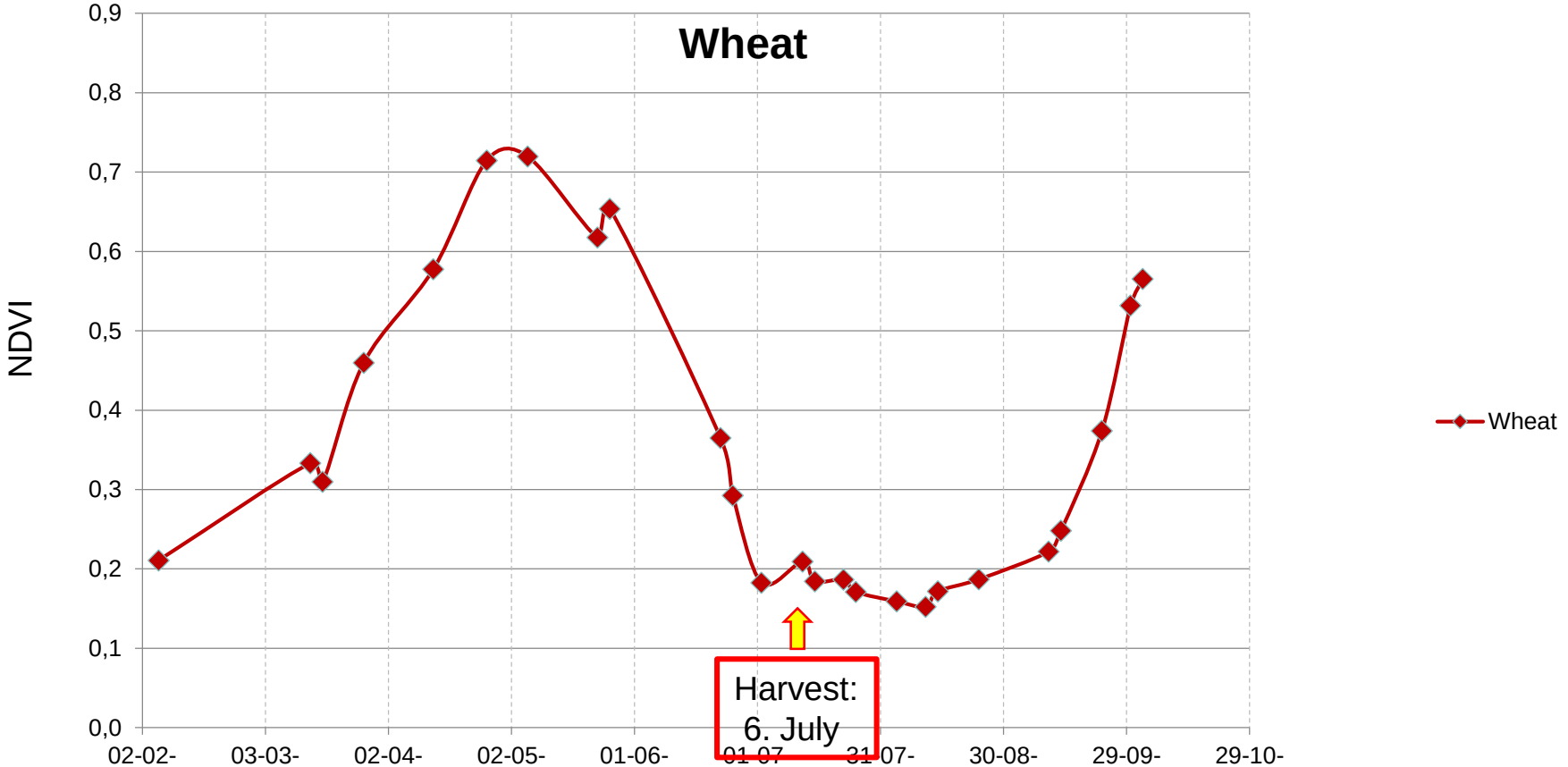


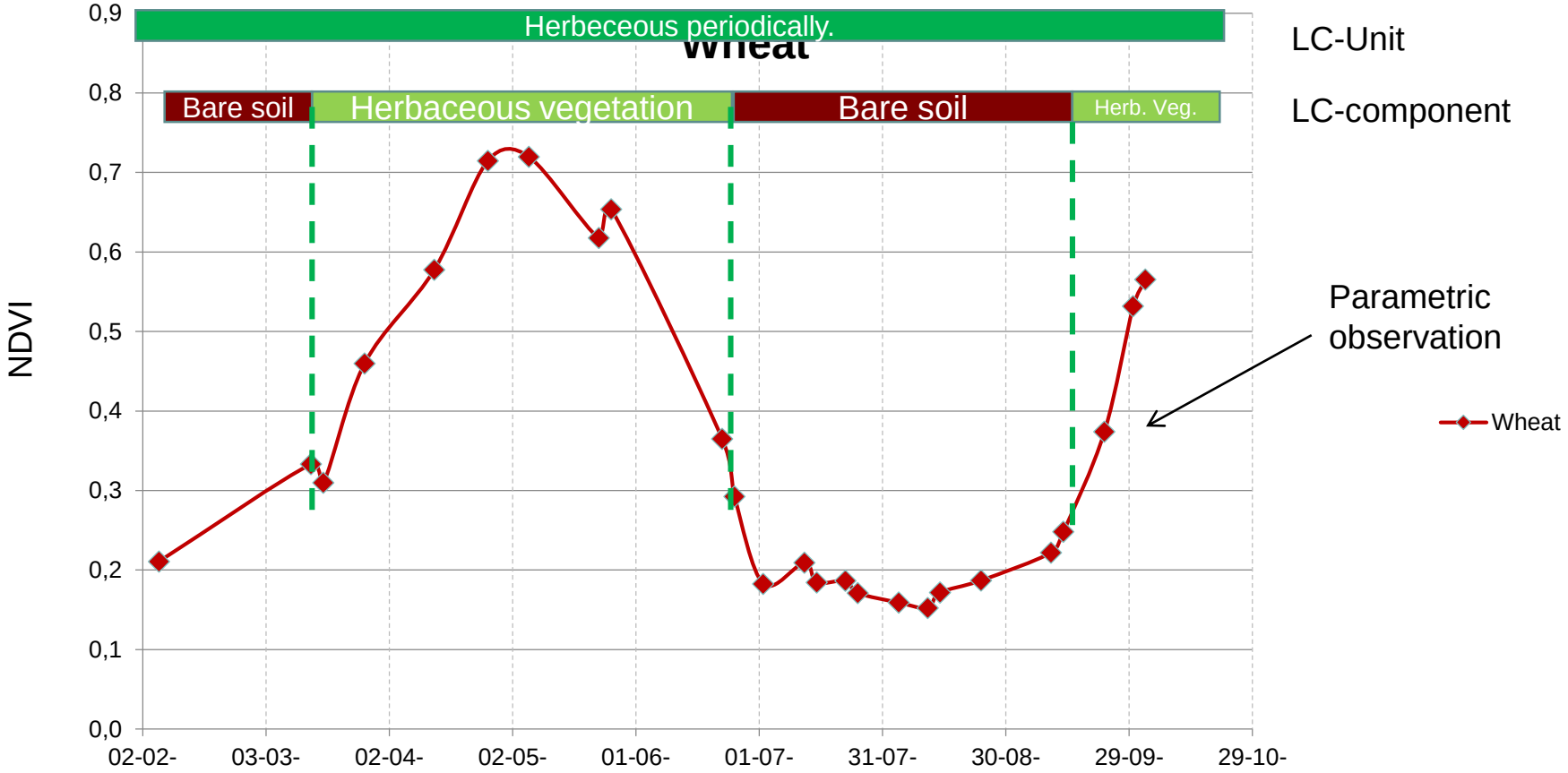

Herbeceous periodically.
LC-Unit
Herbeceous veg.
Herbeceous veg.
bare soil
bare soil
bare soil
LC-component
Parametric observation
80
70
60
50
40
30
20
10
0
-10
22.11
22.12
21.01
20.02
21.03
20.04
20.05
19.06
19.07
18.08
17.09
17.10
16.11
16.12
15.01
NDVI



Wheat – vegetation cycle




Wheat
NDVI
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
02-02-
03-03-
02-04-
02-05-
01-06-
01-07-
31-07-
30-08-
29-09-
29-10-
Harvest:
6. July
Wheat


Wheat
Herbeceous periodically.
Bare soil
Herbaceous vegetation
Bare soil
Herb. Veg.
NDVI
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
02-02-
03-03-
02-04-
02-05-
01-06-
01-07-
31-07-
30-08-
29-09-
29-10-
LC-Unit
LC-component
Parametric observation
Wheat

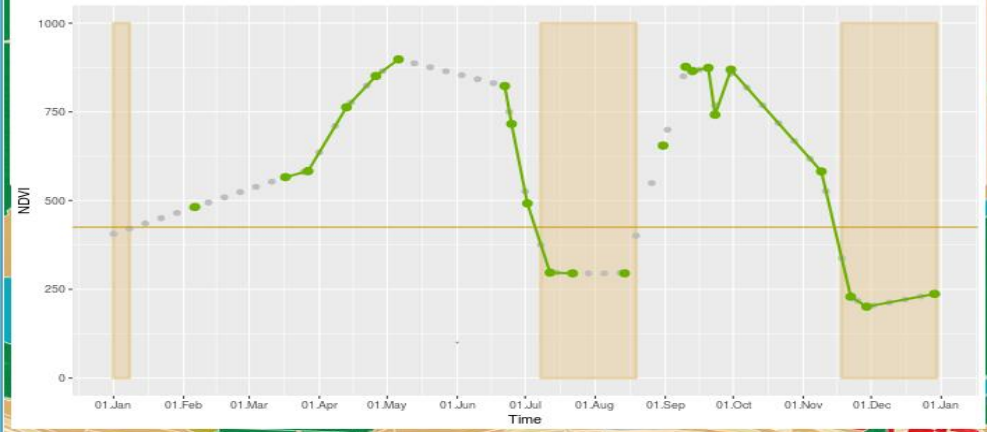
GeoVille - Shiny Server | Final Enriched LISA Land

demo.geoville.com/shiny/cadenv/p2/wien/

Final Enriched LISA LandCover Dataset - Vienna East | Showcase

Data Explorer

Parametric observation: NDVI



LC components

Valid from	Valid to	Type
2016-01-01	2016-01-08	Bare Soil
2016-07-08	2016-08-19	Bare Soil
2016-11-18	2016-12-30	Bare Soil
2016-01-08	2016-07-08	Herbaceous vegetation
2016-08-19	2016-11-18	Herbaceous vegetation

LC Unit

Class:	Herbaceous periodic
Datasource:	INVEKOS 2016
Bare Soil Count:	3
NDVI min:	195
NDVI max:	898
NDVI mean:	582

Legend

- Buildings
- Sealed Area
- Permanent Soil
- Scree
- Bare rock
- Surface water
- Trees
- Bushes
- Dwarf Shrubs
- Herbaceous
- Coniferous Forest
- Mixed Forest
- Deciduous Forest
- Herbaceous Permanent

DOCUMENTATION AND TOOLS

- EAGLE website: http://land.copernicus.eu/eagle
- 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
  - North-Rhine-Westfalia Environmental Agency: “NUMO NRW”, Nature and Environmental Monitoring for multi-purpose reporting
  - Spain: SIOSE – object oriented data model as successor to EAGLE
  - Austria: LISA – Land Information System Austria, Onthology based reasoning of CLC using LISA-classes
- Scientific applications
  - IIASA: Comparison of OpenStreetMap land use types with EAGLE

EXAMPLE FOR EAGLE LAND COVER COMPONENTS (LCC)

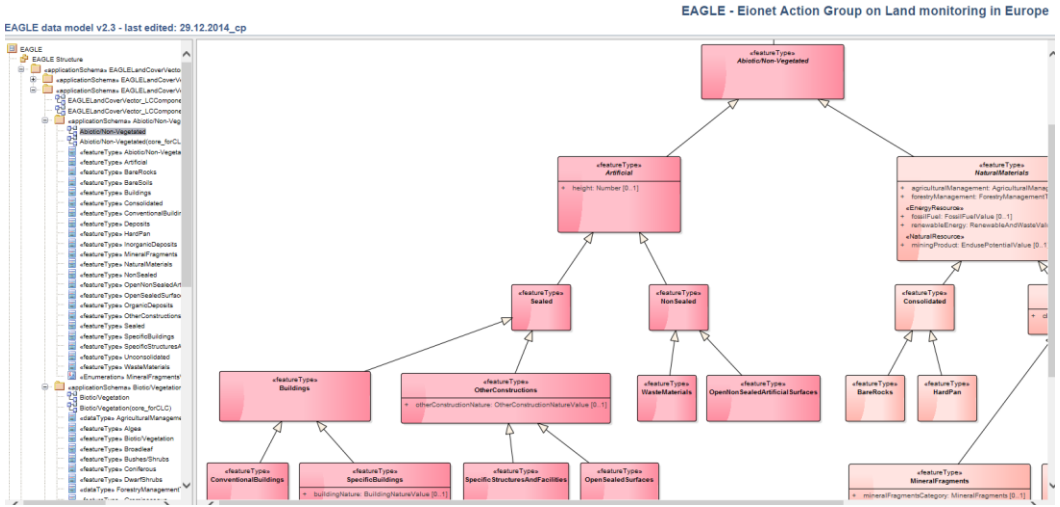
- Transformation of LISA classes (Land Inofrmation System Austria) → EAGLE LCC

LISA-class				EAGLE-classes	
abiotic	built-up	1	building	1111	Buildings
		2	other constructed area	1112	OtherConstructions
	non-built up	3	bare soil	1223	BareSoils
		4	screes	1221	MineralFragments
		5	bare rock	1211	BareRocks
	water	6	surface water	312	InlandWater
		7	snow	321	Snow
		8	ice	322	IceAndGlaciers
biotic	woody	9	trees	211	Trees
		10	bushes	2121	RegularBushes/Shrubs
		11	dwarf shrubs	2122	DwarfShrubs
	herbaceous	12	herbaceous vegetation	22	Herbaceous
		13	reeds	2212	Reeds, Bamboos and Canes

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

Stephan Arnold, Michael Bock, Barbara Kosztra, Stefan Kleeschulte, Gebhard Banko, Geoff Smith, Christoph Perger, Michael Bock, Geir-Harald Strand, Cesar Martinez, Julian Delgado, Roland Grillmayer, Gergeley Maucha, Mario Caetano, Andreas Littkopf, Lena Hallin-Pihlatie, Gerard Hazeu, Nuria Valcarcel, Johannes Scholz, Radko Radkov, ….
….. and many more ….

EAGLE Land Monitoring in Europe

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