Multi-scale Service for Monitoring NATURA 2000 Habitats of European Community Interest

1st World Sustainability Forum

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S. Lang, L. Pernkopf, J. Vanden Borre, M. Förster, B. Haest, O. Buck and A. Frick

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“Biodiversity is (our) life”

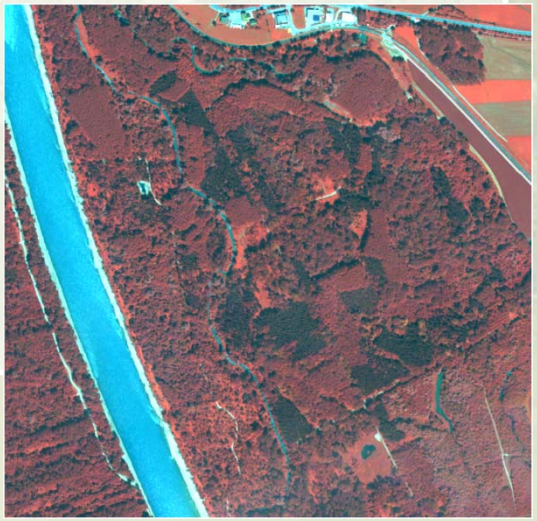
The United Nations has declared 2010 as the International Year of Biodiversity (IYB) to create awareness about the crucial importance of biodiversity to society, to communicate the human costs of biodiversity loss, and to enthuse people, particularly youth, throughout the world in the fight to protect all life on Earth. [Indian Biodiversity Congress 2010]

Hmm -did we reach that target in 2010? Better be a bit more precise …

- UN Convention on Biological Diversity (1992)
  - key for the conservation and sustainable use of biodiversity and for the fair and equitable sharing of benefits
- Biodiversity 2010 target
  - … to halt the decline of biodiversity by the end of 2010!
- Beyond IYB 2010 ➔ 2020 target(s)
  - “Life in harmony” (Nagoya Biodiversity Summit COP 10)
  - Target 1: *Halt the deterioration in the status of all species and habitats covered by EU nature legislation and achieve a significant and measurable improvement so that, by 2020, 100% more habitat assessments [...] show an improved conservation status.*
- The European Way
  - One crucial step, taken already decades ago: protecting habitats (instead of single species)
  - European NATURA 2000 concept (Habitat Directive) – role model?
  - Area effective, umbrella function, (Earth) observable!

NATURA 2000

„ … Is at present [2002!} one of the world‘s most effective legal instruments concerning biodiversity and nature conservation … but also most ambitious“ (Weber & Christophersen, 2002)



Fostering sustainability

- The intention of NATURA 2000 is not to stop any development within the sites!
- But to secure a favourable status under management strategies
- Sustainable development (in ecological, social and economic terms)
- Rich biodiversity…
  - is imperative from an environmental point of view.
  - also ensures sustainable social and economic conditions.

NATURA 2000 (HabDir) – key §

- **Article 17** of the **Habitat Directive (HabDir, 92/43/EEC)** requires Member States (**MS**) to **report** every **six years** about the progress made with the implementation of the Habitats Directive. The main focus of the directive is on **maintaining and/or restoring** a favorable conservation status for habitat types & species of community interest.
- **Monitoring** of conservation status is an obligation arising from **Article 11** for all habitats (as listed in Annex I) and species (as listed in Annex II, IV and V) of community interest. Consequently this provision is not restricted to Natura 2000 sites and data need to be collected both **in and outside** the Natura 2000 network to achieve a full appreciation of conservation status. ➔ **Management plans** and **appropriate assessments** (of impacts)
- According to **Article 10** Member States shall endeavour, where they consider it necessary, in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence of the NATURA 2000 network, to encourage the **management of features of the landscape** which are of major importance for wild fauna and flora.



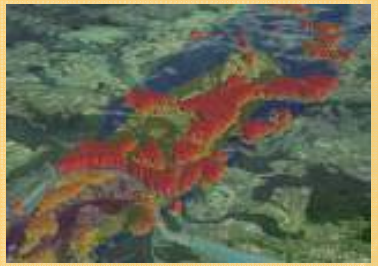

GMES *Because we need to know …*

Environmental integrity

Human security

Supporting monitoring tasks in Europe and globally

Integrated workflows for providing geospatial information services



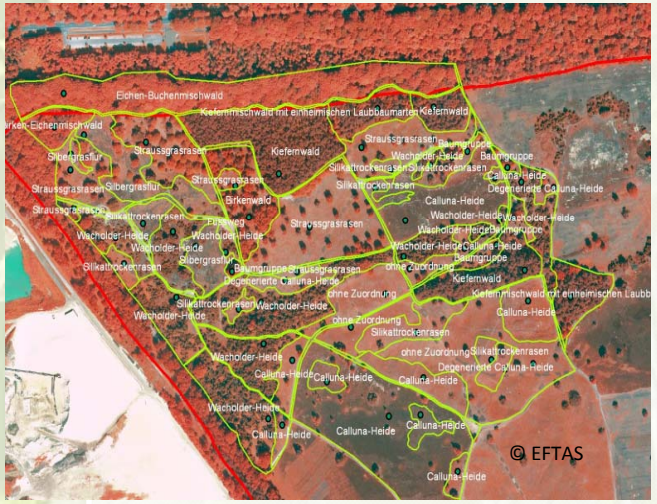
MS.MONINA

- Overall aim
  - MS.MONINA supports European, national and local authorities in monitoring the state of European nature sites of **'community interest'** … not only at the benefit of EU **national authorities**, but also aimed at **local authorities** that manage these sites, and **EU authorities** that oversee the overall development of the NATURA 2000 programme.
- The project is designed to provide three integrated services
  - At the **local level** the project will support site monitoring with information products meeting the requirements of site managers. These products are derived from high resolution satellite images and reflect habitat status and changes.
  - At the **national level**, the project engages in complete reporting on sensitive sites and habitats, delivered to national authorities responsible for reporting on the implementation of the Habitats Directive, and
  - at **European level** MS.MONINA provides region wide reporting on the implementation of the Convention on Biological diversity within the EU.

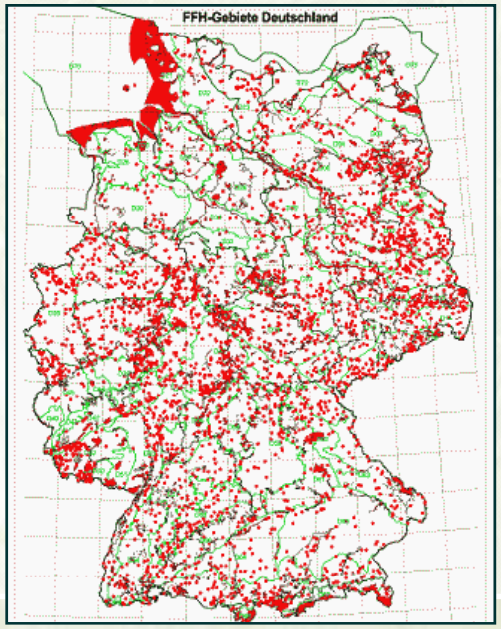
MS.MONINA

Envisaged achievements for European biodiversity monitoring

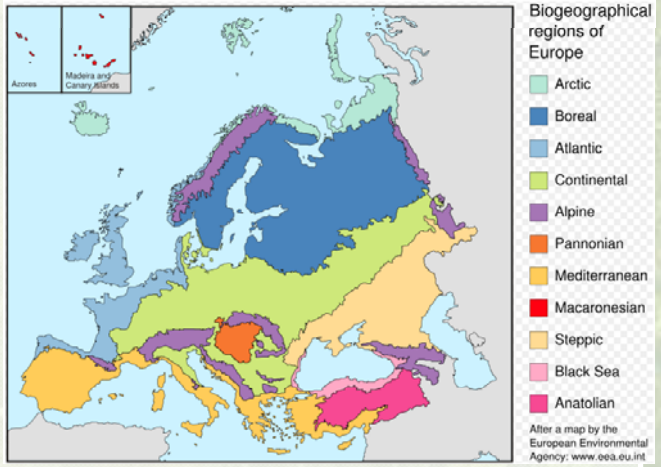
- The integrated multi-level service concept helps ambitious instruments such as NATURA 2000 succeed on different levels of implementation.
- Our tools will also observe precious habitats outside the existing network of protected areas to reduce the loss of biodiversity.



site



State



EU

SEVENTH FRAMEWORK PROGRAMME

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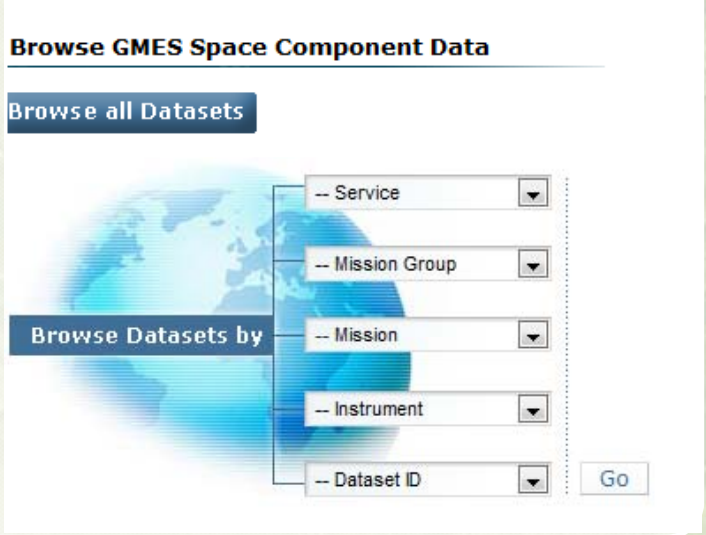
MS.MONINA

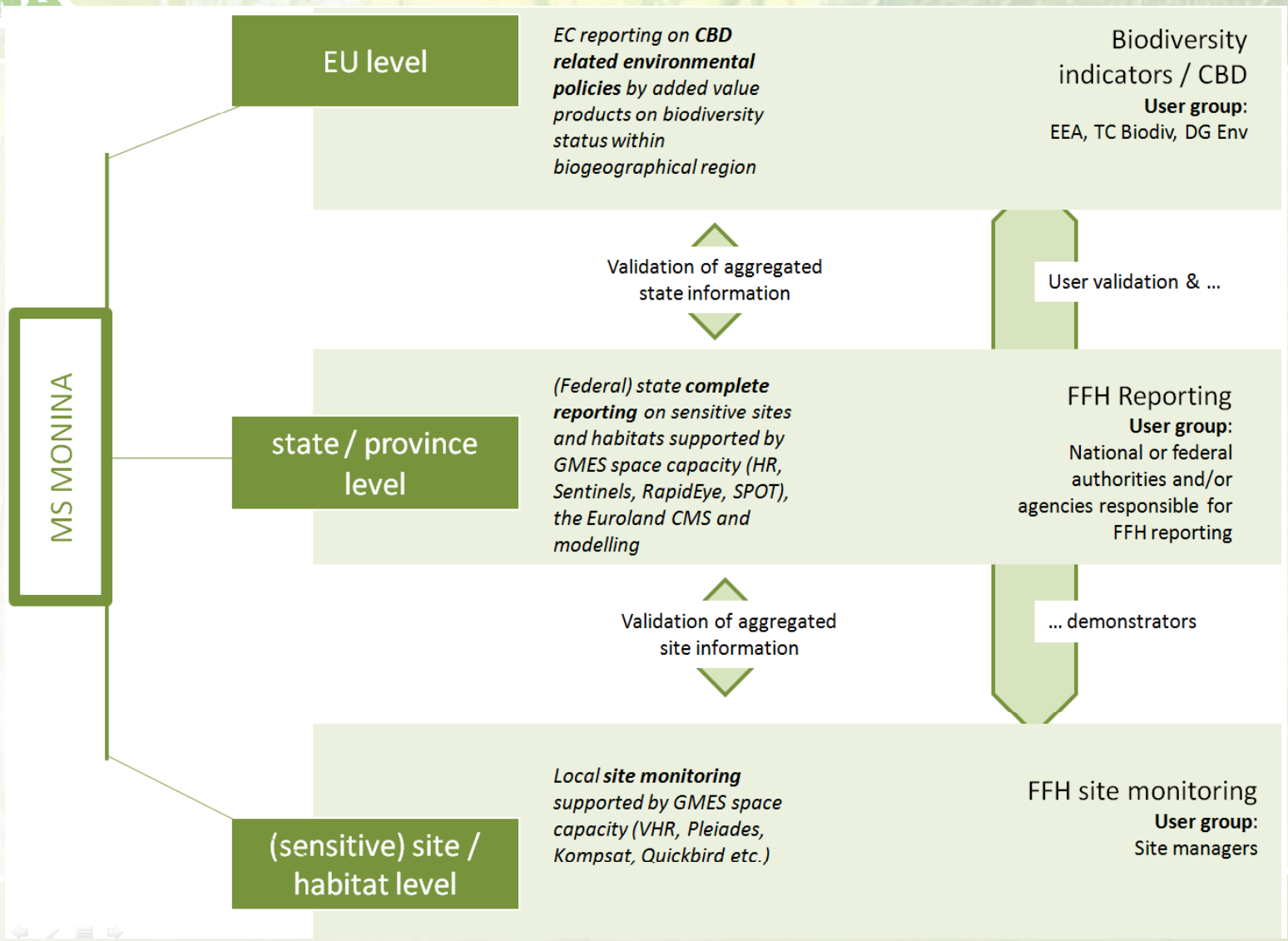
Envisaged technical achievements

- The project shall use EO technology to effectively monitor nature sites of community interest and thus fostering environmental legislation in Europe.
- Europe's outstanding EO-based monitoring tools will encourage other countries for such environmental legislation in the spirit of the CBD.



•**Sentinel 2**: multispectral high-resolution imaging mission for GMES land monitoring to provide, for example, imagery of vegetation, soil and water cover, inland waterways and coastal areas (2012 …)

Overall service concept



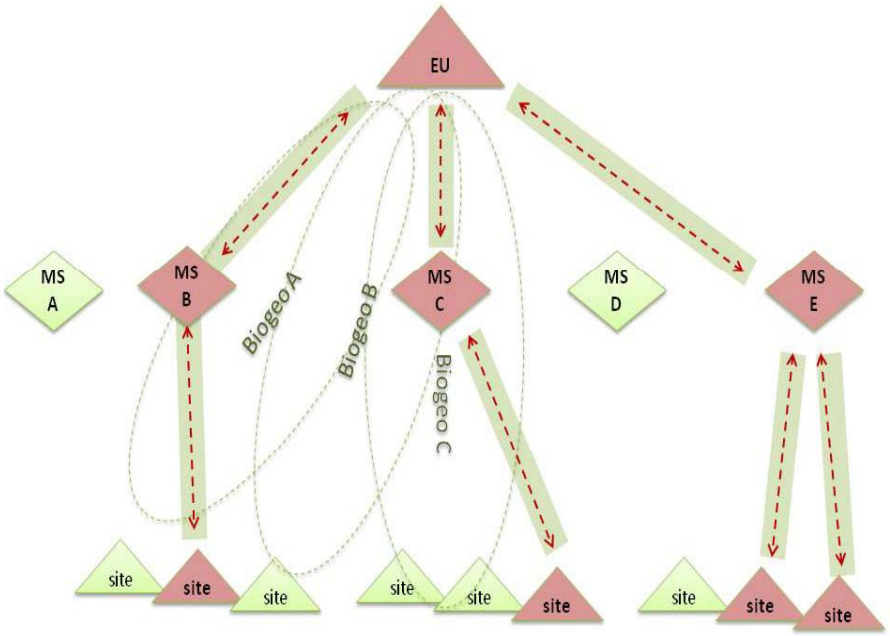
An integrated service …

- Integration strategies
  - MS.MONINA 'state integrator' (pivotal mechanism, member states have core responsibilities)
  - Building a hierarchical service chain

*Among the many possible hierarchical relations between the **EU** (on top) and **individual protected sites** (on the bottom), there are **member states** (MS) in between, located in different biogeographical regions (overlapping).*

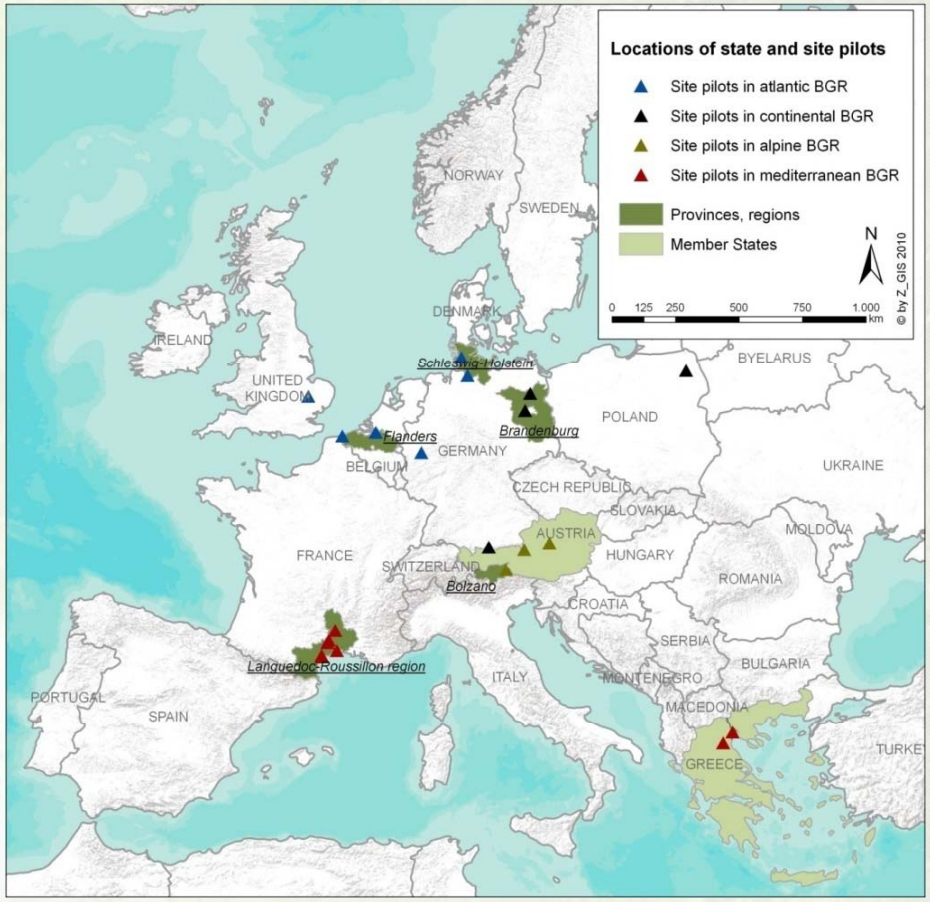
*Vertical view within a specific biogeographical region (BGR), highlighting the **hierarchical relationships** among each of the levels (MS not necessarily within one BGR and vice versa).*

*Selected vertical components (e.g. EU ⇔ MS E ⇔ sites b, c) are building a **service chain**. **Service chains** are formed by 'trans-level' applications within BGR, and including the EU level.*



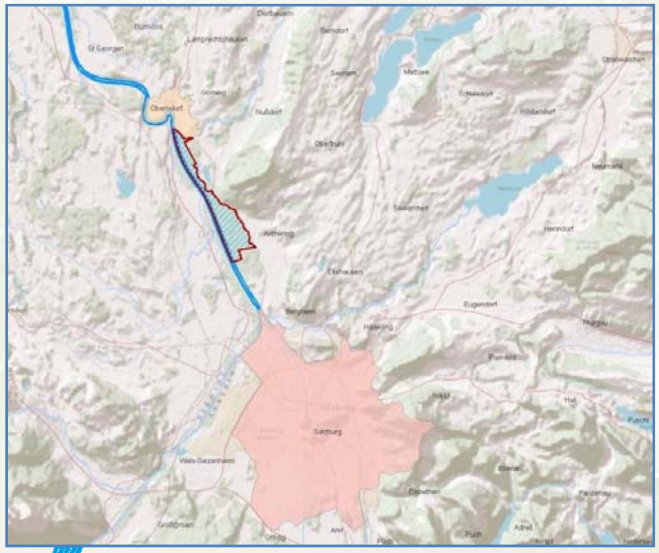
MS.MONINA service pilots

- Detailed specification of pilots (EU, 6 state / 30 site pilots)
  - User needs documented in SLAs
  - Detailed data repository and (satellite and in-situ) and documented requirements
  - Potential threats and human impacts
  - Indicator-based approach (e.g. SEBI indicators)
  - Modelling of potential hot spots outside protected sites



Pilot site Salzachauen (AT)

- Natural fluvial landscape, one of the last not dammed river sections in the Alps (area: 1120 ha)
- Recent re-naturation activities restoring natural riparian structures
- Located in a densely populated area and exposed to a constant development pressure (bridge construction project)



9170	*Galio-Carpinetum* oak-hornbeam forests
9180*	*Tilio-Acerion* forests of slopes, screes and ravines
91E0*	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)
91F0	Riparian mixed forests of *Quercus robur, Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)

91F0*

91E0*

Impacts and information needs

Anthropogenic impacts

- River regulation (J02.03*)
- Agricultural land use (A)
- Settlement pressure (E01)
- Waste deposit site (E03)
- Transport infrastructure (D01)

Information needs

- Monitoring of agricultural intensification
- Land use pressure (mainly infrastructure and settlements)
- Effects of river regulation and deregulation
- Changes in biodiversity and habitats

In particular 91E0* (Alluvial forests)

Pressures: disappearance due to river regulation and lowering of groundwater table, drying up of bayous and cutoff of connections between water courses

Management: restoration and regulation and reactivation of former bayous

Indicators

- increase of habitat area and connectivity
- proximity measures

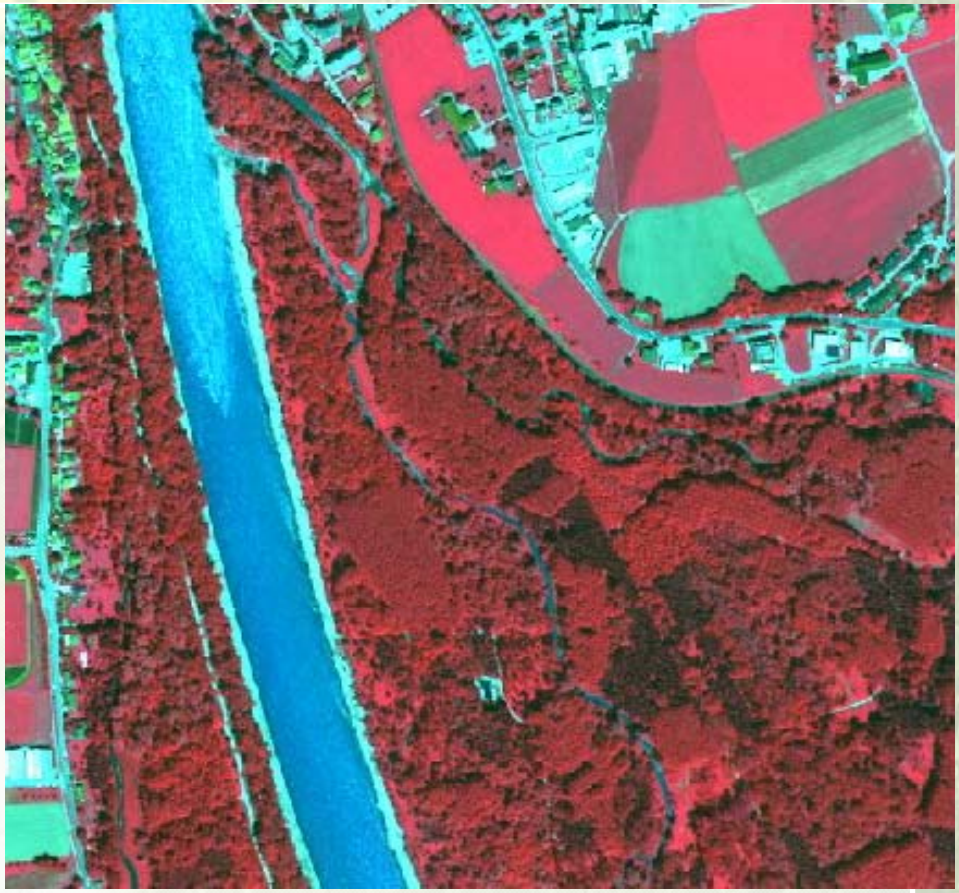
Data

- high-resolution data (HR, better VHR)
- ALS (forest structure, height classes)

* = EIONET code

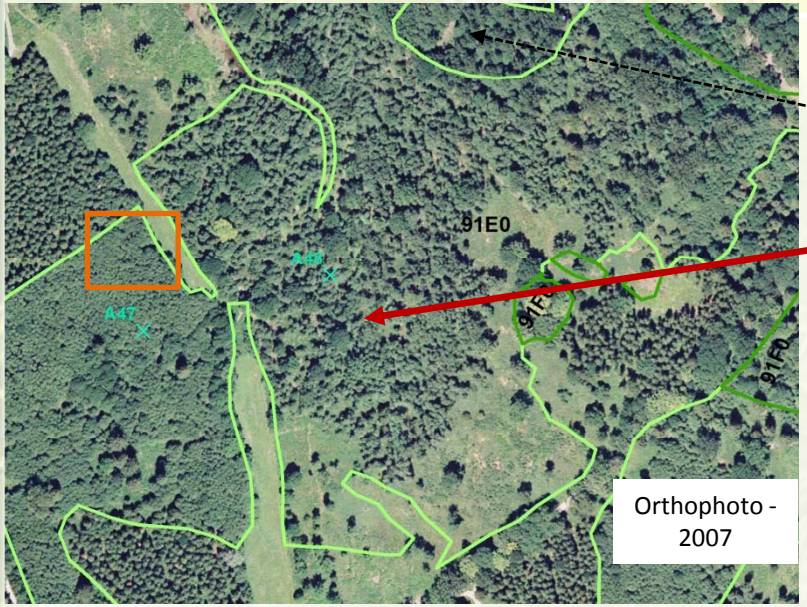
VHR optical satellite data

- Dominating habitat types
  - alluvial forests (91E0) and riparian mixed forest (91F0) including rare geophytes, prevalent species as Fraxinus excelsior, Alnus incana, Salix alba, Quercus robur and Acer pseudoplatanus.
- Disturbances
  - fragmentation of habitats by forest plantations with *Picea abies*, *Popolus canadensis*.
  - Continuous urbanisation
  - invasive non-native species (neophytes) and fungal parasitism on ashes
- Worldview-2 satellite imagery and object-based image analysis (OBIA)
  - habitat type modelling
  - vitality assessment
  - using Coastal, Green, Red Edge and NIR1



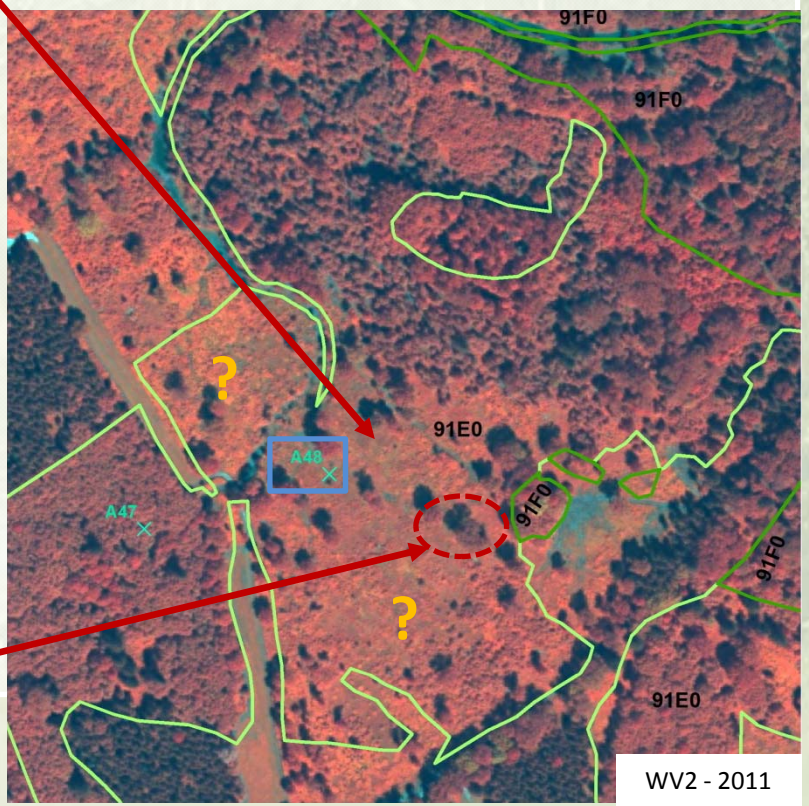
WorldView-II, 8 bands
July 9, 2011
& Sept 12, 2011 (not shown)

Change indication



91F0: ***Riparian mixed forest***

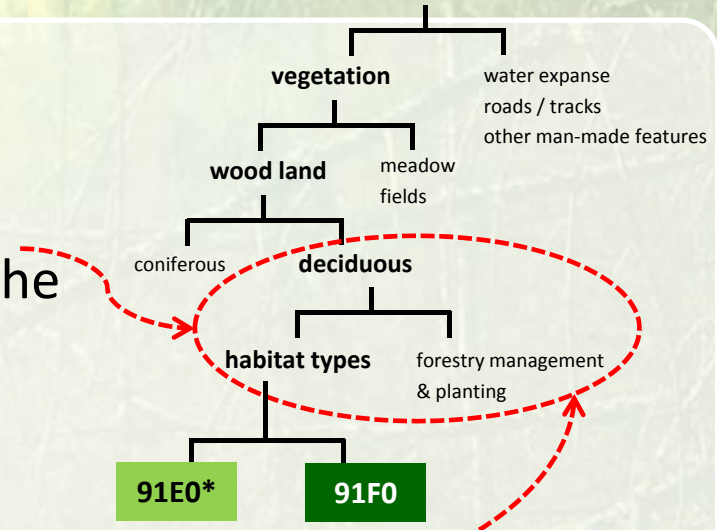
91E0: ***Alluvial forest (alder dominated, single oak trees)***



Oak trees

Habitat classification

- Main challenge
  - separating key habitat types from forestry management composed by the same pre-dominant species
  - Object-based image analysis can be used to model structural habitat arrangements



White Willow *(Salix alba)*
Gray Alder *(Alnus incana)*
Ash *(Fraxinus exclesior)*
Sycamore Maple *(Acer pseudoplatanus)*
Pedunuculate Oak *(Quercus robur)*

Code	Class	Spectral	Shape	Structure	Topology	Predominance	Other Info
91E0	Alluvial forests	No		X	X	X	X
91F0	Riparian mixed forests	No		X	X	X	X

Class modelling

***forest management**:*
homogenous patch
(deciduous)

91F0: ***Riparian mixed forest***

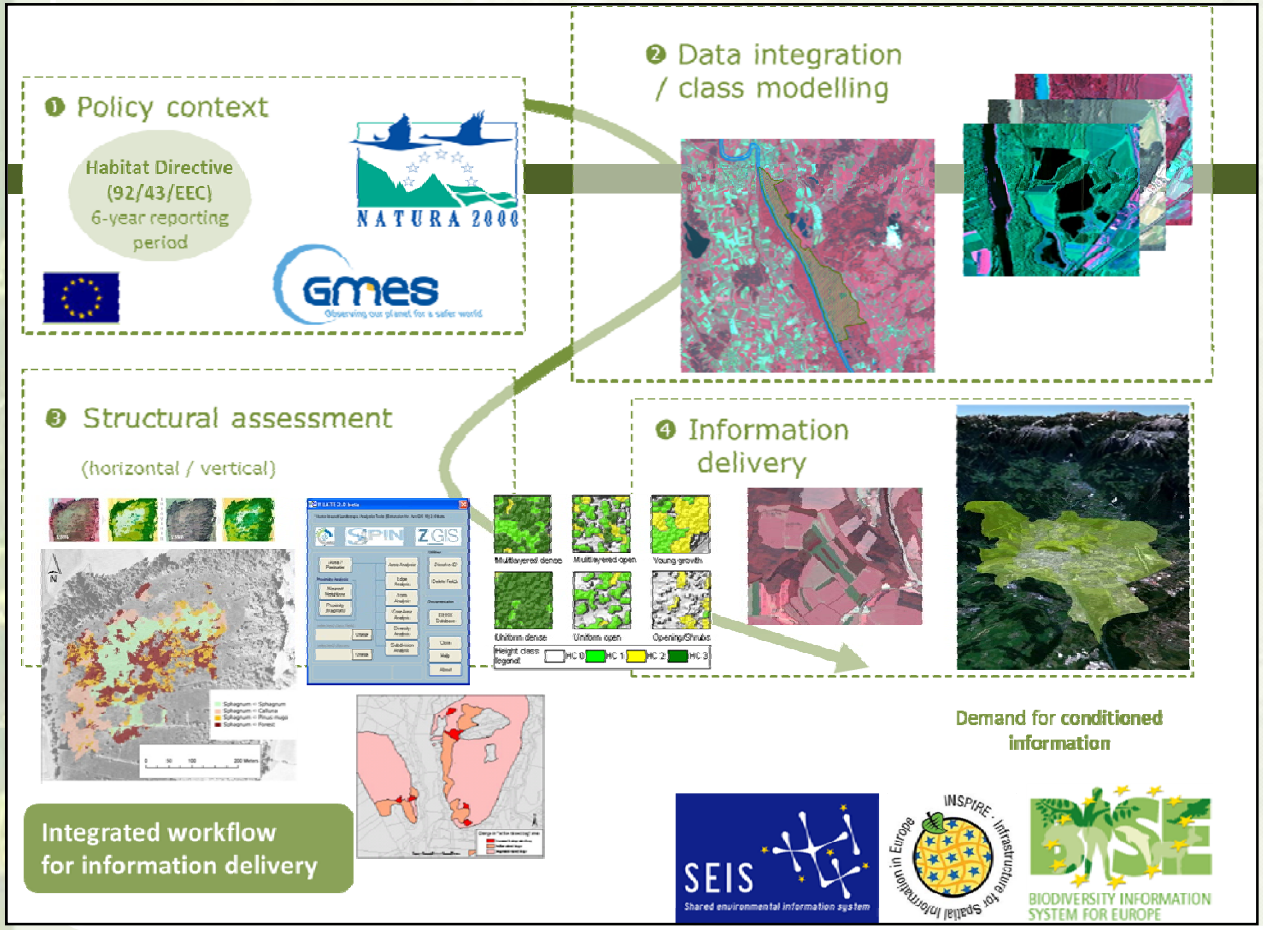
91E0: ***Alluvial forest***

good match

Specific ***composition***

loss** of **area

Integrated workflow

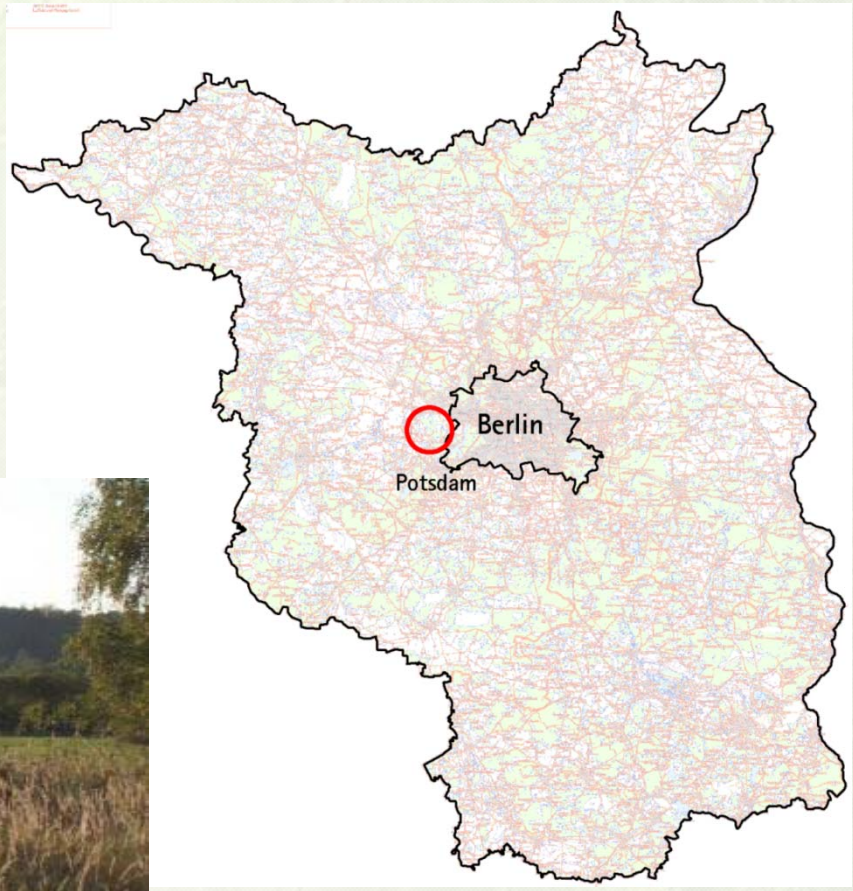


Indicators

- Cover of forest habitats
- Connectedness and fragmentation of habitat patches
- Density / lengths and connectivity of streams
- Percentage of regulated river segments
- Density and distribution of neophytes

Pilot site Döberitzer Heide (DE)

- Nature conservation areas Ferbitzer Bruch & Döberitzer Heide
- Part of Natura2000 SCI and SPA
- Former military training site
- Habitat for many endangered species, especially in wetland and dry heathland habitats



Ground truth data collection

Biotope types:

- reed
- wet grassland
- extensive grassland
- dry grassland
- heathland
- fallow grassland
- forbs

Frischwiesen und -weiden
Extensive grassland and pastures

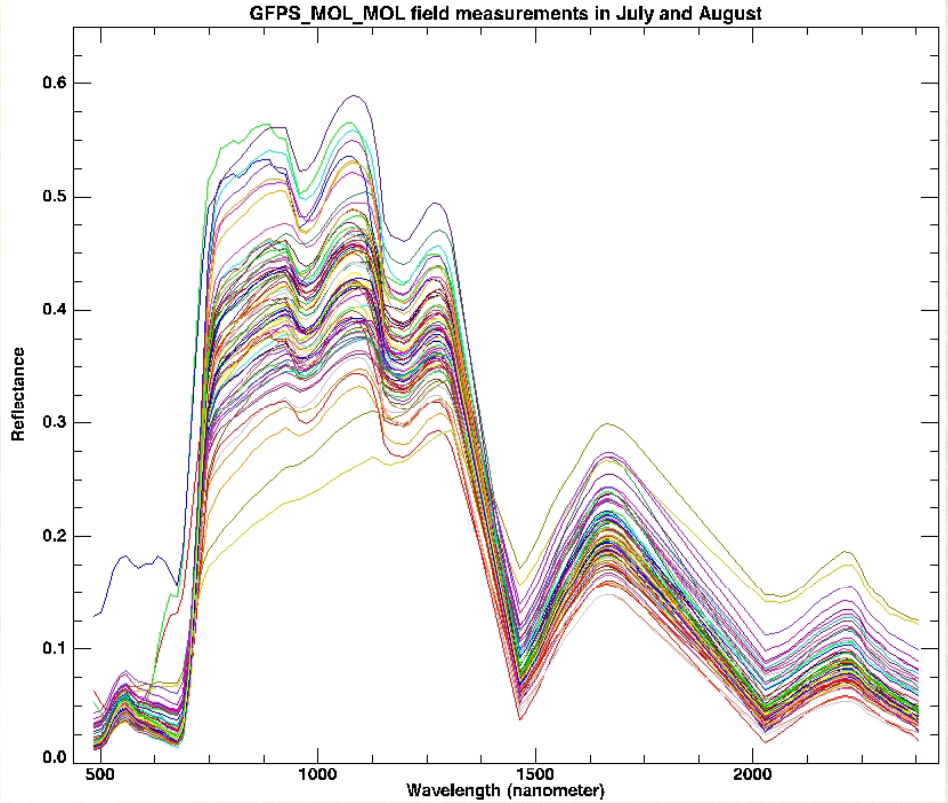
Feuchte Hochstauden/Grünlandbrachen
Wet tall forbs (LRT 6410)

Feuchtwiesen und -weiden
Wet grassland and pastures

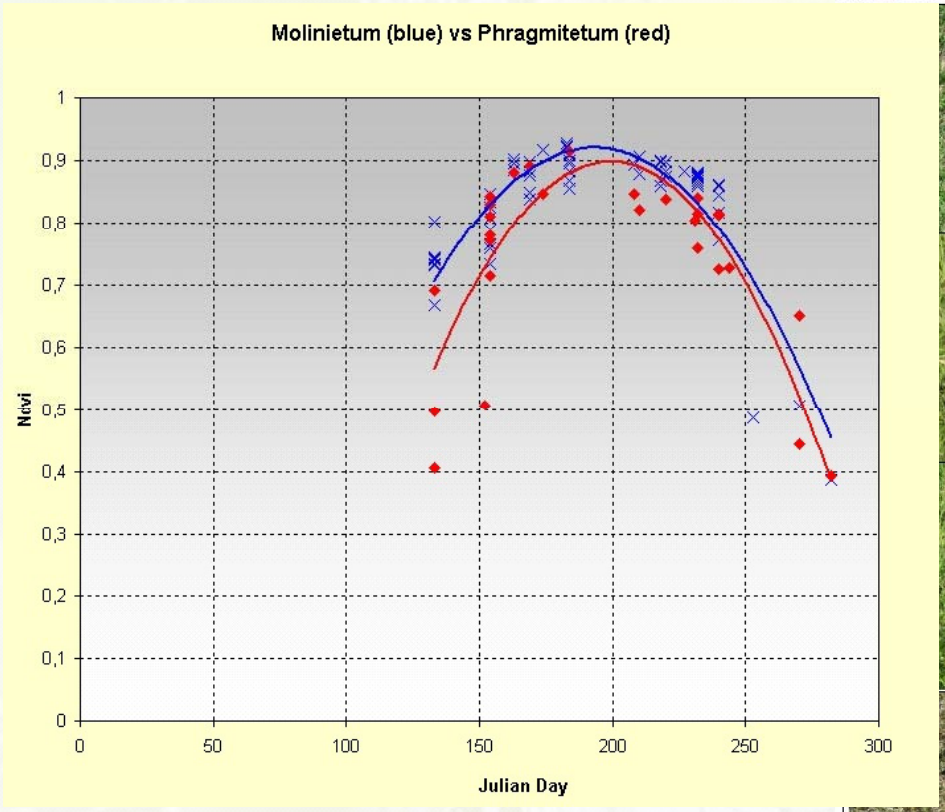
Röhricht
Reed

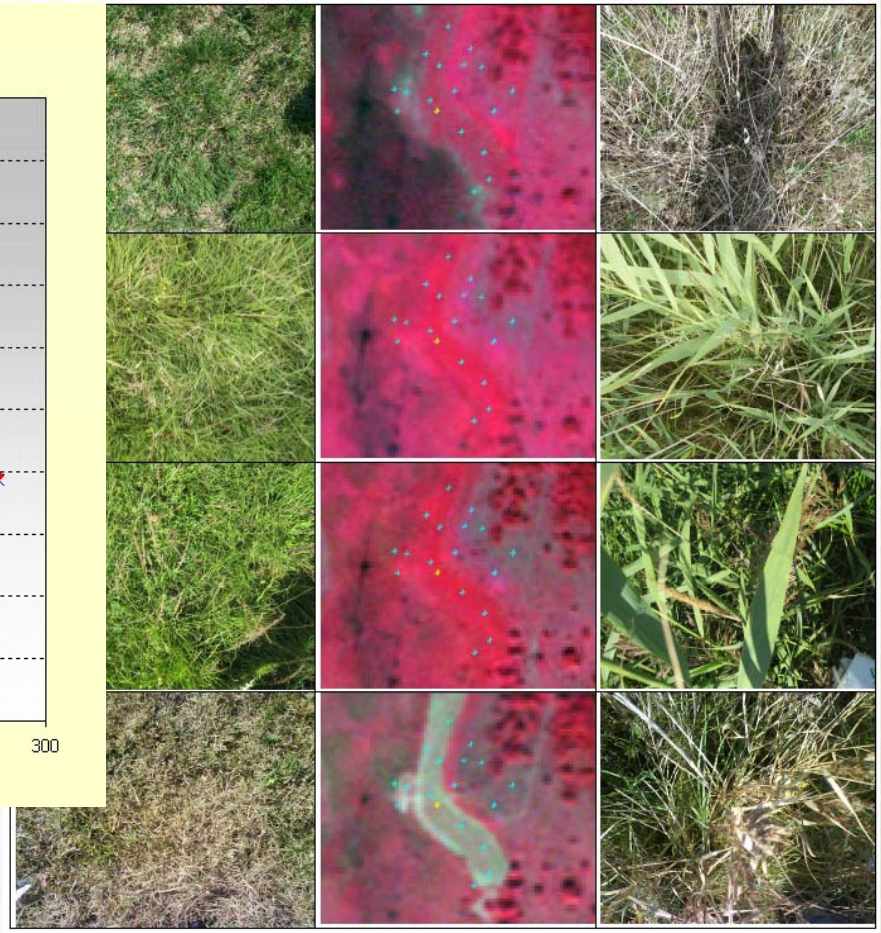
Utilization of Spectral Information (HyMap)

- Inner-class variability can be much higher than inter-class variability (e.g. due to different mowing cycles)
- Thus concentration on indices and derivatives rather than original spectra
- Indices used e.g.:
  - Cellulose absorption index
  - Red edge NDVI
  - Pigment specific simple ratio-chlorophyll-b and chlorophyll-a
  - Ratio analysis of reflectance spectra-chlorophyll-b and chlorophyll-a

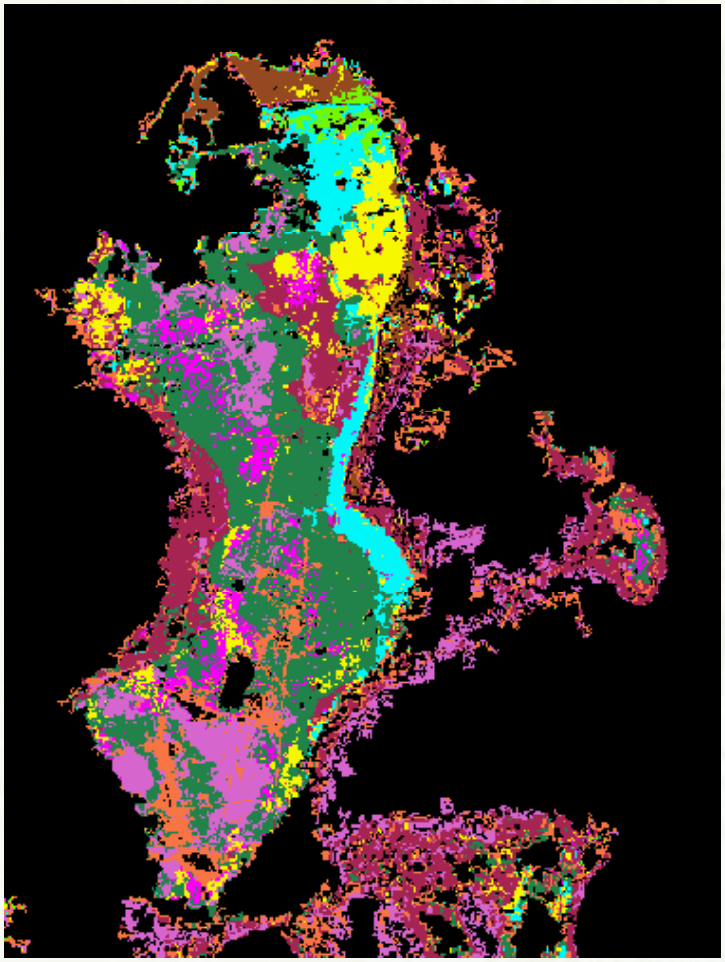


Utilization of temporal information (RapidEye)





First classification results

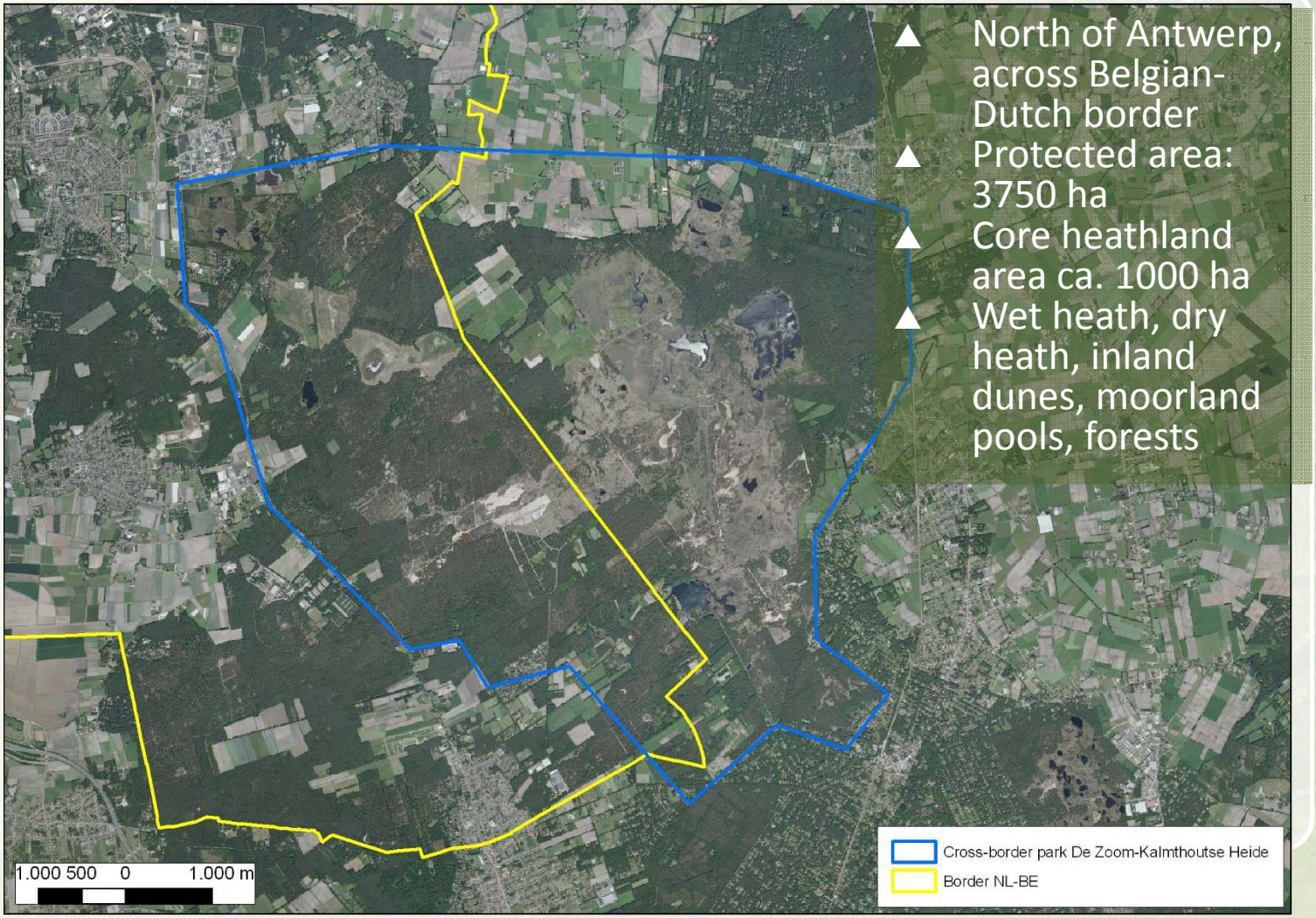


Class	Biotop. type (LRT)	Biotope description	Formation	Association
MEPP_PHR_PHR	04511	common reed in eutroph / polytroph fens and swamps	Phragmition australis (W. Koch 1926)	Phragmitetum australis (Gams 1927) Schmale 1939
MEPA_CAR_PHA	04514	reed canary grass in eutroph / polytroph fens and swamps	Caricion elatae W. Koch 1926	Phalaridetum arundinaceae Lib. 1931
GFS_CAR_XAC	05101	grassland dominated by sedges	Caricion elatae W. Koch 1926	Caricetum acutiformis Eggler 1933
GFS_CAR_XGR	05101	grassland dominated by sedges	Caricion elatae W. Koch 1926	Caricetum gracilis Almquist 1929
GFS_CAR_XAP	05101	grassland dominated by sedges	Caricion elatae W. Koch 1926	Caricetum appropinquatae (W. Koch 1926) Aszod 1936
GFP_MOL_MOL	05102 **(6410)**	nutrient-poor wet grassland	Molinion caeruleae W. Koch 1926	Molinietum caeruleae W. Koch 1926
GFR_CAL	05103	nutrient-rich wet grassland	Calthion palustris Tx. 1937	-
GAFP_PHR_PHR	051311	fallow grassland dominated by common reed	Phragmition australis (W. Koch 1926)	Phragmitetum australis (Gams 1927) Schmale 1939
GAFJ_ELE_ELE	051315	fallow grassland dominated by spike rush	Eleocharito-Sagittarion sagittifoliae Pass. 1964	Eleocharitetum uniglumis Almqu. 1929

Additional aspects

- Remote sensing with either high spectral or high temporal resolution can be a very important database for the monitoring of vegetation especially for:
  - NATURA 2000
  - Biodiversity
  - Invasive species
  - Habitat modelling
- The standardised collection of spectral vegetation characteristics and the integration in a public database should be widely propagated
- More model-based approaches should be tested for complex natural habitats (e.g. PROSPECT+SAIL)

Pilot site Cross-border park De Zoom-Kalmthoutse Heide (BE-NL)



- North of Antwerp, across Belgian-Dutch border
- Protected area: 3750 ha
- Core heathland area ca. 1000 ha
- Wet heath, dry heath, inland dunes, moorland pools, forests

Pilot site Cross-border park De Zoom-Kalmthoutse Heide

- Threats & pressures
  - Desiccation through drinking water extraction (J02.07.02)
  - Grass-encroachment and dune fixation through nitrogen deposition (H04.02)
  - Overrecreation (G05.01)
  - Uncontrolled wildfires (J01)

Pilot site Cross-border park De Zoom-Kalmthoutse Heide

- Indicators
  - Cover of dwarf shrubs
  - Cover of Purple moorgrass
  - Cover of *Campylopus introflexus*
  - Cover of bare soil
  - Dry biomass accumulation

Strategic impact

- The MS.MONINA project will **demonstrate to users** that need to manage and report on NATURA 2000 sites the benefit they can gain by using services based on EO data; therefore it will set the crucial conditions for a significant uptake of products and a long term sustainability of the services.
- The **general goal** of the user communities that will make use of the proposed services is to feed their decision-making process on status evaluation with indispensable information. Such information is currently still largely lacking or very expensive and time-consuming to obtain (i.e. exclusively by field work)
- At **site level**, managers shall use MS.MONINA services to find out where habitat status are deteriorating or habitats are even disappearing, and what internal or external pressures and threats cause this deterioration. Site manager are expected to use this knowledge to make informed decisions about where to apply dedicated management measures in order to obtain an optimum result, and will later on be able to monitor the effects of this management.
- At **EU** and **Member State level**, the services will be used to evaluate policies at different scales and adapt them when necessary.

Conclusions

- Great potential of remote sensing techniques for deriving crucial information on the conditions of habitats and sensitive sites
  - Combining recent very high resolution satellite imagery and advanced image analysis
- Sustainability is attained in at least two aspects:
  - in the purpose of the developed information services
    - maintain and improve the conservation status of sensitive sites and the overall ecological conditions of the European Union and its biological diversity.
  - in the way how these information products are steadily offered
    - tight relationship between service providers and users.

MS.MONINA partners

Three complementary GMES actor groups

ACADEMIA & RESEARCH

UNIVERSITÄT SALZBURG Z_GIS	AT	Paris-Lodron Universität Salzburg, Centre for Geoinformatics (Z_GIS)
Cemagref	FR	Cemagref
vito vision on technology	BE	Flemish Institute for Technological Research
	GR	National Observatory of Athens / Institute for Space Applications and Remote Sensing
EURAC research	IT	EURAC Research - Ins. f. Applied Remote Sensing
universitätbonn / vegetations geographie	DE	Rheinische Friedrich-Wilhelms-Universität
IGiK	PL	Instytut Geodezji i Kartografii
	DE	Berlin Institute of Technology
UNIVERSIDAD DE MÁLAGA / European Topic Centre	ES	University of Málaga - European Topic Center for Spatial Information and Analysis (UMA - ETC/SIA)

INDUSTRY / SME

EFTAS	DE	EFTAS Fernerkundung Technologietransfer GmbH
eoVision	AT	eoVision GmbH
Specto Natura	UK	Specto Natura Limited
Luftbild Umwelt Planung	DE	Luftbild Umwelt Planung GmbH

USERS (with technical contribution)

inbo	BE	Research Institute for Nature and Forest
EKBY	GR	The Goulandris Natural History Museum / Greek Biotope-Wetland Centrel (EKBY)
	DE	State Agency for Agriculture, Environment and Rural Areas of the State of Schleswig-Holstein
	FR	Regional Conservatory for Natural Areas Languedoc – Roussillon

Thank you very much!

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