Recommendations for future monitoring

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BIOPRESS final workshop, Brussels

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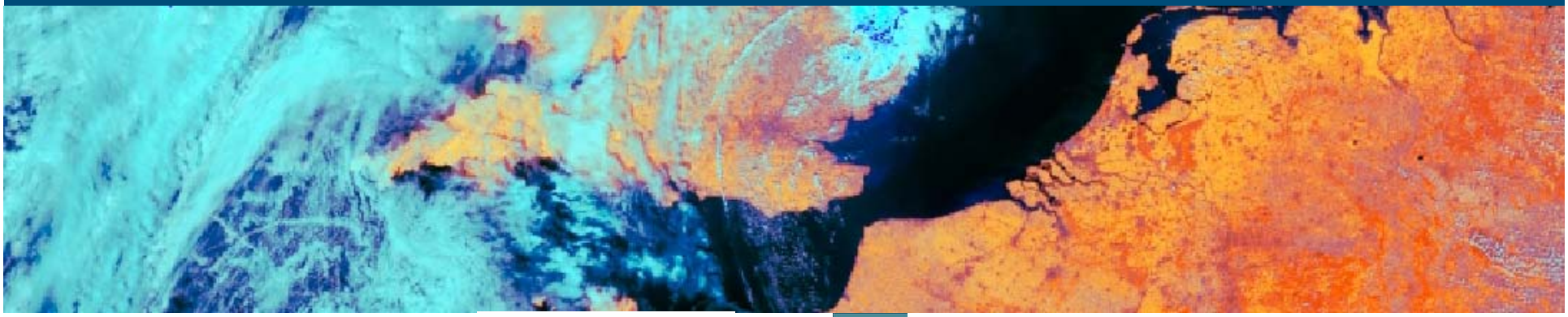


Background

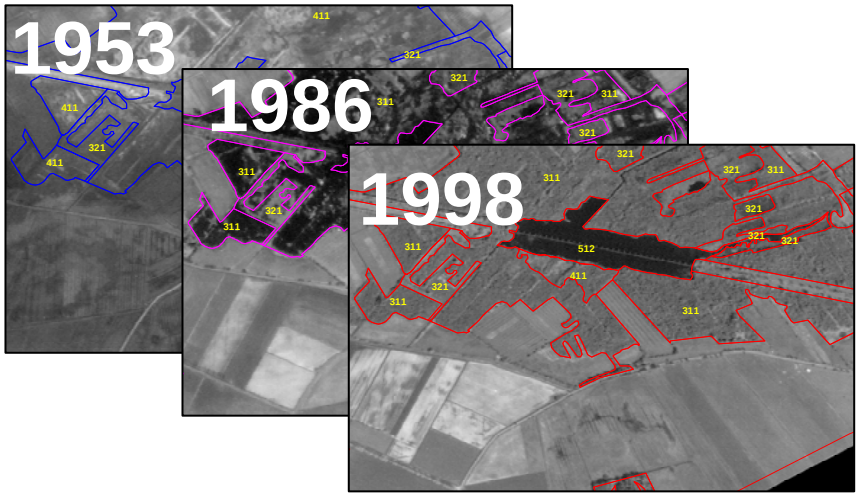
- Land cover changes play a major role in studying landscapes, ecosystems and habitats and associated impacts on climate & biodiversity.
- Urgent need for improved monitoring and survey in Europe.
- Remote Sensing sensed can play a central role in detecting land cover changes supported by in-situ data.
- Due to increased human pressures *the quality and the extent of habitats decreased dramatically across Europe*, but quantitative estimations are still lacking.
- Natura 2000 network protects primary nature conservation areas, but does not conserve *biodiversity* in the wider *countryside*.

Monitoring gap

- Biodiversity in the countryside is important because many species depend on land outside protected areas e.g. during migration and foraging.
- Therefore, we need to monitor dynamics both inside and outside Natura 2000 sites.
- A major requirement is still to provide European estimates on the extent and change of habitats.
- Giving this background, BIOPRESS and BIOHAB can play a central role to fill this gap.

Goals BioPress & BIOHAB project

- BIOPRESS aimed to develop consistent estimates for historic land cover changes through Earth Observation, linked to pressures on biodiversity.



- BIOHAB aimed at collecting consistent in-situ information on habitats through field surveys.

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Lessons from historic AP interpretations

- In many countries it was difficult to access and search AP archives.
- Difficult to find the right AP's related to specific spots.
- No two suppliers did have the same prices and copyright rules.
- Quality AP differed much between countries and years.
- Much effort needed to process the AP.

Recommendations:

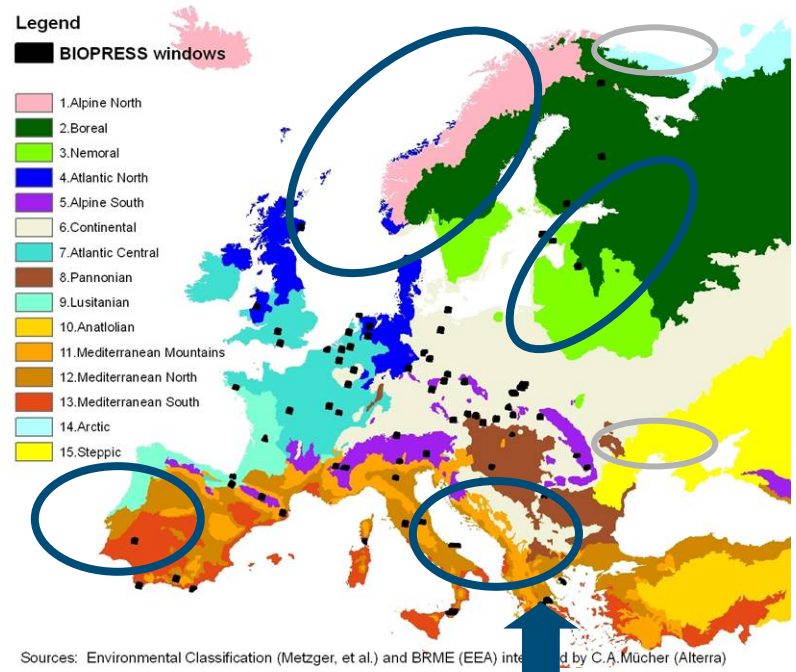
- Future use of VHRS images can speed up the acquisition process.
- Next to consisting updating methodology, it is crucial to have consistency in quality, long-term provision and affordable prices of data.


Slovakia 1974 (source ILE SAS)

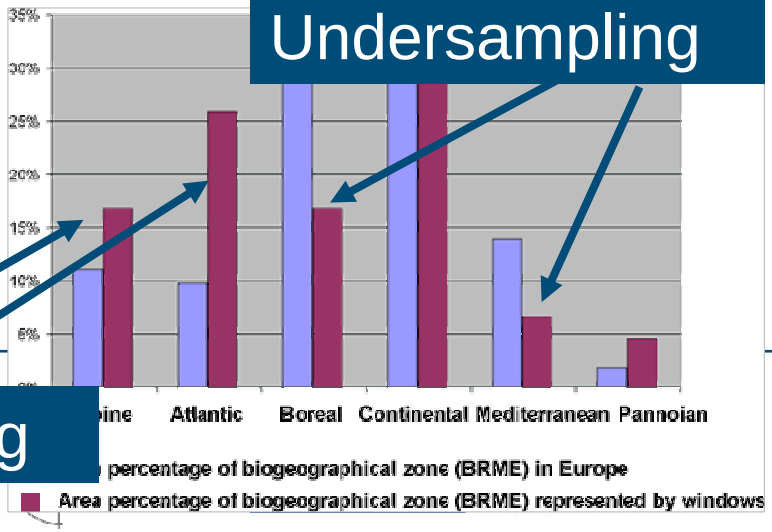

Slovakia 2000 (source ILE SAS)

Major limitations BIOPRESS results

- Although, historic land cover changes were consistent, extrapolation from transects & windows to European figures is difficult since site selection was biased towards Natura 2000 sites and samples were not well distributed.
- Stratified random sampling is needed !
- Link between land cover changes and pressures were not straightforward, except for urbanization.
- Confusion in terminology: increase in tree cover could actually mean; afforestation, natural regeneration, reforestation or canopy closure.
- Integration with in-situ data is much more needed !



Sources: Environmental Classification (Metzger, et al.) and BRME (EEA) int d by C.A.Mücher (Alterra)



Undersampling

Oversampling

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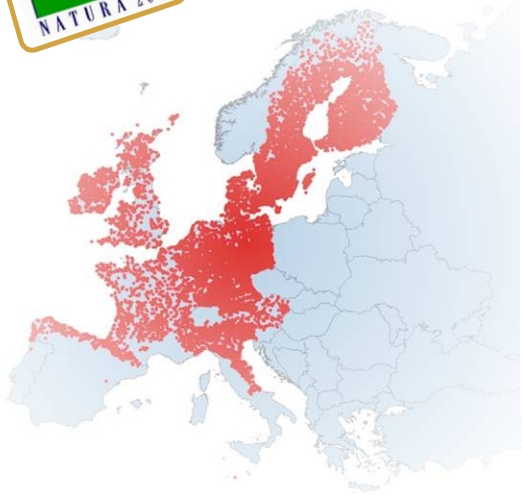
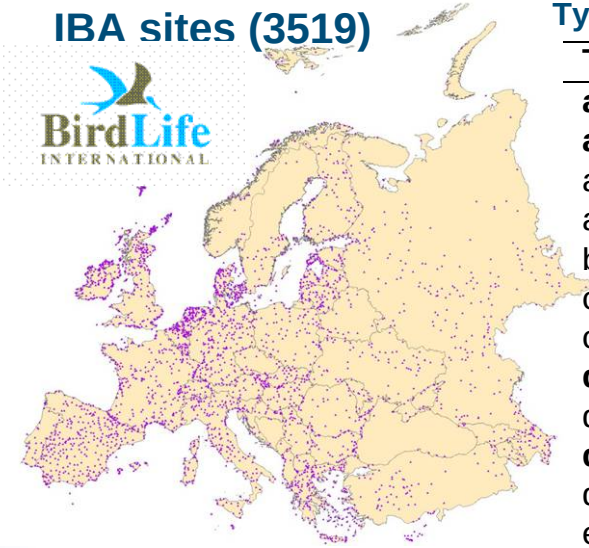
Integration with large in-situ databases

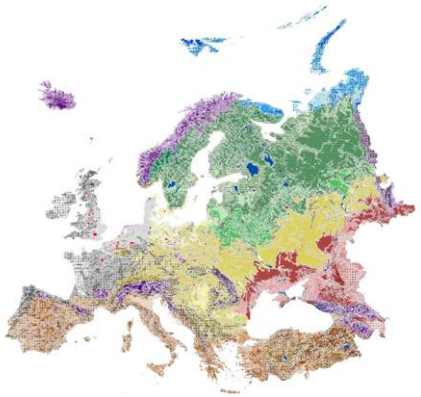
Natura 2000 sites (13.405)



IBA sites (3519)



European landscapes



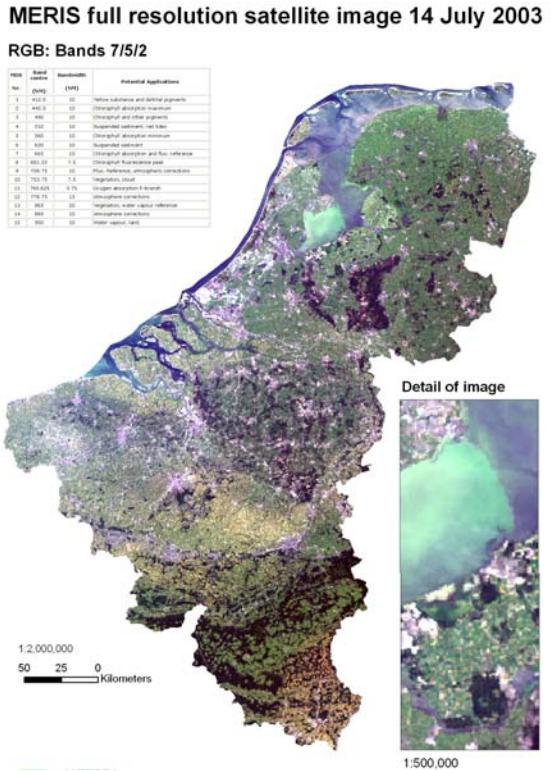
Land abandonment

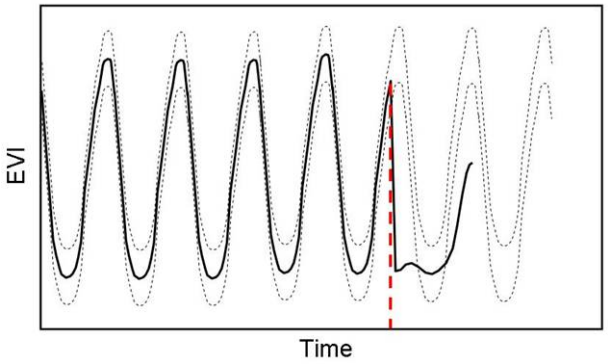
Types of threats within the IBA 2000 database

THREAT	COUNT
abandonment/reduction of land man	652
afforestation	352
agricultural intensification/expa	1340
aquaculture/fisheries	685
burning of vegetation	291
consequences of animal/plant intr	270
construction/impact of dyke/dam/b	337
deforestation (commercial)	281
disturbance to birds	1134
drainage	564
dredging/canalization	243
extraction industry	449
filling-in of wetlands	208
firewood collection	188
forest grazing	218
groundwater abstraction	243
industrialization/urbanization	751
infrastructure	796
intensified forest management	469
natural events	227
no threats identified	16
other	394
recreation/tourism	1621
selective logging/cutting	268
shifting agriculture	1
unknown	102
unsustainable exploitation	1046
Total	**13146**

Monitoring approaches

- **Stratified random sampling using** very high resolution satellite data (e.g. *Quickbird* or *IKONOS*) or AP.
- **Full cover monitoring** using low or medium resolution satellite data (*SPOT-Vegetation* or *MERIS* and *MODIS*). Even possible using *Landsat-TM* or *SPOT-XS* (eg. CORINE).
- **Temporal monitoring** using time-series with high temporal satellite data, e.g. MODIS/MERIS.





Recommendations sampling framework for monitoring European habitats (1)

Based on expiences from BIOPRESS & BIOHAB a monitoring framework should use:

- Stratified random sampling for statistical extrapolation;
- Use environmental classification for stratification
- Sampling of:
  - Natura 2000 sites;
  - Twinned samples outside Natura 2000;
  - Long-term monitoring sites (eg. Alternet.)

Recommendations sampling framework for monitoring European habitats (2)

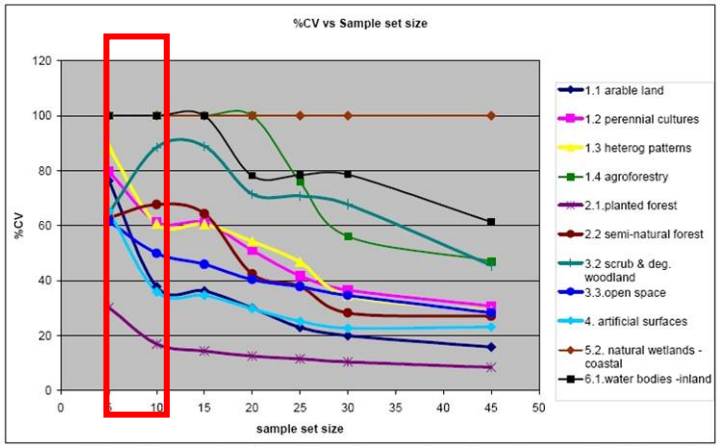
- Baseline survey with km square samples to provide spatial information;
- Use 15 sample units per stratum and 23 samples units if Natura 2000 sites are included;
- A total of 3.335 km^2 (23*145) needs to be monitored if 145 European strata are being used.
- Survey based on interpretation of EO data in combination with field work according to BIOPRESS/BIOHAB methodology.

Number of Samples

Table 1. Land cover categories for stratum LUS3 Low Podzol, presenting population figures and percentage estimates based on 5, 10, 15 and 20 km^2, the whole subclass measures 2008 km^2.

LUS3 Low Podzol	Census data		Sample data (N, sample size)									
	Regional population		N = 5		N = 10		N = 15		N = 20		N = 45	
Land cover type	Area (ha)	%	%	SE	%	SE	%	SE	%	SE	%	SE
Annual cultures	42644.0	21.2	9.6	7.3	18.0	6.8	20.5	7.4	22.9	6.9	24.4	3.9
Perennial cultures	17532.3	8.7	20.0	15.9	12.9	7.9	8.8	5.4	8.1	4.1	6.6	2.0
Heterog. patterns	11231.7	5.6	8.5	7.5	6.4	3.9	4.4	2.6	3.7	2.0	6.1	1.8
Agroforestry	917.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
Planted forest	102641.2	51.1	46.7	14.1	48.1	8.2	52.8	7.6	52.7	6.6	50.5	4.3
Semi-natural forest	2891.6	1.4	3.1	1.9	1.6	1.1	1.1	0.7	1.3	0.5	1.2	0.3
Sclerophyllous vegetation	204.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scrub and degraded woodland	2402.2	1.2	0.7	0.4	3.8	3.4	2.5	2.2	2.4	1.7	1.8	0.8
Sparsely vegetated	7645.5	3.8	6.7	4.1	4.3	2.1	5.8	2.7	5.1	2.1	4.0	1.1
Artificial surfaces	12161.6	6.1	4.8	3.1	4.9	1.8	4.2	1.4	3.7	1.1	4.8	1.1
Inland wetland	34.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coastal wetland	36.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inland water	403.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2
Marine water	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	200757.1	100.0	100.0		100.0		100.0					

In press: Jongman et al. 2005 (landscape Ecology)



Graphic 2 – Variation of %CV values for each Land Cover class of sample sets with different sizes (5, 10, 15, 20, 25, 30 and 45 sample units) in REnC Lus3 Low Podzol.

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Full cover monitoring

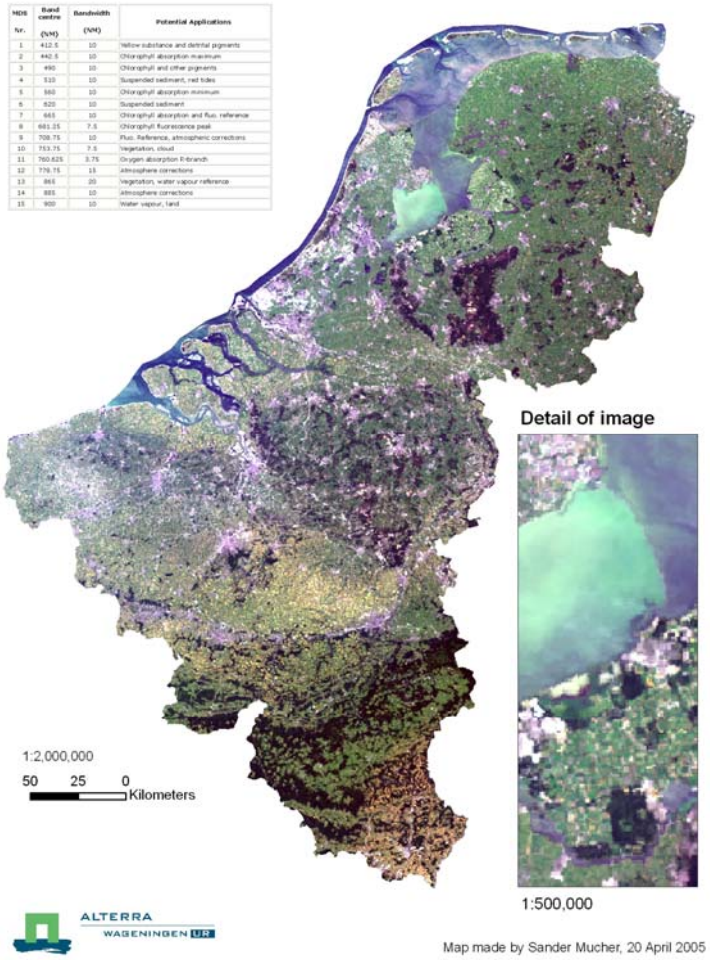
- Medium resolution satellite data (MERIS/MODIS) with spatial resolutions of 250-500m can fill the spatial gap between low (1-5km) and high resolution sensors (20-30m).
- For a change detection method MODIS 250 m data is preferred above MODIS 500/1000 m data since many land cover changes are fargmented.
- **Challenge**: In addition to CORINE and it's updates as CLC2000, there is a need for alternative methods that are faster and cheaper in response to major land cover changes in Europe.

Sensors	Satellite	Owner	Launch	Bands	Ground Resolution	Swath width	Repeating orbit	Orbit height
MODIS	EOS AM-1	NASA	Terra, 18 December 99 Aqua, 4 May 2002	36 bands (0.620-14.38 um)	250m (1-2) 500m (3-7) 1km (8-36)	2300 km	1-2 days	705 km
MERIS	ENVISAT	ESA	1 March 2002	15 bands (400 - 900 nm)	300m (1-15)	1150 km	3 days	780-820 km

Comparison MERIS & MODIS

MERIS full resolution satellite image 14 July 2003

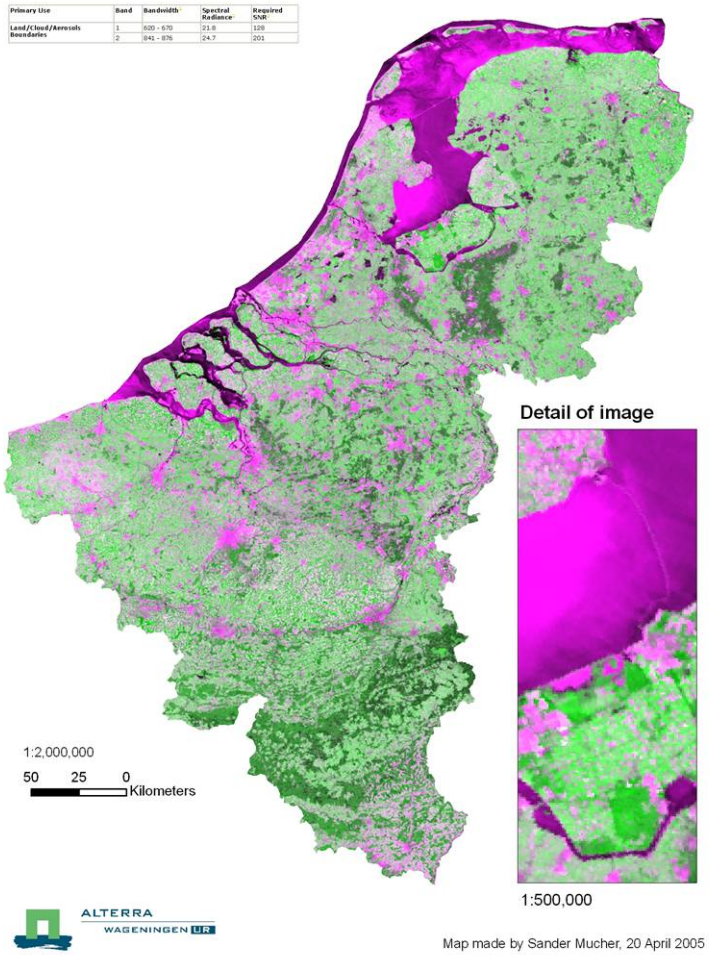
RGB: Bands 7/5/2



Overall accuracy 54.2

MODIS full resolution satellite image 14 July 2003

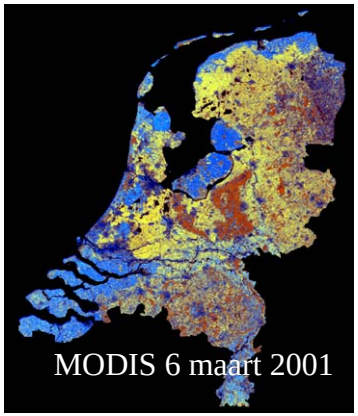
RGB: Bands 1/2/1

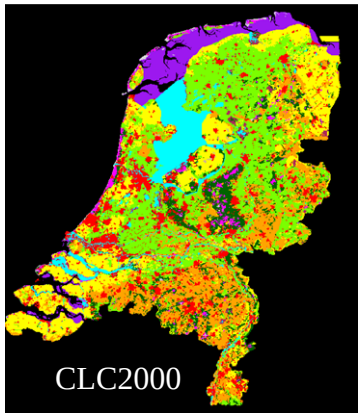


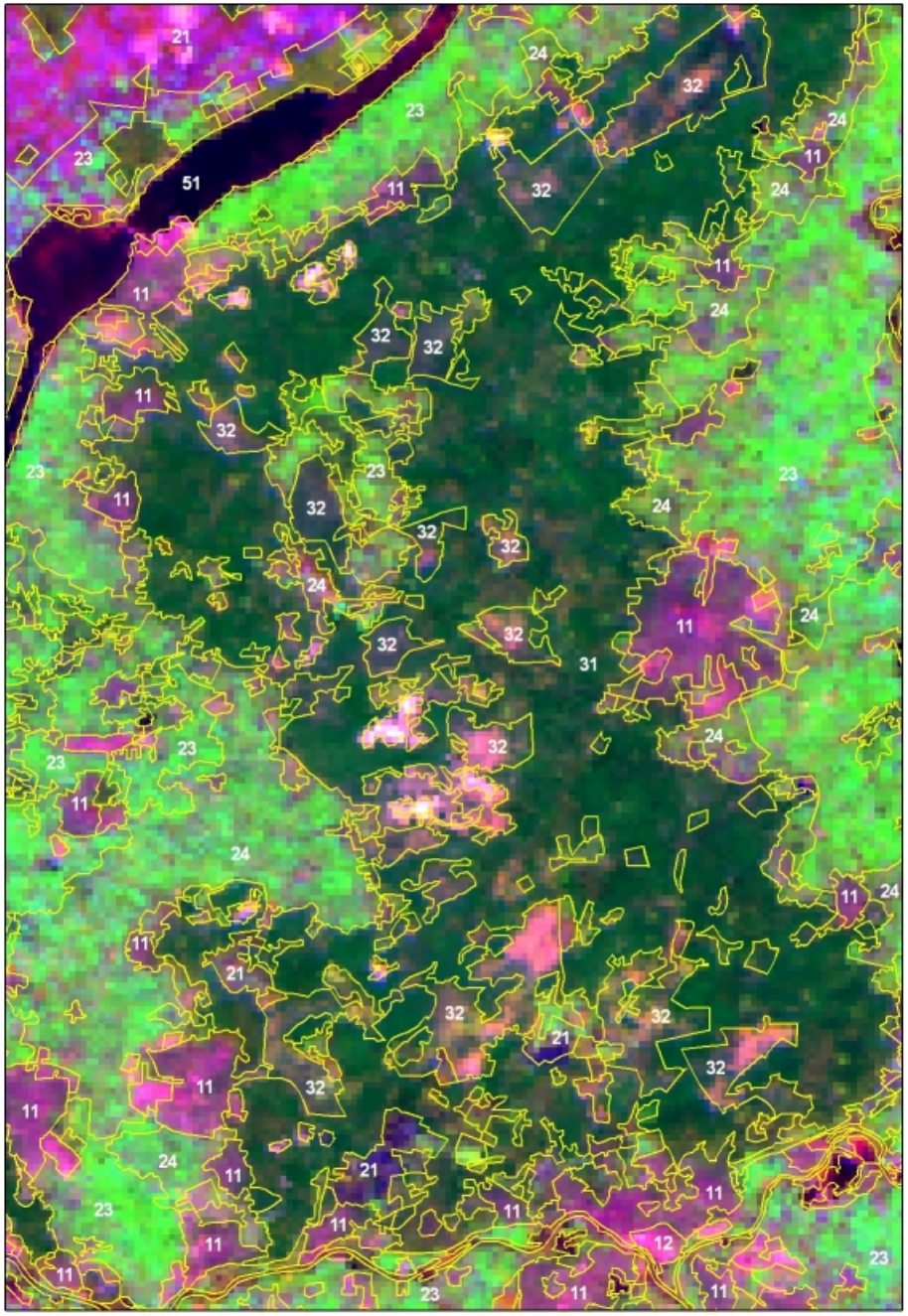
Overall accuracy 54.6

Fisrt Hypothesis

A first hypothesis was that CORINE land cover objects can be identified in a more automated and objective manner using medium resolution satellite data e.g. MERIS and MODIS.


MODIS 6 maart 2001


CLC2000



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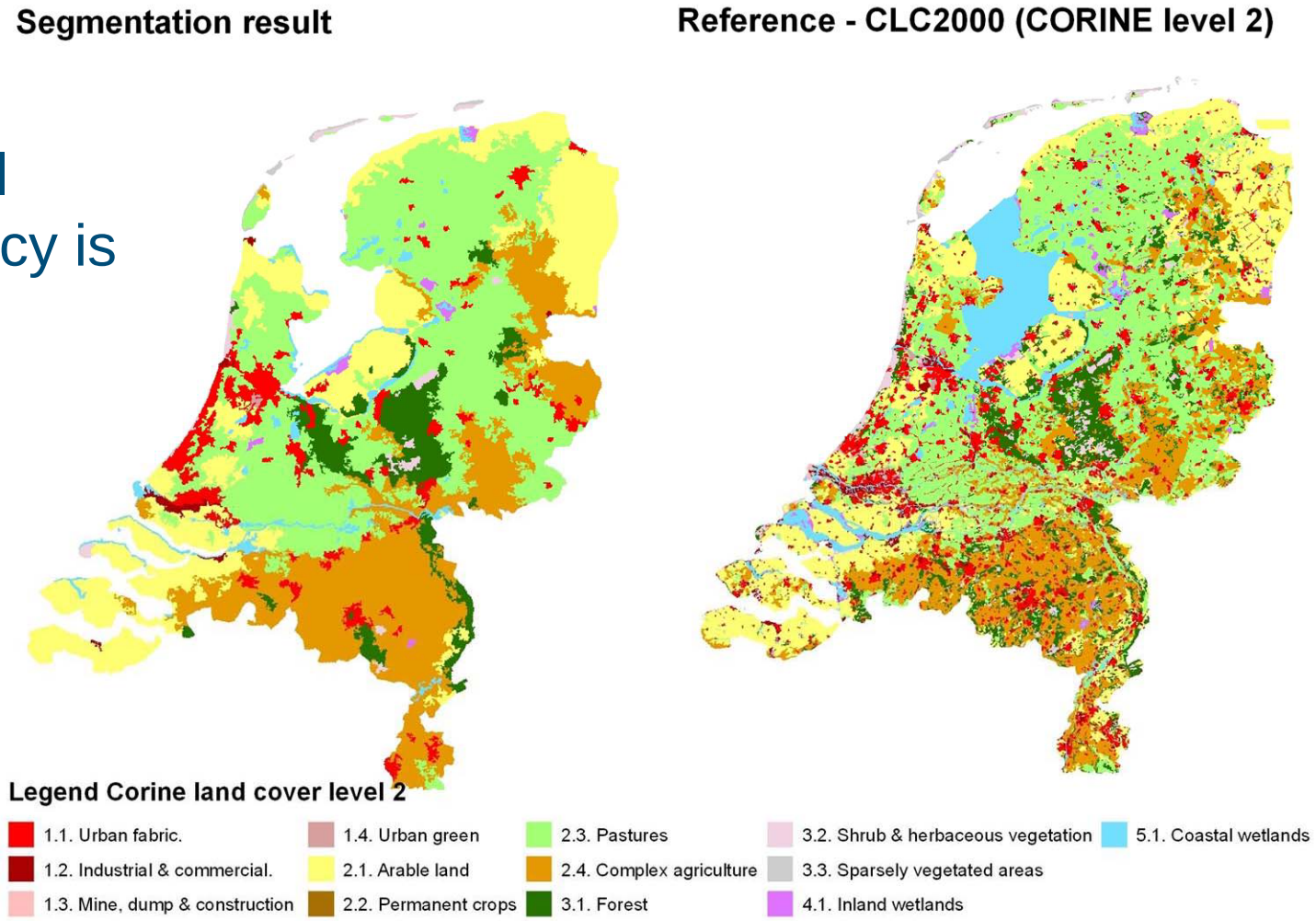
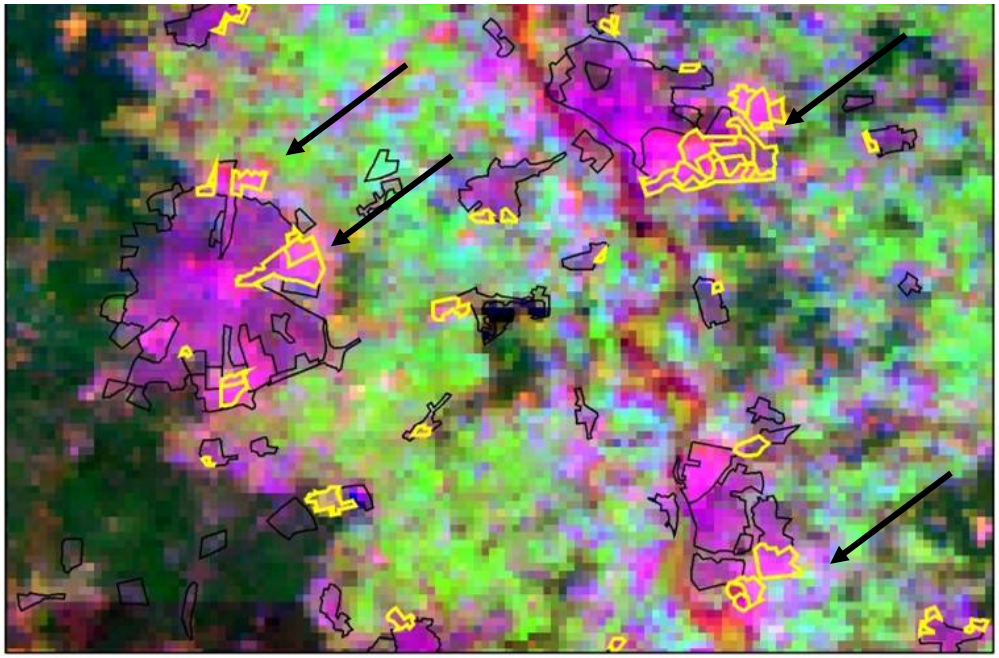
Result segmentation and CORINE level 2

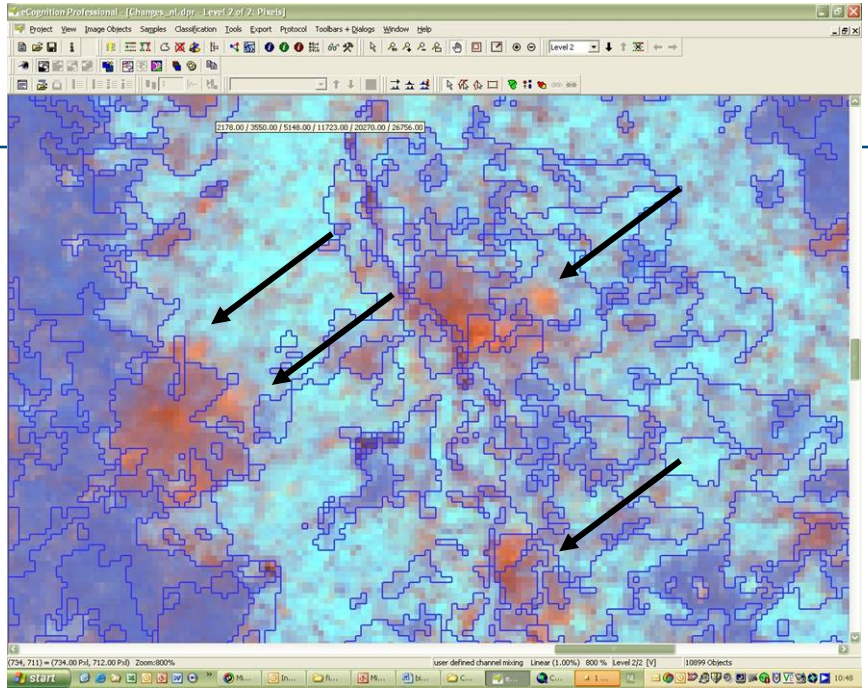
Overall accuracy is 63.4

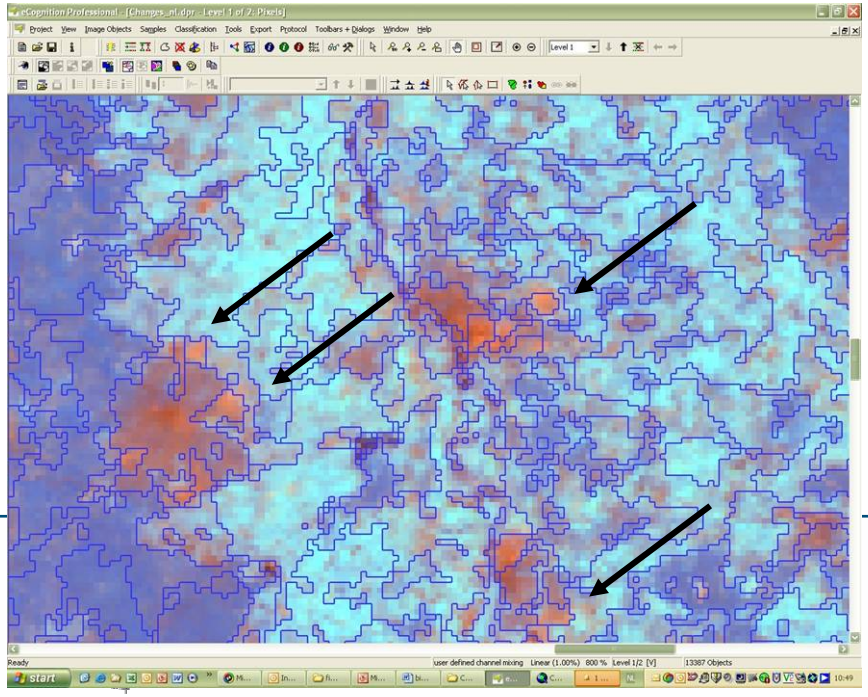


2nd Hypothesis

A second hypothesis was that the identification of major land cover changes in Europe could be accelerated and at lower costs using MODIS or MERIS satellite.







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CLC90
Urbanization

Conclusions (1)

- Past and potential changes in land cover, land use and habitats are essential information for many policy issues.
- Although there is a good synoptic overview of the European land cover much is still missing for habitats and pressures.
- Link between land cover changes and pressures is not straightforward.
- Next to update of CORINE land cover it is recommended to:
  - have a monitoring framework based on consistent EO data in combination with field surveys using stratified random sampling. This enables better identification processes and statistical extrapolation to produce European figures.
  - have a full cover monitoring system based on medium resolution satellite data that can have an alarm function and that enhances the temporal characteracterization of the change.

Conclusions (1)

- Integration with in-situ data is much more needed to identify all the pressures that have an impact on biodiversity.
- Increase timesteps in equal time-periods.
- Future monitoring systems should be based on a combination of various satellite systems and field surveys.


The end