European Landscapes and Habitats –
Spatial identification and associated changes

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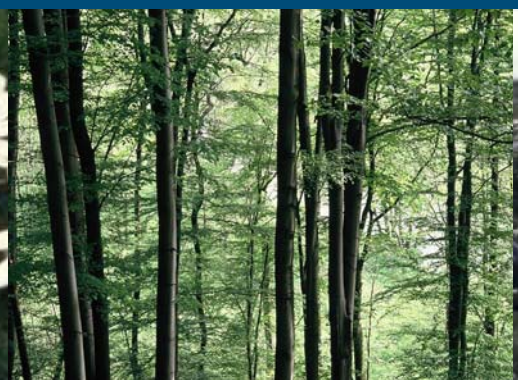
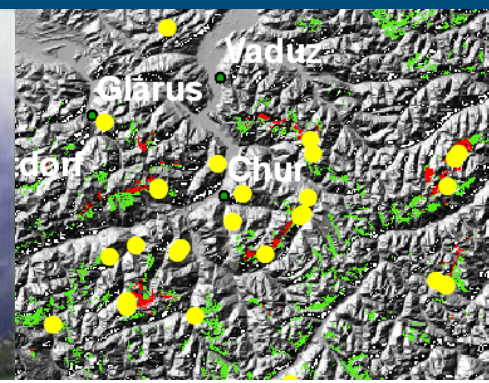
Remote Sensing of the Environment

Thursday, January 15, 2009

Wageningen University and Research Centre (WUR), Wageningen, NL



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Introduction

- Increased human pressures have caused dramatic declines in the quality and the extent of habitats across Europe.
- Habitat degradation and loss – mainly resulting from land use changes - are a primary reason of biodiversity loss.
- Therefore. there is a clear need to monitor LULC !
- These impacts are nowadays widely recognised and have forced national and international agencies to identify protected sites for natural areas with high biodiversity value.

Introduction

- Natura 2000 sites are a good example of protecting valuable sites, but it does not guarantee the preservation of biodiversity in the wider countryside.
- Therefore need to develop a Pan-European Ecological Network (PEEN) to improve the spatial coherence of remaining and fragmented habitats.
- **Spatial information about distribution European habitats is a prerequisite** for the development of a European network.

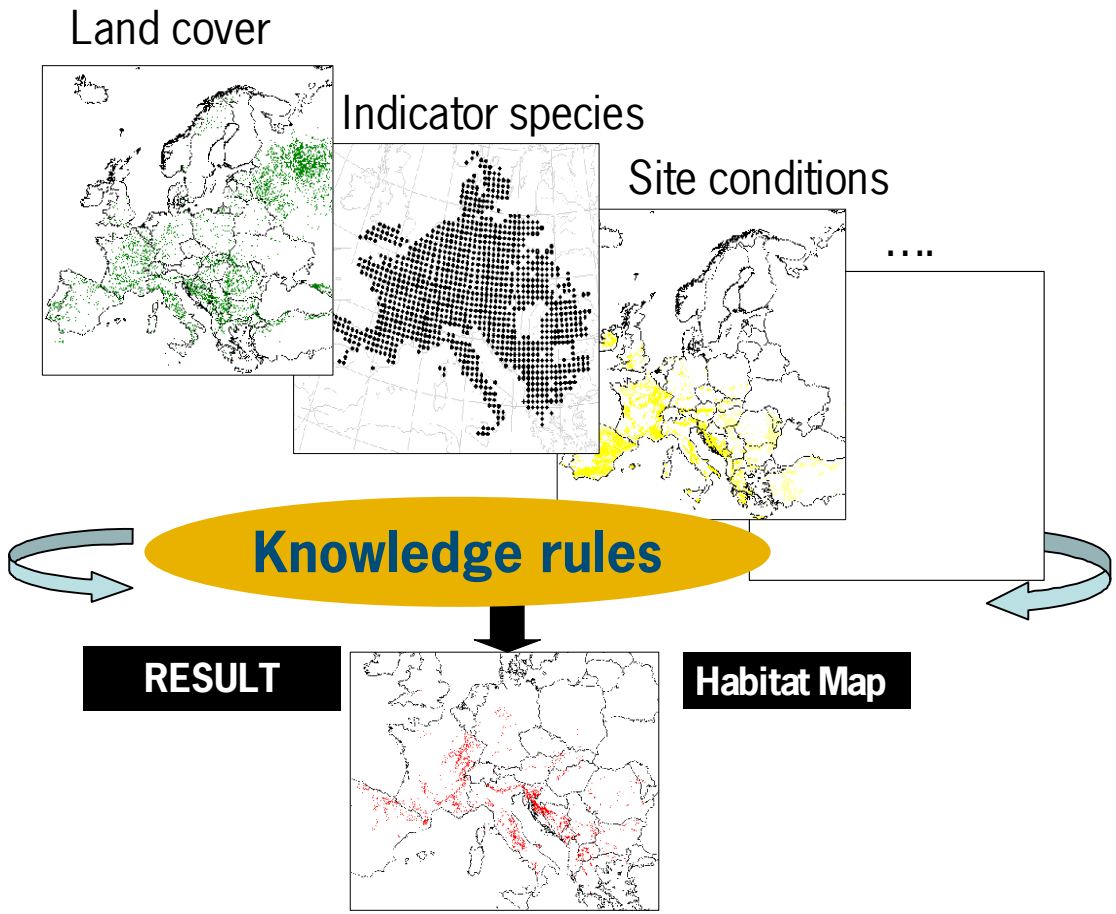
Objective

- However, **NO actual distribution maps of European habitats existed** and
- Therefore our **objective** was to **develop a methodology** for their **spatial identification** across Europe.

Methodology

The methodology should enable the spatial identification of all European habitats using state of the art European databases and decision rules on basis of:

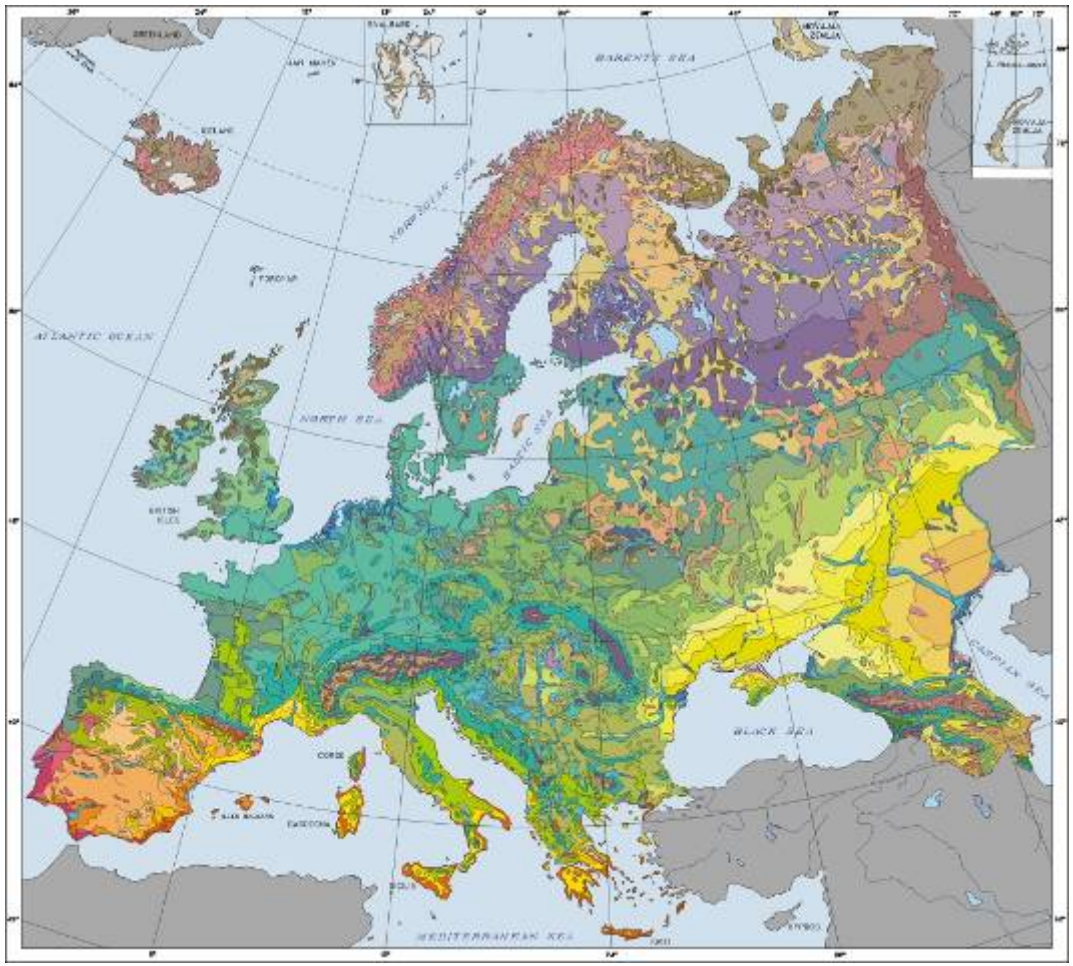
- their description in the Annex I of the Habitat Directive
- Additional expert knowledge
- Available environmental data sets



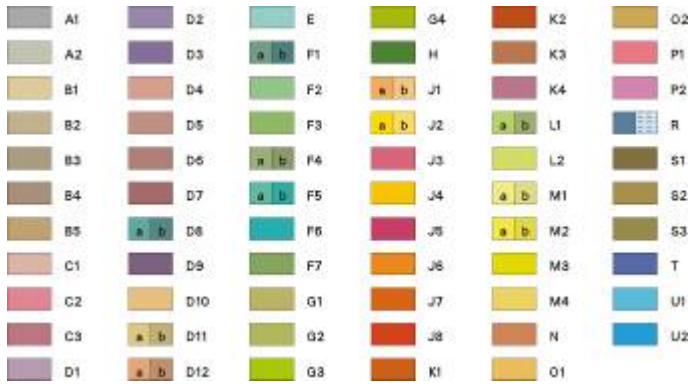
Five-step approach

- Identification, processing and integration of available core spatial data sets covering entire Europe.
- Establishment of knowledge rules for each habitat derived from the descriptions in the Annex I.
- Incorporation of additional ecological knowledge from experts, especially, where the availability of information from the Annex I was limited.
- Construction of predictive spatial distribution models.
- Validation of the results.

Core data: The Map of the Natural Vegetation



Source: Bundesamt für Naturschutz, Bonn



- Scale 1:2.5 M
- Distribution of plant communities, excluding human impact.
- Legend has 699 vegetation classes grouped in 19 main formations.
- It has a very extended database with many attributes.

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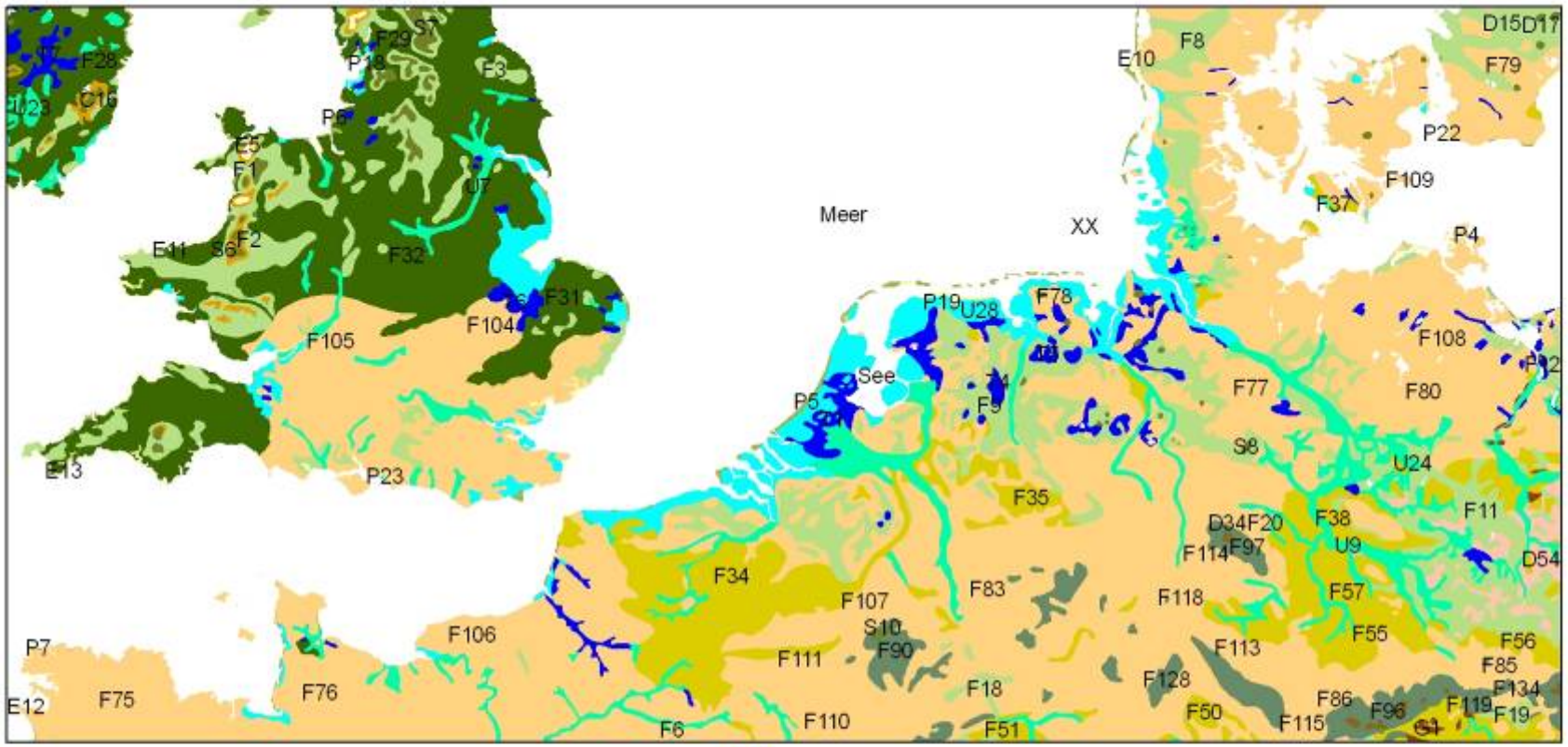
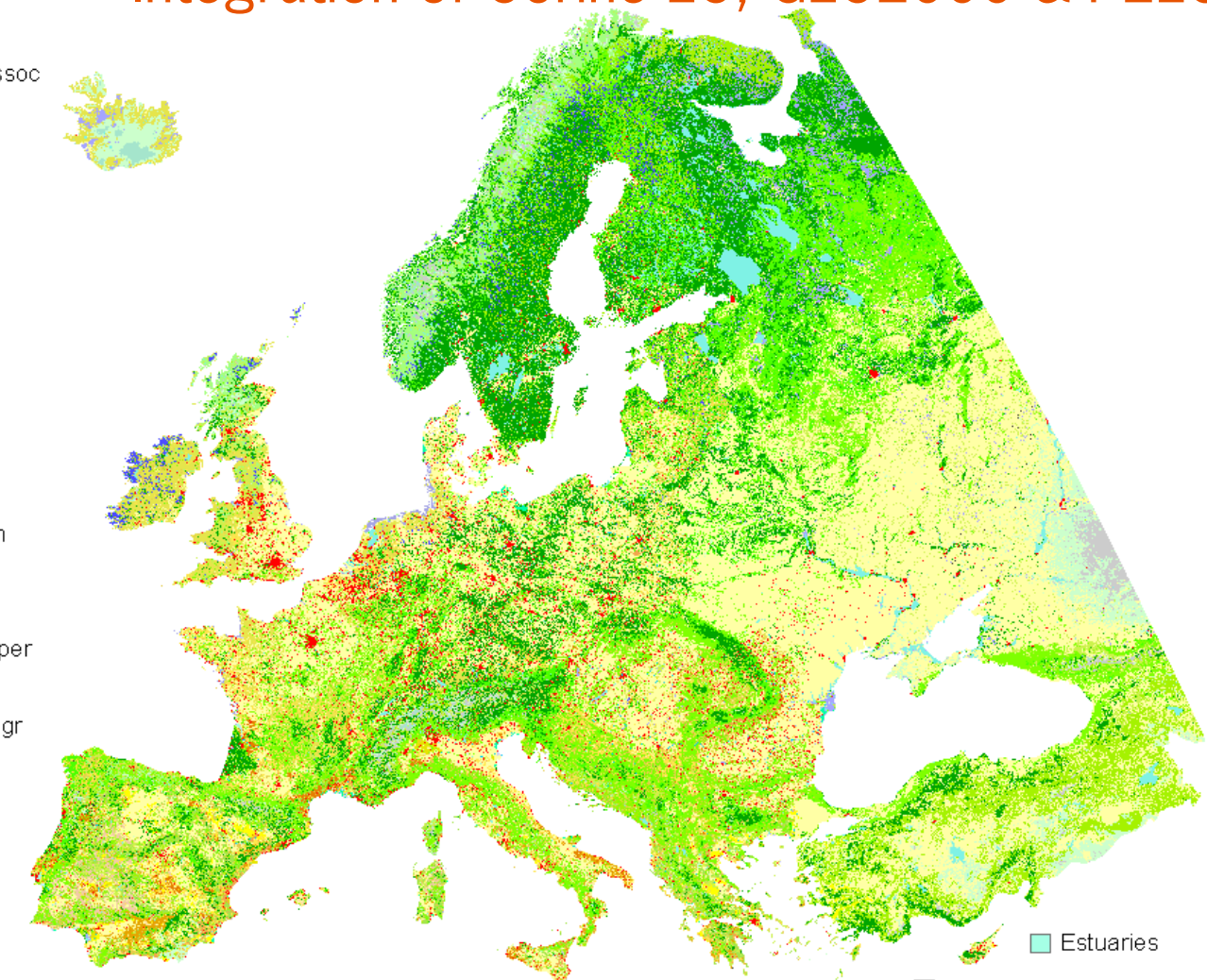
Potential Natural Vegetation



- Atlantic dwarf shrub heaths
- Coastal and inland halophytic vegetation
- Fen and swamp forests
- Flood-plain vegetation and moist lowland forests
- Lowland-colline, partly submontane types (Hemiboreal spruce)
- Lowland (to submontane) types (Hemiboreal and nemoral pine forests)
- Lowland to submontane types
- Lowland to submontane types (Acidophilous oak and mixed oak forests)
- Mixed oak-ash forests
- Mixed oak-hornbeam forests
- Montane to altimontane types, partly with fir and spruce
- Montane to altimontane, partly submontane fir and spruce forests in the nemoral z
- Ombrotrophic mires
- Subcontinental thermophilous (mixed) pedunculate oak and sessile oak forests
- Vegetation of coastal sand dunes and sea shores, often in combinatio with haloph
- Vegetation of estuaries and freshwater polders
- Western boreal and nemoral-montane birch forests, partly with pine fo

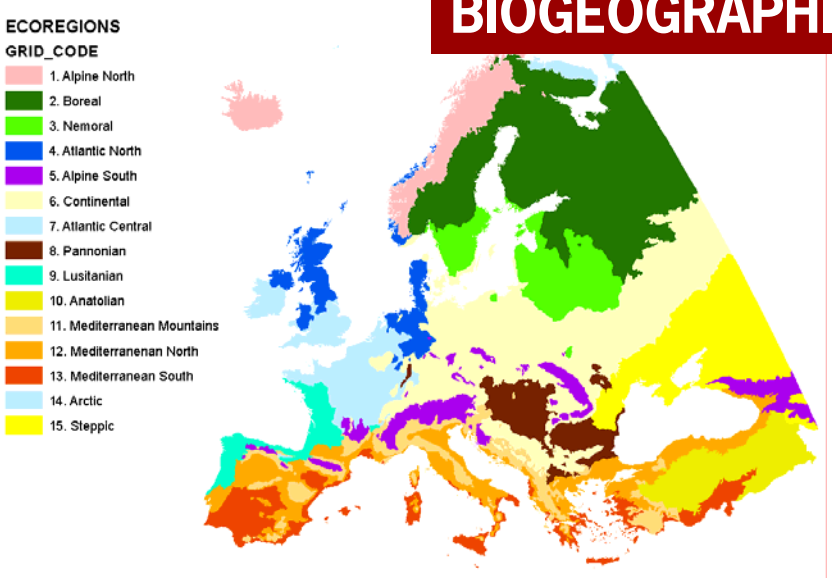
Core data: Land Cover

Integration of Corine LC, GLC2000 & PELCOM

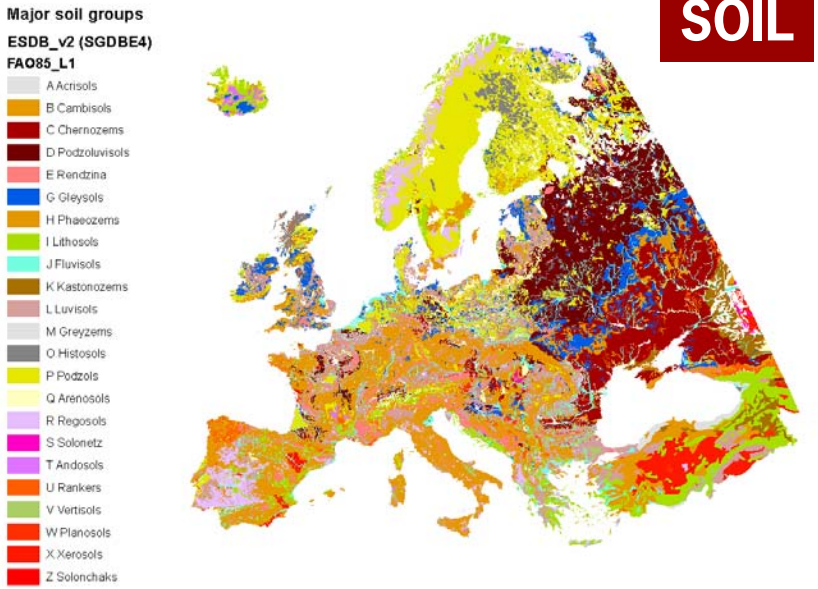


Core environmental data layers

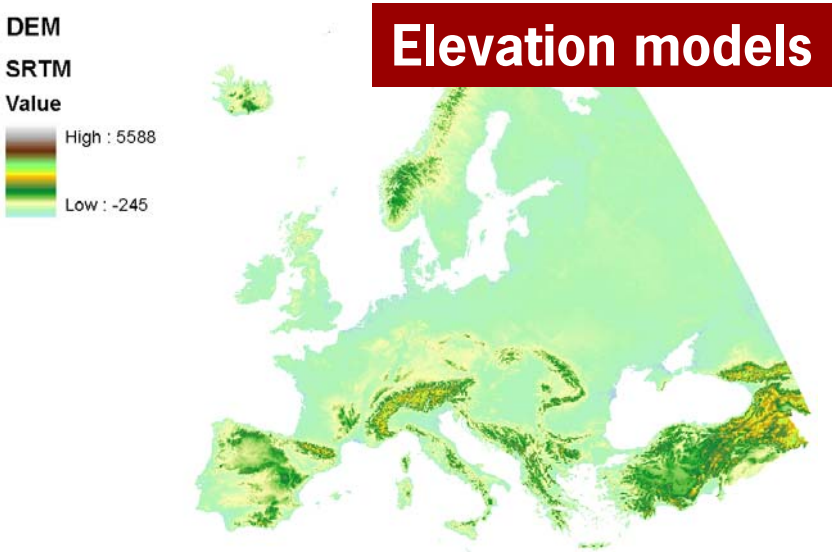
BIOGEOGRAPHIC



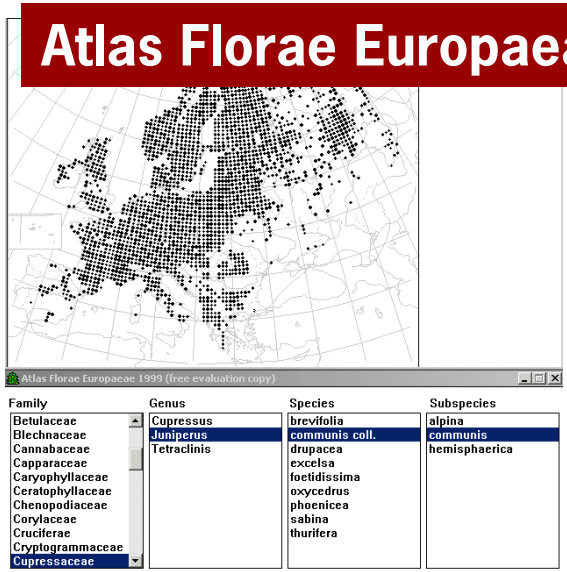
SOIL



Elevation models



Atlas Florae Europaeae



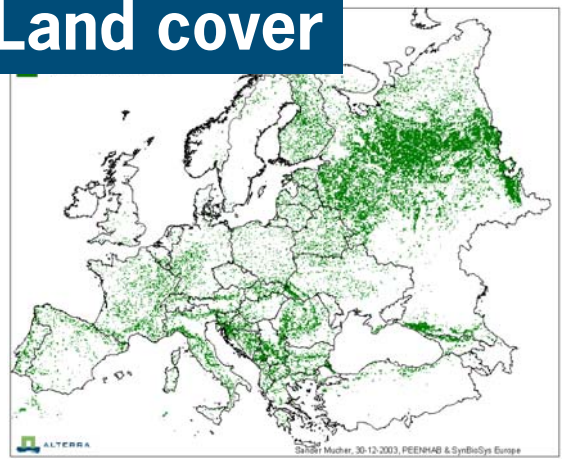
Example expert knowledge

H9150. Medio-European limestone beech forests of the *Cephalanthero-Fagion*

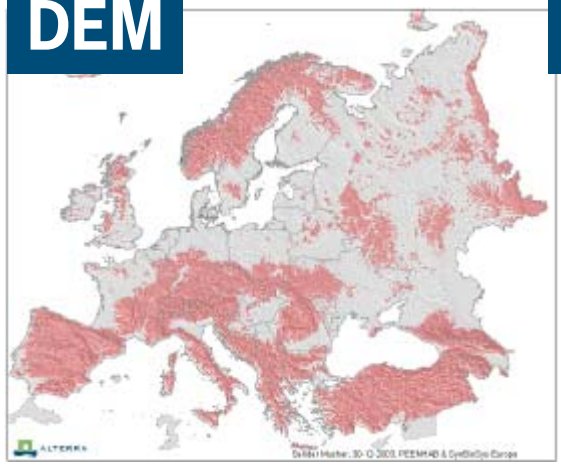
CLC:	**311 - Broad-leaved forest**											
Mapping rules:	**Atlant. Central (all altitudes), Alpine South / Continental (400 m-1200 m) + Calcareous soils + *Fagus sylvatica***											
Indicator species:	***Fagus sylvatica, Carex digita, Cephalantera spp., Neotttia nidus-avis.***											
GHC (BioHab):	**Forest phanerophytes / Winter deciduous + Fagus over 70% + shallow dry calcareous soils + steep slopes + ground flora species.**											
Field identification:	**A well defined category but grades into 9130.**											
Occurrence:	**Widespread in large patches but often replaced by Picea abies in the Alps.**											
Direct threats:	**Felling withy deeper soils conversion to conifer.**											
Climate change:	**Thermophilic species will be favoured.**											
Succession:	**Climax.**											
Distribution	***aln***	***bor***	***nem***	***atn***	**ALS**	**CON**	**ATC**	**PAN**	***lus***	***mdm***	***mdn***	***mds***

Top-down implementation for H9150

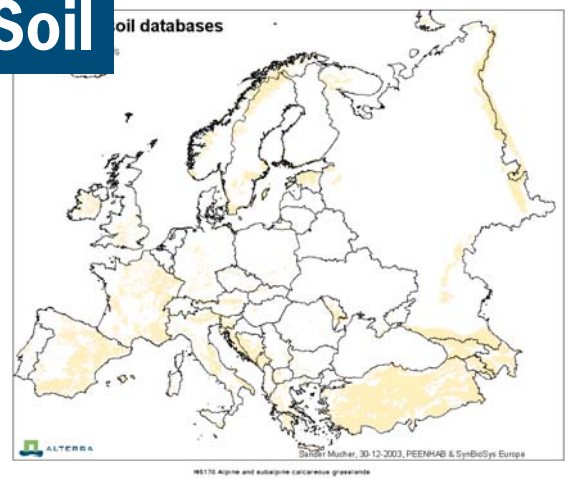
Land cover



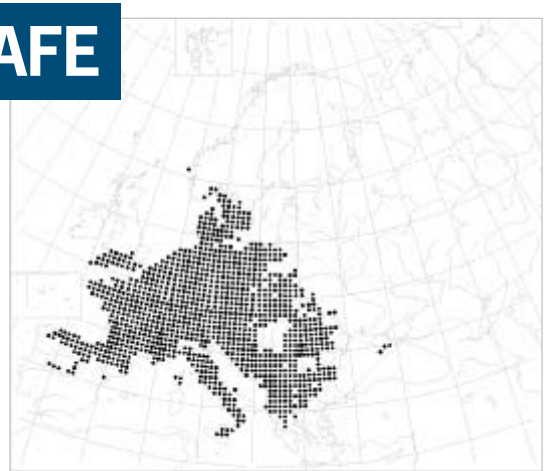
DEM



Soil

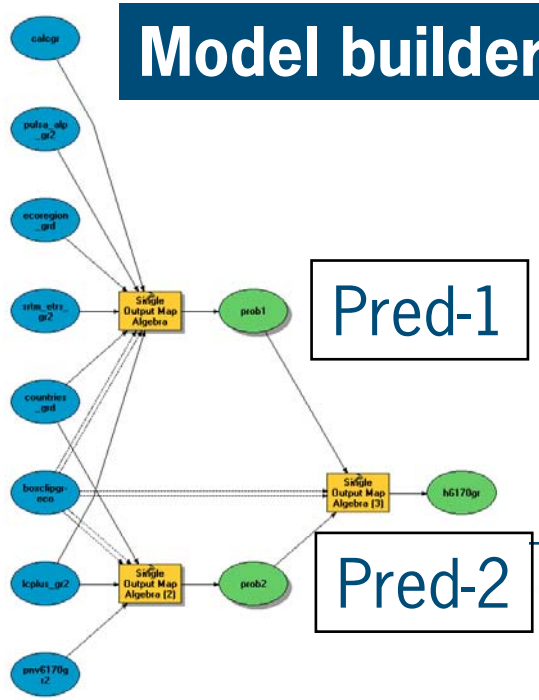


AFE



PNV

Model builder



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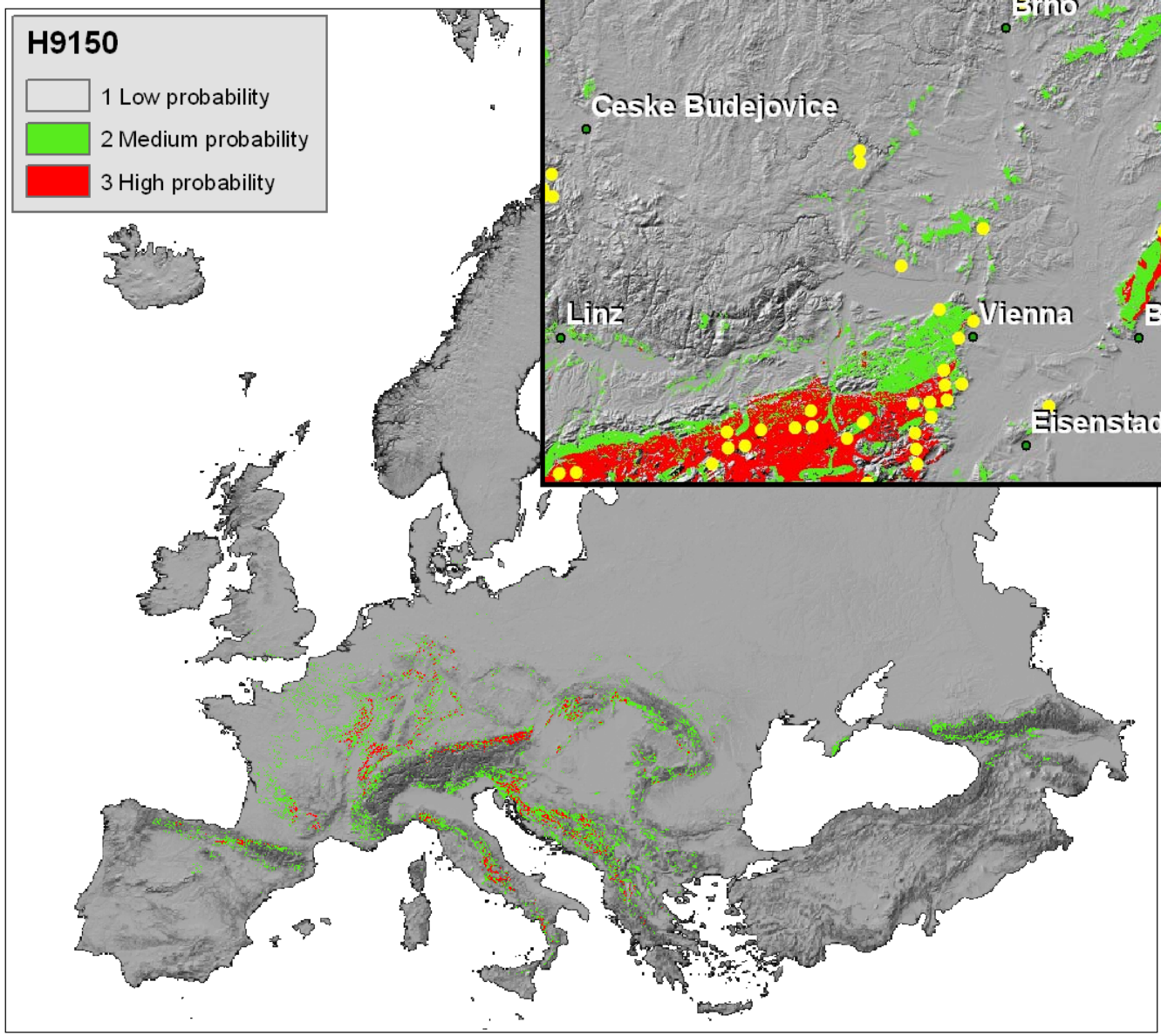
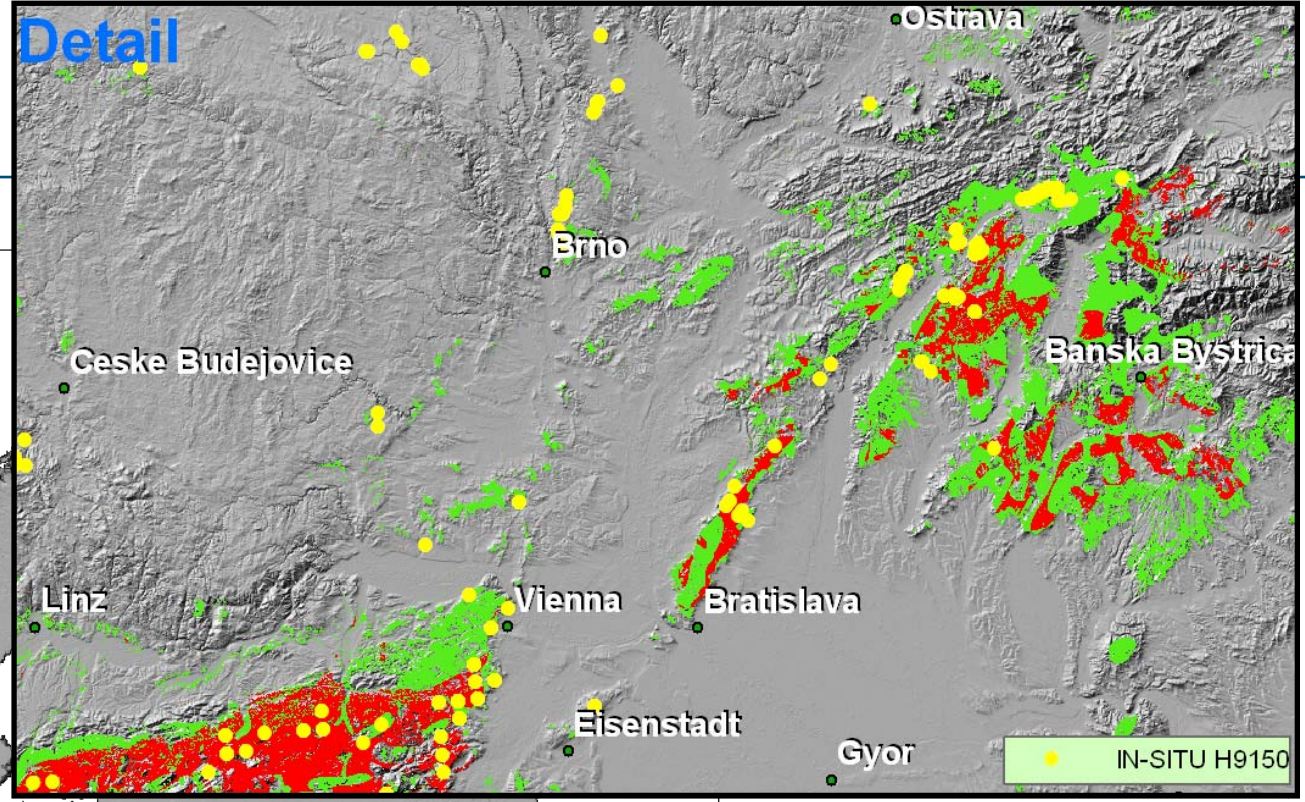
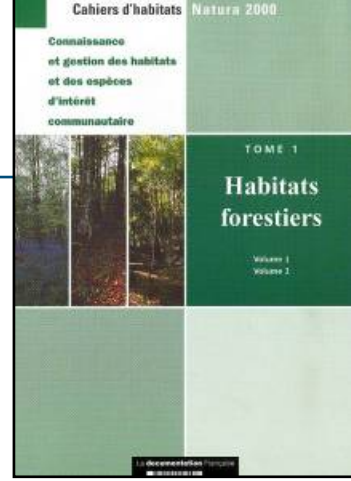
Result H9150



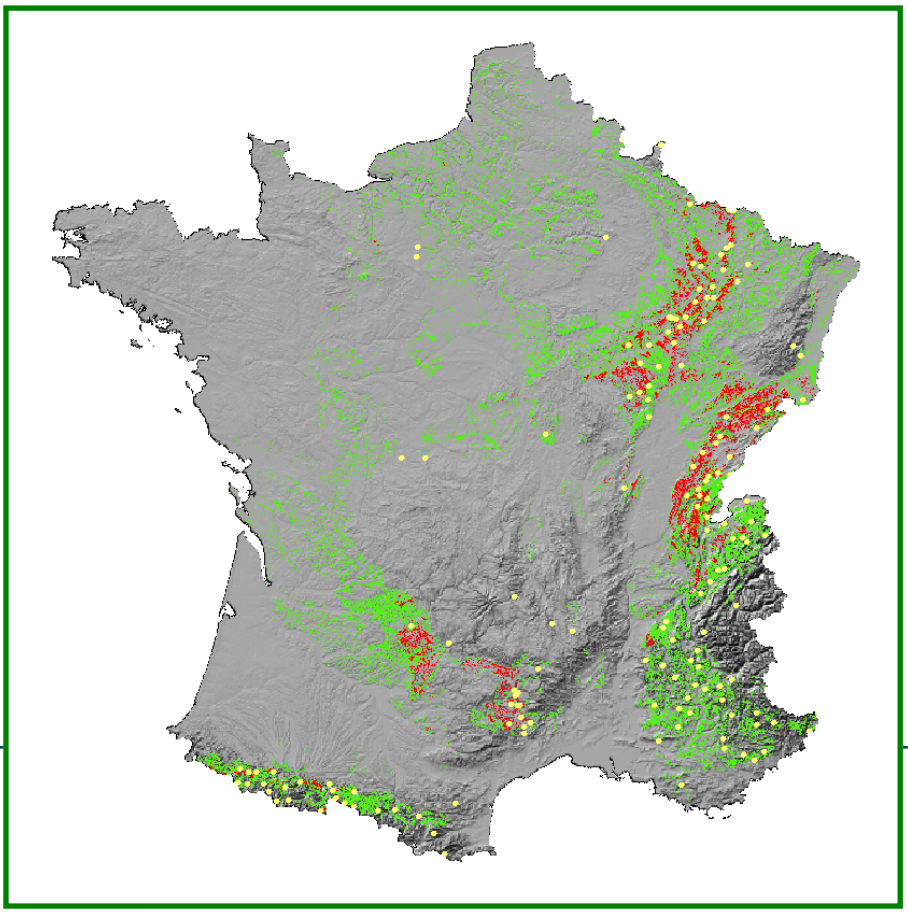


Validation – Visual Comparison



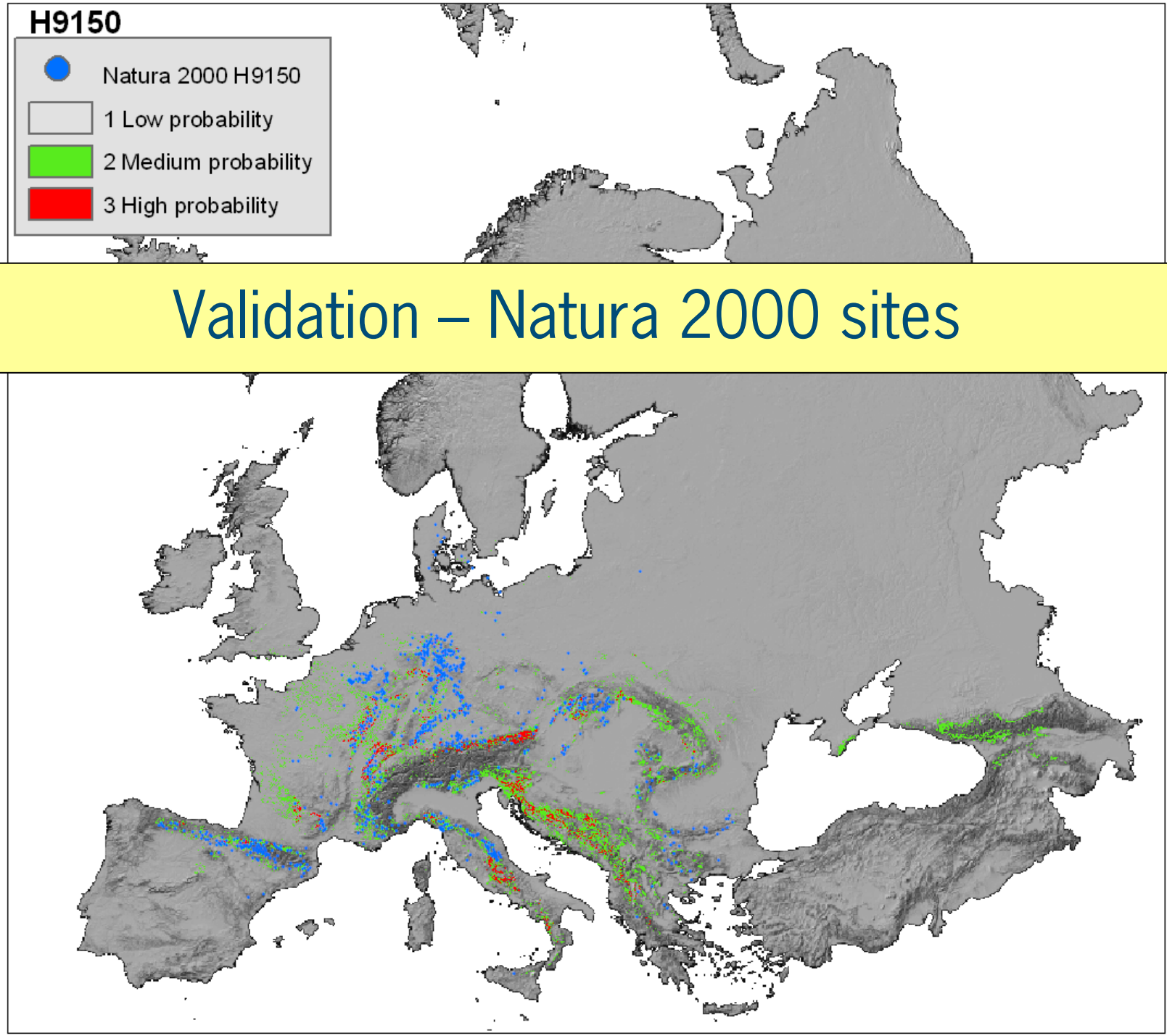
H9150

- Natura 2000
- 1 Low probability
- 2 Medium probability
- 3 High probability

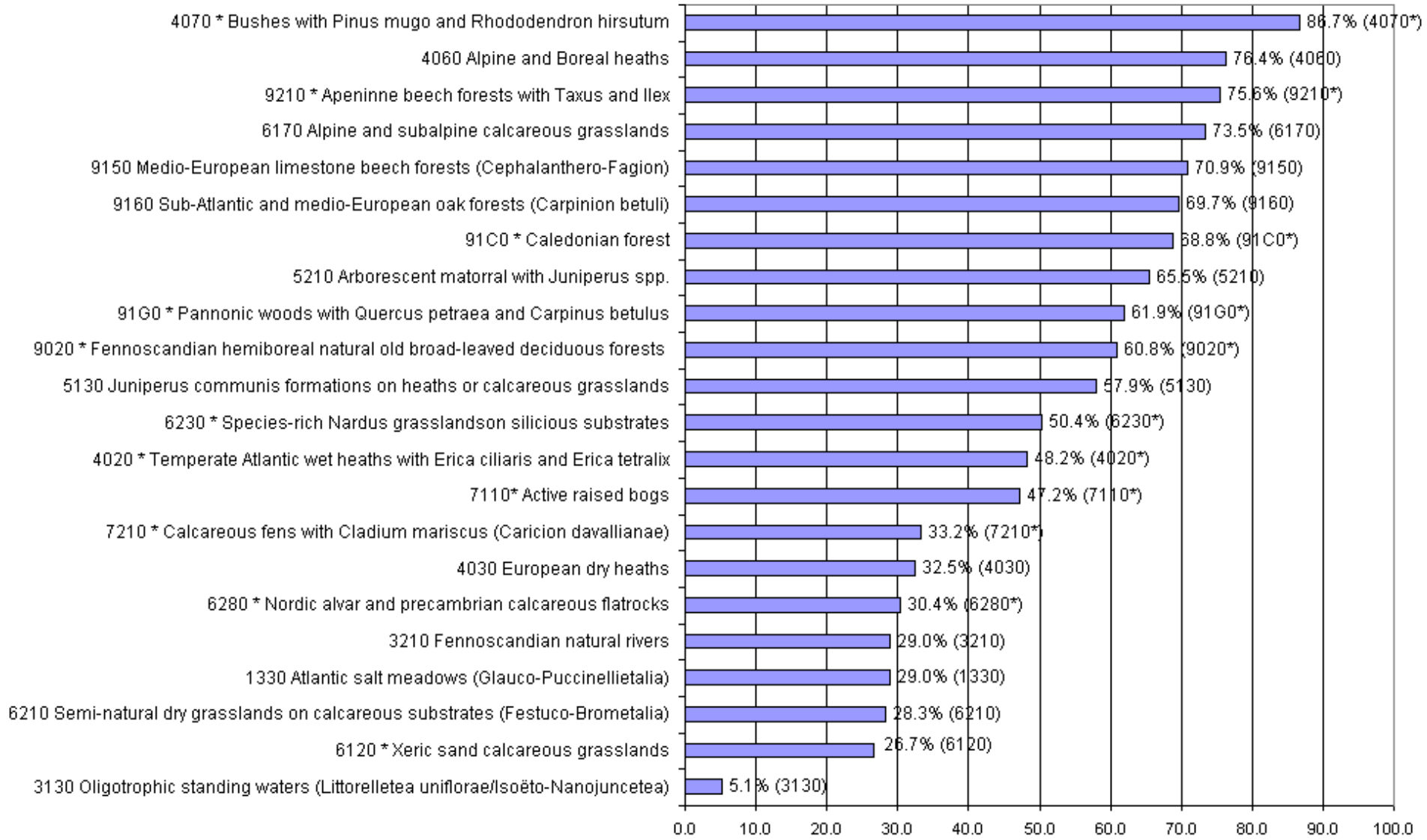


Source : D'après RAMEAU et al., 2000 - Gestion forestière et diversité biologique. Tomes Atlantique et Continental.

Validation – Natura 2000 sites



Validation with Natura 2000 sites



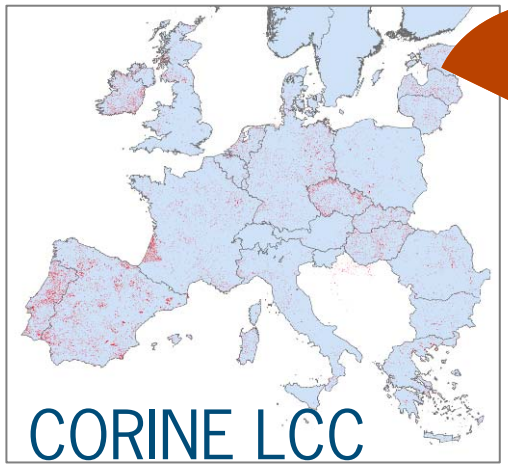
Limitations of used method

- The distribution maps involve only the likely occurrence of the habitat concerned i.e. probability.
- Over- and underestimation of the actual area due to spatial resolution.
- Therefore, we can not directly assess the surface area of the habitats.
- Alternative, is to use stratified sampling approach (e.g. BIOHAB / UK country side), but this does not provide spatial distribution of the habitats.

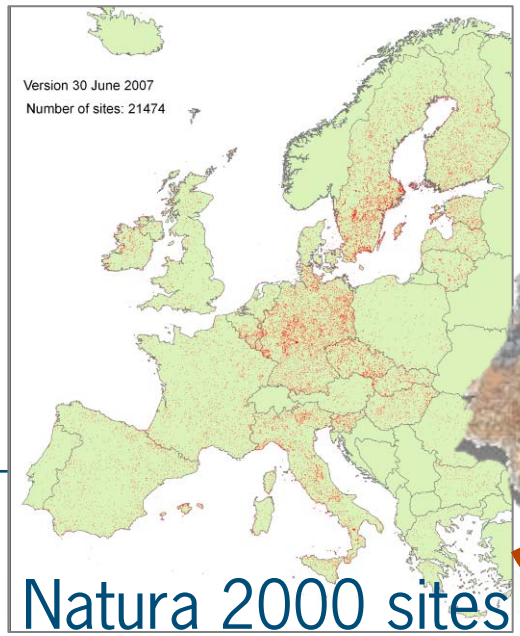
Opportunities of used method

- Integration with in-situ data and survey samples to calibrate model/knowledge rules and to improve areal estimates.
- Further integration with RS derived land surface parameters (eg. FAPAR, surface albedo) and phenology.

Assessement of impact LCC at Landscape level



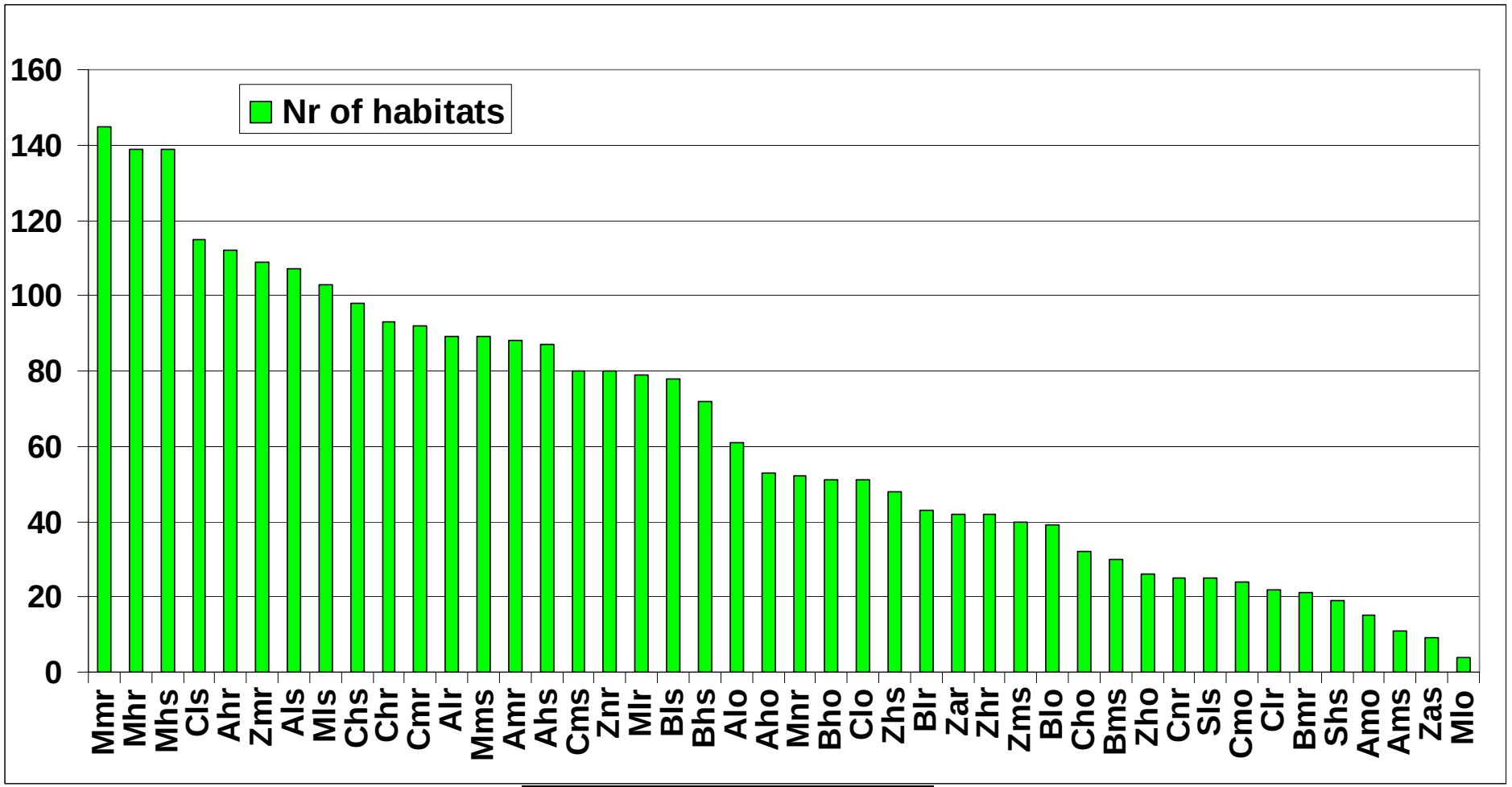
CORINE LCC



Natura 2000 sites

Landscapes (LANMAP)

Variation in habitat types per landscape type



LANMAP – level 3

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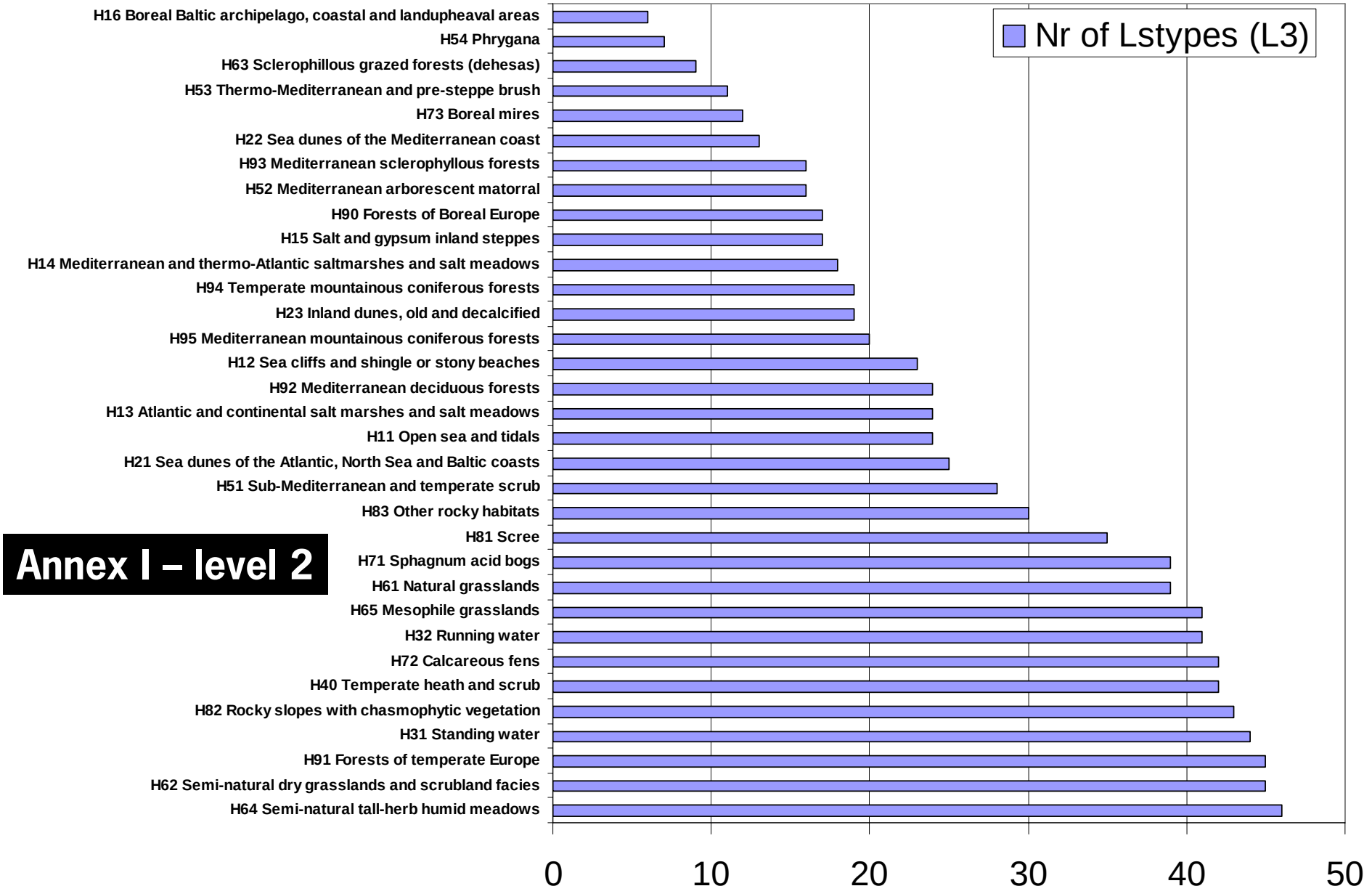
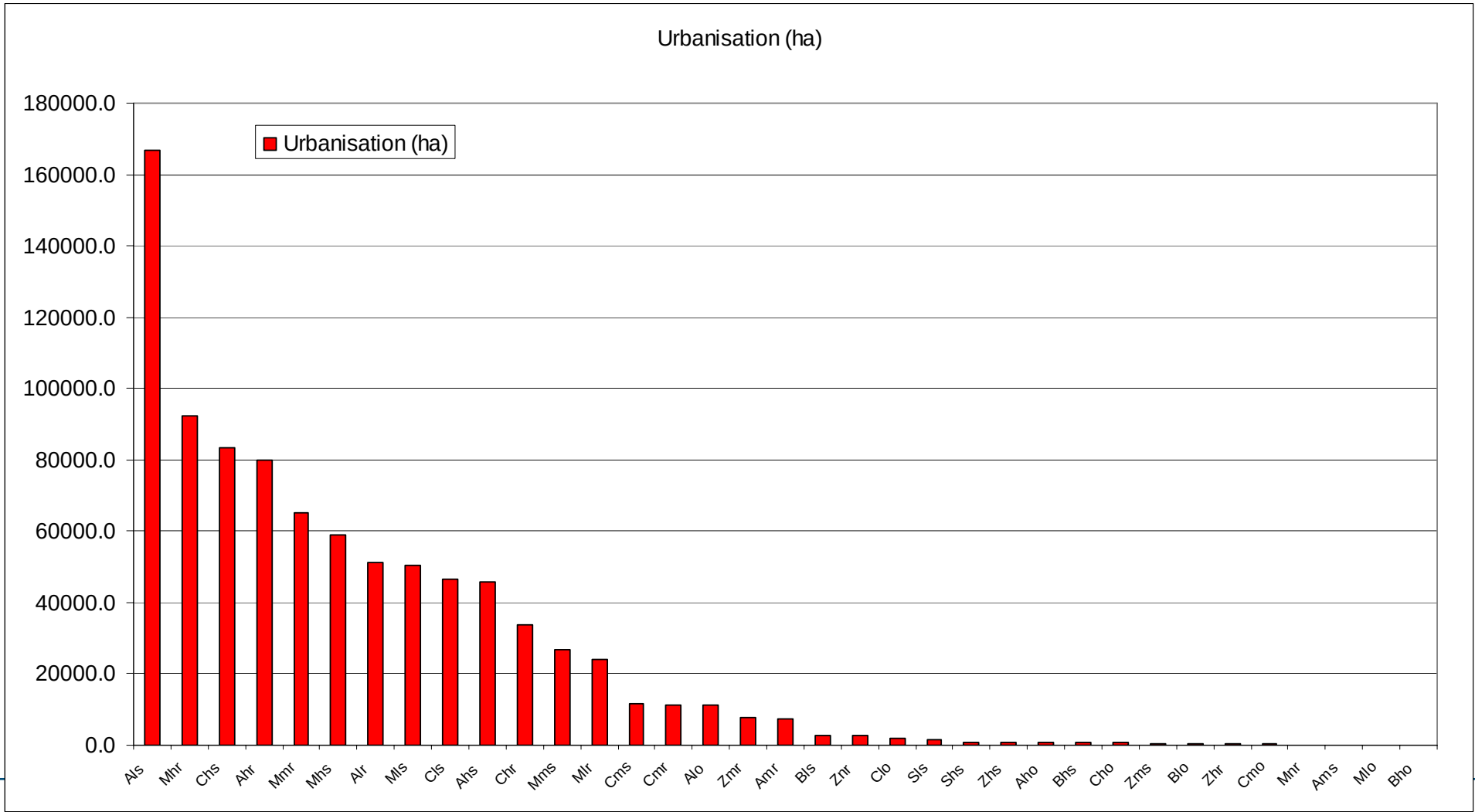
Extent of habitat types across European landscapes



Annex I – level 2

Urbanisation per European Landscape Type

Period: 1990-2000



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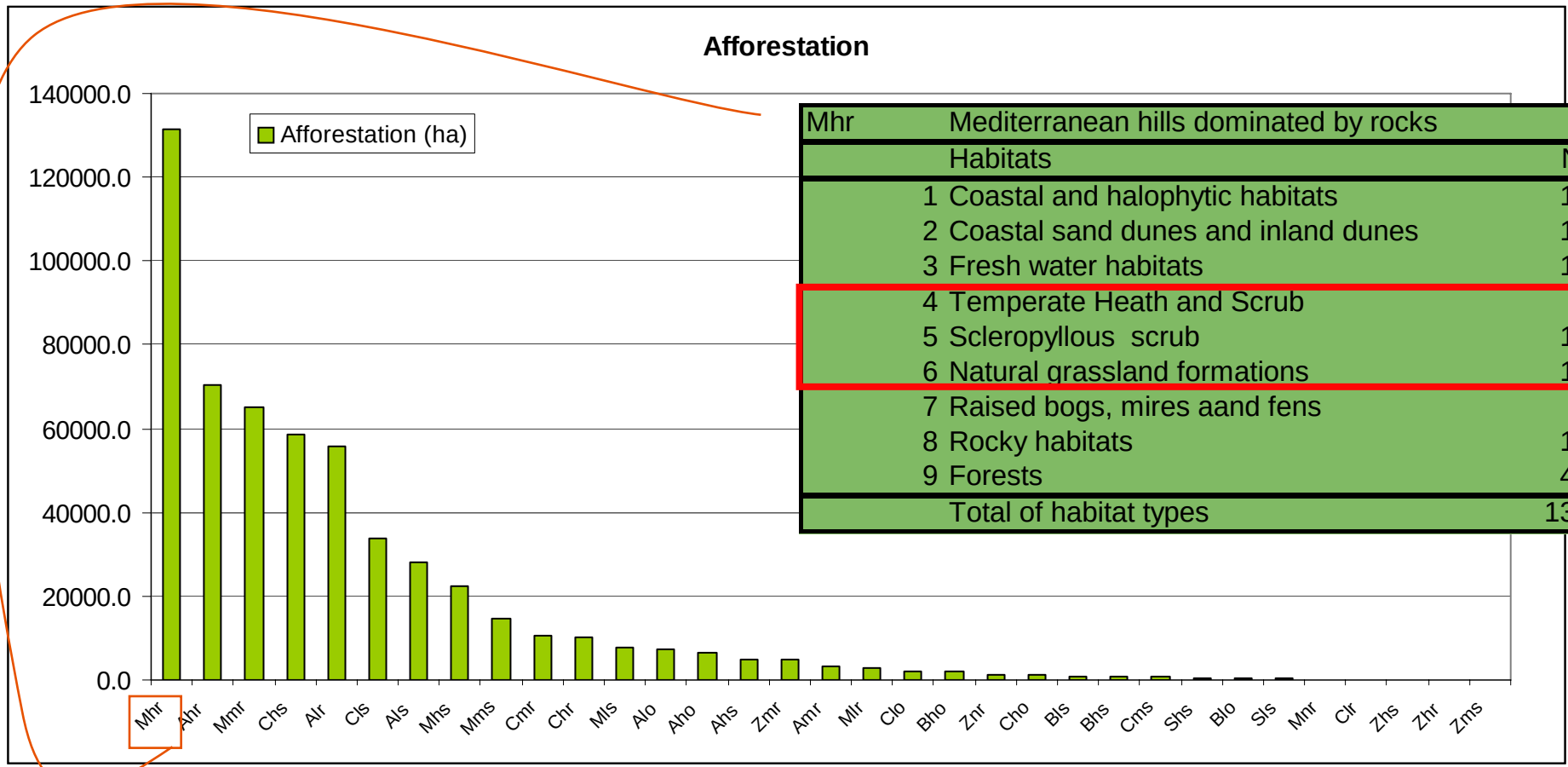
Afforestation per European Landscape Type

Period: 1990-2000 based on CLC



Mhr	Mediterranean hills dominated by rocks	
	Habitats	Nr
1	Coastal and halophytic habitats	17
2	Coastal sand dunes and inland dunes	10
3	Fresh water habitats	15
4	Temperate Heath and Scrub	6
5	Scleropyllous scrub	12
6	Natural grassland formations	15
7	Raised bogs, mires aand fens	7
8	Rocky habitats	12
9	Forests	45
	Total of habitat types	139

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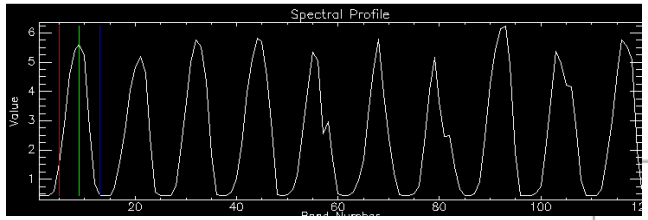
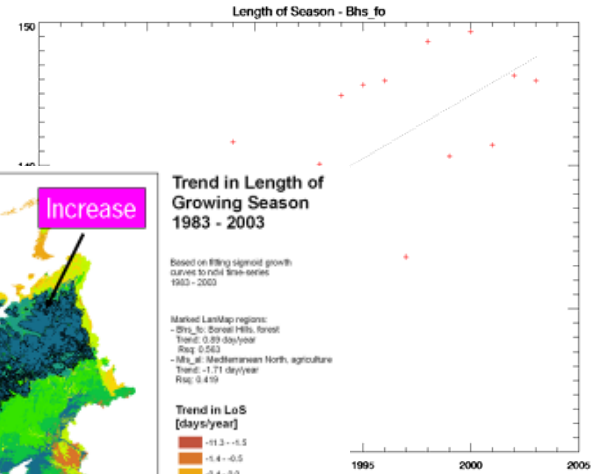
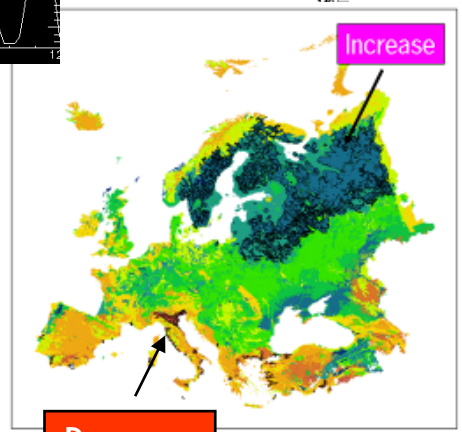
Recent developments

Trends in Phenology

GIMMS NDVI time series 1983-2003







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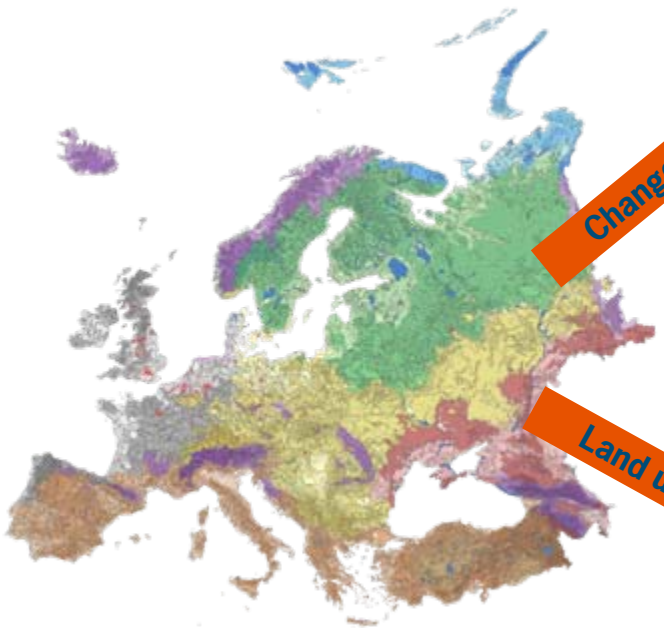
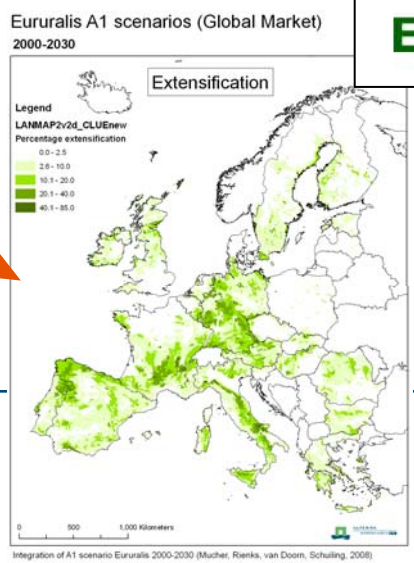
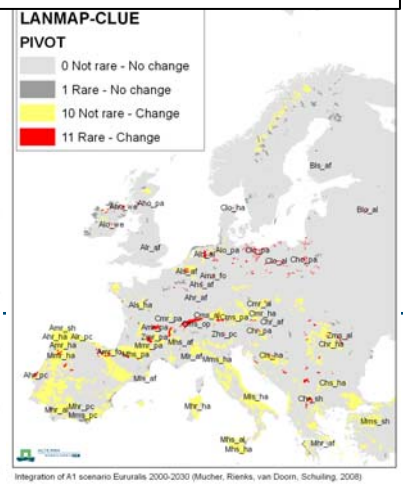


Changes Phenology

Land use scenarios





EURURALIS

LU scenarios

Mücher, Rienks, van Doorn, Verburg

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Impact of land cover changes are site specific

- Strong variation in land cover dynamics over the different landscapes.
- Landscapes differ very much in richness of habitat types and,
- Impact on biodiversity of these land cover dynamics depends on habitat types present in the landscape and the spatial range of the habitat types affected.

Concluding

- The presented method is very useful but provides only an indication of likely occurrence.
- Uncertainties in the mapping results remain in case of poor habitat descriptions, inaccuracies or lack of environmental data sets.
- Habitats with a wider European distribution were easier to identify than local and dispersed habitats.
- Integration with vegetation relevés and survey samples needed to calibrate model/knowledge rules and to improve areal estimates.
- Further integration needed with indicators derived from Remote Sensing.
- Landscapes are suitable for analysing impact of land cover dynamics on biodiversity and shows that impacts are very site specific.

Thank you for your attention !

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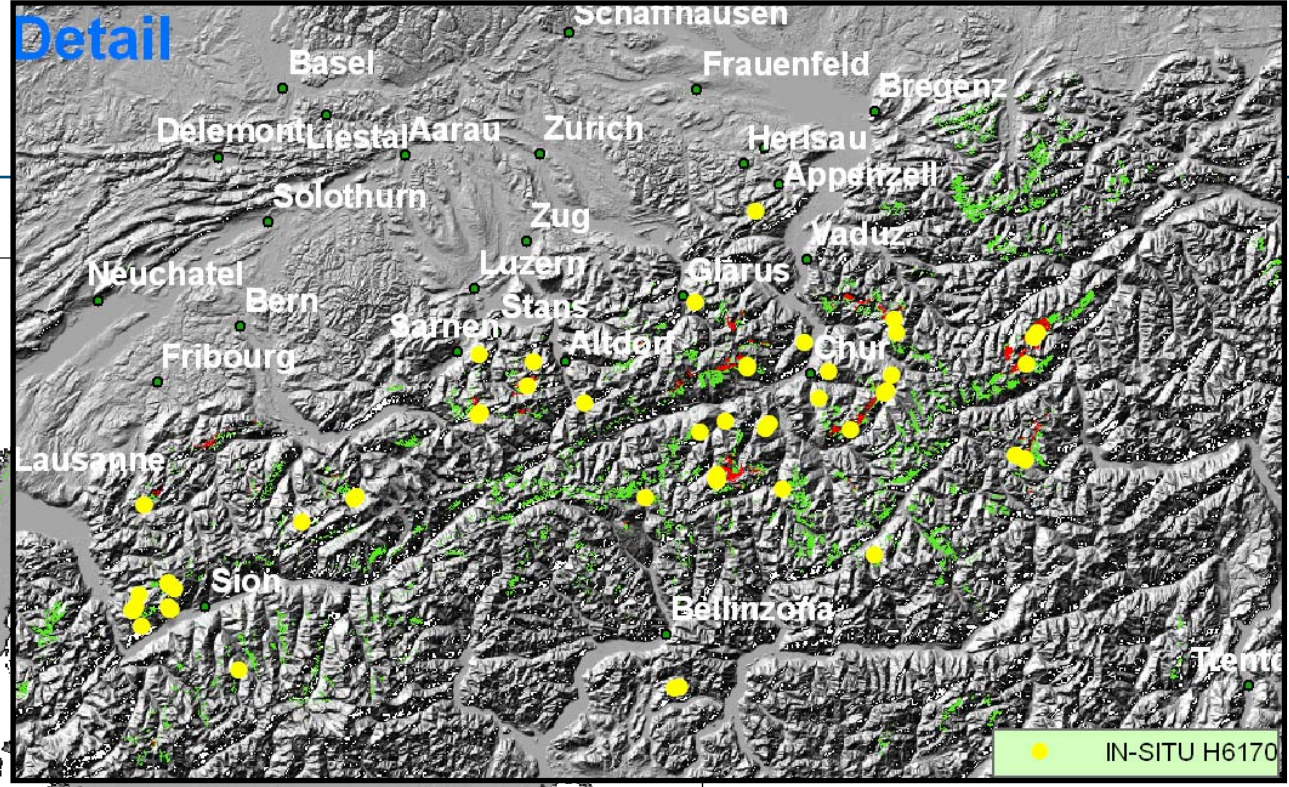
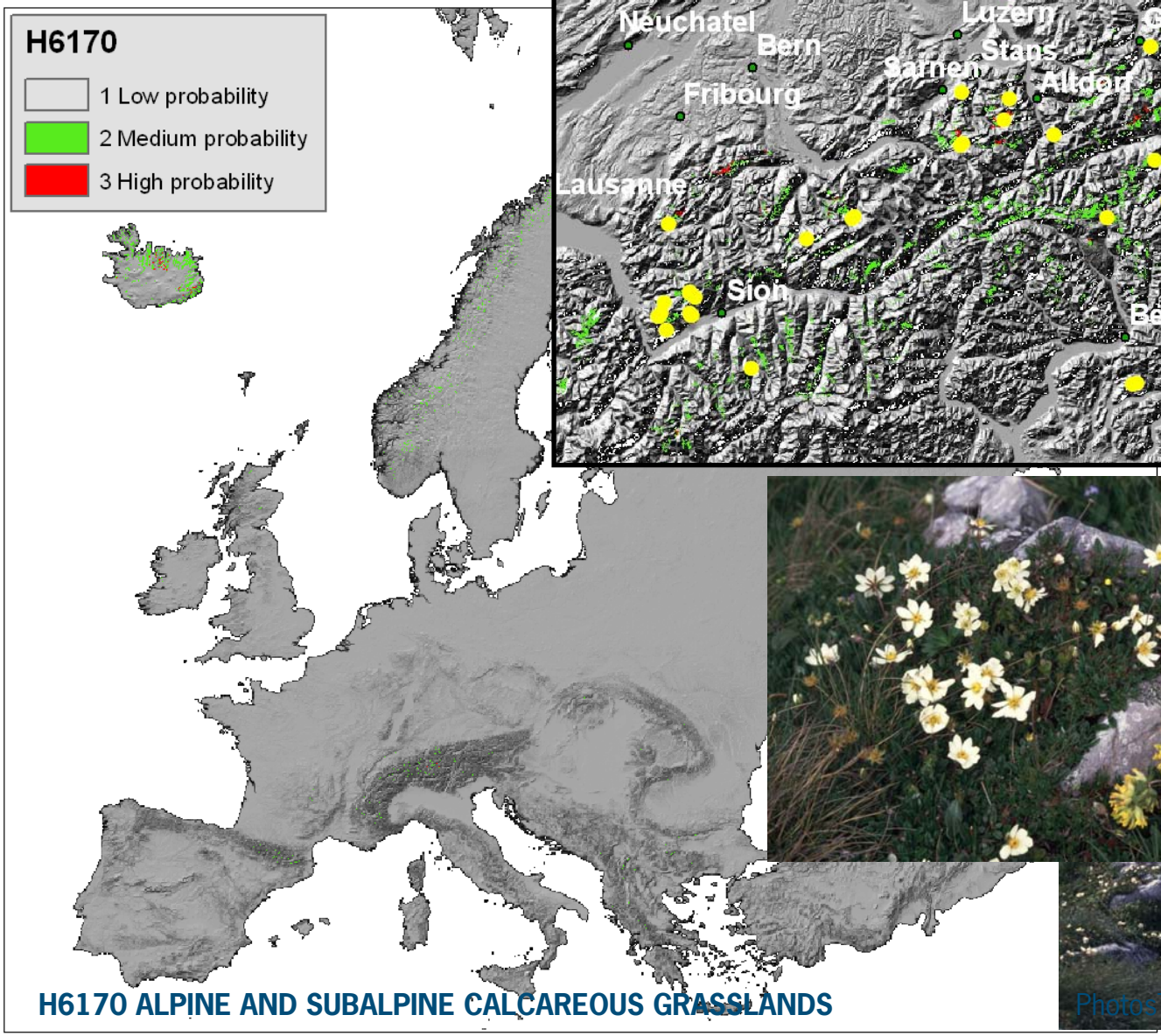
Result H6170





H6170 ALPINE AND SUBALPINE CALCAREOUS GRASSLANDS

PhotosThomas Wrbka