Gliederung der Vorlesung:

Was ist Landschaft ?

>>> *Einführung und Definitionen*

Was ist Landschaftsökologie ?

>>> *Konzepte, Methoden*

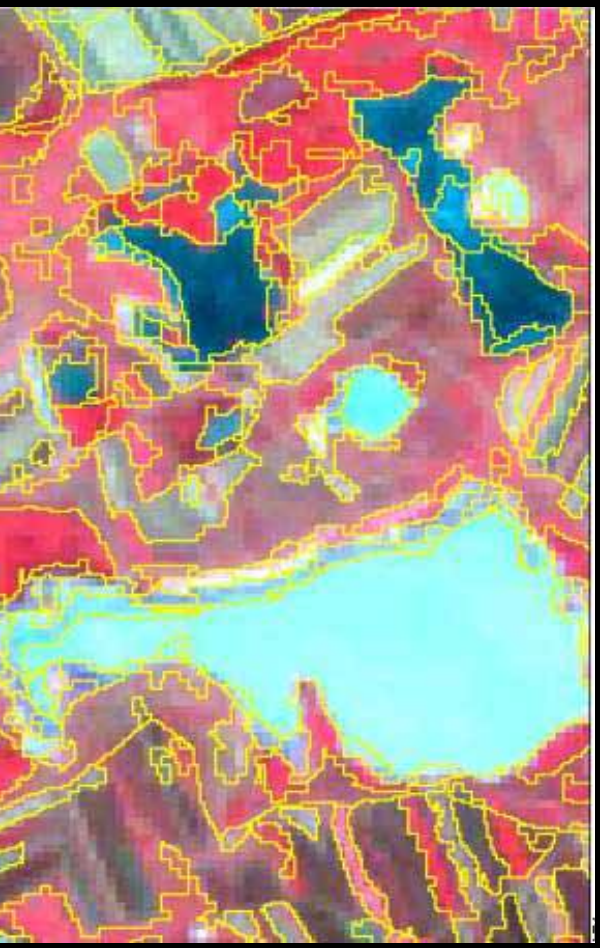
Wie arbeiten LandschaftsökologInnen ?

>>> *Anwendungsbeispiele:* ***SINUS,*** *ÖPUL*

Can we measure “(un)sustainable” land-use?

increasing human influence

semi-natural landscape

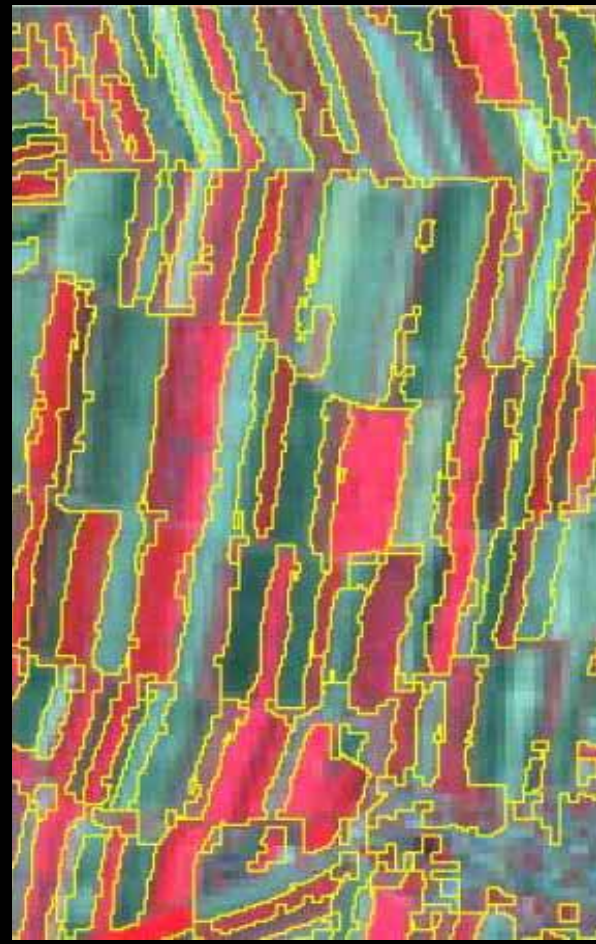


Landscape structure captures “frozen” energycascades and matterflows (“landscape ecology”)

The excessive use of fossil energy creates simple geometry in agricultural landscapes (“fractal geometry”)

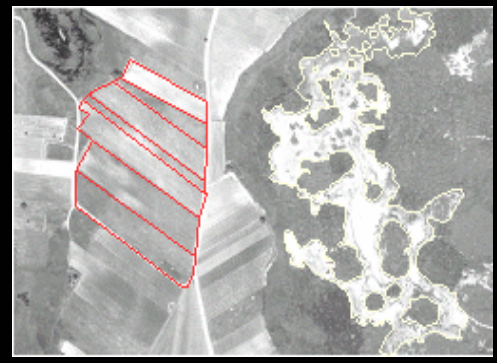
Landscape elements, landscape types, regions, etc. are part of a hierarchical system (“hierarchy theory”)

intensive agriculture



Linking scales and databases

	N.SCP.SUM	HEM-MED	HEM-AVG	SI-AVG	PFD-AVG	SI-AW	PFD-AW	%-FOREST	%-CROP	%-CROPVIN	%-DIS-LOW	%-HEM-LOW	LUC-DIV
NSCP-SUM													
HEM-MED	-0.72**												
HEM-AVG	-0.72**	0.85**											
SI-AVG	-0.27**	0.23*	0.27**										
PFD-AVG	0.55**	-0.46**	-0.41**	0.28**									
SI-AW	0.35**	-0.29**	-0.27**	0.11 n.s.	0.49**								
PFD-AW	0.69**	-0.38**	-0.39**	-0.07 n.s.	0.55**	0.76**							
%-FOREST	0.60**	-0.62**	-0.66**	-0.26**	0.21*	0.15 n.s.	0.24*						
%-CROP	-0.56**	0.60**	0.56**	0.36**	-0.19 n.s.	-0.22*	-0.25*	-0.51**					
%-CROPVIN	-0.49**	0.63**	0.58**	0.27**	-0.14 n.s.	-0.12 n.s.	-0.06 n.s.	-0.61**	0.89**				
%-DIS-LOW	0.61**	-0.62**	-0.71**	-0.28**	0.28**	0.20*	0.28**	0.89**	-0.50**	-0.55**			
%-HEM-LOW	0.57**	-0.74**	-0.72**	-0.36**	0.30**	0.24*	0.25*	0.69**	-0.62**	-0.68**	0.74**		
LUC-DIV	0.74**	-0.57**	-0.51**	-0.23*	0.35**	0.12 n.s.	0.36**	0.55**	-0.36**	-0.45**	0.52**	0.49**	



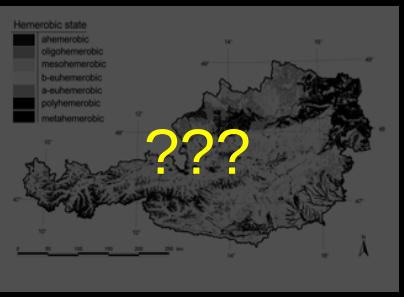
Data base:
description of landscape structure / calculation of indices

knowledge base:
identification of indicators

Local scale:

surveying and monitoring of sampling sites

Indicator assessment



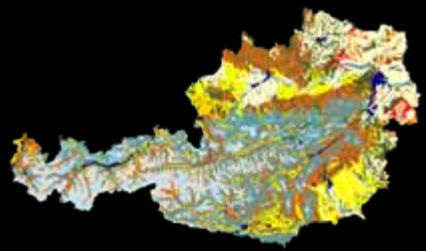
Data base:
ecography of landscape types / description of landscape structure / calculation of indices

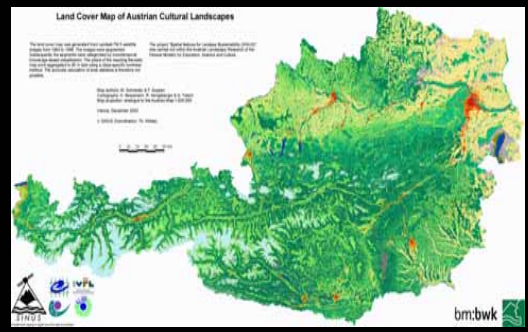
Reference units:

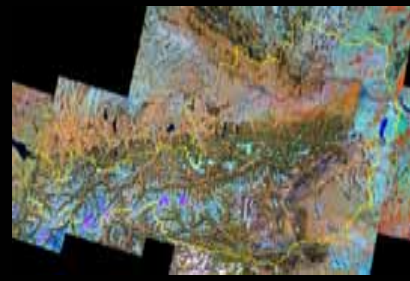
Classification of Land cover and Landscape types

Regional scale:

remote sensing







Linking scales and databases

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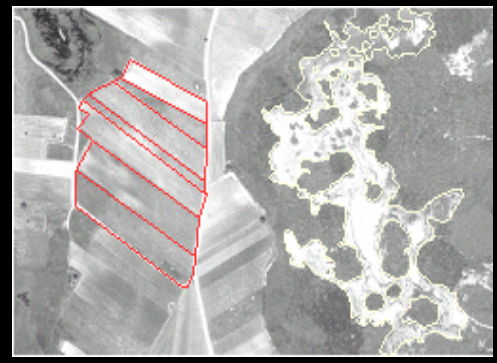


knowledge base:
identification of indicators

←

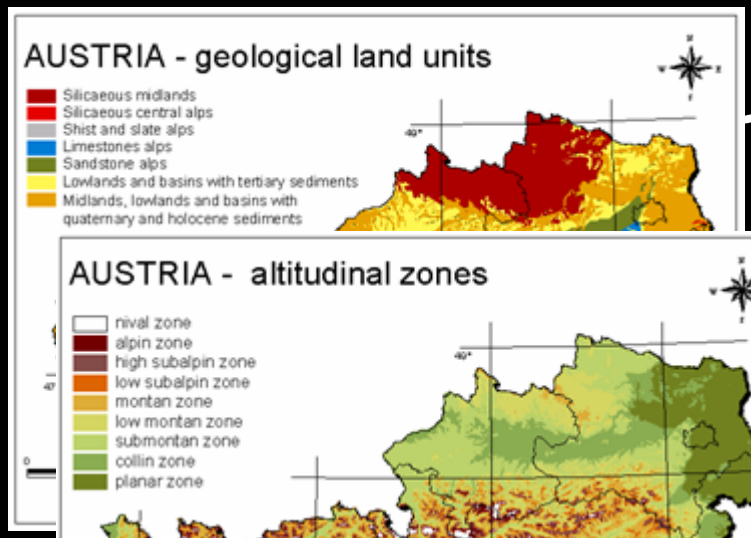
Data base:
description of landscape structure / calculation of indices

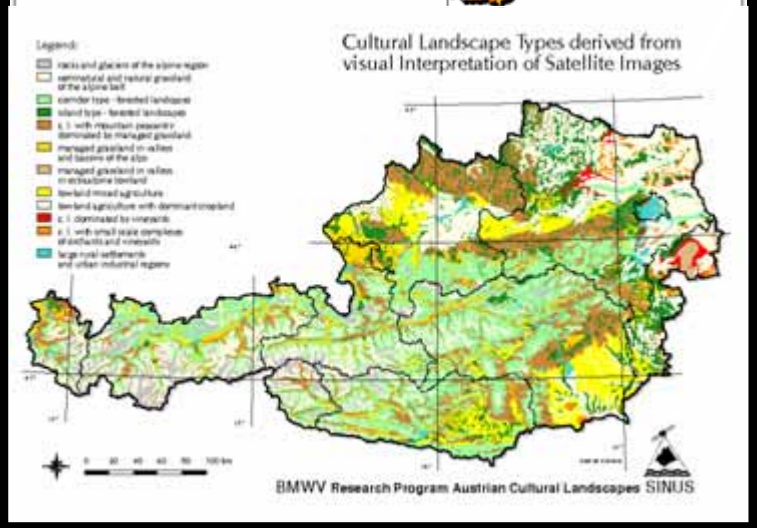
←

Local scale:
surveying and monitoring of sampling sites

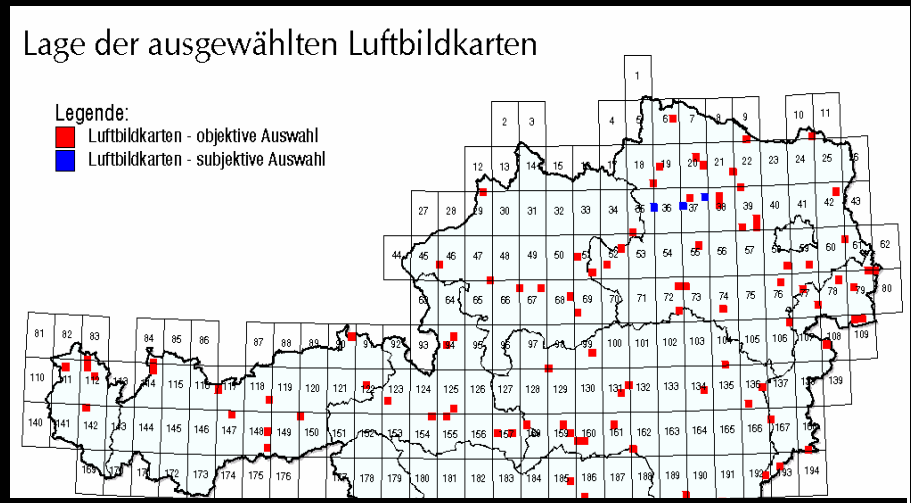
Representativity >>>

Sampling Design





1. GIS - intersection of thematic maps and stratification by isoclustering (8 classes)
2. GIS - intersection of classes with topographical maps and aerial photos
3. Selection of rectified aerial photos

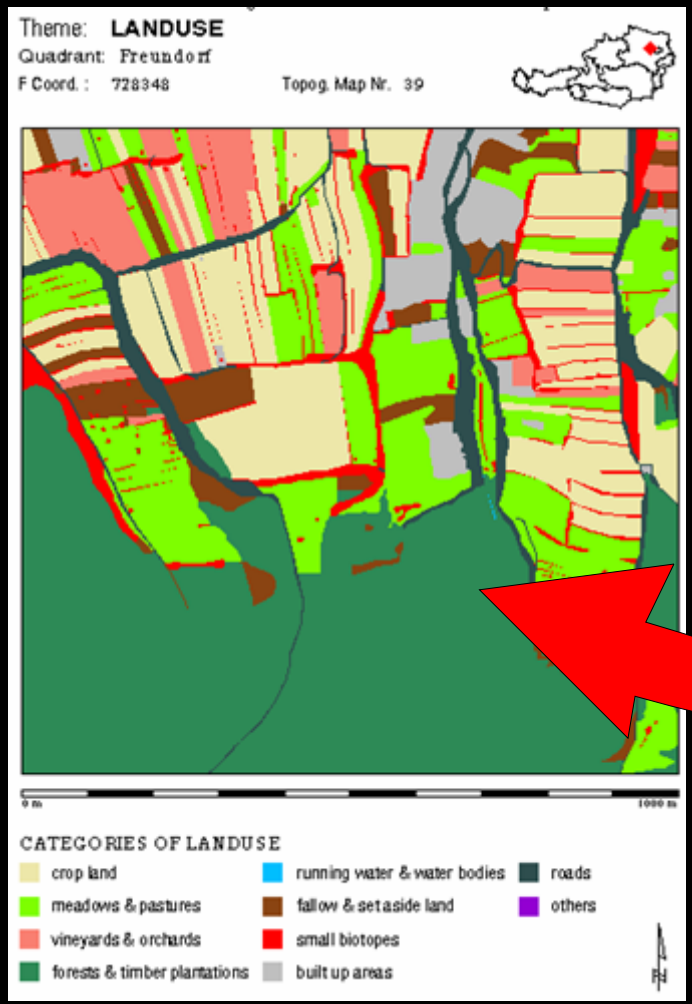


80 random (10 per stratum)

20 subjective

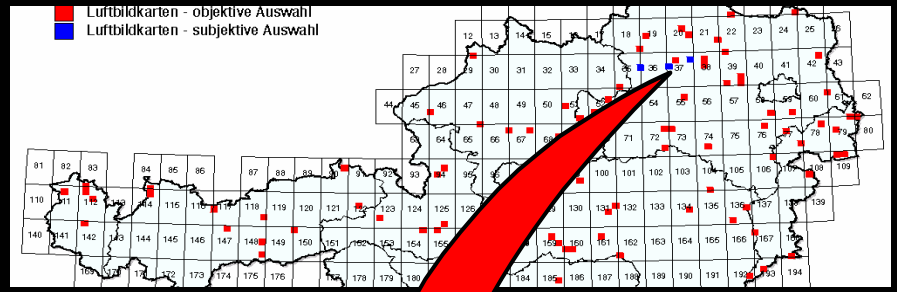
Representativity >>>

Field survey in 200 testsites (160 stratified random, 40 subjective)

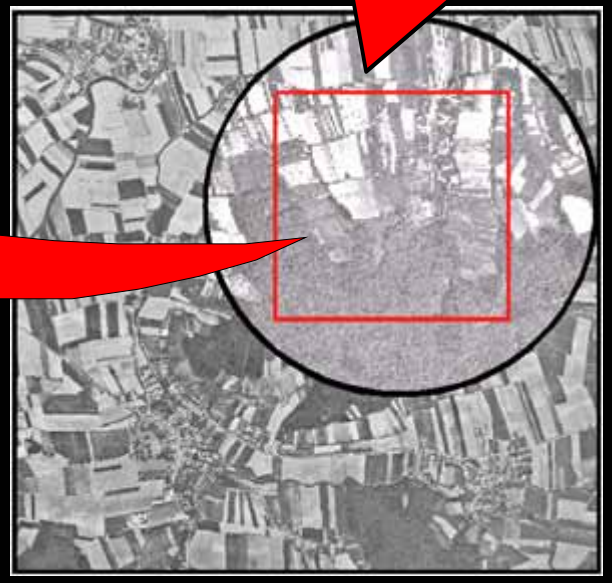


Sampling Design

- 80 random selected aerial photos per stratum (5x5 km)



- 20 subjecti y selected aerial photos (5x5 k



2 paired sites per aerial photo (1x1 km)

Landscape structure: local scale

Scale:

1 : 10.000

Land use, landscape structure, naturalness

- derived from field survey in 200 representative 1x1km sample squares
- database with 100.000 polygons (l.elements) described by up to 20 attributes
- compatible with European projects (Countryside Survey - GB, Landscape and BD-monitoring in the Flemish community,..)
- dataset is maintained and managed by UNIVIE / IECB / CVL

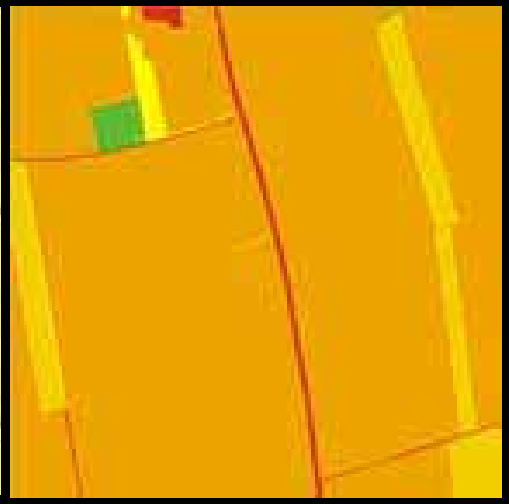
Direct Assessment of Hemerobiotic State

Species poor grassland, species selection by fire management, dense vegetation:
alpha-eu-hemerobiotic

Species rich grassland, species selection by frequent mowing and lateral nitrogen input,
beta-eu-hemerobiotic

Species poor, open vegetation, species selection by agro-chemicals:
poly-hemerobiotic

Land use intensity vs. Landscape structure



Example of two sample sites with comparable land use system but different landscape structure

a) Gradnitz – cropland in strip fields > polyhemerobiotc, but finegrained matrix; intersected by a central meadow corridor alongside a stream

a) Teichhof – cropland in large block parcels > polyhemerobiotic and coarse grained matrix almost without any small biotopes

Correlation between land use intensity and landscape structure

eg. shape parameters:

PFD = patch fractal dimension

SI = Shape index

NSCP = Number of shape characteristic points

	NSCP-SUM	HEM-MED	HEM-AVG	SI-AVG	PFD-AVG	SI-AW	PFD-AW	%-FOREST	%-CROP	%-CROPVIN	%-DIS-LOW	%-HEM-LOW	LUC-DIV
NSCP-SUM													
HEM-MED	-0.72 **												
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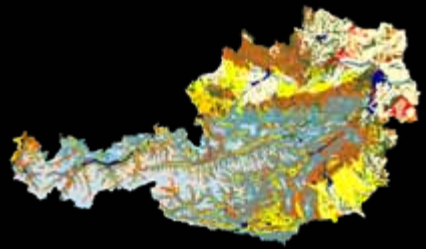
Correlationmatrix of selected variables from landscape structure analysis (Spearman-Rho).

** sig. p < 0.01 * sig. p < 0.05 n.s. nicht sig. p > 0.05

Linking scales and databases

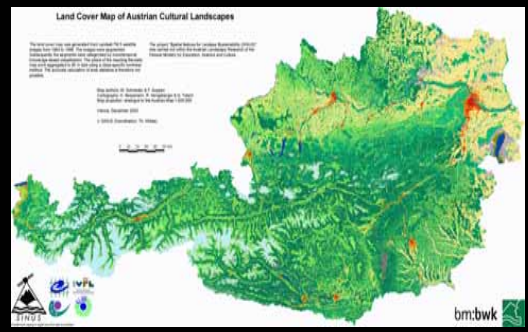
Data base:

ecography of landscape types / description of landscape structure / calculation of indices



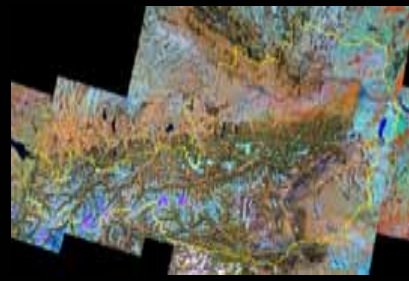
Reference units:

Classification of Land cover and Landscape types

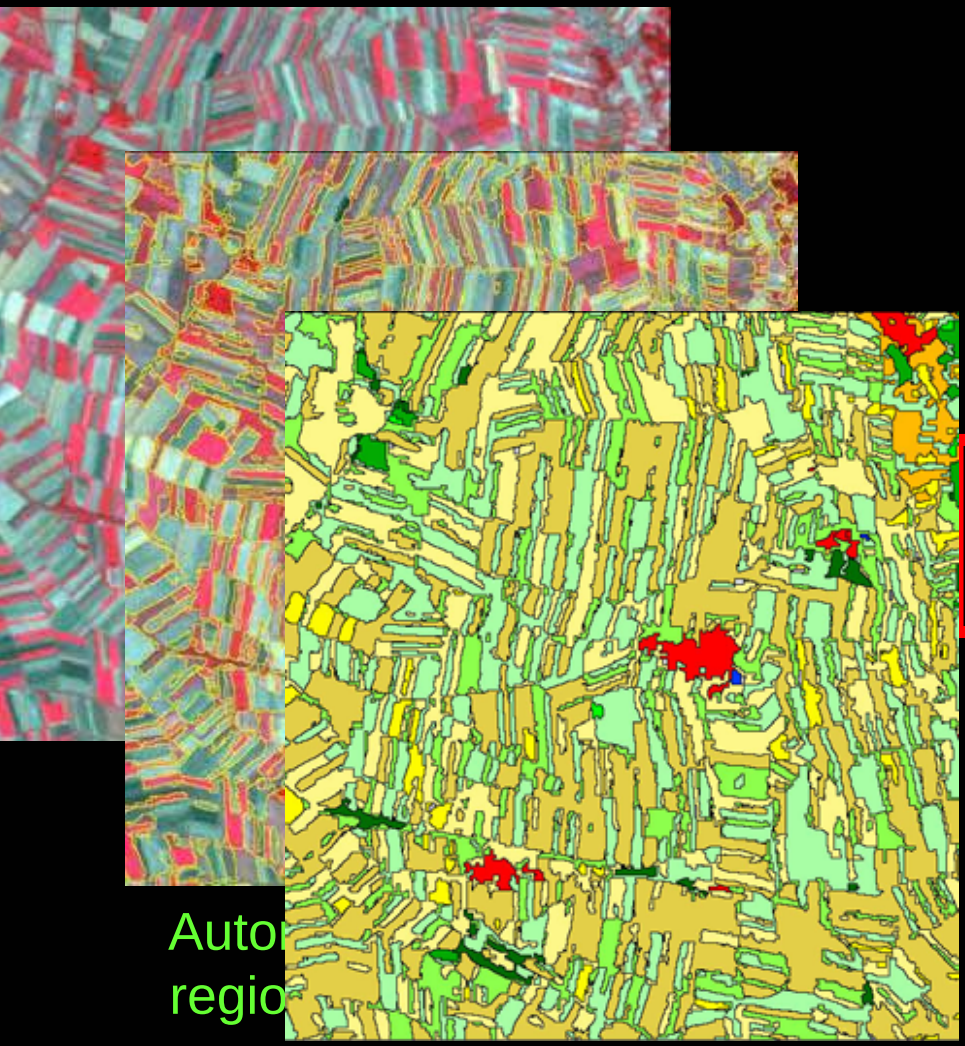


Regional scale:

remote sensing



Landscape structure - regional level >> Land Cover



Auto
regio

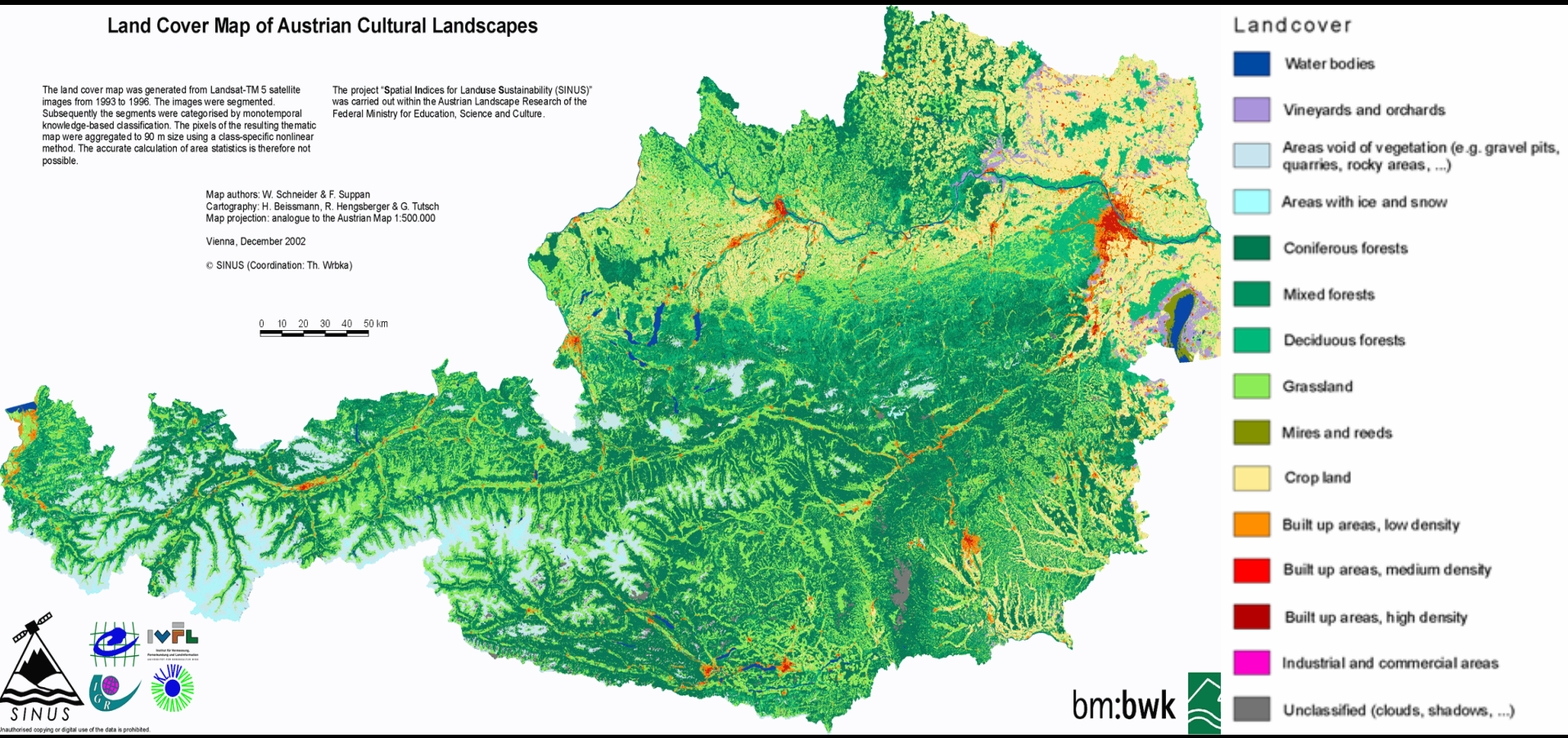
supervised classification

Land Cover Classification of Austria

- derived by processing of satellite images (LandsatTM)
- automatic segmentation (region growing) and supervised classification
- geometrical objects (= segment, not pixels!) with homogeneous spectral signature
- segment attributes include spectral (eg. wetness, vegetation index,..) and geometrical information (eg. shape parameter,...)
- grouped into 15 predefined land cover classes
- database is maintained and managed by BOKU / IVFL
- by linking with other databases the LC-classes can be transformed into “broader habitats” >> ENVIP-Nature project

Land Cover Map: database for regional landscape structure

15 categories



Landscape delineation and classification >> reference units

Scale:

1 : 200.000

Delineation of “Cultural Landscapes”

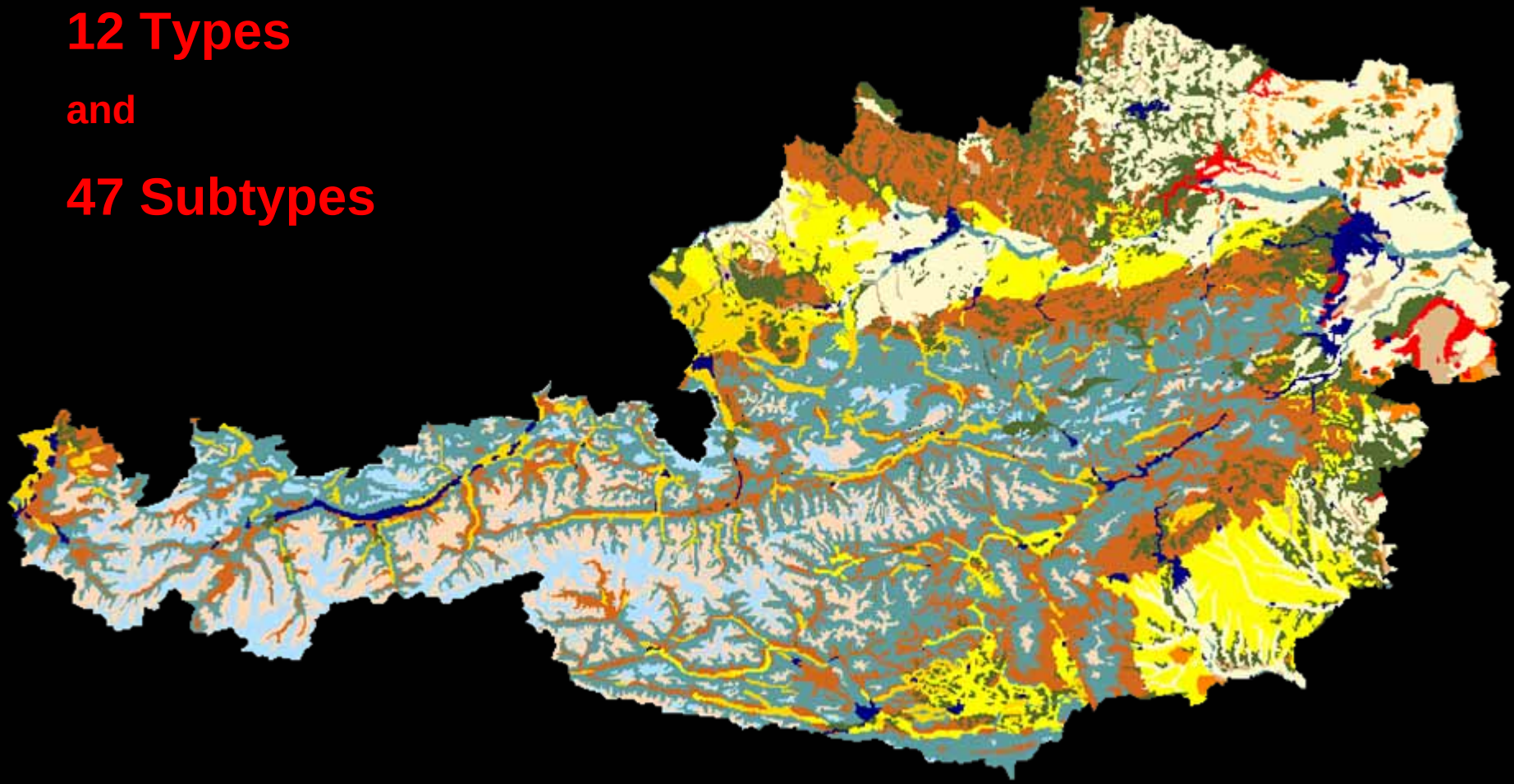
- derived from visual interpretation of satellite images
- about 16.000 individual polygons (“landscapes”)
- grouped into 47 predefined “Cultural Landscape Types”
- ecologically meaningful land-units with homogeneous pattern and processes (l.structure)
- to be used as reference units for “green accounting” etc.
- dataset is maintained and managed by UNIVIE / IECB / CVL

Result:

12 Types

and

47 Subtypes



Indicator assessment: linking scales and databases

	N.SCP.SUM	HEM-MED	HEM-AVG	SI-AVG	PFD-AVG	SI-AW	PFD-AW	%-FOREST	%-CROP	%-CROPVIN	%-DIS-LOW	%-HEM-LOW	LUC-DIV
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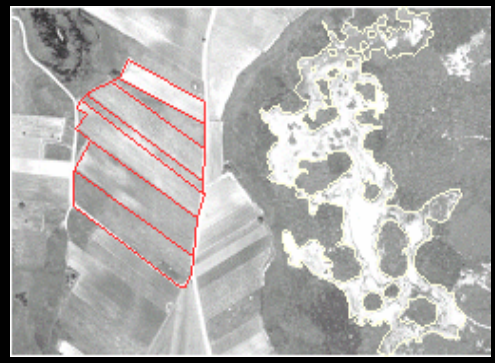
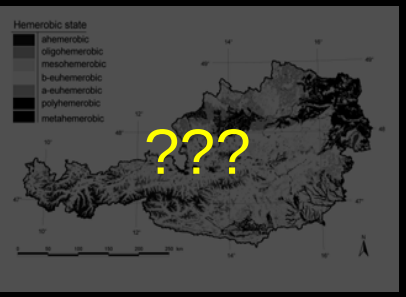


Data base:
description of landscape structure / calculation of indices

knowledge base:
identification of indicators

Local scale:
surveying and monitoring of sampling sites

Indicator assessment



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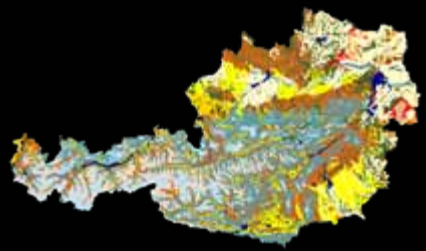
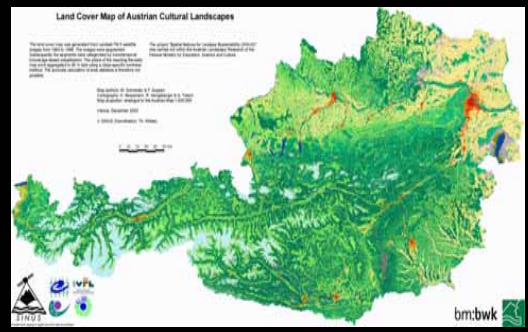
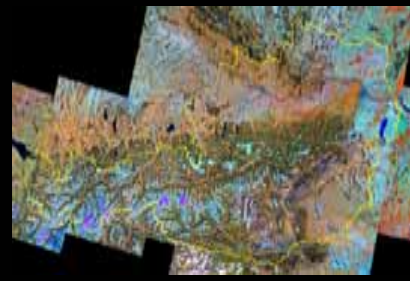






Assessment of Land-Use Sustainability

Three approaches:

- Direct assessment of robust and widely used DPSIR indicators (eg. Fragmentation, percentatge of built up area,..)

- FuzSust =

  Formulation of expert knowledge based rules and application of fuzzy logic algorithms

- RegSust =

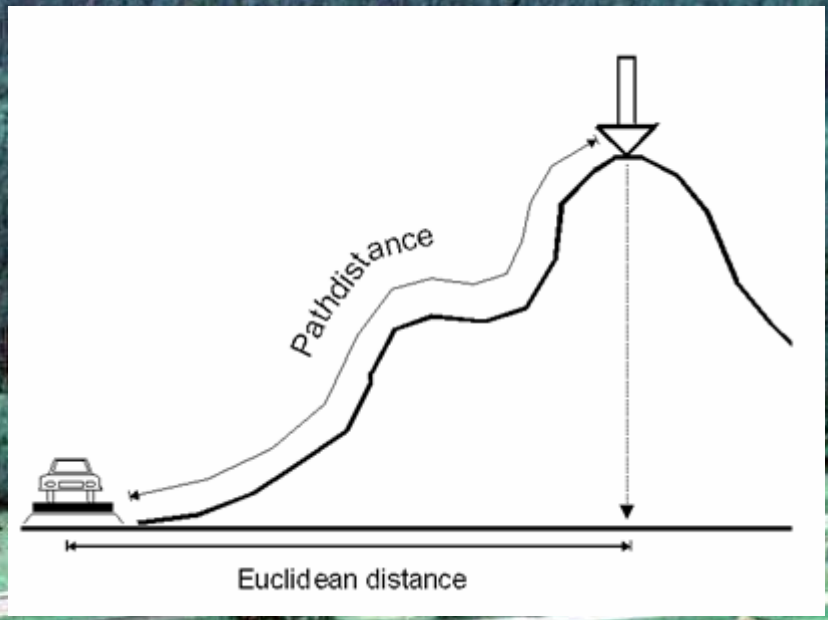
  Determination of human impact by calculating the deviation from an average situation of a certain Cultural landscape type

Direct assessment of DPSIR indicators:
RESLs = REgional Indicators of Sustainable Landuse

How fragmented / remote are Austrian cultural landscapes?

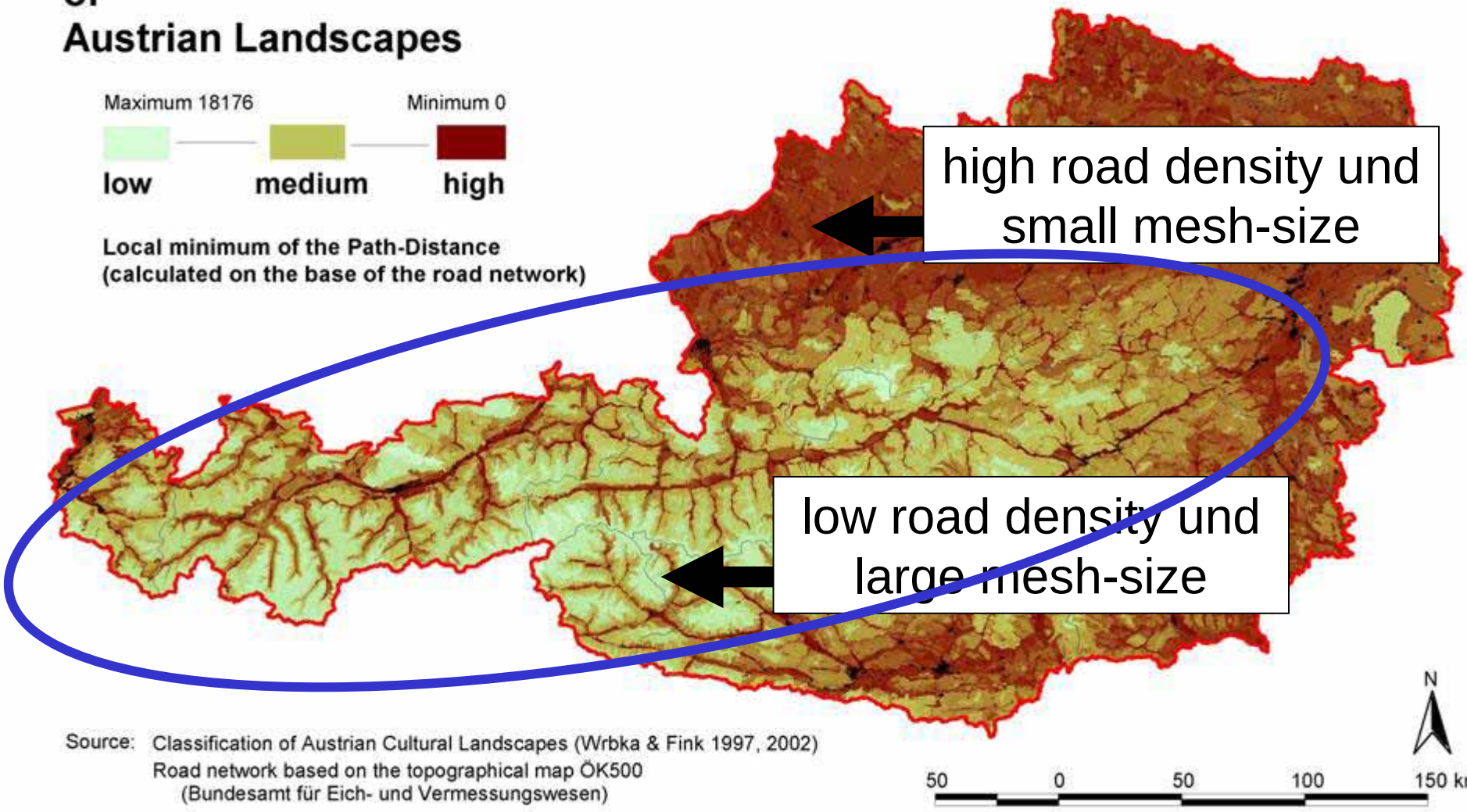
RESL = Density and mesh size of road network

Data source: SINUS landcover classification, Cultural Landscape Types



Calculation of max / min **pathdistance** from roads by means of DTM

Fragmentation of Austrian Landscapes



Source: Classification of Austrian Cultural Landscapes (Wrbka & Fink 1997, 2002)
Road network based on the topographical map ÖK500
(Bundesamt für Eich- und Vermessungswesen)

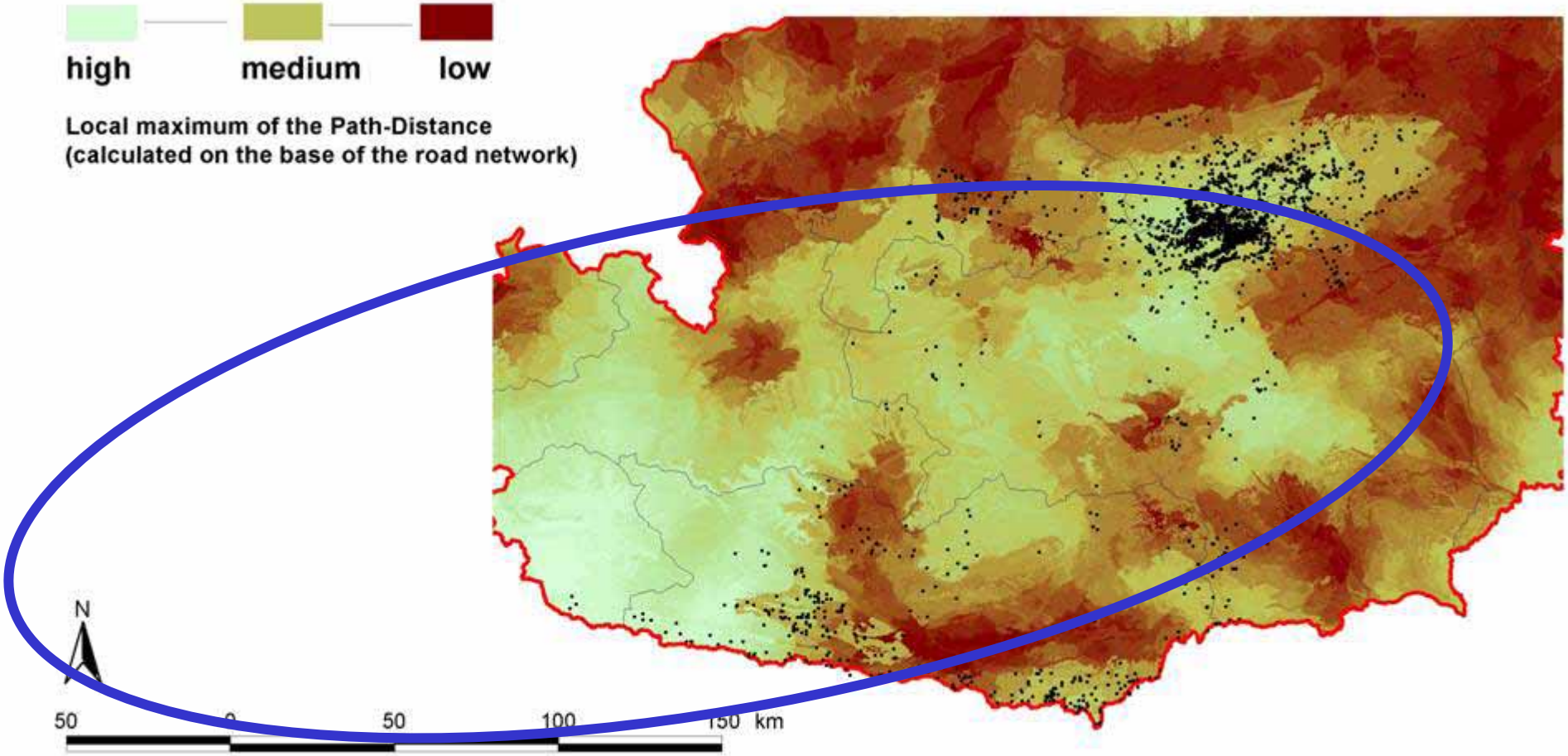
Occurrence of Brown Bear in Remote Landscapes in Austria

Maximum 86640 Minimum 915

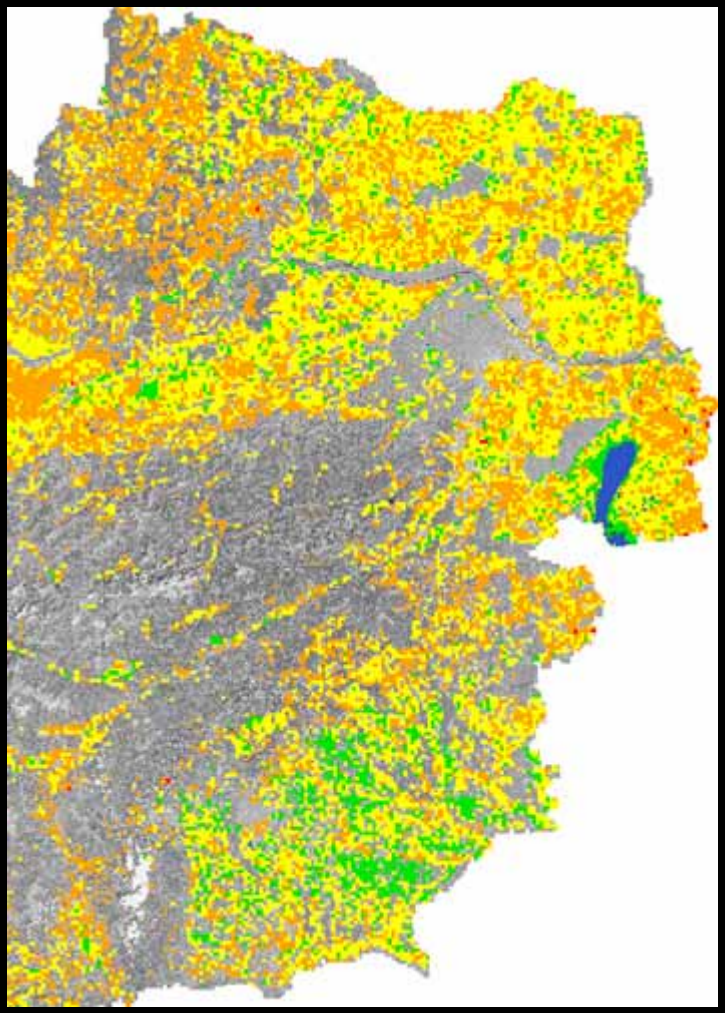
high medium low

Local maximum of the Path-Distance (calculated on the base of the road network)

Sightings of Brown Bear (Ursus arctos) (Source: Monitoring program of the brown bear by the WWF Austria, G.Rauer & B.Gutleb; 1989-1999)



FUZSUST approach



\+ Formulation of knowledge based rules, describing (un)sustainable land use patterns for each Austrian Cultural Landscape Type separately

\+ Application of rule set by using fuzzy logic algorithms

\+ Visualising the degree of membership to the linguistic variable „high land use sustainability“ for 1x1km landscape cells

⇨ Sustainability indicator FUZSUST

FUZSUST approach

Example:

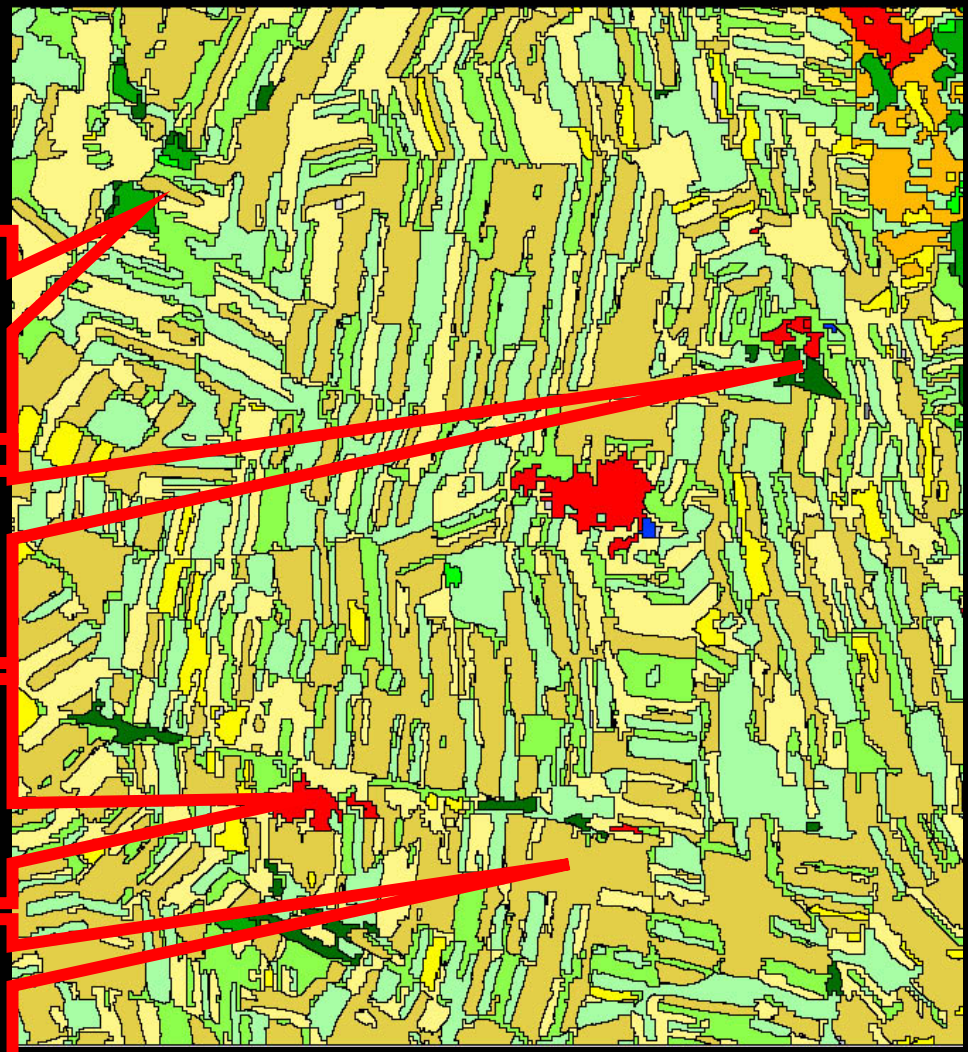
set of rules for lowland cropfarming landscapes

if area of deciduous forest patches is big and compactness is high then sustainability is high

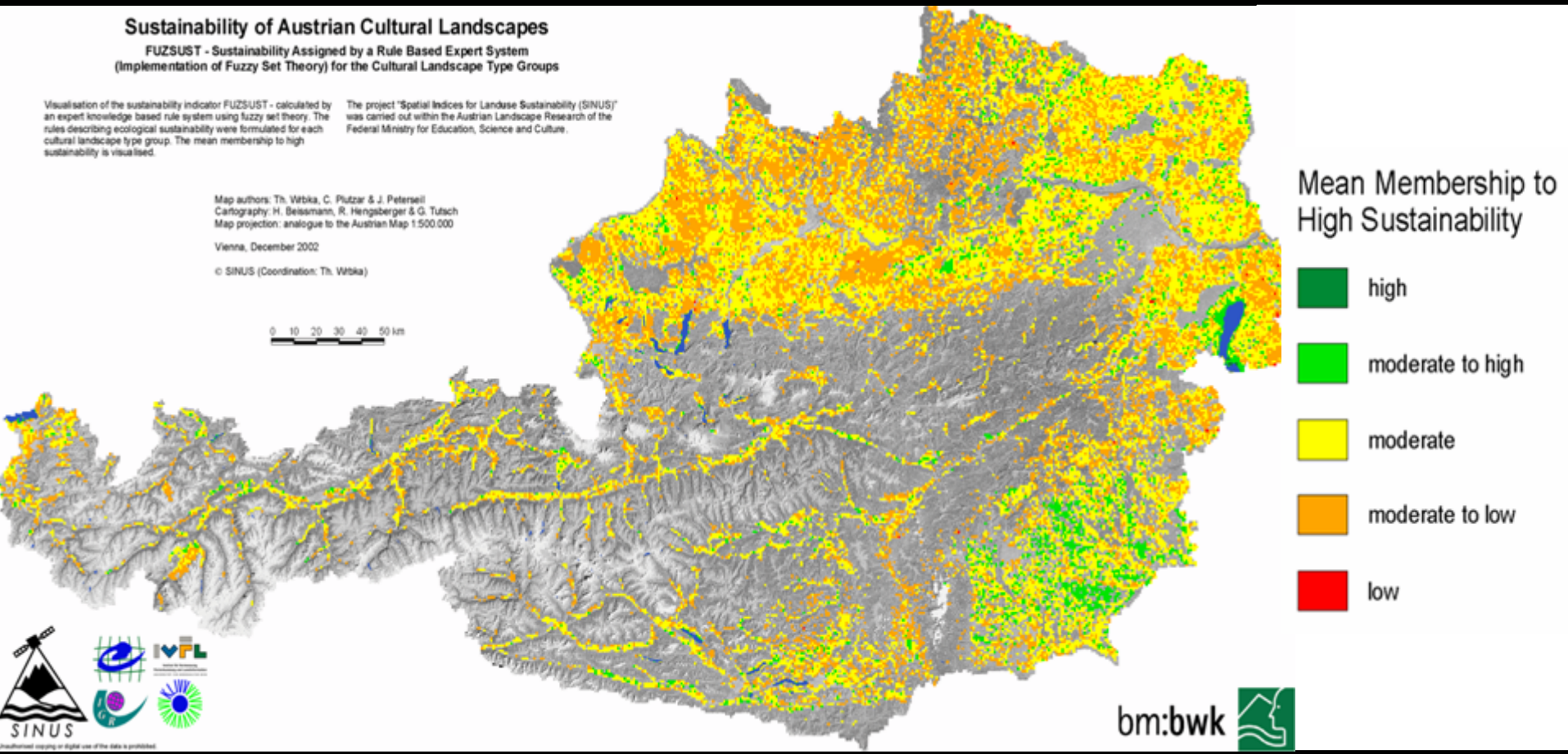
if percentage of pure coniferous forest is high and elevation is low then sustainability is low

if percentage of built-up area is high and percentage of arable land is high then sustainability is low

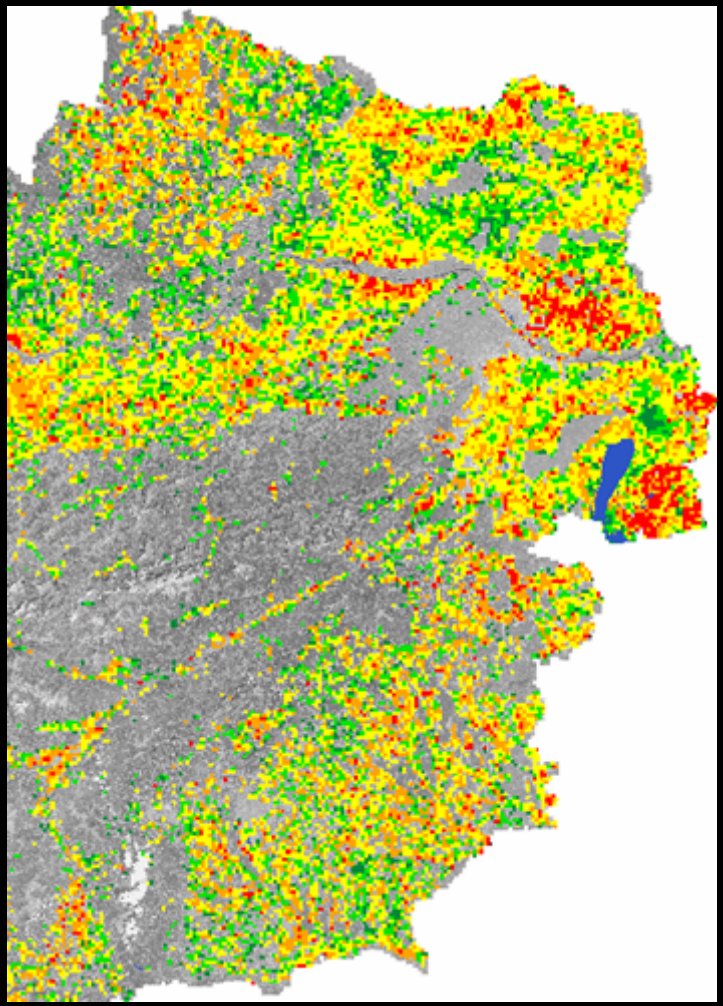
if mean size of landcover segments is high then sustainability is low



FUZSUST results



REGSUST approach



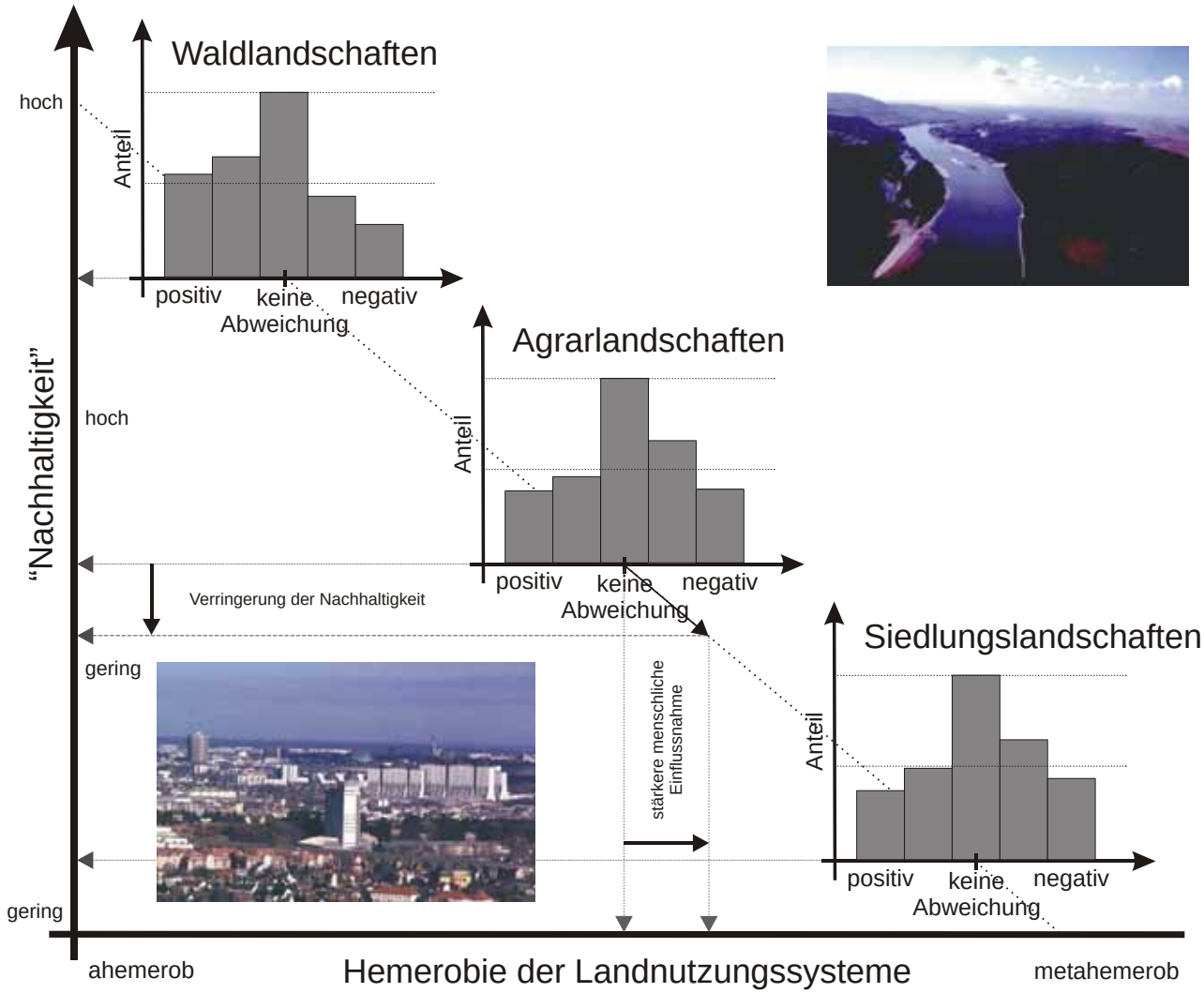
+ Extraploation of hemerobiotic state for the whole Austrian territory by means of an ordinale regression model

+ Calculation of the deviation from the average of the respective landscape type for each single 1x1km landscape cell

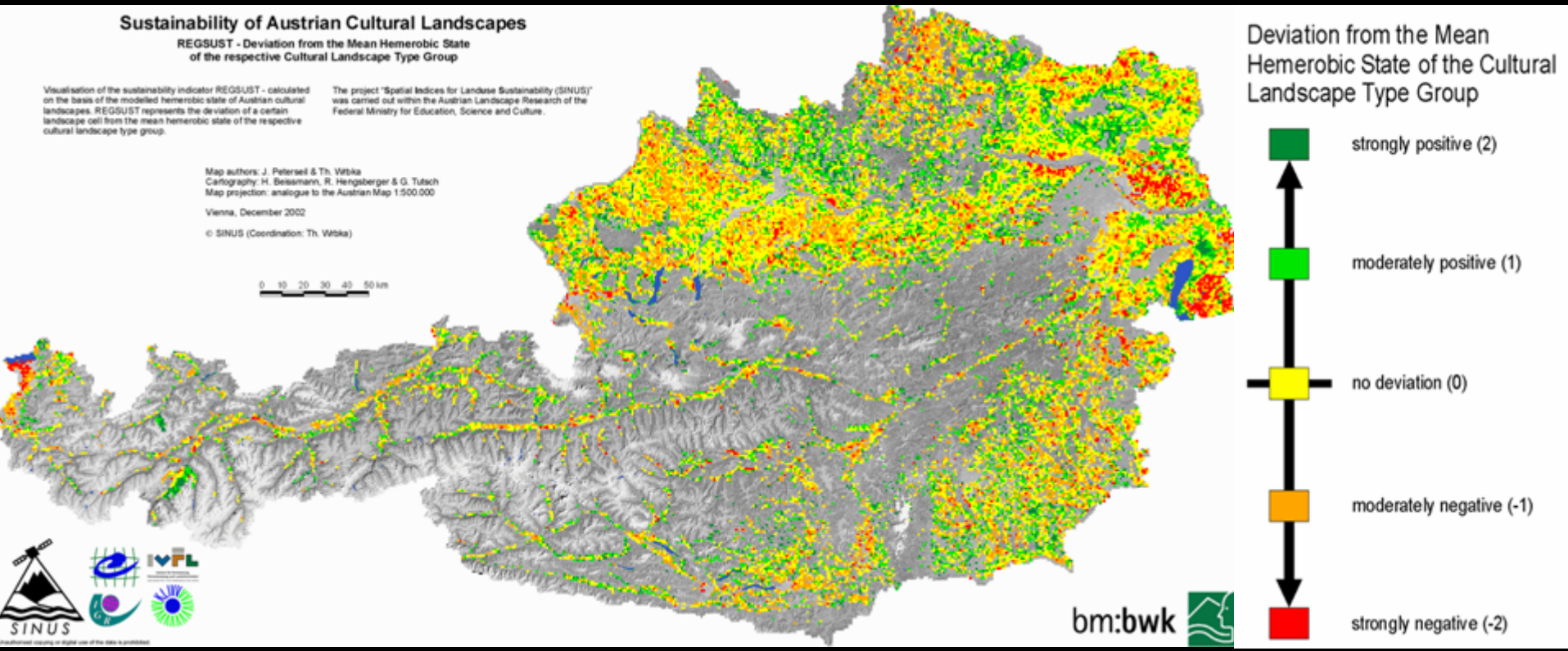
+ Visualisation by classifying the deviation into five categories

⇨ Sustainability indicator REGSUST

Deviation from average distribution of hemerobiotic state



RegSust: Results



Danke für Ihre Aufmerksamkeit !