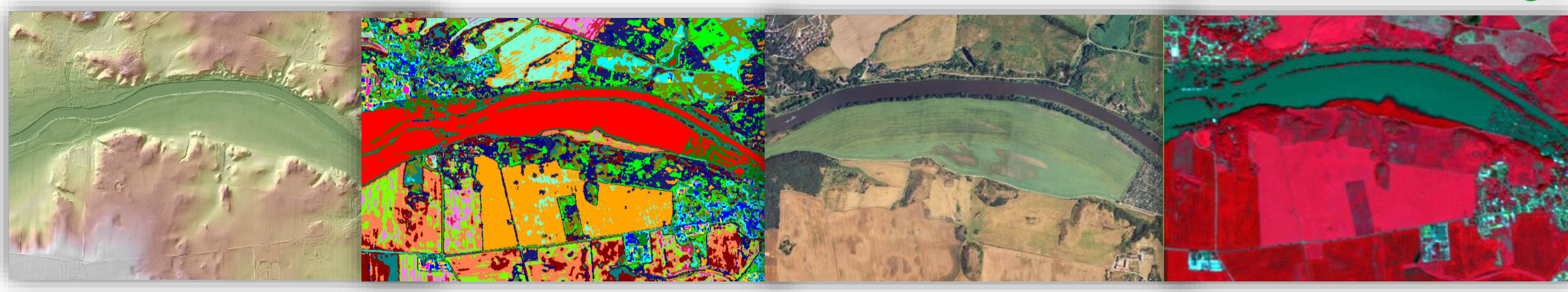


LANDSCAPE ANALYSES & VISUALISATION

Martin Luther University Halle-Wittenberg
Institute of Geosciences and Geography
Department of Remote Sensing and Cartography

Co-funded by the Erasmus+ Programme of the European Union

Our team – Vera Schreiner

- Study: Geoecology (Diploma) in Volgograd (Russia), Specialisation: Landscape Ecology
- Promotion: University of Leipzig, Institute of Geography

Indicator system and assessment of desertification processes within the Northern Kulunda steppe in Western Siberia

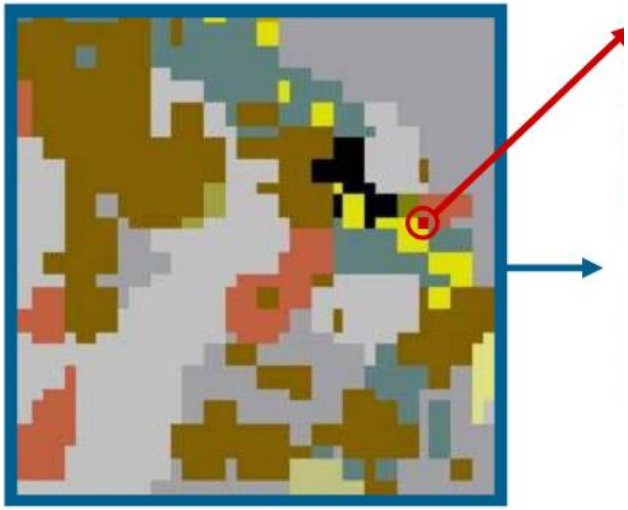
- Scientific assistant in the **Department of Remote Sensing and Cartography** since January 2017
- Lectures in **Geomatics** (Bachelor, Master), **Geodata-analysis** (Bachelor) and **Applied Remote Sensing** (Master)
- Thematic focus: Spatial Analysis, Multiscale and multisensoral remote sensing, Geovisualisation, Landscape Analysis
- Regional focus: Russia (Central Russia, Western Siberia), Israel, Central Asia, Central Germany)

(1) Multiscale, multisensoral and multitemporal approach in landscape analysis and visualisation
(2) Selected examples of landscape analysis and visualisation

Multiscale, multisensoral and multitemporal approach in landscape analysis and visualisation

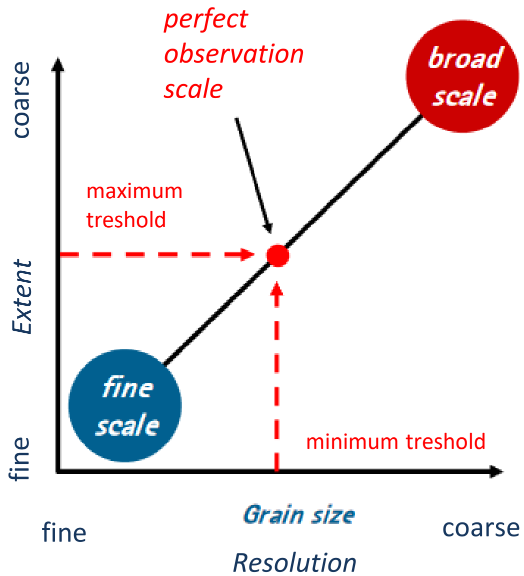
Scale:

- spatial or temporal Dimension of an object or process
- characterized by…



Schneider, D. C. 2002. Scaling theory: application to marine ornithology. - Ecosystems 8: 736-748

http://lanpartei.de/~anubis/Gecko/Faecher/landschafts%C3%B6kologie/Vorlesung/vl_lec_2008_04_21.pdf



Rules:

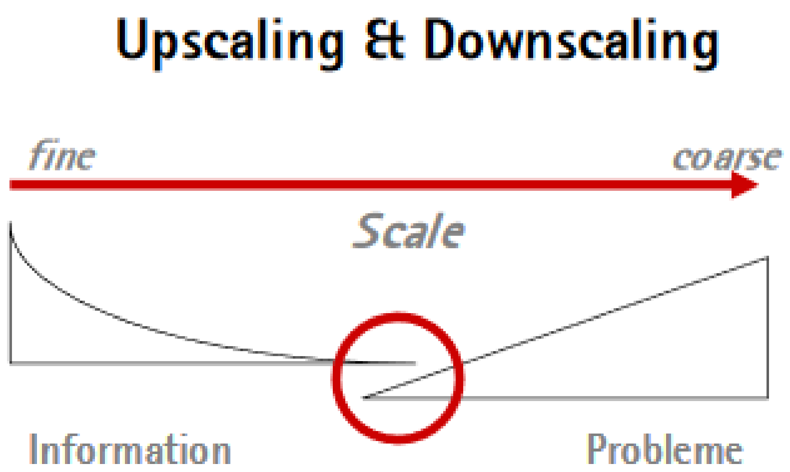
- Status quo → fine grain and large extent
- extent ↑ resolution ↓
- resolution ↑ data ↑
- It is not possible to examine patterns that are finer than the resolution or coarser than the expansion

Data acquisition as a ***trade off*** between extent and resolution

http://lanpartei.de/~anubis/Gecko/Faecher/landschafts%C3%B6kologie/Vorlesung/vl_lec_2008_04_21.pdf

Scale problem

- direct measurements are normally limited to small periods of time & space,
- the most important problems are to be solved on larger scales, but
- direct upscaling fails if patterns and processes on the small scales (**local aspect**) differ from those on the larger scales (**regional aspect**) .



http://lanpartei.de/~anubis/Gecko/Faecher/landschafts%C3%B6kologie/Vorlesung/vl_lec_2008_04_21.pdf

ENV PRO

Multiscale, multisensoral and multitemporal approach in landscape analysis

multiscale

Downscaling

Upscaling

Local aspect (LA)
[small ecological scale,
large cartographic/ map scale,
high spatial resolution data]

Regional aspect (RA)
[large ecological scale,
small cartographic / map scale,
moderate spatial resolution data]

multisensoral

Data	LA	RA
Hyper-spectral	**AVIRIS** (224 bands, 4-20m) **Field Spectrometry**	**Hyperion (EO-1)** (220 bands, 30m) **EnMap** (262 bands, 30m) **HySIS** (60 bands, 30m)
Multi-spectral	**WV-3/4** (pan+VNIR, 1,24m) **RapidEye** (VNIR, 5m) **SPOT-6** (pan+VNIR, 6m)	**Landsat** (VTIR, 30—100m) **Sentinel-2** (VSWIR, 10-60m)
Radar/Laser scanning data	**DTM** (1m)	**Sentinel-1** (5m- 20m)
Elevation Models	**ALOS** (5m)	**SRTM** (30m) **ASTER** (30m)
Landscape elements		

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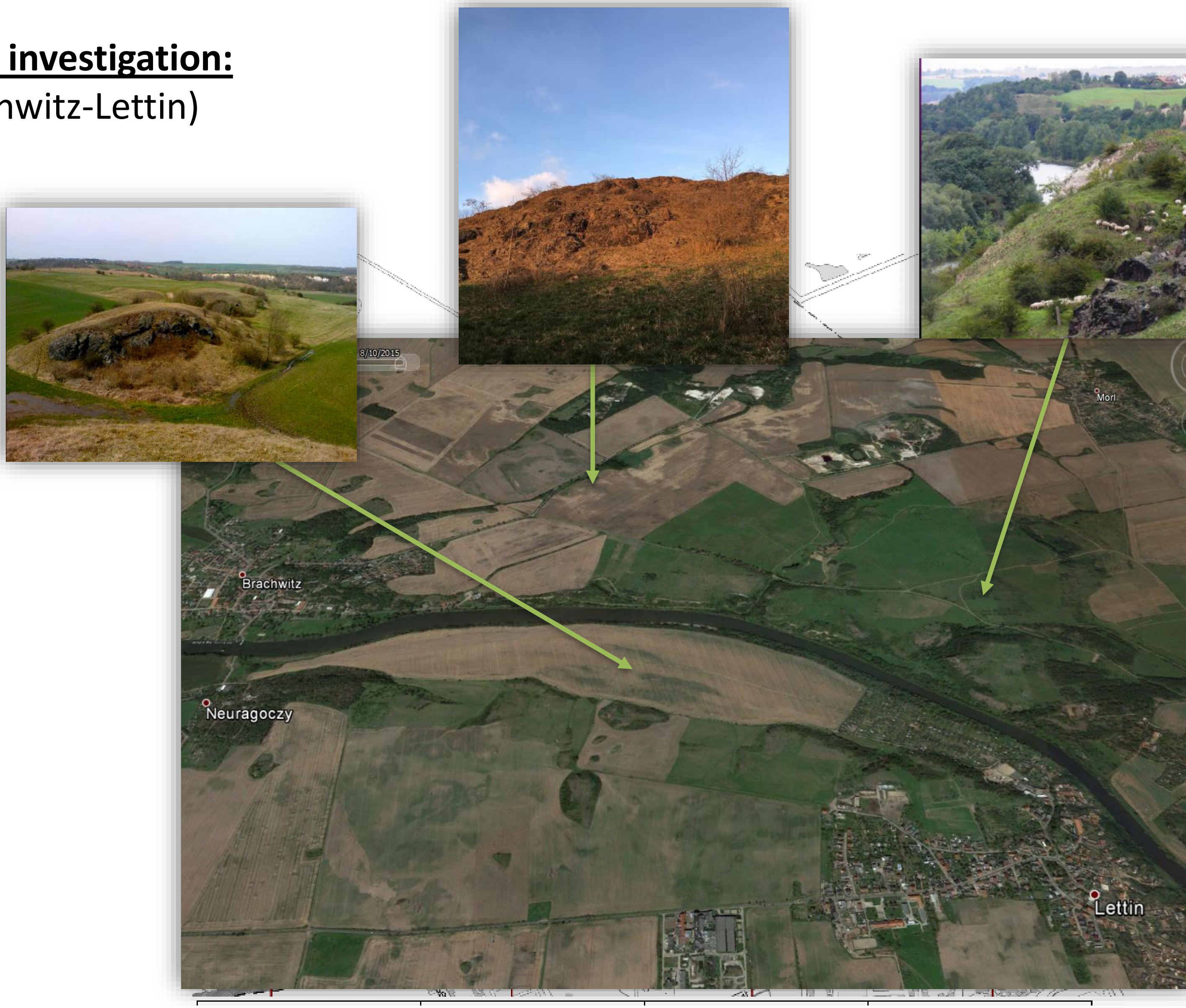
ARSC

Area of investigation:

(Brachwitz-Lettin)



2015

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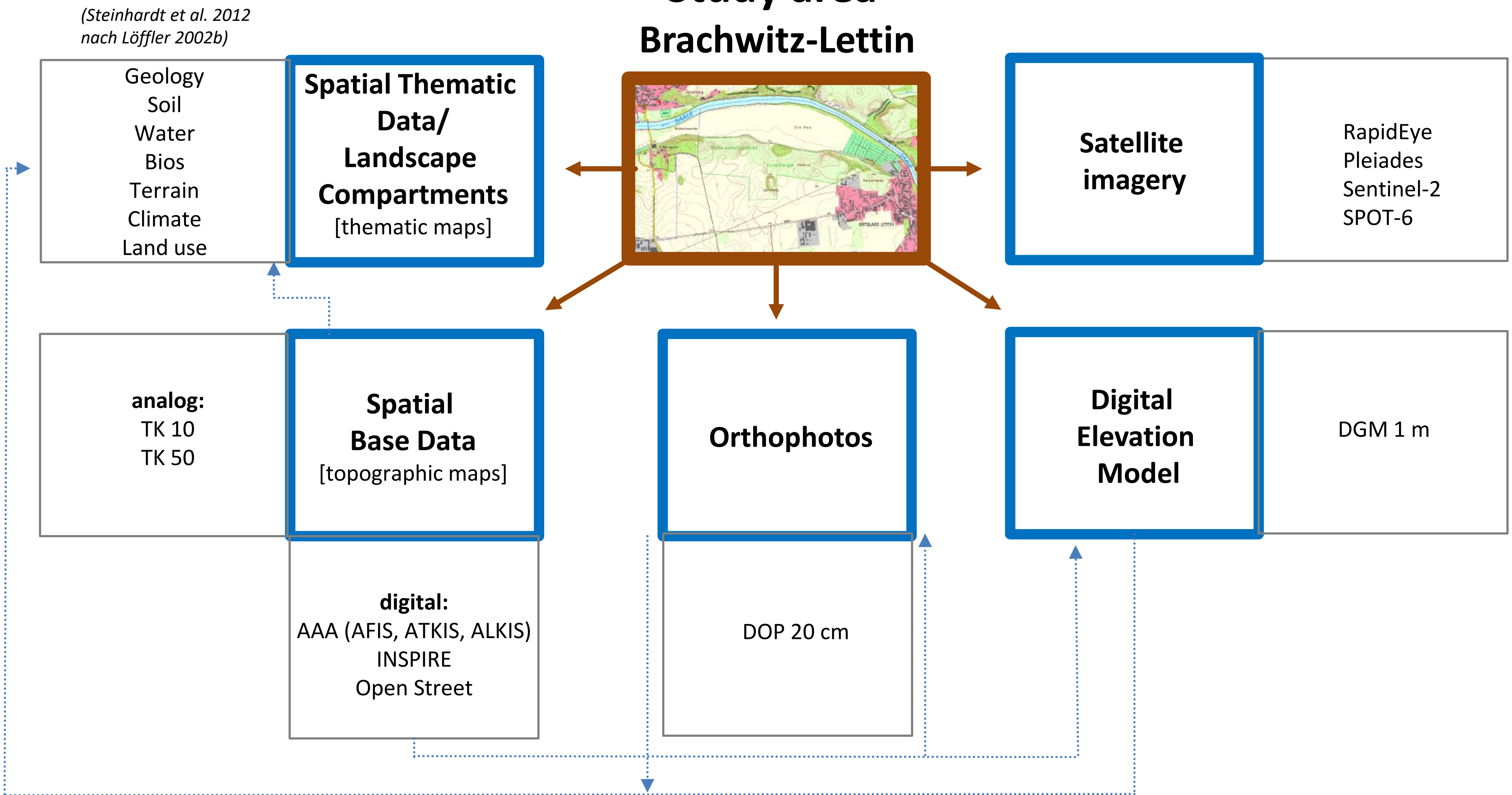
Study area
Brachwitz-Lettin



Area of investigation : 120 x 120 m

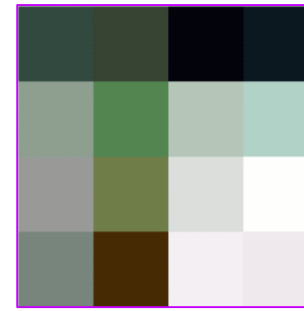
DOP
A: 20 cm
= 600 x 600
= 360 000 Pixel

~ WoldView4
A: 1,2 m
= 100 x 100
= 10 000 Pixel

~ Pleiades
A: 2 m
= 60 x 60
= 3600 Pixel

~ RapidEye
A: 5 m
= 24 x 24
= 576 Pixel

~ Sentinel-2
A: 12 m
= 10 x 10
= 100 Pixel



~ Landsat 8
A: 30 m
= 4 x 4
= 16 Pixel

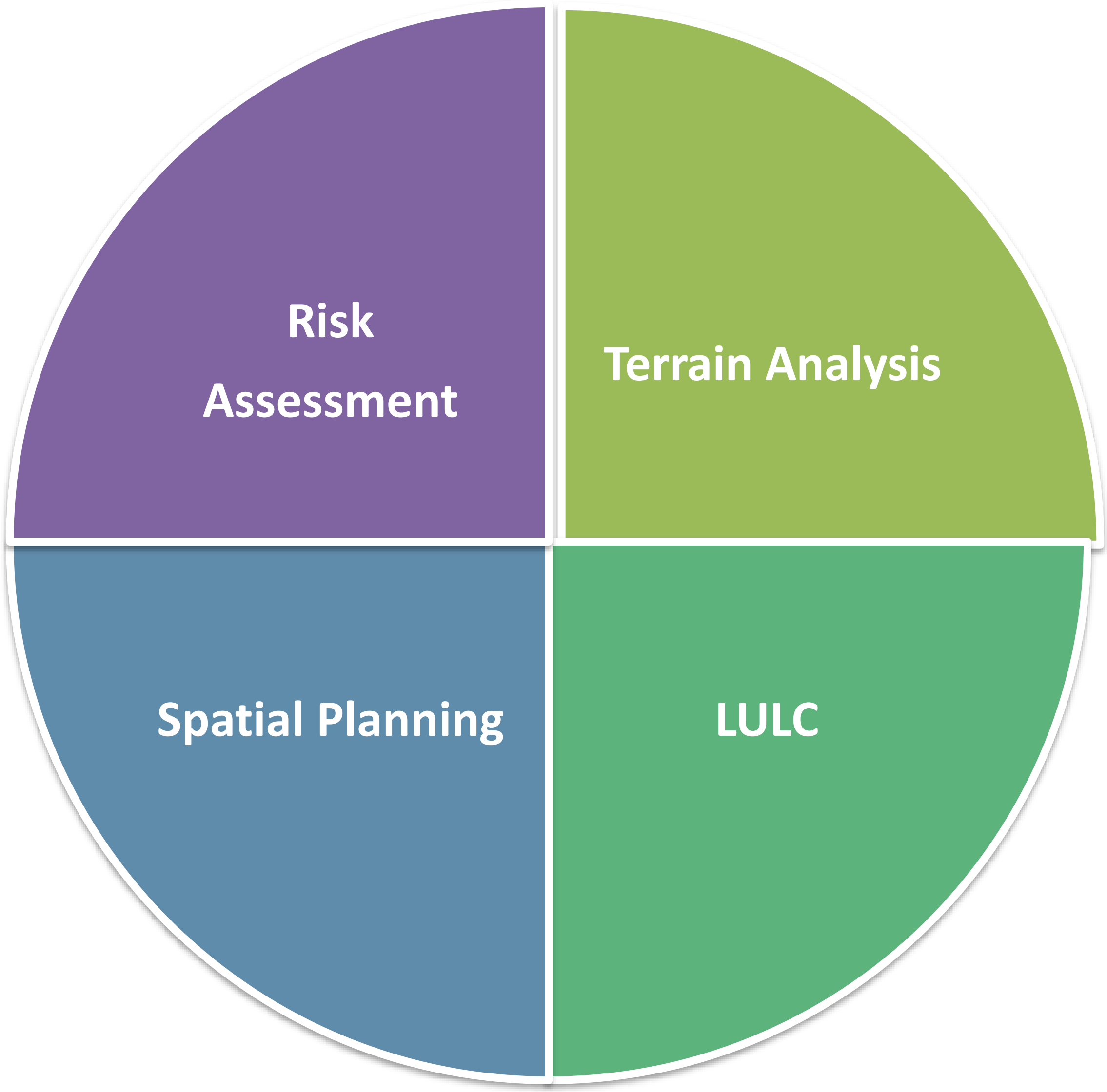
Geobasis and Geofach data: Availability

Extent

Resolution

EU	Deutschland	Sachsen-Anhalt
International Geological Map of Europe and Adjacent Areas (IGME 5000) 1:5.000.000 International Geological Map of Europe and the Mediterranean Regions 1 :1.500.000	Geologische Karte der Bundesrepublik Deutschland 1:1.000.000 (GK1000) Geologische Übersichtskarte der Bundesrepublik Deutschland 1:200.000 (GÜK200)	Geologischen Übersichtskarte von Sachsen-Anhalt 1:400.000 (GÜK 400) Geologische Karte 1:25.000 (GK25)
Soil Regions of the European Union and Adjacent Countries 1:5.000.000 (EUSR5000) Soil Geographical Database of Europe 1:1.000.000	Bodenübersichtskarte 1:1.000.000 (BÜK1000) Bodenübersichtskarte 1:200.000 (BÜK200)	Übersichtskarte der Böden von Sachsen-Anhalt (BÜK400) Vorläufige Bodenkarte von Sachsen Anhalt 1:50.000 bodenkundliche Informationen auf Grundlage der Bodenschätzung 1:10.000
OpenTopoMap Garmin-Edition 1:25 000	Deutschland 1:1.000.000 (D1000 und DTK1000) Topographischen Übersichtskarte 1:500.000 (TK500 und DTK500) Topographische Karte 1:250.000 (TK250 und DTK250) Topographische Übersichtskarte 1:200.000 (TÜK200 und DTK200)	Topographische Übersichtskarte Sachsen-Anhalt 1:250.000 (TÜK250) Topographische Karte 1:100.000 (TK100 und DTK100) Topographische Karte 1:50.000 (TK50 und DTK50) Topographische Karte 1:25.000 (TK25 und DTK25) Topographische Karte 1:10.000 (TK10 und DTK10)

Selected examples of landscape visualisation and analysis


Risk Assessment
Terrain Analysis
Spatial Planning
LULC

Geomorphology → Terrain Analysis

- Topographic Attributes (primary, secondary)
- Visibility Analysis

Environmental Risk Assessment and Management

- Determining the inundation area using predicted flood levels and DEM

Spatial planning

- Development of Settlement Areas (settlement growth) using cellular automata

LULC → Land cover mapping using aerial images and/or satellite images

- Visual Image Interpretation → Digitalisation/Generalisation → Validation in situ
- Classification and segmentation methods, index-based analysis

Vegetation

- Vegetation cover and vitality
- Phenological phases

Topics	Geodata	Spatial resolution
I. **Terrain Analysis** II. **Environmental Risk Assessment and Management**	Digital Terrain Model	1 m
III. **Spatial Planing**	Corine Land Cover 2006	
IV. **Land cover mapping**	aerial images, orthophotos Satellite Images (Pleiades, RapidEye, SPOT-6, Sentinel-2)	20 cm 2 m, 5 m , 6 m, 10 m

+ additional data (spatial base data & spatial thematic data)

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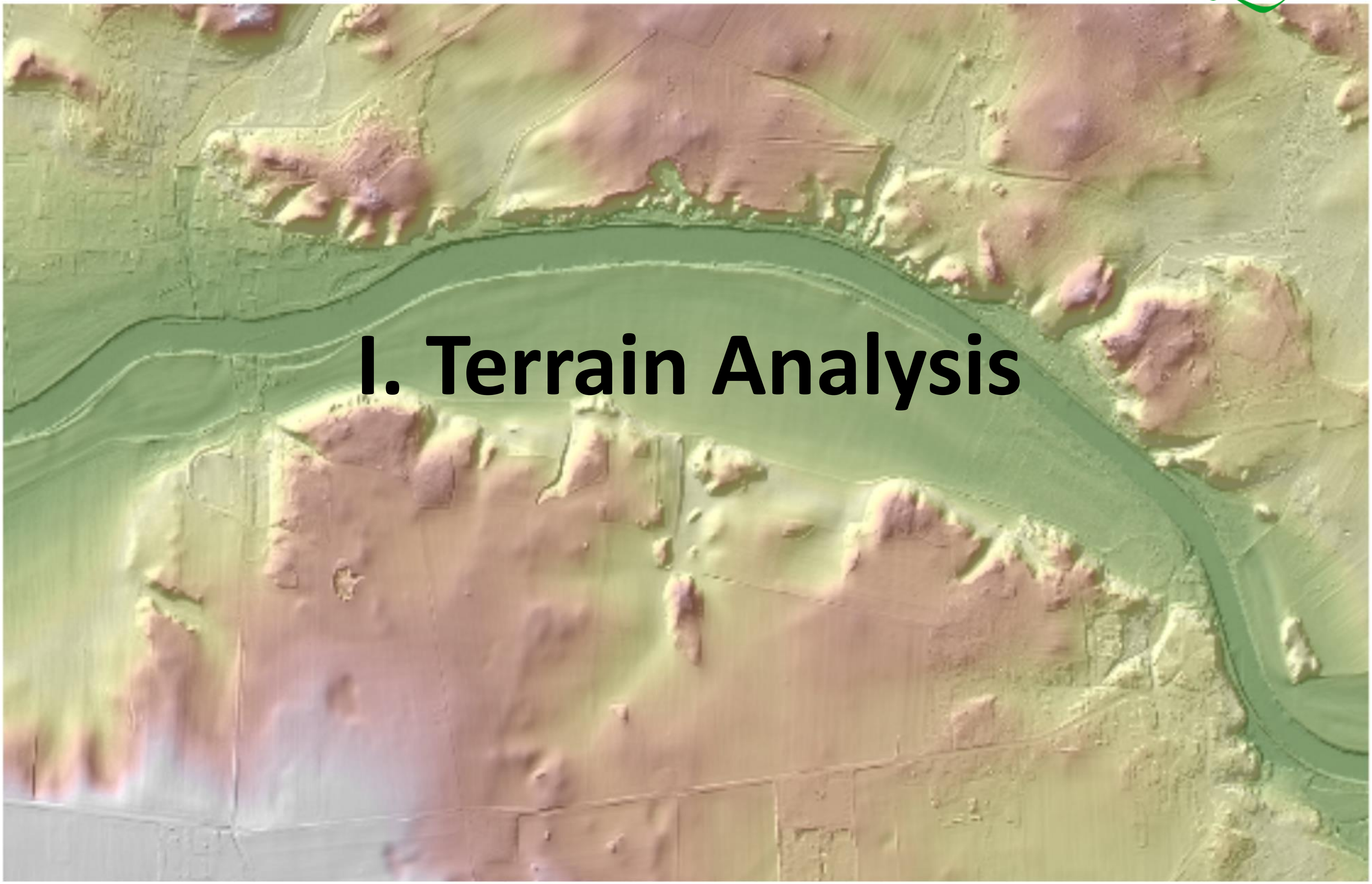

I. Terrain Analysis

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Calculation and Use of Topographic Attributes in Hydrological, Geomorphological, and Biological Applications

Primary Topographic Attributes:

Attribute	Definition	Significance
Slope	Gradient	Overland and subsurface flow velocity and runoff rate, precipitation, vegetation, geo-morphology, soil water content, land capability class
Aspect	Slope azimuth	Solar insolation, evapotranspiration, flora and fauna distribution and abundance
Profile curvature	Slope profile curvature	Flow acceleration, erosion/deposition rate, geomorphology
Plan curvature	Contour curvature	Converging/diverging flow, soil-water content, soil characteristics
Tangential curvature	Plan curvature multiplied by slope	Provides alternative measure of local flow convergence and divergence
Elevation percentile	Proportion of cells in a user-defined circle lower than the center cell	Relative landscape position, flora and fauna distribution and abundance

Calculation and Use of Topographic Attributes in Hydrological, Geomorphological, and Biological Applications

Secondary Topographic Attributes:

Topographic wetness indices	$W_T = \ln\left(\frac{A_s}{T \tan\beta}\right)$

Stream-power indices	$\mathrm{SPI} = A_s \tan\beta$

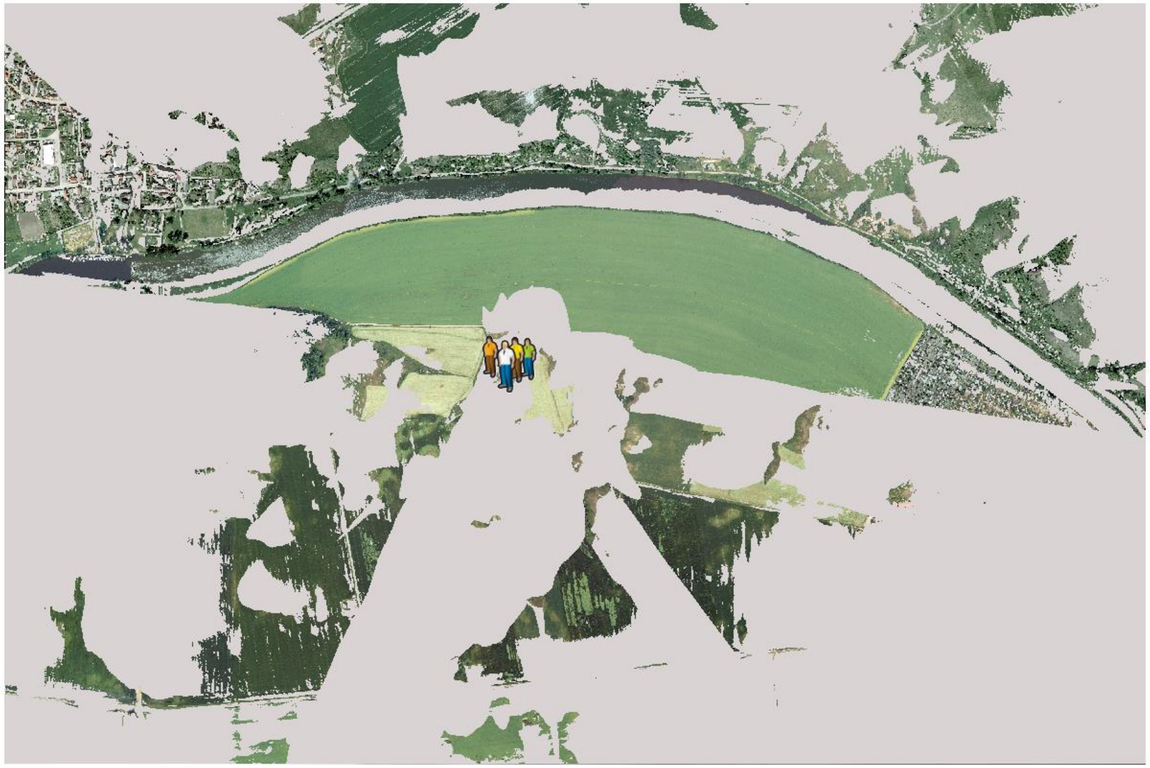
This equation assumes steady-state conditions and describes the spatial distribution and extent of zones of saturation (i.e., variable source areas) for runoff generation as a function of upslope contributing area, soil transmissivity, and slope gradient.

Measure of erosive power of flowing water based on assumption that discharge (*q*) is proportional to specific catchment area (*A*s). Predicts net erosion in areas of profile convexity and tangential concavity (flow acceleration and convergence zones) and net deposition in areas of profile concavity (zones of decreasing flow velocity).

Viewshed Analysis/Raster Surface Visibility

Area of investigation: Lettin-Brachwitz

Determine how many observers can see a given location
Determine which observers see a specific location
Find the height a non-visible location must be raised to become visible



Line of Sight / Visibility Along 2-Point Sightlines

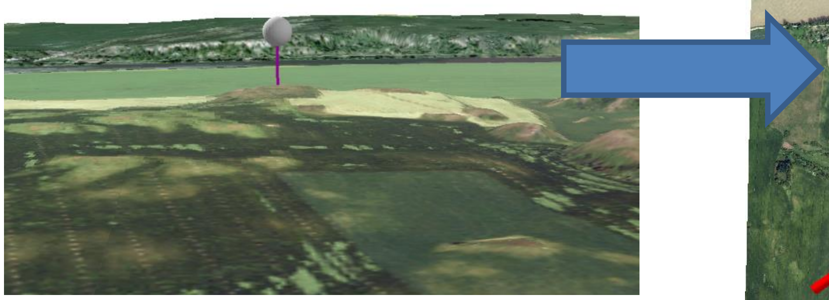
Determine visibility along a line
Identify the obstructions preventing the end point's visibility
Use Construct Sight Lines to generate 2-point lines between observer points and target features

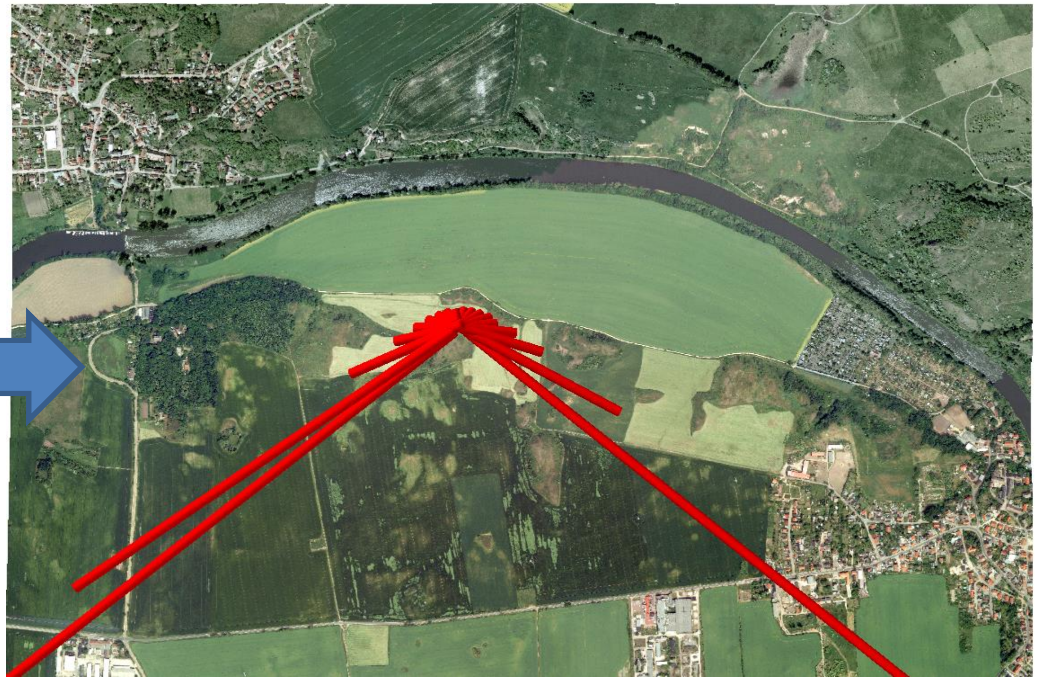
Shadow Modelling/ Shadows from the Sun and Localized Light Sources

Sun Shadow Volume

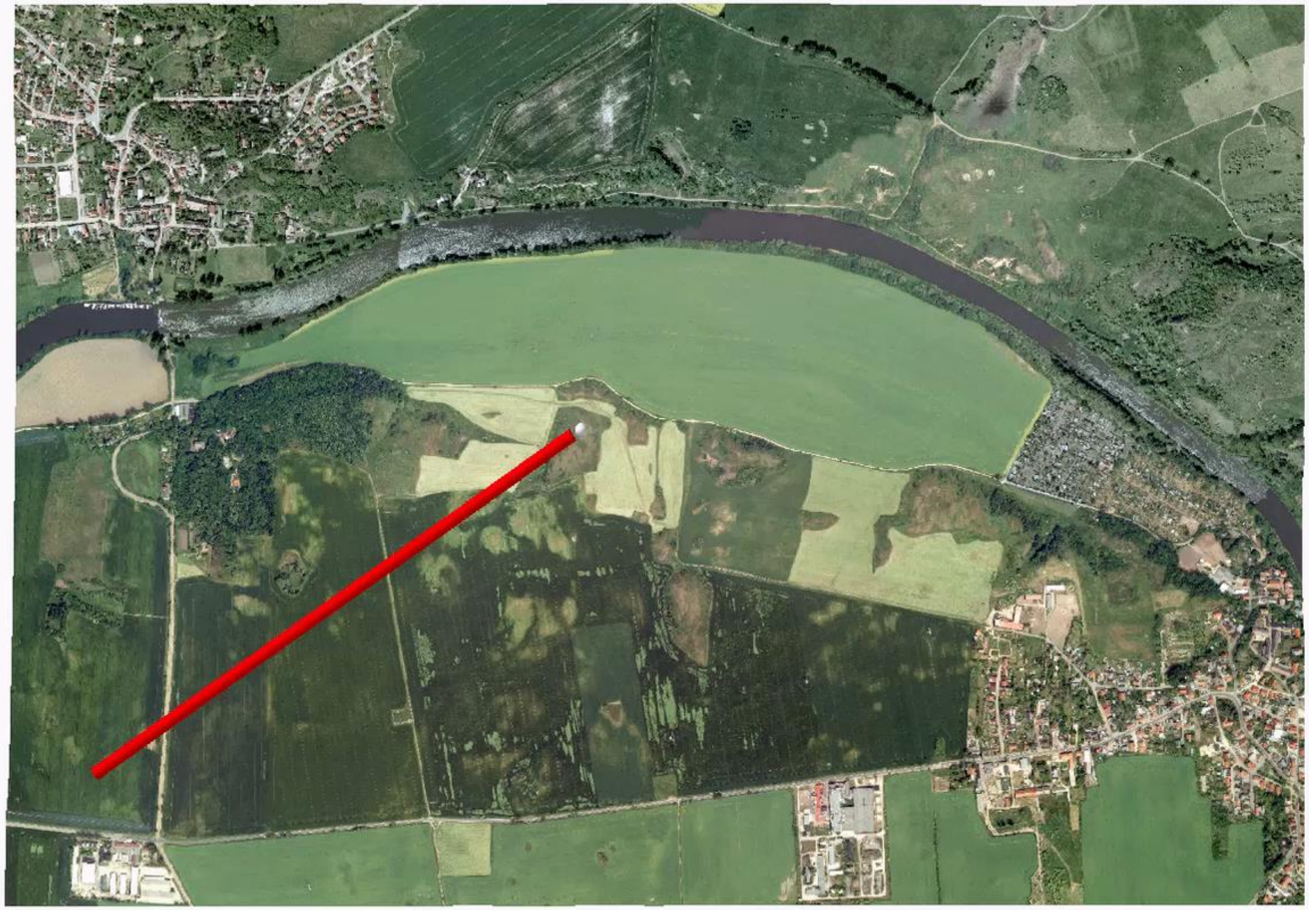
Task: Wind turbine (Fictitious object)

3D-Obect: mast height of 40m and rotor length of 15m





I. Terrain Analysis: Visibility Analysis



II. Environmental Risk Assessment and Management

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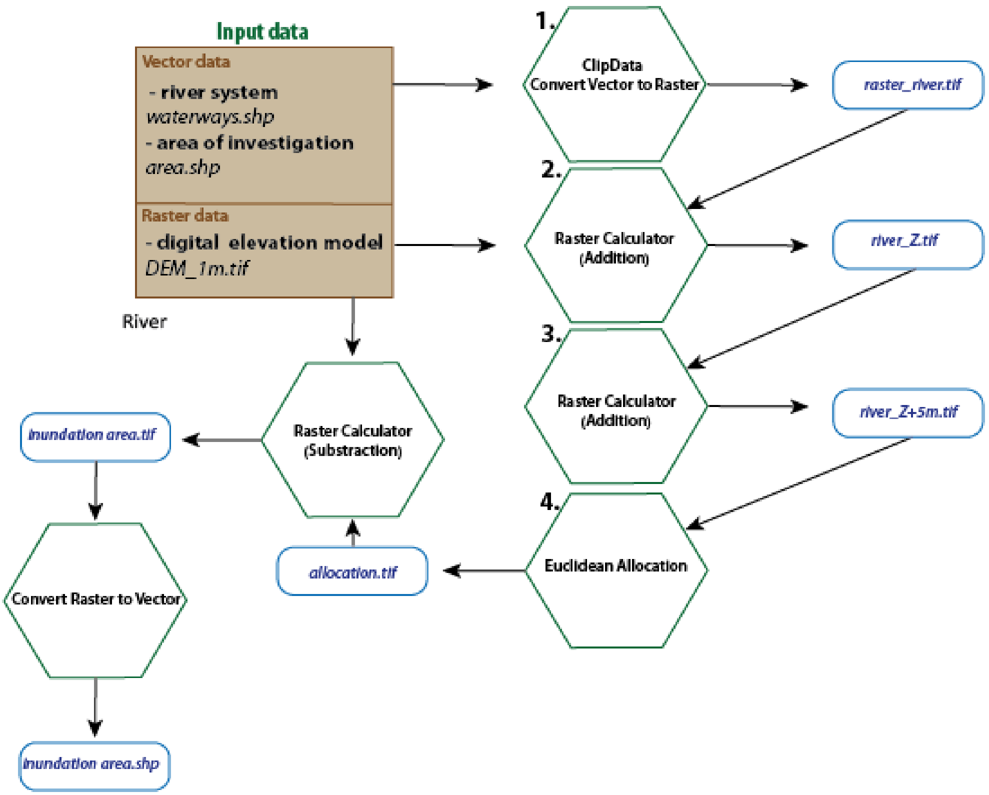
Determining the inundation area using predicted flood levels and DEM

Area of investigation: Lettin-Brachwitz

Input-Data:

Vector data:
- River system
- Area of investigation

Raster data:
- DEM 1m



Determining the inundation area // flood impact area using predicted flood levels (2.5 m)

III. Spatial planning

Development of potential settlement areas (settlement growth) using cellular automata and CLC

Area of investigation: Saxony-Anhalt

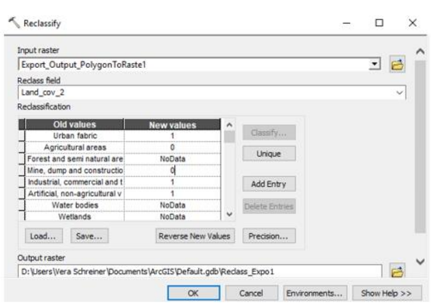
Input-Data:

CLC_2006.shp (LAND COVER *Saxony-Anhalt 2006*)

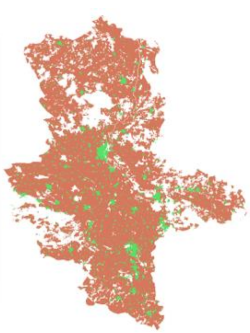
Tab_land cover.xls (The CORINE Land Cover (CLC) nomenclature)

8 categories of land cover:

1. Urban fabric
2. Industrial, commercial and transport units
3. Mine, dump and construction sites
4. Artificial, non-agricultural vegetated areas
5. Agricultural areas
6. Forest and semi natural areas
7. Wetlands
8. Water bodies



Output: starting.tif



Reclassify into 3 categories:

NoData: Forest and semi natural areas, Wetlands, Water bodies

Settlements: settlement area = 1

other areas: potential settlement area = 0

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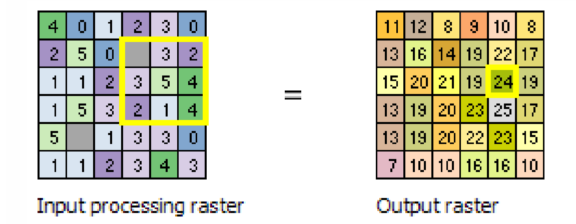
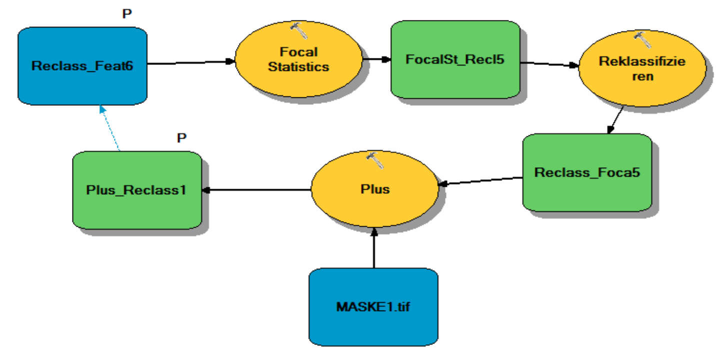
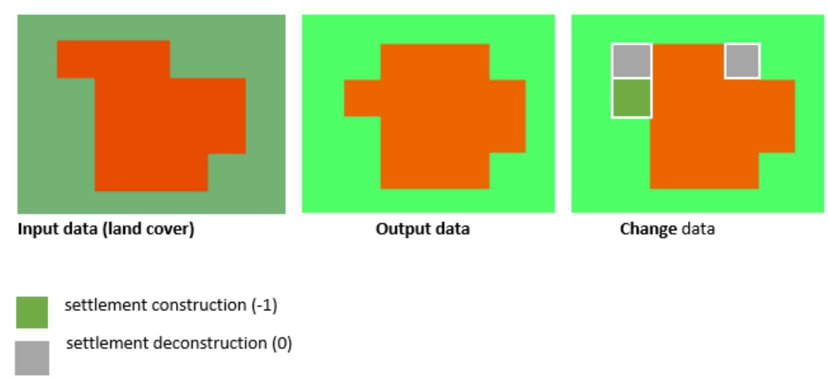
- Calculate **Focal Statistics** (Statistics Type: SUM, Neighborhood: Rectangle) and reclassify into 2 classes:
  - settlement area = 1
  - potential settlement area = 0



- Construction of a **model for multiple runs** and let the model go through 50 times



- **Identify deconstruction and new construction** by subtracting

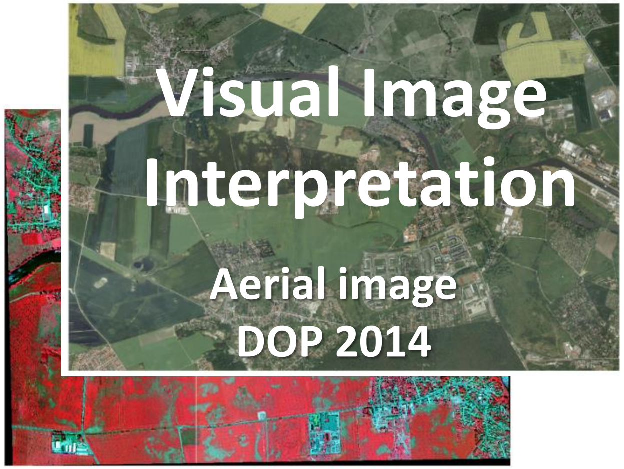


IV. Land cover mapping

LULC → Land cover mapping using aerial images and satellite images

A. Visual Image Interpretation → Digitalisation/Generalisation → Validation in situ

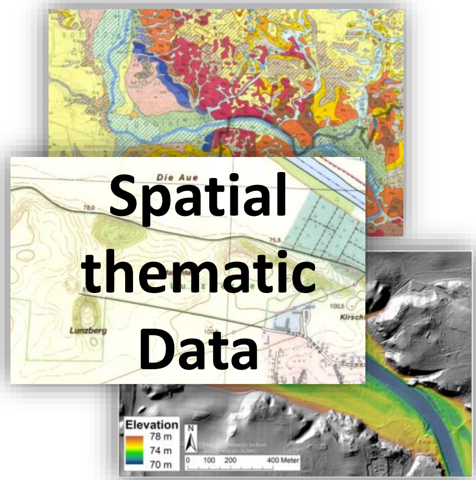
B. Classification and segmentation methods, index-based analysis



Visual Image Interpretation

Aerial image
DOP 2014

\+



Spatial thematic Data

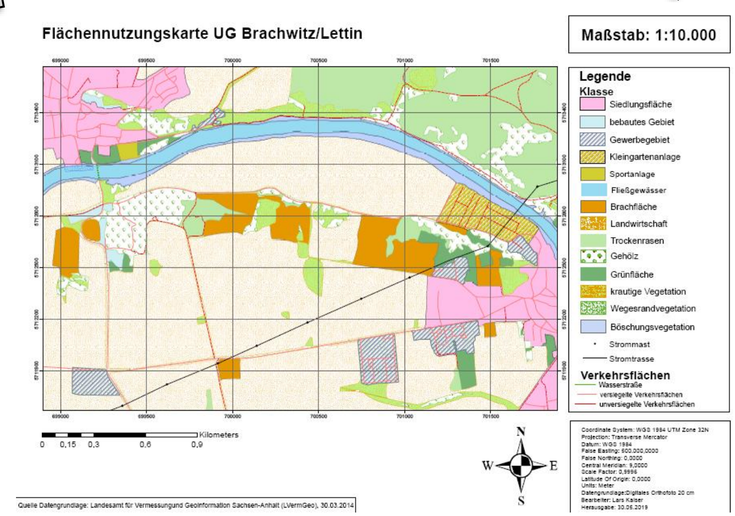
\+

Validation in situ / Field mapping

- Visual features (color, texture, shape ect.)
- Orientation to different catalogues (BTNT, LBM-DE2015, Corine Land Cover, ATKIS)

=

Digitalisation and Generalisation



LULC → Land cover mapping using aerial images and satellite images

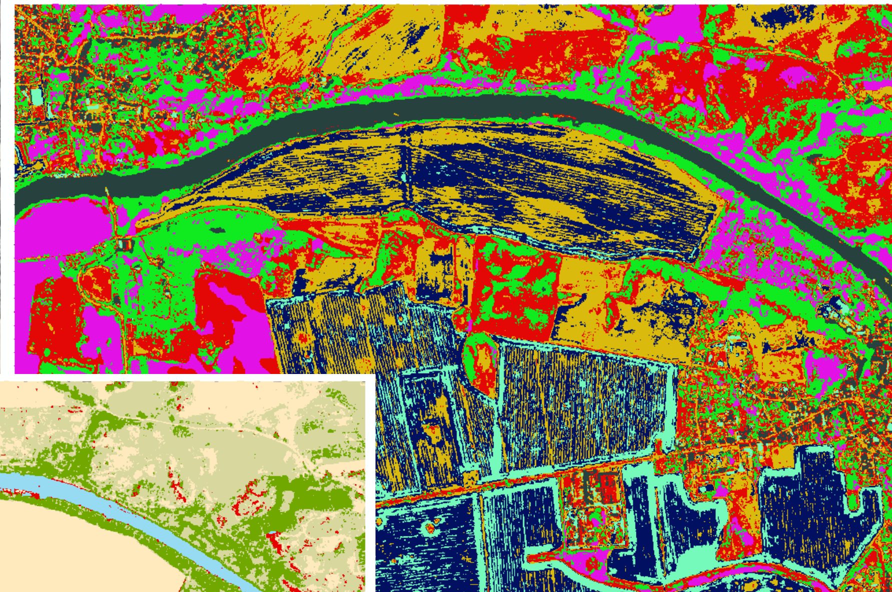
A. Visual Image Interpretation → Digitalisation/Generalisation → Validation in situ

B. Classification and segmentation methods, index-based analysis

IV. Land cover mapping

SPOT-6, 06.08.2018

Iso Cluster Unsupervised Classification



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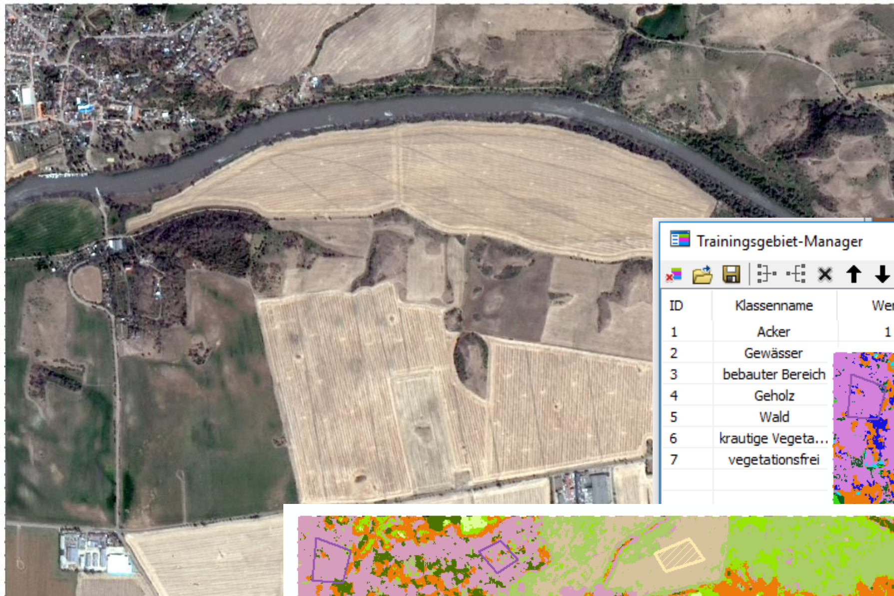
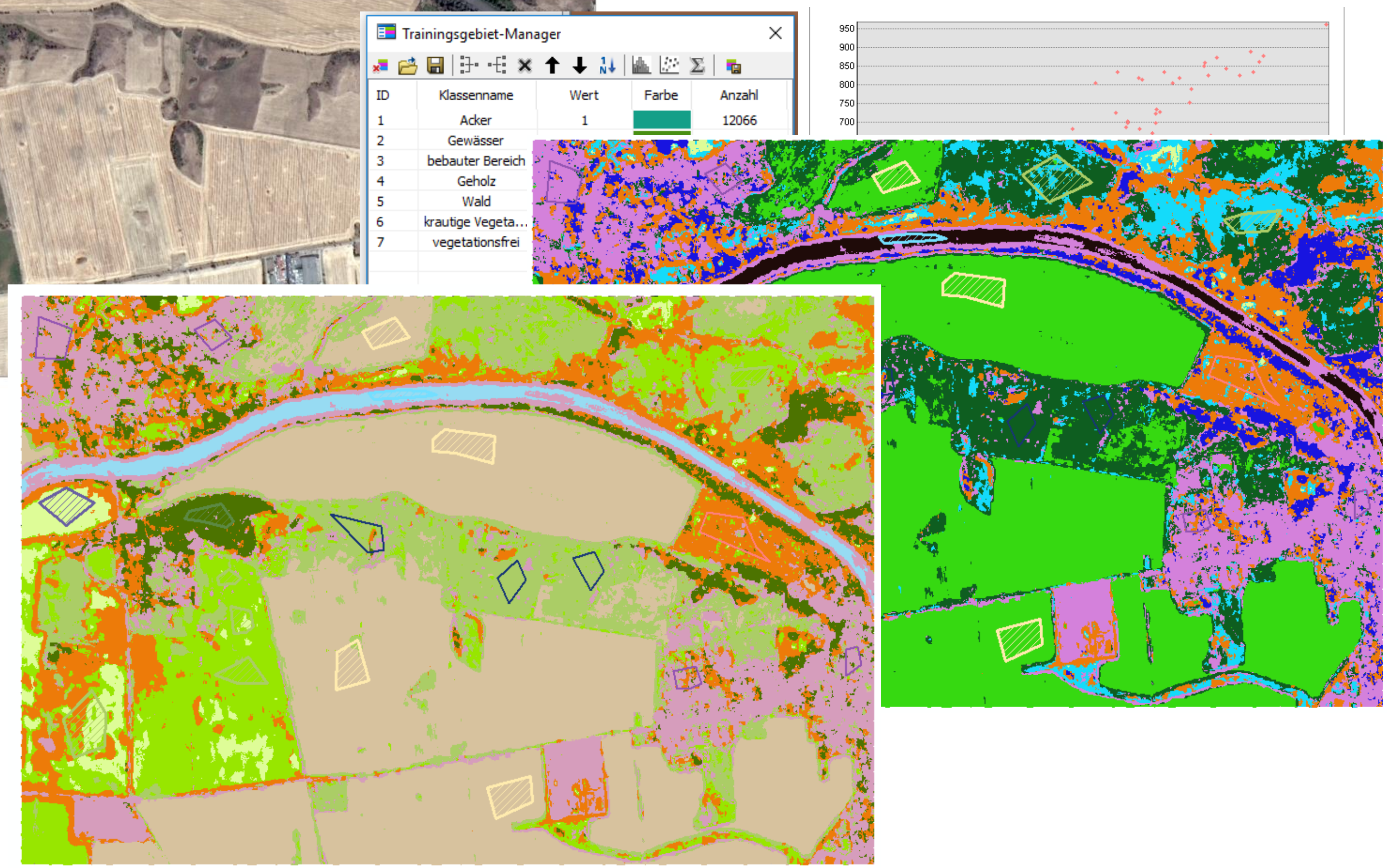
SPOT-6, 06.08.2018

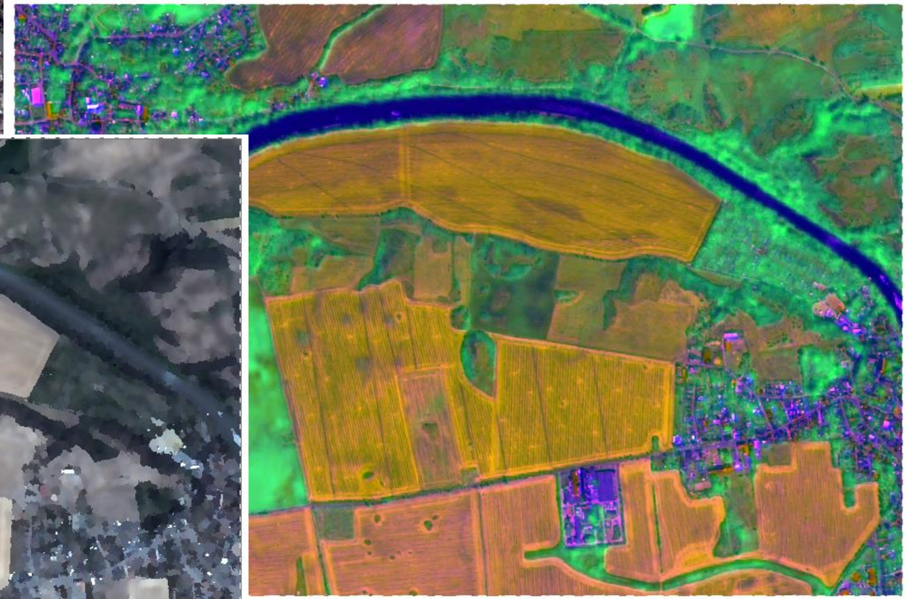


Maximum Likelihood Supervised Classification



SPOT-6, 06.08.2018

Principal Components



Segment Mean Shift

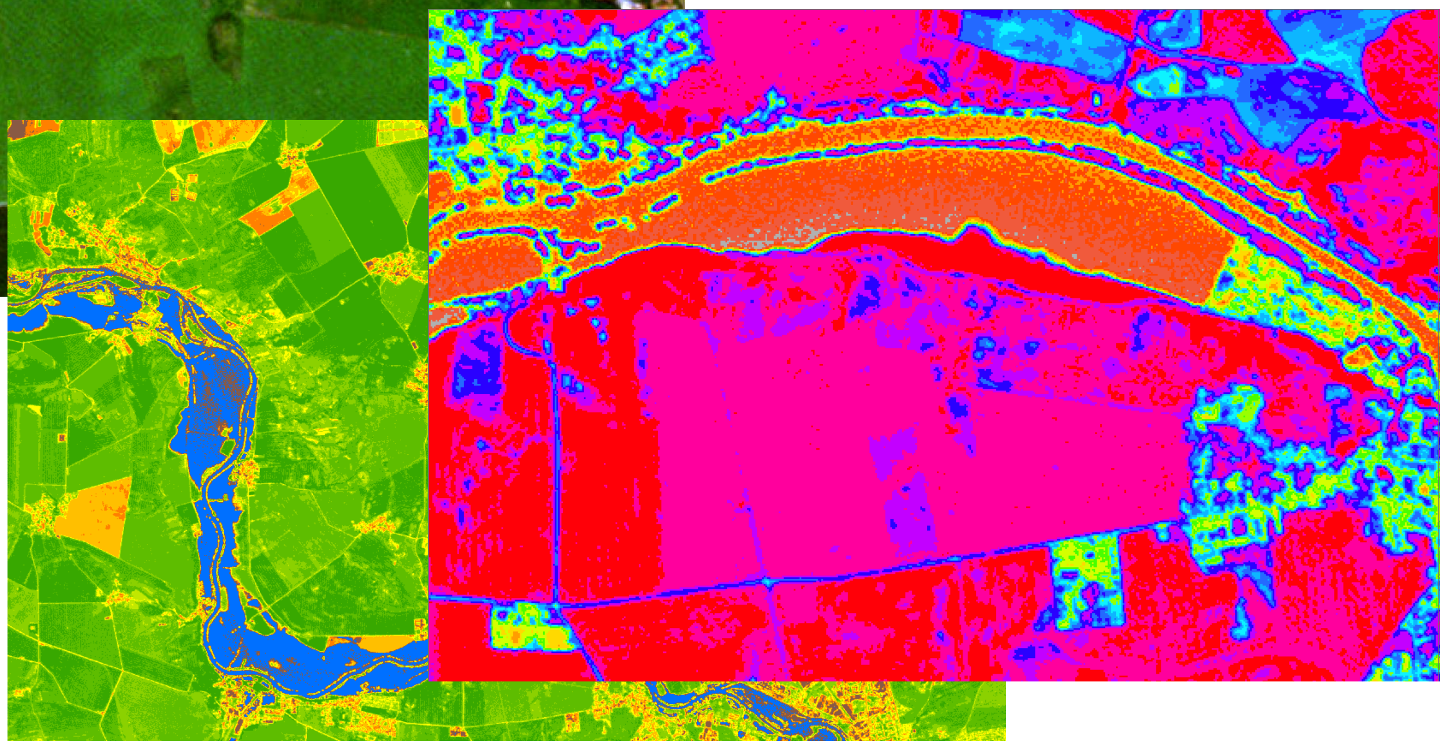
IV. Land cover mapping

RE, 05.06.2013

Index-based analysis →

- **NDVI**
- **WalMa**

Goal: To record the flooded areas as precisely as possible.



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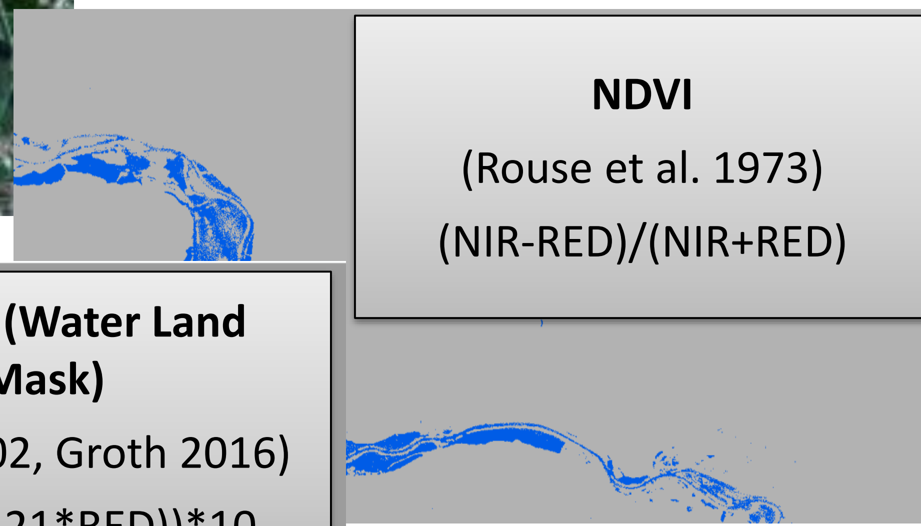
RE, 05.06.2013

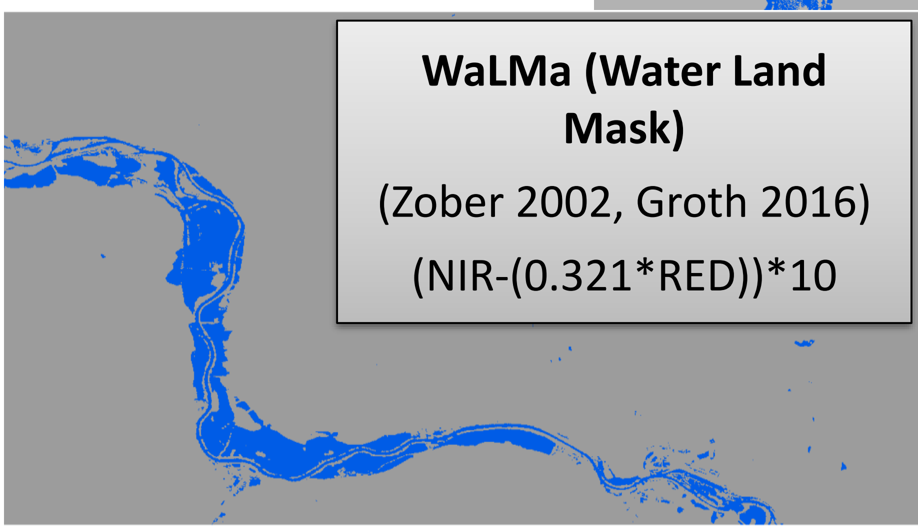
Flood detection and flood mapping → NDVI vs. WalMa



NDVI

(Rouse et al. 1973)

(NIR-RED)/(NIR+RED)



WaLMa (Water Land Mask)

(Zober 2002, Groth 2016)

(NIR-(0.321*RED))*10

THANKS FOR YOUR ATTENTION