XXVII FIG CONGRESS
11–15 SEPTEMBER 2022
Warsaw, Poland

Volunteering for the future – Geospatial excellence for a better living

Exploring geospatial methods of detecting rural vitality, vulnerability and versatility in rural regions in Bavaria

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3VRUT – Project Goal

- To derive a comprehensive and resilient method that integrates socio-economic indicators with remote sensing data in order to derive effective insights in where which rural villages are improving how in :
  1. vitality,
  2. vulnerability
  3. versatility

3VRUT
Assessment of Transformations in Vitality, Vulnerability and Versatility of Rural Towns

(-> 3V)

EIG CONCERT JAPAN
Connecting and Coordinating European Research and Technology Development with Japan

Germany	Japan	Poland	Spain
BMBF	JST	Narodowe Centrum Badań i Rozwoju	AGENCIA ESTATAL DE INVESTIGACIÓN
Technical University of Munich	Remote Sensing Technology Center of Japan	Jan Kochanowski University	Universitat Politècnica de Catalunya
TUM	RESTEC	UJK w Kielcach	UPC

3VRUT – Project Work packages

WP No	WORK PACKAGE	PLANNED ACTIVITIES
WP0	Project management	4 activities
WP1	Data gathering and indicator selection	7 activities (initially 8)
WP2	3VRUT Model conception and calibrating	6 activities (initially 5)
WP3	3VRUT Model implementation and testing	4 activities
WP4	Project consolidation, policy recommendations and result dissemination	4 activities

Main Outcome Goals - 1

1. An integrated conceptualisation, methodology, and set of indicators to verify and validate the degree of vitality, vulnerability and versatility (3Vs) of rural towns using remote sensing, socio-economic data, telecommunication and mobile data, ground interviews and ethnography.

2. A digital report for the local governments (in the local language) that integrates the 3Vs in the diagnosis of the selected rural towns, for them to make the necessary action plans to meet the Sustainable Development Goals.

Main Outcome Goals - 2

3. A documentary film with the research process and results as a teaching material that would explain the concept of the 3Vs in a practical way for it to be widely disseminated and replicated in other case studies.

4. Publication of results in three leading journals and international conferences.

5. A policy brief for discussions at the United Nations SDG Forum.

6. A start-up of transnational collaboration on land management and geospatial sciences.

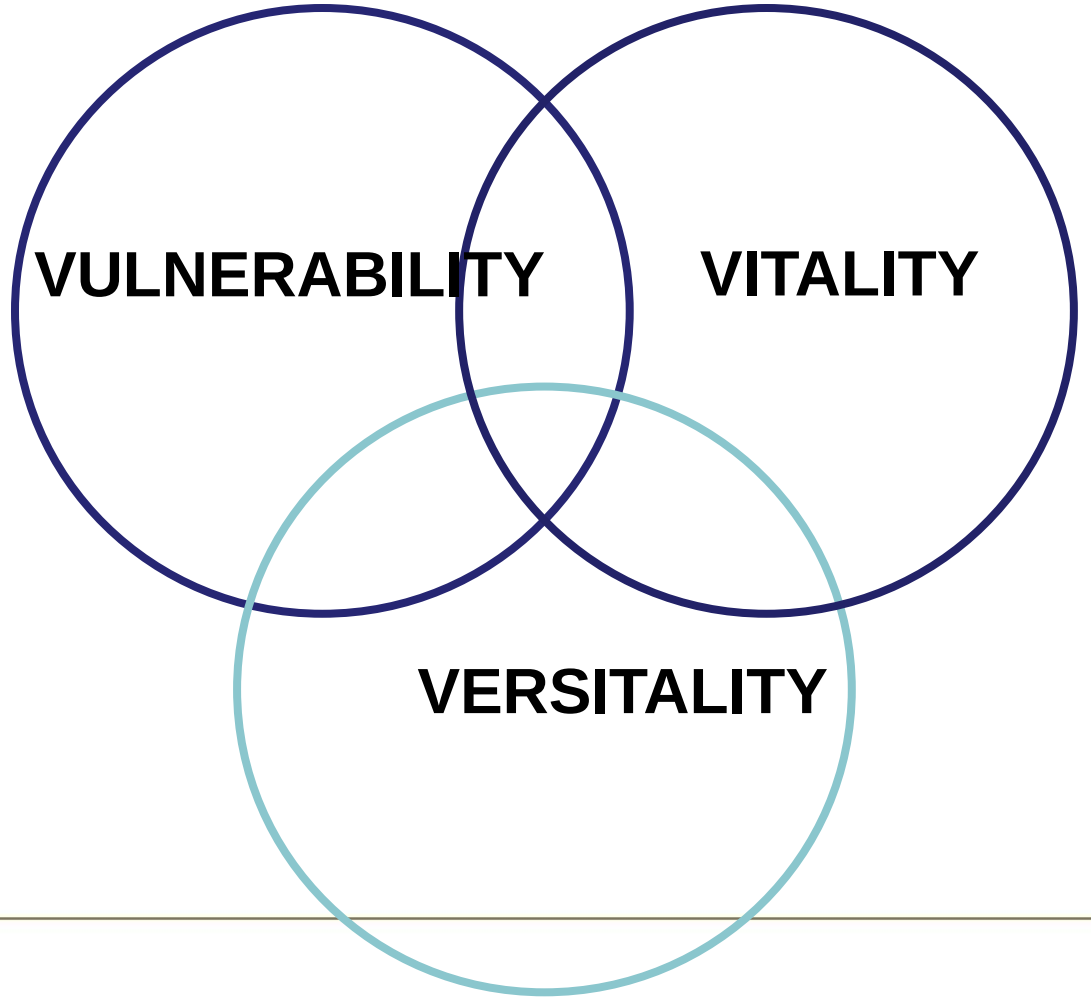
Why Rural Towns?






Depopulation, migrations, tourism, climate change, connectivity, accessibility, mobility, unemployment

Why 3V?



Evaluate
Quantify
Classify

1

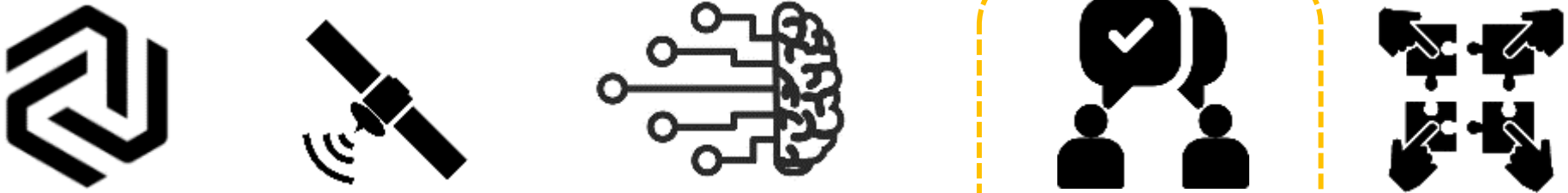
definition of indicators and data gathering

2

Data analysis and data modelling
a) data modeling in time and space
b) Patterns analysis in machine learning

3

Modeling future scenario to define resilience potentiality for each one



3VRUT research project

Model ➡ **Measure** ➡ **Understand** ➡ **Communicate** ➡ **Action**

What is it important to define rural town resilience?

Gathering all the info about indicators + portrait of the towns (main trends & character)

Could be automated?

Machine learning?

Build resilience

Indicators
5 dimensions
3 V
70 indicators

Methodology - 3V assessment in 5 steps

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3VRUT – Test cases

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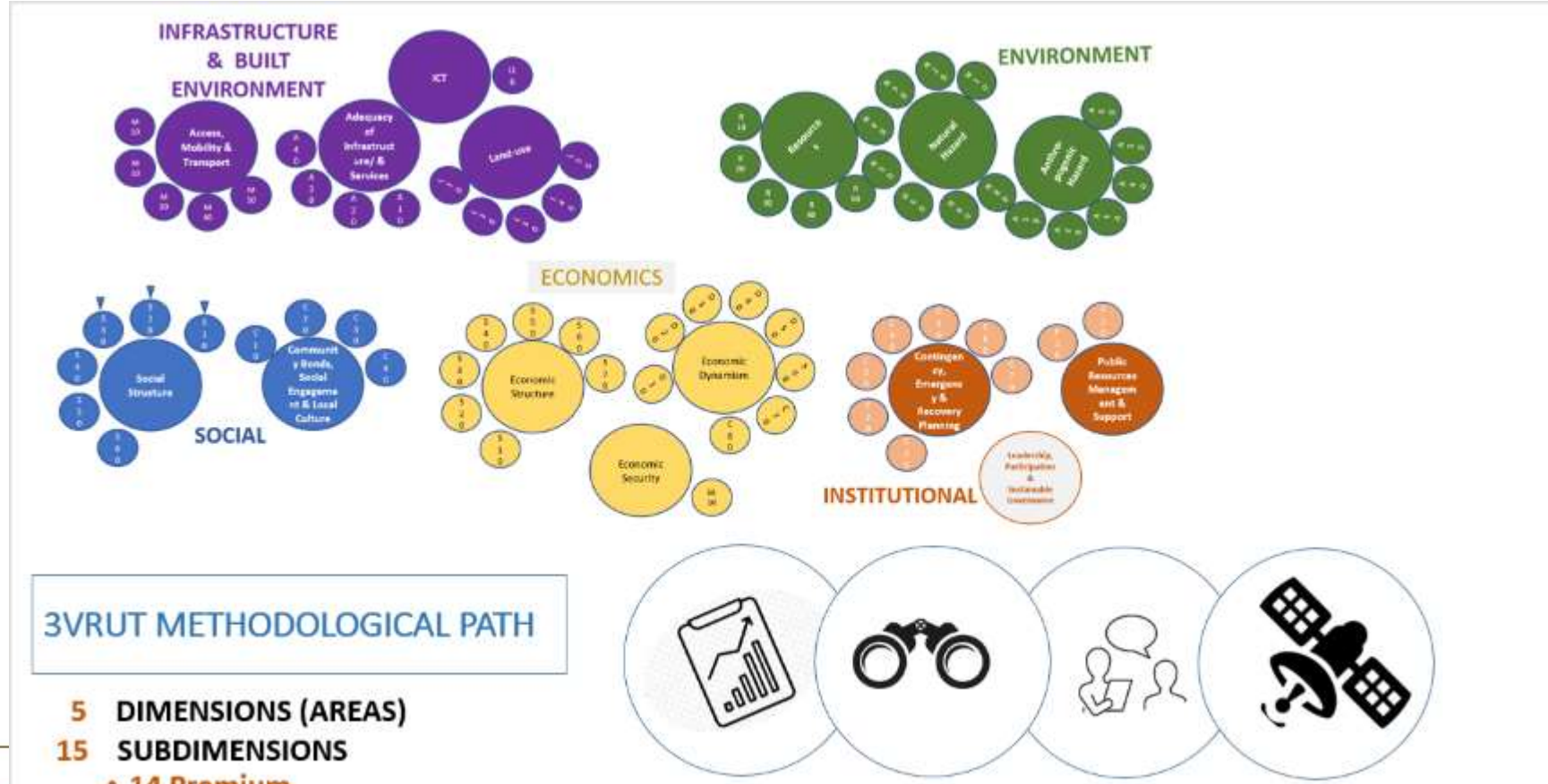
3VRUT – 3V conceptualisation & indicators



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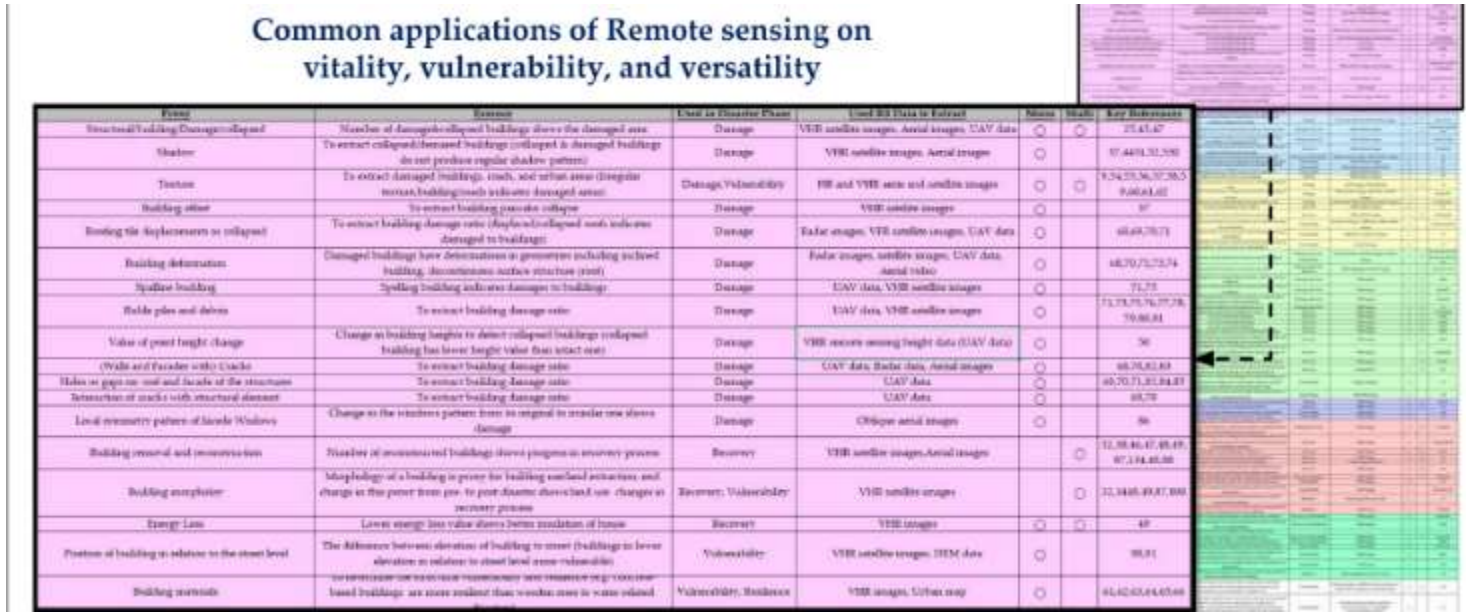
3VRUT – 3V conceptualisation & indicators - RS



Common applications of Remote sensing on vitality, vulnerability, and versatility

Study cases

Yubari, Japan

Zabierzów, Poland

Obermichelbach, Germany

Alp, Spain

Tskuba, Japan

Olesno, Poland

Bayrisch Eisenstein, Germany

Les Planes d'Hostoles, Spain

3VRUT – Project challenges

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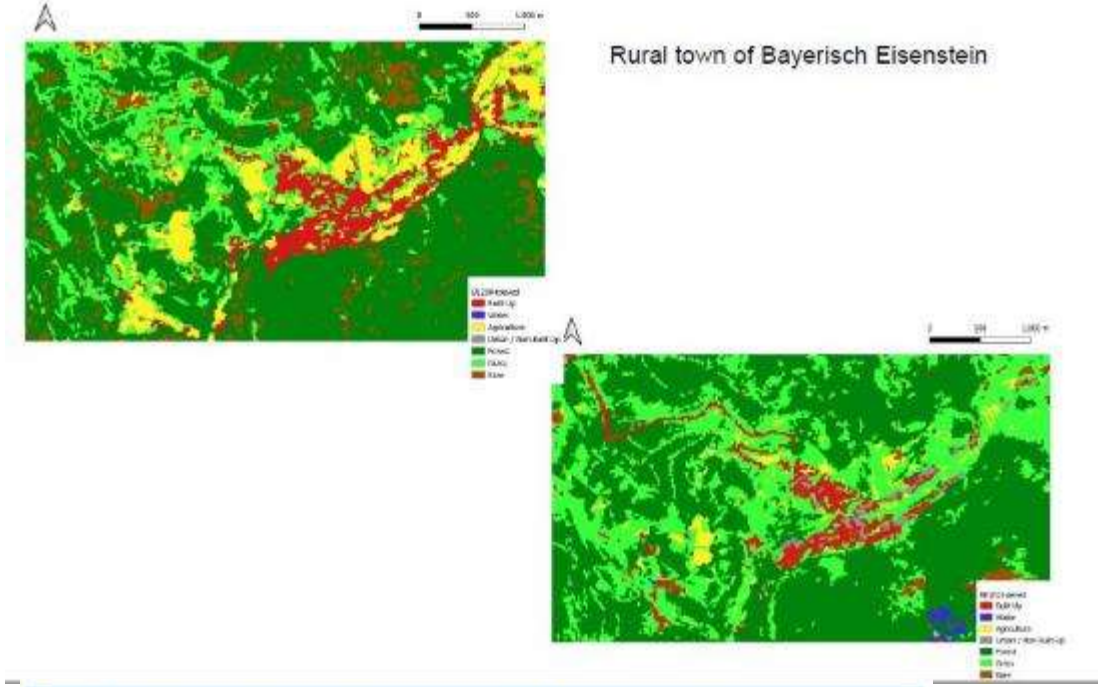


Rural town of Bayerisch Eisenstein

2004				2021			
Class	Pixel Sum	%age	Area (sq. mt.)	Pixel Sum	%age	Area (sq. mt.)	Change (%age)
Built-up	46120	7.44	1037700	29590	0.047	6657750	-36
Water	0	0	0	3760	0.006	846000	0
Agriculture	52900	8.53	11902500	14530	0.023	3269250	-73
Commercial	0	0.00	0	6060	0.009	1363500	0
Forest	35080	56.59	78930000	34940	0.563	78615000	0
Grass	12227	19.72	27510750	19817	0.319	44588250	62
Bare	47830	7.72	10761750	18410	0.029	4142250	-62

Cases Tuchenbach and Bayerisch Eisenstein - Bavaria

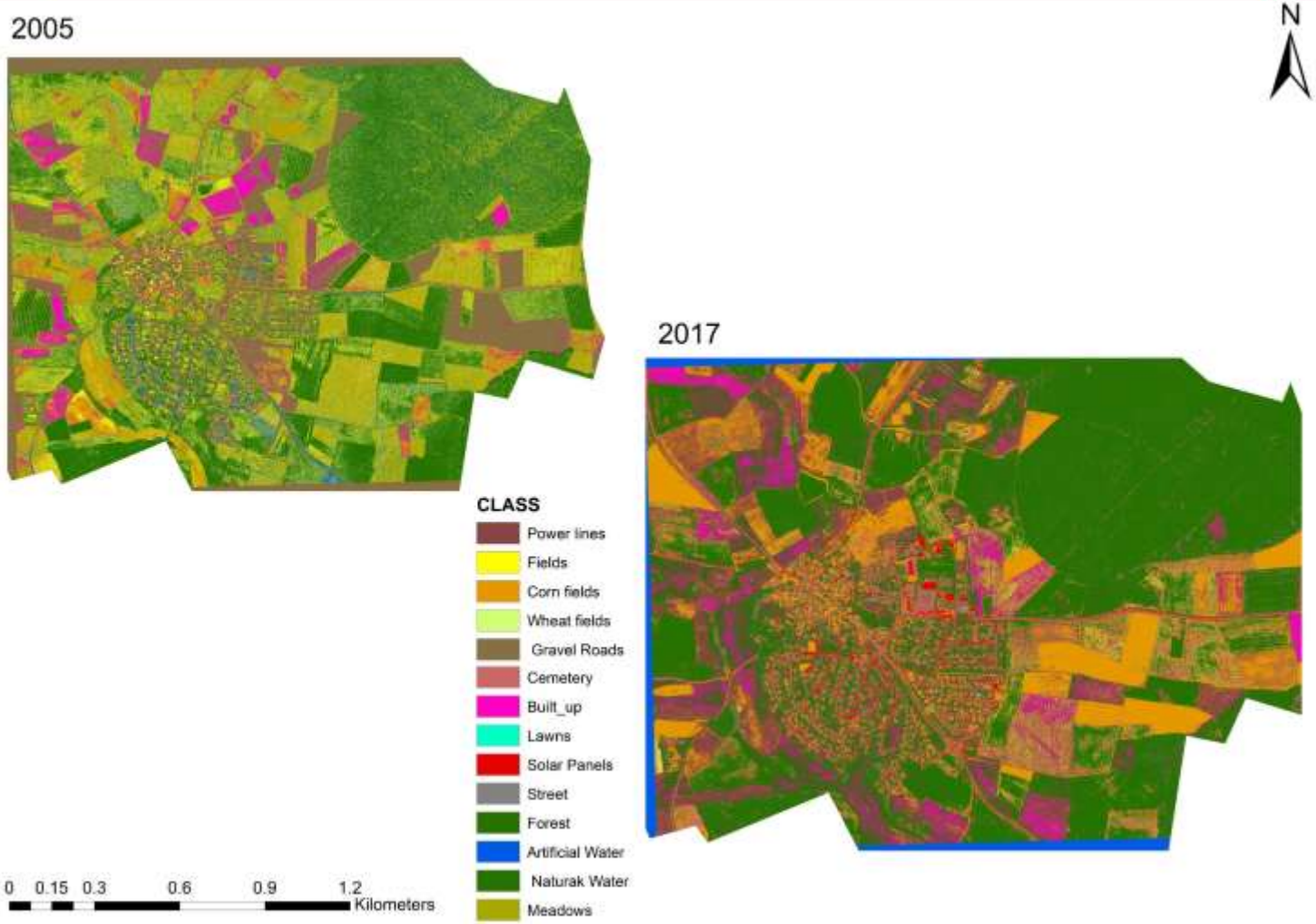
- Tuchenbach is surrounded by fields (Wheat, corn and empty / harvested fields)
- Almost all private homes have swimming pools which have been captured in the classification
- Most private houses are using solar energy which is clearly visible in the orthophotos and efforts have been made to classify
- It has industrial area but it could not be treated as a separate class so merged with Built up
- There are no private swimming pools in Bayerisch Eisenstein
- There are no fields Bayerisch Eisenstien it is more forested
- In case of Tuchenbach there is a change in area in almost every class
- Lot of misclassified pixels in the classification of Bayerisch Eisenstein

Orthophoto at 40 cm resolution for Rural Town of Tuchenbach

2005

2011

2017


2005
N
2017
CLASS
Power lines
Fields
Corn fields
Wheat fields
Gravel Roads
Cemetery
Built_up
Lawns
Solar Panels
Street
Forest
Artificial Water
Naturak Water
Meadows
0 0.15 0.3 0.6 0.9 1.2
Kilometers

Land use / land cover changes

2005			2017			
CLASS	AREA_Sq cm	AREA_Sq_KM	AREA Sq Cm	AREA_Sq KM	Change Area Sq Km	%age Change
Power lines	15920	0.000002	26860921600	2.686092	2.69	0.17
Fields	108847280	0.010885	5833214400	0.583321	0.57	0.04
Corn Fields	46656000	0.004666	17773928000	1.777393	1.77	0.11
Wheat Fields	25759480	0.002576	700940800	0.070094	0.07	0.00
Gravel Roads	182644440	0.018264	6480086400	0.648009	0.63	0.04
Cemetry	17240	0.000002	5746608000	0.574661	0.57	0.04
Built_up	39195280	0.000001	7678164800	0.765238	0.77	0.05
Lawns	530440	0.000053	236540800	0.023654	0.02	0.00
Solar panels	5600	0.000001	2293662400	0.229366	0.23	0.01
Street	880	0.000000	1130244800	0.113024	0.11	0.01
Forest	314207560	0.031421	33396465600	3.339647	3.31	0.21
Artificial Water	51319720	0.005132	11445521600	1.144552	1.14	0.07
Natural water	285840	0.000029	38598865600	3.859887	3.86	0.25
Meadows	220922360	0.022092	281390400	0.028139	0.01	0.00

Orthophoto at 40 cm Resolution for the Rural town of Bayerisch Eisentein

2004

2010

2016

2004

N

2016

CLASS
- Built_up
- Cemetery
- Fields
- Forest
- Meadow
- Rail lines
- Roads
- Solar Panels
- Water

0 0.4 0.8 1.6 2.4 3.2 Kilometers

2004			2016			
CLASS	AREA	AREA_SQKM	AREA	AREA_SQKM	Change Sq Km	Change in % age
Rail lines	585692800	0.058569	326400	0.000033	-0.06	-0.01
Roads	11312587200	1.131259	1002075200	0.100208	-1.03	-0.12
Water	252164800	0.025216	722812800	0.072281	0.05	0.01
Meadow	32251636800	3.225164	156145600	0.015615	-3.21	-0.38
Built_up	159964800	0.015996	10354731200	1.035473	1.02	0.12
Solar Panels	118182400	0.011818	474497600	0.047450	0.04	0.00
Built_up	686017600	0.068602	113108800	0.011311	-0.06	-0.01
Roads	596800	0.000060	13308800	0.001331	0.00	0.00
Forest	32265017600	3.226502	59054896000	5.905490	2.68	0.31
Cemetery	516736000	0.051674	434542400	0.043454	-0.01	0.00
Fields	7166529600	0.716653	12988681600	1.298868	0.58	0.07

Challenges when combining statistical data with remote sensing data

- Different spatial scales - > administratvie boundaries – land use / land cover units ; spatial statistics at regional or municipal level
- Different time scales
- Different contextual and thematic environments
- Different cultures of defining and detecting what is important and relevant (change)

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3VRUT – Upcoming steps

- Testing automated / machine remote sensing procedure to detect 3Vs in Japan case area
- Connect deliverables to field observations using indicator matrix
- Evaluate fit – mismatch – missing insights
- Connect (revised) RS data & procedures with (revised) indicator matrix
- Test in other case areas

Deliverables

- Revised set of 3V concepts and indicators
- Revised procedure of machine based RS detection of 3V
- Peer-reviewed papers (publication plan)
- Plan to upscale 3V at larger areas / multiple towns