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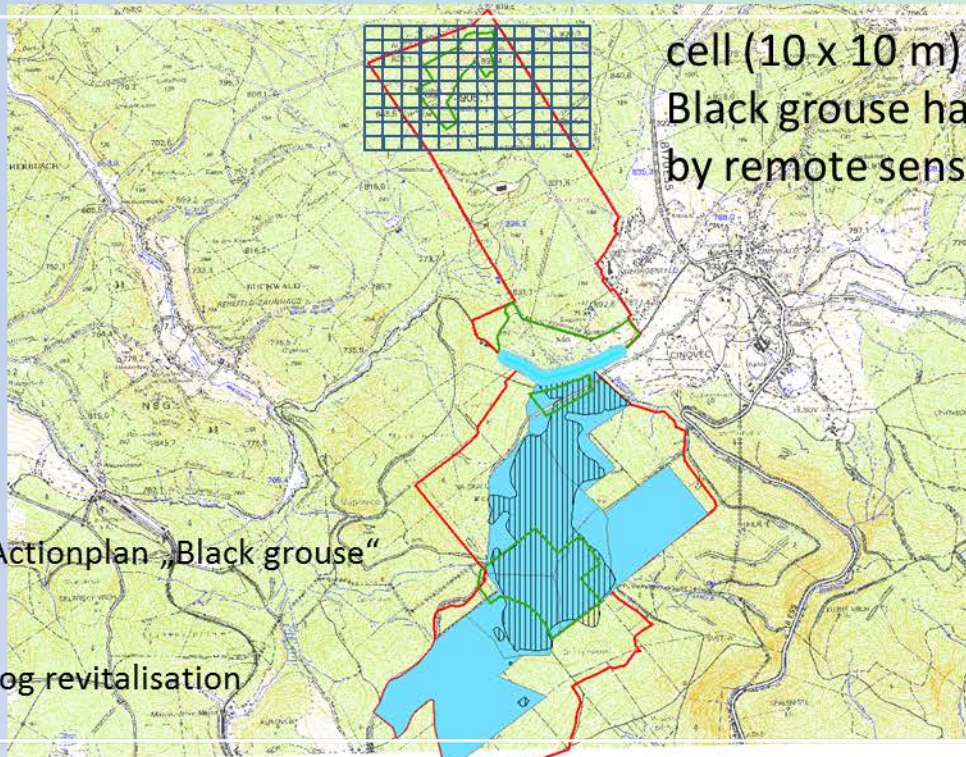
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Revitalisierung von Mooren und Habitatmanagement für das Birkhuhn im Osterzgebirge („TetraoVit“)



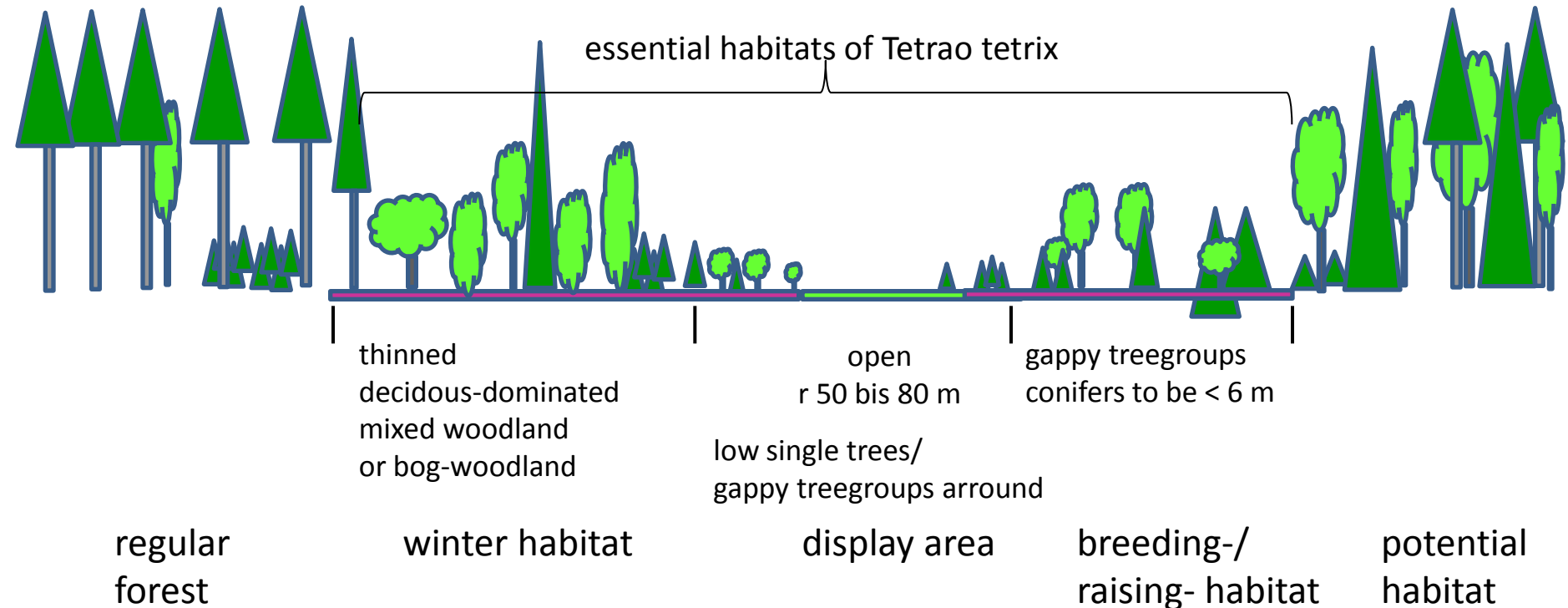
cell (10 x 10 m) -based
Black grouse habitat evaluation
by remote sensing data

Actionplan „Black grouse“

Bog revitalisation



milestone 1. develop a habitat-key system

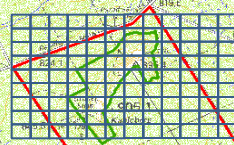


important physical parameters: **1. tree-species, 2. tree-height, 3. tree coverage,**
(habitat-key system) **4. ground-vegetation, 5. topographical exponation**

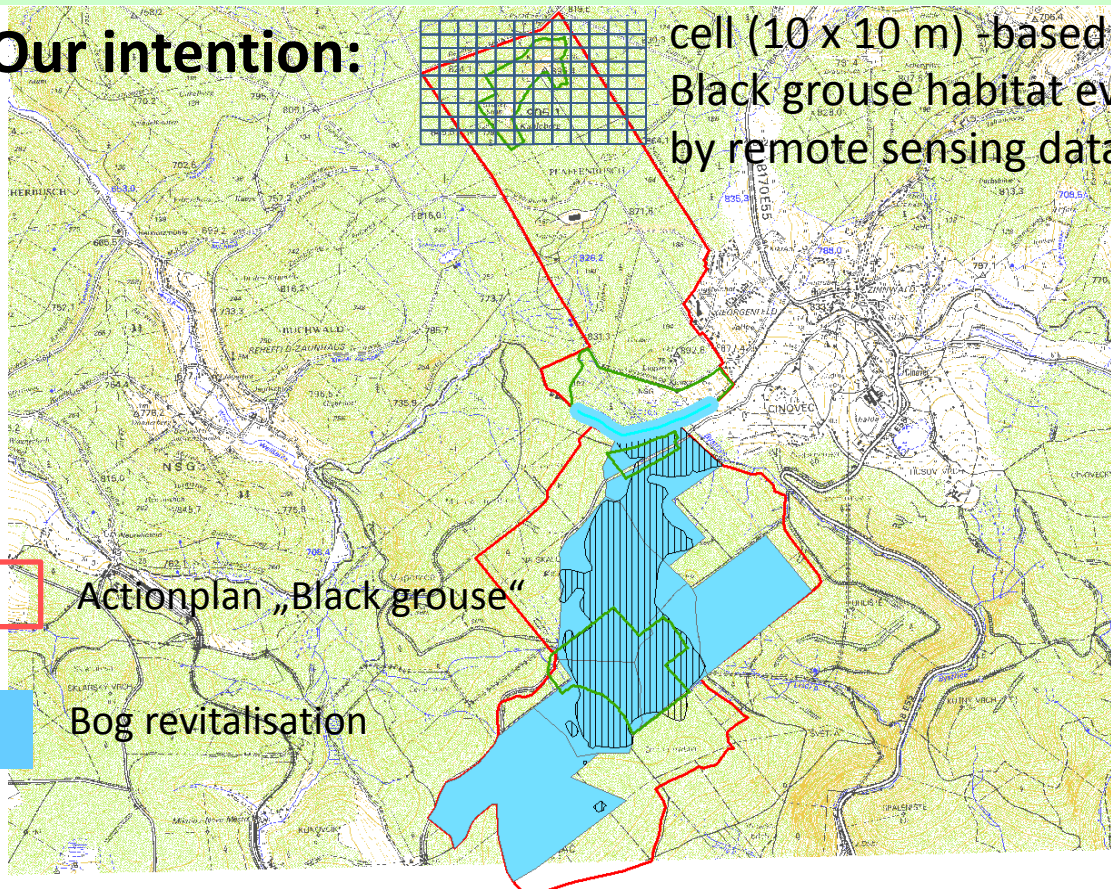


milestone 3. method for (semi-) automatic analysis and prognosis of Black grouse habitat structure

Our intention:



cell (10 x 10 m) -based
Black grouse habitat evaluation
by remote sensing data



Actionplan „Black grouse“

Bog revitalisation



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goals: providing 5 remote sensing parameters for each cell

Tree species (at least treegroups)

-> *Picea abies*, *Picea pungens*, *Pinus silvestris*, *Pinus mugo*,
Larix, soft deciduous (= *Betula*, *Sorbus*, *Salix*), *Fagus*, other deciduous trees

Tree height

-> 0,5m classes

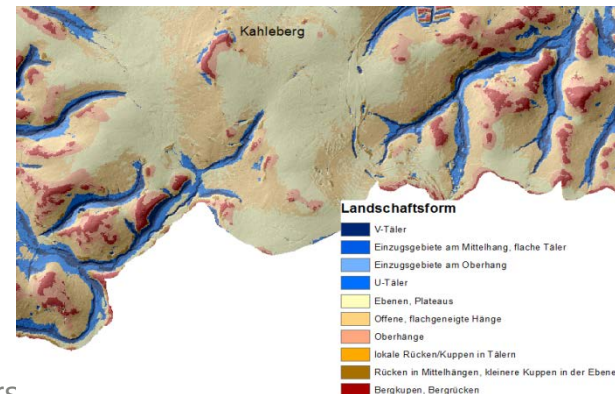
Tree coverage

-> 10 % steps

Ground vegetation -> mostly... pure soil, *Vaccinium/Calluna*, moss, high grass
(*Molinia*, *Calamagrostis*), low grass (*Carex*, *Deschampsia*)

Landforms

->





remote sensing data used for detecting tree-species and type of ground vegetation:

aerial- / satellite data	resolution [m]	bands	shooting date(s)
DOP Sachsen	0,2	4 RGBI	24.06.2016
DOP Tschechien [cuzk]	0,2	4 RGBI	11.06.2017
WorldView2 (WV2) [Digital Globe]	0,52	8 MS	03.07.2015
	0,46	1 PAN	03.07.2015
WorldView3 (WV3) [Digital Globe]	1,24	8 MS	13.08.2018
	0,31	1 PAN	13.08.2018
Pleiades [Airbus DS Geo SA]	2	4 RGBI	21.05.2018
	0,5	1 PAN	21.05.2018
PlanetScope [Planet Labs Inc]	3	4 RGBI	08.05., 07.06., 07.08.2018
Sentinel2B [esa copernicus]	10-60	10 MS	09.04., 04.05., 03.07., 07.08., 11.10.2018

+ sampling reference data by terrestrial proof



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data processing & report done by:

LUP – LUFTBILD UMWELT PLANUNG GmbH

Große Weinmeisterstraße 3a

D-14469 Potsdam

Deutschland

info@lup-umwelt.de





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Resolution:



DOP 0,2m



WorldView3 0,3m



PlanetScope 3m



Sentinel2B 10m



Classification for detecting tree-species / -groups [BA]:

class	short form	tree-species / -group	tree-species
1	RBU	Fagus sylvatica	Fagus sylvatica
2	ELA	Larix	Larix decidua
3	FI	Picea (all without P. pungens)	Picea abies, Picea omorika, Picea sitchensis
4	PFI	Picea pungens	Picea pungens
5	KI	Pinus (all without P. mugo)	Pinus sylvestris, Pinus contorta
6	BKI	Pinus mugo	Pinus mugo
7	SWL	Soft deciduous trees	Betula pendula, Betula pubescens, Sorbus aucuparia, Salix sp.
8	uLW	other deciduous trees	Acer pseudoplatanus, Alnus glutinosa, Populus tremula
9	uNW	other conifers	Pseudotsuga menziesii, Abies alba, Abies normaniana
10	kA		-



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Classification for detecting groundvegetation [BVT_BIRKH]:

class	type
1	pure soil
2	Vaccinium/Calluna (> 50 %)
3	Vaccinium/Calluna (> 20 %)
4	peat vetetation (mosses, low Carex sp.)
5	low grass (f.e. Eriophorum vaginatum, Eriophorum angustifolium, Deschampsia flexuosa, Carex sp.)
6	high grass (f.e. Molinia caerulea, Calamagrostis villosa, Calamagrostis arundinacea)
7	rocks /stones
8	other groundvetegation
99	-



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Classification for detecting tree coverage [KSG] based on normalized surfacemodel (nDOM):

class	short form	Tree coverage
1	0,0	-
2	0,1	10 %
3	0,2	20 %
4	0,3	30 %
5	0,4	40 %
6	0,5	50 %
7	0,6	60 %
8	0,7	70 %
9	0,8	80 %
10	0,9	90 %
11	1,0	100 %



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Classification for detecting tree height [BHOE_DFE]
based on normalized surfacemodel (nDOM):

short form	tree height
0,0	-
0,5	0,5 m
1,0	1,0 m
1,5	1,5 m
2,0	2,0 m
2,5	2,5 m
3,0	3,0 m
3,5	3,5 m
4,0	4,0 m
4,5	4,5 m
...	...



Results

Accuracy detecting treespecies/ -groups:

best results

	classes	DOP_ Sachsen	WV3	Pleiades	PlanetScope	Sentinel2	Sentinel2 + Texturen DOP	Sentinel2 + Texturen WV3	Sentinel2 + Texturen DOP neu
Predictors		RGBI, Tex (IR), nDOM alt	8Bänder, Indices, Tex (pan.), nDOM alt	RGBI, Indices, Tex (pan.), nDOM alt	RGBI * 3, Indices * 3, Tex (IR), nDOM alt	10Bänder * 5, Indices * 5, Tex (IR), nDOM alt	10Bänder * 5, Indices * 5, zonal_Tex (IR), nDOM alt	10Bänder * 5, Indices * 5, zonal_Tex (pan.), nDOM neu	10Bänder * 5, Indices * 5, zonal_Tex (IR), nDOM neu
Resol. [m]		0,2	1	1	1	1	1	1	1
Accuracy ³		0,565	0,673	0,686	0,741	0,71	0,781	0,879	0,879
Kappa ⁴		0,396	0,562	0,572	0,656	0,613	0,713	0,840	0,848
Balanced Accuracy	1 Fagus sylv.	0,638	0,839	0,786	0,881	0,65	0,823	0,852	0,748
	2 Larix	0,738	0,766	0,852	0,91	0,925	0,940	0,957	0,917
	3 Picea	0,687	0,769	0,785	0,842	0,858	0,894	0,946	0,943
	4 Picea pungens	0,553	0,858	0,694	0,867	0,874	0,817	0,953	0,967
	5 Pinus	0,702	0,615	0,600	0,558	0,531	0,769	0,866	0,848
	6 Pinus mugo	0,582	0,87	0,561	0,571	0,518	0,647	0,838	0,984
	7 softwood leavetr	0,781	0,89	0,861	0,913	0,804	0,823	0,918	0,932
	8 other leavetrees	0,851	0,845	0,902	0,975	0,922	0,964	0,999	NA ⁵
	9 other conifers	0,5	0,5	0,5	0,5	0,5	0,5	0,667	NA



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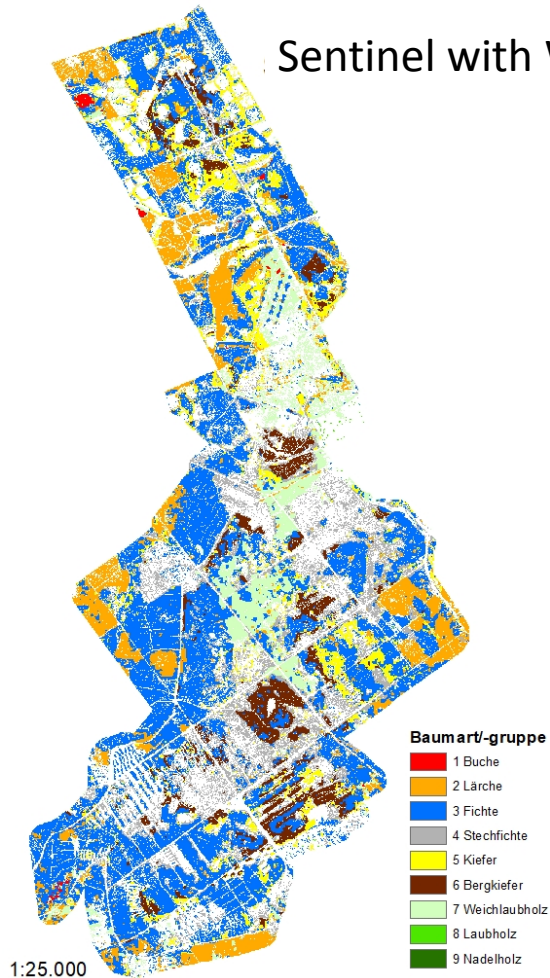
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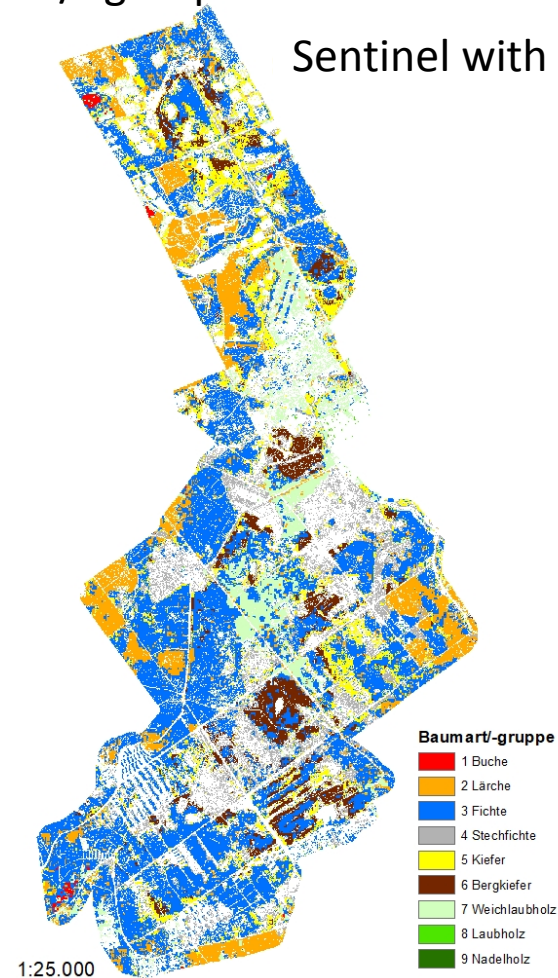
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Results detecting treespecies/ -groups

Sentinel with WV3



Sentinel with DOP





Results detecting groundvegetation

Sentinel with WV3



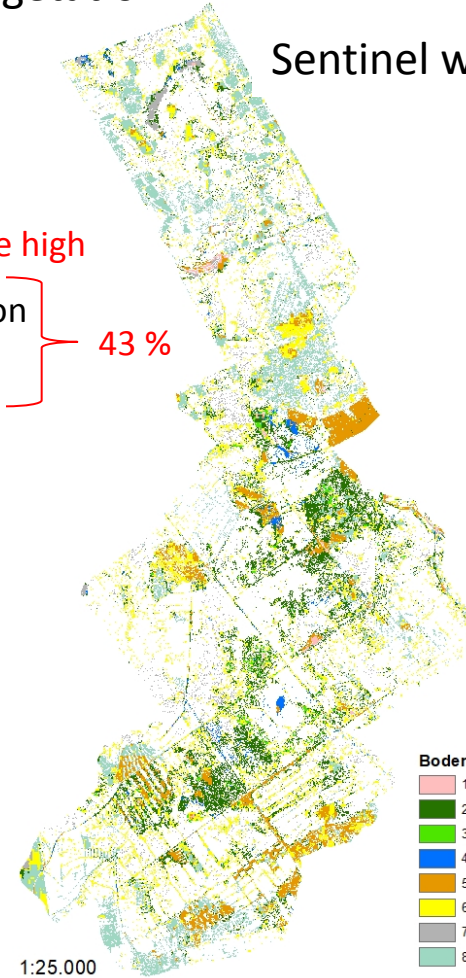
nonspecific classes quite high
- ‚other‘ ground vegetation
- ‚no result‘

43 %

Bodenvegetation

- 1 Rohboden
- 2 Zwerg-/Beerensträucher >50%
- 3 Zwerg-/Beerensträucher >20%
- 4 Moor-Sumpf-Vegetation
- 5 Gräser niedrig
- 6 Gräser hoch
- 7 Stein
- 8 Sonstige Bodenvegetation

Sentinel with DOP



Bodenvegetation

- 1 Rohboden
- 2 Zwerg-/Beerensträucher >50%
- 3 Zwerg-/Beerensträucher >20%
- 4 Moor-Sumpf-Vegetation
- 5 Gräser niedrig
- 6 Gräser hoch
- 7 Stein
- 8 Sonstige Bodenvegetation



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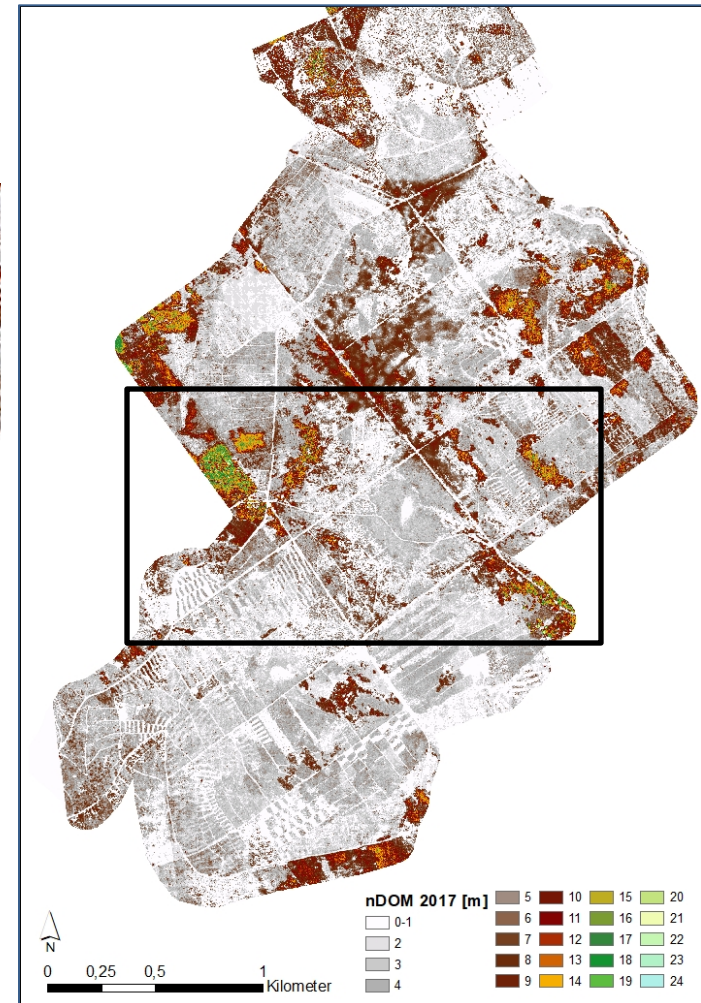
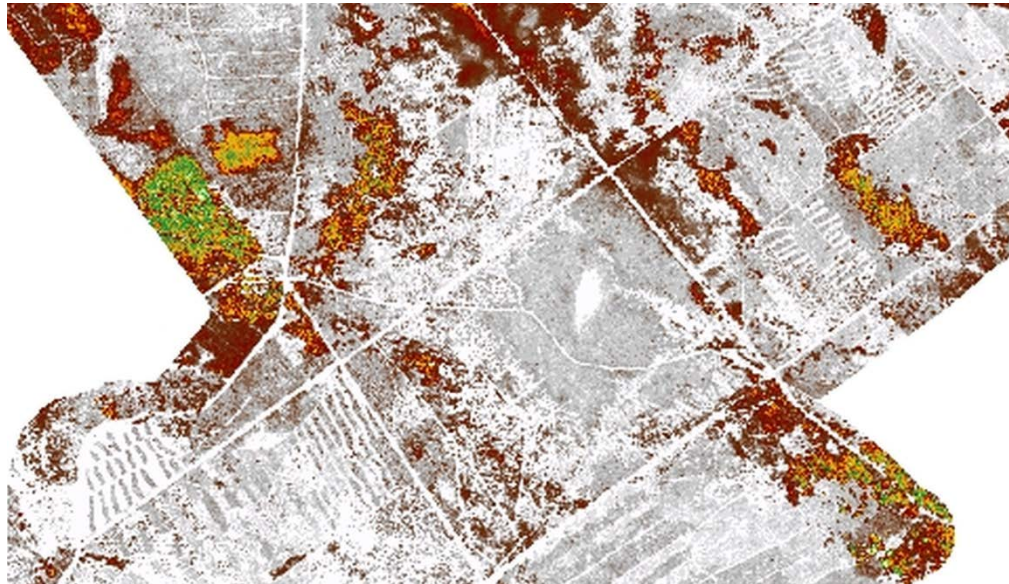
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Results nDOM

(used for tree-height and tree-coverage
determination)





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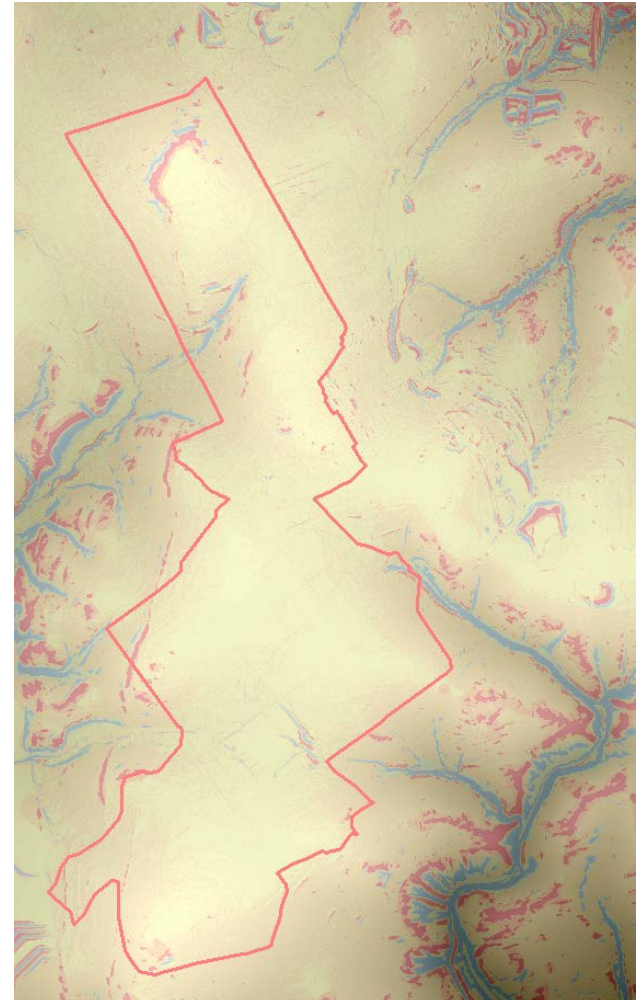
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Results landforms

Using DEM and the Topographic Position Index Tool, applied with Land Facet Corridor Designer (Jeff Jenness, 2013), categories of landforms (such as crests, plains, valleys etc.) were determined.



Landforms TPI 40 100



Application:

query for selected conditions: -> tree-height, tree-coverage, tree-species, groundvegetation

OBJECT	HERKUNFT	KSG	BA	BEHOEH_DFE	BVT_BIRKH
	Nach Größe sortieren (aufsteigend)		kA	0,0	8
	Nach Größe sortieren (absteigend)		FI	4,0	8
	Nach Farbe sortieren		FI	7,5	8
	Filter löschen aus "KSG"		FI	4,0	8
	Nach Farbe filtern		SWL	8,0	8
	Zahlenfilter		ELA	7,5	8
	Suchen		FI	7,5	8
	☒ (Alles auswählen)		FI	5,5	8
	☒ 0,0		FI	7,5	8
	☒ 0,1		kA	5,5	99
	☒ 0,2		FI	5,5	99
	☒ 0,3		FI	6,0	99
	☒ 0,4		FI	4,5	99
	☒ 0,5		FI	5,0	99
	☒ 0,6		FI	3,0	8
	☒ 0,7		FI	2,0	8
	☒ 0,8		SWL	0,0	8
	☒ 0,9		SWL	7,5	8
	☒ 1,0		SWL	7,0	8
			FI	8,0	8
			FI	6,5	8
			FI	0,0	8
			FI	5,5	8
24	Sentinel 2, DOP	0,0	FI	4,5	8
25	Sentinel 2, DOP	0,0	FI	5,5	8
26	Sentinel 2, DOP	0,0	FI	0,0	8
27	Sentinel 2, DOP	0,2	kA	1,0	8
28	Sentinel 2, DOP	1,0	FI	6,0	99
29	Sentinel 2, DOP	1,0	FI	5,0	99
30	Sentinel 2, DOP	1,0	FI	5,5	99



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Application within GIS:
query for selected conditions: -> tree-height, tree-coverage, tree-species, groundvegetation



1 square = 10 x 10 m = 0,01 ha



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Conclusions:

I. The high temporal resolution of more spatially resolved data such as PlanetScope or Sentinel 2 offers a high information value.

Classification based solely on this data, however, is sub-optimal, and the best results can be achieved by including textures from high-resolution spatial data such as Digital Orthophotos or WorldView satellite data.



Conclusions:

II. The introduction of an operationally efficient (semi-)automated process for the structural analysis of potential black grouse habitats seems possible after the evaluation of all classification approaches.

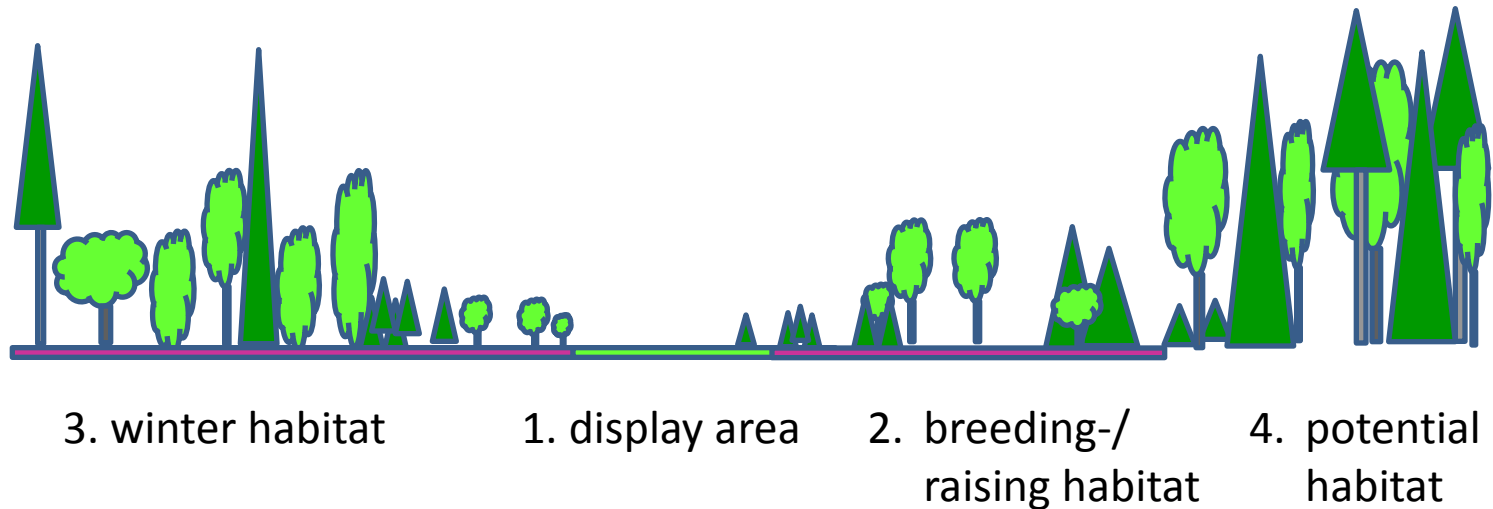
As a favorite both for cost reasons and due to the classification accuracy, the variant "Sentinel 2 plus textures from DOP" emerges. Another important data basis is the surface model. This should be as up-to-date and accurate as possible to be able to locate the tree-covered areas exactly. If no suitable laser scan data is available, stereo aerial images from the orthophotographic observation can alternatively be used to generate surface models (stereomatching).

For a large-scale application on the entire ridge of the Ore Mountains (about 5,000 km²), the collection of good reference (training) data is very important.



Habitat Evaluation - first steps:

- trying to evaluate the project area regarding to four different habitat types
- evaluation steps are done separately for each habitat type
- starting with displaying area (highest requirements), then habitat types 2, 3, 4
- criteria: tree species, coverage of trees, tree height, ground vegetation, topography





First attempt to find and evaluate (potential) display areas

Classification and class borders (topography not integrated yet):

Evaluation	Tree species	Tree coverage	Tree Height	Ground vegetation
very suitable (3 points)	Picea pungens, Betula, Salix, Sorbus	0 - 10 %	0 - 0,5 m	raw soil, low grass, dwarf shrubs > 50%
suitable (2 points)	Pinus spec., Larix, deciduous trees	20 - 30 %	1 - 1,5 m	dwarf shrubs < 50%
less suitable (1 point)	Picea abies, Fagus sylv., no detection	40 - 50 %	2 - 5 m	no detection, high grass, bog, stones
not suitable (false)		> 50 %	> 5 m	

Points for tree coverage and tree height are doubled -> maximum sum of points: 18
cells with less than 10 points or not suitable criteria are eliminated as display area



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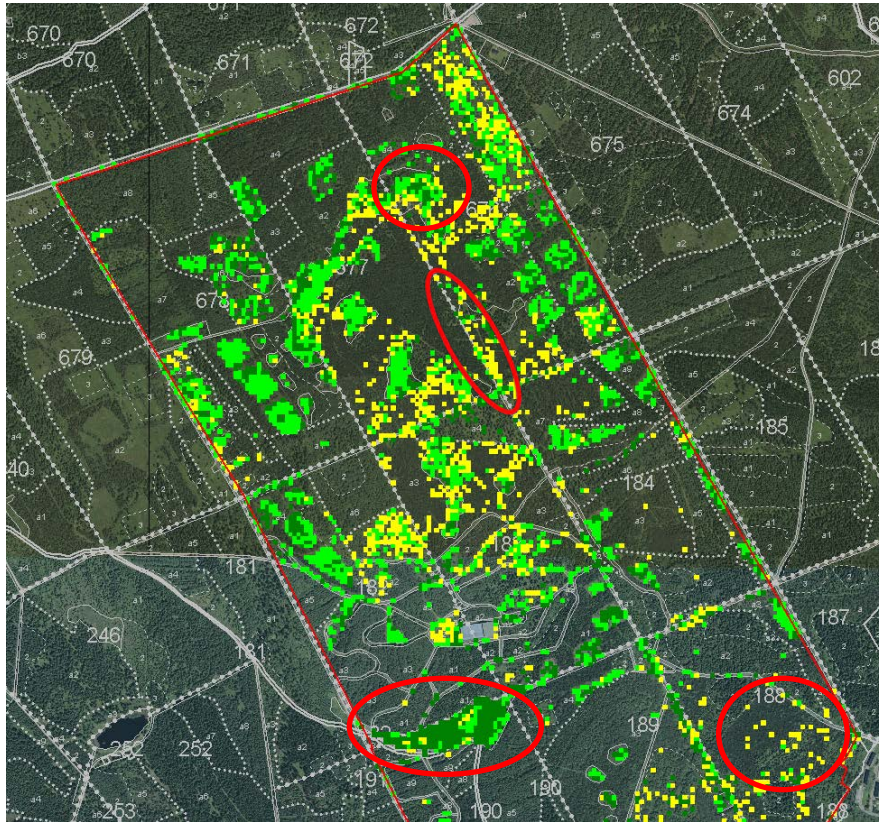
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First results:



Generally, the detection of potential display areas seems to work, results are plausible, but several corrections are necessary, some of them cannot be automatized.



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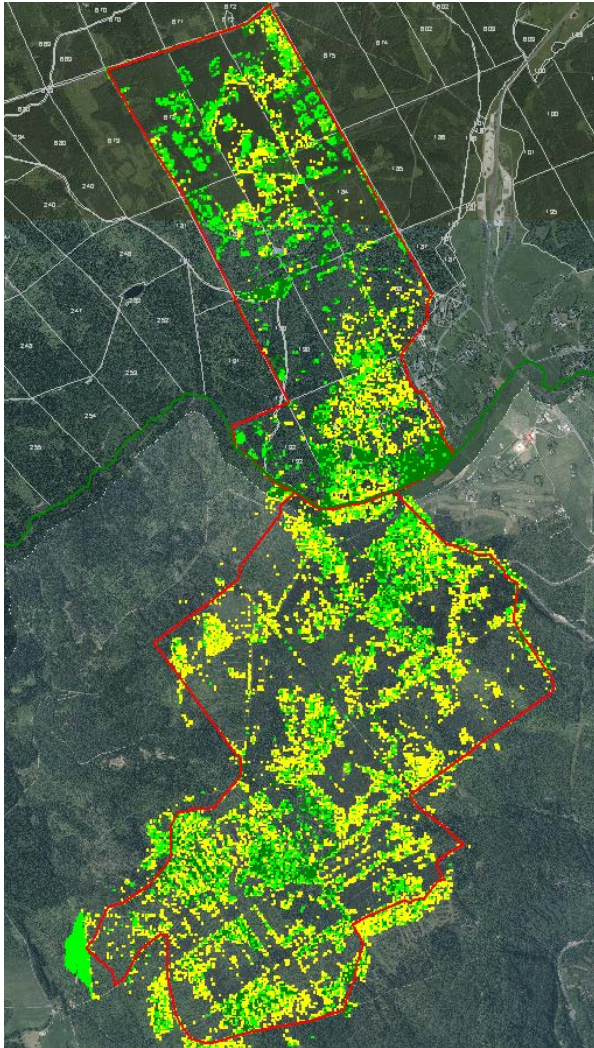


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nearly a fourth (24,7%) of the evaluated cells
were detected as potential display areas

further reductions will result from manual
corrections and eliminating isolated cells
-> trying to use clustering techniques

perhaps more strict class borders and/or
minimum sums of evaluation points are
necessary

habitat evaluation by remote sensing
has to be compared and perhaps calibrated
with results of terrestrial mapping (O. Volf)



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Thank
you ... let's
discuss

