

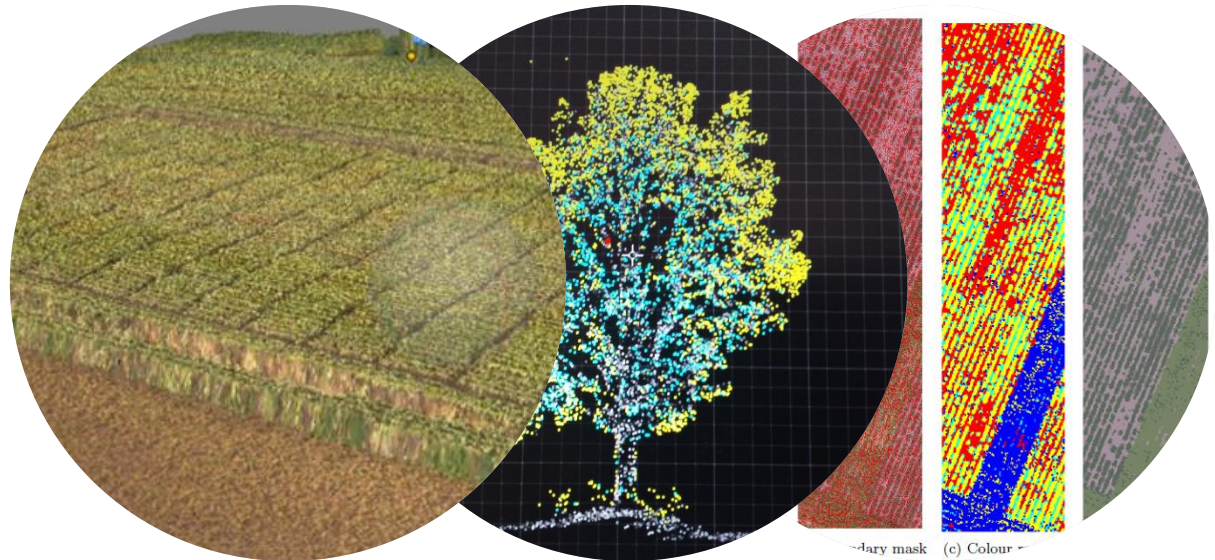
Methods for automated habitat mapping & potential relationship with strategic monitoring

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Cost Action HARMONIOUS, Workshop standardization of procedures in using UAS for environmental monitoring

6th of November 2019, University of Coimbra



WENR remote sensing domain & trends

- Land monitoring
- Monitoring vegetation for agriculture & nature
- Using satellites & drones
- Big Data, Cloud computing, Machine learning



WUR - Unmanned Aerial Remote Sensing Facility (UARSF) since 2012



ROC certified

<http://www.wageningenur.nl/uarsf>



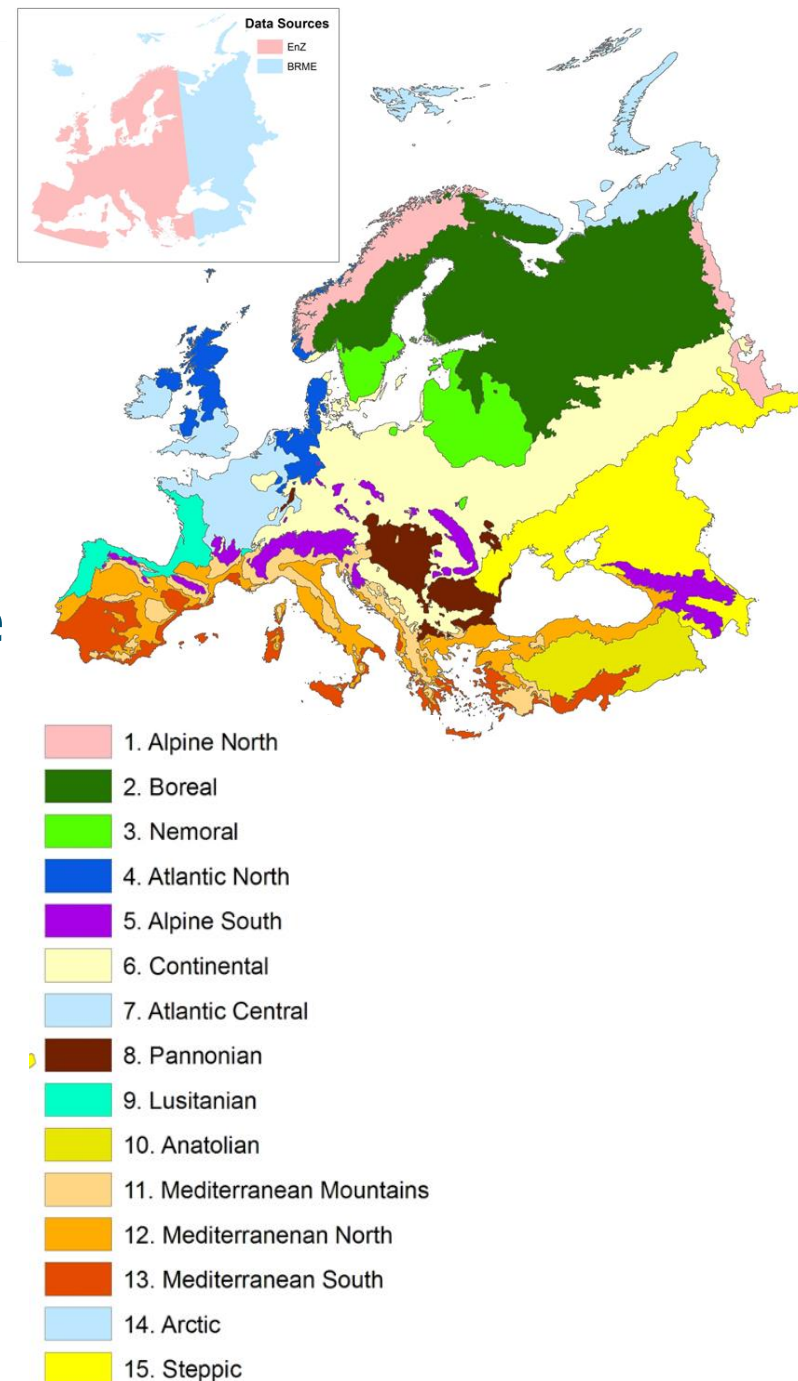
Background

Why we need new strategic European habitat monitoring ?

- **Habitats** are important **indicators** of **biodiversity** in their own right, and have a strong link with species
- Habitats are used a lot in **reporting** on biodiversity
- For reporting consistent mapping and monitoring **habitat extent** and **change** is important
- Remote Sensing techniques are becoming an important tool for this.


Monitoring objectives

- Collect European habitat information consistently from each country, **not only** in **protected sides** but also in the **wide countryside (unbiased)** across all environmental zones
- Provide **consistent** European **statistics** for habitats
- Provide **strict protocols** for habitat mapping & monitoring
- Support existing habitat & vegetation monitoring schemes



Requirements for unbiased European habitat monitoring

- **Stratified random samples of ~ 1km² across Environmental Zones** in Europe, such as used in UK Countryside Survey
- **Wall-wall habitat mapping** in km², including **areal, linear, point** habitats
- Samples should include: 1) Natura 2000 sites; 2) twinned samples outside; 3) LTER sites
- **Habitats of restricted distribution** which will have to be **targeted**
- Use European Habitat typology (EUNIS/General Habitat Categories)
- Plant life forms central
- Dominant species per life form
- Recording of environ. qualifiers optional
- Surveyors must be trained



Areal Unit Recording Sheet

Square name: Katoek 0/je
 Observer: Bob Davis, Geert De Blixt, Desiré Pauls s.l.c.
 Date: 24/05/2009

Code	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8			
General habitat category	Stratified EUNIS Code	Site Code	Max. Grazing	Life form	Species	Pen. Empty class	Regional Class	Phytosociology			
A	UNSP12UBA subarctic/alp herbaceous	-1	0	364 350	-1		-1	-1			
B	HERB11E herbaceous/ coniferous herbary/phyllodes	5.3	102	323 315 246 475	CHH	100	Lobso	100	NAs	sp	NAs
C	TF101E Forest phanerophytes/ shrub deciduous	5.3	102	478	THH	90	ovs Sals	50	NAs	low	NAs
D	HERB11E	5.3	102	315	CHH	100	Ashlan	100	NAs	sp	NAs
E	HERB11E herbaceous/ly shrub evergreen herbary/phyllodes	5.3	102	378	THH	70	Palms	80	NAs	sp + up*	NAs
F	CUL1200 Cultivated herbaceous crops	5.3	102	397	0	0	Grass	20		1	1
G	CUL1200	5.3	102	397	0	0	101	0	-1	1	-1
H	CUL1200 Cultivated Rice cereal	5.3	0	0	0	0	0	0	-1	1	-1
I	CUL1200 Cultivated Woody Crops	5.3	0	461 467	CHH/SFA	50	S20	0	-1	1/20 + 1/10*	-1

Legend Codes/Species

Use environmental code
 Use life index:
 17 Natural forest
 18 Cereals and other crops (e.g. meadow)
 19 Other crops
 20 below 1% tree cover, but above 1% tree
 21 above 1% tree cover, but above 1% tree
 Use management code:
 101 No
 102 Grazing (low)
 103 Grazing (medium)
 104 Grazing (high)
 105 Grazing (very high)
 106 Grazing (other)
 107 intensive crop (less than 10 seed species per 10 m²)
 108 irrigated
 109 cut for hay
 110 planted
 111 planted
 112 planted
 Use species codes:
 101 wheat
 102 maize
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Field computer help standardized in-situ habitat mapping

EBONE FieldDatabase V0.8.4

Start Erstellen Externe Daten Datenbanktools Acrobat

Ausschneiden Kopieren Einfügen Zwischenablage

Neu Summen Speichern Rechtschreibung Löschen Weitere -

Auswahl - Erweitern Filtern Filter ein/aus Sortieren und filtern

Ersetzen Gehe zu Markieren - Suchen

Navigationbereich

Observed Elements

Square: ATA3 ObsDate: 201006

Polygon ID: D3 Observers: Prinz, Martin

ElementType: A (Area) Date: 08.06.2010

Field 1 GHC Code: WOC Reference: SHC2010

Field 6 FFH Annex I: [dropdown]

Field 7 FarmClass Code: 1 (Fields managed on) FarmClass2010

Field 8 Phytosociological Class.:

Vegetation Plot ID: [input] **Edit Plot**

Field 2: Global & Environmental Qualifier

Group	Qualifier	RefListe	Comment	Add	Delete
new	new				
Env. Qualifiers	5.4		Environmental qualifiers		

Field 3: Site Qualifiers

Group	Qualifier	RefListe	Comment	Add	Delete
new	new				
Geology	2.7		SiteQualifier2010		

Field 4: Management Qualifiers

Group	L1	L3	L4	RefListe	Com	Add	Delete
new	new	new	new				
Agricultural	A	1.12	500		Management		


Field 5: LifeForm Species

Life Forms	Bird view	In Layer	Species	SP Cove
LHE (Leafy Hemic)	80		Trifolium repens	20
WOC (Woody Crops)	10		Vitis vinifera s. vinifera	100
LHE (Leafy Hemic)	80		Anthemis avensis	20
CHE (Caespitose He)	10		Secale cereale	70

Datensatz: 1 von 4

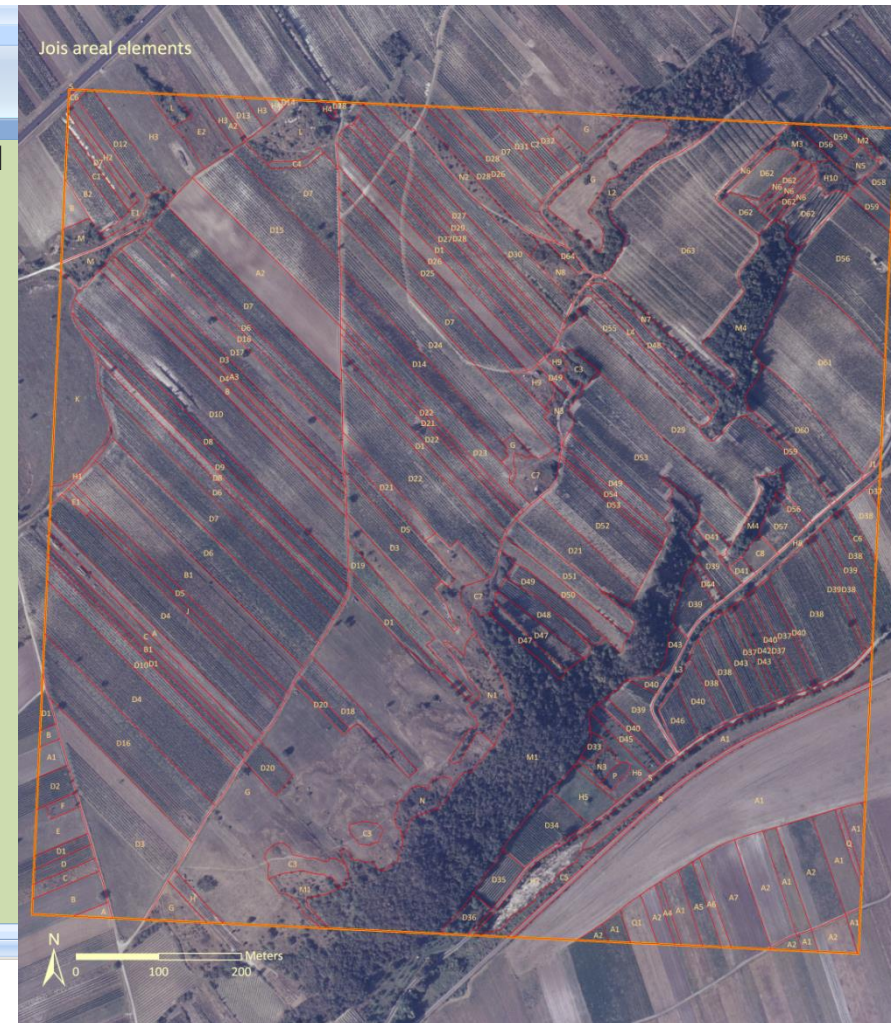
BACK TO SQUARES

Polygon picture



Datensatz: 1 von 161

Formularansicht



Downloadable from: <http://wageningenur.nl/ebone>

European habitat modelling spatial of all EUNIS habitat types to assist sampling

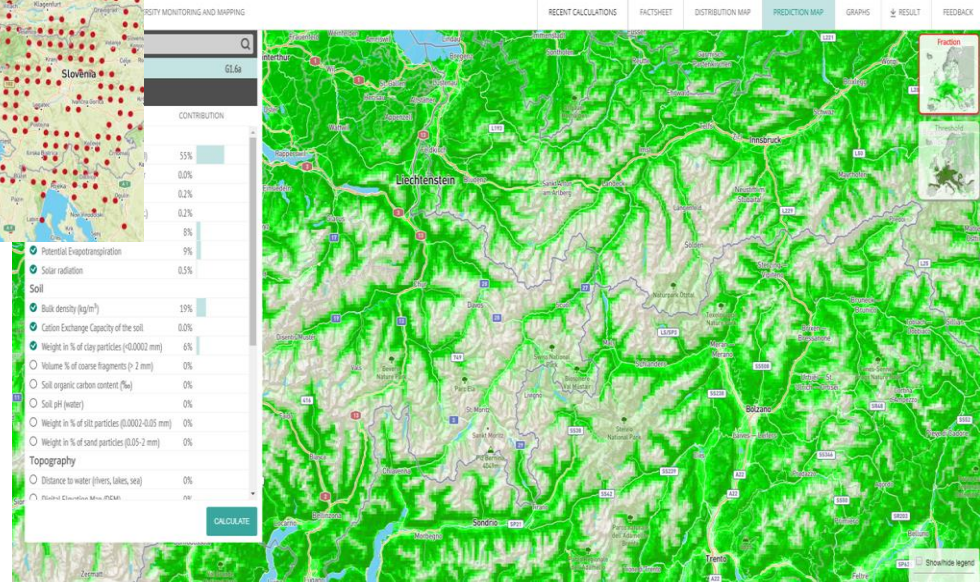
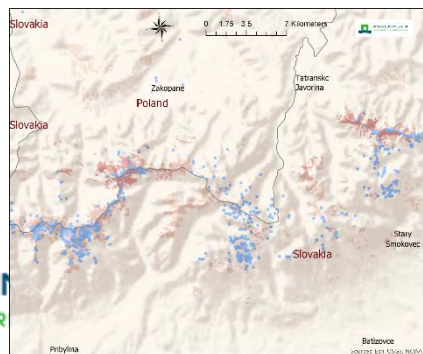
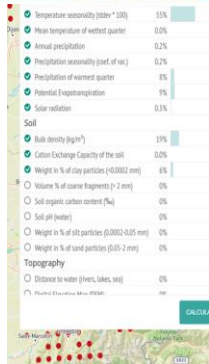
Classification of in-situ vegetation relevés to EUNIS habitat types

In-SITU habitat data
+ environmental
data layers

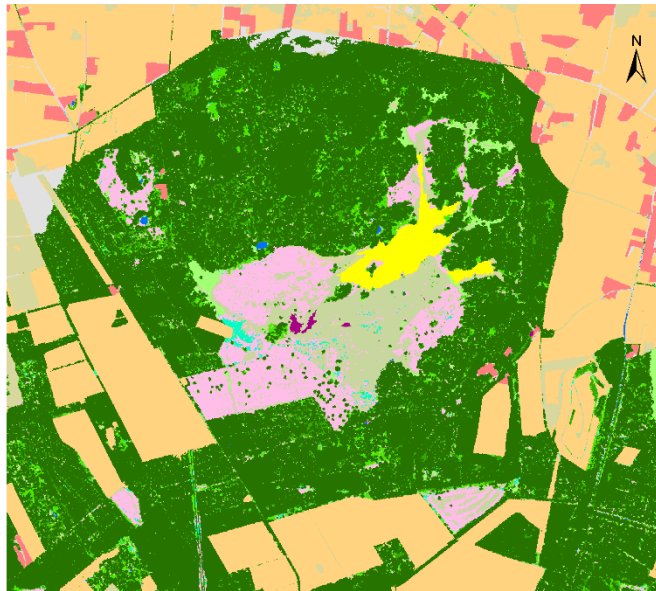
RS-enabled
EBV's

Cloud Modelling
with MAXENT

European Habitat
Suitability
Maps



Many spaceborne EO approaches already exist for automated habitat mapping

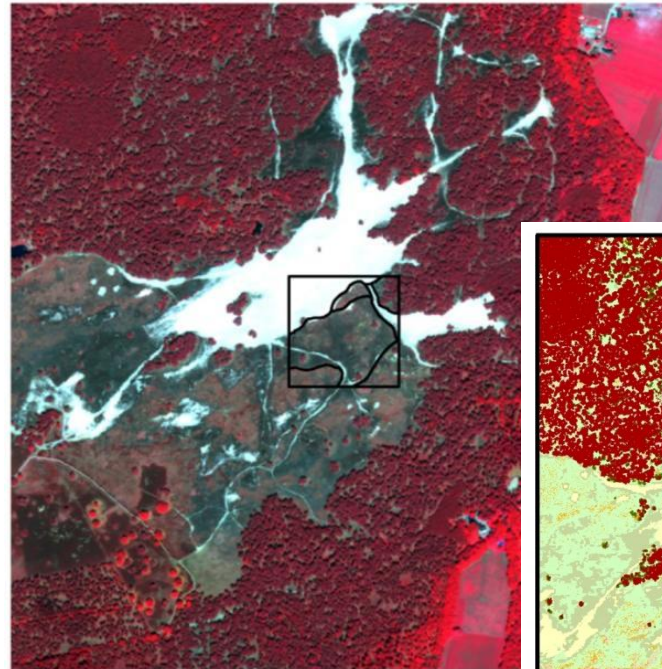
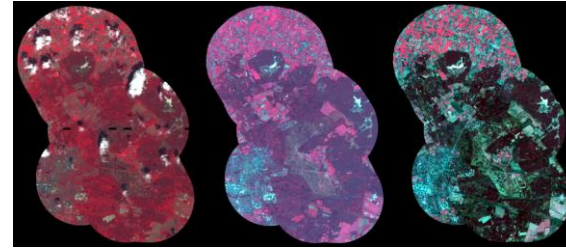


EODHAM Wekeromseazand

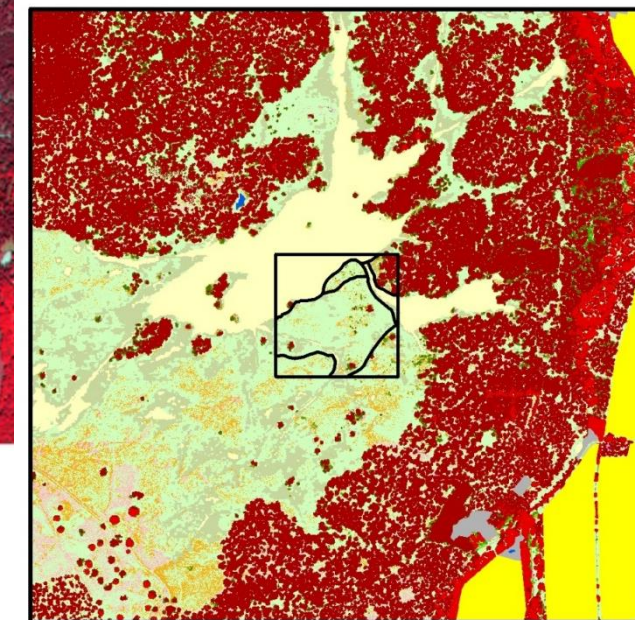
GHC			
NOOMA	SCHSULMCON	MPH/SUMCON	FPK/SUMCON
ART or NON	SCHSULM	MPH/SUM	FPK/SUM
CUL	SCH/EVR/CON	MPH/EVR/CON	FPK/EVR/CON
CUL or LRS	SCH/TVR	MPH/TVR	FPK/TVR
AGH or ART	SCH	MPH/DO/CON	FPK/DO/CON
SAN or GRV or SIO	LPH/SUM/CON	MPH/DO	FPK/DO
GRV or STO or ROU	LPH/SUM	MPH/DEC	FPK/DEC
LHE or THE or HCH or CEO	LPH/EVR/CON	TPH/SUM/CON	
CRV4.C	LPH/EVR	TPH/SUM	
CRV/BRY	LPH/DO/CON	TPH/EVR/CON or FPK/EVR/CON	
	LPH/DEC	TPH/EVR	
	LPH or MPH	TPH/TVR	
	LPH	TPH/DO/CON or FPK/DO/CON	
		TPH/DO or FPK/DO	



VHRS



EODHAM multitemporal decision trees



Lucas et al, 2015. The Earth Observation Data for Habitat Monitoring (EODHAM) System. International Journal of Applied Earth Observation and Geoinformation 37 (2015) 17–28.

Mücher, et al., 2015. Synergy of Airborne LiDAR and Worldview-2 satellite imagery for land cover and habitat mapping: a BIO_SOS-EODHAM case study for the Netherlands. International Journal of Applied Earth Observation and Geoinformation 37 (2015) 48–55.

Rule based versus Machine learning

Rule based classification (RB)

Accuracy
84.1 %

rule based classification

Random Forest classification (RF)

Accuracy
86.4 %

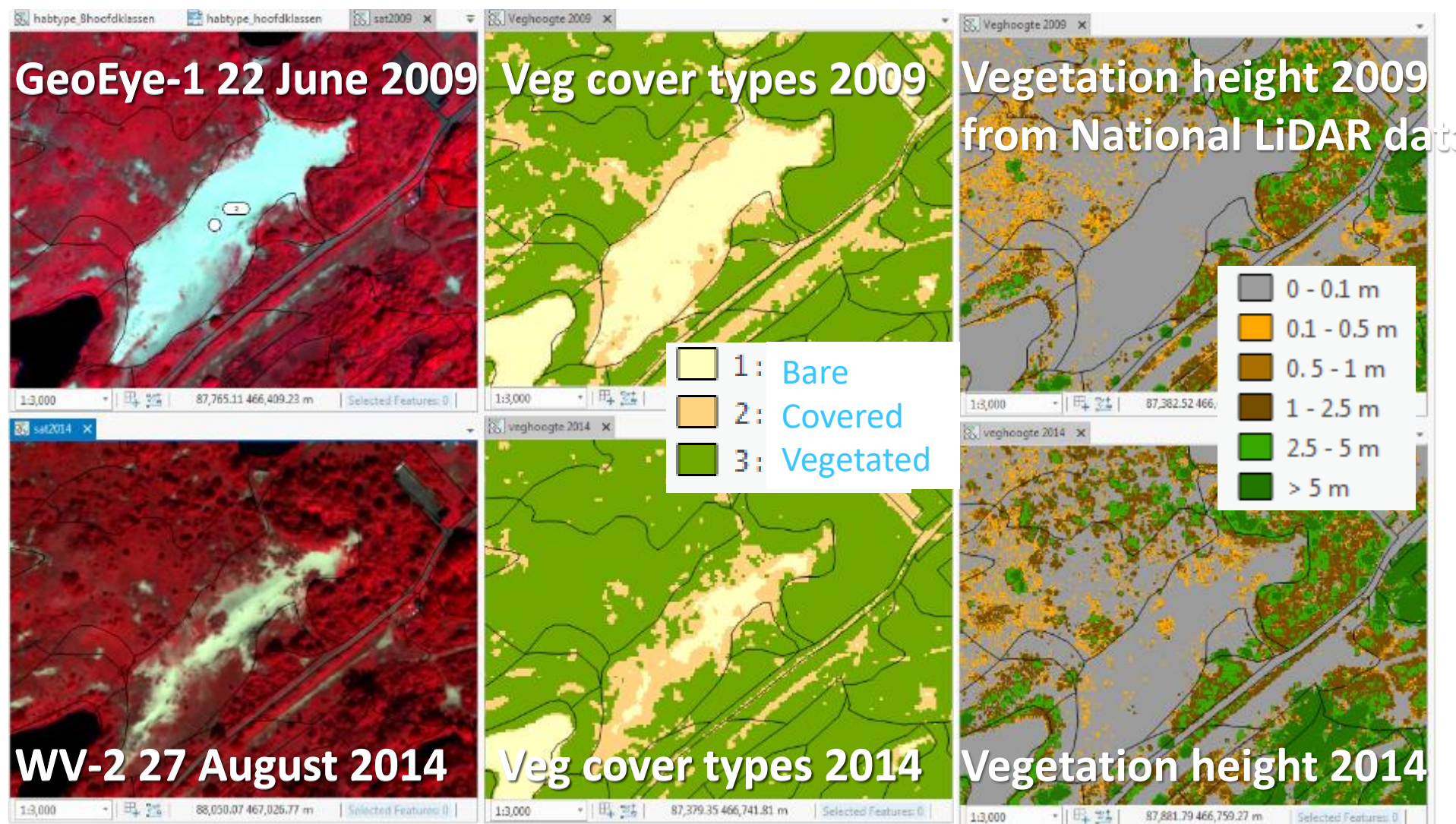
Vegetation structure map

- 01_High thicket (wood)
- 02_Medium thicket
- 03_Low thicket
- 04_Salt marsh vegetation
- 05_Salt marsh sparsely vegetate
- 06_Dune vegetation
- 07_Dune sparsely vegetated
- 08_Reed
- 09_Sand
- 10_Water
- 11_Salt water
- 12_Sea water
- unclassified

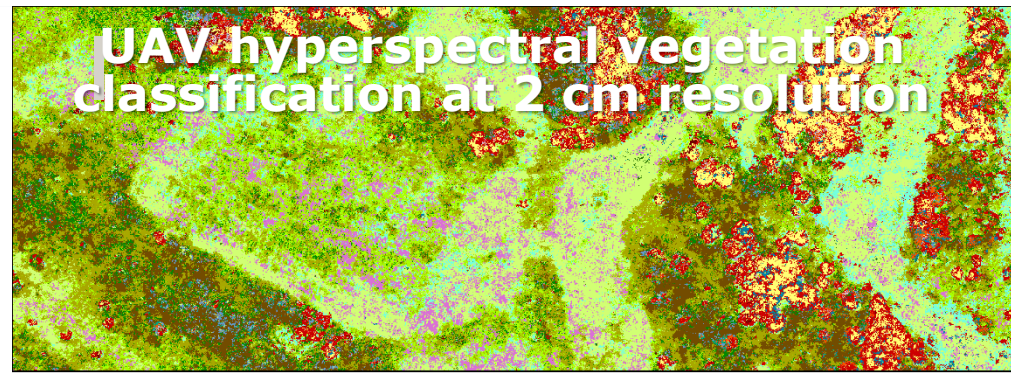
0 50 100 200 Meters

random forest classification

Vegetation structure monitoring possible for entire Netherlands (at scale 1:5000) **once in the 6 years** based on free VHRS and national LiDAR data



Why use of UAVs ?



0 2.5 5 10 15 20 25 30 35 40 Meters

Legend

- Unclassified
- vegetation [vegtype=Acoretum calami]
- vegetation [vegtype=Calthion palustris]
- vegetation [vegtype=Calthion palustris (Juncus eff Fazines)]
- vegetation [vegtype=Caricetum gracilis]
- vegetation [vegtype=Cynosuro-Lolietum]
- vegetation [vegtype=Festuco-Cynosuretum lotetosum uliginos]
- vegetation [vegtype=Festuco-Cynosuretum typicum]
- vegetation [vegtype=Frangulo-Salicetum cinereae (n. Volk.)]
- vegetation [vegtype=Glycerietum maximae]
- vegetation [vegtype=Glycerietum Sparganietum neglecti]
- vegetation [vegtype=Lolio-Cynosuretum cristati lotetosum uliginos (fragm)]
- vegetation [vegtype=Lolio-Cynosuretum cristati typicum]
- vegetation [vegtype=Peucedano-Calamagrostietum canescentis]
- vegetation [vegtype=Phalaridetum arundinaceae]
- vegetation [vegtype=Ranunculo repentis-Alopecuretum geniculati ranunculetosum fl. (GL)]
- vegetation [vegtype=Scirpo-Phragmitetum (Iris pseudacorus)]
- vegetation [vegtype=Scirpo-Phragmitetum (Phragmites austr.)]
- vegetation [vegtype=Shadows]
- vegetation [vegtype=Symphito officinalis-Filipendulion]
- vegetation [vegtype=Valeriano-Filipenduletum typicum]
- vegetation [vegtype=Water]
- vegetation [vegtype=ohne Zuordnung]

Satellites



Airplanes



"Bridging the gap"



In-situ



Advantages UAVs over VHR satellite imagery

- UAV imagery has a much **finer spatial resolution** than VHR satellite imagery enables to map small areal and linear habitats (+ vegetation mapping)
- UAV imagery are **easier to use** for vegetation surveyors that are used to aerial photography
- UAV imagery can nowadays easily cover square km samples **at the required time periods** of the year (up-to-date at right moments) without cloud cover
- Combining multispectral and LiDAR camera's possible on UAV platforms (national LiDAR data is not up-to-date).
- So up-to-date and accurate habitat maps and changes possible with drones across sample sites.
- Remotely classified habitat maps and associated changes as basis for additional field surveys

Standardization UAV data for habitat monitoring

- Choice platform and camera types should be flexible due to user requirements but **imagery** should be **consistent in time** due to monitoring
- **Protocols** for **processing imagery** using photographic principles, including positional accuracy
- **Flight execution** should follow strict rules and should be **repeated consistently** over time.
- Rules for multi-time recording versus weather conditions needs **smart decision making**

Thank you for your attention

<http://www.wur.eu/uarsf>



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