The use of open source aerial photographs and LiDAR data for the semi-automatic mapping of vegetation structure in the Netherlands

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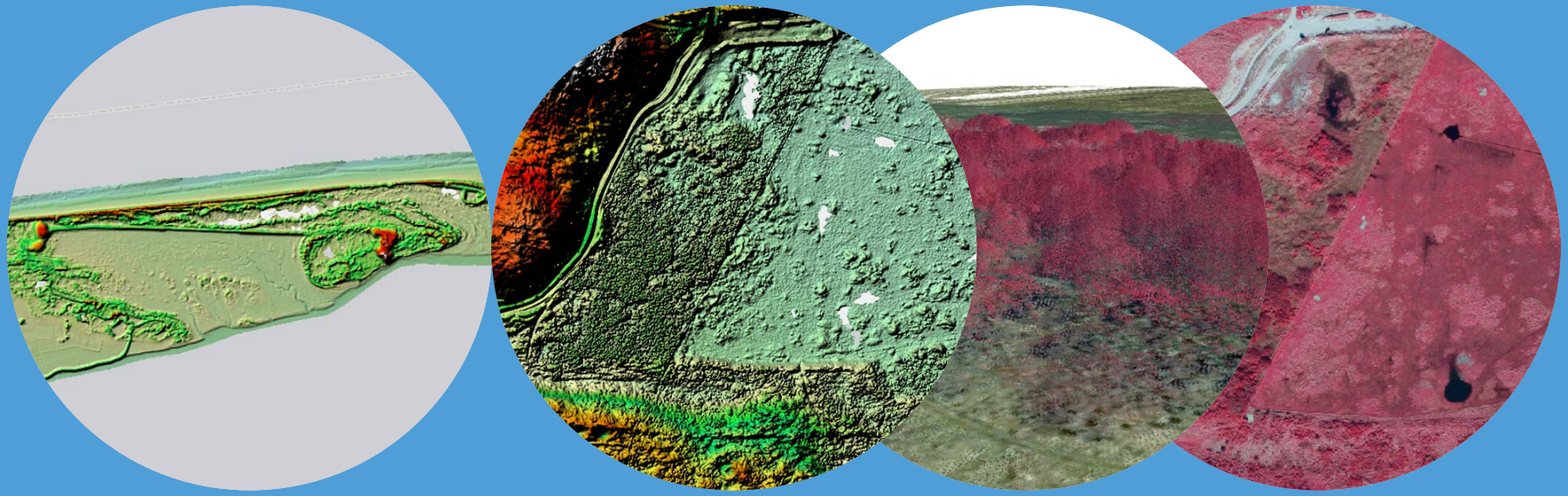

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Introduction

The use of commonly shared aerial photographs and LiDAR data for the semi-automatic mapping of vegetation structure in the Netherlands

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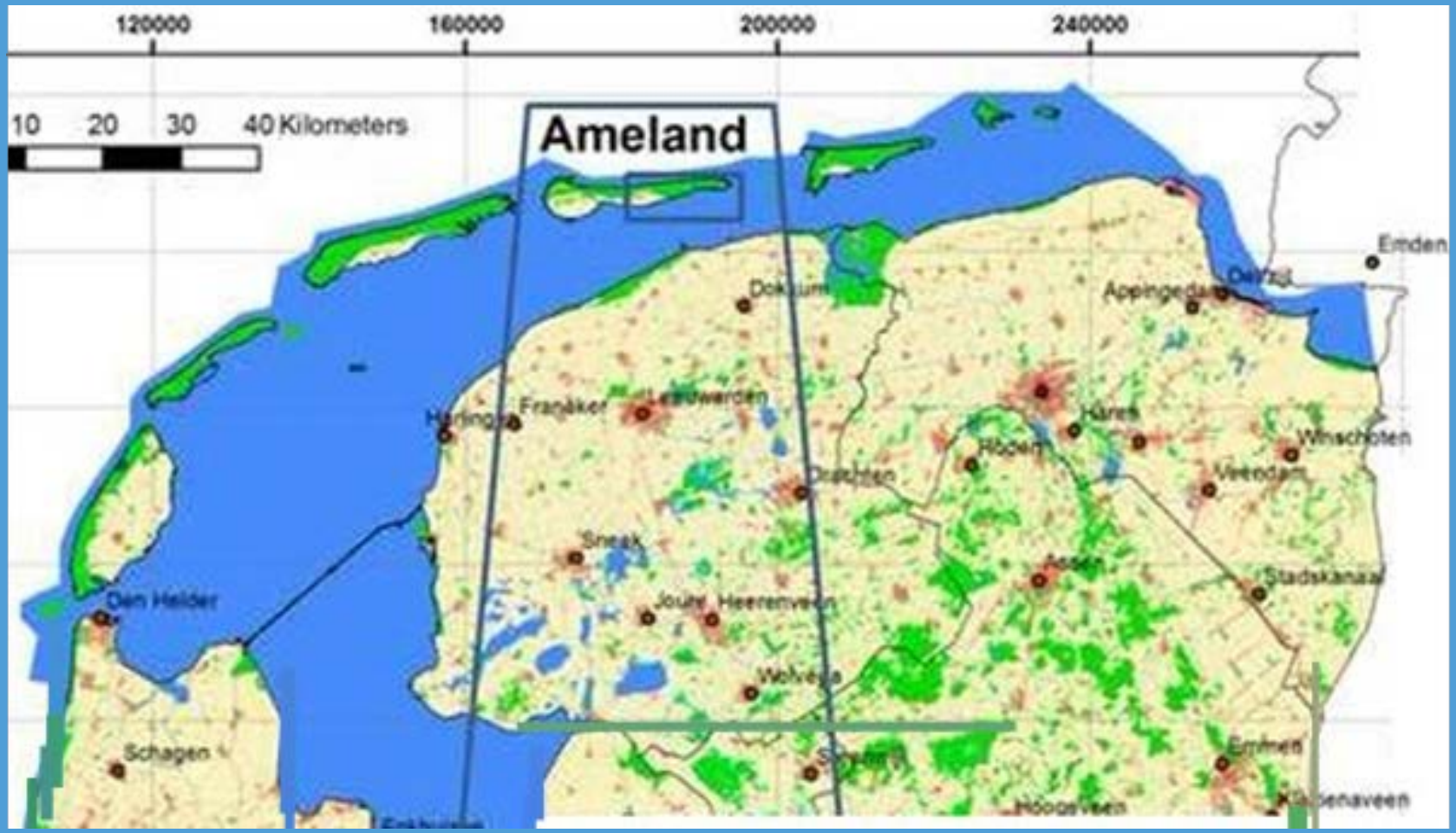
Introduction

Regular mapping of vegetation structure is of importance for biodiversity monitoring. In the Netherlands, vegetation structure mapping is in most cases still done in a traditional way based on field surveys in combination with visual interpretation of aerial photographs. This procedure is time consuming and often limited in its consistency and efficiency to cover large areas. Meanwhile space and airborne imagery are increasingly becoming available at affordable costs. Therefore, the use of alternative and semi-automatic classification techniques was investigated that explores commonly shared Dutch data such as aerial photographs and LiDAR to support the mapping and monitoring of the vegetation structure for larger areas.

Introduction



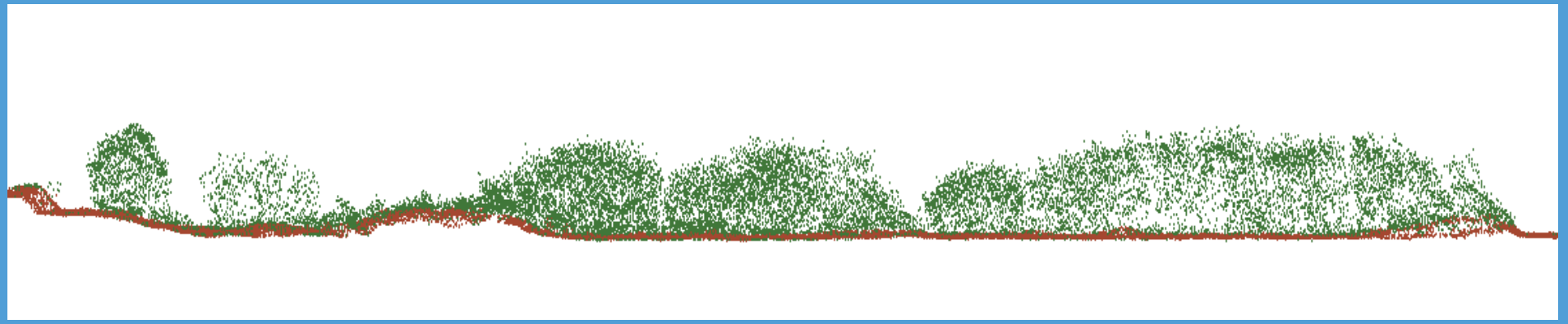
data

- Aerial photographs (RGB + NIR)

- 25 cm resolution
- Yearly coverage for NL
- commonly shared but not open source

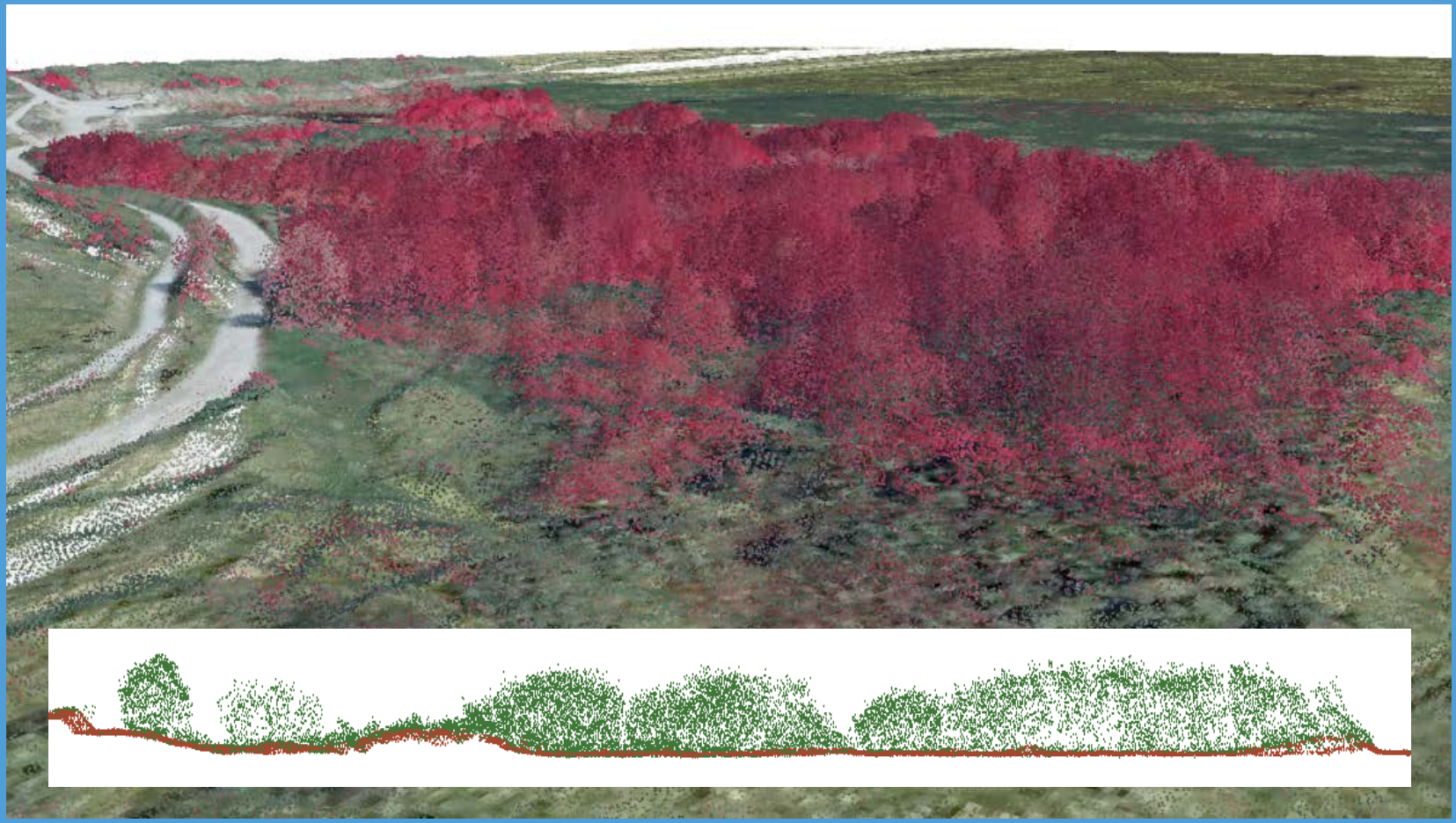
data

- LiDAR Data (AHN = height model of the Netherlands)
- 11 points/m2 -> DEM with 50 cm resolution
- coverage for NL every 6 years (approx)
- Open source



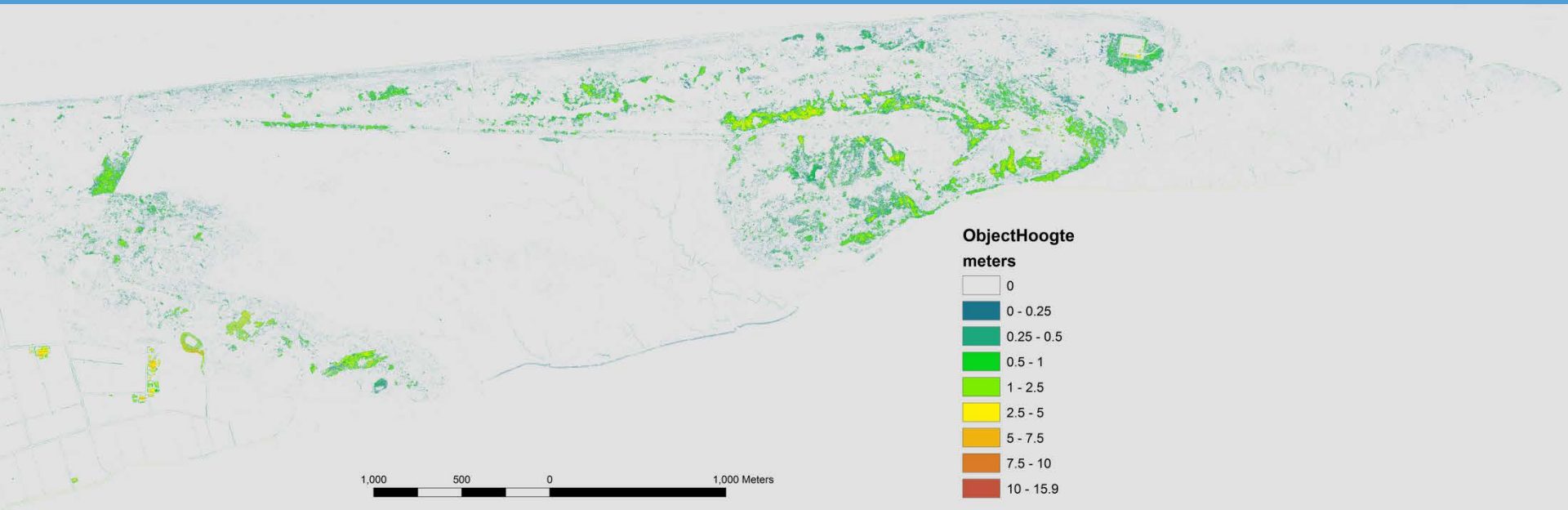
data

- LiDAR Data (AHN = height model of the Netherlands)



data

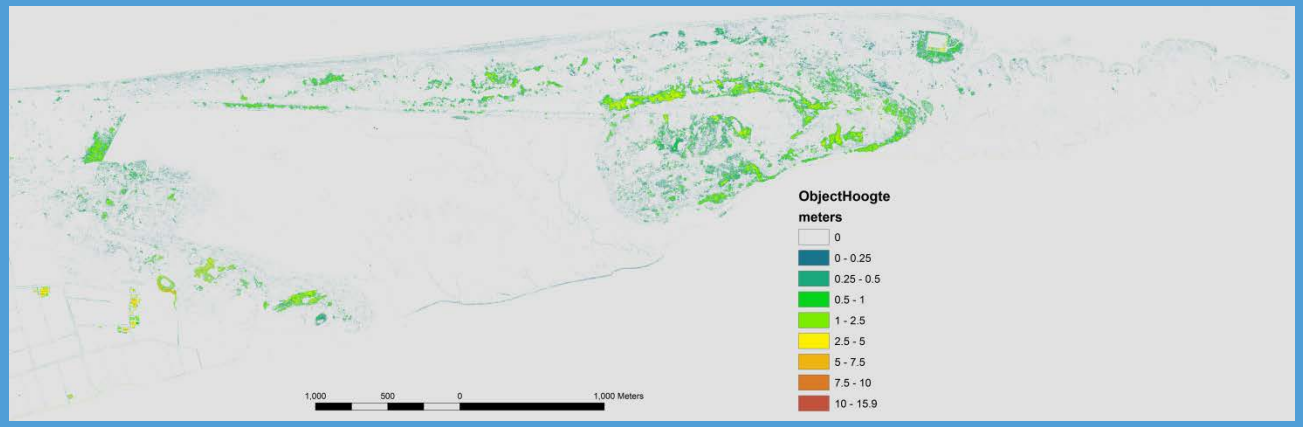
- From the LiDAR Data an Object Height Model is derived, containing per 50 cm gridcel the height of the vegetation.

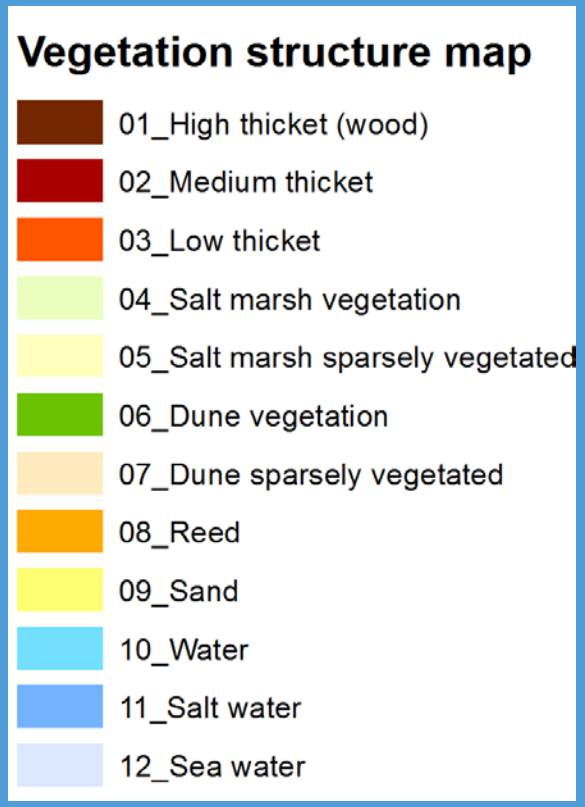


data

- legend

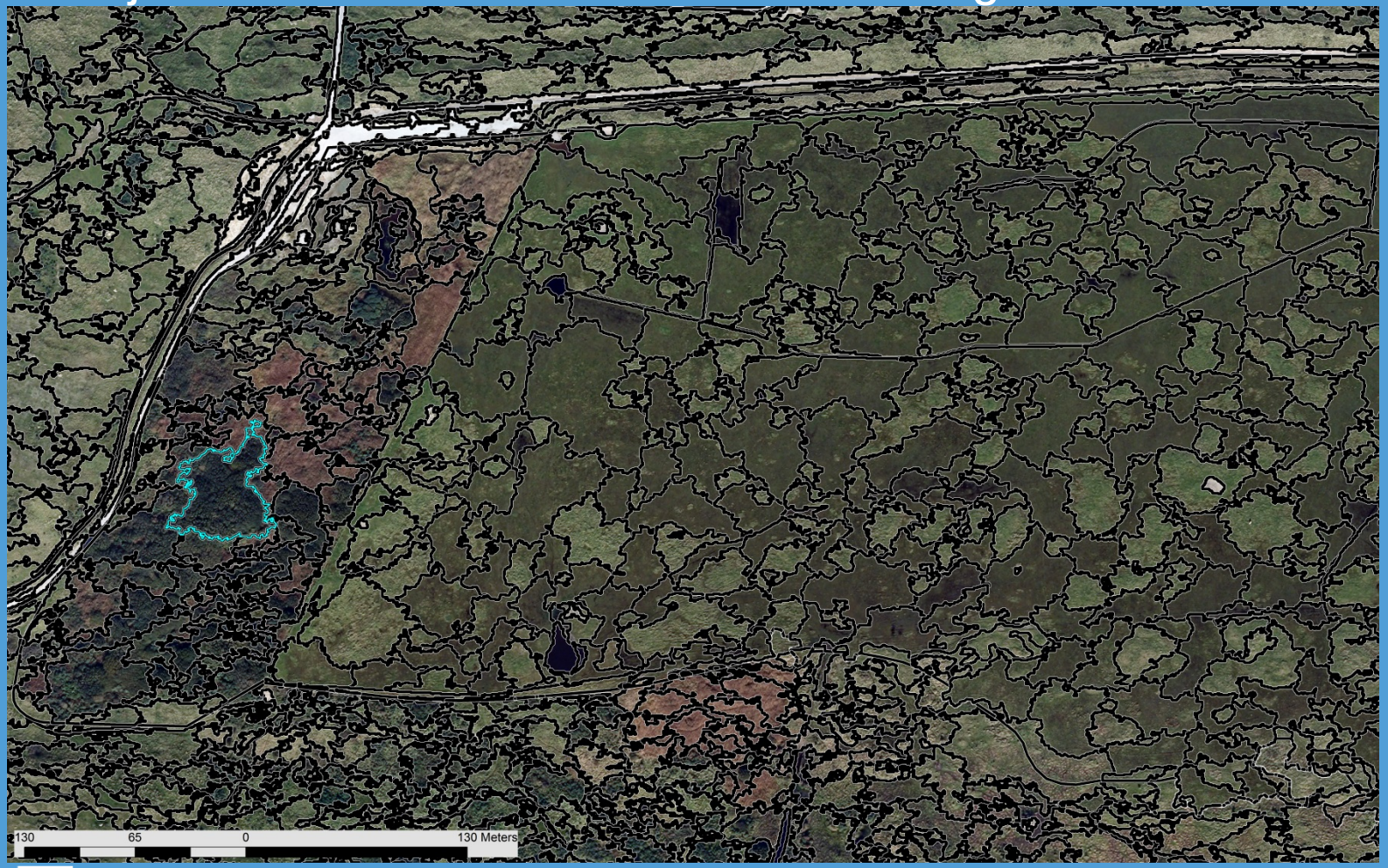

1,000
500
0
1,000 Meters


ObjectHoogte
meters
0
0 - 0.25
0.25 - 0.5
0.5 - 1
1 - 2.5
2.5 - 5
5 - 7.5
7.5 - 10
10 - 15.9
1,000
500
0
1,000 Meters


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

proces

- Object based classification with ecognition

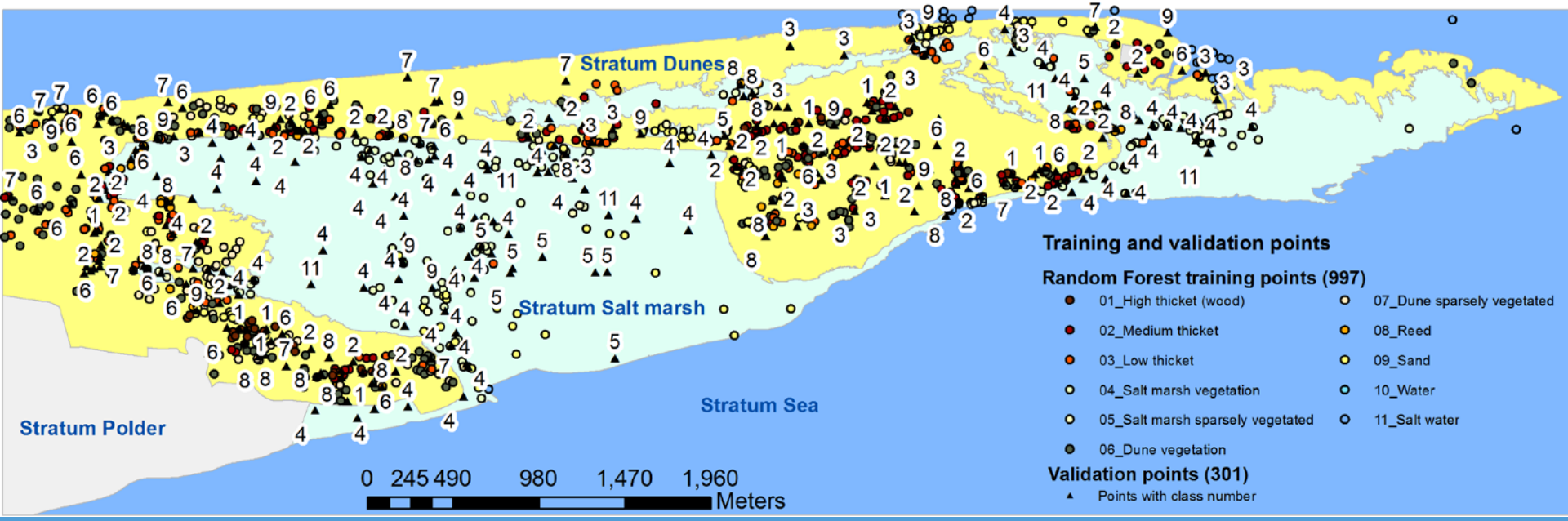


proces

- comparing 2 methods, rule based and Random Forest
- -> benefits of used method (time, effort)
- -> classification accuracy

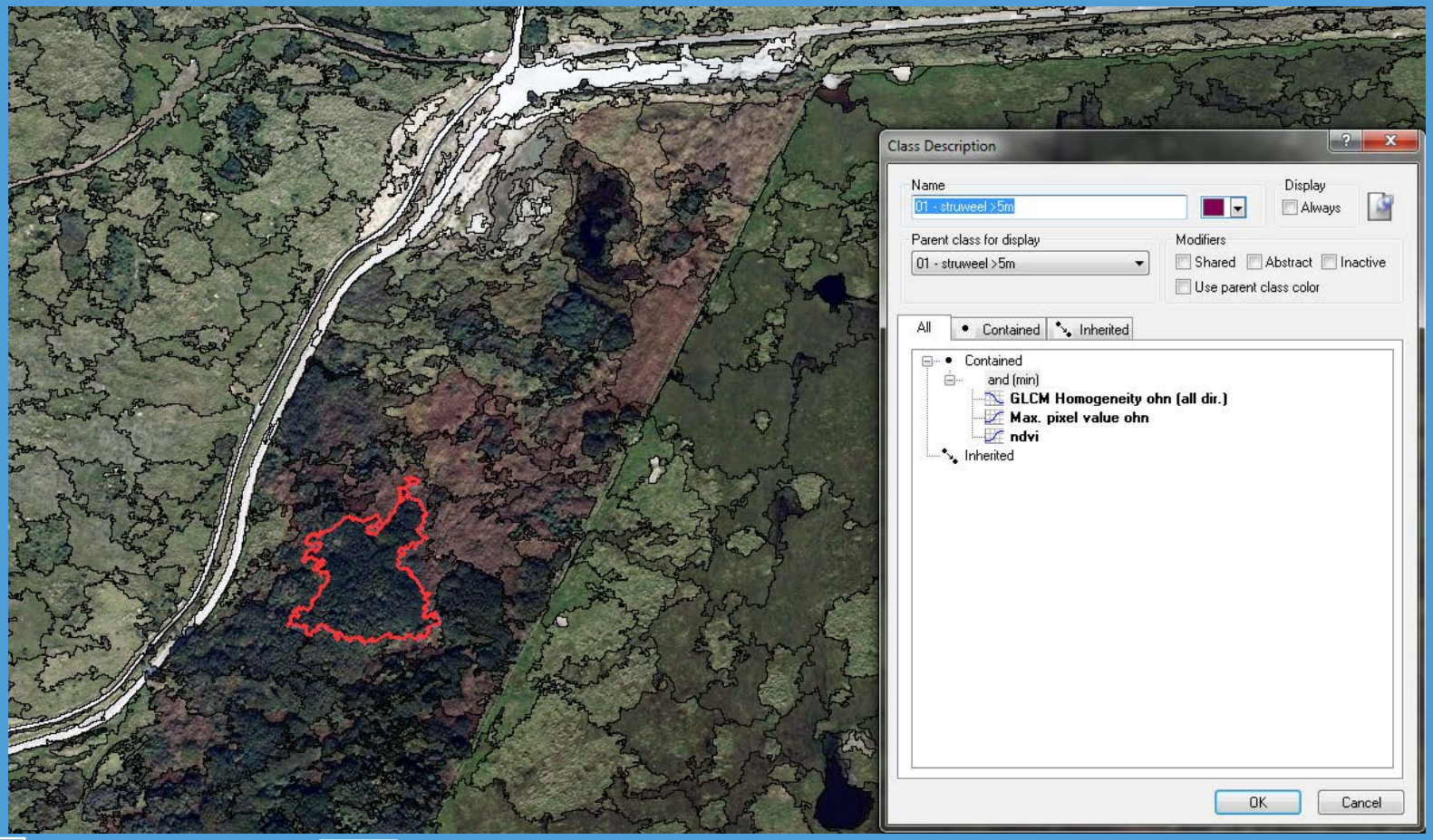
Proces

- Fieldwork using gps
  - Low accuracy of standard gps (5-10 m) reduces the applicability of the field data. Geometric adjustments are necessary.



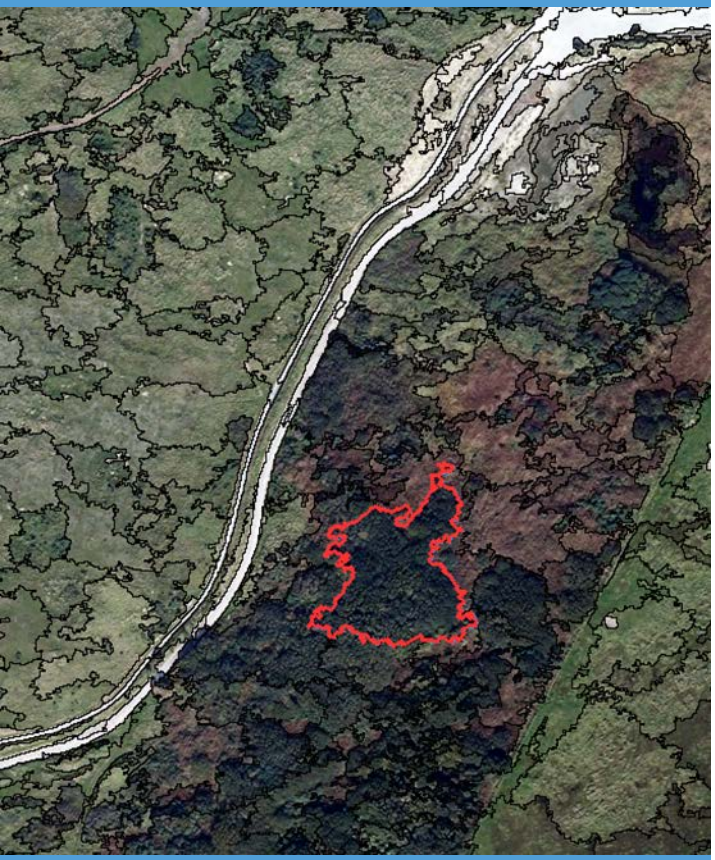
Proces

- Rulebased -> rule development, features and thresholds



Proces

- Iterative,
- time consuming



Class number & name	Feature					
	OHN max OHN in m	Index NDVI	Spectral brightness	GLCM Homogeneity OHN	Ratio red	Stratum
First classification round						
01 High thicket (wood)	> 5	> 0.16		< 0.45		
02 Medium thicket	2 - 5	> 0.16		< 0.45	< 0.31	
03 Low thicket	0.5 - 2	> 0.16		< 0.65	< 0.31	
04a Salt marsh vegetation		> 0.25	55 -110	> 0.95		Salt marsh
04b Salt marsh vegetation		0.14 - 0.25	65 - 110	> 0.95		Salt marsh
06a Dune vegetation		> 0.25	55 - 110	> 0.95		Dunes
06b Dune vegetation		0.14 - 0.25	65 - 110	> 0.95		Dunes
08 Reed	< 3.5	0.05 - 0.31	< 110	< 0.95	> 0.31	
09 Sand		-0.25 - 0.1	> 100			
10a Water		< 0	< 110	> 0.95		Dunes
10b Water		< 0.3	< 50	> 0.95		Dunes
10c Water		< 0.45	< 60	> 0.98		Dunes
10d Water		< -0.1	< 110			Dunes
11a Salt water		< 0	< 110	> 0.95		Salt marsh
11b Salt water		< 0.3	< 50	> 0.95		Salt marsh
11a Salt water		< 0.45	< 60	> 0.98		Salt marsh
11a Salt water		< -0.1	< 110			Salt marsh
Second classification round (applied at unclassified first round)						
01 High thicket (wood)	> 5	> 0.16		> 0.45		
02 Medium thicket	2 - 5					
03 Low thicket	0.5 - 2	> 0.16		> 0.45		
08 Reed	< 3.5	< 0.31	< 110	< 0.45		
05 Salt marsh sparsely vegetated	< 0.5	> 0.16				Salt marsh
07 Dune sparsely vegetated	< 0.5	> 0.16				Dunes
09 Sand		< 0.16				

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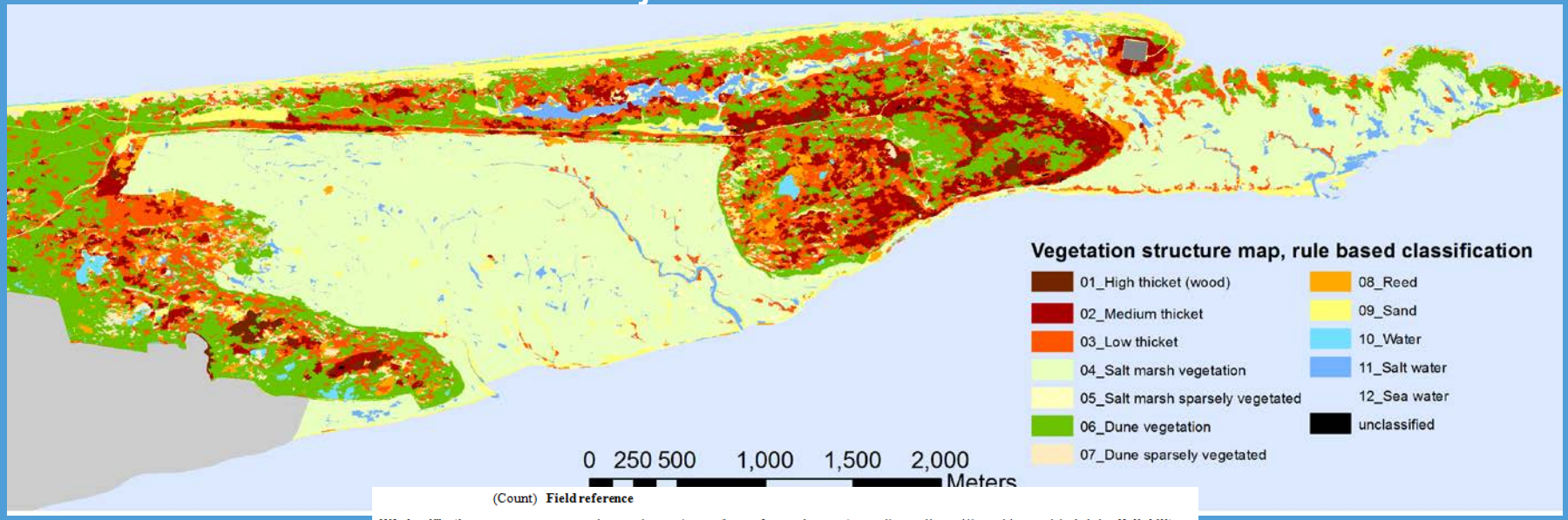
Proces

- Results Rule based object classification



(Count)	Field reference													
RB classification	1	2	3	4	5	6	7	8	9	10	11	12	Total	**Reliability**
01_High thicket (wood)	15	1											16	93.8
02_Medium thicket		54				1		1		1			57	94.7
03_Low thicket			24	1		4		1					30	80.0
04_Salt marsh vegetation			1	70	5			1			2		79	88.6
05_Salt marsh sparsely veg.					4			2	1		2		9	44.4
06_Dune vegetation			1			24	3	2					30	80.0
07_Dune sparsely vegetated						1	7	2					10	70.0
08_Reed		1				1		15					17	88.2
09_Sand					1		5		13				19	68.4
10_Water						2		1		10			13	76.9
11_Salt water				1							16		17	94.1
12_Sea water									1			1	2	50.0
Unclassified								1		1			2	100.0
Total	15	56	26	72	10	33	15	26	15	12	20	1	301	
Accuracy	100.0	96.4	92.3	97.2	40.0	72.7	46.7	57.7	86.7	83.3	80.0	100.0		
Overall accuracy	**84.1**													

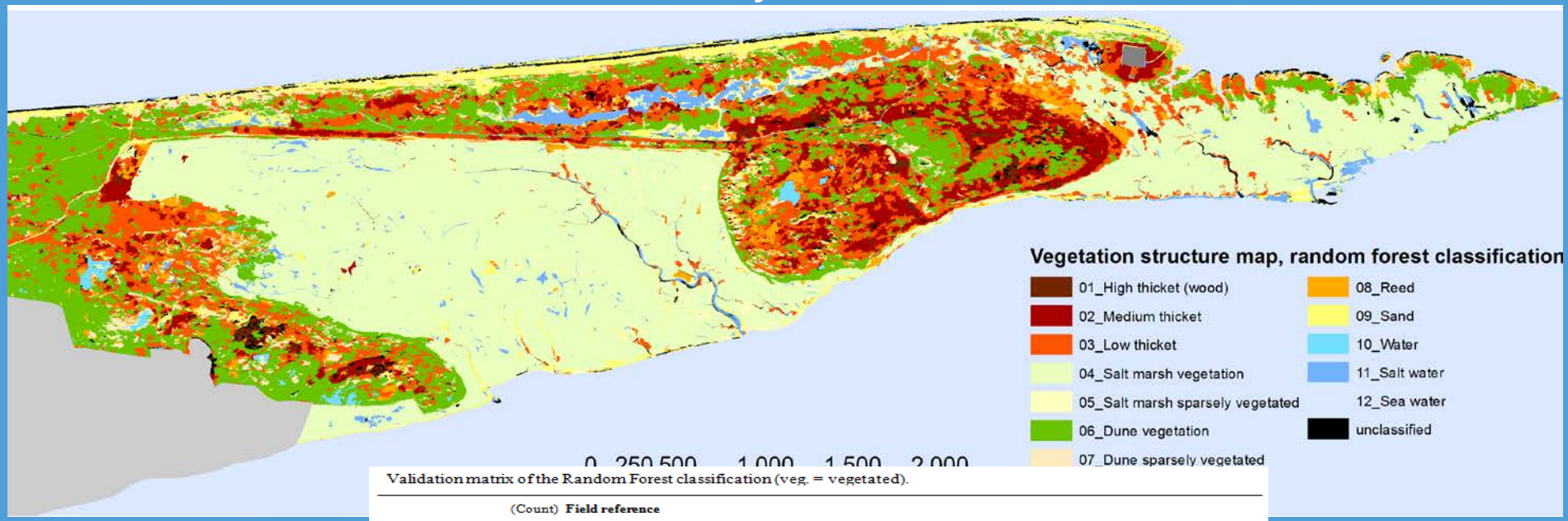
Proces

- Random Forest
  - prepare training data
  - select features
  - No need to set thresholds

- Less time consuming , high demand on quality of training data
- Iterative proces, remove bad training points or add additional training points

Proces

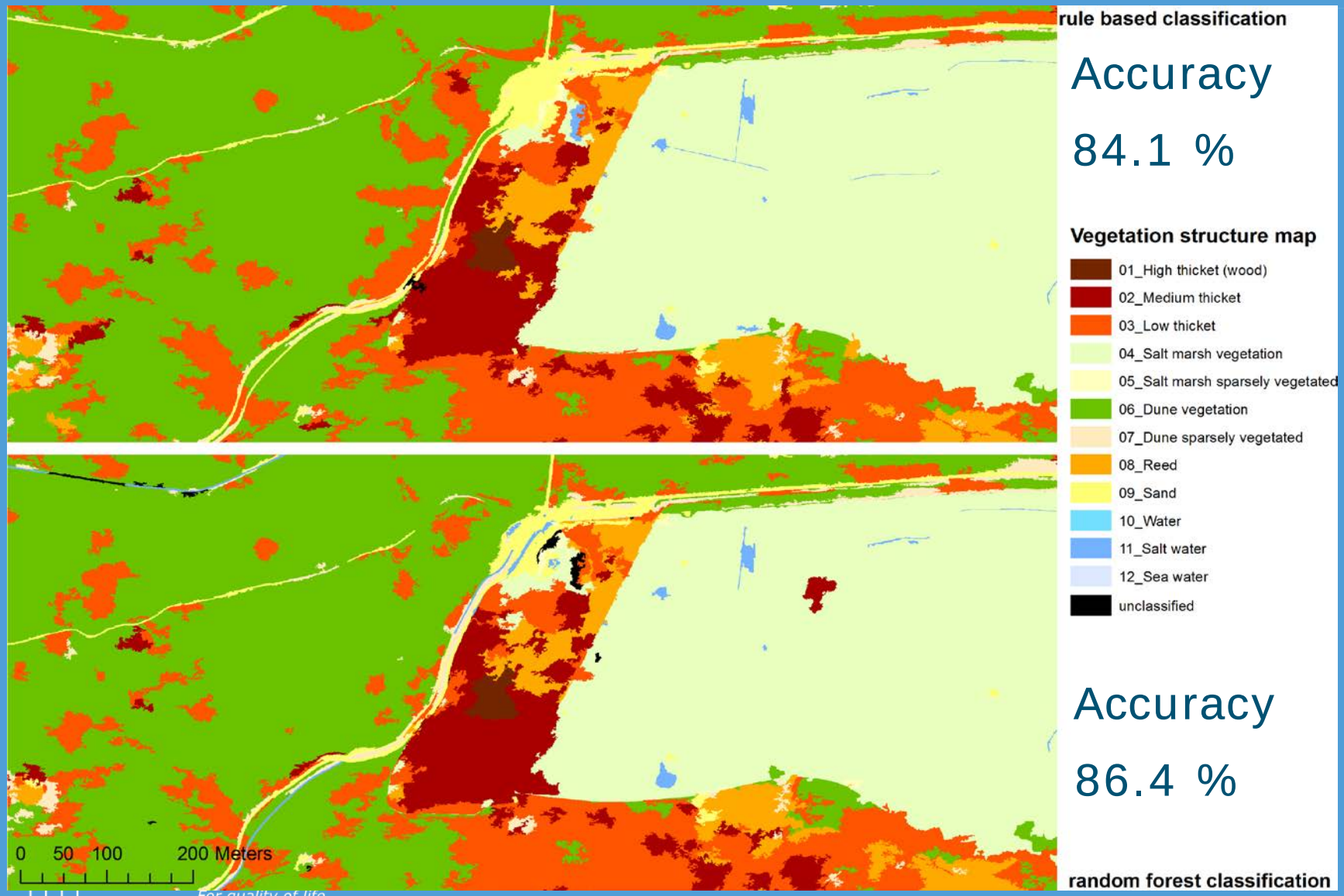
- Results Random Forest object classification



Validation matrix of the Random Forest classification (veg. = vegetated).

(Count)	Field reference													
RF classification	1	2	3	4	5	6	7	8	9	10	11	12	Count	**Reliability**
01_High thicket (wood)	13												13	100.0
02_Medium thicket		54				1				1			56	96.4
03_Low thicket			26	1		3					1		31	83.9
04_Salt marsh vegetation				71	2			1					74	95.9
05_Salt marsh sparsely veg.		1			7			2	1		1		12	58.3
06_Dune vegetation						26	3	1					30	86.7
07_Dune sparsely vegetated						2	7	3					12	58.3
08_Reed								18					18	100.0
09_Sand					1		5		9				15	60.0
10_Water						1		1		11			13	84.6
11_Salt water									4		17		21	81.0
12_Sea water									1			1	2	50.0
Unclassified	2	1									1		4	100.0
Total	15	56	26	72	10	33	15	26	15	12	20	1	301	
Accuracy	86.7	96.4	100.0	98.6	70.0	78.8	46.7	69.2	60.0	91.7	85.0	100.0		
Overall accuracy	**86.4**													

results


rule based classification
Accuracy
84.1 %
Vegetation structure map
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10_Water
11_Salt water
12_Sea water
unclassified
Accuracy
86.4 %
random forest classification
0 50 100 200 Meters

conclusions

- Aerial photos and LiDAR data are good sources for Vegetation Structure classification.
  - These provide the basic information; colour and height
- Object based classification method is a suitable method for Vegetation Structure classification.
- Random Forest classification is a suitable classification algorithm for Vegetation Structure classification
  - Less time consuming compared to rule based classification

recommendations

- A high accuracy gps (< 1m) is very useful for fieldwork
  - Less geometric adjustments when used for Random Forest training data are required
- The use of high resolution satellite images (Quikbird, Sentinel, Pleiades) is expected to improve the classification result
  - More suitable acquisition dates in regard to optimal capture of vegetation are possible

Thank you

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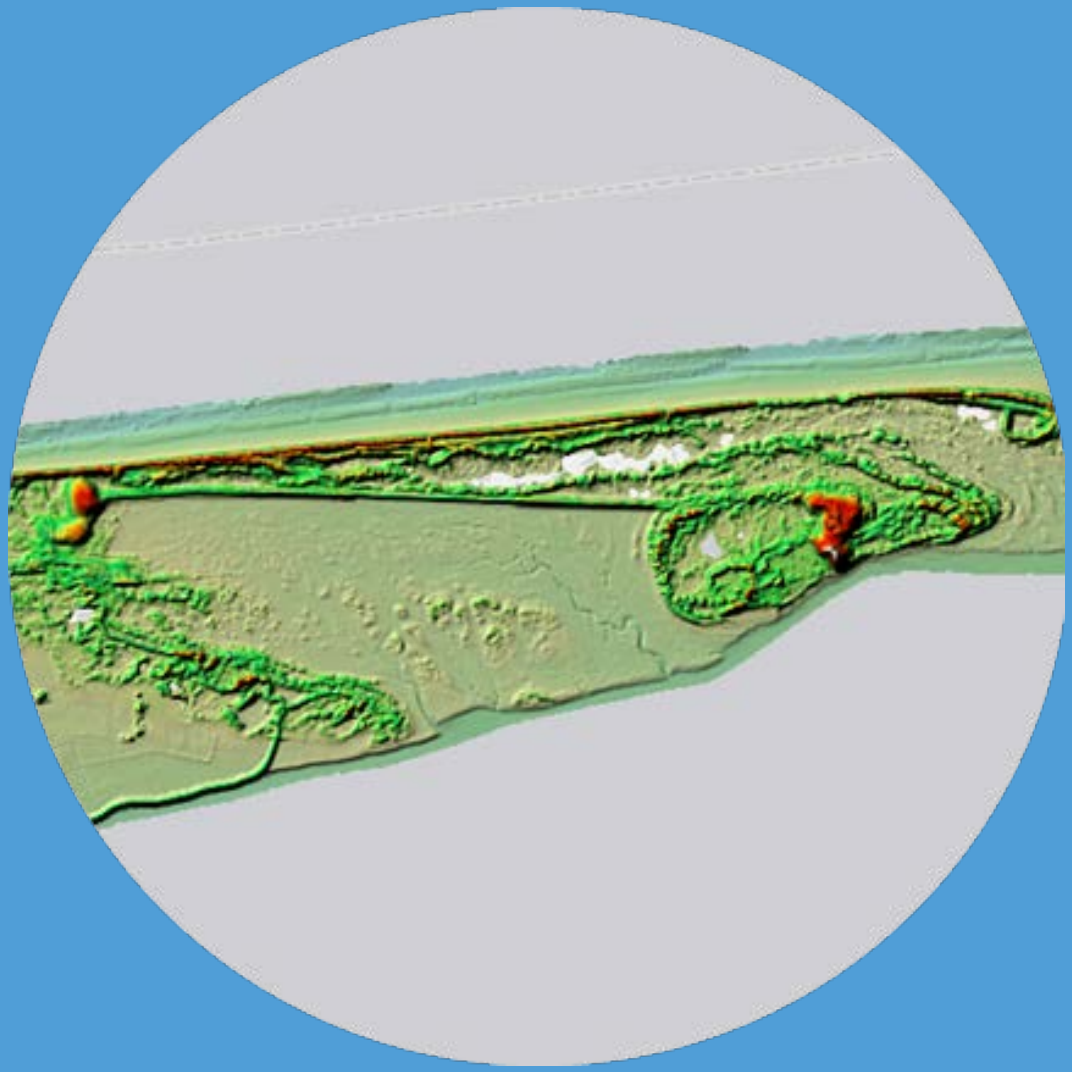

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