

Mapping Invasive Woody Species In Coastal Dunes: A Remote Sensing Approach



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Dune Mapping Team

- Wouter Hantson



- Eric Baptist



- Lammert Kooistra



- Pieter Slim



Introduction

- Coastal zones are amongst the most threatened natural areas in the world due to acidification and eutrophication, sea level rise, demographic pressure,...
 - Many of the habitats within the coastal zone of The Netherlands are listed as Natura 2000 habitat types.
 - We conducted a RS-based inventory of coastal habitats in the dynamic coastal zone of Ameland.
 - ‘Grey dunes’ are a threatened ‘key’ habitat on the Wadden Sea Islands (NL)
 - We conducted a RS mapping of (invasive) shrub species in Vlieland
 - Applied it to measure the effect of management practices
 - Flexible High Resolution Habitat Mapping
 - Future perspective: UAV imagery
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The Wadden Sea Islands (NL)



Why Remote Sensing?

- Up-to-date and accurate maps allow targeted and efficient dune management
 - RS techniques can provide the spatial distribution of habitats and species
 - Coastal management deliver large amounts of RS data in The Netherlands
 - Using existing data for vegetation mapping and monitoring in coastal areas
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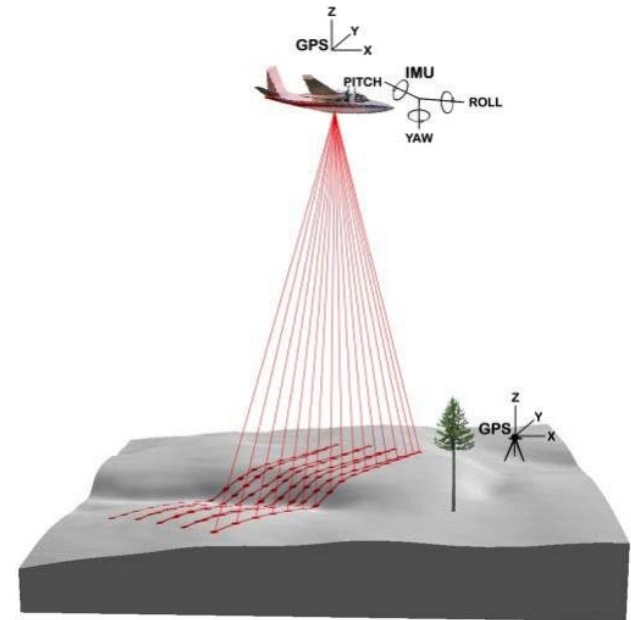
RS data: Aerial Imagery & LIDAR

■ Aerial Imagery

- ❑ RGB & CIR
- ❑ High spatial resolution ($<1\text{m}$)
- ❑ eCognition

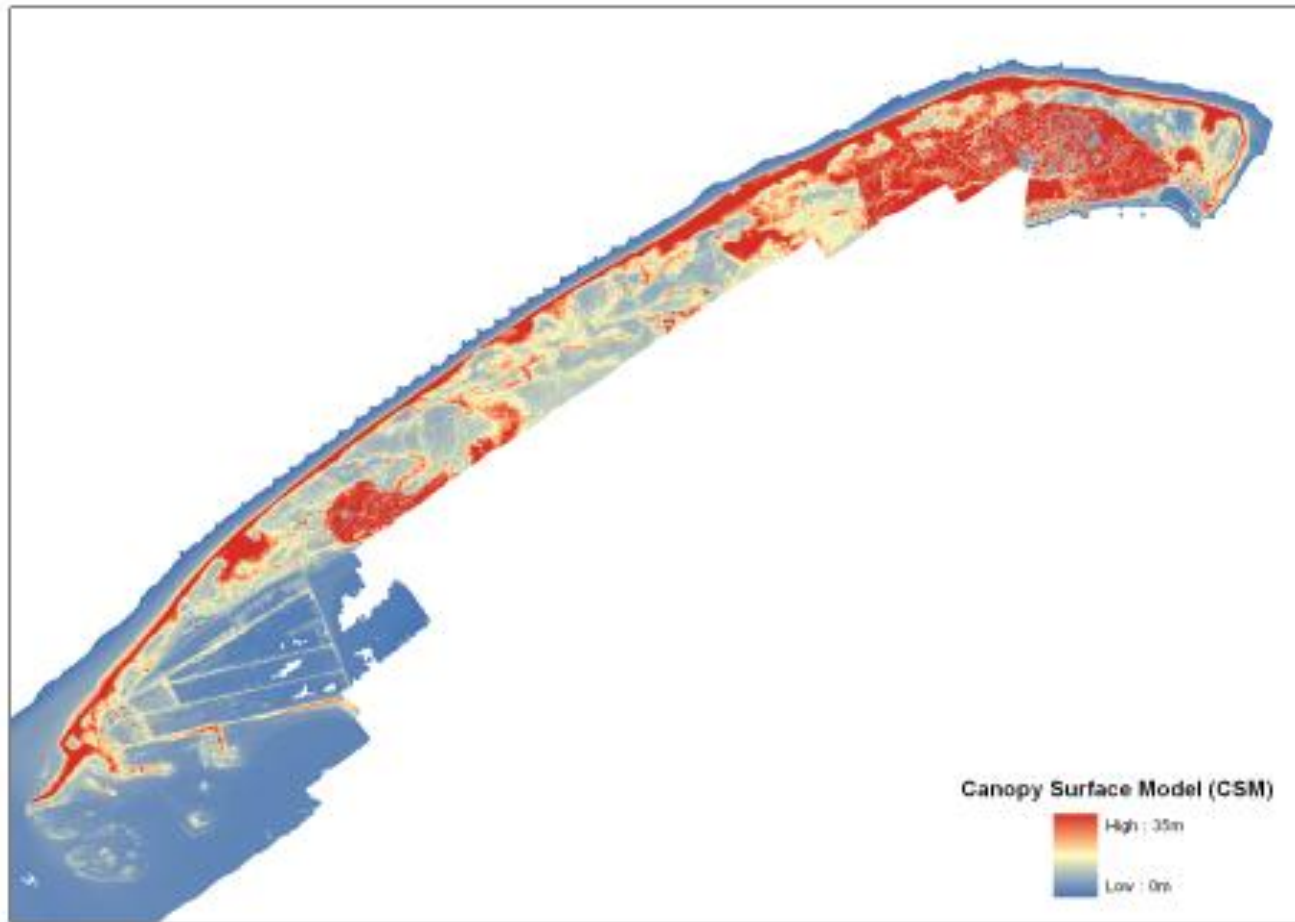
■ LIDAR

- ❑ Obtained for AHN-2
- ❑ Dense point distribution ($<0,2\text{m}$)
- ❑ FUSION
- ❑ Integration with Aerial Imagery

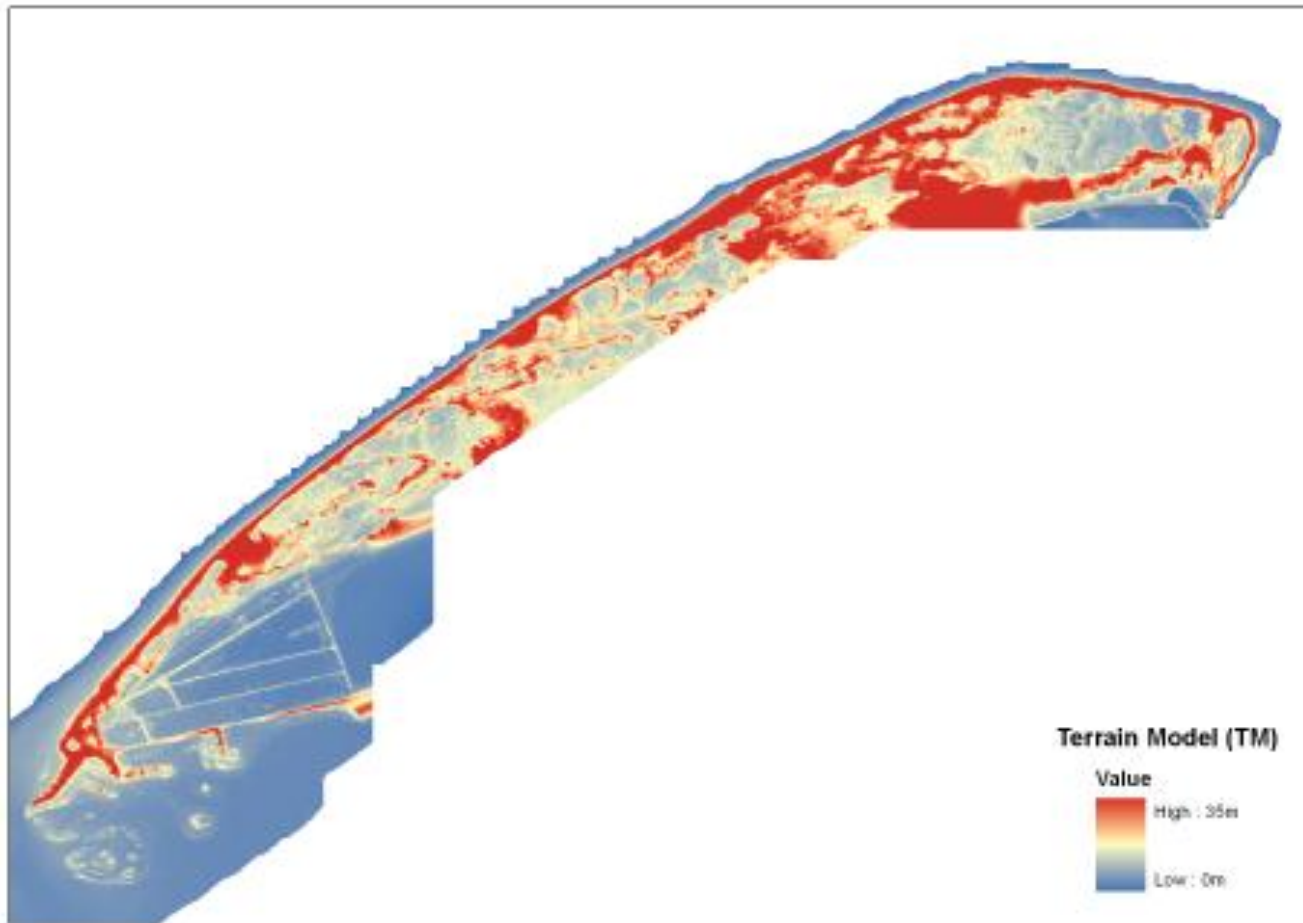


*Airborne laser scanning system
(McGaughey, 2010).*

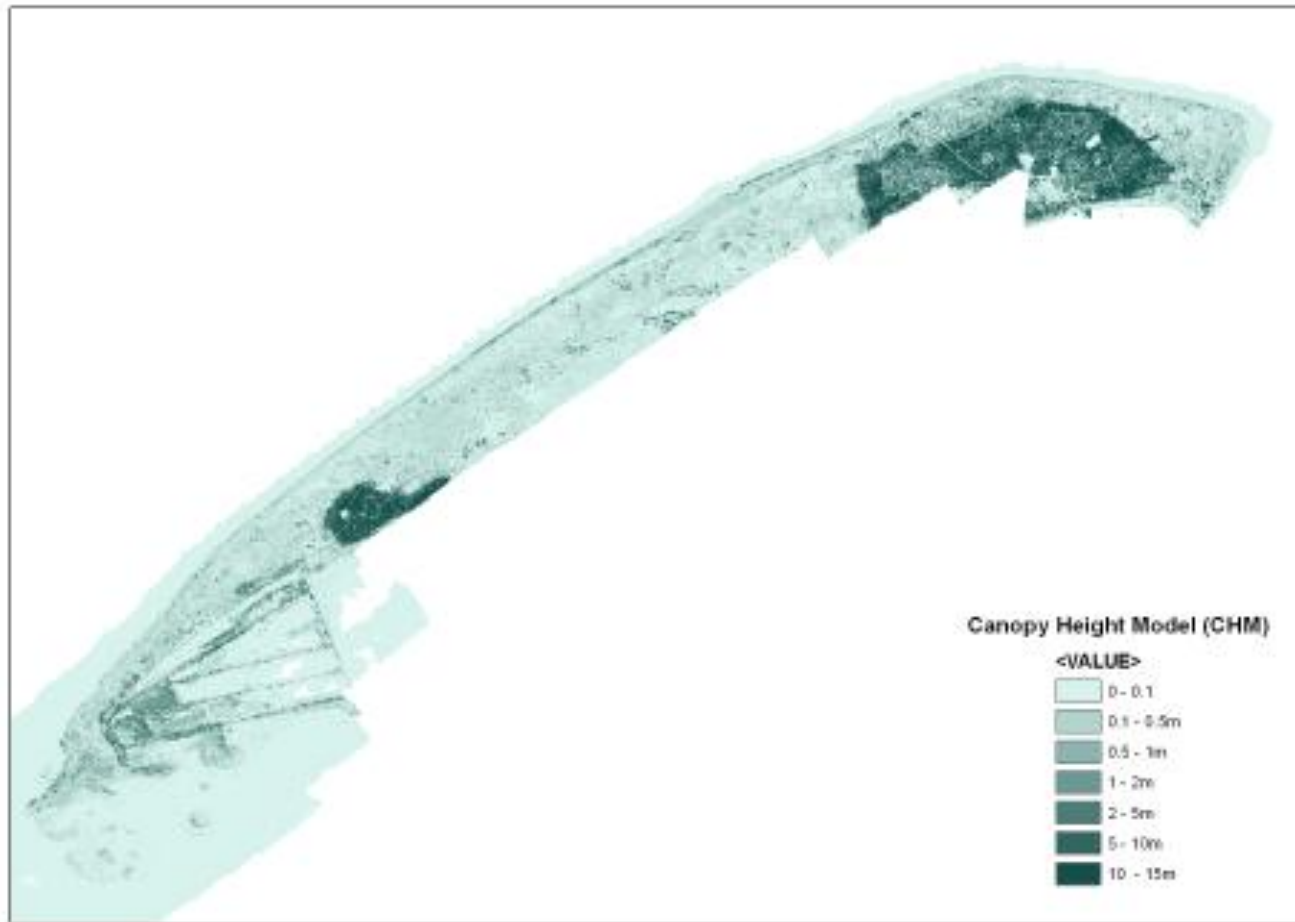
Canopy Surface model



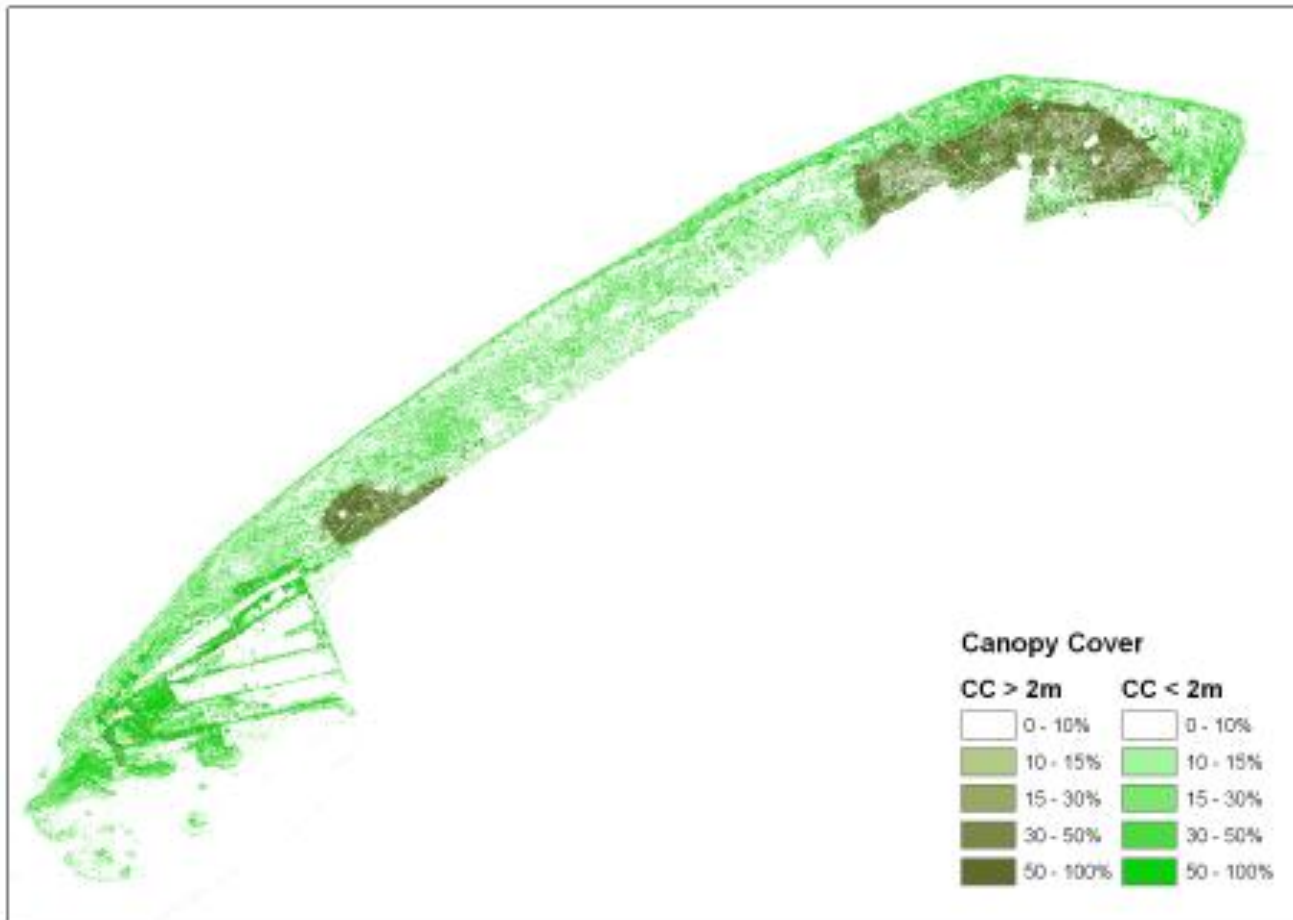
Terrain Model



Canopy Height Model



Canopy Cover



OBIA

- Object based image analysis (OBIA)
 - Clustering pixels to larger “meaningful” objects
 - The size of the created objects is determined by the scale parameter
 - The scale parameter is a dimensionless threshold which controls the heterogeneity of the objects



Scale Parameter

- Multiscale Image Analysis
- Use the scale parameter



Scale parameter 750



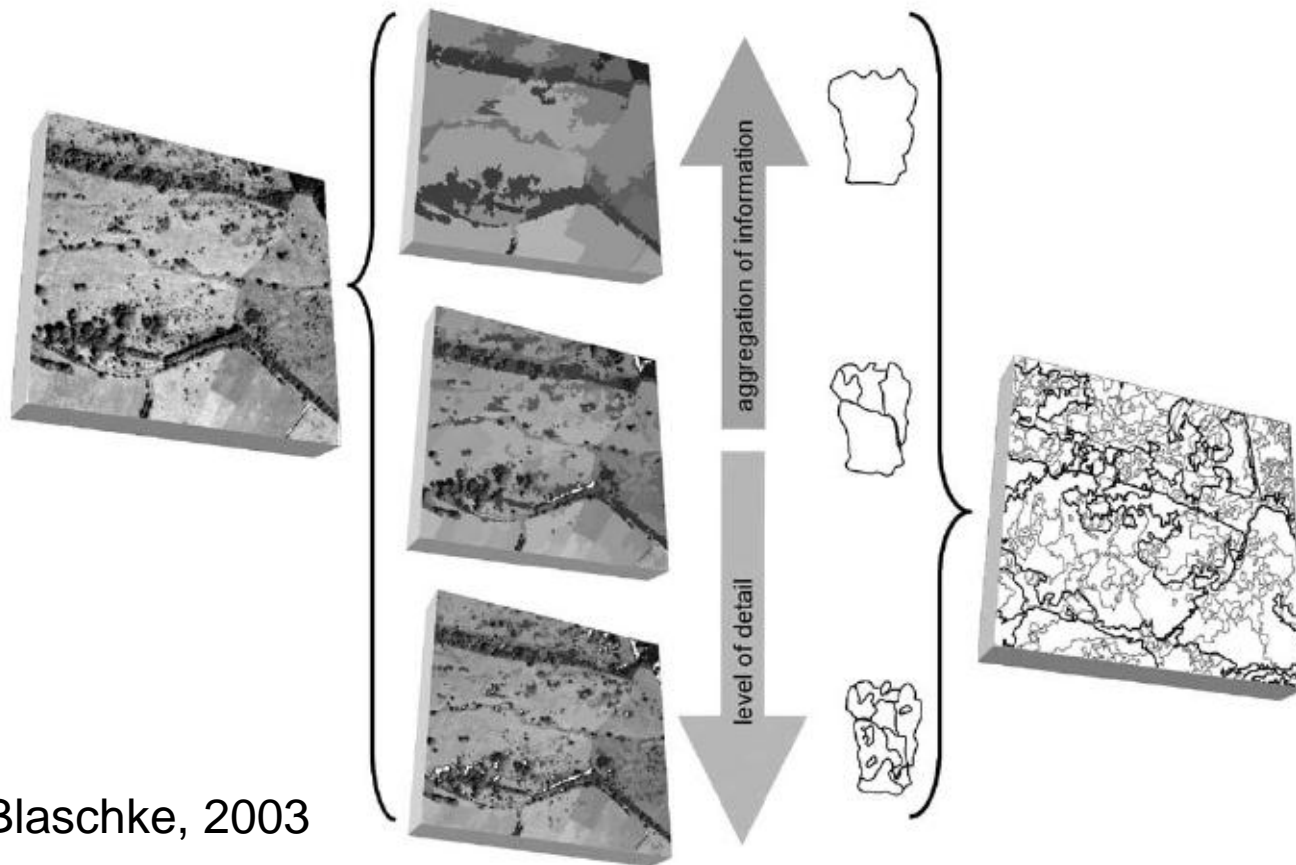
Scale parameter 250



Scale parameter 50



Multi-Scale Image Analysis

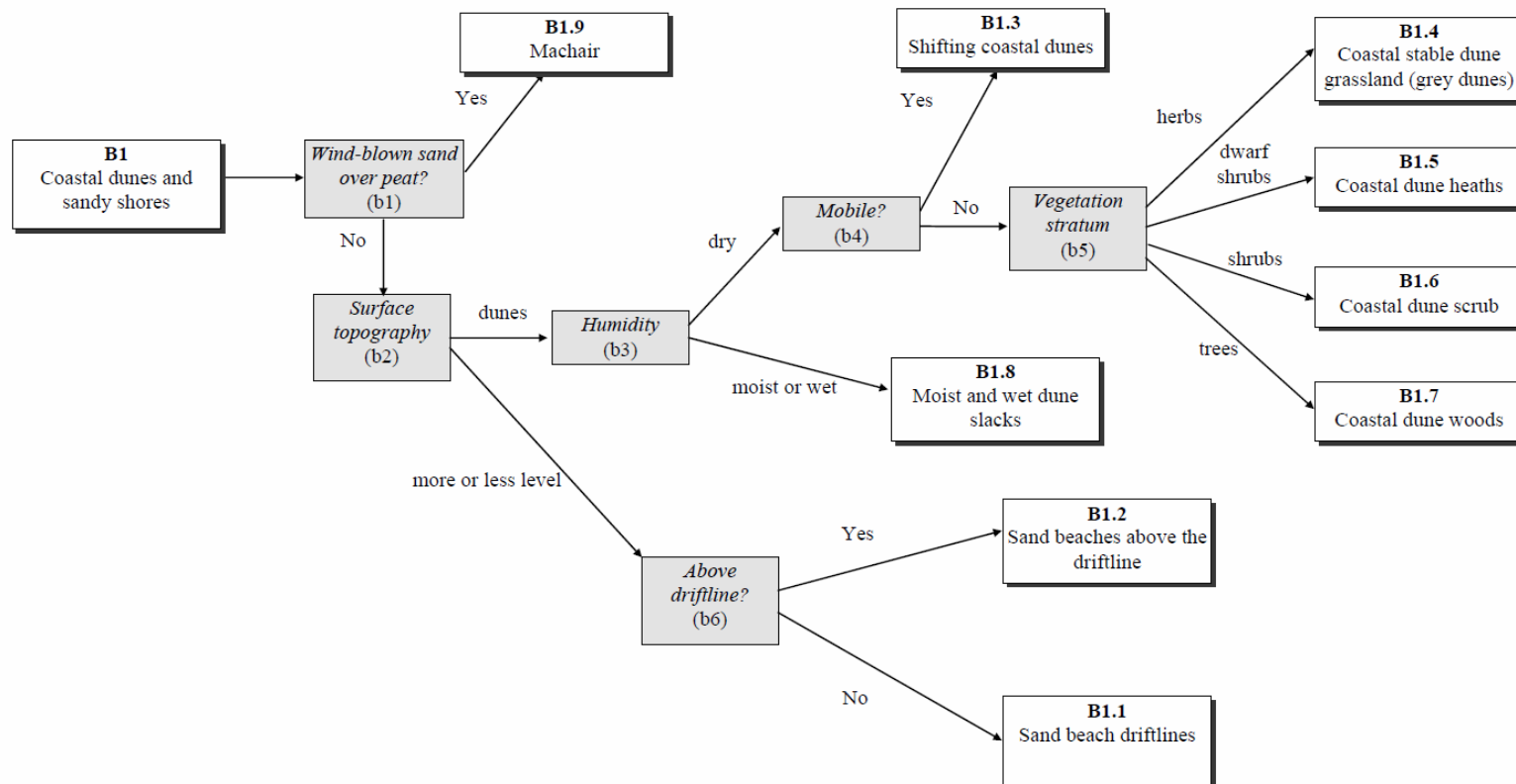


Burnet & Blaschke, 2003

Classification of Natura2000 Habitats

B1: EUNIS Habitat Classification: criteria for coastal dunes and sandy shores (B1) to Level 3

(number) refers to explanatory notes to the key (see following page).

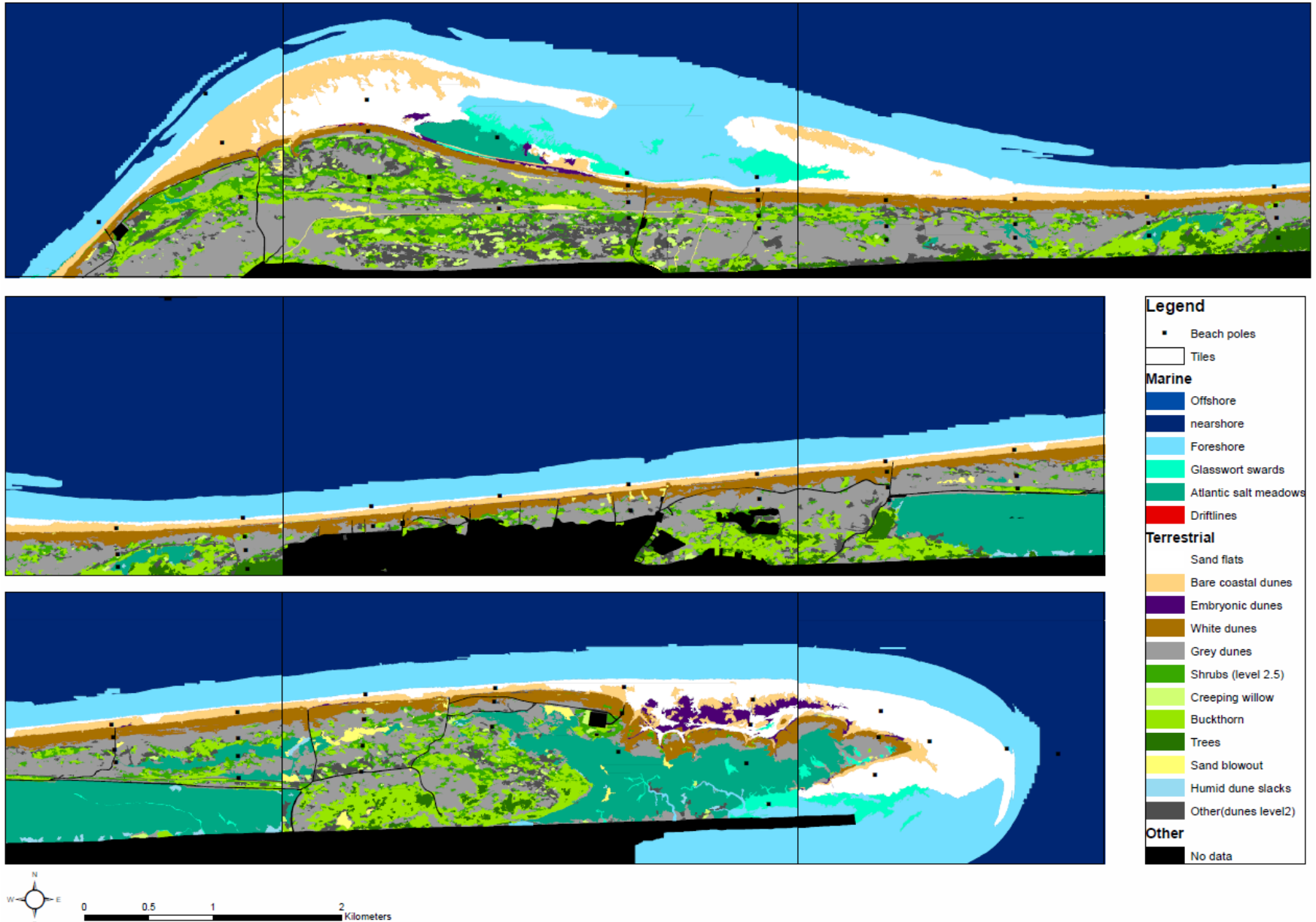


RS: Habitat Mapping

- Study site: Ameland
- Areas not of interest masked
- Image layers:
 - False Color
 - True Color
 - DEM
 - Vegetation height
- First segmentation based on DEM
- Second and third based on True color imagery
- Thresholds (rules) based on known variables or found by iterations



Habitat Map of Ameland



RS Habitat Mapping: Accuracy

- Overall accuracy: 49%
- Confusion
 - Sand flats, bare dunes and drift lines
 - Buckthorn and Creeping willow
 - Humid dune slacks, Atlantic and Glasswort salt marshes
- Discussion:
 - To classify the coastal Natura 2000 habitats accurate this method has potential.
 - Studies conducted in the more or less fixed dune communities have found better results.
 - Studies conducted in a dynamic coastal environment (rare) have found similar results.



Priority Habitat: 'Grey Dunes'

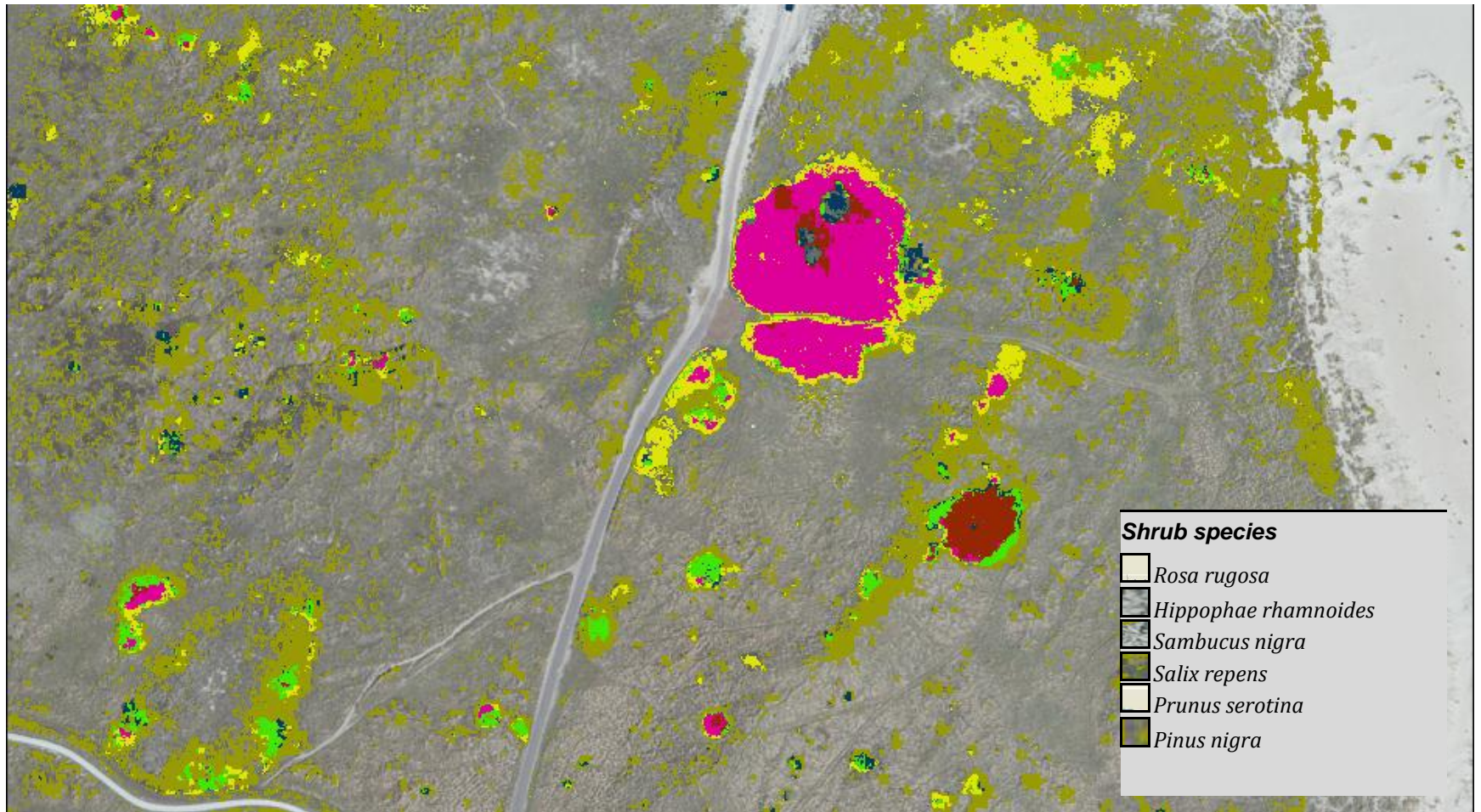


- Threats:
 - ❑ Inappropriate grazing
 - ❑ Afforestation
 - ❑ Growth of shrubs
 - ❑ Invasion of alien species
- RS mapping of the Shrub species

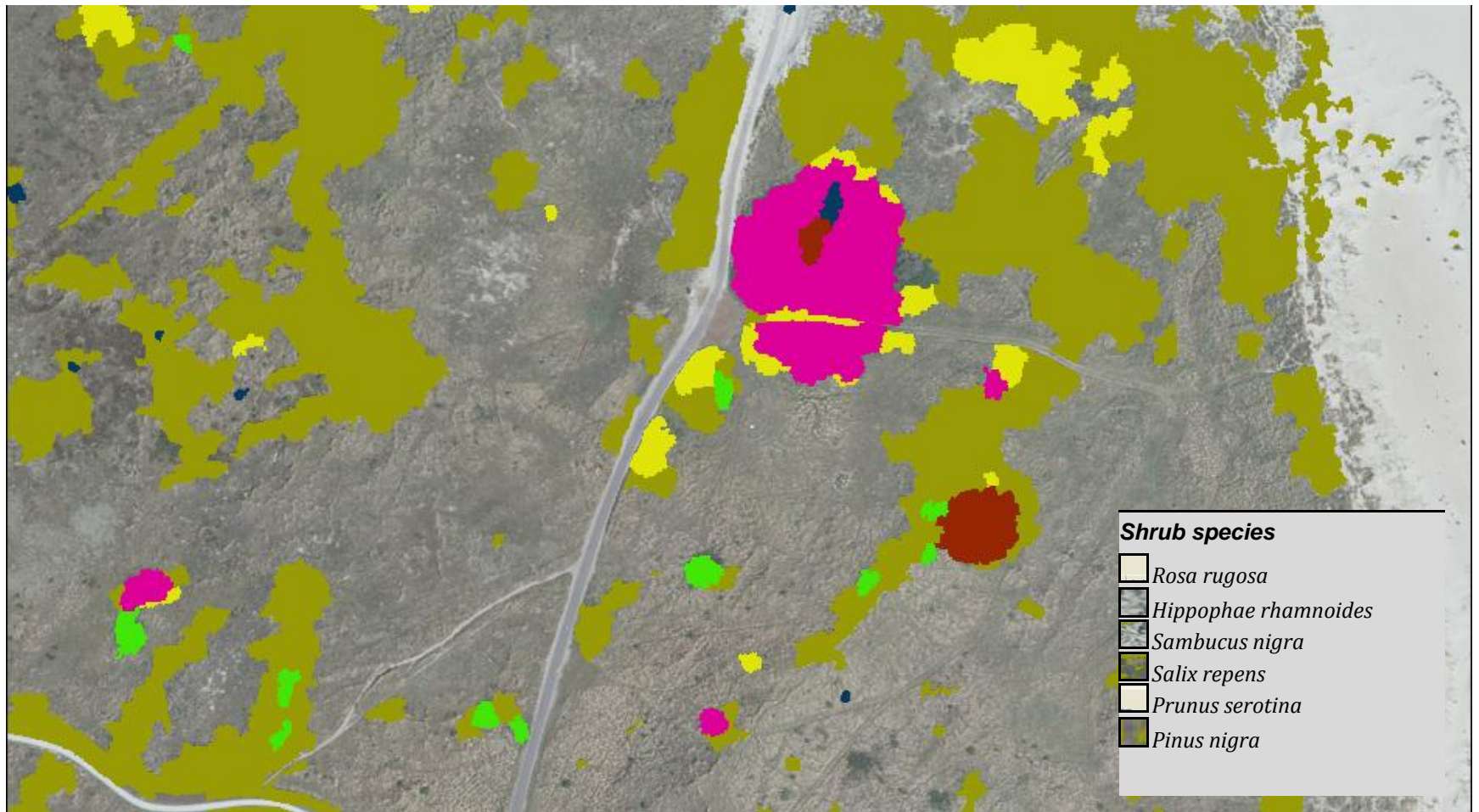
RS: Mapping (Invasive) Shrubs

- Study Site: Vlieland
 - Areas with lacking information are masked
 - Image layers:
 - False Color Imagery
 - Vegetation Height
 - Vegetation Structure
 - Different techniques were compared.
 - (Maximum Likelihood)
 - Maximum Likelihood + Vegetation Height
 - OBIA
-

Maximum Likelihood +



Object Based



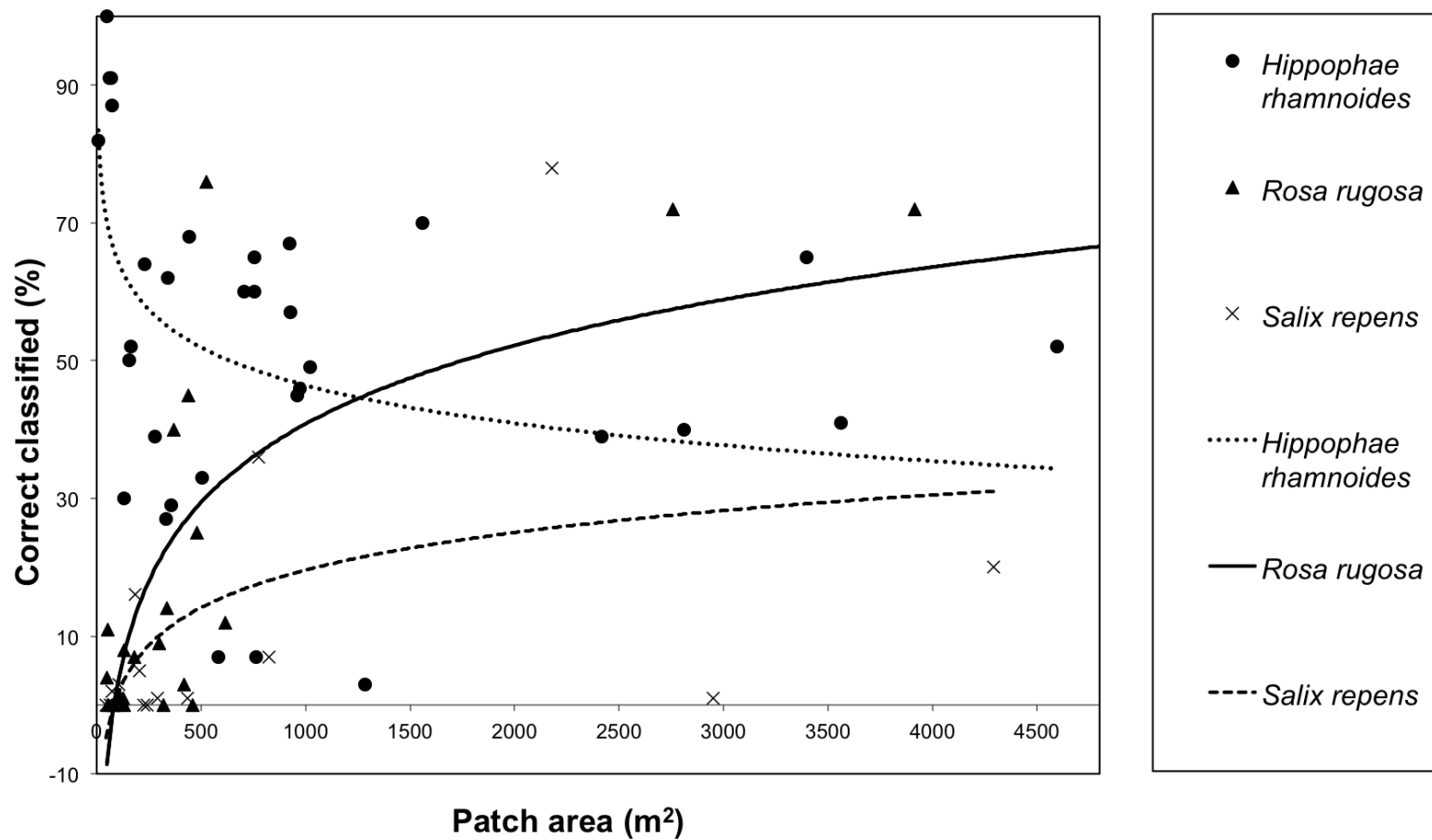
RS Shrub Mapping: Accuracy

- OBIA: overall accuracy increased till 60%
 - *Prunus serotina* & *Salix repens* <30%
 - Shrub management
 - Effect of management practices
-

Results: Shrub map of N-Vlieland



Results: Shrub detection



Future perspective: UAV mapping

- High resolution imagery
 - Mapping of Small Landscape Elements
 - Flexible use makes UAV imagery interesting for:
 - Event monitoring like the effect of a storm, fire,..
 - Creation of time series
 - Legal issues depends on country!
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Google Earth mapping



Avia-GIS: Falcon 8



Future perspective: UAV mapping



Conclusions

- RS can deliver detailed Natura2000 habitat maps
 - More research could increase the mapping accuracy
 - RS can create shrub distribution maps, useful for shrub and dune management.

 - More info:
Hantson, W., L. Kooistra & P.A. Slim 2012. Mapping Invasive Woody Species in Coastal Dunes in The Netherlands: a Remote Sensing Approach Using LIDAR and Aerial Photographs. *Applied Vegetation Science*, 15: 536–547
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