Mapping Invasive Woody Species In Coastal Dunes: A Remote Sensing Approach
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Mapping Invasive Woody Species In Coastal Dunes: 
A Remote Sensing Approach
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Dune Scrub and Woodland Conference, 12 Sept. 2012, Liverpool
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
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
RS data: Aerial Imagery & LIDAR

- Aerial Imagery
  - RGB & CIR
  - High spatial resolution (<1m)
  - eCognition

- LIDAR
  - Obtained for AHN-2
  - Dense point distribution (<0.2m)
  - FUSION
  - Integration with Aerial Imagery

Airborne laser scanning system (McGaughey, 2010).
Canopy Surface model
Terrain Model
Canopy Height Model
Canopy Cover
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).

- B1: Coastal dunes and sandy shores
  - Wind-blown sand over peat? (b1)
    - Yes: Machair
    - No: Surface topography (b2)
      - Dunes
        - Humidity (b3)
          - Moister or wet
            - More or less level
              - Above driftline? (b6)
                - Yes: Sand beaches above the driftline
                - No: Sand beach driftlines
          - Moist and wet dune slacks
        - Dry
          - Mobile? (b4)
            - No: Vegetation stratum (b5)
              - Shrubs
              - Trees
            - Yes: Shifting coastal dunes
              - Yes: Coastal stable dune grassland (grey dunes)
              - No: Coastal dune heaths
      - Dunes
        - Vegetation stratum (b5)
          - Shrubs
          - Trees
    - Yes: Shifting coastal dunes
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’

- Characterised by sandy slopes, lichens, and an open species rich vegetation
- Habitat was maintained by extensive grazing
- Loss of the traditional management: dynamic \(\rightarrow\) stable state

- Threats:
  - Inappropriate grazing
  - Afforestation
  - Growth of shrubs
  - Invasion of alien species

- RS mapping of the Shrub species

(Houston, 2008)
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 +

Shrub species

- Rosa rugosa
- Hippophae rhamnoides
- Sambucus nigra
- Salix repens
- Prunus serotina
- Pinus nigra
Object Based

Shrub species
- Rosa rugosa
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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

Shrub species
- Rosa rugosa
- Hippophae rhamnoides
- Sambucus nigra
- Salix repens
- Prunus serotina
- Pinus nigra
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!
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: