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APEX for heathland and coastal vegetation monitoring applications: first results and ongoing activities

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Overview

- » Background
 - » Nature Conservation in Europe
 - » Resulting data needs
 - » Can RS contribute?
 - » Heathlands and coastal vegetation
 - » Ongoing and past projects overview chart

- » Study areas and APEX imagery acquired

- » Results and ongoing activities
 - » The HABISTAT project
 - » The MS.Monina project
 - » The HyperMix project
 - » The Re-Learn project
 - » The HeathRecover project

Background - Nature conservation in Europe

- » “... Rapid urbanization, industrialization, and successive agricultural revolutions cause changes to the Earth's land surface with a pace, magnitude and spatial reach that are unprecedented...”

Foley et al. (2005) Global consequences of land use. *Science*

- » In Europe, two main legal instruments:

- » Birds Directive (1979)
- » Habitats Directive (1992)

- » The NATURA 2000 network

The designation of SACs and SCIs (Special Areas of Conservation; Sites of Community Importance)

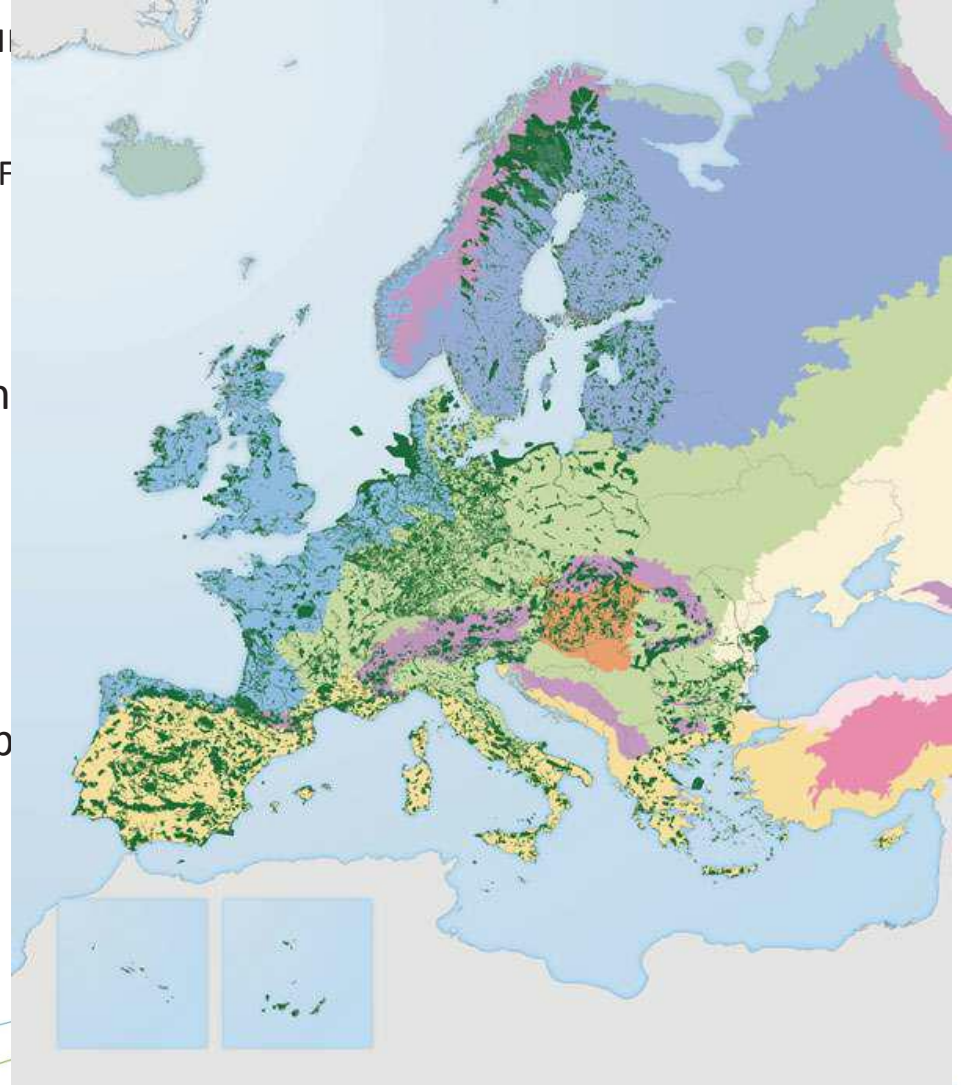


Background - Nature conservation in Europe

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- » In Europe, two main legal instruments
 - » Birds Directive (1979)
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- » The NATURA 2000 network
The designation of SACs and SCIs (Special Importance)



Background - Nature conservation in Europe



- » Member States' commitments:
 - » Bring and maintain habitats and species on the Annexes in favourable Conservation Status (CS)
 - » Report CS to EU every 6 years
 - » ...

- » Data needs at three levels
 - » Site level: appropriate conservation actions
 - » National level: Art. 17 reporting to EU
 - » EU-level: policy evaluations (achievements of HabDir)

Background – Can RS contribute?



- » Some assets of remote sensing (vs field work)
 - » Spatially continuous view over larger areas
 - » Faster (time, labour) → shorter repeat cycles
 - » No a priori typology necessary → image data interpretation is more flexible + less subjective
 - » RS can provide full-coverage quantitative measurements (e.g. of biochemical properties)

- » Art. 17 reports 2007 (period 20001-2006) (data source: ETC/BD, Paris)
Remote sensing was used in:
 - » 18 out of 25 reporting EU member states
 - » 382 habitat CS assessments (out of 2759; 14%)
 - » 130 different habitat types

- » Limited information on type of RS, but points mainly to visual image interpretation (aerial photos or satellite images)

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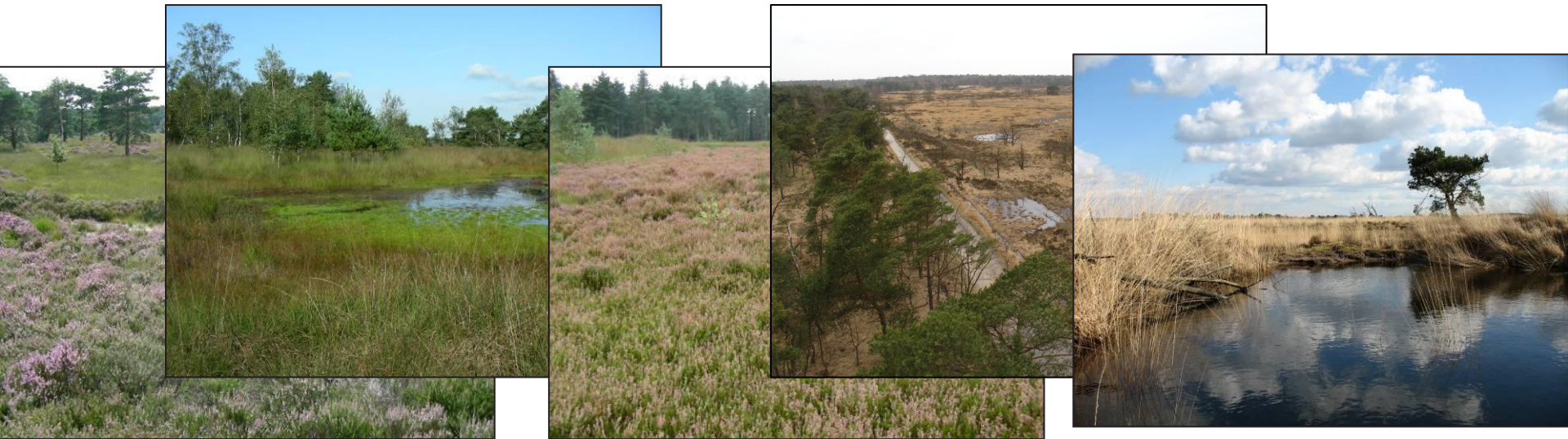
Vanden Borre, J., Paelinckx, D., Mùcher, C. A., Kooistra, L., Haest, B., De Blust, G., & Schmidt, A. M. (2011) Integrating remote sensing in Natura 2000 habitat monitoring: Prospects on the way forward. *Journal for Nature Conservation*, 19(2), 116–125

Vanden Borre, J., Haest, B., Lang, S., Spanhove, T., Förster, M., & Sifakis, N. I. (2011). Towards a Wider Uptake of Remote Sensing in Natura 2000 Monitoring : Streamlining Remote Sensing Products with Users ' Needs and Expectations. *Proceedings of the 2nd International Conference on Space Technology, 15-17 September, 2011, Athens, Greece*, 1–4.

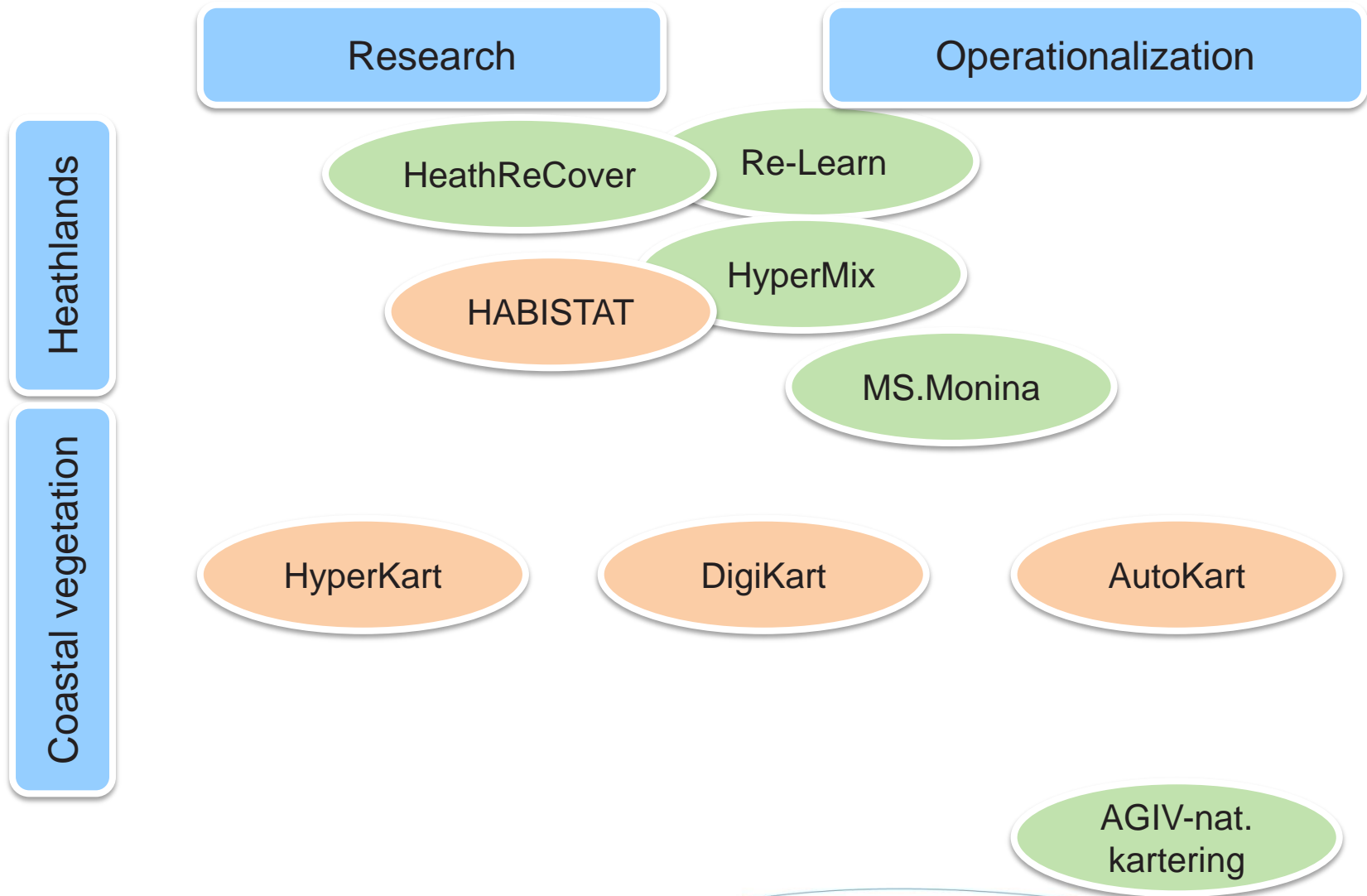
- » Limited information on type of RS, but points mainly to visual image interpretation (aerial photos or satellite images)

Background – Heathlands and coastal vegetation

- » Heathlands, peat bogs and coastal ecosystems
 - » Highly valued landscapes of common European heritage
 - » Large investment of effort and resources to conserve and manage them
 - » Yet ... *under threat*:
 - » Anthropogenic activities
 - » But also: natural phenomenon of uncontrolled fire



Background – Past and Running Projects



Study areas – Overview



Study areas – Overview

Site	Project	Characteristics
<i>Grenspark De Zoom - Kalmthoutse Heide</i>	MS.Monina/HeathReCover/ Re-Learn/HyperMix	<ul style="list-style-type: none"> • Heathland area • Study area for RS projects over the past years • Large amount of data (field and image) • Fire event in May, 2011
<i>De Westhoek</i>	MS.Monina	<ul style="list-style-type: none"> • Coastal dune area • Vegetation maps and newly acquired field data available
<i>Wahner Heide</i>	MS.Monina	<ul style="list-style-type: none"> • Heathland area • Study area for RS projects over the past years • Large amount of data (field and image)
<i>Kamp van Beverlo</i>	MS.Monina/Re-Learn	<ul style="list-style-type: none"> • Heatland area • Restricted access (military use)

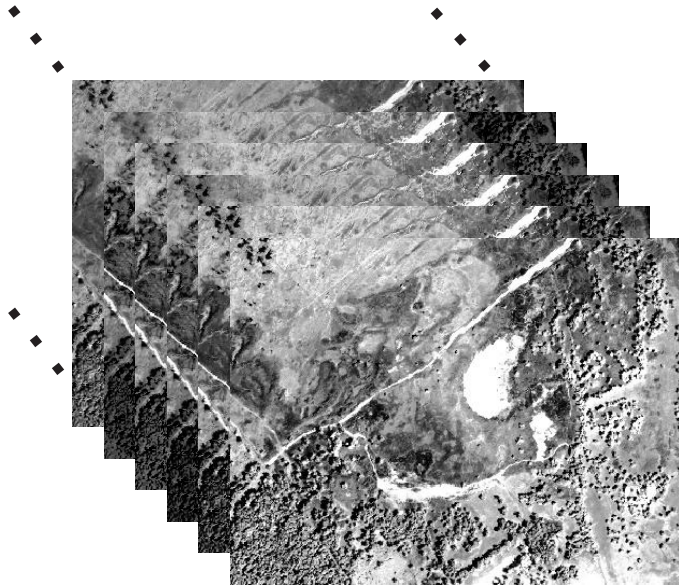
APEX imagery acquired

Date	Site	Project
28 June 2010	<i>Grenspark De Zoom - Kalmthoutse Heide</i>	MS.Monina/HeathReCover/ Re-Learn
27 June 2011	<i>Grenspark De Zoom - Kalmthoutse Heide</i>	MS.Monina/HeathReCover/ HyperMix
24 September 2011	<i>Grenspark De Zoom - Kalmthoutse Heide</i>	MS.Monina/HeathReCover
2 July 2012	<i>Grenspark De Zoom - Kalmthoutse Heide</i>	MS.Monina/HeathReCover
14 June 2011	<i>De Westhoek</i>	MS.Monina
14 September 2011	<i>Wahner Heide</i>	MS.Monina
30 June 2012	<i>Kamp van Beverlo</i>	MS.Monina/Re-Learn

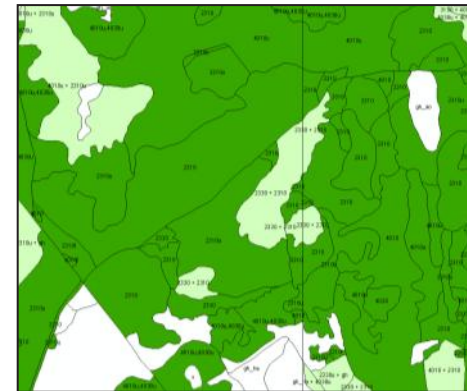
Results and ongoing activities – *HABISTAT*

- » BELSPO STEREO II: Dec 2006 - June 2011
- » *Development of a methodological classification framework for NATURA 2000 habitat mapping and quality assessment using hyperspectral imagery*

Hyperspectral image

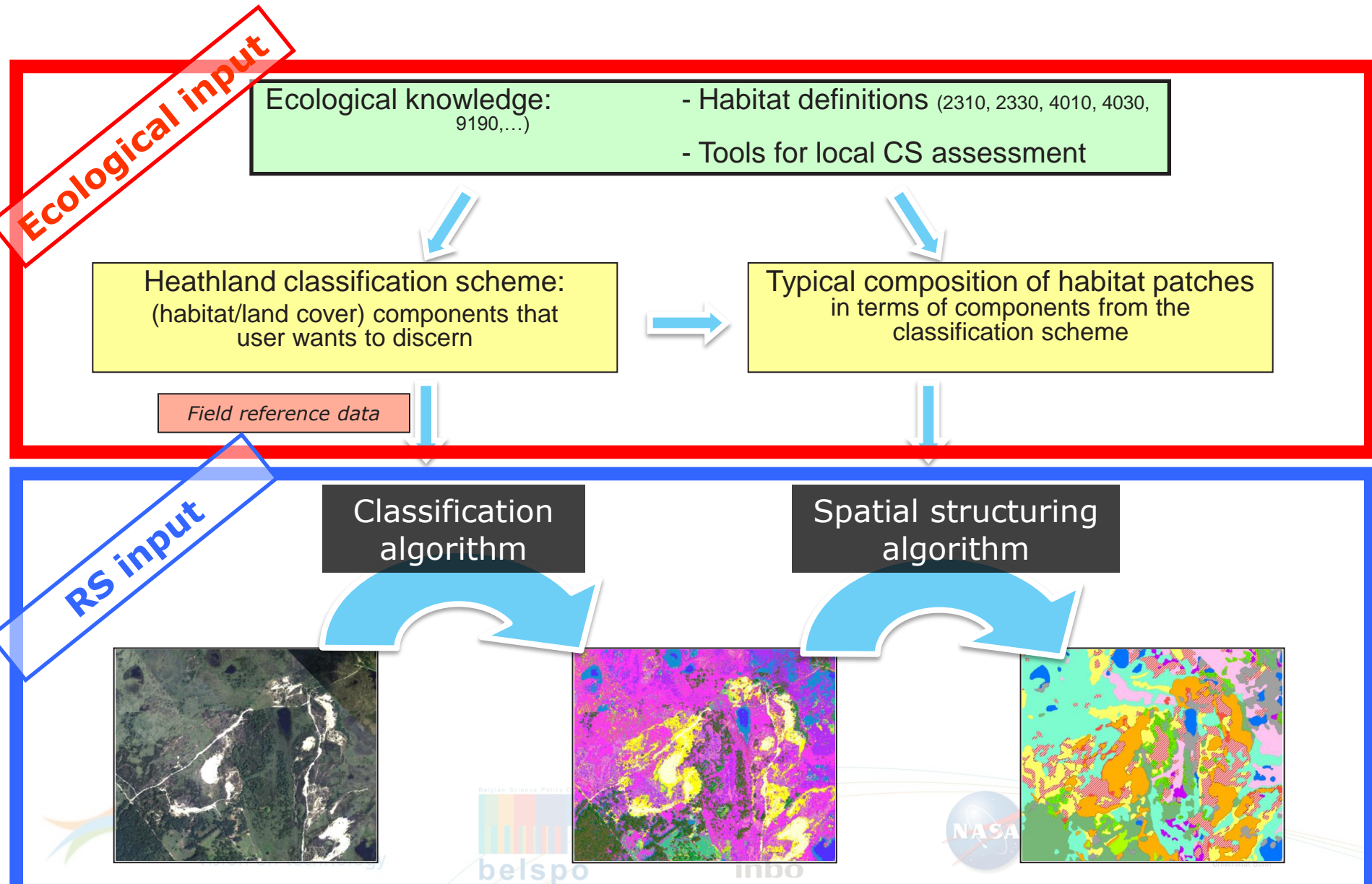


Habitat patch (type and quality) map

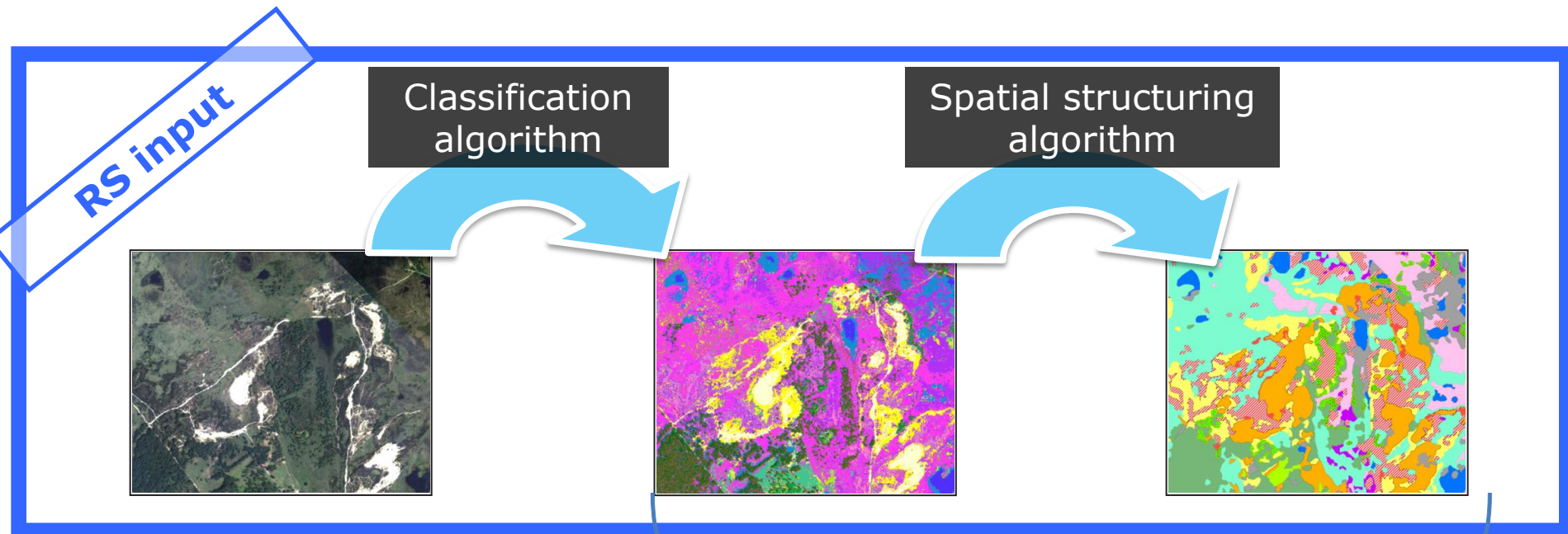


patches down to < 0.01 ha

Results and ongoing activities – *HABISTAT*

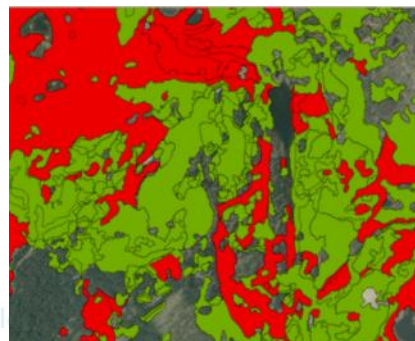


Results and ongoing activities – *HABISTAT*

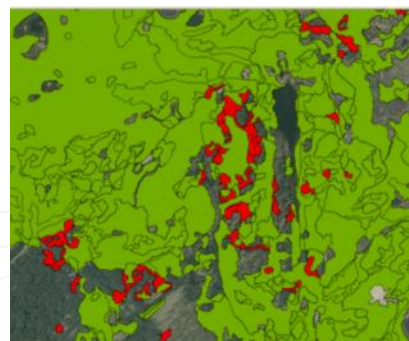


Quality indicators per patch

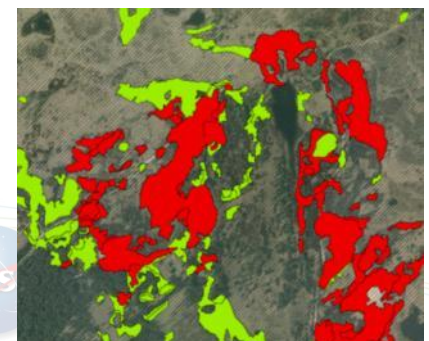
grass encroachment



tree encroachment



Campylopus cover



...

Results and ongoing activities – *HABISTAT heritage*

» HABISTAT outcome:

Integration of ecological knowledge combined with hyperspectral RS data analysis shows potential to map heathland habitat patches and quality-indicating parameters

BUT:

a static local mapping procedure, restricted to certain habitat types with high RS and field data needs

- » Broadening to other habitat types?
 - » Monitoring? Change detection methods
 - » Combining different data sources?
 - » Decreasing the required amount of reference data?
 - » Transferability?
- » MS.Monina
 - » MS.Monina / HeathReCover
 - » HyperMix
 - » Re-Learn
 - » MS.Monina

Results and ongoing activities – *MS.MONINA*

- » Broadening to other habitat types
 - » What:
 - » Coastal dune habitats
 - » *De Westhoek*
 - » Status:
 - » Imagery acquired June 2011 and pre-processed
 - » Field reference data composition: finished August 2012
 - » Started experimenting with the data last week

- » Monitoring – change detection
 - » The *Kalmthoutse Heide*
 - » Status:
 - » Imagery acquired: June 2010 – June and September 2011 – July 2012
 - » Field reference dataset in preparation

Results and ongoing activities – *MS.MONINA*

» Transferability

» What:

» *Kamp van Beverlo*

» Restricted military area

» Similar heathland site in Germany - *Wahner Heide*

» Collaboration with UBO

» Status

» *Kamp van Beverlo*

» Image acquired June 2012 – pre-processing being performed

» Field reference dataset acquired – pre-processing being performed

» *Wahner Heide*

» Image datasets exchanged

» Field reference datasets in preparation

Results and ongoing activities – *Re-Learn*

- » Decreasing the amount of reference data needed
- » *“RE-using field reference data in space and time for vegetation mapping: the potential of semisupervised and active LEARNING techniques”*

Research



Operational scenario

A lot of good quality reference data

Little reference data

- » Algorithmic push:

Semi-supervised learning

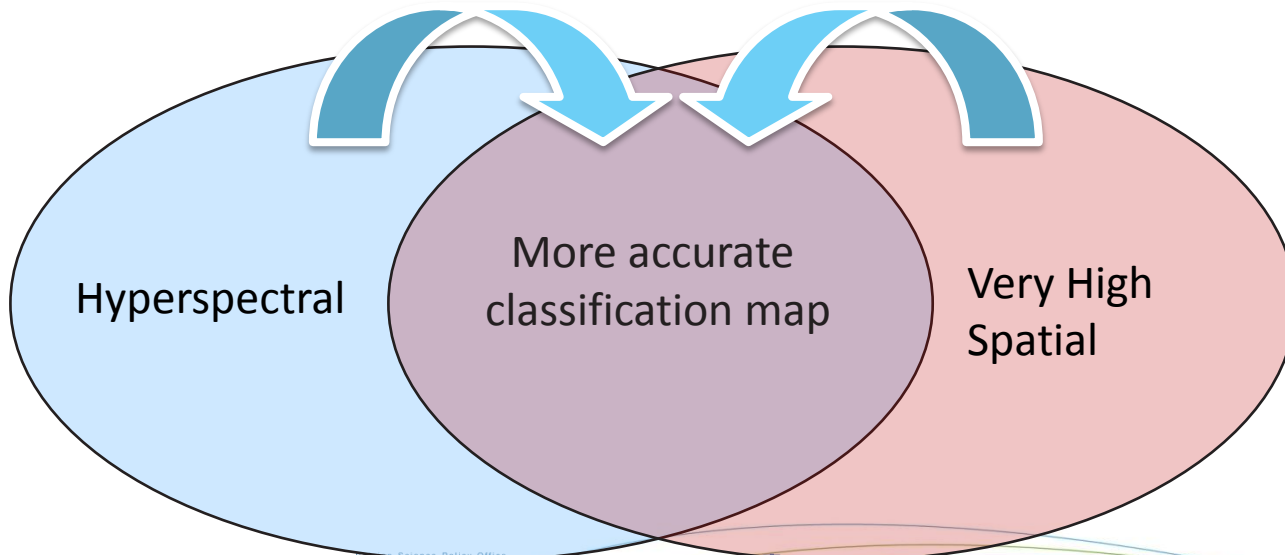
Active learning

- » Status:

- » Imagery acquired – pre-processing ongoing
- » *Kalmthoutse Heide* and *Kamp van Beverlo* (June 2012)
- » Algorithmic developments ongoing
- » Field reference datasets in preparation

Results and ongoing activities – *HyperMix*

- » Combining different data sources
- » Airborne hyperspectral data: operational limitations due to cost, ...
 - Upcoming spaceborne hyperspectral sensors – spatial limitation
 - Very high spatial spaceborne sensors available



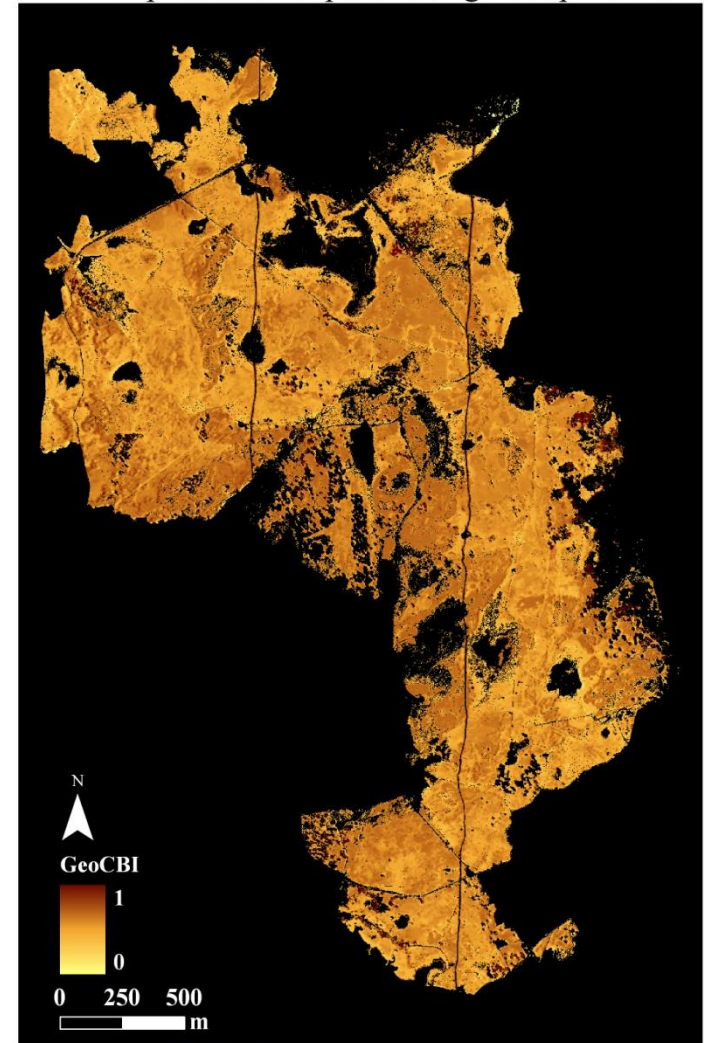
Results and ongoing activities – *HeathReCover*

- » Monitoring – change detection
- » Major fire events: 25-26 May 2011: +/- 450 ha of heathland
- » Status:
 - » Imagery acquired just after the fire
 - » Fire severity field reference dataset acquired
 - » Change detection field reference dataset in preparation

Results and ongoing activities – *HeathReCover*

Regressieparameters		GeoCBI = a * index + b	
Vegetatietype	optimale index	a	b
Struikhei	CSI	-0,2168	0,7640
Dophei	MIRBI	0,1686	0,2815
Pijpenstrootje	MIRBI	0,2716	0,1977
Grove den	NDVI	-1,7498	1,3697
andere klassen	MSAVI	-1,9697	0,7492

GeoCBI op basis van optimale regressieparameters



Schepers, L., Haest, B., Veraverbeke, S., & Others
(in prep.). *Heathland fire severity assessment
using APEX hyperspectral imagery.*

A lot in the pipeline..

Time for Questions..

- » HABISTAT: <http://habistat.vgt.vito.be>
- » MS.Monina: <http://www.ms-monina.eu>
- » HyperMix: <http://hypermix.vgt.vito.be>
- » HeathReCover: <http://heathrecover.vgt.vito.be>
- » Re-Learn: www.ua.ac.be/relearn