



28/11/2014

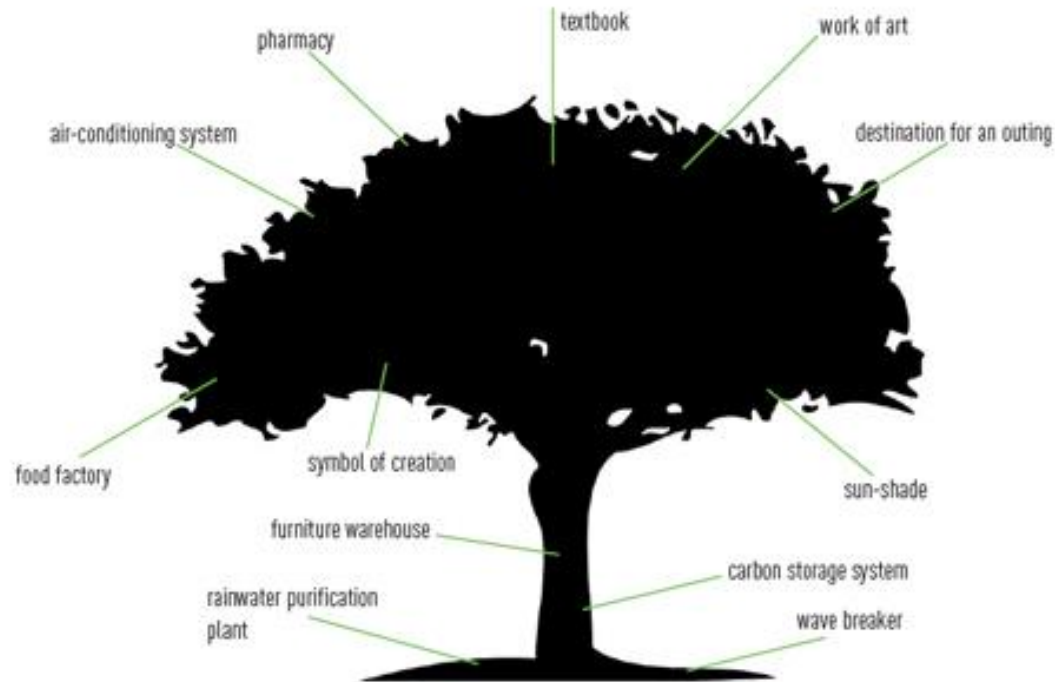
# ESSENSE: Assessing patterns in biodiversity and regulating ecosystem services using imaging spectroscopy

**Ruben Van De Kerchove**, Stephanie Delalieux, Katrien Van der Biest,  
Jan Staes, Ben Somers, Birgen Haest, Luc Bertels, Patrick Meire

# THE ESSENCE OF ESSENCE

## ECOSYSTEM SERVICES (ESS) = The benefits people obtain from ecosystems

The tree – a service station for human beings



# ECOSYSTEM SERVICES (ESS) ?

## Provisioning services



## Regulating services



## Cultural services

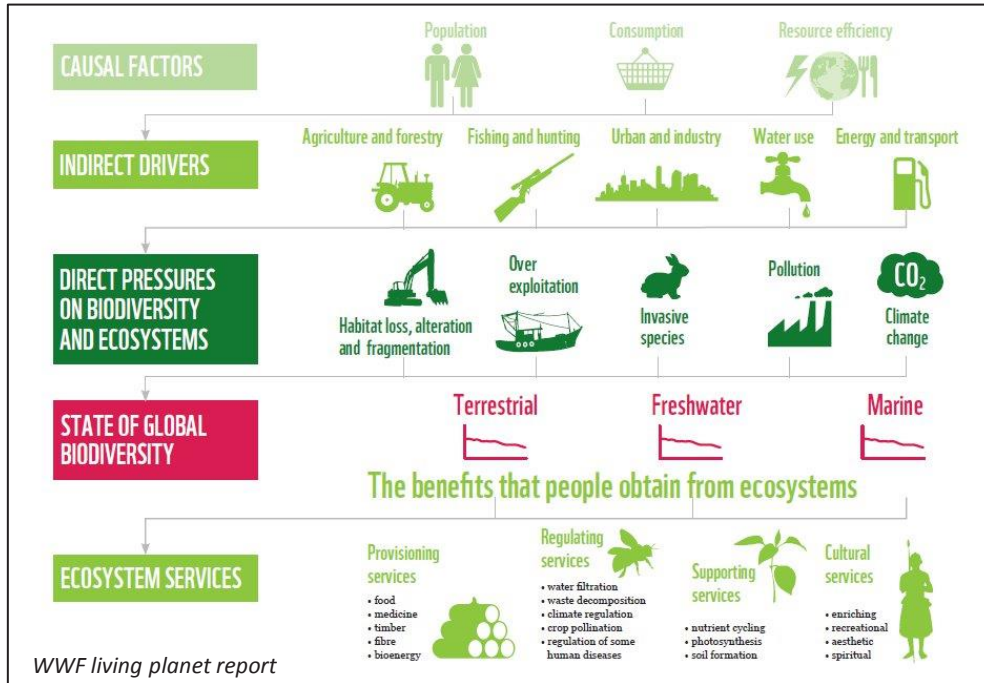


## Supporting services

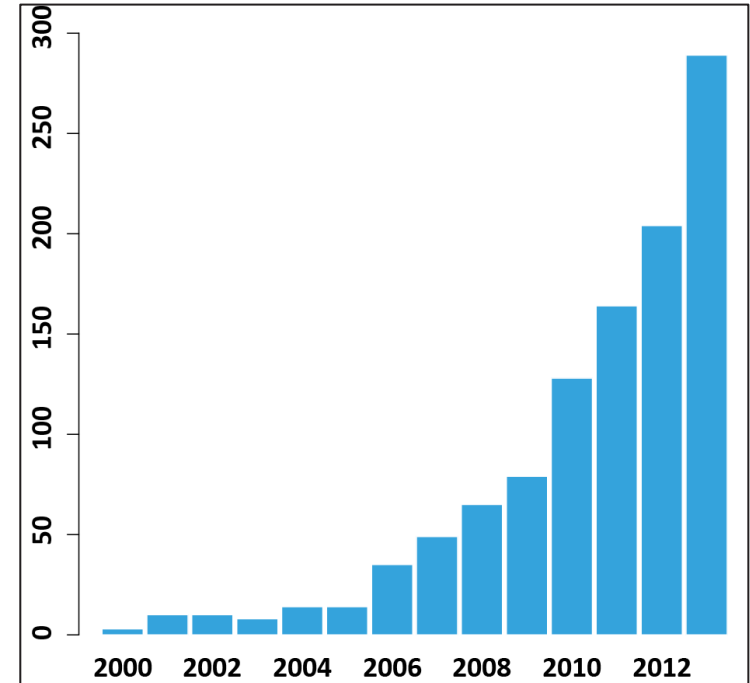


# RELEVANCE?

## Biodiversity loss



## Number of ESS publications



- Biodiversity loss, and loss of the services it supports, highly impacts human well-being
- This represents a high socio-economic risk,
- Well-informed land-use management can decrease this risk

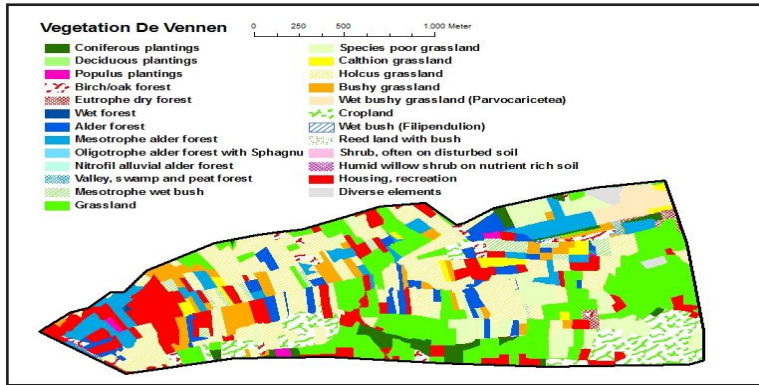
⇒ **Need for sustainable spatial planning**  
**Need to map hotspots of ESS**

⇒ **RS might help**



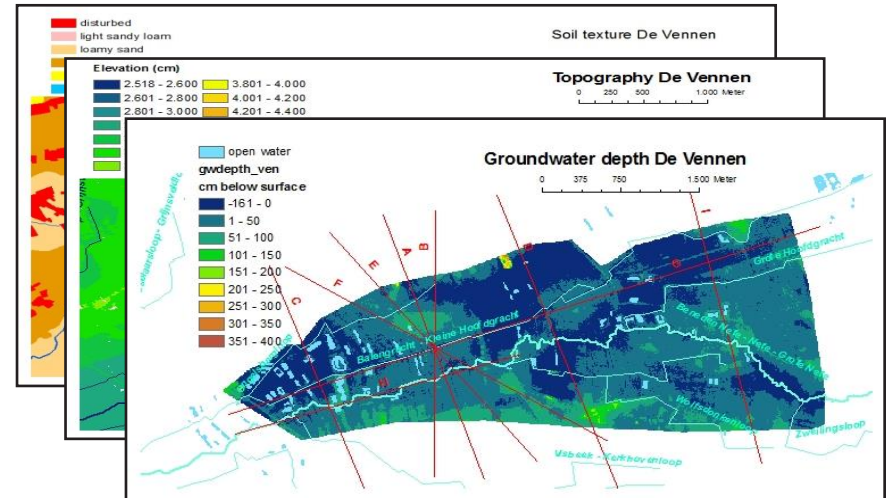
# ROLE OF REMOTE SENSING: TRADITIONALLY

## Land cover / Land use map

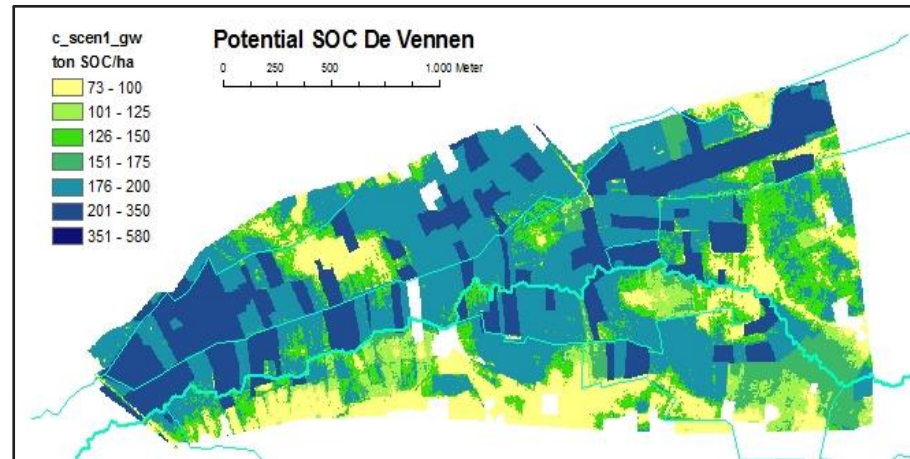
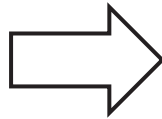


+

## Data layers



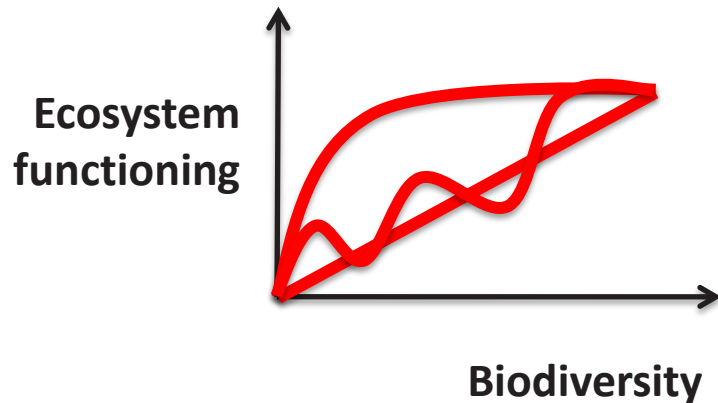
ESS



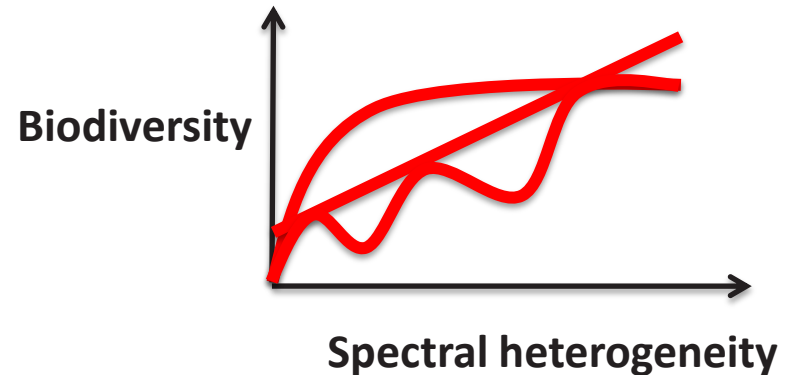
# ROLE OF REMOTE SENSING: ESSENCE

## Main objective:

Test/develop an innovative approach for spatially explicit mapping of regulating ecosystem services using hyperspectral remote sensing data



**Consensus:**  
high biodiversity  
=  
"better" functioning

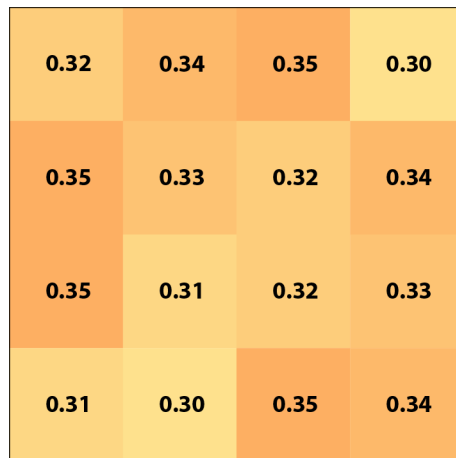


**Consensus:**  
high spectral heterogeneity  
=  
high biodiversity

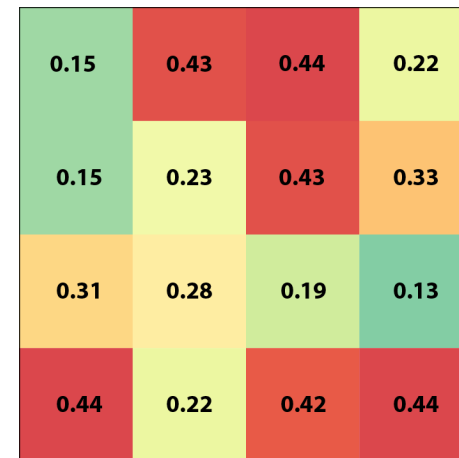
# SPECTRAL VARIATION HYPOTHESIS



Low spectral variation



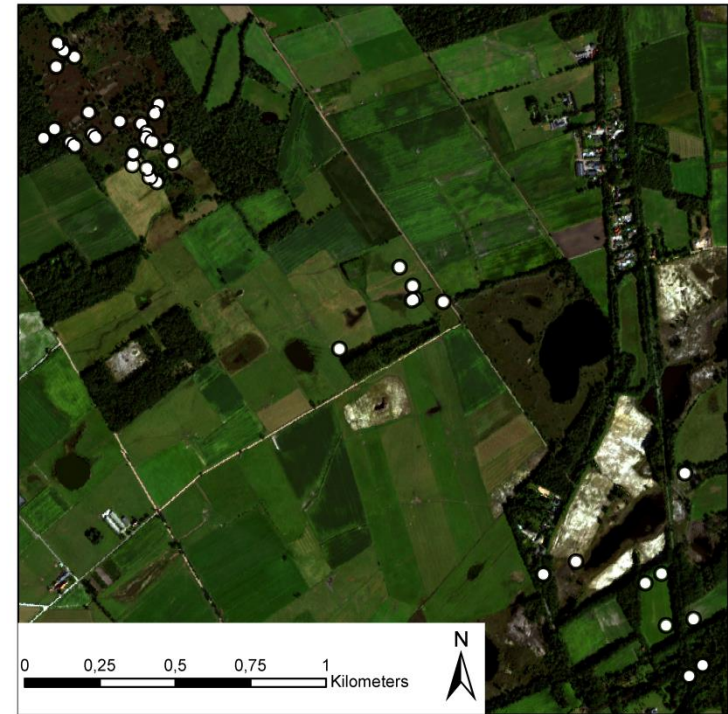
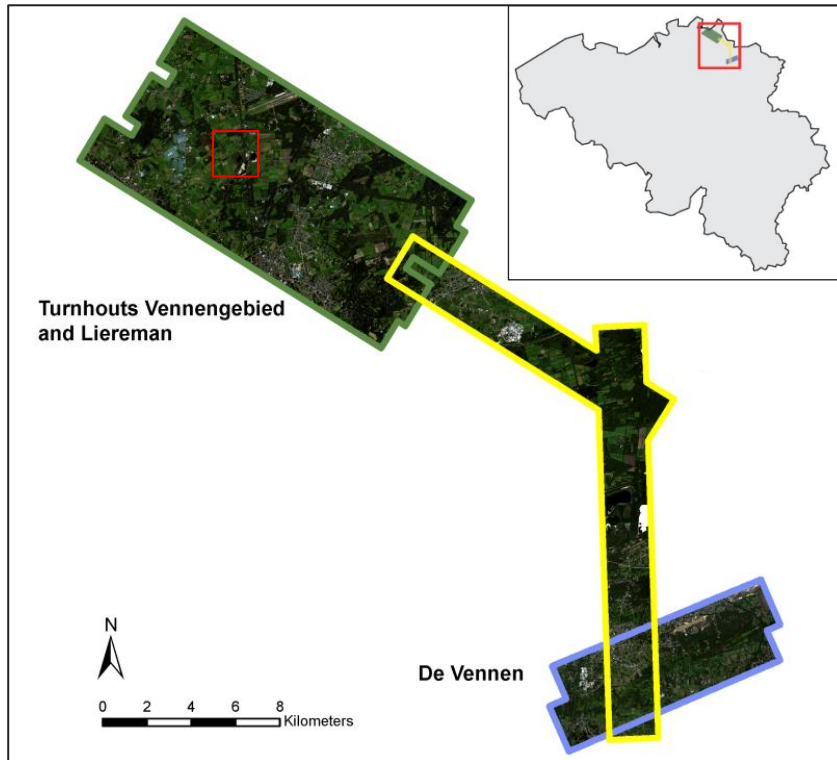
High spectral variation





# STUDY AREA

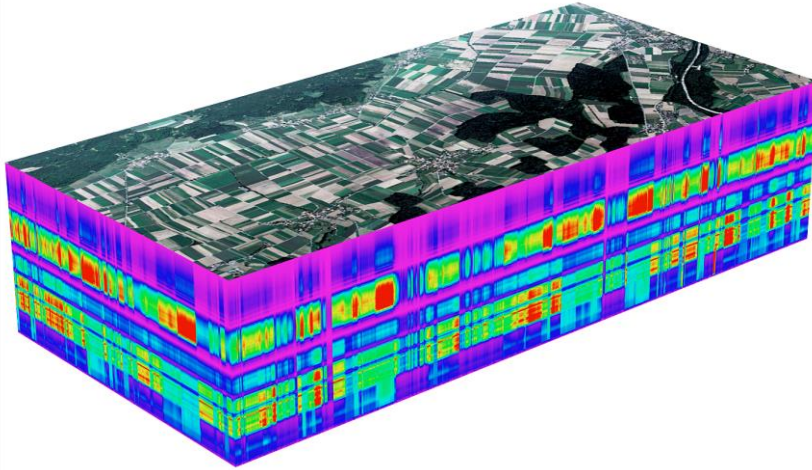
- » Heterogeneous grassland/heathland area in Belgium - Campine region
  - » Landschap de Liereman
  - » Turnhouts Vennengebied
  - » De Vennen





# DATA

## Airborne hyperspectral data from APEX



- » Processed at VITO
- » Up to 532 spectral bands
- » From 380 nm to 2500 nm

## Field data



- » 40, 10\*10m plots
- » Floristic inventory and abundance
- » 7 Plant functional traits

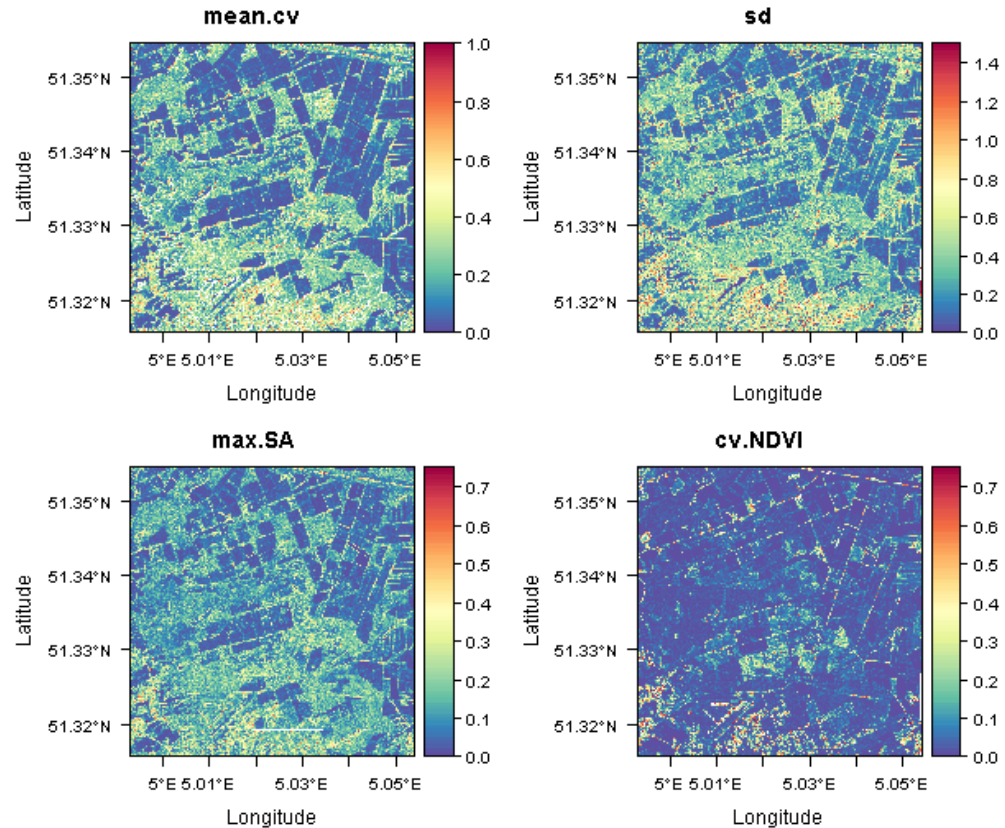
→ **5 different diversity indices were derived**

# RESULTS

## Objective 1:

### Development of hotspot mapping methods / Spectral heterogeneity mapping

- » Spectral heterogeneity mapping based on
  - » Existing methods (CV; spectral distance; generalized entropy; Texture)
  - » New methods (Spectral angle; SID)

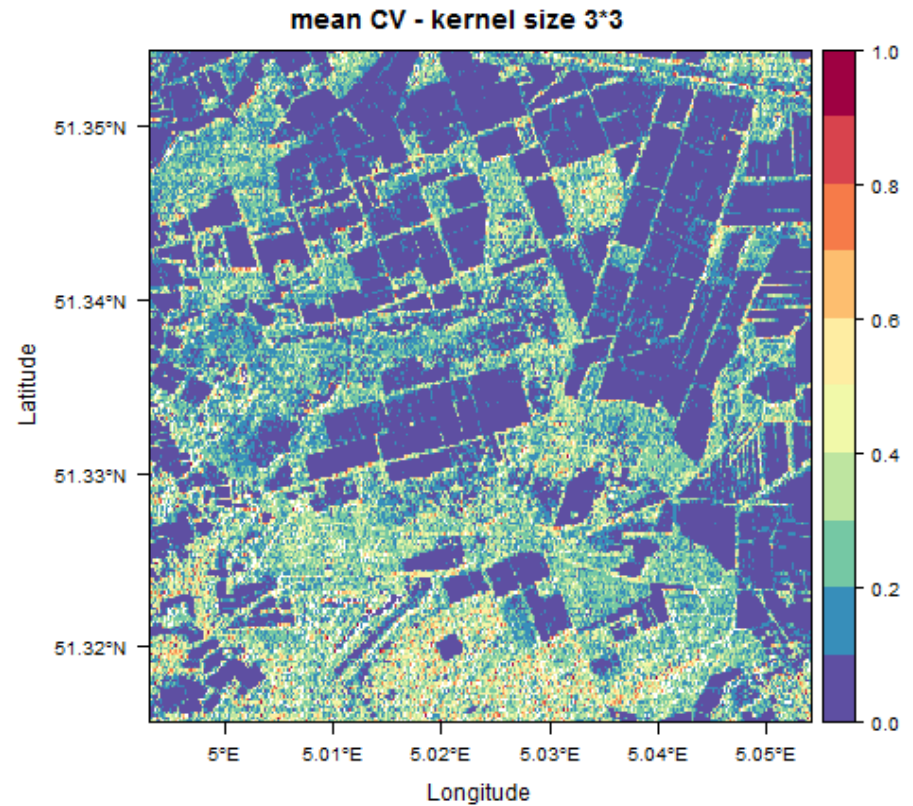


# RESULTS

## Objective 1:

### Development of hotspot mapping methods / Spectral heterogeneity mapping

- » **Spectral heterogeneity mapping** based on
  - » Existing methods (CV; spectral distance; generalized entropy; Texture)
  - » New methods (Spectral angle; SID)
- » **Effect of scale**



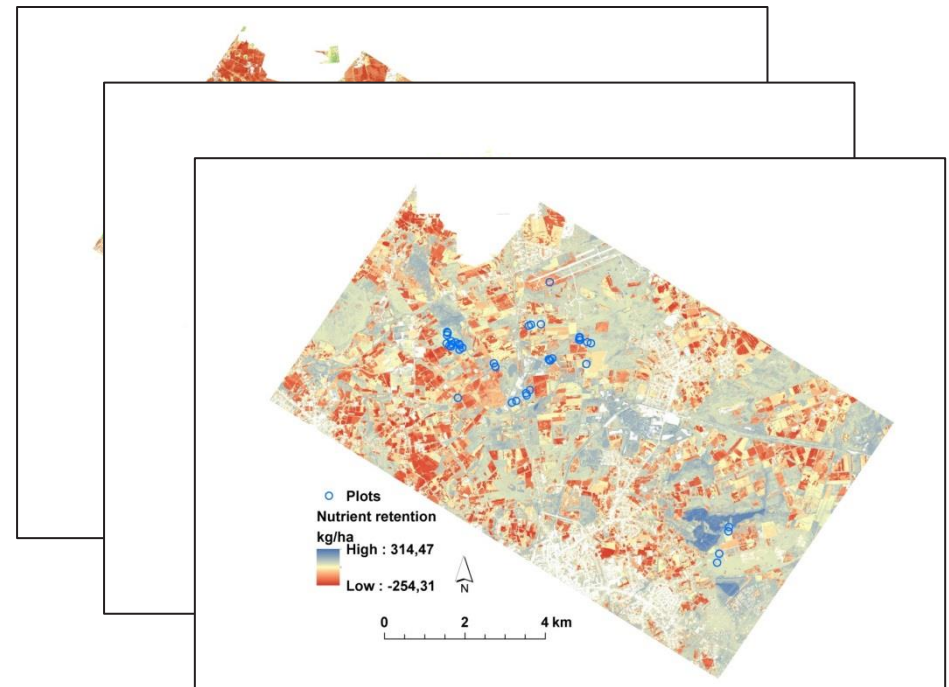
# RESULTS

## Objective 2:

### Modelling of regulating ES

#### » Improved models/maps of ESS

- » Carbon sequestration
- » Denitrification
- » Nutrient retention

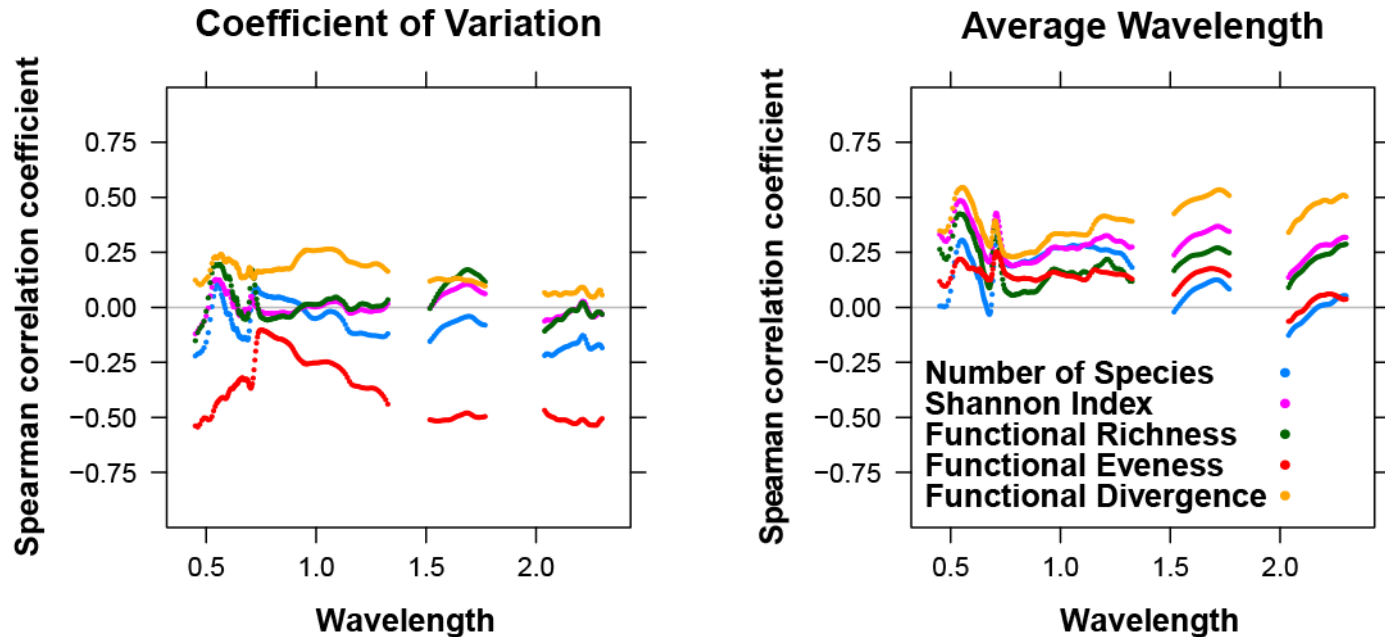




# RESULTS

## Objective 3:

Linking spectral heterogeneity to biodiversity: testing the SVH

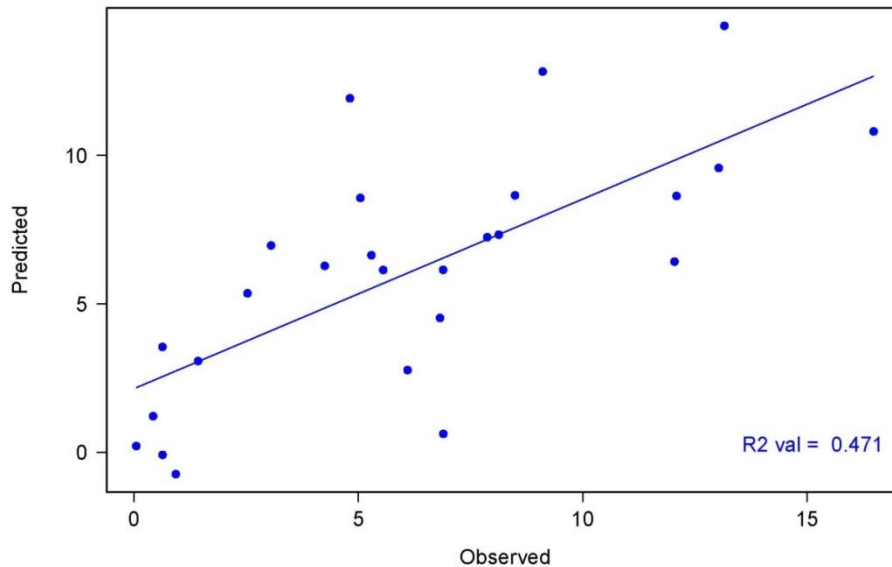


- » We found **little evidence** that the spectral variation hypothesis works in our study area
- » However, **positive relationship** between average wavelength & biodiversity

# RESULTS

- » **Predicting biodiversity:** Using **Partial Least Squares regression** (with variable selection & LOO validation) :
  - » Decent results with averaged wavelength ( $R^2$  between 0.4 and 0.6)
  - » Bad results with CV (all  $R^2 < 0.15$ )

PLS LOO validation for FRic: predicted vs. observed values



Functional Richness

Low

High

# CONCLUSIONS & RECOMMENDATIONS

## Belgium ≠ the tropics

- » So far, we found **little evidence** that the spectral variation hypothesis works in our study area

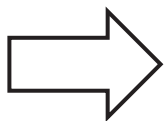
## Grasslands ≠ tropical forests

- » Assessing biodiversity in grasslands is **challenging** (Confounding factors such as litter, bare soil, ...)

## Direct mapping of ESS from Remote Sensing

- » We are not there yet ...
- » More research required to understand the link between RS signal, biodiversity & Ecosystem functioning

## But there is life after ESSENSE



IWT-SBO project ECOPLAN (2013-2017)  
partners (UA, KUL, UGent, INBO, VITO-TAP, VITO-RMA)  
[www.uantwerpen.be/en/rg/ecoplan](http://www.uantwerpen.be/en/rg/ecoplan)

# Thank you

[Ruben.vandekerchove@vito.be](mailto:Ruben.vandekerchove@vito.be)

[lemon.vgt.vito.be](http://lemon.vgt.vito.be)