The game changer for biodiversity?

Mapping and monitoring invasive plants, floristic gradients and ecosystem properties using Sentinel-2

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The bright side of Remote Sensing,
25/10/2016, Brussels, Belgium

INTRODUCTION

- **Mapping & monitoring biodiversity** (s.l.) through Remote Sensing is still primarily (with a few exceptions) **performed at local scale**

- Mapping single plant/tree species, invasive species, plant biochemistry, structure, phenology … **requires a "high enough"**
  - Spectral resolution
  - Spatial resolution
  - Temporal resolution

- Sentinel-2 (A+B) has the potential to be a game changer…

Assess the performance of S2 for different aspects of biodiversity monitoring using airborne imaging spectroscopy (& Landsat) as benchmark

OVERVIEW

- Sentinel-2 @ VITO?
- Case studies: Sentinel-2 vs imaging spectroscopy
  - Mapping invasive species
  - Mapping floristic gradients (single & multi-temporal)
  - Ongoing work

SENTINEL-2 @ VITO: SOME PUBLICITY

- OPERA: an **operational, atmospherical correction algorithm**
  - Sensor generic (Sentinel-3 , Sentinel-2, Landsat, Hyperspectral missions, …)
  - Scene generic allowing to correct both land and water areas
  - Will be included in the ESA SNAP Toolbox

OPERA
operational atmospheric correction for land and water

- VITO is a **principal cooperation partner** in the EODC initiative
  - Cloud-based access to the whole S2 archive & HPC

eodc

- Expanding portfolio of applications in agriculture, biodiversity and coastal/water

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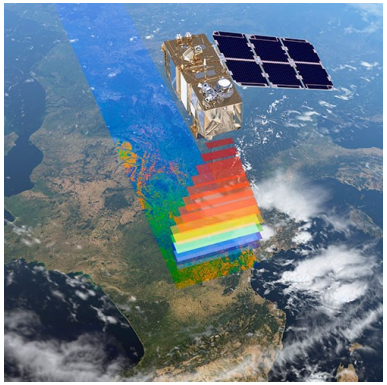
SENTINEL-2 VS AIRBORNE IMAGING SPECTROSCOPY



- 10-60m resolution
- 13 bands
- 5-10 days revisit
- Free!

- 1-3m resolution
- 100+ bands (but highly correlated)
- snapshot
- N * 10000 euro

Is the spatial / spectral resolution of S2 good enough?

MAPPING INVASIVE SPECIES

- **Second most important reason** for biodiversity loss worldwide (after direct habitat loss)
- **Upward trend**
- °2015: **EU Regulation on Invasive Alien Species**
  - Imposes member countries to act
- Remote Sensing as **early warning & monitoring system?**

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MAPPING INVASIVE SPECIES

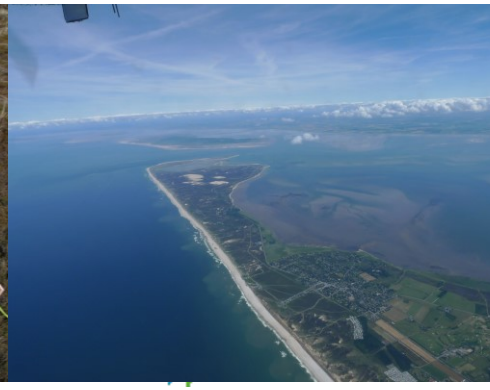
Project DIARS: mapping; modelling and impact assessment of invasive alien species using remote sensing

» **ERA-Net BiodivERsA project**; VITO = coordinator

» **Study sites** in Germany (Sylt); Belgium (Averbode Bos & Heide); France (Compiègne)

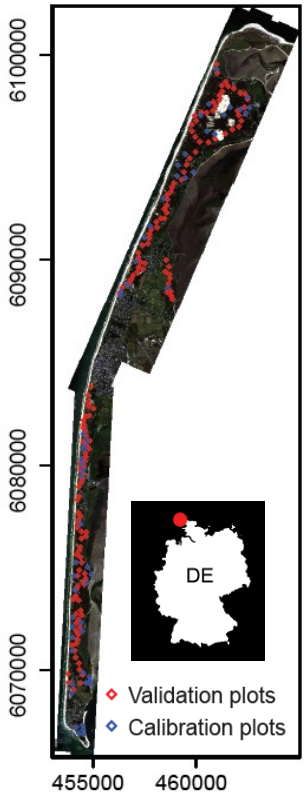
» **Study species**: *Prunus serotina* (black cherry); *Rosa rugosa* (Japanese rose); *Campylopus introflexus* (heath star moss)



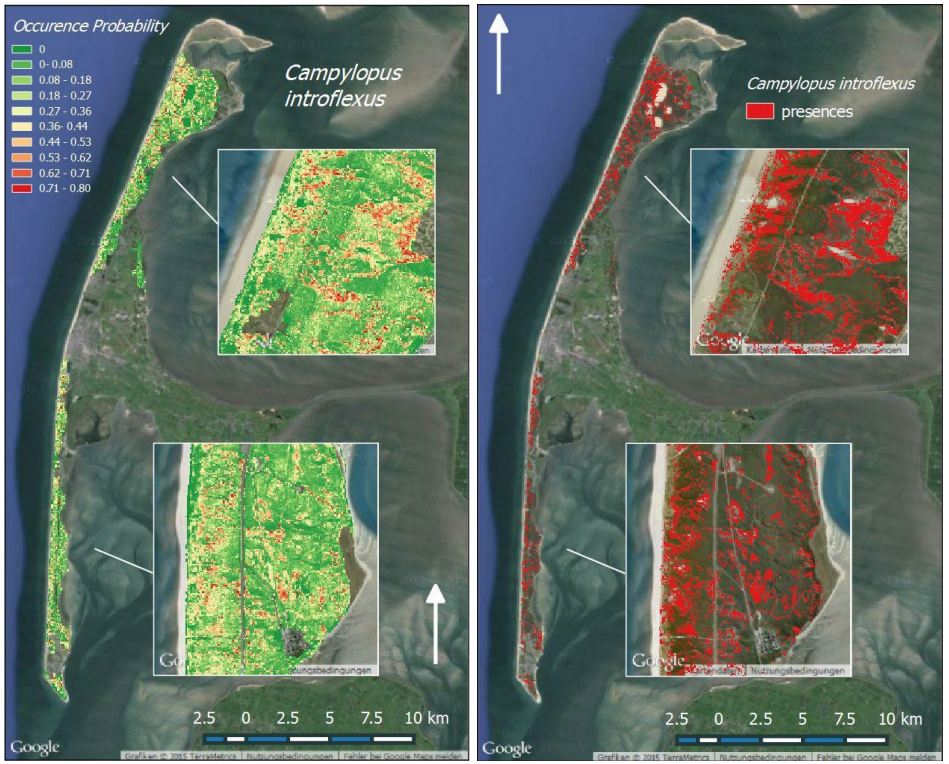



MAPPING INVASIVE SPECIES – AIRBORNE HYPERSPECTRAL (APEX)

- One-class classifier (maxent), using all 244 bands as explanatory variables
- 57 calibration (presence) & 150 validation (presence/absence) plots



MAXENT



AUC: 0,872 - Overall Accuracy: 0,75

Skowronek et al (2016); Biological Invasions

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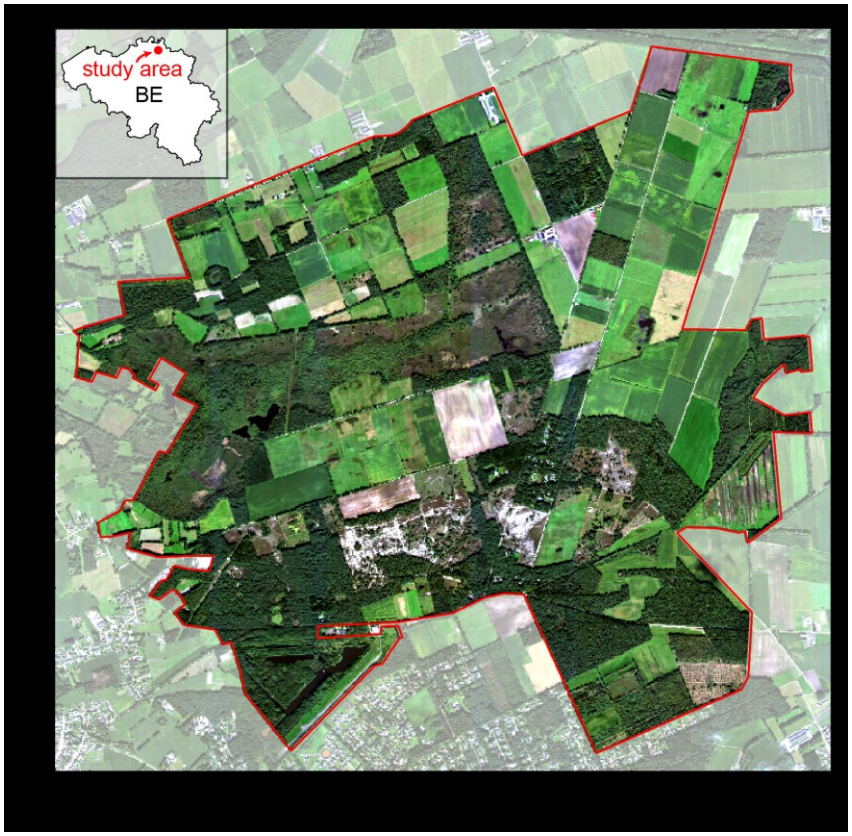
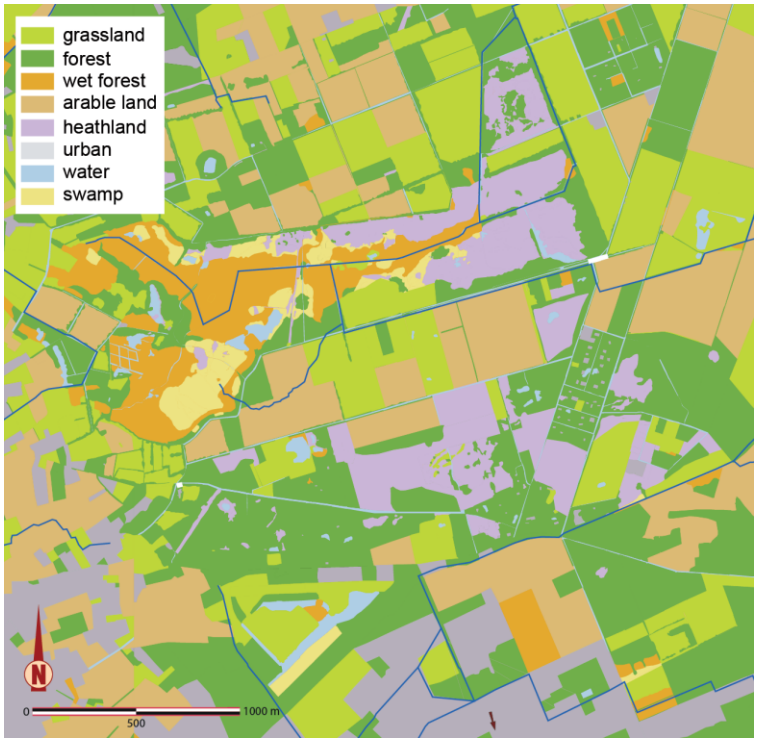
MAPPING INVASIVE SPECIES – SPACEBORNE MULTISPECTRAL (SENTINEL-2)

Although not quite as performant as imaging spectroscopy,
Sentinel-2 allows for a **first screening** which can guide nature conservationists in prioritizing their efforts

MAPPING FLORISTIC GRADIENTS – LANDSCHAP DE LIEREMAN

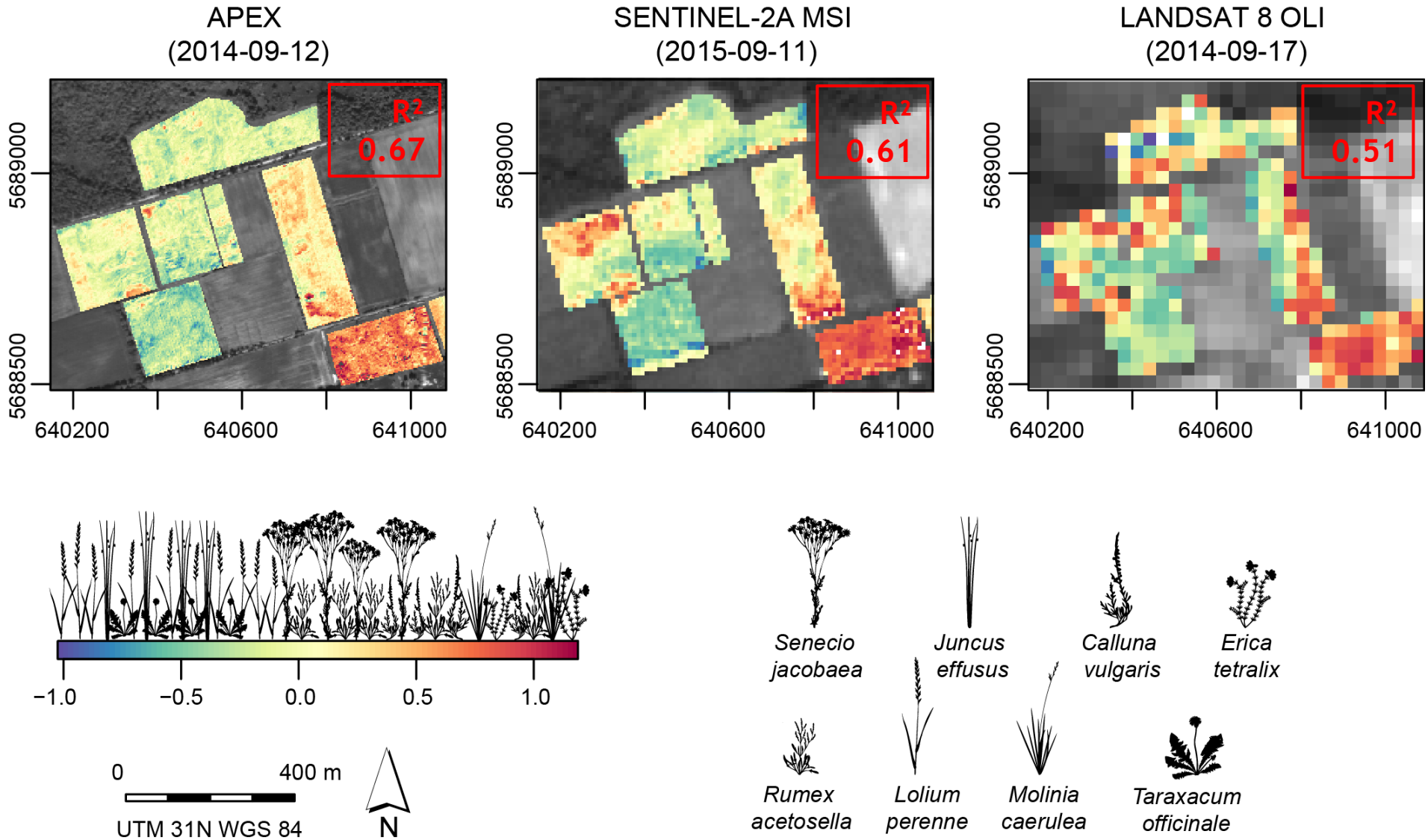




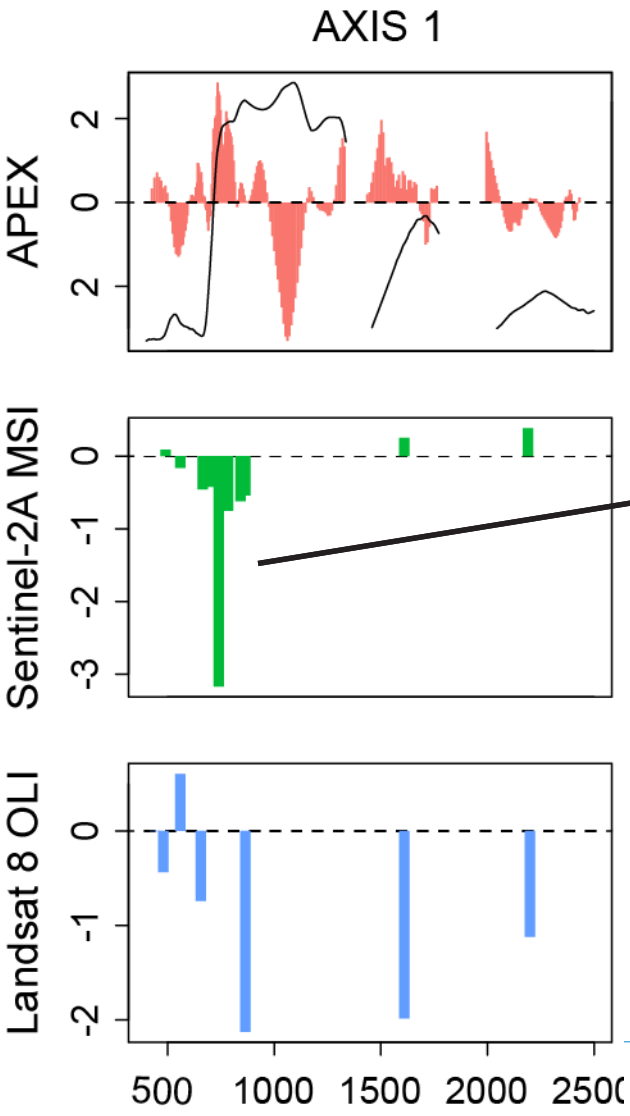
→ To plan, follow-up and monitor the effect of restoration activities/grassland management, stakeholders need more detailed maps

Gradient from species-poor to species-rich grasslands

MAPPING FLORISTIC GRADIENTS – 1ST AXIS



BAND IMPORTANCES



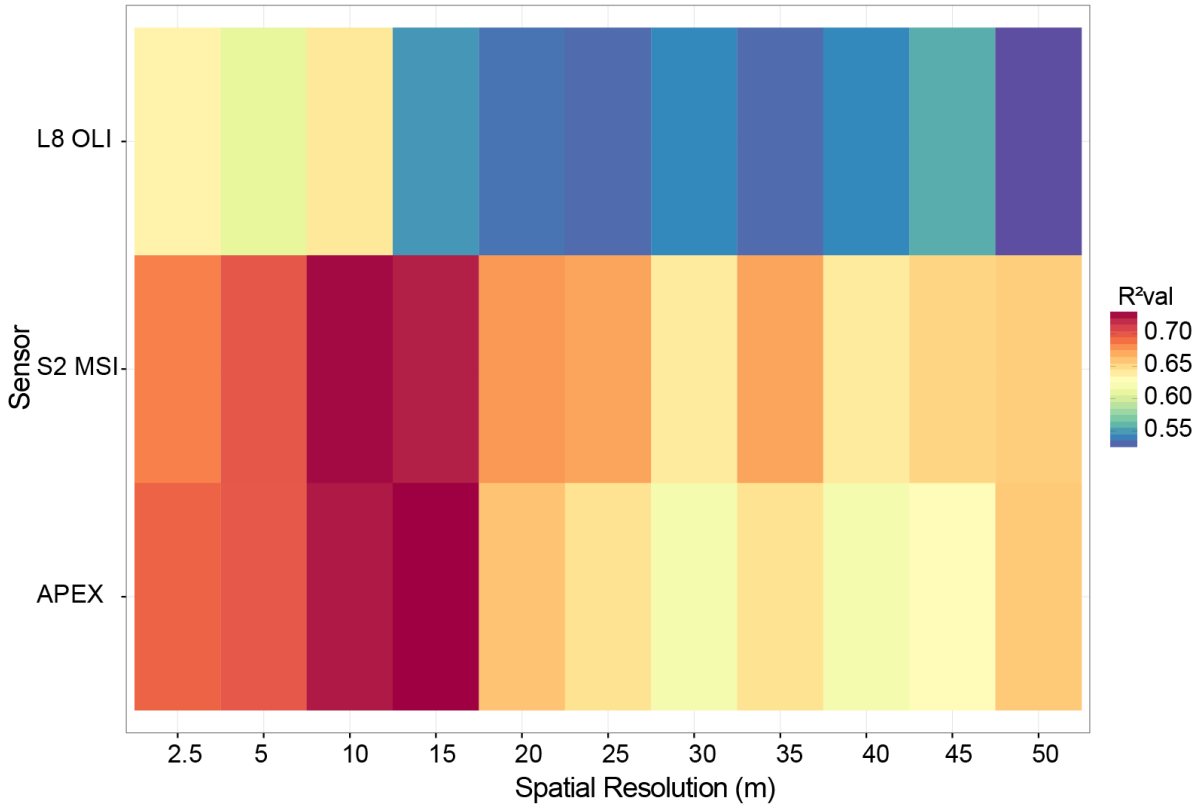
Additional red edge bands are important
(although highly correlated)

SPECTRAL VS SPATIAL RESOLUTION EFFECT: SIMULATION EXPERIMENT

Spectral bands are well chosen

Too much spatial detail introduces noise

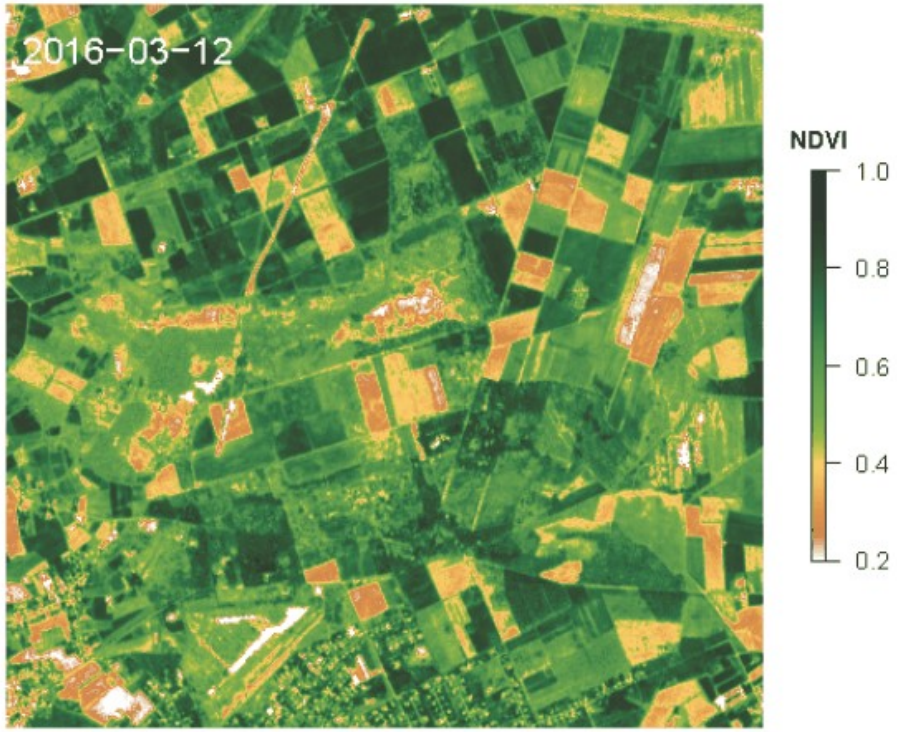
Case study specific



MAPPING FLORISTIC GRADIENTS – MULTITEMPORAL

TCC

NDVI



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MAPPING FLORISTIC GRADIENTS – MULTITEMPORAL

Sentinel-2

- The combination of an increased & spectral resolution enables to **differentiate at species (community) level** in a fragmented landscapes like Flanders
  → something which was before only possible at a high cost price

- allows to choose the optimal timing for mapping floristic gradients in grasslands

IN THE PIPELINE

» Mapping indicators of habitat quality (and quantity) in the framework of the Natura 2000 reporting together with INBO

» Fusing optical (Landsat & Sentinel-2) & radar (ALOS PALSAR, JERS1, Sentinel-2) time series for mapping mangrove dynamics → BeoDay 2016

» Mapping S2 based landcover at larger (continental) scales.

CONCLUSION

A first assessment in our **very local case studies !!** shows that Sentinel-2 can indeed be a game changer,

- We are confident that these findings can be extended to other aspects of biodiversity monitoring and study sites
- Sentinel-2 can give hyperspectral enthusiasts a hard time
- Landsat, although not with the same performance, is an excellent archive
- However
  - We need Sentinel-2B!! Only 8/34 scenes cloudfree. Mapping phenology is still challenging
  - We need performant cloud screening
  - Better data access

Thank You!

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