The game changer for biodiversity?
Mapping and monitoring invasive plants, floristic gradients and ecosystem properties using Sentinel-2

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» **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...

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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

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

» Expanding portfolio of applications in agriculture, biodiversity and coastal/water
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**?
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 HYPERSONTICAL (APEX)

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

Skowronek et al. (2016); Biological Invasions

AUC: 0.872 - Overall Accuracy: 0.75
Although not quite as performant as imaging spectroscopy, Sentinel-2 allows for a **first screening** which can guide nature conservationists in prioritizing their efforts.
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

APEX (2014-09-12)

R² = 0.67

SENTINEL-2A MSI (2015-09-11)

R² = 0.61

LANDSAT 8 OLI (2014-09-17)

R² = 0.51

Senecio jacobaea
Juncus effusus
Calluna vulgaris
Erica tetralix
Rumex acetosella
Lolium perenne
Molinia caerulea
Taraxacum officinale

UTM 31N WGS 84

0 400 m
Additional red edge bands are important (although highly correlated)
Spectral bands are well chosen

Too much spatial detail introduces noise

Case study specific
MAPPING FLORISTIC GRADIENTS - MULTITEMPORAL

TCC

2016-03-12

NDVI

2016-03-12

The bright side of remote sensing
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
» 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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