Heathland Management: Quantification of Birch and Bracken Encroachment on Heather using Airborne and Satellite Imagery

Loreena Jaouen

Geospatial Analyst at 2Excel geo

UK SPACE AGENCY

SPIN
Space Placements in Industry

rspb giving nature a home

2EXCEL geo

Case-Study Background

- The Lodge RSPB Reserve in Sandy, Bedfordshire.
- Investigation of two managed heathland compartments.
- Management requirements set out by the Countryside Stewardship scheme.
- Extensive birch and bracken encroachment on heather is a challenge for restoration work.
- Annual reporting to Natural England relies on *in-situ* estimates.

Aerial and satellite remote sensing has the potential to improve current estimates of heather coverage and fragmentation, while allowing for consistent and efficient monitoring.

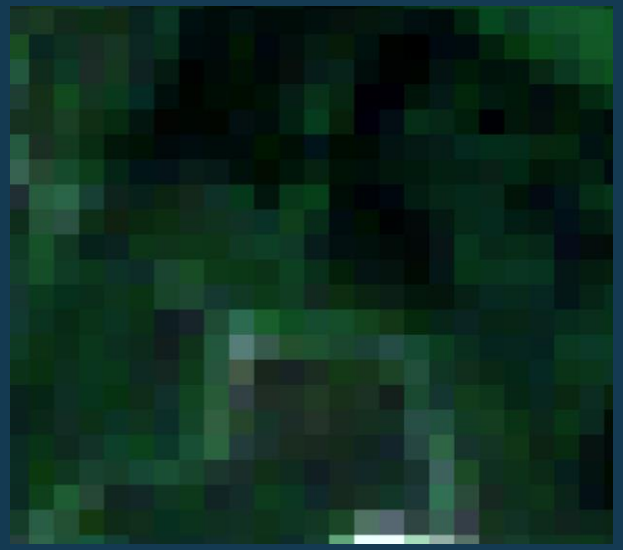
Objectives

1. To classify heather, birch and bracken using vegetation spectral information.
2. To quantify the respective coverage and fragmentation of each class.
3. To carry out classification independently for both hyperspectral airborne data and multispectral satellite imagery and compare the outputs.

Platforms

Satellite

Free

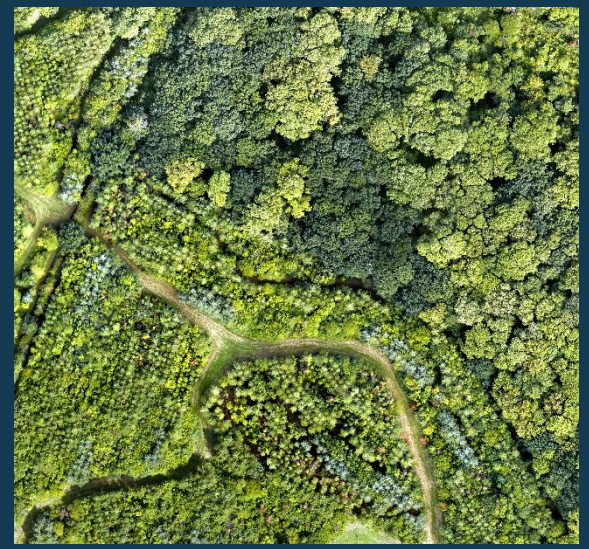


Sentinel-2 (10m)

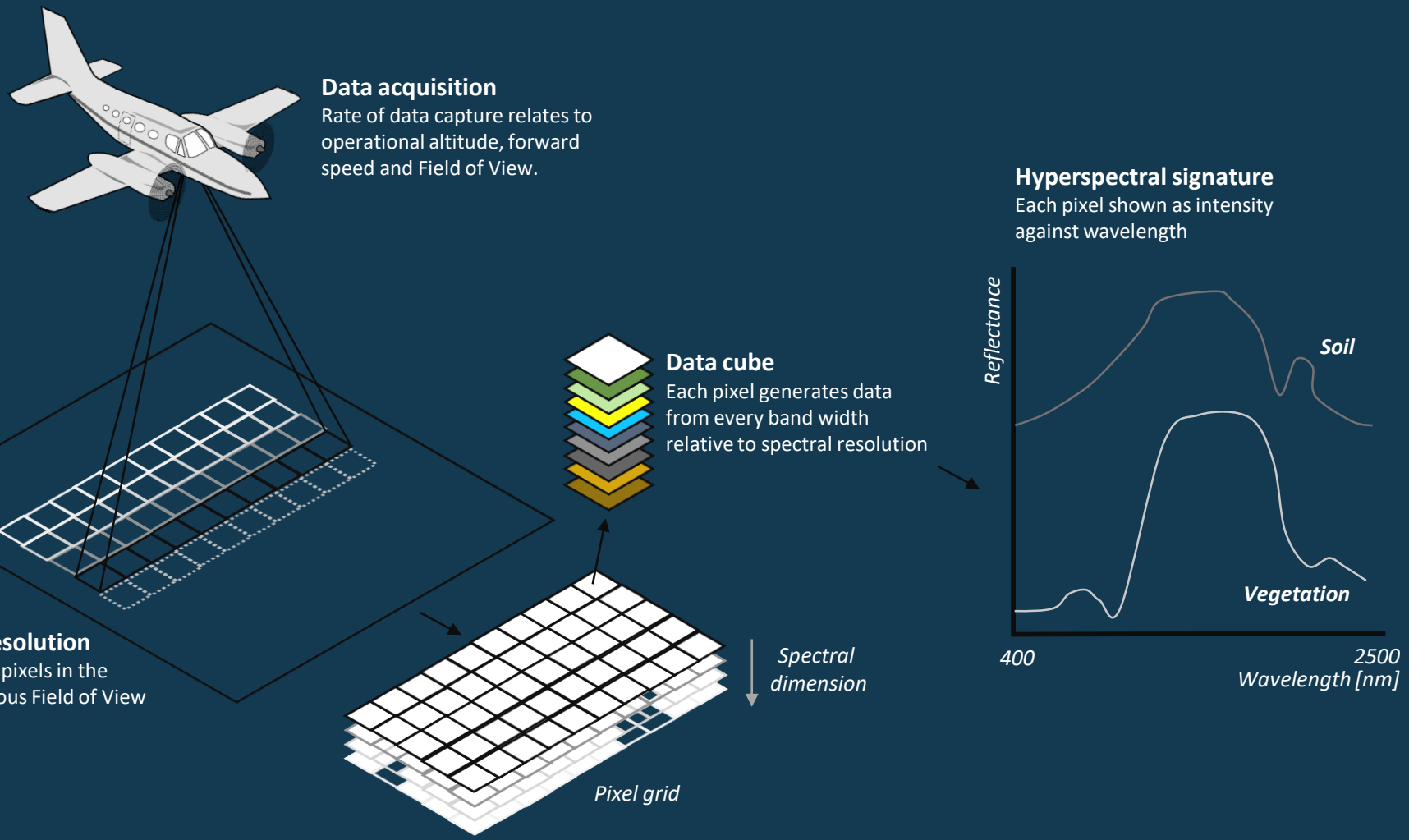
Commercial

WorldView-3 (2 m)

Airborne/UAV



Airborne Phase One iXA 180 Camera (0.04 m)


Data acquisition
Rate of data capture relates to operational altitude, forward speed and Field of View.
Hyperspectral signature
Each pixel shown as intensity against wavelength
Reflectance
Soil
Vegetation
400
2500
Wavelength [nm]
Data cube
Each pixel generates data from every band width relative to spectral resolution
Spectral dimension
Pixel grid
Spatial resolution
Number of pixels in the Instantaneous Field of View
Spectral resolution
Number of bands or band width within the spectrograph

Manned Airborne Collection

Challenges:

- Cloud shadows
- Atmospheric correction
- Temporal variation between aerial and ground collect

Instruments fitted in the nose

HySpex VNIR 1800

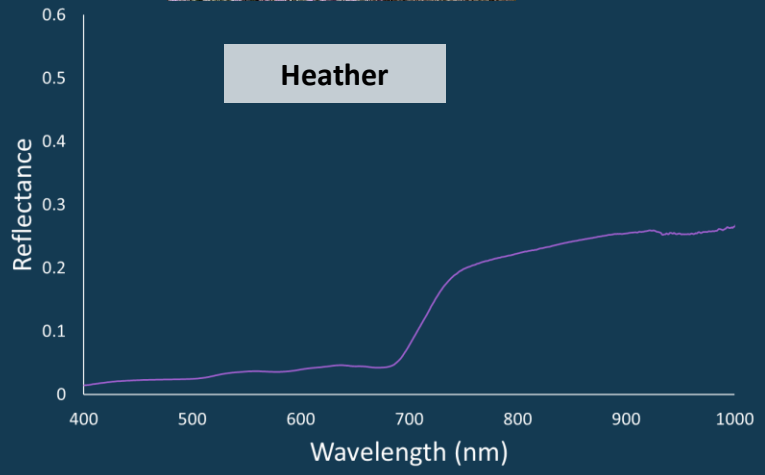
HySpex SWIR 384

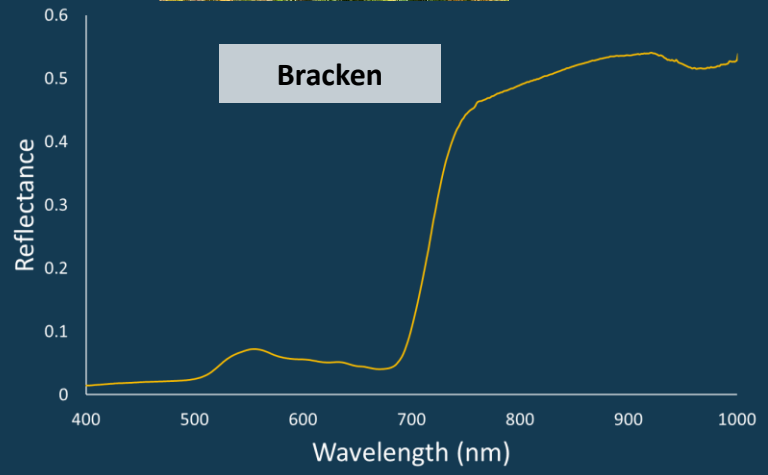
Phase One iXA 180

2EXCEL geo

Field Collection

- Dual field ASD spectroscopy
- ‘Pure’ spectra collected for the 3 vegetation classes of interest

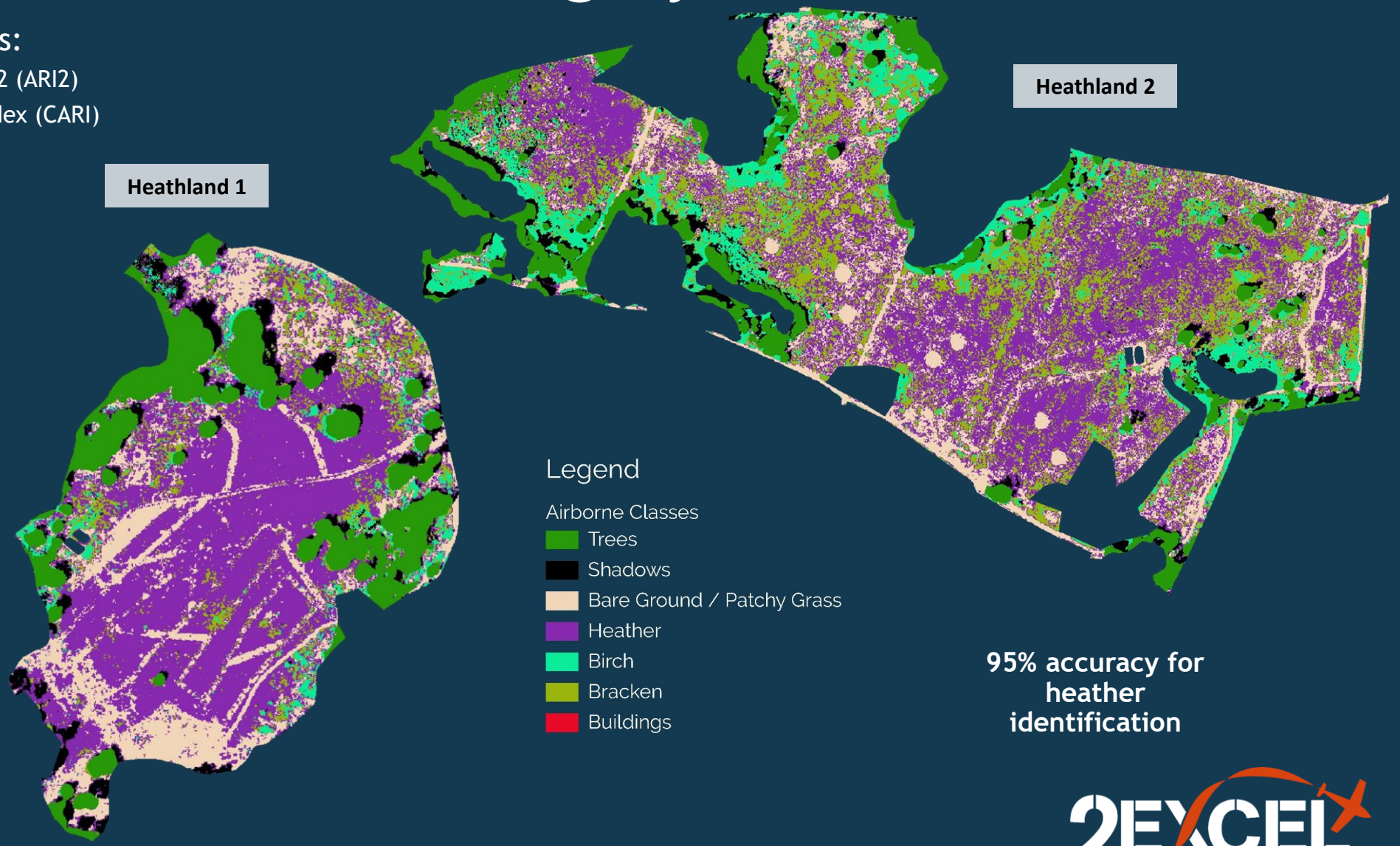




Airborne Imagery

- Use of two vegetation indices:
  - Anthocyanin Reflectance Index 2 (ARI2)
  - Chlorophyll Absorption Ratio Index (CARI)
- 3 step classification:

Segmentation
Multi-resolution segmentation based on orthophoto and CHM
Object threshold classification for shadows, buildings, bare ground and mature trees
Unclassified objects exported
Pixel-level
SAM classification for heather, birch and bracken
Object-level
SAM scores aggregated using the previous unclassified objects
Classes assigned based on highest object mean SAM score

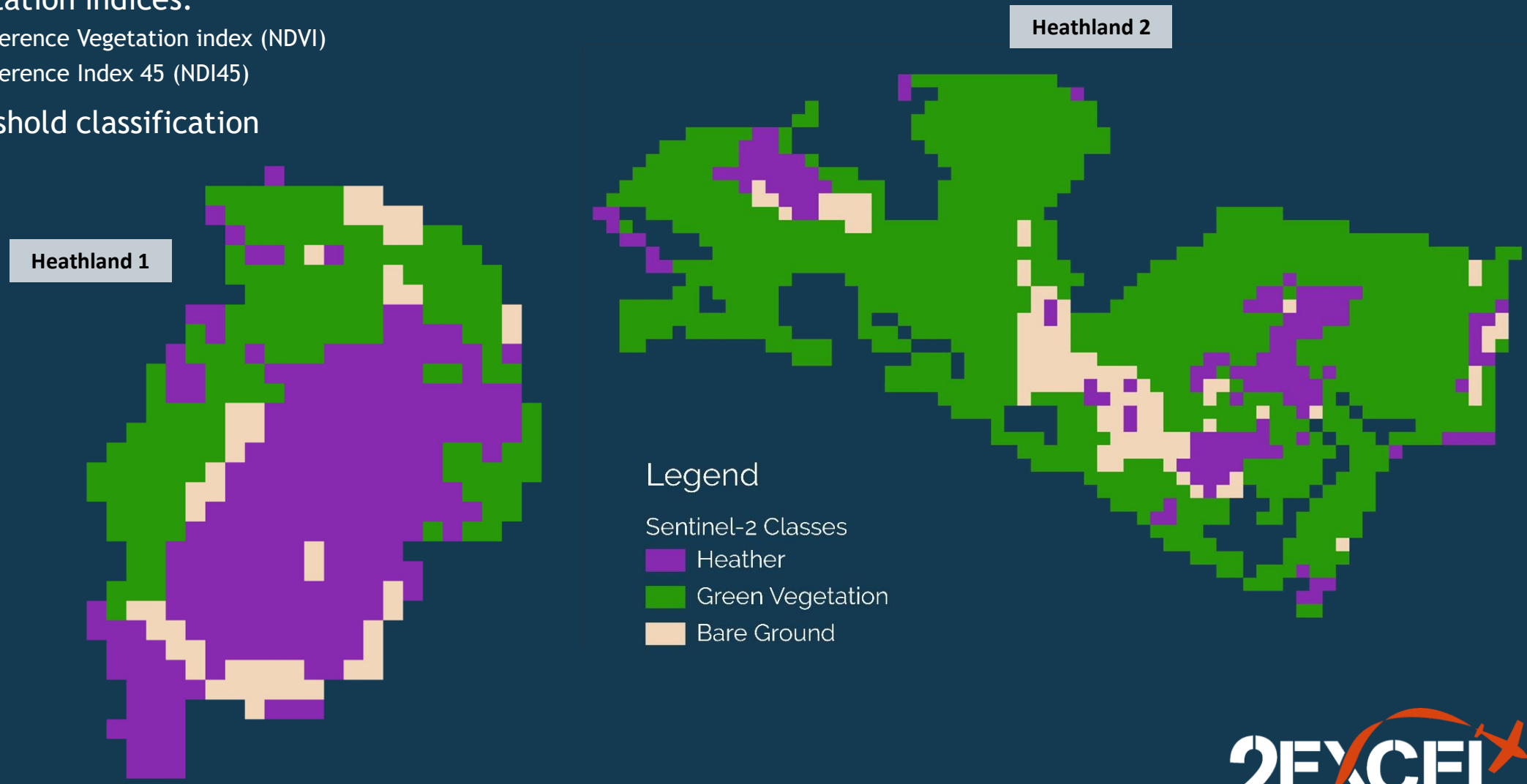


95% accuracy for heather identification

Sentinel-2 Imagery

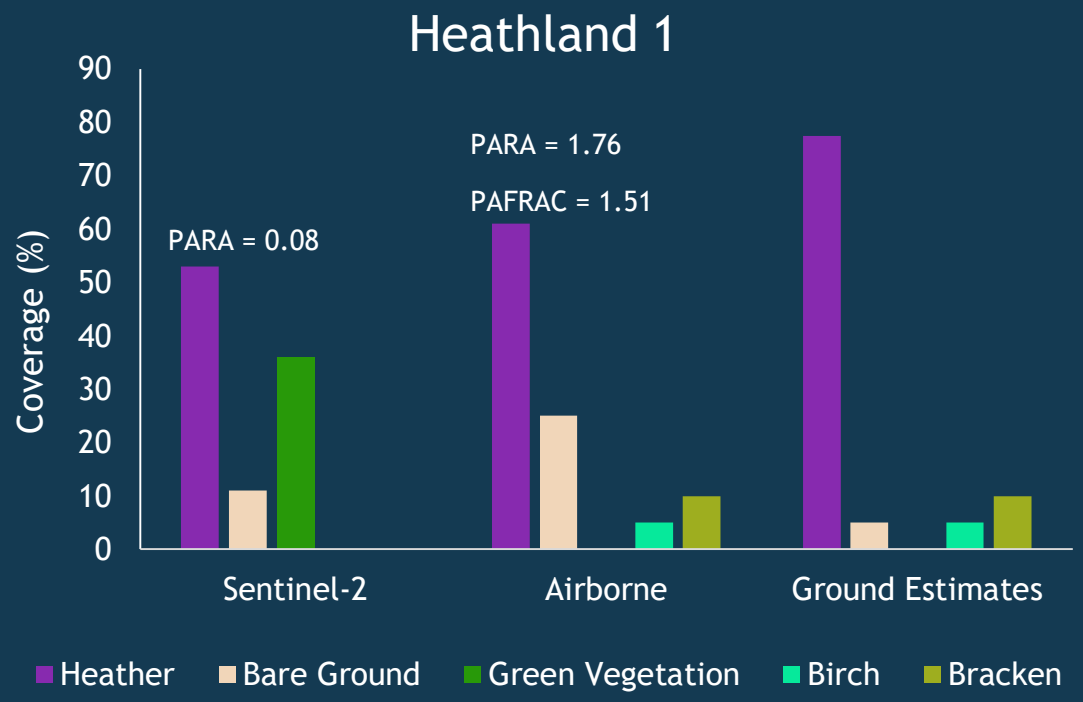
- Use of two vegetation indices:
  - Normalised Difference Vegetation index (NDVI)
  - Normalised Difference Index 45 (NDI45)
- Pixel-based threshold classification

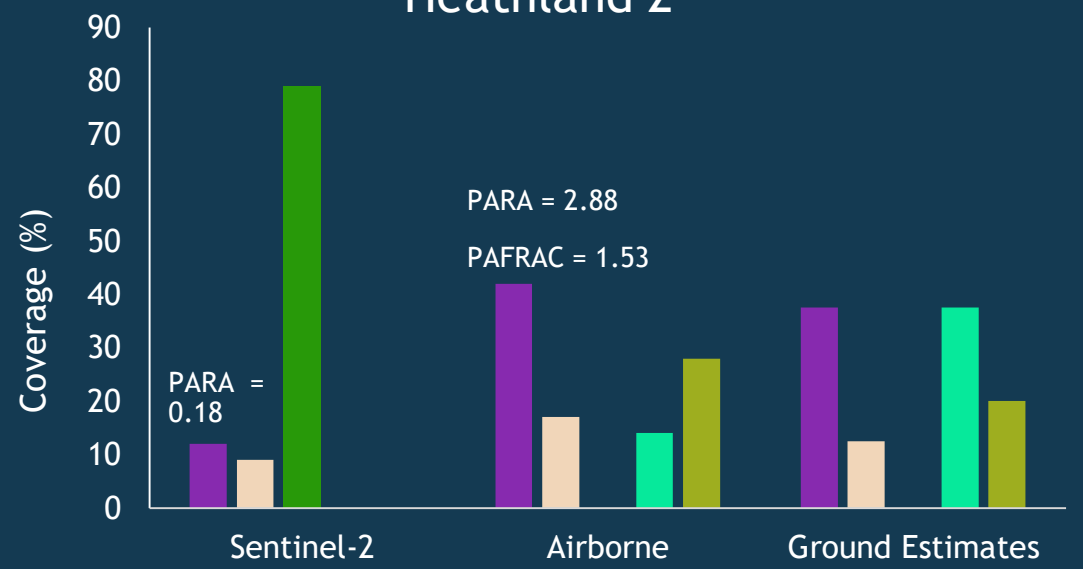
66% accuracy for heather identification



Analysis

- July 2018: RSPB *in-situ* estimates using line surveys
- Sentinel-2 not directly comparable – lacking classes
- Class metrics calculated for heather in Sentinel-2 and airborne classification
  - Perimeter-Area Ratio (PARA)
  - Perimeter-Area Fractal Dimension (PAFRAC)





Conclusion

- Mapping heather patches within fragmented heathlands is feasible
  - High accuracy using airborne imagery
  - Good estimates with Sentinel-2 but much coarser
- Uncertainties
  - Sentinel-2 fails to distinguish birch and bracken from surrounding mature trees
  - ‘Mixed’ spectra where heather or bracken growth occurs under birch canopies
  - Temporal variation
- Relevance
  - Fragmentation and connectivity statistics
  - Can inform on habitat condition and economic value
  - Net Biodiversity Gain assessments

Get in Touch

www.2excelgeo.com

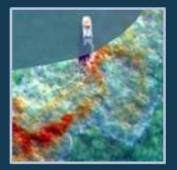
geo@2excel.uk

@2excelgeo

2Excel geo


Tree Disease


Tree Species


Oil Spill Response


Wheat Disease


Weeds in wheat


Landscape management