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TAKING THE PULSE OF OUR PLANET FROM SPACE

EUMETSAT ECMWF EUSPA

UAV-mounted hyperspectral imaging for satellite surface reflectance validation

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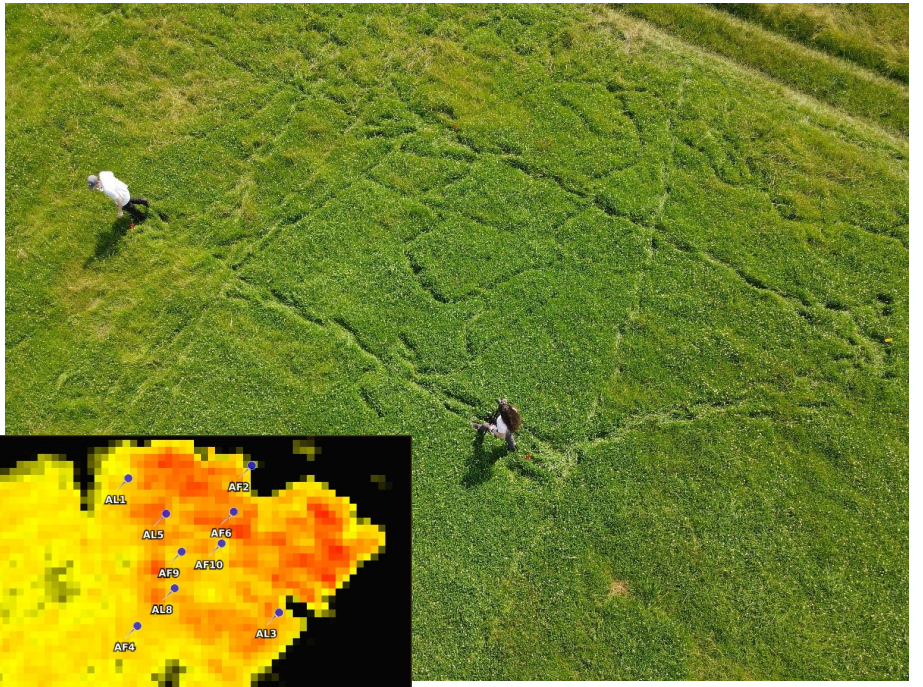
Introduction: Fiducial Reference Measurements for Vegetation (FRM4Veg)

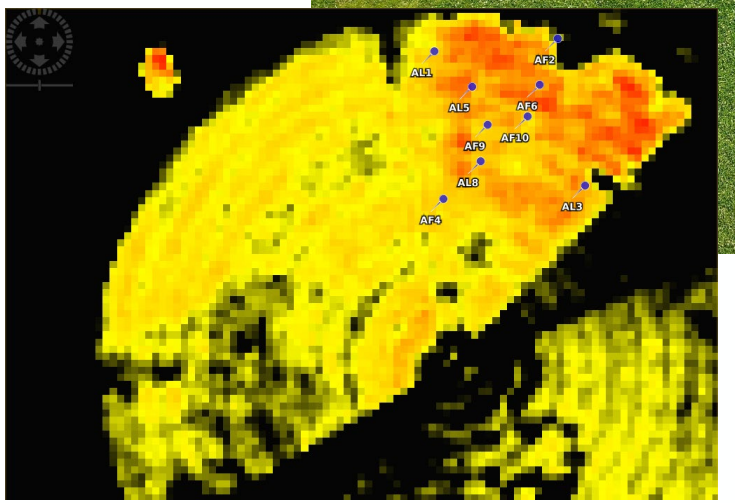
Designing validation data gathering of vegetation parameters that ensures traceability, provision of uncertainty, independence from the satellite & adherence to community agreed protocols

This talk is dealing with surface reflectance validation

First phase of the project used manually-operated field spectrometers

Current phase adapting those principles to UAV-mounted spectrometers





fiducial reference measurements for vegetation

NPL National Physical Laboratory

esa

University of Southampton

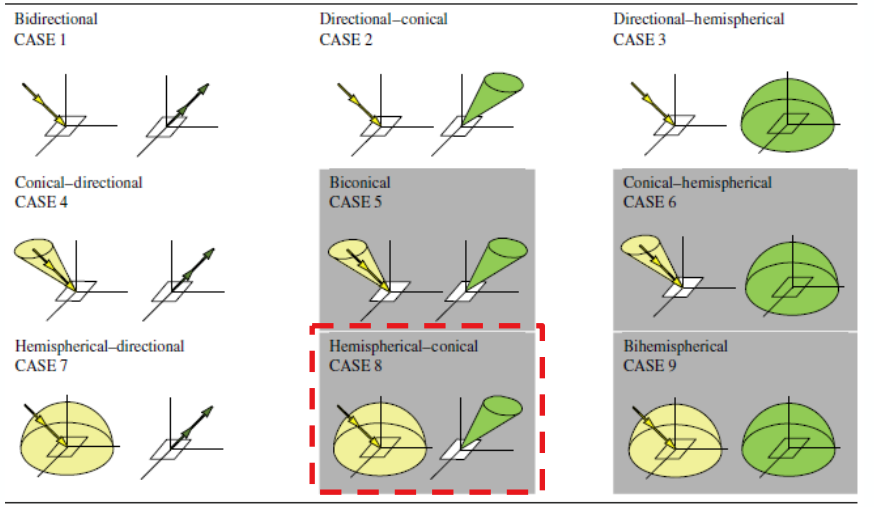
EOLAB

Site selection: Wytham Woods

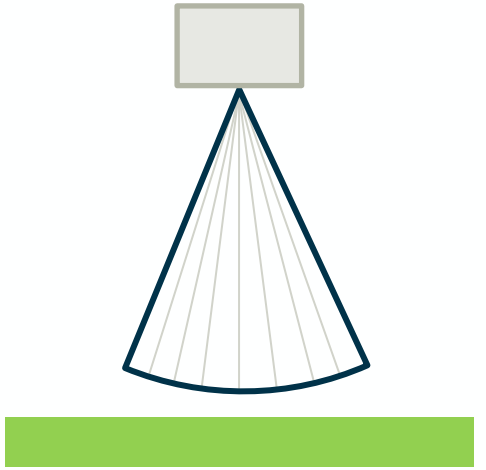
Quantity matching

Sentinal-2 SR:

- HCRF
- Assumed atmospherically corrected (rather than no atmosphere)
- 3 x spatial resolutions (10 m, 20 m and 60 m)
- ~21° AFOV (~0.001° per pixel @ 20 m resolution)
- Orbit inclination at 98.62°
- Overpass of site @ 9.73° (VZA)



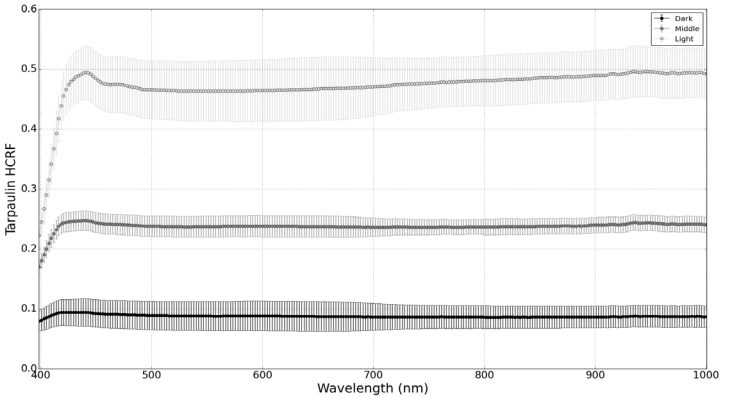
Schaepman-Strub et al (2006) Reflectance quantities in optical remote sensing definitions and case studies. *Remote Sensing of Environment*, **103**:27-42

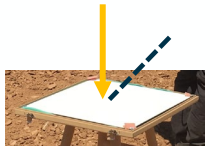


Quantity matching: instruments to meet these needs

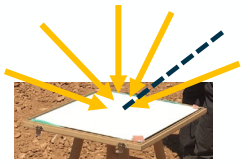
Headwall measuring:

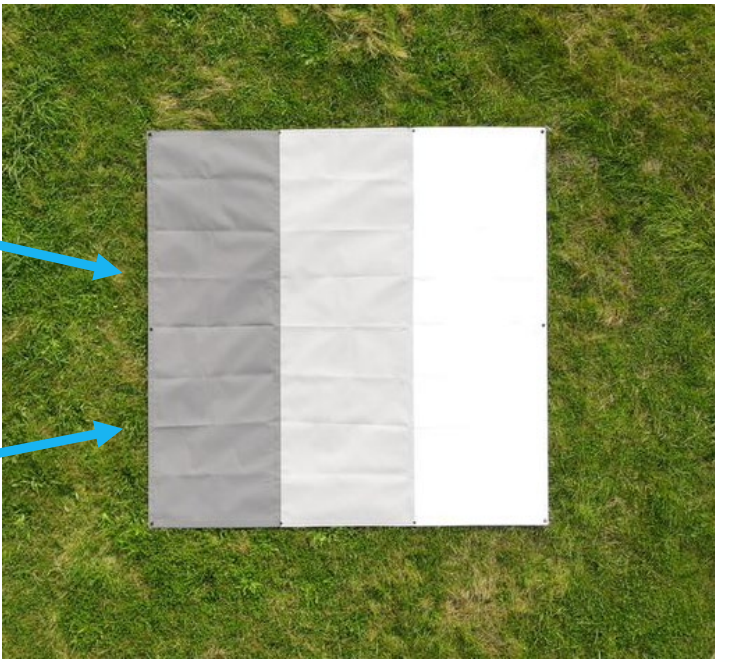
- HCRF
- ~21° AFOV (~0.03° per pixel)
- Direct component from 63.4° (SZA)





SI





Quantity matching: flight design

Details on the flight plan

Flight lines orientated to the Sentinel-2 orbit inclination

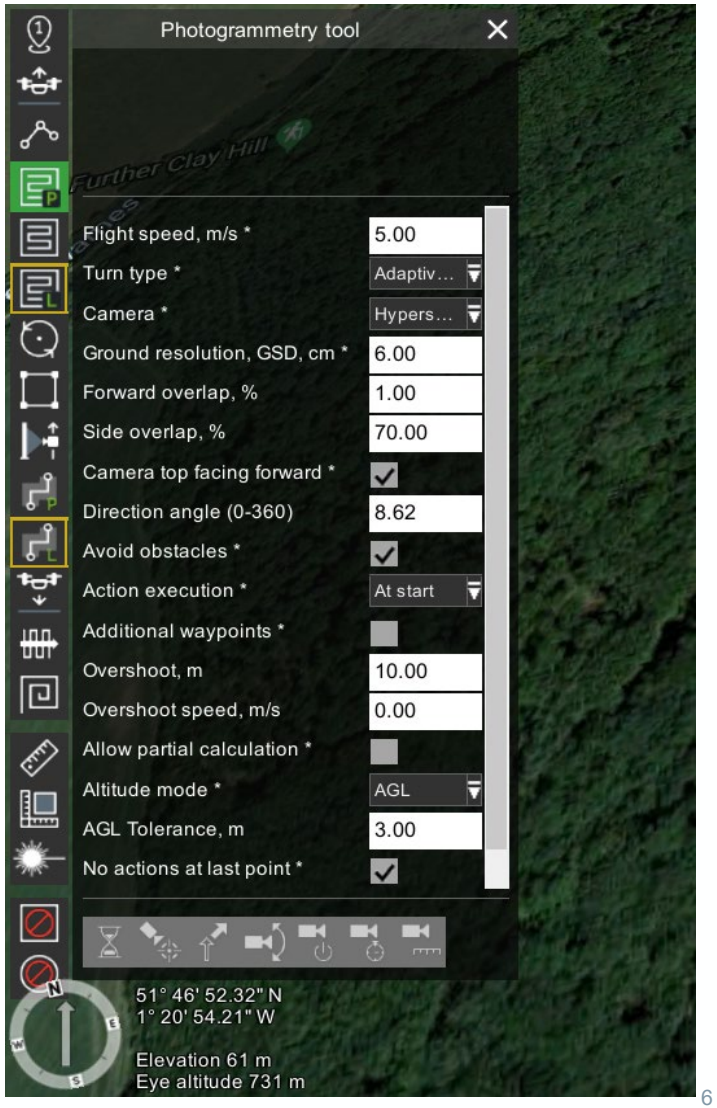
Overlap % increased to get as many pixels at each angle

Speed

Height

GSD

} Optimised to ensure the UAV can cover the area within the battery limits



Quantity matching: view angle filtering

- match the flight lines with the IMU

- match the yaw angle to the Sentinel-2 data (check rotation direction)

- identify an angular tolerance around the VZA of the pixel (± 2.5° chosen here)

- set all UAV pixels outside of the tolerance to the image fill value

- process as normal (replace with the full files)

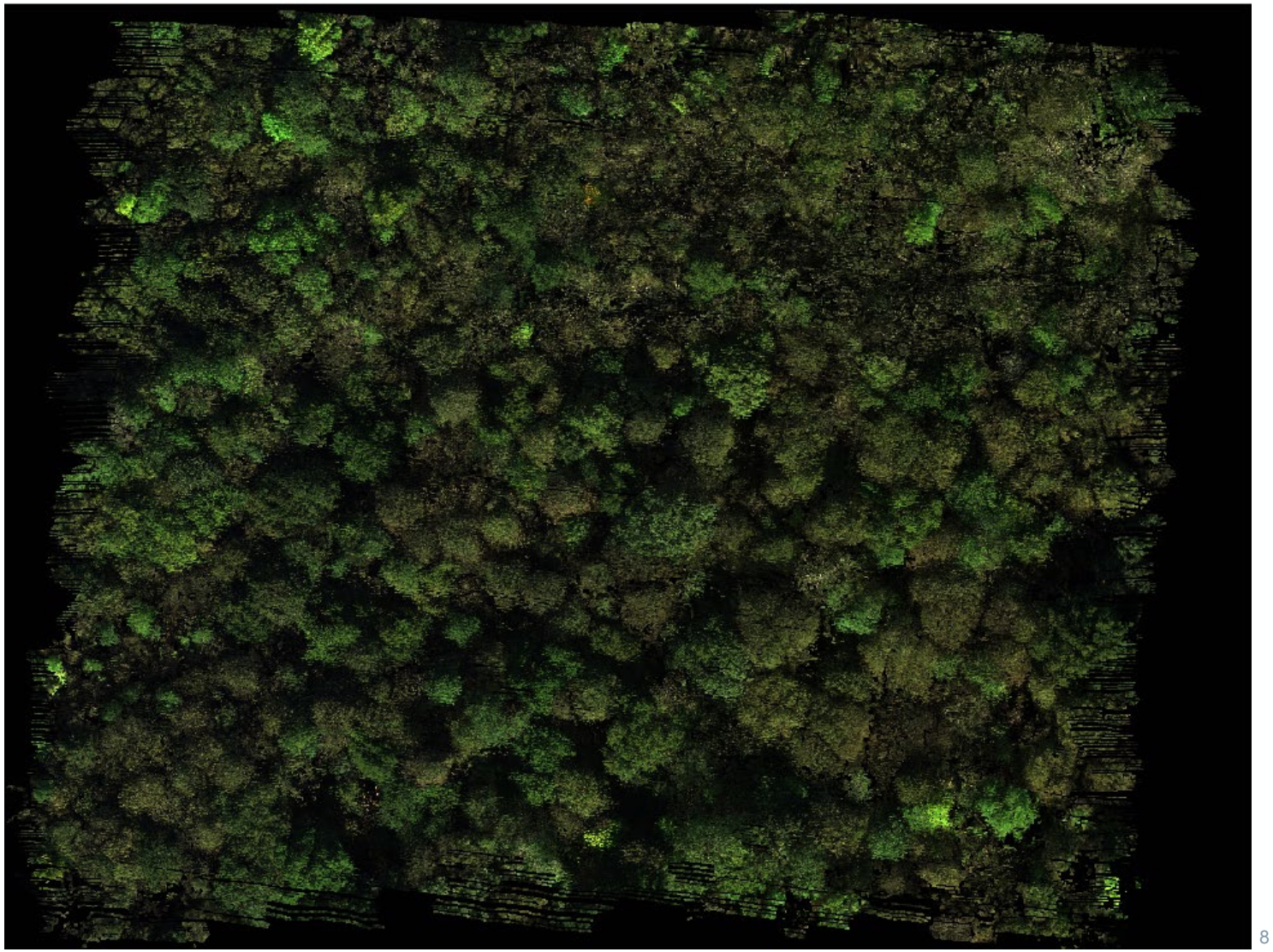
Results: #nofilter

Flight speed greater than recommended to get square pixels

Results in gaps (particularly at the edges)

Greater sampling than could ever be achieved using manual spectrometers

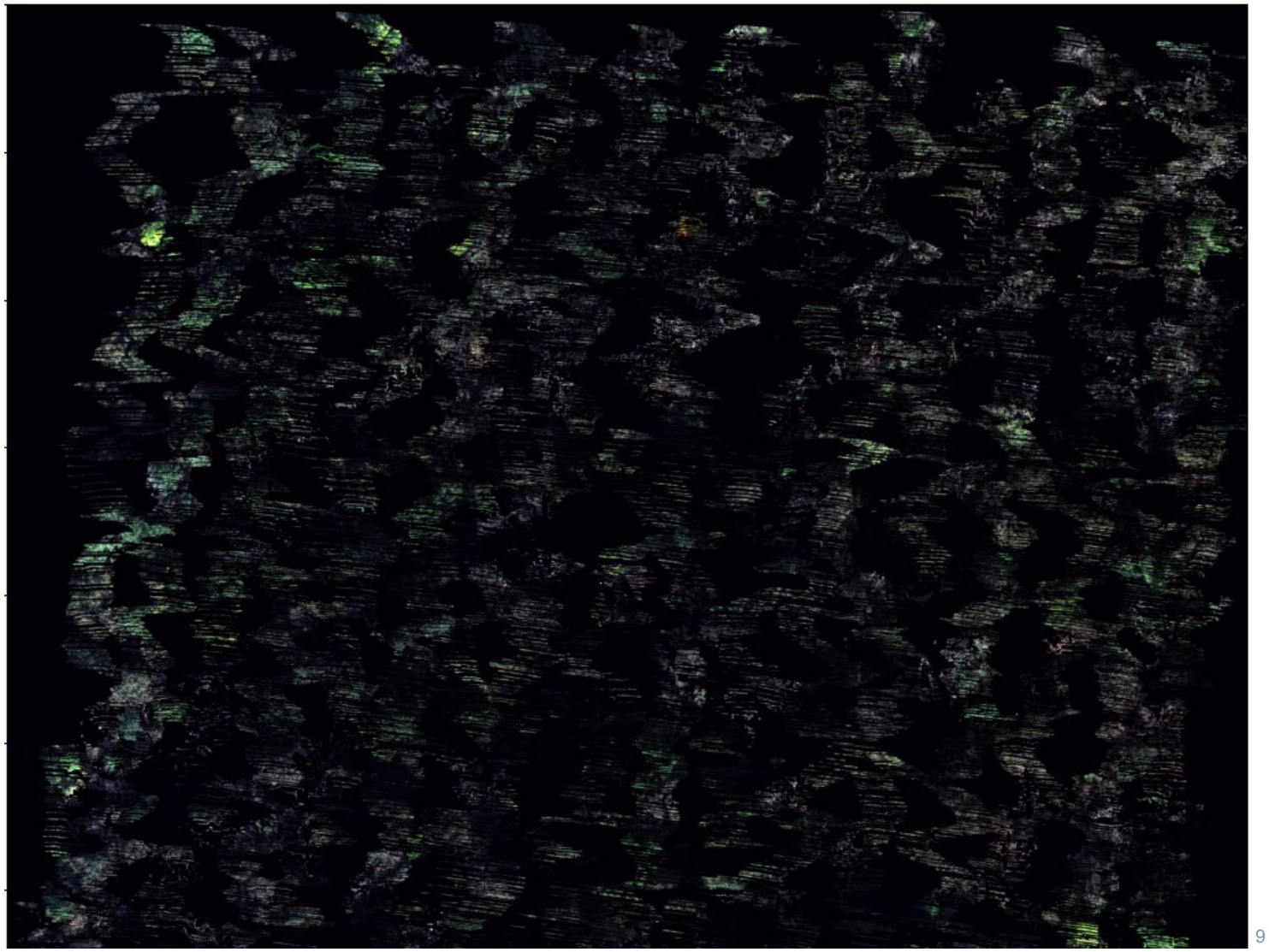
High overlap means each pixel is an average from many different views



Results: VZA filtering

~33% of pixels compared to previous

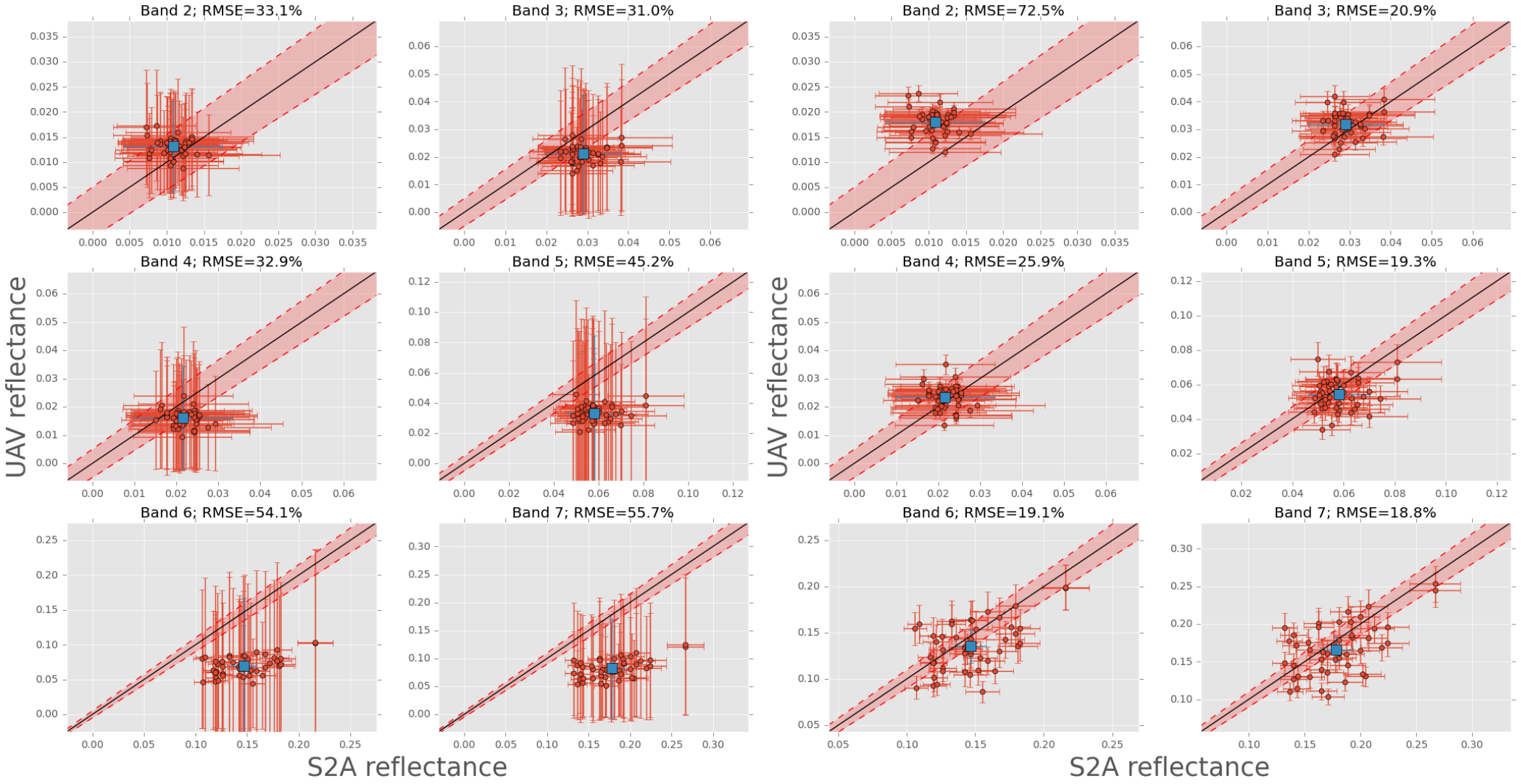
Still much greater sampling than manual spectrometers



Results: comparison (dark)

No filter

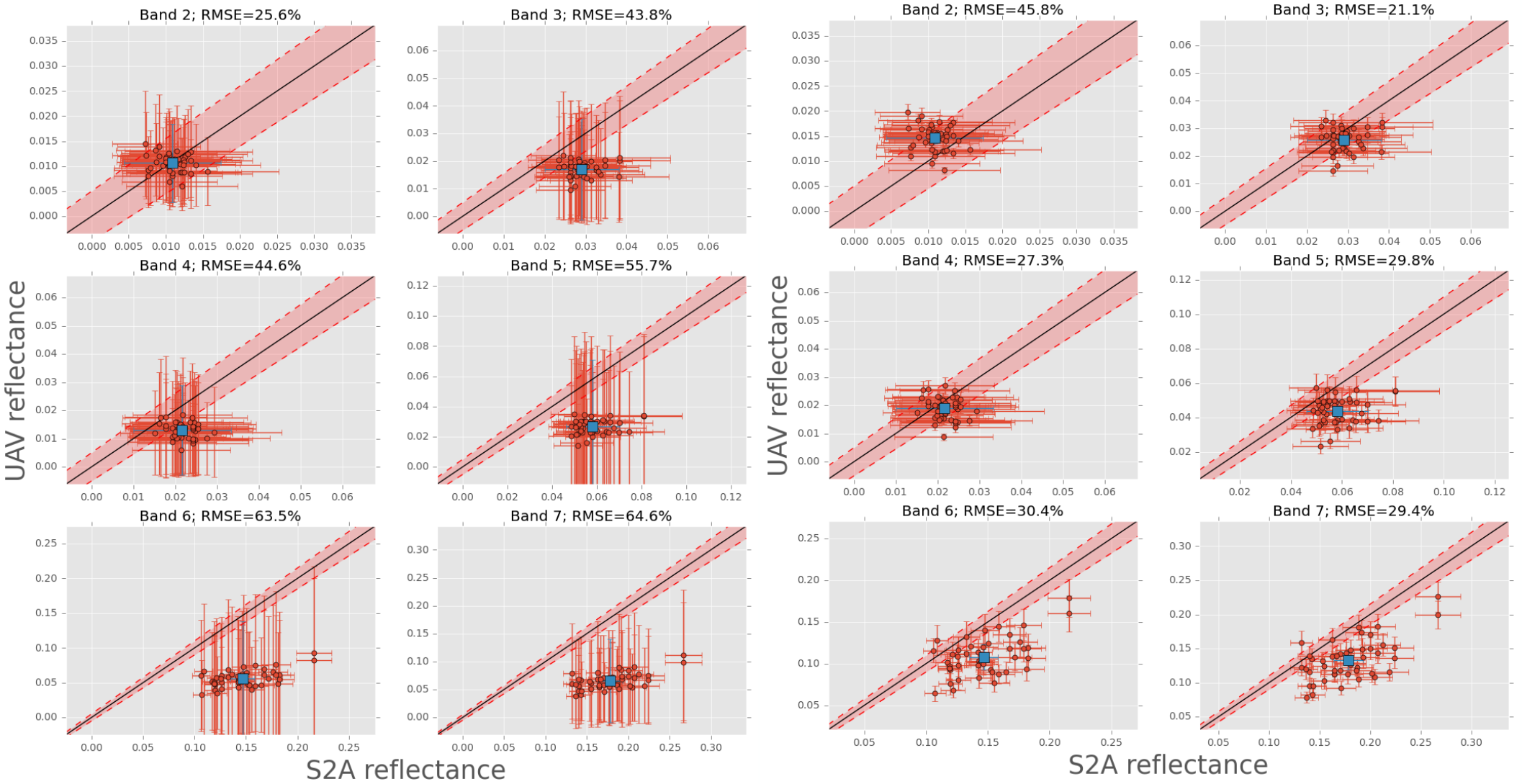
Filtered



Results: comparison (middle)

No filter

Filtered



Surface Reflectance intercomparison for Vegetation (SRIX4Veg)

Endorsed by:

CEOS
Committee on
Earth Observation Satellites

Funded by:

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UCLM
Universidad de
Castilla-La Mancha
CAMPUS DE EXCELENCIA INTERNACIONAL

Project partners:

University of
Southampton

NPL
National Physical Laboratory

EOLAB

SRIX4Veg

Premise is to assess the variability of different teams measuring the same thing

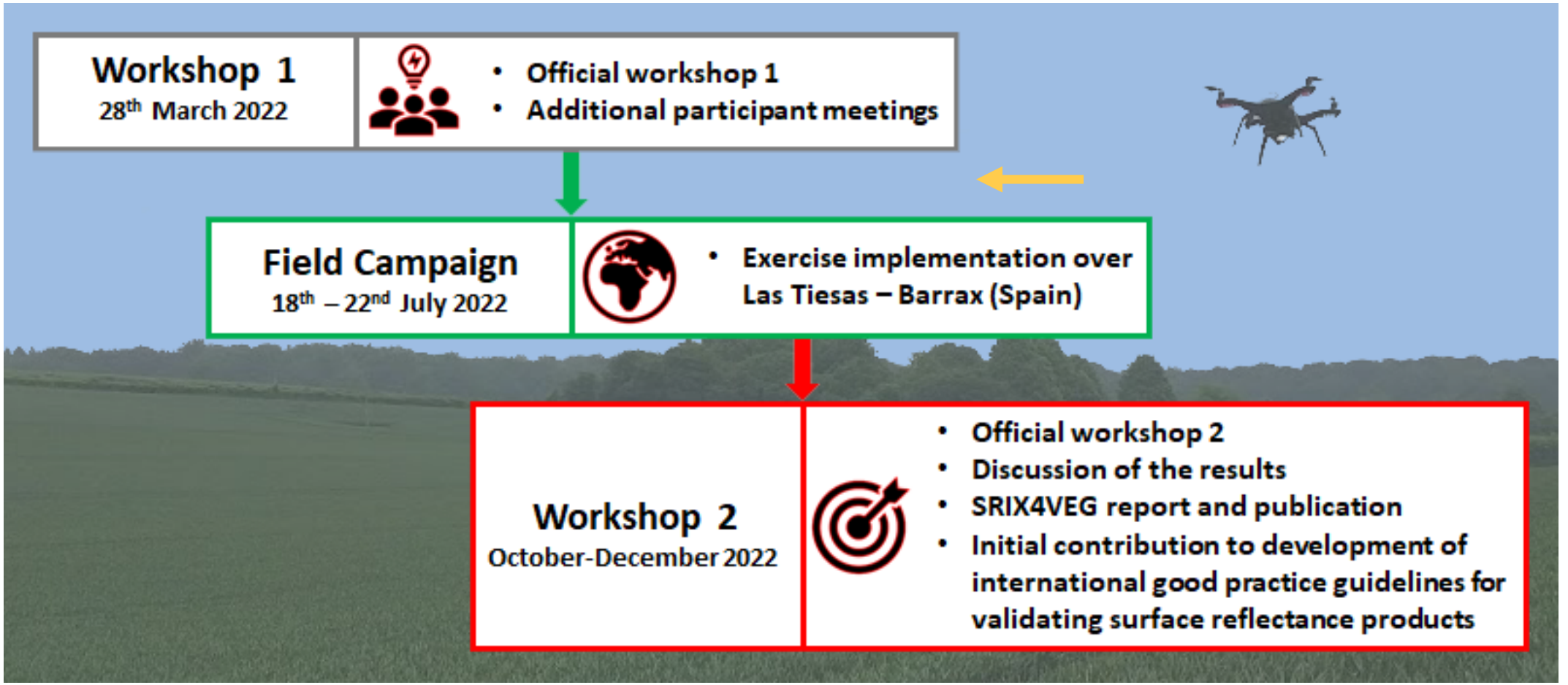
Develop a community-agreed protocol to reduce that variability

SRIX4Veg is composed of two core experiments:

1. Each team is given the same information about a satellite overpass and collects data according to their own plans
2. Each team is given a data collection plan based on an initial, draft protocol

Both experiments are round-robins meaning that each participant will fly back-to-back with every other – only the pairs will be analysed

SRIX4Veg timeline



frm4veg.org/srix4veg/

Conclusions

- Matching the in situ data measurement plan to the satellite quantity is paramount and requires a lot of effort
- SR validation requirements different to most other applications of UAV-based reflectance
- VZA filtering plays significant role in reducing uncertainty and improving differences
- SRIX4Veg activity looking to standardise approaches to SR validation

Questions

Thanks for your attention

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