

COST Action ES1309 OPTIMISE Final Conference
Sofia, Bulgaria, 21-23 February 2018



STSM: Testing the performance of a UAV thermal camera

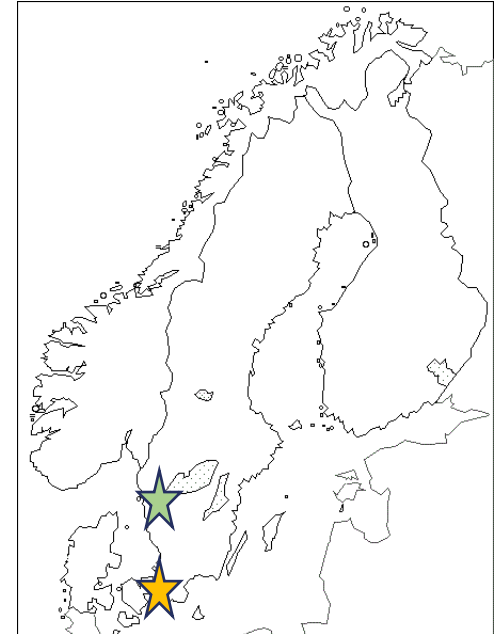
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STSM host: Lars Eklundh (Lund University, Sweden)

Context

- PhD: Combining Close-Range Remote Sensing Approaches to Model Carbon Fluxes in Boreal Mires
- Aim: new method
 - Fixed and UAV sensors
 - Ecosystem respiration → thermal
- Area: Skogaryd Research Station
 - Grass vs moss fluxes



- ★ Lund University
- ★ Skogaryd Research Station

Thermal cameras on UAVs

- Literature: crop water stress, evapotranspiration, GPP

Why test camera performance?

- “plug and play”, cheaper models
- Accuracy $\pm 5^{\circ}\text{C}$
- Uncalibrated vs calibrated
- Air temperature, stabilization time, vignetting...



FLIR Vue Pro 640

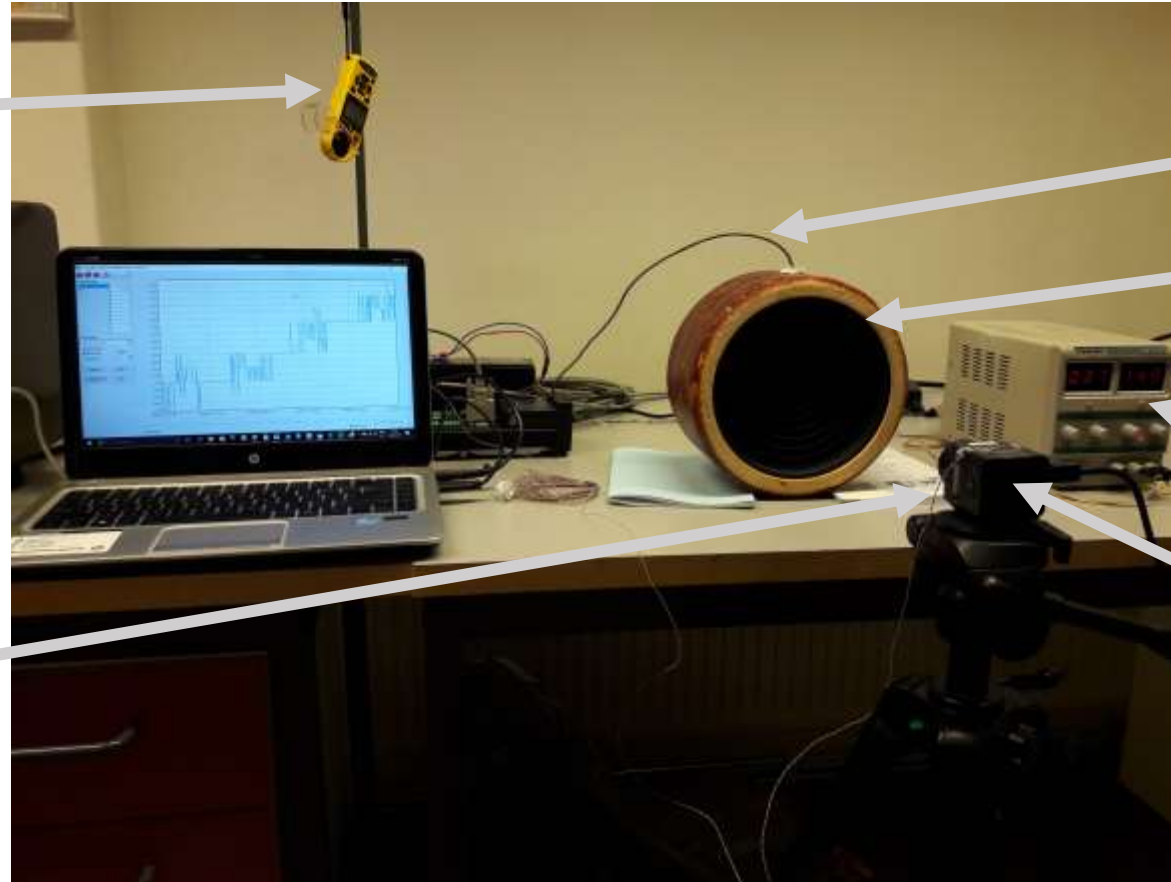
STSM aims

1. Camera stabilization time
2. Blackbody calibration curve
3. Effect of atmospheric temperature variation
4. Sensor noise

Experimental set up

Kestrel pocket weather tracker

Thermocouple recording camera temperature



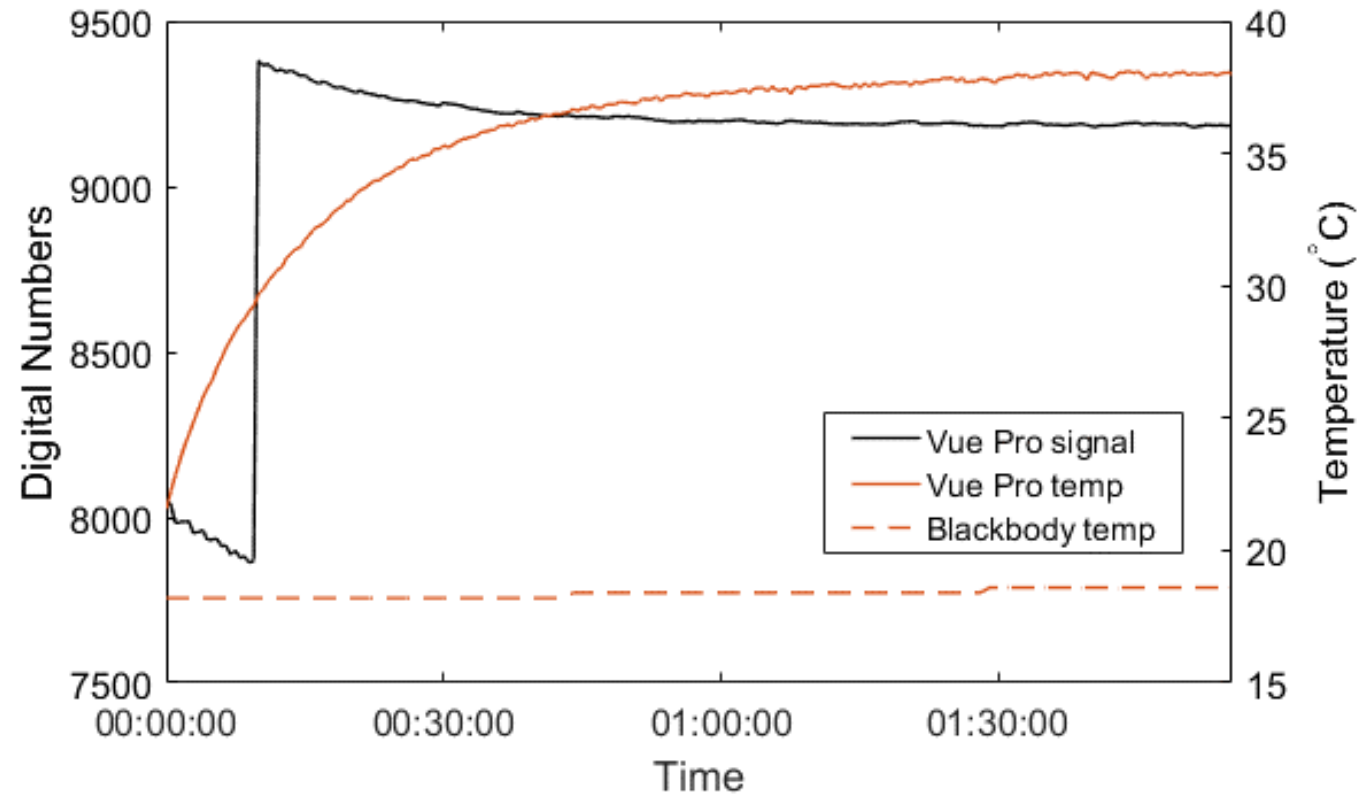
Blackbody resistance thermometer

Blackbody radiator

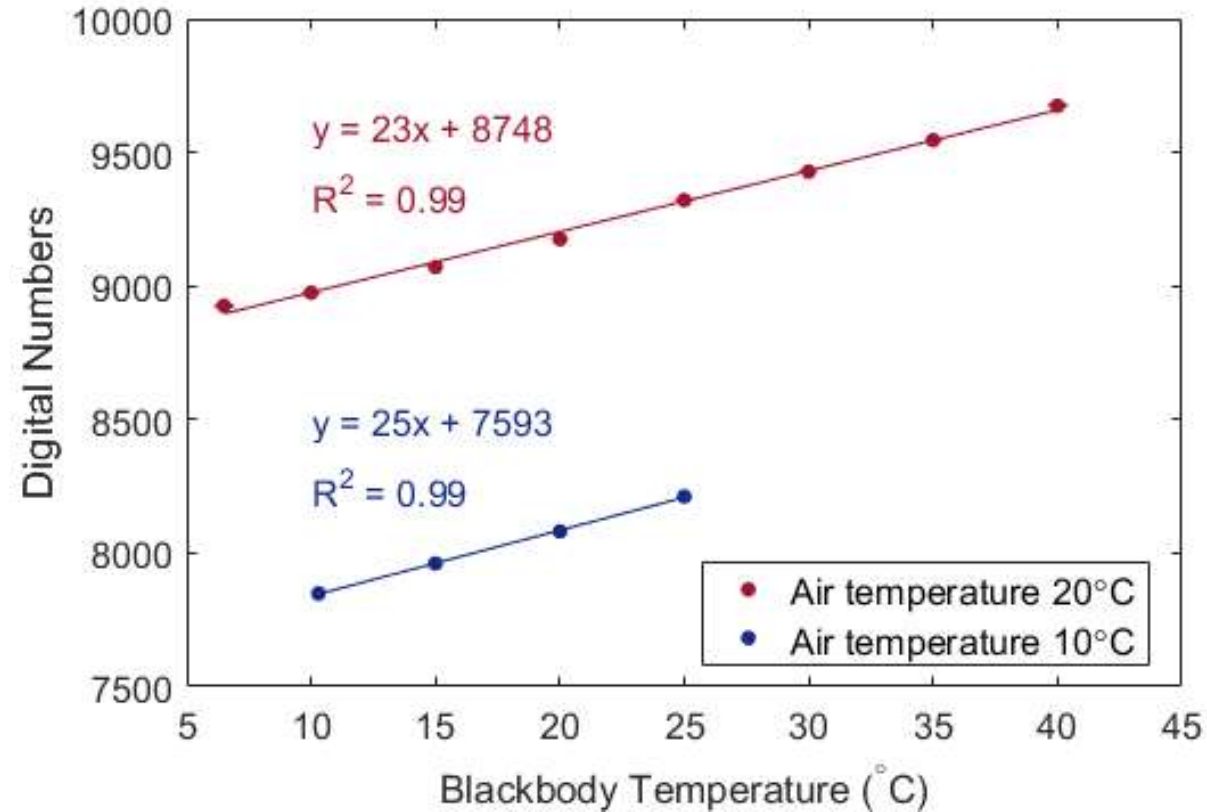
Blackbody power supply and temperature control

FLIR Vue Pro 640

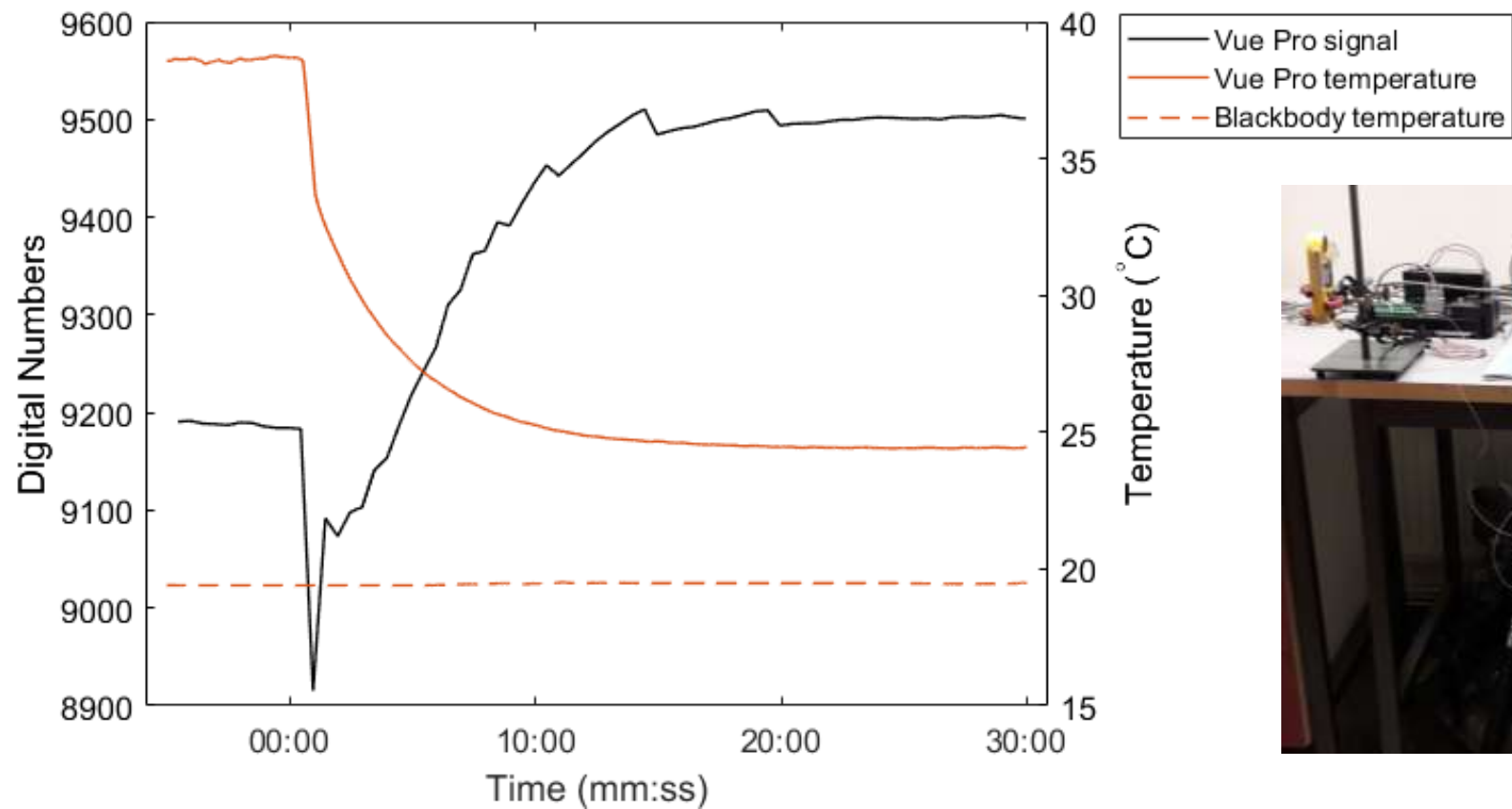
Stabilization time



Blackbody calibration



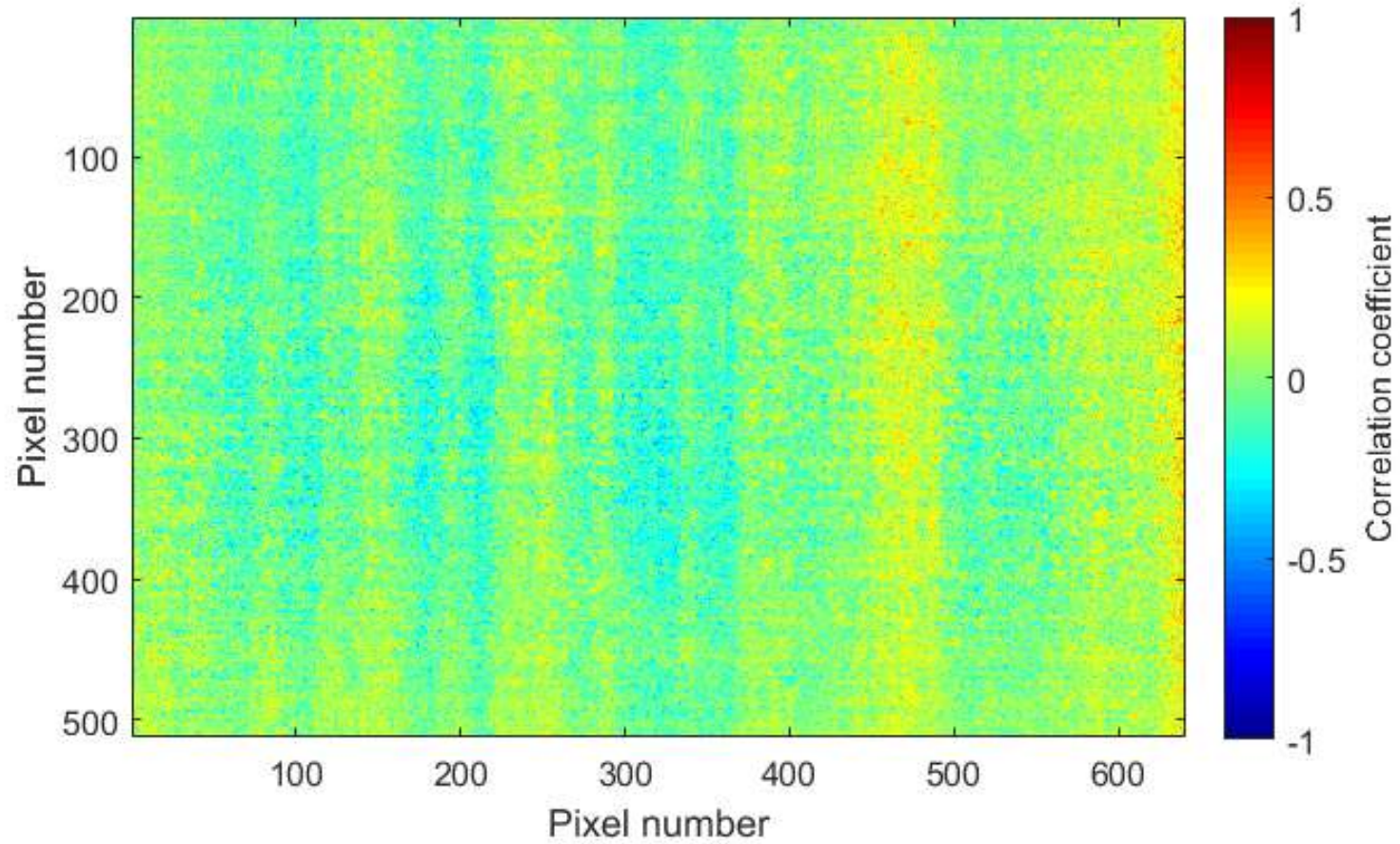
Effect of wind



Why so sensitive to temperature?

- Uncooled camera → sensor temperature fluctuates
- Camera interior produces thermal radiation
- Sensor 'sees' large proportion of camera interior
 - Central pixel receives 4x as much radiation from camera interior as from object (Budzier et al., 2015)

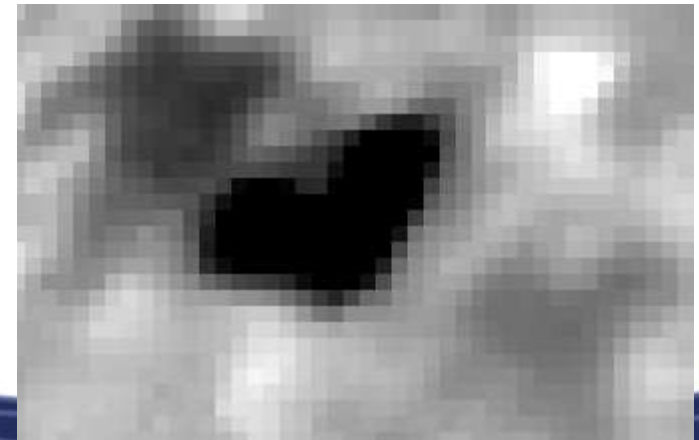
Sensor noise



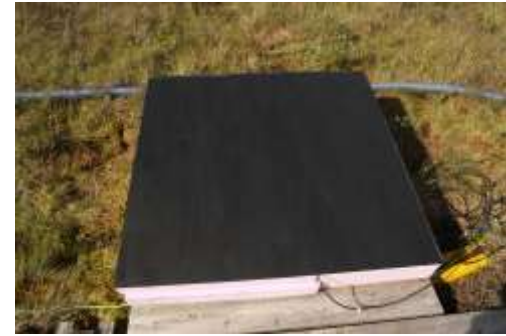
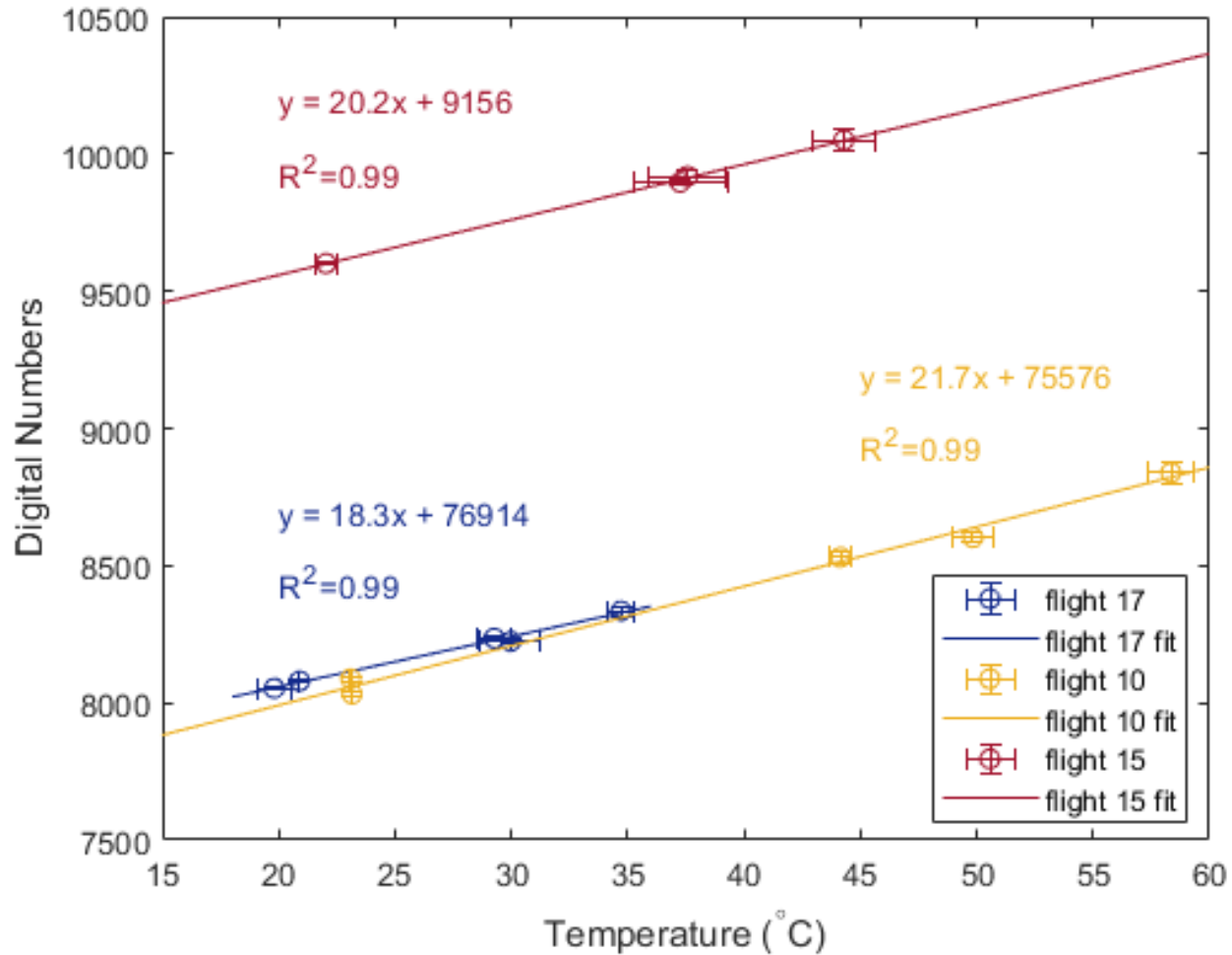
Beyond the STSM

Supported by the Royal Geographical Society (with IBG) Dudley Stamp Memorial Award

- Field testing
 - 6 Calibration plates
 - 10 GCPs
 - 3 flights
- Installation new fixed thermal camera



Field calibration



In the field

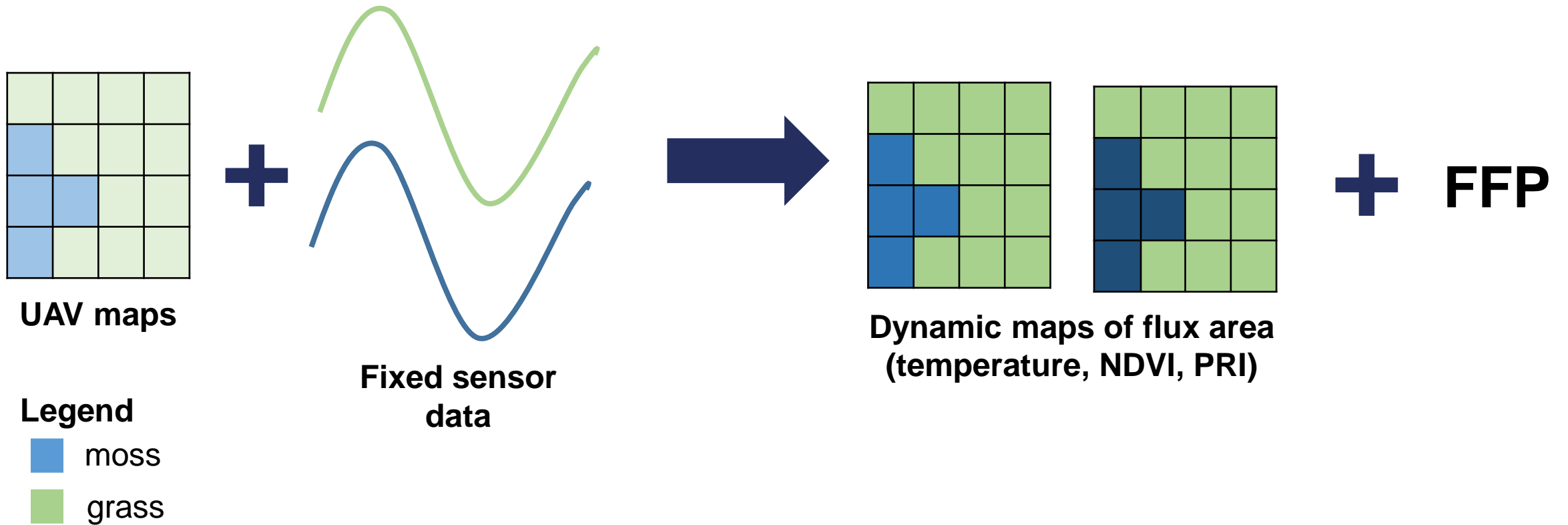
- Best practices for UAV flights with thermal camera
 - Turn on camera at least 15mins before take-off + fan
 - Add extra flight lines
 - Try to shelter camera when on UAV
 - Fly slowly
 - Temperature calibration in the field
 - Spending more money is worth it
- Agisoft Photoscan Pro workflow for FLIR Vue Pro (www.juliageographer.wordpress.com)

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Thank you for listening!

How to upscale fixed camera data?



Mycklemossen



Vignetting

