Bundesamt
für Wasserwirtschaft

Eine Einrichtung des Bundesministeriums für
Nachhaltigkeit und Tourismus

Thermal emission of soil surfaces assessed from temperature data recorded by UAV-thermal sensors

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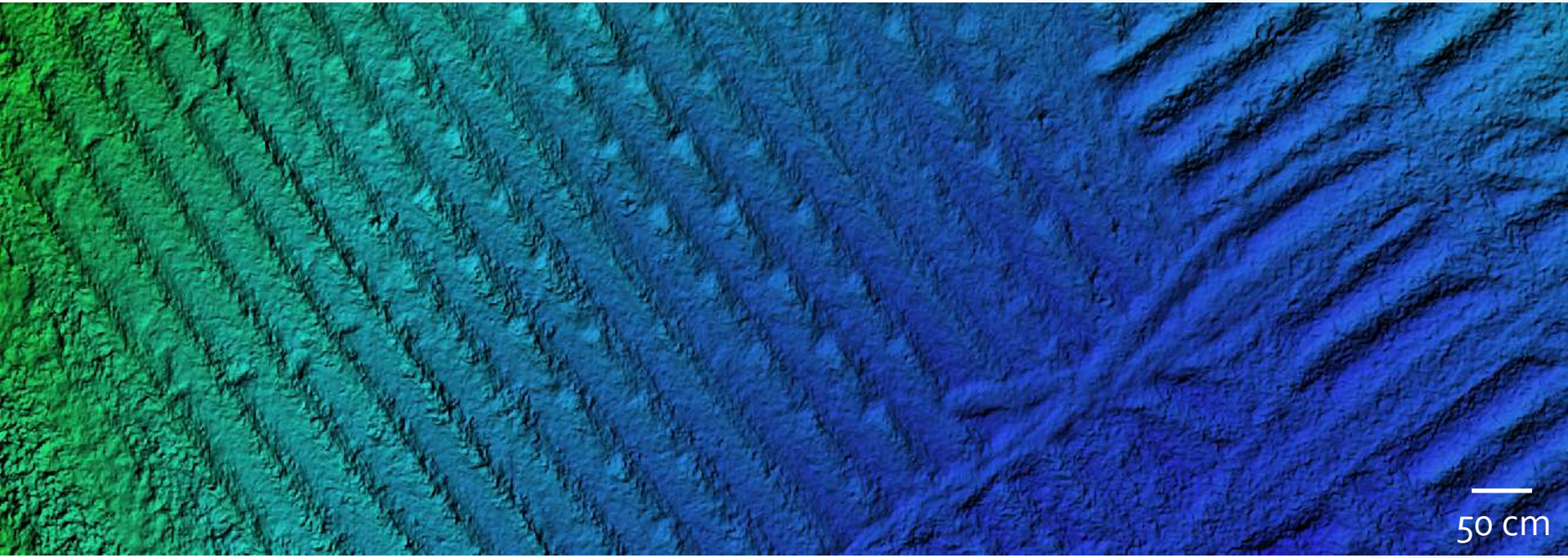
Our intention of using UAV

- Detection and mapping of soil erosion patterns.
- Compilation of Digital Terrain Models (DTMs) as a basis for i) empirical and physically based soil erosion models and ii) DTMs of Difference (DoD) for erosion volume calculation.

Example: Functionality of cross dams in potato fields



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…in combination with thermal sensors

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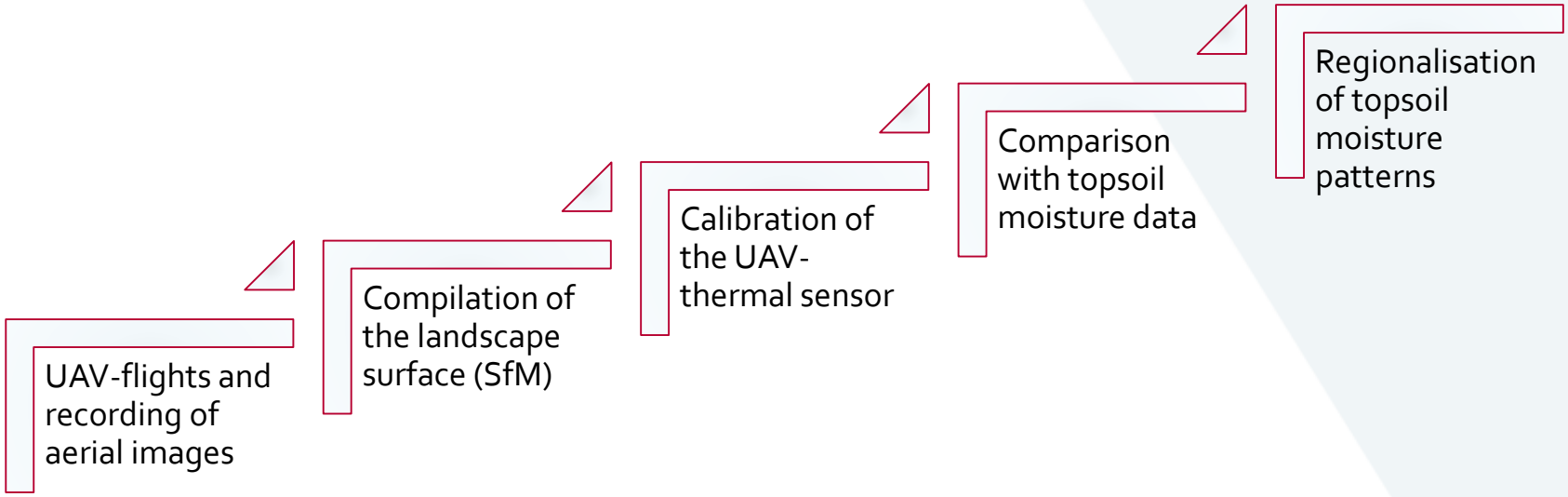
Approach


UAV-flights and recording of aerial images
Compilation of the landscape surface (SfM)
Calibration of the UAV-thermal sensor
Comparison with topsoil moisture data
Regionalisation of topsoil moisture patterns

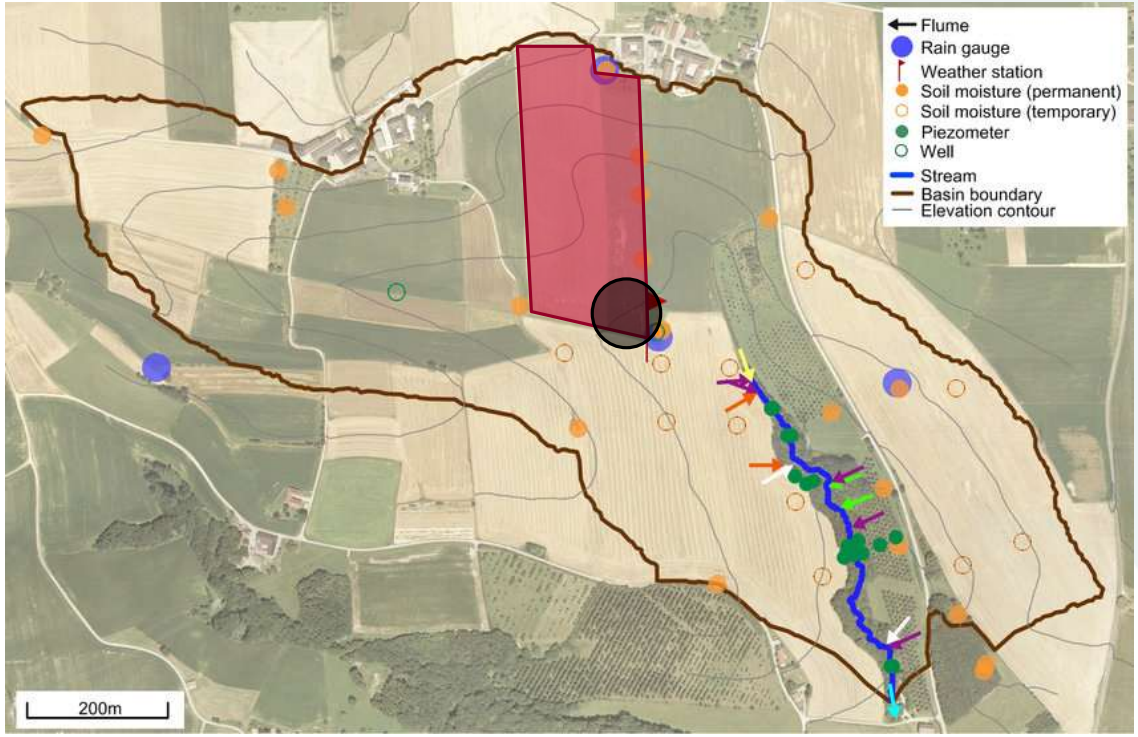
Equipment

- UAV: DJI Matrice 200
- UAV-thermal sensor: FLIR Zenmuse XT2 (9 mm lense, 35° x 27° FoV)
- Handheld thermal sensor: FLIR E 49001
- Soil net sensors for soil moisture and temperature (5 – 50 cm)
- Additional thermometer for surface temperature

Test area

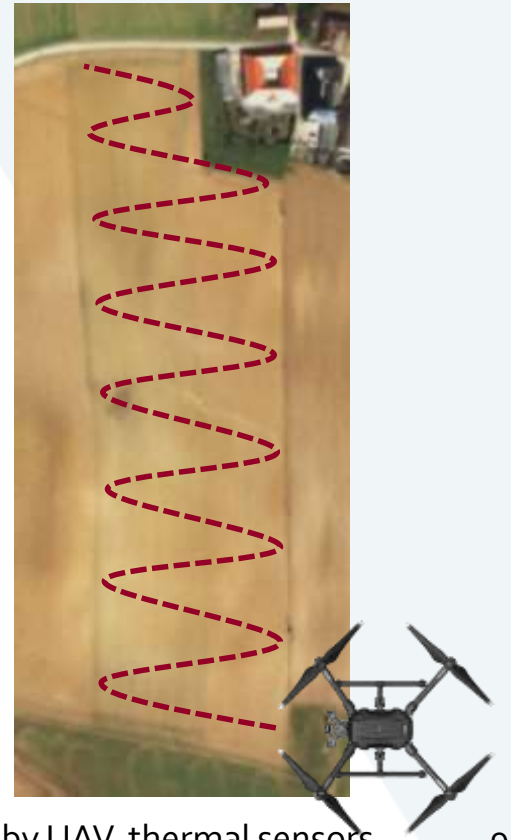
- HOAL catchment Petzenkirchen, Austria
- ~3.5 ha field planted with winter wheat
- Soil properties: sL/zL, approx. 48 % pore volume

Test area


Flume
Rain gauge
Weather station
Soil moisture (permanent)
Soil moisture (temporary)
Piezometer
Well
Stream
Basin boundary
Elevation contour
200m

Aerial images and DTM

- Approx. 350 images with ~20 % of image overlap and 30 m flight height.
- Agisoft Photoscan for DTM-generation (high accuracy of image overlapping and dense cloud calculation).
- DTM of 3 cm x 3 cm.



Calibration of thermal emission

~100 m

20-30 m

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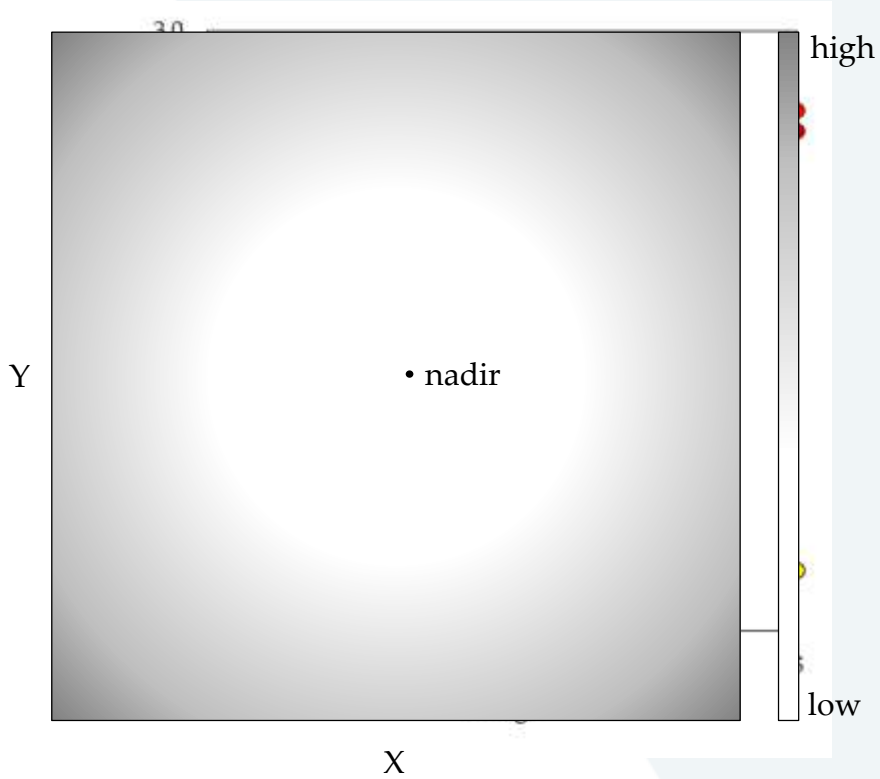
Calibration of thermal emission



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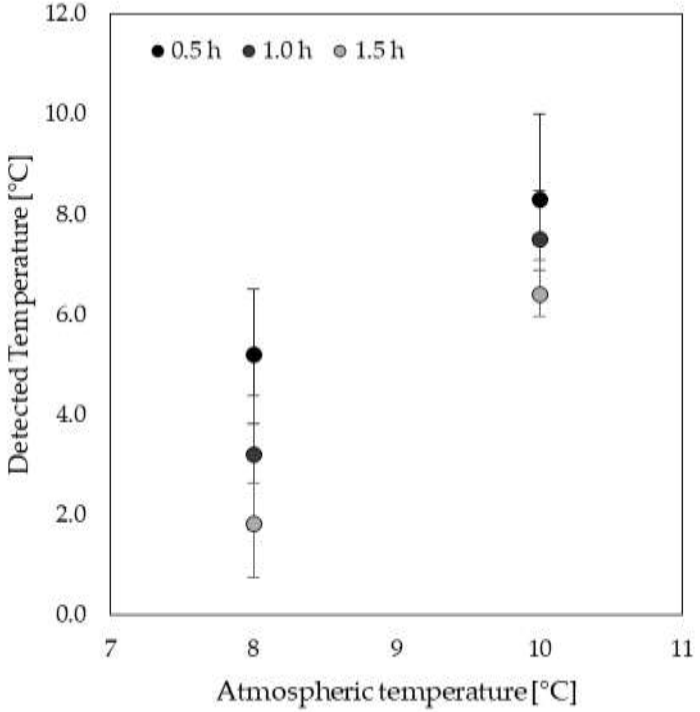
Calibration of thermal emission

- Different detection of surface temperature according to atmospheric temperature.
- ΔT increases with time of sensor in use.



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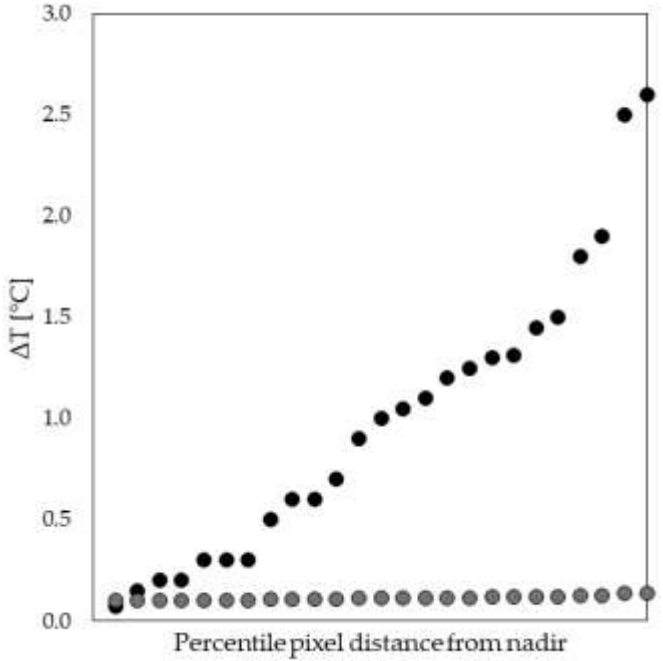
Topsoil moisture from temperature



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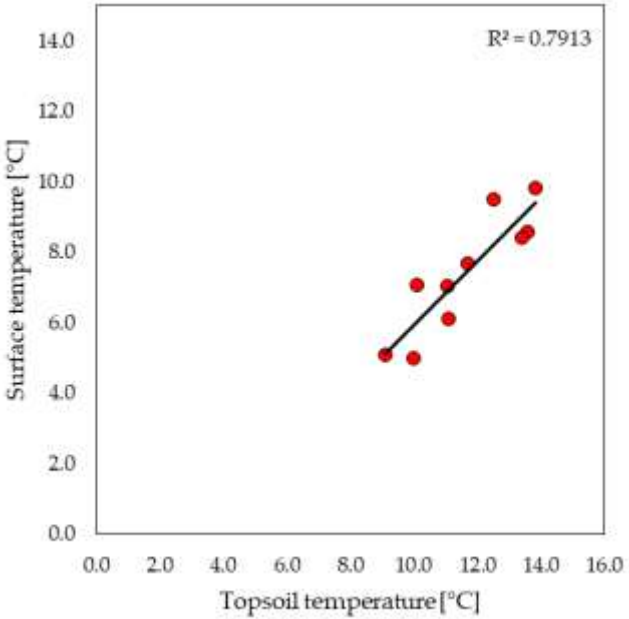

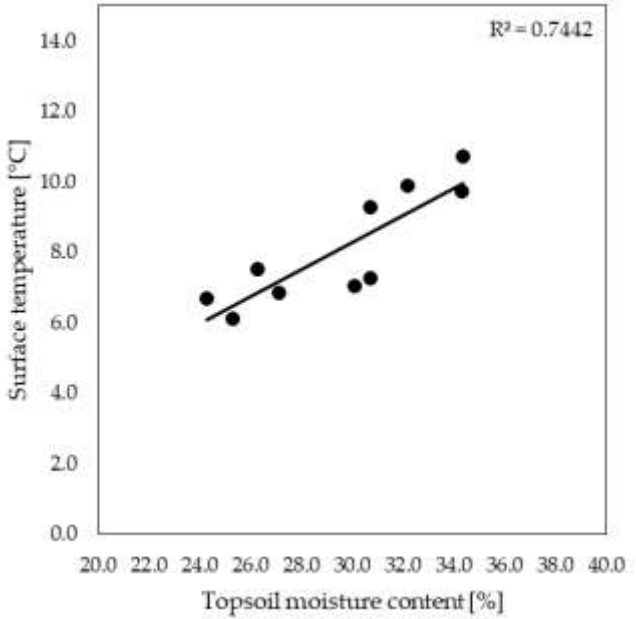

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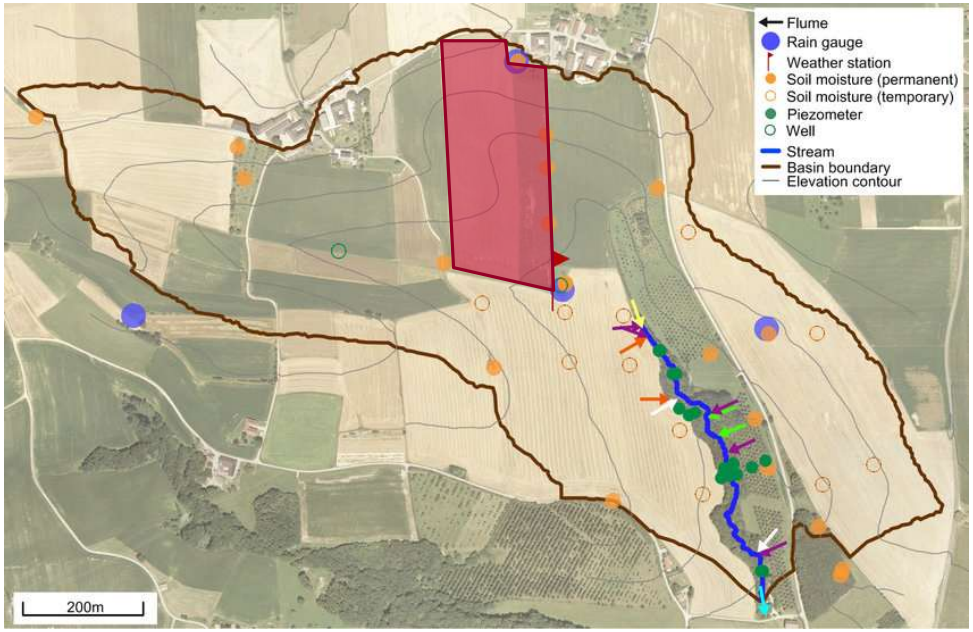
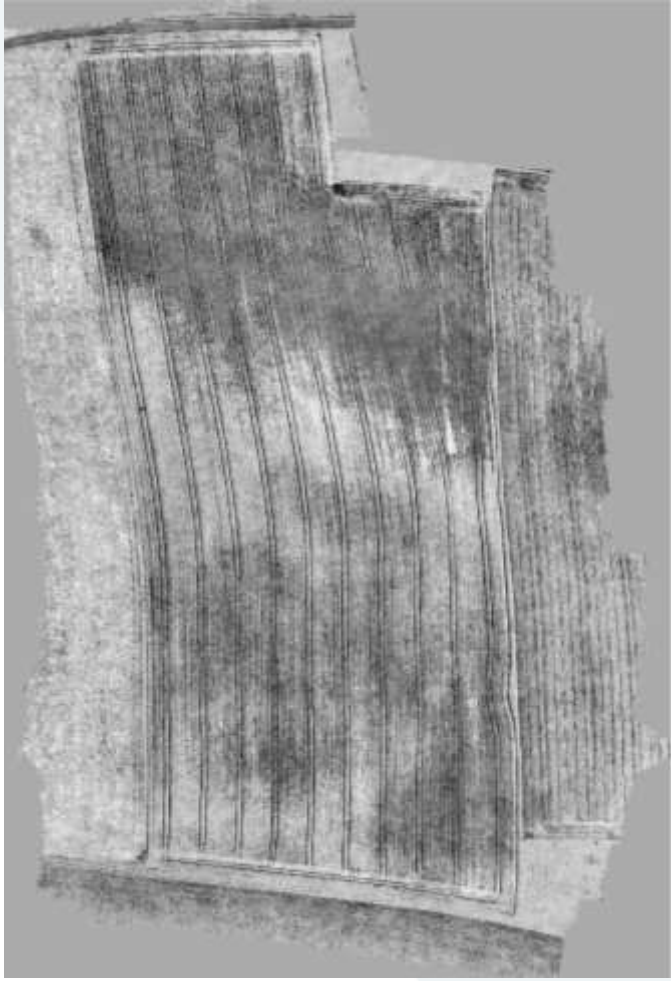
Topsoil moisture from temperature



max



min

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Concluding remarks

- The accuracy of the thermal sensor (Zenmuse XT2) is strongly related to atmospheric influences.
- The thermal images of the sensor most likely need a spatial calibration in the post-processing of the data.
- Our preliminary study provided indication that UAV-thermal imagery can be related to topsoil temperature.

Thank you for your attention!

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