



Do's for UAV spectral remote sensing

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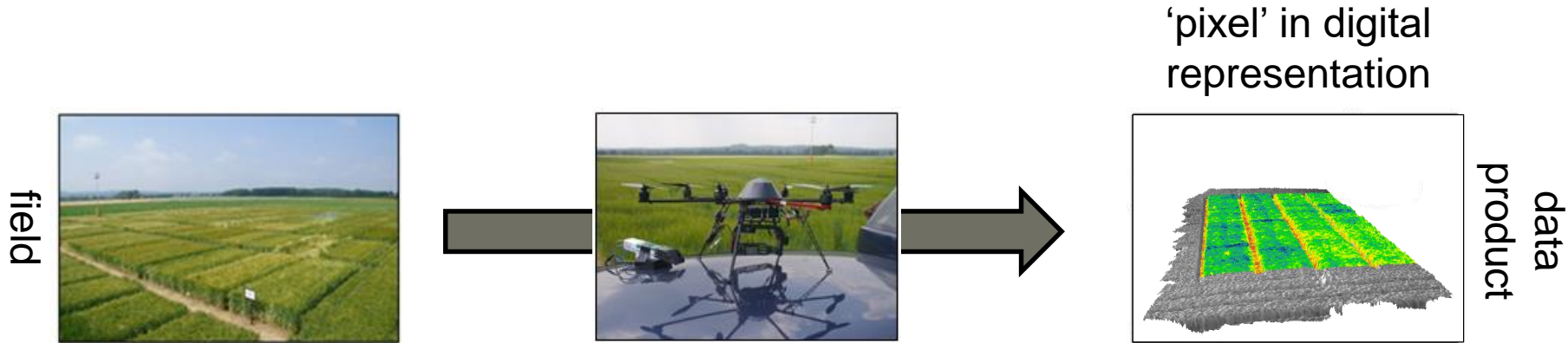
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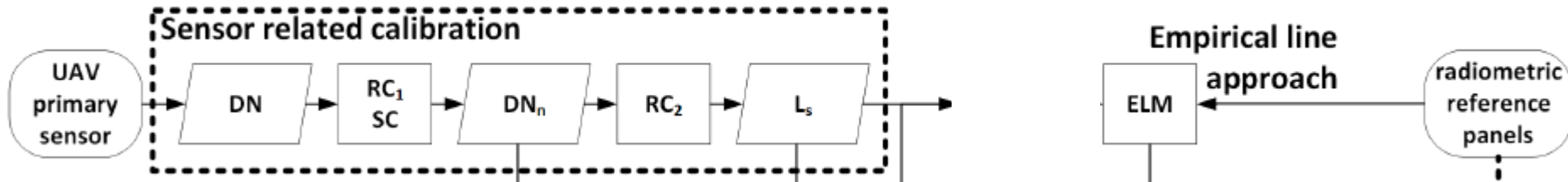
Outline



1. Radiometric in-field (vicarious) calibration
2. Different data processing schemes give you different results
3. How to keep track of all of that

Spectral & radiometric calibration workflow

- Radiometric calibration determines the transformation from pixel values to the physically meaningful information



Laboratory

RC1: relative calibration to uniform response

SC: spectral calibration estimates band configuration

DNn: normalized DN

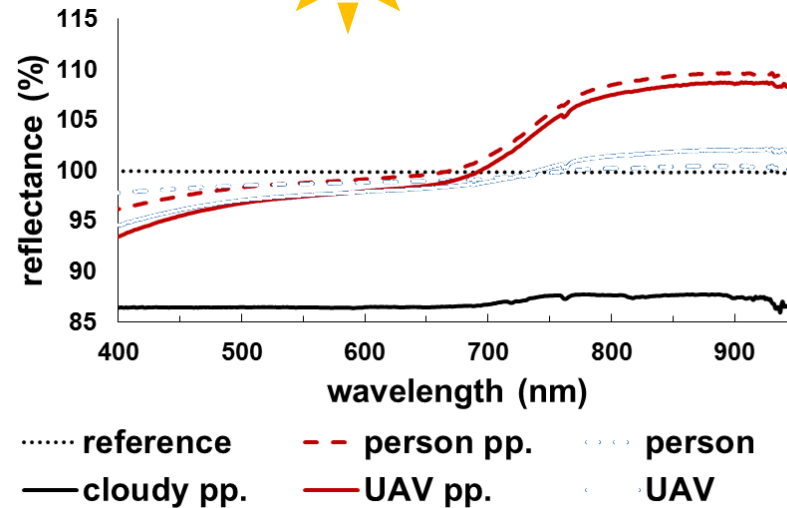
RC2: absolute radiometric calibration to (at-sensor radiance)

Field

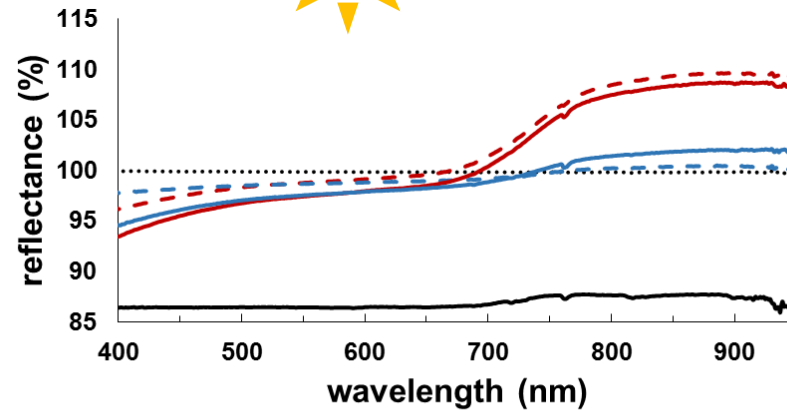
Transformation to reflectance factors

e.g. with the empirical line method (ELM)

Radiometric calibration protocol



Radiometric calibration protocol



..... reference - - - person pp. - - - person
 — cloudy pp. — UAV pp. — UAV

Take home message #1

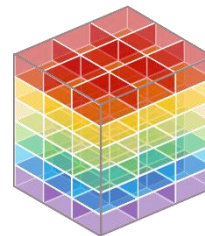
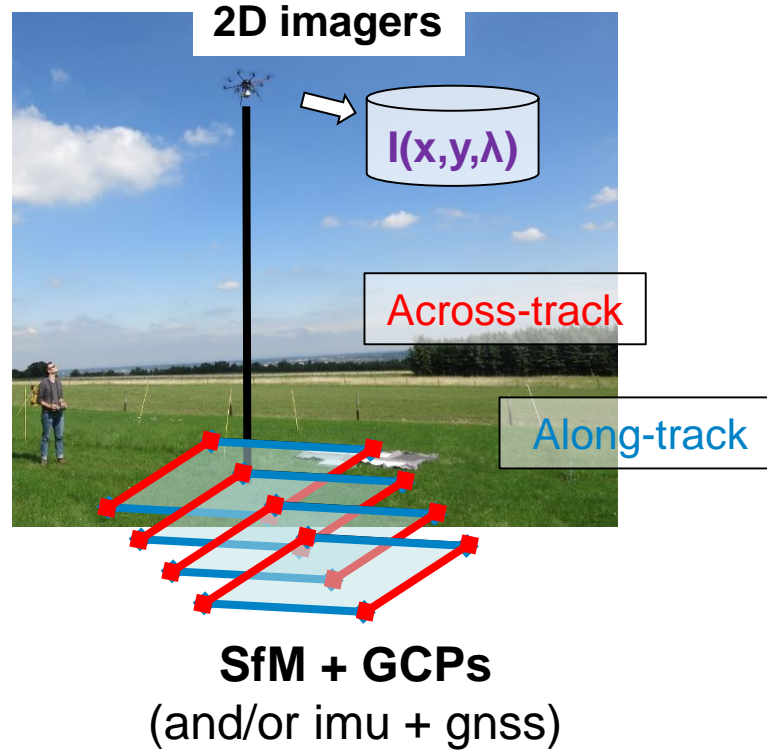
- Radiometric calibration: Don't use “field-spectroscopy like calibration”
 - Use empirical line + radiometric block adjustment or irradiance sensor [1, 2]

[1] Aasen, H., Honkavaara, E., Lucieer, A., Zarco-Tejada, P., 2018. Quantitative Remote Sensing at Ultra-High Resolution with UAV Spectroscopy: A Review of Sensor Technology, Measurement Procedures, and Data Correction Workflows. Remote Sensing

[2] Aasen, H., Bolten, A., 2018. Multi-temporal high-resolution imaging spectroscopy with hyperspectral 2D imagers – from theory to application. Remote Sensing of Environment.

Data processing

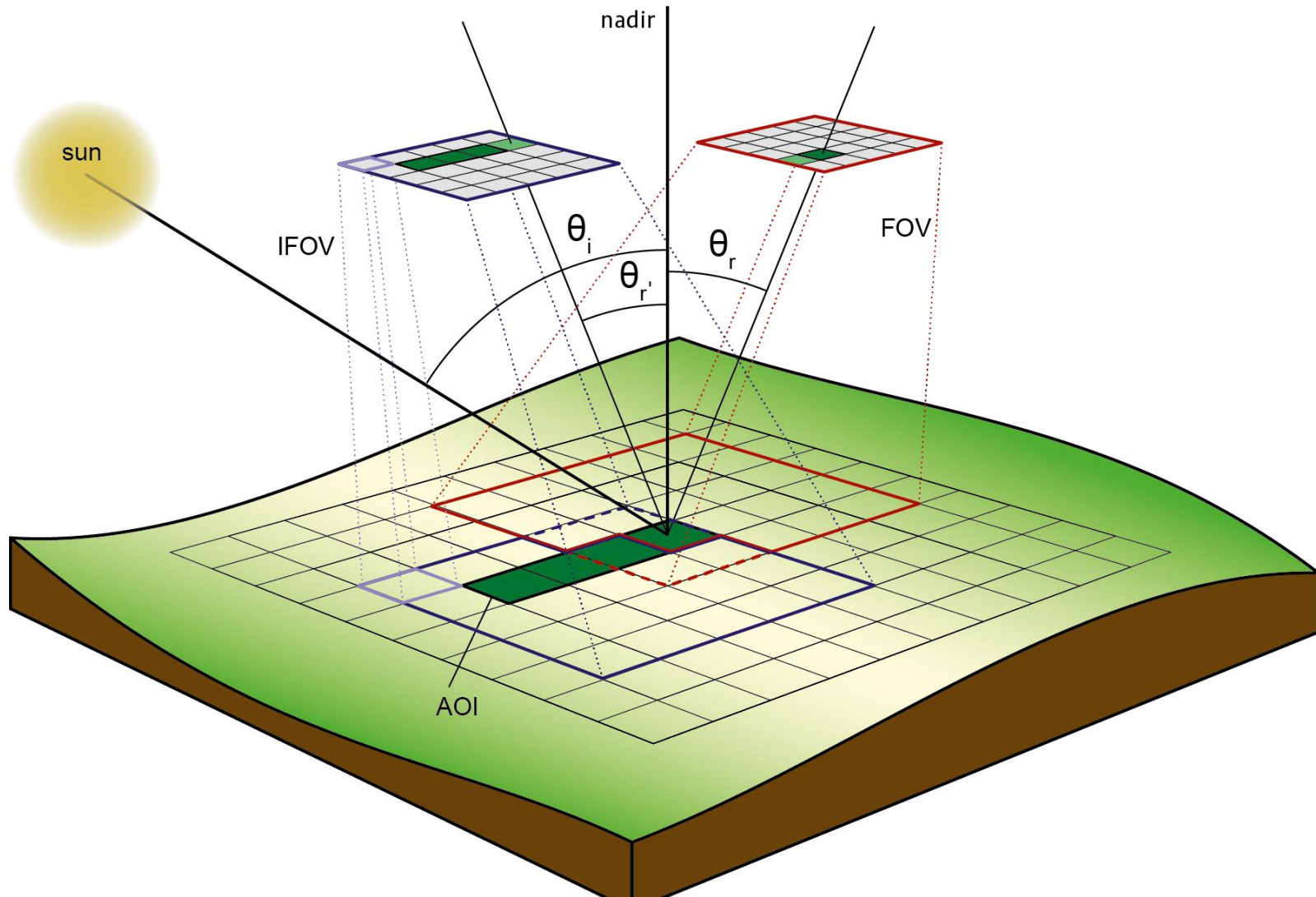
(spectral) 2D imagers



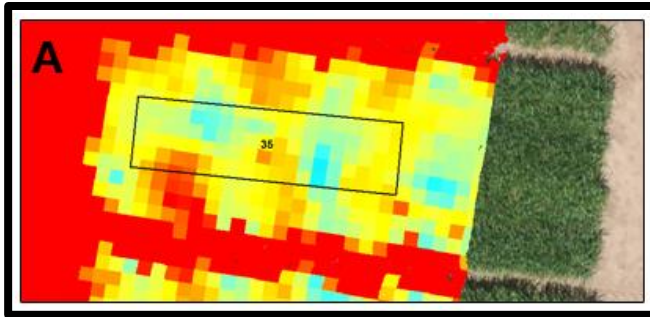
Drawings kindly provided by
Stefan Livens (VITO)

Orthorectification via

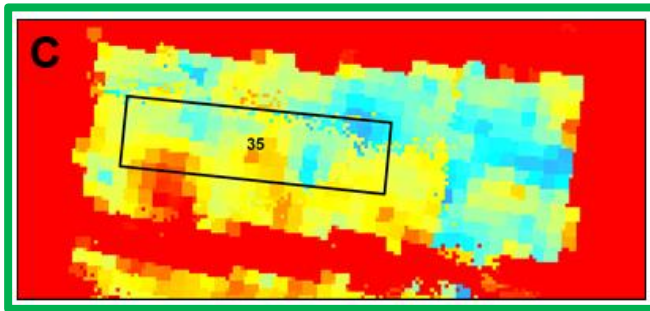
Imaging spectroscopy with 2D imagers



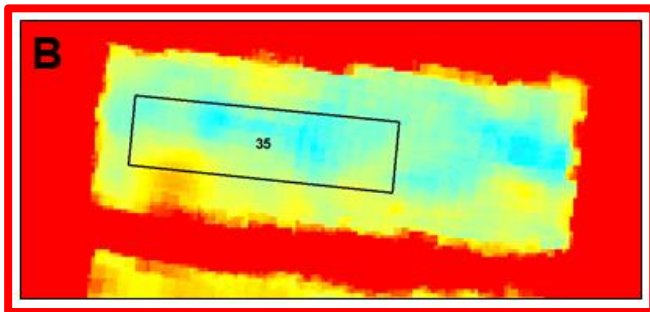
Imaging spectroscopy with 2D imagers



Single (most nadir) image

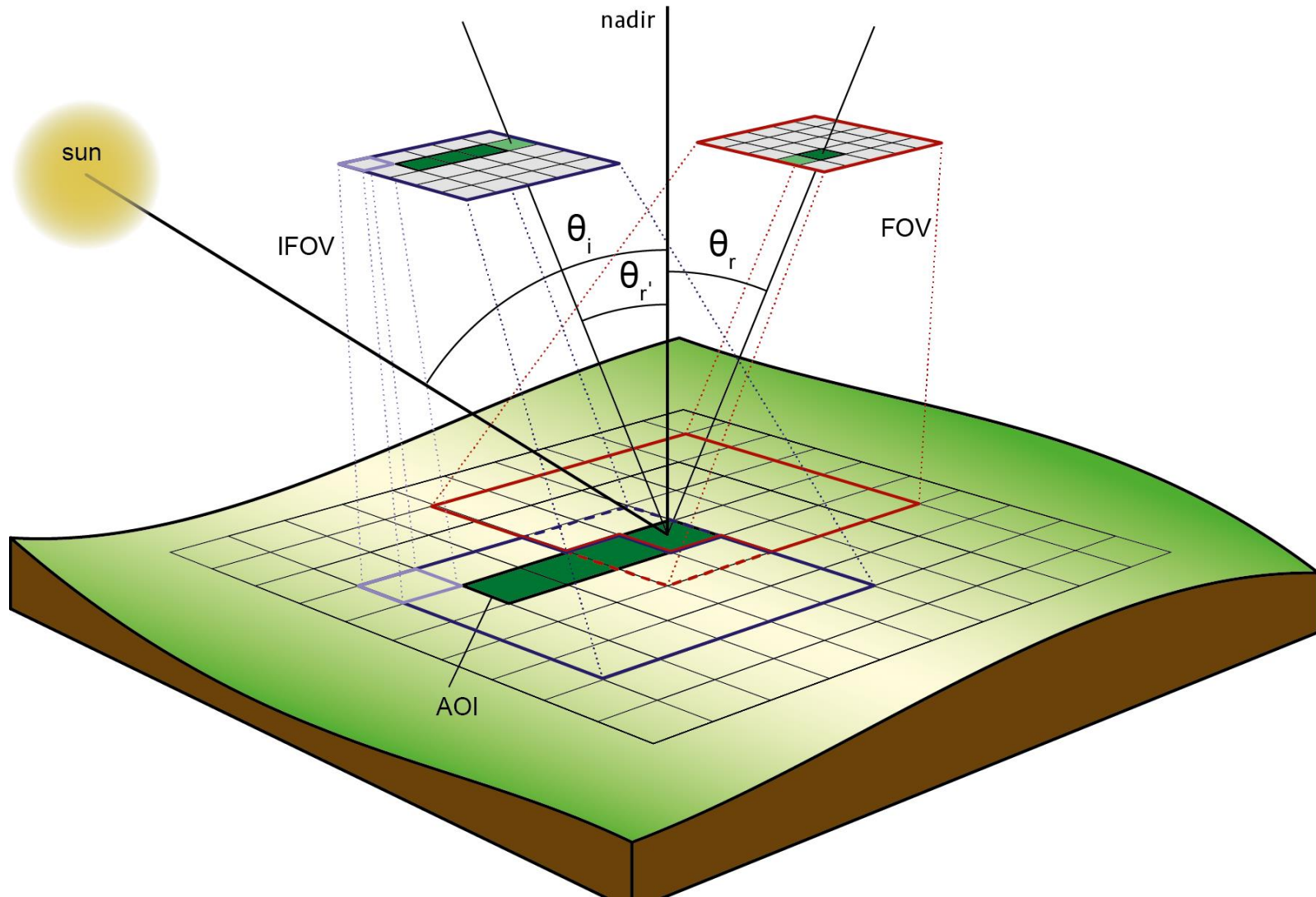


Mosaic, blending: disabled

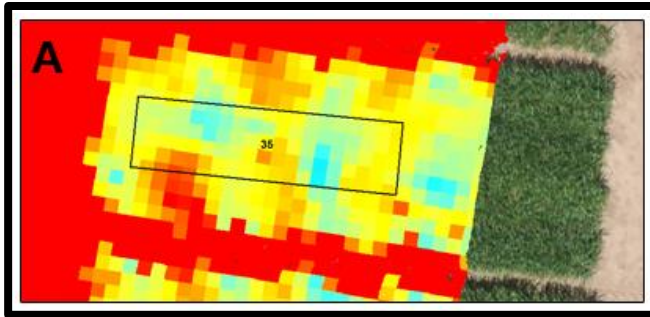


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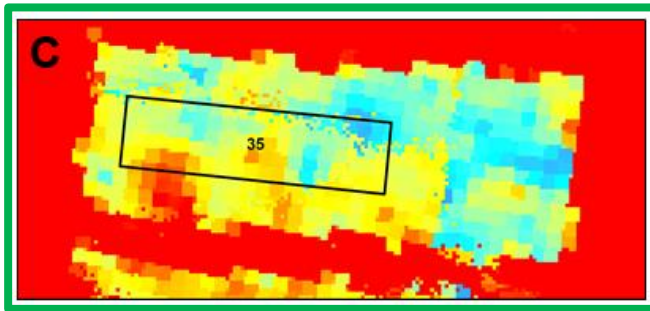
Imaging spectroscopy with 2D imagers



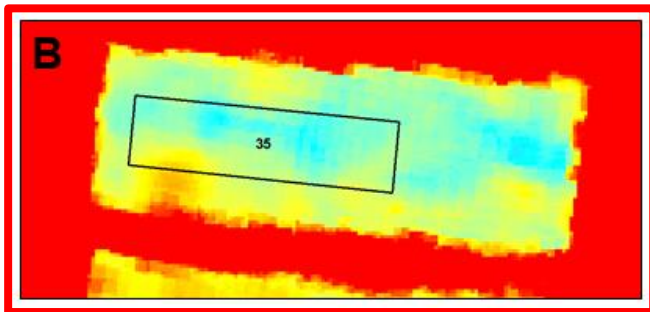
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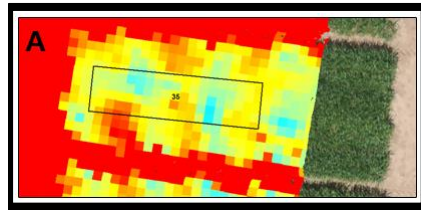
Single (most nadir) image



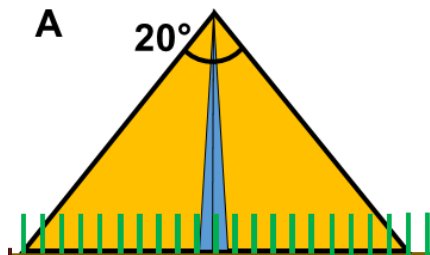
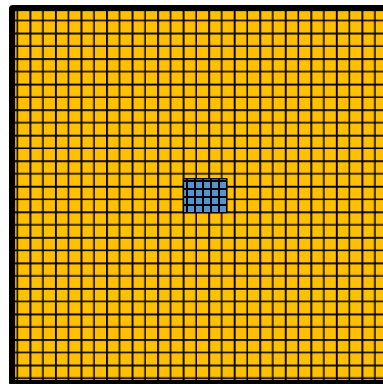
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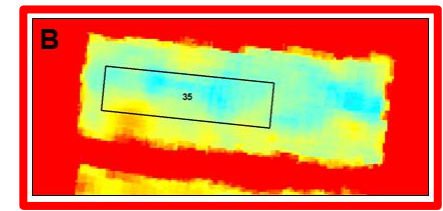
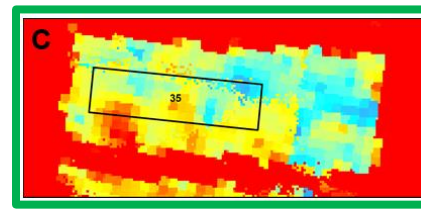
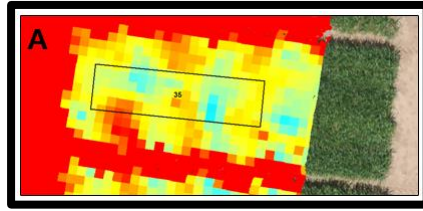
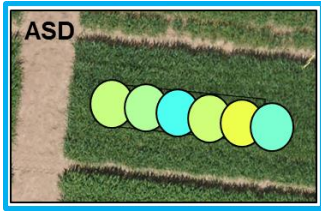


Mosaic, blending: average

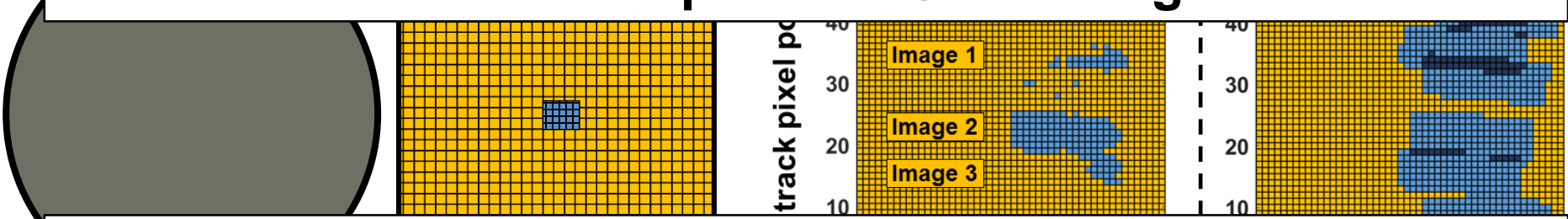


A: single image

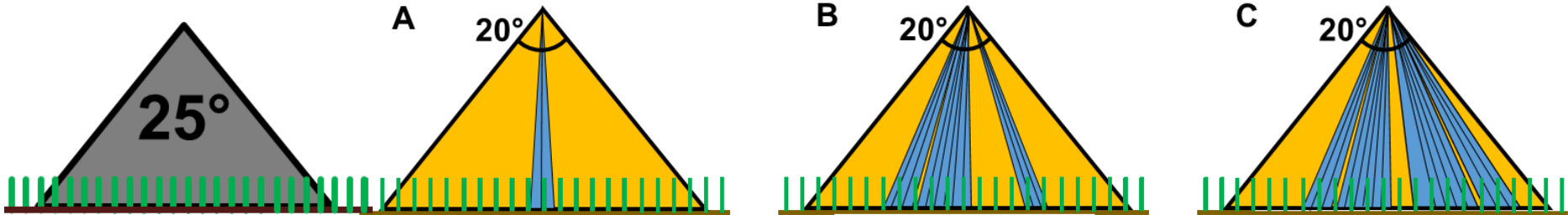




The **specific field of view** is the composition of pixels and their angular properties within a scene used to characterize a specific AOI on the ground

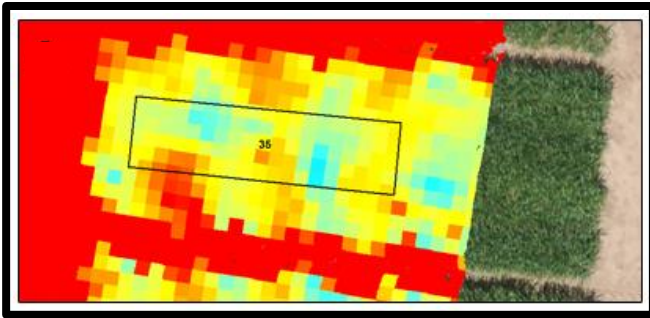


➤ **Not a UAV problem**
➤ **Always when we use different sensing settings**

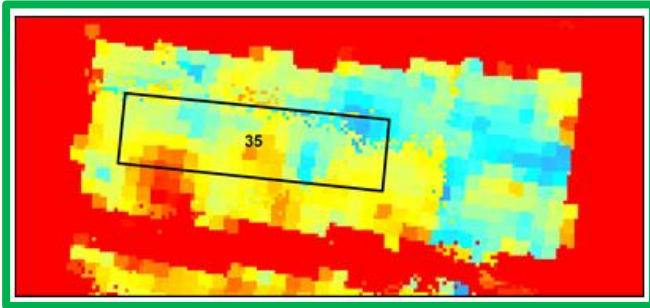


Imaging spectroscopy with 2D imagers

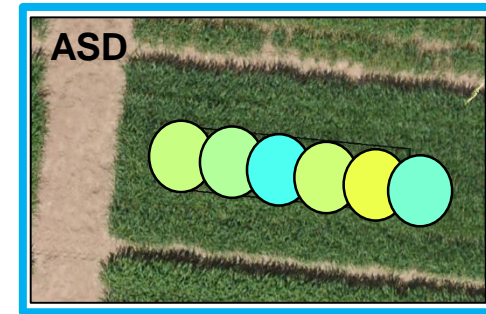
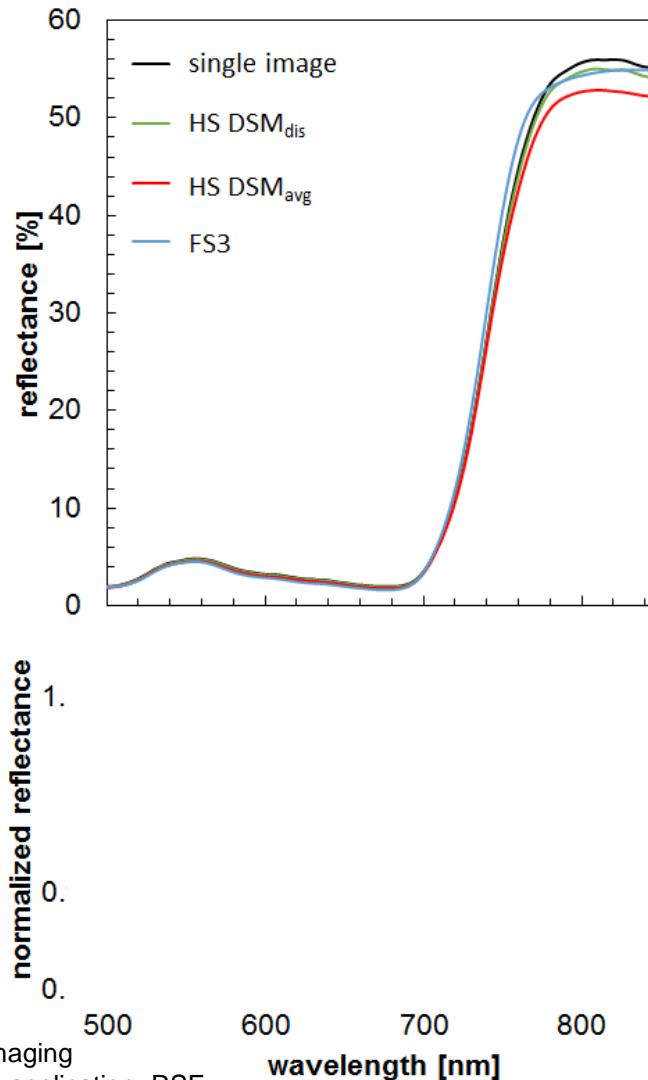
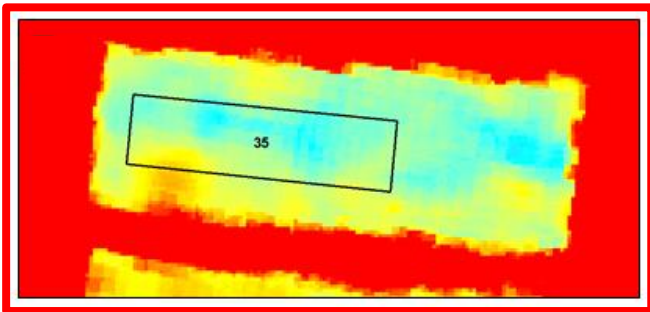
Single image



Blending: disabled



Blending: average



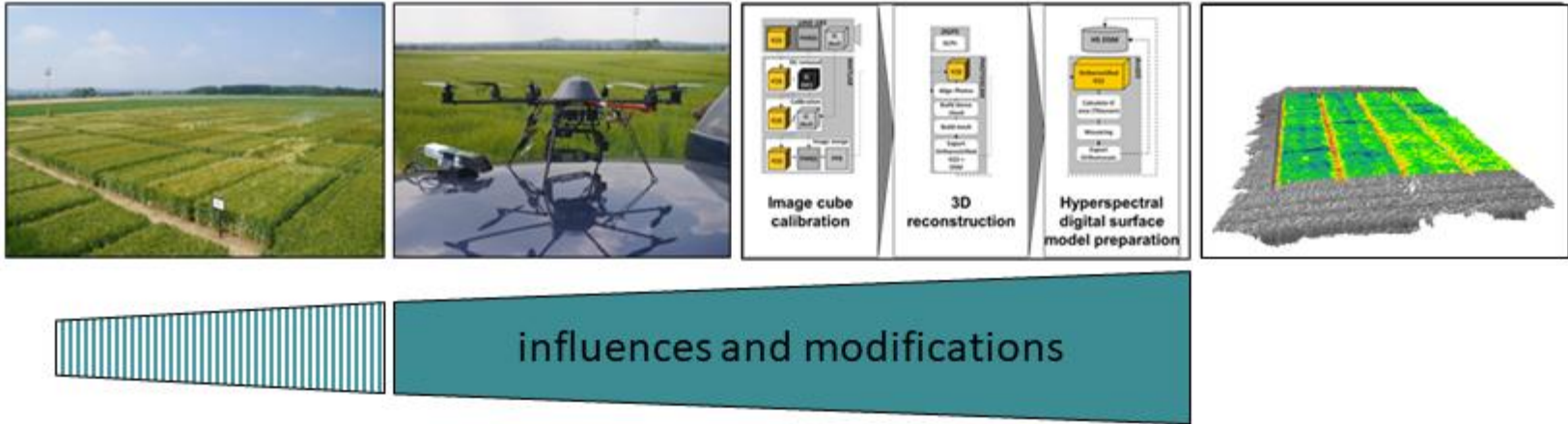
Take home message #2

Different processing modes give different results

- **Blending disabled:**
 - viewing geometry close to nadir
 - More proportion of soil
 - Close to hemispherical directional reflectance factors (HDRF)
 - **Blending mode average**
 - Viewing geometry composed of sensor FOV
 - Relatively more proportion of plant material
 - Hemispherical conical reflectance factors (HCRF)
- Be careful to compare apples with apples [2]

‘pixel’ in digital representation

field



Take home message #3:

- Keep track of your metadata [1,3,4]

[1] Aasen, H., Honkavaara, E., Lucieer, A., Zarco-Tejada, P., 2018. Quantitative Remote Sensing at Ultra-High Resolution with UAV Spectroscopy: A Review of Sensor Technology, Measurement Procedures, and Data Correction Workflows. Remote Sensing

[3] Aasen, H., Burkart, A., Bolten, A., Bareth, G., 2015. Generating 3D hyperspectral information with lightweight UAV snapshot cameras for vegetation monitoring: From camera calibration to quality assurance. ISPRS Journal of Photogrammetry and Remote Sensing

[4] Roth, L., Hund, A., Aasen, H., 2018. PhenoFly Planning Tool: flight planning for high-resolution optical remote sensing with unmanned areal systems. Plant Methods

Summary

- Radiometric calibration: Don't use “field-spectroscopy like calibration”
 - Use empirical line or irradiance sensor [1, 2]
 - Different processing modes
 - Be careful to compare apples with apples [2]
 - Traceability of your workflow
 - Use metadata [1,3,4]

[1] Aasen, H., Honkavaara, E., Lucieer, A., Zarco-Tejada, P., 2018. Quantitative Remote Sensing at Ultra-High Resolution with UAV Spectroscopy: A Review of Sensor Technology, Measurement Procedures, and Data Correction Workflows. Remote Sensing

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