Status on 6P3's WP1: Data Management

NPPN annual workshop
2022-02-01 (virtual)

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KØBENHAVNS UNIVERSITET

Background: Work Package1 "Data Management"

(from the 6P3 application)

Two new major components are very important for the workflow.

One, a quality assurance system to ensure UAV-derived data is of sufficiently high value to be advanced for further analysis.

… an integral part of PlotCut3 as an added functionality incorporating the current and new knowledge of vegetative indices usability (WP3), plant counting (WP4) and field trends (WP2)

The other, a system seamlessly mapping that data with existing breeding software.

… maps data from PlotCut3 with breeders' existing databases as a stand-alone, tailored solution.

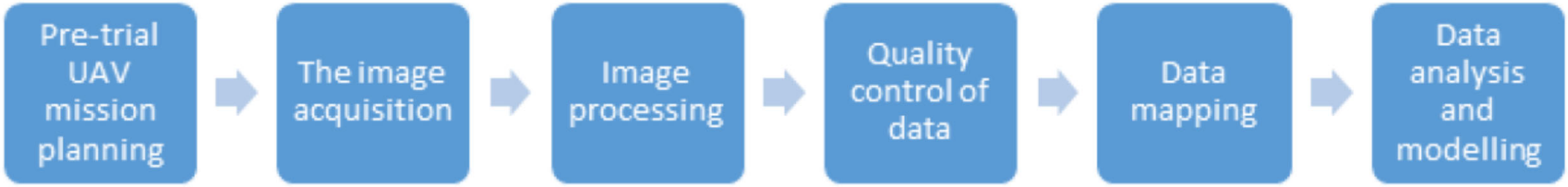


Figure 2: The workflow of using UAV data in plant breeding (expanded version in appendices).

Background: Work Package1 "Data Management"

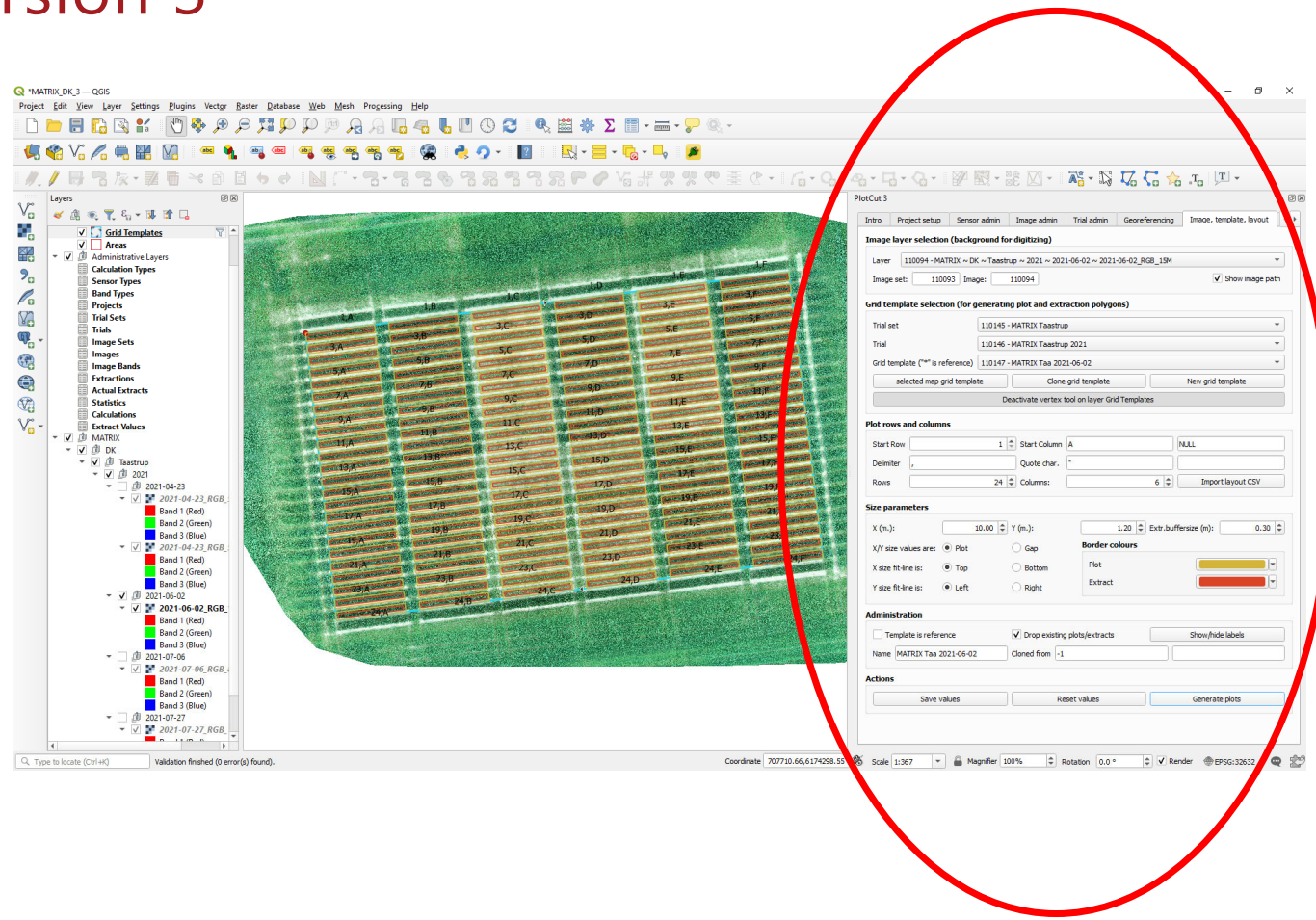
(from the 6P3 application)

Two new major components are very important for the workflow.

The hypothesis for WP1 is that with these two systems built the breeders will arrive at a much faster and more precise usage of their UAV-derived plant phenotyping data in their selection processes.

Background: PlotCut version 3

- Software solution to enable precise and continous trial plot extractions, from drone imagery, taken over field trials
- Built as a plugin in the free and open-source software QGIS
  - Programmed in Python
  - User interface created in Qt Designer
  - Database is PostgreSQL
    - With the PostGIS spatial extension
- Will eventually be released for free public use

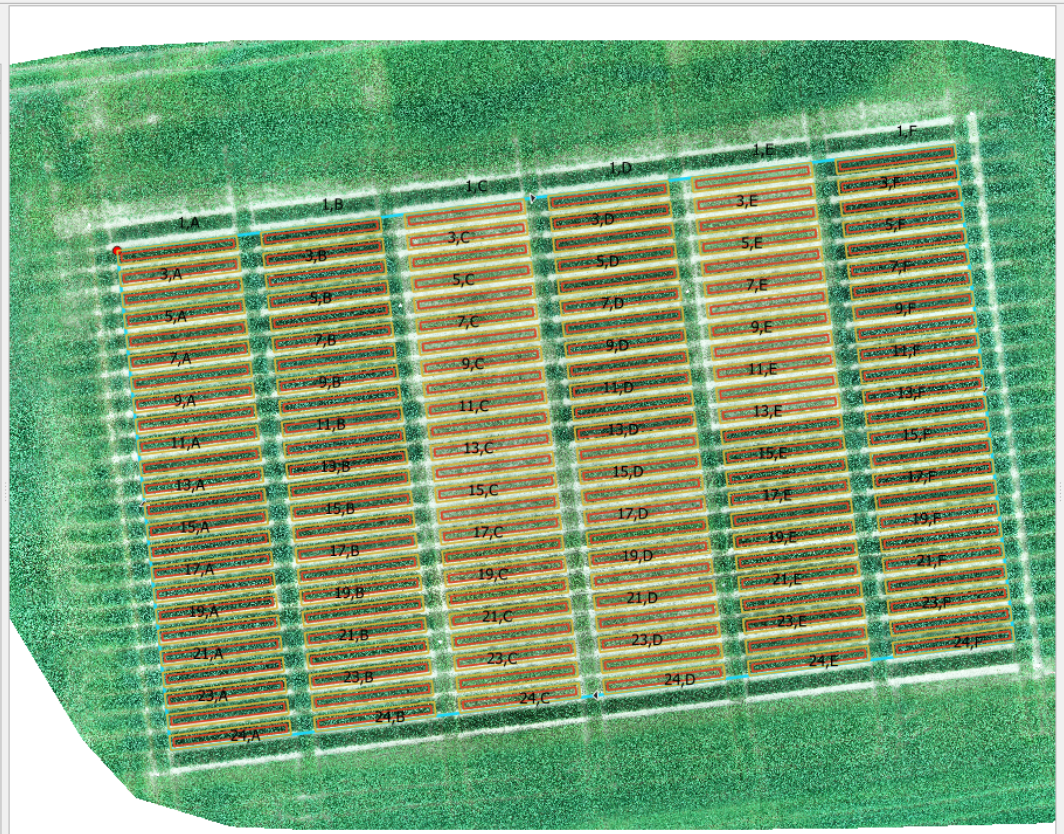


*MATRIX_DK_3 — QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help

Layers

- Grid Templates
- Areas
- Administrative Layers
  - Calculation Types
  - Sensor Types
  - Band Types
  - Projects
  - Trial Sets
  - Trials
  - Image Sets
  - Images
  - Image Bands
  - Extractions
  - Actual Extracts
  - Statistics
  - Calculations
  - Extract Values
- MATRIX
  - DK
    - Taastrup
      - 2021
        - 2021-04-23
          - 2021-04-23_RGB_
            - Band 1 (Red)
            - Band 2 (Green)
            - Band 3 (Blue)
          - 2021-04-23_RGB_
            - Band 1 (Red)
            - Band 2 (Green)
            - Band 3 (Blue)
        - 2021-06-02
          - 2021-06-02_RGB_
            - Band 1 (Red)
            - Band 2 (Green)
            - Band 3 (Blue)
        - 2021-07-06
          - 2021-07-06_RGB_
            - Band 1 (Red)
            - Band 2 (Green)
            - Band 3 (Blue)
        - 2021-07-27
          - 2021-07-27_RGB_



PlotCut 3

Intro | Project setup | Sensor admin | Image admin | Trial admin | Georeferencing | Image, template, layout

Image layer selection (background for digitizing)

Layer: 110094 - MATRIX ~ DK ~ Taastrup ~ 2021 ~ 2021-06-02 ~ 2021-06-02_RGB_15M

Image set: 110093 Image: 110094 Show image path

Grid template selection (for generating plot and extraction polygons)

Trial set: 110145 - MATRIX Taastrup

Trial: 110146 - MATRIX Taastrup 2021

Grid template ("*" is reference): 110147 - MATRIX Taa 2021-06-02

selected map grid template | Clone grid template | New grid template

Deactivate vertex tool on layer Grid Templates

Plot rows and columns

Start Row: 1 Start Column: A NULL

Delimiter: , Quote char: "

Rows: 24 Columns: 6 Import layout CSV

Size parameters

X (m.): 10.00 Y (m.): 1.20 Extr.buffersize (m): 0.30

X/Y size values are: Plot Gap

X size fit-line is: Top Bottom

Y size fit-line is: Left Right

Border colours

Plot

Extract

Administration

Template is reference Drop existing plots/extracts Show/hide labels

Name: MATRIX Taa 2021-06-02 Cloned from: -1

Actions

Save values | Reset values | Generate plots

Type to locate (Ctrl+K) Validation finished (0 error(s) found).

Coordinate: 707710.66,6174298.55 Scale: 1:367 Magnifier: 100% Rotation: 0.0 ° Render EPSG:32632

What happened in 2021?

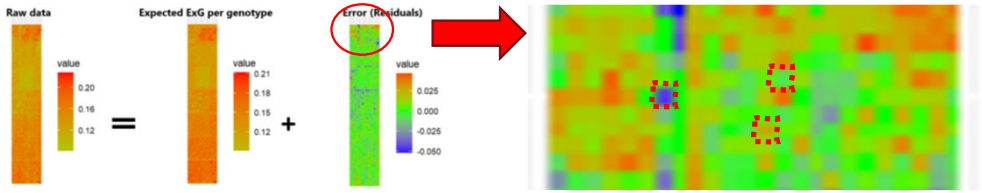
- Continued support to the 6P3 project's core users
  - System install and setup
  - Getting started using PlotCut3
  - Ad-hoc consultations
- Implemented several smaller new features
  - Some requested by core partners (not all were possible)
- Begun implementing new features (e.g. residuals – more on this later)
- Corrections:
  - Any errors in programming, DB etc that showed up
  - User interface improvements
- Fixes in PlotCut3's database backend

What's going to happen in 2022?

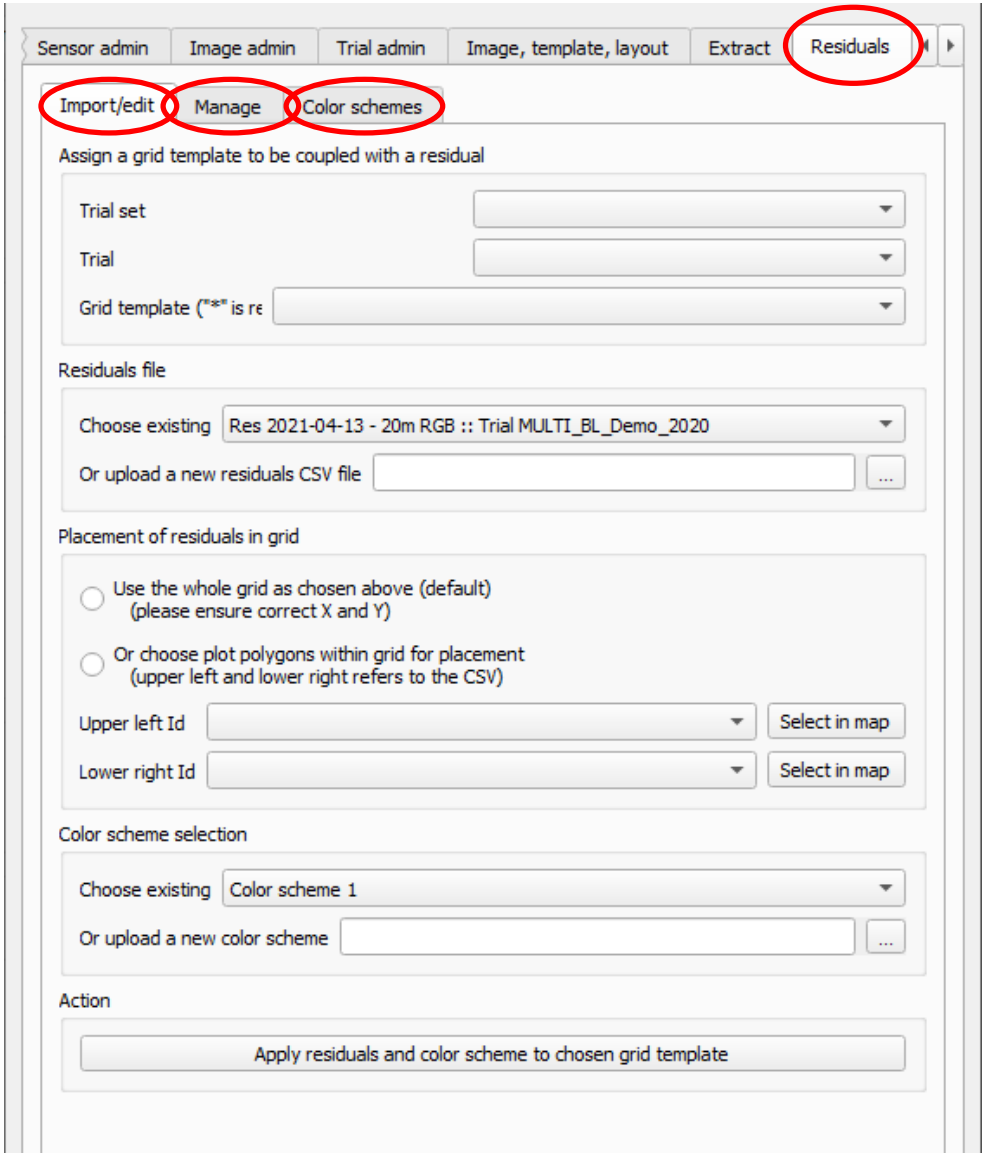
- Continued support to the 6P3 project's core partners
  - For everyday use of PlotCut3
  - Get new users started
- Developing new features with other work packages
  - Feature: Residuals
  - Feature: Job scheduling (starting several extractions)
  - Feature: Vegetative indices
  - Feature: Flower counting (maybe not until 2023)
  - Possible feature: Export datasets specific for Daisy modelling (specific metadata needs etc.)
- Implementing and testing (w. core partners) the new features
- Integrating R-scripts in PlotCut3
  - E.g., for running residuals script(s) directly from within PlotCut3
- Maybe integrating plant counting scripts
  - Need to uncover what types of Machine/Deep Learning models can be used in QGIS
- Preparing PlotCut3's database backend
  - To interface deliveries of the other work packages
  - To enable other software interfacing the DB
- Integration with core partners' downstream decision systems
  - Map needs and wishes
    - Incl. needs annotations (meta data) in PlotCut3
  - Make manuals on data import options

PlotCut3 feature: Residuals

- Together with WP2's Signe Marie Jensen and David Redek

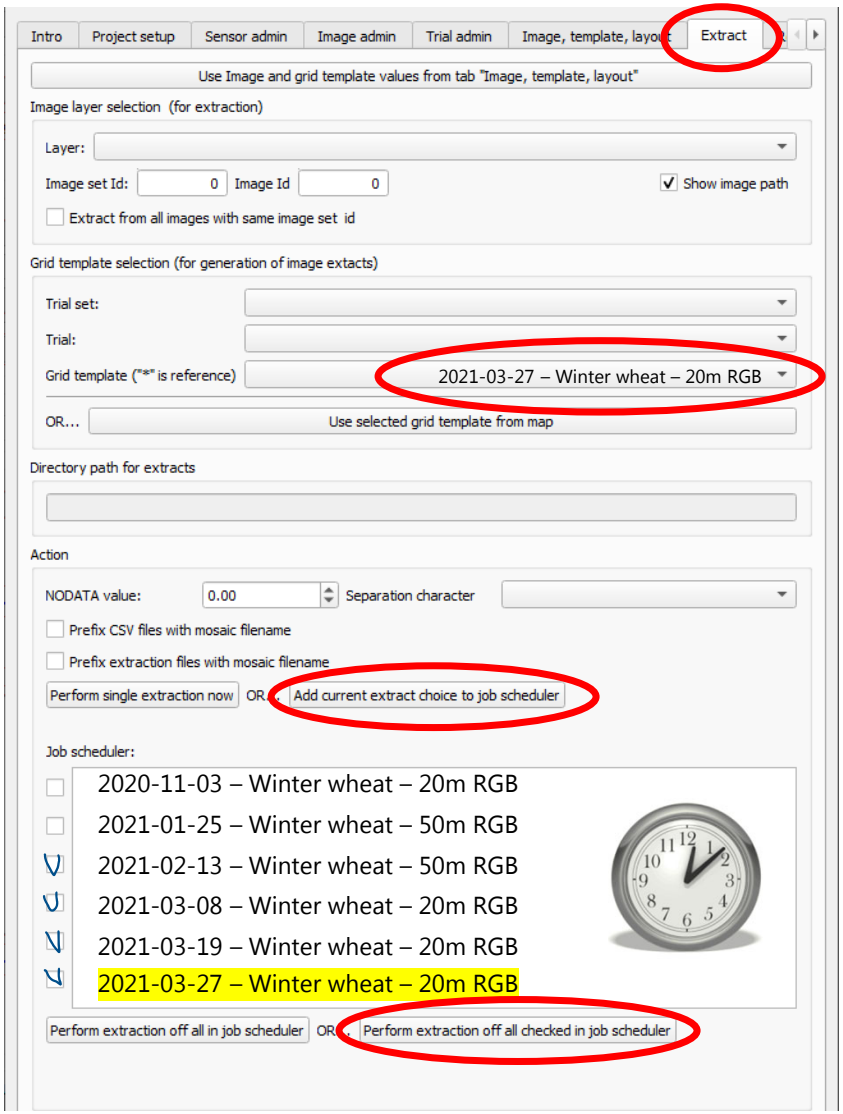


- Each pixel in a residual plot represents a single plot in a field trial
- A new tab named "Residuals" in the plugin.
- This tab will have sub tabs
  - For the initial import and pairing of a residual file with a grid template
  - For managing all the residuals
  - And implementing color schemes best fitting the user, growth stage, residual type etc.
- An overlay of the residual for each single plant plot will appear in QGIS via PlotCut3



PlotCut3 feature: Job scheduling

- In the tab “Extract”
- Enabling the user to start several extractions and then leave the program alone (e.g., until the next day)
- It may become a split of the “Extract” tab into sub tabs, with a separate one for the job scheduler (like in the “Residuals” tab shown in the previous slide)



Further ahead

- Publication on (and release of) a public version(*) of the PlotCut3 software
- Finalize integration possibilities with core partners' downstream decision systems
- A workshop on PlotCut3, for both core partners and NPPN members
  - Could be at the NPPN Annual Meeting November 2022 (pandemic permitting)
  - or, at an NPPN Field Day
  - Possibly also (or instead of the above) as a virtual workshop

(*) Honouring the agreed upon wait-times from 6P2 project-end until any software code (version matching the time of 6P2 project-end) is released to the public.

References

- Thompson, Alison L., et al. “A Data Workflow to Support Plant Breeding Decisions from a Terrestrial Field-Based High-Throughput Plant Phenotyping System.” Plant Methods, vol. 16, no. 1, BioMed Central Ltd, Jan. 2020, pp. 1–97, doi:10.1186/s13007-020-00639-9.