FPCUP USER WORKSHOP

ACTION „DOWNSTREAM SERVICE / APPLICATION DEVELOPMENT FOR NATIONAL STATISTICS AND REPORTING”

Concept and Demonstration

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23.11.2022

BKG

DLR

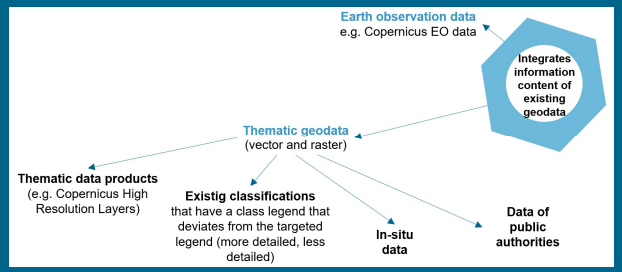
CONCEPTS AND LIVE DEMO

FPCUP Tool

Stage 1

Definition of broader class regions indicating potential locations of training areas

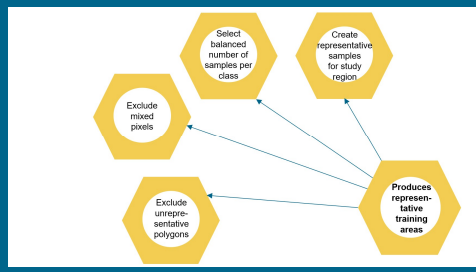
- Integration of existing geodata



Stage 2

Selection of training areas (sampling)

- Produce representative training areas



Goals of Live Demo

Introduce concepts and examples for Jupyter Notebook workflows

- to create input data sets (stage 1)
- for selecting samples (stage 2)

Why Jupyter Notebooks and not any GIS

- no licenses, runs everywhere
- interactive and adaptable (like clicks on a GUI)
- can also be automated (impossible with GUI)
- documentation and code combined
- reproducible
- can be extended on demand

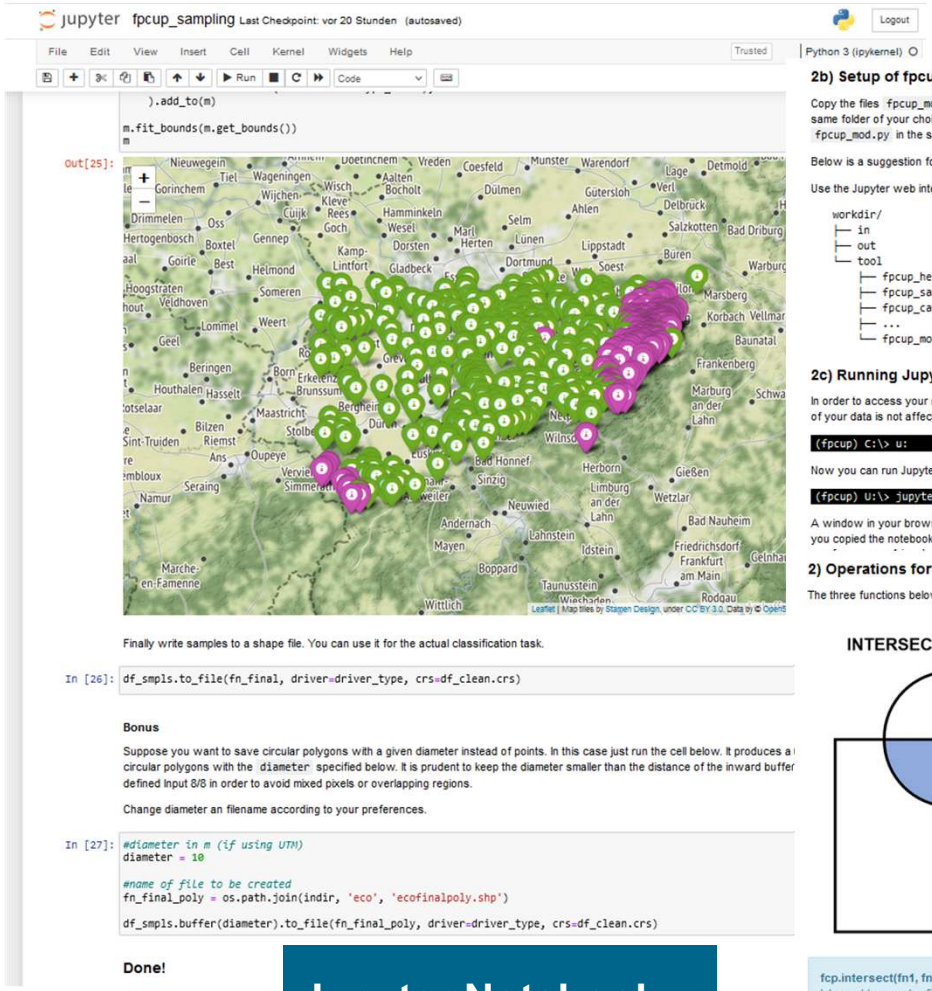
FPCUP Tool – Jupyter Notebooks

What

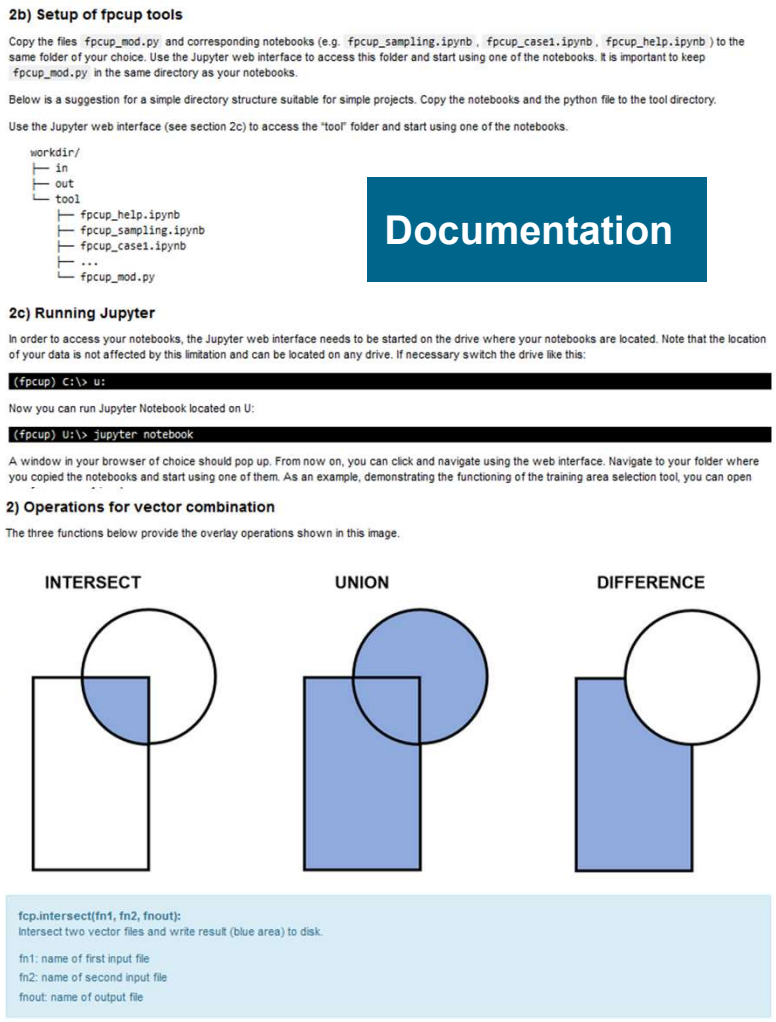
Interactive sampling tool to define a workflow for creating training data

How

- Jupyter notebooks
- Python libraries
- HTML Documentation
- Additional example Workflows

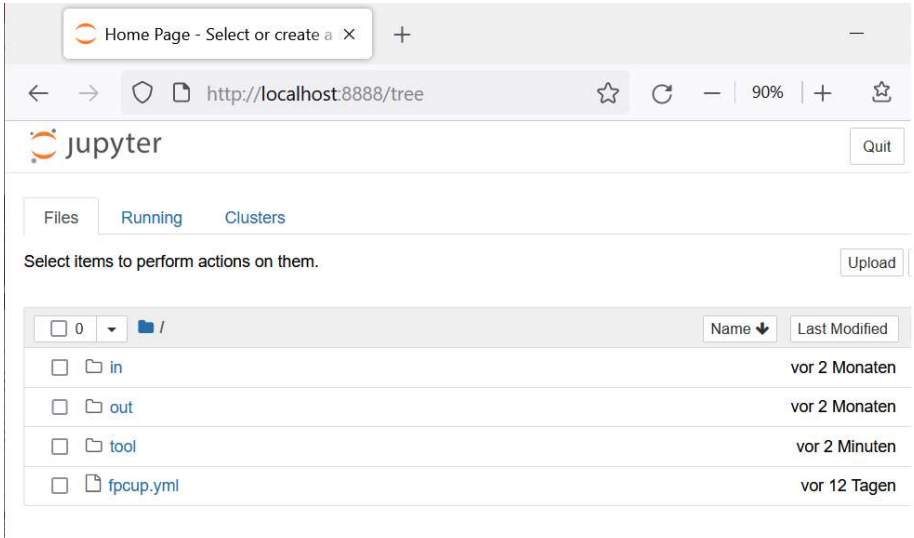


Jupyter Notebook



Documentation

FPCUP Tool – Jupyter Notebooks



Jupyter Start Page

2b) Setup of fpcup tools

Copy the files `fpcup_mod.py` and corresponding notebooks (e.g. `fpcup_sampling.ipynb`, `fpcup_case1.ipynb`, `fpcup_help.ipynb`) to the same folder of your choice. Use the Jupyter web interface to access this folder and start using one of the notebooks. It is important to keep `fpcup_mod.py` in the same directory as your notebooks.

Below is a suggestion for a simple directory structure suitable for simple projects. Copy the notebooks and the python file to the tool directory.

Use the Jupyter web interface (see section 2c) to access the "tool" folder and start using one of the notebooks.

```
workdir/
├── in
├── out
└── tool
    ├── fpcup_help.ipynb
    ├── fpcup_sampling.ipynb
    ├── fpcup_case1.ipynb
    ├── ...
    └── fpcup_mod.py
```

Documentation

2c) Running Jupyter

In order to access your notebooks, the Jupyter web interface needs to be started on the drive where your notebooks are located. Note that the location of your data is not affected by this limitation and can be located on any drive. If necessary switch the drive like this:

```
(fpcup) C:\> u:
```

Now you can run Jupyter Notebook located on U:

```
(fpcup) U:\> jupyter notebook
```

A window in your browser of choice should pop up. From now on, you can click and navigate using the web interface. Navigate to your folder where you copied the notebooks and start using one of them. As an example, demonstrating the functioning of the training area selection tool, you can open e.g. fpcup_case1.ipynb.

Later when you are finished, quit the notebook and deactivate the environment.

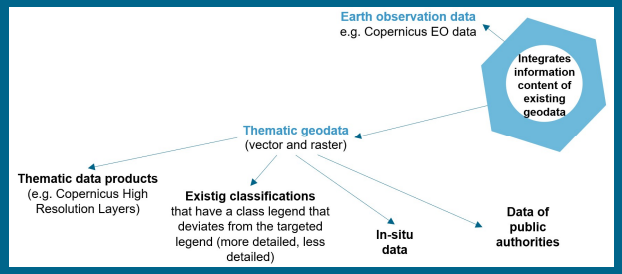
```
(fpcup) U:\> conda deactivate
```

FPCUP Tool

Stage 1

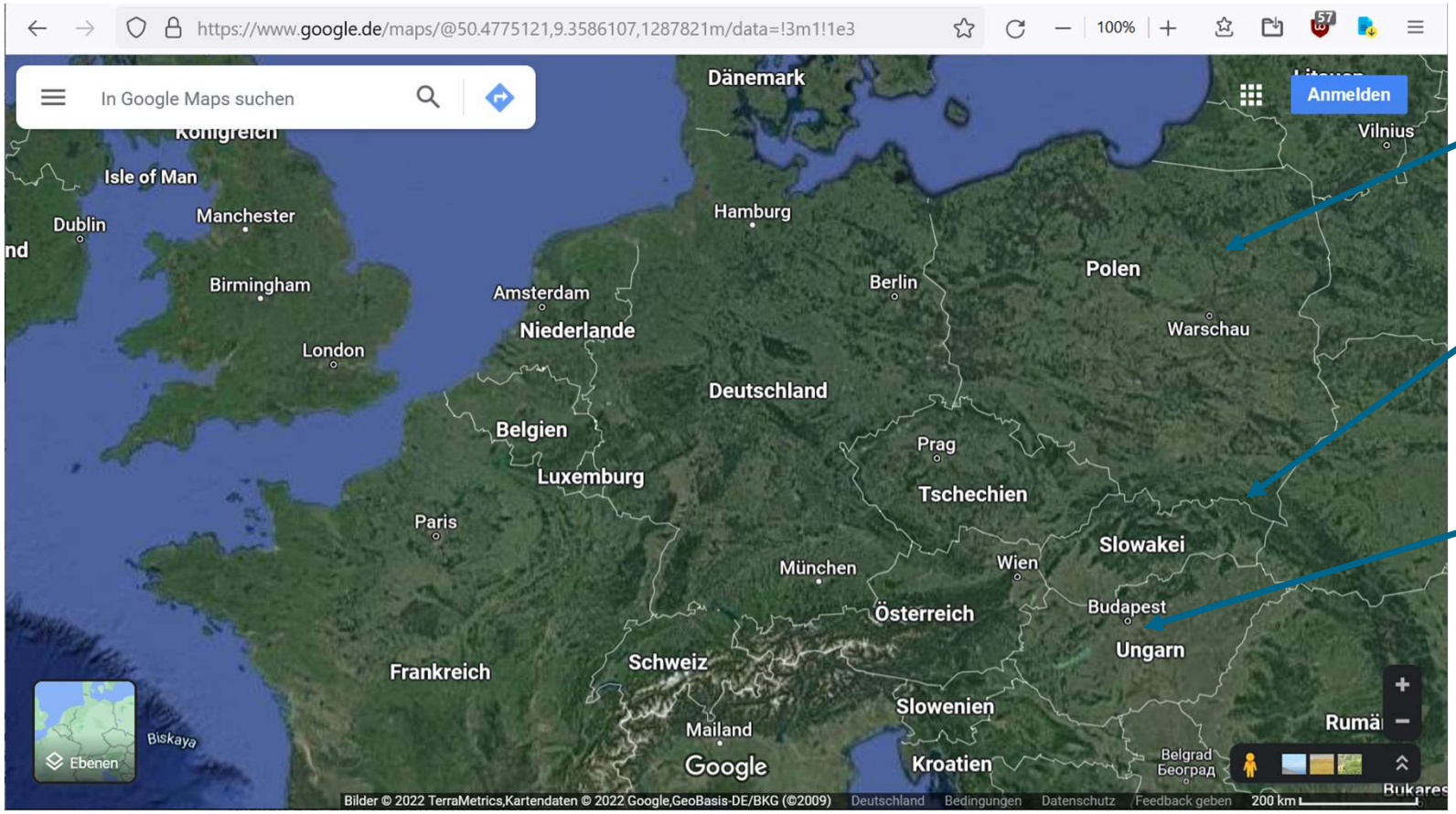
Definition of broader class regions indicating potential locations of training areas

- Integration of existing geodata



Stage 2

Data Types and Spatial Relationships



Satellite RGB Raster

Country Vector (Polygon)

City Vector (Point)

- Target: Retrieve information using spatial relations from raster and vector files

Stage 1 Workflow Example: Define Broader Regions for Class “Flood Plains”

Criteria to be fulfilled:

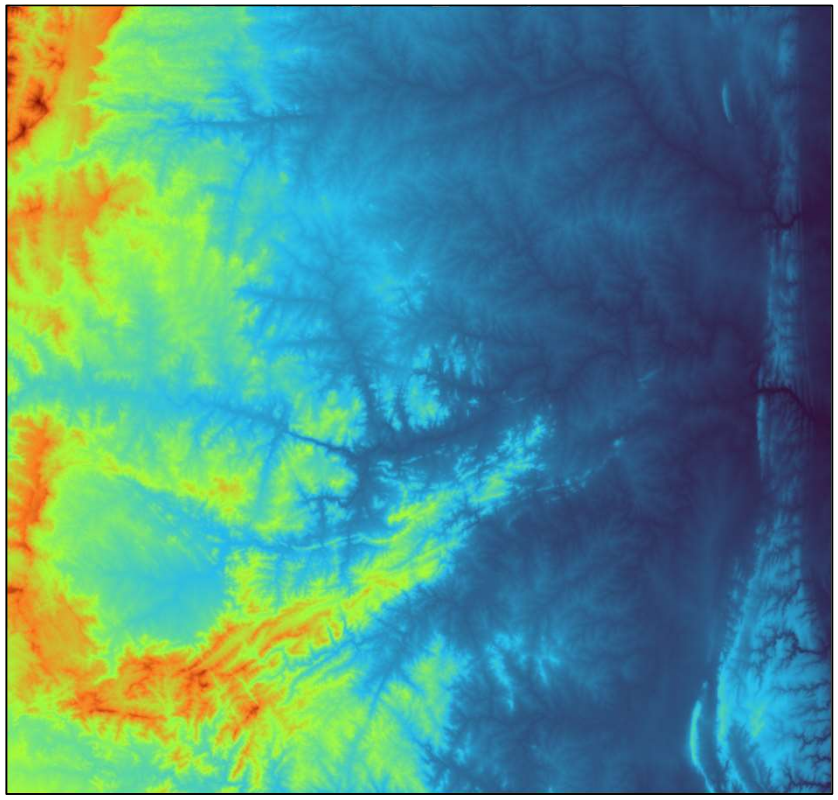
- Low lying areas (200m - 400m)
- Slope lower than 3 degrees

Workflow:

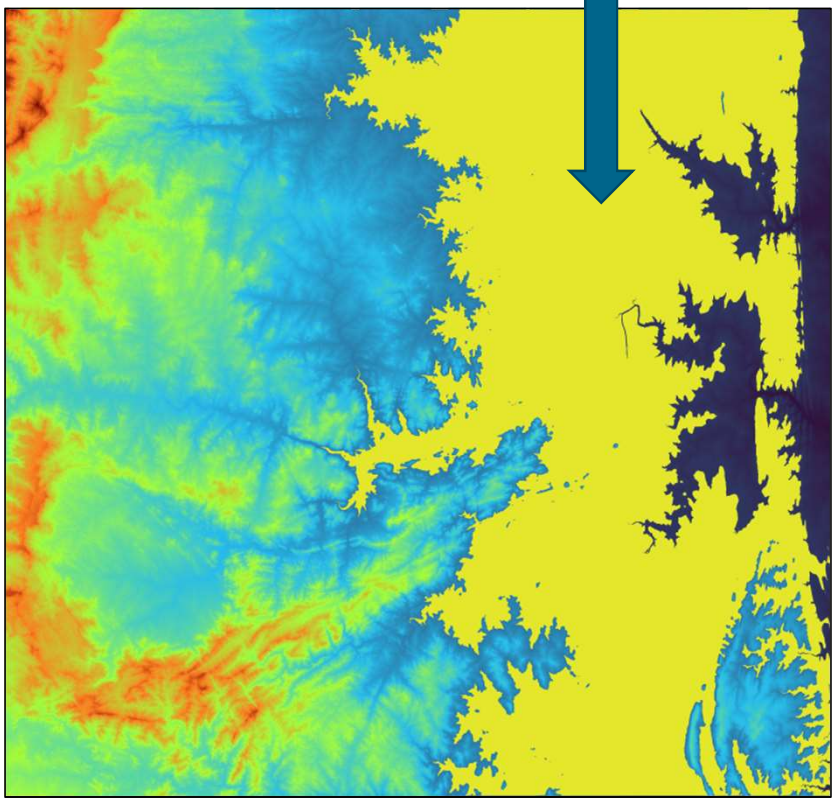
- Select polygons with pixels between 200m - 400m
- Select polygons with pixels lower than 3 degrees
- Intersect both polygons

Stage 1 Workflow „Flood Plains“: Select low lying areas

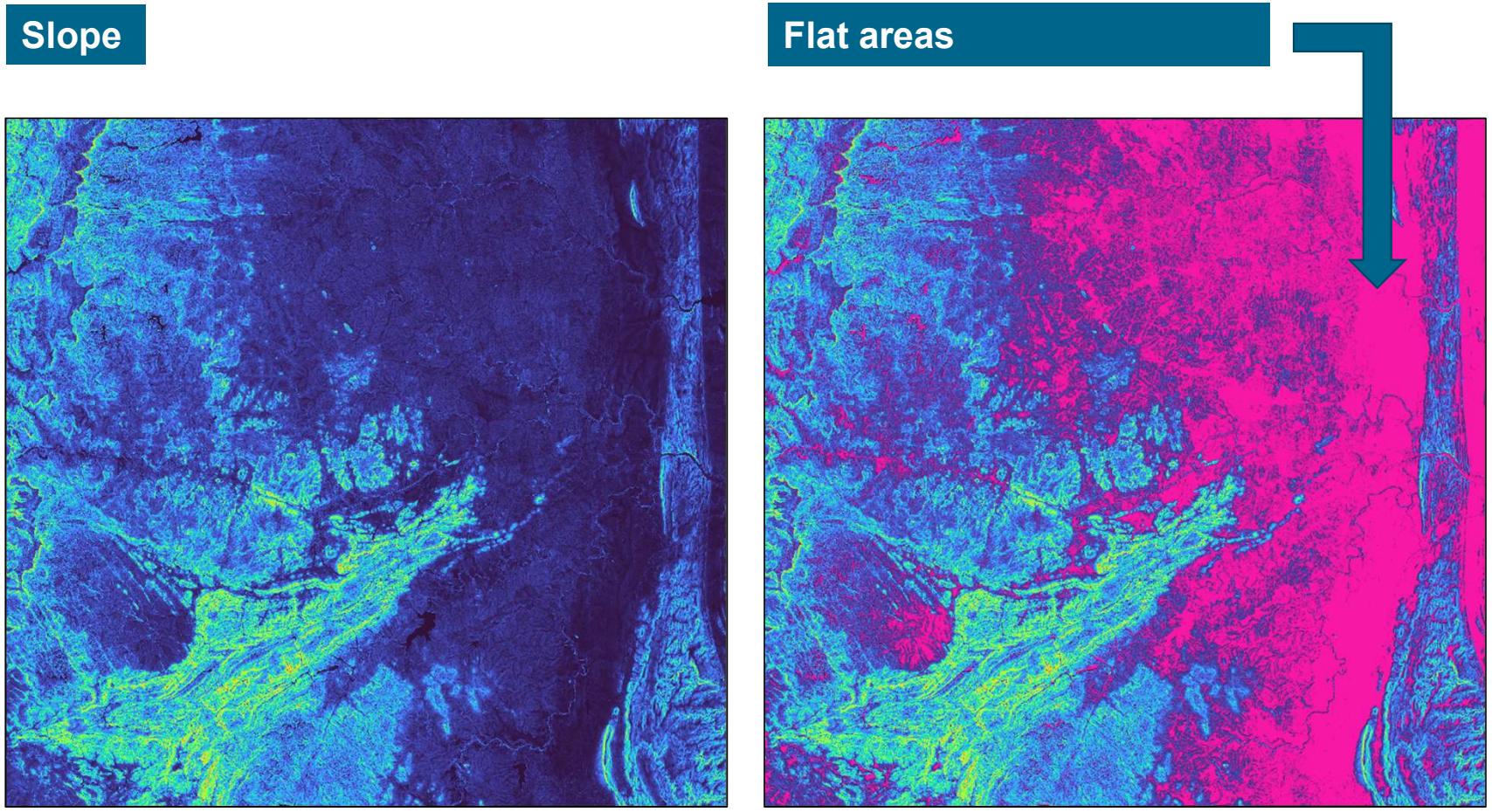
DEM altitude



Low lying areas

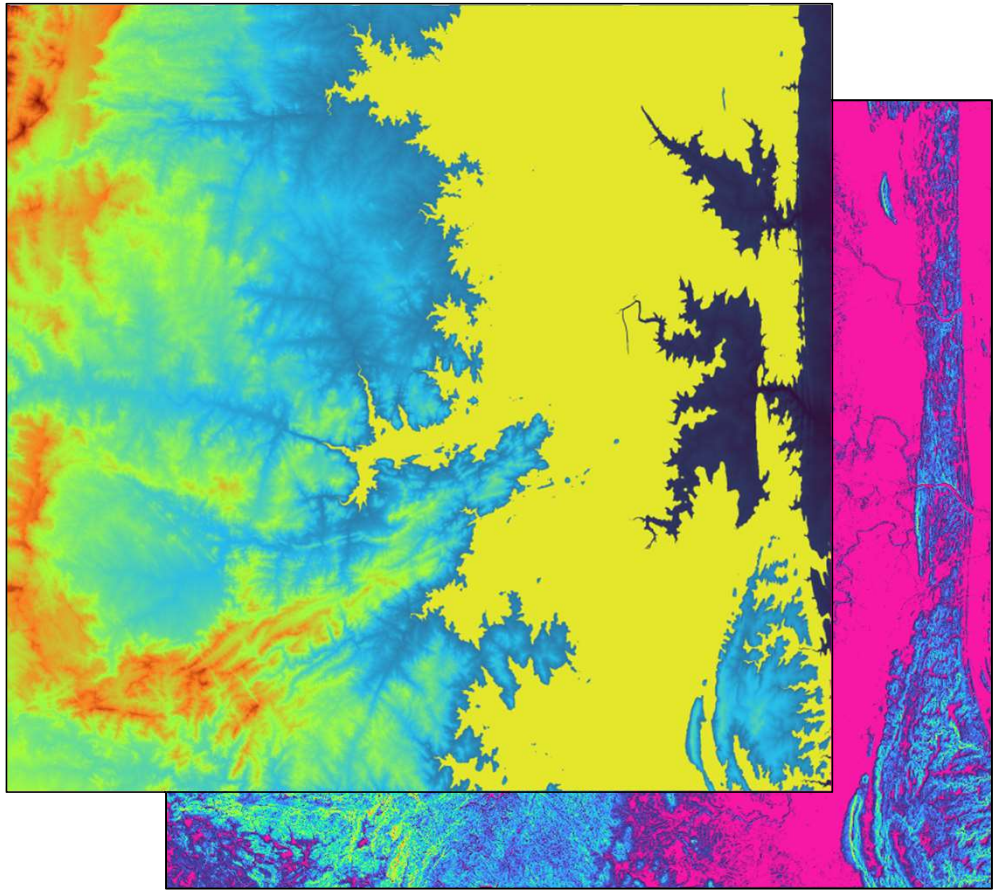


Stage 1 Workflow „Flood Plains“: Select flat areas

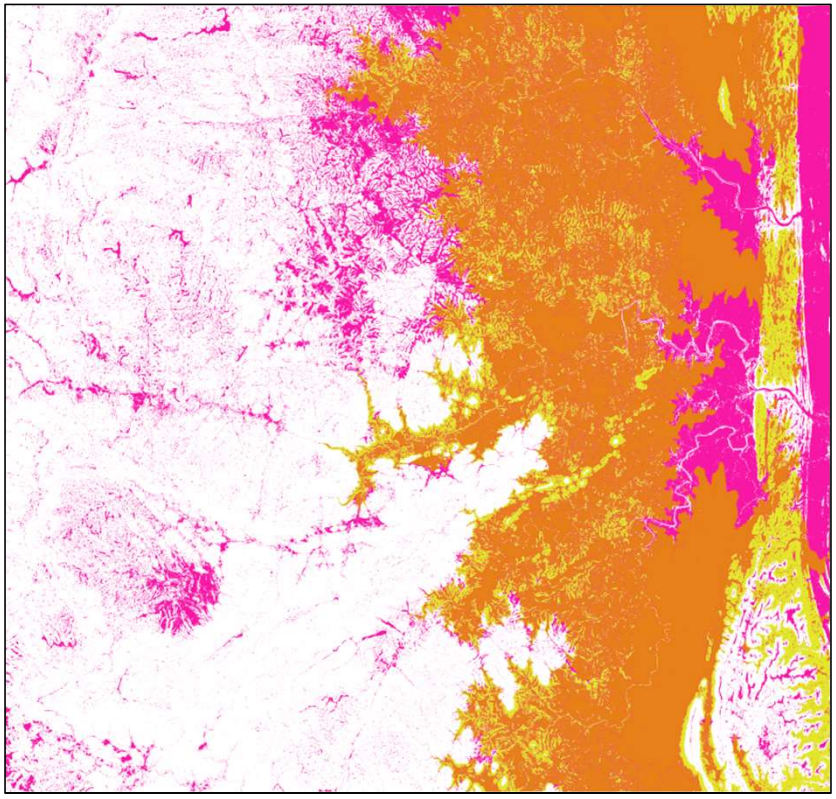


Stage 1 Workflow „Flood Plains“: Combine flat areas with relatively low lying areas

Combine



Intersection



Demonstration

Stage 1

- Case: Potential Flood Plains
- fpcup_case_flood.ipynb

Stage 1 Workflow Example: Define Broader Regions for Class “Riparian Forest”

Criteria to be fulfilled:

- Vegetation above 8m
- Polygons larger 100 m^2
- In potential riparian zone

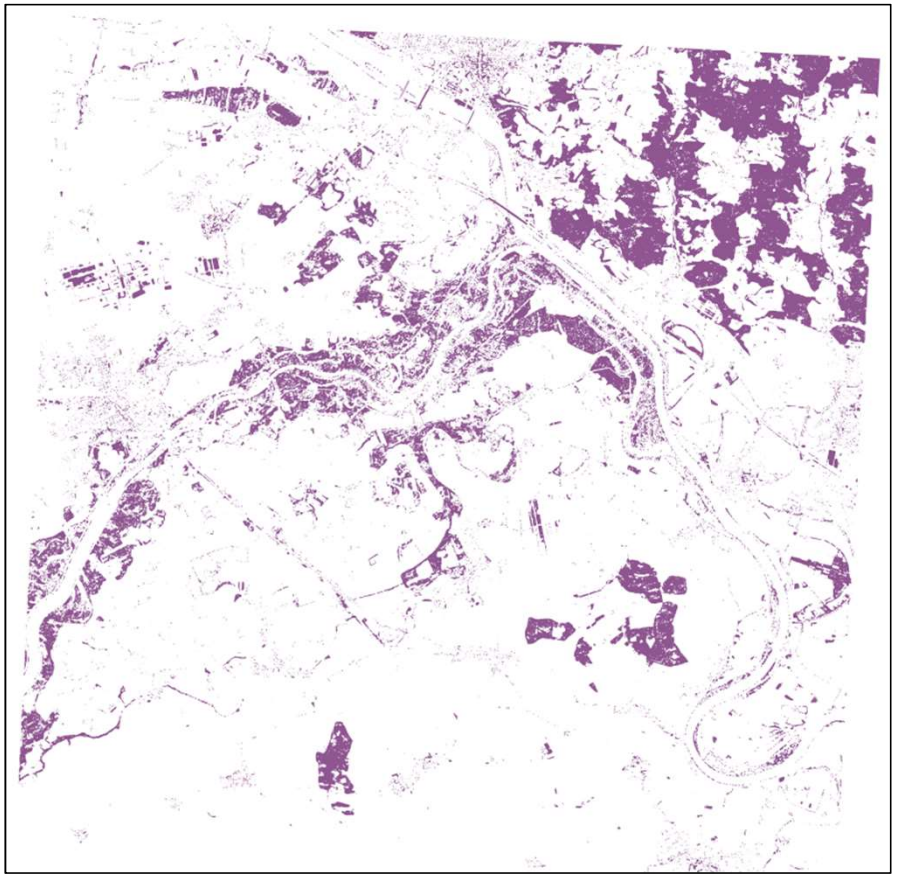
Workflow

- Filter high structures
- Exclude small areas (mainly for speed-up)
- Intersect with riparian zones
- Exclude building footprints
- Exclude small areas (not shown, but theoretically necessary)

Workflow Riparian Forest: Height above Ground

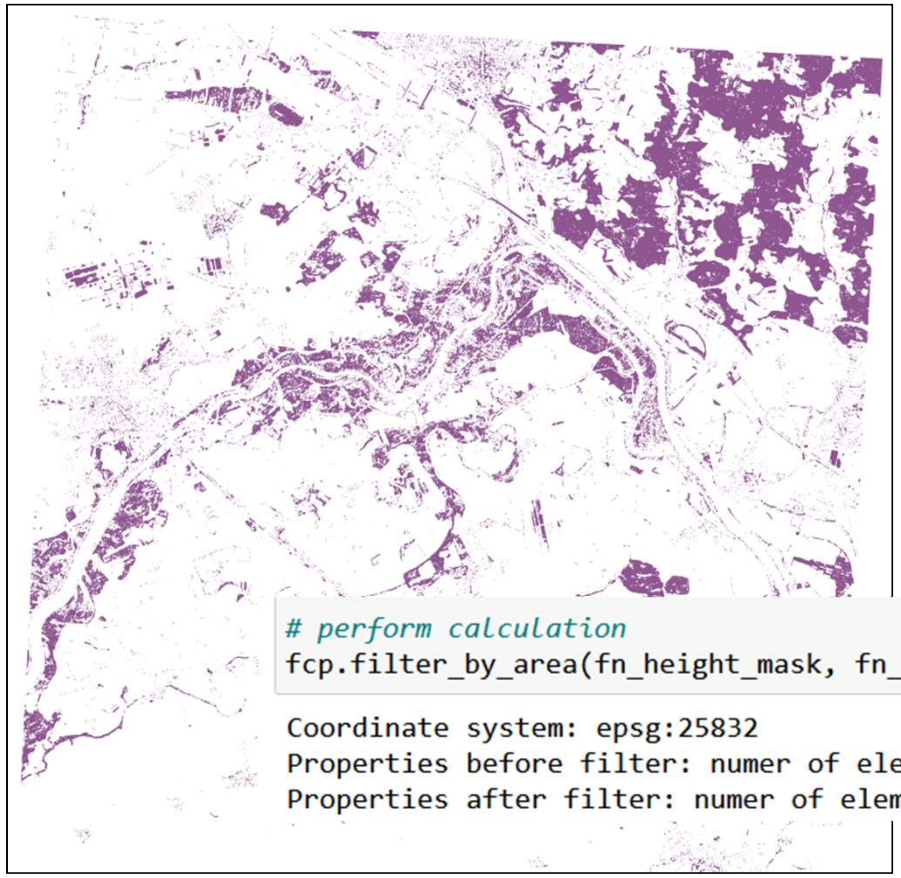
Height above ground

Height mask with structures > 8m

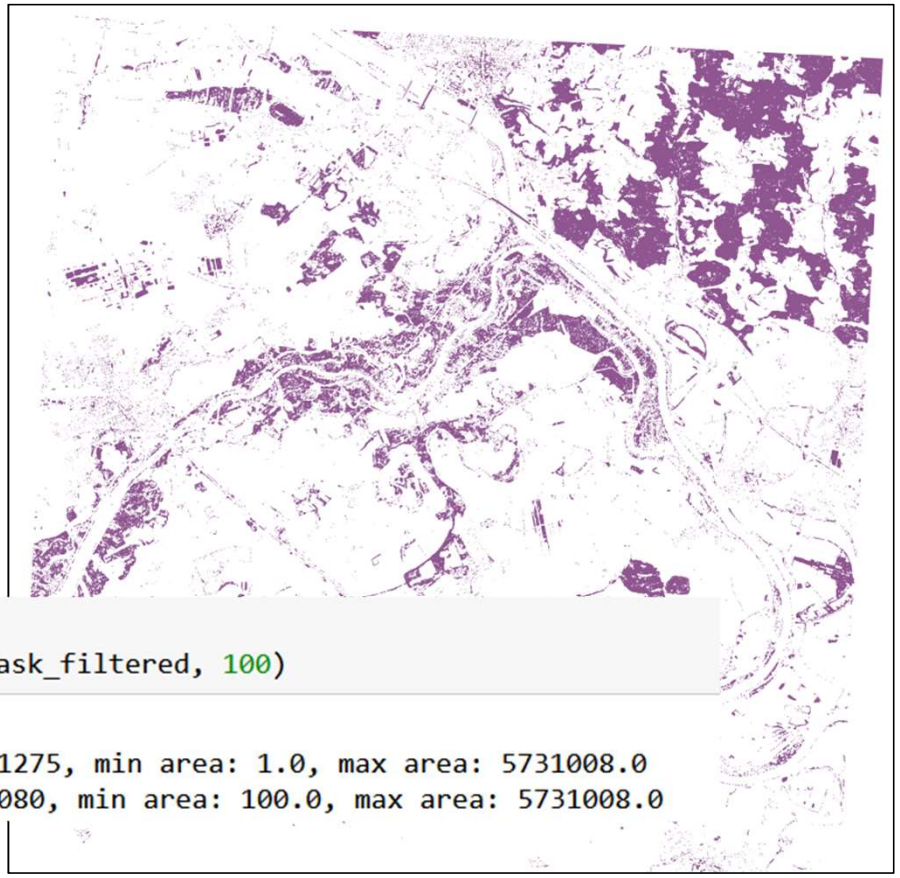


Workflow Riparian Forest: Remove Small Polygons

All Polygons



Polygons > 100 square meters

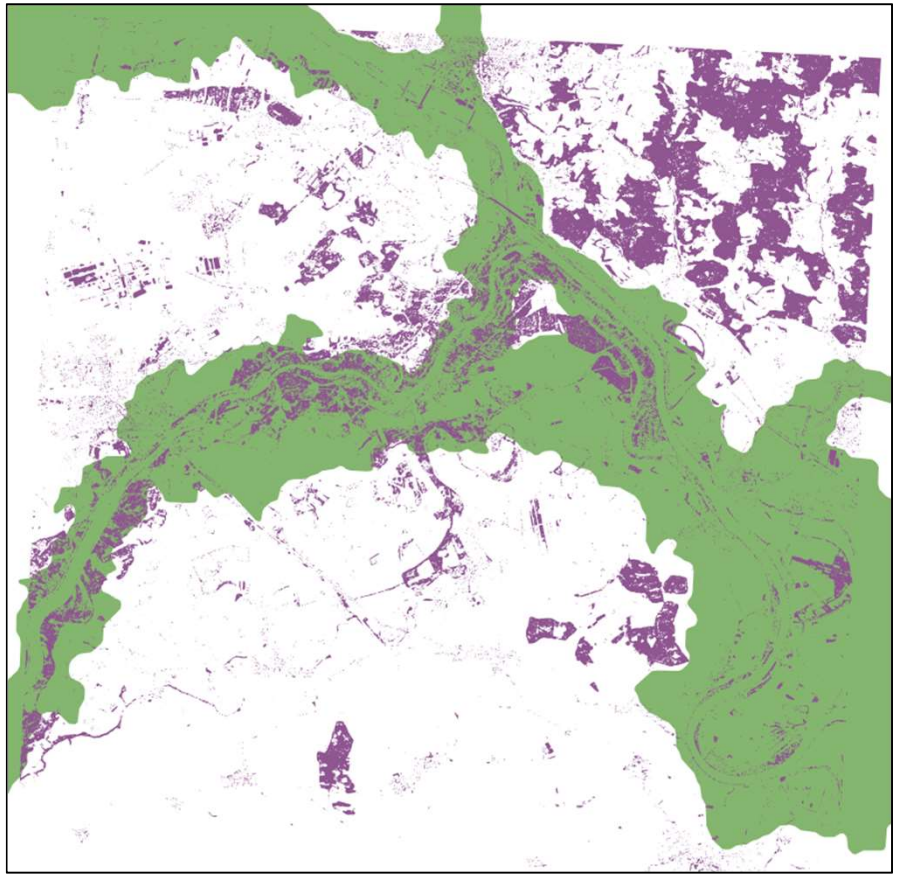


```
# perform calculation
fcp.filter_by_area(fn_height_mask, fn_height_mask_filtered, 100)
```

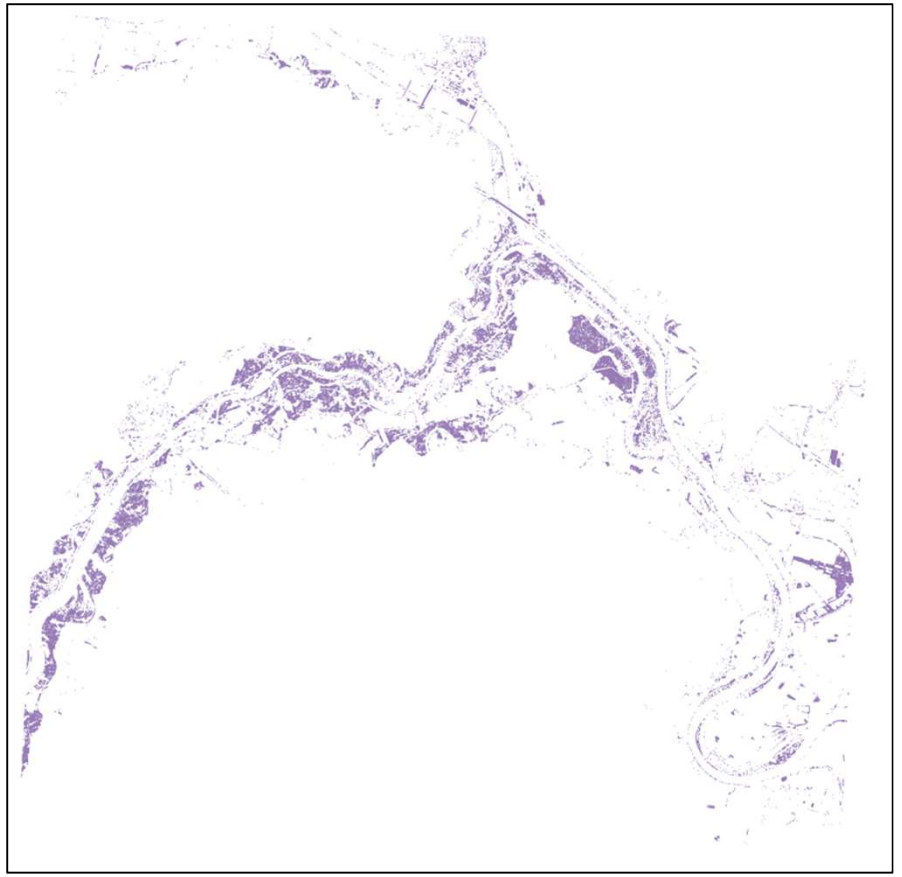
```
Coordinate system: epsg:25832
Properties before filter: numer of elements: 31275, min area: 1.0, max area: 5731008.0
Properties after filter: numer of elements: 10080, min area: 100.0, max area: 5731008.0
```

Workflow Riparian Forest: Height and Riparian Zones

Riparian zones and height mask

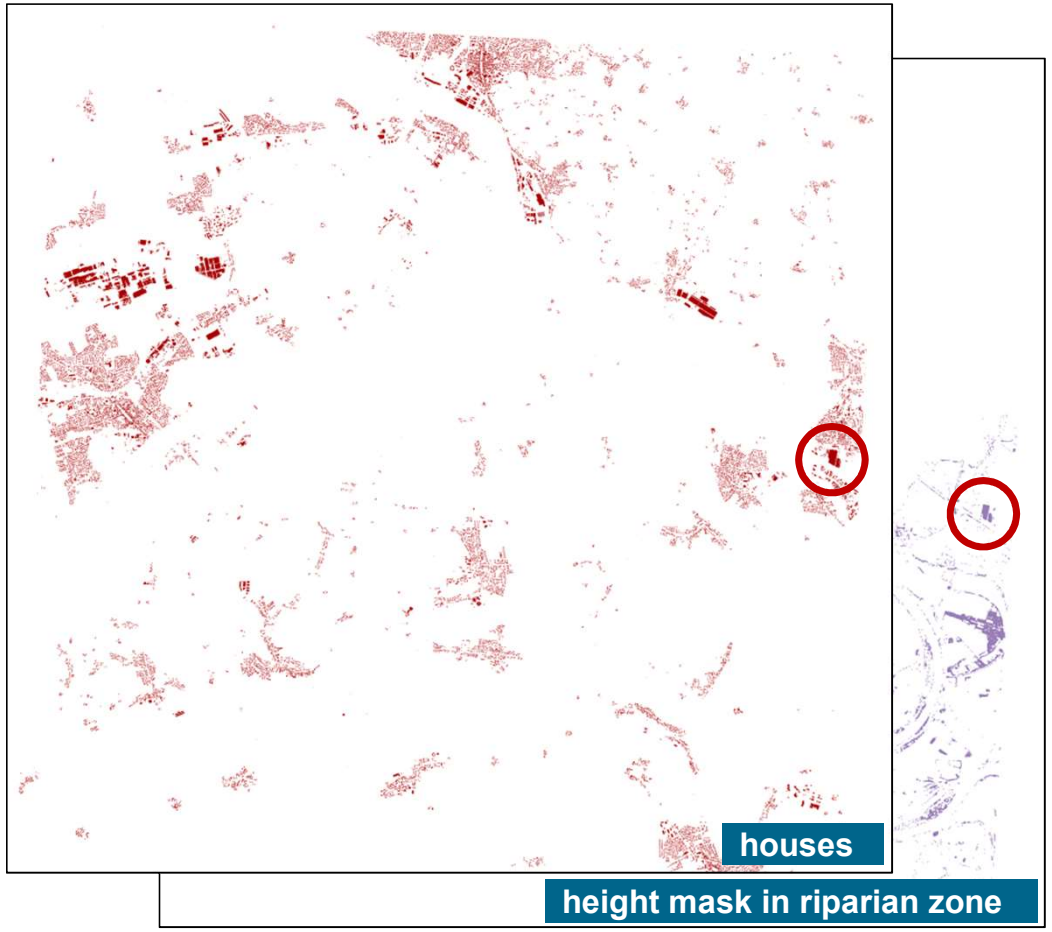


Height mask in riparian zones

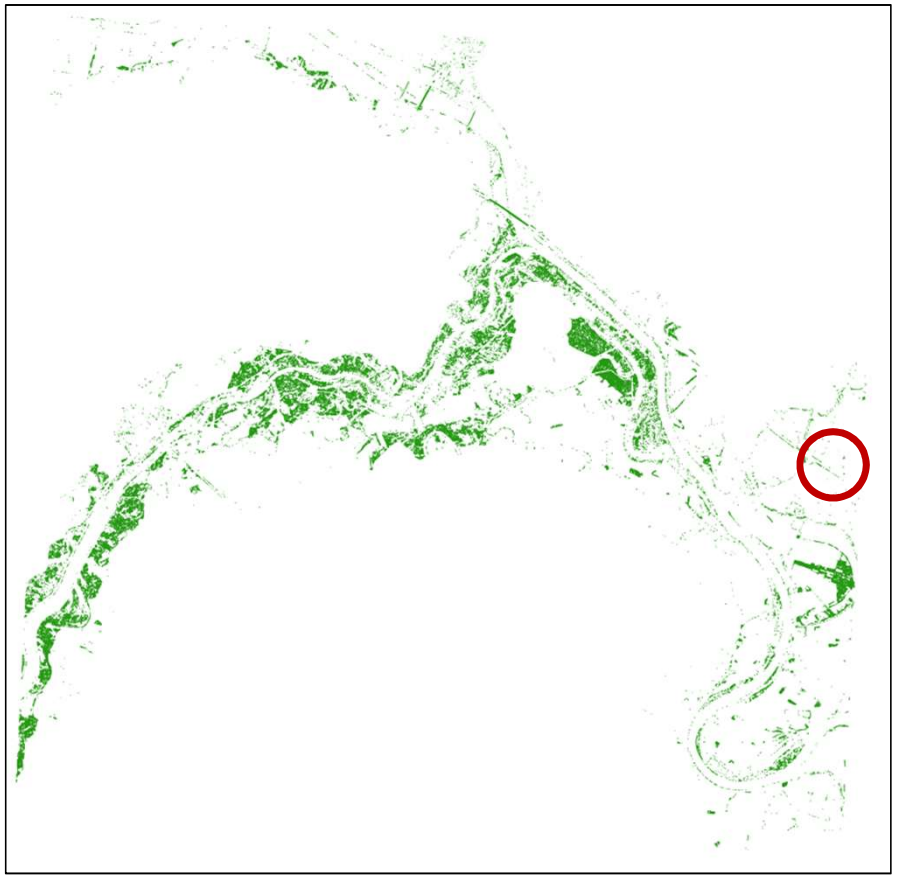


Workflow Riparian Forest: Height Mask Minus Houses

Remove houses from height mask



Riparian Forests



Demonstration

Stage 1

- Case: Riparian Forests
- fpcup_case_ripa.ipynb

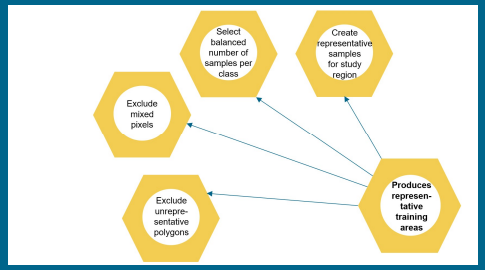
Stage 2

Stage 1

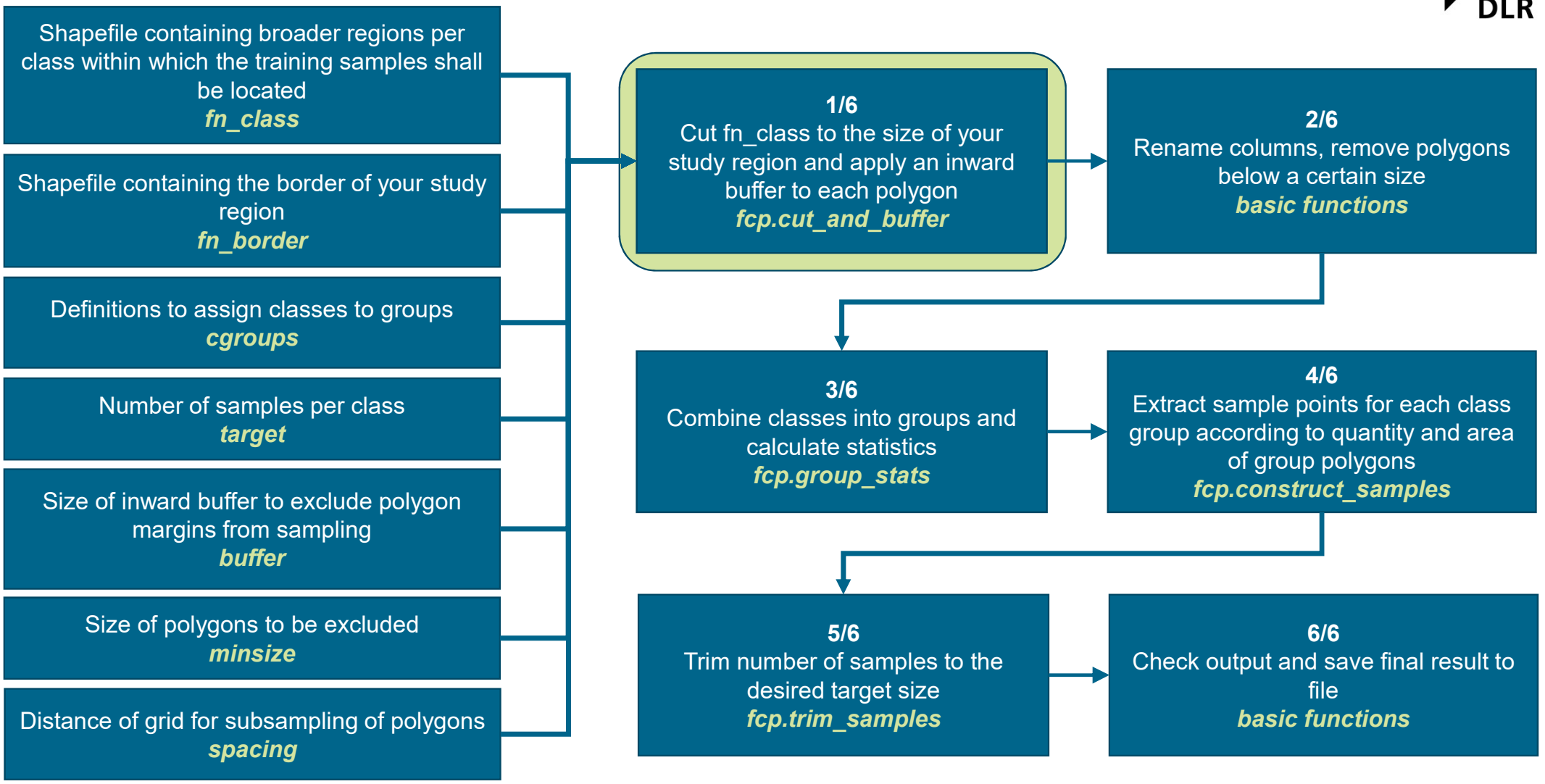
Stage 2

Selection of training areas (sampling)

- Produce representative training areas



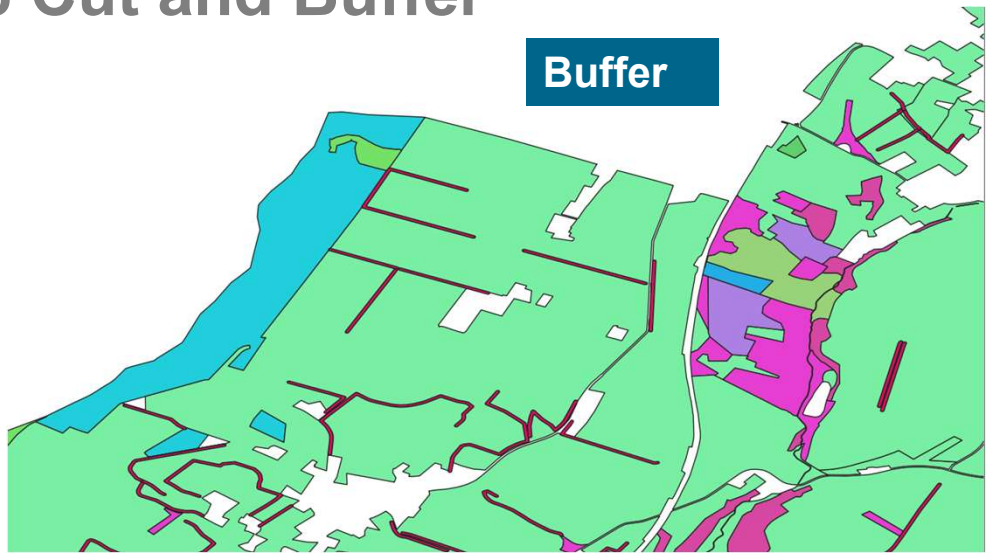
Sampling Tool (Stage 2): General Workflow with Stage 1 Data



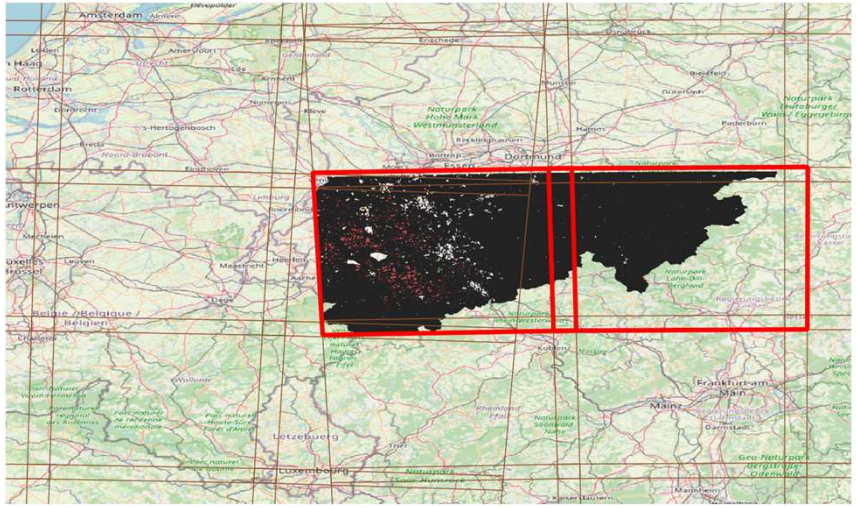
Sampling Visualization: 1/6 Cut and Buffer

Purpose
- Cut data to region of interest
- Exclude mixed pixels

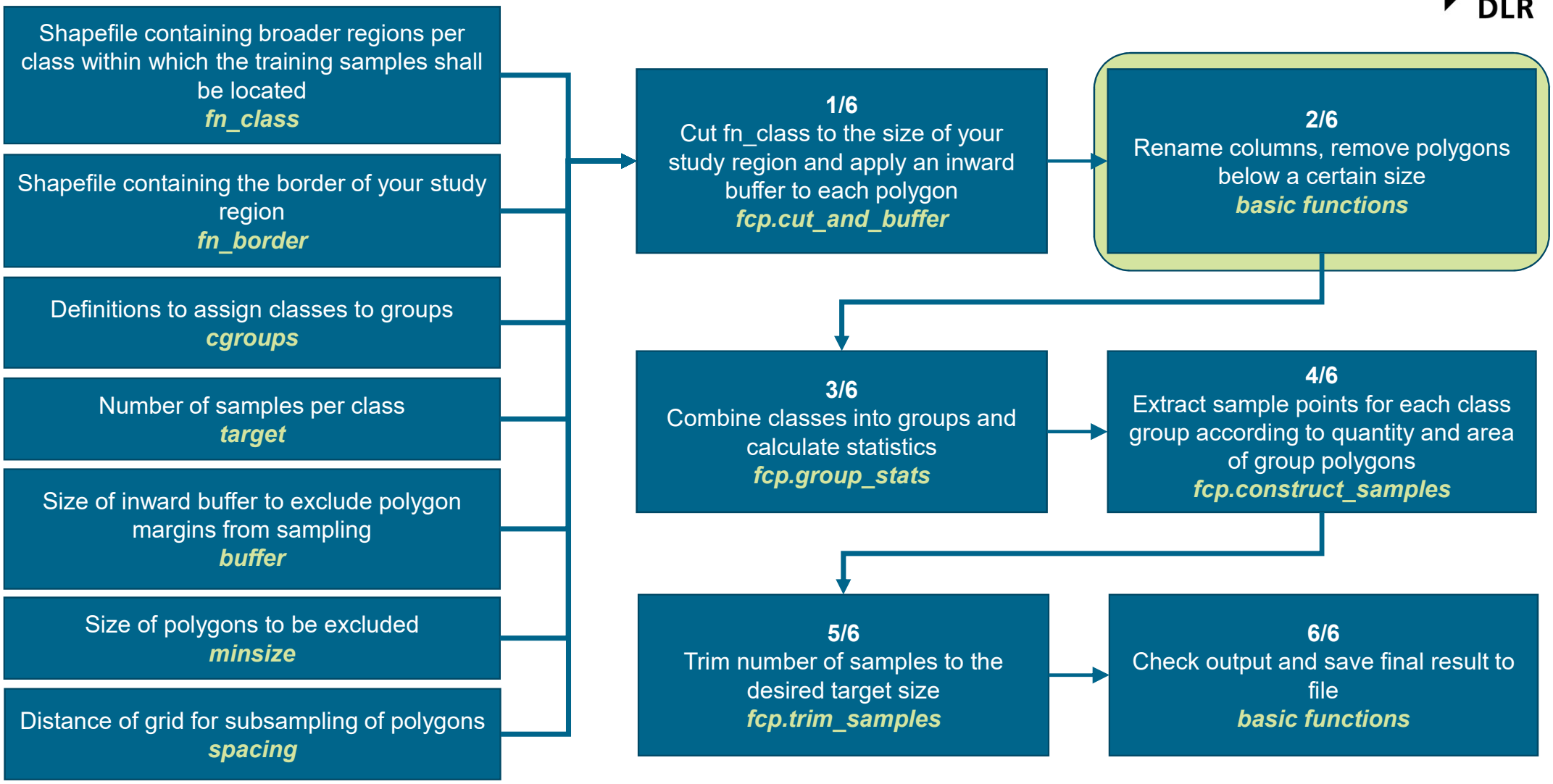
Buffer



Cut



Sampling Tool: General Workflow

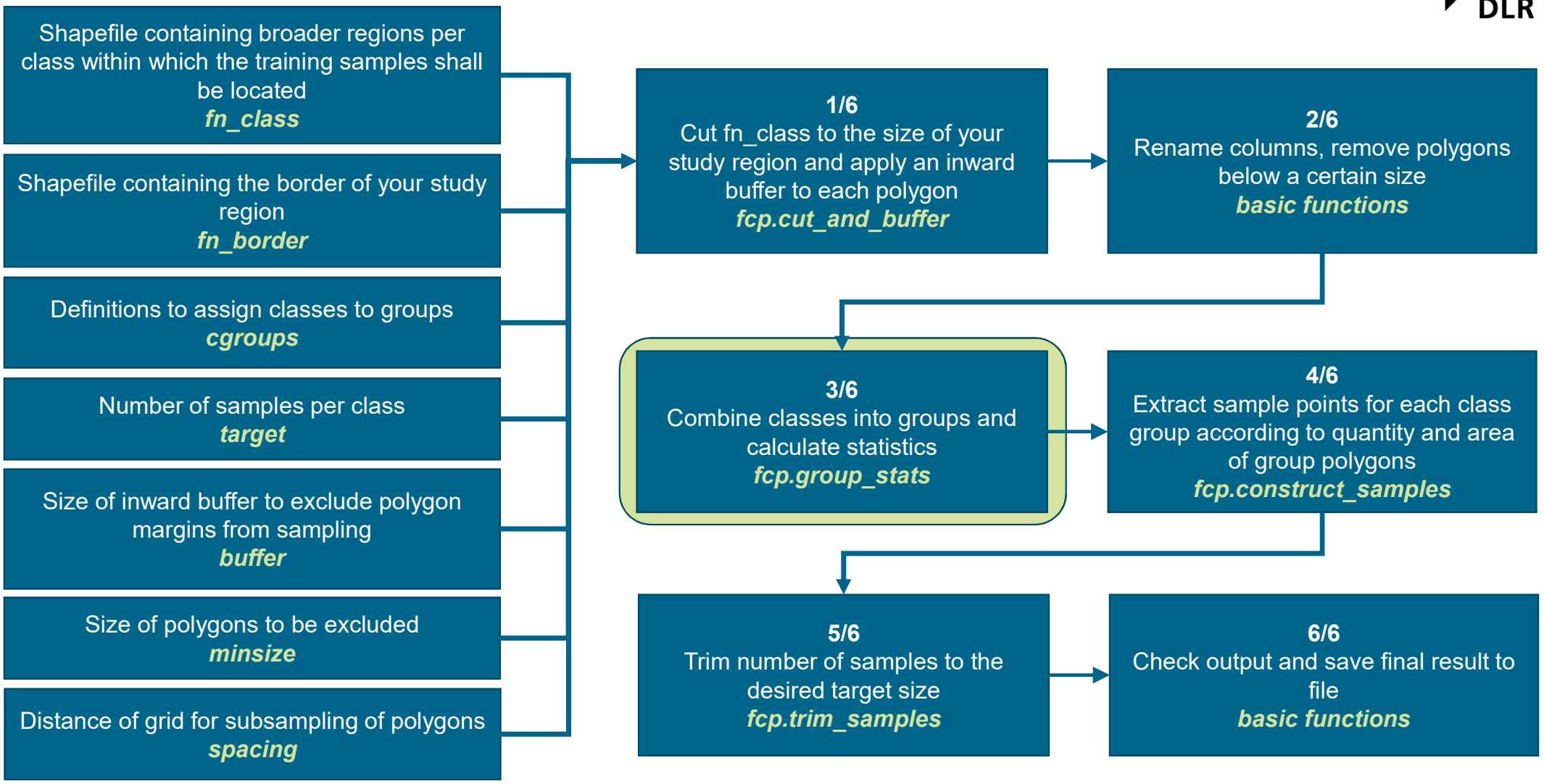


Sampling Visualization: Step 2/6) Rename and Clean-up

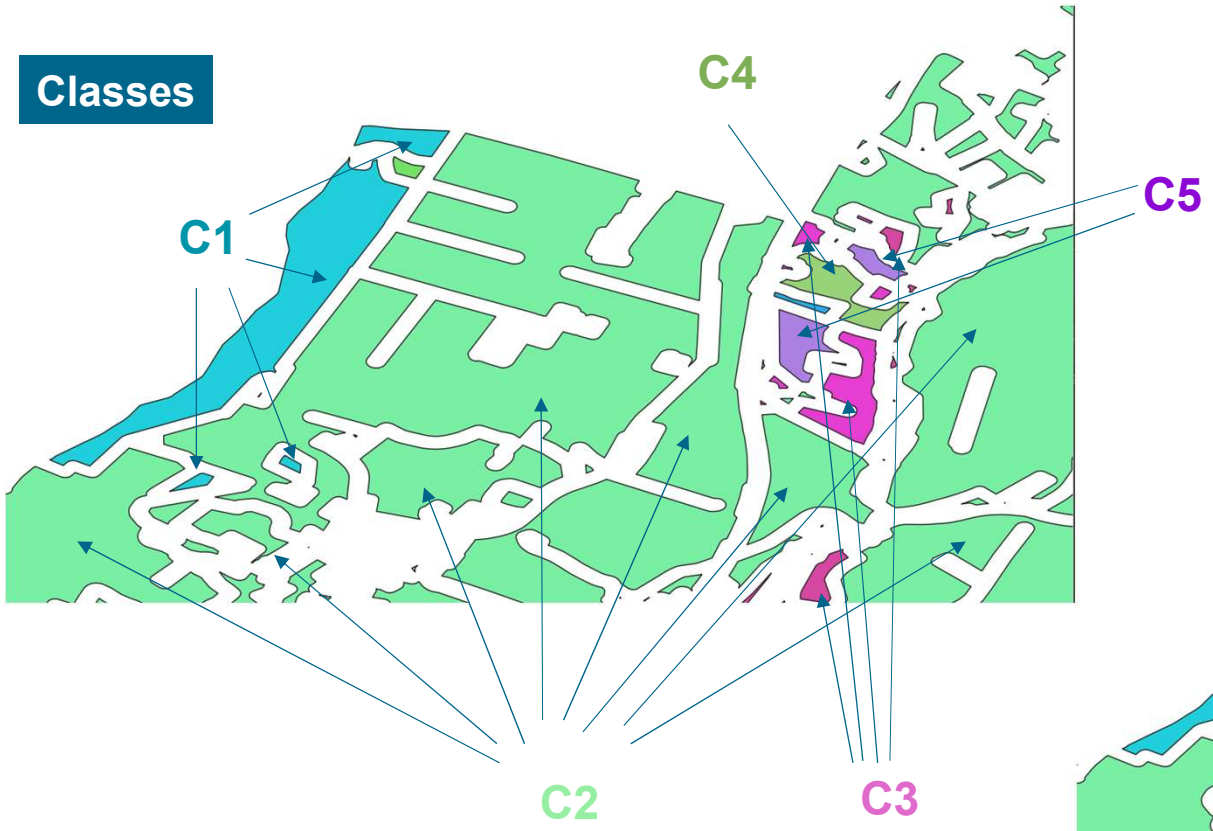
Purpose

- Internal renaming operations
- Exclude small areas

Sampling Tool: General Workflow

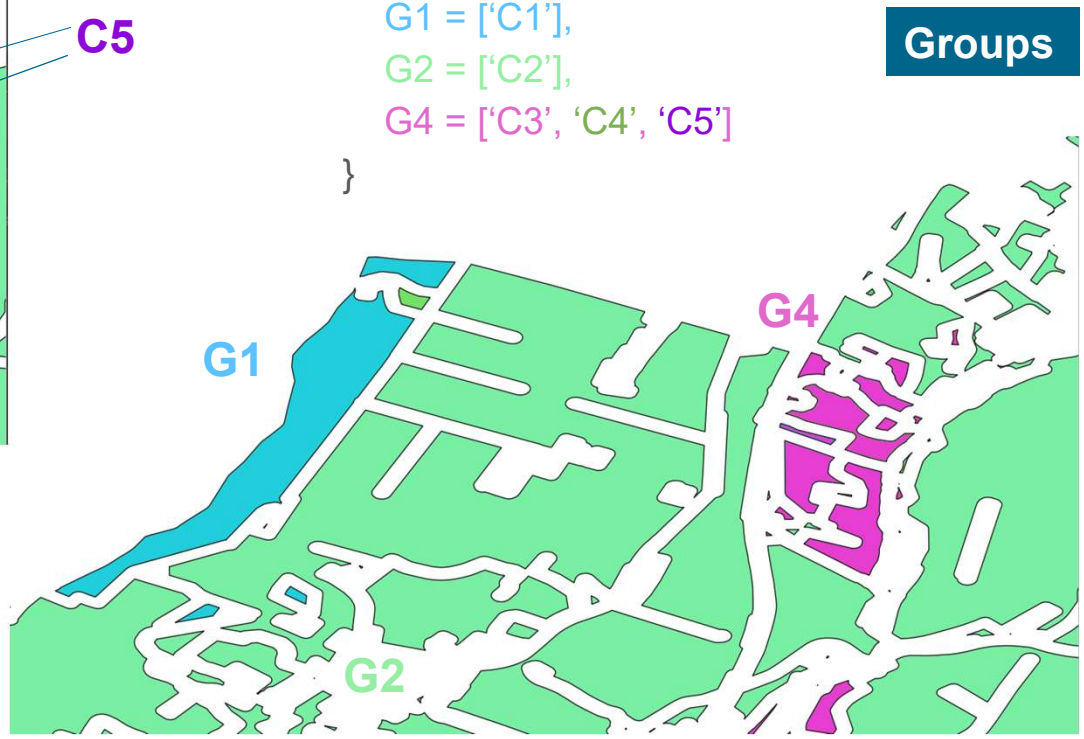


Sampling Visualization: 3/6) Assign classes to class groups, remove redundant classes, get stats

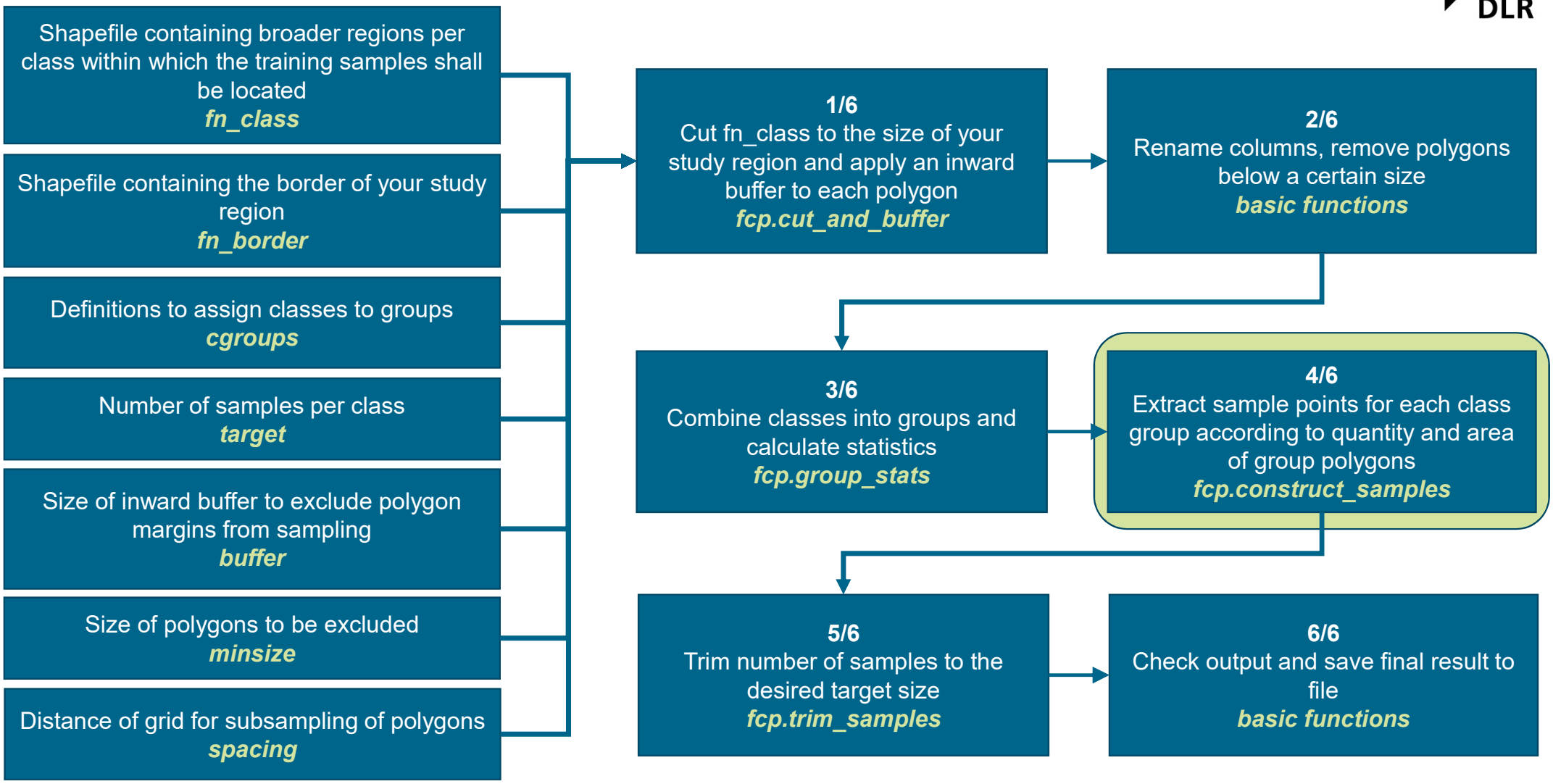


Notation:

```
{
    G1 = ['C1'],
    G2 = ['C2'],
    G4 = ['C3', 'C4', 'C5']
}
```



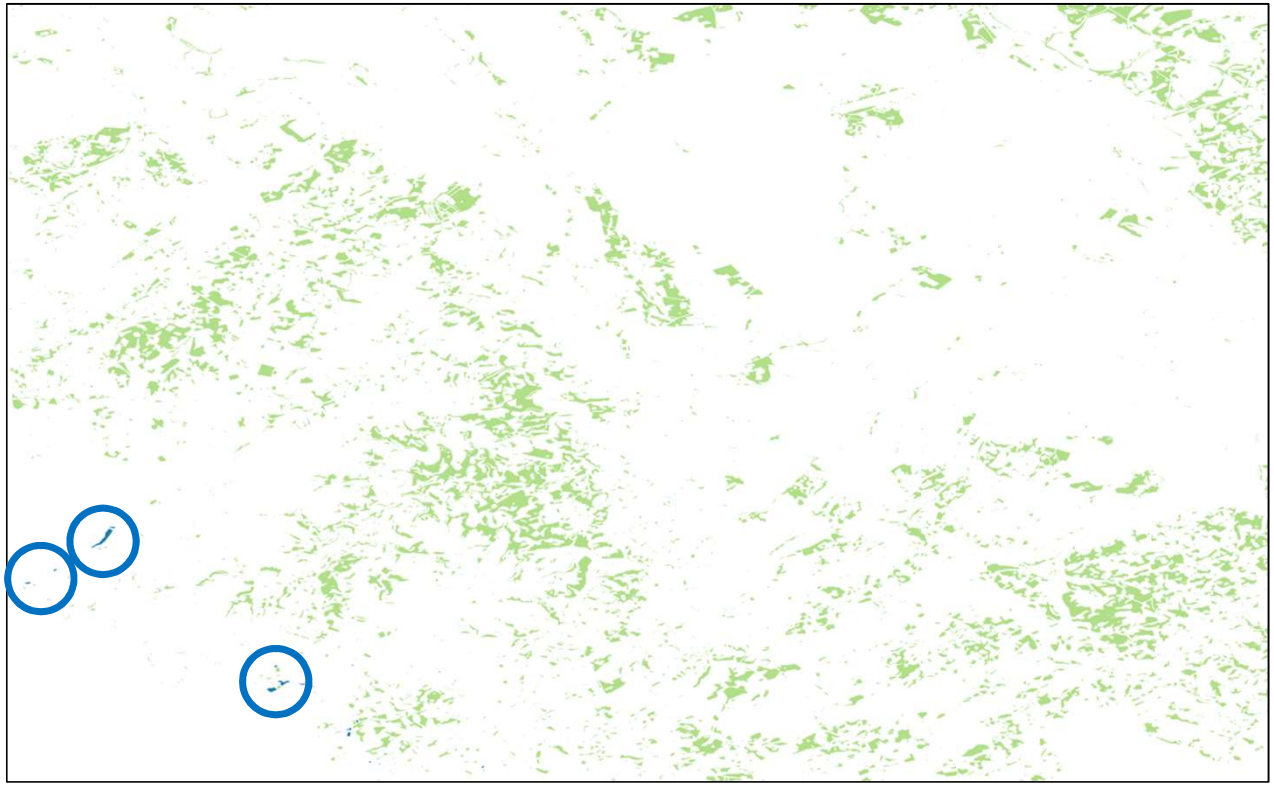
Step 4/6) Create sample point list for each of the groups - General Workflow



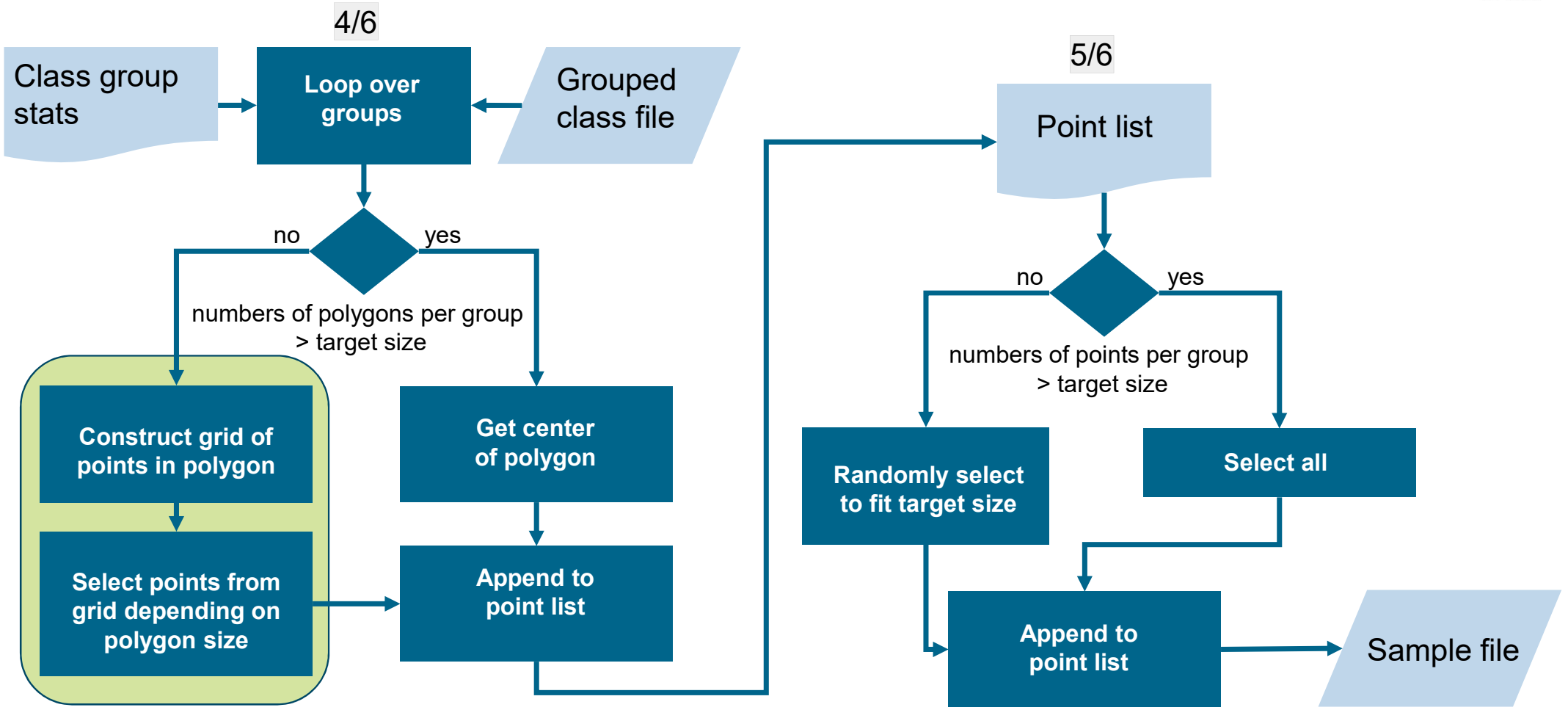
Step 4/6) Create sample point list for each of the groups

Two cases

- More polygons than required samples (green)
- Less polygons than required samples (blue)

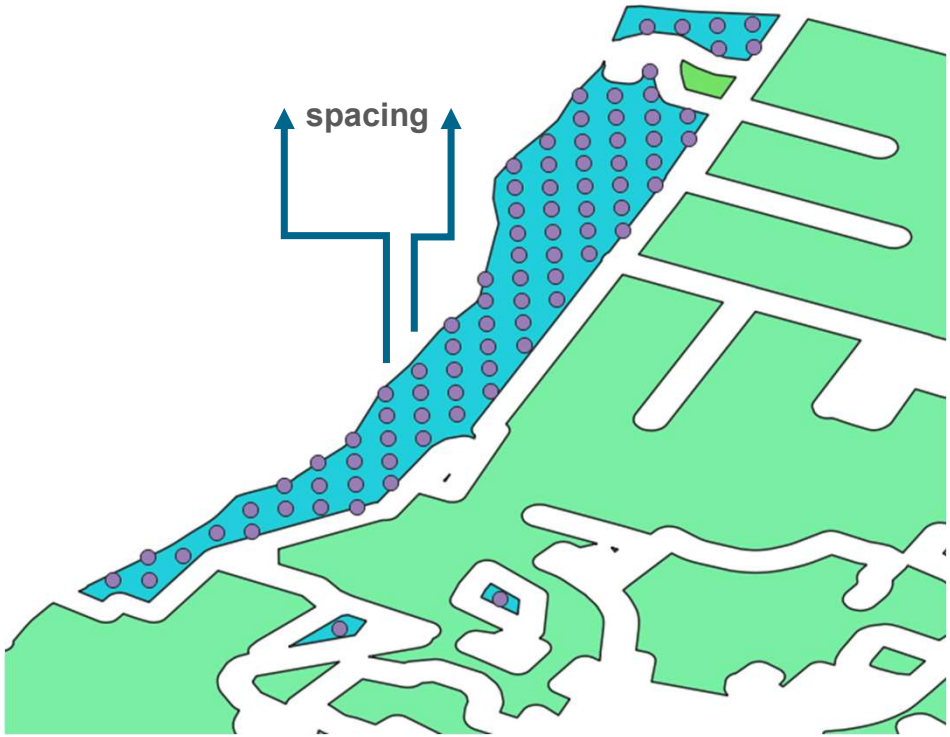


Workflow Detail: Sample Construction



Step 4/6) Sample Construction: Gridding

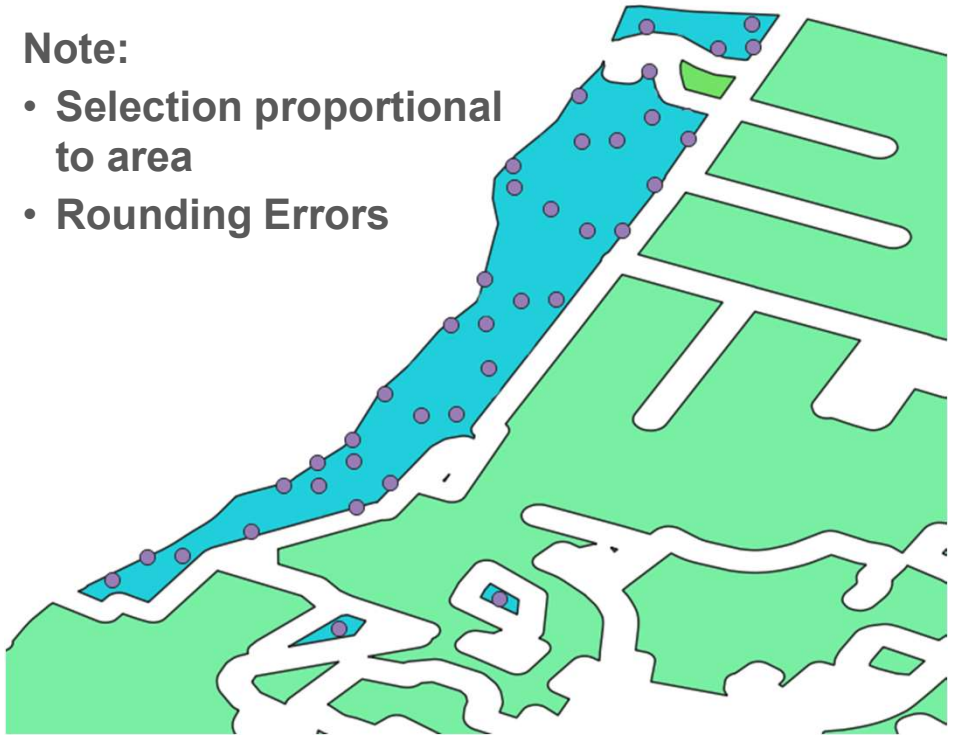
Gridding



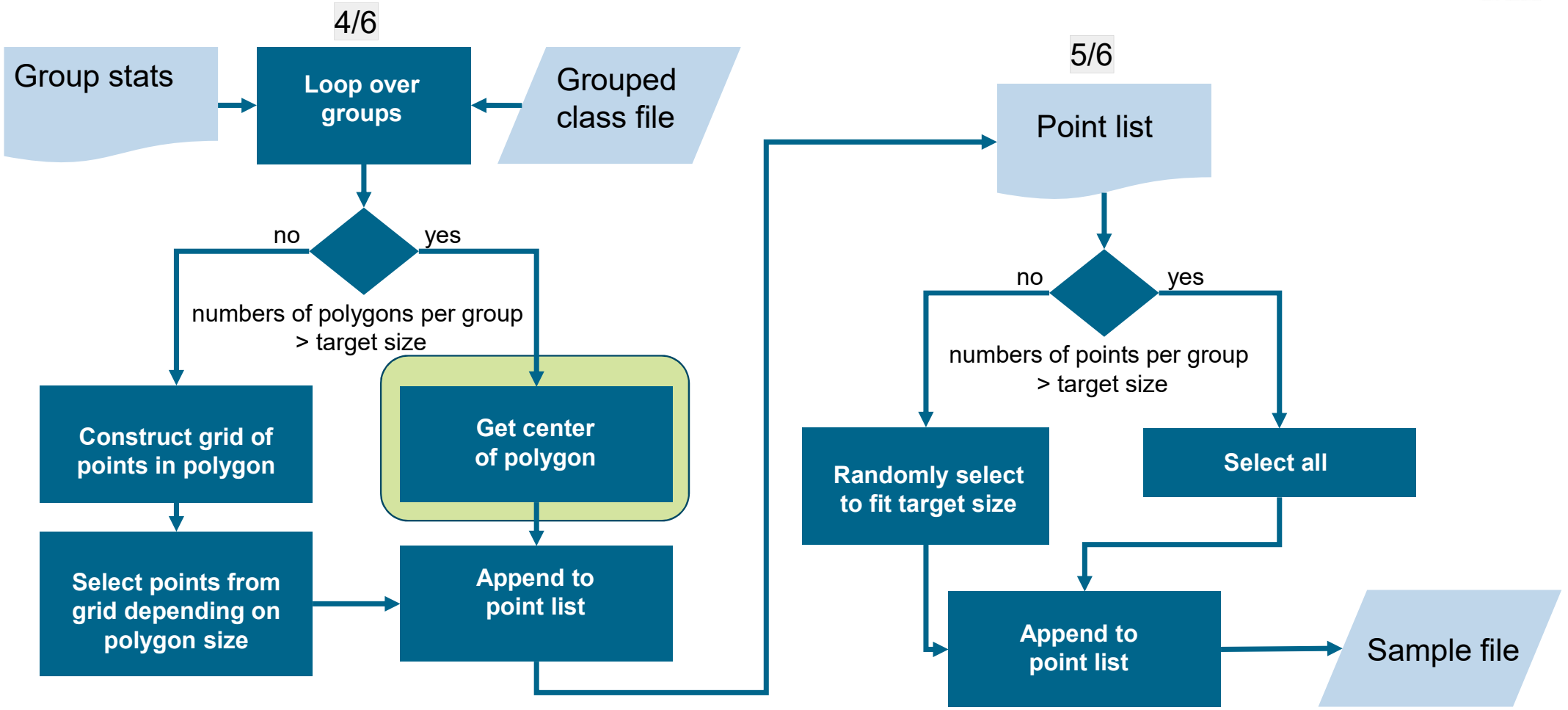
Select points from grid

Note:

- Selection proportional to area
- Rounding Errors

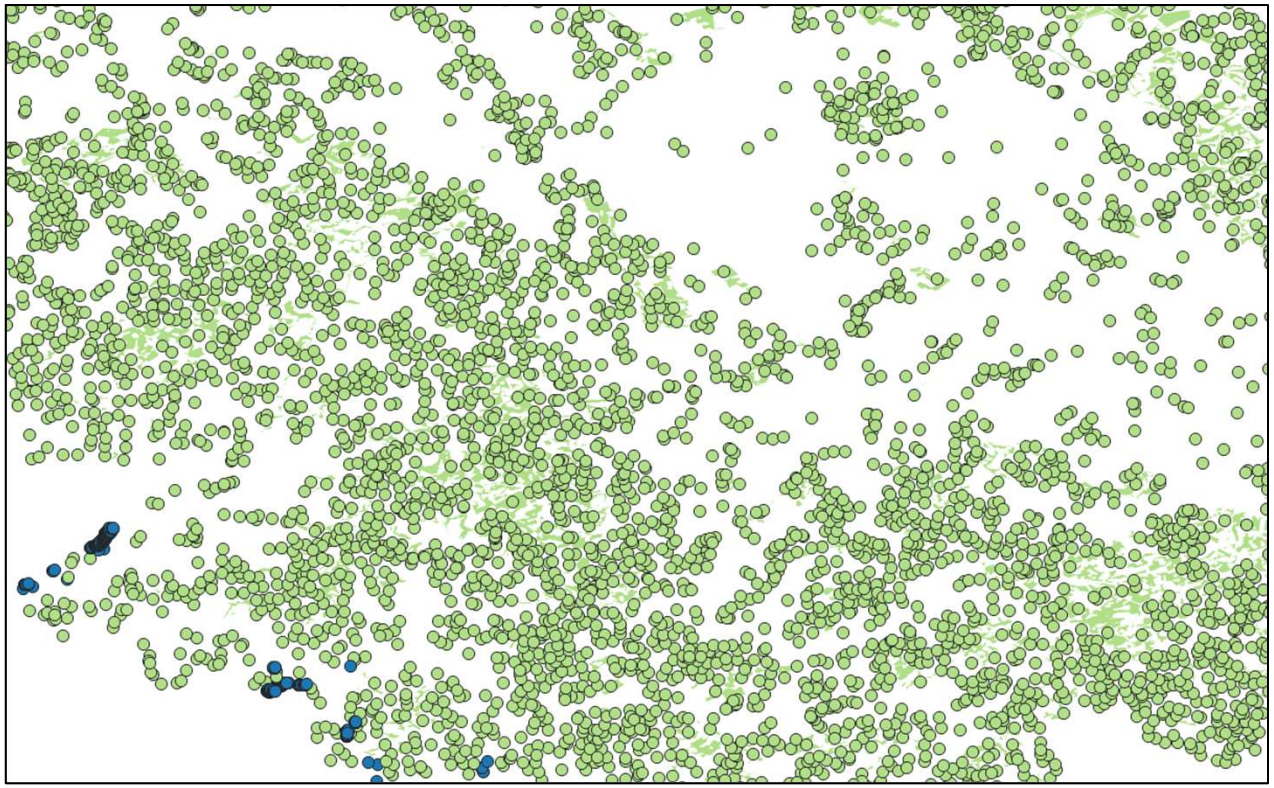


Workflow Detail: Sample Construction

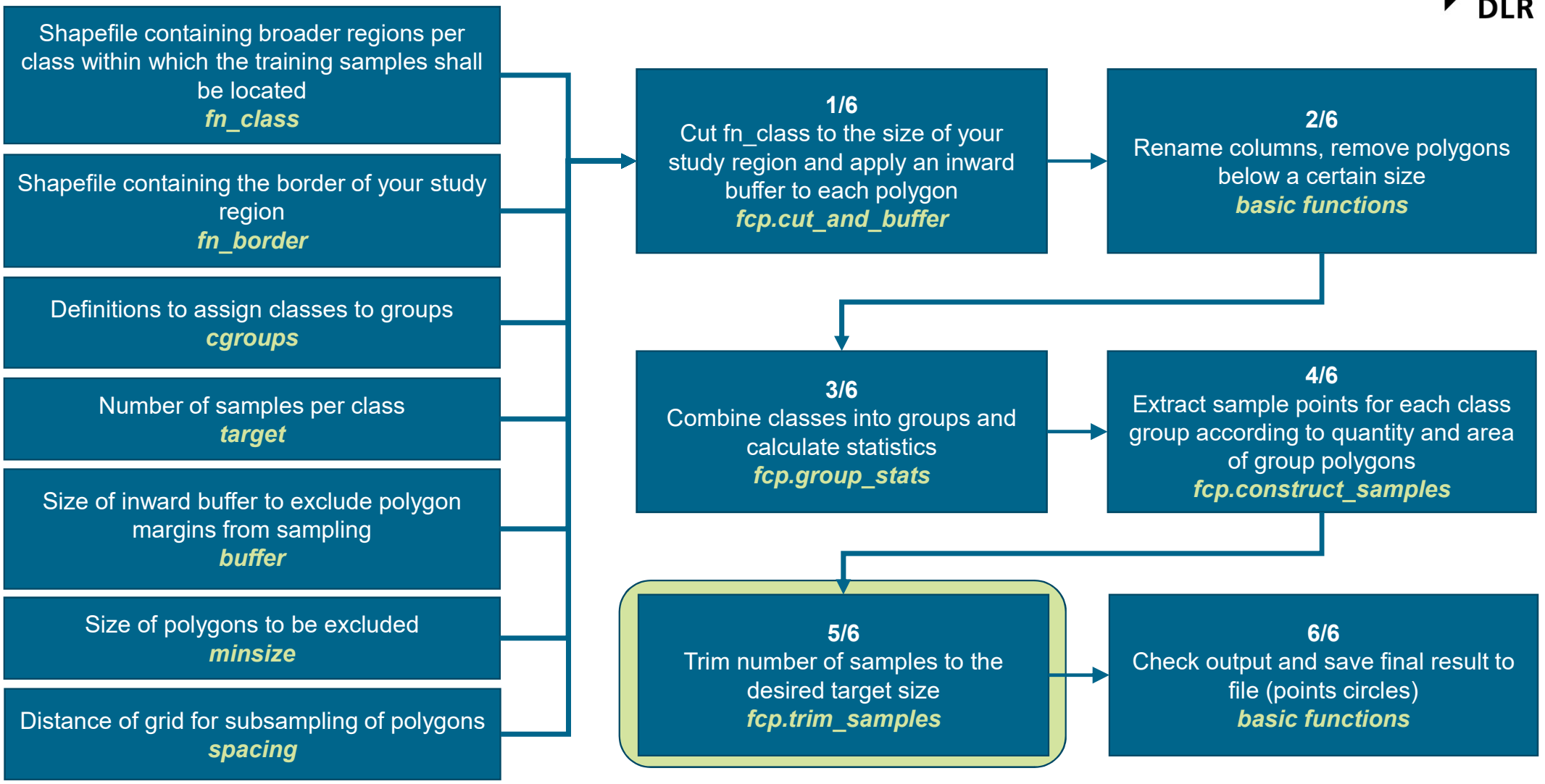


Step 4/6) Sample Construction: Center of Polygon

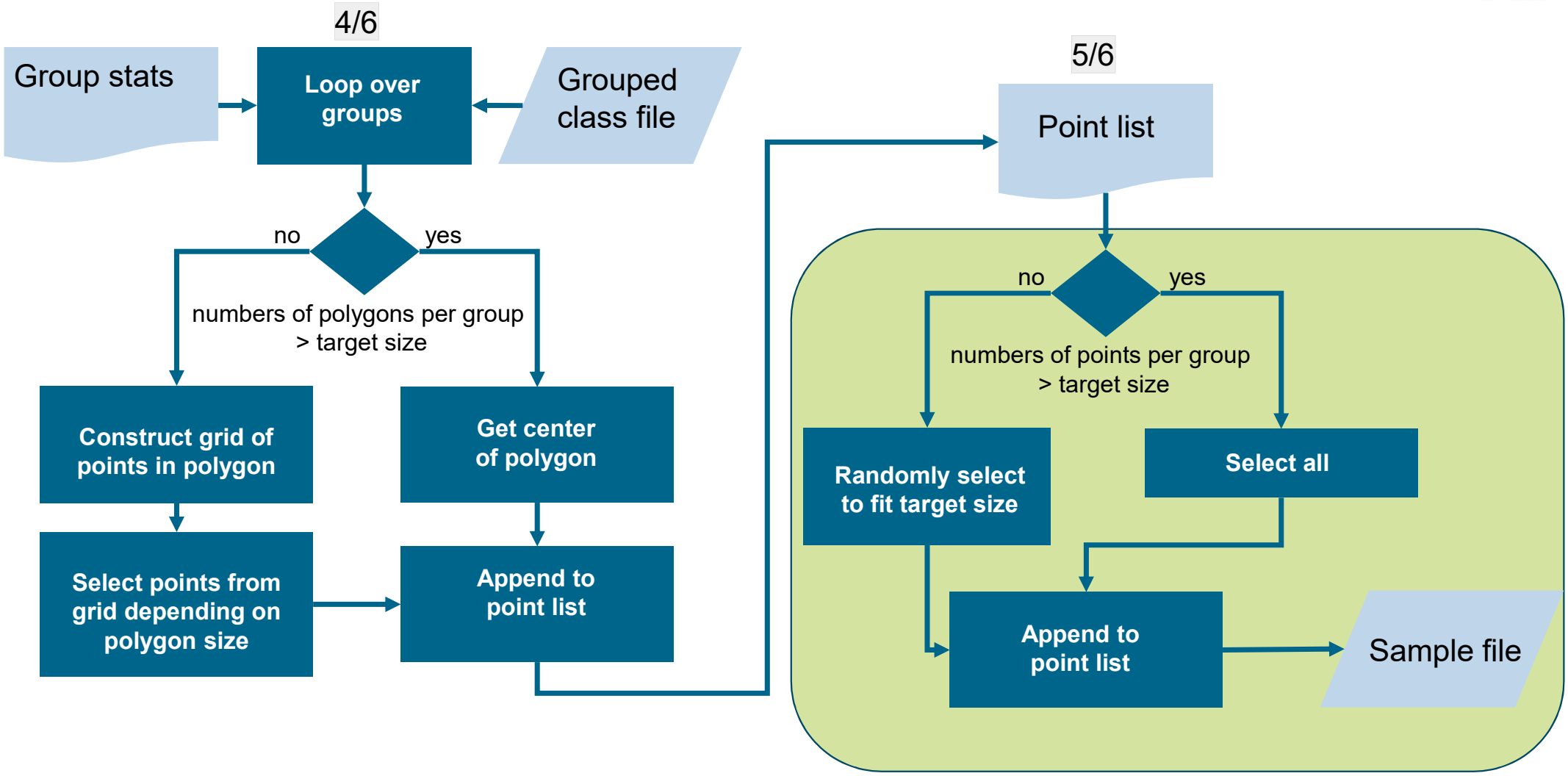
Sample Center of every polygon



Sampling Tool: General Workflow



Workflow Detail: Sample Selection



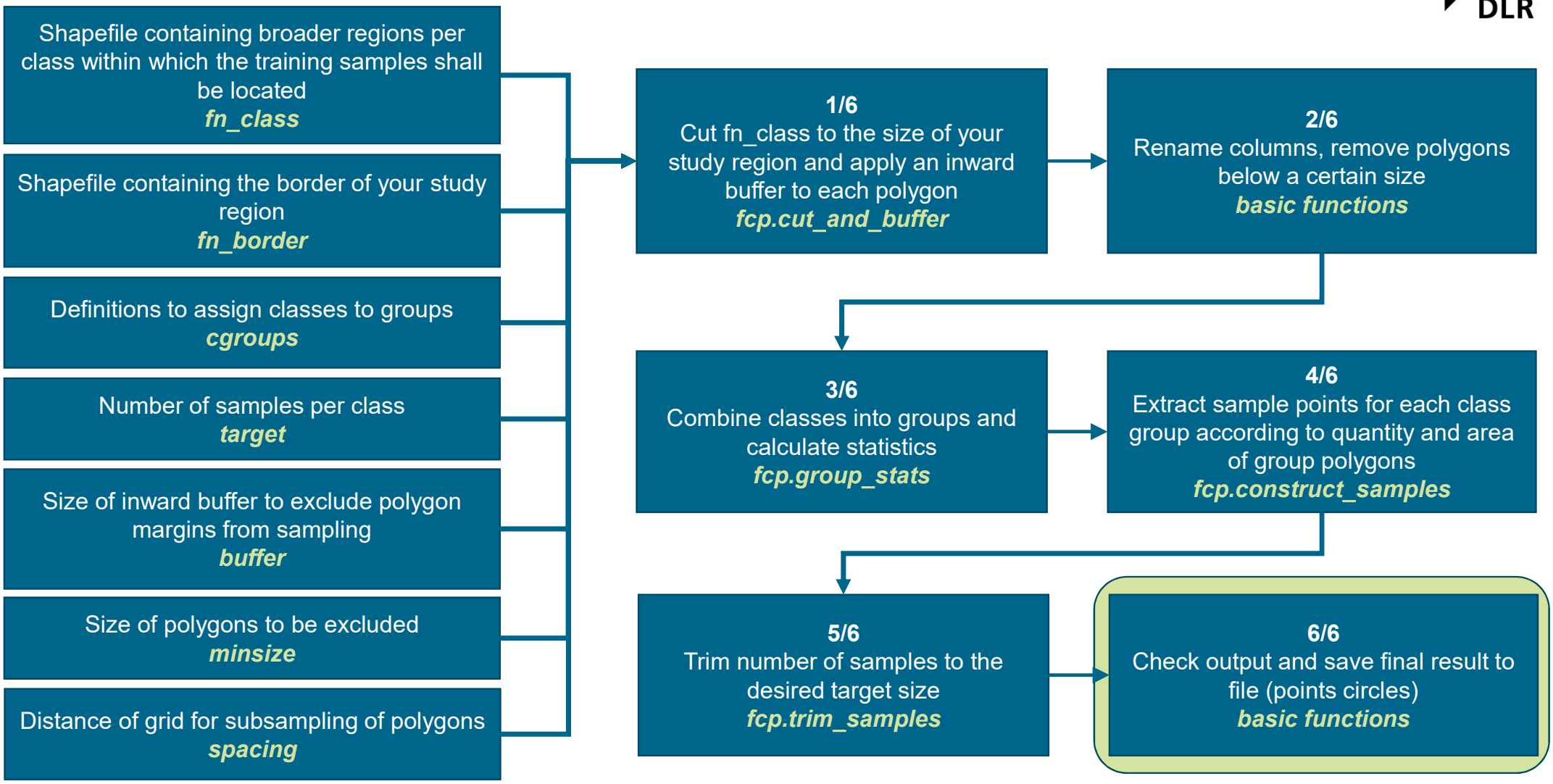
Sampling Visualization: Step 5/6) Sample Selection: Trim to Target Size

Several cases

- Too many sample points (green)
- Rounding error (blue)
  - ➢ Random selection

- To little or right number?
  - ➢ Take all (blue)

Sampling Tool: General Workflow

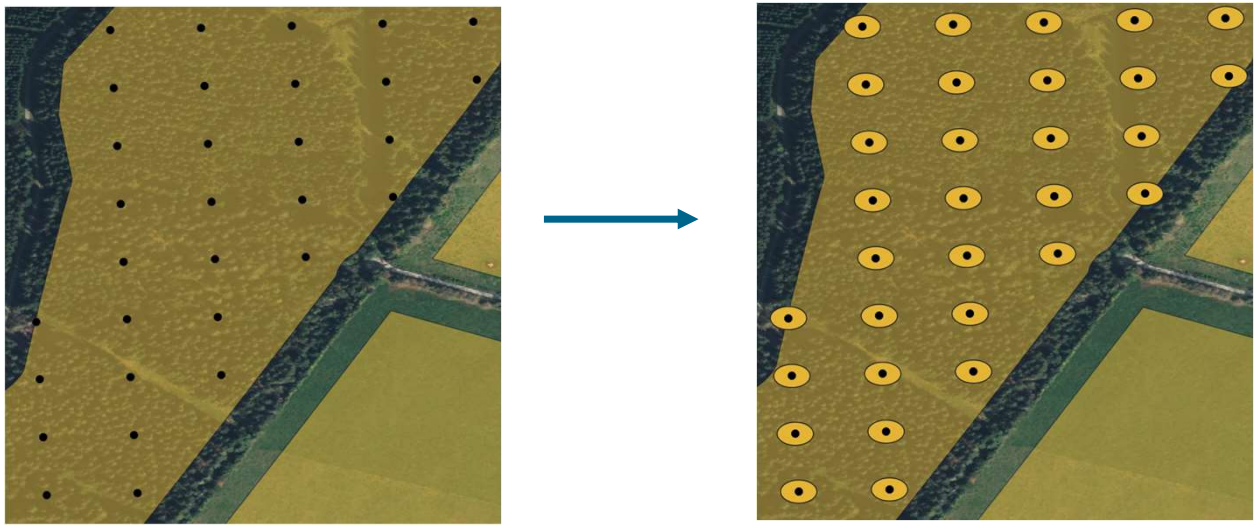


Sampling Visualization: Step 6/6) Visualize and Write Samples

Purpose

- Check numbers of sample points per group
- Quick visual control on a map
- Write sample points to file

Sampling Visualization: Bonus Step) Buffer Points



Demonstration

Stage 2

- Case: Eco System Classification: Deciduous – Coniferous Forest
- fpcup_sampling.ipynb

Sampling Visualization: Final Remarks

Feedback

- What is missing (data and functions)
- Different sampling strategy (stratified or not)
- Offer for short term support

Dissemination

What:
- Notebooks
- Documentation
- Training Data for all three examples

When:
- End of week after incorporation of feedback

Impressum

Thema:	**FPCUP Workshop** Concept and Live Demo
Datum:	23.11.2022
Autor:	Andreas Hirner, Ursula Gessner
Institut:	DFD: Land Surface Dynamics: Agricultural and Forest Ecosystems
Bildrechte:	DLR, ESA