CropRotationViz: A Comprehensive Tool for Crop Rotation Analysis and Visualization

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February 14, 2025

1 Introduction

CropRotationViz is an interactive R package designed for analyzing and visualizing agricultural crop rotation sequences across multiple spatial and temporal scales. The package provides a suite of tools for processing field geometries, analyzing crop rotations across multiple years, and creating interactive visualizations. It is particularly suited for working with Land Parcel Identification System (LPIS) data but can be adapted to other spatial agricultural datasets.

2 Key Features

- Support for multiple spatial file formats (SHP, GeoJSON, FlatGeobuf, GeoPackage)
- Field intersection analysis across multiple years
- Customizable crop classification and aggregation
- Interactive visualization capabilities
- Privacy-preserving spatial aggregation
- Multi-scale analysis (field, district, and catchment levels)

3 Installation

To install CropRotationViz, use the following R commands:

```
# Install remotes package if not already installed
install.packages("remotes")

# Install CropRotationViz from GitHub
remotes::install_github("franz-geoeco/CropRotationViz")
```

4 User Interfaces

The package provides three distinct user interfaces:

1. Processing UI (run_processing_app)
2. Main Visualization UI (run_visualization_app)
3. Fast Visualization UI (run_fast_visualization_app)

5 Processing UI

5.1 Starting the Interface

Launch the processing interface using:

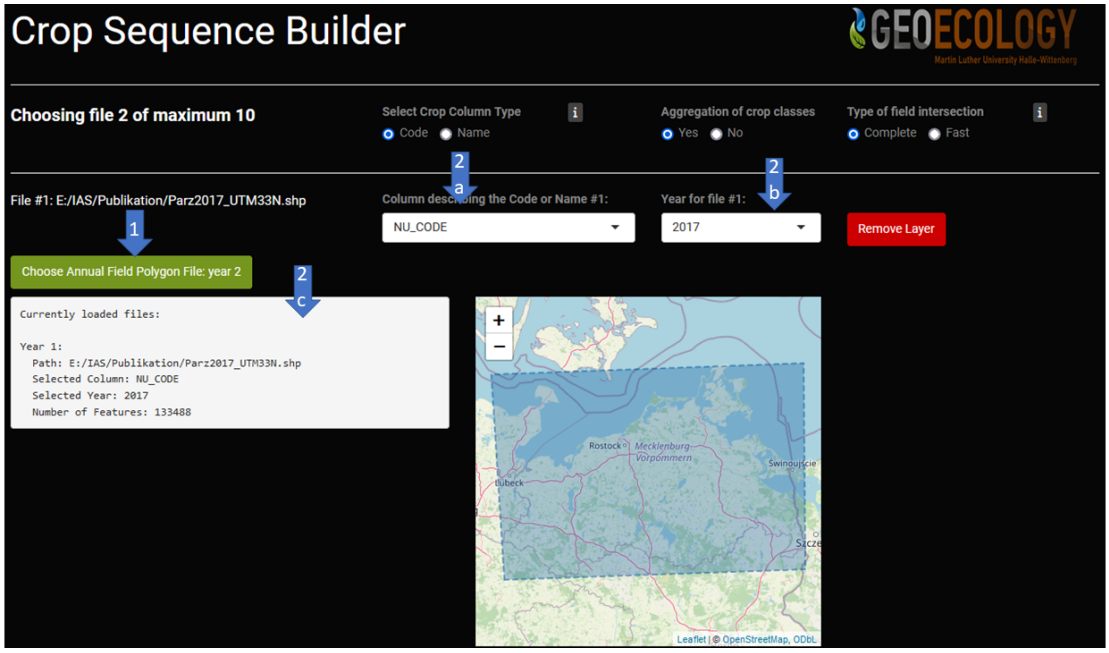
```
# Launch the processing application
CropRotationViz::run_processing_app()

# Launch with specific output directory
CropRotationViz::run_processing_app(
    output_dir = "path/to/output",
    common_column = "crop_code", # Optional
    start_year = 2020         # Optional
)
```

5.2 Step-by-Step Usage

5.2.1 Data Input

1. Click "Choose Annual Field Polygon File" to load your spatial data files (Support for up to 10 years of data)
2. For each file:
   (a) Select the column containing crop information
   (b) Specify the corresponding year
   (c) Verify file settings in the summary panel



5.2.2 Option Details

Crop Column Type The crop column selection determines how your crop data will be processed:

- **Code**: Use when working with national coding systems or when you want to use the aggregation functionality to summarize smaller classes into broader groups.
- **Name**: Use when working directly with crop names without coding system.

Aggregation Options

- **Yes**: Enable crop class aggregation
- **No**: Maintain original classifications

Field Intersection Type Choose between two intersection methods based on your needs:

- **Complete**: Comprehensive method that preserves all areas and includes non-intersecting fields. This method is slower but provides full coverage of the input data.
- **Fast**: Optimized method that processes only intersecting fields across years. Faster but excludes fields not present in all years.

Areas of Interest (AOI) Optional polygon file defining specific areas of interest:

- Divides the region into analyzable subsections
- Used alongside administrative boundaries from GADM

- In Germany, integrates with river basin boundaries
- Enables focused analysis of specific geographic regions

Fast Visualization Version Option to enable pre-rendered visualizations:

- Creates pre-rendered charts for faster visualization
- Enables quick comparison between regions
- Reduces loading times for large datasets
- Recommended for datasets with many regions

Output Format Options When saving processed data, choose between:

- **Shapefile**: Standard format, widely compatible
- **GeoPackage**: Modern, efficient single-file format
- **FlatGeobuf**: Optimized for web visualization

5.2.3 Crop Aggregation Editor

When aggregation is enabled:

1. Access the editor after clicking "Continue to Processing"
2. Drag and drop crops between available crops and aggregation classes
3. Create new aggregation classes as needed
4. View the aggregation flow visualization

5.2.4 Output Options

1. Select output directory
2. Choose output format:
    - Shapefile
    - GeoPackage
    - FlatGeobuf
3. Enable/disable fast visualization version

6 Main Visualization UI

6.1 Starting the Interface

Launch using:

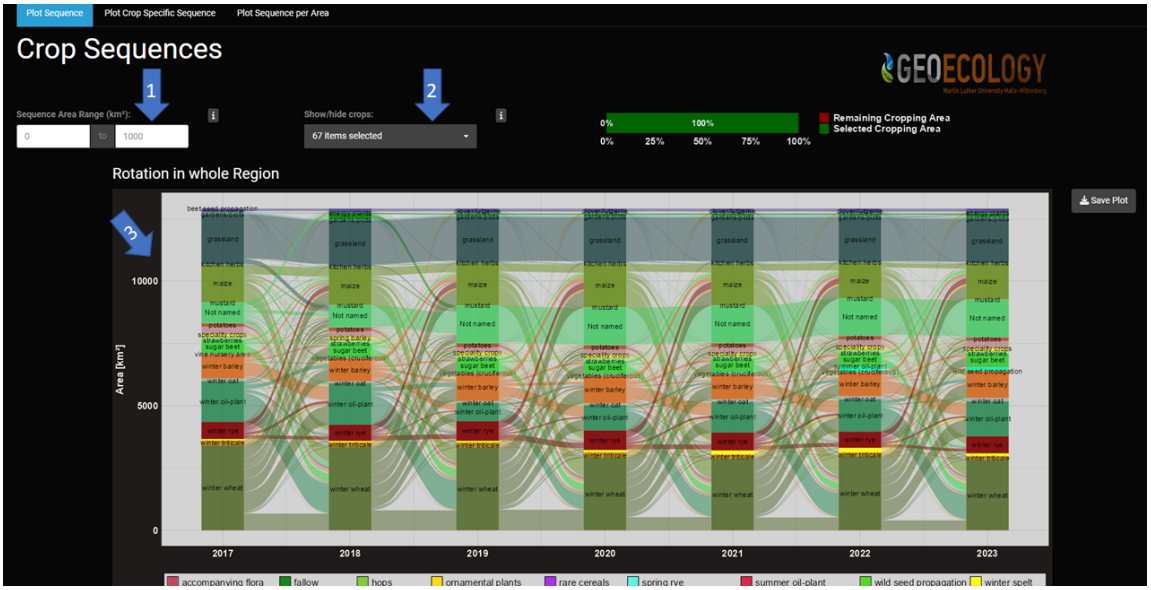
```
# Basic launch
CropRotationViz::run_visualization_app()

# Launch with specific input directory
CropRotationViz::run_visualization_app(
    input_dir = "path/to/processed/data" # Optional
)
```

6.2 Features

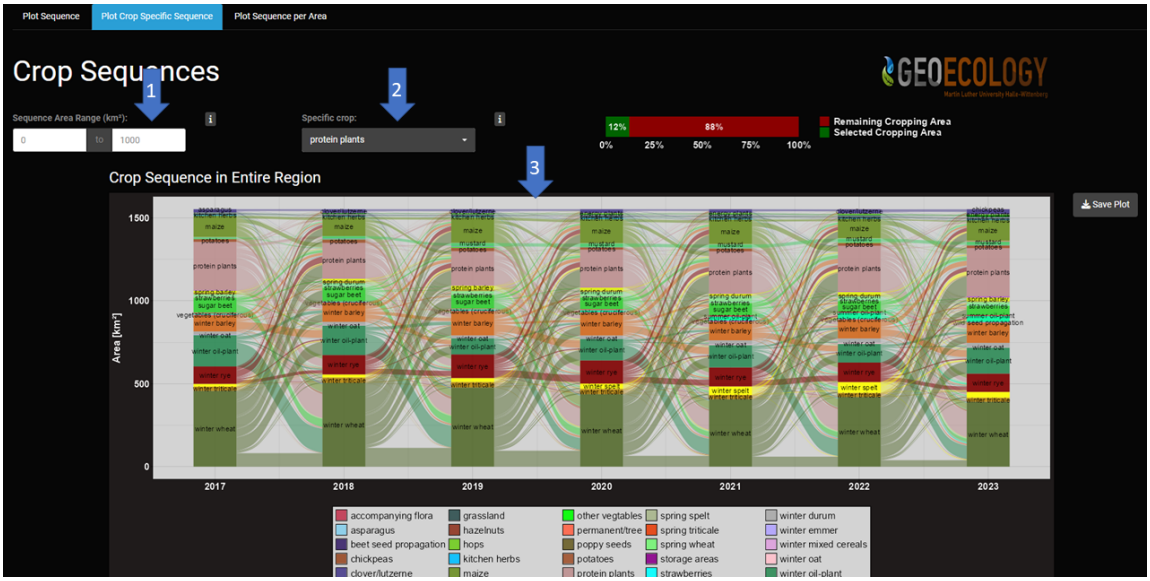
6.2.1 Plot Sequence Tab

1. Area range selection (0-4000 km^2)
2. Crop filtering options
3. Sankey diagram
4. Detailed data table
5. Aggregation visualization



6.2.2 Plot Crop Specific Sequence Tab

1. Area range selection (0-4000 km²)
2. Single crop selection
3. Crop-specific Sankey diagram
4. Detailed sequence table
5. Transition visualization



6.2.3 Plot Sequence per Area Tab

1. District/River Basin selection
2. Area-specific visualizations
3. Temporal analysis options
4. Crop filtering options
5. Area specific Sankey plot
6. Year selector
7. Area specific crop area distribution
8. Area and year specific field size boxplots

7 Fast Visualization UI

7.1 Starting the Interface

Launch using:

```
# Basic launch
CropRotationViz::run_fast_visualization_app()

# Launch with specific input directory
CropRotationViz::run_fast_visualization_app(
    input_dir = "path/to/processed/data"
)
```

7.2 Features

7.2.1 Map Comparison

1. Interactive map for region selection
2. Side-by-side visualization
3. Support for district and catchment comparisons

4. Pre-rendered visualizations for quick loading

7.2.2 Diversity Analysis

1. Structural diversity mapping
2. Bivariate visualization
3. Multiple spatial scales
4. Interactive legend

8 Output Files

The processing generates several files:

- Spatial data file (selected format)
- RData file with processed data
- Processing information text file
- Pre-rendered visualizations (if enabled)

9 Best Practices

1. Ensure consistent coordinate reference systems
2. Verify crop codes/names across years
3. Consider memory requirements for large datasets
4. Use appropriate intersection type based on data size
5. Review aggregation classes before processing

10 Technical Requirements

- R version 3.5.0
- Sufficient RAM for data processing
- Stable internet connection for basemap loading

11 Error Handling

Common errors and their solutions:

```
# Example of handling missing columns
if (!all(required_cols %in% names(data))) {
    stop("Missing required columns: ",
         paste(setdiff(required_cols, names(data)),
               collapse = ", "))
}

# Example of CRS transformation error handling
tryCatch({
    data <- st_transform(data, 4326)
}, error = function(e) {
    stop("CRS transformation failed: ", e$message)
})
```

12 Support and Citation

For issues and feature requests, visit: `https://github.com/franz-geoeco/CropRotationViz`

To cite CropRotationViz:

```
@software{CropRotationViz2024,
    author = {Schulze, Franz},
    title = {CropRotationViz: Interactive Tool for
            Crop Rotation Sequence Analysis},
    year = {2024},
    publisher = {GitHub},
    journal = {GitHub repository},
    url = {https://github.com/franz-geoeco/CropRotationViz}
}
```