Example of the `aitlas` toolbox in the context of crop type prediction

This notebook shows a sample implementation for crop type prediction using the `aitlas` toolbox and the Netherlands 2019 dataset.

```
In [2]:  import os

         from aitlas.datasets import EOPatchCrops
         from aitlas.models import LSTM
         from aitlas.visualizations import display_eopatch_predictions
```

## Load the dataset

```
In [ ]: dataset_config = {
             "root": "/home/dkocev/data/CropTypeNetherlands/2019/",
             "csv_file_path": "index.csv",
             "batch_size": 128,
             "shuffle": True,
             "num_workers": 4,
             "regions":["train", "test", "val",],
         }
         dataset = EOPatchCrops(dataset_config)
```
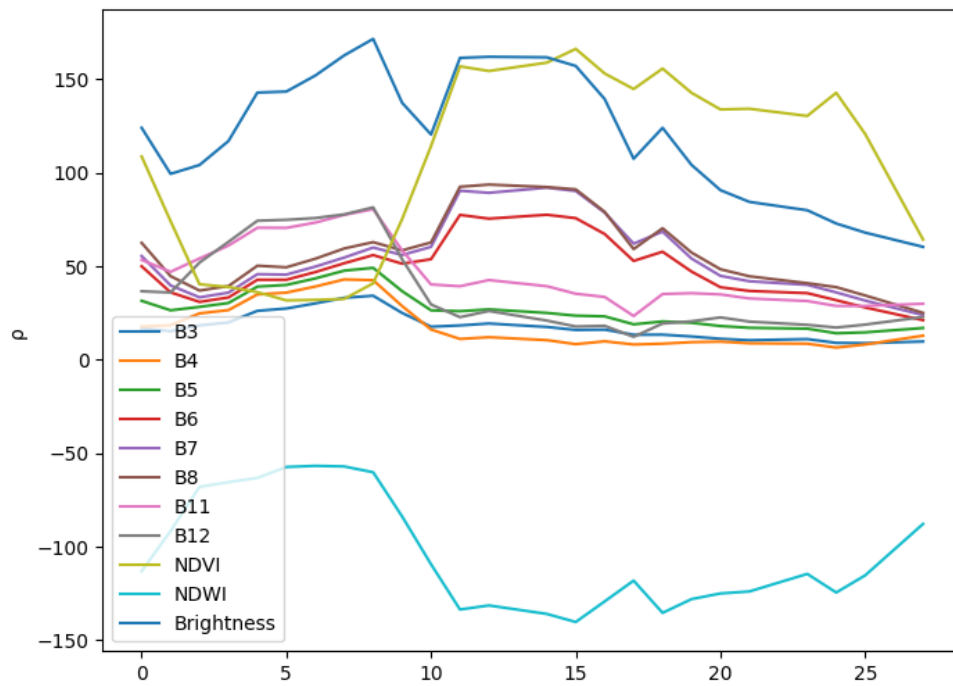
## Visualize sample time series from the dataset

```
In [9]: fig1 = dataset.show_timeseries(0)
         fig2 = dataset.show_timeseries(100)
         fig3 = dataset.show_timeseries(1000)
```
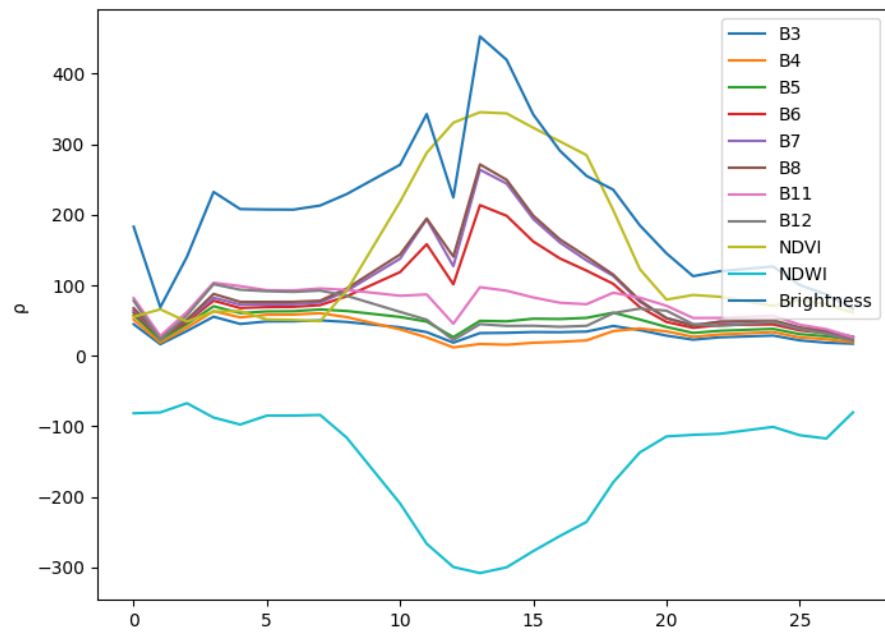
Time series with index 0 from the region train, with label Permanent grassland
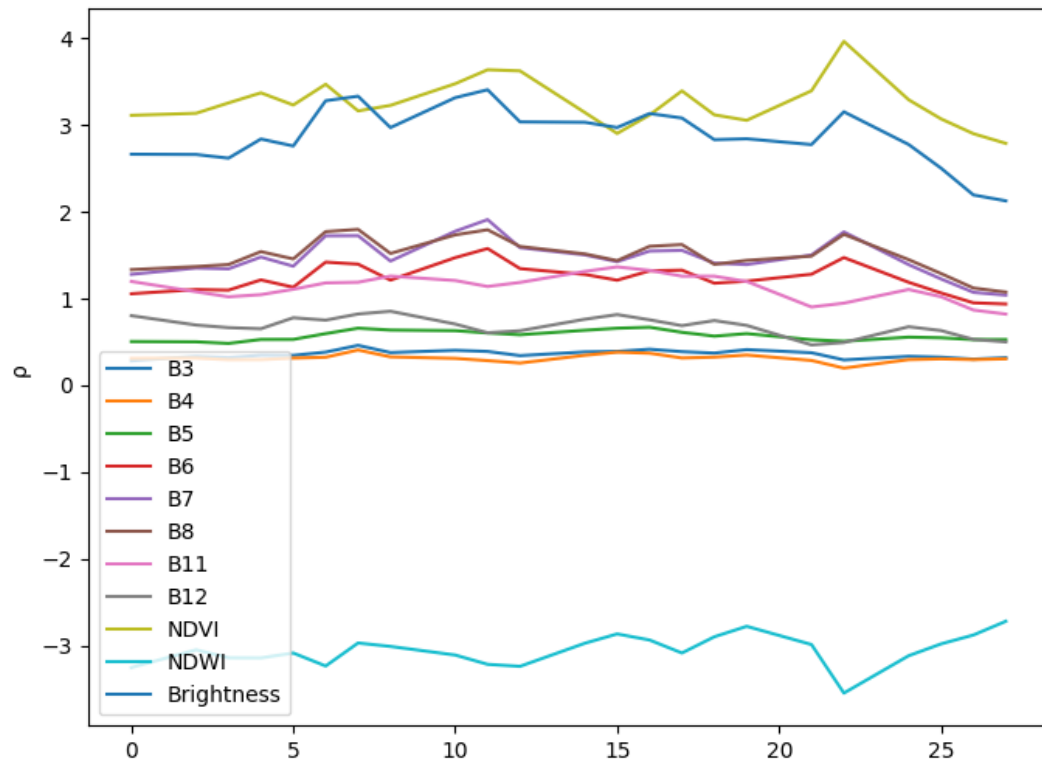


Time series with index 100 from the region train, with label Sugar beet (excluding seed)

Time series with index 1000 from the region train, with label Potatoes (including seed potatoes)

## Inspect the data

In [10]: `dataset.show_samples()`

| | id | path | eopatch | polygon_id | CODE_CULTU | sequencelength |
|---|---|---|---|---|---|---|
| **0** | 0 | eopatch_11173/1666071 | eopatch_11173 | 1666071 | J0000 | ( |
| **1** | 1 | eopatch_10137/1894170 | eopatch_10137 | 1894170 | J0000 | ( |
| **2** | 2 | eopatch_6711/1875243 | eopatch_6711 | 1875243 | J0000 | ( |
| **3** | 3 | eopatch_6590/1924836 | eopatch_6590 | 1924836 | G1000 | ( |
| **4** | 4 | eopatch_3731/2150854 | eopatch_3731 | 2150854 | NUAA+WA+FA9 | ( |
| **5** | 5 | eopatch_939/2018637 | eopatch_939 | 2018637 | NUAA+WA+FA9 | ( |
| **6** | 6 | eopatch_3999/1573533 | eopatch_3999 | 1573533 | G3000 | ( |
| **7** | 7 | eopatch_9569/1709233 | eopatch_9569 | 1709233 | J0000 | ( |
| **8** | 8 | eopatch_2152/2286699 | eopatch_2152 | 2286699 | NUAA+WA+FA9 | ( |
| **9** | 9 | eopatch_10867/1620648 | eopatch_10867 | 1620648 | J0000 | ( |
| **10** | 10 | eopatch_4205/1674540 | eopatch_4205 | 1674540 | G3000 | ( |
| **11** | 11 | eopatch_3465/2142385 | eopatch_3465 | 2142385 | R1000 | ( |
| **12** | 12 | eopatch_2504/2167864 | eopatch_2504 | 2167864 | J0000 | ( |
| **13** | 13 | eopatch_4567/1530529 | eopatch_4567 | 1530529 | G3000 | ( |
| **14** | 14 | eopatch_8115/1825570 | eopatch_8115 | 1825570 | G3000 | ( |
| **15** | 15 | eopatch_8220/2108154 | eopatch_8220 | 2108154 | R2000 | ( |
| **16** | 16 | eopatch_7998/2183462 | eopatch_7998 | 2183462 | G3000 | ( |
| **17** | 17 | eopatch_10489/2192293 | eopatch_10489 | 2192293 | J0000 | ( |

| | id | path | eopatch | polygon_id | CODE_CULTU | sequencelength |
|---|---|---|---|---|---|---|
| **18** | 18 | eopatch_7950/1974596 | eopatch_7950 | 1974596 | C1111 | |
| **19** | 19 | eopatch_8836/1677178 | eopatch_8836 | 1677178 | J0000 | |

In [11]: `dataset.data_distribution_table()`

Out[11]:

| | Label | Region | Number of parcels |
|---|---|---|---|
| 0 | Common winter wheat and spelt | test | 3152 |
| 1 | Common winter wheat and spelt | train | 15467 |
| 2 | Common winter wheat and spelt | val | 2778 |
| 3 | Flowers and ornamental plants (excluding nurse... | test | 1055 |
| 4 | Flowers and ornamental plants (excluding nurse... | train | 5143 |
| 5 | Flowers and ornamental plants (excluding nurse... | val | 911 |
| 6 | Green maize | test | 6841 |
| 7 | Green maize | train | 32271 |
| 8 | Green maize | val | 5614 |
| 9 | Onions | test | 1136 |
| 10 | Onions | train | 5368 |
| 11 | Onions | val | 948 |
| 12 | Other farmland | test | 1566 |
| 13 | Other farmland | train | 7843 |
| 14 | Other farmland | val | 1333 |
| 15 | Permanent grassland | test | 24051 |
| 16 | Permanent grassland | train | 116485 |
| 17 | Permanent grassland | val | 20502 |
| 18 | Potatoes (including seed potatoes) | test | 4758 |
| 19 | Potatoes (including seed potatoes) | train | 22920 |
| 20 | Potatoes (including seed potatoes) | val | 4044 |
| 21 | Spring barley | test | 906 |
| 22 | Spring barley | train | 4422 |
| 23 | Spring barley | val | 773 |
| 24 | Sugar beet (excluding seed) | test | 2391 |
| 25 | Sugar beet (excluding seed) | train | 11490 |
| 26 | Sugar beet (excluding seed) | val | 2032 |
| 27 | Temporary grasses and grazings | test | 7894 |
| 28 | Temporary grasses and grazings | train | 37484 |
| 29 | Temporary grasses and grazings | val | 6752 |

In [12]: 
```python
fig = dataset.data_distribution_barchart()
```
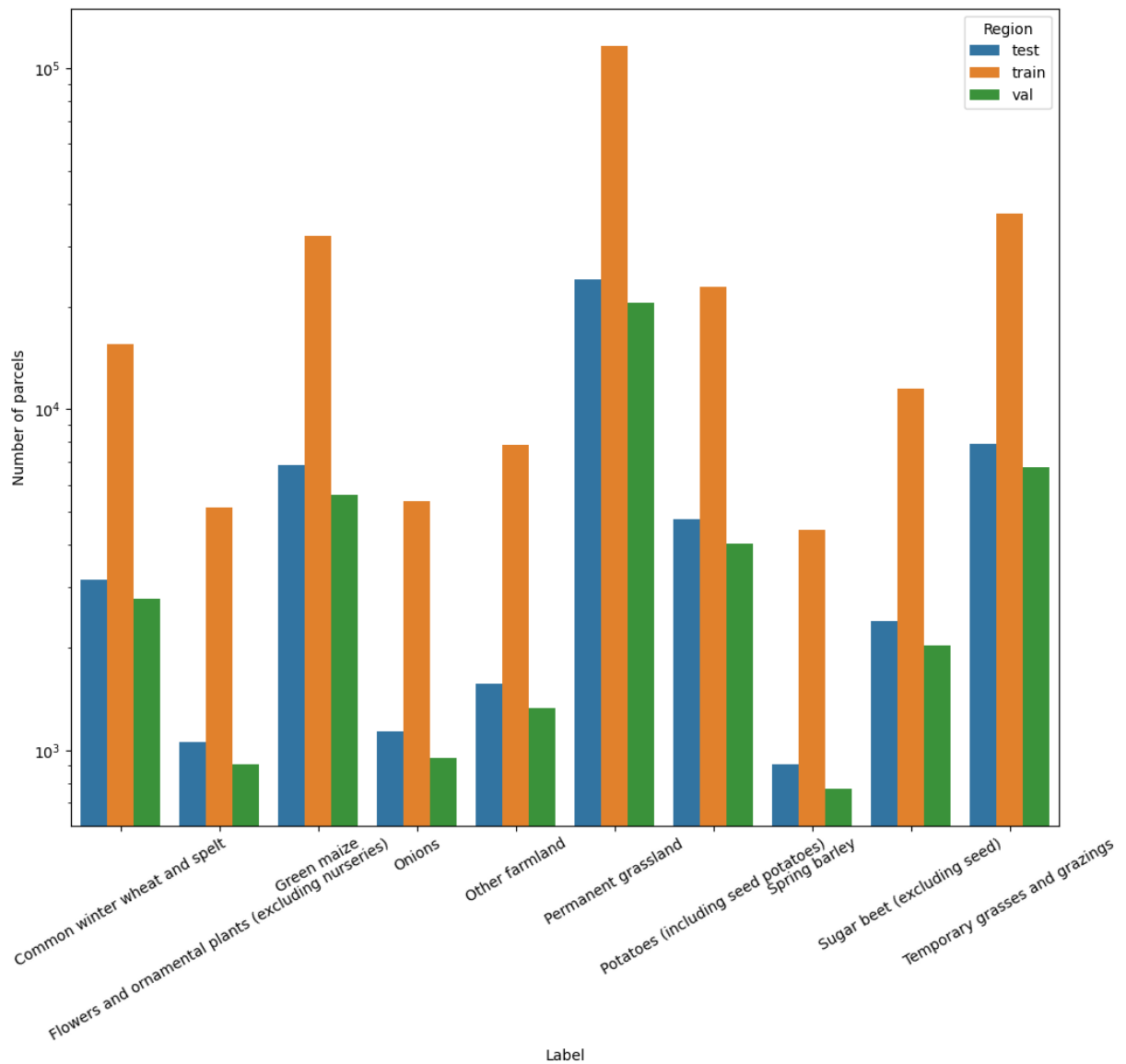
Load train and validation splits

```
In [13]: train_dataset_config = {
             "root": "/home/dkocev/data/CropTypeNetherlands/2019/",
             "csv_file_path": "index.csv",
             "batch_size": 128,
             "shuffle": True,
             "num_workers": 4,
             "regions":["train", ],
         }

         train_dataset = EOPatchCrops(train_dataset_config)

         validation_dataset_config = {
             "batch_size": 32,
             "shuffle": False,
             "num_workers": 4,
             "root": "/home/dkocev/data/CropTypeNetherlands/2019/",
             "csv_file_path": "index.csv",
```

```
        "regions":["val", ],
    }

    validation_dataset = EOPatchCrops(validation_dataset_config)
    len(train_dataset), len(validation_dataset)
```

Out[13]: (258893, 45687)

Setup and create the model for training

In [14]:
```
epochs = 100
model_directory = "./experiments/LSTM"
model_config = {
    "input_dim":11,
    "num_classes": 10,
    "learning_rate": 0.001,
    "dropout" : 0.2,
    "metrics":["accuracy","f1_score", "kappa"]
}
model = LSTM(model_config)
model.prepare()
```

Training and validation

In [ ]:
```
model.train_and_evaluate_model(
    train_dataset=train_dataset,
    epochs=epochs,
    model_directory=model_directory,
    val_dataset=validation_dataset,
    run_id='notebook-1',
)
```

Test the model

In [ ]:
```
labels = ["Permanent grassland", "Temporary grasses and grazings", "Green maize", "
          "Common winter wheat and spelt", "Sugar beet (excluding seed)", "Other fa
          "Flowers and ornamental plants (excluding nurseries)", "Spring barley",]

test_dataset_config = {
    "batch_size": 32,
    "shuffle": False,
    "num_workers": 4,
    "root": "/home/dkocev/data/CropTypeNetherlands/2019/",
    "csv_file_path": "index.csv",
    "regions":["test", ],
}

test_dataset = EOPatchCrops(test_dataset_config)

model_path = "/home/dkocev/aitlas/experiments/LSTM/checkpoint.pth.tar"
model.metrics = ["accuracy", "f1_score", "kappa"]
model.running_metrics.reset()
```

```
model.evaluate(dataset=test_dataset, model_path=model_path)
model.running_metrics.get_scores(model.metrics)
```

Running and visualizing predictions

In [25]:
```
y_true, y_pred, y_prob = model.predict(dataset=test_dataset,)

eopatches_path = "/home/dkocev/data/CropTypeNetherlands/2019/eopatches/"
patch = "eopatch_7495"

fig = display_eopatch_predictions(
    eopatches_path,
    patch,
    y_pred,
    test_dataset.index,
    y_true,
    test_dataset.mapping,
)
```

```
running prediction: 100%|████████████████████████████████████████|
1680/1680 [00:10<00:00, 154.19it/s]
```