SEASONS IN THE ALGORITHM: ERROR-DRIVEN INSIGHTS INTO WINTER & SPRING CROPS CLASSIFICATION

An Exploratory Study by Statistics Portugal

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Table of Contents

1. Context & Objectives

Artificial Intelligence / Machine Learning For Official Statistics

Grant Agreement Number: 101146355 (AIML4OS)
WP7 kick-off, May 15th, 2024

OBJECTIVES

- Strengthen the use of AI within National Statistical Institutes' Spatial Data Infrastructures, collaborating at EU/international level.
- Ensure Earth-Observation-based AI solutions are comparable, robust, and reusable across countries and timeframes.
- Develop common methodological and implementation guidelines for AI/ML in official statistics.

2. Work in Progress: Identification of winter & Spring crops

Data stocktake (2025) and how each dataset was utilised within our workflow

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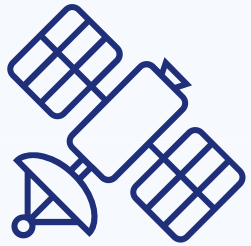

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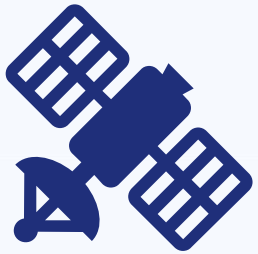

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Ancillary DATA

Land Parcel Information System

Sentinel-2 imagery

Sentinel-1 imagery datasets

Baseline Geospatial data

agricultural land dataset serves as **ground truth** once it is **validated** through the claim verification process

Used to collect data sampling

Used to segment and train the Classification algorithm

Segmentation: OTB Mean-Shift

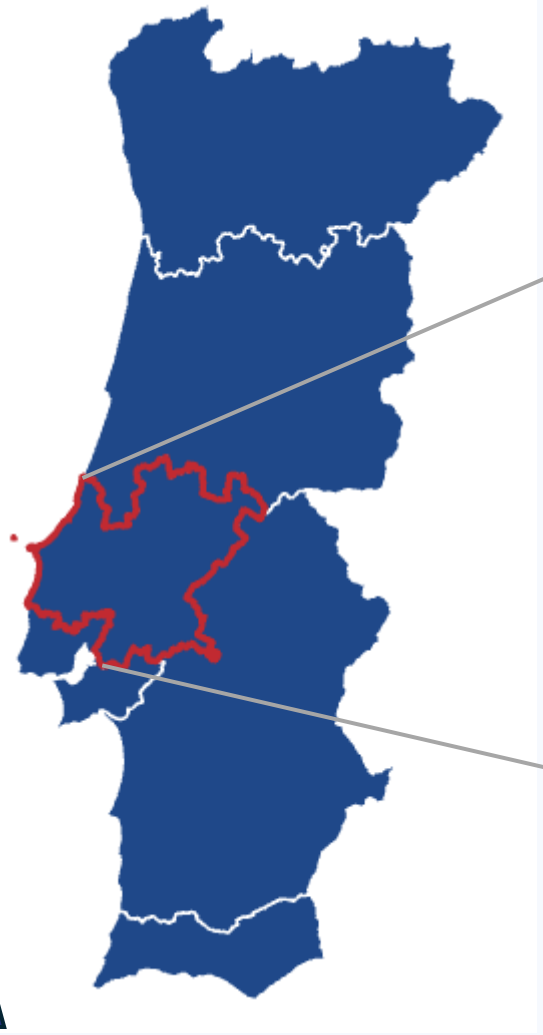
Imagery Data: March

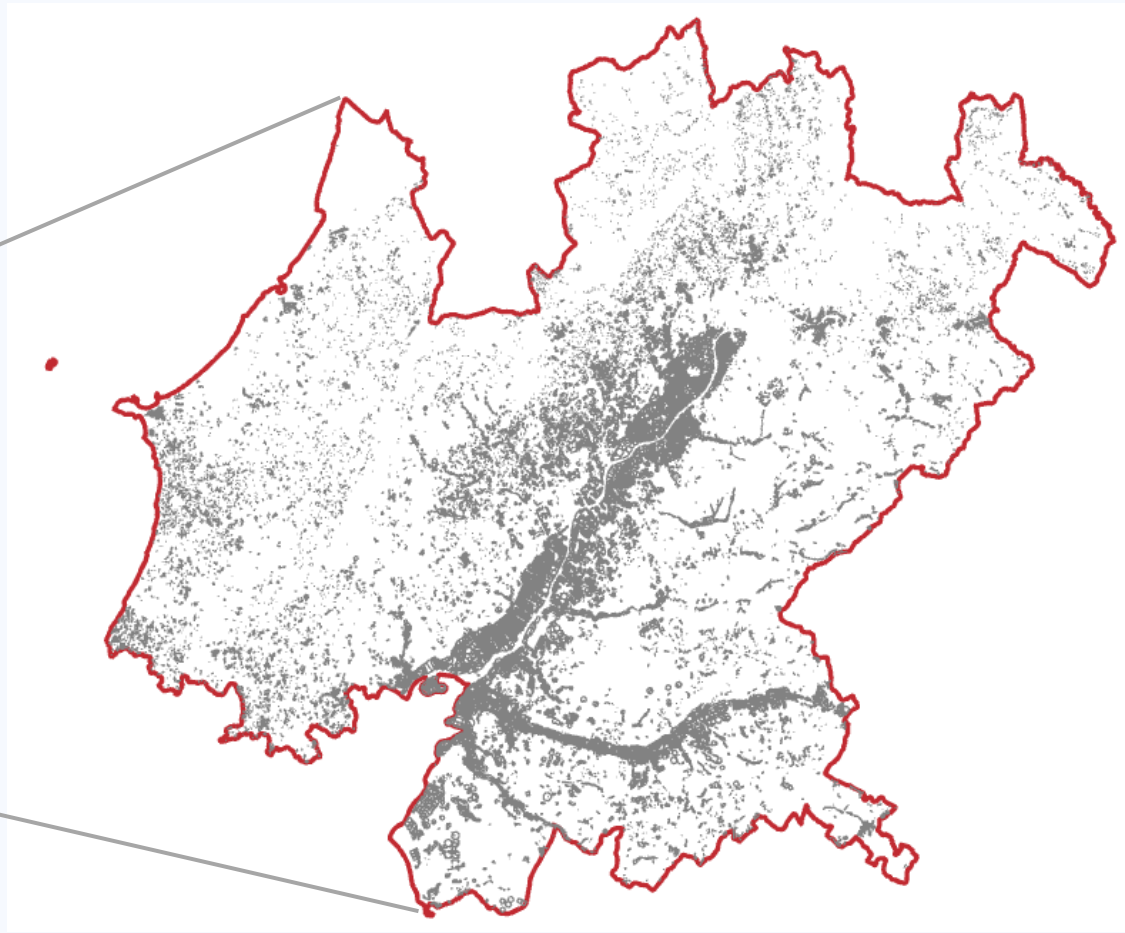
Used to supplement the analysis

Exploratory methodology

2. Work in Progress: Identification of winter & Spring crops

STUDY AREA: PT11D: Oeste e Vale do Tejo





Strategically selected for its natural watercourse, and diverse & representative crops.

Area = 9,200 km^2

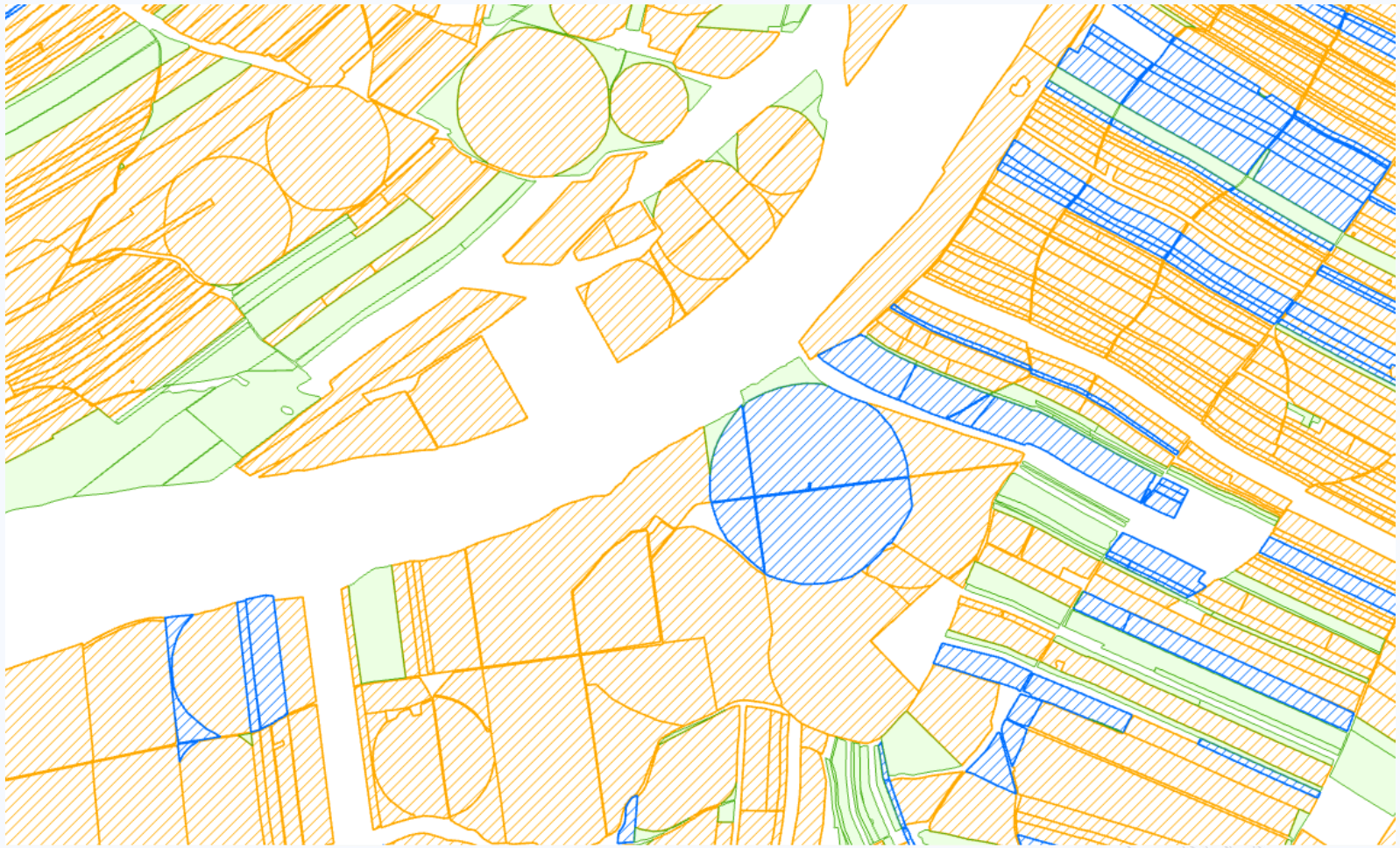
3. Land Parcel Information System data (1/2)

	hectares
Temporary Crops	79,563
Permanent Crops	59,889
Grassland	65,823
Wooded Pasture	65,503
Forest	12,833
Total	283,611

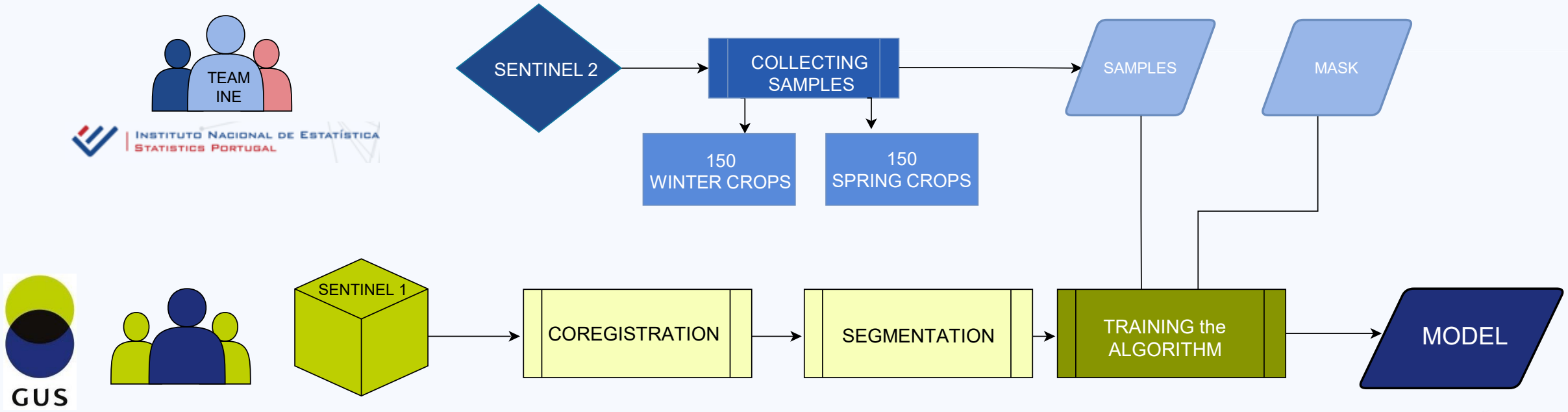
3. Land Parcel Information System data (2/2)

	AREA (ha)	
SPRING Crops	39,101	49 %
WINTER Crops	5,271	7 %
Other Temp. Crops	35,191	44 %

44,372 ha



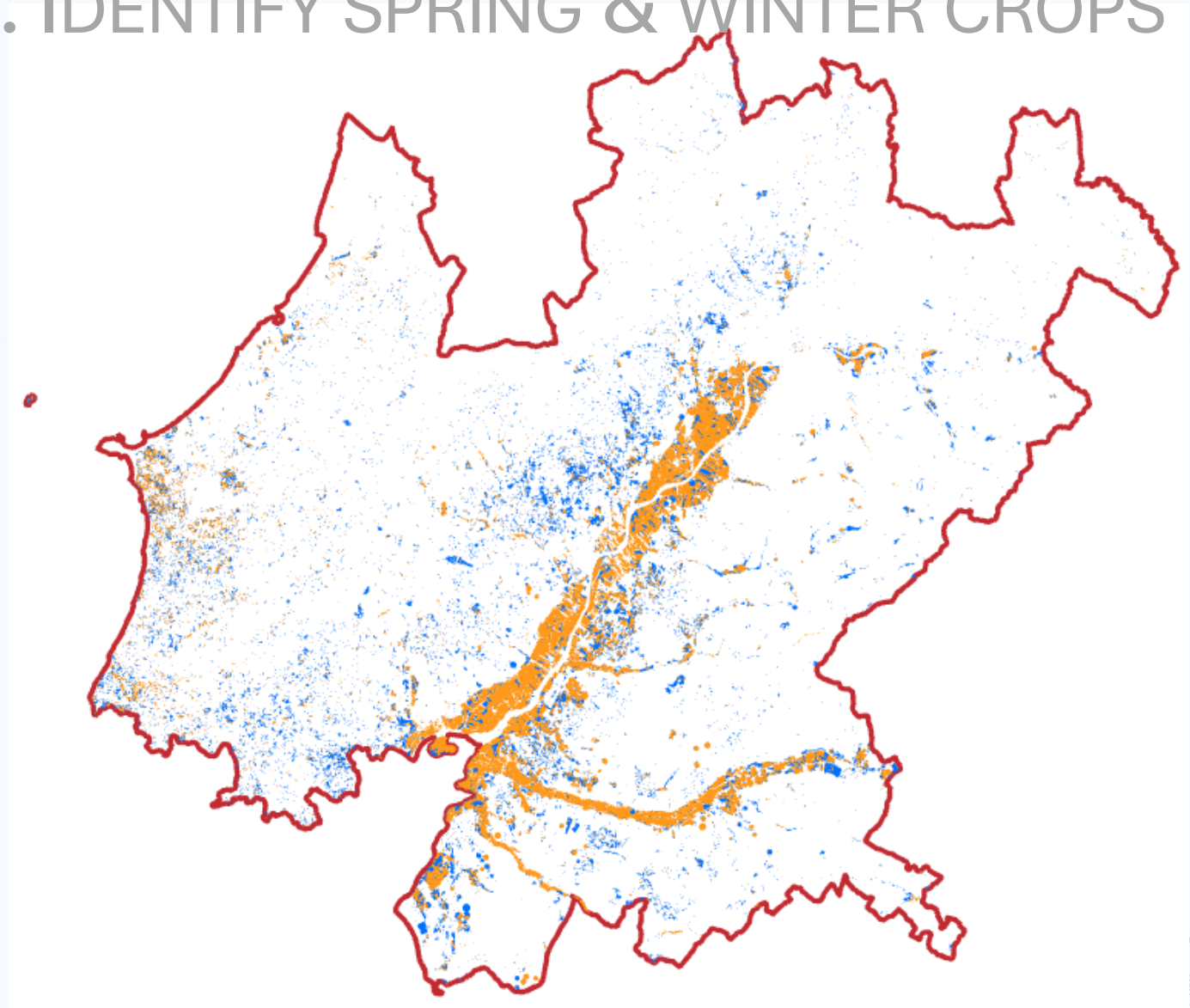
4. ALGORITHM TRAINING: METHODOLOGY



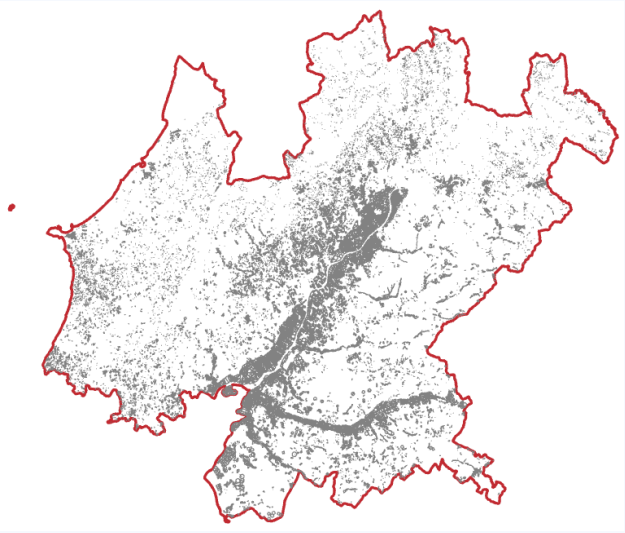
4. ALGORITHM TRAINING: IDENTIFY SPRING & WINTER CROPS

ALGORITHM CLASSIFICATION

	AREA (ha)	
WINTER Crops	35,692	39 %
SPRING Crops	55,798	61 %
Total	**91,490**	



5. Results Analysis: Algorithm Overview (1/2)

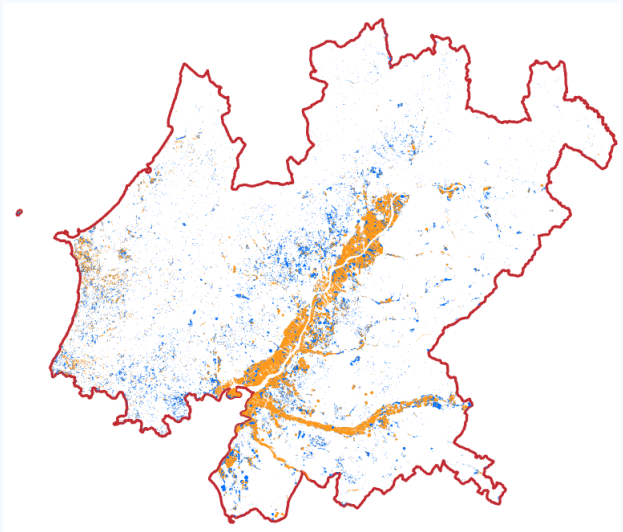


79,563 ha LPIS DATA for TEMPORARY CROPS

OVERLAP

58,557 ha Overlap

LAND USE	AREA (ha)	CLASS DISTRIBUTION
Temporary crops	58,557	64%
Winter & Spring crops	41,083	45%
NON OVERLAP Area	32,933	36%



91,490 ha ALGORITHM Classification

64% of MODEL CLASSIFICATION overlaps with LPIS Data

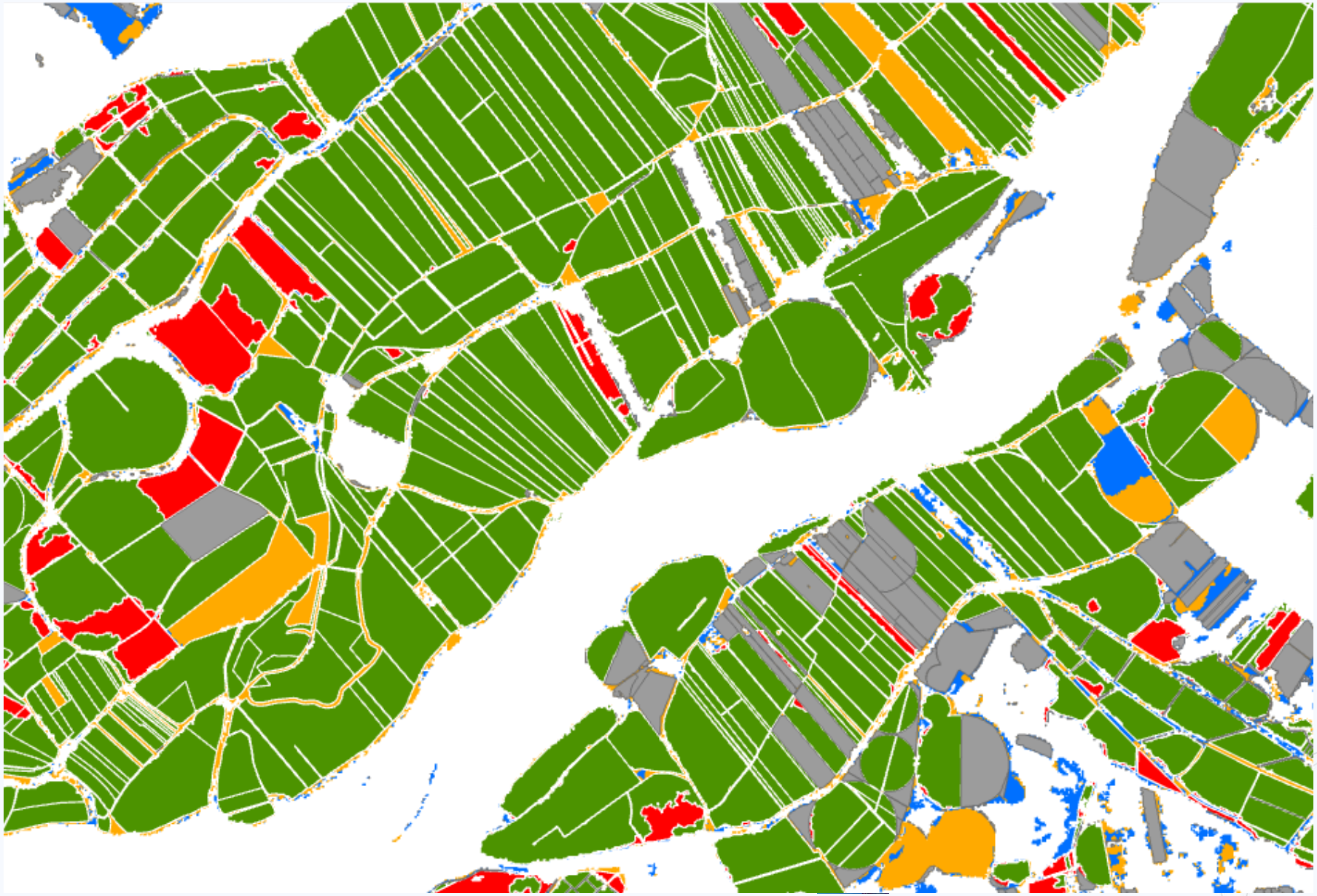
5. Results Analysis: Algorithm Overview (2/2)

Performance of the Algorithm

- MATCH (W & S)
- NO MATCH (W & S)
- NO MATCH (other Temporary crops)

Areas classified by the algorithm **not Overlapped** by LPIS

- WINTER (W)
- SPRING (S)



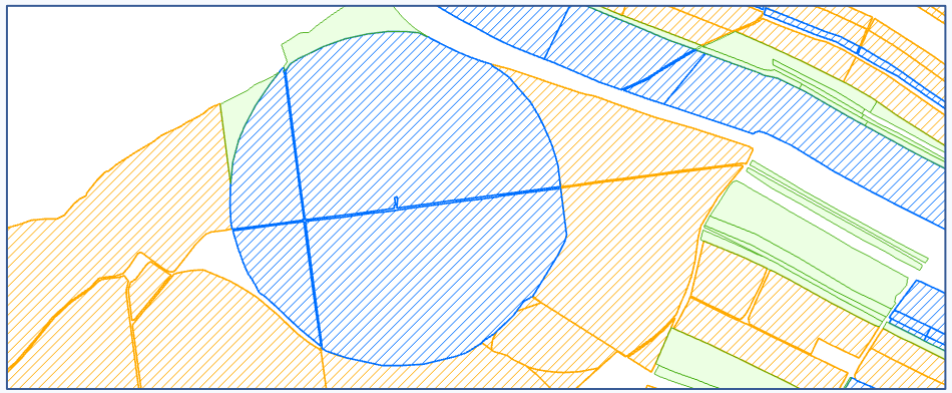
5. Results Analysis: LPIS *vs* Algorithm on Overlapping Area

LPIS

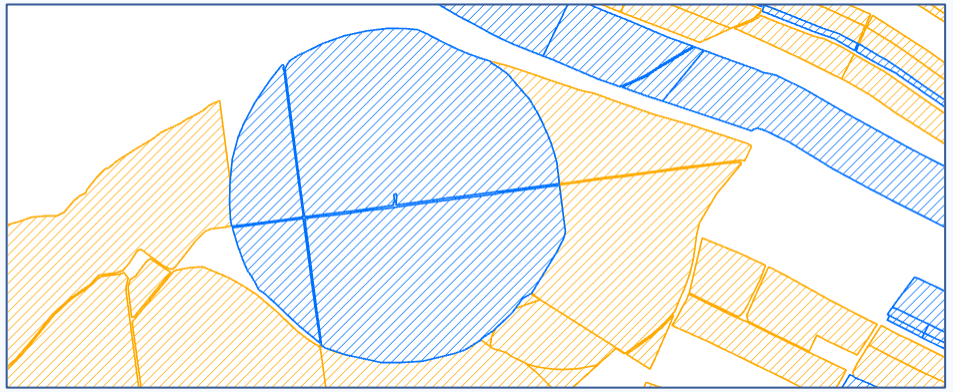
% of LPIS Area Overlapped by ALGORITHM

ALGORITHM CLASSIFICATION

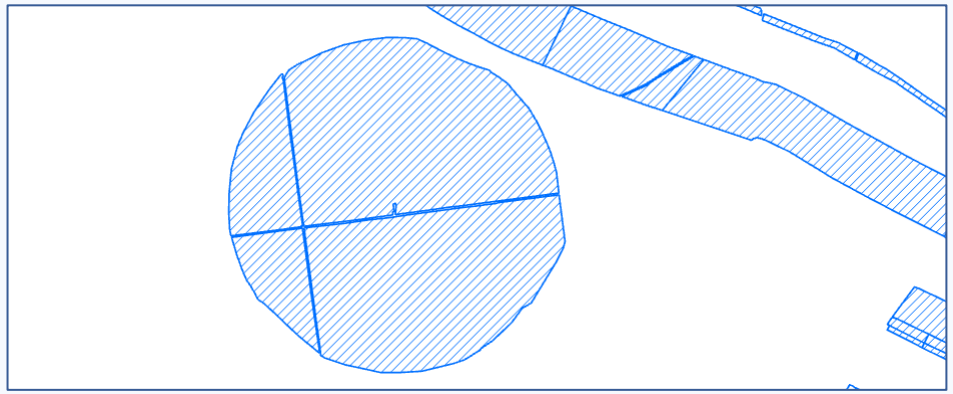
74% TEMPORARY CROPS



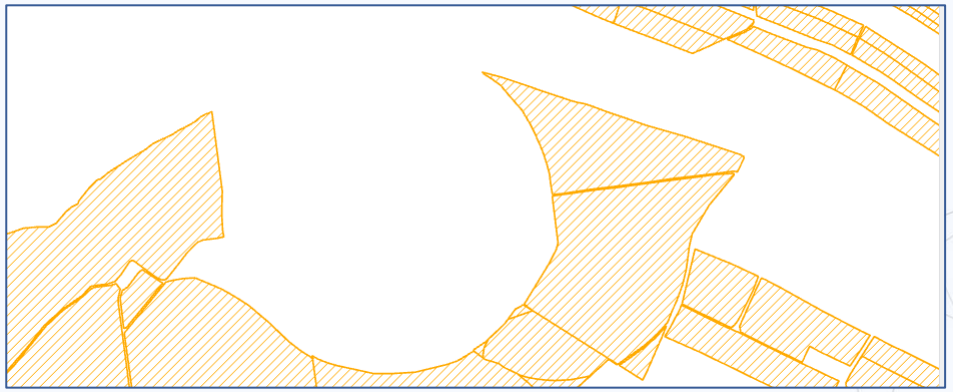
93% WINTER & SPRING CROPS



68% WINTER CROPS

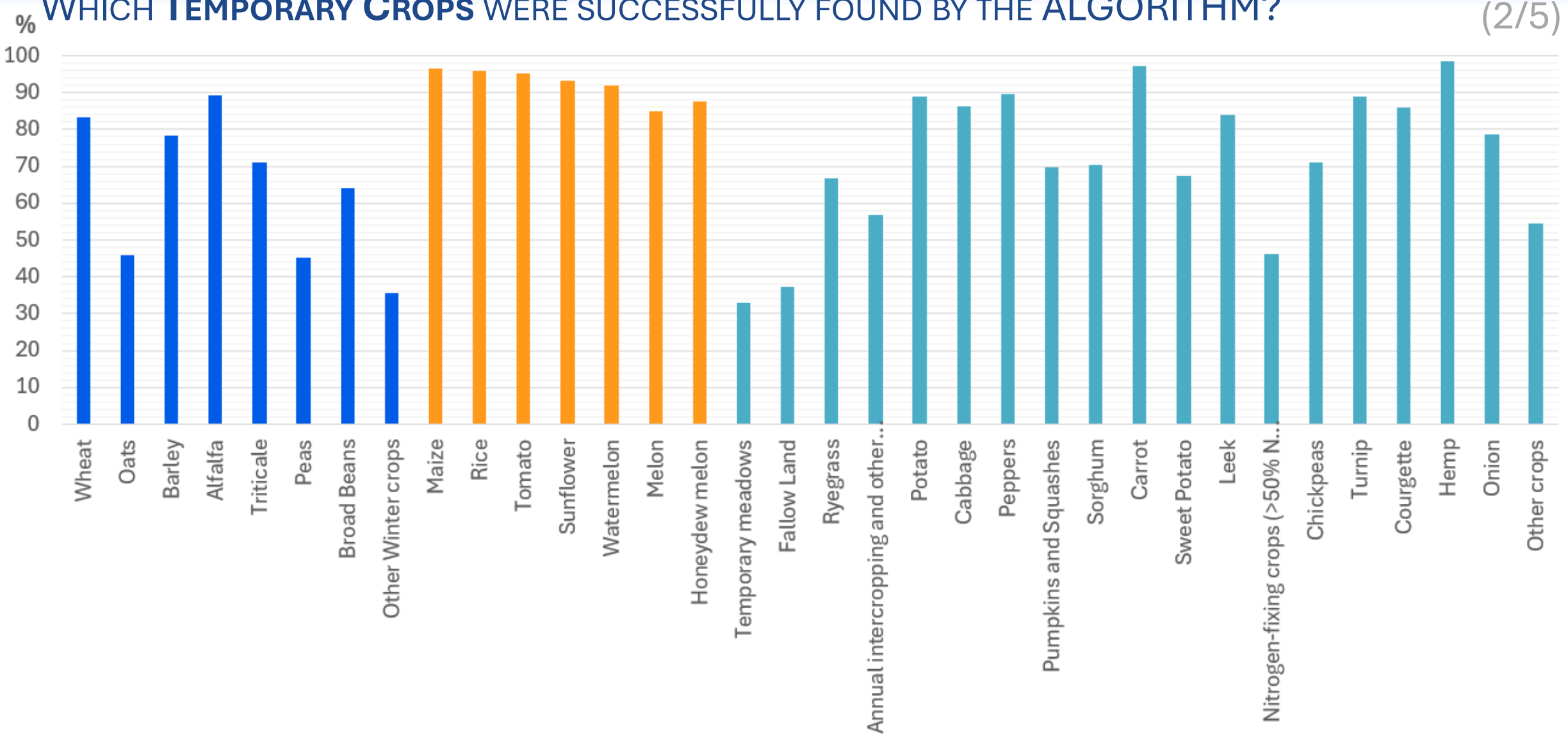


96% SPRING CROPS



5. Results Analysis: LPIS *vs* Algorithm on Overlapping Area

Which **Temporary Crops** were successfully found by the ALGORITHM? (2/5)



WINTER Temporary crops 68%

SPRING Temporary Crops 96%

Other Temporary Crops 50%

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5. RESULTS ANALYSIS: LPIS *VS* ALGORITHM ON OVERLAPPING AREA

WHERE DOES THE **ALGORITHM MATCH CORRECTLY** WINTER (W) AND SPRING (S) CROPS?

(3/5)

Algorithm Classification		LPIS	
		WINTER Crops	SPRING Crops
	WINTER	84%	11%
	SPRING	16%	89%

OVERALL ACCURACY

89%

Considering only the overlapping area of WINTER and SPRING Crops

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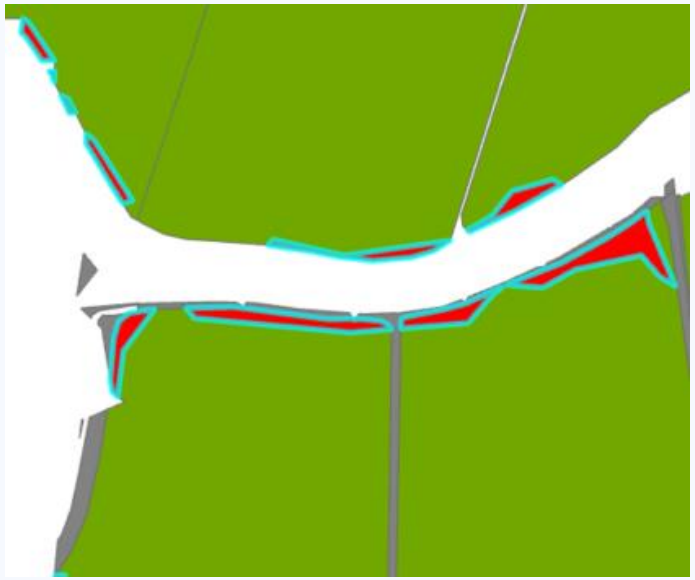
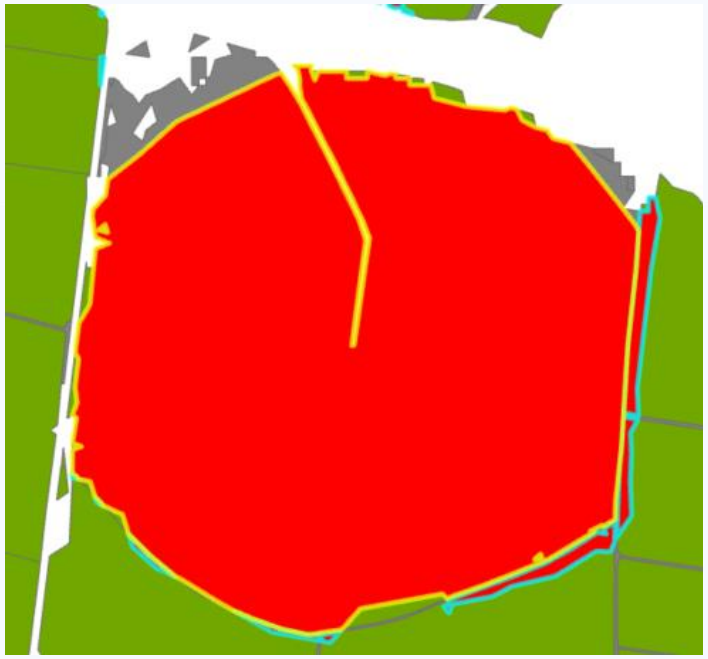
5. Results Analysis: LPIS *vs* Algorithm on Overlapping Area

Where does the **Algorithm fail**? (4/5)



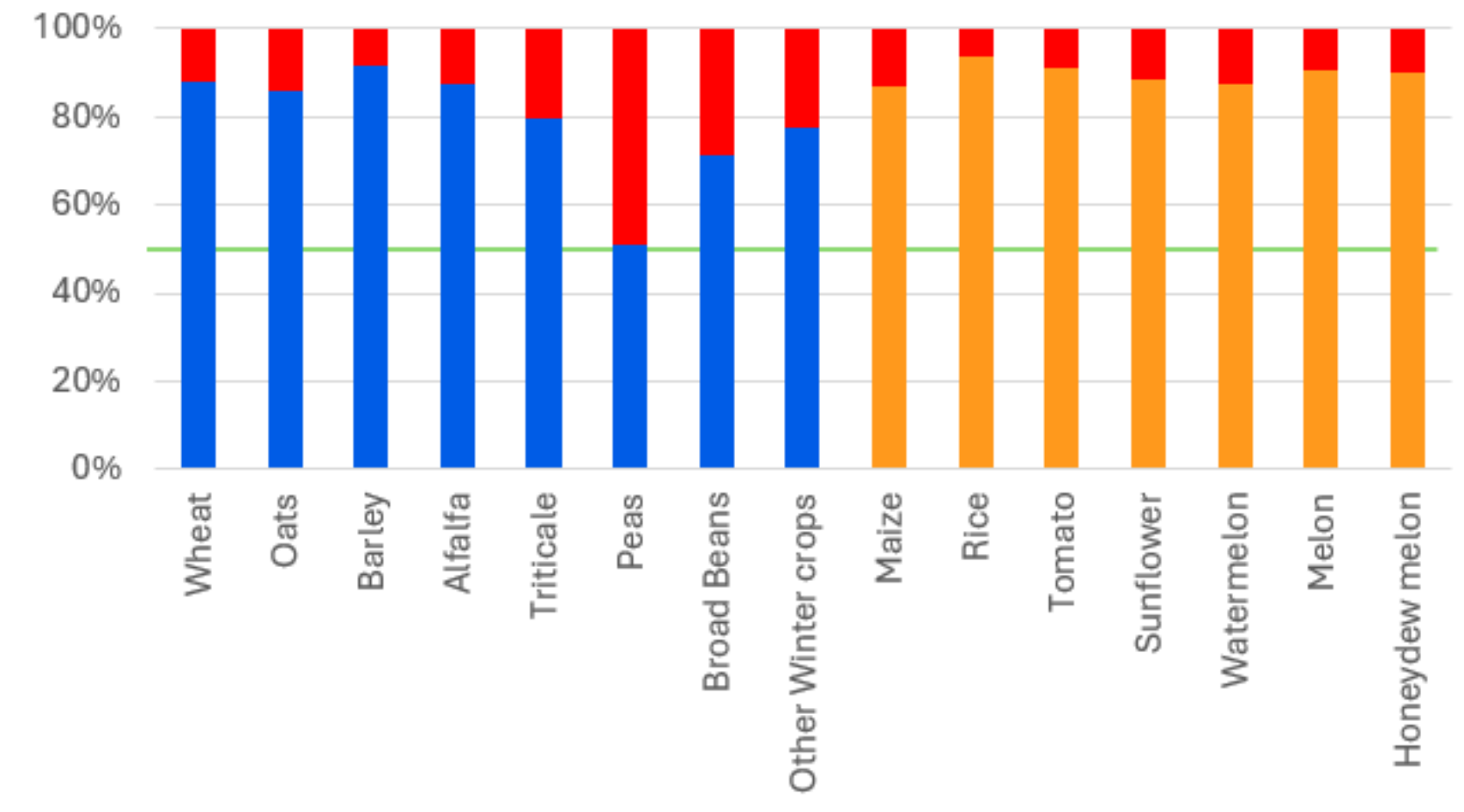
Segmentation error resulting in misclassification

Misclassification



5. RESULTS ANALYSIS: LPIS *VS* ALGORITHM ON OVERLAPPING AREA (5/5)

MODEL'S ABILITY TO DISTINGUISH BETWEEN WINTER AND SPRING CROPS



6. Overview of results

High Performance: Achieved 89% overall accuracy in distinguishing **WINTER** vs. **SPRING** crops.

Spring Crop Success: The algorithm was particularly effective reaching a 96% success.

Specific Crop Challenges: Ex.: Oats Detection coverage was lower (< 50%), but once detected, the algorithm correctly assigned it as a **WINTER** crop in **85%** of the area.

Reasons for 'NO MATCH':

Phenological Misalignment: Spectral signatures at harvest or senescence stages can be mistaken.

Cultivation vs. Classification Dates: Short-cycle winter crops may be confused with early spring growth depending on imagery dates.

Segmentation Issues: Technical errors in parcel segmentation also contributed to misclassification.

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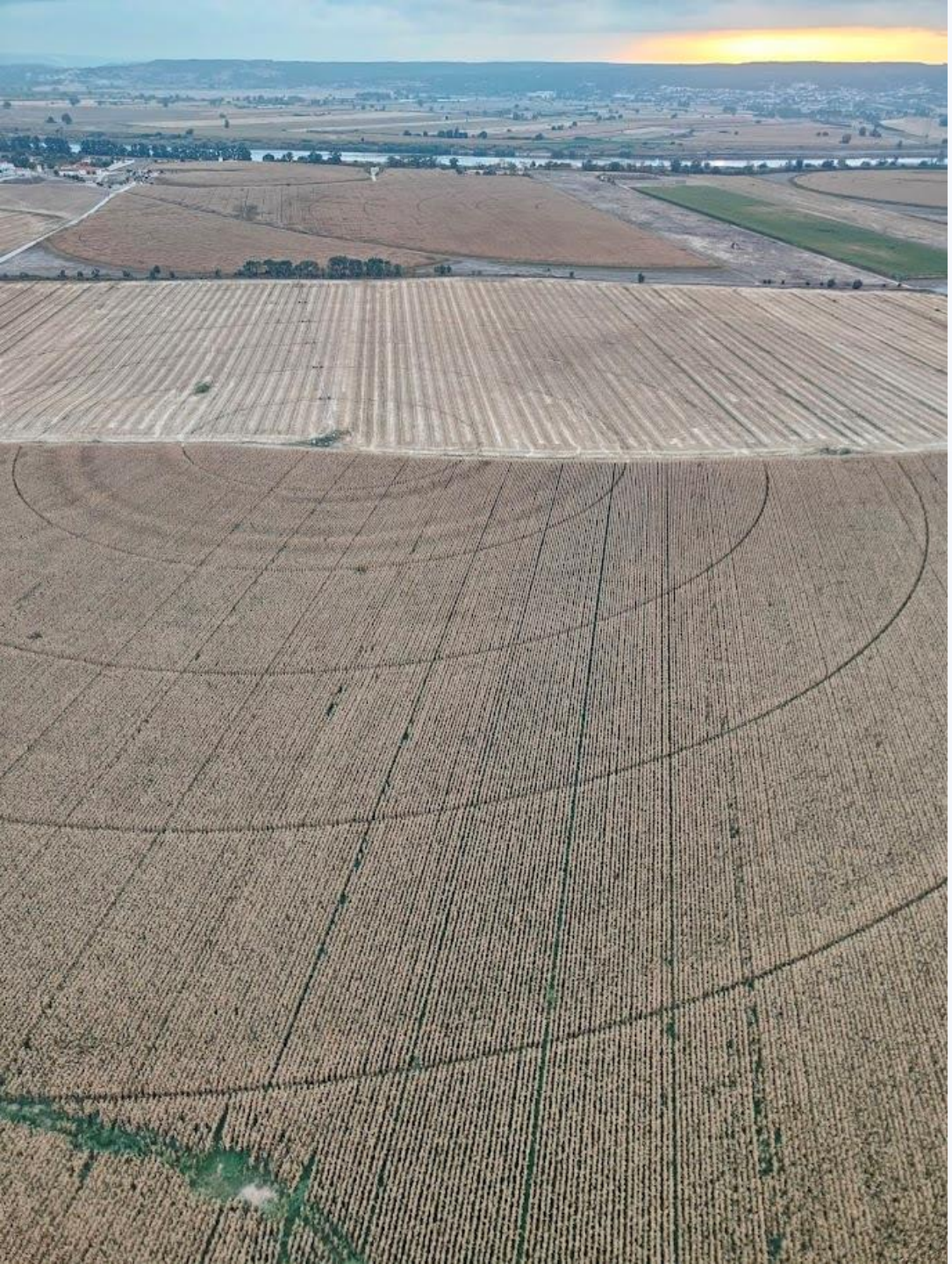
Project 101146355 – AIML4OS

One-Stop-Shop Artificial Intelligence and Machine Learning for Official Statistics



GRAZIE!

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