Implementation of AI methodologies for point cloud classification in the Spanish national LiDAR project (PNOA-LiDAR

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Season 1 recap


WINNER: AI-BOT
HUMAN:
8,85s
9,50s

- More classes
- Less budget
- Faster processing time


PNOA-LiDA
THE BEAM THAT SEES ALL
ABOVE THE CLOUDS, IT PAINTS THE WORLD.
COMING SOON TO A SELF-DRIVING WORLD!

SEASON 2

SPANISH NATIONAL LIDAR PROGRAM

- 2022-2025
- 505.000 km2

(2023-2025 160.000 km2 per year)

- 5 p/m2
- RMSEz: 10 cm
- RGBI medium format
- GSD 25cm
- Galaxy T2000

(except Catalunya Terrain Mapper)

IA IMPLEMENTATION

Levels of classification

- NPC0: traditional classification (geometric, macros…)

- NPC1:
  - Methodology: AI (inference)
  - Basic Classes: ground, vegetation, buildings,
  - Advanced classes: powerlines, poles, antennas, wind turbines, solar panels, vehicles, water
  - Classes under testing: walls, dams, buildings (inner courtyards, facades, types of roofs (flat, pitched, green)
  - Reliability: not defined

Levels of classification

- **NPC2**:
  - Methodology: semi-automatic and manual review
  - Classes: NPC1
  - Reliability: in accordance with what is established in the specifications

Levels of classification

The followin F-score accuracy tresholds are established depending on the classification level and class

- Basic classification: general F-Score >= (0,97/0,96/0,90) in rural / urban / mountainous terrain (rocky or scrubland areas)

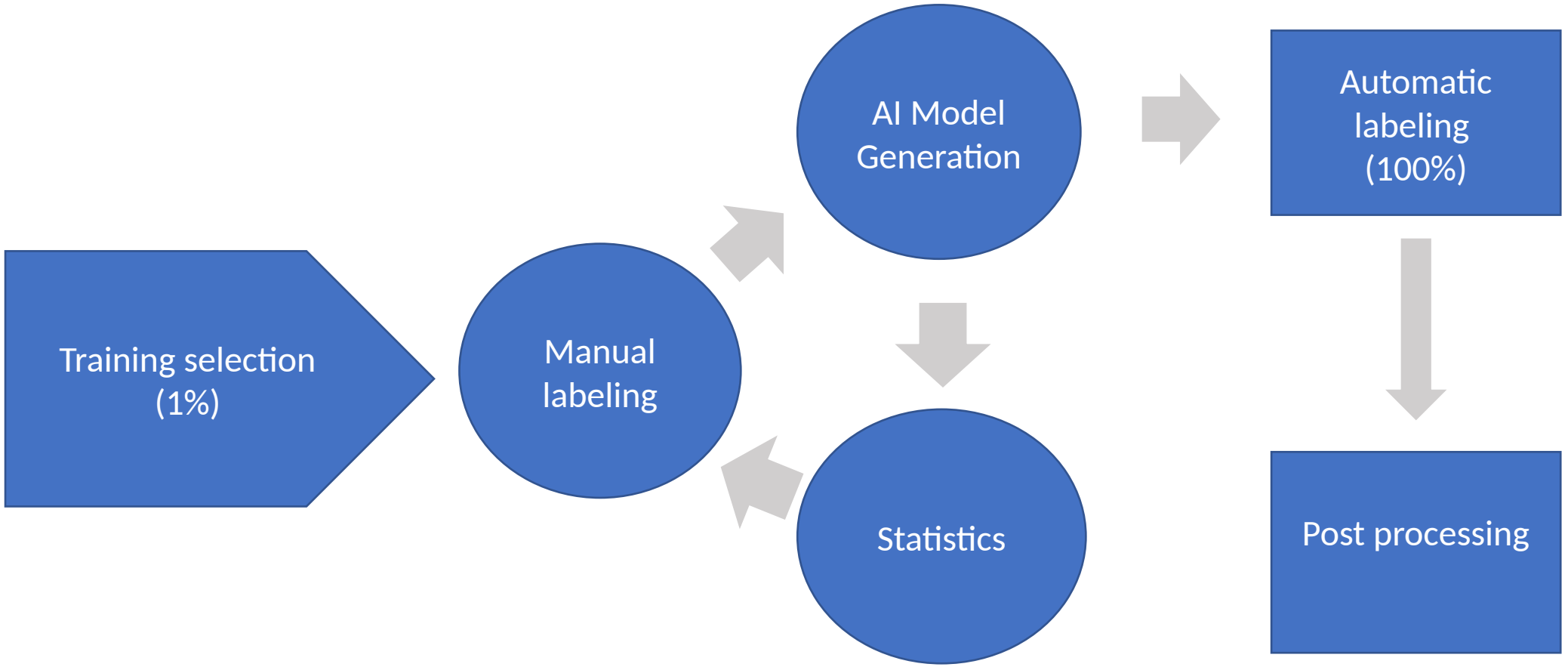
- Ground class: >=0,97/0,97/0,85 in rural / urban / mountainous terrain (rocky or scrubland areas)
- Vegetation class: >=0,97/0,90/0,60 in rural / urban / mountainous terrain (rocky or scrubland areas)
- Buldings: >=0,95/0,90 in rural / urban
- Bridges: >=0,95

- Advanced classes :>=0,85

- For advanced classes, the specification have been conservative in some classes and higher accuraracies are being achieved.

METHODOLOGY

METHODOLOGY AI

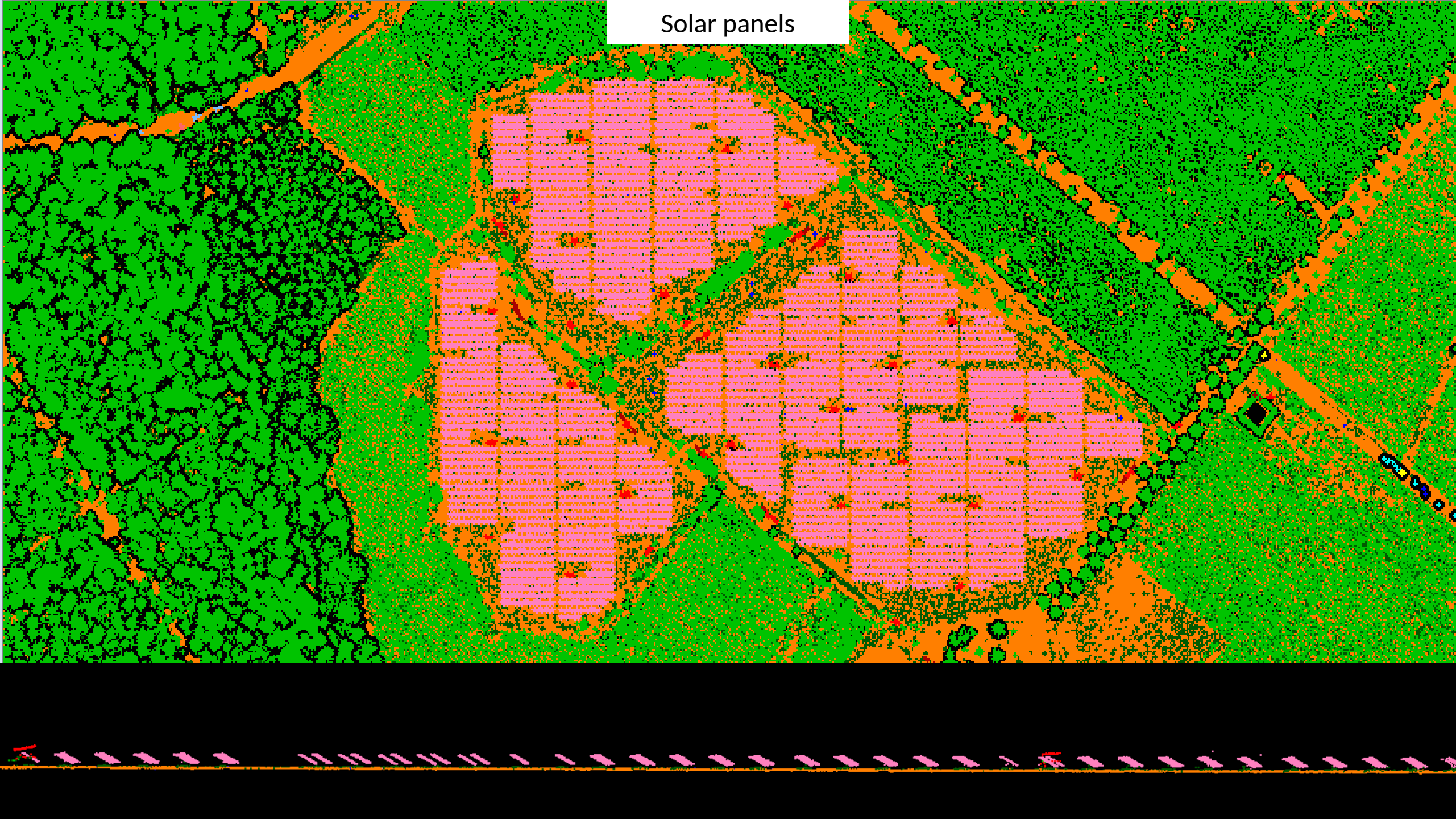


Training

Type	Training		Validation
Number of files	**166**		**40**
1 - Default	32,489,109	3.08%	7,076,152
2 - Ground	654,795,407	62.11%	160,995,975
3 - Low vegetation	69,325,684	6.58%	14,733,267
4 - Medium vegetation	243,008,648	23.05%	52,737,137
6 - Building	28,085,221	2.66%	7,094,186
7 - Noise	135,264	0.01%	31,292
9 - Water	13,165,557	1.25%	4,456,189
12 - Overlap	361,299,501		95,846,486
14 - Power lines (electric cables)	952,235	0.09%	189,870
15 - Power pylons	170,231	0.02%	36,555
16 - Bridges (structural elements)	50,070	0.00%	14,094
17 - Bridges (deck)	713,389	0.07%	104,751
64 - Vehicles (trains_cars_boats)	1,075,978	0.10%	372,550
65 - Construction walls	796,976	0.08%	107,828
66 - Signs_various_advertising	12,156	0.00%	2,611
67 - Solar panels	6,369,639	0.60%	1,732,608
68 - Wind turbines	65,162	0.01%	14,746
69 - Dam / Dike	141,328	0.01%	1,139
70 - Antenna	3,021	0.00%	349
76 - Fixed urban furniture	159,008	0.02%	14,744
77 - Mobile urban furniture	34,034	0.00%	4,572
78 - Irrigation structure (pivot)	17,297	0.00%	91
79 - Bales	24,225	0.00%	11,094
80 - Shade nets	76,941	0.01%	7,286
81 - Greenhouses	415,606	0.13%	74,928
82 - Vegetation walls	583,078	0.06%	206,933
83 - Metal fences	78,347	0.01%	13,640
84 - Aerial pipelines	18,840	0.00%	10,473
85 - Electrical transformer station	42,745	0.00%	5,974
86 - Ruins	10,571	0.00%	4,232
87 - Ramparts / city walls	345	0.00%	0
88 - Hoppers and conveyor belts	11,537	0.00%	4,116
89 - Railway catenary gantry	17,691	0.00%	2,002
90 - Material accumulation	327,208	0.03%	

RESULTS


Solar panes

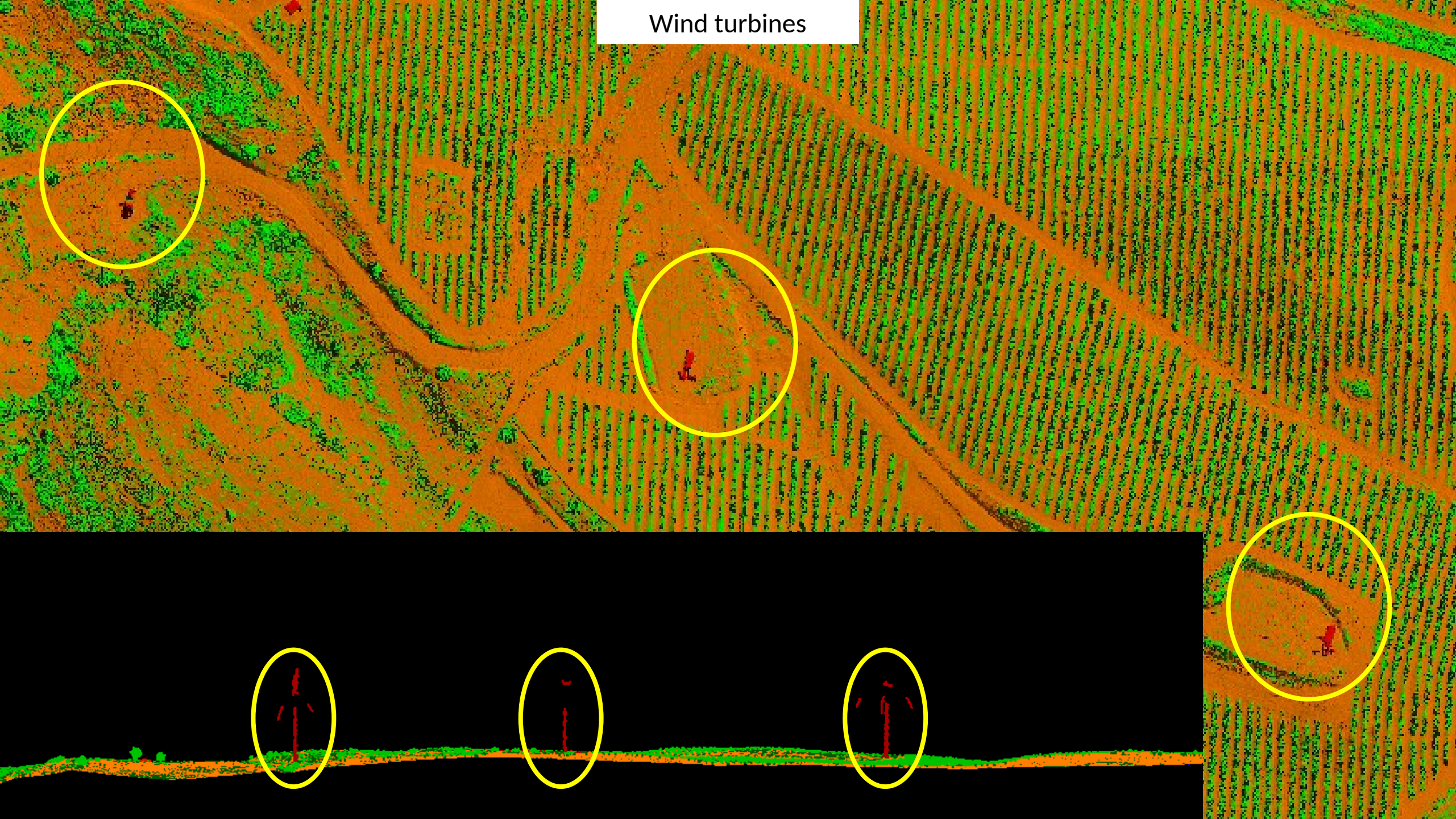

Solar panels


Vehicles


Vehicles traditional


Vehicles AI


Wind turbines


Wind turbines


Electrical transformer station
Pole

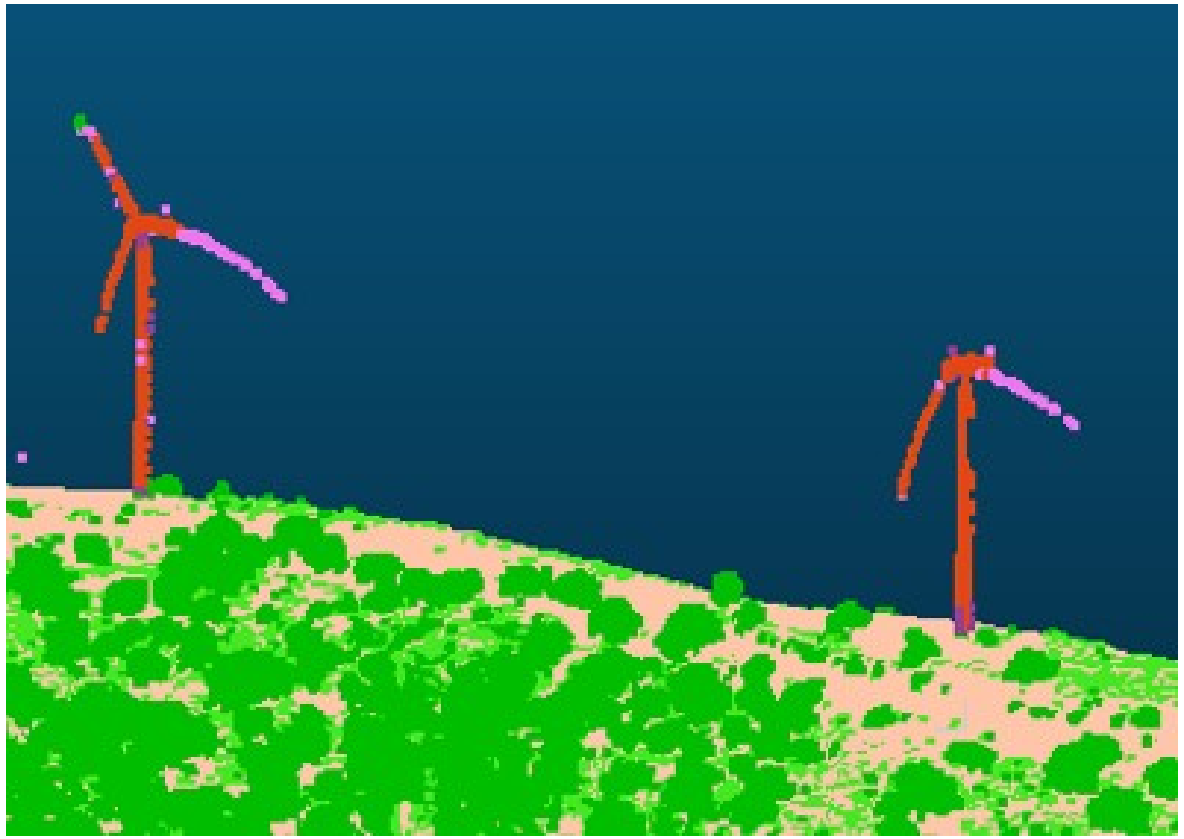

Walls


Walls

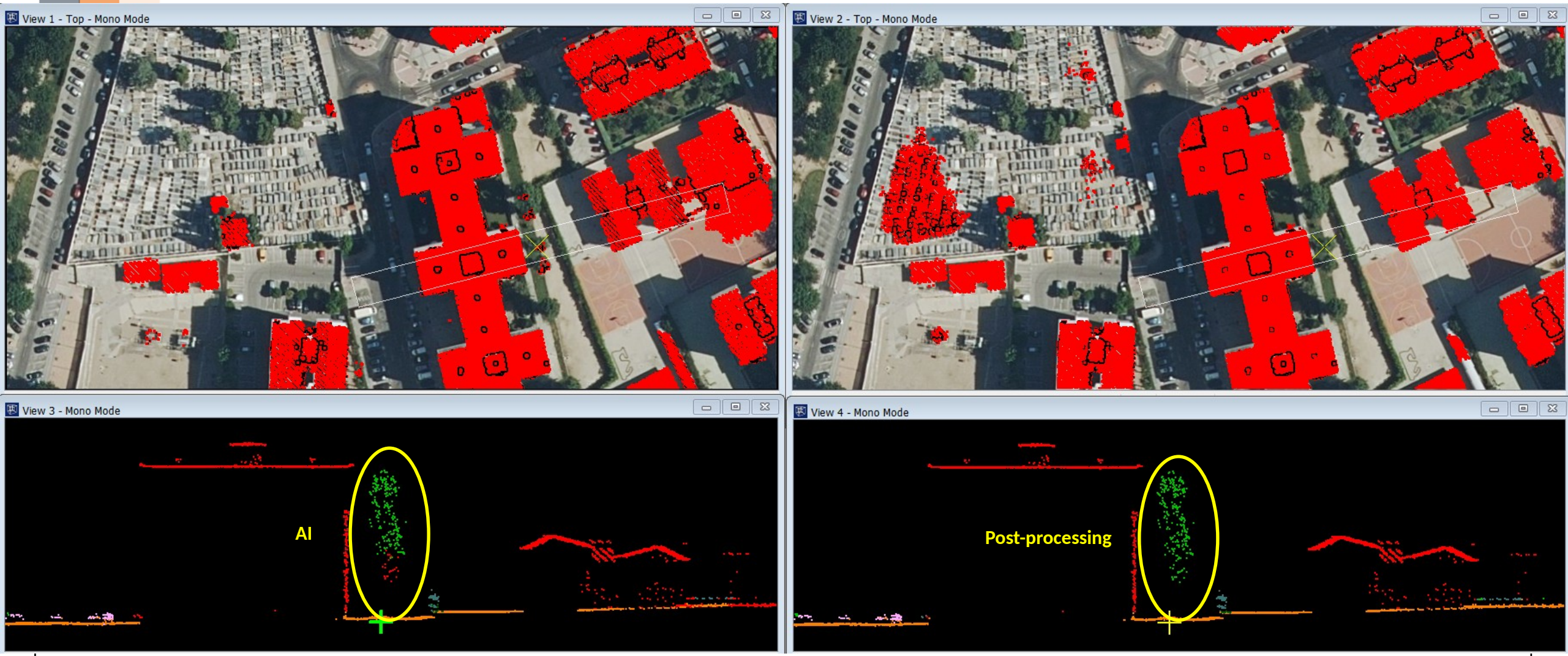
ERRORS POSTPROCESSING

ERRORS POSTPROCESSING

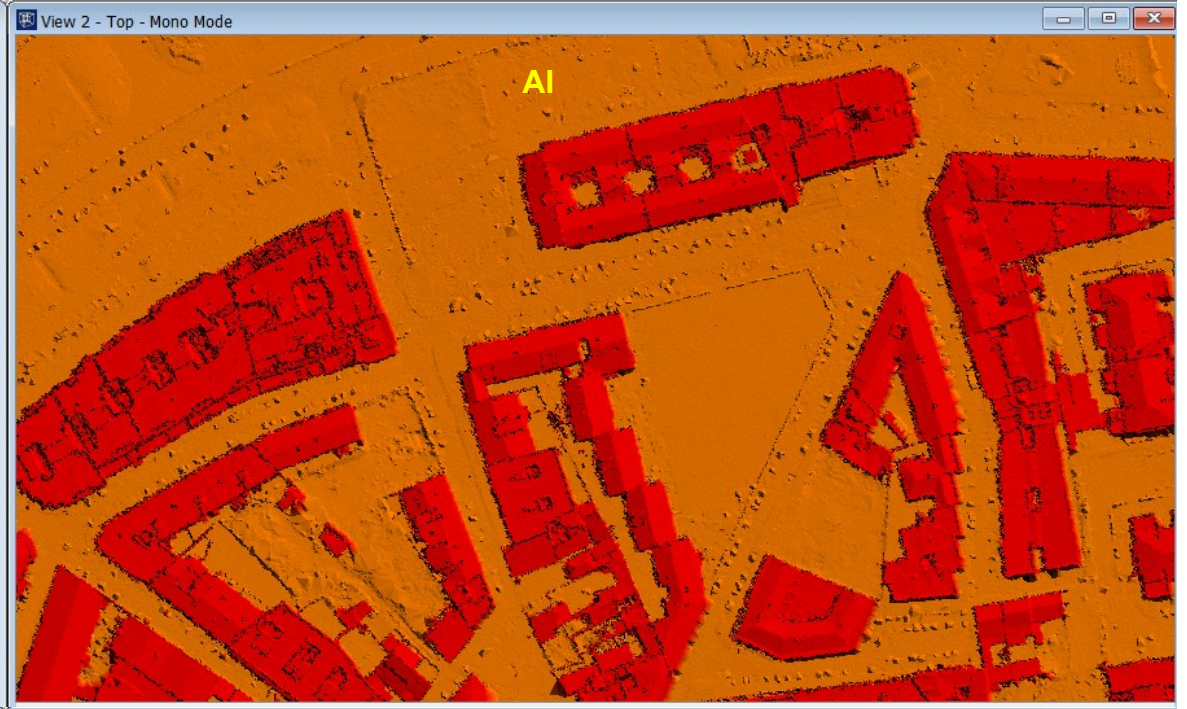
AI



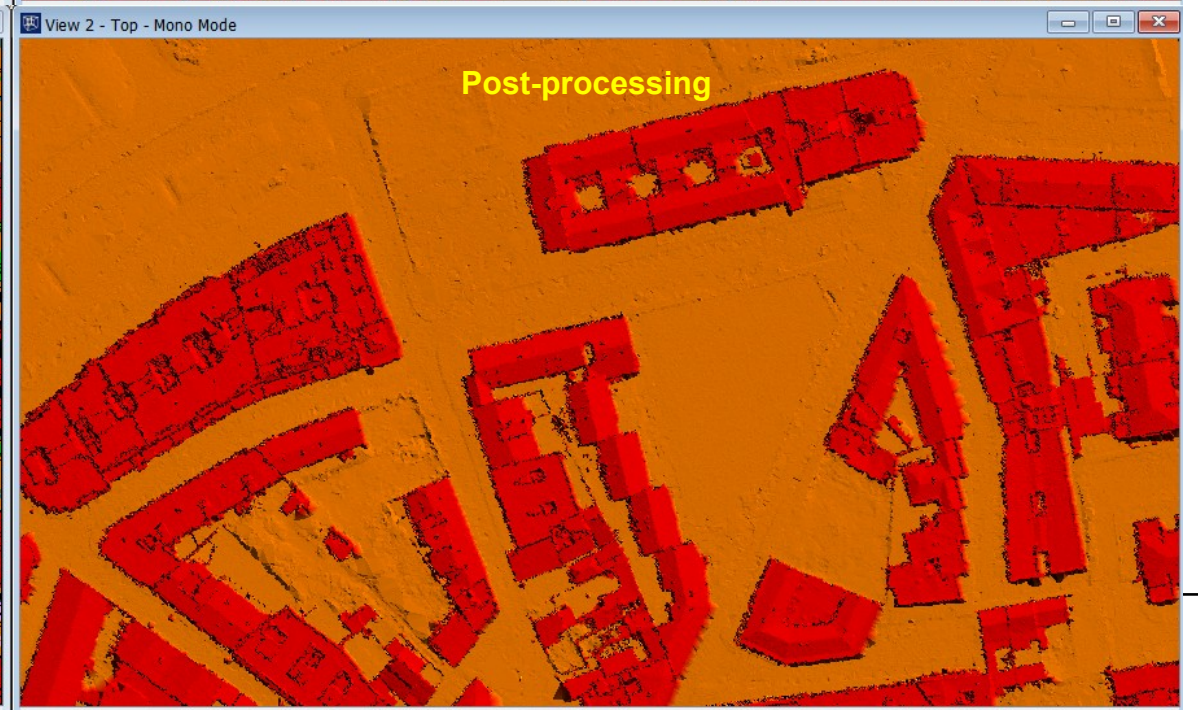
Post-processing


View 1 - Top - Mono Mode
View 2 - Top - Mono Mode
View 3 - Mono Mode
AI
View 4 - Mono Mode
Post-processing


View 1 - Top - Mono Mode


View 2 - Top - Mono Mode
AI


View 1 - Top - Mono Mode


View 2 - Top - Mono Mode
Post-processing

29

		suelo	veg baja	veg media	veg alta	edif	agua	cables	torres	puentes	vehic	muros	pan sol	aerog	antenas
	Acc	**f1_class_2**	**f1_class_3**	**f1_class_4**	**f1_class_5**	**f1_class_6**	**f1_class_9**	**f1_class_14**	**f1_class_15**	**f1_class_17**	**f1_class_64**	**f1_class_65**	**f1_class_67**	**f1_class_68**	**f1_class_70**
V_5(100)	96,4191	97,6079	66,1368	98,7722		97,5220		94,5259	74,6996	80,4914	90,8084	56,1533	97,7593	81,4997	
V_5(100_post) 14 clases	95,9651	97,4580	66,0315	95,5041	99,1024	97,7937	54,2850	95,4492	75,5967	83,7060	90,9746	54,2632	97,9348	95,5578	75,3014

Class 2: *Ground*
Class 3: Low vegetation
Class 4: Medium veg
Class 5: High vegetation
Class 6: Building
Class 9: Water
Class 14: Power lines
Class 15: Poles
Class 17: Bridges
Class 64: Vehicles
Class 65: Walls
Class 67: Solar panels
Class 68: Wind generator
Class 70: Antennas

CONCLUSIONS

	Classes	Costs
Traditional	Basics	10€/km2
AI	Basics, advanced, under testing	7€/km2

Potential future cost saving

- Reuse training data in other areas
- More mature methodology

Instituto Geográfico Nacional

ORGANISMO AUTÓNOMO CENTRO NACIONAL DE INFORMACIÓN GEOGRÁFICA

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