MinesEye by Postup

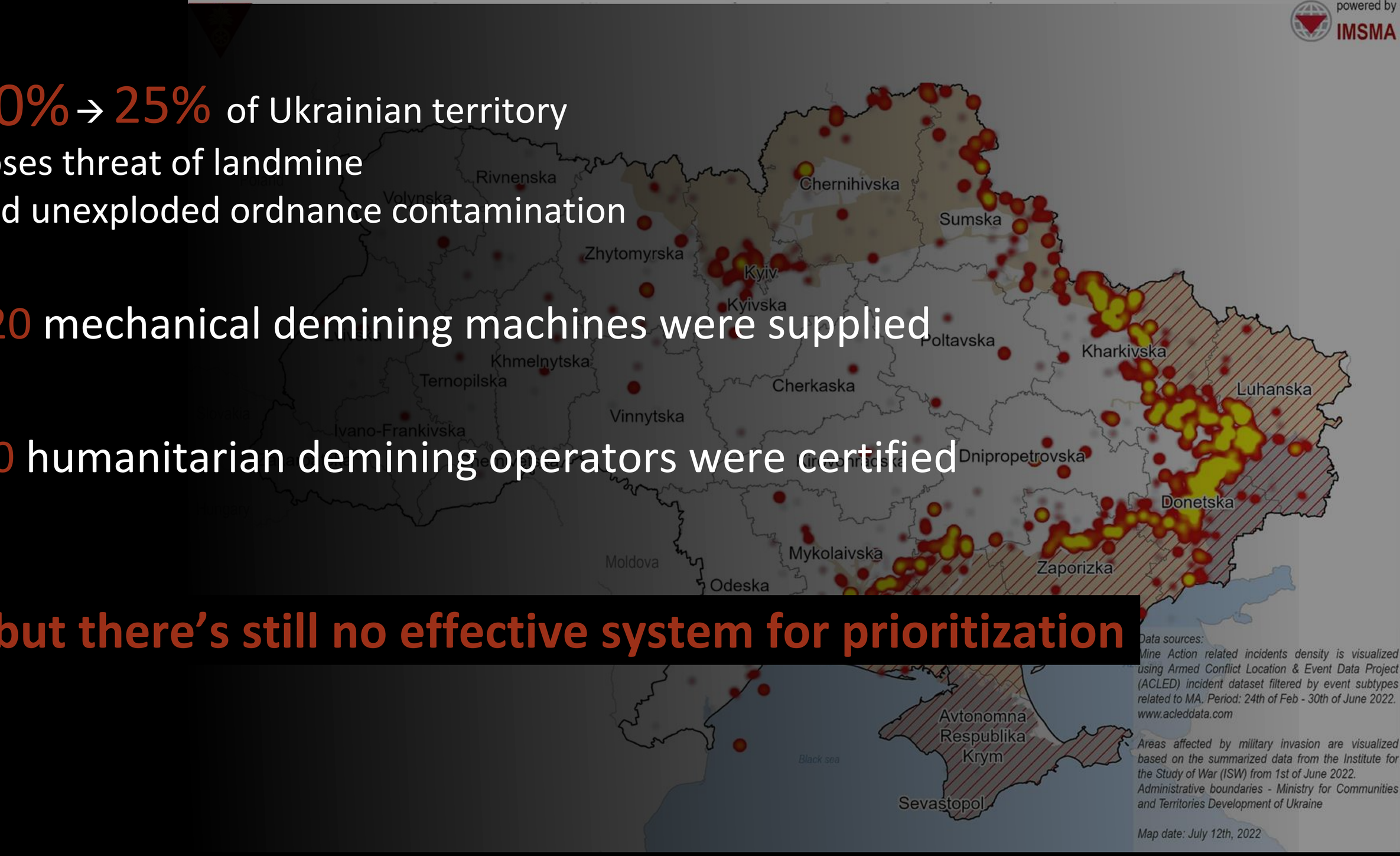
UAS solution for demining prioritization

30% → 25% of Ukrainian territory
poses threat of landmine
and unexploded ordnance contamination

120 mechanical demining machines were supplied

80 humanitarian demining operators were certified

…but there's still no effective system for prioritization



Solution - scalable system for UAS survey

Detects **up to 90%** of explosive remnants of war thanks to sensor combination **and AI**

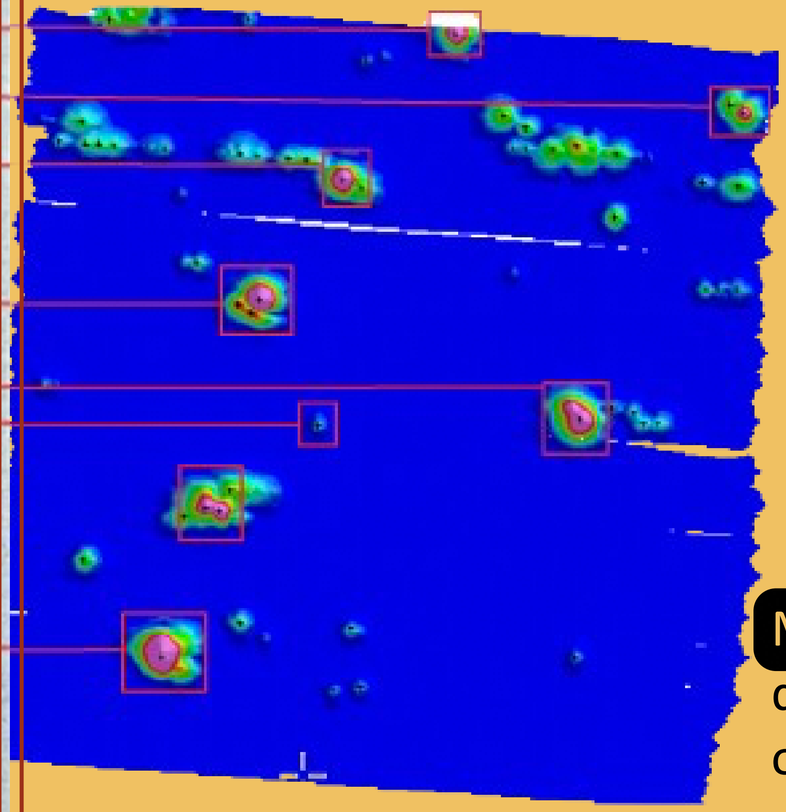
We combine agricultural drones broadly available in Ukraine…

…with a smart system to scan territories in search for landmines

Results

Sensor Fusion helps to address the problem in two dimensions:

Visual method enhanced by AI captures landmines on the ground



Magnetic method detects hidden objects

Current detection techniques per ERW type

ERW category	Short	Detection tech.	Examples
Anti-personnel fragmentation mines	APF	Magnetic	MON, OZM-72
Metal anti-tank mines	ATM	Magnetic	TM-62M, PTM-3
Mortar mines	MM	Magnetic	82mm, 120mm
Artillery shells	ART.	Magnetic	>50mm
Missiles, MLRS, other rockets	ROC	Magnetic	122mm Grad
Aerial bombs	ABO	Magnetic	FAB
Cluster munitions	CLM	Depending on the UXO	9H235
Hand explosives	HEX	Optical methods only	F1 grenade, RGN
Anti-personnel pressure mines	APP	Optical methods only	PMN, PFM
Fuses	FUS	Optical methods only	B-23, MUV
Plastic anti-tank mines	ATP	Optical methods only	TM-62P3

Images from CAT UXO

We spent the last 2.5 years on R&D

Now it’s a time for implementation!

Implementation of MinesEye with SESU

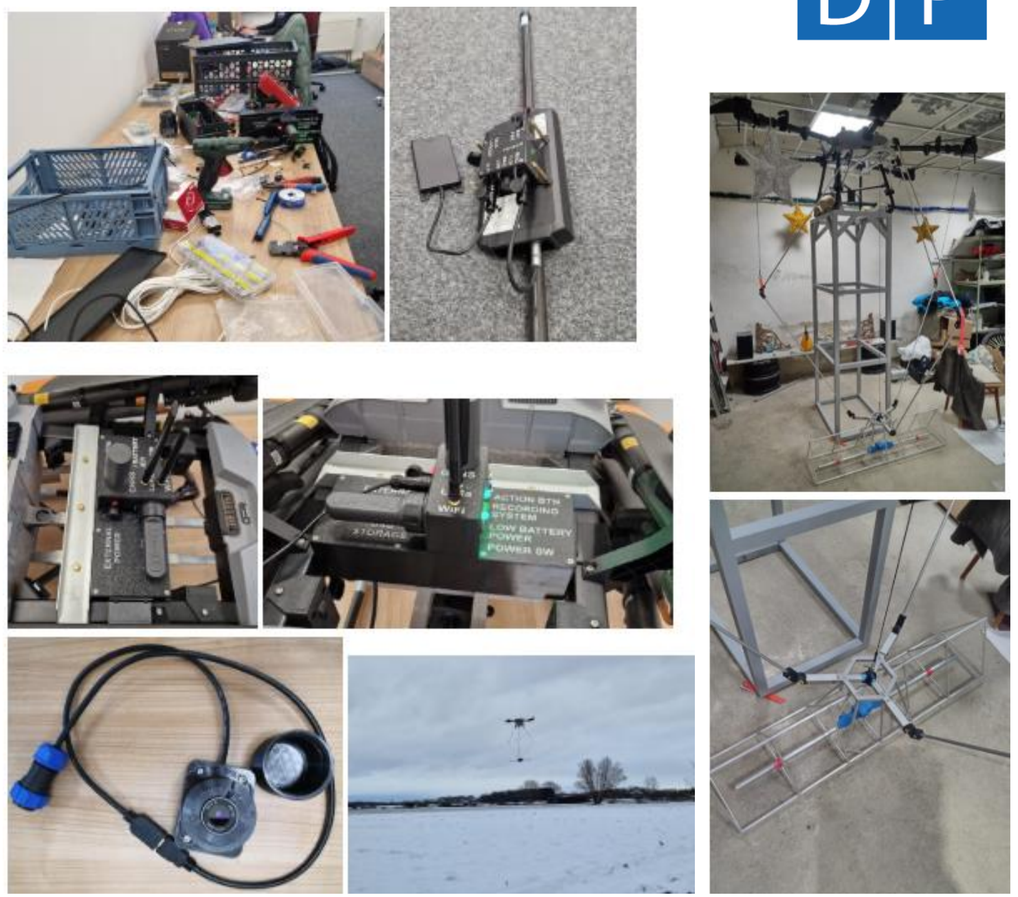
Milestones:

1. Deliver multi sensor UAS to the State Emergency Service of Ukraine (SESU) according to the specification
2. Provide training to SESU personnel on UAS operation
3. Scan at least 400 hectares of potentially contaminated areas in the process of non-technical survey during 5 operational months

Milestone 1: Build of UAS – completed √

What's been done:

1. Data logger improvement to v1.3 and assembly. The device consists of more than 100 different components and was made to operate in difficult conditions (IP54 protection).
2. MinesEye Extender assembly. The new version can be assembled in 3 minutes, has standardized components and dedicated casing
3. Software preparation. Currently, the data from all sensors is streamed in real time; it's possible to start/stop recording during the flight. We released software for mag data visualization and visual data processing and positioning on the map



Milestone 2: Train SESU staff to operate UAS √

What's been done:

1. Training materials prepared and translated to Ukrainian. 5 different handouts, including: orthophoto, operating DJI Agras T30 drone, operating MinesEye payload, and data processing
2. Training conducted for SESU at the dedicated training facility near Kharkiv
3. Executed flights by SESU staff to collect the data and processed this data during the training

Milestone 3 – scan 400 ha to validate promising use cases

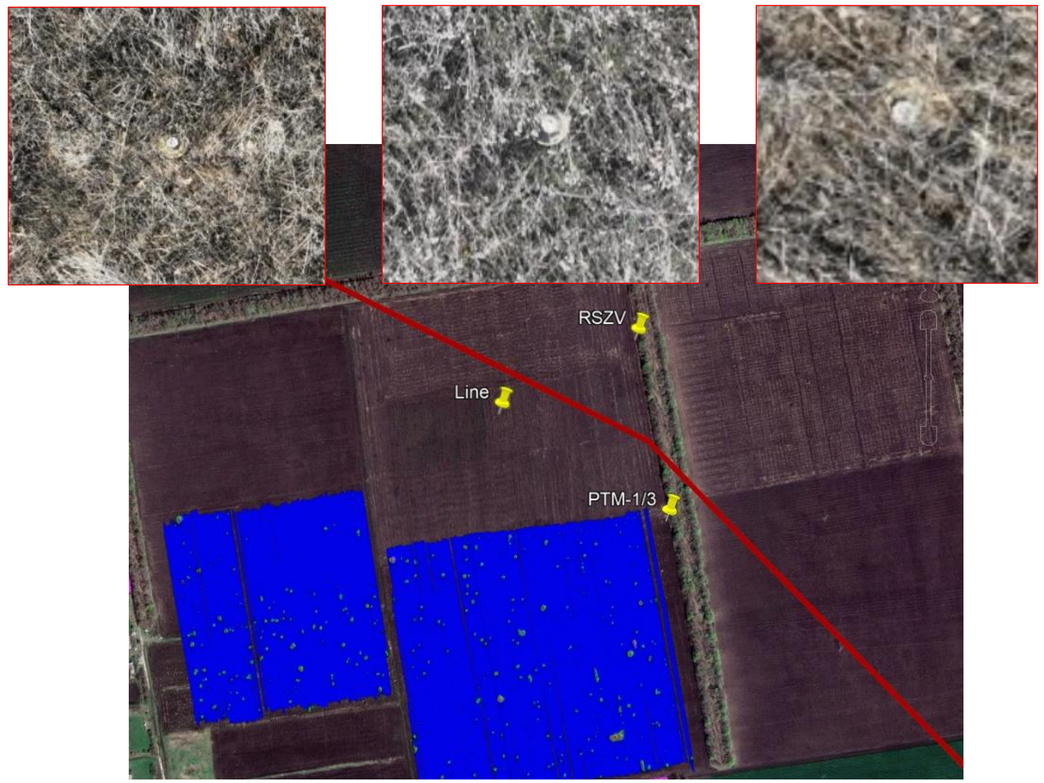
1. Confirmation of area contamination
2. Outlining the boundaries of minefields
3. Reconnaissance before mechanized demining
4. Search for UXO at larger depths (0.5 - 3 m)
5. Underwater survey (up to 7 m deep)

Milestone 3 – what's been done since February

- Visual inspection performed on 133 hectares; collected 300 GB of visual imagery data
- MinesEye multisensory survey conducted on 60 hectares
- Identified almost 500 magnetic anomalies that could be classified as potential target objects
- Detected 3 mine belts - confirmed by visual inspection
    - *Lost 2 small drones…*

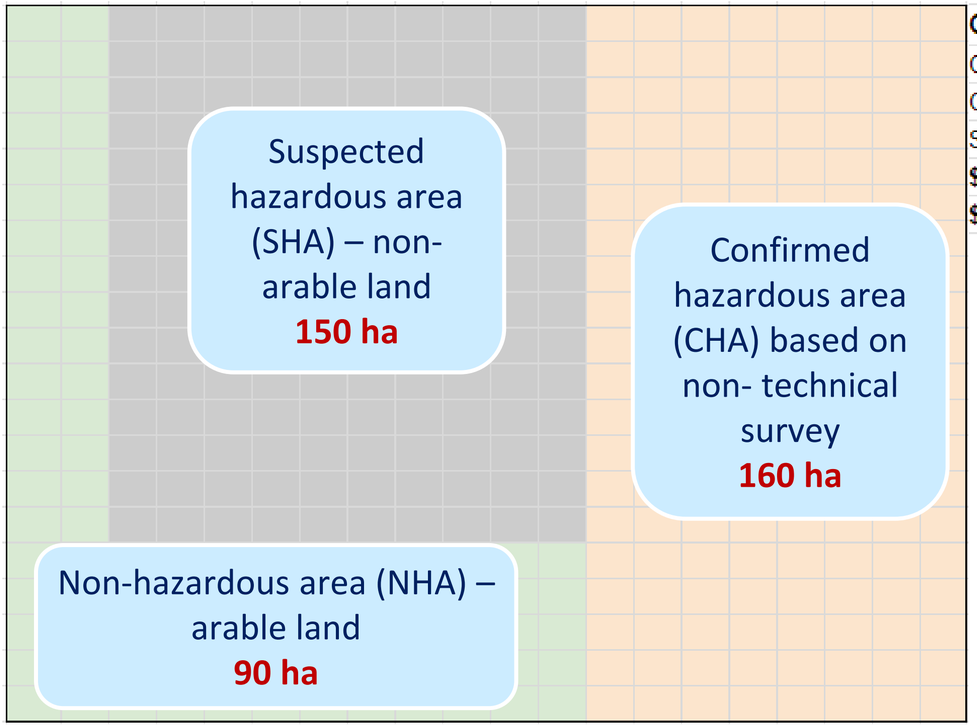
Milestone 3 – first insights

- Remote inspection systems are very useful to survey former defense lines…
- …therefore task prioritization is crucial
- Working with technical inspection teams speeds up validation
- Real productivity in the field could be more important than advancement of sensors
- *Humanitarian demining in active war zones is tough*



How it might work in future – example

Current process



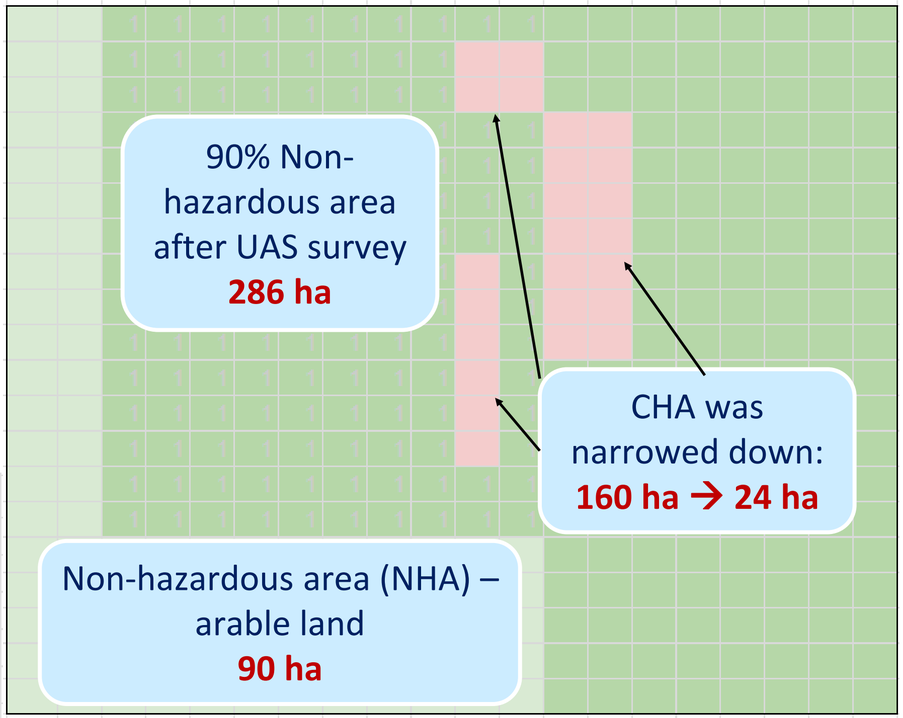
Clearance cost	
CHA(mech) =	800,000
CHA (man) =	1,600,000
SHA =	315,000
$/ha (mech)	**2,788**
$/ha (man)	**4,788**

Future clearance cost	
UAS survey =	46,500
CHA (mech) =	168,000
CHA (man) =	240,000
SHA =	0
Rolling	28,600
$/ha (mech)	**608**
$/ha (man)	**788**

Challenges:

- Non-technical survey is currently done only with visual method
- Very low granularity of surveys
- Results in creating grey zones (SHAs) that aren't cancelled in practice and not processed by farmers

Envisioned process



Approach:

- UAS survey and precise mapping (150 $/ha)
- Unmanned roller used to confirm NHA areas (100 $/ha)
- Confirmed minefields cleared mechanically or manually (5000-10000 $/ha)

Thanks to prioritization, cost of demining is reduced 5x – to 600-800 $/ha

Example results

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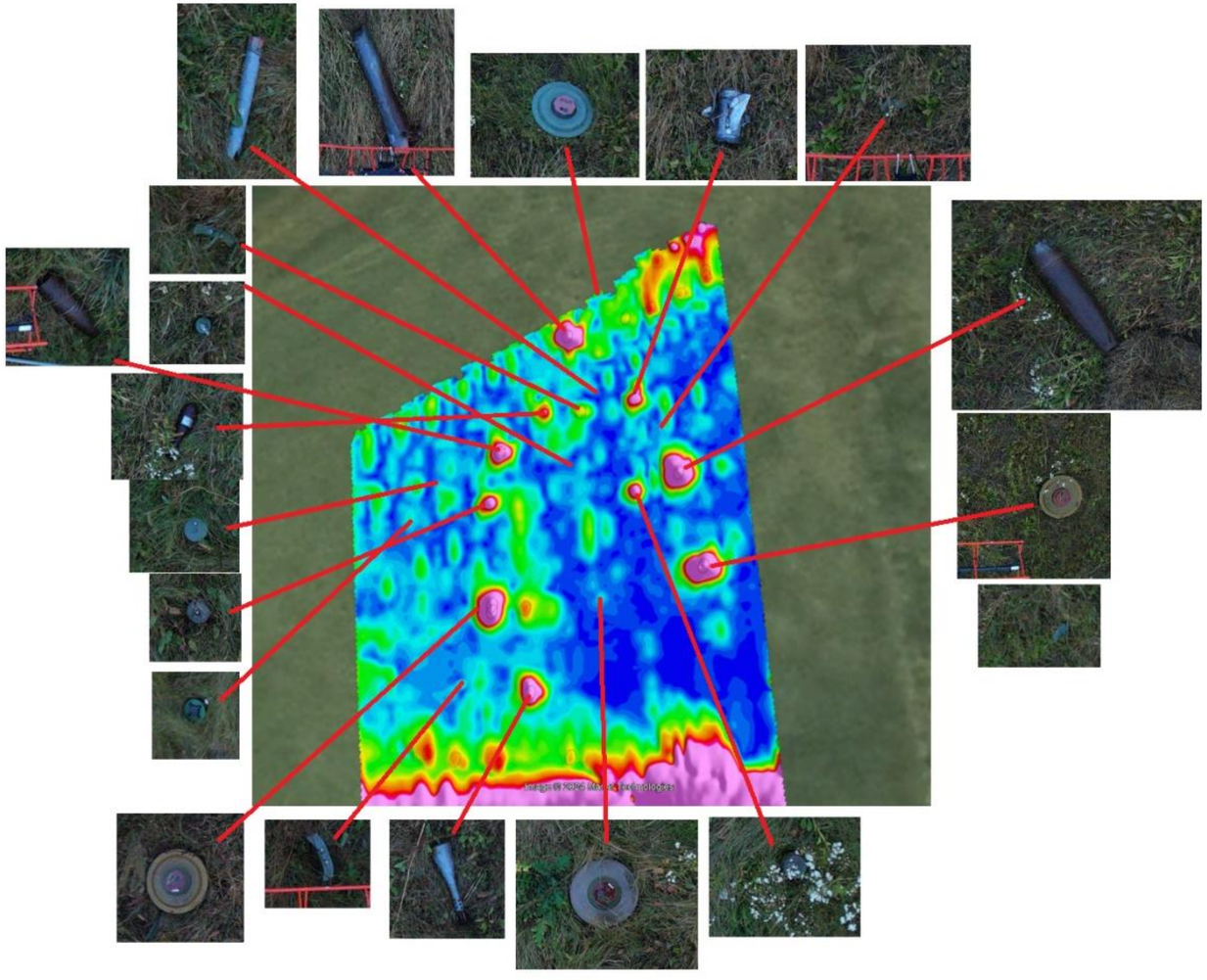
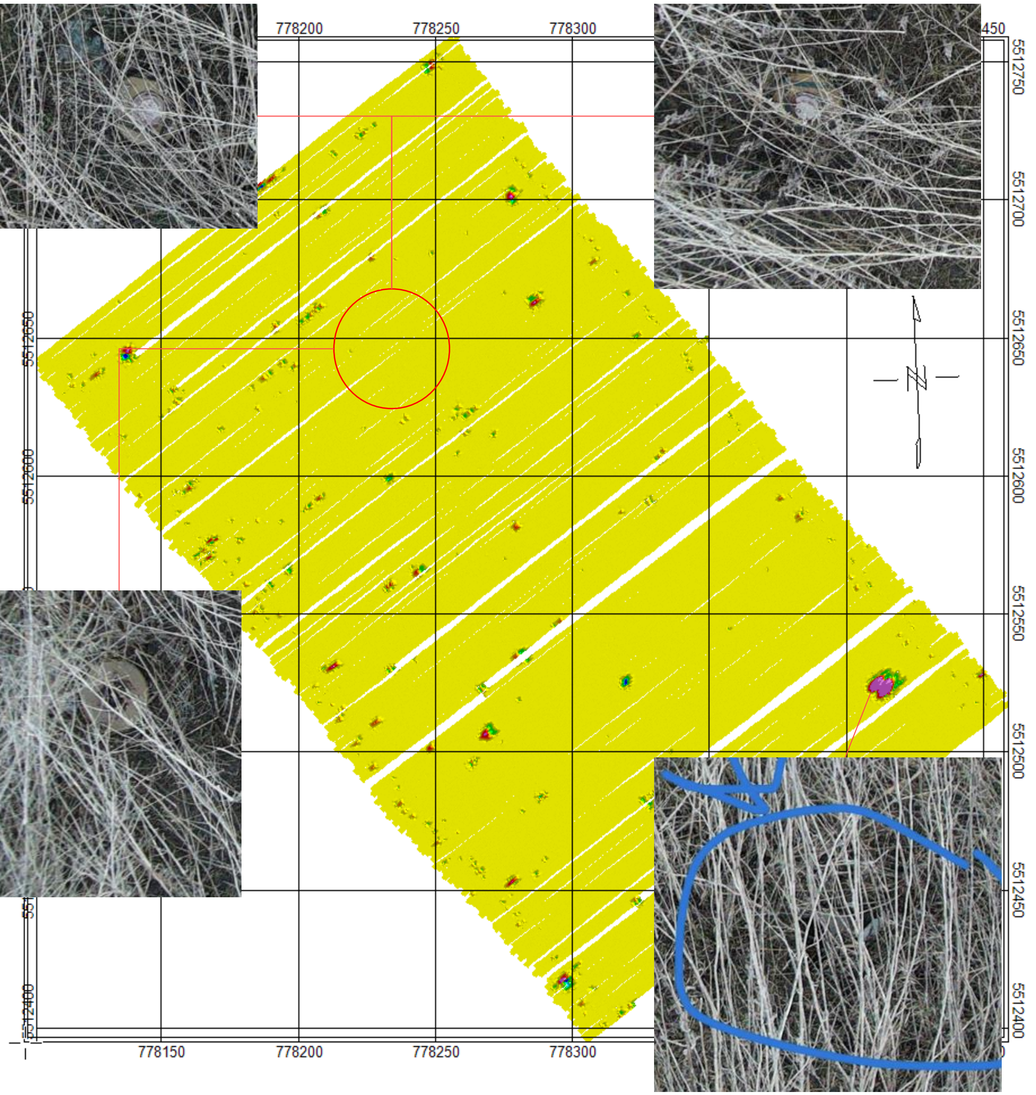
This project is supported by: The NATO Science for Peace and Security Programme

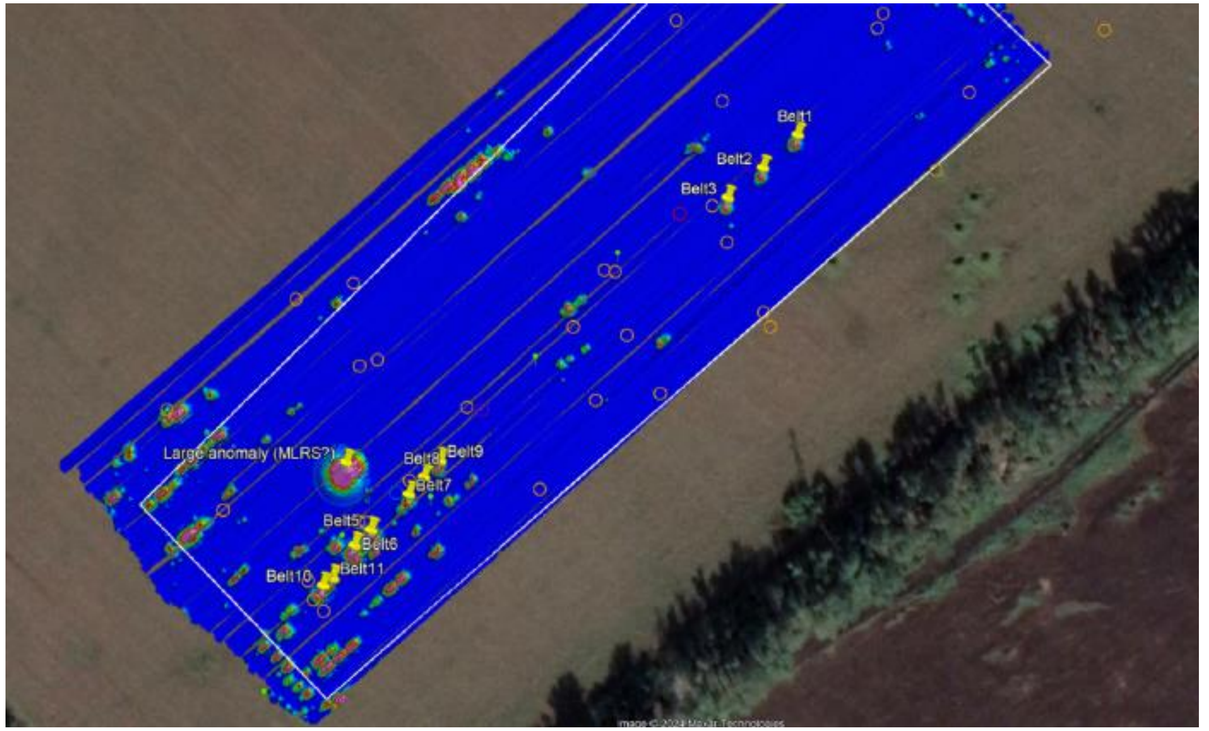
Experiment in October – 93% detection rate



	N	Rate	Comment
Total placed	20		
Total w/o 3D-printed	14		
Magnetic detection	11	79%	% w/o 3D printed mines
RGB recorded	20	100%	of all placed
AI detected/ identified	12	120%	of targets AI was trained for (found also other targets)
Automated detection (AI + Mag)	18	90%	of total
Automated detection (w/o 3D-printed)	**13**	**93%**	**of all placed excluding 3D-printed mines**

Humanitarian demining - Real world - HALO Trust (February 2024)





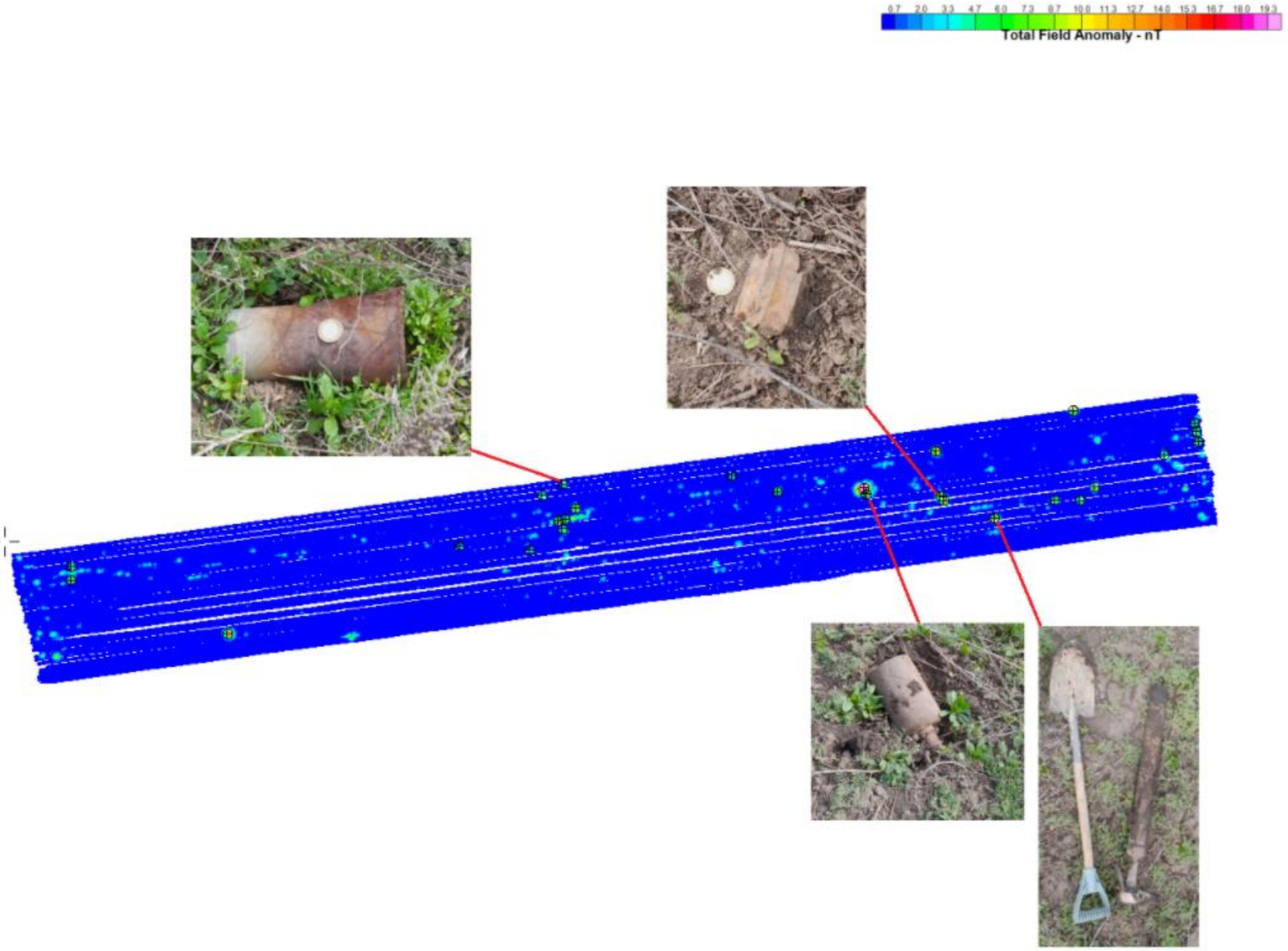
Evidence for this task

Add Indirect evidence

Evidence category	Evidence code	Date of Evidence	Evidence type	Location	EO	Notes
Direct			Debris	349325 / 5510766 UTM zone 37N	Mine AP > Russia - USSR > High Explosive > Bounding Frag > OZM-72	Під час проведення віддаленого збору інформації за допомогою БПЛА, було знайдено кілок зі штатного комплекту протипіхотної осколкової вистрибуючої міни кругового ураження ОЗМ-72.
Direct			Other - Direct	349238 / 5510693 UTM zone 37N	Mine AP > Russia - USSR > High Explosive > Bounding Frag > OZM-72	Під час проведення віддаленого збору інформації за допомогою БПЛА, було знайдено імовірне місце спрацювання протипіхотної осколкової вистрибуючої міни кругового ураження ОЗМ-72.
Direct			Debris	349221 / 5510680 UTM zone 37N	Mine AP > Russia - USSR > High Explosive > Bounding Frag > OZM-72	Під час проведення віддаленого збору інформації за допомогою БПЛА, було знайдено кілок з датчиком цілі у вигляді дроту, зі штатного комплекту протипіхотної осколкової вистрибуючої міни кругового ураження ОЗМ-72.
Direct			Debris	349221 / 5510664 UTM zone 37N	Mine AP > Russia - USSR > High Explosive > Bounding Frag > OZM-72	Під час проведення віддаленого збору інформації за допомогою БПЛА, було знайдено кілок зі штатного комплекту протипіхотної осколкової вистрибуючої міни кругового ураження ОЗМ-72.
Direct			Debris	349215 / 5510660 UTM zone 37N	Mine AP > Russia - USSR > High Explosive > Bounding Frag > OZM-72	Під час проведення віддаленого збору інформації за допомогою БПЛА, було знайдено кілок зі штатного комплекту протипіхотної осколкової вистрибуючої міни кругового ураження ОЗМ-72.

- Postup team found 3 TM-62P3 (plastic), 10 OZM-72 antipersonnel landmines and two unexploded MLRS dug into the ground
- MLRS and most of OZM-72 weren't detected during Non-technical survey that was conducted beforehand

Humanitarian demining - Real world 2 (April 2024)



Details:

Inputs:

Combination of experimental UXO/ERW search with quality control after clearance
Profile length: 750 m
Survey area: 8.5 hectares
Instrument height: 1.3 m

Magnetic:

- 27 targets detected
- 4 objects were extracted within 1 hour
- System noise was confirmed @2 nT

Visual:

- Several suspicious objects were found on contaminated area

Thank you!

About the project

Contact: vlad.kozak@postup.com.pl
+48 518 263 938

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This project is supported by: The NATO Science for Peace and Security Programme