

# Evaluation of the destruction and methods for the rehabilitation of Ukrainian agricultural lands affected by wartime hostilities

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Jean Monnet International School, Kyiv 2024



Co-funded by the  
European Union

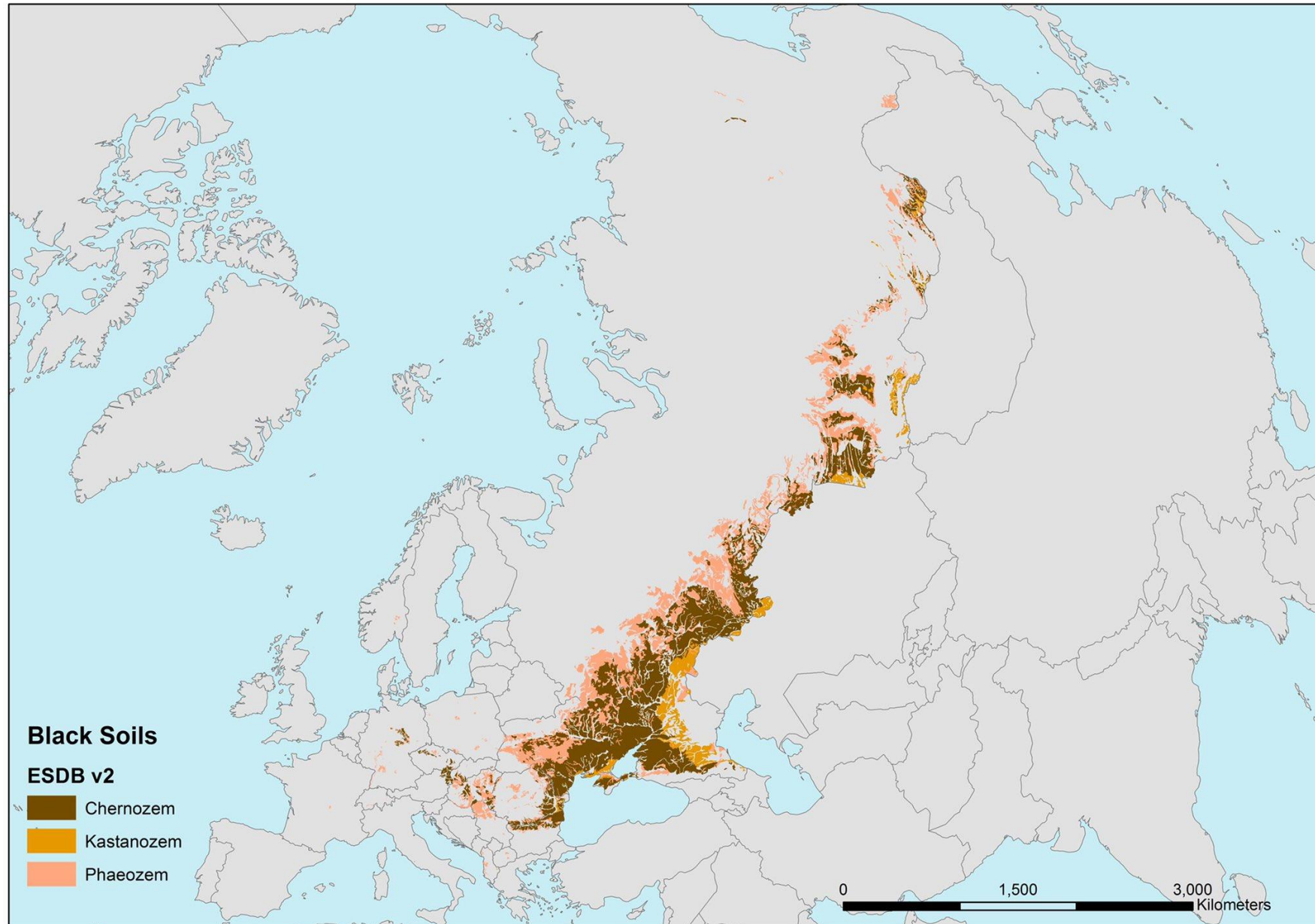




Since the beginning of the war  
russia has launched more than  
10000 drones and 7400 missiles  
and 30 million artillery shots.

Photo Tymur Bedernichek, Donetsk region, Ukraine, 2023

# MAP OF CHERNOZEMS (BLACK SOILS) IN EURASIA



# 400 million people worldwide rely on Ukraine for their food supply

## Before the war, Ukraine was

- the **first** exporter of sunflower oil (more than 50% of world exports)
- the **third** exporter of corn (11.5%), barley (11.5%), rapeseed (10%)
- the **fifth exporter** of wheat (8.5%)



*Source: the United Nations World Food Programme (WFP)*

# THE FACT SHEET OF UKRAINIAN AGRICULTURE PRODUCTION (*January 2022*)

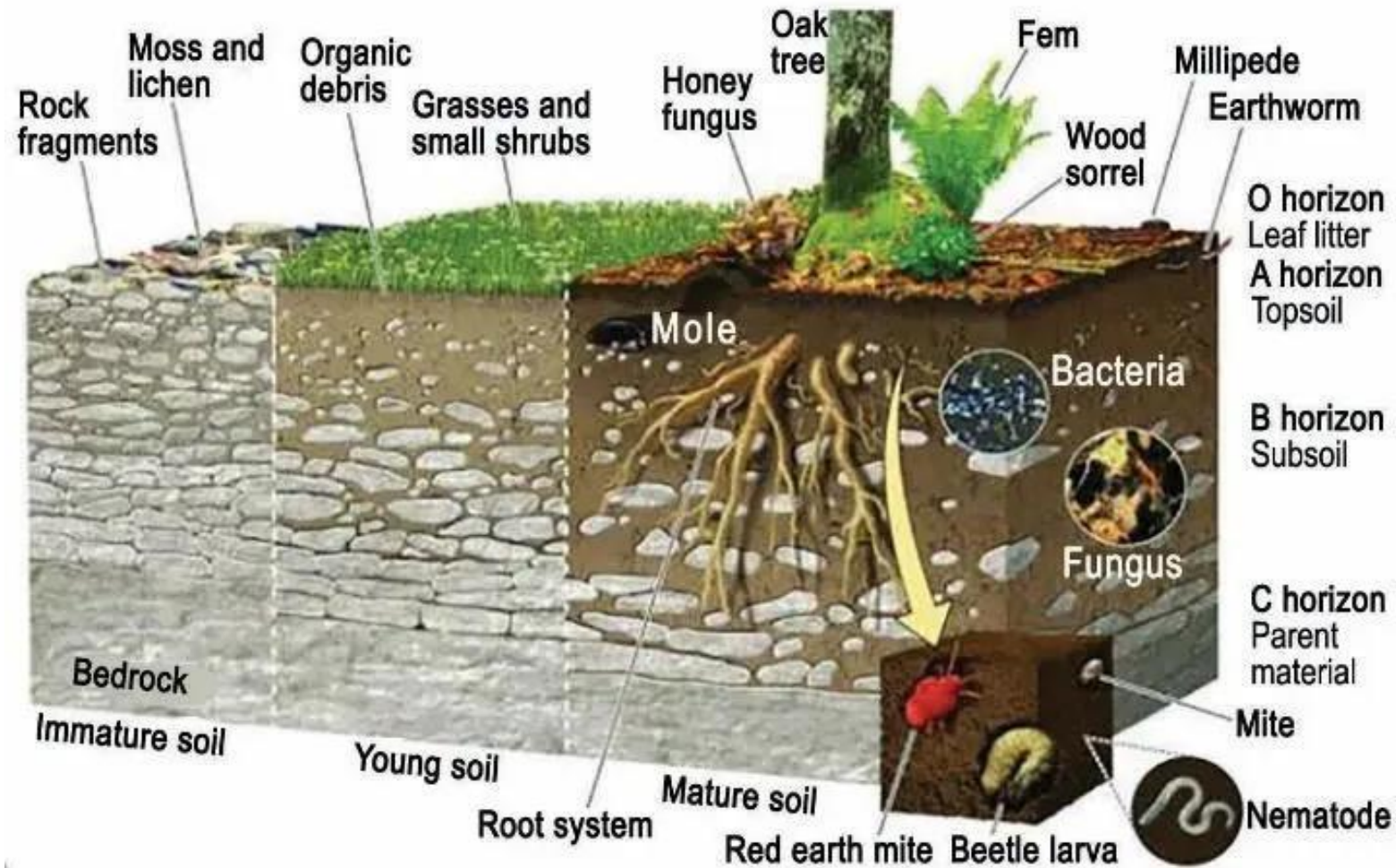
- More than 55% of Ukraine's land area is arable land.
- Before the war agricultural sector contributed up to 12% of GDP and up to 20% of GDP with the processing food industry.
- Agriculture provided employment for 14% of Ukraine's population.
- Agricultural products were Ukraine's most important export. In 2021 they totalled \$27.8 billion, accounting for 41 % of the country's \$68 billion in overall exports.



- Mine pollution
- Pollution caused by burning and spilling of petroleum products
- Pollution from emissions of substances deposited on the ground
- Pollution by military waste and other hazardous substances as a result of military actions



# Soil Formation Over Time



**1 cm of soil is formed in 250-300 years, and 20 cm in 5000-6000 years**

From February 24, more than 424 148 explosives have been neutralised in the territory of Ukraine. The area of about 176,000 square kilometres still needs demining.

➤ 1,5 Greece



➤ 2 Austria



➤ 3 Croatia

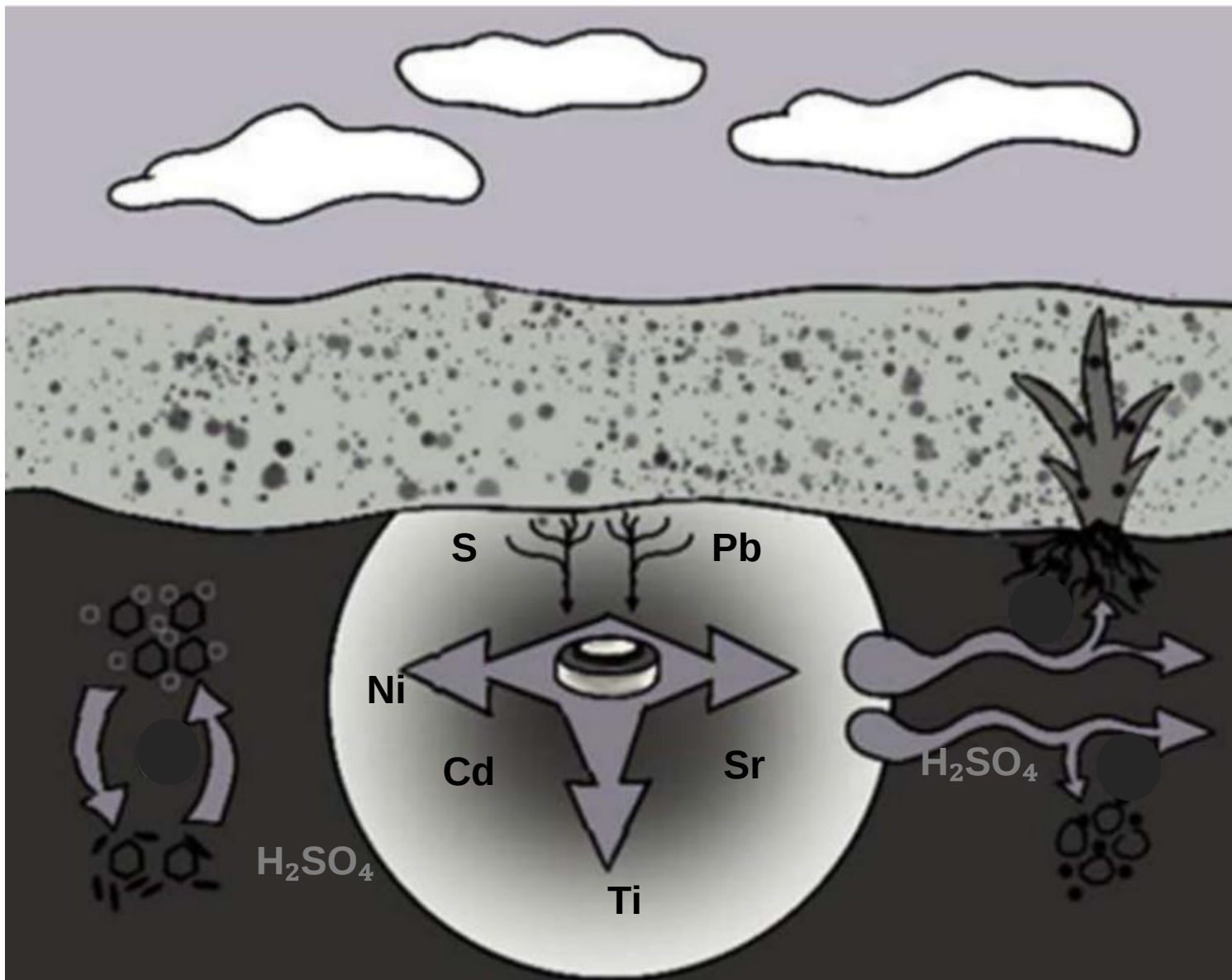


➤ 4 Switzerland



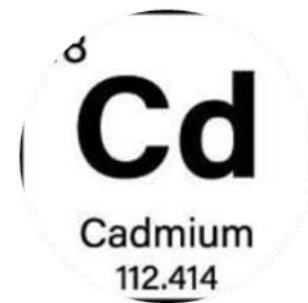
Source: State Emergency Service of Ukraine





*Behaviour of explosive substances compounds in soil*

Source: <https://en.ecoaction.org.ua/impact-of-russias-war-on-soil.html>



A large area of land is unsuitable for agricultural use due to the huge number of trenches, tons of scrap metal and carcinogenic waste, and contamination with heavy metals and chemicals.



- Ukraine can't wait until the war is ended, and foundations for land restoration must be put in place today by interaction with people on the ground who are able to work in an operational and agile way.
- Restoring safe and productive agriculture in Ukraine will take an investment in size and scope equivalent to a 'Marshal Plan'.
- This will need to begin with mapping farmland to document hazards and contamination and prioritise land for production, remediation and conservation.



# PROJECT: ASSESSMENT OF DAMAGES AND WAYS TO RESTORE AGRICULTURAL LANDS OF UKRAINE AS A RESULT OF THE RUSSIAN INVASION



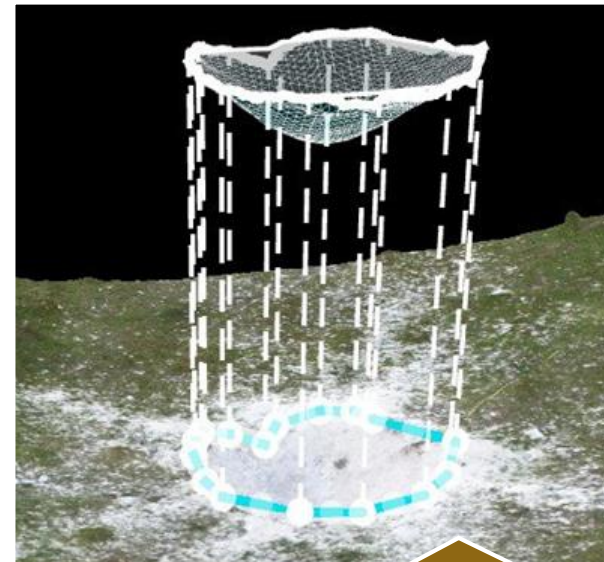
## Research

- Scalable approaches to the assessment of soil contamination



## Studying

- Blended training for former soldiers, researchers, eco-inspectors



## Mapping

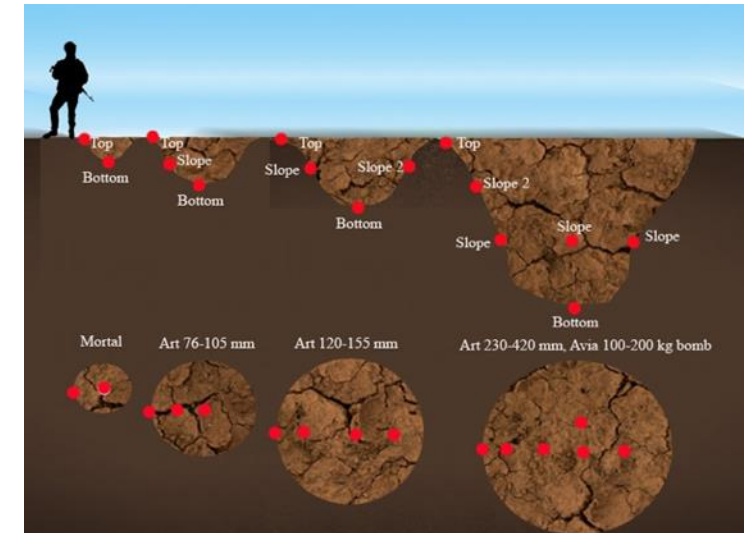
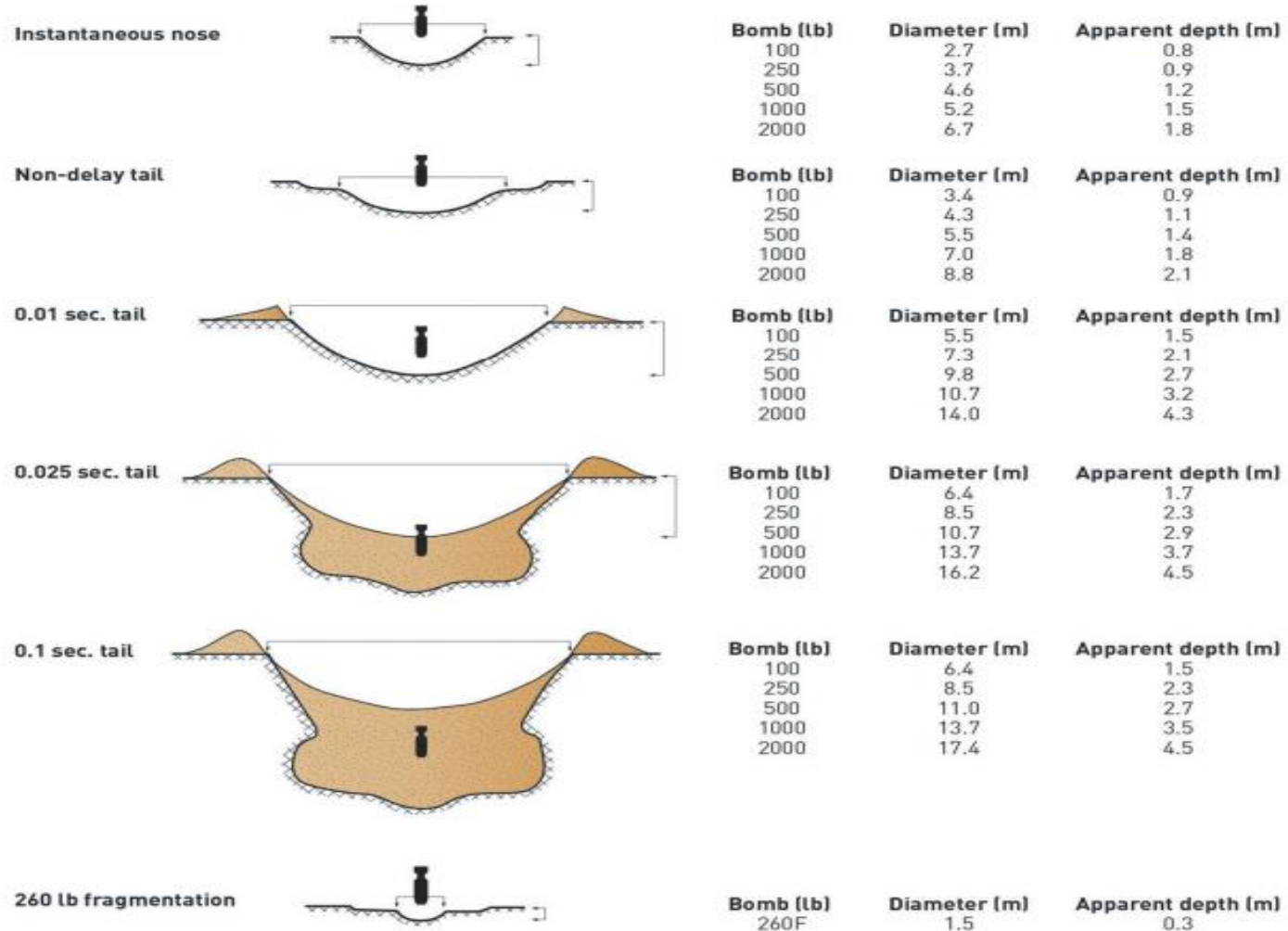
- Farm dashboard with remote sensing and ground truth data



## Networking

- Building international collaboration for developing a soil remediation strategy

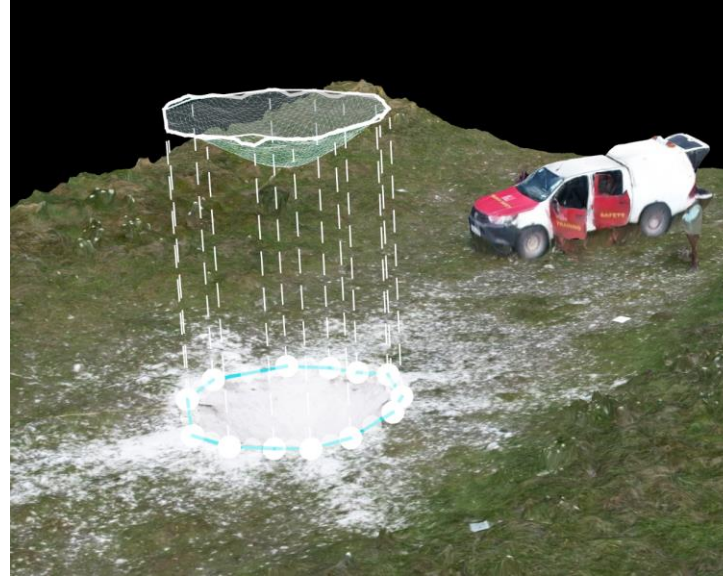
# UKRAINE Experimentation Protocol: BOMBING IMPACT ON FARMING VIABILITY – the effects of bombing on soil chemistry, structure and soil health



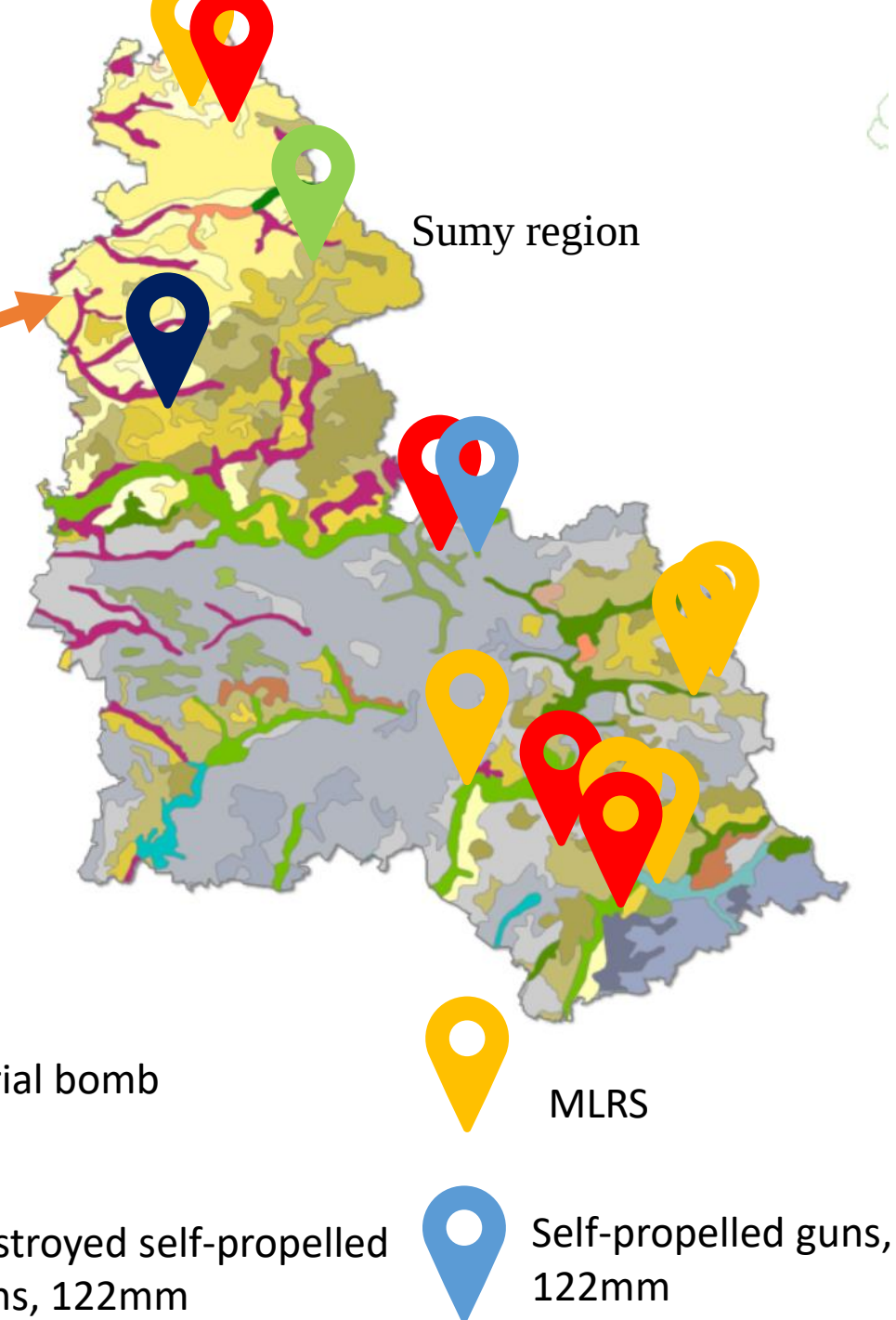
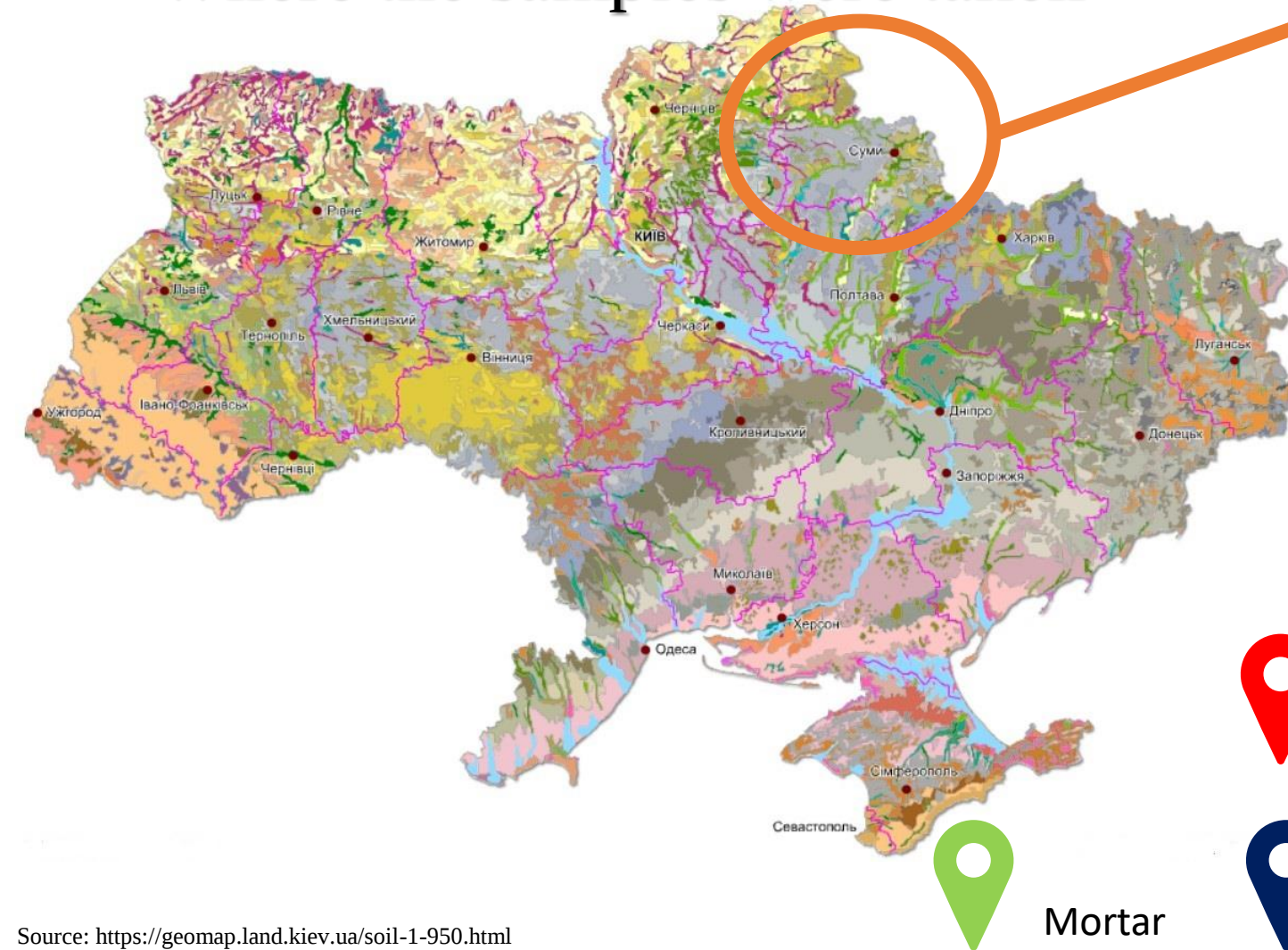
Examples of soil sampling schemes depending on the types of damage

Figure 8. Comparative crater sizes for selected bomb types and fuses. Illustrated craters are for 100lb GP bombs in clay soils (Redrawn after Capps-Tunwell et al. 2016, 316. Based on an original IX Bombardment Division document, AFHRA IRIS Ref. B5755, Operational Research Section).

# Protocol testing on Salisbury Plain Training Area (SPTA), the UK, 2022-2023

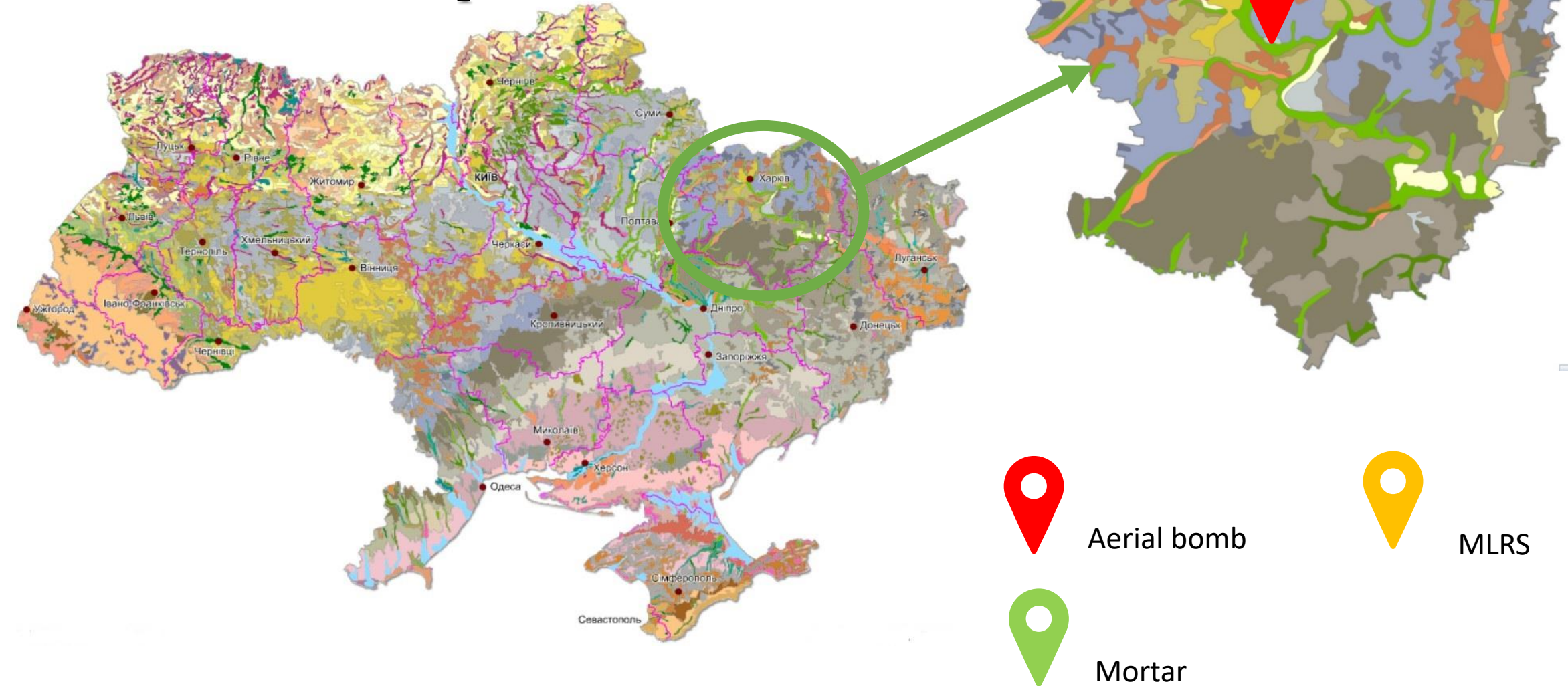


# Where the samples were taken



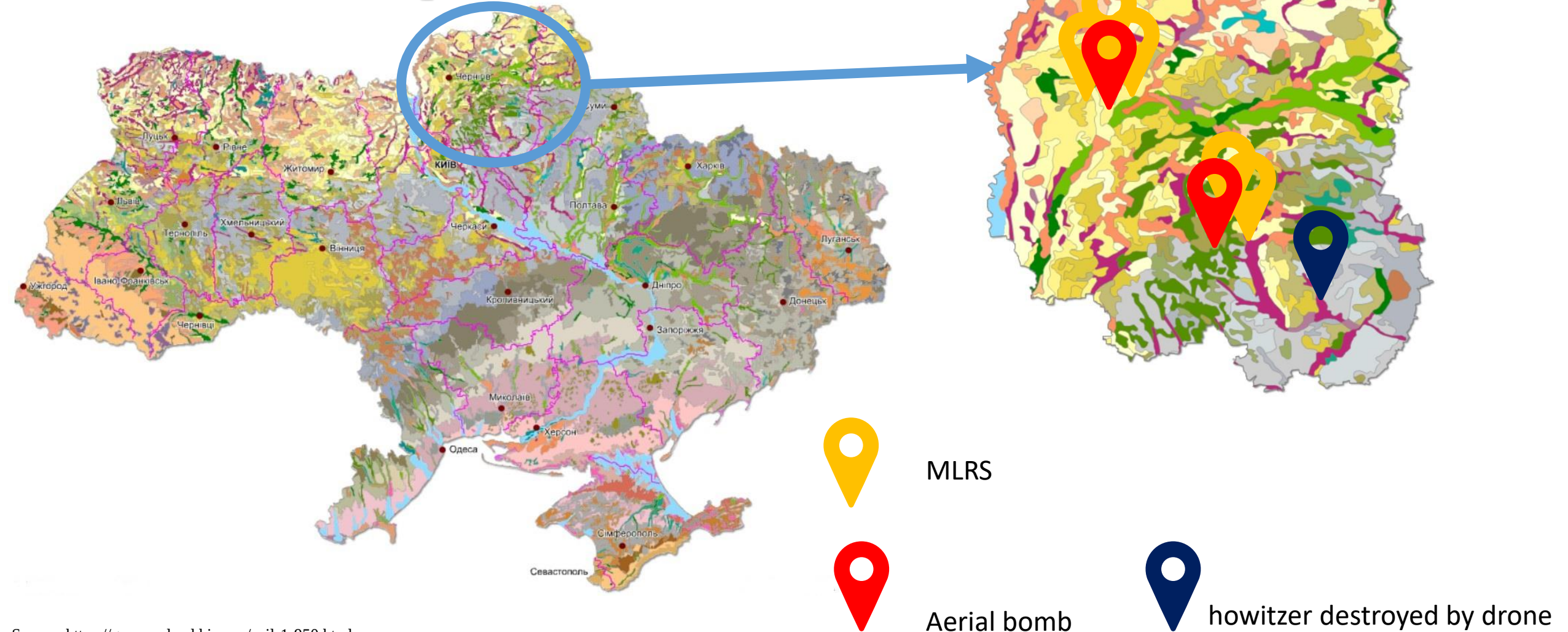
# Where the samples were taken

Kharkiv region



# Where the samples were taken

Chernihiv region



# Soil sampling (April-May 2023, Ukraine)



280 soil samples



28 bomb craters



3 previously  
occupied regions  
of Ukraine



8 labs (the UK,  
Switzerland,  
Poland, Ukraine)

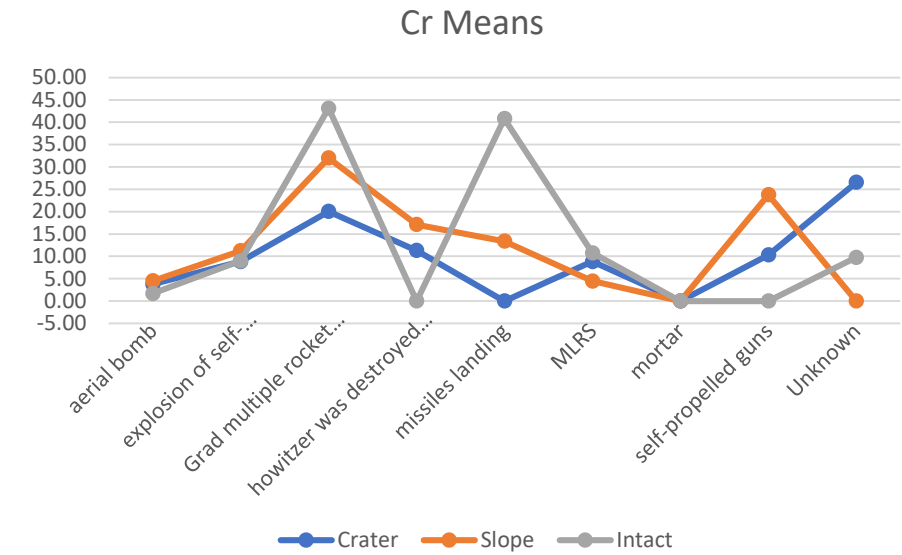
# Managing the results

| Reading No                               | Time  | Type | Duration | Units | Sequence | Flame | SAMPLE | LOCATION | Antimony (Sb) <1ppm | Tin (Sn) <3ppm | Cadmium (Cd) <8ppm | Lead (Pb) <50ppm | Arsenic (As) <50ppm | Mercury (Hg) <10ppm | NICKEL (Ni) <20ppm | Cobalt (Co) <40ppm | Chromium (Cr) <100ppm | Scandium (Sc) <10ppm | Sulphur (S) <300ppm | Vanadium (V) <60ppm | Copper (Cu) <60ppm | Silver (Ag) | Palladium (Pd) | Selenium (Se) | Gold (Au) <10ppm | Tungsten (W) | Iron (Fe) <10ppm | Calcium (Ca) | Potassium (K) <10ppm |          |
|------------------------------------------|-------|------|----------|-------|----------|-------|--------|----------|---------------------|----------------|--------------------|------------------|---------------------|---------------------|--------------------|--------------------|-----------------------|----------------------|---------------------|---------------------|--------------------|-------------|----------------|---------------|------------------|--------------|------------------|--------------|----------------------|----------|
| 319                                      | ##### | Soil | 120.41   | ppm   | Final    |       | 2 1a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 49.99               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15525.83         | 11117.07     | 18707.16             |          |
| 320                                      | ##### | Soil | 120.35   | ppm   | Final    |       | 2 1a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 80.64               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15404.88         | 11196.47     | 18481.49             |          |
| 321                                      | ##### | Soil | 120.6    | ppm   | Final    |       | 2 1a   | crater   | <LOD                | <LOD           | <LOD               | 12.03            | <LOD                | <LOD                | <LOD               | <LOD               | 25.58                 | <LOD                 | <LOD                | 66.42               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15617.39         | 11034.15     | 19114.6              |          |
| 322                                      | ##### | Soil | 120.03   | ppm   | Final    |       | 2 1b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 66.29               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15461.47         | 9381.12      | 19114.94             |          |
| 323                                      | ##### | Soil | 120.46   | ppm   | Final    |       | 2 1b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | 35.03                 | <LOD                 | <LOD                | 68.68               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15383.97         | 9619.51      | 19493.18             |          |
| 324                                      | ##### | Soil | 120.58   | ppm   | Final    |       | 2 1b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | 9.13                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 67.65               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15782.2          | 9329.65      | 19097.44             |          |
| 325                                      | ##### | Soil | 120.48   | ppm   | Final    |       | 2 1c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 53.35               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 14855.92         | 11319.6      | 18500.3              |          |
| 326                                      | ##### | Soil | 120.61   | ppm   | Final    |       | 2 1c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 80.09               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 14978.03         | 11191.02     | 18177.4              |          |
| 327                                      | ##### | Soil | 120.1    | ppm   | Final    |       | 2 1c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | 145.82             | <LOD                  | <LOD                 | <LOD                | 50.47               | 22.92              | <LOD        | <LOD           | <LOD          | <LOD             |              | 14871.66         | 11382.46     | 18902.65             |          |
| No contamination                         |       |      |          |       |          |       |        |          |                     |                |                    |                  |                     |                     |                    |                    |                       |                      |                     |                     |                    |             |                |               |                  |              |                  |              |                      |          |
| 328                                      | ##### | Soil | 120.32   | ppm   | Final    |       | 2 3a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | 8.38                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 88.03               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16192.59         | 10481.79     | 18742.27             |          |
| 329                                      | ##### | Soil | 120.03   | ppm   | Final    |       | 2 3a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | 41.36              | <LOD                  | <LOD                 | 94.08               | 683.01              | 73.43              | <LOD        | <LOD           | <LOD          | <LOD             | <LOD         |                  | 16423.72     | 10512.7              | 18248.72 |
| 330                                      | ##### | Soil | 120.52   | ppm   | Final    |       | 2 3a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 87.51               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16161.21         | 10368.18     | 18481.04             |          |
| 331                                      | ##### | Soil | 120.06   | ppm   | Final    |       | 2 3b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 69.33               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16365.45         | 8458.98      | 18952.71             |          |
| 332                                      | ##### | Soil | 120.33   | ppm   | Final    |       | 2 3b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 62.92               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16574.05         | 8271.69      | 19144.3              |          |
| 333                                      | ##### | Soil | 120.08   | ppm   | Final    |       | 2 3b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | 8.79                | <LOD                | <LOD               | <LOD               | 32.8                  | <LOD                 | <LOD                | 56.44               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16421.79         | 8281.5       | 19172.06             |          |
| 334                                      | ##### | Soil | 120.53   | ppm   | Final    |       | 2 3c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | 9.21                | <LOD                | <LOD               | 122.96             | <LOD                  | <LOD                 | <LOD                | 82.29               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16331.05         | 11900.61     | 19336.36             |          |
| 335                                      | ##### | Soil | 120.21   | ppm   | Final    |       | 2 3c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 74                  | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16452.17         | 11926.54     | 19245.37             |          |
| 336                                      | ##### | Soil | 120.34   | ppm   | Final    |       | 2 3c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | 35.31                 | <LOD                 | <LOD                | 69.56               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16058.51         | 11826.86     | 19417.27             |          |
| Crater with nickel, scandium and sulphur |       |      |          |       |          |       |        |          |                     |                |                    |                  |                     |                     |                    |                    |                       |                      |                     |                     |                    |             |                |               |                  |              |                  |              |                      |          |
| 337                                      | ##### | Soil | 120.11   | ppm   | Final    |       | 2 4a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | 8.73                | <LOD                | <LOD               | 157.16             | <LOD                  | <LOD                 | <LOD                | 56.08               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15309.84         | 39923.51     | 18873.77             |          |
| 338                                      | ##### | Soil | 120.65   | ppm   | Final    |       | 2 4a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 76.96               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15155.07         | 40155.38     | 19055.67             |          |
| 339                                      | ##### | Soil | 120.17   | ppm   | Final    |       | 2 4a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | 45.65              | <LOD                  | 30.88                | <LOD                | 62.82               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 15291.77         | 40228.18     | 18470.77             |          |
| 340                                      | ##### | Soil | 120.45   | ppm   | Final    |       | 2 4b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | 32.08                 | <LOD                 | <LOD                | 80.81               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16458.96         | 11792.4      | 18729.9              |          |
| 341                                      | ##### | Soil | 120.58   | ppm   | Final    |       | 2 4b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | 40.84              | <LOD                  | 39.14                | <LOD                | 73.6                | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16686.73         | 11831.85     | 19427.75             |          |
| 342                                      | ##### | Soil | 120.03   | ppm   | Final    |       | 2 4b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 74.31               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16302.23         | 11678.32     | 19325.99             |          |
| 343                                      | ##### | Soil | 120.4    | ppm   | Final    |       | 2 4c   | intact   | <LOD                | <LOD           | <LOD               | 11.63            | <LOD                | <LOD                | <LOD               | 45.9               | <LOD                  | <LOD                 | <LOD                | 67.22               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16324.05         | 9435.93      | 19065.39             |          |
| 344                                      | ##### | Soil | 120.07   | ppm   | Final    |       | 2 4c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 58.59               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16494.52         | 9492.54      | 18499.88             |          |
| 345                                      | ##### | Soil | 120.55   | ppm   | Final    |       | 2 4c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | 8.03                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 67.06               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 16379.83         | 9414.13      | 19095.43             |          |
| Crater with nickel and cobalt            |       |      |          |       |          |       |        |          |                     |                |                    |                  |                     |                     |                    |                    |                       |                      |                     |                     |                    |             |                |               |                  |              |                  |              |                      |          |
| 346                                      | ##### | Soil | 120.32   | ppm   | Final    |       | 1 1a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | 41.84                 | <LOD                 | 719.9               | 69.05               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 17995.74         | 7637.44      | 18805.89             |          |
| 347                                      | ##### | Soil | 120.38   | ppm   | Final    |       | 1 1a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | 10.26               | <LOD                | <LOD               | 158.01             | <LOD                  | <LOD                 | <LOD                | 86.21               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 17800.72         | 7771.2       | 18391.77             |          |
| 348                                      | ##### | Soil | 120.05   | ppm   | Final    |       | 1 1a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | 170.46             | 35.17                 | <LOD                 | <LOD                | 62.92               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 17779.84         | 7665.76      | 18577.19             |          |
| 349                                      | ##### | Soil | 120.23   | ppm   | Final    |       | 1 1b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | 53.16              | <LOD                  | <LOD                 | <LOD                | <LOD                | 93.43              | <LOD        | <LOD           | <LOD          | <LOD             | <LOD         |                  | 18290.39     | 7887.4               | 19059.42 |
| 350                                      | ##### | Soil | 120.41   | ppm   | Final    |       | 1 1b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 60.48               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 17871.02         | 8010.84      | 19481.79             |          |
| 351                                      | ##### | Soil | 120.33   | ppm   | Final    |       | 1 1b   | slope    | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 73.62               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 18487.05         | 7986.68      | 19277.36             |          |
| 352                                      | ##### | Soil | 120.43   | ppm   | Final    |       | 1 1c   | intact   | <LOD                | <LOD           | <LOD               | 11.91            | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | 64.54               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 17705.88         | 7467.86      | 18571.26             |          |
| 353                                      | ##### | Soil | 120.43   | ppm   | Final    |       | 1 1c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | 30.16                 | <LOD                 | <LOD                | 87.68               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 17875.54         | 7618.08      | 18647.43             |          |
| 354                                      | ##### | Soil | 1.95     | ppm   | Final    |       | 1 1c   | intact   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | <LOD                  | <LOD                 | <LOD                | <LOD                | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 21285.04         |              |                      |          |
| Crater with nickel and cobalt            |       |      |          |       |          |       |        |          |                     |                |                    |                  |                     |                     |                    |                    |                       |                      |                     |                     |                    |             |                |               |                  |              |                  |              |                      |          |
| 355                                      | ##### | Soil | 120.05   | ppm   | Final    |       | 4 1a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | <LOD                | <LOD                | <LOD               | <LOD               | 31.61                 | <LOD                 | <LOD                | 49.8                | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 14905.45         | 6852.44      | 14631.25             |          |
| 356                                      | ##### | Soil | 120.55   | ppm   | Final    |       | 4 1a   | crater   | <LOD                | <LOD           | <LOD               | <LOD             | 9.53                | <LOD                | <LOD               | <LOD               | 30.67                 | 72.64                | <LOD                | 61.12               | <LOD               | <LOD        | <LOD           | <LOD          | <LOD             |              | 14652.77         | 6940.7       | 14094.76             |          |

# Evaluating the data

Cr

| Bomb type                                        | Means  |       |        | Comparison      |                  |                 |
|--------------------------------------------------|--------|-------|--------|-----------------|------------------|-----------------|
|                                                  | Crater | Slope | Intact | Crater vs Slope | Crater vs Intact | Slope vs Intact |
| aerial bomb                                      | 3.73   | 4.51  | 1.68   | 0.886           | 0.708            | 0.603           |
| explosion of self-propelled guns with ammunition | 8.82   | 11.22 | 8.97   | 0.870           | 0.992            | 0.878           |
| Grad multiple rocket launchers                   | 20.03  | 31.99 | 43.12  | 0.170           | 0.011            | 0.193           |
| howitzer was destroyed by drone                  | 11.29  | 17.10 | 0.00   | 0.693           | 0.445            | 0.251           |
| missiles landing                                 | 0.00   | 13.37 | 40.78  | 0.203           | 0.000            | 0.012           |
| MLRS                                             | 8.84   | 4.47  | 10.77  | 0.498           | 0.764            | 0.334           |
| mortar                                           | 0.00   | 0.00  | 0.00   | 1.000           | 1.000            | 1.000           |
| self-propelled guns                              | 10.29  | 23.74 | 0.00   | 0.364           | 0.486            | 0.115           |
| Unknown                                          | 26.56  | 0.00  | 9.77   | 0.014           | 0.108            | 0.349           |



## Significant Bomb Types

| Bomb Type                                        | Compound |    |    |    |   |
|--------------------------------------------------|----------|----|----|----|---|
|                                                  | Pb       | Zn | Cu | Cr | S |
| aerial bomb                                      | X        | X  | X  | X  | X |
| explosion of self-propelled guns with ammunition | X        | X  | X  | X  | X |
| Grad multiple rocket launchers                   | X        | X  | X  | X  | X |
| howitzer was destroyed by drone                  | X        | X  | X  | X  | X |
| missiles landing                                 | X        | X  | X  | X  | X |
| MLRS                                             | X        | X  | X  | X  | X |
| mortar                                           | X        | X  | X  | X  | X |
| self-propelled guns                              | X        | X  | X  | X  | X |
| Unknown                                          | X        | X  | X  | X  | X |

Never Sig

X

X

X

*After* Chernihiv oblast, farmland №22



*Before*

Kharkivska oblast, farmland №18



*After*



*After* Chernihiv oblast, farmland №21



*Before*

Kharkivska oblast, farmland №16



*After*



# FIRST UKRAINIAN TRAINING OF EXPERTS TO ASSESS SOILS DAMAGED DUE TO HOSTILITIES



*1-month intensive programme  
34 trainers from Switzerland, the UK,  
Ukraine*



*Study programme:*

- Ground truth data analysis
- Remote sensing analysis
- Machine learning



*26 experts from 10 regions of Ukraine  
were trained*





# Land Remediation Strategies for Local Farms in Ukraine

including the concept of smart-carbon land usage



YEVGEN  
GETMAN



YEVHENIIA  
KOZYR



GALYNA  
CHOS



HANNA  
STEPANENKO



IGOR  
STORCHAK



DR. OLENA  
MELNYK  
ETH ZURICH

# Screen 1



**Marked in Red** Expert level , available after authorisation

**Marked in Black** User level , available upon request

|                                                   |                                                                     |
|---------------------------------------------------|---------------------------------------------------------------------|
| Location:                                         | 51.133380, 34.761758,                                               |
| Farm:                                             | Agrofirma Lan 1                                                     |
| Address::                                         | Osiivka, Krasnopil OTG,<br>Sumy reg.                                |
| Main focus:                                       | agricultural crops<br>(sunflower, millet)                           |
| Soil :                                            | Heavy Loamy (43%<br>physical clay)                                  |
| Humus:                                            | 2.7% (average)                                                      |
| pH <sub>сол</sub> 5,27,<br>pH <sub>вод</sub> 6,03 | Soil acidity close to neutral                                       |
| Contacts:                                         | <b>+380984230104</b><br><b>Bolshakov M.I. Agronom</b>               |
| Photo:                                            | <a href="#">Photo 1</a> , <a href="#">Photo 2</a>                   |
| Damage:                                           | Aerial Bomb FAB500                                                  |
| Land Area                                         | 10 HA                                                               |
| Probe:                                            | <a href="#">rXPF Oct.30 2023</a><br><a href="#">AAS Jun.14 2025</a> |
| Level of damage: drop down bar :                  | <input type="text"/> 1/2/3/n/a                                      |

## Restoring damaged land

**Remediation** is a set of technologies that involve the artificial restoration and return of fertile soil characteristics.

**Conservation** is when we return the land to nature, temporarily withdraw it from cultivation and allow it to recover naturally.



# Thank you!

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Do you have any questions?

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