

Drone-Based Investigation of Uranium Mining Legacies – Recent Developments in the DUB-GEM Project

Benedikt Preugschat^{1,5}, Malte Ibs-von Seht¹, Christian Kunze², Robert Arndt², Felix Kandzia², Benjamin Wiens³, Sven Altfelder⁴ and Clemens Walther⁵

¹Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany

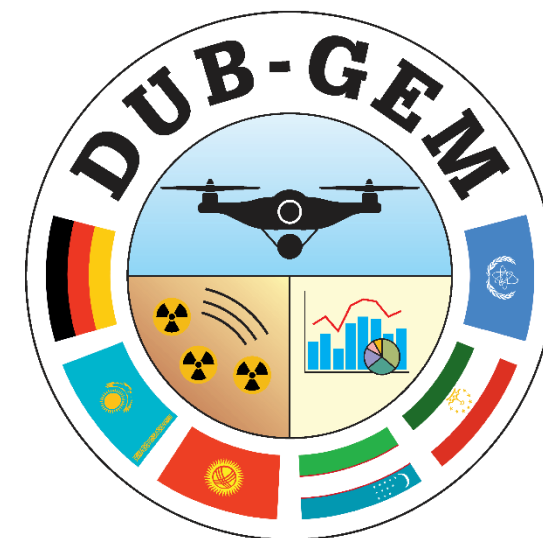
²IAF-Radioökologie GmbH, Radeberg, Germany

³Third Element Aviation GmbH, Bielefeld, Germany

⁴International Atomic Energy Agency (IAEA), Vienna, Austria

⁵Leibniz University Hannover (LUH), Hannover, Germany

Funding number: 01LZ1706A-C





- Uranium mining legacies still pose a significant risk to human health and the environment on certain Central Asian regions.
- The DUB-GEM project:
Development of a UAV-Based Gamma Spectrometry for the Exploration and Monitoring of Uranium Mining Legacies

Equipment: Gamma Spectrometer



MEDUSA - Spectrometer		
Properties	Detector 1	Detector 2
Scintillation-Crystals	Caesium-Iodide (CsI)	Cerium-Bromid (CeBr ₃)
Crystal-Size (volume)	3" x 6" (700 ml)	3" x 6" (700 ml)
Energy-Resolution at 662 keV	8,6 %	3,9 %

innoRIID - Spectrometer		
Properties	Detector 1	Detector 2
Scintillation-Crystals	Sodium-Iodide (NaI)	Cerium-Bromid (CeBr ₃)
Crystal-Size (volume)	3" x 3" (350 ml)	2" x 2" (100 ml)
Energy-Resolution at 662 keV	7,5 %	4,3 %

Fig. 01: Medusa-gamma-spectrometer

Fig. 02: innoRIID-gamma-spectrometer

Equipment: Unmanned Aerial Vehicle (UAV)



Project drone

Medusa gamma spectrometer

Fig. 03: Drone-Detector-System on a calibration pad of Wismut GmbH in Thuringia, Germany.

Measurement Sites in Germany

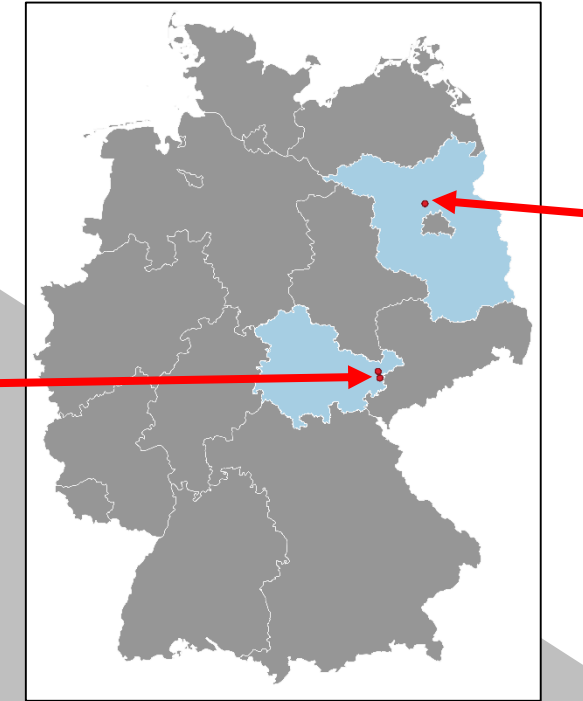


Fig. 04: Map of the investigation area Culmitzsch, Thuringia.

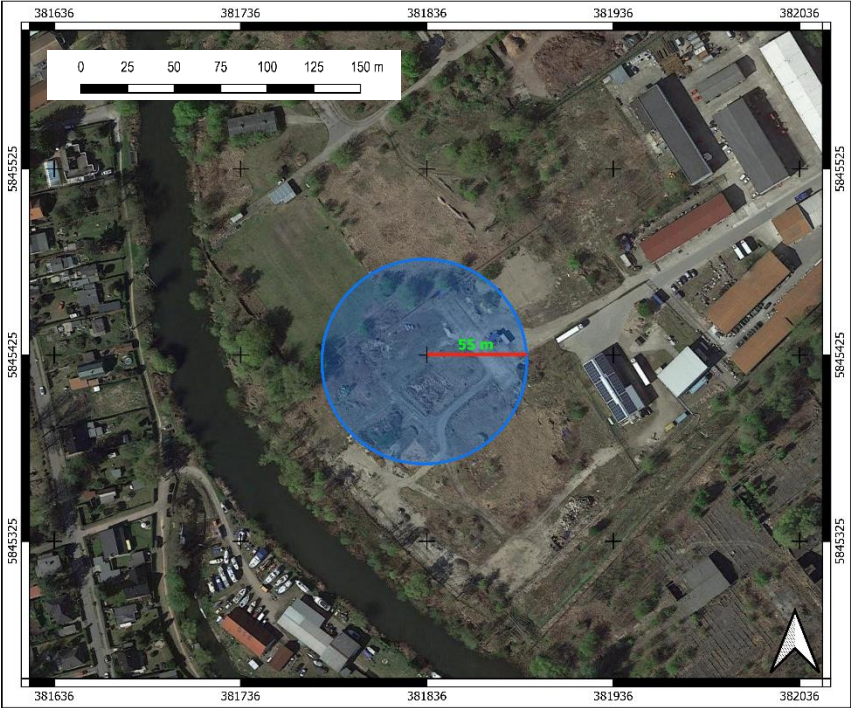


Fig. 05: Map of the investigation area in Oranienburg Brandenburg.

Results: Germany (Thuringia)

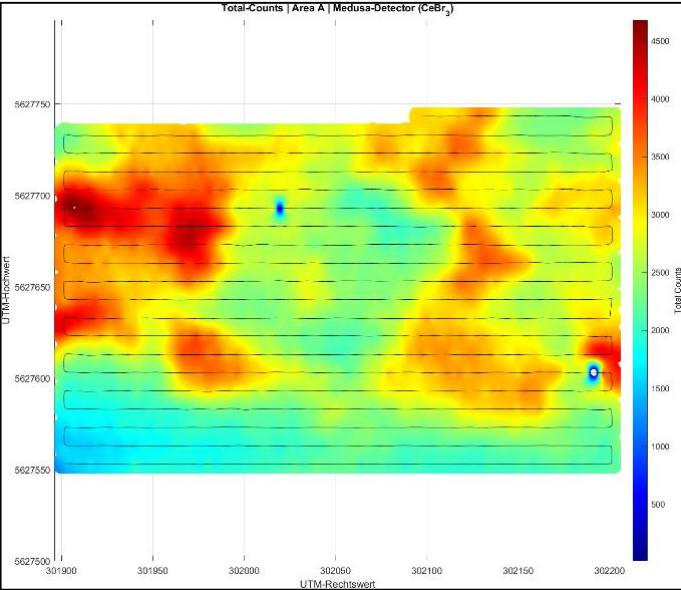


Fig. 06: Total counts distribution in CPS of the test site in Culmitzsch, Thuringia.

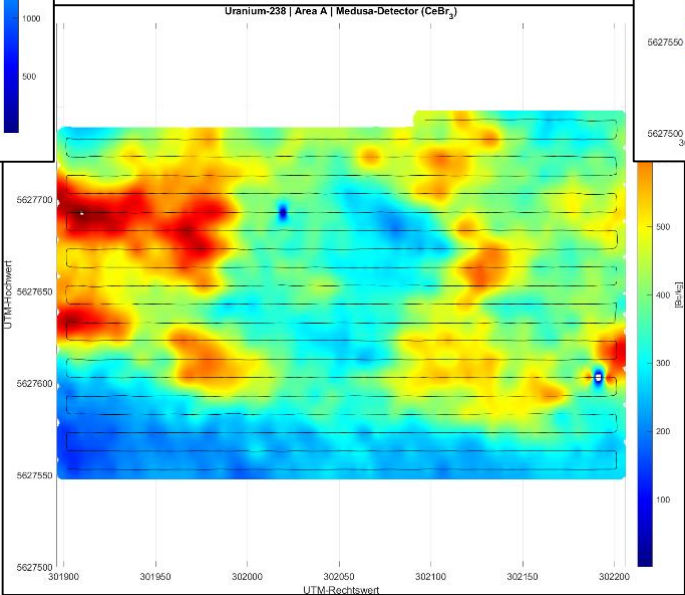


Fig. 07: Uranium-238 distribution in Bq/kg of the test site in Culmitzsch, Thuringia.

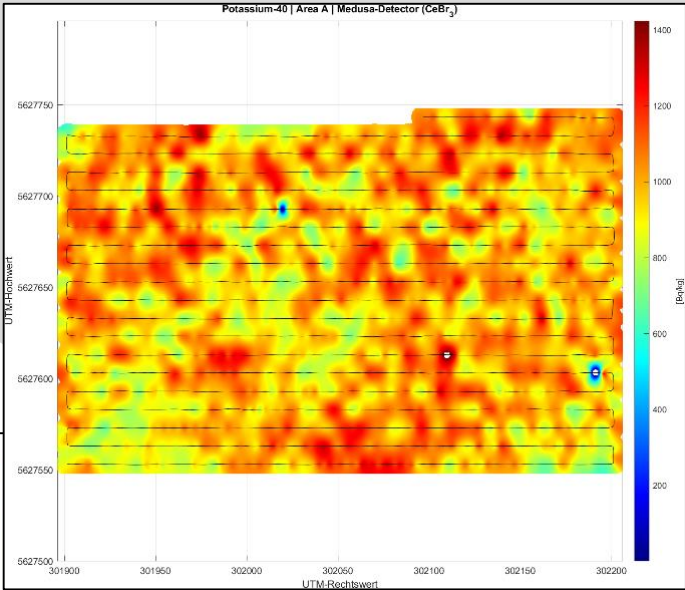


Fig. 08: Potassium-40 distribution in Bq/kg of the test site in Culmitzsch, Thuringia.

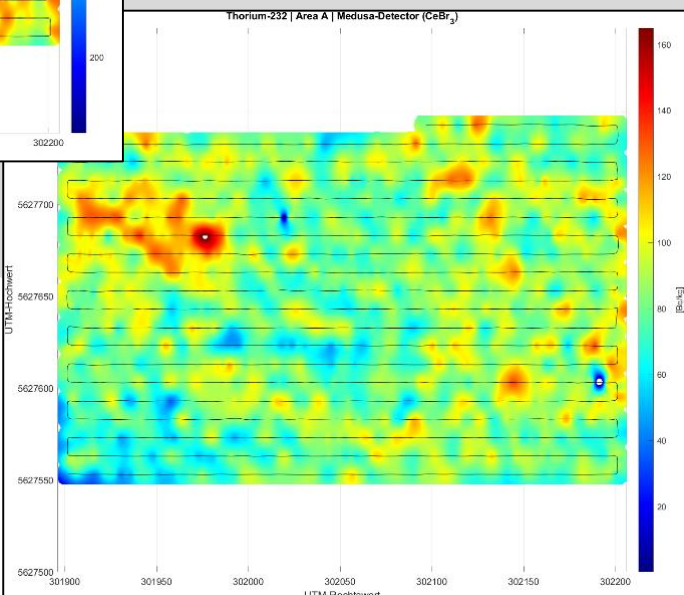


Fig. 09: Thorium-232 distribution in Bq/kg of the test site in Culmitzsch, Thuringia.

Measurement Sites in Central Asia: Mailuu Suu, Kyrgyzstan

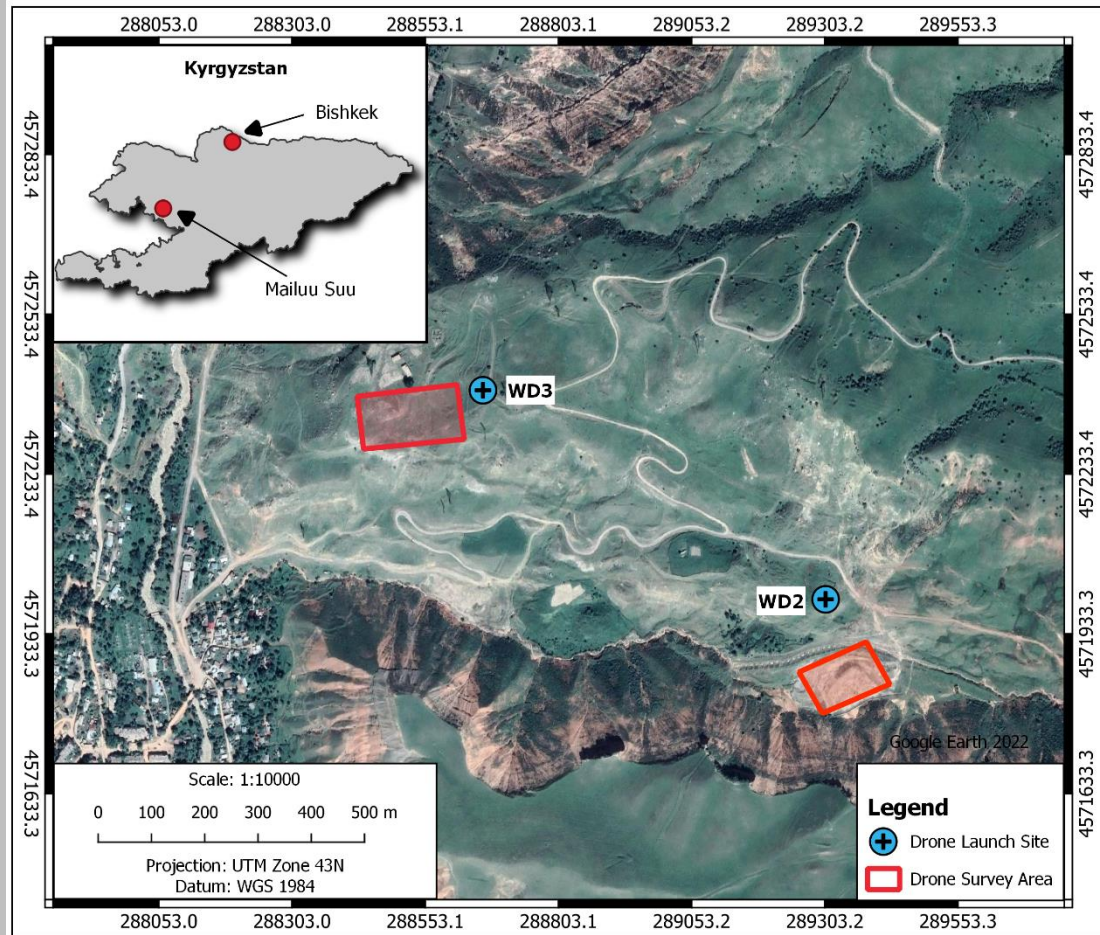


Fig. 10: Test sites WD2 and WD3 in Mailuu Suu, Kyrgyzstan.

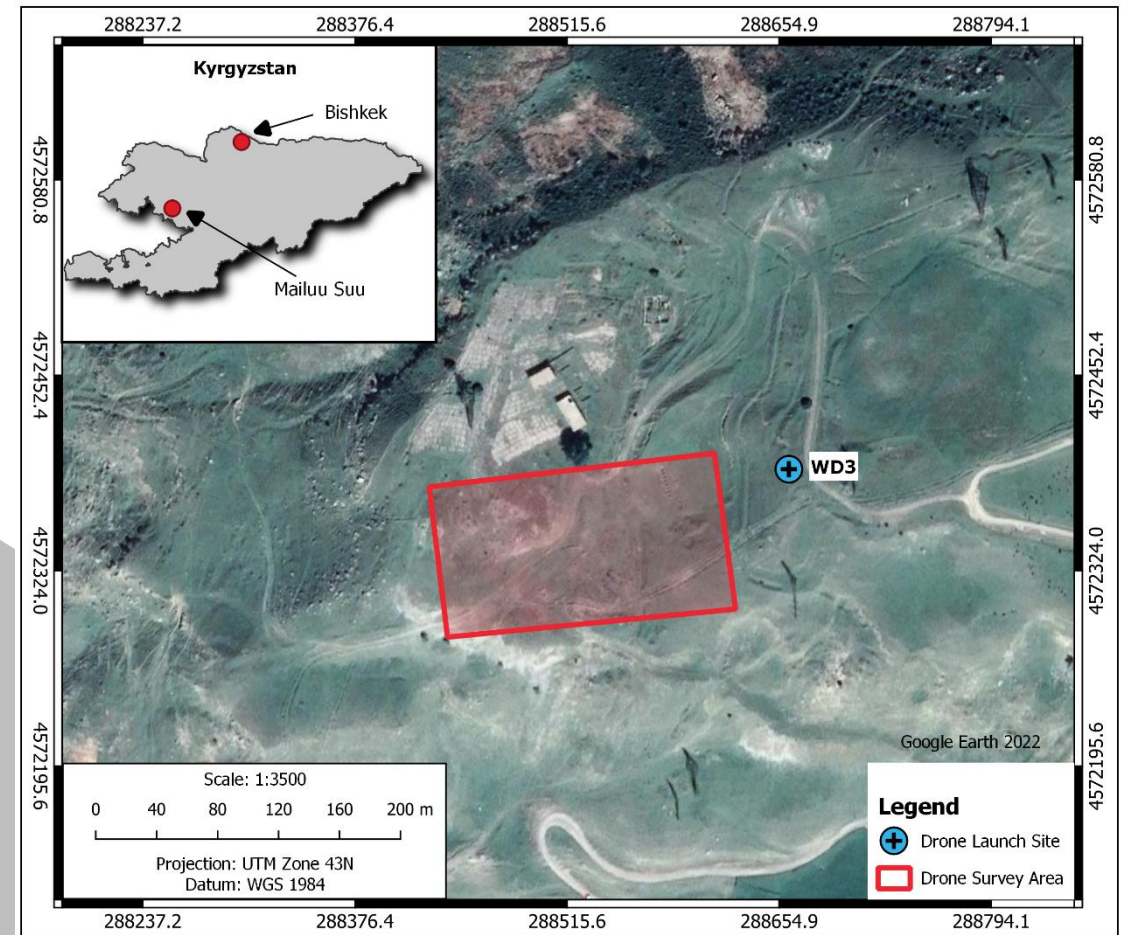


Fig. 11: First test site WD3 in Mailuu Suu, Kyrgyzstan

Results: Mailuu Suu (WD3)

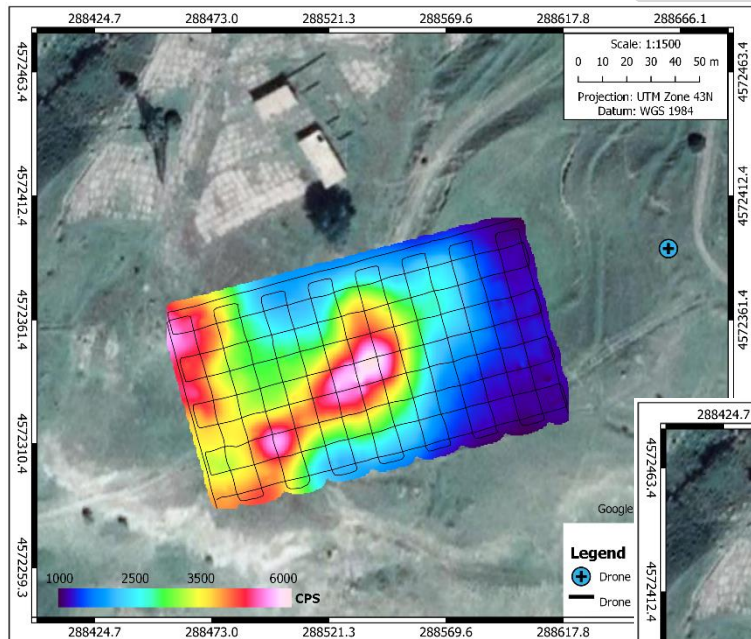


Fig. 12: Total counts distribution in CPS of the test site WD3, Mailuu Suu.

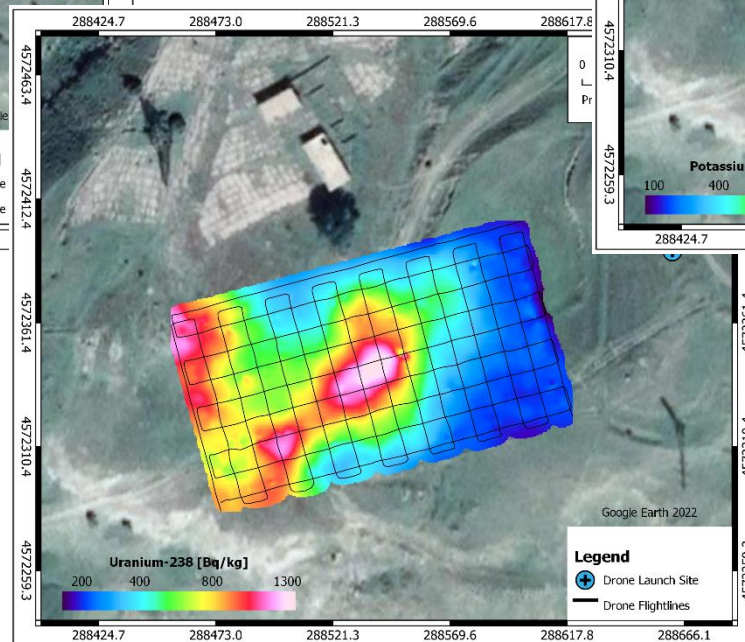


Fig. 13: Uranium-238 distribution in Bq/kg of the test site WD3, Mailuu Suu.

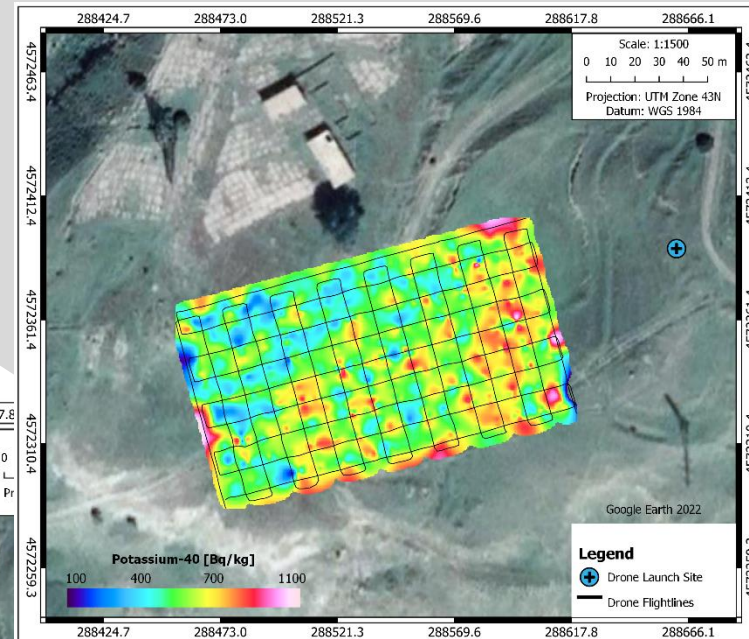


Fig. 14: Potassium-40 distribution in Bq/kg of the test site WD3, Mailuu Suu.

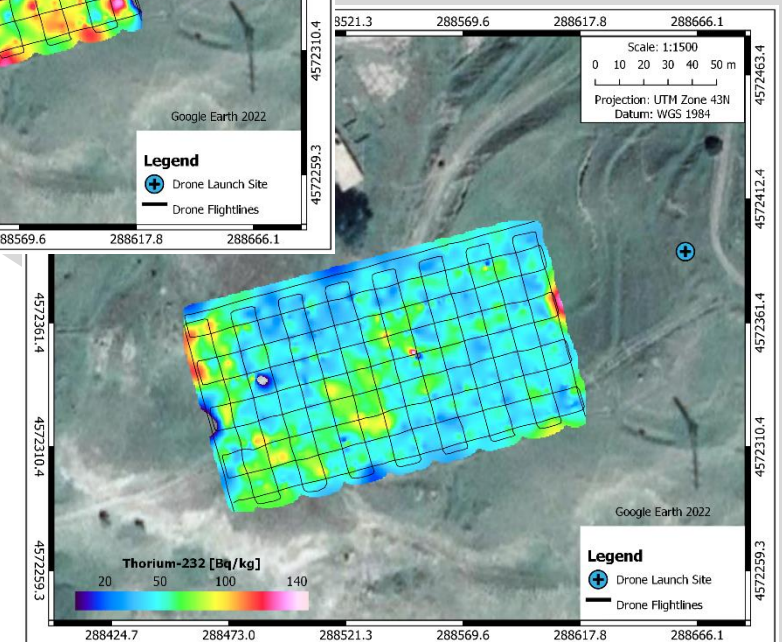


Fig. 15: Thorium-232 distribution in Bq/kg of the test site WD3, Mailuu Suu.

Measurement Sites in Central Asia: Muzbel, Kazakhstan

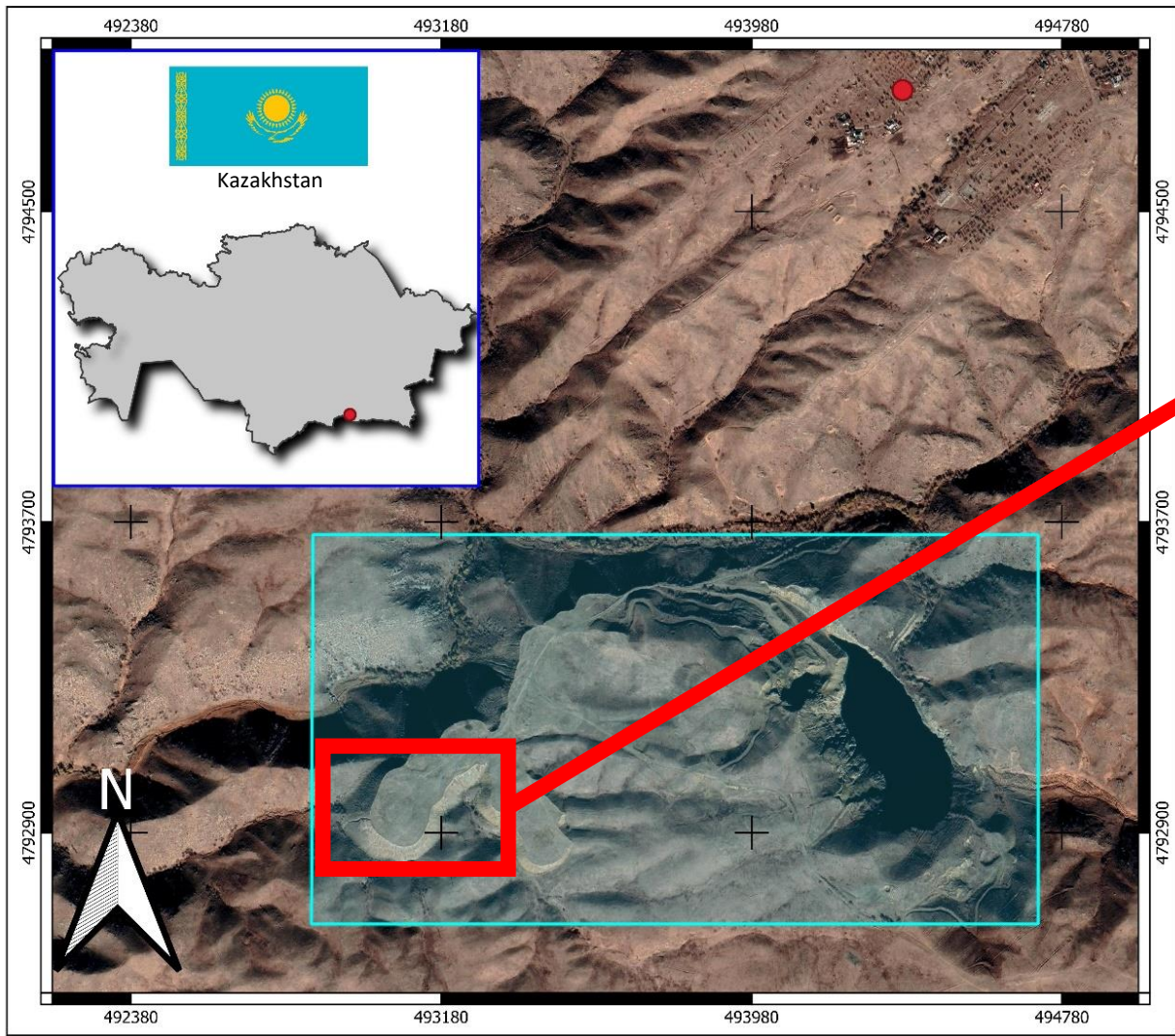
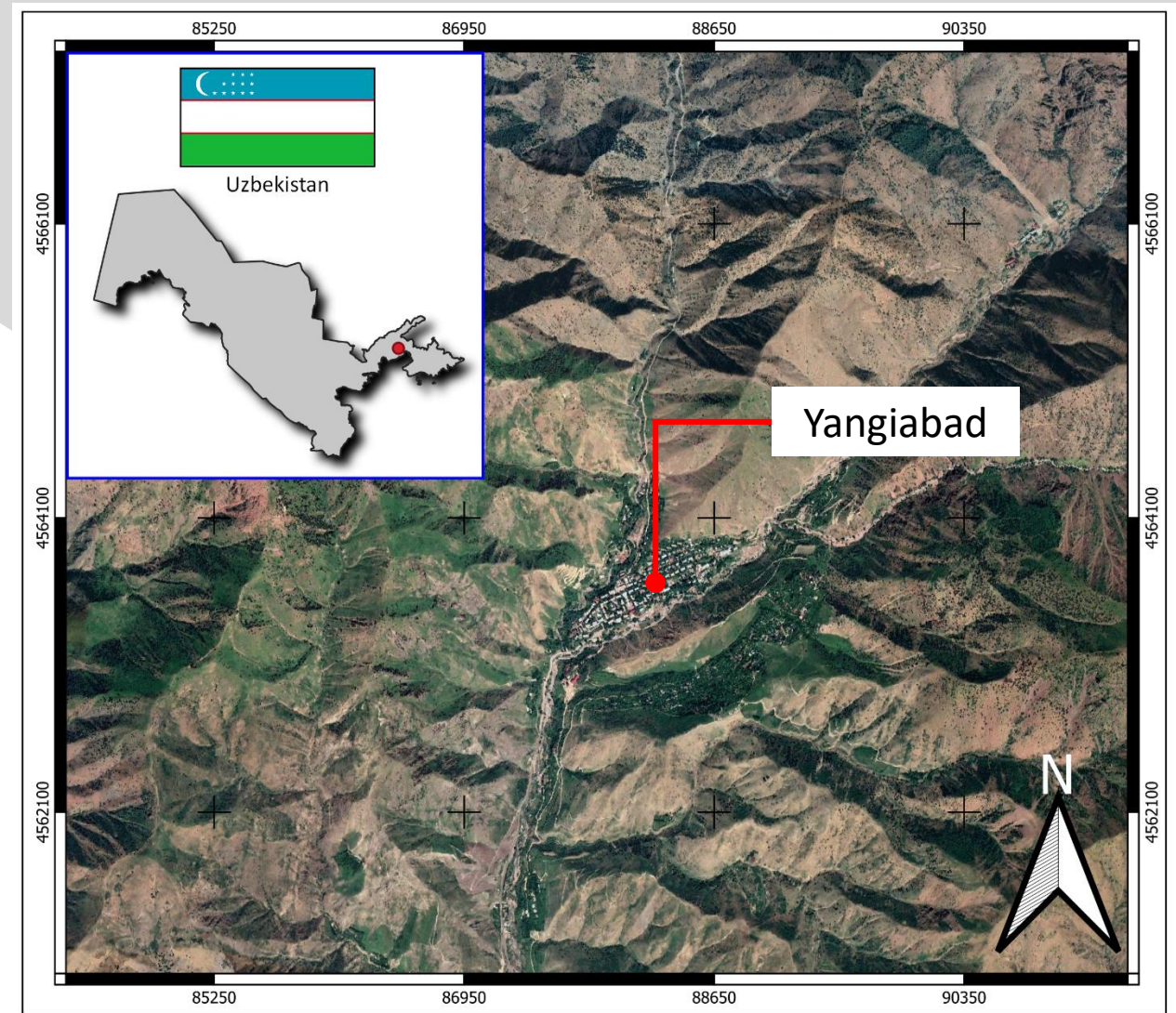


Fig. 17: Total count rate (CeBr₃-detector)

Fig. 16: Test site in Muzbel, Kazakhstan.

- Further data processing and evaluation of the data sets of the measurement campaigns from Central Asia and Germany.
- Planning and implementation of the second measurement campaign in Central Asia in August 2022 to Uzbekistan.

Fig. 18: Planned test area in Yangiabad, Uzbekistan.



MOTIVATION



Uranium mining legacies endanger human health and the environment.



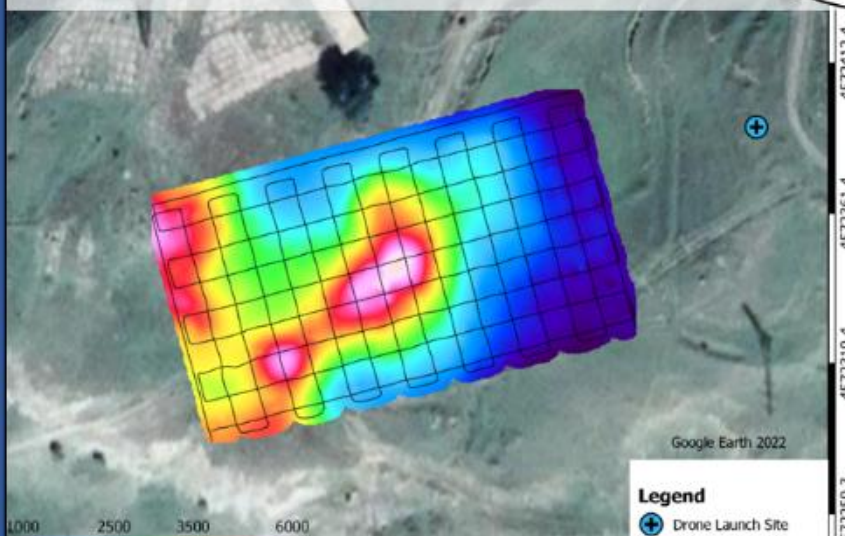
DUB-GEM PROJECT

DUB-GEM (Development of a UAV-Based Gamma Spectrometry for the Exploration and Monitoring of Uranium Mining Legacies).

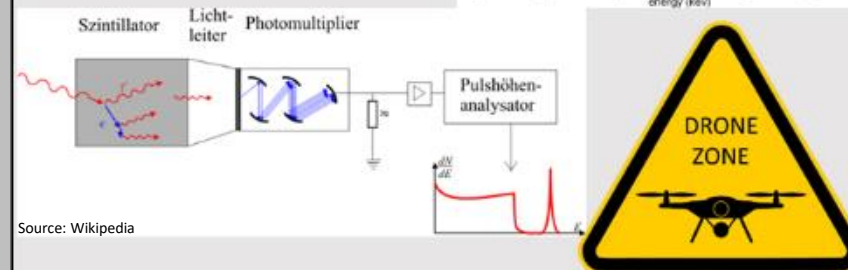
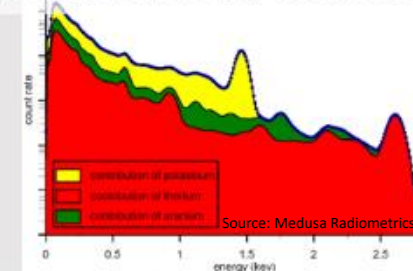


OBJECTIVES

Development of a drone-based method for **mapping** radioactive contaminations.



Combination of modern **scintillation measurement technology** and **processing methods** as well as a **heavy-lift drone**



METHODS