UAV-based Mobile Gamma Spectrometry

Ralf Kaiser, Iain Darby, Milan Matos, Mladen Bogovac, Richard Murphy, Phillipe Ortega

IAEA Physics Section

Topics

- Fukushima Dai-ichi Accident
- IAEA UAV System
- Results from UAV Missions

IAEA Report

The Fukushima Daiichi Accident

Non-serial Publications

Subject Classification: 0610-Accident response

STI/PUB/1710; (ISBN:978-92-0-107015-9); 1254 pp.; 311 figures; € 60.00;
Date Published: 2015

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thttp://www-pub.iaea.org/books/IAEABooks/10962/The-Fukushima-Daiichi-Accident

IAEA Remediation Mission October 2011

Options for Radiation Mapping after the Accident

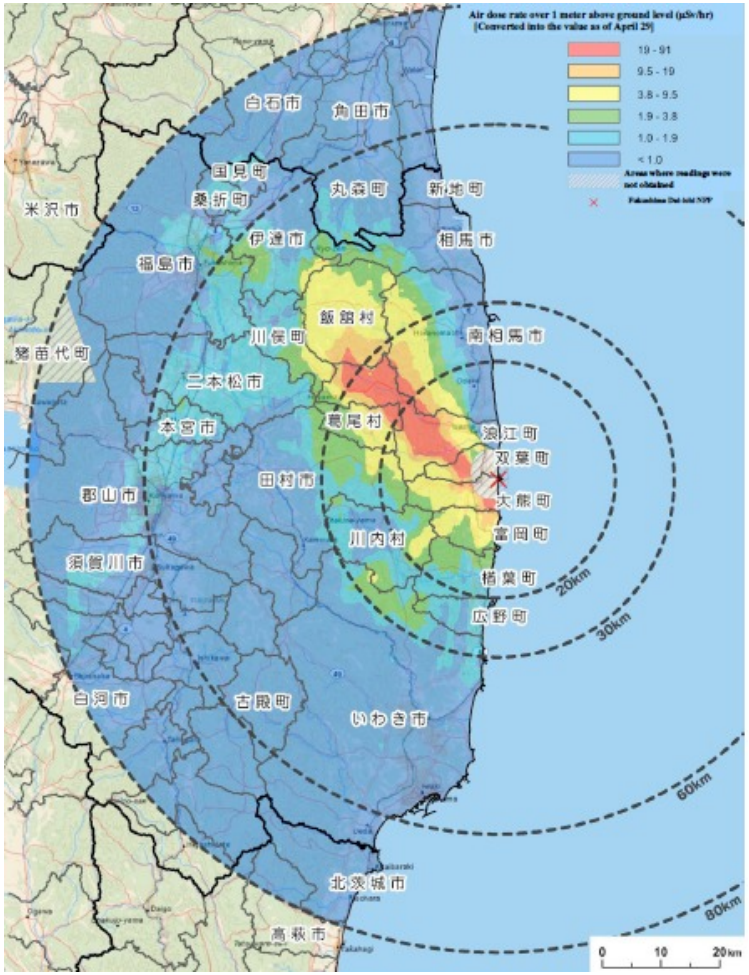
Only the US, specifically the NNSA Aerial Measuring System, had a stand-by capacity for aerial monitoring and mapping.

Such a large scale system, based on piloted aircraft, is expensive to maintain and deploy, but the only way to cover large areas of the scale of 100 km^2 or more.

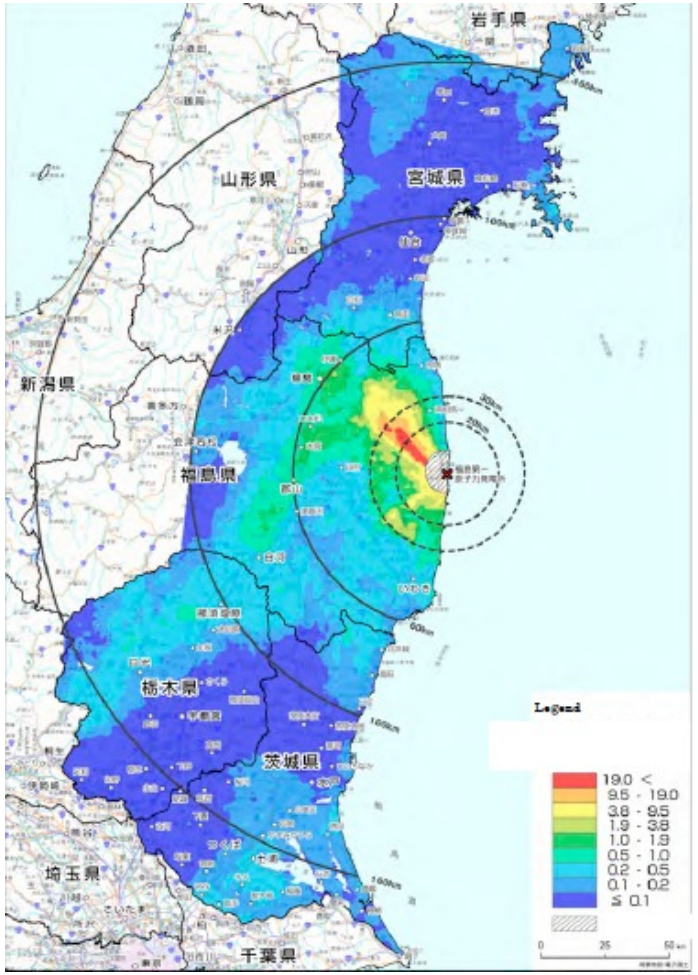
At the IAEA at that time only the Dept. of Safeguards, concerned with non-proliferation, had capabilities for radiological mapping.

The US DOE and Japanese MEXT started aerial monitoring on 6. April 2011. The first report was issued on 6.May 2011, based on 42 flights with Bell helicopters and Beechcraft C-12, at heights between 150 m and 700 m. The exclusion zone was ultimately based on these measurements.

Monitoring after the Accident



Air dose rate, first survey, April 2011



Air dose rate, extended survey, July 2011

UAV-based Environmental Monitoring

After the Fukushima accident, it would have been useful to have had a drone with a spectrometer that transmits the radiation data and GPS location in real time and makes them available on an online map. But nobody had one.

The technology was/is available; small drones have made huge progress recently, mainly thanks to parts from the smartphone industry: batteries, GPS, accelerometers.

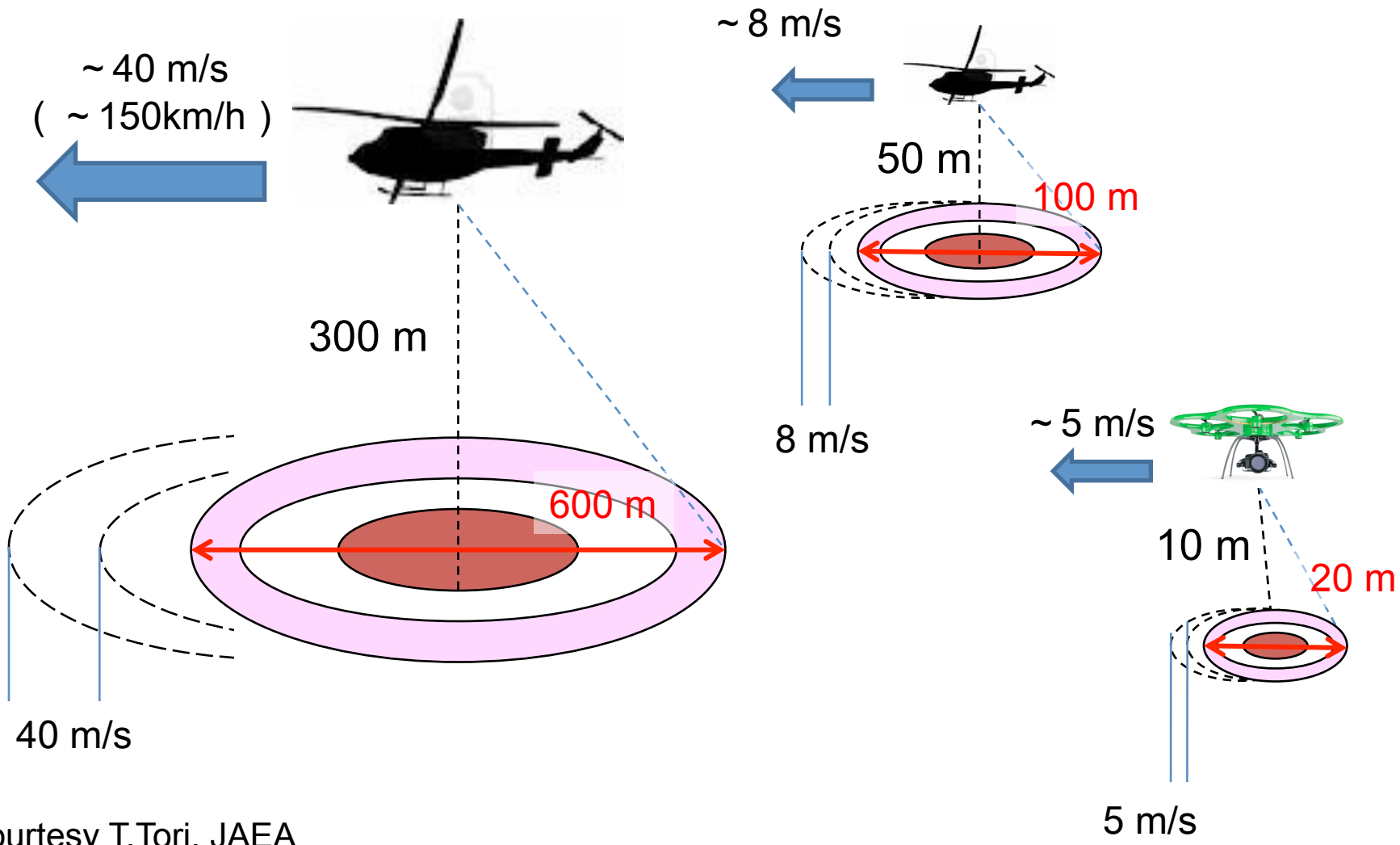
The IAEA Physics Section has developed a UAV-based radiation monitoring and mapping system under the Fukushima Action Plan. We already had expertise in mobile gamma spectrometry and have transferred it to UAVs. A prototype system has been delivered to Fukushima Prefecture in July 2016.

UAV-based Mobile Gamma Spectrometry

- Fill the gap between large scale helicopter-based aerial surveys and car-based or walking surveys:
  - Less expensive and better resolution than helicopter-based surveys
  - Faster than walking surveys
  - Cover areas inaccessible for vehicles
  - Measure unknown radiation level without danger to human operator

- Final goal: A drone with a spectrometer that transmits the radiation data and GPS location in real time and makes them available on an online map.

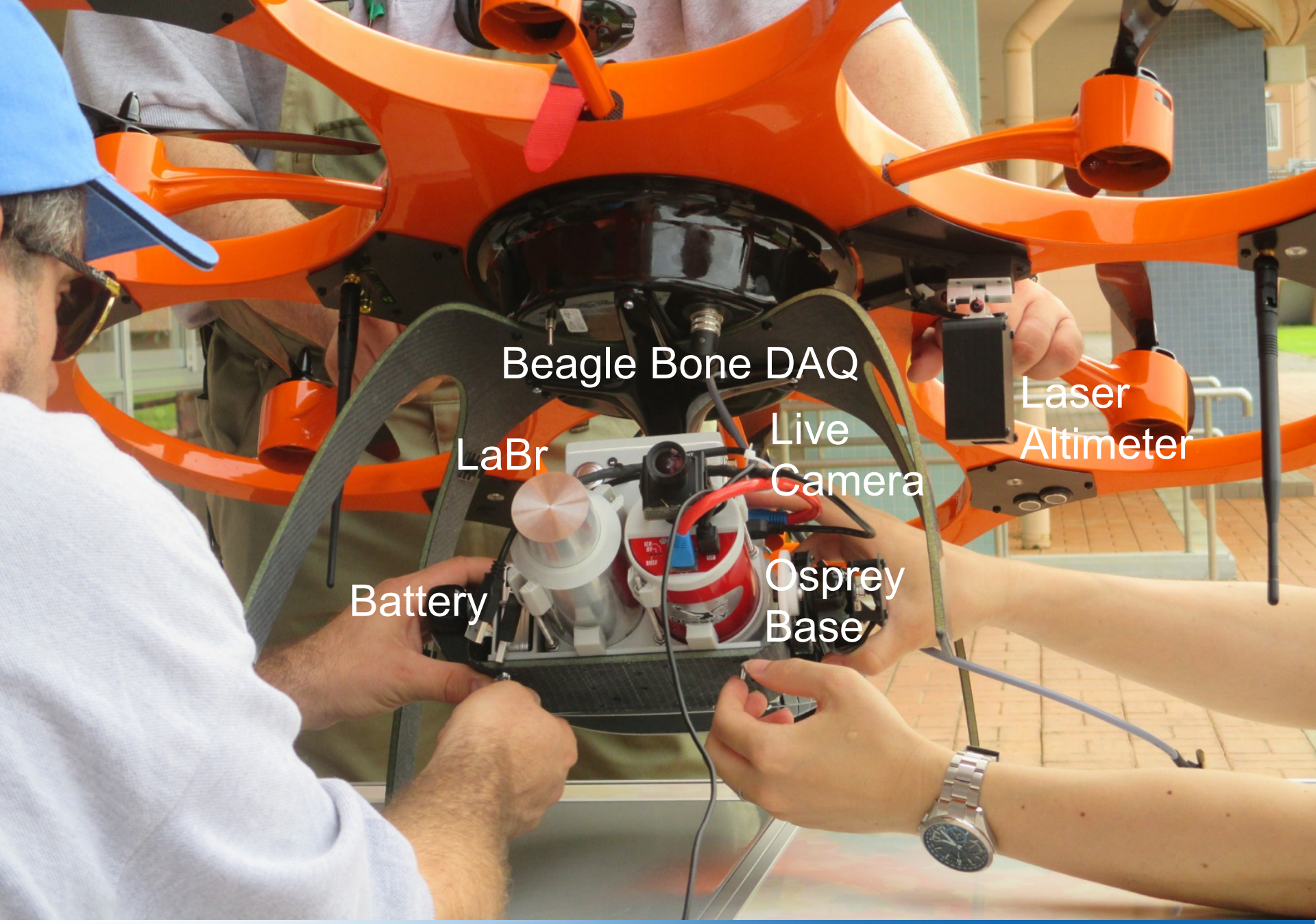
Resolution of Airborne Systems

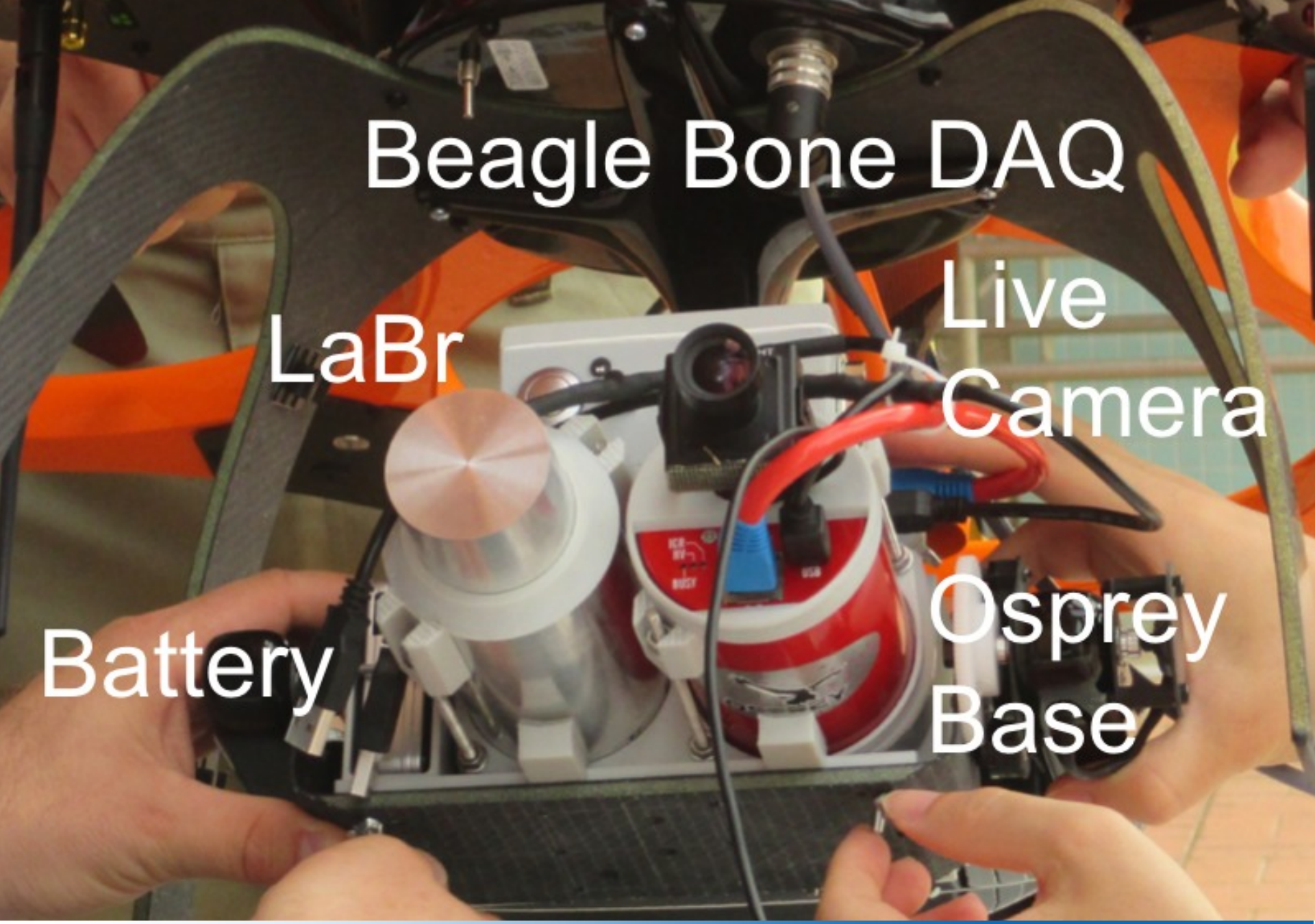


Courtesy T.Tori, JAEA

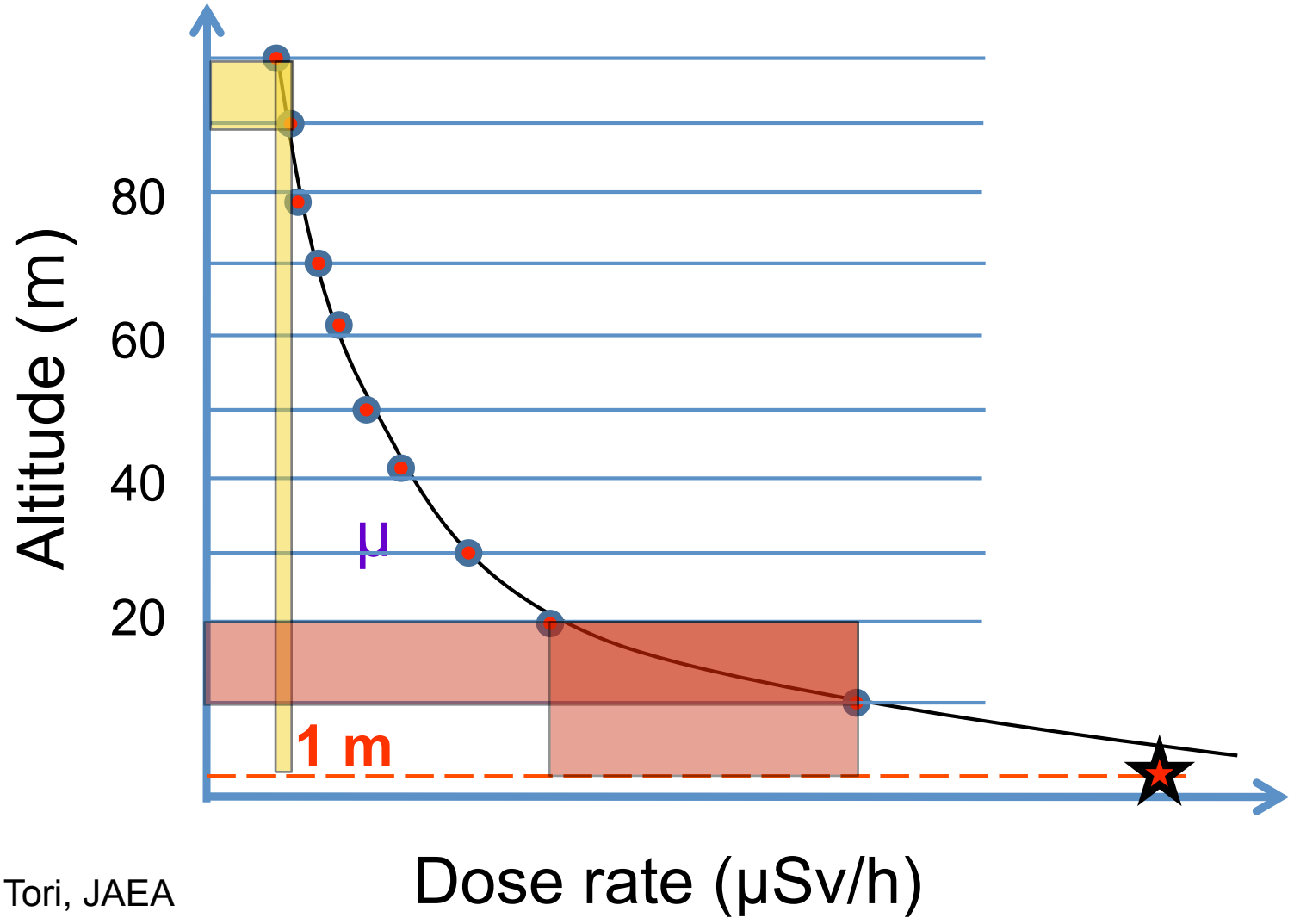
IAEA UAV System


Geiger-Müller Counter


Beagle Bone DAQ
Laser Altimeter
LaBr
Live Camera
Battery
Osprey Base


Beagle Bone DAQ
LaBr
Live Camera
Battery
Osprey Base

Effective Attenuation Factor μ



Courtesy T.Tori, JAEA

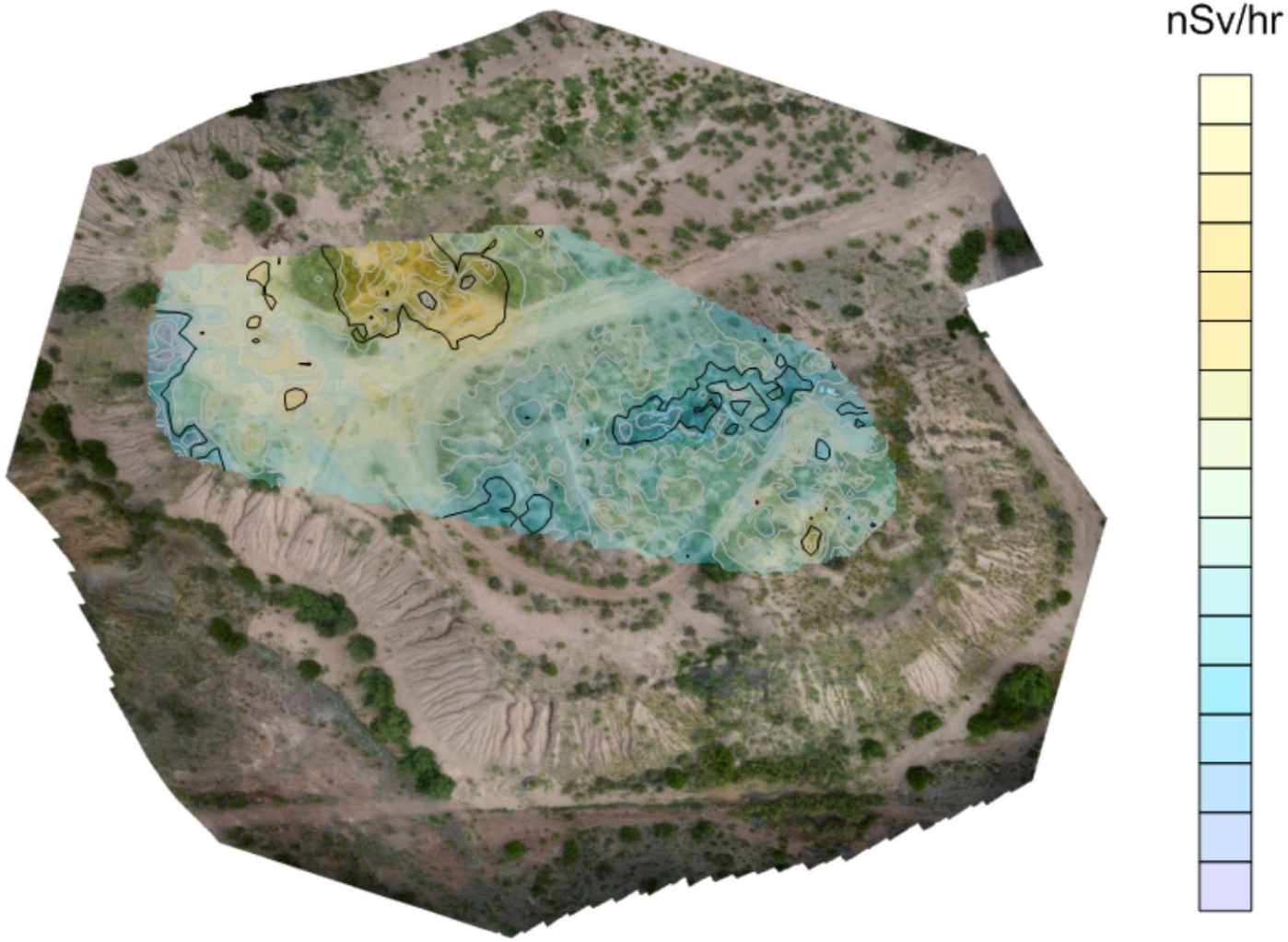
Dose Rate Correction

- Measure Attenuation Factor vs Height for our Detector System
- 3D Digital Elevation Model for each Measured Site, based on photographs and laser altimeter data
- 2D Height-Correction for Dose Rate Measurement
- [Eventually 3D Correction for Complex Site Geometries]

UAV at Uranium Mine in Argentina February 2016

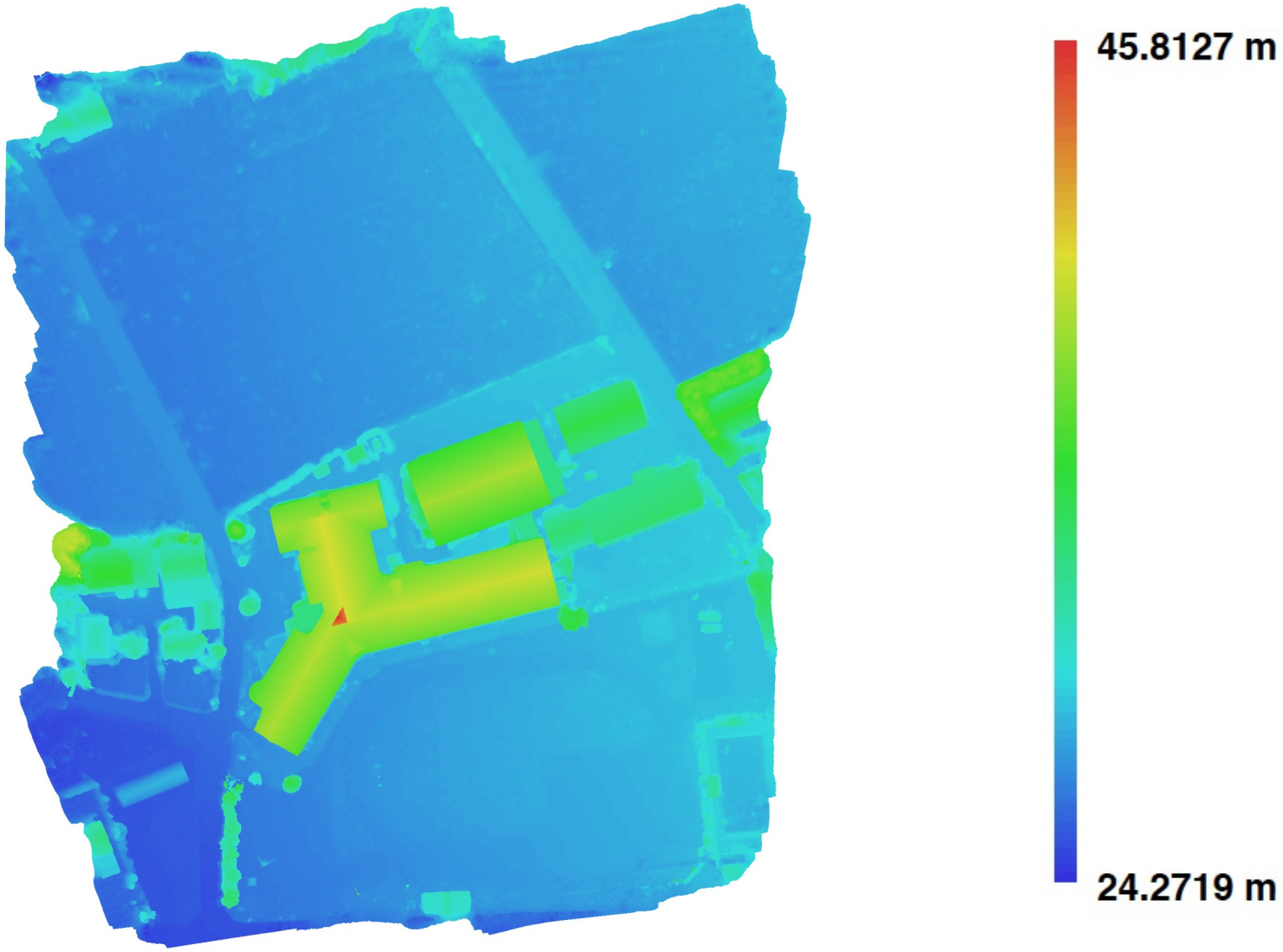
Uranium Mine in Argentina - 3D Model

Uranium Mine in Argentina



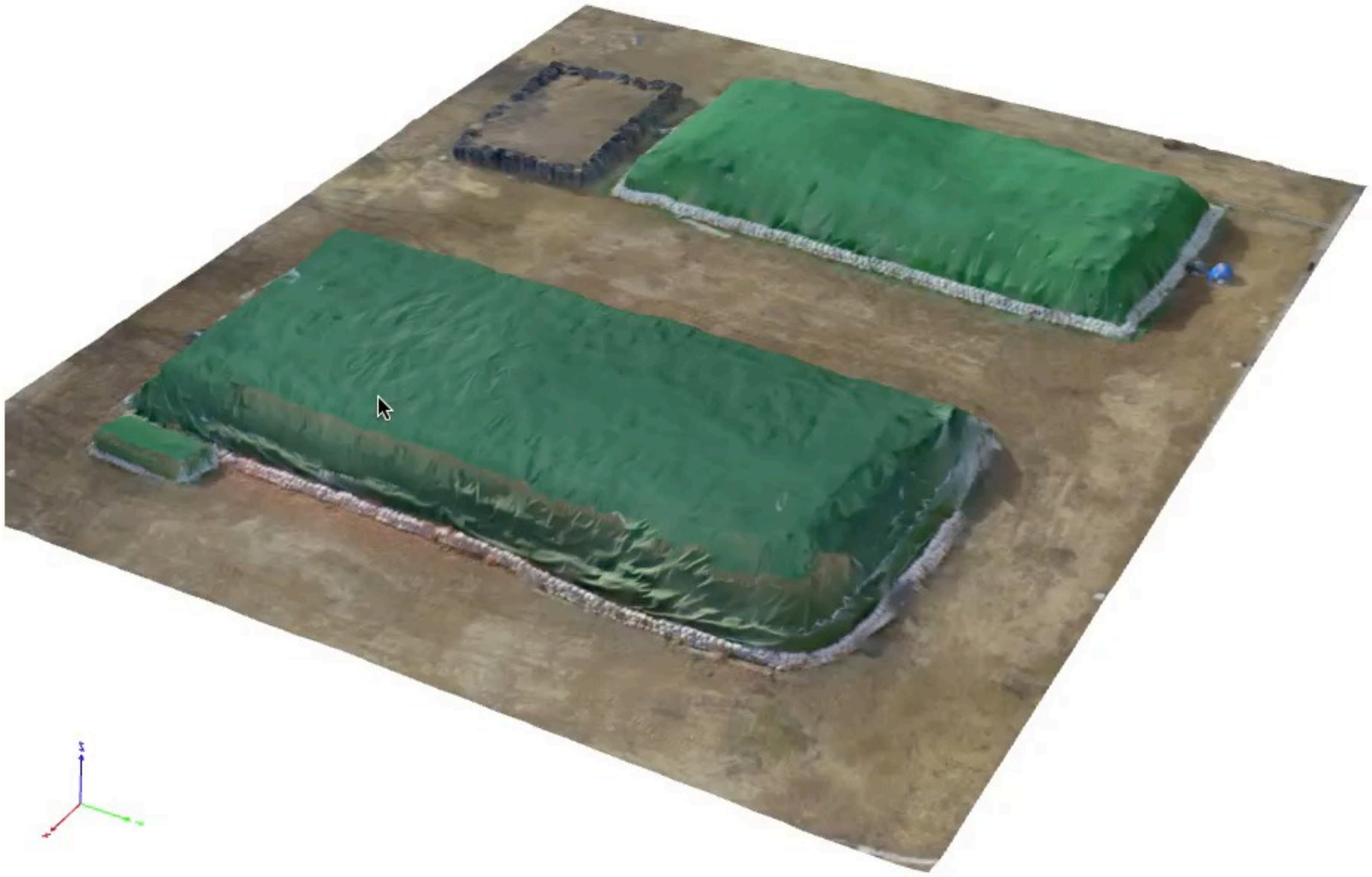
Elementary School

Elementary School - Digital Elevation Model



Temporary Storage Site - UAV Flight

Temporary Storage Site - 3D Model



Fukushima - Elementary School

Fukushima - Elementary School

Thank you for your attention !