Regional Workshop on the use of Wireless Sensor Networks & UAVs for Radiation Monitoring

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IAEA

International Atomic Energy Agency

IAEA by the numbers

- Created in **1957**
- **167** Member States (Nov'15) (164 Mar'15)
- **2400+** Staff
- **1** Headquarters (Vienna)
- **2** Liaison Offices (New York, Geneva)
- **2** Regional Safeguards Offices (Tokyo, Toronto)
- **3** International laboratories and research centres
- (Seibersdorf, Monaco, Trieste)

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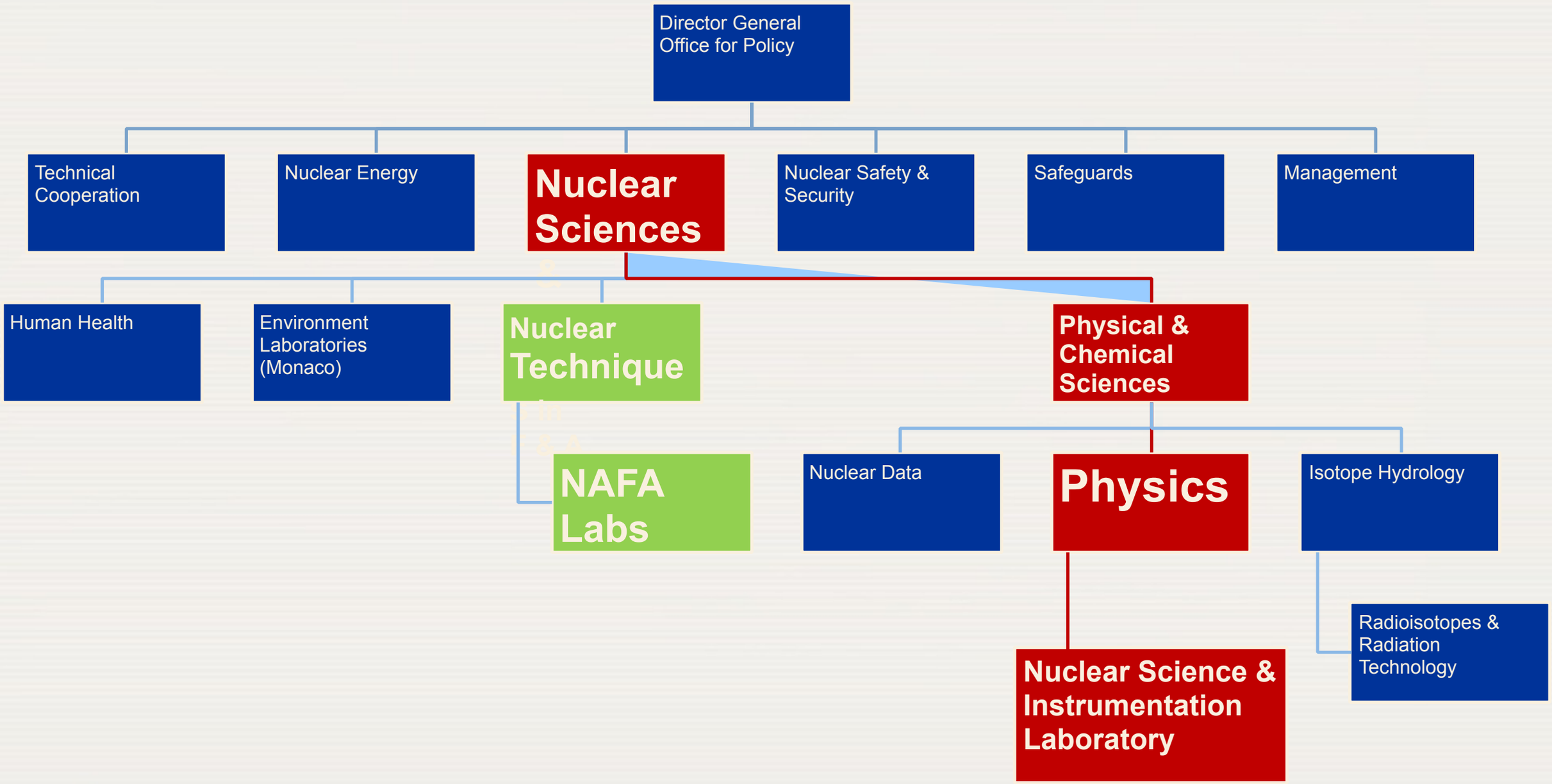
Organisation



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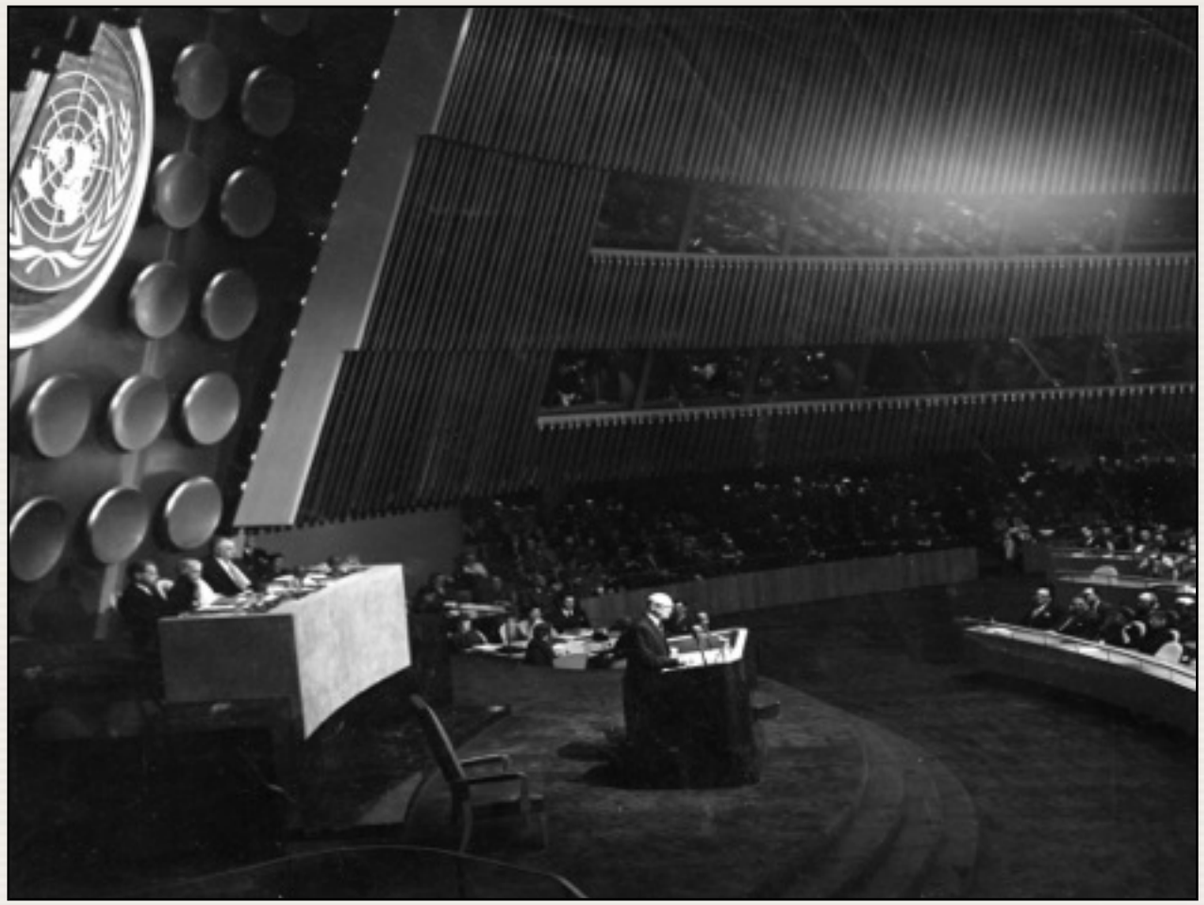
IAEA Statute, Article II



U.S. President Dwight D. Eisenhower addresses the U.N. General Assembly, 8 December 1953
Atoms for Peace Speech

- The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world.

Nuclear Sciences & Applications (NA)

- *"to enhance (the IAEA's) role in promoting the advantages of nuclear technology and applications where they have an added value for addressing basic human and socio-economic development needs and in promoting capacity building in Member States"*

- *In the Areas of:*

Food Security	Human Health
Cancer Control	*Water Resources Management*
Industrial Applications	*Environmental Protection*

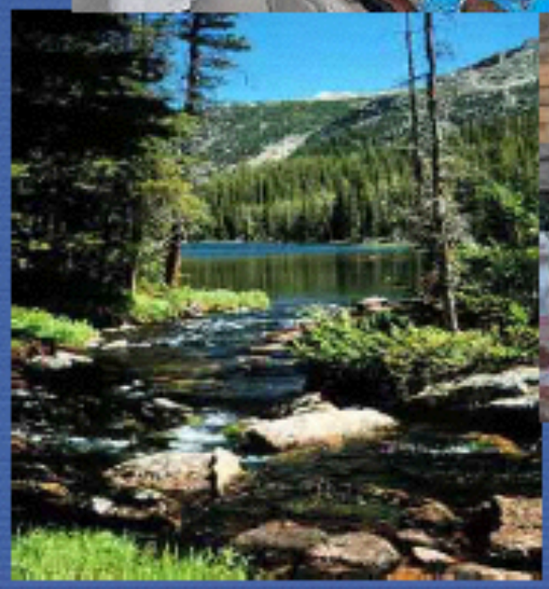
Nuclear Sciences & Applications (NA)

Fighting a global cancer epidemic

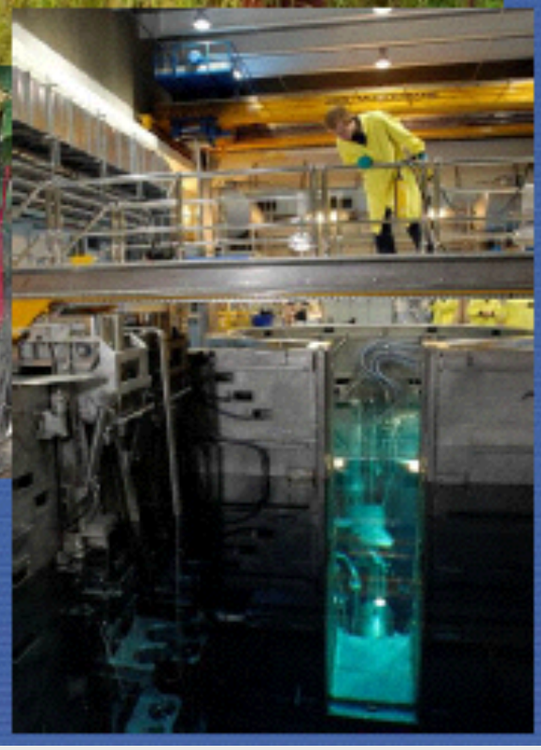
Improving the diagnosis and treatment of disease

Promoting food security and sustainable economic development

Understanding and protecting the environment



Making more, and cleaner water available to more people



Providing knowledge and expertise for science and industry

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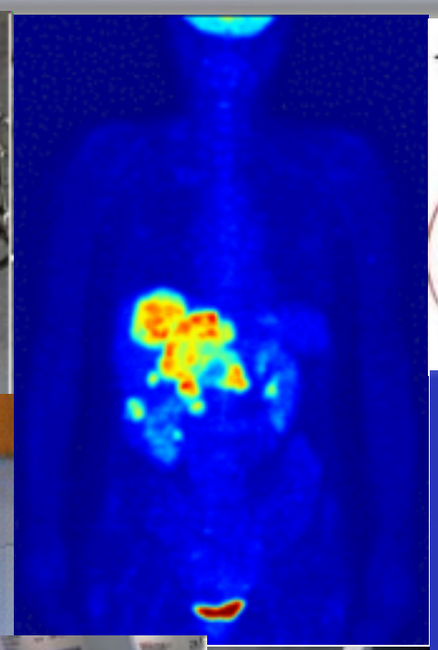
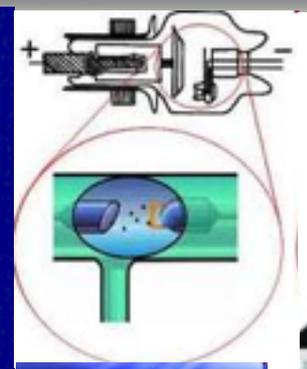
Nuclear Aplications



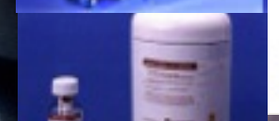



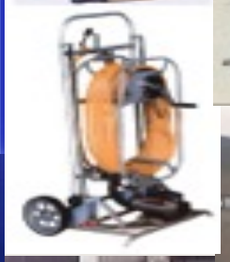
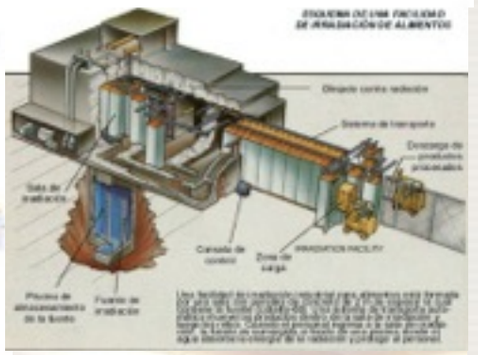








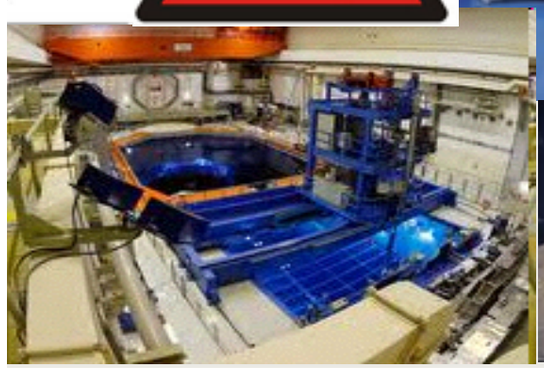



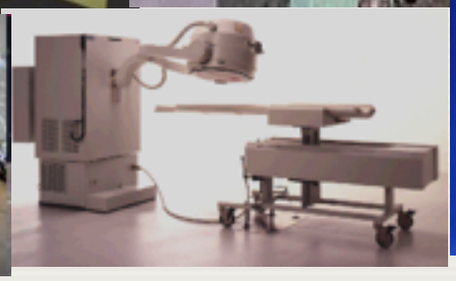










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Vision

- Member States will eventually have in place a proper infrastructure and technologies for radiological characterization of the sites in a **timely**, **safe** and **cost-effective** manner.

- The INSITU Working Group within ENVIRONET will produce a variety of products and services aimed at facilitating and increasing the exchange of information and experiences in the specific field of in-situ methods for characterization of sites.

- The ultimate goal is to build capacity in the different Member States and to facilitate the full implementation of remediation projects.

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An ideal analytic technique

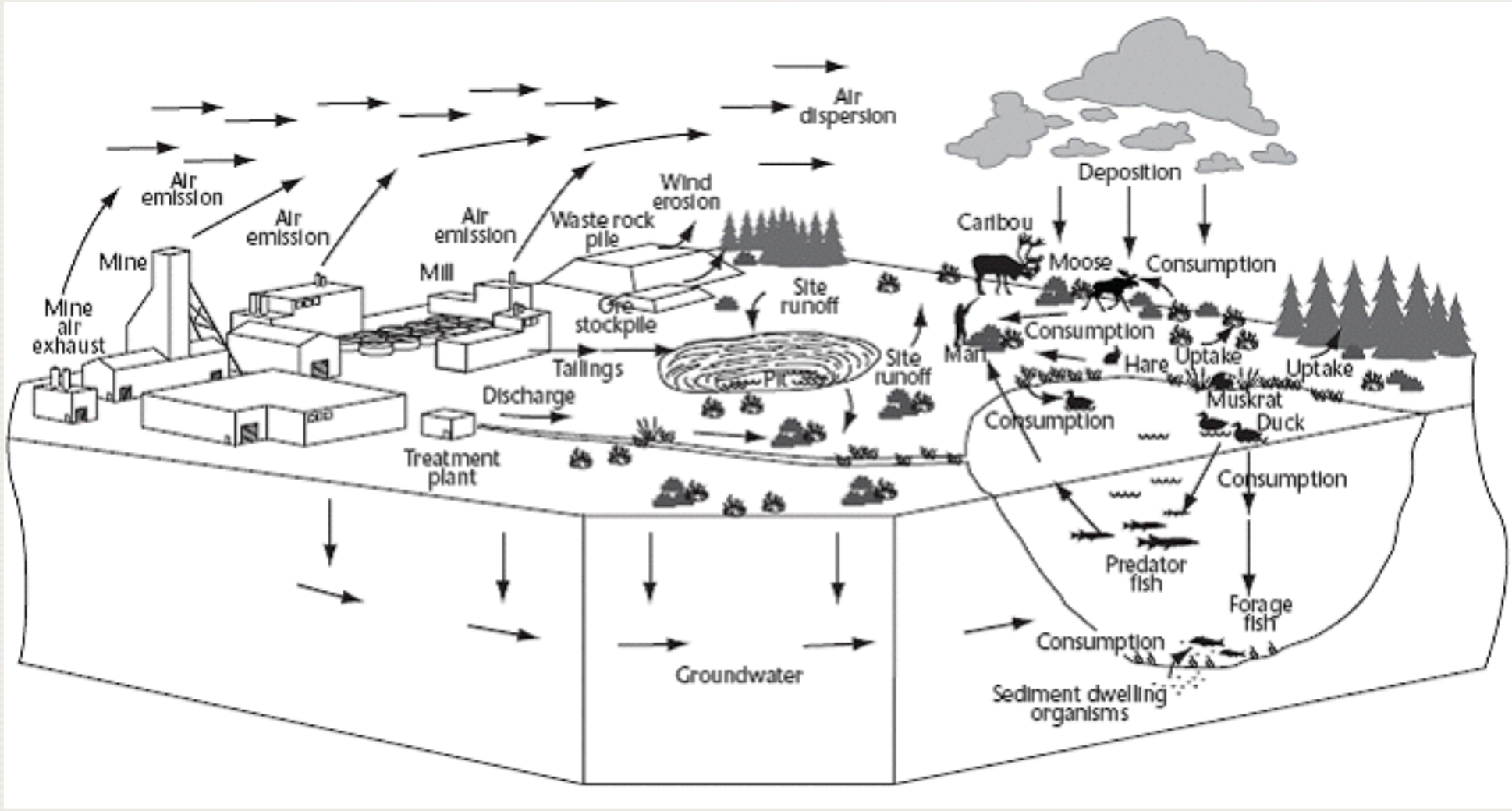
- Uncertainty of measurement result
  - Uncertainty is the parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand
    - **Minimal possible uncertainty !**
- Time delay in obtaining the results
    - **Immediate !**
- Cost
    - **Minimal !**

In real life what matters is

- Fitness for purpose
  - To which extent the analytical method fulfils the expectations in regard to the results of analysis
- Analytical Problem definition
  - What my sample is?
    - Matrix type
    - Homogeneity of distribution of the property
  - What do I need to assess in it?
    - Analytes (COC)
  - What is the expected level of presence of the analyte?
    - Mass fraction, activity concentration
  - How accurate and uncertain can be the results?
    - Depends on the purpose of the characterization

Cycle monitoring

Problem: Monitoring of Radionuclides and/or other Hazardous Substances in the Environment



Example of conceptual model for a mining / milling site

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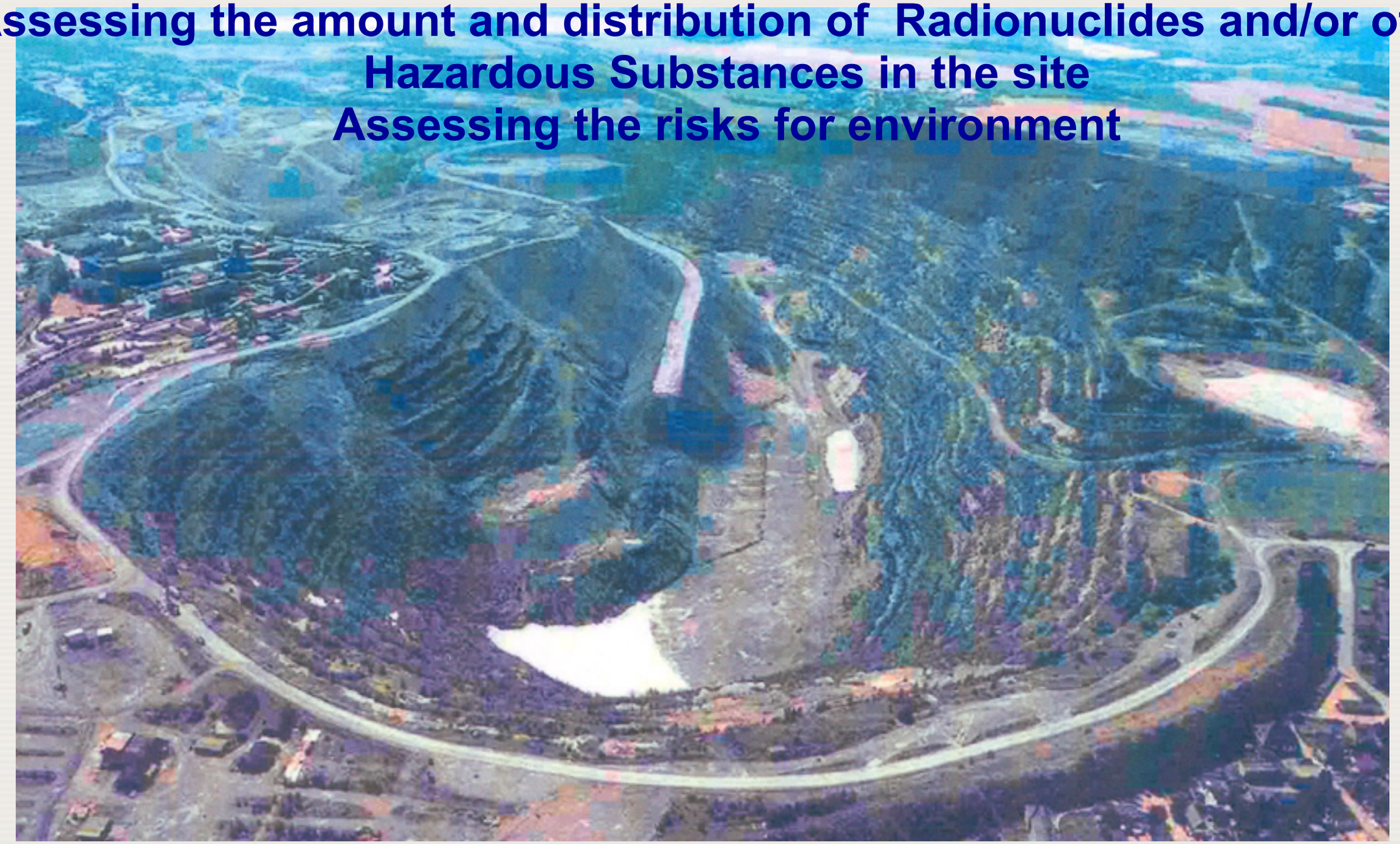
Characterization of sites for remediation

Problems:

Assessing the amount and distribution of Radionuclides and/or other Hazardous Substances in the site

Assessing the risks for environment



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Typical cases of radiologically affected sites

- Uranium mining / milling sites
- Sites with increased amounts of NORM
  - mining of phosphate rocks, REE, bismuth, zirconium, titanium
- Sites affected by discharges (accidental or planned) of radionuclides
- Nuclear weapons test areas
- Military sites
- Nuclear industry or other radiological facilities accidents

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Site characterization challenges

- Samples may differ by composition and aggregation
- The concentration of contaminants of concern (abundance) is unknown
- Heterogeneous spatial distribution of the COC
- Need to analyze different compartments (soil, water, biota)
- Large amount of samples required to evaluate the status and extent of the contamination

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In-situ techniques for radiological assessment

Surface measurements:

Shift from Gas-filled (GM / PIC / PC) to

Low resolution gamma spectrometry (Scintillation detectors)

NaI(Tl), BGO, LaBr CdZnTe

Measurement time:

For dose rate ~ 1 s

For radionuclide activity concentration ~ 1 – 5 min.

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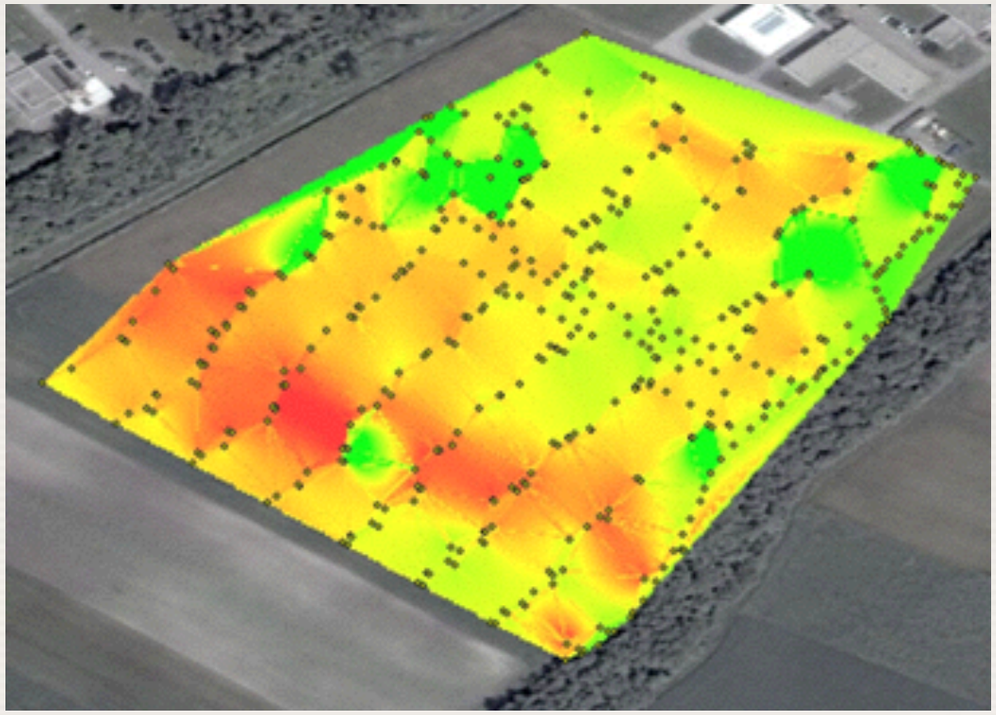
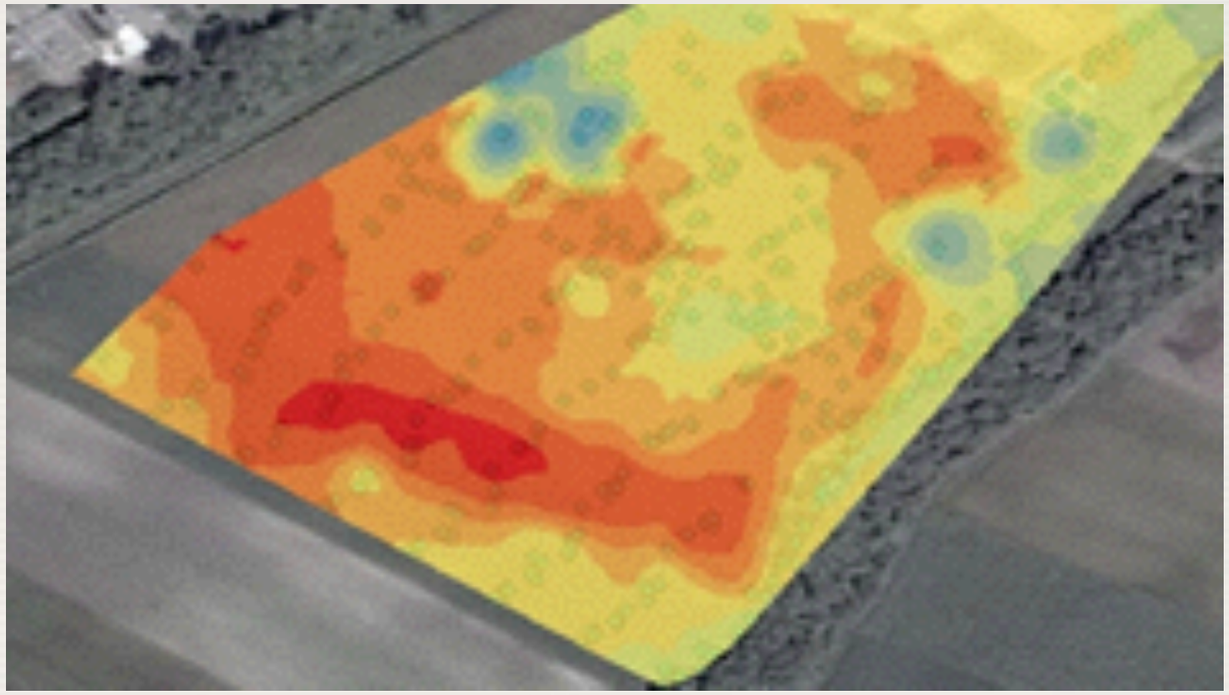
GIS representation of results

Dose rate or gamma results:



Natural neighbor interpolation:
Finds the closest subset of input samples to a query point and applies weights based on proportionate areas



Kriging: based on the regionalized variable theory, the spatial variation represented by the values is statistically homogeneous throughout the surface

ArcGIS

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NSIL/NEFW activities: Demonstration of capabilities for surface characterization of NORM affected sites

Gabon (July, 2012)

- 114 165 measurements (5 instruments)
- 2 ½ days of measurements
- Detailed surveyed areas

Dose rate (nSv/h)	Number	(%)
10 - 114	*61 267*	*56.7*
114 - 250	*24 771*	*22.9*
250 - 500	*11 660*	*10.8*
500 - 1140	*5 283*	*4.9*
1140 - 10400	*5 036*	*4.7*

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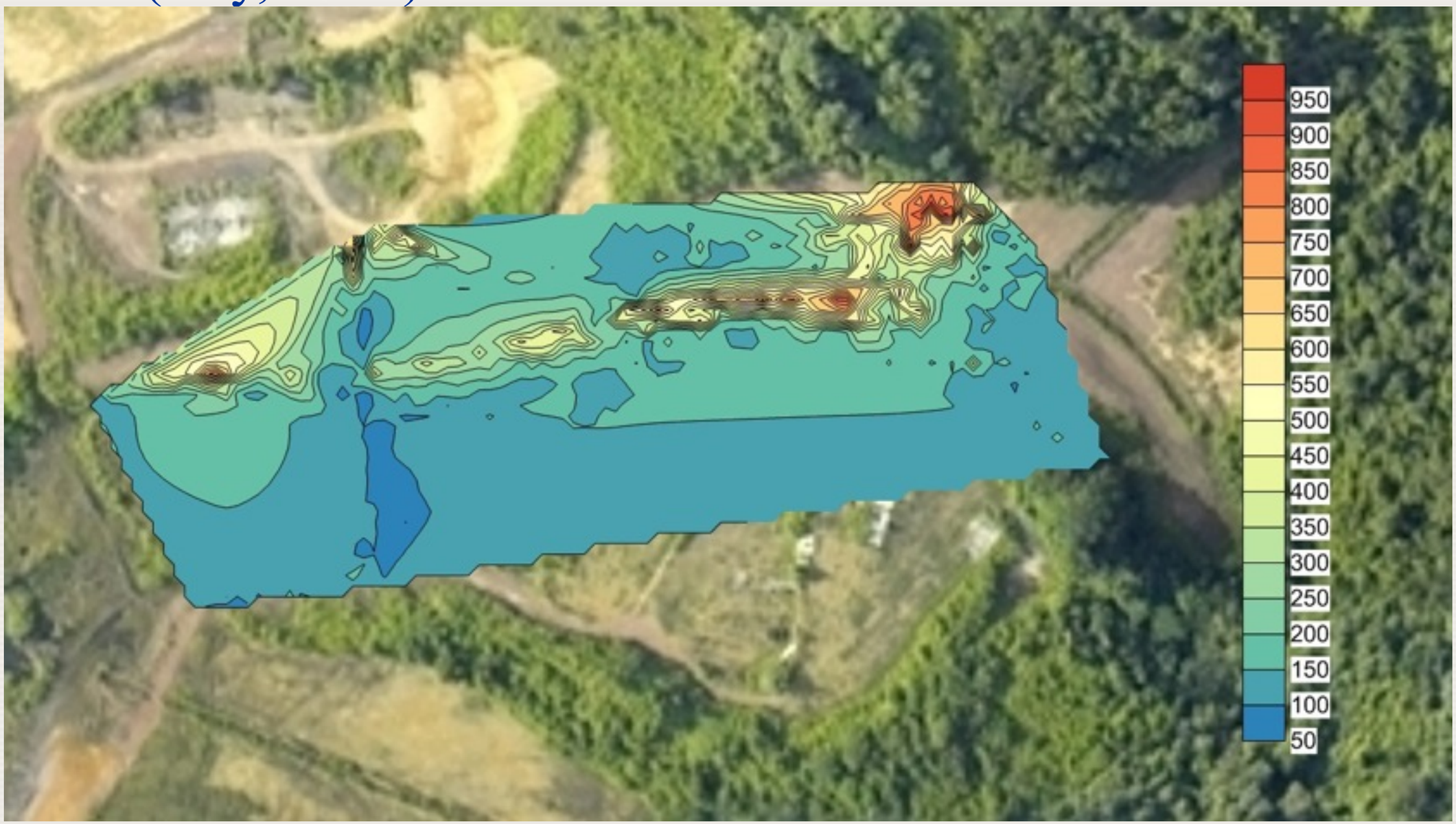
NSIL/NEFW activities: Demonstration of capabilities for surface characterization of NORM affected sites

Gabon (July, 2012)



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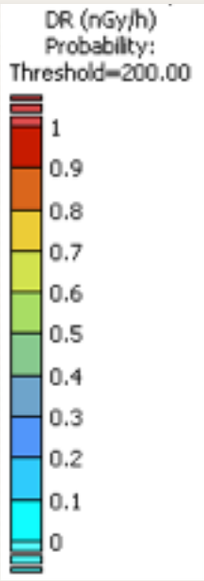
Radiological characterization of sites
Expert mission to Azerbaijan (TC project AZB9005)

- Maps of surface DR for 3 areas (2 remediated sites, one disposal facility)
- 4 different instruments
- Total area surveyed: ~ 30 ha (16.04, 6.32 and 7.66)
- Total length of each pathway: ~ 15 km (5.4, 2.9, 6.5)
- 2 ½ days of measurements



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NSIL/NEFW activities:
Surface characterization of NORM affected sites

Azerbaijan (September, 2012)

Total surveyed area: ca. 30 ha (16, 6.3, 7.6), 2 days

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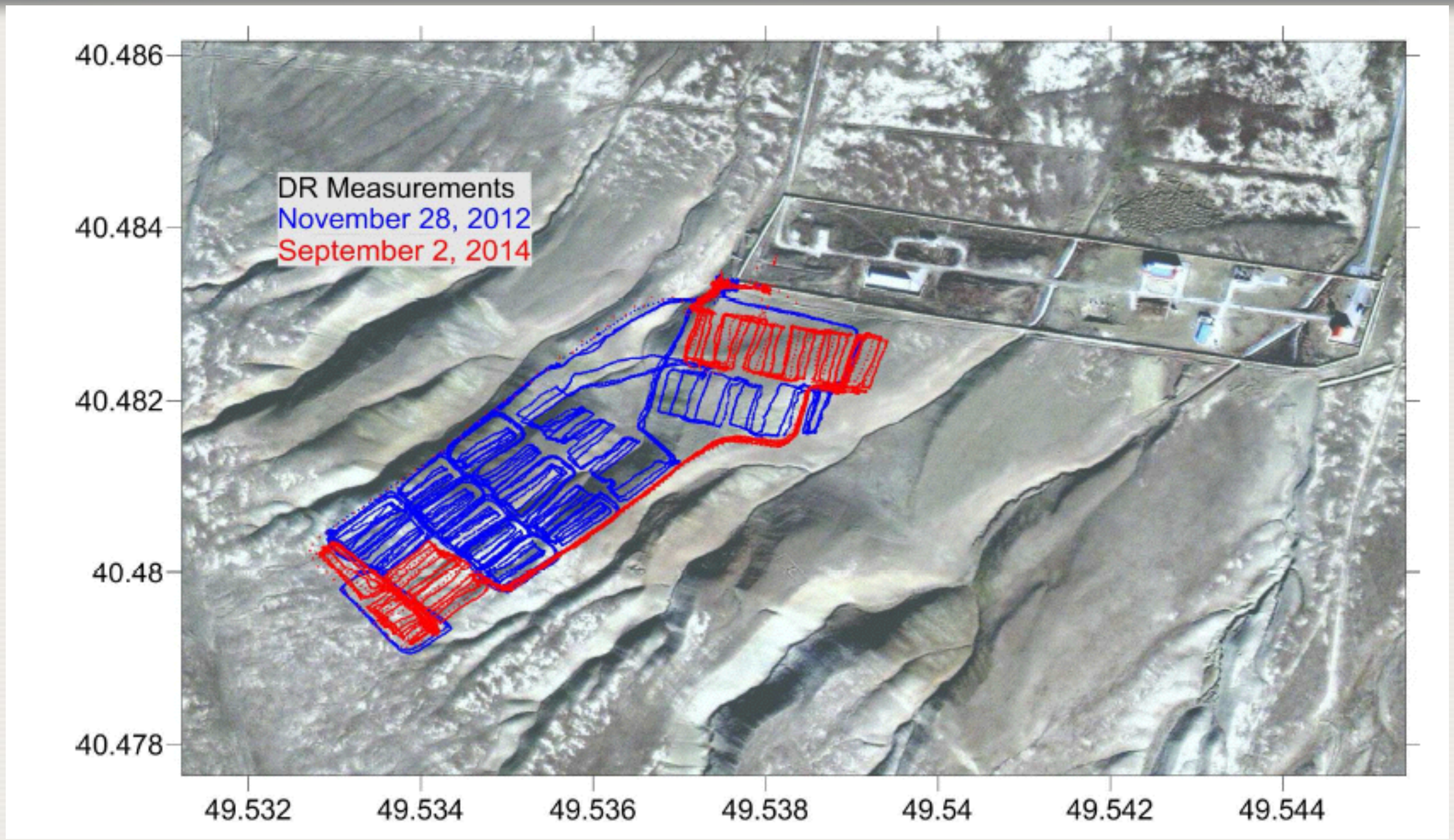
Site Characterization in Azerbaijan, Nov. 2014

Radiological characterization of remediated sites of former Iodine Plants near Baku



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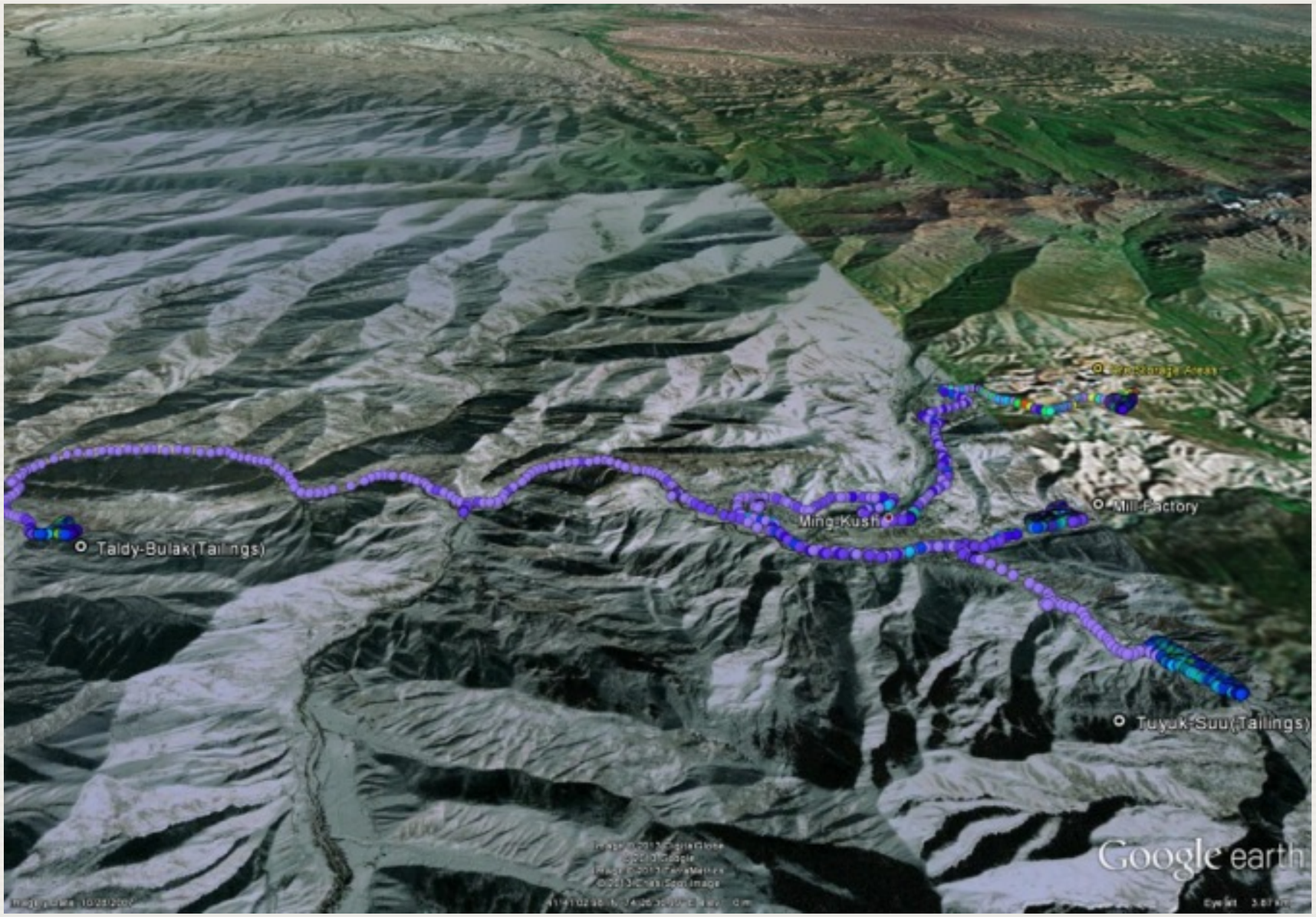
NSIL / NSRW: Training on surface characterization of NORM affected sites

Kyrgyzstan (May, 2013), 21 ha



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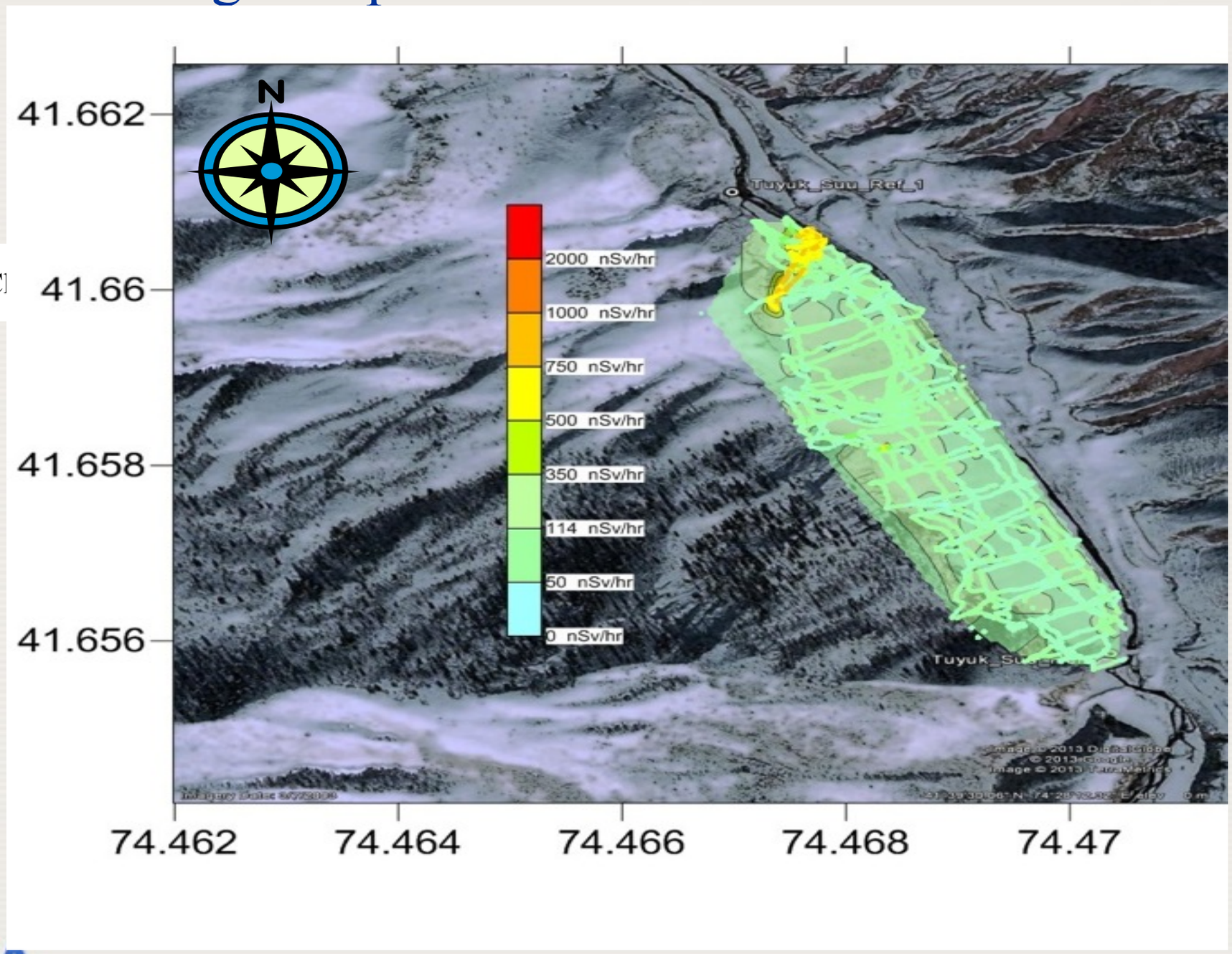
NSIL / NSRW: Training on surface characterization of NORM affected sites

Tuyuk-Suu tailing dumps



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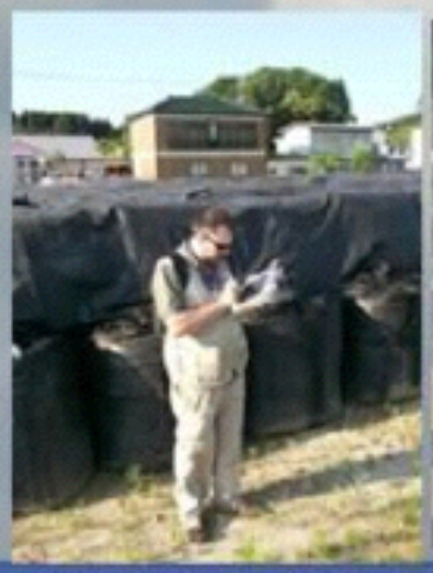
Low Altitude UAV surveys

NSIL Mobile Unit Field Demonstration *showing*:
Unmanned Aerial Vehicle Flight
Portable Instrumentation

Thursday 25th September 14h – 16h
VIC Plaza
Grassy area by the statues
(weather dependent)



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2014

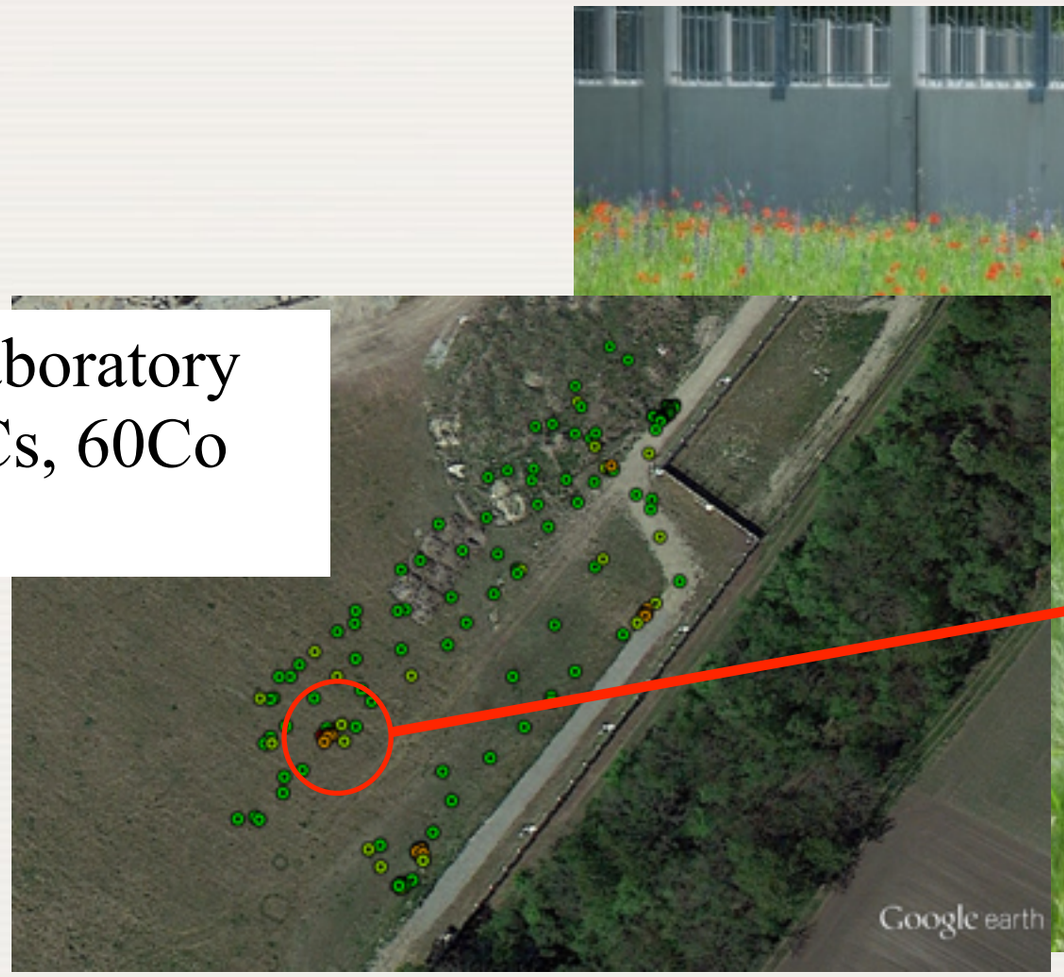
NSAP FP-Cooperation NA9/2

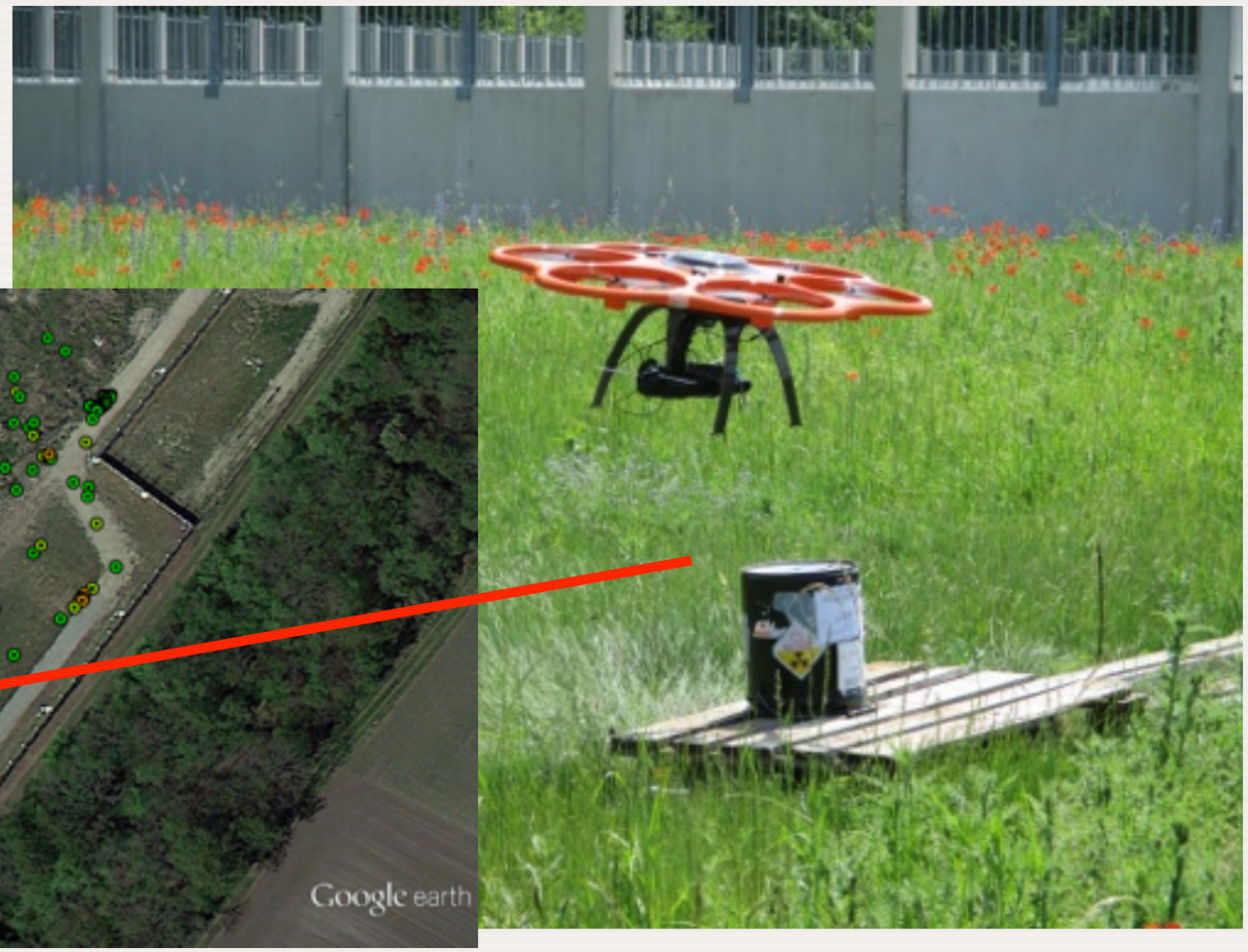
‘Application of Environmental Mapping Technology using Unmanned Aerial Vehicles’.

Deliverables (to Fukushima Prefecture) by end of 2015:

- Prototype UAV-based spectrometry system
- Field test and report
- Documentation
- Training

Test at Seibersdorf Laboratory
370kBq (10uCi) 137Cs, 60Co
0.5 - 1m height





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