

Training Workshop on In Situ Characterisation of Contaminated Sites (EVT1805791) Training Course on Environmental Monitoring and Mapping (EVT1701960)

**Pecs, Hungary, May 6-10, 2019
Pecs, Hungary**

Summary report

A training course was conducted on in-situ characterisation of contaminated sites for environmental radioactivity, in Pecs, Hungary, during 6-10 May 2019, jointly organised by NAEL/TEL and NAPC/NSIL. The course was attended by 40 participants from 29 countries with previous experience in environmental radioactivity monitoring.

This advanced training course covered all relevant practical aspects of characterising a potentially contaminated site, from field surface scanning by backpack systems, in situ gamma-ray spectrometry and object measurements to gamma dose rate measurements, including aerial exploration by helicopter (with the support of the Hungarian Army). Later the data measured by six individual teams were evaluated and maps depicting the spatial distribution of the surface contamination were produced, with findings presented by the teams on the last day. The course thus provided comprehensive training on the entire process of environmental contamination monitoring (see Agenda in Annex 1).

To ensure a realistic scenario, the training was conducted on a partly remediated uranium mining area, and at a working yellow cake production facility. The local organisers were the Mecsekerc Laboratory and Mine Property Utilisation LTD with the coordination of the National Food Chain Safety Directorate (Hungary) as Collaboration Centre of the IAEA.



Fig.1: Field calibration of a high resolution gamma spectrometer.

On right side in the back, a team wearing protective overalls can be seen working on a simulated contaminated field with well-known radioactivity level.



Fig.2: One of the training teams performing measurements on radioactive material located behind a wall within a building by dose rate monitoring.



Fig. 3: Gamma spectrometry measurements performed inside a yellow cake production facility



Fig 4: A team performs surface screening measurements with backpack detectors to find out the spatial distribution of the radioisotopes

2. RESULTS FROM FIELD MEASUREMENTS AND PRODUCTION OF MAPS

Geo-referenced measurements were carried out over three different areas. The purpose of the exercises was to introduce the participants into the following actions:

- Study of background information on the site
- Definition of measurement strategy and measurement pathways
- Collection of measurement results
- Production of maps using the software tool developed by NSIL for R platform

The three areas comprised:

1. Uranium natural outcrop, as to identify dose rate anomalies and gathering data to produce maps (supervised by Mr Roman Padilla-Alvarez, NSIL)
2. Former Car wash area with significant contamination with materials from former uranium exploitation and milling, as to identify dose rate anomalies and gathering data to produce maps (supervised by Mr Sandor Tarjan, TEL)
3. Large territory comprising the two previous areas was airborne surveyed by an helicopter unit from Hungarian Army

Participants were instructed to make an initial walk following the perimeter of the area and then to follow parallel transects separated by 5-10 m from each other.

The treatment of the data included:

- Comparison of measurements across instruments, as to avoid inclusion of biased measurements
- Basic statistics on measurement results
- Refining the area of interest for interpolation
- Inspection of spatial variability of data
- Interpolation using ordinary Kriging and production of maps for interpolated values, uncertainty of the interpolation and probability of exceeding a given level.

Natural Uranium outcrop area

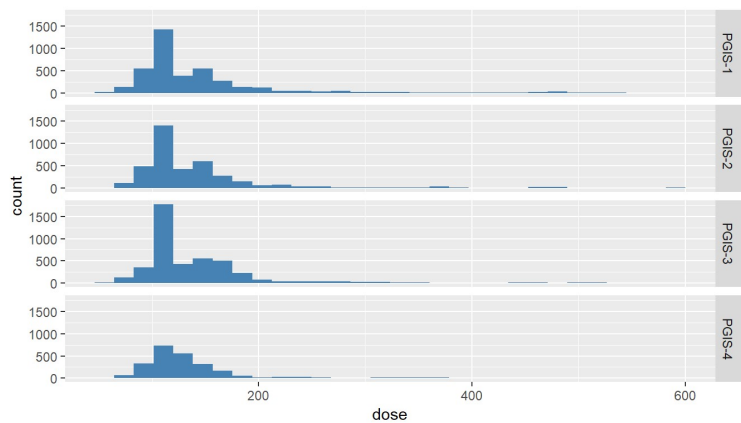
Area: 9092 m²

Perimeter: 355.8 m

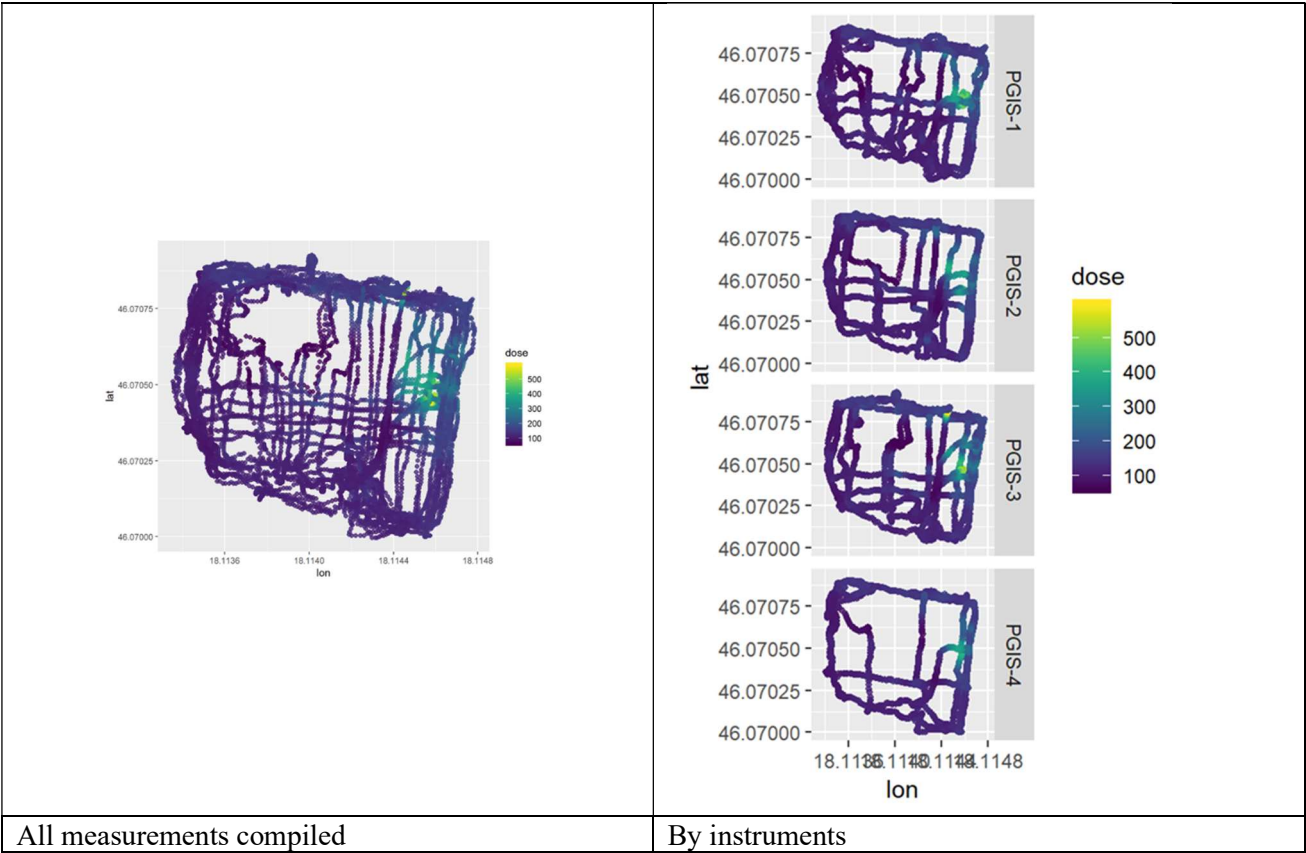
Radiation detectors: 3 x PGIS (3x3 NaI) + 1 PGIS (2.7 l NaI)

Measurements collected by each team ~ 6500

Comparison of readings:



Followed pathways:



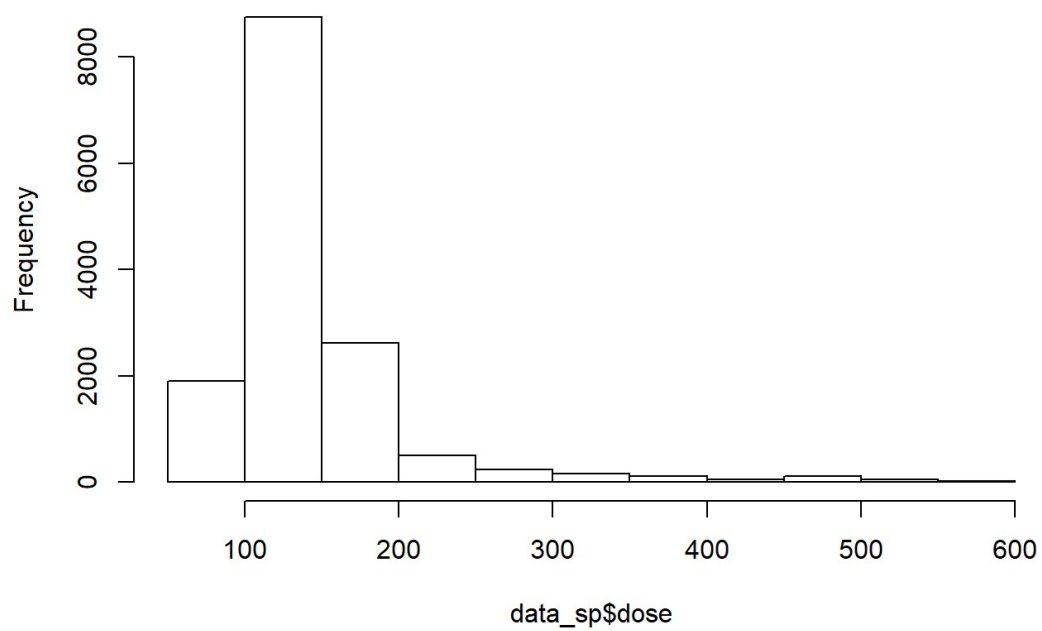
Density of measurements:



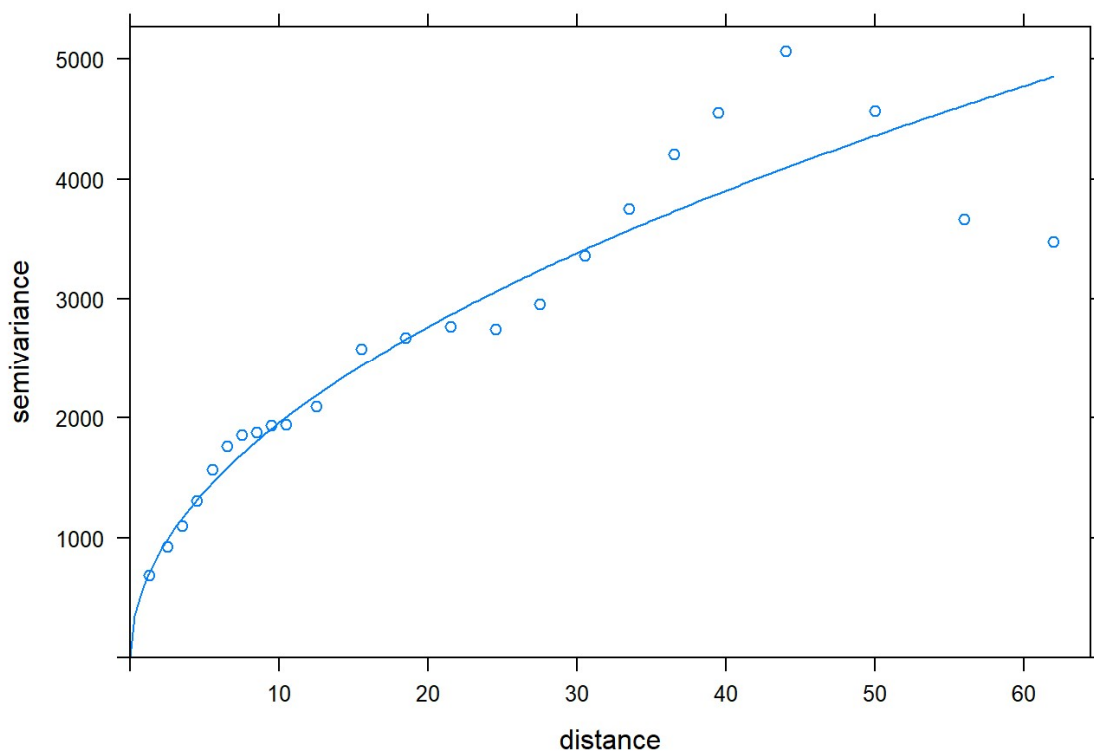
Hot spots (values > 114 nSv/hr):



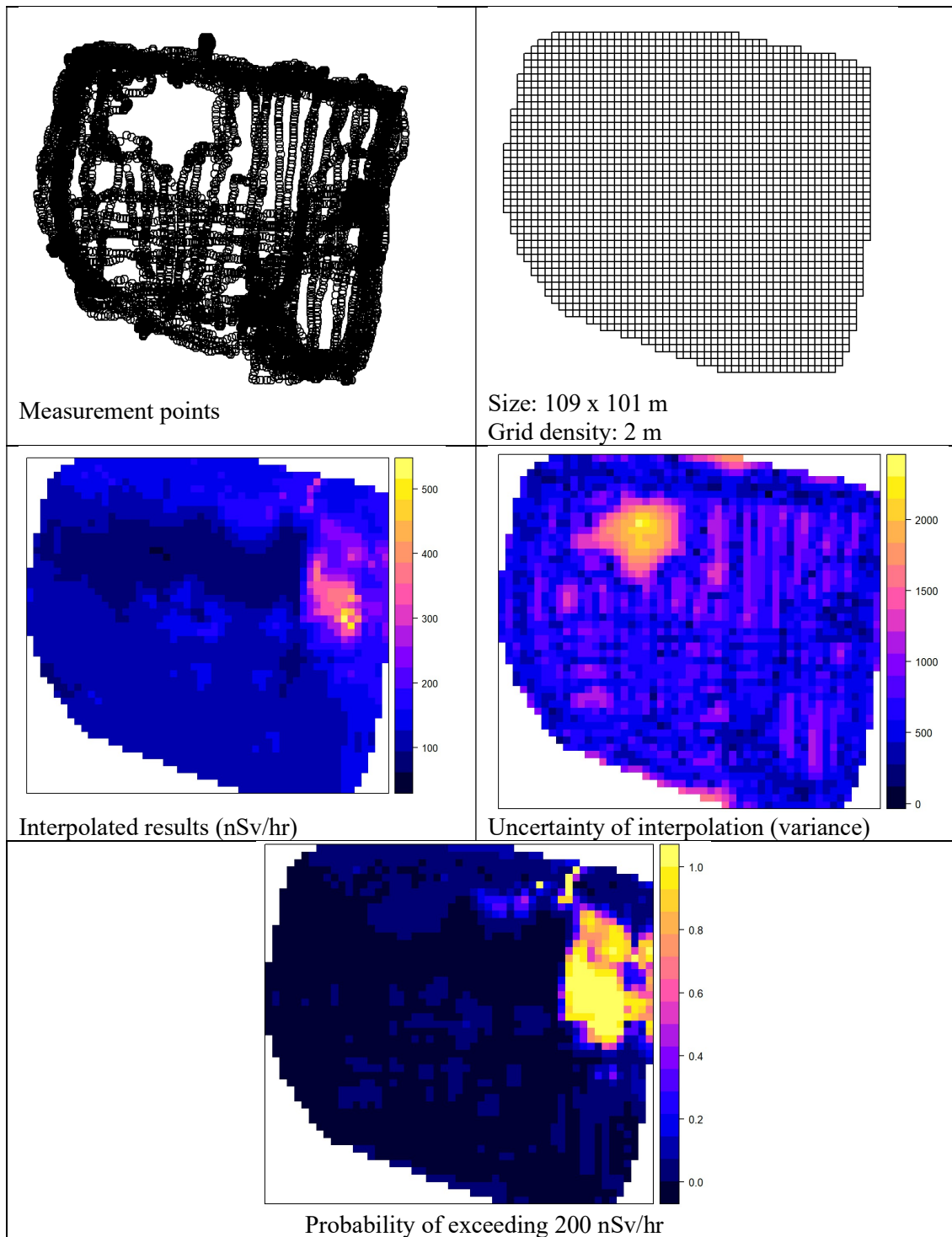
Histogram of measurement results:



Variography analysis: Model- Power



Interpolation:



Car wash area

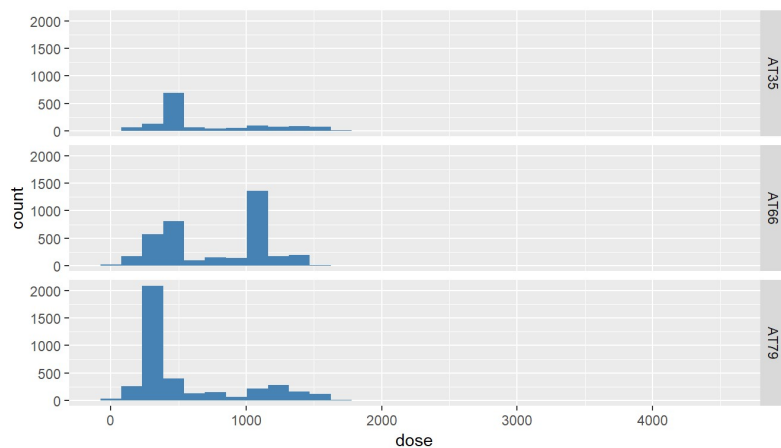
Area: 6610 m²

Perimeter: 378 m

Radiation detectors: 3 x ATOMTEX (3x3 NaI)

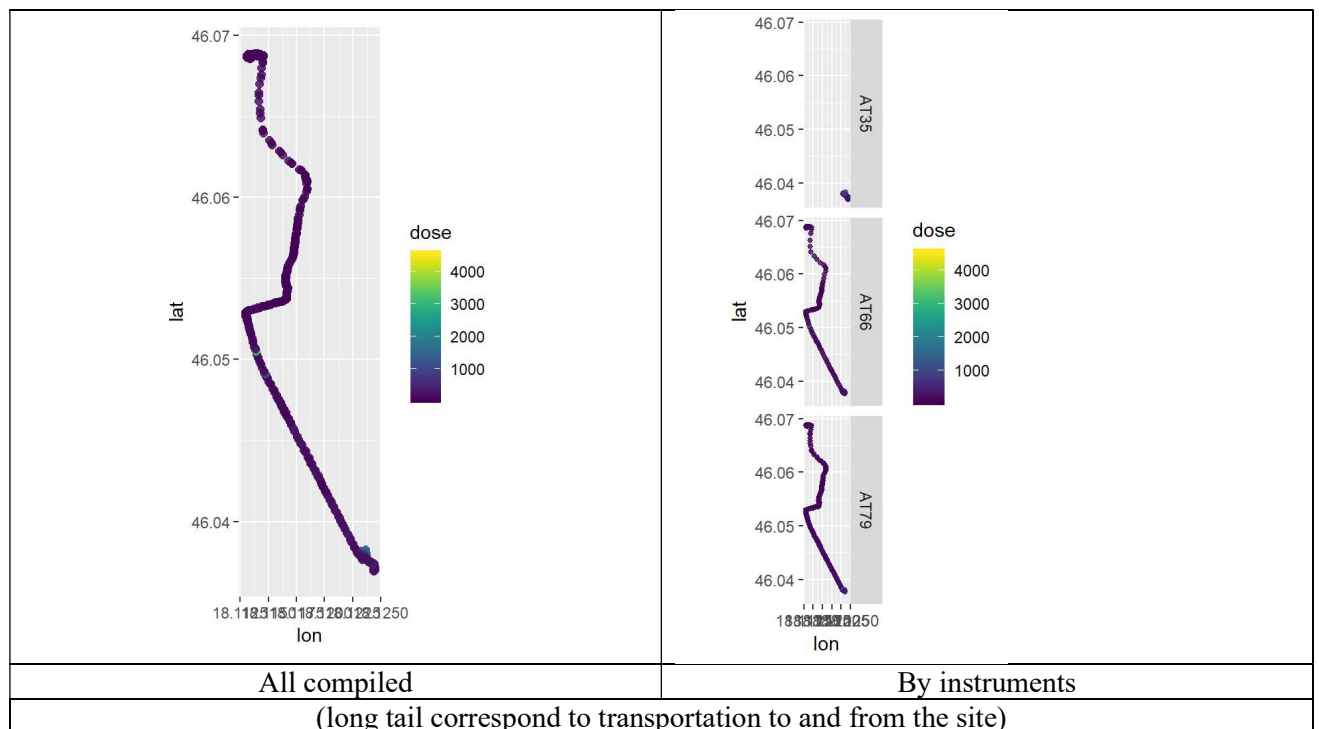
Measurements collected by each team ~ 8400

Comparison of readings:

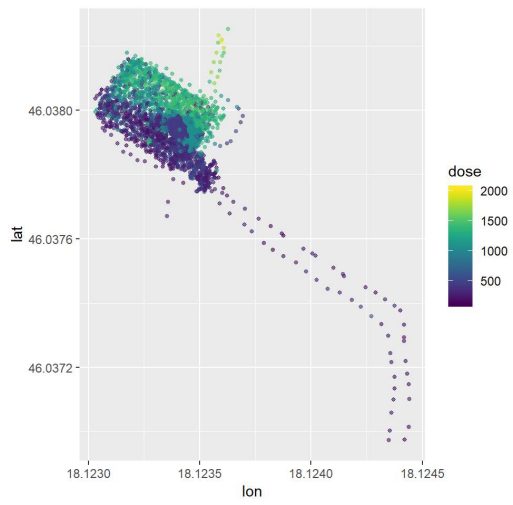


(detector AT66 was used mostly in the contaminated area)

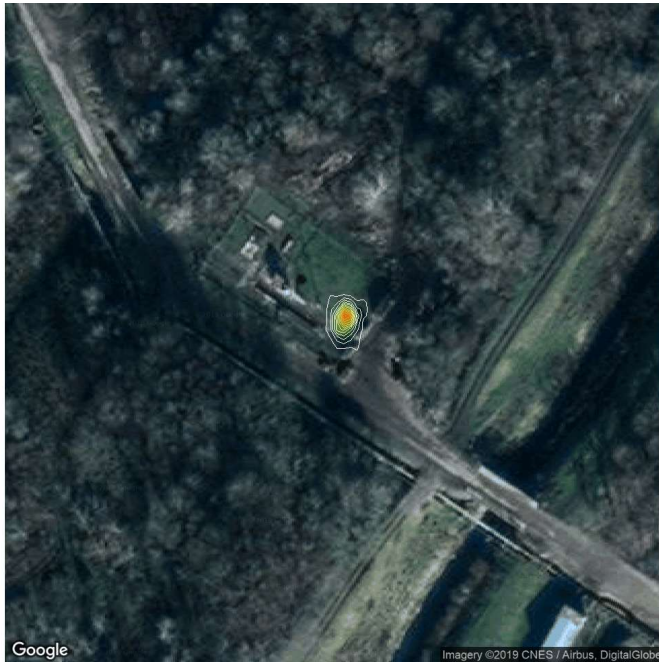
Followed pathways:



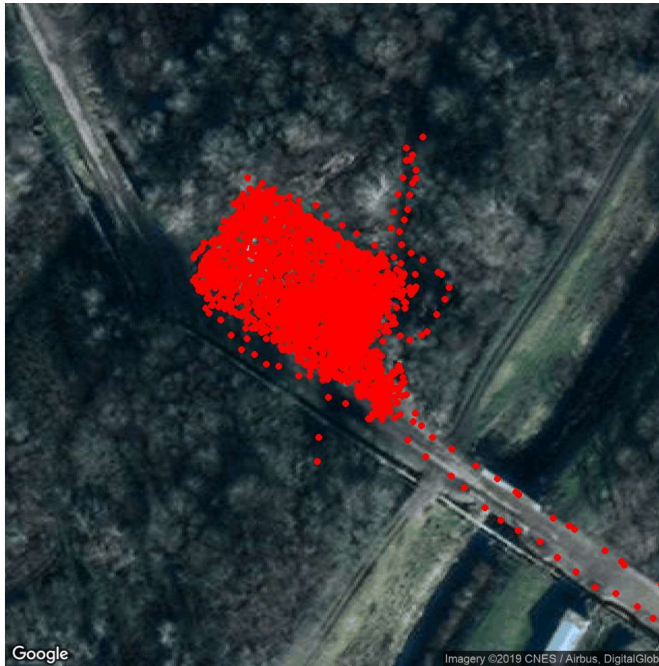
Refined area (after excluding travel to and from the area):



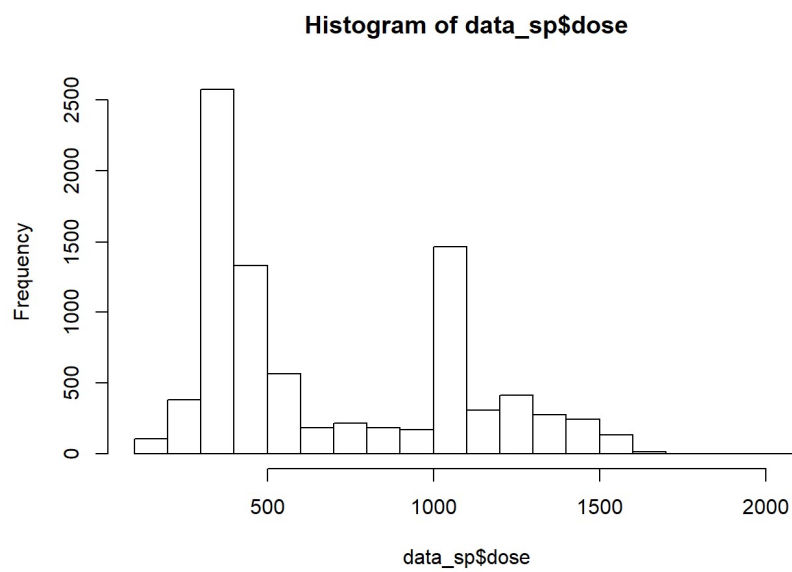
Density of measurements:



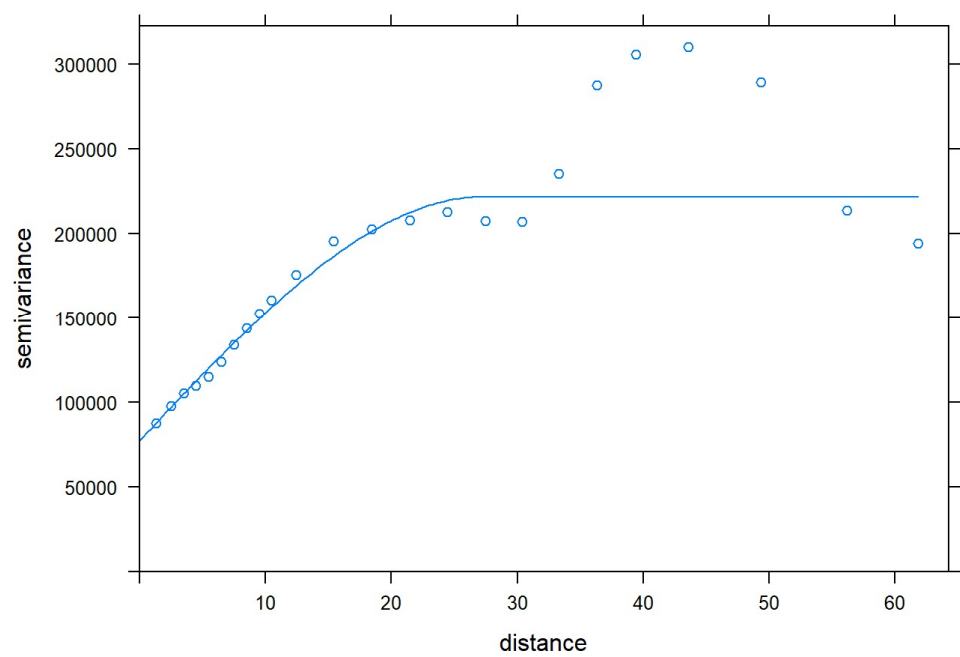
Hot spots (values > 114 nSv/hr):



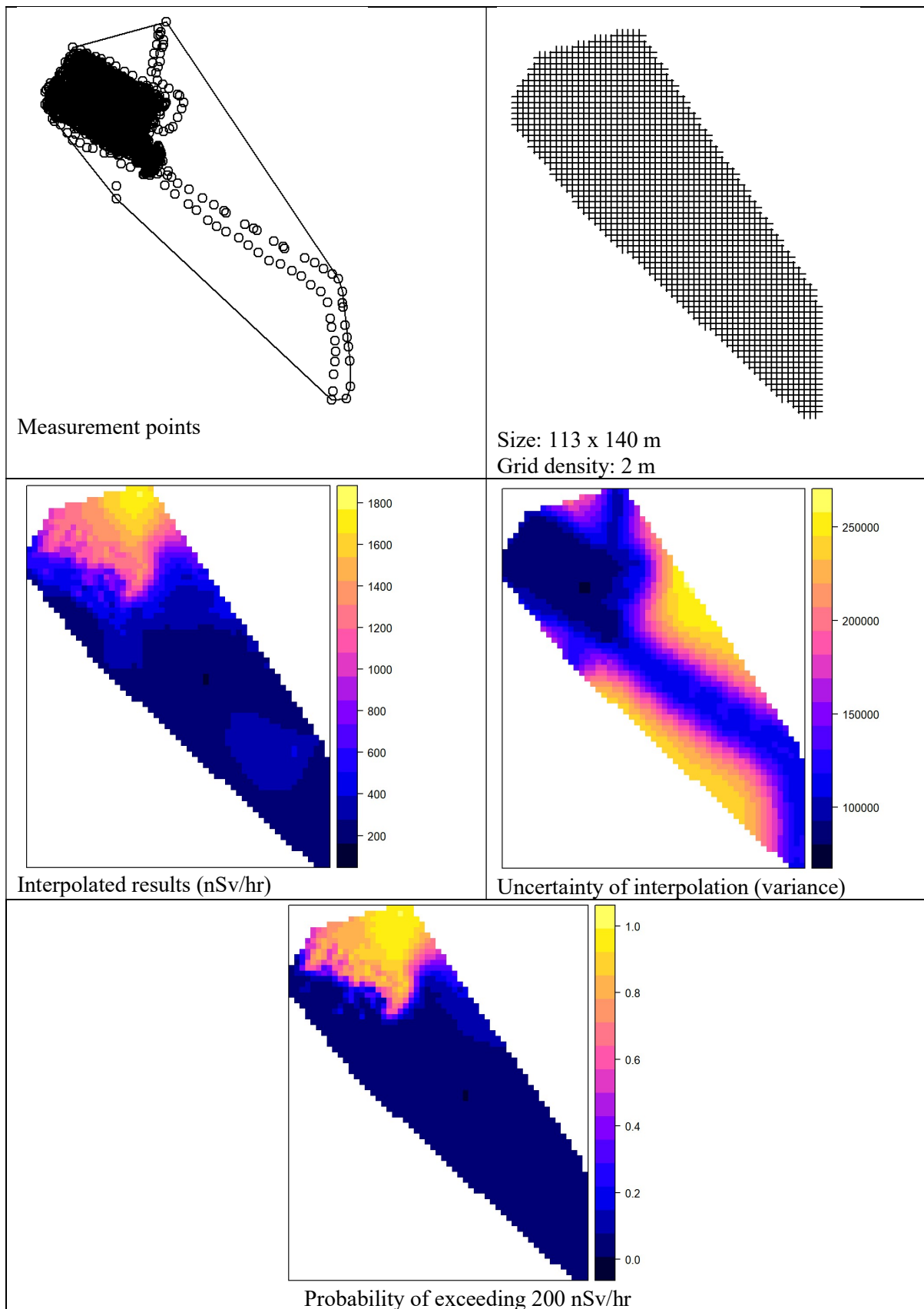
Histogram of measurement results:



Variography analysis: Model- Spherical



Interpolation:

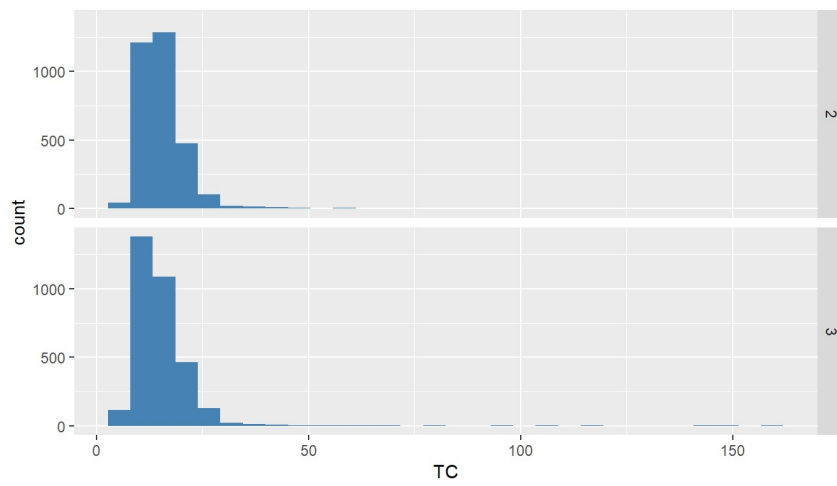


Airborne measurements

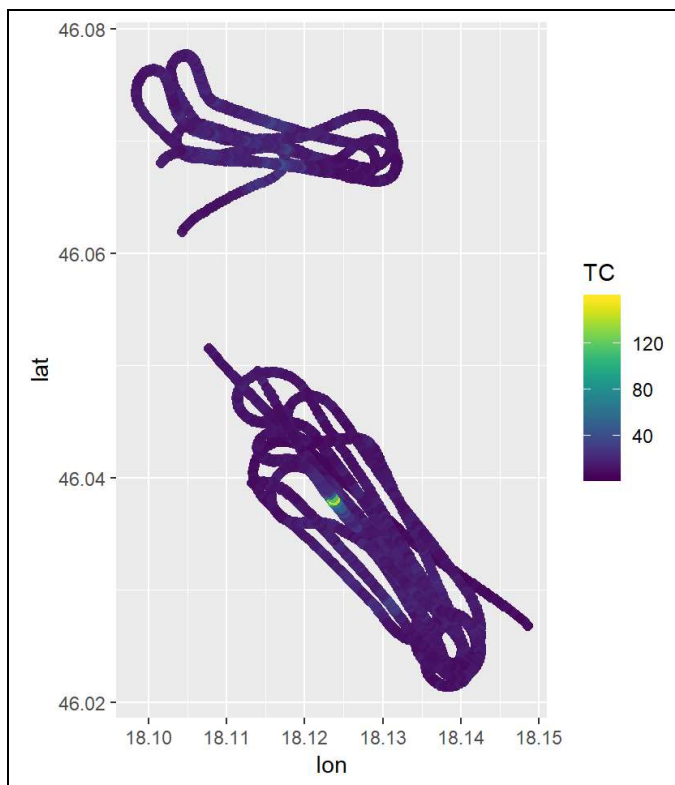
Radiation detectors: 2 x Large volume plastic scintillators

Measurements collected: 3185 (Detector 2) and 3245 (Detector 3)

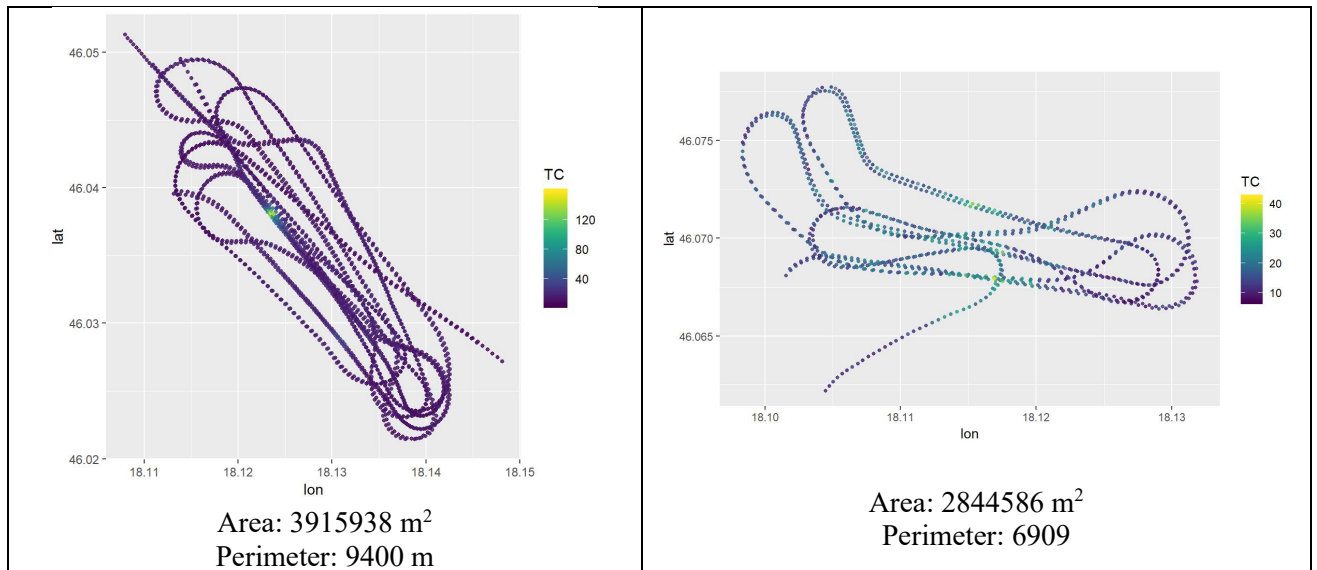
Comparison of readings (cps):



Followed pathways:



Surveyed Areas: Area 1 – Car wash, Area 2 – Uranium mine



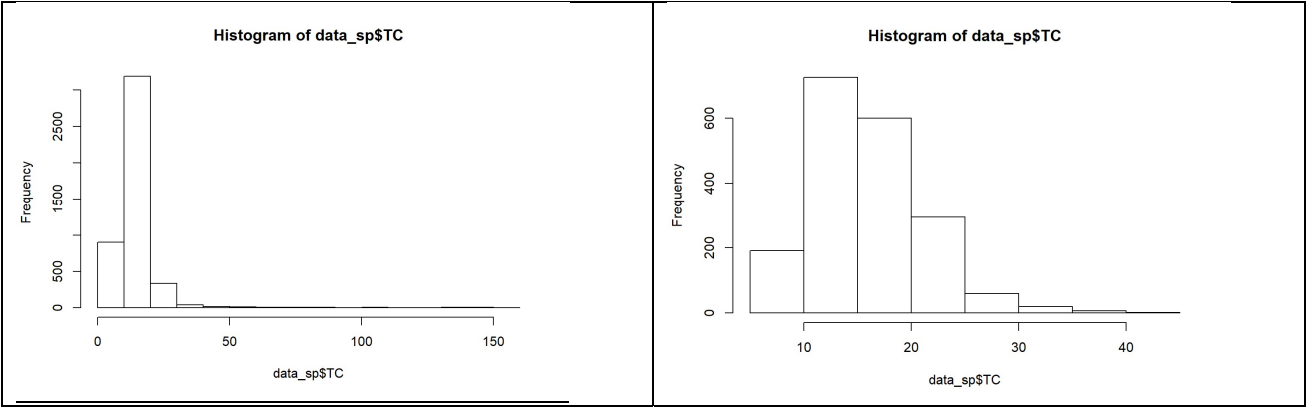
Density of measurements:



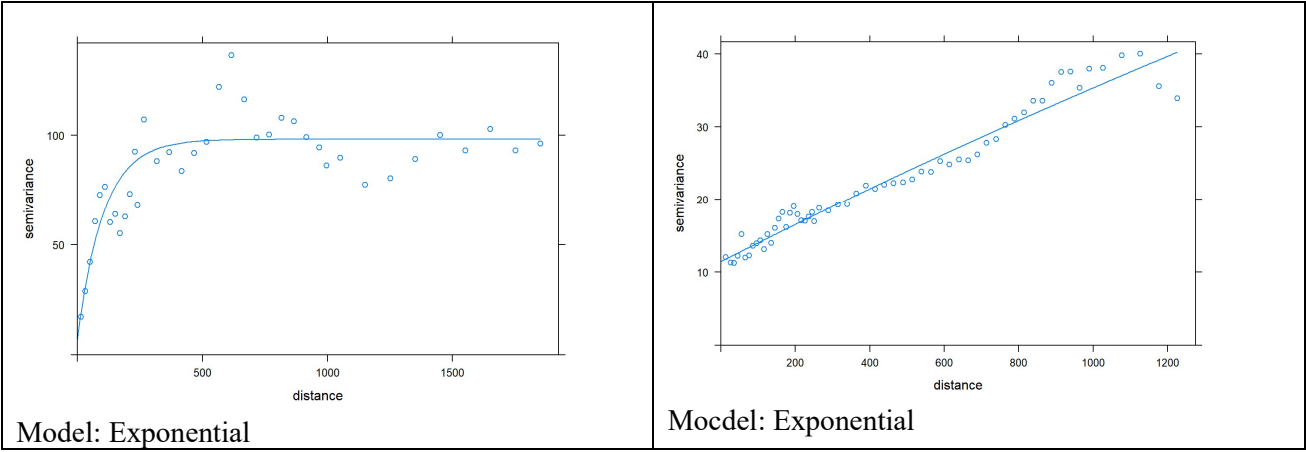
Hot spots (values > 25 cps):



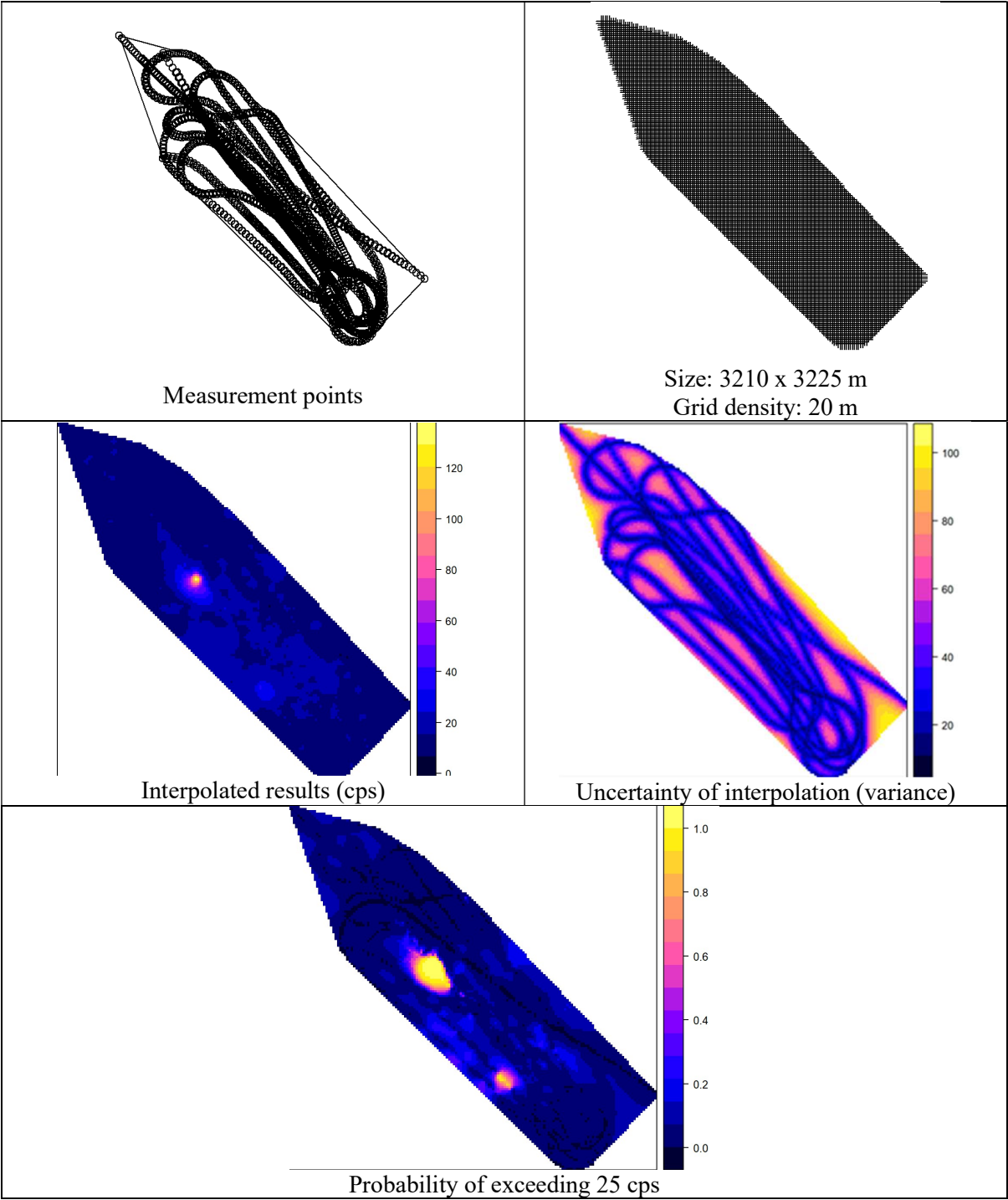
Histogram of measurement results:



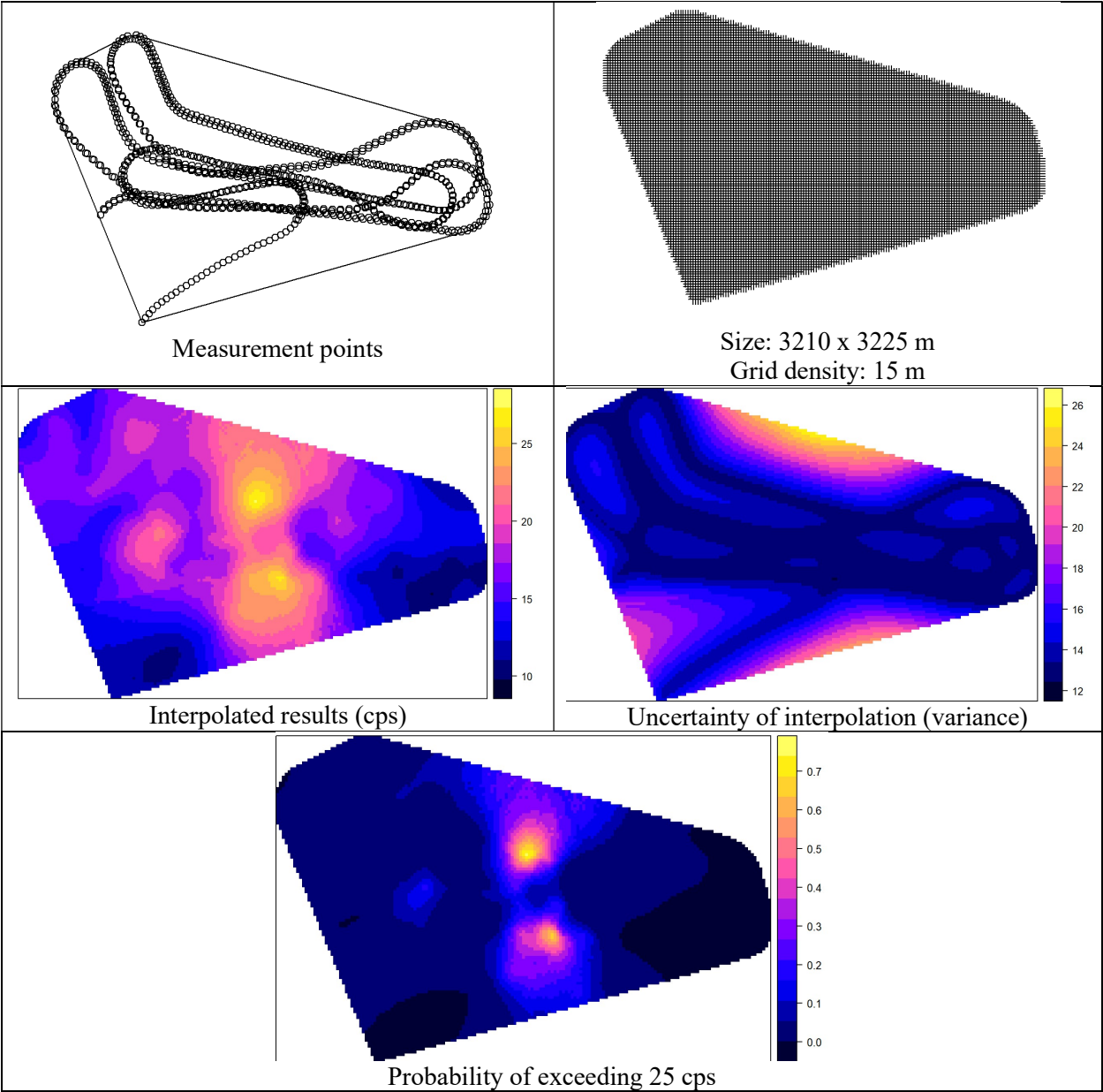
Variography analysis: Model- Spherical



Interpolation: (Area 1)



Interpolation: (Area 1)



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Agenda

Time	Monday 6	Tuesday 7	Wednesday 8	Thursday 9	Friday 10
9:00 – 9:45	Official opening: <i>Mr R. Padilla</i> ⁽¹⁾ <i>Mr S. Tarjan</i> ⁽²⁾ <i>Mr A. Muring</i> ⁽³⁾ <i>Mr/Ms Local organizer</i> Self-introduction of the participants	Field exercises: In working groups <i>A. Muring, S. Tarjan, R. Padilla</i>	Field exercises (continued)	Field exercises (continued)	Practical exercise 4: Presentation of results by working groups
9:45– 10:30	Lecture 1: Short history of the exercise field as former uranium mining area <i>A. Varhegyi</i> ⁽⁴⁾				
10:30 – 10:45	<i>Coffee break</i>				
10:45 – 11:30	Lecture 2: The rationale of in-situ approach: NSIL activities <i>R. Padilla</i>	Field exercises (continued)	Field exercises (continued)	Field exercises (continued)	Practical exercise 4: Presentation of results by working groups
11:30 – 12:15	Lecture 3: Radiation detectors for in situ measurements: Comparison of performance, calibration, control checks <i>S. Tarjan</i>				Final discussions and remarks Official closure
12:15-13:45	<i>Lunch break</i>				

¹ Mr Roman Padilla Alvarez, Nuclear Instrumentation Physicist, Nuclear Science & Instrumentation Laboratory, IAEA, Seibersdorf, Austria

² Mr Sandor Tarjan, Reference Materials Specialist, Terrestrial Environmental Laboratory, IAEA, Seibersdorf, Austria

³ Mr Alexander Muring, Gamma Spectrometry Specialist, Terrestrial Environmental Laboratory, IAEA, Seibersdorf, Austria

⁴ Mr Andras Varhegyi, Mecsek Environmental Protection Branch, Hungary

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Time	Monday 6	Tuesday 7	Wednesday 8	Thursday 9	Friday 10
13:45 – 14:30	Lecture 4: In situ measurements using HPGe detectors: Methodology, calibration and verification. <i>A. Muring</i>	Field exercises (continued)	Field exercises (continued)	Practical exercise 2: Installation of R-based module for production of maps: demonstration of use <i>R. Padilla</i>	
14:30 – 15:15	Lecture 5: In-situ measurements using dose rate meters and high efficiency scintillators. Data interpretation and geo-statistics for production of maps. <i>R. Padilla</i>			Practical exercise 3: Production of maps	
15:15 – 15:45	<i>Coffee break</i>				
15:45 – 16:15	Lecture 6: Radiological evaluation of contaminated sites and soil <i>M. Lavielle</i> ⁵	Field exercises (continued)	Field exercises (continued)	Practical exercise 3: Production of maps	
16:15 – 17:30	Practical exercise 1: Description of the field exercises and demonstration of used instruments <i>R. Padilla, A. Muring, S. Tarjan</i>				
17:30 – 19:30		Reserved for calculations and reporting	Reserved for calculations and reporting	Reserved for calculations and reporting	

⁵ Dr. Marie Lavielle, Commissariat à l'Energie Atomique (CEA), France

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Field exercises:

1. Verification of GPS readings at a reference point
2. Calibration of gamma-ray spectrometer using Eu-152 source and determining angular correction
3. Control measurements over a mosaic reference field
4. Measurement of bulk calibration containers
5. Measurement of tanks in precipitation reactor
6. GPS-linked pathway measurements over uranium tailings dumps area to identify dose rate anomalies and gathering data to produce maps
7. GPS-linked pathway measurements over rock waste area to identify dose rate anomalies and gathering data to produce maps
8. Dose rate measurements around yellowcake storage building