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Citizens Measurements in Radiation Protection and Emergency Preparedness and Response - its role, **pros** and **cons**

The paper shows selected results of selected security research projects aimed at this field, supported by the Czech Ministry of Interior (project “RAMESIS” ID: VI20152019028) and by the Technology Agency of the Czech Republic (project “CK RANUS“ ID: TE01020445).

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Experience from severe accidents in past

1986 - Chernobyl

- **information provided by authorities to public rather limited and mostly unappropriate**
- almost no availability of suitable equipment for citizens measurement
- no social networks for sharing information

2011 - Fukushima

- **information provided by authorities to public often considered unadequate**
- citizens measurements started using at first improvised devices, consequently design, development and proliferation of suitable devices for CM by volunteers (SAFECAST) based on open-source hardware and software approach
- internet and social networks widely used for sharing monitoring results

Lesson learned: reasons for lack of public confidence to authorities were

- **poor and/or rather limited communication** between official authorities and stakeholders and general public,
- **restricted access to information** for stakeholders and general public, what may have extremely negative impacts on their
  - understanding of actual situation, its possible risks and implemented protective measures
  - acceptance of these protective measures
  - participation and collaboration in remediation of affected areas.

Involvement of stakeholders and general public

plays one of the key roles in the process of effective solving problems in emergency preparedness, response and remediation on affected territories.

To accomplish these tasks, it is necessary to gain all the **participants´ confidence** - especially of **stakeholders and general public** - in information on radiation situation provided by the authorities.

Citizen Radiation Monitoring

Possible way to improve the situation in future can be implementation and support of **citizen radiation monitoring** performed on voluntary basis.

Whether the authorities like it or not, people will not only demand for information, but active try to find ways how to get information:

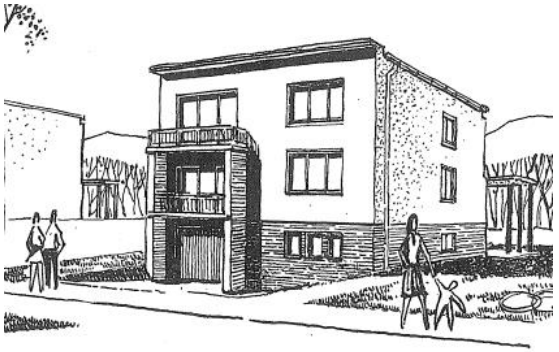
- manage for detectors and carry out measurements by themselves - especially if suitable detectors (acceptable price, simply operable) are available,
- sharing data, information, meanings etc. on social networks…

Perspective:

- making sure, the official results are compatible with these by citizens self-measured ones, the public may gains more confidence to official information
- increasing capability of monitoring if implemented as supplement to professional monitoring

Examples of citizens initiative in past in Czechia

1) Family houses built using radioactive clinker concrete panels, (built: 1972-1983, dose rate up to 2 μGy/h)



discovered in 1987 by house owner (*he borrowed a detector from U mine*)

2) orphan source ^{226}Ra (700 MBq used for radiotherapy, lost before WW2 in Prague)

discovered 29.9.2011 by radiation enthusiast near to the playground

(using Wrist Gamma Watch)

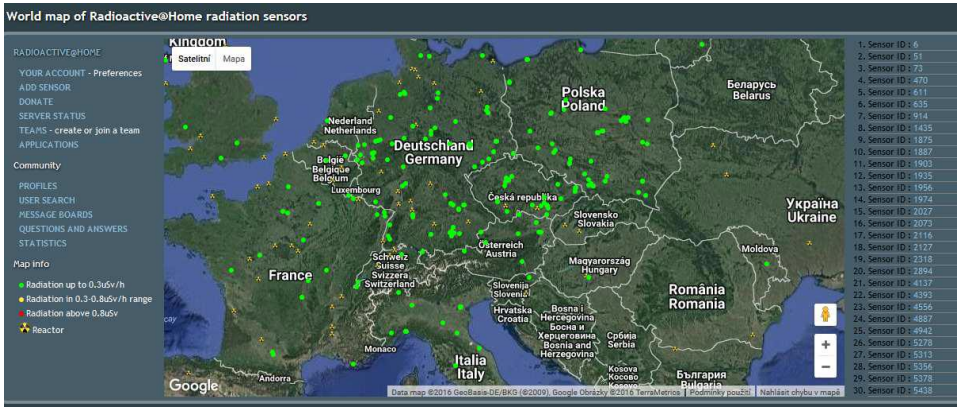
Actual trends in devices design for citizens monitoring

fixed stations - detector coupled with simple processor unit providing
- store measured values together with date/time information
- capability for data transfer to central database via internet

Examples:

Radioactive@Home (scientific project - Poland)

- simple device with GM detector with
- USB connection to PC
- local display of actually measured value
- automatic transfer of results to central database via PC internet connection
- in-door use
- unit price: ~ 25 euro

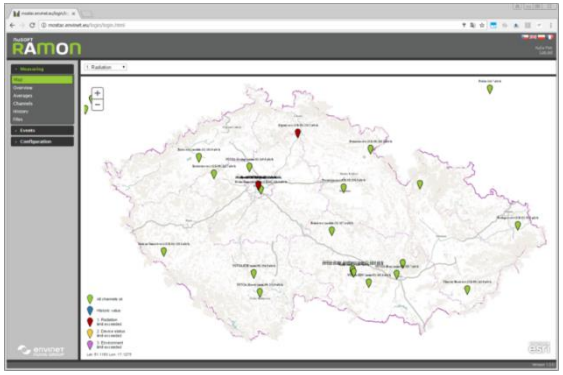


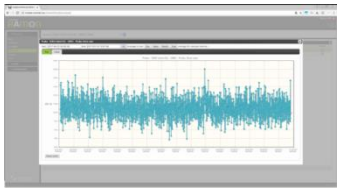
web:
radioactivehome.org/boinc/
(registration necessary)

Actual trends in devices design for citizens monitoring

MOSTAR – R&D project SURO & NUVIA – Czechia

- sophisticated device with up to three GM* detectors
- USB/LAN connection to PC
- local display of full range of measured values and parameters on PC/NB (including history)
- full user control of measurement parameters,
- off-line operation possible
- automatic transfer of results to central database via PC/NB internet connection or mobile networks (stand-alone version)
- web: ***mostar.envinet.eu*** *(registration necessary)*
- intended for municipalities, schools, youth tech-centers, local volunteer organizations (fire brigades, scouts, …)





hand-held gadgets

SOEKS 01M Plus Generation 2 Geiger Counter Radiation Detector Dosimeter
★★★★½ 8
$224.46

GQ GMC-320-Plus Geiger Counter Nulcear Radiation Detector Meter Beta Gamma X ray test...
★★★★☆ 72
$118.00 Prime

RADEX RD1212 Advanced Radiation Detector / Geiger Counter with Online Software
★★★★☆ 116
$199.95 Prime

Greentest, High Accuracy Radiation Detector ,Personal Geiger Counter/ Nitrate Tester Combo...
★★★★½ 7
$126.99 Prime

TM-91 Geiger Counter and Nuclear Radiation Monitor: Measures Beta, Gamma and X-ray...
$356.00 Prime

International Medcom Radalert 100X Radiation Detection Meter
$450.00 Prime

$650

Smart geiger for Smartphone

$26

mobile monitoring

- **detector** coupled with **processor unit** and **GPS module**, providing storage of measured values together with date/time and geographical coordinates
- **display** of measured values and additional information and parameters,
- capability for **data transfer to central database** via internet connection
- **compact**, **resistant** to weather and mechanical influences
- **battery powered** system with long operation time

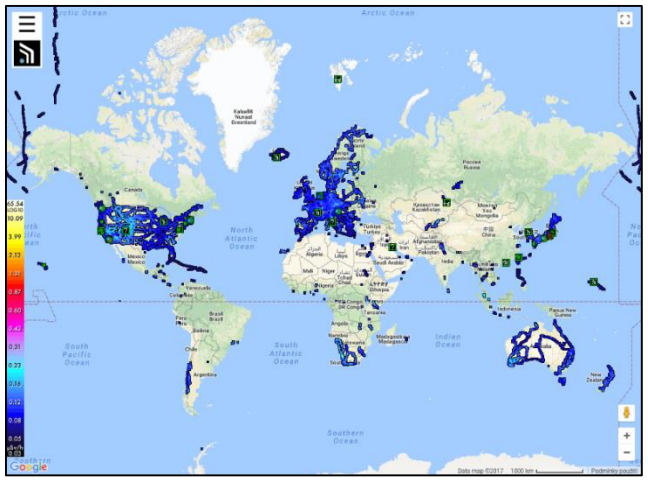
Example:

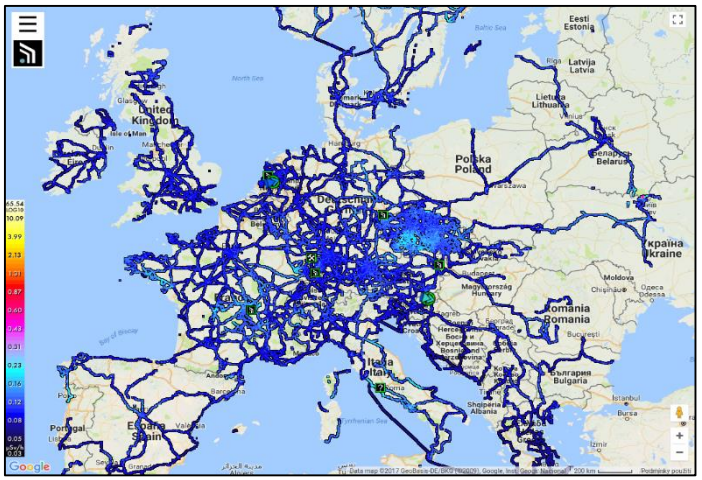
Safecast bGeigie Nano (Japan/USA)

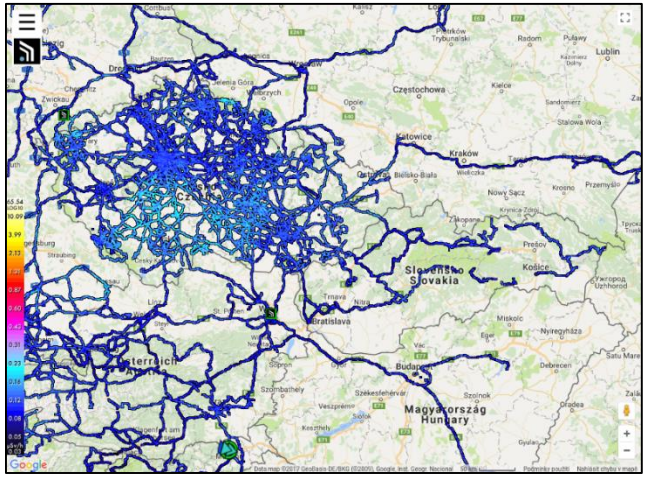
- GM pancake detector
- Li-Ion battery charged via USB (>30h operation)
- display of actually measured value (CPS/µSv/h)
- data storage on removable SD-card (every 5 sec)
- data transfer to central database via PC (SD-card) or via BT coupled smartphone (on-line data transfer)
- blog.safecast.org *(registration necessary for data providers only)*

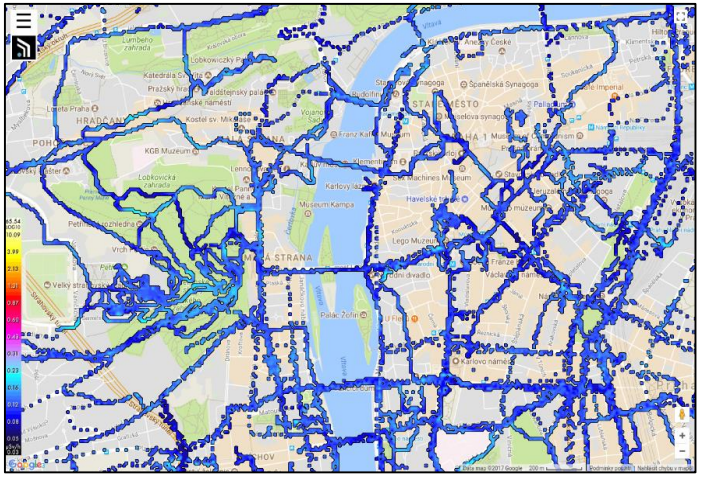
price ~ 600 euro

Web presentation of results from citizens monitoring









features: - acceptable sensitivity - validation of data - widely spread over the world

amount of data obtained even in normal situation larger than from governmental systems

Czech Security Research supported by Ministry of Interior

ID 20152019028 RAMESIS - research (SURO & UTEF CTU) and commerce (NUVIA)

„Radiation Monitoring Network for institutions and schools to assure early awareness and enhancing safety of citizens“

Improvement safety of population through introducing of radiation monitoring system at level of institutions, schools and citizens in accordance with current international trends. Instrumentation including central application for receipt, storage, administration and publication of monitoring results will be analyzed, projected, developed and obtained. System will be implemented at selected institutions and schools, including training and informational materials for understanding radiation problems.

Objectives of the project:

- design, development, operational testing and implementation of **tools for supporting citizens radiation monitoring networks** (detectors, communication, central database/application for local&web data presentation)
- prepare of **information materials**, methodics, manuals, etc. for users and **public**
- prepare the system for possible future integration of results of citizens monitoring into **Radiation Monitoring Network** operated by authorities

Roles of participants in RAMESIS project

SURO - **project coordinator**,

- formulation of requirements for design and parameters of detectors, monitoring network and central database/application,
- communication to public
- testing functionality of both detectors and network
- preparation of inform. materials, documents, guides etc. for users&public
- implementation of mobile monitoring

NUVIA

- design and realization of **central database&applicaton** for receiving, storing, processing measurement results and publication on web

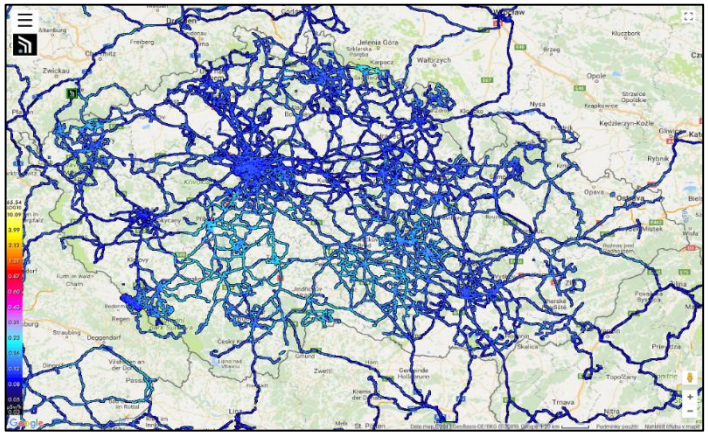
UTEF

- **development of detectors**
  - for **fixed stations** network based on Si-diode
  - advanced detectors based on pixel Si/GaAs detectors for schools

Results of the RAMESIS project (up to autumn 2017)

SURO - mobile monitoring utilizing SAFECAST bGeigie nano detectors

territory coverage July 2015



territory coverage September 2017

UTEF - **development of detectors** for **fixed stations** network (based on Si-diode) and of advanced detectors (based on pixel Si/GaAs detectors) for schools

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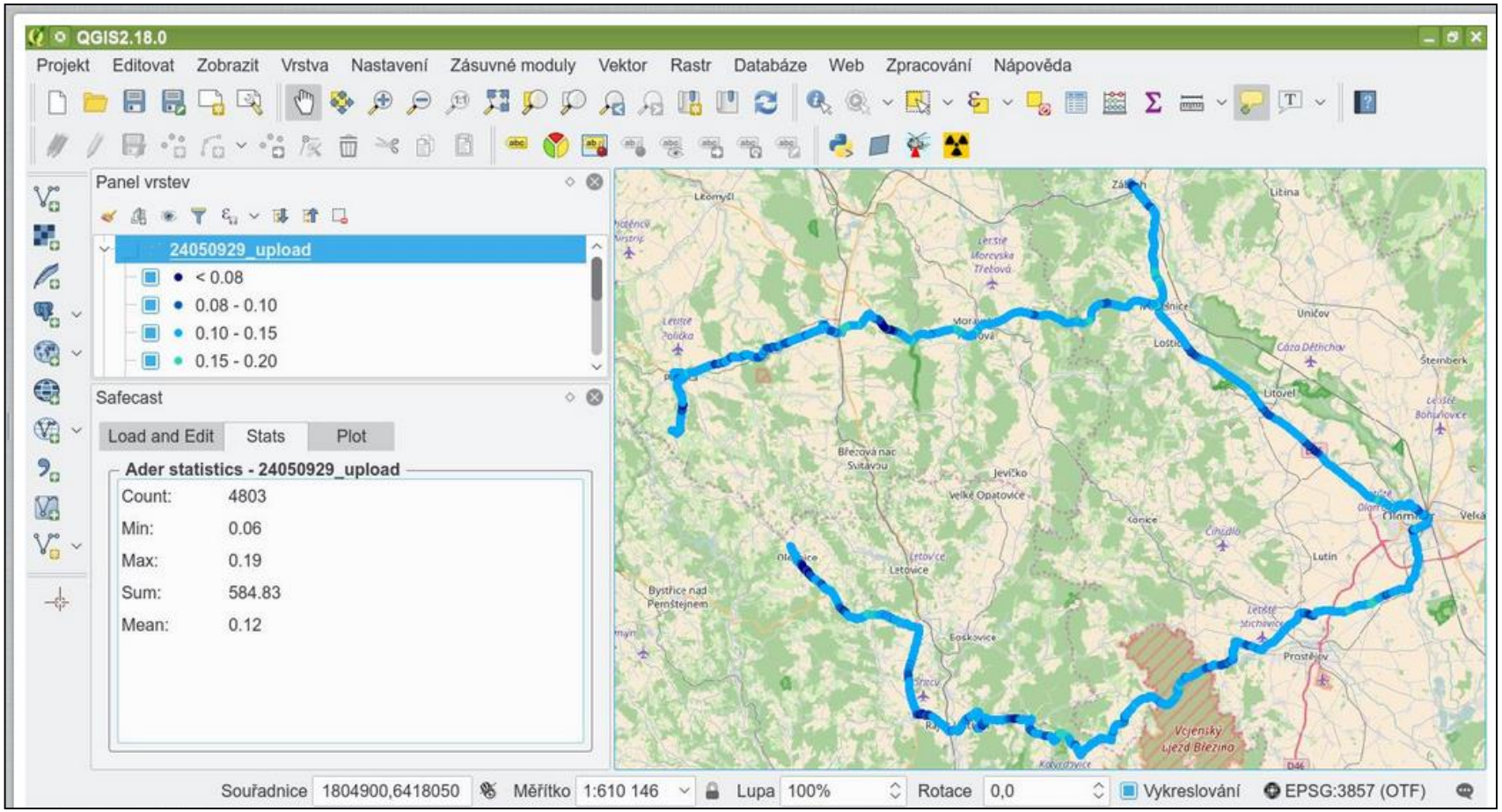
SURO is preparing mapping software, tools and map-data

for citizens, schools, municipalities etc.
enabling measurement results processing and presentation on local level
(based on open source solutions – free of charge)



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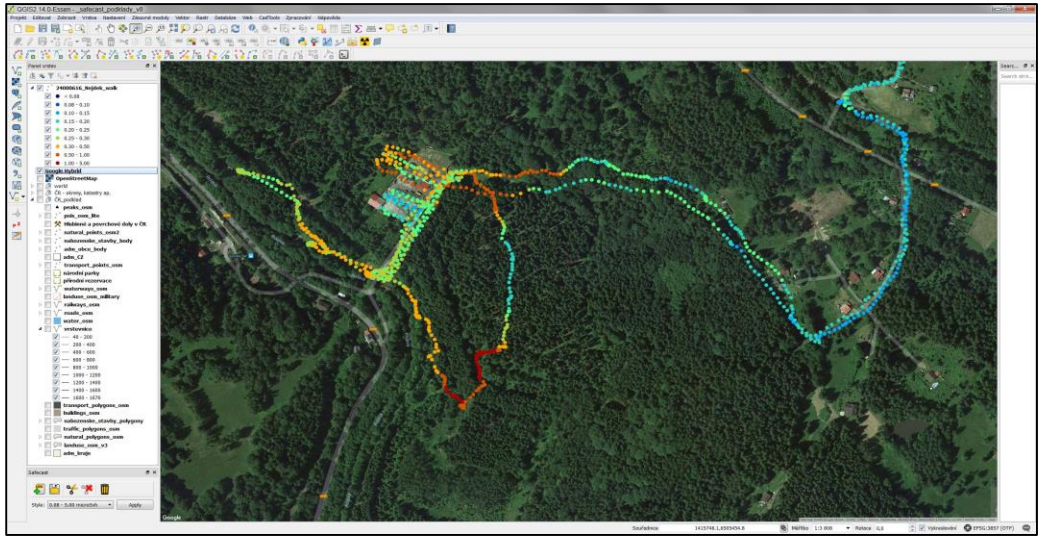
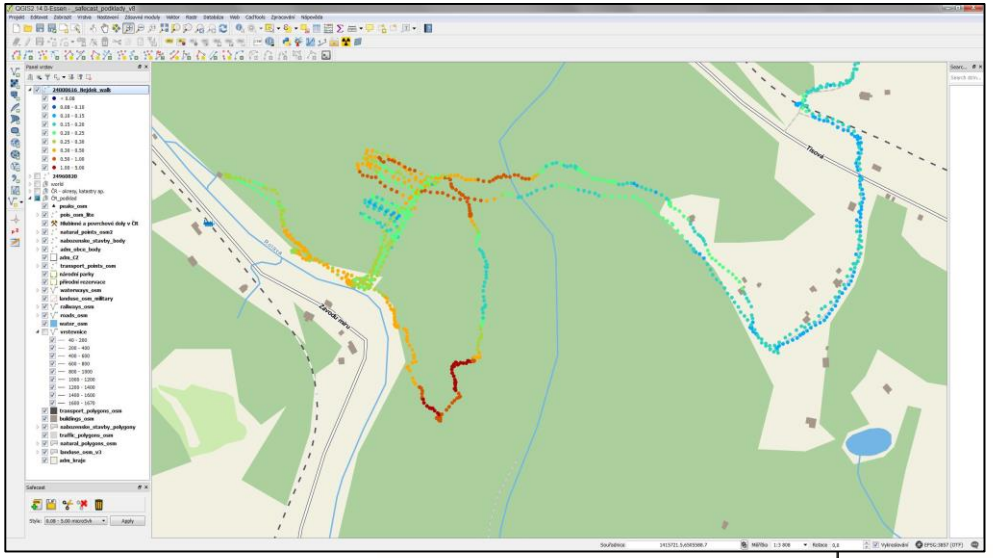
Map presentation of citizen monitoring results on local PC

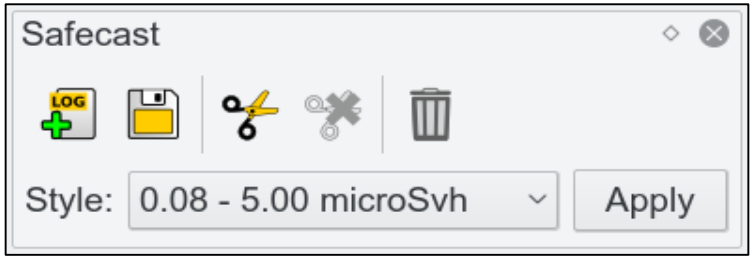


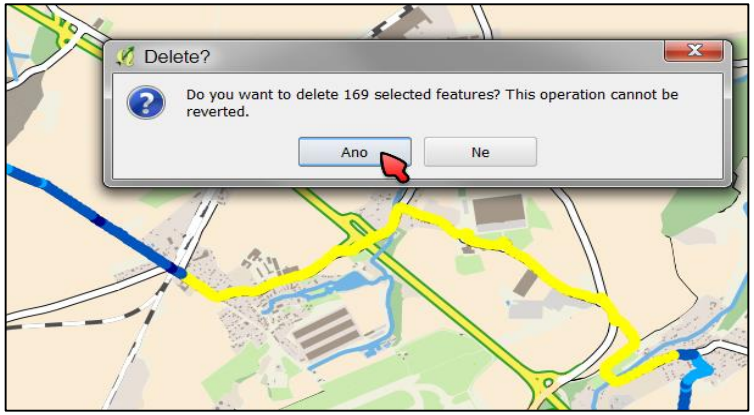
QGIS using off-line maps
- prepared by SURO
- based on OpenStreetMap

QGIS using on-line maps
- Google
- Bing
- OpenStreetMap
- …

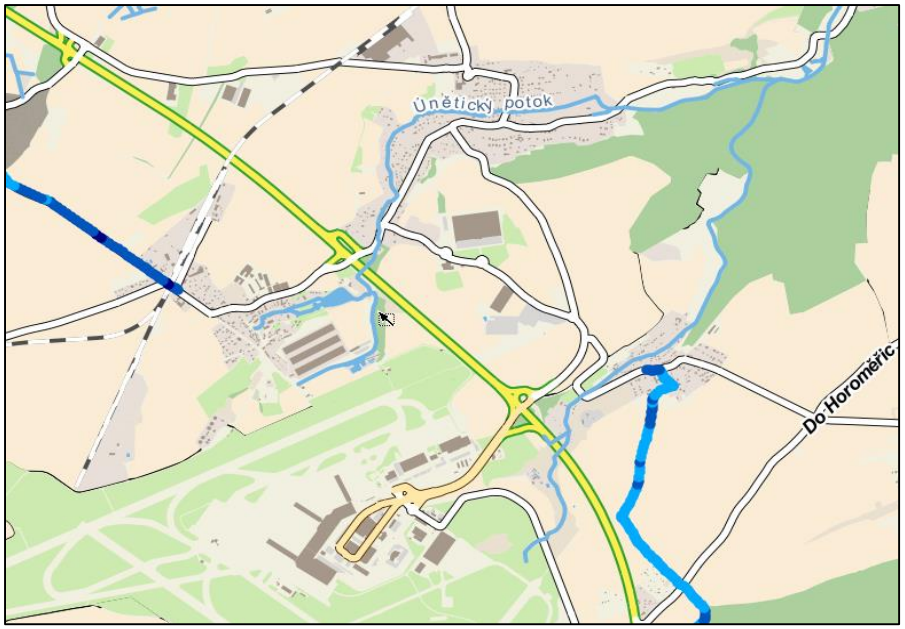


QGIS plugins for processing SAFECAST data



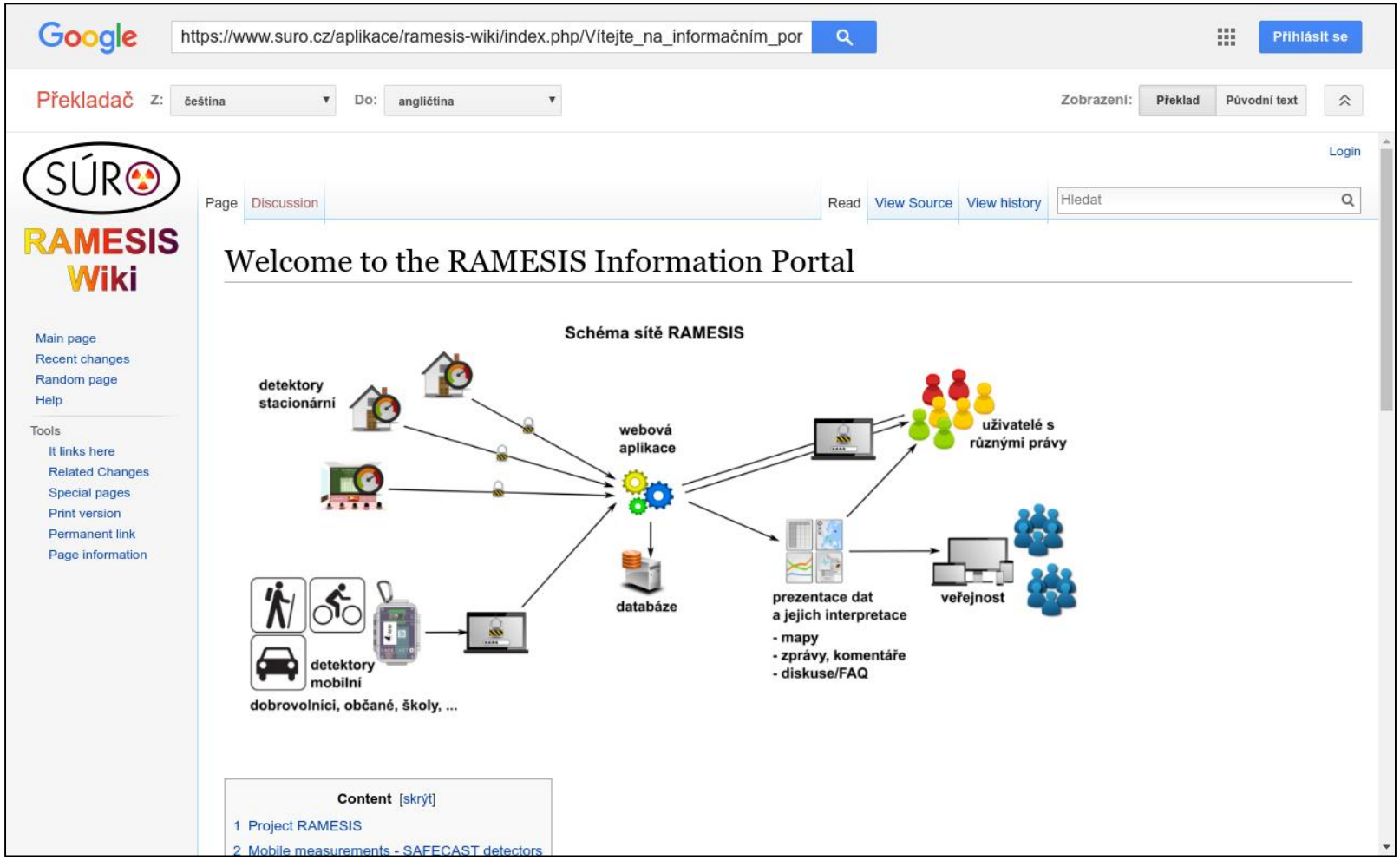


- simple input data by direct reading *.LOG files from Safecast SDcard
- possibility to easily remove selected parts of data not intended to share (personal/private information protection etc.)



Results of the RAMESIS project (up to summer 2017)

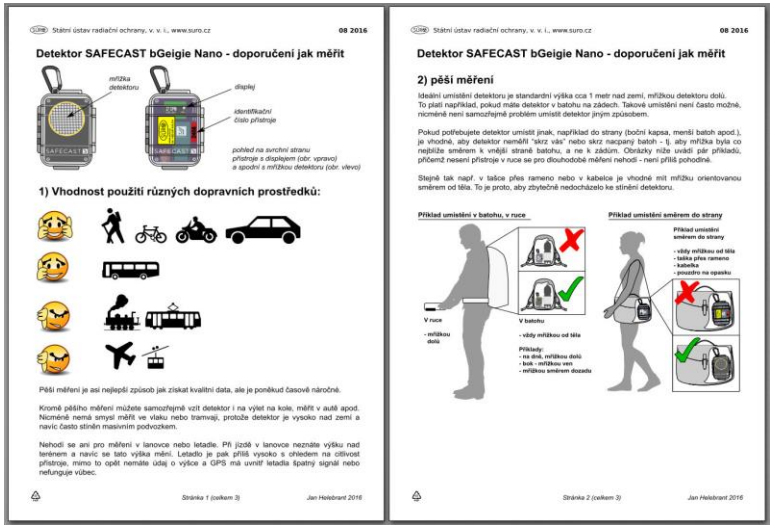
SURO & NUVIA - Web Information Portal

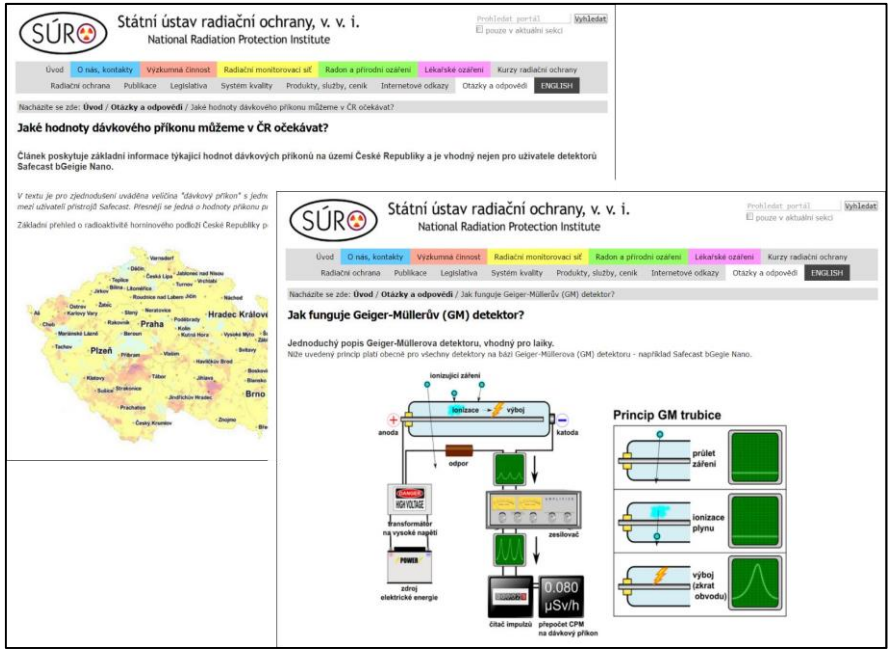


Results of the RAMESIS project (up to summer 2017)

Information materials for users and public

documents prepared by SURO available
- on www.suro.czwww.suro.cz
- on Wikipedia (synchronized)
- on WIKI





CONs and PROs
of engaging citizens monitoring in coping emergency

experience from Chernobyl and Fukushima accidents:

- **public will demand informatio**n
  in case authorities and/or NPP operator fail in providing
  complex, reliable and in-time information
  they will **loose credibility** at all…

- **public cannot be stopped or restricted**
  - in attempts to obtain information,
  including obtaining of detectors and performing their own measurements
  - in sharing results of monitoring, information, etc. **on social networks**

CONs - questions/risks:

results of citizen monitoring provide usually only a basic rough information - total dose-rates measured by simple detectors usually used by the public may not be sufficient for proper and complex evaluation of radiation situation and for prognosis of its development, nevertheless if properly treated they can make significant contribution to overall evaluation of the radiation situation

expert engagement is inevitable, providing appropriate evaluation of radiation situation based on as much complex information on the situation as available to avoid misunderstandings and/or misinterpretations (e. g. noble gas release from the Fukushima NPP)

results misinterpretation and/or hoaxes - may cause incommensurate reactions of public and even panic behavior…

overwhelming of the authorities by requests for evaluation/explanation etc., often followed by endless discussions of possible (including not reasonable) alternatives

demands of public for „alternative opinions“ by „independent“ experts - who are they?

PROs – benefits:

- **citizen data can help in more efficient usage of response capabilities**
  in the event of an accident an enormous amount of data could be obtained by citizens (very quick and cheap) at the time when government could have only limited capacity of measurements
  e.g. all roads on Czechia (approx. 131 000 km of national&local roads) can be measured during one day using about 333 Safecasts, assuming monitoring speed of 40-50km/h)
- **citizens (stakeholders) involvement in measurements in advance** *(under normal circumstances yet)* can help increase their **education for better understanding** of radiation risks
- **increase stakeholders and general public confidence to information provided by authorities** both before and during emergency
- **local data** could be **available** even in case of a large/total blackout

Conclusions

- **engaging public in monitoring** performed on voluntarily basis can help **keeping** or even **increasing credibility** of both stakeholders and general public to information and recommendation given by authorities for proper coping the emergency

- for proper **understanding the radiation situation** and giving chance for wide **adopting** necessary radiation **protection measures by the stakeholders and general public**, **they must get appropriate information and education in advance**

Thank you for your attention

Questions?