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INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

THE POTENTIAL USEFULNESS OF CITIZEN RADIOACTIVITY MEASUREMENT TO IMPROVE INSTITUTIONAL MONITORING

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MEMBRE DE ETSON

Conflict situations



- Recent conflict situations (Ukraine, Israel) highlighted the risks for nuclear installations:
  - Infrastructures and energy network become a strategic target
  - Nuclear power plants may become targets
- But also other risks:
  - Resuspension of deposited radionuclides due to military activities in contaminated area of Ukraine and Belarus (especially in the Chornobyl exclusion zone)
  - Threats of nuclear weapons use
- In such a context, environmental monitoring becomes a major concern
  - Availability of environmental monitoring network, especially around nuclear power plants
  - Need for an increased number of measurements in case of nuclear or radiological emergency
- Moreover, two main characteristics of such a conflict situation:
  - A situation with a potential rapid kinetics of dispersion
  - An unknown source term

How managing environmental monitoring in such degraded situations?

- No such previous accidental situations where environmental monitoring was unavailable, excepted some ancient accidents
- Goiania, 1987: absence of environmental monitoring induced a delay of 19 days in the recognition of the radiological nature of the accident.
- Need to explore lessons learn from previous major accidents: Chornobyl, Fukushima
  - During these accidents, the expert environmental monitoring was available and strongly and rapidly implemented.
  - However, in both situations, measurements of environmental radioactivity by citizens rise progressively, during the post-accident phase: ETHOS and CORE programs in Belarus, NGO ETHOS in Fukushima in Japan.
  - These measurement activities are continuing even more than 35 years after the accident.
  - Radioactivity measurement have been demonstrated as a good tool to empower inhabitants living on contaminated territories and effective in reducing mental health troubles



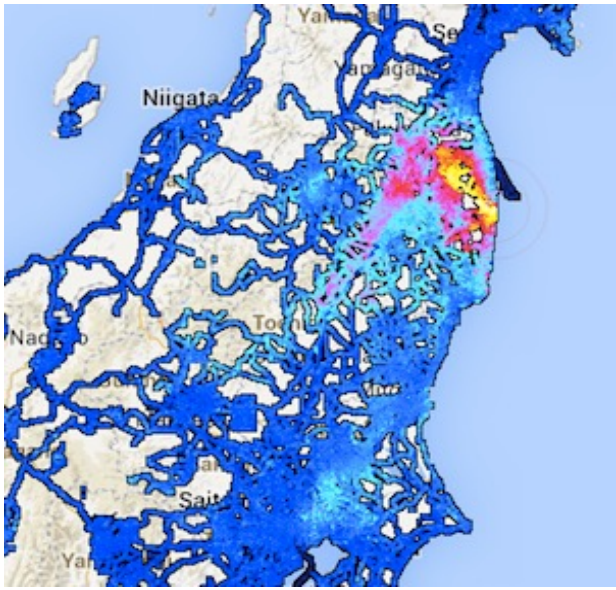
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Citizen measurements could be a solution …

- Several citizen science measurements were developed in the aftermath of the Fukushima accident (Safecast)
- Advantages in situations where the environmental monitoring network is not anymore available:
  - A network of contributors dispersed and potentially abundant
  - A network of contributors independent from energy network
  - A network of contributors able to move
- But some disadvantages:
  - A dependence on the availability of a cell phone network
  - Time needed to develop a network of contributors
  - Training needed, although short.
  - Ethical issues (see later on)



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… but need to be developed before any event

- Numerous projects were developed in the aftermath of the Fukushima accident and disappeared in the following years: Atomtag, Pocket geiger
- Several projects of citizen measurement of radioactivity are currently working: Safecast, Openradiation, Citistra
- How to maintain such projects of environmental monitoring during peaceful time, i.e., in absence of any radiological issue?
  - Absolute need for reliable measurement results
  - Environmental dose rates vary mainly with some environmental parameters: altitude, soil composition, presence of radon
  - Variations of dose rates are usually in a narrow range: 0.04 – 0, 250 $\mu Sv.h^{-1}$



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Potential uses of citizen measurement systems

- Main possible actions in the absence of radiological issue:
  - Education to science and technology
  - Education to radiation protection
  - Awareness-raising actions about nuclear and radiological risks (e.g. training of potential first and second responders: rescuers, firefighters, army, deminers and clearers)
  - Support to citizen network of environmental monitoring
  - Tool for research activities in various domains: physics, biology, environmental sciences, social sciences and humanities, …
- Are such activities sufficient to support citizen measurements tools in a sustainable way?
- Some absolute requirements:
  - Reliability of measurement tools
  - Diffusion of measurement protocols
  - Objective: providing reliable measurements results both to citizen and to public decision

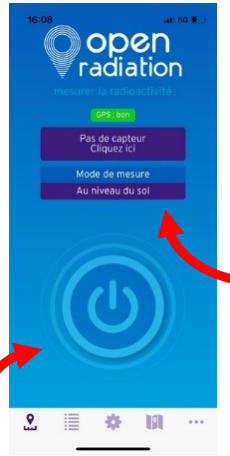
What is OpenRadiation?

open radiation is dedicated to the radioactivity measurements by and for citizens

It is made of three components:

- A detector with an integrated calibration function connectable through bluetooth
- A smartphone application to drive the detector, to collect data (GPS location, date and time, etc) and to send the informations to the web site
- A web site with the interactive map to present the results and to communicate

- Everything is in open source (creative common licence) and open data

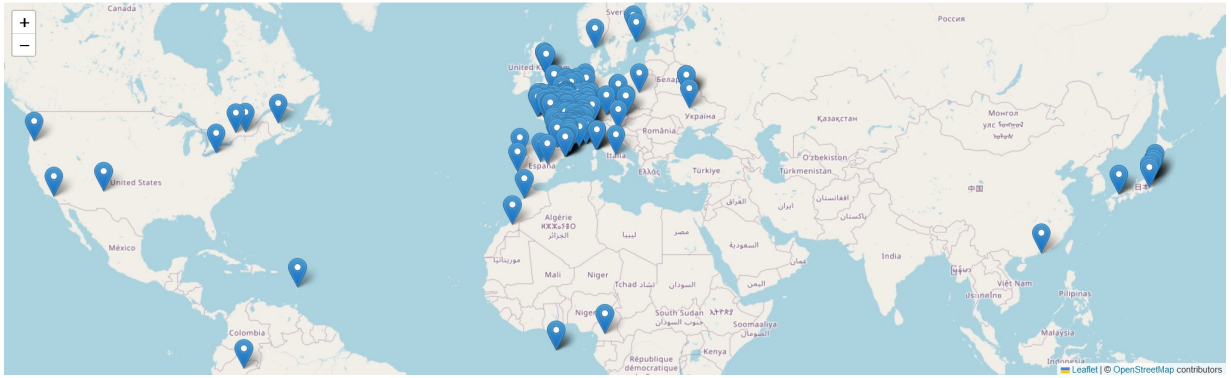




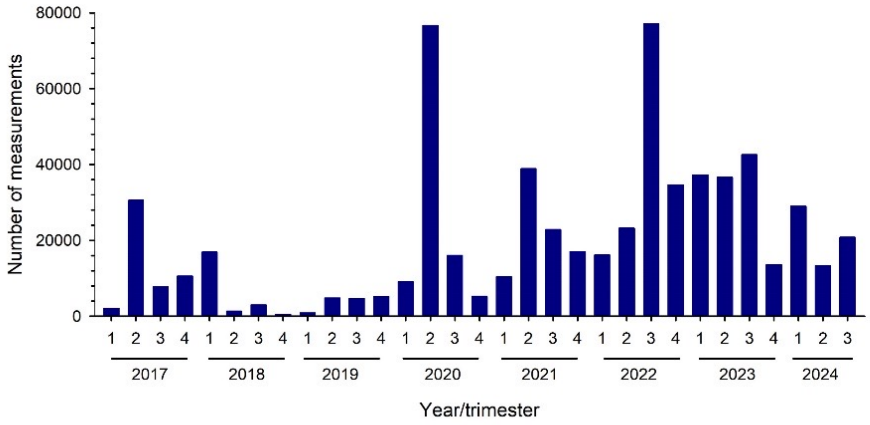


Some data about OpenRadiation

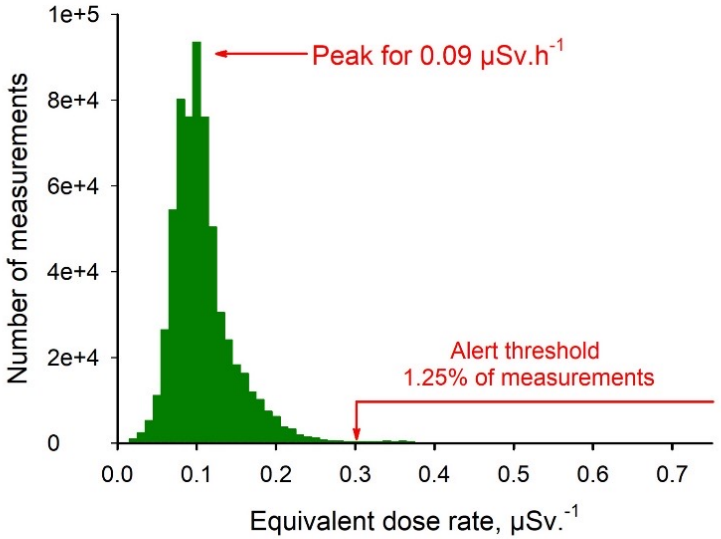
- 300 contributors, worldwide



- < 800,000 measurements since 2017



- An action threshold at 0,3 µSv.h^{-1}



A Guide for citizen measurement

- The French steering committee for the management of post-accidental situation identified a need for a guide to provide some guidance about radiation activity measurement.
- The guide was created with a group including both experts of radiation activity measurements and citizen interested in such measurements
- Requirements:
  - Simple, concise: 11 factsheets for eleven matrix
  - Presenting what is feasible by a citizen and what is not.
  - With 8 annexes explaining some complex concepts and detailing useful information.
- In French only, unfortunately.





FICHE 5

Mesurer la radioactivité ambiante

Difficulté: + Investissement: €€€

L'Homme est exposé en permanence à un bruit de fond radiologique en provenance de son environnement. Dans les situations post-accidentelles, les dépôts radioactifs augmentent la radioactivité ambiante de façon importante. La mesure du débit de dose ambiant permet d'évaluer le niveau de radioactivité sur le lieu de la mesure. En situation normale, le débit de dose ambiant mesuré correspond au bruit de fond radiologique. En situation post-accidentelle, le débit de dose ambiant correspond au bruit de fond radiologique augmenté de la radioactivité due à l'accident. La mesure du débit de dose ambiant rend compte de la présence de la radioactivité dans l'air et de la répartition des dépôts radioactifs dans l'environnement et peut permettre d'adapter son comportement pour réduire son exposition.

Les appareils disponibles

Il est relativement aisé de mesurer l'exposition externe, à l'aide d'appareils accessibles dans le commerce. Ce sont des radiamètres (ou des débitmètres) constitués généralement d'un tube Geiger-Müller. Le résultat est affiché en nanosievert par heure (nSv/h) ou en microsievert par heure (µSv)(4). Ces appareils peuvent détecter des variations de la radioactivité ambiante.

Ces appareils sont autonomes ou pilotés par une application sur téléphone mobile. Dans tous les cas, il est possible de déposer les résultats de la mesure sur certains sites, soit de façon automatique soit de façon manuelle, permettant de les comparer avec ceux obtenus par d'autres utilisateurs.

Ce que ces appareils ne peuvent pas mesurer

Ces appareils ne sont pas adaptés à la mesure de la contamination des produits alimentaires ou de l'eau, de la contamination des sols ou encore à la mesure de la radioactivité dans le corps humain (*voir les fiches-mesures correspondantes*).

Les conseils sur la mesure

Voir la fiche n°4 « Comment réaliser une mesure de bonne qualité ? »

(4) Sur certains appareils l'unité du sievert peut être remplacée par le gray (Gy) pour les rayonnements gamma, ou en taux de comptage (coups par seconde, ou choco par seconde, CPS). Voir la fiche 4 « Les grandeurs en radioprotection ».

Is Openradiation adapted to a degraded situation?

- A secured web site
- The anonymity of contributors is guaranteed
- Possibility to post individual measurement results in an anonymous way
- Possibility to define a specific project to be associated to the measurements
- Some detectors are available for loaning
- The current limitation is to find volunteers at the places of interest

OpenRadiation might be useful in such situations and could be deployed rapidly if there are some active contributors in the area

Ethical issues

- For the Openradiation project:
  - Make free access codes and data but protect personal data of contributors (EU Data protection regulation)
  - All the data are public, none retrieved. Data over the alert threshold are commented.
- During normal situation, some basic recommendations:
  - Do not place yourself in danger, especially dangers others that radiation exposure.
  - Respect private properties and places forbidden to the public.
- During degraded situations, which recommendations?
  - Do not place yourself in danger of receiving excessive exposure (be aware that there may be high activity sources lost)
  - What is an ‘excessive’ exposure? In France some limits exist for public and responder exposures either during emergency or during existing exposure situations.
  - During conflict situations, avoid battle areas, be discrete while making measurements
  - Consider risks of GIS uses, and identification of users that may become highly sensitive data. Should these results be publicly available ? If not, who and how to inform?

Thanks a lot for your attention!

For further discussions

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