IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Enhancing nuclear safety

Modernization of the IRSN's remote sensing network

TSO conference 2018

PSE-ENV/SIRSé
16/10/2018
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Topics

Introduction

Framework

From 2007 to 2018

Technical challenges

Conclusion

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- **IRSN** is the French national technical support organization on radiation protection and nuclear safety risks

- **Environmental monitoring** is one of the goals given by the French regulation to IRSN at its creation in 2002, in collaboration with French national authority ASN

- The main goals of radiological environmental monitoring are (**during peacetime or emergency situation**) :
  - Establishing knowledge about environmental levels to **define normal situation** : permanent monitoring all over France
  - Alarming : being able to **detect any abnormal increase** of radioactivity levels and to characterize it (natural or artificial)
  - Ensuring a **complementary monitoring** made by the operators of nuclear installations : independent monitoring strategy
  - Protecting population : providing data to allow calculations to **estimate doses or consequences on population**
  - Data dissemination : providing as quickly as possible relevant **information to public** to ensure transparency

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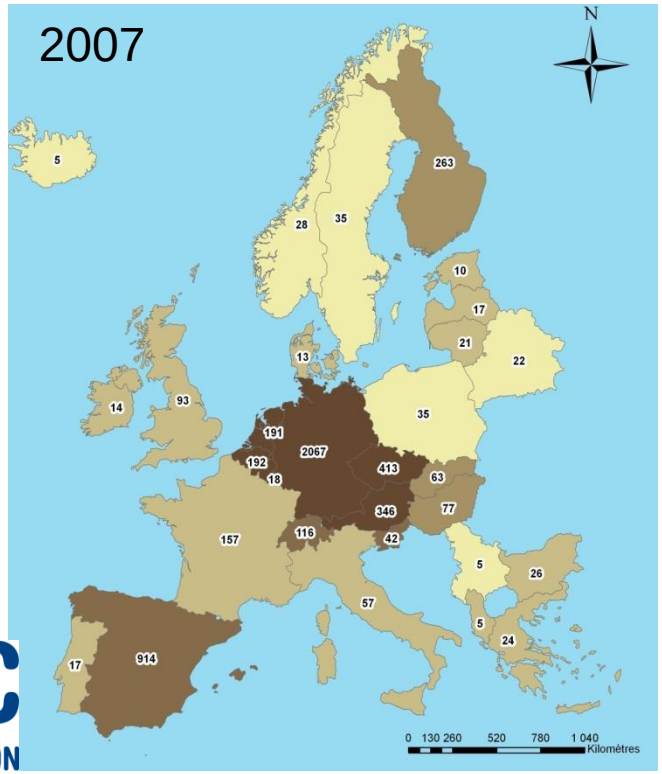
- Téléray network was established in 1991, following the accident of the Chernobyl NPP
- In 2007, a deep technical analysis led to consider that the components of the network became dramatically obsolete
- A survey over Europe was done to feel how the other countries were working
- Strategies are depending of national policies, the existence of nuclear installations or not, size of the country, culture, financial resources, history, etc.
- “Compromise” is the key



JRC
EUROPEAN COMMISSION

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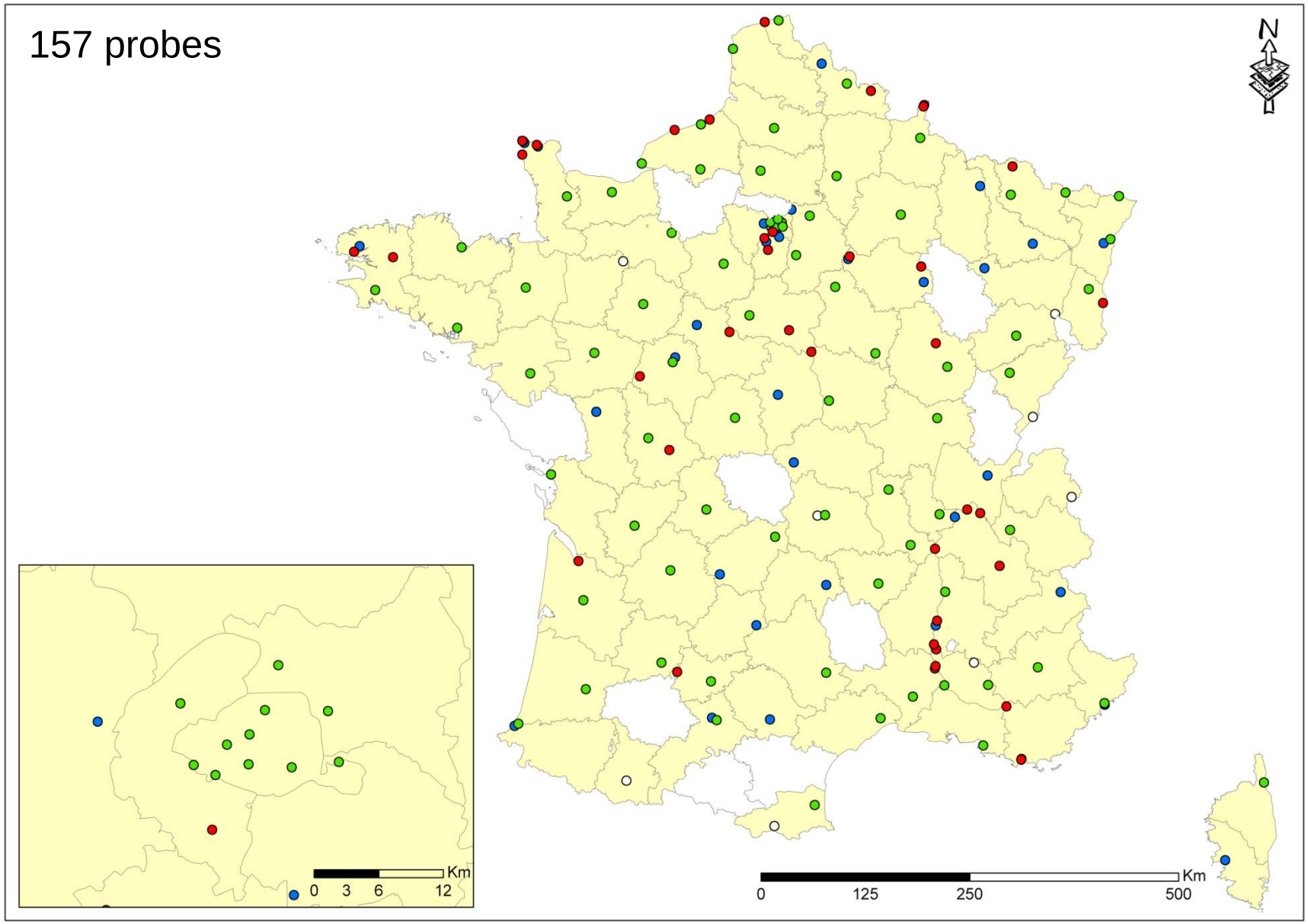

157 probes
N
Km
0 3 6 12
Km
0 125 250 500

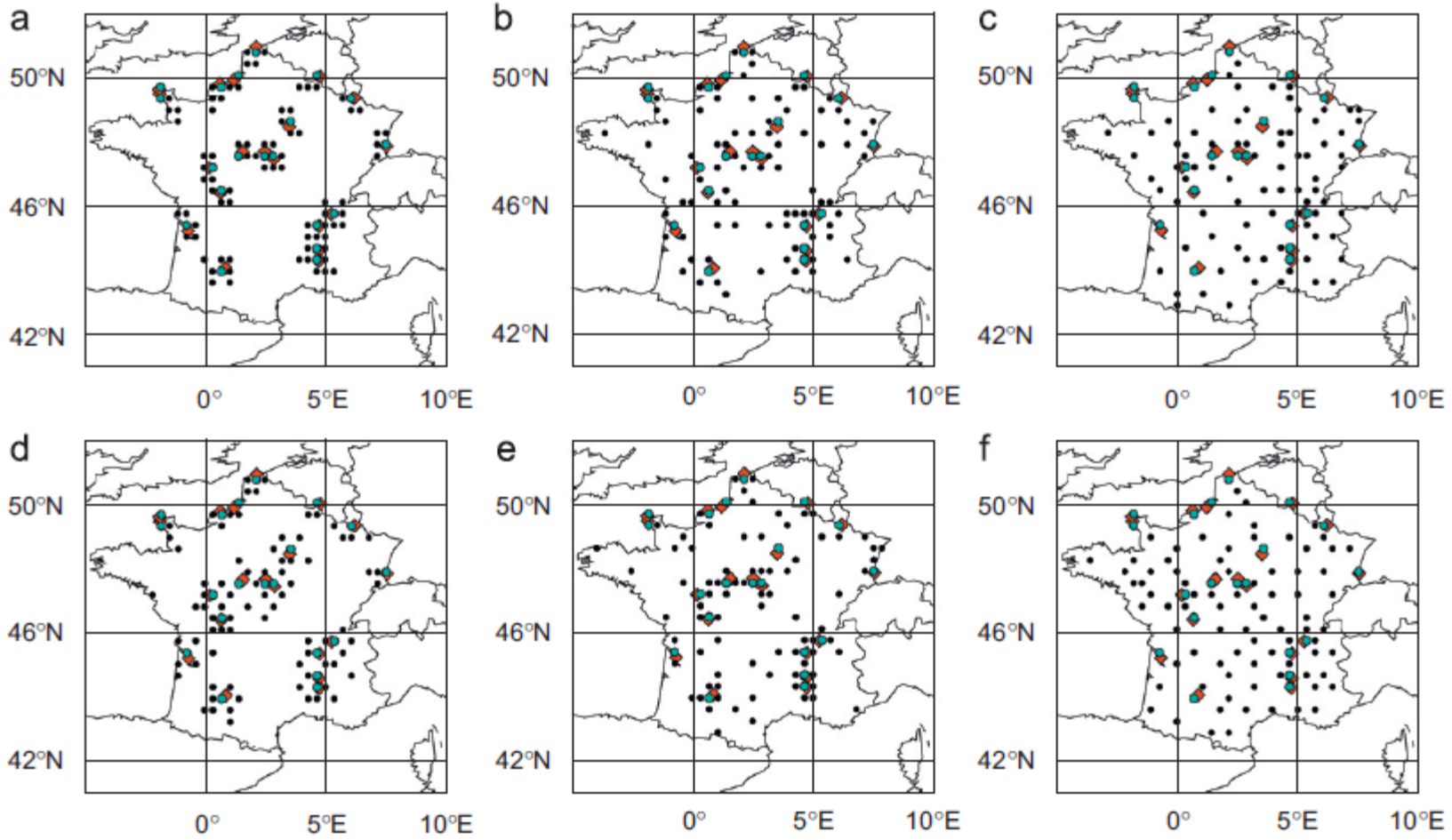
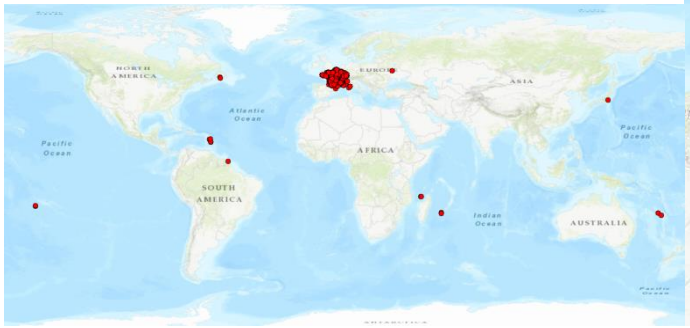
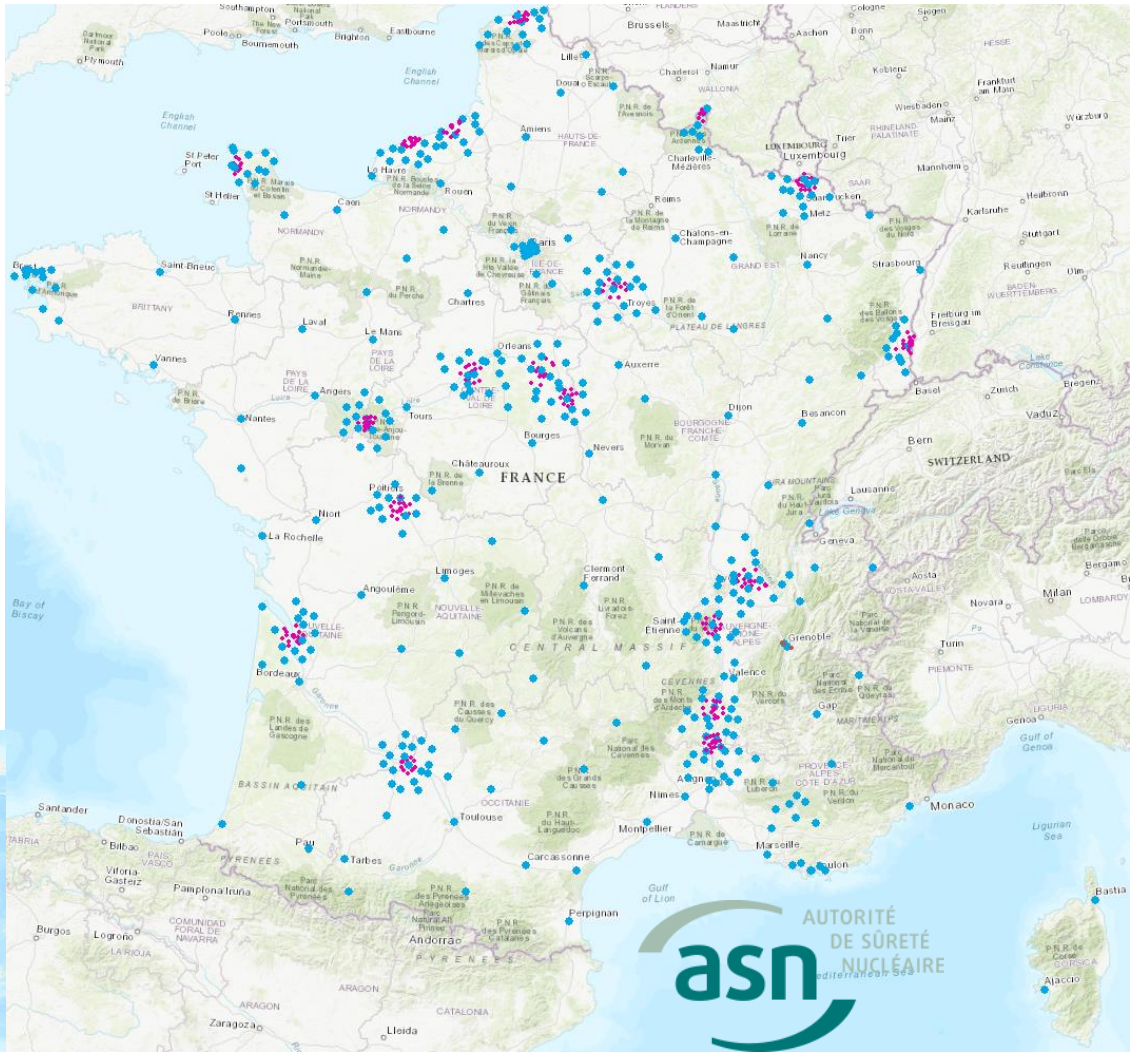


Fig. 5. Optimal design of size $n = 100$ obtained by SA using kriging (upper line) and closest point (lower line). (a) Optimal design obtained for $\alpha = 2$. (b) Optimal design obtained for $\alpha = 1$. (c) Optimal design obtained for $\alpha = 0.5$. (d) Optimal design obtained for $\alpha = 2$. (e) Optimal design obtained for $\alpha = 1$. (f) Optimal design obtained for $\alpha = 0.5$. The monitoring stations are depicted with dots, fixed stations are marked with disks, rhombus show nuclear sites locations.

- As a compromise, it was decided to implement probes on the major cities over France and to focus on the populated areas around nuclear installations (between 10 to 30 km)

- Today
  - **420 probes**
    - ~ 100 probes on major cities
    - ~ 300 probes around nuclear sites
  - **~ 500 probes** operated by nuclear operators (10 km area)

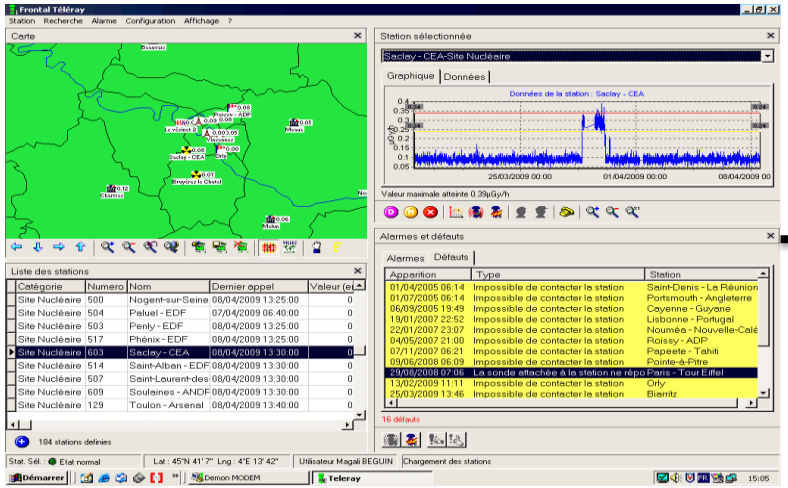


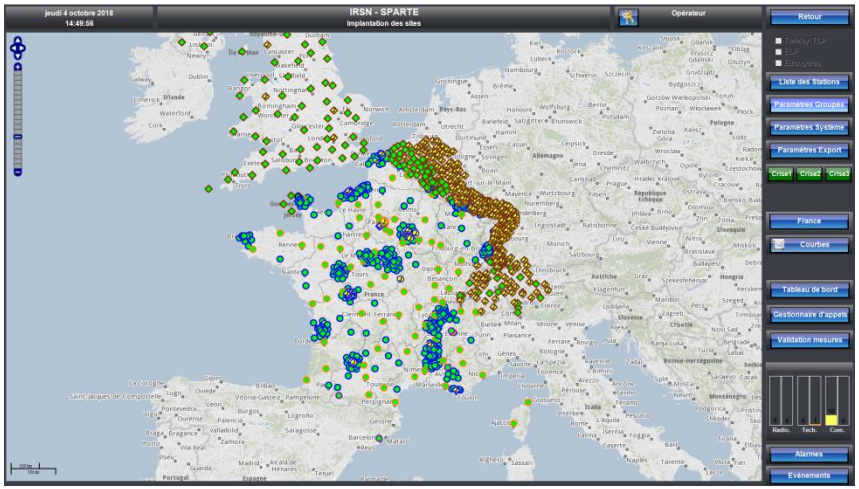


2009 → 2018

GM tube → Proportional counter

Telephonic lines → xDSL - MPLS





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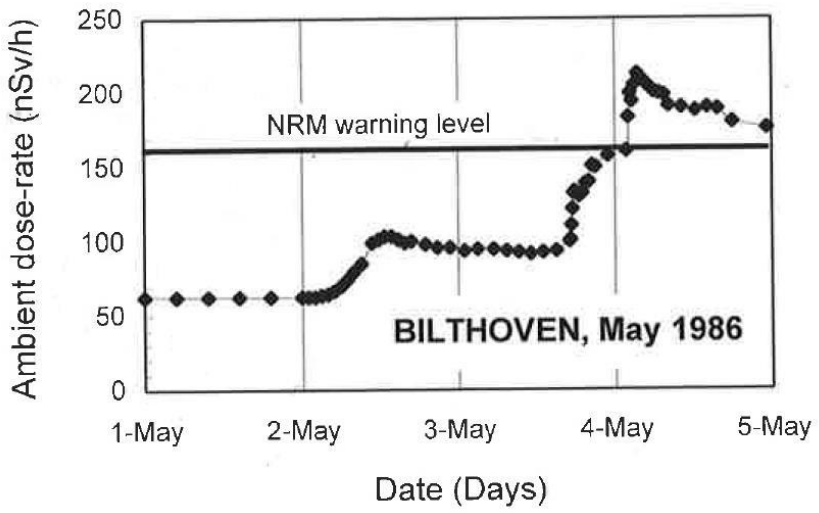
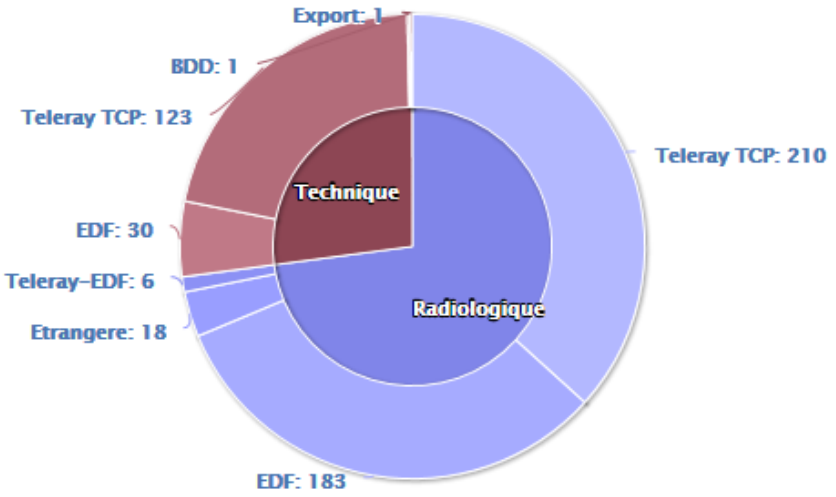


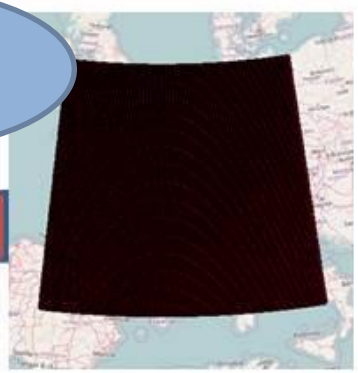
Some progress to improve the detection capability of the early warning network were made

572 alarms during 1 month

Today, the supervising system allows to detect increases of 40 nSv/h including geographical criteria to (try to) escape from false positives… but still a lot !!!



Dispersion modelling



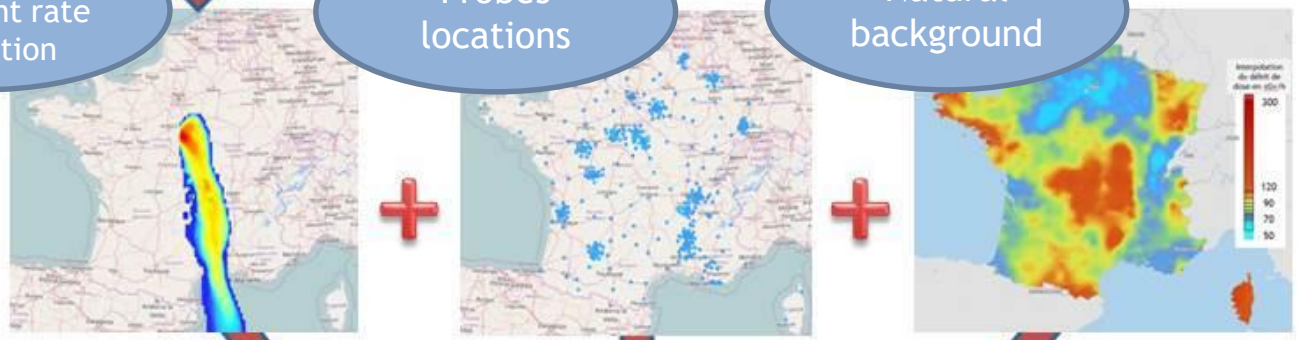
Simulating many releases with dispersion modeling tools using yearly data

Extracting added values

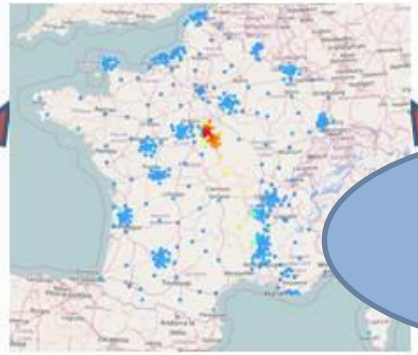
Ambient dose equivalent rate estimation

Probes locations

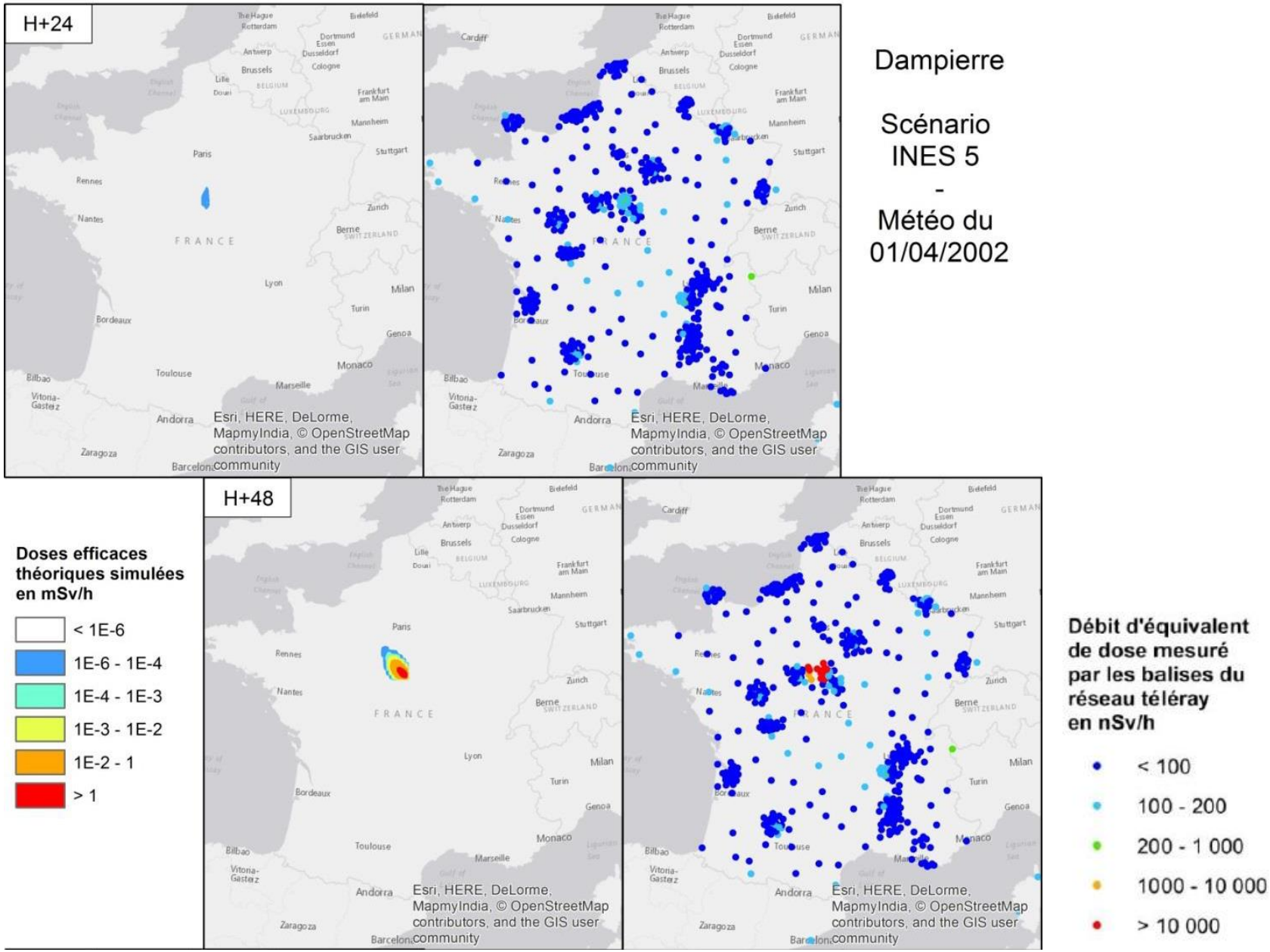
Natural background



Merging scenario and real life



Background + Ambient dose equivalent rate estimation

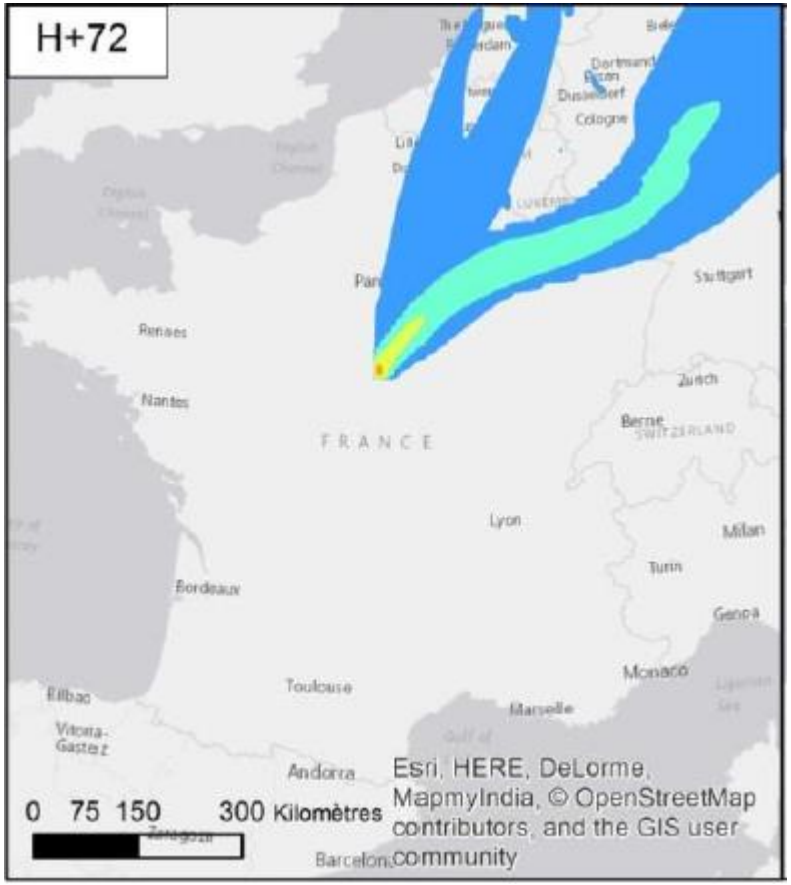


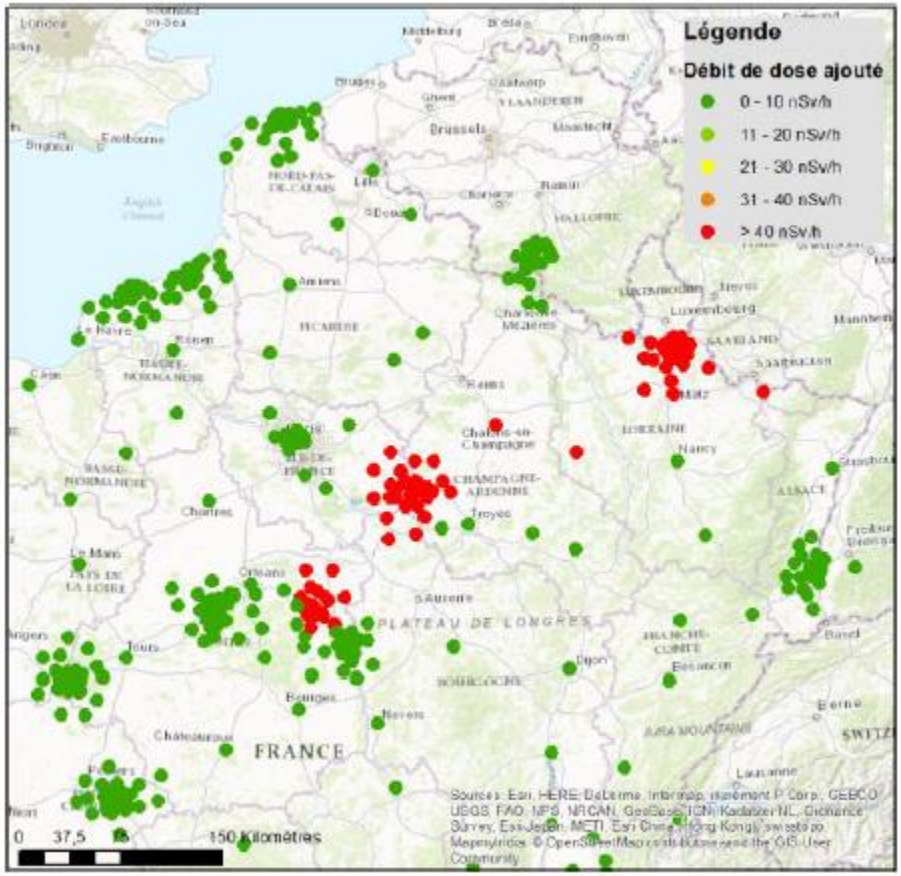
Dampierre

Scénario INES 5

-

Météo du 01/04/2002





The detection capability is OK but for certain small releases, the ambient dose equivalent rate doesn't increase so much → not a sanitary problem but a metrological challenge because the acquisition period is 10 minutes.

- In most cases the early warning network is able to detect very fast increases of the dose rate in less than one hour, based on alarming threshold > 40 nSv/h and at least 3 probes detecting almost simultaneously within 1 hour

- For one INES 5 scenario, depending of specific weather conditions, detecting the release and/or deposition is not possible before…
  7 hours… because the dose rate is low…

- Improvements are necessary to be able to decrease the threshold but also to avoid from false alarms

- Increasing the amount of probes could be a solution and…

- … 25 spectroscopic probes will be installed in 2019 close to nuclear installations → higher efficiency and nuclide specific identification

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- After this modernization phase :
  - The amount of probes seems OK but optimization still possible
  - Increasing amount of probes increases maintenance and costs
  - New monitoring techniques have to be considered in this strategy : aerial monitoring, gamma spectroscopy…
  - IT performance is going fast, we have to find new tools for online data analysis
  - Finding locations to install probes is a tricky problem

- Fukushima feedback showed how important an early warning network is relevant in the early phase, especially for gas and iodine timeline monitoring linked with inverse modeling techniques

- This feedback also demonstrated how fast and efficient the aerial radiological monitoring capability is, especially where no probe is located : IRSN has developed this tool.

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Dispersion modeling: provides prognosis and deposition estimation

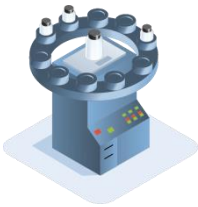
Early warning network: fast time series monitoring with high kinetic capability

Aerial measuring system (fixed wing aircraft and helicopter): allow to provide a fast and complementary overview of the situation

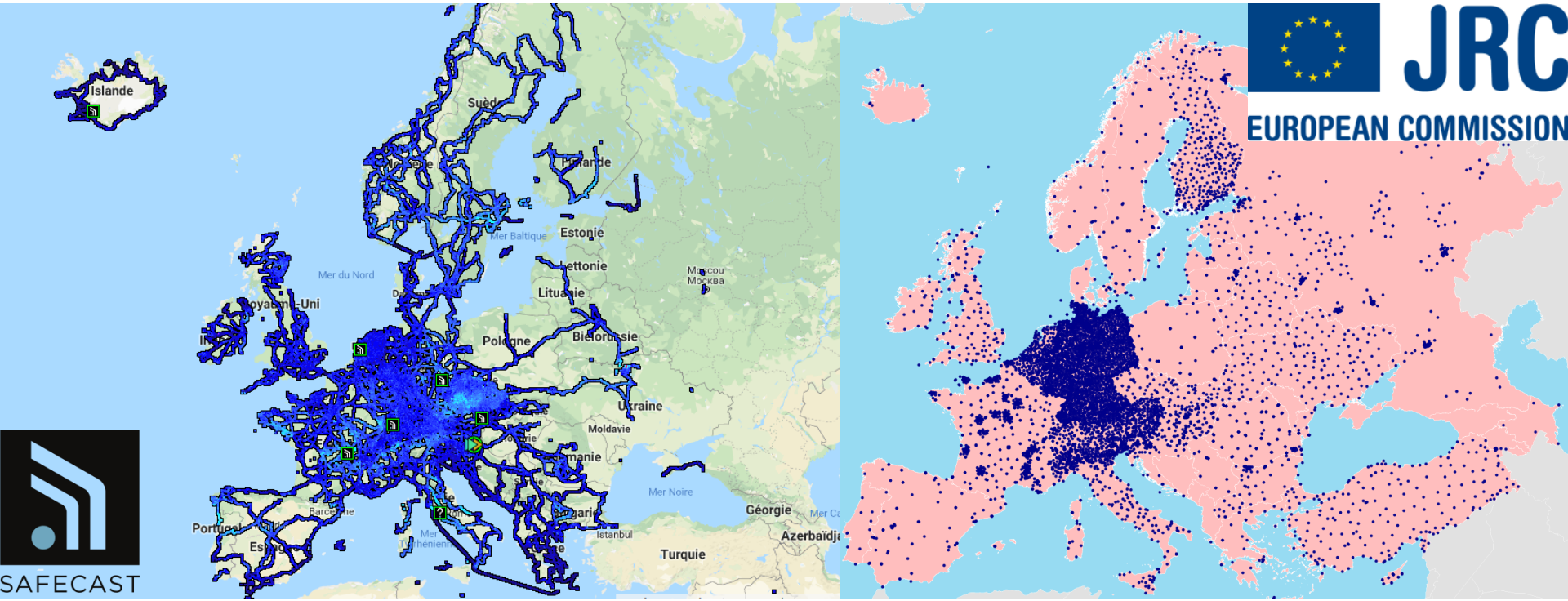
Ground vehicle surveys (carborne) : provides comparison datasets with higher resolution

In situ gamma spectrometry coupled with field samplings

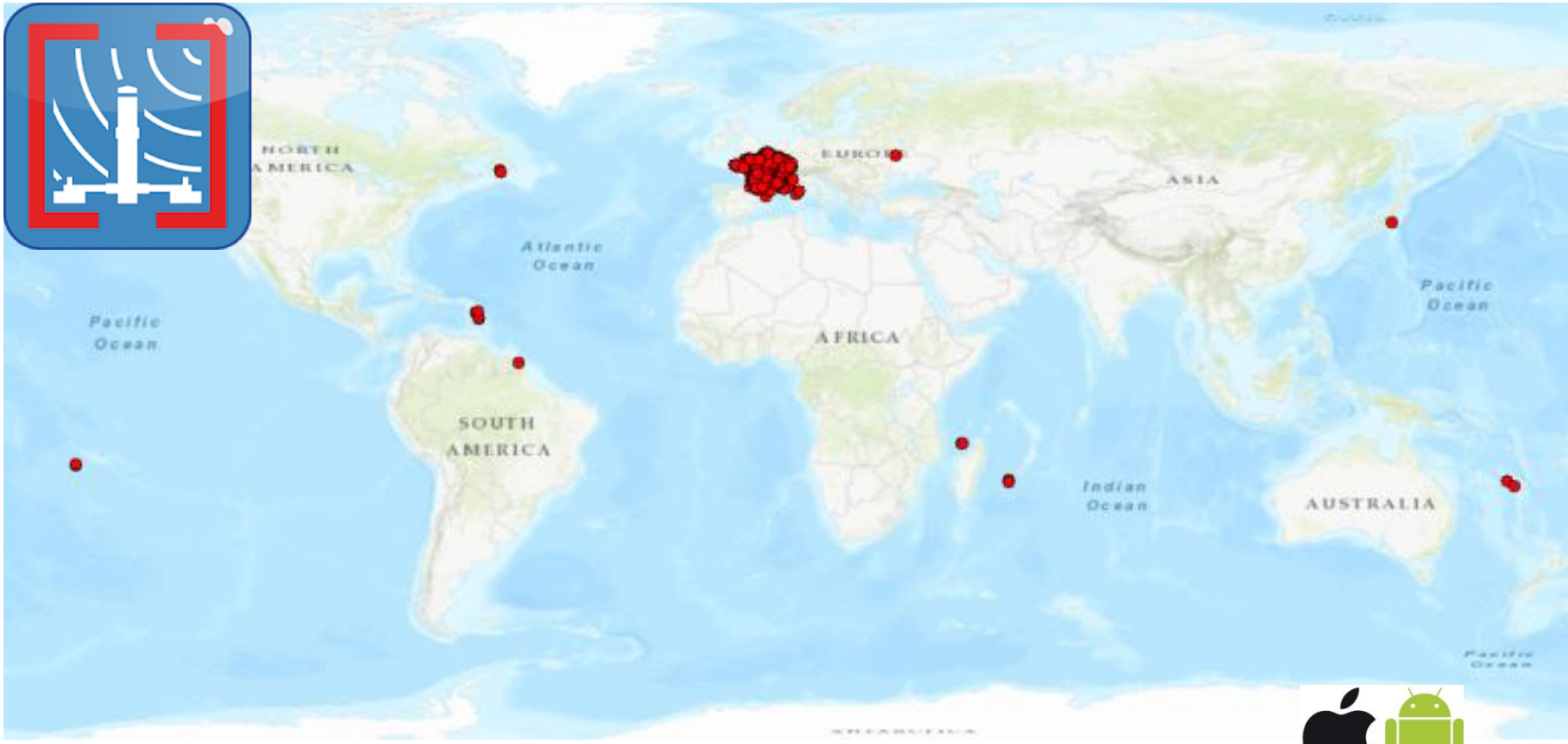
Environmental samplings measured in mobile laboratories or in fixed laboratories

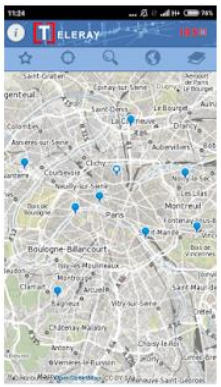


… environmental radiological monitoring monopoly is an old story…



citizen monitoring and social media should be given special attention related to institutional monitoring





FEEL FREE TO DOWNLOAD THE "WEBTELERAY" APPLICATION ON YOUR SMARTPHONE !