CENTRE D'ÉTUDE SUR L'ÉVALUATION DE LA PROTECTION DANS LE DOMAINE NUCLÉAIRE

What is at stake for the development of a holistic approach for the management of radioactive pollution?

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What do we mean by a holistic approach? (1/2)

- **Holistic approach:**
  - Analysing a problem or a system as a whole including its multi-facets and not focusing only on each part separately

e.g. **Sustainable Development**
- emphasis on the interdependency of humans and the environment

What do we mean by a holistic approach? (2/2)

- **The complexity of the issues to be addressed in the assessment and management of radioactive contamination, call for the application of a holistic approach**

- **Issues to be covered:**
  - Definition of releases and zones of contamination
  - Scientific understanding of environmental transfer of radionuclides and impacts on biota (agricultural sector and wildlife)
  - Ability to model and predict the evolution in space and time
  - Efficiency and acceptability of protection strategies and waste management
  - Governance and ethical issues including considerations on:
    - Socio-economic impacts
    - Participatory processes
    - Sustainability of the strategies, including future generations
    - Contribution to overall well-being of people, including individual and collective resilience and vigilance
    - …

(some) Ethical Aspects contributing to the well-being

	Dignity/ Integrity	Justice	Prudence
Public	Self-help, participation	Distribution of exposure and risk, zoning and boundaries	Balancing uncertainties
Farmers /Fisheries /Tourist sector	Loss of control over livelihood	Differences in distribution of benefits and cost	Consequences of changing intevention levels
Environment /Wildlife	Changes in perceptions of environment	Consequences for future generations Changing access to environment	Balancing radiation impacts with management impacts
…. etc.			

Different actors will be affected in different ways: need to engage with different stakeholders

Holistic Approach in NERIS Roadmap

- **Key features for the development of a trans-disciplinary / holistic approach and inclusive framework:**
  - Further developing emergency response and recovery frameworks,
  - Better addressing stakeholder engagement processes,
  - Integrating non radiological aspects into the management strategies, including:
    - Health surveillance
    - Ethical issues
    - Socio-economic aspects
    - Environmental impacts of remediation (benefits and costs)
  - Coping with uncertainty and incomplete information regarding environmental and health impacts of the accident.


Photo by Tetsuo Yasutaka

Some Challenges related to Session 1

'Processes and environmental factors influencing the water- and solid-mediated fluxes of radionuclides from source to ocean'

What releases from the contaminated site?

- Release type
  - Direct liquid release
    - To river then ocean
    - To ocean (coastal facilities)
  - Contamination due to the plume deposit
    - Direct water contamination
    - Delayed contamination due to watershed runoff
  - Both (Fukushima)

- The water transport of contamination is, after the atmospheric dispersion, the processes which can modify the contamination distribution the most, the main one in Post accidental situation.
  - The related risks need to be assessed and forecast soon

What are the vulnerabilities ? What is at stake for decision makers, for populations ?

- Water supply
  - River contamination or ground water (slow) contamination → Doses
  - Contamination of drinking water treatment plant and distribution network → Economic
  - Sensitive commodity for population (Fukushima)
    - Stakeholder : Need to take into account this sensitivity, and how to disseminate relevant information, putting into perspective the different risks at stake.
  - Risk for delayed issues (watershed runoff, flood)

Considering different pollution scenarios, what are the risks?

How to anticipate/forecast ? What kind of strategy to limit the consequences?

- Accumulated zones
  - Risk for delayed or unpredictable increase of contaminated food
    - Rice field in Fukushima which collected contaminated water from runoff.
  - Forest, mountain effects → complex situation

How the scientific development can help identify such situations and assess the risks?

What are the vulnerabilities ? What is at stake for decision makers, for populations ?

- Crop irrigation & fish farming
  - Food contamination → doses
  - Economic impact : irrigation restrictions, exceedance of Maximum Permitted Level in food
    - Tricastin accident (2008) :
      - Irrigation ban induced crop losses

What kind of protective/remedial actions ?

- Recreational use : fishing, aquatic sports…
  - Tricastin/Fukushima : lake bathing ban; fishing ban …

What could be the decontamination strategies ? Cost/benefits ?

- Detrimental effects due to restrictions in access and loss of image
  - Tourism → loss of image effect, restrictions effect.
  - Loss of consumer trust in critical products (e.g., local specialities) or Consumer bans for critical products

How to share a common understanding of the situation among the different stakeholders ?

Some Challenges related to Session 1

How the scientific development can help to :

- **assess and forecast the risks (RP, env. , socio-eco),**
- **inform the decision making process (develop and test strategies)**
- **and influence the organization of the vigilance (environmental and health surveillance, socio-economic aspects involving all the different actors) ?**

➜ Requires stakeholder dialogue and engagement to ensure that the information provided by the scientists is relevant to the needs and concerns of affected populations.

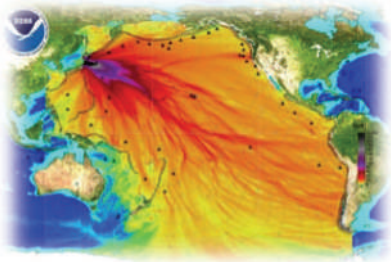
Some Challenges related to Session 2

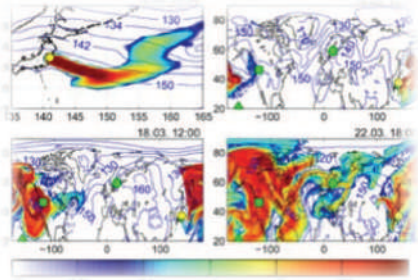
'Combination of model predictions and measurements (big data sets) in various situations'

General Comments

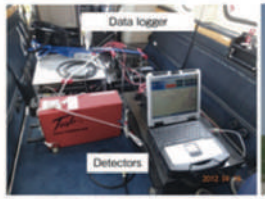
Models:

- Can propose projection of the environmental contamination, estimation of ambiant dose rates, *etc.*
- Can predict the evolution of the situation and the influence of different management scenarios





Monitoring post Real-time dosimeter



Airborne radiation monitoring

http://jolisfukyu.tokai-sc.jaea.go.jp/fukyu/mirai-en/2012/1_6.html

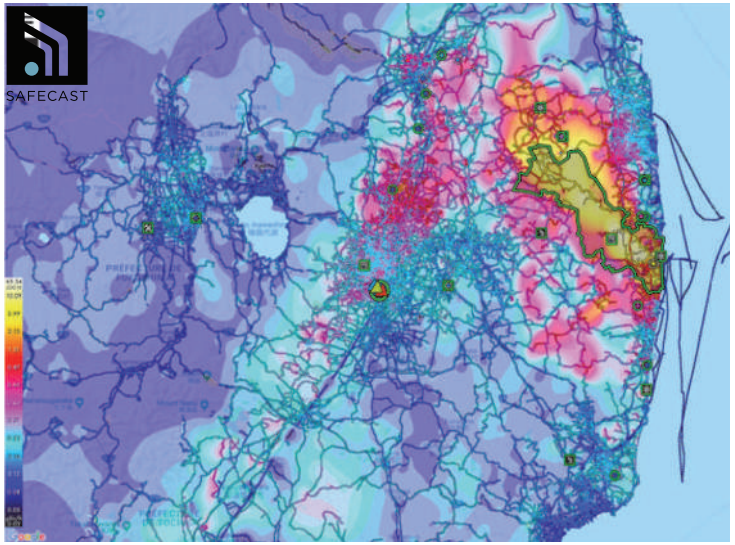
Environmental measurements:

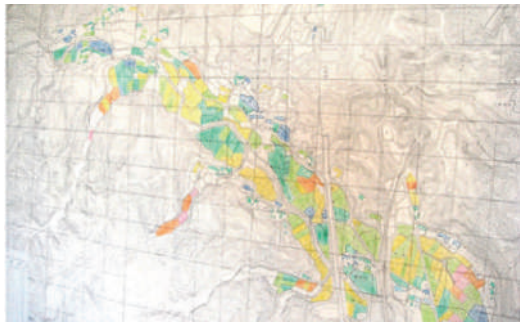
- Key information to refine models and try to reduce the related uncertainties
- Need to manage a large set of data produced with various protocols, at different scales, etc.

What are the lessons learnt from Fukushima?

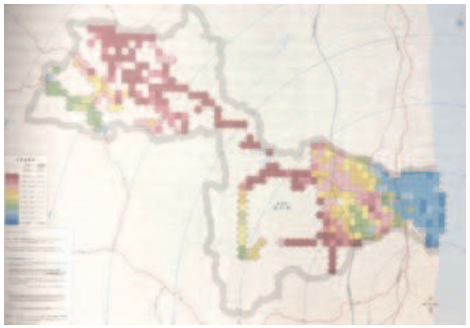
Multiplicity of measurements (1/2)

- **Mistrust towards authorities, official institutions → multiplication of citizen measurements**
  - Allow populations to characterize their own environment
  - Help populations to understand what is at stake in their own environment, how they can behave to avoid potential contamination
- **Multiplication of measurements (1/2)**
  - Ambient dose rates, soil contamination measured by NGOs, citizens, local municipalities…





Suetsugi Village contamination map



Namie Village contamination map

Multiplicity of measurements (2/2)

Multiplication of measurements (2/2)

- Foodstuff contamination measured by local population, NGOs, cooperatives…

http://en.minnanods.net

Massive amount of data

- Many measurements/actors : official, NGO, public etc.
- Data produced by local initiatives are often untapped and not shared
- Very heterogeneous data (quality, type) which could be a challenge for expertise: how to comment? How to deal with discrepancies and variabilities?

How to coordonate all these initiatives (local + national)?

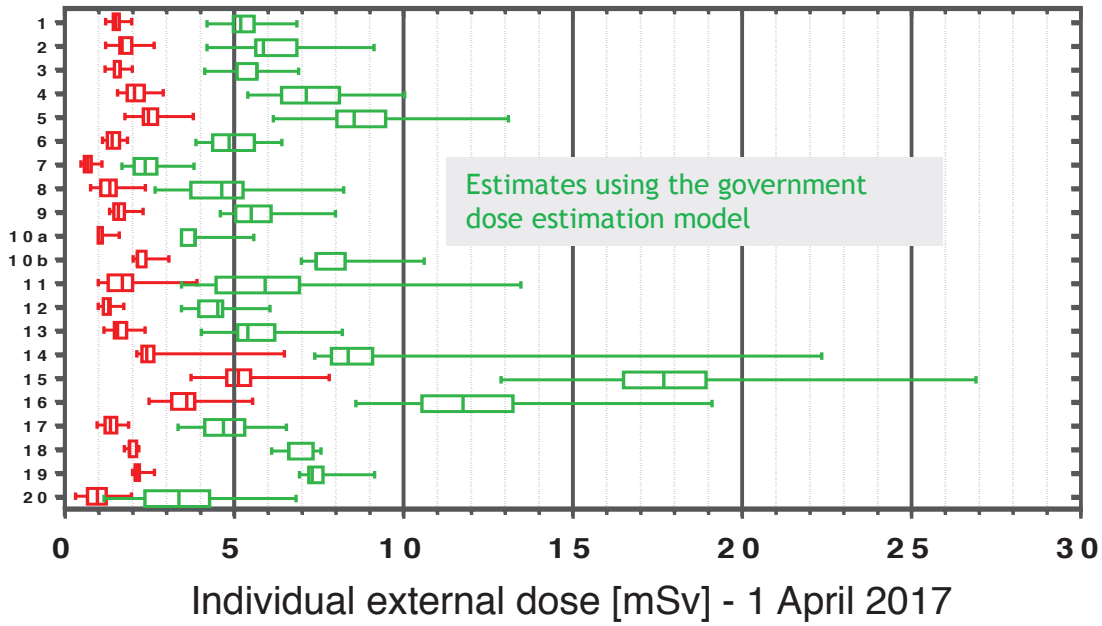
How to consider these citizen data and integrate it to models?

Estimated dose Vs Accurate dose (1/2)

- The initial modelling approach relies on average parameters to assess zones. By definition, it can not (and should not pretend to) reproduce individual exposures.
- Solutions can be found that enrich such assessments using a range of parameters which could be based on local specificities and local habits (perhaps assimilation process).
- This could be useful to forecast more realistic exposures and maybe to lift protective actions /reduce zones.
- What are the expectations of the pubic and decision-makers or What expectations do people in relation to the decision-making

Estimated dose Vs Accurate dose (2/2)

- Development of individual dosimeter (D-Shuttle)
  - Another lever to help people to understand what is at stake
  - Estimated doses (from the ambient dose rate) and accurate doses: 4 times higher -> can help local population to put the real situation into perspective



From W. Naito et al., J. Radiol. Prot. 37 (2017) 606

What other scientific developments can help this way?

How to refine predictions?

What consideration of socio-economic aspects?

- There is basically a 'gap' between pure modelling outputs and decision makers questions/issues which tends to encompass all consequences at stake in an affected territory
- Need to better translate modelling output in concrete/operational stakes
- Models do not allow to take into account local specificities or socio-economic aspects of a territory
  - In Belarus, inefficiency of decontamination work as some local practices were not taking into account *(chimney fire with contaminated wood and ash spreading)*
  - Yamakiya case – Despite decontamination work, paddy fields are still contaminated as very few farmers came back. Irrigation canal / paddy fields need to be cleaned ⇾ lack of manpower.

How to put into perspective the results of the models in a broader view taking into account all aspects of a territory ?

CONCLUSION - TRANSVERSAL ISSUES

Transversal Issues

The management of a radioactive pollution relies on major components:

- **The temporal dynamic of a territory** *(evolution of the contamination, effectiveness of the countermeasure strategies, socio-economic changes, etc.)*
  - **How the scientific development can take into account these aspects?**
- **The spatial variability and its consequences on exposures**
  - **How the scientific development can help to assess more realistic exposures?**
    - **Development of individual monitoring devices and related assimilation process**
    - **How to take into account local habits, etc. And how to develop statistical approaches to assess the variability of doses among affected population**
- **Need to build a long-term governance**
  - **How to involve all the different stakeholders (authorities, experts, health professionals, population) in the decision-making process? And coordinate the actions?**
  - **How to develop an holistic approach for that purpose (environmental, health, socio-economic aspects)?**
  - **How models can contribute to make an informed decision?**