Uncertainties that decision makers, affected population and emergency responders may face during a nuclear emergency

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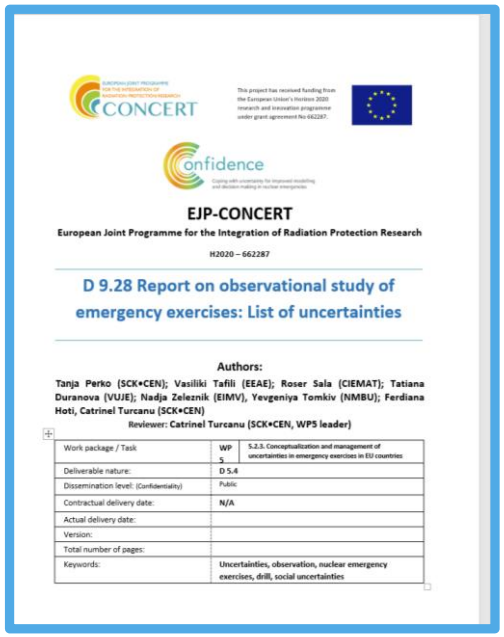
Objectives of this research

- to identify uncertainties in emergency response;
- to gain insight in the way uncertainties are addressed and handled during emergency exercises by looking at the information flow and communication between actors, as well as the assumptions and decisions made under emergency exercises;
- to make a list of uncertainties



EJP-CONCERT

European Joint Programme for the Integration of Radiation Protection Research

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D 9.28 Report on observational study of emergency exercises: List of uncertainties

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Methodology: Collection of data
Observation of emergency exercises

- **Non-participatory observation** as a technique for the systematic study of human behaviour
- (Barner-Barry, 1986; Liu and Maitlis, 2010)
- **6 Countries**
- **11 national + 1 international nuclear or radiological drills**
- **29 observation points**

Preparation for decontamination of high school students in one of the 6 participating countries.

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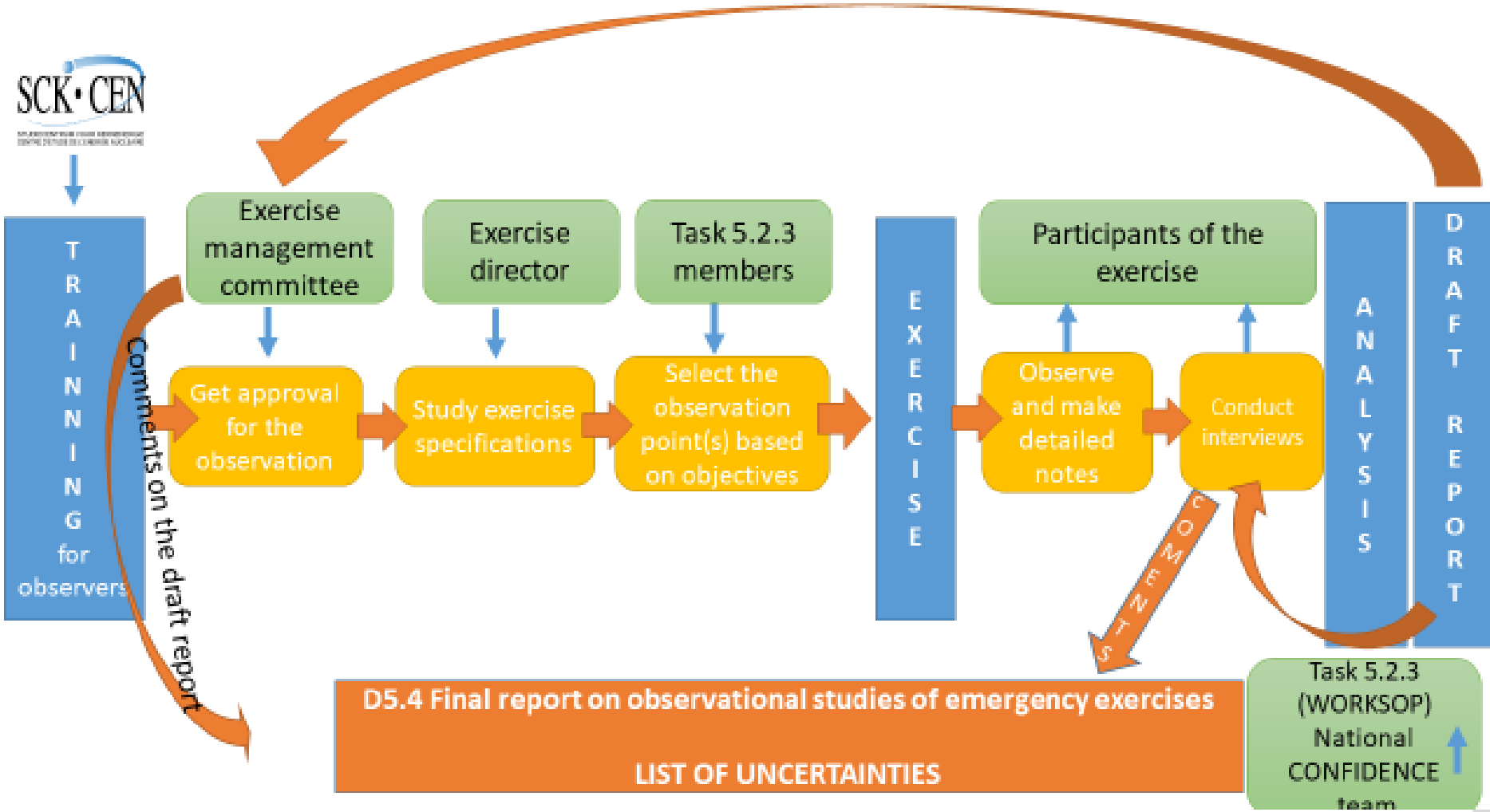
Method

Perko et al. (2017), *Research design for the observational study of emergency exercises in selected CONFIDENCE countries: Guidelines for researchers*



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Data collection

Data management

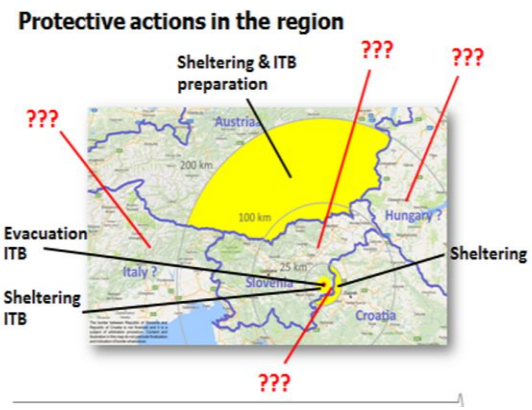
Data analysis

Field notes

Anonymized

An example:
Uncertainty: How to coordinate cross-border aspects?

- *"Protective measures are not harmonized. - One country has different values for children (10mSv) than for adults (50 mSv), the other not, they have only 50mSv";*
- *"You would give tablets to your children but what about our children. Where would you provide tablets to our children? At your embassy?";*
- *"How to implement 360 radius if it includes neighboring country with other intervention levels?";*
- *"I would suggest to have emergency plan for the border and not national emergency plan";*
- *"There is a foreign ship in the country proximity. Who does what?";*
- *"But the decision for this is probably too complicated to be taken around this table – decisions belong to nation – ministry and prime minister";*
- *"Will neighboring country be informed before starting sirens in Emergency Planning Zone?"; "*
- *"Understanding of what coordination means is an issue";*



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An example:
Uncertainty: Will people follow the instructions or recommendations given?

- *"Will we face self-evacuation, and voluntary evacuation?";*
- *"Some people did not come to the assembly room but remained instead at their desk or outside of a building, working.";*
- *"If it is real accident I will surely call home."*
- *"How to force people to understand how we do this and to follow our instructions?";*
- *"Take a coat, possibly evacuation will take place. - An answer: I will take it later";*
- *"Please, attention. 4 people did not sign the list. Please, come on here and sign";*
- *"Some employees did not use protective measures passing to shelters/assembly points";*
- *"Children coming out first are staying in a group. Do not hear the instructions; do not pay attention and don't listen."*
- *"The use of mobile phones and consuming food is not permitted." This was ignored. A lot of people were still using their mobile phones.";*
- *"Woman shouting: Call ambulance, I do not want you, no fireman, call ambulance, I am in pain";*

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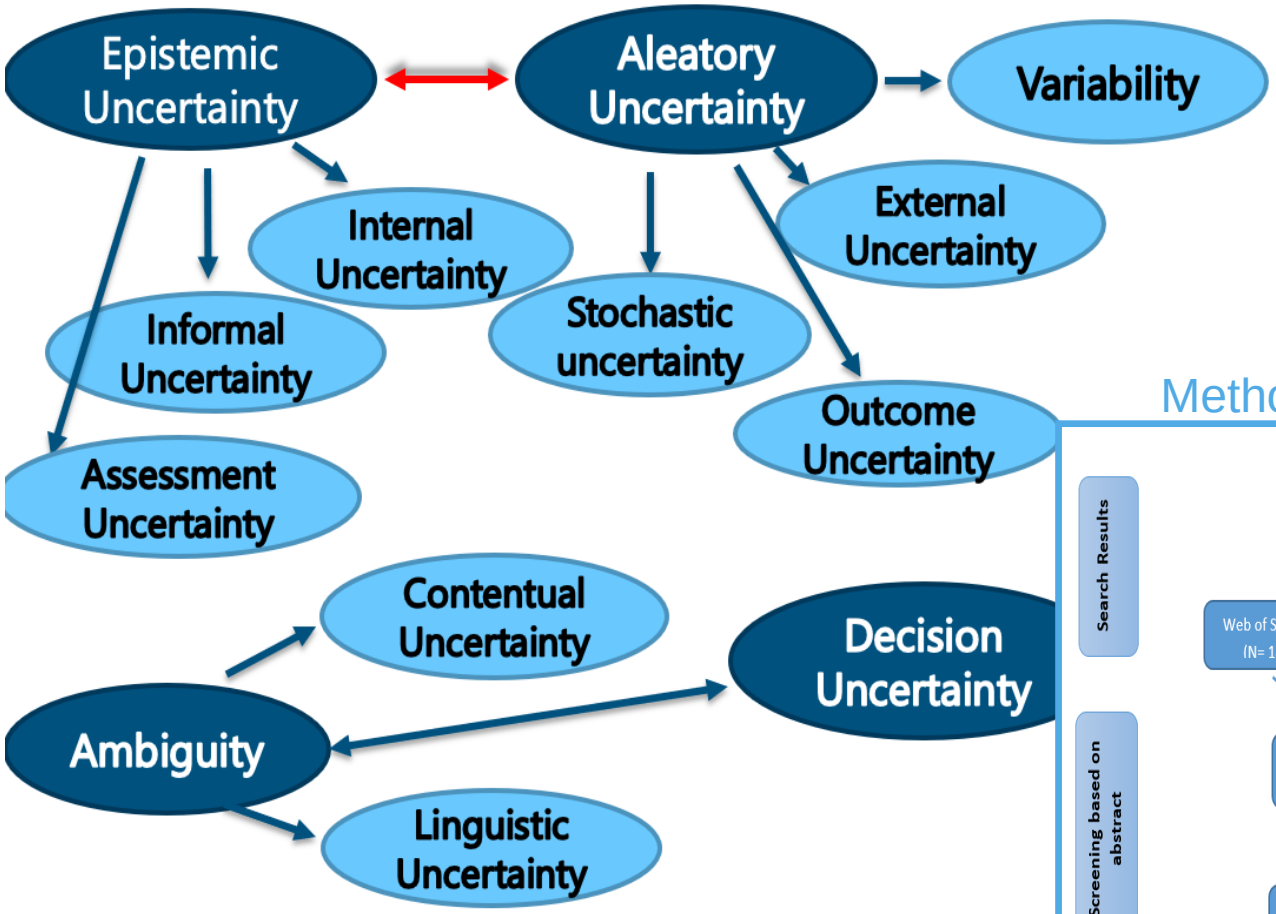
Uncertainty definition based on sources and types:
Literature review (N=54 scientific articles)



Method: systematic lit. review

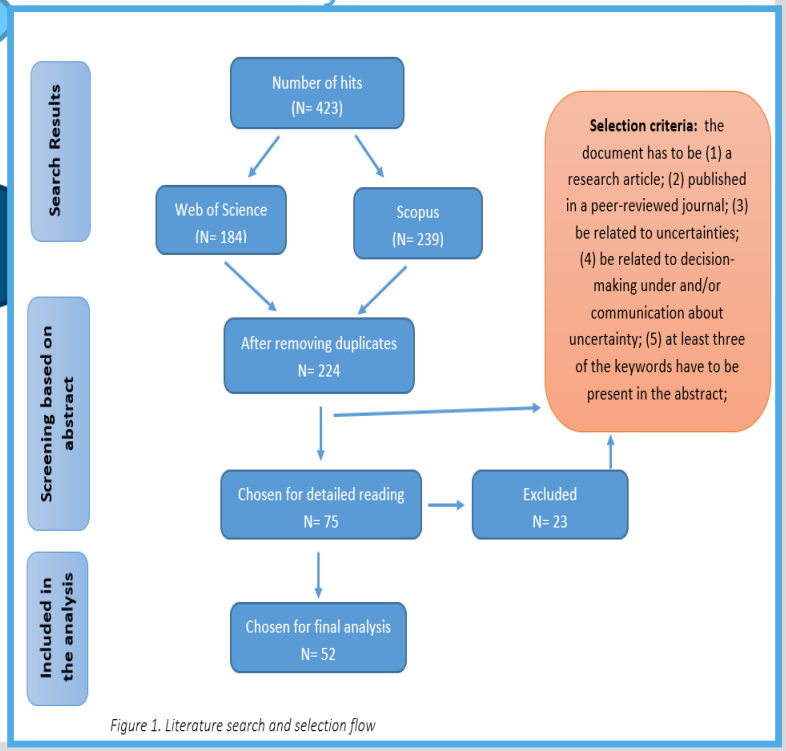


Figure 1. Literature search and selection flow

Source: Hoti F. et al; 2019, SRA Benelux

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Classification of uncertainties based on a decision-making process

Knowing - Judging – Deciding – Implementing - Evaluating

UNCERTAINTIES

- **Knowledge uncertainty** is related to lack (or availability) of knowledge or information;
- **Judgement** uncertainty is related to balancing options;
- **Decision** uncertainty is related to prioritizing which option to choose;
- **Implementation** uncertainty is related to how to take actions based on the decision we made? How to put it in practice
- **Evaluation/Monitoring** uncertainty is related to observation (What did I do and with what effect)

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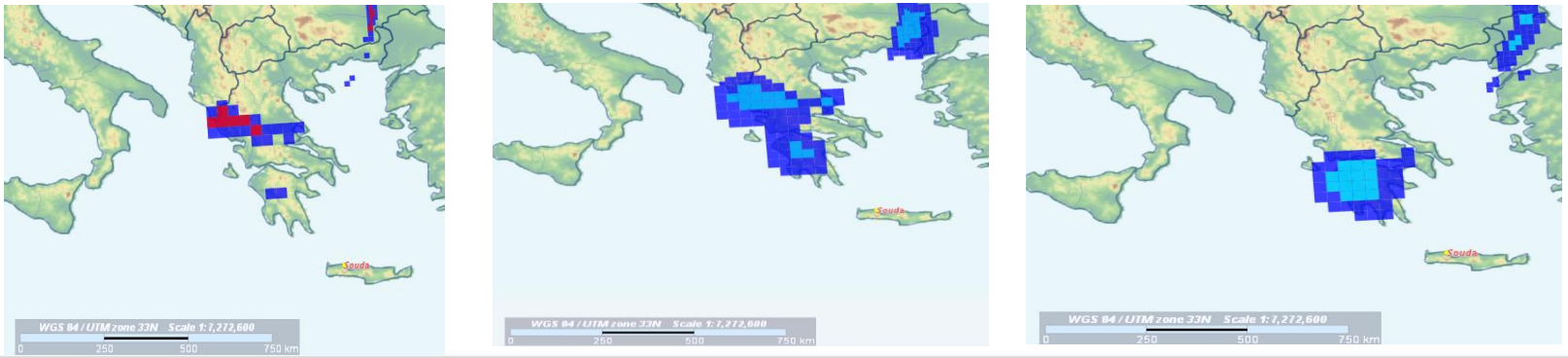
Knowledge uncertainty

is related to lack (or availability) of knowledge or information

- What is the origin of the first information?
- Which areas will be affected?
- How serious is the accident?
- When is the time of the beginning of the release?
- Is radiological assessment consistent?
- Is information consistent?
- How to deal with technical aspects (e.g. source term) during the early phase of the emergency?



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Judgement uncertainty
is related to **balancing** options

- How is information understood by different stakeholders?
- How to decide on protective actions?
- How to interpret dispersion models maps?
- Are social and ethical considerations taken into account?
- Which information is public and which information should be restricted to the emergency management teams?
- What comes first: safety or security?

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Decision uncertainty
is related to **prioritizing** which option to choose

- How to deal with long-term consequences?
- Are the preconditions of the functioning systems taken into account?
- Which protective actions to apply?
- How to communicate negligible impacts?

Examples: "Problem is that all acute decisions have long term consequences which makes this all more challenging". "The level of water was wrongly given in the report (1.031 instead of 10.31)."

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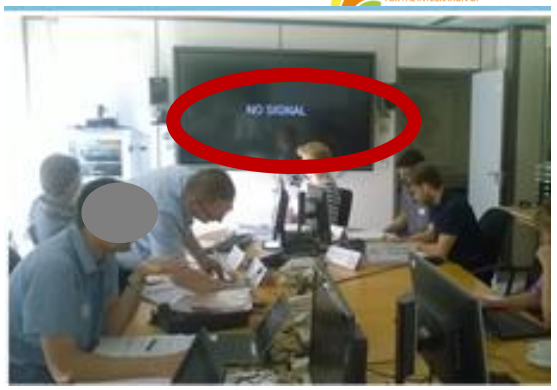
Implementation uncertainty

is related to how to take actions based on the decision we made?

How to **put it in practice**?



- Which tools of information exchange are reliable?
- How to deal with time pressure?
- Is ICT reliable?
- How to implement protective actions?
- How to coordinate cross-border aspects?
- Is there a gap between legislation (including plans) and reality?
- Are all emergency response actors familiar with their roles, procedures and plans?

- Are the available resources adequate?
- Are all emergency actors informed timely?
- Which factors impact information exchange?
- Are the emergency actors familiar with and trained to use the equipment?

- How will public communication/information needs be addressed effectively?
- How will coordination and collaboration among emergency response actors be achieved?

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Evaluation/Monitoring

- Will people follow the instructions or recommendations given?
- Is the information exchange sufficient?

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e.g. "*Some people did not come to the gathering place but remained instead at their desk or still outside, working*."

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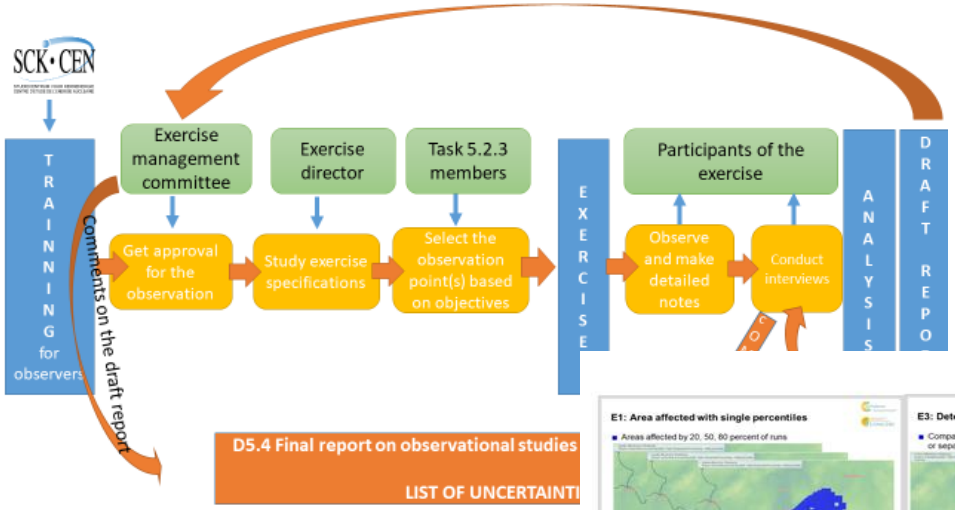
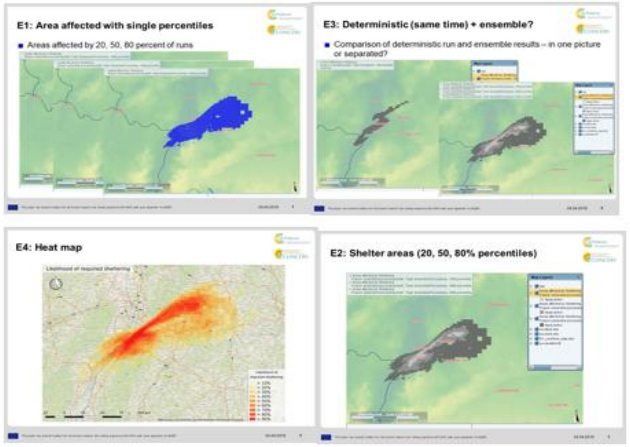
Impact of this study
from knowledge to implementation





In this study we maintain the **integrity of unique cases/findings**, **we chrystallise** rather than generalize, and we contribute to **theory and dialogue** about nuclear emergency management under uncertainties.

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