

RISK MAPS AS A DECISION-MAKING TOOL IN NUCLEAR ACCIDENTS AFFECTING AGRICULTURAL AREAS

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Introduction

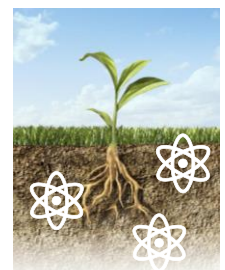
In the aftermath of a nuclear accident, when the recovery of the affected area has to be addressed, the advantages of having recovery actions identified and planned beforehand are obvious. This information will help decision makers in the selection of the most adequate recovery strategy, with the aim of returning as soon as possible to a normal living situation.

To design a proper recovery strategy it is necessary to have as much information as possible regarding, not only the evolution of the release, also the radiological characterisation of the affected area. This, understood both in terms of the deposition distribution according to its severity degree and the potential impact of the population due to the food ingestion pathway, is also needed. The elaboration of risk maps to help this characterisation will be very useful as tools for decision making.

A methodology to elaborate risk maps is presented in this work, using as case-scenario an hypothetical accident with offsite consequences from Almaraz NPP (Spain). Two approaches are followed. On one hand, the identification of the affected areas where recovery strategies should be applied as a priority to reduce the radiological impact to population due to the ingestion of food stuffs. For this approach ^{137}Cs deposition and in agricultural areas where rainfed cereals are grown has been selected.

On the other, the identification of the areas, where there is a probability of exceedance of the maximum permissible level (MPL) in food. In this approach the same radionuclide deposition is considered and cow milk selected as foodstuff. An analysis of the seasonal influence of the transfer of ^{137}Cs in cow milk is also shown.

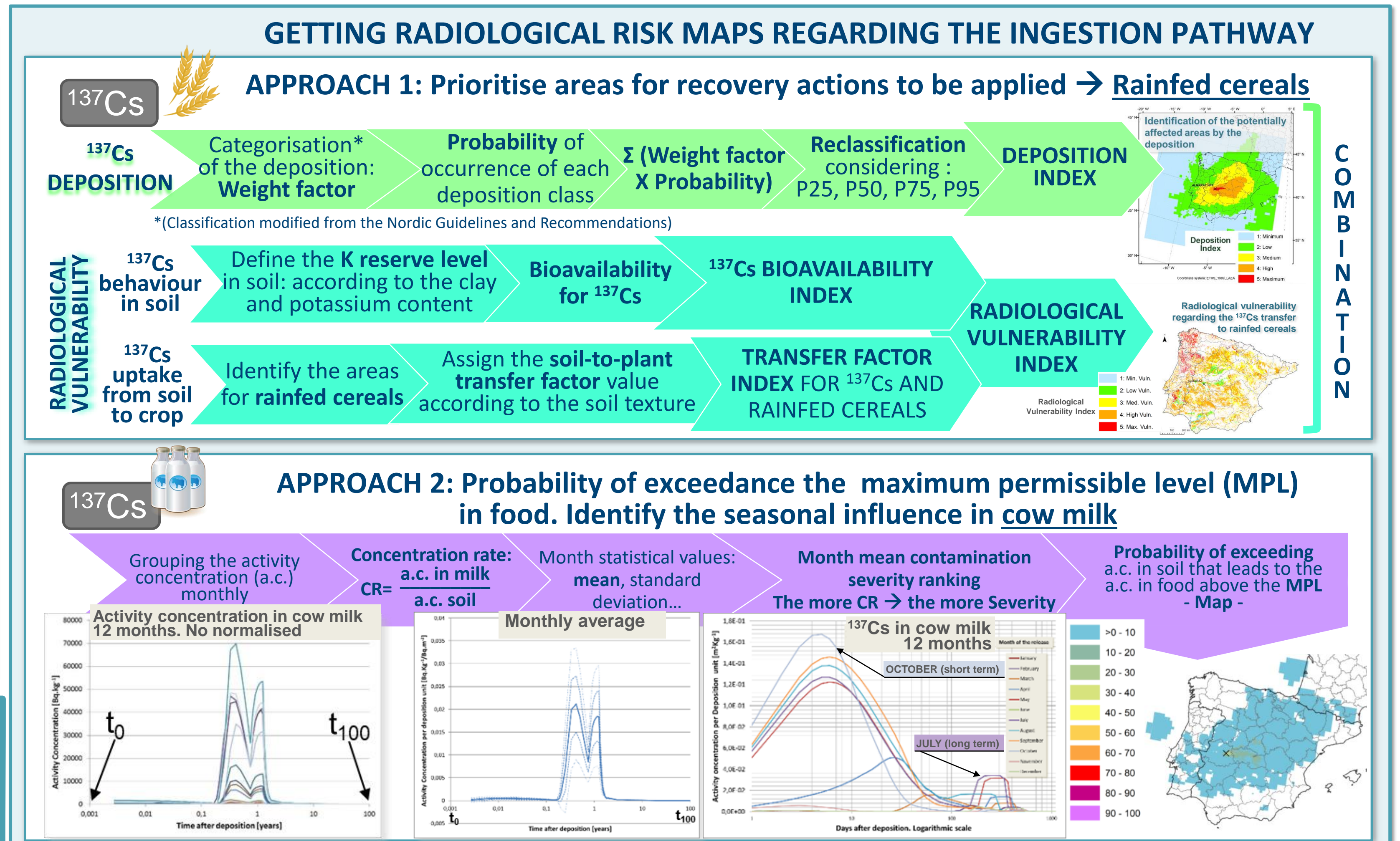
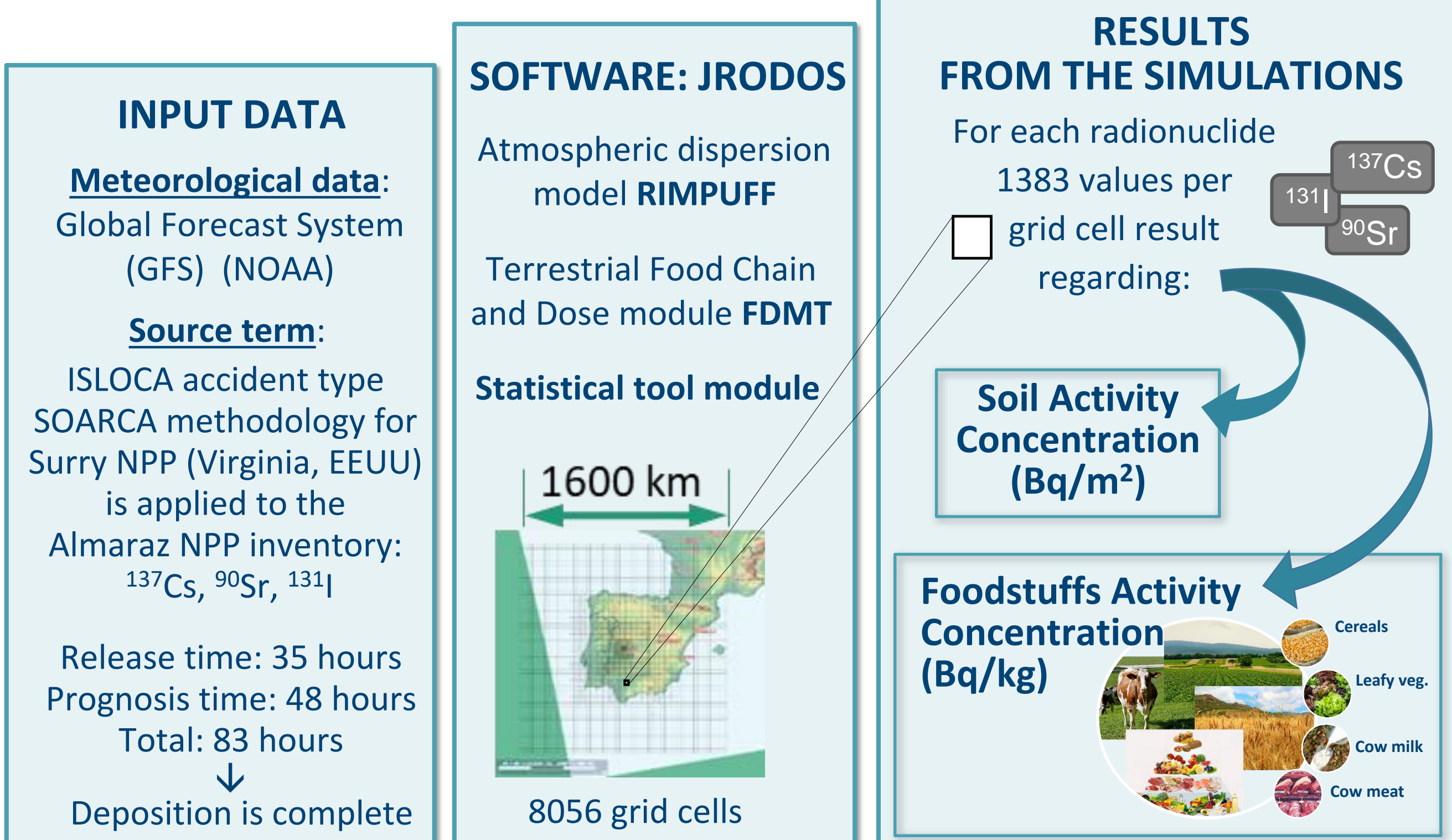
Objectives



- ✓ To obtain **tools to be used in the planning phase**
 - ✓ To design a **methodology to be applied in agricultural areas in a post-accident situation**
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- To avoid/reduce (ALARA principle) the contamination transfer to the food-chain.

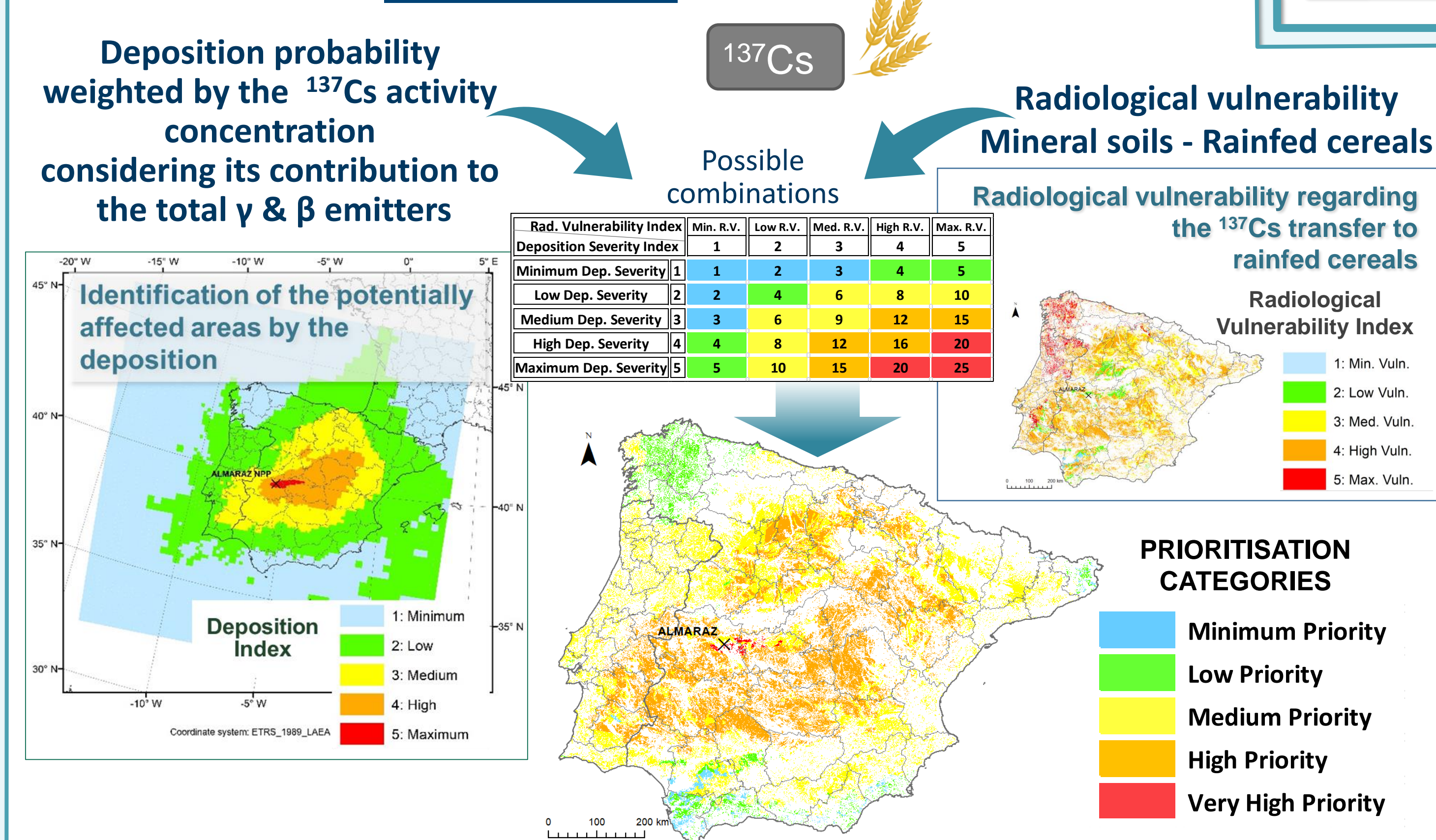
- ✓ To elaborate **maps to be used as decision-making supporting tools** to design recovery strategies in radiological contaminated agricultural areas.

Materials and Methods

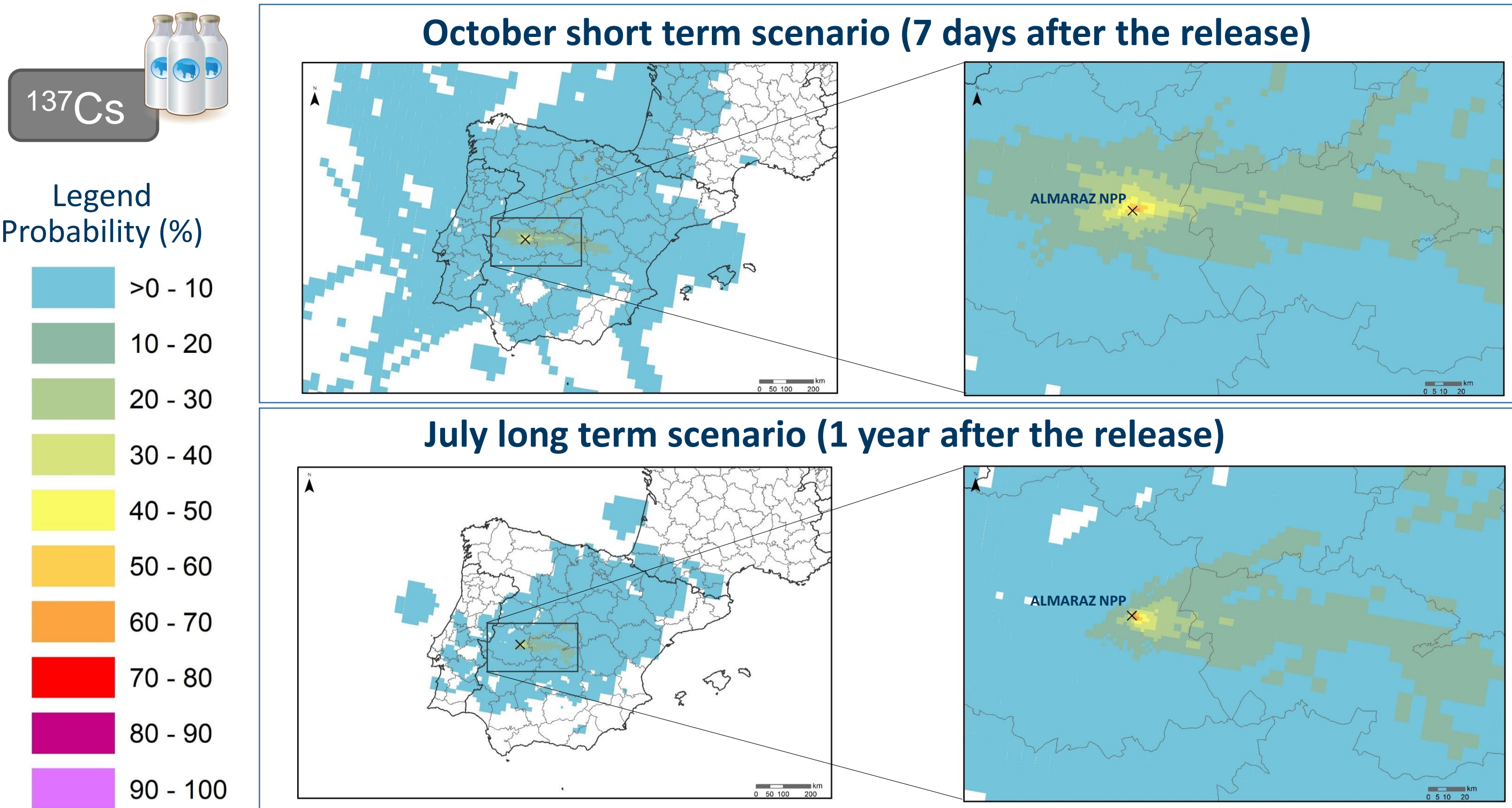


Results

APPROACH 1: PRIORITISE AREAS FOR RECOVERY ACTIONS TO BE APPLIED FOR RAINFED CEREALS



APPROACH 2: IDENTIFY THE PROBABILITY OF EXCEEDANCE THE MPL IN COW MILK



Discussion

On the basis of the hypothetical severe accident in Almaraz NPP simulated along 5 consecutive years, 1383 values per grid cell have been obtained regarding the soil activity concentration (a.c.) (Bq/m²) and the foodstuff a.c. (Bq/kg). ^{137}Cs is the radionuclide analysed.

- ✓ The prevailing meteorological conditions (wind and rainfall pattern) influences the dispersion and the ^{137}Cs deposition.
- ✓ The radiological vulnerability of the rainfed cereal areas, regarding the ^{137}Cs , increases with low K and clay content. It is higher for sandy soils, which show the highest soil-to-plant transfer.
- ✓ According to the prioritisation categories, the recovery actions can be applied first where the radiological impact is higher.

- ✓ Activity concentration on crops depends on their growing stage when the deposition occurs.
- ✓ Different deposition times implies different activity concentration in soil to reach the MPL.
- ✓ The lowest is the deposition needed to reach the MPL, the worst the scenario is.

Conclusion

Risk maps related to the radioactive contamination transfer to the food chain are useful tools in different phases of an accident in the decision-making process.

- ✓ A high a.c. on ground does not imply a high priority where to act on, because the radiological vulnerability modulates the **prioritisation categories**. Thus, both, the **Deposition** (its severity and its probability) and the **Radiological Vulnerability** should be considered.
- ✓ By taking into account the **prioritisation areas** and the **probability of exceeding the MPLs** to initiate the recovery to the long term, the **optimisation** of the countermeasures is gained.
- ✓ The ultimate aim is to reduce the public doses through the food chain: **ALARA** principle.
- ✓ In the **Emergency Preparedness phase** these maps may be used to design the response to be applied in the aftermath of a severe accident facing the long term recovery. **Recovery strategies**, such as: fertilising or ploughing, can be planned in advance.
- ✓ In the **Transition and Recovery phases**, once the contamination values are measured, these methodologies can be applied in order to eliminate the uncertainty related to the ground and foodstuff a.c.
- ✓ Assess **operational levels** is useful practice for planning protective or recovery actions.

