18 month post-doctoral position at IRSN

Dose averted by populations following the rehabilitation of a territory contaminated by the fallout of a nuclear accident

Required skills

You have strong skills in modelling and a PhD in environmental sciences, in earth sciences or in physics.
You have experience of scientific programming (physics) with a software such as GoldSim, or R.
Familiarity with remediation of contaminated soils/sites, or with occupational or environmental risk analysis, or with radiation protection would be assets.
Expected qualities: analytical and synthetic skills, autonomy, team spirit, writing skills.
Occasional travel in France and abroad is to be expected.

Employer

The Institute for Radiological Protection and Nuclear Safety (IRSN) is a French public establishment of an industrial and commercial nature (EPIC), a French expert in research and expertise in the fields of nuclear safety, control and protection of nuclear materials and protection against ionising radiation.

Within IRSN, Laboratory for Studies and Expertise on Radioactivity in the Environment (LEREN) is in charge of studying the behavior of radionuclides in the environment. This team develops SYMBIOSE, a platform for simulating the transfer of radionuclides within ecosystems and for calculating exposure of human populations and biota. This research contributes to IRSN's assessment mission in terms of radiation protection.

Position and missions

In the frame of a project funded by BPI France (call “Plan de relance pour l'industrie - Secteur stratégique Nucléaire”), IRSN is committed to developing and validating decision support tools that will provide decision-makers and the general public with information on the choice of remediation actions to be implemented in post-nuclear crisis situations, to promote the recovery of territories.

In this context, the objective of this 18-month post-doctoral fellowship is to propose a method to evaluate different remediation strategies for territories contaminated by atmospheric fallout of radiocesium (eg ^{134}Cs, ^{136}Cs, ^{137}Cs) and then to apply this method to two typical situations: the Fukushima accident in Japan and a hypothetical accident in France. The method will in particular target the definition of a new criterion: the “dosimetric gain” (a concept derived from occupational dosimetry), that is to say the balance between the averted dose (decrease of the population exposure, thanks to the remediation) versus the additional dose (exposure of the workers engaged in remediation).

The assessment will focus on agricultural, forestry, and urban areas using transfer and dosimetric impact models developed or to be developed in the IRSN SYMBIOSE platform. The selection of regions of interest, target populations (eg children, rural adults, workers) and remediation actions to be considered in the cases of application (eg stripping or ploughing of agricultural or forest soils, cleaning of urban areas, etc) will be done in consultation with the other actors of the project.

The first step will be to characterize the different remediation actions in agricultural, forestry and urban environments, in order to achieve a detailed specification of a (new) SYMBIOSE module allowing to quantify in a simple way the impact of these actions on the decrease of the levels of cesium contamination predicted in the environment (soils, plants, etc). In a second step, it will be necessary to specify the method for quantifying the volume of waste generated and the levels of contamination

expected in this waste. The evaluation method will be based on the information provided by the remediation module (eg.areas treated, dates of application) as well as the levels of contamination predicted by the transfer models in the environmental compartments targeted by these actions (eg surface soil, plants, various man-made materials etc.). As in the previous step, the candidate will aim to specify in a detailed way a (new) SYMBIOSE module to be added downstream of the calculation chain. Concerning the evaluation of the transfer in the environment of atmospherically deposited cesium and its dosimetric impact on the population, the post-doc will benefit from existing SYMBIOSE modules. Once the chaining of the modules will be done, the candidate will proceed to the numerical simulations allowing to quantify the dosimetric gain for each of the application cases and each of the management strategies.

Contact

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Bibliography of the team related to the subject

- Gonze M.-A. et al. (2014). SYMBIOSE: A Simulation Platform for Performing Radiological Risk Assessments. Link
- Mourlon C. et al. (2014). A Landscape-level Dose Assessment of a French NPP Using the SYMBIOSE Platform NPP Using the SYMBIOSE Platform. Link
- Gonze M.-A. et al. (2015). Modeling the Dynamics of Ambient Dose Rates Induced by Radiocesium in the Fukushima Terrestrial Environment. Journal of Environmental Radioactivity, 215.
- Sy M. et al. (2016). Uncertainty analysis in post-accidental risk assessment models: An application to the Fukushima accident. Annals of Nuclear Energy, 93.
- Masoudi P. et al. (2020). Estimation of Fukushima radio-cesium deposits by airborne surveys: Sensitivity to the flight-line spacing. Journal of Environmental Radioactivity, 222.
- Brimo K. et al. (2021). Evaluation of semi-mechanistic models to predict soil to grass transfer factor of 137Cs based on long term observations in French pastures. Journal of Environmental Radioactivity, 227.
- Hashimoto S. et al. (2021). Dynamics of radiocaesium within forests in Fukushima - results and analysis of a model inter-comparison. Journal of Environmental Radioactivity, 238-239.
- Gonze M.-A. et al. (2022) Modeling of ^{137}Cs transfer, ambient dose rates and remediation actions in contaminated forests: Model description and application (in preparation).