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ANALYSIS AND MODELLING OF TRANSFER PROCESSES TO PLANTS BY FOLIAR PATHWAY OF RADIONUCLIDES IN PARTICLE FORM

#poster

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Following normal/incidental releases of nuclear facilities, radionuclides may be released into the atmosphere under different speciations (gaseous, particulate, dissolved in water), then be intercepted and possibly retained by plant foliage and translocated to other organs. In the upcoming years, new release scenarios (ITER, UNGG dismantlement) potentially involving particles will be evaluated, thus increasing the need to assess/ improve the existing tools describing transfers of particles and dosimetric evaluation. Knowledge on foliar transfer is still limited and operational tools do not consider the particulate form leading to possible dose underestimation [1]. So, this PhD work aims at quantifying and modelling the key processes influencing particulate radionuclide transfers to plants by foliar pathway.

Particles covers a wide range of scenarios depending on their nature, size and reactivity [2, 3]. At leaf interface, radionuclides may be incorporated by stomatal or cuticular pathways, then possibly reaching conductive tissues [4, 5, 6, 7]. The extent of these processes will depend on the possible dissolution of particles on/within foliage, or intact particles transfer. Yet the conditions (particle size?, reactivity) and mechanisms for intact particles transfer are unknown, thus requiring investigation of both incorporation pathways in relation to particle properties [8, 9]. The resulting radionuclide stocks and fluxes have to be quantified and compared to non-particulate source terms and finally, models need to be tested and/or specifically parametrized and/or completed to allow global assessment of foliar transfer whatever the transfer pathways.

To address these different questions, the project will consist of:

1) Controlled conditions experiments to obtain data on the plant incorporation-leaf absorption through transcuticular/stomatal pathways and translocation as a function of the main following factors: plants characteristics (e.g. foliage interface physico-chemical and morphological criteria: roughness, cuticle thickness, stomatal density and size), particles characteristics (low/high reactive particles with variety of sizes ranging from nano [20-50 nm] to micrometer [>5 µm]), or type of deposit (dry/wet). Monitoring of contaminant absorption in/translocation out in leaves will be followed qualitatively/quantitatively by different techniques: e.g. assessing particles locations by 2D and 3D imaging (SEM-EDX, micro-X-ray fluorescence, micro and nano-Xray tomography).

2) Development and validation of a simple generic model of radionuclides foliar transfer, potentially including specific treatment for low diameter/low reactivity particles. The data obtained from the experiments (see 1) would be compared to aggregated transfer factor predictions and outputs of other generic models related to non-particle source terms. Based on results of comparisons, existing tools will be completed and improved if needed.

3) Numeric application to a real-case scenario (e.g. ITER/ UNGG-like scenario involving tritiated or ^{36}Cl-bearingparticles).

Référence

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