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Assessment of radiological doses to wildlife due to its exposure to radionuclides in the Rhône River: case studies in link with natural background and actual NPP releases.

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Artificial radionuclides are commonly observed in the environment due to their authorized releases by the nuclear industry, atmospheric fallouts from past events (nuclear weapon testing, Chernobyl and Fukushima accidents) and other accidental releases. Wildlife is chronically exposed to the associated ionizing radiation, leading to the need of demonstration of the level of radiological risk for fauna and flora. Investigations was conducted according to the recommendations and guidance provided by the International Commission on Radiological Protection (ICRP) to characterize ecological impact of the presence of such artificial radionuclides in the Rhône River (France). First, radionuclides doses were estimated using the ERICA Assessment Tool at a monitoring station near the outlet of the Rhône River at Arles. Second, an integrated ecological risk assessment was conducted on current liquid releases of the 4 Nuclear Power Plants (NPP) located along the river. This second approach deals specifically with the problem of mixtures of radioactive substances and chemicals.

Monitoring results related to particulate and dissolved concentrations were available at Arles from 2006 to 2013 with at least representative monthly concentration for anthropogenic radionuclides. Dose rate estimation was conducted for the Reference Organisms defined in the ERICA Tool. Results demonstrated that doses resulting from artificial radionuclides (137Cs, 54Mn, 110mAg, 60Co…) were significantly lower than the expected background dose rate and the PNEDR (Predicted No-Effect Dose Rate - 10 μGh.h-1). The higher dose rates were estimated for insect larvae (0.01μGy.h-1) and the lower for phytoplankton (0.0001μGy.h-1).

A multiple stressors approach was conducted using Species Sensitivity Distributions (SSD) in combination with mixture models (concentration addition (CA) and independent action (IA)). This approach allowed the derivation of an integrated proxy of the ecological impact of radioactive and stable stressors, the so-called msPAF (multi-substances Potentially Affected Fraction of species). The msPAF results indicated a negligible potential ecological risk in the context of routine effluents from nuclear plants, with a higher contribution of ionizing radiation to the overall impact compared to the 8 stable chemicals considered.