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Where does the iodine go? – A modelling approach of iodine 127 and 129 cycling in forested environments

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Differences in the origin and behaviour of ^{129}I versus ^{127}I isotopes have been illustrated for several surface environments, but little is known about the recycling rates of each isotope in terrestrial ecosystems. We developed a dynamic compartment model of iodine cycle in forest ecosystem as a tool to summarize and integrate empirical data from most recent monitoring's and the literature (Fig. 1). The recycling of atmospheric deposition in forest was simulated for stable ^{127}I and modern anthropogenic ^{129}I in various ecological conditions (Thiry et al., 2022).

Some outcomes supported by the model results are detailed here:

- Dry deposition can contribute significantly to local atmospheric inputs that represent a major source of iodine to be recycled at most sites, except where calcareous parent-rocks are an important reservoir for weathered iodine.
- Soil is the predominant sink for atmospheric iodine in forest ecosystems, mainly due to organic matter iodination and the gradual accumulation of organic iodine in a non-labile pool.
- Under steady-state conditions, the non-labile iodine cycle can lead to the storage of about 20 % of the total deposition with a mean residence time of 900 years, while labile iodine is recycled in soil with a mean residence time of 90 years.
- Volatilization of iodine from soil, which contributes to about 80% of iodine losses by volatilization, was shown to be a much more important export pathway than drainage for most sites.
- Regarding anthropogenic ^{129}I deposits in forest, a stabilization of the labile and non-labile fractions in soil is not established within decades to centuries, explaining why isotopic disequilibrium is common in field data analysis.

As highlighted by the modelling exercises, better simulations of iodine cycling at some specific sites may require improved estimates of dry atmospheric deposits, parent rock weathering and volatilization from soil and vegetation, those processes remaining poorly investigated and insufficiently documented so far.

Reference:

Thiry, Y., Tanaka, T., Bueno, M., Pisarek, P., Roulier, M., Gallard, H., ... & Nicolas, M. (2022). Recycling and persistence of iodine 127 and 129 in forested environments: A modelling approach. *Science of The Total Environment*, 831, 154901.

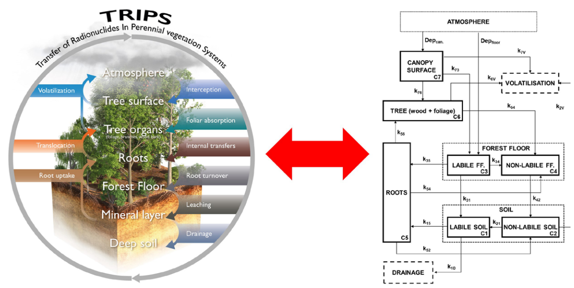

Fig.1. Phenomenological description of element cycling in forest and its discretization in a compartment model for iodine (TRIPS-iodine), including a simplified representation of the complex mobility of various inorganic and organic iodine species in the forest floor and the underlying soil layer through the coexistence of labile and non-labile pools.