

Back-of-an-envelope calculations of dose rates to lake biota resulting from releases from geological repositories for different types of nuclear waste

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Motivation

- Most recent biosphere assessments for nuclear waste use large and complex dynamic landscape models – easier methods for checking are needed
- Older assessments did not include doses to plant and animals (only in recent regulations)
- At Olkiluoto, four nuclear waste repositories planned or in operation:
 - 1) for power plant's operational waste;
 - 2) for power plant's decommissioning waste;
 - 3) for spent nuclear fuel;
 - 4) for maintenance and decommissioning waste from spent fuel encapsulation
- Few data on combined radiation risks

Source data

Waste type	Data source
Operational	Vieno & Nordman 1998, fig. 10-3 & fig. 10-12
Decommissioning	Vieno <i>et al.</i> 1993, fig. 8-1 & table 6-1*
Encapsulation	Nummi <i>et al.</i> 2012, fig. 9-7 (real.) & table 9-9* (lake)
Spent fuel	Posiva 2012, fig. 7-3 & Posiva 2014, fig. 6-6

& the ERICA Assessment Tool

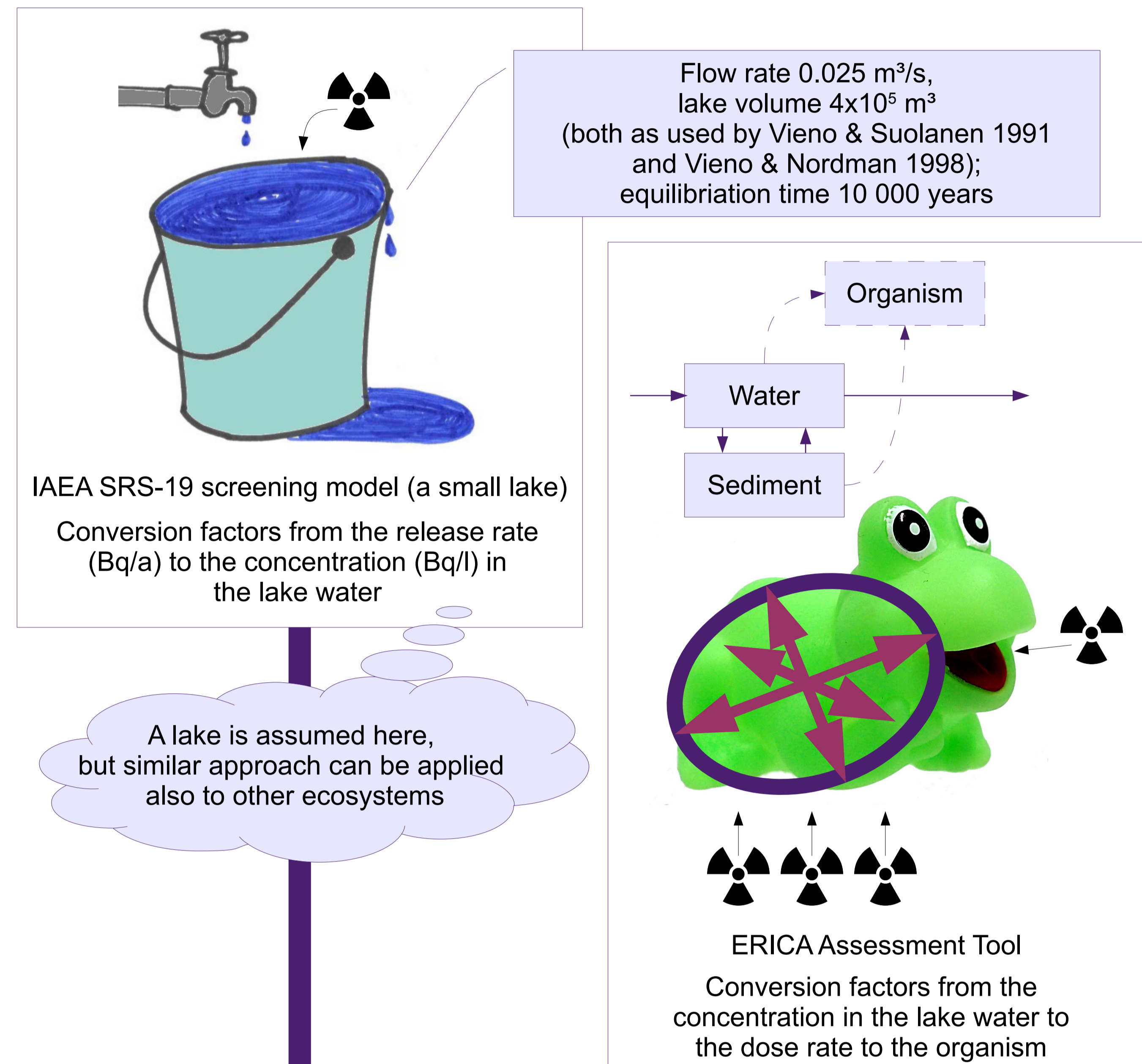
* Original figure in terms of dose rates, converted with the dose conversion factors provided in the table.

Stylised approach to estimate level of radiation exposure of wildlife

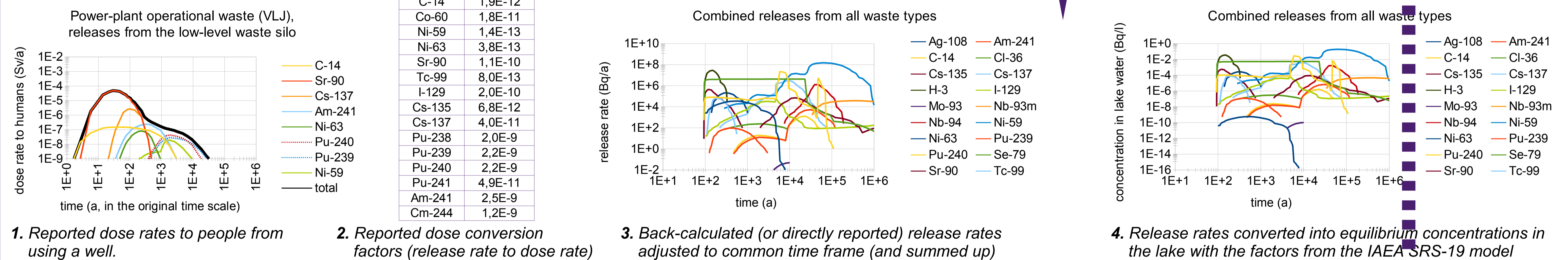
- Release rates from the geosphere to the biosphere are obtained from reports either directly or by back-calculating with the reported release-to-dose conversion factors from data on dose rates for people
- A simple "bucket model" is assumed for a lake of a suitable size, and conversion factors are derived to turn the release rates into equilibrium concentrations in lake water
- Such are often readily tabulated or accessible from free assessment tools
- Further conversion factors from the concentration in the lake water to the dose rates to the representatives of plants and animals
- The EU ERICA integrated assessment approach assumes reference organisms simplified into ellipsoids and provides an easy assessment tool with default data
- Comparison against established screening levels (and other benchmarks)

Main tools

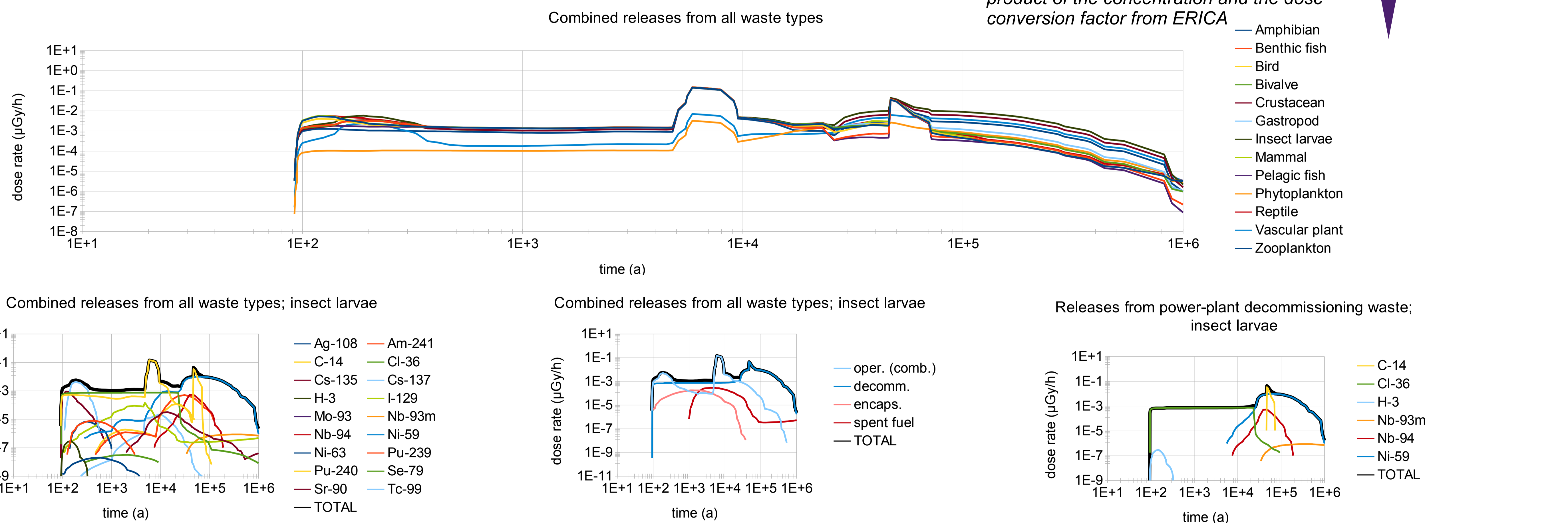
- Good ruler, discipline and care
- OpenOffice Calc (free and open-source)
- ERICA Assessment Tool (free on registration)



The sequence of calculations



Examples of results



Conclusions

- A coarse but (relatively) quick – and free – method has been outlined
- Even this simple method provides results reasonably similar to those in more advanced analyses (e.g., Posiva 2014)
- In the more recent reports, little data helpful in this analysis have been provided, unlike in the older ones, which – in turn – lack in some key nuclides
- Even if all releases from all the four repositories ended up in a relatively small lake, the subsequent radiation doses to the biota would remain well below the screening value (10 µGy/h), exceeding of which would only prompt a more detailed assessment but not necessarily indicate a harmful radiation level

References

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