UPDATES TO THE ERICA TOOL – VERSION RELEASED 2014

Background

Since being released in 2007, a number of updates have been released. Typically these have been to resolved minor 'bugs' and other problems reported by users. Changes are noted in 'Release Notes' accessed via the 'Help' drop down menu. A revised version of the Tool is now being released (November 2014) with more substantial changes.

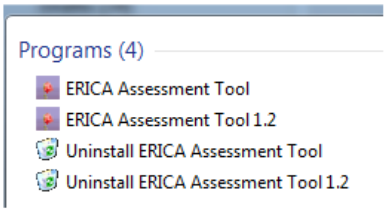
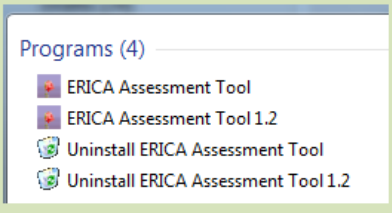
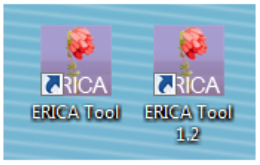
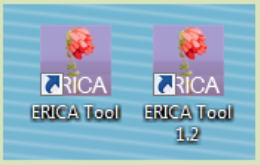
The changes to the Tool were predominantly prompted by experience gained since 2007 and user feedback, developments in and analyses of transfer parameter databases (see Copplestone et al., 2013).

Since the **new ERICA version (1.2)** has a new database with a new index list (new reference organisms) and considering that:

a. users may have created their own, "user", database with a previous version;

b. users may have assessment files that includes reference organisms that are no longer supported in the new version (plus other compatibility issues linked to new extrapolation codes used to estimate the CR values – see below).

A decision has been made to distribute the new version as a new independent tool; Users can choose to have both versions installed on their PC as shown below:

On Windows	**ERICA Assessment Tool 1.0 (Nov 2012)**	**ERICA Assessment Tool 1.2 (Nov 2014)**
Installation directory	C:\Program Files (x86)**ERICA**	C:\Program Files (x86)**ERICA 1.2**
When searching in Win7		
Desktop Shortcut		
Location of My ERICA Database & My ERICA Assessments	C:\Users\<user-name>\Documents\	C:\Users\<user-name>\Documents**\ERICA 1.2**

However, we obviously recommend that ONLY ERICA version 1.2 is used for subsequent assessment. DO NOT continue to use the old version for new assessment – changes in, for instance, reference organisms, CR values etc. have been made for justifiable reasons.

Default Radionuclides

Ba-140, Ca-45, Cr-51, Cf-252, Ir-192, La-140, Pa-231 & Zn-65 have been added to the default list within the Tool. This means the ERICA Tool is now consistent with radionuclides considered within the ICRP Reference Animal and Plant approach (see ICRP Publications 108 and 114); default radionuclides, Concentration Ratios (CRs) and Dose Conversion Coefficients (DCCs) have been generated for these additional radionuclides.

You can continue to add additional radionuclides.

Reference Organisms

The ERICA Tool was supposed to contain Reference Organisms encompassing all European protected species. User feedback noted that it was missing Freshwater Reptile; there are protected freshwater reptile species in Europe. The 2014 version (v1.2) of the Tool contains a Freshwater Reptile Reference Organism. The geometry assumed is: length 18 cm, width 12 cm, height 6cm and mass of 1 kg. This is representative of an adult female European pond turtle (*Emys orbicularis*). The default occupancy factor is 1 at the sediment-water interface (i.e. it is assumed to spend 100% of the time on bed sediments).

Bird egg has been removed from the default Reference Organism list. This was inconsistent with approaches for other organism and furthermore there are no empirical $CR_{wo\text{-}soil}$ data for bird eggs. If users wish, they can add a bird egg geometry at Tiers 2 and 3.

The original Tool had two geometries for the 'Sea anemones or true corals' geometry, polyp and colony. This has now been simplified with only the polyp geometry being retained. Some changes have been made to the naming of the default references organism. These make the Tool more consistent with the terminology used in the IAEA wildlife transfer parameter handbook (IAEA, 2014) and remove some ambiguity. The revised and original reference organism lists are compared in Table 1.

The marine Macroalgae reference organism geometry (mass 0.0065 kg) was based upon information provided by the ICRP during the initial stages of the development of the ICRP Reference Animals and Plant (RAP) approach. However, the brown seaweed geometry as published by the ICRP (Publication 108) has a mass of 0.652 kg. The 2014 version of the ERICA Tool is consistent with ICRP Publication 108.

All DCCs for external exposure of the Lichen & Bryophytes geometry have been recalculated (discrepancies had been noted within the original dataset).

For technical reasons (i.e. the lower bound of the dosimetric extrapolation tool (see the "add organism" function) has a lower cutoff which exceeds selected default masses) the mass of both marine and freshwater Phytoplankton has been set to 1.00E-06 Kg replacing the old values of 6.54E-11 kg and 2.05E-12 kg for marine and freshwater Phytoplankton respectively. This is a relatively small geometry and can be considered to represent an accreted mass of phytoplankton cells.

DCCs have been generated for the new and modified reference organism geometries.

Table 1. Reference Organisms from the original and revised ERICA Tool versions.

Original	**Revised**
Terrestrial	
Amphibian	
Bird	
Bird egg	*Removed*
Detritivorous invertebrate	*Arthropod - detritivorous*
Flying insects	
Gastropod	*Mollusc - gastropod*
Grasses & Herbs	
Lichen & Bryophytes	
Mammal (Deer)	*Mammal - large*
Mammal (Rat)	*Mammal - small-burrowing*
Reptile	
Shrub	
Soil Invertebrate (worm)	*Annelid*
Tree	
Freshwater	
Amphibian	
Benthic fish	
Bird	
Bivalve mollusc	*Mollusc - bivalve*
Crustacean	
Gastropod	*Mollusc - gastropod*
Insect larvae	
Mammal	
Pelagic fish	
Phytoplankton	
Vascular plant	
Zooplankton	
Missing	*Reptile (new reference organism)*
Marine	
(Wading) bird	*Bird*
Benthic fish	
Benthic mollusc	*Mollusc - bivalve*
Crustacean	
Macroalgae	
Mammal	
Pelagic fish	
Phytoplankton	
Polychaete worm	
Reptile	
Sea anemones or true corals - colony	*Sea anemones & True corals*
Sea anemones or true corals - polyp	*Removed*
Vascular plant	
Zooplankton	

Occupancy Factors

The default occupancy factors for terrestrial amphibian and reptile have been changed to 100% in soil to ensure conservatism in Tier 1 and be consistent with the treatment of other organisms.

Default Transfer Parameters

There has been a significant effort to improve the wildlife transfer ($CR_{wo\text{-}media}$ values) databases (e.g. IAEA TRS 479).

Where empirical data exist for a Reference Organism – radionuclide combination these are used to provide the revised default value within the ERICA database.

In the original ERICA Tool only about 40% of the required CR_{wo} values were available. Where no empirical data were available a range of extrapolation approaches have been applied. There is still a need to derive missing CR_{wo} values using extrapolation approaches. However, these approaches have been simplified and refined in part based on an evaluation of how well the approaches used in the original ERICA Tool had worked now that additional data are available (see Brown et al. 2013). The revised extrapolation approaches are shown in Table 2.

The method used to derive each CR_{wo} value is clearly indicated within the Tier 2 screens presenting the default values.

CR_{wo} and K_d values are assumed to be log-normally distributed in the ERICA Tool when based upon empirical data. When values were derived by extrapolation approaches, or if no standard deviation estimate was available for an empirically derived value, then an exponential distribution was assumed in the original Tool. There has been an attempt to avoid using exponential distribution assumptions in the revised Tool on the basis that it did not make best use of available knowledge and, most especially in aquatic ecosystems, it resulted in some extreme estimates of EMCL values. Therefore, in the updated Tool databases approaches such as Bayesian statistics (see Hosseini et al., 2013) have been used to derive SD values when they are not available.

Table 2. Revised extrapolation approaches used in the ERICA Tool

Ref (code)	Descriptor
1	Similar reference organism
2	From published review
3	Modelling approaches
4	Element of similar biogeochemistry for reference organism
5	Element of similar biogeochemistry for similar reference organism
6	Highest available value
7	Estuarine data
8	Highest animal value
9	Highest plant/algae value
10	Combined method*

*using one or more of the above approaches and/or methods to derive a missing SD value.

The original ERICA Tool applied a number of marine K_d values for the freshwater ecosystem – where possible these have been replaced by values derived in freshwater environments.

Environmental Media Concentration Levels (EMCLs) & Benchmarks

EMCL values have been derived using the revised transfer parameters, distributions and where appropriate geometries/occupancies. The EMCL is the media activity concentration that gives rise to the highest 95th percentile predicted dose rate to any Reference Organism in an ecosystem type.

The application of the 95th percentile dose rate per unit concentration has been retained where transfer parameters are based on empirical data.

There was an option to apply dose rate screening values of 40 μGy h^{-1} for terrestrial animals and 400 μGy h^{-1} for terrestrial plants and aquatic biota in the original ERICA Tool. The revised version applies 40 μGy h^{-1} to aquatic mammals and birds; this is consistent with the US DOE's Graded Approach (as implemented in RESRAD Biota).

Uncertainty factors

In Tier 2 of the ERICA Tool uncertainty factors (UFs) that are intended to provide approximations of the 95th or 99th percentile risk quotient (RQ) are used. The 95th and 99th percentiles of the RQ are estimated by multiplying the expected value of the RQ by an uncertainty factor. The values of UF used in the original ERICA Tool were 3 and 5 to provide approximations of the 95th and 99th percentile RQs respectively. There has been some discussion of if these are the most appropriate values of UF to use (see Avila et al 2014). The approach adopted in earlier versions of the Tool is still judged to be reasonably robust (see Brown et al., 2014) although further consideration will be given to the requirement to adjust UFs in future releases of the Tool.

References

Avila, R., Beresford, N., Brown, J., Hosseini, A. 2014. The selection of parameter values in studies of environmental radiological impacts. J. Radiol. Prot. 34, 261-262. http://stacks.iop.org/0952-4746/34/261

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Brown, J.E., Alfonso, B., Avila, R., Beresford, N.A, Copplestone D., Hosseini A. 2014. Updating Environmental Media Concentration Limits and Uncertainty factors in the ERICA Tool. P-127. ICRER 2014 - Third International Conference on Radioecology and Environmental Radioactivity. Barcelona, September 2014. https://intranet.pacifico-meetings.com/amsysweb/publicacionOnline.jsf?id=146.

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Hosseini, A., Stenberg, K., Avila, R., Beresford, N.A. & Brown, J.E. 2013. Application of the Bayesian approach for derivation of PDFs for concentration ratio values. J. Environ. Radioact. 126, 376-387. http://dx.doi.org/10.1016/j.jenvrad.2013.04.007.

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