Why Site Specific Parameterization is Vital for Dose Assessment

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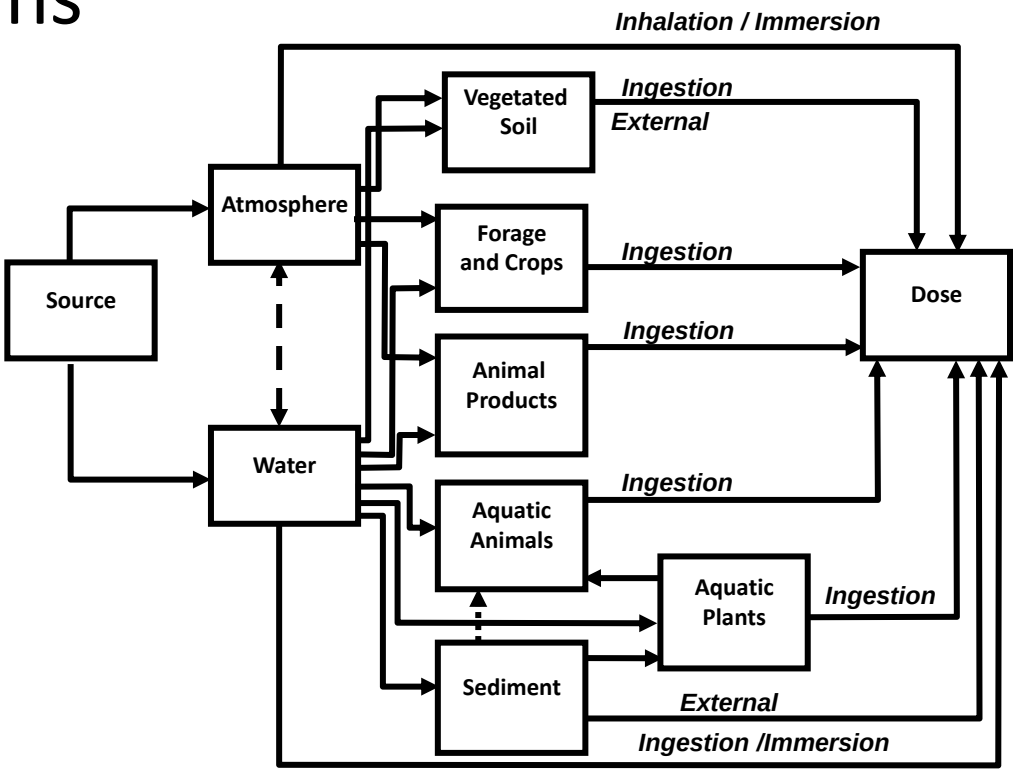
Overview

- Variables used in dose assessment calculations
- Problems / concerns
- An approach
- Conclusions



Known Variables in Dose Assessment

- At the point of impact
  - Decay Energy – E_i
  - Absorbed Fractions – AF_i
  - Radiation Weighing Factor – W_r
  - Total Number of Source Decays– U_s
  - Target Mass – m

Internal Dose Determination

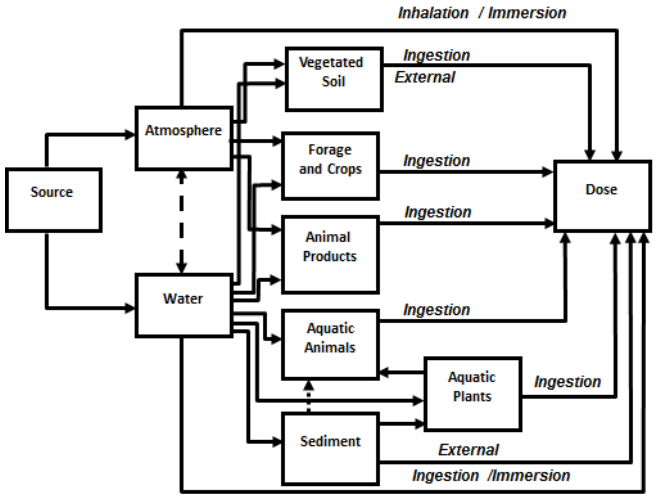
Calculation of dose

$$H_{50,T} = 1.6 \times 10^{-10} \sum_{s} U_s SEE$$

$$SEE = \frac{\sum_{i} Y_i * E_i * AF_i * W_r}{m}$$

$$U_s = A_o \int R(t) dt$$

How do you determine A_o?



- For food consumption:
  - Concentration Ratios or
  - Transfer factors (similar)
- What is a concentration ratio?
  - Ratio between soil and the plant or animal.

$$CR = \frac{\text{Activity in Plant (Bq/kg)}}{\text{Activity in Soil (Bq/kg)}}$$

  - Assumes equilibrium

Problems / Concerns

- The “problem with concentrations ratios is that they are influenced by many factors associated with the properties of the radionuclide, the organism, and the ecosystem. As a result, individual measurements display a great deal of variability.” – Whicker and Schultz 1982.

- Data Gaps - plentiful *but largely ignored*

Protein-based Transfer Factors *from IAEA TecDoc 1616*

Element	Beef	Cow Milk	Sheep Meat	Sheep Milk	Goat Meat	Goat Milk	Pork	Poultry	Egg
Ag	No Data	No Data	1	No Data	No Data	No Data	No Data	No Data	No Data
Am	1	1	1	No Data	No Data	2	No Data	No Data	1
Ba	2	15	No Data	1	1	3	No Data	2	1
Be	No Data	1	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ca	3	15	No Data	Stable	No Data	12	No Data	2	1
Cd	8	8	1	1	No Data	1	No Data	2	No Data
Ce	No Data	6	1	No Data	No Data	1	No Data	No Data	1
Cl	1	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Co	4	4	2	2	No Data	1	No Data	2	2
Cr	No Data	3	No Data	1	No Data	2	No Data	No Data	No Data
Cs	58	288	41	28	11	28	22	13	11
Fe	4	7	No Data	Stable	No Data	Stable	1	No Data	2
I	5	104	1	7	No Data	24	2	3	4
La	3	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Mn	2	4	1	1	No Data	Stable	1	2	3
Mo	1	7	No Data	No Data	No Data	4	No Data	1	3
Na	2	7	1	No Data	No Data	Stable	No Data	1	2
Nb	1	1	No Data	No Data	1	1	No Data	1	1
Ni	No Data	2	No Data	1	No Data	2	No Data	No Data	No Data
Np	No Data	No Data	No Data	No Data	No Data	1	No Data	No Data	No Data
P	1	Stable	No Data	Stable	No Data	Stable	1	No Data	1
Pb	5	15	2	Stable	No Data	No Data	No Data	No Data	No Data
Po	No Data	4	No Data	No Data	No Data	2	No Data	1	1
Pu	5	No Data	2	No Data	No Data	No Data	No Data	No Data	2
Ra	1	11	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ru	3	6	2	No Data	No Data	No Data	1	No Data	1
S	No Data	1	3	Stable	No Data	12	No Data	No Data	No Data
Sb	2	3	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Se	No Data	12	No Data	No Data	No Data	2	1	4	4
Sr	35	154	25	4	8	21	12	7	9
Te	1	11	No Data	1	1	1	No Data	1	1
Th	6	3	No Data	No Data	No Data	No Data	No Data	No Data	No Data
U	3	3	No Data	No Data	No Data	1	2	2	2
W	No Data	7	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Key:

- No Data
- > 5 values
- 6 - 25 values
- > 25 values
- Stable data

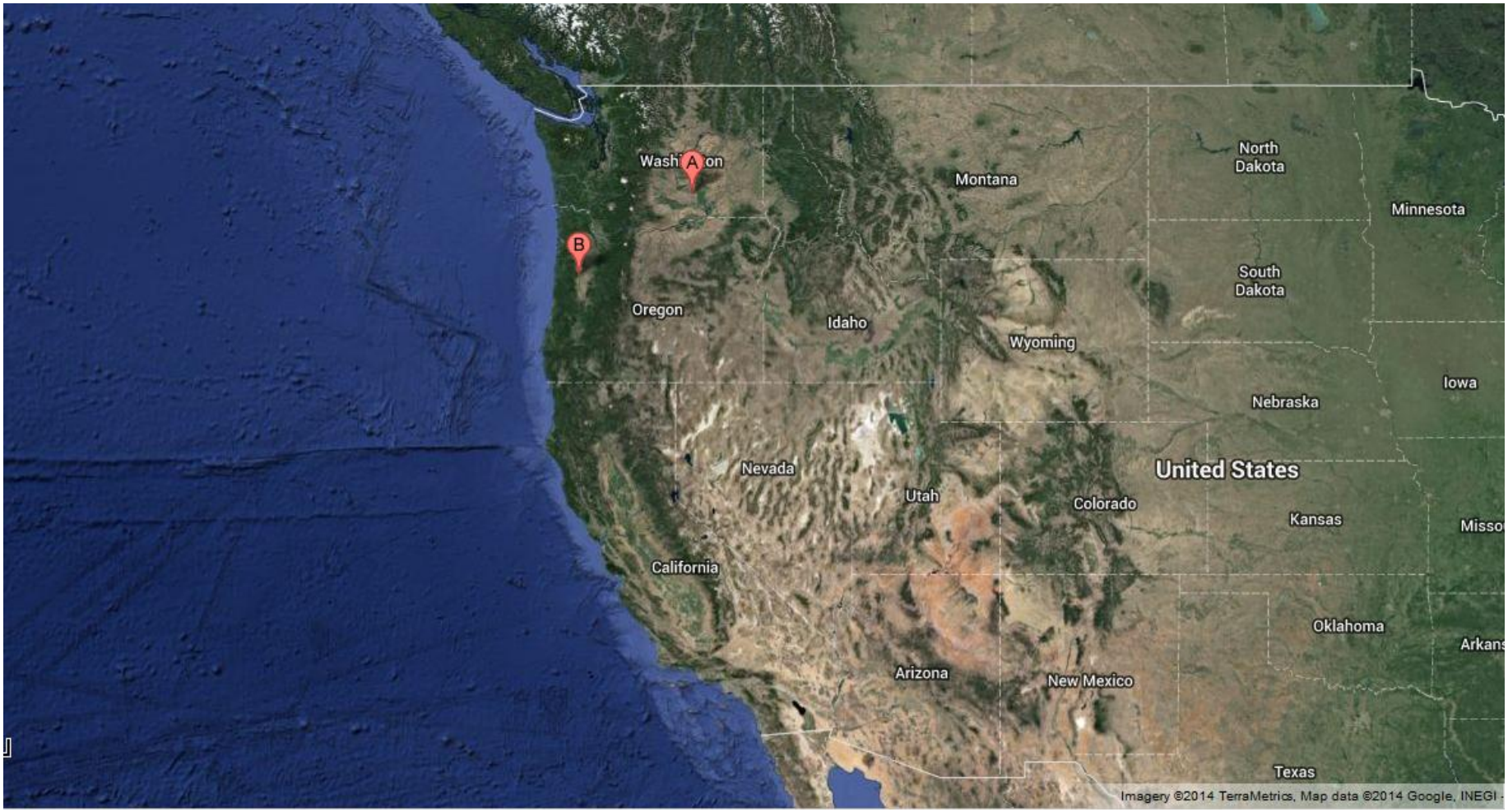
Approach to Addressing Data Gaps

- Mass Sampling
  - Collect samples of opportunity
    - Water
    - Soil
    - Vegetation
    - Invertebrates
- Determine elemental concentrations
  - Neutron Activation Analysis
  - Atomic Spectroscopy

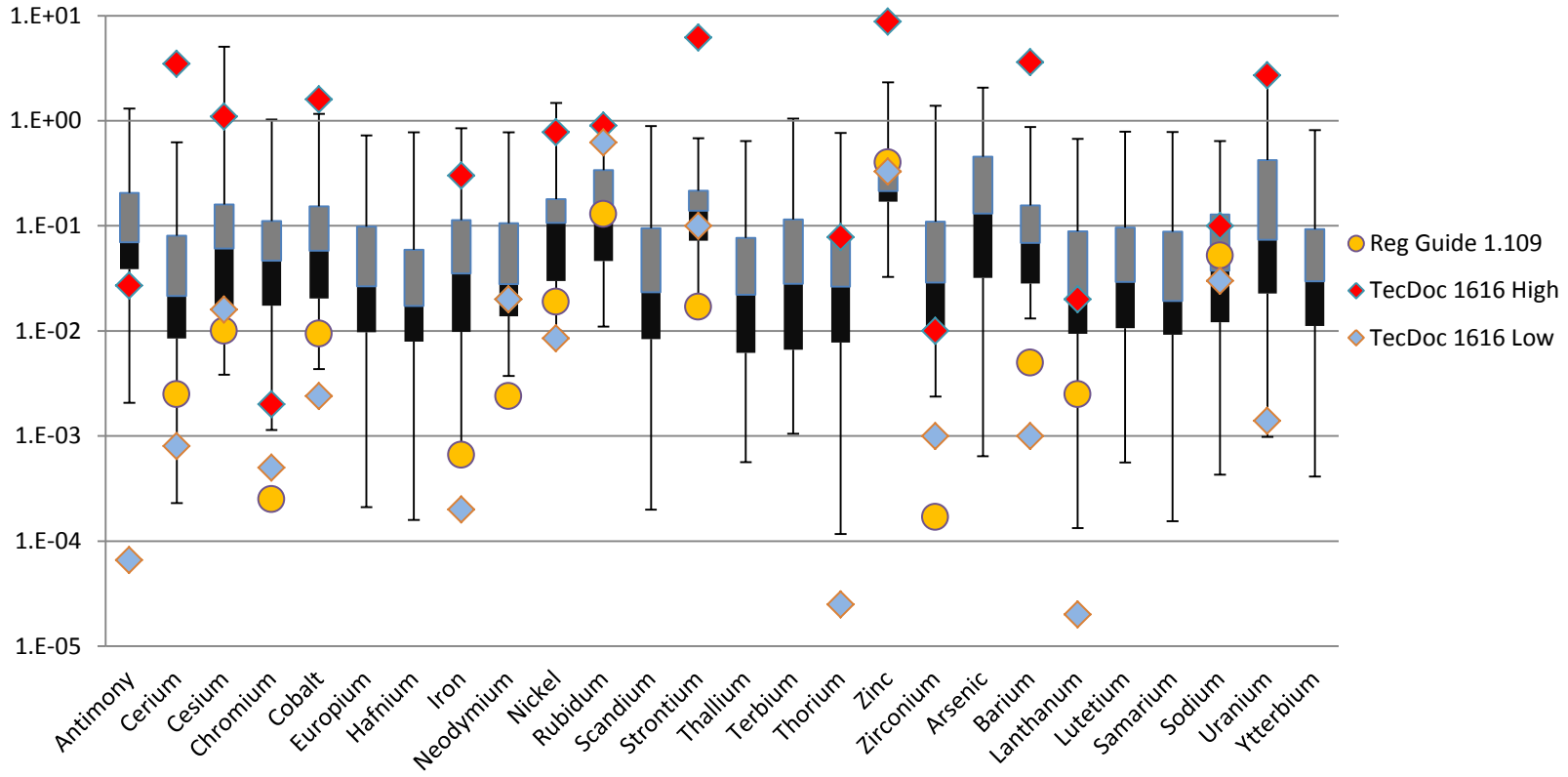
Two examples of Mass Sampling

- Hanford Site at Richland, WA, USA
  - Napier, JB 2013
- OSU McDonald-Dunn Research Forest at Corvallis, OR, USA.
  - Higley, KA 2010

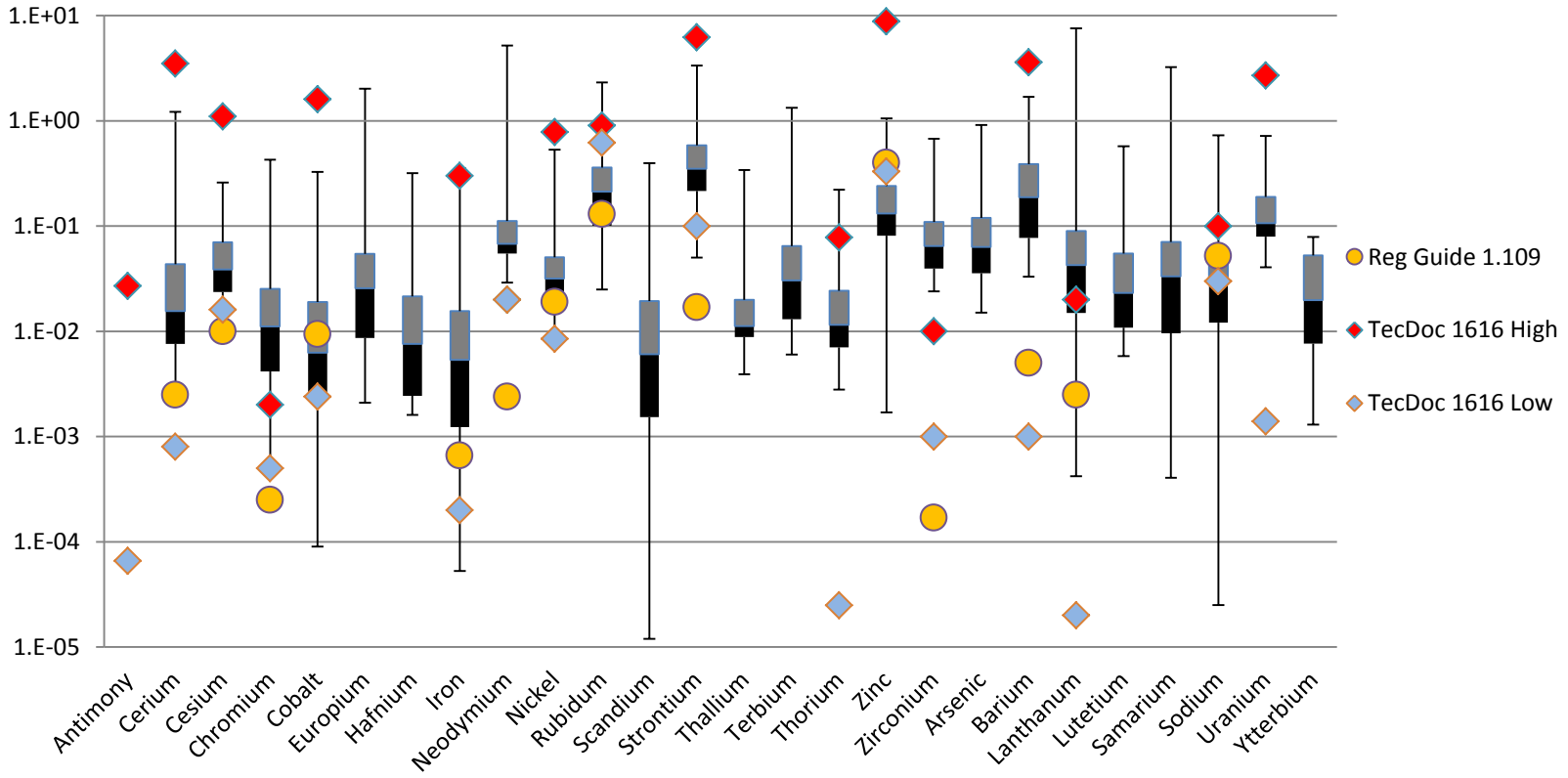
Studied Locations



Hanford Site Riparian and Shrub Steppe



McDonald-Dunn Forest



Conclusion

- Site Assessments give data specific to that location
  - This data can be then included in transport codes such as ERICA (Brown et al) or RESRAD
- Gives best answer instead of best guess
- Promotes confidence in assessment and understanding of results

References

Brown, J.E., Alfonso, B., Avila, R., Beresford, N.A., Copplestone, D., Pröhl, G., Ulanovsky A. (2008). The ERICA Tool. Journal of Environmental Radioactivity 99, Issue 9, pp.1371-1383.

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