



## Normalization references for USEtox<sup>TM</sup>-based toxic impact categories: North American and European economic systems

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# Normalization references for USEtox™-based toxic impact categories: North American and European economic systems

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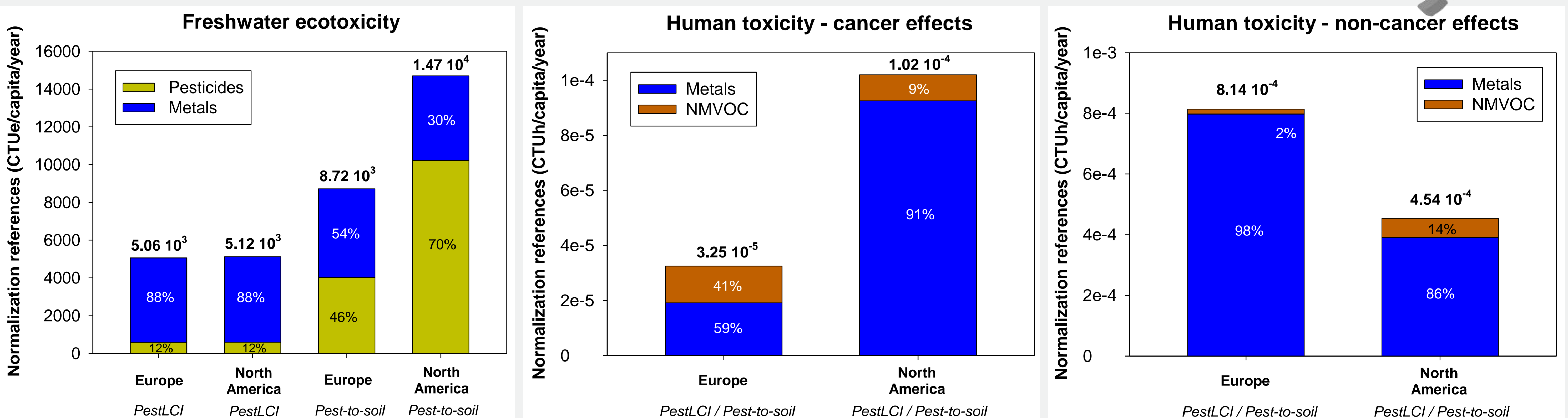
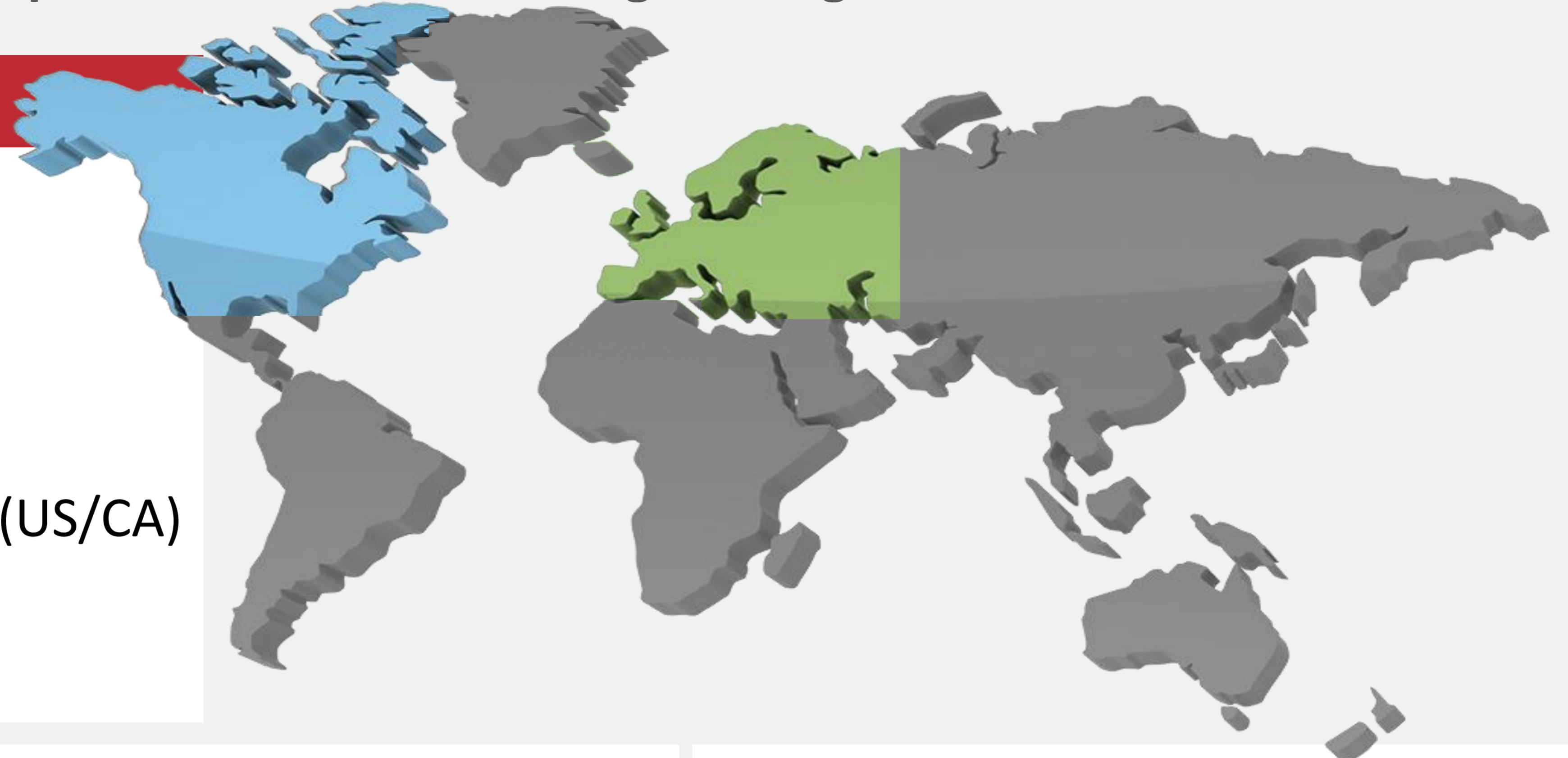
## Methods & Results

### Characterization factors (CF)

- Interim and recommended CFs
- USEtox version v.1.0 (February 2010)

### Emission inventories

- Reference years: 2004 (Europe), 2002-2008 (US/CA)
- 2 pesticide modelling approaches
- No extrapolations from other regions



\* **Pest-to-soil**: 100% of applied pesticides inventoried as "emissions to agricultural soil"; **PestLCI**: 0.1% and 5% of applied pesticides inventoried as "emissions to freshwater" and "emissions to air" (to embrace only leachings to biosphere) <sup>1,2,3</sup>

## Uncertainties

- **Incomplete emission inventory** for organics/inorganics
- **Incomplete coverage of CFs** for several organics and inorganics
- **Extrapolations** performed to bridge data gaps of covered chemicals (e.g. pesticides)
- **Interim status of CFs** for some chemicals, incl. *metals*
- **Sensitivity analysis (changes in inventory of metals mainly)**  
⇒ Europe: within one order of magnitude  
⇒ North America: up to factor 20 (due to metal emissions)

## Application in practice

- Use of **European normalization references as default set**
- **Consideration of uncertainties in interpretation** of results

### References:

- Laurent, A., Lautier, A., Rosenbaum, R. K., Olsen, S. I. & Hauschild, M. Z. **2011**. Normalization references for Europe and North America for application with USEtox™ characterization factors. *International Journal of Life Cycle Assessment* (accepted for publication in USEtox Special Issue, Summer 2011)
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## Further improvements

### Future updates

- Integration of **updated CFs** (incl. metals)
- Increased **coverage of emitted substances**
- Refinement in emission **data extrapolations**

### Expansion to other regions:

- **Substances to prioritize** when building inventory (based on existing knowledge):

Organic substances	Metals
Atrazine	Copper
Chlorpyrifos	Lead
Benz(a)pyrene	Arsenic
Benzene	Cadmium
Cypermethrin	Mercury
Dioxins	Zinc
Formaldehyde	Chromium, incl. Cr (+VI)
Acrolein	Nickel

- **Check with regional conditions** (only industrialized countries represented here)