Normalization references for Europe and North America for application with USEtox™ characterization factors

Purpose: In life cycle impact assessment, normalization can be a very effective tool for the life cycle assessment practitioner to interpret results and put them into perspective. The paper presents normalization references for the recently developed USEtox™ model, which aims at calculating globally applicable characterization factors. Normalization references for Europe and North America are determined, and guidance for expansions to other geographical regions is provided. Materials and methods The base years of the European and North American inventories are 2004 and 2002/2008, respectively. Emission data were extracted from two literature sources referring to each of the considered regions. The inventory for North America was adapted to avoid extrapolation of data from other regions and thus bring consistency with the emission inventory for Europe. In spite of different inventory assumptions, a similar coverage of substances was obtained for both regions with relatively high representation of metals and a number of organic compounds, mainly consisting of non-methane volatile organic compounds and pesticides. The two inventory sets were eventually characterized with the characterization factors (CFs) calculated with the version 1.0 of the USEtox™ model and substance database; both interim and recommended CFs were used. Results and discussion: Normalization references are provided for Europe and North America for the three USEtox™ toxic impact categories; ratios between the normalization references for the two regions in all cases lie below a factor of 3. Causes for the observed discrepancies are found to be different inventory assumptions as well as variations in the type and intensity of actual emissions between the two regions. Additional causes are inventories that only cover a limited number of substances, and the characterization model, which can only provide interim factors for certain substances like metal compounds. Based on these causes and on a review of recent studies on normalization references, a list of substances to be prioritized when collecting emission data was built, demonstrating the importance of metals. Conclusions: In the perspective of further refining the presented normalization references and of calculating new references for other regions, guidance is provided including a list of priority substances that should be considered when building emission inventories for normalization references.