



Modeling human and ecosystems exposures and impacts for life-cycle assessment: the USEtox model

Abstract

To address the increasing need for methods to assess the impacts of toxic chemical emissions on human health and ecosystems, this course provides a practical overview of multimedia chemical fate modeling, multi-pathway human exposure modeling, ecosystem and human health effects modelling, and comparative indicators for human health and ecotoxicological impacts. We begin by explaining basic concepts for environmental mass balance modeling—including partitioning coefficients, first order rate coefficients, cross-media transport, persistence, and long-range transport. We next present the fundamentals of multi-pathway models for human intake via inhalation, drinking water and food. We will review hazard-based and risk-based effects modeling approaches that are used to assess effect factors and illustrate how fate, exposure, effects and damage factors can be combined to construct characterization factors. We then guide the participants through a series of examples in which they will develop characterization factors for human health and ecological impacts using the USEtox model. Students will explore USEtox as a tool for the comparative assessment of chemical fate, human exposure, and ecological impacts. We will conclude with a demonstration of how the model can be used in various applications, including the prioritization and ranking of chemicals for agencies such as the US-EPA.

Course objectives

The aim of this workshop is to introduce participants to the exposure science methods used in life-cycle and comparative risk assessment. The participants will learn to use and evaluate basic tools for mass-balance, fate modeling, intake fraction, and effect factor estimation. Participants will review underlying model assumptions and evaluate data needs along with data and knowledge gaps in these assessments.

The course is intended for environmental science practitioners interested in the scientific fundamentals of chemical impact assessment for a broad range of environmental emissions. Only a basic background knowledge of environmental modeling, risk assessment or LCA is considered necessary. Participants will come away with a knowledge of basic concepts of exposure science for chemical impact assessment and be able to perform their own assessment using the USEtox model and interpret results.

Course level

Intermediate