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# Microplastics in Soils: Risk and Impact Assessment

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82nd LCA Discussion Forum, ETH  
November, 2022

# Introduction

- Mass flows to soils
- Routes
- Effects

Soil Ecosystem

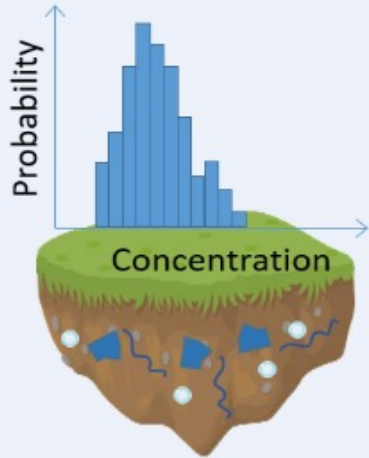


*(Photo by Alan Levine, 2016)*

# Risk Assessment

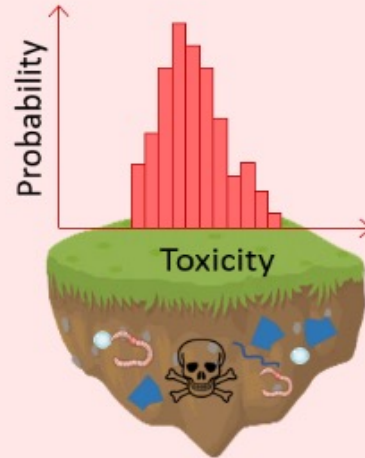
# Methods

## Exposure assessment

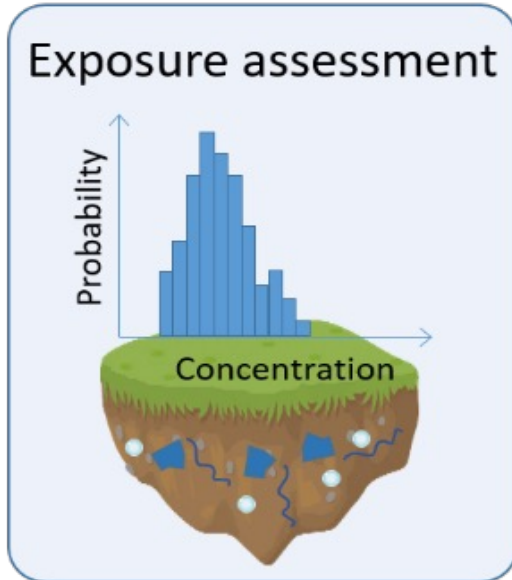


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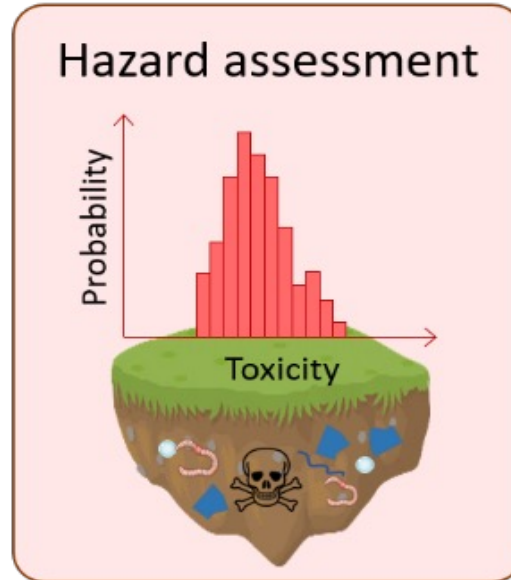
## Hazard assessment



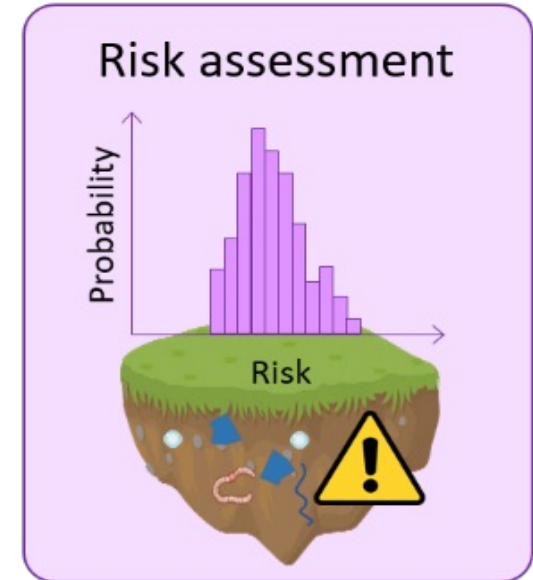
# Methods



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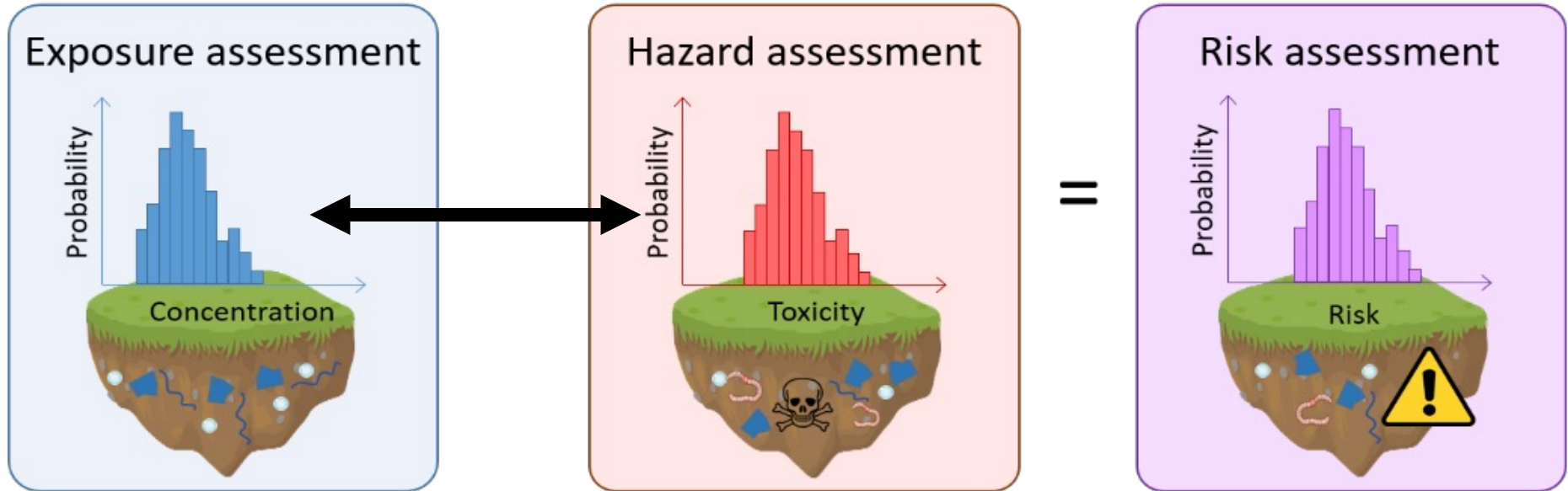
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$$\text{Risk Char. Ratio} = \frac{\text{MEC Probability Dist.}}{\text{PNEC probability Dist.}}$$

Overlapping of probability distributions

# Methods

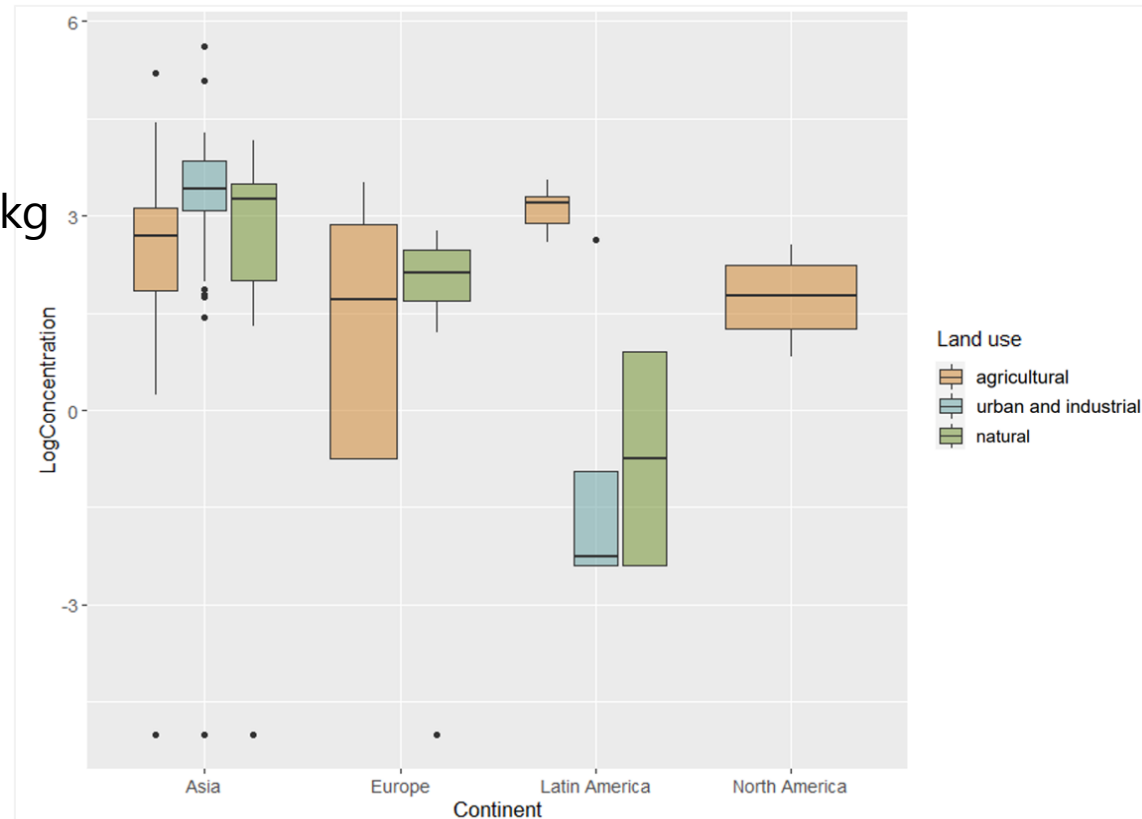


$$\text{Risk Char. Ratio} = \frac{\text{MEC Probability Dist.}}{\text{PNEC probability Dist.}}$$

Overlapping of probability distributions

# Results

- Exposure Assessment
  - Globally: 0-410,000 part/kg

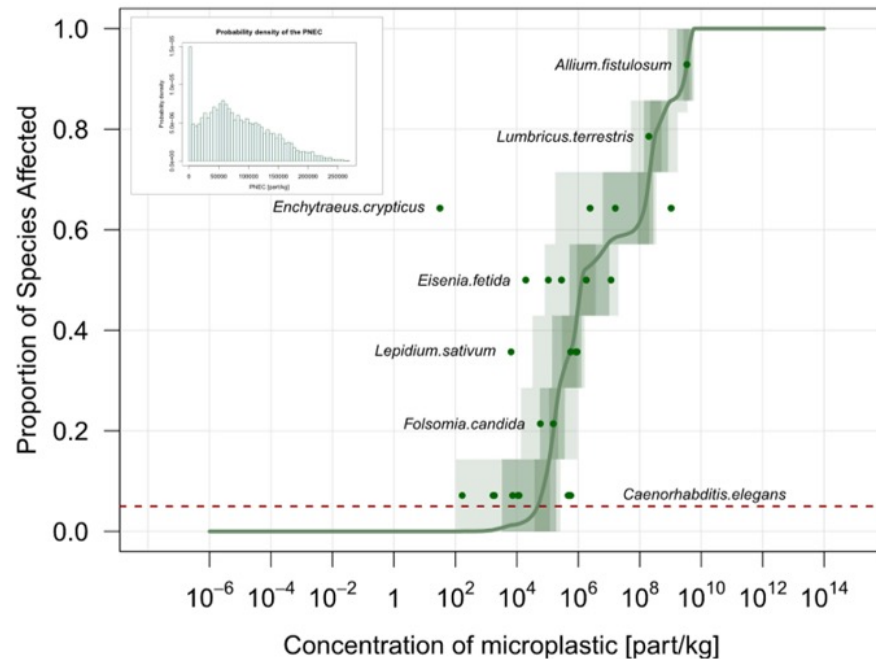
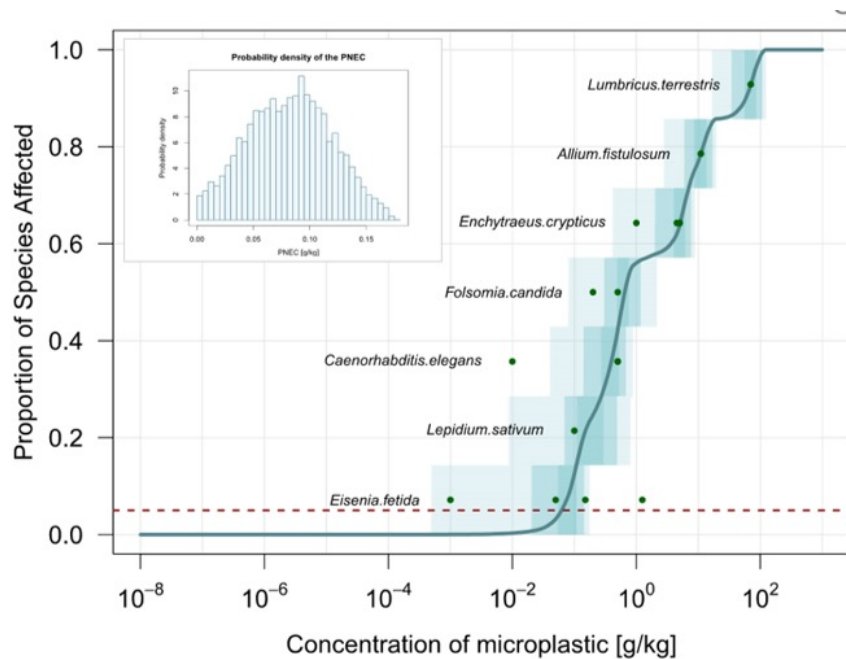


# Results

- Hazard Assessment
  - pSSD
    - $$\text{NOEC}_{\text{eq.}} = \frac{\text{LOEC}/\text{NOEC}/\text{HONEC}}{\text{UF}_t * \text{UF}_d}$$
  - Uncertainties
  - PNEC -> by combining in one vector the 5% percentiles of pSSDs.
    - 82,000 part/kg, 0.82 g/kg



# pSSDs



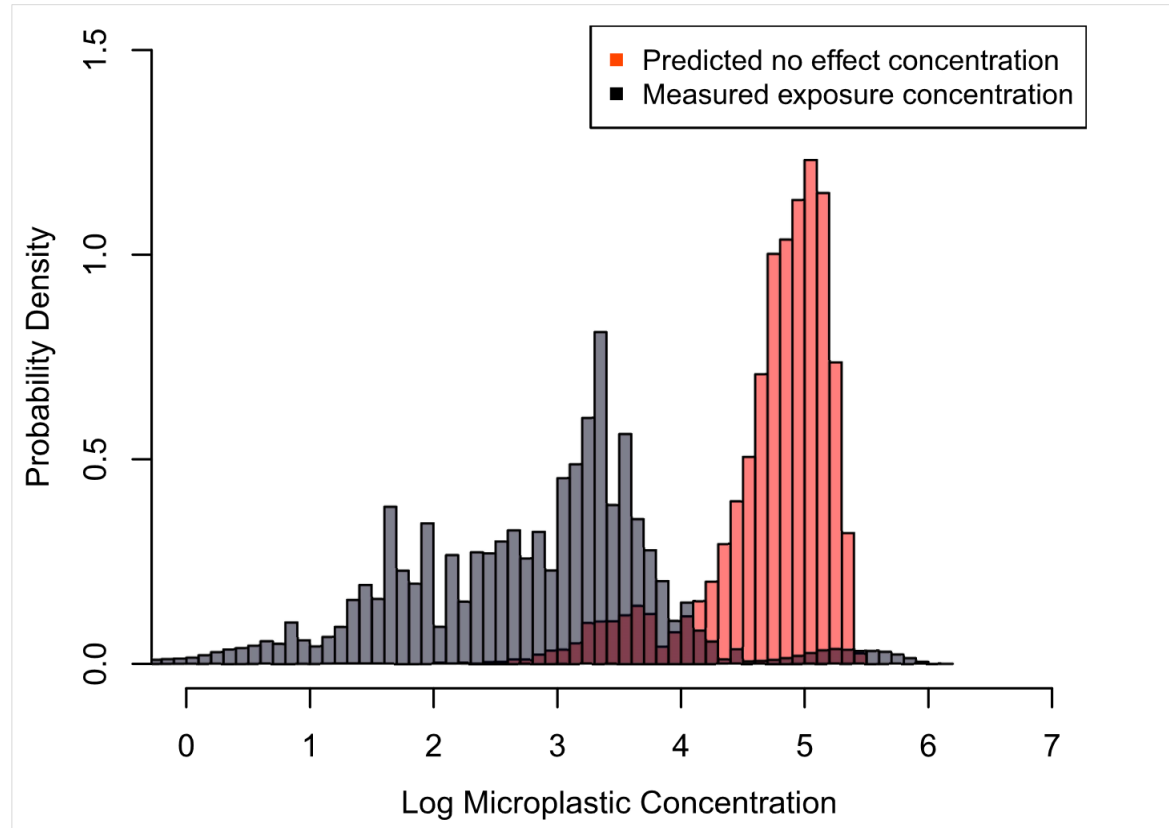
# Results

- Risk Assessment

- Overlap

- RCR

$\%RCR \geq 1 \rightarrow 4.9\%$



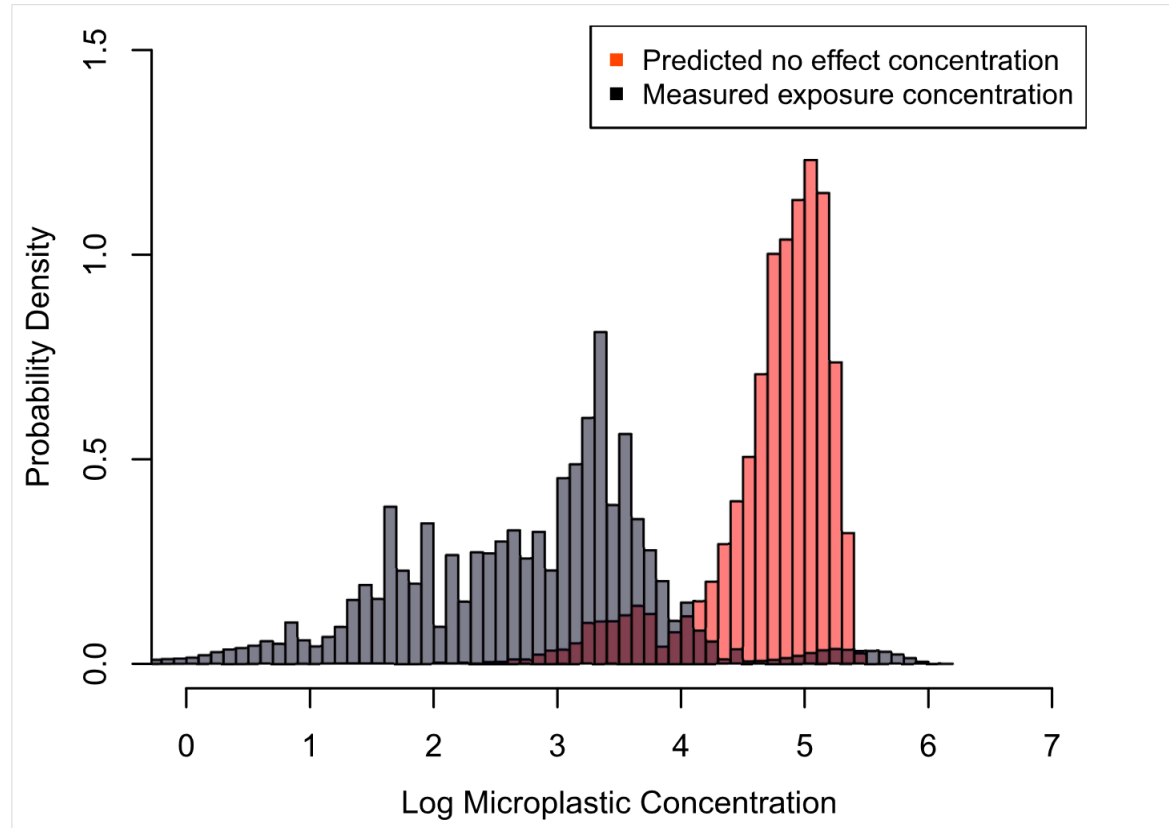
# Results

- Risk Assessment

- Overlap

- RCR

- %RCR $\geq 1$  -> **4.9%**



# Impact Assessment

## Quantification of Flows

*Inventory  
Development*

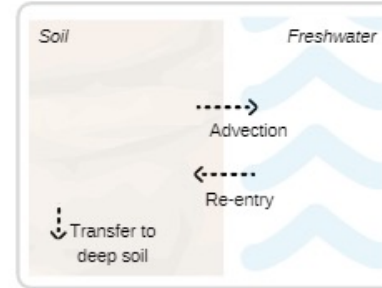


## Development of Characterization Factors

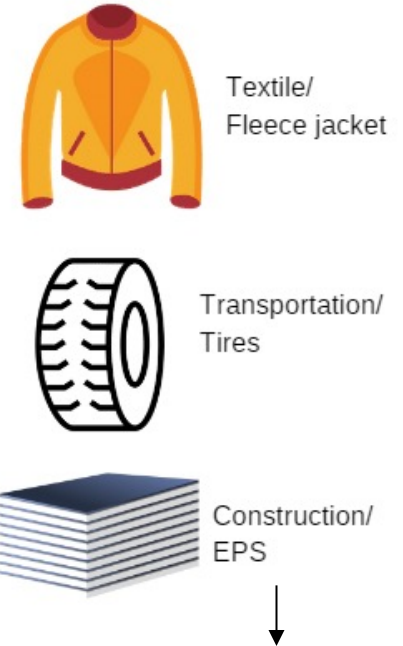
*Effect factor*



*Fate factor*



## Life Cycle Assessment of Case Studies



**Soil toxicity**

**Quantification of Flows**

*Inventory Development*

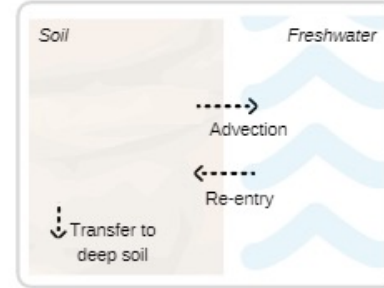


**Development of Characterization Factors**

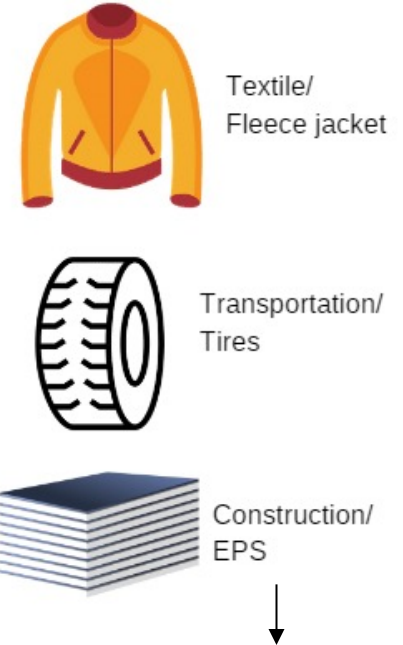
*Effect factor*



*Fate factor*



**Life Cycle Assessment of Case Studies**



$$CF = EF * FF * XF$$

Soil toxicity

(Based on Kawecki and Nowack, 2019.)

## Quantification of Flows

Inventory  
Development

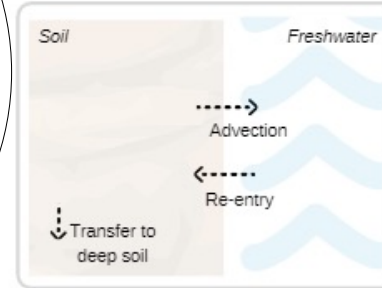


## Development of Characterization Factors

Effect factor



Fate factor



## Life Cycle Assessment of Case Studies



Textile/  
Fleece jacket



Transportation/  
Tires



Construction/  
EPS

$$CF = EF * FF * XF$$

↓  
Soil toxicity

# Life Cycle Assessment

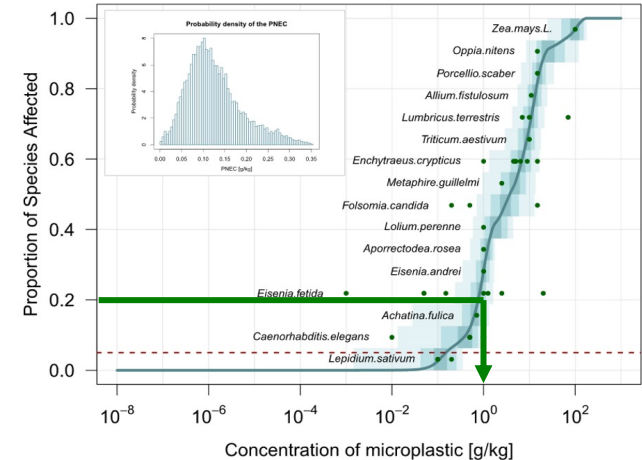
- **Effect factor** determination

- pSSD

- ~ 20 species

- $$EC10_{eq.} = \frac{LOEC/NOEC/HONEC}{UF_t \cdot UF_d}$$

- EF -> at which 20% of the species effected.



\*Graph does not represent the results of this study, it is provided to give an example for the calculation method.



## Quantification of Flows

*Inventory  
Development*

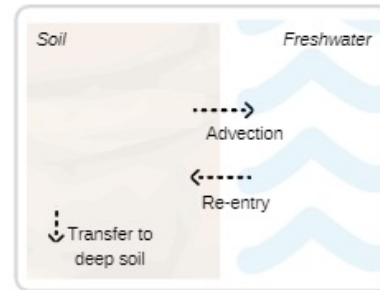


## Development of Characterization Factors

*Effect factor*



*Fate factor*



## Life Cycle Assessment of Case Studies



Textile/  
Fleece jacket



Transportation/  
Tires



Construction/  
EPS

$$CF = EF * FF * XF$$



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Thank You

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