

Willkommen
Welcome
Bienvenue



The plastic continuum from litter to microplastic and finally to nanoplastic: Release and exposure considerations

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The Plastic Size Continuum

Macroplastics

Larger 5 mm



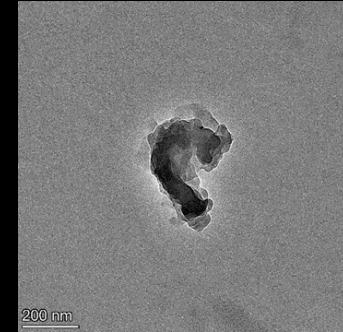
Microplastics

Between 5 mm and 1 μm



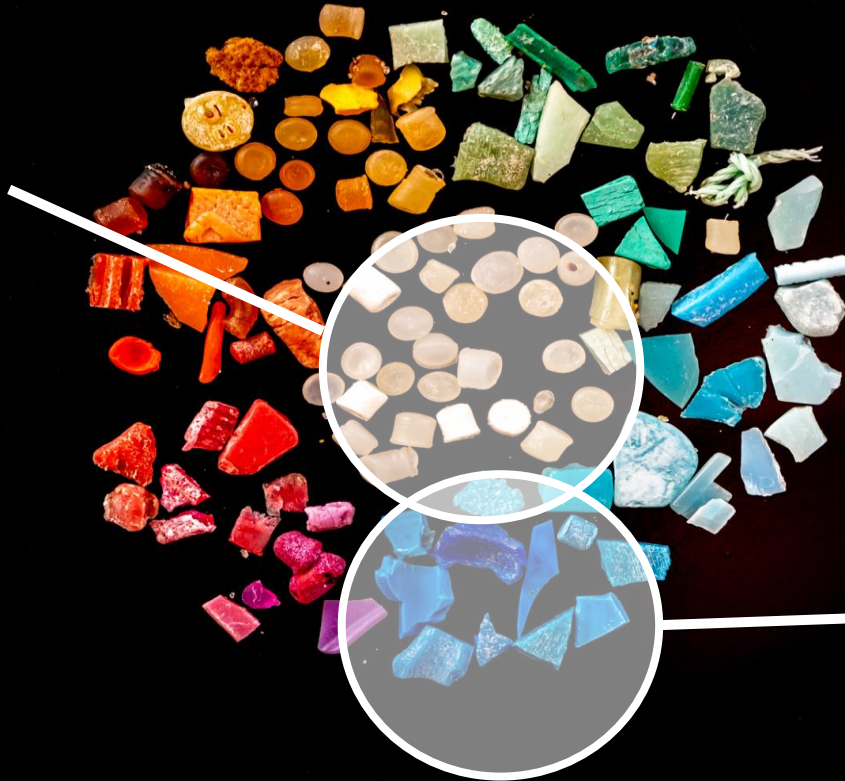
Nanoplastics

Smaller than 1 μm



Microplastics

Primary
microplastics

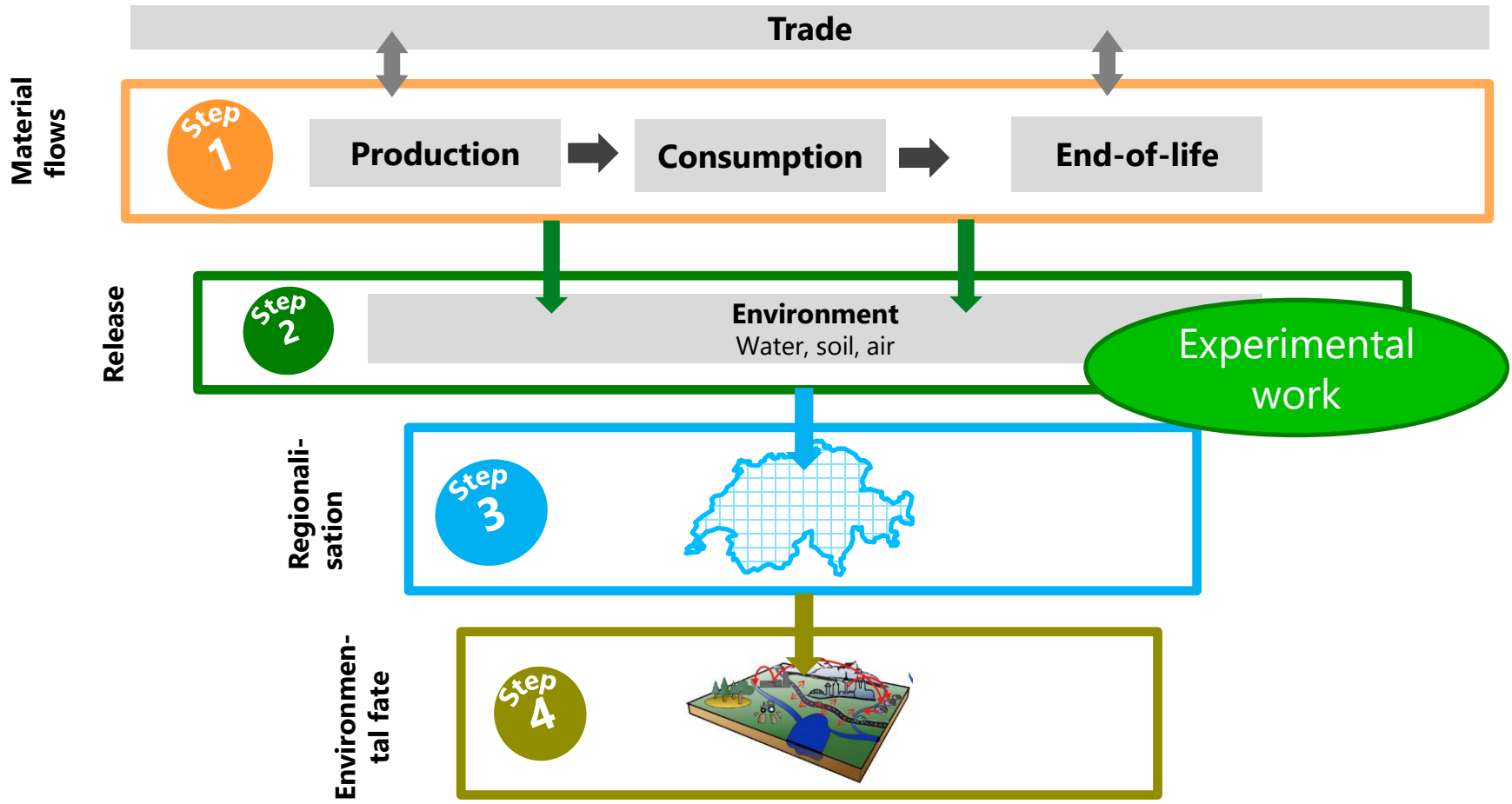


Secondary
microplastics

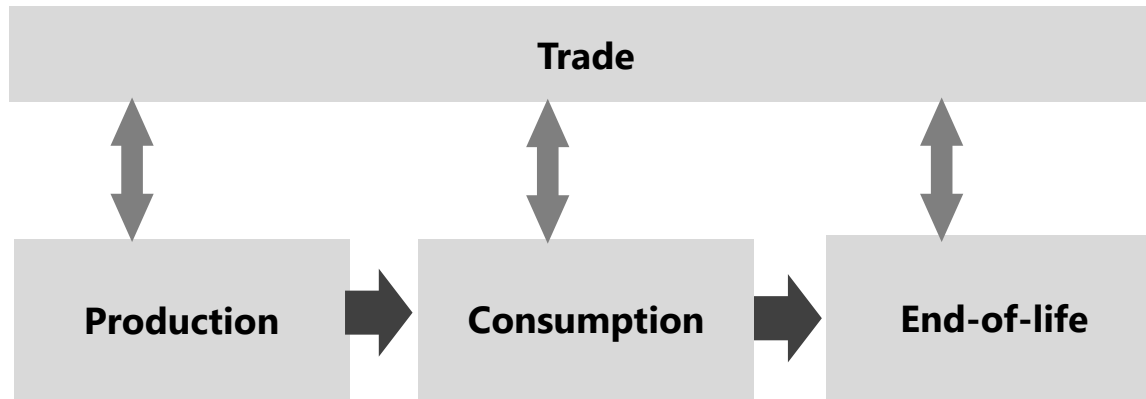
Fragmentation as connection



Assessing plastic release

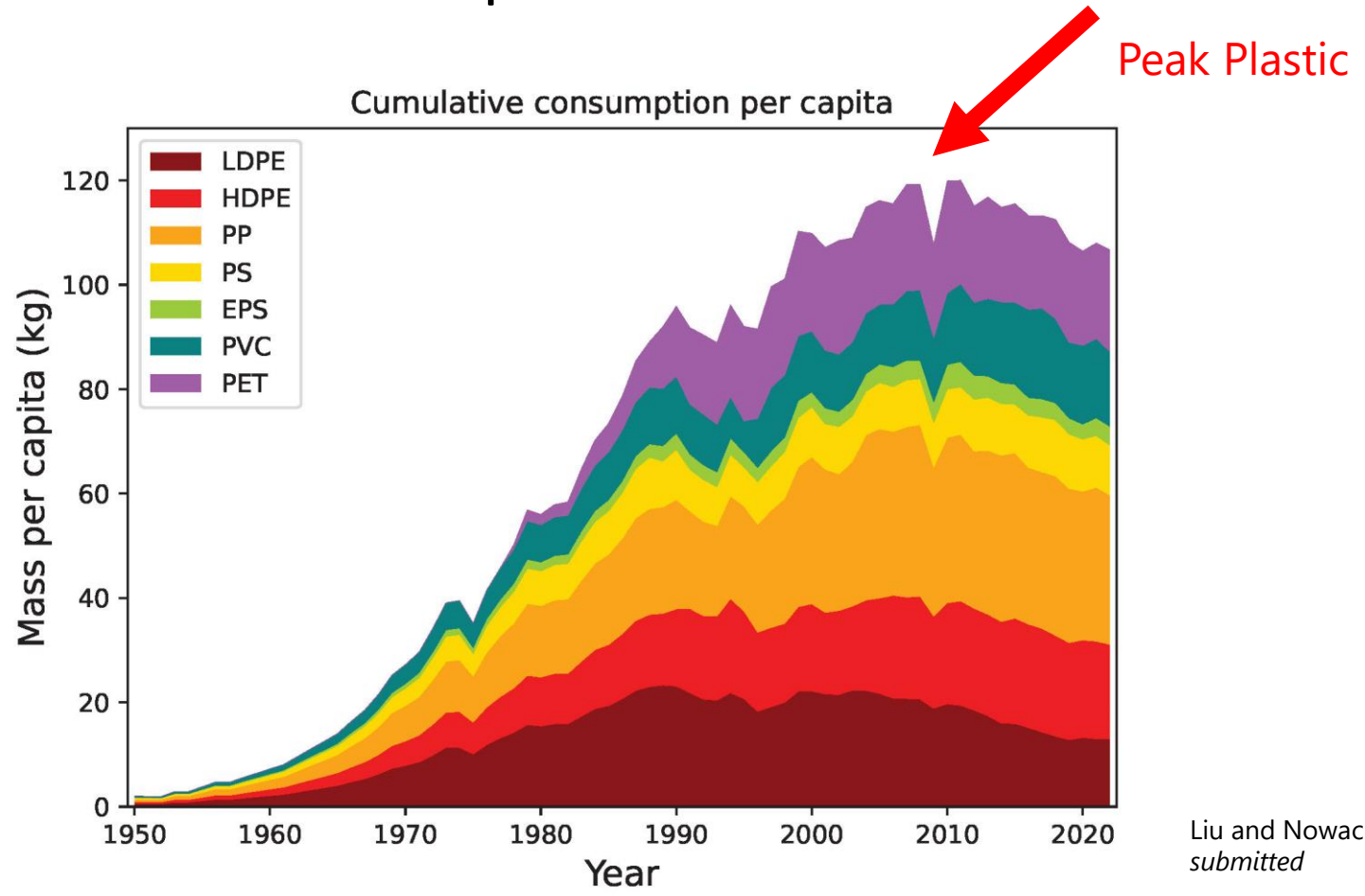


Material flow analysis

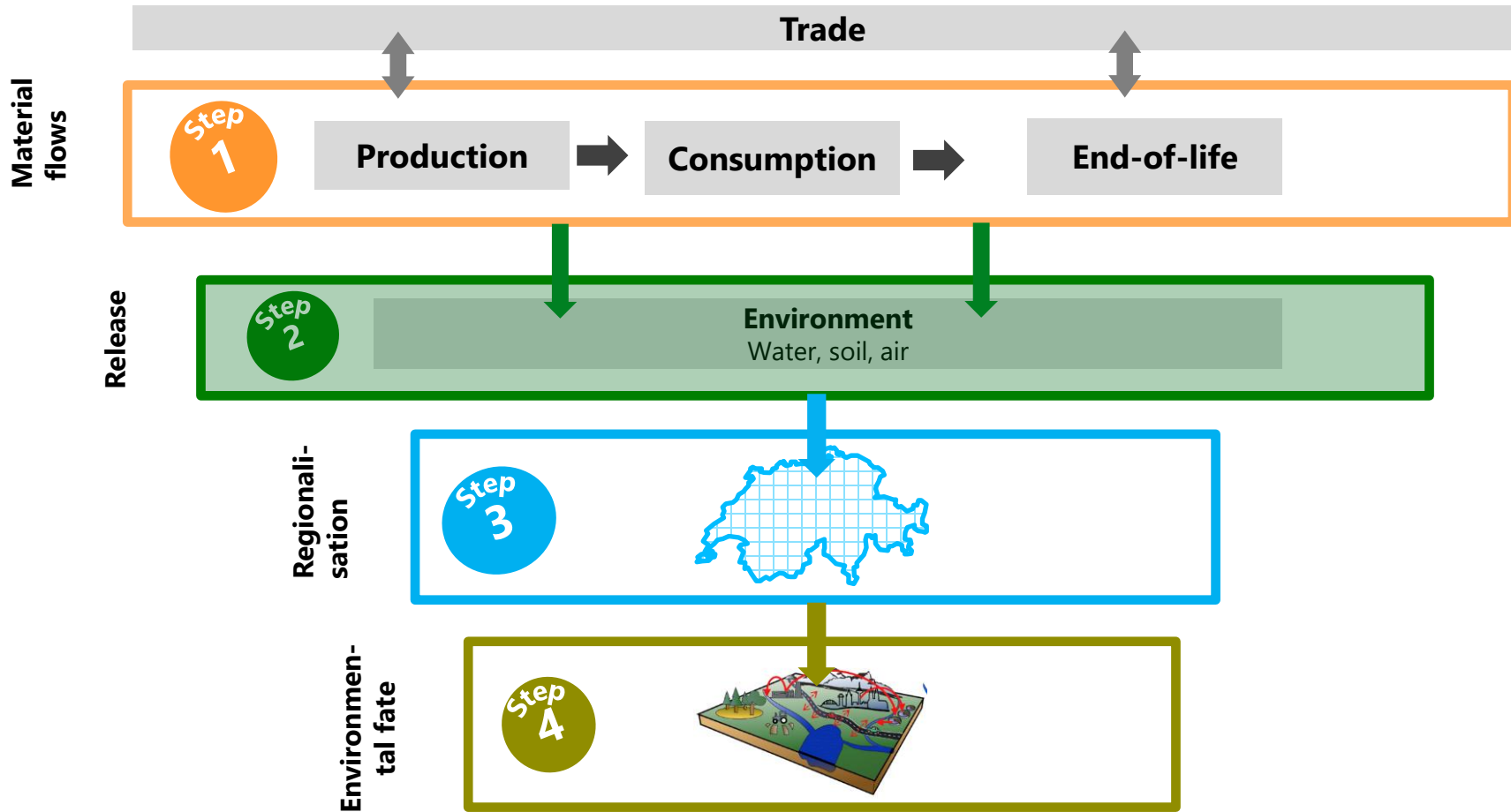


- Considered polymers: LDPE, HDPE, PP, PS, EPS, PVC, PET, PUR, PMMA, ABS, PA, PC
- Tire wear (rubber) as additional polymer
- Regions: EU, Switzerland, China
- 9 product sectors, 36 product categories

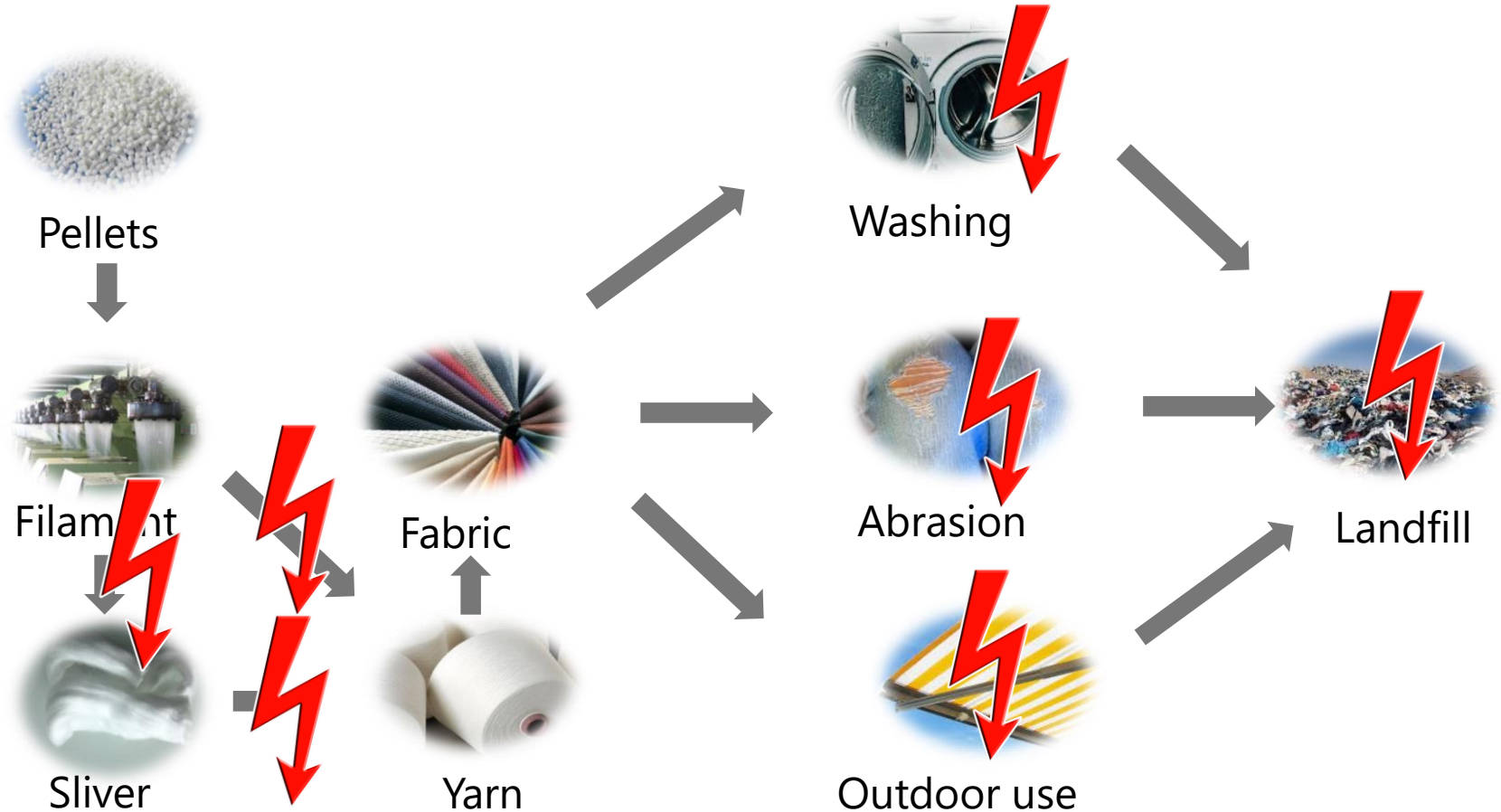
Plastic Consumption in Switzerland



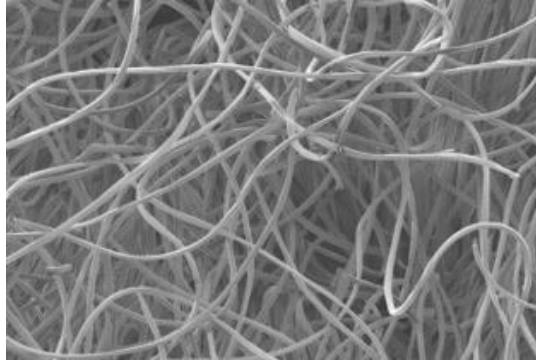
The modeling approach



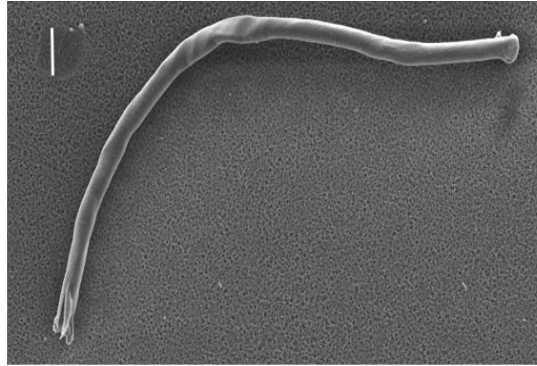
Release of microplastic fibers from textiles



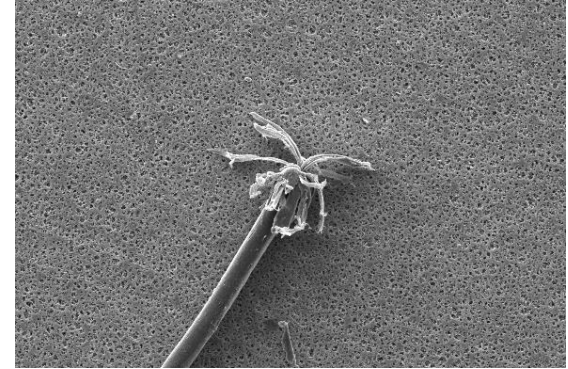
Fiber shapes



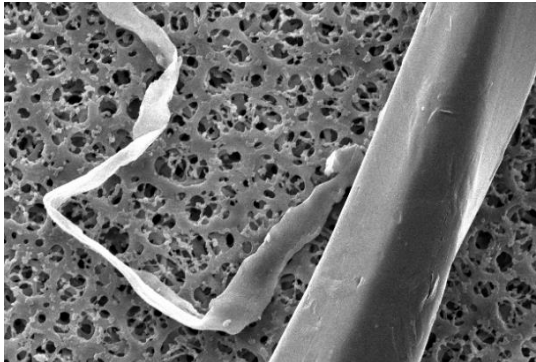
Fabric



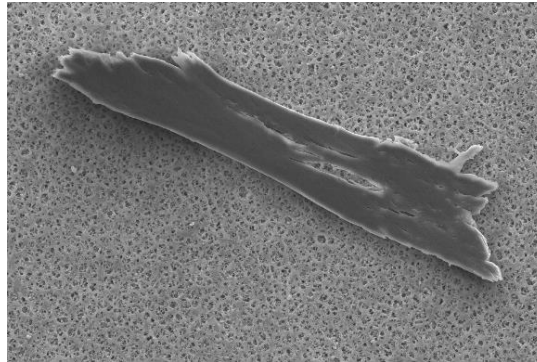
Washing



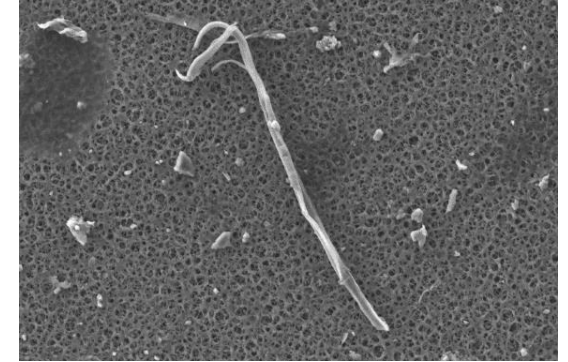
Abrasion



Abrasion



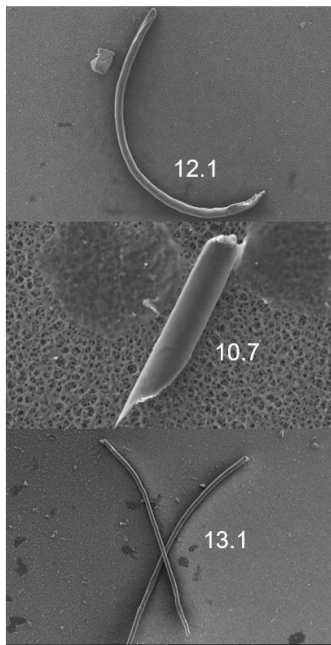
Weathering



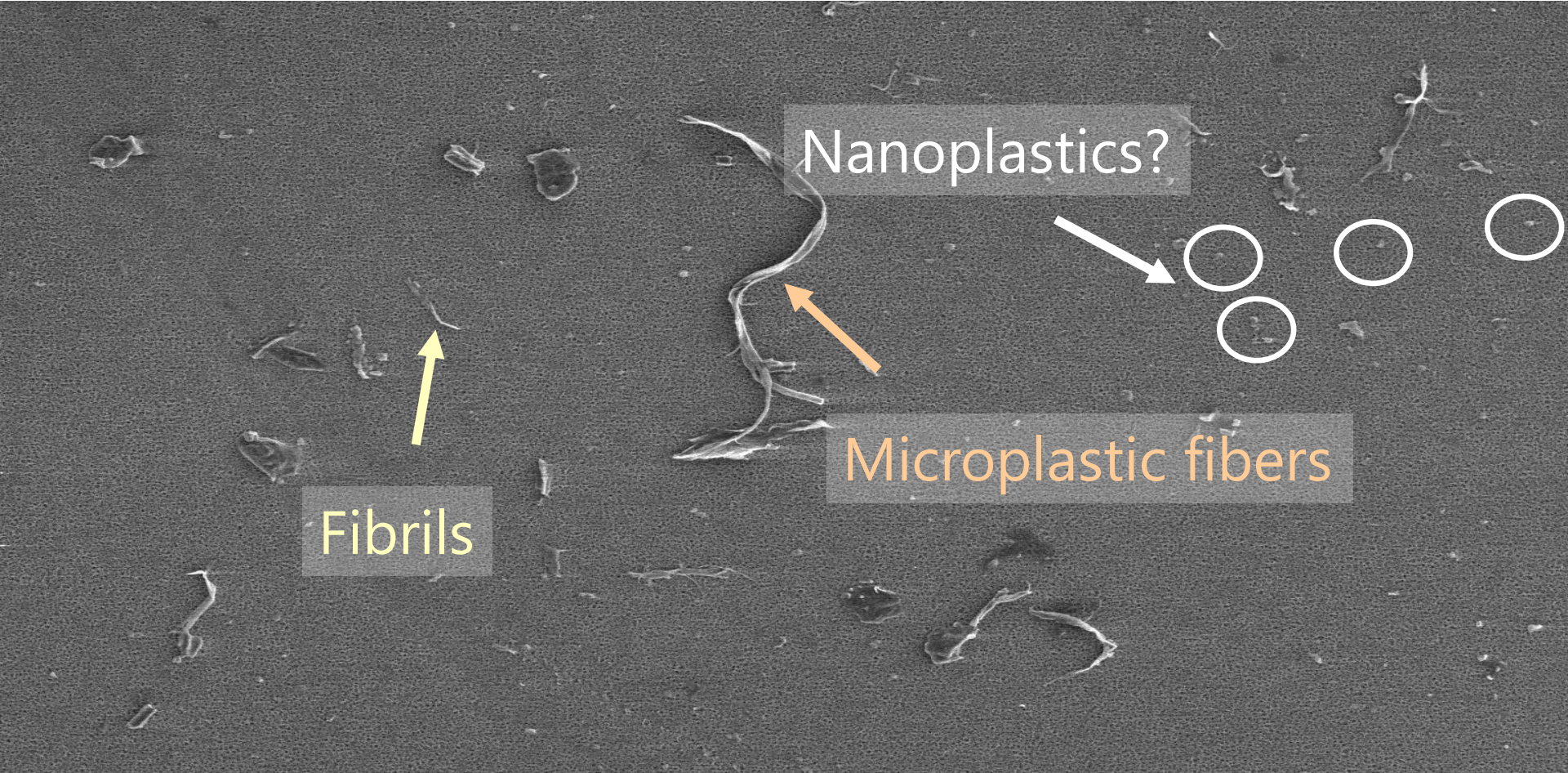
Weathering

UV weathering: a zoo of particles is formed!

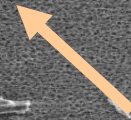
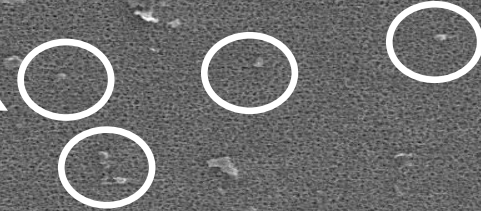
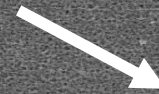
Regular MPF



From micro- to nanoplastic



Nanoplastics?



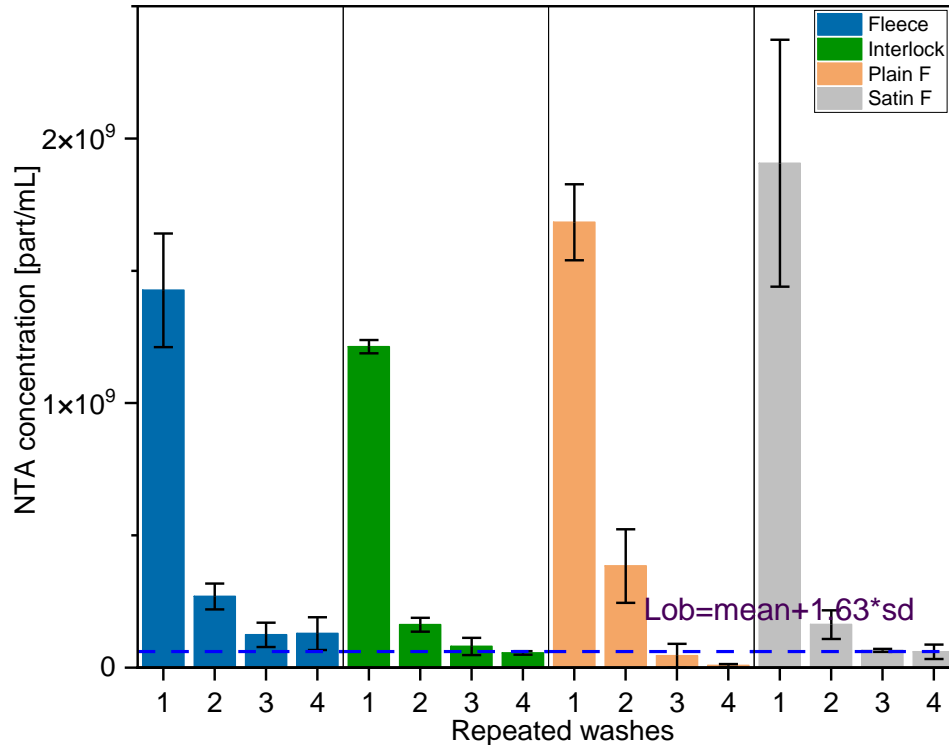
Microplastic fibers



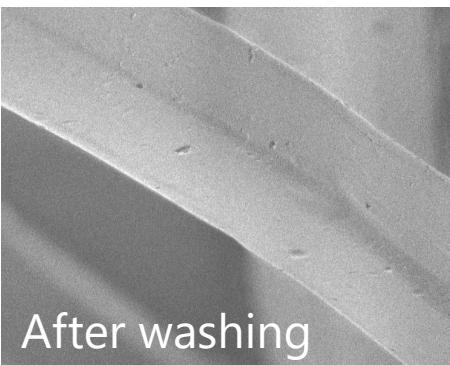
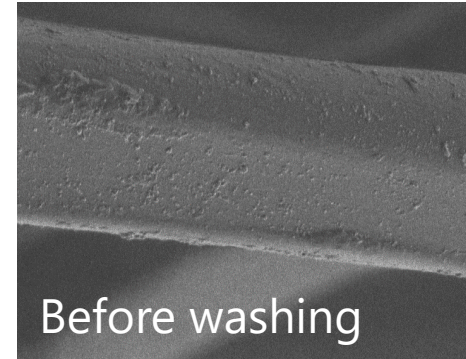
Fibrils

Nanoplastic release during washing

Release with repeated washings

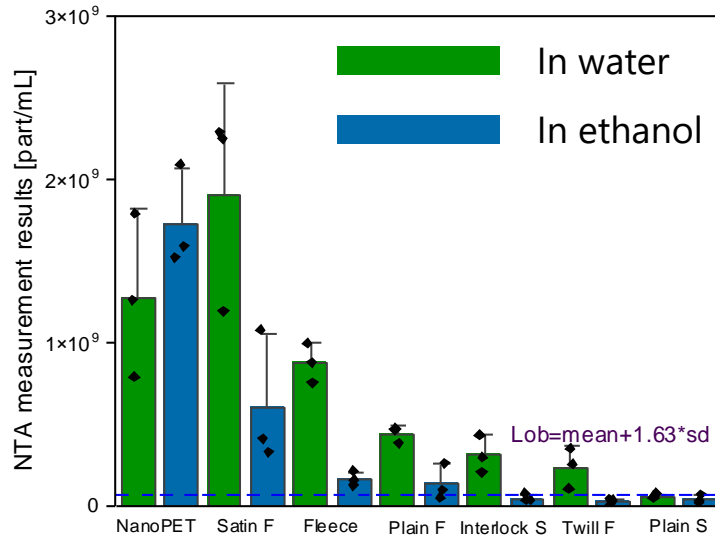


Surface of polyester fibers

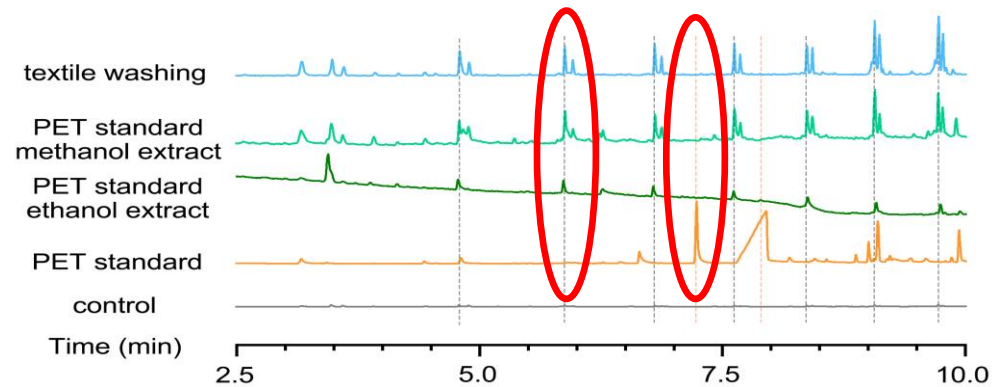


Is really nanoplastic released?

Oligomers are soluble in ethanol



Analysis by Pyrolysis GC-MS

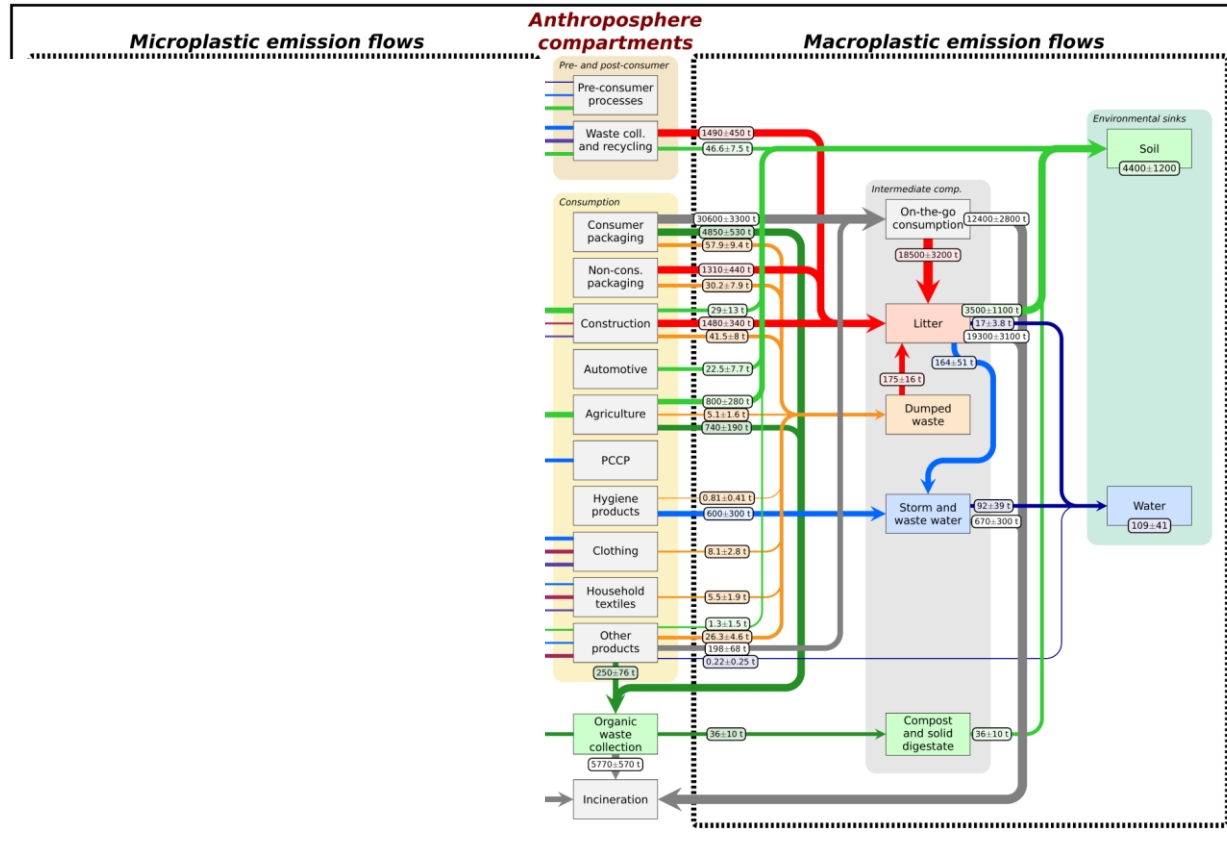


Release assessment

- Based on material flow models for plastics
- Identification of release processes throughout the whole life-cycle
- Parameterizing the amount released (release factors)
- Performed separately for macro- and microplastics

Plastic emissions to the environment

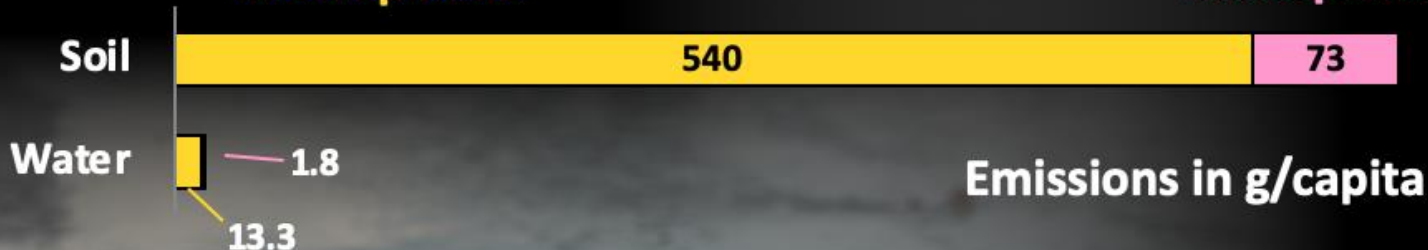
Plastic emissions in Switzerland



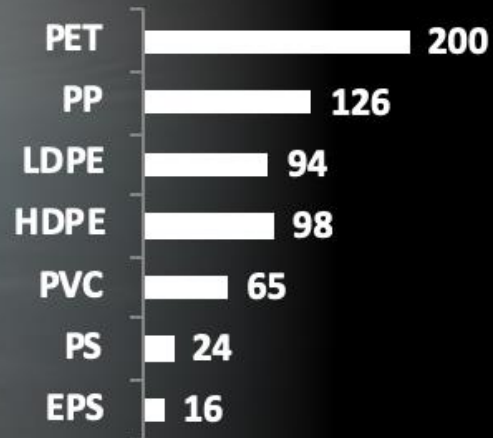
Release in gram/capita/year

Macroplastic

Microplastic



Emissions in g/capita



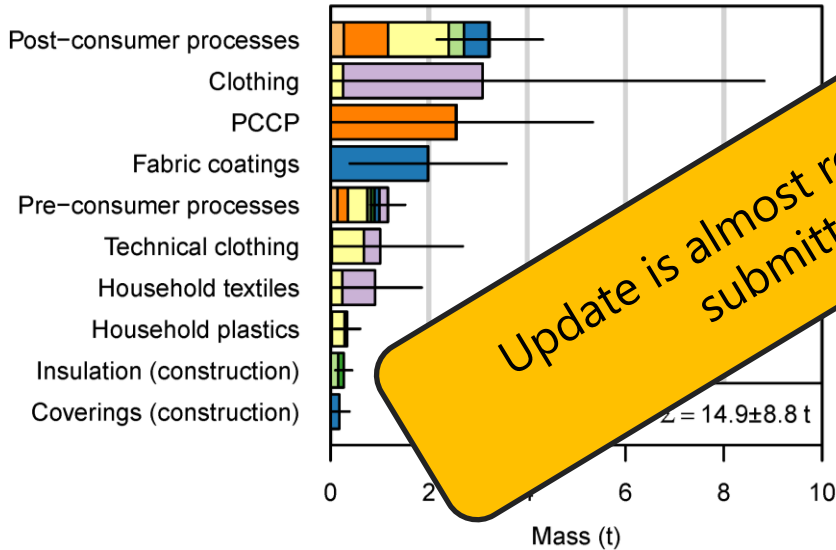
Microplastic emissions in Switzerland

in Gram/capita/ year

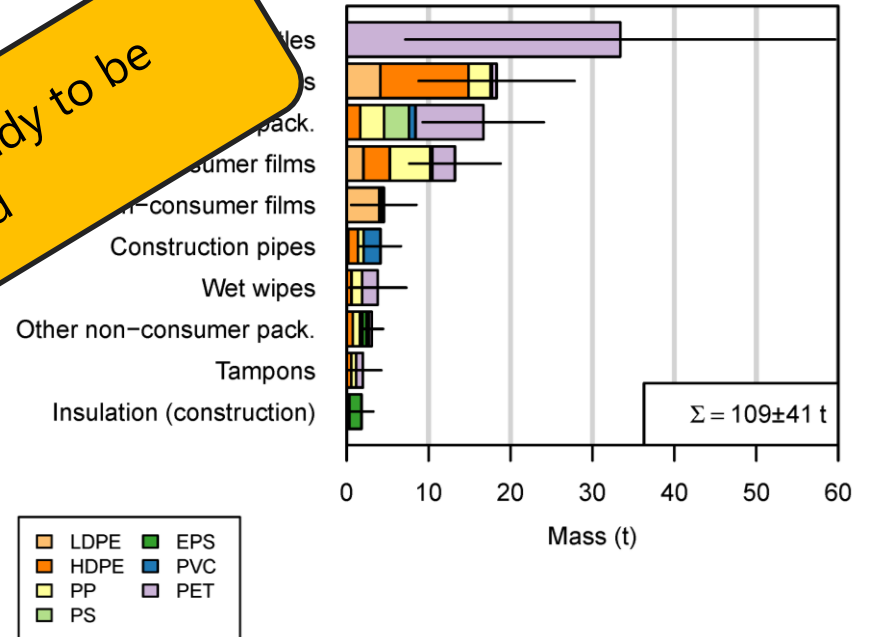


Release to water in Switzerland

Microplastic emissions to water



Macroplastic emissions to water

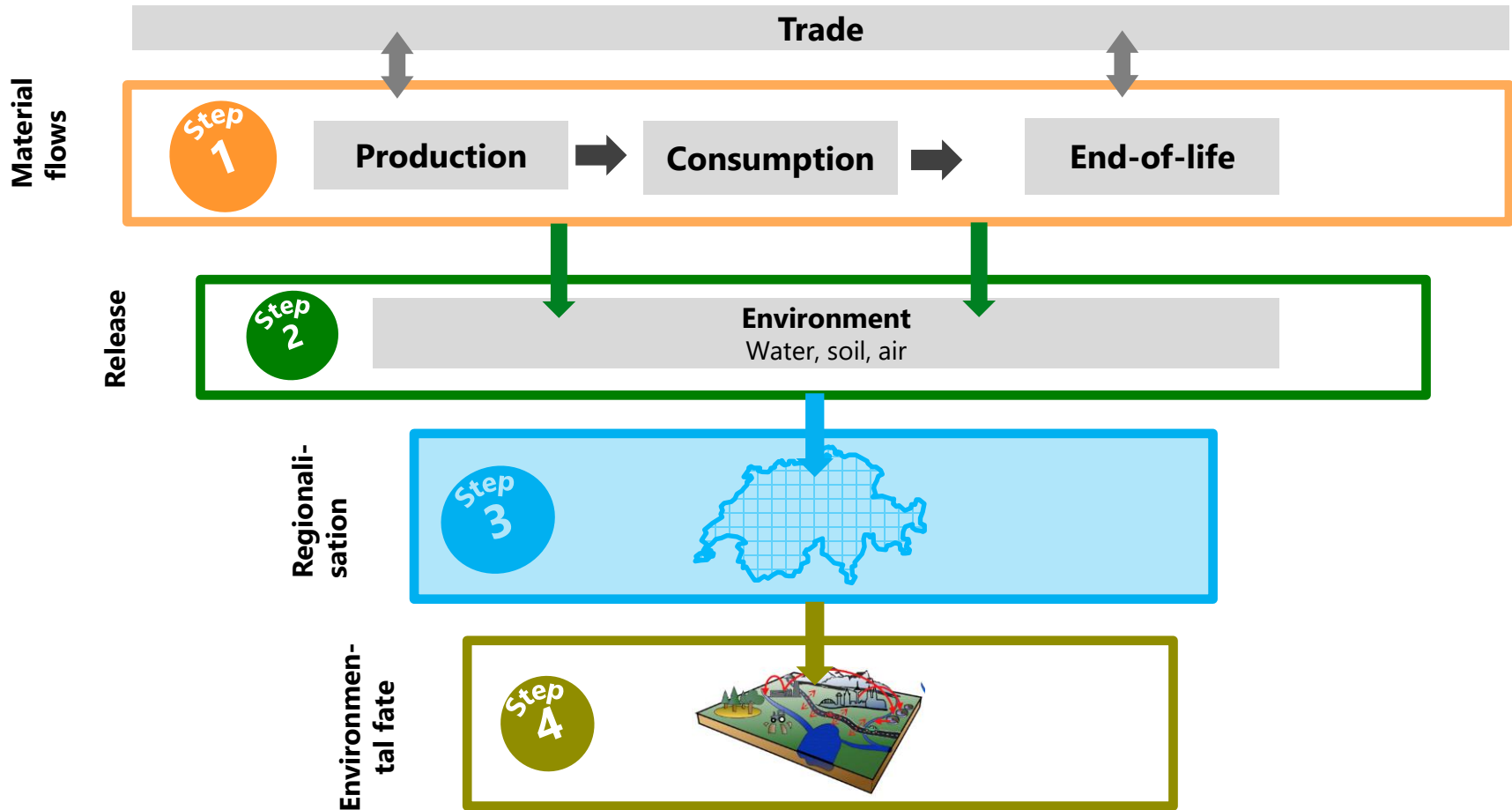


Microplastic vs. Tire wear

in gram/capita/ year in Switzerland

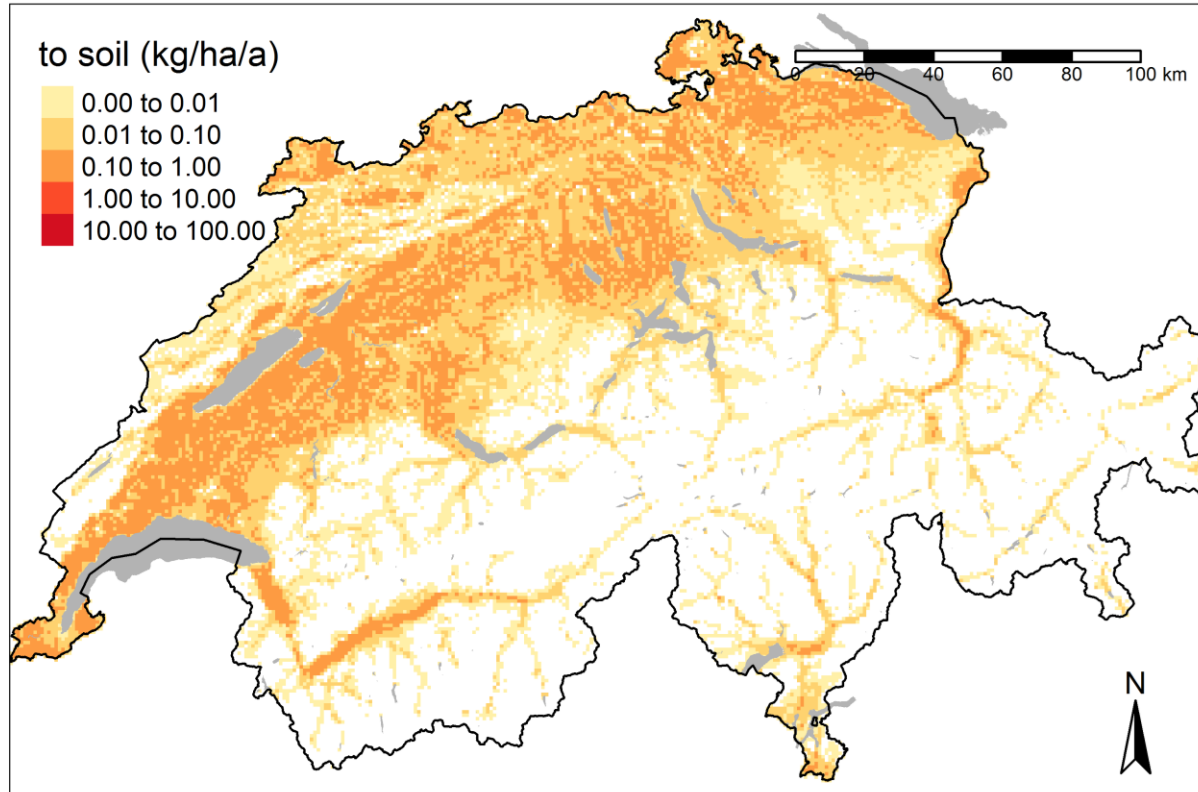


The modeling approach

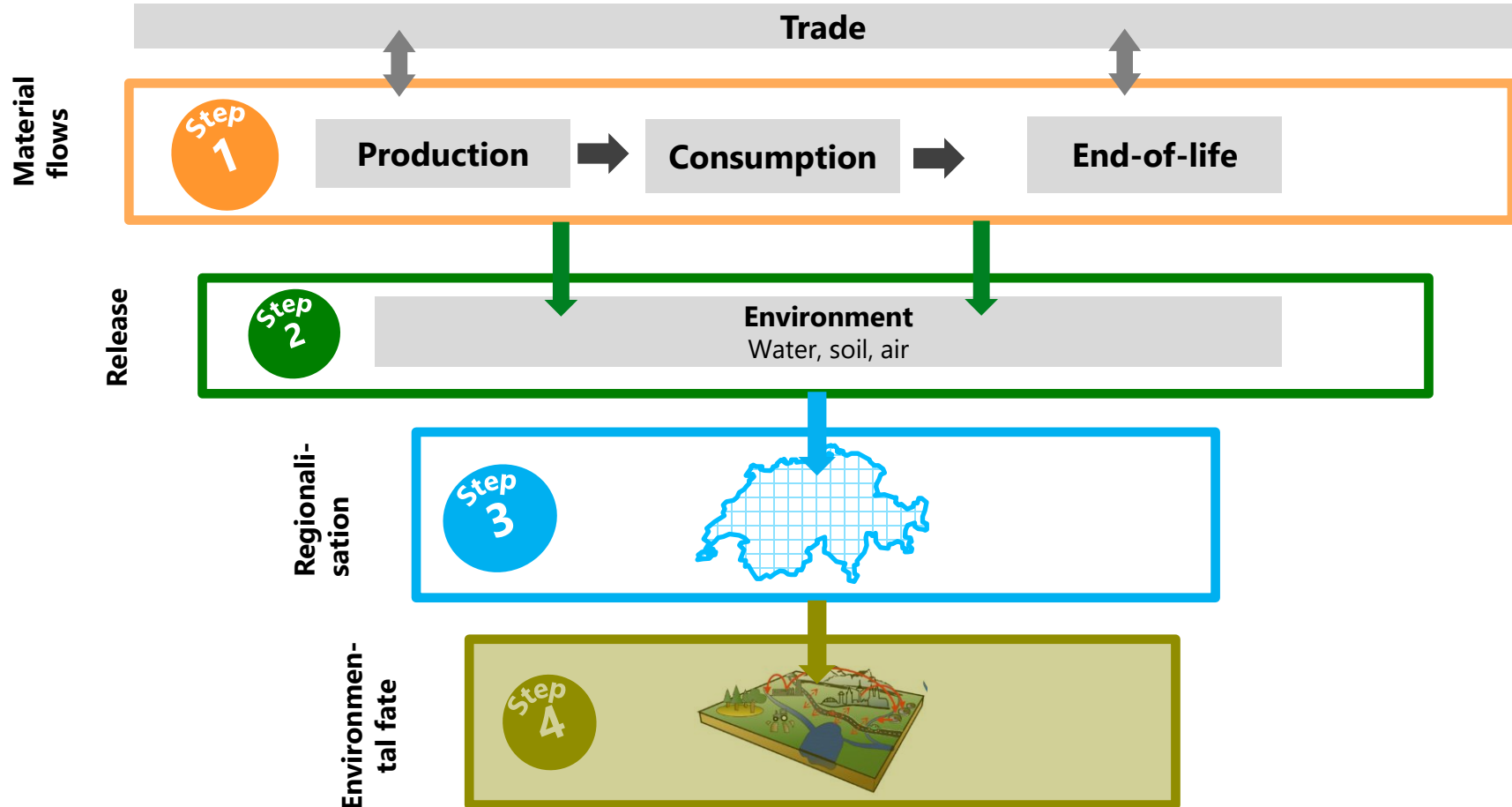


Emission maps for Switzerland

LDPE microplastic to soil

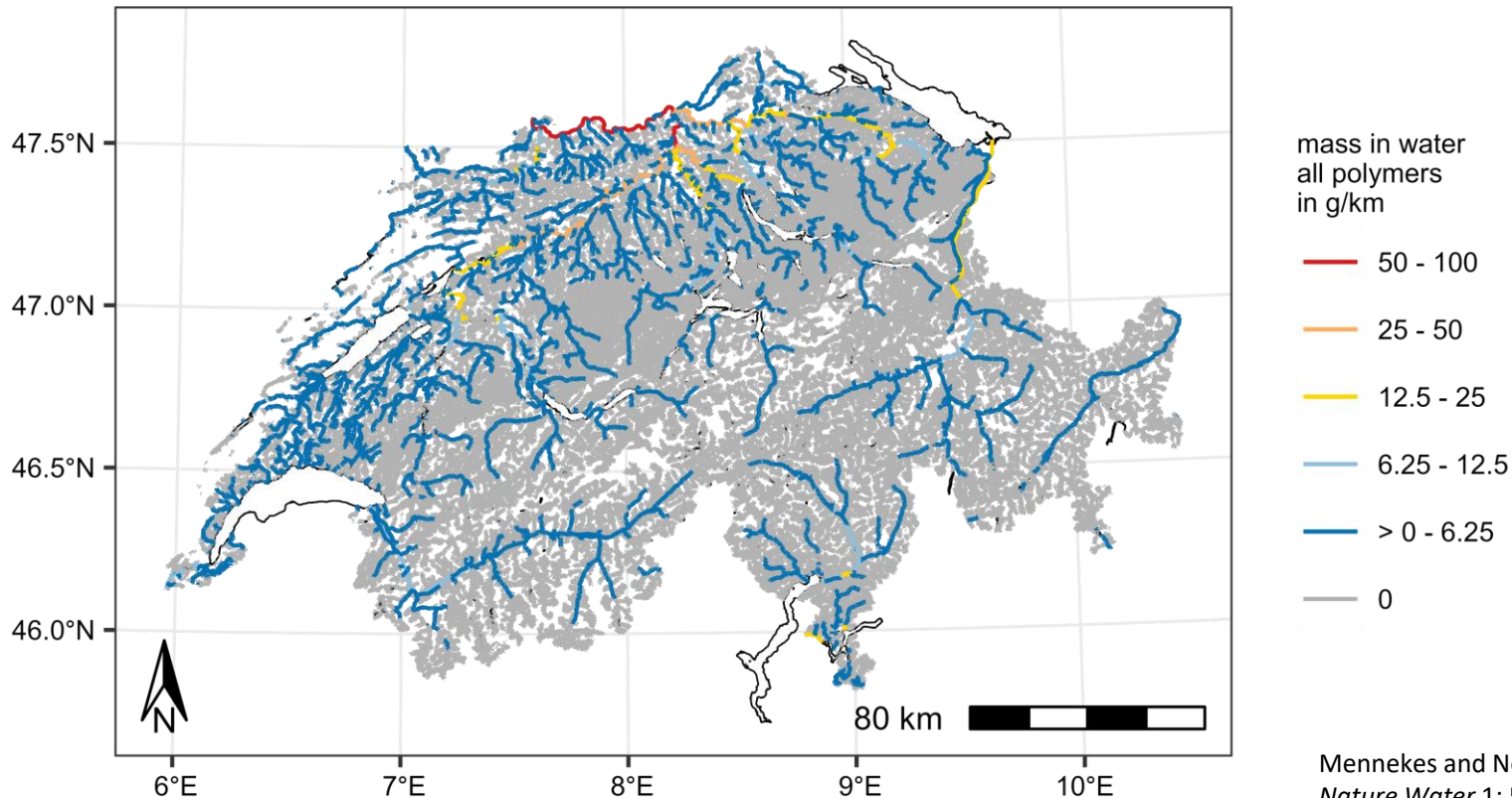


The modeling approach

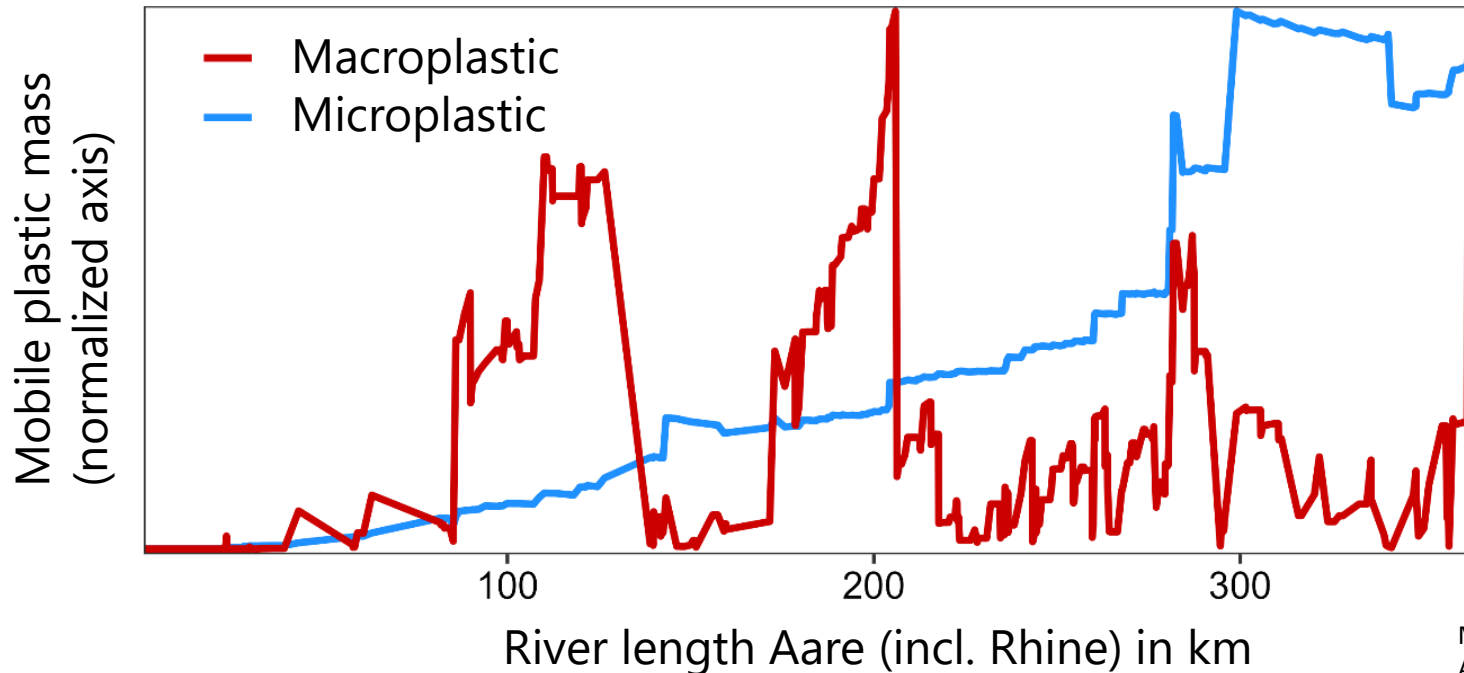


Prediction of microplastic concentrations

all polymers in rivers



Comparison between micro- und macroplastics in rivers



Conclusions

- Modeling microplastic release and concentrations is possible
- Knowledge about the flows through the anthroposphere forms the basis to quantify releases
- Microplastic emissions to soils are much more important than into water
- Tire wear is the most important microplastic
- Large variety of fibers types can be released from textiles
- Abrasion and weathering produce a “zoo of particles”
- Nanoplastics and oligomer nanoparticles should be distinguished

Acknowledgements

Delphine
Kawecki



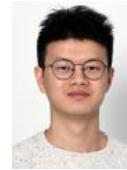
David
Mennekes



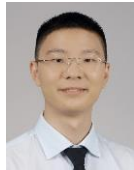
Barbora
Pinlova



Tong
Yang



Zipeng Liu



Ramona
Sieber



Yaping
Cai



Rudolf
Hufenus



Manfred
Heuberger



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Uffizi federal d'ambient UFAM



Thank you for your attention!

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