Risk assessment of microplastics

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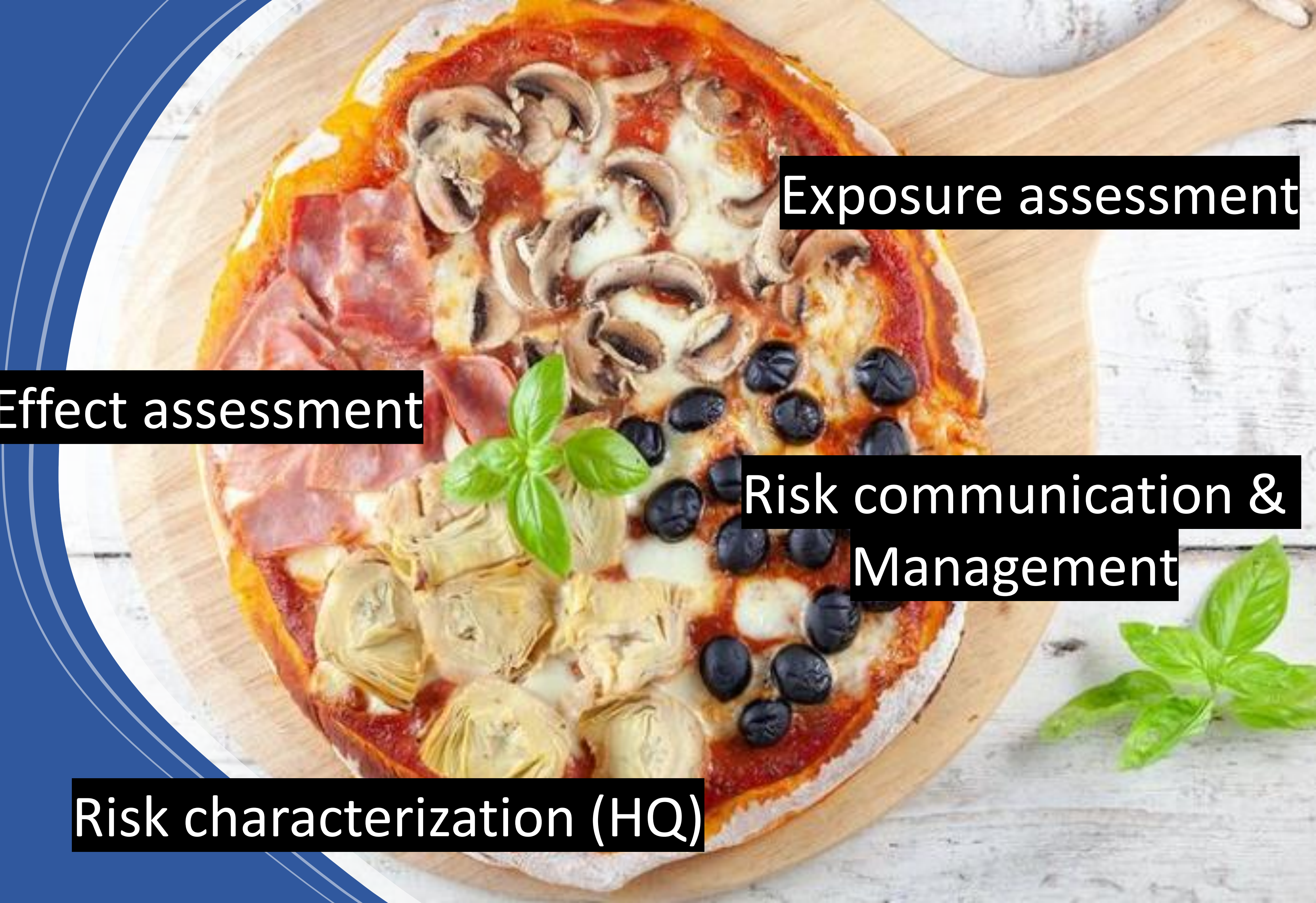
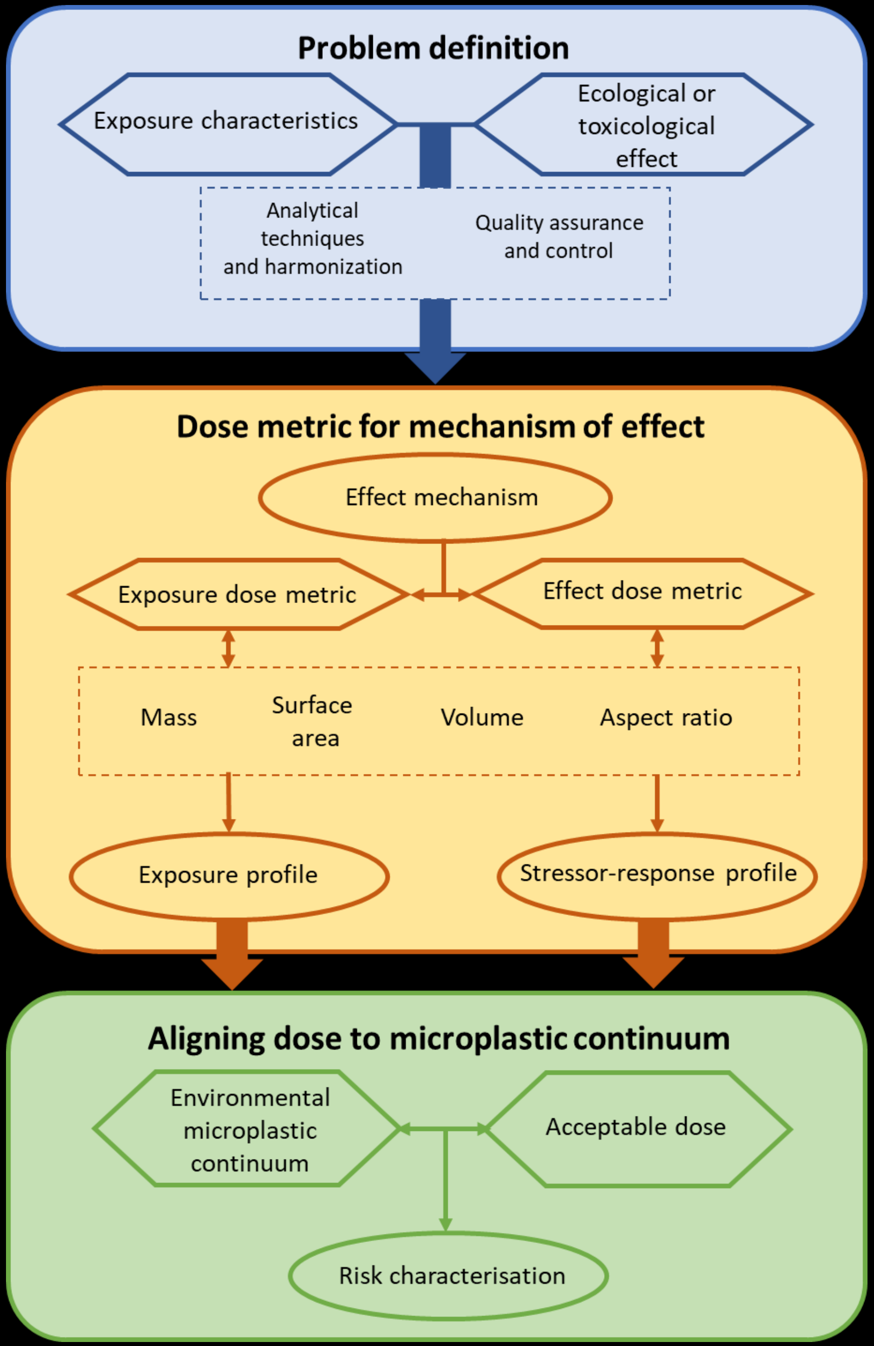


‘Cooking is a good metaphor for many things’

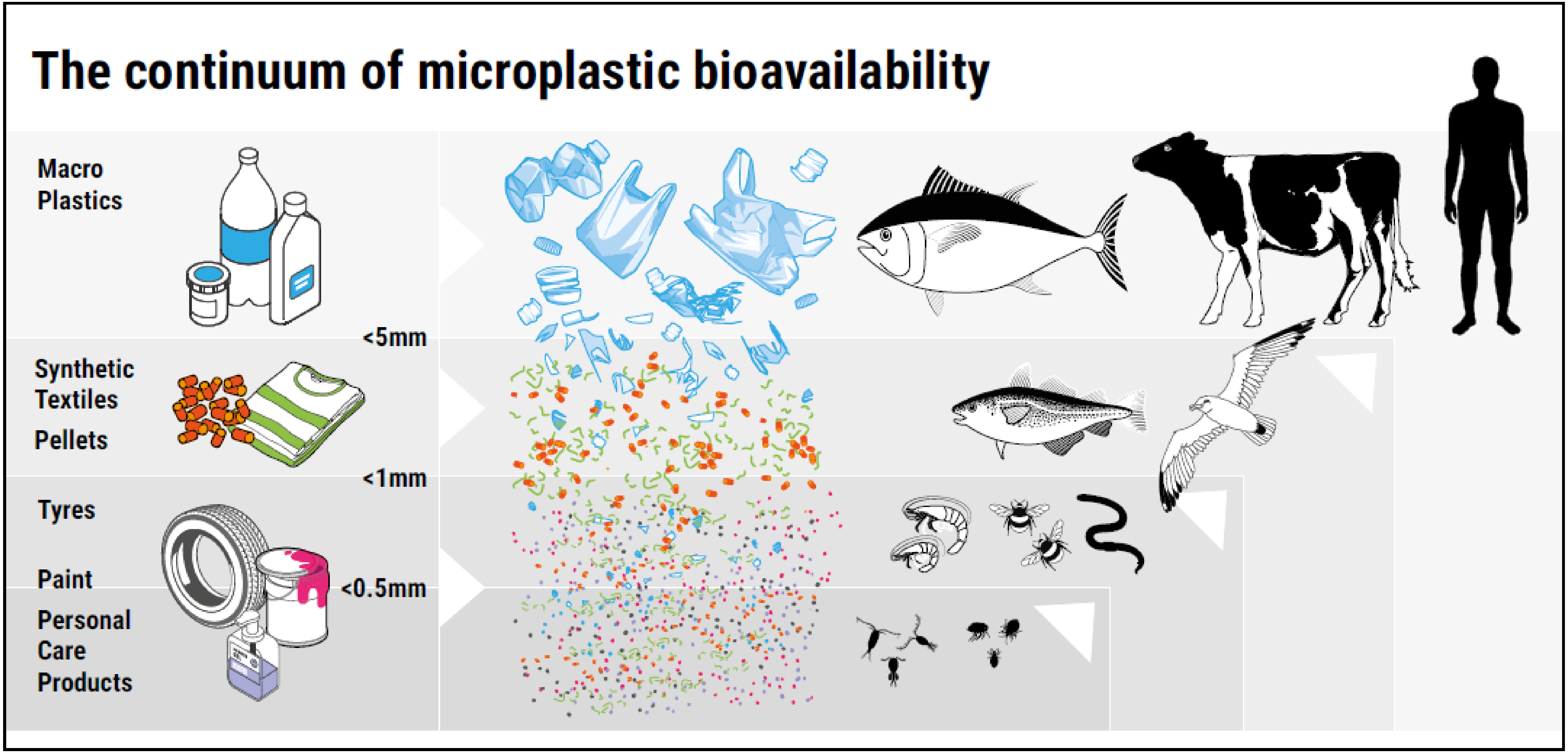


Ecologically Relevant Metrics (**ERM**)

Koelmans, A.A. et al. (2022). Risk assessment of microplastics. Nature Reviews Materials

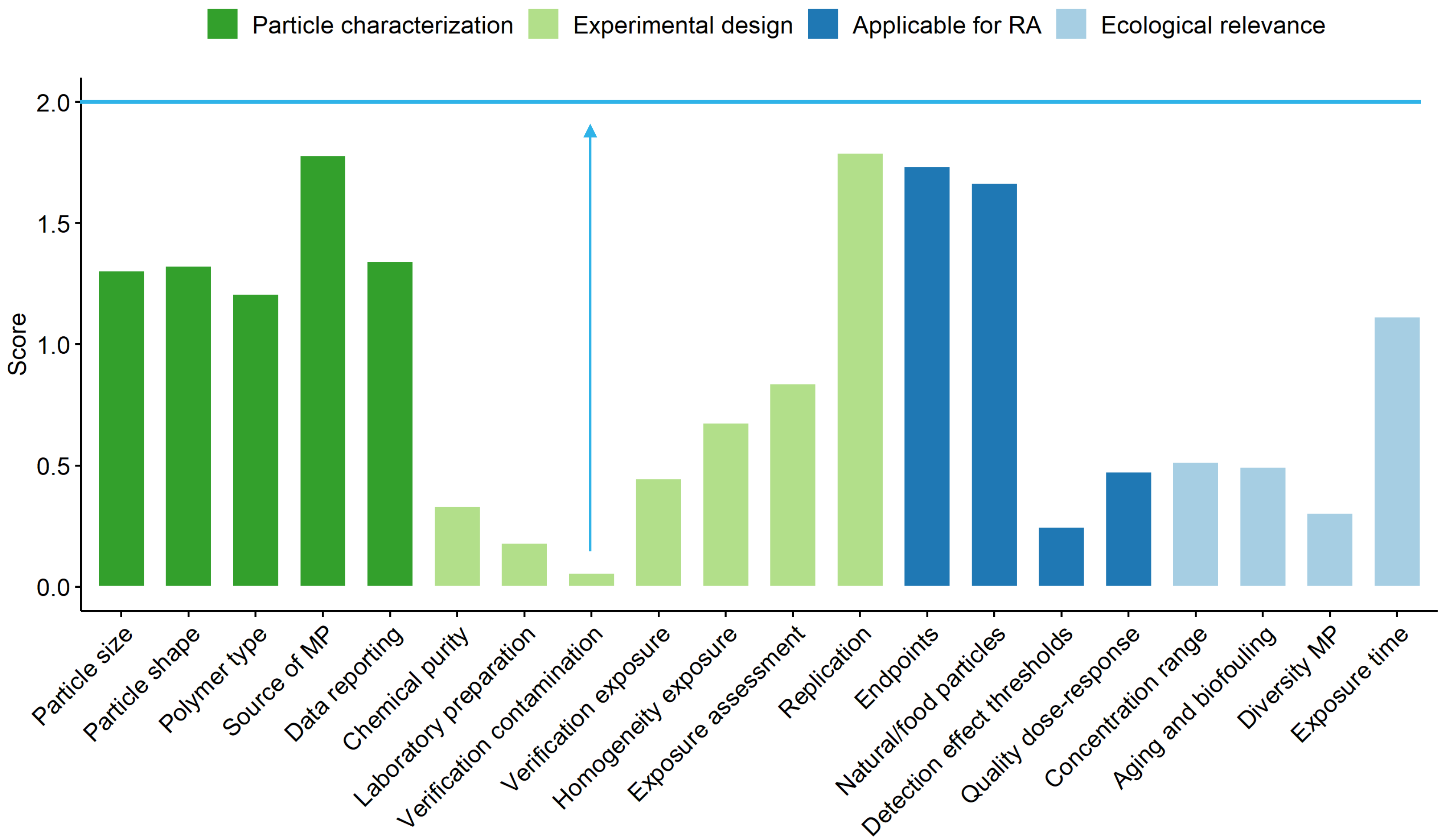
How to 'get' these ERMs ?

1. Weight-of-evidence analysis 105 studies → food dilution (**V**), and oxidative stress (**A**)
   de Ruijter et al., ES&T, 2020
2. GLM 160 studies: → **A** (μm^2/L) ($p=0.0012$) and **V** (μm^3/L) ($p=0.038$)
   Thornton Hampton et al. Microplastics and Nanoplastics, 2022
3. Machine learning modeling using 5293 datapoints → **A** (μm^2/L) and **V** (μm^3/L) as best dose descriptors
   In prep.



Thompson, R.C., Courtene-Jones, W., Boucher, J., Pahl, S., Raubenheimer, K., Koelmans, A.A. 2024.
Twenty years of microplastics pollution research – what have we learned? *Science*

Challenge 1: Data not 'fit for purpose' due to QA/QC limitations

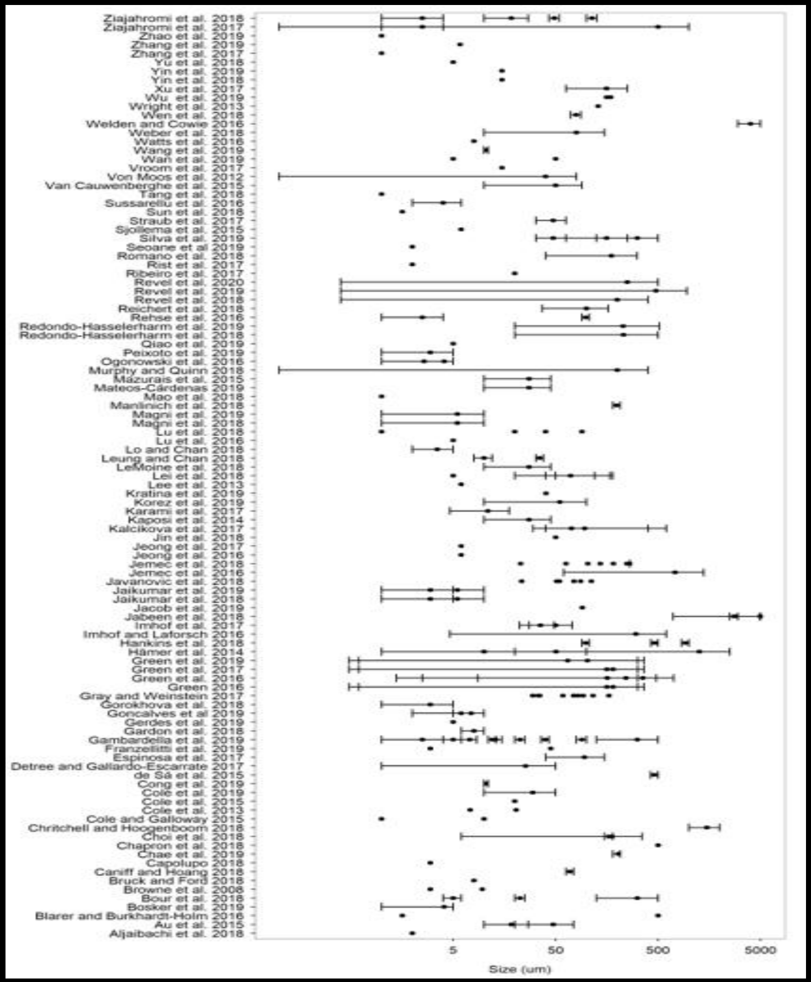


De Ruijter et al, 2020, ES&T

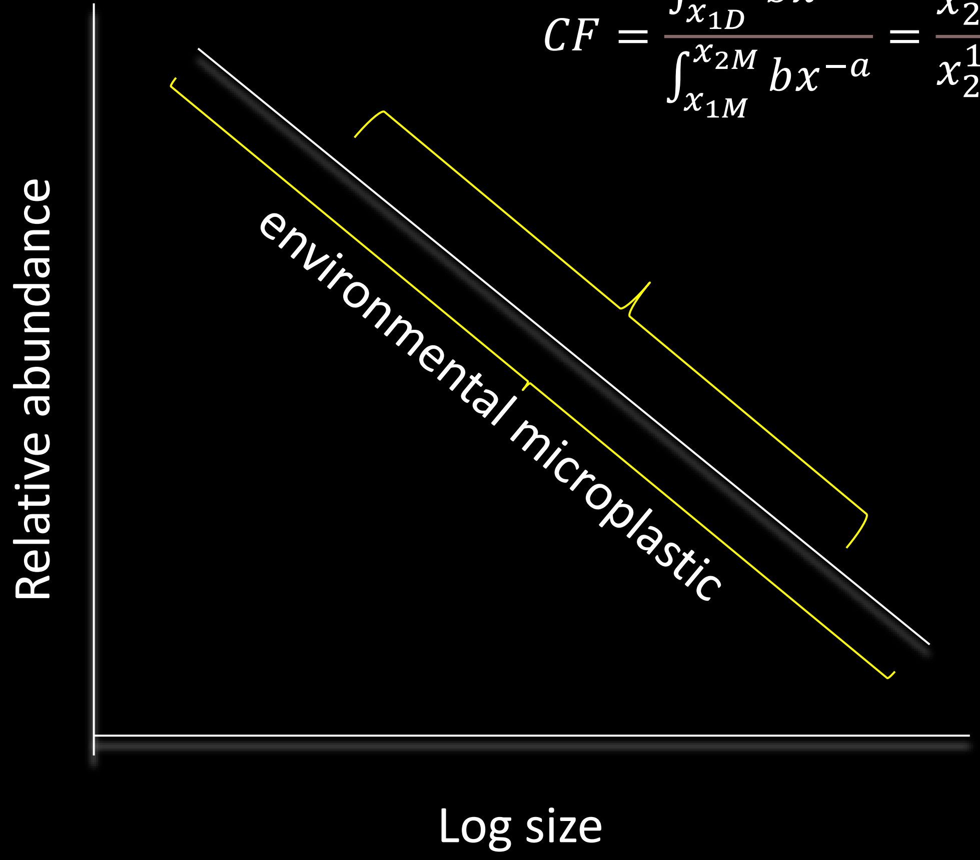
Challenge 2: Data not aligned

Alignment of data that are obtained with methods that target different size ranges

Imagine: 'default' microplastic 1 to 5000 μm

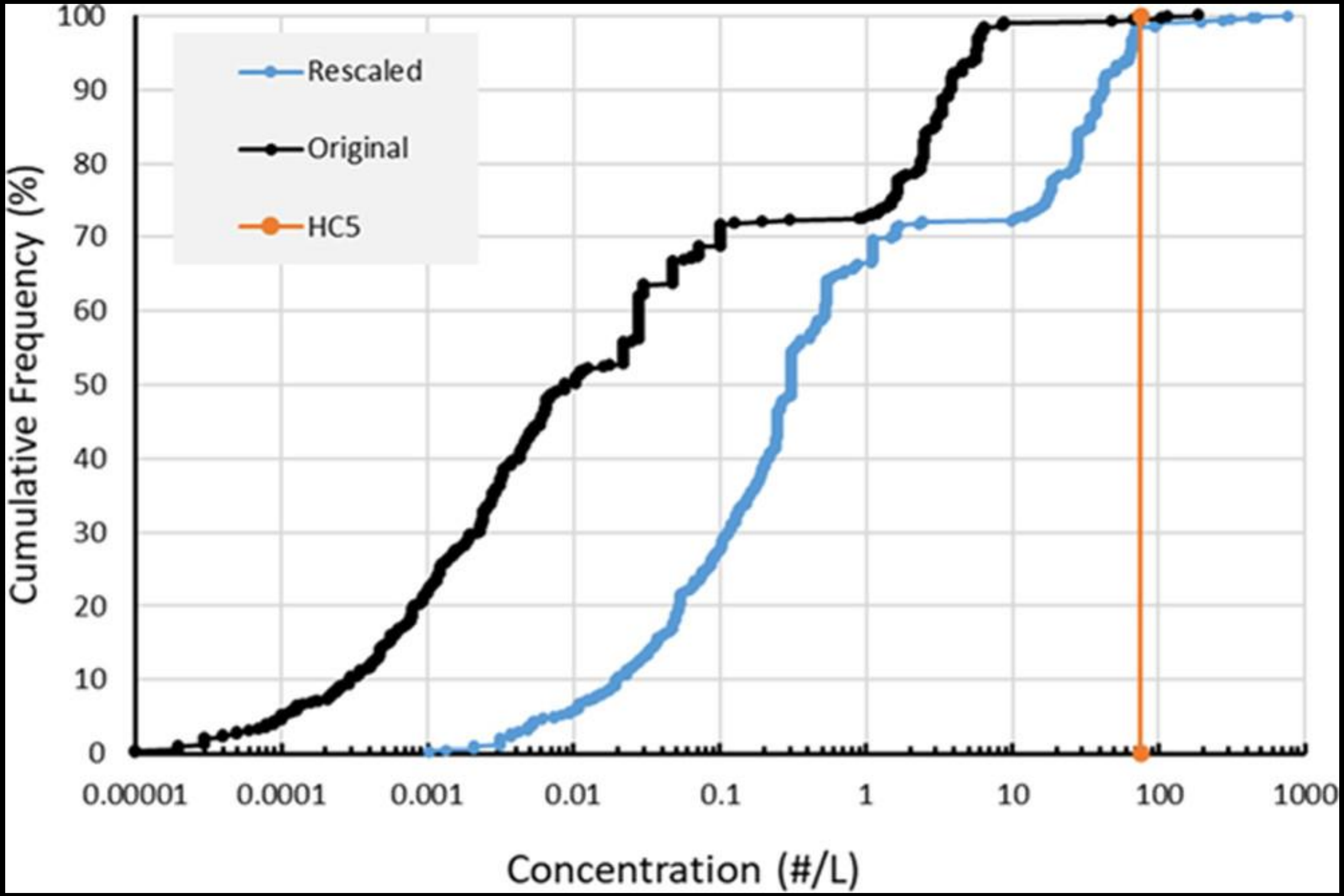


$$CF = \frac{\int_{x_{1D}}^{x_{2D}} bx^{-a}}{\int_{x_{1M}}^{x_{2M}} bx^{-a}} = \frac{x_{2D}^{1-a} - x_{1D}^{1-a}}{x_{2M}^{1-a} - x_{1M}^{1-a}}$$



Koelmans, A.A., et al. 2020. Solving the non-alignment of methods and approaches used in microplastic research in order to consistently characterize risk. Environ. Sci. Technol.

Alignment of data that are obtained with methods that target different size ranges



Koelmans, A.A., et al. 2020. Solving the non-alignment of methods and approaches used in microplastic research in order to consistently characterize risk. Environ. Sci. Technol.

$$\mu_x = \frac{x_{UL} - x_{LL}}{ln\left(\frac{x_{UL}}{x_{LL}}\right)}$$

$$P(x) = Cx^{-\alpha}$$

$$\int_{LL}^{UL} P(x)dx = 1$$

$$\mu_x = \frac{ln\left(\frac{x_{UL}}{x_{LL}}\right)}{x_{LL}^{-1} - x_{UL}^{-1}}$$

$$CF_{meas} = \frac{L_{UL,D}^{1-\alpha} - L_{LL,D}^{1-\alpha}}{L_{UL,M}^{1-\alpha} - L_{LL,M}^{1-\alpha}}$$

$$\mu_x = \frac{C}{2-\alpha}(UL^{2-\alpha} - LL^{2-\alpha})$$

$$\mu_{x,poly} = \frac{1-\alpha_x}{2-\alpha_x} \times \frac{x_{UL}^{2-\alpha_x} - x_{LL}^{2-\alpha_x}}{x_{UL}^{1-\alpha_x} - x_{LL}^{1-\alpha_x}}$$

$$EC_{poly} \times \mu_{x,poly} = EC_{mono} \times \mu_{x,mono}$$

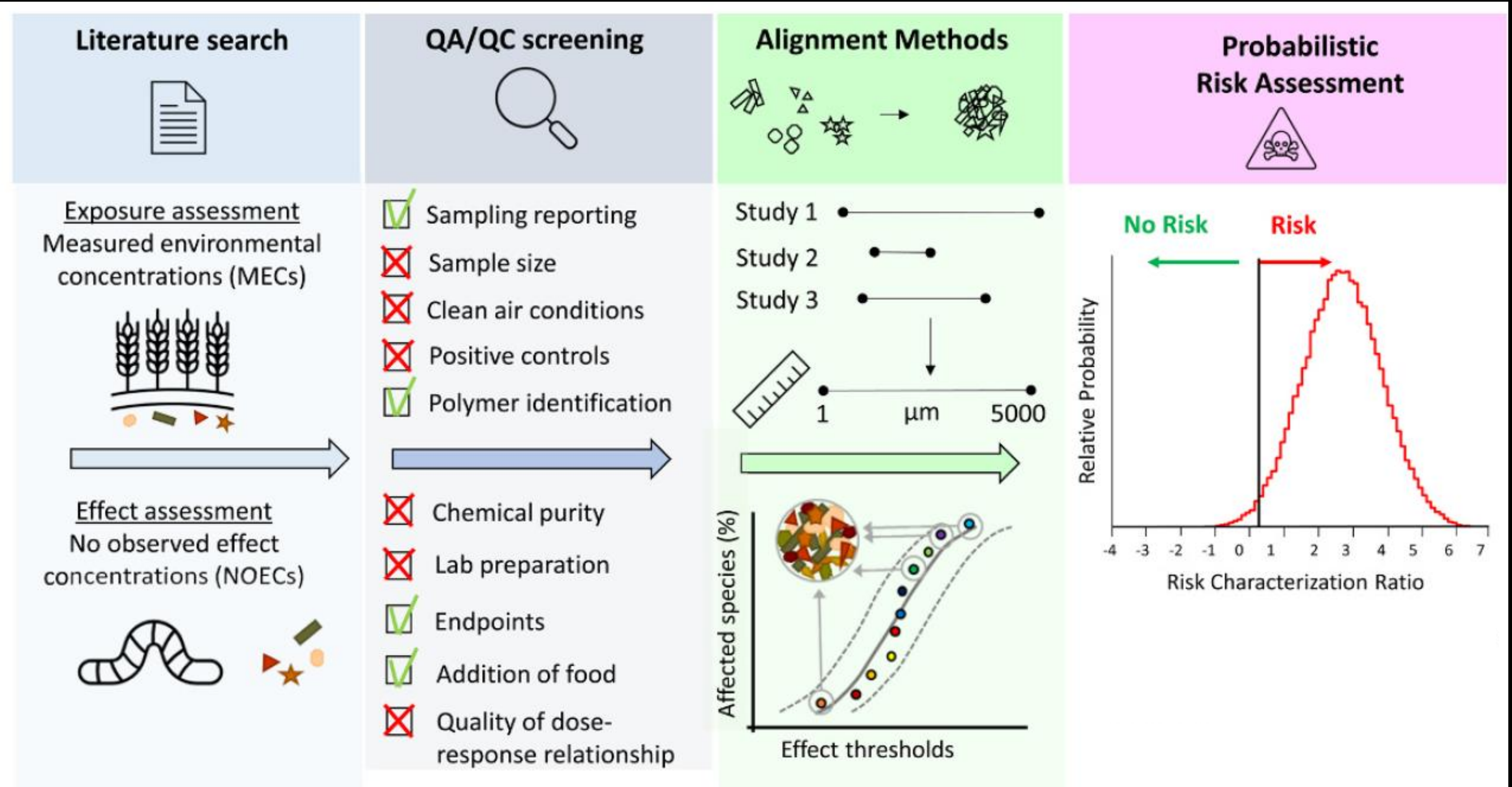
$$EC_{env} = EC_{poly} \times CF_{bio}$$

Koelmans et al (2020, 2022), Kooi et al (2021)

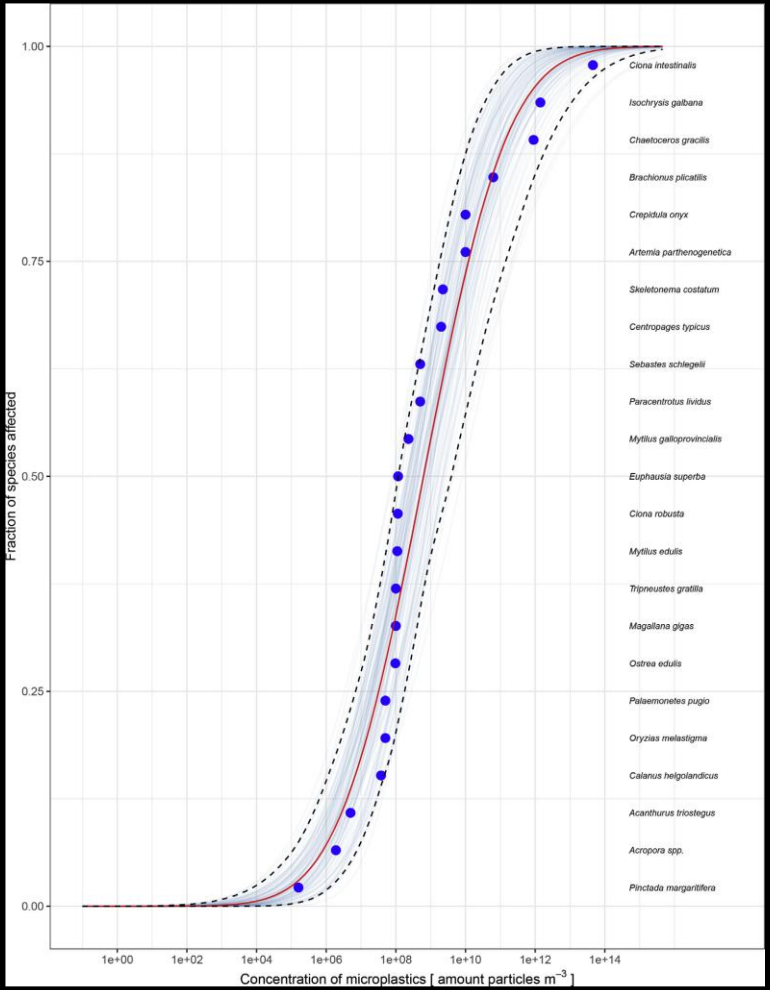
Aligning incomparable exposure & effects data

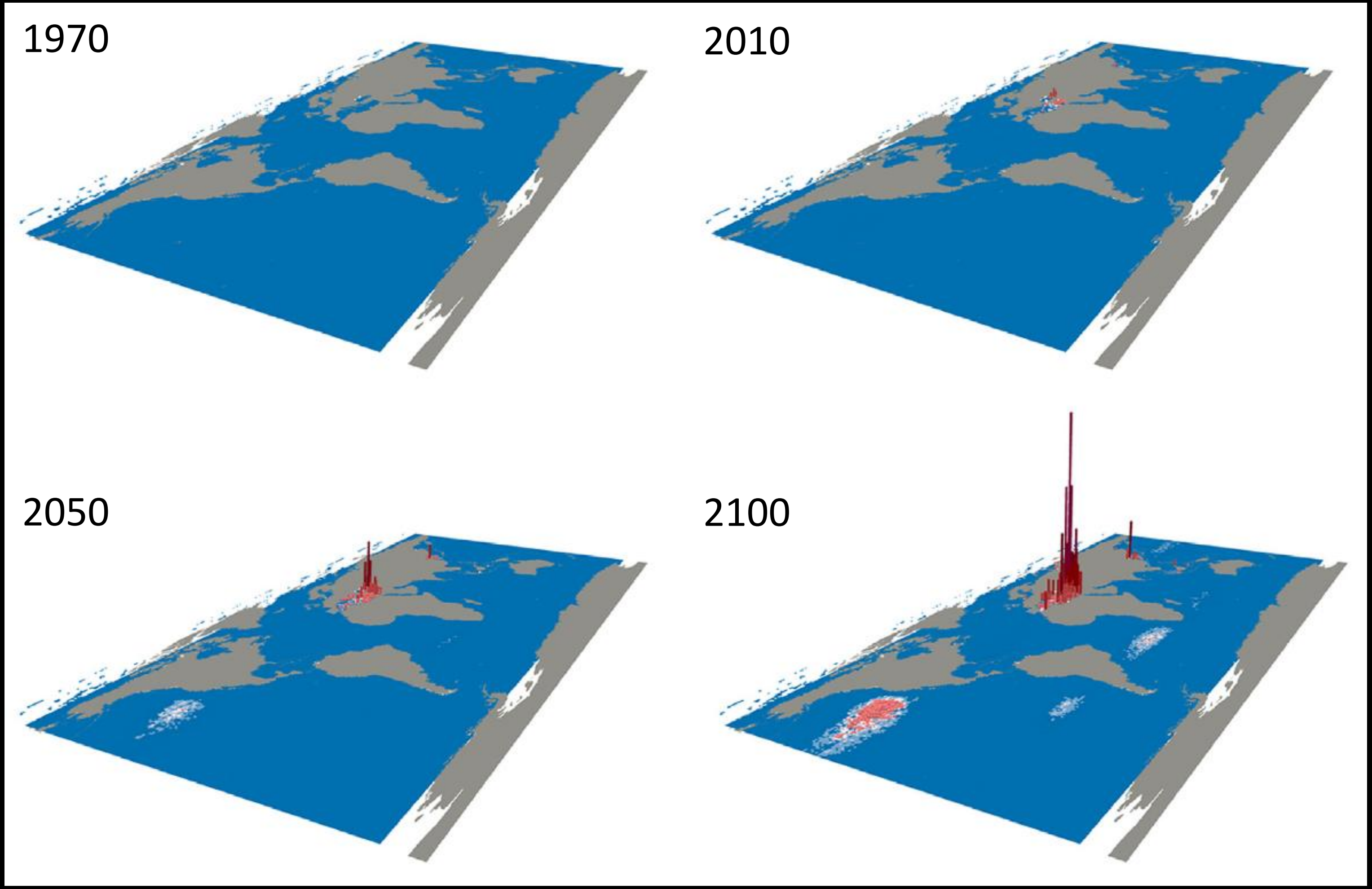
$$HQ = \frac{\text{Exposure}}{\text{Reference Dose (RfD) or Acceptable Daily Intake (ADI}}$$

MP Risk assessment pipeline



Risk assessment – Global Oceans

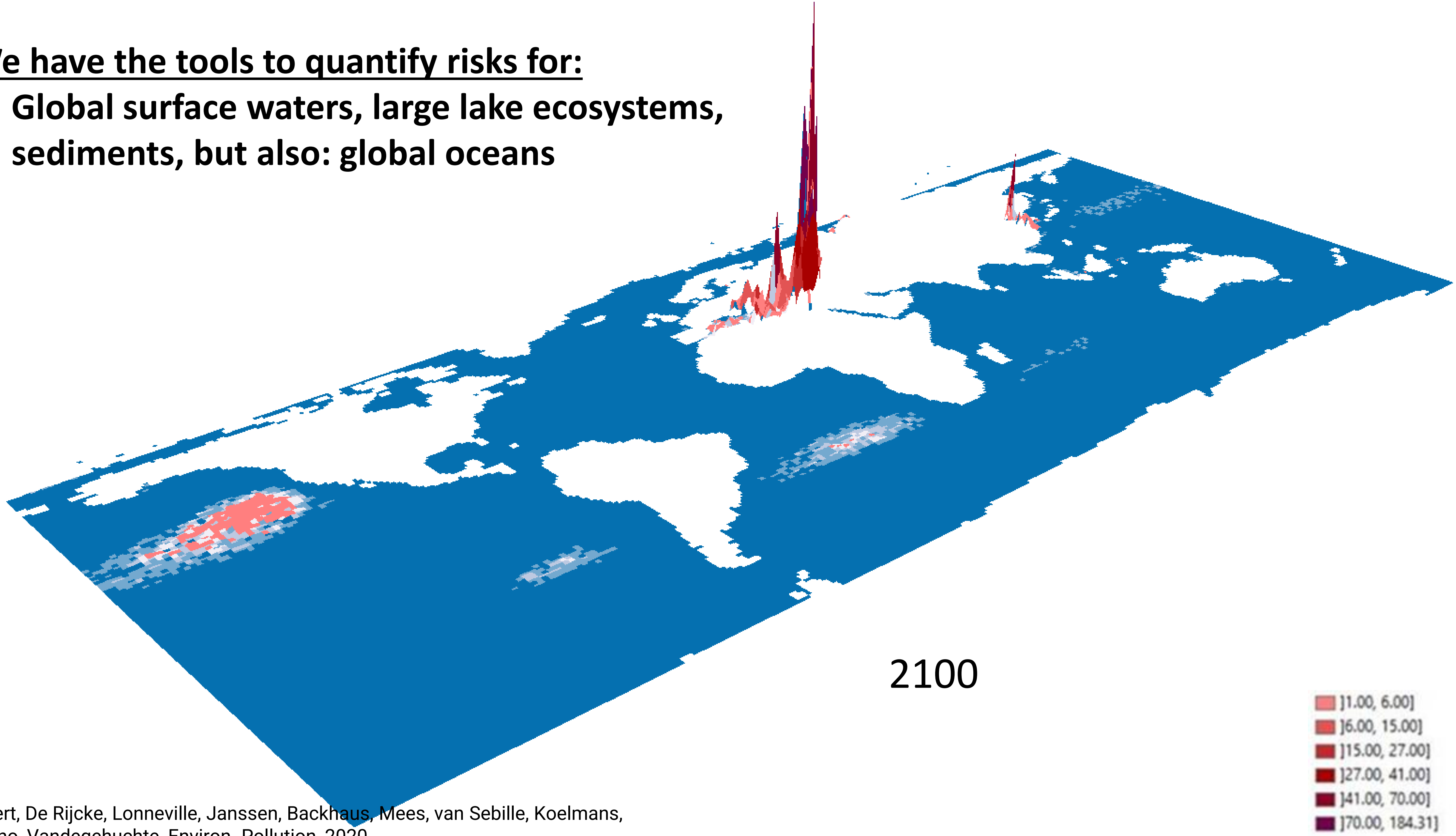




Everaert, De Rijcke, Lonneville, Janssen, Backhaus, Mees, van Sebille, Koelmans, Catarino, Vandegehuchte, Environ. Pollution, 2020

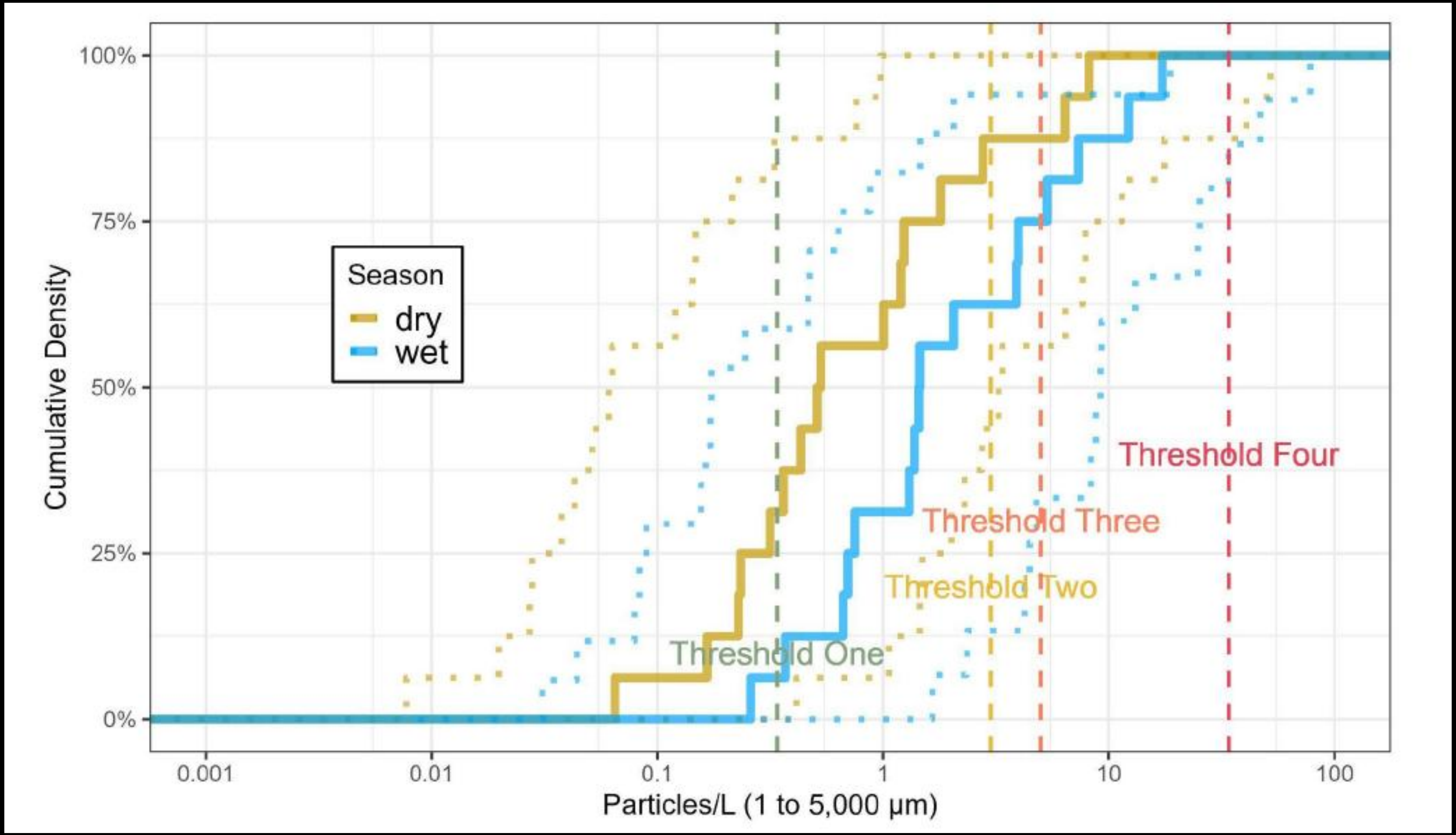
We have the tools to quantify risks for:

- **Global surface waters, large lake ecosystems, sediments, but also: global oceans**



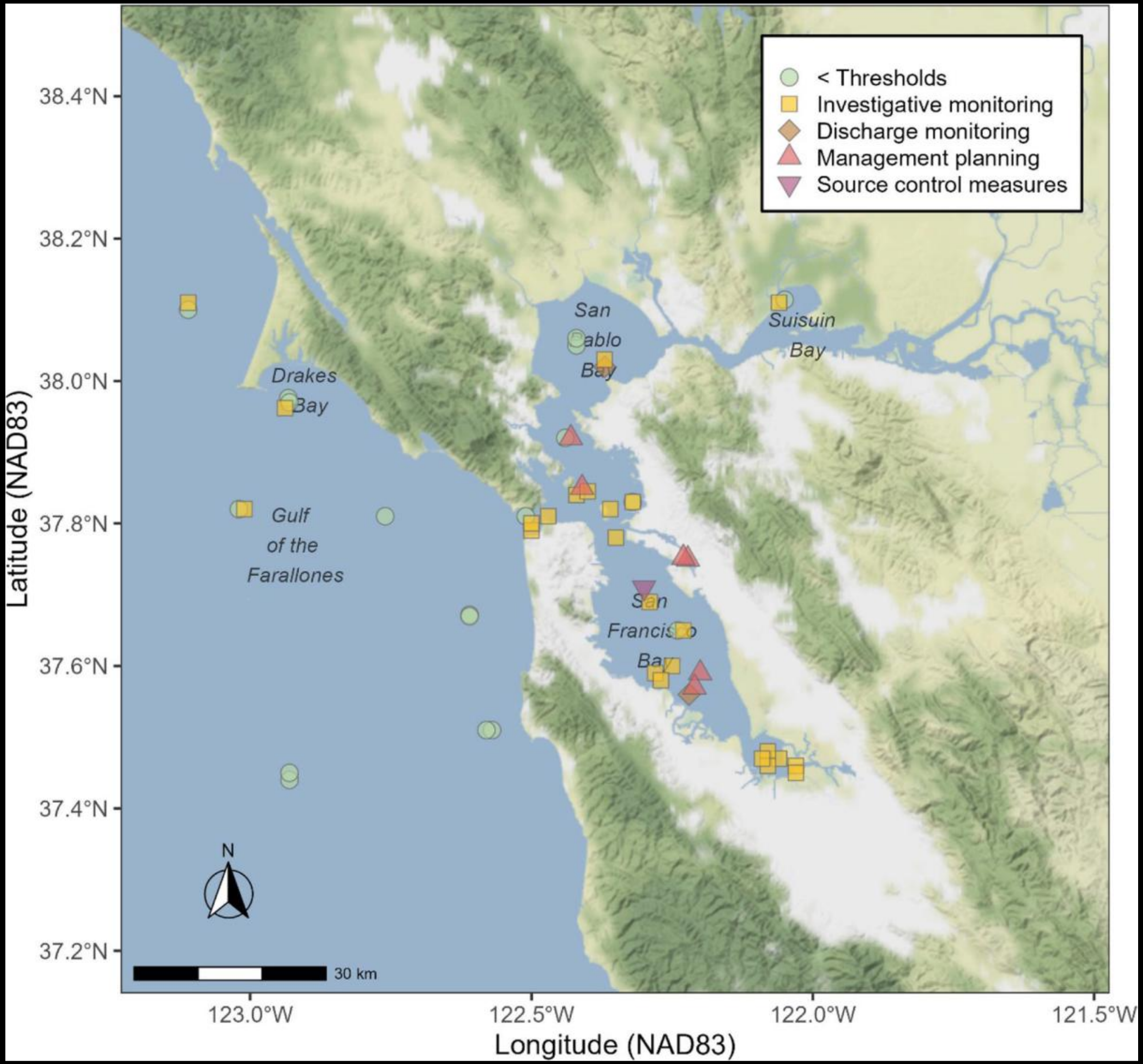
Everaert, De Rijcke, Lonneville, Janssen, Backhaus, Mees, van Sebille, Koelmans, Catarino, Vandegehuchte, Environ. Pollution, 2020

Risk assessment – San Francisco Bay



Coffin, S., Weisberg, S.B., Rochman, C.M., Kooi, M., Koelmans, A.A. 2022. Risk Characterization of Microplastics in San Francisco Bay, California. *Micropl.&Nanopl.* 2,19

Risk assessment – San Francisco Bay



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Take home

- Prospective risk assessment methods available
- They hint at the exceedance of risk thresholds in marine systems








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by all of us


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Thank you!


Aquatic Ecology & Water Quality Management Group

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