



IMPACT WORLD+ method and application showcase

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CIRAIG

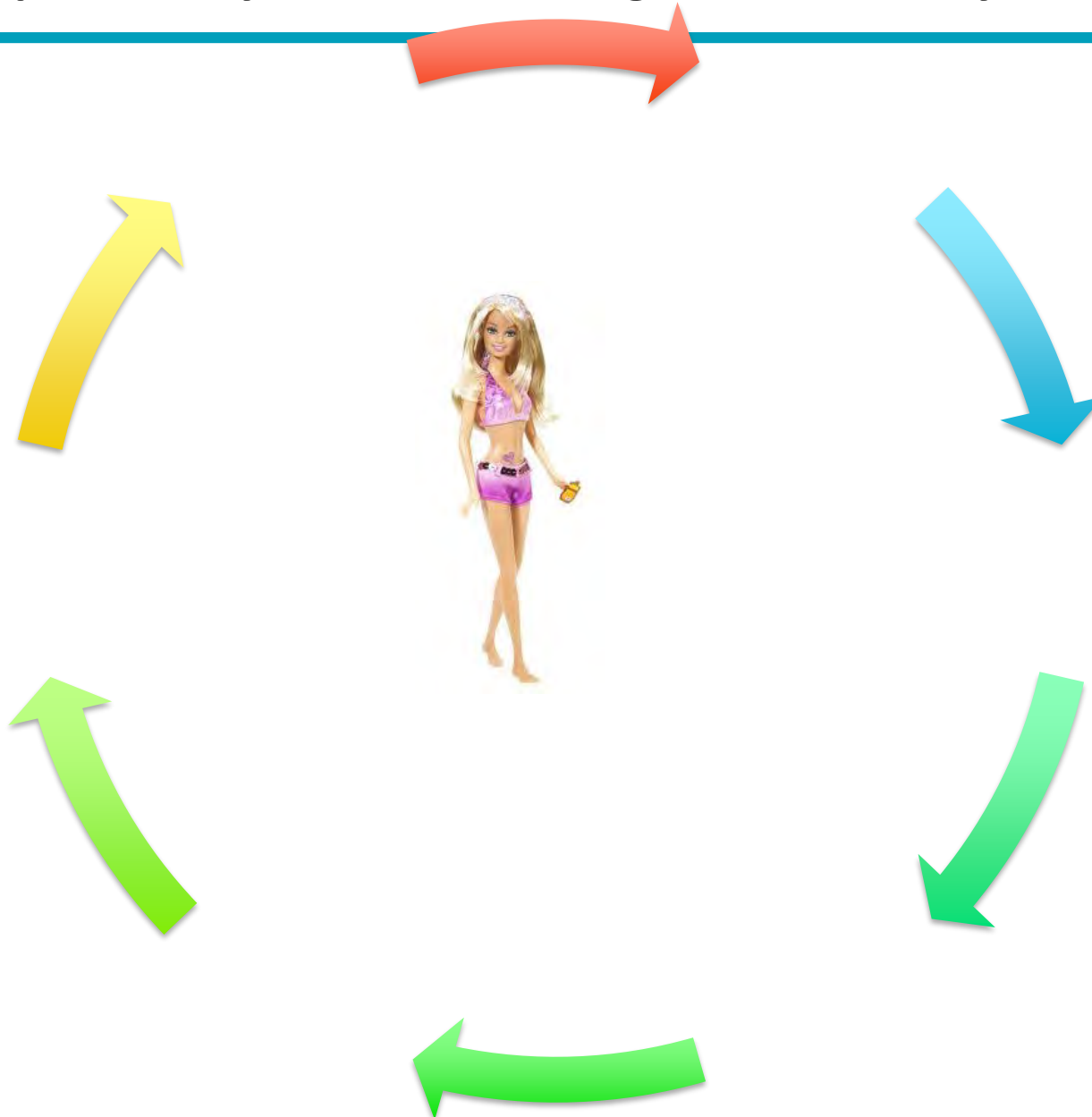
ESG UQÀM

**POLYTECHNIQUE
MONTREAL** 

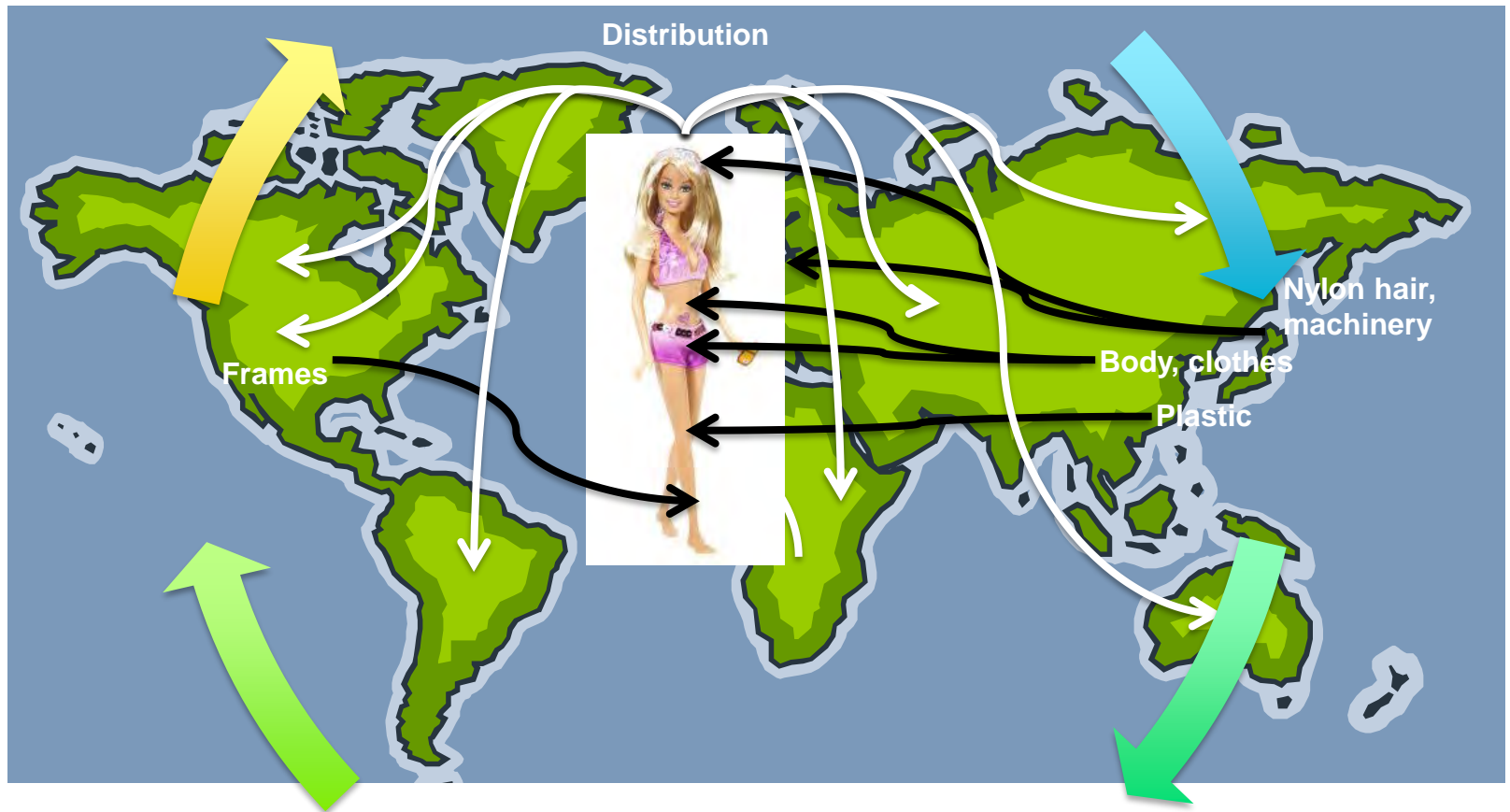
Introduction on regionalization



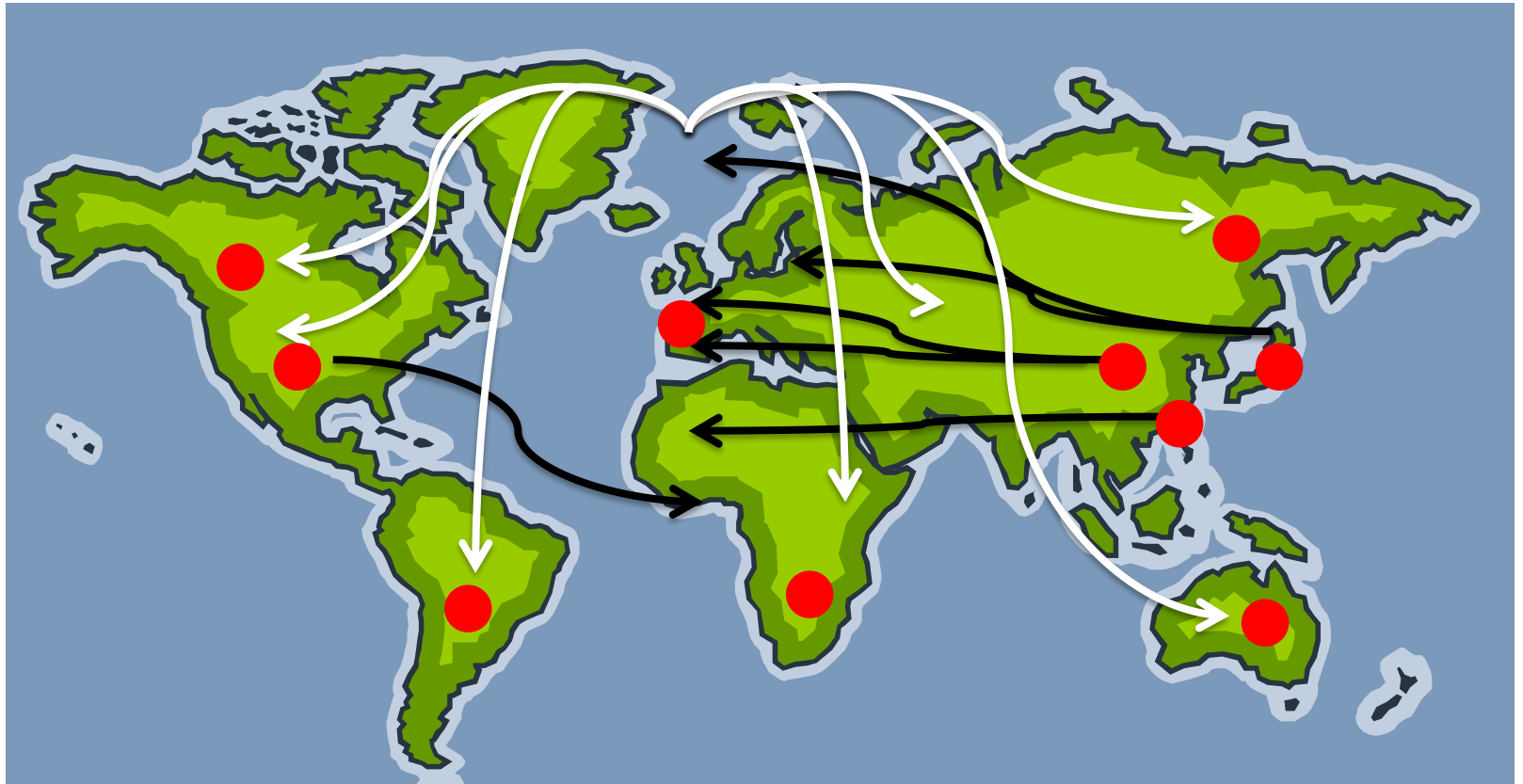
Evaluate product systems within a global economy



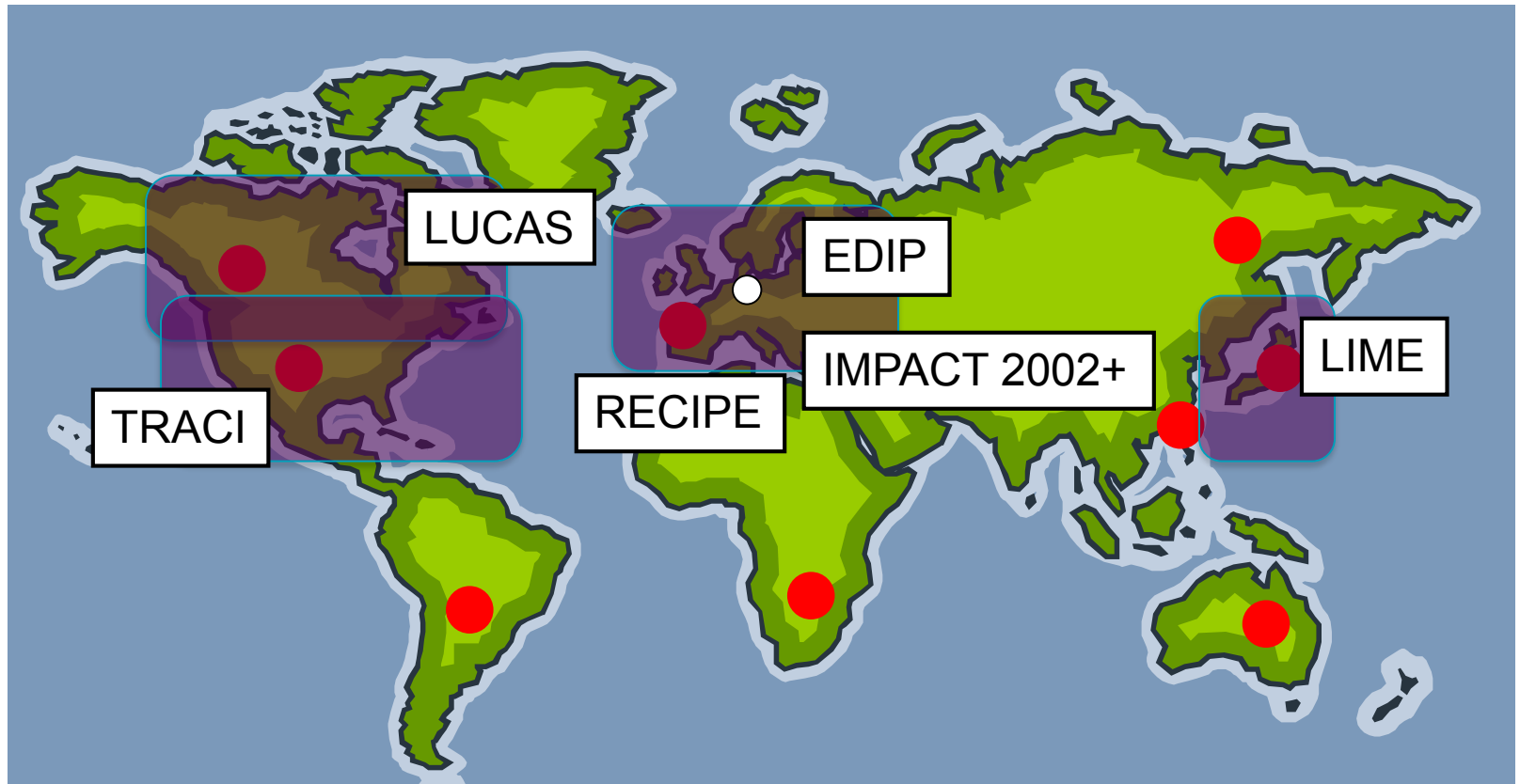
Evaluate product systems within a global economy



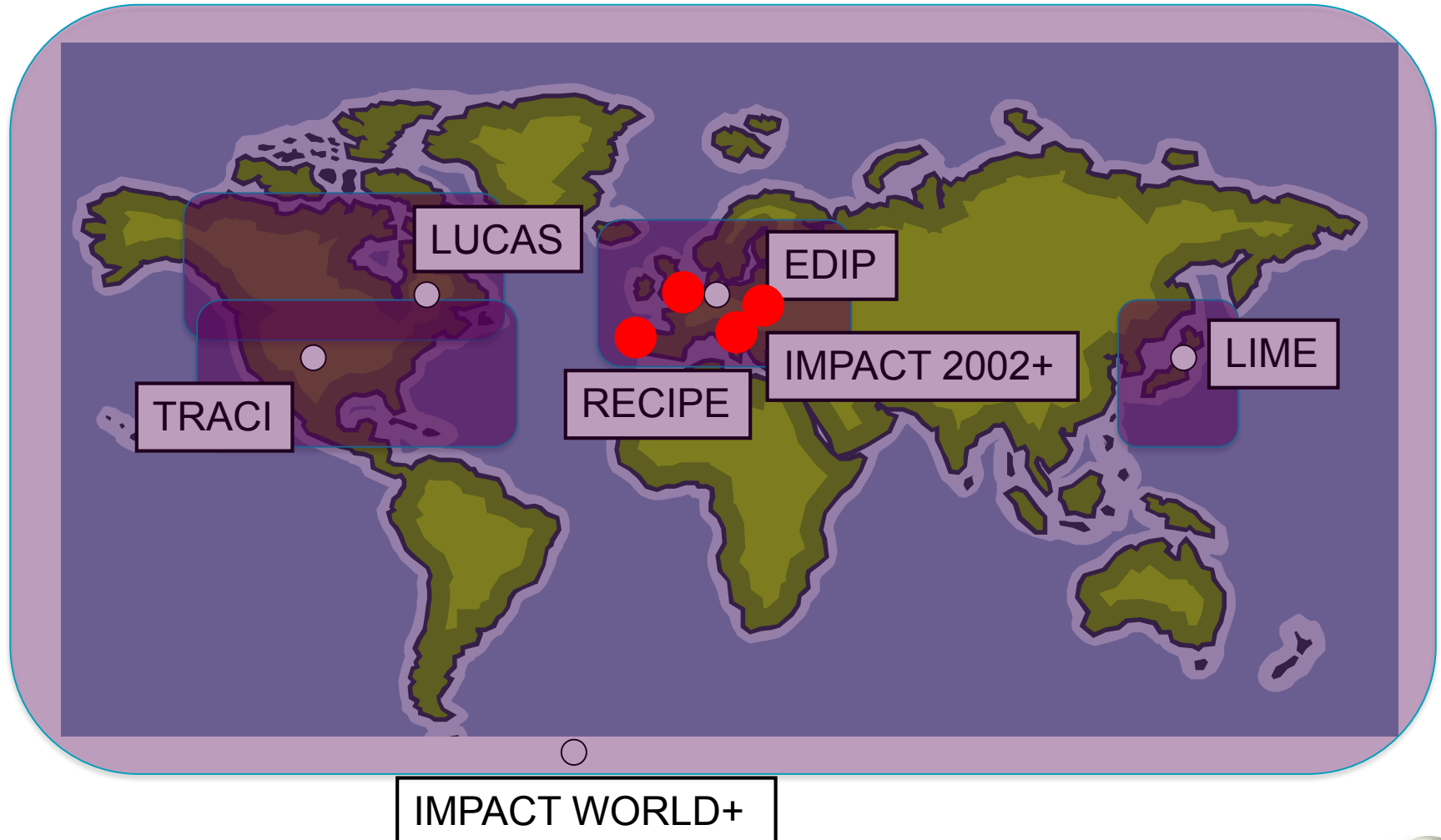
Evaluate product systems within a global economy



Evaluate product systems within a global economy



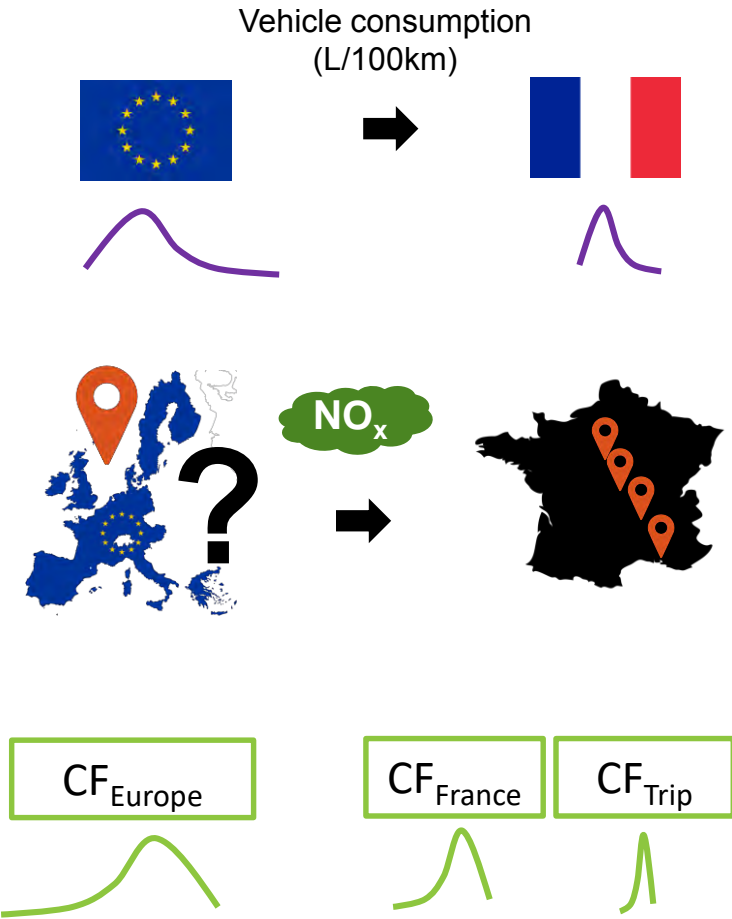
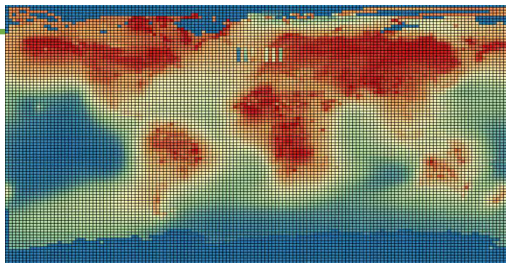
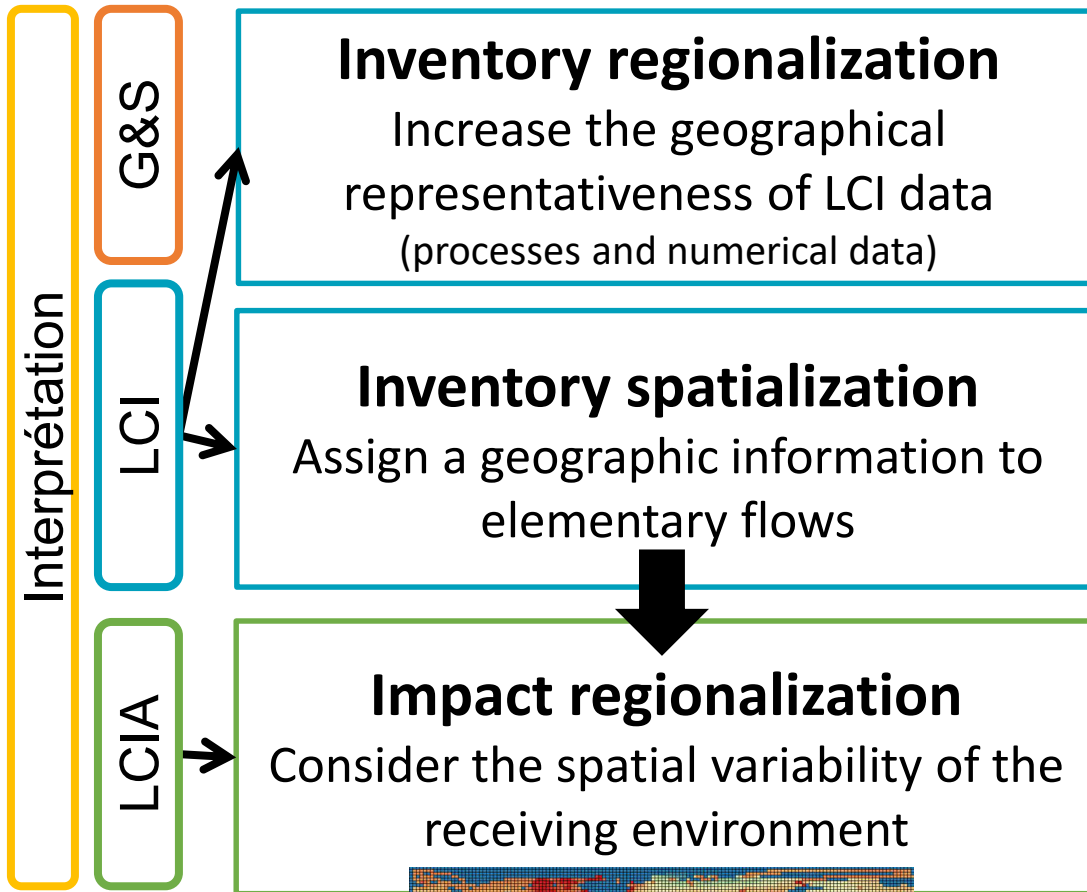
Different spatial coverages depending on LCIA methodologies



Several levels of regionalization in LCA



Paris → Marseille



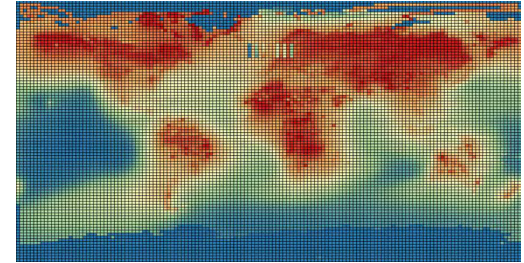
Impact regionalization in IMPACT World+



Why do characterization factors vary depending on the location?

Impact of an emission depends on:

- the location of the emission n and its environmental fate (FF)
- The exposure (or sensitivity) of the receiving environment j (XF)
- The effect on the exposed ecosystem/population (EF)
- The severity of the effect (SF)



$$CF_n^{sk} = \sum_j FF_{nj}^{sk} \times XF_j^{sk} \times EF_j^{sk} \times SF_j^{sk}$$



Regionalization in IMPACT World+



IMPACT World+ simplified framework

Group of impact categories
(midpoint level) (damage level)

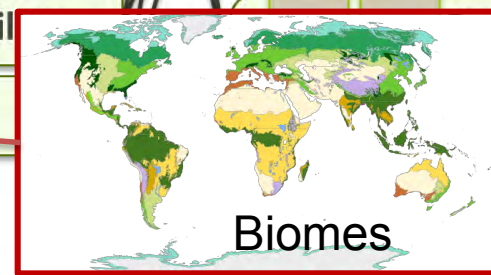
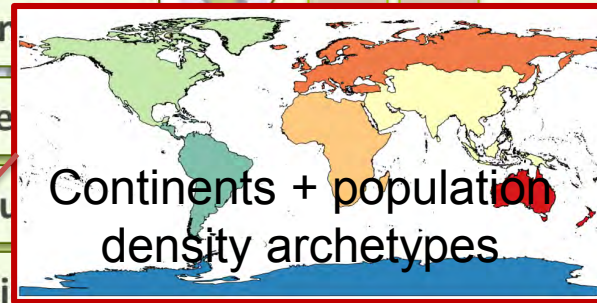
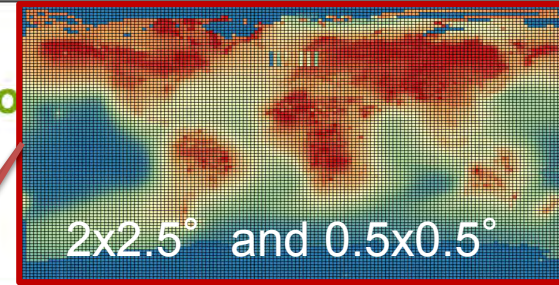
- Inputs**
- Groundwater
 - Arable land
 - Crude oil
 - Iron ore
 - ...

- Outputs**
- Pesticide
 - Particles
 - Copper
 - CO₂
 - Phosphate
 - ...

& hundreds more...

- Midpoint Level Categories:**
- Climate change
 - Ozone layer depletion
 - Resource use
 - Acidification
 - Eutrophication
 - Ecotoxicity
 - Human toxicity
 - Water scarcity
 - Land use

- Damage Level Categories:**
- Global warming
 - Ozone layer depletion
 - Resource use
 - Acidification
 - Eutrophication
 - Ecotoxicity
 - Human toxicity
 - Water availability
 - Land use



Damage
AoP

Human health

System quality

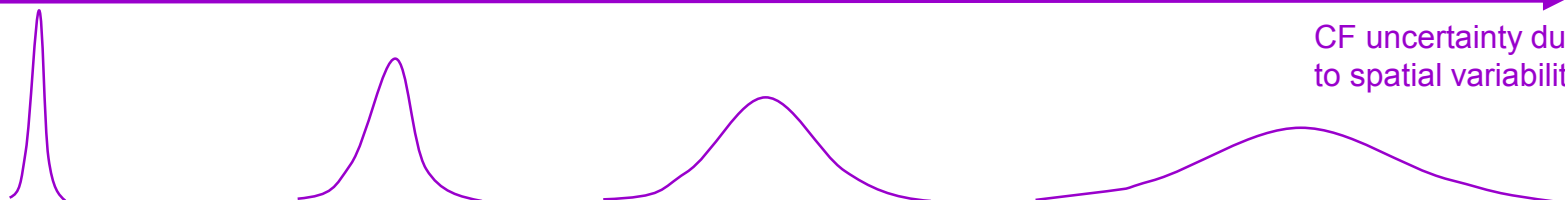
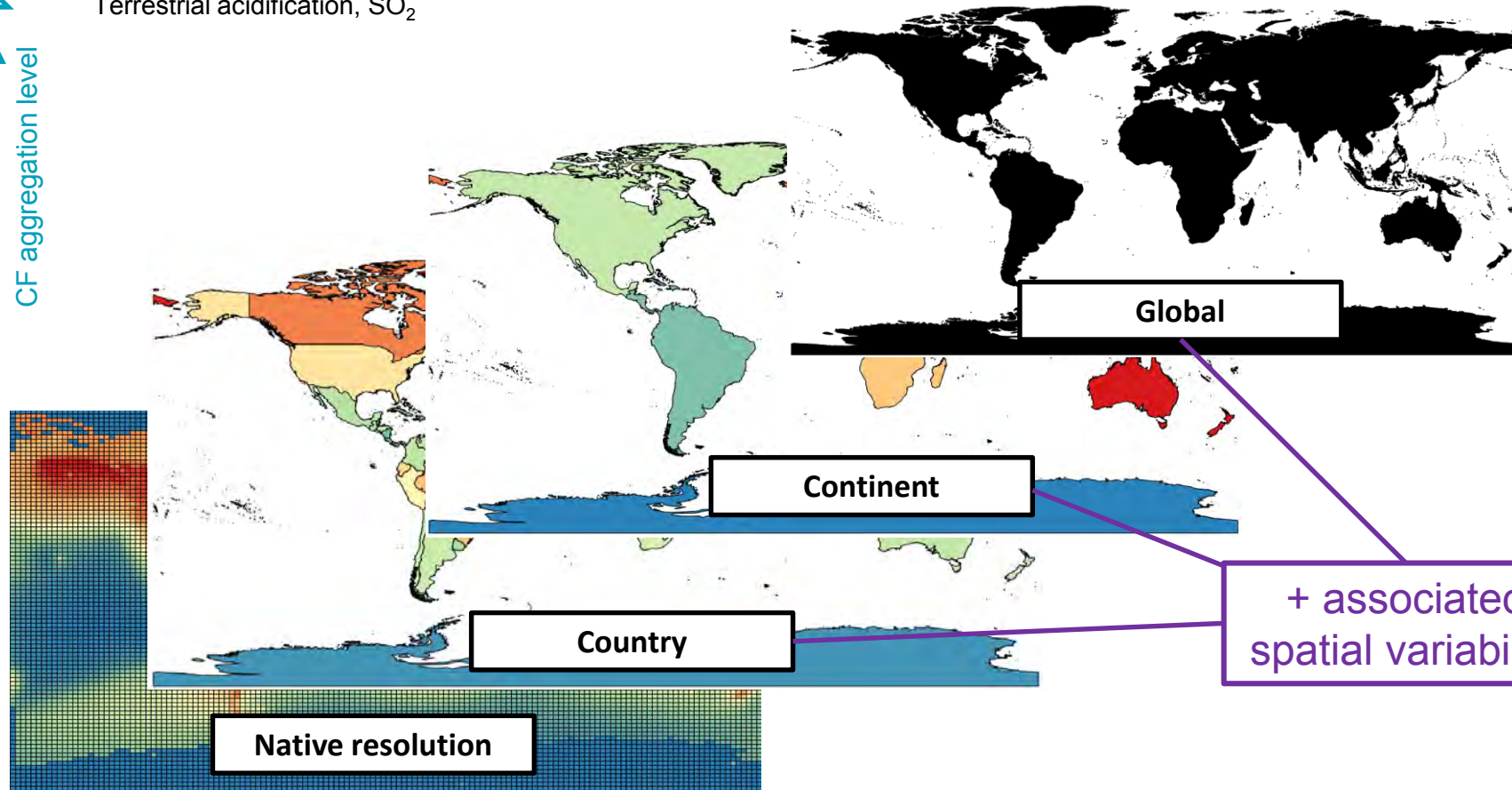
Resources & ecosystem services

Regionalization in IMPACT World+

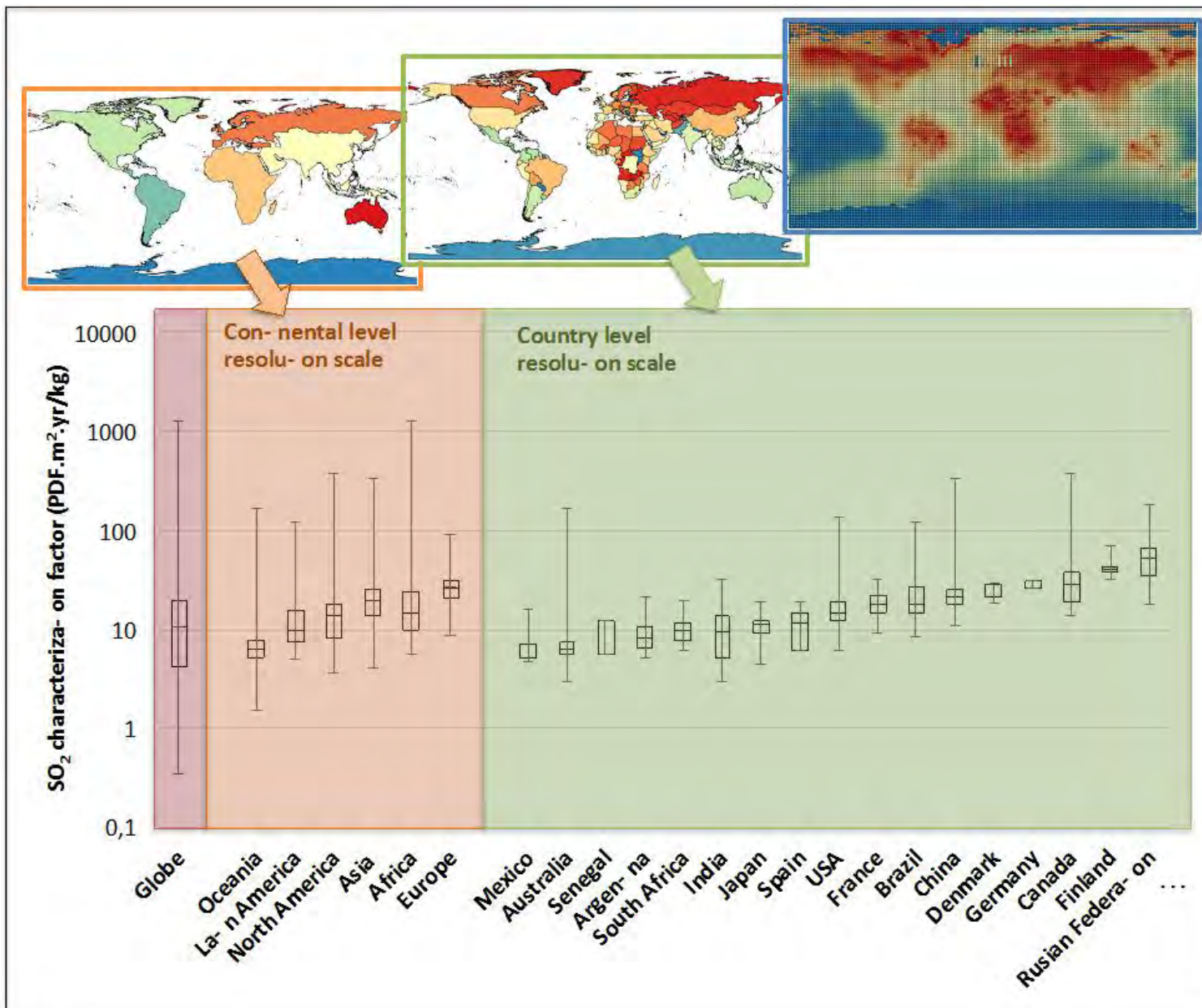
Terrestrial acidification, SO₂

Level of spatial aggregation

CF aggregation level

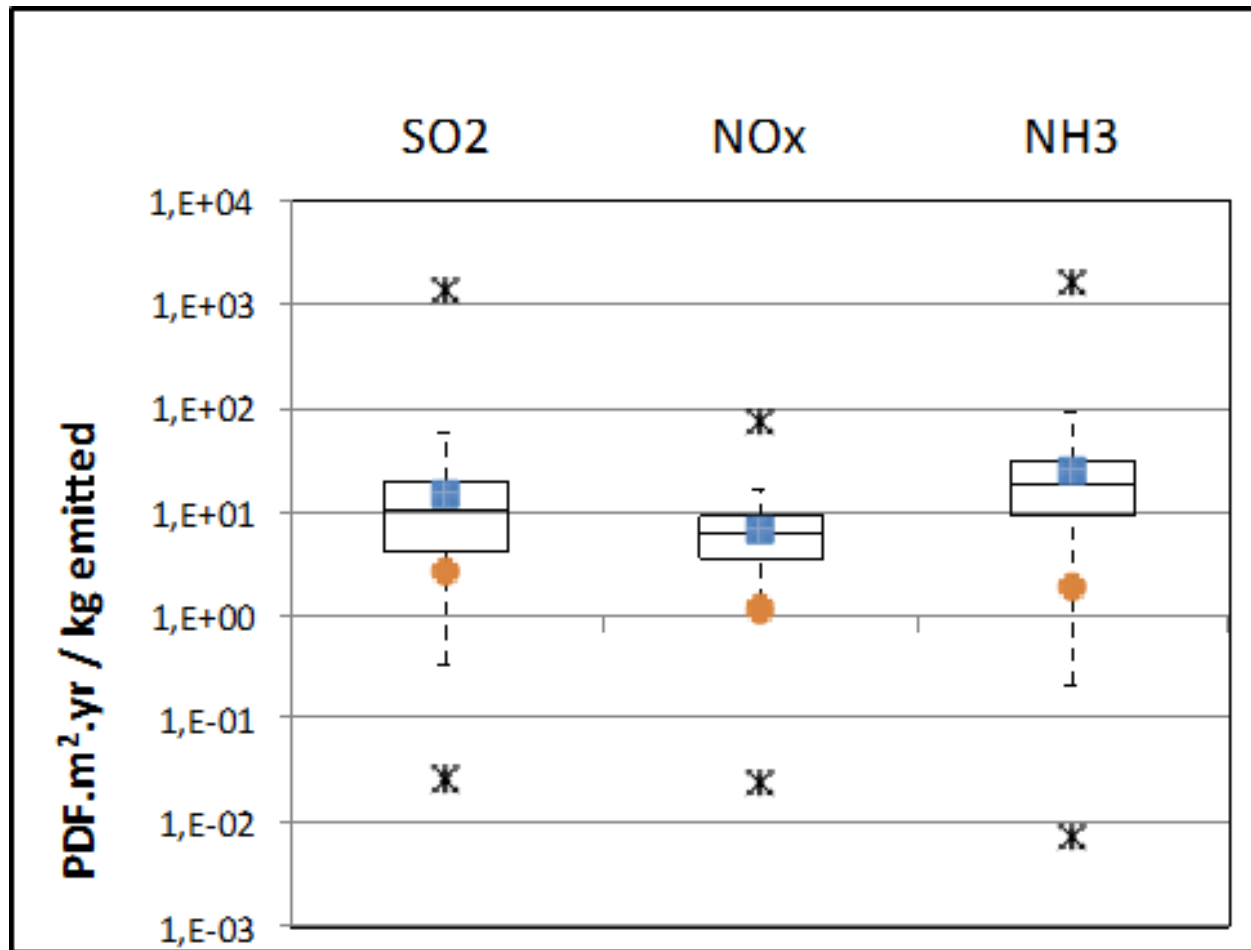


Level of aggregation & related uncertainty to spatial variability



Spatial variability of terrestrial acidification...

... is higher (worldwide) than the variability between chemicals!



Weighted average based on emission probability

Median w/o weighting



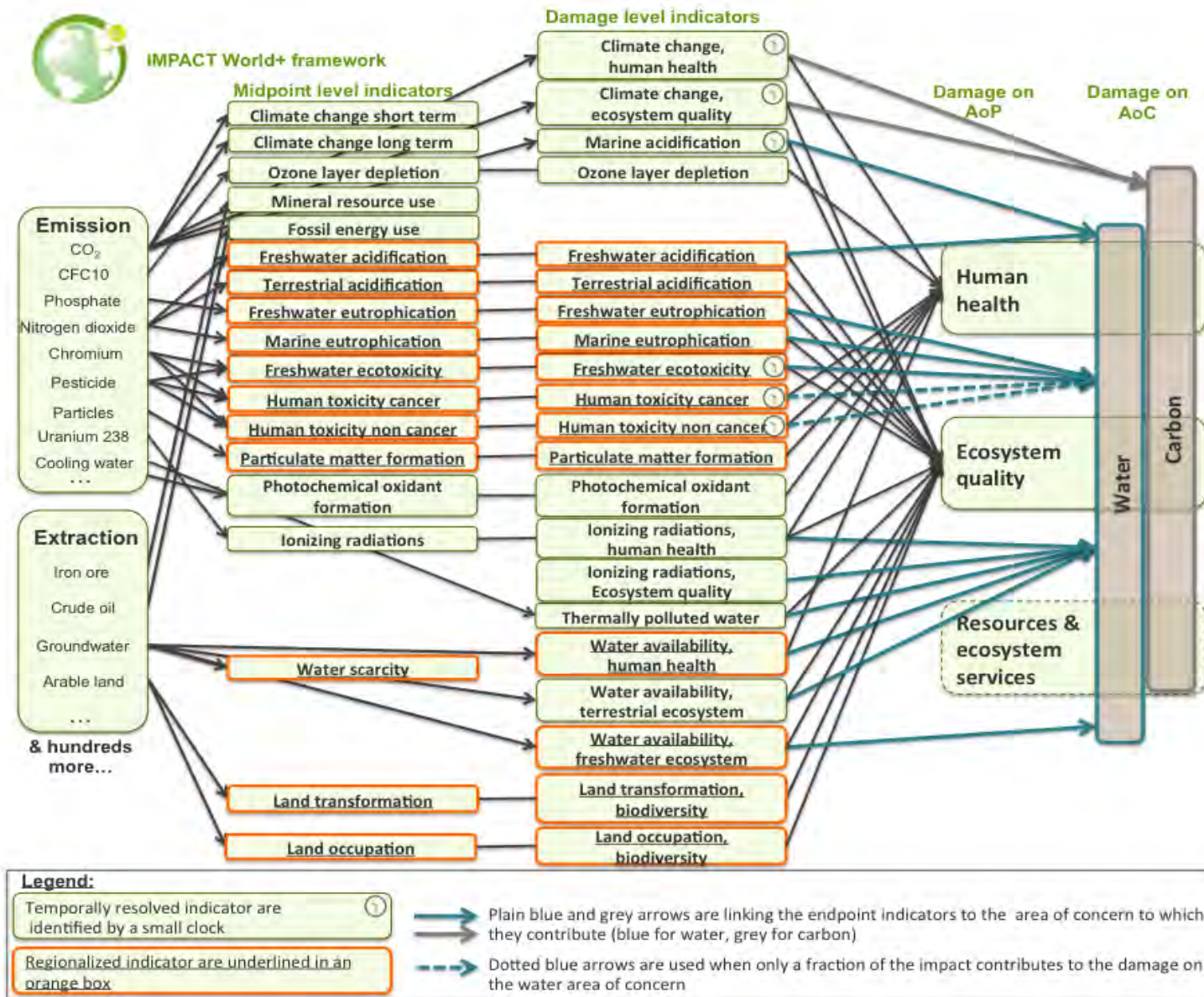
Model evaluation: Contribution to normalization values – Human Health



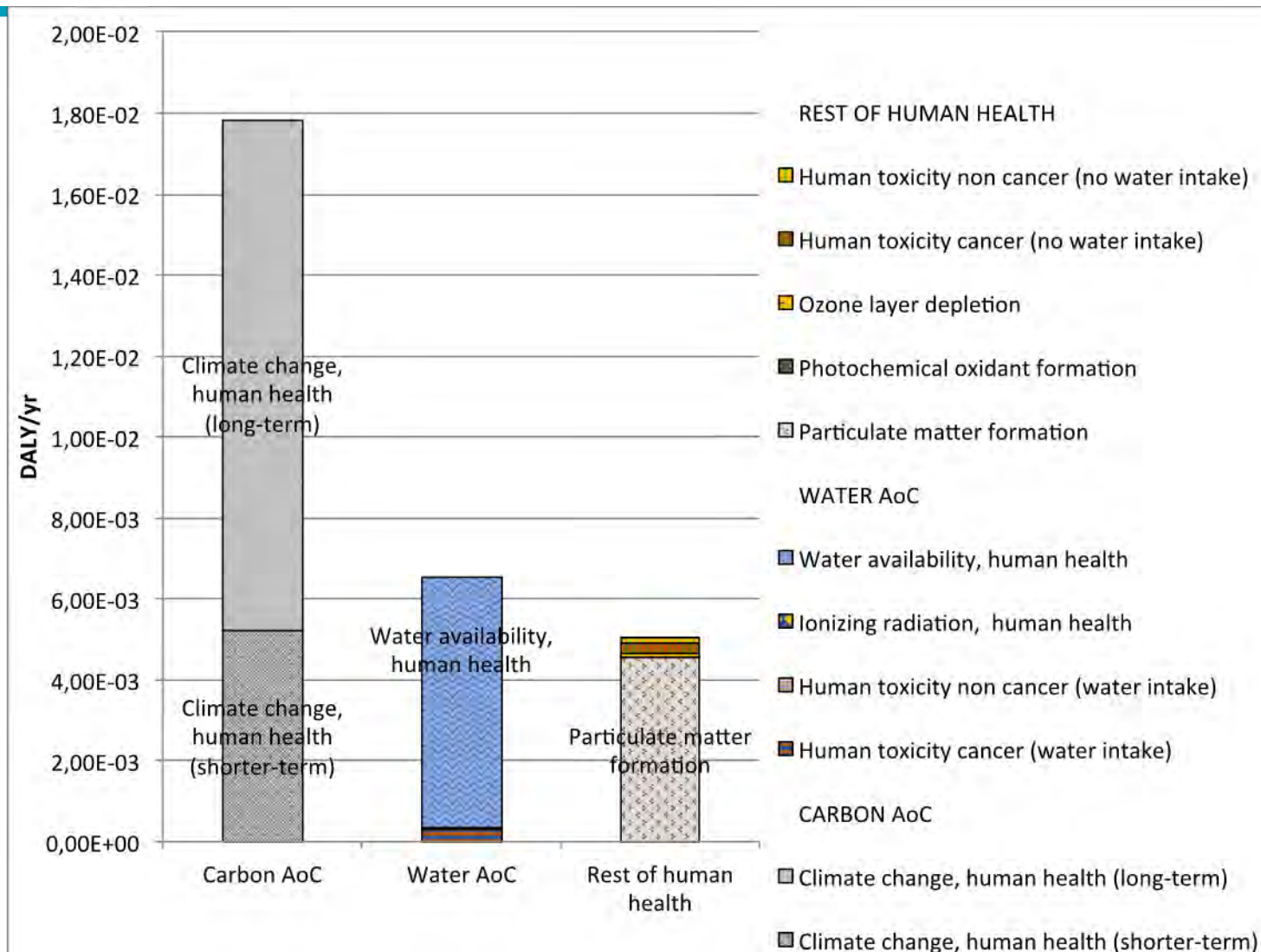
Results examples with IMPACT World+



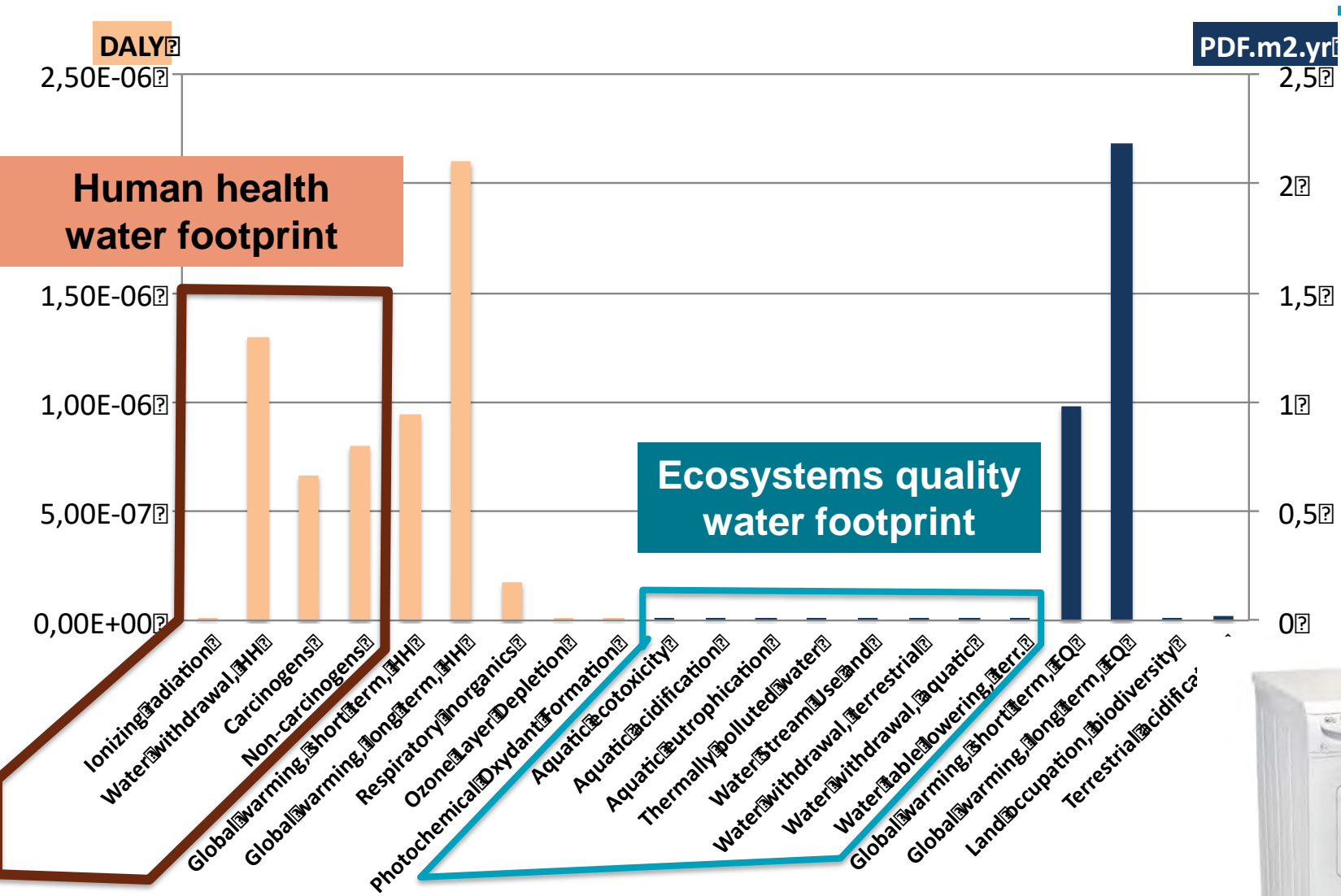
The IMPACT World+ framework and interpretation viewpoints



Normalization values - Footprint version of IMPACT World+



Example: damage profile of 1 load of laundry

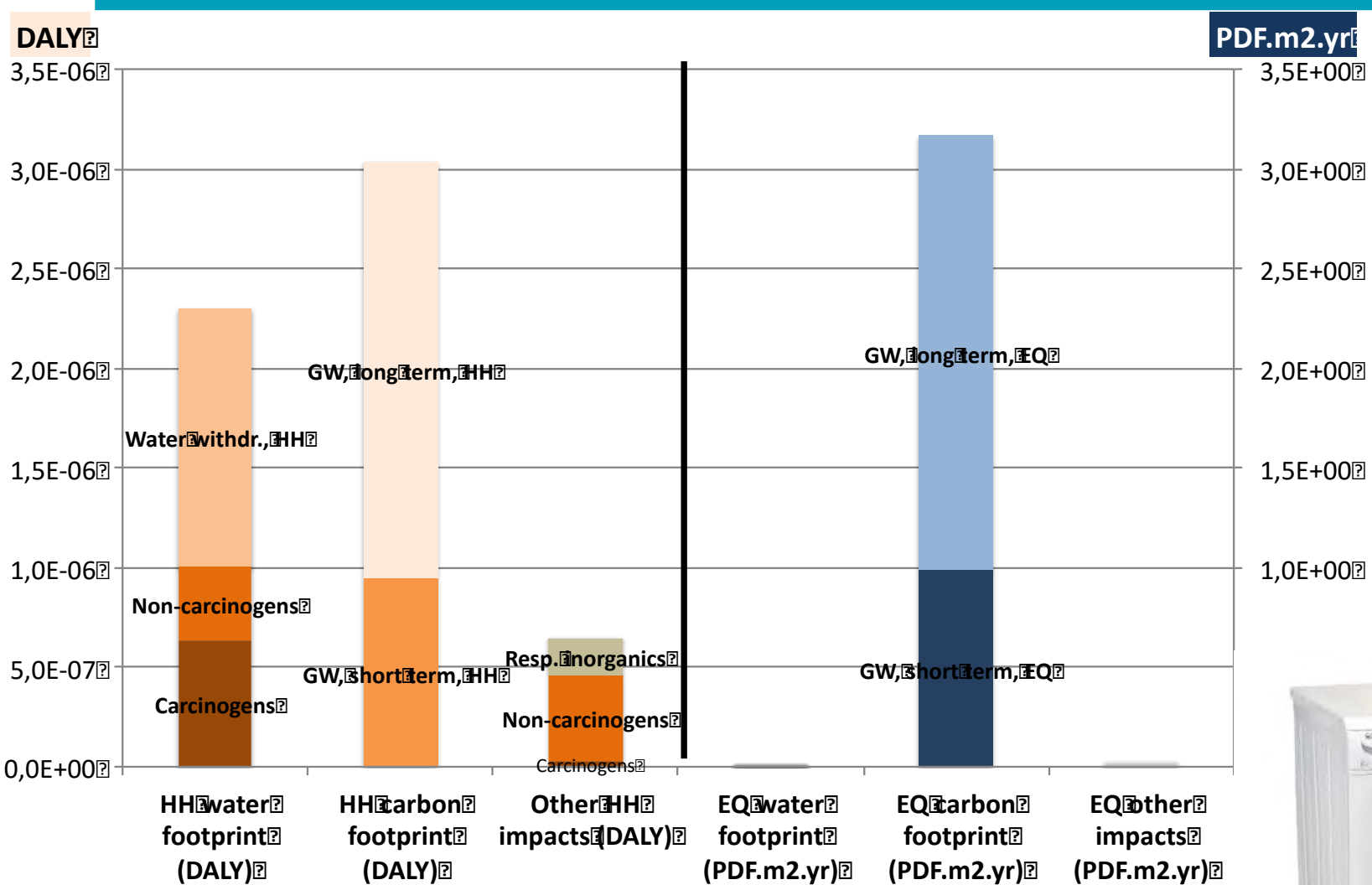


Adapted from (Boulay, A.-M., et al., 2015. Int. JLCA).

1 load of laundry



LCIA profile in respect to the AoC viewpoint at damage level



Adapted from (Boulay, A.-M., et al., 2015. Int. JLCA).

1 load of laundry





**All this is interesting, but...
We are still blind on the uncertainty of LCA results**

Uncertainty vs. variability: where do we stand?

- **How to compute variability vs uncertainty?**
 - Spatial variability from regionalized characterization models
 - Basic uncertainty of CF (work in progress)
- **How to operationalize uncertainty calculation in LCA softwares for an enhanced interpretation?**
 - Contribution to overall uncertainty (instead impact contribution) should drive data collection enhancement

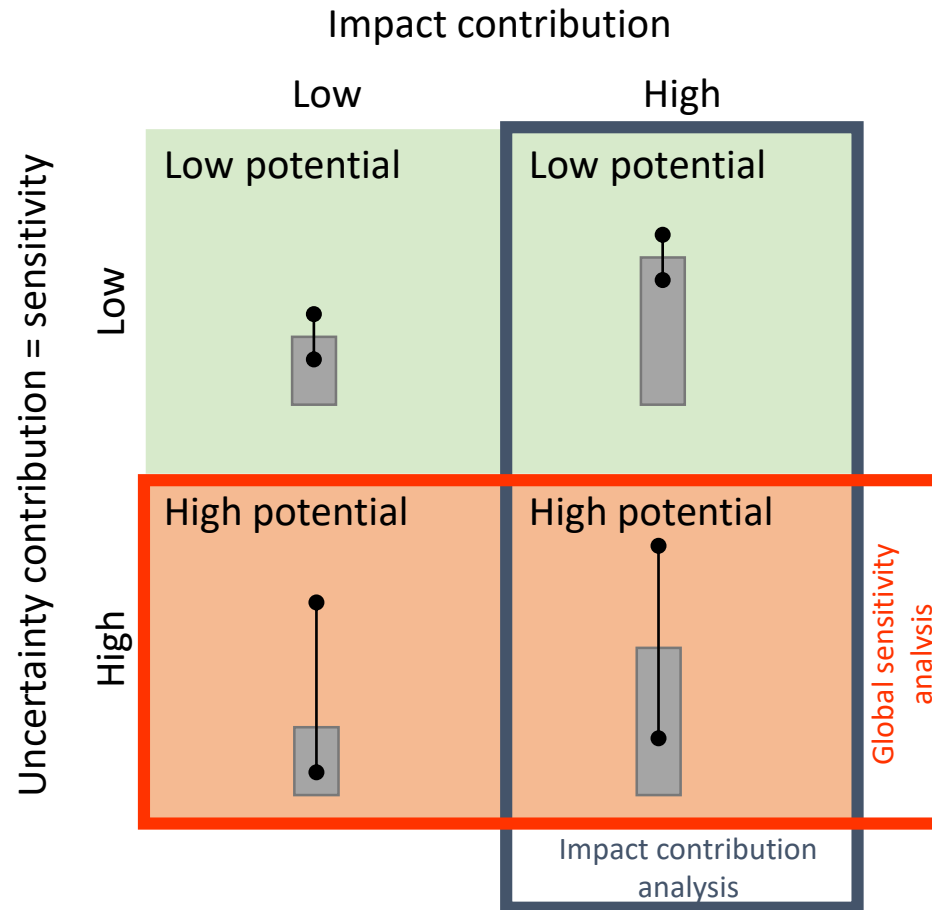


Approaches to prioritize regionalization effort

Priority on highly uncertain data that highly contribute to the impact score

Heijungs (1996)

Goal =
Reduce
results
uncertainty



Patouillard, L., Collet, P., Lesage, P., Tirado-Seco, P., Bulle, C., & Margni, M. (2018). Prioritizing regionalization efforts in life cycle assessment through global sensitivity analysis: A sector meta-analysis based on ecoinvent v3. *International Journal of Life Cycle Assessment*, Submitted.

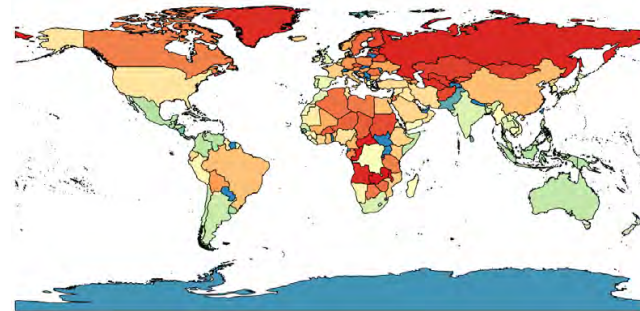
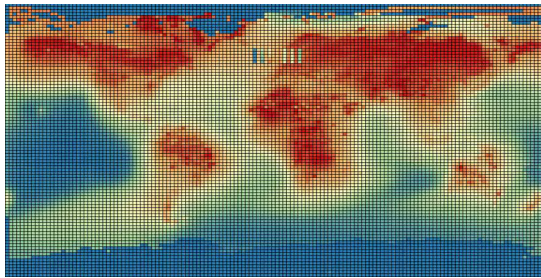
Best practice

Patouillard, L., Bulle, C., & Margni, M. (2016). Ready-to-use and advanced methodologies to prioritise the regionalisation effort in LCA. *Matériaux & Techniques*, 104(1), 105.



LCIA modelers and Software developers: how do we proceed further?

Who should aggregate native CFs?



- Regions evolve or users can define their own regions → need for systematic procedure in LCA software
- Spatial variability of results should be calculated during aggregation process
- aggregation factors + maps should be provided by LCIA modelers



How do you access IW+?

<http://www.impactworldplus.org/en/>



SimaPro

Brightway²



CF database available

https://www.dropbox.com/s/h9jw1nnl4xnxqj/IWplus_public.accdb?dl=0

