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Challenges of linking regionalised LCIA methods and LCA databases

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Challenges of linking regionalised LCIA and LCA databases

1 Mapping process locations and LCIA methods spatial units

2 Spatial uncertainty

3 Software implementation

1 Mapping inventory and LCIA methods spatial units

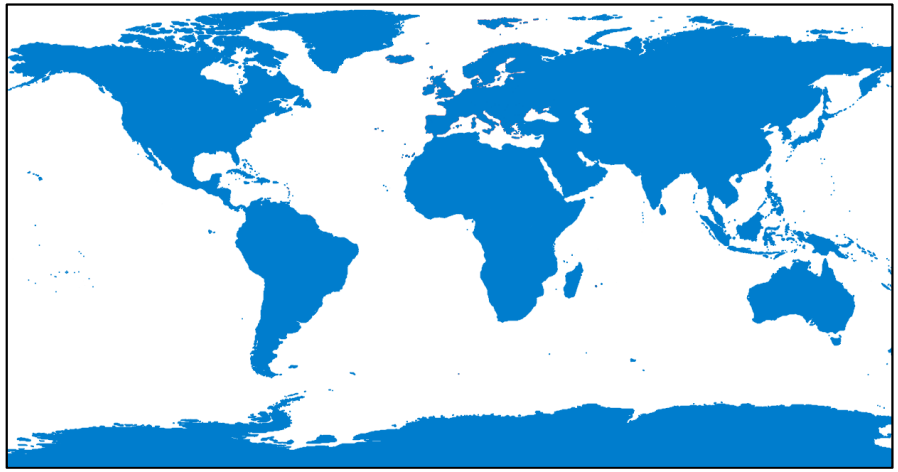
Challenges

- Different spatial scales between processes and methods
- Several levels of regionalisation within a life cycle
- Quantity of different locations in a high spatial resolution regionalised inventory
- Different spatial units per impact category

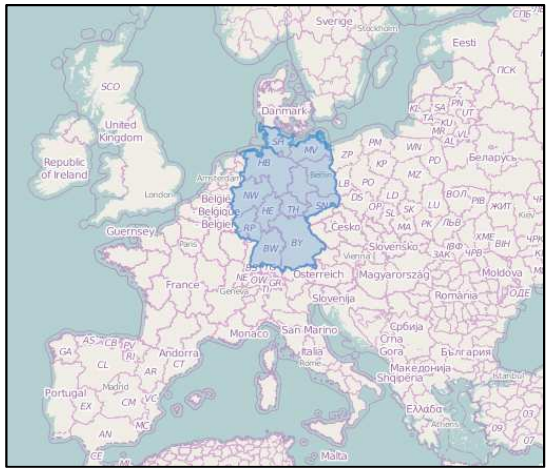
Levels of regional differentiation in the inventory

Foreground processes

Site-generic



Site-dependent



Site-specific

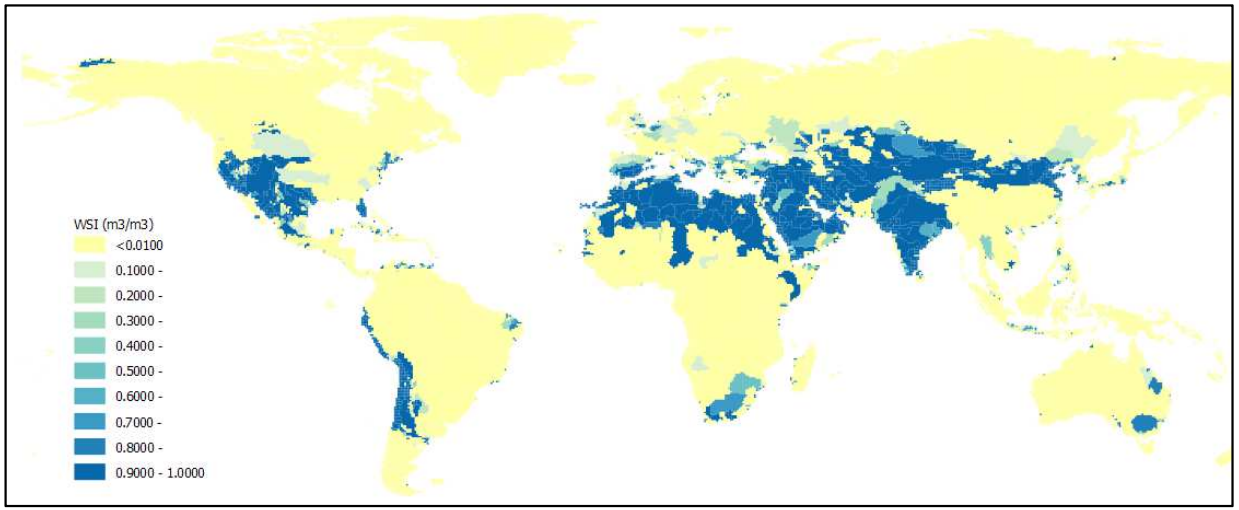
Most common in LCA databases

Background processes

Regionalised LCIA methods

- Spatial units may be different from the inventory and vary per impact category

  e.g. biomes, watersheds, etc.

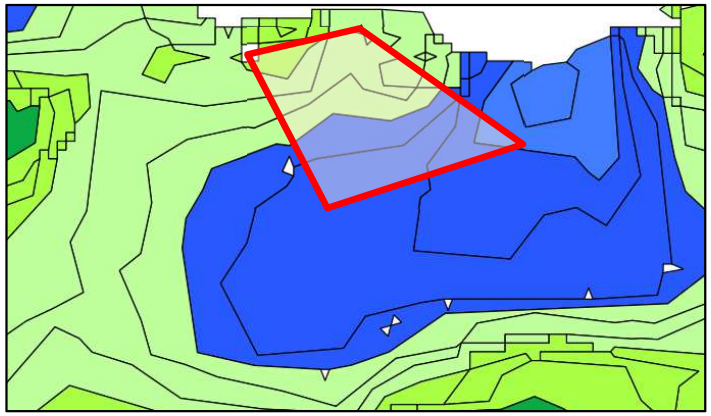


WSI per m3 water consumed (Source: EI99+)

Linking inventory and LCIA methods

GIS (Geographic Information Systems)

- Calculate intersected areas of the impact assessment spatial units by each inventory geometry



- Weighted average characterisation factors (CFs)

→ Geographical distribution of emissions

Linking inventory and LCIA methods

- LCIA method developers provide also aggregated CFs at lower spatial resolution scales

  → Higher spatial variability

- For very detailed regionalised inventories the weighted mean CFs should be calculated in the LCA software

  → GIS + LCA tools is now a reality

  e.g. Brigthway2, openLCA

2 Spatial uncertainty

Spatial uncertainty

- High spatial resolution might add precision to results but decrease relative accuracy
- Spatial uncertainty of inventory and CFs should be considered
  - → What is the likelihood of an activity occurring in a specific location?
  - → What is the real area of impact of an emission?

3 Software implementation

Challenges

- High amount of data:

  ∑processes*elementary exchanges*locations

  → Data storage capacity

  → Computing power

  → Interpretation of results by non-expert users

- Adapt calculation frameworks
- Extension of process locations → site-specific differentiation
- Spatial uncertainty

Parameterization of regionalised LCA systems

- Separate site-dependent and independent information
- Regional characteristics are included as parameters in process data sets and LCIA methods
- Data for regionalised parameters retrieved from GIS datasets

  →Reduces the amount of data to store

  →Enhances sensitivity assessment of spatial variation

New calculation frameworks

- A new dimension needs to be added to the calculation

  →In matrix-based LCA new matrices are created

- Calculation of weighted mean CFs using GIS

  → Is the speed of the calculation highly affected?

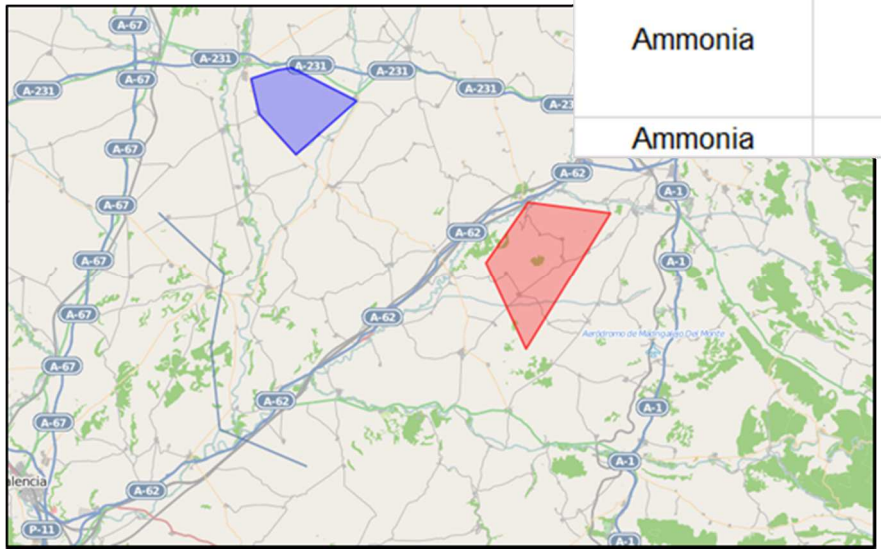
  → Is feasible in very complex LCAs (e.g. ecoinvent 3 product systems)?

Regionalised results

- Contributions per flow/impact category and location

  → Easily interpretable?

Flow	Compartment	Coordinates	Amount	Unit
Ammonia	river	[7.27713346481301,47.03916583052327]	0.023	kg
Ammonia	river	[-5.907967686653199,42.305130129490706 - 5.90831637382513,42.3045032823678 - 5.9102636575700105,42.30480877193532]	0.157	kg
Ammonia	river	[7.191857993602852,47.049604064965536 7.194218337536014,47.04843441171633 7.1960744261742775,47.04766681283223 7.195162475109187,47.04725742224354]	1.035	kg
Ammonia	river	[-5.940331941651743,42.3729584457095]	0.003	kg



4 Conclusions

Conclusions

- GIS can be used for linking regionalised inventories and LCIA methods
- Regionalised LCIA should not compromise accuracy of results or calculation time
- High spatial resolution differentiation in inventories still under debate
- Regionalisation in LCA needs interrelation of LCI databases, LCIA methods and LCA software developers

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Thank you!

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