



Quantis

Sustainability counts

Making regionalization a reality in life cycle assessment of human health impacts caused by pollutants

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LCA forum DF39, Zurich, Switzerland, November 13, 2009

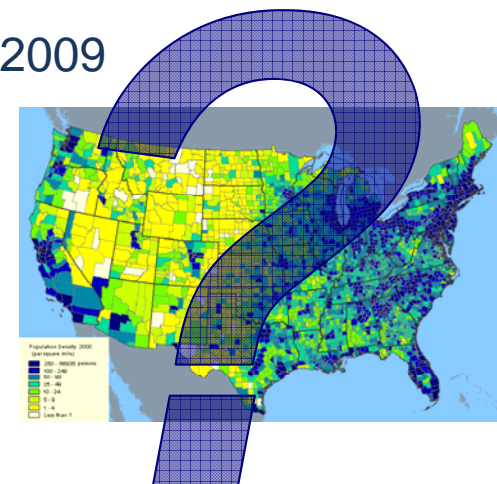
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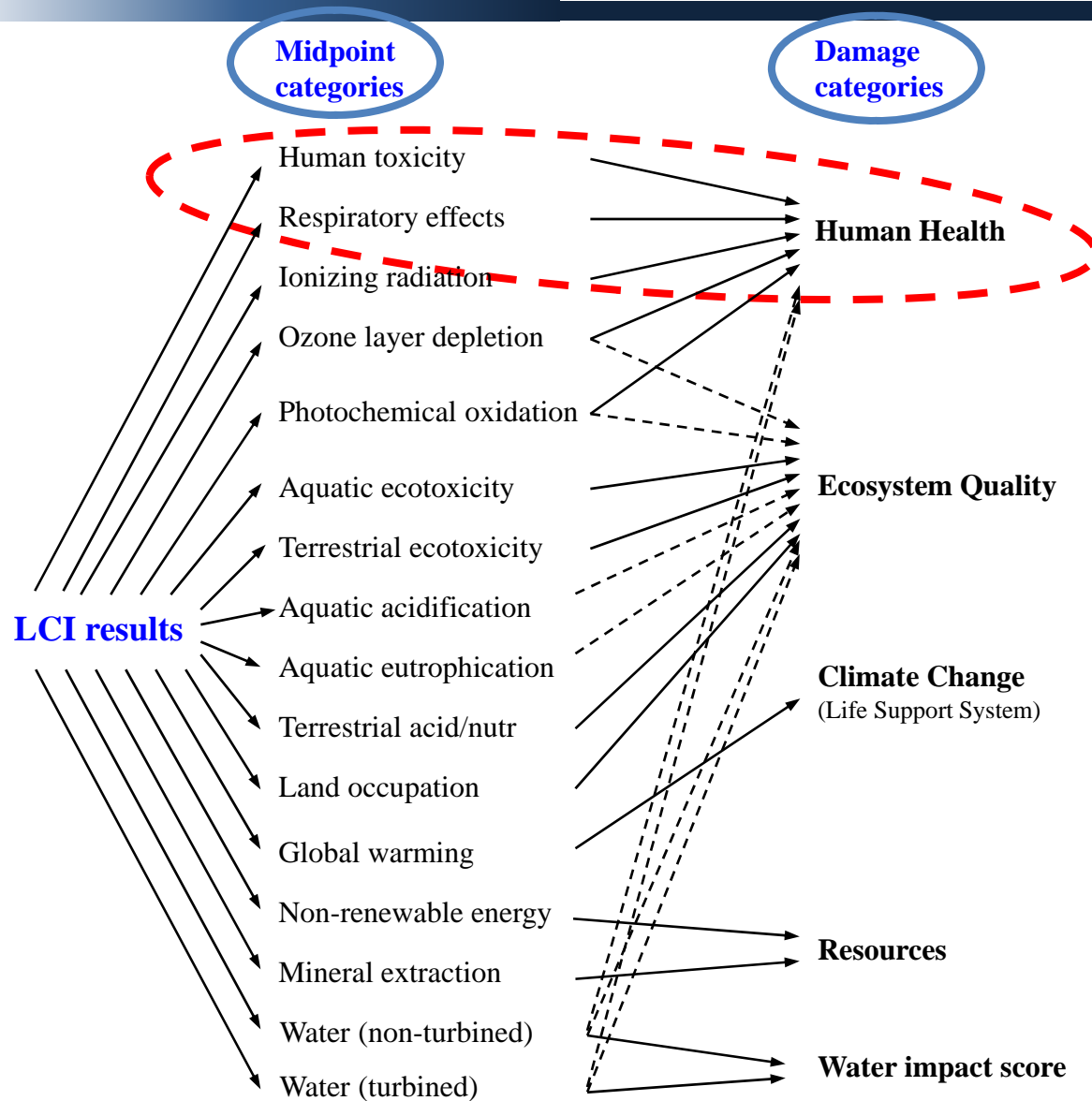


Objectives

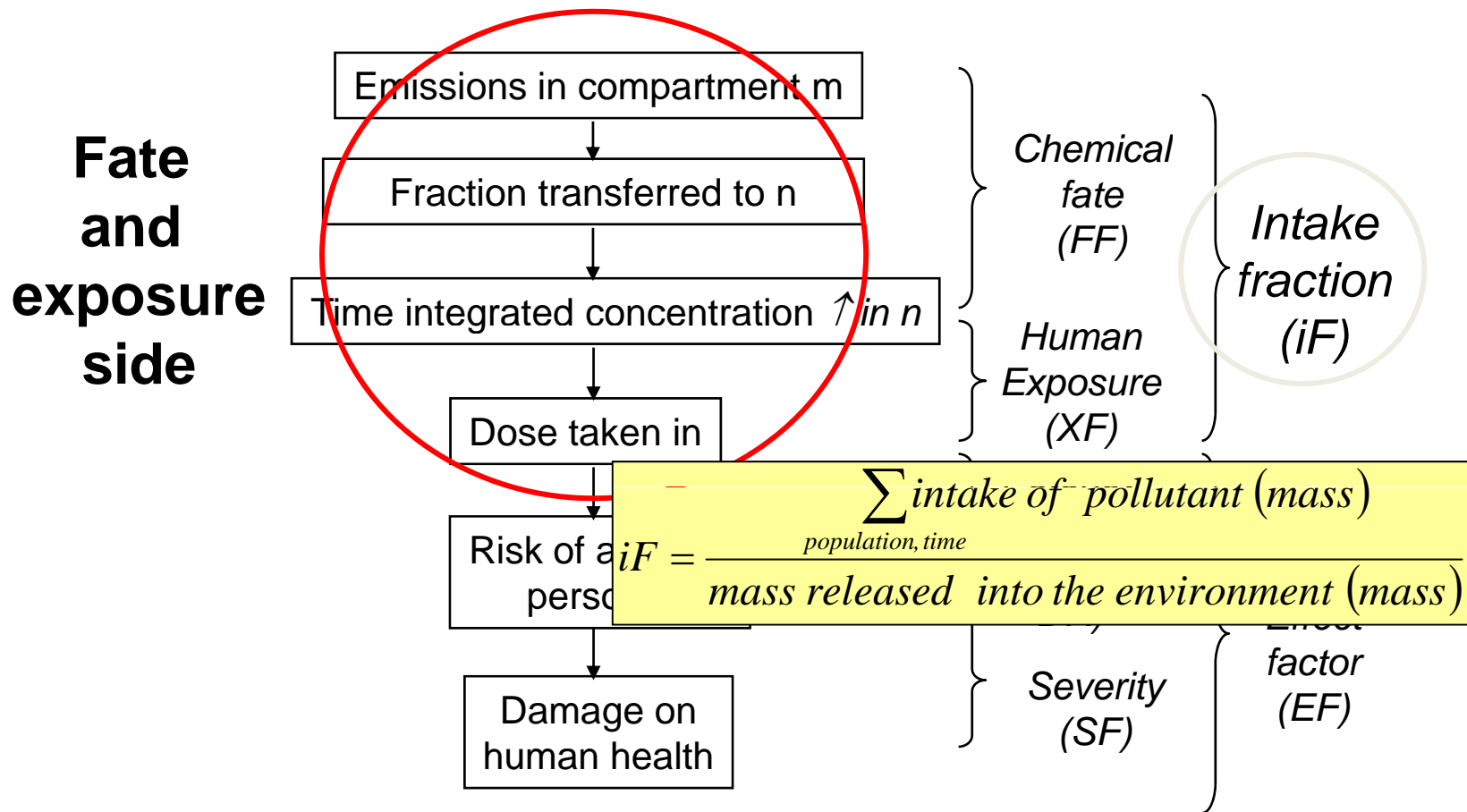
- 1) To evaluate how human health damage varies when using geographically regionalized CFs versus generic CFs
- 2) To discuss the advantages and disadvantages of the two approaches 'archetype' and 'geographic' when performing regionalization in LCA

Framework

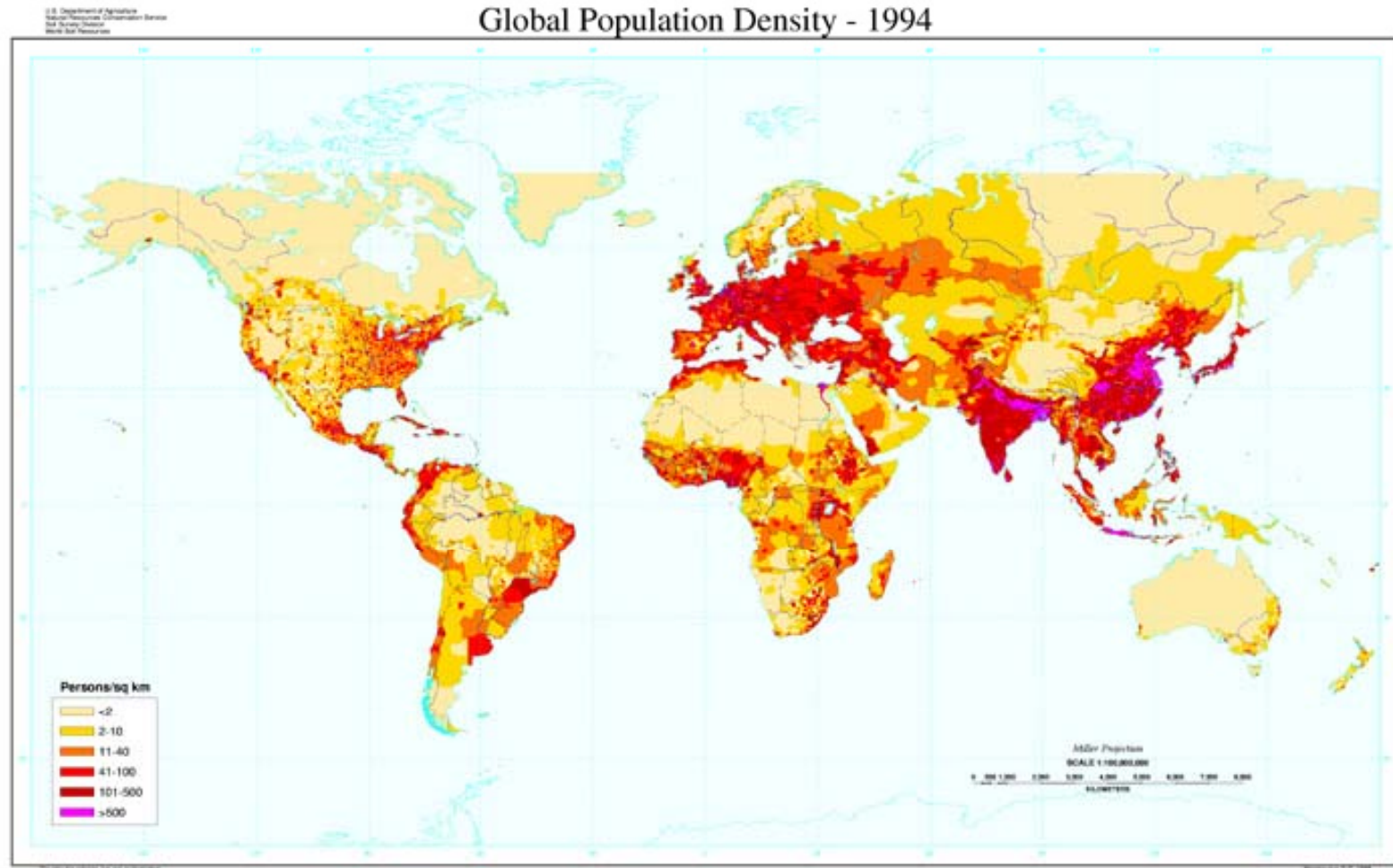
(based on IMPACT 2002+)



From emissions to damage, Framework

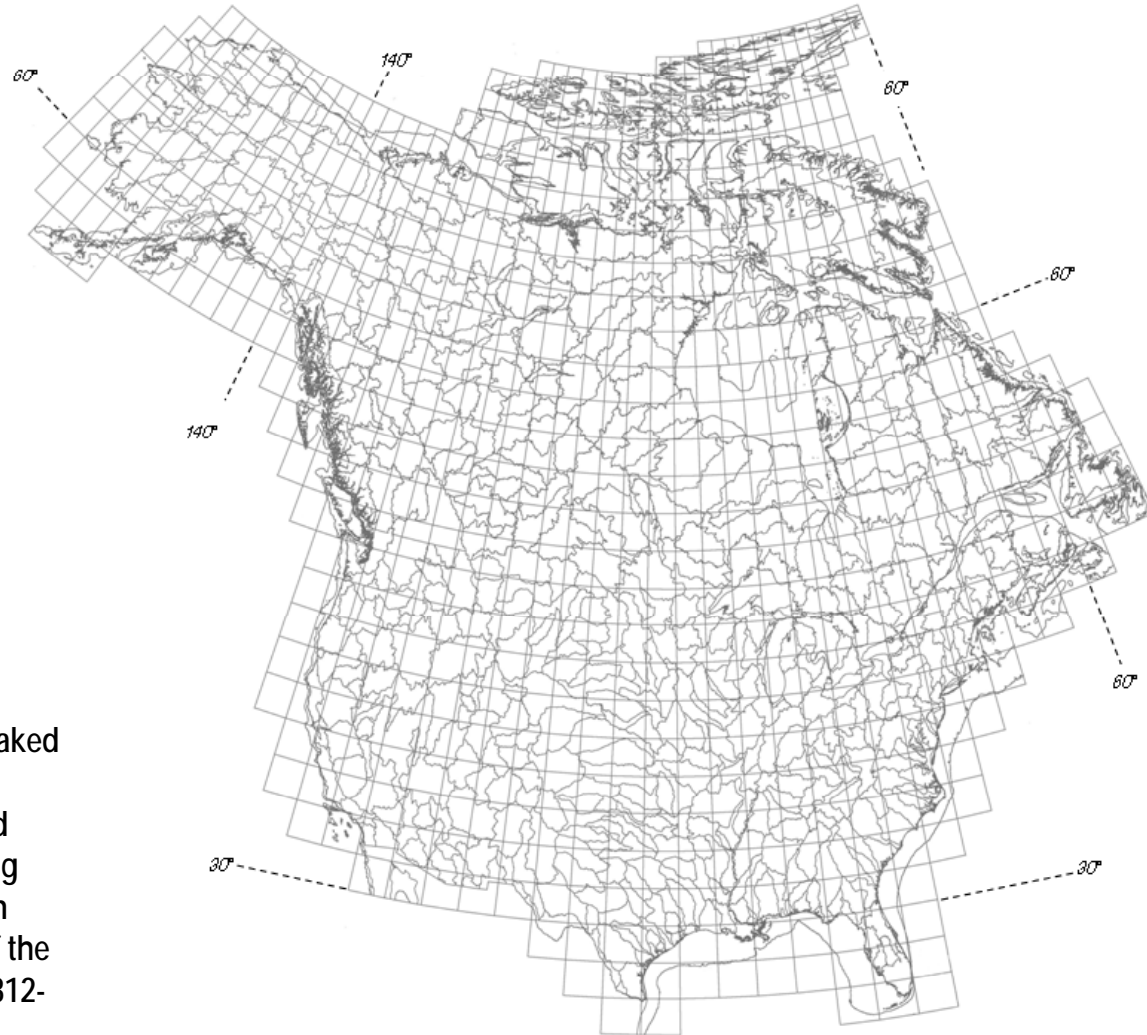


Variation of population in the world



High variation → difference in exposure!

IMPACT North America



Humbert S, Manneh R, Shaked S, Wannaz C, Horvath A, Deschênes L, Jolliet O and Margni M (2009). Assessing regional intake fractions in North America. *Science of the Total Environment*, 407, 4812-4820.

Definition of archetypes

~1000m

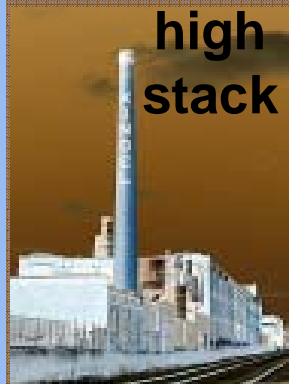
Mixing height H

$$iF_{urban} = a \cdot BR \cdot \frac{LPD}{u \cdot H}$$

Windspeed u

~250m

urban - high population



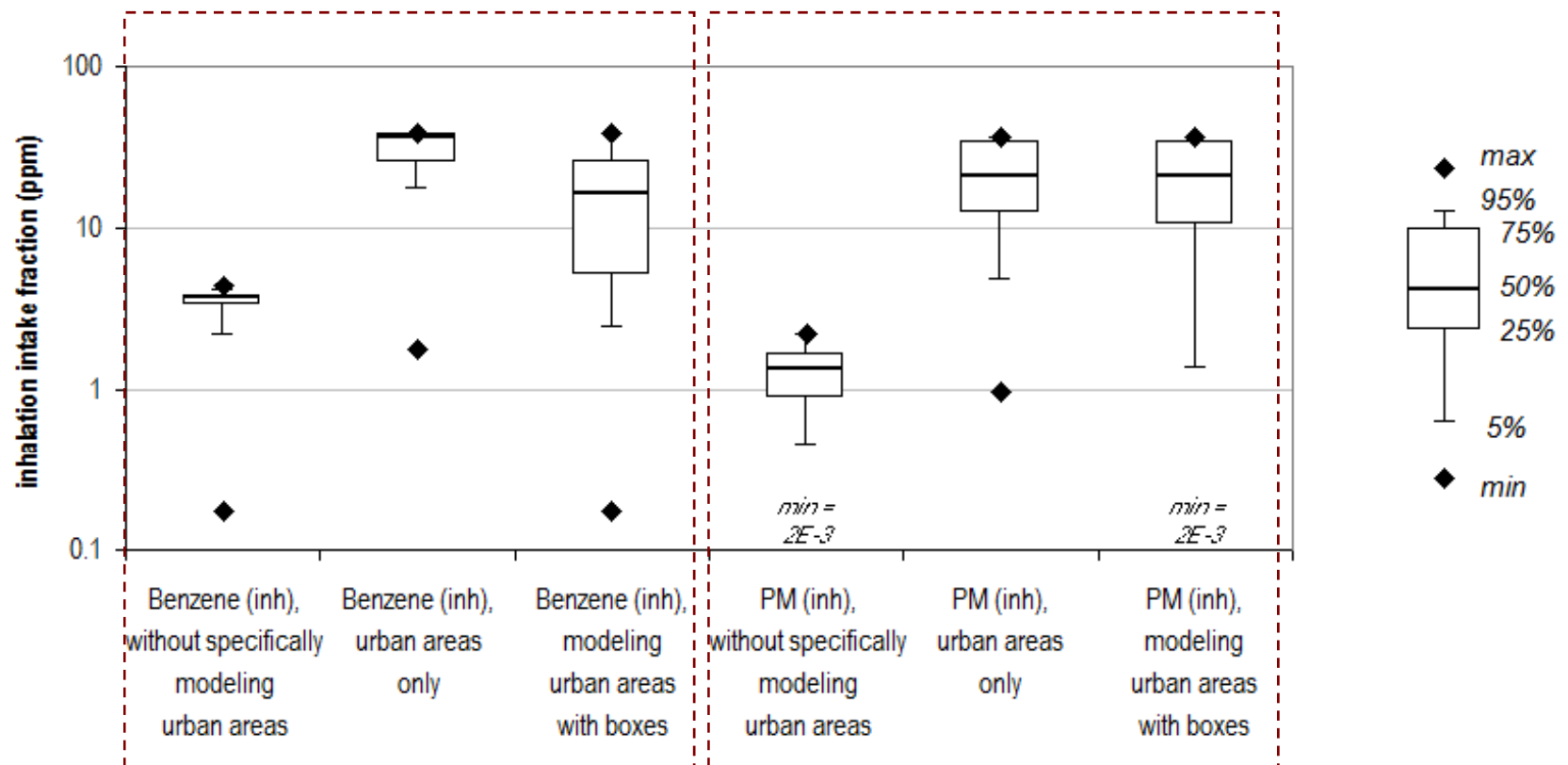
rural - low population



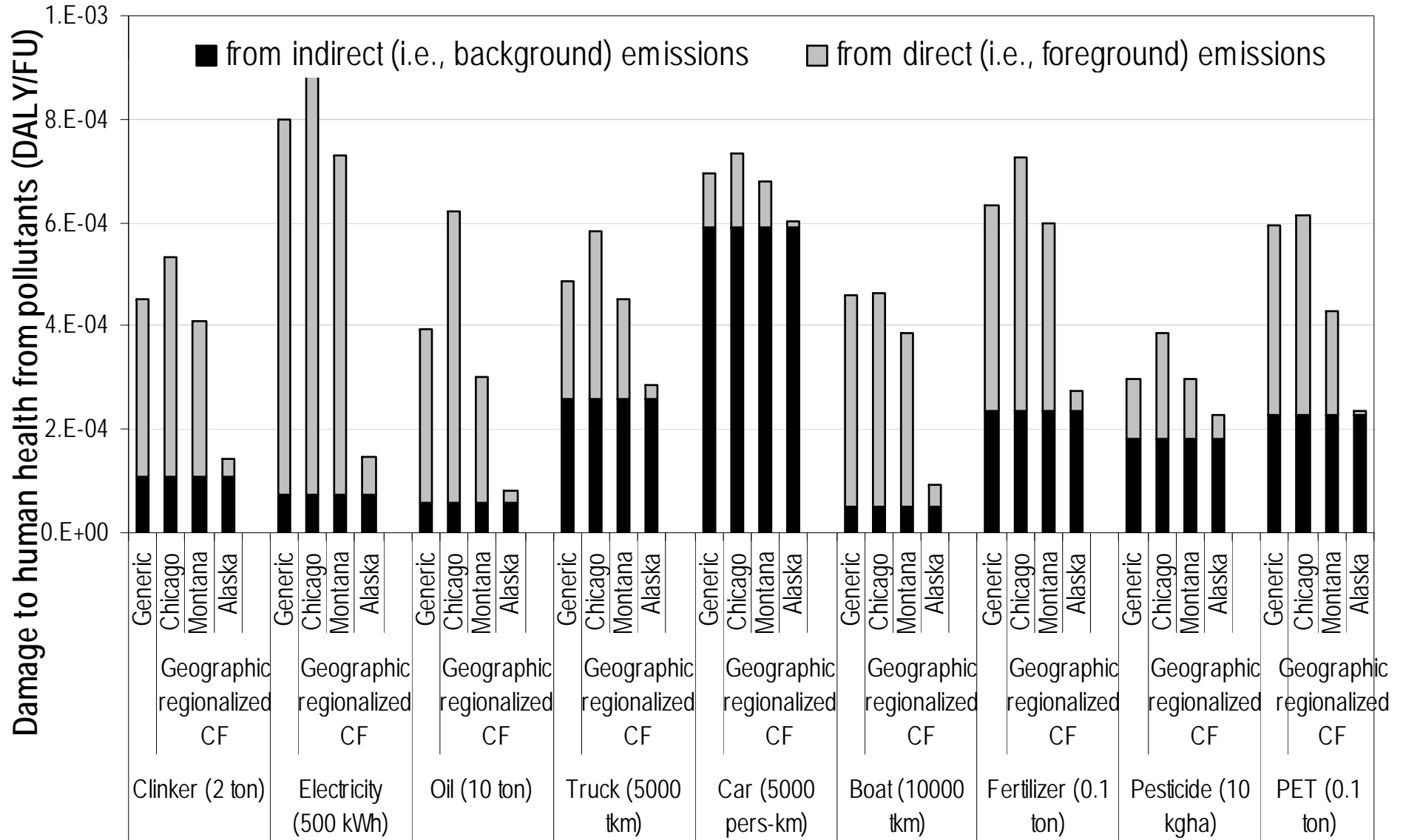
remote



Importance of the urban box

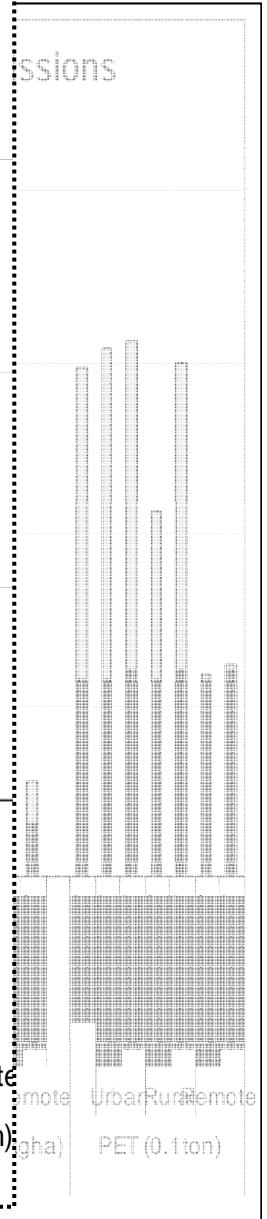
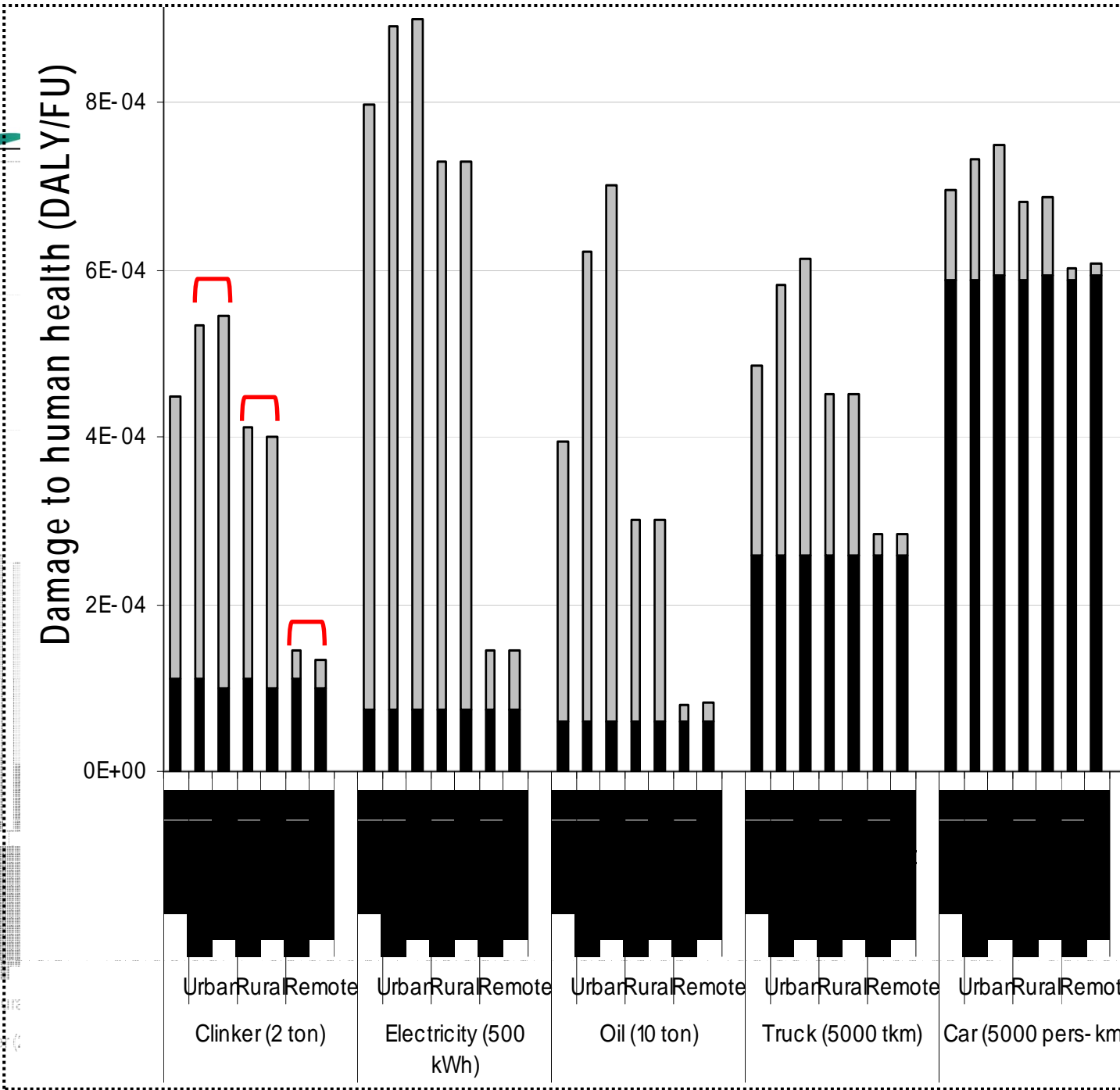
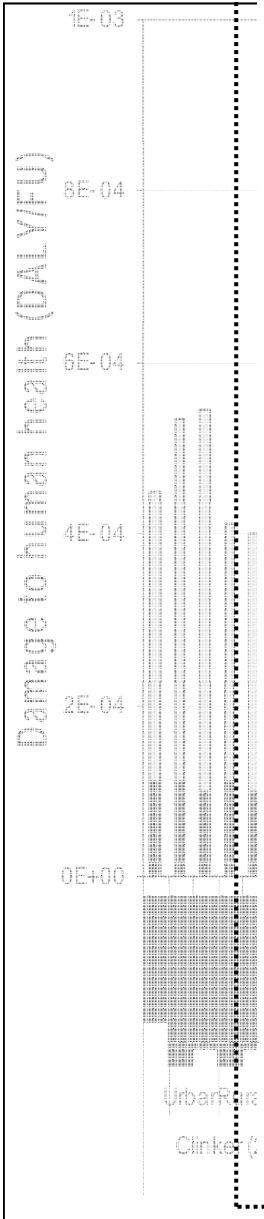
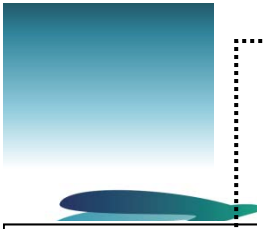


Generic vs Geographic



Pollutants dominating the impact

Process	Pollutants contributing to more than 99% of the damage score to human health for direct emissions, for each process
Clinker	PM(SO ₂), PM(NO _x), PM _{2.5} , PM(NH ₃)
Electricity	PM(SO ₂), PM(NO _x), PM _{2.5}
Oil	PM(NO _x), PM _{2.5} , PM(SO ₂)
Truck	PM(NO _x), PM _{2.5} , Zinc in soil, PM(SO ₂)
Car	PM(NO _x), PM(NH ₃), PM _{2.5} , PM(SO ₂), Zinc in soil, Benzene
Boat	PM(SO ₂), PM(NO _x), PM _{2.5} , PM(NH ₃)
Fertilizer	Zinc in soil, PM(NH ₃), PM(NO _x), PM _{2.5}
Pesticide	PM(NO _x), PM _{2.5} , PM(SO ₂)
PET	PAH, PM(SO ₂), PM _{2.5}



Conclusions

- Regionalization can be important
 - especially for comparative LCA that want to compare two alternatives situated in different type of environment
 - for processes that are dominated by foreground impacts
- Archetype approach as accurate as geographic
 - but more practical to implement
 - as long as no detailed geographic information systems (GIS) allows generating geographically differentiated inventories and matching those inventories with impact assessments
 - use the archetype approach in order to make the regionalization a practical reality of LCA
- Distributed background impacts dominated by PM?
- Additional archetype in ecoinvent:
 - Remote in addition to urban and rural (=low in ecoinvent)

Further work

- This study:
 - regionalization for non-global damage to human health caused by pollutants emitted in North America
- Should be expanded to:
 - other regions of the world
 - other type of impact categories (e.g., tropospheric ozone formation, ecotoxicity, acidification, eutrophication, land use or water use)
 - for all processes?

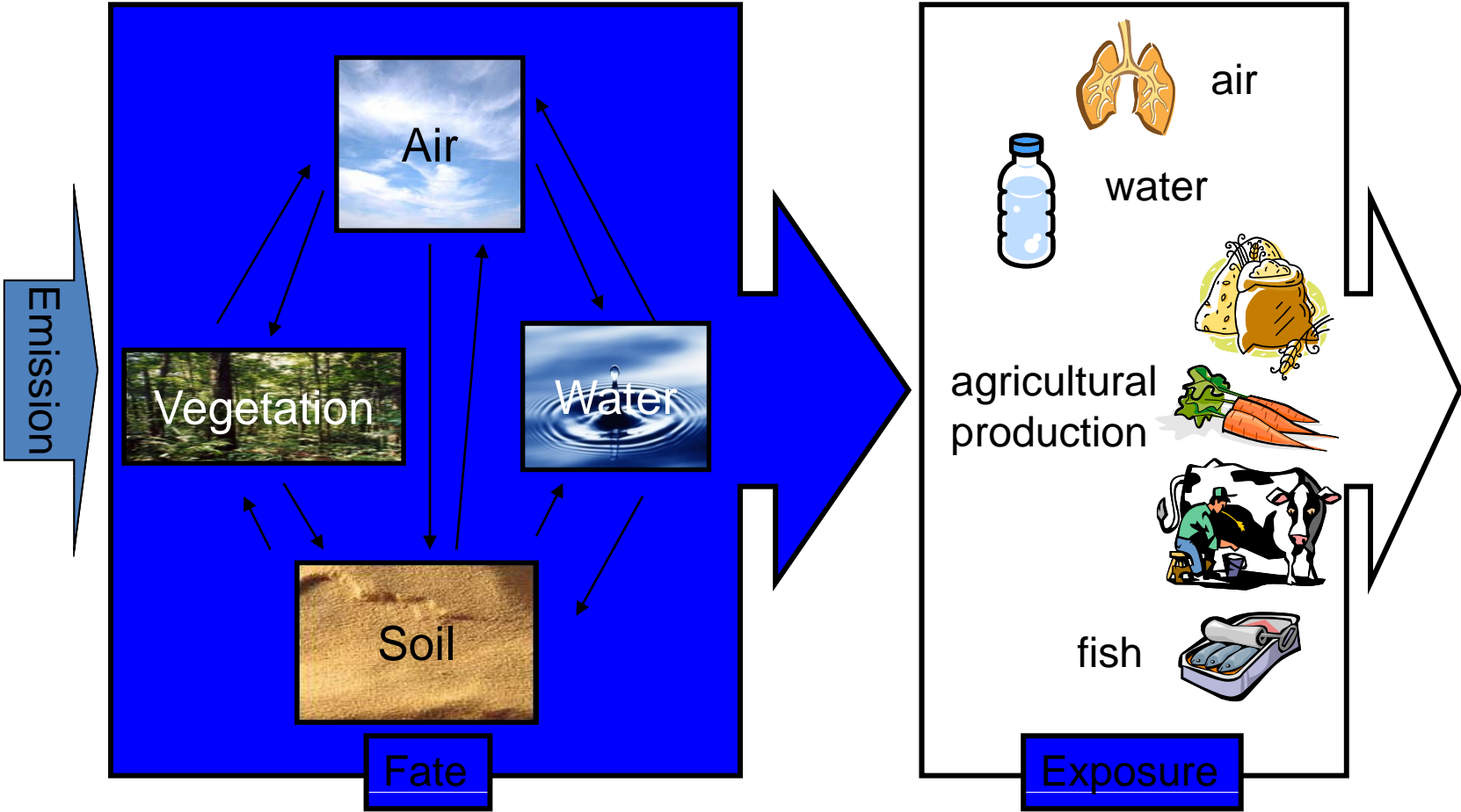


Do you have any questions?

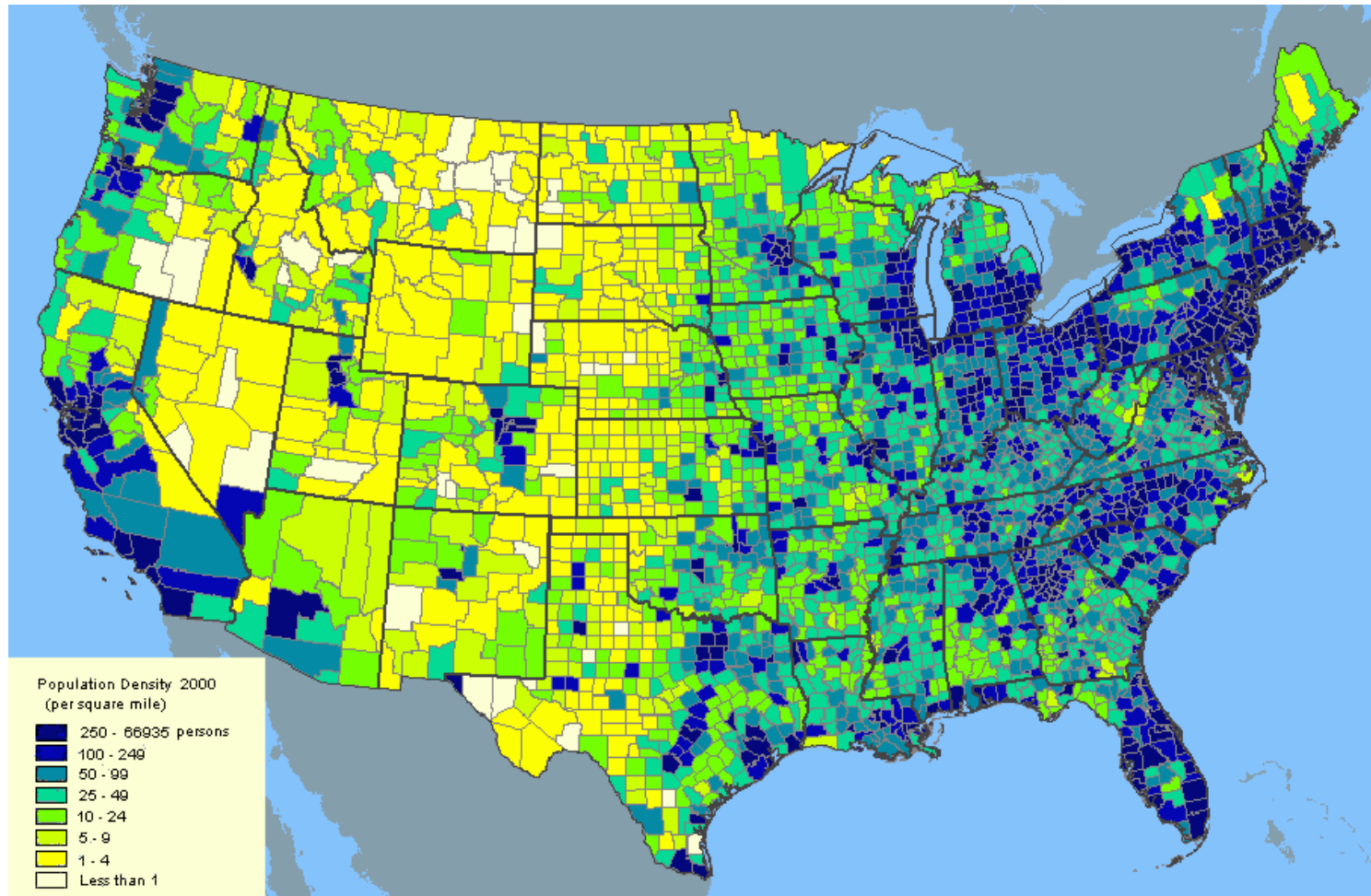


Additional slides of the study

Fate + Exposure → iF



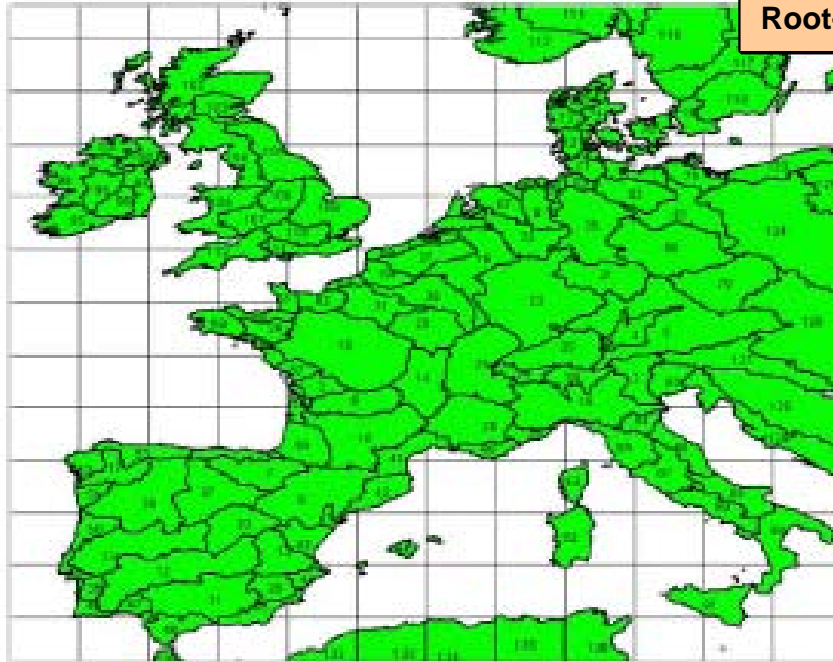
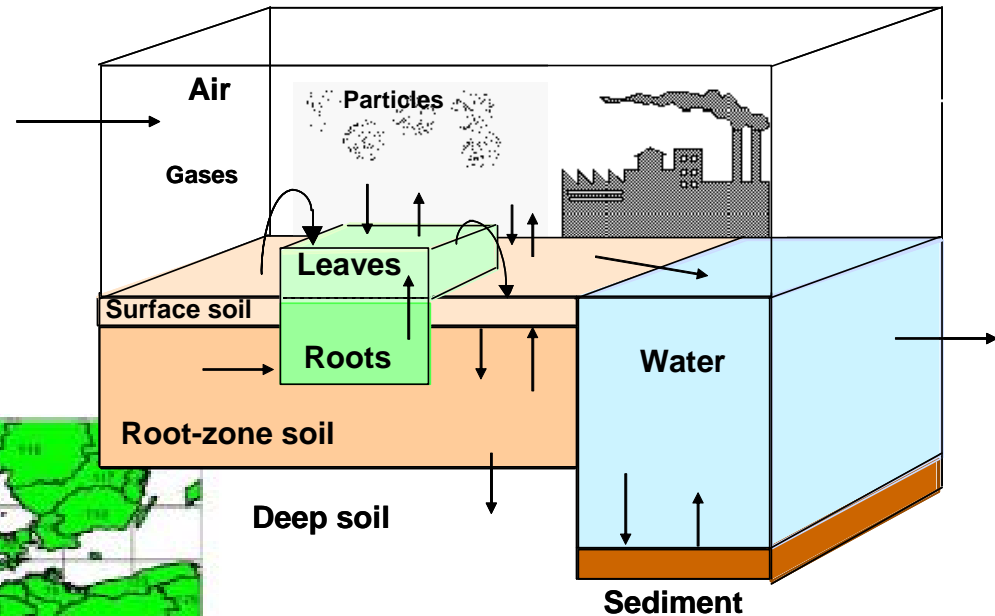
Variation of population in the U.S.



High variation → difference in exposure!

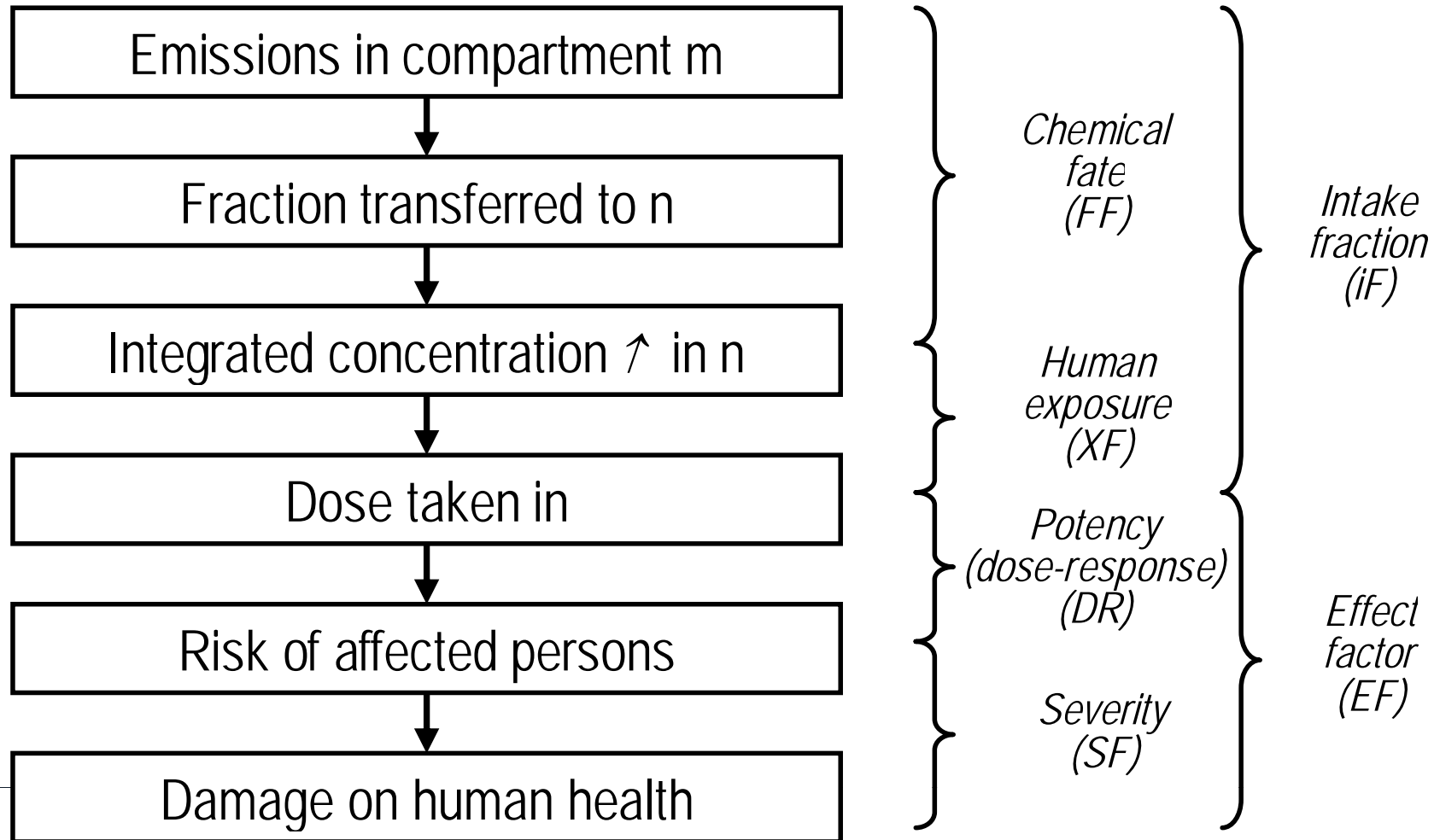
Modeling how pollutant diffuses in the environment

Fate

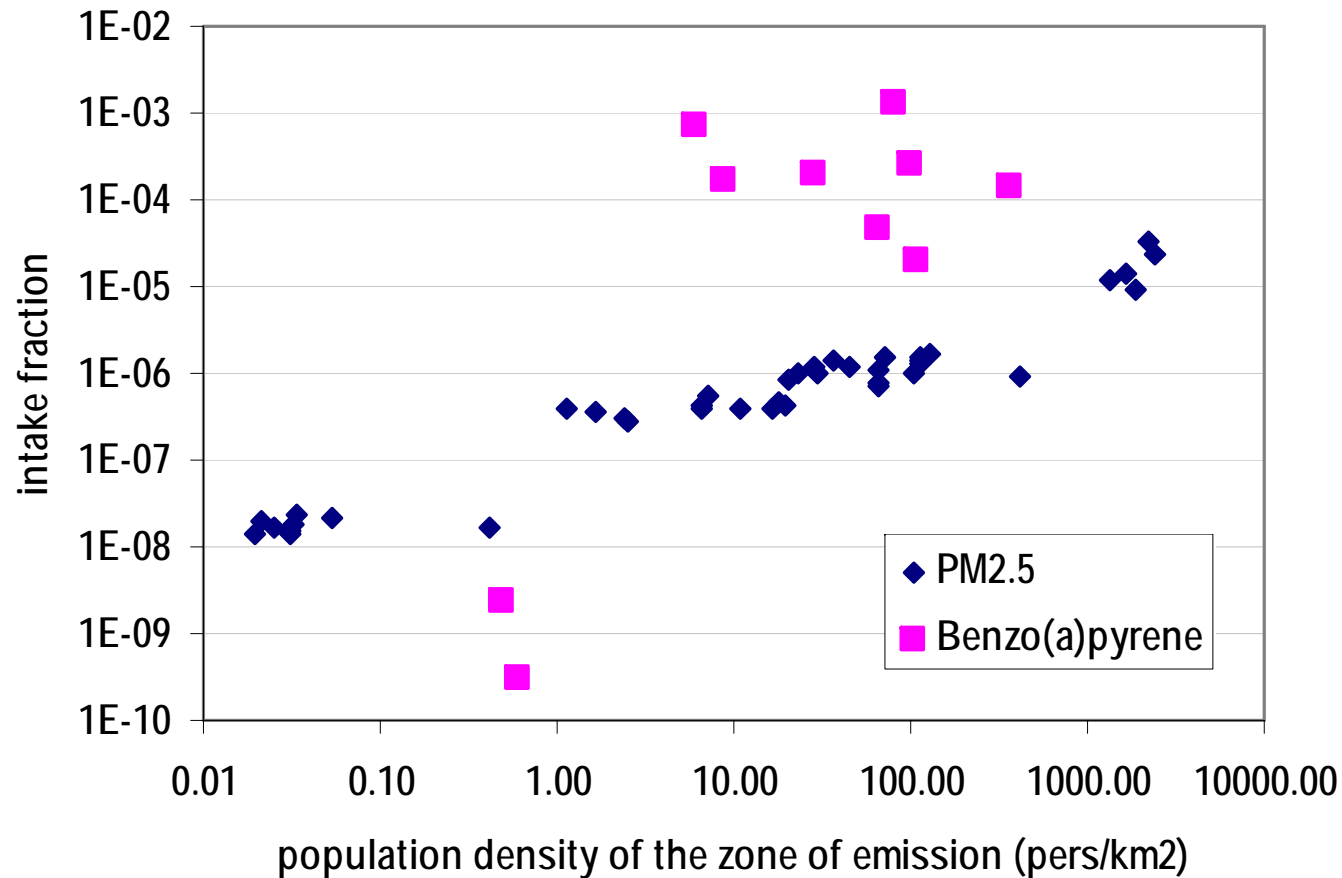


→ Calculate the concentration in the environment

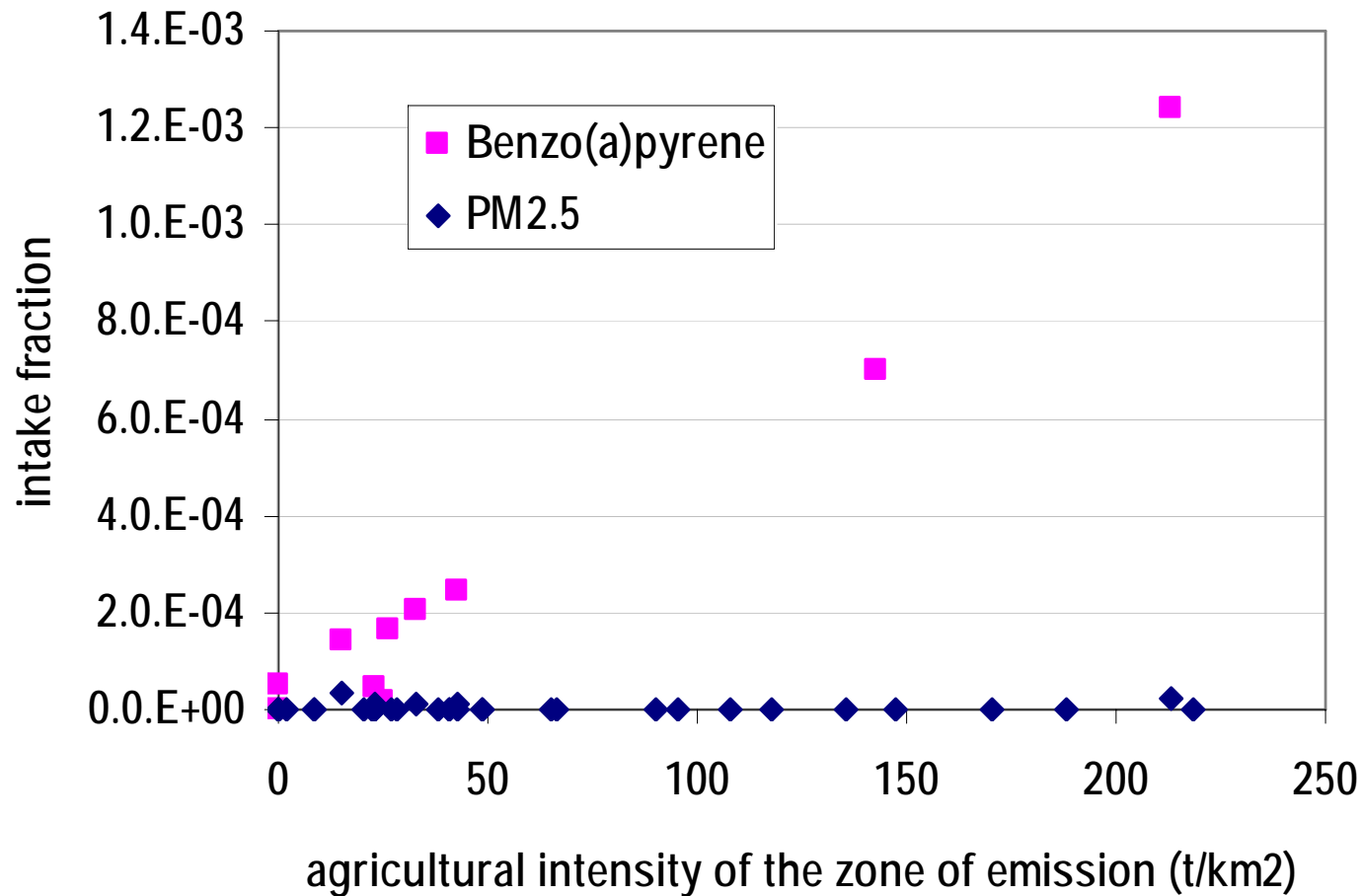
Framework



Identifying archetypes *variation with population density*



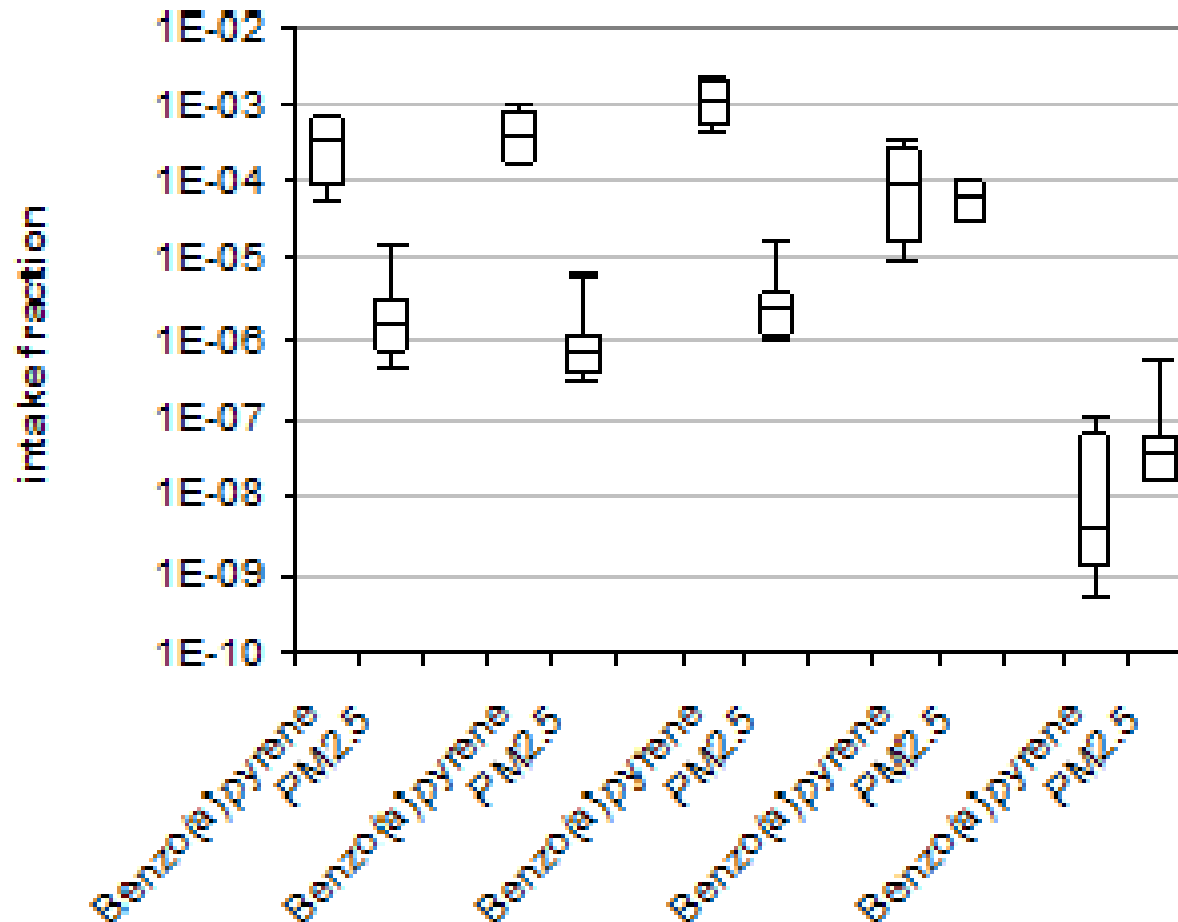
Identifying archetypes *variation with agricultural intensity*



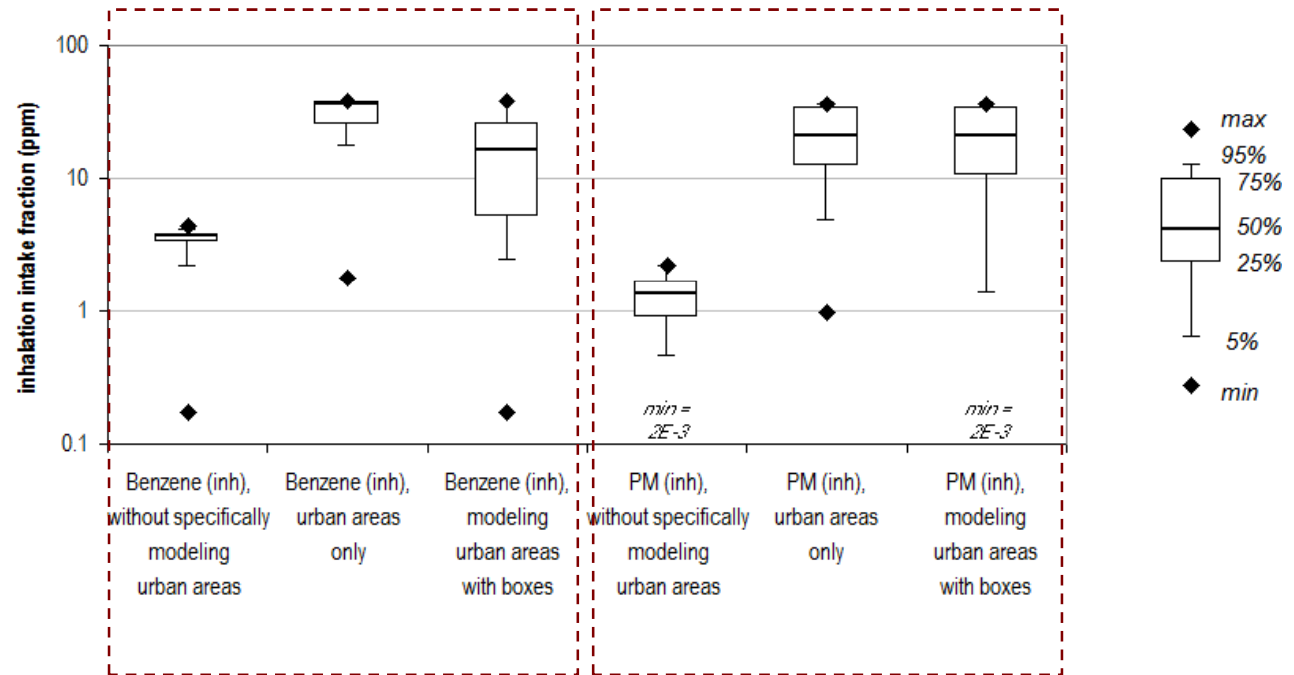
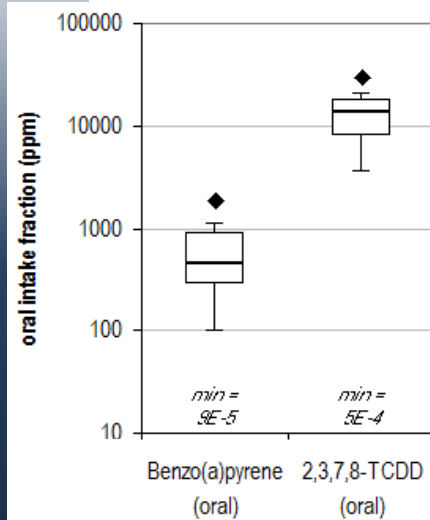
Variation within regions vs variation between regions

Emulsion in the different geographic parts of US

West Rockies Midwest East Alaska



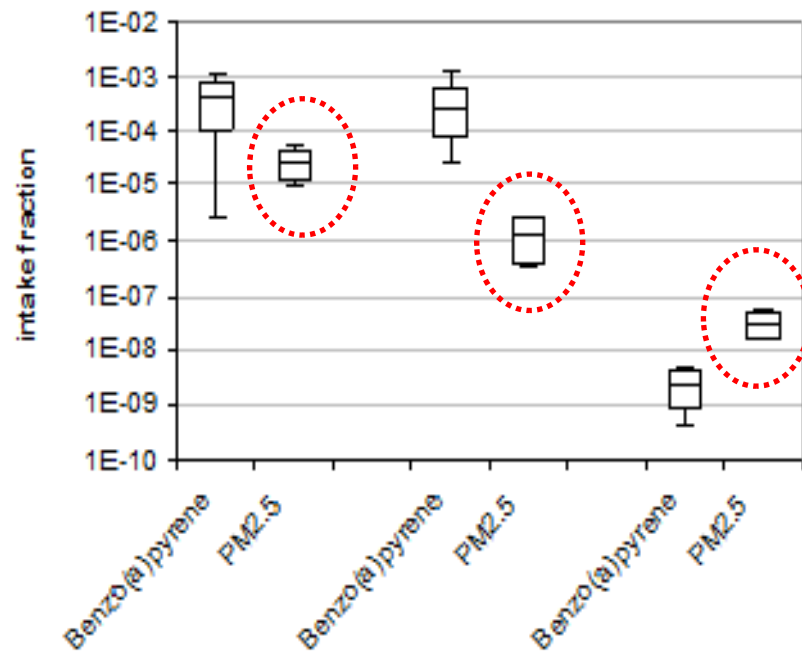
Importance of the urban box



iF classified by archetypes

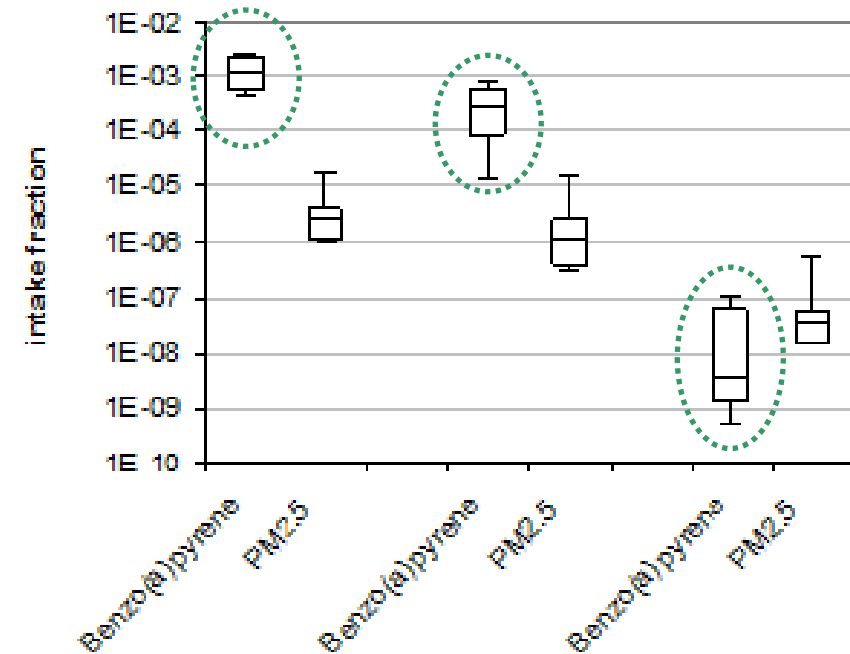
(a) Emission in the different archetypes

Population density
Urban Rural Remote

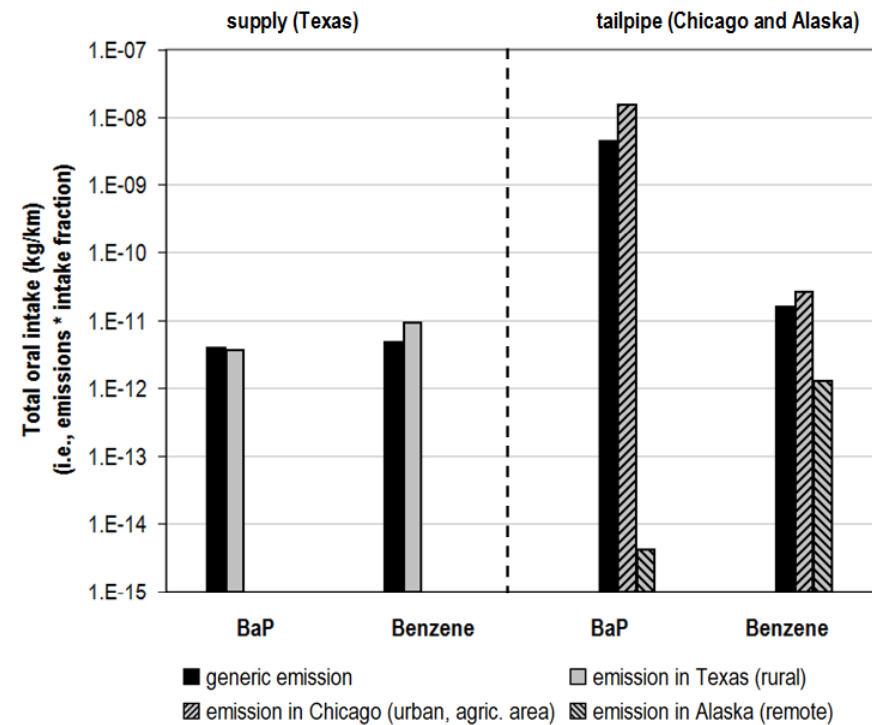
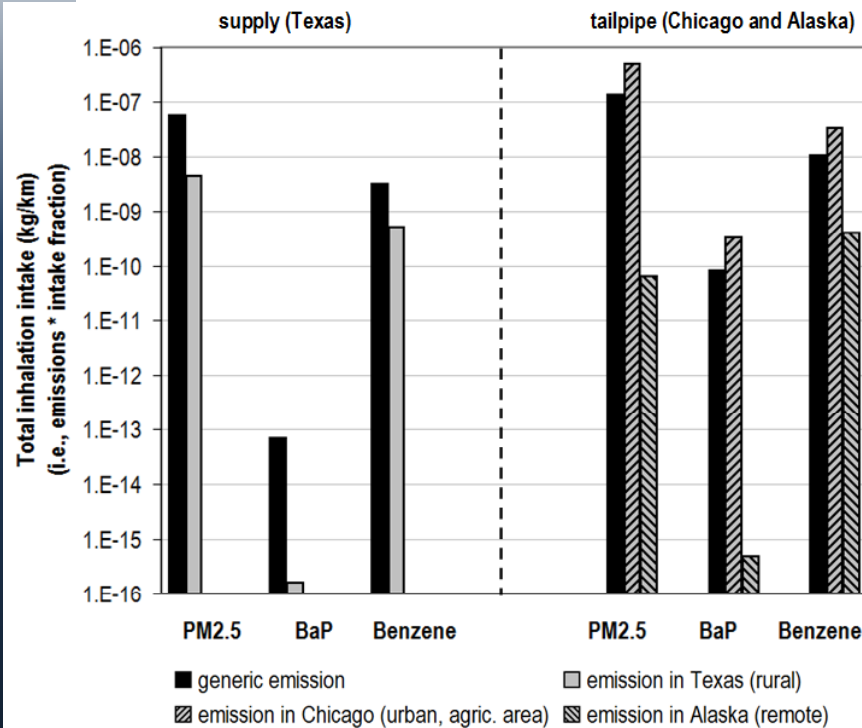


(b) Emission in the different archetypes

Agricultural production intensity
High agr. (> 100 tkm²) Low agr. (1-100 tkm²) Non agr. (< 1 tkm²)



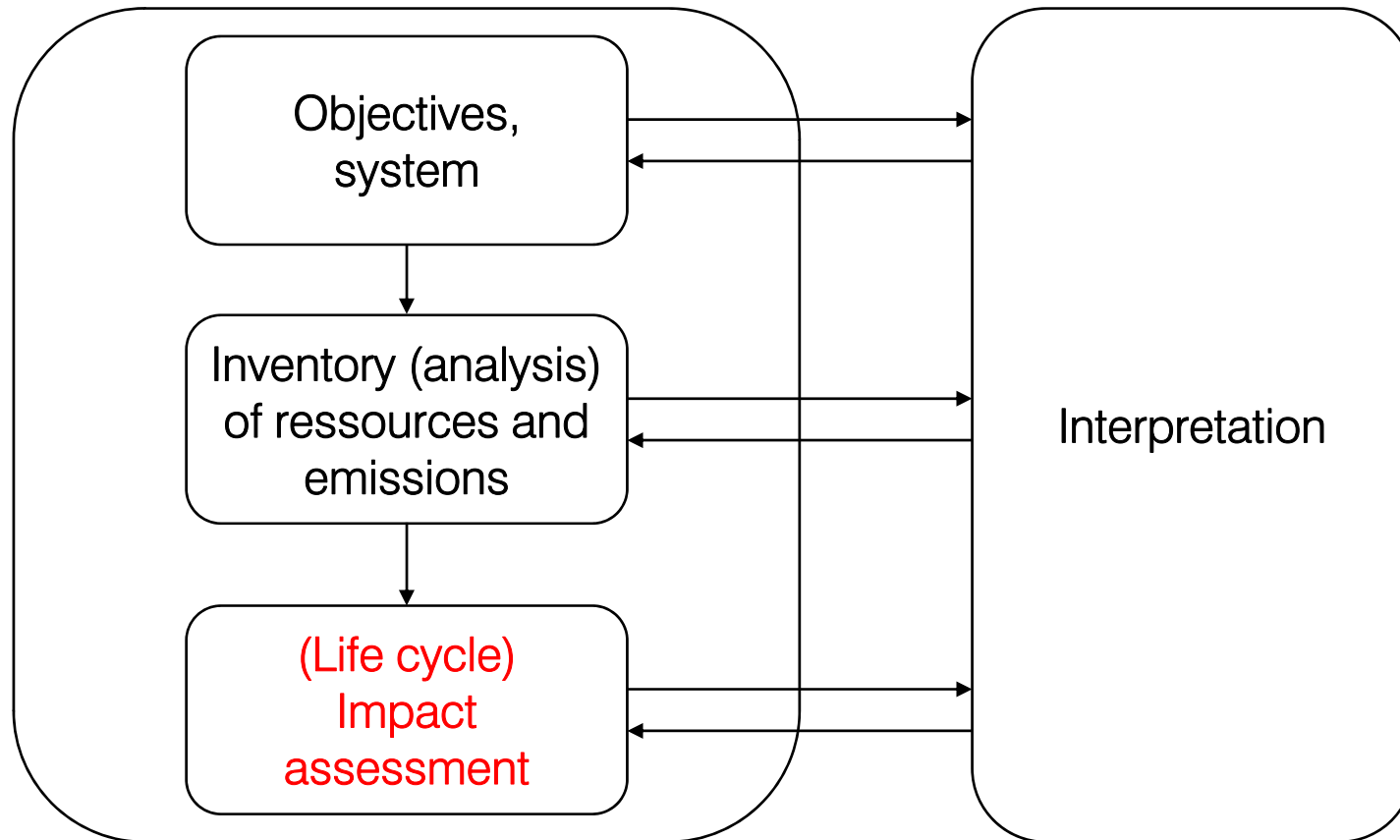
Case study: *a car driving in Chicago or in Alaska*





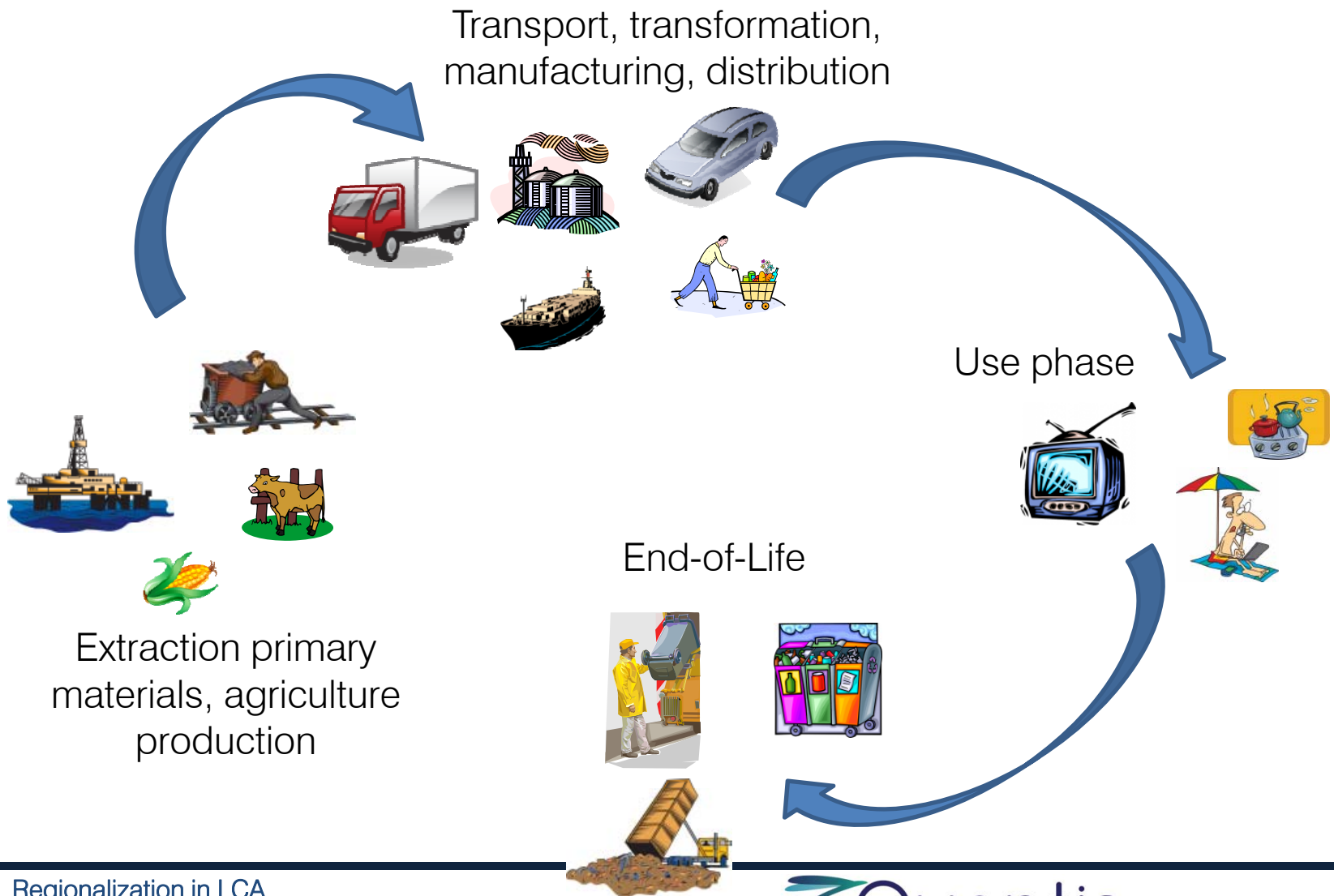
Supporting info of LCA

Life Cycle Assessment (LCA)



Though inventory can be the same between 2 alternatives, the actual impacts can be different!

The Life Cycle Approach



The life cycle perspective (life cycle stages and impacts)

