MuSA Project

Integrating Multiple Scale Impact Assessment on Ecosystems for Contaminated Land Management

-Integrating LCA and EcoRA in a one decision support tool?

- Assessing impact at different time and space scale?

- Applying the method to a Case Study

-MuSA is partly funded by the ERA-NET SNOWMAN

Researches

- Comparison between ERA and LCA for impact on ecosystems

- Improving the modeling of the bioavailability and mobility of metals in soils

- Identifying data needed at the interface between LCA and ERA (media characterisation, biodiversity…)

- Case study: Ronde Venen

Life Cycle Assessment (LCA)

“From the Cradle to the Grave”

Standard ISO 14040:

1-Scope and Goal Definition

2- Life Cycle Inventory

3- Life Cycle Impact Assessment

4 - Interpretation

Impact Indicator

Energy; Global warming; Human Health; Biodiversity

Case study Ronden Venen

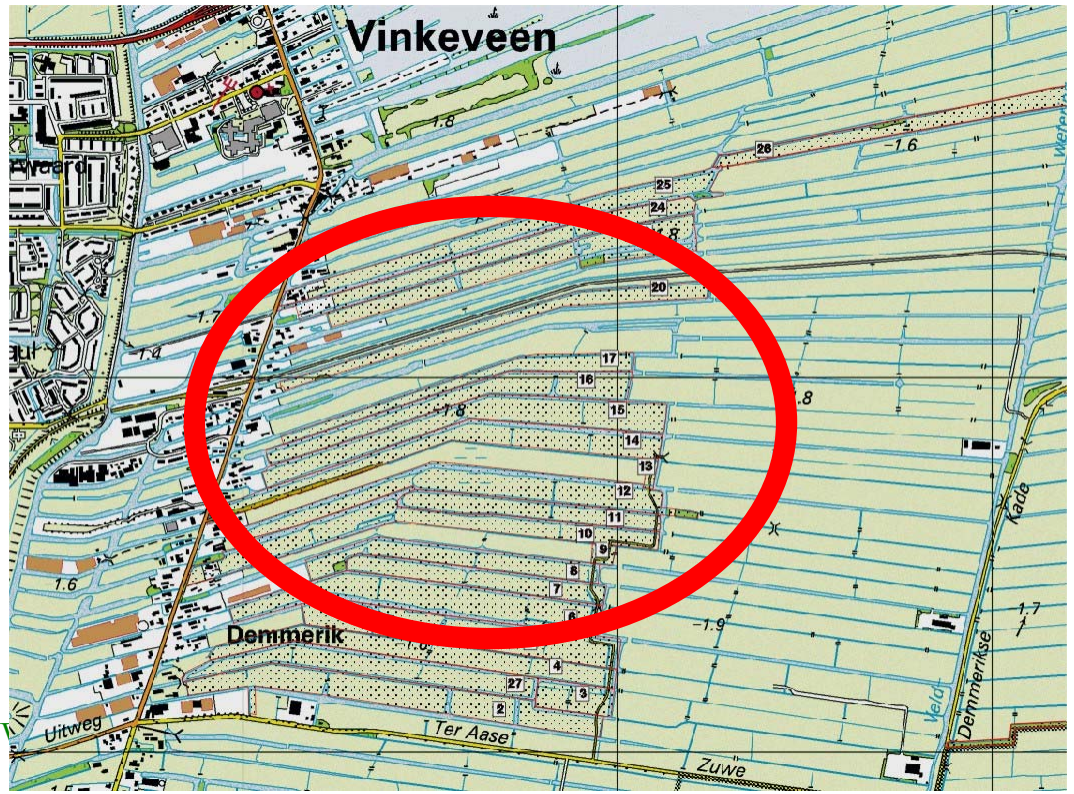
Application of LCA to a contaminated site

Functional unit:

- the cleaning (decontamination) of one field of Ronde Venen, contaminated by heavy metals (Cd, Cu, Pb, Zn).

Three selected scenarios:

1) Phytoremediation
2) Excavation & thermal treatment
3) No intervention



Estimation of impacts of different scenarios

LCA methodology derives the impact due to emissions.

Assumption:

Soil is a pollutant reservoir that emits metals during time

Impact categories:

- Impact on human health
- Toxic impact on water
- Climate Change & Resources

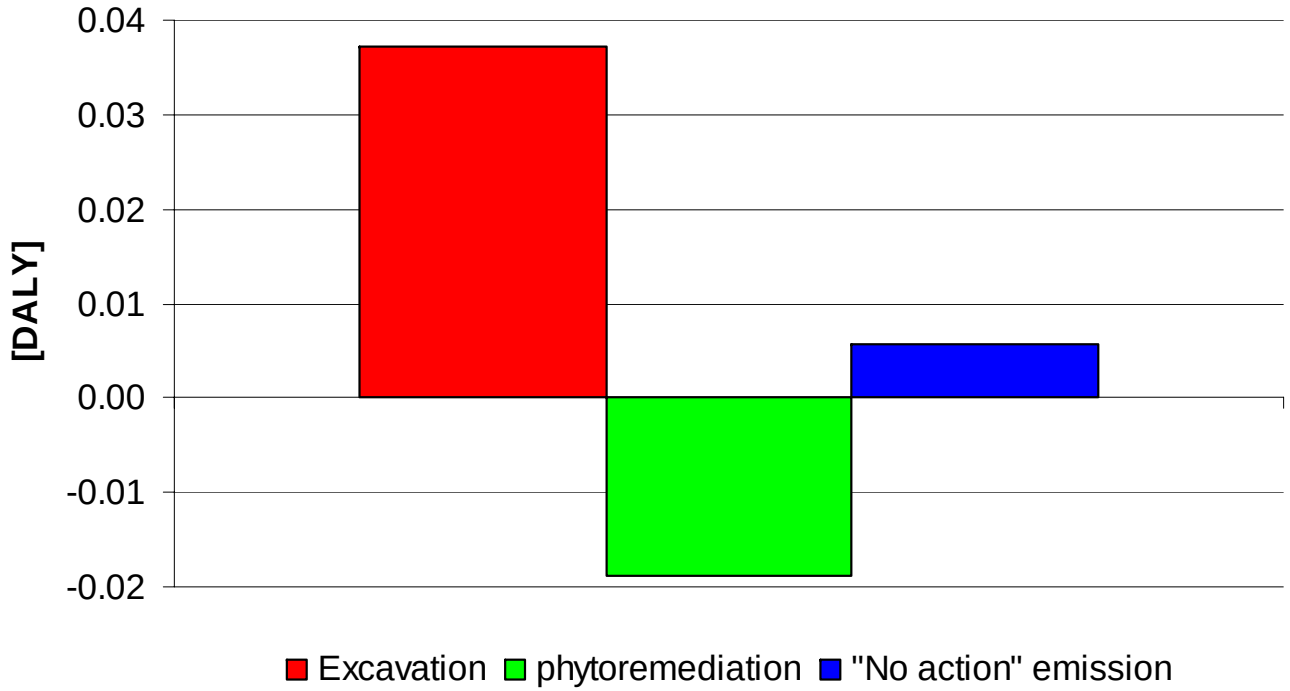
Information needed:

- Soil sequential extraction
- Metal porewater concentration
- Local site characteristics

Scenarios:

1) Phytoremediation with reed plants
2) Excavation and thermal treatment of the soil
3) No intervention

Impact on human health

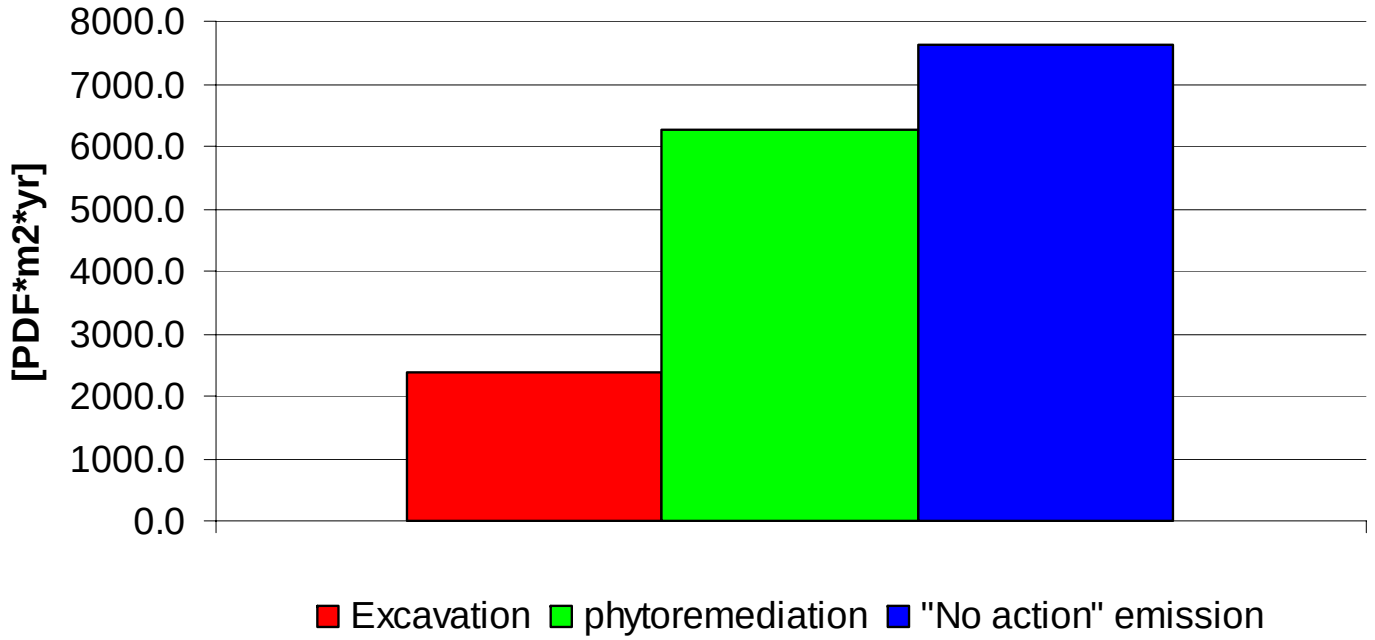


Categories contributing the most to the impact:

- emission of non-carcinogens (*phytoremediation, no action*)

- emission of inorganic substances influencing respiration (NO_x, PM2.5, dioxins, SO_2) (*excavation*)

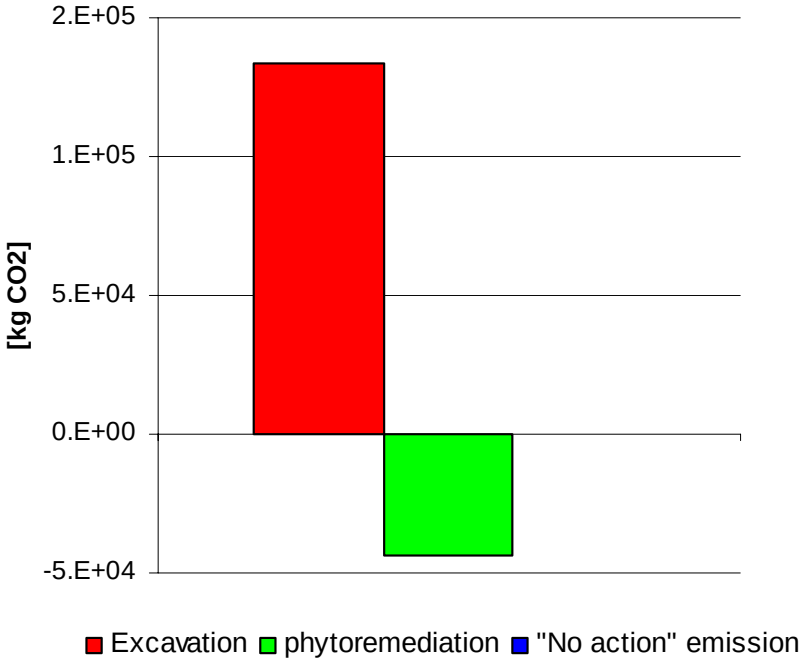
Toxic impact on water

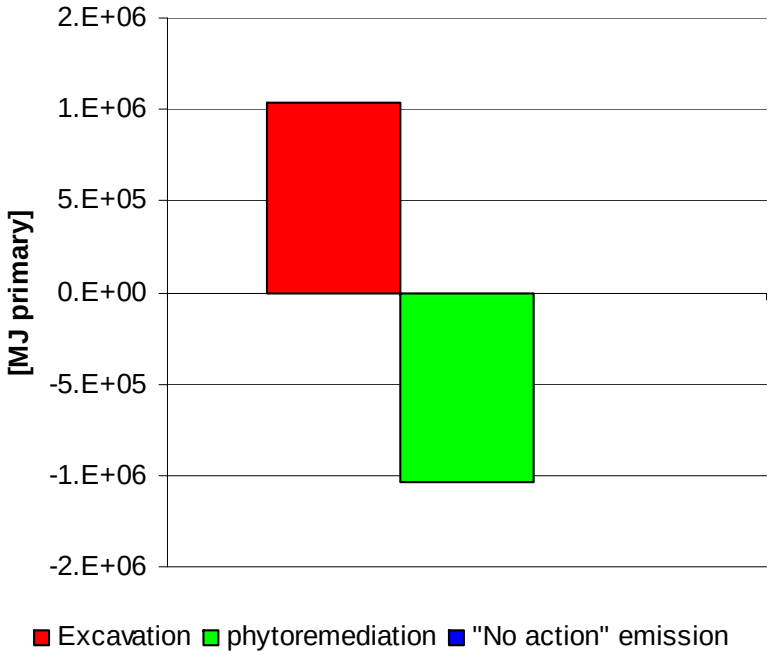


Categories contributing the most to the impact:

Aquatic ecotoxicity for the three scenarios

Climate Change & Resources





- Excavation has the biggest impact on climate change and resources consumption

First conclusions

- Phytoremediation interesting with energy cogeneration

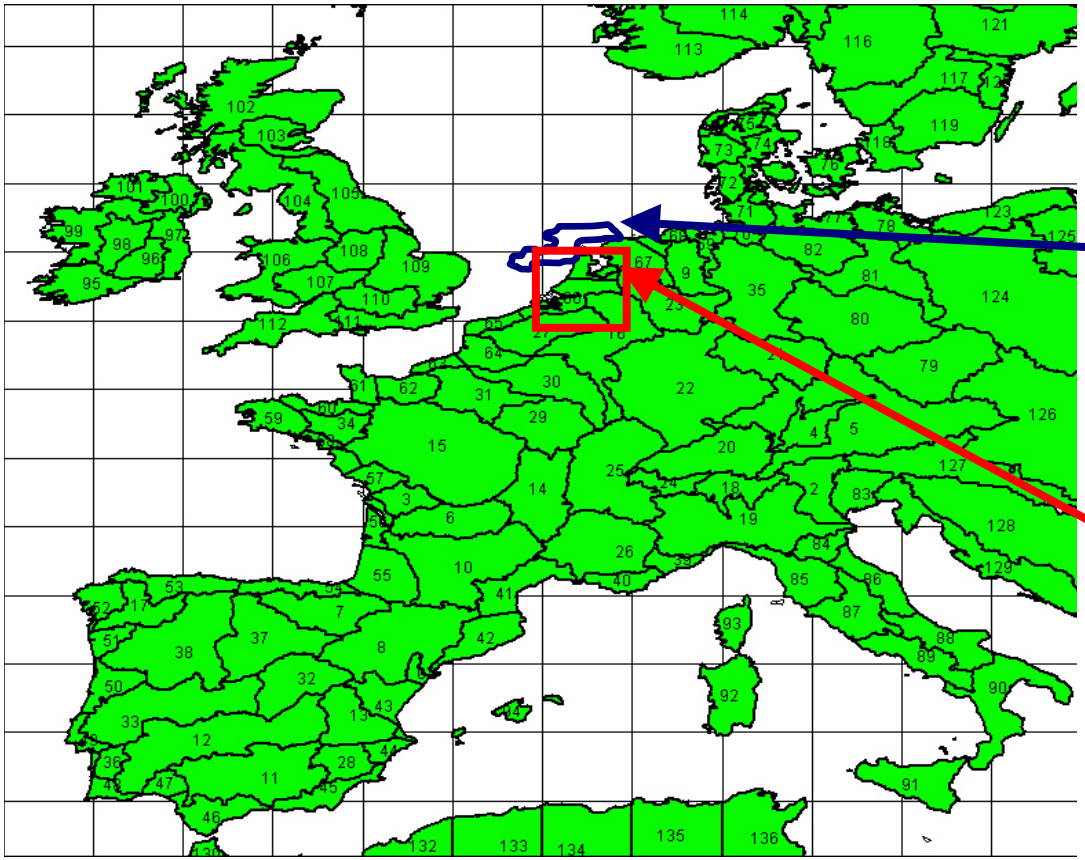
- Excavation has the greatest impact on human health, but « no intervention » is very negative for water environment.

Identification of the categories of concern:

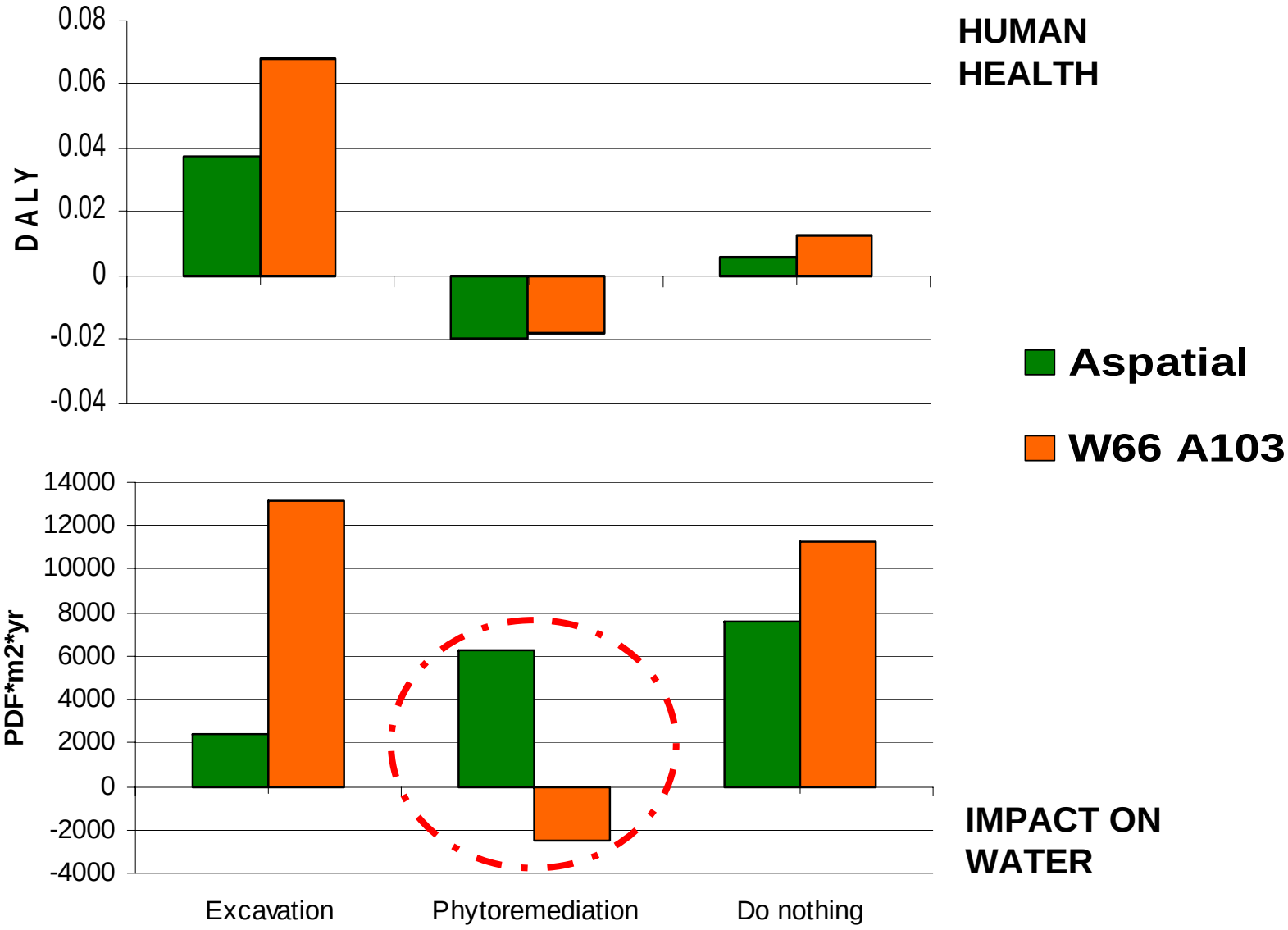
- non-carcinogen substances
- inorganics affecting respiration
- aquatic ecotoxicity

Regionalisation: would it change the results?

Regionalisation of the impact (IMPACT2002)



Aspatial vs. Regionalised



Regionalised Impact

- Impact on human health ↗

Increase due to the increase of the impact of non-carcinogen substances, and the high population density.
Inorganics affecting respiration become less important compared to non-carcinogens!

- Impact on water ↗ (not for phytoremediation)

Aluminium contributes the most for aquatic ecotoxicity, more than copper and cobalt that were responsible in the global model.
Phytoremediation: cogeneration environmental value is more important, the total impact is thus smaller

Conclusions of the Case Study

- Regionalisation of the impact changes can change the priority of categories.

- Time scale is a factor that has to be taken into account while analysing the scenarios. It helps prioritising the different management actions.
- A site scale assessment can be achieved with local parameters

MuSA Workshop

22-23 September 2008 Amsterdam

Integration of LCA and ERA for Contaminated site management:

Current Status and perspectives

- State of the Art
- Research needs
- Aim towards the future

36 participants, from 16 countries

www.setemip-env.eu

LCA and ERA for contaminated sites

LCA

Functional Unit: 1 cubic meter of soil remediated

3 scénarios (or more)

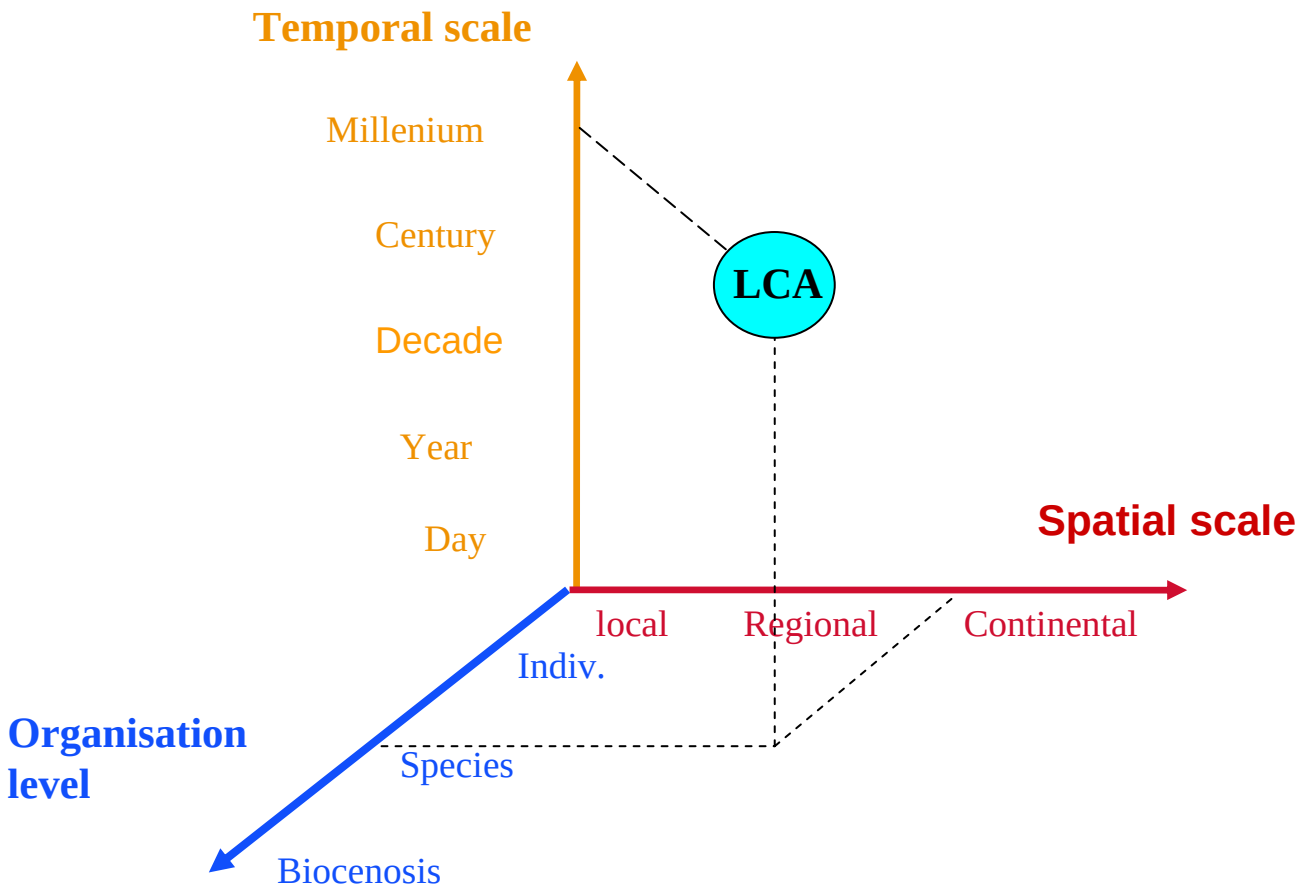
Scénario 1: Impact of the site itself without any treatment
Scénario 2: Impact of the treatment A (e.g. in-situ)
Scénario 3: Impact of the treatment B (e.g. ex-situ)

Sc3>Sc2>Sc1

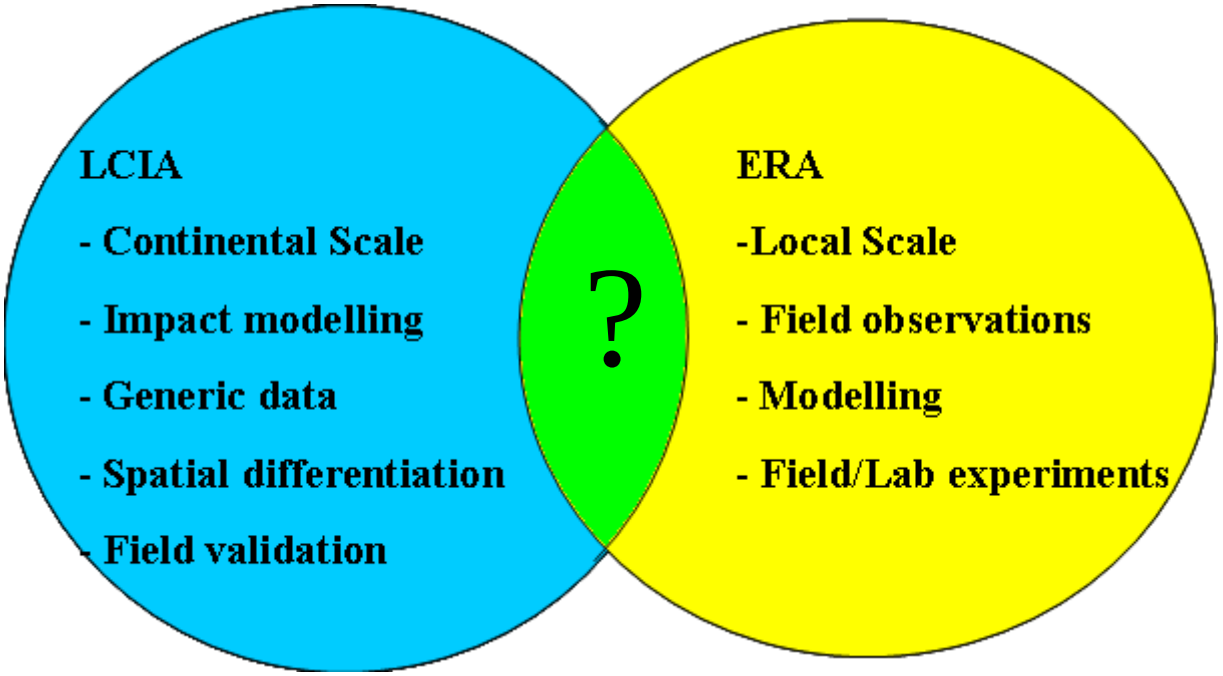
ERA

Sc1>threshold then Sc2 or Sc3

Specificities of LCA and ERA for Contaminated site management



Integration of LCA and ERA for Contaminated site management



- LCA & ERA now tend to overlap for some case studies
- Are the two approaches coherent and complementary?

Reasons of divergence between tools

Input data : Mainly laboratory data or theoretical data for impact assessment on Ecosystems in LCA (fate and effect) …

Model skills: Steady state, integration over time, average over space, linear models, relative impact…

Output data : Unit used to express the impact differs between tools …

Limitations for LCA for contaminated sites

System boundaries: the site is considered as a pollutant reservoir without ecological value

Spatial differentiation: numbers of soil parameters increases at regional and local scales, intermedia transfer

Time scale: Dynamic modelling or several time scale assessment

Biodiversity: Multiple stressors, level of biological organisation, Measure Unit for biodiv.

Ecotox measures : laboratory tests, bioindicators …

Metals/salts: Bioavailability and mobility largely influenced by local parameters

Thank You

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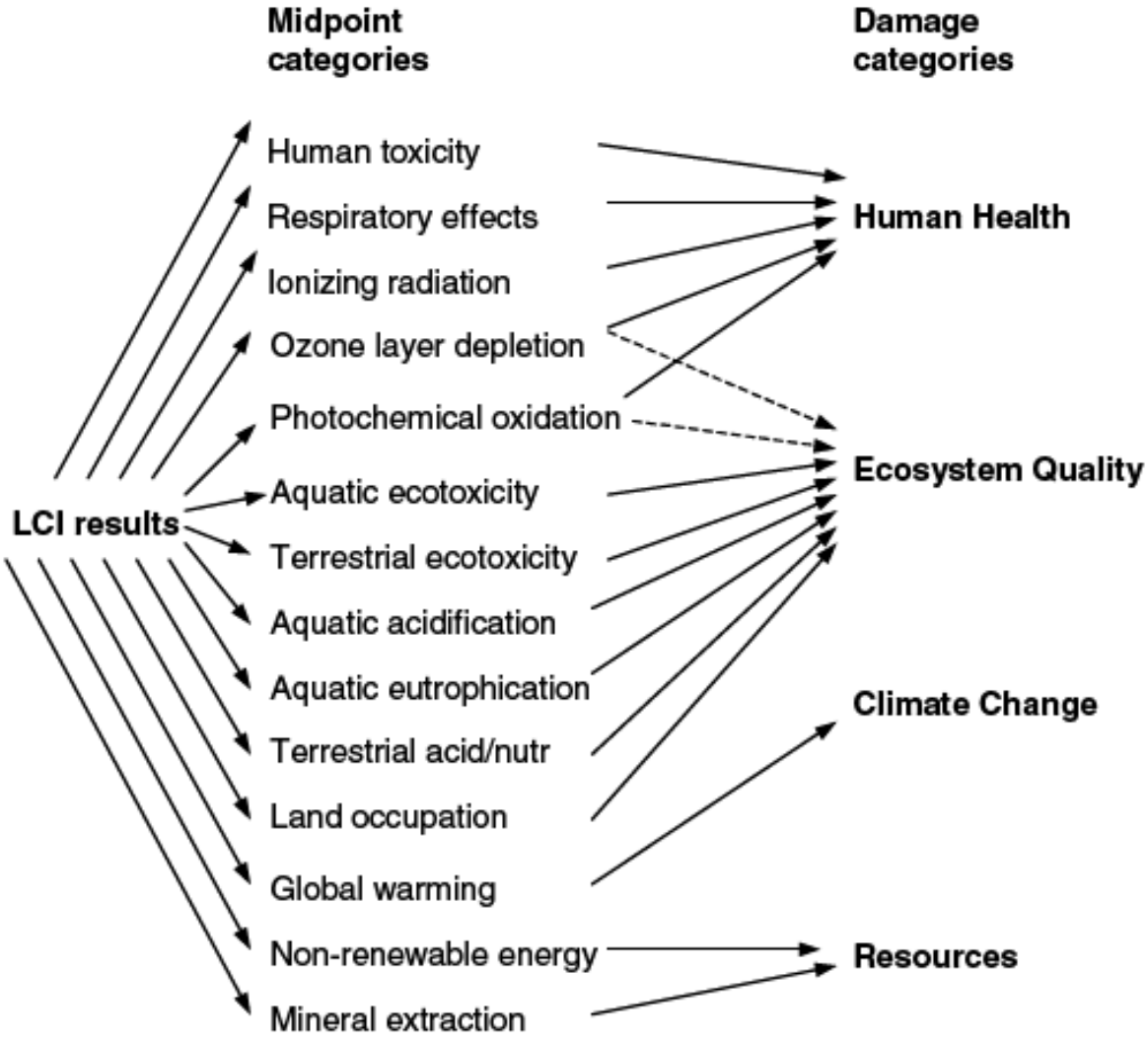
LCA method: IMPACT2002+



(Joillet et al. 2003)

LCA units (IMPACT2002)

Damage units

HUMAN HEALTH: DALY = « Disability Adjusted Life Years »

IMPACT ON ECOSYSTEMS: PDF·m2·yr = « Potentially Disappeared Fraction of species over 1 m2 during 1 year »

CLIMATE CHANGE: Kg CO2 = contribution to global warming

RESOURCES: Primary MJ = Primary energy consumed

Biodiversity unit

- Biodiversity indicator such as the HC50 (LCIA)
- Index of living species (WWF)
- Red list of species (UICN)
- Genetic diversity (DNA barcoding)
- Addressing ecological functions of the ecosystem