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Toward an improvement of the environmental assessment of Alternative Materials for road construction

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The context

90's: growing demand for using Alternative Materials

→ **Clarifying the environmental relevance**

Can the Road Soil prevent the spread of heavy metals ?

In France: some field experiments

- Back analysis
- Capacity of retention
- Stability of fixing
- Acceptability

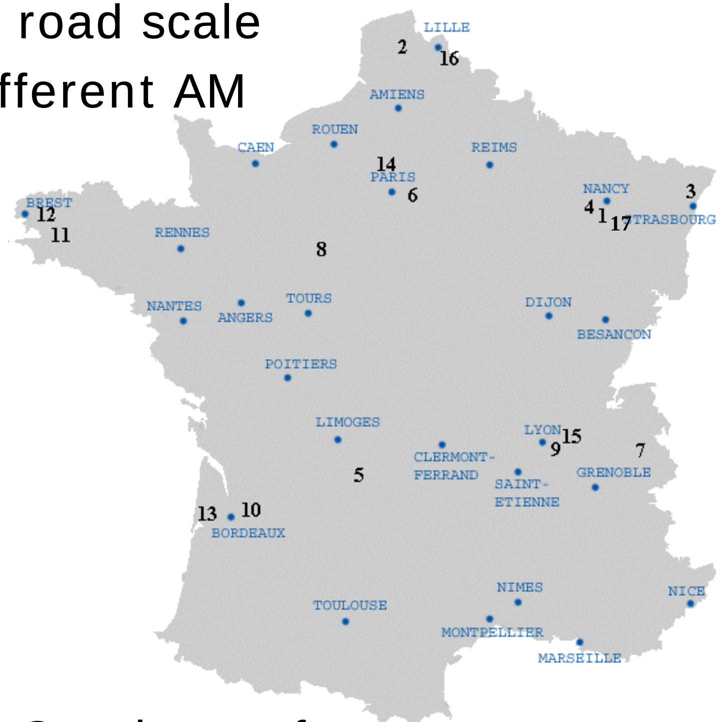
→ **An assessment method for Road Soils**

Back analysis of Alternative Materials in roads

Objectives

To analyse practices of study for testing at road scale

To derive rules of behaviour and use for different AM



Results

Strong concern about MSWI bottom ash:

12 **C**ase **S**tudies + 5 others AM

15 **CS** with environmental aim

Varied alternative materials / structures / layers

Problem of scaling: Laboratory prediction / On-site performance

Difficult comparisons: inter-material & inter-site (use scenarios)

→ To harmonize practices of study: Methods and Criteria

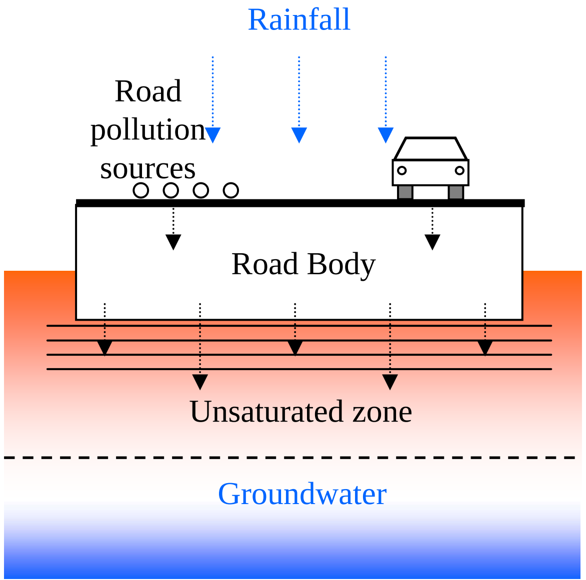
Schema for environmental assessment

From the Eco-compatibility approach (ADEME)

« when pollutant fluxes released by wastes [...] are compatible with those that are acceptable for receiving environments of the site »

Eco-comp.	Source	Flux	Transport	Flux	Impact on aquatic (F_{CA}) or terrestrial environments (F_{CB})
Road scenario	**AM**	F_S	into the Road Body	F_T	**Road Soil**

… considering specificities of the Road scenario



Other pollution sources: chronic, seasonal, accidental

RS: poor in clay and organic material, compacted

→ Diagnosis on old sites

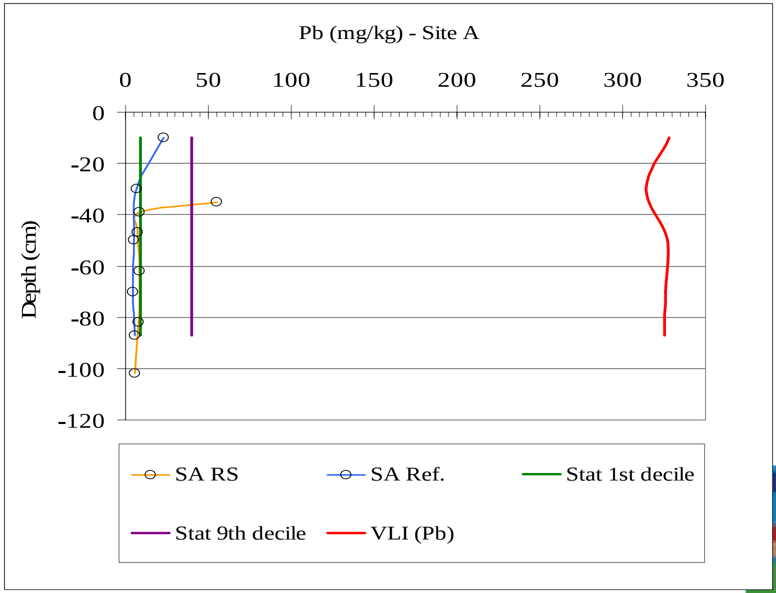
On-site diagnosis

MSWI residue (bottom and fly ash) < year 1991

Site A: 22-year old - Site B: 20-year old – Subbases

Results for Road Soils:

Heavy **M**etals contents (Cd; Cu; Ni; Pb; Zn) decrease from contact with AM to deeper levels



Comparisons with reference values:

Intervention Limit Values (NL-Soil Protection Act):

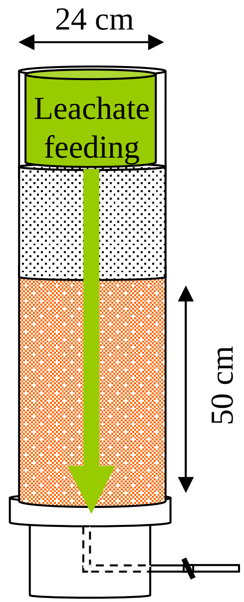
[RS] = 5 to 82% of C-ILVs; 24 % on average

Statistics on similar ordinary soils (France-INRA):

75% of **[RS]** < 9^{th} decile of contents

→ **Dynamic of fixing and Stability at longer term ?**

Laboratory simulations in columns



RS: Long-term pollution barrier toward migration ?

Source: Fresh production MSWI bottom ash (Cr; Cu; Pb; Zn)

Different RS tested : 50-cm thick subbases

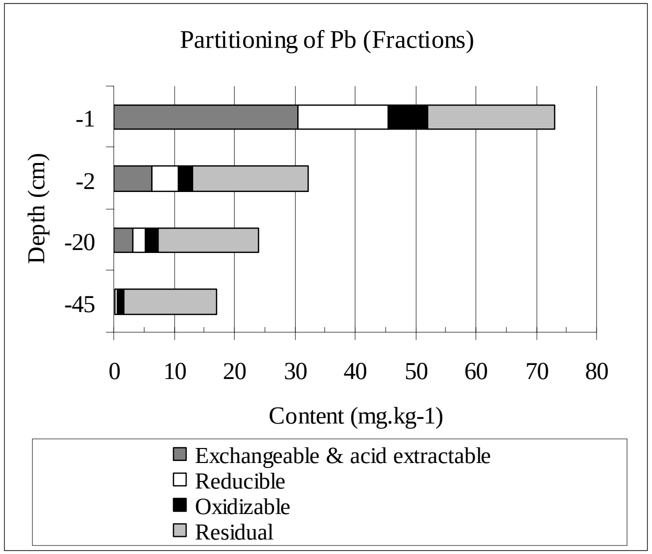
Unsaturated conditions

Final L/S ratios (l/kg)	0.34	2.75	5.50
« On-site time » (year)	1	10	20

Final contents:

No increase below –5 cm : Consistent with site observations

Higher increase when higher L/S



BCR protocol Partitioning results:

1^{st} cm: more than 50% of the **HM** content not easily exchangeable

Exchangeable fraction decreases fast from 1^{st} to 2^{nd} cm

Lessons from comparisons to reference values

Normative approach:

→ Detail on the Effect induced by the alternative material ?

Statistical approach:

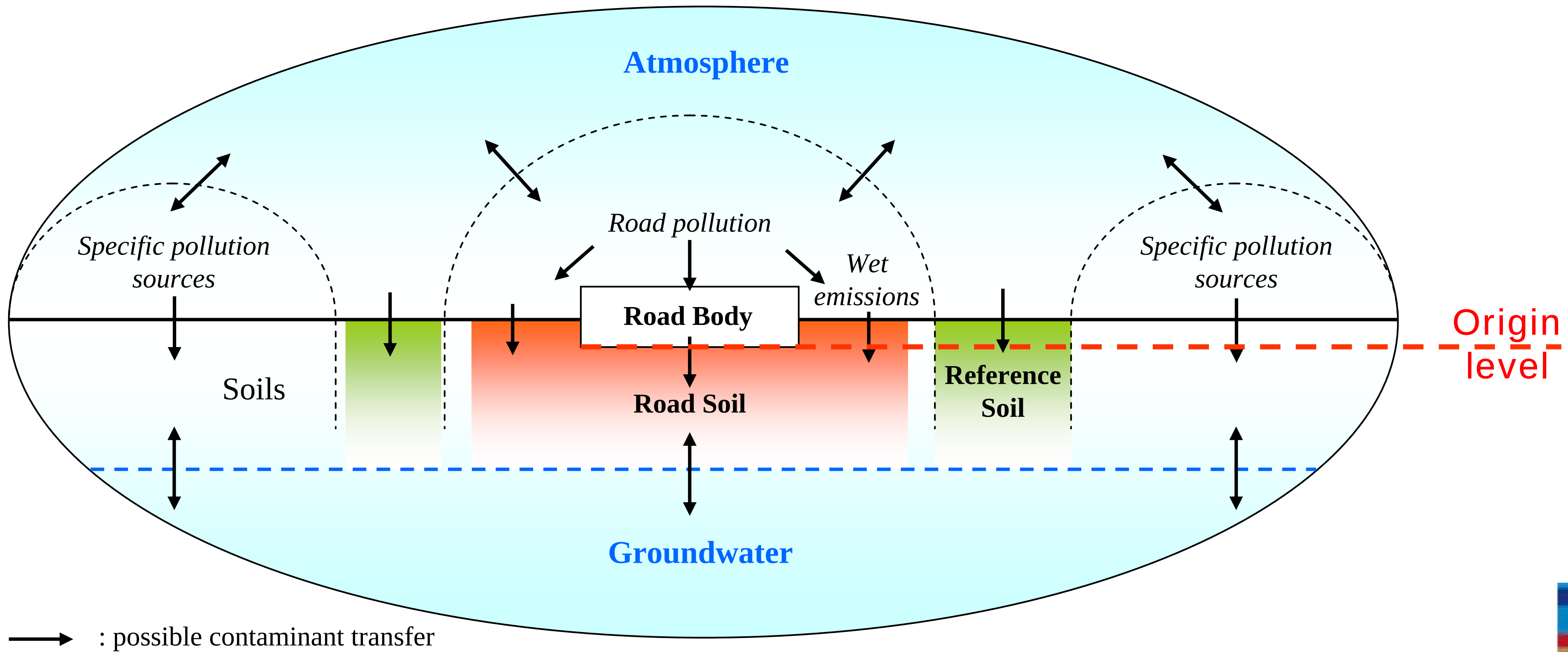
→ Specificities of RS (clay, organic matter, compaction)

→ A tool suitable for RS, allowing:

- to highlight **Effects** specifically induced by the AM application in an open environment
- **Comparisons** between alternative materials; application layers; different structures; different natures of RS

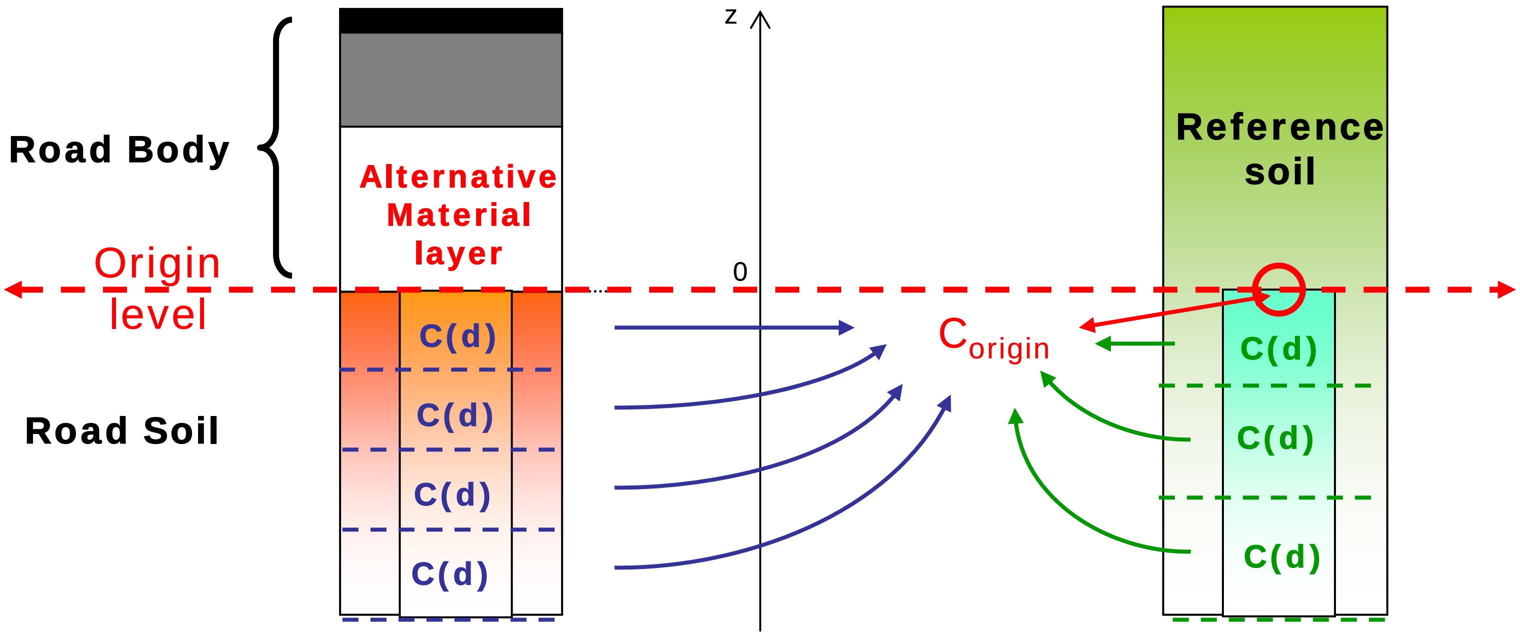
A specific assessment method: The road system

Positioning of the Reference soil, Definition of the Origin level



A specific assessment method: Indicators

Definition of C_{origin} and Road Effect formula



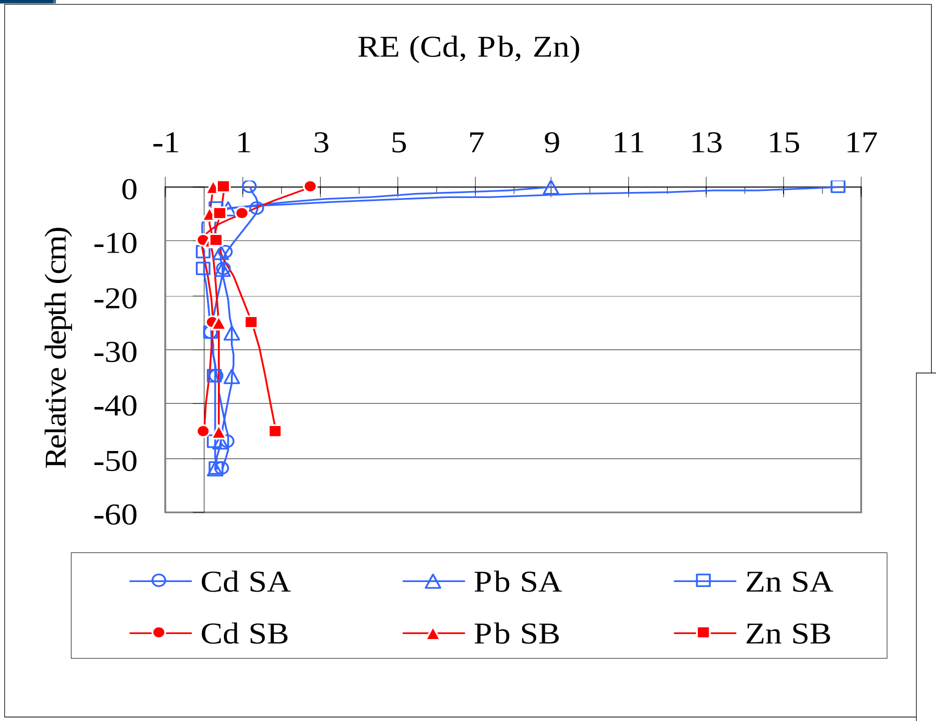
Soil Indicator (Ø): $IS(d) = (C(d) - C_{origin}) / C_{origin}$

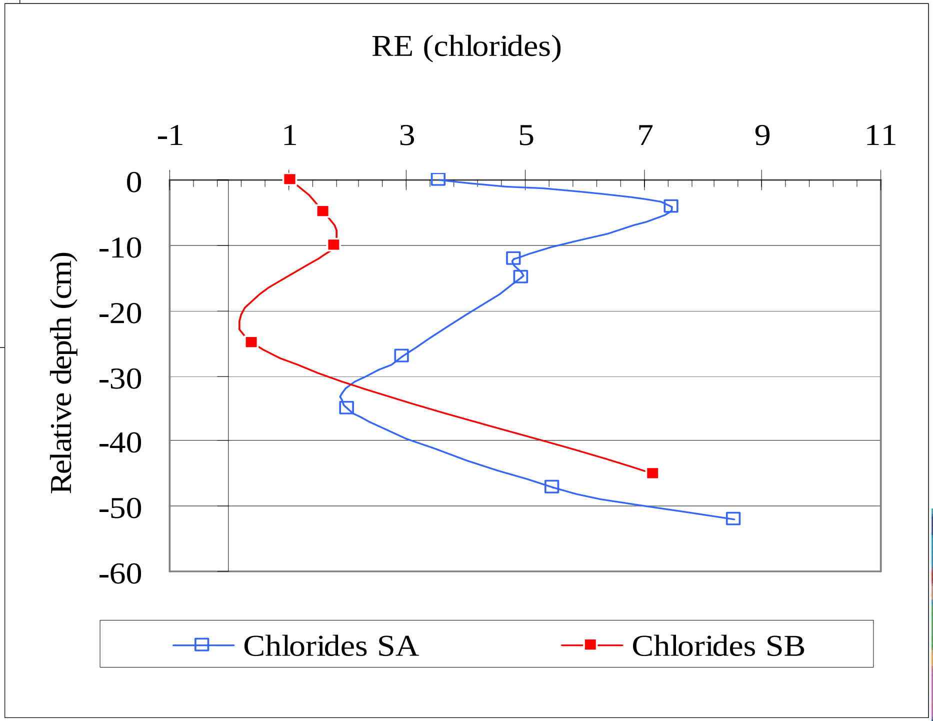
$-1 \leq IS(d) < +\infty$ $\qquad$ $IS_{Ref}(0) = 0$

Road Effect (Ø): $RE(d) = IS_{RS}(d) - IS_{Ref}(d)$

$-1 \leq RE(d) < +\infty$

A specific assessment method: Illustrations





Conclusion

Road Soil: un-addressed target until now

- Capacity to serve as a chemical barrier toward downstream targets
    - Prevention of pollutant dispersion
- Stability of fixing until medium-term
    - To be studied for longer term
- Acceptable content increase on-site

RE indicator: appraisal of the relative effect of the whole road structure

- Takes the local context into account (Reference Soil)
- Allows comparisons between sites, chemicals and materials
- → Calibration with regard to classical materials is necessary