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(RISK) MANAGEMENT OF EMERGING POLLUTANTS IN SOIL

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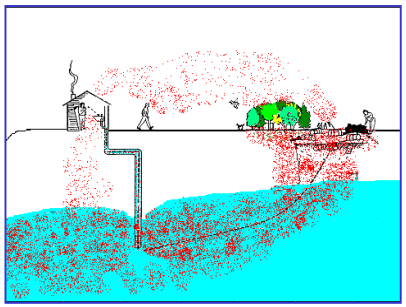
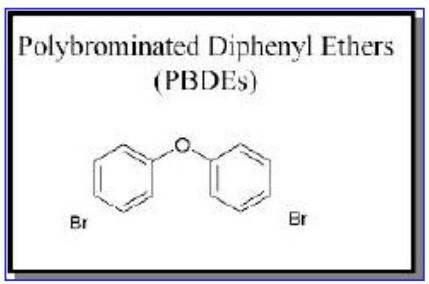
Presentation index:



- Risk based management of contaminants in soil

- The HERACLES research framework

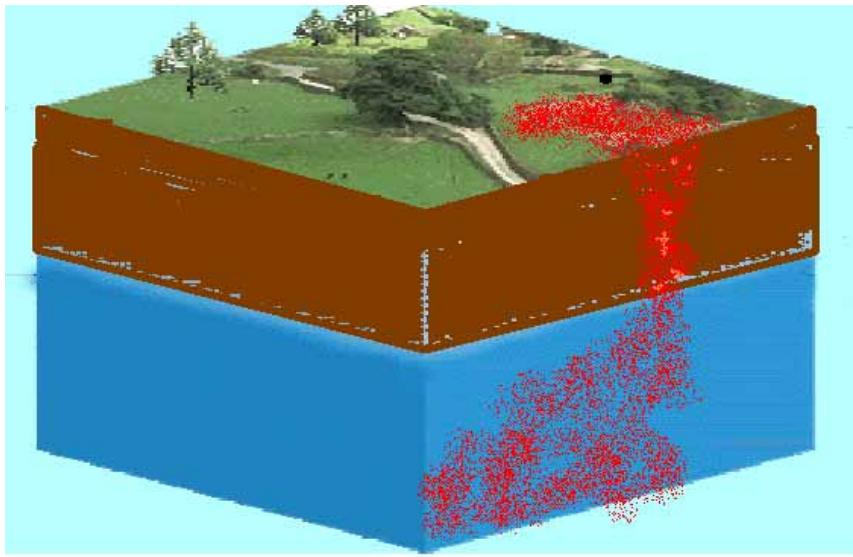


- Moving targets: towards emerging pollutants

RISK BASED MANAGEMENT OF CONTAMINATED LAND

Land

a geographical area* (single site, region, etc.), including *soil, groundwater* beneath the surface of the land and *surface water



Spatial dimension

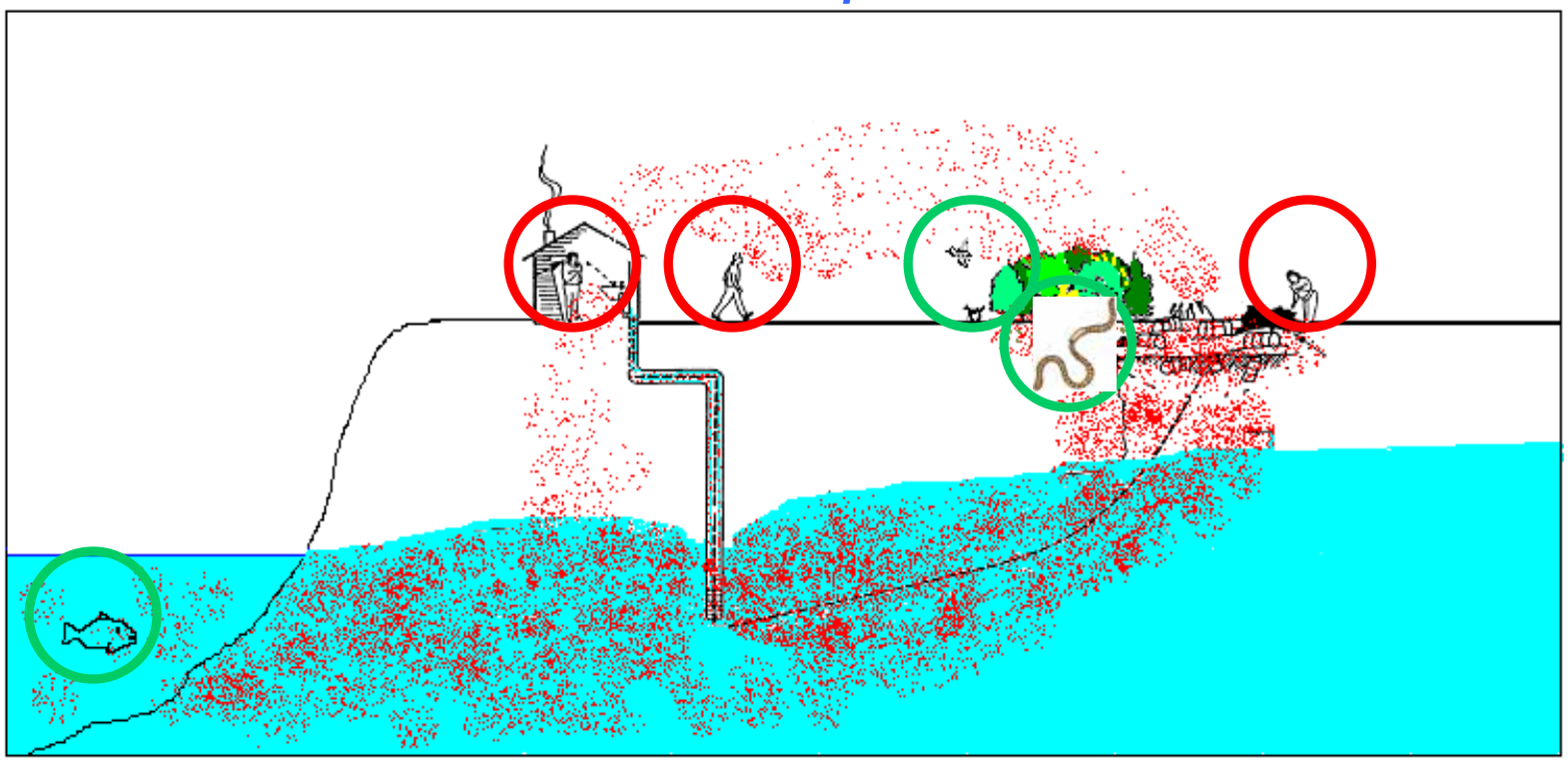
- ✓ ***Local and diffuse contamination***
- ✓ ***Management is driven by "fitness for use"***

Temporal dimension

- ✓ ***Historic contamination and future contamination***
- ✓ ***Long term care objectives in consideration of mobility and natural attenuation***

Integration of approaches to human and ecological receptors, soil, groundwater and surface water

***Contaminated land*: ...with confirmed presence of "dangerous substances" causes by man in such a level that they may *pose a risk to a receptor*...**



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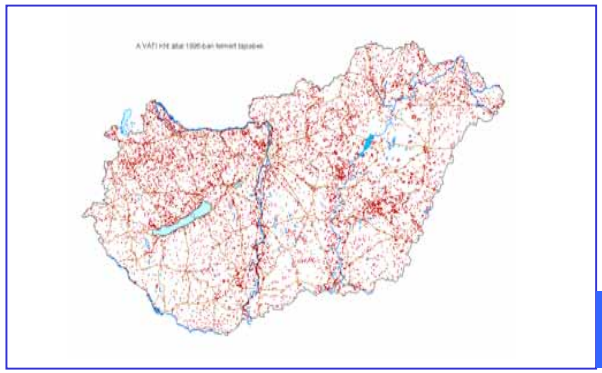
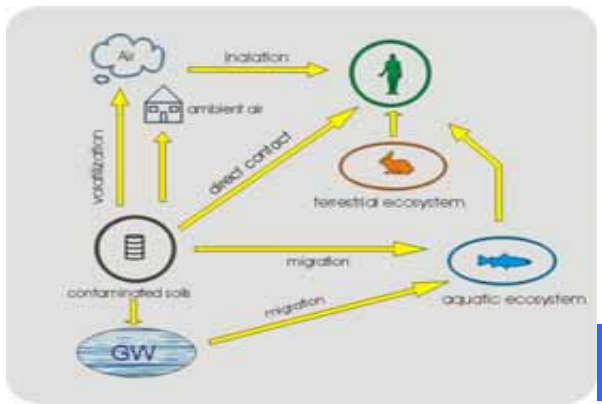
Risk Assessment: three levels



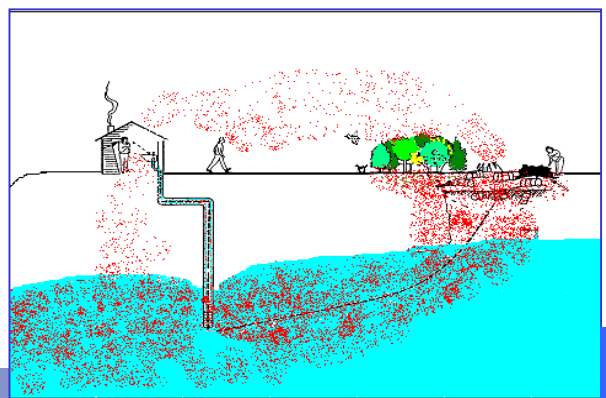
Relative Risk Assessment **aims at identifying priority risk sources in order to support environmental policies at regional scale.**

qualitative model, site specific scenario



Screening Risk Assessment **aims at providing (EU or national) regulatory threshold values**

quantitative model, standard scenario



Site Specific Risk Assessment **aims at providing site specific risk estimations (and threshold values)**

quantitative model, site specific scenario

Regulatory threshold values for soil in Europe

provided thresholds varies from 30 to 290 chemicals, most common are:

- ***heavy metals***
- ***cyanides***
- ***monocyclic aromatic hydrocarbons (BTEX) and phenols***
- ***aromatic and aliphatic chlorinated solvents***
- ***polyciclic aromatic hydrocarbons (17 PAHs)***
- ***dioxins and PCBs***
- ***pesticides (most conventional)***

Regulatory role: varies, from trigger values to remediation targets

Land use based: always (one exception)

Background values: not always considered

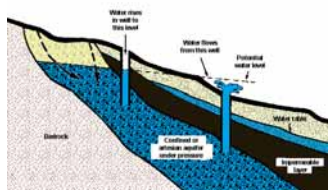
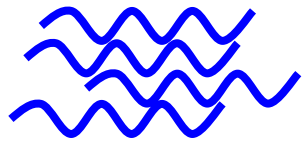
Function of soil properties: often

Mixtures effects: never properly considered

Regulatory threshold values for soil in Europe

Protected receptors



	Human health	Terrestrial Ecosystem	Groundwater drinking	Surface Water
Austria				
Belgium (F&W)				
Czech Rep.				
Denmark				
Germany				
Finland				
Italy				
Lithuania				
Netherlands				
Poland				
Spain				
Sweden				
UK				

Exposure to non soil-related sources

Considered in Flanders, Germany, Spain, Sweden and UK

Reduction of TDI due to non soil related exposure, e.g. diet, air and water, e.g.:

- **80% of non carcinogens in Germany from food and drinking water**
- **Proportion of exposure allocated to contaminated soil in Spain (table below)**

Chemical group	Proportion soil exposure
Pesticides	0.05
Organochorinated compounds	0.20
Polycyclic Aromatic Hydrocarbons	0.05
Monocyclic Aromatic Hydrocarbons	0.10

Toxicological and ecotoxicological values

Which data sources?

may differ up to a factor 10 or more

Human health

✓ ***WHO-IPCS; US-EPA-IRIS; IARC; ATSDR; RIVM reports, in some cases national databases or Committee***

Ecological risk

✓ **US-EPA ECO-TOX databases, RIVM e-TOX, RARs**

✓ **other national databases**

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Soil Screening Risk Assessment
National Regulatory Thresholds

Differences in basic assumptions, models and input values. Large differences in threshold values as a consequence. Some related to geographical, social, cultural and regulatory conditions. Others are not supported by robust reasons

mg/kg d.w.	AUT	BEL(F)	BEL(W)	CZH	FIN	DEU	ITA	LIT	NOR	NDL	POL	SWE	USA	max	min
Arsenic	50	110	300	70	50	50	20	10	2	55	20 - 55	15	22	300	2
Cadmium	10	6	30	20	10	20	2	3	3	12	4 - 10	0.002	37	37	0.002
Cromium (total)	250	300	520	500	200	400	150	100	25	380	150 - 380	120	100000	100000	25
Copper	600	400	290	600	150		_	100	100	190	100 - 200	100	3100	3100	100
Mercury	10	15	56	10	1	20	1	1.5	1	10	2 - 10	1	23	56	1
Lead	500	700	700	300	200	400	100	100	60	530	100 - 200	80	400	700	60
Nickel	140	470	300	250	100	140	150	75	50	210	50 - 210	35	1600	1600	35
Zinc	-	1000	710	2500	250	-	-	300	100	720	300 - 720	350		2500	100
Trichloroethylene		1.4				-	1		-	60	0.01 - 10	5	5	60	1
Benzene		0.5	0.4	2	0.2	-	0.1	0.5	-	1	0.1 - 50	-	0.08	2	0.2
Benzo(a)pyrene	5	0.5	4.4	0.8	2	4	0.1	0.1	-	*	0.03 - 40	-	0.09	5	0.1

(*) Total PAH : 40

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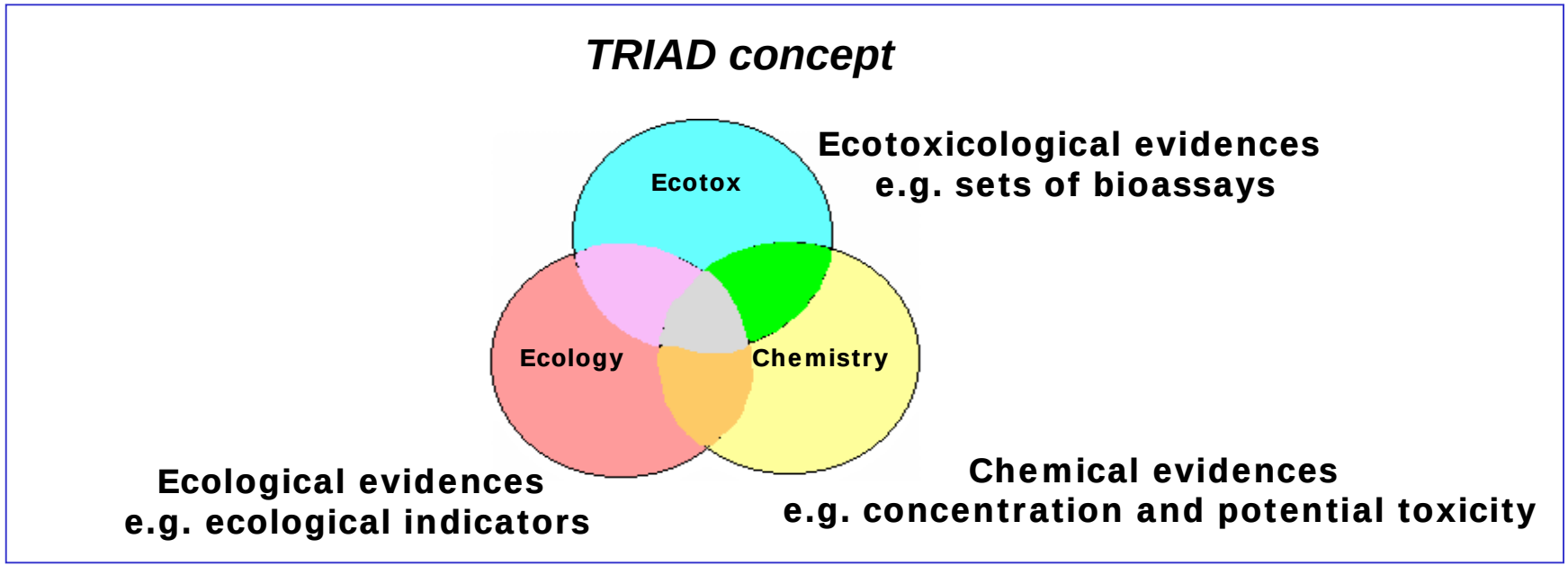
Site specific risk assessment e.g. ecological



In the site specific ecological risk assessment (SS-ERA) combination of chemical, ecotoxicological and ecological evidences

But, how to deal with "evidences"in decision making?

However, SS-ERA is still limited to the research field, no standardisation and poor application

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HERACLES

research framework

towards the development of common references

for Human health and Ecological Risk Assessment

of Contaminated Land in Europe

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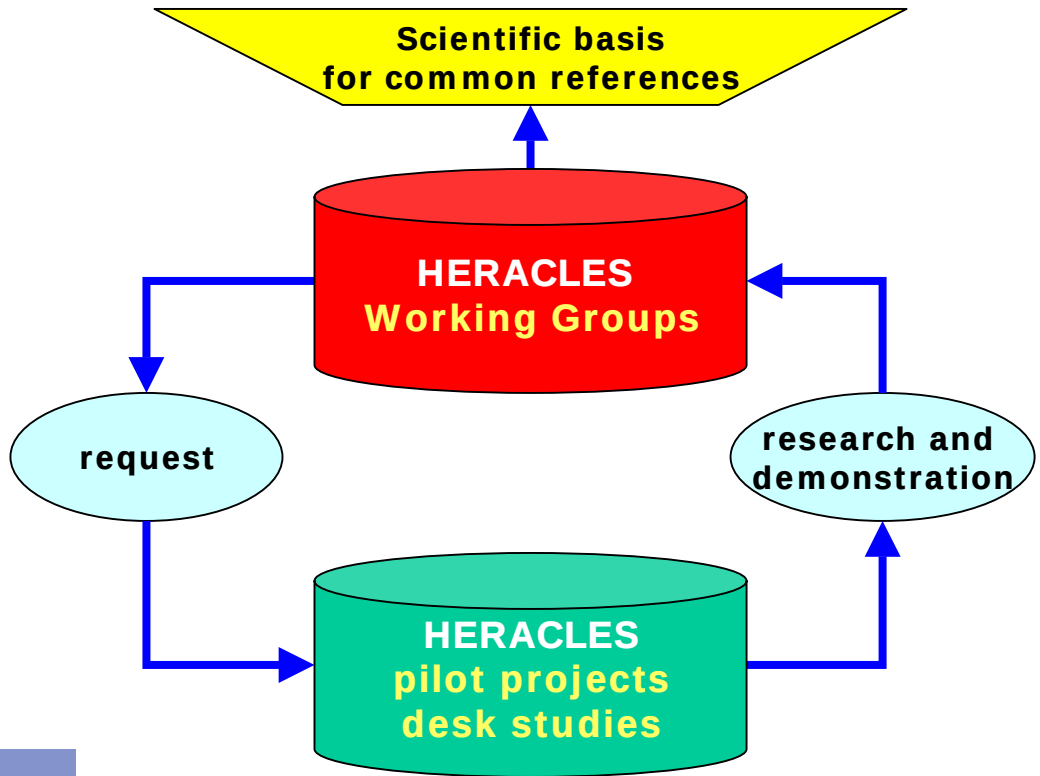
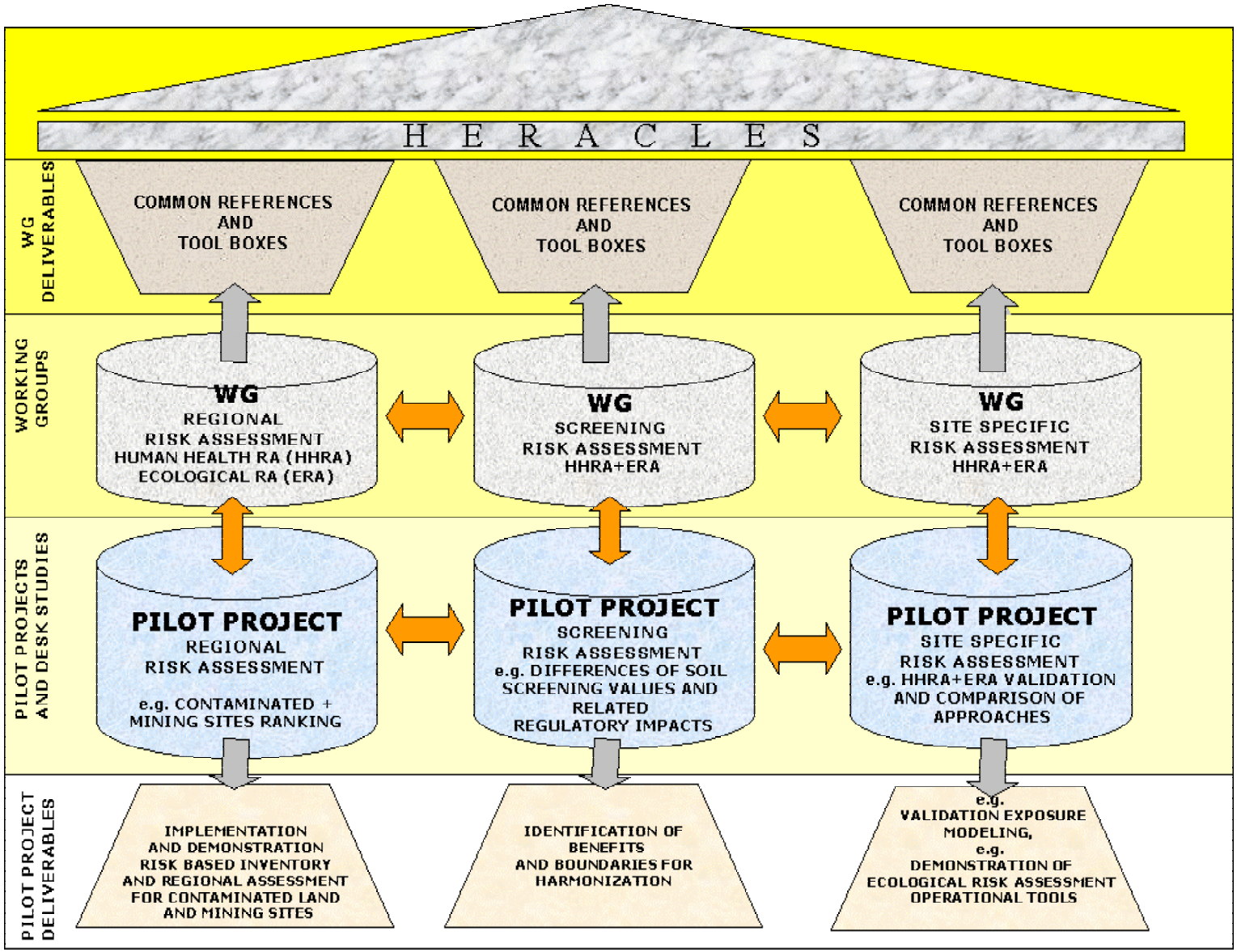
HERACLES

Long Term Research Framework for the collaboration of JRC with other European institutes (research institutes and other interested bodies) in developing common references for risk assessment of contaminated land.

Combination of pilot projects and workgroup discussions.



Outline of the HERACLES framework



HERACLES
Pilot and Desk studies

First Pillar: Relative Risk Assessment

PILOT (1): Regional inventory and risk ranking of contaminated land. Pilot project in Poland. Started at JRC.

started

Second Pillar: Screening Risk Assessment

DESK (1): Analysis of derivation methods of soil screening thresholds in Europe. Application of the tool box concept.

started

Launched by JRC, wide collaboration of EU Research Institutes.

Third Pillar: Site Specific Risk Assessment

DESK (2): Review of approaches and operational tools for SS-ERA. Network case studies of SS-ERA. Proposal under discussion

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EMERGING POLLUTANTS

"Not everything that can be counted counts, and not everything that counts can be counted" A. Einstein (?)

- **New chemicals:**
  - **Newly introduced to commerce**
  - **New anthropogenic processes**
- **Previously unrecognised pollutants:**
  - **New advances in chemical analysis**
  - **New insight in (eco)toxicological properties**
  - **New exposure pathways (e.g. increased production/practices; reconsideration of mechanism of transport)**

The potential risk should be the driving factor. Sources, pathways and receptors to be ranked.

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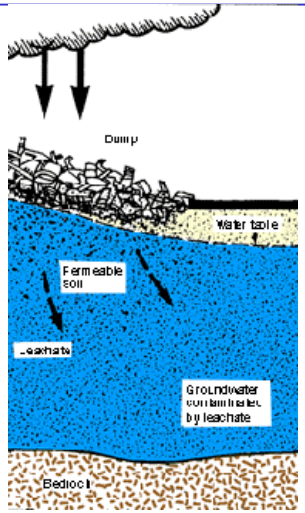
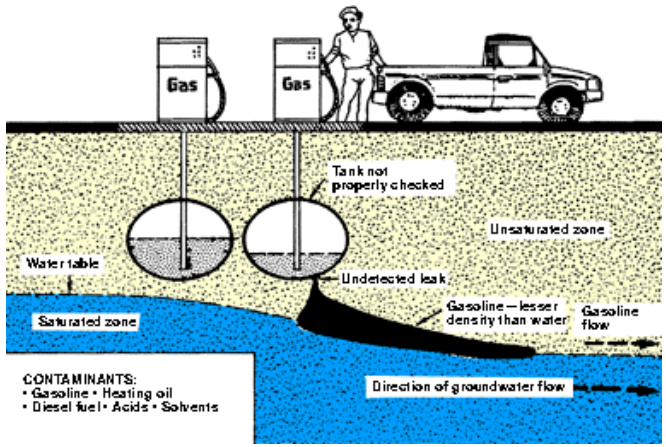
occurrence and sources

- **Occurrence**: in soils has been scarcely investigated compared to other media, and in particular water
- **Sources:** it is convenient to distinguish local and diffuse contamination

e.g. sources of local contamination





- e-waste (brominated flame retardants ca. 60 %)
- Sewage sludge (e.g. pharmaceuticals, EDCs)
- Personal care products

- Gasoline additives, like Methyl-tert-butyl ether (MTBE)
- Explosives in military sites (e.g. CL-20)
- Sewage system

- E.g. use of nanoparticles

Landfills and dumps

Spills and accidental releases

Remediation treatments

soil

groundwater

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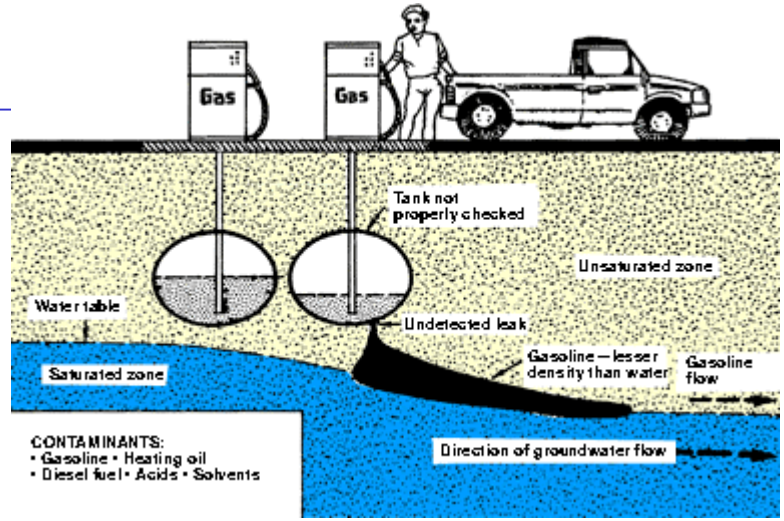
Example of MTBE



Methyl tertiary butyl ether (MTBE): relatively volatile and soluble in water

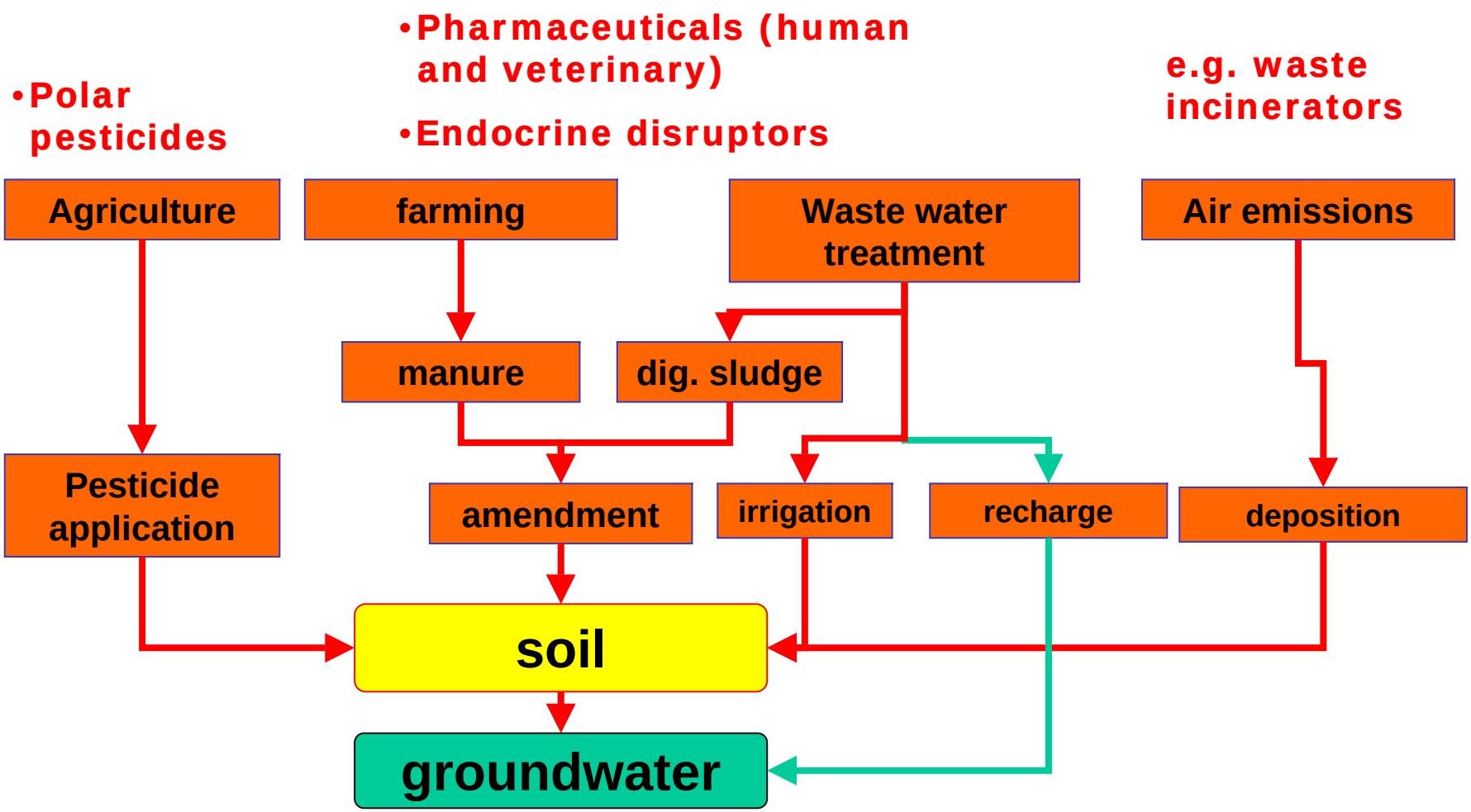
Use: additive (1-5% by volume) to automotive fuels to enhance octane ratings. Improve combustion efficiency and reduce emissions of uncombusted hyd. Low cost.

Emerging: very common leackage from gasoline stations, potential spread in groundwater, suspected toxicity. Alarm of oil companies.

Toxicity studies: 1997: included in EU priority list. IARC (1998) : "not classificable as to its carcinogenicity to humans". EU risk assessment (2001): "not carcinogenic according to the criteria set forth in EU Directive on Dangerouse Substances"

Today: across Europe,
threshold values of MTBE in soil:
from 0.7 to 10 mg/kg, most sensitive uses; from 70 to 250 mg/kg, less sensitive uses
threshold values of MTBE in groundwater: from 10 to 9200 µg/L

e.g. sources of diffuse contamination

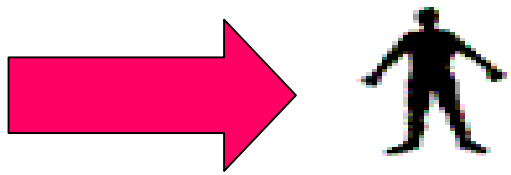


pathways of exposure and receptors

Prioritization needed : preliminary temptative

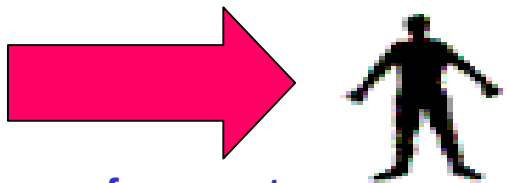
for local contamination

Drinking groundwater
Soil ingestion
Indoor inhalation of soil derived vapours



for diffuse contamination

Drinking groundwater
Bioaccumulation and magnification



Groundwater

Soil

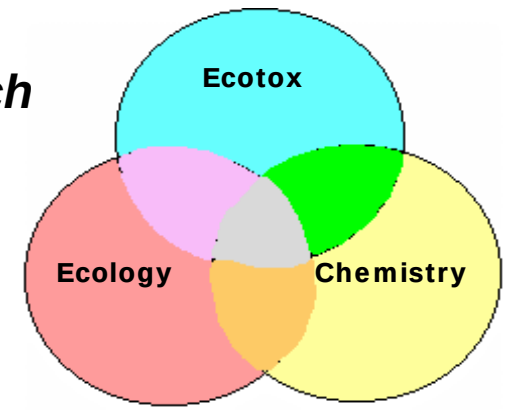
surface water ecosystem

Soil ecosystem and terrestrial wildlife

Effects

Toxicological and ecotoxicological evidences: cause effects and dose-response are difficult to be recognised for large numbers of chemicals, in particular for mixture. Combination of chemical, ecotoxicological and ecological evidences is needed

TRIAD approach



Large scale effects and long term scenarios should be defined: what is the effect at population level, on groundwater reservoir at paneuropean scale, on soil biodiversity?

Conclusions remarks

- **Large uncertainties for current conventional pollutants**

- **What to measure**
  - ✓ targets should not be simply moved, but better focused
  - ✓ relate emerging pollutants to current uncertainty in the assessment of conventional pollutants
  - ✓ need of indicators
  - ✓ necessary combination of bio-assays with chemical analysis
  - ✓ Pragmatic identification of most relevant sources, pathways and receptors to focus research
  - ✓ Evaluation of large scale effects and long term scenarios are needed

- **Who has to take action? The role of stakeholders is importat** (e.g. producers, liable parties, public perception) and change for local and diffuse contamination, screening and site specific assessment