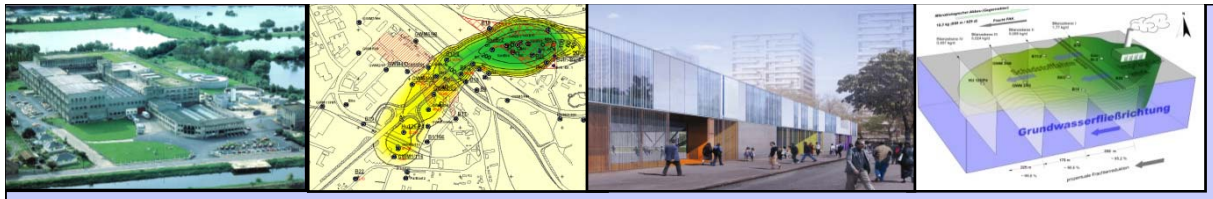
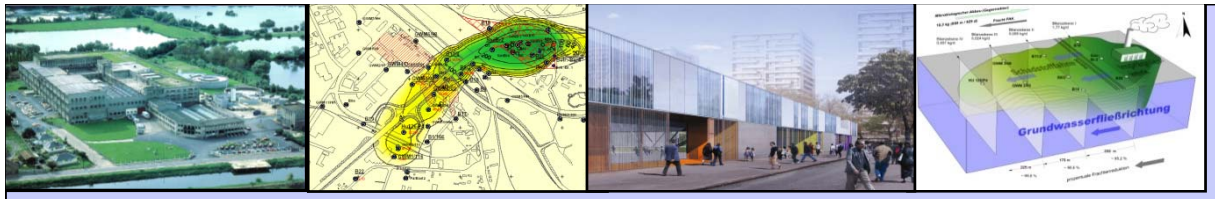


global thinking

SENES Consultants Limited
delta-simons environmental consultants
oranjewoud DGE Group
HPC HARRESS PICKEL CONSULT
ЭКОЦЕНТР МТЭА ENVIRONMENTAL CENTRE IFPA
anteagroup
HPC ENVIROTEC
HPC ENVIROTEC
ESD CHINA LIMITED 伊世特有限公司
PETER J RAMSAY & ASSOCIATES
GENERMASA
GEOINGENIERIA
BECO
IEM
Angel ambiental
AES - DISAB

local delivery

Inogen Environmental Alliance



TERQ: Toxicological Exposure Risk Quantification in case of Environmental Contamination by Pesticide Additives, Impurities and Metabolites:

Examples of Picloram, Bromacile Chlordecone, 2,4-D and Glyphosate/AMPA in Europe, Asia (China & Vietnam) and South America

---

EQRS : Evaluation Quantitative des Risques Sanitaires dans le cas des Pollutions par des additifs, Impuretés et Métabolites :

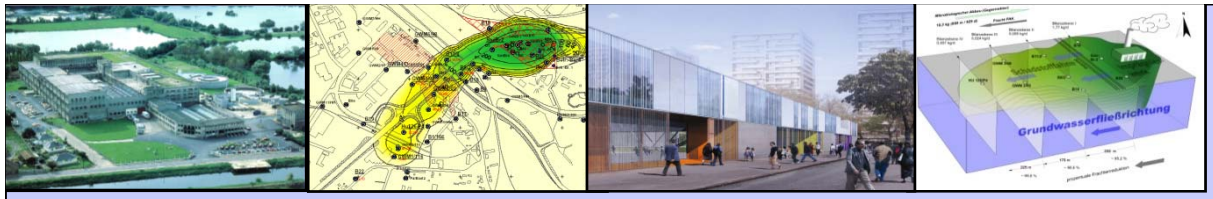
Exemples : Picloram, Bromacile, Chlordecone, 2,4-D et Glyphosate/AMPA en Europe, Asie (Chine et Vietnam) et Amérique du Sud

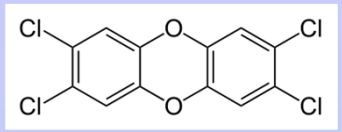
KARG, Frank / HPC Envirotec S.A. / France

Scientific Director of HPC-Group Germany & International

&

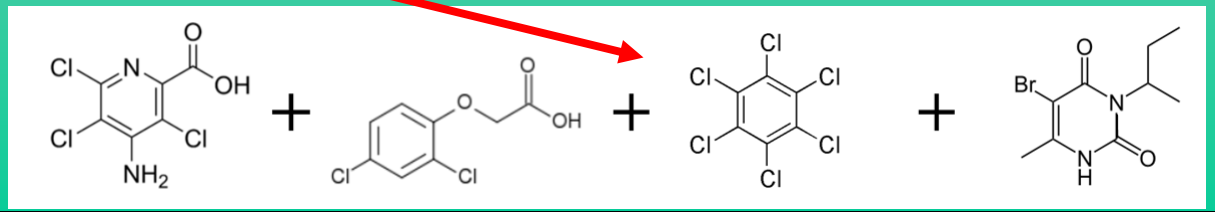
KOPYTYNSKI, Witold / SIM : Servicio Integral de Medioambiente / Argentina

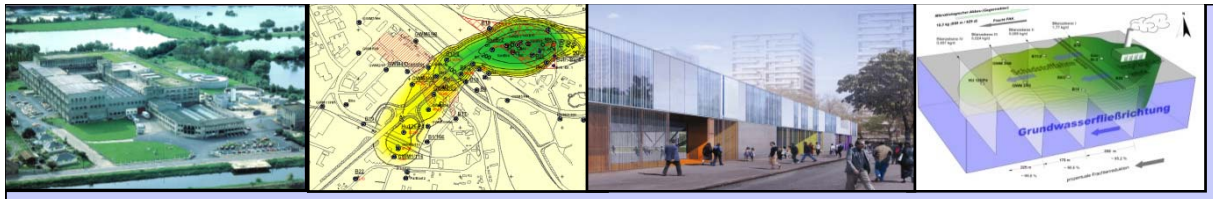




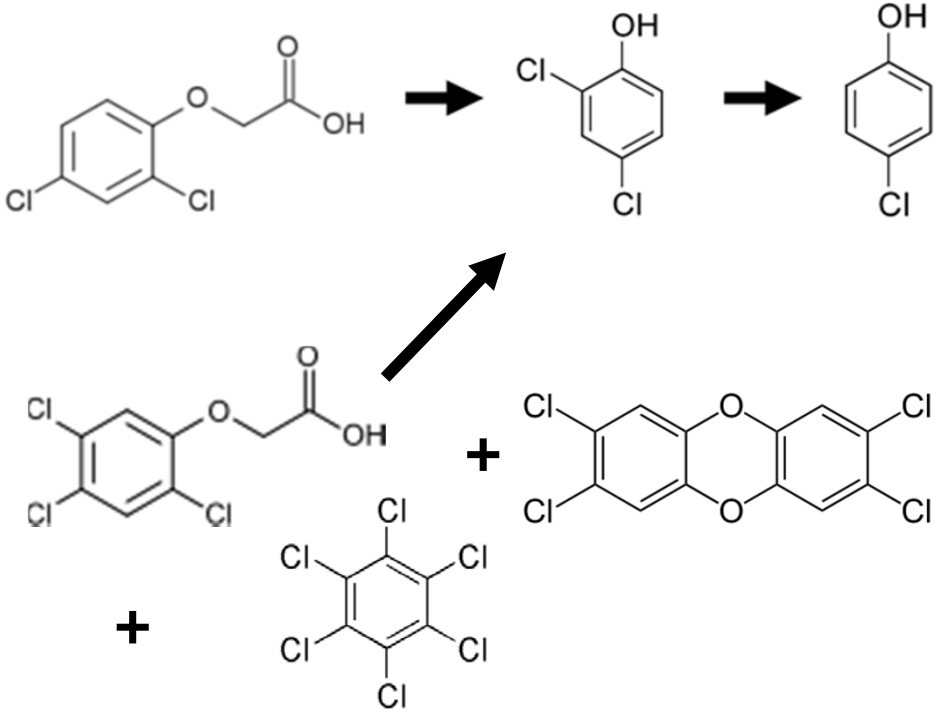
Typical Pesticide Mixtures:

- **Picloram** herbicide (Trade names Tordon & Grazon**)**: Chlorinated derivative of Picolinic acid. In Agriculture (China, India, etc.) & Vietnam War, used together with 2,4-D (2,4-Dichlorophenoxyacetic acid) under the name "**Agent White**", for **Forest areas which showed resistance** to
- **"Agent Orange"** (Mixture between **2,4-D** and **2,4,5-T** (2,4,5-Trichlorophenoxyacetic acid) used in Viet Nam between 1965 – 1971. Agent Orange shows highly resistant **Dioxin** (2,3,7,8-TCDD, etc.) **impurities.**
- **About 30 + 17 million liters of "Agent Orange" + "Agent White"** were sprayed over Viet Nam by the U.S.-Air Force. As known, impurities with lots of catastrophic Public Health Impacts in Viet Nam.
- The Picloram mixture hides also such impurities, as for ex. **HCB: Hexachlorobenzene (200 ppm),** which shows also a strong toxicity and bio-accumulation.

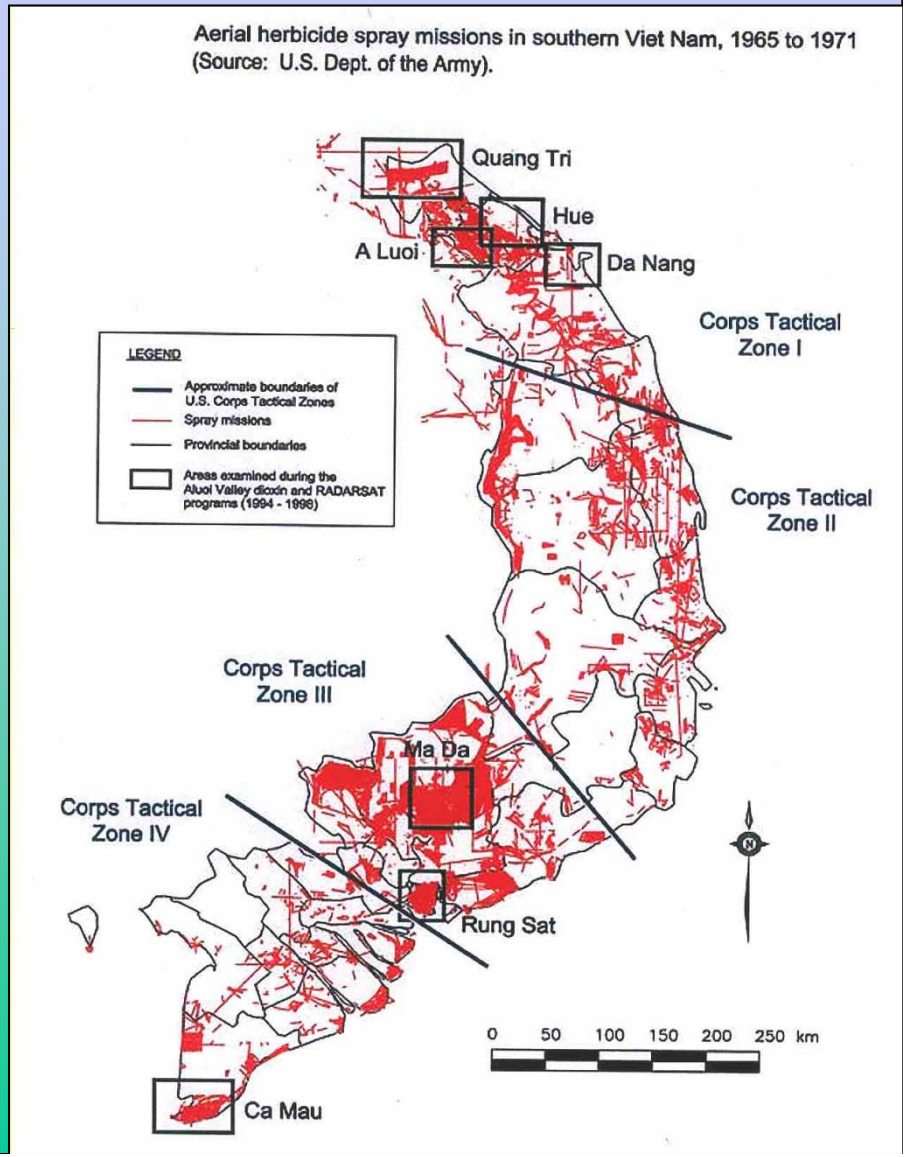


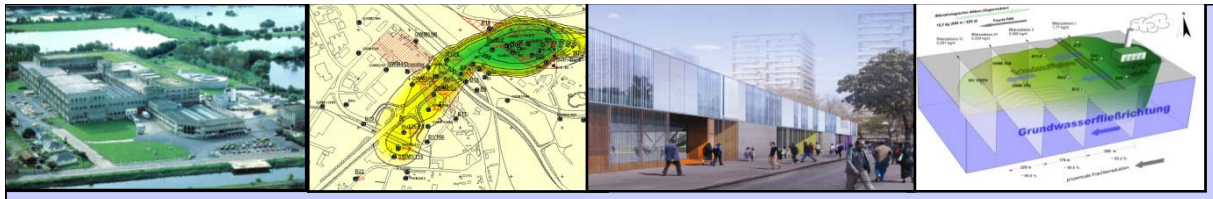


Map of US-Army Pesticide use in Viet Nam: Missions between 1965 - 1971

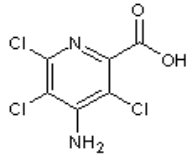


2,4-D & 2,4,5-T – Impurities and Metabolites :
2,4-Dichlorophenol & 4-Chlorophenol
+ 2,3,7,8-TCDD (+general PCDD/F) + HCB

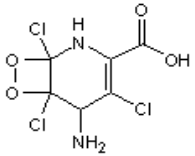




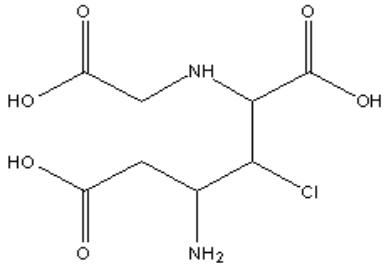
Prior Picloram use



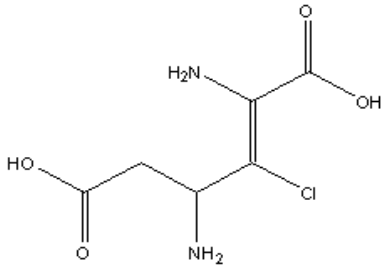
4-amino-3,5,6-trichloropyridine-2-carboxylic acid



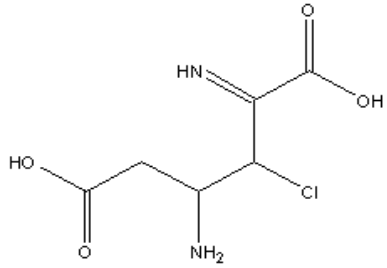
5-amino-1,4,6-trichloro-7,8-dioxa-2-azabicyclo [4.2.0]oct-3-ene-3-carboxylic acid



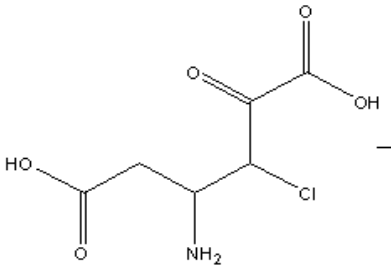
4-amino-2-[(carboxymethyl)amino]-3-chlorohexanedioic acid



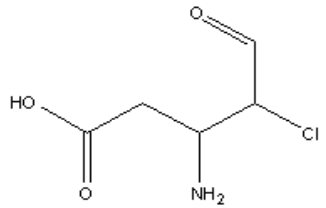
(2*E*)-2,4-diamino-3-chlorohex-2-enedioic acid



4-amino-3-chloro-2-iminohexanedioic acid

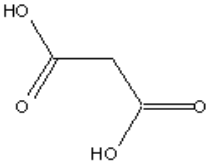


4-amino-3-chloro-2-oxohexanedioic acid



3-amino-4-chloro-5-oxopentanoic acid

(2*E*)-3-aminoprop-2-enal

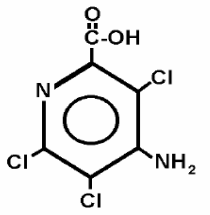


propanedioic acid

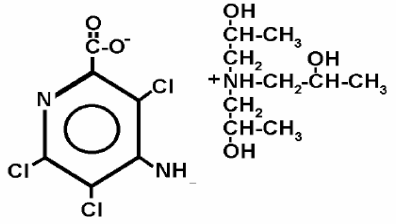
Picloram Forms and Degradation

Only 1 µg/kg

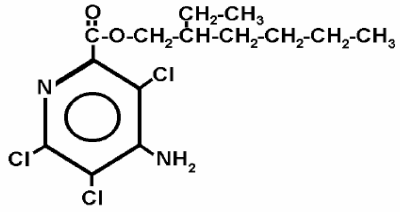
of Picloram, can be lethal to garden plants such as peas, beans, lettuce, spinach, tomatoes and potatoes.



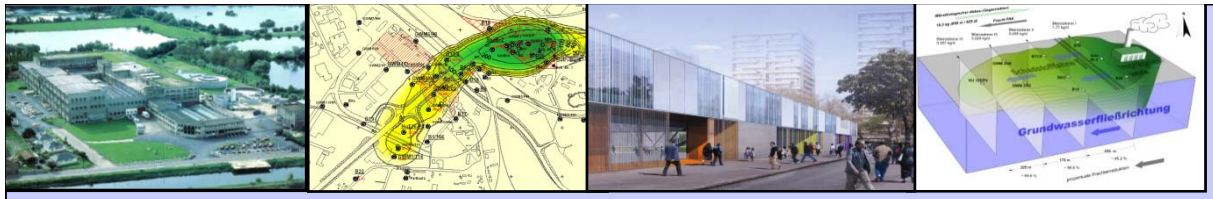
Picloram acid



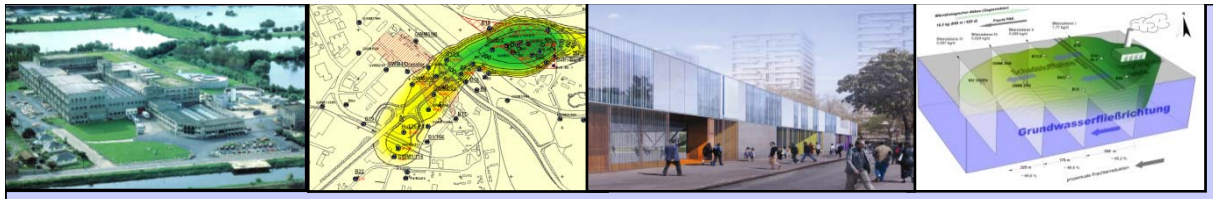
Picloram triisopropanolamine salt

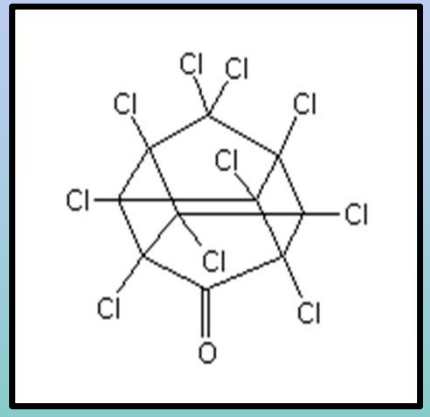


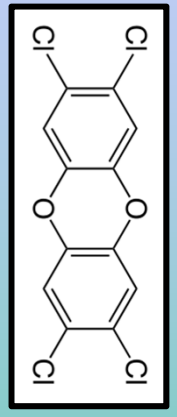
Picloram isooctyl ester



Prior historical Chlordecon use





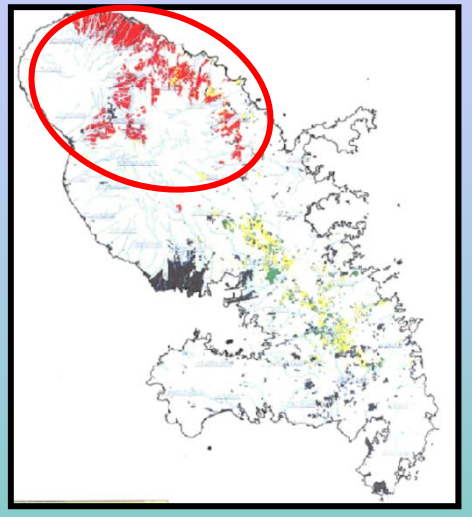


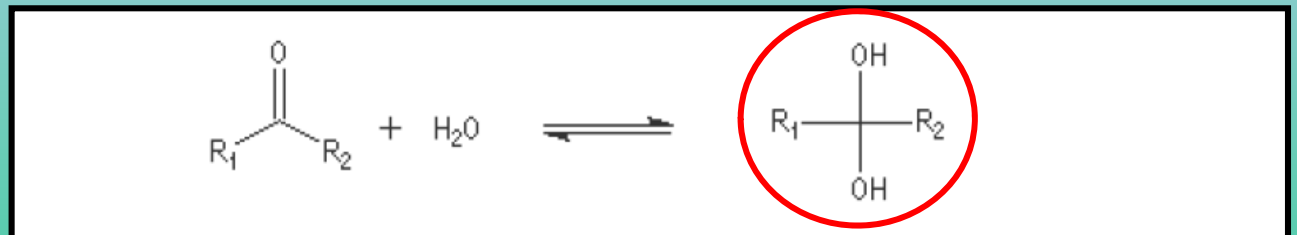
Chlordecon degradation :

Chlordecon was principally used in Germany (potatos) and South of USA, Brazil and Martinique & Guadeloupe (bananas)

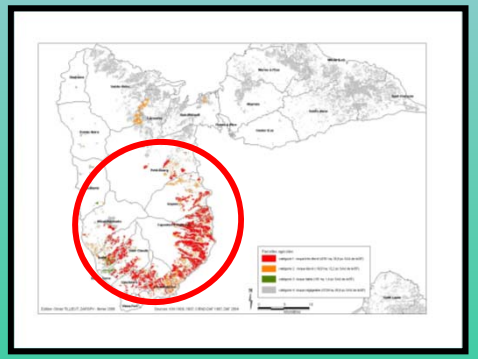
CDE is very stable and toxic.

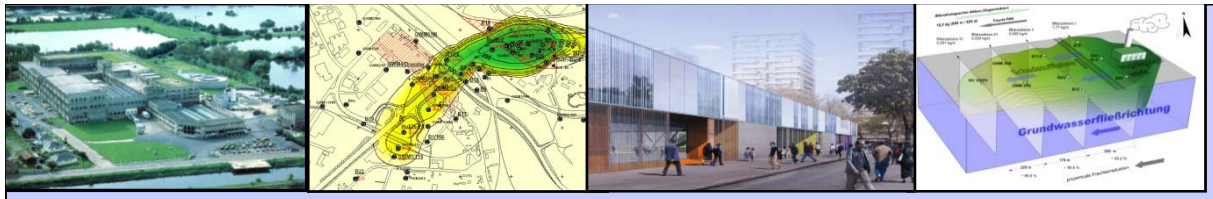
PCDD/F Impurities are existing.



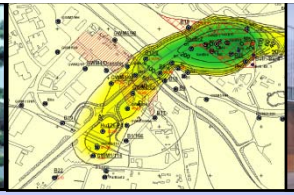


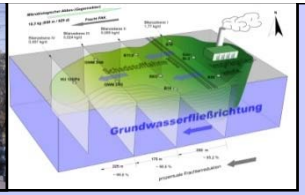
Hydratation d'un composé carbonylé et formation d'un gem-diol (Dupuis, 2005)

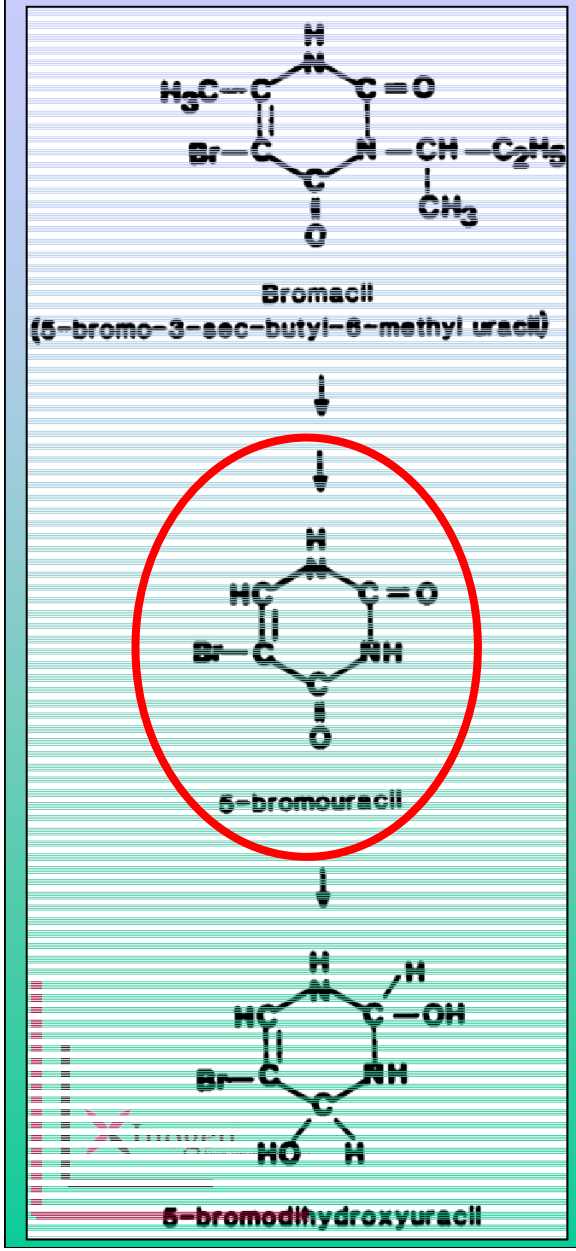




Prior Bromacil use





Bromacil degradation

(very slowly) to

5-Bromouracil &

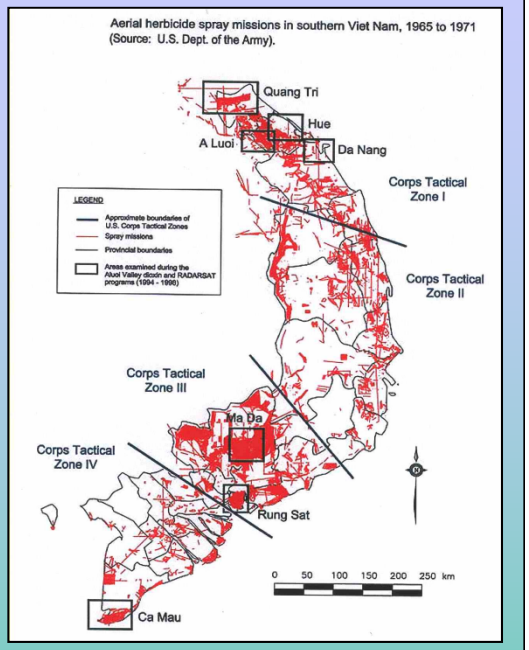
5-Bromo-dihydroxy-uracil

Prior Bromacil use

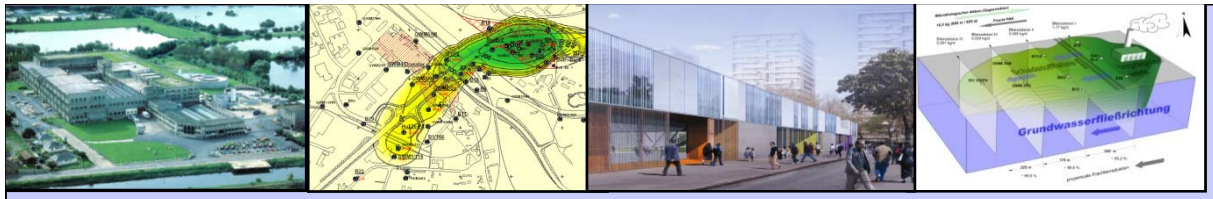
USA,

Germany: Railways,

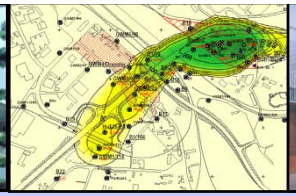
Viet Nam War

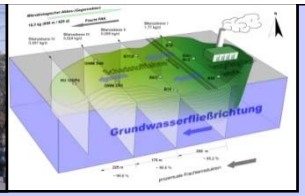


Map of US-Army Pesticide use in Viet Nam: Missions between 1965 - 1971

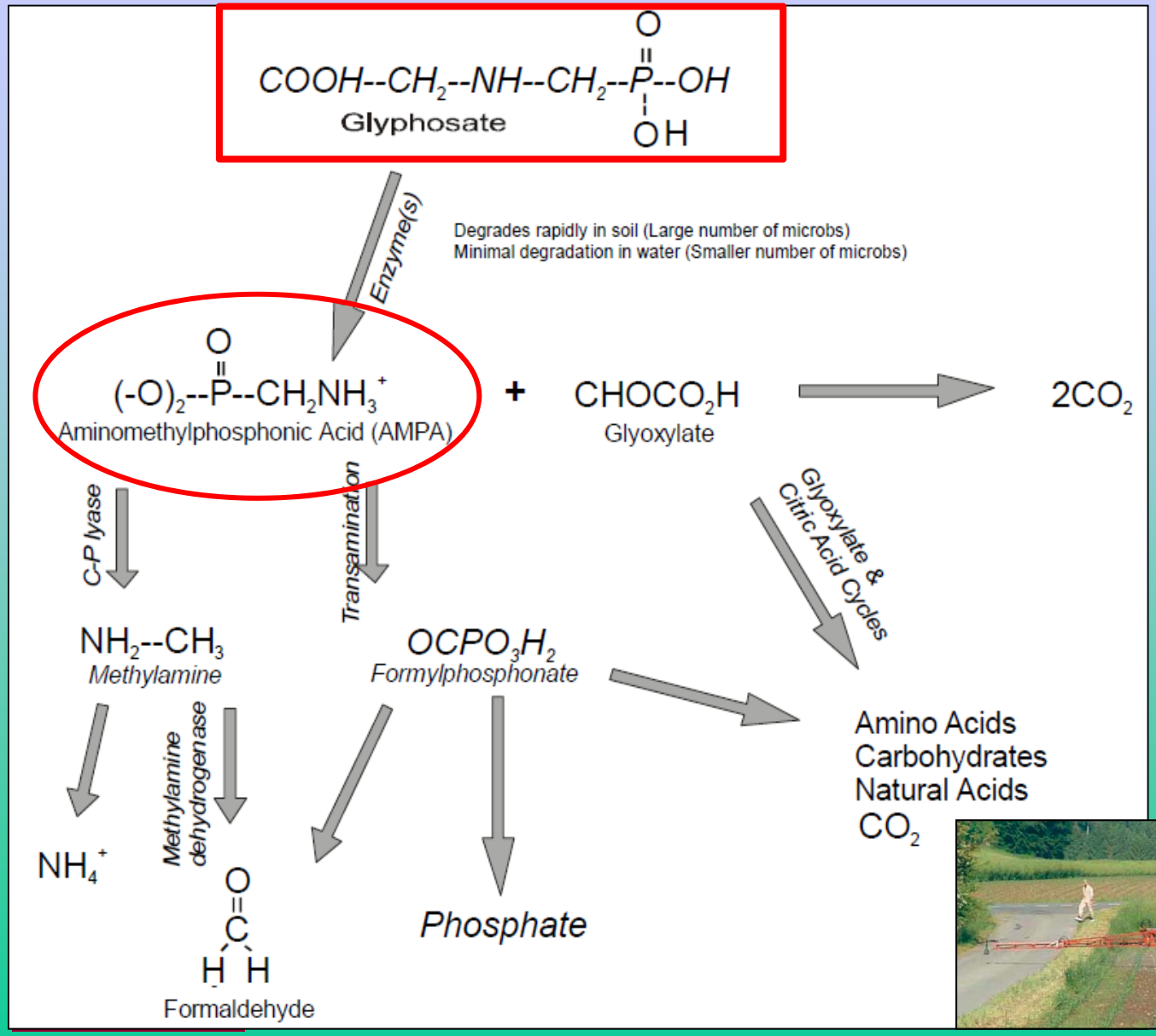


Prior Glyphosate use

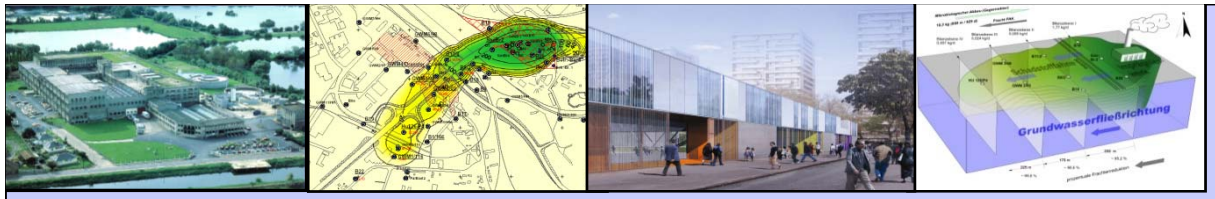


HPC



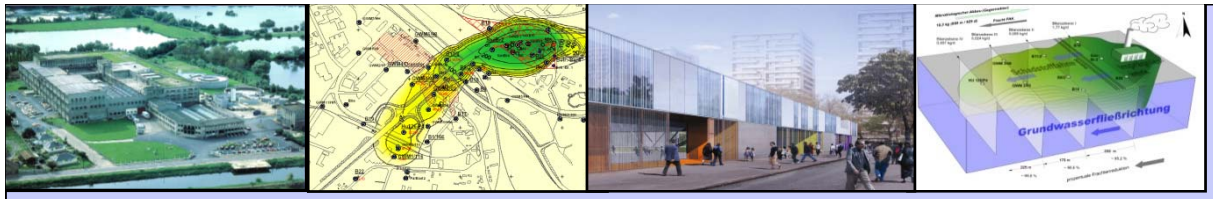
<u>Glyphosate</u> and glyphosate Impurities and Metabolites (AMPA, etc.)

Very strong use in Corn (Mais) Agriculture, as in USA, Europe, South-America and expecially in Argentina



TERQ: Toxicological Exposure-Risk-Quantification (HRA: Health Risk Assessment)

- **Exposure Risk Assessment** per Site use Scenario,
- **Definition of Remediation Goals** for different Site use Scenarios (SS-RG, CMA, etc.) and acceptable Health Risks,
- **Corrective Actions.**



TERQ: Toxicological Exposure-Risk-Quantification (HRA: Health Risk Assessment)

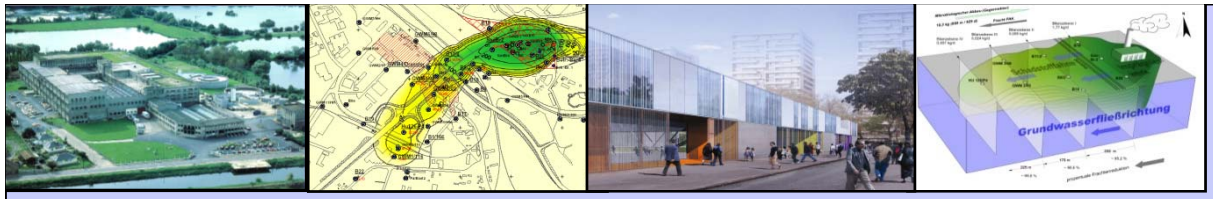
- **Toxic Risks without Effect Threshold Dose (Carcinogenic risk etc.):**

The carcinogenic risk, or individual cancer risk (ICR), is calculated by multiplying the daily dose of exposure with a slope factor (Sf) or an unit risk (UR) from the U.S.-EPA, UBA, and WHO etc.:

The individual cancer risk is compared with the limit of 10^{-5} (*) which represent the limit of an acceptable carcinogenic risk (1:100 000):

$ICR = DED\ (mg/kg/d) * Sf\ (mg/kg/d)^{-1}$ or $ICR = DED\ (mg/kg/d) * UR\ (mg/m^3)^{-1}$

- **$ICR \leq 10^{-5}$: risk acceptable,**
- **$ICR > 10^{-5}$: risk unacceptable**



TERQ: Toxicological Exposure-Risk-Quantification (HRA: Health Risk Assessment)

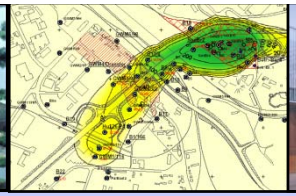
- **Toxic Risks with Effect Threshold Dose (Non carcinogenic risk):**

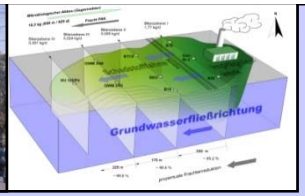
The non-carcinogenic risk, or risk index (RI), is defined according to the ratio of the daily exposure dose (DED) divided by the acceptable daily intake (ADI) or the acceptable concentration (AC) as following:

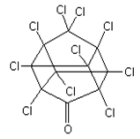
The risk index is compared to the limit of RI = 1 for which the daily exposure dose is equal to the acceptable daily intake dose:

$$RI = DED\ (mg/kg/d) / ADI\ (mg/kg/d) \quad or \quad RI = DED\ (mg/kg/d) / AC\ (mg/m^3)$$

RI ≤ 1: the risk is acceptable,
RI > 1: the risk is unacceptable.

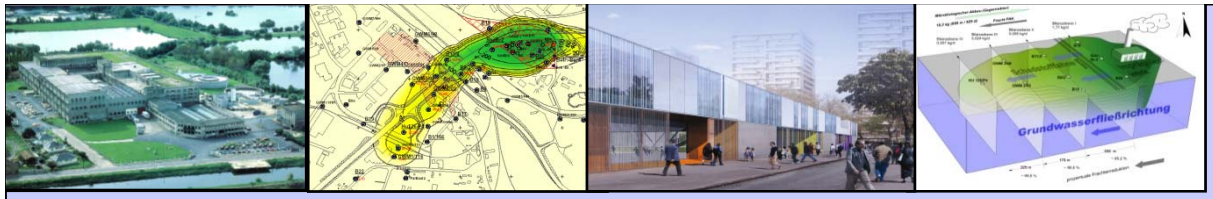




TERQ: Toxicological Exposure-Risk-Quantification

Definition of SS-RG (CMA): Exemple Chlordecon

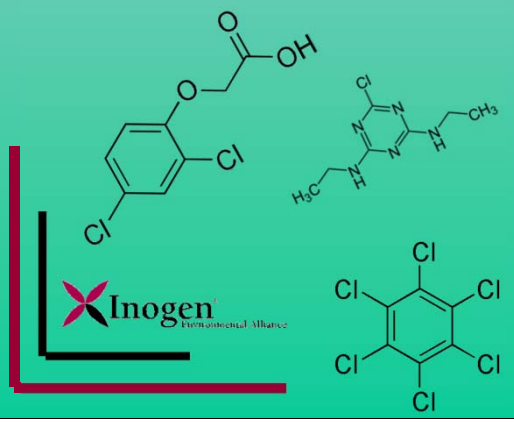
Chlordecone			
Scénario	**Milieu source**	**CMA-A**	**unité**
Scenario résidentiel avec jardin potager	Sols superficiels avec jardin potager	0,033	mg/kg
	Sols profonds partie cultivable	0,033	mg/kg
	Sols superficiels espaces verts	1,3	mg/kg
	Sols profonds hors parties cultivables	24	mg/kg
	Eaux souterraines tous usages sauf eau de boisson	0,00009	mg/l
	Eaux souterraines tous usages avec eau de boisson	0,000045	mg/l
Scenario espace vert	Sols superficiels espaces verts	1,5	mg/kg
	Sols profonds	118	mg/kg
Scenario crèche / école maternelle	Sols superficiels espaces verts	2,9	mg/kg
	Sols profonds	92	mg/kg
Scenario ERP / commercial	Sols superficiels espaces verts	6,6	mg/kg
	Sols profonds	420	mg/kg

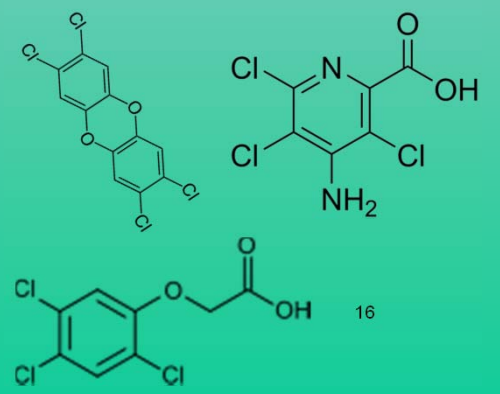


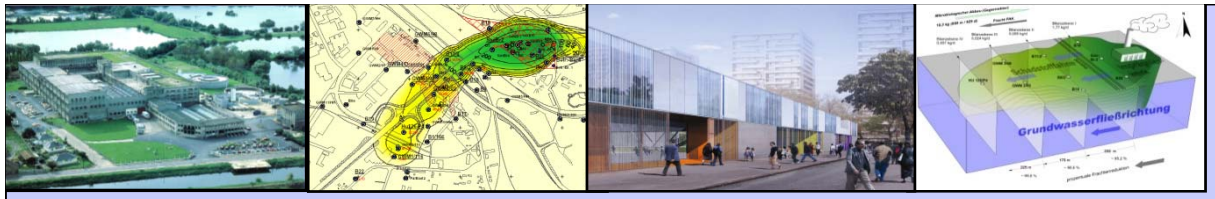
Recommandations

In case of Pesticide pollution !,

- →as for ex. by 2,4-D, Picloram, Bromacil, Chlordecone, etc. ;
- →Co-contaminants & toxic Metabolites,
  as HCH: Hexachlorobenzene, PCDD/F, 2,4-dichlorophenol, 4-chlorophenol, etc.
- →must be also assessed (site investigations & TERQ or HRA)
- →and integrated in corrective actions,
  as shown by the examples from Europe, South America (Argentina, Brazil, etc.) and Asia (China, India, Viet Nam, etc.).







ZEN ?