PROSPECTIVE AND RETROSPECTIVE

ENVIRONMENTAL RISK ASSESSMENT OF MIXTURES

MOVING FROM RESEARCH TO REGULATION

SETAC®

The position of the SCHER WG on "Toxicity and Assessment of Chemical Mixtures". Environmental aspects

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The Terms of Reference

1) Is there scientific evidence that when organisms are exposed to different chemical substances, these may act jointly in a way that affects the overall level of toxicity?

2) Do the current assessment methods take proper account of these joint actions?

3) What are the advantages and disadvantages of the different approaches and is there any particular model sufficiently robust to be used as a default option?

4) What is the most effective way to target resources on those combinations of chemicals that constitute the highest risk for man and the environment?

5) Where are the major knowledge gaps?

6) Does current knowledge constitute a solid foundation upon which to address the toxicity of chemical mixtures in the context of EU legislations?

The general concepts

•The general concepts of mixture toxicity (CA, IA, synergism, etc) may be assumed to be the same for man and for the environment.

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•However there are conceptual differences between human toxicology and ecotoxicology, which may affect the application of the CA and IA approaches.

•The most important difference is the objective of the protection. The goal of human toxicology is the protection of individuals. On the contrary, the goal of ecotoxicology is protecting structure and functions of biological communities and ecosystems.

•The death of individuals is accepted in the frame of natural selection processes.

The choice of endpoints

•It follows that relevant end-points may be different in human toxicology and in ecotoxicology.

•Ecotoxicological end-points are related to relatively broad ecologically-relevant parameters such as massive mortality, reduction of fertility and any other effect affecting reproductive capability.

•Some effects extremely important for individuals but producing a moderate effect on population dynamics (e.g. cancerogenesis) are of negligible relevance in ecotoxicology.

•Therefore, precise end-points, that in human toxicology are often referred to a specific target organ, are meaningless in ecotoxicology.

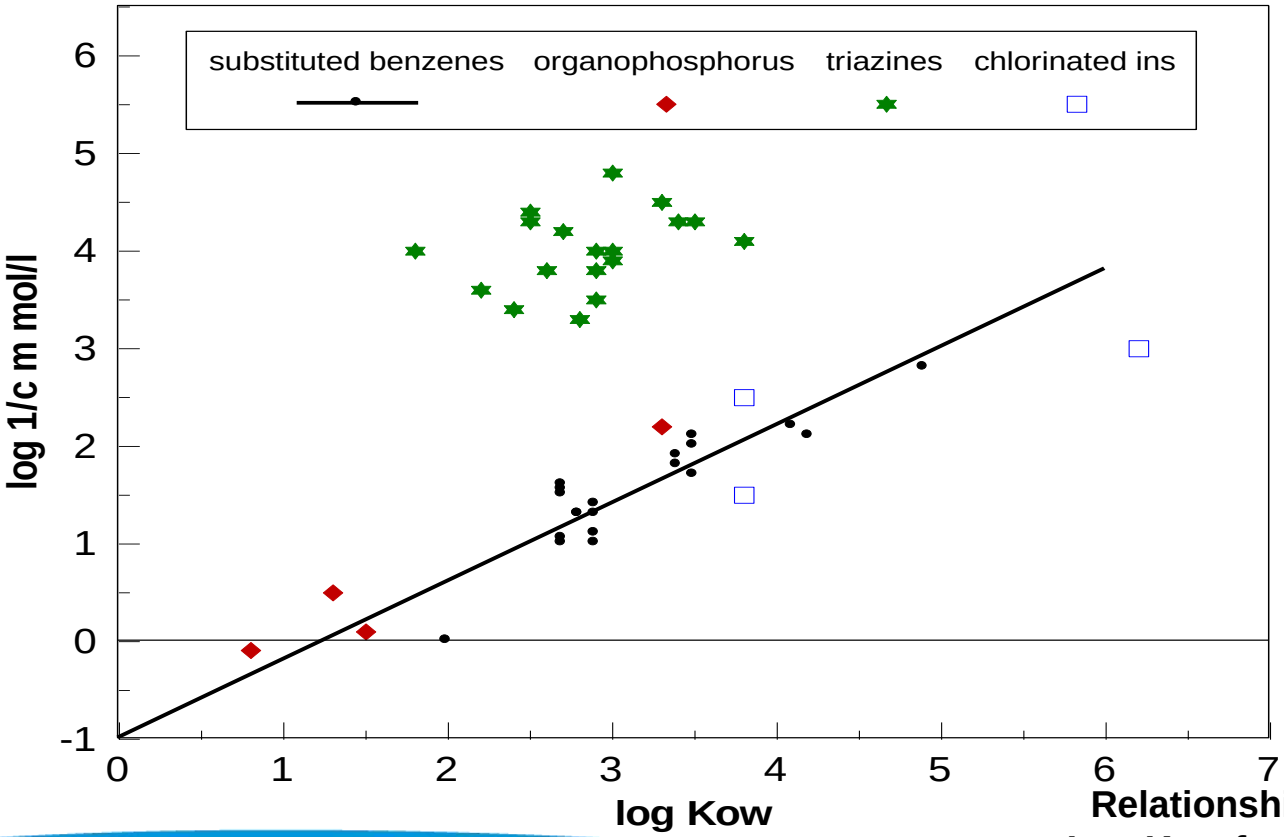
The availability of information

- Moreover, in ecotoxicology, knowledge on the toxicological mode of action on all the different types of organisms that may be present in an ecosystem is largely incomplete.

- Even for chemicals developed with the objective of a specific activity (e.g. pesticides) the toxicological mode of action is well known for target organisms but not for the non target ones.

The specificity of mode of action

Specific toxic chemicals exert their effect on particular functions that, usually, are not common to all living organisms present in a biologic community (photosynthesis inhibitors, ACHe inhibitors, etc.).



For non-target organisms, taxonomically far from the target ones, the effect of the chemical is likely to be narcotic-type (baseline toxicity).

Relationship between toxicity on algae and Log Kow for chemicals with specific and non-specific toxicological mode of action on algae

Environmental exposure

The different origin of environmental mixtures

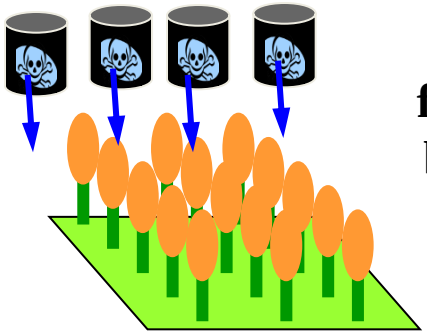
a. Chemicals used as technical mixtures.

b. Chemicals emitted by a human activity

c. Chemicals likely to be present in the environment as the result of multiple emissions

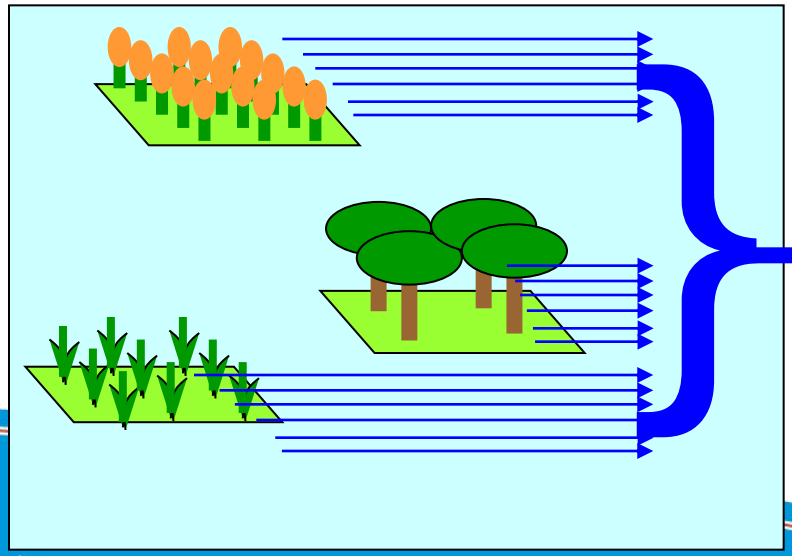
The example of pesticide mixtures

Many active ingredients may be present in the same formulation



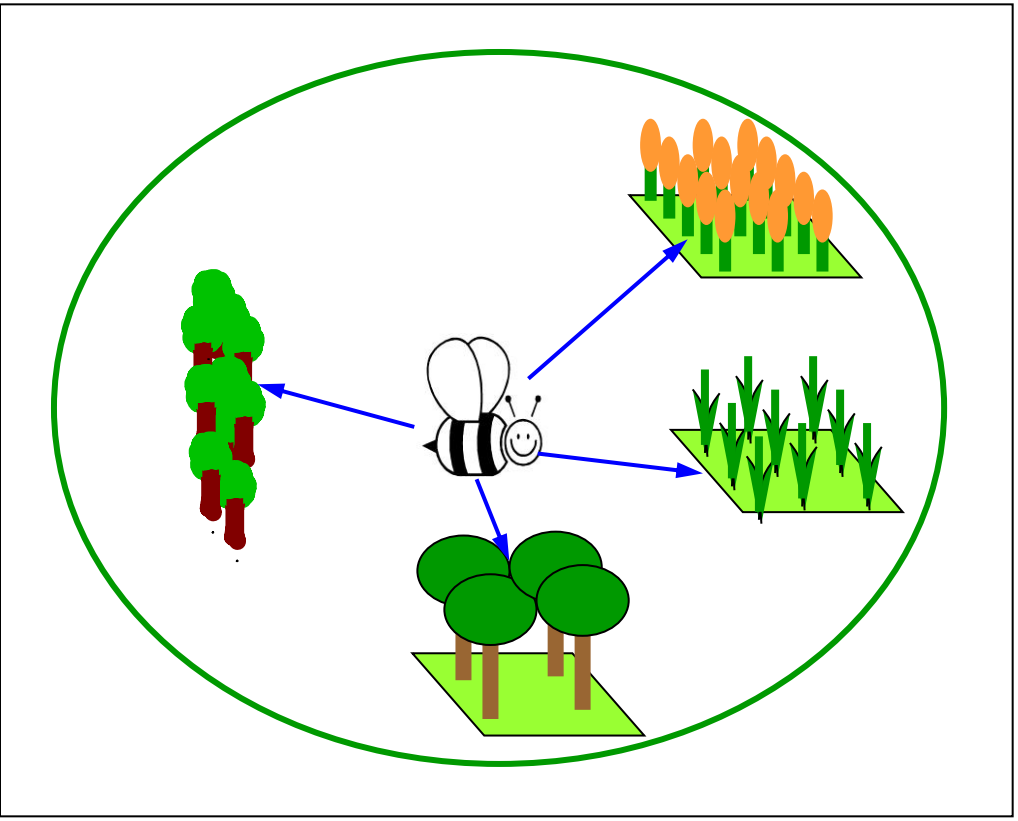
Many formulations may be applied on the same crop

Many crops may be present on the same agricultural area



Final mixture

The terrestrial ecosystem



The community potentially exposed is mouving within the area.

Exposure and mixture cpmposition is a function of the variable concentrations on different systems in the area (e.g.: treated crops, non crop vegetation, etc) as well as of the behaviour and the ecological role and niche of the organism.

PNEC is not a toxicological endpoint

Ecosystems are exposed to a huge number of different substances at very low levels. Any assessment should start with the identification of the relevant components to be assessed.

For substances with specific mechanisms of actions, the sensitivity among tested species may differ by several orders of magnitude. So, the relevant components of a mixture assessment may differ for each species.

The general concepts of mixture toxicity (CA and IA) at levels close to the No Effect Level (NEL) are applicable to individuals/species, but difficult to implement when moving to the PNEC for community effects.

Predicting mixture composition

Even for substances emitted simultaneously, the environmental fate (distribution and persistence) may be different for any individual component of the mixture.

Therefore, the composition of the mixture in the environment may by completely different from those of the originally emitted mixture and highly variable in space (particularly in different environmental compartments) and in time.

This prediction is generally made by modelling for individual substances. It is expected that, at concentrations present in the environment, distribution of each component of a mixture is not influenced by the other components.

Different objectives for different regulations

Approaches to assess mixture composition for regulatory purposes may be different as a function of the objective of the assessment.

For hazardous chemical control (e.g. REACH) mixture exposure can be estimated as the result of a given process that would produce a specific emission into a generic environment assumed as representative of European conditions.

For the WFD, mixture assessment is the result of site specific measurements and the conditions that would produce effects on the real environment that must be taken into account case by case, for each individual water body.

Thanks for your attention