

Critical evaluation of ecological effect models for the risk assessment of plant protection products

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Background

Ecological effect models may support the environmental risk assessment (ERA) required for the registration of plant protection products (PPP). In this project funded by the UBA, we perform a critical evaluation of how such models may be integrated into ERA.



A large number of dossiers for PPP authorization are submitted to authorities each year. They thus have to undergo an environmental risk assessment (ERA) carried out in a tiered process. In this context, mechanistic effect models could be relevant to extrapolate results from the laboratory, semi-field or field studies to field situations. Although ERA could thus benefit from such models, their implementation requires first a thorough evaluation of their quality and reliability for the identification and prediction of risks.

Results

Biotic and abiotic stressors, delayed effects, indirect effects through the food web, mixture toxicity and other factors can increase the sensitivity of organisms¹. Ecological effect models need to consider those processes that are highly relevant according to the addressed level of biological organization. However, a model represents a trade-off between simplicity and realism. As every model simplifies reality, the reliability of model predictions can only be tested inductively via the application to multiple independent data².

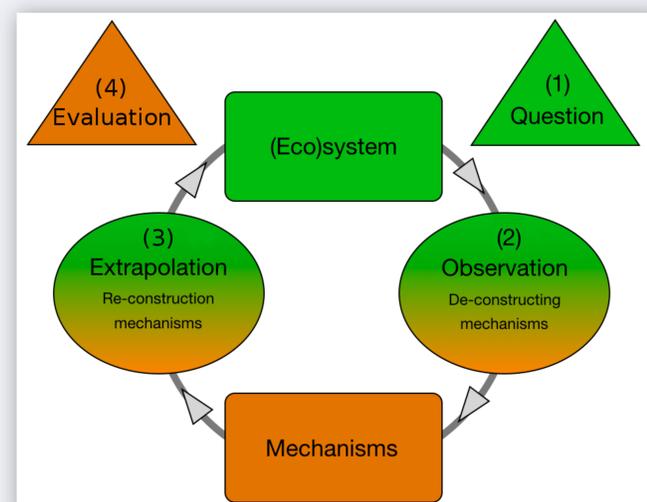


Figure 1: Selection of relevant processes in the modelling cycle. (1) Selection of suitable study system according to the question. (2) Deduction of underlying mechanisms from observations of the study system. (3) Re-constructing of mechanisms using a system of coupled equations (conceptual model) and parameterization. (4) Evaluation of model predictions and testing with observations from the study system.

Testable models for ERA require a sensible equation structure (process model) and a parameterization optimized for a generic representation of the modeled entities (organisms, populations, ...). The conceptual model may be either calibrated to one data set and tested with independent data sets (“validation”), or calibrated to the average of multiple independent data sets (“multiple calibration”). Most of the existing models do not provide such a parameterization and consequently lack thorough testing.

Future work

Nine selected models will be evaluated in more detail according to the EFSA guidelines on good modelling practice³. In a case study, 2 – 3 of the models will be applied on trial to PPP registration, and the results will be compared with those based on the conventional registration of the same PPP.

¹ Liess M, Brown C, Dohmen P, Duquesne S et al. (2005). Effects of pesticides in the field. Society of Environmental Toxicology and Chemistry (SETAC). Berlin, Germany.

² Grimm V, Revilla E, Berger U, Jeltsch F, Mooij WM, Railsback SF, Thulke HH, Weiner J, Wiegand T, DeAngelis WL (2005). Pattern-oriented modeling of agent-based complex systems: Lessons from ecology. Science 310 (5750): 987-991.

³ EFSA PPR (2014). Scientific Opinion on good modelling practice in the context of mechanistic effect models for risk assessment of plant protection products. EFSA Journal 12 (3): 3589.