A Bayesian Network approach to probabilistic risk assessment of pesticide mixtures

Highlight

The BN provides a way to carry out probabilistic risk characterization for a combination of chemicals based on the concept of concentration addition

Background

- Conventional risk assessment approaches use single values of exposure and effect to quantify the risk estimate posed by chemical mixtures to the environment.
- The BN integrates information and uncertainty on physical and toxicological properties of chemicals

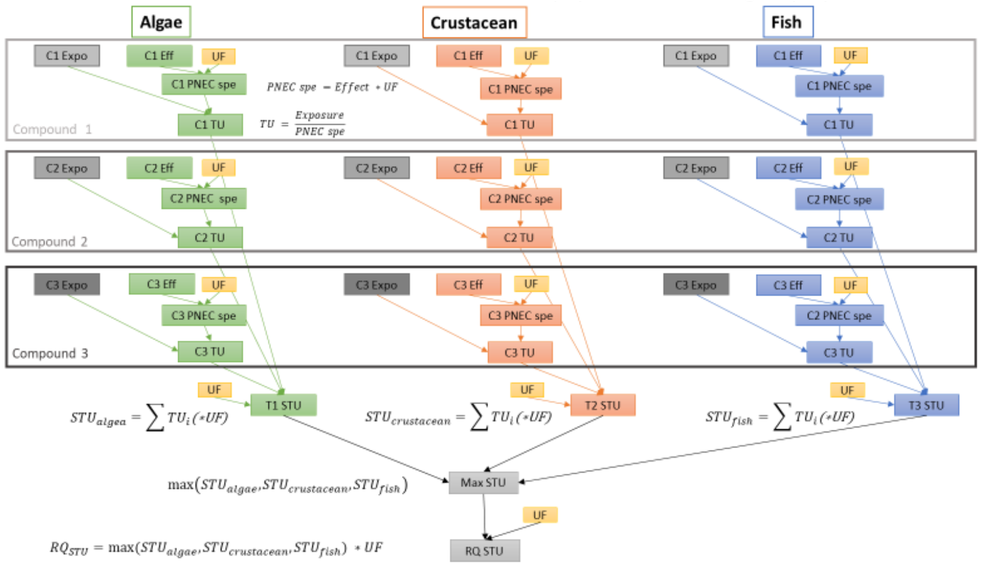

Fig. 1 Conceptual model for mixture assessment for three chemicals and exemplary taxonomic groups. It displays how toxic units and sum of toxic units (TU) are derived, and possible applications for an Uncertainty Factor (UF). Expo = Exposure Concentration, Eff= effect concentration, PNEC spe = predicted no effect concentration species/ taxa specific, STU = Sum of toxic Unit

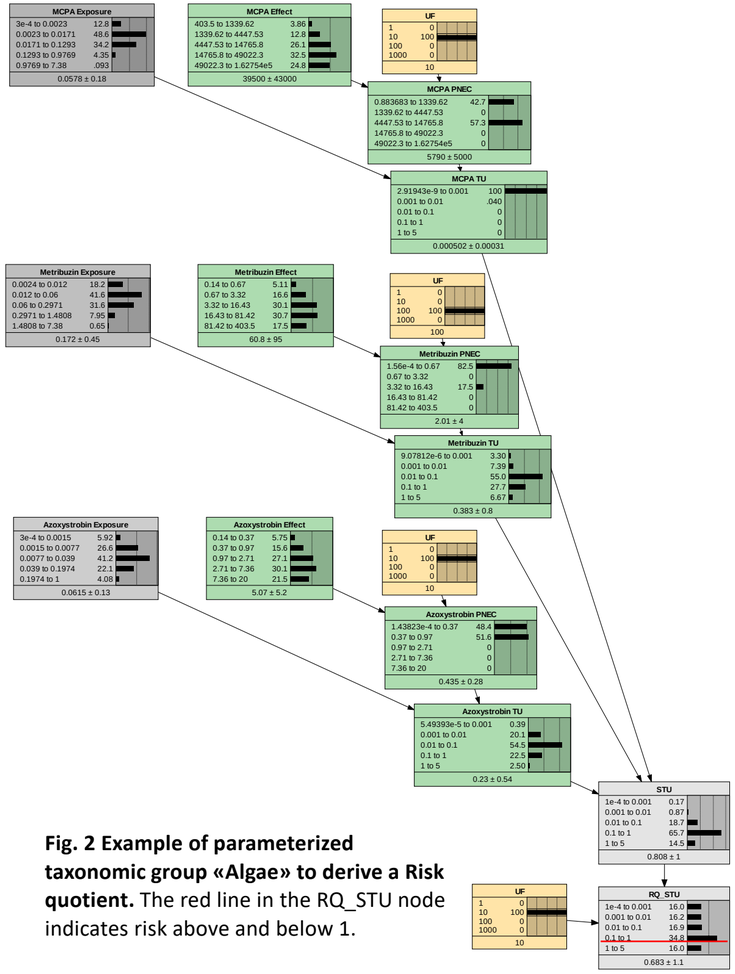

Fig. 2 Example of parameterized taxonomic group «Algae» to derive a Risk quotient. The red line in the RQ_STU node indicates risk above and below 1.

Method

- The conceptual model (Fig. 1) for a concentration addition approach is presented, the method was modified from *Backhaus and Faust (2012)*
- It displays how a distribution of the risk can be calculated using a fully probabilistic approach.

Assessment of the BN approach

In this example, with the used MCPA and Metribuzin distributions derived from EC50 values, and Azoxystrobin distribution were derived from NOEC values.

With the applied Uncertainty Factors, the risk to be above 1 is 16.0% (Fig. 2).

Benefits of the BN approach

Probabilistic approaches can account for variability and uncertainty and are therefore more informative.

BNs can use more of the available data as distributions are used instead of single values

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References

Backhaus, T., & Faust, M. (2012). Predictive environmental risk assessment of chemical mixtures: A conceptual framework. *Environmental Science and Technology*, *46*(5), 2564–2573. https://doi.org/10.1021/es2034125

Sophie Mentzel[1], Merete Grung[1], Knut Erik Tollefsen[1,2,3], Marianne Stenrød[4], Karina Petersen[1] and Jannicke Moe[1]

[1]Norwegian Institute for Water Research [2]Norwegian University of Life Sciences (NMBU) [3]Centre for Environmental Radioactivity (CERAD) [4]Norwegian Institute of Bioeconomy Research

Contact
Sophie Mentzel