# Probabilistic ecological risk assessment of paddy herbicide in Japanese river waters using uncertainty analysis

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For a more realistic risk assessment, the parameters for toxicity and exposure should be expressed as probabilistic distribution, not as a fixed value. We used uncertainty analysis of ecotoxicity and exposure assessment to conduct probabilistic ecological risk assessment of herbicide simetryn, which is used in Japanese paddy field. Acute toxicity study for simetryn for aquatic organisms was collected from open literature. Relationship between simetryn concentration and the fraction of species affected was analyzed using species sensitivity distribution (SSD). The exposure to simetryn was calculated as predicted environmental concentration (PEC) in river water using environmental model and standard scenario for the pesticide concerned, which is incorporated into pesticide registration scheme in Japanese government. Regional variability of parameters for PEC calculation (paddy field area, river flow rate, coverage of simetryn, etc.) were described as statistical distributions, and the distribution of PEC was quantified using Monte Carlo analysis. The sensitivity of algal species was clearly higher than those of aquatic invertebrate and fish species, and the values of $EC_{50}$ for 31 algal genera were fitted to log-normal distribution. Hazardous concentration for 5% of algal species ($HC_5$) was estimated to 8.2 μg/L. The value of PEC for standard scenario was 0.71 μg/L. As the results of Monte Carlo analysis, the mean of PEC was 0.77 μg/L and the 95 percentile was 2.8 μg/L, and the values of PEC were fitted to log-normal distribution. The SSD was compared to the distribution of PECs, and joint probability curve (Risk Curve) was derived by plotting the probability of exceeding a certain PEC versus the fraction of species affected at that concentration. The probability of exceeding $HC_5$ was estimated to 1.5% by Risk Curve. Consequently, we will be able to conduct risk comparison and assessment the risk reduction efficiency by quantifying the risk as probability.