Session

6. Environmental policy, risk management, and risk communication

Fate and Effects of Metals: Regulatory and Risk Assessment Perspective (Koen Oorts, Olivier Perceval)

Poster Presentation

Title: Assessments of bioavailability and mixture toxicity of zinc, copper, and nickel in Japanese surface waters using modeling approaches.

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Abstract

We assessed the mixture effect of zinc, copper, and nickel by combining mixture models (concentration addition and independent action, CA and IA), species sensitivity distribution (SSD), and chronic biotic ligand models (BLM). We applied these models to Japanese water quality data as a case study. First, water quality data in 182 Japanese surface waters were obtained from the Database of Water Quality of Aqueduct managed by Japan Water Works Association. Water hardness, pH, and organic carbon concentration ranged from 5 to 172 mg/L (as $CaCO_3$), 6.0 to 9.3, and 0.05 to 4.9 mg/L, respectively. The chronic toxicity database we used includes NOEC or EC10 values for 22 species (128 test results) for zinc, 28 species (135 test results) for copper, and 31 species (214 test results) for nickel. Then, these chronic toxicity data were normalized using chronic BLMs and the water quality data in each site. After that, SSD analyses were conducted for each metal and each water body. The site-specific 5 percentile of SSD (HC5) for zinc, copper, and nickel ranged from 5.6 to 40.7, from 0.2 to 22.0, and from 0.6 to 16.6 μg/L, respectively. Organic carbon concentration was the most important factor affecting the metal toxicity. Finally, CA and IA models were applied to site-specific SSDs to calculate mixture toxicity as a multi-substance potentially affected fraction (msPAF). The median values (across the whole Japanese monitoring dataset) for msPAF by the CA and IA models were 0.138 and 0.083, respectively. The values of msPAF were mostly determined by copper toxicity. The CA model resulted in a more conservative output (i.e. a higher msPAF) than the IA model.