Can freshwater toxicity models (FIAM and BLM) be applicable to marine ecosystem?

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Can freshwater toxicity models (FIAM and BLM) be applicable to marine ecosystem? 
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Introduction

- Predictive models for metal ecotoxicity such as Biotic Ligand Models (BLM) or Free Ion Activity Models (FIAM) are scarce for saltwater organisms.
- Metal uptake rates by saltwater organisms are comparable to those of freshwater (FW) organisms, while several studies reported higher sensitivities of saltwater (SW) organisms to toxic metals.
- In hypothesis, the difference of toxicity may be caused by difference in ionic strength of saltwater when compared with freshwater.

The aim of this work is to test the applicability of freshwater FIAMs and BLMs to predict ecotoxicity of copper to saltwater organisms.

Results

Comparison of [Cu²⁺]IC₅₀ derived with FIAM and those calculated with extrapolated BLM for saltwater fish.

BLM predicted saltwater fish [Cu²⁺]IC₅₀ values shows up to 1.5 orders of magnitude difference with empirical data.

Comparison of [Cu²⁺]IC₅₀ derived with FIAM and those calculated with BLM for saltwater crustacean.

Within a narrow range of test media, BLM predicted a narrow range of [Cu²⁺]IC₅₀ for crustacean, while empirical data gives a much wider range up to 4 orders of magnitude difference.

Conclusions

1. Freshwater FIAMs cannot be directly used to predict metal ecotoxicity to saltwater organisms.
2. FIAM geomeans correlate with BLMs for freshwater organisms.
3. BLMs developed from freshwater organisms can predict Cu ecotoxicity to saltwater organisms.
4. Lower sensitivity of marine organisms to Cu follows differences in ionic strength between freshwater and saltwater.

Method

Comparison of freshwater FIAMs and saltwater BLMs

Acute total-metal based Cu EC₅₀ (mortality) and media composition for various saltwater fish and crustaceans are obtained from literature. Speciation modeling (WHAM 6.0) is done to derive [Cu²⁺]IC₅₀. Results are compared with FIAMs derived for freshwater fish (F. minnow) and crustacean (D. magna).

Comparison of freshwater BLMs and extrapolated saltwater BLMs

Published BLMs for freshwater fish (P. promelas) and crustacean (D. magna) are used to calculate [Cu²⁺]IC₅₀. These models are also employed to calculate theoretical [Cu²⁺]IC₅₀ for various saltwater fish and crustaceans, taking differences in ionic strength into account.

References