Background: Metal-mixture meta-analyses

- Additivity would under-predict toxicity in ~25-30% of studies
- No large datasets w/ adequate water chemistry for a species
- Relatively small percentage of chronic studies
Acute Toxicity Examples: Colorado School of Mines

• Less-than-additive, additive, or more-than-additive toxicity, depending on metals in mixture, concentrations of metals, and water chemistry

• Ni-mixture toxicity: Ellie Traudt (11:30 Tuesday, Boston 2)
Possible Mechanisms

- Less-than-additive toxicity:
  Metal-metal competition for binding at biotic ligand dominates

- More-than-additive toxicity:
  Metal-metal competition for binding to dissolved organic matter dominates

- Additive toxicity:
  Neither process dominates

- Less-than-additive or more-than-additive toxicity:
  Physiological processes (e.g., metallothionein induction)

⇒ Can models incorporate these mechanisms to accurately predict metal-mixture toxicity?
Special Section of ET&C (in review)

- Van Genderen et al.: Introduction to MMME Project
- Meyer et al.: Technical background
- Farley et al.: Comparative evaluation of four modeling approaches
- Farley & Meyer: Lessons learned and steps forward
- Meyer et al.: Acute toxicity of binary and ternary mixtures of Cd, Cu & Zn
- Naddy et al.: Interactive toxicity of Cd, Cu & Zn
- Santore & Ryan: Technical basis of a multi-metal BLM
- Tipping & Lofts: Testing WHAM-FTOX with lab data for metal mixtures
- Balistrieri & Mebane: Predicting toxicity of metal mixtures to assemblages
- Iwasaki et al.: Testing a BLM to predict effects of metal mixtures on trout
- Iwasaki & Brinkman: Generalized linear model to analyze mixture toxicity